



**CITY OF SAN RAFAEL
ESSENTIAL FACILITIES**

FACILITY EVALUATION REPORT

APPENDIX TO STRATEGIC ANALYSIS REPORT

AUGUST 2003



**San Rafael Essential Facilities
Facility Evaluation Report**

	TABLE OF CONTENTS	i
1.0	INTRODUCTION AND METHODS	1
2.0	FACILITY SUMMARIES	3
	A. Fire Station No. 1	3
	B. Fire Station No. 2	4
	C. Fire Station No. 4	4
	D. Fire Station No. 5	5
	E. Fire Station No. 6	6
	F. Fire Station No. 7	6
	G. San Rafael Community Center	7
	H. Terra Linda Community Center	8
	I. City Hall/Police Station	9
3.0.	STRUCTURAL FINDINGS	11
	A. Fire Station No. 1	17
	B. Fire Station No. 2	22
	C. Fire Station No. 4	31
	D. Fire Station No. 5	36
	E. Fire Station No. 6	41
	F. Fire Station No. 7	44
	G. San Rafael Community Center	49
	H. Terra Linda Community Center	53
	I. City Hall/Police Station	57
4.0	CITY HALL ELECTRICAL AND MECHANICAL FINDINGS	65
	I.1 Electrical Findings	65
	I.2 City Hall HVAC Findings	71
	I.3 City Hall Plumbing System	75
	I.4 City Hall Fire Protection System	75

1.0 INTRODUCTION AND METHODS

The City of San Rafael commissioned a study of nine of its essential facilities:

- Fire Station No. 1
- Fire Station No. 2
- Fire Station No. 4
- Fire Station No. 5
- Fire Station No. 6
- Fire Station No. 7
- San Rafael Community Center
- Terra Linda Community Center
- City Hall and the Police Station

The latter two facilities were included in this study due to their designation as emergency shelters and backup emergency operations centers (EOCs). (Pickleweed Park Community Center, although also identified as an emergency shelter, is the subject of a separate project and as such was not included in this study.)

Building evaluations were conducted at these nine facilities between August 27, 2002 and September 6, 2002. Two facilities were reviewed each day, except for City Hall which was allocated an entire day for its evaluation. Evaluations at all of the facilities were conducted by an architect and a planner representing Group 4 Architecture, Research + Planning, Inc. and a structural engineer representing C.H. Wells, Jr. & Associates. A mechanical engineer from Guttman & Blaevoy and an electrical engineer from O'Mahony & Myer also participated in the City Hall evaluation. The Facility Repair Supervisor of San Rafael's Department of Public Works led each facility tour, along with applicable representatives from the City's Fire, Police, Community Services, and Management Services departments.

The facilities were evaluated for structural, mechanical and electrical deficiencies as well as overall modernization and deferred maintenance issues. After careful review and analysis, it was determined that the information would be divided into seismic, life safety and modernization categories to help coordinate later program and development strategy phases. Seismic improvements are those which increase the ability of a facility to resist the forces resulting from an earthquake or other disaster, so that the facility can remain operational. Life



The evaluation team at Fire Station No.4

INTRODUCTION & METHODS



Evaluating City Hall

safety improvements protect building occupants from fire and contamination hazards so that they can continue to provide emergency services to the community. Modernization improvements increase the functionality of facilities and the efficiency with which emergency personnel can provide service; space, layout/circulation, condition of materials and building systems, and security all

2.0 FACILITY SUMMARIES

General summaries of each of the essential facilities evaluated in this study appear below. More details for each facility can be found in later sections of this document as well as in the final *City of San Rafael Essential Facilities Strategic Analysis* report.

A Fire Station No. 1

A.1 General Description

Originally built in 1916, Fire Station No. 1 has been remodeled several times. It is approximately 9,411 square feet in size and sits on a 7,750 square foot parcel at the corner of Fifth and C Streets downtown. It is a two-story structure built with a wood frame roof and interior steel girders on the second floor. The exterior walls are made of cast-in-place concrete construction. It serves as the Fire Department headquarters and houses Administration, the department's vehicle and equipment service/mechanic's operation, and dispatch (although dispatch is scheduled to move off-site in 2003). This station has both a paramedics unit and a fire-fighting unit.

A.2 Seismic Summary

Little information is available about the structural design of the building; however, evaluation reveals that while it is generally in good condition, it is in poor condition seismically. Given its age, the building does not likely comply with the seismic design requirements of the 1997 Uniform Building Code.

A.3 Life Safety

Overall the building lacks a fire suppression system and adequate exit signage. It does not comply with ADA requirements. The exhaust hoses in the apparatus bay are inadequate, and the exhaust hood over the stove in the kitchen operates poorly. There is no space appropriate for personnel to decontaminate after exposure to dangerous substances (bodily fluids or toxic chemicals) in the field, nor for storage of the potentially hazardous materials used in fire-fighting operations.

A.4 Modernization

Fire Station No. 1 lacks adequate space in its administrative offices, storage areas, workshop and vehicle maintenance area, garbage and recycling area, apparatus bays, and the gym. The ability of the station to accommodate both male and female personnel simultaneously is limited by the open living quarters. The outdated electrical system, poor air conditioning system, and inefficient single-paned windows can make operations difficult and uncomfortable. The manual apparatus bay doors can slow down emergency response. The station also suffers from low site security.

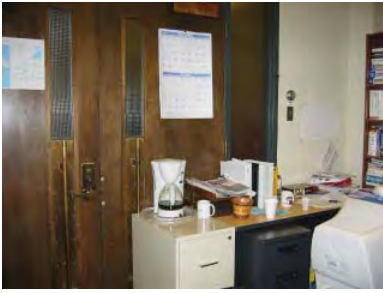


Yellowing, aged fluorescent fixtures and a modified diffuser at City Hall.



The boiler at City Hall is over 35 years old and past its useful life.

FACILITY SUMMARIES



Offices in City Hall are crowded.

B Fire Station No. 2

B.1 General Description

The 3,024 square foot Fire Station No. 2 was built in 1957 of wood frame construction. The station is located on a 33,282 square foot parcel at the corner of Third and Union Streets. The smallest of the City’s fire stations, Fire Station No. 2 serves as the Fire Department’s training station because of its central location as well as its drill tower and (modular) classroom.

B.2 Seismic Summary

Neither the building nor the drill tower comply with the 1997 Uniform Building Code. While the building overall is in good condition structurally, it is in only fair condition seismically, meaning that it is likely to suffer moderate damage in a major earthquake.

B.3 Life Safety

Fire Station No. 2’s life safety issues include the lack of a fire suppression system (e.g., sprinklers), inadequate exit signage, insufficient exhaust from the apparatus bays, and inadequate building access as required by ADA codes. The station lacks an appropriate area for decontamination as well as space for storage of hazardous materials, such as chemicals used for fire-fighting or toxic substances cleaned up in the community and awaiting proper disposal (currently these materials are stored in the drill tower, for lack of a better place).

B.4 Modernization

Fire Station No. 2 suffers from outdated electrical and mechanical systems, inadequate space, worn finishes, and poor ventilation/air conditioning, especially in the dormitory. Space is at a premium in all areas of the facility, including the modular classroom. As a result of its small size and design, Operations are complicated by the layout within the facility (such as in the locker and laundry areas) and on the site (due to the locations of the fueling tank, drill tower, and modular classroom). Genders cannot be separated in the living quarters, which limits staffing options. The station has site security problems as well.

C Fire Station No. 4

C.1 General Description

The 4,120 square foot Fire Station No. 4 was constructed in 1964 on a 13,321 square foot parcel. It is a single-story structure, with the apparatus bay made of tilt-up concrete construction and the living quarters are wood-framed.

C.2 Seismic Summary

The building was designed according to the 1961 Uniform Building Code, and does not comply with the 1997 Uniform Building Code. Overall the building is in good condition structurally, but may suffer significant damage or even collapse in a major earthquake.



The driveway at Fire Station No. 1 is aged and cracking.

C.3 Life Safety

Fire Station No. 4 lacks a fire suppression system, appropriate exit signage, an emergency generator, and appropriate provisions for exhaust in the apparatus bays and over the stove in the kitchen. It does not comply with the ADA requirements for building accessibility. There is no space appropriate for personnel to decontaminate after exposure to dangerous substances (bodily fluids or toxic chemicals) in the field, nor for storage of the potentially hazardous materials used in fire-fighting operations.

C.4 Modernization

The electrical system is inadequate, exterior and interior lighting is inefficient, and there is no dedicated room to house distribution systems. Mechanically, the building lacks floor drains in the apparatus bay, has an inadequate heating system, and needs an air conditioning system. The building's single-paned windows reduce the efficiency of its heating system. Operationally, the building lacks appropriate site security and gender separation in the living quarters. Overall the station is crowded and requires more space, especially in the apparatus bays and storage areas. The station lacks appropriate signage to identify it within the local community. Interior and exterior surfaces are worn.

D Fire Station No. 5

D.1 General Description

Fire Station No. 5 was built in 1966 using an inverted version of the architectural plans from Fire Station No. 4. It is a single-story, wood-framed structure on a 19,482 square foot parcel.

D.2 Seismic Summary

The building was constructed based on the 1964 Uniform Building Code and does not comply with the 1997 Uniform Building Code. Overall the building has been found to be in good condition structurally, however it may suffer moderate damage under major earthquake conditions.

D.3 Life Safety

Fire Station No. 5 requires a fire suppression system, appropriate exit signage, and ADA upgrades for building access. Additionally, the building needs to have an emergency generator, appropriate exhaust over the stove in the kitchen and appropriate exhaust hoses in the apparatus bay. Fire Station No. 5 lacks space where personnel can clean up after exposure to dangerous substances (bodily fluids or toxic chemicals) in the field, as well as for storage of the potentially hazardous materials used in fire-fighting operations.



Fire Station No. 1



Training equipment at Fire Station No. 2 makes the site even more crowded.

FACILITY SUMMARIES



Lack of storage space at Fire Station No. 2 limits the station's efficiency.



Fire Station No. 4 lacks appropriate space for decontamination

D.4 Modernization

While Fire Station No. 5 has fewer structural problems than its counterpart at Fire Station No. 4, it does have some of the same modernization issues. Namely, the building has poorly-functioning and inefficient HVAC systems, a lack of gender separation in the living quarters, and serious space deficiencies, especially in the gym, hose storage, hydrant repair and storage areas. The station's plumbing and sewer system is outdated. Overall, interior and exterior finishes are worn and in need of replacement.

E Fire Station No. 6

E.1 General Description

Built in 1996, Fire Station No. 6 is the most modern fire station in San Rafael. It houses both a paramedics unit and a fire-fighting unit, and can accommodate a mixture of male and female staff in its single-occupancy dormitory rooms and restrooms. This station also features a paramedics office and a reception area. A two-story structure made of mixed construction, Fire Station No. 6 shares its site with the Terra Linda Community Center.

E.2 Seismic Summary

While Fire Station No. 6 is the most seismically sound fire station, it was built using the 1991 Uniform Building Code and thus does not completely comply with the 1997 Uniform Building Code. It is in good condition structurally and seismically and only a few modifications are required to bring it into compliance with current code.

E.3 Life Safety

Fire Station No. 6 has a working fire suppression system and emergency generator. In general, the most significant deficiency is the lack of appropriate space for decontamination and for storage of potentially hazardous materials.

E.4 Modernization

Fire Station No. 6 has some space deficiencies, although to a lesser degree than at other stations. The size of the site is restrictive. The storage area and gym areas are in need of additional space and the parking lot is too small. The facility's adjacency to the neighboring residential community has resulted in complaints about the compressed air equipment and sirens.

F Fire Station No. 7

F.1 General Description

Fire Station No. 7 was built in 1978 and is a small, single-story wood frame building of approximately 3,801 square feet. It sits on a county-owned parcel of approximately 35,00 square feet.

F.2 Seismic Summary

Fire Station No. 7 was designed in accordance with the 1978 Uniform Building Code, and does not comply with the 1997 Uniform Building Code. Overall the building has been found to be in good structural condition, although its design puts it at risk of significant damage or even collapse in a major earthquake.

F.3 Life Safety

Fire Station No. 7 lacks a fire suppression system, adequate exit signage, an emergency generator, and sufficient provisions for exhaust from the apparatus bay. The facility is not compliant with ADA building requirements. There is no space appropriate for personnel to decontaminate after exposure to dangerous substances (bodily fluids or toxic chemicals) in the field, nor for storage of the potentially hazardous materials used in fire-fighting operations. The old refueling tank may be a life safety hazard.

F.4 Modernization

Fire Station No. 7 suffers from outdated electrical and mechanical systems, operational inefficiencies, space deficiencies, and worn interior and exterior finishes. Ventilation is a problem, particularly in the locker room, restroom, and gear storage areas. There is inadequate lighting in the dayroom. The building has site security issues and does not provide gender separation in the living quarters. Space is inadequate in the dormitory, restroom, gear storage area, apparatus bays and gym area.

G San Rafael Community Center

G.1 General Description

The approximately 14,500 square foot San Rafael Community Center was built in 1975 of wood frame construction. It is located on a large parcel of land (581,090 square feet) that also contains a recreational park, a baseball field and a day care center. The building contains a multipurpose room, several classrooms, a commercially-equipped kitchen, and offices for the Community Services Department staff. It has been included in this study due to its designation as both an emergency shelter and a backup emergency operations center (EOC).

G.2 Seismic Summary

San Rafael Community Center was designed using the 1974 Uniform Building Code. While overall it appears to be in good condition, it does not comply with the most recent structural code. Seismically the building has been classified as being in fair condition, and may be expected to weather a major earthquake with minor to moderate damage.

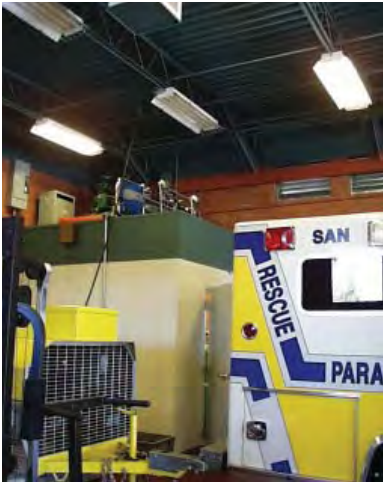


Inappropriate gear storage at Fire Station No. 5.



Electrical panels are close to the driveway on Fire Station No. 6's restrictive site.

FACILITY SUMMARIES



Although it is less than 10 years old, Fire Station No. 6 already lacks storage space.

G.3 Life Safety

The San Rafael Community Center lacks an inadequate fire suppression system (e.g., sprinklers) and an emergency generator to allow it to continue functioning as a shelter or EOC if power service is interrupted. The facility is out of compliance with ADA, and its public address system is essentially non-operational.

G.4 Modernization

Modernization shortcomings of the building with respect to emergency shelter needs include a few minor mechanical and electrical problems, a shortage of storage space for shelter and EOC supplies, and worn exterior and interior finishes. The building was noted for having inadequate interior and exterior lighting systems and a deteriorating irrigation system. Additionally bathrooms are likely inadequate to handle demand during operation as a shelter. Offices, parking and storage all are insufficient to meet daily recreational needs.

H Terra Linda Community Center

H.1 General Description

The Terra Linda Community Center was built in 1954 as a school, and was acquired by the City of San Rafael in 1961. It contains a large multipurpose room, a small kitchen, offices, and a darkroom. It is a 5,400 square foot wood frame facility that shares a 27,950 square foot parcel with Fire Station No. 6. Also on site are a large pool, pool house with classroom, basketball court and park, although none of these were examined as part of this study. The community center is designated as an emergency shelter as well as a backup emergency operations center (EOC).

H.2 Seismic Summary

The building was originally designed using the 1952 Uniform Building Code and does not comply with the 1997 Uniform Building Code. Overall the building is described as being in good condition structurally, but may sustain minor to moderate damage in a major earthquake.

H.3 Life Safety

Life safety issues at Terra Linda Community Center include the lack of a fire suppression (sprinkler) system, noncompliance with ADA requirements, and the lack of an emergency generator. The public address system does not work properly.

H.4 Modernization

Modernization issues at Terra Linda Community Center include mechanical and electrical problems, a leaky roof (possibly caused by the rooftop HVAC unit), inadequate exterior lighting, and single-paned windows that reduce the efficiency of the heating system. The facility lacks sufficient space in its program areas,



Fire Station No. 7 suffers from drainage problems.

kitchen, and restrooms to operate efficiently as a shelter, and lacks dedicated storage for shelter and EOC supplies. As a community center, the facility suffers from some site security problems as well as inadequate space and parking.

I City Hall/Police Station

I.1 General Description

City Hall was constructed in 1966 and is approximately 27,150 square feet. It is located on a parcel of 99,148 square feet. The building houses the Police Department on the first floor, the Council Chambers and Management Services Department on the second floor, and the Community Development Department on the third floor. At the time of the evaluation, the Public Works Department shared the third floor of City Hall with Community Development, but has since relocated to the City's new corp yard facility. Overall, the building has maintained its original exterior and interior finishes, with more recent remodels of the police dispatch room on the first floor, the second floor public restrooms, and the Community Development offices on the third floor. Planning is currently underway to accommodate the expansion of the Community Development into the third floor space vacated by Public Works.

I.2 Structural Summary

City Hall was evaluated structurally as two separate areas, the Council Chambers and the Main Building. The Council Chambers and Main Building were both found to be in fair condition seismically, meaning that they are likely to survive a major earthquake with moderate damage. A number of structural upgrades are needed in order for the building to comply with the 1997 Uniform Building Code; these are described in the *Structural Findings* section of this report.

I.3 Mechanical Summary

The HVAC, plumbing and fire protection systems in the building are all approximately 36 years old and well past the normal life expectancy of 15 to 27 years. The air distribution system was found to be the most problematic component of the HVAC system, as poor ventilation, cooling, heating and temperature control are experienced throughout the building. Code violations include a lack of emergency refrigeration shutdown and ventilation, the lack of rated separation for the boiler and chiller, non-compliance with the energy code, inadequate condensate provisions, and the lack of smoke shutdown provisions for the air handling system. In general, the plumbing system was found to be operational, although it does not comply with code. The entire building lacks fire sprinklers and smoke detectors, a serious life safety issue.

I.4 Electrical Summary

The building's existing electrical systems are outdated, inefficient, and non-compliant with Title 24 energy conservation requirements. The lack of fire



Exterior soffits at San Rafael Community Center show signs of water damage.

FACILITY SUMMARIES



Worn finishes and signs of water leakage in the multipurpose room of Terra Linda Community Center.

alarm and security systems is a serious life safety concern.

I.5 Life Safety

City Hall lacks fire sprinklers, fire alarms, smoke detectors and security systems, all of which are considered essential for a public facility. Additionally, the building lacks appropriate exit signage and is not compliant with ADA building requirements.

I.6 Modernization

A number of deficiencies limit operational efficiency at City Hall. The first floor (the Police Station) suffers from severe space deficiencies, poor layout and circulation, and worn interior finishes. Inadequate space is available for storage, evidence, the armory, locker rooms, and custodial needs. The first floor also does not provide sufficient security in public, staff, or detainee areas; holding cells are a particular problem, as is file security.

Space and operational inefficiencies also limit the second and third floors of City Hall. Not enough space is available for the mailroom, the mechanical room, Human Resources and City Clerk records storage, or the Information Services offices. The parking lot and garbage and recycling area cannot handle demand. Operational, circulation, and security deficiencies plague the upper floors, especially with respect to the Cashier's window, public access throughout the building, and the modular offices in the parking lot.

3.0 STRUCTURAL FINDINGS

Introduction

The seismic evaluation of the nine City of San Rafael buildings has been completed. The following facilities were evaluated:

- A. Fire Station No. 1
- B. Fire Station No. 2
- C. Fire Station No. 4
- D. Fire Station No. 5
- E. Fire Station No. 6
- F. Fire Station No. 7
- G. San Rafael Community Center
- H. Terra Linda Community Center
- I. City Hall/Police Station

The available construction documents for each of the above facilities has been reviewed for compliance with the essential facility requirements in the 1997 Uniform Building Code (UBC). The code review includes the design of the major structural components of the lateral load resisting system for each building. It is not the intent of this study to review the buildings vertical load resisting elements.

Where available, the original structural calculations were used to review each building. Where these calculations were not available, preliminary structural calculations were prepared to assist in the evaluation of each building.

In addition to the code review, the scope of work included one site visit to each facility to observe the “in place” condition of the facility and gather additional information relevant to the assessment of each building. The site investigations did not include destructive investigation. No part of the existing buildings were removed or taken apart to verify the condition of the underlying construction. As a result, this report excludes items that are not readily observable. Providing retrofit details to repair damaged or deficient structural elements is also not within the scope of work.

This report completes the study and will present a summary of the findings.

Executive Summary

The purpose of this investigation was to provide a seismic evaluation of the subject properties. The principal results and conclusions are presented below. Please note that this executive summary is not intended to be used for design

STRUCTURAL FINDINGS

purposes as it is simply a synopsis of the major points of the report. Please see the text of the report for complete information. A brief summary of this report is as follows:

1. The 1997 UBC requires additional considerations in the design of buildings constructed within ten kilometers from known earthquake faults (near source zone). All buildings in this survey fall outside of the near source zone except for Fire Station No. 5 (9 kilometers from the Hayward fault).
2. The City of San Rafael, located in Marin County is almost an equal distance from the San Andreas Fault to the west and the Hayward fault to the east. Both faults are capable of producing earthquakes, which could cause strong ground shaking causing structural damages to any of the buildings in this report.
3. There have been many changes in the building code since the building was originally designed. These changes may affect the performance of the buildings in this study.
4. The results of this study indicate that one building (Fire Station No. 6) receives a seismic performance rating of “good.”
5. The results of this study indicate that five buildings (Fire Stations No. 2 and 5, Terra Linda and San Rafael Community Centers, and City Hall) receive a seismic performance rating of “fair.”
6. The results of this study indicate that three buildings (Fire Stations No. 1, 4 and 7) receive a seismic performance rating of “poor.”

Basis of Structural Review

General

The structural drawings for eight of the facilities were available for us to review. The original drawings for Fire Station No. 1 were not available. However, Fire Station No. 1 was previously reviewed by Engle & Engle Structural Engineers for compliance with the 1997 UBC. The results of their study are indicated in their letter to the City of San Rafael, dated January 21, 2002.

In addition to their letter, Engle & Engle prepared preliminary drawings S-1, S-2 and S-3 to document the scope of improvements required for compliance with the 1997 UBC. The Engle & Engle report and preliminary drawings were used as the basis for this review.

The original design structural calculations were available for only Fire Stations No. 6 and 7. The calculations were not available for the other buildings.

Comparison of the Current Code vs. Original Design Codes

The 1997 UBC is the edition of the code that is currently in effect. All of the original buildings were designed using an earlier version of the UBC. In general, the different versions of the building code are similar when considering the design of the vertical load carrying systems. However, there have been many changes in the building code related to the design of the lateral load resisting system since the original design of these buildings. Some of the changes that would effect the designs are briefly described as follows:

- A. The near source factor, N_a , was introduced in the 1997 UBC, section 1629.4.2. This section requires buildings that are constructed within ten kilometers of an earthquake fault be designed for a higher base shear than buildings constructed outside of that zone. The location of all properties in this report relative to known active faults in the area are shown on the enclosed map titled “Active Fault Near-Source Zones” (See page 7). As indicated on this map, most properties are located outside the ten-kilometer zone. Therefore, near source factor will have a minimum affect on the buildings discussed in this report.
- B. The building type classification has been revised in later editions of the UBC. This classification was referred to as the “K” factor in the code at the time of the original design of most of these buildings. The “K” factor is a numeric value that refers to the type of lateral force resisting system designed for the building (i.e. moment frames, shear wall, braced frame, etc.). This classification was changed to the “R” factor in the 1988 UBC. “R” factors have broader range of values than the “K” factor that was used in earlier codes.
- C. The soil profile factor, “S”, was introduced in the 1997 UBC. Soil types are classified as A, B, C, D, E or F in accordance with section 1636 of the 1997 UBC. The UBC designates type D as the default soil profile type.
- D. The seismic importance factor was introduced in the 1976 UBC. The importance factor was a multiplier that increased the design base shear from that of an ordinary building. This raised the standard of the design for buildings with the types of occupancies listed as below:
 - 1. Hospitals and other medical facilities having surgery or emergency treatment areas.
 - 2. Fire and police stations.
 - 3. Municipal government disaster operation and communication.

The multiplier for buildings with essential facility occupancies was 1.5 in the 1976 UBC. Therefore, an essential facility building was designed for 50% more base shear than a standard occupancy structure. The importance factor was later reduced and is currently 1.25 for a non-state owned or leased essential services building.

- E. The collector requirements in the 1997 UBC were modified to increase the seismic design loads for collectors and their connections.

Seismic Performance

Many faults exist in the bay area, which are capable of producing earthquakes which may cause strong ground shaking causing structural damages to any of the buildings listed in this report. There are many factors that could affect the extent of this damage. Some of these factors would include.

- The relative location of the earthquake to the building site.
- The geological conditions present at the site.
- Type of material used in the construction of the building.

In addition, the seismic performance of buildings will also depend on load path considerations. The load path is the interconnection of the structural components to provide a continuous load path for the transfer of the lateral loads from the roof diaphragm to the building foundation. The load path concepts have been further refined in the more recent editions of the Uniform Building Code.

There have also been many changes in the building code since the original design of the buildings in this study. These changes are a result of understanding building performance in past earthquakes along with the ongoing research related to the seismic design of buildings. The performance rating associated with the buildings in this report does not imply that the building did not comply with the building code when originally designed.

This report will rate the expected earthquake performance of each building as good, fair, or poor. This rating represents an opinion relative to the structural performance of the building in a strong seismic event. This opinion is based on observation of the building, review of the available documents and experience in the design of similar buildings. The level of damages associated with these ratings is described as follows:

- **Good Performance:** The building will resist a major level earthquake at the building site without collapse with minimal structural damages.
- **Fair Performance:** The building will resist a major level earthquake at the building site with minimal to moderate structural damages.
- **Poor Performance:** The extent of structural damages in a major level earthquake will be in the moderate to significant range with the potential of collapse or partial collapse.

In addition, as noted above, the seismic performance of a building can be dependent on geological conditions present at the site. An assessment of site geological conditions is not within the scope of this report. Therefore, such conditions have not been considered in the performance rating.

Design Assumptions

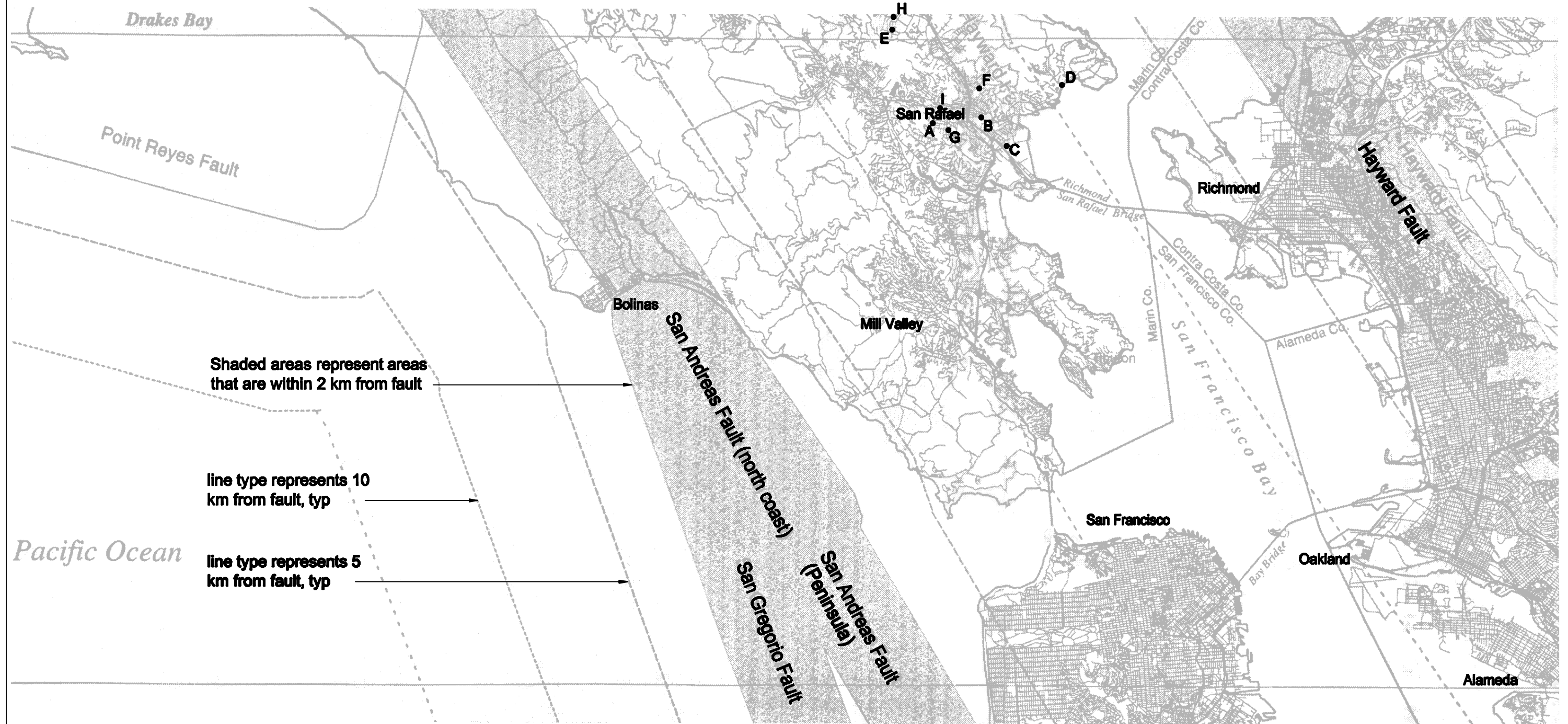
The following design assumptions were used as a basis for the review of the original calculations or for the preparation of the calculations:

- A. The building is located in seismic zone 4. Therefore, per 1997 UBC table 16-I, $Z=0.4$.
- B. The site soils were classified under UBC section 1636 as soil profile Type SD (default soil type).
- C. All buildings were considered as essential services occupancies therefore, the seismic importance factor used was “I” = 1.25.
- D. The locations of the properties relative to the major seismic faults in the bay area was determined using the document titled “Maps Of Known Active Faults, Near-Source Zones In California And Adjacent Portions Of Nevada,” as published by the ICBO, dated February 1998. A partial copy of this document is shown on page 16.

Active Fault Near-Source Zones

(Published by the International Conference of Building Officials, dated February 1998)

- A = Fire Station #1
- B = Fire Station #2
- C = Fire Station #4
- D = Fire Station #5
- E = Fire Station #6
- F = Fire Station #7
- G = Albert Park Community Center
- H = Terra Linda Community Center
- I = San Rafael City Hall



A. Fire Station No. 1

Fire Station No. 1 General Description

The building is a two-story structure in which the original construction was completed in 1917. This pre dates the existence of the Uniform Building Code so that the original design code is unknown. Small one-story wood and masonry additions were later constructed to the north and west of the original building. The original building is constructed of wood framed roof and the second floor is supported by interior steel girders. The exterior walls are of cast in place concrete construction. It is not known if these walls are reinforced.

The first floor is of slab on grade construction. The lateral load resisting system consists of the horizontal roof and floor diaphragms, which transfer the lateral loads to plywood and concrete shear wall elements.

Fire Station No. 1 Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be performing appropriately. No unusual movement or differential settlement of the building foundations was observed.
- The first floor slab on grade appears to be in good condition. There was no visual evidence of excessive cracking of the floor slab.
- The roof framing systems appears to be functioning normally to support the vertical loads. Some areas of ponding are visible at flat roof sections.
- The roof top mechanical units are not connected to the roof.
- The second floor framing system appears to be functioning normally to support the vertical loads. The floor surface is sloping in the kitchen adjacent to the exterior wall. This condition was likely caused by differential shrinking of the floor framing in this area.
- The concrete walls appear to be in good condition. Some modification to the walls appear to have been made since the original construction.

Fire Station No. 1 Seismic Evaluation

There is a limited amount of information available relative to the design of this building. Given the age of this building and the changes in the building code, this building will not comply with the seismic design requirements of the 1997 UBC.

The expected seismic performance of this building in the “as is” condition is

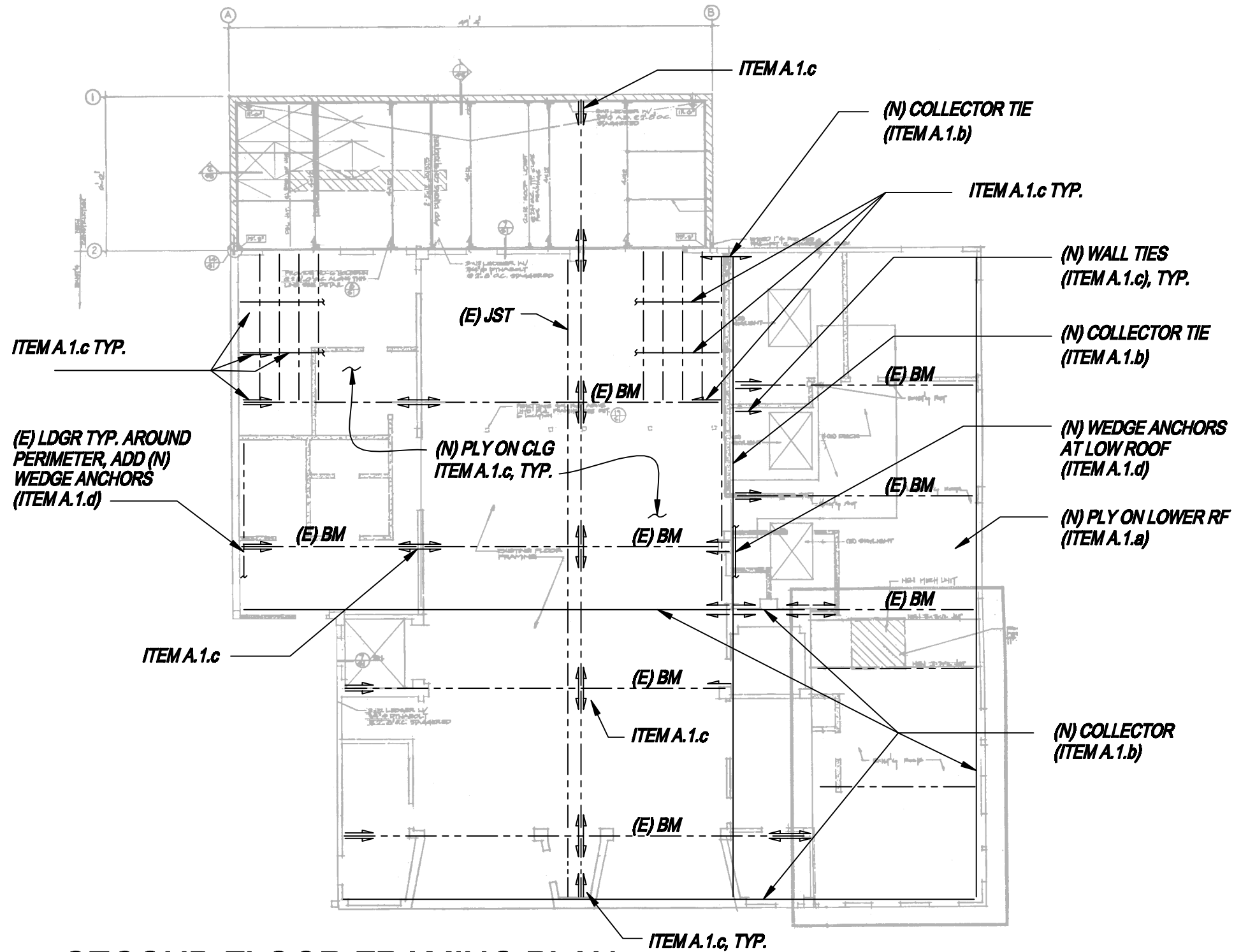
STRUCTURAL FINDINGS

rated as poor, given the age and construction material of the building. Older concrete wall buildings with wood framed floors and roofs are susceptible to significant structural damage during a strong earthquake. The possible damages to this building might include damage to the floor and roof as the concrete wall separates from those levels. This could result in a collapse or partial collapse of the floor or roof.

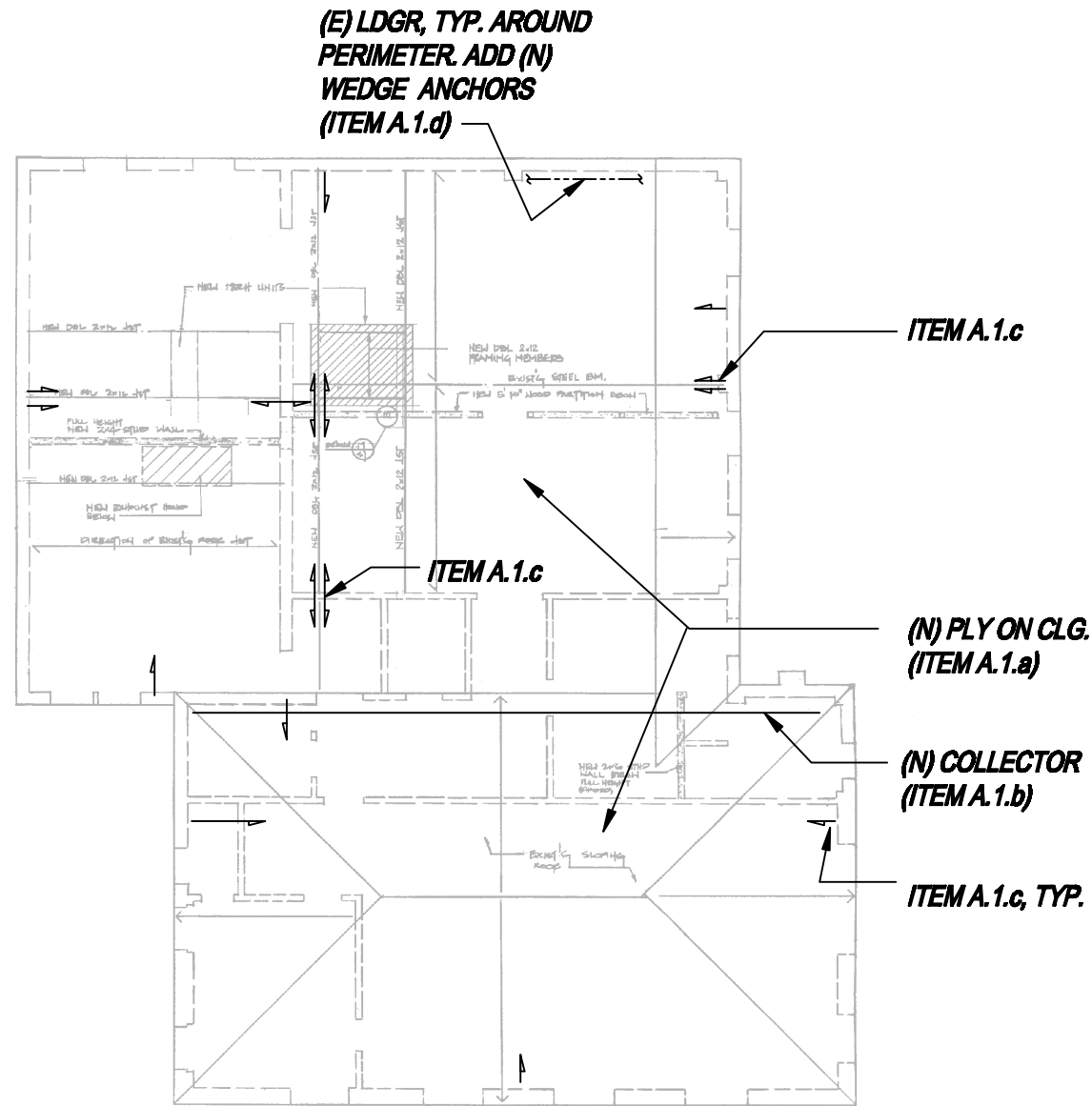
In addition, this building appears to have a minimal amount of concrete shear walls and the existing concrete shear walls have been modified. This could result in damages to the existing concrete shear walls.

The seismic study of this facility prepared by Engle & Engle Structural Engineers highlights the seismic improvements that must be implemented for the structure to comply with the 1997 UBC. This work is shown on the enclosed schematic plan and includes:

1. Diaphragms
 - a. Addition of plywood to the ceiling above the apparatus room and on the ceiling above second floor.
 - b. Addition of new collector ties at the roof and second floor level.
 - c. Addition of new concrete wall and masonry wall ties and continuity ties at the second floor and roof levels. New ties to be spaced at 4'-0" cc.
 - d. Addition of new wedge anchors at roof and second floor ledgers.
2. Shear Walls
 - a. Add new concrete shear walls.
 - b. Add new plywood to the existing walls shown on the schematic plan.
 - c. Add new holdowns where shown.
 - d. Add new foundations where shown.



SECOND FLOOR FRAMING PLAN



ROOF FRAMING PLAN

B. Fire Station No. 2

Fire Station No. 2 General Description

The building is a one-story structure that was originally constructed in 1957. The building was designed using the 1955 UBC. The fire station is a wood framed structure approximately 3,000 square feet in size. The design of the station is shown on the architectural and structural drawings prepared by Eugene E. Crawford, Architect, dated March 4, 1957.

The facility was designed with the apparatus room constructed on the eastern side of the living quarters. The apparatus room features a high roof structure that is 3'-0" taller than the roof over the living quarters. The high roof is constructed of 2x6 tongue and groove decking that is supported by 5"x16 1/4" glulam beams spaced at 7'-6" center to center. The glulam beams span approximately 29 feet and are supported each end by a 6x6 post.

The low roof over the living quarters is constructed of plywood sheathing supported by a 2x roof joist spaced at 16" center to center. The roof joists are supported by interior and exterior bearing walls.

The first floor is constructed of a 3 1/2" thick concrete slab in the living quarters and a 5 1/2" thick concrete slab at the apparatus room.

The foundation consists of shallow continuous footings.

The exterior and interior walls are constructed of wood studs. All exterior walls have 3/8" plywood sheathing applied to the outside face. Interior shear walls have plywood applied to one or both faces of the wall.

The site also contains a 50-foot tall, five-story training tower. This structure is wood framed with exposed plywood floors and unfinished walls on the inside. The exterior of the tower is finished with plaster placed over the wall plywood.

Fire Station No. 2 Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be performing appropriately. No unusual movement or differential settlement of the building foundations was observed.
- The first floor slab on grade appears to be in good condition. There was no visual evidence of excessive cracking of the floor slab.

STRUCTURAL FINDINGS

- The roof framing system appears to be functioning normally to support the vertical loads. Some areas of ponding are visible at flat roof sections.
- There are two mechanical units on top of the roof. The connection of these units to the roof structure will not comply with the 1997 UBC.
- There appears to be some water-related damage to the training tower. Water damaged plywood floor and wall panels were found in areas throughout the tower.
- The exterior plaster around the training tower has been damaged in some areas by the infiltration of water behind the plaster.
- The floor slab of the training tower is lower than the exterior grade. There are no floor drains in the slab to drain water inside of the training tower.
- The code requires 6” separation between the exterior finished grade and wood structure. The wood structure at the base of the training tower does not comply with this requirement.
- Some dry rot was found in the wood structure at the base of the training tower.

Fire Station No. 2 Seismic Evaluation

The fire station main building and training tower are small structures and are of lightweight wood framed construction. These types of buildings will generally perform satisfactorily during an earthquake if the design provides a defined load path for the seismic forces.

The original structural drawings for the fire station main building provides a defined load path appropriate for the transfer of the lateral loads from the roof diaphragms to the building foundation. However, the change in base shear requirements noted below would require improvements to the structural elements in the load path to improve the performance of this building. A general description of these improvements is listed below.

The potential performance of the fire station main building in the “as is” condition is rated as fair.

There are no structural drawings available for the training tower. Therefore, this opinion is based on field observation of this structure and review of documentation prepared by others. It has been determined through observations that some load path considerations have been incorporated in the design of this structure. However, unknown foundation conditions and dry rot conditions of the framing and plywood could affect the performance of this building. The performance of this structure in its “as is” condition would also rate as fair.

The suggested improvements to the training tower are also noted below.

The results of the code evaluation indicate the fire station building and the training tower do not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 35% larger than the base shear required by the original design code. Therefore, some of the lateral force resisting elements will be overstressed if the building is evaluated by the 1997 UBC. In addition, changes incorporated in the code since the original design of these buildings would require that new elements be added in order to comply with the 1997 UBC.

The enclosed schematic plan indicates the areas where improvements must be made in order for the fire station main building and training tower to comply with the seismic requirements 1997 UBC. A brief listing and description of these improvements is as follows:

1. Main Building

a. Diaphragms

- 1) The roof over the apparatus room is not constructed of an approved diaphragm material. The existing roofing should be removed and new 1/2" plywood sheathing placed over the existing 2x6 decking.
- 2) A new collector element is required at the low roof at column line 5.
- 3) The 6x6 posts in the apparatus room wall at column line B are designed to transfer the diaphragm forces from the high roof into the low roof. The connection of these posts to the low roof diaphragm is overstressed.

b. Shear Walls

- 1) The interior shear wall at line 4 must be reframed using 3x members for the studs and sill plate. The sill plate must be anchored with 5/8" diameter anchor bolts.
- 2) New 5/8" diameter anchor bolts must be added to the existing sill plate connection of the interior shear wall along line 3.
- 3) New holdowns are required at four locations.
- 4) New foundations are required at two walls.

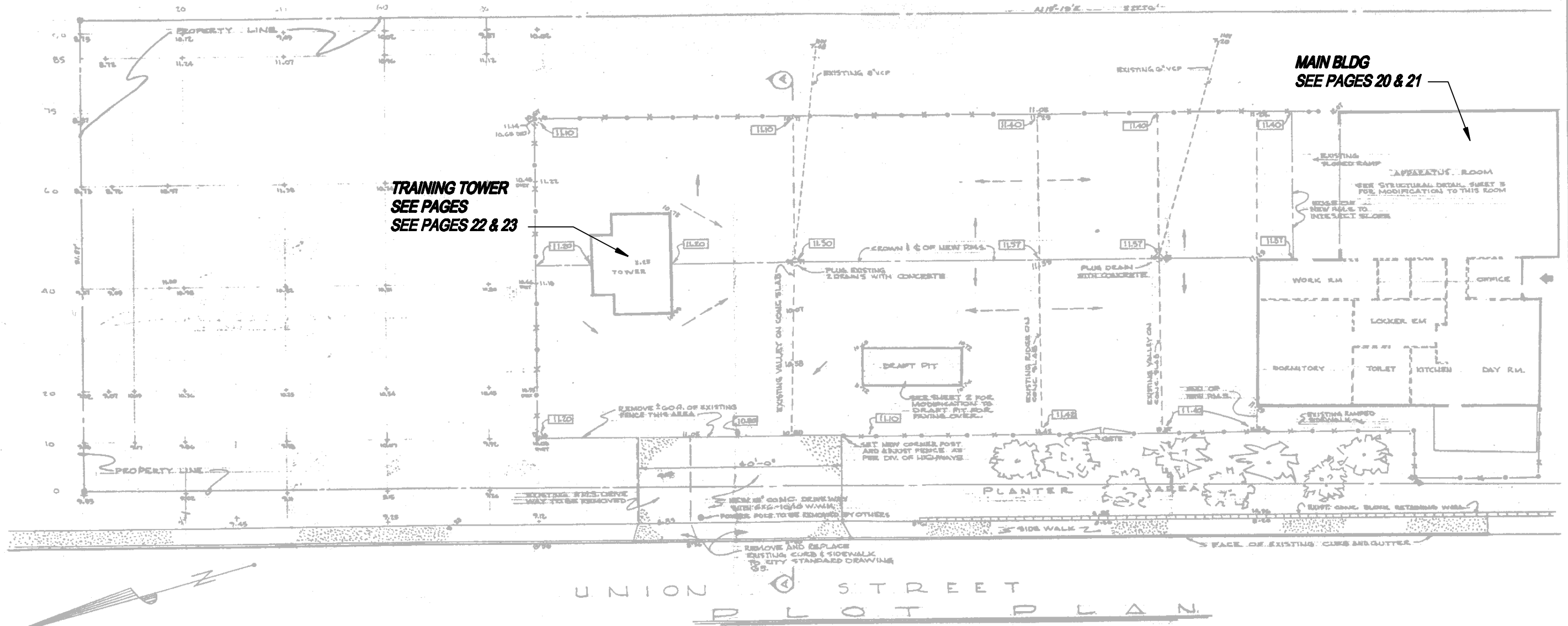
2. Training Tower

a. Shear Walls

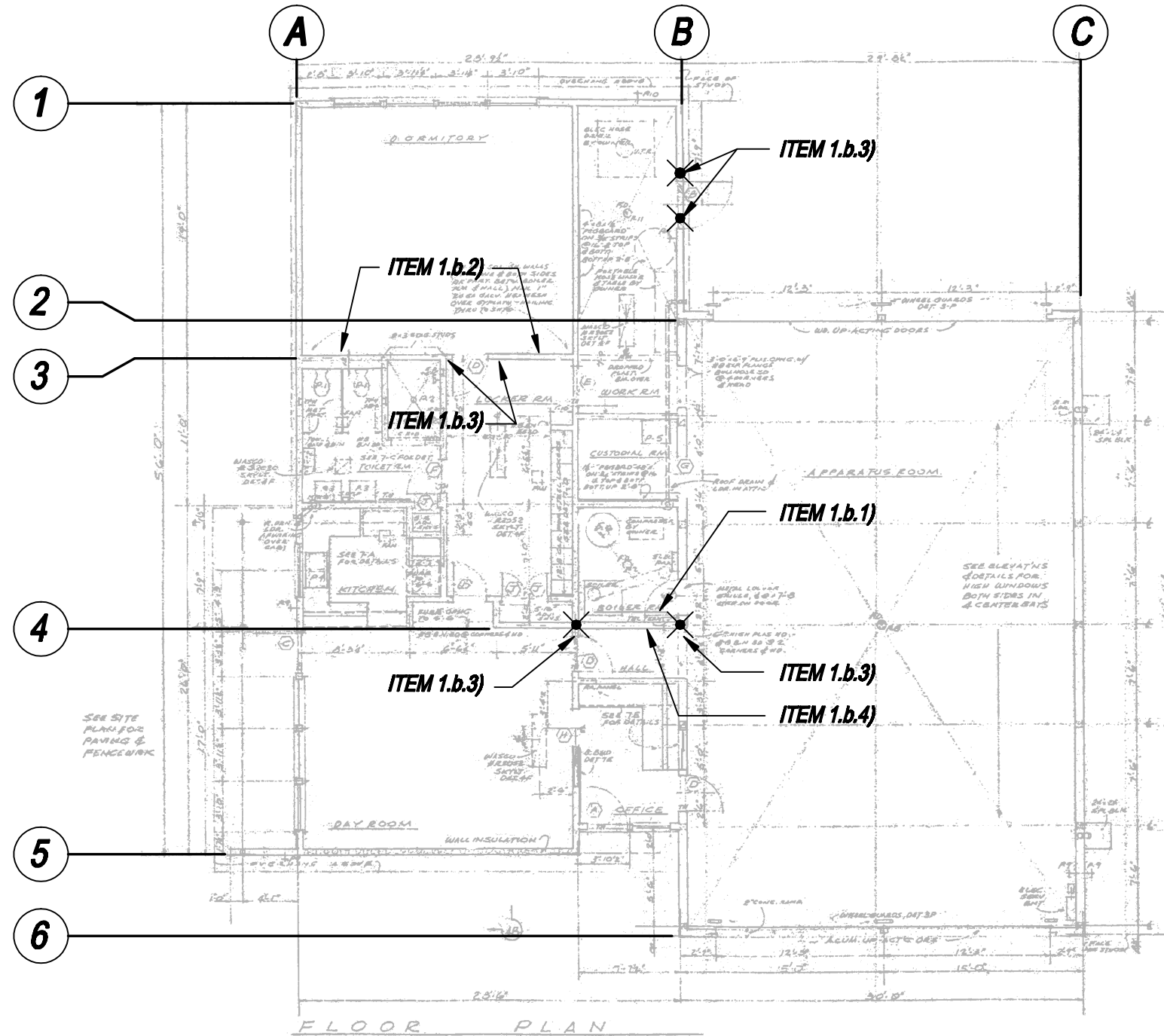
- 1) Replace water damaged plywood and framing.
- 2) Renail the existing interior and exterior wall plywood.

STRUCTURAL FINDINGS

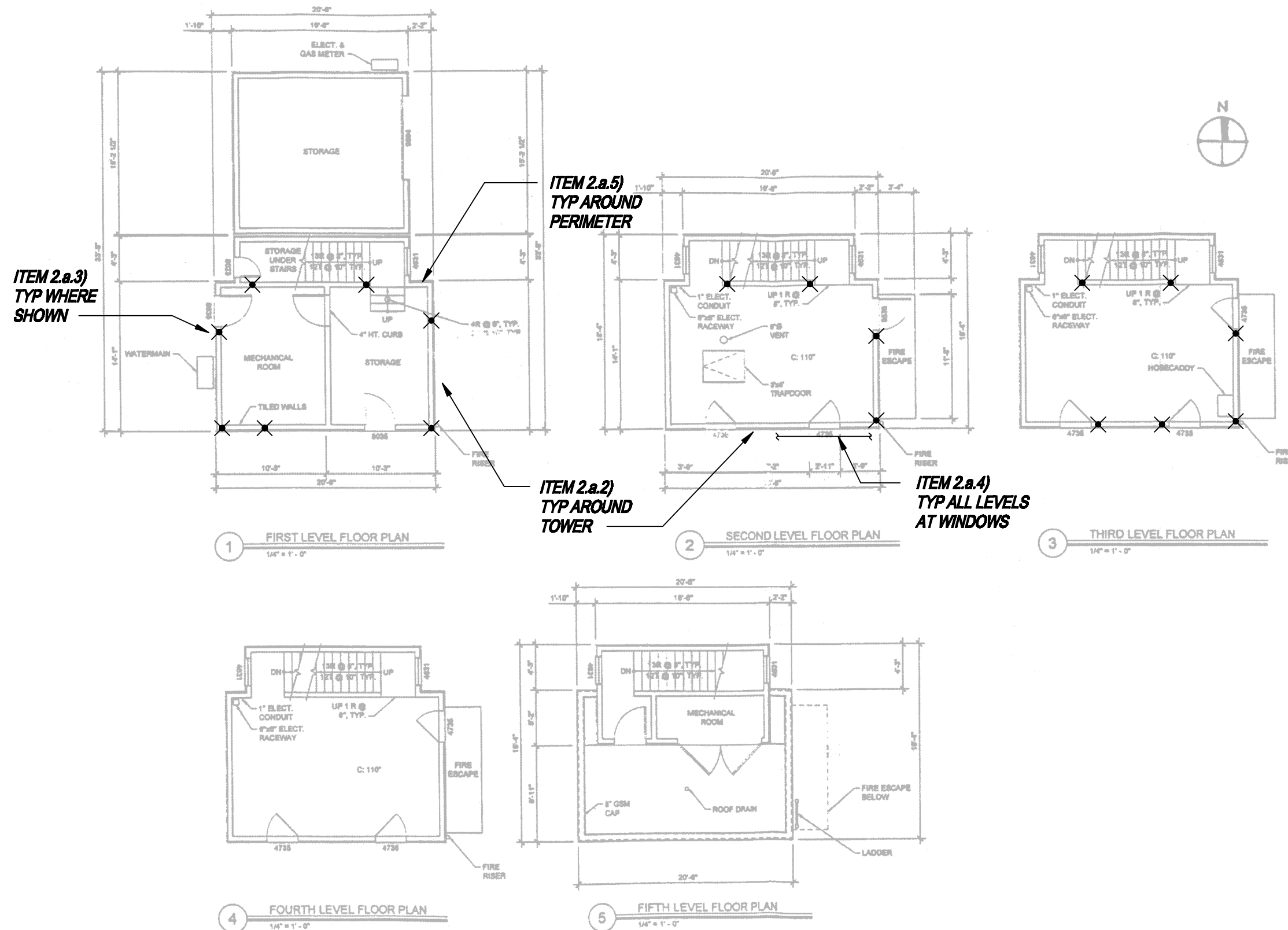
- 3) Add new holdowns at corners and edges of openings through the shear walls.
- 4) Reinforce around window openings with continuous horizontal straps placed above and below the openings over the plywood.
- 5) Increase the size of the existing building foundation.



PLOT PLAN

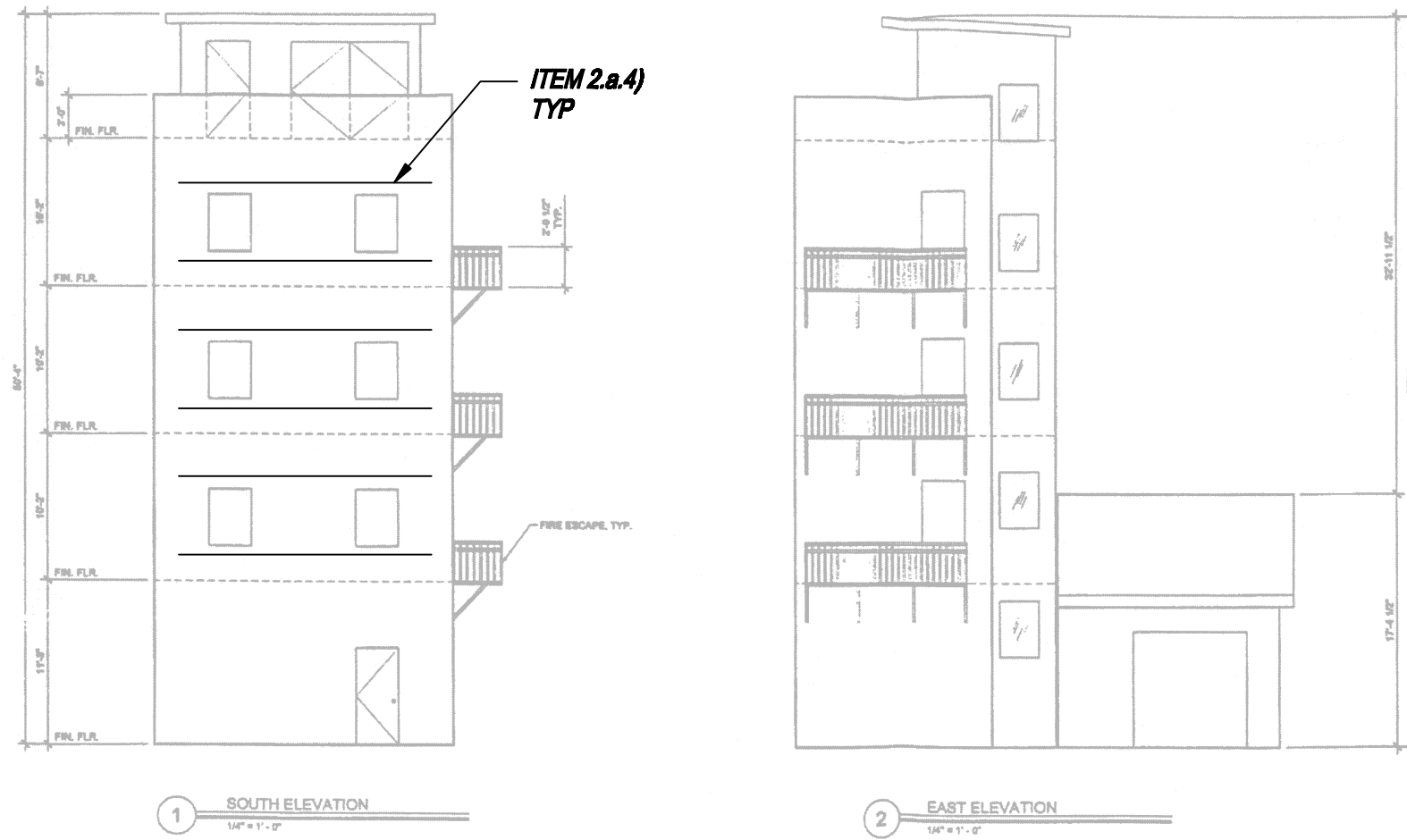


FLOOR PLAN



REF. NORTH

DRILL TOWER



DRILL TOWER

C. Fire Station No. 4

Fire Station No. 4 General Description

The building is a one-story structure that was originally constructed in 1964. The building was designed using the 1961 UBC.

The fire station is approximately 4,100 square feet in size and is of mixed construction. The design of the station is shown on the architectural drawings prepared by Roger F. Hooper and Associates, and the structural drawings prepared by Whitlow, Hoffman & Albritton, Civil & Structural Engineers. The drawings are dated March 17, 1964.

The facility was designed with the apparatus room constructed on the southerly side of the living quarters.

The apparatus room is a tilt up concrete construction. The high roof is constructed of 3/8" plywood sheathing supported by 2x8 tongue and groove decking, 6x8 purlins and steel girders. The perimeter walls are constructed of 6" thick tilt up concrete walls. The walls are supported by a continuous concrete foundation. The first floor is a 6" thick concrete slab on grade.

The living quarter is a one story wood framed structure that is constructed adjacent to the apparatus room. The roof is constructed of 3/8" plywood sheathing supported by 2x10 wood joists. The wood joists are supported by the tilt up concrete wall interior wood framed bearing walls and the north exterior wall at the building. The exterior walls are constructed of 3/8" plywood sheathing placed over wood studs.

The exterior and interior bearing walls are supported by a continuous concrete foundation. The first floor is a 4" thick concrete slab on grade.

Fire Station No. 4 Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be performing appropriately. No unusual movement or differential settlement of the building foundations was observed.
- The first floor slab on grade appears to be in good condition. There was no visual evidence of excessive cracking of the floor slab.
- The roof framing system appears to be functioning normally to support the vertical loads. Some dry rot decay was found at the 2x8 decking located at the eave of the high roof.

STRUCTURAL FINDINGS

- The tilt up concrete walls appear to be in good condition.
- The wood trim is in contact with the asphalt paving at the rear of the building. The Uniform Building Code requires a 6” separation between the wood and grade or the wood must be a material with a natural resistance to decay.

Fire Station No. 4 Seismic Evaluation

The original structural drawings for Fire Station No. 4 do not indicate a complete load path required for the transfer of lateral loads from the roof diaphragm to the foundation. The higher mass of the concrete apparatus room structure will place an increased demand on the lighter wood framed structure of the living quarters. The lateral forces from the apparatus room roof diaphragm will be transferred to the low roof diaphragm by the cantilevered action of the concrete columns in the wall at line B. The drawings do not indicate an appropriate connection of these columns to the low roof diaphragm. This could result in some damages to the low roof at line B.

The columns at line B are also used to transfer the diaphragm shears from the high roof diaphragm along line B to the concrete wall below the low roof at line B. The size and spacing #2 tie reinforcing will not comply with the 1997 UBC. This could result in damages to the concrete columns along this line.

Other potential damages would include damages to the anchor bolt connection at the steel beam on top of the concrete column. The anchor bolts are not properly confined within the concrete core of the columns.

The results of the code evaluation indicate that this building does not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 65% larger than the base shear required by the original design code. Therefore, some of the lateral force resisting elements will be overstressed if the building is evaluated by the 1997 UBC. In addition, changes in the code since the original design of the building would require that new elements be added in order to comply with the 1997 UBC.

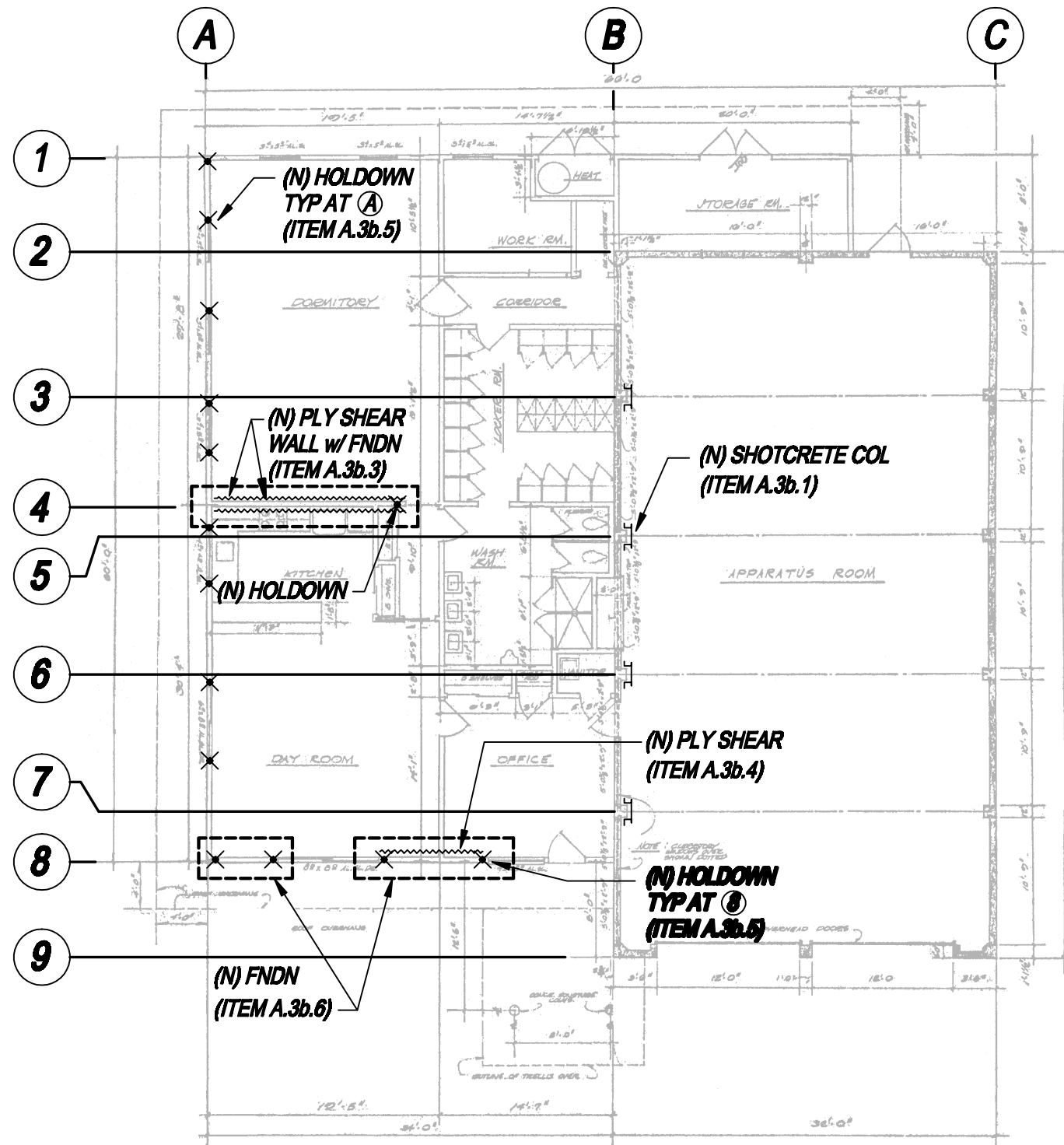
Therefore, in considering the above, the potential performance of this building in the “as is” condition would be rated as poor. The enclosed schematic plan indicates areas of suggested improvements to improve the performance of this building. These improvements would be necessary for the building to comply with the seismic requirements of the 1997 UBC. A brief listing and description of these improvements is as follows:

1. Diaphragms
 - a. A collector tie is required at the low roof at line 2 to connect the low roof diaphragm to the rear wall of the apparatus room.
 - b. New framing and wall ties are required at the low roof at line B to connect the cast in place concrete columns to the low roof diaphragm.
 - c. Nail the low roof plywood to the framing at lines 2, 3, 5, 6, and 7.

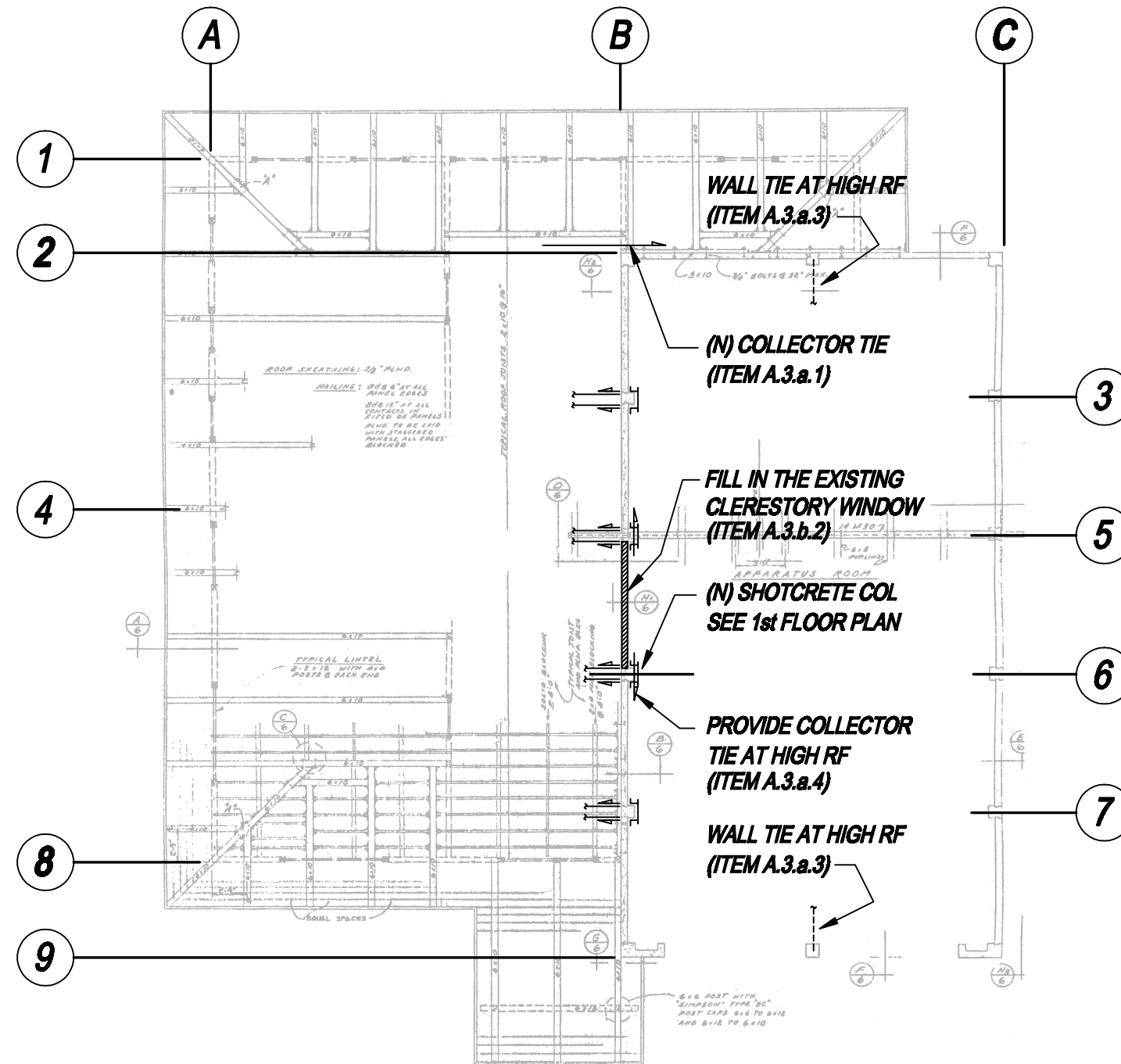
-
- d. New wall ties are required at the high roof at lines 2 and 9 to connect the wall to the high roof diaphragm.
 - e. Provide a collector tie at the high roof at line B-3 and B-6.
 - f. Provide a collector at the low roof at line 4.

2. Shear Walls

- a. The cast in place concrete columns at line B acts as a transfer element between the lower and upper roof diaphragms. This element will need to be strengthened for this transfer.
- b. One of the clear story windows in the concrete wall at line B will need to be filled with concrete to provide for an in plane transfer of the shear from the high roof to the low roof.
- c. A new internal plywood shear wall with new foundations must be added at the wall at line 4.
- d. New plywood is required at the interior face of the front wall at line 8.
- e. New holdowns are required at the walls at lines 4, 8, and A.
- f. New foundations are required at the existing exterior wall at line 8.



FIRST FLOOR PLAN



ROOF FRAMING PLAN (PARTIAL)

D. Fire Station No. 5

Fire Station No. 5 General Description

The building is a one-story structure that was originally constructed in 1966. The building was designed using the 1964 UBC.

The fire station is approximately 4,100 square feet in size and is of wood framed construction. The design of the station is shown on the architectural drawings prepared by Hooper, Olmsted & Emmons, Architects, and the structural drawings prepared by Whitlow, Hoffman & Albritton, Civil & Structural Engineers. The drawings are dated October 1, 1965. The facility was designed with the apparatus room constructed on the westerly side of the living quarters.

The building is a wood framed structure. The high roof over the apparatus room is constructed of 3/8" plywood sheathing, supported by 2x8 tongue and groove decking, 6x8 purlins and steel girders.

The low roof over the living quarters is constructed of 3/8" plywood sheathing supported by 2x10 wood joist. The wood joists are supported by interior and exterior wood framed bearing walls.

The exterior walls are constructed of 3/8" plywood sheathing placed over wood studs.

The first floor is constructed of a reinforced structural slab that is 8" thick in the living quarters and 11" thick at the apparatus room.

The entire structure is supported by a mixed foundation system consisting of cast in place concrete piers and driven wood timber piles.

Fire Station No. 5 Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be performing appropriately. No unusual movement or differential settlement of the building foundations was observed.
- The first floor structural slab appears to be in good condition. There was no visual evidence of excessive cracking of the slab.
- The roof framing appears to be functioning normally to support the vertical loads.
- The exterior walls appear to be in good condition. Some stucco cracks were

STRUCTURAL FINDINGS

found at the corners of the windows. These do not appear to be related to a structural condition.

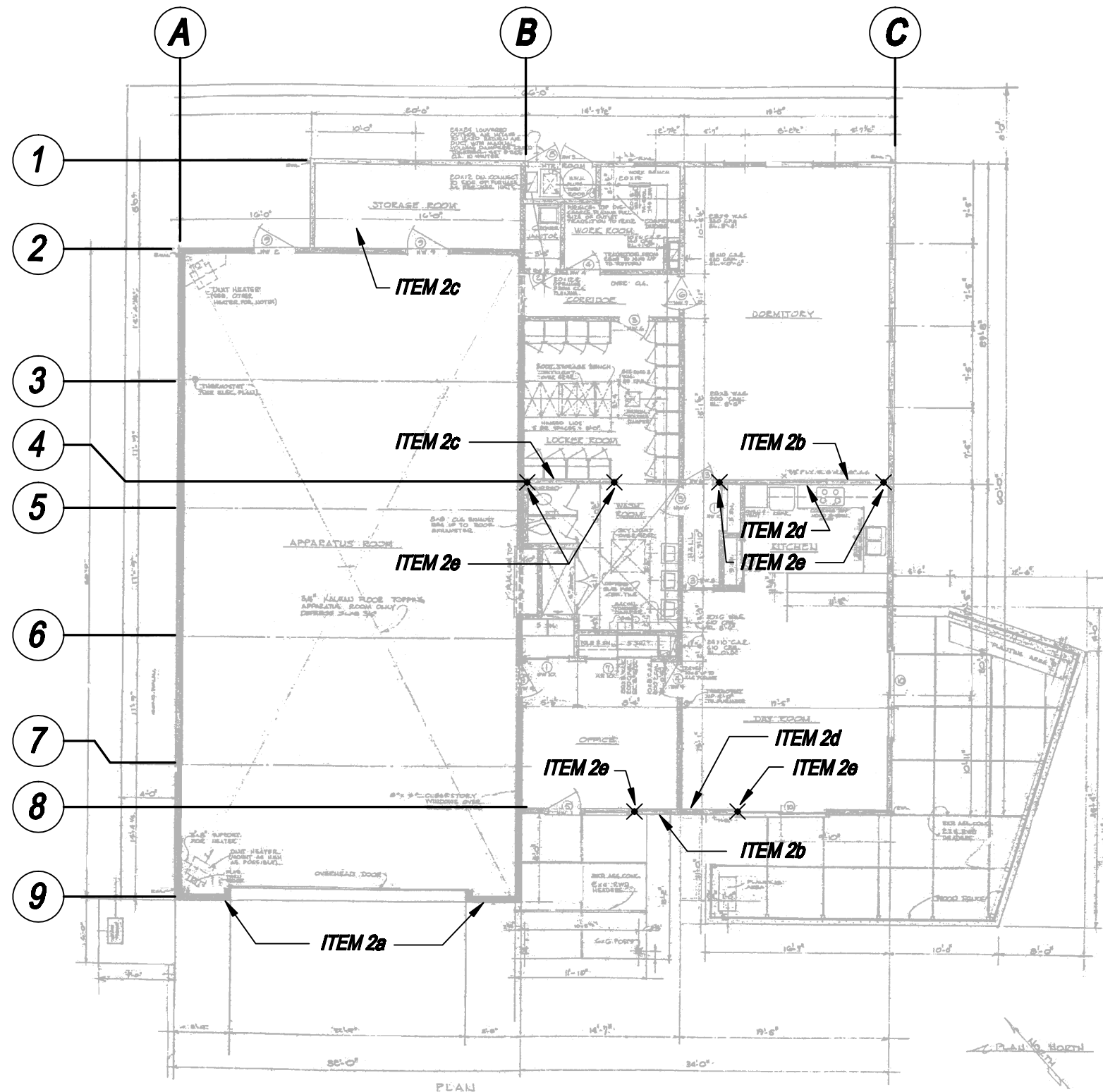
Fire Station No. 5 Seismic Evaluation

Fire Station No. 5 is a small structure and is of lightweight wood framed construction. This type of building will generally perform satisfactorily during an earthquake if the design provides a defined load path for the transfer of the seismic forces. The original structural drawings for the building provide a detailed load path appropriate for the transfer of lateral loads from the roof diaphragms to the building foundation.

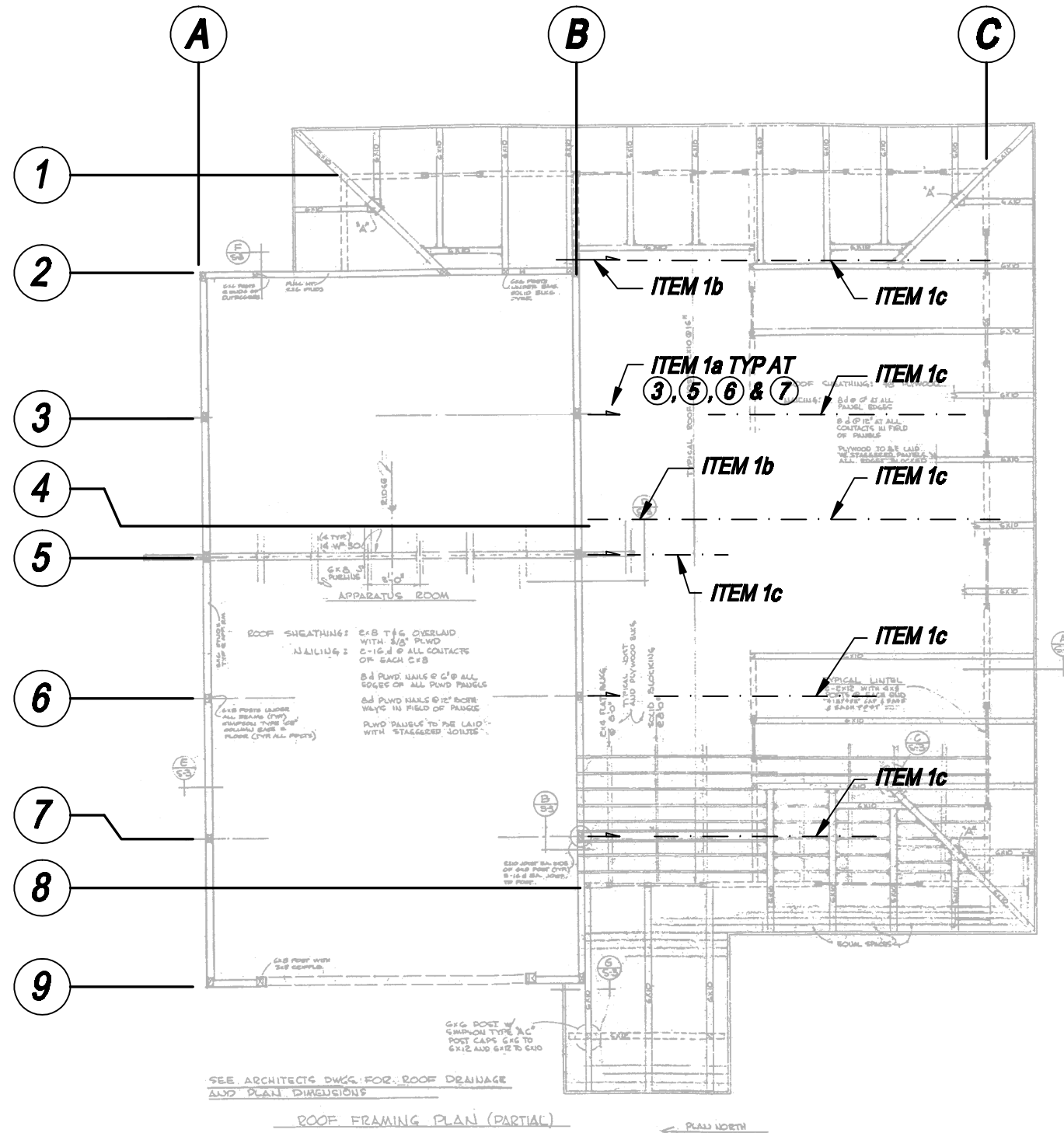
The results of the code evaluation of this building indicate that this building will not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 40% larger than the base shear required by the original design code. Therefore, some of the lateral force resistance elements will be overstressed if the building is evaluated by the 1997 UBC. Therefore, the potential seismic performance of this building in the “as is” condition is rated as fair. The enclosed schematic plan indicates areas of the building that could be strengthened to improve the seismic performance of this building. These improvements are necessary for the building to comply with the seismic requirements of the 1997 UBC. A brief listing and description of these improvements is as follows:

1. Diaphragms
 - a. The diaphragm shears at the high roof over the apparatus room are transferred to the low roof diaphragm over the living quarters by 6x8 posts located in the apparatus room wall at line B. The connection at the post to the low roof diaphragm must be strengthened to transfer the forces required by the 1997 UBC.
 - b. Add a new collector at the roof diaphragm at lines 2 and 4.
 - c. Renail the roof diaphragm at the low roof at lines 2, 3, 5, 6 & 7.
2. Shear Walls
 - a. The height to width ratio of the walls each side of the overhead door located at the front wall at line 9 exceeds 2:1. A new steel frame each side of the opening must be added to brace the wall.
 - b. The existing plywood at the front wall at line 8 and dormitory wall at line 4 needs to be renailed.
 - c. New plywood is required at the rear wall of the apparatus room at line 2 and the dormitory shear wall at line 4.
 - d. New 5/8” diameter anchor bolts are required at the existing sill plate at the front wall at line 8 and dormitory wall at line 4.

-
- e. New holdowns are required at the shear walls at line 4 and 8.



FLOOR PLAN



ROOF PLAN

E. Fire Station No. 6

Fire Station No. 6 General Description

The building is a two-story structure that was originally constructed in 1995. The building was designed using the 1991 UBC.

The fire station is approximately 6,100 square feet in size and is of mixed construction. The design of the station is shown on the architectural drawings prepared by Forsher & Guthrie Architects and the structural drawings prepared by William H. Schmidt Structural Engineer. The drawings are dated January 30, 1995. The facility was designed with the apparatus room constructed on the westerly site of the living quarters.

The apparatus room is a one story concrete masonry building. The high roof is constructed of steel decking supported by steel trusses spaced at 6'-0" cc. The steel trusses span across the apparatus room and are supported by the 8" thick masonry walls around the perimeter of the apparatus room. The first floor is constructed of a 7" thick concrete slab on grade. The foundation system consists of 16" wide continuous concrete footings.

The living quarter is a two story wood framed building. The roof and second floors are constructed of plywood sheathing supported by a wood joist and beam structural system. The floor and roof systems are supported by the exterior and interior wood stud bearing walls. The first floor is constructed of a 5" thick concrete slab on grade. The foundation system consists of 12" wide continuous concrete footing.

Fire Station No. 6 Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be performing appropriately. No unusual movement or differential settlement of the building foundations was observed.
- The first floor slab on grade appears to be in good condition. There was no visual evidence of excessive cracking of the floor slab.
- The roof framing systems appears to be functioning normally to support the vertical loads.
- The second floor framing system appears to be functioning normally to support the vertical loads.
- The masonry walls appear to be in good condition.

STRUCTURAL FINDINGS

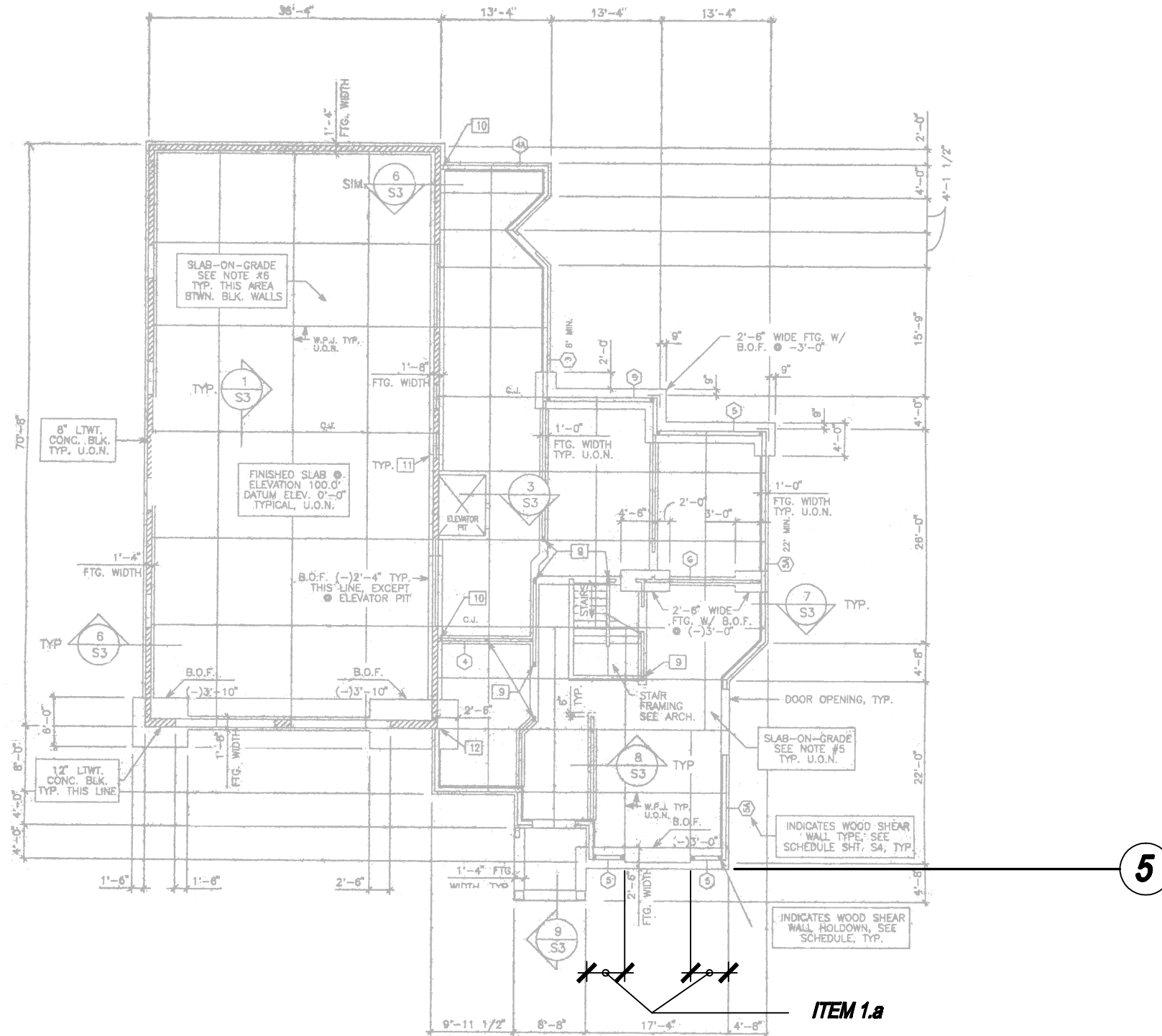
Fire Station No. 6 Seismic Evaluation

In general, the original structural drawings for Fire Station No. 6 provides a detailed load path appropriate for the transfer of lateral loads from the roof and floor diaphragms to the building foundation. In the “as is” condition, only minimal structural damage is likely as a result of future earthquakes. Therefore, the performance of this building in the “as is” condition is rated as good.

The results of the code evaluation of this building indicate that the design of the building appears to comply with the 1997 UBC. The base shear design force required by the 1997 UBC is similar to that required by the original design code. Therefore, the design of the lateral force resisting elements will not be significantly affected by changes in the 1997 UBC. A brief listing of the elements that do not comply with the 1997 UBC is listed below.

1. Shear Walls

- a. The 1997 UBC requires the aspect ratio of the shear wall not be exceed 2:1 (height to width ratio). The shear walls at line 5 adjacent to the sliding glass door do not comply with this requirement



FOUNDATION PLAN

F. Fire Station No. 7

Fire Station No. 7 General Description

The building is a one-story structure that was originally constructed in 1978. The building was originally designed using the 1973 Uniform Building Code.

The fire station is approximately 3,800 square feet in size and is of wood framed construction. The design of the station is shown on the architectural drawings prepared by Backen Arrigoni & Ross, Inc., and the structural drawings prepared by ECM, Inc. The drawings are dated June 19, 1977.

The building is a wood framed structure. The high roof over the apparatus room is constructed of 5/8" T1-11 plywood sheathing supported by 20" deep wood trusses spanning across the apparatus room.

The low roof over the living quarters is constructed of 1/2" plywood supported by 2x10 wood joists. The wood joists are supported by interior and exterior wood framed bearing walls.

The exterior walls are constructed of plywood sheathing placed over 2x4 and 2x6 wood studs.

The first floor is constructed of a 7" thick concrete slab on grade in the apparatus room and a 4" thick slab on grade in the living quarters.

The foundation system consists of 12" and 18" wide continuous footings.

Fire Station No. 7 Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundation system appears to be performing appropriately.
- The first floor slab on grade has many cracks that are visible in the apparatus room and that can be felt through the carpet in the living quarters. The possible causes of this condition could be related to one or a combination of the following conditions:
 1. The details shown on the structural drawings for the slab on grade construction and crack control joints do not allow for shrinkage of the concrete slab.
 2. The improper design and/or placement of the reinforcing in the slab.

STRUCTURAL FINDINGS

3. Improper curing of the slab at the time of construction
4. Conditions related to the existing site soils or the presence of an improper or improperly placed fill.
5. Improper conditioning of the subgrade during construction.

The roof framing appears to be performing appropriately to support the vertical loads. The roof structure has been sloped to provide for drainage. Some areas of ponding are visible at the exterior wall at line 1. Some roof leaks have occurred over the dormitory in the past.

3.7c Fire Station No. 7 Seismic Evaluation

Fire Station No. 7 is small and of lightweight wood framed construction. The original structural drawings provide a detailed load path for the transfer of lateral loads from the roof diaphragm to the building foundation.

However, the original design of the lateral force resisting system for this building included a cantilevered column type of vertical resisting element each side of the overhead door at line C. The design requirements for this type of system have been significantly increased in the 1997 UBC and will affect the design of the entire lateral force resisting system for this building.

This building as originally designed does not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 235% greater than the base shear required by the original design code.

Therefore, the potential seismic performance of this building in the “as is” condition is rated as poor.

The enclosed schematic plan of this building indicates the areas where improvements must be made to comply with the 1997 UBC. A brief listing of these improvements is as follows:

1. Diaphragms
 - a. The high roof over the apparatus is braced by the low roof over the living quarters. The seismic forces of the high roof are transferred to the low roof by the cantilevered wall framing at line 3. The studs along this line and the connection to the roof must be strengthened to comply with the 1997 UBC.
 - b. Add a new collector at Line A.5.
2. Shear Walls
 - a. A new vertical resisting element will need to be designed at the overhead doors along line C. The existing shear wall at line C adjacent to the entry into the office may be strengthened to brace the front of the apparatus

room at line C. This will require new plywood, framing, holdowns and foundations at the shear wall adjacent to the entry at the office.

- b. Add a new interior plywood shear wall at line A.5 with new anchor bolts, holdowns and foundations.
- c. Add new plywood and anchor bolts to the rear exterior wall at line A.
- d. Add new plywood to the existing wall at line B. Work along this line will also include the addition of new anchor bolts, holdowns and foundations.

G. San Rafael Community Center

San Rafael Community Center General Description

The building is a one-story structure that was originally constructed in 1975. The building is an approximate 14,500 square foot wood framed structure. The building was originally designed using the 1973 UBC. The design of the facility is shown on the architectural and structural drawings prepared by Wagstaff & McDonald, Architects, dated November 27, 1974.

The high roof area is constructed of 3/8" plywood sheathing placed over 2x6 tongue and groove decking supported by glulam beam purlins and custom designed wood trusses. The trusses are supported each end by 8" concrete masonry wall segments.

The low roof area is constructed of 3/4" plywood sheathing supported by 16" deep I joist and glulam girders. Additional support for the low roof is provided by the interior and exterior wood stud bearing walls.

The first floor is constructed of a 4" thick concrete slab on grade.

The foundation system consists of 14" wide continuous concrete footings and isolated spread footings.

San Rafael Community Center Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be performing appropriately. No unusual movement or differential settlement of the building foundations was observed.
- The first floor slab on grade appears to be in good condition. There is no visual evidence of excessive cracking of the floor slab.
- The roof framing appears to be functioning normally to support the vertical loads.
- The exterior and interior walls appear to be in good condition. Minor cracks in the finish material were found at some locations.

San Rafael Community Center Seismic Evaluation

The San Rafael Community Center is of lightweight wood framed construction. This type of building will generally perform satisfactorily during an earthquake if the design provides a defined load path for the transfer of the seismic forces.

STRUCTURAL FINDINGS

The original structural drawings provide a detailed load path appropriate for the transfer of the lateral loads from the roof diaphragm to the building foundation. However, the changes in the UBC since the original design of this building will affect the design of the lateral force resisting system for this building.

The results of the code analysis of this building indicate that this building will not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 65% larger than the base shear required by the original design code. Therefore, some of the lateral force resisting elements will be overstressed if the building is evaluated by the 1997 UBC.

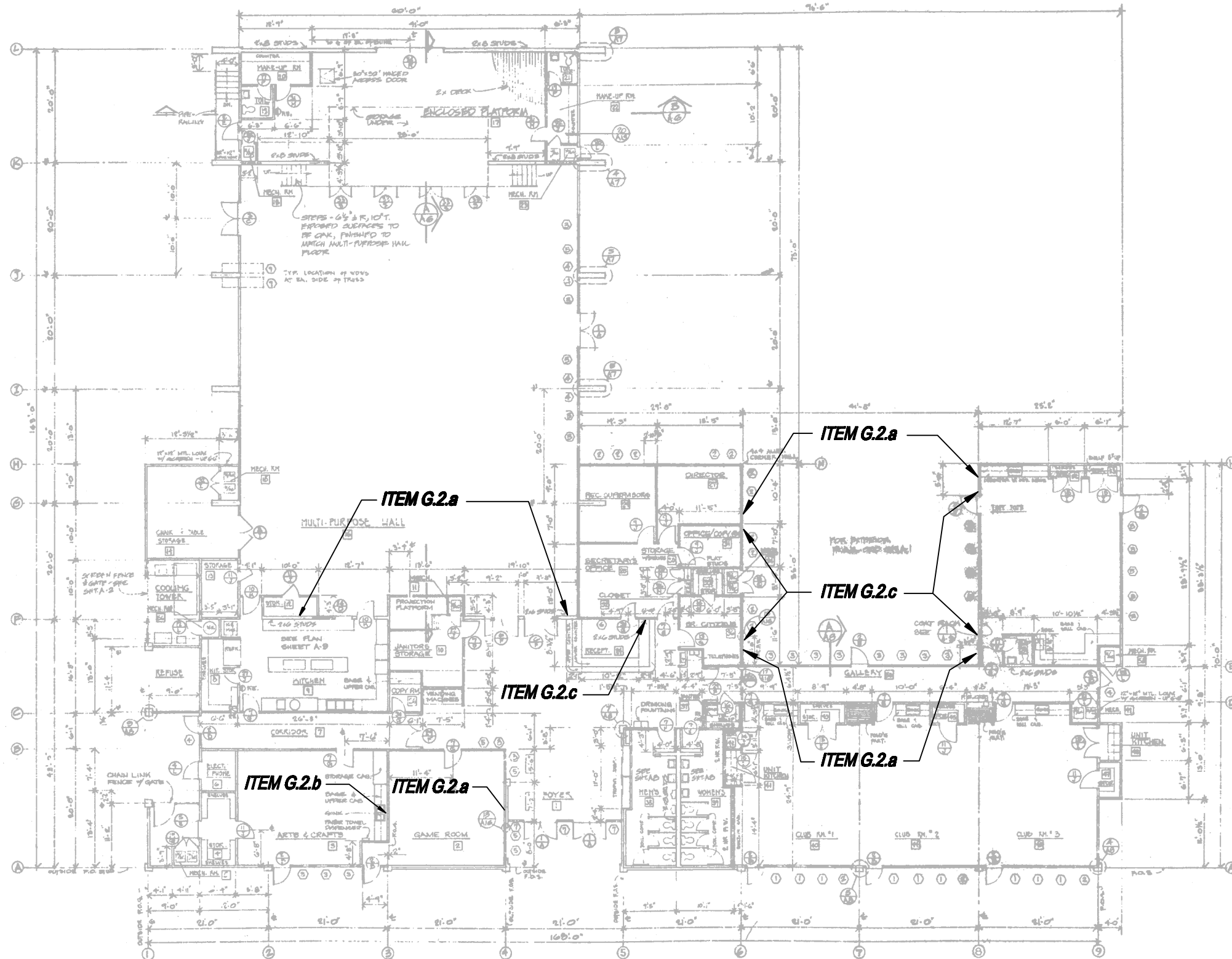
The potential seismic performance of this building in the “as-is” condition is rated as fair. The enclosed schematic plan indicates areas of the building that could be strengthened to improve the seismic performance of this building. These improvements are necessary for the building to comply with the seismic requirements of the 1997 UBC. A brief listing and description of these improvements is as follows:

1. Diaphragms

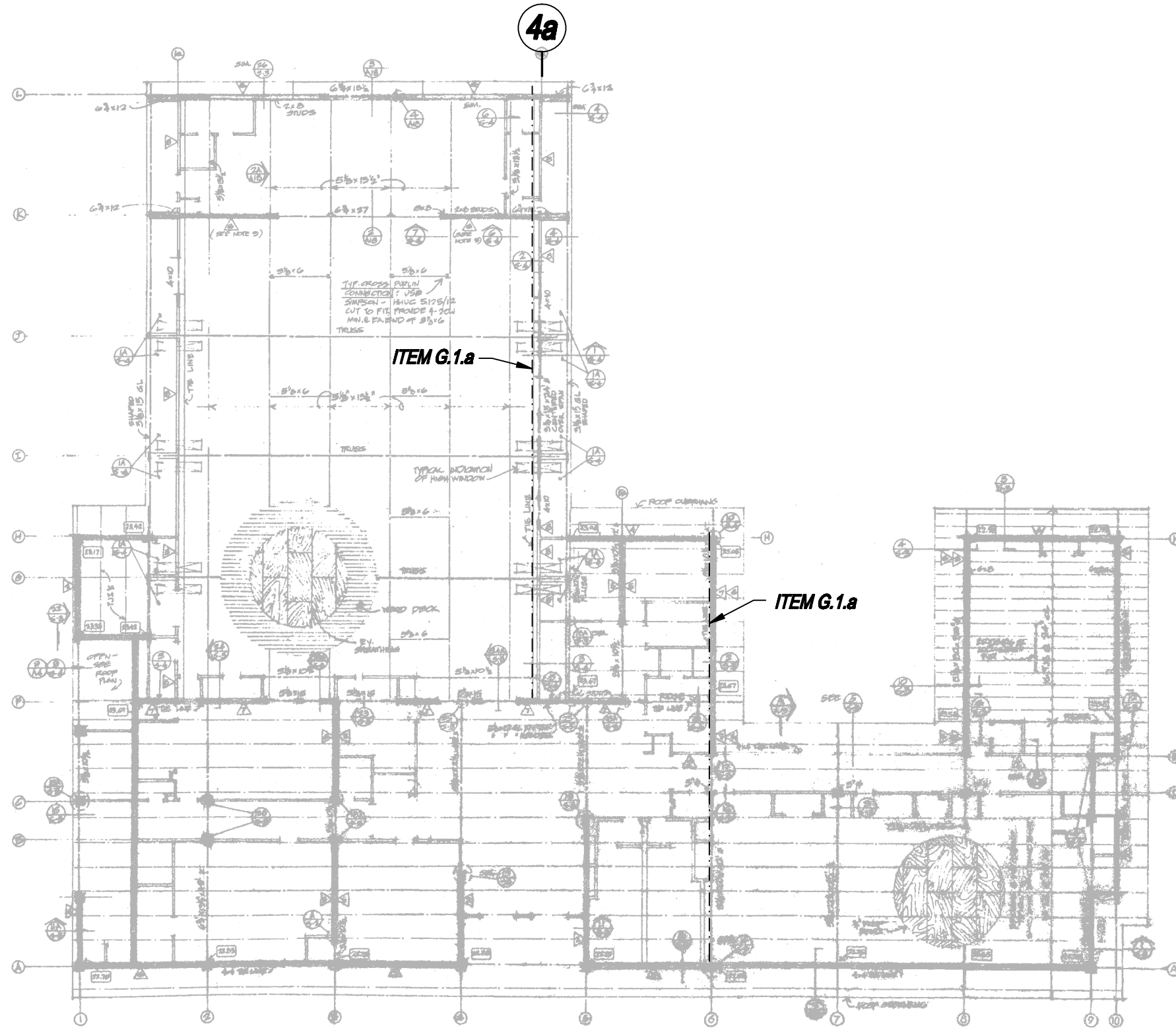
- a. The splices of the collector ties at lines 4a and 6 will need to be strengthened.

2. Shear Walls

- a. 3x studs are required for the wall framing and sill plate at the shear walls located as lines 4, 6, & 8 and F. These walls will need to be reconstructed.
- b. The gypsum board shear wall at line 3 is overstressed. New plywood will need to be added to one face.
- c. The aspect ratio (height to length ratio) of portion of the existing shear walls at lines 6, 8 & F exceed the 2:1 maximum ratio allowed by the 1997 UBC. The existing shear wall segments will need to be lengthened and/or strengthened to comply with these requirements. This will include:
 - 1) The reconstruction of the existing wall segments using 3x studs and sill plates.
 - 2) The addition of new wedge anchor connection of the existing sill plates.
 - 3) The addition of new holdowns each end of the wall segments.
 - 4) The construction of new foundations.
 - 5) New holdowns are required at wall lines E, F and 4.



FLOOR PLAN



ROOF PLAN

H. Terra Linda Community Center

Terra Linda Community Center General Description

The building is a one-story wood framed structure that was originally constructed in 1954. Small additions were later constructed increasing the total building size to approximately 5,400 square feet. The building was originally designed using the 1952 UBC.

The existing roof is constructed of 2x6 tongue and groove decking supported by 4x12 purlins spaced at 4'-0" cc and a 6x girder at the ridge. The roof is supported by the exterior and interior wood framed bearing walls. The first floor is constructed of a 4" thick slab on grade. The foundations consist of 12" wide continuous concrete footings.

Terra Linda Community Center Field Observations

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. The comments relative to the physical condition of the building are as follows:

- The foundations appear to be in good condition. No unusual movement or differential settlement of the building foundations was observed.
- The first floor slab on grade appears to be in good condition. There is no visible evidence of excessive cracking of the floor slab.
- The roof framing system appears to be functioning normally to support the vertical loads. The roof surface is appropriately sloped to provide drainage. Some water stains were noticed at the ceiling in the community room. This staining appears to be associated with former roof leaks at the roof mounted mechanical equipment and screen.

Terra Linda Community Center Seismic Evaluation

In general, the Terra Linda Community Center is a small structure and is of lightweight wood framed construction. These types of buildings will generally perform satisfactorily if the design provides defined load path for the seismic forces.

The original structural drawings for this building provide a load path for the transfer of lateral loads that are not fully developed. In addition, alterations made to the original construction have changed the load path, which may affect the seismic performance of this building. One such alteration would include the rear wall at line 1. Moment frames at lines B and E were added to the building in 1987 as part of an interior remodel. The installation of the two frame columns

STRUCTURAL FINDINGS

at line 1 cut the top plates of the rear wall. The drawings do not indicate an appropriate splice to regain the continuity of the top plates. Therefore, some damage to the wall at line 1 could occur due to the lack of continuity ties.

Other areas of incomplete load path would include the shear wall elements at the rear wall at line 1. Holdowns were not provided but are required at the ends of the shear walls at this line.

The results of the code evaluation indicate that this building does not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 65% larger than the base shear required by the original design code. Therefore, some of the lateral force resisting elements will be overstressed if the building is evaluated by the 1997 UBC. In addition, changes in the building code since the original design will require that new elements be added in order to comply with the 1997 UBC.

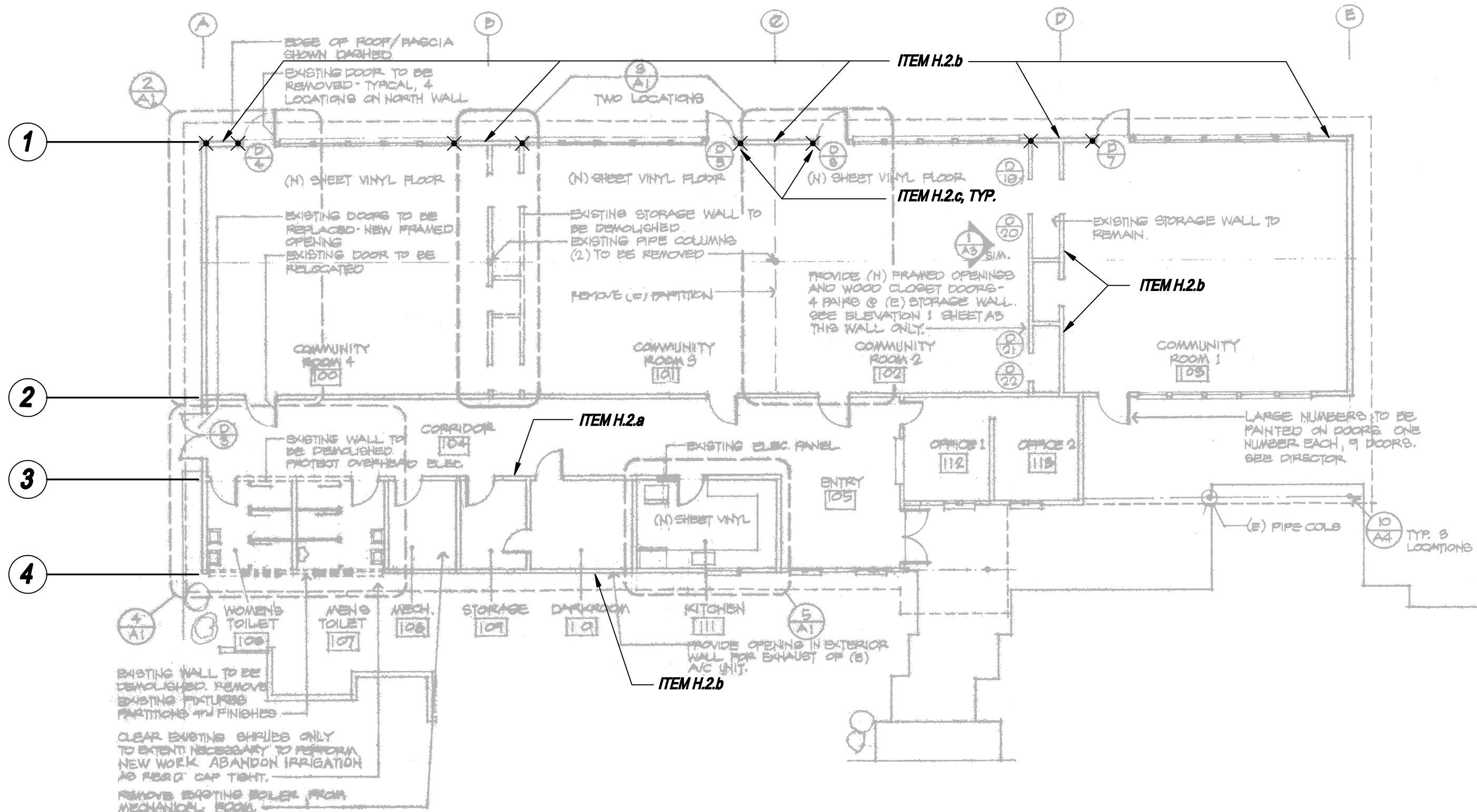
The earthquake performance of this building in the “as-is” condition is rated as fair. The enclosed schematic plan indicates areas of suggested improvements to improve the earthquake performance of the building. These improvements would be necessary for the building to comply with the seismic requirements of the 1997 UBC. A brief listing and description of these improvements is as follows:

1. Diaphragms

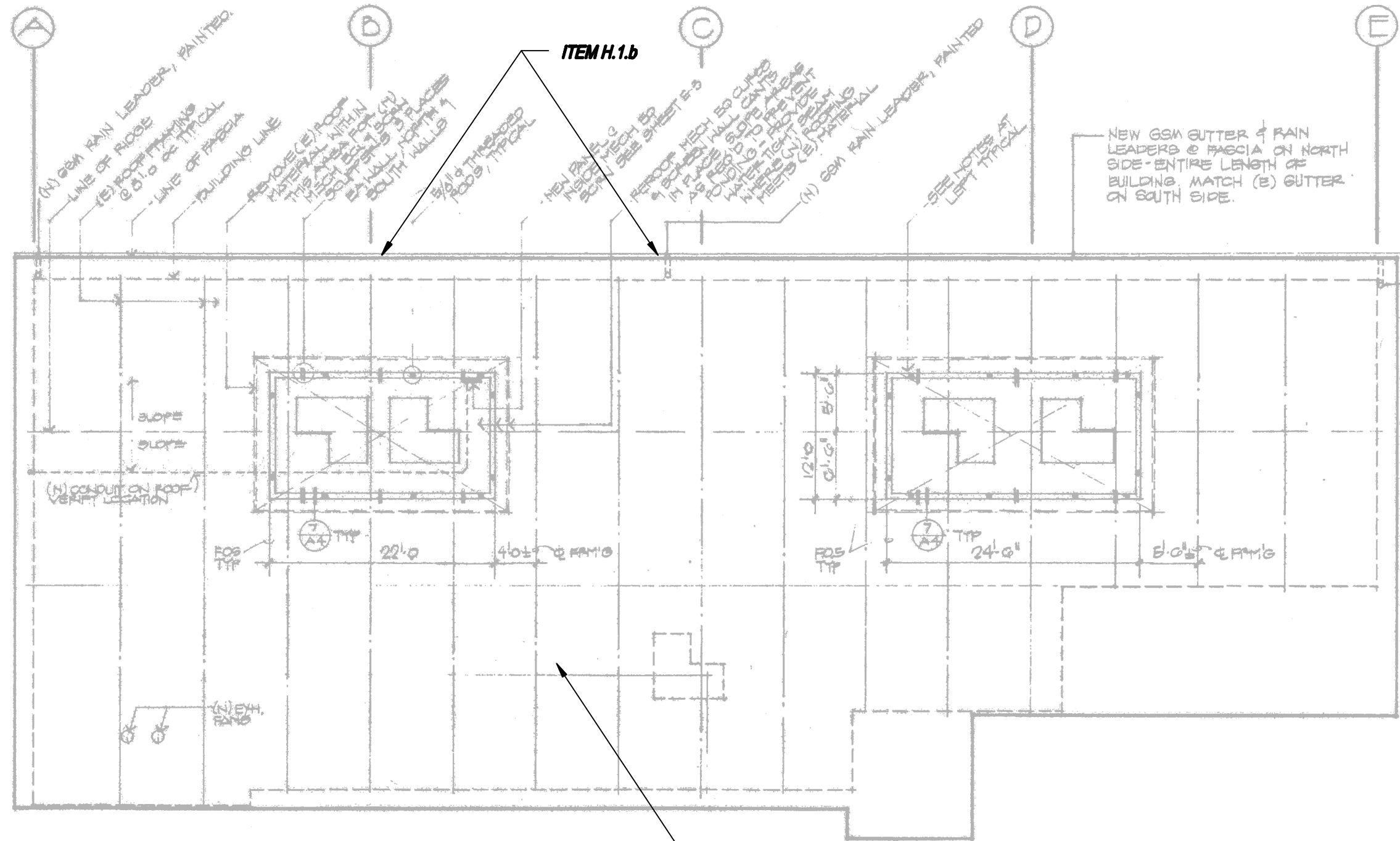
- a. The roof is not constructed of an approved diaphragm material. The existing roofing should be removed and new 1/2” plywood sheathing placed over the existing 2x6 decking.
- b. The wall at line 1 does not have an appropriate collector element. Add new machine bolts at the top plate splices and steel plates with machine bolts at the moment frame locations.

2. Shear Walls

- a. The existing wall plywood at line 3 is overstressed. Remove the existing finish material and re nail the plywood.
- b. New sill plate anchors are required at wall, lines D, 1, 3, and 4. Add new 5/8” diameter wedge anchors spaced at 4’ - 0” cc at those locations.
- c. New holdowns are required at the ends of the wall segments located along line 1.



FLOOR PLAN



ITEM H.1.b
ROOF PLAN

I. City Hall/Police Station

General Description

The city hall facility is a 26,500 square foot structure that was originally constructed in 1965. The building was originally designed using the 1964 UBC. The facility consists of the main building which is occupied by the city offices and police station and the council chambers building that is constructed to the west of the main building. The main building and council chambers are connected at the second floor level of the main building by an 1,100 square foot lobby.

The design of this facility is shown on the architectural drawings prepared by San Rafael Architects Associated and the structural drawings prepared by Engle and Engle, Civil and Structural Engineers. The drawings are dated April 19, 1965. The building is of mixed concrete and reinforced masonry construction.

The main building is a three story concrete structure. The roof, second and third floors are constructed of a 3" thick concrete slab supported by steel trusses and steel girders. The first floor is constructed of a 6" thick slab on grade.

The main building is constructed into the side of the hill towards the north. Therefore, the north exterior wall of the first floor is a reinforced concrete retaining wall. The remaining existing walls are of reinforced concrete construction. The exterior walls above grade at the north and south sides of the building feature narrow, tall window openings along the length of the wall. Other areas of the exterior walls feature a brick veneer finish.

The foundation system for the main building consists of continuous concrete footings under the concrete walls and isolated spread footings at the interior columns.

The council chamber is constructed on grade at the second level elevation of the main building. The council chambers is a one story reinforced masonry building. The roof is constructed of a 3" thick concrete slab supported by steel trusses and steel girders. The first floor is constructed of a 4" thick slab on grade.

The exterior walls are constructed of 11" thick reinforced grouted brick masonry. The exterior walls are not continuous to the bottom of the roof slab. The walls terminate at the exterior soffit, 6'-0" below the roof deck.

The foundation system consists of drilled cast in place belled caisson footings which support the exterior brick masonry walls.

Field Observations

STRUCTURAL FINDINGS

In general, the building appears to be in good physical condition structurally. However, this should not imply that the building will perform well in future earthquakes. See the seismic evaluation portion of this section for further comments relative to the seismic performance of this building. Comments relative to the physical condition of the building are as follows:

- The roof structure at the main building and council chambers appear to be functioning normally to supporting the vertical loads on the roof.
- The seismic anchorage of the mechanical equipment on the roof and in the mechanical areas of the main building will not comply with the 1997 UBC.
- There is evidence of past roof leaks at the main building. These leaks appear to be associated with the roofing condition at some of the parapet walls. These leaks have had no apparent affect on the performance of the roof slab.
- There are water stains on the brick veneer at two locations below the roof overhang at the front and rear of the building.
- The second and third floor structures appear to be functioning normally to support the vertical loads at those levels.
- The first floor slab on grade at the main building and council chambers appear to be in good condition. There is no visual evidence of excessive cracking of the floor slab.
- The foundation systems appear to be functioning appropriately.
- The exterior brick masonry and concrete walls appear to be in good condition.

Seismic Evaluation

The original structural drawings for the city hall building and council chambers indicate a complete load path required for the transfer of the lateral loads from the roof diaphragm to the foundation level. However, the changes in the UBC since the original design of this building will significantly affect the design of the lateral force resisting system for this building.

The results of the code analysis of this building indicate that this building will not comply with the 1997 UBC. The basic base shear design force required by the 1997 UBC is 65% larger than the base shear required by the original design code. Therefore, some of the lateral force resisting elements will be overstressed if the building is evaluated by the 1997 UBC.

The potential seismic performance of this building in the “as-is” condition is rated as fair. The enclosed schematic plans indicate areas of the building that could be strengthened to improve the seismic performance of this building. These improvements are necessary for the building to comply with the seismic requirements of the 1997 UBC. A brief listing and description of these

improvements is as follows:

1. Main Building (3 Story Offices)

a. Diaphragms

- 1) The original drawings specify concrete with a minimum compressive strength of 2500 psi. The 1997 UBC requires concrete with a minimum compressive strength of 3000 psi. The lower strength concrete will have a minimal effect on the seismic performance of this building.
- 2) Collectors are required at the 2nd, 3rd and roof diaphragms at locations shown.

b. Shear Walls

- 1) The original drawings specify concrete with a minimum compressive strength of 2500 psi. The 1997 UBC requires concrete with a minimum compressive strength of 3000 psi. The lower strength concrete will have a minimal effect on the seismic performance of this building.
- 2) The original drawings indicate the spacing of the wall reinforcing to be 20”c.c. at the elevator and stairway shear walls. The 1997 UBC allows a maximum spacing of 18”c.c. This will have a minimal effect on the seismic performance of this building.
- 3) The original drawings indicate that the reinforcing should be lap spliced 45 bar diameters. This will not meet the lap splice requirements noted in the 1997 UBC, but this will not have a significant effect on the seismic performance of this building.
- 4) The wall piers (narrow sections of concrete wall between the window openings) do not meet the requirements of the 1997 UBC. These piers occur at line 3, above the first, second and third floors, and at line 4, above the second and third floors. The deficiencies include:
 - a) The transverse reinforcing on the drawings does not satisfy the requirement for hoops as defined in UBC section 1921.1.
 - b) The spacing of the transverse reinforcing exceeds that required by section 1921.6.13 at some locations.
 - c) Hooks are required for the horizontal reinforcing to develop the reinforcing at the end of the wall.
 - d) The transverse reinforcing does not extend above and below the pier as required by the 1997 UBC.
 - e) The transverse reinforcing does not extend into the foundations.
 - f) Piers supporting the floor and roof girders require increased

STRUCTURAL FINDINGS

transverse reinforcing.

- g) Additional ties are required to confine the anchor bolts at the floor beam connection to the pier.
- 5) The following deficiencies occur at various shear walls (see schematic plans).
 - a) Special boundary zone reinforcing is required at the ends of some walls.
 - b) Overturning requirements are not met for some walls.
 - c) The shear capacity of the wall is exceeded at one wall.
 - d) The allowable foundation bearing pressure is exceeded at some walls.
 - e) Reinforcing hooks are required at the edges of openings.

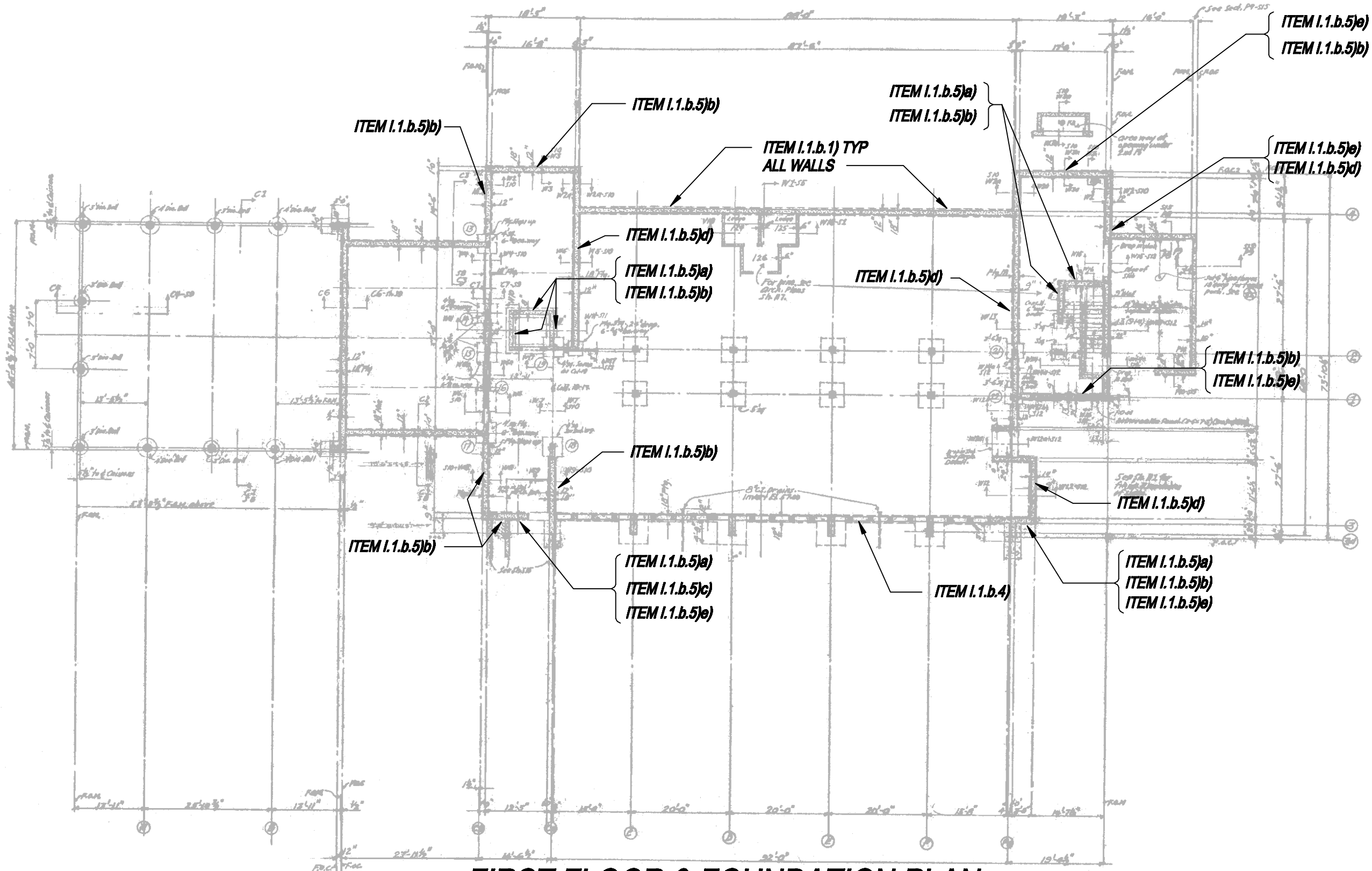
2. Council Chambers

a. Diaphragm

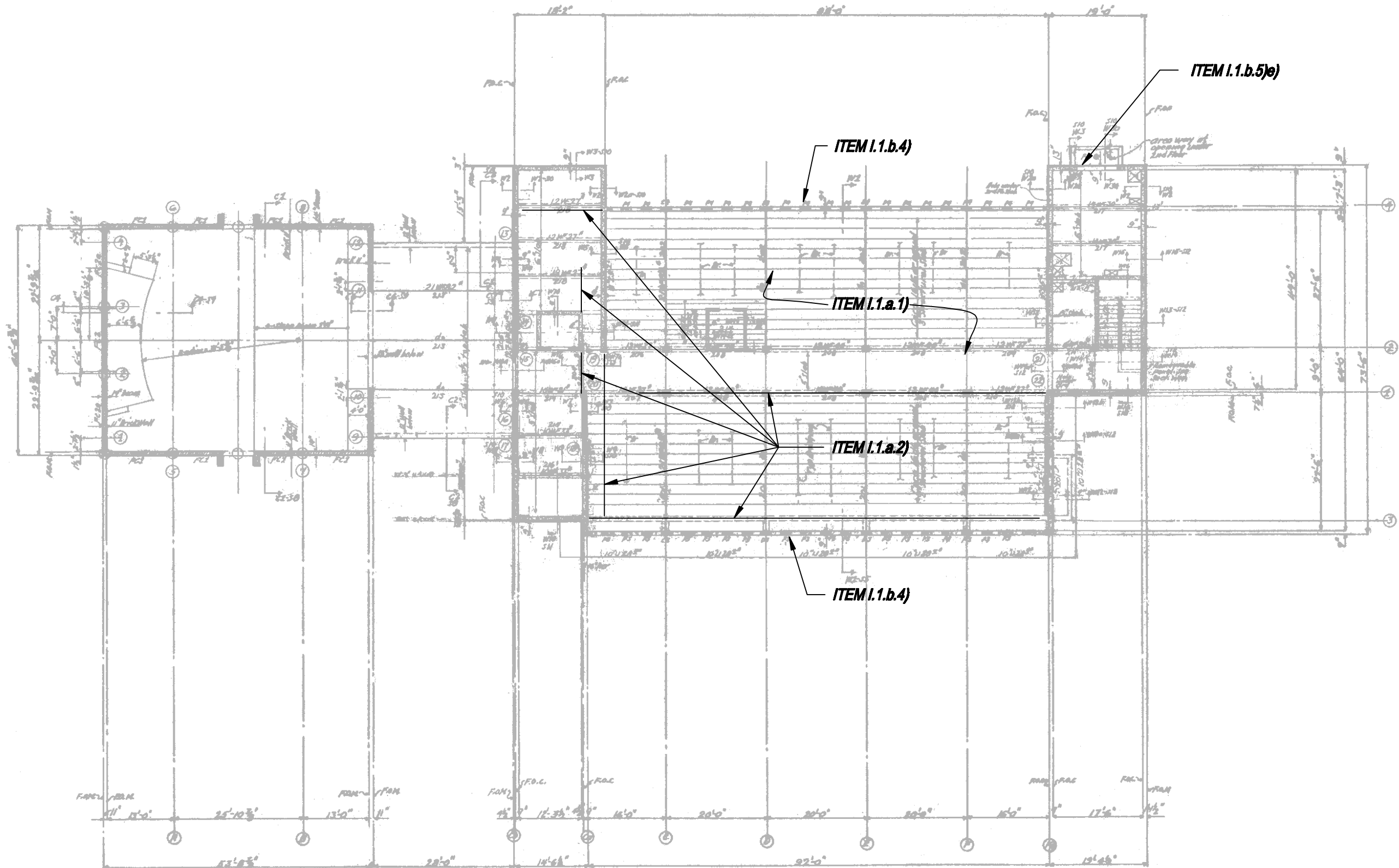
- 1) The original drawings specify concrete with a minimum compressive strength of 2500 psi. The 1997 UBC requires concrete with a minimum compressive strength of 3000 psi. The lower strength concrete will have a minimal effect on the seismic performance of this building.
- 2) The roof over the lobby area is connected to the wall of the main building at line Cb. The vertical elevation of this roof does not match the floor elevations in the main building. Therefore, seismic forces from the council chambers that are out of plane from the wall at line Cb must be transferred to the third floor and roof diaphragms of the main office building by out of plane bending of the wall at line Cb. The wall will need to be strengthened for this transfer.
- 3) Roof diaphragm requires collectors at the east and west wall.

b. Shear Walls

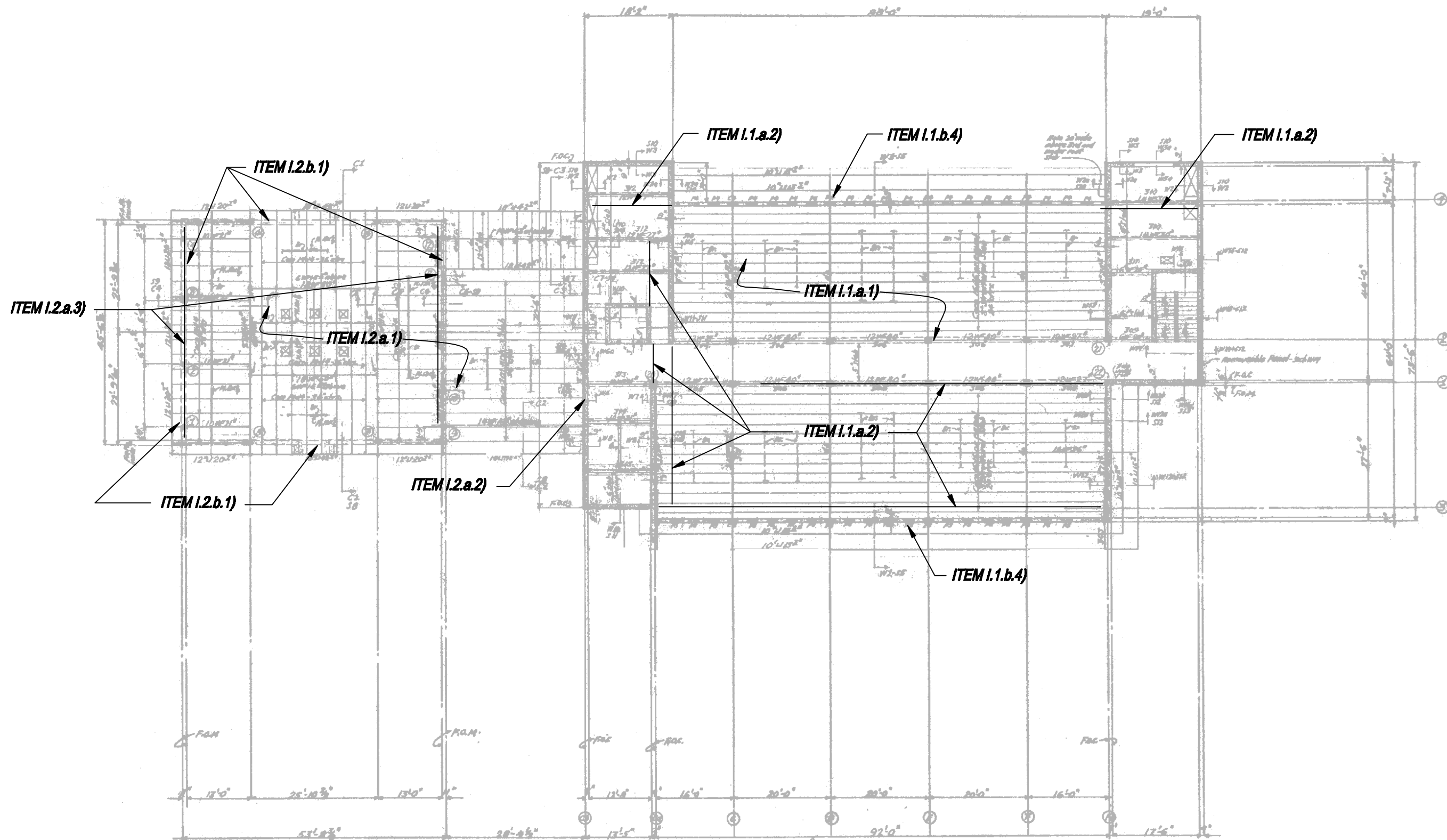
- 1) The reinforced brick masonry walls do not extend to the roof deck of the council chamber. Therefore, the top of the walls are not connected to the roof deck to transfer the in plane or out of plane lateral loads.



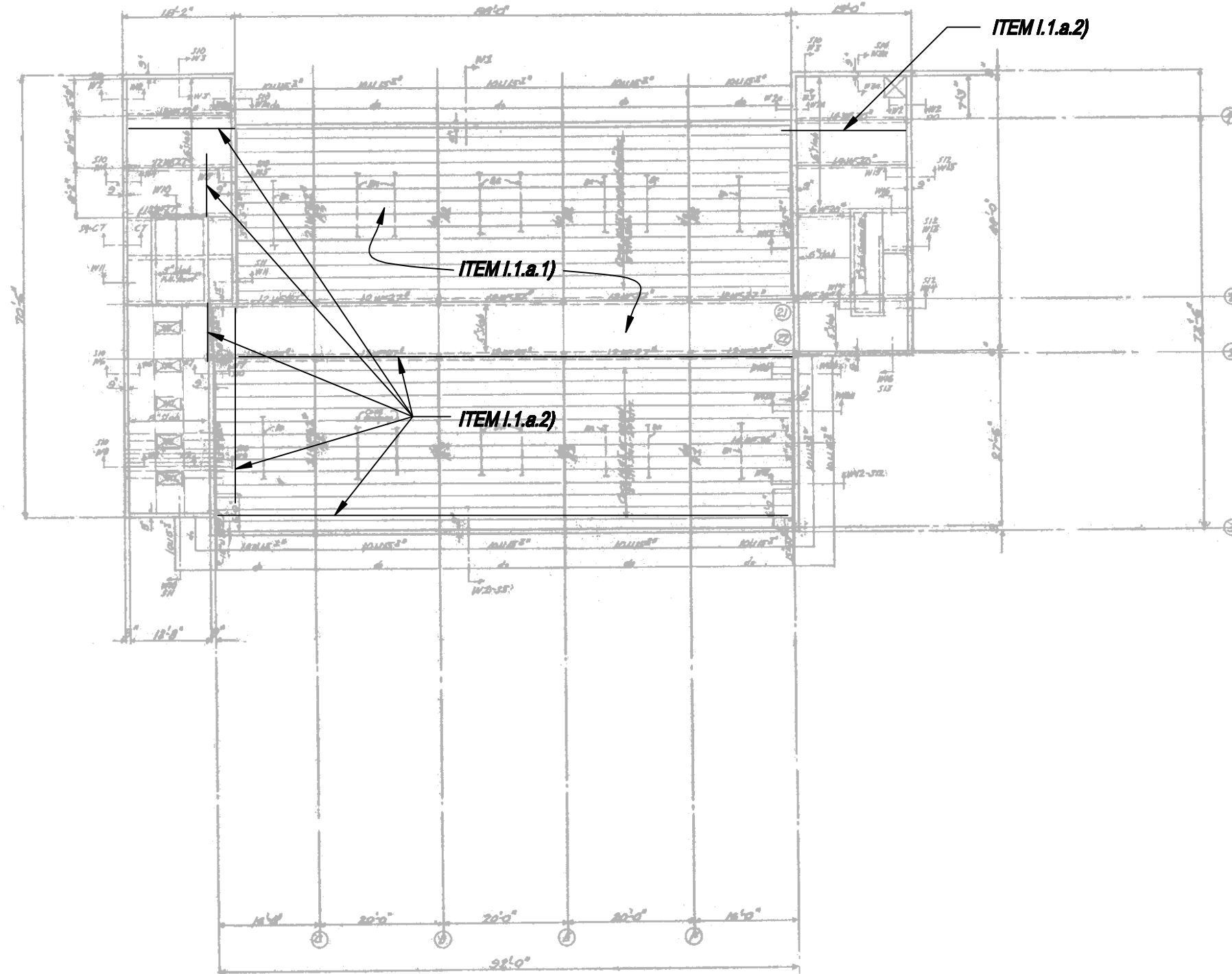
FIRST FLOOR & FOUNDATION PLAN



SECOND FLOOR PLAN



THIRD FLOOR PLAN



ROOF PLAN

4.0 CITY HALL ELECTRICAL AND MECHANICAL FINDINGS

I.1 Electrical Findings

I.1a Fire Alarm System

The building currently has a Fire Alarm System with voice capability over a series of speakers located throughout the building. Honeywell makes the existing main fire alarm control panel. Conversations with the City indicate that new parts are no longer available, severely limiting system repair and expansion of the fire alarm system. A separate stand-alone fire alarm panel by Radionics was noted in the server room on the second floor. The recently remodeled police dispatch room is also provided with another separate stand-alone fire alarm system.

For major renovation, it is recommended that a new centralized fire alarm system be installed in the building. The new fire alarm system will consist of manual pull stations at all exits, automatic smoke detectors in mechanical / electrical rooms and storage closets, duct smoke detectors in large air-handling systems, sprinkler water flow monitor, and visual / audible alarm devices to meet current NFPA and ADA requirements throughout the building. Should the building not be provided with a fire sprinkler system, additional smoke detectors may be required throughout the building.

I.1b Security System

The building currently has a number of security systems in place including CCTV, door controls, panic buttons etc. It is recommended that for a major renovation of the building a new state-of-the-art security system be added to the building consisting of the following:

- CCTV (closed circuit television): Systems with cameras located throughout the building reporting back to monitors at 24-hour operated locations such as police dispatch.
- Building security system to project the building perimeter.
- Access control system: The access control should be placed on all exterior doors and designated interior doors to control movement into and within the building.
- Panic/duress system: This should be located at areas around the building where staff need to deal with the public such as: reception areas, public counters, council chambers, etc.
- Intercom system tied to the security systems.
- For the holding areas: audio monitoring with intercom units will be required.

I.1c Main Switchboard and Service

The original main switchboard was installed in the mid 1960s and is located in the mechanical room on the first floor. The main switchboard is fed from a PG&E pad-mounted transformer located in the covered area adjacent to the mechanical room. The secondary service from the PG&E transformer is installed underground. The PG&E primary service to the transformer is installed underground from Mission Street. The main switchboard is rated at 800 amp, 277/480 volts, 3 phase 4 wire, and contains the utility company meter, main disconnect and feeder circuit breakers for the building distribution system.

It is recommended that the main switchboard be removed and replaced with a new main switchboard. The existing main switchboard is approximately 35 years old and can be expected to be at or near the end of its useful life. Also as time moves on, obtaining spare parts for the existing main switchboard will most likely become more difficult. The delay in getting spare parts for the main switchboard could result in prolonged downtime, which is not desirable for essential facilities. The rating of a new main switchboard would need to be based on the master plan for the facility. It is recommended that a transient voltage surge suppressor (TVSS) unit be provided in the new main switchboard.

It is recommended that a new electrical room be built to house the new main switchboard together with all other required electrical distribution equipment. The existing main switchboard has a number of mechanical ducts and plumbing pipes installed over it, which do not meet current electrical codes. With these existing overhead ducts and pipes, it would not be feasible to install a new main switchboard in the existing mechanical room. The advantage of putting a new main switchboard in a new room allows the new switchboard to be installed while the existing switchboard remains on line, minimizing the downtime required for the change over.

The existing PG&E pad-mounted transformer location does not meet with current PG&E standards, as the transformer is in an area where a roof structure was added in a subsequent renovation. Under current PG&E rules, for safety reasons oil filled transformers can only be installed outdoors or within the building in a 3-hour rated vault. In the event that PG&E would need to replace the existing transformer due to a failure, the roof of the enclosed area would need to be removed before replacement could take place. With this type of facility, any delays in transformer replacement need to be avoided to minimize down time. Should a major remodel of the building take place, it is recommended that a new electrical service be obtained for the building together with placing the new pad mounted transformer outside the building in one of the parking lots.

I.1d Emergency Power

The building currently has a diesel emergency generator rated at 500KW, 277/480volts. The generator is an indoor model and is installed adjacent to the PG&E transformer within the covered area outside the mechanical room. The generator provides 100% emergency backup to the building via the 800amp automatic transfer switch, which is located within the mechanical room adjacent to the main switchboard. The City currently tests the generator and automatic transfer switch each Saturday under building loads.

The generator has experienced water leaking in from the roof structure. The water appears to leak onto the terminal cabinet on the generator, which has been addressed by placing plastic covering over the terminal box. It is recommended that the roof leakage issue be addressed and the terminal cabinet and cable connections be checked for possible damage. The generator is an indoor model and should be installed within a completely watertight room with the required airflow, ventilation, and exhaust systems. Should the generator be retained under any modernization to the building it is recommended that the enclosure area be converted to a full watertight room with all the required mechanical systems added to the room to handle the generator air and exhaust requirements. The conversion of the generator area into a room will not be feasible unless the PG&E transformer is relocated out of the area.

Should a major renovation of the building take place, it is recommended that a new generator be provided together with a new automatic transfer switch. The new generator would need to be rated for outdoor use if it is to be located in the same area as the existing generator, or it could be located outdoors in the parking area. The generator would need to be connected to the existing above-ground diesel fuel tank.

The recently remodeled police dispatch room is currently supported by a Best Inc. UPS. The UPS module is located in the telephone equipment room adjacent to the dispatch room. In addition to the Best UPS, the dispatch workstations have individual standalone UPS modules. Should any additional equipment be added, such as for the county MERA system, the existing UPS may need to be upgraded to a larger unit.

The Information Services data room on the second floor has a combination of stand-alone rack-mounted UPS modules and standard small UPS modules. Should any major upgrades be considered for the data room, the existing stand-alone UPS modules could be replaced with a larger, higher quality single UPS system.

1.1e Distribution Service

All of the building's general lighting and power loads are fed from branch panels

CITY HALL ELECTRICAL & MECHANICAL FINDINGS

located throughout the building.

The newer panelboards in the police dispatch area are in excellent condition and could remain in use, should a major remodel of the building take place. The only issue which could affect these panels is if they needed to be relocated (such as to allow walls to be moved). The remaining panelboards installed in the 1960s are near or at the end of their useful life and should be replaced.

For major renovation work it is recommended that a system of new distribution panels, transformers, feeders and branch circuit panels be provided throughout the building.

i.1f Branch Circuit Power

The building wiring systems were not visible during the review. The extent of any future remodel will obviously dictate which areas must be upgraded, but in general, all branch wiring and devices should be replaced in areas of remodel. Selective replacement in these areas, although cheaper, almost always proves to be more costly as electrical inspectors and contractors uncover hidden deteriorating conditions that must be corrected.

The building currently has an electrical underfloor duct system that could be potentially used for new wiring in areas of remodel. The extent to which the underfloor duct could be used depends on the proposed new room layouts.

Selected areas that will remain unchanged could be left with existing branch circuits in place as long as the circuits and devices were not modified during the course of construction, and a contractor can ascertain that no code violations exist.

The Information Services data room on the second floor will require extensive rewiring should a major renovation of the building take place. With the advancement of information technology, the data room equipment use has grown substantially, resulting in higher power requirements. It is recommended that any new data room be rewired with branch circuit wiring from UPS backed up power. Also a remodeled room will need to be provided with a new emergency power-off system to comply with the latest codes.

i.1g Lighting Systems

The general lighting systems in the building are mostly incandescent and older fluorescent fixtures. While the fixtures appear to be in operational condition and have been maintained fairly well, these sources consume much more energy than comparable modern sources. New T8 fluorescent and compact fluorescent sources with electronic ballasts should be used wherever possible to maximize lamp life and reduce energy consumption. As with the wiring systems, all lighting in the areas to be remodeled should be replaced and re-wired with new switching and / or dimming (such as in the council chambers.)

Some form of master shut-off lighting control will also need to be provided to comply with current California Title 24 energy compliance requirements. These requirements dictate that grouped areas not to exceed 5,000 square feet each shall be provided with automatic shut-off systems for after hours and weekends to conserve energy. The police department and other essential areas may be exempt from the master shut-off requirements.

To insure adequate security lighting and avoid possible litigation in the future, it is strongly recommended that all traveled areas around the building, within the property line be provide with lighting levels to meet the current Illumination Engineering Society (IES) recommendations. Additional pole mounted light fixtures will most likely need to be added to supplement the existing parking lot lighting. New exterior lighting should be connected to a time clock control to provide automatic operation.

A dimmable lighting system is recommended in the Council Chambers. This will comprise of lighting tracks with incandescent light fixtures and ceiling mounted dimmable fluorescent light fixtures. A Lutron Graphic Eye system should be considered.

As the building has 100% Emergency Power backup all lighting in the building is available during a loss of normal power.

1.1h Telephone and Data System

The telephone service enters the building from underground below the street and terminates on a backboard located in the telephone room. The building has an existing telephone/data wiring infrastructure. For major renovation it is expected the building will be required to meet current city needs. New modern 4-pair telephone and data cables should be installed from the server rooms to each individual room requiring telephone and/or data service. It is recommended that the wiring be Category 5E or Category 6-rated to accommodate computer network capabilities. Multiple cables extended to each room will allow the wiring infrastructure to be utilized for telephone and data communications, which will become even more prevalent in the coming years. Now would be the time to upgrade the wiring infrastructure to avoid future added costs. Should the council chambers remain as the City's emergency operations center, it is recommended that additional telephone and data lines be installed to this area.

Data backbone cabling within the building between telephone/data rooms will require fiber optic cable to be installed. Telephone backbone cabling within the building between telephone/data rooms will require multipair copper cables. A system of equipment racks with fiber optic distribution panels, punch down blocks, patch cabling and wire management systems will be required should a major renovation take place within the building.

Exposed cables unprotected by conduit serve existing rooftop antenna and signal dishes. It is recommended that the cable be routed in conduit to protect against the elements and cable failure.

I.1i Cable TV

The building does not currently have cable TV service. It is recommended that cable TV service be provided to the building. Cable TV is provided to emergency operations centers as a means of data gathering during an emergency. Should the council chambers remain as the emergency operations center, it is recommended that a number of cable TV outlets be added within this room.

The City may also want to have its council meetings televised by the cable TV company. For any remodel work of the council chambers it is recommended that provisions be added to allow the cable TV company to broadcast events in the council chambers. At a minimum, new conduits should be stubbed out to the outside of the building, and power and signal conduits should be provided at all potential camera positions within the council chambers.

I.1j Maintenance

Following is a general summary of recommended maintenance items for the building. Should a major renovation of the building take place in the near future, a number of these items will not be required, as new systems will have been installed to replace the existing systems.

- **Distribution system:** It is recommended that a testing company be hired to carry out a thermographic survey (infrared scanning) of all panelboards, main switchboard, MCC (motor control center), automatic transfer switch, generator circuit breaker and major disconnects. Any corrective measures noted by the testing company should be carried out. The last thermographic survey was carried out in February 1995.
- **Grounding:** A system ground test should be carried out on the building by a testing company to verify the effectiveness of the existing system.
- **Generator:** It is understood that the generator is put on building load once a week and it is recommended that the City hire a generator servicing company to carry out regular scheduled maintenance on the generator, if they are not currently doing so. The water damage to the generator lug area, as noted previously in this report, needs to be addressed.
- **Fire alarm:** It is recommended that the City hire a fire alarm testing company to carry out scheduled testing of the systems.
- **Lighting:** It is recommended that all light fixtures be cleaned and relamped. Consideration should be given to replacing existing ballasts with new electronic ballasts and T8 lamps.

I.2 City Hall HVAC Findings

I.2a HVAC Description

The building is provided with one gas-fired boiler located in a first floor mechanical room. The boiler has a scheduled capacity of 1,200 MBH input and 960 MBH output (Bryan AB-120) on the construction drawings – a Parker Model 49783 was actually installed. The boiler and associated pumps and equipment appear to be in reasonably good condition, having been recently installed in 1998. A new flue was also provided as part of the 1998 boiler replacement project. Heating hot water is circulated by a new (1998) 100-gpm pump to air handling unit S-1 on the second floor, unit S-2 on the third floor, and unit S-3 on the roof.

A single water-cooled chiller, located in the same room as the boiler, provides cooling for the three main air-handling systems serving the building. The chiller is a reciprocating compressor, Trane Model 2F5F87 Serial 65J1631, which had the compressor replaced in 1996 with a Trane Model 2ESR88. A single pump (P-1) circulates chilled water, with a condenser water pump (P-2) circulating water to the roof mounted cooling tower – BAC Model TMA-60AL. The capacity of the chilled water system is not scheduled on the available drawings.

Air-conditioning is provided by three air handling systems – two indoor dual-duct units and one rooftop multi-zone unit, each with a separate return fan. The capacity of these systems is not scheduled on the drawings that were made available. Condensate pans of the indoor units were replaced in the 1970s. The systems reportedly have 13% minimum outside air and fans operate at high speed during normal hours and low speed after hours. The second floor unit serves both the first and second floors, and has been retrofitted with a new outside air intake and fan that appears to connect to the cold duct serving the first floor. This operates during after hours periods and boosts cold deck air quantity to the first floor. Return air from each zone is typically ducted to a plenum space that is formed by the roof overhang on each floor.

Each of the three floors is provided with dual duct mixing boxes for individual zone temperature control. The mixing boxes appear to be constant volume with Honeywell pneumatic controls. The rooftop multi-zone unit serving the council chambers and main lobby provides four separate zone ducts.

In addition, two split DX systems serve the dispatch room and main telephone room (Bryant Model FBANF036000AFAA with 1/3 hp motor) on the first floor with condensing units at the loading dock, and one split DX system serves Information Services on the second floor with a roof mounted condenser. These are not scheduled or shown on the drawings available. The dispatch condenser appears to be 1970 vintage with a recently replaced evaporator. The main telephone room unit is provided with two buckets for condensate collection. The second floor information systems unit has condensate pumped up to a roof storm drain.

CITY HALL ELECTRICAL & MECHANICAL FINDINGS

A separate exhaust fan system is provided for toilet areas (E-6). The penthouse elevator machine room is provided with a louvered door for ventilation.

I.2b HVAC Evaluation

- The mechanical systems are mostly 36 years old, well past the normal life expectancy of 15-27 years.
- The boiler, replaced in 1998, and the chiller compressor, replaced in 1996, appear to be in good condition, are reported to be reliable, and should last another 20 years and 15 years respectively. The efficiency of the chiller, however, could probably be significantly improved with a new chiller.
- Visual inspection suggests that the cooling tower is in surprisingly good shape, but a more detailed inspection is recommended, along with water quality and pipe corrosion testing.
- Split DX systems were added for dispatch and the main telephone room on the first floor, due to the inadequacy of central system and the need for 24-hour operation. These systems appear to be functioning currently, but lack proper condensate and return air provisions. The Information Services room was observed at the time of the site visit to have a set point of 70F, but could only maintain 78F.
- Information systems on the second floor has a split cooling system that has no provision for redundancy and is liable to fail, causing Information Services problems.
- Condensate from split systems is either not provided for (buckets are used) or pumped up to a roof drain.
- The rooftop multi-zone air handling unit serving the lobby and council chambers is in very poor condition (rusted, standing water inside unit, poor access).
- The council chambers system needs to be run all day to heat up, run several hours to pre-cool, and cannot handle hot and stuffy conditions when the house is full. The lobby only gets heating and cooling when the council chambers are in use. The outside air intake for this system is in a well close (12 feet) to the main building toilet exhaust.
- The second and third floor indoor dual-duct AHUs are also in poor condition (numerous patching and repairs). The constant volume dual duct system is inherently inefficient, with leakage, mixing of heated and cooled air, and no outside air economizer.
- A separate fan supplying outside air to the first floor was added in an attempt to improve the inadequate ventilation and cooling of this floor, which is used for after hours operation.

-
- Poor ventilation, cooling, heating, and temperature control zoning are experienced throughout the building, but are worst on the first floor due to the lack of windows and claustrophobic atmosphere. The council chambers and the police report writing room, briefing room, and locker rooms were specifically mentioned as being uncomfortable.
 - Indoor air quality is questionable, given the age of ducts and condition of systems. The condition of the extensive sound lining in the supply and return ducts is a particular concern.
 - Excessive duct leakage is likely, reducing comfort and increasing energy costs (It is rumored that the ductwork was over-pressurized when first started up and never repaired). The plenum return between the mechanical room and the return ducts that connect to ceiling grilles may be particularly leaky.
 - Some fire dampers are indicated on the original drawings. To meet current codes, fire/smoke dampers would be required. The lack of smoke detectors in the system, or automatic shutdown, is an ongoing concern.
 - The dual duct boxes are outdated and inefficient, and have poor pneumatic controls.
 - Operation of outside air and multi-zone damper controls is questionable.
 - There are numerous code violations, such as lack of emergency refrigeration shutdown and ventilation, separate rated rooms for the boiler and chiller, lack of compliance with the energy code, inadequate condensate provisions, and the lack of smoke detectors or smoke shut down provisions for the air handling systems.

I.2c HVAC Upgrade Options

A wide range of mechanical upgrade options is possible, depending on budget and the scope of other upgrades, ranging from working with the existing systems to complete replacement of all systems. The most serious shortcomings appear to be in the air distribution systems, which unfortunately need the largest budget. However, this may be less of an issue if other related work is planned, such new interiors and ceilings and the addition of fire sprinklers.

Reuse: If the air handling, chilled water and heating systems are to be kept, further testing is recommended. For example, a full air and water balance should be undertaken, and air quantities should be measured at each grille, along with main supply, return, outside air and relief ducts, and water flow rates at pumps, coils, and equipment to determine system performance, leakage, and capabilities. The 36-year-old duct lining should be examined closely, along with other potential health hazards such as condensate drain pans, cooling tower water quality, return plenums, filters, and outside air provisions.

The condition of the chiller condenser and evaporator barrels should be

CITY HALL ELECTRICAL & MECHANICAL FINDINGS

examined, along with the condenser water, heating water and chilled water piping systems. The air handling units should be evaluated in more detail, including examination of the cooling and heating coils, control valves, control dampers, and pneumatic control system. A complete replacement of the control system has been previously proposed by Honeywell, but not implemented. Consideration should be given to adding outside air economizer capability to the cold duct system. The dual-duct mixing boxes should be tested for leakage and controls.

Any of the above components or systems which are not performing adequately, are in deteriorated condition, which have related renovation work planned, or for which new equipment would have a reasonable payback should be replaced. Life safety provisions, such as automatic system shutdown on smoke detection and fire/smoke dampers should definitely be undertaken, particularly in light of the absence of any fire suppression systems in the building.

Replacement: Considering the age, efficiency and numerous problems with the existing systems, replacement is a more desirable choice if the project scope will permit this. An example of a likely replacement scenario is outlined below.

The air handling units and ductwork distribution would be removed in entirety, to be replaced by new VAV air handling units with supply and return fans, VFD's, chilled water coils and outside air economizers. The air handling unit locations and areas served could remain the same, although it would make sense for the first floor Police Department to have a separate unit from the second floor because of the different operation schedules. New supply ducts would be run to DDC-controlled VAV boxes with hot water reheat for zone temperature control, and a new return duct system would be provided.

The existing heating hot water system could be retained, although to meet code, a separate one-hour boiler room will need to be created. The piping distribution would be extended beyond the air handling units to each ceiling mounted VAV box, for which a new pump may be required.

The chilled water system may also potentially be retained; further evaluation is required, along with an economic analysis of the payback for a new, higher efficiency chiller. A new one-hour chiller room will need to be created to meet current codes, along with refrigerant monitoring and emergency refrigeration exhaust systems. It is possible the chilled water piping distribution would remain "as is" if the piping system and pump are in good condition and the air handling systems are located in their current positions. Consideration should be given to the part load performance of the chiller in serving the 24-hour Police Department, which may predicate a different approach, such as making the first floor unit (or the whole building) water-cooled DX.

After the testing recommended above, it also may be possible for the condenser water system to remain as is. The cooling tower may also remain although it has an ASHRAE service life of 20 years and is 36 years old. Cooling towers are relatively inexpensive, so it may make sense to replace this component.

If the first floor unit is not provided with 24-hour refrigeration, split systems for critical areas such as the dispatch and telephone rooms may need to be retained or new ones provided. A new computer room quality cooling system is recommended for the information systems room on the second floor.

I.3 City Hall Plumbing System

I.3a Plumbing System Description

The plumbing systems for the building are largely concealed within the building fabric and therefore visible inspection without opening up walls and shafts is difficult. However, indications are that the basic needs of water supply sanitary drainage and storm drainage are functional.

A first floor mechanical room gas-fired water heater and storage tank provide domestic hot water. Storm water is collected in rooftop drains connected to internal leaders.

There is a 500-gallon above-ground diesel fuel oil tank next to the building that serves the yard-mounted emergency generator that was installed in 1999. This new arrangement appears to have replaced the original natural gas-fired generator that was mounted in the boiler/chiller room.

I.3b Plumbing System Evaluation

The basic plumbing functions appear to be operational, with no problems reported by the facilities engineer other than roof leakage. Systems that have been added, such as condensate drains, often do not comply with code.

I.3c Plumbing System Upgrade

This work would mainly be required for programmatic reasons such as the upgrade of restrooms to meet current ADA requirements and addition of new fixtures. Some inadequacies of the current system such as the condensate drains should also be rectified. The condition of the domestic hot water system should also be looked at more closely.

I.4 City Hall Fire Protection System

The building is not provided with a fire sprinkler system. There is no fire suppression system for the Information Services room.

The lack of fire sprinklers and smoke detectors in this important essential facility is a serious concern.

A new fire sprinkler system is recommended, which would require a new building service connection to the street main. Consideration should be given



G R O U P 4

ARCHITECTURE
RESEARCH +
PLANNING, INC