Long Beach Remodel

A Senior Project

Presented to

the Faculty of the Architectural Engineering Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science

by

John Hinrichs

December, 2016

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Summary of Long Beach Remodel

For my senior project, I created a set of plans for a remodel of a single family residence located in Long Beach, California. The project mandate included the following:

1) Create a set of as-built drawings (i.e. existing drawings of the building and site)
2) Work with an architect on a proposed design
3) Produce a set of structural drawings and calculations

The house was built in 1949. The prior owner of the house added a detached three-car garage and converted an existing attached garage into a den. The current owner wanted to demolish the den and build a larger family and dining room, and a more functional kitchen.

A surveyor was hired to identify the two front corners of the lot. Without a survey, it would have been difficult to determine exactly where the property lines were located and thus, how to “set” the house on the lot.

Meeting California’s stringent Title 24 Energy Requirements was a challenging aspect of the project, based on the proposed window, glass door, and skylight configuration. Unfortunately, just upgrading the insulation in the floors, walls and ceilings wasn’t enough to meet California’s Title 24 Energy Requirements. We faced a choice of either having to upgrade the existing windows in the house or converting the existing conventional water heater to a more energy efficient tankless model. Due to more favorable economics, we proceeded with the tankless model.

Another challenge we faced was making sure the new roof would plane in properly with the existing roof. The existing roof was framed with 2x4 members, which were of sufficient strength per code when the house was built in 1949. However, under the current code, roof framing members required more strength. Since the owner wanted to expedite construction, we decided to use roof trusses. This also enabled ceiling heights and eaves to match up, without a great deal of labor.

I decided to pursue this project primarily because I wanted “hands on” experience creating a comprehensive set of construction documents. Wood construction is something I can relate to well given my background and find it to be an aesthetically appealing material. I suspect wood design will be an important part of my focus as an engineer.

The documents that follow include a set of as-built drawings, a proposed design and structural drawings and details. I also included in the package that follows a set of calculations for gravity and lateral loads.
### Floor Construction

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### Window Schedule

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<td>A</td>
<td>E</td>
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<td>V</td>
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ELEVATION NOTES:
1. CHIMNEY TO EXTEND A MIN. OF 2'-0" ABOVE ROOF OR PARAPET WITHIN 1 1/2'-0" VERTICAL OF CHIMNEY.
2. PROVIDE AN APPROVED SPARK ARRESTOR AT ALL CHIMNEY CAPS. NOT LESS THAN FOUR (4) TIMES NET FREE AREA OF OUTLET OF CHIMNEY.
3. ALL EXTERIOR STUCCO SIDING TO BE PAINTED WITH ELASTOMERIC TYPE PAINT.
4. ALL EXTERIOR STUD WALL TO RECEIVE CORROSION-RESISTANT WEEP SCREED AT A MINIMUM OF 4" ABOVE GRADE, OR 2" ABOVE PAVED AREAS.
ELEVATION NOTES

1. CHIMNEY TO EXTEND A MIN. OF 2'-0" ABOVE ROOF OR PARAPET WALLS WITHIN 2'-0" RADIUS OF CHIMNEY.

2. PROVIDE AN APPROVED SPARK ARRESTOR AT ALL CHIMNEY CAPS NOT LESS THAN FOUR TIMES NET FREE AREA OF OUTLET OF CHIMNEY.

3. ALL EXTERIOR STUCCO SIDING TO RECEIVE CORROSION-RESISTANT WEEP HORIZONTAL AT A MINIMUM 2'-0" ABOVE GRADE OR 2'-0" ABOVE FINISH FLOOR.

4. ALL EXTERIOR STUD WALL TO RECEIVE CORROSION-RESISTANT WEEP VERTICAL AT A MINIMUM 2'-0" ABOVE GRADE OR 2'-0" ABOVE FINISH FLOOR.
1. Roofing Shingles to be Architectural Roof Shingles.
2. Roofing Nails to be Copper, Brass or Stainless Steel, U.N.O.
3. All necessary Flashing to be Galv. Steel, Including Ridge, Valley, Eave, Chimney, U.N.O.
4. All Gutter to be 4" K-Style Galv. Steel, U.N.O.
5. All Downspouts to be Rectangular and Galv. Steel, U.N.O.
6. All Concentrated Drainage Including Roof Water to be Conducted to an Approved Location.
7. Oversized Drains, if Applicable, to be Same Size as Roof Drain. Oversize Drain to be Insulated With the Insulation Valley of Above the Location of the Downspout. oversized Drain Shall be Installed in Accordance with Manuf's Current Recommendations for Material, Proportion Codes and Registration.
9. Attic Ventilation Openings to be Covered with Corrosion Resistant Metal Mesh With Mesh Openings of ¼" in Dimension.
10. Where Eave Vents Are Installed, insulation Shall Not Block the Free Flow of Air. A Minimum of 1" of Air Space Shall be Provided Between the Insulation and the Roof Sheathing. To Accommodate the Insulation, Insulation Plus Required 1" of Air Space, Rafter Ceiling Joists (Section 1505.3) May Have to Be Increased.
11. Chimney Flue to be in Wood Framed Chase; Chimney is to terminate in a Factory-Built Spark Arrestor Manufactured by "Majestic" or Equal.
12. Chimney to Extend a Min. of 2'0" Above Roof with a 10'0" Radius of Chimney. All Architectural Features at Chimney Top Must be Permitted with Manufacturer's Approval.
13. All Plumbing and Heating Roof Vents to be Out of View if Practical.

Attic Ventilation (New):
Code Requirement: 1/150 of Attic Area.
(Expected Area: 60 sq ft)
(Min. Area: 0.59 sq ft)
Total is 0.59 sq ft of additional vent area required.
GENERAL NOTES:
1. All exterior lighting shall be high efficacy, or controlled by a motion sensor with photocontrol.
2. Luminaires that are recessed into insulated ceilings shall be approved for zero clearance (IC) and certified airtight, and labeled as air tight (AT).
3. Smoke detectors for (N) areas shall be hard wired with battery backup; smoke detectors for (E) areas shall be hard wired or battery operated; smoke detectors shall be for carbon monoxide as well.

Dedicated REC. outlet in cab.

S.D.

S.D.

S.D.

Split circuit for GD & DW

(E) 200A service panel

50A (N) Carrier 17" compact A/C to replace (E) (N) disconnect

(N) Rinnai tankless water heater. RU98E w/grundfos recirc. pump. Min. 0.80 eff.

Undercab. lights (3 locations)

(N) 36" direct vent gas fireplace. Heat n Glo 6000CL

FP outlet (lower right corner)

Switched outlet in eave
GENERAL NOTES:
1. THE FOLLOWING SPECIFICATIONS SHALL CONFORM TO THE 2012 CBC AND ANY OTHER CITY OR COUNTY ORDINANCES THAT ARE IN FORCE AT THE TIME OF THIS PROJECT.
2. THE SELECTED GENERAL CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS, AND CONDITIONS PRIOR TO STARTING ANY FIELDWORK.
3. ANY Deviation-called-by-the-field-conditions OR ANY CONDITIONS DIFFERENT FROM THOSE INDICATED ON THE PLANS SHALL BE BROUGHT TO THE DESIGNED ATTENTION.
4. TYPICAL DETAILS SHALL APPLY WHERE NO SPECIFIC DETAILS OR SECTIONS ARE PROVIDED.
5. DIMENSIONS SHOWN ON PLANS OR DETAILS TAKE PRECEDENCE OVER ELEVATIONS SHOWN.
6. THE SELECTED GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE SATISFACTORY COMPLETION OF ALL WORK IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS.

STRUCTURAL STEEL:
1. STRUCTURAL STEEL SHALL CONFORM TO A.S.T.M. (A-36) SPECIFICATIONS AND TO THE LATEST APPROVED EDITIONS OF THE AISC SPECIFICATIONS FOR BRIDGES AND OTHER CODES APPLICABLE.
2. ALL BOLTS SHALL CONFORM TO A.S.T.M. (A-307) REQUIREMENTS.
3. ALL BOLTS HOLED IN STEEL MEMBERS SHALL BE TRUE. BURROWS OF HOLES FOR CONNECTIONS WILL NOT BE PERMITTED.
4. PROVIDE FULL BEARINGS ON UNBROKEN SECTION OF BOLTS SHANK FOR ALL STEEL CONNECTIONS.
5. PROVIDE LINING NUTS FOR ALL BOLTS AT BORE SEATS AND COLUMN BASE PLATES.
6. ALL NUTS FOR STRUCTURAL STEEL CONNECTIONS SHALL BE HEAVY DUTY WASHERS TYPE.
7. ALL WELDING SHALL BE MADE IN A CLEANED AREA, UNDER CONTINUOUS INSPECTION PER A.I.S.C. TOWA 3-1, FIELD WELDING, OTHER THAN SMALL WELDING THAT WELDING IS NOT PERMITTED.
8. PROVIDE FULL BEARINGS ON UNBROKEN SECTION OF BOLTS SHANK FOR ALL STEEL CONNECTIONS.
9. PROVIDE LINING NUTS FOR ALL BOLTS AT BORE SEATS AND COLUMN BASE PLATES.
10. PROVIDE LINING NUTS OR STRUCTURAL STEEL CONNECTIONS SHALL BE HEAVY DUTY WASHERS TYPE.

CONCRETE:
1. CONCRETE FOR SLABS ON GRADE, BEAM FOOTINGS OR PIPES SHALL BE FIBER REINFORCED.
2. CONCRETE FOOTINGS SHALL BE FIBER REINFORCED WITH A Minimum STRENGTH OF 1500 PSI AT 28 DAYS. UNLESS NOTED OTHERWISE ON THE PLANS.
3. THE MINIMUM AGGREGATE SIZE SHALL BE 3/4", AND MAXIMUM SLUMP SHALL BE 3/8" OR WIDER.
4. ALL REINFORCING SPLICES SHALL BE LAPPED A MINIMUM OF 30 BAR DIAMETERS.
5. CONCRETE COVER FOR REINFORCEMENT SHALL BE:
   a. 2" MINIMUM POUR AGAINST FORMS.
   b. 2" MINIMUM POUR AGAINST FORMS.
   c. 2" MINIMUM POUR AGAINST FORMS.
   d. ALL PLATESnaire BEARING ON UNTHREADED PORTION OF BOLT SHANK FOR ALL STRUCTURAL MEMBERS SHALL NOT BE CUT FOR PIPES, ETC., UNLESS NOTED OTHERWISE ON THE PLANS.
6. PROVIDE LEVELING NUTS FOR ALL BOLTS AT BEAM SEATS AND COLUMN BASE PLATES.
7. PROVIDE LINING NUTS OR STRUCTURAL STEEL CONNECTIONS SHALL BE HEAVY DUTY WASHERS TYPE.
8. ALL WELDING SHALL BE AS INDICATED ON THE DETAILS AND PERFORMED IN A SATISFACTORY MANNER.
9. CONCRETE IS PLACED AND STRENGTH TESTING SHALL BE PER PER 2007 CBC, SECTION 1704.3.3.
10. ALL MASONRY WORK SHALL BE REINFORCED GROUTED MASONRY AND ALL MASONRY BLOCKS SHALL BE CLEANED PRIOR TO THE APPLICATION OF GROUT.
11. CONCRETE PLACEMENT AND STRENGTH TESTING SHALL BE PER 2007 CBC, SECTION 1704.3.3.
12. ALL MASONRY BLOCK WALLS SHALL BE PROVIDED WITH AN APPROVED SWEAT OR DRAINAGE SYSTEM.
13. CONCRETE FOR SLABS ON GRADE, BEAM FOOTING OR PIERS SHALL BE FIBER REINFORCED.
14. CONCRETE IS PLACED AND STRENGTH TESTING SHALL BE PER 2007 CBC, SECTION 1704.3.3.
15. CONCRETE IS PLACED AND STRENGTH TESTING SHALL BE PER 2007 CBC, SECTION 1704.3.3.

SOILS REPORT:
1. SOILS REPORT (N/A; CHAPTER 18 MINIMUMS.) APPLY:
2. OTHER CITY OR COUNTY ORDINANCES THAT ARE IN FORCE AT THE TIME OF THIS PROJECT.
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4. SOILS REPORT (N/A; CHAPTER 18 MINIMUMS.) APPLY:
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28. SOILS REPORT (N/A; CHAPTER 18 MINIMUMS.) APPLY:
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**FOUNDATION NOTES:**

1. SEE S-1 FOR GENERAL NOTES.
2. SEE S-2 FOR GENERAL NOTES.
3. VERIFY ALL DIMENSIONS ON SITE AND NOTIFY ARCHITECT & ENGINEER OF ANY CONFLICTING DIMENSIONS UNDER CONDITIONS.
4. ANCHOR BOLTS, DOWELS AND HOLD-DOWN ANCHORS SHALL BE SECURELY HELD IN PLACE PRIOR TO FOUNDATION INSPECTION.
5. HOLES FOR BOULDERS SHALL BE 1/8" TIGHTER THAN PRIOR TO COVERING THE WALL FRAMING.
6. FOUNDATION SILL SHALL BE NATURALLY DURABLE OR PRESSURE TREATED WOOD MEMBERS.
7. IF ADVERSE SOIL CONDITIONS ARE ENCOUNTERED, A SOILS INVESTIGATION REPORT MAY BE REQUIRED.
8. CONCRETE STRENGTH FOR FOUNDATIONS SHALL BE 2,500 PSI MIN.
9. ALL CONCRETE IN CONTACT WITH SOIL SHALL BE 2,000 PSI AT 28 DAYS WITH TYPE V CEMENT AND INTERMEDIATE MORTAR TO 2,000 PSI UNLESS OTHERWISE RECOMMENDED IN SOILS REPORT.
10. MINIMUM ANCHOR BOLT SIZE AND SPACING SHALL BE 5/8" DIAMETER AT 3" O.C. WITH MINIMUM 3 1/2" LONG AND 3" X 3" X 1/4" THICK WASHERS, TYPICAL.
11. FOOTINGS SHALL BE LOCATED AT CENTER OF COLUMNS AND WALLS, UNLESS NOTED OTHERWISE ON PLANS.
12. FOUNDATION SILLshall be 1/8" TIGHTER THAN PRIOR TO FOUNDATION INSPECTION.
13. THE CONCRETE SLAB ON GRADE HAS NOT BEEN DESIGNED FOR ANY SPECIFIC VEHICULAR TRAFFIC OR CRANE LOADS. ONLY GENERAL OFFICE OCCUPANCY UNIFORMLY DISTRIBUTED LOADS ARE CONSIDERED.

** SHEAR WALL SCHEDULE NOTES:**

1. MINIMUM OF TWO BOLTS PER PIECE OF SILL.
2. USE COMMON NAILS UNLESS OTHERWISE NOTED.
3. PLYWOOD SHEATHING SHALL BE STRUCTURAL 1 GRADE U.N.O. ON SCHEDULE.
4. NAILING SHALL BE 36" FROM EDGES OF PANEL MINIMUM.
5. PANELS SHALL BE 4x8 MINIMUM EXCEPT @ BOUNDARIES.
6. PANELS SHALL CONFORM TO DOC PS-1 OR PS-2.
7. MINIMUM ANCHOR BOLT SIZE AND SPACING shall be 5/8" DIAMETER AT 72" O.C. WITH MINIMUM 3" LONG AND 3" X 3" X 1/4" THICK WASHERS, TYPICAL.
8. FOOTINGS SHALL BE LOCATED AT CENTER OF COLUMNS AND WALLS, UNLESS NOTED OTHERWISE ON PLANS.
9. CONCRETE STRENGTH FOR FOUNDATIONS SHALL BE 2,500 PSI MIN.
10. ALL CONCRETE IN CONTACT WITH SOIL SHALL BE 2,000 PSI AT 28 DAYS WITH TYPE V CEMENT AND INTERMEDIATE MORTAR TO 2,000 PSI UNLESS OTHERWISE RECOMMENDED IN SOILS REPORT.
11. MINIMUM ANCHOR BOLT SIZE AND SPACING SHALL BE 5/8" DIAMETER AT 3" O.C. WITH MINIMUM 3 1/2" LONG AND 3" X 3" X 1/4" THICK WASHERS, TYPICAL.
12. MINIMUM ANCHOR BOLT SIZE AND SPACING SHALL BE 5/8" DIAMETER AT 3" O.C. WITH MINIMUM 3 1/2" LONG AND 3" X 3" X 1/4" THICK WASHERS, TYPICAL.
13. ALL ANCHOR BOLTS TO BE 5/8" DIAMETER MINIMUM AT 12" O.C. WITH MINIMUM 3" LONG AND 3" X 3" X 1/4" THICK WASHERS, TYPICAL.
14. USE DOUBLE THE ANCHOR BOLTS IN SCHEDULE IF 2x SILL PLATE IS USED INSTEAD OF 3x SILL PLATE.

**FOUNDATION SCHEDULE:**

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FLOOR FRAMING NOTES:

1. SEE S-1 FOR GENERAL NOTES.
2. SEE S-4 FOR TYPICAL DETAILS.
3. SEE ARCHITECTURAL AND MECHANICAL PLANS FOR FLOOR PENTRATION SIZES AND LOCATIONS.
4. VERIFY ALL DIMENSIONS ON SITE AND NOTIFY ARCHITECT AND ENGINEER OF ANY CONFLICTING CONDITIONS AND/OR DIMENSIONS.
5. FACE GRAIN OF PLYWOOD SHALL BE PERPENDICULAR TO SUPPORTS. FLOOR SHALL HAVE TONGUE AND GROOVE OR BLOCKED PANEL EDGES.
6. WALL TOP PLATE ELEVATION AT 8'-0" ABOVE F.F., UNLESS OTHERWISE NOTED ON PLANS.
7. FLOOR SECTION CLAY:
   1" x 12" PLY (AT JOISTS)
8. ELEVATED FLOOR STRUCTURES HAVE NOT BEEN DESIGNED FOR SPECIFIC VIBRATION EFFECTS FROM MECHANICAL EQUIPMENT OR SPECIAL OCCUPANCIES SUCH AS GYMNASTICS, AEROBICS OR DANCE STUDIOS.
ROOF FRAMING NOTES:

1. SEE S-1 FOR GENERAL NOTES.
2. SEE S-5 FOR TYPICAL DETAILS.
3. SEE ARCHITECTURAL AND MECHANICAL PLANS FOR FLOOR PENETRATION SIZES AND LOCATIONS.
4. VERIFY ALL DIMENSIONS ON SITE AND NOTIFY ARCHITECT AND ENGINEER OF ANY CONFLICTING CONDITIONS.
5. ROOF SHEATHING SHALL CONSIST OF MIN. 1/2" THICK CDX PLYWOOD w/ 10d @ 6", 6", 12" NAILING & BLOCKED.
6. ROOF FRAMING/MAURING TO BE INSPECTED BEFORE COVERING. FACE GRAIN OF PLYWOOD SHALL BE PERPENDICULAR TO SUPPORTS.
7. ROOF DESIGN LOADS:
   1. D = 15 PSF (AT JOISTS)
   2. L = 20 PSF
   3. N = 15 PSF (AT JOISTS)
   4. V = 18 PSF
   5. W = 12 PSF
   6. X = 18 PSF
   7. Y = 15 PSF

ROOF SHEATHING:
- MIN. 1/2" THICK CDX PLYWOOD w/ 10d @ 6", 6", 12" NAILING & BLOCKED.
- FACE GRAIN OF PLYWOOD SHALL BE PERPENDICULAR TO SUPPORTS.
STRUCTURAL DETAILS

FLOOR SHEATHING (SEE PLAN)

FLOOR SHEATHING EDGE NAILING

(3) 8D TOE NAIL AT EACH JOIST GIRDER HANGER

SILL NAILING. 16D @ 16" O.C. U.N.O. ON SHEAR WALL SCHEDULE

A35 @ 16" O.C. U.N.O. ON PLAN

2X6 P.T. MUD SILL

2X FLOOR JOISTS (SEE PLAN FOR SIZE AND PLACING)

5/8" Ø X 10" A.B. @ 4'-0" O.C. U.N.O. ON SHEAR WALL SCHEDULE

WALL EDGE NAILING (SEE PLAN AND SHEAR WALL SCHEDULE)

MIN. 12" MIN. 18"

EXTERIOR FINISH GRADE

#5 REBAR TOP AND BOTTOM

MIN. 6"

WALL EDGE NAILING (SEE PLAN AND SHEAR WALL SCHEDULE)

2X6 FLOOR JOIST (SEE PLAN)

MIN. 12"

DRILL & EPOXY SET (2) 1/2" Ø X 24" LG. DOWELS 4" MIN. INTO EXISTING FOUNDATION LAP SPLICE MIN. 20" TO CONT. REBARS CLEAN AND DISTRESS SURFACE FOR A GOOD BOND AT TIE-IN AREA

NOTE: VERIFY EXACT HEIGHT REQUIRED FOR FLUSH SUBFLOOR TIE-IN. FLOOR STRUCTURE MAY DIFFER NEW FOUNDATION STRUCTURE

MIN. 20" LAP

NEW FOUNDATION TO BE Poured

EXISTING FOUNDATION STRUCTURE

MIN. 20" LAP

EXTERIOR FINISH GRADE

#5 REBAR TOP AND BOTTOM

MIN. 6"
FINISH FLOOR

PLATE LINE

MASONRY CHIMNEY

STUCCO SIDING

ASPHALT SHINGLE ROOF, TYP.
AB3.2

RAISED FOUNDATION
CONCRETE SLAB
FINISH FLOOR

0' - 0"
PLATE LINE
8' - 0"

Scale
Project number
Date
Drawn by

No.
Description
Date

LONG BEACH, CA

REMODELING PROJECT

(E) FDN. & SECTION

AB3.2
STRUCTURAL CALCULATIONS
FOR
LONG BEACH REMODEL

ARCE 415
SR. PROJECT
DECEMBER 1, 2016

JOHN HINRICHS
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PROJECT DESCRIPTION / DATA

Project: Residential Remodel & Addition
Location: Long Beach, CA
Architect: --
Owner: --
Jurisdiction: Long Beach, CA
Building Code: 2013 California Building Code (CBC)

Selected IBC References:

Loads: ASCE 7-10
Steel: AISC 360-10
AISC 341-10 (Seismic)
Wood: NDS -15
NDS Supplement - 15
NDS SDPWS -15 (Wind & Seismic)
Concrete: ACI 318-14
ACI 530

Structural Systems:

Vertical
Wood stud bearing walls
Raised foundation with spread footings

Lateral
Wood shear walls

Soils Engineer: --
Soils Report No.: --
Soils Report Date: --
Soils Bearing: Assume 1500 PSF bearing capacity per Table 1806-2
Other Soils Data: Assume soil site Class D
STRUCTURAL MATERIALS

Lumber: Visually Graded Douglas Fir – Larch
2x Framing DF-L #2
4x framing DF-L #1
Posts/Timbers DF-L #1
Glu-Lam Beams – Visual Comb. 24F-V4 DF/DF
Hardware: Simpson “Strong-Tie”

Masonry: Grade “N” Units: f’m = 1,500 psi (all cells grouted)

Concrete: (f’c in 28 days)
- Roof Deck 3000 psi Lightweight (110 pcf)
- Floor Deck 3000 psi Lightweight (110 pcf)
- Beams 3000 psi
- Columns 4000 psi
- Walls 4000 psi
- Foundation 2500 psi

Reinforcing: ASTM A615 – Grade 60 ASTM A706 – Grade 60

Steel:
- Structural ASTM A992 for WF beams Fy = 50 ksi
  ASTM A36 for channels, angles Fy = 36 ksi
- Pipes ASTM A53 Fy = 35 ksi
- Tubes ASTM A500 Grade B Fy = 46 ksi
- Bolts ASTM A307 Per code
  ASTM A325SC Per code
- Metal Studs SSMA Member
  Studs < 18Ga, Fy = 33ksi
  Studs > 16Ga, Fy = 50 ksi

Note: Unless noted otherwise in structural calculations or drawings.
### BUILDING WEIGHTS

#### ROOF DEAD LOAD TAKE OFF (PSF)

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit Weight (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp. Roofing</td>
<td>3.6</td>
</tr>
<tr>
<td>Insulation, 10-inch Fiberglass Batt</td>
<td>0.6</td>
</tr>
<tr>
<td>1/2&quot; Plywood / Sheathing</td>
<td>1.5</td>
</tr>
<tr>
<td>Pre-fab Trusses</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Total, Sloped Members</strong></td>
<td><strong>8.5</strong></td>
</tr>
<tr>
<td><strong>Horizontal Conversion</strong></td>
<td><strong>9.0</strong></td>
</tr>
<tr>
<td>Gypsum Wallboard</td>
<td>2.5</td>
</tr>
<tr>
<td>MEP &amp; Misc.</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Total to Rafters/Joists</strong></td>
<td><strong>15.0</strong></td>
</tr>
<tr>
<td>Beams</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Total to Beams</strong></td>
<td><strong>18.0</strong></td>
</tr>
<tr>
<td>Columns (King Post)</td>
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</tr>
<tr>
<td><strong>Total to Columns</strong></td>
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**LIVE LOADS**

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof (Reducible)</td>
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#### FLOOR DEAD LOAD TAKE OFF (PSF)

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<tr>
<th>Material</th>
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<tr>
<td>Flooring - Hardwood</td>
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<tr>
<td>3/4&quot; Plywood / Sheathing</td>
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<td>Insulation, 6-inch Fiberglass Batt</td>
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<td>MEP &amp; Misc.</td>
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<td>Joists 2x6 @ 16&quot; O.C.</td>
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<td><strong>Total to Joists</strong></td>
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<tr>
<td>Beams</td>
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<tr>
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**LIVE LOADS**

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<td>Residential (Reducible)</td>
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#### EXTERIOR WALL DEAD LOAD TAKE OFF (PSF)

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<th>Unit Weight</th>
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<tr>
<td>Gypsum Wallboard, 1/2&quot;</td>
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<tr>
<td>Studs, 2x4 @ 16&quot; O.C.</td>
<td>1.0</td>
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<tr>
<td>1/2&quot; Plywood / Sheathing</td>
<td>1.5</td>
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<tr>
<td>Stucco, 7/8&quot;</td>
<td>10.0</td>
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<tr>
<td>Insulation, 4-inch Fiberglass Batt</td>
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<tr>
<td>Misc.</td>
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<td><strong>Total to Joists</strong></td>
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#### INTERIOR WALL DEAD LOAD TAKE OFF (PSF)

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<td>Studs, 2x4 @ 16&quot; O.C.</td>
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<tr>
<td>Insulation, 4-inch Fiberglass Batt (Sound Barrier)</td>
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<th>Customer</th>
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<tr>
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<td>LONG BEACH REMODEL</td>
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_Job Engineering Criteria:_

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<td>15.01.01.0611.00</td>
<td>1VP82920001</td>
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<table>
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<tr>
<th>Wind Standard</th>
<th>Wind Speed (mph)</th>
<th>Roof Load (psf)</th>
<th>Floor Load (psf)</th>
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</thead>
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<tr>
<td>ASCE 7-10</td>
<td>110</td>
<td>20.00-14.00-0.00-0.00</td>
<td>None</td>
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This package contains a job notes page, 5 truss drawings and 1 details.

<table>
<thead>
<tr>
<th>Item</th>
<th>Seal #</th>
<th>Truss</th>
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<tbody>
<tr>
<td>1</td>
<td>090.16.1728.21503</td>
<td>A MONO HIP H8</td>
</tr>
<tr>
<td>2</td>
<td>090.16.1728.25540</td>
<td>A1 HIP 9-2-6</td>
</tr>
<tr>
<td>3</td>
<td>090.16.1728.29487</td>
<td>A2 HP H12</td>
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<tr>
<td>4</td>
<td>090.16.1728.36887</td>
<td>B HIP H6</td>
</tr>
<tr>
<td>5</td>
<td>090.16.1728.41957</td>
<td>B1 COMN</td>
</tr>
</tbody>
</table>

Printed 3/31/2015 9:10:36 AM
**WARNING** READ AND FOLLOW ALL NOTES ON THIS DRAWING!

**IMPORTANT** FURNISH THIS DRAWING TO ALL CONTRACTORS INCLUDING THE INSTALLERS

Trusses require extreme care in fabricating, handling, shipping, installing and bracing. Refer to and follow the latest edition of BCSI (Building Component Safety Information) by TPI and SBCA for safety practices prior to performing these functions. Installers shall provide temporary bracing per BCSI. Unless noted, bracing on top chord shall have properly attached structural sheathing and bottom chord shall have a properly attached rigid ceiling. Locations shown for permanent lateral restraint of webs shall have bracing installed per BCSI sections 83, 87, or 810 as applicable. Apply plates to each face of truss and position as shown above and on the Joint Details, unless noted otherwise. Refer to drawings 160-1-A for standard plate positions.

Alpine, a division of TVW Building Components Group Inc. shall not be responsible for any deviation from this drawing. Any failure to build the trusses in conformance with ANS/AS3101, or for handling, shipping, installing and bracing of trusses is the responsibility of the fabricator, unless otherwise noted. The suitability and use of this drawing is the responsibility of the Building Designer per ANS/AS3101 Sec. 2. For more information see the job's general notes page and these web sites: ALPINE: www.alpineinc.com TPI: www.tpi.net SBCA: www.sbcaindustries.com ICC: www.iccsafe.org

**Loading Criteria**
- TCDL: 20.00
- BCDL: 10.00
- DesLd: 44.00
- NGBCLL: 10.00
- Wind Criteria:
  - Wind Std: ASCE 7-10
  - Speed: 110 mph
  - Sec. Category: II
- Temperature: C
- Mean Temperature: 15.00 ft
- Snow Coefficient: NA
- Snow Duration: NA
- MWFRS Parallel Dist. 0 to h2
- C&D Dist. = 3.00 ft
- Loc. from endwall: Any
- GSP: 0.18
- Wind Duration: 1.33
- Snow Duration: NA
- Def/CIS Criteria:
  - PP Deflection in loc. Udef Lfp
  - VERT(L): 0.003 C 999 240
  - VERT(T): 0.184 C 193 180
  - HORIZ(T): 0.039 F
  - HORIZ(L): 0.065 F
  - Creep Factor: 2.0
  - Max TC CSI: 0.806
  - Max BC CSI: 0.734
  - Max Web CSI: 0.730
- VIEW Ver: 15.01.01C.0611.001

**Lumber**
- Top chord 2x4 DF-L #1&Bet.(g)
- Bot chord 2x4 DF-L #1&Bet.(g)
- Web 2x4 DF-L Standard(g)

**Plating Notes**
Connectors in green lumber (g) designed using NDS/TPI reduction factors.

**Loading**
- #1 with 7-10-15 setback supports jack trusses, or rafters and joists, spanning between this truss and the end wall. Corner(s) framed with a hipJack supporting corner rafters and joists, or open-end jack.
- Use this design for common hip trusses @ 24° OC.
- Extend sloping TC of truss and jack to hip rafter.
- Support extensions every 4.00 ft to flat TC. Spacing of support originates from #1 hip. Attach 2x4 lateral bracing to flat TC @ 32° OC with 2-16d Box or Gun nails (0.135 x 3.5 mm) and diagonally brace per DWG. BRCAL#1014. Support hip rafter with cripples @ 5-14 OC.

**Purlins**
In lieu of structural panels or rigid ceiling use purlins to brace all flat TC @ 32° OC, all BC @ 12° OC.

**Wind**
Member design based on both MWFRS and C&C.
Right end vertical not exposed to wind pressure.
**WARNING**: READ AND FOLLOW ALL NOTES ON THIS DRAWING!

**IMPORTANT**: FURNISH THIS DRAWING TO ALL CONTRACTORS INCLUDING THE INSTALLERS

Trusses require extreme care in handling, handling, shipping, installing, and bracing. Refer to and follow the latest edition of BCSI (Building Component Safety Information) by TPI and SBCA for safety practices prior to performing these functions. Installers shall provide temporary bracing per BCSI. Unless noted otherwise, truss chord shall have properly attached structural sheathing and bottom chord shall have properly attached rigid ceiling. Locations shown for permanent lateral restraint of webs shall have bracing installed per BCSI sections B9, B10, or B11 as applicable. Apply plates to each face of truss and position as shown above and on the Joint Details, unless noted otherwise. Refer to drawings 100A-2 for standard plate positions.

Alpine, a division of ITW Building Components Group Inc., shall not be responsible for any deviation from this drawing, any failure to build the truss as shown, or for handling, shipping, installation and bracing of trusses. A seal on this drawing or cover page listing this drawing indicates acceptance of professional engineering responsibility solely for the design shown. The suitability and use of this drawing for any structure is the responsibility of the Building Designer per ANSI/TPI 1 Sec. 2.

For more information see this job's general notes page and these web sites: ALPINE: www.alpineute.com; TPI: www.tpiert.com; SBCA: www.abci.org; ICC: www.iccsafe.org
Lumber
Top chord 2x4 DF-L #1&Bet (g)
Bot chord 2x4 DF-L #1&Bet (g)
Webs 2x4 DF-L Standard (g)

Plating Notes
Connectors in green lumber (g) designed using
NDS/TPI reduction factors.

Loading
Bottom chord checked for 10.00 psf non-concurrent
live load.

Purlins
In lieu of structural panels or rigid ceiling use purlins
to brace all sloping TC @ 24° OC, all flat TC @ 32°
OC, all BC @ 120° OC.

Wind
Member design based on both MWPRS and C&C.
Right end vertical not exposed to wind pressure.

**WARNING** READ AND FOLLOW ALL NOTES ON THIS DRAWING!

**IMPORTANT** FURNISH THIS DRAWING TO ALL CONTRACTORS INCLUDING THE INSTALLERS

Trusses require extreme care in fabricating, handling, shipping, installing and bracing. Refer to and follow the latest edition of BCSI (Building Component Safety Information) by TPI and SBCA for safety practices prior to performing these functions. Installers shall provide temporary bracing per BCSI. Unless noted otherwise, top chord shall have properly attached structural sheathing and bottom chord shall have a properly
attached rigid ceiling. Locations shown for permanent lateral restraint of webs shall have bracing installed per BCSI sections B3. B7, or B10, as applicable. Apply plates to each face of truss and position as shown above and on the Joint Details, unless noted otherwise. Refer to drawings 160A-2 for standard plate positions.

Alpine, a division of ITW Building Components Group Inc. shall not be responsible for any deviation from this drawing or any failure to build the
truss in conformance with ANSI/TP1 1, or for handling, shipping, implating and bracing of trusses. A seal on this drawing or cover page,
listing this drawing, indicates acceptance of professional engineering responsibility solely for the design shown. The suitability
and use of this drawing for any structure is the responsibility of the Building Designer per ANSI/TP1 1 Sec. 2.

For more information see this job's general notes page and these web sites:
Job Number: T920
LONG BEACH REMODEL
Truss Label: B1 COMM

Ply: 1
Qty: 1
SEG# 270829 / T46
COMM
DwNo: 06015172941957
BFR / GWH
03/30/2016

Loading Criteria (psf)
TCCL: 20.00
TCDL: 14.00
BCLL: 0.00
BCDL: 10.00
Des Ld: 44.00
NCBCLL: 10.00
Soft: 2.00
Load Duration: 1.25
Spacing: 24.0"

Wind Criteria
Wind Std: ASCE 7-10
Speed: 110 mph
Enclosure: Closed
Risk Category: II
Exp: C
Mean Height: 15.00 ft
TCDL: 8.4 psf
BCDL: 6.0 psf

Code / Misc Criteria
Bldg Code: CBC 2013 Res
TPI Std: 2007
Rep Factors Used: No
FT/RT: 20(0)/00

Def/CSI Criteria
PP Deflection in loc L/def L/P
VERT(LLL): 0.031 G 999 240
VERT(TL): 0.105 G 999 180
HORZ(LL): 0.010 G - -
HORZ(TL): 0.035 G - -
Creep Factor: 2.0
Max TC CSI: 0.137
Max BC CSI: 0.452
Max Web CSI: 0.179

Maximum Reactions (lbs)
Loc R / U / Rw / Rh / RL / W
B 733 / 196 / 441 / - / 146 / 3.5
F 648 / 152 / 394 / - / - / -
Wind reactions based on C&C
B Min Brd Width Req = 1.5
F Min Brd Width Req = 1.5
B & F are a rigid surface.

Members not listed have forces less than 375#
Maximum Top Chord Forces Per Ply (lbs)
B D 317 - 1382 D E 234 - 1059
C D 221 - 1058 E F 326 - 1398

Maximum Bot Chord Forces Per Ply (lbs)
B G 1279 - 259 G F 1259 - 254

Maximum Web Forces Per Ply (lbs)
Webs Tens.Compl.
D G 440 - 28

Lumber
Top chord 2x4 DF-L #1&Bet (g)
Bot chord 2x4 DF-L #1&Bet (g)
Vents 2x4 DF-L (Standard)

Plating Notes
Connectors in green lumber (g) designed using NDS/TPI reduction factors.

Loading
Bottom chord checked for 10.00 psf non-concurrent live load.
Purlins
In lieu of rigid ceiling use purlins to brace BC @ 120° OC

Wind
Member design based on both MWFRS and C&C.

"WARNING" READ AND FOLLOW ALL NOTES ON THIS DRAWING!

"IMPORTANT" FURNISH THIS DRAWING TO ALL CONTRACTORS INCLUDING THE INSTALLERS.

Trusses require extreme care in fabricating, handling, shipping, installing and bracing. Refer to and follow the latest edition of BCSI (Building Component Safety Information) by TPI and SBCC for safety practices prior to performing these functions. Installers shall provide temporary bracing per BCSI. Unless noted otherwise, top chord shall have properly attached structural sheathing and bottom chord shall have a properly attached rigid ceiling. Locations shown for permanent lateral restraint of webs shall have bracing installed per BCSI sections B3, B7 or B10, as applicable. Apply plates to each face of truss and position as shown above and on the Joint Details, unless noted otherwise. Refer to drawings 160A-2 for standard plate positions.

Alpine, a division of ITW Building Components Group Inc, shall not be responsible for any deviation from this drawing. Any failure to build the trusses in conformance with ANSI/TPI 1, or for handling, shipping, installing and bracing of trusses, shall result in a voiding of this warranty and any liability. The suitability and use of this drawing for any structure is the responsibility of the Building Designer per ANSI/TPI 1 Sec. 3.

For more information see this job’s general notes page and these web sites:
ALPINE: www.alpineinc.com
TPI: www.tpi-net.org
SBCC: www.sbcc.industry.com
ICC: www.iccsafe.org
CALIFORNIA HIP PERMANENT BRACING DETAIL - END JACKS SUPPORTED 48" o/c

PERMANENT BRACING

START OF TOP CHORD EXTENSIONS (SLOPING TO FLAT)
FLAT TOP CHORD (TYPICAL)
PURLINS (CONTINUOUS)
START OF TOP CHORD EXTENSIONS (SLOPING TO FLAT)

PERMANENT Diagonal bracing

Permanent diagonal bracing
Permanent diagonal bracing form braced bays. Repeat at all hip ends.
Maximum interval equals 20 ft. Note: The first braced bay at the #1 hip can be exclud ed when the following conditions are met:
1) Continuous purlins are attached to the flat top chord of the #1 hip.
2) The end jacks are sheathed with properly attached structural panels.

Note: Conventional framing, including cripples and their connections, is not the responsibility of the truss designer, plate manufacturer, or truss fabricator. Persons erecting trusses are cautioned to seek advice of a local professional engineer regarding conventional framing. Trusses shall be designed for the appropriate tributary area.

CRIPPLE SUPPORT LAYOUT

B-B

PITCHED AND SHEathed CHORD AREA:

Wind: Maximum wind speed 120 mph, Exp. C, Cat. II, 30 ft. mean roof height and 5 psf max. dead load. Connect cripples to rafter extensions with (6) 10d nails (0.128"x3"), and to top chord of hip truss and purlin with (3) 10d nails. OR - Butt cripples to jack rafter and hip truss top chord, and provide connection for 360º uplift each end (17) BWC/112.5 clip with 8d nails (0.13"x1.5") or equivalent.
(A) Hip truss top chord. (B) 2X4 continuous purlin, 24" o/c typ.
(C) CRIPPLES a - Cripple Location. (4") o.c. cripple spacing shown.
Cripples support extended top chords of end jacks, hip jacks, and hips. Material: 2X4 SPF, HF, DF-L, or SoPine Standard/Std/No. min. grade.
Max. cripple length = 6'3". Max. 40 psf Snow Load = 14 psf Dead Load.
(D) Cripples and horizontal false top chords may be built into truss.

FIELD APPLIED CRIPPLE
CRIPPLE SPACING

Section A-A

Section B-B

Cripple Connections

See truss drawings for specific design information.

REF CALIF. BRACE
DATE 10/01/14
DRWG BRCAH1014

Design Crit: NDS-2012
Spacing: 24" o.c., typ.
**Roof Beams**

**HDR-1 & HDR-2**

\[ W = 556 \text{ Pounds} \]

\[ 8\frac{1}{2}'' \]

**HDR-1 has similar loading as HDR-2**

\[ L_T = L_0 R_1 R_2 \]
\[ L_1 = 1.0 \quad (T_a < 200\text{SE}) \]
\[ L_2 = 1.0 \quad (F = 4) \]
\[ L_T = L_0 = 20\text{ BF} \]

\[ W = (18 \text{ BF} + 20 \text{ BF}) \times 14'' \]
\[ 18 \text{ BF} \left( \frac{16}{12} \right) = 556 \text{ Pounds} \]

\[ V = \frac{W \times L}{2} = \frac{556 \times 8}{2} = 2220\# \]

\[ M = \frac{W \times L^2}{8} = \frac{556 \times 8^2}{8} = 4450\# \]

**Deflection**

\[ \Delta_0 = \frac{W \times L^2}{24E} = \frac{8 \times 14^2}{24E} = 0.46'' \]

\[ I_{eq} = \frac{5WL^4}{384EI} \Delta_0 = \frac{5 \times 20 \times 14^4}{384 \times 12^3} \times 0.46 = 38 \text{ in}^4 \]

\[ \Delta_{DL} = \frac{W \times L^2}{180} = \frac{8 \times 14^2}{180} = 0.53 \]

\[ I_{eq} = \frac{5 \times 556 \times 8^4}{384 \times (1.7 \times 10^6) \times 0.53} = 57 \text{ in}^4 \text{ (controls)} \]

**Try:** 4 x 10 DE-L #1

\[ I = 230.8 \text{ in}^4 \]
\[ S = 49.91 \text{ in}^3 \]
\[ A = 52.38 \text{ in}^2 \]
\[ C_L = 1.0 \Rightarrow \frac{d}{b} = \frac{1.5}{4} = 2.25 \quad \text{Per KDS 4.4.1} \]

**Check Bondage**

\[ f_b = \frac{8450 \times 12}{49.91} = 1070 \text{ PSi} \]

\[ F'_b = F_b \times C_f = (1000 \text{ PSi}) \times (1.25) \times 1.20 = 1500 \text{ PSi} \]

\[ f_b = 1070 \text{ PSi} < F'_b = 1500 \text{ PSi} \quad \text{OK} \]

**Check Stress**

\[ f_c = \frac{3v}{2k} = \frac{3 \times (2220)}{2 \times (3238)} = 103 \text{ PSi} \]

\[ F'_c = F_c \times C_f = (180 \times 1.25) = 225 \text{ PSi} \]

\[ f_c = 103 \text{ PSi} < F'_c = 225 \text{ PSi} \quad \text{OK} \]

Use 4X10 DF-L #1 (HBL1 & HBL2)
$w = 556 \text{ lb}$

$L_1 = 40 \text{ in}$

$L_2 = 10 \text{ ft}$

$F = 20 \text{ lb}$

$\theta = \frac{45}{180} \pi$ radians

$\theta = \frac{1}{4}$ of a circle

$\theta = \frac{\pi}{4}$ radians

$V = \frac{\omega L^2}{2} = \frac{556 \times (2.33)^2}{2} = 648 \text{ lb}$

$M = \frac{\omega L^2}{8} = \frac{556 \times (2.33)^2}{8} = 578 \text{ lb-ft}$

**Deflection**

$\Delta_L = \frac{L}{240} = \frac{2.33 \times 12}{240} = 0.12''$

$I_{eq} = \frac{5wL^4}{384EI} = \frac{5 \times (20 \times 14) \times 2.33^4 \times 12^4}{384 \times 1.7 \times 10^6} 0.12 = 0.91 \text{ in}^4$

$\Delta_{L+D} = \frac{L}{180} = \frac{2.33 \times 12}{180} = 0.16''$

$I_{eq} = \frac{5wL^4}{384EI} = \frac{5 \times (556) \times 2.33^4 \times 12^4}{384 \times (1.7 \times 10^6) 0.16} = 1.36 \text{ in}^4$

**Try 4 x 4 DF-L #1**

$I = 12.5 \text{ in}^4$

$S = 7.65 \text{ in}^2$

$A = 12.25 \text{ in}^2$
\[ C_e = 1.0 \Rightarrow \frac{d}{L} = \frac{4}{4} = 1.0 \]  \[ \text{Per NDS 4.4.1} \]

**Check Bending**

\[ F_b = \frac{M_e}{S} = \frac{378 \times 12}{7.15} = 634 \text{ PSI} \]

\[ F'_b = F_L C_D C_T = 1000 (1.25) (1.50) = 1875 \text{ PSI} \]

\[ F_L = 643 \text{ PSI} \leq F'_b = 1875 \text{ PSI} \quad \text{OK} \]

**Check Shear**

\[ F_v = \frac{3V}{2h} = \frac{3 \times 648}{2 \times 12.25} = 79.3 \text{ PSI} \]

\[ F'_v = F_L C_D = 180 \times 1.25 = 225 \text{ PSI} \]

\[ F_v = 79.3 \text{ PSI} \leq F'_v = 225 \text{ PSI} \quad \text{OK} \]

\[ \text{Use 4\times4 BE-L #1 (HID3)} \]
HBR 4

\[ w = 556 \text{ PSF} \]

\[ \Delta_{4''-3''} \]

\[ L_f = 40 \text{ ft} \]
\[ t_1 = 1.0 \text{ (Ta = 200 SF)} \]
\[ P_2 = 1.0 \text{ (P = 4)} \]
\[ L_r = 40 = 20 \text{ PSF} \]

\[ w = (10 \text{ PSF} + 20 \text{ PSF}) 4'' + \frac{10 \text{ PSF} (\frac{4}{12})}{12} = 556 \text{ PSF} \]

\[ V = \frac{wL^2}{2} = 556 \left( \frac{4.25^2}{8} \right) = 1160' \text{ ft-lb} \]

\[ M = \frac{wL^2}{6} = 556 \left( \frac{4.25^2}{8} \right) = 1260 \text{ in-lb} \]

DEFLECTION

\[ \Delta_c = \frac{c}{240} = \frac{4.25^2}{240} = 0.21'' \]

\[ I_{res} = \frac{5wl^4}{384EA} = \frac{5(2044)(4.25^4)(23)}{384(1.7)(106)} 0.21 = 5.76 \text{ in}^4 \]

\[ \Delta_{del} = \frac{c}{180} = \frac{4.25^2}{180} = 0.28'' \]

\[ I_{res} = \frac{5wl^4}{384EA} = \frac{5(556)(4.25^4)(23)}{384(1.7)(106)} 0.28 \]

\[ = 8.57 \text{ in}^4 \text{ controls} \]

Try 4x6 DF -> #1

\[ I = 48.53 \text{ in}^4 \]
\[ S = 17.65 \text{ in}^3 \]
\[ A = 19.25 \text{ in}^2 \]
\[ c_2 = 1.0 \Rightarrow \frac{d}{b} = \frac{6}{4} = 1.5 \]  

**Per AASHTO 4.4.1**

**Check Bending**

\[ F_b = \frac{W}{b} = \frac{1200 \times 12}{17.65} = 857 \text{ psi} \]

\[ F' = F_b C_D C_f = 1000 (1.25)(0.3) = 1625 \text{ psi} \]

\[ F_b = 857 \text{ psi} < F' = 1625 \text{ psi} \]  \( \text{OK} \)

**Check Shear**

\[ F_v = \frac{3V}{2A} = \frac{3 (1180)}{2 (19.25)} = 91.9 \text{ psi} \]

\[ F'_v = F_v C_D = 180 (1.25) = 225 \text{ psi} \]

\[ F_v = 91.9 \text{ psi} < F'_v = 225 \text{ psi} \]  \( \text{OK} \)

**Use 4x6 DF-L #1 (HDR-F)**
**Floor Framing**

**FJ-1**

\[ W = 69.3 \text{ lb} \]

\[ 7'0" \]

\[ A_T = 7'(4.5) = 31.5 \text{ SF} \]

\[ k_w A_T = 20 \text{ SF} < 400 \text{ SF} \]

\[ \Rightarrow \text{ No Reduction Allowed} \]

\[ w = \left( 12.5\text{ SF} + 40 \text{ SF} \right) \left( \frac{1}{2} \right) = 69.3 \text{ lb} \]

\[ V = \frac{4w}{2} = \frac{69.3}{2} = 24.3 \text{ ft} \]

\[ M = \frac{4w^2}{8} = \frac{69.3^2}{8} = 425 \text{ in} \cdot \text{lb} \]

**Deflection**

\[ A_L = \frac{wL^2}{360} = \frac{2x12^2}{360} = 0.12 \text{ in} \]

\[ I_{BLQ} = \frac{5WL^4}{384EA_L} = \frac{5\left( 40 \times \frac{12}{2} \right)^4 12^2}{384\left( 1.6 \times 10^6 \right) 0.12} = 7.83 \text{ in}^4 \]

\[ \Delta_{BLQ} = \frac{12AL}{240} = \frac{2x12^2}{240} = 0.35 \text{ in} \]

\[ I_{BLQ} = \frac{5WL^4}{384EA_{BLQ}} = \frac{5\left( 69.3 \right)^4 12^2}{384\left( 1.6 \times 10^6 \right) 0.35} = 6.69 \text{ in}^4 \]

**Try 2x6 Def-L #2**

\[ I = 20.8 \text{ in}^4 \]

\[ S = 7.56 \text{ in}^3 \]

\[ A = 8.25 \text{ in}^2 \]
**Check Bending**

\[ F_6 = \frac{M}{S} = \frac{425 \times 12}{7.56} = 675 \text{ psi} \]

\[ F_6 = F_u C_D F_n = 900 \times (1.0) \times 1.3 \times (1.15) = 1350 \text{ psi} \]

\[ F_6 = 675 \text{ psi} < F_6 = 1350 \text{ psi} \quad \text{OK} \]

**Check Shear**

\[ F_V = \frac{3V}{2A} = \frac{3 \times (243)}{2 \times (8.25)} = 44.2 \text{ psi} \]

\[ F_V = F_u C_D = 900 \times (1.0) = 900 \text{ psi} \]

\[ F_V = 44.2 \text{ psi} < F_V = 900 \text{ psi} \quad \text{OK} \]

**Check Torsion**

\[ C_6 = \frac{2q + \frac{h}{2}}{2q} = \frac{4 + \frac{5}{2}}{4} = 1.09 \]

\[ A = C_6 b = 4 \times (2) = 8 \text{ in}^2 \]

\[ F_{C_t} = \frac{P}{A} = \frac{242}{8} = 30.4 \text{ psi} \]

\[ F'_{C_t} + F_{C_t} C_6 = 625 \times (1.09) = 681 \text{ psi} \]

\[ F_{C_t} = 30.4 \text{ psi} < F_{C_t} = 681 \text{ psi} \quad \text{OK} \]

**Use** 2x6 DF-L #2 (FT-1)
FB-1

\[ W = 770 \text{ lb} \]

\[ \delta = \frac{6}{360} = 0.12 \text{ in} \]

\[ I_{toq} = \frac{5wL^4}{384EA} = \frac{5(40 \times 14)^4}{384(1.7 \times 10^6)} \times 0.20 = 480 \text{ in}^4 \text{ continuous} \]

\[ \Delta_{DL} = \frac{0}{240} = 0.13 \text{ in} \]

\[ I_{toq} = \frac{5wL^4}{384ED_{DL}} = \frac{5(770)^4}{384(1.7 \times 10^6)} \times 0.20 = 44 \text{ in}^4 \]

Try 4x10 DF-L #1

\[ I = 230.8 \text{ in}^4 \]

\[ S = 49.91 \text{ in}^3 \]

\[ A = 32.38 \text{ in}^2 \]
CHECK BENDING

\[ f_b = \frac{M}{S} = \frac{3470 \times 12}{49.91} = 834 \text{ psi} \]

\[ F_b = F_e C_b C_p = 1000 (1.0) (1.2) = 1200 \text{ psi} \]

\[ f_b = 834 \text{ psi} < F_b = 1200 \text{ psi} \quad \text{OK} \]

CHECK STOQUE

\[ f_u = \frac{3V}{2A} = \frac{3(230)}{2(32.38)} = 107 \text{ psi} \]

\[ F_b = F_u C_b = 180 (1.0) = 180 \text{ psi} \]

\[ f_u = 107 \text{ psi} < F_b = 180 \text{ psi} \quad \text{OK} \]

\[ \text{USO } 4 \times 10 \text{ BE-L } \#1 (\text{FB-1}) \]
Foundations

Wall Footings (FTG-1)

- **Loads**
  - \((5 \text{ PSF} + 20 \text{ PSF}) \times 7' = 235 \text{ PLF}\)
  - \(18 \text{ PSF} \times 8' = 144 \text{ PLF}\)
  - \((12 \text{ PSF} + 40 \text{ PSF}) \times 3.5' = 182 \text{ PLF}\)
  - 150 PLF (1' x 0.5' + 2' x 0.5') = 225 PLF

\[
\text{Total PLF} = 796 \text{ PLF}
\]

- **Maximum FTG. Width**
  \[
  \frac{796 \text{ PLF}}{1500 \text{ PLF}} = 0.53'
  \]

  **Use 1/2" wide FTG.**

- **Minimum Deft.**
  \[
  24'' \times 6'' \times 0.0018 = 0.26 \text{ in}^2
  \]
  **Use #5 Deft. (0.31 \text{ in}^2)**

**Use 1/2" wide 6" thick wall FTG. W/ 1# 5' Const. 251 PLF, TOP (1/2).**

Pier Footings (FTG-2)

- **Loads**
  \((15 \text{ PSF} + 40 \text{ PSF}) \times 6' \times 7' = 2310\) #

\[
\frac{2310\#}{1500 \text{ PSF}} = 1.54 \text{ SF}
\]

**Use 18'' SQ. FTGS.**
\( V = CsW \) (lbs) Seismic Base Shear.

<table>
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<tr>
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<tr>
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<tr>
<td>S1</td>
<td>0.584 G</td>
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<td>1.051 G</td>
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<tr>
<td>SD1</td>
<td>0.584 G</td>
</tr>
</tbody>
</table>

\[ R = 6.5 \]

\[ l = 1 \]

\[ Ta = C_i h_n^x \]

\[ C_i = 0.02 \]

\[ h_n = 10.5 \text{ ft} \]

\[ x = 0.75 \]

\[ T = Ta = 0.117 \text{ sec} \]

**Calculate Cs:**

| Cs | 0.162 |
| Cs max | 0.770 |
| Cs min | 0.046 |

**Solutions**

| Cs | 0.162 |

Use Cs = 0.2
**SEISMIC**

**BUILDING WEIGHTS**

**ROOF**
\[ 15 \text{ p.f.} \left[ (14.5' \times 26.25') + (19' \times 14.25') + (11' \times 1.5') + (11' \times 15') \right] = 25,700 \text{#} \]

**INTERIOR WEAUS**
\[ 8 \text{ p.f.} \left[ (62.25' \times 4') + (83.25' \times 4') \right] = 4650 \text{#} \]

**EXTERIOR WEAUS**
\[ 18 \text{ p.f.} \left( 2 \times 45.5' + 2 \times 40.25' + 2 \times 2 ' \right) \times 4' = 13600 \text{#} \]

**Bldg. wt = 43,000 # \text{W}**

---

**DIAPHRAGM**

\[ F_{pk} = \frac{\sum F_i \cdot w_{pk}}{w_{wi}} \quad \Rightarrow \quad \text{Building is 1-story} \]

\[ F_{pk} = 0.2 \cdot w_{pk} \]

---

**LINES**

\[ 0.5 \leq \sigma_{st} \leq \frac{w_{pk}}{w_{pc}} = 0.4 \cdot (1.05') \cdot 1 (w_{pk}) = 0.420 w_{pk} > F_{pk} 0.25 \]

\[ 0.2 \leq \sigma_{st} \leq \frac{w_{pk}}{w_{pc}} = 0.2 \cdot (1.05') \cdot 1 (w_{pk}) = 0.210 w_{pk} > F_{pk} 0.2 \]

\[ F_{pk} = 0.210 w_{pk} \]
DIAPHRAGM DESIGN

\[ F_{pc} = 0.2 \times 10 \times 12 \times \frac{43000}{1.4} = 8390 \text{#} \]

\[ F_{\text{roof}} = \frac{F_{pc}}{\text{roof area}} = \frac{8390 \text{#}}{1500 \text{ sf}} = 5.60 \text{ psf} \]

N-S DIR.

\[ N_{N-S} = \frac{5.60 \text{ psf} \times 1500 \text{ sf}}{2 \times 4.75} = 88.9 \text{ plf} \]

Use 1/8" DFX w/ 100 @ 6" 6" 12"

Blocked 2/12 CF

\[ V_n = 290 \text{ plf} > V_{N-S} \quad \text{OK} \]

E-W DIR.

\[ N_{E-W} = \frac{5.60 \text{ psf} \times 1500 \text{ sf}}{2 \times 45.5} = 92.3 \text{ plf} \quad \text{OK} \]
Shorewall Design

N-S Direction

\( V = 5.60 \text{ kF} \)

\( V_1 = 5.60 \text{ kF} \times 28.25' \times 15.25' \times \frac{1}{2} = 1210\text{ kF} \)

\( V_1 = \frac{1210\text{ kF}}{(12' + 4')} = 76 \text{ kF} \)

USA Shorewall 1 For Schedule (\( V_a = 280 \text{ kF} \)) OK

\( V_2 = 5.60 \text{ kF} \times 28.25' \times \left( \frac{15.25'}{2} + \frac{15'}{2} \right) = 2160\text{ kF} \)

\( V_2 = \frac{2160\text{ kF}}{12'} = 180 \text{ kF} \)

USA Shorewall 1 For Schedule (\( V_a = 280 \text{ kF} \)) OK

\( V_3 = 5.60 \text{ kF} \times 47.25' \times \left( \frac{15'}{2} + \frac{8.75'}{2} \right) \)

\( = 4070\text{ kF} \)

\( V_3 = \frac{4070\text{ kF}}{8.5'} = 478 \text{ kF} \)

USA Shorewall 2 For Schedule (\( V_a = 510 \text{ kF} \)) OK

\( V_4 = 5.60 \text{ kF} \times 26.25' \times \frac{18.75'}{2} = 1380\text{ kF} \)

\( V_3 = \frac{1380\text{ kF}}{6'} = 230 \text{ kF} \)

USA Shorewall 1 For Schedule (\( V_a = 280 \text{ kF} \)) OK
E-W DIRECTION

\[ V_a = 5.60 \text{ PSF} \times 45.5' \times \frac{28.25'}{2} = 3600 \text{#} \]

\[ V_a = \frac{3600 \text{#}}{11.5'} = 313 \text{ PLF} \]

USE SHORTWALL \( \text{2 Per Schedule} \) \( (U_a = 510 \text{ PLF}) \)

\[ V_B = 5.60 \text{ PSF} \times 41' \times \left( \frac{28.25'}{2} + \frac{17'}{2} \right) = 5190 \text{#} \]

\[ V_B = \frac{5190 \text{#}}{10'} = 519 \text{ PLF} \]

USE SHORTWALL \( \text{3 Per Schedule} \) \( (U_a = 665 \text{ PLF}) \)

\[ V_C = 5.60 \text{ PSF} \times 14.75' \times \frac{17'}{2} = 678 \text{#} \]

\[ V_C = \frac{678 \text{#}}{41'} = 170 \text{ PLF} \]

USE SHORTWALL \( \text{1 Per Schedule} \) \( (U_a = 280 \text{ PLF}) \)
Use seismic load combi.
(0.6 - 0.14 * 0.15) * 32 + 0.37 * 2
0.6 - 0.14 (1.051) = 0.467

V = 76 Psf x 6' = 912#
UPLIFT = [912 # x 8' - 0.467 (15 Psf x 7.38' x 0.5^2 + 10 Psf x 8' x 4.5^2)] / 2
= 49.4 #

V = 76 Psf x 4' = 304#
UPLIFT = [304 # x 8' - 0.467 (15 Psf x 4' x 4^2 + 10 Psf x 8' x 4.5^2)] / 4
= 418 #

Use Simpson HDU2 Holddown

T_a = 3075 > T = 418 #  OK

V = 2 (60 #)
UPLIFT = [2 (60 # x 8' - 0.467 (15 Psf x 7.38' x 0.5^2 + 10 Psf x 8' x 4.5^2)] / 2
= 120 #

Use Simpson HDU2 Holddown  OK
**Ground 3**

\[ V = 4070 \text{#} \]

\[ \text{UPLIFT} = \left[ \frac{4070 \times 8}{1} - 0.467 \left( 15 \times 7 \times 5^2 + 18 \times 8 \times 5 \frac{5^2}{2} \right) \right] + 8.5 \]

\[ = 3440 \text{#} \]

**Use Simpson Hdl 4 Holdown**

**OK**

\[ T_a = 4065 \text{#} > T = 3440 \text{#} \]

**Ground 4**

\[ V = 1380 \text{#} \]

\[ \text{UPLIFT} = \left[ \frac{1380 \times 6}{1} - 0.467 \left( 15 \times 6 \times 6^2 + 18 \times 8 \times 6 \frac{6^2}{2} \right) \right] + 6 \]

\[ = 1580 \text{#} \]

**Use Simpson Hdl 2 Holdown**

**OK**
**E-W Walls**

**Guideline A**

\[ V = \frac{3}{3} \text{ plf} \times 3.5' = 1100' \]

\[
U_{\text{uplift}} = \left[ 1100 \times 8' - 0.467 \left( 15 \text{ plf} \times 3.5' \times \frac{3.5'^2}{2} + 18 \text{ plf} \times 8' \times \frac{8'^2}{2} \right) \right]^{1/3}
\]

\[ = 2380' \] #

**Uplift forces for other two walls on Guideline A are similar.**

**Use Simpson Hduz Holdown OK**

---

**Guideline B**

\[ V = 519 \text{ plf} \times 3' = 1560' \]

\[
U_{\text{uplift}} = \left[ 1560 \times 8' - 0.467 \left( 15 \text{ plf} \times 3' \times \frac{3'^2}{2} + 18 \text{ plf} \times 8' \times \frac{8'^2}{2} \right) \right]^{1/3}
\]

\[ = 4040' \] #

**Uplift forces for other two walls on Guideline B are similar.**

**Use Simpson Hduz Holdown**

\[ T_a = 4565' > T = 4040' \text{ OK} \]
GRIDLINE C

\[ V = 678 \text{ ft} \]

\[ \text{UPLIFT} = \left[ 678 \times 8 - 0.467 \left( 15.73 \times 1.4 \times 4 \times \frac{4}{2} + 10.73 \times 8 \times \frac{4}{2} \right) \right] \cdot \frac{1}{2} \]

\[ = 1190 \text{ ft} \]

USE SIMPSON HDU2 HOLDOWN OK