For questions regarding this report contact Tom Lauck, Director, District IV, via email at tom.lauck.twcm@gmail.com or by phone at 415-819-7217.

IDA STRUCTURAL ENGINEERS

ASCE 41-17 Tier 1 and Tier 2 Seismic Evaluation Report Rossmoor Buildings:

600 Terra California Drive, Walnut Creek, CA
1605 Ptarmigan Drive, Walnut Creek, CA
1995 Cactus Ct., Walnut Creek, CA
2516 Ptarmigan Drive, Walnut Creek, CA
3101 Terra Granada Drive, Walnut Creek, CA

Prepared for: Clayton Clark
TWCM Building Maintenance Manager
800 Rockview Drive
Walnut Creek, CA 94595

December 12, 2022

IDA Job No. 22054

Table of Contents

Introduction

Rossmoor is a senior living community located in Walnut Creek, California. The community was opened in 1964 and is comprised of variety of residential buildings ranging from multi-unit buildings to single family buildings.

Per the request of Clayton Clark, Building Maintenance Manager, IDA Structural Engineers (IDA) has performed a seismic assessment of 5 buildings which are part of the Third Walnut Creek Mutual of Rossmoor. This is a voluntary review and based on current codes and ordinances, the existing lateral load resisting system does not require strengthening. The specific buildings were selected by Mr. Clark and are located at 600 Terra California, 1605 Ptarmigan Drive, 1995 Cactus Ct., 2516 Ptarmigan Drive and 3101 Terra Granada in Walnut Creek, California. The seismic assessment was performed using an ASCE 41-17 Tier 1 and Tier 2 procedure modified by ASCE 41-17, titled “Seismic Evaluation and Retrofit of Existing Buildings”, published by the American Society of Civil Engineers (ASCE) in 2017. This document is the industry standard procedure for the seismic evaluation and retrofit of existing buildings.

A Tier 1 screening is a checklist-based procedure. The checklists identify potential deficiencies in a building based on performance of similar buildings in past earthquakes. The results from the Tier 1 screening forms the basis for the Tier 2 deficiency-based procedure. There was no nondestructive testing performed and observations were limited to visual observations only. The assessment was performed using original construction drawings provided by Mr. Clark.

The information below forms the foundation for the evaluation. This information is either derived from owner requirements, such as risk category and desired structural performance level, or is site specific, such as seismic hazard level.

Subject Property	Rossmoor TWCM 5 Buildings
Address	Building 1-600 Terra California Drive Building 2-1605 Ptarmigan Drive Building 3-1995 Cactus Ct. Building 4-2516 Ptarmigan Drive Building 5-3101 Terra Granada Drive Walnut Creek, California
Latitude and Longitude	37.8628606, -22.0655455
Risk Category	II
Basic Performance Objective for Existing Buildings (BPOE)	Collapse Prevention Structural Performance at BSE-2E Life Safety Structural Performance at BSE-1E

For Tier 1 assessments of Risk Category II buildings, structural performance of Life Safety Structural performance for the BSE-1E hazard level is not explicitly checked. Conformance with the BSE-1E is implied through the structure meeting Collapse Prevention at the BSE-2E hazard. The BSE-1E and BSE-2E represent reduced earthquake hazards for evaluation of existing buildings. The BSE-1E represents and earthquake with a 20% probability of exceedance in 50 years (225 year return period) and the BSE-2E represents an earthquake with a 5% probability of exceedance in 50 years (975 year return period). For comparison, a new building would be designed with consideration of the MCE (Maximum Considered Earthquake) with a 2% exceedance in 50 years (2,475 year return period). A longer return period represents, a larger, rarer earthquake event. Seismic parameters are site specific and are determined from publicly available information from the United States Geological Survey (USGS). The Basic Performance Objective for Existing Buildings (BPOE) uses the BSE-1E with Life Safety Structural Performance Objective, and BSE-2E hazard levels with Collapse Prevention Performance Objective.

The ASCE 41 Tier 1 procedure consists of a series of checklists that quickly identifies deficiencies. Based on the Tier 1 results, a Tier 2 analysis is performed to more accurately analyze element demands and capacities identified as deficiencies in Tier 1.

Site Information

General

The buildings are located in Rossmoor, a senior living community located in Walnut Creek, California. The address of each building is noted in the discussion for each building.

Geotechnical and Seismic Hazard Information

No site-specific geotechnical data was available. Information used in the reports was found via publicly available USGS maps and information.

Building Information

All 5 buildings are multi-unit residential buildings. Per the record drawings, the buildings appear to have been constructed in 1970s. Detailed information for each building is provided in the specific building sections.

Existing Building Information and Site Observations

IDA performed a site visit on September 22, 2022. The site visit consisted of visual observations only, primarily from the outside of the buildings. No destructive testing or localized demolition was performed. We had access to a part of structural set of record drawings which included structural plan and some details.

	Record Drawings Available
Building 1	600 Terra California Drive, Walnut Creek, CA January 17, 1976
Building 2	1605 Ptarmigan Drive, Walnut Creek, CA January 4, 1971 Hayes, Smith, Trockey & Blair Architects and Planners AIA
Building 3	1995 Cactus Ct., Walnut Creek, CA November 16, 1973
Building 4	2516 Ptarmigan Drive, Walnut Creek, CA November 27, 1972
Building 5	3101 Terra Granada Drive, Walnut Creek, CA June 23, 1967

Conclusions

Seismic demands have increased, and detailing demands have become more stringent since the original construction of the buildings. Some construction methods which were acceptable at the time of construction would not be acceptable by current building standards for new construction. The purpose of an ASCE 41 assessment is not to assess the buildings to current building code standards for new buildings but to identify deficiencies of the building construction which may keep them from meeting the desired Structural Performance Levels. The specific deficiencies and mitigation recommendations are described in the sections for each specific building. The mitigation recommendations are conceptual. If a seismic strengthening for a building is desired, more detailed seismic analysis and construction documents can be prepared for permit submission and construction. IDA can prepare a fee proposal for these services upon request.

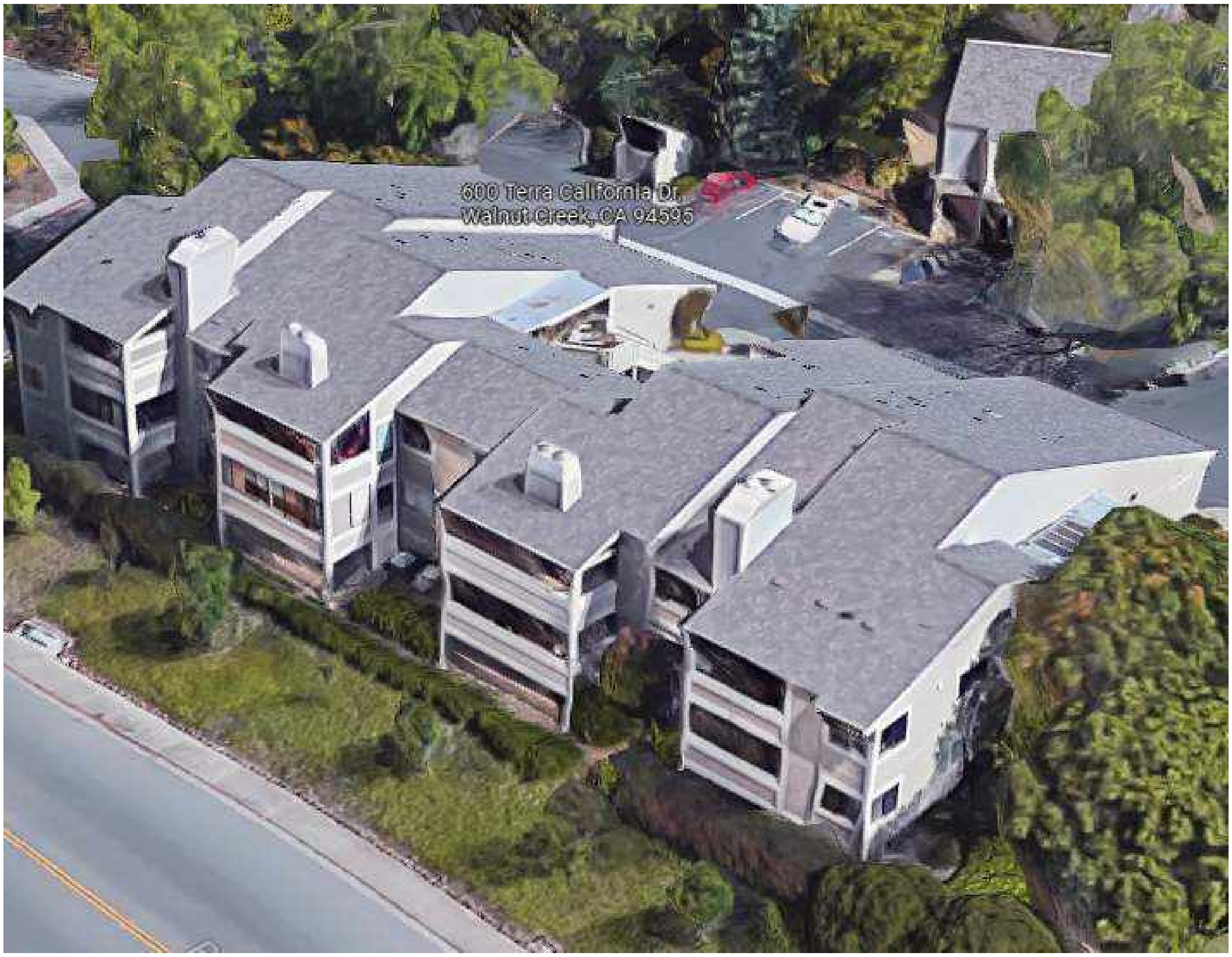
Thank you for the opportunity to be of service. Please do not hesitate to call with any questions regarding the analysis.

IDA Structural Engineers, Inc.

Amruta Chanabasanavar, P.E.
Project Engineer

Jason M. Lee, S.E.
Principal

BUILDING 1
600 TERRA CALIFORNIA DRIVE



Building 1 – 600 Terra California Drive, Walnut Creek, CA

1 General

600 Terra California Drive is bounded by Terra California Drive to the North and east, Rossmoor Pkwy to the west and residential properties to the south.

The building is a 2-story wood framed building with plywood sheathing supported on wood trusses at the roof and joists at the floor. Those are supported on wood stud walls which are supported on shallow concrete foundations. Lateral resistance is provided by wood shear walls. Shear wall sheathing is 3/8" standard. These buildings are ASCE 41 Building Type W1A.

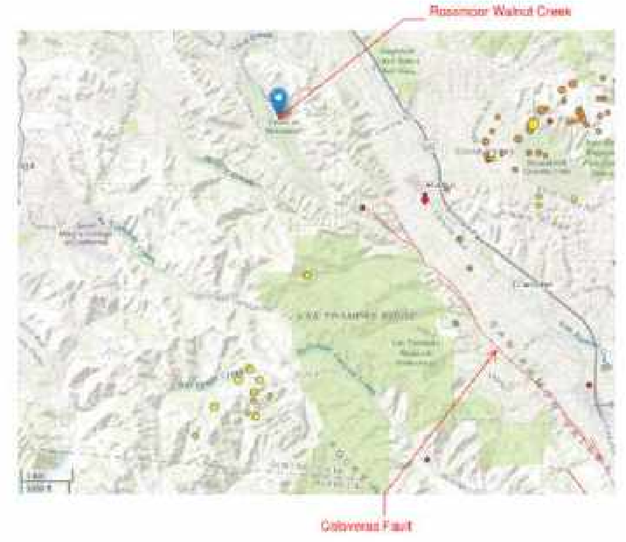
The roof is framed prefabricated trusses at 24" OC. The trusses are supported by bearing wall studs. Roof sheathing is 3/8" thick Douglas Fir plywood sheathing.

2 Tier 1 Structural Deficiencies

The following items were deficiencies identified as part or the Tier 1 assessment.

2.1 Surface Fault Rupture

The building site is in close proximity (within 2 miles) to the Calaveras Fault. See Figure 12. In the near field of active faults, there is a potential for large fissures and differential movement to occur in the surface soils. Foundations of buildings located above these ruptures are subjected to large differential movements that induce large forces in the building superstructure. These forces are concurrent with all existing gravity loads and seismic forces during an earthquake.



2.2 Narrow Shear Walls

Narrow shear walls are highly stressed and subject to severe deformations that reduce the capacity of the walls. Most of the damage occurs at the base and consists of sliding of the sill plate and deformation of hold-down anchors where present. As the deformation continues, the plywood pulls up on the sill plate, causing splitting. Splitting of the end studs at the bolted attachment of hold-down anchors is also common. The aspect ratio for wood walls is the story height to wall length.

2.3 Interconnection ties and holdown anchors

The shear walls do not have interconnection ties to transfer overturning forces through the floor. Shear walls in East-West direction do not have holdowns called out on the plans. Shear walls without holdown anchors may be subjected to significant overturning, and damage can be caused by uplift and racking of the shear walls. Hold down anchorage can help resist overturning forces and can greatly strengthen shear walls vs. walls without anchorage.

3 Tier 2 Analysis

The ASCE 41 Tier 1 procedure consists of a series of checklists that quickly identifies deficiencies. Based on the Tier 1 results, a Tier 2 analysis is performed to more accurately analyze element demands and capacities.

The following items are analyzed in greater detail under the Tier 2 procedure:

- Shear stress check in walls
- Narrow Shear Walls

Missing building elements causing Tier 1 deficiencies (such as redundancy, interconnection ties and holdowns) were not required to be analyzed under the Tier 2 procedure. These elements are required to meet the BPOE and need to be installed as part of any seismic rehabilitation.

3.1 Narrow Shear walls

Tier 2 analysis finds that the shear stress check is compliant without considering narrow shear walls to be a part of the lateral force resisting system.

4 Mitigation

4.1 Interconnection ties and holdown anchors

New straps can be added at shear walls to transfer overturning forces between floor to floor. Shear walls without hold downs should be retrofitted with hold down hardware and compression posts. New hold down hardware could be retrofitted at shear wall ends and anchor bolts would need to be epoxied into the existing foundations. Compression posts could be installed along with the hold down hardware as required. Foundation strengthening may be required if existing foundations are shallow or weak in local areas.

5 Conclusion

While the building has holdowns in the transverse loading direction, holdowns appear to be missing in the longitudinal loading direction. In some cases, the original designer of the building may have assumed there was sufficient dead load to resist overturning forces. Lower seismic forces at the time of design may have allowed for this design. However, wood shear walls without holdowns or ties between floors have reduced ductility and may be subject to overturning at excessive deflections. Seismic demands have increased, and detailing demands have become more stringent since the original construction. Therefor we conclude the building has an incomplete lateral force resisting system, which does not meet the requirements of ASCE 41-17 for the BPOE performance. Retrofitting these conditions are required to meet the Structural Performance Level of the BPOE.

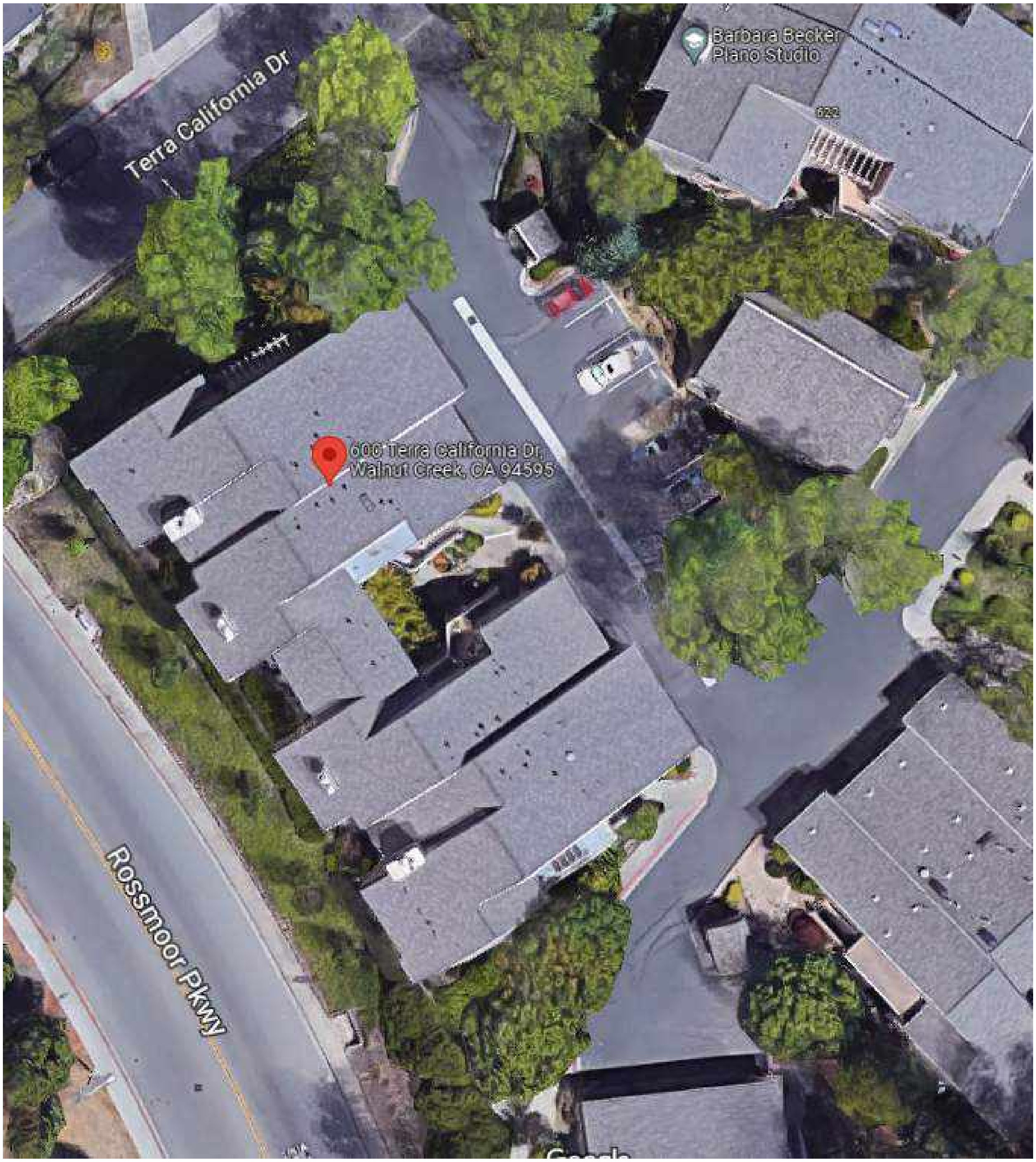
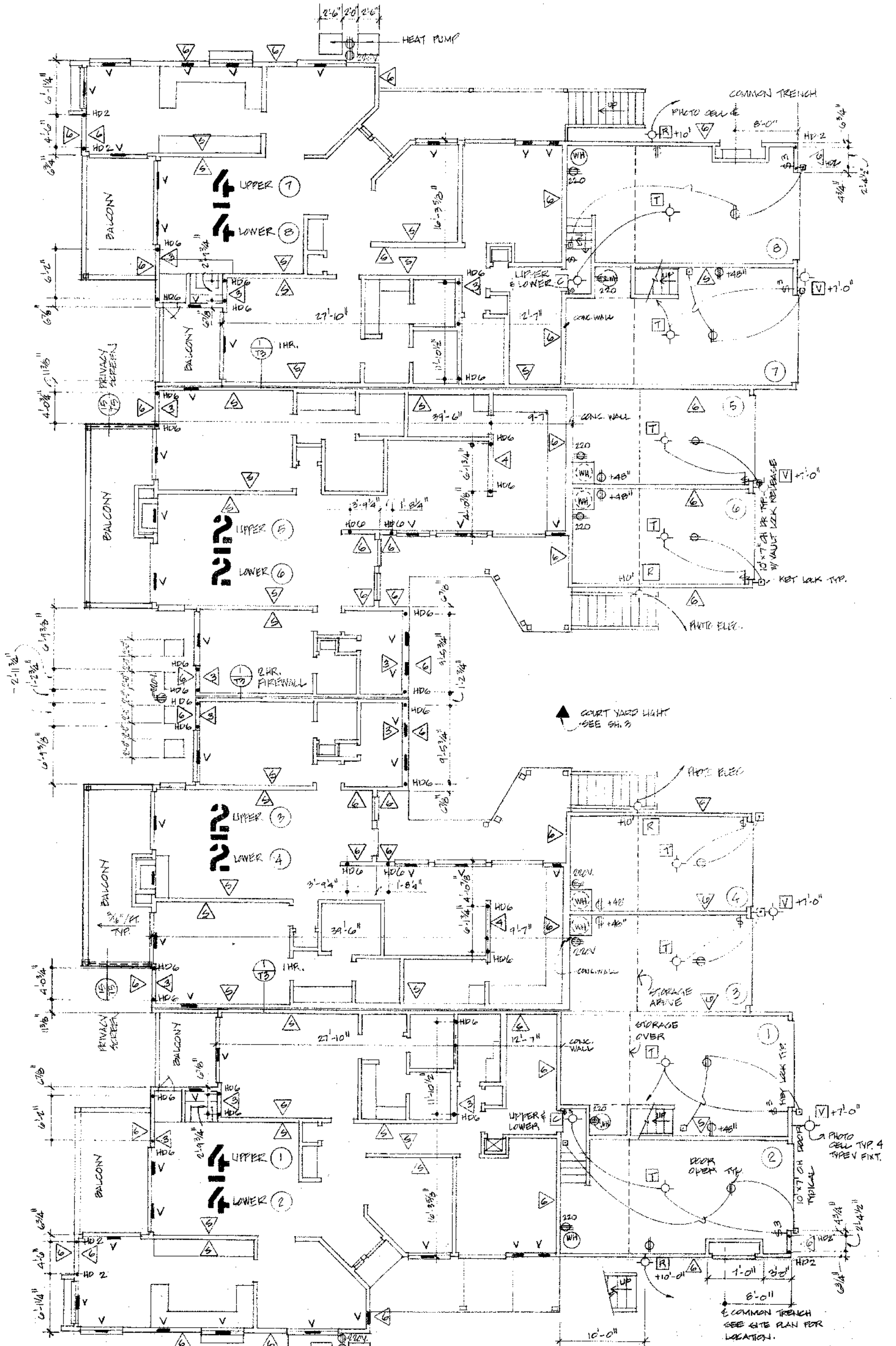


Figure 1. Site Location – 600 Terra California Drive

Deficiencies and Mitigations

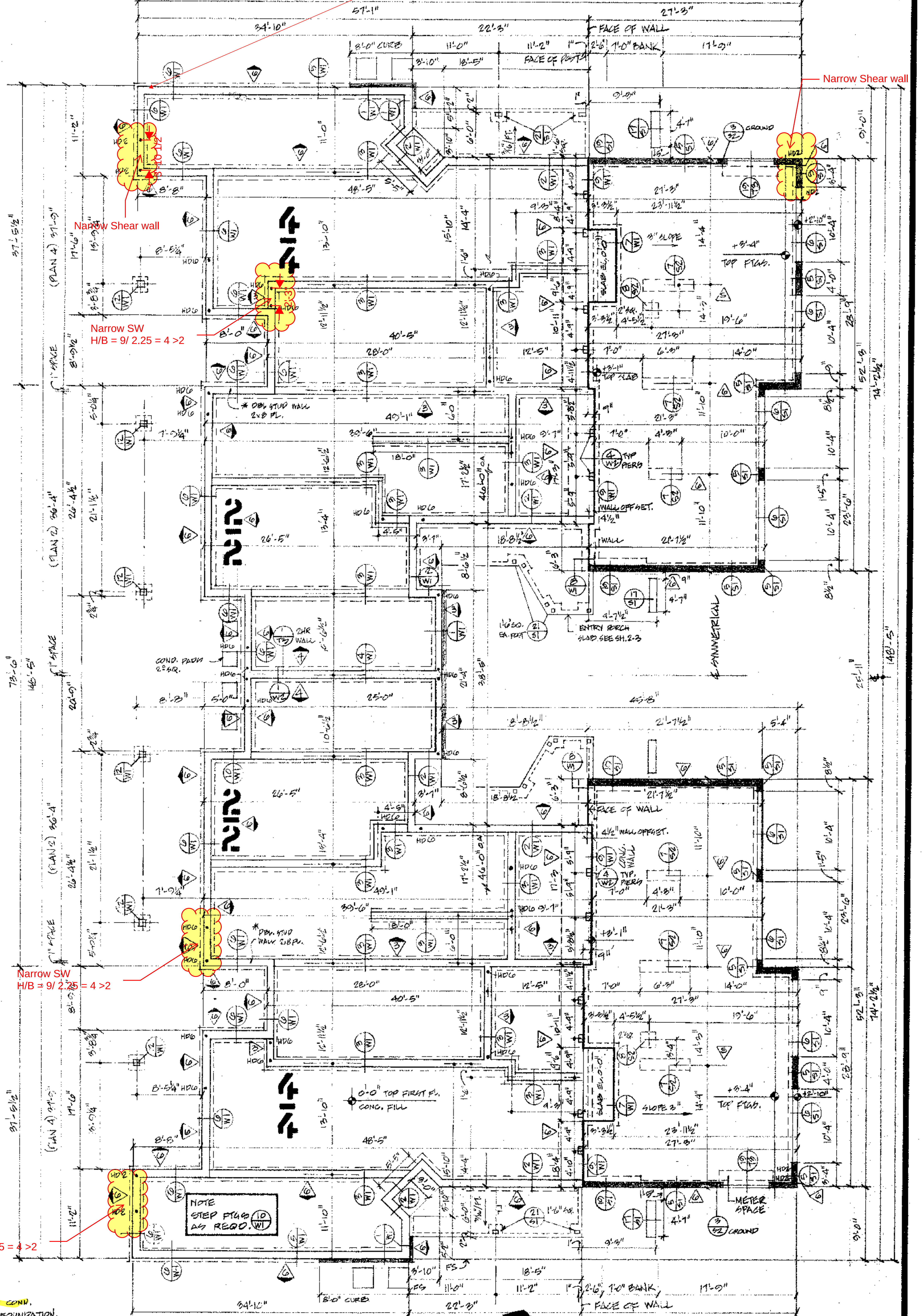
IDENTIFIED DEFICIENCIES



UTILITY PLAN

UTILITY PLAN NOTES:
1. △ FIRST FL. SHEAR WALLS (FIRST TO SEC. FL.) SEE 1/V-1
2. ○ GARAGE ASSIGNMENT NO. BY APT. NO.
3. V 6x14 LOUVER FOUND. VENTS SEE 19/T-2

No Holdowns on 1st floor and 2nd floor. Typ.



Narrow Shear wall

Narrow Shear wall

Narrow SW
H/B = 9/ 2.25 = 4 >2

Narrow SW
H/B = 9/ 2.25 = 4 >2

Narrow SW
H/B = 9/ 2.25 = 4 >2

FOUNDATION PLAN

FOUNDATION PLAN NOTES:
1. FOUND. TO FIRST FL. OR SILL CONN. SEE 18/V-1 FOR BOLTS, PN & CONN.
2. AT DETAIL 1&2/W-1 DIM. SHOWN ARE TO FACE OF STUD NOT FACE FOUNDATION.
3. SEE UTILITY PLAN FOR HOLDOWN BOLT DIM.
4. HOLDOWNS BY SIMPSON CO. OR EQ. SEE DETAIL 3/V1 5/V1 6/V1
5. ALL EXT. & INT. FOUND. WALL BOLTS NOT SHOWN USE 5/8''⌀ AB @ 4'-0'' O.C.

RECEIVED FEB 13 1976

WF-08

REVISIONS	BY
M-42 1-16-76	TG
M-42 FOUNDATION & DIM. 1-25-76	LW
M-42 GROUND, CURBS 2-11-76	LW

Terra California reserves the right to make substitutions of materials and/or methods to obtain the general intent of the drawings. Terra California reserves the right to make design changes to buildings, site work and landscaping to conform to specific site conditions. All substitutions and/or design changes shall conform to all applicable building codes and/or ordinances having jurisdiction over such changes.
By Terra California
Contractor & Developer of Rossmoor Walnut Creek

TERRA CALIFORNIA
1717 ROSSMOOR PARKWAY
WALNUT CREEK, CALIFORNIA
BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK
CONTRACTOR'S LICENSE NO. 252750 - B1

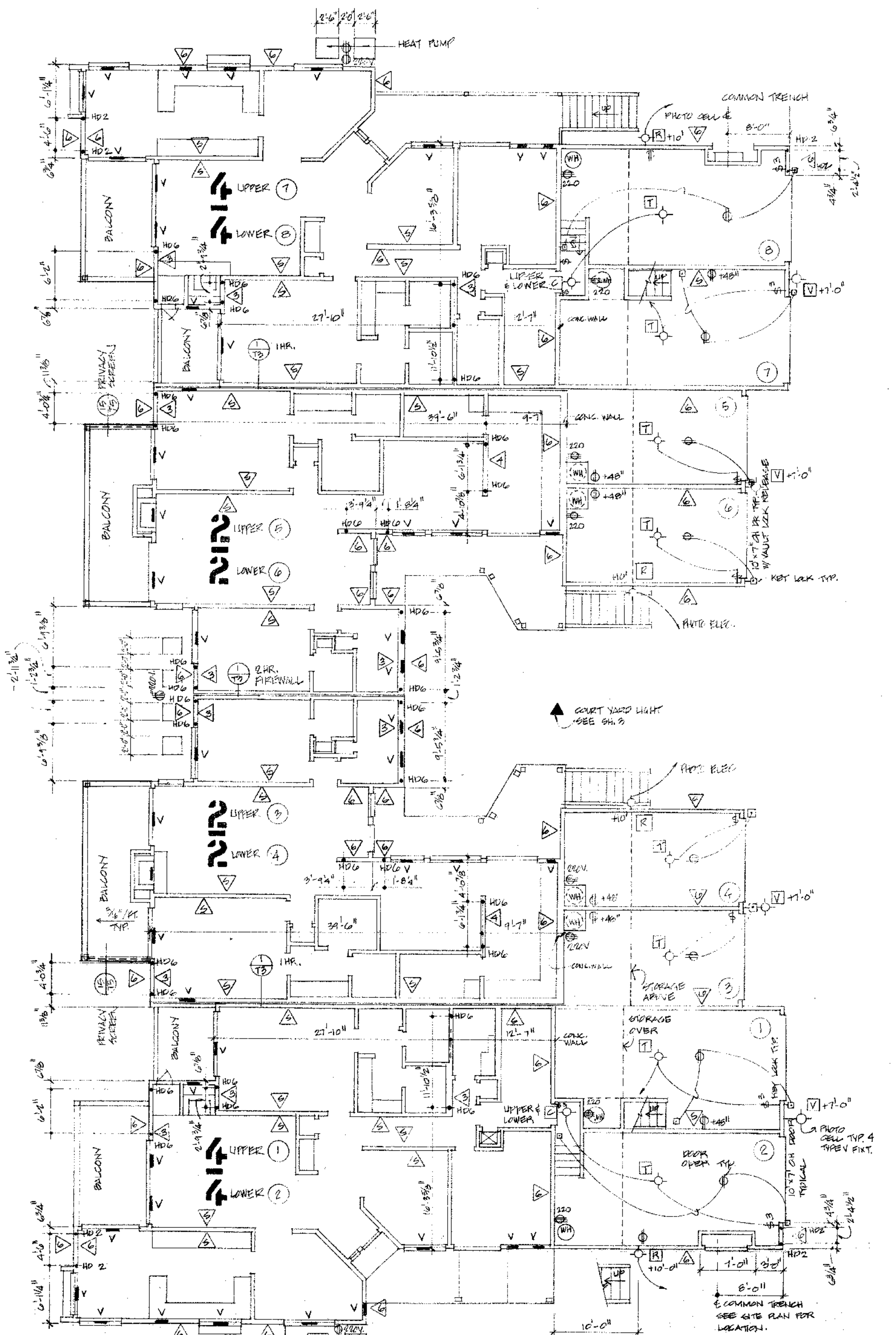
ROSSMOOR
WALNUT CREEK
CALIFORNIA
WALNUT CREEK
PROJECT

WOOD SUBFLOOR
FOUNDATION
& UTILITY PLAN

DRAWN TG
CHECKED
DATE 1-16-76
SCALE 1/8'' = 1'-0''
JOB NO. MUTUAL 42
SHEET 43
F-4
OF SHEETS

NO. 186A-24X36

REVISIONS	BY
M-42 1-16-76	TG
M-42 FOUNDATION & DIM. 1-25-76	LW
M-42 GROUND, CURBS 2-11-76	LW



UTILITY PLAN

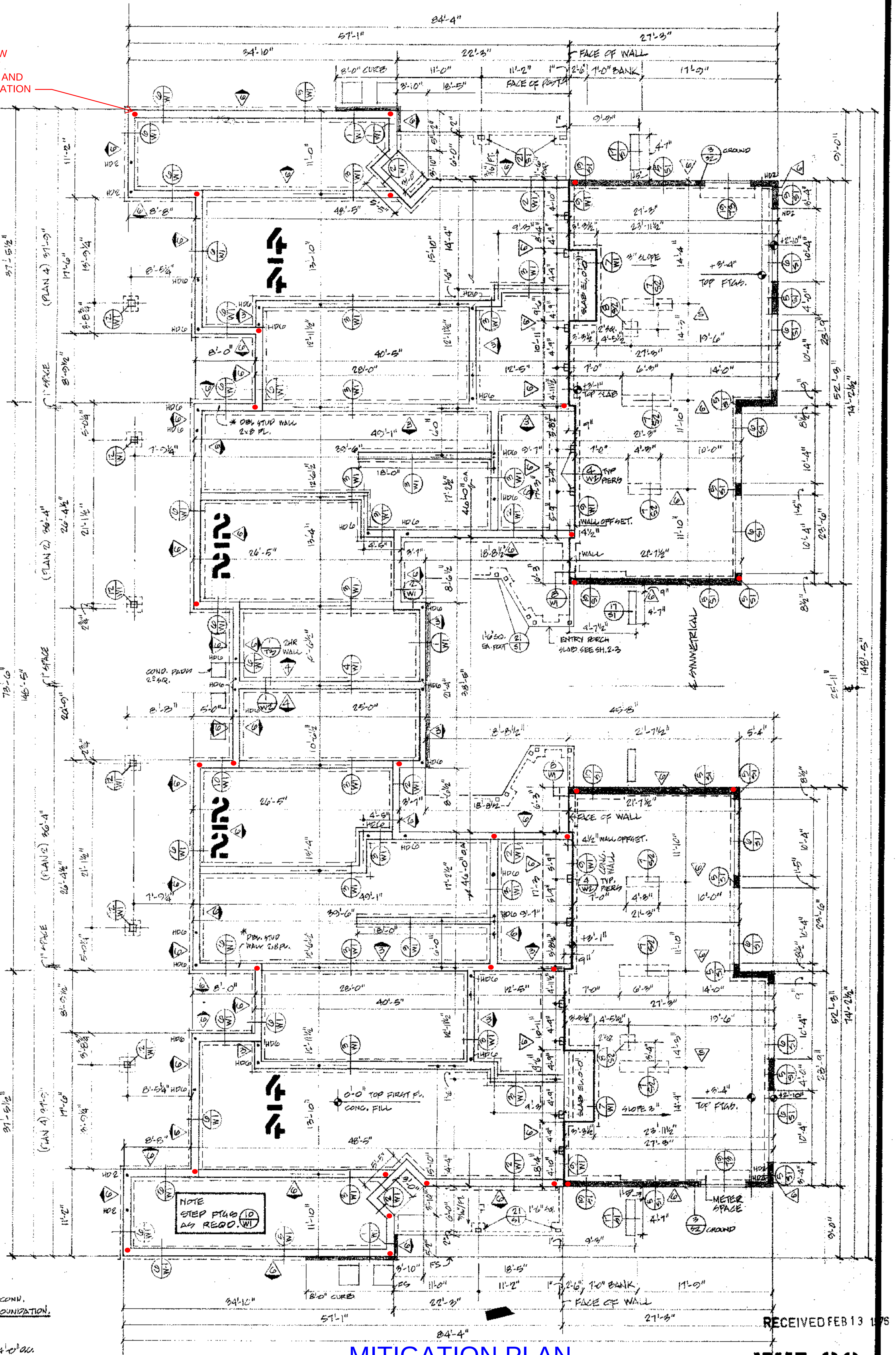
UTILITY PLAN NOTES:

1. △ FIRST FL. SHEAR WALLS (FIRST TO SEC. FL.) SEE 1/V-1
2. ○ GARAGE ASSIGNMENT NO. BY APT. NO.
3. V 6x14 LOUVER FOUND. VENTS SEE 19/T-2

FOUNDATION PLAN NOTES:

1. △ FOUND. TO FIRST FL. OR SILL CONN. SEE 1B/V-1 FOR BOLTS, PN & CONN.
2. AT DETAIL 1&2/W-1 DIM. SHOWN ARE TO FACE OF STUD NOT FACE FOUNDATION.
3. SEE UTILITY PLAN FOR HOLDOWN BOLT DIM.
4. HOLDOWNS BY SIMPSON CO. OR EQ. SEE DETAIL (3/V1) (5/V1) (6/V1)
5. ALL EXT. & INT. FOUND. WALL BOLTS NOT SHOWN USE 5/8"ϕ AB @ 4'-0" O.C.

DENOTES NEW HOLDOWN ST FIRST FLOOR AND AT SAME LOCATION ON SECOND FLOOR. TYP.



FOUNDATION PLAN

MITIGATION PLAN

RECEIVED FEB 13 1976

WF-08

By Terra California
Contractor & Developer of Rossmoor Walnut Creek

TERRA CALIFORNIA
1717 ROSSMOOR PARKWAY
WALNUT CREEK, CALIFORNIA

BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK
CONTRACTOR'S LICENSE NO. 252750 — B1

ROSSMOOR WALNUT CREEK
CALIFORNIA
WALNUT CREEK PROJECT

WOOD SUBFLOOR FOUNDATION & UTILITY PLAN

DRAWN TG
CHECKED
DATE 1-16-76
SCALE 1/8" = 1'-0"
JOB NO. MUTUAL 42
SHEET 43
F-4
OF SHEETS

NO. 186A-24X36

BUILDING 2
1605 PTARMIGAN DRIVE

Building 2 – 1605 Ptarmigan Drive, Walnut Creek, CA

1 General

1605 Ptarmigan is bounded by Ptarmigan Drive to the north and residential properties to the east, west and south.

The building is a 2-story wood framed building with plywood sheathing supported on wood trusses at the roof. Those are supported on wood stud walls which are supported on shallow concrete foundations. The ground floor is concrete slab on grade. Lateral resistance is provided by wood shear walls. Shear wall sheathing is 3/8” standard. These buildings are ASCE 41 Building Type W1A.

The roof is framed prefabricated trusses at 24” OC. The trusses are supported by bearing wall studs. Roof sheathing is 3/8” thick Douglas Fir plywood sheathing.

2 Tier 1 Structural Deficiencies

The following items were deficiencies identified as part or the Tier 1 assessment.

2.1 Surface Fault Rupture

The building site is in close proximity (within 2 miles) to the Calaveras Fault. See Figure 12. In the near field of active faults, there is a potential for large fissures and differential movement to occur in the surface soils. Foundations of buildings located above these ruptures are subjected to large differential movements that induce large forces in the building superstructure. These forces are concurrent with all existing gravity loads and seismic forces during an earthquake.

2.2 Interconnection ties and holdown anchors

The shear walls do not have interconnection ties to transfer overturning forces through the floor. Shear walls in East-West direction do not have holdowns called out on the plans. Shear walls without holdown anchors may be subjected to significant overturning, and damage can be caused by uplift and racking of the shear walls. Hold down anchorage can help resist overturning forces and can greatly strengthen shear walls vs. walls without anchorage.

2.3 Shear stress check in walls

ASCE 41 provides a quick check to assess the strength of the lateral force resisting system. The potential seismic demands on the shear walls exceed the capacities of the wood shear walls and is further evaluated in Tier 2 analysis.

3 Tier 2 Analysis

The ASCE 41 Tier 1 procedure consists of a series of checklists that quickly identifies deficiencies. Based on the Tier 1 results, a Tier 2 analysis is performed to more accurately analyze element demands and capacities.

The following items are analyzed in greater detail under the Tier 2 procedure:

- Shear stress check in walls
- Narrow Shear Walls

Missing building elements causing Tier 1 deficiencies (such as redundancy, interconnection ties and holdowns) were not required to be analyzed under the Tier 2 procedure. These elements are required to meet the BPOE and need to be installed as part of any seismic rehabilitation.

3.1 Shear stress check in walls

This building has a redundancy of lateral force resisting system in both the unit plans. Tier 2 evaluation of the shear walls finds that the shear stress checks are not compliant.
The shear stresses in some walls exceed the assumed capacity of the walls. The wall lines which require strengthening are identified in the mitigation plan.

4 Mitigation

4.1 Redundancy

The most prudent retrofit strategy for a building without redundancy is to add new seismic force resisting elements. New shear walls may be added. Other mitigations include adding sheathing to interior and exterior walls and adding or prefabricated shear resisting elements.

4.2 Shear stress check in walls

At existing plywood shear walls, new plywood sheathing should be added to the opposite side of the walls (creating double sided plywood shear walls) so that shear capacity is significantly increased.

4.3 Interconnection ties and holdown anchors

Shear walls without hold downs should be retrofitted with hold down hardware and compression posts. New hold down hardware could be retrofitted at shear wall ends and anchor bolts would need to be epoxied into the existing foundations. Compression posts could be installed along with the hold down hardware as required. Foundation strengthening may be required if existing foundations are shallow or weak in local areas.

5 Conclusion

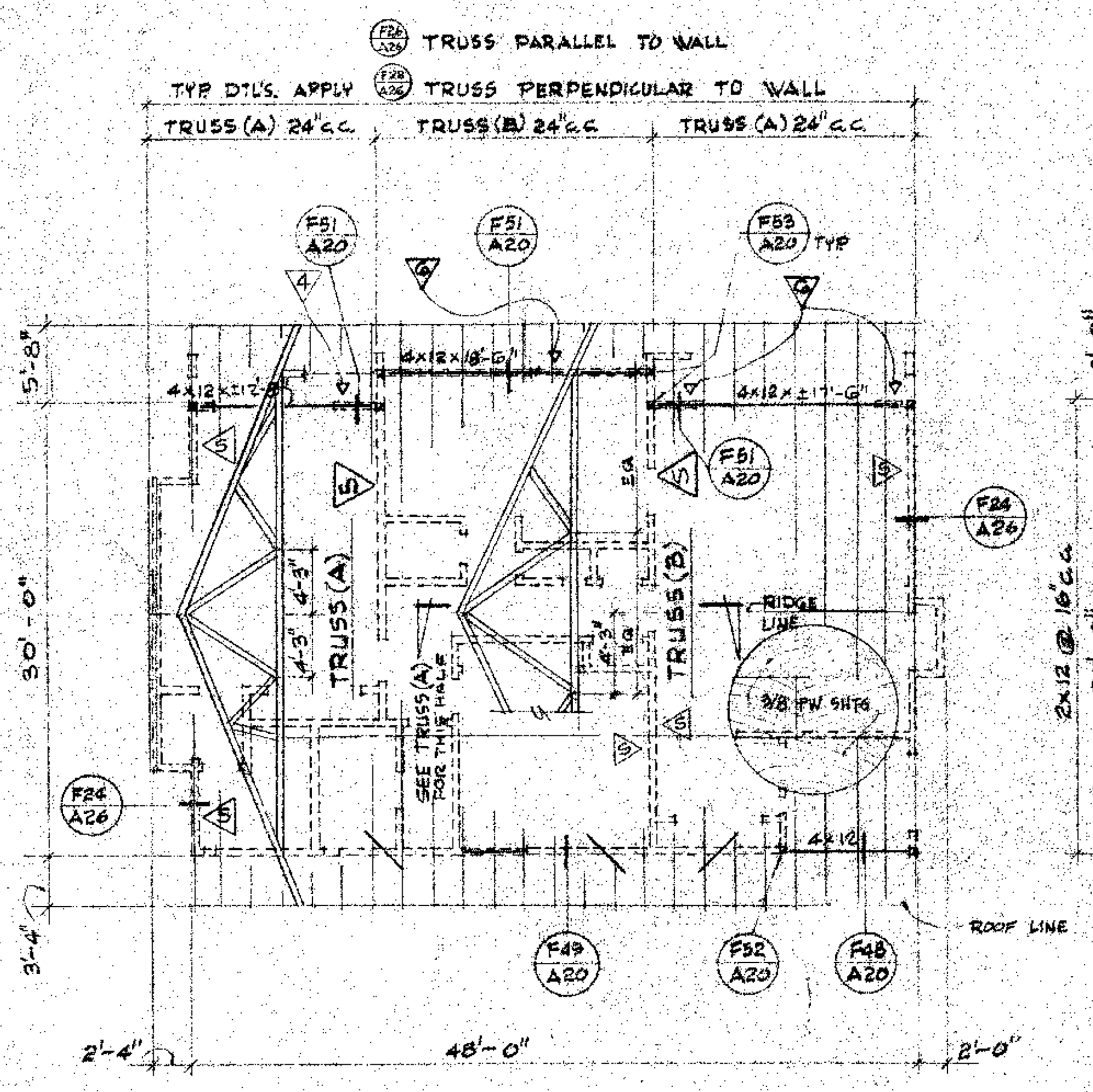
While the building has holdowns in the transverse loading direction, holdowns appear to be missing in the longitudinal loading direction. In some cases, the original designer of the building may have assumed there was sufficient dead load to resist overturning forces. Lower seismic forces at the time of design may have allowed for this design. However, wood shear walls without holdowns or ties between floors have reduced ductility and may be subject to overturning at excessive deflections. Seismic demands have increased, and detailing demands have become more stringent since the original construction. Additionally, we recommend the addition of lateral load resisting elements to address the lack of redundancy.

With the lack of redundancy, and insufficient tiedowns we recommend retrofitting these conditions to meet the Structural Performance Level of the BPOE.

Figure 2. Site Location – 1605 Ptarmigan Drive

See Deficiencies and mitigations on next pages

DEFICIENCIES AND MITIGATIONS

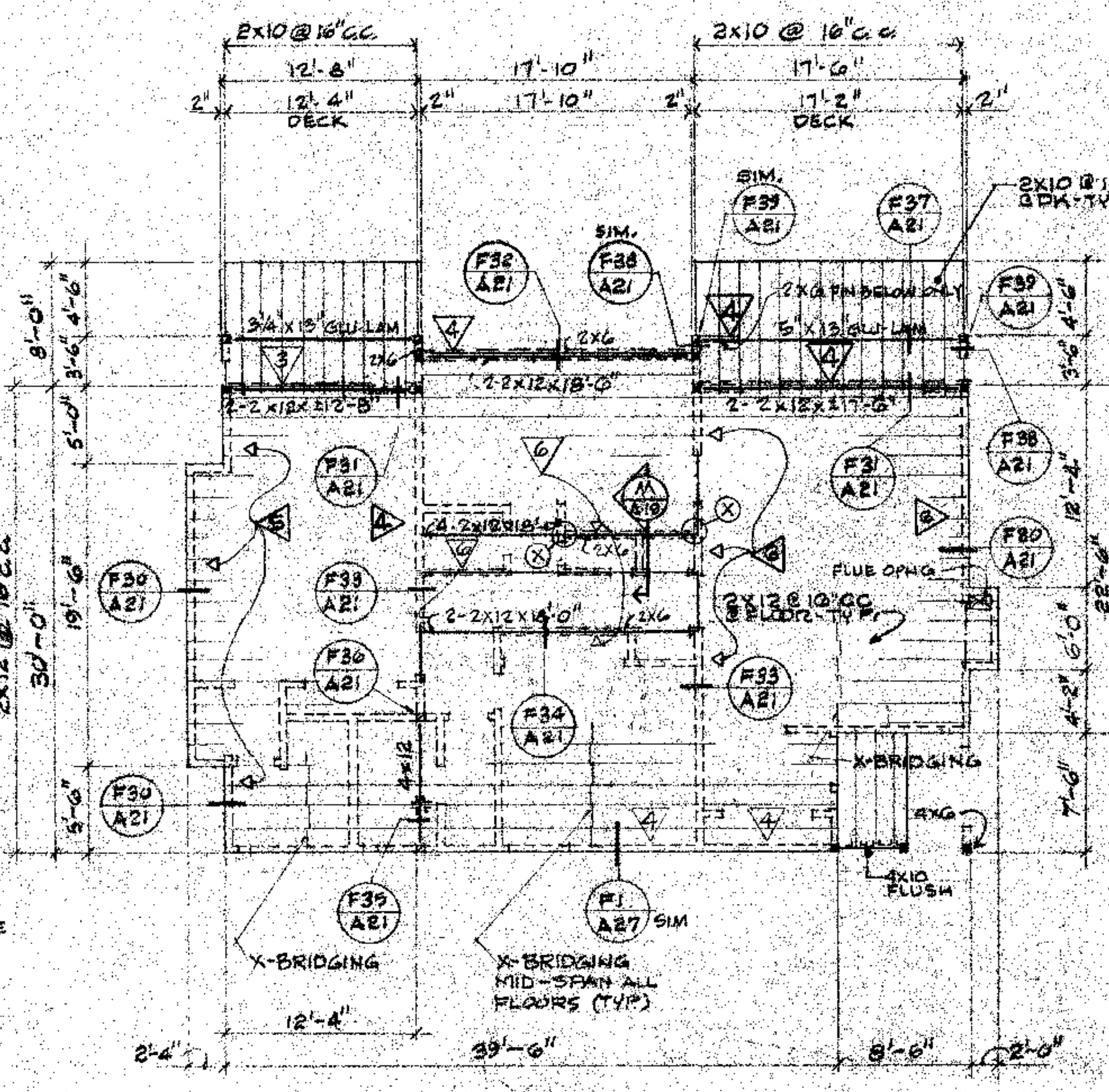


ROOF FRAMING PLAN :"EW"&"ES" UNIT

SCALE : 1/8"=1'-0"

LEGEND :

▭	STUD WALL @ 2ND FL.
▤	FRAM'G DIRECTION
△	SHEAR WALL ON FLOOR BELOW PLAN SEE SCHED SHT: A-10-B
⁄	1 X 6 LET IN BRACE 3-8d PER STUD 5-8d PER END



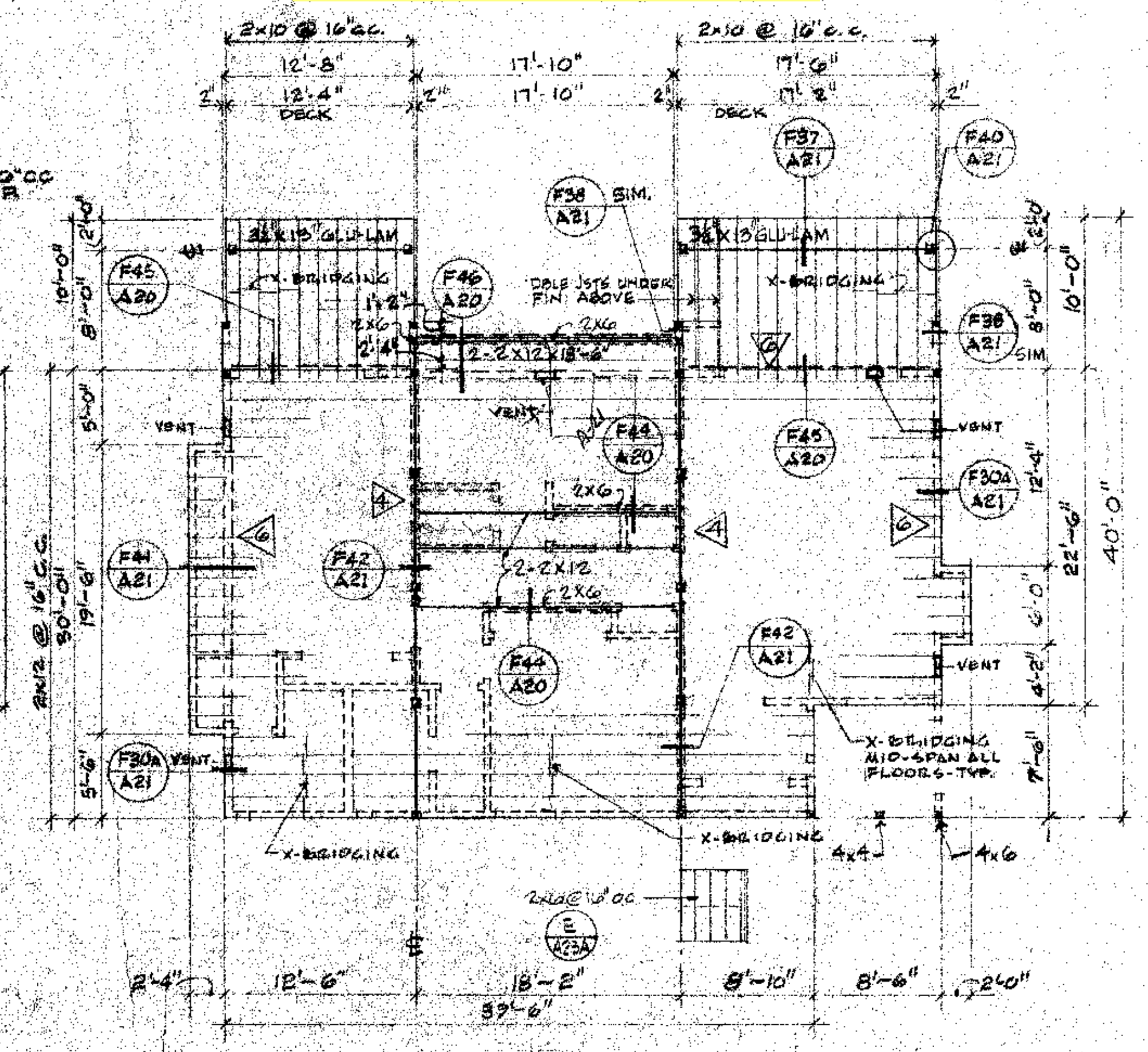
SECOND FLOOR FRAMING PLAN - "EW"&"ES" UNIT

SCALE : 1/8"=1'-0"

LEGEND :

▭	STUD WALL @ 2ND FL.
▤	FRAM'G DIRECTION
▣	CONT. POST
☒	SUPPORTING POST

No Holdowns on this floor

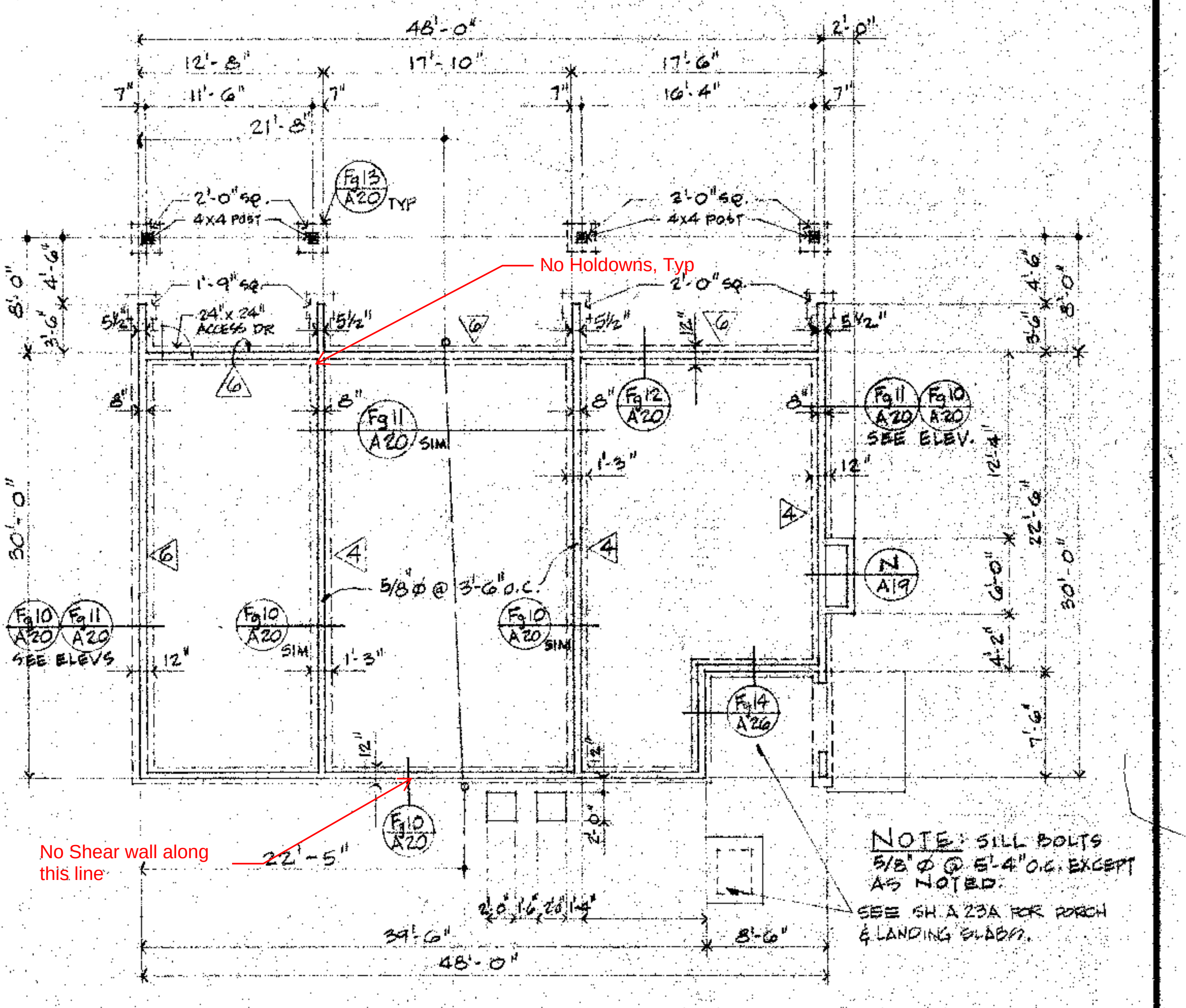


FIRST FLOOR FRAMING PLAN (WOOD FLOOR) :"EW" UNIT

SCALE : 1/8"=1'-0"

LEGEND :

▭	STUD WALL @ 1ST FL.
▤	FRAM'G DIRECTION
☐	CONT. POST
☒	SUPPORTING POST



No Holdowns, Typ

No Shear wall along this line

NOTE: SILL BOLTS 5/8" Ø @ 5'-4" O.C. EXCEPT AS NOTED.
SEE SH. A 23A FOR PORCH & LANDING SLABS.

FOUNDATION PLAN (WOOD FLOOR) :"EW" UNIT

SCALE : 1/8" = 1'-0"

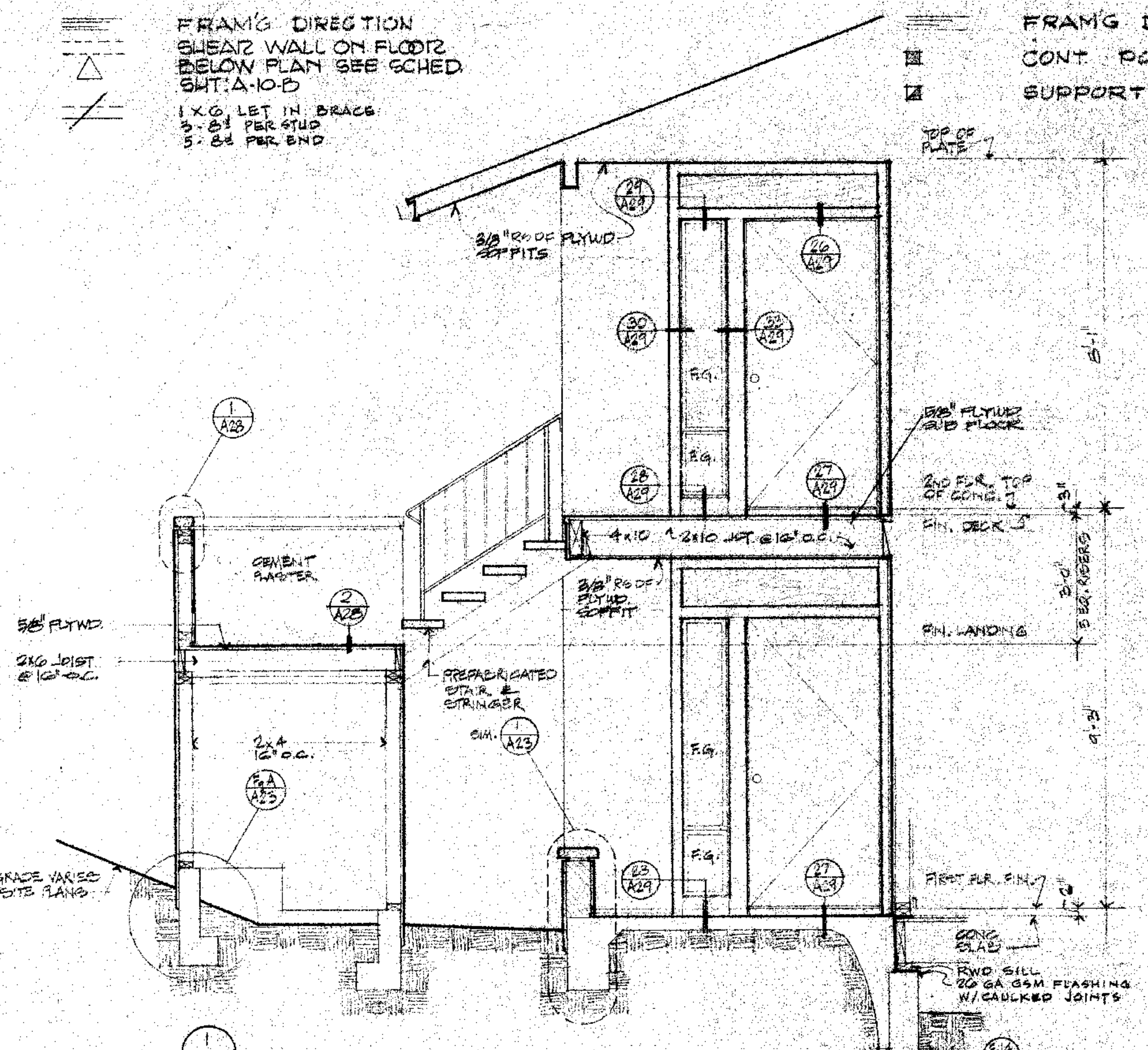
LEGEND :

═══	FOUNDATION WALL
- - -	FOOTING OUTLINE

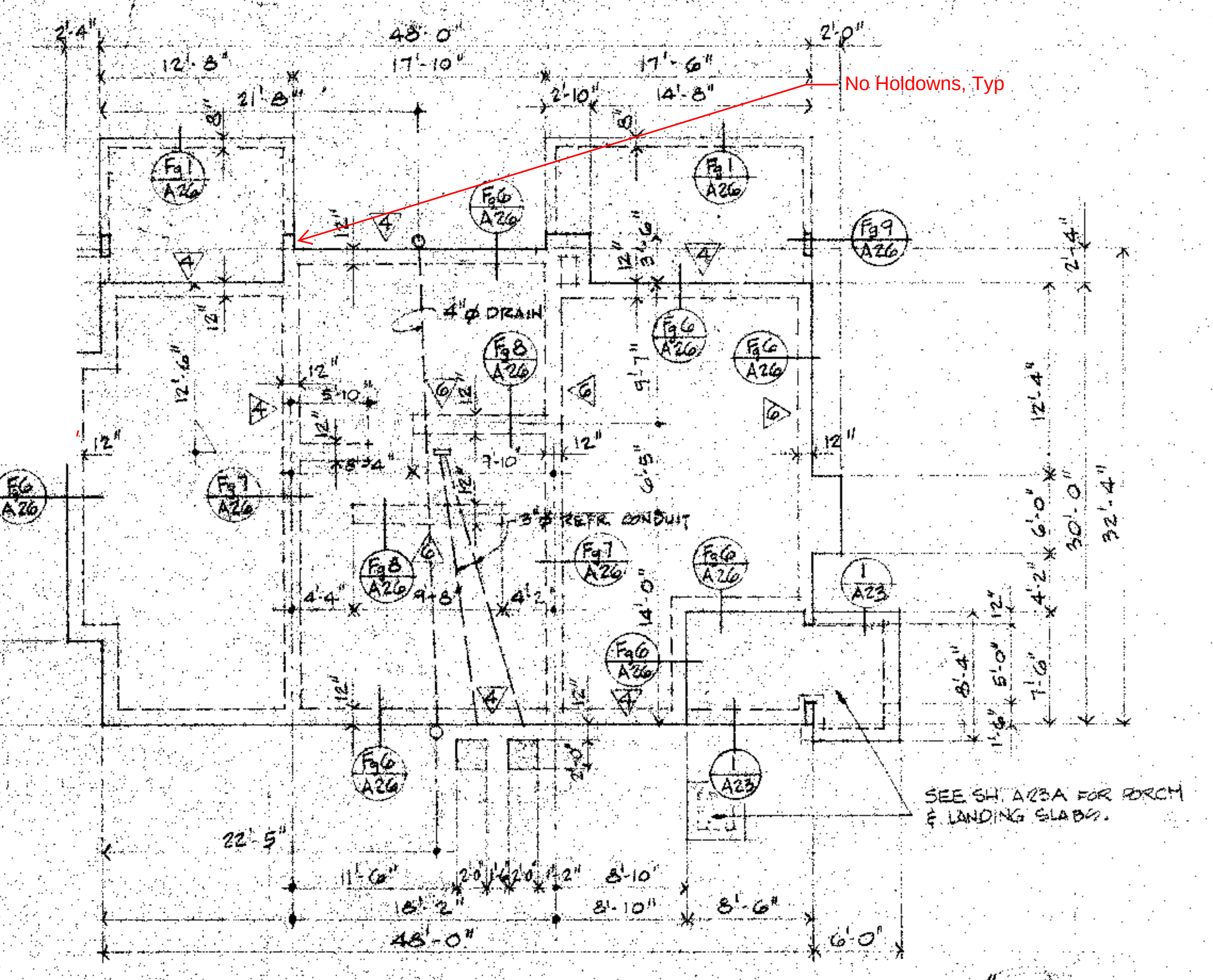
STRUCTURE NOTES

REFER TO SHT: A-25 "F" UNIT

NOTE: ALL GLU-LAM BEAMS COMBINATION C, EXT. GLUE



1 A19 SECTION · ENTRY STAIRS
FOR BUILDING E & F 1/2"=1'-0"



SEE SH. A23A FOR PORCH & LANDING SLABS.

No Holdowns, Typ

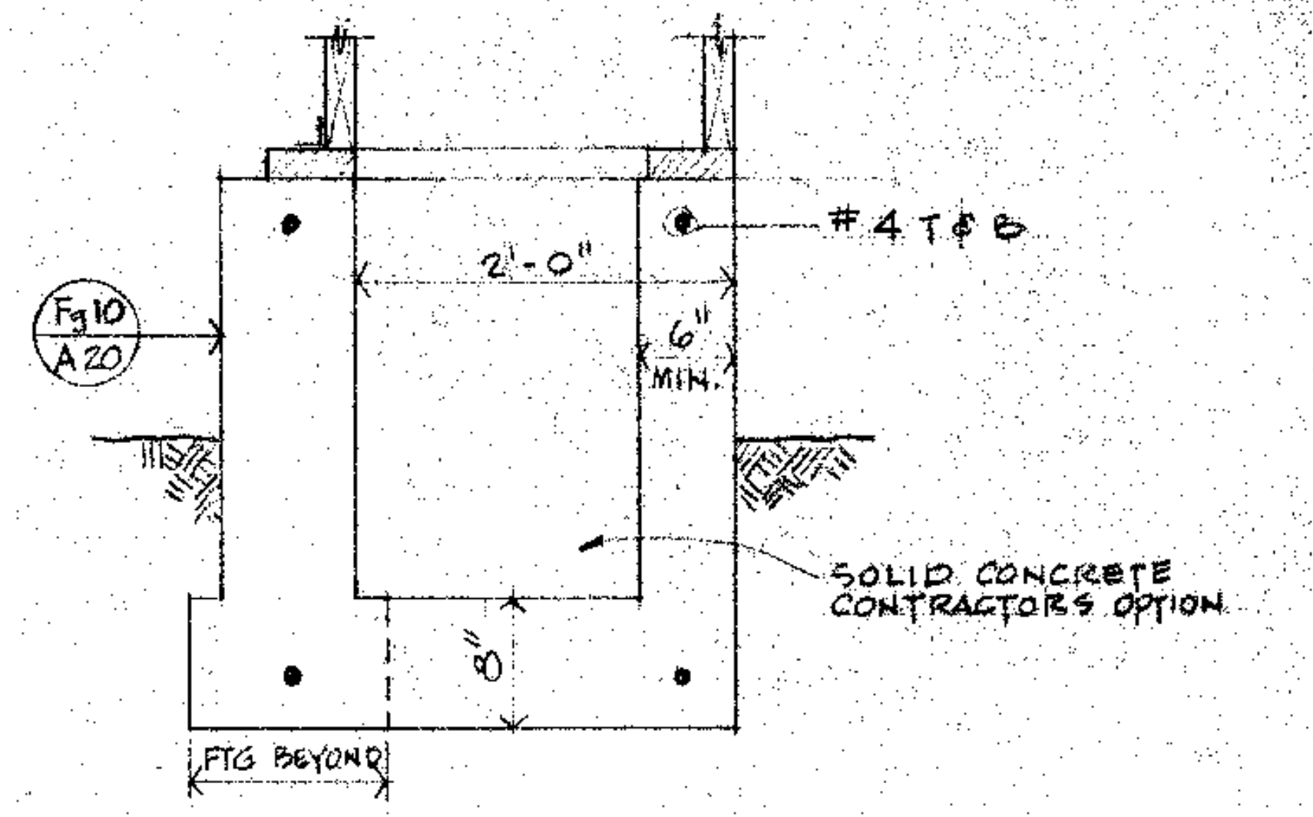
FOUNDATION PLAN (SLAB FLOOR) :"ES" UNIT

SCALE : 1/8" = 1'-0"

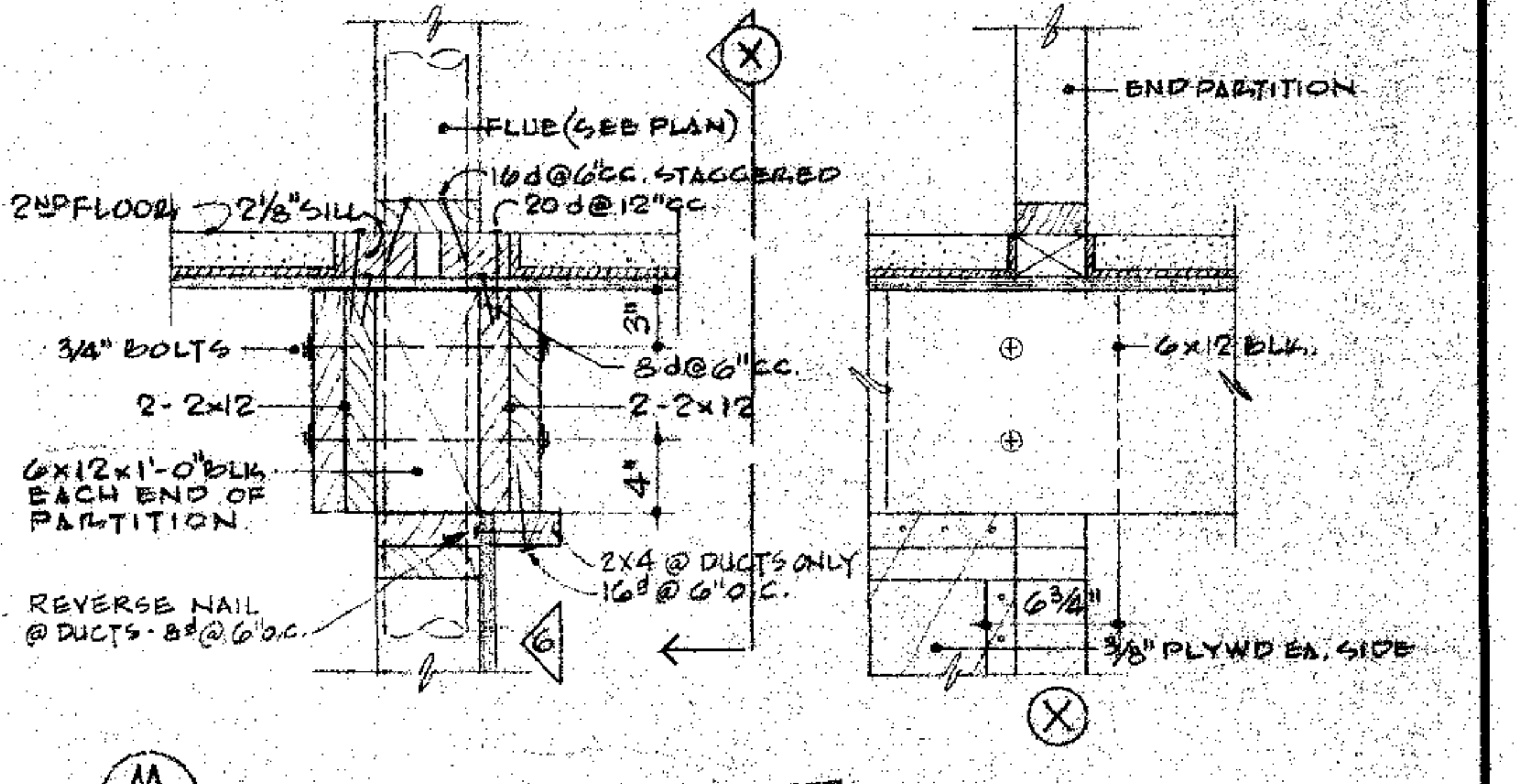
LEGEND

- - -	FOOTING OUTLINE

IDENTIFIED DEFICIENCIES



N A19 SECT. FIREPLACE FOOTING



M A19 SCALE 1 1/2" = 1'-0"

CONSTRUCTION SET
MUTUAL 26
1-8-71

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M-26 REV. 1-4-71

Hayes, Smith, Trockey & Blair
Architects & Planners AIA
70 Broadway • San Francisco, California
433-4080
Approved By____________

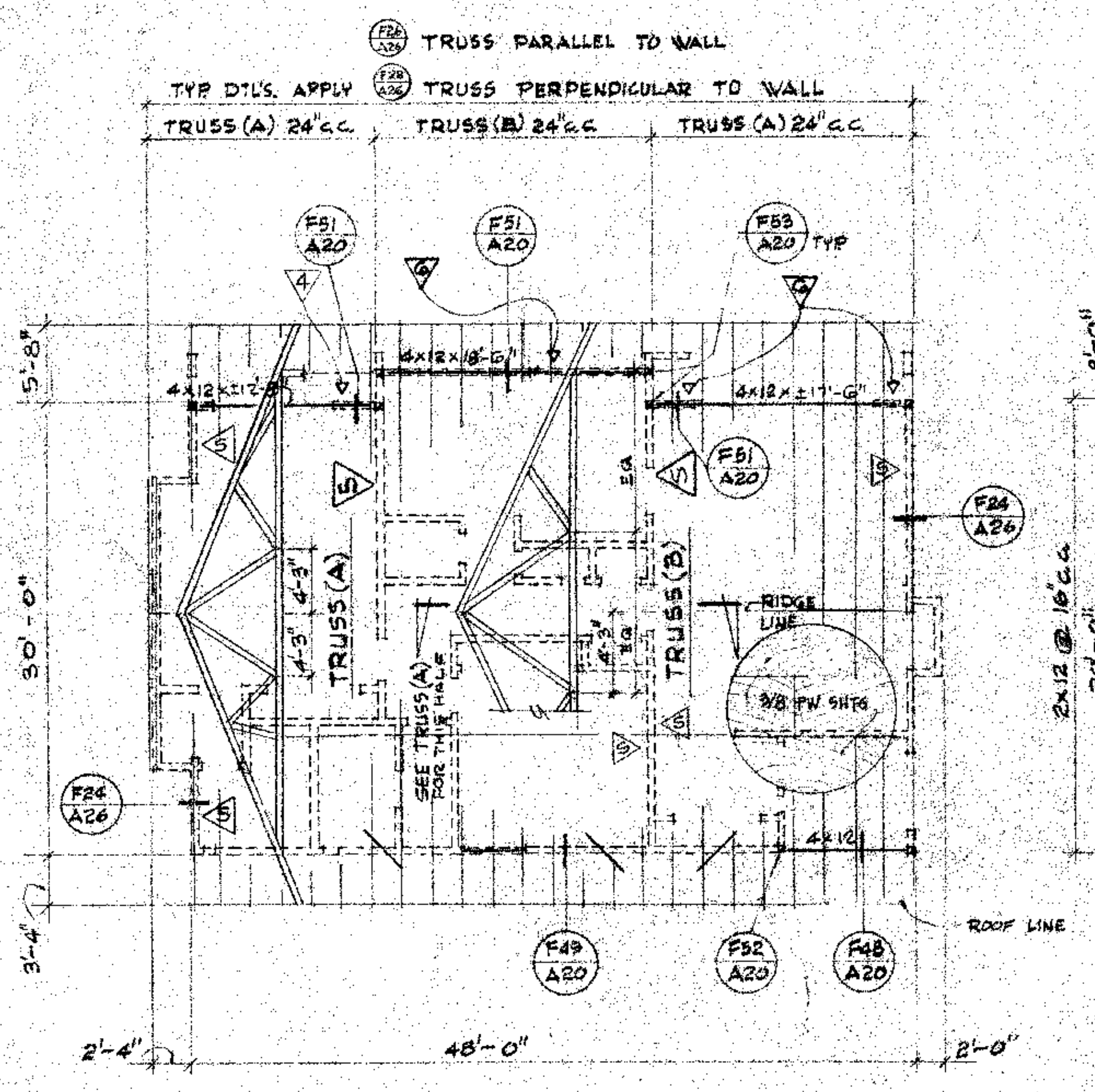
ROSSMOOR—WALNUT CREEK

TC Terra, California
999 Rockview Drive
Walnut Creek, Calif.

SHEET TITLE
TWO-BEDROOM DUPLEX BUILDING
FRAMING PLANS - BLDG. E
WOOD & SLAB FLOORS - FND. PLANS
PROJECT No. 69.02 DATE MAR. 11, 70 PLAN TYPE: E

SHEET 23
A 19
OF 46 SHEETS
IN M SERIES 26

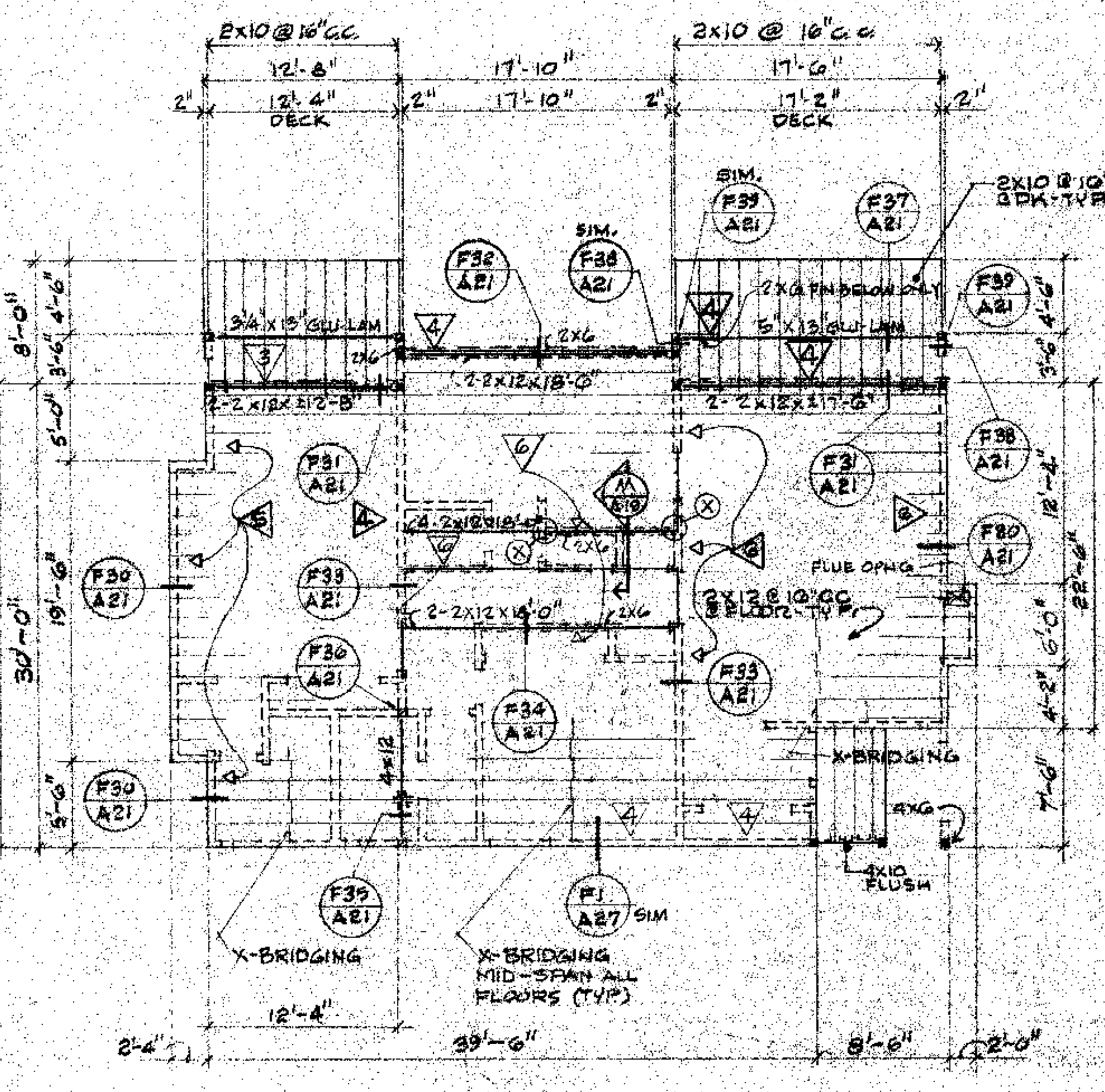
1605 PTARMIGAN DRIVE



ROOF FRAMING PLAN : "EW" & "ES" UNIT

SCALE : 1/8" = 1'-0"

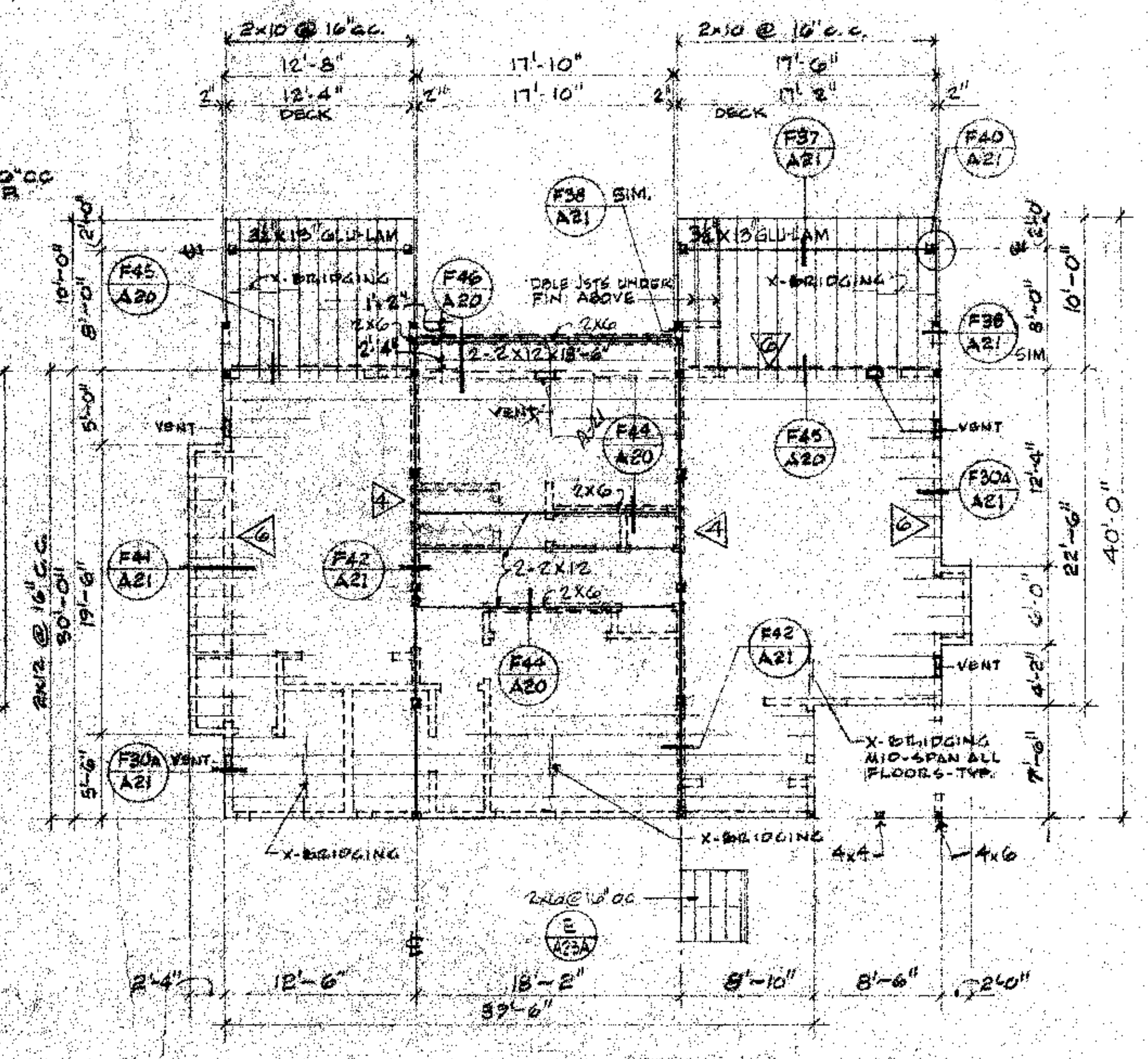
LEGEND :
- STUD WALL @ 2ND FL.
- FRAM'G DIRECTION
- SHEAR WALL ON FLOOR BELOW PLAN SEE SCHED SHT: A-10-B
- 1 X 6 LET IN BRACE 3-8d PER STUD 5-8d PER END



SECOND FLOOR FRAMING PLAN - "EW" & "ES" UNIT

SCALE : 1/8" = 1'-0"

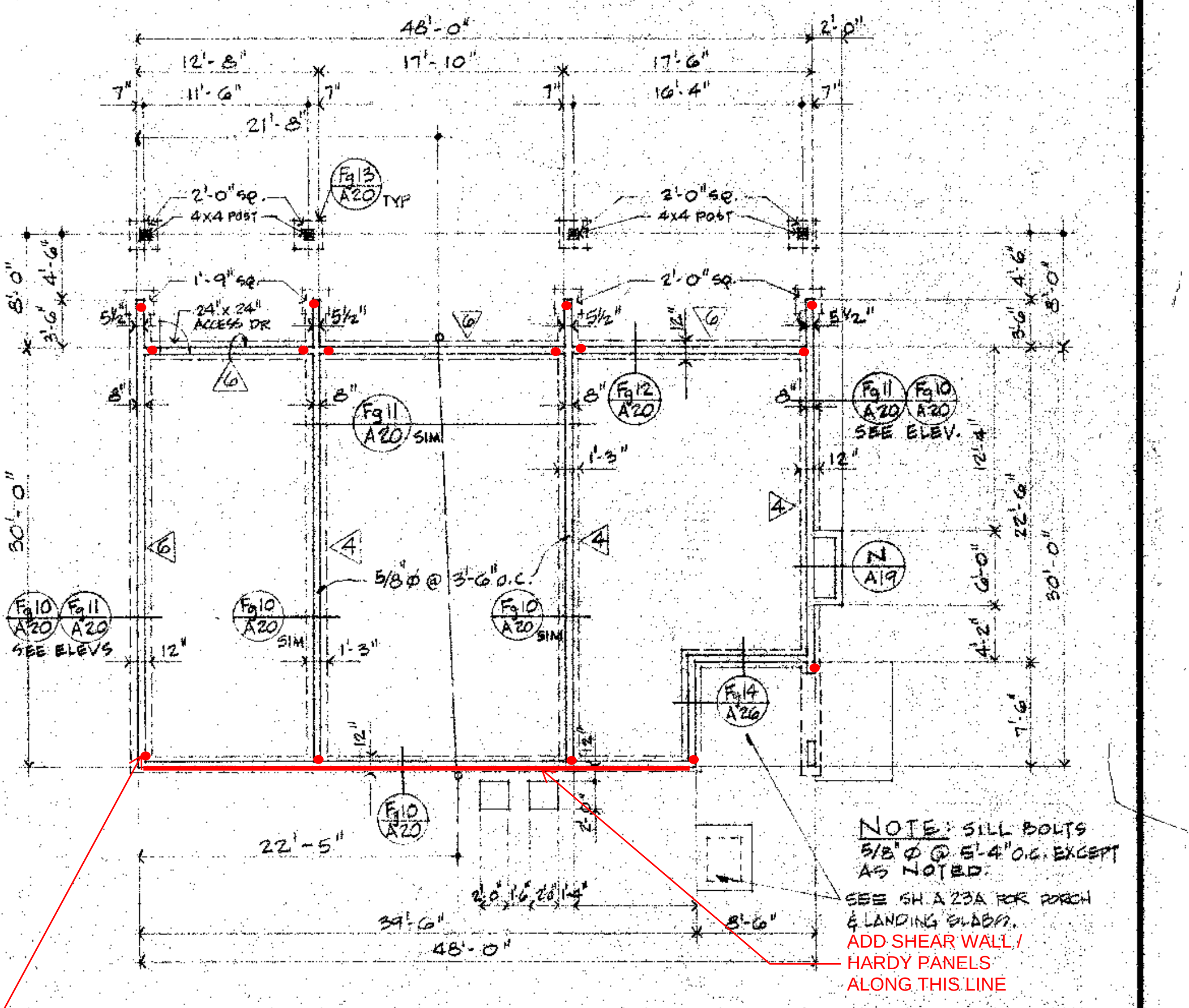
LEGEND :
- STUD WALL @ 2ND FL.
- FRAM'G DIRECTION
- ▣ CONT POST
- ☒ SUPPORTING POST



FIRST FLOOR FRAMING PLAN (WOOD FLOOR) : "EW" UNIT

SCALE : 1/8" = 1'-0"

LEGEND :
- STUD WALL @ 1ST FL.
- FRAM'G DIRECTION
- ☐ CONT. POST
- ☒ SUPPORTING POST



FOUNDATION PLAN (WOOD FLOOR) : "EW" UNIT

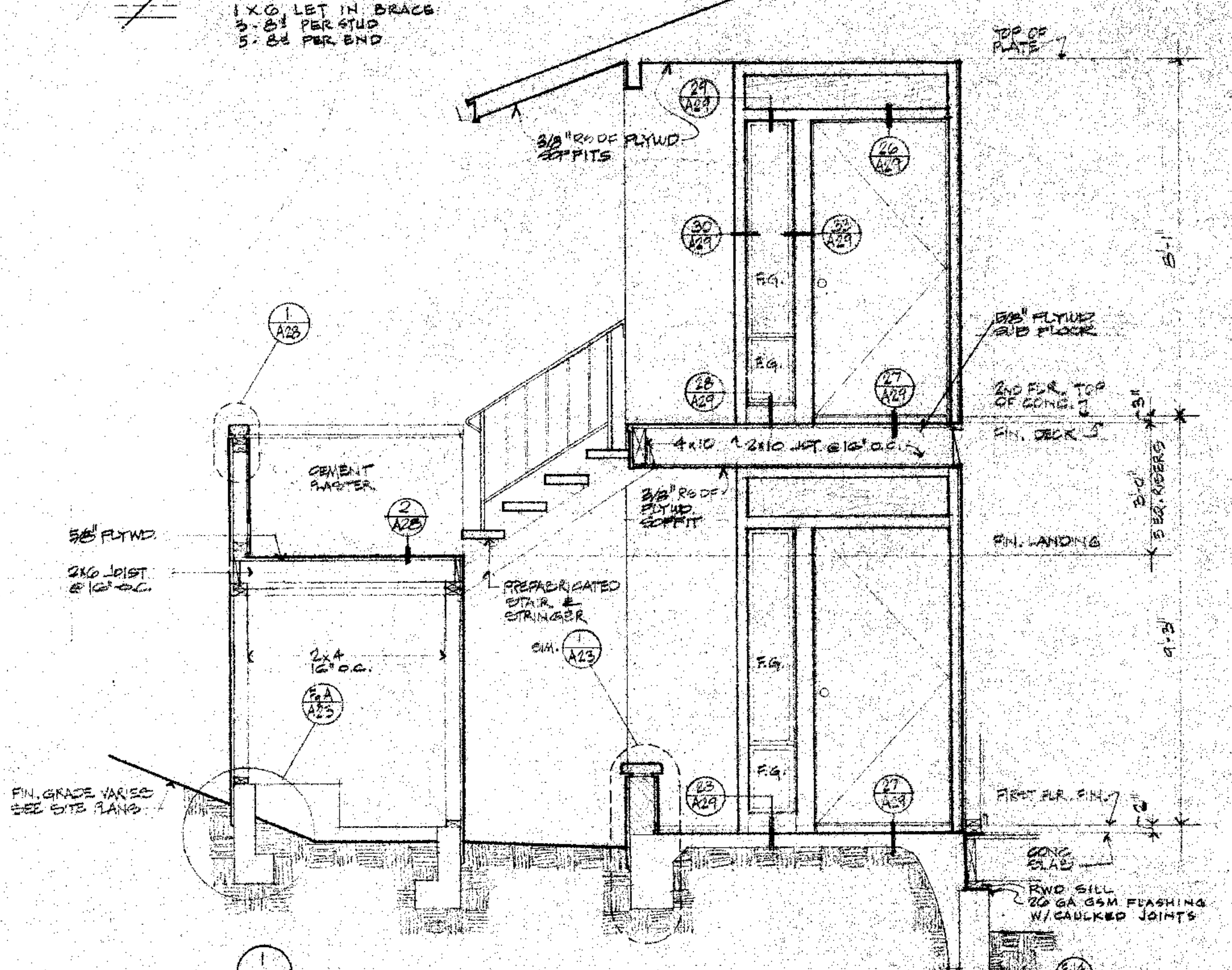
SCALE : 1/8" = 1'-0"

LEGEND :
- FOUNDATION WALL
- FOOTING OUTLINE

STRUCTURE NOTES

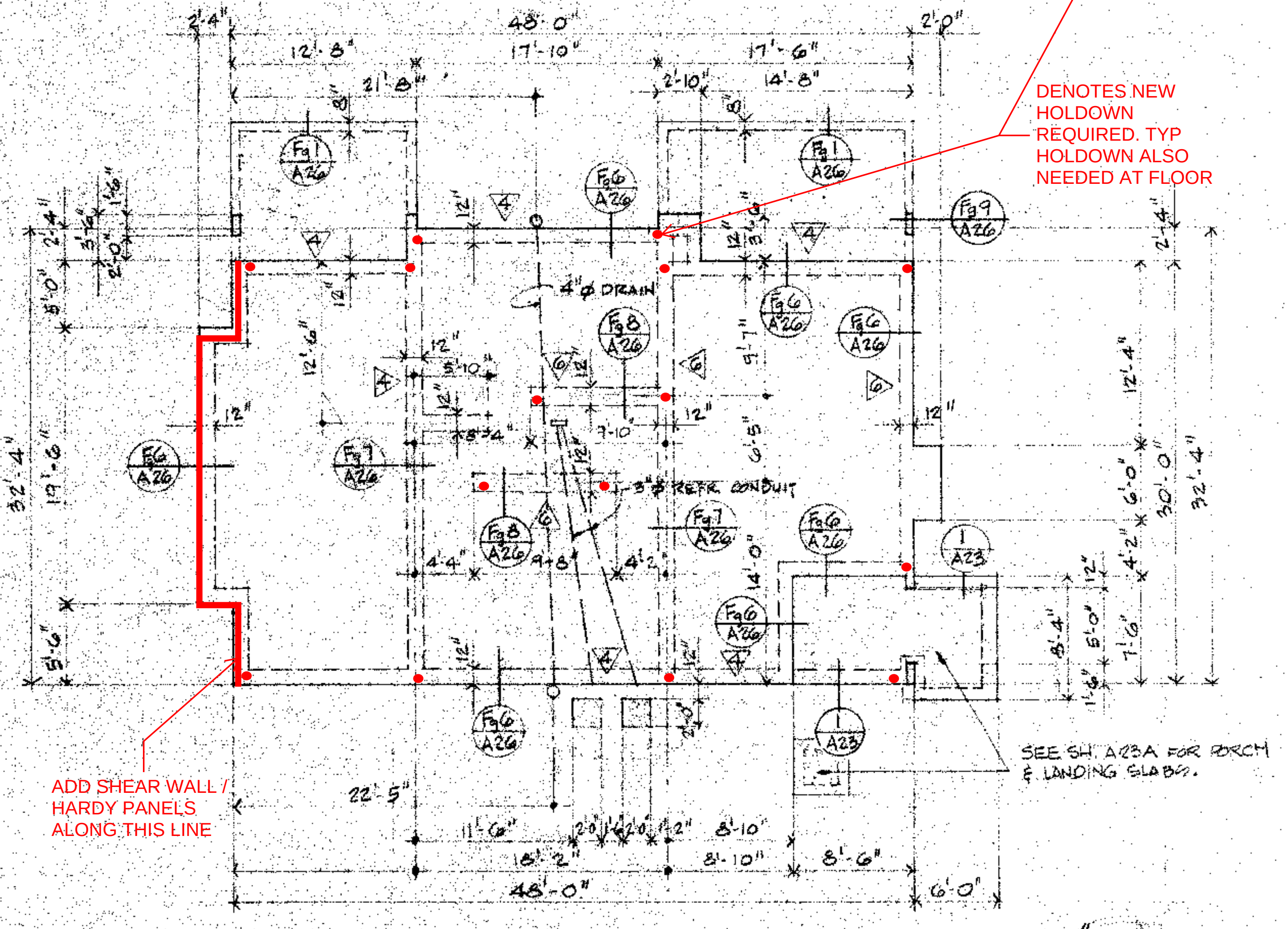
REFER TO SHT: A-25 "F" UNIT

NOTE: ALL GLU-LAM BEAMS COMBINATION C, EXT. GLUE



SECTION - ENTRY STAIRS

FOR BUILDING E & F 1/2" = 1'-0"

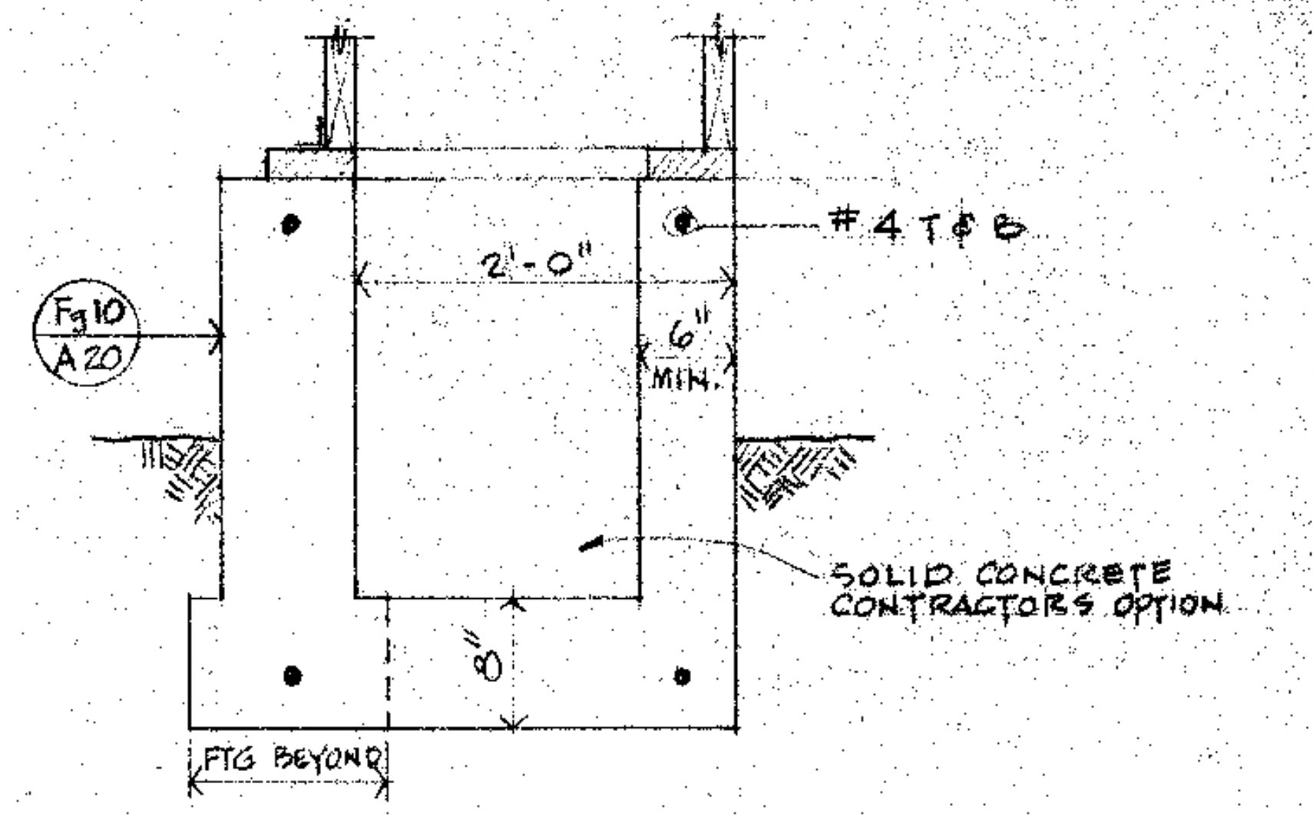


FOUNDATION PLAN (SLAB FLOOR) : "ES" UNIT

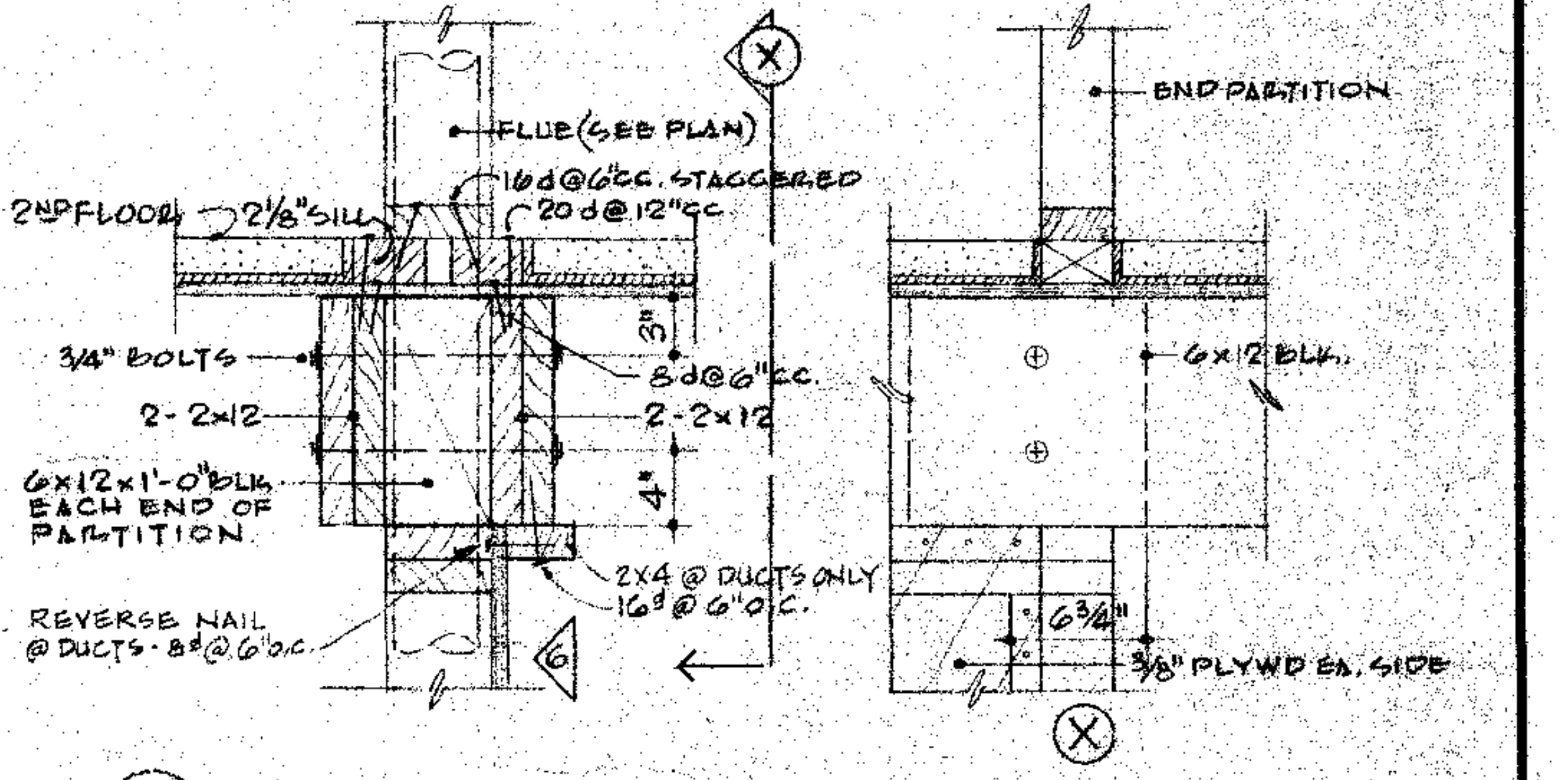
SCALE : 1/8" = 1'-0"

LEGEND
- FOOTING OUTLINE

MITIGATIONS



N / A19 SECT. FIREPLACE FOOTING



M / A-19

CONSTRUCTION SET
MUTUAL 26
1-8-71

SCALE 1 1/2" = 1'-0"

M-26 REV. 1-4-71

Hayes, Smith, Trockey & Blair
Architects & Planners AIA
70 Broadway • San Francisco, California
433-4080
Approved By

ROSSMOOR—WALNUT CREEK
TC Terra, California
999 Rockview Drive
Walnut Creek, Calif.

SHEET TITLE
TWO-BEDROOM DUPLEX BUILDING
FRAMING PLANS - BLDG: E
WOOD & SLAB FLOORS - FND PLANS
PROJECT No. 69.02 DATE MAR 11, 70 PLAN TYPE: E

SHEET 23
A 19
OF 46 SHEETS
IN M SERIES 26

BUILDING 3
1995 CACTUS COURT

Building 3 –1995 Cactus Ct, Walnut Creek, CA

1 General

1995 Cactus Ct is bounded by Cactus Ct on the north and west and open area on the east and south.

The building is a 2-story wood framed building with plywood sheathing supported on wood trusses at the roof and floor framing of 9-1/4" 16" Super C Joists @ 24" OC. Those are supported on wood stud walls which are supported on shallow concrete foundations. Lateral resistance is provided by wood shear walls. Shear wall sheathing is 3/8" standard. These buildings are ASCE 41 Building Type W1A.

The roof is framed prefabricated trusses at 24" OC. The trusses are supported by bearing wall studs. Roof sheathing is 3/8" thick Douglas Fir plywood sheathing.

2 Tier 1 Structural Deficiencies

2.1 Surface Fault Rupture

The building site is in close proximity (within 2 miles) to the Calaveras Fault. See Figure 12. In the near field of active faults, there is a potential for large fissures and differential movement to occur in the surface soils. Foundations of buildings located above these ruptures are subjected to large differential movements that induce large forces in the building superstructure. These forces are concurrent with all existing gravity loads and seismic forces during an earthquake.

2.2 Narrow Shear Walls

Narrow shear walls are highly stressed and subject to severe deformations that reduce the capacity of the walls. Most of the damage occurs at the base and consists of sliding of the sill plate and deformation of hold-down anchors where present. As the deformation continues, the plywood pulls up on the sill plate, causing splitting. Splitting of the end studs at the bolted attachment of hold-down anchors is also common. The aspect ratio for wood walls is the story height to wall length.

2.3 Interconnection ties and holdown anchors

The shear walls do not have interconnection ties to transfer overturning forces through the floor. Shear walls in East-West direction do not have holdowns called out on the plans. Shear walls without holdown anchors may be subjected to significant overturning, and damage can be caused by uplift and racking of the shear walls. Hold down anchorage can help resist overturning forces and can greatly strengthen shear walls vs. walls without anchorage.

3 Tier 2 Analysis

The ASCE 41 Tier 1 procedure consists of a series of checklists that quickly identifies deficiencies. Based on the Tier 1 results, a Tier 2 analysis is performed to more accurately analyze element demands and capacities.

The following items are analyzed in greater detail under the Tier 2 procedure:

- Shear stress check in walls
- Narrow Shear Walls

Missing building elements causing Tier 1 deficiencies (such as redundancy, interconnection ties and holdowns) were not required to be analyzed under the Tier 2 procedure. These elements are required to meet the BPOE and need to be installed as part of any seismic rehabilitation.

3.1 Narrow Shear walls

Tier 2 analysis finds that the shear stress check is compliant without considering narrow shear walls to be a part of the lateral force resisting system.

4 Mitigation

4.1 Interconnection ties and holdown anchors

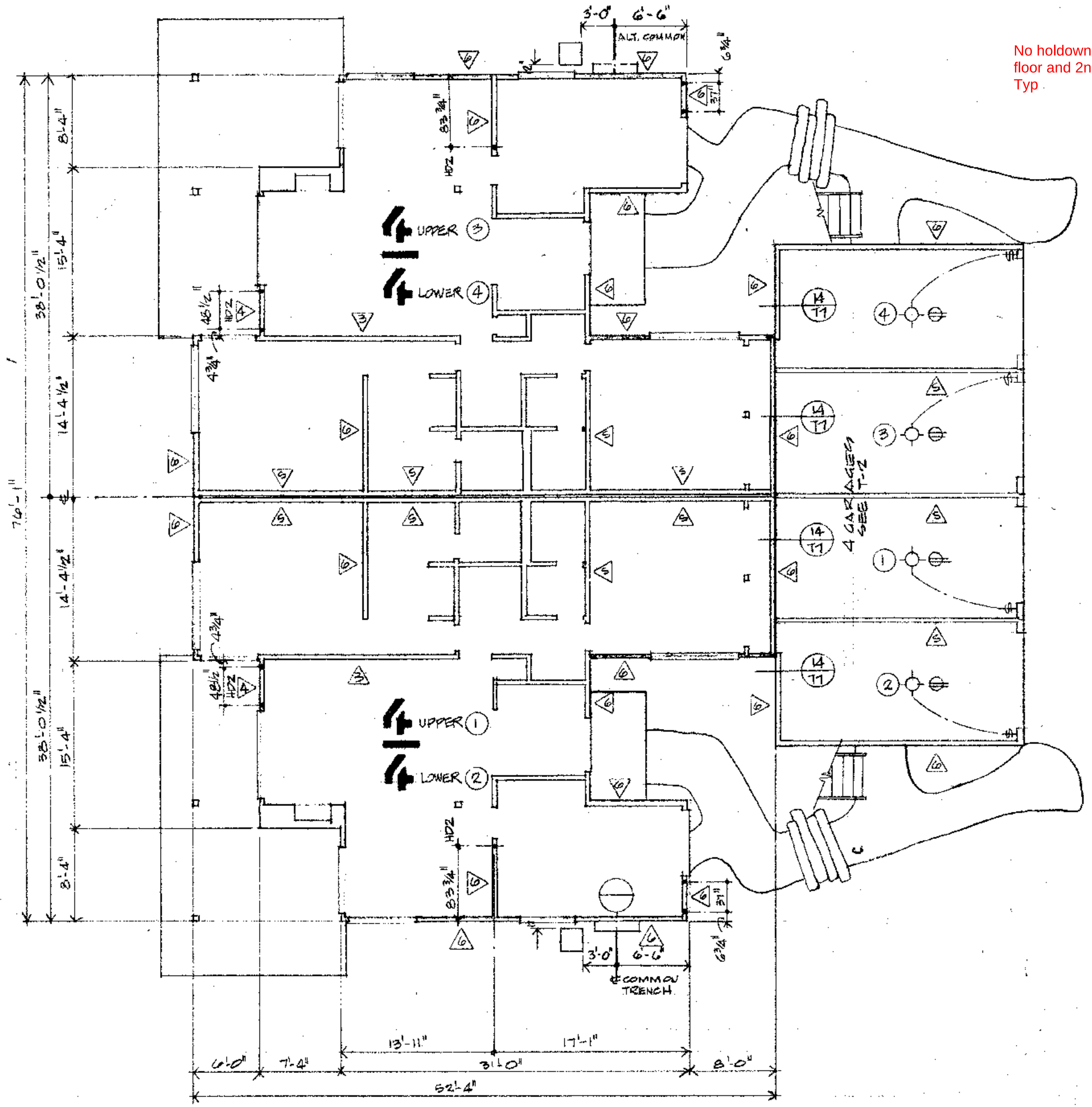
New straps can be added at shear walls to transfer overturning forces between floor to floor. Shear walls without hold downs should be retrofitted with hold down hardware and compression posts. New hold down hardware could be retrofitted at shear wall ends and anchor bolts would need to be epoxied into the existing foundations. Compression posts could be installed along with the hold down hardware as required. Foundation strengthening may be required if existing foundations are shallow or weak in local areas.

5 Conclusion

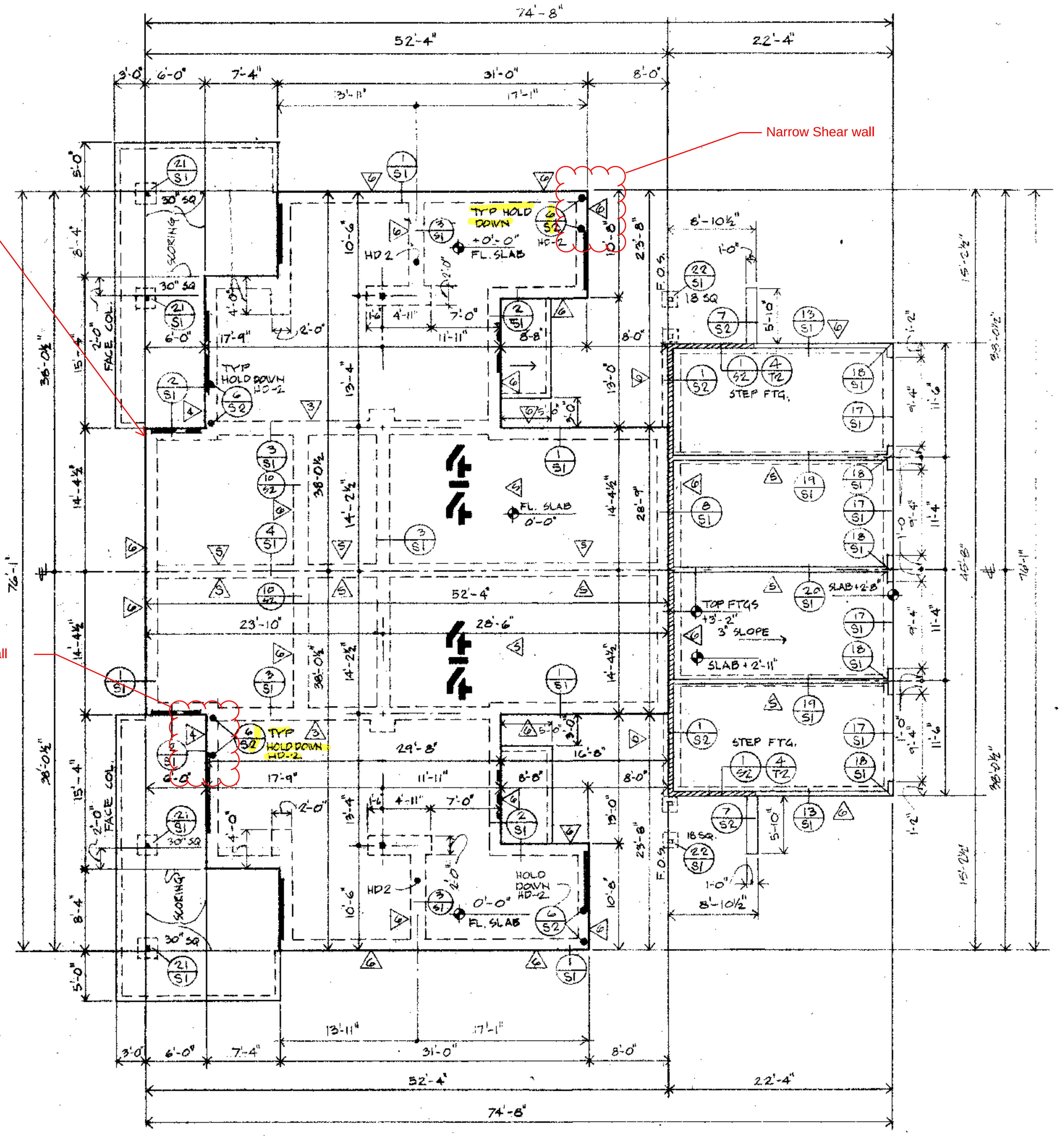
While the building has holdowns in the transverse loading direction, holdowns appear to be missing in the longitudinal loading direction. In some cases, the original designer of the building may have assumed there was sufficient dead load to resist overturning forces. Lower seismic forces at the time of design may have allowed for this design. However, wood shear walls without holdowns or ties between floors have reduced ductility and may be subject to overturning at excessive deflections. Seismic demands have increased, and detailing demands have become more stringent since the original construction. Therefor we conclude the building has an incomplete lateral force resisting system, which does not meet the requirements of ASCE 41-17 for the BPOE performance. Retrofitting these conditions are required to meet the Structural Performance Level of the BPOE.

Figure 3. Site Location – 1995 Cactus Ct

DEFICIENCIES AND MITIGATIONS



UTILITIES PLAN
○ APT. NO. & CARPORT ASSIGNMENT



No holdown at 1st floor and 2nd floor. Typ

Narrow Shear wall

Narrow Shear wall

1/T1 Not available

SLAB FOUNDATION PLAN

△ FIRST FLOOR SHEAR WALL DESIGNATIONS, SEE ⓣ FOR SILL BOLTING & FRAMING DETAILS

ALL EXTERIOR WALLS △6 UNLESS NOTED OTHER WISE.
SEE UTILITY PLAN FOR HOLDOWN DIMENSIONS

IDENTIFIED DEFICIENCIES

RECEIVED JAN 2 5 1974

REVISIONS	BY
M-31 11-16-73	TG
M-37 12-12-73	TG

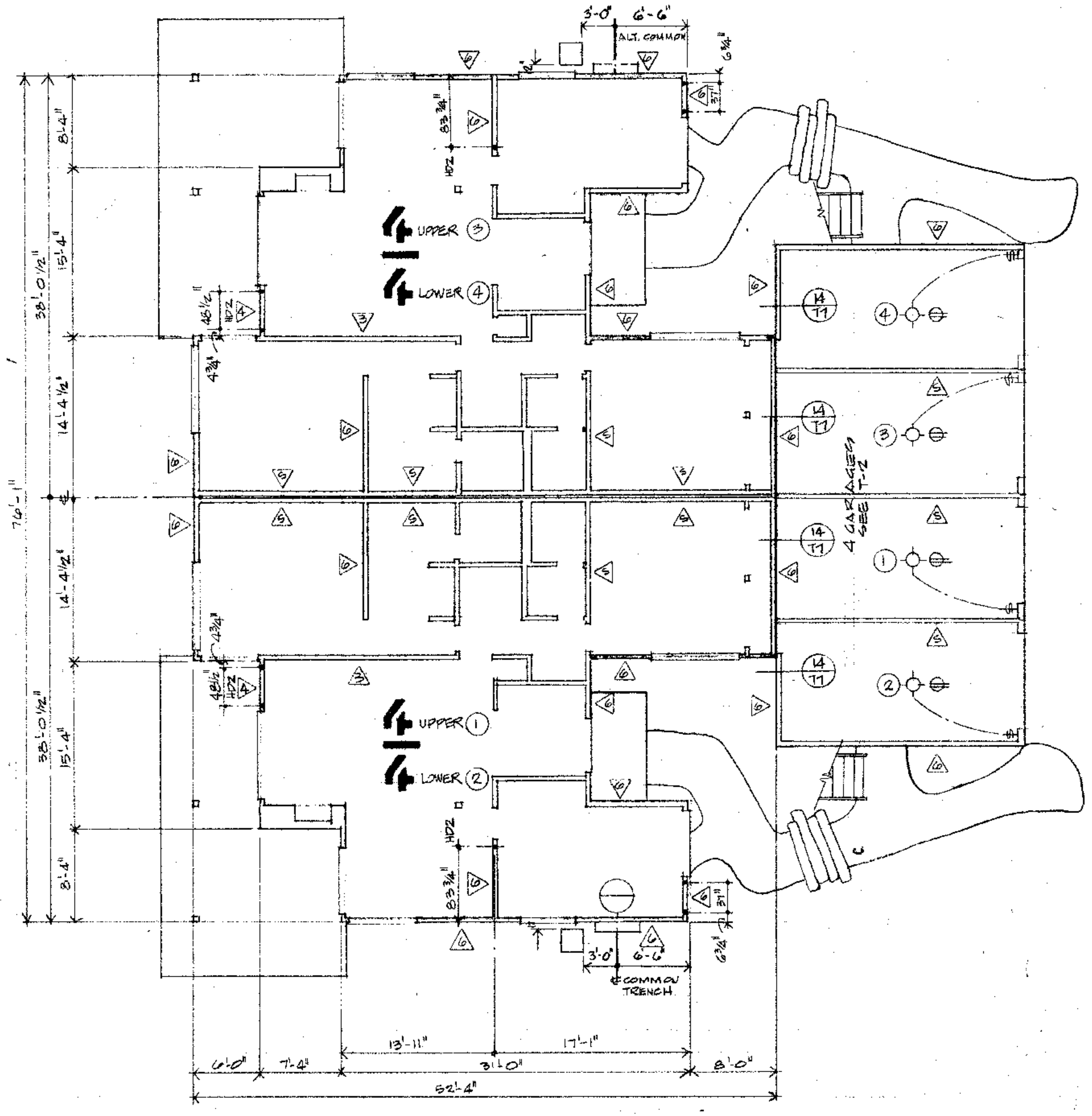
TERRA CALIFORNIA
999 ROCKVIEW DRIVE
WALNUT CREEK, CALIF
BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK

ROSSMOOR WALNUT CREEK
CALIFORNIA
WALNUT CREEK PROJECT

SLAB FOUNDATION & UTILITY PLAN

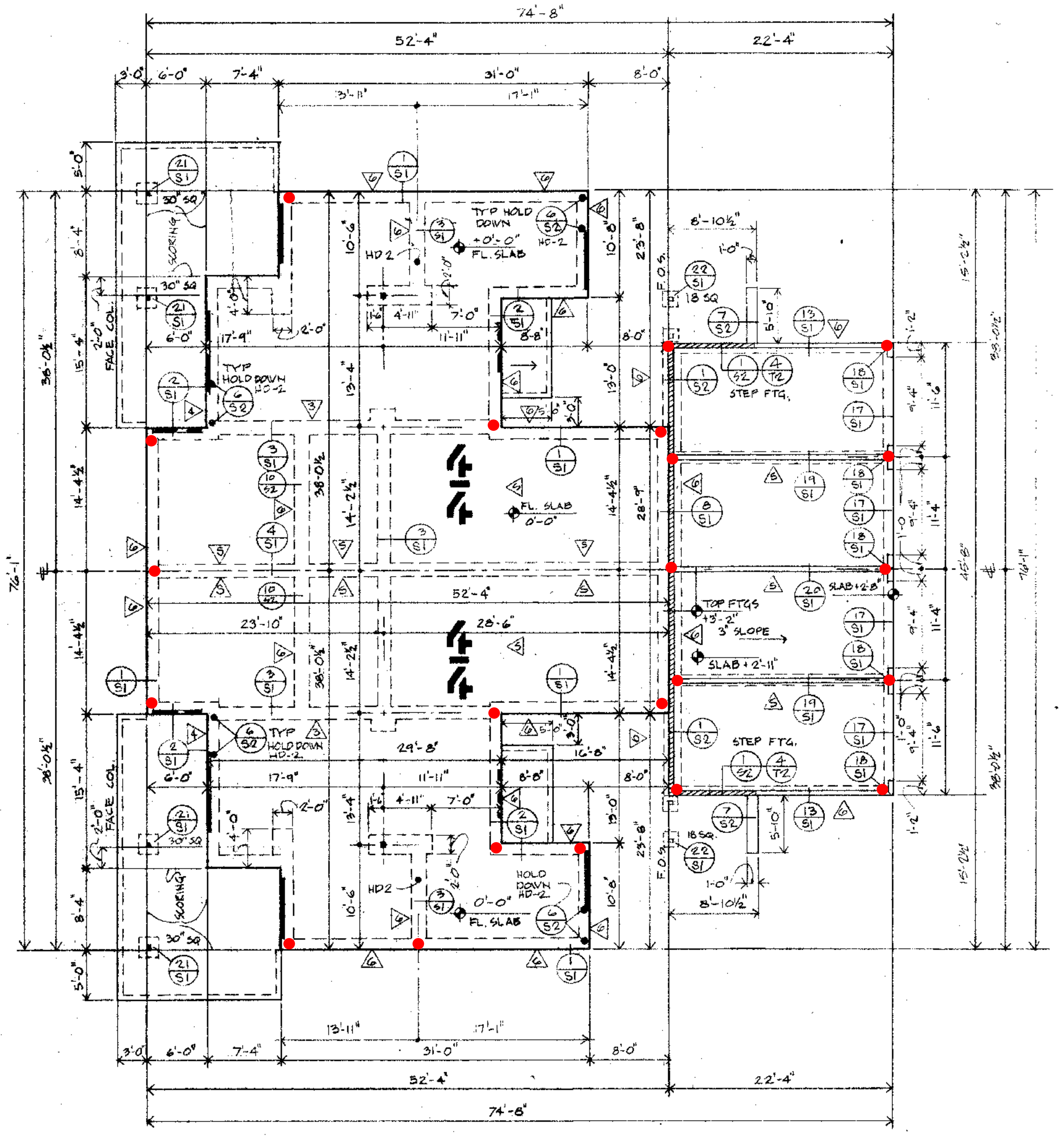
DATE 16/NOV.'73
SCALE 1/8" = 1'-0"
DRAWN FRED
JOB MUTUAL 37
SHEET 37
H-2
OF 56 SHEETS

1995 CACTUS CT



UTILITIES PLAN

○ APT. NO. & CARPORT ASSIGNMENT



SLAB FOUNDATION PLAN

△ FIRST FLOOR SHEAR WALL DESIGNATIONS, SEE ⊖ FOR SILL BOLTING & FRAMING DETAILS

ALL EXTERIOR WALLS △ UNLESS NOTED OTHER WISE.

SEE UTILITY PLAN FOR HOLDOWN DIMENSIONS

● DENOTES NEW HOLDOWN LOCATIONS
HOLDOWNS ON FLOOR MAY BE SIMPSON HD OR STRAPS

RECEIVED JAN 2 5 1974

HS-04

REVISIONS		BY
Page 27 M-31	11-16-73	TG
M-31	12-12-73	TG

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BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK

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CALIFORNIA
WALNUT CREEK PROJECT

SLAB FOUNDATION & UTILITY PLAN

DATE 16/NOV.'73
SCALE 1/8" = 1'-0"
DRAWN FRED
JOB MUTUAL 37
SHEET 37
H-2
OF 56 SHEETS

DATAPRINT CORP 400 LITTLEFIELD AVE. SO. SAN FRANCISCO CA 94080

DATAPRINT STOCKDRAFTING FORM NO. 101-34

BUILDING 4
2516 PTARMIGAN DRIVE

Building 4 –2516 Ptarmigan Drive, Walnut Creek, CA

1 General

2516 Ptarmigan Drive is bounded by Ptarmigan Drive to the west and residential property to the east and parking lots on north and south.

The building is a 1-story wood framed building with plywood sheathing supported on wood trusses at the roof. Those are supported on wood stud walls which are supported on shallow concrete foundations. The ground floor is concrete slab on grade. Lateral resistance is provided by a combination of wood shear walls and let-in bracing. Shear wall sheathing is 3/8" standard. These buildings are ASCE 41 Building Type W1A.

The roof is framed prefabricated trusses at 24" OC. The trusses are supported by bearing wall studs. Roof sheathing is 3/8" thick Douglas Fir plywood sheathing.

2 Tier 1 Structural Deficiencies

2.1 Interconnection ties and holdown anchors

The shear walls do not have interconnection ties to transfer overturning forces through the floor. Shear walls in East-West direction do not have holdowns called out on the plans. Shear walls without holdown anchors may be subjected to significant overturning, and damage can be caused by uplift and racking of the shear walls. Hold down anchorage can help resist overturning forces and can greatly strengthen shear walls vs. walls without anchorage.

3 Tier 2 Analysis

The ASCE 41 Tier 1 procedure consists of a series of checklists that quickly identifies deficiencies. Based on the Tier 1 results, a Tier 2 analysis is performed to more accurately analyze element demands and capacities.

The following items are analyzed in greater detail under the Tier 2 procedure:

- Shear stress check in walls
- Narrow Shear Walls

Missing building elements causing Tier 1 deficiencies (such as redundancy, interconnection ties and holdowns) were not required to be analyzed under the Tier 2 procedure. These elements are required to meet the BPOE and need to be installed as part of any seismic rehabilitation.

4 Mitigation

4.1 Interconnection ties and holdown anchors

New straps can be added at shear walls to transfer overturning forces between floor to floor. Shear walls without hold downs should be retrofitted with hold down hardware and compression posts. New hold down hardware could be retrofitted at shear wall ends and anchor bolts would need to be epoxied into the existing foundations. Compression posts could be installed along with the hold down hardware as required. Foundation strengthening may be required if existing foundations are shallow or weak in local areas.

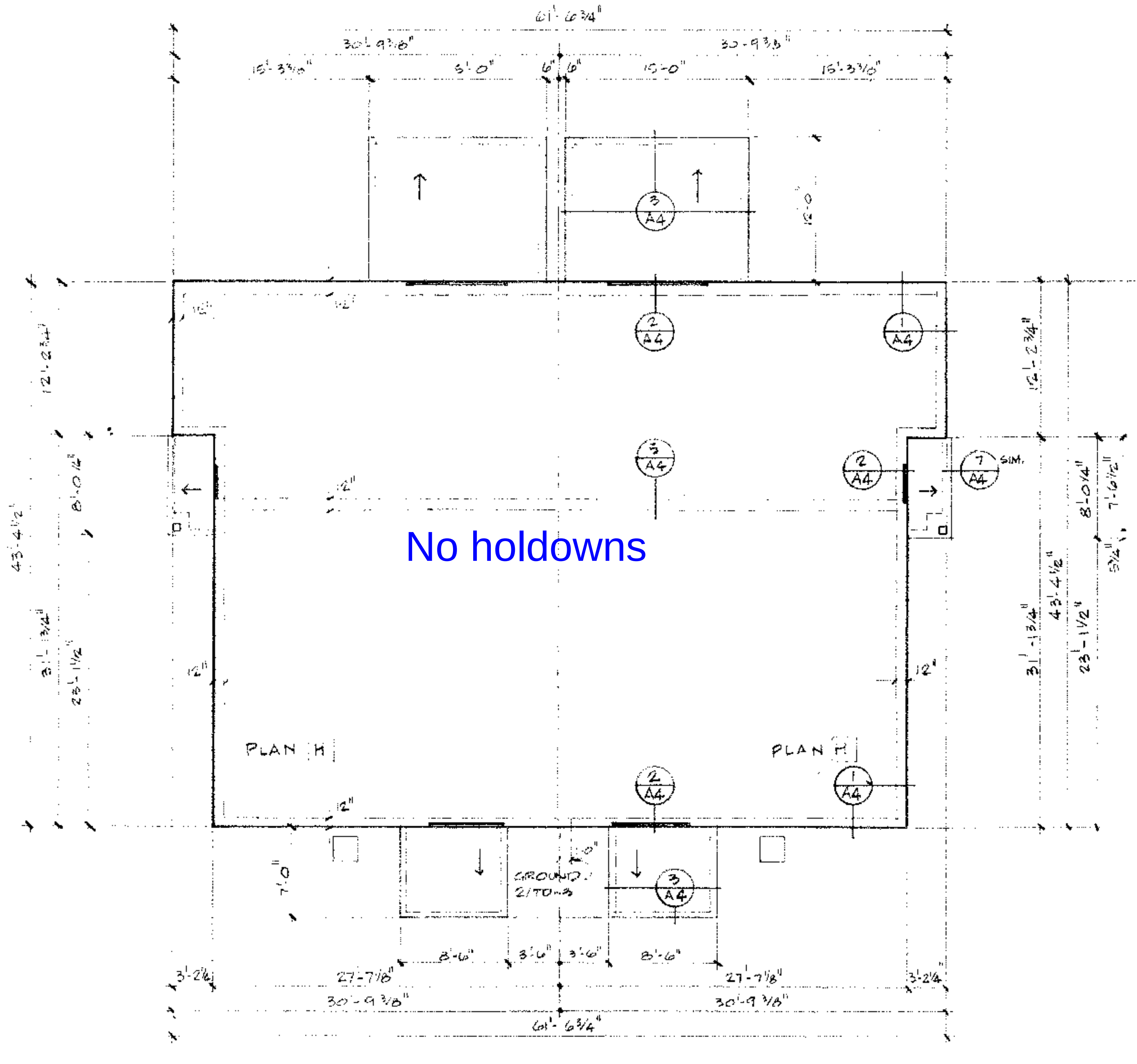
5 Conclusion

The building has an incomplete lateral force resisting system, which does not meet the requirements of ASCE 41-17 for the BPOE performance requirement or the current building code. Shear walls are missing the required hold downs to allow them to reach their capacity.

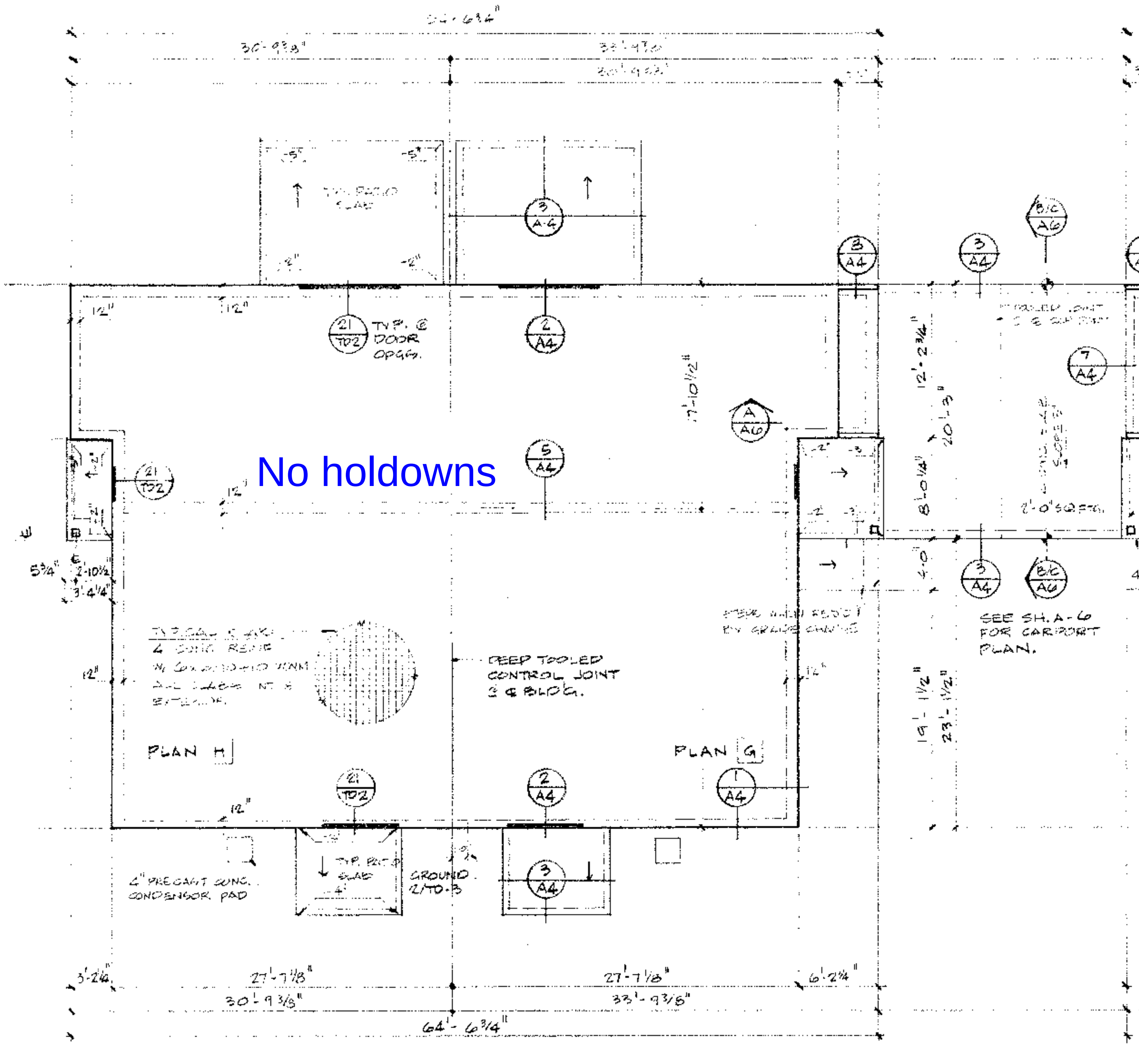
The building is almost 50 years old. Seismic demands have increased and detailing demands have become more stringent since the original construction. Retrofits are required to meet the Structural Performance Level.

Figure 4. Site Location – 2516 Ptarmigan Drive

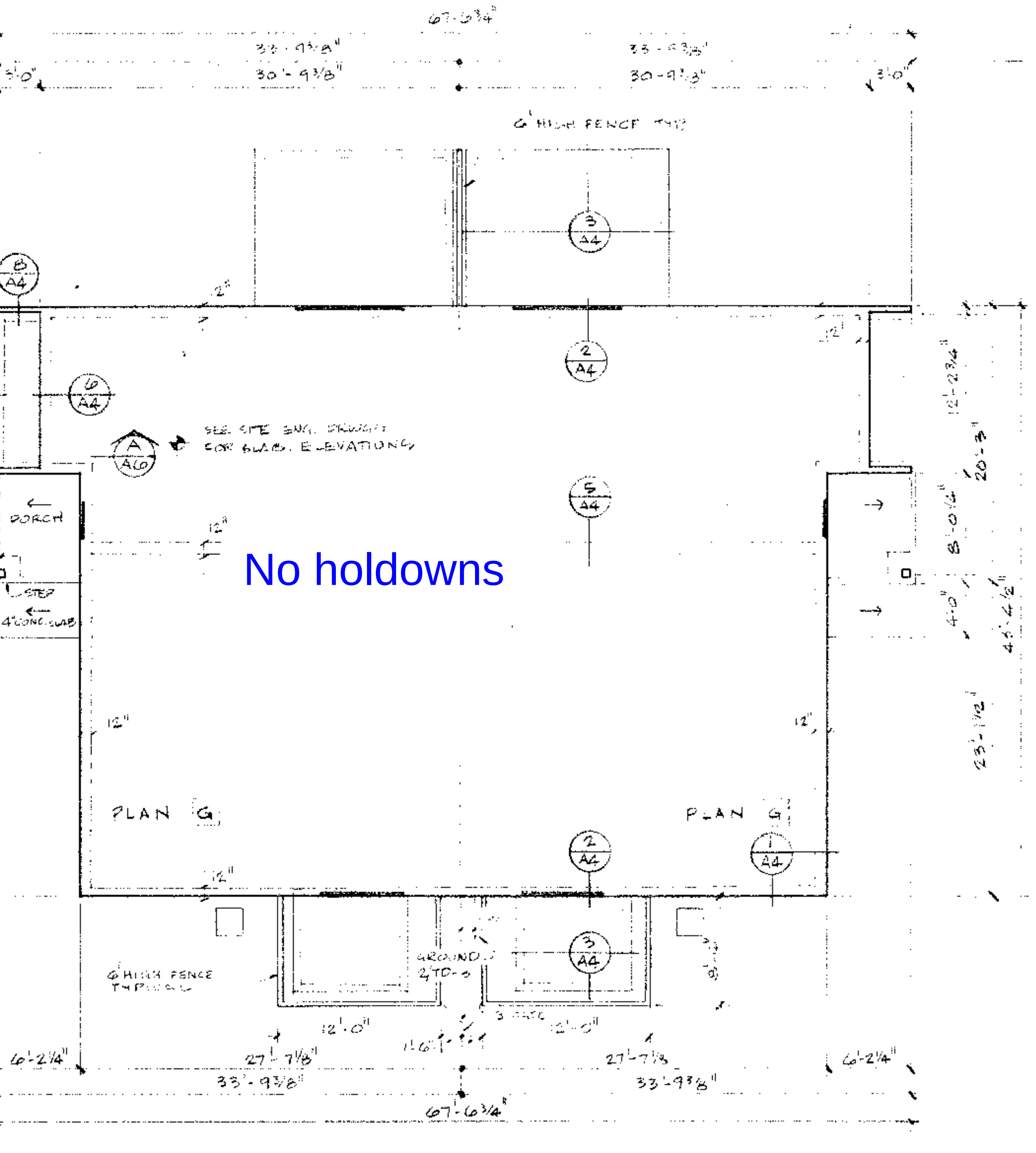
DEFICIENCIES AND MITIGATIONS



FOUNDATION PLANS HH-02
SEE GH-02 FOR TYP NOTES.
SEE GG-02 FOR TYP FENCES



FOUNDATION PLAN 1/8" = 1'-0" GH-02
SEE GH-02 FOR PATIO DIM.
SEE GG-02 FOR TYP FENCES

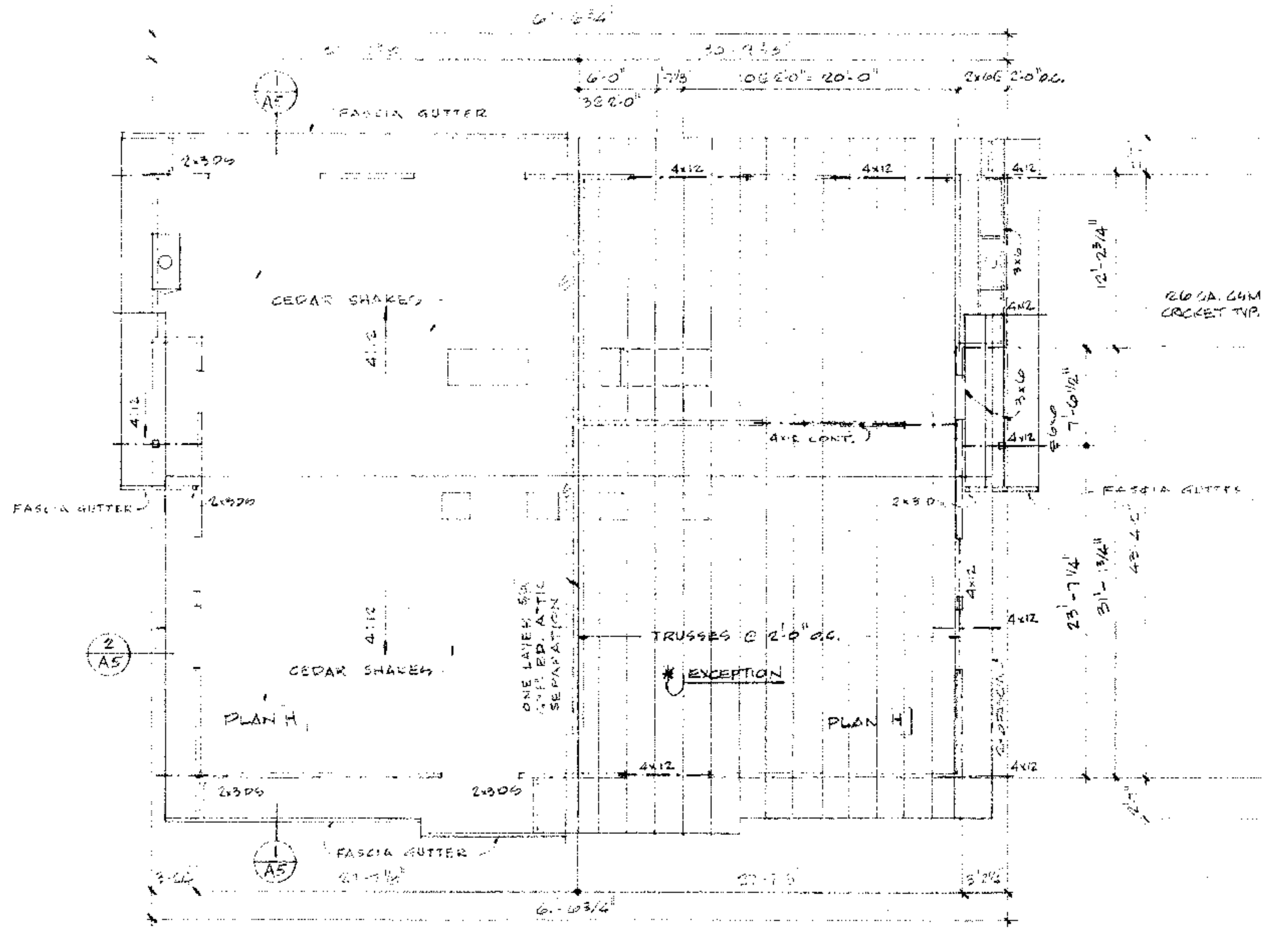


FOUNDATION PLAN GG-02
SEE GH-02 FOR TYP NOTES
SEE HH-02 FOR PATIO DIM.

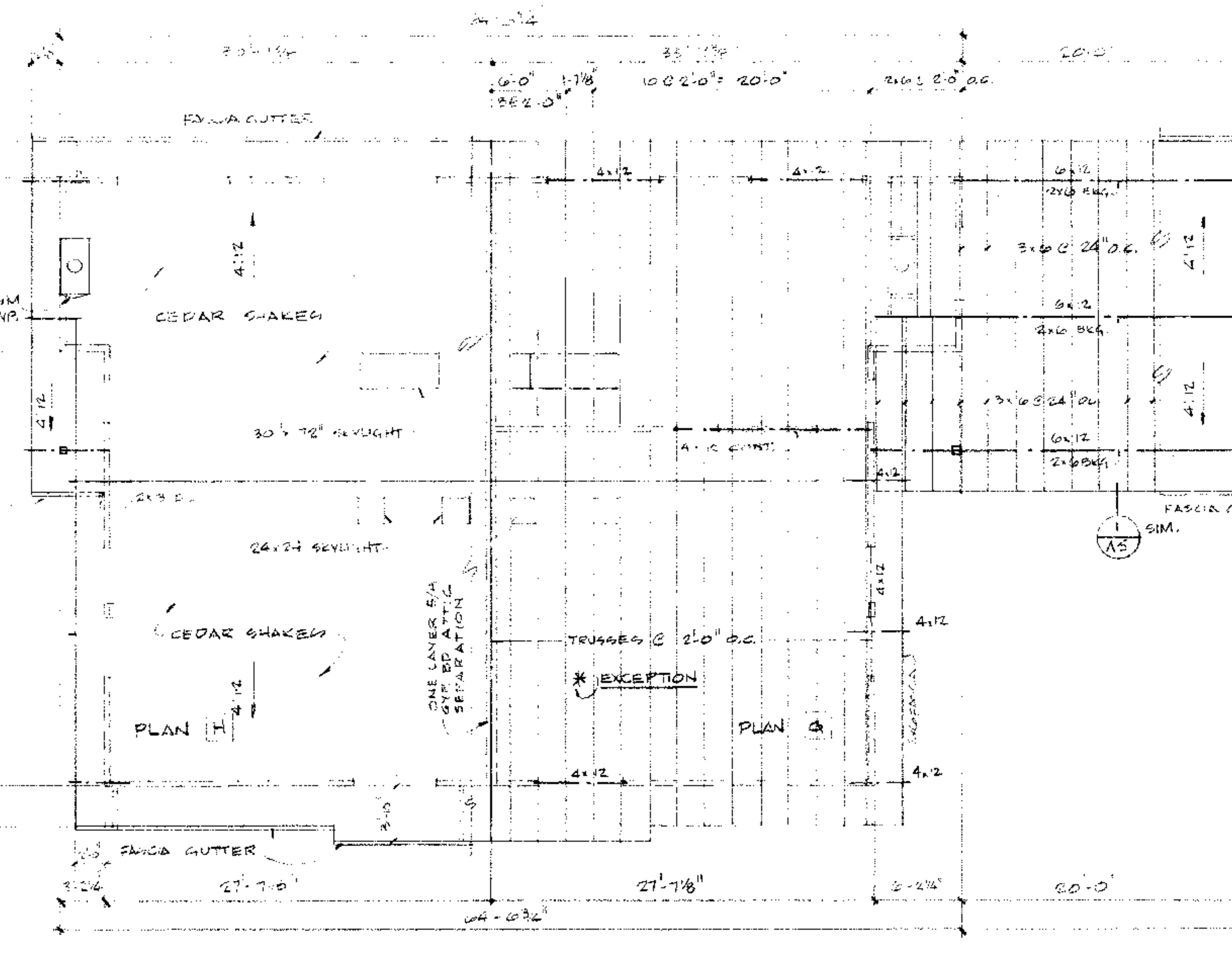
Terra California reserves the right to make substitutions of materials and/or methods to obtain the general intent of the drawings. Terra California reserves the right to make design changes to buildings, site work and landscaping to conform to specific site conditions. All substitutions and/or design changes shall conform to all applicable building codes and/or ordinances having jurisdiction over such changes.

By Terra California
Contractor & Developer of Rossmoor Walnut Creek

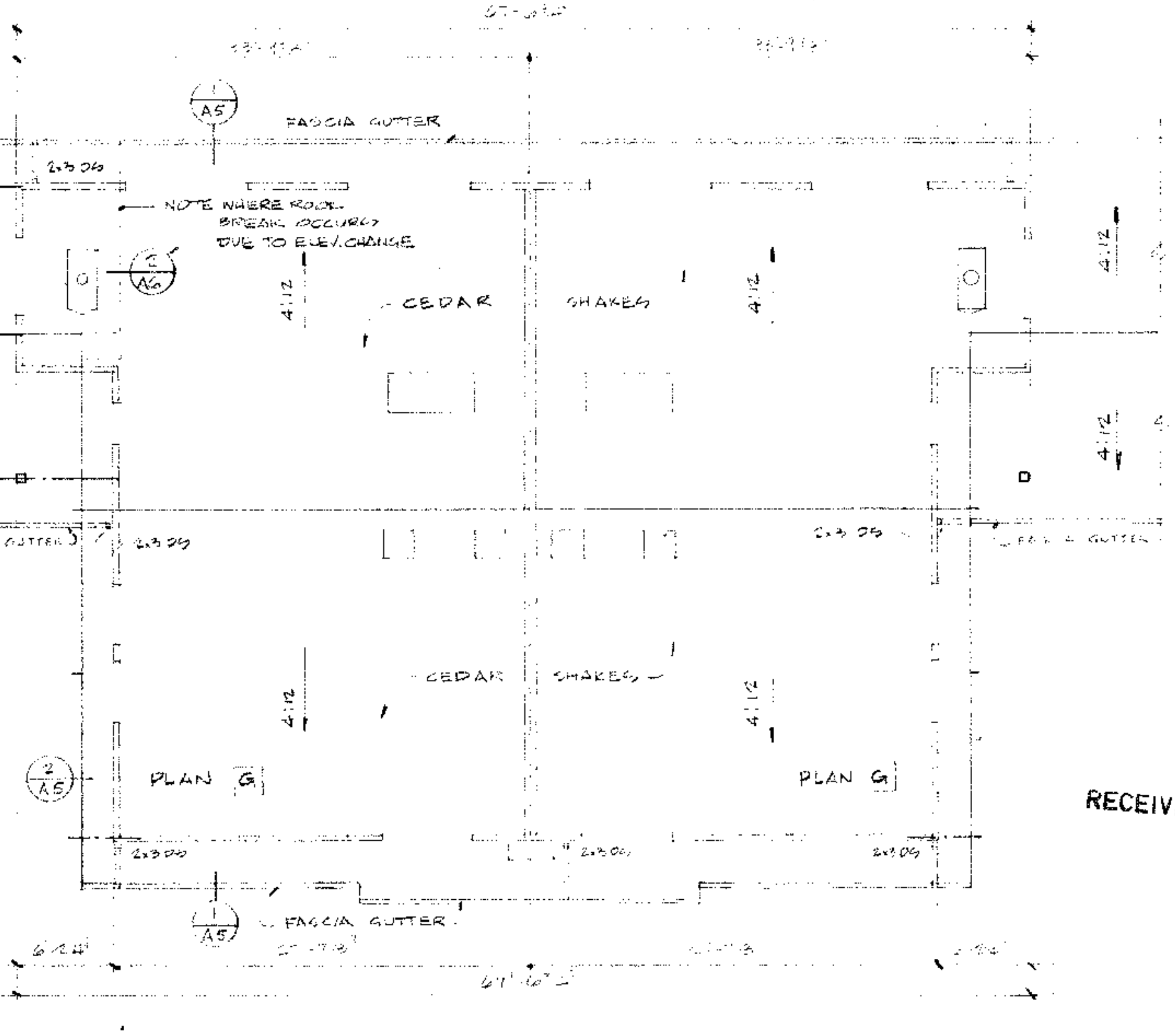
IDENTIFIED DEFICIENCIES



ROOF PLAN HH-02



ROOF PLAN 1/8" = 1'-0" GH-02



ROOF PLAN GG-02

TERRA CALIFORNIA
999 ROCKVIEW DRIVE
WALNUT CREEK, CALIF.
BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK

ROSSMOOR WALNUT CREEK
CALIFORNIA
WALNUT CREEK
PROJECT

FOUNDATION, ROOF FRAMING & ROOF PLANS

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DATE 11-27-72
SCALE 1/8" = 1'-0"
DRAWN
JOB M-31 & 32

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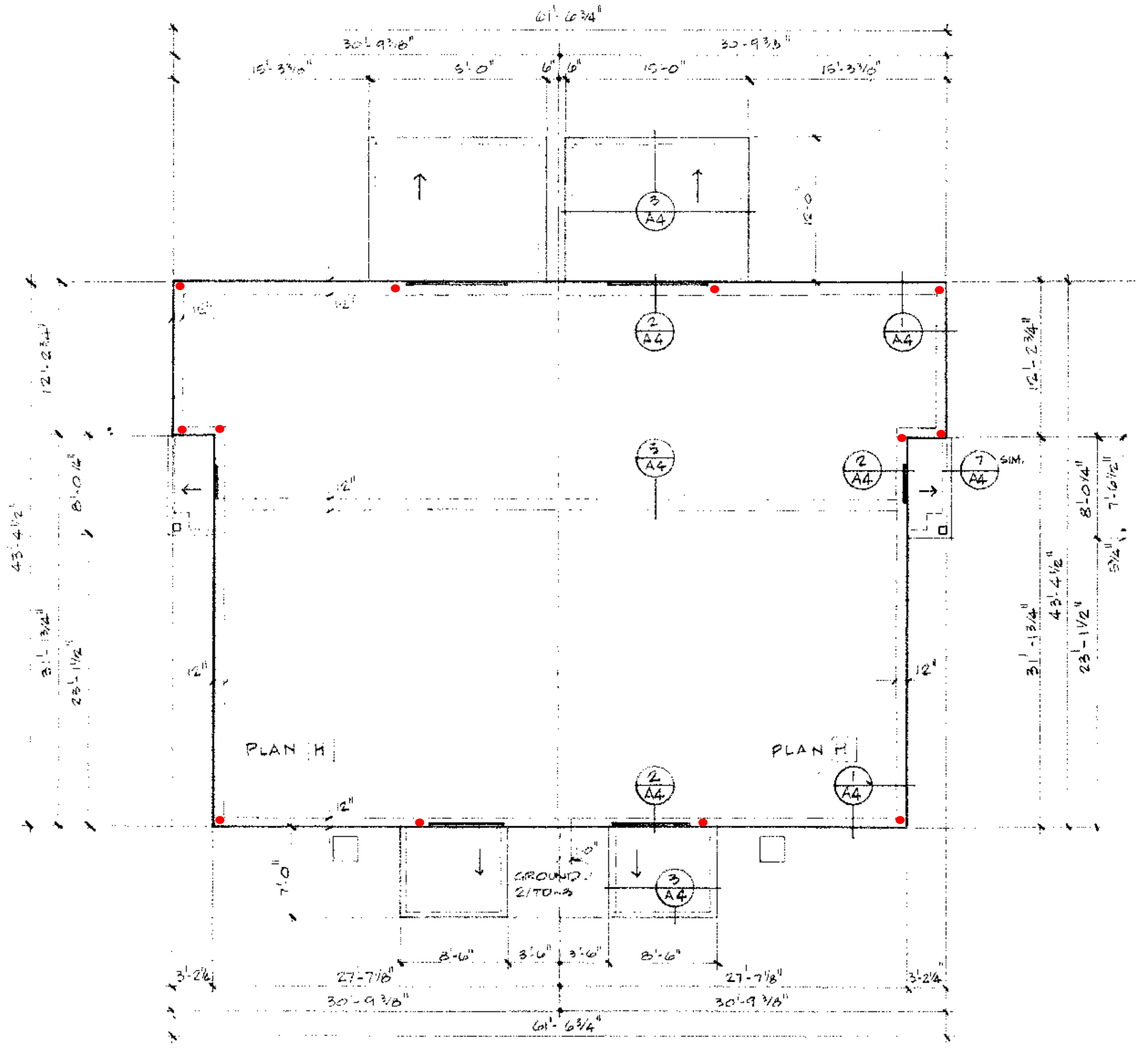
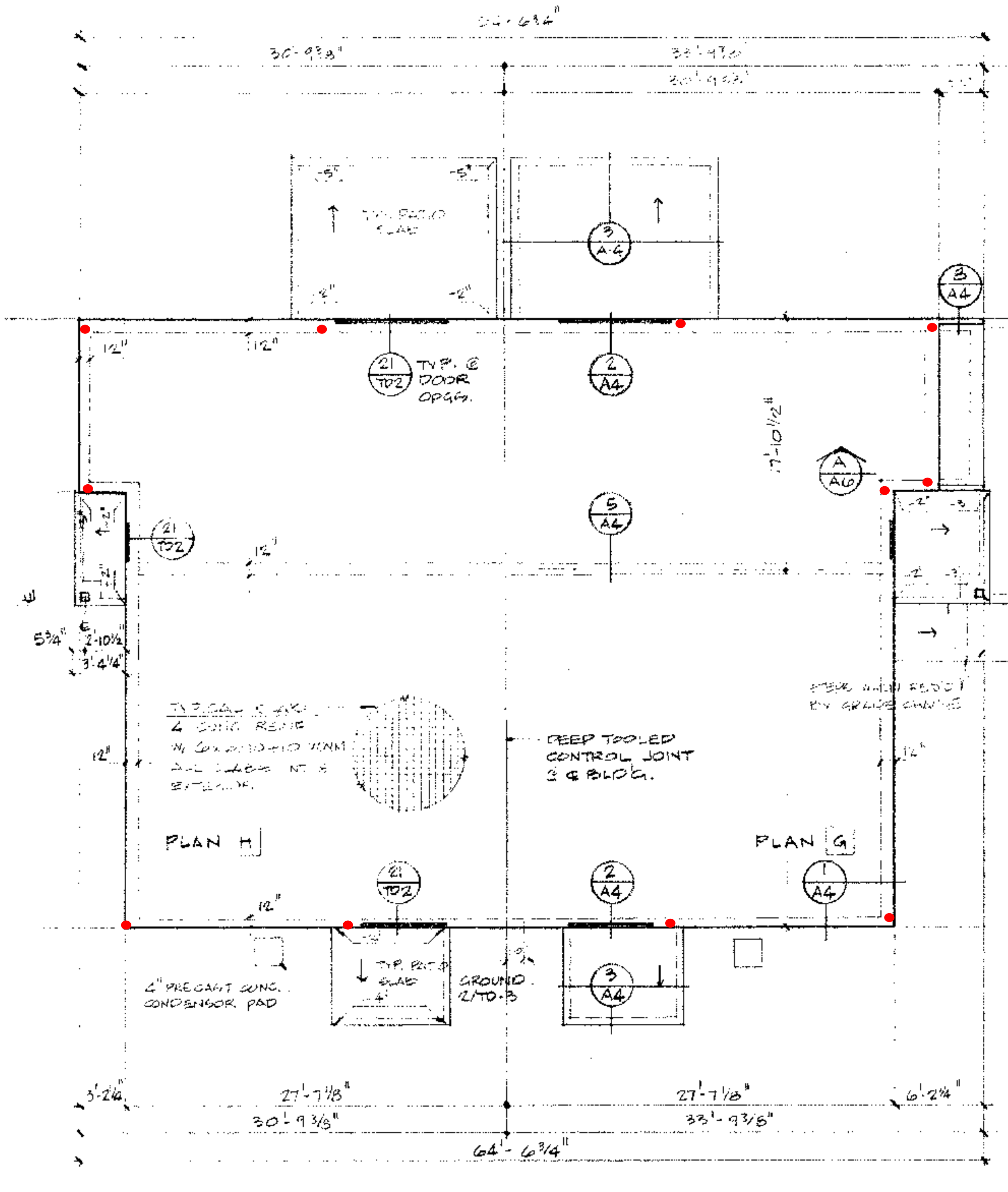
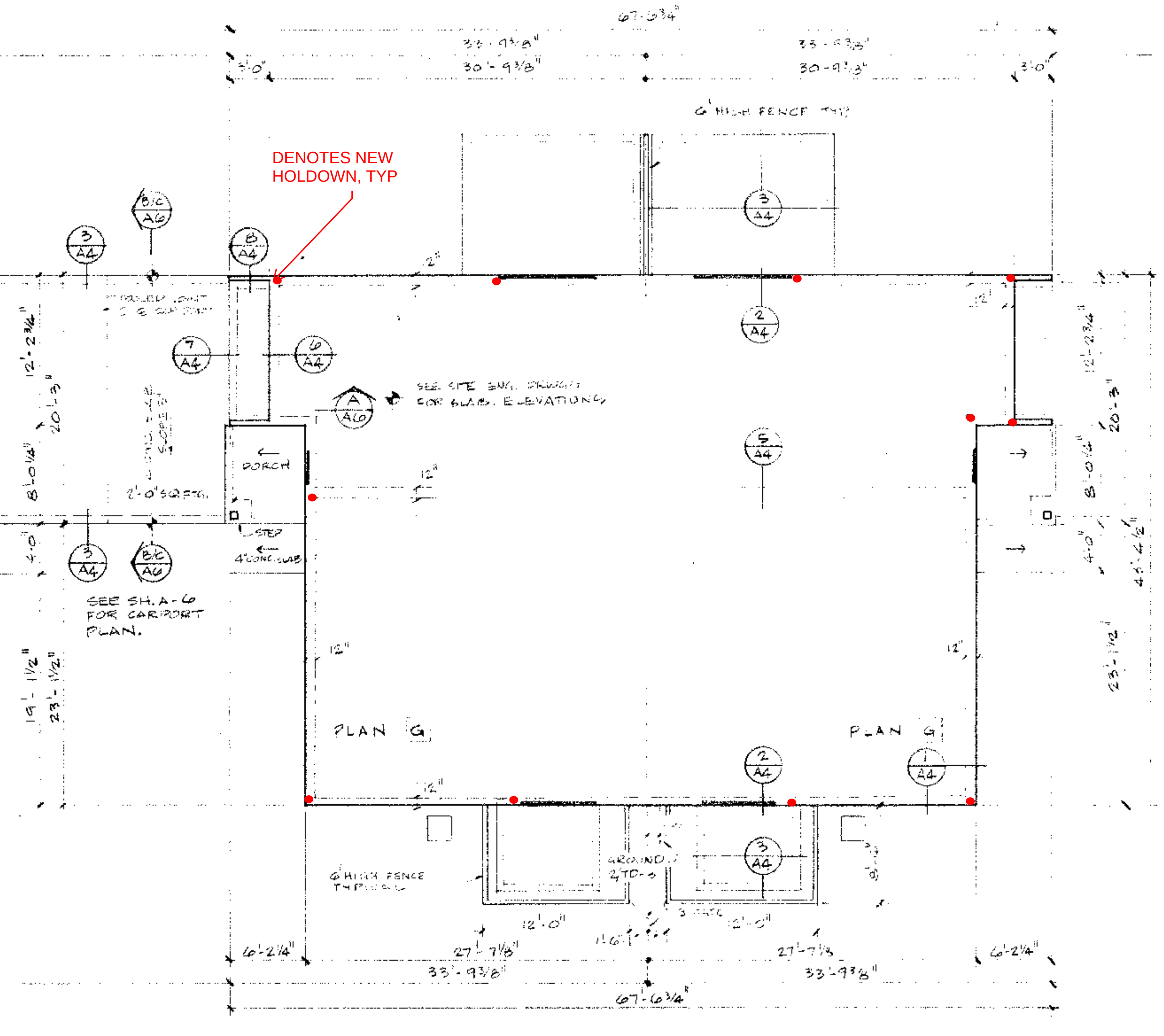


FOUNDATION PLANS HH-02
SEE GH-02 FOR TYP NOTES.
SEE GG-02 FOR TYP FENCES.



FOUNDATION PLAN 1/8" = 1'-0" GH-02
SEE HH-02 FOR PATIO DIM.
SEE GG-02 FOR TYP FENCES.

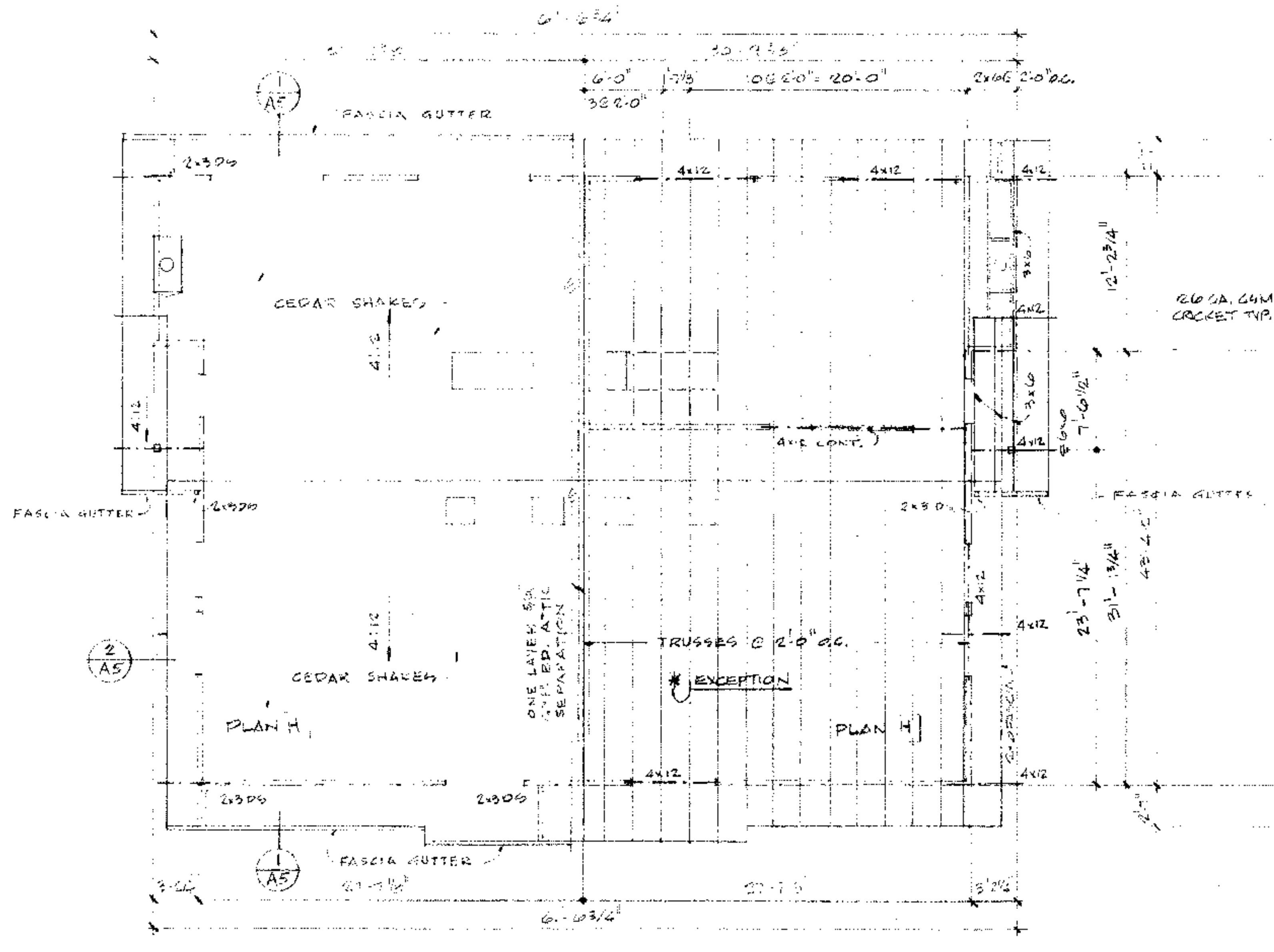


FOUNDATION PLAN GG-02
SEE GH-02 FOR TYP NOTES
SEE HH-02 FOR PATIO DIM.

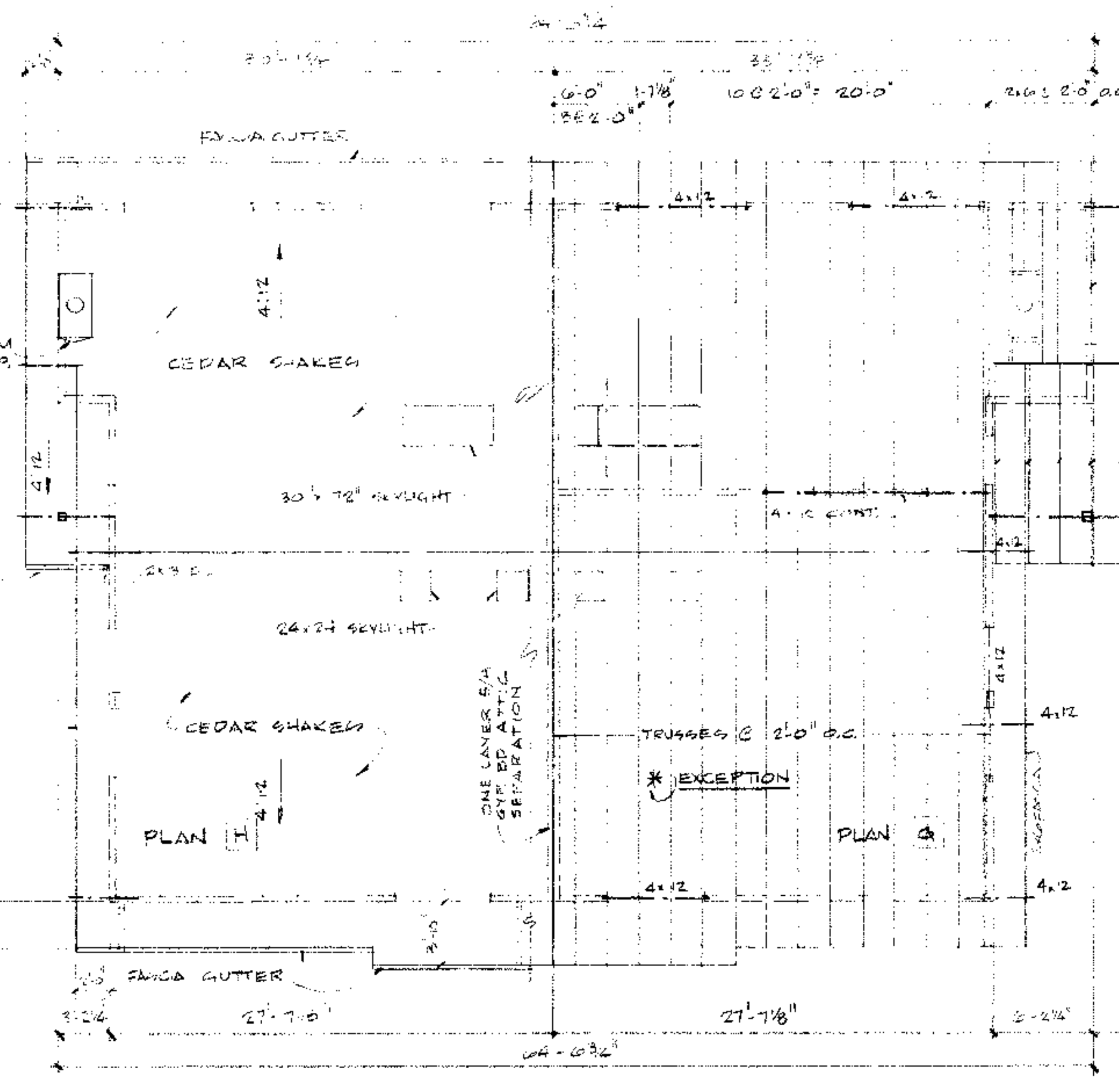
MITIGATION PLAN

Terra California reserves the right to make substitutions of materials and/or methods to obtain the general intent of the drawings. Terra California reserves the right to make design changes to buildings, site work and landscaping to conform to specific site conditions. All substitutions and/or design changes shall conform to all applicable building codes and/or ordinances having jurisdiction over such changes.

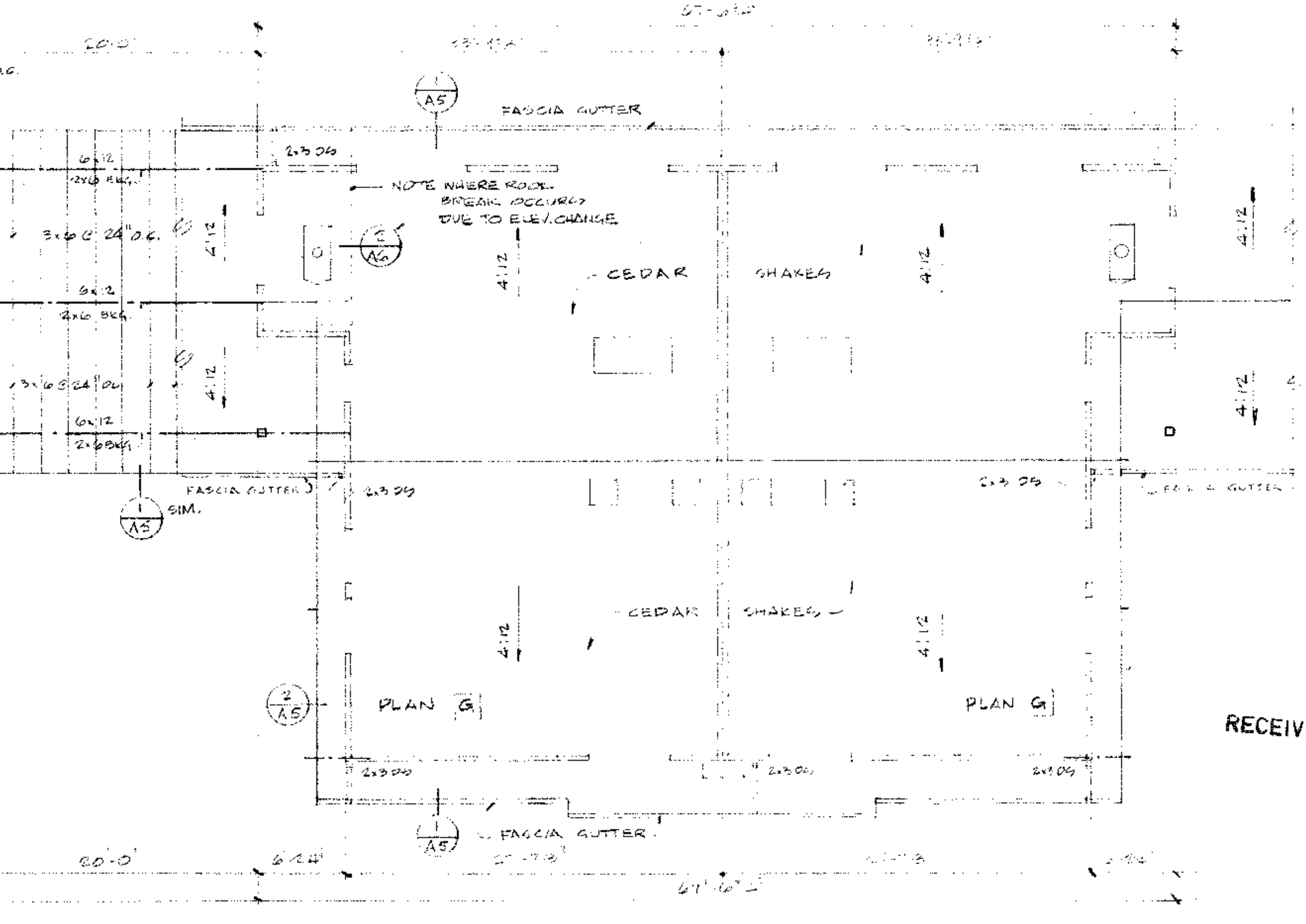
By Terra California
Contractor & Developer of Rossmoor Walnut Creek



ROOF PLAN HH-02



ROOF PLAN 1/8" = 1'-0" GH-02



ROOF PLAN GG-02

REVISIONS BY

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999 ROCKVIEW DRIVE
WALNUT CREEK, CALIF.
BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK

ROSSMOOR WALNUT CREEK
CALIFORNIA
WALNUT CREEK
PROJECT

FOUNDATION, ROOF FRAMING & ROOF PLANS

RECEIVED JAN 2 5 1973

DATE 11-27-72
SCALE 1/8" = 1'-0"
DRAWN
JOB M-31 & 32

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BUILDING 5
3101 TERRA GRANADA DRIVE

Building 5 –3101 Terra Granada Drive, Walnut Creek, CA

1 General

3101 Terra Granada Dr is bounded by Terra Granada Dr to the north, east & south and residential property to the west.

The building is a 2-story wood framed building with plywood sheathing supported on wood trusses at the roof and joists at the floor. Those are supported on wood stud walls which are supported on shallow concrete foundations. Lateral resistance is provided by wood shear walls. Shear wall sheathing is 3/8" standard. Lateral resistance is also provided by 1-1x6 LET-IN Diagonal Brace in addition to plywood shear walls.

These buildings are ASCE 41 Building Type W1A.

The roof is framed prefabricated trusses at 24" OC. The trusses are supported by bearing wall studs. Roof sheathing is 3/8" thick Douglas Fir plywood sheathing.

2 Tier 1 Structural Deficiencies

2.1 Interconnection ties and holdown anchors

The shear walls do not have interconnection ties to transfer overturning forces through the floor. Shear walls in East-West direction do not have holdowns called out on the plans. Shear walls without holdown anchors may be subjected to significant overturning, and damage can be caused by uplift and racking of the shear walls. Hold down anchorage can help resist overturning forces and can greatly strengthen shear walls vs. walls without anchorage.

2.2 Let-In Diagonal Bracing

The building is lateral braced by a combination of let-in diagonal bracing and shear walls. Let-In bracing is a diagonal wood member which is recessed or "let-in" to the wall studs to provide lateral load resistance. This bracing system lacks the ductility of plywood shear walls and are not desirable as a primarily lateral load resisting system for the building. This lateral load resisting system is not permitted in new construction under current building loads.

3 Tier 2 Analysis

The ASCE 41 Tier 1 procedure consists of a series of checklists that quickly identifies deficiencies. Based on the Tier 1 results, a Tier 2 analysis is performed to more accurately analyze element demands and capacities.

The following items are analyzed in greater detail under the Tier 2 procedure:

- Shear stress check in walls
- Narrow Shear Walls

Missing building elements causing Tier 1 deficiencies (such as redundancy, interconnection ties and holdowns) were not required to be analyzed under the Tier 2 procedure. These elements are required to meet the BPOE and need to be installed as part of any seismic rehabilitation.

4 Mitigation

4.1 Interconnection ties and holdown anchors

New straps can be added at shear walls to transfer overturning forces between floor to floor. Shear walls without hold downs should be retrofitted with hold down hardware and compression posts. New hold down hardware could be retrofitted at shear wall ends and anchor bolts would need to be epoxied into the existing foundations. Compression posts could be installed along with the hold down hardware as required. Foundation strengthening may be required if existing foundations are shallow or weak in local areas.

4.2 Let-In Bracing

Additional shear wall sheathing, ties across floors, and holdowns are recommended to strengthen the buildings in lieu of let-in bracing.

5 Conclusion

The building has an incomplete lateral force resisting system, which does not meet the requirements of ASCE 41-17 for the BPOE performance requirement or the current building code. Shear walls are missing the required hold downs to allow them to reach their capacity.

The building is almost 50 years old. Seismic demands have increased and detailing demands have become more stringent since the original construction. Retrofits are required to meet the Structural Performance Level.

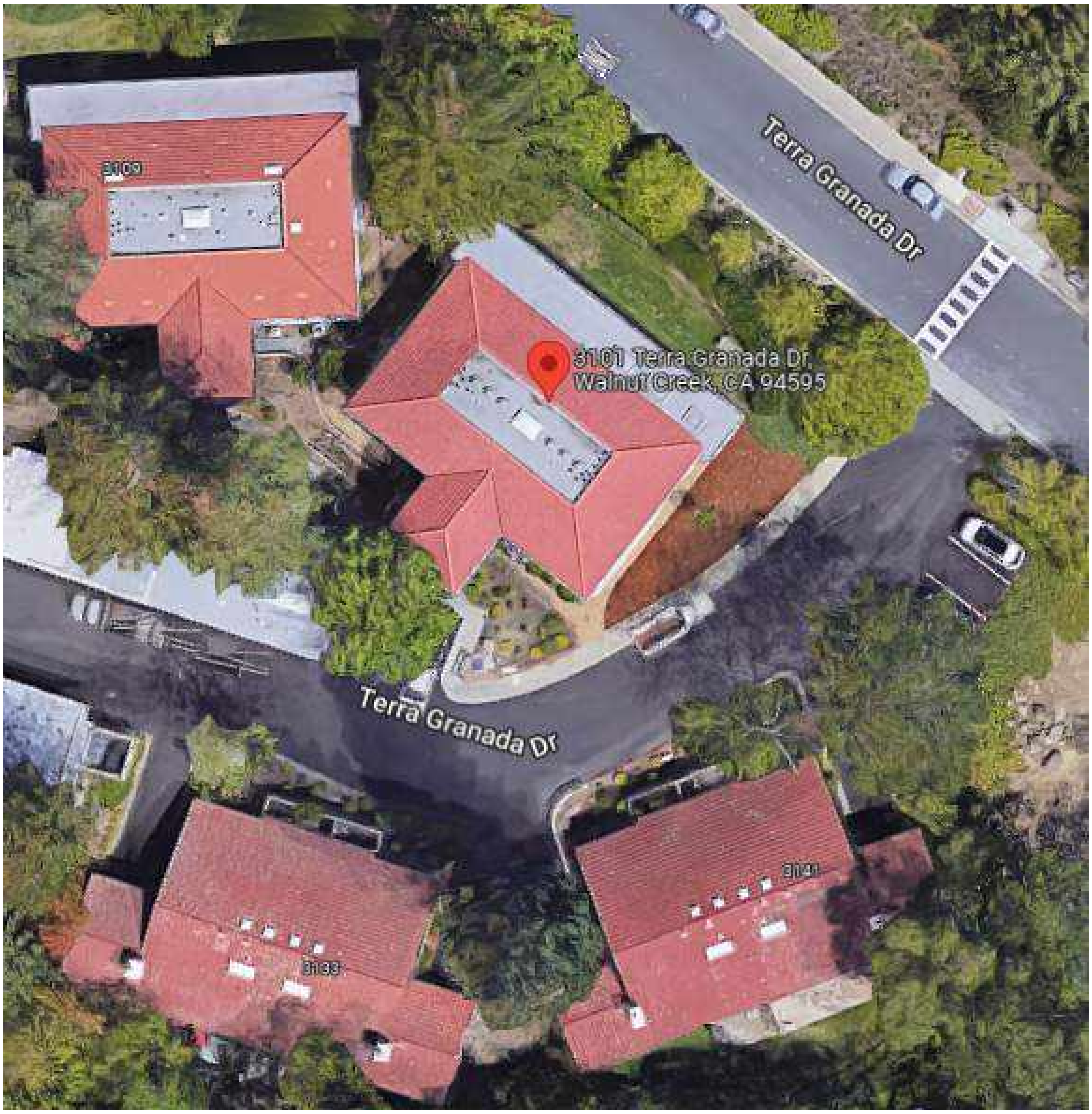
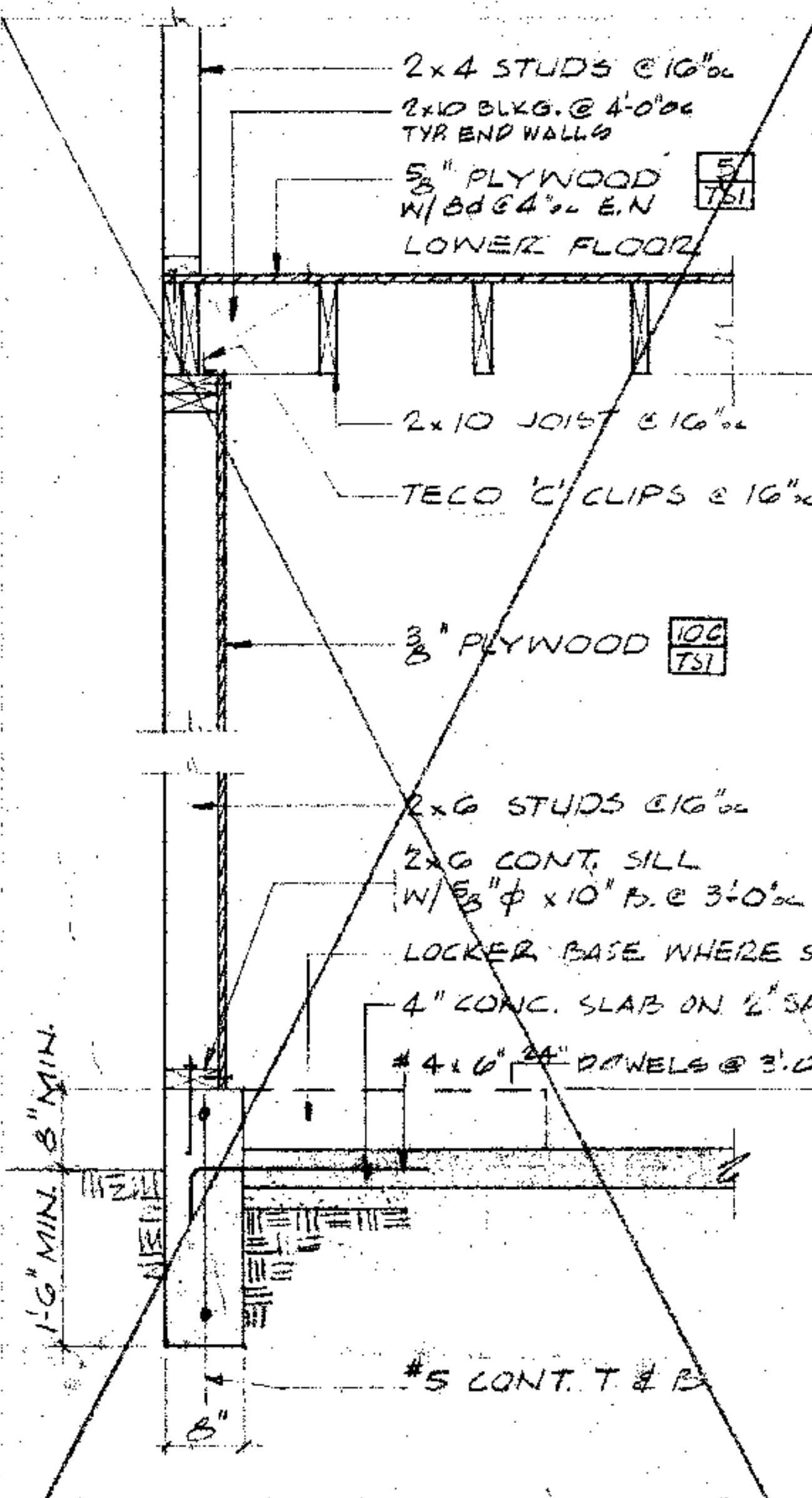
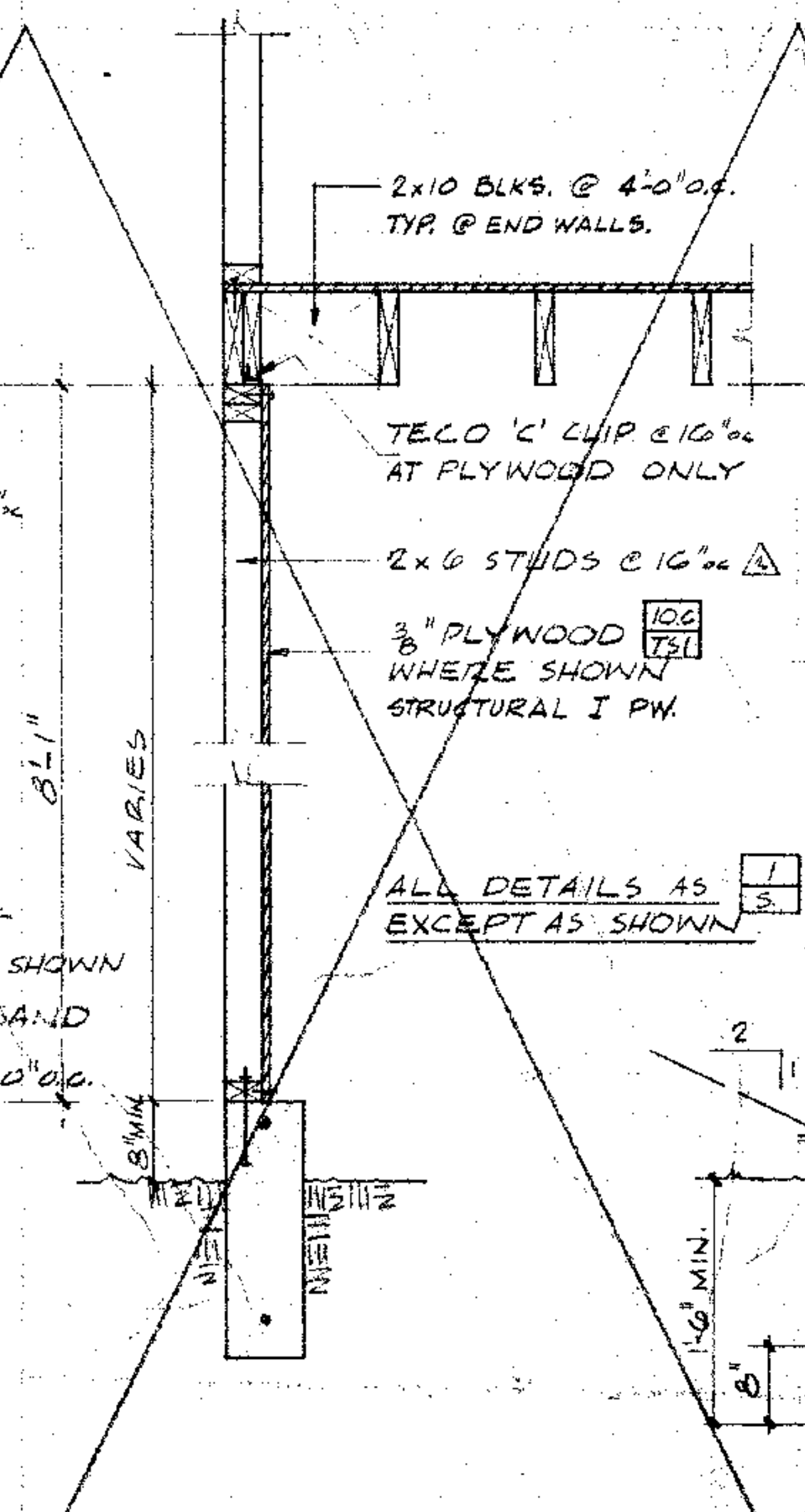


Figure 5. Site Location – 3101 Terra Granada Drive

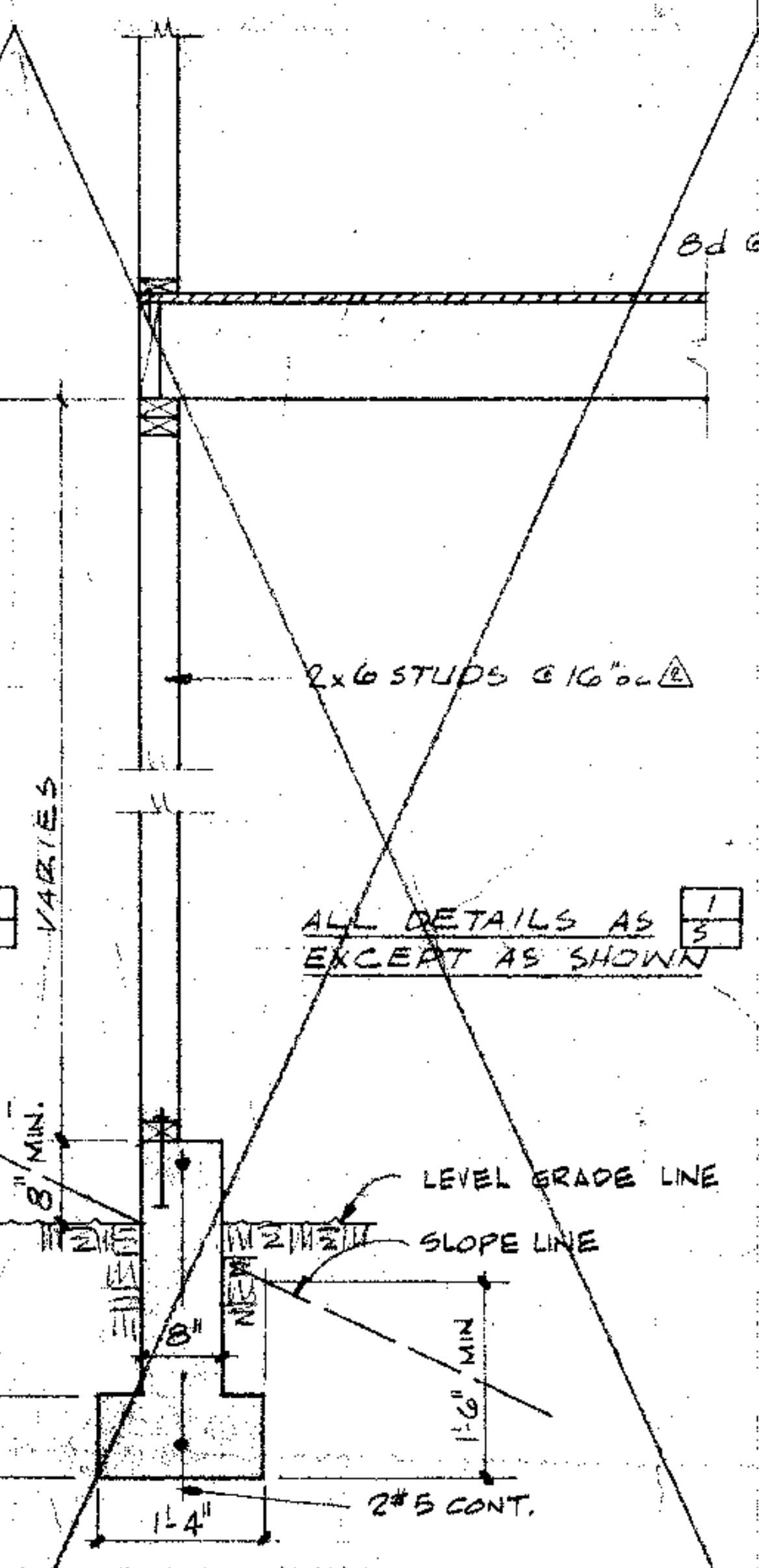
DEFICIENCIES AND MITIGATIONS



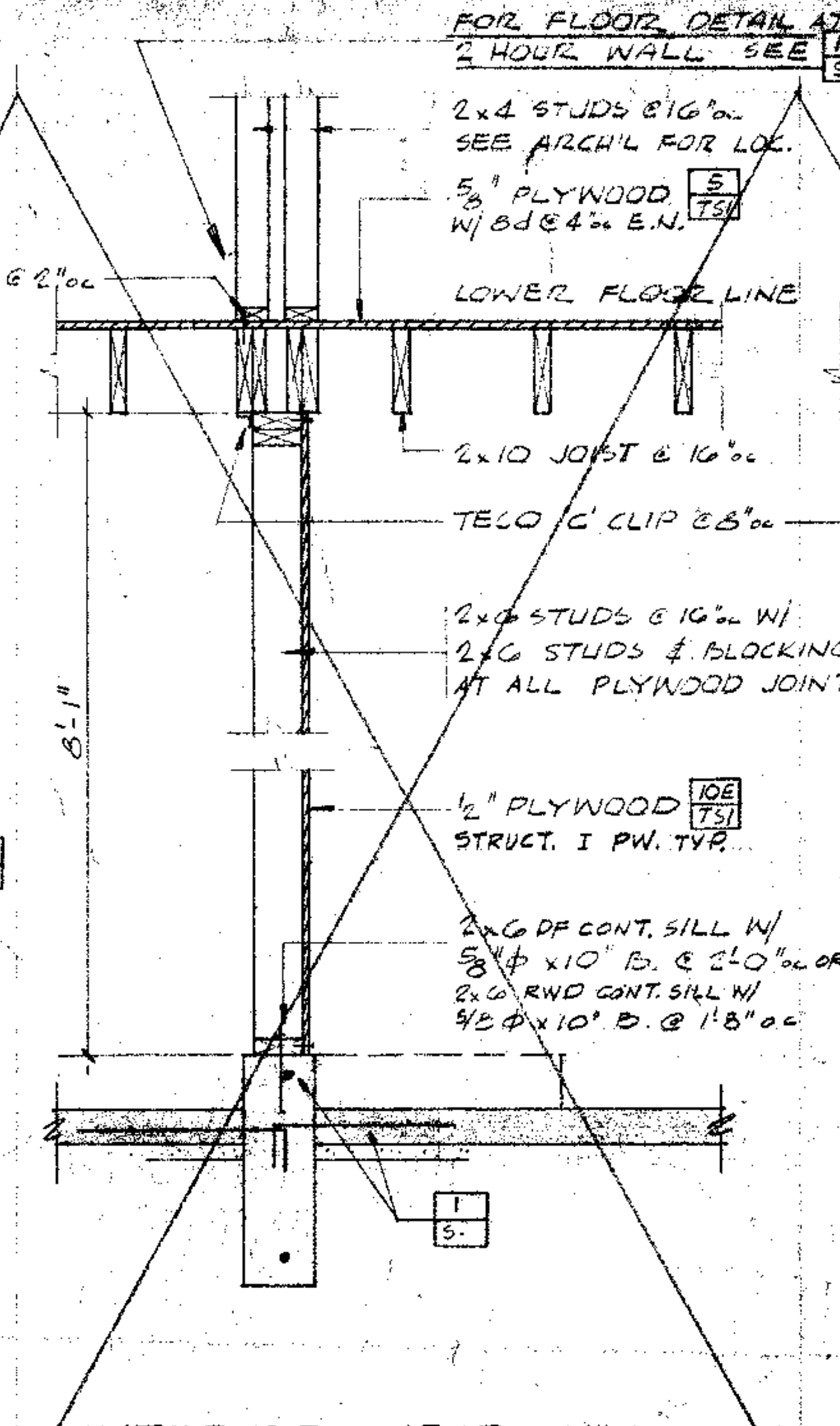
END WALL
3/4" = 1'-0"



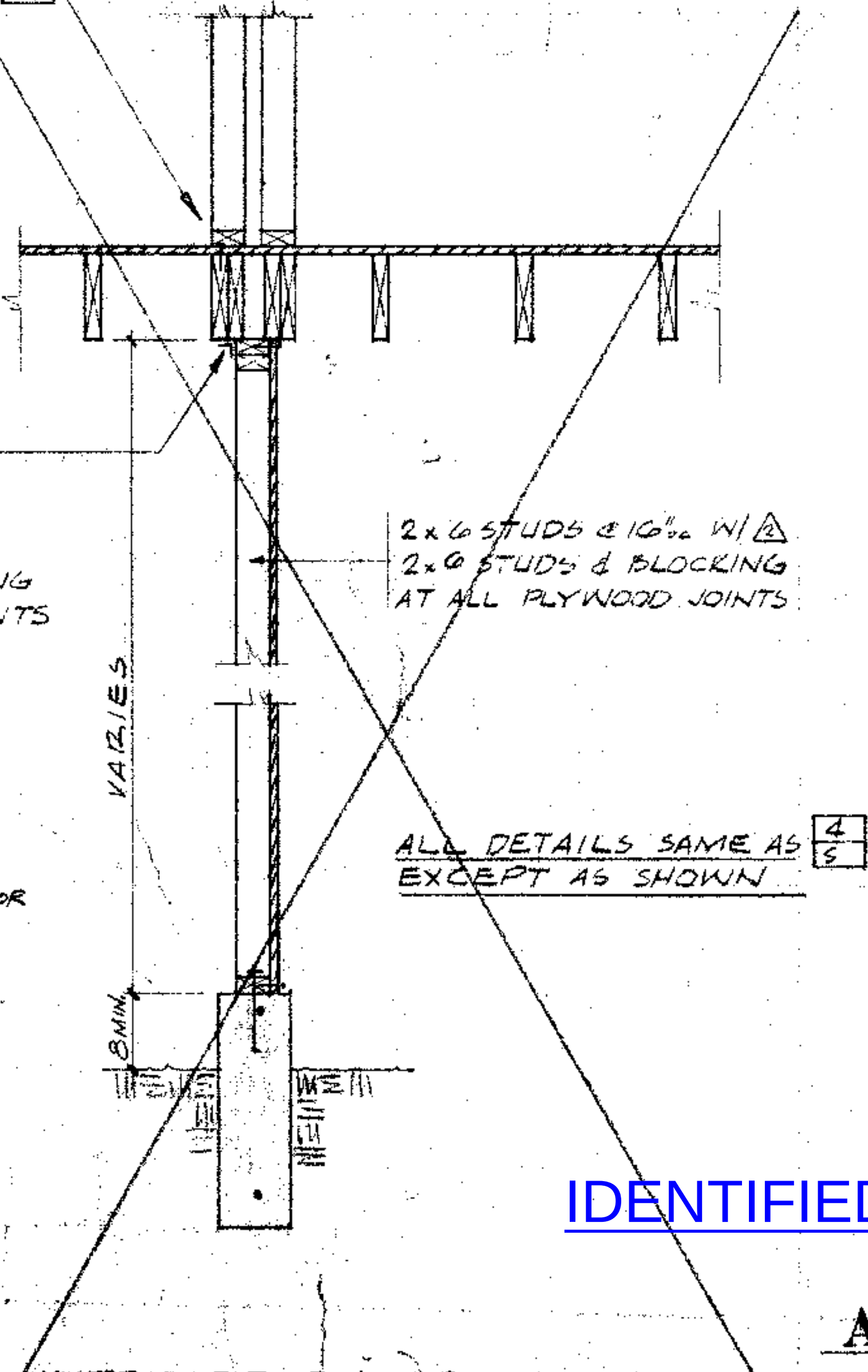
END WALL AT CRAWL SPACE
3/4" = 1'-0"



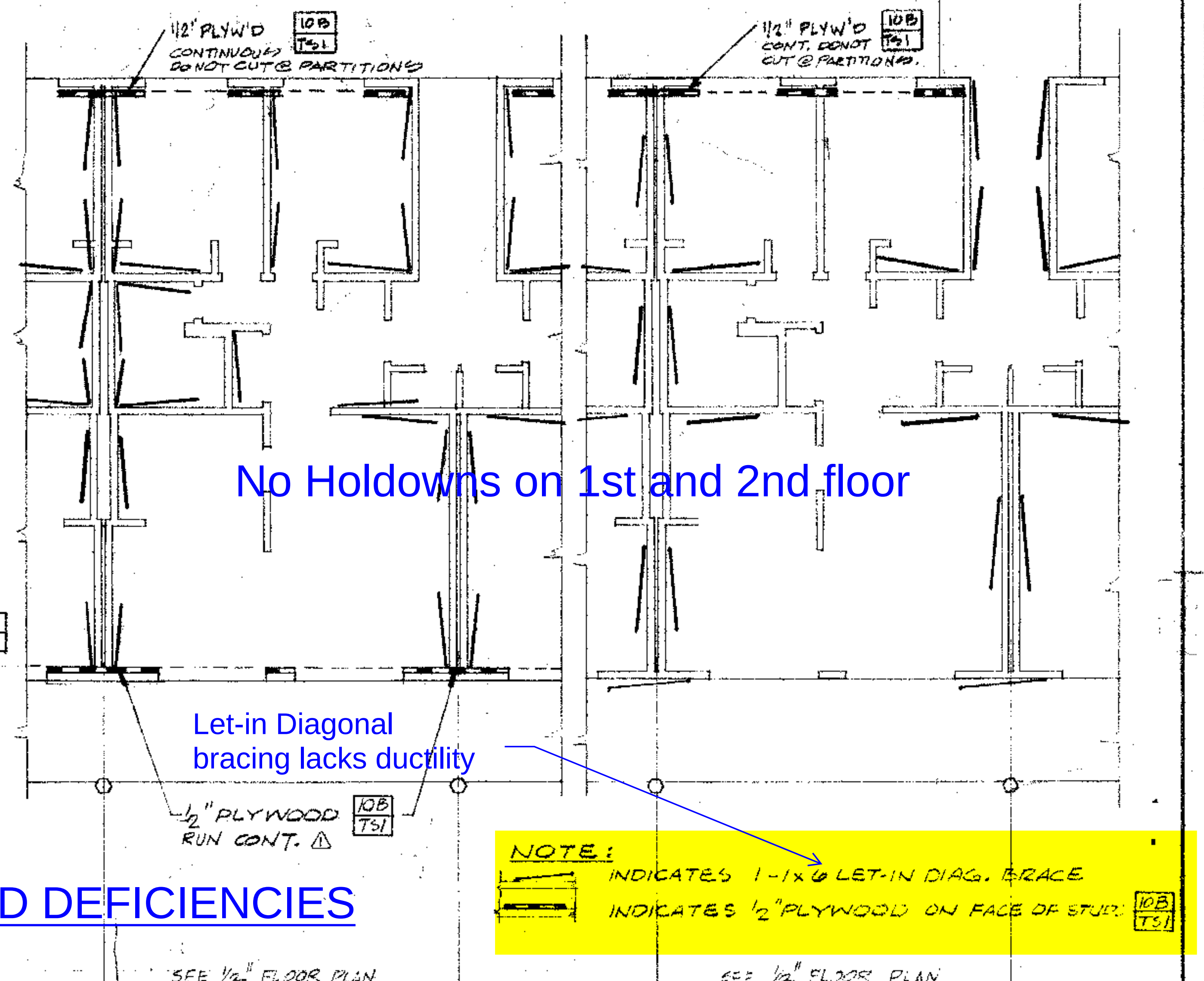
END WALL
3/4" = 1'-0"



INTERIOR SHEAR WALL
3/4" = 1'-0"



INTERIOR SHEAR WALL
3/4" = 1'-0"



No Holdowns on 1st and 2nd floor

Let-in Diagonal bracing lacks ductility

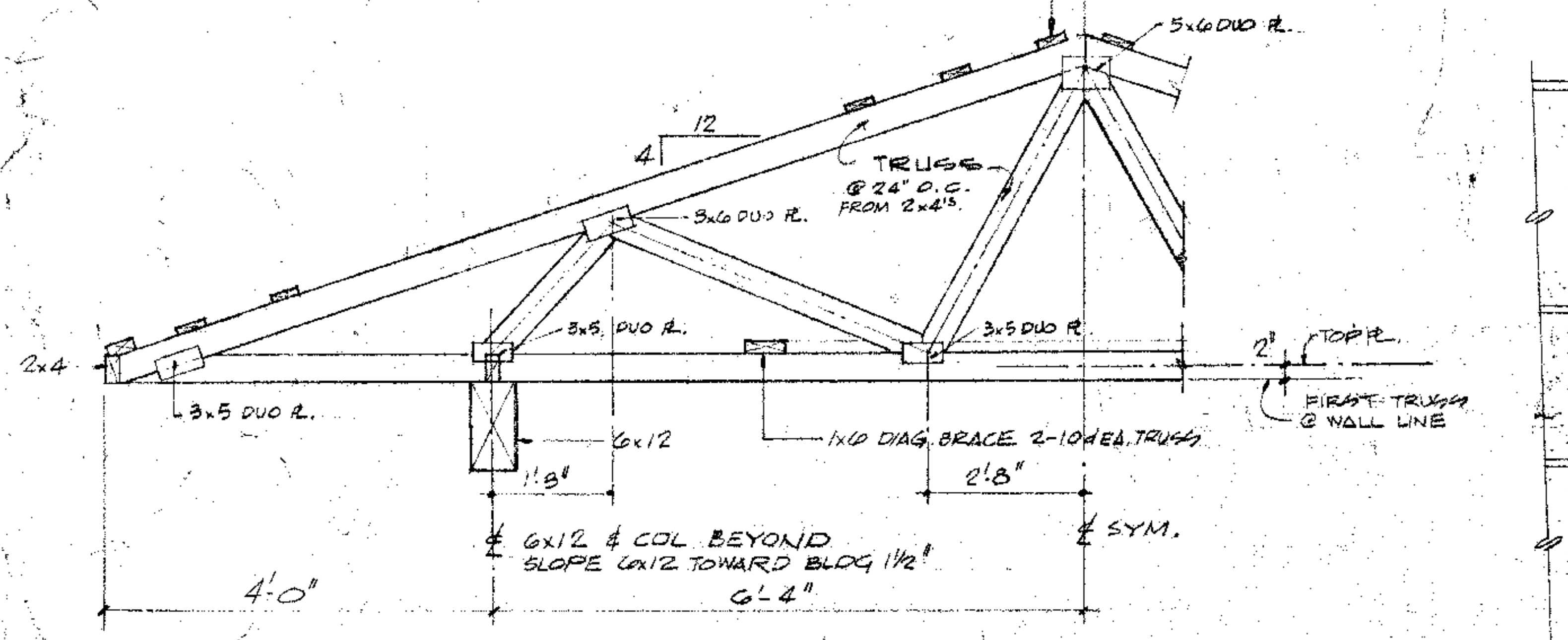
IDENTIFIED DEFICIENCIES

NOTE:
INDICATES 1-1x6 LET-IN DIAG. BRACE
INDICATES 1/2" PLYWOOD ON FACE OF STUD 10B/TS1

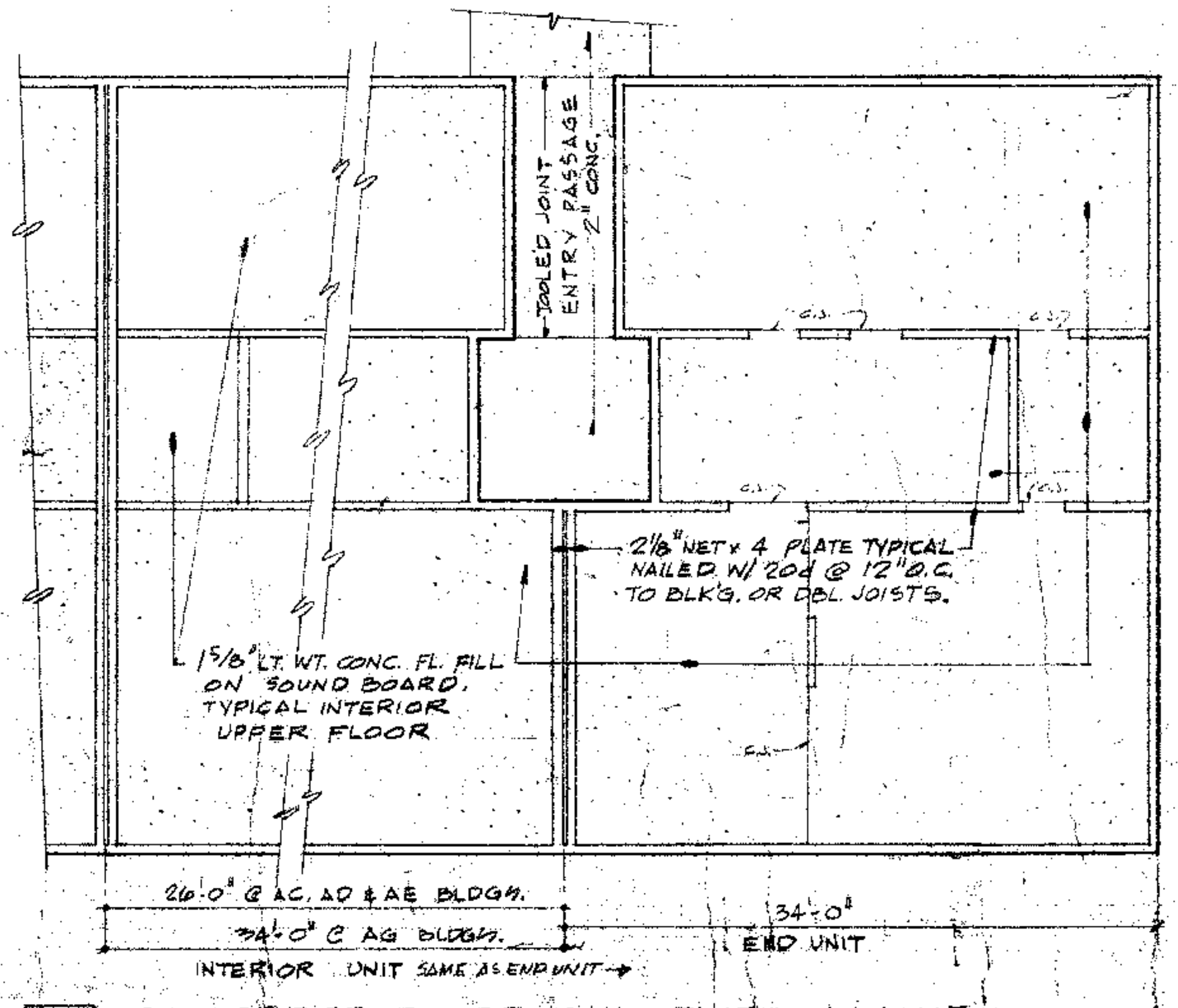
A TYP. LOWER LEVEL UNIT

B TYP. UPPER LEVEL UNIT

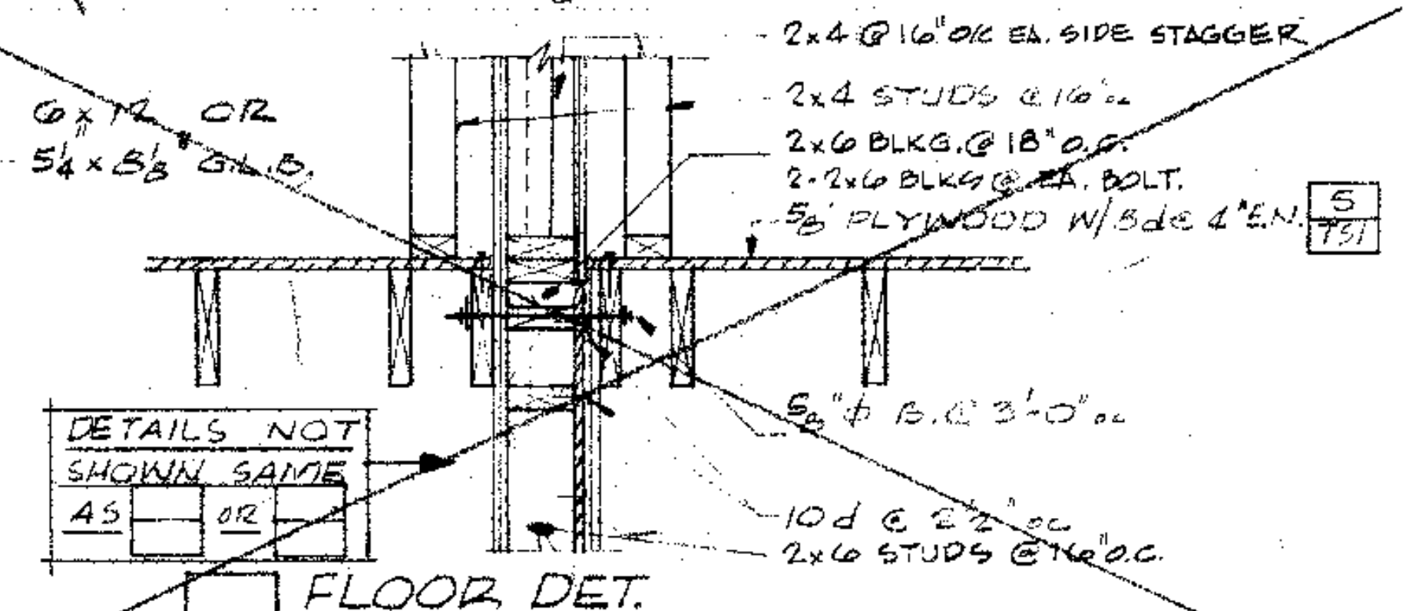
12/S5 TYPICAL LATERAL BRACING REQUIREMENTS
1/8" = 1'-0"



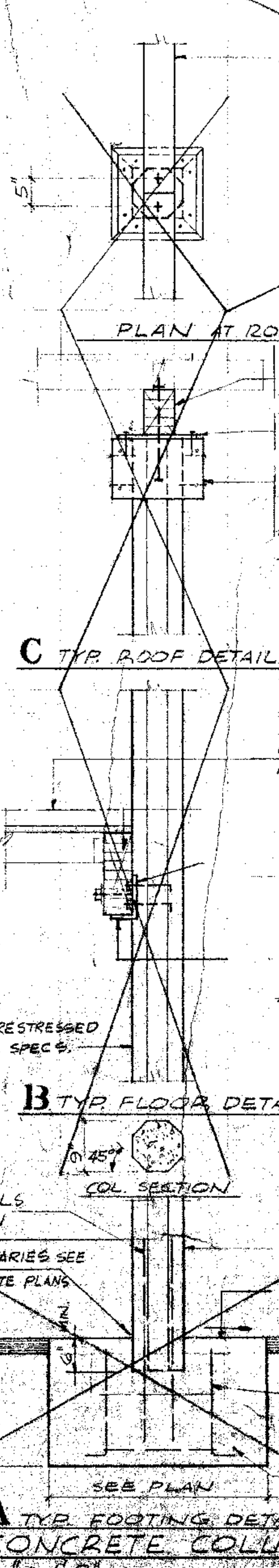
6/S5 ENTRY CANOPY ROOF
3/4" = 1'-0"



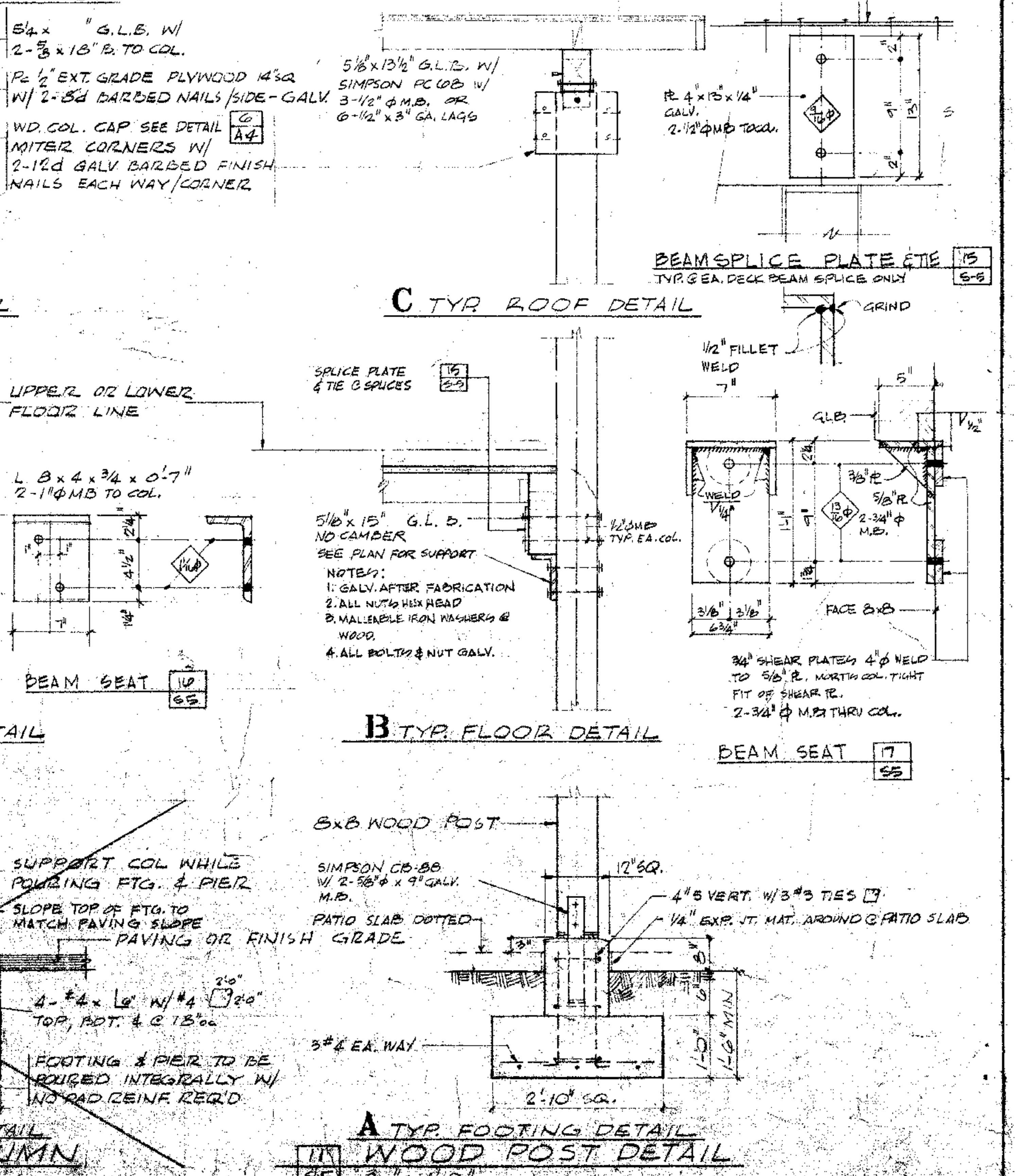
7/S-5 CONCRETE FLOOR FILL PLATE LAYOUT
UPPER FLOOR ONLY
1/8" = 1'-0"



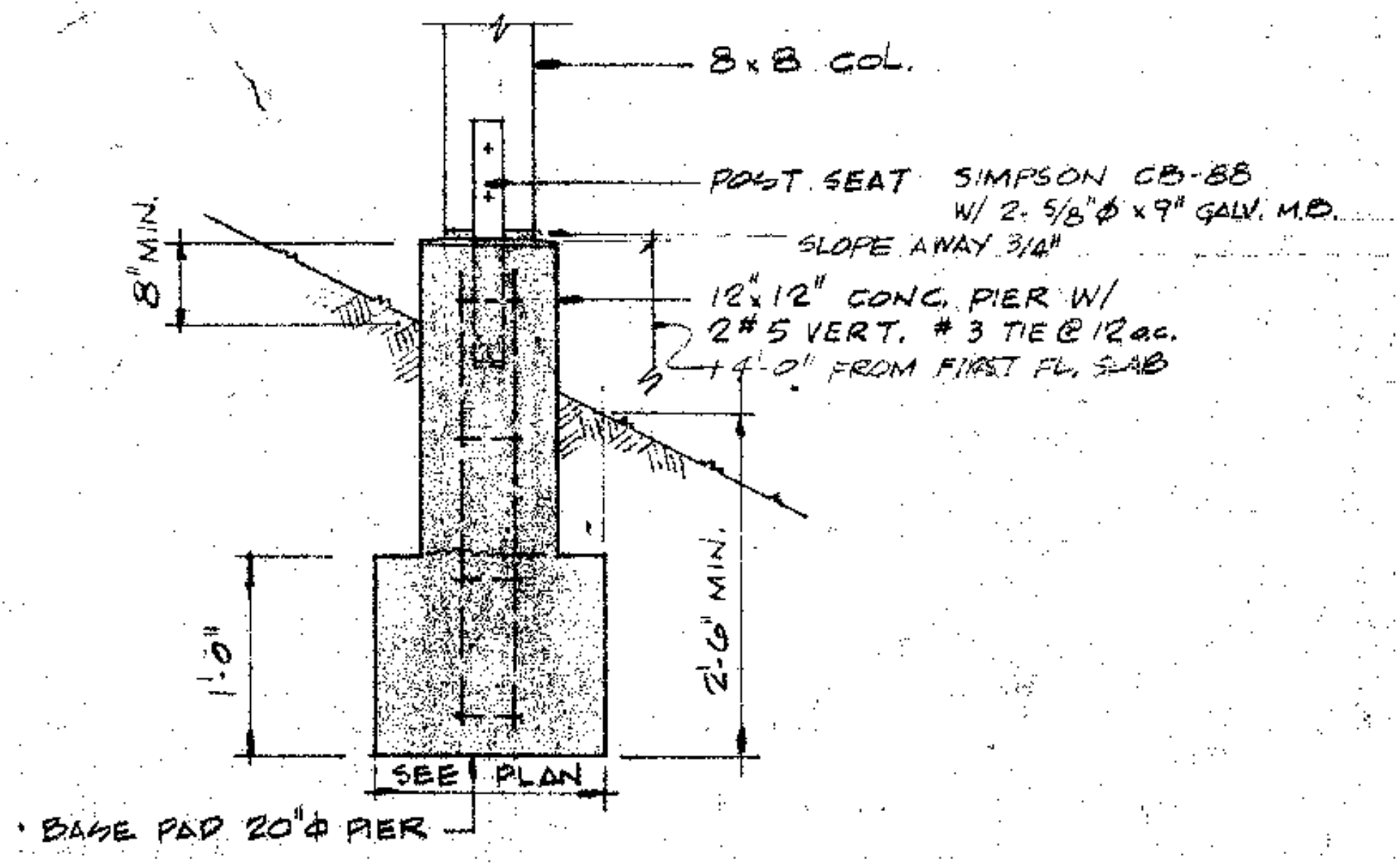
FLOOR DET.
3/4" = 1'-0"



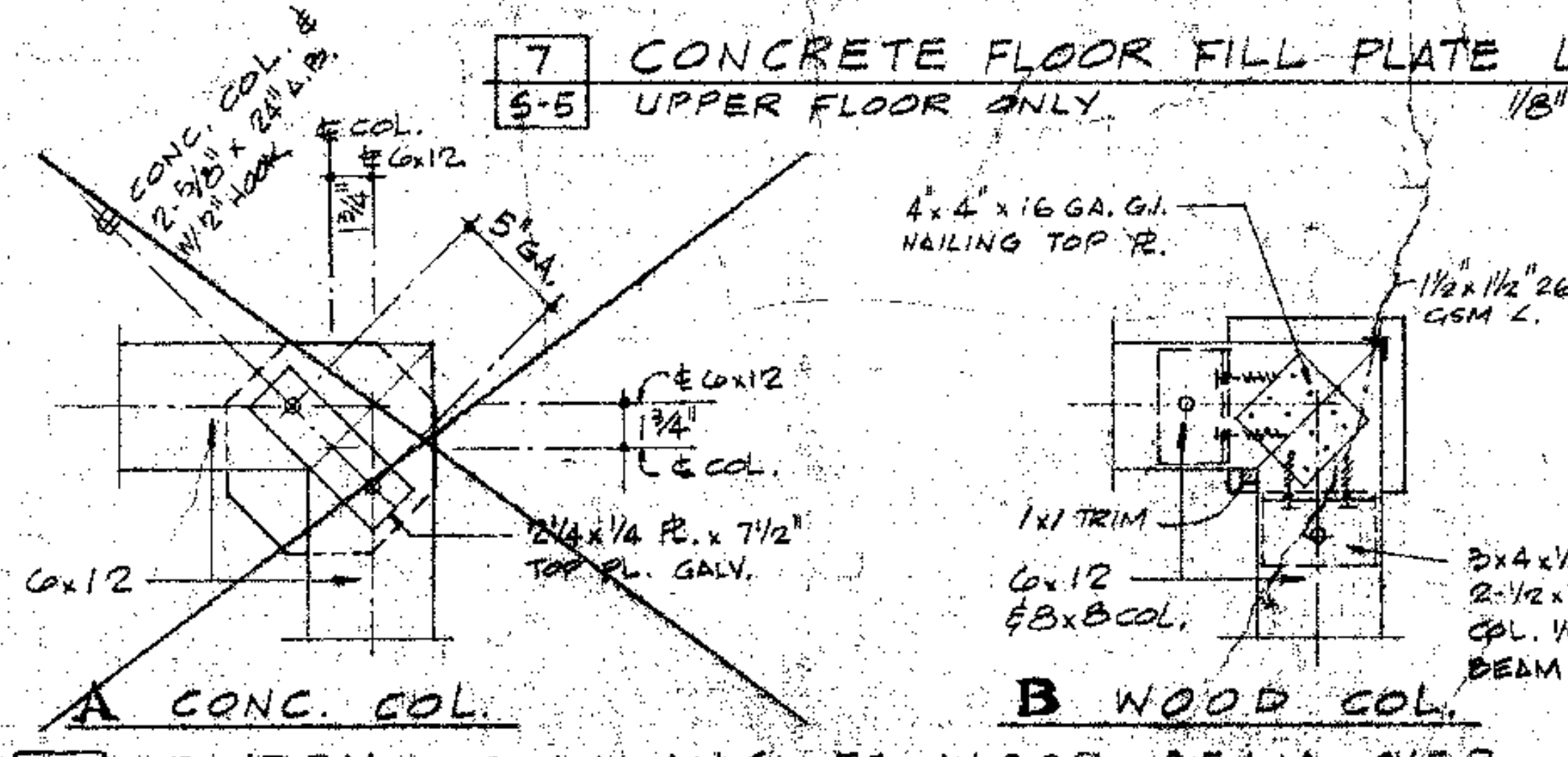
CONCRETE COLUMN
3/4" = 1'-0"



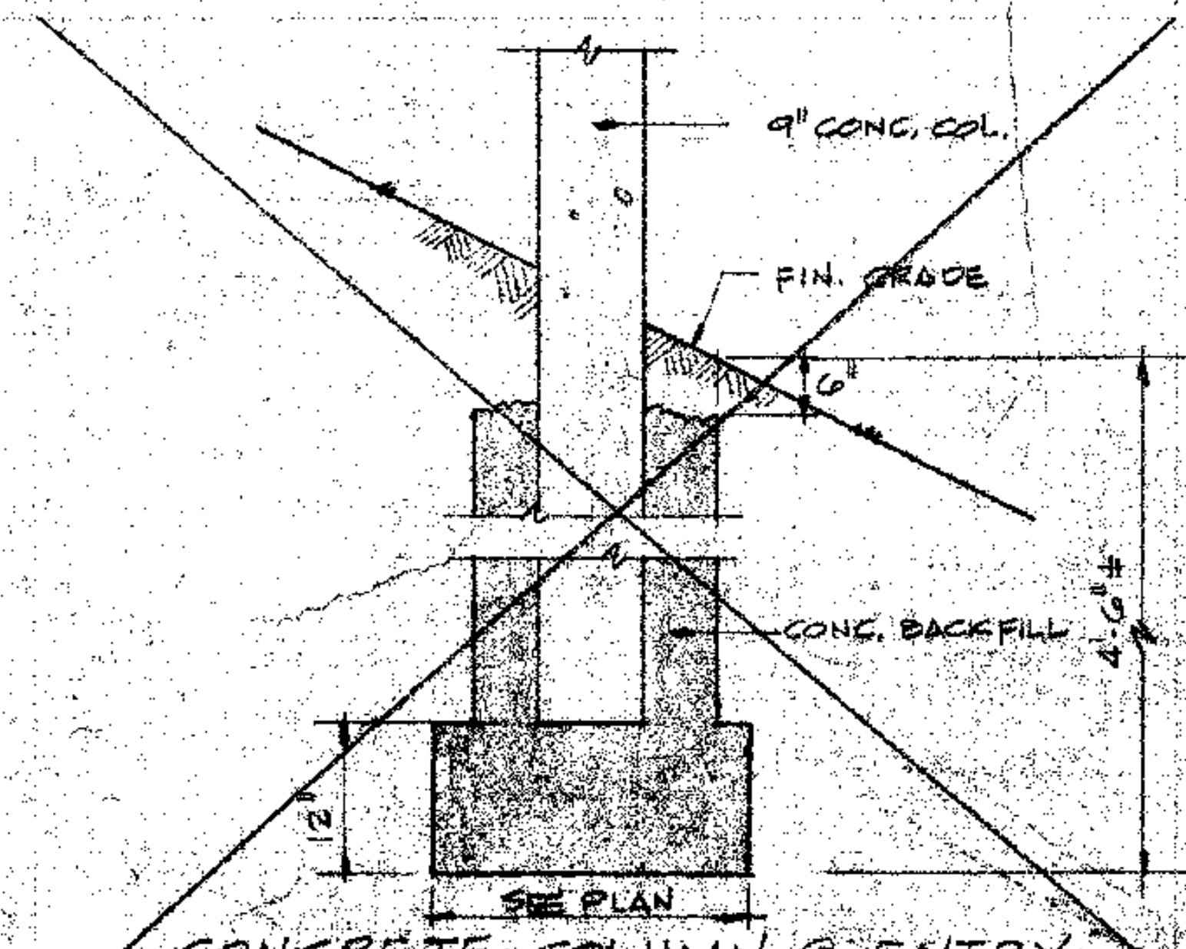
11/S5 WOOD POST DETAIL
3/4" = 1'-0"



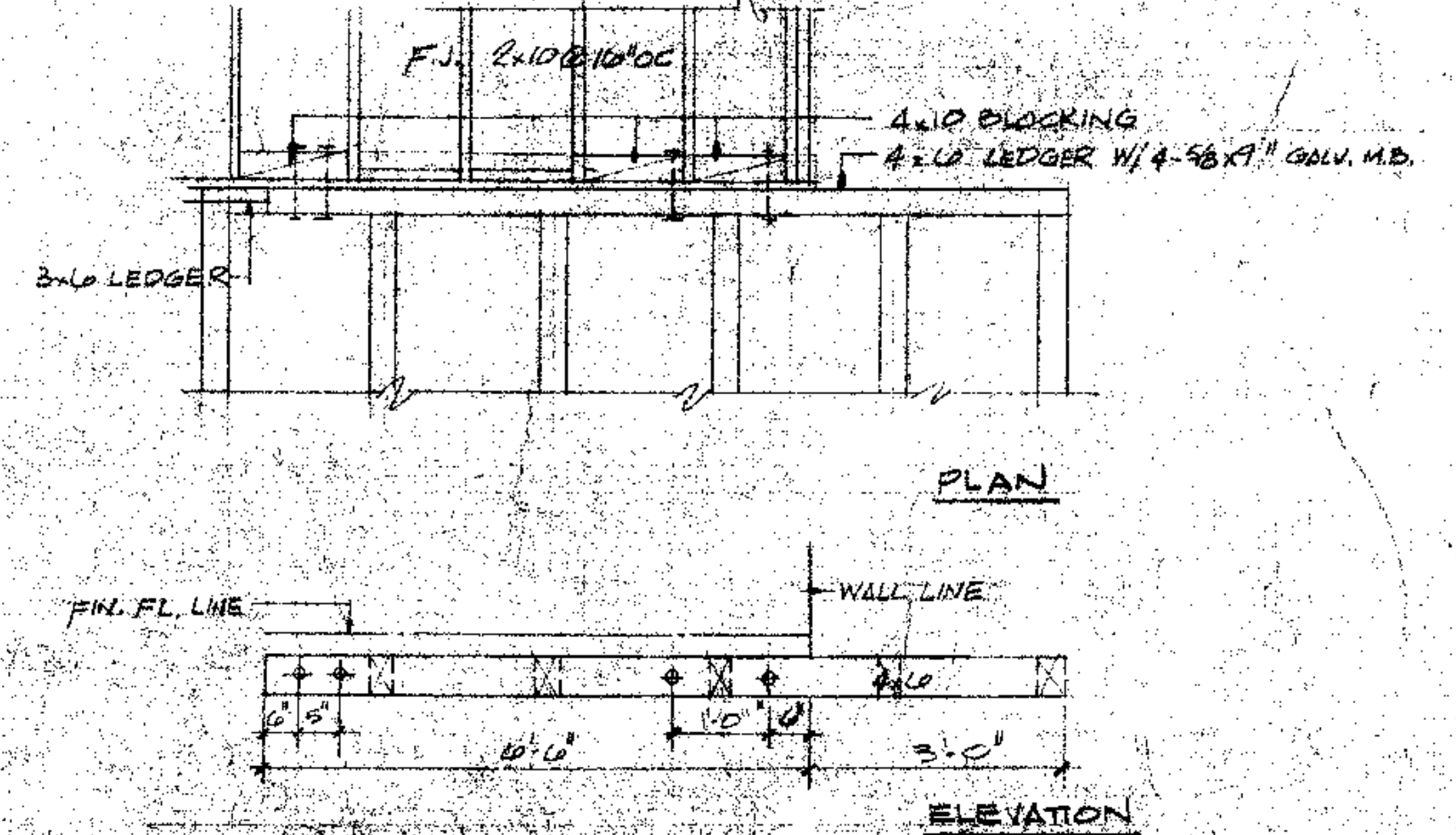
8/S5 WOOD COLUMN @ ENTRY
3/4" = 1'-0"



13/S5 ENTRY COLUMNS TO WOOD BEAM OVER
1 1/2" = 1'-0"



CONCRETE COLUMN @ ENTRY
3/4" = 1'-0"



14/S5 BALCONY LEDGER
1/2" = 1'-0"

Page 40

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BUILDER AND DEVELOPER OF ROSSMOOR WALNUT CREEK

ROSSMOOR
WALNUT CREEK
WALNUT CREEK CALIFORNIA
PROJECT

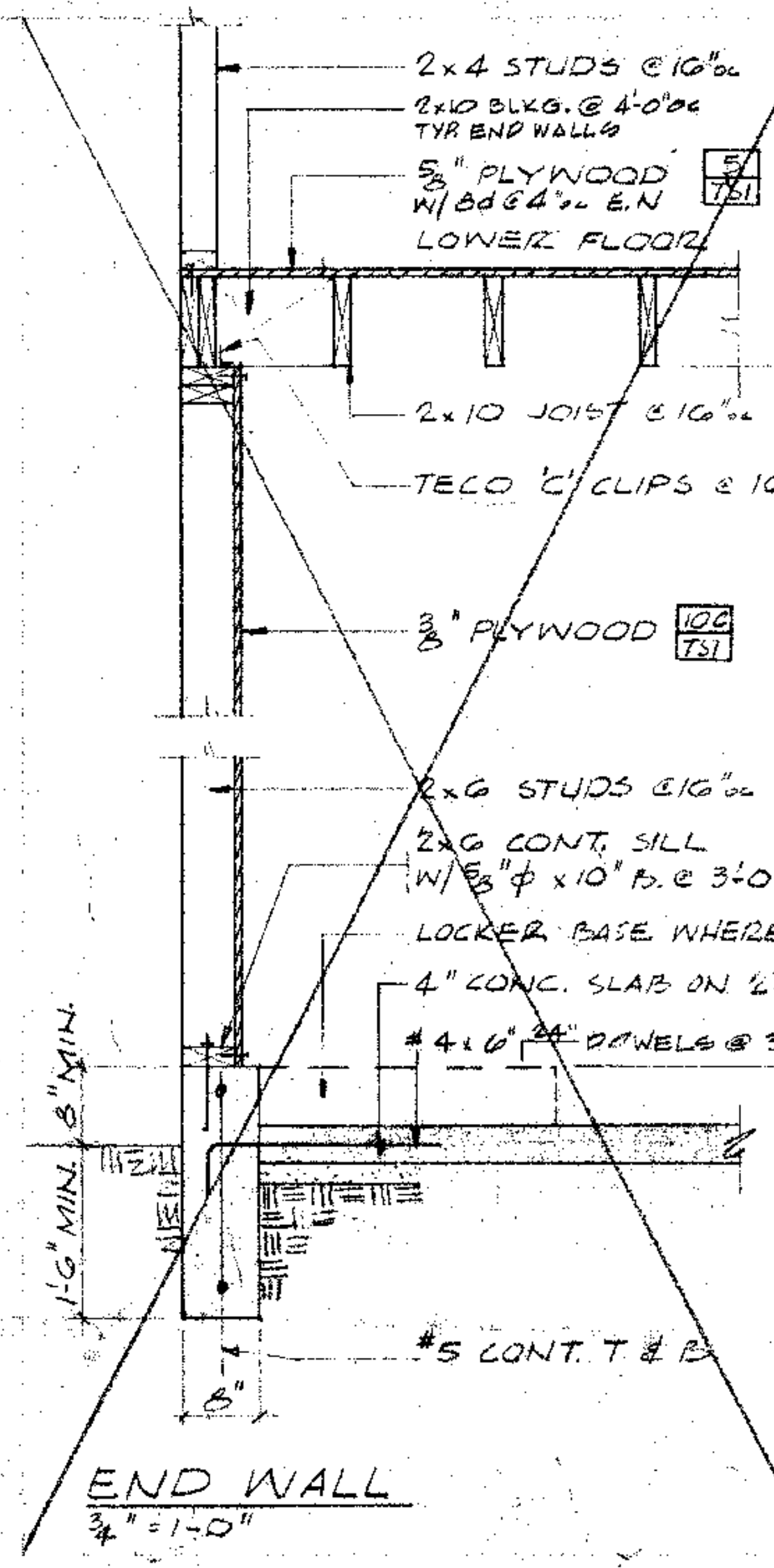
M30 9.19.72

DATE
REVISIONS

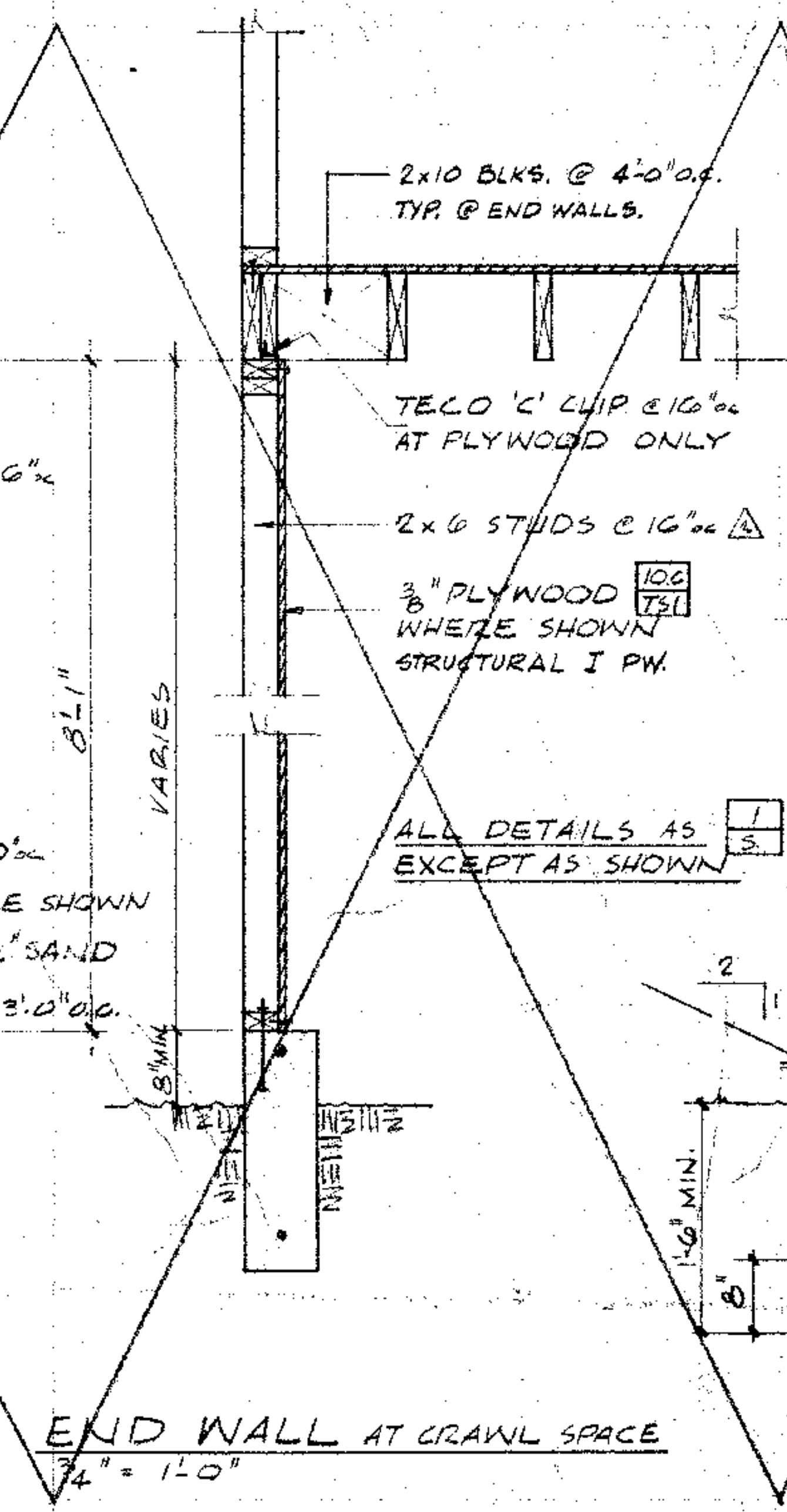
BUILDINGS
AG, AE
TYPICAL
SECTIONS

MUTUAL 35

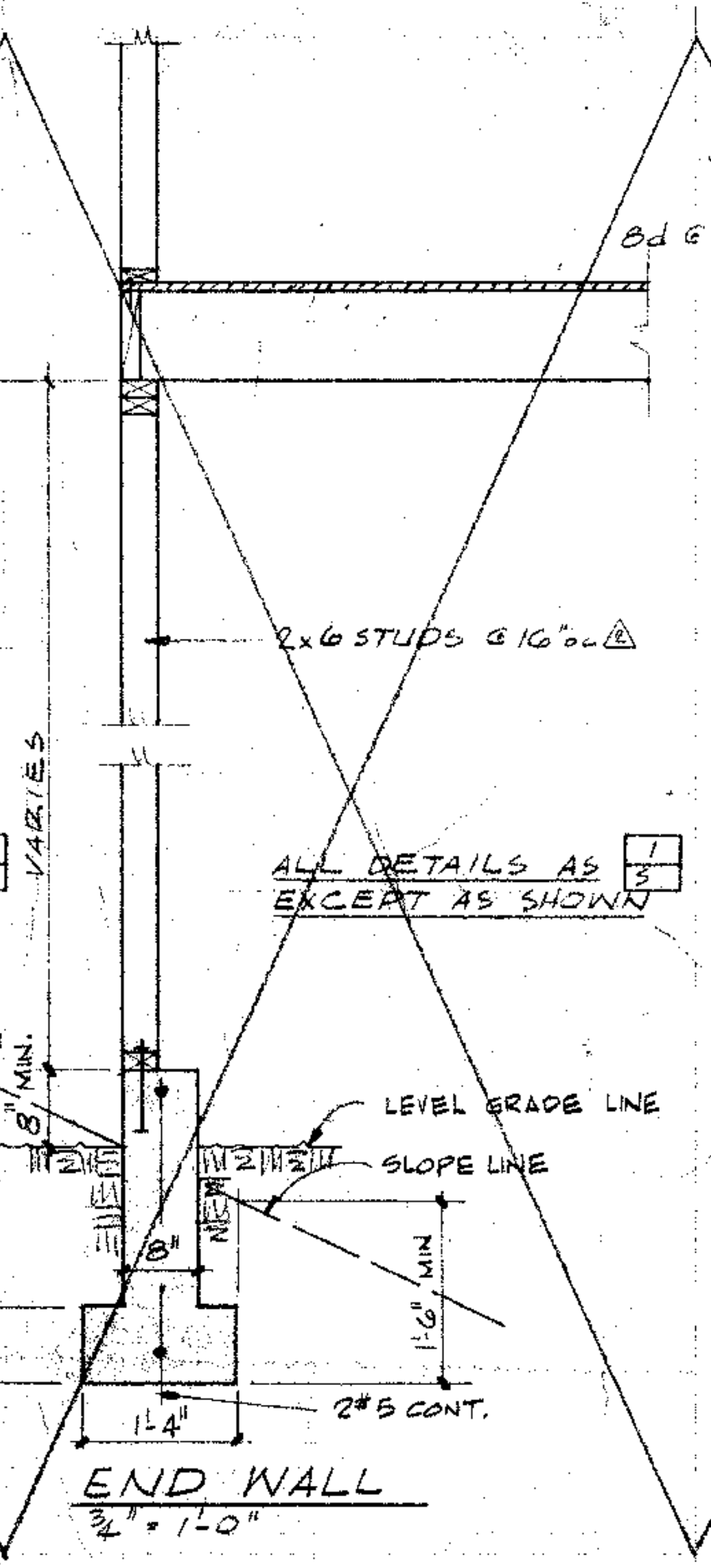
DATE 6-23-67
SHEET 23
S-5



END WALL
3/4" = 1'-0"

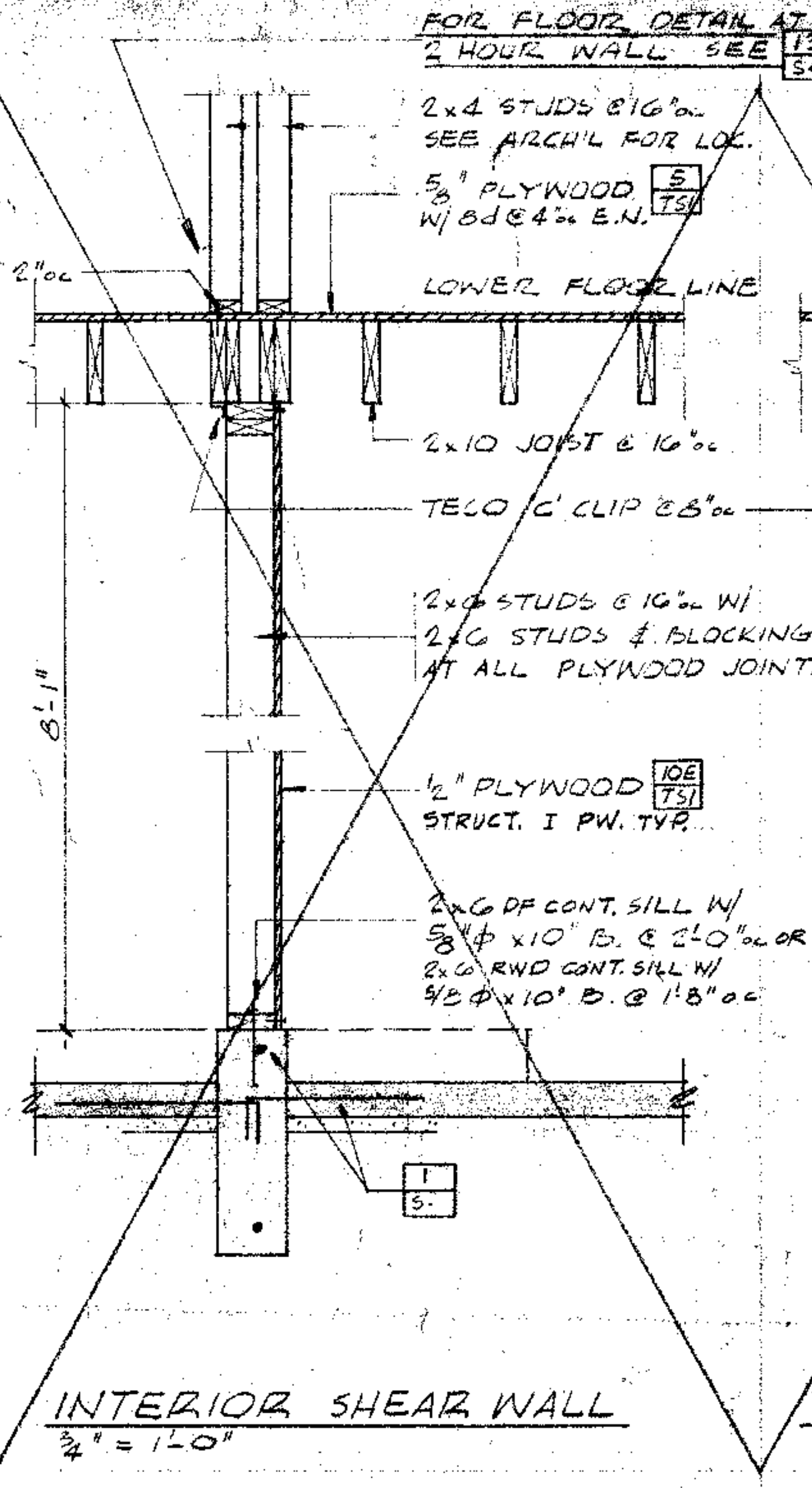


END WALL AT CRAWL SPACE
3/4" = 1'-0"

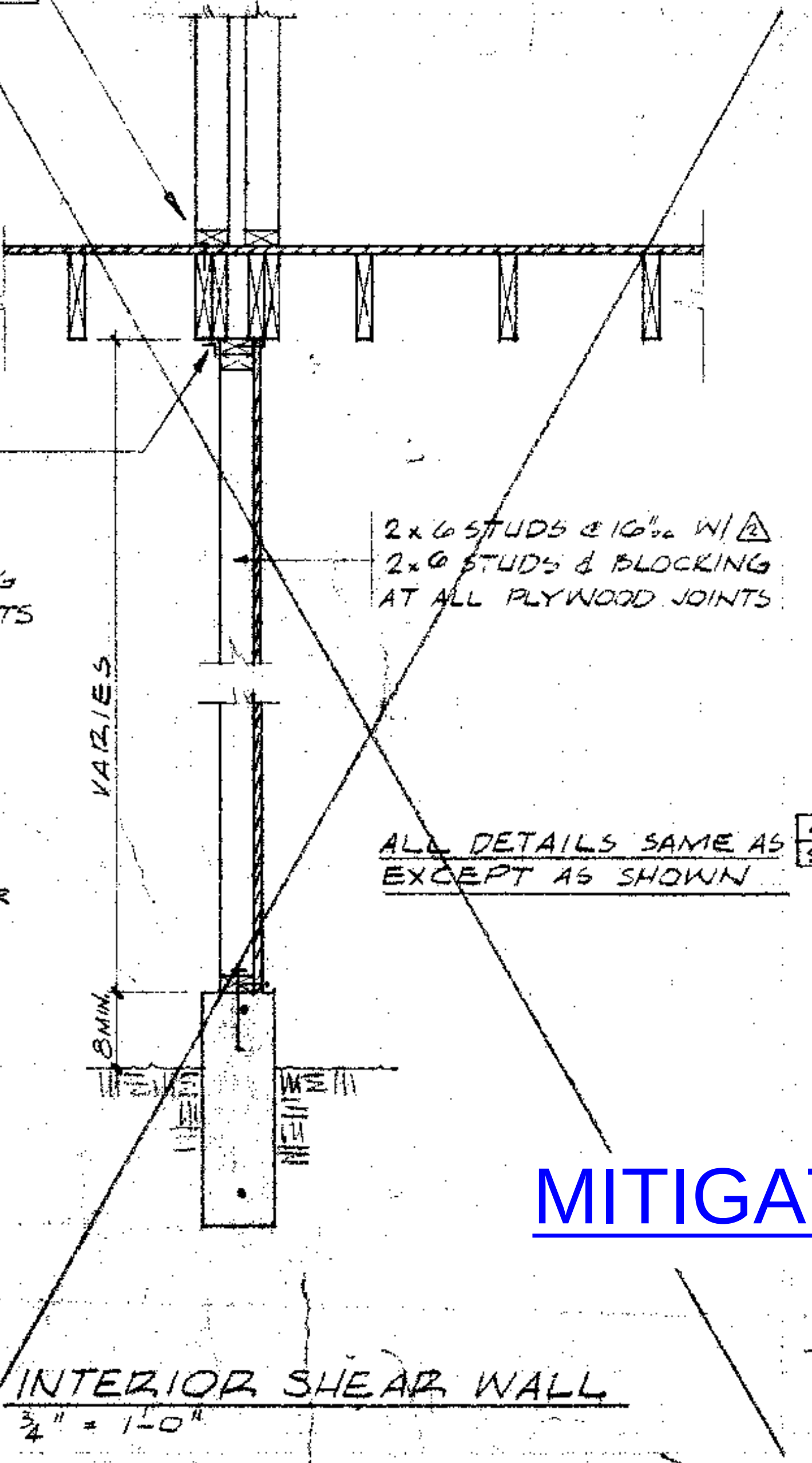


END WALL
3/4" = 1'-0"

FOR FLOOR DETAIL AT 2 HOUR WALL SEE 13/S4

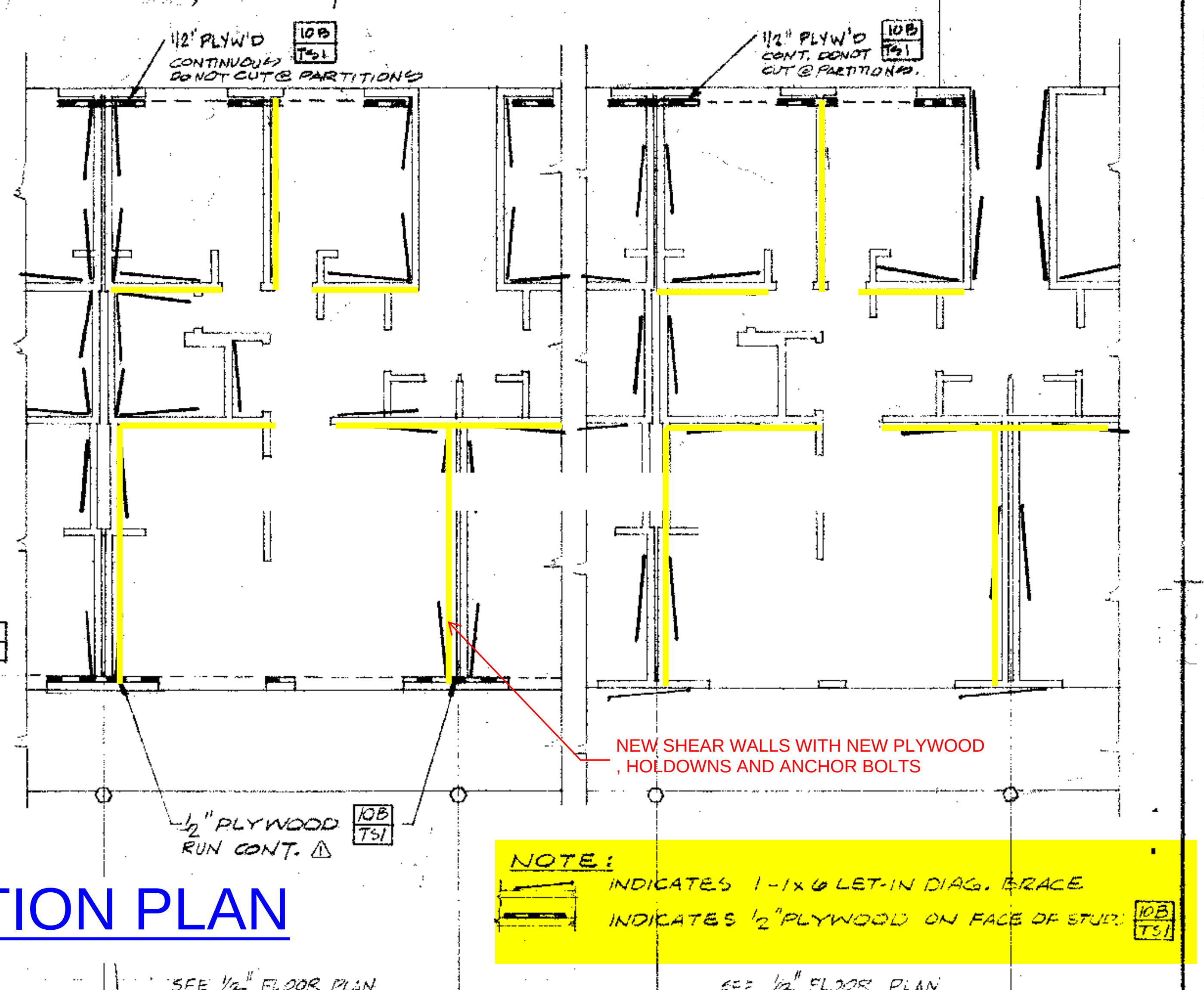


INTERIOR SHEAR WALL
3/4" = 1'-0"



INTERIOR SHEAR WALL
3/4" = 1'-0"

MITIGATION PLAN

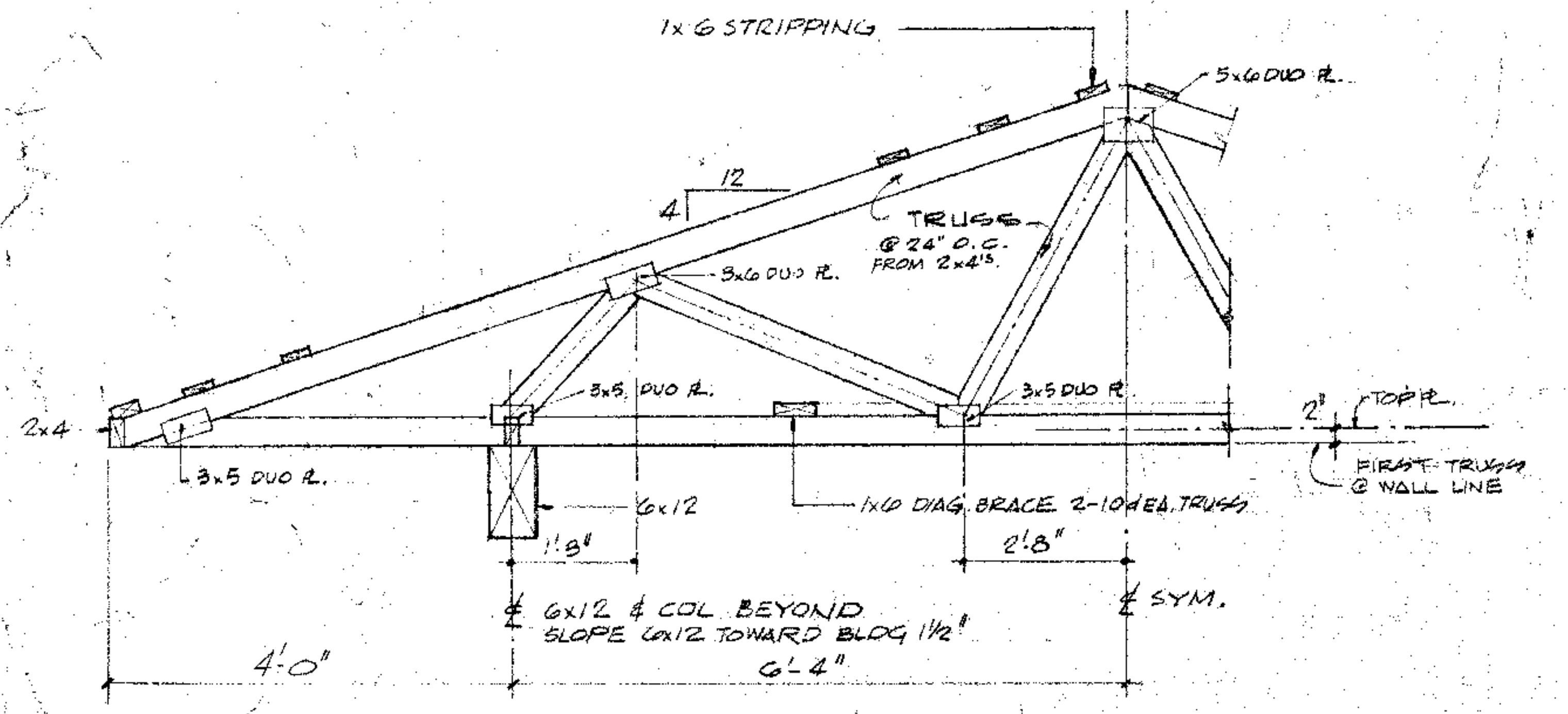


NOTE:
INDICATES 1-1x6 LET-IN DIAG. BRACE
INDICATES 1/2" PLYWOOD ON FACE OF STUD 10B/T51

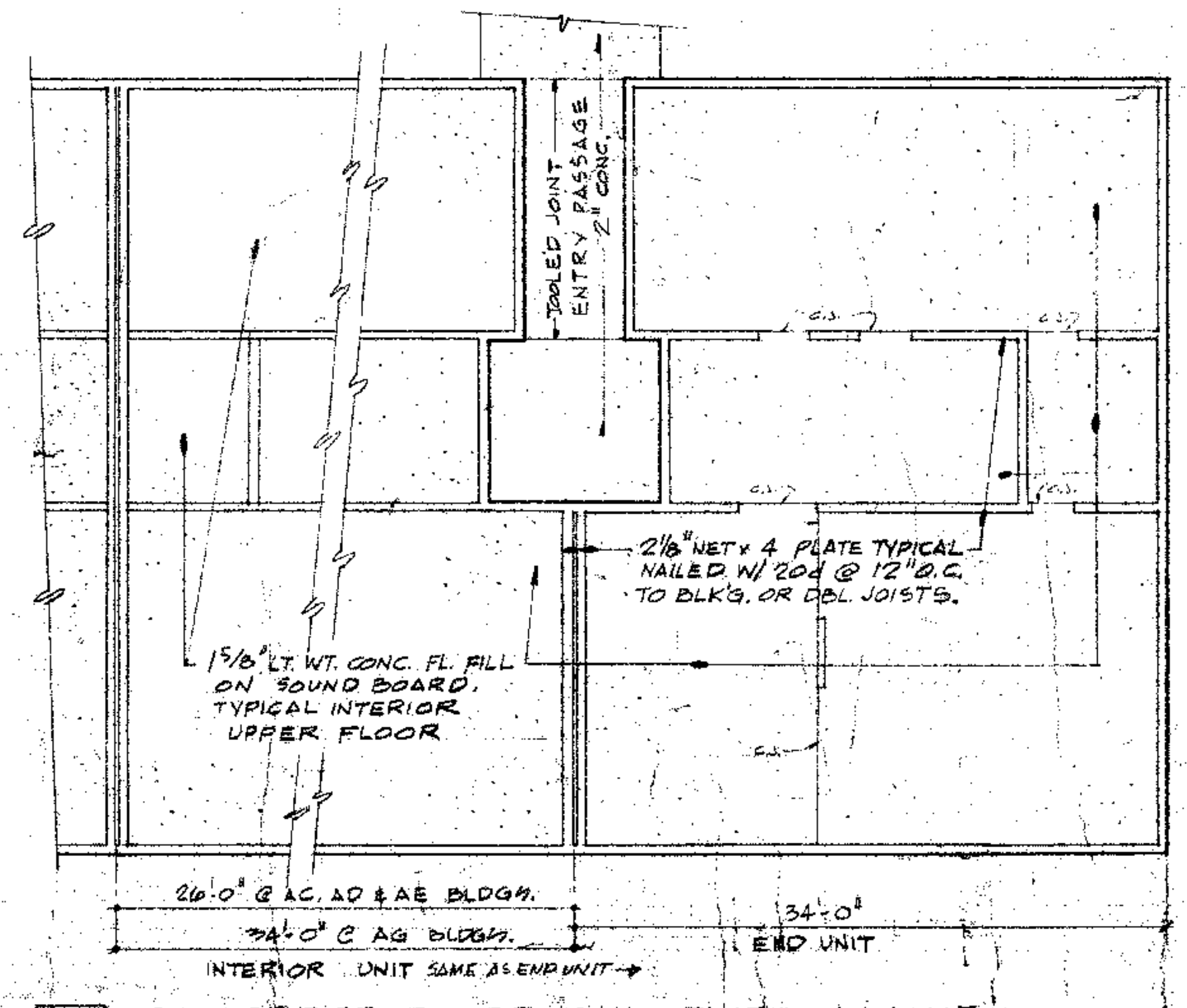
A TYP. LOWER LEVEL UNIT
SEE 1/2" FLOOR PLAN

B TYP. UPPER LEVEL UNIT
SEE 1/2" FLOOR PLAN

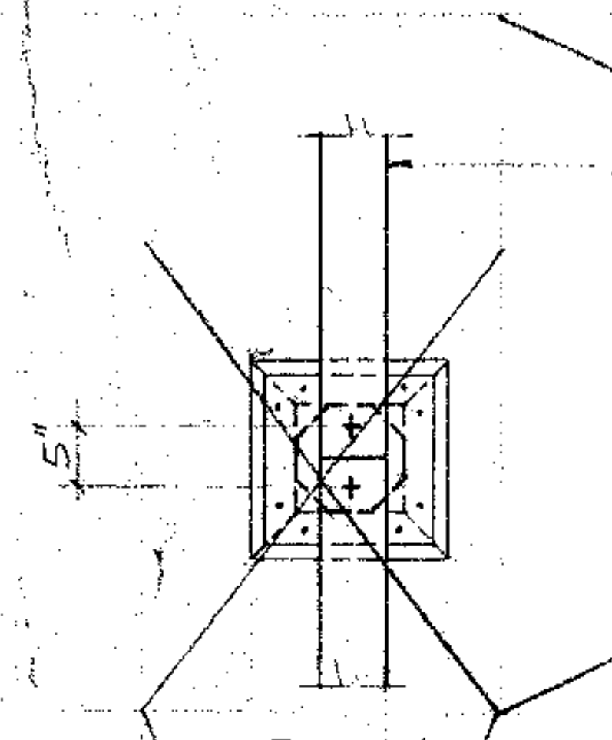
12/S5 TYPICAL LATERAL BRACING REQUIREMENTS
1/8" = 1'-0"



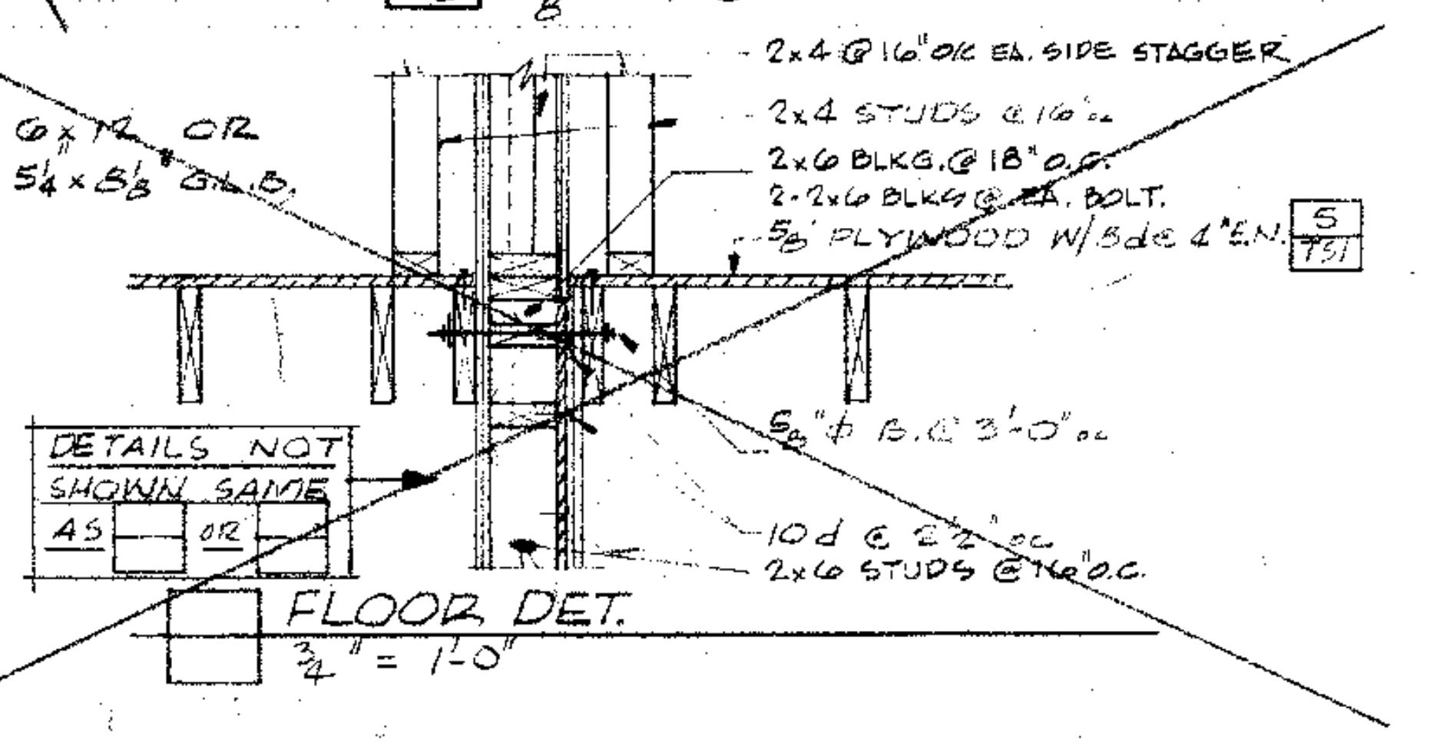
6/S5 ENTRY CANOPY ROOF
3/4" = 1'-0"



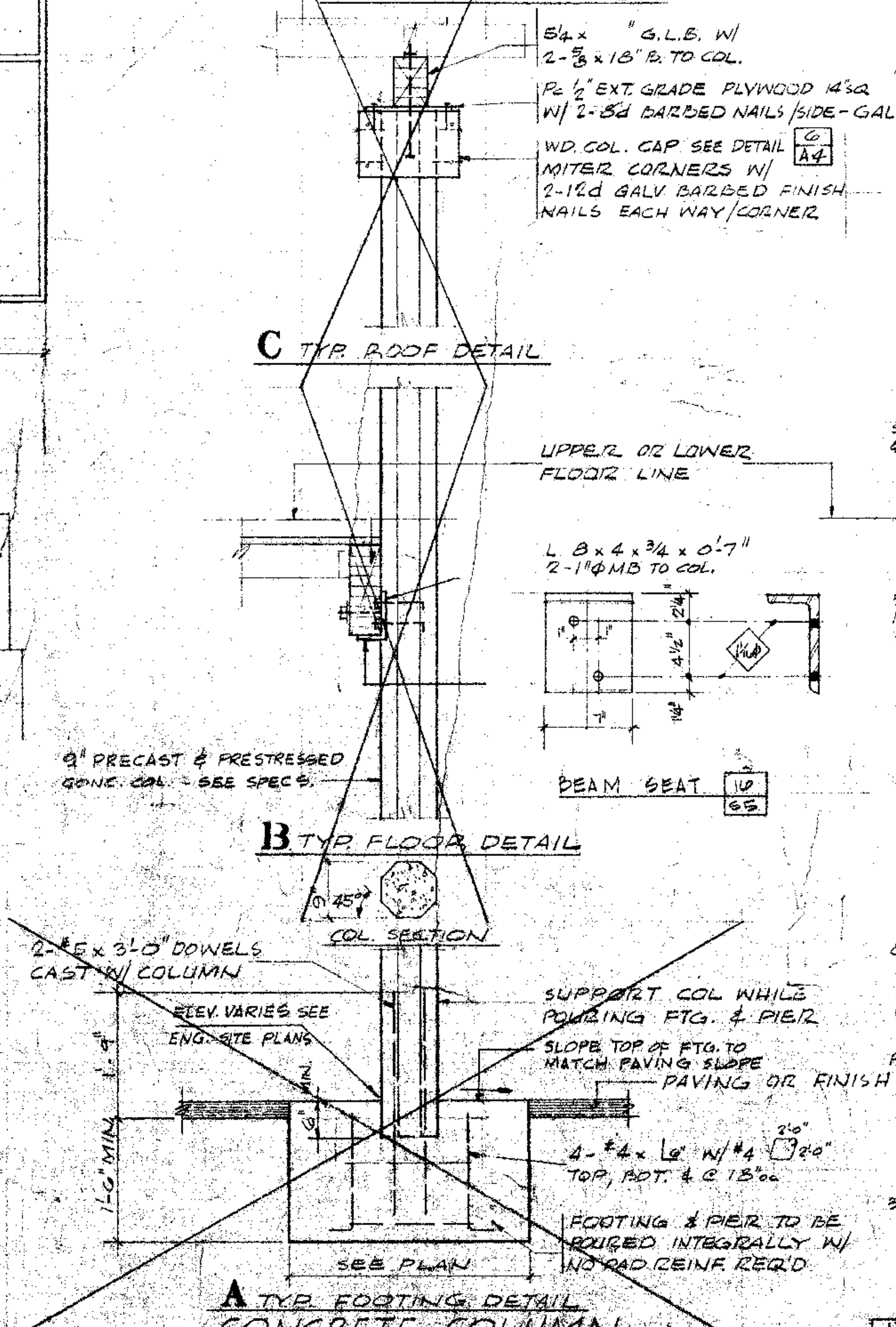
7/S-5 CONCRETE FLOOR FILL PLATE LAYOUT
UPPER FLOOR ONLY
1/8" = 1'-0"



PLAN AT ROOF BEAM



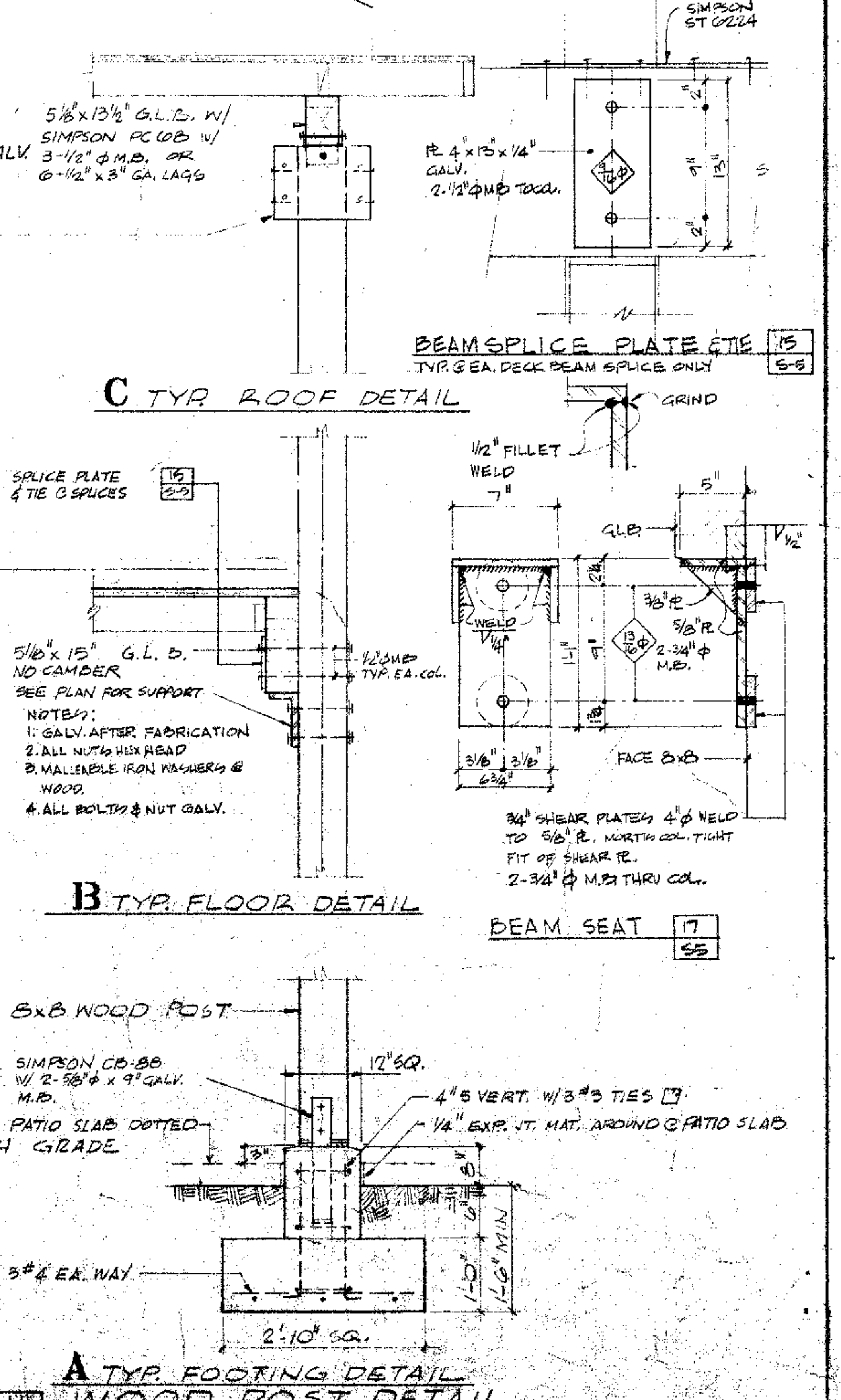
FLOOR DET.
3/4" = 1'-0"



C TYP. ROOF DETAIL

B TYP. FLOOR DETAIL

A TYP. FOOTING DETAIL
CONCRETE COLUMN
3/4" = 1'-0"



BEAM SPLICE PLATE & TIE 15/S-5
TYP. @ EA. DECK BEAM SPLICE ONLY

C TYP. ROOF DETAIL

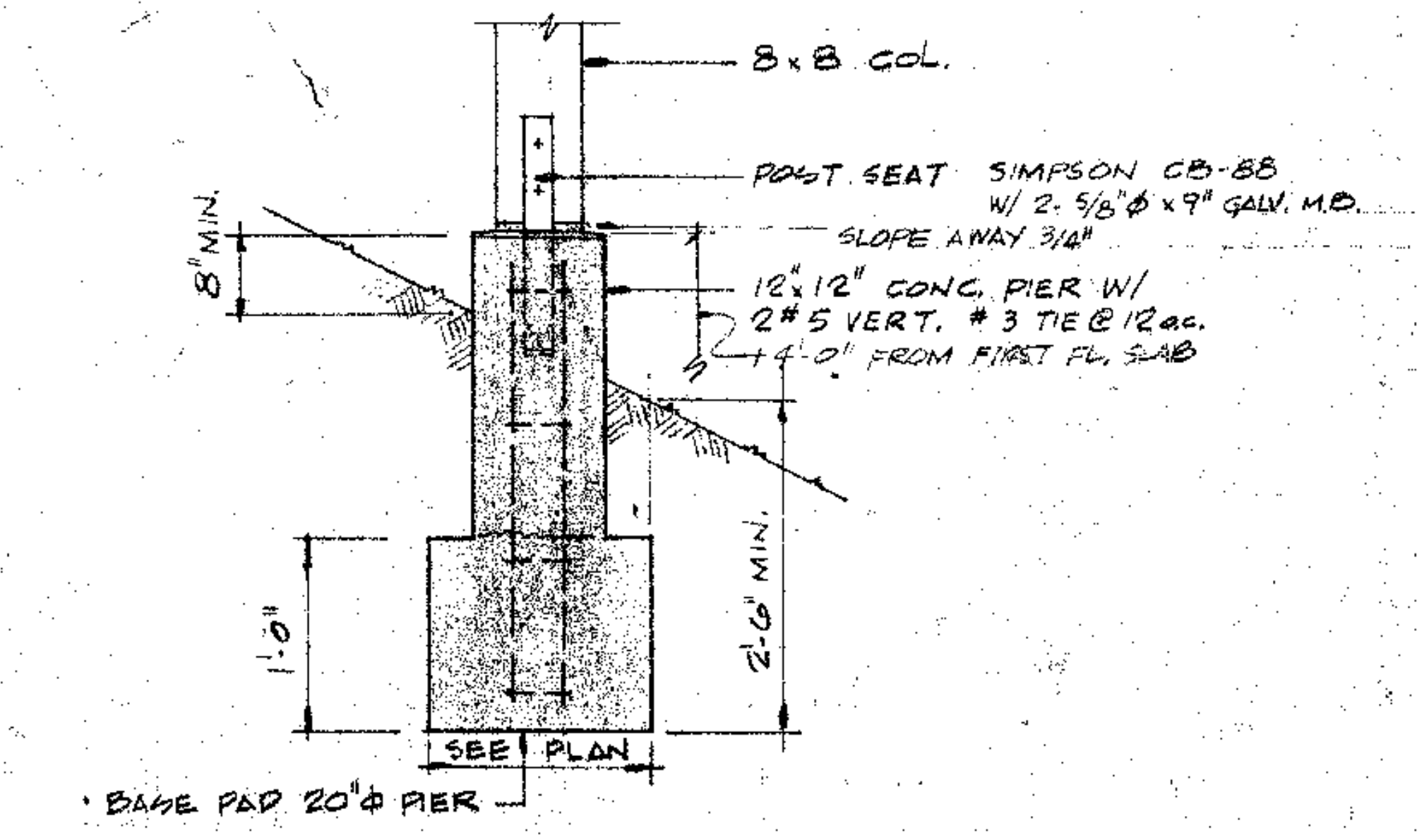
BEAM SEAT 16/S5

B TYP. FLOOR DETAIL

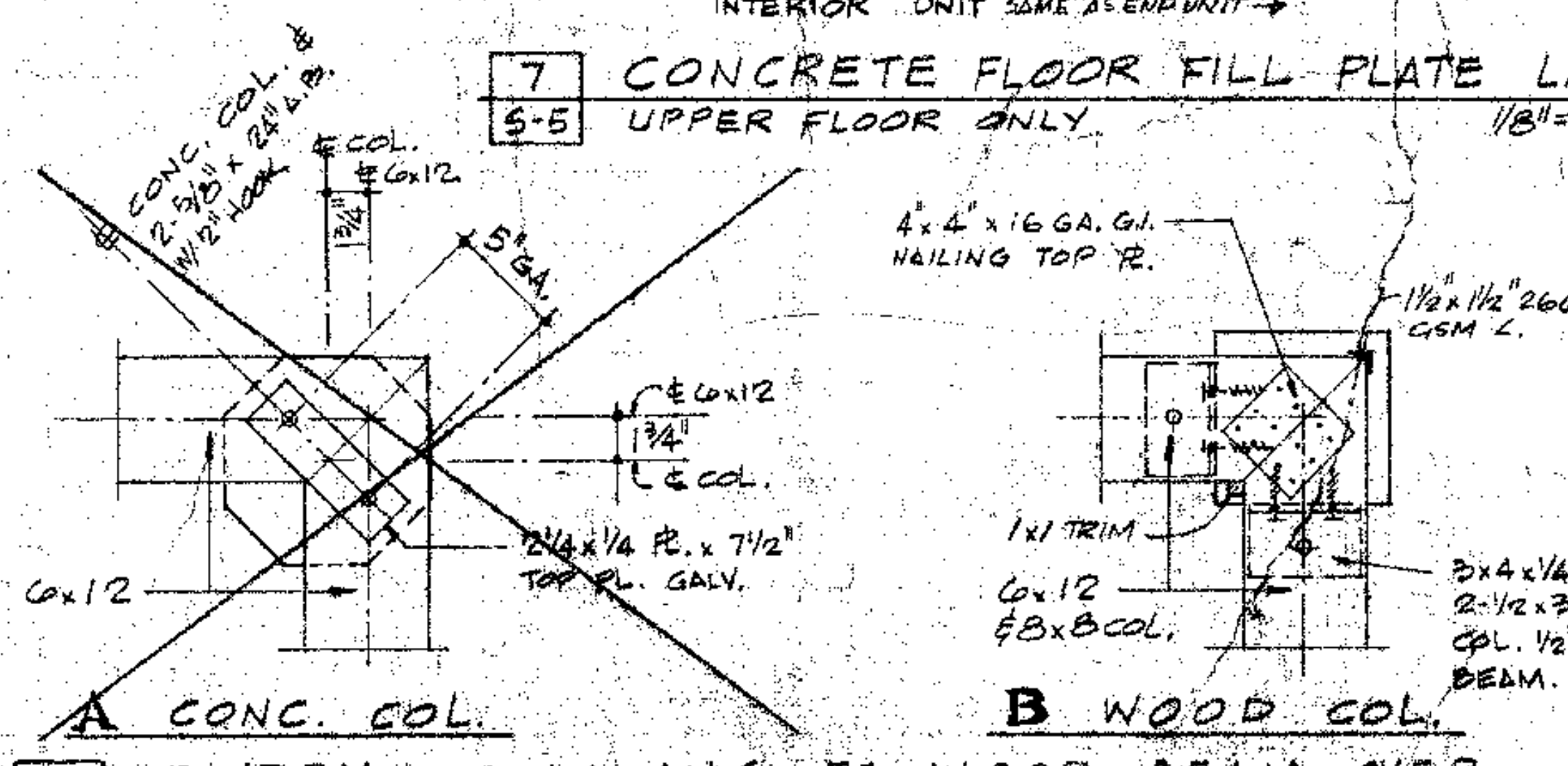
BEAM SEAT 17/S5

A TYP. FOOTING DETAIL

17/S5 WOOD POST DETAIL
3/4" = 1'-0"



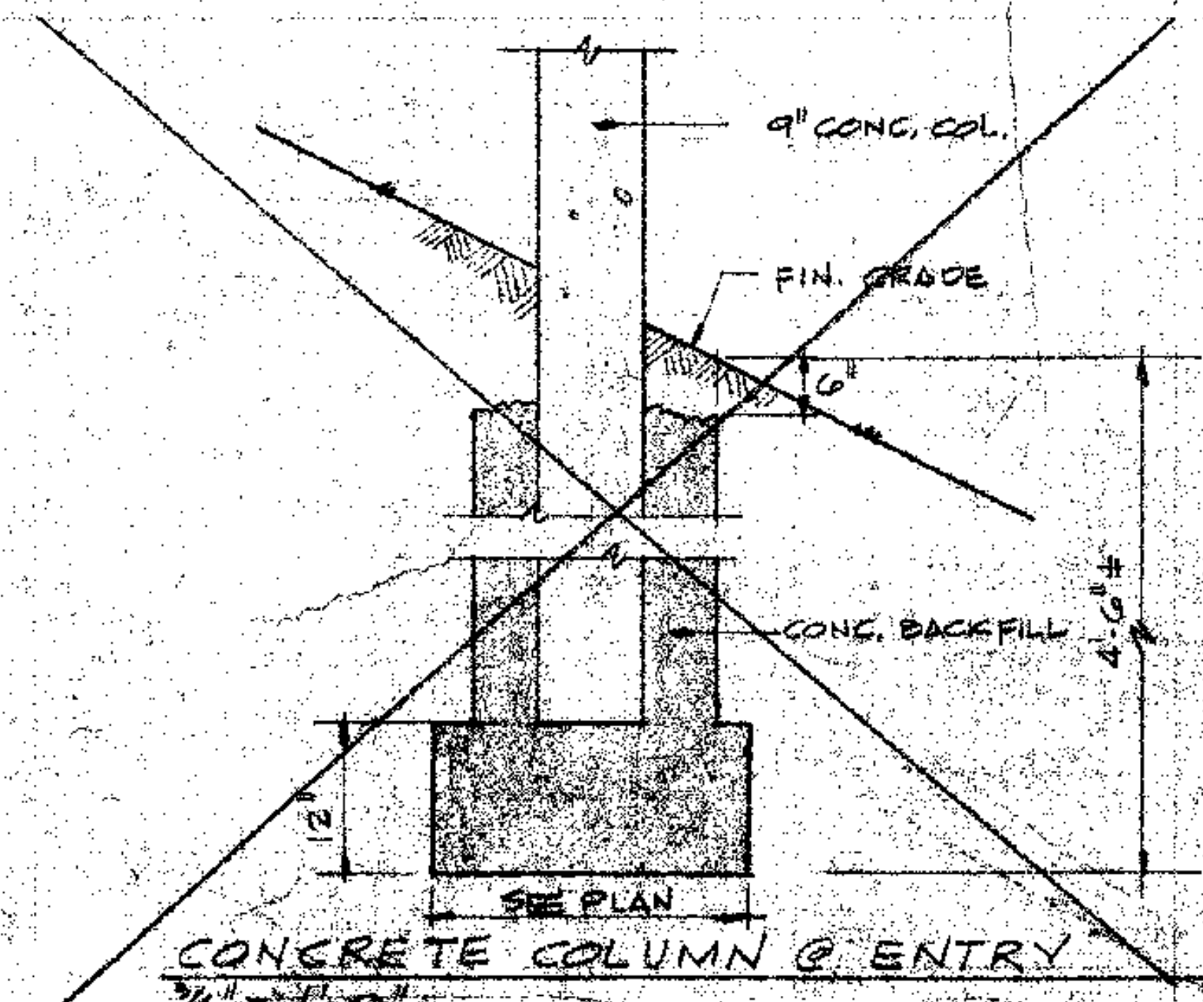
8/S5 WOOD COLUMN @ ENTRY
3/4" = 1'-0"



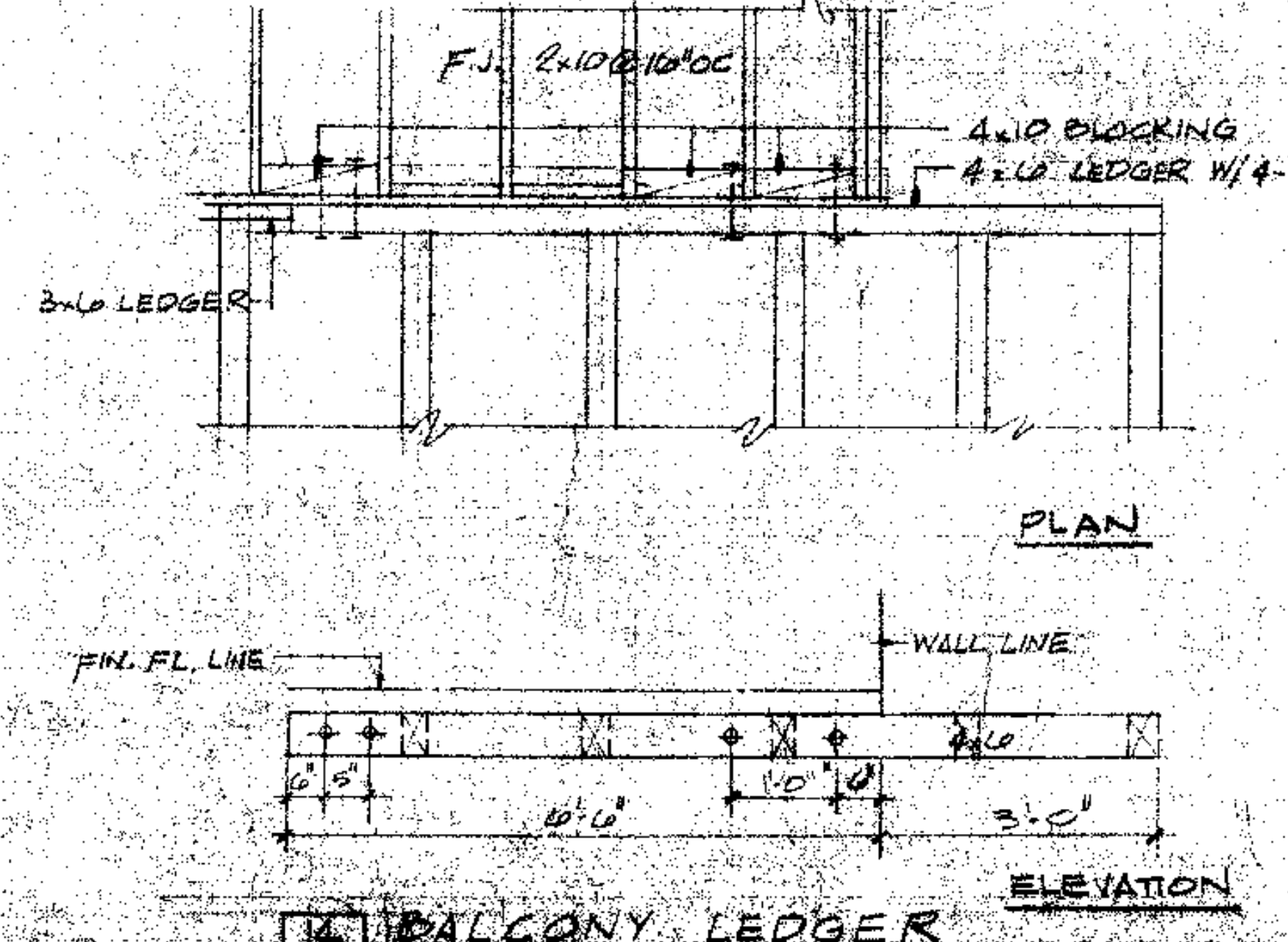
A CONC. COL.

B WOOD COL.

13/S5 ENTRY COLUMNS TO WOOD BEAM OVER
1 1/2" = 1'-0"



CONCRETE COLUMN @ ENTRY
3/4" = 1'-0"



14/S5 BALCONY LEDGER

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PROJECT

M30 9.19.72

DATE
REVISIONS

BUILDINGS
AG, AE
TYPICAL
SECTIONS

MUTUAL 35

DATE 6-25-69
SHEET 23
S-5

APPENDIX A
BUILDING 1
600 TERRA CALIFORNIA DRIVE

600 Terra California Dr, Walnut Creek, CA 94595, USA

Latitude, Longitude: 37.8628606, -122.0655455

Date	9/21/2022, 1:42:13 AM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Default (See Section 11.4.3)

Type	**Description**	**Value**
Hazard Level		BSE-2N
S_S	spectral response (0.2 s)	2.084
S_1	spectral response (1.0 s)	0.772
S_{XS}	site-modified spectral response (0.2 s)	2.501
S_{X1}	site-modified spectral response (1.0 s)	1.313
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.7
ssuh	max direction uniform hazard (0.2 s)	2.823
crs	coefficient of risk (0.2 s)	0.923
ssrt	risk-targeted hazard (0.2 s)	2.607
ssd	deterministic hazard (0.2 s)	2.084
s1uh	max direction uniform hazard (1.0 s)	1.033
cr1	coefficient of risk (1.0 s)	0.908
s1rt	risk-targeted hazard (1.0 s)	0.938
s1d	deterministic hazard (1.0 s)	0.772

Type	**Description**	**Value**
Hazard Level		BSE-1N
S_{XS}	site-modified spectral response (0.2 s)	1.667
S_{X1}	site-modified spectral response (1.0 s)	0.875

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	2.041
S_1	spectral response (1.0 s)	0.722
S_{XS}	site-modified spectral response (0.2 s)	2.449
S_{X1}	site-modified spectral response (1.0 s)	1.228
f_a	site amplification factor (0.2 s)	1.2
f_v	site amplification factor (1.0 s)	1.7

Type	Description	Value
Hazard Level		BSE-1E
S_S	spectral response (0.2 s)	1.065
S_1	spectral response (1.0 s)	0.353
S_{XS}	site-modified spectral response (0.2 s)	1.277
S_{X1}	site-modified spectral response (1.0 s)	0.687
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.947

Type	Description	Value
Hazard Level		TL Data
T-Sub-L	Long-period transition period in seconds	8

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Table 17-1. Very Low Seismicity Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Structural Components			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-2. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Building System—General			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. No adjacent buildings	5.4.1.2	A.2.1.2
C NC [✓ N/A] U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. No mezzanines	5.4.1.3	A.2.1.3
Building System—Building Configuration			
[✓ C] NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
[✓ C] NC N/A U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. Lateral system is same for both floors	5.4.2.2	A.2.2.3
[✓ C] NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
[✓ C] NC N/A U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
[✓ C] NC N/A U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6
C NC [✓ N/A] U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension.	5.4.2.6	A.2.2.7

continues

Table 17-2 *(Continued)*. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)			
Geologic Site Hazards			
[✓ C] NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	5.4.3.1	A.6.1.1
[✓ C] NC N/A U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure.	5.4.3.1	A.6.1.2
C [✓ NC] N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. Calavares fault is close to site	5.4.3.1	A.6.1.3
High Seismicity (Complete the Following Items in Addition to the Items for Moderate Seismicity)			
Foundation Configuration			
[✓ C] NC N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$. See calc	5.4.3.3	A.6.2.1
[✓ C] NC N/A U	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C.	5.4.3.4	A.6.2.2

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-4. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity **Seismic-Force-Resisting System**			
[✓ C] NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. Sheet F4 of record drawings	5.5.1.1	A.3.2.1.1
[✓ C] NC N/A U	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: See calc Structural panel sheathing 1,000 lb/ft (14.6 kN/m) Diagonal sheathing 700 lb/ft (10.2 kN/m) Straight sheathing 100 lb/ft (1.5 kN/m) All other conditions 100 lb/ft (1.5 kN/m)	5.5.3.1.1	A.3.2.7.1
[✓ C] NC N/A U	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system.	5.5.3.6.1	A.3.2.7.2
[✓ C] NC N/A U	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building.	5.5.3.6.1	A.3.2.7.3
C [✓ NC] N/A U	NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. See F4	5.5.3.6.1	A.3.2.7.4
C NC N/A [✓ U]	WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. No details to verify	5.5.3.6.2	A.3.2.7.5
C NC [✓ N/A] U	HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1.	5.5.3.6.3	A.3.2.7.6

continues

COLLAPSE PREVENTION CHECKLIST FOR TYPICAL TWO-STORY BUILDINGS

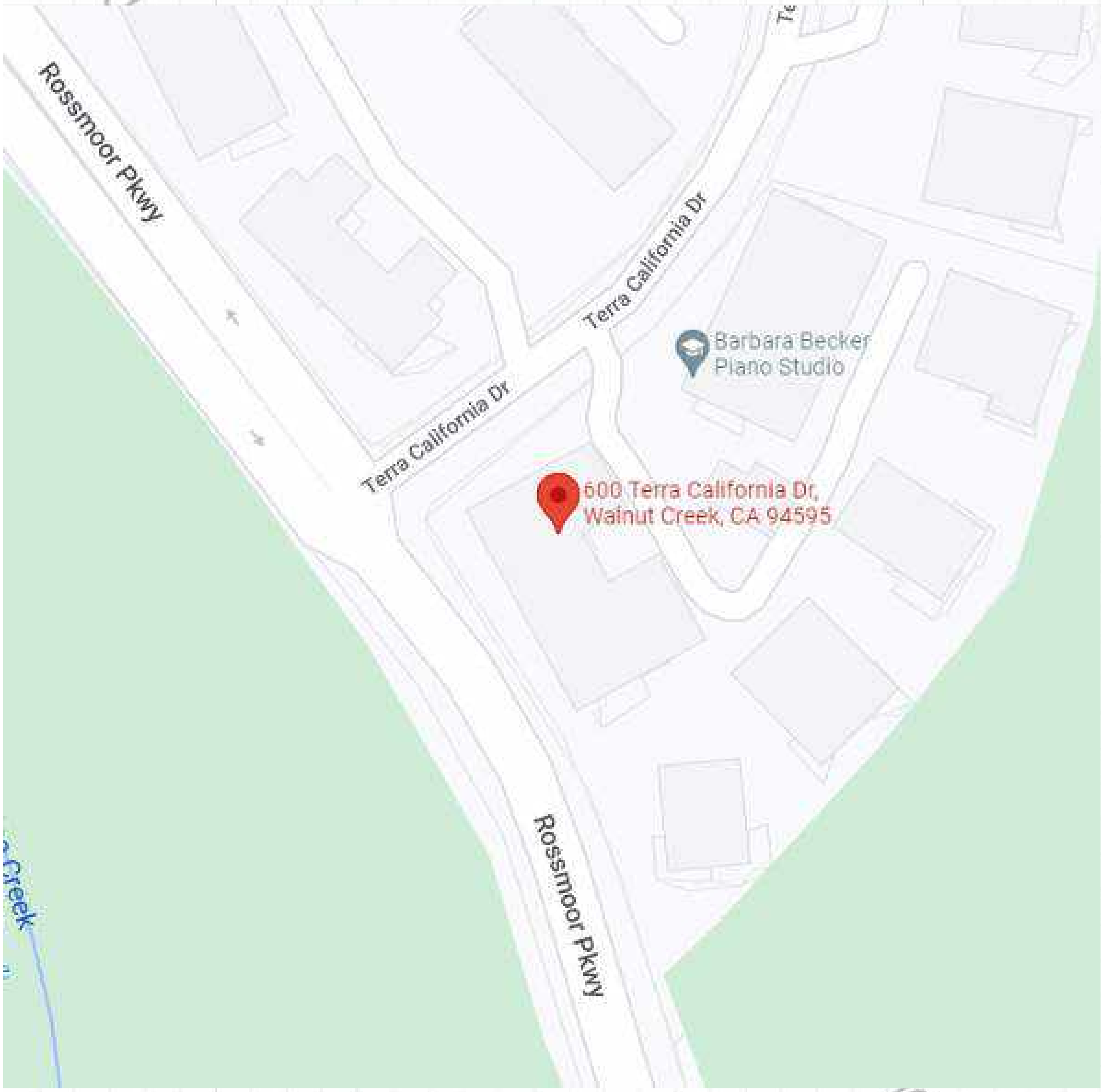
Table 17-4 ***(Continued)*****. Collapse Prevention Structural Checklist for Building Types W1 and W1a** Page 48

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC [✓ N/A] U	CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels.	5.5.3.6.4	A.3.2.7.7
C NC [✓ N/A] U	OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces.	5.5.3.6.5	A.3.2.7.8
Connections	Per detail 13/F1		
[✓ C] NC N/A U	WOOD POSTS: There is a positive connection of wood posts to the foundation.	5.7.3.3	A.5.3.3
[✓ C] NC N/A U	WOOD SILLS: All wood sills are bolted to the foundation. Per SW Notes on F4	5.7.3.3	A.5.3.4
C NC N/A [✓ U]	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support. Details not available	5.7.4.1	A.5.4.1
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Connections			
[✓ C] NC N/A U	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft or less with acceptable edge and end distance provided for wood and concrete. Per SW Notes on A4	5.7.3.3	A.5.3.7
Diaphragms			
[✓ C] NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
[✓ C] NC N/A U	ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation.	5.6.1.1	A.4.1.3
C NC [✓ N/A] U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered.	5.6.2	A.4.2.1
[✓ C] NC N/A U	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC [✓ N/A] U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12 m) and have aspect ratios less than or equal to 4-to-1.	5.6.2	A.4.2.3
[✓ C] NC N/A U	OTHER DIAPHRAGMS: The diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

ASCE 41-17 Tier 1 Two Story

Building Information $Lat := 37.8628606$ $Long := -122.0655455$



Evalute the BPOE with the BSE-2E at S-5 Structural Performance Level (Collapse Prevention) and N-D Non structural performance Level (Hazards Reduced)

Compliance with BSE-2E implies compliance with BSE-1E 3-C Performance Objective (Life Safety Structural Non structural)

$RiskCategory := \text{“II”}$

$BuildingType := \text{“W1A”}$

$S_{XS} := 2.449$ $F_a := 1.2$ $F_v := 1.7$

$S_{X1} := 1.228$

$S_s := 2.041$ $S_1 := 0.722$

$S_{DS} := \frac{2}{3} \cdot F_a \cdot S_s = 1.63$ $S_{D1} := \frac{2}{3} \cdot F_v \cdot S_1 = 0.82$

$LevelOfSeismicity := \text{“High”}$ Table 2-4

For Tier 1, W1A CP Checklists from Table 17-4,

SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than the following values:

Structural panel sheathing	1000 lb/ft
Diagonal sheathing	700 lb/ft
Straight sheathing	100 lb/ft
All other conditions	100 lb/ft

ASCE 41-17, 4.4.3.3 Shear Stress in Shear Walls. The average stress in shear walls, v, shall be calculated in accordance with Eq. (4-8)

Note that the subscript j has been removed since this is a one story building an j indicates level. The superscript avg has also been removed since it seemed hard to do in Mathcad

$$v := \frac{1}{\boxed{M_s}} \cdot \left(\frac{V}{A_w}\right)$$

$M_s := 4.5$ System modification factor; shall be taken from Table 4-8

A_w Summation of the horizontal cross-sectional area of all shear walls in the direction of loading. Openings shall be taken into consideration where computing A_w. For masonry walls, the net area shall be used. For wood-framed walls, the length shall be used rather than the area

V Story shear computed in accordance with Section 4.4.2.2

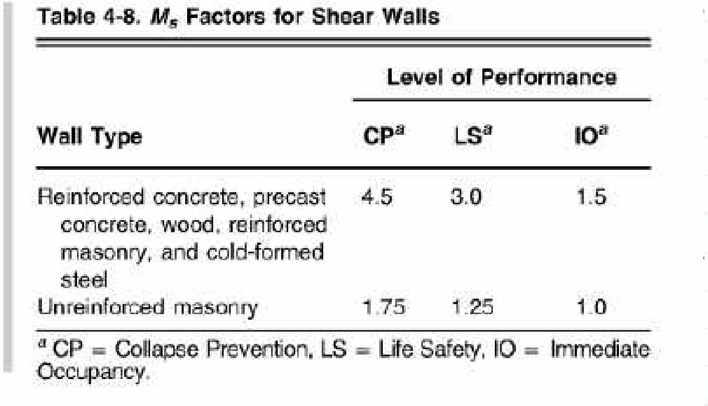


Table 4-8. M_s Factors for Shear Walls

	Level of Performance		
Wall Type	**CP**[a]	**LS**[a]	**IO**[a]
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

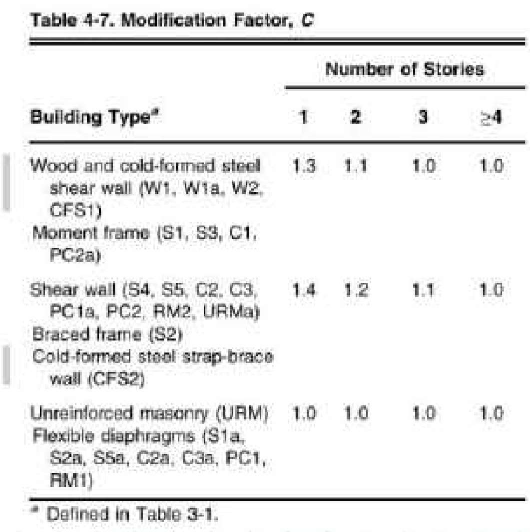


Table 4-7. Modification Factor, C

	Number of Stories			
Building Type[a]	**1**	**2**	**3**	**≥4**
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Determine V, the pseudo lateral force from Equation 4-1. V is a function of

- C, modification factor to relate expected maximum inelastic displacements to displacements calculated for linear elastic response; shall be taken from table 4-7
- S_a, the response spectral acceleration at the fundamentla period of the building in the diretion under consideration. S_a shall be calculated in accordance with Section 4.4.2.3
- W, the total dead load

Building type W1A

$C := 1.1$ Factor for TWO story building.

Determine S_a

1 second period spectral acceleration of the BSE-2E $S_{X1} = 1.228$

Short period spectral acceleration of the BSE-1N Design $S_{XS} = 2.449$

Factor per table 4-8 $M_s = 4.5$

Determine T

Coefficient to determine building period $C_t := 0.020$

Height in feet above the base to the roof level $h_n := 19\ ft = 19\ ft$

$\beta := 0.75$ for all other

Fundamental period of vibration of the building, calculated in accordance with Section 4.4.2.4 $T := C_t \cdot \left(\frac{h_n}{1\ ft}\right)^{\beta} = 0.182$

$S_a := min\left(\frac{S_{X1}}{T}, S_{XS}\right) = 2.449$ Equation 4-3 from 4.4.2.3

Overturning

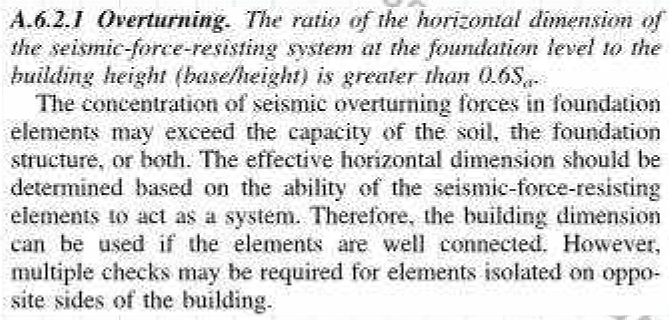
Minimum base dimension of C2A $base := 84\ ft = 84\ ft$

$$\frac{base}{h_n} = 4.42 \qquad 0.6 \cdot S_a = 1.47$$

$$Overturning := \mathbf{if}\left(\frac{base}{h_n} > 0.6 \cdot S_a, \text{“Compliant”}, \text{“Non compliant”}\right)$$

$$Overturning = \text{“Compliant”}$$

Per commentary if building is well connected can use building dimensions, not individual shear wall lengths



A.6.2.1 Overturning. *The ratio of the horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$.*

The concentration of seismic overturning forces in foundation elements may exceed the capacity of the soil, the foundation structure, or both. The effective horizontal dimension should be determined based on the ability of the seismic-force-resisting elements to act as a system. Therefore, the building dimension can be used if the elements are well connected. However, multiple checks may be required for elements isolated on opposite sides of the building.

Two story portion Weigh up and Geometry

Floor heights from base

$$h := \begin{bmatrix} 9\ ft \\ 18\ ft \end{bmatrix} = \begin{bmatrix} 9 \\ 18 \end{bmatrix} ft$$

Area of walls in north south direction in

$$A_{wNS} := \begin{bmatrix} 600\ ft \\ 600\ ft \end{bmatrix}$$

$$A_{wEW} := \begin{bmatrix} 440\ ft \\ 440\ ft \end{bmatrix}$$

$$RoofArea := 12500\ ft^2$$
$$FloorArea := 12500\ ft^2$$

$$WallPerimeter := (150\ ft \cdot 2) + (84\ ft \cdot 4) = 636\ ft$$

Weight of roof and walls trib to roof

$$WallWeight := 20\ psf$$

$$RoofWeight := 20\ psf$$

$$FloorWeight := 30\ psf$$

$$w := \begin{bmatrix} FloorArea \cdot FloorWeight + WallWeight \cdot WallPerimeter \cdot 9\ ft \\ RoofArea \cdot RoofWeight + WallWeight \cdot WallPerimeter \cdot 4.5\ ft \end{bmatrix} = \begin{bmatrix} 489.48 \\ 307.24 \end{bmatrix} kip$$

Total seismic weight of structure

$$W := \sum_{i=1}^{\text{length}(w)} w_i = 796.72\ kip$$

Psuedo seismic force

Psuedo seismic force per 4.4.2.1 Eq. 4-1 $V := C \cdot S_a \cdot W = 2146\ \textbf{kip}$

factor per 4.4.2.2 $k := \textbf{if}(T > 2.5, 2, \textbf{if}(T \le 0.5, 1, 0.5 \cdot T + 0.75)) = 1$

$x := 1 .. 2$
$j := 1 .. 2$ $Floors := 2$

Vertical distribution of psuedo seismic force per 4.5.2.2 Eq 4-3a

$$F_x := \frac{w_x \cdot h_x^{\ k}}{\sum_{i=1}^{2} w_i \cdot h_i^{\ k}} \cdot V = \begin{bmatrix} 952 \\ 1195 \end{bmatrix} \textbf{kip}$$

Story shear at story level j

$$V_j := \sum_{x=j}^{Floors} F_x = \begin{bmatrix} 2146 \\ 1195 \end{bmatrix} \textbf{kip}$$

Shear stress in shear walls in north south direction

$$v_{NS} := \frac{1}{M_s} \cdot \frac{V}{A_{wNS}} = \begin{bmatrix} 794.92 \\ 442.46 \end{bmatrix} \textbf{plf}$$

Shear stress in shear walls in east west direction

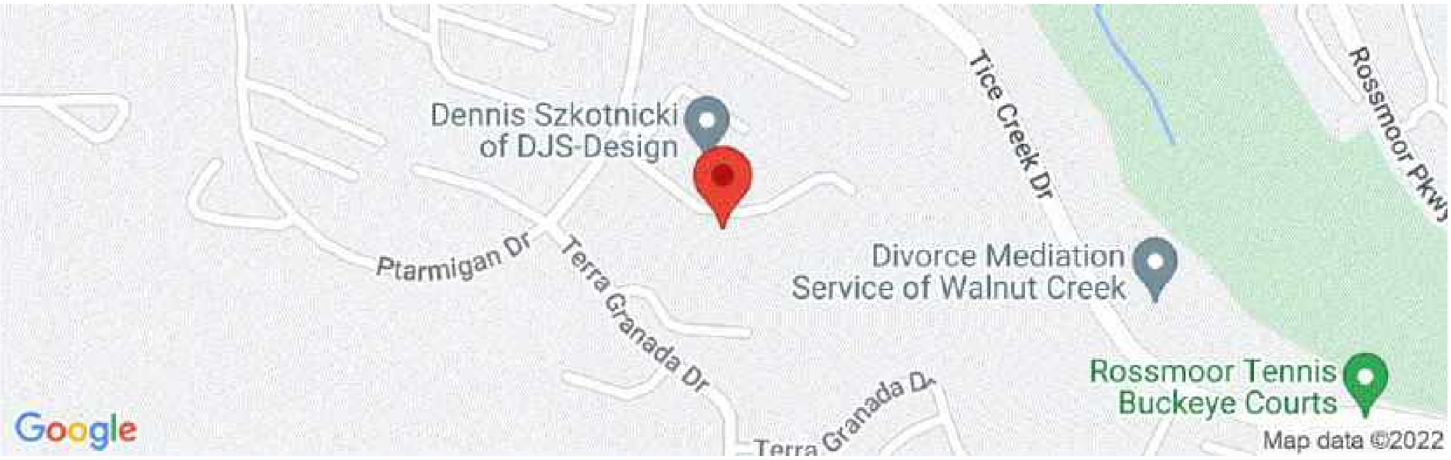
$$v_{EW} := \frac{1}{M_s} \cdot \frac{V}{A_{wEW}} = \begin{bmatrix} 1083.98 \\ 603.36 \end{bmatrix} \textbf{plf}$$

<u>Shear Stress is slightly more than 1000 plf in E-W (<10%)</u>

APPENDIX B
BUILDING 2
1605 PTARMIGAN DRIVE

1605 Ptarmigan Dr, Walnut Creek, CA 94595, USA

Latitude, Longitude: 37.8555633, -122.0672989



Date	10/30/2022, 11:50:28 PM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Default (See Section 11.4.3)

Type	**Description**	**Value**
Hazard Level		BSE-2N
S_S	spectral response (0.2 s)	2.147
S_1	spectral response (1.0 s)	0.796
S_{XS}	site-modified spectral response (0.2 s)	2.577
S_{X1}	site-modified spectral response (1.0 s)	1.354
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.7
ssuh	max direction uniform hazard (0.2 s)	2.825
crs	coefficient of risk (0.2 s)	0.924
ssrt	risk-targeted hazard (0.2 s)	2.61
ssd	deterministic hazard (0.2 s)	2.147
s1uh	max direction uniform hazard (1.0 s)	1.037
cr1	coefficient of risk (1.0 s)	0.908
s1rt	risk-targeted hazard (1.0 s)	0.942
s1d	deterministic hazard (1.0 s)	0.796

Type	**Description**	**Value**
Hazard Level		BSE-1N
S_{XS}	site-modified spectral response (0.2 s)	1.718
S_{X1}	site-modified spectral response (1.0 s)	0.903

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	2.044
S_1	spectral response (1.0 s)	0.726
S_{XS}	site-modified spectral response (0.2 s)	2.453
S_{X1}	site-modified spectral response (1.0 s)	1.234
f_a	site amplification factor (0.2 s)	1.2
f_v	site amplification factor (1.0 s)	1.7

Type	Description	Value
Hazard Level		BSE-1E
S_S	spectral response (0.2 s)	1.068
S_1	spectral response (1.0 s)	0.355
S_{XS}	site-modified spectral response (0.2 s)	1.282
S_{X1}	site-modified spectral response (1.0 s)	0.69
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.945

Type	Description	Value
Hazard Level		TL Data
T-Sub-L	Long-period transition period in seconds	8

DISCLAIMER

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Table 17-1. Very Low Seismicity Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Structural Components			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-2. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Building System—General			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. No adjacent buildings	5.4.1.2	A.2.1.2
C NC [✓ N/A] U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. No mezzanines	5.4.1.3	A.2.1.3
Building System—Building Configuration			
[✓ C] NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
[✓ C] NC N/A U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. Lateral system is same for both floors	5.4.2.2	A.2.2.3
[✓ C] NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
[✓ C] NC N/A U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
[✓ C] NC N/A U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6
C NC [✓ N/A] U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension.	5.4.2.6	A.2.2.7

continues

Table 17-2 *(Continued)*. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)			
Geologic Site Hazards			
[✓ C] NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	5.4.3.1	A.6.1.1
[✓ C] NC N/A U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure.	5.4.3.1	A.6.1.2
C [✓ NC] N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. Calavares fault is close to site	5.4.3.1	A.6.1.3
High Seismicity (Complete the Following Items in Addition to the Items for Moderate Seismicity)			
Foundation Configuration			
[✓ C] NC N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$. See calc	5.4.3.3	A.6.2.1
[✓ C] NC N/A U	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C.	5.4.3.4	A.6.2.2

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-4. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity			
Seismic-Force-Resisting System			
[✓ C] NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. Sheet F4 of record drawings	5.5.1.1	A.3.2.1.1
[✓ C] NC N/A U	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: See calc Structural panel sheathing 1,000 lb/ft (14.6 kN/m) Diagonal sheathing 700 lb/ft (10.2 kN/m) Straight sheathing 100 lb/ft (1.5 kN/m) All other conditions 100 lb/ft (1.5 kN/m)	5.5.3.1.1	A.3.2.7.1
[✓ C] NC N/A U	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system.	5.5.3.6.1	A.3.2.7.2
[✓ C] NC N/A U	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building.	5.5.3.6.1	A.3.2.7.3
C [✓ NC] N/A U	NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. See F4	5.5.3.6.1	A.3.2.7.4
C NC N/A [✓ U]	WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. No details to verify	5.5.3.6.2	A.3.2.7.5
C NC [✓ N/A] U	HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1.	5.5.3.6.3	A.3.2.7.6

continues

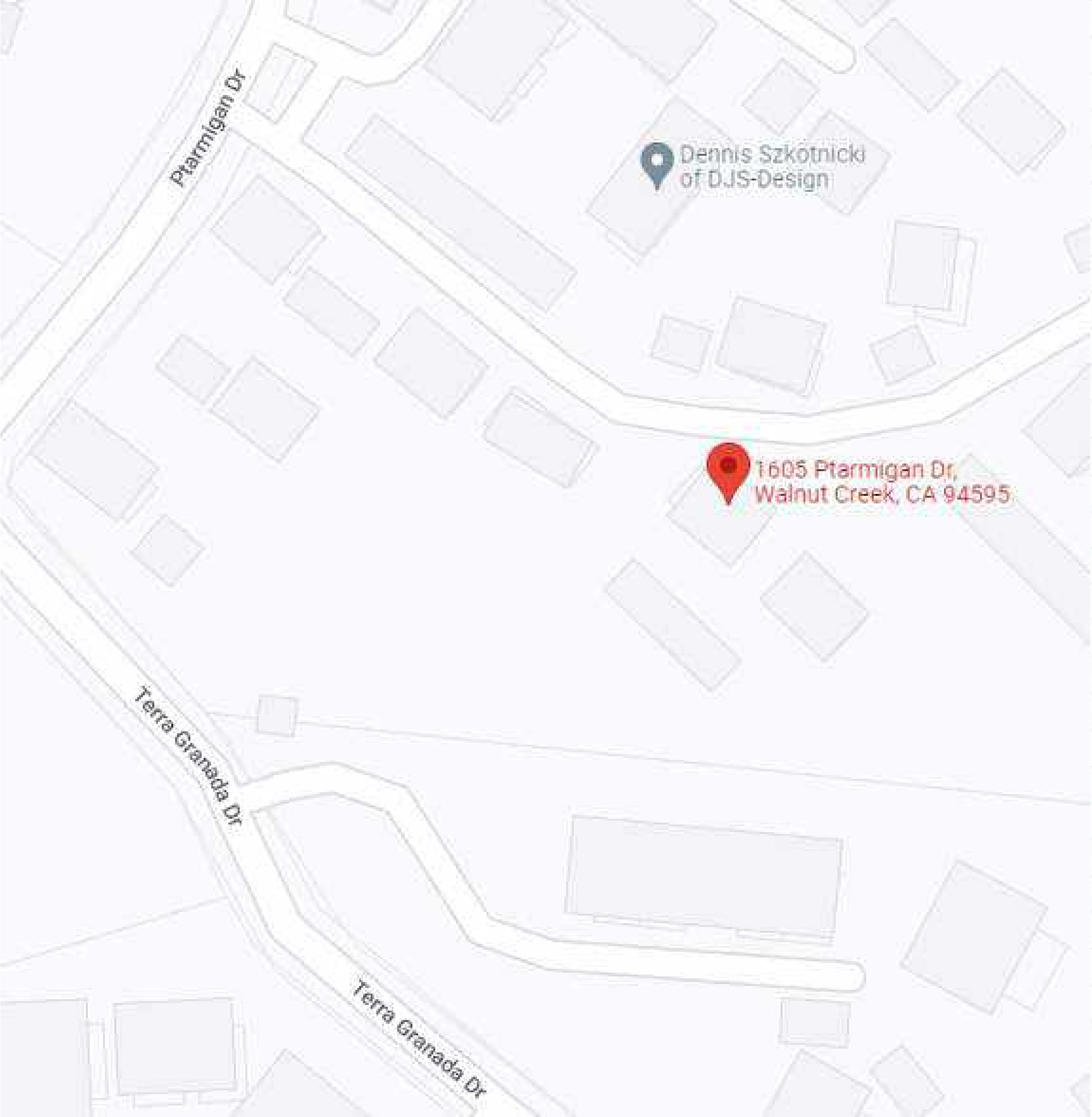
Table 17-4 *(Continued)*. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC [✓ N/A] U	CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels.	5.5.3.6.4	A.3.2.7.7
C NC [✓ N/A] U	OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces.	5.5.3.6.5	A.3.2.7.8
Connections			
[✓ C] NC N/A U	WOOD POSTS: There is a positive connection of wood posts to the foundation. Per detail 13/F1	5.7.3.3	A.5.3.3
[✓ C] NC N/A U	WOOD SILLS: All wood sills are bolted to the foundation. Per SW Notes on F4	5.7.3.3	A.5.3.4
C NC N/A [✓ U]	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support. Details not available	5.7.4.1	A.5.4.1
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Connections			
[✓ C] NC N/A U	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft or less with acceptable edge and end distance provided for wood and concrete. Per SW Notes on A4	5.7.3.3	A.5.3.7
Diaphragms			
[✓ C] NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
[✓ C] NC N/A U	ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation.	5.6.1.1	A.4.1.3
C NC [✓ N/A] U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered.	5.6.2	A.4.2.1
[✓ C] NC N/A U	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC [✓ N/A] U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12 m) and have aspect ratios less than or equal to 4-to-1.	5.6.2	A.4.2.3
[✓ C] NC N/A U	OTHER DIAPHRAGMS: The diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

ASCE 41-17 Tier 1 Two Story

Building Information $Lat := 37.8555633$ $Long := -122.0672989$



Evalute the BPOE with the BSE-2E at S-5 Structural Performance Level (Collapse Prevention) and N-D Non structural performance Level (Hazards Reduced)

Compliance with BSE-2E implies compliance with BSE-1E 3-C Performance Objective (Life Safety Structural Non structural)

$RiskCategory := \text{"II"}$

$BuildingType := \text{"W1A"}$

$S_{XS} := 2.453$ $F_a := 1.2$ $F_v := 1.7$
$S_{X1} := 1.234$
$S_s := 2.044$ $S_1 := 0.726$

$S_{DS} := \frac{2}{3} \cdot F_a \cdot S_s = 1.64$ $S_{D1} := \frac{2}{3} \cdot F_v \cdot S_1 = 0.82$

$LevelOfSeismicity := \text{"High"}$ Table 2-4

For Tier 1, W1A CP Checklists from Table 17-4,

SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than the following values:

Structural panel sheathing	1000 lb/ft
Diagonal sheathing	700 lb/ft
Straight sheathing	100 lb/ft
All other conditions	100 lb/ft

ASCE 41-17, 4.4.3.3 Shear Stress in Shear Walls. The average stress in shear walls, v, shall be calculated in accordance with Eq. (4-8)

Note that the subscript j has been removed since this is a one story building an j indicates level. The superscript avg has also been removed since it seemed hard to do in Mathcad

$$v := \frac{1}{\boxed{M_s}} \cdot \left(\frac{V}{A_w} \right)$$

$M_s := 4.5$	System modification factor; shall be taken from Table 4-8
A_w	Summation of the horizontal cross-sectional area of all shear walls in the direction of loading. Openings shall be taken into consideration where computing A_w. For masonry walls, the net area shall be used. For wood-framed walls, the length shall be used rather than the area

V Story shear computed in accordance with Section 4.4.2.2

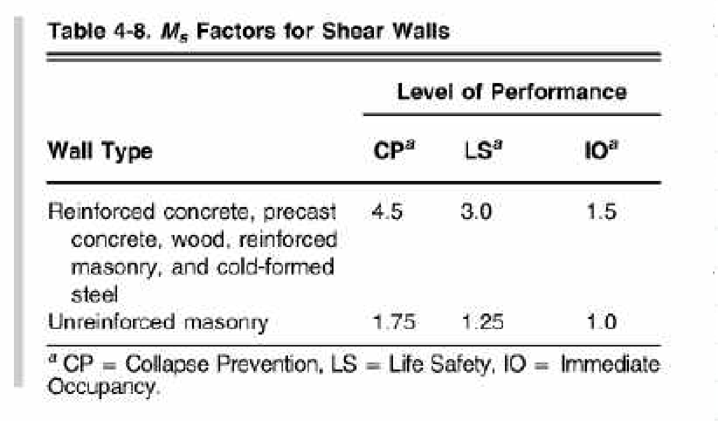


Table 4-8. M_s Factors for Shear Walls

	Level of Performance		
Wall Type	**CP[a]**	**LS[a]**	**IO[a]**
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

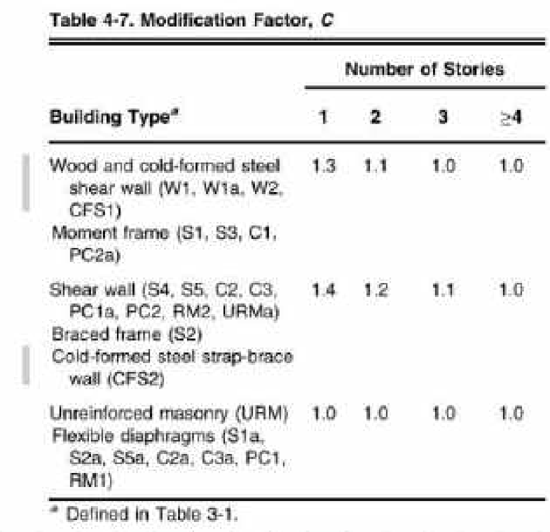


Table 4-7. Modification Factor, C

	Number of Stories			
Building Type[a]	**1**	**2**	**3**	**≥4**
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Determine V, the pseudo lateral force from Equation 4-1. V is a function of

- C, modification factor to relate expected maximum inelastic displacements to displacements calculated for linear elastic response; shall be taken from table 4-7
- S_a, the response spectral acceleration at the fundamentla period of the building in the diretion under consideration. S_a shall be calculated in accordance with Section 4.4.2.3
- W, the total dead load

Building type W1A

$C := 1.1$ Factor for TWO story building.

Determine S_a

1 second period spectral acceleration of the BSE-2E $S_{X1} = 1.234$

Short period spectral acceleration of the BSE-1N Design $S_{XS} = 2.453$

Factor per table 4-8 $M_s = 4.5$

Determine T

Coefficient to determine building period $C_t := 0.020$

Height in feet above the base to the roof level $h_n := 19\ ft = 19\ ft$

$\beta := 0.75$ for all other

Fundamental period of vibration of the building, calculated in accordance with Section 4.4.2.4 $T := C_t \cdot \left(\frac{h_n}{1\ ft}\right)^{\beta} = 0.182$

$S_a := min\left(\frac{S_{X1}}{T}, S_{XS}\right) = 2.453$ Equation 4-3 from 4.4.2.3

Overturning

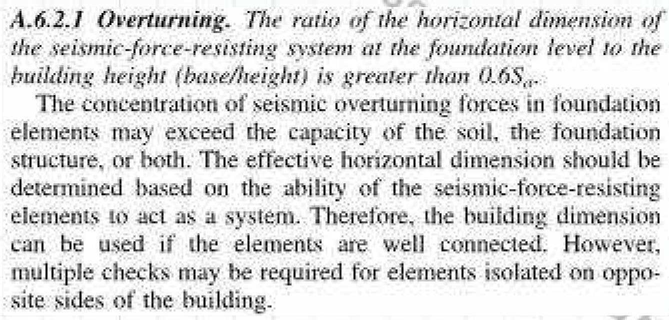
Minimum base dimension of C2A $base := 30\ ft = 30\ ft$

$$\frac{base}{h_n} = 1.58 \qquad 0.6 \cdot S_a = 1.47$$

$$Overturning := \textbf{if}\left(\frac{base}{h_n} > 0.6 \cdot S_a, \text{“Compliant”}, \text{“Non compliant”}\right)$$

$$Overturning = \text{“Compliant”}$$

Per commentary if building is well connected can use building dimensions, not individual shear wall lengths



A.6.2.1 Overturning. *The ratio of the horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than* $0.6S_a$.

The concentration of seismic overturning forces in foundation elements may exceed the capacity of the soil, the foundation structure, or both. The effective horizontal dimension should be determined based on the ability of the seismic-force-resisting elements to act as a system. Therefore, the building dimension can be used if the elements are well connected. However, multiple checks may be required for elements isolated on opposite sides of the building.

Two story portion Weigh up and Geometry

Floor heights from base $h := \begin{bmatrix} 9\ ft \\ 18\ ft \end{bmatrix} = \begin{bmatrix} 9 \\ 18 \end{bmatrix} ft$

Area of walls in north south direction in $A_{wNS} := \begin{bmatrix} 112\ ft \\ 112\ ft \end{bmatrix}$

$A_{wEW} := \begin{bmatrix} 48\ ft \\ 48\ ft \end{bmatrix}$

$RoofArea := 1440\ ft^2$

$FloorArea := 1440\ ft^2$

$WallPerimeter := (30\ ft \cdot 2) + (48\ ft \cdot 2) = 156\ ft$

Weight of roof and walls trib to roof $WallWeight := 20\ psf$

$RoofWeight := 20\ psf$

$FloorWeight := 30\ psf$

$$w := \begin{bmatrix} FloorArea \cdot FloorWeight + WallWeight \cdot WallPerimeter \cdot 9\ ft \\ RoofArea \cdot RoofWeight + WallWeight \cdot WallPerimeter \cdot 4.5\ ft \end{bmatrix} = \begin{bmatrix} 71.28 \\ 42.84 \end{bmatrix} kip$$

Total seismic weight of structure $W := \sum_{i=1}^{\text{length}(w)} w_i = 114.12\ kip$

Psuedo seismic force

Psuedo seismic force per 4.4.2.1 Eq. 4-1

$$V:=C\cdot S_a\cdot W=308\ \textbf{kip}$$

factor per 4.4.2.2

$$k:=\textbf{if}\left(T>2.5,2,\textbf{if}\left(T\le 0.5,1,0.5\cdot T+0.75\right)\right)=1$$

$$x:=1..2$$

$$j:=1..2 \qquad Floors:=2$$

Vertical distribution of psuedo seismic force per 4.5.2.2 Eq 4-3a

$$F_x:=\frac{w_x\cdot h_x^{\ k}}{\sum_{i=1}^{2} w_i\cdot h_i^{\ k}}\cdot V=\begin{bmatrix}140\\168\end{bmatrix}\textbf{kip}$$

Story shear at story level j

$$V_j:=\sum_{x=j}^{Floors} F_x=\begin{bmatrix}308\\168\end{bmatrix}\textbf{kip}$$

Shear stress in shear walls in north south direction

$$v_{NS}:=\frac{1}{M_s}\cdot\frac{V}{A_{wNS}}=\begin{bmatrix}610.97\\333.51\end{bmatrix}\textbf{plf}$$

Shear stress in shear walls in east west direction

$$v_{EW}:=\frac{1}{M_s}\cdot\frac{V}{A_{wEW}}=\begin{bmatrix}1425.6\\778.2\end{bmatrix}\textbf{plf}$$

Shear Stress is slightly more than 1000 plf in E-W with only one shear wall.

APPENDIX C
BUILDING 3
1995 CACTUS COURT

1995 Cactus Ct, Walnut Creek, CA 94595, USA

Latitude, Longitude: 37.8723046, -122.0706504

Date	10/31/2022, 12:08:56 AM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Default (See Section 11.4.3)

Type	Description	Value
Hazard Level		BSE-2N
S_S	spectral response (0.2 s)	1.952
S_1	spectral response (1.0 s)	0.721
S_{XS}	site-modified spectral response (0.2 s)	2.342
S_{X1}	site-modified spectral response (1.0 s)	1.225
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.7
ssuh	max direction uniform hazard (0.2 s)	2.793
crs	coefficient of risk (0.2 s)	0.924
ssrt	risk-targeted hazard (0.2 s)	2.581
ssd	deterministic hazard (0.2 s)	1.952
s1uh	max direction uniform hazard (1.0 s)	1.019
cr1	coefficient of risk (1.0 s)	0.908
s1rt	risk-targeted hazard (1.0 s)	0.925
s1d	deterministic hazard (1.0 s)	0.721

Type	Description	Value
Hazard Level		BSE-1N
S_{XS}	site-modified spectral response (0.2 s)	1.561
S_{X1}	site-modified spectral response (1.0 s)	0.817

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	2.02
S_1	spectral response (1.0 s)	0.713
S_{XS}	site-modified spectral response (0.2 s)	2.342
S_{X1}	site-modified spectral response (1.0 s)	1.212
f_a	site amplification factor (0.2 s)	1.2
f_v	site amplification factor (1.0 s)	1.7

Type	Description	Value
Hazard Level		BSE-1E
S_S	spectral response (0.2 s)	1.056
S_1	spectral response (1.0 s)	0.35
S_{XS}	site-modified spectral response (0.2 s)	1.268
S_{X1}	site-modified spectral response (1.0 s)	0.682
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.95

Type	Description	Value
Hazard Level		TL Data
T-Sub-L	Long-period transition period in seconds	8

DISCLAIMER

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Table 17-1. Very Low Seismicity Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Structural Components			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-2. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Building System—General			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. No adjacent buildings	5.4.1.2	A.2.1.2
C NC [✓ N/A] U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. No mezzanines	5.4.1.3	A.2.1.3
Building System—Building Configuration			
[✓ C] NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
[✓ C] NC N/A U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. Lateral system is same for both floors	5.4.2.2	A.2.2.3
[✓ C] NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
[✓ C] NC N/A U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
[✓ C] NC N/A U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6
C NC [✓ N/A] U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension.	5.4.2.6	A.2.2.7

continues

1995 CACTUS CT

COLLAPSE PREVENTION BASIC CONFIGURTION CHECKLIST FOR TYPICAL TWO-STORY BUILDINGS

Table 17-2 *(Continued)*. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)			
Geologic Site Hazards			
[✓ C] NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	5.4.3.1	A.6.1.1
[✓ C] NC N/A U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure.	5.4.3.1	A.6.1.2
C [✓ NC] N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. Calavares fault is close to site	5.4.3.1	A.6.1.3
High Seismicity (Complete the Following Items in Addition to the Items for Moderate Seismicity)			
Foundation Configuration			
[✓ C] NC N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$. See calc	5.4.3.3	A.6.2.1
[✓ C] NC N/A U	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C.	5.4.3.4	A.6.2.2

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-4. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity			
Seismic-Force-Resisting System			
[✓ C] NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. Per record drawings	5.5.1.1	A.3.2.1.1
[✓ C] NC N/A U	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: See calc Structural panel sheathing 1,000 lb/ft (14.6 kN/m) Diagonal sheathing 700 lb/ft (10.2 kN/m) Straight sheathing 100 lb/ft (1.5 kN/m) All other conditions 100 lb/ft (1.5 kN/m)	5.5.3.1.1	A.3.2.7.1
[✓ C] NC N/A U	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system.	5.5.3.6.1	A.3.2.7.2
[✓ C] NC N/A U	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building.	5.5.3.6.1	A.3.2.7.3
C [✓ NC] N/A U	NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. See F4	5.5.3.6.1	A.3.2.7.4
C NC N/A [✓ U]	WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. No details to verify	5.5.3.6.2	A.3.2.7.5
C NC [✓ N/A] U	HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1.	5.5.3.6.3	A.3.2.7.6

continues

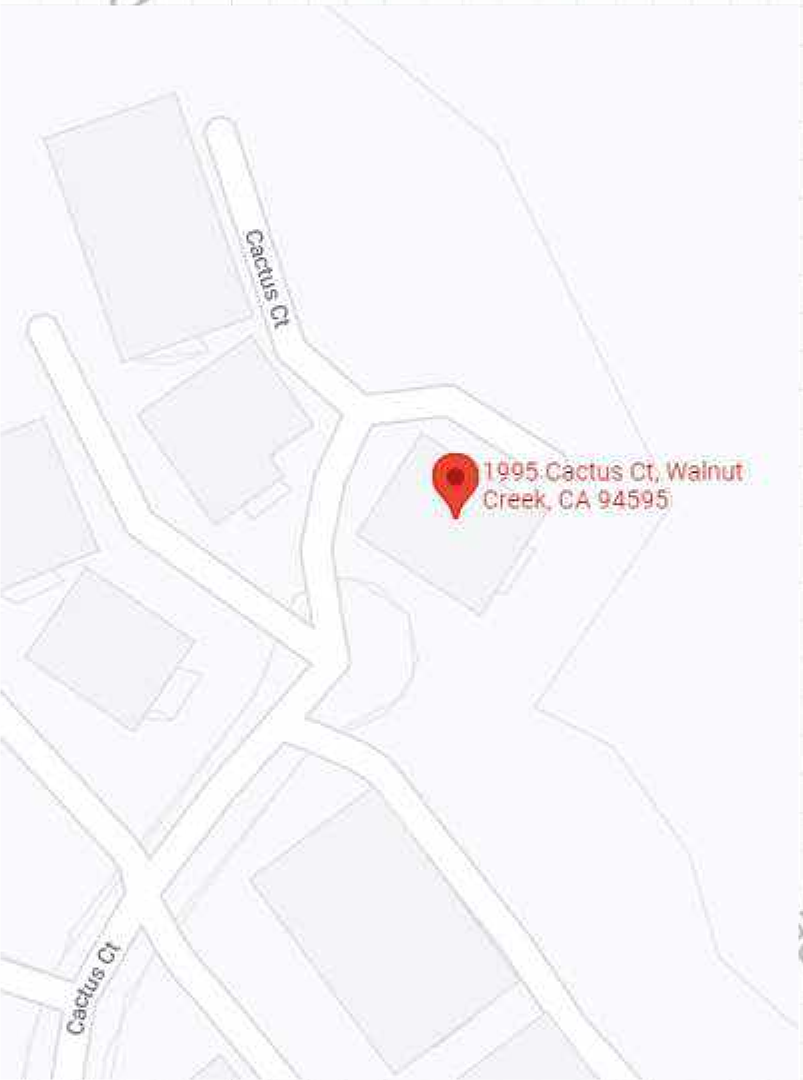
Table 17-4 *(Continued)*. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC [✓ N/A] U	CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels.	5.5.3.6.4	A.3.2.7.7
C NC [✓ N/A] U	OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces.	5.5.3.6.5	A.3.2.7.8
Connections			
[✓ C] NC N/A U	WOOD POSTS: There is a positive connection of wood posts to the foundation. Per detail 13/F1	5.7.3.3	A.5.3.3
[✓ C] NC N/A U	WOOD SILLS: All wood sills are bolted to the foundation. Per notes on T-1	5.7.3.3	A.5.3.4
[✓ C] NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1	A.5.4.1
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Connections			
[✓ C] NC N/A U	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft or less with acceptable edge and end distance provided for wood and concrete. Per notes on T-1	5.7.3.3	A.5.3.7
Diaphragms			
[✓ C] NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
[✓ C] NC N/A U	ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation.	5.6.1.1	A.4.1.3
C NC [✓ N/A] U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered.	5.6.2	A.4.2.1
[✓ C] NC N/A U	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC [✓ N/A] U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12 m) and have aspect ratios less than or equal to 4-to-1.	5.6.2	A.4.2.3
[✓ C] NC N/A U	OTHER DIAPHRAGMS: The diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

ASCE 41-17 Tier 1 Two Story

Building Information $Lat := 37.8723046$ $Long := -122.0706504$



Evalute the BPOE with the BSE-2E at S-5 Structural Performance Level (Collapse Prevention) and N-D Non structural performance Level (Hazards Reduced)

Compliance with BSE-2E implies compliance with BSE-1E 3-C Performance Objective (Life Safety Structural Non structural)

$RiskCategory := \text{“II”}$

$BuildingType := \text{“W1A”}$

$S_{XS} := 2.342$ $F_a := 1.2$ $F_v := 1.7$

$S_{X1} := 1.212$

$S_s := 2.02$ $S_1 := 0.713$

$S_{DS} := \frac{2}{3} \cdot F_a \cdot S_s = 1.62$ $S_{D1} := \frac{2}{3} \cdot F_v \cdot S_1 = 0.81$

$LevelOfSeismicity := \text{“High”}$ Table 2-4

For Tier 1, W1A CP Checklists from Table 17-4,

SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than the following values:

Structural panel sheathing	1000 lb/ft
Diagonal sheathing	700 lb/ft
Straight sheathing	100 lb/ft
All other conditions	100 lb/ft

ASCE 41-17, 4.4.3.3 Shear Stress in Shear Walls. The average stress in shear walls, v, shall be calculated in accordance with Eq. (4-8)

Note that the subscript j has been removed since this is a one story building an j indicates level. The superscript avg has also been removed since it seemed hard to do in Mathcad

$$v := \frac{1}{\boxed{M_s}} \cdot \left(\frac{V}{A_w}\right)$$

$M_s := 4.5$ System modification factor; shall be taken from Table 4-8

A_w Summation of the horizontal cross-sectional area of all shear walls in the direction of loading. Openings shall be taken into consideration where computing A_w. For masonry walls, the net area shall be used. For wood-framed walls, the length shall be used rather than the area

V Story shear computed in accordance with Section 4.4.2.2

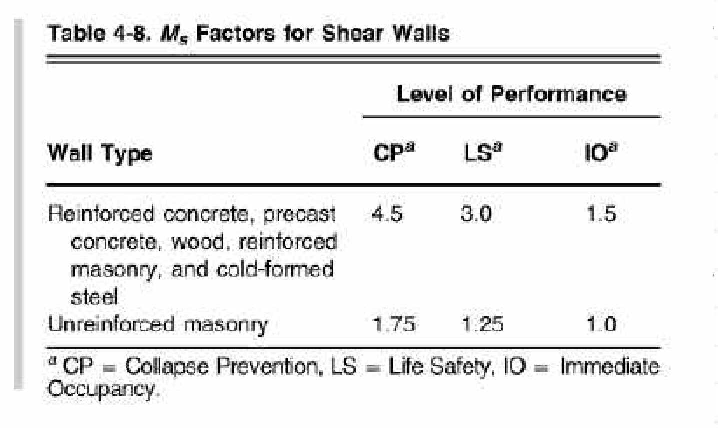


Table 4-8. M_s Factors for Shear Walls

	Level of Performance		
Wall Type	**CP[a]**	**LS[a]**	**IO[a]**
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

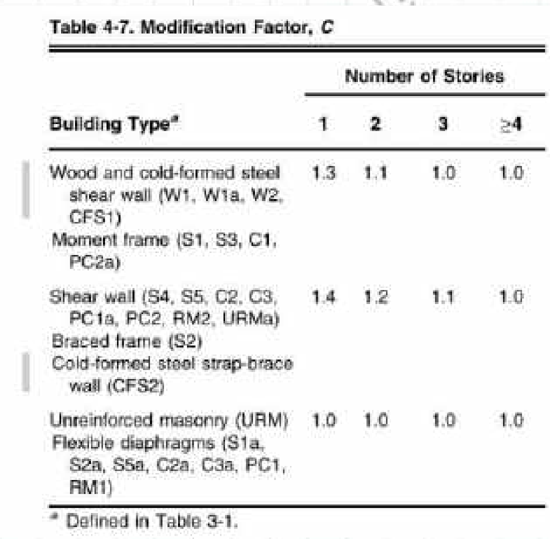


Table 4-7. Modification Factor, C

	Number of Stories			
Building Type[a]	**1**	**2**	**3**	**≥4**
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Determine V, the pseudo lateral force from Equation 4-1. V is a function of

- C, modification factor to relate expected maximum inelastic displacements to displacements calculated for linear elastic response; shall be taken from table 4-7
- S_a, the response spectral acceleration at the fundamentla period of the building in the diretion under consideration. S_a shall be calculated in accordance with Section 4.4.2.3
- W, the total dead load

Building type W1A

$C := 1.1$ Factor for TWO story building.

Determine S_a

1 second period spectral acceleration of the BSE-2E $S_{X1} = 1.212$

Short period spectral acceleration of the BSE-1N Design $S_{XS} = 2.342$

Factor per table 4-8 $M_s = 4.5$

Determine T

Coefficient to determine building period $C_t := 0.020$

Height in feet above the base to the roof level $h_n := 19\ ft = 19\ ft$

$\beta := 0.75$ for all other

Fundamental period of vibration of the building, calculated in accordance with Section 4.4.2.4 $T := C_t \cdot \left(\frac{h_n}{1\ ft}\right)^{\beta} = 0.182$

$S_a := min\left(\frac{S_{X1}}{T}, S_{XS}\right) = 2.342$ Equation 4-3 from 4.4.2.3

Overturning

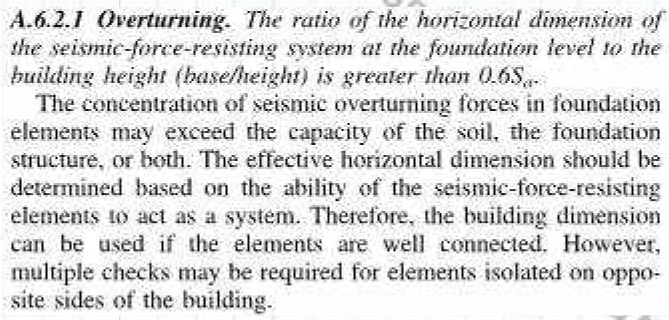
Minimum base dimension of C2A $base := 45\ ft = 45\ ft$

$$\frac{base}{h_n} = 2.37 \qquad 0.6 \cdot S_a = 1.41$$

$$Overturning := \textbf{if}\left(\frac{base}{h_n} > 0.6 \cdot S_a, \text{“Compliant”}, \text{“Non compliant”}\right)$$

$$Overturning = \text{“Compliant”}$$

Per commentary if building is well connected can use building dimensions, not individual shear wall lengths



A.6.2.1 Overturning. *The ratio of the horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$.*

The concentration of seismic overturning forces in foundation elements may exceed the capacity of the soil, the foundation structure, or both. The effective horizontal dimension should be determined based on the ability of the seismic-force-resisting elements to act as a system. Therefore, the building dimension can be used if the elements are well connected. However, multiple checks may be required for elements isolated on opposite sides of the building.

Two story portion Weigh up and Geometry

Floor heights from base $h := \begin{bmatrix} 9\ ft \\ 18\ ft \end{bmatrix} = \begin{bmatrix} 9 \\ 18 \end{bmatrix} ft$

Area of walls in north south direction in $A_{wNS} := \begin{bmatrix} 225\ ft \\ 225\ ft \end{bmatrix}$

$A_{wEW} := \begin{bmatrix} 200\ ft \\ 200\ ft \end{bmatrix}$

$RoofArea := 4740\ ft^2$

$FloorArea := 4740\ ft^2$

$$WallPerimeter := (75\ ft \cdot 2) + (75\ ft \cdot 4) = 450\ ft$$

Weight of roof and walls trib to roof $WallWeight := 20\ psf$

$RoofWeight := 20\ psf$

$FloorWeight := 30\ psf$

$$w := \begin{bmatrix} FloorArea \cdot FloorWeight + WallWeight \cdot WallPerimeter \cdot 9\ ft \\ RoofArea \cdot RoofWeight + WallWeight \cdot WallPerimeter \cdot 4.5\ ft \end{bmatrix} = \begin{bmatrix} 223.2 \\ 135.3 \end{bmatrix} kip$$

Total seismic weight of structure $W := \sum_{i=1}^{\text{length}(w)} w_i = 358.5\ kip$

Psuedo seismic force

Psuedo seismic force per 4.4.2.1 Eq. 4-1 $V := C \cdot S_a \cdot W = 924\ \textbf{kip}$

factor per 4.4.2.2 $k := \textbf{if}\left(T > 2.5, 2, \textbf{if}\left(T \le 0.5, 1, 0.5 \cdot T + 0.75\right)\right) = 1$

$x := 1 .. 2$

$j := 1 .. 2$ $Floors := 2$

Vertical distribution of psuedo seismic force per 4.5.2.2 Eq 4-3a

$$F_x := \frac{w_x \cdot h_x^{\ k}}{\sum_{i=1}^{2} w_i \cdot h_i^{\ k}} \cdot V = \begin{bmatrix} 417 \\ 506 \end{bmatrix} \textbf{kip}$$

Story shear at story level j

$$V_j := \sum_{x=j}^{Floors} F_x = \begin{bmatrix} 924 \\ 506 \end{bmatrix} \textbf{kip}$$

Shear stress in shear walls in north south direction

$$v_{NS} := \frac{1}{M_s} \cdot \frac{V}{A_{wNS}} = \begin{bmatrix} 912.17 \\ 499.86 \end{bmatrix} \textbf{plf}$$

Shear stress in shear walls in east west direction

$$v_{EW} := \frac{1}{M_s} \cdot \frac{V}{A_{wEW}} = \begin{bmatrix} 1026.19 \\ 562.35 \end{bmatrix} \textbf{plf}$$

<u>Shear Stress is slightly more than 1000 plf in E-W (<10%)</u>

APPENDIX D
BUILDING 4
2516 PTARMIGAN DRIVE

2516 Ptarmigan Dr, Walnut Creek, CA 94595, USA

Latitude, Longitude: 37.8575956, -122.0717157

Date	10/28/2022, 2:58:49 PM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Default (See Section 11.4.3)

Type	**Description**	**Value**
Hazard Level		BSE-2N
S_S	spectral response (0.2 s)	2.107
S_1	spectral response (1.0 s)	0.78
S_{XS}	site-modified spectral response (0.2 s)	2.528
S_{X1}	site-modified spectral response (1.0 s)	1.327
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.7
ssuh	max direction uniform hazard (0.2 s)	2.806
crs	coefficient of risk (0.2 s)	0.925
ssrt	risk-targeted hazard (0.2 s)	2.595
ssd	deterministic hazard (0.2 s)	2.107
s1uh	max direction uniform hazard (1.0 s)	1.031
cr1	coefficient of risk (1.0 s)	0.909
s1rt	risk-targeted hazard (1.0 s)	0.937
s1d	deterministic hazard (1.0 s)	0.78

Type	**Description**	**Value**
Hazard Level		BSE-1N
S_{XS}	site-modified spectral response (0.2 s)	1.686
S_{X1}	site-modified spectral response (1.0 s)	0.884

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	2.033
S_1	spectral response (1.0 s)	0.722
S_{XS}	site-modified spectral response (0.2 s)	2.44
S_{X1}	site-modified spectral response (1.0 s)	1.228
f_a	site amplification factor (0.2 s)	1.2
f_v	site amplification factor (1.0 s)	1.7

Type	Description	Value
Hazard Level		BSE-1E
S_S	spectral response (0.2 s)	1.065
S_1	spectral response (1.0 s)	0.354
S_{XS}	site-modified spectral response (0.2 s)	1.278
S_{X1}	site-modified spectral response (1.0 s)	0.689
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.946

Type	Description	Value
Hazard Level		TL Data
T-Sub-L	Long-period transition period in seconds	8

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Table 17-1. Very Low Seismicity Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Structural Components			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-2. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Building System—General			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. No adjacent buildings	5.4.1.2	A.2.1.2
C NC [✓ N/A] U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. No mezzanines	5.4.1.3	A.2.1.3
Building System—Building Configuration			
C NC [✓ N/A] U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
C NC [✓ N/A] U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above.	5.4.2.2	A.2.2.3
[✓ C] NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
C NC [✓ N/A] U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
C NC [✓ N/A] U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6
C NC [✓ N/A] U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension.	5.4.2.6	A.2.2.7

continues

2516 PTARMIGAN
COLLAPSE PREVENTION BASIC CONFIGURTION CHECKLIST

Table 17-2 *(Continued)*. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)			
Geologic Site Hazards			
[✓ C] NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	5.4.3.1	A.6.1.1
[✓ C] NC N/A U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure.	5.4.3.1	A.6.1.2
C [✓ NC] N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. Calavares fault is close to site	5.4.3.1	A.6.1.3
High Seismicity (Complete the Following Items in Addition to the Items for Moderate Seismicity)			
Foundation Configuration			
[✓ C] NC N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$. See calc	5.4.3.3	A.6.2.1
C NC N/A [✓ U]	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C.	5.4.3.4	A.6.2.2

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-4. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity			
Seismic-Force-Resisting System			
[✓ C] NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
[✓ C] NC N/A U	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: Structural panel sheathing 1,000 lb/ft (14.6 kN/m) Diagonal sheathing 700 lb/ft (10.2 kN/m) Straight sheathing 100 lb/ft (1.5 kN/m) All other conditions 100 lb/ft (1.5 kN/m)	5.5.3.1.1	A.3.2.7.1
[✓ C] NC N/A U	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system.	5.5.3.6.1	A.3.2.7.2
[✓ C] NC N/A U	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building.	5.5.3.6.1	A.3.2.7.3
C NC [✓ N/A] U	NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces.	5.5.3.6.1	A.3.2.7.4
C NC [✓ N/A] U	WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. No details to verify	5.5.3.6.2	A.3.2.7.5
C NC [✓ N/A] U	HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1.	5.5.3.6.3	A.3.2.7.6

continues

Table 17-4 *(Continued)*. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC [✓ N/A] U	CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels.	5.5.3.6.4	A.3.2.7.7
C NC [✓ N/A] U	OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces.	5.5.3.6.5	A.3.2.7.8
Connections			
[✓ C] NC N/A U	WOOD POSTS: There is a positive connection of wood posts to the foundation. Per detail 11/TS-1	5.7.3.3	A.5.3.3
[✓ C] NC N/A U	WOOD SILLS: All wood sills are bolted to the foundation. NO DETAIL FOUND	5.7.3.3	A.5.3.4
[✓ C] NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support. Details not available	5.7.4.1	A.5.4.1
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Connections			
C NC N/A U	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft or less with acceptable edge and end distance provided for wood and concrete.	5.7.3.3	A.5.3.7
Diaphragms			
[✓ C] NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
[✓ C] NC N/A U	ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation.	5.6.1.1	A.4.1.3
C NC [✓ N/A] U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered.	5.6.2	A.4.2.1
[✓ C] NC N/A U	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC [✓ N/A] U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12 m) and have aspect ratios less than or equal to 4-to-1.	5.6.2	A.4.2.3
[✓ C] NC N/A U	OTHER DIAPHRAGMS: The diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

ASCE 41-17 Tier 1 One Story

Building Information $Lat := 37.8575956$ $Long := -122.0717157$

Evalute the BPOE with the BSE-2E at S-5 Structural Performance Level (Collapse Prevention) and N-D Non structural performance Level (Hazards Reduced)

Compliance with BSE-2E implies compliance with BSE-1E 3-C Performance Objective (Life Safety Structural Non structural)

$RiskCategory := \text{“II”}$

$BuildingType := \text{“W1A”}$ Multistory, multiunit residential

$S_{XS} := 2.44$ $F_a := 1.2$ $F_v := 1.7$

$S_{X1} := 1.228$

$S_s := 2.033$ $S_1 := 0.722$

$S_{DS} := \frac{2}{3} \cdot F_a \cdot S_s = 1.63$ $S_{D1} := \frac{2}{3} \cdot F_v \cdot S_1 = 0.82$

$LevelOfSeismicity := \text{“High”}$ Table 2-4

For Tier 1, W1A CP Checklists from Table 17-4,

SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than the following values:

Structural panel sheathing	1000 lb/ft
Diagonal sheathing	700 lb/ft
Straight sheathing	100 lb/ft
All other conditions	100 lb/ft

ASCE 41-17, 4.4.3.3 Shear Stress in Shear Walls. The average stress in shear walls, v, shall be calculated in accordance with Eq. (4-8)

Note that the subscript j has been removed since this is a one story building an j indicates level. The superscript avg has also been removed since it seemed hard to do in Mathcad

$$v := \frac{1}{\boxed{M_s}} \cdot \left(\frac{V}{A_w}\right)$$

$M_s := 4.5$ System modification factor; shall be taken from Table 4-8

A_w Summation of the horizontal cross-sectional area of all shear walls in the direction of loading. Openings shall be taken into consideration where computing A_w. For masonry walls, the net area shall be used. For wood-framed walls, the length shall be used rather than the area

V Story shear computed in accordance with Section 4.4.2.2

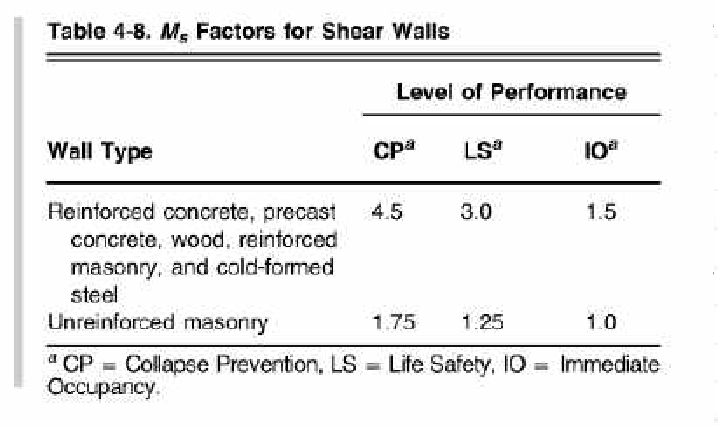


Table 4-8. M_s Factors for Shear Walls

	Level of Performance		
Wall Type	**CP[a]**	**LS[a]**	**IO[a]**
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

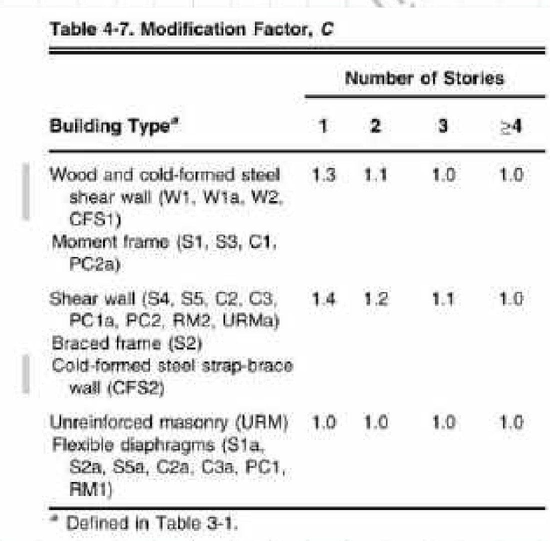


Table 4-7. Modification Factor, C

	Number of Stories			
Building Type[a]	**1**	**2**	**3**	**≥4**
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Determine V, the pseudo lateral force from Equation 4-1. V is a function of

- C, modification factor to relate expected maximum inelastic displacements to displacements calculated for linear elastic response; shall be taken from table 4-7
- S_a, the response spectral acceleration at the fundamentla period of the building in the diretion under consideration. S_a shall be calculated in accordance with Section 4.4.2.3
- W, the total dead load

Building type W1A

$C := 1.3$ Factor for One story building.

Determine S_a

1 second period spectral acceleration of the BSE-2E $S_{X1} = 1.228$

Short period spectral acceleration of the BSE-1N Design $S_{XS} = 2.44$

Factor per table 4-8 $M_s = 4.5$

Determine T

Coefficient to determine building period $C_t := 0.020$

Height in feet above the base to the roof level $h_n := 19\ ft = 19\ ft$

$\beta := 0.75$ for all other

Fundamental period of vibration of the building, calculated in accordance with Section 4.4.2.4 $T := C_t \cdot \left(\frac{h_n}{1\ ft}\right)^{\beta} = 0.182$

$S_a := min\left(\frac{S_{X1}}{T}, S_{XS}\right) = 2.44$ Equation 4-3 from 4.4.2.3

Overturning

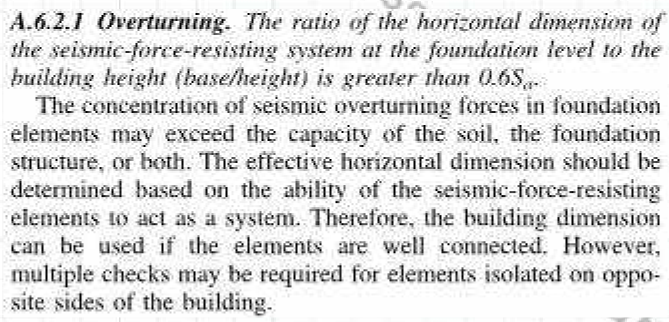
Minimum base dimension of C2A $base := 40\ ft = 40\ ft$

$$\frac{base}{h_n} = 2.11 \qquad 0.6 \cdot S_a = 1.46$$

$$Overturning := \mathbf{if}\left(\frac{base}{h_n} > 0.6 \cdot S_a, \text{“Compliant”}, \text{“Non compliant”}\right)$$

$$Overturning = \text{“Compliant”}$$

Per commentary if building is well connected can use building dimensions, not individual shear wall lengths



A.6.2.1 Overturning. *The ratio of the horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than* $0.6S_a$.

The concentration of seismic overturning forces in foundation elements may exceed the capacity of the soil, the foundation structure, or both. The effective horizontal dimension should be determined based on the ability of the seismic-force-resisting elements to act as a system. Therefore, the building dimension can be used if the elements are well connected. However, multiple checks may be required for elements isolated on opposite sides of the building.

Two story portion Weigh up and Geometry

Floor heights from base

$$h := \begin{bmatrix} 9\ ft \\ 0\ ft \end{bmatrix} = \begin{bmatrix} 9 \\ 0 \end{bmatrix} ft$$

Area of walls in north south direction in

$$A_{wNS} := \begin{bmatrix} 65\ ft \\ 1\ ft \end{bmatrix}$$

$$A_{wEW} := \begin{bmatrix} 65\ ft \\ 1\ ft \end{bmatrix}$$

$$RoofArea := 2400\ ft^2$$
$$FloorArea := 2400\ ft^2$$

$$WallPerimeter := (66\ ft \cdot 2) + (23.5\ ft \cdot 2) = 179\ ft$$

Weight of roof and walls trib to roof

$$WallWeight := 20\ psf$$

$$RoofWeight := 20\ psf$$

$$FloorWeight := 0\ psf$$

$$w := \begin{bmatrix} FloorArea \cdot FloorWeight + WallWeight \cdot WallPerimeter \cdot 9\ ft \\ RoofArea \cdot RoofWeight + WallWeight \cdot WallPerimeter \cdot 4.5\ ft \end{bmatrix} = \begin{bmatrix} 32.22 \\ 64.11 \end{bmatrix} kip$$

Total seismic weight of structure

$$W := \sum_{i=1}^{\text{length}(w)} w_i = 96.33\ kip$$

Psuedo seismic force

Psuedo seismic force per 4.4.2.1 Eq. 4-1 $V := C \cdot S_a \cdot W = 306\ \textbf{kip}$

factor per 4.4.2.2 $k := \textbf{if}\left(T > 2.5, 2, \textbf{if}\left(T \le 0.5, 1, 0.5 \cdot T + 0.75\right)\right) = 1$

$x := 1..2$

$j := 1..2$ $Floors := 2$

Vertical distribution of psuedo seismic force per 4.5.2.2 Eq 4-3a

$$F_x := \frac{w_x \cdot h_x^{\ k}}{\sum_{i=1}^{2} w_i \cdot h_i^{\ k}} \cdot V = \begin{bmatrix} 306 \\ 0 \end{bmatrix} \textbf{kip}$$

Story shear at story level j

$$V_j := \sum_{x=j}^{Floors} F_x = \begin{bmatrix} 306 \\ 0 \end{bmatrix} \textbf{kip}$$

Shear stress in shear walls in north south direction

$$v_{NS} := \frac{1}{M_s} \cdot \frac{V}{A_{wNS}} = \begin{bmatrix} 1044.65 \\ 0 \end{bmatrix} \textbf{plf}$$

Shear stress in shear walls in east west direction

$$v_{EW} := \frac{1}{M_s} \cdot \frac{V}{A_{wEW}} = \begin{bmatrix} 1044.65 \\ 0 \end{bmatrix} \textbf{plf}$$

Shear Stress is more than 1000 plf for structural panel sheathing <10% overstress. OK

APPENDIX E

BUILDING 5

3101 TERRA GRANADA DRIVE

3101 Terra Granada Dr, Walnut Creek, CA 94595, USA

Latitude, Longitude: 37.8545483, -122.0681867

Date	10/31/2022, 12:48:39 AM
Design Code Reference Document	ASCE41-17
Custom Probability	
Site Class	D - Default (See Section 11.4.3)

Type	**Description**	**Value**
Hazard Level		BSE-2N
S_S	spectral response (0.2 s)	2.151
S_1	spectral response (1.0 s)	0.798
S_{XS}	site-modified spectral response (0.2 s)	2.581
S_{X1}	site-modified spectral response (1.0 s)	1.356
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.7
ssuh	max direction uniform hazard (0.2 s)	2.823
crs	coefficient of risk (0.2 s)	0.924
ssrt	risk-targeted hazard (0.2 s)	2.609
ssd	deterministic hazard (0.2 s)	2.151
s1uh	max direction uniform hazard (1.0 s)	1.037
cr1	coefficient of risk (1.0 s)	0.909
s1rt	risk-targeted hazard (1.0 s)	0.942
s1d	deterministic hazard (1.0 s)	0.798

Type	**Description**	**Value**
Hazard Level		BSE-1N
S_{XS}	site-modified spectral response (0.2 s)	1.721
S_{X1}	site-modified spectral response (1.0 s)	0.904

Type	Description	Value
Hazard Level		BSE-2E
S_S	spectral response (0.2 s)	2.043
S_1	spectral response (1.0 s)	0.726
S_{XS}	site-modified spectral response (0.2 s)	2.452
S_{X1}	site-modified spectral response (1.0 s)	1.234
f_a	site amplification factor (0.2 s)	1.2
f_v	site amplification factor (1.0 s)	1.7

Type	Description	Value
Hazard Level		BSE-1E
S_S	spectral response (0.2 s)	1.069
S_1	spectral response (1.0 s)	0.355
S_{XS}	site-modified spectral response (0.2 s)	1.282
S_{X1}	site-modified spectral response (1.0 s)	0.691
F_a	site amplification factor (0.2 s)	1.2
F_v	site amplification factor (1.0 s)	1.945

Type	Description	Value
Hazard Level		TL Data
T-Sub-L	Long-period transition period in seconds	8

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Table 17-1. Very Low Seismicity Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Structural Components			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-2. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Building System—General			
[✓ C] NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC [✓ N/A] U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. No adjacent buildings	5.4.1.2	A.2.1.2
C NC [✓ N/A] U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. No mezzanines	5.4.1.3	A.2.1.3
Building System—Building Configuration			
[✓ C] NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
[✓ C] NC N/A U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. Lateral system is same for both floors	5.4.2.2	A.2.2.3
[✓ C] NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
[✓ C] NC N/A U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
[✓ C] NC N/A U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6
C NC [✓ N/A] U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension.	5.4.2.6	A.2.2.7

continues

Table 17-2 *(Continued)*. Collapse Prevention Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)			
Geologic Site Hazards			
[✓ C] NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	5.4.3.1	A.6.1.1
[✓ C] NC N/A U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure.	5.4.3.1	A.6.1.2
C [✓ NC] N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. Calavares fault is close to site	5.4.3.1	A.6.1.3
High Seismicity (Complete the Following Items in Addition to the Items for Moderate Seismicity)			
Foundation Configuration			
C [✓ NC] N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$. See calc	5.4.3.3	A.6.2.1
C NC N/A [✓ U]	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C.	5.4.3.4	A.6.2.2

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-4. Collapse Prevention Structural Checklist for Building Types W1 and W1a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity			
Seismic-Force-Resisting System			
[✓ C] NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C [✓ NC] N/A U	SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: Structural panel sheathing 1,000 lb/ft (14.6 kN/m) Diagonal sheathing 700 lb/ft (10.2 kN/m) Straight sheathing 100 lb/ft (1.5 kN/m) All other conditions 100 lb/ft (1.5 kN/m)	5.5.3.1.1	A.3.2.7.1
[✓ C] NC N/A U	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system.	5.5.3.6.1	A.3.2.7.2
[✓ C] NC N/A U	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building.	5.5.3.6.1	A.3.2.7.3
C NC N/A [✓ U]	NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces.	5.5.3.6.1	A.3.2.7.4
[✓ C] NC N/A U	WALLS CONNECTED THROUGH FLOORS: Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor.	5.5.3.6.2	A.3.2.7.5
C NC [✓ N/A] U	HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1.	5.5.3.6.3	A.3.2.7.6

continues

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COLLAPSE PREVENTION CHECKLIST FOR TYPICAL TWO-STORY BUILDINGS

Table 17-4 *(Continued)*. Collapse Prevention Structural Checklist for Building Types W1 and W1a Page 104

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC [✓ N/A] U	CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels.	5.5.3.6.4	A.3.2.7.7
C NC [✓ N/A] U	OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces.	5.5.3.6.5	A.3.2.7.8
Connections			
[✓ C] NC N/A U	WOOD POSTS: There is a positive connection of wood posts to the foundation.	5.7.3.3	A.5.3.3
C NC N/A [✓ U]	WOOD SILLS: All wood sills are bolted to the foundation. No plans/details to verify	5.7.3.3	A.5.3.4
C NC N/A [✓ U]	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1 Details not available	A.5.4.1
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Connections			
C NC N/A [✓ U]	WOOD SILL BOLTS: Sill bolts are spaced at 6 ft or less with acceptable edge and end distance provided for wood and concrete. No plans/details to verify	5.7.3.3	A.5.3.7
Diaphragms			
[✓ C] NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
[✓ C] NC N/A U	ROOF CHORD CONTINUITY: All chord elements are continuous, regardless of changes in roof elevation.	5.6.1.1	A.4.1.3
C NC [✓ N/A] U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered.	5.6.2	A.4.2.1
[✓ C] NC N/A U	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC [✓ N/A] U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12 m) and have aspect ratios less than or equal to 4-to-1.	5.6.2	A.4.2.3
[✓ C] NC N/A U	OTHER DIAPHRAGMS: The diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

ASCE 41-17 Tier 1 Two Story

Building Information $Lat := 37.8545483$ $Long := -122.0681867$

Evalute the BPOE with the BSE-2E at S-5 Structural Performance Level (Collapse Prevention) and N-D Non structural performance Level (Hazards Reduced)

Compliance with BSE-2E implies compliance with BSE-1E 3-C Performance Objective (Life Safety Structural Non structural)

$RiskCategory := \text{"II"}$

$BuildingType := \text{"W1A"}$

$S_{XS} := 2.452$ $F_a := 1.2$ $F_v := 1.7$

$S_{X1} := 1.234$

$S_s := 2.043$ $S_1 := 0.726$

$S_{DS} := \frac{2}{3} \cdot F_a \cdot S_s = 1.63$ $S_{D1} := \frac{2}{3} \cdot F_v \cdot S_1 = 0.82$

$LevelOfSeismicity := \text{"High"}$ Table 2-4

For Tier 1, W1A CP Checklists from Table 17-4,

SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than the following values:

Structural panel sheathing	1000 lb/ft
Diagonal sheathing	700 lb/ft
Straight sheathing	100 lb/ft
All other conditions	100 lb/ft

ASCE 41-17, 4.4.3.3 Shear Stress in Shear Walls. The average stress in shear walls, v, shall be calculated in accordance with Eq. (4-8)

Note that the subscript j has been removed since this is a one story building an j indicates level. The superscript avg has also been removed since it seemed hard to do in Mathcad

$$v := \frac{1}{\boxed{M_s}} \cdot \left(\frac{V}{A_w}\right)$$

$M_s := 4.5$	System modification factor; shall be taken from Table 4-8
A_w	Summation of the horizontal cross-sectional area of all shear walls in the direction of loading. Openings shall be taken into consideration where computing A_w. For masonry walls, the net area shall be used. For wood-framed walls, the length shall be used rather than the area

V Story shear computed in accordance with Section 4.4.2.2

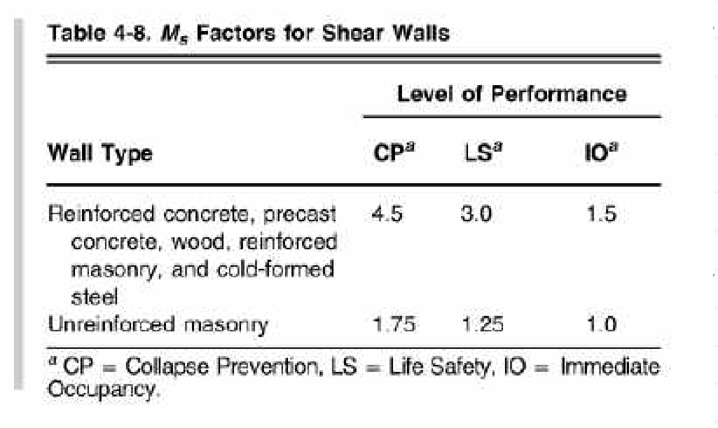


Table 4-8. M_s Factors for Shear Walls

Wall Type	Level of Performance CP[a]	LS[a]	IO[a]
Reinforced concrete, precast concrete, wood, reinforced masonry, and cold-formed steel	4.5	3.0	1.5
Unreinforced masonry	1.75	1.25	1.0

[a] CP = Collapse Prevention, LS = Life Safety, IO = Immediate Occupancy.

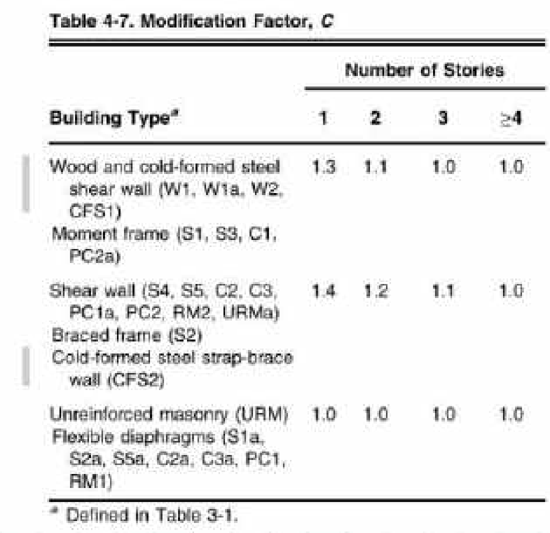


Table 4-7. Modification Factor, C

Building Type[a]	Number of Stories 1	2	3	≥4
Wood and cold-formed steel shear wall (W1, W1a, W2, CFS1) Moment frame (S1, S3, C1, PC2a)	1.3	1.1	1.0	1.0
Shear wall (S4, S5, C2, C3, PC1a, PC2, RM2, URMa) Braced frame (S2) Cold-formed steel strap-brace wall (CFS2)	1.4	1.2	1.1	1.0
Unreinforced masonry (URM) Flexible diaphragms (S1a, S2a, S5a, C2a, C3a, PC1, RM1)	1.0	1.0	1.0	1.0

[a] Defined in Table 3-1.

Determine V, the pseudo lateral force from Equation 4-1. V is a function of

- C, modification factor to relate expected maximum inelastic displacements to displacements calculated for linear elastic response; shall be taken from table 4-7
- S_a, the response spectral acceleration at the fundamentla period of the building in the diretion under consideration. S_a shall be calculated in accordance with Section 4.4.2.3
- W, the total dead load

Building type W1A

$C := 1.1$ Factor for TWO story building.

Determine S_a

1 second period spectral acceleration of the BSE-2E $S_{X1} = 1.234$

Short period spectral acceleration of the BSE-1N Design $S_{XS} = 2.452$

Factor per table 4-8 $M_s = 4.5$

Determine T

Coefficient to determine building period $C_t := 0.020$

Height in feet above the base to the roof level $h_n := 19\ ft = 19\ ft$

$\beta := 0.75$ for all other

Fundamental period of vibration of the building, calculated in accordance with Section 4.4.2.4 $T := C_t \cdot \left(\dfrac{h_n}{1\ ft}\right)^{\beta} = 0.182$

$S_a := min\left(\dfrac{S_{X1}}{T}, S_{XS}\right) = 2.452$ Equation 4-3 from 4.4.2.3

Overturning

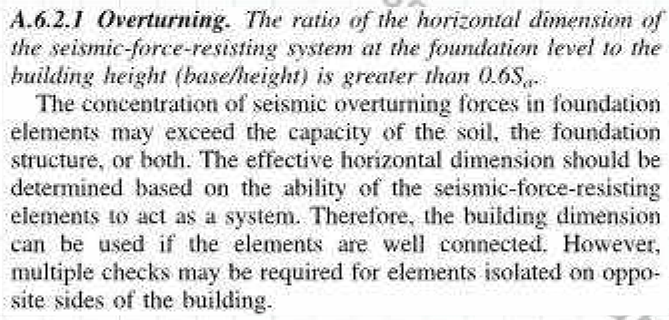
Minimum base dimension of C2A $base := 30\ ft = 30\ ft$

$\frac{base}{h_n} = 1.58$ $0.6 \cdot S_a = 1.47$

$$Overturning := \mathbf{if}\left(\frac{base}{h_n} > 0.6 \cdot S_a, \text{“Compliant”}, \text{“Non compliant”}\right)$$

$Overturning = \text{“Compliant”}$

Per commentary if building is well connected can use building dimensions, not individual shear wall lengths



A.6.2.1 Overturning. *The ratio of the horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$.*

The concentration of seismic overturning forces in foundation elements may exceed the capacity of the soil, the foundation structure, or both. The effective horizontal dimension should be determined based on the ability of the seismic-force-resisting elements to act as a system. Therefore, the building dimension can be used if the elements are well connected. However, multiple checks may be required for elements isolated on opposite sides of the building.

Two story portion Weigh up and Geometry

Floor heights from base

$$h := \begin{bmatrix} 9\ ft \\ 18\ ft \end{bmatrix} = \begin{bmatrix} 9 \\ 18 \end{bmatrix} ft$$

Area of walls in north south direction in

$$A_{wNS} := \begin{bmatrix} 28\ ft \\ 28\ ft \end{bmatrix}$$

$$A_{wEW} := \begin{bmatrix} 20\ ft \\ 20\ ft \end{bmatrix}$$

$$RoofArea := 1496\ ft^2$$

$$FloorArea := 1496\ ft^2$$

$$WallPerimeter := (34\ ft \cdot 2) + (44\ ft \cdot 2) = 156\ ft$$

Weight of roof and walls trib to roof

$$WallWeight := 20\ psf$$

$$RoofWeight := 20\ psf$$

$$FloorWeight := 30\ psf$$

$$w := \begin{bmatrix} FloorArea \cdot FloorWeight + WallWeight \cdot WallPerimeter \cdot 9\ ft \\ RoofArea \cdot RoofWeight + WallWeight \cdot WallPerimeter \cdot 4.5\ ft \end{bmatrix} = \begin{bmatrix} 72.96 \\ 43.96 \end{bmatrix} kip$$

Total seismic weight of structure

$$W := \sum_{i=1}^{\text{length}(w)} w_i = 116.92\ kip$$

Psuedo seismic force

Psuedo seismic force per 4.4.2.1 Eq. 4-1 $V:=C \cdot S_a \cdot W=315\ kip$

factor per 4.4.2.2 $k:=\mathbf{if}\left(T>2.5,2,\mathbf{if}\left(T\leq 0.5,1,0.5 \cdot T+0.75\right)\right)=1$

$x:=1..2$

$j:=1..2$ $Floors:=2$

Vertical distribution of psuedo seismic force per 4.5.2.2 Eq 4-3a

$$F_x:=\frac{w_x \cdot h_x^{\,k}}{\sum_{i=1}^{2} w_i \cdot h_i^{\,k}} \cdot V=\begin{bmatrix}143\\172\end{bmatrix}\ kip$$

Story shear at story level j

$$V_j:=\sum_{x=j}^{Floors} F_x=\begin{bmatrix}315\\172\end{bmatrix}\ kip$$

Shear stress in shear walls in north south direction

$$v_{NS}:=\frac{1}{M_s} \cdot \frac{V}{A_{wNS}}=\begin{bmatrix}2502.83\\1367.78\end{bmatrix}\ plf$$

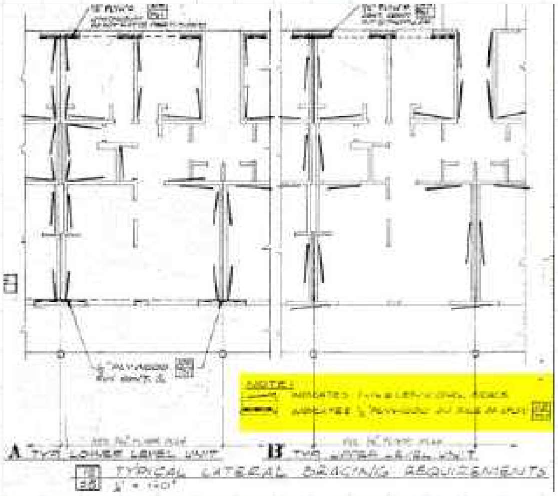
Shear stress in shear walls in east west direction

$$v_{EW}:=\frac{1}{M_s} \cdot \frac{V}{A_{wEW}}=\begin{bmatrix}3503.96\\1914.9\end{bmatrix}\ plf$$

Shear Stress exceeeds 1000 plf in both directions.

Check 1-1 X6 LET-IN Diagonal Brace

Consider half of the lateral load to be resisted by Brace as shownin plan:



$V := \frac{143}{2}\ kip = 71.5\ kip$

Total no. of braces = 8

$Vb := \frac{V}{8} = 8.94\ kip$ Force in each brace

Check 1-1x6 in tension:

$Ab := 0.75\ in \cdot 5.5\ in = 0.03\ ft^2$ Area of brace

$Ft := 800\ psi$ $Cd := 1.6$

$Ft' := Ft \cdot Cd = 1280\ psi$

$P := Ft' \cdot Ab = 5.28\ kip$ Tension capacity of brace

Tension capacity of brace < Demand