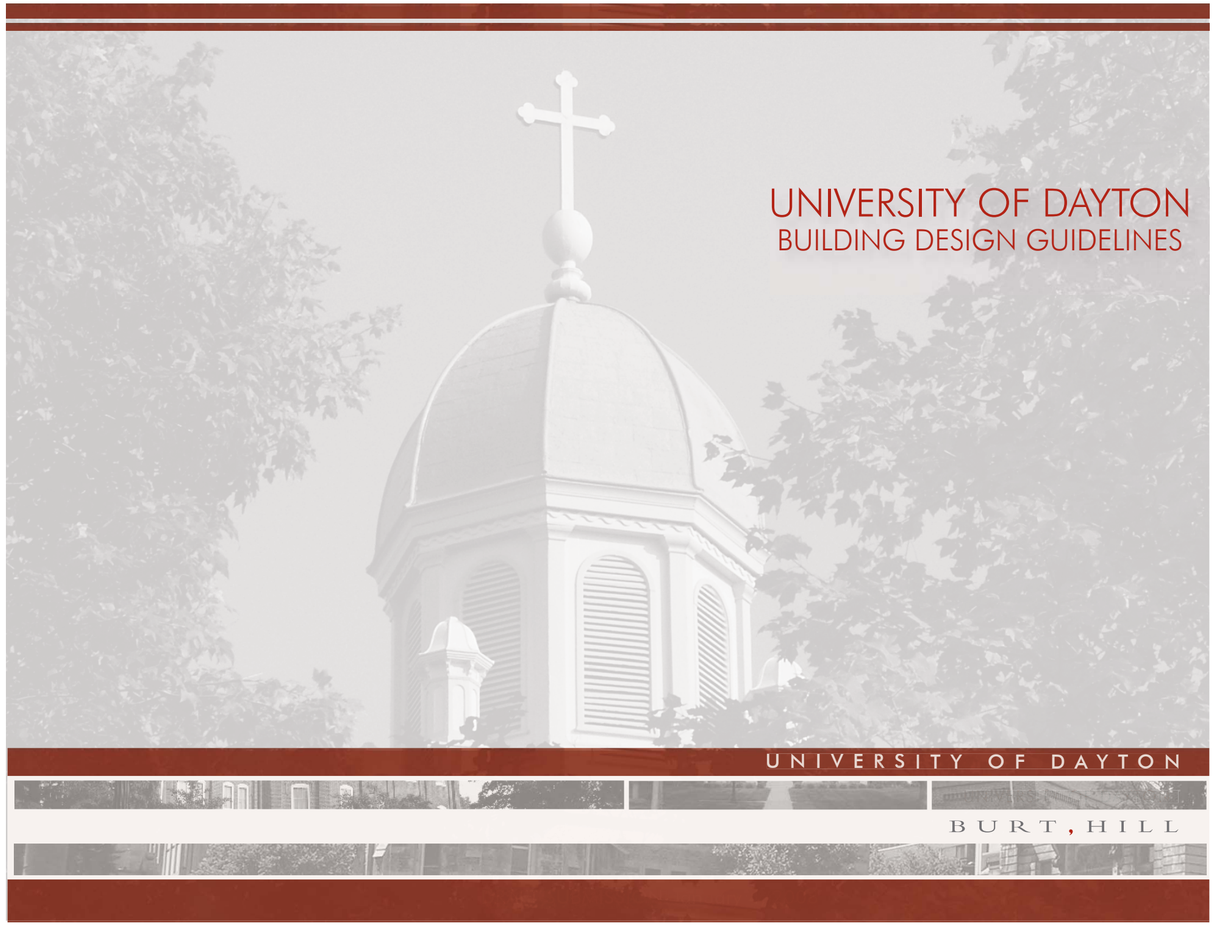
UNIVERSITY OF DAYTON
BUILDING DESIGN GUIDELINES
UNIVERSITY OF DAYTON
BURT, HILL

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Overview

PURPOSE OF THE GUIDELINES

The purpose of these design guidelines is to establish a set of criteria to which all future building on the University of Dayton Campus, including additions and renovations to existing buildings, shall abide. Through the criteria described herein and established through the architectural legacy of the University, future projects are to form a cohesive environment, respect and maintain the unique qualities of the University, and promote enrollment and endowment goals.

UD ARCHITECTURAL LEGACY

The growth of the University over its 150-year history has created a campus unique to its heritage and effective at fostering its ideals.

The historic core buildings of the Chapel of the Immaculate Conception, St. Mary's Hall, St. Joseph Hall, and Liberty Hall, among others, contain elements of the Italianate style common in the Midwest during the mid-to-late 19th century. The style was initiated during the English Picturesque movement, favoring the informal, rural models of the country house to the severe Classicism of other revival movements. For the University's first buildings, this was appropriate imagery, and was technologically sound and economically responsible.

With each succeeding era of expansion, the University's buildings similarly reflect the age in which they were built, being contemporary, while largely being sympathetic to the surrounding context in scale, color, materials, and connections. It is in this spirit that these Guidelines are developed, to continue this tradition while allowing for the flexibility required by building type, program, and budget.

PROCESS

In order to produce the best possible design results for the University, there will be a group of University representatives included in the design process of each project. This standing committee will review each project and assign individuals from appropriate University departments and outside consultants to be included in this process. Ultimately, the integration of design professionals and University representatives will bring success to the overall plan implementation.

Construction mockups for each new project's major materials are required (masonry, windows, roofing, trim). These mockups are to be reviewed and approved by the Administration Team.

Spatial Connections

Whether intentionally designed or leftover from an addition, the spaces between buildings help to create and frame numerous experiences. Many people pass through these spaces when traveling from building to building; individuals may stop to reflect, and others may use these spaces to enjoy a conversation with a colleague. These formal and informal outdoor rooms are linked throughout campus, carved from the areas between buildings, and manicured in a way that exhibits that these spaces are to be used by people.

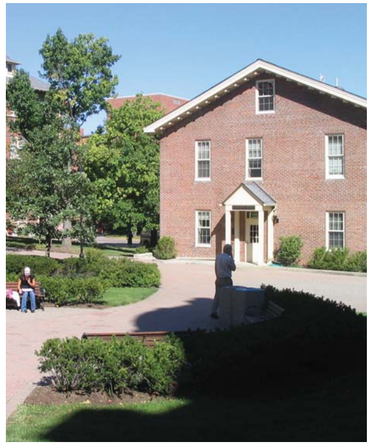
There is value in both the formal and informal arrangement of buildings on campus; it is in this theme that future architecture can reflect the importance of not only the structure, but also the design of the exterior environment including the entry, path, and place before arriving at the destination. Consideration of building orientation, axis, exterior space, sensitivity to existing context, and the dialogue created between structures is of utmost importance when thinking schematically about the future design of the campus.

CONTEXT

- In the campus context, the design of the space between buildings (i.e. negative space in the figure-ground relationship) is just as critical as the building object in creating a unique sense of place.
- All connections should embrace a sensitivity to design, including surface material treatments, lighting, plantings and furniture selection. These are further detailed in the Landscape Guidelines.

OUTDOOR ROOMS

- Buildings should frame the boundaries for outdoor rooms of varying scale and levels of intimacy/social participation.



The landscaped spaces framed by Liberty Hall, Humanities Center, St. Joseph Hall, and the Chapel help to form outdoor rooms, such as Nazareth Courtyard.

- Design should enhance the experience of moving through or occupying the outdoor spaces, each with an introduction, a body, and a denouement or conclusion before passing to the next.
- Successful models currently at the University of Dayton include the Humanities Plaza, Central Mall, the Chapel/St. Mary's garden, and Nazareth Courtyard.
- Accessibility for the disabled must be designed into the site transitions connecting outdoor spaces.

Elevation changes along the path act as thresholds and help denote separations of space within the campus network.

A sense of anticipation and arrival is set up by effective transitions to a space, as in the site wall opening to Chapel / St. Mary's Hall garden.

Alumni Hall frames the Humanities Plaza through its orientation, axial arrangement, and massing.

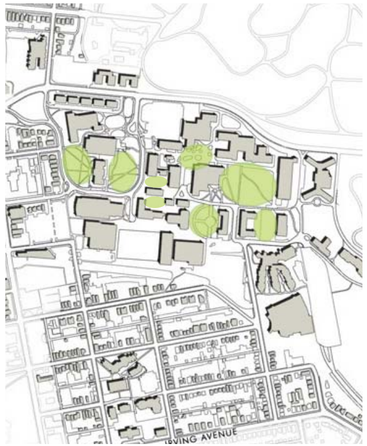


Diagram of existing outdoor room to building (open space) relationship throughout the University of Dayton campus.

ORIENTATION

- Primary façades should contain the primary entry and should be street-facing or outdoor-room facing.
- The principle orientation of the front façade of all buildings should be parallel, or nearly parallel, to the streets or outdoor room.
- The entry door should be a prominent, welcoming feature on the front façade and should not be excessively recessed from the face of the primary façade.
- Sensitivity to adjacent structures' orientation, entries, views and exterior space is important when designing future campus buildings.

DIALOGUE

- A dialogue between building façades should be established, with "fronts talking to fronts", and service areas or "backs" addressing similar conditions on neighboring buildings.
- When designing primary and secondary façades, thought should be geared toward how the building and site react to adjacent context. This may include building scale, material, datum lines, building use, and campus identity.

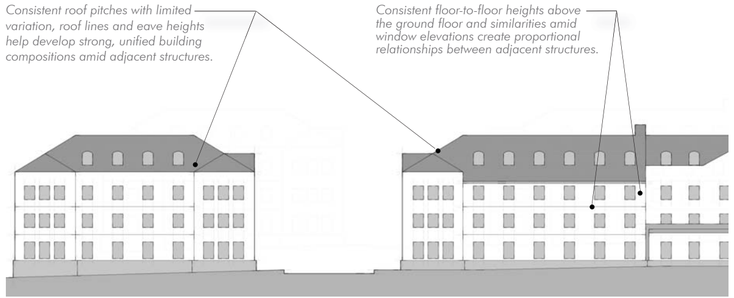
Massing & Scale

Massing is the three-dimensional bulk of a structure: height, width, and depth. Scale is the perceived relative height and bulk of a building relative to that of neighboring buildings. Proper scale, proportion, and details are essential when blending any new building into the existing campus fabric. The massing of new buildings must have a scale and form articulation that establishes ties to the older campus, reflecting an understanding of the University of Dayton's architectural tradition.

All new construction must respect the existing context and building relationships in order to maintain the established campus image. Where new buildings are to be significantly taller than adjacent ones, the massing should be transitional in order to minimize contrasts in scale.

Traditionally, building massing and scale have been broken down by a repetition of window fenestration, establishing a rhythm across the length of a building. Scale is broken down even more by providing a number of mullions within door and window fenestration proportional to those of human beings. Shadow lines created by the mullions and various façade movements help to add to this overall scale breakdown.

A combination of roof lines with varying roof heights adds visual interest and termination from the building form to the sky. Roof pitch should be consistent within individual structures, with no more than two pitch changes per primary structure.



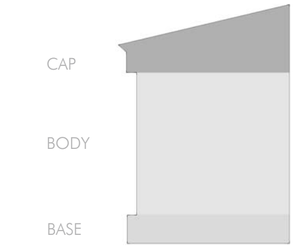
Campus building elevation massing and scale diagram.

Proposed schematic perspective of the new Campus Union, a future replacement of the Kennedy Union building which is presently used for student, faculty, and administrative functions, and is the center of campus dining.

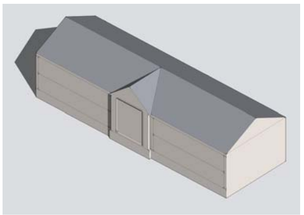
Taller buildings should be located on campus edges, as in the existing precedents of Miriam Hall and Marycrest Complex.

Sheer uninterrupted faces of masonry, glass curtainwall, stone panels, or other monolithic surfaces without scale are to be prohibited.

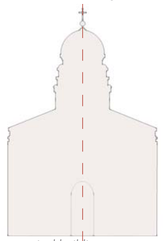
Articulated scale in larger building masses.



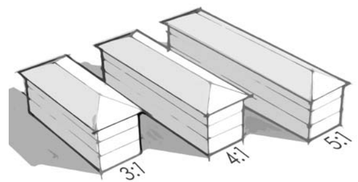
Three-part organization of a building section/façade.



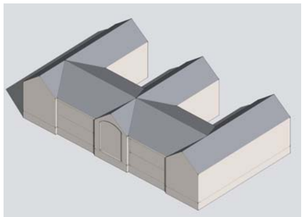
A central projected gable adds architectural formality, emphasizes symmetry, and announces entry.



Symmetrical building mass.



Long and narrow building ratio.



The use of gabled, projecting wings helps to frame the entry and provide optimal bays to maximize light.

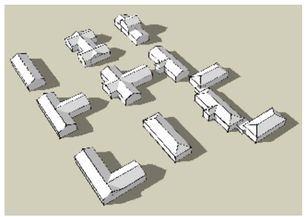
MASSING

- To promote outdoor room establishment, distribution of natural light to interiors, and natural ventilation, future buildings should generally be long and narrow, with a width to depth ratio of 3, 4, or 5:1.

- Composition of building mass is to be generally symmetrical. The use of gabled or pedimented projecting pavilions, L-shaped wings, and central porticos is common to achieve formality while reducing large structures to a more human scale. Important special function buildings (as determined by the Facilities Committee) may be further emphasized through the use of cupolas, attic stories, and similar elements. Although symmetrical building composition is preferred, asymmetrical composition is also compatible with the existing context.

- Where building type or program requires a larger, broad floor area, such as assembly and athletic facilities, the building mass should still be articulated. Smaller wings and additions to the main building mass will help modulate the scale. A precedent is the RecPlex, with its entry portico and clock tower. It transitions the scale from the adjacent street and student neighborhood to the larger volume of the main facility behind it.

- Subtle visual emphasis is to be given to the main or ground floor through door and window scale, architectural detailing, and greater floor-to-floor height on this level; detailing features designed to alter the perceived scale should also be employed. Buildings should employ a clearly delineated base, body, and cap.



These building block layouts are variations on linear form and indirectly create exterior rooms.

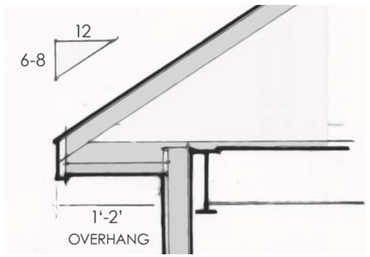
Roofscape

Special attention must be paid to the arrangements and design of the roof and its various elements. Roofs must be organized and designed as carefully as the other primary elements of the building. Equipment must be integrated into the building form or placed within enclosures well integrated with the roofscape.

In most cases, the major roof form should be sloped on a 6:12 or 8:12 pitch and must have overhangs proportional to the building's size and height.

Stacks, exhaust hoods, and vents must be grouped and incorporated into the architectural composition of the building or buildings they serve. Since they are visible from a considerable distance, it is important that they be designed with a high degree of uniformity so that the distant image is harmoniously composed or screened appropriately.

Southeast aerial view of campus; note the various existing roof pitches and massing.



Sloped roof overhangs are modest, projecting beyond façades no more than 1'-0" to 2'-0'.

ROOFS

- Existing roofs on historic buildings are gabled or hipped, cascading down from the higher building forms to the edges of buildings, respecting human scale.
- Eaves should be sensitive to the context of adjacent structures. Traditional proportions should be used wherever possible to keep within the language of the existing campus.

TRADITION

- The Campus precedent of pitched roofs is to be respected for buildings of moderate depth.
- Gabled and hipped roofs are a feature of the majority of the historic buildings on campus, with a common slope of 6:12 to 8:12.

MATERIALS

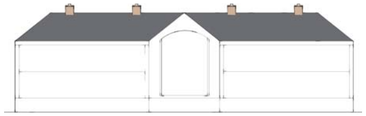
- Sloped roofing should be asphalt or composite slate, concrete, or fiber-reinforced shingles. These synthetic materials should be implemented at all opportunities due to their long life and ease of maintenance.

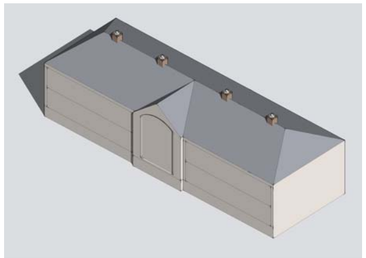
Northwest aerial view of campus; note the various existing roof pitches and massing.

- Low slope or flat roofs are to be built up.
- The use of single-ply membrane roofing is discouraged due to a short system longevity.
- Coordinate roof colors with existing context.

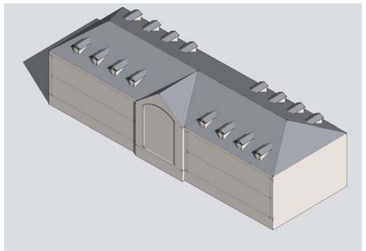
ELEMENTS

- Historic structures also include finer-scaled roof elements, such as dormers, chimneys, and cupolas. These features break down scale, lead the eye, and properly transition the building lines to the infinite sky, while also fitting into the context of existing structures.
- Roofscape elements such as dormers, cupolas, vents, or chimneys should support a program function and not be a decoration.
- Parapet walls may be employed at low slope or flat roofs to conceal exposed rooftop equipment.
- Other means to house or conceal rooftop equipment include full attic enclosures (such as St. Mary's Hall), equipment penthouses (similar ot those at Kettering Hall), or roof screen walls (as are utilized at the Science Center and the RecPlex).
- Mansard roof screens should not be used.



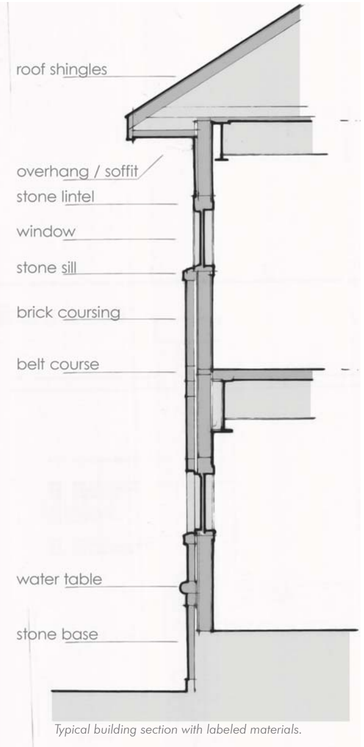


Use of chimneys helps transition the building lines to the sky.

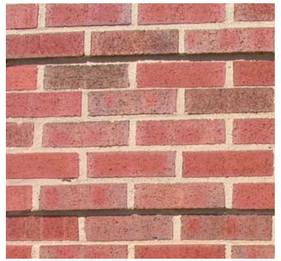


Use of dormers helps break down large-scale roofs.

Materials & Color



Typical building section with labeled materials.



Brick masonry

Indiana limestone

Clear or light bronze anodized aluminum for window and curtainwall framing

Asphalt shingles

BUILDING MATERIALS

- Use of Indiana limestone, precast concrete, or cast stone for water tables, belt courses, copings, lintels, sills, bases, column enclosures, and accent/spandrel panels is a common campus element, and is also encouraged.
- Exterior stucco, if used, should complement the major building material color. A beige or cream color has been used successfully at the top floor of St. Joseph Hall, as an example of a historical precedent.

BUILDING COLORS

- Painted surfaces such as doors and frames, window frames and trim, soffits, gutters, downspouts, etc. should also match the nearest adjacent buildings, or be of a neutral color. Cream paint, clear anodized aluminum, or medium bronze anodized aluminum have been used successfully on campus.
- Bold colors should be used only in limited locations, reserved to signify a special application or function within an individual building, such as the blue dome of the Chapel.

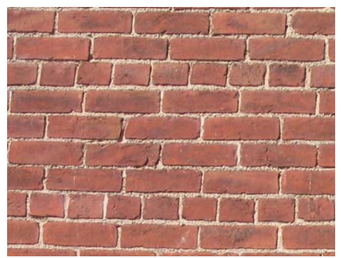
Example of Common Bond at Liberty Hall.

Running Bond is used at the Humanities Center, with limited areas of soldier coursing and special shapes for additional detail.

BRICKWORK

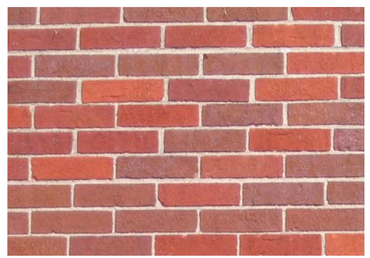
The use of brick helps to enhance the quality and character of the University's architecture while preserving the image of the campus. As a common building material brick creates continuity across different styles, epochs, and types of construction unifying the new and the old.

For new construction, brick masonry of a red or terra cotta color range should be used. Ideally, clay masonry from local sources is preferred. Brick sizes are to be modular, in running, common, or Flemish bond coursing. Jumbo or utility brick, and stack bond coursing should not be used.



Common Bond: Also known as the American Bond, Common Bond would have a pattern of five rows of stretchers followed by one row of headers.

Flemish Bond: Brick, coursed in Flemish bond, may include a two-color scheme for accented areas.



Running Bond is the most common bond in contemporary projects, as it is easy to lay with little waste. It is entirely comprised of stretcher bricks.

Windows

Historic campus buildings utilize an individual or punched window unit. In such a pattern, windows account for 15% to 30% of a façade area.

For more contemporary building designs, larger windows and sections of curtainwall are permitted but subject to the approval of the Facilities Committee, and must be thoughtfully ordered and located for compatibility with neighboring buildings.

Operable windows are highly encouraged for appropriate building types, such as housing and offices, to promote natural ventilation, in keeping with sustainable practices. Double-hung windows are the preferred operable window type following campus precedents. Sash divisions commonly used are 1/2:1/2, 1/3:2/3, and 2/3:1/3.

Larger modules of fixed window walls and curtainwalls may also be used when organized in a façade to denote a special element, such as an entry or a large space, or to break up scale.

Windows may be of painted or anodized aluminum, or clad wood. The window color and mullion pattern should match existing neighboring buildings to help unify the building group into a related whole.

Thermal performance of glazing is to be in compliance with exterior envelope requirements of ASHRAE 90.1. This thermal performance of glazing should be high while maximizing visible daylight. The use of reflective glazing is discouraged.

Windows should be a standardized heavy commercial grade throughout future additions, renovations or new construction.

Divided lights are encouraged for their contextual relationship to other campus buildings, and to humanize the scale, as in this example of Keller Hall.

Fixed window wall assemblies in the rear gable of Keller Hall support and announce the interior function of the space behind them.

Albert Emanuel Hall side wing with both 1/2:1/2 and 2/3:1/3 double-hung windows

Marianist Hall with a variety of window types set in a common rhythm on the façade

Double-hung windows are the preferred operable type, organized in individual, paired, and triple units as in Keller Hall.

Entrances

Building entrances should serve as beacons for the pedestrian, and be of an appropriate large scale compatible with the building façade. Benchmark examples on campus include Keller Hall and the Humanities Center.

Adequate lighting, canopy protection, and clear signage should be incorporated into entry design.

Doors make an important entry statement. Bottom rails should provide a strong base with side and top rails of a smaller dimension. The style of the door should be compatible with its surroundings and the manner of the building.

The Nazareth Courtyard entrance to St. Joseph Hall uses a projected addition, reaching out into the prominent corner of the courtyard. The entrance addition is not the dominant element of the building façade, but still serves as the entrance beacon. Its gabled form is contextual with St. Joseph Hall, and its scale is reduced to the pedestrian level, becoming a part of the courtyard as much as the building.

The entrance and central curtainwall assembly anchors the major axis of Humanities Plaza.

Albert Emanuel Hall features a classical approach to a defined entrance through the use of a monumental portico and elevation change from the ground to the first floor lobby.

The large, articulated entrance of Keller Hall helps to navigate pedestrians, and incorporates a covered loggia to guard pedestrians from the elements.

Student Neighborhoods

The University of Dayton's ownership of complete groupings of neighborhood housing is unique among its peer institutions. Most campus housing within the existing neighborhoods was purchased by the University over time.

Through student focus group interviews, neighborhood authenticity is valued by students and is important for recruitment. The individual character of the existing homes should be preserved.

New housing within neighborhoods should be small, individual buildings that maintain the existing scale, each having a unique façade treatment. Single and duplex homes have been successful within the student neighborhoods, as well as multi-unit townhouse models. Monolithic block buildings are discouraged.

Holy Angels Neighborhood existing housing mix; note large porches that act as a transition from public sidewalk to private homes.

Existing student neighborhood housing in brick

Existing student neighborhood housing in wood siding

Existing student neighborhood housing with textured walk and street trees

Typical student housing with front porch, and wide stable guardrails

Duplex and multi-unit housing on Stonemill Road successfully integrates the scale, massing and details of the existing neighborhood.

PLANNING

Student neighborhoods must respond to the ways in which students use both the interior and exterior spaces. Designing adequate spaces for student congregation on a semi-private porch or private patio should be considered, and must be flexible to accommodate various uses.

New student neighborhood houses should be limited to five or six occupants, to simplify code-compliance measures.

UTILITY AND DURABILITY

Integration of proven, structurally-sound details, as well as composite materials designed to outlive traditional materials, will ensure longevity in residential renovation projects and future housing designs.

All architectural elements should be designed to resist pedestrian traffic, be impact-resistant, and stand up to heavy use. For example, porch guardrails will need to accommodate students sitting on them. Lighting fixtures should be located beyond arm's reach. Step lights and bollard lighting are not to be used.

Access to adjacent roof structures (including porches) from residence windows should be eliminated from new construction.

Materials to include:

- Siding - fiber cement board, in lap, cut shakes, or board and batten styles
- Roofing - asphalt shingles
- Windows - insulated, low-e glazing in PVC, aluminum, or clad wood frames
- Soffits, gutters, and downspouts - prefinished aluminum
- Trim - fiber cement or cellular PVC
- Railings - painted wood

COLOR

A limited color palette shall be implemented for general upkeep and repairs to weathered and soiled interior and exterior wall surfaces. A limited number of bold accent colors shall also be adopted and implemented throughout the neighborhood, thus creating a dynamic character within the streetscape. Limited colors will allow Facilities Management to control their stocked paint materials, simplifying repair in the field.

RENOVATIONS

As individual houses are renovated, sustainable design practices are to be incorporated. At a minimum, these will include insulated windows and doors, exterior wall and roof insulation, and Energy Star efficient appliances, fixtures, and mechanical systems. All student neighborhood houses are to be renovated with sprinklers and hard-wired smoke detectors that signal directly to the Department of Public Safety.

Mixed-Use/Commercial District

The southwest corner of Brown and Stewart Streets offers an opportunity to extend the existing successful commercial corridor. Ground-level retail use with upper-floor office or housing would provide an appropriate transition to campus. The architecture of the building should respect the newly established design guidelines, and will be sited to take advantage of the Plaza at the proposed University Center for the Arts. When realized, it will provide an important link to the community.

The blending of the campus edges provides some unique challenges at the University of Dayton. Creating a seamless transition between the campus and community by overlapping uses should be paramount.

Diagram denoting ground floor glazing, signage areas, and upper floor human scaled fenestration

ORGANIZATION AND PLANNING

- Ground floors of new and existing facilities within the mixed-use zone designated per the Master Plan shall provide retail/mercantile opportunities to mix both the needs of the campus while respecting the impact on the adjacent community.
- Other uses such as commercial office shall have a street presence and transparency with generous amounts of light transmitted through the space via large storefront windows.
- Upper floors shall be office, health club, housing, or other various campus or commercial uses.
- Access for service, deliveries, and refuse removal is critical for all mixed-use facilities. Organization and screening of dumpsters out of the main street or public zone right-of-way is essential. Most existing campus buildings do not require true loading docks, but double doors on a minor side of the building for service requirements; this model could apply to future campus development, depending on the intended use.

MATERIALS AND DETAILS

- Sensitivity should be paid to implementing durable and long-lasting materials within the public way along the street edge. These materials include glass and aluminum storefronts, brick masonry, or stone, and should generally match the adjacent campus buildings.
- Enlarged sidewalks with appropriate street trees, urban furniture, and landscaping should be implemented within the Landscape Design Guidelines.

Proposed campus improvements incorporating overlap of the campus and community uses

- Elevations of ground floors should be of an 18-20' minimum with high ceilings and large glazed areas to allow for retail display and to maximize light transmittance into the building.
- At ground floors, ratio of storefront glass area to solid exterior wall elements is to be 3:5.
- Signage should be limited to storefront-mounted displays (interior side), and linear exterior signs mounted parallel to the building face above the storefront. Signage is not to exceed 15% of the adjacent storefront area. Internal and external illumination is acceptable. Blade signs projecting from the building face area are not acceptable.
- Individual commercial tenant awnings or canopies (with or without signage) are not acceptable. The lines of the overall buildings in the mixed-use district are to be maintained.

Sustainability

Balancing the fulfillment of our current needs without compromising the ability of future generations to meet their own needs is the essence of sustainability. Sustainability allows the simultaneous pursuit of economic efficiency, environmental quality, and social equity.

The University of Dayton can enjoy the economic benefits of sustainable design, such as lower operational/energy costs, while setting an example for its students and the community in responsible stewardship.

These guidelines are intended to articulate a vision of a sustainable campus and some of the steps needed to achieve this vision.

GOAL 1: Design and build all major new projects at the University of Dayton with best practice standards of sustainable design.

BACKGROUND

- Sustainable design emphasizes state-of-the-art strategies for sustainable site development, based on well-founded scientific standards, water savings, energy-efficiency, materials selection, and indoor environmental quality.
- LEED certification is not a mandate for future projects, but its individual credits can provide a benchmark for selected aspects of sustainable design.

RECOMMENDATIONS

- Any project team selected for a building should have the ability and expertise to implement sustainable design standards. They should have team members that have experience with sustainable design and a belief that sustainable design is an integral aspect through all stages of a project.
- Life cycle costing should be as important an economic factor as first cost. Sustainable design and building practices may cost more upfront, but can be more economical over the long term.

GOAL 2: Maximize the energy efficiency of all new construction as well as existing buildings.

BACKGROUND

- Maximizing energy efficiency helps to minimize a building's impact on the environment and reduce operating costs for the campus.
- Energy efficiency requires a holistic approach to building design. Solar orientation, building envelope design, glazing placement and design, HVAC system design, lighting control, landscape design, and many other factors must be carefully considered to make a building efficient.

RECOMMENDATIONS

- Design building envelopes to optimize thermal control by specifying appropriate insulation levels, placement of overhangs and sun shading devices, and selection of glazing, particularly to reduce heat gain.
- Take advantage of passive solar heating and cooling opportunities. Large buildings typically overheat from lighting, equipment, and occupants. Coordinate the development of building orientation, glazing design, and thermal mass.

GOAL 3: Design buildings to take advantage of Ohio's climate through the implementation of alternative energy solutions.

BACKGROUND

- The University of Dayton has the potential to take advantage of Ohio's climate and ultimately yield energy from its environment.
- The majority of renewable energy technologies are directly or indirectly powered by the sun.

RECOMMENDATIONS

- Solar array opportunities, solar hot water, geothermal heating and cooling systems, and other alternative energy systems should be considered.

GOAL 4: Reduce, Reuse, and Recycle: Minimize waste by providing opportunities for recycling, and the salvaging and reusing of existing materials.

BACKGROUND

- Construction and demolition waste is a significant portion of the waste stream, making up 31% of waste disposed to landfills (based on a 2006 study). Industrial and commercial waste from the construction and demolition industry constitute the largest proportion of waste.

RECOMMENDATIONS

- Campus recycling: To enhance the University's recycling and composting standard practices that have been developed by Facilities Management, new projects are to incorporate dedicated areas for recycling containers per the Landscape Design Guidelines.
- Salvage/reuse: Find ways of using debris from renovation projects and demolished buildings on site and through recycling (avoid sending to landfills). Means may include reuse of masonry, doors, hardware, equipment, and specialties. Divert construction waste from landfills.

University of Dayton students promoting the Sustainability Club

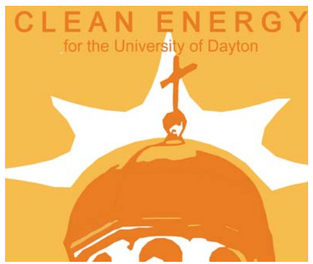
GOAL 5: Protect occupant health and well-being through better indoor air quality, access to daylight, and thermal comfort.

BACKGROUND

- "The USA EPA ranks indoor air pollution among the top five environmental risks to public health. Unhealthy indoor air is found in up to 30% of new and renovated buildings." (Sustainable Building Technical Manual, Washington DC, Public Tech., Inc. 1996)
- Construction and renovations can expose inhabitants to abnormally high levels of volatile organic compounds (VOCs), which are the toxic gases, such as formaldehyde, released from everyday materials that are responsible for contributing to cancer, asthma, fatigue, and other ailments.

RECOMMENDATIONS

- Source control: Eliminate individual sources of pollution and/or reduce their emissions. Specify maximum low-level volatile organic compound (VOC) off-gassing levels for all building materials.
- Improved ventilation: Increase the amount of outdoor air coming indoors. Create building envelopes that can provide cross ventilation through narrow floor plans and openings in floors and ceilings that allow vertical circulation.
- Light management: Provide natural daylighting without glare.



Renewable Energy

Renewable energy resources are naturally occurring sources of energy that are replenished on a daily (i.e. sun or wind) to almost yearly (i.e. water power and biomass wood or energy crops) cycle. Renewable energy sources emit either zero greenhouse gases into the atmosphere (i.e. sun or wind), or are "carbon neutral" (i.e. biomass sources, such as energy crops absorb as much CO_2 during their growth cycle as they emit when burned for fuel).

The opportunity for solar and other renewable energy applications at the University of Dayton is greater than in many other larger cities in the country.

Harvard Business School recently installed 172 solar photovoltaic panels which will supplant the emission of about 75,000 pounds of carbon monoxide annually -- the equivalent of about 220 fewer cars on the road each year.

SOLAR ENERGY

- The potential for solar energy in Dayton, Ohio is much better than most locations in the country. The available solar energy on a horizontal surface in December is 407 BTU/sq.ft. and in July it is 1873 BTU/sq.ft. The average clearness index (clear skies) for the area ranges from 0.33 in December to 0.506 in July. This is considered a good climate for solar applications.

SOLAR THERMAL

- A water heating system using flat plate or evacuated tube solar collectors could potentially be used for dorms, office buildings, labs, recreational dining and laundry facilities, and indoor/outdoor pools.

NATURAL VENTILATION

- For certain large volume spaces such as atriums, multi-story lobbies, arts studios, and recreational facilities, natural ventilation systems can be considered. Using motorized louvers at the bottom and top at the exterior wall will allow natural thermal convection to ventilate the space.

WIND POWER

- The wind resource at Dayton is slightly better than marginal. If open areas or other suitable sites are available, then wind turbines of 50 meters high may be considered. As an example, a 50 KW-rated wind turbine at 50 meters high will produce about 70,000 KWH of electricity per year.