

Minnesota Attorney General: Administrative Rules Proceedings

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Version 3
August 20, 2018

MINNESOTA STATE REGULATIONS

Notice of filing by the Commissioner of Administration

We have received on this date, stamped and filed 2 copies of Rules and Regulations pertaining to

the Dept of Administration - Bldg. Code Div.
(Agency or Board)

Regulation No. State Bldg Code 6001 thru 6014 with S.BC 103 updating

Subject: Design and Evaluation Criteria for Energy Conservation in new bldgs additions and Remodeled Elements of Bldgs with S.BC 103 updating

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FILED
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JUL 30 1975

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AUTH. SIGNATURE

10:45 AM

Stamped and filed with the Secretary of State 7-30-75

Rev. 9-72

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 Providing for the Design, Evaluation, Construction and Re-Construction of New Buildings and Re-Modeling of Buildings Undertaken after the Effective Date of these R Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

The following rules are adopted:

(See attached)

SBC 103 General. Building or structures to which additions, alterations, or repair are made shall comply with all the requirements for new buildings or structures except as specifically provided in this Code.

Note: For the requirements of energy conservation in remodeled buildings see SBC 6001 through SBC 6003.

DESIGN AND EVALUATION CRITERIA

for

ENERGY CONSERVATION IN NEW BUILDINGS, ADDITIONS AND REMODELED ELEMENTS OF BUILDINGS

State of Minnesota
Department of Administration
Building Code Division
July 16, 1975

SBC 337 to 5999 reserved for future use.

DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS, ADDITIONS AND REMODELED ELEMENTS OF BUILDINGS

SBC 6001 AUTHORIZATION. These Rules are authorized by Laws of 1974, Chapter 116H.12, Subdivision 4, and established through the rule making procedures set forth in Minn. Stats. 1969, Sections 15.0411 to 15.0417, in order to implement, interpret and carry out the provisions of Laws of 1974, Chapter 116H.12, Subdivision 4, regarding energy conservation standards for design, evaluation, construction or reconstruction of all new buildings and remodeling undertaken after the effective date of these Rules. Additionally, these Rules constitute amendments to the State Building Code. In the event that these Rules differ with the State Building Code, these Rules shall govern in all cases not affecting safety and health requirements.

SBC 6002 ENFORCEMENT

(a) Building Officials, in the municipality for which they are appointed, shall enforce these Rules.

(b) In all other areas of the State these Rules shall be enforced by the Commissioner of Administration or his designated representatives. The fees for such enforcement shall be based on the schedule established in Chapter 3 of the Uniform Building Code, 1973 Edition, as adopted by SBC 201.

SBC 6003 PURPOSE: The purpose of these Rules is to provide design requirements and criteria that will result in the effective utilization of energy in new buildings, additions and remodeled elements of buildings.

(a) The requirements and criteria are performance-oriented and are directed toward the design of building envelopes with high thermal resistance, low air leakage, and toward requiring practices in the design and selection of mechanical, electrical and illumination systems and equipment which promote the efficient use of energy and the conservation or reuse of energy from potential internal loads such as computer systems or other internal systems.

(b) It is intended that the rules shall be performance-oriented and designers shall be encouraged to use innovative approaches and techniques to achieve efficient utilization of energy. Efficient use of energy can be achieved by the use of design solutions that shall be shown to use equivalent or lesser amounts of energy without following each specific requirement.

(c) It is intended that these Rules shall be used in the design of new buildings, additions and for the remodeled elements of existing buildings, and that compliance with their requirements should be determinable in the pre-construction stage by evaluation and analysis of design specifications, drawings, and calculations.

SBC 6004 SCOPE

(a) These Rules set forth requirements for the design and construction of all types of buildings containing conditioned space covering their exterior envelopes and selection of their HVAC, service water heating, electrical distribution and illuminating systems, and equipment for efficient use of energy. Observance of the requirements does not necessarily lead to an optimization of initial and operating cost, and these Standards are not intended to replace economic evaluation to arrive at such an optimization. Economic evaluation of thermal design criteria may show that further reductions in energy consumption will be economically desirable.

(b) These Rules principally cover the features of a building, its equipment, and systems that determine the energy used within the building and on its site.

(c) Exempt Buildings. Buildings whose peak design energy demand is less than 1 Watt/sq.ft. or 3.4 BTU/sq.ft. of floor area for all purposes are specifically excluded from the scope of this Standard.

1. Certain buildings or elements thereof may be exempted when design data are not applicable. In these cases, the request for exemption shall be made in writing in accordance with SBC 6004(b)2. Where submitted to a building official, a copy must be submitted to the State Building Inspector.

2. The requirements of SBC 103, Subparagraphs 1, 2, 3 and 4 shall not apply with respect to energy conservation regulations when compliance would not be economically feasible. A request for an exemption to compliance with the above shall be submitted to the Building Official together with evaluation and documentation that shows compliance with the energy conservation requirements is not economically feasible. The request shall be submitted to the Building Official of the municipality where the State Building Code applies and to the State Building Code Division for all other areas of the State.

SBC 103 1. Application to Existing Buildings: Additions, Alterations, and Repairs. More than 50 percent. When additions, alterations, or repairs within any 12 month period exceed 50 percent of the value of an existing building or structure, such building or structure shall be made to conform to the requirements for new buildings or structures.

2. Additions, Alterations, and Repairs: 25 to 50 percent. Additions, alterations, and repairs exceeding 25 percent but not exceeding 50 percent of the value of an existing building or structure and complying with the requirements for new buildings or structures may be made to such building or structure within any 12 month period without making the entire building or structure comply. The new construction shall conform to the requirements of this Code for a new building of a like area, height and occupancy.

3. Additions, Alterations, Repairs: 25 percent or Less. Structural additions, alterations, and repairs to any portion of an existing building or structure, within any 12 month period, not exceeding 25 percent of the value of the building or structure shall comply with all the requirements for new buildings or structures, except that minor structural additions, alterations, or repairs, when approved by the building official, may be made with the same material of which the building or structure is constructed. Such building or structure, including new additions, shall not exceed the areas and heights specified in this Code.

4. Nonstructural Alterations and Repairs: 25 percent or Less. Alterations or repairs not exceeding 25 percent of the value of an existing building or structure, which are nonstructural and do not affect any member or part of the building or structure having required fire resistance, may be made with the same materials of which the building or structure is constructed.

   EXCEPTION: The installation or replacement of glass in hazardous locations, as specified in UBC Section 5406, shall be as required for new installation.

(d) These Rules do not incorporate specific procedures for the operation, maintenance and use of buildings.

SBC 6005 DEFINITIONS

Buildings	a. Existing Buildings - Buildings constructed prior to the effective date of these Rules. b. New Buildings - Those buildings constructed or having permits issued subsequent to the effective date of these Rules.
Building Envelope	The elements of a building which enclose conditioned spaces through which thermal energy is transferred to or from the exterior ambient environment.
Coefficient of Performance (COP), Cooling Mode	The ratio of the rate of heat removed (by the refrigeration cycle) to the rate of energy input, in consistent units and under designated operating conditions.
Coefficient of Performance (COP), Heat Pump, Heating Mode	The ratio of the rate of heat delivered by the complete heat pump unit (exclusive of supplementary heating) to rate of energy input, in consistent units and under designated operating conditions.
Conditioned Space	Any space heated, cooled or lighted whose design energy usage is greater than 1 Watt/sq.ft. or 3.4 BTU/sq.ft.
Cooled Space	Space within a building in which new energy is used for cooling.
Deadband	The range of controlled temperature within its normal operating span in which no corrective action is called for by the controller.
Energy	Includes all fossil fuels, solar, wind and electricity, and products from their use such as steam and chilled water which are delivered to the building to perform work.
Energy, New	Electrical or chemical energy converted to thermal or mechanical energy expressly for heating, cooling, lighting or mechanical power.
Energy, Recovered	Energy utilized which would otherwise be wasted from an energy utilization system.
Energy Efficiency Ratio (EER)	The ratio in Btuh output to total input in Watts. The higher the ratio, the more efficient the unit.

Energy Significant Equipment	Central station unitary or room-type space conditioning equipment including, but not limited to energy converting/processing equipment used in engineered systems and packaged subsystems, service water-heating equipment and lighting equipment.
Heat Flux	The heat transmitted per unit of time per unit of cross-sectional area (Q/A), Btu/hr./sq.ft.
Heated Space	Space within a building which is provided with a positive heat supply.
HVAC System	A system that provides either collectively or individually the processes of comfort heating, ventilating and/or cooling within or associated with buildings.
Infiltration	The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.
Opaque Areas	All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.
Outside Air	Air taken from the outdoors and therefore not previously circulated through the system.
Positive Heat Supply	Heat supplied to a space by design or by heat losses occurring from energy consuming systems or components associated with that space.
Reheat	Sensible heat added to condition a zone to overcome cooling produced by expenditure of energy within the HVAC system serving that zone.
Remodeled Element	Remodeled elements of existing buildings shall include but are not limited to the following: windows, doors, and other portions of the building envelope as well as the interior portions of the building that affect heat/gain loss control, illumination or the climate control.
Remodeling	The reconstruction, removal, or replacement of any portion or element of an existing building which affects the heat/gain loss control, illumination, or climate control, but does not include normal maintenance and repair.

Service Systems	The HVAC, service water heating, electrical distribution, and illuminating systems provided in a building.
Thermal Break	A material of low thermal conductivity that is installed between the cold and warm parts of the members in a building element to reduce the heat transmission through the structural members. The member itself can serve as a thermal break, if it has low thermal conductivity.
Total Energy System	An on-site electrical generating system arranged to salvage by-product or waste heat from the generating process.
Unheated Space	Space within a building which is not provided with a positive heat supply.
Unitary Air Conditioner	One or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separated assemblies shall be designed to be used together.
Value, Valuation	The estimated cost to replace the building in kind, based on current replacement costs.
Ventilation Air	That portion of supply of air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space, as established by ASHRAE Standard 62-73, Natural and Mechanical Ventilation.
Zone	A portion of the occupied space within a building which, recognizing the nature of its heating/cooling load, could be satisfactorily controlled to desired temperature limits, under varying indoor loads and outdoor conditions, by the operation of control at a single point. For specific purpose of this definition, the term "occupied space" is defined as the region within a space between the three inch and the six foot level above the floor and more than two feet from exterior walls or fixed air conditioning fixtures or equipment.

SBC 6006 EXTERIOR ENVELOPE

(a) SCOPE: This section contains design criteria that limit the heat loss through the building envelope in winter and heat gain in summer.

(b) GENERAL: Design criteria is given for the thermal transmittance values (U-values)for floor/ceiling, exposed walls and floors; for glass; for air leakage and for water vapor condensation. The standard design criteria for the building envelope is contained in SBC 6006(c) through (f). The alternative design criteria may be used as contained in SBC 6006(g) in lieu of (c) through (f).

1. SITE AND SHAPE ANALYSIS: All building designs should consider building compass orientation, geometric shape, aspect ratio (length to width), number of stories for a given floor area requirement, thermal mass, color, shading or reflections from adjacent structures, ground surfaces or vegetation,opportunities for natural ventilation, and wind direction and speed. Guidelines for design procedures dealing with some of these considerations are given in Chapters 17 through 22, ASHRAE Handbook of Fundamentals.

2. For calculating heat loss or gain through the exterior envelope of the building, the following design temperatures shall apply:

	Indoor	Outdoor
Winter	68°F. maximum	See Table 6007-A
Summer	78°F. minimum	

(c) HEATING DESIGN: The requirements of this section apply to designs for buildings or portions of buildings in which energy is used for space heating.

1. CEILINGS/ROOFS: The thermal transmittance value(Uo)for the combined gross area of exposed ceilings/roofs assembly, consisting of opaque ceiling/roof and skylights, enclosing an interior heated space shall not exceed .05 BTU/hr./sq.ft./ degree F. for construction where vented air space occurs above the insulation and below the roof, and 0.10 BTU/hr./ sq.ft./degree F. for all other construction. Equation 6006-1 shall be used to calculate overall Uo and to determine acceptable combinations of construction materials. A ceiling roof assembly shall be considered as those components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss. If a ceiling is employed as an element of a building air distribution plenum, the thermal transmittance value of the assembly shall be the thermal transmittance value of the roof portion only.

2. EXPOSED WALLS: The overall thermal transmittance value (U_o) for the combined gross area of walls consisting of opaque wall areas, window areas, door areas, and foundation walls above grade, enclosing an interior heated space shall not exceed 0.17 BTU/hr./sg.ft./degrees F. for one and two-family dwellings, and 0.22 BTU/hr./sq.ft./degrees F. for all other buildings. Equation 6006-1 shall be used to determine acceptable combinations of construction materials and to calculate overall U_o of the exposed walls.

Equation 6006-1

$$U = \frac{U_o A_o + U_g A_g + U_d A_d}{A}$$

Where:

U = the average or combined transmittance of the gross wall or ceiling area.

A = the external exposed (above grade) gross area (wall or ceiling) of the building that faces heated spaces.

U_o = the thermal transmittance of all elements of the opaque area (wall or ceiling).

A_o = opaque wall area.

U_g = the thermal transmittance of the glazing area (window or skylight).

A_g = glazing area.

U_d = the thermal transmittance of the door or similar opening, considered as an assembly, including the frame.

A_d = door or similar opening area.

3. FLOOR SECTIONS. Floors over heated spaces need not provide thermal resistance except that the peripheral edges of the floor must contain thermal resistance equivalent to that of the wall areas. Floors facing unheated spaces shall have a maximum thermal transmittance of 0.1.

4. SLAB-ON-GRADE FLOORS. For slab-on-grade floors, the insulation around the perimeter of the floor shall have a thermal resistance of not less than 7.5 and the insulation shall extend downward below the grade line to the design frost line or an equivalent distance horizontally inward from the edge under the floor. Where the type of construction precludes the use of insulation between the slab and foundation wall, perimeter insulation may be installed vertically on the outside of the foundation wall and shall extend downward below the grade line to the design frost line.

(d) COOLING DESIGN: The requirements of this section apply to designs for buildings or portions of buildings in which new energy is used for cooling by any means, such as mechanical or evaporative cooling, well water or city water cooling, chilled water or chemical cooling.

1. OPAQUE AREAS OF WALLS AND CEILINGS/ROOFS: The thermal transmittance values shall be as determined in SBC 6006(c).

2. FENESTRATIONS: The maximum instantaneous combined solar and air-to-air heat transmission of each window at design conditions for exterior fenestration enclosing an interior cooled space shall not exceed 120 BTU/hr./sq.ft. as an average of the transparent area of each window. The usage of shading devices is encouraged to minimize the solar heat gains through the building envelope window areas during summer.

(e) AIR LEAKAGE CONTROL

1. AIR LEAKAGE. Exterior joints around windows and door frames; openings between walls and foundations, between walls and roofs, between wall panels; openings at penetrations of utility services through walls, floors and roofs; and all other such openings in the building envelope shall be caulked, gasketed or otherwise weatherstripped to limit infiltration. Windows and storm windows shall be designed so as to limit air leakage into or from the building. All exterior doors shall be designed so as to limit air leakage into or from the building when in the closed position. Air infiltration rates shall be no greater than those allowed in Table 6006-A. An airlock such as a vestibule or revolving door where permitted by other sections of this code, shall be constructed at each primary means of access to buildings open to the public during normal business hours.

2. WINDOWS AND DOORS: Windows and doors shall be designed to limit air leakage into or from the building when in the closed position. The air infiltration rate shall not exceed the value listed in Table 6006-A when tested at a pressure differential of 1.567 lb/sq.ft., equivalent to the impact pressure of a 25 mile per hour wind.

   A. Compliance with the air leakage requirements of all types of windows and doors shall be determined by ASTM E283-73, Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors.

Table 6006-A

Allowable Air Infiltration Rates for Doors and Windows (cfm per foot of crack)[1,2]

Windows	Sliding Glass Doors	Swinging Doors	Residential Doors
0.5	0.75	1.0	1.25

[1]When tested at a pressure differential of 1,567 lb/sq.ft., which is equivalent to the impact pressure of a 25 mph wind.

[2]Compliance with the criteria for air leakage of all types of doors shall be determined by ASTM E 283-73, Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors.

3. CAULKING AND SEALANTS: Joints around window and door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations of utility services through walls, floors, and roofs, and all other openings in the building envelope shall be caulked, gasketed, or otherwise weatherstripped.

(f) CONDENSATION CONTROL

1. VAPOR BARRIERS: The design of the building envelope for one and two-family dwellings and other buildings having humidification requirements in excess of those set forth in SBC 6007(c)2 shall provide maintenance of thermal performance and durability by protecting against cold weather water vapor condensation.

2. THERMAL BREAKS: All window and door frames, ceiling, roof, floor, and wall construction shall contain a thermal break.

(g) ALTERNATE BUILDING ENVELOPE DESIGNS

1. TOTAL ENVELOPE METHOD: Alternative thermal transmittance values for building envelope components in lieu of the criteria given in SBC 6006(c) through (f) are acceptable if it is shown that the total building envelope heat loss in winter and heat gain in summer at design conditions exclusive of overall air leakage is equal or less than the quantities determined by the criteria given in SBC 6006(c) through (f). Alternative design for the total building envelope for comparison shall be based upon the same indoor and outdoor design temperatures, building compass orientation, geometric shape, aspect ratio (length to width), height, number of stories, periphery and building volume, as used to satisfy the criteria of SBC 6006(c) through (f).

2. ENERGY ANALYSIS METHOD: Building envelope design criteria may be developed based on annual energy analysis method contained in SBC 6012, in lieu of the criteria of SBC 6006. Total heat losses and heat gains calculated for the building envelope based on the application of the criteria of SBC 6006(c) through (f) or SBC 6006(g)1 shall be used as a reference for comparison with designs resulting from the application of SBC 6012.

SBC 6007 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) SYSTEMS

(a) SCOPE: This Section covers determination of heating and cooling loads, design requirements, and control requirements for general comfort applications in · buildings. Criteria is established for insulating piping and air handling systems, and for duct construction. For special applications such as hospitals, laboratories, thermally sensitive equipment, computer rooms, and manufacturing processes, etc., the design concepts and parameters shall conform to the requirements of the application at minimum energy levels. Where these special applications are described in the 1974 ASHRAE Handbook - Applications, the criteria described therein should be used.

(b) GENERAL: This Section establishes HVAC system requirements for efficient utilization of energy. System criteria developed from the requirements of this Section shall be the basis for equipment selection as described in SBC 6008. System design shall permit operation of HVAC systems with minimum energy consumption.

(c) CALCULATION OF HEATING AND COOLING LOADS: The total heating and cooling design loads shall be calculated in accordance with the design parameters of this section and in conjunction with one of the procedures described in the 1972 ASHRAE Handbook of Fundamentals, Chapters 21 and 22, or in accordance with a format or computerized program acceptable to the Minnesota Building Code Division. For residential heating and cooling design load calculations, the procedures in NESCA Manual J and ARI Standard 230-62 are acceptable.

1. OUTDOOR DESIGN CONDITIONS: The outdoor design temperatures shall be used from Table 6007-A based on the location of the building. Use the value of the nearest city listed for the locations not shown.

2. INDOOR DESIGN CONDITIONS: Winter indoor design temperature shall be 68°F. DB or less. Winter design indoor relative humidity, if provided, shall not exceed 20% where new energy is required to produce humidification. Summer indoor design temperature shall be 78°F. DB or higher. Summer indoor design relative humidity shall be 55% or higher where new energy is required for dehumidification, with controlled dehumidification being optional.

Table 6007-A

LOCATION	OUTDOOR TEMPERATURE (Degrees F.)		
	WINTER	SUMMER	
	db	db	wb
Albert Lea	-20	89	76
Alexandria	-26	88	74
Bemidji	-38	84	72
Brainerd	-31	85	73
Duluth	-25	82	71
Faribault	-23	88	75
Fergus Falls	-28	89	74
International Falls	-35	82	69
Mankato	-23	89	75
Minneapolis/St. Paul	-19	89	75
Rochester	-23	88	75
St. Cloud	-26	88	75
Virginia	-32	83	71
Willmar	-25	88	75
Winona	-19	89	76

3. VENTILATION: In HVAC systems with temperature control and filtration, in which air is recirculated, the heating and/or cooling design loads caused by the outdoor air portion of the ventilation air supplied to rooms or spaces shall be based on outdoor air quantities of not more than 33% of the maximum recommended ventilation rated cited in Section 6 of ASHRAE Standard 62-73, Natural and Mechanical Ventilation. The air quality shall conform with the requirements of ASHRAE Standard 62-73.

   A. VARIATIONS: The quantity of outdoor air introduced into spaces conditioned for comfort for the purpose of meeting normal respiratory and odor control needs shall be no greater than 5 cfm per person, except as indicated in SBC 6007(c)3. If values of outdoor air other than those shown in ASHRAE Standard 62-73, Natural and Mechanical Ventilation, are used because of special occupancy or process requirements, source control of air contaminants, or conflicting codes, these required outdoor air quantities shall be used as the basis of calculating the heating and/or cooling design loads.

4. INFILTRATION: Shall comply with SBC 6006(e). Calculations for infiltration shall be based on guidelines as shown in Chapters 19 and 21 of the 1972 ASHRAE Handbook of Fundamentals. In pressurized buildings the infiltration and exhause design load may be offset by the ventilation air load.

5. SYSTEM DESIGN HEATING/COOLING CAPACITY: The rated capacity of the heating/cooling system at design conditions shall not be greater than 115% for heating, 100% for cooling of the design output load calculated in accordance with SBC 6007(c) whenever appropriate equipment is available. Equipment designed for standby purposes is not included in the capacity limitation requirement. The cooling cycle of heat pumps are exempt from this requirement.

(d) CONTROLS

1. TEMPERATURE CONTROL: Each HVAC system shall be provided with at least one automatic, space-temperature control device for the regulation of system as required in SBC 6007(d)3. These automatic, space-temperature control devices shall be capable of being set to maintain space temperature set points from 55°F. to 85°F.

2. HUMIDITY CONTROL: If an HVAC system is equipped with a means for adding moisture, to maintain specific selected relative humidities in spaces or zones, an automatic, space-humidity control device shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 20%. The exception to the above is process operations that require different environmental conditions to maintain product quality. Where an automatic humidity control device is used in an HVAC system with means for removing moisture to maintain specific selected relative humidities in spaces or zones, this device shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 55%.

3. ZONING FOR TEMPERATURE CONTROL

   A. ONE AND TWO-FAMILY DWELLING UNITS: At least one automatic space temperature control device, as required in SBC 6007(d)1, shall be provided for each separate dwelling unit.

   B. MULTIPLE-FAMILY DWELLING UNITS: For multiple-family dwelling units, each individual dwelling unit shall be considered separately and shall meet the requirements of SBC 6007(d)3A. Spaces other than living units shall meet the requirements of SBC 6007(d)3C.

   C. ALL OTHER TYPES OF BUILDINGS OR OCCUPANCIES: At least one automatic space temperature control device as required in SBC 6007(d)1 shall be provided for each separate zone. As a minimum each floor of a building shall be considered a separate zone.

4. CONTROL SETBACK AND SHUTOFF

   A. SINGLE AND MULTIPLE FAMILY DWELLING UNITS: Each HVAC system shall have a readily accessible means for reducing the energy required for heating and cooling during periods of non-use or reduced need (such as unoccupied periods, sleeping hours, etc.). Lowering set points of automatic space temperature control devices to reduce energy consumption of heating systems shall not cause new energy to be expended to reach the reduced setting. Where HVAC systems provide outdoor air for ventilation, a readily accessible means shall be provided for reducing the outdoor air quantity during periods of reduced need.

B. OTHER BUILDINGS AND OCCUPANCIES: Each HVAC system shall be equipped with a readily accessible means of reducing the energy used for HVAC during periods of non-use or alternate uses of the building spaces or zones served by the system. The following are examples that meet this requirement:

(i) Manually adjustable automatic timing devices.
(ii) Manual control systems for use by operating personnel.
(iii) Automatic control systems.

(e) SIMULTANEOUS HEATING AND COOLING: Simultaneous heating and cooling of a zone by reheat, recooling or concurrent operation of independent heating and cooling systems shall be restricted as delineated below.

1. Recovered energy, including new energy expended in the recovery process (provided the amount expended is less than the amount recovered), may be used for control of temperature and humidity.

2. New energy may be used, when necessary, to prevent relative humidity from rising above 55% for comfort control or to prevent condensation on terminal units.

3. New energy may be used for control of temperature if minimized as delineated in SBC 6007(e)4 through (e)8.

4. REHEAT SYSTEMS: Systems serving multiple zones, other than those employing variable air volume for temperature control, shall be provided with controls that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the most cooling. Single zone reheat systems shall be controlled so as to sequence reheat and cooling by reducing the cooling capacity first, on a call for reheat from the space thermostat.

A. NEW ENERGY: Whenever possible, new energy shall not be used for reheat purposes. The total installed capacity of all reheat using new energy shall be limited to 15% of the total system design cooling capacity.

5. DUAL DUCT AND MULTIZONE SYSTEMS: These systems shall be designed with means to automatically reset the cold deck temperature to the highest temperature necessary to satisfy the zone requiring the most cooling during predominately cooling operation, and to automatically reset the hot deck temperature to the lowest temperature necessary to satisfy the zone requiring the most heating during the predominately heating operation.

6. RECOOLING SYSTEMS: The system design shall limit the use of new energy for recooling of heated air to 15% of the total system heating capacity. Such systems shall provide means for limiting the use of energy for recooling of heated air by automatically resetting the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the most heating.

7. For multiple zone systems, one zone may be chosen to represent a number of zones with similar heating/cooling characteristics. The supply air temperature reset in SBC 6007(e)4 is not required for multiple zone HVAC systems that employ reheating or recooling for control of less than 20% of the total air in the system.

8. Concurrent operation of independent heating and cooling systems serving common spaces, and requiring the use of new energy for heating, shall be minimized by one or both of the following:

   A. By providing sequential temperature control of both heating and cooling capacity in each zone.

   B. By limiting the heating energy input, through automatic reset control of the heating medium temperature (or energy input rate), to only that necessary to offset heat loss due to transmission and infiltration.

(f) COOLING WITH OUTDOOR AIR: Each fan system, having greater than 134,000 BTU/hr. total cooling capacity or more than 5,000 cfm, shall be designed to use up to 100% of the fan system capacity for cooling with outdoor air whenever cooling, requiring new energy, is needed and whenever the enthalpy of outdoor air and/or outdoor dry bulb temperature is lower than that of the indoor air, and/or return air.

EXCEPTIONS: Cooling with outdoor air is not required under the following conditions:

1. The quality of the outdoor air (as defined in Table 1 of ASHRAE Standard 62-73, Natural and Mechanical Ventilation) is such as to require extensive treatment of the air.
2. The need for humidification and/or dehumidification requires the use of more energy than is conserved by outdoor air cooling.
3. The use of outdoor air cooling may affect the operation of other systems (such as return air fans or supermarket refrigeration) so as to increase the overall energy consumption of the building.
4. Internal/external zone heat recovery is used.

(g) MECHANICAL VENTILATION: Each mechanical ventilation system (supply and/or exhaust) shall be equipped with a readily accessible method for volume reduction and/or shutoff when ventilation is not required. The following are examples meeting this requirement:

1. Manual and/or automatic volume dampers and devices.

2. Localized on-off switches and/or automatic time clocks.

(h) PIPING INSULATION

1. All piping installed to serve buildings and within buildings shall be insulated in accordance with Table 6007-B except piping carrying fluid between 60°F. and 105°F. temperature is not required to be insulated.

2. OTHER INSULATION THICKNESSES: Insulation thicknesses in Table 6007-B are based on insulation having thermal resistances in the range of R = 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 or may be reduced for materials having R values greater than 4.6 per inch of thickness.

A. For materials with thermal resistance greater than R = 4.6, the insulation thickness may be reduced as follows:

$$\frac{4.6 \times \text{Table 6007-B Thickness}}{\text{Actual R}} = \text{New minimum thickness}$$

B. For materials with thermal resistance less than R = 4.0, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 6007-B Thickness}}{\text{Actual R}} = \text{New minimum thickness}$$

C. For domestic hot water systems see SBC 6009.

(i) AIR HANDLING DUCT SYSTEM INSULATION: All ducts, supply plenums and enclosures installed in or on buildings shall be insulated as follows:

1. All duct systems, or portions thereof, where the temperature differential between the air surrounding the duct and the design temperature of the air in the duct exceeds 30°F., shall be thermally insulated (externally or internally) to provide a minimum thermal resistance of R = 4.0, exclusive of film resistances. The thermal resistance of the duct insulation shall be increased by R = 1 for each increase of 25°F. or fraction thereof over the 30°F. temperature differential.

2. Insulation is not required:

   A. For ducts installed in basements and cellars for either supply or return air in one and two family dwelling construction.

   B. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.

   C. Within HVAC equipment.

(j) DUCT CONSTRUCTION: All ductwork shall be constructed and erected in accordance with Chapter 25 of the 1972 ASHRAE Handbook of Fundamentals or the following SMACNA Standards:

Residential Heating and Air Conditioning Systems - Minimum Installation Standards, August, 1973
Low Velocity and Duct Construction Standards, 4th Edition, 1969
High Velocity Duct Construction Standards, 2nd Edition, 1969
Fibrous Glass Duct Construction Standards, 3rd Edition, 1972

1. High pressure and medium pressure ducts shall be leak tested in accordance with the applicable SMACNA standard.

Table 6007-B

Minimum Pipe Insulation

Piping System Types	Temperature Range - °F.	Insulation Thickness in inches for pipe sizes*				
		1" and less	1¼-2	2½-4	5-6	8" and larger
Heating Systems Steam & Hot Water						
High Pressure/Temp.	306-460	2	2½	3½	4	4½
Medium Pressure/Temp.	251-305	1½	2	2½	3	3½
Low Pressure/Temp.	201-250	1	1½	2	2½	3
Low Temperature	140-200	1	1½	1½	2	2½
Steam Condensate (for feed water)	Any	1	1½	2	2	2½
Cooling Systems						
Chilled Water	40-60	1	1	1	1	1
Refrigerant or Brine	Below 39	1	1½	1½	1½	1½
Heating and/or Cooling Systems Runouts to individual units (not exceeding 12' in length)	Below 39	3/4	1½	1½	1½	1½
	40-60	3/4	1	1	1	1
	140-200	3/4	1½	1½	2	2½
	201-250	3/4	1½	2	2½	3
	251-305	3/4	2	2½	3	3½
	306-460	3/4	2½	3½	4	4½
	Stm. Cond.	3/4	1½	2	2	2½

* See SBC 6007(h)2

SBC 6008 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT

(a) SCOPE: This section establishes criteria to regulate the performance of equipment and the documentation of such performance by the manufacturer to ensure efficient utilization of energy.

(b) COOLING SYSTEMS EQUIPMENT, ELECTRICALLY OPERATED: Cooling systems equipment whose energy input is entirely electric shall, at the conditions specified in Table 6008-A, show a Coefficient of Performance-Cooling (or Energy Efficiency Ratio) not less than those shown in Table 6008-B.

Table 6008-A Rating Conditions for COP

Item	Temperatures, °F. DB	WB	Inlet	Outlet
Return Air (entering equipment)	80	67	-	-
Outdoor Ambient (air cooled)	95	75	-	-
Condenser Water (water cooled)	-	-	85	95

Table 6008-B Minimum COP (EER), Cooling - Unitary Equipment

Effective Date	Standard Rating Capacities Under 65,000 BTU/hr.	65,000 BTU/hr. and over
	COP (EER)	COP (EER)
Beginning January 1, 1977	1.8 (6.1) 1.97 KW/Ton	2.0 (6.8) 1.76 KW/Ton
Beginning January 1, 1980	2.0 (6.8) 1.76 KW/Ton	2.2 (7.5) 1.60 KW/Ton

1. These standards in Table 6008-B apply to unitary cooling equipment (both air-cooled and water-cooled), the cooling mode for unitary heat pumps (both air-source and water-source), packaged terminal air conditioners, room air conditioners, and applied systems. The COP values shall include the inputs to all compressors, evaporator fans, condenser fans and pumps.

2. In applied systems where components from several equipment suppliers are to be utilized, it shall be the function of the system designer to determine the full-load system COP, using data from the equipment supplier(s) as a means of determining compliance with Table 6008-B.

(c) COOLING SYSTEMS, HEAT-OPERATED (ABSORPTION) WATER-CHILLING EQUIPMENT: The performance of heat-operated (absorption) water-chilling equipment shall be based not only on the components included in the unit but shall include cooling tower fans, chilled water pumps, condenser water pumps, boiler auxiliaries and boiler efficiency.

1. PERFORMANCE: Absorption water-chilling units, employing steam or hot water as the energy source, and water-cooled absorbers and condensers shall comply with the requirements of ARI Standard 560.75, Absorption Water-Chilling Packages. Direct-fired absorption water-chillers and air conditioners shall comply with ANSI Standard Z21.40.1-73, Gas-Fired Absorption Summer Air-Conditioning Appliances.

2. EFFICIENCY LIMITATION: Heat operated cooling equipment shall show a COP not less than as listed in Table 6008-C when tested at Standard Rating Conditions established in the applicable standards referenced in SBC 6008(c)1, except when it is supplied by recovered energy, such as steam rejected from another process.

3. In applied systems where components from several equipment suppliers are to be utilized, it shall be the responsibility of the system designer to determine the full load system COP using data from the equipment supplier(s) to determine the energy consumption of the system as applied in the building in the cooling mode, as a means of determining compliance with Table 6008-C.

Table 6008-C
Minimum COP-Cooling, Heat-Operated Cooling Equipment

	Standard Rating Capacities	
	Under 65,000 Btuh	65,000 Btuh and over
Beginning 1/1/77	0.45	0.50
Beginning 1/1/80	0.50	0.55

(d) COMBUSTION HEATING EQUIPMENT: The equipment supplier shall furnish data as specified in SBC 6008(h). Boilers not listed in the American Boiler Manufacturers Association (ABMA) PFT Rating Book, shall be accepted subject to a performance test in accordance with the ASME Power Test Code for Steam Generating Units, PTC 4.1-64. Forced warm air heaters and central furnaces shall be accepted if AGA listed or if tested in accordance with ANSI Standard Z83.5-67 (Rev. 1972), Gas-Fired Heavy-Duty Forced Air Heaters, or ANSI Standard Z91.1-72, Performance Requirements for Oil-Powered Central Furnaces, as applicable.

(e) HEAT PUMPS, HEATING: Heat-pump heating systems, whose energy input is entirely electric shall have a COP heating not less than shown in Table 6008- at the conditions stated therein. The indoor temperature for these rating conditions is 70°F.

Table 6008-

Minimum COP - Heating Heat Pumps

	Air Source			Water Source [1]
	Outdoor Air Temperature, °F.			Entering Water Temperature, °F.
	DB/WB 45/43	DB/WB 20/19	DB 0	60
Beginning January 1, 1977	2.2	1.4	Permit Shut-off	2.2
Beginning January 1, 1980	2.5	1.7	1.0	2.5

1. Water flow rate to be as determined in the cooling test.

1. SUPPLEMENTARY HEATER CONTROL: The heat pump shall be installed with a control system to prevent electric resistance, supplementary heater operation when the steady state heating load can be met by the heat pump alone. A two-stage room thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement.

(f) ELECTRIC RESISTANCE SPACE HEATING EQUIPMENT: The manufacturer of electric resistance space heating equipment shall make available to prospective purchasers, designers or contractors, upon request, full load energy input and output, over the range of voltages at which the equipment is intended to operate.

(g) MAINTENANCE: Equipment which requires periodic routine maintenance to maintain efficient operation shall be furnished complete with the necessary maintenance information. Required routine maintenance actions shall be clearly stated as required and incorporated on a permanent label, affixed in a readily accessible location on the equipment. The label may be limited to identifying required actions that are explained in greater detail in an operation and maintenance manual. The label should identify, by title and/or publication number, the operation and maintenance manual for that particular model and type of product. At least one copy of each required manual shall be furnished by the manufacturer to the original owner upon request.

(h) RESPONSIBILITY OF EQUIPMENT SUPPLIERS: Manufacturers of HVAC equipment shall furnish, upon request by prospective purchasers, designers, or contractors, the full and partial capacity and standby input(s) and output(s) of all equipment, and components of applied systems, based on equipment in new condition, to enable determination of their compliance with this standard. This includes performance data under all modes of operation and at all ambient conditions necessary to make the energy analysis outlined in SBC 6012. This requirement for performance data shall be satisfied by either data from a nationally certified program approved by the State or data certified in writing by an officer of the company manufacturing the product.

(d) TEMPERATURE CONTROLS: Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use (see Table 1 from ASHRAE 1973 Handbook-Systems, Chapter 37). Thermostats in water heaters serving more than one function may be set to deliver water at the maximum temperature.

(e) PUMP OPERATION: Circulating hot water systems shall be arranged so that the pump energy consumption is low, consistent with correct operation of the pump. Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off (automatically or manually) when the hot water system is not in operation.

(f) CONSERVATION OF HOT WATER

1. Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 2 gpm per shower head.

2. Lavatories in restrooms of public facilities shall be equipped with slow closing automatic valves set to deliver no more than one quart at a time.

(g) SWIMMING POOLS: Consideration of heating swimming pools by solar heat, air conditioning condenser water or waste heat is encouraged. Swimming pools for other than therapeutic purposes shall be equipped to be heated to no more than 80°F. (26.7°C.).

SBC 6010 ELECTRICAL DISTRIBUTION SYSTEMS

(a) SCOPE: The electrical distribution system in a building shall be designed for efficient distribution of energy from the service entrance to the point of use.

(b) POWER FACTOR: The power factor of the overall electric distribution system in a building shall be not less than 90% under rated design installed load of the building, either by utilization equipment design or by the use of power factor corrective devices. The power factor corrective devices may be installed on individual equipment, rated greater than 1,000 Watts, and switched therewith, regionally grouped, located at the service equipment or power factor correction achieved by other equivalent means. The choice among these corrective methods should be made based upon an engineering evaluation of each distribution system.

(c) SERVICE VOLTAGE: The available service voltage shall be so selected as to minimize energy losses.

(d) VOLTAGE DROP: In any building, the combined voltage drop in the feeders and branch circuits shall not exceed the recommended total voltage drop of the ANSI-C1 1975 Standard, National Electrical Code (NFPA 70-1975), as adopted by SBC 8601.

SBC 6011 LIGHTING SYSTEMS

(a) SCOPE: In establishing a lighting load, the illumination in any space within a building shall be based on the use for which the space is intended, and on efficient utilization of energy. The actual illumination design is to be coordinated with the envelope and other system designs.

(b) GENERAL: An allowable total connected load for installed lighting shall be established by using the criteria in this section and the calculation procedures recommended by the Illuminating Engineering Society in the 5th Edition of the IES Lighting Handbook.

1. PURPOSE: The requirement for calculating the connected load in the manner specified is:

   A. To provide a uniform method for establishing permissible power consumption, and

   B. To institute energy conserving lighting design practices while allowing for maximum freedom of design, including the use of inefficient lamps in a trade-off approach, provided the total power demand does not exceed the calculated load.

2. CRITERIA: The use of more efficient lamps and luminaires than specified, and the use of luminaires providing for heat removal and/or recovery, is encouraged in actual design to allow for additional savings in energy.

(c) ILLUMINATION LEVELS: For the purpose of establishing a load, the levels of illumination shall be no greater than those recommended in the IES Lighting Handbook, Figure 9-80, and ANSI Standards covering lighting practices as listed in Appendix A, Part I. Those levels shall be used as follows:

1. TASK LIGHTING: In most cases, the levels of illumination listed in the IES Lighting Handbook, Figure 9-80, are for specific tasks. In some cases, however, the levels of illumination are listed for locations (auditoriums, etc.), and these levels shall be considered average levels.

2. GENERAL LIGHTING: In areas surrounding task locations the maximum average level of brightness shall be 1/3 the level for the tasks performed in the area. Where more than one task level occurs in a space, the maximum general level shall be 1/3 the average of the task levels determined.

3. NONCRITICAL GENERAL LIGHTING: In circulation and seating areas, and other seldom occupied spaces or those in which no critical visual tasks occur, the maximum average levels of illumination shall be 1/3 of the average general lighting in the adjacent task spaces, but not less than one footcandle or OSHA recommended levels for safety. (See MOSHC 42)

(d) LIGHTING SYSTEMS: For the purpose of establishing a load, only efficient lamps and luminaires shall be used, as follows:

1. EFFICIENT LAMPS: Efficient lamps are defined herein as those producing at least the following initial lumen output per watt input, including ballast losses, as listed by manufacturers,

   A. Where color rendition is not of significance or use of higher wattage lamps is appropriate, 55 lumens/watt.

   B. Where moderate color rendition is appropriate, 40 lumens/watt.

   C. Where high color rendition is appropriate, or spaces are less than 50 sq.ft., or where use of low wattage high-intensity discharge lamps under 250 watts or flourescent lamps under 40 watts is appropriate, 10 lumens/watt.

2. EFFICIENT LUMINAIRES: Efficient luminaires are defined herein by Room Cavity Ratio (RCR) = 1 values according to space use. An efficient luminaire for use in each space described below shall have a Coefficient of Utilization (CU) for RCR = 1 of at least the value listed for that space.

   A. For spaces with tasks subjected to veiling reflections and where visual comfort is important, CU = 0.55.

   B. For spaces without tasks or with tasks not subjected to veiling reflections but where visual comfort is important, CU = 0.63.

   C. For spaces without tasks and where visual comfort is not a criterion, CU = 0.70.

(e) LOAD CALCULATIONS: In establishing the load, the lighting calculation procedures recommended in the IES LIghting Handbook shall be used, utilizing efficient lamps and luminaires, except as follows:

1. REFLECTANCES: For interior spaces the following initial cavity and surface reflectance shall be assumed:

   A. Ceiling Reflectance - 80%

   B. Wall Reflectance - 50%

   C. Floor Reflectance - 30%

2. LIGHT LOSS FACTOR: A light loss factor of 0.70 shall be used, as a minimum , accounting for lumen depreciation and dirt accumulation.

3. EXCEPTIONS: The criteria of SBC 6011(d)1 and (d)2 shall not apply to the following lamps and luminaires, however their use shall be accounted for in the calculation of task lighting loads for specific tasks. The allowable load shall be based on the luminaire wattage to achieve the levels of illumination as covered in SBC 6011(c) using a point calculation method given in the IES Lighting Handbook.

   A. Luminaires for medical and dental diagnostic or surgical purposes.

   B. Luminaires for highlighting applications, such as sculpture exhibits, art exhibits, and individual items of display merchandise.

   C. Luminaires for specialized lighting applications, including color matching, where electrical interference cannot be tolerated, etc.

   D. All residential occupancies.

   E. Similar residential areas in institutions, such as hospitals.

(f) USAGE: Energy used for lighting purposes is a product of the lighting load and the hours of usage. Therefore, circuiting and switching (or non-resistive dimming) shall be provided so that:

1. Lighting in task areas larger than 100 sq. ft. can be reduced by at least 50% when the task is not being performed or is relocated.

2. In any space requiring two or more branch circuits for lighting, switching shall be provided for each circuit or for portions of each circuit, so that a portion of the lighting system adequate for custodial or maintenance purposes or for effective complementary use of natural and artificial lighting may be operated without switching on/off all of the lighting in that space.

3. Lighting can be reduced or turned off where day-lighting is adequate and can be used effectively.

(g) EXTERIOR LIGHTING: The illumination for exterior lighting shall conform to SBC 6011(c) and (d), using at least the minimum luminaire efficiencies as listed in the IES Lighting Handbook, Figure 9-64. The beam lumen method shown in the IES Lighting Handbook, and a Coefficient of Beam Utilization of 0.75, shall be used for calculations. Illumination design shall be based upon the use for which the area is intended.

1. FACADE LIGHTING: Building facade lighting, including signs, shall be no greater than 1,000 watts, or 2% of the total interior lighting load of the building, whichever is greater.

(h) LIGHTING DOCUMENTATION: Lighting loads shall be determined in accordance with one of the procedures described in the 5th Edition of the IES Lighting Handbook and presented in a format acceptable to the Minnesota Building Code Division. The total lighting wattage per square foot for each area and the entire structure shall be indicated. The calculated lighting load shall be submitted in accordance with SBC 6002 and SBC 6004.

SBC 6012 SYSTEM ANALYSIS DESIGN

(a) SCOPE: Alternative building and system designs shall be accepted that can be shown to reduce the total energy supplied to a similar building which would have followed each of the detailed requirements of SBC 6006 through SBC 6011 of this standard.

(b) EQUIVALENT ANNUAL ENERGY CONSUMPTION: Under the provisions of this Section, the designer may propose any design of building and energy-using service systems for which the total annual amount of those forms of building energy covered by SBC 6006 through SBC 6011 (expressed as equivalent Btu's or equivalent Kwh) is less than that for the building and systems designed according to SBC 6006 through 6011 of this standard.

1. BASIS FOR COMPARISON: The standard building and service systems designed according to SBC 6006 through SBC 6011 of this standard and used as the basis of comparison to the proposed alternate building and systems shall meet the criteria of accepted common practice in the geographic region for the given type of usage, except for those specific items where such common practice conflicts with the requirements of SBC 6006 through SBC 6011. All sources of energy usage by both designs (standard and proposed alternate) covered under the provisions of SBC 6006 through 6011 shall be included in the comparison. Common climatic data, building occupancy, and operational schedules of both basic building service systems and HVAC systems shall be used in the comparison. Where similar types of equipment are applicable to the standard and proposed alternative designs, similar equipment characteristics shall be used in the comparison.

(c) ANALYSIS PROCEDURE: The analysis of the annual energy usage of the standard and the proposed alternative building and systems designs shall meet the following criteria:

1. The building heating/cooling load calculation procedure used within or as the basis for the annual energy consumption analysis shall be of sufficient detail to permit the identification of the annual energy savings resulting from the proposed alternative building design features.

2. The calculation procedure used to similate the operation of the building and its service systems through a full-year operating period shall be of sufficient detail to permit the evaluation of the effect of system design and operational characteristics (such as space temperature and humidity control supply airflow and temperature, outside air quantities, lighting and occupancy schedules) and mechanical plant characteristics (such as part-load profiles, sequencing and accessories) on annual energy usage. Manufacturer's data or comparable field test data shall be used, when available, in the simulation of all systems and equipment. The calculation procedure shall utilize simulation techniques similar to the current recommendations in the appropriate ASHRAE Bulletin or produce results consistent with such recommended procedures.

   A. ASHRAE bulletin on "Procedure for Simulating the Performance of Components and Systems for Energy Calculations"

(d) DOCUMENTATION: Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis comparison report prepared by a registered professional engineer or architect. The report must provide sufficient technical detail on the two building and systems designs and on the data used in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of SBC 6013(b) through 6013(c)2.

(e) EXCLUSION: Proposed alternative designs for residential and light commercial structures of less than 5,000 sq. ft. shall be exempted from the requirement of a full-year energy system analysis as a criteria for departure from the design requirements of SBC 6006 through 6011, providing a professional engineer registered in Minnesota concurs in writing that the specific proposed alternative design would be expected to have a lower annual energy consumption than a similar building and service systems designed according to SBC 6006 through 6011.

SBC 6013 SOLAR AND WIND POWERED ENERGY SOURCES

(a) GENERAL: When a proposed alternative building and service system design submitted and evaluated in accordance with SBC 6012 of this standard utilizes solar or wind power for all or part of its energy source, the solar or wind-powered energy supplied to the building shall be excluded from the total energy chargeable to the proposed alternative design. To qualify for this exclusion, solar energy must be derived from a specific collection, distribution device. Natural solar energy passing through windows shall not qualify for the exclusion, but may contribute to a reduction in overall energy usage under the terms of SBC 6013. All other criteria covered in SBC 6012 shall apply to the proposed alternative design utilizing solar or wind power.

(b) DOCUMENTATION: Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis comparison report prepared by a registered professional engineer or architect. The report must provide sufficient technical detail on the two building and systems designs and on the data used in and resulting from the comparative analysis as to verify that both the analysis and the designs meet the criteria of SBC 6012(b) through 6012(c)2 and this Section. The energy derived from solar or wind-powered devices must be separately identified from the overall building energy use. Supporting documentation on the basis of the performance estimates of the solar or wind-powered devices must be submitted.

(c) EXCLUSION: Proposed alternative designs for residential and light commercial structures of less than 5,000 sq. ft. which derive a significant part of their annual energy usage from solar or wind-power shall be exempt from the requirement of a full-year energy system analysis, providing a professional engineer registered in Minnesota concurs that the solar or wind power is significant and that the overall building annual energy consumption would not exceed that of a building and service systems designed under the provisions of SBC 6006 through 6011. Other commercial, institutional, and industrial structures which derive over 50% of their annual thermal energy requirements (heating, cooling, service water heating) or over 30% of their annual total energy requirements from solar or wind power shall be exempted from the necessity of comparing the proposed design to a standard design (which follows the specific provisions of SBC 6007 through 6011). Documentation verifying the percentage of annual energy use deriving from solar or wind power shall be required as provided in SBC 6013(b).

SBC 6014 ENERGY SOURCE AND COST CALCULATIONS

This section, identified as Section 10 in the May 6, 1975 hearing document, was not adopted. The evidence presented at the hearing and in the written documents was preponderantly opposed to the section. The only favorable evidence was predicated on a substantially revised section. The revision was of such a nature as to require an additional public hearing.

SBC 6014 through 7099 reserved for future use.

APPENDIX A

Part I

General: Several Standards and publications are recommended in this document. The Standards mentioned are noted below with the Section number where they are referenced. Part II of this Appendix lists the organizations where the Standards may be obtained.

Organization	Standard	Section
ANSI	A11.1-1973 Standard Practice for Industrial Lighting	6011(c)
	A23.1-1962 (Rev. 1970) Standard Practice for School Lighting	6011(c)
	A85.1-1956 (Rev. 1970) Standard Practice for Protective Lighting	6011(c)
	A132.1-1973 Standard Practice for Office Lighting	6011(c)
	C1-1975 (NFPA 70-75) National Electrical Code	6010(d)
	C72.1-72 Household Automatic Electric Storage-Type Water Heaters	6009(c)1A
	Z21.10.3-74 Circulating Tank, Instantaneous and Large Automatic Storage Type Water Heaters, Approval Requirements for Gas Water Heaters, Volume III	6009(c)1B
	Z21.40.1-73 Gas Fired Absorption Summer Air Conditioning Appliances	6008(c)1
	Z83.5-1967 (Rev. 1972) Gas Fired Heavy Duty Forced Air Heaters	6008(d)
	Z91.1-72 Performance Requirements for Oil-Powered Central Furnaces	6008(d)
ARI	230-62 Application Engineering Standard for Year-Round Residential Air Conditioning	6007(c)
	560-75 Standard for Absorption - Water Chilling Packages	6008(c)1
ASHRAE	1972 Handbook of Fundamentals	6006(b)1 6007(c) 6007(c)a 6007(j)
	1973 Handbook - Systems	6009(a) 6009(d)

ASHRAE	1974 Handbook - Applications	6007(a)
	Bulletin on "Procedure for Simulating the Performance of Components and Systems for Energy Calculations"	6012(c)2
	Standard 62-73 Natural and Mechanical Ventilation	Definitions 6007(c)3 6007(c)3A 6007(f)
ASME	PTC 4.1-64 Power Test Code for Steam Generating Units	6008(d)
ASTM	E283-73 Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors	6006(e)2A Table 6006-A
IES	Lighting Handbook, 5th Edition	6011(b) 6011(c) 6011(c)1 6011(e) 6011(e)3 6011(g) 6011(h)
NESCA	Manual J - Load Calculations	6007(c)
SMACNA	Fibrous Glass Duct Construction Standards, 3rd Edition, 1972	6007(j)
	High Velocity Duct Construction Standards, 2nd Edition, 1969	6007(j)
	Low Velocity and Duct Construction Standards, 4th Edition, 1969	6007(j)
	Residential Heating and Air Conditioning Systems Minimum Installation Standards, August 1973	6007(j)

Part II

ADDRESSES OF ORGANIZATIONS REFERENCED IN THE STANDARD

Air Conditioning and Refrigeration Institute (ARI)
1915 North Fore Myer Drive
Arlington, Virginia 22209

American National Standards Institute, Inc. (ANSI)
1430 Broadway
New York, New York 10018

American Society of Hearing, Refrigeration, Air Conditioning Engineers (ASHRAE)
345 East 47th Street
New York, New York 10017

American Society of Mechanical Engineers (ASME)
345 East 47th Street
New York, New York 10017

American Society of Testing and Materials (ASTM)
1916 Race Street
Philadelphia, Pennsylvania 19103

Illuminating Engineering Society (IES)
345 East 47th Street
New York, New York 10017

National Environmental System Contractors Association (NESCA)
1501 Wilson Boulevard, Suite 1110
Arlington, Virginia 22209

Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1611 North Kent Street, Suite 200
Arlington, Virginia 22209

Underwriters Laboratory (UL)
1285 Walt Whitman Road
Melville, Long Island, New York 11746

FILED
RICHARD L. BRUBACHER
Commissioner of Administration
JUL 30 1975
BY Ella Henderson
AUTH. SIGNATURE

APPROVED AS TO FORM AND LEGALITY
JUL 29 1975 19
WARREN SPANNAUS, ATTORNEY GENERAL
BY /s/ Michael B. Miller
SPECIAL ASSISTANT ATTORNEY GENERAL

STATE OF MINNESOTA
DEPARTMENT OF STATE
FILED
JUL 30 1975 10:30 A.M.
Joan Anderson Growe
Secretary of State

ADMIN 1000

STATE OF MINNESOTA

DEPARTMENT Administration

Office Memorandum

TO : Mike Miller
Special Assistant Attorney General

DATE: July 17, 1975

FROM : Kathy Durkee kd
Building Code Division

SUBJECT: Energy hearings - May 6, 1975 and June 18, 1975

Enclosed are the following sets of documents relating to the subject:

Set #1 (Originals)

1. Copy of Rules to be adopted

2. Statement of Compliance with rulemaking procedures
   Order for Hearing
   Statement of Need
   Notice of Hearing
   Proposed Rules
   Affidavit of Acquisition of Secretary of State's mailing list
   Certificate
   Affidavit of Mailing
   Appointment of Hearing Officer
   Findings of Fact
   Order Adopting Rules
   Other exhibits introduced at the hearings
   Written comment received relative to the hearings.

3. Transcript of public hearings.

Sets 2 and 3

1. Copy of Rules to be adopted

2. All items listed under number 2 above.

Sets 4 and 5

1. Copy of Rules to be adopted.

SET #4

Public Hearings

May 6, 1975
June 18, 1975

Building Code Division
Department of Administration
State of Minnesota

SET #5

Public Hearings

May 6, 1975
June 18, 1975

Building Code Division
Department of Administration
State of Minnesota

STATEMENT OF COMPLIANCE WITH

MANUAL OF RULE MAKING PROCEDURES

I, Special Assistant Attorney General J. Michael Miles, do hereby declare that I have examined the proposed rules and all related documents and that, based on them and my personal familiarity with the applicable procedures, the Manual of Rule Making Procedures has been followed. Any exceptions are noted below.

J. Michael Miles
Special Assistant Attorney General

Date: 7/15/75

SET #2

Public Hearings

May 6, 1975
June 18, 1975

Building Code Division
Department of Administration
State of Minnesota

Exhibit A

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction and Re-construction of new Buildings and Re-modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendements to the State Building Code.

ORDER FOR HEARING

To effectively implement Minn. Stat. 1971, Section 16.86, the Commissioner of Administration deems it necessary to consider adoption of certain amendments to the State Building Code pursuant to the authority vested in the Commissioner by the Statute cited above.

NOW, THEREFORE, IT IS ORDERED this 6th day of May, 1975 that a Public Hearing on the proposed amendments be held at the Howard Johnson Motor Lodge, 8401 Cedar Avenue, Bloomington, Minnesota, commencing at 9:00 a.m. and continuing until all local governmental units, representatives of associations and other interested groups or persons have had an opportunity to be heard.

IT IS FURTHER ORDERED, that notice of said hearing be given pursuant to the provisions of Minn. Stat. 1971, Section 15.0412, Subdivision 4, and to all representatives of associations or other interested groups or persons who have registered their names with the Secretary of State for that purpose and all persons who are presently members of the Minnesota Legislature.

Dated: 3-13-75

Richard L. Brubacher

Richard L. Brubacher
Commissioner of Administration

Exhibit A

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

ORDER FOR HEARING

To effectively implement Minn. Stat. 1974, Section 16.86, the Commissioner of Administration deems it necessary to consider adoption of certain amendments to the State Building Code pursuant to the authority vested in the Commissioner by the Statute cited above.

NOW, THEREFORE, IT IS ORDERED this 13th day of May, 1975, that a Public Hearing on the proposed amendments be held at Room 83, State Office Building, Wabasha Street, St. Paul, Minnesota, commencing at 9:00 a.m., June 18, 1975, and continuing until all local governmental units, representatives of associations and other interested groups or persons have had an opportunity to be heard.

IT IS FURTHER ORDERED, that notice of said hearing be given pursuant to the provisions of Minn. Stat. 1974, Section 15.0412, Subdivision 4, and to all representatives of associations or other interested groups or persons who have registered their names with the Secretary of State for that purpose and all persons who are presently members of the Minnesota Legislature.

Dated: May 13, 1975

Richard L. Brubacher

Richard L. Brubacher
Commissioner of Administration

Exhibit B

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction and Re-construction of new Buildings and Re-Modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

STATEMENT OF NEED

The above-captioned proposed rules are amendments to the existing State Building Code.

Pursuant to Minn. Stat. 1971, Section 16.86, the Commissioner of Administration is charged with the responsibility of applying the State Building Code to all local governmental units having building codes, with limited exceptions, and with the duty of amending the State Building Code from time to time to maintain the most modern code standards regarding the construction, addition to or alteration of building, including life safety.

Further, the Commissioner of Administration may hold public hearings at such times as interested parties petition for amendments to the State Building Code. Pursuant to Minn. Stat. 1971, Section 15.0412, Subdivision 1 and 4, the Commissioner is empowered to promulgate reasonable substantive rules and may also amend rules as is deemed necessary upon a showing of need for the Amendment subsequent to a public hearing. Further, the Commissioner of Administration may hold Public Hearings at such times as interested parties petition for Amendments to the State Building Code. The above-captioned amendments that fall within the above mentioned conditions are deemed of sufficient importance to warrent consideration through the process of Public Hearing.

Dated: 3-13-75

Richard L. Brubacher

Richard L. Brubacher
Commissioner of Administration

Exhibit B

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

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Dated: May 19, 1975

Richard L. Brubacher

Richard L. Brubacher
Commissioner of Administration

Exhibit C

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction and re-construction of new Buildings and Re-Modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

NOTICE OF HEARING

Notice is hereby given that a public hearing will be held pursuant to Chapter 307, Laws of 1974, Minn. Stat. 1971, Section 16.86, and Minn. Stat. 1971, Section 15.0412, Subdivision 4, regarding the above-entitled matter, at Howard Johnson Motor Lodge, 8401 Cedar Ave., Bloomington, Minnesota, commencing at 9:00 a.m., May 6, 1975, and continuing until all local governmental units, all representatives of associations and other interested groups or persons have had an opportunity to be heard concerning adoption of the proposed rules captioned above by submitting either oral or written data, statements or arguments. Statements or briefs may be submitted without appearing at the hearing.

The Rules and Regulations may be secured by sending written request to Herbert W. Meyer, State Building Inspector, 408 Metro Square Building, St. Paul, Minnesota 55101. The Rules and Regulations may be reviewed at the Building Code Division Office. The Rules and Regulations will also be available at the door on the date of the hearing. Telephone inquiries regarding the amendments should be directed to 612-296-4639.

A copy of the procedural rules for the hearing is attached. Testimony or other evidence to be submitted for consideration should be pertinent to the matter at hand and may be presented either orally or in writing at the public hearing or by mailing a statement to Herbert W. Meyer, State Building Inspector, at the above-mentioned address within 20 days following the conclusion of the subject hearing. If the person submitting a statement cannot be present to read his statement at the time of the hearing, the statement will be entered into the record. For those wishing to submit written statements or exhibits it is requested that at least three (3) copies of such statement, exhibit, or summary be furnished at the hearing. It is suggested that to save time and avoid duplication, those organizations or associations having common viewpoint or interest in these proceedings join together where possible and present a single statement in behalf of such interests.

MINNESOTA DEPARTMENT OF ADMINISTRATION

Dated: 3-13-75

Richard J. Brubacher

Richard L. Brubacher
Commissioner of Administration

Exhibit

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

NOTICE OF HEARING

Notice is hereby given that a public hearing will be held pursuant to Chapter 307, Laws of 1974, Minn. Stat. 1974, Section 16.86, and Minn. Stat. 1974, Section 15.0412, Subdivision 4, regarding the above-entitled matter, at Room 83, State Office Building, Wabasha Street, St. Paul, Minnesota, commencing at 9:00 a.m., June 18, 1975, and continuing until all local governmental units, all representatives of associations and other interested groups or persons have had an opportunity to be heard concerning adoption of the proposed rules captioned above by submitting either oral or written data, statements or arguments. Statements or briefs may be submitted without appearing at the hearing.

The proposed amendments are in conjunction with the document entitled "Design and Evaluation Criteria for Energy Conservation in New Buildings", which may be secured by sending written request to Herbert W. Meyer, State Building Inspector, 408 Metro Square Building, 7th and Robert Streets, St. Paul, Minnesota, 55101. Telephone inquiries regarding the amendments should be directed to 612-296-4624.

The proposed amendments are as follows:

SBC 103 is amended to read as follows:

General. Building or structures to which additions, alterations, or repair are made shall comply with all the requirements for new buildings or structures except as specifically provided in this Code.

Note: For the requirements of energy conservation in remodeled buildings see SBC 6001 through SBC 6003.

Proposed Rules and Regulations for Design and Evaluation Criteria for Energy Conservation in New Buildings, Additions and Remodeled Elements of Buildings.

SBC 6002 ENFORCEMENT

1.0 Building Officials, in the municipality for which they are appointed, shall enforce these Rules.

1.1 In all other areas of the State these Rules shall be enforced by the Commissioner of Administration or his designated representatives. The fees for such enforcement shall be based on the schedule established in Chapter 3 of the Uniform Building Code, 1973 Edition, as adopted by SBC 201.

SBC 6003 PURPOSE

1.0 PURPOSE. The purpose of these Rules is to provide design requirements and criteria that will result in the effective utilization of energy in new buildings, additions and remodeled elements of buildings.

1.3 It is intended that these Rules can be used in the design of new buildings, additions and for the remodeled elements of existing buildings, and that compliance with ~~its~~ their requirements should be determinable in the pre-construction stage by evaluation and analysis of design specifications, drawings, and calculations.

SBC 6003 SECTION 2 - SCOPE

2.1.2 The requirements of SBC 103, Subparagraphs 1, 2, 3 and 4 shall not apply with respect to energy conservation regulations when compliance would not be economically feasible.

A request for an exemption to compliance with the above shall be submitted to the Building Official together with evaluation and documentation that shows compliance with the energy conservation requirements is not economically feasible.

The request shall be submitted to the Building Official of the municipality where the State Building Code applies and to the State Building Code Division for all other areas of the State.

Section 3 - DEFINITIONS

Add to the list of definitions:

Remodeled Element	Remodeled elements of existing buildings shall include but are not limited to the following: windows, doors, and other portions of the building envelope as well as the interior portions of the building that affect heat loss control, illumination or the climate control.
Remodeling	The reconstruction, removal, or replacement of any portion or element of an existing building which affects the heat loss control, illumination, or climate control, but does not include normal maintenance and repair.

A copy of the procedural rules for the hearing is attached. Testimony or other evidence to be submitted for consideration should be pertinent to the matter at hand and may be presented either orally or in writing at the public hearing or by mailing a statement to Herbert W. Meyer, State Building Inspector, at the above-mentioned address within 20 days following the conclusion of the subject hearing. If the person submitting a statement cannot be present to read his statement at the time of the hearing, the statement will be entered into the record. For those wishing to submit written statements or exhibits it is requested that at least three (3) copies of such statement, exhibit, or summary be furnished at the hearing. It is suggested that to save time and avoid duplication, those organizations or associations having common viewpoint or interest in these proceedings join together where possible and present a single statement in behalf of such interests.

MINNESOTA DEPARTMENT OF ADMINISTRATION

Dated: 5-14-75

Richard L. Brubacher
Commissioner of Administration

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 Providing for the Design, Evaluation, Construction and Re-Construction of New Buildings and Re-Modeling of Buildings Undertaken after the Effective Date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

FINDINGS OF FACT

The above-entitled matter came on for hearing before the Commissioner of Administration of the State of Minnesota on the 6th day of May, 1975, at 9:00 a.m. at the Howard Johnson Motor Lodge, 8401 Cedar Avenue, Bloomington, Minnesota, and on the 18th day of June, 1975 at 9:00 a.m. in Room 83 of the State Office Building, Wabasha Street, St. Paul, Minnesota, after proper notice required by Minn. Stat. 1974, Section 15.0412, Subdivision 4 was served upon all persons, associations and other interested groups registered with the Secretary of State for that purpose.

After affording interested persons an opportunity to present written and oral data, statements and arguments, having heard all the testimony, having considered all of the evidence adduced and upon the records, files and proceedings herein, I find the following:

SBC 103 — The Rule provides a ready cross-reference to requirements for energy conservation in remodeled buildings and is needed for clarification. Testimony at the hearing supported the need for clarification.

SBC 6001 — Authorization. The Rule is required by Minn. Stat. 116H.12 in authorizing adoption of rules to ensure energy conservation. Exhibits L and M requested clarification and addition of requirements for remodeling. Ellerbe Architects, Inc. (CE1) and the Minnesota Society of Architects (CM9) supported the same in written testimony. Oral testimony at the June 18, 1975 hearing supported the revisions.

SBC 6002 — Enforcement. Minn. Stat. 16.861, Subdivision 4, mandates Building Code enforcement by municipal building officials.

SBC 6002(b) — The revised rule is necessary to provide statewide enforcement pursuant to Minn. Stat. 116H.12, Subdivision 4. Testimony at the June 18, 1975 hearing endorsed enforcement by the State in areas not covered by the State Building Code.Testimony at the May 6, 1975 hearing recommended enforcement by the State or designated representative. Written testimony by the St. Paul Association of Building Owners and Managers, Inc. (St. Paul BOMA) favors and supports the proposed form of enforcement by the State Building Code Division or its designated representative in areas not covered by SBC 6002(a). Northwestern Lumbermans Association was concerned with the cost of enforcement by the State.

SBC 6003 Purpose. The revised rule is necessary to ensure energy conservation in not only new buildings but also in additions and in remodeled buildings as required by Minn. Stat. 16.860, Subdivision 6a and Minn. Stat. 116H.12. Oral and written testimony was presented at the May 6, 1975 public hearing as outlined below:

Ellerbe Architects in written testimony questioned the limitation to new buildings and requested clarification if applied to additions and remodeling. The Minnesota Society of Architects requested additions of remodeled buildings to this section or to provide a separate code for remodeled buildings.

Written testimony by the Control Data Corporation requested the "re-use of energy from potential internal loads such as computer systems" to be added to create awareness on the part of designers to incorporate recovery techniques in building systems.

Exhibit J questioned who would make the necessary determinations or decisions required by this Section. Exhibits I, J and M asked for clarification and addition of remodeled buildings in the section. Testimony including oral and written at the June 18, 1975 hearing was in favor of the Section as heard on that date.

On June 18, 1975, revised Sections 6003(a), (b) and (c) were heard and both oral and written testimony was favorable and supported the revised Rule.

SBC 6004 Scope. This Section is necessary as it outlines the broad application of the rules, and also indicates the buildings or areas exempted from conformance with the Rules.

Exhibit H of the May 6, 1975 hearing requested clarification and revision to use 3.4 BTU/sq.ft. of floor area in addition to 1 Watt/sq.ft. and to include in the section when SBC 103 would not be applicable. The request was supported by Exhibits L and M, by the Consulting Engineers Council of Minnesota, the Minnesota Society of Architects, SMARCA, and other speakers. The Building Code Standards Committee further clarified the wording to delineate when a copy of an exemption approved by a building official must be submitted to the State Building Inspector.

SBC 6004(b)2 clarifies how and when paragraphs 1, 2, 3 and 4 of SBC 103 need not be complied with and when exemptions may be granted for non-compliance with those parts of SBC 103. The clarification was requested by both oral and written testimony at the May 6, 1975 hearing. Oral testimony supported SBC 6004 at the June 18, 1975 hearing with some question as to the desirability of defining "economically feasible". An adequate or general definition is not possible without consideration of the building involved. Economic feasibility is a test that must be applied individually to each building. Subparagraphs 1, 2, 3 and 4 of SBC 103 are included for immediate reference to insure clarification as to its application with the energy code. The energy code is not designed to incorporate specific procedures for the normal operation, maintenance and use of buildings.

SBC 6005 Definitions. Definitions are provided to state and delineate the meanings of words and phrases that are significant to the energy rules. Revisions were made to some definitions as outlined in Exhibits H, I and M of the May 6, 1975 hearing. The revisions were supported by other speakers at that hearing. "Remodeled Element and Remodeling" were added to the definitions as a result of the June 18, 1975 hearing and favorable oral and written testimony.

Subsequent action by the Building Code Standards Committee incorporated the definition of "Valuation" from Section 423 of the 1973 edition of the Uniform Building Code to provide immediate reference to its use with SBC 103, Subparagraphs 1, 2, 3 and 4 for use and aid in determining "economic feasibility" in energy conservation.

Both oral and written testimony recognized the importance and need for clear definitions as being necessary for the implementation and use of the code. The Section is necessary to properly enforce the code.

SBC 6006 Exterior Envelope. The Legislature, pursuant to Minn. Stat. 116H.12, Subdivision 4, clearly intended that the building exterior envelope be subject to rules and regulations limiting the heat loss/gain. SBC 6006, Exterior Envelope, is the base on which other succeeding sections depend for successful implementation of energy saving and conservation. Based on the exhibits and testimony, both oral and written, as outlined below, the revised section is necessary.

The Consulting Engineers Council of Minnesota conducted a joint study of the rules with the Minnesota Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE-MC), Minnesota Society of Architects (MSA), Minneapolis Chapter of the National Electrical Contractors Association (NECA - MC), SMARCA of Minnesota, Inc. and the Minnesota Masonry Institute (MMI). As a result of that study, the Minnesota Chapter of ASHRAE submitted as Exhibit H, a statement in support of the energy rules, and suggested certain revisions to SBC 6006. Exhibit H was supported by the above members of the joint study as shown in Exhibits I, J, N and P. Written testimony by CEC, MC-NECA, SMARCA-MC, and oral testimony from representatives of those organizations supported the rules. Rauenhorst Corporation in Exhibit L, Metal Building Dealers Association (Northland Chapter)(NBDA-NC) in Exhibit K, and Hammel Green and Abrahamson (HGA) in Exhibit M supported the rule. Supporting written testimony was submitted by ASHRAE-Minn. (CA4), Blomberg Windows (CB1), Brin Glass (CB3), Cornell Corporation (CC2), Ellerbe Architects (CE1), Foss, Engelstad, Foss (CF2), I.D.S. Properties (CI1), Marathon Metallic Building Company (CM1), Mattson Building and Supply, Inc. (CM2), Metal Building Dealers Association-Northland Chapter (CM3), Mid-Continent Steel Corporation (CM4), Minneapolis Public Schools (CM5), Minnesota Masonry Institute (CM7), Minnesota Mining and Manufacturing Company (CM5), Minnesota Society of Architects (CM9), Minnesota Housing Institute (CM10), Minneapolis Chapter of the National Electrical Contractors Association (CN1), National Mineral Insulation Association (CN2), Sahf Construction, Inc. (CS1), Setter Leach and Lindstrom, Inc. (CS2), Swift Systems Company (CS3), Strack Construction Company, Inc. (CS4), R.E. Stock, Inc. (CS5).

Supporting oral testimony was offered at the public hearing of May 6, 1975 by Joe Pfost of Ellerbe Architects. Dr. Paul R. Achenbach of the National Bureau of Standards and Dr. Eric A. Swenson of the Federal Energy Administration appeared and testified on behalf of their agencies in support of the energy rules and the importance of adoption of the rules to help solve the national problems and shortage of energy both now and in the future.

Empirehouse, Inc. and David Hagen expressed in written testimony, concern for addition revisions to SBC 6006. These revisions were not adopted since there was not full opportunity for consideration at the public hearing. No other criticism of the rule was heard or received after the hearing.

The following subsections and subparagraphs of SBC 6006 were revised in accordance with the above testimony, comments and exhibits; 6006(a), (b), (c)1, (c)2, (c)3, (c)4, (d)2, (e)1, (e)2, (f)2, (g)1, (g)2. All other parts of SBC 6006 are accepted without revision.

SBC 6007 Heating, Ventilating and Air Conditioning (HVAC) Systems. HVAC systems regulated by this section are among the principal users of energy in buildings. The criteria and parameters for the efficient utilization of energy as regulated by this section are necessary to ensure energy conservation in buildings.

It is necessary to incorporate in the rules certain nationally recognized standards to provide technical data, information and calculations to ensure the proper implementation of the rules. A list of the standards and the organizations from which the standards may be obtained are in Appendix A of the energy document.

The calculation of heating and cooling loads, control requirements, insulation of piping and air handling systems, construction of ducts, design requirement concepts and parameters based on the application of minimum energy levels outlined in the rules are necessary to provide efficient use of energy.

A joint study of the section was made by CA4, CC1, CM9, CN1, and SMARCA-M. CA4 submitted an Exhibit H which recommended some revisions to the section which were primarily editorial and to correct spelling and references to standards or other sections. CC1 in Exhibit I, and SMARCA-M in Exhibit J supported CA4's recommendations. Rauenhorst in Exhibit L further recommended a limit on the ventilation rate in SBC 6007(c)3. In Exhibit M, Hammel, Green and Abrahamson, Inc. supported CA4.

Written testimony was submitted in support of the section with generally the same revisions suggested by CA4. Those submitting favorable written testimony are identified as CA4, CB2, CE1, CI1, CM9, CS2, and CT2. No testimony in opposition to the rule was presented at the hearing.

The following subsections and subparagraphs of SBC 6007 were revised in accordance with testimony, comments and exhibits relating to SBC 6007: SBC 6007(c)4, (d)3C, (d)4B, (e)4, (f), (g) and (h). All other parts of SBC 6007 are accepted without revision.

SBC 6008 Heating, Ventilating and Air Conditioning (HVAC) Equipment. In addition to regulating energy conservation in buildings and HVAC systems, it is necessary to establish criteria regulating the performance of HVAC equipment and to require documentation of such performance by the manufacturer to ensure efficient energy utilization. Certain nationally recognized standards outlined in the section are necessary to ensure standard uniform criteria for the manufacturer to measure the performance of his HVAC equipment and to provide documentation of such performance to the user of the equipment. In order to assure continuous energy efficient use of equipment, the manufacturer shall provide instructions for periodic maintenance and operation of the equipment on a permanent label in a readily accessible location on the equipment.

CA4 in Exhibit H suggested substantial revisions including an additional table. CC1 in Exhibit I supported CA4. In Exhibit M Rauenhorst questioned the value of the information required. SMARCA-M concurred with this question. CS2 suggested a correction to an incorrect section reference. The Building Code Standards Committee recommended that the section not be revised since other interested persons were not afforded an opportunity to review and comment. The Committee made the recommendation with the knowledge that the effective date for compliance with SBC 6008 is January 1, 1977, and there is sufficient time for a future hearing.

Based on the evidence adduced at the hearing and the recommendation of the Building Code Standards Committee , the original SBC 6008 is necessary to afford at the earliest time notice to manufacturers of equipment of the criteria to be used for performance rating and and documentation of such ratings.

SBC 6008(d) and (h) were revised.

SBC 6009 Service Water Heating. Service water heating is a separate form of energy use and application and requires special regulations. It is determined that to provide optimal energy saving, equipment for service water heating shall provide performance efficiency as outlined in the nationally recognized standards referenced in Section 6009.

Tables 6009-A and 6009-B outlining insulation requirements for service water heating equipment and piping are necessary in tabular form to ensure ready and accurate provisions for energy efficiency. Certain equipment shall have special provisions to provide conservation of the use of hot water.

SBC 6009(c)3 was revised to convert the requirements to tabular form.

SBC 6010 Electrical Distribution. The design for the electrical distribution systems shall be such that the most efficient use of electricity is provided.

The power factor shall be designed to not less than 90% of the rated power load based on engineering evaluations, the utilization equipment design or the power factor corrective devices and shall be installed at the equipment or at the service entrance.

The power factor correction as outlined in these rules provides efficient distribution of energy to insure savings in the cost of energy consumption.

It is necessary to limit the voltage drop as required in SBC 8601 to provide safe efficient use within the system.

Exhibits H, I and M support the revised section. CE1 and CN1 submitted written testimony supporting the revised section. The written testimony, Exhibits H, I and M, and the oral testimony as indicated in the transcript of the hearing opposed the requirement of individual metering devices in multi-tenant buildings as was originally considered in paragraph 8.6 of the May 6, 1975 hearing document.

Sections 6010(b) and (d) were revised.

SBC 6011 Lighting Systems. It is necessary to coordinate lighting system design with the envelope and other system designs to secure the optimum efficient utilization of energy. A uniform method for establishing permissible power consumption is necessary to conserve energy.

Energy conserving lighting design practices shall be established as mandated in Minn. Stat. 16.86, Subdivision 6a and in Minn. Stat. 116H.12, Subdivision 4.

Certain nationally recognized standards incorporated by reference in the rule are necessary to provide technical data and information to ensure uniform implementation of the rules. A list of the Standards is found in Appendix A.

Lighting systems shall be provided with adequate circuiting and switching so as to reduce the energy consumption to a minimum when lighting is not needed for general or task use or space is not occupied.

Exhibits H, I, M and R support the revised section. CN1 supports the revised section. CE1 generally supports the section, but requested additional clarification of task lighting. James Tegan presented some possible problems at the May 6, 1975 hearing with reference to this section. However, no evidence contrary to the revised rule was adduced at the hearing. No written comments opposing the rule were received.

SBC 6011(a), (c), (f) and (h) were revised.

SBC 6012 System Analysis Design. It is necessary to permit alternative building and design systems that can be shown to reduce the energy supplied to a similar building designed to comply with SBC 6006 through SBC 6011.

This rule is necessary to properly carry out the requirement authorized by Minn. Stat. 16.86, Subdivision 6a and Minn. Stat. 116H.12, Subdivision 4.

Exhibit H supports the revised section. CM6 and CM9 support the revised section. CA1, CS3 and CS5 opposed the requirements in SBC 6012(e) using 5,000 sq. ft. buildings but recommended an increase to 20,000 or 30,000 sq. ft. buildings. The State Building Code Standards Committee recommended SBC 6012 as revised.

SBC 6012(c)2 and (e) were revised.

SBC 6013 Solar and Wind Powered Energy Sources. Use of solar or wind powered energy sources does not deplete the energy source and such use shall be excluded from the total energy chargeable to the alternative design submitted. Qualification of such exclusion of chargeable energy depends on the solar energy being derived from a specific collection distribution device and not from natural solar energy passing through windows.

The exhibits and written testimony are as outlined for SBC 6012. No other evidence or testimony opposed the revised rule. The Building Code Standards Committee recommended the revised rule.

The revisions to SBC 6013 are editorial in nature, correcting references to other sections and the deletion of granting an energy bonus which is not possible to administer.

Three hearings were held to consider rules for energy conservation. They were held on January 14, 1975, May 6, 1975 and June 18, 1975. The rules as heard on January 14, 1975 were the result of a study by a committee of professional and technical experts known as the Heat Loss Technical Committee. Because numerous questions were posed at the January 14, 1975 hearing as well as recommended changes, further hearings were scheduled. Testimony at the May 6, 1975 hearing as shown by the exhibits, oral and written comments, was overwhelmingly in favor of the rules with certain further revisions especially as concerned additions and remodeling of buildings. Those revisions were considered at the June 18, 1975 hearing and testimony supported the revised rules.

The State entered into a contract for a computer simulation program which considered typical buildings designed in accordance with the rules to determine the results of such design. Plans for a single family residence, a school, and a supermarket were used and the results were submitted to the State. The results indicate that buildings designed in accordance with the rules provide energy savings as well as an economic return.

The Building Code Standards Committee, whose members attended the hearings, considered together with an ad-hoc committee, at two meetings, the transcripts, exhibits and written comments submitted for the hearings. The ad hoc committee consisted of architects, engineers, industry members and manufacturer's representatives. The committee considered each rule and voted to recommend that the rules as considered or revised are necessary to provide energy conservation as mandated by the legislature and that rules be incorporated as a part of the State Building Code.

After consideration of the support engendered at the public hearings, the exhibits and written testimony submitted, and the recommendations of the Building Code Standards Committee, I find that the rules as revised are necessary to carry out the objectives and provisions of Minn. Stat. 16.861, Subdivision 6a and Minn. Stat. 116H.12, Subdivision 4, which are to regulate and control heat loss, illumination levels and climate control in buildings, additions and remodeling of buildings, and are adopted.

The following rules are not adopted:

SBC 6004 Original Section 2.3 is not adopted because the subject was already covered in the language of the preceding section.

SBC 6007 Original Section 5.5.9 is not adopted because criteria are vague and do not recognize some limitations due to corrosive and hazardous exhaust (see MOSHC 41(g)). Where some energy recovery systems may not produce energy savings, the economic feasilibity should determine the application of such systems.

Original 5.9.3 is not adopted. Regulated by SBC 6007(i).

Original 5.9.4 is not adopted. Alternative designs allowed by the Code provide for those special conditions mentioned in the section, therefore, 5.9.4 is not necessary.

Original 5.10.2 deleted as there is no standard published to provide uniform and standard testing procedures.

SBC 6008 Original Sections 6.2.2 and 6.2.3 are deleted because of vagueness and redundancy.

Original 6.3.2, Subparagraphs B and C, were deleted because of no justification for the exemptions. Testimony by Exhibit H indicated that the systems in B and C should meet the COP values required by the table.

Original 6.4, 6.4.1, 6.4.2, 6.4.3 and 6.6.2 were deleted because this section does not provide information that is either accurate or significant to the State of Minnesota. Full load COP is calculated and energy usage is calculated under the requirements of original Chapter 10. The "Seasonal COP" would appear to be unjustifiable.

Original 6.8 was deleted because it refers to Section 10 which is not being adopted.

SBC 6010 Original 8.5 and 8.6 are deleted because 8.5 was already included in new section 6011 and 8.6 is deleted because it was not substantiated that it would result in a reduction of cost.

SBC 6013 Original Section 12.1 is deleted because the granting of an energy bonus is not possible to administer.

SBC 6014 This section, identified as Section 10 in the May 6, 1975 hearing document, is not adopted. The evidence presented at the hearing and in the written documents was preponderantly opposed to the section. The only favorable evidence was predicated on a substantially revised section. The revision was of such a nature as to require an additional public hearing.

Date: 7-17-75

Richard J. Brubacher

Richard L. Brubacher
Commissioner of Administration

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 Providing for the Design, Evaluation, Construction and Re-Construction of New Buildings and Re-Modeling of Buildings Undertaken after the Effective Date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

ORDER ADOPTING RULES

The above-entitled matter came on for hearing before the Commissioner of Administration of the State of Minnesota on the 6th day of May, 1975, at 9:00 a.m. at the Howard Johnson Motor Lodge, 8401 Cedar Avenue, Bloomington, Minnesota, and on the 18th day of June, 1975, at 9:00 a.m. in Room 83 of the State Office Building, Wabasha Street, St. Paul, Minnesota, after proper notice required by Minn. Stat. 1974, Section 15.0412, Subdivision 4 was served upon all persons, associations and other interested groups registered with the Secretary of State for that purpose.

After affording interested persons an opportunity to present written and oral data, statements and arguments, having heard all of the testimony, having considered all of the evidence adduced and upon the records, files, and proceedings herein, and applicable statutory standards or criteria, and having confirmed the need for the above-captioned rules:

NOW, THEREFORE, IT IS ORDERED that these rules identified as SBC 103 and SBC 6001 through SBC 6013, a copy of which is hereto attached, are adopted this 17th day of July, 1975, pursuant to the authority vested in me by Minn. Stat. 1974, Section 16.86.

Date: 7-17-75

Richard L. Brubacher
Commissioner of Administration

Exhibit D

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction and Re-construction of new Buildings and Re-modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

AFFIDAVIT

Herbert W. Meyer, being duly sworn, on oath deposes and says:

1) That he is an employee of the Department of Administration of the State of Minnesota.

2) That on the 19th day of March, 1975, he requested from the Secretary of State's office for the State of Minnesota current list of all representatives of associations and other interested groups or persons who had registered their names with the Secretary of State for the purpose of obtaining notices of public hearings relating to the promulgation of regulations pursuant to Minn. Stat. 15.0412.

3) That on the 21st day of March, 1975, in response to the above request, the Secretary of State provided him with such a list, a copy of which is attached hereto and incorporated by reference.

Further affiant sayeth not.

Herbert W. Meyer

Herbert W. Meyer
State Building Inspector
Minnesota Department of Administration

Subscribed to and sworn to before
me this 1st day of April, 1975.

CYNTHIA L. CLAASON
NOTARY PUBLIC - MINNESOTA
RAMSEY COUNTY
My Commission Expires Feb. 23, 1982

Exhibit D

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

AFFIDAVIT

Herbert W. Meyer, being duly sworn, on oath deposes and says:

1) That he is an employee of the Department of Administration of the State of Minnesota.

2) That on the 13th day of May, 1975, he requested from the Secretary of State's office for the State of Minnesota current list of all representatives of associations and other interested groups or persons who had registered their names with the Secretary of State for the purpose of obtaining notices of public hearings relating to the promulgation of regulations pursuant to Minn. Stat. 15.0412.

3) That on the 14th day of May, 1975, in response to the above request, the Secretary of State provided him with such a list, a copy of which is attached hereto and incorporated by reference.

Further affiant sayeth not.

Herbert W. Meyer

Herbert W. Meyer
State Building Inspector
Minnesota Department of Administration

Subscribed to and sworn to before
me this 14th day of May, 1975.

CYNTHIA L. CLAWSON
NOTARY PUBLIC - MINNESOTA
RAMSEY COUNTY
My Commission Expires Feb. 23, 1982

Cynthia L. Clawson

Exhibit E

STATE OF MINNESOTA

COUNTY OF RAMSEY

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction and re-construction of new Buildings and Re-Modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

CERTIFICATE

I hereby certify that the attached 420 labels and 4 sheets constitute the complete list of persons, associations, and other interested groups who as of 11:20 o'clock a.m., this 21st day of March, 1975, have requested pursuant to Minn. Stat. 1971 Section 15.0421, that their names be placed on file with the Secretary of State for the purpose of receiving notice of public hearing on proposed rules on the subject captioned above.

Joan Anderson Growe

SECRETARY OF STATE

By: Virginia Daniels

Exhibit E

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

CERTIFICATE

I hereby certify that the attached 425 labels and 4 sheets constitute the complete list of persons, associations, and other interested groups who as of 8:40 o'clock a.m., this 14th day of May, 1975, have requested pursuant to Minn. Stat. 1974, Section 15.0421, that their names be placed on file with the Secretary of State for the purpose of receiving notice of public hearing on proposed rules on the subject captioned above.

Joan Anderson Growe

Joan Anderson Growe
SECRETARY OF STATE

By: Cecil Dion

Exhibit F

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction and Re-construction of new Buildings and Re-modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

AFFIDAVIT OF MAILING

Herbert W. Meyer, being first duly sworn, deposes and says:

That on the 26th day of March, 1975, at the City of St. Paul, County of Ramsey, State of Minnesota, he served the attached Notice of Hearing by depositing in the United States mail at said City of St. Paul, a true and correct copy thereof, properly enveloped, with postage prepaid, to all local governmental units, all persons and associations at the addresses listed on the attached Certificate regarding the Secretary of State, members of the Minnesota legislature, and other interested individuals.

Herbert W. Meyer

Herbert W. Meyer
State Building Inspector
Minnesota Department of Administration

Subscribed and sworn to before me
this 1st day of April, 1975.

CYNTHIA L. GLEASON
NOTARY PUBLIC - MINNESOTA
RAMSEY COUNTY
My Commission Expires Feb. 23, 1982

Cynthia L. Gleason

Exhibit F

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

AFFIDAVIT OF MAILING

Herbert W. Meyer, being first duly sworn, deposes and says:

That on the 15th day of May, 1975, at the City of St. Paul, County of Ramsey, State of Minnesota, he served the attached Notice of Hearing by depositing in the United States mail at said City of St. Paul, a true and correct copy thereof, properly enveloped, with postage prepaid, to all local governmental units, all persons and associations at the adresses listed on the attached Certificate regarding the Secretary of State, members of the Minnesota legislature, and other interested individuals.

Herbert W. Meyer

Herbert W. Meyer
State Building Inspector
Minnesota Department of Administration

Subscribed and sworn to before me
this 15th day of May, 1975

CYNTHIA L. CLAASON
NOTARY PUBLIC - MINNESOTA
RAMSEY COUNTY
My Commission Expires Feb. 23, 1982

Cynthia L. Claason

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of the Proposed Rules and Regulations to provide Energy Conservation Standards to Carry Out the Provisions of Laws of 1974, Chapter 307 providing for the Design, Evaluation, Construction, and re-construction of new Buildings and re-modeling of buildings undertaken after the effective date of these Rules and Regulations. These Rules and Regulations will also constitute amendments to the State Building Code.

APPOINTMENT

Herbert W. Meyer is hereby appointed to serve as hearing officer on behalf of the Commissioner of Administration in the above-captioned matter, said hearing to be held on May 6, 1975, and continue until all representatives of associations or other interested groups or persons have had an opportunity to be heard.

This appointment is made pursuant to Minn. Stat. 1971, Section 16.86, Subdivision 4.

Dated: 3-13-75

Richard L. Brubacher
Commissioner of Administration

STATE OF MINNESOTA

COUNTY OF RAMSEY

BEFORE THE

COMMISSIONER OF ADMINISTRATION

In the Matter of Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling.

APPOINTMENT

Herbert W. Meyer is hereby appointed to serve as hearing officer on behalf of the Commissioner of Administration in the above-captioned matter, said hearing to be held on June 18, 1975, and continue until all representatives of associations or other interested groups or persons have had an opportunity to be heard.

This appointment is made pursuant to Minn. Stat. 1974, Section 16.86, Subdivision 4.

Dated: May 19, 1975

Richard L. Brubacher
Commissioner of Administration

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Exhibit H

Minnesota Chapter

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR - CONDITIONING ENGINEERS, INC.

LARRY J. HINK
PRESIDENT

PHILIP A. DUGAN
VICE-PRESIDENT

DONALD L. TRIMMER
SECRETARY

ROBERT J. SNYDER
TREASURER

May 5, 1975

BOARD OF GOVERNORS
LARRY E. HEINEN
CURTIS H. WENTZ
OSCAR S. SAMUELSON

Mr. Richard L. Brubacker
Commissioner of Administration
408 Metro Square Building
St. Paul, Minnesota 55101

Gentlemen:

Enclosed you will find three (3) copies of our comments on the document titled "Design and Evaluation Criteria for Energy Conservation in New Buildings" dated March 17, 1975.

We wish to introduce these comments as an Exhibit for the record.

The Energy Conservation Committee of the Minnesota Chapter of ASHRAE submitting these comments is composed of thirteen individuals who have varied experience backgrounds that include consulting engineers, design engineers, equipment manufacturer representatives, temperature control specialists, an energy program computer specialist and representatives of the utility or energy supply industry. We also solicited the aid of an electrical engineer for review of Sections 8 and 9.

Our comments are in a form that we hope will expedite their review.

The ASHRAE Energy Committee has also been involved with the review of the ASHRAE proposed Standard 90-P document titled "Design and Evaluation Criteria for Energy Conservation in New Buildings".

We would estimate the total man hours used by the Committee would exceed 200 man hours since we started our review in mid March.

The ASHRAE Committee would like to go on record as supporting the proposed Code. We don't agree with all the specific Code requirements as evidenced by our Exhibit, but we do agree with the basic content and overall approach.

We would like to express our concern in this letter over one aspect of the Code. This has to do with Administration. We question the availability of qualified people to properly review and enforce building design to guarantee compliance. We are certain you have

given this a good deal of consideration and trust you will find a solution.

In closing, the ASHRAE Energy Conservation Committee would like to commend the Minnesota Department of Administration, the Governor's Heat-Loss Technical Committee and the State of Minnesota Energy Agency in providing Minnesota with a needed Energy Code and being a leader in the nation in this endeavor.

Very truly yours,

Allan W. Wessel

Allan W. Wessel
Chairman
ASHRAE Energy Conservation Committee

Richard D. Cramer
Earl H. Bartels
Ram Gada
Robert O. Halvorson
Arthur F. Hovda
Edward M. Wiik
Joe W. Kuns
Jack J. Schutz
Tom Lidberg
Larry Hink
Bill Wharton
Basant Kharbanda
George Ellison (Electrical Consultant)

DESIGN AND EVALUATION CRITERIA

FOR

ENERGY CONSERVATION IN NEW BUILDINGS

State of Minnesota
Department of Administration
Building Code Division
March 17, 1975

MEMBERS:

Allan W. Wessel - Chairman
Richard D. Cramer
Earl H. Bartels
Ram Gada
Robert O. Halvorson
Arthur F. Hovda
Edward M. Wiik
Joe W. Kuns
Jack J. Schutz
Tom Lidberg
Larry Hink
Bill Wharton
Basant Kharbanda
George Ellison (Electrical Consultant)

EXHIBIT

American Society of
Heating, Refrigerating and
Air Conditioning Engineers

Comments on the New Proposed
Minnesota Energy Code - March 17, 1975

May 1, 1975

DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS

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NOTICE

In response to Laws of 1974, Chapter 307, these Proposed Amendments will become effective six months after adoption.

These proposed energy conservation requirements are performance oriented and are not intended to be specifications for construction.

To supplement the performance standards, it is the intent of the Building Code Division to provide a "Code Manual" which will acquaint building officials, designers and the construction industry with specific methods of construction which have been evaluated and found to meet these performance standards.

PROPOSED RULES AND REGULATIONS

Building Code Division

Department of Administration

Relating to:

DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS

SBC 6001 Authorization. These Rules are authorized by Laws of 1974, Chapter 307, and established through the rule making procedures set forth in Minn. Stats. 1969, Sections 15.0411 to 15.0417, in order to implement, interpret and carry out the provisions of Laws of 1974, Chapter 307 regarding energy conservation standards for design, evaluation, construction or reconstruction of all new buildings and remodeling undertaken after the effective date of these Rules. Additionally, these Rules constitute amendments to the State Building Code. In the event that these Rules differ with the State Building Code, these Rules shall govern in all cases not affecting safety and health requirements.

SBC 6002 Enforcement. Building Officials, in the municipality for which they are appointed, shall enforce these Rules.

SECTION 1

SBC 6003 PURPOSE

1.0 PURPOSE. The purpose of these Rules is to provide design requirements and criteria that will result in the effective utilization of energy in new buildings.

1.1 The requirements and criteria are performance-oriented and are directed toward the design of building envelopes with high thermal resistance, low air leakage, and toward requiring practices in the design and selection of mechanical, electrical and illumination systems and equipment which promote the efficient use of energy.

1.2 It is intended that the rules shall be flexible and designers shall be encouraged to use innovative approaches and techniques to achieve efficient utilization of energy. Efficient use of energy can be achieved by the use of design solutions that shall be shown to use equivalent or lesser amounts of energy without following each specific requirement.

1.3 It is intended that these Rules be used in the design of new buildings and that compliance with its requirements should be determinable in the preconstruction stage by evaluation and analysis of design specifications, drawings, and calculations.

SBC 337 to SBC 5999 reserved for future use.

SBC 6004 to SBC 7099 reserved for future use.

SECTION 2 - SCOPE

2.0 These Rules set forth requirements for the design of all types of new buildings covering their exterior envelopes and selection of their HVAC, service water heating, electrical distribution and illuminating systems, and equipment for efficient use of energy. Observance of the requirements does not necessarily lead to an optimization of initial and operating cost, and these Standards are not intended to replace economic evaluation to arrive at such an optimization. Economic evaluation of thermal design criteria will generally show that further reductions in energy consumption will be economically desirable.

2.1 This standard applies to the design and construction of all types of new buildings or those portions of new buildings containing conditioned space. Vacation homes used for summer occupancy and buildings whose peak design demand ~~energy usage~~ is less than ~~1-watt/~~3 Btu/sq.ft. of floor area for all purposes are specifically excluded from the scope of this standard.

2.1.1 Certain other buildings or elements thereof may be exempted when design data are not applicable ~~or calculations show that internal heat gains exceed heat losses~~. In these cases, the request for exemptions shall be made in writing and ~~a copy of such exemptions shall be~~ submitted to the State Building Inspector ~~within fifteen (15) days of the granting of such exemption~~ for approval.

2.2 These Rules principally cover the features of a building, its equipment, and systems that determine its use of energy. ~~The energy uses covered shall be that~~ energy used within the building and on its site.

~~2.3 These Rules shall not abridge any safety or health requirements.~~

2.3

~~2.4~~ These Rules do not incorporate specific procedures for the operation, maintenance and use of buildings.

Section 2 Comments:

2.1 The word demand or peak is correct. Three (3) Btu/sq.ft. is more easily understood than 1 watt/sq.ft. and is more consistent with the entire document.

2.1.1 Clarification.

2.2 Clarification.

2.3 Already stated in SBC 6002 Enforcement.

SECTION 3 - DEFINITIONS

Buildings	a. Existing buildings - Buildings constructed prior to the effective date of these Rules. b. New buildings - Those buildings constructed or having permits issued subsequent to the effective date of these Rules.
Building Envelope	The elements of a building which enclose conditioned spaces through which thermal energy is transferred to or from the exterior ambient environment.
Coefficient of Performance (COP) Heat Pump, Heating Mode	The ratio of the rate of heat delivered by the complete heat pump unit (exclusive of supplementary heating) to rate of energy input, in consistent units and under designated operating conditions.
Coefficient of Performance (COP) Cooling Mode	The ratio of the rate of heat removed (by the refrigeration cycle) to the rate of energy input, in consistent units and under designated operating conditions.
Conditioned Space	Any space heated, cooled or lighted whose design energy usage is greater than ~~1 Watt~~ 3 BTU/sq.ft.
Cooled Space	Space within a building in which new energy is used for cooling.
Deadband	The range of controlled temperature within its normal operating span in which no corrective action is called for by the controller.
Energy	Includes all fossil fuels, solar, wind and electricity, and products from their use such as steam and chilled water which are delivered to the building to perform work.
Energy, New	Electrical or chemical energy converted to thermal or mechanical energy expressly for the purpose of heating or cooling.
Energy, Recovered	Energy utilized which would otherwise be wasted from an energy utilization system.
Energy Efficiency Ratio (EER)	a. The ratio of net cooling capacity in Btu's output and total electric input in watts. b. The number of Btu's output divided by the watts of power used. The higher the number the more cooling obtained for less electrical input.

Energy Significant Equipment	Central station unitary or room-type space conditioning equipment including, but not limited to energy converting/processing equipment used in engineered systems and packaged subsystems, service water-heating equipment and lighting equipment.
Heat Flux	The heat transmitted per unit of time per unit of cross-sectional area (Q/A), Btu/hr./sq.ft.
Heated Space	Space within a building which is provided with a positive heat supply.
HVAC System	A system that provides either collectively or individually the processes of comfort heating, ventilating and/or cooling within or associated with buildings.
Infiltration	The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.
Opaque Areas	All exposed ~~opaque~~ areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.
Outside Air	Air taken from the outdoors and therefore not previously circulated through the system.
Positive Heat Supply	Heat supplied to a space by design or by heat losses occurring from energy consuming systems or components associated with that space.
Reheat	Sensible heat added to condition a zone to overcome cooling produced by expenditure of energy within the HVAC system serving that zone.
Service Systems	The HVAC, service water heating, electrical distribution, and illuminating systems provided in a building.
Thermal Break	A material of low thermal conductivity that is installed between the cold and warm parts of the members in a building element to reduce the heat transmission through the structural members. The member itself can serve as a thermal break, if it has low thermal conductivity.

Total Energy System	An on-site electrical generating system arranged ~~for the maximum utilization of input fuel energy by salvaging~~ To salvage by-product or waste heat from the generating process.
Unheated Space	A ~~cellar, basement, crawl space, garage, attic or other~~ space, within a building, which is not provided with a positive heat supply.
Unitary Air Conditioner	One or more factory made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separated assemblies shall be designed to be used together.
Ventilation Air	That portion of supply of air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space as established by A.S.H.R.A.E. Standard 62-73 - Standards for Natural and Mechanical Ventilation. Adopted Feb. 16, 1973 By board of Directors.
Zone	A portion of the occupied space within a building which, recognizing the nature of its heating/cooling load, could be satisfactorily controlled to desired temperature limits, under varying indoor loads and outdoor conditions, by the operation of control at a single point. For specific purpose of this definition, the term "occupied space" is defined as the region within a space between the three inch and the six foot level above the floor and more than two feet from exterior walls or fixed air conditioning fixtures or equipment.

Section 3 Comments:

Conditioned Space - Clarification more easily understood.

Energy Efficiency Ratio - a and b clarification.

Opaque Areas - Clarification.

Unheated Space - Clarification.

Ventilation Air - Reference to A.S.H.R.A.E. establishes a standard for recirculated air.

Total Energy System - A total energy system does not necessarily use maximum fuel input salvage efficiency.

BUILDING
SECTION 4 - ~~EXTERIOR~~ ENVELOPE

4.0 SCOPE: This section contains design criteria that limit the heat loss through the building envelope in winter and heat gain in summer. ~~The heating and cooling design criteria are given as thermal transmittance values (U-values) and the cooling design criteria is given for fenestrations. Design criteria are given for control of air leakage between indoors and outdoors in winter and summer and for control of water vapor condensation. Two alternatives for design are given, both using a total building envelope approach instead of designing to meet stated criteria for roof/ceiling, wall, window, door and foundation assemblies.~~ Design criteria is given for the thermal transmittance values (U-values) for roof/ceiling, exposed walls and floors; for glass; for air leakage and for water vapor condensation.

standard building

4.1 GENERAL: The/design criteria for the ~~exterior~~ envelope ~~of a building are~~ is contained in 4.2 through 4.5. ~~The designer may choose either alternative given in 4.6 in lieu of 4.2 through 4.5.~~ The alternative design criteria may be used as contained in 4.6 in lieu of 4.2 through 4.5.

All building designs should consider

4.1.1 SITE AND SHAPE ANALYSIS: ~~The proposed design submitted for either alternative stated in 4.1 should show that energy conservation was taken into account in determining~~ building compass orientation, geometric shape, aspect ratio (length to width), number of stories for a given floor area requirement, thermal mass, color, shading or reflections from adjacent structures, ground surfaces or vegetation, opportunities for natural ventilation, and wind direction and speed. Guidelines for design procedures dealing with some of these considerations are given in Chapters 17 through 22, 1972 ASHRAE Handbook of Fundamentals.

4.1.2 For calculating heat loss or gain through the exterior envelope of the building, the following design temperatures shall apply:

	Indoor	Outdoor See Table 5.1
Winter	68° F. Maximum	~~Median of annual extremes*~~
Summer	78° F. Minimum	2½%*

4.2 HEATING DESIGN: The requirements of this section apply to designs for buildings or portions of buildings in which energy is used for space heating.

(Uo)

4.2.1 CEILINGS/ROOFS: The thermal transmittance value/for the combined gross area of ~~exterior~~ exposed ceilings/roofs assembly, consisting of opaque ceiling/roof and skylights, enclosing an interior heated space shall not exceed .04 Btu/hr./sq. ft./degree F. for construction where vented air space occurs above the insulation and below the roof, and 0.10 Btu/hr./sq.ft./degree F. for all other construction. Equation 4-1 shall be used to ~~determine~~ calculate overall Uo and to determine acceptable combinations of construction ~~in meeting this requirement.~~ materials. A ceiling roof assembly shall be considered as those components of the roof/ceiling envelope through which

4.2.1 (Cont.) heat fl[illegible]s, thereby creating a building [illegible]nsmission heat loss. If a ceiling is employed as an element of a building air distribution plenum, the thermal ~~performance of the assembly~~ transmittance value of the assembly shall be the thermal ~~performance~~ transmittance value of the roof ~~assembly.~~ portion only.

~~*Values from 1972 ASHRAE Handbook of Fundamentals, Chapter 33.~~

overall

4.2.2 EXPOSED ~~EXTERIOR~~ WALLS: The/thermal transmittance value (Uo) for the combined gross area of ~~exterior~~ walls, consisting of opaque wall areas, window areas, door areas, and foundation walls above grade, enclosing an interior heated space shall not exceed 0.17 Btu/hr./sq.ft./degrees F. for one and two-family detached dwellings, and 0.22 Btu/hr./sq.ft./ degrees F. for all other buildings. ~~The value for an opaque wall shall not exceed .10 Btu/hr./sq.ft./degrees F.~~ Equation 4-1 shall be used to determine acceptable combinations of construction ~~in meeting this~~ materials ~~requirement.~~ and to calculate overall Uo of the exposed walls.

opaque Equation 4-1 For overall Uo of exposed walls or

$$U_o = \frac{U_{\text{wall}} A_{\text{wall}} + U_{\text{window}} A_{\text{window}} + U_{\text{door}} A_{\text{door}}}{A_o}$$

ceiling/roofs

overall

Where U_o = the ~~average~~ thermal transmittance of the gross wall or gross ceiling/roof area, Btu/hr./sq.ft./degrees F.

A_o = the ~~external~~ exposed (above grade) gross wall area or gross ceiling/roof AREA of the building that faces heated spaces, sq.ft.

opaque

U_{wall} = the thermal transmittance of all elements of the opaque wall area, Btu/hr./sq.ft./degrees F.

opaque

A_{wall} = opaque wall area or roof/ceiling, sq. ft. of ceiling/roof area.

U_{window} = the thermal transmittance of the window sash area or skylights, Btu/hr/sq.ft./degrees F.

A_{window} = window sash area or skylight, sq. ft.

U_{door} = the thermal transmittance of the door, considered as an assembly, including the frame, Btu/hr./sq.ft./ degrees F.

A_{door} = door area, sq.ft.

FLOOR EDGES

4.2.3 ~~FLOORS OVER~~ HEATED SPACES: The peripheral edges of floors that face heated spaces above and below the floor line shall contain thermal ~~resistance~~ transmittance value equivalent to that of the opaque ~~exterior~~ wall areas above and below the floor. The peripheral edge may be considered a part of the gross exterior wall area as a component in accordance with 4.2.2 if the equivalent thermal ~~resistance~~ transmittance requirement cannot be met.

~~4.2.4 FLOORS OVER UNHEATED SPACES: The thermal transmittance value of floors above unheated spaces, enclosing an interior heated space, shall not exceed 0.08 Btu/hr./sq.ft./degrees F. A basement, crawl space, or garage shall be considered unheated unless it is provided with a positive heat supply.~~

4.2.4 FLOORS OVER UNHEATED SPACES AND FLOORS EXPOSED TO OUTSIDE CONDITIONS: The thermal transmittance value of floors above unheated spaces, unheated basements, unheated garages or ventilated crawl spaces with outside louvers, enclosing an interior heated space, shall not exceed 0.1 Btu/hr./sq.ft./degrees F. If a basement, a crawl space or garage is to be considered a heated area with a positive heat supply, the enclosing walls and floors of such areas shall meet the thermal transmittance values for the heated spaces. Floors exposed to outdoor conditions shall have a thermal transmittance not to exceed 0.1 Btu/hr./sq.ft./degrees F.

4.2.5 SLAB-ON-GRADE FLOORS: The thermal transmittance value (U-value) ~~resistance of the insulation~~ around the perimeter of slab-on-grade floors shall be not ~~less~~ greater than ~~0.20~~ 0.22 Btu/hr./sq.ft./degrees F., and the insulation used to meet this requirement shall extend downward below the grade line to the footing or the design frost line, or an equivalent distance horizontally inward from the edge under the floor. The perimeter loss shall be considered as a part of the gross exterior wall.

4.2.6 FOUNDATION WALLS: The areas of foundation walls and the windows and doors therein, enclosing a heated space and exposed to outdoor air, shall meet the thermal transmittance of 4.2.2. The areas of foundation walls below grade and enclosing a heated space shall have a thermal ~~resistance not less than 50 percent of the thermal resistance of the opaque wall area above grade.~~ transmittance (U-value) not greater than 0.51 Btu/hr./sq.ft./degrees F.

4.3 COOLING DESIGN

4.3.1 SCOPE: The requirements of this section apply to designs for buildings or portions of buildings in which new energy is used for cooling by any means, such as ~~forced ventilation,~~ mechanical or evaporative cooling, well water or city water cooling, chilled water or chemical cooling.

4.3.2 OPAQUE AREAS OF WALLS AND CEILINGS/ROOFS: The thermal transmittance values shall be as ~~defined~~ determined in Heating Design Section 4.2 and shall apply to the cooling design calculations.

4.3.3 FENESTRATIONS: The maximum instantaneous combined solar and air-to-air heat transmission of each window at design conditions for exterior fenestration enclosing an interior cooled space shall not exceed ~~100~~ 120 Btu/hr./sq.ft. as an average of the transparent area of each ~~entire~~ window. ~~The heat gain through transparent window areas of the exterior building envelope shall be controlled during the cooling season by interior and/or exterior shading devices and/or the utilization of different glass types.~~ The usage of interior and/or exterior shading devices is encouraged to minimize the solar heat gains through the building envelope window areas during summer.

4.4 AIR LEAKAGE CONTROL (INFILTRATION)

4.4.1 OVERALL AIR LEAKAGE: The natural leakage of air between outdoors and indoors for the building envelope shall not exceed 0.7 air changes per hour, for one and two-family detached dwellings ~~or~~ 0.5 air changes per hour for all other buildings that are not pressurized. ~~In pressurized buildings, the infiltration shall be offset by the ventilation air.~~ Air leakage data shall be determined from certified data furnished by the manufacturer of doors, windows, and exterior curtain walls, and supplemented by calculations using guidelines given in Chapters 19 and 21, 1972 ASHRAE Handbook of Fundamentals. A wind condition of 15 miles per hour shall be used in ~~all~~ calculations. An air lock, such as a vestibule or revolving door, shall be constructed at each primary means of access to a building used by the public.

4.4.2 WINDOWS AND DOORS: Windows and doors shall be designed to limit air leakage into or from the building when in the closed position. The air infiltration rate shall not exceed the value listed in Table 4-2 when tested at a pressure differential of 1.567 lb/sq.ft., equivalent to the impact pressure of a 25 mile per hour wind.

4.4.2.1 Compliance with the air leakage requirements of all types of windows and doors shall be determined by ASTM E283-73, Standard Method of Test for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.

TABLE 4-2

Type of Opening	CFM/Ft of Crack
Windows/Exterior curtain walls	0.5
Sliding Doors	0.75
Swinging Doors	1.0

4.4.3 CAULKING AND SEALANTS: Joints around window and door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations of utility services through walls, floors, and doors, and all other openings in the ~~exterior~~ envelope shall be caulked, gasketed, or otherwise weatherstripped.

4.5 CONDENSATION CONTROL

4.5.1 VAPOR BARRIERS: The design of the building envelope for one and two-family dwellings and other buildings having humidification requirements in excess of those set forth in ~~5.1.2.1 should~~ 5.3.2.2 shall provide maintenance of thermal performance and durability by protecting against cold weather water vapor condensation.

4.5.2 THERMAL BREAKS: All window, ~~door~~, ceiling, roof, floor, and wall construction shall contain thermal breaks to prevent excessive heat transmission.

~~4.6 ALTERNATIVE DESIGNS~~

~~4.6.1 TOTAL ENVELOPE METHOD: Alternative designs and methods of construction shall be acceptable provided it is shown that the total building heat loss and heat gain exclusive of overall air leakage at winter and summer design conditions, respectively, is equal to or less than design developed to satisfy criteria given in Sections 4.2 through 4.5 above. Alternative designs for comparison shall be based upon the same indoor and outdoor design temperatures, occupancies and use schedules, and equivalent useful floor area, perimeter and building volume, as used to satisfy the criteria of Sections 4.2 through 4.5.~~

~~4.6.2 ENERGY ANALYSIS METHOD: Section 11, instead of Section 4, may be used for building designs. Designs of the building envelope resulting from application of the requirements of Sections 4.2 through 4.5, or Section 4.6.1, shall be used to establish a reference heat loss and heat gains for comparison with designs resulting from the application of Section 10.~~

4.6 ALTERNATE BUILDING ENVELOPE DESIGNS

4.6.1 TOTAL ENVELOPE METHOD: Alternative thermal transmittance values for building envelope components in lieu of the criteria given in sections 4.2 through 4.5 are acceptable if it is shown that the total building envelope heat loss in winter and heat gain in summer at design conditions exclusive of overall air leakage is equal or less than the quantities determined by the criteria given in sections 4.2 through 4.5. Alternative Design for the total building envelope for comparison shall be based upon the same indoor and outdoor design temperatures, building compass orientation, geometric shape, aspect ratio (length to width), height, number of stories for a given floor area requirements, perimeter and building volume, as used to satisfy the criteria of sections 4.2 through 4.5.

4.6.2 ENERGY ANALYSIS METHOD: Building envelope design criteria may be developed based on annual energy analysis method contained in Section 11, in lieu of the criteria of Section 4. Total heat loss and heat gains calculated for the building envelope based on the application of the criteria of sections 4.2 through 4.5 or section 4.6.1 shall be used as a reference for comparison with designs resulting from the application of Section 11.

Section 4 Comment

Change title to "Building Envelope" in lieu of "Exterior Envelope" as per definition, Section 3.

4.0 Omit last sentence, as it is covered in detail in 4.6. Reword second sentence.

4.1 Rephrase the sentence. Substitute "Building" in lieu of exterior.

4.1.1 Rephrase the beginning.
(Comment: All designs should consider site and shape analysis instead of only alternatives).

4.2 Modify for the proper meaning and intent.

4.2.2 Omit word "Exterior" as "exposed" has the same meaning. Use word "calculate" in lieu of "determine". Omit opaque wall U=0.1 requirement as it is too restrictive and has been dealt in overall Uo requirement for exposed wall to allow the envelope material and construction freedom. Equation 4-1: Modify the entire equation so that it can be applied to calculate overall Uo of roof/ceiling assembly as well.

4.2.3 Omit "Floors" and substitute "Floor Edges" for the proper meaning. Omit "resistance" and substitute "transmittance".

4.2.4 Change value to 0.1 in lieu of 0.08 to match with the requirement for exposed roofs. Positive heat supply to garages or crawl spaces should not be encouraged to exempt from the floor insulation requirement. Also include floors exposed to outdoors such as overhangs, etc.

4.2.5 Omit word "resistance" and substitute "transmittance". Change U=0.20 in lieu of 0.22 to match with exterior wall overall U and floor edge requirement.

4.2.6 Specify definite "U" value for the foundation wall below the grade.
(Comment: Foundation wall below grade does not have a high temperature gradient between inside and outside compared to structures above grade and the heat loss of a foundation wall below grade is quite low, 3 or 4 Btu/sq.ft./hr. This U value will permit a foundation wall below grade without insulation.

4.3.1 Add: Cooling by well water, city water, etc. - Delete forced ventilation. A simple ventilation system should not be penalized.

4.3.2 Reworded so that "U" values of Section 4.2 apply for cooling calculations.

4.3.3 Increase value to 120 in lieu of 100 to accommodate present double glass and storm windows. The usage of shading devices

should not be mandatory as long as the fenestration values are met. However, the use should be encouraged. North windows may not need shading devices. Sometimes energy savings may not result due to human judgement in the use of devices.

4.4.1 Editorial.

4.4.3 Editorial.

4.5.1 Correct reference section number and make the requirement mandatory with high humidity buildings.

4.6 Rewrite the complete paragraph for the proper meaning.

4.6.1 Should allow alternate total envelope design if it can be shown that heat gain or loss through envelope are equal or less to standard design criteria.

~~SECTION 5~~

~~5.0 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) SYSTEMS~~

~~5.1 GENERAL: This Section establishes HVAC system requirements for efficient utilization of energy. System criteria developed from the requirements of this Section shall be the basis for equipment selection as described in Section 6. System design shall permit operation of HVAC systems with minimum energy consumption.~~

~~5.2 SCOPE: This Section covers determination of heating and cooling loads, design requirements, and control requirements for general comfort applications in new buildings. Criteria is established for insulating piping and air handling systems, and for duct construction. For special applications such as hospitals, laboratories, thermally sensitive equipment, computer rooms, and manufacturing processes, etc., the design concepts and parameters shall conform to the requirements of the application at minimum energy levels. Where these special applications are described in the 1974 ASHRAE Handbook - Applications, the criteria described therein should be used.~~

SECTION 5 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC) SYSTEMS

5.1 SCOPE: This section contains calculation of heating and cooling loads based on the building envelope designs developed in Section 4 and design parameters established in this section. Criteria is established for controls, duct construction, piping insulation and air handling duct system insulation. For special applications to certain portions of the buildings or to certain equipments and the processes of the buildings such as hospitals, laboratories, thermally sensitive equipment, computer rooms, supermarket produce cooling and manufacturing processes, the design concepts and parameters shall confirm to the requirements of the special application at minimum energy levels. Where these special applications are described in the 1974 ASHRAE Handbook-APPLICATIONS, the criteria described therein should be used.

5.2 GENERAL: This section establishes HVAC system criteria which shall be used for HVAC equipment and system component selection as described in Section 6, for an efficient utilization of energy.

~~5.3.1 RECOMMENDED PRACTICES: Heating and cooling design loads shall be determined in accordance with one of the procedures described in the 1972 ASHRAE Handbook of Fundamentals, Chapters 21 and 22, or shall be calculated in a format or computerized program acceptable to the Minnesota Building Code Division. For residential heating and cooling design load calculations, NESCA Manual J and ARI Standard 230-62 are considered equivalent.~~

~~5.3.2 DESIGN PARAMETERS: The following design parameters in conjunction with other provisions of this Standard, shall be used for HVAC system design load determination for general comfort applications.~~

~~5.3.2.1 OUTDOOR DESIGN CONDITIONS: The outdoor design conditions shall be determined by location of the building as indicated in Table 5-1. For locations not shown, use the value of the nearest city listed.~~

~~5.3.2.2 INDOOR DESIGN CONDITIONS: The indoor design conditions shall be 68°F, db in winter and 78°F, db in summer. Design indoor winter relative humidity shall not exceed 15 percent where new energy is required to produce humidification. Design indoor summer relative humidity shall not be less than 55 percent where new energy is required for dehumidification.~~

5.3 CALCULATION OF HEATING AND COOLING LOADS: Heating and cooling loads shall be calculated for the purpose of sizing HVAC systems and equipments for a building with an efficient use of energy.

5.3.1 RECOMMENDED PRACTICES: The total heating and cooling design loads shall be calculated in accordance with the design parameters of this Section and in conjunction with one of the procedures described in the 1972 ASHRAE Handbook of Fundamentals, Chapter 21 and 22 or in accordance with a format or computerized program acceptable to the Minnesota Building Code Division. For residential heating and cooling design load calculations, the procedures in NESCA Manual J and ARI Standard 230-62 are acceptable.

5.3.2 DESIGN PARAMETERS

5.3.2.1 OUTDOOR DESIGN CONDITIONS: The winter and summer outdoor design temperatures shall be used from Table 5-1 based on the location of the building. Use the value of the nearest city listed for the locations not shown.

5.3.2.2 INDOOR DESIGN CONDITIONS. Winter indoor design temperature shall be 68°F DB or less. Winter design indoor relative humidity, if provided, shall not exceed 20 percent where new energy is required to produce humidification. Summer indoor design temperature shall be 78°F DB or higher. Summer indoor design relative humidity shall be 55% or higher where new energy is required for dehumidification, with controlled dehumidification being optional.

TABLE 5-1

LOCATION	OUTDOOR TEMPERATURE (Degrees F.)		
	WINTER	SUMMER	
	db	db	wb
Albert Lea	-20	89	76
Alexandria	-26	88	74
Bemidji	-38	84	72
Brainerd	-31	85	73
Duluth	-25	82	71
Faribault	-23	88	75
Fergus Falls	-28	89	74
International Falls	-35	82	69
Mankato	-23	89	75
Minneapolis/St. Paul	-19	89	75
Rochester	-23	88	75
St. Cloud	-26	88	75
Virginia	-32	83	71
Willmar	-25	88	75
Winona	-19	89	76

5.3.2.3 VENTILATION: In HVAC systems with temperature control and filtration, in which air is recirculated, the heating and/or cooling design loads caused by the outdoor air portion of the ventilation air supplied to rooms or spaces shall be based on outdoor air quantities of not more than 33% of the recommended ventilation rates cited in Section 6 of ASHRAE Standard 62-73 - Natural and Mechanical Ventilation. The air quality shall conform with the requirements of ASHRAE Standard 62-73.

5.3.2.3.1 VARIATIONS: The quantity of outdoor air introduced into spaces conditioned for comfort for the purpose of meeting normal respiratory and odor control needs shall be no greater than 5 cfm per person, except as indicated in Section 5.3.2.3. If values of outdoor air, other than those shown in ASHRAE Standard 62-73, are used because of special occupancy or process requirements, source control of air contaminants, or conflicting codes, these required outdoor air quantities shall be used as the basis of calculating the heating and/or cooling design loads.

5.3.2.4 INFILTRATION: ~~Unless specifically calculated otherwise,~~ heating and/or cooling design load calculations ~~determinations~~ for the entire structure shall include infiltration at the rate of no more than 0.7 air changes per hour for one and two-family dwellings and 0.5 air changes per hour for all other buildings that are not pressurized. In pressurized buildings, the infiltration and exhaust design load shall be offset by the ventilation air load.

5.3.2.5 SYSTEM DESIGN HEATING/COOLING CAPACITY: Heating and/or cooling system(s) shall be capable of functioning to accomplish the requirements of Section 5.3 as applicable. ~~The rated capacity of the heating/cooling system at design conditions shall not be greater than 110% of the design output load calculated in accordance with Section 5.1 whenever appropriate equipment is available. Equipment designed for standby purposes is not included in the capacity limitation requirement. The cooling cycle of heat pumps are exempt from this requirement.~~

5.4 CONTROLS

5.4.1 TEMPERATURE CONTROL: Each HVAC system shall be provided with at least one automatic, space-temperature control device for the regulation of system ~~temperature~~ as required in 5.4.3. These automatic, space-temperature control devices shall be capable of being set to maintain space temperature set points from 55°F. to 85°F. ~~and shall be capable of operating the system heating and/or cooling in sequence, if both are provided. These controls shall be adjustable to provide a temperature range of up to 10°F. between the full heating and full cooling being supplied, except as allowed in paragraph 5.5.8.6.~~

5.4.2 HUMIDITY CONTROL: If an HVAC system is equipped with a means for adding moisture, to maintain specific selected relative humidities in spaces or zones, an automatic, space-humidity control device shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above ~~75~~ 20 percent ~~RH~~. The exception to the above is process operations that require different environmental conditions to maintain product quality. Where an automatic humidity control device is used in an HVAC system with means for removing moisture to maintain specific selected relative humidities in spaces or zones, this device shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 55 percent ~~RH~~.

5.4.3 ZONING FOR TEMPERATURE CONTROL

5.4.3.1 ONE AND TWO-FAMILY DWELLING UNITS: At least one automatic space temperature control device, as required in paragraph 5.4.1, shall be provided for each separate dwelling unit.

5.4.3.2 MULTIPLE-FAMILY DWELLING UNITS: For multiple-family dwelling units, each individual dwelling unit shall be considered separately and shall meet the requirements of 5.4.3.1. Spaces other than living units shall meet the requirements of 5.4.3.3.

5.4.3.3 ALL OTHER TYPES OF BUILDINGS OR OCCUPANCIES: At least one automatic space temperature control device as required in paragraph 5.4.1 shall be provided for each separate zone.

~~a. Each separate zone. Each floor of a building shall be considered as a separate zone (as a minimum).~~
~~b. Each zone served by a separate HVAC system.~~
~~c. Each zone as covered in paragraph 5.5.~~

5.4.4 CONTROL SETBACK AND SHUTOFF

5.4.4.1 SINGLE AND MULTIPLE FAMILY DWELLING UNITS: Each HVAC system ~~The automatic space temperature control device required in paragraphs 5.4.3.1 and 5.4.3.2, or an alternate means (such as a switch or clock),~~ shall have ~~shall provide~~ a readily accessible, ~~non-automatic or automatic~~ means for reducing the energy required for heating and cooling during periods of non-use or reduced need (such as unoccupied periods, sleeping hours, etc.). Lowering set points of automatic space temperature control devices to reduce energy consumption of heating systems shall not cause new energy to be expended to reach the reduced setting. Where HVAC systems provide outdoor air for ventilation, a readily accessible means shall be provided for reducing the outdoor air quantity during periods of reduced need.

5.4.4.2 OTHER BUILDINGS AND OCCUPANCIES: Each HVAC system shall be equipped with a readily accessible means of reducing the energy used for HVAC during periods of non-use or alternate uses of the building spaces or zones served by the system. ~~The thermal inertia effects to the building mass shall be considered in determining what the set back can realistically be.~~ The following are examples that meet this requirement:

5.4.4.2.1 a. Manually adjustable automatic timing devices.
5.4.4.2.2 b. Manual control systems for use by operating personnel.
5.4.4.2.3 c. Automatic control systems.
d. ~~Manually or automatically set devices (one and two family dwelling units only).~~

5.5 SIMULTANEOUS HEATING AND COOLING: Simultaneous heating and cooling of a zone by reheat, recooling or concurrent operation of independent heating and cooling systems shall be restricted as delineated below.

5.5.1 Recovered energy, including new energy expended in the recovery process (provided the amount expended is less than the amount recovered), may be used for control of temperature and humidity.

5.5.2 New energy may be used, when necessary, to prevent relative humidity from rising above 55% for comfort control or to prevent condensation on terminal units.

5.5.3 New energy may be used for control of temperature if minimized as delineated in paragraphs 5.5.4 through 5.5.8.

5.5.4 REHEAT SYSTEMS: Systems serving multiple zones, other than those employing variable air volume for temperature control, shall be provided with controls that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the most cooling. Single zone reheat systems shall be controlled so as to sequence reheat and cooling by reducing the cooling capacity first, on a call for reheat from the space thermostat.

5.5.4.1 NEW ENERGY: Whenever possible, new energy shall not be used for reheat purposes. The total installed capacity of all reheat using new energy shall be limited to 15% of the total design system cooling capacity.

5.5.5 DUAL DUCT AND MULTIZONE SYSTEMS: These systems shall be designed with means to automatically reset the cold deck temperature to the highest temperature necessary to satisfy the zone requiring the most cooling during predominately cooling operation, and to automatically reset the hot deck temperature to the lowest temperature necessary to satisfy the zone requiring the most heating during the predominately heating operation.

5.5.6 RECOOLING SYSTEMS: The system design shall limit the use of new energy for recooling of heated air to 15 percent of the total system heating capacity. Such systems shall provide means for limiting the use of energy for recooling of heated air by automatically resetting the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the most heating.

5.5.7 For multiple zone systems, one zone may be chosen to represent a number of zones with similar heating/cooling characteristics. The supply air temperature reset in 5.5.4 is not required for multiple zone HVAC systems that employ reheating or recooling for control of less than 20% of the total air in the system.

5.5.8 Concurrent operation of independent heating and cooling systems serving common spaces, and requiring the use of new energy for heating, shall be minimized by one or both of the following:

5.5.8.1 a. By providing sequential temperature control of both heating and cooling capacity in each zone.

5.5.8.2 b. By limiting the heating energy input, through automatic reset control of the heating medium temperature (or energy input rate), to only that necessary to offset heat loss due to transmission and infiltration.

~~5.5.9 ENERGY RECOVERY: Each exhaust-makeup system having a total outdoor air capacity of more than 4000 cfm should employ energy recovery equipment which shall be capable of recovering at least 50% of the potential heating or cooling effect in the exhaust air, whenever the temperature difference between exhaust and makeup air is 10°F or greater. Energy recovery equipment should be capable of intermittent operation as required to conform to Section 5.4, and shall not interfere with normal air flow when the energy recovery equipment is not functioning.~~

5.6 COOLING WITH OUTDOOR AIR: Each fan system, having greater than 134,000 Btu/hr. total cooling capacity or more than 5000 cfm, shall be designed to use up to 100% of the fan system capacity for cooling with outdoor air whenever cooling, requiring new energy, is needed and/or outdoor dry bulb temperature are

WHENEVER the enthalpy of outdoor air is lower than that of the indoor air, and/or return air. ~~The outdoor dry bulb temperature is lower than that of the return or indoor air.~~

5.6.1 EXCEPTIONS: Cooling with outdoor air is not required under the following conditions:

5.6.1.1 a. The quality of the outdoor air (as defined in Table 1 of ASHRAE Standard 62-73) is so poor as to require extensive treatment of the air.

5.6.1.2 b. The need for humidification and/or dehumidification requires the use of more energy than is conserved by outdoor air cooling.

5.6.1.3 c. The use of outdoor air cooling may affect the operation of other systems (such as return air fans or supermaket refrigeration) so as to increase the overall energy consumption of the building.

5.6.1.4 d. Internal/external zone heat recovery is used.

5.7 MECHANICAL VENTILATION: Each mechanical ventilation system (supply and/or exhaust) shall be equipped with a readily accessible means for volume reduction and/or shutoff when ventilation is not required. The following are examples meeting this requirement: 5.7.1 Manual and/or automatic volume dampers and devices.
5.7.2 Localized on-off switches and/or automatic time clocks.

5.8 PIPING INSULATION: All piping installed to serve buildings and within buildings shall be insulated in accordance with Table ~~10~~, except ~~as shown in paragraph 5.8.1.~~ 5-1 piping carrying fluid between 60°F. and 105°F. temperature is not required to be insulated.

~~5.8.1 EXCEPTIONS -- Piping insulation is not required in the following cases:~~

~~a. Piping installed within HVAC equipment.~~
~~b. Piping at temperatures between 60°F. and 120°F.~~
~~c. When the heat loss and/or heat gain of the piping, without insulation, does not increase the new energy requirements of the building.~~

5-1
~~5.8.2~~ 5.8.1 OTHER INSULATION THICKNESSES: Insulation thicknesses in Table ~~10~~ are based on insulation having thermal resistances in the range of R=4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 or may be reduced for materials having R values greater than 4.6 per inch of thickness.

a. For materials with thermal resistance greater than R=4.6, the insulation thickness may be reduced as follows:

$$\frac{4.6 \times \text{Table } \overset{5-1}{5} \text{ Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

b. For materials with thermal resistance less than R = 4.0, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table } \overset{5-1}{5} \text{ Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

c. For domestic hot water systems see Section 7.

5.9 AIR HANDLING DUCT SYSTEM INSULATION: All ducts, supply plenums and enclosures installed in or on buildings shall be insulated as follows:

5.9.1 All duct systems, or portions thereof, where the temperature differential between the air surrounding the duct and the design temperature of the air in the duct exceeds 30°F., shall be thermally insulated (externally of internally) to provide a minimum thermal resistance of R = 4.0, exclusive of film resistances. The thermal resistance of the duct insulation shall be increased by R = 1 for each increase of 25°F or fraction thereof over the 30°F. temperature differential.

~~5.9.2 EXCEPTIONS~~ -- Duct insulation is not required ~~in the following cases:~~

For a. ~~D~~ucts installed in basements and cellars for either supply or return air in ~~residential construction~~ one and two family dwelling construction.
b. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.
c. Within HVAC equipment.

~~5.9.3 Uninsulated ducts in uninsulated sections of exterior walls are unacceptable and will not meet the requirements of this Standard.~~

~~5.9.4 The required thermal resistances do not consider condensation. Additional insulation may be required to prevent condensation under some conditions.~~

5.10 DUCT CONSTRUCTION: All ductwork shall be constructed and erected in accordance with the ASHRAE Handbook or the following SMACNA standards:

a. Residential Heating and Air Conditioning Systems - Minimum Installation Standards, August 1973.
b. Low Velocity and Duct Construction Standards, 4th Edition, 1969.
c. High Velocity Duct Construction Standards, 2nd Edition, 1969.
d. Fibrous Glass Duct Construction Standards, 3rd Edition, 1972.
e. Pressure Sensitive Tape Standards, 1973 (where required in paragraph 5.10.2).

5.10.1 High pressure and medium pressure ducts shall be leak tested in accordance with the applicable SMACNA standard.

~~5.10.2 There is no standard at this time for leak testing of low pressure ducts. When low pressure ducts are located where the air leakage loss is nonbeneficial, then all transverse joints shall be sealed using mastic and/or tape.~~

5.1

Table 10 - Minimum Pipe Insulation

Piping System Types	Temperature Range - F	Insulation Thickness in Inches for Pipe Sizes*				
		1" and less	1½-2	2½-4	5&6	8" and larger
Heating Systems Steam & Hot Water						
High Pressure/Temp	306-460	2	2½	3½	4	4½
Medium Pressure/Temp	251-305	1½	2	2½	3	3½
Low Pressure/Temp	201-250	1	1½	2	2½	3
Low Temperature	140-200	1	1½	1½	2	2½
Steam Condensate (for Feed Water)	Any	1	1½	2	2	2½
Cooling Systems						
Chilled Water	40-60	1	1	1	1	1
Refrigerant or Brine	Below 39	1	1½	1½	1½	1½
Heating and/or Cooling Systems Runouts to Individual Units. (not exceeding 12' in length)	Below 39	3/4	1½	1½	1½	1½
	40-60	3/4	1	1	1	1
	140-200	3/4	1½	1½	2	2½
	201-250	3/4	1½	2	2½	3
	251-305	3/4	2	2½	3	3½
	306-460	3/4	2½	3½	4	4½
	Stm.Cond.	3/4	1½	2	2	2½

* See 5.8.2

Section 5 Comments:

Section 5 - Heating, Ventilating and Air Conditioning (HVAC) Systems.
Omit 5.0 to match with other section titles.

Interchange 5.1 General with 5.2 Scope to match with other sections.

5.1 SCOPE: Rewrite. Use "calculation" in lieu of "determination". Exemptions from Section 5 design parameters for certain buildings has been limited only to certain portions or processes or equipments only as special application as per 1974 ASHRAE Handbook at minimum energy level. These buildings should not be given a blanket exemption to deviate from all Section 5 parameters.

5.3 Add: "The purpose of loads."

5.3.1 Add: "the design shall be based on Section 5 parameters."

5.3.2.1 Reword.

5.3.2.2 Rewrite to allow lower than 68° F temperature in winter and higher than 78° F and 55% R.H. in summer if selected. Increase winter humidity to 20% max. if reqd. 15% requirement is too low.

5.3.2.4 Editorial

5.3.2.5 Omitted material did not define adequately as well as 110%. Size requirement is ambiguous due to the following:

1. For heating it may not be adequate.
2. For cooling it will result in oversizing.
3. It does not allow the modest of economical future growth of the building.
4. Exemption of standby capacity can result in cheating and is hard to implement.
5. It does not define whether it applies to control equipment or terminal equipment. We recommend to omit the limitation on the system capacity as it will be governed by the economics of the first cost.

5.4.1 Change word "temperature" to "system" as the regulation is of heating-cooling media or air volume. Omitted material is ambiguous and is covered somewhat in another paragraph 5.5.

5.4.2 Humidity to 20%.

5.4.3.3 Omit sub-paragraphs a, b and c. As each zone by its definition will require a separate thermostat. Paragraph 5.4.1 requires a control device for each HVAC system.

Section 5 Comments: (Cont.)

5.4.4.1 Omit mention of switch or clock as it becomes specification. Criteria is enough for reducing the energy during non-occupied or non-use hours for each HVAC system.

5.4.4.2 Omit (d) as it is covered in 5.4.4.1. Renumber a, b, c.

5.5.2 Editorial

5.5.4 Added explanation.

5.5.6 Define "Recooling Systems" in Section 3.

5.5.9 Omit. Code should contain which can be implemented with proper criteria. Criteria is vague in terms of 50%, 4,000 cfm, 10° F diff. between exhaust and make-up. Criteria does not address to limitation due to corrosive and hazardous exhaust. Some exhaust recovery systems may not lend to energy savings. Let economic justify the use of heat recovery for a special application basis.

5.6 Rewrite. Renumber paragraphs.

5.7 Add the acceptable means.

5.8 Renumber Table number. Omit a. As piping within HVAC equipment needs insulation for proper temp. control. Modify b. to limit insulation exception between 60° and 105° F fluid temp. Omit c. Vague. How do you implement? Rewrite the paragraph.

5.9 Add: "supply plenums" in lieu of plenums.

5.9.2 Omit b - Vague. Omit c.

5.9.3 Omit negative statement.

5.9.4 Omit.

5.10.2 Omit. Why write if it does not say anything definite.

SECTION 6 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT

~~6.0~~

~~6.1~~ 6.0 SCOPE: This section deals with ~~the~~ equipment performance and manufacturer's documentation ~~in accordance with the criteria~~ for efficient utilization of energy ~~established in this standard for HVAC equipment used~~ in new buildings. *See Note 1*

~~6.2~~ 6.1 COOLING SYSTEMS EQUIPMENT, ELECTRICALLY OPERATED: Cooling systems equipment whose energy input is entirely electric shall, at the conditions specified in Table ~~11~~ 6.1, show a Coefficient of Performance-Cooling (or Energy Efficiency Ratio) not less than those shown in Table ~~12~~ 6.2. *See Note 2*

Table ~~11~~ 6.1 - Rating Conditions for COP

Item	Temperatures, °F			
	DB	WB	Inlet	Outlet
Return Air (entering equipment)	80	67	-	-
Outdoor Ambient(air cooled)	95	75	-	-
Condenser Water (water cooled)	-	-	85	95

Table ~~12~~ 6.2 - Minimum COP (EER), Cooling - Unitary Equipment

Effective Date	Standard Rating Capacities	
	Under 65,000 Btu/hr	65,000 Bth/hr ~~& over~~ to 130,000 Btu/hr
	COP (EER)	COP (EER)
Beginning January 1, 1977	1.8 (6.1) 1.97 KW/Ton	2.0 (6.8) 1.76 KW/Ton
Beginning January 1, 1980	2.0 (6.8) 1.76 KW/Ton	2.2 (7.5) 1.60 KW/Ton

Table 6.3 - Minimum COP(EER), Cooling - Applied Equipment

Effective Date	BASIC SYSTEM TYPE					
	Air Cooled			Water Cooled		
	Reciprocating	Rotary	Centrifugal	Reciprocating	Rotary	Centrifuga
January 1, 1976						
anuary 1, 1980						

NOTE: Energy input shall include: compressors, condenser water pumps, chilled water pumps, cooling tower fans, air cooled condenser fans and any other machine auxiliaries.

EXHIBIT 1

6.1.1 ~~6.2.1~~ These standards in Table 6.2 apply to unitary cooling equipment (both air-cooled and water-cooled), the cooling mode of unitary heat pumps (both air-source and water-source), packaged terminal air conditioners, room air conditioners, and applied systems up to 130,000 Btu/hr. The COP values shall include the inputs to all compressors, ~~fans, blowers~~, evaporator fans, condenser fans and pumps. Values of EER as listed in the current "Directory of Certified Unitary Air Conditioners and Unitary Heat Pumps" published bi-annually by the Air Conditioning and Refrigeration Institute (ARI) shall be used to determine compliance. *Note*

~~6.2.2 Cooling systems using equipment combinations that have a total electric input, which may or may not consist of components that are shipped and mounted separately within the building HVAC systems, shall have a coefficient of performance which includes, but is not necessarily limited to, the energy consumed by all system refrigerant compressors, fans and pumps.~~ *Note 4*

~~6.2.3 The cooling systems may consist of unitary cooling equipment (air cooled, evaporatively cooled or water cooled), cooling mode of unitary heat pumps (air or water source), packaged terminal air conditioners, room air conditioners, or larger applied systems consisting of several components in a field built-up system.~~

6.1.2 ~~6.2.4~~ In large applied systems (over 10 ~~1~~ tons), where components from several equipment suppliers are to be utilized, it shall be the function of the system designer to determine the full-load system COP, using data from the equipment supplier(s) as a means of determining compliance with Table ~~12~~ 6.3. *Note 5*

6.3 COOLING SYSTEMS, HEAT-OPERATED (ABSORPTION)WATER-CHILLING EQUIPMENT: The performance of heat-operated (absorption) water-chilling equipment shall be based not only on the components included in the unit but shall include cooling tower fans, ~~pumps and other parts of the complete system, which are supplied separately.~~ chilled water pumps, condenser water pumps, boiler auxiliaries and boiler efficiency. *Note 6*

6.3.1 PERFORMANCE: Absorption water-chilling units, employing steam or hot water as the energy source, and water-cooled absorbers and condensers shall comply with the requirements of ARI Standard for Absorption Water-Chilling Packages, 560.74. Direct-fired, absorption water-chillers and air conditioners shall comply with AMSI Standard for Gas-Fires Absorption Summer Air-Conditioning Appliances, 721.40.1-73.

6.3.2 EFFICIENCY LIMITATION: Heat-operated cooling equipment shall show a COP not less than as listed in Table ~~13~~ 6.4 when tested at Standard Rating Conditions established in the applicable standards referenced in paragraph 6.3.1, except when:

a. It is supplied by recovered energy, such as steam rejected from another process.
b. ~~It is used in areas where restrictions on electrical energy are present on new construction.~~
c. ~~It is used in systems requiring air conditioning that is independent of local power sources (standby) for critical applications, i.e., hospitals, essential electronic processing systems, etc.~~

6.3.3 In applied systems where components from several equipment suppliers are to be utilized, it shall be the responsibility of the system designer to determine the full load system COP using data from the equipment supplier(s) to determine the energy consumption of the system as applied in the building in the cooling mode, as a means of determining compliance with Table ~~13~~ 6.4.

Table ~~13~~ 6.4

Minimum COP-Cooling, Heat-Operated Cooling Equipment

	Standard Rating Capacities	
	Under 65,000 Btuh	65,000 Btuh and over
Beginning January 1, 1977	0.45	0.50
Beginning January 1, 1980	0.50	0.55

Note 8

~~6.4 SEASONAL COOLING COEFFICIENT OF PERFORMANCE (COP). Building cooling systems, and associated equipment for most applications, will typically operate at 100% of design capacity for a maximum of 5% of the total operating hours in an average year. Equipment part-load performance data is therefore an important requirement of this Section. This estimated yearly energy consumption of the proposed HVAC system and equipment in the building, when designed in accordance with Sections 4 through 9.~~

Note 9

~~6.4.1 To assist designers and purchasers in their selection of energy conserving equipment and systems, the manufacturers of cooling equipment shall provide, upon request, information so that the designer can compute columns 3 and 4 of Form 1 or Form 2, at outdoor ambient conditions as applicable.~~

~~6.4.2 The system designer may then construct building system load vs. outdoor ambient curves and, by means of tabular weather data*, arrive at the total annual cooling hours that occur at each outdoor ambient segment. By performing the operations indicated in Form 1 or 2, it is possible to sum up all values and obtain a seasonal cooling energy requirement and coefficient of performance. Adjustments are necessary for any standby energy input(s), e.g., continuously operated pumps or fans, crankcase heaters, control system power, etc.~~

~~6.4.3 As an alternate, the system designer may elect to establish the building cooling energy estimate using a dynamic computerized energy analysis which calculates building system and equipment energy consumption in a more detailed manner.~~

6.4 ~~6.5~~ COMBUSTION HEATING EQUIPMENT: The equipment supplier shall furnish data as specified in paragraph 6.10 6.8. ~~In the case of~~ Boilers not listed ~~under a~~ in the American Boiler Manufacturers Association (ABMA) PFT Rating Book, ~~nationally recognized certification program, the manufacturer's rating~~ shall be accepted, subject, ~~at the designer's option~~, to a performance test in accordance with the ASME Power Test Code for Steam Generating Units, PTC 4.1-64. *Note 10*

~~In the case of~~ Forced warm air heaters and central furnaces ~~not so listed, the manufacturer's rating~~ shall be accepted if AGA approved or if tested in accordance with the ANSI Standard for Gas-Fired Heavy-Duty Forced Air Heaters ~~Z83.5-67~~ Z21.47 (Rev. 1972) or the ANSI Standard for Oil-Powered Central Furnaces Z91.1-72, as applicable. *Note 11*

~~*Engineering Weather Data Manual NAVFAC P-89, Dept. of Navy, Navy Publication and Printing Service, Building 157, Washington Navy Year, Washington, D. C. 20390~~

~~6.6~~ 6.5 HEAT PUMPS, HEATING: Heat-pump heating systems, whose energy input is entirely electric shall have a COP heating not less than shown in Table ~~14~~ 6.5 at the conditions stated therein. The indoor temperature for these rating conditions is 70F.

Table ~~14~~ 6.5

Minimum COP - Heating Heat Pumps

	Air Source			Water Source [1]
	Outdoor Air Temperature, °F			Entering Water Temperature, °F
	DB/WB 45/43	DB/WB 20/19	DB 0	60
Beginning Jan. 1, 1977	2.2	1.4	Permit Shut-off	2.2
Beginning Jan. 1, 1980	2.5	1.7	1.0	2.5

1. Water flow rate to be as determined in the cooling test

~~6.6.1~~ 6.5.1 SUPPLEMENTARY HEATER CONTROL: The heat pump shall be installed with a control system to prevent electric resistance, supplementary heater operation when the steady state heating load can be met by the heat pump alone. A two-stage room thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement.

~~6.6.2 SEASONAL PERFORMANCE FACTOR HEATING (Air Source Heat Pump): The Seasonal Performance Factor (SPF) Heating for heat pumps is defined as the ratio of the heat delivered to the conditioned space during the full heating season to the energy input in consistent units. To assist designers and purchasers in their selection of air source heat pump equipment, manufacturers shall provide, upon request, information so that the SPF can be determined. Form 3 can be used to calculate SPF. Manufacturers shall provide information so that the~~

~~designer can complete columns "E" and "G" of this form. This calculation procedure takes into account all system energy requirements, including defrost operations and supplementary heat. The weather information is available from the same source as that used for calculating cooling energy requirements and seasonal cooling efficiency (paragraph 6.4.2).~~ *Note 12*

~~6.7~~ 6.6 ELECTRIC RESISTANCE SPACE HEATING EQUIPMENT: The manufacturer of electric resistance space heating equipment shall make available to prospective purchasers, designers or contractors, upon request, full load energy input and output, over the range of voltages at which the equipment is intended to operate.

~~6.8 ANNUAL ENERGY REQUIREMENTS AND COEFFICIENTS OF PERFORMANCE: For all buildings over 5,000 sq.ft. gross floor area, the system designer shall compute the total amount of fuels and electricity required to cool and to heat the building during a typical year. The Heating Seasonal Performance Factor (where applicable) and the Cooling Seasonal COP shall also be determined.~~ *Note 13*

~~6.9~~ 6.7 MAINTENANCE: Equipment which requires periodic routine maintenance, to maintain efficient operation, shall be furnished complete with the necessary maintenance information. Required routine maintenance actions shall be clearly stated as required and incorporated on a permanent label, affixed in a readily accessible location on the equipment. The label may be limited to identifying required actions that are explained in greater detail in an operation and maintenance manual. The label should identify, by title and/or publication number, the operation and maintenance manual for that particular model and type of product. At least one copy of each required manual shall be furnished by the manufacturer to the original owner upon request.

~~6.10~~ 6.8 RESPONSIBILITY OF EQUIPMENT SUPPLIERS: ~~Suppliers~~ Manufacturers of HVAC equipment shall furnish, upon request by prospective purchasers, designers, or contractors, the full and partial capacity and standby input(s) and output(s) of all equipment, and components of applied systems, based on equipment in new condition, to enable determination of their compliance with this standard. This includes performance data under all modes of operation and at all ambient conditions necessary to make the energy analysis outlined in ~~this standard~~ Section 10. *Note 14*

~~6.10.1 Performance data furnished by the equipment supplier~~
6.8.1 ~~or certification under a nationally recognized certification program, when available, satisfies this requirement when all energy input(s) and output(s) and operating modes are included~~. This requirement for performance data shall be satisfied by either data from a nationally certified program approved by the State or data certified in writing by an officer of the company manufacturing the product. *Note 15*

COMMENTS AND BACKUP DATA

SECTION 6

PROPOSED STATE OF MINNESOTA ENERGY CODE

Note 1: Meaning was not clear and sentence jumbled.

Note 2: Numbering of paragraphs and tables changed to be consistent with format in other sections.

Note 3: Unitary equipment should be defined separately from large applied systems since there is a reliable and consistent source of data in the ARI Directory for unitary products. Large applied systems require that they system designer calculate system COP based on data from a variety of manufacturers. Design of the system, its duct sizing, pipe sizing, shape of building, etc. have a substantial effect on the system COP.

Also, the COP values listed for 65,000 Bth/hr and over are not at all restrictive on water-cooled equipment over 130,000 Btu/hr and may result in no energy savings over present design techniques. It is suggested that a second table be established to cover applied systems over 15 tons (see attached Exhibit 1).

Note 4: Paragraphs 6.2.2 and 6.2.3 were deleted because they were vague and redundant.

Note 5: This paragraph and Table 6.3 should provide the designer with enough guidelines to properly calculate the COP of large systems.

Note 6: Wording was not specific enough.

Note 7: It was felt that even under the conditions of paragraphs "b" and "c", the system should meet the values of COP required by Table 6.4.

Note 8: Assuming that evaporator fan horsepowers are not included, the values in Table 13 (6.4) appear to be extremely tight and may prohibit the use of absorption equipment in high rise or spread out buildings due to high pump heads and resulting higher horsepowers.

If evaporator fan horsepowers are to be included, the values would probably not be achievable with current technology.

Note 9: It is felt that this section would not provide information that is either accurate or significant to the State of Minnesota. Full load COP is calculated and energy useage is calculated under the requirements of Chapter 10. The "Seasonal COP" would appear to be redundant.

Note 10: Firetube boiler capacities are certified by the ABMA in their "PFT Rating Book". This is the only nationally recognized certification program for boilers. The code should be specific where possible.

Note 11: The paragraph on furances should be more specific in terms of nationally certified program. AGA does test and certify ratings. The ANSI Standard referred to is for installation of equipment, not performance.

Note 12: It is felt that this section would not provide information that is either accurate or significant to the State of Minnesota. Full load COP is calculated and energy useage is calculated under the requirements of Chapter 10. The "Seasonal COP" would appear to be redundant.

Note 13: It was felt that Section 10 covers this paragraph adequately.

Note 14: It should be made clear that the manufacturer is responsible for this data, not the manufacturers representative or salesman.

Note 15: The paragraph needs more strength to be sure that accurate data is present from the people who actually design and rate the equipment. ARI has many certification programs for a wide variety of equipment. In almost every case, part load performance on major equipment should be obtained from the manufacturer with officer certification.

SECTION 7

7.0 SERVICE WATER HEATING

7.1 GENERAL: Hot water for domestic, sanitary, and swimming pool purposes shall be generated and delivered in a manner conducive to saving heat energy. When possible, heat recovery shall be used for a portion of the water heating requirements.

7.2 SCOPE

7.2.1 The purpose of this section is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating. The selection of the specific fuel (as with the specific equipment or system) is left to the designer. Fuel availability (both locally and as a national resource), generation, transmission capacity, efficiency, and local and national energy policies will require consideration and assessment before selection.

7.2.2 It is not the intention of this section to develop either a procedure or method for designing a water distributing system, other than to offer criteria which, when applied, will reduce unnecessary uses of energy. For a more complete systems design guide, the reader should consult the 1973 ASHRAE Handbook-Systems, Chapter 37, Service Water Heating.

7.3 WATER HEATERS, STORAGE TANKS, BOILERS, AND PIPING

7.3.1 PERFORMANCE EFFICIENCY

7.3.1.1 All automatic, electric, storage water heaters shall have a stand-by loss not exceeding 4 watts per square foot ($43 W/m^2$) of tank surface area. The method of test of stand-by loss shall be as described in Section 4.3.1 of ANSI-C72.1-72-Household Automatic Electric Storage-Type Water Heaters.

7.3.1.2 All gas and oil-fired, automatic, storage heaters shall have a recovery efficiency, E_r, not less than 75% and a stand-by loss S, not exceeding 7%. The method of test of E and S shall be as described in Section 2.7 of ANSI Z21.10.3-74-Circulating Tank, Instantaneous and Large Automatic Storage Type Water Heaters, Approval Requirements for Gas Water Heaters, Volume III, including Addenda Z21.10.3a-1972 and Z21.10.3b-1972; except that for oil-fired units CF = 1.0, Q = total gallons of oil consumed, and H - total heating value of oil in Btu/gallon.

7.3.2 COMBINATION SERVICE WATER HEATING/SPACE HEATING BOILERS: Subject to the exceptions noted below, service water heating equipment shall not be dependent on year-round operation of space heating boilers; that is, boilers that have as their only function winter space heating. Exceptions to this provision are: boiler/space heating systems where boiler capacity is less than 120% of the service water heating demand of boiler/space heating systems, regardless of usage, which have a minimum overall system efficiency of no less than 65% based on total annual energy usage.

7.3.3 INSULATION *

~~7.3.3.1 Heat loss from unfired hot water storage tanks shall be limited to a maximum of 35 Btu/hr/sq.ft. (47 W/m^2) of external tank surface area.~~

~~7.3.3.2 Heat loss shall be limited to a maximum of 25 Btu/hr/sq.ft. (79 W/m^2) of pipe surface from above ground external piping and a maximum of 35 Btu/hr/sq.ft. (110 W/m^2) of external pipe surface for underground piping and recirculation systems.~~

7.3.4 POINT OF USE OR INSTANTANEOUS APPLICATIONS: Where point of use or instantaneous water heaters will reduce overall energy consumption, their use should be considered.

7.4 TEMPERATURE CONTROLS: Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use (see Table 1 from ASHRAE 1973 Handbook-Systems, Chapter 37). Thermostats in water heaters serving more than one function may be set to deliver water at the maximum temperature.

7.5 PUMP OPERATION: Circulating hot water systems shall be arranged so that the pump energy consumption is low, consistent with correct operation of the pump. Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off (automatically or manually) when the hot water system is not in operation.

7.6 CONSERVATION OF HOT WATER

7.6.1 Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 2gpm m^3/s (1.9×10^{-4}) per shower head.

7.6.2 Lavatories in restrooms of public facilities ~~should~~ shall be equipped with push button, slow closing valves set to deliver no more than one ~~gallon~~ quart at a time.

7.7 SWIMMING POOLS: Consideration of heating swimming pools by solar heat, air conditioning condenser water or waste heat is encouraged. Swimming pools for other than therapeutic purposes shall be equipped to be heated to no more than 80°F. (26.7°C.).

*Provide insulation table such as Table 10, Chapter 5

Section 7 Comments:

7.3.3 Insulatio n*

*Provide insulation table such as Table 10, Chapter 5. The inclusion of a table was recommended to facilitate the compliance with the code by this design aid.

ASHRAE will submit a Table within the 20 day comment period.

Chapter 7.6 Conservation of Hot Water

Section 7.6.2 - Lavatories . . . ~~should~~ shall be equipped with push button, slow closing valves set to deliver no more than one ~~gallon~~ quart at a time.

For most applications, one quart is adequate for washing and two quarts may be easily gotten by a second valve operation.

Setting the volume at up to one gallon will merely continue the wasteful practice of washing under an open tap with the drain open.

SECTION 8

8.0 ELECTRICAL DISTRIBUTION SYSTEMS

8.1 SCOPE: The electrical distribution system in a building shall be designed for efficient distribution of energy from the service entrance to the point of use.

8.2 POWER FACTOR: Utilization equipment, rated greater than 1,000 watts, and lighting equipment, with an inductive reactance load component, shall have a power factor of not less than 85% under rated load conditions. Utilization equipment with a power factor of less than 85% shall be corrected to at least ~~90%~~ 95% under rated load conditions. ~~Power factor corrective devices, installed to comply with this criterion, shall be switched with the utilization equipment, except where this results in an unsafe condition or interferes with the intended operation of the equipment.~~

8.3 SERVICE VOLTAGE: The available service voltage shall be so selected as to minimize energy losses.

8.4 VOLTAGE DROP: In any building, the combined voltage drop in the feeders and branch circuits shall not exceed the recommended total voltage drop of the ANSI-C1 1971 Standard-National Electrical Code (NFPA 70-1971).

8.5 ~~LIGHTING SWITCHING: Switching shall be provided for each lighting circuit, or for portions of each circuit, so that the partial lighting required for custodial or for effective complementary use with natural lighting may be operated selectively.~~

8.5.2

~~8.6~~ ~~ENERGY USE DETERMINATION:~~ In any multi-tenant building, provisions shall be made to separately determine the energy consumed by each tenant. Hotels, college dormitories, and other transient facilities are excluded from the provisions of this paragraph.

8.5 RECOMMENDED PRACTICES: Electrical Distribution loads shall be determined and presented in a format acceptable to the Minnesota Building Code Division.

8.5.1 Continuous and Non-Continuous loads shall be grouped in such a manner as to estimate the demand vs. the connected load. Historical data obtained from similar actual facilities may be used to support the demand estimated.

SECTION 9 - LIGHTING SYSTEMS

9.0 GENERAL: An allowable total connected load for installed lighting shall be established by using the criteria in this section and the calculation procedures recommended by the Illuminating Engineering Society in the 5th Edition of the IES Lighting Handbook, hereinafter referred to as the "Handbook".

9.0.1 PURPOSE: The requirement for calculating the connected load in the manner specified is:

a. To provide a uniform method for establishing permissible power consumption, and
b. To institute energy conserving lighting design practices while allowing for maximum freedom of design, including the use of inefficient lamps in a trade-off approach, provided the total power demand does not exceed the calculated load.

9.0.2 CRITERIA: The use of more efficient lamps and luminaires than specified, and the use of luminaires providing for heat removal and/or recovery, is encouraged in actual design to allow for additional savings in energy.

9.1 SCOPE: In establishing a lighting load, the illumination in any space within a building shall be based on the use for which the space is intended, and on efficient utilization of energy. The actual illumination design is to be coordinated with the envelope and other system designs.

9.2 ILLUMINATION LEVELS: For the purpose of establishing a load the levels of illumination shall be no greater than those recommended in the Handbook, Figure 9-80, and ANSI Standards covering lighting practices. Those levels shall be used as follows:

9.2.1 TASK LIGHTING: In most cases, the levels of illumination listed in the Handbook, Figure 9-80, are for specific tasks. In some cases, however, the levels of illumination are listed for locations (auditoriums, etc.), and these levels shall be considered average levels.

9.2.2 GENERAL LIGHTING: In areas surrounding task locations the maximum average level of brightness shall be 1/3 the level for the tasks performed in the area. Where more than one task level occurs in a maximum space, the general level shall be 1/3 the average of the task levels determined.

9.2.3 NONCRITICAL GENERAL LIGHTING: In circulation and seating areas, and other seldom occupied spaces or those in which no critical visual tasks occur, the maximum average levels of illumination shall be 1/3 of the average general lighting in the adjacent task spaces, but not less than one footcandle or OSHA recommended levels for safety.

9.3 LIGHTING SYSTEMS: For the purpose of establishing a load, only efficient lamps and luminaires shall be used, as follows:

9.3.1 EFFICIENT LAMPS: Efficient lamps are defined herein as those producing at least the following initial lumen output per watt input, including ballast losses, as listed by manufacturers,

a. Where color rendition is not of significance or use of higher wattage lamps is appropriate, 55 lumens/watt.
b. Where moderate color rendition is appropriate, 40 lumens/watt.
c. Where high color rendition is appropriate, or spaces are less than 50 sq.ft., or where use of low wattage high-intensity discharge lamps under 250 watts or flouresecent lamps under 40 watts is appropriate, 10 lumens/watt.

9.3.2 EFFICIENT LUMINAIRES: Efficient luminaires are defined herein by Room Cavity Ratio (RCR) = 1 values according to space use. An efficient luminaire for use in each space described below shall have a Coefficient of Utilization (CU) for RCR = 1 of at least the value listed for that space.

a. For spaces with tasks subjected to veiling reflections and where visual comfort is important, CU = 0.55.
b. For spaces without tasks or with tasks not subjected to veiling reflections but where visual comfort is important, CU = 0.63.
c. For spaces without tasks and where visual comfort is not a criterion, CU = 0.70.

9.4 LOAD CALCULATIONS: In establishing the load, the lighting calculation procedures recommended in the Handbook shall be used, utilizing efficient lamps and luminaires, except as follows:

9.4.1 REFLECTANCES: For interior spaces the following initial cavity and surface reflectance shall be assumed:

a. Ceiling Reflectance - 80%
b. Wall Reflectance - 50%
c. Floor Reflectance - 30%

9.4.2 LIGHT LOSS FACTOR: A light loss factor of 0.70 shall be used, as a minimum, accounting for lumen depreciation and dirt accumulation.

9.4.3 EXCEPTIONS: The criteria of Sections 9.3.1 and 9.3.2 shall not apply to:

9.4.3.1 The following lamps and luminaires, however, their use shall be accounted for in the calculation of task lighting loads for specific tasks. The allowable load shall be based on the luminaire wattage to achieve the levels of illumination as covered in Section 9.2 using a point calculation method given in the Handbook.

a. Luminaires for medical and dental diagnostic or surgical purposes.

b. Luminaires for highlighting applications, such as sculpture exhibits, art exhibits, and individual items of display merchandise.
c. Luminaires for specialized lighting applications, including color matching, where electrical interference cannot be tolerated, etc.
d. All residential occupancies.
e. Similar residential areas in institutions, such as hospitals.

9.5 USAGE:

9.5.1 Lighting in task areas larger than 100 sq.ft. can be reduced by at least 50% when the task is not being performed or is relocated.

9.5.2 In any space requiring two or more branch circuits for lighting, switching shall be provided for each circuit or for portions of each circuit, so that a portion of the lighting system adequate for custodial or maintenance purposes or for effective complementary use of natural and artificial lighting may be operated without switching on/off all of the lighting in that space.

9.5.3 Lighting can be reduced or turned off where day-lighting is adequate and can be used effectively.

9.6 EXTERIOR LIGHTING: The illumination for exterior lighting shall conform to Sections 9.2 and 9.3, using at least the minimum luminaire efficiencies as listed in the Handbook, Figure 9-64. The beam lumen method shown in the Handbook, and a Coefficient of Beam Utilization of 0.75, shall be used for calculations. Illumination design shall be based upon the use for which the area is intended.

9.6.1 FACADE LIGHTING: Building facade lighting, including signs, shall be no greater than 1,000 watts, or 2% of the total interior lighting load of the building, whichever is greater.

9.7 ~~DOCUMENTATION: In selecting illumination levels and lighting system criteria, all data, assumptions, and calculations used in establishing the total lighting load shall be shown for three (3) of the areas with the highest levels of illumination. The basis for all assumptions shall be given, and total lighting wattage per square foot for the entire structure shall be indicated.~~

~~9.7.1 Charts and/or tables may be used to simplify calculations provided they are prepared in accordance with procedures recommended in the Handbook.~~

9.7 RECOMMENDED PRACTICES: Lighting loads shall be determined in accordance with one of the procedures described in the fifth Edition of the IES Lighting Handbook and presented in a format acceptable to the Minnesota Building Code Division. The total lighting wattage per square foot for each area and the entire structure shall be indicated.

9.7.1 Charts and/or tables may be used in determining the lighting loads.

Section 8 Comments:

8.2 The majority of equipment operates at something less than rated load. Therefore, we felt that in order to obtain reasonably high average power factor the power factor at rated load be higher. A 95% power factor is reasonable.

8.2 The placement of the power factor corrective devices should be left to the judgement of the designer.

8.5 Subject of lighting switching is adequately covered in Section 9.

8.5.1 The statements made in 8.5 will produce information that will be of future
8.5.2 value in code formation.
8.5.3

Section 9 Comments:

9.2.2 The correction makes the second sentence consistent with the first sentence.

9.7 The correction provides flexibility for the enforcing agency in the form of documentation required.

SECTION 10

10.0 ENERGY ~~SOURCE AND COST~~ CALCULATIONS

10.1 ENERGY USE CALCULATION: An energy use calculation shall be prepared for each proposed building over 5,000 sq. ft. of gross floor area, giving the estimated total annual energy required ~~and the estimated total energy required for the first ten (10) years of the life of the building~~, based on the input to the building site. Energy use shall be separately identified for at least the following subcategories: space heating, space cooling, service water heating and illumination. ~~For building projects totaling more than 5,000 sq. ft. of~~ gross floor area, Such energy use calculations shall be performed and certified by a registered professional engineer or architect. ~~For each type of fuel or power, the quantity of energy required shall be converted to a common equivalent energy basis for the purpose of comparing the total energy used.~~ Simplified energy analysis, such as bin or degree-day methods, details of which can be found in Chapters 11 and 43 of the 1973 ASHRAE Handbook-Systems, may be used for this analysis. ~~The contractor or other person responsible for the design of building projects under 5,000 sq. ft. of total gross floor area may prepare energy use calculations in compliance with this paragraph in lieu of preparation and certification by a professional engineer or architect.~~

10.1.1 ~~ALTERNATE ENERGY SOURCES: If more than one type of energy source is available or could readily be made available to the proposed building project, the energy use calculation prepared in compliance with 10.1 shall include at least two different types or combinations of types of fuel or power suitable for supplying the space heating, space cooling, and service water heating components of the total annual energy required by the building project.~~

10.1.2 ~~ENERGY SUPPLY COMPARISON: For each energy use calculation prepared in compliance with 10.1.1, an energy supply calculation shall be prepared by the person stipulated in 10.1, giving the sum of the estimated annual prime energy input directly to the boundary of the building project plus the estimated annual prime energy input (see Equivalent Energy Consumption) to any off site energy conversion processes which provide refined energy to the building project. The procedures stipulated in 10.1.3 shall be used as a basis for calculating the equivalent energy consumption.~~

10.1.3 ~~EFFECTIVE HEAT RATE FOR OFF SITE ENERGY REFINEMENT PROCESSES: An effective heat rate shall be obtained for each off site energy refinement process supplying energy to the building project, using the method stipulated in 10.1.3.1 through 10.1.3.6 as appropriate. (See Definitions Section for Effective Heat Rate, Energy Refinement Efficiency, Equivalent Energy Consumption, and Refined Energy Source.)~~

10.1.3.1 ~~FUEL FIRED CENTRAL UTILITY ELECTRIC ONLY OR DISTRICT HEATING/COOLING ONLY. The effective heat rate may be obtained from the utility(s) serving the building project. If such a utility sells energy which is generated in more than one franchise area, the overall effective heat rate shall be calculated by the serving utility based on all the effective heat rates, weighted in proportion to the transfers of energy over a seasonal or annual period, as appropriate.~~

~~10.1.3.2 NATIONAL AVERAGE EFFECTIVE HEAT RATE: If supporting data are unavailable from utilities, estimated national average values shall be based on reports of the Federal Power Commission or the Edison Electric Institute, or on Table 5 and the Appendices to "Energy and the Environment - Electric Power," Council on Environmental Quality, August 1973.~~

~~10.1.3.3 FUEL-FIRED CENTRAL UTILITY - ELECTRIC PLUS DISTRICT HEATING/COOLING, OR OFF-SITE TOTAL ENERGY PLANT: The effective fuel rate for purchased electricity, steam, hot water or chilled water from a fuel-fired combination electric plus district heating/cooling plant or off-site total energy plant shall be based on the overall plant thermal efficiency for all processes, calculated for the appropriate season of operation.~~

~~10.1.3.4 NUCLEAR CENTRAL UTILITY - ELECTRIC ONLY: The effective heat rate for nuclear central utilities selling electricity only shall be computed the same as for fossil fuel fired electric utilities, except that the energy input to the energy conversion process shall be based on the total thermal energy (useful plus waste heat) that is generated by the nuclear fuel.~~

~~10.1.3.5 NUCLEAR CENTRAL UTILITY - ELECTRIC PLUS DISTRICT HEATING/COOLING: The effective heat rate for purchased electricity, steam hot water or chilled water from a nuclear energized combination electric plus district heating/cooling plant shall be based on the overall plant thermal efficiency for all processes, calculated for the appropriate season of operation. The energy input to the energy conversion process shall be based on the total thermal energy (useful plus waste heat) that is generated by the nuclear fuel. For such combination plants using nuclear breeder or fusion processes, and in which a minimum of 50 percent of the waste heat is sold, the effective heat rate shall be taken as zero. See "Effective Heat Rate", Section 3 Definitions.~~

~~10.1.3.6 HYDROELECTRIC, SOLAR OR GEOTHERMAL CENTRAL UTILITY: The energy refinement efficiency for an off-site hydroelectric (without pumped storage), solar electric, or geothermal central utility that sells only energy generated or recovered within its service area shall be taken as 91 percent, to cover final distribution losses. Where hydroelectric (without pumped storage), solar electric or geothermal energy is transferred between service areas, the equivalent of an effective heat rate shall be determined as specified in 10.1.3.1. The energy refinement efficiency of pumped storage hydroelectric plants shall take into account the energy used for pumping.~~

10.2 DOCUMENTATION: Energy use calculations shall be tabulated on forms available from the Minnesota Energy Agency, and submitted to the local building official in duplicate before construction begins. The building official shall forward an approved copy to the Minnesota Energy Agency when a building permit has been issued.

~~10.3 EXCEPTION: Buildings deriving at least 50 percent of their total annual energy requirement from on site solar or wind energy sources need not comply with the requirements of 10.1.1.~~

SECTION 10 - COMMENTS

The building designer, or consultant, can readily tabulate and calculate energy use within the project boundary. Extending the use beyond this parameter will increase the error, and consequently the value, of the information submitted. Comparisons between designer's tabulated data would be impossible because of wide-spread assumptions that would certainly be made beyond the building site regarding line losses, pressure drops, transformer and pump efficiencies, etc.

This section simply states that calculations "shall be prepared", without setting limits on the results or even indicating their purpose. Paragraph 10.2 has been added assuming that the state intends to establish a data bank for future information.

New Paragraph 10.2 should possibly include a requirement that the owner submit total annual energy actually used each year for the first three years. Calculated data and actual use could then be compared for future projections in establishing energy budgets, etc. Maybe utilities and fuel dealers could cooperate and simplify this gathering of data.

SECTION 11 - ENERGY REQUIREMENTS FOR BUILDING DESIGNS BASED ON SYSTEM ANALYSIS

11.0 SCOPE: Alternative building and system designs shall be accepted that can be shown to reduce the total energy supplied to a similar building which would have followed each of the detailed requirements of Sections 4 through 9 of this standard.

11.1 EQUIVALENT ANNUAL ENERGY CONSUMPTION: Under the provisions of this Section, the designer may propose any design of building and energy-using service systems for which the total annual amount of those forms of building energy covered by Sections 4 through 9 (expressed as equivalent Btu's or equivalent Kwh) is less than that for the building and systems designed according to Sections 4 through 9 of this standard.

11.1.1 BASIS FOR COMPARISON: The standard building and service systems designed according to Sections 4 through 9 of this standard and used as the basis of comparison to the proposed alternate building and systems shall meet the criteria of accepted common practice in the geographic region for the given type of usage, except for those specific items where such common practice conflicts with the requirements of Sections 4 through 9. All sources of energy usage by both designs (standard and proposed alternate) covered under the provisions of Sections 4 through 9 shall be included in the comparison. Common climatic data, building occupancy, and operational schedules of both basic building service systems and HVAC systems shall be used in the comparison. Where similar types of equipment are applicable to the standard and proposed alternative designs, similar equipment characteristics shall be used in the comparison.

11.2 ANALYSIS PROCEDURE: The analysis of the annual energy usage of the standard and the proposed alternative building and systems designs shall meet the following criteria:

11.2.1 The building heating/cooling load calculation procedure used within or as the basis for the annual energy consumption analysis shall be of sufficient detail to permit the identification of the annual energy savings resulting from the proposed alternative building design features.

11.2.2 The calculation procedure used to simulate the operation of the building and its service systems through a full-year operating period shall be of sufficient detail to permit the evaluation of the effect of system design and operational characteristics (such as space temperature and humidity control supply airflow and temperature, outside air quantities, lighting and occupancy schedules) and mechanical plant characteristics (such as part-load profiles, sequencing and accessories) on annual energy usage. Manufacturer's data or comparable field test data shall be used, when available, in the simulation of all systems and equipment. The calculation procedure shall utilize simulation techniques similar to the current recommendations in the appropriate ASHRAE publication or produce results consistent with such recommended procedures.

11.3 DOCUMENTATION: Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis comparison report prepared by a registered professional engineer or architect. The report must provide sufficient technical detail on the two building and systems designs and on the data used in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of paragraphs 11.1 through 11.2.2.

11.4 EXCLUSION: Proposed alternative designs for residential and light commercial structures of less than 5,000 sq. ft. shall be exempted from the requirement of a full-year energy system analysis as a criteria for departure from the design requirements of Sections 4 through 9, providing a ~~registered~~ professional engineer registered in Minnesota ~~from the geographic region~~ concurs in writing that the specific proposed alternative design would be expected to have a lower annual energy consumption than a similar building and service systems designed according to Sections 4 through 9.

SECTION 11 - COMMENTS

Paragraph 11.4 is unclear on whether the engineer has to reside in the "region" or not. Since this proposed code revision applies to Minnesota structures, an engineer licensed to practice in the state should be sufficient evidence of credibility.

SECTION 12 - REQUIREMENTS FOR BUILDINGS UTILIZING SOLAR OR WIND POWERED ENERGY SOURCES

12.0 GENERAL: When a proposed alternative building and service system design submitted and evaluated in accordance with Section 11 of this standard utilizes solar or wind power for all or part of its energy source, the solar or wind-powered energy supplied to the building shall be excluded from the total energy chargable to the proposed alternative design. To qualify for this exclusion, solar energy must be derived from a specific collection, distribution device. Natural solar energy passing through windows shall not qualify for the exclusion, but may contribute to a reduction in overall energy usage under the terms of Section 11. All other criteria covered in Section 11 shall apply to the proposed alternative design utilizing solar or wind power.

~~12.1 SCOPE: An energy bonus shall be granted to buildings designed to use solar or wind-powered energy sources to supply part or all of the building energy requirements.~~

12.2 DOCUMENTATION: Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis comparison report prepared by a registered professional engineer or architect. The report must provide sufficient technical detail on the two building and systems designes and on the data used in and resulting from the comparative analysis as to verify that both the analysis and the designs meet the criteria of paragraphs 11.1 through 11.2.2 and this Section. The energy derived from solar or wind-powered devices must be separately identified from the overall building energy use. Supporting documentation on the basis of the performance estimates of the solar or wind-powered devices must be submitted.

12.3 EXCLUSION: Proposed alternative designs for residential and light commercial structures of less than 5,000 sq. ft. which derive a significant part of their annual energy usage from solar or windpower shall be exempt from the requirement of a full-year energy system analysis, providing a ~~registered~~ professional engineer registered in Minnesota, ~~from the geographic region~~ concurs that the solar or wind power is significant and that the overall building annual energy consumption would not exceed that of a building and service systems designed under the provisions of Sections 4 through 9.

Other commercial, institutional, and industrial structures which derive over 50% of their annual thermal energy requirements (heating, cooling, service water heating) or over 30% of their annual total energy requirements from solar or wind power shall be exempted from the necessity of comparing the proposed design to a standard design (which follows the specific provisions of Sections 5 through 9). Documentation verifying the percentage of annual energy use deriving from solar or wind power shall be required as provided in paragraph 12.2.

SECTION 12 - COMMENTS

Paragraph 12.1 implies that someone is going to grant an energy bonus! Who? How much? What form? Unless the intent is clarified, the statement should be omitted.

Paragraph 12.2. Same comment as for paragraph 11.4.

Exhibit I

CONSULTING ENGINEERS COUNCIL OF MINNESOTA

5009 EXCELSIOR BLVD. SUITE 126 WOOD-EXCEL BUILDING MINNEAPOLIS, MINN. 55416 612/922-9696

May 5, 1975

Mr. Herbert W. Meyer, Director
Department of Administration
State of Minnesota

SUBJECT: DRAFT OF PROPOSED DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS - DATED MARCH 17, 1975

The Consulting Engineers Council of Minnesota wishes to commend the Building Code Division of Minnesota and their advisors for putting together, in a relatively short period of time, such a comprehensive document as the proposed amendments to the Building Code entitled "Design and Evaluation Criteria for Energy Conservation in New Buildings", dated March 17, 1975.

The Consulting Engineers Council has thoroughly studied the subject document and has held meetings with representatives of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), the Minnesota Society of Architects, the National Electrical Contractors Association, Sheet Metal and Roofing Contractors Association of Minnesota, the Minnesota Masonry Institute and others who have an interest in seeing the State adopt an effective, viable code. We found unanimity of opinions on a goodly number of particulars. In general, the Consulting Engineers Council is in substantial agreement with the thoughts and the specific language ASHRAE has proposed.

The Consulting Engineers Council strongly urges the State to accept the ASHRAE version of the document, and in addition offers a number of suggestions which are summarized on the attached sheets for your consideration.

In conclusion, Consulting Engineers Council of Minnesota wishes to thank the Director and the State Building Code Division for giving it the opportunity to express its views on this important matter.

Yours very truly,

Joseph H. Mindrum

Joseph H. Mindrum, P.E.
Chairman, Energy Committee

Member of American Consulting Engineers Council

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CONSULTING ENGINEERS COUNCIL OF MINNESOTA

5009 EXCELSIOR BLVD. SUITE 126 WOOD-EXCEL BUILDING MINNEAPOLIS, MINN. 55416 612/922-9696

RECOMMENDATIONS RELATIVE TO PROPOSED DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS - DATED MARCH 17, 1975

Section 1, SBC 6003
Par. 1.3

It is suggested that the Building Code be revised to give the Director of the Building Code Division authority to grant waivers from such provisions of these amendments as he deems appropriate in the cases of existing buildings that are being refurbished.

Section 2
Par. 2.0.-2.4 incl: CEC concurs with revisions proposed by ASHRAE

Section 3 - Definitions

a) It may eliminate some confusion if the definition of existing buildings is expanded to include buildings for which building permits have been issued prior to the effective date of these rules.

b) The Energy Efficiency Ratio (EER) would be more correctly defined as follows: "The Ratio of net cooling capacity in BTU's output to the total electric input in watts."

c) CEC agrees with other revisions to the definitions suggested by ASHRAE.

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I-2

Section 4

Par. 4.0.-4.1.2 incl: CEC concurs with the revisions proposed by ASHRAE

Par. 4.2.1 - Pertaining to the thermal transmittance

a) It is suggested that the figure .10 BTU/Hr/Sq. Ft./Degree F for "all other construction" be changed to .11 BTU/Hr/Sq. Ft./Degree F. This suggestion is made so the code requirements can be met through the application of 3-inches of commonly used roofing insulating boards on top of metal deck in industrial buildings and other applications where no ceilings are used.

b) CEC believes that the intent would be clearer if the last sentence of paragraph 4.2.1 is changed to read: "A roof assembly shall be considered as those components of the roof/ceiling through which heat flows into or out from a conditioned space to the outside air; when the space between a ceiling and roof is used as a plenum, only the resistance of the roof assembly may be considered in calculating heat flow."

c) The application of insulation on roofs in amounts needed to comply with the provisions of this paragraph will result in roof assemblies which have not been tested or approved by Underwriters Laboratories or other recognized testing agencies. CEC suggests that the State take steps to develop standards for roofs with sufficient insulation to conform to and exceed the requirements of this paragraph, and until such approval is obtained that it not enforce the provisions of this paragraph.

Par. 4.2.2-4.6.2 incl: CEC concurs with the revisions proposed by ASHRAE

Section 5

Par. 5.1-5.3.2.2 incl: CEC concurs with the revisions proposed by ASHRAE

Par. 5.3.2.3 - Pertaining to Ventilation

It is suggested that the following words be added to the first sentence: "provided the application of these restrictions does not result in contaminant concentrations in ventilation air for spaces intended for human occupancy in excess of the Maximum Allowable Contaminant Concentrations set forth in par. 3.3 and Table 1 of ASHRAE Standard 62-73."

Sub Par. 5.3.2.3.1 - Pertaining to Variations

It is suggested that the last sentence, beginning with the words: "If values of outdoor air, other than....." be deleted and the following be substituted therefore: "In industrial applications where speical ventilation and contaminant control systems are required, local exhaust systems and other techniques described in "INDUSTRIAL VENTILATION, A Manual of Recommended Practice," published by the American Conference of Governmental Industrial Hygienists should be employed, when applicable, to reduce energy consumption.

Par. 5.3.2.4-5.3.2.5

CEC feels <u>very strongly</u> that 5.3.2.5 be changed as ASHRAE has recommended.

Par. 5.4-5.5.3 incl: CEC concurs with the revisions proposed by ASHRAE

Par. 5.5.4.1 - Pertaining to "new energy" used in Reheat Systems

It is suggested that paragraph 5.5.4.1 be changed to read: NEW ENERGY: When reheat systems are employed they shall be designed so the maximum quantity of "new energy" used to reheat air that "new energy" has been used to cool will not exceed 20 per cent of the energy used in cooling under any anticipated load." Comment: As it appears in the preliminary draft, paragraph 5.5.4.1 would for all practical purposes, eliminate systems that employ controlled heating coils to neutralize the wintertime heat losses of individual zones, if the coils are also employed as "reheat coils" during the summer months because the "installed capacity" of the coils would be insufficient.

Par. 5.5.9-5.10.2 incl: CEC concurs with the revisions proposed by ASHRAE

Section 6
Par. 6.1-6.10.1 incl: CEC concurs with the revisions proposed by ASHRAE

Section 7
Par. 7.1

It is suggested that the word "practicable" be substituted for the word "possible" in par. 7.1

Par. 7.3.1.1 - Pertaining to electric water heaters

It is recommended that the first sentence be made to read: "All automatic electric storage water heaters shall have a stand-by loss no greater than 6 watts per square foot of net external surface area."

Par. 7.3.1.2 - Pertaining to gas and oil-fired water heaters

It is recommended that the first sentence of this paragraph be made to read: "All gas and oil-fired automatic storage heaters shall have a recovery efficiency, Er, not less than 70% and a stand-by loss, S, not exceeding 10%. Comment: The changes suggested by CEC would require that the water heaters to which the provisions of paragraph 7.3.1.1 and 7.3.1.2 pertain meet the requirements of the referenced ANSI Standards. It is suggested that the Building Code Division or the Minnesota Energy Agency communicate with ANSI and the manufacturers of water heaters to explore the feasibility of developing designs and standards for better insulated and more efficient heaters than are currently being built, with the understanding that if such heaters become generally available, the Minnesota Building Code Division would consider prohibiting the installation of less efficient heaters in new construction within the State. Until such standards are adopted and heaters that have been designed and proven to meet such standards are generally available, we believe it would not be in the interests of the people of the State to prohibit the installation of heaters that are generally available and that do meet all the standards established by nationally recognized agencies such as ANSI.

T-4

Par. 7.3.3 - CEC concurs with the revisions proposed by ASHRAE

Par. 7.6.2

It is recommended that paragraph 7.6.2 be changed to read: "Consideration should be given to the use of slow closing, push-button valves in the lavatories of public facilities." If allowed to stand as drafted, the provisions of this paragraph would probably necessitate the installation of mixing valves and other complications---There is some question as to whether or not the application of this rule would result in any energy savings.

Section 8
Par. 8.2 incl: CEC concurs with the revisions proposed by ASHRAE

Par. 8.6

It is suggested that paragraph 8.6 be deleted, or, if it is retained, that it be changed to read: "ENERGY USE DETERMINATION: In any multi-tenant residential building, the distribution system shall be arranged so it will be possible to determine the energy consumed by any individual tenant. College dormitories, hotels and other transient facilities are excluded from the provisions of this paragraph. Comment: If the paragraph were enacted as originally drafted, compliance would in many instances entail the expenditure of more energy than would ever be saved."

Section 9
Par. 9.7-9.7.1 incl: CEC concurs with the revisions proposed by ASHRAE

Section 10
Par. 10.1-10.3 incl: CEC concurs with the revisions proposed by ASHRAE

Section 11
Par. 11.4 - CEC concurs with the revisions proposed by ASHRAE

Section 12
Par. 12.1-12.3 incl: CEC concurs with the revisions proposed by ASHRAE

Exhibit J

SMARCA of Minnesota, Inc.

2929 UNIVERSITY AVE. S.E. MINNEAPOLIS, MINN. 55414

PHONE: 331-7136

May 6, 1975

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TO: The Minnesota Department of Administration

FROM: The Sheet Metal, Air Conditioning and Roofing Contractors' Association of Minnesota, Inc.

SUBJECT: Comments on "Design and Evaluation Criteria for Energy Conservation in New Buildings."

Gentlemen:

We compliment the code writers for doing an excellent job of covering a difficult area and doing it in a precise and well-defined manner.

A Committee from our Association has met and reviewed the referenced proposed code changes and we wish to make several observations, along with our reasons for our opinions.

The portions we question are listed by paragraph number on the attached sheets.

Respectfully submitted,

SMARCA ENERGY COMMITTEE

By John C. Borry
John Borry, Spokesman
Richard Cramer
William Forder
Merland Kispert
James McCarthy
James Parson

JB:mdb

COMMENTS ON "DESIGN AND EVALUATION CRITERIA
FOR ENERGY CONSERVATION IN NEW BUILDINGS"

6002 How can a document as complex as this one possibly be intelligently enforced at the State level, let alone at the local level? You are asking for great expenditures of time and money. The value of these expenditures is extremely questionable, if the resulting product is never used. It seems the net result is going to be increased costs to the user for buildings that are already overpriced. Specific items will be enumerated later.

6003 1.2 and 1.3. Who is going to determine if we have "compliance" with the "flexible" requirements in the preconstruction state?

4.0 Are we to assume that this section, as well as all other sections, unless specifically excluded, apply to residential, commercial and industrial construction?

4.4.2 and 4.4.2.1 Most manufacturers of windows and doors do not now have this material available. Will they be given a certain length of time to produce it? Can their products be used before they publish such data? Who will certify their data?

4.5.1 and 4.5.2 4.5.1 refers to 5.1.2.1, which is not contained in this material. What does "protecting against" mean? What is "excessive heat"?

4.6.1 Since we have not specified an actual design or construction method in the "Evaluation" to this point, what do we mean by "alternative" designs and methods of design?

5.3.1 Will any method other than 1972 ASHRAE method be acceptable? If so, what? Will forms be supplied, such as now supplied by Minneapolis? How about the Minneapolis form that is now quite universally in use for permits in this area?

5.3.2.2 The relative humidity in residences, hospitals, retirement homes and other types of usages of this nature should be allowed to go to 30%, whether new energy is needed or not. A relative humidity of 15% is rather hard on people, furnishings and structures, although we realize that all three of them usually recover.

5.3.2.3 We assume that the maximum ventilation rates you are specifying here are also the minimum ventilation rates. If this is not the case, what is the minimum ventilation rate? Is ASHRAE standard 62-73 in one of the three ASHRAE guide publications and, if so, in which one?

5.3.2.4 It seems that here we are saying what the infiltration rate of the building shall be, as far as the calculation is concerned, no matter what the actual infiltration rate may be. To qualify for neglecting infiltration, what does the difference in static pressure between inside and outside of the building have to be? It should be pointed out that, normally, pressurization should not be used as a method to stop infiltration. If a building is pressurized to a certain point for some other reason, we will probably decrease or stop the normal infiltration.

5.4.1 With the normal plus or minus 2° temperature control variation that most thermostat manufacturers use today, it is possible, by expanding the dead band to the full 10°, to get a legal and supposedly acceptable 14° temperature swing in a space. We think this is too great a swing.

5.4.2 We think that residential applications, hospitals, retirement homes and other similar applications should be excluded from the 15% rule and that 30° should be substituted in their case.

5.5.9 The word "should" after 4,000 CFM ought to be changed to "shall", unless the situation is such that excessive freeze-up problems with moisture, grease, etc., are encountered in the application.

5.9.1 All rooftop heating ducts would be required to have a resistance of approximately 9 under this situation. This basic requirement is certainly good, but it might be better to restrict the heat loss through rooftop ducts to a certain percentage of the heating input of the rooftop heating appliance.

5.9.3 The minimum acceptable resistance of insulation between the duct and the outside air should be specified.

6.8 At what time during the construction of a building would this have to be done? Does this paragraph exclude a developer of a shopping center from building a space without having a tenant for the space before it is constructed? How can he possibly determine the total energy usage if he does not know who his tenant is? If we have

specified a building thermal envelope, specified the amount of ventilation or infiltration, the indoor and outdoor design temperatures and the minimum design performance for the equipment being used in the building, what is the purpose of computing the total amount of fuel and electricity required to cool and heat the building during a typical year? Who is going to use this information? Who is going to check this information to see if it is correct?

10 Up to this point in the criteria, we have specified the actual maximum heat loss of the building and the actual maximum cooling load of the building, since we have specified the average maximum "U" values of the envelopes, the temperature differentials and the infiltration and ventilation rates. Of what value, to whom, is a projected 1-year and 10-year energy consumption, broken into space heating, space cooling, service water heating and ventilation? Who is going to use it? Who is going to read it? Who is going to check it? Who is going to say, one year or ten years from now, if it was right or wrong and, if by some magic happenstance it is right or wrong, so what? How are we going to account for the changes that the average progressive building owner is going to make in the number of people that he has in his building? The number of lights that he may need in his building? The type and areas used for various processes in his building? The amount of equipment taken in and out of his building in the next year or ten years? Etc., etc. We are in full agreement with the idea of making a building thermally sound and of putting in equipment that is thermally efficient and versatile, but we feel that we are getting into somewhat of a worthless operation trying to determine what is going to happen in this building for the next year or next ten years. If the owner requests this type of information for his purposes in budgeting his building operation, that is one thing, but to do it for code purposes to go into the archives of the local or state administration, we feel, is a waste of money. We also feel that this type of operation is one of those things that is needlessly increasing the cost of buildings and making them less available to the ultimate user by sheer over-pricing. We think everything possible should be done to make the buildings efficient to operate, but doing a great amount of calculation on a building that will do nothing but be an expense to the user is not our idea of economy or conservation.

Respectfully submitted,

SMARCA OF MINNESOTA ENERGY COMMITTEE

John Borry
Richard Cramer
William Forder
Merland Kispert
James McCarthy
James Parson

EC:mdb

Exhibit K

METAL BUILDING DEALERS ASSOCIATION

Northland Chapter

(507) 288-9397 117 NORTH BROADWAY ROCHESTER, MINNESOTA 55901

May 5, 1975

Karl Schuller
117 North Broadway
Rochester, Minnesota 55901
President - Metal Building Dealers Association
Northland Chapter

The Northland Chapter of MBDA supports the proposed standard calling for .10 BTU/hr/sq.ft./Degrees F value for the roof and opaque wall areas in Paragraphs 4.2.1 and 4.2.2.

We also encourage a minimum of .17 BTU/hr/sq.ft./Degrees F for the total envelope, since this is economically attainable with todays technology, especially in light of the fact that our neighboring state of Wisconsin has a standard in effect calling for a minimum of .13 BTU/hr/sq.ft./Degrees F.

This new standard will lower the overall requirements of energy usage, and, therefore, lower the operating costs to all owners, which are presently increasing at a rapid rate due to the tremendous rise in energy costs.

As each state adopts a fair standard as the one proposed here, the overall energy requirements in the nation will be lowered, and, therefore, our balance of payments picture will improve along with a lowering of the inflation rate.

We would encourage a change in Paragraph 10.1 that refers to energy use calculations. The wording should read that a registered professional engineer or architect shall not be required for projects under 20,000 sq.ft. of gross floor area to perform the calculations.

OFFICERS

Karl Schuller, President, Rochester, Minn.
Kenneth Palmer, Vice President, Sioux Falls, S. Dak.
Lowell Christianson, Secretary, Minneapolis, Minn.
Larry Fischer, Treasurer, Minneapolis, Minn.

DIRECTORS

Kale Danberg, Cokato, Minn.
Allen Dipple, West Fargo, N. Dak.
Russ Melland, Jamestown, N. Dak.
James Towey, Rochester, Minn.
Isadore Pitts, Sioux Falls, S. Dak.

Exhibit L

RAUENHORST CORPORATION

May 5, 1975

State of Minnesota
Department of Administration
Building Code Division
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Proposed Rules and Regulations to Provide Energy Conservation Standards to Carry out the Provisions of Laws of 1974, Chapter 307, Providing for the Design, Evaluation, Construction and Re-construction of New Buildings and Remodeling of Buildings Undertaken After the Effective Date of These Rules and Regulations

Gentlemen:

We have listed below our comments pertaining to the above referenced subject with a view towards arriving at a more workable and realistic document that will not only achieve the aims of reduced energy consumption, but will also permit a greater degree of flexibility for the designers and will not destroy all economic incentives for building in the State of Minnesota. Our comments are not intended to be criticisms of the work of the committee, for we recognize that the committee has spent many long, productive hours in arriving at these proposed changes and we commend them most highly for their accomplishments. However, because our company has had great experience in the design and construction of a great variety of buildings throughout the state and, perhaps even more important, have a great working knowledge of the economics involved, we feel that our input can be of assistance to the committee in their final draft of these proposed changes. Our comments are as follows:

The "code manual" referred to under the notice on page 1 should contain a listing of the standards, codes and other references referred to in the proposed code changes with the address of the issuing organization and, if available, prices to better insure that these publications will be referred to.

SUITE 2200, NORTHWESTERN FINANCIAL CENTER, 7900 XERXES AVENUE SOUTH, MINNEAPOLIS, MINNESOTA 55431 (612) 830-4444

SBC 6001-Authorization: This states that the standards will be applied to remodeling projects, but this is inconsistent with paragraph 1.3 under SBC 6003-Purpose, which only refers to new buildings. Our feeling is that any upgrading of remodeled structures to meet the new standards should be left to the discretion of the designer and owner because of the serious economic considerations involved. Adding wall insulation to a remodeled industrial plant, for instance, would not only entail the cost of material and labor for the installation, but would require a durable wall surface to be added to protect the insulation and would require the removal and replacement of existing facilities such as electrical wiring, piping, storage racks, work benches and other wall hung equipment. Further, the addition of roof insulation would not only entail costs in excess of those for the same insulation on a new building, but would require new roof expansion joints because of the increased expansion and contraction of the roofing which in turn would require additional roof drains, at least one for every area bounded by roof expansion joints. Buildings that are drained only by means of roof scuppers and exterior down spouts would be subjected to a particurlarly severe hardship. (As you are aware, roofing is maintained at a more even temperature with a relatively small amount of roof insulation due to the heat transfer from the interior spaces to the roofing. With less heat transfer due to a greater amount of insulation, the roofing temperature varies more closely with the fluctuation in the outside temperature, causing greater expansion and contraction).

Section 2-Scope: Paragraphs 2.0 and 2.1 again refer to new buildings only, so we hope the reference to remodeling under SBC 6001 was merely a typographical error. However, we feel that the last sentence of paragraph 2.0 should be stricken because our economic studies show conclusively that U values better than those called for in the document do not, in fact, prove to be economically desirable. We feel this sentence is an unfounded opinion, and not fact, so should therefore be omitted.

4.2.2-Exposed Exterior Walls: The average U value of 0.22 is, in our opinion, quite realistic, but requiring a maximum U value of .10 for the opaque wall is not only difficult to attain with conventional commercial construction methods, but is also inconsistent with the stated intent of the rules to provide flexibility. We feel there should be no requirement for the U value of opaque walls as long as the average U value of 0.22 is a criteria.

4.2.4-Floors over Unheated Spaces: It does not appear logical to assign any maximum heat transfer value that is dependent upon differences in temperatures. An unheated space below grade does not fluctuate in temperature in accordance with outside temperature but primarily in accordance with ground temperature and the thermal diffusivity of the soil. This would mean that a totally underground basement would drop to no lower than 45°F during the winter, resulting in a temperature difference between the two spaces of only 23°F. How much energy can be saved by requiring a maximum U value of 0.08 in relation to the cost of the insulation to achieve this U value? A more realistic approach may be to assign a maximum heat loss such as 10 BTU/HR/SQ.FT., which would require insulation to vary in accordance with the temperature differences between the spaces.

4.2.5- Slab-On-Grade Floors: Here there seems to be a problem in terminology. If thermal resistance minimums are to be stipulated, the units should be changed to °F/BTU/HR/SQ.FT. and the value should be changed to 5.0. However, if the 0.20 BTU/HR/SQ.FT./°F is to be the criteria, then the word "resistance" should be changed to "conductance" and the word "less" changed to "more."

4.2.6-Foundation Walls: We would like to re-emphasize our position stated in our letter of January 31, to Mr. Herbert W. Meyer wherein we stated that the resistance of below grade walls enclosing heated spaces should not be related to the resistance of opaque wall surfaces above grade. Because the major factor in determining the heat loss through a below grade wall is the depth of the wall below the earth's surface and because of the wide variations in the K-factor, moisture content and thermal diffusivity of various types of soils, we feel the amount of insulation should be left up to the designer.

4.3.3-Fenestrations: The value of 100 BTU/HR/SQ.FT. as the maximum instantaneous combined solar and air-to-air heat transmission for windows is low. Any value lower than 110 to 120 will require capital expenditures out of relation to the benefits to be derived. The major problem areas are on the east and west exposures and any treatment of those exposures to maintain this maximum figure of 100, such as glass type, shading, etc., would be carried out throughout the building for consistency of design, but on the north and south exposures would result in a reduced energy savings in relation to the investment.

4.5.1-Vapor Barriers: We are glad to see that the matter of condensation control as provided by vapor barriers is left to the design team. However, we noted that the reference of 5.1.2.1 should actually read 5.3.2.2.

5.3.2.3-Ventilation: Because the recommended ventilation rates listed in Section 6 of ASHRAE Standard 62-73 are in almost all cases a range from a lower figure to a higher figure, we suggest that this paragraph starting with the 5th line be changed to read, ".... based on outdoor quantities of not more than 33% of the maximum recommended ventilation rates sited in Section 6...". This will not only provide greater flexibility for the design engineer, but will also save many questions on the interpretation of this paragraph in the future. Our only exception to this requirement would be enclosed parking garages and auto repair workrooms. Because of the strict federal emissions control standards it would seem logical to require a ventilation rate of no more than 0.4 cfm/ sq. ft. or as determined by actual contaminent measurement.

5.3.2.4-Infiltration: We believe the last sentence in this paragraph requires some clarification. We do not think that it means in pressurized buildings ventilation air is added to the point that no infiltration exists because in most buildings this is a practical impossibility. In theory, it requires a static pressure differential of 0.1" W.C. between inside and outside to negate a 15mph wind, but in actual practice when a windward overhead door is opened the heated, pressurized air relieves to the outside through the upper portion of the door and colder 15 mph wind enters through the lower portion of the door. When more than one door is opened, the pressure differential actually decreases, permitting more air to enter from the outside. Therefore, what is the meaning of the last sentence in this paragraph?

5.3.2.5-System Design Heating/Cooling Capacity: Does the phrase, "whenever appropriate equipment is available" limit competition? Are we to assume that if only one manufacturer can provide equipment of capacity not greater than 110% of the design output load, that his equipment must be furnished, even though equipment furnished by other manufacturers may be of only slightly greater capacity, but may have better all-around characteristics? We think that the figure of 110% should be raised to at least 115% to permit a greater selection of equipment and to maintain competition among suppliers.

5.4.4.2-A clarification of the types of controls for set-back would be helpful. The way we read items b and d a single temperature thermostat having a manually adjustable set point would be permitted for these two cases.

6.8-Annual Energy Requirements and Coefficients of Performance: If the building is designed and constructed in accordance with the requirements set forth in the proposed code changes, these calculations should serve no useful

purpose to the reviewing agency. They would only be of interest to the owner and the design engineer and would, for that reason, be desirable that they be made. However, we do not feel that these calculations should be mandatory.

7.1-General: In the sentence, "When possible, heat recovery shall be used for a portion of the water heating requirements", who determines when heat recovery is possible? We recommend that the sentence be changed to read, "The feasibility of heat recovery should be considered as an energy source for water heating requirements."

7.3.3-Insulation: Under sub-paragraph 7.3.3.2, maximum heat loss values are specified, though no reference is made to temperatures of the water within the piping. Because in many projects hot water of no greater than 120° is distributed throughout the building to lavatories, showers, wash fountains, etc., and because there is a growing trend towards distributing a single supply of tempered water at approximately 105°F to lavs and other handwashing facilities, we recommend that to be consistent with paragraph 5.8.1-b, no insulation be required on hot water piping carrying water at temperatures of 120°F and lower.

10.0-Energy Sources and Cost Calculations: This entire section appears to be of very small value to the state in relation to the great amount of time and expense required to furnish the data. As stated earlier in this letter, we feel that energy use information is valuable to the owner and to the design engineer, and energy use calculations are presently made on many buildings. However, if the needs of the state for this information is to facilitate the development of energy budgets for future buildings, we feel that more accurate data can be obtained by metering the energy usages during occupancy of the building. These data could then be correlated with the reams of information on each building already supplied to the department to arrive at a realistic energy budget for each specific building type, occupancy, size range, geographic location, etc. These energy budgets could be calculated by department personnel during slack periods. We are assuming, of couse, that the department will be staffed to handle the review of plans and calculations with a minimum of delay even during the peak periods of the year, resulting in many slack periods where productive work is needed.

10.1.2-Energy Supply Comparison: It would be helpful if "prime energy input" could be defined. Does this include the energy required to pump oil and

gas through the pipelines, to transport coal to the power station, to manufacture coal mining or well drilling equipment, etc.? We question the need for this comparison because there are available fairly well documented figures on remaining supplies of our various prime energy resources, and if, in fact, this requirement is aimed towards discouraging the use of electricity for heating and/or cooling, we should bear in mind that about 98% of electric power in Minnesota is generated through the use of coal, atomic power and hydro-electric power, prime energy resources that are in relatively good supply.

10.1.3-Effective heat rate for off site energy refinement processes: The definitions mentioned in the first paragraphs are not listed in the document. Again, we do not see that benefits arising from obtaining this data can be justified.

10.2-Here we have no disagreements because there is no 10.2 appearing in our copy of the document.

Respectfully submitted,

RAUENHORST CORPORATION

J. Robert Snyder

J. Robert Snyder, P.E.
Chief Mechanical Engineer

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Exhibit M

HGA

Hammel Green and Abrahamson Inc. Architects & Engineers 2675 University Ave., St. Paul, Minnesota 55114 612/646 7501

5 May 1975

State of Minnesota
Department of Administration
Building Code Division
Metro Square Building
Saint Paul, Minnesota 55101

Re: Design Evaluation Criteria for Energy Conservation in New Buildings March 17, 1975

Gentlemen:

The Department of Administration and the Building Code Division deserves praise for compilation of the above comprehensive document. We recognize both the need to have rules limiting the use of energy and the complexity of any effort to form these rules.

We would encourage continued investigation into an acceptable "Energy Budget" Code for future adoption, but we do see the present proposal as a necessary interim measure. After reviewing the proposed rules, several members of the architectural and engineering disciplines in our office have arrived at comments intending to improve the clairity and equitability of these rules. Due to lack of time it has not been possible to completely integrate these concerns with professional organizations making similar comments.

We thank you for the opportunity to make these comments and your consideration in reviewing them.

HAMMEL GREEN AND ABRAHAMSON, INC.
Energy Conservation Committee

Daniel L. Swedberg
Chairman

DLS:dw

M-1

Bruce A. Abrahamson, William E. Anderson, Richard D. Babcock, Duane E. Blanchard, Eldon O. Burow, Theodore R. Butler, M. Lee Dahlen, Rodney L. Erickson, James F. Goulet, Curtis H. Green, Gary A. Hall, Richard F. Hammel, Jerrald B. Olson, Robert M. Parupsky, John E. Potterton, George T. Riches, Wesley E. Sorensen, Harry R. Wilcox

Exhibit M

Proposed Revisions to:

DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS

Page	Section	Comment	Reason for Change
2	6001	Strike "... and remodeling" in 6th line	New buildings only are mentioned throughout the rest of the code. All requirements are now directed towards new buildings- a separate code addressing itself soley to remodeling would be advisable. The problem is complex and merits further study. Applying these requirements may create an excessive economic burden discouraging remodeling work - consider the following thoughts: 1 - Reducing heat loss to old masonry building envelopes which esthetically should remain exposed would accelerate deterioration due to increased thermal stress. 2 - Reuse of existing materials (i.e. existing elements in a remodeled building) is energy conserving. 3 - Preservation of historical buildings may appropriately take precedence over energy conservation in some instances. An alternative approach might be that buildings remodeled by a value exceeding 50% of their assessed value should conform to the code with all numerical requirements reduced in severity by an arbitrary amount, such as 25% or 50%.
3	6003.1.3	Add at end-"Evaluation of proposals shall be made promptly by local officials with the aid of the office of the State Building Inspector."	It is essential to the orderly progress of design professionals work and the goals of their clients that the office of the State Building Inspector maintain a qualified staff of professionals to evaluate proposals. Local officials may need direction, help, and an availability of the State office in order to efficiently review projects.
4	6002.0	Add - "(unless otherwise approved)" after new buildings in 1st line.	Many exceptions are mentioned in latter sections for special use conditions.

Page	Section	Comment	Reason for Change
4	6002.1	Is 1 watt/sq. ft. the correct Figure? Does it include heating, cooling and lighting energy only?	This allowance appears to be low.
5	6003	Definition - New Buildings, after permits issues add - "except for remodeling".	Comments above for Section 6001 Page 2 apply.
6	6003	Definition - Infiltration Add - "And outward" after "... inward" in Line 1.	Air leakage out of a building due to pressurization is just as energy consuming as air leakage into a building.
6	6003	Definition - Opaque Areas, strike "Opaque" in 1st line.	This eliminates a redundancy.
6	6003	Definition - Thermal Break strike "through the structural members " in 4th line.	It is not clear whether "Structural members" applies only to the building's structural frame or to elements of a building component.
5-7	6003	Add definitions for "effective heat rate, energy refinement efficiently, equivalent energy consumption, and refined energy source" as referenced in Section 10.1.3. Also add definitions for "Curtainwall" and "Crack" (Section 6004. 4.2.1) and "Building Used by the Public" (Section 6004.4.1)	Their definition would add clarity to sections referenced.
8	6004.2.1	Add "only" at end of paragraph.	This would clearly exclude the ceiling as a contributing element to the total roof "U" value under ceiling plemium applications.
10	6004.2.5	Change "perimeter" to "periphery" in line 2.	Perimeter refers to a line while periphery also refers to a surface.
10	6004.3.3	Add at end of paragraph - "other buildings, trees & other planting are not considered exterior shading devices."	The future existence of these elements can not be relied on. This may be best handled with a definition for exterior shading devices in Section 6003.
11	6004.4.1	Strike - "...that are not pressurized in pressurized buildings, the infiltration shall be offset by the ventilation air."	Comments for Section 6003 Page 6 Definition - Infiltration apply.

Page	Section	Comment	Reason for Change
11	6004.4.2.1	Add "inside the periphery of opening edge" after "leakage requirements" in Line 1.	This clearly limits air leakage concerned with to be that within the opening element and will not require testing for every possible installation method.
11	6004.4.3	Add "non-concrete and non-masonry" after "between" in Line 1 and strike "Between wall & roof" in Line 2.	Sealant joints are not necessary where the exterior wall is continuation of a similar material as the foundation wall. Open joints between wall (exterior facing) and roof edge are often beneficial in preventing moisture from being contained within building insulation.
11	6004.5.1	Insert "5.3.2.2" in lieu of "5.1.2.1" in 3rd line.	Remedies incorrect reference.
11	6004.5.2	Strike entire Section	Thermal break values are not defined, are difficult to obtain in metal doors, and greatly limited window frame selections. The heat loss from these elements should be included in the calculations of the exposed exterior wall "U" valves of Section 6004.2.2. Thermal breaks in ceiling, roof, floor and wall constructions are now adequately covered in other sections.
12	6004.6.1	Insert "peripheral envelope area" in lieu of "perimeter" in 8th line, and add at end- "Buildings with portions of their walls or roof below grade may be compared to the same building above ground.	Insulation value reductions should not be allowed for changing the physical shape of a building for comparison. The reason for this can be seen by comparing three possible building shapes for heat loss using the minimum acceptable "U" values roof (.10) (slab on grade) floor (.20), and walls (.22) for flat deck and non - 1 or 2 family dwelling construction which show major variances. Total heat loss for a 1,000,000 cubic foot bldg. 50' wide, 2000' long and 10' high would be 2,021,900 BUT/Hr. a building with the same volume and 100' wide, 100' long and 100' high would have a total heat loss of 951,000 BTU'S/Hr. a third building with the same volume and 40' wide, 50' long and 500' high would have a total heat loss of 1,909,000 BTU'S/Hr. in essence the heat loss for a building comparision should not be allowed to be manipulated to allow insulation values to be reduced. Buildings designed to have walls or roofs below ground should not be unfairly discouraged, however. Their comparison with an identical shape above ground appears to be fair.

Page	Section	Comment	Reason for Change
12	6004.6.2	Insert "Design" in lieu of "designs" at two points in Line 2.	In stating "Designs" it may be implied that a totally different comparison design than that commented on above (Sect. 6004.6.1) would be allowed.
13	6005.1	Insert "should" in lieu of "shall" in Line 4.	This would be consistent with the Change made in Section 6004.1.1 (2nd Line) after the 1st public hearing.
13	6005.3.2.2	Add "when outside air below 0°F, with 5 percentage points additional allowed for each 10°F increase in temperature. This requirement shall not apply to buildings of residential use." After ..."not exceed 15 percent" in Line 3.	Higher humidity may be desirable with higher temp. for both human comfort and to prevent excessive drying out of building elements. Individual health problems may require residences to operate with higher humidities.
15	6005.3.2.3.1	The statement - "These required outdoor air quantities shall be" needs clarification	The intent of this statement is unclear, which required air quantities are referred to is unclear.
15	6005.3.2.4	Strike "...that are not pressurized, in pressurized buildings, the infiltration shall be offset by the ventilation air."	Comments above for Section 6003 infiltration definition, Page 6 apply.
20	6005.10.2	Insert "Unless low pressure ducts are located in the space in which they are serving..." in lieu of "When low pressure ducts are located where the air leakage loss is non-beneficial, then..."	The meaning of "nonbeneficial" was not clear.
27	6007.1	Insert "practicable" in lieu of "possible", and "should" in lieu of "shall" in Line 3.	This change would be consistent with other Sections and would allow an exception when the application of heat recovery is not "practicable".
27	6007.2.1	Delete "Fuel availability ...before selection." in Lines 4, 5, 6, and 7.	This statement appears to be general in nature and does not state a clear requirement.
29	6008.1	Insert "should" in lieu of "shall" in Line 1.	Comments above for Section 6005.1 Page 13 apply.

Page	Section	Comment	Reason for Change
29	6008.6	Add "or other living units below 600 sq. ft. net area, after "...dormitories," in Line 3.	This would allow buildings such as Housing for the Elderly to exempted from costly individual metering. Energy benefits from including these living units would appear inconsequential
32	6009.5	Add "Energy used for... provided so that:" after "usage".	This statement appears to have been overlooked from draft distributed at 1st public hearing.
32	6009.6.1	Add at end "Lighting for security purposes is not to be limited by this Section."	Control of security lighting would be appropriate in a separate section, or to be left to the discretion of the professional.
33	6010.1	Insert "...$30,000 in value," in lieu of $5,000 Sq. Ft. of Gross Floor area," in Line 7.	This would be consistent with the existing state law, Section 326.03 Minnesota statutes 1969 - Registration Required. Other exemptions a, b, c, d, and e of Section 326.03 might also be included.



minnesota masonry institute

COMMENTS TO

DESIGN AND EVALUATION CRITERIA

FOR

ENERGY CONSERVATION IN NEW BUILDINGS

SECTION 4. EXTERIOR ENVELOPE

4.2.2 EXPOSED EXTERIOR WALLS

BY

Minnesota Masonry Institute
7851 Metro Parkway, Suite 103
Minneapolis, Minnesota 55420

Phone: 612/854-0196

Contact: Thomas F. Richardson
Executive Director

N-1

7851 METRO PARKWAY SUITE 103 MINNEAPOLIS, MINNESOTA 55420 PHONE: 612 854-0196

Section 4.2.2 EXPOSED EXTERIOR WALLS

The organizations supporting the Minnesota Masonry Institute are the Associated General Contractors of Minnesota, the Minnesota Concrete & Masonry Contractors Association, the State Conference of Bricklayers, the Minnesota Concrete Products Association, the Minnesota Brick Manufacturers and Dealers, and the Portland Cement Association.

Section 1 Purpose 1.2 I quote "It is intended that the rules shall be flexible and designers shall be encouraged to use innovative approaches and techniques to achieve efficient utilization of energy."

We feel that the sentence in Section 4.2.2, "The value for an opaque wall shall not exceed .10 Btu/hr./sq.ft./degrees F." should be deleted.

This sentence is disciminatory in that it only affects the opaque portion of the wall. Equation 4-1 should be followed to arrive at the average Thermal Transmittance Value (U_o). This would allow design flexibility and fairness between opaque walls, windows and doors. In this case the amendment would return to a performance requirement instead of a prescriptive requirement.

It should also be drawn to your attention that this discriminating requirement is not found in the National Energy Study 90-P report.

We would also like to bring your attention to the Minnesota Energy Agency Act Chapter 307, HF. NO. 2675 page 490 116H.12 Energy Conservation Subd. 4. Quote "Such standards shall be economically feasible in that the resultant savings in energy procurement shall exceed the cost of the energy conserving requirements amortized over the life of the building."

I am submitting studies that we have made showing that there are a number of single wythe masonry walls that will conserve energy and maintain cost control within the limits of U_o. These studies also show that the .10 "U" requirement is not economically feasible for some types of building and does exceed the cost of energy conserving requirements amortized over the life of the building.

We would also submit for your consideration that the .17 U_o be changed to .19 U_o and the .22 U_o be changed to .26 U_o which are presently the recommended average values by ASHRAE Committee 90-P. Supportive data will be submitted within the 20-day period.

SUPPORTING DATA

I. HEATING

ASSUMPTIONS:

1. Design Temperatures: Inside Temperature = 68° F; Outside Temperature = -19° F (Minneapolis).
2. Degree Days = 8,382 (Minneapolis).
3. Heating System Efficiency = 80%.
4. Interruptible Natural Gas, at $1.03 per MCF and 1,000,000 BTU's per MCF, used 80% of the year.
5. Propane, at $.30 per gallon and 91,500 BTU's per gallon, used 20% of the year.

A. ANNUAL HEATING COST

$$\text{ANNUAL HEAT LOSS, BTU's} = \frac{H_L \times \text{DEGREE DAYS} \times \text{HOURS/DAY OF EQUIVALENT FULL LOAD OPERATING HOURS}}{\text{HEATING SYSTEM EFFICIENCY} \times \text{DEGREE DAYS/MAXIMUM DAY}}$$

$$= \frac{(\text{AREA} \times U \times [68 - (-19)]) \times 8{,}382 \times 21}{.80 \times [65 - (-19)]}$$

$$= \underline{\underline{228{,}000 \times \text{AREA} \times \text{"U"}}}$$

$$\text{ANNUAL HEATING COST} = \frac{\text{ANNUAL HEAT LOSS} \times \text{FUEL COST/UNIT}}{\text{HEAT CONTENT OF FUEL/UNIT}}$$

$$\underline{\text{GAS}}\ \text{ANNUAL HEATING COST, DOLLARS} = \frac{(228{,}000 \times \text{AREA} \times U) \times \$1.03/\text{MCF}}{1{,}000{,}000\ \text{BTU's/MCF}} \times .80$$

$$= \underline{\underline{.188 \times \text{AREA} \times \text{"U"}}}$$

$$\underline{\text{PROPANE}}\ \text{ANNUAL HEATING COST, DOLLARS} = \frac{(228{,}000 \times \text{AREA} \times U) \times \$.30/\text{GAL.}}{91{,}500\ \text{BTU's/GAL.}} \times .20$$

$$= \underline{\underline{.150 \times \text{AREA} \times \text{"U"}}}$$

$$\text{TOTAL ANNUAL HEATING COST} = (.188 + .150) \times \text{AREA} \times \text{"U"}$$

$$= \underline{\underline{.338 \times \text{AREA} \times \text{"U"}}}$$

B. HEATING EQUIPMENT COST

1. ASSUME $10.00 Per 1000 BTUH

$$H_L = \text{AREA} \times \text{"U"} \times \left[68 - (-19)\right]$$

$$= 87 \times \text{AREA} \times \text{"U"}$$

$$\text{COST} = H_L \times \frac{\$10.00}{1000}$$

$$= \underline{\underline{.87 \times \text{AREA} \times \text{"U"}}}$$

II. AIR CONDITIONING

ASSUMPTIONS:

1. Temperature Difference of 10° F.
2. Equipment Cost = $750 per ton.
3. Electricity Cost = $.034 per KW.
4. Electricity Fuel Content = 3413 BTU per KW Hour.
5. 350 Hours of Operation Per Year.

A. ANNUAL AIR CONDITIONING OPERATING COST

$$\text{COST} = \frac{(\text{AREA} \times U \times \text{TD}) \times 350 \times \text{COST/UNIT}}{\text{FUEL CONTENT/UNIT}}$$

$$= \frac{(\text{AREA} \times \text{"U"} \times 10^{\circ}) \times 350 \times \$.034}{3413}$$

$$= \underline{\underline{.035 \times \text{AREA} \times \text{"U"}}}$$

B. AIR CONDITIONING EQUIPMENT COST

$$\text{COST} = \frac{(\text{AREA} \times U \times \text{TD}) \times \text{COST/UNIT}}{\text{FUEL CONTENT/UNIT}}$$

$$= \frac{(\text{AREA} \times \text{"U"} \times 10) \times \$750/\text{TON}}{12{,}000 \text{ BTU/TON}}$$

$$= \underline{\underline{.625 \times \text{AREA} \times \text{"U"}}}$$

NOTE: Heating and Air Conditioning Equipment and Operating Costs are for Heat Loss or Gain by Thermal Transmission Only, and Do Not Include Ventilation, etc.

A STUDY OF SECTION 4. EXTERIOR ENVELOPE 4.2.2 OF THE DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS.

A COMPARISON OF TWO BUILDINGS OF SAME SIZE

SIZE OF BUILDINGS: 200 FT. x 200 FT. x 20 FT. HIGH

ANNUAL HEAT LOSS DUE TO TRANSMISSION = 228,000 x AREA x "U"

BUILDING A: NO WINDOWS - U_o = .10 FOR TOTAL WALL

WALL: ALL MASONRY (OPAQUE) - 16,000 SQ.FT. - "U" = .10

WALL H_t = 228,000 x 16,000 x .10 = 364,000,000

BUILDING B: 75% MASONRY (U = .10) & 25% WINDOW (U = .58, DOUBLE PANE) - U_o = .22 FOR TOTAL WALL

WALL: MASONRY (OPAQUE) - 12,000 SQ.FT. - U = .10

WINDOW - 4,000 SQ.FT. - U = .58

MASONRY H_t = 228,000 x 12,000 x .10 = 273,600,000

WINDOW H_t = 228,000 x 4,000 x .58 = 528,960,000

TOTAL = 802,560,000 BTU's

CONCLUSIONS:

1. BUILDING "B" IS ALLOWED TO USE 437,760,000 BTU's MORE THAN BUILDING "A."

2. BUILDING "A" IS PENALIZED FOR HAVING ALL MASONRY WALLS AND NO WINDOWS. IN THE INTEREST OF FAIR AND REASONABLE ENERGY CONSERVATION CRITERIA, BUILDINGS "A" AND "B" SHOULD HAVE THE SAME HEAT LOSS REQUIREMENT FOR THE COMBINED GROSS AREA OF EXTERIOR WALLS AS DETERMINED BY EQUATION 4-1.

3. SECTION 4.2.2 OF THE DESIGN AND EVALUATION CRITERIA SHOULD BE AMENDED BY DELETING THE SENTENCE "THE VALUE FOR AN OPAQUE WALL SHALL NOT EXCEED .10 BTU/HR/SQ.FT./DEGREES F." THUS, EQUATION 4-1 CAN BE FOLLOWED WITH DESIGN FLEXIBILITY TO ARRIVE AT THE THERMAL TRANSMITTANCE VALUE (U_o) OF .17 OR .22 BTU/HR/SQ.FT./DEGREES F. AS REQUIRED.

ESTIMATED COSTS FOR "TYPICAL" INDUSTRIAL/COMMERCIAL WALL CONSTRUCTIONS

ASSUME: 1. 200 Ft. x 200 Ft. x 20 Ft. High
2. No windows, doors, etc.

WALLS

No. 1 -- 8" Lightweight Concrete Masonry, cores filled with vermiculite or equal. U = .17

No. 2 -- 12" Lightweight Concrete Masonry, cores filled with vermiculite or equal. U = .15 (ASHRAE)

No. 3 -- 12" Lightweight Concrete Masonry, cores filled with vermiculite or equal. U = .12 (Vermiculite Institute Test Report)

No. 4 -- 4" S&G Concrete Masonry/1½" Rigid Polystyrene (K = .19)/ 8" S&G Concrete Masonry cavity wall. U = .095

HEATING EQUIPMENT COST -- .87 x Area x "U"

Wall No. 1 = $2,365
Wall No. 2 = $2,085
Wall No. 3 = $1,670
Wall No. 4 = $1,320

AIR CONDITIONING EQUIPMENT COST -- .625 x Area x "U"

Wall No. 1 = $1,700
Wall No. 2 = $1,500
Wall No. 3 = $1,200
Wall No. 4 = $ 950

ANNUAL HEATING OPERATING COST -- .338 x Area x "U"

Wall No. 1 = $920
Wall No. 2 = $810
Wall No. 3 = $650
Wall No. 4 = $515

ANNUAL AIR CONDITIONING OPERATING COST -- .035 x Area x "U"

Wall No. 1 = $95
Wall No. 2 = $85
Wall No. 3 = $65
Wall No. 4 = $55

INITIAL WALL COST

Wall No. 1 = $40,000 (@ $2.50/Sq. Ft.)
Wall No. 2 = $44,800 (@ $2.80/Sq. Ft.)
Wall No. 3 = $44,800 (@ $2.80/Sq. Ft.)
Wall No. 4 = $66,400 (@ $4.15/Sq. Ft.)

TOTAL INITIAL COST

Wall No. 1 = $44,065
Wall No. 2 = $48,385
Wall No. 3 = $47,670
Wall No. 4 = $68,670

SUMMARY

WALL NO.	"U"	TOTAL INITIAL COST	ANNUAL OPERATING COST
1	.17	$44,065	$1,015
2	.15	$48,385	$ 895
3	.12	$47,670	$ 715
4	.095	$68,670	$ 570

CONCLUSIONS

To get a return on the extra initial cost of Wall No. 4, it would take:

145 years when compared to Wall No. 3;
62.5 years compared to Wall No. 2;
55.3 years compared to Wall No. 1.

ESTIMATED COSTS FOR "TYPICAL" INDUSTRIAL/COMMERCIAL WALL CONSTRUCTIONS

NOTES: 1. 200 Ft. x 200 Ft. x 20 Ft. High Building.
2. No windows, doors, etc.
3. Heating Equipment & Operating Costs are for Heat Loss by Transmission Only.

WALL CONSTRUCTION	"U" VALUE	INITIAL COST			ANNUAL HEATING COST	10 YEAR "LIFE-CYCLE" COSTS
		WALL	HT.EQUIP.	TOTAL		
1. 8" S&G Conc. Masonry	.51	$32,800 ($2.05/SF)	$7,800	$40,600	$2,760	$68,200
2. 12" S&G Conc. Mason.	.47	$33,600 ($2.10/SF)	$6,540	$40,140	$2,540	$65,540
3. 8" S&G Conc Masonry/ Vermiculite Core Fill	.36	$39,200 ($2.45/SF)	$5,010	$44,210	$1,945	$63,660
4. 8" S&G Conc Masonry/ Polystyrene Core Fill	.34	$39,200 ($2.45/SF)	$4,735	$43,935	$1,840	$62,335
5. 8" Lt.Wt. Conc Mas	.33	$34,400 ($2.15/SF)	$4,595	$38,995	$1,785	$56,845
6. 12" Lt.Wt. Conc Mas	.30	$35,200 ($2.20/SF)	$4,175	$39,375	$1,620	$55,575
7. 12" S&G Conc Masonry/ Vermiculite Core Fill	.25	$43,200 ($2.70/SF)	$3,480	$46,680	$1,350	$60,180
8. 12" S&G Conc Masonry/ Polystyrene Core Fill	.22	$43,200 ($2.70/SF)	$3,060	$46,260	$1,190	$58,160
9. 8" Lt.Wt. Conc Mason/ Vermiculite Core Fill	.17	$40,000 ($2.50/SF)	$2,365	$42,365	$ 920	$51,565
10. 8" Lt.Wt. Conc Mason/ Polystyrene Core Fill	.15	$40,000 ($2.50/SF)	$2,085	$42,085	$ 810	$50,185
11. 12" Lt.Wt. Conc Mason/ Vermiculite Core Fill	.12	$44,800 ($2.80/SF)	$1,670	$46,470	$ 650	$52,970
12. 12" Lt.Wt. Conc Mas/ Polystyrene Core Fill	.10	$44,800 ($2.80/SF)	$1,390	$46,190	$ 540	$51,590
13. 4" S&G Conc Masonry/ 1½" Rigid Polystyrene (Extruded)/8" S&G C/M	.095	$66,400 ($4.15/SF)	$1,320	$67,720	$ 515	$72,870

CONCLUSIONS:

Masonry walls 8-13 will meet the gross exterior wall requirement of U_o .22. If the .10 U maximum requirement for opaque walls is not deleted, only walls 12 and 13 would be allowed under the energy amendment.

The polystyrene core fill used in wall #12 has a questionable supply availability. In case of a limited supply of this material, only wall #13 would meet the .10 U requirement. Wall #13 would have excessive life cycle costs.

Therefore we recommend that the .10 U maximum requirement for opaque walls be deleted from section 4.2.2, thus allowing design flexibility of Equation 4-1.

MODEL BILL TO REQUIRE EFFICIENT ENERGY UTILIZATION
IN RESIDENTIAL, COMMERCIAL AND PUBLIC BUILDINGS
(Proposed for Enactment by State Legislatures)

Printer's No.

THE GENERAL ASSEMBLY OF (STATE)

SENATE OR HOUSE BILL

No._____ SESSION OF 1975

A BILL

To provide for the most efficient utilization of energy in new residential, commercial and public buildings.

BE IT ENACTED BY THE PEOPLE OF THE STATE OF (Insert Name of State), REPRESENTED IN THE LEGISLATURE:

Section 1. Definitions

Structures -- shall include residential dwellings whether single or multi-family, permanent or transient, institutional or other health aid facilities, schools, places of public assembly, public or governmental buildings, and commercial establishments, as more specifically set forth in the Schedule in Section 3a.

Energy -- shall include that derived from fossil or atomic fuels and shall exclude that derived from solar, wind, geothermal or other non-depletive sources.

Section 2. Each application for a building permit for new structures shall contain a Certificate of Compliance by a Registered Architect or Registered Professional Engineer, that said structure has been designed to comply with and does not exceed the maximum energy consumption standards as herein set forth.

Section 3. Maximum Energy Consumption

a. The designed maximum annual energy consumption at building boundary excluding process equipment in thousands of Btu's per gross square foot of floor area (ANSI Z-65) per annum shall not exceed the following:

Occupancy or Use	Thousands of Btu's/gsf/year
Non-transient Residential:	125
Apartment Houses	
Dormitories	
Rooming Houses	
One and Two Family Dwellings	
Transient Residential:	125
Hotels	
Motels	
Lodging Houses	
Institutional:	150
Infirmaries	

1	Sanitariums	
2	Nursing Homes	
3	Convalescent Homes	
4	Maternity Homes	
5	Childrens Homes	
6	Penal Institutions	
7	Hospitals:	175
8	Schools:	125
9	Elementary	
10	Junior High	
11	Senior High	
12	University and College	
13	Laboratory Buildings	
14	Assembly - Large:	200
15	Arena	
16	Auditorium	
17	Gymnasium	
18	Theater	
19	Music Hall	
20	Assembly - Small:	150
21	Armory	
22	Art Gallery	
23	Ballroom	
24	Church	
25	Dance Hall	
26	Dining Hall	
27	Funeral Chapel	
28	Museum	
29	Night Club	
30	Restaurant	
31	Mercantile:	200
32	Business:	150

Banks

Barber Shops

Beauty Shops

Mortuary

Office Building

Industrial Buildings: 175

Bakeries

Breweries

Creameries

Distilleries

Factories

Slaughterhouses

Aircraft Hangars

Automobile Sales and Service

b. The method of determination of Btu/gsf/year for purpose of this Act should be as set forth in ASHRAE Handbook of Fundamentals-1972 or other ASHRAE approved method.

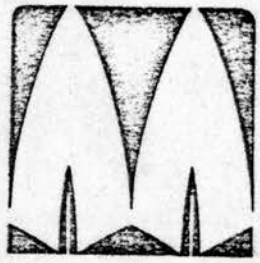
c. GSA/PBS publication "Energy Conservation Design Guidelines for Office Buildings" of January 1974 and ASHRAE proposed 90-P - "Design and Evaluation Criteria for Energy Conservation in Buildings" may be used as guidelines to achieve a design within the maximum energy consumption levels.

Enforcement -- The local Building Inspection Agency or State or Local Agency charged with implementation of this act shall be responsible for its enforcement.

Section _____. EFFECTIVE DATE

This Act shall be effective in _____ days, but shall not apply to applications for building permits submitted before the effective date hereof.

Exhibit P



minnesota masonry institute

7851 METRO PARKWAY SUITE 103 MINNEAPOLIS, MINNESOTA 55420 PHONE: 612 854-0196

COMMENTS TO

DESIGN AND EVALUATION CRITERIA

FOR

ENERGY CONSERVATION IN NEW BUILDINGS

SECTION 4. EXTERIOR ENVELOPE

4.2.6 FOUNDATION WALLS

BY

Minnesota Masonry Institute
7851 Metro Parkway, Suite 103
Minneapolis, Minnesota 55420

Phone: 612/854-0196

Contact: Thomas F. Richardson
Executive Director

Section 4.2.6 FOUNDATION WALLS

We are recommending that the second sentence be changed to read as follows:

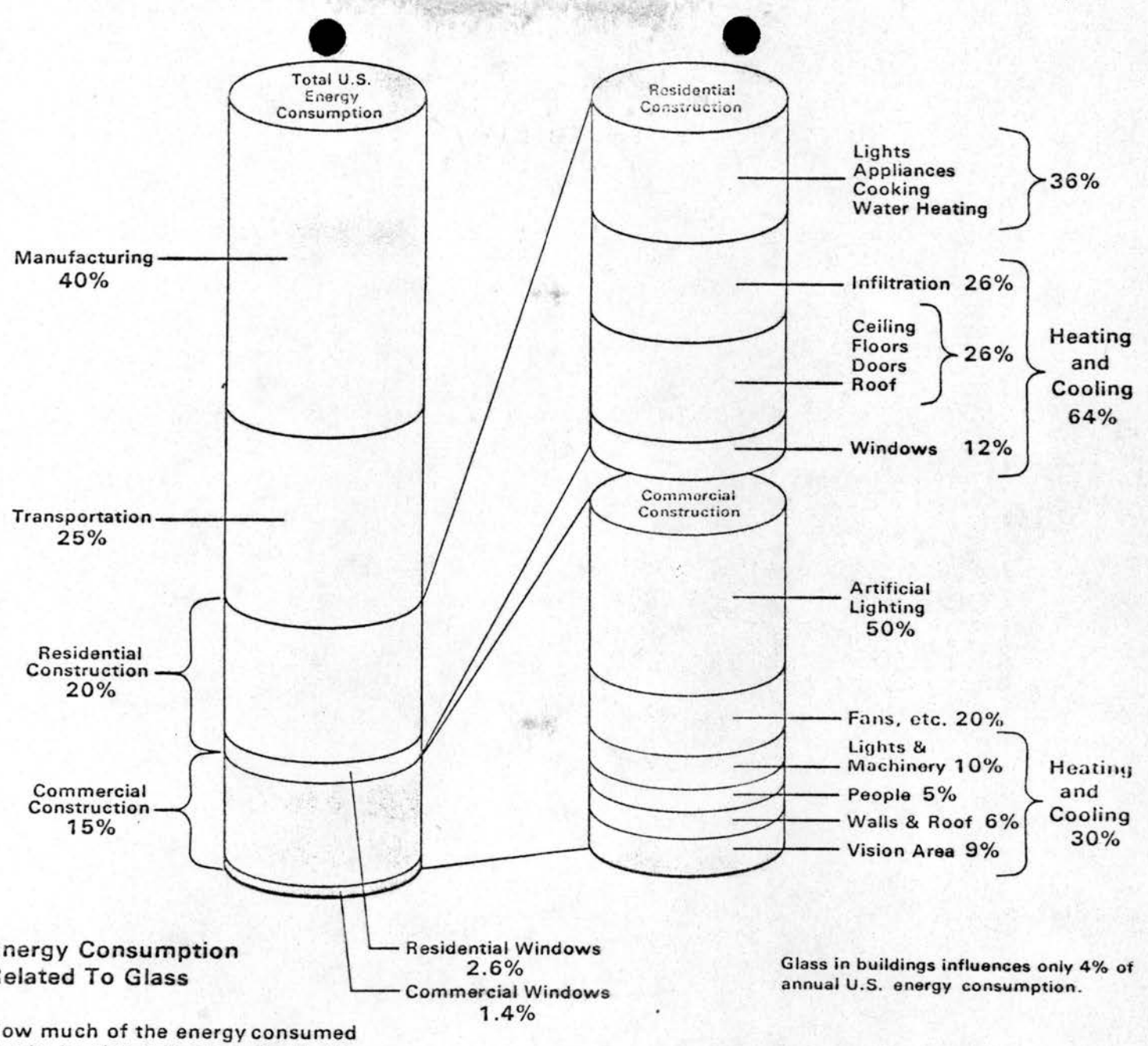
> The areas of foundation walls below grade and enclosing a heated space shall require no insulation.

COMMENT:

From the ASHRAE Handbook of Fundamentals 1972. Chapter 21 Heating Load P. 377 Temperatures Adjacent to Basement Walls, Second Paragraph.

Quote: "The ground temperature adjacent to the walls of a heated basement is greatly affected by the heat gain from the basement. Unfortunately, complete data on ground temperatures adjacent to buildings are not available, but since the recommended transmission for basement walls in contact with the soil is only 0.10, any reasonable, assumed ground temperature will not materially affect the calculated heat loss."

Exhibit R



Energy Consumption Related To Glass

Glass in buildings influences only 4% of annual U.S. energy consumption.

How much of the energy consumed yearly in the U.S. goes for buildings?

Of the total annual energy consumption, 40 per cent goes for manufacturing, 25 per cent for transportation, 20 per cent for residential use, and 15 per cent for commercial building use.

How much energy consumption does glass account for in a typical home?

The Department of Housing and Urban Development (HUD) has estimated that 36 per cent of the energy consumed in a typical home goes for lights, appliances, cooking and water heating, and 64 per cent is used for heating and cooling.

Of this 64 per cent, other estimates show that the floors, roof, ceiling and doors account for 26 per cent, infiltration for 26 per cent, and windows for 12 per cent.

Relating this figure to the total energy consumption for residential usage, we can roughly estimate that the glass area in existing residential buildings accounts for just 2.6 per cent of the total energy consumed in the U.S. each year.

What about glass-related energy consumption in commercial buildings?

A subcommittee of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) has approximated the energy distribution for a typical office building this way:

(1) 50 per cent of the energy consumed is for artificial lighting.

(2) 20 per cent is used by fans, pumps, elevators, and office machinery.

(3) 10 per cent goes to remove excess heat generated by lighting and machinery.

(4) 5 per cent handles excess heat from people.

(5) 6 per cent is energy loss through the roof and opaque walls.

(6) 9 per cent is energy loss through the vision area.

Referring to the energy consumption figure for commercial usage, we thus can estimate that the glass area in existing commercial buildings accounts for only about 1.4 per cent of the total energy consumed in the U.S. yearly.

Recently, it's been suggested that if new buildings had smaller windows, energy consumption would be reduced considerably. Any comments?

In terms of the total energy consumed in the United States each year for all purposes, a reduction in window size in new buildings would have little impact.

R-1

Exhibit S

NSP

NORTHERN STATES POWER COMPANY
414 Nicollet Mall
Minneapolis, Minnesota 55401

April 15, 1975

Richard L. Brubacher
Commissioner of Administration
Room 208 - Administration Building
50 Sherburne Avenue
St. Paul, Minnesota 55155

Dear Mr. Brubacher:

Subject: Design and Evaluation Criteria For Energy Conservation In Buildings

My name is Jack Schutz, Manager of Energy Services for Northern States Power Company. I am a 12 year employee of NSP, a Registered Professional Engineer and a member of ASHRAE, including membership in its Energy Conservation Committee. I was General Chairman of the recent Minnesota Energy Conference.

My present assignment at Northern States Power Company includes responsibility for counseling our customers on energy utilization, energy management and conservation as well as other internal functions.

We are actively involved in many projects with the Minnesota Energy Agency and have expressed through these activities and others, our willingness to promote efficient energy utilization.

We support adoption of the amendments to the State Building Code entitled "Design and Evaluation Criteria For Energy Conservation In Buildings", with the exception of Section 10.

We do not take opposition to the premise that proper use of our energy resources is important. We do, however, feel that this proposed evaluation is completely inappropriate as a part of the State Building Code.

In evaluating proper use of energy resources many things must be considered. Is the use environmentally proper? Which use is more appropriate from the standpoint of availability? And to deal with the question raised in Section 10 we must ask "Is this an efficient use of our resources?" We contend that answering the former questions are equally important and should be considered in the appropriate forum, along with the latter. Even then, these considerations become far more complex than the relatively simplified but technically incorrect analysis required in Section 10.

Consider, the entire analysis that would be necessary to determine comparative energy use. Oil use should include, for example, the energy expended in transporting the oil to the point of use. This use can be substantial, particularly, if the oil is foreign produced. Similarly, natural gas must be piped and in some cases liquified with additional energy expended in both cases. In addition to losses due to the generation process, electricity has further reductions in end use capability due to transmission and distribution losses. Further, all of these energy resources require energy for the drilling and mining process. We raise these questions to point out the types of complexities that arise when considering the proper use of energy resources, and to suggest that this process, regardless of the depth of analysis, is inappropriate as a part of this document. We further object to the associated expense that will be borne by our customers.

The State Legislature in assigning this task stated the need to "provide building design and construction standards consistent with the most efficient use of energy".* They further ordered the Commissioner of Administration to "promulgate building design and construction standards regarding heat loss control, illumination and climate control".

The intent of this mandate had been carried out prior to the inclusion of Section 10 which clearly violates the scope of the document. Section 2.2 states that "the energy uses covered shall be that energy used within the building and on its site".

We recommend the elimination of Section 10 for these reasons and suggest that the following sections 11 and 12 be renumbered 10 and 11 respectively.

*Sect. 12 Subd. 4 Chapter 307 HF2675, 1974 Minnesota Energy Agency Act

Yours truly,

Jack J. Schutz, Manager
Energy Services Department
Northern States Power Company

JJS:gkn

Drinking water coolers	204 040	242 922	292 451	267 896	275 167	296 570	271 937	247 561		
Cooling towers, factory-assembled	28 567	30 664	23 735	22 143	19 937	18 408	15 612	14 034	14 747	14 733
Unit coolers	129 656	139 767	164 832	147 547	150 823	164 201	154 329	160 201	186 434	192 766

Rusk presents new incentive plan for add-on sales

SOUTHFIELD, Mich. — A plan to give salesmen additional incentive to increase sales of add-on equipment, such as electronic air cleaners, was presented to a group of Detroit-area contractors by Thomas R. (Doc) Rusk.

Rusk told the group that the plan he implemented in his company, Rusk Heating & Air Conditioning Co., Covington, Ky., began March 1 and will run for a year.

It works like this: If a salesman sells up to 34 electronic air cleaners in the period, he receives a commission of $5 for each unit; for up to 36 units, he receives $7.50 for each; for up to 38, $10 for each; for up to 40, $15 each; for up to 42, $20 each; and for up to 45, $25 for each.

For example, if a salesman sells 30 air cleaners, he would receive a commission of $5 per unit for a total of $150. If he sells 45 air cleaners, he would receive $25 per unit for a total of $1125.

Rusk assigns each salesman to one of two categories of quotas based on past performance. The first is described above; the second pays $5 per unit for up to 22 units, and runs in progressive steps to the top pay of $25 for each of 30 or more units sold.

The program is based on increased sales above previous performance. The company expects its six salesmen to sell 300 units in the period, an increase of about 50% over 1974 sales.

On another subject, Rusk told the group that if there is one week of hot weather before the 15th of June, residential air conditioning contractors will have a good summer.

(Next Page, Please)

Engineer testifies energy estimates costly, inaccurate

WASHINGTON, D. C. — A consulting engineer who deals exclusively with energy management in buildings told the Senate's Commerce Committee that the cost of estimating energy use in nonresidential buildings would range from $1000 to tens of thousands of dollars for each building and still would not be within 100% of actual energy usage.

Testifying at hearings on S. 349 and S. 594 "truth in energy" bills, Larry Spielvogel, Wyncote, Pa., said present-day methods can be reasonably accurate but require a great deal of detail on how a building will be used. For example, annual heating-cooling costs for a 1000 ft² office used by a psychiatrist three days a week might be $300, but if the same space is used

(Next Page, Please)

Kansas a/c contractors propose ways to cut 'Yellow Pages' ads

WICHITA, Kan. — In an effort to reduce the number of listings in the "Yellow Pages" of the telephone directory, the Kansas Air Conditioning Contractors Association (KACCA) is recommending that:

• All Wichita contractors move their display advertisements from "Furnaces-Heating" to "Heating-Contractors" and wholesalers move their trademark advertisements from "Furnaces-Heating" to "Heating Equipment and Systems."

• All Wichita contractors limit their display advertisements to a minimum of one-eighth of a page under "Air Conditioning Contractors" and under "Heating Contractors" and that they give serious consideration to one-sixteenth-of-a-page display advertisements as a maximum size.

In a new leaflet, KACCA explains that the reasons for the proposed changes "are the simplification for users and customers in order that they can find us faster in the Yellow Pages and in order that we may clarify our product to the users through the use of display ads."

The association proposes that the following categories be deleted: air conditioning cleaning; air conditioning control instru-

(Next Page, Please)

Climate Control Div appoints Hawkins marketing vice pres



Hawkins

Meeting OSHAct ventilation standards

First of two parts



OSHAct [Occupational Safety and Health Act] has made manda-

termined whether it is meeting OSHAct specifications for air volumes and velocities. Secondly, this information will be available for

check each branch duct individually to be certain that each one handles its required flow rate. That is, the system must be "balanced."

B·O·M·A EXH.

BUILDING OWNERS AND MANAGERS ASSOCIATION

OF MINNEAPOLIS

927 SOO LINE BUILDING MINNEAPOLIS, MINNESOTA 55402 • 338-8627

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LARRY STROHKIRCH

June 17, 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Department of Administration
St. Paul, Minnesota 55155

Dear Mr. Brubacher:

The Energy Conservation Committee of this Association has met and reviewed the Proposed Amendments to the State Building Code relating to Energy Conservation with respect to remodeling which is the subject of a Public Hearing on June 18 and offer the following comments:

We are concerned that the proposed changes are too ambiguous as to interpretation and meaning and need further definition. For example, if an office building replaced existing glass windows with energy conserving double pane units, the cost could exceed 50% of the value of the building which would require the entire building to comply in accordance with SBC 104 of the State Building Code.

We feel that any materials replaced, such as windows, should be done with energy saving materials no matter what the dollar relationship is to the existing building value. We feel that in remodeling, the building envelope when remodeled should not be inhibited by a building valuation % figure.

Our concern is that only those component parts of the building to be remodeled should be required to comply with the new proposed code.

This Association continues to offer its services to the Department of Administration, State Building Inspection Department and the Minnesota State Code Technical Committees.

Sincerely,

Minneapolis Association of
Building Owners and Managers, Inc.

AWO

Arthur W. Olofson

AWO:ck
cc:Raymond B. Vecellio
Herbert Meyer
Norman Osterby

PROFESSIONALISM IN BUILDING MANAGEMENT

FEDERATED WITH BUILDING OWNERS AND MANAGERS ASSOCIATION INTERNATIONAL

Ex I
June 18

CONSULTING ENGINEERS COUNCIL OF MINNESOTA

5009 EXCELSIOR BLVD. SUITE 126 WOOD-EXCEL BUILDING MINNEAPOLIS, MINN. 55416 612/922-9696

June 17, 1975

Mr. Herbert W. Meyer, Director
Building Code Division
Department of Administration
State of Minnesota

Subject: Proposed Ammendments to the State Building Code relating to Energy Conservation with respect to Remodeling

Dear Sir:

The Consulting Engineer's Council of Minnesota offers the following comments and suggestions relative to the subect matter:

1. It is suggested that paragraph 1.1 be changed to read as follows:

   1.1 ~~In-all-other-areas-of-the-State-these-Rules-shall be-enforced-by~~ In areas of the State where there is no duly elected or appointed building official, these rules shall be enforced by the Commissioner of Administration or his designated representatives. The fees for such enforcement shall be based on the schedule established in Chapter 3 of the Uniform Building Code, 1973 Edition, as adopted by SBC 201.

2. It is suggested that paragraph 2.1.2 be changed to read as follows:

   2.1.2 ~~The-requirements-of-SBC-103,-Subparagraphs-1,-2, 3-and-4-shall-not-apply-with-respect-to-energy conservation-regulations-when-compliance-would not-be-economically-feasible.~~

Member of American Consulting Engineers Council

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~~A-request-for-an-exemption-to-compliance-with-the above-shall-be-submitted-to-the-Building-Official together-with-evaluation-and-documentation-that shows-compliance-with-the-energy-conservation requirements-is-not-economically-feasible.~~

~~The-request-shall-be-submitted-to-the-Building Official-of-the-municipality-where-the-State Building-Code-applies-and-to-the-State-Building Code-Division-for-all-other-areas-of-the-State.~~

The Commissioner of Administration or such of his representatives as he may designate may grant exemptions from compliance with such provisions of the code as he may deem advisable to preserve the architectural or historic qualities of a building, or when in his opinion, compliance would be economically unsound.

Requests for exemption from compliance shall be submitted to the local building official in areas where a local building official has been elected or appointed; the local building official shall forward such requests together with his comments and/or recommendations to the Director of the Building Code Division. Requests for exemption from compliance for buildings located in areas where there is no duly elected or appointed building official, shall be submitted to the Director of the State Building Code. Requests should be accompanied by a presentation of the reasons supporting the requests, including economic analyses when appropriate.

Comments:

CEC believes it is virtually impossible to foresee all the conditions and cases that might arise. It believes that the best course under such circumstances is to start with the requirement that all the provisions of the code apply, and that the code be written in such a manner that it is clearly intended that the Commissioner or his representative will grant authorizations to deviate for any of the reasons stated, if conclusive evidence is presented.

It is conceiveable that the Division will be swamped with requests for deviations. In order to make rulings seem less arbitrary, the Commissioner may deem it prudent to appoint an advisory board made up of practicing engineers, architects and developers to develop guidelines upon which to base decisions and to pass judgement on each request, in which case, CEC would suggest that machinery be

set up so the members of such an advisory board could be compensated for the time they spend in such determinations.

Respectively submitted,

Consulting Engineer Council
of Minnesota

Joseph H. Mindrum, P.E.
Chairman, Energy Committee

JHM:mo

Minnesota Chapter

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR – CONDITIONING ENGINEERS, INC.

EX J June 18

PHILIP A. DUGAN
PRESIDENT

J. ROBERT SNYDER
VICE-PRESIDENT

WILLIAM F. WHARTON
SECRETARY

JAMES R. WOHLFORD
TREASURER

BOARD OF GOVERNORS

RICHARD J. HARJU
DONALD J. LOZINSKI
ROBERT L. OLSON
LARRY J. HINK

June 18, 1975

Mr. Robert L. Brubacker
Commissioner of Administration
408 Metro Square
St. Paul, Minnesota 55101

Dear Mr. Brubacker:

Enclosed you will find three (3) copies of our comments on the proposed amendments (dated May 14, 1975) to the document entitled, "Design and Evaluation Criteria for Energy Conservation in New Buildings".

We wish to introduce these comments as an exhibit for the record. We are reproducing the amendment and showing our suggested additions, corrections and deletions.

The proposed amendments are as follows:

SBC 103 is amended to read as follows:

General. Building or structures to which additions, alterations, or repair are made shall comply with all the requirements for new buildings or structures except as specifically provided in this ~~section~~ Code.

Note: For the requirements of energy conservation in remodeled buildings see SBC 6001 through SBC 6003.

Proposed Rules and Regulations for Design and Evaluation Criteria for Energy Conservation in New Buildings, Additions and Remodeled Elements of Buildings.

SBC 6002 ENFORCEMENT

1.0 Building Officials, in the municipality for which they are appointed, shall enforce these Rules.

1.1 In all other areas of the State these Rules shall be enforced by the Commissioner of Administration or his

designated representatives. The fees for such enforcement shall be based on the schedule established in Chapter 3 of the Uniform Building Code, 1973 Edition, as adopted by SBC 201.

SBC 6003 PURPOSE

1.0 PURPOSE. The purpose of these Rules is to provide design requirements and criteria that will result in the effective utilization of energy in new buildings, additions and remodeled elements of buildings.

1.3 It is intended that these Rules can be used in the design of new buildings, additions and for the remodeled elements of existing buildings and that compliance with ~~its~~ their requirements should be determinable in the pre-construction stage by evaluation and analysis of design specifications, drawings and calculations.

SECTION 2 - SCOPE

2.0 These Rules set forth requirements for the design of all types of new buildings, (additions and remodeled elements of buildings) covering their exterior envelopes and selection of their HVAC, service water heating, electrical distribution and illuminating systems, and equipment for efficient use of energy. Observance of the requirements does not necessarily lead to an optimization of initial and operating cost, and these Standards are not intended to replace economic evaluation to arrive at such an optimization. Economic evaluation of thermal design criteria will generally show that further reductions in energy consumption will be economically desirable.

2.1 This standard applies to the design and construction of all types of new buildings, (additions and remodeled elements of buildings) or those portions of new buildings containing conditioned space. Vacation homes used for summer occupancy and buildings whose peak design energy demand is less than 1 watt/sq. ft. or 3.4 Btu of floor area for all purposes are specifically excluded from the scope of this standard.

~~2.1.1 Certain other buildings or elements thereof may be exempted when design data are not applicable or calculations show that internal heat gains exceed heat losses. In these cases, the exemptions shall be made in writing and a copy of such exemptions shall be submitted to the State Building Inspector within fifteen (15) days of the granting of such exemption.~~

~~2.1.2 The requirements of SBC 103, Subparagraphs 1, 2, 3 and 4 shall not apply with respect to energy conservation regulations when compliance would not be economically feasible.~~

2.1.1 A request for an exemption to compliance with the above shall be submitted to the Building Official together with evaluation and documentation that shows compliance with the energy conservation requirements is not ~~economically~~ feasible.

The request shall be submitted to the Building Official of the municipality where the State Building Code applies and to the State Building Code Division for all other areas of the State.

SECTION 3 - DEFINITIONS

Add to the list of definitions:

Remodeled Element: Remodeled elements of existing buildings shall include but are not limited to the following: windows, doors and other portions of the building envelope as well as the interior portions of the building that affect heat loss control, illumination or the climate control.

Remodeling: The reconstruction, removal or replacement of any portion or element of an existing building which affects the heat loss control, illumination, or climate control, but does not include normal maintenance and repair.

Comments:

Note: ( ) Parenthesis indicates additions recommended by ASHRAE.

2.0 and 2.1 Additions and remodeled elements of building should be covered in the scope.

2.1.1 Exemptions can be covered in Section 2.1.2. The term "economically" feasible is difficult to define. There may be other valid reasons for non-compliance

besides economics, although economics may be a reason for granting an exemption.

We believe energy conservation is of extreme importance and should be applied to additions and remodeled elements as is fire protection, OSHA and other code requirements.

Very truly yours,

Allan W. Wessel

Allan W. Wessel
Chairman
ASHRAE Energy Conservation Committee

Richard D. Cramer
Earl H. Bartels
Ram Gada
Robert O. Halvorson
Arthur F. Hovda
Edward M. Wiik
Joe W. Kuns
Jack J. Schutz
Tom Lidberg
Larry Hink
Bill Wharton
Basant Kharbanda
George Ellison (Electrical Consultant)

A. B. SYSTEMS, INC.
117 N. Broadway
ROCHESTER, MINN. 55901
Phone: 507-288-9397

April 29, 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Department of Administration
Building Code Division
408 Metro Square Building
7th & Robert Streets
St. Paul, Minnesota 55101

Re: Proposed Rules and Regulations to Provide
Energy Conservation Standards for Buildings

Dear Mr. Brubacher:

It is very encouraging to see that Minnesota is one of the leaders in providing standards for energy conservation in buildings, since there seems to be no end in sight as to the future cost of energy.

These standards will help all the citizens of Minnesota lower their fuel costs, and at the same time, help our country meet its balance of payment problem, thereby, also reducing the inflation factor.

These standards are easily and economically achievable with todays technology, and, therefore, I will support these standards, with the exception that the requirement to retain a professional architect or engineer to perform energy use calculations for buildings totaling more than 5,000 sq.ft. shall be changed to 20,000 sq.ft. Many qualified individuals working for manufacturers or suppliers are capable of performing these calculations, and, thereby, the total construction cost to the clients will be lowered.

Thank you for your support on these standards.

Very truly yours,

A. B. SYSTEMS, INC.

Karl Schuller

Karl Schuller
President

KSchuller/rmq

COMMENT-May 6, 1975

the Aluminum Association
Incorporated

750 Third Avenue, New York
N.Y. 10017

(212) 972-1800

May 1, 1975

Mr. Herbert W. Meyer, Director
Building Code Division
Department of Administration
408 Metro Square Building
Seventh & Robert Street
St. Paul, Minnesota 55101

Dear Mr. Meyer:

The purpose of this letter is to inquire whether you have adopted, or are considering adopting, regulations for energy conservation in buildings in your state. If you already have or are considering such rules, we would appreciate receiving a copy of them, and your timetable for implementing them.

I would also like to inquire whether it would be possible for us to be placed on your mailing list for proposed changes to your state code.

Your advise on these matters will be appreciated.

Sincerely,

The Aluminum Association

P. V. Mara
Vice President - Technical

PVM:jg

The Mark of Aluminum

American Gas Association

1515 Wilson Boulevard, Arlington, VA 22209
Telephone: (703) 524-2000

April 25, 1975

Mr. Samuel J. Stewart
Energy Engineer
State of Minnesota Energy Agency
740 American Center Building
160 East Kellogg Blvd.
St. Paul, Minnesota 55101



Dear Mr. Stewart:

The American Gas Association would like to express its support for the "Design and Evaluation Criteria for Energy Conservation in New Buildings" which was compiled by the Building Code Division of the State of Minnesota, dated March 17, 1975.

This document has all the ingredients of a true energy conservation document. More specifically, the inclusion of the methodology to evaluate the effects of design alternatives on the consumption of our natural resources is extremely important, and we applaud its inclusion. This supports the primary energy position of the National Bureau of Standards (NBS), the Federal Energy Agency (FEA), The Department of Housing and Urban Development (HUD), The Council of Environmental Quality (CEQ) and others. It should be emphasized that all energy should be conserved. This can only be done if the efficiency of the energy system is considered. We feel the proposed chapter will, in fact, achieve those goals.

For your information I have enclosed a copy of the gas industry comments to the latest draft of ASHRAE 90-P. You will see that the Minnesota version is consistent with our comments. Therefore, most of our concerns have been satisfied in it.

In conclusion, I would again like to express our support for a job well done.

If you have any questions please do not hesitate to contact me.

Sincerely,

Kenneth T. Cuccinelli

Kenneth T. Cuccinelli
Manager, Energy Systems and
Energy Systems Analysis

KTC:pb

Enclosure

cc: R. McChane
W. Walleen
P. Kunz
D. Deyoe

Minnesota Chapter

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR - CONDITIONING ENGINEERS, INC.

LARRY J. HINK
PRESIDENT

PHILIP A. DUGAN
VICE-PRESIDENT

DONALD L. TRIMMER
SECRETARY

ROBERT J. SNYDER
TREASURER

BOARD OF GOVERNORS
LARRY E. HEINEN
CURTIS H. WENTZ
OSCAR S. SAMUELSON

May 19, 1975

Mr. Richard L. Brubacker
Commissioner of Administration
408 Metro Square Office Building
St. Paul, Minnesota 55101

Gentlemen:

At the Hearing on May 6, 1975 regarding the "Design and Evaluation Criteria for Energy Conservation in New Buildings" (dated March 17, 1975) we submitted comments for the record that were identified by Mr. Meyer as Exhibit H.

This letter augments Exhibit H with some additions and corrections as follows:

1. On Page 13 under 5.1 Scope - delete the word "supermarket" in the third sentence.

2. Substitute attached subsection 7.3.3 through 7.3.3.2 including the insulation tables for section 7.3.3 in the original document.

3. Delete subsection 4.2.5 and in lieu thereof substitute the following:

   4.2.5 SLAB ON EARTH FLOORS: Floor slabs on earth which are not more than four (4) feet below grade shall be provided with insulation having a thermal resistance in the range of R= 6.5 to 7.5 at a mean temperature of 75°F. The insulation shall be applied vertically to the foundation wall and shall extend from the floor slab to a point four (4) feet below outside grade. Insulation may also be applied horizontally four (4) feet from the edge wall under the floor.

We wish to compliment you and your staff on the business like, objective and expeditious manner in which the May 6 Hearing was conducted.

Very truly yours,

Allan W. Wessel

Allan W. Wessel

AWW/jac

RECEIVED
MAY 21 1975
BUILDING CODE

7.3.3 Insulation

7.3.3.1 Heat Loss for Piping including recirculating water lines and Unfired Hot Water Storage Tanks shall be limited by application of insulation as indicated in tables 7.1 and 7.2.

Table 7.1 - Minimum Pipe Insulation

Piping System Type	Temperature Range - ° F	Insulation Thickness in Inches for Pipe Sizes			
		1" and less	1¼"-3"	4"-6"	8" and over
Domestic (Service) Water Piping	106°-149° 150°-212°	½" 1"	1" 1½"	1½" 2"	1½" 2½"

Table 7.2 - Minimum Insulation Unfired Water Storage Vessels

System	Water Temperature	Thickness of Insulation
Water storage tank, convertor, generator	Up to 150° F 151° to 212° F	2 inches 3 inches

7.3.3.2 Insulation thicknesses in tables 7.1 and 7.2 are based on thermal resistances in the range of R= 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75° F. Insulation thicknesses in table 7.1 and 7.2 are based on insulation having thermal resistances in the range of R= 4.0 to 4.6 per inch of insulation at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 or may be reduced for materials having R values greater than 4.6 per inch of thickness.

Architectural Aluminum Manufacturers Association

EXECUTIVE OFFICES
35 EAST WACKER DRIVE, CHICAGO, ILLINOIS 60601
TELEPHONE: 312/782-8256

EXECUTIVE VICE PRESIDENT
Edward W. Haggarty

May 22, 1975

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VICE PRESIDENT
John M. Wolf

Mr. Herbert W. Meyer
Director Building Code Division
Room 408
Metro Square Building
St. Paul, Minnesota 55107

Dear Mr. Meyer:

At the request of AAMA member Mel Mermell, (Winter Seal of Flint), we are enclosing information on AAMA's Thermal Performance Specification.

It is our pleasure to be of service to you.

Sincerely,

A.S. Coorlim

Anthony S. Coorlim

ASC/lp
Encl.

c.c.: Mel Mermell
Winter Seal of Flint



architectural aluminum

Dee Krog file

Armstrong
CORK COMPANY

AREA CODE 717 | TELEPHONE 397-0611

LANCASTER, PA. 17604

April 29, 1975



Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, MN 55101

Dear Mr. Meyer:

Subject: Proposed Rules and Regulations to Provide Energy Conservation Standards to Carry Out The Provisions of Laws of 1974, Chapter 307

A representative from Armstrong Cork Company will not be offering an oral statement at the hearing set for May 6, 1975 to comment on "Design and Evaluation Criteria for Energy Conservation in New Buildings." We are submitting this written statement which we respectfully offer for your consideration.

We are commenting, specifically, regarding caption paragraph 5.8 PIPING INSULATION and Table 10--Minimum Pipe Insulation.

Table 10 is copied verbatum from the proposed ASHRAE Standard 90P. We ask that Table 10 not be accepted in its present form because--

-- ASHRAE Standard 90P is in a preliminary or proposed draft form and has not yet been finalized.

-- ASHRAE Standard 90P was circulated for comments and the comments are only now being evaluated.

-- We have been informed, as of April 17, 1975, that ASHRAE has received responses from a total of 281 commentors regarding contents of ASHRAE Standard 90P.

-- It is almost certain that Table 10 within ASHRAE 90P will be revised.

Since you have used Section 5 of ASHRAE Standard 90P as the model to build your own Section 5.0 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) SYSTEMS; and since you have copied Table 10 verbatum from ASHRAE Standard 90P, we are, therefore, offering the entire file of comment we sent to ASHRAE regarding their Table 10 as our comments to you regarding your Table 10.

Our comments are furnished in original and three copies.

We, again, respectfully ask for your consideration of our comments and recommendations.

Very truly yours,

W. H. Offermann

W. H. Offermann
Marketing Manager
Insulation Products
Industry Products Division

BMV

Armstrong
CORK COMPANY

AREA CODE 717 | TELEPHONE 397-0611

LANCASTER, PA 17604

February 24, 1975

American Society of Heating, Refrigerating and
Air Conditioning Engineers, Inc.
United Engineering Center
345 East 47th Street
New York, NY 10017

Gentlemen: Attention: Mr. Nicholas A. LaCourte
Director of Standards

In response to your letter of January 14, 1975 we are submitting suggested changes to ASHRAE Standard 90P, Energy Conservation in New Building Design. Our changes relate to Section 5.0, Heating, Ventilating and Air Conditioning Systems with specific comment applicable to Table 10 as it pertains to Section 5.8, Piping Insulation.

We respectfully ask for your consideration of our comments and recommendations.

Very truly yours,

W. H. Offermann

W. H. Offermann
Marketing Manager
Insulation Products
Industry Products Division

BMV

Enclosure

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

UNITED ENGINEERING CENTER, 345 EAST 47th STREET
New York, N. Y. 10017 (212) 752-6800

Nicholas A. La Courte
Director of Standards

February 25, 1975

Mr. W.H. Offermann
Armstrong Cork Company
Lancaster, Pa. 17604

Subject: ASHRAE Standard 90P - Energy Conservation in New Building Design

Dear Mr. Offermann:

This is to acknowledge receipt of your comments on ASHRAE's Standard 90P.

Your comments will be distributed to the appropriate panels for consideration in a revision of Draft Standard 90P. If there are any questions regarding your comments the Panel Chairman will contact you directly.

Thank you for your time, energy and interest in ASHRAE's Standard 90P.

Sincerely,

Elizabeth Stroukoff

(Mrs.) Elizabeth Stroukoff
Assistant to Mr. La Courte

ES/ld

Table 10
Minimum Pipe Insulation
Heating and/or Cooling Systems
Runouts to Individual Units
Not Exceeding 12' in Length
Temperature Range 40°F - 200°F

1. As the enclosed photographs show, runouts to individual units are frequently made of soft copper tubing and run (particularly in perimeter systems) in areas with minimum clearances and limited room for application. As a result, a flexible unicellular pipe insulation is often the only suitable method of adequately insulating these runouts. Further, when operating on the cooling cycle, the prevention of condensation is of major importance, and the difficulty of installing rigid materials requiring separate vapor barriers becomes a problem.

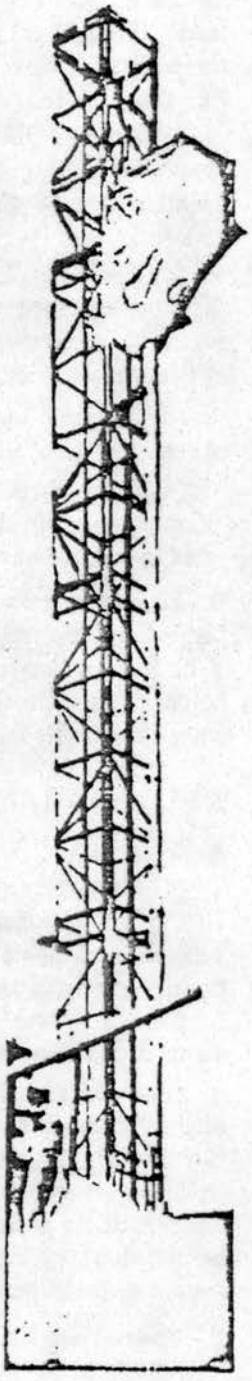
2. Table 10 recognizes the importance of using flexible unicellular materials on small diameter runout pipes in calling for 3/4" insulation thickness on pipe sizes of 1" and less. However, other design criteria, primarily concerned with fire hazard ratings for pipe insulating materials, might preclude the use of 3/4" thick flexible unicellular insulations. Flexible unicellular insulations in 1/2" wall thickness will meet the criteria of recognized Federal standards (see enclosed portions of HEW and GSA standards).

3. The enclosed revision to Table 10 reflects our suggested thickness changes for runouts to individual units for systems operating between 40°F and 200°F. Portions of the existing table have been eliminated for simplicity and clarity.

Supporting Documentation

1. HEW Standard (portion)
2. GSA Standard (portion)
3. Applicable Photographs
4. Revised Table 10
5. Product Literature

MINIMUM REQUIREMENTS OF CONSTRUCTION & EQUIPMENT FOR HOSPITAL & MEDICAL FACILITIES



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Resources Administration
Division of Facilities Utilization
Rockville, Md. 20852

HEW Publication No. (HRA) 74-4000

modate a patient bed and attendants, and shall be at least 5'0" (1.52 m) wide by 7'6" (2.29 m) deep. The car door shall have a clear opening of not less than 3'8" (1.12 m).

(3) Leveling. Elevators shall be equipped with an automatic leveling device of the two-way automatic maintaining type with an accuracy of ½ inch (1.3 cm).

(4) Operation. Elevators, except freight elevators, shall be equipped with a two-way special service switch to permit cars to bypass all landing button calls and be dispatched directly to any floor.

(5) Elevator controls, alarm buttons, and telephones shall be accessible to wheelchair occupants.

(6) Elevator call buttons, controls, and door safety stops shall be of a type that will not be activated by heat or smoke.

B. Field Inspection and Tests.

Inspections and tests shall be made and the owner shall be furnished written certification that the installation meets the requirements set forth in this section and all applicable safety regulations and codes.

8.18. MECHANICAL REQUIREMENTS

A. General.

(1) Prior to completion and acceptance of the facility, all mechanical systems shall be tested, balanced, and operated to demonstrate to the owner or his representative that the installation and performance of these systems conform to the requirements of the plans and specifications.

(2) Upon completion of the contract, the owner shall be furnished with a complete set of manufacturers' operating, maintenance, and preventive maintenance instructions, and parts list with numbers and description for each piece of equipment. He shall also be provided with instruction in the operational use of systems and equipment as required.

B. Thermal and Acoustical Insulation.

(1) Insulation shall be provided for the following within the building:

(a) Boilers, smoke breeching, and stacks.

(b) Steam supply and condensate return piping.

(c) Hot water piping above 180°F (82°C) and all hot water heaters, generators, and convertors.

(d) Hot water piping above 125°F (52°C) which is exposed to contact by patients.

(e) Chilled water, refrigerant, other process piping and equipment operating with fluid temperatures below ambient dew point.

(f) Water supply and drainage piping on which condensation may occur.

(g) Air ducts and casings with outside surface temperatures below ambient dew point.

(h) Other piping, ducts, and equipment as necessary to maintain the efficiency of the system.

(2) Insulation may be omitted from hot water and steam condensate piping not subject to contact by patients when such insulation is unnecessary for preventing excessive system heat loss or excessive heat gain.

(3) Insulation on cold surfaces shall include an exterior vapor barrier.

(4) Insulation including finishes and adhesives on the exterior surfaces of ducts, pipes, and equipment shall have a flame spread rating of 25 or less and a smoke developed rating of 150 or less as determined by an independent testing laboratory in accordance with ASTM Standard E 84 (see sec. 8.18.B(5) for exceptions).

(5) Linings in air ducts and equipment shall meet the Erosion Test Method described in Underwriters' Laboratories Publication No. 181. These linings, including coatings and adhesives, and insulation on exterior surfaces of pipes and ducts in building spaces used as air supply plenums, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with ASTM Standard E 84.

C. Steam and Hot Water Systems.

(1) Boilers. Boilers shall have the capacity, based upon the net ratings published by the Hydronics Institute, to supply the normal requirements of all systems and equipment. The number and arrangement of boilers shall be such that when one boiler breaks down or routine maintenance requires that one boiler be temporarily taken out of service, the capacity of the remaining boiler(s) shall be at least 70 percent of the total required capacity, except that in areas with a design temperature of 20°F (-7°C) or more, based on the Median of Extremes in the ASHRAE Handbook of Fundamentals, the remaining boiler(s) do not have to include boiler capacity for space heating.

(2) Boiler accessories. Boiler feed pumps, heating circulating pumps, condensate return pumps, and fuel

GENERAL SERVICES ADMINISTRATION
WASHINGTON, D. C. 20405

PBS: 4-1516
September 1969
Amendment-3
April 1974

PUBLIC BUILDINGS SERVICE
GUIDE SPECIFICATION

THERMAL INSULATION
(Mechanical)

Amendment-3

The requirements of this amendment are in addition to those of Amendments 1 and 2.

1. Delete pages 1516-3 and 1516-4 and substitute the attached pages 1516-3 and 1516-4.

2. Delete pages 1516-6, 1516-7, 1516-8 and 1516-9 and substitute the attached pages 1516-6, 1516-7, 1516-8, 1516-9 and 1516-9.1.

3. Delete pages 1516-13, 1516-13.1, 1516-14 and 1516-15 and substitute the attached pages 1516-13, 1516-14, 1516-15 and 1516-15.1.

4. Page 1516-16: Subparagraph 10.6, second line: Change Category "4" to Category "5". Subparagraph 10.7, first and third lines: Change Category "5" to Category "6".

5. Page 1516-18, subparagraph 11.7, last line: Change Category "4" to Category "5".

6. Page 1516-19, subparagraph 11.8, sixth line: Change Category "5" to Category "6".

7. Page 1516-20, subparagraph 12.2.1, second line: Change Category "6" to Category "7".

8. Page 1516-21, subparagraph 12.2.2, last line: Change Category "6" to Category "7".

4. FIRE HAZARD RATING

4.1 Except for the materials listed hereinafter, all insulation materials, coating and other accessories shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed and 150 for smoke developed, except duct coverings smoke developed rating shall not exceed 50; materials shall not produce flaming droplets when subjected to fire. The materials which are excepted are:

a. Nylon anchors for securing insulation to ducts or equipment.

b. Cork or treated wood inserts used between shields and piping at hangers on low-temperature piping.

c. Factory premolded one piece PVC fitting and valve covers.

4.2 Ratings shall be determined by the Standard Method of Test for Surface Burning Characteristics of Building Materials, ASTM E-84 or NFPA No. 255.

4.3 Underwriters' Laboratories, Inc., label or listing, satisfactory test results from the National Bureau of Standards, or satisfactory certified test report from an approved testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified.

4.4 Flameproofing treatments subject to deterioration due to the effect of moisture or high humidity, are not acceptable.

5. INSULATION MATERIALS

5.1 Basic insulation materials for the various services shall be selected from those listed in Table I.

TABLE I

INSULATION MATERIALS

Group	Material	Fed. or Mil Spec. No.	Form	Type	Class	Grade or Other	Notes
CP Cold Piping Plumbing	Mineral Fiber Cellular Glass Flex. Unicellular	HH-I-558a HH-I-551c HH-I-573b	D	III II	12 4 T		
LTP Cold Piping Low & Dual Temperature	Mineral Fiber Cellular Glass Flex. Unicellular	HH-I-558a HH-I-551c HH-I-573b	D	III II	12 4 T		

CDE Cold Ducts & Equipment	Mineral Fiber	HH-I-558a					
	Exposed		A	Rigid	1 or 2		2
	Concealed		A		1 or 2		2
	Concealed		B	I	6 or 7	B-3	2
	Cellular Glass	HH-I-551c		I			2
HP Hot Piping Plumbing & Heating	Mineral Fiber	HH-I-558a	D	III	12 or 13		2, 3
	Cellular Glass	HH-I-551c		II	4		4
	Asbestos, Molded	HH-I-561e	2	III			
	Therm. Pipe Ins.	MIL-I-2781D		I or II	e	III	2
	Calc. Silicate	HH-I-523c		II	D		
	Flex. Unicellular	HH-I-573b			T		1
HDE Hot Ducts & Equipment	Mineral Fiber	HH-I-558a					
	Exposed		A	Rigid	1 thru 5		2, 3
	Concealed		A		1 thru 5		2, 3
	Concealed		B	Type 1	6, 7 or 8		2, 3
	Concealed		C		10 or 11		
	Calc. Silicate	HH-I-523c		I	D		
	Asbestos Blocks	HH-I-561e	1	III			
	Thermal Block	MIL-I-2819D			1, 2 or 3		2
	Cellular Glass	HH-I-551c		I			4

NOTES ON TABLE I

Note 1. Flexible unicellular insulation may not be used for hot piping systems operating above 210F., or equipment operating above 180F.; it also may not be used for low temperature water 1-1/2 inch ips and larger.

Note 2. Where more than one form, type, or class is listed, material shall be selected to meet specific requirements for the service involved.

Note 3. HH-I-558a. Classes 1, 2, 6, 12 and 16, may not be used for services with temperatures above 320 F.

Note 4. HH-I-551c. Cellular glass may not be used for services with temperatures above 180 F. All sections of cellular glass insulation shall be bedded in and all joints butted together with bedding compound, category 5.

5.2 Insulation for Fittings, Valves and Flanges.

5.2.1 Except as modified under the specification for the services involved, all fittings, valves and flanges shall be covered with factory precut, factory molded or job fabricated insulation of equivalent thickness and identical in composition to material applied on the pipe in which they are installed. Insulation shall be installed to provide a complete and tight fit over the surfaces to be covered. Except for flexible unicellular insulation, fittings, valves and flanges on piping of 4-inch size or less, in plumbing and heating systems may be covered with one of the insulation and finishing cements of type and grade listed in Federal Specification SS-C-160.

5.3 Jackets.

5.3.1 Vapor barrier jackets, type I, II, and III, shall be in accordance with Federal Specification HH-B-100a, or may be of other materials permanently resistant to flame, having a perm rating not more than 0.05; Beach puncture not less than 25 units and bursting strength (Mullen) of not less than 300 p.s.i.

Proposed Revision To
Table 10 - Minimum Pipe Insulation

Piping System Types	Temp. Range, °F	Insulation Thickness in Inches for Pipe Sizes *					
		Runouts Up to 2" **	1" and Less	1¼-2	2½-4	5&6	8" and Larger
Heating Systems Steam & Hot Water							
High Pressure/Temp	306-460	-	2	2½	3½	4	4½
Medium Pressure/Temp	251-305	-	1½	2	2½	3	3½
Low Pressure/Temp	201-250	-	1	1½	2	2½	3
Low Temperature	140-200	½	1	1½	1½	2	2½
Steam Condensate (for Feed Water)	Any	-	1	1½	2	2	2½
Cooling Systems							
Chilled Water	40-60	½	1	1	1	1	1
Refrigerant or Brine	Below 39	-	1	1½	1½	1½	1½

* See 5.8.2.

** Runouts to Individual Units (not exceeding 12' in length)

FR/Armaflex® Pipe Insulation



DESCRIPTION

FR/Armaflex Pipe Insulation is a flexible, elastomeric thermal insulation, black in color, supplied as slit or unslit tubing, in nominal wall thicknesses of ⅜" and ½", in sizes ranging from ⅜" ID to 5" IPS. Pre-Cut FR/Armaflex Pipe Insulation, supplied in flat sheet form is available in nominal wall thicknesses of ½" and ¾" for 6", 8", and 10" IPS sizes. The expanded closed-cell structure of FR/Armaflex Pipe Insulation makes it an efficient insulation, and because of its low water vapor permeance, it is considered a vapor barrier in itself.

USES

FR/Armaflex Pipe Insulation is used to retard heat gain and prevent condensation or frost formation on cold-water plumbing, chilled-water, and refrigeration lines. It also efficiently reduces heat flow for hot-water plumbing and liquid-heating and dual-temperature piping. The recommended temperature usage range for FR/Armaflex Pipe Insulation is −40 F to +220 F.

For use on cold pipes, FR/Armaflex Pipe Insulation thicknesses have been calculated to prevent condensation, as shown in the table of thickness recommendations.

APPLICATION

FR/Armaflex Pipe Insulation in unslit tubular form can be slipped on to piping before it is connected, or it can be slit lengthwise and applied to piping already connected. Pre-Cut FR/Armaflex Pipe Insulation in flat sheet form is wrapped around the pipe. In all cases, butt joints and longitudinal seams are to be sealed with Armstrong 520 Adhesive. 520 Adhesive is a contact adhesive; therefore, in all cases, both surfaces to be joined are coated with adhesive.

Indoors, no protective finish is required but may be desirable. Outdoors, a weather-resistant protective finish is to be applied. The recommended protective finish is Armstrong Armaflex® Finish; however, other compatible finish systems are not ruled out.

SPECIFICATION COMPLIANCE

FR/Armaflex can be supplied upon request to meet:

ASTM C534, Type I-Tubular
ASTM D1056, SBE 41–42
MIL-C-3133B (MIL STD 670B), Grade SBE 3
HH-I-573B, Class T-Tubular
HH-I-1751/2
MIL-P-15280E & Amendment 1, Form T-Tubular

FLAMMABILITY

FR/Armaflex is an organic material specially compounded to be a fire-retardant insulation. The flammability of this insulation has been tested by exposing a 25-ft-long sample to the ASTM E84 method of test. The ASTM E84 test entitled "Surface Burning Characteristics of Building Materials" is a measure of the tendency of a material to spread flame and develop smoke; it is not a measure of total involvement in a fire.

Flame spread (available nominal thicknesses)	25	— ASTM E84
Smoke developed (available nominal thicknesses)		— ASTM E84
⅜"	110	
½"	150	

Copyright 1974, Armstrong Cork Company, Lancaster, Pa.

Industry Products Division, Lancaster, Pa. 17604

FR/Armaflex Pipe Insulation

Average physical properties*

		Test Method (See note 4)
Density, lb/cu ft	6.0	ASTM D1622
Thermal conductivity, Btu/hr sq ft (F deg/in.)		
75 F mean temp	0.27	ASTM C177
90 F mean temp	0.276	or C518
Upper use limit, deg F (See note 1)	220	—
Lower use limit, deg F (See note 2)	−40	—
Thermal stability, % shrinkage		
7 days, 200 F	5.0	ASTM C548
7 days, 220 F	5.6	
Water vapor permeability, wet cup, perm-in.	0.24	ASTM C355
Water absorption, % by weight	4.6	ASTM D1056
Ozone resistance	GOOD	—
Odor	NEGLIGIBLE	—
Sizes		
Wall thickness, inches (nominal)(See note 3)	⅜, ½, ¾	—
Inside diameter, tubular form	⅜"ID to 5"IPS	—
Length of sections, feet, tubular form	6	—
Inside diameter, Pre-Cut, sheet form	6" to 10" IPS	—
Length of section, feet, Pre-Cut, sheet form	4	—

Notes

[1]On the heating cycle, Armaflex Pipe Insulations will withstand temperatures as high as 220 F. Where the pipe size is greater than 5" IPS and Armaflex Pre-Cut Pipe Insulation and Armaflex Sheet are installed by adhering butt joints and seams only, the upper temperature limit is 220 F. 520 Adhesive may be used with pipe insulation applications up to 220 F.

[2]At −20 F, flexible Armaflex Insulations become hard and, as temperatures drop below −20 F, will be increasingly brittle; however, this hardening characteristic does not affect thermal efficiency or water vapor permeability. Application below −40 F is at user's discretion.

[3]FR/Armaflex tubular form insulation is not manufactured in nominal ¾" wall series. Only Pre-Cut Pipe Insulation is available in nominal ¾" series for 6" to 10" IPS.

[4]ASTM method, in some cases, may be modified slightly to make results more meaningful for end-use application. If details are required, contact Armstrong Cork Company.

*Average values are not to be used for writing material specifications. Contact Armstrong for specification ranges.

Thickness recommendations

Pipe Size	Line Temperatures		
	50 F	35 F	0 F
BASED ON **NORMAL** DESIGN CONDITIONS*			
⅜" ID thru 3" IPS	Nom ⅜"	Nom ½"	....
Over 3" IPS thru 5" IPS	Nom ½"	Nom ½"	....
6" IPS thru 10" IPS †	Nom ½"	Nom ½"	Nom ¾"
Over 10" IPS	⅜" Sheet	⅝" Sheet	1" Sheet
BASED ON **MILD** DESIGN CONDITIONS**			
⅜" ID thru 3" IPS	Nom ⅜"	Nom ⅜"	Nom ½"
Over 3" IPS thru 10" IPS †	Nom ½"	Nom ½"	Nom ½"
Over 10" IPS	⅜" Sheet	⅜" Sheet	½" Sheet
BASED ON **SEVERE** DESIGN CONDITIONS***			
6" IPS thru 10" IPS †	Nom ¾"	Nom ¾"	....
Over 10" IPS	¾" Sheet	1⅛" Sheet	....

*Armaflex in the thicknesses noted and within the specified temperature ranges will prevent condensation on indoor piping under **normal** design conditions, a maximum severity of **85 F and 70% RH.** Armstrong research and field experience indicate that indoor conditions anywhere in the United States seldom exceed this degree of severity.

Armaflex in the thicknesses noted and within the specified temperature ranges will prevent condensation on indoor piping under **mild design conditions, a maximum severity of **80 F and 50% RH.** Typical of these conditions are most air-conditioned spaces and arid climates.

***Armaflex in the thicknesses noted and within the specified temperature ranges will prevent condensation on indoor piping under **severe** design conditions, a maximum severity of **90 F and 80% RH.** Typical of these conditions are indoor areas in which excessive moisture is introduced or in poorly ventilated confined areas where the temperature may be depressed below ambient.

†Pipe sizes 6" IPS thru 10" IPS refer to Pre-Cut Pipe Insulation.

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Herbert W. Meyer
Department of Administration
408 Metro Square Building
Saint Paul, Minnesota 55101

May 24, 1975



Dear Mr. Meyer,

I enjoyed speaking with you today.

Enclosed is a rough draft of a letter I will be sending out to many interested parties at both the State and Federal levels.

Here in California the residential insulation standard is now in effect. The residential standard does not use an average U value for the walls including fenestration, but seperates the U values for the opeque walls (.095) and limits the glazing area to 20% of the gross floor area. In areas of 4500 degree days and over, insulating glass or storm sash are required. 90% of Californias population lives in areas of 3000 degree days or less.

By seperating the opeque wall from the fenestration it eliminates the possibility of reducing the insulation in the opeque wall by reducing the glazing area. Conversely the average U value for the total wall area need not be raised unreasonabely in order to allow the proper amount of glazing to take full advantage of the potential solar heat gain.

It is important to use the gross floor area to determine fenestration area in order not to discriminate against multi- family structures that reduce the amount of wall exposed to exterior ambient temperature to the smallest possible area. If buildings are to use this simplest and most effective way of reducing energy loss they must not be penalized by also having the benefits of adaque daylight and ventilation reduced proportionately.

In order to attract people to energy efficient multi-family living these structures must be as desirable and attractive as single family detached homes. Single family detached homes under the ASHRAE formulas may be allowed more than four times as much window area as low rise multi-family dwellings.

California is in the process of developing an Energy Conservation Standard for new non-residential buildings.

I am on the advisory committee writing these regulations under Senate Bill 144. The committee is using the format of 90P but is finding it necessary to rewrite every section to make the language more clear, to make it enforcable by the local building departments and to make it responsive to energy conservation and the needs of California. The schedule for adoption is as follows. The seventh and final draft (approximately 3000 copies) will go to the interested public by June 1. Public hearings will be held on June 16th in San Fransisco, and in Los Angles on June 18th. Adoption by the California Energy Resources Conservation and Development Commission will be held on July 1 in Sacramento.

I realize that you have your own needs and desires in Minnesota and you surely do not need some Californian telling you how to write your regulations. However we have found that 90P as published in January is poorly written, most sections are little more than recommendations that could not be enforced. Section four is the exception. It is only assumed that the limitations on the envelope of the building as prescribed in section four will reduce energy consumption; there is no numerical proof.

The basic fault that I find in Section four is that it does not take solar heat gain, during the heating season, into consideration nor does it give any credit for daylighting from windows and skylights. When properly used windows and skylights can be extremely beneficial in energy conservation. I am enclosing the Trace study for windows in the San Fransisco bay area which definitly indicates that 90P is complety wrong and counter productive for San Fransisco.

Using the same formulas as Dr. Sam Berman used for a study of skylights in Sacramento and Los Angles I have made the calculations for skylights in Saint Cloud, Minnesota. I am confident these calculations are accurate within 20% to 30%.

I have assumed that the heat that comes in the skylights during the months of October, November, December, January, Febuary , March, and April is all usable. If the heat that comes in during some of the other months is beneficial then so much the better. The conducted losses are based on a formula combining U value of the skylight .65x24 (an unknown number to me but used in Dr. Berman's formula) times the degree days for Saint Cloud,8000. .65x24x8000=124,800 BTUs (conducted heat loss) during the heating season, per square foot of skylight. These losses are calculated for a 24 hour day over the heating season. The solar heat gain during the same period is the total as shown in Liu an Jordans paper " A Rational Proceedure for Predicting the Long Term Average Performance of Flat Plate Solar-Energy Collectors". Copy is inclosed.

October	890.4	BTU per sq. ft. per day
November	545.4	
December	463.1	
January	632.8	
Febuary	976.7	
March	1383.0	
April	1598.1	
	6,489.5	
	x30	days
	194,685.0	BTUs per sq ft. for heating season
	x.86	
	167,429.10	Transmission thru the skylights

Using manufactures literature showing a transmission rate of 93% for a diffusing lense. I assumed 93%x93%=86% as a proper calculation for a double skylight.

+167,429 BTU gain during the heating season
-124,629 conducted losses during the heating season
42,629 net energy gain per sq. ft. during the heating season.

The opeque roof area with the U value of .06 as per ASHRAE 90P for 8000 degree days, would lose 11,520 BTU per square foot per heating season by concucted loss.

The total difference then is approximately 54,000 BTUs per square foot per heating season.

Using oil at 40¢ per gallon and a furnance efficiency of of 67% the net savings in energy is approximately 24¢ in heating energy.

The replacement of artificial light with free daylight is of greater value than the free solar heat gain. The energy saving through the use of daylight is calculated in the following manner. The average light falling on one square foot of skylight, in Saint Paul, is equal to 3600 lumens. An efficient diffusing lens would have 93% light transmission. 86% x 3600 = 3096 usable lumens. A75 watt fluorescent light produces approximately 5400 lumens. 3096 divided by 5400x75 watts = 42.75 watts. Now, if we assume that some form of lighting would be required over and eight hour day, we would have 42.75 watts x 8 hours = 342 watts or .342 kwh. (.342 kwh) x (2.8¢ per kwh) = 1¢ per day savings per square foot =

$2.60-	Savings of energy for light per yr.
+ .24-	Savings of heating energy per heating season
$2.84-	Savings totaled per square foot of skylight per year

The above calculations are for heated buildings only and would not show the same benefit if cooling was required.

Another area of major concern to the California Advisory Committee is the 90P formulas used in calculating wall requirements during the cooling season. Using the formulas as written could easily require reflective glass on a north facing wall. This of course would be costly to the owner in first cost as well as substancially reducing the opportunity of replacing artificial light with free day light. In Draft 7 of the California Regulation any wall within 22½ degrees of true north will be exempt from the cooling requirements as shown in 4.5.1. ASHRAE 90P. The required shading coefficient of all other exterior wall orientations may be satisfied by interior, exterior shading devices as described in Chapter 22 of the ASHRAE Handbook of Fundamentals 1972.

Draft 7 will be published by June 1 and I will send you a copy so you can compare the results of your deliberations with Californias.

Let me know if there is any information I might gather for you as you struggle towards an effective energy conservation regulation for Minnesota. The American Physical Sociatie's Paper, Energy Conservation and Window Systems, is avaiable from Dr. Kurt Reigel at FEA. See enclosed letter from C.S. WU to Professor Sam Berman concerning this study.

Thank you for the opportunity to present these obervations to the problems we are all facing.

Respectfully yours,

Jerome O. Blomberg

Jerome O. Blomberg
President

Attachments

cc: L. J. Niederhofer- President, WAUSAU Metals Corp.
Roger O' Shaughnessy- Pesident, Cardinal Glass
Randy Johnson- Vice President, Viracon
George Stoltz- Chairman, AAMA Energy Conservation Committee

Do hang file for attachments

BOWLER PLUMBING & HEATING CO.
511 EAST LAKE ST. • MINNEAPOLIS, MINN. 55408 • 823-5253

May 9, 1975

Building Code Division
408 Metro Square Building
7th and Robert
St. Paul, Minnesota 55101

Gentlemen,

As representative of the Minnesota Association of Plumbing Heating and Cooling Contractors I wish to record the consensus opinion of our group on the "Design and Evaluation Criteria for Energy Conservation in New Buildings", and the hearing in regard to this document.

It is our hope that our veiwpoint will be evaluated and weighed in the scale with the other comments from around the State of Minnesota.

First of all, we are in accord with the general purpose and scope of the proposed regulations and place our trust in the people who established the new maximums for factors for figuring heat loss or heat gain.

However, there are areas where physical principles have not been taken into account.

The first of these occurs in section 5.3.2.2 in which a maximum of 15% relative humidity is printed. We believe that this figure is 5% too low to promote good health, even at design conditions, and is at too great a variance with accepted levels of humidity.

In the selection of equipment we very often find that one size boiler or air conditioner is slightly undersized, but in going to the next largest unit we could very easily go over the 110% maximum capacity expressed in 5.3.2.5 making an impossible situation. Perhaps such an exception could be covered in the final draft.

Referring to 7.6.2 please include all self closing faucets rather than just the push button style referred to.

BUILDING CODE 75

T. R. BOWLER, PRESIDENT R.W. BOWLER, SECRETARY-TREASURER

We see a possibility of misinterpretation of the sections relating to pipe insulation. In general we would like to see a clause which would require such insulation where energy loss to the building would result. Many basements are heated by bare pipe which would only require additional radiation if the piping were insulated.

Thank you for your consideration,

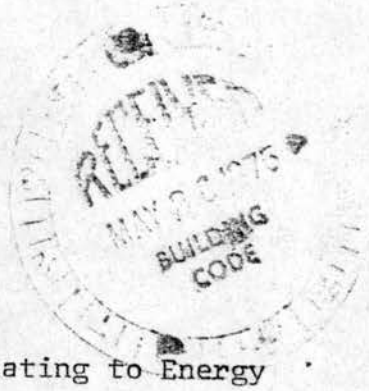
R W Bowler

Robert W. Bowler
M. P. H. C. C.

Brin GLASS COMPANY

Since 1912 • 600 Washington Avenue North • Minneapolis, Minn. 55401 • (612) 335-7761

May 22, 1975



Herbert W. Meyer, State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Proposed Amendments to the State Building Code relating to Energy Conservation in New Buildings.

Dear Mr. Meyer:

As my testimony at the May 6, 1975 hearing indicated, I feel that the proposed rules are concentrating on the visable areas of buildings instead of the large energy using segments. Examples of these large users in commercial construction are artificial lighting (50%) and fans (20%). The ASHRAE tables I submitted documented this as well as pointed out that all heat loss or gain through walls, roofs, and vision areas amount to 15% of the energy used by the buildings.

The citizens of Minnesota have prided themselves in the quality of life they have in this beautiful state. Restrictive codes should not be given us that lay down very prescriptive insulation values for all walls and thus eliminate our opportunity to see the outdoors during our work, leisure and living periods. We all want energy conservation, but why sacrifice our views of outdoors when the major energy users are relatively untouched.

My testimony pointed out areas within section 9 - lighting systems - that could save up to 20% of the energy allocated for artificial lighting. Why "encourage" heat removal fixtures, but yet demand a very stringent "U" value for walls, windows, and doors? The same is true for not using actual reflectances, and for using IES Handbook lighting levels.

The HVAC Sections also can provide great savings. The two attached exhibits from sources unconnected with the glass industry point out that the major elements in decreasing the amount of energy used by a building are not the exterior, but the interior equipment, its design and its use.

The study done by the Chicago Building Managers Association shows that the "glass tower" can be energy efficient. Here the owners, designers, and engineers of the IBM Building used very efficient lighting and HVAC equipment and full vision areas of standard insulated glass to achieve a building that was the most energy efficient in the Chicago study.

Attachments to hearing file

Note how this tradeoff of effiecient equipment versus a slightly less effiecient "U" value on the exterior provides a building that is a joy to work in while conserving energy. The full glass also allows large amounts of "free" light to enter the working areas - something again that is not considered in the proposed Minnesota Code.

The second exhibit points out other areas that affect energy usage that should be of interest to the committee. Please consider these facts versus the proposed rules before making a final code.

I hope that our progressive state does not recieve rules such as referred to in the National Bureau of Standards report "Technical Options for Energy Conservation in Buildings". They state here that most standards "deal principally with the thermal properties of the building envelope; they place few limitations on lighting levels, the ventilation standards are rather general, and they reference existing industry standards for the mechanical systems."

A more realistic attitude that would give the best of each world to our citizens is an effective energy budget as was presented at your first hearing. This allows the owner, designer, and engineer to decide together how best they want to use the energy allocated to them.

Your committee has worked hard and long to formulate these rules, lets hope that the final ones binding on us are just to all and are decided for the betterment of our energy future and our way of life.

Sincerely,

James R. Tegan

JRT/mb

Brin GLASS COMPANY

Since 1912 • 600 Washington Avenue North • Minneapolis, Minn. 55401 • (612) 335-7761

April 23, 1975

Herbert W. Meyer, State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Proposed Rules and Regulations to provide Energy Conservation Standards.

Dear Mr. Meyer:

I have followed your departments quest toward a energy conservation law for buildings with great interest. In attending the hearing of January 15, 1975 I found that you were desirous of any information on this subject - especially from a non-biased group.

Enclosed is a photo-copy of a paper presented by the National League of Cities and the U.S. Conference of Mayers that in my estimation should be of great interest to you and others on your panel. This is especially timely as it gives this learned groups opinions on methods and codes to encourage energy conservation in building design as well as their definition of the principles of energy conservation in buildings.

Our firm has provided quality products to the citizens of Minnesota for over 60 years and we feel that any regulation on use of these products must be for the betterment of all citizens. We do not oppose such regulation, we just desire fair standards that consider <u>all</u> facits of a building, not just the visable ones.

I look forward to attending the upcoming hearings. If our firm can be of any assistance, please feel free to contact us at any time.

Sincerely,

James R. Tegan
Sales & Marketing Manager

JRT/mb



See hearing file for attachments.

CONSULTING ENGINEERS COUNCIL OF MINNESOTA
5009 EXCELSIOR BLVD. SUITE 126 WOOD-EXCEL BUILDING MINNEAPOLIS, MINN. 55416 612/922-9696

May 16, 1975

Mr. Herbert W. Meyer, Director
Building Code Division
Department of Administration
State of Minnesota

SUBJECT: PROPOSED AMENDMENTS TO THE BUILDING CODE ENTITLED: "DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS"

The Consulting Engineers Council of Minnesota wishes to again thank the Building Code Division for giving it an opportunity to express its opinions relative to the provisions of the proposed amendments to the Minnesota Building Code entitled: "DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS".

CEC's comments and recommendations are summarized in the document submitted at the public hearing on May 6.

The purpose of this letter is to offer CEC's comments relative to certain suggestions that were made at the public hearing and certain other matters that came to our attention subsequent to the public hearing. Our comments follow:

1. Re Section 2, paragraph 2.0: Perhaps the objections raised at the hearing could be overcome without loss of the intent of the paragraph if the words "will generally show" are replaced by the words "may show".

2. Re Section 2, paragraph 2.1: CEC believes that vacation homes used for summer occupancy should be excluded from the provisions of the code, as indicated in the original draft.

3. Re Section 5, paragraph 5.3.2.2: CEC believes it would be prudent to delete the reference to indoor relative humidity design levels at this time. Although it is recognized that it may be impossible

Member of American Consulting Engineers Council

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to maintain the relative humidity at fifteen percent at design conditions in many buildings without water vapor condensing on cold surfaces, we believe it would be contrary to the interests and well being of the people of Minnesota to require that relative humidity levels be held down to fifteen or twenty percent throughout the winter. CEC suggests that instead of specifying maximum humidity levels, the following be included: "Humidistats should be reset downwards when outdoor temperatures are low to preclude the condensing out of moisture introduced through the expenditure of "new energy". The use of humidistats with means to automatically reset their control points in response to changes in outdoor temperature is encouraged."

We thank you for the courtesies you have extended to CEC, and we wish to express our willingness to assist the Building Code Division in any way we can.

Yours very truly,

CONSULTING ENGINEERS COUNCIL OF MINNESOTA

Joseph H Mindrum

Joseph H. Mindrum, P.E.
Chairman, Energy Committee

CORPORATE HEADQUARTERS
8100 34TH AVENUE SOUTH, MINNEAPOLIS, MINNESOTA
MAILING ADDRESS • BOX O, MINNEAPOLIS, MINNESOTA 55440

CONTROL DATA
CORPORATION

27 May 1975

Mr. Meyer
Building Code Division
State of Minnesota
408 Metro Square Building
St. Paul, Minnesota 55101

Dear Mr. Meyer:

Per our telephone conversation of 22 May 1975, I request your consideration of the following addition to your proposed document titled "Design and Evaluation Criteria for Energey Conservation in New Buildings".

Section 1
SBC6003 Purpose
Paragraph 1.1, add the following to the end of the existing paragraph:

"and the conservation or reuse of energy from potential internal loads such as computer systems, etc."

The above would hopefully create awareness on the part of designers to incorporate recovery techniques into their systems.

Yours truly,

CONTROL DATA CORPORATION

N. W. Paurus, General Manager
Engineering & Architectural Services

NWP/lm

cc: J. F. Liska
F. E. Winker



MITTA

612/546-8911

Cornell Corporation

1330 JERSEY AVENUE SOUTH
MINNEAPOLIS, MINNESOTA 55426

April 29, 1975

Mr. Richard Brubaker
Comission of Administration
State of Minnesota
St. Paul, Minnesota

Dear Mr. Brubaker:

We are very much interested in the requirements for a .10 "U" factor in the proposed changes in the legislation for Energy Conservation Standards. We are very much in favor of this proposed legislation and we plan to be at the May 6th meeting at the Blooming, Minnesota Howard Johnson Motel to voice our opinion and our support.

Thank you very much for your attention to this matter.

Sincerely yours,

CORNELL CORPORATION

H. L. Dahlen

H. L. Dahlen,
President

HLD/k

Architects/Engineers/Planners
One Appletree Square
Bloomington, Minnesota 55420
Telex 290-814 Tel. 612/853-2000

Ellerbe®

May 12, 1975

Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Dear Mr. Meyer:

Proposed Rules & Regulations
Building Code Division
Design & Evaluation Criteria For
Energy Conservation In New Buildings

In accordance with the Notice of Hearing dated March 13, 1975 for the referenced proposal, we are herewith submitting 3 copies of comments which we hope you will find constructive and useful.

Ellerbe Architects-Engineers-Planners has been involved in design of buildings for over 50 years. We are very much aware of the limitations of fossil fuels available. Our concern is that these fuels be used wisely. Designing buildings for energy conservation is our goal and obligation to this and future generations.

Our comments made by design professionals of all disciplines are objective in nature. They are made to improve and clarify the proposed rules and regulations. We trust you will give them favorable consideration.

Sincerely,

Roger Sauterman

ELLERBE ARCHITECTS, INC.

RS/rh



COMMENTS ON

PROPOSED RULES & REGULATIONS

BUILDING CODE DIVISION

DEPARTMENT OF ADMINISTRATION

STATE OF MINNESOTA

RELATING TO:

DESIGN & EVALUATION CRITERIA FOR ENERGY CONSERVATION

IN NEW BUILDINGS

DATED 3-17-75

SUBMITTED BY
ELLERBE ARCHITECTS/ENGINEERS/PLANNERS
ONE APPLETREE SQUARE
BLOOMINGTON, MINNESOTA 55420

SBC 6001 Authorization

This paragraph refers to Laws of 1974, Chapter 307 regarding energy conservation standards for design, evaluation, construction or reconstruction of all new buildings and remodeling undertaken after effective date of these Rules.

Under Section 1 - SBC 6003 Purpose - 1.0 reference is made only to new buildings.

Do these Rules apply only to new buildings?

Clarification that these rules and regulations apply only to new buildings and new additions will reduce or eliminate individual interpretations that remodeling is also included. Please note that SBC 6001 Authorization includes both new and remodeled buildings.

Section 3 - Definitions

To further clarify the intent and minimize differences in interpretation we suggest definitions of the following:

Total System Heating Capacity
Total System Cooling Capacity
Transparent Window Area
Should
Shall

Justification will be stated in the particular paragraphs in which these phrases or words occur.

Section 4 - Exterior Envelope

4.1 General

4.1.1 Site and Shape Analysis

Site and Shape Analysis should be made for buildings using design criteria 4.2 through 4.5 as well as for alternative approaches.

Section 4.2 Heating Design

Include or add to "Heating Design" the necessary requirements for cantilevered floor slabs over exterior unheated space.

Section 4.3.3 Fenestration

Define "Transparent Window Area"

An interpretation from Webster's Dictionary would include tinted and reflective glass which is not the intent as used in this section.

Section 4.5 Condensation Control

4.5.2 Thermal Breaks

All window, door, ceiling, roof, floor and wall construction shall contain thermal breaks to prevent excessive heat transmission.

Revision to read -

All window framing, door frames, ceiling, roof, floor and wall construction shall contain thermal breaks (frost stops) to prevent excessive heat transmission loss.

Section 5 - Heating, Ventilating & Air Conditioning (HVAC) Systems

5.4.2 Humidity Control

List exceptions for process or research application for use of new energy to reduce relative humidity below 55%.

Exceptions are listed for exceeding winter relative humidity for process applications. Many research and process applications require relative humidity less than 55%.

5.5.4 Reheat Systems

Reheat is defined as "Sensible heat added to condition a zone to overcome cooling produced by expenditure of energy within the HVAC system serving that zone."

5.5.4.1 New Energy

Under this subparagraph reheat using new energy is limited to 15% of the total system cooling capacity.

What is the definition of Total System Cooling Capacity? Is it the total of all systems within the building?

We recommend the Total System Cooling Capacity be defined as the total of all systems within the building. This would allow an entire system to use reheat so long as its capacity was less than 15% of the total building cooling capacity.

5.5.6 Recooling Systems

Under this subparagraph recooling using new energy is limited to 15% of the total system cooling capacity.

What is the definition of total system heating capacity?

We recommend the total system heating capacity be defined as the total of all air system heating capacities (measured above 63°F.) within the building.

5.5.9 Energy Recovery

We quote a portion of the first sentence of this paragraph: "Each exhaust-makeup system having a total outdoor air capacity of more than 4000 cfm should employ energy recovery equipment. The word should also appears elsewhere in this and other paragraphs.

At the hearing on 5-6-75 a member of the panel answered a question about the use of the word should implying that it is used where a requirement is not mandatory.

According to Webster, should is the past tense of shall which implies mandatory compliance where it is used.

We can foresee the word should being widely interpreted - some as implying compliance without exception - some as an option.

We believe definition of the words should and shall to reflect the intent of the committee is essential to avoid misinterpretation and delays.

5.9.3 Change to read:

Uninsulated ducts in uninsulated sections of exterior walls, except outside air and exhaust air ducts, are unacceptable and will not meet the requirements of this standard.

Section 8

8.4 Voltage Drop

We recommend a revision to include the new and latest Ansi Standard ANSI-CI-1975 and National Electrical Code (NFPA-70-1975).

8.5 Lighting Switching

"Switching shall be provided for each circuit, or for portions of each circuit, so that partial lighting required

for custodial or for effective complimentary use with natural lighting may be operated selectively. Switching by means of panel switches or circuit breakers shall not be acceptable".

8.6 Energy Use Determination:

This paragraph concerns us in regard to the benefits from this requirement. As a case in point: If this requirement was in force when the IDS building was designed it would have increased the amount of materials used in the building considerably. This design requirement would be such that each branch circuit can be readily transferred from one metering panel to any other metering panel. Any tenant that increased his rented space in the building would entail the expense of rewiring all existing branch circuits in the new space from the existing meter and panel to his metering panel. If all the metering was located at one location in the building such as the basement, this would necessitate an exorbitant amount of material and labor which in turn requires additional energy to produce this material.

Incidentally, this requirement was originally proposed in the Federal Energy Conservation Guidelines developed by the National Standards Bureau and were eliminated in the final draft.

Section 9 - Lighting Systems

9.2.2 General Lighting:

Substitute the word "illumination" in lieu of brightness. Brightness is a term normally used to describe glare and not intensity.

9.2.2 General Lighting:

In researching this requirement, it appears to us that further definition of task location is required. If task location in a general office as limited to a desk area, it would be impossible to reduce the lighting to the level of 1/3 of the task level and use ceiling lighting for task illumination.

Section 10

10.0 Energy Source and Cost Calculations

This section deals with energy use, source and cost calculations. Much of the input is judgemental in nature and will affect the final answers materially. It is reasonable

to assume that ten persons would get ten different answers for a similar project.

Obtaining Effect Heat Rates for Off-Site Energy Refinement Processes will not only be difficult to obtain but time consuming as well. If an average is obtained as outlined in 10.1.3.2 the final result is once again affected by estimated input.

The actual consumption of energy is greatly affected by the building operators, degree day variations, wind and building usage which may change over a ten year period.

To expect the actual energy consumption to equal the estimated consumption one must believe in miracles.

If this section has a place in the proposed rules and regulations, which we doubt, it belongs under Section 11.

We believe obtaining energy consumption of buildings is best done by metering by a separate agency designated to gather historical data in this area.

JP/jac

Empirehouse, Inc.

Architectural Building Products

1055 North Fifth Street

Minneapolis, Minn. 55411

(612) 338-5877

EMPIREHOUSE, INC. WINDOWS DOORS ENTRANCES GLASS MIRRORS

May 14, 1975

MR. HERBERT MEYER
Director of Building Code Division
408 Metro Square Building
Saint Paul, Minnesota 55101

RE: Design and Evaluation Criteria for Energy Conservation in New Buildings, State of Minn., Dept. of Admn., Bldg. Code Division, March 17, 1975

Dear Mr. Meyer:

The intent of the people writing these amendments certainly cannot be questioned, because all of us must be concerned with energy conservation. It is merely in the approach that we differ.

These amendments, as written, would bring utter chaos to many, many businesses, including our own.

The building business is a complicated business, and when one tries to legislate across the board such a diverse business as this - housing, office buildings, apartments, nursing homes, warehouses, shopping centers, farms, hospitals, etc., one cannot help but be in trouble; as each category is a separate study in itself.

Specifically, I take issue with Section 4.5.2. under condensation, bottom of page 11, that all windows, doors, must have a vinyl break.

FIRST, THE DOOR: COMMERCIAL ALUMINUM DOOR (STORE FRONTS)
There is no way to have a true vinyl break without weakening the product, and increasing the cost. The door as it is presently designed, has evolved because of the need for easy, maintenance-free ingress and egress. These doors are made from aluminum because they are light-weight, strong and will not warp or twist out of shape. The reason that our industry was born and has flourished was because it furnished a trouble-free, light-weight secure door that is weatherstripped. Remember, a door is for ingress and egress, and in commercial applications, is normally in use; so tightness in important, but <u>not</u> the most important characteristic. The only door that would qualify at the present time, as I read it, is a wood door, that does <u>rot</u>, <u>warp</u> and <u>twist</u> after a few months under heavy usage, completely defeating the intent of the proposed amendment: The conservation of energy.

May 14, 1975

con't from page 1

SECOND, THE WINDOW.
Under Section 4.5, Condensation Control, we are referring specifically to 4.5.2. - Thermal-Breaks. We should not legislate condensation control. It has no bearing on energy conservation when we are talking about windows, because so little material is used in the sash and frame members. In Section 4.4, the State has already set-up standards the industry must meet. We must not legislate how a manufacturer meets these standards, because it hampers creative design. Therefore, I respectfully submit that in Section 4.5.2., bottom of page 11, the words, WINDOWS AND DOORS be deleted.

IN CONCLUSION: We have too many workers out of work at the present time, in the building industry. Let us not throw more of these people out of work with hastily written legislation, that will create turmoil before it is amended to a workable piece of legislation.

If you are in accordance with our proposals on this legislation, please take immediate action and contact Commissioner Richard Brubacker, Department of Administration, Building Code Division.

Cordially,

John M. Griffith
EMPIREHOUSE, INC.

JMG/asg

FLAT GLASS MARKETING ASSOCIATION
The Association of Professional Glass Distributors

White Lakes Professional Building,
3310 Harrison,
Topeka, Kansas 66611
Phone 913-266-7013

May 22, 1975

Mr. Herbert W. Meyer, Director
Building Code Division
Department of Administration
408 Metro Square Building
St. Paul, Minnesota 55101

Dear Mr. Meyer:

After a careful review of the Design and Evaluation Criteria for energy conservation in new buildings being proposed by the State of Minnesota, one must conclude that the citizens of your state are being unjustly penalized in the name of energy conservation. Your proposed standard will have the practical effect of reducing the vision area in all new construction without any clear indication that such prescriptive limitations are necessary.

Since vision areas consume 9% of the total energy consumed by commercial buildings, and artificial lighting consumes 50%; attempts to reduce the use of glass only compounds the problem. I sincerely hope that you will objectively review the attached material before finalizing the proposed standard. The "Glass Is Not Just Glass" brochure is a very concise and easily understandable explanation of how glass is meeting the country's energy needs; but the technical report prepared by Dr. Samuel Berman is an unbiased evaluation of the performance characteristics of glass.

If you have any questions, or would like to discuss the attached, please call me collect at the above number.

Sincerely yours,

Wm. J. Birch
Executive Vice President

RECEIVED
MAY 27 1975
BUILDING CODE

WJB:jp

cc: R. C. Heymann
Jim Tegan

Encl: Berman Report
LOF brochure

Attachments in hang file

Foss Engelstad Foss | Architects Engineers | 28 North Third Street | Box 306 | Moorhead Minn 56560 | 218 236-1202

May 2, 1975

Mr. John Weidt
Minnesota Society of Architects
Suite 100
Northwestern National Bank Building
St. Paul, Minnesota 55101

Re: Comments on Proposed Energy Conservation Law

Dear Mr. Weidt:

We are concerned with a potential problem caused by the requirement for more insulation on roofs. We do not disagree with the additional insulation, but are concerned with how it will effect the fire rating of a roof assembly.

In the U.L. handbook, fire ratings in some cases restrict the thickness of insulation that can be used. It appears that the new Energy Code could eliminate the use of some standard economical roof systems such as steel deck over steel joists.

Our question is, would the Minnesota Codes Department and insurance companies make special allowances so that more insulation can be added without losing the fire rating and low cost advantages of commonly used roof system.

As we are all aware, our major problem is the rising cost of construction and the increasing difficulty of clients to obtain financing.

Sincerely,

Foss, Engelstad & Foss

By Willis Stelter

Willis Stelter

WS/gm

cc: Herb Meyer

IDS
PROPERTIES, INC.
IDS TOWER
MINNEAPOLIS, MINN. 55402
PHONE: (612) 372-2500

EXECUTIVE OFFICE

May 12, 1975

Mr. Herbert W. Meyer
State Building Inspector's
408 Metro Square Building
St. Paul, Minnesota 55101

SUBJECT: Design and Evaluation Criteria for Energy Conservation in New Building

Dear Mr. Meyer:

I regret that I was unable to remain for the entire hearing on the subject State Code on May 6 as I would have liked to have heard the entire testimony of interested individuals with regard to the code.

It is my opinion that the code itself is well written and reflects a lot of time and thought by your people and other interested groups.

I would like to make two recommendations as to changes which are in clarification only and will not change the contents of the code itself. The first one is on Page 10, Paragraph 4.3.3 under the subject of FENESTRATIONS. This paragraph requires that the maximum instantaneous combined solar and air to air heat transmission of each window at design conditions shall not exceed 100 BTU per hour per square foot. It is my opinion that you could interpret the design conditions being the time of day at which the load is calculated. Thus, a building with a major exposure to the west would probably be designed at 4 o'clock in the afternoon at which time solar load would be in excess of 100 BTU per hour per square foot on the west exposure. However, the northeast and south exposures would all have solar loads on the glass of considerably less than 100. Therefore, the only windows that would need any special treatment would be the west exposure. Is this the intent of the paragraph?

Perhaps the paragraph could be rewritten so that the average instantaneous combined solar and air to air heat transmission for the design conditions for all glass should not exceed 100 BTU per hour per square foot and could utilize a similar equation to that of 4-1 for averaging this condition. I believe this paragraph needs some more thought and more clarification.

On Page 18, Paragraph 5.5.9 - ENERGY RECOVERY, requires that each exhaust make up system having a total outdoor air capacity of more than 4,000 cfm should employ energy recovery equipment. Does this leave the option to the designing engineer as to whether or not he wants to employ this equipment? If this is the case, then I have no objection to the paragraph. However, if it really is a mandatory requirement, then I think the paragraph should be qualified such that when cooling with outdoor air as stated in Paragraph 5.6 of the same page, no heat recovery equipment should be required. Obviously if you are using outdoor air for cooling, there is no way you can use the exhaust heat unless your minimum ventilation requirements demand preheating of the outside air.

I would be happy to discuss this with you or Sam Stewart at your convenience, or to submit suggested rewording of these paragraphs after the intent of the paragraphs are clarified.

Very truly yours,

IDS PROPERTIES, INC.

G. Clinton Hedsten

G. Clinton Hedsten
Staff Engineer

GCH/jk

cc; K. A. Linwick
A. W. Liefert

Stran®
The other way to build

MATTSON
BUILDING AND SUPPLY CO., INC.

METAL BUILDING DEALERS ASSOCIATION

COKATO, MINNESOTA
PHONE 612/286-2151 55321

May 20, 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Department of Administration
Building Code Division
408 - Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Re: Design and Evaluation Criteria for Energy Conservation in New Buildings

Dear Mr. Brubacher:

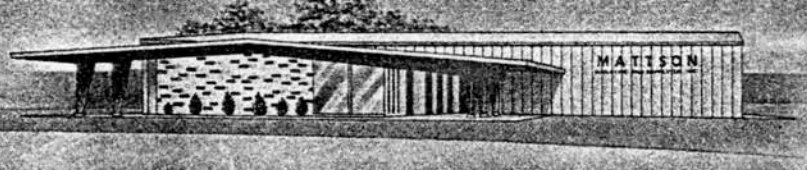
First of all we'd like to say that we wholeheartedly agree with the "NEED" for "Energy Conservation", especially here in Minnesota with our extreme climates and with the end in sight, very shortly, of Energy fuels from Canada. We also would truly like to commend the Energy Committee for the fine job they did, with the little time they had to do it in. We would like to comment on some of the items discussed at the May 6, 1975 Hearing and on some of the items in the Proposed Regulations.

Some of the people who testified at the Hearing seemed to be losing sight of what must be accomplished, which is, of course, that we MUST CONSERVE ENERGY, even if we do create higher costs (this can and will be argued later on in this letter) and somewhat less of the non-essentials used in construction, such as glazing and other high "U" factor type construction materials, which we totally agree are nice to have, but are not necessities. It's entirely possible that if the quantity of these non-essentials are cut down on, we would all spend more time out of doors and be healthier, rather than "watching" the out of doors through oversized windows from our easy chairs in overconditioned homes, offices and factories. If we don't do everything possible to conserve energy NOW, we won't have any need for our protective structures because there will be no way to condition or power them! Therefore, it is our responsibility now to conserve energy and, if not for us, definitely for our Children and our Children's Children! We feel that you, who must make this important decision, should not be pressured by any special interest groups, but instead do only what your conscience dictates. Please, DON'T lose sight of what must be accomplished!

We feel that, if you do anything at all to change the proposed ENERGY CODE, it should be more, rather than less, stringent! We know that our Children and our Grandchildren will never be able to enjoy the quality of life that we have had (and most probably never appreciated) but we can do our part now to make sure that they can, at least, have the necessary essentials so very vital to life. We leave it in your able hands and we truly do trust your judgement.

Now, our comments on the PROPOSED RULES AND REGULATIONS FOR ENERGY CONSERVATION.

We know these proposals are for new construction, but we must also look into codes for existing buildings. This is where our energy is now wasted and will continue to be



wasted. And remember, it's entirely possible that some unscrupulous individuals could build a COLD storage warehouse today and six months from now could convert it into a factory and then not have to comply with a code. We feel that any summer homes, unheated warehouses, etc., constructed after this code goes into effect should, if at any time in the future convert to heated structures, at the time of remodeling, have to comply with this code.

Since the Energy Conservation Code would be administered under the State Building Code, another problem is created. As we all know, many of our Municipalities DO NOT have any code and therefore do not have to comply with the State Building Code. Therefore Energy Conservation would not be practiced throughout the State which make it very inequitable. And couldn't it possibly tempt many of our Industries to move to a non-code area of our State, especially those considering new construction? We feel the entire State should be subject to this code as well as to the remainder of the State Building Code!

At this point, a question comes to mind. Which buildings will this code affect? Those that are under construction when the code goes into effect or those whose contracts are signed after the code is in effect?

Page 8: 4.2.1 - We wholeheartedly agree with the 0.10 Btu/hr./sq. ft./degree F., but if any changes are to be made, they should be more, rather than less, stringent. The roof area is the simplest and most economical area to insulate a structure properly.

Page 9: 4.2.2 - We totally agree with the 0/10 Btu/hr./sq. ft./degree F. Again, we definitely feel that if there is any decision to change this, it should be more stringent. We feel, to be totally energy conscious, the 0.17 Btu/hr./sq. ft./degree F. should apply to all buildings, not just the one and two family residences. Proper insulation is not that expensive that it would greatly increase the price of construction.

Page 10: 4.2.6 - We feel the sentence that reads: "The areas of foundation walls below grade and enclosing a heated space shall have a thermal resistance not less than 50 percent of the thermal resistance of the opaque wall area above grade.", should be changed to read: "The areas of foundation walls below grade and enclosing a heated space shall have a thermal resistance not less than 50 percent of the allowable thermal resistance of the opaque wall area above grade."

Note: We also feel the word "heated" should be changed to "conditioned" so it would apply to any area whether just air-conditioned or just heated, etc.

SECTION 10. 10.1, Page 33. - We feel this will probably be a real problem area because most, if any, energy suppliers will not or cannot supply this information and they, normally, are the most qualified to perform these calculations!

For many years, we have believed in the true value of insulating properly. We can submit a list of over 200 buildings we have insulated to thermal resistant values much greater than listed in the proposed code. We're sure that all of these Owners could attest to the economies of proper insulation. We're also sure that you'd find that the costs of these buildings are very reasonable. We submit the following example to show why, as we stated previously, we don't feel that excessive higher costs are created by insulating properly.

In 1973, we completed a building, as described below and in the attached literature, for Henry's Candy Company, in Morris, Mn. For your reference, we selected this particular building for our advertising brochures prior to having any knowledge of their heating costs. We selected it solely because the building is attractive and contains many of the items we use in our construction. During the time we were preparing our advertising literature, the Owner was compiling his natural gas bills to give us the total heating cost, which by the way, even includes his gas hot water heater. The total cost (see attached) to heat this facility through the dates shown on the attached, including his water heating was $846.32. If you check, you'll find that this is extremely good for over 17,000 sq. ft. of single story construction. This building is also located out in the open with virtually no protection provided at all from other buildings, trees, etc. We know many of our buildings would show better energy conservation even than this one, but this is the only one which we have figures at hand on, at this writing.

BASIC BUILDING SPECIFICATIONS

Total Square Footage - 17,180 sf - Single Story
Total Cubic Footage - 255,894 cf
Heated Office and Showroom Portion - 5,180 sf.
Heated, Working, Warehouse - 12,000 sf (60° - 65°)
S. F. of Roof Area - 17,180
SF of Wall Area (exterior) - 7,593, which breaks down thus:
- Opaque Wall - 6,658 s.f.
- Overhead Doors - 644 sf
- Walk Doors - 63 sf
- 8" poured concrete - 20 sf at lowered dock area.
- Thermopane Glazing - 208 sf

Total lineal feet of the building perimeter - 588'

The approximate "U" values of the above are:
- Roof - 0.035
- Opaque Walls - 0.06
- Overhead Doors - 1.00
- Thermopane Glazing - 0.50
- Walk Doors - 1.00

To give you an indication that insulating a building properly does not cost a great deal, we offer the following:

> This total, turn-key, building project, in 1973, including building, plumbing, heating, air conditioning, blacktopping, site preparation, sodding, parking lot lines, electrical, brickwork, all interior decorating, ventilation and Architectural fees did not exceed $11.00 per square foot. And, as an added note, the cost of the insulation installed amounted to approximately four percent of the total cost.

Again, we could have selected any of the number of buildings we have constructed over the past 10 to 12 years, and we feel confident that each would have given us the same answer, but as we stated previously, this is the building we have the most complete details on, at this writing.

As further evidence to substantiate our statement included herein, we would like to submit the following cost calculations to show the minimal cost of insulating properly.

Consider an opaque concrete wall where you might add 2" of "Dow" Styrofoam and sheetrock, adding to the Construction Cost approximately $1.20 per sq. ft. of wall area and 2" of "Dow" Styrofoam to a built-up roof system, adding approximately $0.60 per sq. ft. of roof area to the cost.

Analysis - First Building - A 200' square x 100' (10-story) high rise office building.

Approximate cost at $20.00 per sq. ft. per story = $8,000,000.00
Add $1.20 per sq. ft. of wall area = 200 x 4 x 100 = 80,000 x $1.20 = $96,000.00
Add $0.60 per sq. ft. of roof area = 200 x 200 = 40,000 x $0.60 = $24,000.00
Total added cost of construction = $120,000.00, which is 1.5% of the initial cost.
The additional cost per year using a 10% interest rate with a 25 year payback = $13,220./yr.
The savings in fuel costs (today), using natural gas, for a 0.17 "U" as opposed to a 0.26 "U" on the walls and a 0.10 "U" on the roof as opposed to a 0.26 "U", on heating only, would be:

(80,000 sf [wall area] x 24 [hrs/day] x .09 ["U" value differential] x 7,850 [Avg. degree days]) + (40,000 sf [roof area] x 24 [hrs/day] x .16 ["U" value differential] x 7,850 [Avg. degree days]) = 2,562,240,000 BTU's.
Using natural gas, based on 70% efficiency, this amounts to 2,562,240,000 Btu's divided by 1,000 btu's/cu.ft. x .70 = 3,660,342 ADDITIONAL c.u. ft. of Natural Gas for heating only. Converting this to dollars at 15.5¢/c.c.f. = (3,660,342 cf ÷ 100) x .155 = $5,673.00 per year additional cost. Therefore the additional cost per year to insulate properly, considering heat only, would be: $13,220.00 less 5,673.00 = $7,547.00 at today's fuel prices. How many dollars would be saved on air conditioning? The yearly payment on an $8,000,000.00 project at 10% interest over 25 years would be $872,376.00. If we divide the additional cost above, $7,547.00 by the $872,376.00, we find that the additional cost per year would be less than 9/10 of 1%. Far more important, however, is the savings of more than Three and One Half Million Cu. Ft. of Natural Gas per year.

Analysis - Second Building - A 200' sq. x 12' (single story) high office building.

Approximate cost at $20.00 per sq. ft. = $800,000.00.
Add $1.20 per sq. ft. of wall area = 200 x 4 x 12 = 9,600 sf x $1.20 = $11,520.00
Add $0.60 per sq. ft. of roof area = 200 x 200 = 40,000 sf x $0.60 = $24,000.00
Total added cost of construction = $35,520.00, which is 4.4% of the initial cost.
The added cost per year using a 10% interest rate with a 25 year payback = $3,874.00
The savings in fuel costs (today), using natural gas, for a 0.17 "U" as opposed to a 0.26 "U" on the walls and a 0.10 "U" on the roof as opposed to a 0.26 "U", on heating only, would be:
(9,600 sf [wall area] x 24 [hrs/day] x .09 ["U" value differential] x 7,850 [Avg. degree days]) + (40,000 sf [roof area] x 24 [hrs/day] x .16 ["U" value differential] x 7,850 [Avg. degree day]) = 1,368,537,600 Btu's.
Using natural gas, based on 60% efficiency, this amounts to 1,368.537,600 btu's divided by 1,000 btu's/cu.ft. x .70 = 1,955,054 ADDITIONAL cu. ft. of natural gas for heating only. Converting this to dollars at 15.5¢/c.c.f. = (1,955,054 cf ÷ 100) x .155 = $3,030.00 per year additional cost. Therefore the additional cost per year to insulate properly, considering heat only, would be: $3,874.00 less $3,030.00 = $844.00 at today's fuel prices. Again, how many dollars would be saved on air conditioning? The yearly payment on an $800,000.00 project at 10% interest over 25 years would be $87,238.00. If we divide the additional cost above, $844.00 by the $87,238.00, we find that the additional

cost per year would be less than 1%. Again, far more important is the savings of just under Two Million Cu. Ft. of natural gas per year!

We offer these comparisons for you to consider when setting up the final Energy Conserving Insulation standard. The comparisons are based on masonry construction and may not be even that expensive. If we consider other types of construction such as wood or pre-engineered steel, the additional cost to use Energy Conserving Insulation would be negligible.

The most important thing we must consider is; can we afford to spend less than one percent more for our construction to save Three and One Half Million cubic feet of Natural Gas per year? And then, let's multiply the savings in one building by 100 buildings or even 1,000 buildings. How many cubic feet of natural gas are we saving then? We know there will be many, many buildings constructed using this new energy code. Can we afford NOT to pay the additional one percent?

We appreciate the time you've taken to read this and we know you'll use your very best judgement when arriving at a final Energy Conservation decision, because this decision will have a tremendous affect on all future generations.

Yours very truly,

MATTSON BUILDING & SUPPLY CO., INC.

Kale W. Danberg

Kale W. Danberg
President

KWD;cm

Enclosure

cc: Mr. Herb Meyers, State Building Inspector
Energy Conservation Committee Members
Energy Conservation Hearing Members

METAL BUILDING DEALERS ASSOCIATION
Northland Chapter

(507) 288-9397 117 NORTH BROADWAY ROCHESTER, MINNESOTA 55901

May 26, 1975



Mr. Herbert Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Proposed Energy Conservation Standards

Dear Mr. Meyer:

Regarding testomony given on May 6, 1975, on behalf of the proposed standards for energy conservation, the Northland Chapter of MBDA, consisting of North Dakota, South Dakota, and Minnesota dealers, (see enclosed list), who have put into place approximately 100 million dollars of commercial, industrial, and institutional construction in 1974 in the state of Minnesota, supports the following items:

1. The roof value should not be less than .10 BTU/Hr./sq.ft./Degrees F, but should be considered a minimum.

2. The value for opaque walls should not be less than .10 BTU/Hr./sq.ft./Degrees F, or less than .17 for the total wall envelope. To lower this requirement would increase the overall "U" factor in the building envelope. If the "U" factor in the roof is lowered, this would lower the roof life for a build-up roof as applied presently. (See enclosure).

3. Cost factors to attain the roof and wall "U" values as proposed are minimal compared to the energy savings attained. Our industry is presently constructing facilities with a wall "U" value of .05 and roof "U" value of .04. Needless to say, this results in a tremendous energy savings to the customer, and, therby, reduces his overall operating costs. (See enclosed Armco Steel Corp. cost analysis booklet as to the cost savings achieved by proper insulation and the methods used in our industry).

4. To achieve the roof "U" value of .04, the cost of construction increased approximately $ .50/sq.ft. of floor area. Including the added cost of wall insulation to achieve the "U" factor of .06, a pay back period of approximately 2 years is required to offset the additional construction cost. After this period, the net annual savings in energy cost results in increased profits for the customer and a lesser burden on our total energy requirement. (See enclosed Armco booklet for example).

See hearing file for attachments

OFFICERS

Karl Schuller, President, Rochester, Minn.
Kenneth Palmer, Vice President, Sioux Falls, S. Dak.
Lowell Christianson, Secretary, Minneapolis, Minn.
Larry Fischer, Treasurer, Minneapolis, Minn.

DIRECTORS

Kale Danberg, Cokato, Minn.
Allen Dipple, West Fargo, N. Dak.
Russ Meiland, Jamestown, N. Dak.
James Towey, Rochester, Minn.
Isadore Pitts, Sioux Falls, S. Dak.

METAL BUILDING DEALERS ASSOCIATION
Northland Chapter

(507) 288-9397 117 NORTH BROADWAY ROCHESTER, MINNESOTA 55901

5. Section 10 of proposed standard should be eliminated, since it becomes unnecessary if all other sections have been adhered to. The additional costs related to calculations and enforcement do not warrent this section.

6. In order to achieve the intended energy savings, the standard should apply to all construction in all municipalities in the state of Minnesota. The present state code exempts municipalities that do not have a code, and, therefore, do not have to abide to the state code. This portion of the code must be changed, otherwise a large segment of our state would continue to waste energy.

If I can be of any future assistance or clarify any of the above items, please feel free to contact me at any time.

Very truly yours,

Karl Schuller

Karl Schuller, President
Northland Chapter MBDA

KSchuller/rmq

Enclosures

OFFICERS

Karl Schuller, President, Rochester, Minn.
Kenneth Palmer, Vice President, Sioux Falls, S. Dak.
Lowell Christianson, Secretary, Minneapolis, Minn.
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Russ Melland, Jamestown, N. Dak.
James Towey, Rochester, Minn.
Isadore Pitts, Sioux Falls, S. Dak.

marathon metallic building company
P. O. BOX 14240 • HOUSTON, TEXAS 77021 • (713) 734-1611

May 2, 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Dept. of Administration
Building Code Division
408 Metro Square Building
Saint Paul, Minnesota

Dear Mr. Brubacher:

I would like to register full support to the proposed changes in the Minnesota State Building Code that will require greater thermal efficiency of ALL NEW CONSTRUCTION than has been allowable to date! May I also suggest that no less efficient standard than that proposed in paragraph 4.2.1 and 4.2.2 of this proposed change be accepted. May I point out that Minnesota will not be the first to require better use of critical and expensive fuels through this requirement of a very minimum thermal efficiency and may I commend you and your department in every effort you make to see that this is accomplished at the very earliest date.

The proposed change is very specific and understandable and in my estimation does not require the interpretation of a professional registered engineer or architect as is requested inparagraph 10.1. referring to energy use calculations.

Thank you sir for your consideration.

Yours truly,

Norman P. Craven
Regional Sales Manager
Marathon Metallic Building Company
res. 10637 Thomas Av. South
Bloomington, Minnesota 55431

Norm O.

MID-CONTINENT
STEEL CORP.

April 29, 1975

Mr. Richard Brubaker
Comissioner of Administration
State of Minnesota
St. Paul, Minnesota

Dear Mr. Brubaker:

I am in receipt of a 37 page description of the Design & Evaluation Criteria for Energy Conservation in New Buildings in Minnesota. We note that you are basically asking for a maximum "U" loss of .10 thru the roofs and .17 thru the walls of new construction. It is my belief this requirement is modest in scope, Mr. Brubaker, and certainly I want you to know that we support your efforts toward this very worthy cause.

If you feel we here at Mid-Continent Steel Corporation can be of any further assistance, please do not hesitate to contact us at your convenience.

Very truly yours,

MID-CONTINENT STEEL CORPORATION

R T Fitzgerald

R. T. Fitzgerald,
President

RTF/k

SPECIAL SCHOOL DISTRICT NO. 1

MINNEAPOLIS PUBLIC SCHOOLS

AN EQUAL OPPORTUNITY EMPLOYER

807 N.E. BROADWAY, MINNEAPOLIS, MINNESOTA 55413

May 23, 1975

BUILDING CODE 1975

Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Proposed State Energy Code

Dear Herb:

We have reviewed the proposed code as discussed at the hearing on May 6, 1975. We find that generally we feel it is good and we concur with its recommendations with the following exceptions:

Section 4.2.2 Exposed Exterior Walls

We would like to strike the following words from this section:
"...and foundation walls above grade."

Section 4.2.6 Foundation Walls

We would like to see the thermal resistance of basement walls to be averaged between those portions of walls exposed to outside air and those portions below grade to equal the resistance required in Section 4.2.2

We see that given the conditions as proposed by the code as to require treating a typical masonry or concrete wall with insulation for its portions above grade in order to meet the recommended U Value. This would result in considerable additional expense at a nominal savings in energy for school buildings as they are typically constructed with the majority of their basement walls below grade.

Perhaps I have not adequately explained our position, but I have discussed this matter with Max Oftedal, a member of your committee. I believe Max understands what I am driving at, and hopefully he would concur with my suggestions.

I regret not being able to be present for the hearing on the 15th on the proposed amendments to the State Fire Marshall's Code. Hopefully, I will be able to review the proposal and offer some comments.

Thank you for your consideration.

Yours truly,

James P. Clubb/co

James P. Clubb, Director
School Construction

cc: Max Oftedal

Minnegasco minnesota gas company
733 marquette avenue, minneapolis, minnesota 55402

May 2, 1975



Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

RE: "Design and Evaluation Criteria for Energy Conservation in New Buildings", Dated March 17, 1975

Dear Mr. Meyer:

We offer the following comments regarding the subject "Criteria for Energy Conservation" based on a thorough review by Mr. Spence Young, Utilization Engineer, and Mr. Earl Bartels, Energy Engineer.

It has been a distinct pleasure to work with you and your staff as well as the Minnesota Energy Agency and staff regarding these Code Amendments.

Section 7 Service Water Heating
Par. 7.2 Scope
Sub Par. 7.2.1 The selection of the specific fuel (as with the specific equipment or system) is left to the designer. Fuel availability (both locally and as a national resource) generation, transmission capacity, (add: overall energy conversion) efficiency, and local and national energy policies will require assessment before selection.
We recommend that this significant paragraph be relocated to Section 2 - Scope, since it is applicable to HVAC equipment also.

The addition of Section 10 - Energy Source and Use Calculations, is, we believe, a significant and progressive step in our mutual energy conservation goal. As a result of Par. 10.1.2 - Energy Supply Comparison, each project participant-owner, design professional and finance representative-will have a "prime energy" yardstick with which to compare projects for their energy effectiveness. This section's requirement will also show us the benefit of refining prime energy to only that level at which it can be effectively utilized.

Section 11 - Energy Requirements for Building Designs Based on System Analysis, should provide adequate flexibility, as written, to encourage innovation in design of both the outer shell of the structures as well as their HVAC systems.

While we recognize the need for a prescriptive code at this time, hopefully, the State will continue its efforts toward an energy budget approach to permit further innovation in energy conscious design.

Sincerely,

A. L. Pooler
Vice President
Regulatory Affairs

/ns

MINNESOTA HOUSING INSTITUTE
7801 Metro Parkway, Minneapolis, Minnesota 55420 □ (612) 854-4140

May 23, 1975



Mr. Herbert W. Meyer
Building Code Division
408 Metro Square Building
7th & Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Meyer:

Re: Building Code Hearing - 5/6/75

The following are comments to the proposed amendments which were subject to public hearing on May 6, 1975. We understand that these comments will be incorporated in the hearing record since they were prepared within the 20 day period following the hearing.

I. General

A. Cost comparison study

1. We encourage the division to make the fullest possible use of the cost comparison studies that ASHRAE is developing to compare existing standards and the new criteria.

1. We encourage the state to develop tools for assisting local officials in their interpretation of the criteria, ie, sketches, specific details, field training, alternative designs, etc. The state must also be prepared to administer and to provide methods of analyzing alternative systems, programs to review, accept and/or reject, these systems and a follow-up program to see that they are accepted locally.

II. Page 8, section 4, Exterior Envelope

A. Paragraph 4.1.1, Site and Shape Analysis

It is outside the ability of the residential contractor to incorporate these guidelines in the design process. Most often building sites are predetermined by governmental restrictions. Items such as wind direction and speed, thermal mass, color, shading or reflections from adjacent structures are components

that are byond the control and capability of the residential builder.

B. Heating Design, Paragraph 4.2.1, Ceilings/Roofs

1. The point of .04 BTU/Hr./Sq. Ft./degree F. criteria would require 7" of batted insulation in the attic space. The insulation industry does not provide this size of insulation at this time, 6" is the standard batt dimension. It appears that 6" of batted insulation would produce something less than .04 BTUs per hour. The alternative of blowing fiberglass does not exist in some localities and this criterion would then require 8-10" of batted material and additional expense.

C. Paragraph 4.2.2 Exposed Exterior Walls

One and two family detached dwellings are required to transmit less heat per hour than are multi-family structures .17 and .22 respectively. A definition of townhouses is needed.

A conflict will begin to develop given this criterion between exterior wall ratings and window light and ventilation requirements. The state should be prepared to accept a trade-off, ie, .17 BTU ratings may be possible only by reducing the 10% light and ventilation requirement to say 8%. This kind of flexibility will be necessary and the state should begin to prepare for the eventuality.

D. Page 10, Paragraph 4.2.6, Foundation Walls

The sentence referring to those areas of foundation walls below grade and enclosing a heated space need to be reconsidered. Exposed foundation walls found in split entry and walk-out building types should meet the standard. However, the one or two block exposure found in normal basement conditions should not have to meet the same requirements. The energy savings are negligible, but the cost problems are reasonably severe.

III. Page 10, Paragraph 4.3, Cooling Design

A. Paragraph 4.3.3 Fenestrations

The sentence requiring controlled interior and/or exterior shading devices is both unrealistic and unenforceable. This criterion in so far as residential construction is concerned should be eliminated.

IV. Page 29, Section 8

A. Paragraph 8.6 Energy Use Determination

This section requires in multi-tenant provisions to determine tenant energy consumption. We question the need and the use

for this kind of information. Particularly if the building has been designed to meet the code criterion. Testimony at the public hearing indicated that there is no existing organization that has any use for this information once it is gathered.

V. Page 33, Section 10, Energy Source and Cost Calculations

A. Paragraph 10.1 Energy Use Calculations

This requirement is well beyond the ability and economic framework of the residential builder. It's speculative and subject to occupancy attitude and habit. These are variables of which a residential contractor does not have a firm grasp. We question why this seciongis necessary?

VI. Page 31, Section 11, Energy Requirements for Building Design Based on Systems Analysis

A. Paragraph 11.0, Scope

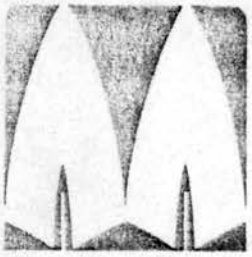
We challenge this section, not on its intent, but on the practical ability of the state and the local officials to provide a system for analyzing new methods, and implementing new methods uniformly across the state. This section is here to encourage innovation. It has been our experience that until a process is designed wherein innovations are reviewed, accepted, rejected, and implemented, that we'll not obtain much value from Section 11.

We hope you and the Standards Committee will give these comments your careful consideration. We will be plased to provide whatever additional information you deem necessary.

Sincerely,

Neill T. Carter
Executive Director

NTC/fm
cc: MHI State Building Code Cmte.



minnesota
masonry
institute

7851 METRO PARKWAY SUITE 103 MINNEAPOLIS, MINNESOTA 55420 PHONE: 612 854-0196

May 14, 1975

Mr. Richard L. Brubacker
Commissioner of Administration
408 Metro Square Building
St. Paul, Minnesota 55101

Gentlemen:

Enclosed you will find three (3) copies of written comments from the Portland Cement Association to support my testimony on May 6, 1975 on Sections 4.2.2. Exposed Exterior Walls and 4.2.6. Foundation Walls.

Other section comments are on Sections 4.2.1. Ceilings/ Roofs, 4.2.5. Slab-on-Grade Floors and 4.5.2. Thermal Breaks.

We wish to introduce these comments as an Exhibit for the record.

Very truly yours,

Thomas F. Richardson

Thomas F. Richardson
Executive Director

TFR:sc
Enclosures

PORTLAND CEMENT ASSOCIATION *inter-office correspondence*

May 6, 1975

R. W. Randall

Minneapolis

This is a confirmation of most of our recent phone conversation about the changes that should be made to "Design and Evaluation Criteria for Energy Conservation in New Buildings."

First, we strongly suggest that the passage of any law be delayed until ASHRAE 90-P is issued and available as an official standard. As presently drafted it rightfully separates one- and two-family dwellings from other buildings. It also recognizes building configuration by setting aside buildings over three stories from buildings three stories and under.

I agree with you, the term watts/s.f. should be omitted from Sec. 2.1. The fourth line of Sec. 2.1 should be changed to, "... energy usage for heating or cooling is less than 7 btu/s.f. of floor area ...." We are advised that California is setting the limit at 10 btu/s.f. (see attached xerox of the California proposed paragraph).

Sec. 4.2.1 Ceilings/Roofs: This looks good as written. The value 0.04 apparently applies primarily to wood framed ceilings or other systems where blanket or loose fill insulation can be economically placed even though it is quite thick. The 0.10 value apparently applies to roof construction where the insulation is a rigid type laid over the roof deck.

Sec. 4.2.2 Exposed Exterior Walls: Omit next to last sentence, "The value for an opaque wall shall not exceed .10 Btu/hr/sq.ft./degrees F." This defeats the concept of U_o. Why does a gross area with no windows have to have a lower heat transmission rate than a gross area with windows? This double standard provision is wrong. You should strongly oppose it.

To conform to 90-P change 0.17 to 0.19 and 0.22 to 0.26. Actually for this last value (0.26) ASHRAE recommends 0.24 for three story or less and 0.28 for over three-stories.

Sec. 4.2.5 Slab-on-Grade Floors: In the second line, the value 0.20 should be changed to -- "6.0 btu/hr/s.f./F for unheated slabs and 8.5 btu/hr/s.f./F for heated slabs." The paragraph is specifying the resistance of the insulation, rather than the U value at the slab edges. Values 6.0 and 8.5 indicate the insulation thickness in your area should be 1-1/2 in. minimum and about 2 in. for heated slabs.

Sec. 4.2.6 Foundation Walls: All of this paragraph should be omitted. If that cannot be done, the last sentence should be omitted because walls below grade do not present a problem and therefore they should not be in the code. Below grade walls have an average resistance of about 7, that is, a U of 0.14. This is sufficiently low, since it is lower than the U_o values called for in Sec. 4.2.2. Furthermore, if the below grade portion is combined with the above grade portion which has a low U value -- the gross U_o of the combined portions is even lower than U_o called for in Sec. 4.2.2.

Another argument against insulating below grade is that it increases the summer cooling load. This is because the benefits of the cool earth are blanked out by the insulation. Still another argument against insulating below grade walls is, what about basement floors? Should they be insulated? Of course not! Then why should the walls below grade be insulated? Some may say that the walls being cool are uncomfortable. They will still be too cool for comfort even if insulated, unless the heat source to heat the space is near the bottom of the wall.

In conclusion, since walls exposed to the outside, including foundation walls, are handled in Sec. 4.2.2 the entire Sec. 4.2.6 should be omitted. It has been omitted from the 90-P draft.

Sec. 4.5.2 Thermal Breaks. We did not talk about this section when you phoned. As the definition of thermal breaks is worded this section could be interpolated to say that balcony slabs or any structural member extending from the warm space to the outside must have "low thermal conductivity," or the member must have a thermal break. This section appears to conflict some with the last sentence of Sec. 4.2.3, Floors Over Heated Spaces.

MJC bgh

MARIO J. CATANI
Building Construction

nj

Copy to - R. K. Schmickle, M. L. Burgener, S. E. Goodwin

Member of 90-P Committee

RECEIVED
MAY 12 1975
NORTH CENTRAL REGION

If the design does not comply explicitly with Divisions 4, 6, 7 and 9, the provisions of Section 6011.3 shall apply, except that the systems defined in Divisions 5 and 8 need not be considered in the analysis.

6012. New nonresidential buildings using non-depleting energy sources shall be designed and constructed in accordance with Division 3 of this standard.

6013. Process Heating or Cooling

6013.1. The provisions of these standards shall not apply to the energy used by processing or manufacturing equipment or appliances that consume energy at a rate in excess of 1/2 watt per square foot of gross floor area of the room housing such equipment or appliances.

6013.2. The provisions of these standards shall not apply to the energy required by make-up air or water systems or product heating or cooling systems as may be required by equipment or appliances in Subsection 6011.1.

The design of make-up air or water systems and product heating or cooling systems shall make use of available energy conservation techniques.

6014. Partially Heated or Cooled Buildings.

6014.1. The provisions of Division 4 of these standards shall not apply to the energy used for heating and cooling when the total output of the heating and cooling system does not exceed 10 BTU per square foot of gross area in a building or building space.

6014.2. Enclosed portions of a building which are heated or cooled, shall comply with the provisions of these standards.

3M COMPANY

GENERAL OFFICES • 3M CENTER • SAINT PAUL, MINNESOTA 55101 • TEL. (612) 733-1110

CENTRAL ENGINEERING DEPARTMENT • 3M COMPANY
P.O. BOX 33331 • 900 BUSH AVENUE • SAINT PAUL, MINNESOTA 55133

Subject: Design and Evaluation Criteria for Energy Conservation in New Buildings

May 22, 1975

Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Dear Sir;

Enclosed are three (3) copies of 3M's statement dated May 22, 1975, with recommendations on changes and additions to the proposed State of Minnesota energy conservation code.

3M was represented at May 6, 1975 hearing, but did not make a statement at that time.

We thank you for your considering these recommendations.

Very truly yours,

R. L. Aspenson
Manager, Mechanical Utilities
and Energy Conservation
Mechanical Engineering

RLA:kp

Encl.



cc: Mr. Richard Brubacher
Commissioner of Administration

Mr. Robert Rogers
Bldg. Code Division, Dept. of Admin.

STATEMENT OF RECOMMENDATIONS

ON

STATE OF MINNESOTA PROPOSED

"DESIGN AND EVALUATION CRITERIA

FOR CONSERVATION IN BUILDINGS"

BY

3M ENGINEERING ENERGY CONSERVATION TASK FORCE

SBC 6002 - Enforcement.

Should be enlarged to include enforcement by technically knowledgeable people.

Section 2 - Scope.

Suggest deletion of last sentence of 2.0 re: Economic Evaluation, etc.

Section 3 - Definitions.

Energy
Energy New - There is redundancy between these two definitions and should be clarified.

Add the definitions for "vapor barrier" and "fenestration".

Section 4.2.1

Change "0.10 Btu/hr/sq. ft./degrees F." to "0.15 Btu/hr/sq. ft./degrees F."
3M cannot justify additional cost of insulation based on operation cost savings.

Change "0.04 Btu/hr/sq. ft./degrees F." to "0.06 Btu/hr/sq. ft./degrees F."
Reason the same as above.

Add "pitched deck without vented space shall also have "U" value of 0.15".

Section 4.2.5

Add "The insulation shall extend 12" below ground line" for industrial type buildings.

Section 4.4.2.1

What are compliance conditions for air leakage for overhead doors and door shrouds?

Section 4.6.1

Substitute "peripheral envelope area" for perimeter.

Section 5.3.2.2

Change "15 perçent" to "20 percent". Add to the paragraph "the exception to above is process operations that require different environmental conditions to maintain product quality."

Section 5.4.2

Change "15 percent" to "20 percent".

Section 5.5.4.1

Delete the second sentence in its entirety.

Section 5.5.9

A $10^{o}F$ temperature difference is not economically feasible. Should be at least $50^{o}F$. $\triangle$ T.

Section 5.6-(a)

Parts (a) and (b) should be clarified. Add "enthalpy control shall be provided on fan systems having a capacity greater than 25,000 CFM."

Section 6.2

Clarify the KW/Ton statement for both January 1, 1977 and January 1, 1980.

Section 7.6.1

Clarify the "m 3/s ($1.9x10^{-4}$)" statement.

Section 8

Paragraph may be appropriate for residential and small commercial buildings; however the last sentence would imply any motor driven equipment rated more than one horsepower would require individual power factor correction devices. This would impose unrealistic conditions which would be nearly impossible to achieve from a technical standpoint. For power factor correction of small individual items of equipment the cost is excessive. This correction could be better accomplished for the total equipment, at the highest voltage level and for the least capital expenditure.

Section 10

Delete in its entirety.

minnesota society of architects
aia
northwestern national bank building
suite 100
st paul, minnesota 55101
(612)-227-0761
executive director daniel j. sheridan

May 27, 1975

State of Minnesota
Department of Administration
Building Code Division
Metro Square Building
St. Paul, Minnesota 55101

Re: Design and Evaluation
Criteria for Conservation
in Buildings - 12/23/74

Gentlemen:

The Minnesota Society of Architects appreciates the opportunity to comment on the proposed "Design and Evaluation Criteria for Energy Conservation in New Buildings", and our suggested revisions to these standards are attached herewith.

We realize that the adoption of these standards for new building design represents an important first step toward the goal of energy conservation. We also strongly urge that your department undertake a similar concentrated effort to adopt standards which can be applied to retro-fitting and to the operation and maintenance of existing buildings.

The Minnesota Society of Architects must re-state its strong support for eventual standards based on criteria of overall energy consumption - the often named "energy budget" concept. We realize that the mechanics for enforcement of this concept are not presently available, and therefore support the standards as a necessary interim measure. It is our belief that, when a workable model regulation of the "budget" type can be presented, you will be favorably disposed towards it adoption.

Thank you for your consideration of our comments. We continue to offer our aid in further considerations of energy conservation in buildings.

For the Energy Conservation and
Building Design Task Force

Minnesota Society of Architects

John Weidt, AIA
Chairman

Page	Section	Comment	Reason for Change
3	1.0	Add to the end of sentence "new and remodeled buildings".	Although we support this code for new buildings we feel it is essential to begin conserving energy now in existing and remodeled buildings. We therefore emphsize the importance or resolving the difficulty of dealing with remodeled buildings under this code or adopt a code for remodeled buildings only.
4	2.1	Delete "vacation homes used for summer occupancy"	Specific exemptions should not be stated.
4	2.1.1	Delete the word 'other' in the first sentence	The word other should be deleted along with specific reference to vacation homes.
4	2.2	Support change suggest by Ashrae	A buildings systems may be on an adjacent or near-by site.
4	2.3		U.L. ratings are currently not available for some insulation thicknesses which may be required under this code.
5	3.0	Solar Energy - An energy product derived from collection of short and long wave radiation emanationg from the sun Wind Energy - An energy product derived from extraction of the kinetic energy available in the wind	These two definitions are required to complete list of major components mentioned in code.
8	4.2.1	Support changes suggested by Ashrae.	
9	4.2.2	We support the concept of specifying minumum values for major building components, but withdraw our suggestion that these be incorporated at this time.	Impact on construction trades and practices must be studied further.

Page	Section	Comment	Reason for Change
10	4.2.5	We support the changes suggested by Ashrae, and additionally suggest that a sentence be added at the end of the paragraph which would duplicate the last sentence of section 4.2.3, "The peripheral edge.....cannot be met."	Certain design solutions may pre-preclude the installation of massive insulation between the wall and slab edge.
10	4.3.1	Support the changes suggested by Ashrae.	
11	4.4.3	Change portion of sentence which reads "... services through walls, floors, and door ..." to read "... services through walls, floors, and roofs ..."	
11	4.5.2	Support changes suggested by Ashrae.	Current door technology does not include thermal break construction.
13	5.0	We support the changes recommended by the Minnesota Chapter of Ashrae with the folowing exception	
19	5.8.1	Provisions of subparagraph C should be retained	
22	6.0	We support the changes recommended by the Minnesota Chapter of Ashrae.	
27	7.0	We support the changes recommended by the Minnesota Chapter of Ashrae.	

Page	Section	Comment	Reason for Change
29	8.0	We support the changes recommended by the Minnesota Chapter of Ashrae.	
30	9.0	We support the changes recommended by the Minnesota Chapter of Ashrae.	
30	10.0	We support the changes recommended by the Minnesota Chapter of Ashrae with the following additions	
		Add the following sentency to 10.1 following sentence 2. "Calculations shall list separately the energy type and source."	Provisions for submittal of actual energy use during building use, although desirable for accumulation of useful, data should not be included in a building code.
35	11.0	We support the changes recommended by the Minnesota Chapter of Ashrae.	
67	12.0	We support the changes recommended by the Minnesota Chapter of Ashrae.	

Minneapolis Chapter
NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION
2101 HENNEPIN AVENUE • ROOM 202 • MINNEAPOLIS, MINNESOTA 55405 • 871-4000

May 23, 1975

Mr. Herbert W. Meyer, State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Disign and Evaluation Criteria
for Energy Conservation in
New Building-Dated March 17, 1975

Dear Mr. Meyer:

The Minneapolis Chapter, NECA recognizes the urgent need for energy conservation in the design and construction of new buildings, and supports the adoption of the referenced document subject to the modifications mentioned in the following.

We have reviewed the exhibit dated May 1, 1975 as submitted by the American Society of Heating, Refrigerating and Air Conditioning Engineers, and are in general agreement with the modifications recommended therein. We specifically urge that the proposed revisions to Sections 8, 9 and 10 be adopted as submitted. We further recommend that Paragraph 8.6 be amended as described in the Consulting Engineers Council of Minnesota letter dated May 5, 1975.

It is our opinion that the above proposed revisions, if adopted, will contribute to creating regulations which will be readily understood by both the Public and the Design Professional; and will achieve the desired objective of conserving energy with a minimum of cost and confusion to all parties concerned.

Very truly yours,

MINNEAPOLIS CHAPTER
N.E.C.A.

J. A. Lang, P.E.
Technical Advisor

JAL-mb

National
Mineral Wool Insulation Association, Inc.

382 Springfield Ave. · Summit, N.J. 07901

STANLEY L. MATTHEWS, President
E. F. CUSICK JR., Vice President
BARTON W. BROMLEY, Treasurer

SHELDON H. CADY, Executive Vice President
M. B. HOLT III, Manager, Technical Services

(201) 277-1550

May 20, 1975



STATE OF MINNESOTA
Department of Administration
Building Code Division
408 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Attention: Mr. Hendrickson

Dear Mr. Hendrickson:

Thank you for sending the copy of Minnesota's new energy standard. I have reviewed it carefully and see that it is obviously based on the March version of Chapter 4 in ASHRAE 90-P. (The April version differs very little -- it was cleared up editorially).

I have a few comments and appreciate the opportunity to submit them.

4.2.1 a) We feel that U_o of 0.08 for roof decks is a better requirement than 0.10 in Minnesota. 90-P requires 0.08. Panel 4 had considerable difficulty in defining "other roofs". You may be interested in the current wording:

> "Roof/ceiling assemblies in which the finished interior surface is essentially the underside of the roof deck, such as a wooden cathedral ceiling, may have a U_a value not to exceed 0.08 etc etc."

b) Your reference to Equation 4.1 as related to Ceilings/Roofs won't work. I am attaching a copy of 90-P's Equation 2 which probably should be the referenced equation in your standard.

4.2.2 Your requirement for a U=0.10 for the opaque wall is insufficient for Minnesota. 0.10 requires an insulation R=7 in a wood frame wall. We strongly recommend that nothing less than R=11 should be required in wall sections which cannot be improved upon later. This would be met by a U=0.07.

continued . . . . .

4.2.3 Treatment of the peripheral edges of floors over heated spaces could be complicated. Since your wall requirements of U_o include the entire gross wall from grade level to top plate, this requirement may not be necessary. Meeting the U_o should permit adequate trade-offs that would compensate for any heat loss through the peripheral edges. 90-P came to this conclusion and eliminated any requirements for Floors Over Heated Spaces.

4.2.5 Is there an error in the requirement of R=.20 for Slab-On-Grade Floors? An R=10.0 is good for perimeter insulation. About the only way to require perimeter insulation is by the resistance value of the insulation, as you have it.

4.2.6 The ASHRAE 90-P group decided not to include a requirement for foundation walls below grade. This decision was based on Canadian research which concluded that the earth was a good insulator below grade. Also, it would be very difficult for the builder to include one thickness of insulation for that portion of the foundation wall above grade and another thickness for that portion below grade. The section as you have written it is conventional but we're not sure anyone really investigated the actual installation.

4.3.3 The paragraph on FENESTRATIONS would be extremely difficult to interpret, particularly for the small builder. Perhaps this should be limited to the high-rise buildings designed by engineers.

4.4.1 I wonder if a requirement controlling air changes, particularly in one and two family dwellings and low-rise apartments is feasible? A limitation on air changes per hour can be required but how can it be enforced? The living habits of the individual homeowners can destroy this requirement. I believe that control of air changes by the requirements in 4.4.2 is about as far as you can go.

4.5.2 A requirement for thermal breaks in ALL construction could result in very expensive construction. Does this mean that a conventional wood stud wall must have thermal breaks? The homebuilder would be in trouble.

I hope these comments have been constructive. If you have any questions, please let me know.

Sincerely,

Sheldon H. Cady

Sheldon H. Cady
Executive Vice President

SHC/o
Attachment

EQUATION 2

$$U_o = \frac{U_{roof} A_{roof} + U_{skylight} A_{skylight}}{A_o}$$

where U_o = the average thermal transmittance of the gross roof/ceiling area, BTU/hr ft^2 F

A_o = the gross area of a roof/ceiling assembly, ft^2 (See 4.2)

U_{roof} = the thermal transmittance of all elements of the opaque roof/ceiling area, BTU/hr. ft^2 F

A_{roof} = opaque roof/ceiling area, $ft.^2$

$U_{skylight}$ = the thermal transmittance of all skylight elements in the roof/ceiling assembly, BTU/hr ft^2 F

$A_{skylight}$ = skylight area, ft^2

Note: Where more than one type of roof/ceiling and/or skylight is used, the U x A term for that exposure shall be expanded into its sub-elements, as: $U_{roof_1} A_{roof_1} + U_{roof_2}, A_{roof_2}$, etc.

JOHN SAHF CONSTRUCTION INC.

Building Contractor: Commercial - Industrial

420 NORTH CEDAR STREET BOX 524

OWATONNA, MINNESOTA 55060

TELEPHONE: AREA CODE 507
451-3370

May 5, 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Minn. Dept. of Administration
Building Code Division
408 Metro Square Building
7th & Robert Streets
St. Paul, Mn. 55101

RE: State of Minnesota hearings Proposal Regulations for Energy Conservation Standards

Dear Sir:

Referring to insulation values in paragraphs 4.2.1 and 4.2.2, I support the .10 BTU per hour per square foot for roof and wall areas and a minimum total envelope value of .17 BTU per hour per square foot.

Referring to paragraph 10.1, I prefer to furnish calculations on building floor area over 20,000 square feet.

We are members of the Metal Building Dealers Association, and hope we can work through their officers to affect a balanced set of regulations.

Sincerely,

John Sahf
President



612/338-8741
1011 Nicollet Mall
Minneapolis, Minnesota 55403

American Institute of Architects

National Society of
Professional Engineers

Setter, Leach & Lindstrom Inc.
Architects and Engineers

May 13, 1975



Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Design and Evaluation Criteria for
Energy Conservation in New Buildings

Dear Mr. Meyer:

The following are comments and proposed revisions suggested by architects, mechanical engineers and electrical engineers of Setter, Leach & Lindstrom, Inc. regarding the Proposed Rules and Regulations of the Building Code Division relating to "Design and Evaluation Criteria for Energy Conservation in New Buildings" in the State of Minnesota:

1. Page 2, SBC 6002, Enforcement

"Building Officials, in the municipality for which they are appointed, shall enforce these Rules."

Comment: We continue to be very concerned about the enforcement of these Rules and Regulations. We all know an excellent code with inconsistent or inadequate enforcement will not provide the intended results. Enforcement is one of the most important factors of this codes success.

It is our opinion that building officials in the great majority of the state municipalities will not be technically qualified to evaluate design criteria for energy conservation in buildings proposed for construction in their areas of the state. It is imperative that the evaluation abilities of these officials be equal and provide uniformity of judgment throughout the state. Therefore, we strongly suggest that enforcement of these Rules and Regulations be a state organization with qualified professionals who can provide the uniformity for evaluation and proper enforcement for energy conservation in new buildings throughout the state.

At the very least, a state organization consisting of qualified professionals should be established to provide the necessary assistance to review and approve new building design criteria.

2. Page 4, Section 4.2.2
We suggest there should be a statement relating to cooling.

3. Page 8, Section 4
This section should include a comment on special areas such as intensive care areas.

4. Page 10, Section 4.2.5, line 2
Change "gloors" to read "floors."

5. Page 11, Section 4.4.3, line 3
Change "doors" to read "roofs"

6. Page 11, Section 4.5.1, line 3
Change "5.1.2.1" to read "5.3.2.2"

7. Page 15, Section 5.4.1, last line
"Paragraph 5.5.8.6" cannot be identified.

8. Page 19, Section 5.7, line 2
Change "colume" to read "volume"

9. Page 24, Section 6.4.3, line 2
"Dynamic" is confusing. Wouldn't "extensive computerized energy analysis" be more appropriate?

10. Page 28, Section 7.6.2, line 2
Omit "push button", too exclusive.

11. Page 32, Section 9.6.1
We suggest that a distinction be made between lighting that is primarily for decorative purposes as opposed to security lighting essential for the protection of life and property.

We hope our efforts and comments have been helpful. If we can be of further assistance, please contact me.

Very truly yours,

Arnold J. Cisewski P.E.
Arnold J. Cisewski, P.E.
Vice President Engineering

srl

SWIFT SYSTEMS CO

STEEL BUILDINGS & DRYING EQUIPMENT

May 2, 1975

Mr. Richard L. Brubacher
Minn. Dept. of Administration
Building Code Division
408 Metro Square Building
7th & Robert Streets
St. Paul, MN 55101

Re: Proposed Rules & Regulations to Provide Energy Conservation Standards.

Dear Mr. Brubacher:

With reference to the proposed standard for energy conservation I would encourage you to maintain the rating of .10 BTU value for roof and wall areas and total envelope value of .17.

Also I would like to have you reconsider the requirement of having an architect or professional engineer calculate the losses for buildings of 5000 sq. ft. or more. I feel this is putting an undue burden on the purchaser of these smaller units. I would suggest the requirement be raised to project of 20,000 sq. ft. or more.

Respectfully,

Donald A. Swift

Donald A. Swift
Swift Systems Co.
Northrop, Minn. 55075

CC: Representative Darrell Petersen
Senator Howard Olson



Strack Construction Company, Inc.

GENERAL CONTRACTORS
ESTABLISHED 1938

NORTH HIGHWAY 10
TELEPHONE 251-5933
ST. CLOUD, MINNESOTA 56301

MAILING ADDRESS
BOX 668

May 2, 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Dept. of Administration
Building Code Division
408 Metro Square Building
7th & Robert Streets
St. Paul, MN 55101

Dear Mr. Brubacher:

We are writing regarding the proposed changes in the State Building Code Rules and Regulations to provide energy conservation standards. A hearing on this matter is going to be held Tuesday, May 6 at the Howard Johnson Motor Lodge in Bloomington. We have just been notified of this meeting and due to a previous commitment will be unable to attend. We are writing however, to express our feelings on these changes.

We strongly support a change making it mandatory that all buildings have a minimum of a .10 BTU/hr/sq.ft/degree F value for the roof and wall area and a minimum total envelope value of .17 BTU hr/sq.ft/degree F. This concerns paragraphs 4.2.1 and 4.2.2.

We also ask for a change in paragraph 10.1 so that a registered professional engineer or architect will not be required for projects under 20,000 sq.ft. of gross floor area to perform the energy use calculations. The present standard states that an architect or engineer is required for all projects larger than 5,000 sq.ft. We feel that this is a discriminatory piece of legislation since there are many people equally qualified who have been in the business many years and are capable of making this determination. The existing law adds to the cost of construction which costs are already high enough. We ask that you consider our above requests when this matter comes to your attention.

Very truly yours,

Don Strack

Don Strack
Strack Construction Company, Inc.

DS/lb

BUILDING CODE

R. E. STOCK, INC.
Franchised Butler Builder

BUTLER

Phone AC 507-388-3614
340 PIERCE AVE.
NO. MANKATO, MINN. 56001
2 May 1975

Mr. Richard L. Brubacher
Commissioner of Administration
Building Code Division
408 Metro Square Building
7th & Robert Streets
St. Paul, MN 55101

Dear Sir:

It has come to my attention that on May 6, 1975 a public hearing will be held on Proposed Rules & Regulations To Provide Energy Conservation Standards in the Building Industry.

I would urge that the .10 BTU/hr/sq.ft/degree F value for the roof and wall area and a minimum total envelope value of .17 BTU/hr/sq.ft/degree F as stated in Paragraphs 4.2.1. in theproposed standard be adopted.

I also strongly feel that a registered professional engineer or architect should not be required for projects less than 30,000 sq. ft. of gross floor area to perform the calculations. These overall heat transmission coefficients should be based upon a guarded Hot Box test facility for measuring heat transfer. This would supply actual performance and not a theoretical performance. The public has been duped for too long a time by these "theoretical performance" figures.

Sincerely yours,

Richard E. Stock



TRUSSBILT, INC.

HOME ADDRESS
2575 COMO AVE.
ST. PAUL, MINN. 55108
612 – 646-7181

CHICAGO OFFICE
P. O. BOX 21
WESTCHESTER, ILL. 60153
312 – 562-0144



May 22, 1975

Building Code Division
Department of Administration
Metro Square Building
7th & Robert Streets
St. Paul, Minesota 55101

Attention: Mr. Herb Meyer

Subject: Design and Evaluation Criteria
for Energy Conservation in New Buildings

Dear Sir:

While attending a meeting of May 6, 1975, the writer approached the committee at approximately 10:30 a.m. and would like to confirm my verbal questions and statements made at the meeting as follows:

My attendance at the May 6, 1975 meeting was to represent Trussbilt, Inc. in my position as Engineering Manager. Trussbilt manufactures hollow metal doors and door frames among other hollow metal and specialized metal formed products for the building industry.

I have registered as a lobbyist in accordance with the rules set forth at that meeting within the five days and my registration is on file at the Ethics Commission, Room 410, State Office Building, St. Paul, Minnesota.

Trussbilt questioned the committee for an interpretation of the extent of the thermal break to be built into an exterior door which is mentioned on page 9, paragraph 4.2.2. I was told that the original intent was to include the four edges as well as the panel faces of the door requiring a thermal break. At that point I stated that while we could accomplish a thermal break between the exterior face and the interior face of the door, we can find no physical way to accomplish this along the top and bottom or two side door edges, particularly the door edges.

ALL SALES ARE SUBJECT TO THE CONDITIONS SET FORTH ON THE REVERSE SIDE OF THIS SHEET

To further our feeling that having a thermal break in the door edge is probably unnecessary, we point out that the hinges which are attached to both the door and the frame would conduct a heat or cold flow because the hinge carries through approximately 1½" of a normal 1-3/4" door thickness. The screw hole spacing for attaching the hinges are such that it requires such accomodation, thus making the termal break an impossibility at a point ¼" from the edge of the hinge to the face of the door.

The writer also stated that Trussbilt had developed and were using a thermal break door frame for several years and we would have no problem with continuing to use such a door frame.

It is our opinion that it is unnecessary to provide a thermal break on the two side edges and the top and bottom edge of the door because the thermal break would directly affect the attachment of the hinges or the attachment of the door lock. We also questioned the value of providing a thermal break from one panel side to the other or from the exterior face to the interior face. We think that if a value or U factor were developed for a properly insulated hollow metal door, this factor could be established and publicized so that designing architects could use the U factor in determining the total thermal transmittance value (Uo) as described in paragraph 4.2.2 and the small door area would not greatly change the total thermal transmittance value for the combined gross area of the exterior walls. We think it is more important to concentrate on the thermal break in the door frame, the window frame, etc.

It is our recommendation that you and the committee consider inserting the proper phraseology and terms into paragraph 4.2.2 so that there are no misunderstandings by anyone regarding the thermal break to be provided in the door panel itself. We would further recommend that the door be subjected to a published U factor to be considered in the combined gross area of the exterior wall thermal transmittance value. This could be readily established by having the manufacturers of hollow metal doors submit their thermal break frame with their normally insulated door panel as a unit for testing according to recommended test procedures. and then establishing either in their advertising or product literature, the U factor for the assembly, making it available to the designing architects.

We sincerely hope that our recommendation will be considered.

Yours very truly,

TRUSBILT INCORPORATED

W.F. Gibis
Engineering Manager

WFG/pjk

TWIN CITY INDUSTRIAL INSULATION CONTRACTORS ASSOCIATION
169 James Avenue North
Minneapolis, Minnesota 55405

May 15, 1975

Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Re: Laws of 1974, Chapter 307
Proposed Amendments

Dear Mr. Meyer:

We would like to thank you and your office personnel for keeping us well informed on the proposed amendments.

Our members have had some feedback on "Table 10 - Minimum Pipe Insulation," in so far as increased building costs. We feel that the energy conserved and the energy dollars saved will far exceed these added costs.

If there are any questions, please feel free to call (see enclosed list).

Yours truly,

Jack Schwartz

Jack Schwartz, Vono Pipe Covering Company
Member, T.C.I.I.C.A.

Enclosure
JS/kh
cc: T.C.I.I.C.A.

TWIN CITY INDUSTRIAL INSULATION CONTRACTORS ASSOCIATION
169 James Avenue North, Minneapolis, Minnesota 55405

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Ed Clark
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117 - 27th Avenue S. E.
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Lyman Moore

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1608 Como Avenue
St. Paul, Minnesota 55108

Jack Schwartz

April 22, 1975

Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

STATEMENT SUBMITTED FOR CONSIDERATION AT PUBLIC HEARINGS ON ENERGY CONSERVATION STANDARDS FOR BUILDINGS, 6 MAY, 1975.

I would like to make three basic points in this statement: (1) Building design should allow maximum use of natural energy-saving processes, such as light from windows and cooling from opening windows; (2) Lighting standards should be reduced from the current IES recommendations to 1951 levels or lower; and (3) Buildings should be designed so that solar energy devices for heating and cooling can be added at minimal cost.

With regard to the first point above, many buildings have recently been constructed which have no effective windows, with the result that all lighting must be artificial and energy-consumptive, and also that all cooling must be by energy-consuming air conditioning systems. They are completely artificial environments, out of contact with the real world. They generally centralize control over these lighting and cooling (and heating) systems so that the individual has no role. The use of windows as a light and heat source, of course, must be carefully designed so that it does not generate an energy penalty in terms of heat loss that is greater than that gained using solar heat and in substituting natural for artificial light.

With regard to standards for light intensity I would like to enter as evidence the following excerpt from an article entitled "Kill-a-watt" by Russell McKee that appeared in the March/April issue of Michigan Natural Resources magazine. It alerts us to the folly of following the self-serving recommendations of industrial groups such as the Illuminating Engineering Society etc. in establishing specifications for energy-consuming systems.

John C. Green

Professor John C. Green
Geology Department
University of Minnesota, Duluth

New York CONSERVATIONIST magazine, in an article last year, quotes Dr. Robert Rienecke, chairman of the Department of Ophthalmology at Albany Medical College as follows: "There is no substantive evidence that high light levels help in visual acuity. The eye is an extremely effective organ which can adjust to almost any conditions. It is impossible to lower lighting levels to where they would harm the eyes. Very high levels, on the other hand, may actually cause problems. Excessive exposure to glaring lighting conditions can contribute to eye fatigue, irritation, or other discomforts." He recommends that light levels be reduced as low as possible while still maintaining visual comfort.

Other medical authorities concur. From a review of the literature at Ford Hospital in Detroit and discussions with opthalmologists at both Ford and the University of Michigan Hospital at Ann Arbor, it is clear that excessive lighting can injure the retina, while no damage is sustained from low-intensity lighting. Eyestrain, a temporary condition in which the muscles of the eye are overworked, can occur if too much eye effort is concentrated in low-light situations, but it is a condition far more common nowadays because of too much light. Rienecke, for example, terms the presently recommended level of 100 foot candles of light for office deskwork "ridiculously high. I would prefer to see light levels at 7½ to 20 foot candles," he says. "We have done visual examinations at 7½ foot candles and the eye functions perfectly." A foot candle is the amount of luminous intensity produced by one candle at a distance of one foot.

Perhaps even more disturbing than the over-use of electricity, bad as that is, is the observed and constant *waste* of electrical power in our society. Notice around you the many buildings, parking lots, shopping malls, and public facilities that are so frequently over-lighted and lighted when not in use. True, there may be a need for all-night lighting in high-crime areas, or at dangerous intersections, but these situations are clearly limited.

Who recommends lighting levels? For the most part they come from such agencies as the Illuminating Engineering Society (IES), the Better Light Better Sight Bureau, lighting equipment manufacturers, and other sources that feed information into architectural practices, building codes, engineering courses, etc. Understandably, these agencies have a built-in desire to see the world well lit, and in fact have moved forward steadily in zealous pursuit of this objective. The CONSERVATIONIST article, for example, provides an interesting comparison between past and present standards, which have risen sharply in the last 32 years, at least. In 1943, for example, the IES standard for classroom illumination was only five foot candles. By 1952, this was up to 30 foot candles. Today, the IES recommends 70 foot candles for classrooms. In 1951, Professor Emeritus William E. Barrow of the University of Maine published a textbook entitled "Light, Photometry, and Illuminating Engineering." His recommended levels, below, may be compared with the 1972 IES recommendations:

LIGHTING STANDARDS COMPARISON
(in Foot Candles)

	1951 Textbook	*1972 IES*
Bank Lobby	20	50
Office buildings		
Corridors	5	20
Bookkeeping, accounting	50	150
Deskwork, reading	30	100
Prolonged close work, as drafting, etc.	50	200
Restaurants	10	50
School classrooms	30	70
Store merchandise areas	50	100

These recommendations should today be required to stand the test of critical review, in light of current energy shortages, high tax levels, and general economic difficulties. The year 1951 was hardly the Dark Ages, but if classrooms could operate at 30 foot candles back then, why are 70 needed today? In search of an answer, local taxpayers, for example, might wish to examine both the lighting levels and the electrical bills of schools where they send their children.

One-fourth of all electrical power used in the United States is consumed in lighting our way through the night —and day. Much of that electrical energy comes from generators powered with petroleum, and most of the remainder run on coal. Only five percent of our total power comes from nuclear sources, and the future of nuclear power is now very doubtful because of legal and environmental questions. So we must say that petroleum and coal provide nearly all our light. With petroleum in short supply, now under tariff, and very high priced, there is a growing move to relax air quality standards so that more cheap, high-sulfur coal can be used—so that we may continue to waste as much electricity as we have for a long, long time! That way, seemingly, we can have both empty pockets and air pollution as well. Somehow, there just has to be a better way. —*Russell McKee*

Proposed amendments to the "Design and Evaluation Criteria for Evaluating Energy Conservation in New Buildings"

To the State of Minnesota
Department of Administration
Building Code Division
May 27, 1975

by David Hagen
1027 University Ave. S.E
Minneapolis Mn. 55414

In recognition that the United States is a signatory to the General Conference on Weights and Measures, which gave official status to the metric SI system of units in 1960, let all units be expressed in the SI system whenever values are specified; that a table of common conversion factors be appendixed. Dual useage of SI and British units will be acceptable until the nation has officially converted.

In view of the long term energy shortage, and economic factors, let sec. 4.2 be ammended to include

"The thermal transmittance value for opaque walls and ceilings and roofs, be the optimum amount based on complete lifecycle costs. Where various options are within 5% of each other, the option utilising the minimum total energy shall be chosen."

recommend that in section 4.2.1, the section"for construction where vented space occurs above the insulation and below the roof, and .10 Btu/he/sq.ff./degree F for all other construction" be struck.

In light of the fact that triple pane windows are actually optimum on a cost effective basis in Minnesota, let the code be ammended to require thermopanes (or double glass panes) or tight fitting storms. The use of insulating shutters at night should be recommended.

I recommend that section 10 be kept. The greatest source of opposition probably comes from people being unfamiliar with the prime energy calculations, or uncertain where to find the coefficients. Therefore I reccomend that the coefficients of the total prime energy required and the average costs to supply the various forms of energy to the buildings boundary be compiled and made available to the public for all supplies of energy being used in Minnesota for the purpose of these calculations. Let the Code be ammended to state that these will be available from the Building Code Division. The long term rates of increase in energy costs (real) should also be provided for the calculations of the optimum insulation.

If it is not possible to yet specify the thermal transmittance values in terms of the optimums, then specify that these optimum calculations be included in section 10 for the benefit of the consumer as well as the enlightment of the architects and engineers.

In conjunction with these optimum values, the definition of degree days should be ammended to 21°C (70°F) so that the heat load from the occupants, electrical load and solar

insolation can accurately be included in calculations. See the study and reccomendations by Leonard, Erickson and Jordan: Energy Sources and Requirements for Residential Heating. ASHRAE vol 68, 1962 # 1783 p174-203.

The air leakage rates in sec. 4.41 and 5.3.2.4 are excessive in view of the above study. I recommend that the infiltration rate be specified as no more than double the minimum recommended ventilation rate of 5 cfm per person.

THE OPTIMUM INSULATION OF BUILDINGS

David Hagen

University of Minnesota

May 26, 1975



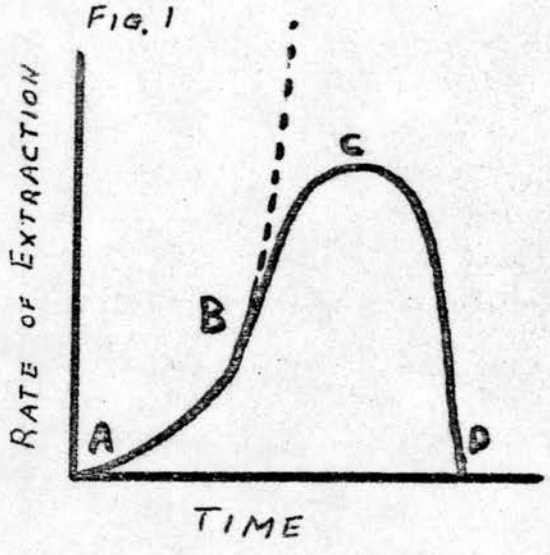
The Optimum Insulation of Buildings

David Hagen

May 1975

When we consider the space conditioning requirements of buildings, we must put this in the perspective of the current and future availability and costs of energy. Our society is presently almost totally dependent on fossil fuels, with space heating and cooling particularly dependent on oil and natural gas. However, these fuels are limited, and we can expect almost complete exhaustion of both the United States' as well as the world's resources within the lifetimes of the buildings now being constructed.[1-4]

Looking at the life cycles of finite resources[1,4] (See Fig.1) the period or ready availability A leads to expectations of unlimited growth, and incorporates wasteful habits. A.B. Meinel in an analysis of previous cycles shows that a disruptive crisis in policy occurs at B when the supply can no longer keep up with the exponential expectations. At C the crunch really hits society when the resource is no longer able even to sustain past practices, let alone



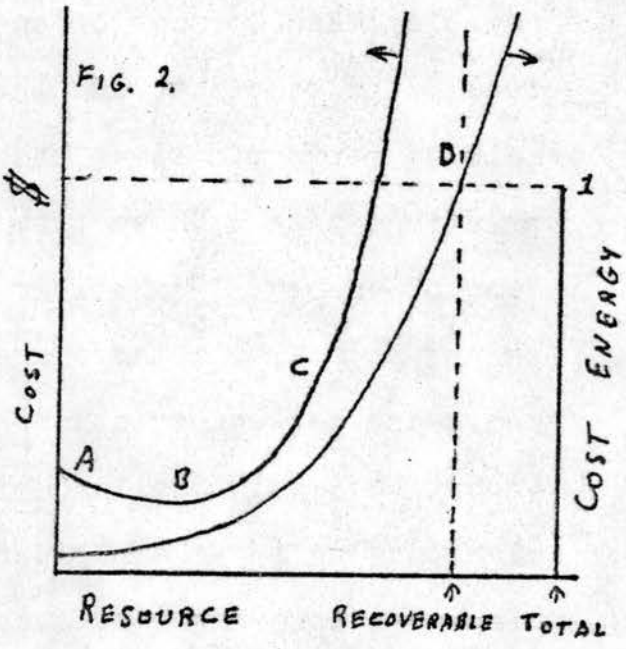
further growth. At D the resource can no longer be extracted for technical or economic reasons. The U.S.Domestic oil production is already at stage C [1,4] while the natural gas cycle is already past B. The effects of these crises have been masked by imports of oil, but were partially revealed by the recent O.P.E.C. embargo . The whole world's oil and natural gas cycle is already at B and will reach C around the turn of the century. We must face these facts now.

The only real long term solutions are first to develop renewable clean sources of energy to completely replace the fossil fuels, and second to use the minimum amount of energy and materials to perform a given task, and eliminate all the wasteful practices that we have from the period of easily available "cheap" energy.[2,6] Nuclear fission has been proposed as an energy source, but there are serious questions as to the real costs and net energy contribution in the long run[4]. Of more import, the political and environmental problems are of such magnitude as to make nuclear fission totally unuseable if we wish to retain any semblance of a civilised habitable society.[3,7] Fusion may be available in the future, but it awaits major breakthroughs in technology and research, besides the following developmental problems. Solar energy, on the other hand, is technically feasible now, and only needs the development and mass production of practical units. The costs of solar energy are rapidly becoming competitive with those of fossil fuels.

George Hoffman has analysed the historic fuel costs, the rates of depletion of the fossil reserves, and the costs of

synthetic fuels.[8] From these factors he projects a long term rate of increase in real costs of 5% per annum. Real costs of fuel will be be tripling or quadrupling within twenty-five years. During this time synthetic fuels using coal or renewable sources will have to supplant the shortage of traditional fuels. In keeping with these figures, the American Institute of Architects estimates average annual increases in the cost of fuel to be 10% to 15% when inflation is included.[9]

The era of prices of fossil fuels falling due to improved technology is over. See A fig.2. From now on we will have exponentially increasing energy and capital investment required to extract the fuels, and the depletion of the resources.



More than half of the domestic oil and a quarter of the domestic natural gas have already been consumed. The existing reserves are being used almost exclusively for existing contracts and even these are being curtailed. Fuel for new construction will have to be obtained from new sources of fuels for which prices are much higher than historic and interstate sources. Furthermore, fossil fuels will only be available for the first part of the building's life. Within a couple of decades most fuels for new space heating will be synthesized from coal or renewable organic matter. The costs

of these fuels will be several times the present prices, when available. With these new costs of fuel we could expect that the space conditioning costs of a building with today's average insulation will be greater than the building is worth, over the lifetime of the building. These facts require a total re-analysis of all building, insulation and economic practices.

When we compare present energy consumption with the actual requirements, we can, with adequate insulation and other methods, reduce the consumption by an order of magnitude, and the total cost of insulation, fuel and space conditioning equipment by about half that. The American Institute of Architects in 1972-'73 made initial estimates that with reasonable energy planning a 60% reduction of energy consumption in new buildings was a reasonable average, with up to 80% readily achievable.[6] They now consider these estimates to be very conservative[9]. When they conservatively compare the capital required to insulate and build energy efficient buildings, as opposed to the current practice of developing energy sources and then wasting that energy, they find the latter practice costs 45% more, to the tune of $500 billion nationally. They also predict a possible capital shortage of $635 to $915 billion or 15%-20% in the next decade if present practices continue. Finally, they present a very cohesive plan, showing the need to invest in energy efficient buildings rather than in generating wasted supply.

Thus when we look at the overall picture of fuel and capital availability as well as costs, we can either build energy efficient buildings now that will rely on renewable sources of energy, and

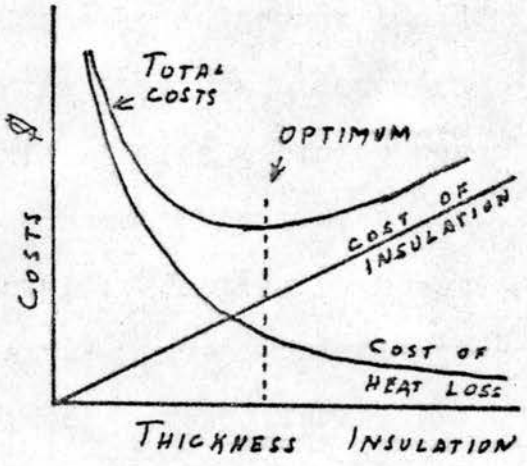
have stable costs, or we can continue present practices, and come to a point of where we can neither afford to pay for the fuels (if they are available), or to insulate the buildings.

The cost of insulation varies directly with the amount installed, while that of fuel and the HVAC equipment is inversely proportional to it. The optimum amount of insulation is found by differentiation to be:

$$\text{Thermal conductivity U optimum} = \sqrt{\frac{k \text{ Insulation}}{\text{Fuel + furnace}}}$$

The basic calc ulations of the annual cost of heating and insulating a given area of wall were published in a technical brochure by the Rockwell Company[10] in 1966. They are reproduced by Diamant in his recent text on space conditioning[11]. (See Fig.3) Lapthorne expands these to specifically include the cost of the heating installation.[12] These calculations are most applicable to adding insulation to an existing structure. They can also be used for a new design by choosing the heating plant near the optimum point. These calculations can be refined further, but the optimum value of insulation is fairly insensitive to large fluctuations in price. A quadrupling in fuel costs will only double the optimum insulation. However, this optimum is typically a factor of three to five or more times below the present average insulation, without counting the much high future costs. The optimum thermal conductivity is also

FIG 3



typically an order of magnitude less than that of an uninsulated building.

Lapthorne compared the average amount of insulation of buildings in Britain with the optimum economic amount.[12].

	Heat Transmission W/m^2 K	Btu/ft^2 hr R
Minimum British Statutory limit (=11" cavity brickwork)	1.7	.30
Mean roof values	1.04	.183
Mean Wall values	0.99	.174
Swedish Building Code	0.57	.10
Optimum economic U value	0.29	.05

These values are for Cambridge which has 3800 K degree days (6840 F degree days) using 1973 prices, and they were calculated on an annual basis. When the present worth of the lifecycle fuel costs with a 5% rate of increase the optimum U value will decrease further.

In the past, fuel costs were assumed to remain constant or ignored, while insulation was considered primarily from first costs and the apparent discount rates. This had the obvious effect of decreasing the insulation installed. If we look instead at the real discount rates after taxes and inflation, and use a real rate of increase in fuel rates over the lifetime of the building, we will reverse this effect. Gerry Smith goes into the details of these factors for investments of HVAC equipment,[13] and Steve Petersen of the National Bureau of Standards, incorporates these factors into fuel prices, in his recent study on Retrofitting Existing Housing[14]. Note that if we take a conservative value for the real discount rate to be 5%, after taxes and inflation, this will effectively cancel the 5% rate of increase in fuel

prices. Petersen similarily uses 1% for both when considering homeowners.

The consequences of this is that when we calculate the optimum U value we essentially have the incremental cost of the insulation balanced over the cost of fuelat a fixed rate over the lifetime of the building. At this point, the heat load from the electrical consumption and the people in the building becomes of the same order as the heat required for the building. At this point the very definition of the conventional degree day must be re-examined, since it assumed heat loads and insulation that existed in the 1930's[15]. Leonard, Erickson and Jordan in their study,, recommend a return to 70°F as a base instead of 65°F, and then properly take into account the heat load from the buildings ' occupants, the electrical equipment and the solar insolation. Thus instead of investing in a large heating plant and enormous quantities of fuel, we have the viable option of investing instead in insulation and small heating, ventillating equipment, or better yet in some solar panels with adequate storage facilities.

We can no longer afford the myopic view of first costs. For the benefit of the buildings' owners as well as the preservation of our society, it is imperative that we consider minimizing both the total energy and materials consumed as well as the total cost involved in all activities. As costs of various fuels are allowed to rise to their true value these two analysis should converge.

Bibliography

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3. Schumacher, E. F. Small is Beautiful, 1973.

4. "Transition: A Report to the Oregon Energy Council" by the Office of the Governor, State of Oregon, January 1975.

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6. "Energy and the Built Environment: A Gap of Current Strategies" American Institute of Architects, Energy Steering Committee.

7. Handler, Philip, Presilent National Academy of Sciences: "When one adds the nightmare of the existence of the 15,000 tons of plutonium required for that many breeder reactors, the health hazards in handling plutonium, the police effort required so that no plutonium is removed for the construction of illicit nuclear weapons, and the task of waste disposal, one need not invoke the possibility of a catastrophic accident to consider that this is an insupportable scenario. Somehow, the world must skip the breeder reactor and go from petroleum and coal -- solid, liquid and gasified -- to fusion and/or solar energy or it is inconceivable that the human race will avoid a worldwide calamity on so large a scale as to jeopardize the continuing future of our species." p.13

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8. Hoffman, George A. "Hydrogen-Rich Automotive Fuels: Future Costs and Supply Projections," The American Society of Mechanical Engineers, Proceedings of the 9th Intersociety Energy Conversion Engineering Conference, San Francisco, 1974. #749103 and "The U.S. Fuel Industry in the 21st Century", Technical Report 75-1, January 1975. U of So. California.

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10. Rockwool Company, Technical Brochure on Economics of Insulation, 1966.

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12. Lapthorne, Kieth. "Integration of Autonomous and Industrialized Building Systems": Autonomous Housing Study, Working paper #7, Univeristy of Cambridge, March 1973.

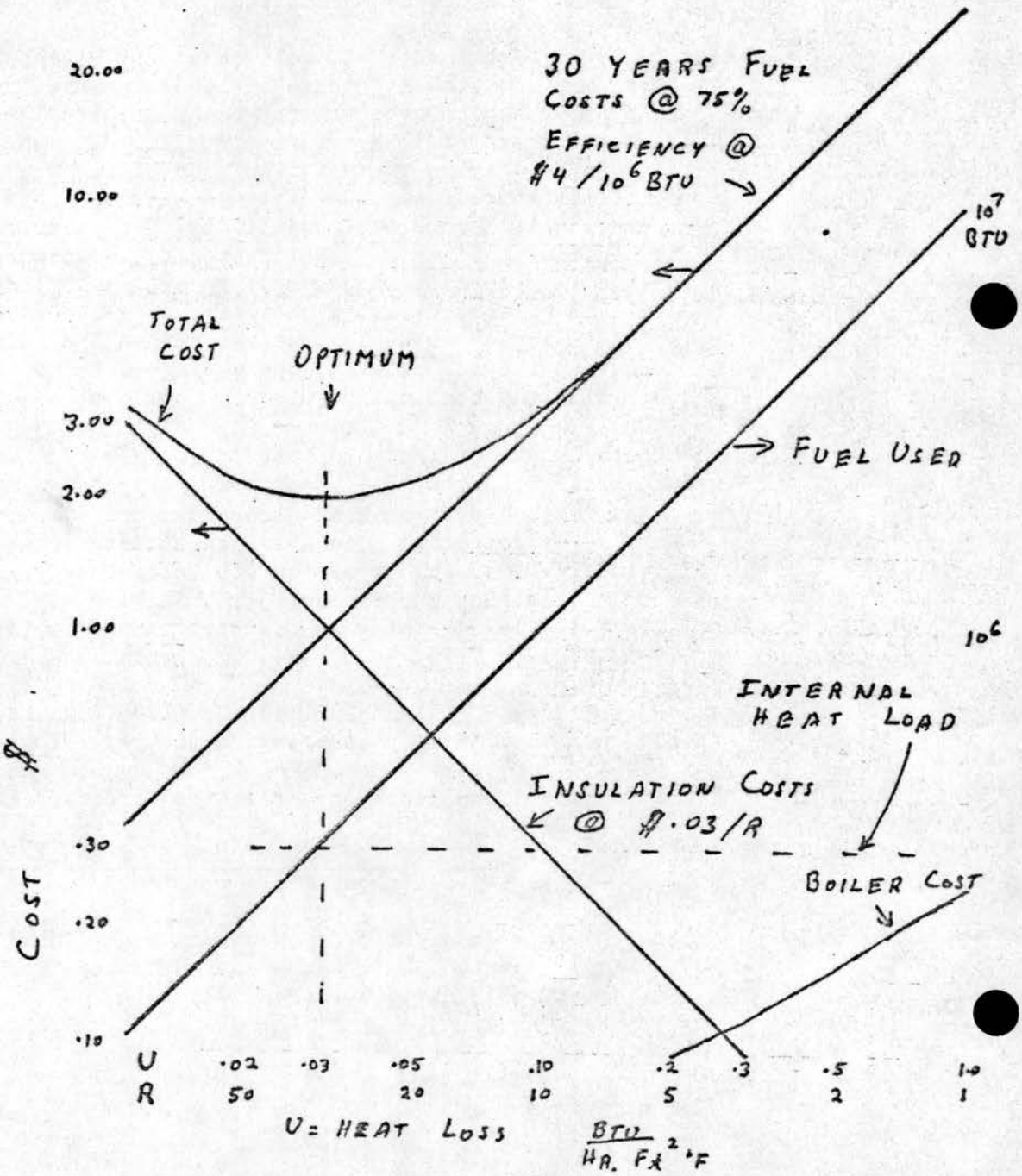
13. Smith, Gerry E. "Economics of Solar Collectors Heat Pumps and Wind Generators", Autonomous Housing Study, Working Paper #3, U of Cambridge, April 1973.

14. Petersen, Steve."Retrofitting Existing Housing for Energy Conservation: An Economic Analysis," National Bureau of Standards Building, Science Series #64.

15. "Energy Sources and Requirements for Residential Heating" ASHRAE Transactions, Vol. 68, 1962 #1783.

INSULATION VS FUEL COSTS. EXAMPLE.

FIG 4.



winter seal OF FLINT INC.

Thermell "Frost Free" Window

209 Elm Street • Holly, Michigan 48442 • Phone: (313) 634-8261

May 22, 1975

Herbert W. Meyer
Director Building Code Division
Room 408
Metro Square Building
St. Paul, MINN. 55101

Dear Mr. Meyer;

Confirming our telephone conversation of May 21st, you will find enclosed copy of AAMA Standards and Tests as well as a copy of news release from AAMA of April 14, 1975.

You might note that THERMELL WINDOWS have always met the Humidity Standards of Anderson Wood Windows that are also published.

I am further enclosing our literature which is self explanatory, and a copy of letters between our Company and our Director of Building Code for Michigan.

I wish to voice an objection to the word THERMAL BREAK. This is an advertised slogan and should read Thermalized or Thermal Window.

This is now adopted by AAMA.

Trusting we can be of service.

Sincerely yours,

WINTER SEAL OF FLINT, INC.

Mel Mermell

M.W. Mermell
Marketing/Engineering

RECEIVED MAY 27 1975 BUILDING CODE

See hrng. file for attachments

Minnesota Turkey Growers Association, Inc.

The Official Publication of the Minnesota Turkey Growers Association.

2387 UNIVERSITY AVENUE / Phone 646-4553 / SAINT PAUL, MINNESOTA 55114

June 18th hrng.

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Spicer

ROY MUNSON
Executive Secretary

June 30, 1975



Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Bldg.
7th & Robert
St. Paul, MN 55101

Dear Mr. Meyer:

I was not able to attend your hearing on June 18 regarding amendments on building code relating to energy conservation with respect to remodeling.

The Minnesota turkey industry is concerned about some of the proposed amendments that were considered at this hearing, and in the next few paragraphs, I will try to point them out to you.

Almost all of these turkey buildings used for brooding today are heated by stoves or furnaces which must maintain these buildings as 95 degrees Farenheit for day-old poults for the first few days of their life. The economics of growing turkeys along with health problems has encouraged turkey producers to insulate their buildings to reduce heat loss, thereby reducing the fuel costs as much as possible. Metal buildings especially, or uninsulated buildings, create a health hazard because of condensation that occurs when you have extremely cold weather and then it warms up, the frost melts and drops to the floor and creates damp litter.

Heating and ventilation has been a vital part of our production program and as more and more turkeys are raised in confinement, it becomes ever more important. However, we are cpncerned about agriculture buildings, especially turkey buildings having to meet the same requirements as our office or residential buildings. These are buildings that house animals and for various reasons cannot be made as tight or use the construction materials that we do in our homes or office buildings.

We also oppose giving the authority to a designated representative who possibly does not understand agriculture, especially in the rural areas.

The phrase, "economically feasible" is very vague, and can have many different meanings to many people. We hope this little language can be corrected, and be more specific. I hope that these comments can be included on the record, and consideration given to them when you add the amendments to the State Building Code.

Sincerely yours,

MINNESOTA TURKEY GROWERS ASSOCIATION, INC.

Roy C. Munson
Executive Secretary

RCM/jt

Architects/Engineers/Planners
One Appletree Square
Bloomington, Minnesota 55420
612/853 2361

Ellerbe®

Roger Santelman, PE
Vice President
Professional Services

26 June 1975

Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Dear Mr. Meyer:

Re: Proposed Amendments to the State Building Code Relative to Energy Conservation with Respect to Remodeling

In accordance with the Notice of Hearing dated May 14, 1975 for the referenced proposal, we are herewith submitting three (3) copies of comments which we believe will serve to improve and clarify the proposed rules and regulations.

Refer to SBC6003 Section 2 - Scope 2.1.2

We believe it would be prudent to provide an additional guideline to be used when one must show that compliance with requirements of SBC103, Subparagraphs 1, 2, 3 and 4 would not be economically feasible.

More specifically, we suggest the time period for amortization of capital improvement cost by fuel cost savings be limited to ten (10) years.

It is our opinion that establishment of a definite limit for the pay off period will result in a uniform evaluation system, elimination of multiple studies, and will control or eliminate arbitrary or prejudical interpretation of the requirements.

Very truly yours,

Roger Santelman

RDS:gml

RECEIVED
JUN 27 1975
BUILDING
CODE

Minnegasco minnesota gas company
733 marquette avenue, minneapolis, minnesota 55402

June 26, 1975



Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Dept. of Administration
408 Metro Square Building
St. Paul, MN. 55101

Re: Proposed Amendments to the State Building Code relating to Energy Conservation with respect to remodeling.

Dear Mr. Brubacher,

We concur that energy conservation in additions to- and remodeled elements of- existing buildings should be included in the "Energy Conservation Amendments."

The following discussion is provided for your consideration with respect to the subject Amendments:

SBC6003
Section 2- SCOPE
Renumber par 2.1.2 as 2.1.2.1.

Add par 2.2.2.2
Re: SBC 103.1 Application to Existing Buildings

Exclude "Additions" from paragraph SBC 103.1, sentence number 1.

Add a second sentence:
Additions within a 12 month period that exceed 50 percent of the value of a building or structure and that comply with the requirements for new buildings or structures may be made to such building or structure without making the entire building or structure comply.

Reason-
For example, under the code as written, an owner of an 80,000 sq ft building valued at, say $20./sq ft wants to add 20,000 sq ft at $42./sq ft. He must first replace all windows, add to or install new roof insulation, and, in most cases, install wall insulation. The HVAC system will need to be updated many times also. In many cases, we believe he will build a separate structure for cost reasons as well as practical ones. The combined structures then would have two additional exposed walls. Our suggested alternative would provide for an annual energy consumption less than if a separate structure were built.

Section 3 - DEFINITIONS
Add definition for Economically Feasible.

Add .... heat loss/gain control to line 4 of definition for remodeled element, and for the remodeling definition.

Reason - Obvious.

Thank you for the opportunity to give you our commentary.

Sincerely,

A. L. Pooler

A L Pooler
Vice President
Regulatory Affairs

St. Paul Association
Building Owners & Managers, Inc.

330 NORTHERN FEDERAL
CAPITOL CENTRE PLAZA
ST. PAUL, MINNESOTA 55102 PHONE 222-1070

June 12, 1975

EXECUTIVE DIRECTOR
WILLIAM BUTH

Herbert W. Meyer
State Building Inspector
408 Metro Square Building
St. Paul, Minnesota 55101

Dear Mr. Meyer:

The Codes & Regulations Committee of the St. Paul Association of Building Owners & Managers (BOMA) met on June 10th, 1975 to review the proposed amendments to the State Building Code relative to energy conservation with respect to remodeling. Our findings were in turn shared with our Board of Directors and were unanimously approved.

St. Paul BOMA is currently involved in a variety of energy conservation programs directed at preserving our countrys most valuable energy resource. We are encouraged that the State of Minnesota via the proposed amendments will require effective utilization of energy in new buildings. We fully support this concept.

Our Association is also in favor of and supports the form of enforcement of these rules wherein the State or its designated representative will enforce the rules in areas where certified building officials are non-existent.

In summary, St. Paul BOMA is in full agreement with and supports the proposed amendments which will be discussed at the June 18th Public Hearing and expect to see such changes made.

Sincerely,

ST. PAUL ASSOCIATION OF BUILDING
OWNERS & MANAGERS, INC.

George Falkenborg, Chairman
Codes & Regulations Committee

GF/gm

BUILDING OWNERS AND MANAGERS ASSOCIATION
OF MINNEAPOLIS
927 SOO LINE BUILDING MINNEAPOLIS, MINNESOTA 55402 • 338-8627

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June 17, 1975

6/19/75

Mr. Richard L. Brubacher
Commissioner of Administration
Minnesota Department of Administration
St. Paul, Minnesota 55155

Dear Mr. Brubacher:

The Energy Conservation Committee of this Association has met and reviewed the Proposed Amendments to the State Building Code relating to Energy Conservation with respect to remodeling which is the subject of a Public Hearing on June 18 and offer the following comments:

We are concerned that the proposed changes are too ambiguous as to interpretation and meaning and need further definition. For example, if an office building replaced existing glass windows with energy conserving double pane units, the cost could exceed 50% of the value of the building which would require the entire building to comply in accordance with SBC 104 of the State Building Code.

We feel that any materials replaced, such as windows, should be done with energy saving materials no matter what the dollar relationship is to the existing building value. We feel that in remodeling, the building envelope when remodeled should not be inhibited by a building valuation % figure.

Our concern is that only those component parts of the building to be remodeled should be required to comply with the new proposed code.

This Association continues to offer its services to the Department of Administration, State Building Inspection Department and the Minnesota State Code Technical Committees.

Sincerely,

Minneapolis Association of
Building Owners and Managers, Inc.

Arthur W. Olofson

AWO:ck
cc:Raymond B. Vecellio
Herbert Meyer
Norman Osterby

PROFESSIONALISM IN BUILDING MANAGEMENT
FEDERATED WITH BUILDING OWNERS AND MANAGERS ASSOCIATION INTERNATIONAL

northwestern lumbermens association

SINCE 1890

June 13, 1975

Mr. Herbert W. Meyer
408 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Meyer,

I am unable to attend the hearing on June 18 on the amendments to the State Building Code with respect to the remodeling, but I do have a question.

Under SBC 103, it is stated that altered buildings shall be made to comply with the code, except as exempted. I presume this means the exemption for farm homes and other buildings that are mentioned as such in the code.

Then under SBC 6002, Enforcement, Sec. 1.1 adds new language for the enforcement of the code in areas in which there is no building official.

This sounds quite simple, but I wonder if we aren't getting into something that could be difficult to enforce. Let's take an example of an exempt structure such as an open pole-type loafing shed in an area not covered by the code. Let's carry it one step further and say the community has no system of building permits.

There is no jurisdiction over this construction, but at the same time, in your office you don't really know but what there will be some part of the building that will require heat, cooling, or hot water and therby come under your jurisdiction. You will therefore be forced to establish some sort of permit system is all communities of the state, even if it is only a sort of negative affidavit, regarding energy requirements.

In this instance, the farmer will be paying an additional fee which normally would cover the costs of inspections by an accredited building official, but in this case, will just be a formality and an unjustified extra cost of construction.

I'm sure the provisions of the code that are being added at this time are primarily for compliance with federal regulations and wonder if you could give me your thoughts in case my analysis is wrong.

Most cordially yours,

James E. Toepel
Executive Director

JET/ms

RECEIVED
JUN 14 1975
BUILDING CODE

7300 FRANCE AVE. SO., MINNEAPOLIS, MN 55435 612/835-7411

General Mills, Inc.
General Offices

Post Office Box 1113
Minneapolis, Minnesota 55440

Engineering Policy

July 8, 1975

Mr. Herbert W. Meyer
State Building Inspector
408 Metro Square Building
7th & Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Meyer:

The following comments are made in response to the public hearing of June 18, 1975 regarding "Proposed Amendments to the State Building Code relating to Energy Conservation with respect to Remodeling". Please note that these comments also apply to Section 2.0.

References are made to economically feasible and desirable building improvements to achieve energy conservation. It is our understanding from discussions at the hearings that the Building Code Division's interpretation of an economically feasible energy conservation improvement to a new or remodeled building is one that will yield a net energy cost savings equal to or greater than the cost of capital over the economic life of the improvement.

Each industry has a different definition of the cost of capital and that cost is constantly changing; hence, clarification of these terms is essential.

When the terms are defined, General Mills will be able to give further testimony on the reasonableness of the Code.

Very truly yours,

William Taylor

W. T. Taylor
Senior Energy Engineer

WTT/nll

This is recycled paper

DESIGN AND EVALUATION CRITERIA

FOR

ENERGY CONSERVATION IN NEW BUILDINGS

State of Minnesota
Department of Administration
Building Code Division
March 17, 1975

DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS

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NOTICE

In response to Laws of 1974, Chapter 307, these Proposed Amendments will become effective six months after adoption.

These proposed energy conservation requirements are performance oriented and are not intended to be specifications for construction.

To supplement the performance standards, it is the intent of the Building Code Division to provide a "Code Manual" which will acquaint building officials, designers and the construction industry with specific methods of construction which have been evaluated and found to meet these performance standards.

PROPOSED RULES AND REGULATIONS

Building Code Division

Department of Administration

Relating to:

DESIGN AND EVALUATION CRITERIA FOR ENERGY CONSERVATION IN NEW BUILDINGS

SBC 6001 Authorization. These Rules are authorized by Laws of 1974, Chapter 307, and established through the rule making procedures set forth in Minn. Stats. 1969, Sections 15.0411 to 15.0417, in order to implement, interpret and carry out the provisions of Laws of 1974, Chapter 307 regarding energy conservation standards for design, evaluation, construction or reconstruction of all new buildings and remodeling undertaken after the effective date of these Rules. Additionally, these Rules constitute amendments to the State Building Code. In the event that these Rules differ with the State Building Code, these Rules shall govern in all cases not affecting safety and health requirements.

SBC 6002 Enforcement. Building Officials, in the municipality for which they are appointed, shall enforce these Rules.

SECTION 1

SBC 6003 PURPOSE

1.0 PURPOSE. The purpose of these Rules is to provide design requirements and criteria that will result in the effective utilization of energy in new buildings.

1.1 The requirements and criteria are performance-oriented and are directed toward the design of building envelopes with high thermal resistance, low air leakage, and toward requiring practices in the design and selection of mechanical, electrical and illumination systems and equipment which promote the efficient use of energy.

1.2 It is intended that the rules shall be flexible and designers shall be encouraged to use innovative approaches and techniques to achieve efficient utilization of energy. Efficient use of energy can be achieved by the use of design solutions that shall be shown to use equivalent or lesser amounts of energy without following each specific requirement.

1.3 It is intended that these Rules be used in the design of new buildings and that compliance with its requirements should be determinable in the preconstruction stage by evaluation and analysis of design specifications, drawings, and calculations.

SBC 337 to SBC 5999 reserved for future use.

SBC 6004 to SBC 7099 reserved for future use.

SECTION 2 - SCOPE

2.0 These Rules set forth requirements for the design of all types of new buildings covering their exterior envelopes and selection of their HVAC, service water heating, electrical distribution and illuminating systems, and equipment for efficient use of energy. Observance of the requirements does not necessarily lead to an optimization of initial and operating cost, and these Standards are not intended to replace economic evaluation to arrive at such an optimization. Economic evaluation of thermal design criteria will generally show that further reductions in energy consumption will be economically desirable.

2.1 This standard applies to the design and construction of all types of new buildings or those portions of new buildings containing conditioned space. Vacation homes used for summer occupancy and buildings whose peak design energy usage is less than 1 watt/sq.ft. of floor area for all purposes are specifically excluded from the scope of this standard.

2.1.1 Certain other buildings or elements thereof may be exempted when design data are not applicable or calculations show that internal heat gains exceed heat losses. In these cases, the exemptions shall be made in writing and a copy of such exemptions shall be submitted to the State Building Inspector within fifteen (15) days of the granting of such exemption.

2.2 These Rules principally cover the features of a building, its equipment, and systems that determine its use of energy. The energy uses covered shall be that energy used within the building and on its site.

2.3 These Rules shall not abridge any safety or health requirements.

2.4 These Rules do not incorporate specific procedures for the operation, maintenance and use of buildings.

SECTION 3 - DEFINITIONS

Buildings	a. Existing buildings - Buildings constructed prior to the effective date of these Rules. b. New buildings - Those buildings constructed or having permits issued subsequent to the effective date of these Rules.
Building Envelope	The elements of a building which enclose conditioned spaces through which thermal energy is transferred to or from the exterior ambient environment.
Coefficient of Performance (COP) Heat Pump, Heating Mode	The ratio of the rate of heat delivered by the complete heat pump unit (exclusive of supplementary heating) to rate of energy input, in consistent units and under designated operating conditions.
Coefficient of Performance (COP) Cooling Mode	The ratio of the rate of heat removed (by the refrigeration cycle) to the rate of energy input, in consistent units and under designated operating conditions.
Conditioned Space	Any space heated, cooled or lighted whose design energy usage is greater than 1 Watt/sq.ft.
Cooled Space	Space within a building in which new energy is used for cooling.
Deadband	The range of controlled temperature within its normal operating span in which no corrective action is called for by the controller.
Energy	Includes all fossil fuels, solar, wind and electricity, and products from their use such as steam and chilled water which are delivered to the building to perform work.
Energy, New	Electrical or chemical energy converted to thermal or mechanical energy expressly for the purpose of heating or cooling.
Energy, Recovered	Energy utilized which would otherwise be wasted from an energy utilization system.
Energy Efficiency Ratio (EER)	a. The ratio of net cooling capacity in Btu's and total electric input in watts. b. The number of Btu's divided by the watts of power used. The higher the number the more cooling obtained for less electrical input.

Energy Significant Equipment	Central station unitary or room-type space conditioning equipment including, but not limited to energy converting/processing equipment used in engineered systems and packaged subsystems, service water-heating equipment and lighting equipment.
Heat Flux	The heat transmitted per unit of time per unit of cross-sectional area (Q/A), Btu/hr./sq.ft.
Heated Space	Space within a building which is provided with a positive heat supply.
HVAC System	A system that provides either collectively or individually the processes of comfort heating, ventilating and/or cooling within or associated with buildings.
Infiltration	The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.
Opaque Areas	All exposed opaque areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.
Outside Air	Air taken from the outdoors and therefore not previously circulated through the system.
Positive Heat Supply	Heat supplied to a space by design or by heat losses occurring from energy consuming systems or components associated with that space.
Reheat	Sensible heat added to condition a zone to overcome cooling produced by expenditure of energy within the HVAC system serving that zone.
Service Systems	The HVAC, service water heating, electrical distribution, and illuminating systems provided in a building.
Thermal Break	A material of low thermal conductivity that is installed between the cold and warm parts of the members in a building element to reduce the heat transmission through the structural members. The member itself can serve as a thermal break, if it has low thermal conductivity.

Total Energy System	An on-site electrical generating system arranged for the maximum utilization of input fuel energy by salvaging by-product or waste heat from the generating process.
Unheated Space	A cellar, basement, crawl space, garage, attic or other space, within a building, which is not provided with a positive heat supply.
Unitary Air Conditioner	One or more factory made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separated assemblies shall be designed to be used together.
Ventilation Air	That portion of supply of air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.
Zone	A portion of the occupied space within a building which, recognizing the nature of its heating/cooling load, could be satisfactorily controlled to desired temperature limits, under varying indoor loads and outdoor conditions, by the operation of control at a single point. For specific purpose of this definition, the term "occupied space" is defined as the region within a space between the three inch and the six foot level above the floor and more than two feet from exterior walls or fixed air conditioning fixtures or equipment.

SECTION 4 - EXTERIOR ENVELOPE

4.0 SCOPE: This section contains design criteria that limit the heat loss through the building envelope in winter and heat gain in summer. The heating and cooling design criteria are given as thermal transmittance values (U-values) and the cooling design critera is given for fenestrations. Design criteria are given for control of air leakage between indoors and outdoors in winter and summer and for control of water-vapor condensation. Two alternatives for design are given, both using a total building envelope approach instead of designing to meet stated criteria for roof/ceiling, wall, window, door and foundation assemblies.

4.1 GENERAL: The design criteria for the exterior envelope of a building are contained in 4.2 through 4.5. The designer may choose either alternative given in 4.6 in lieu of 4.2 through 4.5.

4.1.1 SITE AND SHAPE ANALYSIS: The proposed design submitted for either alternative stated in 4.1 should show that energy conservation was taken into account in determining building compass orientation, geometric shape, aspect ratio (length to width), number of stories for a given floor area requirement, thermal mass, color, shading or reflections from adjacent structures, ground surfaces or vegetation, opportunities for natural ventilation, and wind direction and speed. Guidelines for design procedures dealing with some of these considerations are given in Chapters 17 through 22, 1972 ASHRAE Handbook of Fundamentals.

4.1.2 For calculating heat loss or gain through the exterior envelope of the building, the following design temperatures shall apply:

	Indoor	Outdoor
Winter	68° F. Maximum	Median of annual extremes*
Summer	78° F. Minimum	$2\frac{1}{2}\%$ *

4.2 HEATING DESIGN

4.2.1 CEILINGS/ROOFS: The thermal transmittance value for the combined gross area of exterior ceilings/roofs, consisting of opaque ceiling/roof and skylights, enclosing an interior heated space shall not exceed .04 Btu/hr./sq.ft./degree F. for construction where vented air space occurs above the insulation and below the roof, and 0.10 Btu/hr./sq.ft./degree F. for all other construction. Equation 4-1 shall be used to determine acceptable combinations of construction in meeting this requirement. A roof assembly shall be considered as those components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss. If a ceiling is employed as an element of a plenum, the thermal performance of the assembly shall be the thermal performance of the roof assembly.

* Values from 1972 ASHRAE Handbook of Fundamentals, Chapter 33.

4.2.2 EXPOSED EXTERIOR WALLS: The thermal transmittance value (Uo) for the combined gross area of exterior walls, consisting of opaque wall areas, window areas, door areas, and foundation walls above grade, enclosing an interior heated space shall not exceed 0.17 Btu/hr./sq.ft./degrees F. for one and two-family detached dwellings, and 0.22 Btu/hr./sq.ft./ degrees F. for all other buildings. The value for an opaque wall shall not exceed .10 Btu/hr./sq.ft./degrees F. Equation 4-1 shall be used to determine acceptable combinations of construction in meeting this requirement.

Equation 4-1

$$U_o = \frac{U_{wall} A_{wall} + U_{window} A_{window} + U_{door} A_{door}}{A_o}$$

Where U_o = the average thermal transmittance of the gross wall area, Btu/hr./sq.ft./degrees F.

A_o = the external exposed (above grade) gross wall area of the building that faces heated spaces, sq.ft.

U_{wall} = the thermal transmittance of all elements of the opaque wall area, Btu/hr./sq.ft./degrees F.

A_{wall} = opaque wall area, sq. ft.

U_{window} = the thermal transmittance of the window sash area, Btu/hr/sq.ft./degrees F.

A_{window} = window sash area, sq. ft.

U_{door} = the thermal transmittance of the door, considered as an assembly, including the frame, Btu/hr./sq.ft./ degrees F.

A_{door} = door area, sq.ft.

4.2.3 FLOORS OVER HEATED SPACES: The peripheral edges of floors that face heated spaces above and below the floor line shall contain thermal resistance equivalent to that of the opaque exterior wall areas above and below the floor. The peripheral edge may be considered a part of the gross exterior wall area as a component in accordance with 4.2.2 if the equivalent thermal resistance requirement cannot be met.

4.2.4 FLOORS OVER UNHEATED SPACES: The thermal transmittance value of floors above unheated spaces, enclosing an interior heated space, shall not exceed 0.08 Btu/hr/sq.ft./degrees F.. A basement, crawl space, or garage shall be considered unheated unless it is provided with a positive heat supply.

4.2.5 SLAB-ON-GRADE FLOORS: The thermal resistance of the insulation around the perimeter of slab-on-grade gloors shall be not less than 0.20 Btu/hr/sq.ft./degrees F., and the insulation shall extend downward below the grade line to the footing or the design frost line, or an equivalent distance horizontally inward from the edge under the floor.

4.2.6 FOUNDATION WALLS: The areas of foundation walls and the windows and doors therein, enclosing a heated space and exposed to outdoor air, shall meet the thermal transmittance of 4.2.2. The areas of foundation walls below grade and enclosing a heated space shall have a thermal resistance not less than 50 percent of the thermal resistance of the opaque wall area above grade.

4.3 COOLING DESIGN

4.3.1 SCOPE: The requirements of this section apply to designs for buildings or portions of buildings in which new energy is used for cooling by any means, such as forced ventilation, mechanical or evaporative cooling.

4.3.2 OPAQUE AREAS OF WALLS AND CEILINGS/ROOFS: The transmittance values shall be as defined in Heating Design (Section 4.2).

4.3.3 FENESTRATIONS: The maximum instantaneous combined solar and air-to-air heat transmission of each window at design conditions for exterior fenestration enclosing an interior cooled space shall not exceed 100 Btu/hr./sq.ft. as an average of the transparent area of each entire window. The heat gain through transparent window areas of the exterior building envelope shall be controlled during the cooling season by interior and/or exterior shading devices and/or the utilization of different glass types.

4.4 AIR LEAKAGE CONTROL (INFILTRATION)

4.4.1 OVERALL AIR LEAKAGE: The natural leakage of air between outdoors and indoors for the building envelope shall not exceed 0.7 air changes per hour, for one and two-family detached dwellings or 0.5 air changes per hour for all other buildings that are not pressurized. In pressurized buildings, the infiltration shall be offset by the ventilation air. Air leakage data shall be determined from certified data furnished by the manufacturer of doors, windows, and exterior curtain walls, and supplemented by calculations using guidelines given in Chapters 19 and 21, 1972 ASHRAE Handbook of Fundamentals. A wind condition of 15 miles per hour shall be used in all calculations. An air lock, such as a vestibule or revolving door, shall be constructed at each primary means of access to a building used by the public.

4.4.2 WINDOWS AND DOORS: Windows and doors shall be designed to limit air leakage into or from the building when in the closed position. The air infiltration rate shall not exceed the value listed in Table 4-2 when tested at a pressure differential of 1.567 lb/sq.ft., equivalent to the impact pressure of a 25 mile per hour wind.

4.4.2.1 Compliance with the air leakage requirements of all types of windows and doors shall be determined by ASTM E283-73, Standard Method of Test for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.

TABLE 4-2

Type of Opening	CFM/Ft of Crack
Windows/Exterior curtain walls	0.5
Sliding Doors	0.75
Swinging Doors	1.0

4.4.3 CAULKING AND SEALANTS: Joints around window and door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations of utility services through walls, floors, and doors, and all other openings in the exterior envelope shall be caulked, gasketed, or otherwise weatherstripped.

4.5 CONDENSATION CONTROL

4.5.1 VAPOR BARRIERS: The design of the building envelope for one and two-family dwellings and other buildings having humidification requirements in excess of those set forth in 5.1.2.1 should provide maintenance of thermal performance and durability by protecting against cold weather water vapor condensation.

4.5.2 THERMAL BREAKS: All window, door, ceiling, roof, floor, and wall construction shall contain thermal breaks to prevent excessive heat transmission.

4.6 ALTERNATIVE DESIGNS

4.6.1 TOTAL ENVELOPE METHOD; Alternative designs and methods of construction shall be acceptable provided it is shown that the total building heat loss and heat gain exclusive of overall air leakage at winter and summer design conditions, respectively, is equal to or less than design developed to satisfy criteria given in Sections 4.2 through 4.5 above. Alternative designs for comparison shall be based upon the same indoor and outdoor design temperatures, occupancies and use schedules, and equivalent useful floor area, perimeter and building volume, as used to satisfy the criteria of Sections 4.2 through 4.5

4.6.2 ENERGY ANALYSIS METHOD: Section 11, instead of Section 4, may be used for building designs. Designs of the building envelope resulting from application of the requirements of Sections 4.2 through 4.5, or Section 4.6.1, shall be used to establish a reference heat loss and heat gains for comparison with designs resulting from the application of Section 10.

SECTION 5

5.0 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)SYSTEMS

5.1 GENERAL: This Section establishes HVAC system requirements for efficient utilization of energy. System criteria developed from the requirements of this Section shall be the basis for equipment selection as described in Section 6. System design shall permit operation of HVAC systems with minimum energy consumption.

5.2 SCOPE: This Section covers determination of heating and cooling loads, design requirements, and control requirements for general comfort applications in new buildings. Criteria is established for insulating piping and air handling systems, and for duct construction. For special applications such as hospitals, laboratories, thermally sensitive equipment, computer rooms, and manufacturing processes, etc., the design concepts and parameters shall conform to the requirements of the application at minimum energy levels. Where these special applications are described in the 1974 ASHRAE Handbook - Applications, the criteria described therein should be used.

5.3 CALCULATION OF HEATING AND COOLING LOADS

5.3.1 RECOMMENDED PRACTICES: Heating and cooling design loads shall be determined in accordance with one of the procedures described in the 1972 ASHRAE Handbook of Fundamentals, Chapters 21 and 22, or shall be calculated in a format or computerized program acceptable to the Minnesota Building Code Division. For residential heating and cooling design load calculations, NESCA Manual J and ARI Standard 230-62 are considered equivalent.

5.3.2 DESIGN PARAMETERS: The following design parameters in conjunction with other provisions of this Standard, shall be used for HVAC system design load determination for general comfort applications.

5.3.2.1 OUTDOOR DESIGN CONDITIONS: The outdoor design conditions shall be determined by location of the building as indicated in Table 5-1. For locations not shown, use the value of the nearest city listed.

5.3.2.2 INDOOR DESIGN CONDITIONS: The indoor design conditions shall be 68°F. db in winter and 78°F. db in summer. Design indoor winter relative humidity shall not exceed 15 percent where new energy is required to produce humidification. Design indoor summer relative humidity shall not be less than 55 percent where new energy is required for dehumidification.

TABLE 5-1

LOCATION	OUTDOOR TEMPERATURE (Degrees F.)		
	WINTER	SUMMER	
	db	db	wb
Albert Lea	-20	89	76
Alexandria	-26	88	74
Bemidji	-38	84	72
Brainerd	-31	85	73
Duluth	-25	82	71
Faribault	-23	88	75
Fergus Falls	-28	89	74
International Falls	-35	82	69
Mankato	-23	89	75
Minneapolis/St. Paul	-19	89	75
Rochester	-23	88	75
St. Cloud	-26	88	75
Virginia	-32	83	71
Willmar	-25	88	75
Winona	-19	89	76

5.3.2.3 VENTILATION: In HVAC systems with temperature control and filtration, in which air is recirculated, the heating and/or cooling design loads caused by the outdoor air portion of the ventilation air supplied to rooms or spaces shall be based on outdoor air quantities of not more than 33% of the recommended ventilation rates cited in Section 6 of ASHRAE Standard 62-73 - Natural and Mechanical Ventilation. The air quality shall conform with the requirements of ASHRAE Standard 62-73.

5.3.2.3.1 VARIATIONS: The quantity of outdoor air introduced into spaces conditioned for comfort for the purpose of meeting normal respiratory and odor control needs shall be no greater than 5 cfm per person, except as indicated in Section 5.3.2.3. If values of outdoor air, other than those shown in ASHRAE Standard 62-73, are used because of special occupancy or process requirements, source control of air contaminants, or conflicting codes, these required outdoor air quantities shall be used as the basis of calculating the heating and/or cooling design loads.

5.3.2.4 INFILTRATION: Unless specifically calculated otherwise, heating and cooling design load determinations for the entire structure shall include infiltration at the rate of no more than 0.7 air changes per hour for one and two-family dwellings and 0.5 air changes per hour for all other buildings that are not pressurized. In pressurized buildings, the infiltration shall be offset by the ventilation air.

5.3.2.5 SYSTEM DESIGN HEATING/COOLING CAPACITY: Heating and/or cooling systems shall be capable of functioning to accomplish the requirements of Section 5.3 as applicable. The rated capacity of the heating/cooling system at design conditions shall not be greater than 110% of the design output load calculated in accordance with Section 5.1 whenever appropriate equipment is available. Equipment designed for standby purposes is not included in the capacity limitation requirement. The cooling cycle of heat pumps are exempt from this requirement.

5.4 CONTROLS

5.4.1 TEMPERATURE CONTROL: Each HVAC system shall be provided with at least one automatic, space-temperature control device for the regulation of temperature as required in 5.4.3. These automatic, space-temperature control devices shall be capable of being set to maintain space temperature set points from 55°F. to 85°F. and shall be capable of operating the system heating and/or cooling in sequence, if both are provided. These controls shall be adjustable to provide a temperature range of up to 10°F. between the full heating and full cooling being supplied, except as allowed in paragraph 5.5.8.6.

5.4.2 HUMIDITY CONTROL: If an HVAC system is equipped with a means for adding moisture, to maintain specific selected relative humidities in spaces or zones, an automatic, space-humidity control device shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 15 percent RH. The exception to the above is process operations that require different environmental conditions to maintain product quality. Where an automatic humidity control device is used in an HVAC system with means for removing moisture to maintain specific selected relative humidities in spaces or zones, this device shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 55 percent RH.

5.4.3 ZONING FOR TEMPERATURE CONTROL

5.4.3.1 ONE AND TWO-FAMILY DWELLING UNITS: At least one automatic space temperature control device, as required in paragraph 5.4.1, shall be provided for each separate dwelling unit.

5.4.3.2 MULTIPLE-FAMILY DWELLING UNITS: For multiple-family dwelling units, each individual dwelling unit shall be considered separately and shall meet the requirements of 5.4.3.1. Spaces other than living units shall meet the requirements of 5.4.3.3.

5.4.3.3 ALL OTHER TYPES OF BUILDINGS OR OCCUPANCIES: At least one automatic space temperature control device as required in paragraph 5.4.1 shall be provided for:

a. Each separate zone. Each floor of a building shall be considered as a separate zone (as a minimum).
b. Each zone served by a separate HVAC system.
c. Each zone as covered in paragraph 5.5.

5.4.4 CONTROL SETBACK AND SHUTOFF

5.4.4.1 SINGLE AND MULTIPLE FAMILY DWELLING UNITS: The automatic space temperature control device required in paragraphs 5.4.3.1 and 5.4.3.2, or an alternate means (such as a switch or clock), shall provide a readily accessible, non-automatic or automatic means for reducing the energy required for heating and cooling during periods of non-use or reduced need (such as unoccupied periods, sleeping hours, etc.). Lowering set points of automatic space temperature control devices to reduce energy consumption of heating systems shall not cause new energy to be expended to reach the reduced setting. Where HVAC systems provide outdoor air for ventilation, a readily accessible means shall be provided for reducing the outdoor air quantity during periods of reduced need.

5.4.4.2 OTHER BUILDINGS AND OCCUPANCIES: Each HVAC system shall be equipped with a readily accessible means of reducing the energy used for HVAC during periods of non-use or alternate uses of the building spaces or zones served by the system. The thermal intertia effects to the building mass shall be considered in determining what the set-back can realistically be. The following are examples that meet this requirement:

a. Manually adjustable automatic timing devices.
b. Manual control systems for use by operating personnel.
c. Automatic control systems.
d. Manually or automatically set devices (one and two-family dwelling units only).

5.5 SIMULTANEOUS HEATING AND COOLING: Simultaneous heating and cooling of a zone by reheat, recooling or concurrent operation of independent heating and cooling systems shall be restricted as delineated below.

5.5.1 Recovered energy, including new energy expended in the recovery process (provided the amount expended is less than the amount recovered), may be used for control of temperature and humidity.

5.5.2 New energy may used, when necessary, to prevent relative humidity from rising above 55% for comfort control or to prevent condensation on terminal units.

5.5.3 New energy may be used for control of temperature if minimized as delineated in paragraphs 5.5.4 through 5.5.8.

5.5.4 REHEAT SYSTEMS: Systems serving multiple zones, other than those employing variable air volume for temperature control, shall be provided with controls that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the most cooling. Single zone reheat systems shall be controlled so as to sequence reheat and cooling.

5.5.4.1 NEW ENERGY: Whenever possible, new energy shall not be used for reheat purposes. The total installed capacity of all reheat using new energy shall be limited to 15% of the total system cooling capacity.

5.5.5 DUAL DUCT AND MULTIZONE SYSTEMS: These systems shall be designed with means to automatically reset the cold deck temperature to the highest temperature necessary to satisfy the zone requiring the most cooling during predominately cooling operation, and to automatically reset the hot deck temperature to the lowest temperature necessary to satisfy the zone requiring the most heating during the predominately heating operation.

5.5.6 RECOOLING SYSTEMS: The system design shall limit the use of new energy for recooling of heated air to 15 percent of the total system heating capacity. Such systems shall provide means for limiting the use of energy for recooling of heated air by automatically resetting the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the most heating.

5.5.7 For multiple zone systems, one zone may be chosen to represent a number of zones with similar heating/cooling characteristics. The supply air temperature reset in 5.5.4 is not required for multiple zone HVAC systems that employ reheating or recooling for control of less than 20% of the total air in the system.

5.5.8 Concurrent operation of independent heating and cooling systems serving common spaces, and requiring the use of new energy for heating, shall be minimized by one or both of the following:

a. By providing sequential temperature control of both heating and cooling capacity in each zone.
b. By limiting the heating energy input, through automatic reset control of the heating medium temperature (or energy input rate), to only that necessary to offset heat loss due to transmission and infiltration.

5.5.9 ENERGY RECOVERY: Each exhaust-makeup system having a total outdoor air capacity of more than 4000 cfm should employ energy recovery equipment which shall be capable of recovering at least 50% of the potential heating or cooling effect in the exhaust air, whenever the temperature difference between exhaust and makeup air is 10°F. or greater. Energy recovery equipment should be capable of intermittent operation as required to conform to Section 5.4, and shall not interfere with normal air flow when the energy recovery equipment is not functioning.

5.6 COOLING WITH OUTDOOR AIR: Each fan system, having greater than 134,000 Btu/hr. total cooling capacity or more than 5000 cfm, shall be designed to use up to 100% of the fan system capacity for cooling with outdoor air whenever cooling, requiring new energy, is needed and:

a. The enthalpy of outdoor air is lower than that of the indoor air, and/or
b. The outdoor dry bulb temperature is lower than that of the return or indoor air.

5.6.1 EXCEPTIONS: Cooling with outdoor air is not required under the following conditions:

a. The quality of the outdoor air (as defined in Table 1 of ASHRAE Standard 62-73) is so poor as to require extensive treatment of the air.
b. The need for humidification and/or dehumidification requires the use of more energy than is conserved by outdoor air cooling.
c. The use of outdoor air cooling may affect the operation of other systems (such as return air fans or supermaket refrigeration) so as to increase the overall energy consumption of the building.
d. Internal/external zone heat recovery is used.

5.7 MECHANICAL VENTILATION: Each mechanical ventilation system (supply and/or exhaust) shall be equipped with a readily accessible means for colume reduction and/or shutoff when ventilation is not required.

5.8 PIPING INSULATION: All piping installed to serve buildings and within buildings shall be insulated in accordance with Table 10, except as shown in paragraph 5.8.1.

5.8.1 EXCEPTIONS - Piping insulation is not required in the following cases:

a. Piping installed within HVAC equipment.
b. Piping at temperatures between 60°F. and 120°F.
c. When the heat loss and/or heat gain of the piping, without insulation, does not increase the new energy requirements of the building.

5.8.2 OTHER INSULATION THICKNESSES: Insulation thicknesses in Table 10 are based on insulation having thermal resistances in the range of R=4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 or may be reduced for materials having R values greater than 4.6 per inch of thickness.

a. For materials with thermal resistance greater than R=4.6, the insulation thickness may be reduced as follows:

$$\frac{4.6 \times \text{Table 5 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

b. For materials with thermal resistance less than R = 4.0, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 5 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

c. For domestic hot water systems see Section 7.

5.9 AIR HANDLING DUCT SYSTEM INSULATION: All ducts, plenums and enclosures installed in or on buildings shall be insulated as follows:

5.9.1 All duct systems, or portions thereof, where the temperature differential between the air surrounding the duct and the design temperature of the air in the duct exceeds 30°F., shall be thermally insulated (externally of internally) to provide a minimum thermal resistance of R = 4.0, exclusive of film resistances. The thermal resistance of the duct insulation shall be increased by R = 1 for each increase of 25°F or fraction thereof over the 30°F. temperature differential.

5.9.2 EXCEPTIONS - Duct insulation is not required in the following cases:

a. Ducts installed in basements and cellars for either supply or return air in residential construction.
b. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.
c. Within HVAC equipment.

5.9.3 Uninsulated ducts in uninsulated sections of exterior walls are unacceptable and will not meet the requirements of this Standard.

5.9.4 The required thermal resistances do not consider condensation. Additional insulation may be required to prevent condensation under some conditions.

5.10 DUCT CONSTRUCTION: All ductwork shall be constructed and erected in accordance with the ASHRAE Handbook or the following SMACNA standards:

a. Residential Heating and Air Conditioning Systems - Minimum Installation Standards, August 1973.
b. Low Velocity and Duct Construction Standards, 4th Edition, 1969.
c. High Velocity Duct Construction Standards, 2nd Edition, 1969.
d. Fibrous Glass Duct Construction Standards, 3rd Edition, 1972.
e. Pressure Sensitive Tape Standards, 1973 (where required in paragraph 5.10.2).

5.10.1 High pressure and medium pressure ducts shall be leak tested in accordance with the applicable SMACNA standard.

5.10.2 There is no standard at this time for leak testing of low pressure ducts. When low pressure ducts are located where the air leakage loss is nonbeneficial, then all transverse joints shall be sealed using mastic and/or tape.

Table 10 - Minimum Pipe Insulation

Piping System Types	Temperature Range - F	Insulation Thickness in Inches for Pipe Sizes*				
		1" and less	1¼-2	2½-4	5&6	8" and larger
Heating Systems Steam & Hot Water						
High Pressure/Temp	306-460	2	2½	3½	4	4½
Medium Pressure/Temp	251-305	1½	2	2½	3	3½
Low Pressure/Temp	201-250	1	1½	2	2½	3
Low Temperature	140-200	1	1½	1½	2	2½
Steam Condensate (for Feed Water)	Any	1	1½	2	2	2½
Cooling Systems						
Chilled Water	40-60	1	1	1	1	1
Refrigerant or Brine	Below 39	1	1½	1½	1½	1½
Heating and/or Cooling Systems Runouts to Individual Units. (not exceeding 12' in length)	Below 39	3/4	1½	1½	1½	1½
	40-60	3/4	1	1	1	1
	140-200	3/4	1½	1½	2	2½
	201-250	3/4	1½	2	2½	3
	251-305	3/4	2	2½	3	3½
	306-460	3/4	2½	3½	4	4½
	Stm.Cond.	3/4	1½	2	2	2½

* See 5.8.2

SECTION 6

6.0 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT

6.1 SCOPE: This section deals with the equipment performance and manufacturer's documentation in accordance with the criteria for efficient utilization of energy established in this standard for HVAC equipment used in new buildings.

6.2 COOLING SYSTEMS EQUIPMENT, ELECTRICALLY OPERATED: Cooling systems equipment whose energy input is entirely electric shall, at the conditions specified in Table 11, show a Coefficient of Performance-Cooling (or Energy Efficiency Ratio) not less than those shown in Table 12.

Table 11 - Rating Conditions for COP

Item	Temperatures, °F. DB	WB	Inlet	Outlet
Return Air (entering equipment)	80	67	-	-
Outdoor Ambient (air-cooled)	95	75	-	-
Condenser Water (water cooled)	-	-	85	95

Table 12 - Minimum COP (EER), Cooling

Effective Date	Standard Rating Capacities: Under 65,000 Btu/hr	65,000 Btu/hr and over
	COP (EER)	COP (EER)
Beginning January 1, 1977	1.8 (6.1) 1.97 KW/Ton	2.0 (6.8) 1.76 KW/Ton
Beginning January 1, 1980	2.0 (6.8) 1.76 KW/Ton	2.2 (7.5) 1.60 KW/Ton

6.2.1 These standards apply to unitary cooling equipment (both air-cooled and water-cooled), the cooling mode of unitary heat pumps (both air-source and water-source), packaged terminal air conditioners, room air conditioners, and applied systems. The COP values shall include the inputs to all compressors, fans, blowers and pumps.

6.2.2 Cooling systems using equipment combinations that have a total electric input, which may or may not consist of components that are shipped and mounted separately within the building HVAC systems, shall have a coefficient of performance which includes, but is not necessarily limited to, the energy consumed by all system refrigerant compressors, fans and pumps.

6.2.3 The cooling systems may consist of unitary cooling equipment (air-cooled, evaporatively cooled or water-cooled), cooling mode of unitary heat pumps (air or water source), packaged terminal air conditioners, room air conditioners, or larger applied systems consisting of several components in a field built-up system.

6.2.4 In applied systems, where components from several equipment suppliers are to be utilized, it shall be the function of the system designer to determine the full-load system COP, using data from the equipment supplier(s) as a means of determining compliance with Table 12.

6.3 COOLING SYSTEMS, HEAT-OPERATED (ABSORPTION) WATER-CHILLING EQUIPMENT: The performance of heat-operated (absorption) water-chilling equipment shall be based not only on the components included in the unit but shall include cooling tower fans, pumps and other parts of the complete system, which are supplied separately.

6.3.1 PERFORMANCE: Absorption water-chilling units, employing steam or hot water as the energy source, and water-cooled absorbers and condensers shall comply with the requirements of ARI Standard for Absorption Water-Chilling Packages, 560-74. Direct-fired, absorption water-chillers and air conditioners shall comply with ANSI Standard for Gas-Fires Absorption Summer Air-Conditioning Appliances, Z21.40.1-73.

6.3.2 EFFICIENCY LIMITATION: Heat-operated cooling equipment shall show a COP not less than as listed in Table 13 when tested at Standard Rating Conditions established in the applicable standards referenced in paragraph 6.3.1, except when:

a. It is supplied by recovered energy, such as steam rejected from another process.
b. It is used in areas where restrictions on electrical energy are present on new construction.
c. It is used in systems requiring air conditioning that is independent of local power sources (standby) for critical applications, i.e., hospitals, essential electronic processing systems, etc.

6.3.3 In applied systems where components from several equipment suppliers are to be utilized, it shall be the responsibility of the system designer to determine the full load system COP using data from the equipment supplier(s) to determine the energy consumption of the system as applied in the building in the cooling mode, as a means of determining compliance with Table 13.

Table 13

Minimum COP-Cooling, Heat-Operated Cooling Equipment

	Standard Rating Capacities	
	Under 65,000 Btuh	65,000 Btuh and over
Beginning January 1, 1977	0.45	0.50
Beginning January 1, 1980	0.50	0.55

6.4 SEASONAL COOLING COEFFICIENT OF PERFORMANCE (COP): Building cooling systems, and associated equipment for most applications, will typically operate at 100% of design capacity for a maximum of 5% of the total operating hours in an average year. Equipment part-load performance data is therefore an important requirement of this Section. This information will allow the system designer to calculate the estimated yearly energy consumption of the proposed HVAC system and equipment in the building, when designed in accordance with Sections 4 through 9.

6.4.1 To assist designers and purchasers in their selection of energy conserving equipment and systems, the manufacturers of cooling equipment shall provide, upon request, information so that the designer can compute columns 3 and 4 of Form 1 or Form 2, at outdoor ambient conditions as applicable.

6.4.2 The system designer may then construct building system load vs. outdoor ambient curves and, by means of tabular weather data*, arrive at the total annual cooling hours that occur at each outdoor ambient segment. By performing the operations indicated in Form 1 or 2, it is possible to sum up all values and obtain a seasonal cooling energy requirement and coefficient of performance. Adjustments are necessary for any standby energy input(s), e.g., continuously-operated pumps or fans, crankcase heaters, control system power, etc.

6.4.3 As an alternate, the system designer may elect to establish the building cooling energy estimate using a dynamic computerized energy analysis which calculates building system and equipment energy consumption in a more detailed manner.

*Engineering Weather Data Manual NAVFAC-P-89, Dept. of the Navy, Navy Publication and Printing Service, Building 157, Washington Navy Yard, Washington, D.C., 20390

6.5 COMBUSTION HEATING EQUIPMENT: The equipment supplier shall furnish data as specified in paragraph 6.10. In the case of boilers not listed under a nationally recognized certification program, the manufacturer's rating shall be accepted, subject, at the designer's option, to a performance test in accordance with the ASME Power Test Code for Steam Generating Units, PTC 4.1 - 64. In the case of forced warm air heaters (central furnaces) not so listed, the manufacturer's rating shall be accepted, subject, at the designer's option, to an acceptance test in accordance with the ANSI Standard for Gas-Fired Heavy-Duty Forced-Air Heaters Z83.5-67 (Rev. 1972). ANSI Standard for Oil-Powered Central Furnaces Z91.1-72, as applicable.

6.6 HEAT PUMPS, HEATING: Heat-pump heating systems, whose energy input is entirely electric shall have a COP heating not less than shown in Table 14 at the conditions stated therein. The indoor temperature for these rating conditions is 70F.

Table 14

Minimum COP - Heating Heat Pumps

	Air Source			Water Source[1]
	Outdoor Air Temperature, °F.			Entering Water Temperature, °F.
	DB/WB 45/43	DB/WB 20/19	DB 0	60
Beginning Jan. 1, 1977	2.2	1.4	Permit shut-off	2.2
Beginning Jan. 1, 1980	2.5	1.7	1.0	2.5

1. Water flow rate to be as determined in the cooling test.

6.6.1 SUPPLEMENTARY HEATER CONTROL: The heat pump shall be installed with a control system to prevent electric resistance, supplementary heater operation when the steady state heating load can be met by the heat pump alone. A two-stage room thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement.

6.6.2 SEASONAL PERFORMANCE FACTOR-HEATING (Air Source Heat Pump): The Seasonal Performance Factor (SPF)-Heating for heat pumps is defined as the ratio of the heat delivered to the conditioned space during the full heating season to the energy input in consistent units. To assist designers and purchasers in their selection of air-source heat pump equipment, manufacturers shall provide, upon request, information so that the SPF can be determined. Form 3 can be used to calculate SPF. Manufacturers shall provide information so that the designer can complete columns "E" and "G" of this form. This calculation procedure takes into account all system energy requirements, including defrost operations and supplementary heat. The weather information is available from the same source as that used for calculating cooling energy requirements and seasonal cooling efficiency (paragraph 6.4.2).

6.7 ELECTRIC RESISTANCE SPACE HEATING EQUIPMENT: The manufacturer of electric resistance space heating equipment shall make available to prospective purchasers, designers or contractors, upon request, full load energy input and output, over the range of voltages at which the equipment is intended to operate.

6.8 ANNUAL ENERGY REQUIREMENTS AND COEFFICIENTS OF PERFORMANCE: For all buildings over 5,000 sq. ft. gross floor area, the system designer shall compute the total amount of fuels and electricity required to cool and to heat the building during a typical year. The Heating Seasonal Performance Factor (where applicable) and the Cooling Seasonal COP shall also be determined.

6.9 MAINTENANCE: Equipment which requires periodic routine maintenance, to maintain efficient operation, shall be furnished complete with the necessary maintenance information. Required routine maintenance actions shall be clearly stated as required and incorporated on a permanent label, affixed in a readily accessible location on the equipment. The label may be limited to identifying required actions that are explained in greater detail in an operation and maintenance manual. The label should identify, by title and/or publication number, the operation and maintenance manual for that particular model and type of product. At least one copy of each required manual shall be furnished by the manufacturer to the original owner upon request.

6.10 RESPONSIBILITY OF EQUIPMENT SUPPLIERS: Suppliers of HVAC equipment shall furnish, upon request by prospective purchasers, designers, or contractors, the full and partial capacity and standby input(s) and output(s) of all equipment, and components of applied systems, based on equipment in new condition, to enable determination of their compliance with this standard. This includes performance data under all modes of operation and at all ambient conditions necessary to make the analysis outlined in this standard.

6.10.1 Performance data furnished by the equipment supplier or certification under a nationally recognized certification program, when available, satisfies this requirement when all energy input(s) and output(s) and operating modes are included.

SECTION 7

7.0 SERVICE WATER HEATING

7.1 GENERAL: Hot water for domestic, sanitary, and swimming pool purposes shall be generated and delivered in a manner conducive to saving heat energy. When possible, heat recovery shall be used for a portion of the water heating requirements.

7.2 SCOPE

7.2.1 The purpose of this section is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating. The selection of the specific fuel (as with the specific equipment or system) is left to the designer. Fuel availability (both locally and as a national resource), generation, transmission capacity, efficiency, and local and national energy policies will require consideration and assessment before selection.

7.2.2 It is not the intention of this section to develop either a procedure or method for designing a water distributing system, other than to offer criteria which, when applied, will reduce unnecessary uses of energy. For a more complete systems design guide, the reader should consult the 1973 ASHRAE Handbook-Systems, Chapter 37, Service Water Heating.

7.3 WATER HEATERS, STORAGE TANKS, BOILERS, AND PIPING

7.3.1 PERFORMANCE EFFICIENCY

7.3.1.1 All automatic, electric, storage water heaters shall have a stand-by loss not exceeding 4 watts per square foot ($43 W/m^2$) of tank surface area. The method of test of stand-by loss shall be as described in Section 4.3.1 of ANSI-C72.1-72-Household Automatic Electric Storage-Type Water Heaters.

7.3.1.2 All gas and oil-fired, automatic, storage heaters shall have a recovery efficiency, E_r, not less than 75% and a stand-by loss S, not exceeding 7%. The method of test of E_r and S shall be as described in Section 2.7 of ANSI Z21.10.3-74-Circulating Tank, Instantaneous and Large Automatic Storage Type Water Heaters, Approval Requirements for Gas Water Heaters, Volume III, including Addenda Z21.10.3a-1972 and Z21.10.3b-1972; except that for oil-fired units CF = 1.0, Q = total gallons of oil consumed, and H - total heating value of oil in Btu/gallon.

7.3.2 COMBINATION SERVICE WATER HEATING/SPACE HEATING BOILERS: Subject to the exceptions noted below, service water heating equipment shall not be dependent on year-round operation of space heating boilers; that is, boilers that have as their only function winter space heating. Exceptions to this provision are: boiler/space heating systems where boiler capacity is less than 120% of the service water heating demand of boiler/space heating systems, regardless of usage, which have a minimum overall system efficiency of no less than 65% based on total annual energy usage.

7.3.3 INSULATION

7.3.3.1 Heat loss from unfired hot water storage tanks shall be limited to a maximum of 35 Btu/hr/sq.ft. (47 W/m^2) of external tank surface area.

7.3.3.2 Heat loss shall be limited to a maximum of 25 Btu/hr/sq.ft. (79 W/m^2) of pipe surface from above ground external piping and a maximum of 35 Btu/hr/sq.ft. (110 W/m^2) of external pipe surface for underground piping and recirculation systems.

7.3.4 POINT OF USE OR INSTANTANEOUS APPLICATIONS: Where point of use or instantaneous water heaters will reduce overall energy consumption, their use should be considered.

7.4 TEMPERATURE CONTROLS: Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use (see Table 1 from ASHRAE 1973 Handbook-Systems, Chapter 37). Thermostats in water heaters serving more than one function may be set to deliver water at the maximum temperature.

7.5 PUMP OPERATION: Circulating hot water systems shall be arranged so that the pump energy consumption is low, consistent with correct operation of the pump. Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off (automatically or manually) when the hot water system is not in operation.

7.6 CONSERVATION OF HOT WATER

7.6.1 Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 2gpm m^3/s (1.9×10^{-4}) per shower head.

7.6.2 Lavatories in restrooms of public facilities should be equipped with push button, slow closing valves set to deliver no more than one gallon at a time.

7.7 SWIMMING POOLS: Consideration of heating swimming pools by solar heat, air conditioning condenser water or waste heat is encouraged. Swimming pools for other than therapeutic purposes shall be equipped to be heated to no more than $80^{o}F.$ ($26.7^{o}C.$).

SECTION 8

8.0 ELECTRICAL DISTRIBUTION SYSTEMS

8.1 SCOPE: The electrical distribution system in a building shall be designed for efficient distribution of energy from the service entrance to the point of use.

8.2 POWER FACTOR: Utilization equipment, rated greater than 1,000 watts, and lighting equipment, with an inductive reactance load component, shall have a power factor of not less than 85% under rated load conditions. Utilization equipment with a power factor of less than 85% shall be corrected to at least 90% under rated load conditions. Power factor corrective devices, installed to comply with this criterion, shall be switched with the utilization equipment, except where this results in an unsafe condition or interferes with the intended operation of the equipment.

8.3 SERVICE VOLTAGE: The available service voltage shall be so selected as to minimize energy losses.

8.4 VOLTAGE DROP: In any building, the combined voltage drop in the feeders and branch circuits shall not exceed the recommended total voltage drop of the ANSI-C1 1971 Standard-National Electrical Code (NFPA 70-1971).

8.5 LIGHTING SWITCHING: Switching shall be provided for each lighting circuit, or for portions of each circuit, so that the partial lighting required for custodial or for effective complementary use with natural lighting may be operated selectively.

8.6 ENERGY USE DETERMINATION: In any multi-tenant building, provisions shall be made to separately determine the energy consumed by each tenant. Hotels, college dormitories, and other transient facilities are excluded from the provisions of this paragraph.

SECTION 9 - LIGHTING SYSTEMS

9.0 GENERAL: An allowable total connected load for installed lighting shall be established by using the criteria in this section and the calculation procedures recommended by the Illuminating Engineering Society in the 5th Edition of the IES Lighting Handbook, hereinafter referred to as the "Handbook".

9.0.1 PURPOSE: The requirement for calculating the connected load in the manner specified is:

a. To provide a uniform method for establishing permissible power consumption, and
b. To institute energy conserving lighting design practices while allowing for maximum freedom of design, including the use of inefficient lamps in a trade-off approach, provided the total power demand does not exceed the calculated load.

9.0.2 CRITERIA: The use of more efficient lamps and luminaires than specified, and the use of luminaires providing for heat removal and/or recovery, is encouraged in actual design to allow for additional savings in energy.

9.1 SCOPE: In establishing a lighting load, the illumination in any space within a building shall be based on the use for which the space is intended, and on efficient utilization of energy. The actual illumination design is to be coordinated with the envelope and other system designs.

9.2 ILLUMINATION LEVELS: For the purpose of establishing a load the levels of illumination shall be no greater than those recommended in the Handbook, Figure 9-80, and ANSI Standards covering lighting practices. Those levels shall be used as follows:

9.2.1 TASK LIGHTING: In most cases, the levels of illumination listed in the Handbook, Figure 9-80, are for specific tasks. In some cases, however, the levels of illumination are listed for locations (auditoriums, etc.), and these levels shall be considered average levels.

9.2.2 GENERAL LIGHTING: In areas surrounding task locations the maximum average level of brightness shall be 1/3 the level for the tasks performed in the area. Where more than one task level occurs in a space, the general level shall be 1/3 the average of the task levels determined.

9.2.3 NONCRITICAL GENERAL LIGHTING: In circulation and seating areas, and other seldom occupied spaces or those in which no critical visual tasks occur, the maximum average levels of illumination shall be 1/3 of the average general lighting in the adjacent task spaces, but not less than one footcandle or OSHA recommended levels for safety.

9.3 LIGHTING SYSTEMS: For the purpose of establishing a load, only efficient lamps and luminaires shall be used, as follows:

9.3.1 EFFICIENT LAMPS: Efficient lamps are defined herein as those producing at least the following initial lumen output per watt input, including ballast losses, as listed by manufacturers,

a. Where color rendition is not of significance or use of higher wattage lamps is appropriate, 55 lumens/watt.
b. Where moderate color rendition is appropriate, 40 lumens/watt.
c. Where high color rendition is appropriate, or spaces are less than 50 sq.ft., or where use of low wattage high-intensity discharge lamps under 250 watts or flourescent lamps under 40 watts is appropriate, 10 lumens/watt.

9.3.2 EFFICIENT LUMINAIRES: Efficient luminaires are defined herein by Room Cavity Ratio (RCR) = 1 values according to space use. An efficient luminaire for use in each space described below shall have a Coefficient of Utilization (CU) for RCR = 1 of at least the value listed for that space.

a. For spaces with tasks subjected to veiling reflections and where visual comfort is important, CU = 0.55.
b. For spaces without tasks or with tasks not subjected to veiling reflections but where visual comfort is important, CU = 0.63.
c. For spaces without tasks and where visual comfort is not a criterion, CU = 0.70.

9.4 LOAD CALCULATIONS: In establishing the load, the lighting calculation procedures recommended in the Handbook shall be used, utilizing efficient lamps and luminaires, except as follows:

9.4.1 REFLECTANCES: For interior spaces the following initial cavity and surface reflectance shall be assumed:

a. Ceiling Reflectance - 80%
b. Wall Reflectance - 50%
c. Floor Reflectance - 30%

9.4.2 LIGHT LOSS FACTOR: A light loss factor of 0.70 shall be used, as a minimum, accounting for lumen depreciation and dirt accumulation.

9.4.3 EXCEPTIONS: The criteria of Sections 9.3.1 and 9.3.2 shall not apply to:

9.4.3.1 The following lamps and luminaires, however their use shall be accounted for in the calculation of task lighting loads for specific tasks. The allowable load shall be based on the luminaire wattage to achieve the levels of illumination as covered in Section 9.2 using a point calculation method given in the Handbook.

a. Luminaires for medical and dental diagnostic or surgical purposes.

b. Luminaires for highlighting applications, such as sculpture exhibits, art exhibits, and individual items of display merchandise.
c. Luminaires for specialized lighting applications, including color matching, where electrical interference cannot be tolerated, etc.
d. All residential occupancies.
e. Similar residential areas in institutions, such as hospitals.

9.5 USAGE:

9.5.1 Lighting in task areas larger than 100 sq.ft. can be reduced by at least 50% when the task is not being performed or is relocated.

9.5.2 In any space requiring two or more branch circuits for lighting, switching shall be provided for each circuit or for portions of each circuit, so that a portion of the lighting system adequate for custodial or maintenance purposes or for effective complementary use of natural and artificial lighting may be operated without switching on/off all of the lighting in that space.

9.5.3 Lighting can be reduced or turned off where day-lighting is adequate and can be used effectively.

9.6 EXTERIOR LIGHTING: The illumination for exterior lighting shall conform to Sections 9.2 and 9.3, using at least the minimum luminaire efficiencies as listed in the Handbook, Figure 9-64. The beam lumen method shown in the Handbook, and a Coefficient of Beam Utilization of 0.75, shall be used for calculations. Illumination design shall be based upon the use for which the area is intended.

9.6.1 FACADE LIGHTING: Building facade lighting, including signs, shall be no greater than 1,000 watts, or 2% of the total interior lighting load of the building, whichever is greater.

9.7 DOCUMENTATION: In selecting illumination levels and lighting system criteria, all data, assumptions, and calculations used in establishing the total lighting load shall be shown for three (3) of the areas with the highest levels of illumination. The basis for all assumptions shall be given, and total lighting wattage per square foot for the entire structure shall be indicated.

9.7.1 Charts and/or tables may be used to simplify calculations provided they are prepared in accordance with procedures recommended in the Handbook.

SECTION 10

10.0 ENERGY SOURCE AND COST CALCULATIONS

10.1 ENERGY USE CALCULATION: An energy use calculation shall be prepared for each proposed building, giving the estimated total annual energy required and the estimated total energy required for the first ten (10) years of the life of the building, based on the input to the building site. Energy use shall be separately identified for at least the following subcategories: space heating, space cooling, service water heating and illumination. For building projects totaling more than 5,000 sq. ft. of gross floor area, such energy use calculation shall be performed and certified by a registered professional engineer or architect. For each type of fuel or power, the quantity of energy required shall be converted to a common equivalent energy basis for the purpose of comparing the total energy used. Simplified energy analysis, such as bin or degree-day methods, details of which can be found in Chapters 11 and 43 of the 1973 ASHRAE Handbook-Systems, may be used for this analysis. The contractor or other person responsible for the design of building projects under 5,000 sq. ft. of total gross floor area may prepare energy use calculations in compliance with this paragraph in lieu of preparation and certification by a professional engineer or architect.

10.1.1 ALTERNATE ENERGY SOURCES: If more than one type of energy source is available or could readily be made available to the proposed building project, the energy use calculation prepared in compliance with 10.1 shall include at least two different types or combinations of types of fuel or power suitable for supplying the space heating, space cooling, and service water heating components of the total annual energy required by the building project.

10.1.2 ENERGY SUPPLY COMPARISON: For each energy use calculation prepared in compliance with 10.1.1, an energy supply calculation shall be prepared by the person stipulated in 10.1, giving the sum of the estimated annual prime energy input directly to the boundary of the building project plus the estimated annual prime energy input (see Equivalent Energy Consumption) to any off-site energy conversion processes which provide refined energy to the building project. The procedures stipulated in 10.1.3 shall be used as a basis for calculating the equivalent energy consumption.

10.1.3 EFFECTIVE HEAT RATE FOR OFF-SITE ENERGY REFINEMENT PROCESSES: An effective heat rate shall be obtained for each off-site energy refinement process supplying energy to the building project, using the method stipulated in 10.1.3.1 through 10.1.3.6 as appropriate. (See Definitions Section for Effective Heat Rate, Energy Refinement Efficienty, Equivalent Energy Consumption, and Refined Energy Source.)

10.1.3.1 FUEL-FIRED CENTRAL UTILITY--ELECTRIC ONLY OR DISTRICT HEATING/COOLING ONLY: The effective heat rate may be obtained from the utility(s) serving the building project. If such a utility sells energy which is generated in more than one franchise area, the overall effective heat rate shall be calculated by the serving utility based on all the effective heat rates, weighted in proportion to the transfers of energy over a seasonal or annual period, as appropriate.

10.1.3.2 NATIONAL AVERAGE EFFECTIVE HEAT RATE: If supporting data are unavailable from utilities, estimated national average values shall be based on reports of the Federal Power Commission or the Edison Electric Institute, or on Table 5 and the Appendices to "Energy and the Environment - Electric Power," Council on Environmental Quality, August 1973.

10.1.3.3 FUEL-FIRED CENTRAL UTILITY - ELECTRIC PLUS DISTRICT HEATING/COOLING, OR OFF-SITE TOTAL ENERGY PLANT: The effective fuel rate for purchased electricity,steam, hot water or chilled water from a fuel-fired combination electric plus district heating/cooling plant or off-site total energy plant shall be based on the overall plant thermal efficiency for all processes, calculated for the appropriate season of operation.

10.1.3.4 NUCLEAR CENTRAL UTILITY - ELECTRIC ONLY: The effective heat rate for nuclear central utilities selling electricity only shall be computed the same as for fossil fuel-fired electric utilities, except that the energy input to the energy conversion process shall be based on the total thermal energy (useful plus waste heat) that is generated by the nuclear fuel.

10.1.3.5 NUCLEAR CENTRAL UTILITY - ELECTRIC PLUS DISTRICT HEATING/COOLING: The effective heat rate for purchased electricity, steam hot water or chilled water from a nuclear energized combination electric plus district heating/cooling plant shall be based on the overall plant thermal efficiency for all processes, calculated for the appropriate season of operation. The energy input to the energy conversion process shall be based on the total thermal energy (useful plus waste heat) that is generated by the nuclear fuel. For such combination plants using nuclear breeder or fusion processes, and in which a minimum of 50 percent of the waste heat is sold, the effective heat rate shall be taken as zero. See "Effective Heat Rate", Section 3 Definitions.

10.1.3.6 HYDROELECTRIC, SOLAR OR GEOTHERMAL CENTRAL UTILITY: The energy refinement efficiency for an off-site hydroelectric (without pumped storage), solar electric, or geothermal central utility that sells only energy generated or recovered within its service area shall be taken as 91 percent, to cover final distribution losses. Where hydroelectric (without pumped storage), solar electric or geothermal energy is transferred between service areas, the equivalent of an effective heat rate shall be determined as specified in 10.1.3.1. The energy refinement efficiency of pumped storage hydroelectric plants shall take into account the energy used for pumping.

10.3 EXCEPTION: Buildings deriving at least 50 percent of their total annual energy requirement from on-site solar or wind energy sources need not comply with the requirements of 10.1.1.

SECTION 11 - ENERGY REQUIREMENTS FOR BUILDING DESIGNS BASED ON SYSTEM ANALYSIS

11.0 SCOPE: Alternative building and system designs shall be accepted that can be shown to reduce the total energy supplied to a similar building which would have followed each of the detailed requirements of Sections 4 through 9 of this standard.

11.1 EQUIVALENT ANNUAL ENERGY CONSUMPTION: Under the provisions of this Section, the designer may propose any design of building and energy-using service systems for which the total annual amount of those forms of building energy covered by Sections 4 through 9 (expressed as equivalent Btu's or equivalent Kwh) is less than that for the building and systems designed according to Sections 4 through 9 of this standard.

11.1.1 BASIS FOR COMPARISON: The standard building and service systems designed according to Sections 4 through 9 of this standard and used as the basis of comparison to the proposed alternate building and systems shall meet the criteria of accepted common practice in the geographic region for the given type of usage, except for those specific items where such common practice conflicts with the requirements of Sections 4 through 9. All sources of energy usage by both designs (standard and proposed alternate) covered under the provisions of Sections 4 through 9 shall be included in the comparison. Common climatic data, building occupancy, and operational schedules of both basic building service systems and HVAC systems shall be used in the comparison. Where similar types of equipment are applicable to the standard and proposed alternative designs, similar equipment characteristics shall be used in the comparison.

11.2 ANALYSIS PROCEDURE: The analysis of the annual energy usage of the standard and the proposed alternative building and systems designs shall meet the following criteria:

11.2.1 The building heating/cooling load calculation procedure used within or as the basis for the annual energy consumption analysis shall be of sufficient detail to permit the identification of the annual energy savings resulting from the proposed alternative building design features.

11.2.2 The calculation procedure used to simulate the operation of the building and its service systems through a full-year operating period shall be of sufficient detail to permit the evaluation of the effect of system design and operational characteristics (such as space temperature and humidity control supply airflow and temperature, outside air quantities, lighting and occupancy schedules) and mechanical plant characteristics (such as part-load profiles, sequencing and accessories) on annual energy usage. Manufacturer's data or comparable field test data shall be used, when available, in the simulation of all systems and equipment. The calculation procedure shall utilize simulation techniques similar to the current recommendations in the appropriate ASHRAE publication or produce results consistent with such recommended procedures.

11.3 DOCUMENTATION: Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis comparison report prepared by a registered professional engineer or architect. The report must provide sufficient technical detail on the two building and systems designs and on the data used in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of paragraphs 11.1 through 11.2.2.

11.4 EXCLUSION: Proposed alternative designs for residential and light commercial structures of less than 5,000 sq. ft. shall be exempted from the requirement of a full-year energy system analysis as a criteria for departure from the design requirements of Sections 4 through 9, providing a registered professional engineer from the geographic region concurs in writing that the specific proposed alternative design would be expected to have a lower annual energy consumption than a similar building and service systems designed according to Sections 4 through 9.

SECTION 12 - REQUIREMENTS FOR BUILDINGS UTILIZING SOLAR OR WIND POWERED ENERGY SOURCES

12.0 GENERAL: When a proposed alternative building and service system design submitted and evaluated in accordance with Section 11 of this standard utilizes solar or wind power for all or part of its energy source, the solar or wind-powered energy supplied to the building shall be excluded from the total energy chargable to the proposed alternative design. To qualify for this exclusion, solar energy must be derived from a specific collection, distribution device. Natural solar energy passing through windows shall not qualify for the exclusion, but may contribute to a reduction in overall energy usage under the terms of Section 11. All other criteria covered in Section 11 shall apply to the proposed alternative design utilizing solar or wind power.

12.1 SCOPE: An energy bonus shall be granted to buildings designed to use solar or wind powered energy sources to supply part or all of the building energy requirements.

12.2 DOCUMENTATION: Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis comparison report prepared by a registered professional engineer or architect. The report must provide sufficient technical detail on the two building and systems designes and on the data used in and resulting from the comparative analysis as to verify that both the analysis and the designs meet the criteria of paragraphs 11.1 through 11.2.2 and this Section. The energy derived from solar or wind-powered devices must be separately identified from the overall building energy use. Supporting documentation on the basis of the performance estimates of the solar or wind-powered devices must be submitted.

12.3 EXCLUSION: Proposed alternative designs for residential and light commercial structures of less than 5,000 sq.ft. which derive a significant part of their annual energy usage from solar or windpower shall be exempt from the requirement of a full-year energy system analysis, providing a registered professional engineer from the geographic region concurs that the solar or wind power is significant and that the overall building annual energy consumption would not exceed that of a building and service systems designed under the provisions of Sections 4 through 9.

Other commercial, institutional, and industrial structures which derive over 50% of their annual thermal energy requirements (heating, cooling, service water heating) or over 30% of their annual total energy requirements from solar or wind power shall be exempted from the necessity of comparing the proposed design to a standard design (which follows the specific provisions of Sections 5 through 9). Documentation verifying the percentage of annual energy use deriving from solar or wind power shall be required as provided in paragraph 12.2.