APPENDIX A: Definitions of Common Construction Terms

Anchor side plate--A metal plate or plates used to connect the sill plate or floor framing to the side of a concrete stem wall when conditions prevent anchor or bolt installation vertically through the sill plate.

Chemical anchor--A fastener placed in hardened concrete that derives its holding strength from a chemical adhesive compound placed between the wall of the hole and the embedded portion of the anchor. Chemical adhesive compounds are organic compounds, composed of resin and hardener, that form adhesives when blended together. Examples of chemical adhesive compounds include epoxies, polyurethanes, polyesters, methyl methacrylates and vinylesters.

Composite panel--A wood structural panel product composed of a combination of wood veneer and wood-based material and bonded with waterproof adhesive.

Pony wall--A wood-framed stud wall extending from the top of the foundation to the underside of the lowest floor framing. Also called a cripple wall or knee wall.

Embedment depth--The depth of the anchor into the concrete prior to setting of the anchor.

Expansion bolt --A mechanical fastener placed in hardened concrete designed to expand in a self-drilled or pre-drilled hole of a specified size and engage the sides of the hole in one or more locations to develop shear and/or tension resistance to applied loads without grout, adhesive or drypack.

Installation torque--The minimum moment applied to a torque-set anchor that creates the degree of anchorage required for full load values.

Minimum concrete edge distance--The measure between the free edge of the concrete and the centerline of the bolt at which the concrete will not break away when the anchor is set or loaded in service. Minimum edge distances for anchors are given in the produce approval

Oriented strand board (OSB)--A mat-formed structural panel product composed of thin rectangular wood strands or wafers arranged in oriented layers and bonded with waterproof adhesive.

Perimeter foundation--A foundation system that is located under the exterior walls of a building.

Plan detail--An individual drawing of a specific portion of construction containing dimensions, notes, and other information necessary to guide the work to be done.

Plywood--A structural panel product composed of sheets of wood veneer bonded together and with the grain of adjacent layers oriented at right angles to one another.

Snug tight--The condition when the full surface of the plate washer is in contact with the wood member and begins to slightly indent the wood surface.

Torque-set anchor--An expansion anchor whose wedge or sleeve engages the concrete base material in the drilled hole by the application of torque and where the amount of torque applied controls the degree of anchorage.

Waferboard--A mat-formed wood structural panel product composed of thin rectangular wood wafers arranged in random layers and bonded with waterproof adhesive.

Wood structural panel--A structural panel product composed primarily of wood and meeting the requirements of United States Voluntary Product Standard PS 1 and United States Voluntary Product Standard PS 2. Wood structural panels include all-veneer plywood, composite panels containing a combination of veneer and wood-based materials, and mat-formed panels such as oriented strand board and wafer board.

APPENDIX B: Basic Concepts for Earthquake Resistant Design

Earthquake Shaking

When an earthquake occurs, the ground beneath a building shakes in all directions. How strong the shaking is at the building site and how much damage is produced depends on the following factors:

- **The "size" of the earthquake**. The size of an earthquake is usually described by either a number related to the amplitude of the recorded ground motion, called magnitude, or by a subjective description of the level of damage observed at a particular site, called the intensity. The initial magnitude reported by different earthquake centers may vary slightly due to differences in the recorded signals used to calculate the magnitude. These minor differences generally are resolved when measurements of recorded signals for a number of centers are combined. There are also different types of magnitude determined by measuring the amplitude of different parts of the recorded earthquake ground motion. The earthquake's magnitude will be reported as a single number. The magnitude is often used in equations to calculate the amount of energy released by the earthquake. The magnitude of an earthquake is similar to the number of watts used to indicate the strength of a light bulb.

  The intensity of an earthquake is measured using a scale of increasing numbers representing increasing levels of observed damage. Each earthquake will produce many different intensities. The intensity assigned to a particular event will represent the greatest amount of damaged observed, called the maximum intensity. The intensity of an earthquake is similar to the brightness of a light bulb observed at different locations relative to the bulb.

- **The depth of the earthquake**. A shallow earthquake will typically cause the most severe damage near the epicenter, which is the point on the Earth's surface directly above the earthquake's point of origin. A deep earthquake of the same magnitude will cause less damage near the epicenter because the point of origin is now farther from the surface, but it will typically cause damage over a larger area.

- **The distance of the building from the fault causing the earthquake**. A fault is a weakness in the Earth's brittle outer layer along which movement occurs. Sudden slip along a fault generates the shaking we call an earthquake. The distance to the place along the fault where slip occurred, called the hypocenter, is important in determining the resulting shaking. Buildings close to the fault will usually feel stronger shaking than those farther away.

- **The composition of the soil at the building site**. Hard, rocky or firm ground will tend to shake the most in response to rapid back and forth movements. A short, stiff building also shakes more strongly in response to rapid back and forth movements. Thus, a short stiff building like an Unreinforced Masonry building will typically sustain greater damage when shaken rapidly on a firm site. Soft sandy or clayey soil will tend to shake more in response to slower back and forth motions. A tall, flexible building shakes more strongly in response to slower ground motions. Thus, a tall, flexible building like a high rise will typically sustain greater damage when shaken more slowly on a soft site. This matching of ground motion to the natural period of vibration of the building producing stronger (amplified) motions is called resonance.

Building Forces

The size of the shaking generated in a building during an earthquake will depend upon the building's size and type of building materials as well as the ground accelerations produced by the earthquake’s shaking. A large, heavy building will generate more force when set into motion by earthquake ground shaking than a small, light building. Force may be calculated by multiplying the building’s weight times the ground acceleration caused by the earthquake’s shaking.

During an earthquake the ground shakes back and forth. This causes forces to act on a building in all directions. The building’s foundation tends to move with the ground. The overlying building tends to lag behind. This tendency of the building to lag behind the ground’s motion is called inertia. Imagine a person in a speeding car. If the car stops suddenly, the person's inertia continues the forward movement of the body against the seat belt. If the car speeds up quickly, the person’s inertial force resists the movement and the body is pressed into the seat as the car moves forward. An earthquake may repeat this sudden back and forth movement many times, weakening the building and possibly leading to collapse.

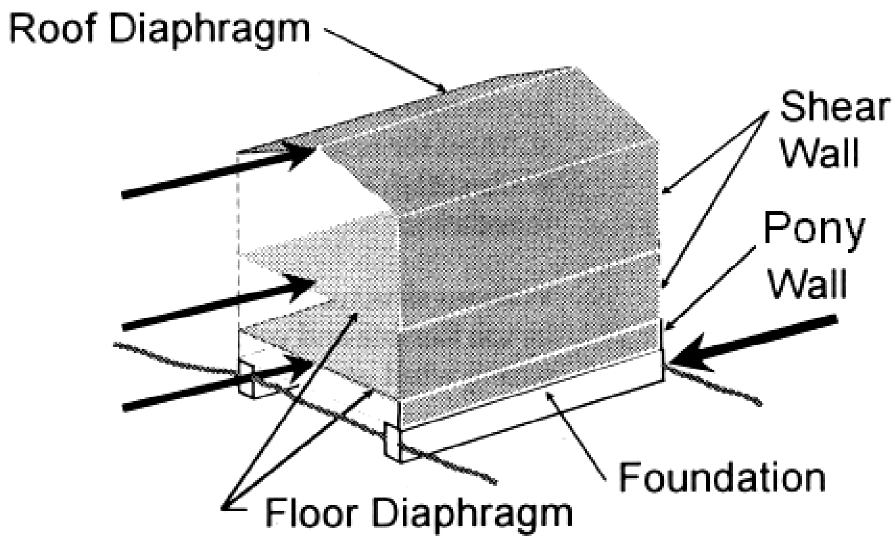
Building forces are greatest between the foundation and the first floor of the building. At this location the total weight of each overlying floor, walls and roof adds together, resulting in the highest level of force experienced by the building. This is also where the movement between the foundation and overlying building shifts back and forth relative to each other. For this reason, strengthening the connections between the foundation and the first floor of the building is the most important part of a home earthquake retrofit.

Horizontal Force Resisting System

Roof and floor systems are the horizontal elements of a house's earthquake force-resisting system. These horizontal elements are called diaphragms. The floor and roof systems transfer the horizontal, side-to-side earthquake forces to the vertical elements of a house (the walls) which, in turn, transfer the forces to the foundation and then the ground. This connected system allowing the transfer of forces through each building element to the ground is called the complete load path.

Weak walls do not do a good job of transferring the horizontal forces from the roof and floors to the foundation. Large picture windows, garage doors and other openings that weaken the ability of the wall to transfer the earthquake loads to the foundation may result in collapse of that floor. Also, inadequate materials and connections weaken the ability of the walls to transfer forces. These weaknesses can be especially damaging in the foundation area. Weak pony walls and inadequately bolted foundation sill plates are usually the most vulnerable to earthquake damage because they are located where the forces in the building are typically strongest due to the weight of the overlying structure and to the inertial movement between that structure and the foundation.

Horizontal Force Resisting System



Need for Retrofit

Building code design requirements for earthquake resistance have improved dramatically in the last few decades, but there are many thousands of homes in communities throughout the Pacific Northwest that were constructed prior to the development of modern earthquake design requirements. These homes usually have hidden weaknesses in the foundation and pony wall areas that require strengthening in order for the structure to resist the potential forces of a major earthquake.

APPENDIX C – THE HAZARD ASSESSMENT CHECKLIST

Booklet 2 provides detailed instructions for completing the checklist. “Yes” answers to all questions indicates the home (1) qualifies to use the SHER Planset; (2) is adequately anchored and braced to resist earthquake ground shaking; and (3) is constructed of structural elements that are in good condition. Space is provided at the end of the checklist for you to enter comments related to questions answered “no” or “uncertain”.

PART 1 – THIS SECTION TO BE FILLED IN BY THE HOMEOWNER			
1. Owner Name:	**2. Telephone Number:**		
3. Mailing Address:	**City**	**State**	**Zip Code**
4. Property Address (If different from above)	**City**	**State**	**Zip Code**
❑ **Owner Occupied** ❑ **Non owner occupied**			

PART 2 – Qualification Requirements

All answers to the questions in Part 2 must be yes or NA (not applicable) for your home to qualify to use the Standard Home Earthquake Retrofit Plan. You may need to hire an engineer or architect to develop the appropriate retrofit method if “no” or “uncertain” is checked.

Home Characteristics	**Yes or NA**	**No**	**Uncertain**
5. Is the home of light, wood-frame residential construction?			
6. Does the home have four or fewer dwelling units?			
7. Is the roof made of standard lightweight roofing materials, such as wood or composition shingle?			
8. Is the home built on a flat or moderate slope of less than 30 percent (approximately 18 degrees from horizontal)?			
9. Is the foundation wall around the perimeter of the home continuous except for allowable exclusions?			
10. Is the foundation of concrete or reinforced masonry that is in good condition?			
11. Are the pony walls 4 feet or less in height?			
12. Is the home three stories or less, including pony walls over 18 ½ inches as one story?			
13. Is a sill plate present?			
14. What is the overall height of the pony wall? **(Specify dimension.)**			
15. How many floors are above the pony wall (or above the foundation if there is not a pony wall)? **(Specify # of floors.)**			

PART 3 – Identify Retrofit Needs for Homes Qualifying to Use the Standard Plan "Yes" answers indicate no retrofit work is needed. "No" or "Uncertain" answers indicate retrofit and/or repair work is needed to improve the resistance of the home to earthquake shaking.			
Anchoring the Sill Plate	**Yes or NA**	**No**	**Uncertain**
16. Are sill plates in good condition?			
17. Are sill plates anchored (bolted) to the foundation?			
18. Are sill plate anchor bolts spaced 4 to 6 feet apart, placed near the center of the concrete foundation wall (about 2 ½ inches from the inside concrete edge of a 6 inch foundation wall), and in good conditions?			
19. Are sill plate anchor bolts at least ½ inch in diameter for one to two story buildings and 5/8 inch for a three-story building (½ inch bolts may be used in a three-story home if places 2 feet 8 inches apart)?			
20. Are sill plate anchor bolts located not more than 12 inches from the ends of each piece of sill plate more than 30 inches in length?			
Connecting the Floor Framing	**Yes or NA**	**No**	**Uncertain**
21. Are floor joists and either continuous rim joists or joist blocking present?			
22. Are pony wall double top plates present and in good condition?			
23. Is the floor framing system connected to the underlying sill plate with metal framing clips or are 8d nails placed 6 inches on center?			
24. Does the continuous rim joist rest on top of the pony wall studs?			
Strengthening the Pony Wall	**Yes or NA**	**No**	**Uncertain**
25. Do structural panels (also called sheathing) cover the stud walls on either the inside or the outside of the pony wall?			
26. Does existing pony wall sheathing in a crawl space have sufficient stud space ventilation to prevent the growth of fungus?			
27. Are the nails around the perimeter of the structural paneling spaced 3 to 6 inches apart?			
28. Are the nails along the studs spaced 6 to 14 inches apart?			
29. Are there screened ventilation holes in each structural panel located in the crawl space?			

Name of person who completed the Home Assessment Checklist (PLEASE PRINT)
Signature of person who completed the Home Assessment Checklist:
Date assessment completed:
Relationship of person completing the Home Assessment Checklist to the home retrofit project: (CIRCLE ONE) Owner Lessee Contractor Licensed Architect Licensed Engineer Owner's Agent
If a contractor completed the Home Assessment Checklist, please supply the following information. (The original license or a notarized copy will need to be provided when you apply for a building permit.)

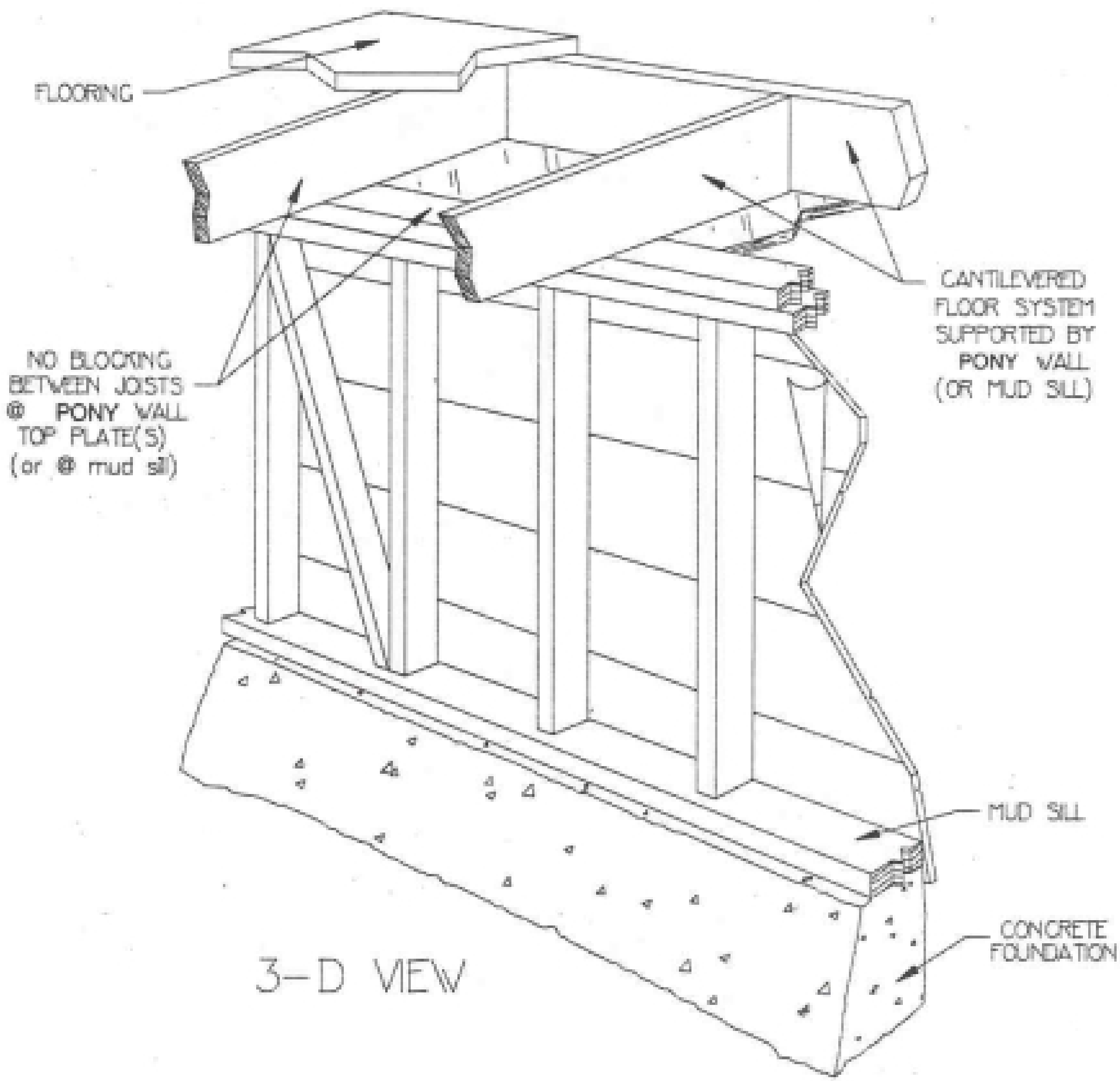
Name	Address	Telephone	License #	Exp.Date
Company Name: Consultant Name:		Work Number: Home Number:		

Has the contractor completed an approved Home Retrofit Training Class? ________ Yes ________ No If yes, enter workshop date and location: ______________________________

RESULTS of the Home Assessment Checklist (CHECK ALL THAT APPLY):
❑ Home qualifies to use the Standard Home Earthquake Retrofit Plan
❑ Home does not qualify to use the standard Home Earthquake retrofit Plan
❑ Home earthquake retrofit not needed
❑ Damaged or missing structural elements must be repaired or installed before completing the retrofit

COMMENTS
If you answered "no" or "uncertain" to any of the checklist questions, use this space to explain the problem and your proposed solution.

APPENDIX D – ADDITIONAL PLAN DETAILS

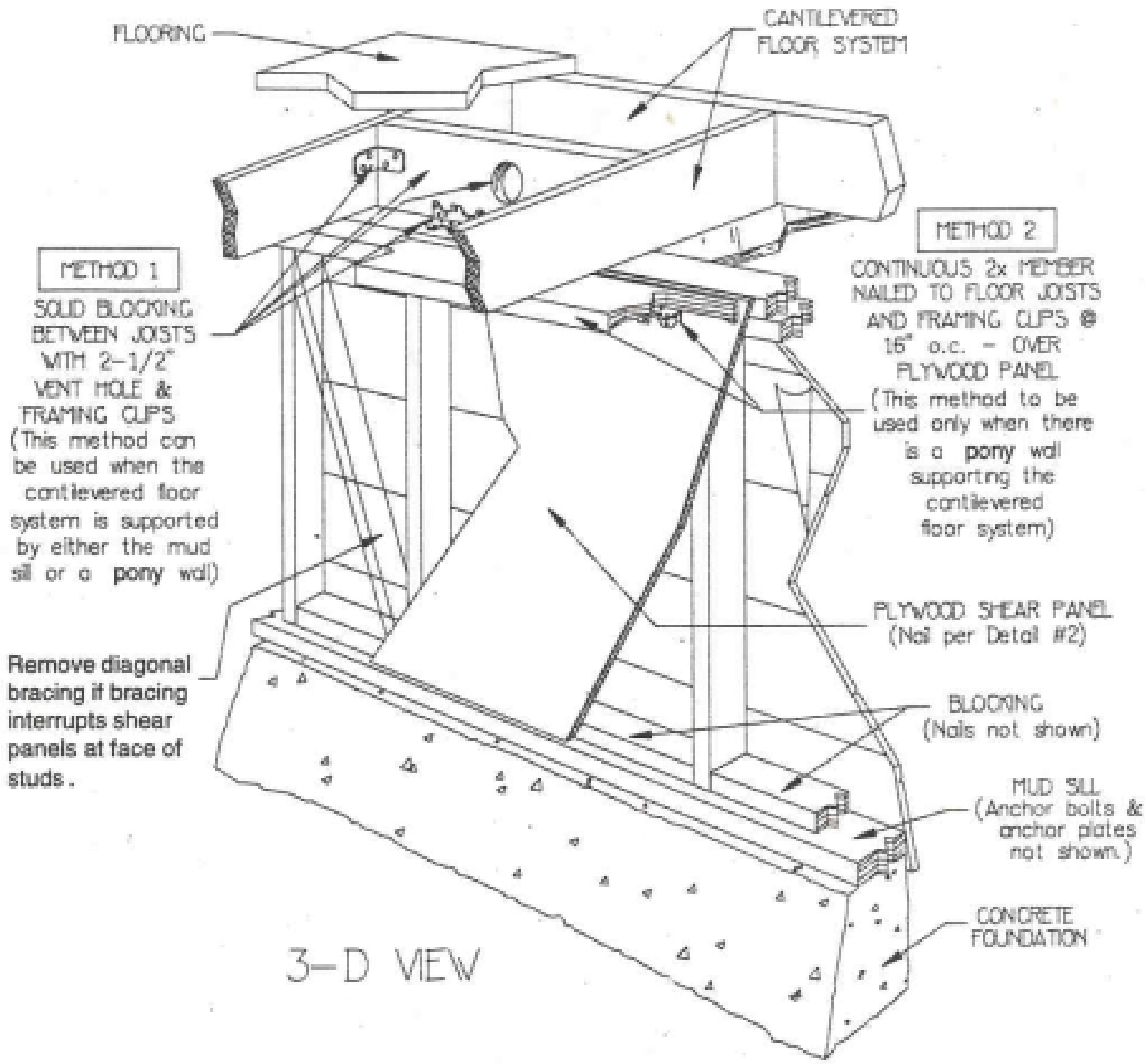


REPAIR CONDITION 3a-1

LACK OF BLOCKING ABOVE PONY WALL AT CANTILEVERED FLOOR

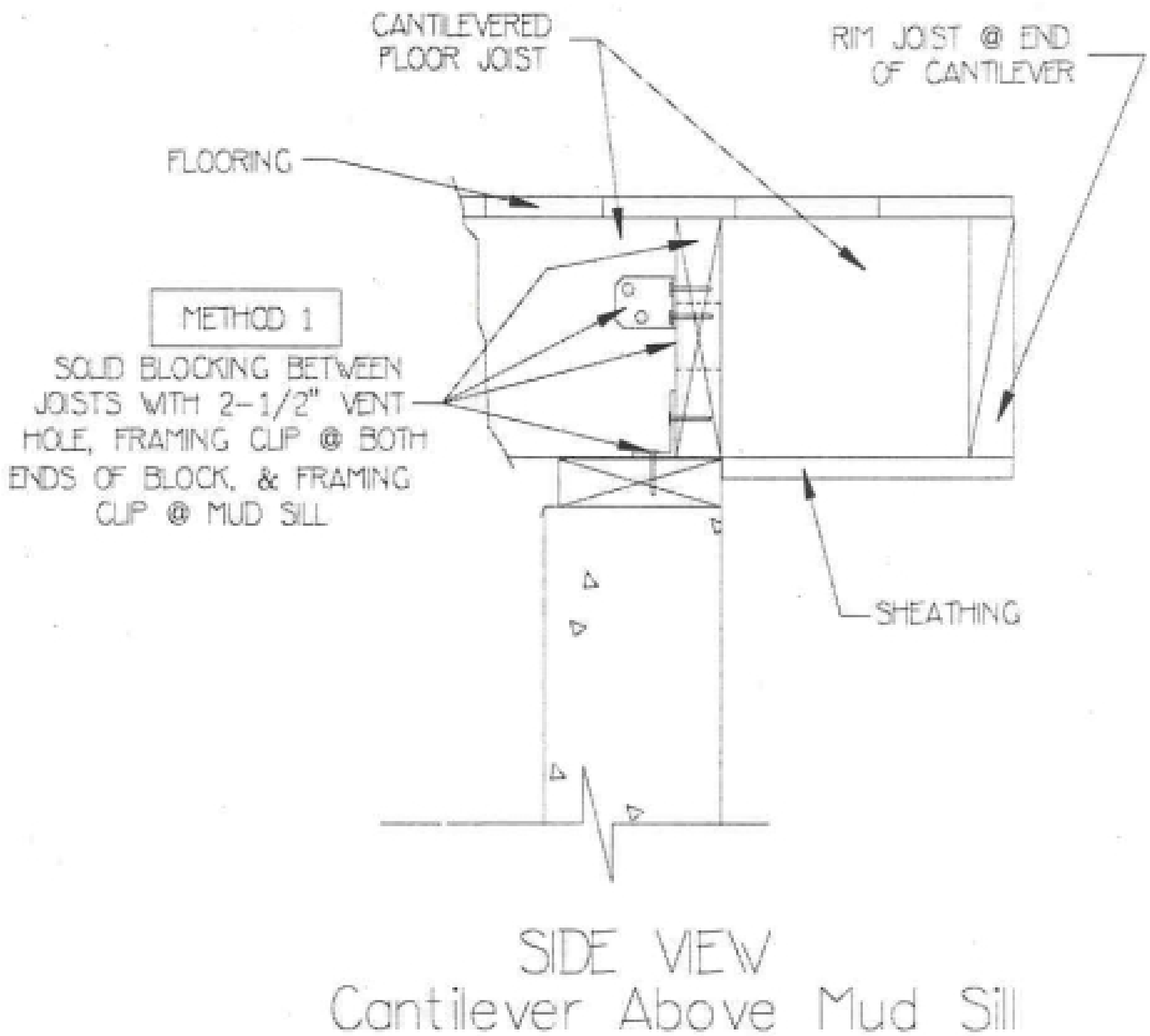
NO FRAMING ELEMENTS ON WHICH TO INSTALL FRAMING CLIPS

Framing modifications are necessary to provide the required nailing surfaces for the framing clips and to ensure connections that complete the load path between the pony wall and the floor system.



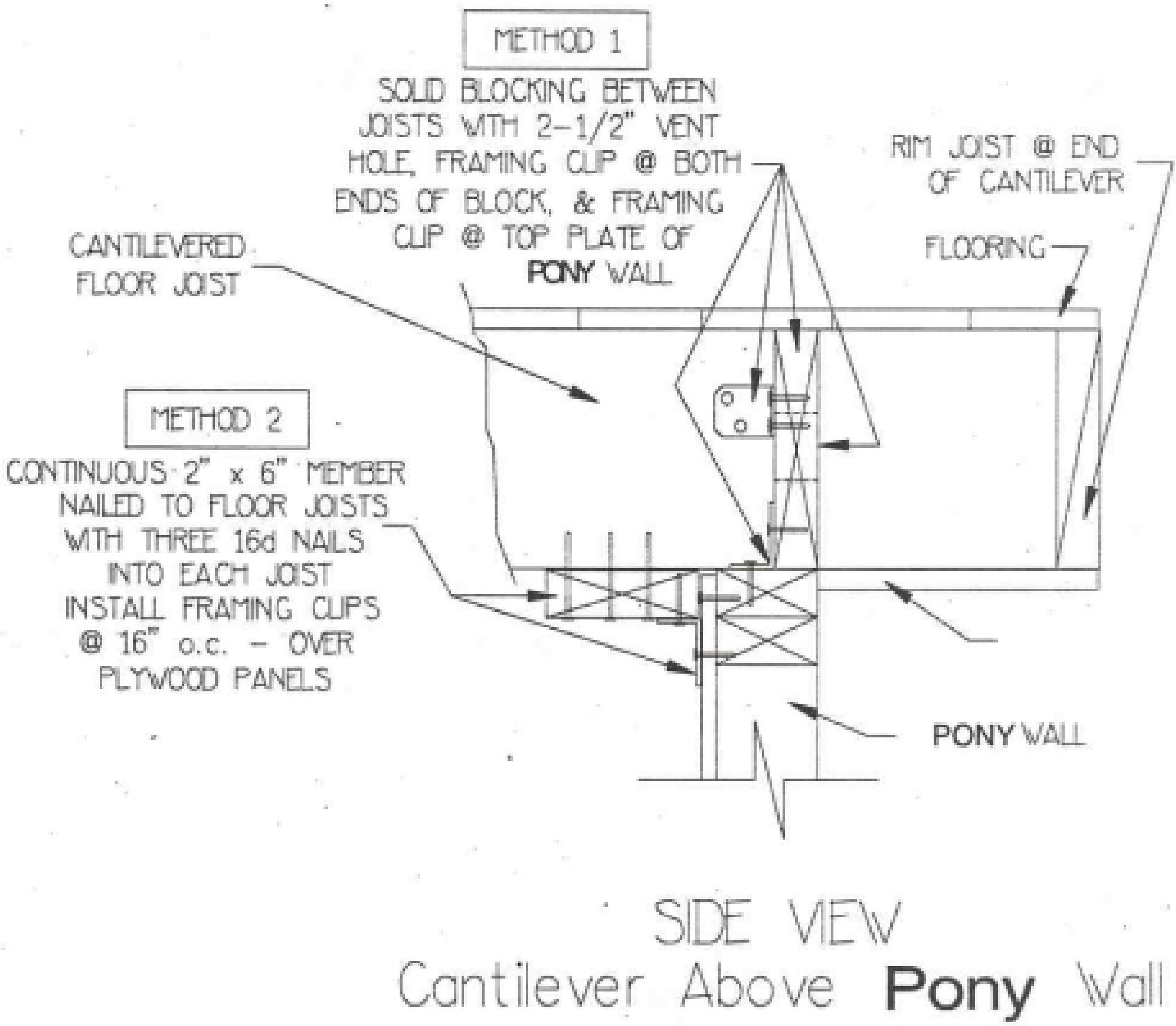
Plan Detail 3a-1.1a
[For use with the City of Seattle
SHER Planset}

PLAN DETAIL SHOWING TWO METHODS FOR INSTALLING FRAMING CLIPS FOR A CANTILEVERED FLOOR WITH NO BLOCKING ABOVE PONY WALL
(Install solid blocking between joists - "METHOD 1"
or
install continuous 2x member - "METHOD 2")



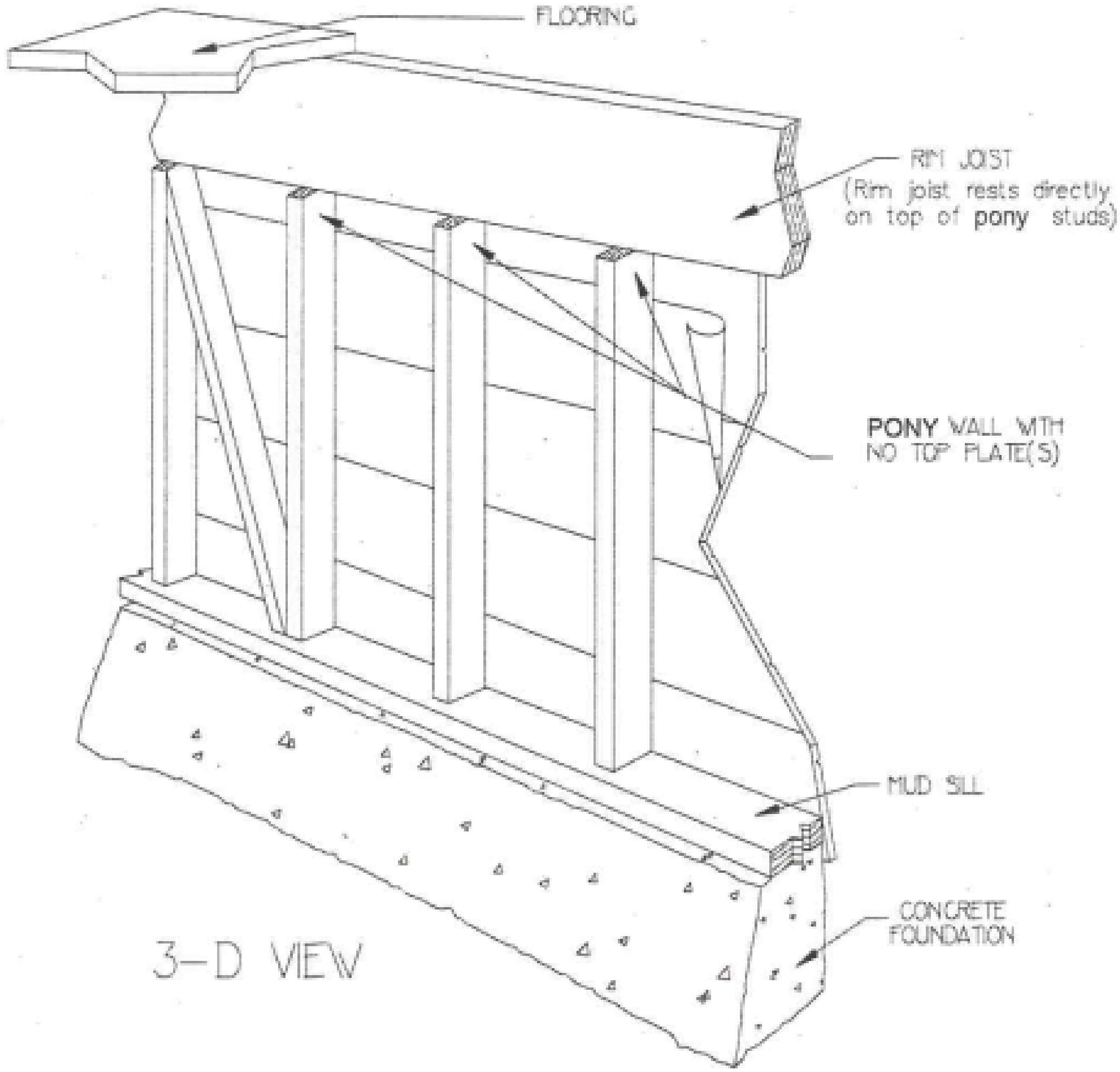
PLAN DETAIL 3a-1.1b
[For use with the City of Seattle
SHER Planset]

REPAIR DETAIL FOR CANTILEVERED FLOOR WITH NO BLOCKING ABOVE SILL PLATE
(Install solid blocking between joists - "METHOD 1")



Plan Detail 3a-1.1c
[For use with the City of Seattle
SHER Planset]

REPAIR DETAIL FOR CANTILEVERED FLOOR WITH NO BLOCKING ABOVE PONY WALL
(Install solid blocking between joists - "METHOD 1"
or install continuous 2x member - "METHOD 2")

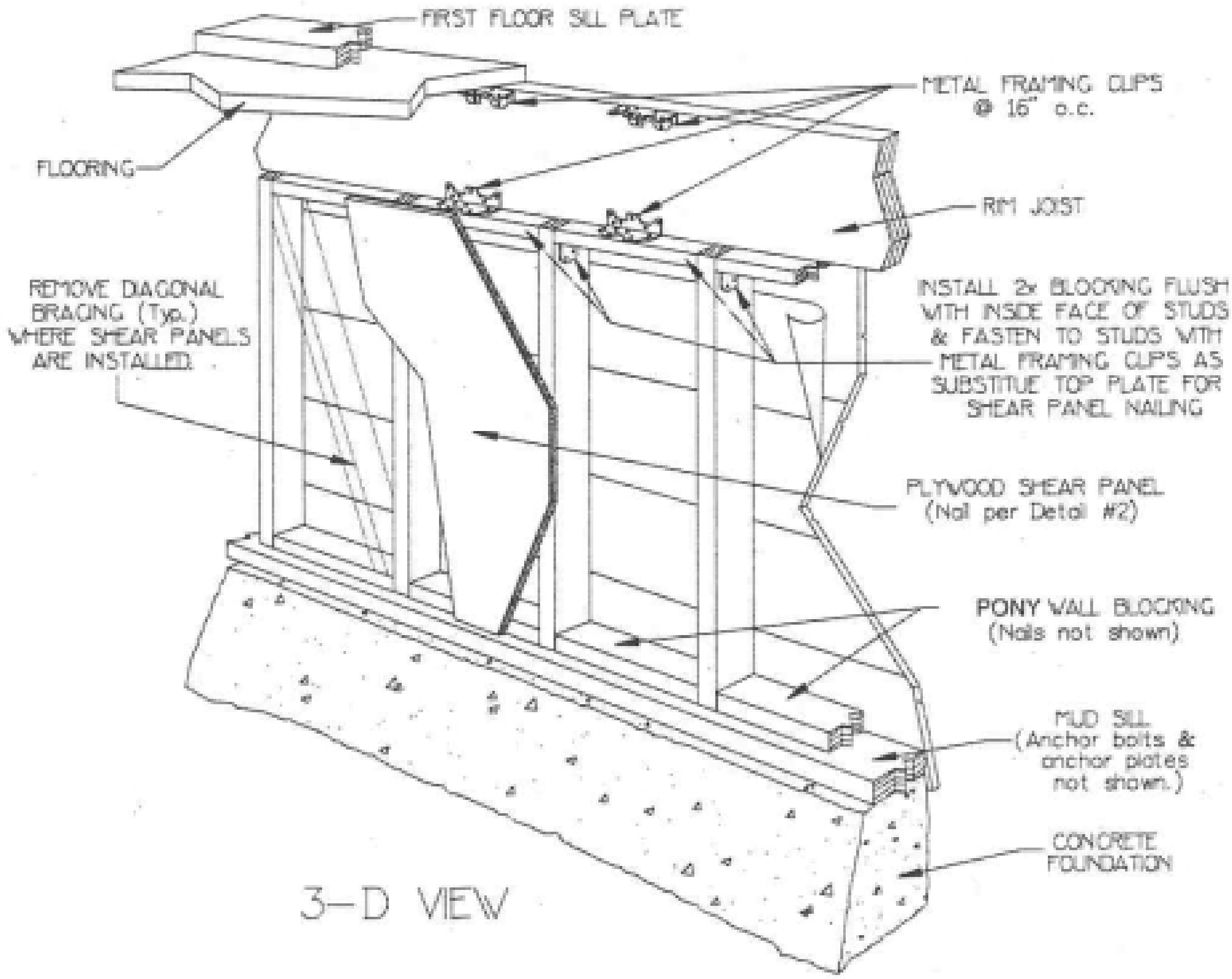


REPAIR CONDITION 3b-1

NO PONY WALL TOP PLATE(S)

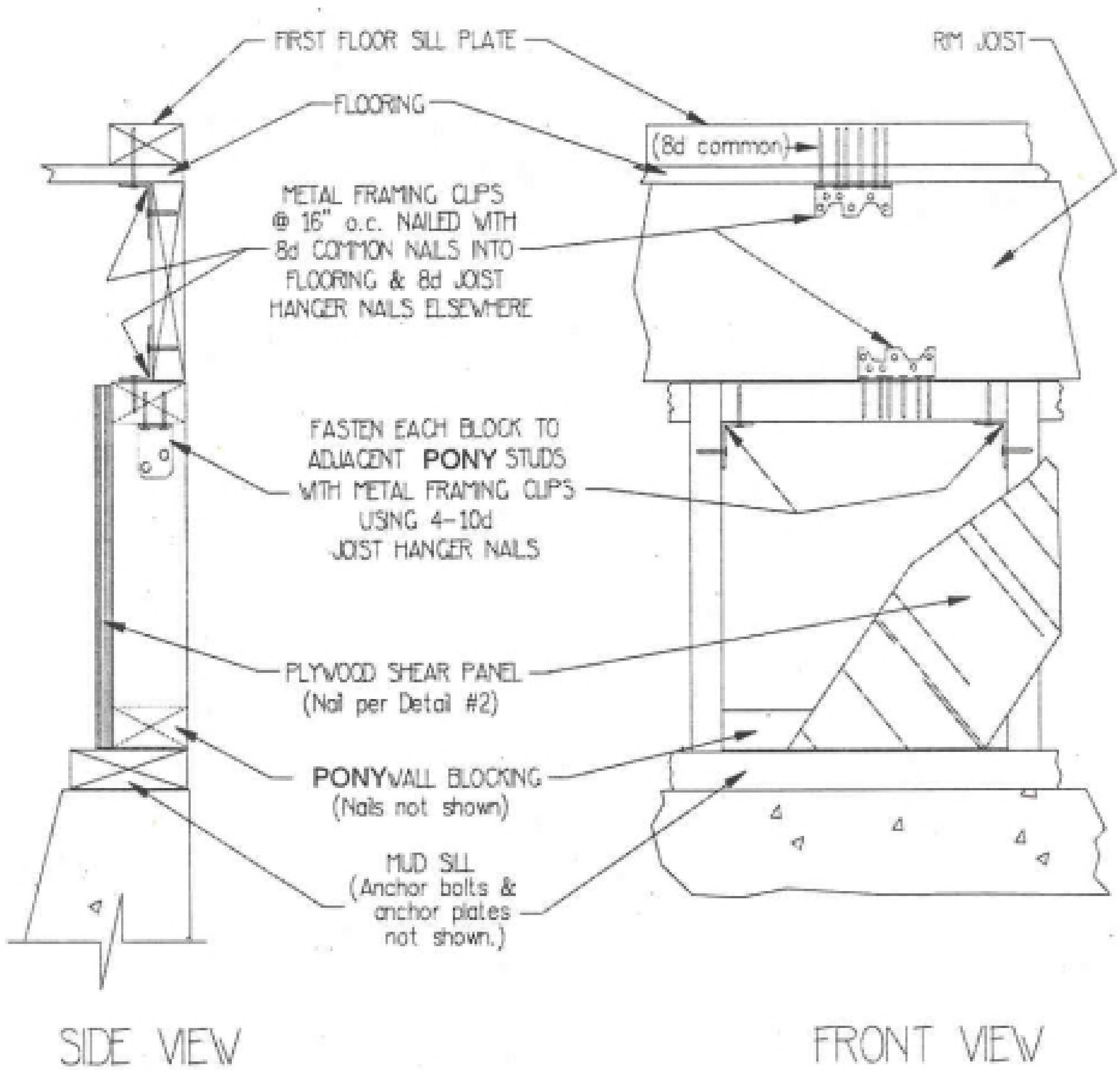
RIM JOIST RESTS ON TOP OF PONY WALL STUDS

Framing modifications are necessary to provide the required nailing surfaces for the plywood shear panels and to ensure connections which complete the load path between the pony wall and the floor system.



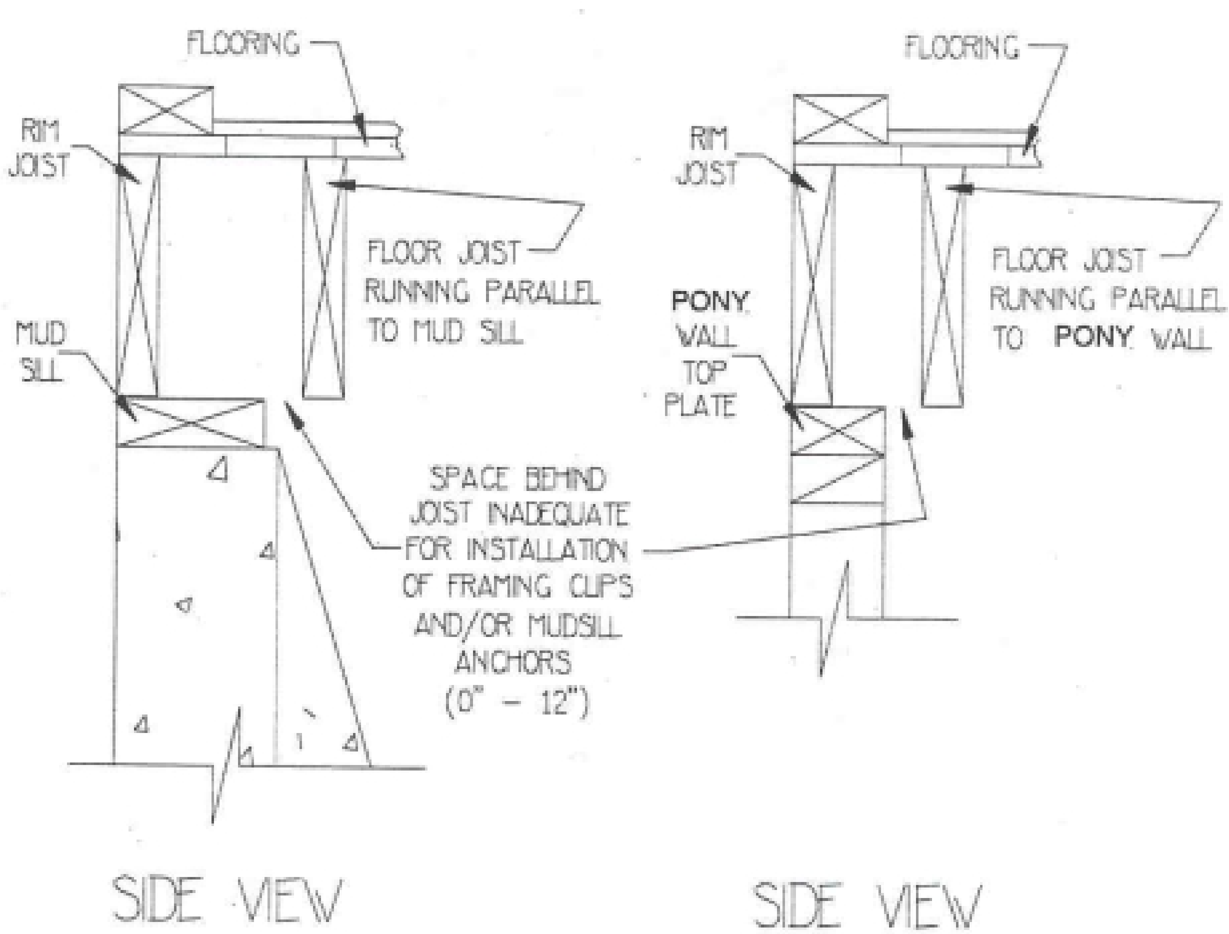
Plan Detail 3b-1.1a
[For use with the City of Seattle
SHER Planset]

REPAIR DETAIL FOR PONY WALLS WITH NO TOP PLATE(S) WHERE THE RIM JOIST RESTS DIRECTLY ON THE PONY WALL STUDS (FRAMING CLIPS SHOWN BETWEEN FLOOR FRAMING SYSTEM AND CONTINUOUS RIM JOIST NOT REQUIRED; FRAMING CLIPS BETWEEN CONTINUOUS RIM JOIST AND NEWLY INSTALLED 2X BLOCKING ARE REQUIRED)



PLAN DETAIL 3b-1.1b
[For use with the City of Seattle SHER Planset]

REPAIR DETAIL FOR PONY WALLS WITH NO TOP PLATE(S) WHERE THE RIM JOIST RESTS DIRECTLY ON THE PONY WALL STUDS (UPPER FRAMING CLIPS BETWEEN FLOOR FRAMING SYSTEM AND CONTINUOUS RIM JOIST NOT REQUIRED; FRAMING CLIPS BETWEEN CONTINOUS RIM JOIST AND NEWLY ADDED JOIST BLOCKING ARE REQUIRED)



REPAIR CONDITION 3b-2

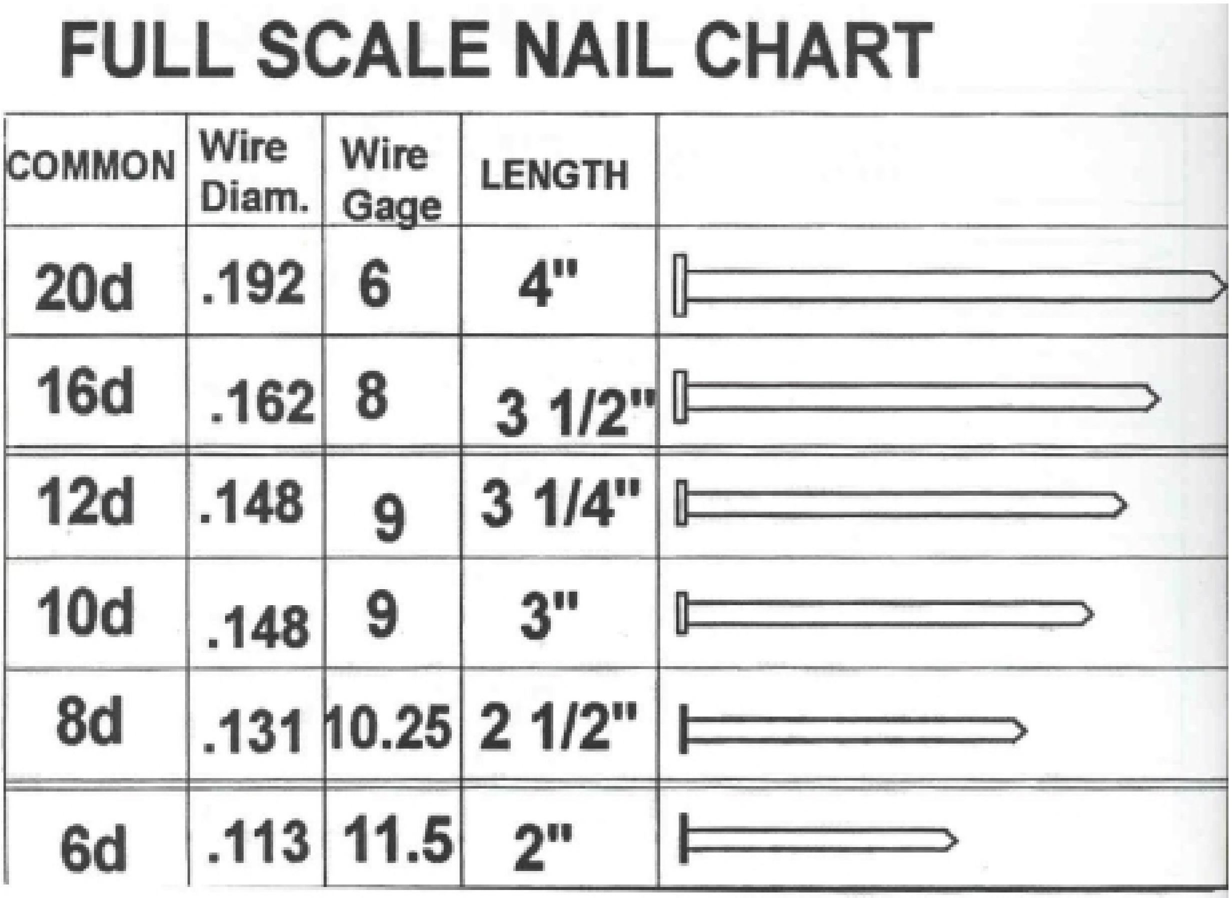
INADEQUATE SPACE BETWEEN RIM JOIST & FLOOR JOIST

NO ROOM TO INSTALL FRAMING CLIPS AND/OR ANCHORS

Framing modifications are necessary to allow access to the rim joist and the mud sill (or the top of the pony wall) to permit the installation of the required framing clips and/or mud sill anchors.

APPENDIX E

NAIL AND LAG SCREW SIZES FROM SAN LEANDRO BOOKLET



FULL SCALE NAIL CHART

COMMON	Wire Diam.	Wire Gage	LENGTH	
20d	.192	6	4"	
16d	.162	8	3 1/2"	
12d	.148	9	3 1/4"	
10d	.148	9	3"	
8d	.131	10.25	2 1/2"	
6d	.113	11.5	2"	