Supplemental Facility Seismic Evaluation

Benton County Courthouse
120 NW 4th Avenue, Corvallis, Oregon

Prepared for
Benton County

Prepared by

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BENTON COUNTY COURTHOUSE EXECUTIVE SUMMARY

Overview

Benton County has contracted Miller Consulting Engineers, Inc. (MCE) to provide an additional seismic evaluation for the Benton County Courthouse using the *ASCE 41-13* standard to supplement our previous report dated January 29, 2016. For this additional seismic evaluation, we evaluated the building using the BPOE-2E seismic hazard, which is considered a severe earthquake, coupled with the Life Safety Building Performance Level objective. The goal of this objective is to allow the occupants to safely exit the structure after a severe earthquake; however, continued occupancy might not be likely before repair work is completed. This additional evaluation is a non-standard combination when reviewing the *ASCE 41-13* and will be referred to as the Supplemental Performance Objective (SPOE) henceforth and is a combination of the Basic Safety Objective for Life-Safety (3-C) with a BSE-2E seismic hazard level that is an earthquake that has the probability of exceedance of 5% in 50 years or a mean return period of 975 years between occurrences. In addition, Benton County also contracted MCE to provide an engineer's estimate of probable construction cost for a new criminal justice center that houses the courts and offices currently in the courthouse located on county property or new property. The new center is intended to be a generic multiple-story courthouse building at about 45,000 square feet (SF).

As previously noted, the ASCE 41-13 standard has been developed so that buildings meeting the Basic Performance Objective (BPOE) are expected to experience little damage from relatively frequent, moderate earthquakes but significantly more damage and potential economic loss from the most severe and infrequent earthquakes. To seismically evaluate the building, the *ASCE 41-13* uses site-specific information that is generated from the U.S. Geological Survey (USGS). The USGS information provides the spectral acceleration for different return periods in which the BPOE-1E seismic hazard, considered a moderate earthquake, has a 225-year return period and the BPOE-2E seismic hazard, considered a severe earthquake, has a 975-year return period. This information is then modified into a design acceleration considering the building's structural system along with other factors such as the soil conditions at the site.

To summarize the building performance objectives used within this report (see the table below for additional clarification), the Basic Performance Objective is to allow the occupants to safely

exit the structure after a moderate earthquake. However, continued occupancy might not be likely before repair work is completed. The Enhanced Performance Objective is to allow the building to be immediately operable after a moderate earthquake. It is expected that the building will develop cracks, but items that are damaged will remain in place. The Limited Performance Objective is to prevent the building from collapsing during a major earthquake. Therefore it is expected that the building will be severely damaged and should not continue to be occupied following the earthquake. Lastly, the Supplemental Performance Objective is similar to the Basic Performance Objective, but considers a severe earthquake as the seismic hazard in lieu of a moderate earthquake.

Performance Objective	Seismic Hazard	Occurrence	Performance Level
Basic	Moderate	225 Years	Life Safety standard
Enhanced	Moderate	225 Years	Immediate Occupancy standard
Limited	Severe	975 Years	Collapse Prevention standard
Supplemental	Severe	975 Years	Life Safety standard

This additional evaluation identified the following items that need to be addressed considering the performance objective as part of the proposed seismic upgrade:

- Strengthening the roof and floor diaphragms to transfer lateral loads to the walls.
- Providing connections between the walls and roof and floor diaphragms for in-plane and out-of-plane loads.
- Providing connections at the roof and floor diaphragm to account for plan irregularities.
- Providing concrete shear walls for many of the unreinforced masonry walls to support the in-plane loading.
- Providing bonded shear walls to reinforce the unreinforced masonry walls at the fourth floor bell lounge for out-of-plane loads.
- Providing structural steel horizontal framing members at the stairway openings to support the unreinforced masonry walls for out-of-plane loads.
- Providing structural steel support columns for the secondary support of the trusses and beams that are independent of the unreinforced masonry walls.
- Addressing the non-structural concerns identified in the evaluation including bracing the fire suppression lines, bracing the gas line, bracing the suspended gypsum ceilings, bracing the in-line mechanical equipment and anchoring the non-compliant shelves.

We anticipate that the proposed upgrade work for this supplemental evaluation will take approximately 24 months to complete and will require the building to be vacated during construction. It is intended that the above repairs will be completed in such a way that the new construction will be encapsulated within a wall cavity or masked in some manner to preserve the historical and architectural features where possible. The following is our preliminary estimate of probable construction cost to upgrade the building based on the additional seismic evaluation (listed as Supplemental), as well as the cost estimates from our previous report as well:

Performance Objective	Construction	Contingency	Total Cost	Cost per sq. foot
Basic	$4,312,271	$1,078,068	$6,737,923	$204
Enhanced	$5,824,570	$1,456,143	$9,100,891	$275
Limited	$6,966,813	$1,741,703	$10,885,645	$329
Supplemental	$7,876,117	$1,969,029	$12,306,433	$372

The above costs only consider the structural upgrades and corresponding work as required by the structural upgrades; the other concerns with the building such as HVAC, plumbing, ADA access or other tenant improvement costs are not included in this cost. The above cost estimate is based on the work being completed as a whole and not broken into phases to allow for the continued occupancy of the building during construction. Furthermore, these estimates are limited to the repairs of the detailed items and do not include relocation costs of staff or other soft costs. Within our opinion of probable construction cost estimate, we have included the contractor's overhead and profit, as well as a 25% construction contingency as further detailed in the cost portion of this report.

Scope of Work

For this additional evaluation, Miller Consulting Engineers, Inc. was contracted by Benton County to provide an ASCE 41-13 evaluation of the county courthouse located in Corvallis, Oregon, using criteria found in the *ASCE 41-13* document. In addition, Benton County also contracted MCE to provide an engineer's estimate of probable construction cost for a new criminal justice center that houses the courts and offices currently in the courthouse located on county property or new property. The new center is intended to be a generic multiple-story courthouse building at about 45,000 square foot.

For this additional evaluation, the non-structural review excludes building contents and furnishings. Furthermore, soils information was based on information obtained from the Oregon

Department of Geology and Mineral Information (DOGAMI) website, which provided the site classification, soil rupture information, and liquefaction information for this study.

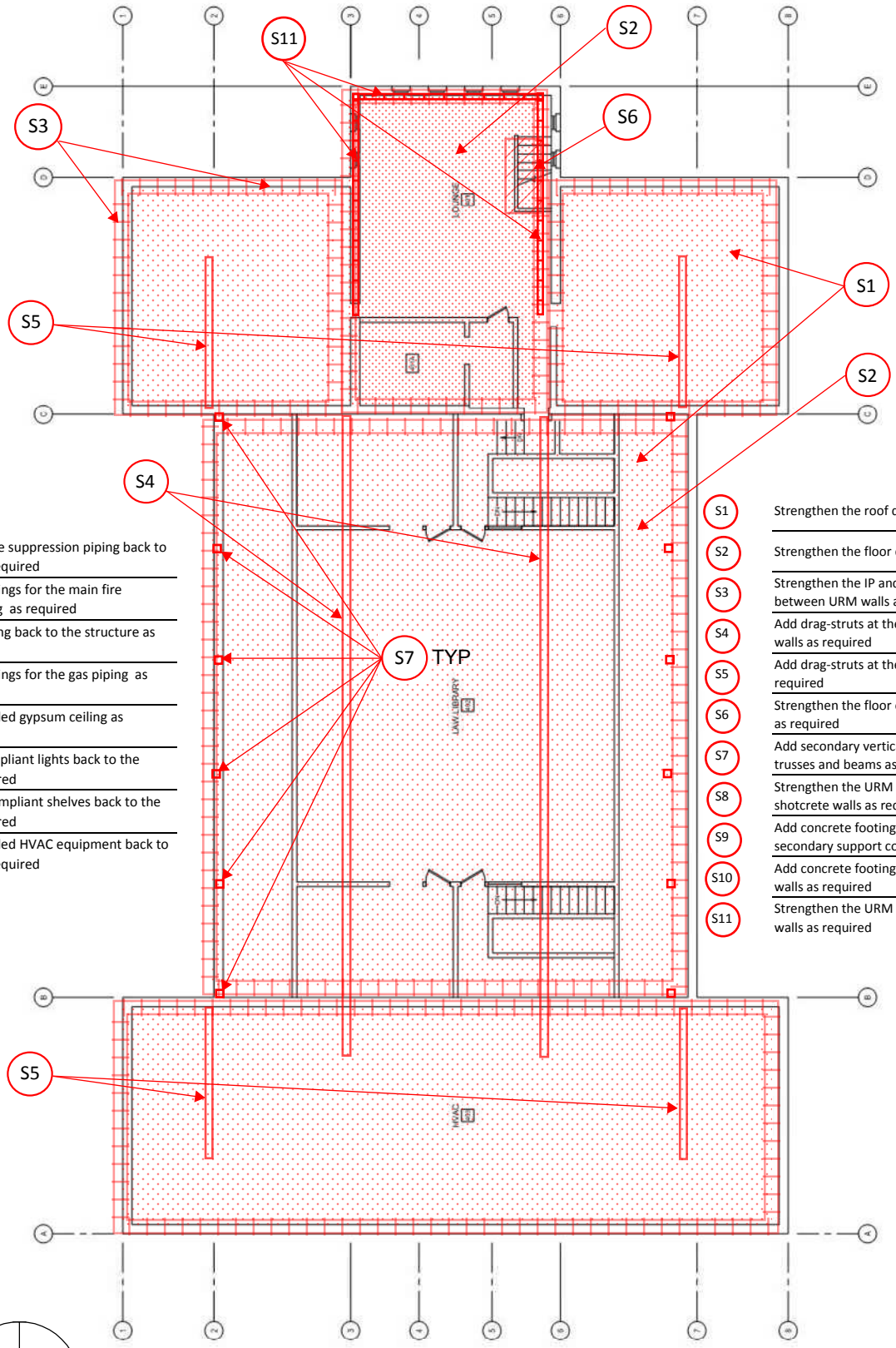
Miller Consulting Engineers, Inc. also provided an engineer's preliminary estimate of probable construction costs as detailed within this report to correct the deficiencies found based on this evaluation, as well as the cost estimate for the new criminal justice center. These estimates are limited to the repairs of the items within this report or for the new construction of the criminal justice center and do not include relocation costs of staff or other soft costs unless noted otherwise. Due to the current marketplace and the construction boom that is currently ongoing in the area, these cost estimates may not accurately depict the current construction costs due to rapid changes in construction material costs, as well as labor availability.

New Building Cost Estimate

With regard to the engineer's estimate of probable construction cost for a new criminal justice center, MCE developed a cost estimate considering a new 45,000 square foot, three-story, steel-framed courthouse building that has moderate interior and exterior finishes. The cost estimate does include some additional amenities that are included in the cost estimate table such as taller ceilings for two of the floors to enhance the courtrooms, closed circuit video production, and a secondary elevator for public and private access. It is estimated that the exterior facade would consist of glazing with limestone or masonry veneer. The following is our preliminary estimate of probable construction cost to build the above-proposed building:

Item	Construction	Contingency	Total Cost	Cost per sq. foot
Base Cost	$10,795,500	$2,698,875	$13,494,375	$300
Additive Cost	$1,620,864	$405,216	$2,026,080	$44
Total Cost	$12,416,364	$3,104,091	$15,520,455	$344

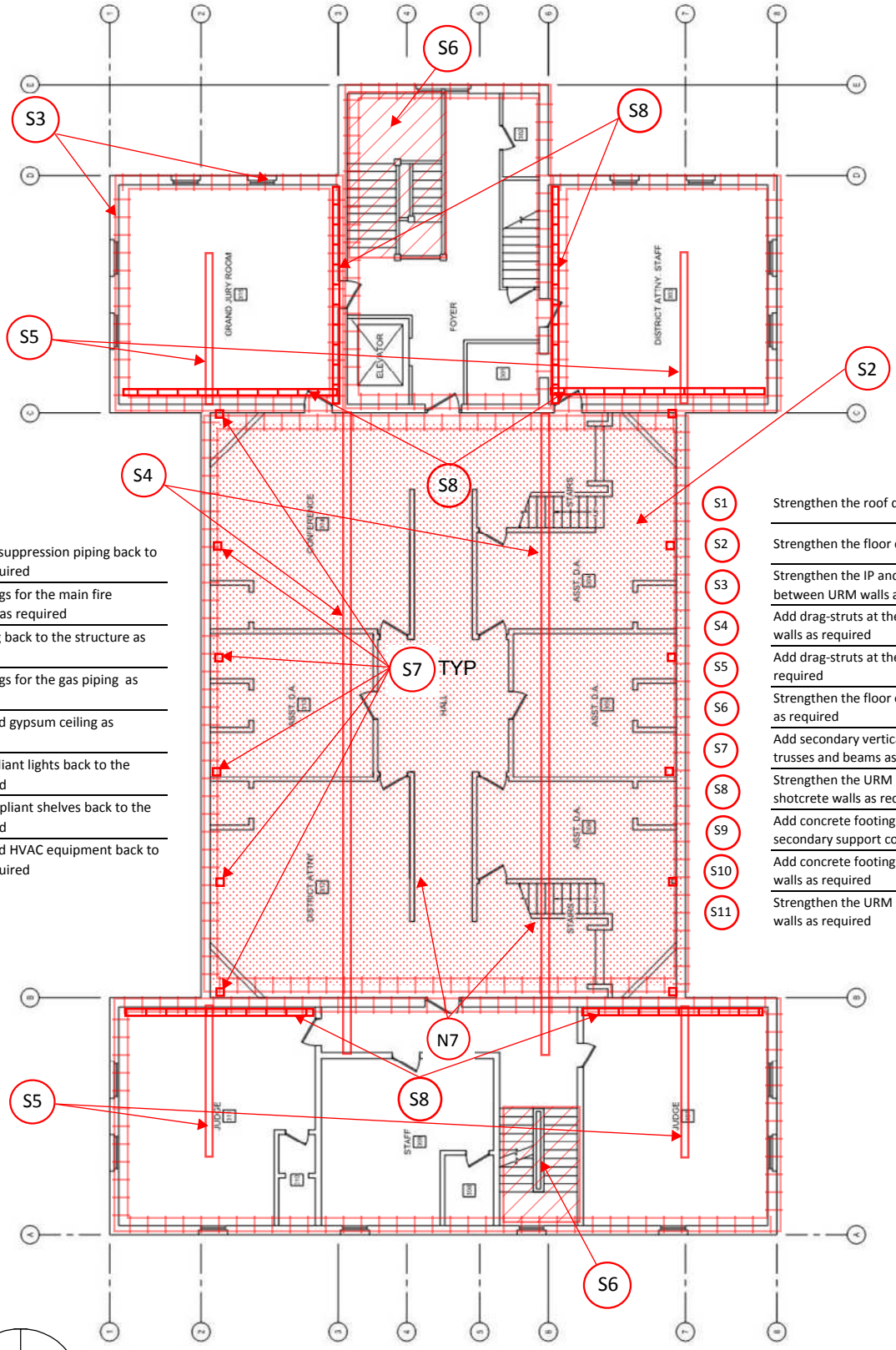
The above costs are based on using today's dollars and include soft costs such as permitting and architectural design fees, as well as the contractor's overhead and profit and a 25% construction contingency as further detailed in the cost portion of this report. However, only the structural permitting fees are included in the above and other permitting fees such as HVAC, plumbing, and electrical may apply. Lastly, the costs are for the building itself and do not include site development or site development upgrades that may be necessary to build the proposed building. For planning purposes using this cost estimate, an escalation factor should be used to account for when the construction can begin compared with today's dollars.



N1	Brace the main fire suppression piping back to the structure as required
N2	Add flexible couplings for the main fire suppression piping as required
N3	Brace the gas piping back to the structure as required
N4	Add flexible couplings for the gas piping as required
N5	Brace the suspended gypsum ceiling as required
N6	Brace the noncompliant lights back to the structure as required
N7	Anchor the noncompliant shelves back to the structure as required
N8	Brace the suspended HVAC equipment back to the structure as required

S1	Strengthen the roof diaphragm
S2	Strengthen the floor diaphragm
S3	Strengthen the IP and OOP connections between URM walls and the diaphragm
S4	Add drag-struts at the discontinuous URM walls as required
S5	Add drag-struts at the reentrant corners as required
S6	Strengthen the floor openings at the stairways as required
S7	Add secondary vertical support for the girder trusses and beams as required
S8	Strengthen the URM walls by adding concrete shotcrete walls as required
S9	Add concrete footings to support the secondary support columns as required
S10	Add concrete footings to support the shotcrete walls as required
S11	Strengthen the URM walls by adding bonded walls as required

FOURTH FLOOR PLAN



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S7	Add secondary vertical support for the girder trusses and beams as required
S8	Strengthen the URM walls by adding concrete shotcrete walls as required
S9	Add concrete footings to support the secondary support columns as required
S10	Add concrete footings to support the shotcrete walls as required
S11	Strengthen the URM walls by adding bonded walls as required

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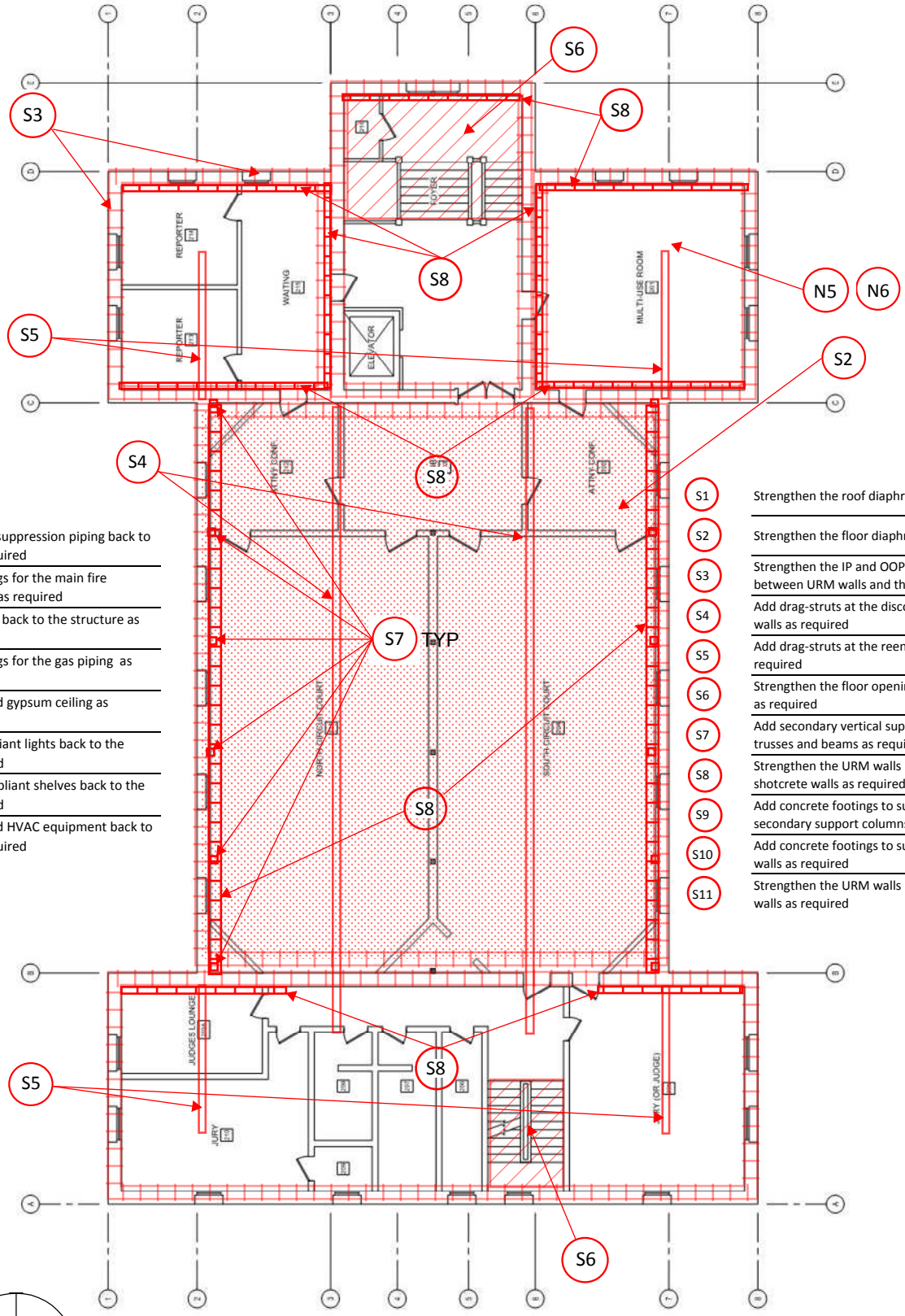
THIRD FLOOR PLAN



N1	Brace the main fire suppression piping back to the structure as required
N2	Add flexible couplings for the main fire suppression piping as required
N3	Brace the gas piping back to the structure as required
N4	Add flexible couplings for the gas piping as required
N5	Brace the suspended gypsum ceiling as required
N6	Brace the noncompliant lights back to the structure as required
N7	Anchor the noncompliant shelves back to the structure as required
N8	Brace the suspended HVAC equipment back to the structure as required

S1	Strengthen the roof diaphragm
S2	Strengthen the floor diaphragm
S3	Strengthen the IP and OOP connections between URM walls and the diaphragm
S4	Add drag-struts at the discontinuous URM walls as required
S5	Add drag-struts at the reentrant corners as required
S6	Strengthen the floor openings at the stairways as required
S7	Add secondary vertical support for the girder trusses and beams as required
S8	Strengthen the URM walls by adding concrete shotcrete walls as required
S9	Add concrete footings to support the secondary support columns as required
S10	Add concrete footings to support the shotcrete walls as required
S11	Strengthen the URM walls by adding bonded walls as required

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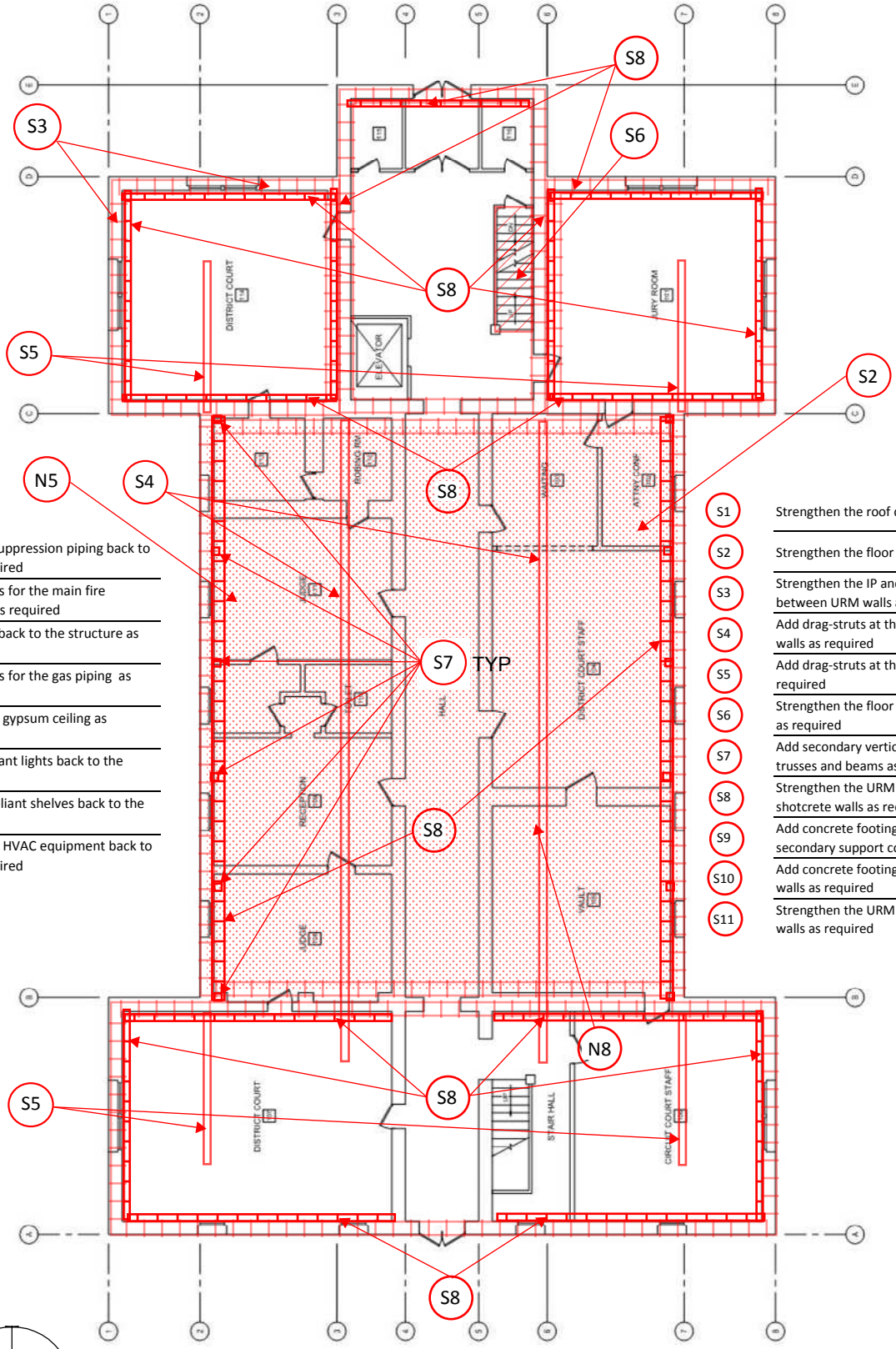
SECOND FLOOR PLAN



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N2	Add flexible couplings for the main fire suppression piping as required
N3	Brace the gas piping back to the structure as required
N4	Add flexible couplings for the gas piping as required
N5	Brace the suspended gypsum ceiling as required
N6	Brace the noncompliant lights back to the structure as required
N7	Anchor the noncompliant shelves back to the structure as required
N8	Brace the suspended HVAC equipment back to the structure as required

S1	Strengthen the roof diaphragm
S2	Strengthen the floor diaphragm
S3	Strengthen the IP and OOP connections between URM walls and the diaphragm
S4	Add drag-struts at the discontinuous URM walls as required
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S7	Add secondary vertical support for the girder trusses and beams as required
S8	Strengthen the URM walls by adding concrete shotcrete walls as required
S9	Add concrete footings to support the secondary support columns as required
S10	Add concrete footings to support the shotcrete walls as required
S11	Strengthen the URM walls by adding bonded walls as required

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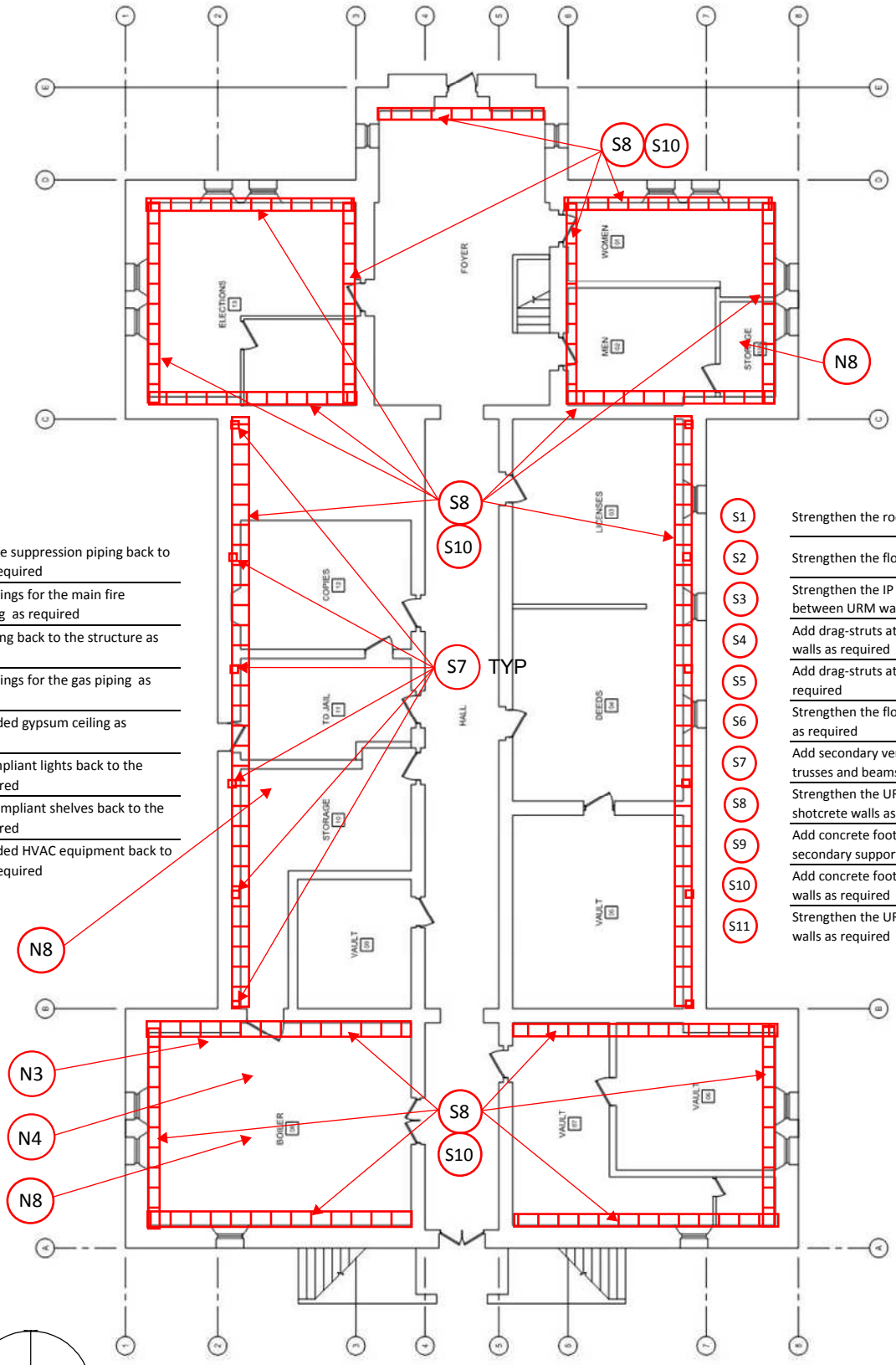
FIRST FLOOR PLAN



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S7	Add secondary vertical support for the girder trusses and beams as required
S8	Strengthen the URM walls by adding concrete shotcrete walls as required
S9	Add concrete footings to support the secondary support columns as required
S10	Add concrete footings to support the shotcrete walls as required
S11	Strengthen the URM walls by adding bonded walls as required

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BASEMENT FLOOR PLAN

Supplemental Performance Objective

The goal of this objective is to allow the occupants to safely exit the structure after an earthquake. Continued occupancy might not be likely before repair work is completed. The Supplemental Performance Objective (SPOE) uses the Life Safety standard and has checklists that provide a systematic approach to the evaluation of the building considering the system modification factors for the materials in the building. Furthermore, this evaluation uses the BSE-2E seismic hazard level, which is an earthquake that has the probability of exceedance of 5% in 50 years or a mean return period of 975 years between occurrences.

The courthouse building is a five-story structure comprised of three primary areas on each floor, which consist of a central core area and an east and west wing area to the east and west of the core area. Also, the clock tower is located at the center of the east wing and protrudes to the east 10 feet from the remainder of the east wing. There are several unknown structural conditions, which include the condition of the unreinforced masonry walls considering the tensile and shear strength of the masonry, if there is an isolation joint between the courthouse and the adjacent jail building and how the existing anchors at the ceiling of the fourth floor are attached to the ceiling diaphragm.

There is a concern with the unknown condition of the isolation joint; if there is no isolation joint between the jail and the courthouse there is a potential pounding concern between the buildings. There are a few options to address this concern one of which is to cut in a new isolation gap into the jail building and provide support for the jail building as required. The other option is to tie the courthouse to the jail building. We anticipate that the preliminary estimate of probable construction cost for the new isolation gap could be approximately $120,000 and could cause some disruption along the south wall of the jail. Tying the buildings together is a more complicated concern and more investigation and design will be required to provide the specifics and the probable construction cost estimate. However, this concern would be covered by the contingency we have used in our preliminary estimate of probable construction cost. The following is the structural evaluation of the courthouse building.

Roof Level Evaluation

The roof framing of the building consists of 2x roof rafters at 24" on center (o.c.) typically that bear on the exterior walls with straight tongue-and-groove lumber roof sheathing (the lumber is installed perpendicular to the framing). The rafters are notched and toenailed to a 4 x 12 wood bearing plate that was set in a bed of mortar on top of the brick walls that also has small diameter bolts (3/8" diameter) spaced at 10' o.c. that appear to be embedded into the top of the brick wall. The bolts have wood spacers for unknown reasons of varying length where the nut bears on top of the spacer. The core area roof is framed differently than the wings and has heavy timber trusses at 12' o.c. that bear on heavy steel plates on the exterior brick walls, of which the trusses support the roof and ceiling framing. However, the heavy steel plates at the truss bearing locations do not appear to be anchored or connected to the top of the brick wall in any way.

Considering the straight sheathing, the west wing exceeds the allowable aspect ratios, as allowed by the checklists, and based on our analysis has a demand-to-capacity ratio (DCR) of 2.53, which is to say that there is 2.53 times more demand (or load) than the capacity of the sheathing. At the core roof area the straight sheathing also spans greater than 24 feet, as allowed by the checklists, and based on our analysis has a DCR of 13.2.

As far as anchorage is concerned, the standard states that when anchors are nonexistent, mitigation with connections needed to anchor the walls to the diaphragm is necessary to meet the performance goals. This concern applies both to the connection of the roof diaphragm, as well as the connection at the heavy timber trusses. Furthermore, the roof lacks connections capable of transferring the loads as a result of the building irregularities (the offset walls on the north and south sides of the building) and offset shear walls (i.e., the shear walls at gridlines 3 and 6 are offset to the east).

Roof Level Recommendations

To address the noncompliant concerns at the roof level we recommend the following: For the straight sheathing, overlay the existing sheathing with new plywood sheathing and while addressing the sheathing add anchors and blocking for both the in-plane and out-of-plane loading concerns. For the missing connections, add custom structural steel drag struts from the offset shear walls and at the reentrant corners. Add connections from the heavy timber trusses to the heavy steel plates and then to the top of the unreinforced masonry walls. Lastly, provide

structural steel support columns for the secondary support of the trusses that are independent of the unreinforced masonry walls.

Fourth Floor Evaluation

The fourth floor is predominately located within the original attic space of the heavy timber trusses and was finished as part of the 1978 renovation. The fourth floor bell lounge room is an original finished space that is at the base of the clock tower and is slightly above the remaining fourth floor level; also, the unreinforced masonry walls in the Bell Tower Lounge are inadequate to support the out-of-plane loading. The renovated fourth floor space has light wood floors that span between the bottom chords of the heavy timber trusses, but the floor diaphragm does not extend out to the north and south walls of the core area. At the core area, the unblocked diaphragm has a span greater than 40 feet, as allowed by the checklists, and based on our analysis has a DCR of 3.25. In addition, the floor opening at the stairway at the bell lounge room is more than 8 feet, as allowed by the checklists, and based on our analysis the diaphragm has a DCR of 1.28 and the unreinforced masonry walls at the stairway opening has a DCR of 6.2.

As far as anchorage is concerned, connections were not observed from the floor framing to the unreinforced masonry walls. This concern applies both to the connection of the floor diaphragm as well as to the lack of connections capable of transferring the loads as a result of the building irregularities and offset shear walls.

Fourth Floor Recommendations

To address the noncompliant concerns on the fourth floor (most of the repairs at the fourth floor are similar to the repairs as required at the roof level), we recommend including the strengthening of the floor diaphragm and the addition of connections between the walls and the diaphragm for in-plane and out-of-plane loads. For the unreinforced masonry walls in the Bell Tower Lounge, add bonded walls to support the out-of-plane loading. For the stairway openings, add structural steel horizontal framing members to support the unreinforced masonry walls for out-of-plane loads and drag struts to transfer the loads from the diaphragm to the shear walls.

Third Floor Evaluation

The third floor layout covers the footprint of the building including the area within the core, as well as the east and west wings of the building. The third floor core area was added as part of the

1978 renovation when a floor was framed in the upper 10 feet of the second floor. The floor is supported by glulam beams that span in the north-south direction with floor joists spanning in between the glulam beams. The area in the east and west wing is part of the original finished space of the building and is level with the remaining third floor level. At the core area, the unblocked diaphragm has a span greater than 40 feet, as allowed by the checklists, and based on our analysis has a DCR of 3.3. Based on the Tier I quick check, the unreinforced masonry walls at Gridlines 3, 6, B and C in the east wing are not adequate to resist the in-plane loading from the diaphragm and have a DCR as high as 20 (see the calculations for the individual DCR for each wall line). In addition, the floor opening at the stairways at the east and west wings are more than 8 feet, as allowed by the checklists, and based on our analysis the diaphragm has a DCR of 2.3 and the unreinforced masonry walls at the stairway opening has a DCR of 3.8.

As far as anchorage is concerned, connections were not observed from the floor framing to the unreinforced masonry walls. This concern applies both to the connection of the floor diaphragm as well as to the lack of connections capable of transferring the loads as a result of the building irregularities and offset shear walls.

Third Floor Recommendations

To address the noncompliant concerns on the third floor (most of the repairs at the third floor are similar to the repairs as required at the roof level), we recommend including the addition of connections between the walls and the diaphragm for in-plane and out-of-plane loads. For the inadequate unreinforced masonry shear walls, add shotcrete concrete shear walls to support the in-plane loading. For the stairway openings, add structural steel horizontal framing members to support the unreinforced masonry walls for out-of-plane loads and drag struts to transfer the loads from the diaphragm to the shear walls. Also, continue to provide structural steel support columns to the secondary support of the trusses, as well as the glulam beams of the third floor that are independent of the unreinforced masonry walls.

Second Floor Evaluation

The second floor layout appears to be part of the original finished space of the building and covers the footprint of the building including the area within the core, as well as the east and west wings of the building. At the core area, the unblocked diaphragm has a span greater than 40 feet, as allowed by the checklists, and based on our analysis has a DCR of 5.2. Based on the Tier

I quick check, the unreinforced masonry walls at Gridlines 2, 3, 6, 7, B, C, D and E are not adequate to resist the in-plane loading from the diaphragm and have a DCR as high as 10.9 (see the calculations for the individual DCR for each wall line). In addition, the floor opening at the stairways at the east and west wings are more than 8 feet, as allowed by the checklists, and based on our analysis the diaphragm has a DCR as high as 3.2 and the unreinforced masonry walls at the stairway opening has a DCR as high as 7.9.

As far as anchorage is concerned, connections were not observed from the floor framing to the unreinforced masonry walls. This concern applies both to the connection of the floor diaphragm, as well as to the lack of connections capable of transferring the loads as a result of the building irregularities and offset shear walls.

Second Floor Recommendations

To address the noncompliant concerns on the second floor (most of the repairs at the second floor are similar to the repairs as required at the roof level), we recommend including the addition of connections between the walls and the diaphragm for in-plane and out-of-plane loads. For the stairway openings, add structural steel horizontal framing members to support the unreinforced masonry walls for out-of-plane loads and drag struts to transfer the loads from the diaphragm to the shear walls. For the inadequate unreinforced masonry shear walls, add shotcrete concrete shear walls to support the in-plane loading. Continue to provide structural steel support columns as the secondary support of the trusses and third floor glulam beams that are independent of the unreinforced masonry walls.

First Floor Evaluation

The first floor layout appears to be part of the original finished space of the building and covers the footprint of the building including the area within the core, as well as the east and west wings of the building. At the core area, the unblocked diaphragm has a span greater than 40 feet, as allowed by the checklists, and based on our analysis has a DCR of 1.92. Based on the Tier I quick check, the unreinforced masonry walls at Gridlines 1, 2, 3, 6, 7, 8, A, B, C, D and E are not adequate to resist the in-plane loading from the diaphragm and have a DCR as high as 4.1 (see the calculations for the individual DCR for each wall line). The floor opening at the stairways at the east and west wings are more than 8 feet, as allowed by the checklists, and based on our

analysis the diaphragm has a DCR of 1.6 and the unreinforced masonry walls at the stairway opening has a DCR of 5.2.

As far as anchorage is concerned, connections were not observed from the floor framing to the unreinforced masonry walls. This concern applies both to the connection of the floor diaphragm, as well as to the lack of connections capable of transferring the loads as a result of the building irregularities and offset shear walls.

First Floor Recommendations

To address the noncompliant concerns on the first floor (most of the repairs at the first floor are similar to the repairs as required at the roof level), we recommend including the addition of connections between the walls and the diaphragm for in-plane and out-of-plane loads. For the stairway openings, add structural steel horizontal framing members to support the unreinforced masonry walls for out-of-plane loads and drag struts to transfer the loads from the diaphragm to the shear walls. For the inadequate unreinforced masonry shear walls, add shotcrete concrete shear walls to support the in-plane loading. Continue to provide structural steel support columns as the secondary support of the trusses and third floor glulam beams that are independent of the unreinforced masonry walls. In addition, the proximity of the jail building creates a potential pounding concern, which, if it is determined to be too close, a seismic isolation joist should be added between the courthouse and the adjacent jail.

Basement Evaluation

The basement layout appears to be part of the original finished space of the building and covers the footprint of the building including the area within the core, as well as the east and west wings of the building. Based on the Tier I quick check, the unreinforced masonry walls at Gridlines 1, 2, 3, 6, 7, 8, A, B, C, D and E are not adequate to resist the in-plane loading from the diaphragm and have a DCR as high as 6.9 (see the calculations for the individual DCR for each wall line).

Basement Recommendations

To address the noncompliant concerns on the basement, we recommend the following: For the inadequate unreinforced masonry shear walls, add shotcrete concrete shear walls to support the in-plane loading. Continue to provide structural steel support columns as the secondary support of the trusses and third floor glulam beams that are independent of the unreinforced masonry

walls. The concrete shear walls and the independent support columns will both require new foundation supports, which will need to be placed without impacting the existing foundation system of the building. To address this concern, we used deep foundation elements such as grouted micropiles to provide vertical support to the heavily loaded foundation elements.

Nonstructural Evaluation

On all levels of the courthouse, a number of non-structural deficiencies were observed, including unbraced fire suppression lines, missing flexible pipe connections at the fire suppression lines, unbraced gas lines, missing flexible pipe connections at the gas lines, noncompliant suspended gypsum board ceiling bracing, and unbraced light fixtures that are supported by the suspended gypsum board ceiling. There are also some noncompliant tall slender contents (book shelves, vertical storage cabinets, etc.) located on the first and third floors of the building. There are a few unknown non-structural conditions, which include whether the appendages including the statue at the east wall are reinforced and whether the fall-prone equipment weighing more than 20 pounds are braced.

Limitations

The information contained in this report is for the exclusive use of Benton County. Miller Consulting Engineers, Inc. assumes no responsibility or liability for any use of this report by other parties. This report relates solely to the stated purpose of this investigation; no representations concerning other aspects (if any) of the circumstance, structure or site are included. The conclusions (if any) are based on the above stated visual structural observations, and no destructive testing or monitoring was performed. Specific construction details exceed the scope of this report. No guarantee or warranty, expressed or implied, is provided.

Opinions of Probable Construction Cost

In providing opinions of probable construction cost, the Client understands that the Consultant has no control over the cost or availability of labor, equipment or materials, or over market conditions of the Contractor's method of pricing, and that the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. Within our opinion of probable construction cost estimate, we have included the contractor's overhead and profit, as well as a 25% construction contingency to account for some

differences in the field during construction. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.

Opinions of probable construction cost only include the cost to perform the retrofit work, cost to provide temporary storage for displaced material, removal of contents, a contained work environment with ventilation, and protection of fragile finishes. Items excluded from the opinions of probable construction cost that should also be considered include, but are not limited to, staff relocation, bonding, insurance, and permits.

STRUCTURAL AND NON-STRUCTURAL DEMAND CAPACITY RATIOS

DEFICIENCIES - BASIC PERFORMANCE OBJECTIVES

DCR:	Structural Items	Repair Solutions:
20.1**	Overstressed URM shear walls at the third floor at gridlines 3, 6, B and C	Reinforce URM shear walls by adding concrete shotcrete walls.
10.4**	Overstressed URM shear walls at the second floor at GLs 2, 3, 6, 7 and B-E	Reinforce URM shear walls by adding concrete shotcrete walls.
5.8**	Overstressed URM shear walls at the first floor at gridlines 1-3, 6-8, and A-E	Reinforce URM shear walls by adding concrete shotcrete walls.
13.8**	Overstressed URM shear walls at the basement at gridlines 1-3, 6-8 and A-E	Reinforce URM shear walls by adding concrete shotcrete walls.
10*	Missing/overstressed out-of-plane anchorage at URM walls to floor/roof	Install out-of-plane anchorage from URM walls to wood diaphragms.
10*	Transfer to shear walls is inadequate	Add continuous angles from roofs and floors to shear walls.
10*	Missing connection between heavy timber trusses and the URM walls	Install anchors from URM walls to trusses
10*	Missing drag strut connections at gridlines 3 & 6 from roof to URM walls	Install anchors from URM walls to the wood roof diaphragm
10*	Missing drag strut connections at gridlines 3 & 6 from floor to URM walls	Install anchors from URM walls to the wood floor diaphragms
1.7	URM walls at the bell lounge do not have adequate out-of-plane capacity	Strengthen the URM walls for out-of-plane load capacity
3.2**	Openings at the URM walls do not have drag struts for in-plane loads	Strap wood diaphragm back to URM wall.
7.9**	URM walls at the openings do not have adequate out-of-plane capacity	Add horizontal girts at the openings to support the URM walls
10*	Missing diaphragm cross ties across the wood diaphragms	Install straps ties at the floor joists across the floor diaphragm
2.5**	Straight sheathed wood roof diaphragm aspect ratio too large	Add plywood overlay sheathing over the west wing roof area
13.1**	Straight sheathed wood roof diaphragm span > 24'	Add plywood overlay sheathing over the core roof area
5.2**	Unblocked wood structural panel diaphragm span > 40'	Remove floor finishes and add blocking and nailing to the sheathing as required
10*	Missing independent secondary support columns for the heavy timber trusses	Install secondary support columns for the heavy timber trusses

* DCR ranking was limited to 10 to items that have no capacity
** DCR varies from floor to floor or gridline to gridline

DCR: Non-structural Items		Repair Solutions:
10*	Main fire suppression piping is inadequately braced.	Brace main fire suppression piping back to the structure.
10*	Fire suppression piping does not have flexible couplings per the NFPA-13	Install flexible couplings as required by the NFPA-13
10*	Natural gas piping inadequately braced.	Brace gas piping back to the structure.
10*	No flexible connections at gas piping to	Install flexible connections to equipment to
10*	Suspended gypsum ceiling is not braced.	Brace ceiling with guy wires and posts every
10*	The lights in Courtroom #3 are not	Install connections for the lights
10*	Noncompliant shelves are located on the	Brace the shelves back to the structure.
10*	The suspended HVAC inline air handlers	Install connections to equipment back to

* DCR ranking was limited to 10 to items that have no capacity

** DCR varies from floor to floor or gridline to gridline

COST BENEFIT TABLES AND COST TABLES

COST BENEFIT TABLE

PROJECT:	Owner Directed Facility Seismic Evaluations	JOB NO.:	151029
LOCATION:	Benton County Courthouse - SPOE		
CLIENT:	Benton County	DATE:	11-Aug-16
TAKE-OFF BY:	ERW	CHECKED BY:	RGV

SEISMIC DESCRIPTION	LEVEL	ACTIVITY	COST	DCR RATIO	AREA	BENEFIT RATIO	RANKING OF 25
Structural Items:							
Roof Level							
Insufficient roof diaphragm	Roof	Add plywood overlay sheathing over the core roof area	$466,000	8.1	6,600	8.72	18
Insufficient IP and OOP anchorage	Roof	Install anchors from URM walls to the wood roof diaphragm	$172,000	10	7,420	2.32	7
Bell Tower Lower Level							
Insufficient floor diaphragm	4th Floor	Add plywood overlay sheathing over the core roof area	$22,200	2.2	828	12.19	20
Insufficient IP and OOP anchorage	4th Floor	Install anchors from URM walls to the wood roof diaphragm	$41,300	10	828	4.99	11
Insufficient OOP URM capacity	4th Floor	Build bonded shear wall	$66,100	1.3	1,613	31.52	25
Floor Opening Strengthening	4th Floor	Install steel girt for OOP support of the URM wall at the stairway	$2,300	5.1	100	4.51	10
Fourth Floor Level							
Insufficient floor diaphragm	4th Floor	Add plywood overlay sheathing over the core roof area	$68,100	2.3	3,392	8.73	19
Insufficient IP and OOP anchorage	4th Floor	Install anchors from URM walls to the wood roof diaphragm	$139,000	10	7,420	1.87	6
Third Floor Level							
Insufficient floor diaphragm	3rd Floor	Add plywood overlay sheathing over the core roof area	$76,300	3.6	3,392	6.25	12
Insufficient IP and OOP anchorage	3rd Floor	Install anchors from URM walls to the wood roof diaphragm	$500,300	10	7,420	6.74	15
Floor Opening Strengthening	3rd Floor	Install steel girt for OOP support of the URM wall at the stairway	$8,300	3.1	200	13.39	22
Missing secondary truss supports	3rd Floor	Add independent HSS column supports	$25,700	10	3,392	0.76	4
Insufficient IP shear wall capacity	3rd Floor	Build shotcrete walls	$352,542	20.1	14,840	1.18	5
Second Floor Level							

COST BENEFIT TABLE

SEISMIC DESCRIPTION	LEVEL	ACTIVITY	COST	DCR RATIO	AREA	BENEFIT RATIO	RANKING OF 25
Insufficient floor diaphragm	2nd Floor	Add plywood overlay sheathing over the core roof area	$86,500	3.2	3,392	7.97	17
Insufficient IP and OOP anchorage	2nd Floor	Install anchors from URM walls to the wood roof diaphragm	$553,000	10	7,420	7.45	16
Floor Opening Strengthening	2nd Floor	Install steel girt for OOP support of the URM wall at the stairway	$12,200	4.2	200	14.52	23
Missing secondary beam supports	2nd Floor	Add independent HSS column supports	$33,100	10	6,784	0.49	2
Insufficient IP shear wall capacity	2nd Floor	Build shotcrete walls	$649,288	10.9	22,260	2.68	8
First Floor Level							
Insufficient floor diaphragm	1st Floor	Add plywood overlay sheathing over the core roof area	$86,500	1.7	3,392	15.00	24
Insufficient IP and OOP anchorage	1st Floor	Install anchors from URM walls to the wood roof diaphragm	$485,000	10	7,420	6.54	14
Floor Opening Strengthening	1st Floor	Install steel girt for OOP support of the URM wall at the stairway	$2,700	2	104	12.98	21
Missing secondary beam supports	1st Floor	Add independent HSS column supports	$36,400	10	10,176	0.36	1
Insufficient IP shear wall capacity	1st Floor	Build shotcrete walls	$1,098,258	5.8	29,680	6.38	13
Basement Level							
Missing secondary beam supports	Basement	Add independent HSS column supports and footings	$69,400	10	13,568	0.51	3
Insufficient IP shear wall capacity	Basement	Build shotcrete walls with concrete footings	$2,026,098	13.8	37,100	3.96	9

NOTES:

1	Benefit Ratio=cost/(floor area*DCR)
2	Lower ranking = better benefit vs. cost.
3	DCR= demand capacity ratio

RANKED COST BENEFIT TABLE

PROJECT:	Owner Directed Facility Seismic Evaluations	JOB NO.:	151029
LOCATION:	Benton County Courthouse - SPOE		
CLIENT:	Benton County	DATE:	11-Aug-16
TAKE-OFF BY:	ERW	CHECKED BY:	RGV

SEISMIC DESCRIPTION	LEVEL	ACTIVITY	COST	DCR RATIO	AREA	BENEFIT RATIO	RANKING OF 25
Structural Items:							
Missing secondary beam supports	1st Floor	Add independent HSS column supports	$36,400	10	10,176	0.36	1
Missing secondary beam supports	2nd Floor	Add independent HSS column supports	$33,100	10	6,784	0.49	2
Missing secondary beam supports	Basement	Add independent HSS column supports and footings	$69,400	10	13,568	0.51	3
Missing secondary truss supports	3rd Floor	Add independent HSS column supports	$25,700	10	3,392	0.76	4
Insufficient IP shear wall capacity	3rd Floor	Build shotcrete walls	$352,542	20.1	14,840	1.18	5
Insufficient IP and OOP anchorage	4th Floor	Install anchors from URM walls to the wood roof diaphragm	$139,000	10	7,420	1.87	6
Insufficient IP and OOP anchorage	Roof	Install anchors from URM walls to the wood roof diaphragm	$172,000	10	7,420	2.32	7
Insufficient IP shear wall capacity	2nd Floor	Build shotcrete walls	$649,288	10.9	22,260	2.68	8
Insufficient IP shear wall capacity	Basement	Build shotcrete walls with concrete footings	$2,026,098	13.8	37,100	3.96	9
Floor Opening Strengthening	4th Floor	Install steel girt for OOP support of the URM wall at the stairway	$2,300	5.1	100	4.51	10
Insufficient IP and OOP anchorage	4th Floor	Install anchors from URM walls to the wood roof diaphragm	$41,300	10	828	4.99	11
Insufficient floor diaphragm	3rd Floor	Add plywood overlay sheathing over the core roof area	$76,300	3.6	3,392	6.25	12
Insufficient IP shear wall capacity	1st Floor	Build shotcrete walls	$1,098,258	5.8	29,680	6.38	13
Insufficient IP and OOP anchorage	1st Floor	Install anchors from URM walls to the wood roof diaphragm	$485,000	10	7,420	6.54	14
Insufficient IP and OOP anchorage	3rd Floor	Install anchors from URM walls to the wood roof diaphragm	$500,300	10	7,420	6.74	15
Insufficient IP and OOP anchorage	2nd Floor	Install anchors from URM walls to the wood roof diaphragm	$553,000	10	7,420	7.45	16

RANKED COST BENEFIT TABLE

SEISMIC DESCRIPTION	LEVEL	ACTIVITY	COST	DCR RATIO	AREA	BENEFIT RATIO	RANKING OF 25
Insufficient floor diaphragm	2nd Floor	Add plywood overlay sheathing over the core roof area	$86,500	3.2	3,392	7.97	17
Insufficient roof diaphragm	Roof	Add plywood overlay sheathing over the core roof area	$466,000	8.1	6,600	8.72	18
Insufficient floor diaphragm	4th Floor	Add plywood overlay sheathing over the core roof area	$68,100	2.3	3,392	8.73	19
Insufficient floor diaphragm	4th Floor	Add plywood overlay sheathing over the core roof area	$22,200	2.2	828	12.19	20
Floor Opening Strengthening	1st Floor	Install steel girt for OOP support of the URM wall at the stairway	$2,700	2	104	12.98	21
Floor Opening Strengthening	3rd Floor	Install steel girt for OOP support of the URM wall at the stairway	$8,300	3.1	200	13.39	22
Floor Opening Strengthening	2nd Floor	Install steel girt for OOP support of the URM wall at the stairway	$12,200	4.2	200	14.52	23
Insufficient floor diaphragm	1st Floor	Add plywood overlay sheathing over the core roof area	$86,500	1.7	3,392	15.00	24
Insufficient OOP URM capacity	4th Floor	Build bonded shear wall	$66,100	1.3	1,613	31.52	25

NOTES:

1	Benefit Ratio=cost/(floor area*DCR)
2	Lower ranking = better benefit vs. cost.
3	DCR= demand capacity ratio

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

PROJECT:	Owner Directed Facility Seismic Evaluations	JOB NO.:	151029
LOCATION:	Benton County Courthouse - SPOE		
CLIENT:	Benton County	DATE:	11-Aug-16
TAKE-OFF BY:	ERW	CHECKED BY:	RGV

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
General						
Mobilization	Job Trailer	18	Month	$500	$9,000	
	Supervisor	78	Week	$4,125	$321,750	
Construction Aids						
Lift 500# capacity	Provide (2) boom lifts	18	Month	$8,600	$154,800	
Temporary Storage	Provide (2) 40' container for storage as required	18	Month	$300	$5,400	
Ventalation	Negative Air Equipment per (4) zones	78	Week	$2,000	$156,000	
						$646,950
Strengthen West, East & Core Roofs	Remove (E) tile roofing	6600	S.F.	$4	$26,400	
	Add framing angles from rafters to top PL and anchors to TOW @ 4' o.c.	470	L.F.	$50	$23,500	
	Add perimeter steel PL and anchors in masonry	470	L.F.	$223	$104,810	
	Add Blocking between rafters@ anchors	470	L.F.	$25	$11,750	
	Add Plywood	6600	S.F.	$6	$39,600	
Cross ties	Install steel PLs on each side of the rafters across the west/east wings (18 per wing)	36	Ea.	$1,000	$36,000	
	Install steel PLs on each side of the rafters splaices at the core area (13 per 2nd inboard truss)	26	Ea.	$1,000	$26,000	
Heavy timber truss connections	Install steel angles to the sides of the truss and welded to steel PL	12	Ea	$4,000	$48,000	
	Add (4) anchors from the steel PL to the URM wall	12	Ea	$2,000	$24,000	
Roof Drag- Strut	Custom steel strut (32k load) at GL 3 & 6 64' to west wing with URM wall anchor at east wing	2	Ea.	$30,000	$60,000	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
Re-entrant corners	Custom drag-strut (7k load) at the corners of the core area	4	Ea.	$10,000	$40,000	
New Roofing	Add new tile roofing to match existing	6600	S.F.	$30	$198,000	
Strengthen Bell Tower	Temporary work area	828	S.F.	$2	$1,242	
	Out of plane ties @ 4' o.c.	30	Ea.	$400	$11,800	
	Install straps at E&W walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between rafters@ anchors	118	L.F.	$25	$2,950	
	Add perimeter angle and anchors in masonry	118	L.F.	$223	$26,314	
	Re-nail the plywood floor sheathing or add as req'd	828	S.F.	$6	$4,968	
	Replace the floor finishes	828	S.F.	$5	$4,140	
Floor Opening Strengthening	Custom steel girt (9' span) for OOP support of the URM wall at the stairway	1	Ea.	$1,296	$1,296	
	Install straps at ea. end of the stairway opening	2	Ea.	$500	$1,000	
Strengthen Bell Lounge Level URM Walls	Demo (E) wall finishes	1613	S.F.	$4	$6,452	
	Build 23' x 13.67 bonded shear wall	629	S.F.	$25	$15,721	
	Build 36' x 13.67 bonded shear wall	984	S.F.	$25	$24,606	
	(N) gypsum and finish	1613	S.F.	$8	$12,904	
						$763,453
Strengthen 4th Floor Core Area	Remove the contents from the floor	2368	S.F.	$10	$23,680	
	Temporary work area	3392	S.F.	$2	$5,088	
	Remove (E) floor finishes (along E&W walls)	2368	S.F.	$3	$7,104	
	Out of plane ties @ 4' o.c.	59	Ea.	$400	$23,400	
	Install straps at N&S walls for subdiaphragm	32	Ea.	$1,000	$32,000	
	Add Blocking between rafters@ anchors	234	L.F.	$25	$5,850	
	Add perimeter angle and anchors in masonry	234	L.F.	$223	$52,182	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
	Extend plywood sheathing to the N&S	3392	S.F.	$6	$20,352	
	Replace the floor finishes	2368	S.F.	$5	$11,840	
Cross ties	Install steel PLs on each side of the joists splices (13 per 2nd inboard truss)	26	Ea.	$1,000	$26,000	
						$207,496
Strengthen 3rd Floor Core Area	Remove the contents from the floor	3392	S.F.	$10	$33,920	
	Temporary work area	3392	S.F.	$2	$5,088	
	Remove (E) floor finishes	3392	S.F.	$3	$10,176	
	Out of plane ties @ 4' o.c.	59	Ea.	$400	$23,400	
	Install straps at E&W walls for subdiaphragm	28	Ea.	$1,000	$28,000	
	Add Blocking between rafters@ anchors	234	L.F.	$25	$5,850	
	Add perimeter angle and anchors in masonry	234	L.F.	$223	$52,182	
	Re-nail the plywood floor sheathing	3392	S.F.	$3	$10,176	
	Replace the floor finishes	3392	S.F.	$5	$16,960	
Cross ties	Install steel PLs on each side of the joists splices (13 per 2nd inboard beam)	26	Ea.	$1,000	$26,000	
Re-entrant corners	Custom drag-strut (11k load) at the corners of the core area	4	Ea.	$15,000	$60,000	
Add independent HSS column supports	Demo (E) 3FL wall finishes at (12) locations	480	S.F.	$4	$1,920	
	Install HSS 4 x 4 column from truss to 3FL beam	12	Ea.	$1,500	$18,000	
	(N) gypsum and finish	480	S.F.	$8	$3,840	
GL 2 URM Strengthening	Demo (E) wall finishes	567	S.F.	$4	$2,268	
	Demo adjoining (E) walls and finishes	567	S.F.	$6	$3,402	
	Install shear anchors at URM wall @ 3 SF o.c.	189	Ea.	$100	$18,900	
	Build 63' x 9' x 8" shotcrete wall	1	Ea.	$21,000	$21,000	
	Re-build adjoining walls	567	S.F.	$6	$3,402	
	(N) gypsum and finish	1134	S.F.	$8	$9,072	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL 7 URM Strengthening	Demo (E) wall finishes	567	S.F.	$4	$2,268	
	Demo adjoining (E) walls and finishes	567	S.F.	$6	$3,402	
	Install shear anchors at URM wall @ 3 SF o.c.	189	Ea.	$100	$18,900	
	Build 63' x 9' x 8" shotcrete wall	1	Ea.	$21,000	$21,000	
	Re-build adjoining walls	567	S.F.	$6	$3,402	
	(N) gypsum and finish	1134	S.F.	$8	$9,072	
Strengthen 3rd Floor East Wing Area	Remove contents from the URM walls (4' wide)	1000	S.F.	$10	$10,000	
	Temporary work area	1000	S.F.	$2	$1,500	
	Remove (E) floor finishes	1000	S.F.	$3	$3,000	
	Out of plane ties @ 4' o.c.	63	Ea.	$400	$25,000	
	Install straps at N&S walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between joist @ anchors	250	L.F.	$25	$6,250	
	Add perimeter angle and anchors in masonry	250	L.F.	$223	$55,750	
	Replace the floor finishes	1000	S.F.	$5	$5,000	
Drag- Strut	Custom steel strut (49k load) at GL 3 & 6 64' to west wing with URM wall anchor at east wing	2	Ea.	$45,000	$90,000	
Floor Opening Strengthening	Custom steel girt (10' span) for OOP support of the E URM wall at the stairway	1	Ea.	$1,440	$1,440	
	Custom steel girt (18' span) for OOP support of the N URM wall at the stairway	1	Ea.	$2,592	$2,592	
	Install straps at ea. end of the stairway opening	4	Ea.	$500	$2,000	
GL 3 URM Strengthening	Demo (E) wall finishes	328	S.F.	$4	$1,311	
	Install shear anchors at URM wall @ 3 SF o.c.	109	Ea.	$100	$10,925	
	Build 23' x 14.25' x 10" shotcrete wall	1	Ea.	$22,760	$22,760	
	(N) gypsum and finish	328	S.F.	$8	$2,622	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL 6 URM Strengthening	Re-build 3' tall wainscotting	69	S.F.	$22	$1,518	
	Demo (E) wall finishes	328	S.F.	$4	$1,311	
	Install shear anchors at URM wall @ 3 SF o.c.	109	Ea.	$100	$10,925	
	Build 23' x 14.25' x 10" shotcrete wall	1	Ea.	$22,760	$22,760	
	(N) gypsum and finish	328	S.F.	$8	$2,622	
GL C URM Strengthening	Re-build 3' tall wainscotting	69	S.F.	$22	$1,518	
	Demo (E) wall finishes	670	S.F.	$4	$2,679	
	Install shear anchors at URM wall @ 3 SF o.c.	223	Ea.	$100	$22,325	
	Build 23' x 14.25' x 10" shotcrete wall	2	Ea.	$23,255	$46,510	
	(N) gypsum and finish	670	S.F.	$8	$5,358	
Strengthen 3rd Floor West Wing Area	Re-build 3' tall wainscotting	138	S.F.	$22	$3,036	
	Remove contents around the perimeter (4' wide)	792	S.F.	$10	$7,920	
	Temporary work area	792	S.F.	$2	$1,188	
	Remove (E) floor finishes	792	S.F.	$3	$2,376	
	Out of plane ties @ 4' o.c.	50	Ea.	$400	$19,800	
	Install straps at N&S walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between joist @ anchors	198	L.F.	$25	$4,950	
	Add perimeter angle and anchors in masonry	198	L.F.	$223	$44,154	
	Replace the floor finishes	792	S.F.	$5	$3,960	
Floor Opening Strengthening	Custom steel girt (9' span) for OOP support of the URM wall at the stairway	1	Ea.	$1,296	$1,296	
	Install straps at ea. end of the stairway opening	2	Ea.	$500	$1,000	
GL B URM Strengthening	Demo (E) wall finishes	656	S.F.	$4	$2,622	
	Install shear anchors at URM wall @ 3 SF o.c.	219	Ea.	$100	$21,850	
	Build 23' x 14.25' x 10" shotcrete wall	2	Ea.	$22,760	$45,521	
	(N) gypsum and finish	656	S.F.	$8	$5,244	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
	Re-build 3' tall wainscotting	138	S.F.	$22	$3,036	
						$961,230
Strengthen 2nd Floor Core Area	Remove the contents from the floor	3392	S.F.	$10	$33,920	
	Temporary work area	3392	S.F.	$2	$5,088	
	Remove (E) floor finishes	3392	S.F.	$3	$10,176	
	Out of plane ties @ 4' o.c.	59	Ea.	$400	$23,400	
	Install straps at E&W walls for subdiaphragm	28	Ea.	$1,000	$28,000	
	Add Blocking between rafters@ anchors	234	L.F.	$25	$5,850	
	Add perimeter angle and anchors in masonry	234	L.F.	$223	$52,182	
	Re-nail the plywood floor sheathing or add as req'd	3392	S.F.	$6	$20,352	
	Replace the floor finishes	3392	S.F.	$5	$16,960	
Cross ties	Install steel PLs on each side of the joists splices (1 lap per joist at midspan)	16	Ea.	$1,000	$16,000	
Re-entrant corners	Custom drag-strut (17k load) at the corners of the core area	4	Ea.	$25,000	$100,000	
Add independent HSS column supports	Demo (E) 2FL wall finishes at (12) locations	720	S.F.	$4	$2,880	
	Install HSS 4 x 4 column from 3FL to 2FL beam	12	Ea.	$1,800	$21,600	
	(N) gypsum and finish	720	S.F.	$12	$8,640	
GL 2 URM Strengthening	Demo (E) wall finishes	945	S.F.	$4	$3,780	
	Demo adjoining (E) walls and finishes	945	S.F.	$6	$5,670	
	Install shear anchors at URM wall @ 3 SF o.c.	315	Ea.	$100	$31,500	
	Build 63' x 15' x 8" shotcrete wall	1	Ea.	$35,000	$35,000	
	Re-build adjoining walls	945	S.F.	$6	$5,670	
	(N) gypsum and finish	1890	S.F.	$8	$15,120	
	Re-build 3' tall wainscotting	189	S.F.	$22	$4,158	
GL 7 URM Strengthening	Demo (E) wall finishes	945	S.F.	$4	$3,780	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
	Demo adjoining (E) walls and finishes	945	S.F.	$6	$5,670	
	Install shear anchors at URM wall @ 3 SF o.c.	315	Ea.	$100	$31,500	
	Build 63' x 15' x 8" shotcrete wall	1	Ea.	$35,000	$35,000	
	Re-build adjoining walls	945	S.F.	$6	$5,670	
	(N) gypsum and finish	1890	S.F.	$8	$15,120	
	Re-build 3' tall wainscotting	189	S.F.	$22	$4,158	
Strengthen 2nd Floor East Wing Area	Remove contents around the perimeter (4' wide)	1000	S.F.	$10	$10,000	
	Temporary work area	1000	S.F.	$2	$1,500	
	Remove (E) floor finishes	1000	S.F.	$3	$3,000	
	Out of plane ties @ 4' o.c.	63	Ea.	$400	$25,000	
	Install straps at N&S walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between joist @ anchors	250	L.F.	$25	$6,250	
	Add perimeter angle and anchors in masonry	250	L.F.	$223	$55,750	
	Replace the floor finishes	1000	S.F.	$5	$5,000	
Floor Opening Strengthening	Custom steel girt (14' span) for OOP support of the N/S URM wall at the stairs	2	Ea.	$2,016	$4,032	
	Custom steel girt (20' span) for OOP support of the E URM wall at the	1	Ea.	$2,880	$2,880	
	Install straps at ea. End of the stairway opening	6	Ea.	$500	$3,000	
Drag- Strut	Custom steel strut (77k load) at GL 3 & 6 64' to west wing with URM wall anchor at east wing	2	Ea.	$75,000	$150,000	
GL 3 URM Strengthening	Demo (E) wall finishes	345	S.F.	$4	$1,380	
	Install shear anchors at URM wall @ 3 SF o.c.	115	Ea.	$100	$11,500	
	Build 23' x 15' x 12" shotcrete wall	1	Ea.	$38,333	$38,333	
	(N) gypsum and finish	345	S.F.	$8	$2,760	
	Re-build 3' tall wainscotting	69	S.F.	$22	$1,518	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL 6 URM Strengthening	Demo (E) wall finishes	345	S.F.	$4	$1,380	
	Install shear anchors at URM wall @ 3 SF o.c.	115	Ea.	$100	$11,500	
	Build 23' x 15' x 12" shotcrete wall	1	Ea.	$38,333	$38,333	
	(N) gypsum and finish	345	S.F.	$12	$4,140	
	Re-build 3' tall wainscotting	69	S.F.	$22	$1,518	
GL C URM Strengthening	Demo (E) wall finishes	690	S.F.	$4	$2,760	
	Install shear anchors at URM wall @ 3 SF o.c.	230	Ea.	$100	$23,000	
	Build 23' x 15' x 12" shotcrete wall	2	Ea.	$38,333	$76,667	
	(N) gypsum and finish	690	S.F.	$8	$5,520	
	Re-build 3' tall wainscotting	138	S.F.	$22	$3,036	
GL D URM Strengthening	Demo (E) wall finishes	705	S.F.	$4	$2,820	
	Install shear anchors at URM wall @ 3 SF o.c.	235	Ea.	$100	$23,500	
	Build 23.5' x 15' x 8" shotcrete wall	2	Ea.	$13,056	$26,111	
	Custom drag-strut (17k load) tieing new walls	1	Ea.	$25,000	$25,000	
	Demo (E) wall finishes at drag strut location	80	S.F.	$4	$320	
	(N) gypsum and finish	785	S.F.	$8	$6,280	
	Re-build 3' tall wainscotting	141	S.F.	$22	$3,102	
GL E URM Strengthening	Demo (E) wall finishes	300	S.F.	$4	$1,200	
	Install shear anchors at URM wall @ 3 SF o.c.	100	Ea.	$100	$10,000	
	Build 20' x 15' x 8" shotcrete wall	1	Ea.	$11,111	$11,111	
	(N) gypsum and finish	300	S.F.	$8	$2,400	
	Re-build 3' tall wainscotting	60	S.F.	$22	$1,320	
Strengthen 2nd Floor West Wing Area	Remove contents around the perimeter (4' wide)	792	S.F.	$10	$7,920	
	Temporary work area	792	S.F.	$2	$1,188	
	Remove (E) floor finishes	792	S.F.	$3	$2,376	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
	Out of plane ties @ 4' o.c.	50	Ea.	$400	$19,800	
	Install straps at N&S walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between joist @ anchors	198	L.F.	$25	$4,950	
	Add perimeter angle and anchors in masonry	198	L.F.	$223	$44,154	
	Replace the floor finishes	198	S.F.	$5	$990	
Floor Opening Strengthening	Custom steel girt (9' span) for OOP support of the URM wall at the stairway	1	Ea.	$1,296	$1,296	
	Install straps at ea. End of the stairway opening	2	Ea.	$500	$1,000	
GL B URM Strengthening	Demo (E) wall finishes	690	S.F.	$4	$2,760	
	Install shear anchors at URM wall @ 3 SF o.c.	230	Ea.	$100	$23,000	
	Build 23' x 15' x 12" shotcrete wall	2	Ea.	$38,333	$76,667	
	(N) gypsum and finish	690	S.F.	$8	$5,520	
	Re-build 3' tall wainscotting	138	S.F.	$22	$3,036	
						$1,368,422
Strengthen 1st Floor Core Area	Remove contents around the perimeter	3392	S.F.	$10	$33,920	
	Temporary work area	3392	S.F.	$2	$5,088	
	Remove (E) floor finishes	3392	S.F.	$3	$10,176	
	Out of plane ties @ 4' o.c.	59	Ea.	$400	$23,400	
	Install straps at E&W walls for subdiaphragm	28	Ea.	$1,000	$28,000	
	Add Blocking between rafters@ anchors	234	L.F.	$25	$5,850	
	Add perimeter angle and anchors in masonry	234	L.F.	$223	$52,182	
	Re-nail the plywood floor sheathing or add as req'd	3392	S.F.	$6	$20,352	
	Replace the floor finishes	3392	S.F.	$5	$16,960	
Cross ties	Install steel PLs on each side of the joists splices (1 lap per joist at midspan)	16	Ea.	$1,000	$16,000	
Re-entrant corners	Custom drag-strut (12k load) at the corners of the core area	4	Ea.	$18,000	$72,000	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
Add independent HSS column supports	Demo (E) 1FL wall finishes at (12) locations	792	S.F.	$4	$3,168	
	Install HSS 4 x 4 column from 2FL to 1FL beam	12	Ea.	$1,980	$23,760	
	(N) gypsum and finish	792	S.F.	$8	$6,336	
GL 1 URM Strengthening	Demo (E) wall finishes	660	S.F.	$4	$2,640	
	Install shear anchors at URM wall @ 3 SF o.c.	220	Ea.	$100	$22,000	
	Build 20' x 16.5' x 8" shotcrete wall	2	Ea.	$12,222	$24,444	
	(N) gypsum and finish	660	S.F.	$8	$5,280	
	Re-build 3' tall wainscotting	120	S.F.	$22	$2,640	
GL 2 URM Strengthening	Demo (E) wall finishes	1040	S.F.	$4	$4,158	
	Demo adjoining (E) walls and finishes	1040	S.F.	$6	$6,237	
	Install shear anchors at URM wall @ 3 SF o.c.	347	Ea.	$100	$34,650	
	Build 63' x 16.5' x 10" shotcrete wall	1	Ea.	$72,188	$72,188	
	Re-build adjoining walls	1040	S.F.	$6	$6,237	
	(N) gypsum and finish	2079	S.F.	$8	$16,632	
	Re-build 3' tall wainscotting	189	S.F.	$22	$4,158	
GL 7 URM Strengthening	Demo (E) wall finishes	1040	S.F.	$4	$4,158	
	Demo adjoining (E) walls and finishes	1040	S.F.	$6	$6,237	
	Install shear anchors at URM wall @ 3 SF o.c.	347	Ea.	$100	$34,650	
	Build 63' x 16.5' x 10" shotcrete wall	1	Ea.	$72,188	$72,188	
	Re-build adjoining walls	1040	S.F.	$6	$6,237	
	(N) gypsum and finish	2079	S.F.	$12	$24,948	
	Re-build 3' tall wainscotting	189	S.F.	$22	$4,158	
GL 8 URM Strengthening	Demo (E) wall finishes	660	S.F.	$4	$2,640	
	Install shear anchors at URM wall @ 3 SF o.c.	220	Ea.	$100	$22,000	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
Strengthen 1st Floor East Wing Area	Build 20' x 16.5' x 8" shotcrete wall	2	Ea.	$12,222	$24,444	
	(N) gypsum and finish	660	S.F.	$8	$5,280	
	Re-build 3' tall wainscotting	120	S.F.	$22	$2,640	
	Remove contents around the perimeter (4' wide)	1898	S.F.	$10	$18,980	
	Temporary work area	1898	S.F.	$2	$2,847	
	Remove (E) floor finishes	1000	S.F.	$3	$3,000	
	Out of plane ties @ 4' o.c.	63	Ea.	$400	$25,000	
	Install straps at N&S walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between joist @ anchors	250	L.F.	$25	$6,250	
	Add perimeter angle and anchors in masonry	250	L.F.	$223	$55,750	
	Replace the floor finishes	1000	S.F.	$5	$5,000	
Floor Opening Strengthening	Custom steel girt (12' span) for OOP support of the URM wall at the stairway	1	Ea.	$1,728	$1,728	
	Install straps at ea. end of the stairway opening	2	Ea.	$500	$1,000	
Drag- Strut	Custom steel strut (33k load) at GL 3 & 6 64' to west wing with URM wall anchor at east wing	2	Ea.	$30,000	$60,000	
	Remove contents from drag strut path (4' wide)	256	S.F.	$10	$2,560	
	Temporary work area	256	S.F.	$2	$384	
	Remove (E) floor finishes	256	S.F.	$3	$768	
	Replace the floor finishes	256	S.F.	$5	$1,280	
GL 3 URM Strengthening	Demo (E) wall finishes	380	S.F.	$4	$1,518	
	Install shear anchors at URM wall @ 3 SF o.c.	127	Ea.	$100	$12,650	
	Build 23' x 16.5' x 12" shotcrete wall	1	Ea.	$52,708	$52,708	
	(N) gypsum and finish	380	S.F.	$8	$3,036	
	Re-build 3' tall wainscotting	69	S.F.	$22	$1,518	
GL 6 URM Strengthening	Demo (E) wall finishes	380	S.F.	$4	$1,518	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL C URM Strengthening	Install shear anchors at URM wall @ 3 SF o.c.	127	Ea.	$100	$12,650	
	Build 23' x 16.5' x 12" shotcrete wall	1	Ea.	$52,708	$52,708	
	(N) gypsum and finish	380	S.F.	$12	$4,554	
	Re-build 3' tall wainscotting	69	S.F.	$22	$1,518	
	Demo (E) wall finishes	776	S.F.	$4	$3,102	
GL D URM Strengthening	Install shear anchors at URM wall @ 3 SF o.c.	259	Ea.	$100	$25,850	
	Build 23.5' x 16.5' x 12" shotcrete wall	2	Ea.	$53,854	$107,708	
	Custom drag-strut (42k load) tieing new walls	1	Ea.	$45,000	$45,000	
	Demo (E) wall finishes at drag strut location	80	S.F.	$4	$320	
	(N) gypsum and finish	856	S.F.	$8	$6,844	
	Re-build 3' tall wainscotting	141	S.F.	$22	$3,102	
	Demo (E) wall finishes	776	S.F.	$4	$3,102	
GL E URM Strengthening	Install shear anchors at URM wall @ 3 SF o.c.	259	Ea.	$100	$25,850	
	Build 23.5' x 16.5' x 8" shotcrete wall	2	Ea.	$21,542	$43,083	
	Custom drag-strut (17k load) tieing new walls	1	Ea.	$25,000	$25,000	
	Demo (E) wall finishes at drag strut location	80	S.F.	$4	$320	
	(N) gypsum and finish	856	S.F.	$8	$6,844	
	Re-build 3' tall wainscotting	141	S.F.	$22	$3,102	
	Demo (E) wall finishes	330	S.F.	$4	$1,320	
Strengthen 1st Floor West Wing Area	Install shear anchors at URM wall @ 3 SF o.c.	110	Ea.	$100	$11,000	
	Build 20' x 16.5' x 8" shotcrete wall	1	Ea.	$18,333	$18,333	
	(N) gypsum and finish	330	S.F.	$8	$2,640	
	Re-build 3' tall wainscotting	60	S.F.	$22	$1,320	
	Remove contents around the perimeter (4' wide)	792	S.F.	$10	$7,920	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL B URM Strengthening	Temporary work area	792	S.F.	$2	$1,188	
	Remove (E) floor finishes	792	S.F.	$3	$2,376	
	Out of plane ties @ 4' o.c.	50	Ea.	$400	$19,800	
	Install straps at N&S walls for subdiaphragm	12	Ea.	$1,000	$12,000	
	Add Blocking between joist @ anchors	198	L.F.	$25	$4,950	
	Add perimeter angle and anchors in masonry	198	L.F.	$50	$9,900	
	Replace the floor finishes	198	S.F.	$5	$990	
	Demo (E) wall finishes	974	S.F.	$4	$3,894	
	Install shear anchors at URM wall @ 3 SF o.c.	325	Ea.	$100	$32,450	
	Build 29.5' x 16.5' x 12" shotcrete wall	2	Ea.	$67,604	$135,208	
	Custom drag-strut (17k load) tieing new walls	1	Ea.	$25,000	$25,000	
	Demo (E) wall finishes at drag strut location	80	S.F.	$4	$320	
	(N) gypsum and finish	1054	S.F.	$8	$8,428	
	Re-build 3' tall wainscotting	177	S.F.	$22	$3,894	
						$1,671,121
Strengthen Basement Area Add independent HSS column supports	Temporary work area for HSS columns	960	S.F.	$2	$1,440	
	Demo (E) basement wall finishes at (12) locations	480	S.F.	$4	$1,920	
	Demo (E) slab for new footings (12) locations	480	S.F.	$10	$4,800	
	Excavate for new footings (12) locations	192	S.F.	$30	$5,760	
	Add concrete foundation (12) locations	192	S.F.	$100	$19,200	
	Install HSS 4 x 4 column from 1FL to footing	12	Ea.	$2,700	$32,400	
	(N) gypsum and finish	480	S.F.	$8	$3,840	
GL 1 URM Strengthening	Temporary work area	240	S.F.	$2	$360	
	Demo (E) wall finishes	400	S.F.	$4	$1,600	
	Demo (E) slab for new footings	160	S.F.	$10	$1,600	
	Excavate for new footings	160	S.F.	$40	$6,400	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL 2 URM Strengthening	Install (1) micropiles @ ea. end of the (N) SW	2	Ea.	$18,000	$36,000	
	Add concrete foundation	160	S.F.	$100	$16,000	
	Install shear anchors at URM wall @ 3 SF o.c.	133	Ea.	$100	$13,333	
	Build 20' x 10' x 10" shotcrete wall	1	Ea.	$13,889	$13,889	
	(N) gypsum and finish	400	S.F.	$8	$3,200	
	Temporary work area	378	S.F.	$2	$567	
	Demo (E) wall finishes	630	S.F.	$4	$2,520	
	Demo adjoining (E) walls and finishes	1040	S.F.	$6	$6,237	
	Demo (E) slab for new footings	252	S.F.	$10	$2,520	
	Excavate for new footings	252	S.F.	$40	$10,080	
GL 3 URM Strengthening	Install (3) micropiles @ ea. end of the (N) SW	1	Ea.	$48,000	$48,000	
	Add concrete foundation	252	S.F.	$100	$25,200	
	Install shear anchors at URM wall @ 3 SF o.c.	210	Ea.	$100	$21,000	
	Build 63' x 10' x 15" shotcrete wall	1	Ea.	$87,500	$87,500	
	Re-build adjoining walls	1040	S.F.	$6	$6,237	
	(N) gypsum and finish	1670	S.F.	$8	$13,356	
	Temporary work area	138	S.F.	$2	$207	
	Demo (E) wall finishes	230	S.F.	$4	$920	
	Demo (E) slab for new footings	92	S.F.	$10	$920	
	Excavate for new footings	92	S.F.	$40	$3,680	
GL 6 URM Strengthening	Install (3) 500k micropiles @ ea. end of the (N) SW	1	Ea.	$72,000	$72,000	
	Add concrete foundation	92	S.F.	$100	$9,200	
	Install shear anchors at URM wall @ 3 SF o.c.	77	Ea.	$100	$7,667	
	Build 23' x 10' x 18" shotcrete wall	1	Ea.	$57,500	$57,500	
	(N) gypsum and finish	230	S.F.	$8	$1,840	
	Temporary work area	138	S.F.	$2	$207	
	Demo (E) wall finishes	230	S.F.	$4	$920	
	Demo (E) slab for new footings	92	S.F.	$10	$920	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL 7 URM Strengthening	Excavate for new footings	92	S.F.	$40	$3,680	
	Install (3) 500k micropiles @ ea. end of the (N) SW	1	Ea.	$72,000	$72,000	
	Add concrete foundation	92	S.F.	$100	$9,200	
	Install shear anchors at URM wall @ 3 SF o.c.	77	Ea.	$100	$7,667	
	Build 23' x 10' x 18" shotcrete wall	1	Ea.	$57,500	$57,500	
	(N) gypsum and finish	230	S.F.	$8	$1,840	
	Temporary work area	378	S.F.	$2	$567	
	Demo adjoining (E) walls and finishes	1040	S.F.	$6	$6,237	
	Demo (E) wall finishes	630	S.F.	$4	$2,520	
	Demo (E) slab for new footings	252	S.F.	$10	$2,520	
GL 8 URM Strengthening	Excavate for new footings	252	S.F.	$40	$10,080	
	Install (3) micropiles @ ea. end of the (N) SW	1	Ea.	$48,000	$48,000	
	Add concrete foundation	252	S.F.	$100	$25,200	
	Install shear anchors at URM wall @ 3 SF o.c.	210	Ea.	$100	$21,000	
	Build 63' x 10' x 15" shotcrete wall	1	Ea.	$87,500	$87,500	
	Re-build adjoining walls	1040	S.F.	$6	$6,237	
	(N) gypsum and finish	1670	S.F.	$8	$13,356	
	Temporary work area	240	S.F.	$2	$360	
	Demo (E) wall finishes	400	S.F.	$4	$1,600	
	Demo (E) slab for new footings	160	S.F.	$10	$1,600	
GL A URM Strengthening	Excavate for new footings	160	S.F.	$40	$6,400	
	Install (1) micropiles @ ea. end of the (N) SW	2	Ea.	$18,000	$36,000	
	Add concrete foundation	160	S.F.	$100	$16,000	
	Install shear anchors at URM wall @ 3 SF o.c.	133	Ea.	$100	$13,333	
	Build 20' x 10' x 10" shotcrete wall	1	Ea.	$13,889	$13,889	
	(N) gypsum and finish	400	S.F.	$8	$3,200	
	Temporary work area	354	S.F.	$2	$531	
	Demo (E) wall finishes	590	S.F.	$4	$2,360	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL B URM Strengthening	Demo (E) slab for new footings	236	S.F.	$10	$2,360	
	Excavate for new footings	236	S.F.	$40	$9,440	
	Install (1) micropiles @ ea. end of the (N) SW	2	Ea.	$18,000	$36,000	
	Add concrete foundation	236	S.F.	$100	$23,600	
	Install shear anchors at URM wall @ 3 SF o.c.	197	Ea.	$100	$19,667	
	Build 29.5' x 10' x 10" shotcrete wall	2	Ea.	$20,486	$40,972	
	Custom drag-strut (7k load) tieing new walls	1	Ea.	$10,000	$10,000	
	Demo (E) wall finishes at drag strut location	32	S.F.	$4	$128	
	(N) gypsum and finish	622	S.F.	$8	$4,976	
	Temporary work area	354	S.F.	$2	$531	
GL C URM Strengthening	Demo (E) wall finishes	590	S.F.	$4	$2,360	
	Demo (E) slab for new footings	236	S.F.	$10	$2,360	
	Excavate for new footings	236	S.F.	$40	$9,440	
	Install (3) 500k micropiles @ ea. end of the (N) SW	2	Ea.	$60,000	$120,000	
	Add concrete foundation	236	S.F.	$100	$23,600	
	Install shear anchors at URM wall @ 3 SF o.c.	197	Ea.	$100	$19,667	
	Build 29.5' x 10' x 18" (avg thick) shotcrete wall	2	Ea.	$73,750	$147,500	
	Custom drag-strut (7k load) tieing new walls	1	Ea.	$10,000	$10,000	
	Demo (E) wall finishes at drag strut location	32	S.F.	$4	$128	
	(N) gypsum and finish	622	S.F.	$8	$4,976	
	Temporary work area	282	S.F.	$2	$423	
	Demo (E) wall finishes	470	S.F.	$4	$1,880	
	Demo (E) slab for new footings	188	S.F.	$10	$1,880	
	Excavate for new footings	188	S.F.	$40	$7,520	
	Install (2) 500k micropiles @ ea. end of the (N) SW	2	Ea.	$60,000	$120,000	
	Add concrete foundation	188	S.F.	$100	$18,800	
	Install shear anchors at URM wall @ 3 SF o.c.	157	Ea.	$100	$15,667	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
GL D URM Strengthening	Build 23.5' x 10' x 18" (avg thick) shotcrete wall	2	Ea.	$58,750	$117,500	
	Custom drag-strut (18k load) tieing new walls	1	Ea.	$26,000	$26,000	
	Demo (E) wall finishes at drag strut location	80	S.F.	$4	$320	
	(N) gypsum and finish	550	S.F.	$8	$4,400	
	Temporary work area	276	S.F.	$2	$414	
	Demo adjoining (E) walls and finishes	920	S.F.	$6	$5,520	
	Demo (E) wall finishes	460	S.F.	$4	$1,840	
	Demo (E) slab for new footings	184	S.F.	$10	$1,840	
	Excavate for new footings	184	S.F.	$40	$7,360	
	Install (2) micropiles @ ea. end of the (N) SW	2	Ea.	$36,000	$72,000	
	Add concrete foundation	184	S.F.	$100	$18,400	
	Install shear anchors at URM wall @ 3 SF o.c.	153	Ea.	$100	$15,333	
GL E URM Strengthening	Build 23.5' x 10' x 12" (avg thick) shotcrete wall	2	Ea.	$25,556	$51,111	
	Custom drag-strut (7k load) tieing new walls	1	Ea.	$10,000	$10,000	
	Demo (E) wall finishes at drag strut location	80	S.F.	$4	$320	
	Re-build adjoining walls	460	S.F.	$6	$2,760	
	(N) gypsum and finish	1460	S.F.	$8	$11,680	
	Temporary work area	120	S.F.	$2	$180	
	Demo adjoining (E) walls and finishes	200	S.F.	$6	$1,200	
	Demo (E) wall finishes	200	S.F.	$4	$800	
	Demo (E) slab for new footings	80	S.F.	$10	$800	
	Excavate for new footings	80	S.F.	$40	$3,200	
	Install (2) micropiles @ ea. end of the (N) SW	1	Ea.	$36,000	$36,000	
	Add concrete foundation	80	S.F.	$100	$8,000	
	Install shear anchors at URM wall @ 3 SF o.c.	67	Ea.	$100	$6,667	
	Build 20' x 10' x 12" (avg thick) shotcrete wall	1	Ea.	$22,222	$22,222	
	Re-build adjoining walls	200	S.F.	$6	$1,200	

ESTIMATE OF PROBABLE CONSTRUCTION COST
STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
	(N) gypsum and finish	400	S.F.	$8	$3,200	
						$2,095,458
					Sub-total	**$7,714,131**
					Construction Contingency (25%)	**$1,928,533**
					Contractor Overhead and Profit (25%)	**$2,410,666**
					Total Seismic Construction Cost	**$12,053,329**

ESTIMATE OF PROBABLE CONSTRUCTION COST
NON-STRUCTURAL

PROJECT:	Owner Directed Facility Seismic Evaluations	JOB NO.:	151029
LOCATION:	Benton County Courthouse - SPOE		
CLIENT:	Benton County	DATE:	11-Aug-16
TAKE-OFF BY:	ERW	CHECKED BY:	RGV

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
Mobilization	Job Trailer	2	Month	$500	$1,000	
	Supervisor	9	Week	$4,125	$37,125	
Construction Aids						
Lift 500# capacity	(1) Scissor lift	2	Month	$4,300	$8,600	
Temporary Storage	Provide (1) 40' container for storage as required	2	Month	$500	$1,000	
Ventalation	Negative Air Equipment per each zone	9	Week	$500	$4,500	
						$52,225
Fire suppresion piping	Brace to NFPA standards	120	Each	$300	$36,000	
	Add Flex Connection	30	Each	$430	$12,900	
Gas piping	Brace to FM standards	6	Each	$300	$1,800	
	Add Flex Connection	2	Each	$430	$860	
Brace Courtroom #3 suspended ceiling	Remove contents	540.5	S.F.	$10	$5,405	
	Demo (E) ceiling	540.5	S.F.	$6	$3,243	
	Temporary work area	540.5	S.F.	$2	$811	
	Temporary flooring	540.5	S.F.	$2	$1,081	
	Add seismic bracing	540.5	S.F.	$16	$8,648	
	(N) metal suspended ceiling	540.5	S.F.	$5	$2,703	
	(N) gypsum and finish	540.5	S.F.	$12	$6,486	
Brace Room #111 suspended ceiling	Remove contents	310	S.F.	$10	$3,100	
	Demo (E) ceiling	310	S.F.	$6	$1,860	
	Temporary work area	310	S.F.	$2	$465	
	Temporary flooring	310	S.F.	$2	$620	
	Add seismic bracing	310	S.F.	$16	$4,960	
	(N) metal suspended ceiling	310	S.F.	$5	$1,550	
	(N) gypsum and finish	310	S.F.	$12	$3,720	
Brace Courtroom #3 suspended lights	Add independent braces/safety chains	5	Each	$300	$1,500	
Secure lens covers for Courtroom #3 suspended lights	Add clips to secure the lens covers of the lights	5	Each	$150	$750	

ESTIMATE OF PROBABLE CONSTRUCTION COST
NON-STRUCTURAL

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
Brace NC tall contents on 1FL and 3FL	Add independent braces/safety chains	29	Each	$200	$5,800	
Brace suspended inline HVAC equip.	Add independent braces/safety chains	5	Each	$1,000	$5,000	
Anchor the gas boiler in the boiler room	Add concrete anchors at each corner	1	Each	$500	$500	
						$109,761
					Sub-total	**$161,986**
					Construction Contingency (25%)	**$40,497**
					Contractor Overhead and Profit (25%)	**$50,621**
					Total Seismic Construction Cost	**$253,104**

NEW BUILDING COST TABLE

ESTIMATE OF PROBABLE CONSTRUCTION COST
NEW COURTHOUSE BUILDING

PROJECT:	Owner Directed Facility Seismic Evaluations	JOB NO.:	151029
LOCATION:	Benton County Courthouse - SPOE		
CLIENT:	Benton County	DATE:	11-Aug-16
TAKE-OFF BY:	RGV	CHECKED BY:	ERW

SEISMIC DESCRIPTION	ACTIVITY	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE	SUBTOTALS
General	Building Permit Fee	1	Each	$140,000	$140,000	
						$140,000
Base Building	Steel frame building w/ stone or brick veneer	45000	S.F.	$240	$10,795,500	
						$10,795,500
Common Additives						
Floor height addition	Increase 12' to 16' ceilings (2 floors)	8	L.F.	$148,500	$1,188,000	
Benches Hardwood	2 Courtrooms	96	L.F.	$234	$22,464	
Closed circuit Surveillance	1 Station	1	Each	$20,600	$20,600	
Directory boards	2 Locations	2	Each	$1,075	$2,150	
Elevators	1 Additional elevators	1	Each	$158,520	$158,520	
Emergency lighting	With nickel cadmium batteries	24	Each	$685	$16,440	
Flagpole	70 Foot flagpole	1	Each	$12,000	$12,000	
Intercom	12 Station and master	1	Each	$800	$800	
Safe	60" x 36" X 18" double door safe	1	Each	$9,350	$9,350	
Smoke detectors	Duct type smoke detectors	36	Each	$565	$20,340	
Clock system	20 Room clock system	1	Each	$20,600	$20,600	
						$1,471,264
					Sub-total	**$12,406,764**
					Construction Contingency (25%)	**$3,101,691**
					Contractor Overhead and Profit (25%) (included in the sub-total above)	**$3,101,691**
					Total Seismic Construction Cost	**$15,508,455**

APPENDIX A
ASCE 41 CHECKLIST

SUMMARY DATA SHEET

BUILDING DATA

Building Name: Benton County Courthouse Date: August 29, 2016

Building Address: 120 NW 4th Street, Corvallis, Oregon

Latitude: 44.56528 N Longitude: 123.26237 W By:

Year Built: 1887 Year(s) Remodeled: 1977 Original Design Code: N/A

Area (sf): 33,052 Length (ft): Varies Width (ft): Varies

No. of Stories: Four Story Height: Varies Total Height: 59'-6"(Tower:115'-5")

USE ☐ Industrial ☒ Office ☐ Warehouse ☐ Hospital ☐ Residential ☐ Educational ☒ Other: Assembly

CONSTRUCTION DATA

Gravity Load Structural System: Unreinforced masonry bearing walls with interior steel supports

Exterior Transverse Walls: Unreinforced masonry shear walls Openings? Punched openings

Exterior Longitudinal Walls: Unreinforced masonry shear walls Openings? Punched openings

Roof Materials/Framing: Timber trusses and 2x rafters with T&G straight sheathing

Intermediate Floors/Framing: Timber 3 x 16 floor joists with T&G straight sheathing

Ground Floor: Concrete slab on grade

Columns: Wood and steel columns Foundation: Unknown foundation

General Condition of Structure: Well maintained structure in good condition

Levels Below Grade? N/A

Special Features and Comments: The building houses the Benton County Courts

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System:	Masonry shear wall	Masonry shear wall
Vertical Elements:	Bearing wall	Bearing wall
Diaphragms:	Flexible wood sheathing	Flexible wood sheathing
Connections:	Unknown	Unknown

EVALUATION DATA

BSE-1N Spectral Response Accelerations: S_{Ds} = 0.712 S_{D1} = 0.480

Soil Factors: Class = D F_a = 1.12 F_v = 1.53

BSE-1E Spectral Response Accelerations: S_{XS} = 0.86 S_{X1} = 0.58

Level of Seismicity: High Performance Level: Life Safety w/ BSE-2E

Building Period: T = 0.43

Spectral Acceleration: S_a = 0.86

Modification Factor: $C_mC_1C_2$ = 1.0 Building Weight: W = 7,344,016 lb

Pseudo Lateral Force: V= 0.86

$C_mC_1C_2S_aW$= 6,298,375 lb

BUILDING CLASSIFICATION: Unreinforced Masonry Building with flexible diaphragms

REQUIRED TIER 1 CHECKLISTS	**Yes**	**No**
Basic Configuration Checklist	☒	☐
Building Type URM **Structural Checklist**	☒	☐
Nonstructural Component Checklist	☒	☐

FURTHER EVALUATION REQUIREMENT:

Table 2-1. Basic Performance Objective for Existing Buildings (BPOE)

	Tier 1[a]	Tier 2[a]	Tier 3	
Risk Category	**BSE-1E**	**BSE-1E**	**BSE-1E**	**BSE-2E**
I & II	Life Safety Structural Performance Life Safety Nonstructural Performance (3-C)	Life Safety Structural Performance Life Safety Nonstructural Performance (3-C)	Life Safety Structural Performance Life Safety Nonstructural Performance (3-C)	Collapse Prevention Structural Performance Nonstructural Performance Not Considered (5-D)
III	See footnote *b* for Structural Performance Position Retention Nonstructural Performance (2-B)	Damage Control Structural Performance Position Retention Nonstructural Performance (2-B)	Damage Control Structural Performance Position Retention Nonstructural Performance (2-B)	Limited Safety Structural Performance Nonstructural Performance Not Considered (4-D)
IV	Immediate Occupancy Structural Performance Position Retention Nonstructural Performance (1-B)	Immediate Occupancy Structural Performance Position Retention Nonstructural Performance (1-B)	Immediate Occupancy Structural Performance Position Retention Nonstructural Performance (1-B)	Life Safety Structural Performance Nonstructural Performance Not Considered (3-D)

[a]For Tier 1 and 2 assessments, seismic performance for the BSE-2E is not explicitly evaluated.
[b]For Risk Category III, the Tier 1 screening checklists shall be based on the Life Safety Performance Level (S-3), except that checklist statements using the Quick Check procedures of Section 4.5.3 shall be based on MS-factors and other limits that are an average of the values for Life Safety and Immediate Occupancy.

Per USGS Sds = 0.712, so the courthouse site is considered in a region with high level of seismicity.

Table 2-5. Level of Seismicity Definitions

Level of Seismicity[a]	S_{DS}	S_{D1}
Very low	<0.167 g	<0.067 g
Low	≥0.167 g <0.33 g	≥0.067 g <0.133 g
Moderate	≥0.33 g <0.50 g	≥0.133 g <0.20 g
High	≥ 0.50 g	≥0.20 g

[a]The higher level of seismicity defined by S_{DS} or S_{D1} shall govern.

C2.5 LEVEL OF SEISMICITY

The Levels of Seismicity in this standard have been adjusted to match the Seismic Design Categories in ASCE 7 as follows:

SDC A: Very Low
SDC B: Low
SDC C: Moderate
SDC D–F: High

Therefore, the parameters S_{DS} and S_{D1} correspond to the parameters at the BSE-1N level.

The courthouse does not meet the Benchmark Building Criteria

Table 4-6. Benchmark Buildings

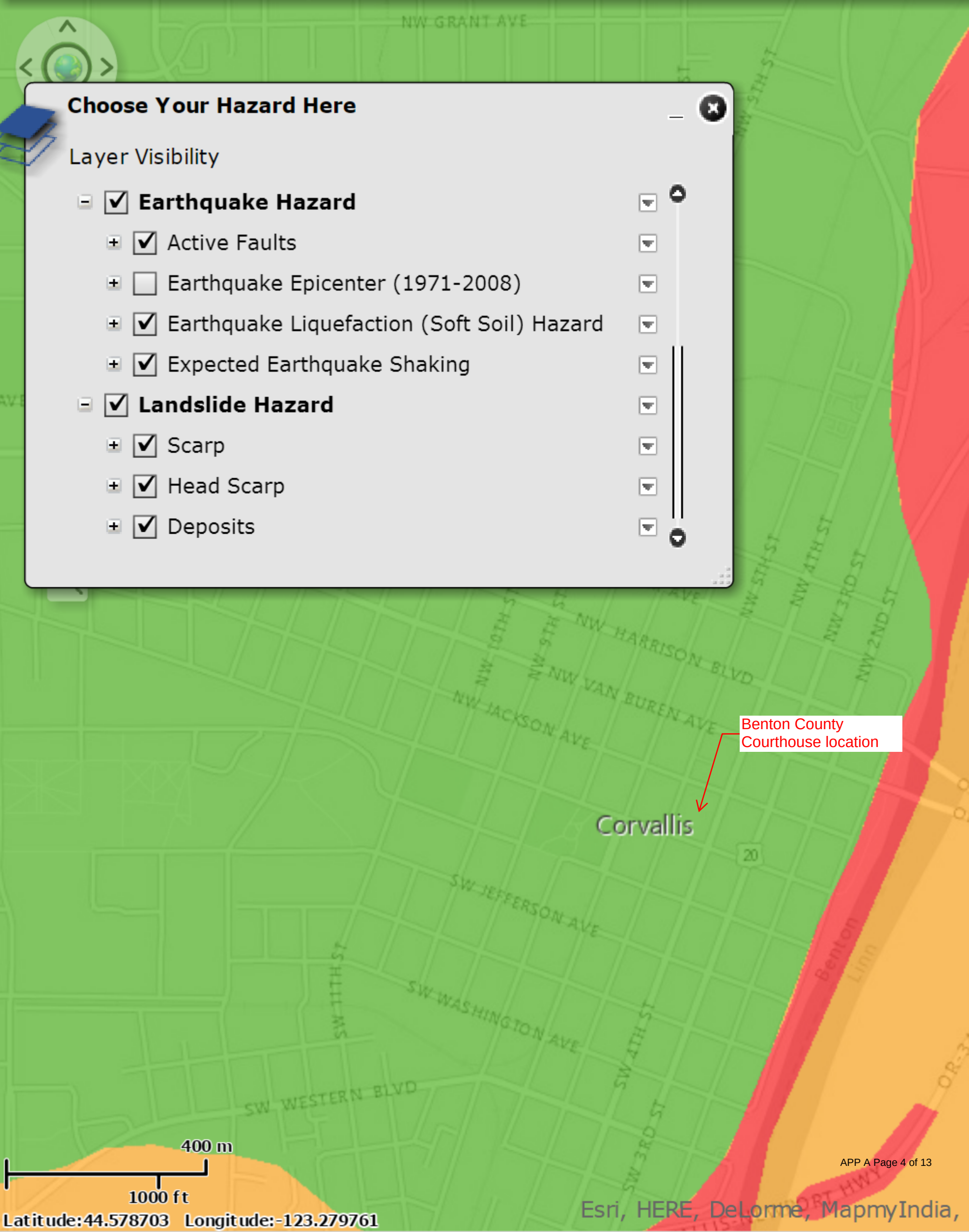
Building Type[a,b]	Building Seismic Design Provisions				Seismic Evaluation or Retrofit Provisions		
	NBC[LS] SBC[LS]	UBC[LS]	IBC[LS]	NEHRP[LS]	FEMA 178[LS]	FEMA 310 (1998e)/ ASCE 31[LS,IO]	FEMA 356 (2000)/ ASCE 41[LS,IO][c,d]
Wood frame, wood shear panels (Types W1 & W2)	1993	1976	2000	1985	[e]	1998	2000
Wood frame, wood shear panels (Type W1a)	[e]	1997	2000	1997	[e]	1998	2000
Steel moment-resisting frame (Types S1 & S1a)	[e]	1994[f]	2000	1997	[e]	1998	2000
Steel concentrically braced frame (Types S2 & S2a)	[e]	1997	2000	[e]	[e]	1998	2000
Steel eccentrically braced frame (Types S2 & S2a)	[e]	1988[f]	2000	1997	[e]	[e]	2000
Buckling-restrained braced frame (Types S2 & S2a)	[e]	[e]	2006	[e]	[e]	[e]	2000
Light metal frame (Type S3)	[e]	[e]	2000	[e]	1992	1998	2000
Steel frame w/ concrete shear walls (Type S4)	1993	1994[?]	2000	1985	[e]	1998	2000
Steel frame with URM infill (Types S5 & S5a)	[e]	[e]	2000	[e]	[e]	1998	2000
Steel plate shear wall (Type S6)	[e]	[e]	2006	[e]	[e]	[e]	2000
Reinforced concrete moment-resisting frame (Type C1)[g]	1993	1994	2000	1997	[e]	1998	2000
Reinforced concrete shear walls (Types C2 & C2a)	1993	1994	2000	1985	[e]	1998	2000
Concrete frame with URM infill (Types C3 & C3a)	[e]	[e]	2000	[e]	[e]	1998	2000
Tilt-up concrete (Types PC1 & PC1a)	[e]	1997	2000	[e]	[e]	1998	2000
Precast concrete frame (Types PC2 & PC2a)	[e]	[e]	2000	[e]	1992	1998	2000
Reinforced masonry (Type RM1)	[e]	1997	2000	[e]	[e]	1998	2000
Reinforced masonry (Type RM2)	1993	1994[?]	2000	1985	[e]	1998	2000
Unreinforced masonry (Type URM)[h]	[e]	1991[i]	2000	[e]	1992	1998	2000
Unreinforced masonry (Type URMa)	[e]	[e]	2000	[e]	[e]	1998	2000
Seismic isolation or passive dissipation	[e]	1991	2000	[e]	[e]	[e]	2000

[a]Building type refers to one of the common building types defined in Table 3-1.
[b]Buildings on hillside sites shall not be considered Benchmark Buildings.
[c]LS: S-3 Structural Performance Level for the BSE-1.
[d]IO: S-1 Structural Performance Level for the BSE-1.
[e]No benchmark year; buildings shall be evaluated using this standard.
[f]Steel moment-resisting frames and eccentrically braced frames with links adjacent to columns shall comply with the 1994 UBC Emergency Provisions, published September/October 1994, or subsequent requirements.
[g]Flat slab concrete moment frames shall not be considered Benchmark Buildings.
[h]URM buildings evaluated or retrofitted and shown to be acceptable using Special Procedure (the ABK Methodology, 1984) may be considered benchmark buildings subject to the limitation of Section 15.2.
[i]Refers to the GSREB or its predecessor, the Uniform Code of Building Conservation (UCBC), or its successor, IEBC Appendix Chapter A1.
[LS]Only buildings designed and constructed or evaluated in accordance with these documents and being evaluated to the Life Safety Performance Level may be considered Benchmark Buildings.
[IO]Buildings designed and constructed or evaluated in accordance with these documents and being evaluated to the Immediate Occupancy Performance Level may be considered Benchmark Buildings.

Table 4-7. Checklists Required for a Tier 1 Screening

Level of Seismicity[b]	Level of Building Performance[c]	Required Checklists[a]					
		Very Low Seismicity Checklist (Sec 16.1.1)	Basic Configuration Checklist (Sec. 16.1.2)	Life Safety Checklist (Sec. 16.2LS through 16.15LS)	Immediate Occupancy Checklist (Sec. 16.2IO through 16.15IO)	Life Safety Nonstructural Checklist (Sec. 16.17)	Position Retention Nonstructural Checklist (Sec. 16.17)
Very low	LS	X					
Very low	IO		X		X		X
Low	LS		X	X		X	
Low	IO		X		X		X
Moderate	LS		X	X		X	
Moderate	IO		X		X		X
High	LS		X	X		X	
High	IO		X		X		X

[a]An X designates the checklist that must be completed for a Tier 1 screening as a function of the level of seismicity and level of performance.
[b]Defined in Section 2.5.
[c]LS = Life Safety Performance Level, and IO = Immediate Occupancy Performance Level (defined in Section 2.3.3).


Choose Your Hazard Here
Layer Visibility
Earthquake Hazard
Active Faults
Earthquake Epicenter (1971-2008)
Earthquake Liquefaction (Soft Soil) Hazard
Expected Earthquake Shaking
Landslide Hazard
Scarp
Head Scarp
Deposits
NW GRANT AVE
NW HARRISON BLVD
NW VAN BUREN AVE
NW JACKSON AVE
Corvallis
Benton County Courthouse location
SW JEFFERSON AVE
SW WASHINGTON AVE
SW WESTERN BLVD
SW 11TH ST
SW 4TH ST
SW 3RD ST
NW 2ND
Benton
Linn
20
400 m
1000 ft
Latitude:44.578703 Longitude:-123.279761
Esri, HERE, DeLorme, MapmyIndia,

Project: Benton County Courthouse

Location: 120 NW 4th Street, Corvallis, OR

Completed by: Miller Consulting Engineers

Date: August 29, 2016

16.1.2LS LIFE SAFETY BASIC CONFIGURATION CHECKLIST

Low Seismicity

Building System

General

C NC N/A U LOAD PATH: The structure shall contain 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. (Commentary: Sec. A.2.1.1. Tier 2: Sec. 5.4.1.1)

C NC N/A U ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 4% of the height of the shorter building. This statement shall not apply for the following building types: W1, W1a, and W2. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)

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. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3)

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. (Commentary: Sec. A2.2.2. Tier 2: Sec. 5.4.2.1)

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. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2)

C NC N/A U VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3)

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. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4)

C NC N/A U MASS: There is no change in effective mass more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5)

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. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6)

Moderate Seismicity: Complete the Following Items in Addition to the Items for Low Seismicity.

Geologic Site Hazards

Based on information from the DOGAMI Statewide Geohazard Online Map

C NC N/A U LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 ft under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1)

C NC N/A U SLOPE FAILURE: The building site is sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1)

C NC N/A U SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: 5.4.3.1)

High Seismicity: Complete the Following Items in Addition to the Items for Low and 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 $0.6S_a$. (Commentary: Sec. A.6.2.1. Tier 2: Sec. 5.4.3.3)

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. (Commentary: Sec. A.6.2.2. Tier 2: Sec. 5.4.3.4)

Project: Benton County Courthouse Location: 120 NW 4th Street, Corvallis, OR

Completed by: Miller Consulting Engineers Date: August 29, 2016

16.16LS LIFE SAFETY STRUCTURAL CHECKLIST FOR BUILDING TYPES URM: UNREINFORCED MASONRY BEARING WALLS WITH FLEXIBLE DIAPHRAGMS AND URMA: UNREINFORCED MASONRY BEARING WALLS WITH STIFF DIAPHRAGMS

Low and Moderate Seismicity

Most of the existing shear walls from the basement up to the the 3rd floor are NC (see the calculations for locations)

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. (Commentary: Sec. A.3.2.1.1. Tier 2: Sec. 5.5.1.1)

C NC N/A U SHEAR STRESS CHECK: The shear stress in the unreinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.5.3.3, is less than 30 lb/in.^{2} for clay units and 70 lb/in.^{2} for concrete units. (Commentary: Sec. A.3.2.5.1. Tier 2: Sec. 5.5.3.1.1)

Connections

The masonry walls have anchors at 8' o.c. at the ceiling of the upper level; no anchors were observed at the other floors

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 shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 4.5.3.7. (Commentary: Sec. A.5.1.1. Tier 2: Sec. 5.7.1.1)

C NC N/A U WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Commentary: Sec. A.5.1.2. Tier 2: Sec. 5.7.1.3)

C NC N/A U TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls. (Commentary: Sec. A.5.2.1. Tier 2: Sec. 5.7.2)

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. (Commentary: Sec. A.5.4.1. Tier 2: Sec. 5.7.4.1)

High Seismicity: Complete the Following Items in Addition to the Items for Low and Moderate Seismicity.

Seismic-Force-Resisting System

C NC N/A U PROPORTIONS: The height-to-thickness ratio of the shear walls at each story is less than the following (Commentary: Sec. A.3.2.5.2. Tier 2: Sec. 5.5.3.1.2):

Top story of multi-story building	9
First story of multi-story building	15
All other conditions	13

C NC N/A U MASONRY LAYUP: Filled collar joints of multi-wythe masonry walls have negligible voids. (Commentary: Sec. A.3.2.5.3. Tier 2: Sec. 5.5.3.4.1)

The bell tower lounge walls are NC

Diaphragms (Stiff or Flexible)

C NC N/A U OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Commentary: Sec. A.4.1.4. Tier 2: Sec. 5.6.1.3)

C NC N/A U OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft long. (Commentary: Sec. A.4.1.6. Tier 2: Sec. 5.6.1.3)

Openings are > 8 feet at: 4th GL6; 3rd GL A, E & 6; 2nd GL A, 3 & 6; and 1st GL 3 & 6.

Flexible Diaphragms

The west roof diaphragm has a 2.75 : 1 ratio in the E-W direction

C NC N/A U CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2) Cross ties were not observed

C NC N/A U STRAIGHT SHEATHING: All straight sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2)

C NC N/A U SPANS: All wood diaphragms with spans greater than 24 ft consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2)

The west roof diaphragm has straight sheathing with 71.5 span in the E-W direction

The core floor diaphragm span is 51.5' x 65.5' with a 1.27 : 1 ratio in the N-S direction (Vact > Vall)

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 and aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2)

C NC N/A U OTHER DIAPHRAGMS: The diaphragm does not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5)

Connections

The (E) anchors are installed tight, but the connection from the joist to the diaphragm is unknown

C NC N/A U STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors. (Commentary: Sec. A.5.1.4. Tier 2: Sec. 5.7.1.2)

C NC N/A U BEAM, GIRDER, AND TRUSS SUPPORTS: Beams, girders, and trusses supported by unreinforced masonry walls or pilasters have independent secondary columns for support of vertical loads. (Commentary: Sec. A.5.4.5. Tier 2: Sec. 5.7.4.4)

The trusses do not have secondary supports and there is not a Tier 2 path to evaluate the load path

Project: Benton County Courthouse Location: 120 NW 4th Street, Corvallis, OR

Completed by: Miller Consulting Engineers Date: August 29, 2016

16.17 NONSTRUCTURAL CHECKLIST

Life Safety Systems

One transverse brace was observed in Storage Room #10, but does not meet NFPA-13, Sect. 9.3.5.1 bracing requirements

C NC N/A U LS-LMH; PR-LMH. FIRE SUPPRESSION PIPING: Fire suppression piping is anchored and braced in accordance with NFPA-13. (Commentary: Sec. A.7.13.1. Tier 2: Sec. 13.7.4)

C NC N/A U LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Fire suppression piping has flexible couplings in accordance with NFPA-13. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.4)

C NC N/A U LS-LMH; PR-LMH. EMERGENCY POWER: Equipment used to power or control life safety systems is anchored or braced. (Commentary: Sec. A.7.12.1. Tier 2: Sec. 13.7.7)

C NC N/A U LS-LMH; PR-LMH. STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Commentary: Sec. A.7.14.1. Tier 2: Sec. 13.7.6)

C NC N/A U LS-MH; PR-MH. SPRINKLER CEILING CLEARANCE: Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Commentary: Sec. A.7.13.3. Tier 2: Sec. 13.7.4) Observed 1" clearance per NFPA-13, Sect. 9.3.4.2

C NC N/A U LS-not required; PR-LMH. EMERGENCY LIGHTING: Emergency and egress lighting equipment is anchored or braced. (Commentary: Sec. A.7.3.1. Tier 2: Sec. 13.7.9)

Hazardous Materials

The natural gas line does not have seismic bracing or flexible couplings

C NC N/A U LS-LMH; PR-LMH. HAZARDOUS MATERIAL EQUIPMENT: Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Commentary: Sec. A.7.12.2. Tier 2: 13.7.1)

C NC N/A U LS-LMH; PR-LMH. HAZARDOUS MATERIAL STORAGE: Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Commentary: Sec. A.7.15.1. Tier 2: Sec. 13.8.4)

C NC N/A U LS-MH; PR-MH. HAZARDOUS MATERIAL DISTRIBUTION: Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC N/A U LS-MH; PR-MH. SHUT-OFF VALVES: Piping containing hazardous material, including natural gas, has shut-off valves or other devices to limit spills or leaks. (Commentary: Sec. A.7.13.3. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC N/A U LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Hazardous material ductwork and piping, including natural gas piping, has flexible couplings. (Commentary: Sec. A.7.15.4, Tier 2: Sec.13.7.3 and 13.7.5)

C NC N/A U LS-MH; PR-MH. PIPING OR DUCTS CROSSING SEISMIC JOINTS: Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.13.6. Tier 2: Sec.13.7.3, 13.7.5, and 13.7.6)

Partitions

C NC N/A U LS-LMH; PR-LMH. UNREINFORCED MASONRY: Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft in Low or Moderate Seismicity, or at most 6 ft in High Seismicity. (Commentary: Sec. A.7.1.1. Tier 2: Sec. 13.6.2)

C NC N/A U LS-LMH; PR-LMH. HEAVY PARTITIONS SUPPORTED BY CEILINGS: The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)

C NC N/A U LS-MH; PR-MH. DRIFT: Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Commentary A.7.1.2 Tier 2: Sec. 13.6.2)

C NC N/A U LS-not required; PR-MH. LIGHT PARTITIONS SUPPORTED BY CEILINGS: The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)

C NC N/A U LS-not required; PR-MH. STRUCTURAL SEPARATIONS: Partitions that cross structural separations have seismic or control joints. (Commentary: Sec. A.7.1.3. Tier 2. Sec. 13.6.2)

C NC N/A U LS-not required; PR-MH. TOPS: The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft. (Commentary: Sec. A.7.1.4. Tier 2. Sec. 13.6.2)

Ceilings

The Category C suspended gypsum ceilings are not braced at 144 ft2 and do not have a sufficient gap to allow for relative displacement in accordance with 13.6.4.3

C NC N/A U LS-MH; PR-LMH. SUSPENDED LATH AND PLASTER: Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft^2 of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)

C NC N/A U LS-MH; PR-LMH. SUSPENDED GYPSUM BOARD: Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft^2 of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)

C NC N/A U LS-not required; PR-MH. INTEGRATED CEILINGS: Integrated suspended ceilings with continuous areas greater than 144 ft^2, and ceilings of smaller areas that are not surrounded by restraining partitions, are laterally restrained at a spacing no greater than 12 ft with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Commentary: Sec. A.7.2.2. Tier 2: Sec. 13.6.4)

C NC N/A U LS-not required; PR-MH. EDGE CLEARANCE: The free edges of integrated suspended ceilings with continuous areas greater than 144 ft^2 have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in.; in High Seismicity, 3/4 in. (Commentary: Sec. A.7.2.4. Tier 2: Sec. 13.6.4)

C NC N/A U LS-not required; PR-MH. CONTINUITY ACROSS STRUCTURE JOINTS: The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Commentary: Sec. A.7.2.5. Tier 2: Sec. 13.6.4)

C NC N/A U LS-not required; PR-H. EDGE SUPPORT: The free edges of integrated suspended ceilings with continuous areas greater than 144 ft^2 are supported by closure angles or channels not less than 2 in. wide. (Commentary: Sec. A.7.2.6. Tier 2: Sec. 13.6.4)

C NC N/A U LS-not required; PR-H. SEISMIC JOINTS: Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2500 ft^2 and has a ratio of long-to-short dimension no more than 4-to-1. (Commentary: Sec. A.7.2.7. Tier 2: 13.6.4)

Light Fixtures

C NC N/A U LS-MH; PR-MH. INDEPENDENT SUPPORT: Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Commentary: Sec. A.7.3.2. Tier 2: Sec. 13.6.4 and 13.7.9)

C NC N/A U LS-not required; PR-H. PENDANT SUPPORTS: Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft and, if rigidly supported, are free to move with the structure to which they are attached without damaging adjoining components. (Commentary: A.7.3.3. Tier 2: Sec. 13.7.9)

C NC N/A U LS-not required; PR-H. LENS COVERS: Lens covers on light fixtures are attached with safety devices. (Commentary: Sec. A.7.3.4. Tier 2: Sec. 13.7.9)

Cladding and Glazing

C NC N/A U LS-MH; PR-MH. CLADDING ANCHORS: Cladding components weighing more than 10 lb/ft^2 are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft. (Commentary: Sec. A.7.4.1. Tier 2: Sec. 13.6.1)

C NC N/A U LS-MH; PR-MH. CLADDING ISOLATION: For steel or concrete moment frame buildings, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02. (Commentary: Sec. A.7.4.3. Tier 2: Section 13.6.1)

The glazing for the original and renovated skylights are laminated wire glass annealed material

C NC N/A U LS-MH; PR-MH. MULTI-STORY PANELS: For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicty, 0.02. (Commentary: Sec. A.7.4.4. Tier 2: Sec. 13.6.1)

C NC N/A U LS-MH; PR-MH. PANEL CONNECTIONS: Cladding panels are anchored out-of-plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Commentary: Sec. A.7.4.5. Tier 2: Sec. 13.6.1.4)

C NC N/A U LS-MH; PR-MH. BEARING CONNECTIONS: Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Commentary: Sec. A.7.4.6. Tier 2: Sec. 13.6.1.4)

C NC N/A U LS-MH; PR-MH. INSERTS: Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Commentary: Sec. A.7.4.7. Tier 2: Sec. 13.6.1.4)

C NC N/A U LS-MH; PR-MH. OVERHEAD GLAZING: Glazing panes of any size in curtain walls and individual interior or exterior panes over 16 ft^2 in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Commentary: Sec. A.7.4.8: Tier 2: Sec. 13.6.1.5)

Masonry Veneer

C NC N/A U LS-LMH; PR-LMH. TIES: Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft^2, and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in.; for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (Commentary: Sec. A.7.5.1. Tier 2: Sec. 13.6.1.2)

C NC N/A U LS-LMH; PR-LMH. SHELF ANGLES: Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Commentary: Sec. A.7.5.2. Tier 2: Sec. 13.6.1.2)

C NC N/A U LS-LMH; PR-LMH. WEAKENED PLANES: Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Commentary: Sec. A.7.5.3. Tier 2: Sec. 13.6.1.2)

C NC N/A U LS-LMH; PR-LMH. UNREINFORCED MASONRY BACKUP: There is no unreinforced masonry backup. (Commentary: Sec. A.7.7.2. Tier 2: Section 13.6.1.1 and 13.6.1.2)

C NC N/A U LS-MH; PR-MH. STUD TRACKS: For veneer with metal stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. on center. (Commentary: Sec. A.7.6.1. Tier 2: Section 13.6.1.1 and 13.6.1.2)

C NC N/A U LS-MH; PR-MH. ANCHORAGE: For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Commentary: Sec. A.7.7.1. Tier 2: Section 13.6.1.1 and 13.6.1.2)

C NC N/A U LS-not required; PR-MH. WEEP HOLES: In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Commentary: Sec. A.7.5.6. Tier 2: Section 13.6.1.2)

C NC N/A U LS-not required; PR-MH. OPENINGS: For veneer with metal stud backup, steel studs frame window and door openings. (Commentary: Sec. A.7.6.2. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)

Parapets, Cornices, Ornamentation, and Appendages

C NC N/A U LS-LMH; PR-LMH. URM PARAPETS OR CORNICES: Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Commentary: Sec. A.7.8.1. Tier 2: Sec. 13.6.5)

C NC N/A U LS-LMH; PR-LMH. CANOPIES: Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft; for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft. (Commentary: Sec. A.7.8.2. Tier 2: Sec. 13.6.6)

C NC N/A U LS-MH; PR-LMH. CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Commentary: Sec. A.7.8.3. Tier 2: Sec. 13.6.5)

C NC N/A U LS-MH; PR-LMH. APPENDAGES: Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft. This checklist item does not apply to parapets or cornices covered by other checklist items. (Commentary: Sec. A.7.8.4. Tier 2: Sec. 13.6.6)

The statue and sloped cornices at the east wall elevation are anchored back to the structure less than 6' o.c.; it is unknown whether they are reinforced.

Masonry Chimneys

The west chimney h/w = 2.1; the URM chimneys are built integrally with the exterior walls

C NC N/A U LS-LMH; PR-LMH. URM CHIMNEYS: Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney. (Commentary: Sec. A.7.9.1. Tier 2: 13.6.7)

C NC N/A U LS-LMH; PR-LMH. ANCHORAGE: Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Commentary: Sec. A.7.9.2. Tier 2: 13.6.7)

Stairs

Each of the exterior walls at the stairway openings is non-compliant

C NC N/A U LS-LMH; PR-LMH. STAIR ENCLOSURES: Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out-of-plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Commentary: Sec. A.7.10.1. Tier 2: Sec. 13.6.2 and 13.6.8)

C NC N/A U LS-LMH; PR-LMH. STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure does not rely on shallow anchors in concrete. Alternatively, the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.5.3.1 without including any lateral stiffness contribution from the stairs. (Commentary: Sec. A.7.10.2. Tier 2: 13.6.8)

Contents and Furnishings

Non-compliant contents are located on the 1st and 3rd Floors with aspect ratios as high as 8.4 : 1

C NC N/A U LS-MH; PR-MH. INDUSTRIAL STORAGE RACKS: Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/MH 16.1 as modified by ASCE 7 Chapter 15. (Commentary: Sec. A.7.11.1. Tier 2: Sec. 13.8.1)

C NC N/A U LS-H; PR-MH. TALL NARROW CONTENTS: Contents more than 6 ft high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Commentary: Sec. A.7.11.2. Tier 2: Sec. 13.8.2)

C NC N/A U LS-H; PR-H. FALL-PRONE CONTENTS: Equipment, stored items, or other contents weighing more than 20 lb whose center of mass is more than 4 ft above the adjacent floor level are braced or otherwise restrained. (Commentary: Sec. A.7.11.3. Tier 2: Sec. 13.8.2)

C NC N/A U LS-not required; PR-MH. ACCESS FLOORS: Access floors more than 9 in. high are braced. (Commentary: Sec. A.7.11.4. Tier 2: Sec. 13.8.3)

C NC N/A U LS-not required; PR-MH. EQUIPMENT ON ACCESS FLOORS: Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Commentary: Sec. A.7.11.5. Tier 2: Sec. 13.7.7 and 13.8.3)

C NC N/A U LS-not required; PR-H. SUSPENDED CONTENTS: Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Commentary. A.7.11.6. Tier 2: Sec. 13.8.2)

Mechanical and Electrical Equipment

The suspended HVAC equipment in the boiler room, storage room 10, storage room 02 and vault room 105 are not seismically anchored

C NC N/A U LS-H; PR-H. FALL-PRONE EQUIPMENT: Equipment weighing more than 20 lb whose center of mass is more than 4 ft above the adjacent floor level, and which is not in-line equipment, is braced. (Commentary: A.7.12.4. Tier 2: 13.7.1 and 13.7.7)

C NC N/A U LS-H; PR-H. IN-LINE EQUIPMENT: Equipment installed in-line with a duct or piping system, with an operating weight more than 75 lb, is supported and laterally braced independent of the duct or piping system. (Commentary: Sec. A.7.12.5. Tier 2: Sec. 13.7.1)

C NC N/A U LS-H; PR-MH. TALL NARROW EQUIPMENT: Equipment more than 6 ft high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Commentary: Sec. A.7.12.6. Tier 2: Sec. 13.7.1 and 13.7.7)

C NC N/A U LS-not required; PR-MH. MECHANICAL DOORS: Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Commentary: Sec. A.7.12.7. Tier 2: Sec. 13.6.9)

C NC N/A U LS-not required; PR-H. SUSPENDED EQUIPMENT: Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Commentary: Sec. A.7.12.8. Tier 2: Sec. 13.7.1 and 13.7.7)

C NC N/A U LS-not required; PR-H. VIBRATION ISOLATORS: Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Commentary: Sec. A.7.12.9. Tier 2: Sec. 13.7.1)

C NC N/A U LS-not required; PR-H. HEAVY EQUIPMENT: Floor-supported or platform-supported equipment weighing more than 400 lb is anchored to the structure. (Commentary: Sec. A.7.12.10. Tier 2: 13.7.1 and 13.7.7)

C NC N/A U LS-not required; PR-H. ELECTRICAL EQUIPMENT: Electrical equipment is laterally braced to the structure. (Commentary: Sec. A.7.12.11. Tier 2: 13.7.7)

C NC N/A U LS-not required; PR-H. CONDUIT COUPLINGS: Conduit greater than 2.5 in. trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Commentary: Sec. A.7.12.12. Tier 2: 13.7.8)

Piping

C NC N/A U LS-not required; PR-H. FLEXIBLE COUPLINGS: Fluid and gas piping has flexible couplings. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC N/A U LS-not required; PR-H. FLUID AND GAS PIPING: Fluid and gas piping is anchored and braced to the structure to limit spills or leaks. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC N/A U LS-not required; PR-H. C-CLAMPS: One-sided C-clamps that support piping larger than 2.5 in. in diameter are restrained. (Commentary: Sec. A.7.13.5. Tier 2: Sec. 13.7.3 and 13.7.5)

C NC N/A U LS-not required; PR-H. PIPING CROSSING SEISMIC JOINTS: Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A7.13.6. Tier 2: Sec.13.7.3 and Sec. 13.7.5)

Ducts

C NC N/A U LS-not required; PR-H. DUCT BRACING: Rectangular ductwork larger than 6 ft^2 in cross-sectional area and round ducts larger than 28 in. in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft. The maximum spacing of longitudinal bracing does not exceed 60 ft. (Commentary: Sec. A.7.14.2. Tier 2: Sec. 13.7.6)

C NC N/A U LS-not required; PR-H. DUCT SUPPORT: Ducts are not supported by piping or electrical conduit. (Commentary: Sec. A.7.14.3. Tier 2: Sec. 13.7.6)

C NC N/A U LS-not required; PR-H. DUCTS CROSSING SEISMIC JOINTS: Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.14.5. Tier 2: Sec. 13.7.6)

Elevators

C NC N/A U LS-H; PR-H. RETAINER GUARDS: Sheaves and drums have cable retainer guards. (Commentary: Sec. A.7.16.1. Tier 2: 13.8.6)

C NC N/A U LS-H; PR-H. RETAINER PLATE: A retainer plate is present at the top and bottom of both car and counterweight. (Commentary: Sec. A.7.16.2. Tier 2: 13.8.6)

C NC N/A U LS-not required; PR-H. ELEVATOR EQUIPMENT: Equipment, piping, and other components that are part of the elevator system are anchored. (Commentary: Sec. A.7.16.3. Tier 2: 13.8.6)

C NC N/A U LS-not required; PR-H. SEISMIC SWITCH: Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Commentary: Sec. A.7.16.4. Tier 2: 13.8.6)

C	NC	N/A	U	LS-not required; PR-H. SHAFT WALLS: Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Commentary: Sec. A.7.16.5. Tier 2: 13.8.6)
C	NC	N/A	U	LS-not required; PR-H. COUNTERWEIGHT RAILS: All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.6. Tier 2: 13.8.6)
C	NC	N/A	U	LS-not required; PR-H. BRACKETS: The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.7. Tier 2: 13.8.6)
C	NC	N/A	U	LS-not required; PR-H. SPREADER BRACKET: Spreader brackets are not used to resist seismic forces. (Commentary: Sec. A.7.16.8. Tier 2: 13.8.6)
C	NC	N/A	U	LS-not required; PR-H. GO-SLOW ELEVATORS: The building has a go-slow elevator system. (Commentary: Sec. A.7.16.9. Tier 2: 13.8.6)

APPENDIX B
CALCULATIONS

Building Code: 2014 Oregon Structural Specialty Code and the ASCE 41-13 Standard

Soils Report: No **Soils Report by:** N/A **Dated:** N/A

Soil Bearing: 1500 PSF **Retaining Walls:** No

Equivalent Fluid Pressure (active): N/A PCF **Passive bearing:** N/A PCF **Friction:** N/A

Structural System: Building Structure

Vertical System: Wood framed roof / masonry walls **Lateral Sys:** Flexible Diaphragm / Concrete or Masonry Shearwalls

Basic Design Loads:

Element	Roof	Floor	Corridor	
Load Type	Dead	Dead	Dead	
Value (PSF)	20	20	20	
Load Type	Snow	Floor Live	Corridor Live	
Value (PSF)	25	50	100	
Deflection Criteria	L/240	L/360	L/360	

Lateral Design Parameters:

Wind Design: Other: ASCE 41-13 **Wind Speed (3 sec Gust):** 120 MPH

Exposure B

Importance Factors I_W = (ice) I_E = (seismic) I_S = (snow) I_i = (ice) **Risk Cat:** II

Seismic Design

Seismic design parameters are based on published values from the USGS web site.

Design Summary:

The following calculations are for the Tier I and II analysis of the courthouse building based on the ASCE 41-13 standard for evaluating an existing building considering BSE-2E seismic loading with the Life Safety Performance Objective. In these calculations this combination will be referred to as the Supplemental Performance Objective (SPOE).

Calculation index:

- USGS Maps: 2-3
- Loading: 4-8
- Basic Checklist: 9
- Tier I and II: 10-25
- Sample Column: 26-27
- Sample Shear Wall: 28-113

MILLER CONSULTING ENGINEERS

9570 SW Barbur Blvd.
Suite One Hundred
Portland, OR 97219

(503)246-1250
FAX: 246-1395

Project Name: Benton County Courthouse Seismic Review Project #: 151029

Location: 120 NW 4th Street, Corvallis, Oregon

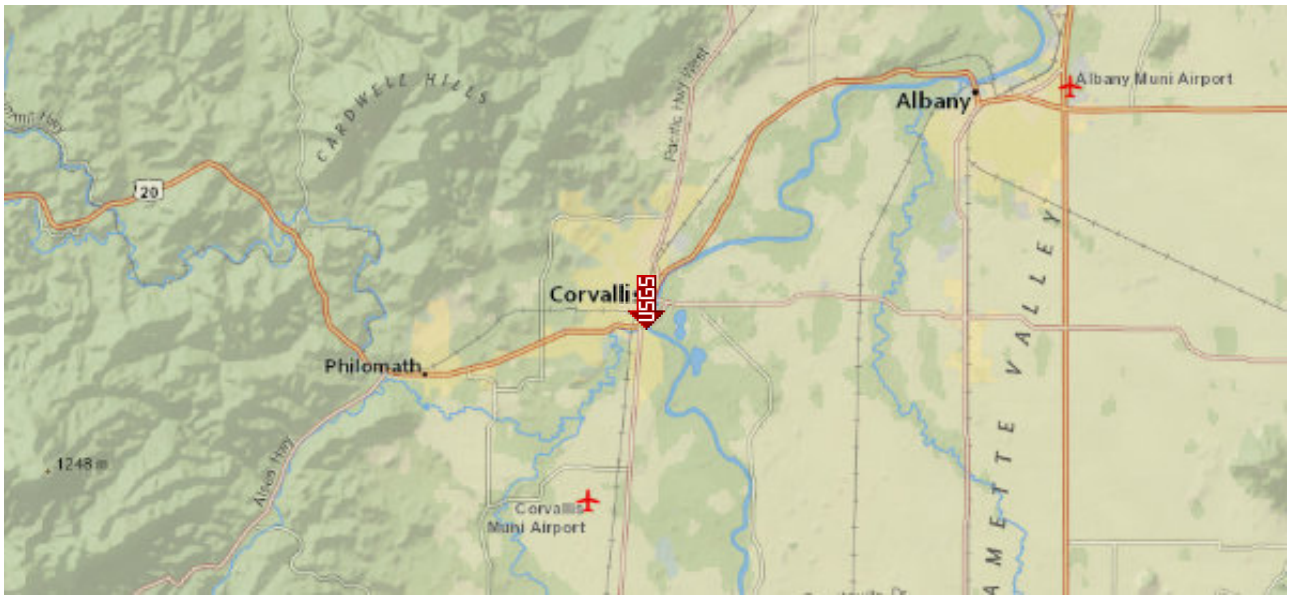
Client: Benton County Public Works

BY: ERW Ck'd: Date: 08/29/16 Page

USGS Design Maps Summary Report

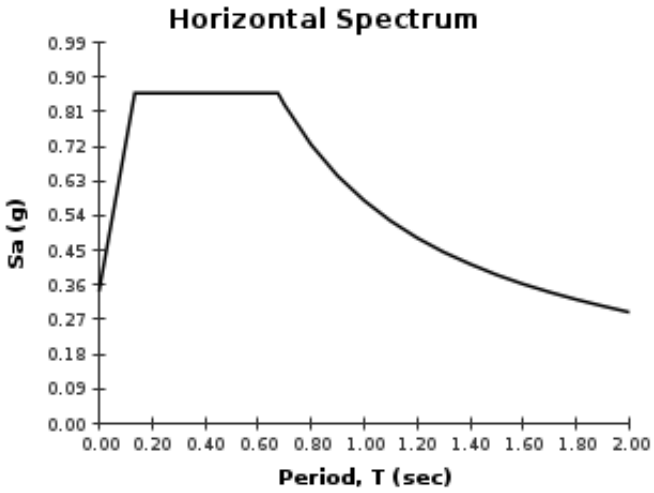
User–Specified Input

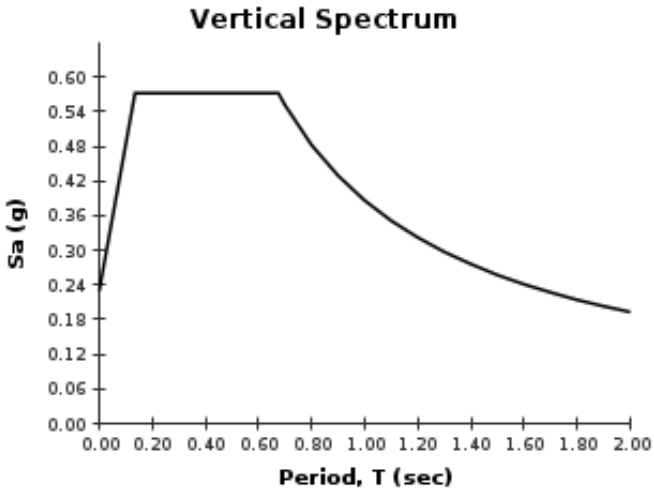
Report Title	Benton County Courthouse Thu December 10, 2015 17:15:56 UTC
Building Code Reference Document	ASCE 41-13 Retrofit Standard, BSE-2E (which utilizes USGS hazard data available in 2008)
Site Coordinates	44.56528°N, 123.26237°W
Site Soil Classification	Site Class D – "Stiff Soil"



USGS–Provided Output

$S_{S,5/50}$	0.685 g	$S_{XS,BSE-2E}$	0.858 g
$S_{1,5/50}$	0.334 g	$S_{X1,BSE-2E}$	0.579 g





Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

USGS Design Maps Summary Report

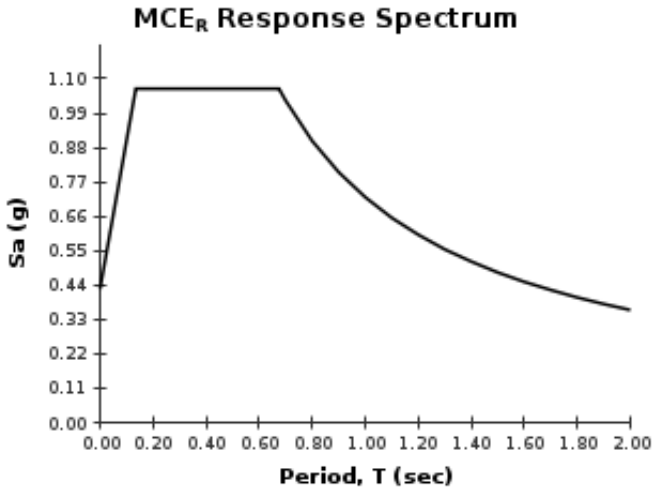
User–Specified Input

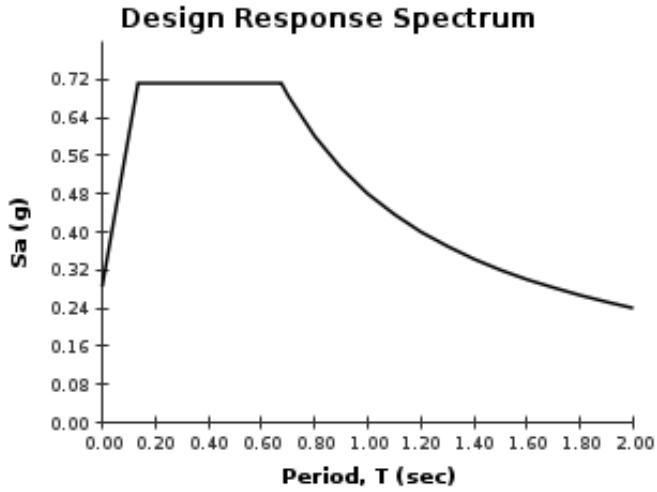
Report Title	Benton County Couthouse Wed November 18, 2015 23:04:50 UTC
Building Code Reference Document	2012 International Building Code (which utilizes USGS hazard data available in 2008)
Site Coordinates	44.56528°N, 123.26237°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	0.956 g	S_{MS} =	1.068 g	S_{DS} =	0.712 g
S_1 =	0.472 g	S_{M1} =	0.721 g	S_{D1} =	0.480 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





Benton County Courthouse SPOE Calculations:

Building Weights:

Roof Weights =	20	psf
Wood Floor =	20	psf
Light Framed =	8	psf
8" CMU =	80	psf
12" brick =	120	psf
18" brick =	180	psf
20" brick =	200	psf
30" stone =	350	psf

Building Geometries:

West =	1752	ft^2
Center =	3373	ft^2
East =	1752	ft^2
Total sq footage =	6877	ft^2
Total width =	114.50	ft
Total length =	71.50	ft
Total height =	59.50	ft

Roofs:

West =	35035	lb
Center =	67465	lb
East =	35035	lb
Sub Total =	137535	lb

Partial Floors:

Upper Foyer=	14513	lb
Speaker Floor=	9138	lb
Bell Floor=	4102	lb
Top Floor=	995	lb
Sub Total =	28747	lb

Floors:

West =	35035	lb
Center =	67465	lb
East =	35035	lb
Sub Total =	137535	lb

East Section

Width =	24.50	ft
Length =	71.50	ft
Bell Tower Lounge Height =	13.67	ft
3rd Floor Height =	14.25	ft
2nd Floor Height =	15.00	ft
1st Floor Height =	16.50	ft
Basement Floor Height =	10.50	ft

Center Section

Width =	65.50	ft
Length =	51.50	ft
4th Floor Height =	8.50	ft
3rd Floor Height =	9.00	ft

West Section

Width =	24.50	ft
Length =	71.50	ft

4th East-West Walls: (starting at north wall)

Gridline 8 =	11760	lb
GL 7 =	2180	lb
GL 6 =	42445	lb
GL 5 =	0	lb
GL 4 =	0	lb
GL 3 =	42445	lb
GL 2 =	2180	lb
GL 1 =	11760	lb
Sub Total =	112770	lb

4th North-South Walls: (starting at west wall)

Gridline A =	17160	lb
GL B =	17160	lb
GL C =	38451	lb
GL D =	12000	lb
GL E =	26451	lb
Sub Total =	111223	lb
Total =	**375763**	**lb**

3rd East-West Walls: (starting at north wall)

Gridline 8 =	41895	lb
GL 7 =	35370	lb
GL 6 =	86692	lb
GL 5 =	0	lb
GL 4 =	0	lb
GL 3 =	86692	lb
GL 2 =	35370	lb
GL 1 =	41895	lb
Sub Total =	327913	lb

3rd North-South Walls: (starting at west wall)

Gridline A =	61133	lb
GL B =	61133	lb
GL C =	96775	lb
GL D =	42750	lb
GL E =	54025	lb
Sub Total =	315815	lb
Total =	**795776**	**lb**

2nd East-West Walls: (starting at north wall)

Gridline 8 =	128993	lb
GL 7 =	172429	lb
GL 6 =	90821	lb

2nd North-South Walls: (starting at west wall)

Gridline A =	188224	lb
GL B =	188224	lb
GL C =	188224	lb

GL 5 =	0	lb
GL 4 =	0	lb
GL 3 =	90821	lb
GL 2 =	172429	lb
GL 1 =	128993	lb
Sub Total =	784485	lb

GL D =	131625	lb
GL E =	56599	lb
Sub Total =	752895	lb
Total =	**1674915**	**lb**

1st East-West Walls: (starting at north wall)

Gridline 8 =	154350	lb
GL 7 =	206325	lb
GL 6 =	108675	lb
GL 5 =	108075	lb
GL 4 =	108075	lb
GL 3 =	108675	lb
GL 2 =	206325	lb
GL 1 =	154350	lb
Sub Total =	1154850	lb

1st North-South Walls: (starting at west wall)

Gridline A =	225225	lb
GL B =	225225	lb
GL C =	225225	lb
GL D =	157500	lb
GL E =	67725	lb
Sub Total =	900900	lb
Total =	**2193285**	**lb**

Basement East-West Walls: (starting at north wall)

Gridline 8 =	162803	lb
GL 7 =	217624	lb
GL 6 =	114626	lb
GL 5 =	159165	lb
GL 4 =	159165	lb
GL 3 =	114626	lb
GL 2 =	217624	lb
GL 1 =	162803	lb
Sub Total =	1308435	lb

Basement North-South Walls: (starting at west wall)

Gridline A =	237559	lb
GL B =	191595	lb
GL C =	191595	lb
GL D =	166125	lb
GL E =	71434	lb
Sub Total =	858308	lb
Total =	**2304278**	**lb**

4.5.2.1 - Pseudo Seismic Force - for use with quick check proceedures

S_s=	68.50%	
S_1 =	33.40%	
F_a =	1.25	Table 2-3, page 46
F_v =	1.73	Table 2-4, page 46
S_{XS} =	0.86	eqn. 2-1, pg. 46
S_{X1} =	0.58	eqn. 2-2, pg. 46
C_t =	0.02	eqn. 4-5, pg. 69
h_n =	59.50	ft (roof height)
β =	0.75	eqn. 4-5, pg. 69
T =	0.428	eqn. 4-5, pg. 69
Sa =	0.86	eqn. 4-4, pg. 68

Evaluation: Life Safety

Immediate Occupancy Responses:	
S_s=	22.20%
S_1 =	9.10%
Life Safety:	
S_s=	68.50%
S_1 =	33.40%
Collapse Prevention:	
S_s=	68.50%
S_1 =	33.40%

Total Diaphragm Weight

C =	1	table 4-8, pg. 68
W_1 =	2304278	lb (lowest floor)
W_2 =	2193285	lb
W_3 =	1674915	lb
W_4 =	795776	lb
W_5 =	375763	lb

Heights of floors to base:

h_1 =	10.50	ft
h_2 =	27.00	ft
h_3 =	42.00	ft
h_4 =	51.00	ft
h_5 =	59.50	ft

W_{total} =	7344016	lb
V_{total} =	6298375	lb

4.5.2.2 - Story Shear Forces - eqn. 4-3a, pg. 68

k =	1.00		
F_1 =	703216	lb	0.36
F_2 =	1721169	lb	0.92
F_3 =	2044592	lb	1.42
F_4 =	1179575	lb	1.73
F_5 =	649823	lb	2.02
Σ =	6298375	lb	

7.4.1.3.1 - Pseudo Seismic Force for LSP (linear static proceedure)

Sa =	0.9	
C_1C_2 =	1	from Table 7-3
C_m =	1	from Table 7-4
V =	0.86	*W

Diaphragm Weights East-West Walls:

W_1 =	995843	lb (lowest floor)
W_2 =	1038435	lb
W_3 =	890430	lb
W_4 =	467863	lb
W_5 =	262992	lb
W_{total} =	3655563	lb
V_{total} =	3135084	lb

4.5.2.2 - Story Shear Forces - eqn. 4-3a, pg. 68

F_1 =	284066	lb
F_2 =	761696	lb
F_3 =	1015986	lb
F_4 =	648228	lb
F_5 =	425108	lb
Σ =	3135084	lb

Diaphragm Weights North-South Walls:

W_1 =	1445970	lb (lowest floor)
W_2 =	1292385	lb
W_3 =	922020	lb
W_4 =	479961	lb
W_5 =	264540	lb
W_{total} =	4404875	lb
V_{total} =	3777709	lb

4.5.2.2 - Story Shear Forces - eqn. 4-3a, pg. 68

F_1 =	444549	lb
F_2 =	1021709	lb
F_3 =	1133864	lb
F_4 =	716716	lb
F_5 =	460871	lb
Σ =	3777709	lb

URM Shear Wall Loads/Diaphragm Loads for Life Safety Evaluation:

Ms =	1.5	URM Wall, from Table 4-9, pg. 70
M_1 =	2.0	Straight Diaphragm (chorder), from Table 12-3
M_2 =	1.5	Straight Diaphragm (unchorder), from Table 12-4
M_3 =	2.5	Wood Diaphragm (chorder), from Table 12-3
M_4 =	2.0	Wood Diaphragm (unchorded), from Table 12-3

4th Floor / Roof	Shear (lb)	Length (ft)	v_{Total} (plf)	v_{Total} (psi)	v_{cap} (psi)		v_{dia} (plf)	v_{cap} (plf)	
Gridline 8 =	39813	49	542	4	30	OK	303	120	NG
GL 7 =	76189	66	775	5	30	OK	567	120	NG
GL 6 =	144908	20	4954	23	30	OK	434	450	OK
GL 5 =	0	0							
GL 4 =	0	0							
GL 3 =	144908	20	4954	23	30	OK	434	450	OK
GL 2 =	76189	66	775	5	30	OK	567	120	NG
GL 1 =	39813	49	542	4	30	OK	303	120	NG
Gridline A =	60063	72	560	4	30	OK	423	120	NG
GL B =	181297	72	1690	12	30	OK	1569	120	NG
GL C =	199557	72	1861	10	30	OK	1330	120	NG

GL D =	74147	50	989	7	30	OK	423	120	NG
GL E =	41194	15	1894	9	30	OK	430	300	NG
	521822	556258	268	279					

3rd Floor

	Shear (lb)	Total (lb)	Length (ft)	v_{Total} (plf)	v_{Total} (psi)	v_{cap} (psi)		v_{dia} (plf)	v_{cap} (plf)	
Gridline 8 =	81261	121074	38	2124	15	30	OK	463	300	NG
GL 7 =	143661	219850	66	2238	16	30	OK	692	450	NG
GL 6 =	239805	384714	24	10686	49	30	NG	534	450	NG
GL 5 =	0	0								
GL 4 =	0	0								
GL 3 =	239805	384714	32	7933	37	30	NG	534	450	NG
GL 2 =	143661	219850	66	2238	16	30	OK	692	450	NG
GL 1 =	81261	121074	38	2124	15	30	OK	463	300	NG
Gridline A =	122949	183012	58	2104	15	30	OK	395	450	OK
GL B =	311483	492779	67	4879	34	30	NG	1464	450	NG
GL C =	342050	541607	62	5871	31	30	NG	1241	450	NG
GL D =	135967	210114	39	3638	25	30	OK	395	450	OK
GL E =	75117	116311	16	4846	22	30	OK	536	450	NG
	929453	987566	263	241						

2nd Floor

	Shear (lb)	Total (lb)	Length (ft)	v_{Total} (plf)	v_{Total} (psi)	v_{cap} (psi)		v_{dia} (plf)	v_{cap} (plf)	
Gridline 8 =	181675	302749	38	5311	25	30	OK	725	300	NG
GL 7 =	325498	545348	47	7708	36	30	NG	1085	450	NG
GL 6 =	407204	791917	33	16160	75	30	NG	837	450	NG
GL 5 =	0	0								
GL 4 =	0	0								
GL 3 =	407204	791917	33	16160	75	30	NG	837	450	NG
GL 2 =	325498	545348	47	7708	36	30	NG	1085	450	NG
GL 1 =	181675	302749	38	5311	25	30	OK	725	300	NG
Gridline A =	272989	456002	55	5527	26	30	OK	624	450	NG
GL B =	571255	1064034	63	11319	52	30	NG	2317	450	NG
GL C =	571255	1112862	59	12628	58	30	NG	1963	450	NG
GL D =	269986	480100	39	8207	38	30	NG	624	450	NG
GL E =	94077	210388	16	8766	41	30	NG	847	450	NG
	1828753	1779562	236	231						

1st Floor

	Shear (lb)	Total (lb)	Length (ft)	v_{Total} (plf)	v_{Total} (psi)	v_{cap} (psi)		v_{dia} (plf)	v_{cap} (plf)	
Gridline 8 =	185639	488388	36	8982	37	30	NG	544	300	NG
GL 7 =	310112	855460	47	12134	51	30	NG	595	450	NG
GL 6 =	205059	996977	29	22661	94	30	NG	447	450	OK
GL 5 =	175249	175249	80	1463	6	30	OK	367	450	OK
GL 4 =	175249	175249	81	1437	6	30	OK	367	450	OK
GL 3 =	205059	996977	33	20344	85	30	NG	447	450	OK
GL 2 =	310112	855460	47	12134	51	30	NG	595	450	NG
GL 1 =	185639	488388	36	8982	37	30	NG	544	300	NG
Gridline A =	293687	749689	50	9996	46	30	NG	562	450	NG
GL B =	562450	1626484	62	17396	81	30	NG	2087	450	NG
GL C =	562450	1675312	62	18014	83	30	NG	1769	450	NG
GL D =	276637	756737	36	13886	64	30	NG	562	450	NG
GL E =	99115	309503	16	12635	58	30	NG	763	450	NG
	1752119	1794338	390	227						

Basement Floor	Shear (lb)	Total (lb)	Length (ft)	v_{Total} (plf)	v_{Total} (psi)	v_{cap} (psi)		v_{dia} (plf)	v_{cap} (plf)	
Gridline 8 =	159487	647875	36	11915	33	30	NG	203	300	OK
GL 7 =	236300	1091760	59	12301	34	30	NG	303	450	OK
GL 6 =	140022	1136998	24	31155	87	30	NG	484	450	NG
GL 5 =	167293	342542	78	2915	8	30	OK	137	450	OK
GL 4 =	167293	342542	69	3298	9	30	OK	137	450	OK
GL 3 =	140022	1136998	29	26439	73	30	NG	484	450	NG
GL 2 =	236300	1091760	62	11787	33	30	NG	303	450	OK
GL 1 =	159487	647875	36	11915	33	30	NG	203	300	OK
Gridline A =	247476	997165	60	11111	31	30	NG	245	450	OK
GL B =	324996	1951480	63	20651	57	30	NG	908	450	NG
GL C =	324996	2000308	67	19854	55	30	NG	770	450	NG
GL D =	204066	960804	39	16286	45	30	NG	245	450	OK
GL E =	79116	388619	16	16192	45	30	NG	332	450	OK
	1406206	1180651	394	245						

Foundation Design	M_{OT} (ft*lb)	M_R (ft*lb)	Uplift (lb)	250k MP
Gridline 8 =	10253228	3589560	256294.9266	1.0
GL 7 =	35839163	21075390	567837.4245	2.3
GL 6 =	47173513	8106480	1502578.182	6.0
GL 5 =	6317026.8	10076625	-144599.9298	-0.6
GL 4 =	6317026.8	10076625	-144599.9298	-0.6
GL 3 =	47173513	8106480	1502578.182	6.0
GL 2 =	35839163	21075390	567837.4245	2.3
GL 1 =	10253228	3589560	256294.9266	1.0
				0.0
Gridline A =	31339183	27146047.5	161274.4354	0.6
GL B =	34144162	4163040	1070754.37	4.3
GL C =	35454671	4163040	1117558.245	4.5
GL D =	15908494	4163040	419480.5093	1.7
GL E =	14372659	4228380	390164.5789	1.6

Section 16.1.2 Basic Configuration - Life Safety (Tier 1 evaluations)

Life Safety

Adjacent Building, Sect. 5.4.1.1

Taller Building =	59.50	ft
Shorter Building =	10	ft
Clear Distance =	4.80	inch

Weak Story, Sect. 5.4.2.1

Basement SW (NS) =	245.33	ft	108% of story above
1st Floor SW (NS) =	226.99	ft	98% of story above
2nd Floor SW (NS) =	231.42	ft	96% of story above
3rd Floor SW (NS) =	241.33	ft	86% of story above
4th Floor SW (NS) =	279.00	ft	
Basement SW (EW) =	394.00	ft	101% of story above
1st Floor SW (EW) =	389.66	ft	165% of story above
2nd Floor SW (EW) =	235.67	ft	89% of story above
3rd Floor SW (EW) =	263.33	ft	98% of story above
4th Floor SW (EW) =	268.00	ft	

Change in Building Mass, Sect. 5.4.2.5

Basement Mass =	2304278	lbs	105% of story above
1st Floor Mass =	2193285	lbs	131% of story above
2nd Floor Mass =	1674915	lbs	210% of story above
3rd Floor Mass =	795776	lbs	212% of story above
4th Floor Mass =	375763	lbs	

Foundation - Overturning, Sect. 5.4.3.3

Basement SW (NS) =	71.5	ft	
b/h Ratio (NS) =	1.20		
Basement SW (EW) =	113.5	ft	
b/h Ratio (EW) =	1.91		
0.6 x Sa =	0.51		**< MIN b/h ratio of 1.2 OK**

Section 16.16 URM Bearing Walls - Life Safety Evaluation

Wall Shear Stress Check - Shear Stress in Shear Walls, Sect. 4.5.3.3

Tier 1 Quick Check - see previous pages for shear wall loading

Tier 2 - Shear Wall Capacities - Sect. 7.5.1.5

m =	3.0	from Table 11-3 for Life Safety
K =	0.75	from 11.2.4
F_m =	600	PSI, from Table 11-2(a)
F_t =	45	PSI, from Table 11-2(a)
F_v =	78.38367	PSI per shear area, 80% of TMS 402, Section 3.2.4
E_m =	420000	PSI, per TMS 402, Section 1.8.2.2
G_m =	168000	PSI, per TMS 402, Section 1.8.2.2

Check 3rd Floor Gridline 3:

Total Wall Load=	384714	lb				
Wall height =	14.25	ft		14.25	ft	
Pier height =	8.00	ft		8.00	ft	
Pier length =	11.5	ft		21.25	ft	
Pier thickness =	1.33	ft		1.33	ft	
L / h_{eff} =	0.81	for (11-12)		1.49		
Trib DL P_D =	23464.6	lb		43358.5	lb	
Pier SW P_W =	29497.5	lb		54506.25	lb	
Wall Rigidity =	181027			483802		
Load to Pier =	104754.2	9109.064		279959.4	13174.56	384713.6
Shear Stress=	48	psi		69	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0		
LB Bed-Joint V_{mL} =	43	psi, 11.2.3.6.3 (11-6)		43	psi	
In-plane V_{bjs1} =	94325	lb, 11.3.2.2.2 (11-9)		174297	lb	
In-plane V_{bjs2} =	11732	lb, 11.3.2.2.2 (11-10)		21679	lb	
Rocking V_r =	27755	lb, 11.3.2.2.1 (11-8)		94768	lb	
Lower Bound V_{tc} =	29073	lb, 11.3.2.2.3 (11-11)		99269	lb	
Lower Bound V_{dt} =	102545	lb, 11.3.2.2.4 (11-12)		217800	lb	
Lower Bound P_{CL} =	898612	lb, 11.3.2.2.5 (11-13)		1660478	lb	
Controlling Q_{CE} =	11732	lb		21679	lb	
Allowable Stress=	12	psi **NG**		12	psi **NG**	
DCR =	3.97	6813.614	DCR =	5.74	10879.11	

Check 3rd Floor Gridline 6:

Total Wall Load=	384714	lb
Wall height =	14.25	ft
Pier height =	8.00	ft
Pier length =	24	ft
Pier thickness =	1.33	ft
L / h_{eff} =	1.68	for (11-12)
Trib DL P_D =	48969.6	lb
Pier SW P_W =	61560	lb
Wall Rigidity =	569140	
Load to Pier =	384713.6	16029.73
Shear Stress=	84	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1
LB Bed-Joint V_{mL} =	43	psi, 11.2.3.6.3 (11-6)
In-plane V_{bjs1} =	196853	lb, 11.3.2.2.2 (11-9)
In-plane V_{bjs2} =	24485	lb, 11.3.2.2.2 (11-10)
Rocking V_r =	120884	lb, 11.3.2.2.1 (11-8)
Lower Bound V_{tc} =	126625	lb, 11.3.2.2.3 (11-11)

Lower Bound V_{dt} =	214008	lb, 11.3.2.2.4 (11-12)									
Lower Bound P_{CL} =	1875364	lb, 11.3.2.2.5 (11-13)									
Controlling Q_{CE} =	24485	lb									
Allowable Stress=	12	psi	**NG**								
DCR =	6.98	13734.28									

Check 3rd Floor Gridline B:

Total Wall Load=	492779	lb									
Wall height =	15.00	ft			15.00	ft					
Pier height =	8.00	ft			8.00	ft					
Pier length =	33.67	ft			33.67	ft					
Pier thickness =	1	ft			1	ft					
L / h_{eff} =	2.24	for (11-12)			2.24						
Trib DL P_D =	14814.8	lb			14814.8	lb					
Pier SW P_W =	90909	lb			90909	lb					
Wall Rigidity =	648494				648494						
Load to Pier =	246389.6	7317.778			246389.6	7317.778					
Shear Stress=	51	psi			51	psi					
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1			1.0						
LB Bed-Joint V_{mL} =	39	psi, 11.2.3.6.3 (11-6)			39	psi					
In-plane V_{bjs1} =	189225	lb, 11.3.2.2.2 (11-9)			189225	lb					
In-plane V_{bjs2} =	7407	lb, 11.3.2.2.2 (11-10)			7407	lb					
Rocking V_r =	121756	lb, 11.3.2.2.1 (11-8)			121756	lb					
Lower Bound V_{tc} =	128261	lb, 11.3.2.2.3 (11-11)			128261	lb					
Lower Bound V_{dt} =	174822	lb, 11.3.2.2.4 (11-12)			214983	lb					
Lower Bound P_{CL} =	1978180	lb, 11.3.2.2.5 (11-13)			1978180	lb					
Controlling Q_{CE} =	7407	lb			7407	lb					
Allowable Stress=	3	psi	**NG**		3	psi	**NG**				
DCR =	14.78	6822.778		DCR =	14.78	6822.778					

Check 3rd Floor Gridline C:

Total Wall Load=	541607	lb													
Wall height =	15.00	ft			15.00	ft			15.00	ft			16.50	ft	
Pier height =	8.00	ft			8.00	ft			8.00	ft			8.00	ft	
Pier length =	10.75	ft			10.75	ft			20	ft			20	ft	
Pier thickness =	1.33	ft			1.33	ft			1.33	ft			1.33	ft	
L / h_{eff} =	0.72	for (11-12)			0.72				1.33				1.21		
Trib DL P_D =	4730	lb			4730	lb			8800	lb			8800	lb	
Pier SW P_W =	29025	lb			29025	lb			54000	lb			59400	lb	
Wall Rigidity =	159190				159190				444745				444745		
Load to Pier =	71380.37	6640.034			71380.37	6640.034			199423.1	9971.157			199423.1	9971.157	
Shear Stress=	35	psi			35	psi			52	psi			52	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1			1.0				1.0				1.0		
LB Bed-Joint V_{mL} =	39	psi, 11.2.3.6.3 (11-6)			39	psi			39	psi			39	psi	
In-plane V_{bjs1} =	79572	lb, 11.3.2.2.2 (11-9)			79572	lb			148040	lb			148040	lb	
In-plane V_{bjs2} =	2365	lb, 11.3.2.2.2 (11-10)			2365	lb			4400	lb			4400	lb	
Rocking V_r =	12411	lb, 11.3.2.2.1 (11-8)			12411	lb			42960	lb			42000	lb	
Lower Bound V_{tc} =	13252	lb, 11.3.2.2.3 (11-11)			13252	lb			45870	lb			44688	lb	
Lower Bound V_{dt} =	70271	lb, 11.3.2.2.4 (11-12)			86414	lb			176671	lb			178919	lb	
Lower Bound P_{CL} =	840007	lb, 11.3.2.2.5 (11-13)			840007	lb			1562803	lb			1562803	lb	
Controlling Q_{CE} =	2365	lb			2365	lb			4400	lb			4400	lb	
Allowable Stress=	3	psi	**NG**		3	psi	**NG**		3	psi	**NG**		3	**NG**	
DCR =	13.41	6145.034		DCR =	13.41	6145.034		DCR =	20.14	9476.157		DCR =	20.14	9476.157	

Check 2nd Floor Gridline 2 (& 7):

Total Wall Load=	545348	lb													
Wall height =	16.50	ft			16.50	ft			16.50	ft			16.50	ft	
Pier height =	10.00	ft			10.00	ft			10.00	ft			10.00	ft	

Pier length =	7.167	ft	(3) at	7.5	ft		8.5	ft		8.83	ft	
Pier thickness =	1.83	ft		1.83	ft		1.83	ft		1.86	ft	
L / h_{eff} =	0.43	for (11-12)		0.45			0.52			0.54		
Trib DL P_D =	11252.19	lb		11775	lb		13345	lb		13863.1	lb	
Pier SW P_W =	21285.99	lb		22275	lb		25245	lb		26225.1	lb	
Wall Rigidity =	53547		(3) at	59977	lb for (3) piers		81295			90403		
Load to Pier =	72071.9	10056.08		242179.6	10763.54		109418.2	12872.73		121678.1	13780.08	
Shear Stress=	38	psi		41	psi / pier		49	psi		51	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0		
LB Bed-Joint V_{mL} =	40	psi, 11.2.3.6.3 (11-6)		40	psi		40	psi		40	psi	
In-plane V_{bjs1} =	76450	lb, 11.3.2.2.2 (11-9)		80003	lb		90670	lb		95620	lb	
In-plane V_{bjs2} =	5626	lb, 11.3.2.2.2 (11-10)		5888	lb		6673	lb		6932	lb	
Rocking V_r =	8559	lb, 11.3.2.2.1 (11-8)		9373	lb		12039	lb		12992	lb	
Lower Bound V_{tc} =	9120	lb, 11.3.2.2.3 (11-11)		9988	lb		12828	lb		13853	lb	
Lower Bound V_{dt} =	79414	lb, 11.3.2.2.4 (11-12)		95522	lb		108258	lb		113914	lb	
Lower Bound P_{CL} =	770568	lb, 11.3.2.2.5 (11-13)		806371	lb		913887	lb		964931	lb	
Controlling Q_{CE} =	5626	lb		5888	lb		6673	lb		6932	lb	
Allowable Stress=	7	psi **NG**		7	psi **NG**		7	psi **NG**		7	**NG**	
DCR =	5.69	8289.827	DCR =	6.09	8997.289	DCR =	7.29	11106.48	DCR =	7.80	12013.83	

Check 2nd Floor Gridline 3:

Total Wall Load=	791917	lb			
Wall height =	15.00	ft	15.00	ft	
Pier height =	8.00	ft	8.00	ft	
Pier length =	11.5	ft	21.25	ft	
Pier thickness =	1.5	ft	1.5	ft	
L / h_{eff} =	0.77	for (11-12)	1.42		
Trib DL P_D =	55262.1	lb	102114.8	lb	
Pier SW P_W =	31050	lb	57375	lb	
Wall Rigidity =	204166		545641		
Load to Pier =	215632.3	18750.63	576284.9	27119.29	791917.2
Shear Stress=	87	psi	126	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1	1.0		
LB Bed-Joint V_{mL} =	49	psi, 11.2.3.6.3 (11-6)	49	psi	
In-plane V_{bjs1} =	120781	lb, 11.3.2.2.2 (11-9)	223182	lb	
In-plane V_{bjs2} =	27631	lb, 11.3.2.2.2 (11-10)	51057	lb	
Rocking V_r =	48843	lb, 11.3.2.2.1 (11-8)	166773	lb	
Lower Bound V_{tc} =	49780	lb, 11.3.2.2.3 (11-11)	169973	lb	
Lower Bound V_{dt} =	137595	lb, 11.3.2.2.4 (11-12)	292242	lb	
Lower Bound P_{CL} =	1013472	lb, 11.3.2.2.5 (11-13)	1872720	lb	
Controlling Q_{CE} =	27631	lb	51057	lb	
Allowable Stress=	25	psi **NG**	25	psi **NG**	
DCR =	3.47	13344.56	DCR = 5.02	21713.21	

Check 2nd Floor Gridline 6:

Total Wall Load=	791917	lb			
Wall height =	15.00	ft	15.00	ft	
Pier height =	8.00	ft	8.00	ft	
Pier length =	9.5	ft	23.33	ft	
Pier thickness =	1.5	ft	1.5	ft	
L / h_{eff} =	0.63	for (11-12)	1.56		
Trib DL P_D =	45651.3	lb	112110	lb	
Pier SW P_W =	25650	lb	62991	lb	
Wall Rigidity =	140188		618528		
Load to Pier =	146323	15402.42	645594.2	27672.27	791917.2
Shear Stress=	71	psi	128	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1	1.0		

LB Bed-Joint V_{mL} =	49	psi, 11.2.3.6.3 (11-6)		49	psi				
In-plane V_{bjs1} =	99776	lb, 11.3.2.2.2 (11-9)		245028	lb				
In-plane V_{bjs2} =	22826	lb, 11.3.2.2.2 (11-10)		56055	lb				
Rocking V_r =	33331	lb, 11.3.2.2.1 (11-8)		201019	lb				
Lower Bound V_{tc} =	33971	lb, 11.3.2.2.3 (11-11)		204876	lb				
Lower Bound V_{dt} =	113665	lb, 11.3.2.2.4 (11-12)		320848	lb				
Lower Bound P_{CL} =	837216	lb, 11.3.2.2.5 (11-13)		2056026	lb				
Controlling Q_{CE} =	22826	lb		56055	lb				
Allowable Stress=	25	psi	**NG**	25	psi	**NG**			
DCR =	2.85	9996.346	DCR =	5.12	22266.2				

Check 2nd Floor Gridline B:

Total Wall Load=	1064034	lb							
Wall height =	15.00	ft		15.00	ft		15.00	ft	
Pier height =	8.00	ft		8.00	ft		8.00	ft	
Pier length =	17.833	ft		18.75	ft		24	ft	
Pier thickness =	1.33	ft		1.33	ft		1.33	ft	
L / h_{eff} =	1.19	for (11-12)		1.25			1.60		
Trib DL P_D =	30672.76	lb		32250	lb		41280	lb	
Pier SW P_W =	48149.1	lb		50625	lb		64800	lb	
Wall Rigidity =	376760			405560			569140		
Load to Pier =	296631.7	16633.86		319306.1	17029.66		448096.2	18670.68	1064034
Shear Stress=	87	psi		89	psi		97	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0		
LB Bed-Joint V_{mL} =	42	psi, 11.2.3.6.3 (11-6)		42	psi		42	psi	
In-plane V_{bjs1} =	143413	lb, 11.3.2.2.2 (11-9)		150788	lb		193008	lb	
In-plane V_{bjs2} =	15336	lb, 11.3.2.2.2 (11-10)		16125	lb		20640	lb	
Rocking V_r =	58579	lb, 11.3.2.2.1 (11-8)		64758	lb		106099	lb	
Lower Bound V_{tc} =	61511	lb, 11.3.2.2.3 (11-11)		67999	lb		111410	lb	
Lower Bound V_{dt} =	132109	lb, 11.3.2.2.4 (11-12)		170812	lb		240263	lb	
Lower Bound P_{CL} =	1393473	lb, 11.3.2.2.5 (11-13)		1465128	lb		1875364	lb	
Controlling Q_{CE} =	15336	lb		16125	lb		20640	lb	
Allowable Stress=	10	psi	**NG**	10	psi	**NG**	10	psi	**NG**
DCR =	8.60	14698.86	DCR =	8.80	15094.66	DCR =	9.65	16735.68	

Check 2nd Floor Gridline C:

Total Wall Load=	1112862	lb							
Wall height =	15.00	ft		15.00	ft		15.00	ft	
Pier height =	8.00	ft		8.00	ft		8.00	ft	
Pier length =	16.33	ft		19	ft		19	ft	
Pier thickness =	1.5	ft		1.33	ft		1.33	ft	
L / h_{eff} =	1.09	for (11-12)		1.27			1.27		
Trib DL P_D =	28087.6	lb		32680	lb		32680	lb	
Pier SW P_W =	44091	lb		51300	lb		51300	lb	
Wall Rigidity =	371674			413405			413405		
Load to Pier =	345120.6	21134.14		383870.6	20203.72		383870.6	20203.72	1112862
Shear Stress=	98	psi		105	psi		105	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0		
LB Bed-Joint V_{mL} =	41	psi, 11.2.3.6.3 (11-6)		42	psi		42	psi	
In-plane V_{bjs1} =	146317	lb, 11.3.2.2.2 (11-9)		152798	lb		152798	lb	
In-plane V_{bjs2} =	14044	lb, 11.3.2.2.2 (11-10)		16340	lb		16340	lb	
Rocking V_r =	49120	lb, 11.3.2.2.1 (11-8)		66496	lb		66496	lb	
Lower Bound V_{tc} =	51919	lb, 11.3.2.2.3 (11-11)		69825	lb		69825	lb	
Lower Bound V_{dt} =	132312	lb, 11.3.2.2.4 (11-12)		173090	lb		190208	lb	
Lower Bound P_{CL} =	1439130	lb, 11.3.2.2.5 (11-13)		1484663	lb		1484663	lb	
Controlling Q_{CE} =	14044	lb		16340	lb		16340	lb	

Allowable Stress=	9	psi	**NG**		10	psi	**NG**		10	psi	**NG**	
DCR =	10.92	19199.14		DCR =	10.44	18268.72		DCR =	10.44	18268.72		

Check 2nd Floor Gridline D:

Total Wall Load=	480100	lb										
Wall height =	16.50	ft			16.50	ft			16.50	ft		16.50	ft
Pier height =	10.00	ft			10.00	ft			10.00	ft		10.00	ft
Pier length =	9	ft			9	ft			9.25	ft		9.25	ft
Pier thickness =	1.83	ft			1.83	ft			1.83	ft		1.83	ft
L / h_{eff} =	0.55	for (11-12)			0.55				0.56			0.56	
Trib DL P_D =	15480	lb			15480	lb			15910	lb		15910	lb
Pier SW P_W =	26730	lb			26730	lb			27472.5	lb		27472.5	lb
Wall Rigidity =	92997				92997				99089			99089	
Load to Pier =	116219	12913.22			116219	12913.22			123831.1	13387.15		123831.1	13387.15
Shear Stress=	49	psi			49	psi			51	psi		51	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1			1.0				1.0			1.0	
LB Bed-Joint V_{mL} =	41	psi, 11.2.3.6.3 (11-6)			41	psi			41	psi		41	psi
In-plane V_{bjs1} =	96678	lb, 11.3.2.2.2 (11-9)			96678	lb			99364	lb		99364	lb
In-plane V_{bjs2} =	7740	lb, 11.3.2.2.2 (11-10)			7740	lb			7955	lb		7955	lb
Rocking V_r =	14160	lb, 11.3.2.2.1 (11-8)			14160	lb			14958	lb		14958	lb
Lower Bound V_{tc} =	15067	lb, 11.3.2.2.3 (11-11)			15067	lb			15916	lb		15916	lb
Lower Bound V_{dt} =	105448	lb, 11.3.2.2.4 (11-12)			113559	lb			119096	lb		119096	lb
Lower Bound P_{CL} =	967645	lb, 11.3.2.2.5 (11-13)			967645	lb			994524	lb		994524	lb
Controlling Q_{CE} =	7740	lb			7740	lb			7955	lb		7955	lb
Allowable Stress=	7	psi	**NG**		7	psi	**NG**		7	psi	**NG**	7	**NG**
DCR =	6.67	10978.22		DCR =	6.67	10978.22		DCR =	6.92	11452.15	DCR =	6.92	11452.15

Check 2nd Floor Gridline E:

Total Wall Load=	210388	lb				
Wall height =	16.50	ft		16.50	ft	
Pier height =	10.00	ft		10.00	ft	
Pier length =	8.25	ft		8.25	ft	
Pier thickness =	1.83	ft		1.83	ft	
L / h_{eff} =	0.50	for (11-12)		0.50		
Trib DL P_D =	39644.55	lb		39644.55	lb	
Pier SW P_W =	24502.5	lb		24502.5	lb	
Wall Rigidity =	75695			75695		
Load to Pier =	105194	12750.79		105194	12750.79	210388
Shear Stress=	48	psi		48	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0		
LB Bed-Joint V_{mL} =	47	psi, 11.2.3.6.3 (11-6)		47	psi	
In-plane V_{bjs1} =	101349	lb, 11.3.2.2.2 (11-9)		101349	lb	
In-plane V_{bjs2} =	19822	lb, 11.3.2.2.2 (11-10)		19822	lb	
Rocking V_r =	23353	lb, 11.3.2.2.1 (11-8)		23353	lb	
Lower Bound V_{tc} =	24125	lb, 11.3.2.2.3 (11-11)		24125	lb	
Lower Bound V_{dt} =	112674	lb, 11.3.2.2.4 (11-12)		129510	lb	
Lower Bound P_{CL} =	887008	lb, 11.3.2.2.5 (11-13)		887008	lb	
Controlling Q_{CE} =	19822	lb		19822	lb	
Allowable Stress=	21	psi	**NG**	21	psi	**NG**
DCR =	2.36	7344.711	DCR =	2.36	7344.711	

Check 1st Floor Gridline 1 (& 8):

Total Wall Load=	488388	lb										
Wall height =	16.50	ft			16.50	ft			16.50	ft		16.50	ft
Pier height =	10.00	ft			10.00	ft			10.00	ft		10.00	ft
Pier length =	4.25	ft		(3) at	7.5	ft			4.25	ft		7.5	ft
Pier thickness =	1.83	ft			1.83	ft			1.83	ft		1.86	ft
L / h_{eff} =	0.26	for (11-12)			0.45				0.26			0.45	

Trib DL P_D =	19210	lb		33900	lb		19210	lb		33900	lb
Pier SW P_W =	12622.5	lb		22275	lb		12622.5	lb		22275	lb
Wall Rigidity =	13254		(3) at	59977	lb for (3) piers		13254			60961	
Load to Pier =	24207.81	5695.955		328632.2	14605.88		24207.81	5695.955		111339.9	14845.32
Shear Stress=	22	psi		55	psi / pier		22	psi		55	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0	
LB Bed-Joint V_{mL} =	46	psi, 11.2.3.6.3 (11-6)		46	psi		46	psi		46	psi
In-plane V_{bjs1} =	51604	lb, 11.3.2.2.2 (11-9)		91065	lb		51604	lb		92280	lb
In-plane V_{bjs2} =	9605	lb, 11.3.2.2.2 (11-10)		16950	lb		9605	lb		16950	lb
Rocking V_r =	5916	lb, 11.3.2.2.1 (11-8)		18424	lb		5916	lb		18424	lb
Lower Bound V_{tc} =	6129	lb, 11.3.2.2.3 (11-11)		19086	lb		6129	lb		19109	lb
Lower Bound V_{dt} =	57087	lb, 11.3.2.2.4 (11-12)		115795	lb		65617	lb		117045	lb
Lower Bound P_{CL} =	456944	lb, 11.3.2.2.5 (11-13)		806371	lb		456944	lb		819590	lb
Controlling Q_{CE} =	5916	lb		16950	lb		5916	lb		16950	lb
Allowable Stress=	12	psi **NG**		19	psi **NG**		12	psi **NG**		19	**NG**
DCR =	1.82	2563.802	DCR =	2.87	9520.875	DCR =	1.82	2563.802	DCR =	2.92	9760.316

Check 1st Floor Gridline 2 (& 7):

Total Wall Load=	855460	lb									
Wall height =	16.50	ft		16.50	ft		16.50	ft		16.50	ft
Pier height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft
Pier length =	7.167	ft	(3) at	7.5	ft		8.5	ft		8.83	ft
Pier thickness =	1.83	ft		1.83	ft		1.83	ft		1.86	ft
L / h_{eff} =	0.43	for (11-12)		0.45			0.52			0.54	
Trib DL P_D =	32394.84	lb		33900	lb		38420	lb		39911.6	lb
Pier SW P_W =	21285.99	lb		22275	lb		25245	lb		26225.1	lb
Wall Rigidity =	53547		(3) at	59977			81295			90403	
Load to Pier =	113055.6	15774.47		379895.1	16884.23		171638.9	20192.82		190870.4	21616.12
Shear Stress=	60	psi		64	psi / pier		77	psi		81	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0	
LB Bed-Joint V_{mL} =	46	psi, 11.2.3.6.3 (11-6)		46	psi		46	psi		46	psi
In-plane V_{bjs1} =	87022	lb, 11.3.2.2.2 (11-9)		91065	lb		103207	lb		108644	lb
In-plane V_{bjs2} =	16197	lb, 11.3.2.2.2 (11-10)		16950	lb		19210	lb		19956	lb
Rocking V_r =	16825	lb, 11.3.2.2.1 (11-8)		18424	lb		23665	lb		25538	lb
Lower Bound V_{tc} =	17429	lb, 11.3.2.2.3 (11-11)		19086	lb		24515	lb		26487	lb
Lower Bound V_{dt} =	96268	lb, 11.3.2.2.4 (11-12)		115795	lb		131234	lb		137800	lb
Lower Bound P_{CL} =	770568	lb, 11.3.2.2.5 (11-13)		806371	lb		913887	lb		964931	lb
Controlling Q_{CE} =	16197	lb		16950	lb		19210	lb		19956	lb
Allowable Stress=	19	psi **NG**		19	psi **NG**		19	psi **NG**		19	**NG**
DCR =	3.10	10689.47	DCR =	3.32	11799.23	DCR =	3.97	15107.82	DCR =	4.25	16531.12

Check 1st Floor Gridline 3:

Total Wall Load=	996977	lb			
Wall height =	16.50	ft	16.50	ft	
Pier height =	10.00	ft	10.00	ft	
Pier length =	11.5	ft	21.25	ft	
Pier thickness =	1.83	ft	1.83	ft	
L / h_{eff} =	0.70	for (11-12)	1.29		
Trib DL P_D =	88612.1	lb	163739.8	lb	
Pier SW P_W =	34155	lb	63112.5	lb	
Wall Rigidity =	159992		482388		
Load to Pier =	248308.8	21592.07	748667.7	35231.42	996976.5
Shear Stress=	82	psi	134	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1	1.0		
LB Bed-Joint V_{mL} =	52	psi, 11.2.3.6.3 (11-6)	52	psi	
In-plane V_{bjs1} =	157949	lb, 11.3.2.2.2 (11-9)	291862	lb	
In-plane V_{bjs2} =	44306	lb, 11.3.2.2.2 (11-10)	81870	lb	

Rocking V_r =	66296	lb, 11.3.2.2.1 (11-8)		226366	lb	
Lower Bound V_{tc} =	66557	lb, 11.3.2.2.3 (11-11)		227258	lb	
Lower Bound V_{dt} =	183194	lb, 11.3.2.2.4 (11-12)		389093	lb	
Lower Bound P_{CL} =	1236436	lb, 11.3.2.2.5 (11-13)		2284718	lb	
Controlling Q_{CE} =	44306	lb		81870	lb	
Allowable Stress=	33	psi	**NG**	33	psi	**NG**
DCR =	2.49	12923.5	DCR =	4.06	26562.85	

Check 1st Floor Gridline 6:

Total Wall Load=	996977	lb
Wall height =	16.50	ft
Pier height =	10.00	ft
Pier length =	29.25	ft
Pier thickness =	1.83	ft
L / h_{eff} =	1.77	for (11-12)
Trib DL P_D =	225383	lb
Pier SW P_W =	86872.5	lb
Wall Rigidity =	757585	
Load to Pier =	996976.5	34084.67
Shear Stress=	129	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1
LB Bed-Joint V_{mL} =	52	psi, 11.2.3.6.3 (11-6)
In-plane V_{bjs1} =	401740	lb, 11.3.2.2.2 (11-9)
In-plane V_{bjs2} =	112691	lb, 11.3.2.2.2 (11-10)
Rocking V_r =	428889	lb, 11.3.2.2.1 (11-8)
Lower Bound V_{tc} =	430579	lb, 11.3.2.2.3 (11-11)
Lower Bound V_{dt} =	535575	lb, 11.3.2.2.4 (11-12)
Lower Bound P_{CL} =	3144848	lb, 11.3.2.2.5 (11-13)
Controlling Q_{CE} =	112691	lb
Allowable Stress=	33	psi **NG**
DCR =	3.93	25416.09

Check 1st Floor Gridline A:

Total Wall Load=	749689	lb								
Wall height =	16.50	ft	16.50	ft		16.50	ft		16.50	ft
Pier height =	10.00	ft	10.00	ft		10.00	ft		10.00	ft
Pier length =	9.25	ft	10	ft		10	ft	(2) at	12.25	ft
Pier thickness =	1.83	ft	1.83	ft		1.83	ft		1.83	ft
L / h_{eff} =	0.56	for (11-12)	0.61			0.61			0.74	
Trib DL P_D =	42735	lb	46200	lb		46200	lb		56595	lb
Pier SW P_W =	27472.5	lb	29700	lb		29700	lb		36382.5	lb
Wall Rigidity =	99089		118246			118246		(2) at	182272	
Load to Pier =	106103.4	11470.64	126617.2	12661.72		126617.2	12661.72		390350.8	31865.37
Shear Stress=	44	psi	48	psi		48	psi		60	psi / pier
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1	1.0			1.0			1.0	
LB Bed-Joint V_{mL} =	46	psi, 11.2.3.6.3 (11-6)	46	psi		46	psi		46	psi
In-plane V_{bjs1} =	112776	lb, 11.3.2.2.2 (11-9)	121920	lb		121920	lb		149352	lb
In-plane V_{bjs2} =	21368	lb, 11.3.2.2.2 (11-10)	23100	lb		23100	lb		28298	lb
Rocking V_r =	28492	lb, 11.3.2.2.1 (11-8)	33300	lb		33300	lb		49971	lb
Lower Bound V_{tc} =	29487	lb, 11.3.2.2.3 (11-11)	34463	lb		34463	lb		51716	lb
Lower Bound V_{dt} =	106303	lb, 11.3.2.2.4 (11-12)	141323	lb		155300	lb		190243	lb
Lower Bound P_{CL} =	994524	lb, 11.3.2.2.5 (11-13)	1075162	lb		1075162	lb		1317073	lb
Controlling Q_{CE} =	21368	lb	23100	lb		23100	lb		28298	lb
Allowable Stress=	20	psi **NG**	20	psi	**NG**	20	psi	**NG**	20	**NG**
DCR =	2.21	6273.137	DCR = 2.44	7464.221	DCR =	2.44	7464.221	DCR =	3.07	21470.37

Check 1st Floor Gridline B:

Total Wall Load=	1626484	lb

Wall height =	16.50	ft		16.50	ft		16.50	ft		16.50	ft	
Pier height =	8.00	ft		9.00	ft		8.00	ft		9.00	ft	
Pier length =	11.5	ft		14.25	ft		16.83	ft		19.75	ft	
Pier thickness =	1.83	ft		1.83	ft		1.83	ft		1.83	ft	
L / h_{eff} =	0.70	for (11-12)		0.86			1.02			1.20		
Trib DL P_D =	53130	lb		65835	lb		77754.6	lb		91245	lb	
Pier SW P_W =	34155	lb		42322.5	lb		49985.1	lb		58657.5	lb	
Wall Rigidity =	249083			297138			475040			506405		
Load to Pier =	265194.6	23060.4		316358.8	22200.62		505768.7	30051.61		539161.7	27299.33	
Shear Stress=	88	psi		84	psi		114	psi		104	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0		
LB Bed-Joint V_{mL} =	46	psi, 11.2.3.6.3 (11-6)		46	psi		46	psi		46	psi	
In-plane V_{bjs1} =	140208	lb, 11.3.2.2.2 (11-9)		173736	lb		205191	lb		240792	lb	
In-plane V_{bjs2} =	26565	lb, 11.3.2.2.2 (11-10)		32918	lb		38877	lb		45623	lb	
Rocking V_r =	44039	lb, 11.3.2.2.1 (11-8)		67620	lb		94322	lb		129891	lb	
Lower Bound V_{tc} =	45577	lb, 11.3.2.2.3 (11-11)		69981	lb		97615	lb		134426	lb	
Lower Bound V_{dt} =	132161	lb, 11.3.2.2.4 (11-12)		201386	lb		261371	lb		306718	lb	
Lower Bound P_{CL} =	1236436	lb, 11.3.2.2.5 (11-13)		1532105	lb		1809497	lb		2123444	lb	
Controlling Q_{CE} =	26565	lb		32918	lb		38877	lb		45623	lb	
Allowable Stress=	20	psi	**NG**	20	psi	**NG**	20	psi	**NG**	20	**NG**	
DCR =	4.44	17862.9	DCR =	4.27	17003.12	DCR =	5.78	24854.11	DCR =	5.25	22101.83	

Check 1st Floor Gridline C:

Total Wall Load=	1675312	lb										
Wall height =	16.50	ft		16.50	ft		16.50	ft		16.50	ft	
Pier height =	8.00	ft		9.00	ft		8.00	ft		9.00	ft	
Pier length =	14.25	ft		15.25	ft		15.5	ft		17	ft	
Pier thickness =	1.83	ft		1.83	ft		1.83	ft		1.83	ft	
L / h_{eff} =	0.86	for (11-12)		0.92			0.94			1.03		
Trib DL P_D =	65835	lb		70455	lb		71610	lb		78540	lb	
Pier SW P_W =	42322.5	lb		45292.5	lb		46035	lb		50490	lb	
Wall Rigidity =	364047			334521			417652			400927		
Load to Pier =	401998.9	28210.45		369395.6	24222.66		461192.9	29754.38		442724.2	26042.6	
Shear Stress=	107	psi		92	psi		113	psi		99	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0		
LB Bed-Joint V_{mL} =	46	psi, 11.2.3.6.3 (11-6)		46	psi		46	psi		46	psi	
In-plane V_{bjs1} =	173736	lb, 11.3.2.2.2 (11-9)		185928	lb		188976	lb		207264	lb	
In-plane V_{bjs2} =	32918	lb, 11.3.2.2.2 (11-10)		35228	lb		35805	lb		39270	lb	
Rocking V_r =	67620	lb, 11.3.2.2.1 (11-8)		77443	lb		80003	lb		96237	lb	
Lower Bound V_{tc} =	69981	lb, 11.3.2.2.3 (11-11)		80147	lb		82797	lb		99597	lb	
Lower Bound V_{dt} =	201386	lb, 11.3.2.2.4 (11-12)		232096	lb		240716	lb		264011	lb	
Lower Bound P_{CL} =	1532105	lb, 11.3.2.2.5 (11-13)		1639621	lb		1666500	lb		1827775	lb	
Controlling Q_{CE} =	32918	lb		35228	lb		35805	lb		39270	lb	
Allowable Stress=	20	psi	**NG**	20	psi	**NG**	20	psi	**NG**	20	**NG**	
DCR =	5.43	23012.95	DCR =	4.66	19025.16	DCR =	5.72	24556.88	DCR =	5.01	20845.1	

Check 1st Floor Gridline D:

Total Wall Load=	756737	lb										
Wall height =	16.50	ft		16.50	ft		16.50	ft		16.50	ft	
Pier height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft	
Pier length =	9	ft		9	ft		9.25	ft		9.25	ft	
Pier thickness =	1.83	ft		1.83	ft		1.83	ft		1.83	ft	
L / h_{eff} =	0.55	for (11-12)		0.55			0.56			0.56		
Trib DL P_D =	41580	lb		41580	lb		42735	lb		42735	lb	
Pier SW P_W =	26730	lb		26730	lb		27472.5	lb		27472.5	lb	
Wall Rigidity =	92997			92997			99089			99089		
Load to Pier =	183185.2	20353.91		183185.2	20353.91		195183.5	21100.92		195183.5	21100.92	

Shear Stress=	77	psi		77	psi		80	psi		80	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0	
LB Bed-Joint V_{mL} =	46	psi, 11.2.3.6.3 (11-6)		46	psi		46	psi		46	psi
In-plane V_{bjs1} =	109728	lb, 11.3.2.2.2 (11-9)		109728	lb		112776	lb		112776	lb
In-plane V_{bjs2} =	20790	lb, 11.3.2.2.2 (11-10)		20790	lb		21368	lb		21368	lb
Rocking V_r =	26973	lb, 11.3.2.2.1 (11-8)		26973	lb		28492	lb		28492	lb
Lower Bound V_{tc} =	27915	lb, 11.3.2.2.3 (11-11)		27915	lb		29487	lb		29487	lb
Lower Bound V_{dt} =	127191	lb, 11.3.2.2.4 (11-12)		136975	lb		143653	lb		143653	lb
Lower Bound P_{CL} =	967645	lb, 11.3.2.2.5 (11-13)		967645	lb		994524	lb		994524	lb
Controlling Q_{CE} =	20790	lb		20790	lb		21368	lb		21368	lb
Allowable Stress=	20	psi	**NG**	20	psi	**NG**	20	psi	**NG**	20	**NG**
DCR =	3.92	15156.41	DCR =	3.92	15156.41	DCR =	4.06	15903.42	DCR =	4.06	15903.42

Check 1st Floor Gridline E:

Total Wall Load=	309503	lb				
Wall height =	16.50	ft		16.50	ft	
Pier height =	10.00	ft		10.00	ft	
Pier length =	8.25	ft		8.25	ft	
Pier thickness =	1.83	ft		1.83	ft	
L / h_{eff} =	0.50	for (11-12)		0.50		
Trib DL P_D =	63569.55	lb		63569.55	lb	
Pier SW P_W =	24502.5	lb		24502.5	lb	
Wall Rigidity =	75695			75695		
Load to Pier =	154751.4	18757.74		154751.4	18757.74	309502.8
Shear Stress=	71	psi		71	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0		
LB Bed-Joint V_{mL} =	52	psi, 11.2.3.6.3 (11-6)		52	psi	
In-plane V_{bjs1} =	113311	lb, 11.3.2.2.2 (11-9)		113311	lb	
In-plane V_{bjs2} =	31785	lb, 11.3.2.2.2 (11-10)		31785	lb	
Rocking V_r =	34119	lb, 11.3.2.2.1 (11-8)		34119	lb	
Lower Bound V_{tc} =	34254	lb, 11.3.2.2.3 (11-11)		34254	lb	
Lower Bound V_{dt} =	131422	lb, 11.3.2.2.4 (11-12)		151060	lb	
Lower Bound P_{CL} =	887008	lb, 11.3.2.2.5 (11-13)		887008	lb	
Controlling Q_{CE} =	31785	lb		31785	lb	
Allowable Stress=	33	psi	**NG**	33	psi	**NG**
DCR =	2.16	10089.17	DCR =	2.16	10089.17	

Check Basement Gridline 1 (& 8):

Total Wall Load=	647875	lb									
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft
Pier height =	5.00	ft		5.00	ft		5.00	ft		5.00	ft
Pier length =	4.25	ft	(3) at	7.5	ft		4.25	ft		7.5	ft
Pier thickness =	2.5	ft		2.5	ft		2.5	ft		2.5	ft
L / h_{eff} =	0.43	for (11-12)		0.75			0.43			0.75	
Trib DL P_D =	32895	lb		58050	lb		32895	lb		58050	lb
Pier SW P_W =	7650	lb		13500	lb		7650	lb		13500	lb
Wall Rigidity =	111058		(3) at	368182	lb for (3) piers		111058			368182	
Load to Pier =	42453.36	9989.025		422226.3	18765.61		42453.36	9989.025		140742.1	18765.61
Shear Stress=	28	psi		52	psi / pier		28	psi		52	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0	
LB Bed-Joint V_{mL} =	48	psi, 11.2.3.6.3 (11-6)		48	psi		48	psi		48	psi
In-plane V_{bjs1} =	73823	lb, 11.3.2.2.2 (11-9)		130275	lb		73823	lb		130275	lb
In-plane V_{bjs2} =	16448	lb, 11.3.2.2.2 (11-10)		29025	lb		16448	lb		29025	lb
Rocking V_r =	14045	lb, 11.3.2.2.1 (11-8)		43740	lb		14045	lb		43740	lb
Lower Bound V_{tc} =	14621	lb, 11.3.2.2.3 (11-11)		45534	lb		14621	lb		45534	lb
Lower Bound V_{dt} =	79940	lb, 11.3.2.2.4 (11-12)		162150	lb		91885	lb		162150	lb

Lower Bound P_{CL} =	624240	lb, 11.3.2.2.5 (11-13)		1101600	lb		624240	lb		1101600	lb
Controlling Q_{CE} =	14045	lb		29025	lb		14045	lb		29025	lb
Allowable Stress=	21	psi	**NG**	24	psi	**NG**	21	psi	**NG**	24	**NG**
DCR =	1.34	2553.225	DCR =	2.16	10058.11	DCR =	1.34	2553.225	DCR =	2.16	10058.11

Check Basement Gridline 2 (& 7):

Total Wall Load=	1091760	lb									
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft
Pier height =	5.00	ft		5.00	ft		5.00	ft		5.00	ft
Pier length =	7.167	ft	(3) at	7.5	ft		8.5	ft		8.83	ft
Pier thickness =	2.5	ft		2.5	ft		2.5	ft		2.5	ft
L / h_{eff} =	0.72	for (11-12)		0.75			0.85			0.88	
Trib DL P_D =	55472.58	lb		58050	lb		65790	lb		68344.2	lb
Pier SW P_W =	12900.6	lb		13500	lb		15300	lb		15894	lb
Wall Rigidity =	338460		(3) at	368182			459568			490223	
Load to Pier =	154429	21547.23		503970.5	22398.69		209686.9	24669.04		223673.9	25331.14
Shear Stress=	60	psi		62	psi / pier		69	psi		70	psi
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0	
LB Bed-Joint V_{mL} =	48	psi, 11.2.3.6.3 (11-6)		48	psi		48	psi		48	psi
In-plane V_{bjs1} =	124491	lb, 11.3.2.2.2 (11-9)		130275	lb		147645	lb		153377	lb
In-plane V_{bjs2} =	27736	lb, 11.3.2.2.2 (11-10)		29025	lb		32895	lb		34172	lb
Rocking V_r =	39942	lb, 11.3.2.2.1 (11-8)		43740	lb		56182	lb		60629	lb
Lower Bound V_{tc} =	41580	lb, 11.3.2.2.3 (11-11)		45534	lb		58485	lb		63115	lb
Lower Bound V_{dt} =	134807	lb, 11.3.2.2.4 (11-12)		162150	lb		183770	lb		190905	lb
Lower Bound P_{CL} =	1052689	lb, 11.3.2.2.5 (11-13)		1101600	lb		1248480	lb		1296950	lb
Controlling Q_{CE} =	27736	lb		29025	lb		32895	lb		34172	lb
Allowable Stress=	24	psi	**NG**	24	psi	**NG**	24	psi	**NG**	24	**NG**
DCR =	2.47	12839.73	DCR =	2.57	13691.19	DCR =	2.83	15961.54	DCR =	2.91	16623.64

Check Basement Gridline 3:

Total Wall Load=	1136998	lb									
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft
Pier height =	5.00	ft		5.00	ft		8.00	ft		8.00	ft
Pier length =	3.75	ft		6.75	ft		8.33	ft		11.25	ft
Pier thickness =	2.5	ft		2.5	ft		1.83	ft		1.83	ft
L / h_{eff} =	0.38	for (11-12)		0.68			0.83			1.13	
Trib DL P_D =	40782.75	lb		73408.95	lb		90592.08	lb		122348.3	lb
Pier SW P_W =	13125	lb		23625	lb		14994	lb		20250	lb
Wall Rigidity =	81936			301931			129304			238981	
Load to Pier =	123860.1	33029.35		456416.7	67617.29		195463	23464.95		361258.4	32111.86
Shear Stress=	92	psi		188	psi		89	psi		122	psi
Alpha =	0.5	for 11-8 & 11-11 per 11.3.2.2.1		0.5			0.5			0.5	
LB Bed-Joint V_{mL} =	53	psi, 11.2.3.6.3 (11-6)		53	psi		58	psi		58	psi
In-plane V_{bjs1} =	71016	lb, 11.3.2.2.2 (11-9)		127829	lb		127613	lb		172347	lb
In-plane V_{bjs2} =	20391	lb, 11.3.2.2.2 (11-10)		36704	lb		45296	lb		61174	lb
Rocking V_r =	9097	lb, 11.3.2.2.1 (11-8)		29474	lb		39579	lb		72190	lb
Lower Bound V_{tc} =	9147	lb, 11.3.2.2.3 (11-11)		29635	lb		38940	lb		71025	lb
Lower Bound V_{dt} =	69700	lb, 11.3.2.2.4 (11-12)		154282	lb		172509	lb		232980	lb
Lower Bound P_{CL} =	550800	lb, 11.3.2.2.5 (11-13)		991440	lb		895610	lb		1209557	lb
Controlling Q_{CE} =	9097	lb		29474	lb		38940	lb		61174	lb
Allowable Stress=	15	psi	**NG**	27	psi	**NG**	40	psi	**NG**	46	**NG**
DCR =	6.05	27571.19	DCR =	6.88	57792.6	DCR =	2.23	12946.89	DCR =	2.62	19877.03

Check Basement Gridline 6:

Total Wall Load=	1136998	lb									
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft
Pier height =	5.00	ft		6.50	ft		8.00	ft		8.00	ft
Pier length =	3.75	ft		6.75	ft		5.5	ft		9.33	ft

Pier thickness =	2.5	ft		2.5	ft		1.83	ft		1.83	ft	
L / h_{eff} =	0.38	for (11-12)		0.68			0.55			0.93		
Trib DL P_D =	40782.75	lb		73408.95	lb		59814.7	lb		101467.5	lb	
Pier SW P_W =	13125	lb		23625	lb		9900	lb		16794	lb	
Wall Rigidity =	81936			175608			48200			164749		
Load to Pier =	283251.6	75533.77		424375.4	62870.43		166627.5	30295.91		569532.7	61043.16	
Shear Stress=	210	psi		175	psi		115	psi		232	psi	
Alpha =	0.5	for 11-8 & 11-11 per 11.3.2.2.1		0.5			0.5			0.5		
LB Bed-Joint V_{mL} =	53	psi, 11.2.3.6.3 (11-6)		53	psi		58	psi		58	psi	
In-plane V_{bjs1} =	71016	lb, 11.3.2.2.2 (11-9)		127829	lb		84258	lb		142933	lb	
In-plane V_{bjs2} =	20391	lb, 11.3.2.2.2 (11-10)		36704	lb		29907	lb		50734	lb	
Rocking V_r =	9097	lb, 11.3.2.2.1 (11-8)		29474	lb		17254	lb		49652	lb	
Lower Bound V_{tc} =	9147	lb, 11.3.2.2.3 (11-11)		29635	lb		16976	lb		48851	lb	
Lower Bound V_{dt} =	69700	lb, 11.3.2.2.4 (11-12)		154282	lb		113901	lb		193218	lb	
Lower Bound P_{CL} =	550800	lb, 11.3.2.2.5 (11-13)		991440	lb		591339	lb		1003126	lb	
Controlling Q_{CE} =	9097	lb		29474	lb		16976	lb		48851	lb	
Allowable Stress=	15	psi	**NG**	27	psi	**NG**	26	psi	**NG**	45		**NG**
DCR =	13.84	70075.61	DCR =	6.40	53045.74	DCR =	4.36	23351.21	DCR =	5.18	49262.43	

Check Basement Gridline A:

Total Wall Load=	997165	lb										
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft	
Pier height =	5.00	ft		5.00	ft		5.00	ft		5.00	ft	
Pier length =	10	ft		10	ft		20	ft		20	ft	
Pier thickness =	2.5	ft		2.5	ft		2.5	ft		2.5	ft	
L / h_{eff} =	1.00	for (11-12)		1.00			2.00			2.00		
Trib DL P_D =	77900	lb		77900	lb		155800	lb		155800	lb	
Pier SW P_W =	18000	lb		18000	lb		36000	lb		36000	lb	
Wall Rigidity =	600000			600000			1527273			1527273		
Load to Pier =	140625.8	14062.58		140625.8	14062.58		357956.5	17897.83		357956.5	17897.83	
Shear Stress=	39	psi		39	psi		50	psi		50	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0		
LB Bed-Joint V_{mL} =	48	psi, 11.2.3.6.3 (11-6)		48	psi		48	psi		48	psi	
In-plane V_{bjs1} =	173950	lb, 11.3.2.2.2 (11-9)		173950	lb		347900	lb		347900	lb	
In-plane V_{bjs2} =	38950	lb, 11.3.2.2.2 (11-10)		38950	lb		77900	lb		77900	lb	
Rocking V_r =	78210	lb, 11.3.2.2.1 (11-8)		78210	lb		312840	lb		312840	lb	
Lower Bound V_{tc} =	81388	lb, 11.3.2.2.3 (11-11)		81388	lb		325553	lb		325553	lb	
Lower Bound V_{dt} =	160326	lb, 11.3.2.2.4 (11-12)		197158	lb		433315	lb		433315	lb	
Lower Bound P_{CL} =	1468800	lb, 11.3.2.2.5 (11-13)		1468800	lb		2937600	lb		2937600	lb	
Controlling Q_{CE} =	38950	lb		38950	lb		77900	lb		77900	lb	
Allowable Stress=	24	psi	**NG**	24	psi	**NG**	24	psi	**NG**	24		**NG**
DCR =	1.60	5298.828	DCR =	1.60	5298.828	DCR =	2.04	9134.076	DCR =	2.04	9134.076	

Check Basement Gridline B:

Total Wall Load=	1951480	lb										
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft	
Pier height =	10.00	ft		10.00	ft		8.00	ft		8.00	ft	
Pier length =	12.33	ft		12.33	ft		17.75	ft		21.75	ft	
Pier thickness =	2.5	ft		2.5	ft		1.83	ft		1.83	ft	
L / h_{eff} =	1.23	for (11-12)		1.23			1.78			2.18		
Trib DL P_D =	96050.7	lb		96050.7	lb		138272.5	lb		169432.5	lb	
Pier SW P_W =	22194	lb		22194	lb		31950	lb		39150	lb	
Wall Rigidity =	252315			252315			514811			687118		
Load to Pier =	288526.9	23400.4		288526.9	23400.4		588695.4	33165.94		785730.8	36125.55	
Shear Stress=	65	psi		65	psi		126	psi		137	psi	
Alpha =	0.5	for 11-8 & 11-11 per 11.3.2.2.1		0.5			0.5			0.5		
LB Bed-Joint V_{mL} =	48	psi, 11.2.3.6.3 (11-6)		48	psi		52	psi		52	psi	

In-plane V_{bjs1} =	214480	lb, 11.3.2.2.2 (11-9)		214480	lb		244542	lb		299650	lb	
In-plane V_{bjs2} =	48025	lb, 11.3.2.2.2 (11-10)		48025	lb		69136	lb		84716	lb	
Rocking V_r =	65608	lb, 11.3.2.2.1 (11-8)		65608	lb		135965	lb		204150	lb	
Lower Bound V_{tc} =	68274	lb, 11.3.2.2.3 (11-11)		68274	lb		137982	lb		207179	lb	
Lower Bound V_{dt} =	197682	lb, 11.3.2.2.4 (11-12)		243096	lb		318476	lb		390246	lb	
Lower Bound P_{CL} =	1811030	lb, 11.3.2.2.5 (11-13)		1811030	lb		1908412	lb		2338476	lb	
Controlling Q_{CE} =	48025	lb		48025	lb		69136	lb		84716	lb	
Allowable Stress=	24	psi	**NG**	24	psi	**NG**	33	psi	**NG**	33	**NG**	
DCR =	2.67	14636.65	DCR =	2.67	14636.65	DCR =	3.78	24402.19	DCR =	4.12	27361.8	

Check Basement Gridline C:

Total Wall Load=	2000308	lb										
Wall height =	10.00	ft		10.00	ft		10.00	ft		10.00	ft	
Pier height =	5.00	ft		5.00	ft		5.00	ft		5.00	ft	
Pier length =	12.33	ft		12.33	ft		21.75	ft		22	ft	
Pier thickness =	2.5	ft		2.5	ft		1.83	ft		1.83	ft	
L / h_{eff} =	1.23	for (11-12)		1.23			2.18			2.20		
Trib DL P_D =	96050.7	lb		96050.7	lb		169432.5	lb		171380	lb	
Pier SW P_W =	22194	lb		22194	lb		39150	lb		39600	lb	
Wall Rigidity =	819977			819977			1233099			1249474		
Load to Pier =	397864.5	32268.01		397864.5	32268.01		598316.7	27508.82		606262.1	27557.37	
Shear Stress=	90	psi		90	psi		104	psi		105	psi	
Alpha =	0.5	for 11-8 & 11-11 per 11.3.2.2.1		0.5			0.5			0.5		
LB Bed-Joint V_{mL} =	48	psi, 11.2.3.6.3 (11-6)		48	psi		52	psi		52	psi	
In-plane V_{bjs1} =	214480	lb, 11.3.2.2.2 (11-9)		214480	lb		299650	lb		303094	lb	
In-plane V_{bjs2} =	48025	lb, 11.3.2.2.2 (11-10)		48025	lb		84716	lb		85690	lb	
Rocking V_r =	65608	lb, 11.3.2.2.1 (11-8)		65608	lb		204150	lb		208870	lb	
Lower Bound V_{tc} =	68274	lb, 11.3.2.2.3 (11-11)		68274	lb		207179	lb		211969	lb	
Lower Bound V_{dt} =	243096	lb, 11.3.2.2.4 (11-12)		261796	lb		390246	lb		394731	lb	
Lower Bound P_{CL} =	1811030	lb, 11.3.2.2.5 (11-13)		1811030	lb		2338476	lb		2365356	lb	
Controlling Q_{CE} =	48025	lb		48025	lb		84716	lb		85690	lb	
Allowable Stress=	24	psi	**NG**	24	psi	**NG**	33	psi	**NG**	33	**NG**	
DCR =	3.68	23504.26	DCR =	3.68	23504.26	DCR =	3.14	18745.07	DCR =	3.14	18793.62	

Check Basement Gridline D:

Total Wall Load=	756737	lb										
Wall height =	16.50	ft		16.50	ft		16.50	ft		16.50	ft	
Pier height =	5.00	ft		5.00	ft		5.00	ft		5.00	ft	
Pier length =	9	ft		9	ft		9.25	ft		9.25	ft	
Pier thickness =	2.5	ft		2.5	ft		2.5	ft		2.5	ft	
L / h_{eff} =	0.55	for (11-12)		0.55			0.56			0.56		
Trib DL P_D =	70110	lb		70110	lb		72057.5	lb		72057.5	lb	
Pier SW P_W =	26730	lb		26730	lb		27472.5	lb		27472.5	lb	
Wall Rigidity =	506083			506083			529474			529474		
Load to Pier =	184911.1	20545.67		184911.1	20545.67		193457.7	20914.34		193457.7	20914.34	
Shear Stress=	57	psi		57	psi		58	psi		58	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1		1.0			1.0			1.0		
LB Bed-Joint V_{mL} =	48	psi, 11.2.3.6.3 (11-6)		48	psi		48	psi		48	psi	
In-plane V_{bjs1} =	156555	lb, 11.3.2.2.2 (11-9)		156555	lb		160904	lb		160904	lb	
In-plane V_{bjs2} =	35055	lb, 11.3.2.2.2 (11-10)		35055	lb		36029	lb		36029	lb	
Rocking V_r =	40979	lb, 11.3.2.2.1 (11-8)		40979	lb		43287	lb		43287	lb	
Lower Bound V_{tc} =	42292	lb, 11.3.2.2.3 (11-11)		42292	lb		44674	lb		44674	lb	
Lower Bound V_{dt} =	181248	lb, 11.3.2.2.4 (11-12)		195190	lb		204707	lb		204707	lb	
Lower Bound P_{CL} =	1321920	lb, 11.3.2.2.5 (11-13)		1321920	lb		1358640	lb		1358640	lb	
Controlling Q_{CE} =	35055	lb		35055	lb		36029	lb		36029	lb	
Allowable Stress=	24	psi	**NG**	24	psi	**NG**	24	psi	**NG**	24	**NG**	

DCR =	2.34	11781.92	DCR =	2.34	11781.92	DCR =	2.39	12150.59	DCR =	2.39	12150.59

Check Basement Gridline E:

Total Wall Load=	309503	lb			
Wall height =	10.00	ft	10.00	ft	
Pier height =	8.00	ft	8.00	ft	
Pier length =	8.25	ft	8.25	ft	
Pier thickness =	2.5	ft	2.5	ft	
L / h_{eff} =	0.83	for (11-12)	0.83		
Trib DL P_D =	87494.55	lb	87494.55	lb	
Pier SW P_W =	14850	lb	14850	lb	
Wall Rigidity =	172939		172939		
Load to Pier =	154751.4	18757.74	154751.4	18757.74	309502.8
Shear Stress=	52	psi	52	psi	
Alpha =	1	for 11-8 & 11-11 per 11.3.2.2.1	1.0		
LB Bed-Joint V_{mL} =	52	psi, 11.2.3.6.3 (11-6)	52	psi	
In-plane V_{bjs1} =	155122	lb, 11.3.2.2.2 (11-9)	155122	lb	
In-plane V_{bjs2} =	43747	lb, 11.3.2.2.2 (11-10)	43747	lb	
Rocking V_r =	70478	lb, 11.3.2.2.1 (11-8)	70478	lb	
Lower Bound V_{tc} =	71884	lb, 11.3.2.2.3 (11-11)	71884	lb	
Lower Bound V_{dt} =	173867	lb, 11.3.2.2.4 (11-12)	199847	lb	
Lower Bound P_{CL} =	1211760	lb, 11.3.2.2.5 (11-13)	1211760	lb	
Controlling Q_{CE} =	43747	lb	43747	lb	
Allowable Stress=	33	psi **NG**	33	psi **NG**	
DCR =	1.57	6826.668	DCR = 1.57	6826.668	

Wall Anchorage - Check shear capacity of anchorage, Sect. 5.7.1.1

Tier 1 - Quick Check, Sect. 4.5.3.7

Wall thickness =	1.5	ft
Wall W =	180	psf
X =	1.2	from Sect 4.5.3.7
S_x =	0.86	from 4.5.2.1 (2-1)
A_p =	54.68	sf, area to anchor
T_c =	10129.25	lb **Tc > Ta NG**
m =	3.0	from Table 12-3 for Life Safety
Anchor Capacity =	5845.5	lb, per TMS 3.1.6.3.1.2

Tier 2 - Sect. 5.7.1.1 and 7.2.11.1

Height =	13.67	ft
Wall thickness =	1.5	ft
Ratio =	9.11	
X =	1.3	from Table 7-2
K_a =	1.515	Eq 7-11
K_h =	1	Eq 7-12
F_p =	93.55	psf, from 7.2.11.1 (7-9)
F_{pMIN} =	70.90	psf, from 7.2.11.1 (7-10)
T_c =	5115.27	lb **Tc < Ta OK**
DCR =	0.88	

Proportions - Check Height to Thickness Rations, Sect. 5.5.3.1.2

Tier 1 - Quick Check, Sect. 5.5.3.1.2

Top story height =	9.00	ft			
Wall thickness =	1	ft	Ratio:	9.0	**OK**
Bell Lounge h =	13.67	ft			
Wall thickness =	1.33	ft	Ratio:	10.3	**NG**
First story height =	10.00	ft			

Wall thickness =	1.5	ft	Ratio:	6.7	**OK**
Other story height =	16.5	ft			
Wall thickness =	1.5	ft	Ratio:	11.0	**OK**

Tier 2 - Bell Tower Lounge - Sect. 11.3.3.2

Height =	13.67	ft	
Wall thickness =	1.33	ft	
Ratio =	10.28		
X =	1	from Table 7-2	
F_p =	136.88	psf, from 7.2.11.2 (7-13)	
OOP Moment =	3197.237	ft-lbs	
F_t =	75.31	psi	**> Ft = 45 psi NG**
DCR =	1.67		

Tier 2 - Third Floor - Sect. 11.3.3.2

Height =	9.00	ft	
Wall thickness =	1	ft	
Ratio =	9.00		
X =	1	from Table 7-2	
F_p =	102.91	psf, from 7.2.11.2 (7-13)	
OOP Moment =	1042.008	ft-lbs	
F_t =	43.42	psi	**< Ft = 45 psi OK**
DCR =	0.96		

For Collapse Prevention - Bell Tower Lounge - Sect. 11.3.3.2

S_{X1} =	0.58	from 4.5.2.1
TOP Allowable h/t =	9	**per Table 11-5, NG**
1st Allowable h/t =	13	**per Table 11-5, OK**
Other h/t =	15	**per Table 11-5, OK**

Diaphragms - Openings at Shear Walls, Sect. 5.6.1.3

Bell Tower Lounge Floor Opening

Diaphragm strength, Sect. 12.5.2.1

GL 6 Opening =	8.50	ft	
Diaphragm V =	434	plf, from page	
Revised Dia. V =	575.92	plf	**NG**
Dia. Capacity =	450	plf, from page	
DCR =	1.28		

Wall OOP, Sect. 11.3.3.2

Height =	27.92	ft	
Wall thickness =	1.5	ft	
Ratio =	18.61		
X =	1	from Table 7-2	
F_p =	154.37	psf, from 7.2.11.2 (7-13)	
OOP Moment =	15042.09	ft-lbs	
F_t =	278.56	psi	**> Ft = 45 psi NG**
DCR =	6.19		

3rd Floor East Foyer Floor Opening

Diaphragm strength, Sect. 12.5.2.1

GL 3 Opening =	16.75	ft	
Diaphragm V =	534	plf, from page	
Revised Dia. V =	1037.39	plf	**NG**
Dia. Capacity =	450	plf, from page	
DCR =	2.31		

Wall OOP, Sect. 11.3.3.2

Height =	21.75	ft	
Wall thickness =	1.5	ft	
Ratio =	14.50		
X =	1	from Table 7-2	
F_p =	154.37	psf, from 7.2.11.2 (7-13)	
OOP Moment =	9128.427	ft-lbs	
F_t =	169.04	psi	**> Ft = 45 psi NG**
DCR =	3.76		

Diaphragm strength, Sect. 12.5.2.1

GL E Opening =	9.75	ft	
Diaphragm V =	536	plf, from page	
Revised Dia. V =	1044.90	plf	**NG**
Dia. Capacity =	450	plf, from page	
DCR =	2.32		

Wall OOP, Sect. 11.3.3.2

Height =	21.75	ft	
Wall thickness =	1.5	ft	
Ratio =	14.50		
X =	1	from Table 7-2	
F_p =	154.37	psf, from 7.2.11.2 (7-13)	
OOP Moment =	9128.427	ft-lbs	
F_t =	169.04	psi	**> Ft = 45 psi NG**
DCR =	3.76		

3rd Floor West Stairs Floor Opening

Diaphragm strength, Sect. 12.5.2.1

GL A Opening =	8.50	ft	
Diaphragm V =	395	plf, from page	
Revised Dia. V =	447.75	plf	**OK**

Dia. Capacity =	450	plf, from page
DCR =	0.99	

Wall OOP, Sect. 11.3.3.2

Height =	21.75	ft
Wall thickness =	1.5	ft
Ratio =	14.50	
X =	1	from Table 7-2
F_p =	154.37	psf, from 7.2.11.2 (7-13)
OOP Moment =	9128.427	ft-lbs
F_t =	169.04	psi **> Ft = 45 psi NG**
DCR =	3.76	

2nd Floor East Foyer Floor Opening

Diaphragm strength, Sect. 12.5.2.1

GL 3 & 6 Opening =	14.25	ft
Diaphragm V =	837	plf, from page
Revised Dia. V =	1425.20	plf **NG**
Dia. Capacity =	450	plf, from page
DCR =	3.17	

Wall OOP, Sect. 11.3.3.2

Height =	31.50	ft
Wall thickness =	1.5	ft
Ratio =	21.00	
X =	1	from Table 7-2
F_p =	154.37	psf, from 7.2.11.2 (7-13)
OOP Moment =	19146.9	ft-lbs
F_t =	354.57	psi **> Ft = 45 psi NG**
DCR =	7.88	

2nd Floor West Stairs Floor Opening

Diaphragm strength, Sect. 12.5.2.1

GL A Opening =	8.50	ft
Diaphragm V =	624	plf, from page
Revised Dia. V =	708.35	plf **NG**
Dia. Capacity =	450	plf, from page
DCR =	1.57	

Wall OOP, Sect. 11.3.3.2

Height =	16.50	ft
Wall thickness =	1.5	ft
Ratio =	11.00	
X =	1	from Table 7-2
F_p =	154.37	psf, from 7.2.11.2 (7-13)
OOP Moment =	5253.459	ft-lbs
F_t =	97.29	psi **> Ft = 45 psi NG**
DCR =	2.16	

1st Floor East Foyer Floor Opening

Diaphragm strength, Sect. 12.5.2.1

GL 3 Opening =	9.00	ft
Diaphragm V =	447	plf, from page
Revised Dia. V =	605.35	plf **NG**
Dia. Capacity =	450	plf, from page
DCR =	1.35	

Wall OOP, Sect. 11.3.3.2

Height =	25.50	ft
Wall thickness =	1.5	ft
Ratio =	17.00	
X =	1	from Table 7-2
F_p =	154.37	psf, from 7.2.11.2 (7-13)
OOP Moment =	12547.52	ft-lbs
F_t =	232.36	psi **> Ft = 45 psi NG**

Diaphragm strength, Sect. 12.5.2.1

GL 6 Opening =	13.33	ft
Diaphragm V =	447	plf, from page
Revised Dia. V =	729.16	plf **NG**
Dia. Capacity =	450	plf, from page
DCR =	1.62	

Wall OOP, Sect. 11.3.3.2

Height =	25.50	ft
Wall thickness =	1.5	ft
Ratio =	17.00	
X =	1	from Table 7-2
F_p =	154.37	psf, from 7.2.11.2 (7-13)
OOP Moment =	12547.52	ft-lbs
F_t =	232.36	psi **> Ft = 45 psi NG**

DCR =	5.16				DCR =	5.16	

Stair Enclosures - Check Height to Thickness Rations, Sect. A.7.10.2

Tier 1 - Quick Check, Sect. 5.5.3.1.2

3rd Floor Opng =	21.75	ft			
Wall thickness =	1	ft	Ratio:	21.8	**> 12, NG**
2nd Floor Opng =	31.50	ft			
Wall thickness =	1.5	ft	Ratio:	21.0	**> 12, NG**
First story height =	25.50	ft			
Wall thickness =	1.5	ft	Ratio:	17.0	**> 12, NG**

Tier 2 - 3rd Floor Opening - Sect. Sect. 11.3.3.2				**2rd Floor Opening**			**1st Floor Opening**		
Height =	21.75	ft		31.50	ft		25.50	ft	
Wall thickness =	1	ft		1.5	ft		1.5	ft	
Ratio =	21.75			21.00			17.00		
X =	1	from Table 7-2		1	from Table 7-2		1	from Table 7-2	
F_p =	102.91	psf, from 7.2.11.2 (7-13)		154.37	psf, from 7.2.11.2 (7-13)		154.37	psf, from 7.2.11.2 (7-13)	
OOP Moment =	6085.618	ft-lbs		19146.9	ft-lbs		12547.52	ft-lbs	
F_t =	253.57	psi	**> Ft = 45 psi NG**	354.57	psi	**> Ft = 45 psi NG**	232.36	psi	**> Ft = 45 psi NG**
DCR =	5.63			7.88			5.16		

Steel Column/Beam Design - AISC 13th Addition

Shape: HSS AT ROOF **Shape Capacity = 0.49 < 1.0**

Size: 4X4X1/4

	ASD	
Pr =	30.21	k, axial compression load
Mr_x =	0.00	ft-k, strong axis moment
Mr_y =	0.00	ft-k, weak axis moment
Vr_x =	0.00	k, strong axis shear
Vr_y =	0.00	k, weak axis shear
Tr =	0.00	ft-k, torsional load
K_x =	1.00	*(Table C-C2.2, pg 16.1-240)*
K_y =	1.00	*(Table C-C2.2, pg 16.1-240)*
L_x =	10.00	ft
L_y =	10.00	ft
Lv =	N/A	ft, (for round shapes)
KL/r x =	78.95	
KL/r y =	78.95	
E =	29000	ksi
Fy =	46	ksi
Ag =	3.37	in^2
t =	0.233	in
Z_x =	4.69	in^3
Z_y =	4.69	in^3
S_x =	3.9	in^3
S_y =	3.9	in^3
I_x =	7.8	in^4
I_y =	7.8	in^4
r_x =	1.52	in
r_y =	1.52	in
Section is	Compact	in the strong axis (x)
Section is	Compact	in the weak axis (y)

Axial Capacity, Chapter E		
Aeff =	3.37	in^2
Qa =	1	*(Section E7, pg 16.1-42)*
Fe_x =	45.92	ksi, *(Section E3 pg 16.1-33)*
Fe_y =	45.92	ksi, *(Section E3 pg 16.1-33)*
Fcr_x =	30.25	ksi, *(Section E3 pg 16.1-33)*
Fcr_y =	30.25	ksi, *(Section E3 pg 16.1-33)*
Pn_x =	102	k, *(Section E3 pg 16.1-33)*
Pn_y =	102	k, *(Section E3 pg 16.1-33)*
Moment Capacity, Chapter F		
$Seff_x$ =	3.9	in^3
$Seff_y$ =	3.90	in^3
Mn_x =	17.98	*ft-k, (Section F7 pgs 16.1-55,56)*
Mn_y =	17.98	*ft-k, (Section F7 pgs 16.1-55,56)*
Shear Capacity: Chapter G		
kv =	5	*(Section G5, pg 16.1-68)*
Cv_x =	1.00	*(Section G2, pg 16.1-65)*
Cv_y =	1.00	*(Section G2, pg 16.1-65)*
Aw_x =	1.54	in^2, *(Section G5, pg 16.1-68)*
Aw_y =	1.54	in^2, *(Section G5, pg 16.1-68)*
Fcr =	N/A	ksi, *(Section G6, pg 16.1-68)*
Vn_x =	42.6	*k, (Section G2, pg 16.1-65)*
Vn_y =	42.6	*k, (Section G2, pg 16.1-65)*
Torsional Capacity: Chapter H		
Fcr =	27.60	*ksi, (Section H3 pg 16.1-75)*
C =	6.56	torsional shear constant
Tn =	15.1	ft-k, *(Section H3 pg 16.1-74)*

Allowable Capacities: Rn / Ω (ASD); Rn * Φ (LRFD)

(ASD)	Pc, k	Mc, ft-k	Vc, k	Tc, ft-k
x-axis	**61.0**	**10.8**	**25.5**	**9.0**
y-axis		**10.8**	**25.5**	

Interaction Equations:

Pr/Pc =	0.49	
Tr/Tc =		
	0.49	< 1.0 OK

Equation H1-1a, AISC 13 ed., pg 16.1-70

Use HSS 4X4X1/4

Steel Column/Beam Design - AISC 13th Addition

Shape: HSS LOWER **Shape Capacity = 0.68 < 1.0**

Size: 4X4X1/4

	ASD	
Pr =	41.34	k, axial compression load
Mr_x =	0.00	ft-k, strong axis moment
Mr_y =	0.00	ft-k, weak axis moment
Vr_x =	0.00	k, strong axis shear
Vr_y =	0.00	k, weak axis shear
Tr =	0.00	ft-k, torsional load
K_x =	1.00	*(Table C-C2.2, pg 16.1-240)*
K_y =	1.00	*(Table C-C2.2, pg 16.1-240)*
L_x =	10.00	ft
L_y =	10.00	ft
Lv =	N/A	ft, (for round shapes)
KL/r x =	78.95	
KL/r y =	78.95	
E =	29000	ksi
Fy =	46	ksi
Ag =	3.37	in^2
t =	0.233	in
Z_x =	4.69	in^3
Z_y =	4.69	in^3
S_x =	3.9	in^3
S_y =	3.9	in^3
I_x =	7.8	in^4
I_y =	7.8	in^4
r_x =	1.52	in
r_y =	1.52	in
Section is	Compact	in the strong axis (x)
Section is	Compact	in the weak axis (y)

Axial Capacity, Chapter E		
Aeff =	3.37	in^2
Qa =	1	*(Section E7, pg 16.1-42)*
Fe_x =	45.92	ksi, *(Section E3 pg 16.1-33)*
Fe_y =	45.92	ksi, *(Section E3 pg 16.1-33)*
Fcr_x =	30.25	ksi, *(Section E3 pg 16.1-33)*
Fcr_y =	30.25	ksi, *(Section E3 pg 16.1-33)*
Pn_x =	102	k, *(Section E3 pg 16.1-33)*
Pn_y =	102	k, *(Section E3 pg 16.1-33)*
Moment Capacity, Chapter F		
$Seff_x$ =	3.9	in^3
$Seff_y$ =	3.90	in^3
Mn_x =	17.98	*ft-k, (Section F7 pgs 16.1-55,56)*
Mn_y =	17.98	*ft-k, (Section F7 pgs 16.1-55,56)*
Shear Capacity: Chapter G		
kv =	5	*(Section G5, pg 16.1-68)*
Cv_x =	1.00	*(Section G2, pg 16.1-65)*
Cv_y =	1.00	*(Section G2, pg 16.1-65)*
Aw_x =	1.54	in^2, *(Section G5, pg 16.1-68)*
Aw_y =	1.54	in^2, *(Section G5, pg 16.1-68)*
Fcr =	N/A	ksi, *(Section G6, pg 16.1-68)*
Vn_x =	42.6	*k, (Section G2, pg 16.1-65)*
Vn_y =	42.6	*k, (Section G2, pg 16.1-65)*
Torsional Capacity: Chapter H		
Fcr =	27.60	*ksi, (Section H3 pg 16.1-75)*
C =	6.56	torsional shear constant
Tn =	15.1	ft-k, *(Section H3 pg 16.1-74)*

Allowable Capacities: Rn / Ω (ASD); Rn * Φ (LRFD)

(ASD)	Pc, k	Mc, ft-k	Vc, k	Tc, ft-k
x-axis	**61.0**	**10.8**	**25.5**	**9.0**
y-axis		**10.8**	**25.5**	

Interaction Equations:

Pr/Pc =	0.68	
Tr/Tc =		
	0.68	< 1.0 OK

Equation H1-1a, AISC 13 ed., pg 16.1-70

Use HSS 4X4X1/4

Schematic Shear Wall Design for Gridline 1

Current Date: 8/8/2016 5:17 PM
Units system: English
File name: C:\ProgramData\Bentley\Engineering\RAM Elements.en\Data\SPOE GL 1.cwd\

Design Results

Concrete Wall

GENERAL INFORMATION:

Global status : OK

Design code	:	ACI 318-05

Geometry:

Total height	:	26.50 [ft]
Total length	:	21.00 [ft]
Base support type	:	Continuous
Wall bottom restraint	:	Pinned
Column bottom restraint	:	Fixed
Rigidity elements	:	Columns

Materials:

Material	:	C 6-60
Steel tension strength (Fy)	:	60 [Kip/in2]
Concrete compressive strength (fc)	:	6 [Kip/in2]
Steel elasticity modulus (Es)	:	29000 [Kip/in2]
Concrete modulus of elasticity (E)	:	4415.2 [Kip/in2]
Concrete unit weight	:	0.149818 [Kip/ft3]

Number of stories: 2

Story	Story height [ft]	Wall thickness [in]
1	10.00	12.00
2	16.50	8.00

Openings:

Reference	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
Lower left	6.50	13.00	8.00	8.00
Lower left	6.50	3.50	8.00	5.00

Load conditions:

ID	Comb.	Category	Description
DL	No	DL	Dead Load
EQ	No	EQ	Seismic
SC1	Yes		DL
DC1	Yes		1.4DL
D1	Yes		1.4DL
D2	Yes		1.2DL+EQ
D3	Yes		0.9DL+EQ

Concentrated loads:

Story	Condition	Direction	Magnitude [Lb]	Eccentricity [in]	Distance [ft]
1	DL	Vertical	14400.00	0.00	0.00
1	DL	Vertical	14400.00	0.00	21.00
2	DL	Vertical	13700.00	0.00	0.00
2	DL	Vertical	13700.00	0.00	21.00
2	EQ	Horizontal	244194.00	0.00	0.00
1	EQ	Horizontal	79744.00	0.00	0.00

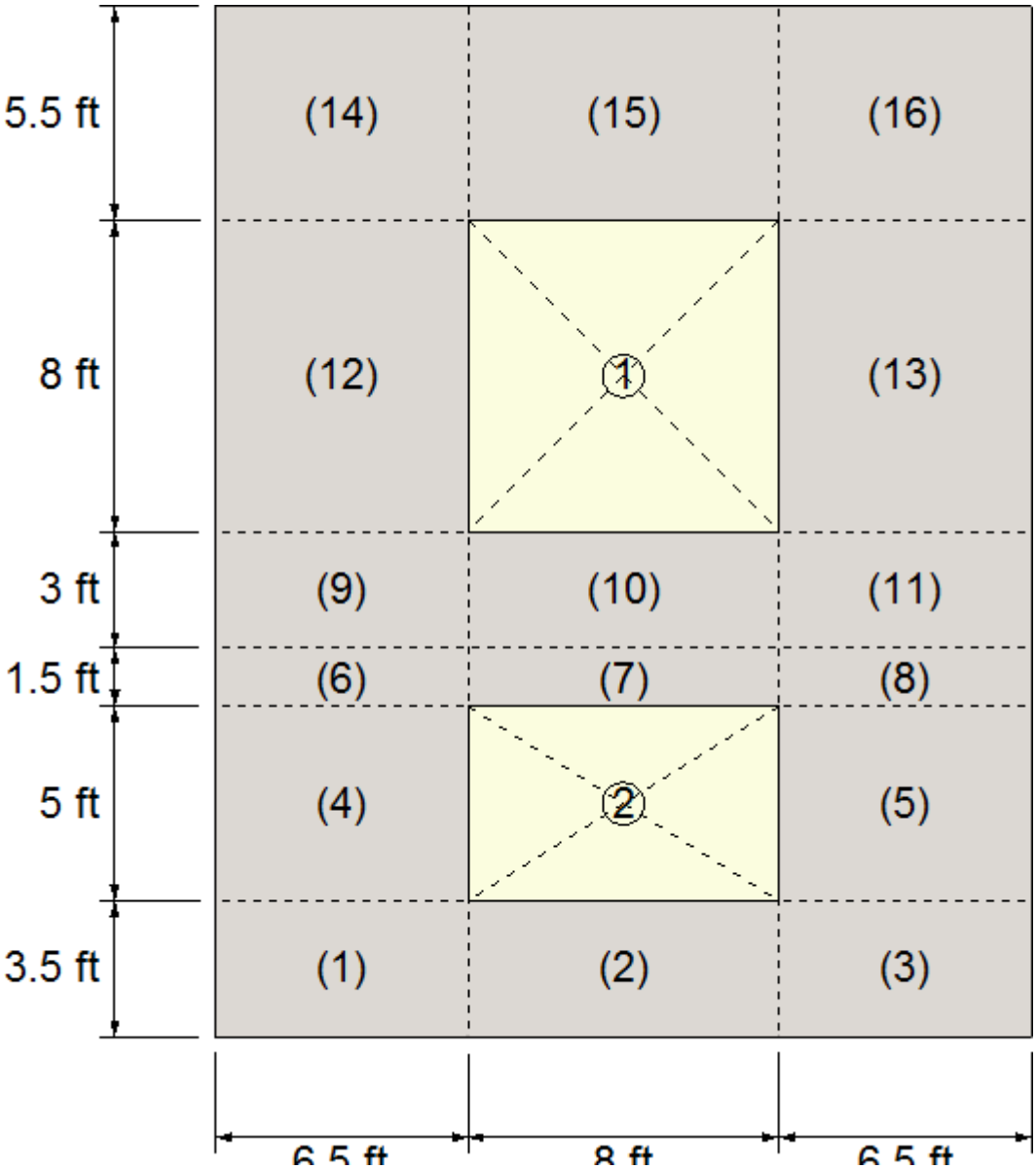
Distributed loads:

Consider self weight : DL

Story	Condition	Direction	Magnitude [Lb/ft]	Eccentricity [ft]
2	DL	Vertical	5460.00	0.00
1	DL	Vertical	2970.00	0.00

BEARING WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	6.50	3.50
2	6.50	0.00	8.00	3.50
3	14.50	0.00	6.50	3.50
4	0.00	3.50	6.50	5.00
5	14.50	3.50	6.50	5.00
6	0.00	8.50	6.50	1.50
7	6.50	8.50	8.00	1.50
8	14.50	8.50	6.50	1.50
9	0.00	10.00	6.50	3.00
10	6.50	10.00	8.00	3.00
11	14.50	10.00	6.50	3.00
12	0.00	13.00	6.50	8.00
13	14.50	13.00	6.50	8.00
14	0.00	21.00	6.50	5.50
15	6.50	21.00	8.00	5.50
16	14.50	21.00	6.50	5.50

Vertical reinforcement:

Reinforcement layers : 2

Segment	Bars	Spacing [in]	Ld [in]
1	6-#8	14.00	38.73
2	6-#5	18.00	19.36
3	5-#5	18.00	19.36
4	6-#8	14.00	38.73
5	5-#5	18.00	19.36
6	6-#8	14.00	38.73
7	6-#5	18.00	19.36
8	5-#5	18.00	19.36
9	6-#6	14.00	23.24
10	6-#5	18.00	19.36
11	5-#5	18.00	19.36
12	6-#6	14.00	23.24
13	5-#5	18.00	19.36
14	6-#6	14.00	23.24
15	6-#5	18.00	19.36
16	5-#5	18.00	19.36

Intermediate results for axial-bending

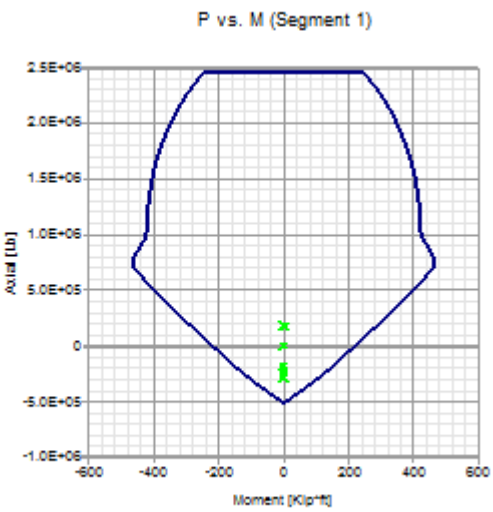
Segment	Condition	c [in]	d [in]
1	DC1 (Top)	1.75	10.13
2	DC1 (Top)	0.67	10.31
3	DC1 (Top)	1.20	10.31
4	DC1 (Top)	1.73	10.13
5	DC1 (Top)	1.18	10.31
6	DC1 (Top)	1.71	10.13
7	DC1 (Top)	0.70	10.31
8	DC1 (Top)	1.15	10.31
9	DC1 (Top)	1.26	6.25
10	DC1 (Top)	0.62	6.31
11	DC1 (Top)	1.01	6.31
12	DC1 (Top)	1.23	6.25
13	DC1 (Top)	0.97	6.31
14	DC1 (Top)	1.16	6.25
15	DC1 (Top)	0.79	6.31
16	DC1 (Top)	0.85	6.31

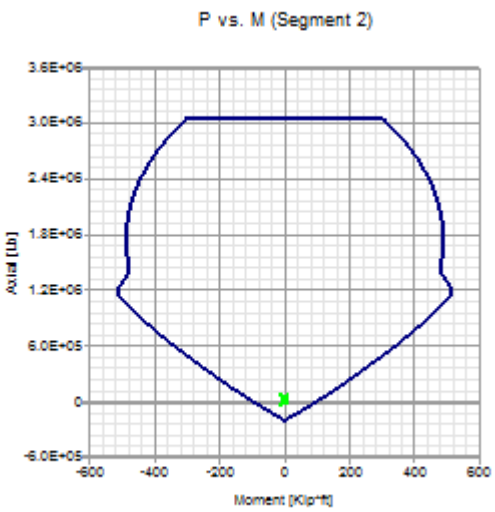
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	DC1 (Top)	184613.50	0.00	287.02	0.00
2	DC1 (Top)	20518.34	0.00	105.98	0.00
3	DC1 (Top)	184599.20	0.00	159.40	0.00
4	DC1 (Top)	175520.70	0.00	283.64	0.00
5	DC1 (Top)	175313.90	0.00	155.68	0.00
6	DC1 (Top)	164501.30	0.00	279.55	0.00
7	DC1 (Top)	30136.45	0.00	110.21	0.00

8	DC1 (Top)	164529.60	0.00	151.35	0.00
9	DC1 (Top)	114858.70	0.00	110.98	0.00
10	DC1 (Top)	3460.10	0.00	64.09	0.00
11	DC1 (Top)	114772.30	0.00	83.79	0.00
12	DC1 (Top)	99824.79	0.00	107.61	0.00
13	DC1 (Top)	99688.89	0.00	80.02	0.00
14	DC1 (Top)	60993.07	0.00	98.92	0.00
15	DC1 (Top)	61577.74	0.00	80.83	0.00
16	DC1 (Top)	60958.81	0.00	69.99	0.00

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Top)	184613.50	2457131.00	0.08
2	D2 (Bottom)	49206.52	3045239.00	0.02
3	D2 (Bottom)	545965.70	2474051.00	0.22
4	D1 (Bottom)	184615.20	2457131.00	0.08
5	D2 (Bottom)	495087.40	2474051.00	0.20
6	DC1 (Bottom)	175518.90	2457131.00	0.07
7	DC1 (Top)	30136.45	3045239.00	0.01
8	D2 (Bottom)	393334.20	2474051.00	0.16
9	D1 (Bottom)	121164.30	1640845.00	0.07
10	DC1 (Top)	3460.10	2026871.00	0.00
11	D2 (Bottom)	342123.70	1646627.00	0.21
12	D1 (Bottom)	114858.80	1640845.00	0.07
13	D2 (Bottom)	287005.30	1646627.00	0.17
14	D2 (Top)	115293.10	1640845.00	0.07
15	DC1 (Top)	61577.74	2026871.00	0.03
16	D2 (Bottom)	176701.00	1646627.00	0.11

Axial tension

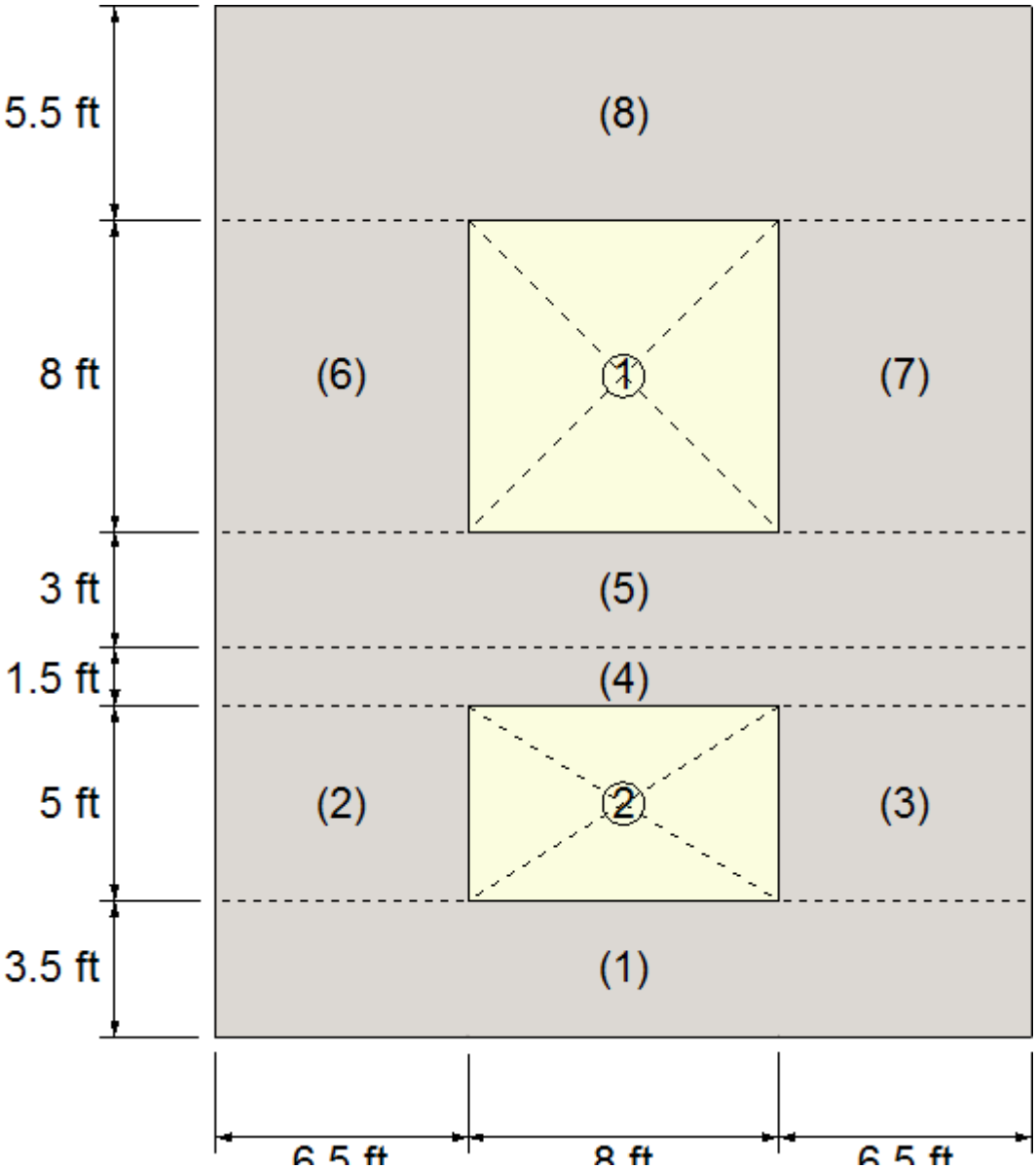
Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Bottom)	289862.10	511920.00	0.57
2	DC1 (Top)	0.00	200880.00	0.00
3	DC1 (Top)	0.00	167400.00	0.00
4	D3 (Bottom)	220081.80	511920.00	0.43
5	DC1 (Top)	0.00	167400.00	0.00
6	D3 (Top)	142603.40	511920.00	0.28
7	DC1 (Top)	0.00	200880.00	0.00
8	DC1 (Top)	0.00	167400.00	0.00
9	D3 (Bottom)	172260.80	285120.00	0.60
10	D3 (Bottom)	1481.03	200880.00	0.01
11	DC1 (Top)	0.00	167400.00	0.00
12	D3 (Bottom)	113957.10	285120.00	0.40
13	DC1 (Top)	0.00	167400.00	0.00
14	D3 (Bottom)	33341.92	285120.00	0.12
15	DC1 (Top)	0.00	200880.00	0.00
16	DC1 (Top)	0.00	167400.00	0.00

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	DC1 (Top)	0.000	91760.658	0.00
2	DC1 (Top)	0.000	115027.610	0.00
3	DC1 (Top)	0.000	93459.929	0.00
4	DC1 (Top)	0.000	91760.658	0.00
5	DC1 (Top)	0.000	93459.929	0.00
6	DC1 (Top)	0.000	91760.658	0.00
7	DC1 (Top)	0.000	115027.610	0.00
8	DC1 (Top)	0.000	93459.929	0.00
9	DC1 (Top)	0.000	56642.381	0.00
10	DC1 (Top)	0.000	70410.837	0.00
11	DC1 (Top)	0.000	57208.805	0.00
12	DC1 (Top)	0.000	56642.381	0.00
13	DC1 (Top)	0.000	57208.805	0.00
14	DC1 (Top)	0.000	56642.381	0.00
15	DC1 (Top)	0.000	70410.837	0.00
16	DC1 (Top)	0.000	57208.805	0.00

SHEAR WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	21.00	3.50
2	0.00	3.50	6.50	5.00
3	14.50	3.50	6.50	5.00
4	0.00	8.50	21.00	1.50
5	0.00	10.00	21.00	3.00
6	0.00	13.00	6.50	8.00
7	14.50	13.00	6.50	8.00
8	0.00	21.00	21.00	5.50

Reinforcement:

Reinforcement layers : 2

Segment	Vertical reinforcement Bars	Spacing [in]	Ld [in]	Horizontal reinforcement Bars	Spacing [in]	Ld [in]
1	6-#8	14.00	38.73	3-#5	18.00	25.17
	6-#5	18.00	38.73	3-#5	18.00	25.17
	5-#5	18.00	38.73	3-#5	18.00	25.17
2	6-#8	14.00	38.73	4-#5	18.00	25.17
3	5-#5	18.00	19.36	4-#5	18.00	25.17
4	6-#8	14.00	38.73	1-#5	18.00	25.17
	6-#5	18.00	38.73	1-#5	18.00	25.17
	5-#5	18.00	38.73	1-#5	18.00	25.17
5	6-#6	14.00	23.24	2-#5	18.00	25.17
	6-#5	18.00	23.24	2-#5	18.00	25.17
	5-#5	18.00	23.24	2-#5	18.00	25.17
6	6-#6	14.00	23.24	6-#5	18.00	25.17
7	5-#5	18.00	19.36	6-#5	18.00	25.17
8	6-#6	14.00	23.24	4-#5	18.00	25.17
	6-#5	18.00	23.24	4-#5	18.00	25.17
	5-#5	18.00	23.24	4-#5	18.00	25.17

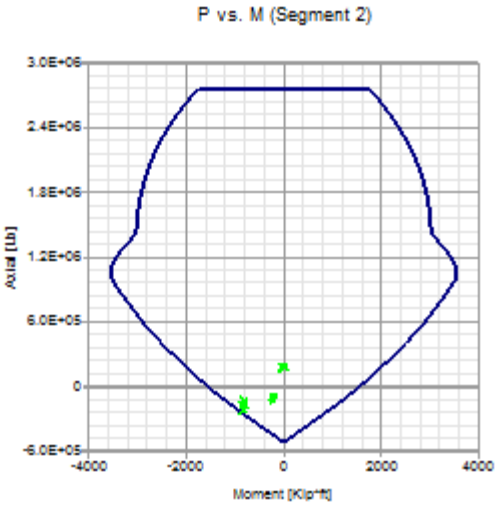
Intermediate results for axial-bending

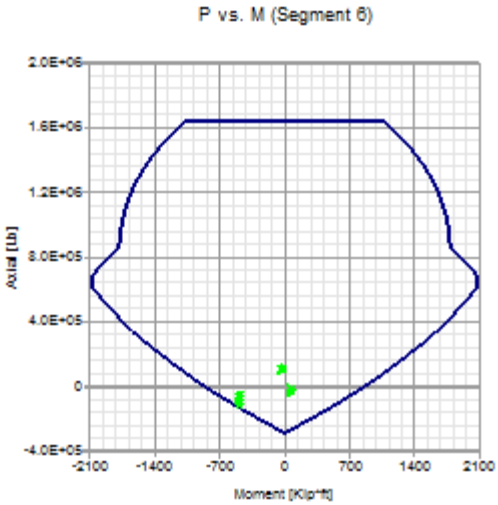
Segment	Condition	c [in]	d [in]
1	D3 (Bottom)	22.56	201.60
2	D3 (Bottom)	3.65	62.40
3	D3 (Bottom)	13.97	62.40
4	D3 (Bottom)	22.34	201.60
5	D3 (Bottom)	24.53	201.60
6	D3 (Bottom)	4.64	62.40
7	D3 (Top)	10.73	62.40
8	D3 (Bottom)	24.58	201.60

Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	D3 (Bottom)	257305.90	-7070.76	8542.22	0.83
2	D3 (Bottom)	-215314.10	-822.36	929.14	0.89
3	D3 (Bottom)	452265.10	-803.77	1737.60	0.46
4	D3 (Bottom)	246898.20	-4409.52	8447.52	0.52
5	D3 (Bottom)	142455.00	-4252.57	6841.63	0.62
6	D3 (Bottom)	-113718.80	-485.71	534.37	0.91
7	D3 (Top)	159380.10	433.54	958.57	0.45
8	D3 (Bottom)	144021.20	-1364.13	6855.92	0.20

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	DC1 (Bottom)	398671.60	7976420.00	0.05
2	D1 (Max)	190480.80	2752907.00	0.07
3	D2 (Bottom)	492170.30	2474051.00	0.20
4	DC1 (Bottom)	373436.70	7976420.00	0.05
5	DC1 (Bottom)	244191.10	5314343.00	0.05
6	DC1 (Bottom)	114870.10	1640845.00	0.07
7	D2 (Bottom)	286815.60	1646627.00	0.17
8	D2 (Top)	219752.70	5314343.00	0.04

Axial tension

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	DC1 (Top)	0.00	880200.00	0.00
2	D3 (Bottom)	215314.10	511920.00	0.42
3	DC1 (Top)	0.00	167400.00	0.00
4	DC1 (Top)	0.00	880200.00	0.00
5	DC1 (Top)	0.00	653400.00	0.00
6	D3 (Bottom)	113718.80	285120.00	0.40
7	DC1 (Top)	0.00	167400.00	0.00
8	DC1 (Top)	0.00	653400.00	0.00

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	D3 (Bottom)	325665.720	783691.960	0.42
2	D3 (Max)	185856.200	214856.290	0.87
3	D3 (Top)	161752.570	294183.880	0.55
4	D3 (Max)	367501.030	813460.230	0.45
5	D3 (Max)	261903.980	643530.050	0.41

6	D3 (Bottom)	104007.740	175365.140	0.59
7	D3 (Top)	150130.910	216329.980	0.69
8	D3 (Max)	250452.380	639959.860	0.39

Notes:

* Pu = Axial load
* Pn = Nominal axial load
* Mu = Section moment
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force
* ld = Embedment length
* As = Effective cross sectional area of reinforcement

Schematic Shear Wall Design for Gridline 2

Current Date: 8/4/2016 3:49 PM
Units system: English
File name: C:\ProgramData\Bentley\Engineering\RAM Elements.en\Data\SPOE GL 2 v2.cwd\

Design Results

Concrete Wall

GENERAL INFORMATION:

Global status : OK

Design code	:	ACI 318-05

Geometry:

Total height	:	50.67 [ft]
Total length	:	64.75 [ft]
Base support type	:	Continuous
Wall bottom restraint	:	Pinned
Column bottom restraint	:	Fixed
Rigidity elements	:	Columns

Materials:

Material	:	C 6-60
Steel tension strength (Fy)	:	60 [Kip/in2]
Concrete compressive strength (fc)	:	6 [Kip/in2]
Steel elasticity modulus (Es)	:	29000 [Kip/in2]
Concrete modulus of elasticity (E)	:	4415.2 [Kip/in2]
Concrete unit weight	:	0.149818 [Kip/ft3]

Number of stories: 4

Story	Story height [ft]	Wall thickness [in]
1	10.00	15.00
2	16.50	10.00
3	14.17	8.00
4	10.00	8.00

Openings:

Reference	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
Lower left	7.50	13.00	4.00	8.00
Lower left	19.00	13.00	4.00	8.00
Lower left	30.25	13.00	4.00	8.00
Lower left	41.75	13.00	4.00	8.00
Lower left	53.25	13.00	4.00	8.00
Lower left	30.25	3.50	4.00	5.00
Lower left	41.75	3.50	4.00	5.00
Lower left	53.25	3.50	4.00	5.00
Lower left	7.50	30.00	4.00	11.75
Lower left	19.00	30.00	4.00	11.75
Lower left	30.25	30.00	4.00	11.75
Lower left	41.75	30.00	4.00	11.75
Lower left	53.25	30.00	4.00	11.75

Load conditions:

ID	Comb.	Category	Description
DL	No	DL	Dead Load
EQ	No	EQ	Seismic
SC1	Yes		DL
DC1	Yes		1.4DL
D1	Yes		1.4DL
D2	Yes		1.2DL+EQ
D3	Yes		0.9DL+EQ

Concentrated loads:

Story	Condition	Direction	Magnitude [Lb]	Eccentricity [in]	Distance [ft]
1	DL	Vertical	14400.00	0.00	0.00
1	DL	Vertical	14400.00	0.00	64.75
2	DL	Vertical	13700.00	0.00	0.00
2	DL	Vertical	13700.00	0.00	64.75
3	DL	Vertical	13100.00	0.00	0.00
3	DL	Vertical	13100.00	0.00	64.75
4	EQ	Horizontal	219850.00	0.00	0.00
3	EQ	Horizontal	325498.00	0.00	0.00
2	EQ	Horizontal	310112.00	0.00	0.00
1	EQ	Horizontal	236300.00	0.00	0.00

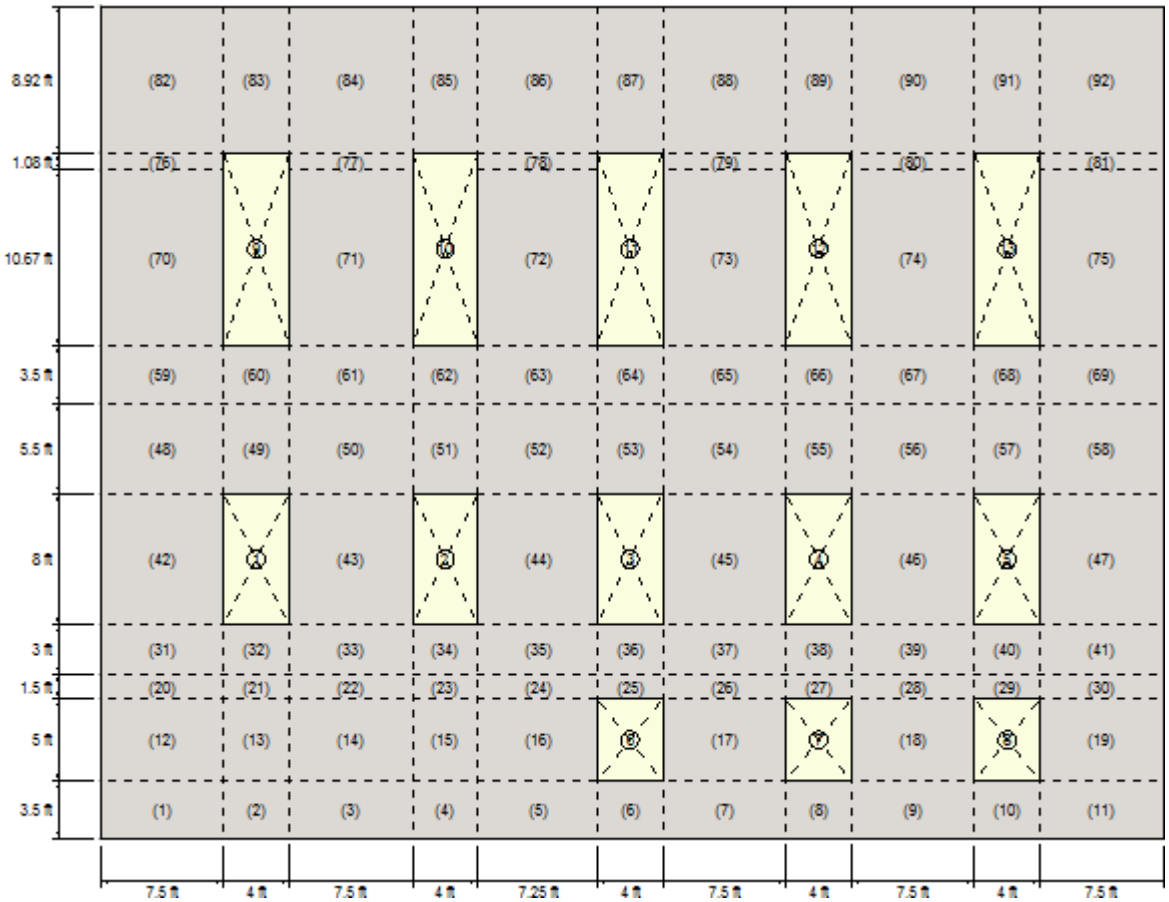
Distributed loads:

Consider self weight : DL

Story	Condition	Direction	Magnitude [Lb/ft]	Eccentricity [ft]
4	DL	Vertical	1050.00	0.00
3	DL	Vertical	1710.00	0.00
2	DL	Vertical	2700.00	0.00
1	DL	Vertical	2970.00	0.00

BEARING WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	7.50	3.50
2	7.50	0.00	4.00	3.50
3	11.50	0.00	7.50	3.50
4	19.00	0.00	4.00	3.50
5	23.00	0.00	7.25	3.50
6	30.25	0.00	4.00	3.50
7	34.25	0.00	7.50	3.50
8	41.75	0.00	4.00	3.50
9	45.75	0.00	7.50	3.50
10	53.25	0.00	4.00	3.50
11	57.25	0.00	7.50	3.50
12	0.00	3.50	7.50	5.00
13	7.50	3.50	4.00	5.00
14	11.50	3.50	7.50	5.00
15	19.00	3.50	4.00	5.00
16	23.00	3.50	7.25	5.00
17	34.25	3.50	7.50	5.00
18	45.75	3.50	7.50	5.00
19	57.25	3.50	7.50	5.00
20	0.00	8.50	7.50	1.50
21	7.50	8.50	4.00	1.50
22	11.50	8.50	7.50	1.50
23	19.00	8.50	4.00	1.50
24	23.00	8.50	7.25	1.50
25	30.25	8.50	4.00	1.50
26	34.25	8.50	7.50	1.50

27	41.75	8.50	4.00	1.50
28	45.75	8.50	7.50	1.50
29	53.25	8.50	4.00	1.50
30	57.25	8.50	7.50	1.50
31	0.00	10.00	7.50	3.00
32	7.50	10.00	4.00	3.00
33	11.50	10.00	7.50	3.00
34	19.00	10.00	4.00	3.00
35	23.00	10.00	7.25	3.00
36	30.25	10.00	4.00	3.00
37	34.25	10.00	7.50	3.00
38	41.75	10.00	4.00	3.00
39	45.75	10.00	7.50	3.00
40	53.25	10.00	4.00	3.00
41	57.25	10.00	7.50	3.00
42	0.00	13.00	7.50	8.00
43	11.50	13.00	7.50	8.00
44	23.00	13.00	7.25	8.00
45	34.25	13.00	7.50	8.00
46	45.75	13.00	7.50	8.00
47	57.25	13.00	7.50	8.00
48	0.00	21.00	7.50	5.50
49	7.50	21.00	4.00	5.50
50	11.50	21.00	7.50	5.50
51	19.00	21.00	4.00	5.50
52	23.00	21.00	7.25	5.50
53	30.25	21.00	4.00	5.50
54	34.25	21.00	7.50	5.50
55	41.75	21.00	4.00	5.50
56	45.75	21.00	7.50	5.50
57	53.25	21.00	4.00	5.50
58	57.25	21.00	7.50	5.50
59	0.00	26.50	7.50	3.50
60	7.50	26.50	4.00	3.50
61	11.50	26.50	7.50	3.50
62	19.00	26.50	4.00	3.50
63	23.00	26.50	7.25	3.50
64	30.25	26.50	4.00	3.50
65	34.25	26.50	7.50	3.50
66	41.75	26.50	4.00	3.50
67	45.75	26.50	7.50	3.50
68	53.25	26.50	4.00	3.50
69	57.25	26.50	7.50	3.50
70	0.00	30.00	7.50	10.67
71	11.50	30.00	7.50	10.67
72	23.00	30.00	7.25	10.67
73	34.25	30.00	7.50	10.67
74	45.75	30.00	7.50	10.67
75	57.25	30.00	7.50	10.67
76	0.00	40.67	7.50	1.08
77	11.50	40.67	7.50	1.08
78	23.00	40.67	7.25	1.08
79	34.25	40.67	7.50	1.08
80	45.75	40.67	7.50	1.08
81	57.25	40.67	7.50	1.08
82	0.00	41.75	7.50	8.92
83	7.50	41.75	4.00	8.92
84	11.50	41.75	7.50	8.92
85	19.00	41.75	4.00	8.92
86	23.00	41.75	7.25	8.92
87	30.25	41.75	4.00	8.92
88	34.25	41.75	7.50	8.92
89	41.75	41.75	4.00	8.92
90	45.75	41.75	7.50	8.92

91	53.25	41.75	4.00	8.92
92	57.25	41.75	7.50	8.92

Vertical reinforcement:

Reinforcement layers : 2

Segment	Bars	Spacing [in]	Ld [in]
1	7-#7	14.00	33.89
2	3-#5	16.00	19.36
3	6-#5	16.00	19.36
4	3-#5	16.00	19.36
5	6-#5	16.00	19.36
6	3-#5	16.00	19.36
7	6-#5	16.00	19.36
8	3-#5	16.00	19.36
9	6-#5	16.00	19.36
10	3-#5	16.00	19.36
11	6-#5	16.00	19.36
12	7-#7	14.00	33.89
13	3-#5	16.00	19.36
14	6-#5	16.00	19.36
15	3-#5	16.00	19.36
16	6-#5	16.00	19.36
17	6-#5	16.00	19.36
18	6-#5	16.00	19.36
19	6-#5	16.00	19.36
20	7-#7	14.00	33.89
21	3-#5	16.00	19.36
22	6-#5	16.00	19.36
23	3-#5	16.00	19.36
24	6-#5	16.00	19.36
25	3-#5	16.00	19.36
26	6-#5	16.00	19.36
27	3-#5	16.00	19.36
28	6-#5	16.00	19.36
29	3-#5	16.00	19.36
30	6-#5	16.00	19.36
31	9-#5	10.00	19.36
32	3-#5	18.00	19.36
33	6-#5	16.00	19.36
34	3-#5	18.00	19.36
35	5-#5	18.00	19.36
36	3-#5	18.00	19.36
37	6-#5	16.00	19.36
38	3-#5	18.00	19.36
39	5-#5	18.00	19.36
40	3-#5	18.00	19.36
41	5-#5	18.00	19.36
42	9-#5	10.00	19.36
43	6-#5	16.00	19.36
44	5-#5	18.00	19.36
45	6-#5	16.00	19.36
46	5-#5	18.00	19.36
47	5-#5	18.00	19.36
48	9-#5	10.00	19.36
49	3-#5	18.00	19.36
50	6-#5	16.00	19.36
51	3-#5	18.00	19.36
52	5-#5	18.00	19.36

53	3-#5	18.00	19.36
54	6-#5	16.00	19.36
55	3-#5	18.00	19.36
56	5-#5	18.00	19.36
57	3-#5	18.00	19.36
58	5-#5	18.00	19.36
59	5-#5	18.00	19.36
60	3-#5	18.00	19.36
61	5-#5	18.00	19.36
62	3-#5	18.00	19.36
63	5-#5	18.00	19.36
64	3-#5	18.00	19.36
65	5-#5	18.00	19.36
66	3-#5	18.00	19.36
67	5-#5	18.00	19.36
68	3-#5	18.00	19.36
69	5-#5	18.00	19.36
70	5-#5	18.00	19.36
71	5-#5	18.00	19.36
72	5-#5	18.00	19.36
73	5-#5	18.00	19.36
74	5-#5	18.00	19.36
75	5-#5	18.00	19.36
76	6-#8	16.00	38.73
77	8-#5	12.00	19.36
78	8-#5	12.00	19.36
79	8-#5	12.00	19.36
80	5-#5	18.00	19.36
81	5-#5	18.00	19.36
82	6-#8	16.00	38.73
83	3-#5	18.00	19.36
84	8-#5	12.00	19.36
85	3-#5	18.00	19.36
86	8-#5	12.00	19.36
87	3-#5	18.00	19.36
88	8-#5	12.00	19.36
89	3-#5	18.00	19.36
90	5-#5	18.00	19.36
91	3-#5	18.00	19.36
92	5-#5	18.00	19.36

Intermediate results for axial-bending

Segment	Condition	c [in]	d [in]
1	DC1 (Top)	1.54	13.19
2	DC1 (Top)	1.02	13.31
3	DC1 (Top)	1.03	13.31
4	DC1 (Top)	1.00	13.31
5	DC1 (Top)	1.08	13.31
6	DC1 (Top)	0.83	13.31
7	DC1 (Top)	1.12	13.31
8	DC1 (Top)	0.84	13.31
9	DC1 (Top)	1.13	13.31
10	DC1 (Top)	0.77	13.31
11	DC1 (Top)	1.20	13.31
12	DC1 (Top)	1.52	13.19
13	DC1 (Top)	0.97	13.31
14	DC1 (Top)	1.02	13.31
15	DC1 (Top)	0.96	13.31
16	DC1 (Top)	1.08	13.31
17	DC1 (Top)	1.12	13.31

18	DC1 (Top)	1.10	13.31
19	DC1 (Top)	1.16	13.31
20	DC1 (Top)	1.56	13.06
21	DC1 (Top)	0.98	13.19
22	DC1 (Top)	1.03	13.19
23	DC1 (Top)	0.96	13.19
24	DC1 (Top)	1.03	13.19
25	DC1 (Top)	0.82	13.19
26	DC1 (Top)	1.09	13.19
27	DC1 (Top)	0.71	13.19
28	DC1 (Top)	1.11	13.19
29	DC1 (Top)	0.86	13.19
30	DC1 (Top)	1.15	13.19
31	DC1 (Top)	1.19	8.31
32	DC1 (Top)	0.78	8.31
33	DC1 (Top)	1.01	8.31
34	DC1 (Top)	0.78	8.31
35	DC1 (Top)	0.92	8.31
36	DC1 (Top)	0.68	8.31
37	DC1 (Top)	1.00	8.31
38	DC1 (Top)	0.74	8.31
39	DC1 (Top)	0.93	8.31
40	DC1 (Top)	0.74	8.31
41	DC1 (Top)	0.94	8.31
42	DC1 (Top)	1.19	8.31
43	DC1 (Top)	1.01	8.31
44	DC1 (Top)	0.89	8.31
45	DC1 (Top)	0.94	8.31
46	DC1 (Top)	0.88	8.31
47	DC1 (Top)	0.93	8.31
48	DC1 (Top)	1.15	8.31
49	DC1 (Top)	0.83	8.31
50	DC1 (Top)	0.91	8.31
51	DC1 (Top)	0.82	8.31
52	DC1 (Top)	0.83	8.31
53	DC1 (Top)	0.82	8.31
54	DC1 (Top)	0.90	8.31
55	DC1 (Top)	0.82	8.31
56	DC1 (Top)	0.81	8.31
57	DC1 (Top)	0.83	8.31
58	DC1 (Top)	0.87	8.31
59	DC1 (Top)	0.73	6.31
60	DC1 (Top)	0.69	6.31
61	DC1 (Top)	0.74	6.31
62	DC1 (Top)	0.69	6.31
63	DC1 (Top)	0.75	6.31
64	DC1 (Top)	0.65	6.31
65	DC1 (Top)	0.72	6.31
66	DC1 (Top)	0.69	6.31
67	DC1 (Top)	0.73	6.31
68	DC1 (Top)	0.69	6.31
69	DC1 (Top)	0.74	6.31
70	DC1 (Top)	0.71	6.31
71	DC1 (Top)	0.72	6.31
72	DC1 (Top)	0.73	6.31
73	DC1 (Top)	0.71	6.31
74	DC1 (Top)	0.72	6.31
75	DC1 (Top)	0.71	6.31
76	DC1 (Top)	1.40	6.00
77	DC1 (Top)	0.93	6.31
78	DC1 (Top)	0.95	6.31
79	DC1 (Top)	0.92	6.31
80	DC1 (Top)	0.62	6.31
81	DC1 (Top)	0.59	6.31

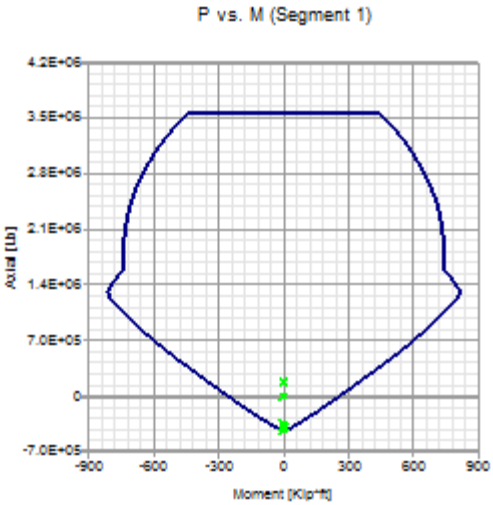
82	DC1 (Top)	1.34	6.13
83	DC1 (Top)	0.65	6.31
84	DC1 (Top)	0.90	6.31
85	DC1 (Top)	0.65	6.31
86	DC1 (Top)	0.92	6.31
87	DC1 (Top)	0.65	6.31
88	DC1 (Top)	0.90	6.31
89	DC1 (Top)	0.65	6.31
90	DC1 (Top)	0.58	6.31
91	DC1 (Top)	0.65	6.31
92	DC1 (Top)	0.58	6.31

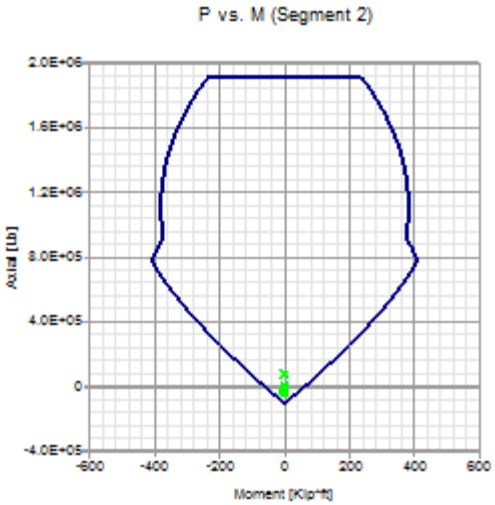
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	DC1 (Top)	182387.20	0.00	349.98	0.00
2	DC1 (Top)	78757.71	0.00	104.78	0.00
3	DC1 (Top)	141287.00	0.00	199.71	0.00
4	DC1 (Top)	75877.26	0.00	103.24	0.00
5	DC1 (Top)	154833.90	0.00	206.38	0.00
6	DC1 (Top)	37163.75	0.00	82.41	0.00
7	DC1 (Top)	182815.00	0.00	221.97	0.00
8	DC1 (Top)	38747.76	0.00	83.29	0.00
9	DC1 (Top)	187196.50	0.00	224.32	0.00
10	DC1 (Top)	26741.58	0.00	76.28	0.00
11	DC1 (Top)	214227.70	0.00	238.82	0.00
12	DC1 (Top)	169847.00	0.00	343.67	0.00
13	DC1 (Top)	69004.83	0.00	99.55	0.00
14	DC1 (Top)	138565.00	0.00	198.25	0.00
15	DC1 (Top)	65929.69	0.00	97.89	0.00
16	DC1 (Top)	154934.20	0.00	206.43	0.00
17	DC1 (Top)	181501.10	0.00	221.27	0.00
18	DC1 (Top)	173966.70	0.00	217.23	0.00
19	DC1 (Top)	198054.90	0.00	230.15	0.00
20	DC1 (Top)	169032.90	0.00	342.59	0.00
21	DC1 (Top)	68241.23	0.00	99.16	0.00
22	DC1 (Top)	138251.10	0.00	198.15	0.00
23	DC1 (Top)	65167.95	0.00	97.50	0.00
24	DC1 (Top)	127429.90	0.00	191.77	0.00
25	DC1 (Top)	35609.66	0.00	81.51	0.00
26	DC1 (Top)	161890.60	0.00	210.87	0.00
27	DC1 (Top)	16561.17	0.00	70.30	0.00
28	DC1 (Top)	168300.70	0.00	214.32	0.00
29	DC1 (Top)	42035.46	0.00	85.04	0.00
30	DC1 (Top)	186108.40	0.00	223.89	0.00
31	DC1 (Top)	126500.60	0.00	156.20	0.00
32	DC1 (Top)	28552.35	0.00	50.51	0.00
33	DC1 (Top)	131325.20	0.00	125.68	0.00
34	DC1 (Top)	27990.62	0.00	50.30	0.00
35	DC1 (Top)	116045.40	0.00	108.99	0.00
36	DC1 (Top)	11947.81	0.00	44.31	0.00
37	DC1 (Top)	123872.40	0.00	123.19	0.00
38	DC1 (Top)	21713.72	0.00	47.96	0.00
39	DC1 (Top)	127958.50	0.00	113.48	0.00
40	DC1 (Top)	22392.95	0.00	48.21	0.00
41	DC1 (Top)	131944.00	0.00	114.82	0.00
42	DC1 (Top)	125853.10	0.00	156.00	0.00
43	DC1 (Top)	130721.70	0.00	125.48	0.00

44	DC1 (Top)	101976.00	0.00	104.27	0.00
45	DC1 (Top)	101924.90	0.00	115.88	0.00
46	DC1 (Top)	108959.60	0.00	107.09	0.00
47	DC1 (Top)	129559.80	0.00	114.02	0.00
48	DC1 (Top)	103977.10	0.00	149.10	0.00
49	DC1 (Top)	36492.59	0.00	53.48	0.00
50	DC1 (Top)	87056.55	0.00	110.92	0.00
51	DC1 (Top)	34637.67	0.00	52.79	0.00
52	DC1 (Top)	80070.15	0.00	96.66	0.00
53	DC1 (Top)	35143.76	0.00	52.98	0.00
54	DC1 (Top)	81727.15	0.00	109.14	0.00
55	DC1 (Top)	34739.34	0.00	52.82	0.00
56	DC1 (Top)	83700.77	0.00	98.16	0.00
57	DC1 (Top)	36643.22	0.00	53.54	0.00
58	DC1 (Top)	106115.90	0.00	106.14	0.00
59	DC1 (Top)	59823.98	0.00	70.41	0.00
60	DC1 (Top)	13206.30	0.00	35.40	0.00
61	DC1 (Top)	62150.36	0.00	71.07	0.00
62	DC1 (Top)	13004.83	0.00	35.35	0.00
63	DC1 (Top)	56136.49	0.00	69.17	0.00
64	DC1 (Top)	6681.82	0.00	33.53	0.00
65	DC1 (Top)	56688.92	0.00	69.52	0.00
66	DC1 (Top)	13472.32	0.00	35.48	0.00
67	DC1 (Top)	60294.37	0.00	70.55	0.00
68	DC1 (Top)	13143.29	0.00	35.38	0.00
69	DC1 (Top)	60813.90	0.00	70.69	0.00
70	DC1 (Top)	52565.93	0.00	68.34	0.00
71	DC1 (Top)	56049.15	0.00	69.33	0.00
72	DC1 (Top)	52287.18	0.00	68.07	0.00
73	DC1 (Top)	52947.23	0.00	68.45	0.00
74	DC1 (Top)	55002.14	0.00	69.04	0.00
75	DC1 (Top)	53692.48	0.00	68.66	0.00
76	DC1 (Top)	12703.30	0.00	140.54	0.00
77	DC1 (Top)	27781.89	0.00	89.09	0.00
78	DC1 (Top)	24834.33	0.00	87.80	0.00
79	DC1 (Top)	21904.34	0.00	87.66	0.00
80	DC1 (Top)	25392.85	0.00	60.46	0.00
81	DC1 (Top)	15504.89	0.00	57.49	0.00
82	DC1 (Top)	12010.14	0.00	140.29	0.00
83	DC1 (Top)	6573.22	0.00	33.50	0.00
84	DC1 (Top)	12682.52	0.00	85.41	0.00
85	DC1 (Top)	6307.44	0.00	33.42	0.00
86	DC1 (Top)	11949.85	0.00	84.66	0.00
87	DC1 (Top)	6533.89	0.00	33.49	0.00
88	DC1 (Top)	12186.53	0.00	85.29	0.00
89	DC1 (Top)	6338.54	0.00	33.43	0.00
90	DC1 (Top)	12076.97	0.00	56.46	0.00
91	DC1 (Top)	6643.30	0.00	33.52	0.00
92	DC1 (Top)	12206.85	0.00	56.50	0.00

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Bottom)	188395.30	3557923.00	0.05
2	D1 (Bottom)	82285.04	1904507.00	0.04
3	DC1 (Bottom)	145080.50	3570335.00	0.04
4	DC1 (Bottom)	80692.89	1904507.00	0.04
5	D2 (Bottom)	245468.80	3450995.00	0.07
6	D1 (Bottom)	47488.31	1904507.00	0.02
7	D2 (Top)	232982.30	3570335.00	0.07
8	D2 (Bottom)	101706.10	1904507.00	0.05
9	D2 (Top)	284674.00	3570335.00	0.08
10	D2 (Bottom)	110101.30	1904507.00	0.06
11	D2 (Bottom)	541280.40	3570335.00	0.15
12	D1 (Bottom)	182387.20	3557923.00	0.05
13	D1 (Bottom)	78757.69	1904507.00	0.04
14	DC1 (Bottom)	141287.00	3570335.00	0.04
15	DC1 (Bottom)	75877.27	1904507.00	0.04
16	D2 (Bottom)	229977.10	3450995.00	0.07
17	D2 (Bottom)	232989.40	3570335.00	0.07
18	D2 (Bottom)	284674.50	3570335.00	0.08
19	D2 (Bottom)	526335.50	3570335.00	0.15
20	D1 (Bottom)	169847.00	3557923.00	0.05
21	D1 (Bottom)	69004.82	1904507.00	0.04
22	DC1 (Bottom)	138564.90	3570335.00	0.04
23	DC1 (Bottom)	65929.68	1904507.00	0.03
24	D2 (Bottom)	162685.10	3450995.00	0.05
25	D2 (Bottom)	107031.50	1904507.00	0.06
26	D2 (Bottom)	191322.70	3570335.00	0.05
27	D2 (Bottom)	118928.80	1904507.00	0.06
28	D2 (Top)	236921.40	3570335.00	0.07
29	D2 (Top)	100266.60	1904507.00	0.05
30	D2 (Bottom)	456404.70	3570335.00	0.13
31	DC1 (Top)	126500.60	2372002.00	0.05
32	DC1 (Bottom)	38892.80	1268027.00	0.03
33	D1 (Top)	131325.20	2376935.00	0.06
34	D1 (Bottom)	39881.11	1268027.00	0.03

35	D1 (Top)	116045.40	2299019.00	0.05
36	D2 (Top)	22875.65	1268027.00	0.02
37	D2 (Top)	164855.00	2376935.00	0.07
38	D2 (Bottom)	54420.56	1268027.00	0.04
39	D2 (Top)	219985.00	2378579.00	0.09
40	D2 (Top)	57469.85	1268027.00	0.05
41	D2 (Top)	378307.00	2378579.00	0.16
42	D1 (Bottom)	126500.80	2372002.00	0.05
43	D1 (Bottom)	131325.60	2376935.00	0.06
44	D1 (Bottom)	116046.00	2299019.00	0.05
45	D2 (Bottom)	164856.50	2376935.00	0.07
46	D2 (Bottom)	219985.60	2378579.00	0.09
47	D2 (Bottom)	378306.80	2378579.00	0.16
48	D1 (Bottom)	118667.00	2372002.00	0.05
49	DC1 (Top)	36492.59	1268027.00	0.03
50	D1 (Bottom)	113910.90	2376935.00	0.05
51	D2 (Top)	48834.60	1268027.00	0.04
52	DC1 (Bottom)	101974.90	2299019.00	0.04
53	D2 (Top)	41128.26	1268027.00	0.03
54	D2 (Bottom)	109176.50	2376935.00	0.05
55	D2 (Top)	34813.15	1268027.00	0.03
56	D2 (Bottom)	165714.20	2378579.00	0.07
57	D2 (Top)	58438.65	1268027.00	0.05
58	D2 (Bottom)	266080.00	2378579.00	0.11
59	D1 (Bottom)	63282.47	1901219.00	0.03
60	D2 (Bottom)	19954.86	1013435.00	0.02
61	D1 (Top)	62150.36	1901219.00	0.03
62	D1 (Bottom)	18667.97	1013435.00	0.02
63	D1 (Top)	56136.49	1837571.00	0.03
64	D2 (Bottom)	27656.31	1013435.00	0.03
65	D2 (Bottom)	61646.78	1901219.00	0.03
66	D2 (Bottom)	55664.10	1013435.00	0.05
67	D2 (Top)	103498.20	1901219.00	0.05
68	D2 (Bottom)	42360.84	1013435.00	0.04
69	D2 (Top)	164986.30	1901219.00	0.09
70	DC1 (Bottom)	59824.35	1901219.00	0.03
71	D1 (Bottom)	62150.60	1901219.00	0.03
72	DC1 (Bottom)	56136.85	1837571.00	0.03
73	D2 (Top)	67237.90	1901219.00	0.04
74	D2 (Bottom)	103498.30	1901219.00	0.05
75	D2 (Bottom)	164985.20	1901219.00	0.09
76	D1 (Bottom)	35664.46	1884299.00	0.02
77	D2 (Bottom)	138427.70	1896286.00	0.07
78	D2 (Bottom)	118884.60	1832638.00	0.06
79	D2 (Bottom)	117566.00	1896286.00	0.06
80	D2 (Bottom)	115621.20	1901219.00	0.06
81	D2 (Bottom)	104941.10	1901219.00	0.06
82	D2 (Top)	77189.60	1884299.00	0.04
83	D2 (Bottom)	53602.62	1013435.00	0.05
84	D1 (Bottom)	27781.26	1896286.00	0.01
85	D2 (Bottom)	35983.90	1013435.00	0.04
86	DC1 (Bottom)	24833.96	1832638.00	0.01
87	D2 (Bottom)	14496.70	1013435.00	0.01
88	D1 (Bottom)	21904.12	1896286.00	0.01
89	DC1 (Top)	6338.54	1013435.00	0.01
90	D1 (Bottom)	25392.32	1901219.00	0.01
91	D1 (Top)	6643.30	1013435.00	0.01
92	D2 (Bottom)	32480.60	1901219.00	0.02

Axial tension

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Bottom)	428434.30	453600.00	0.94
2	D3 (Top)	39874.38	100440.00	0.40
3	DC1 (Top)	0.00	200880.00	0.00
4	DC1 (Top)	0.00	100440.00	0.00
5	DC1 (Top)	0.00	200880.00	0.00
6	DC1 (Top)	0.00	100440.00	0.00
7	DC1 (Top)	0.00	200880.00	0.00
8	DC1 (Top)	0.00	100440.00	0.00
9	DC1 (Top)	0.00	200880.00	0.00
10	DC1 (Top)	0.00	100440.00	0.00
11	DC1 (Top)	0.00	200880.00	0.00
12	D3 (Bottom)	381648.40	453600.00	0.84
13	D3 (Top)	47794.58	100440.00	0.48
14	DC1 (Top)	0.00	200880.00	0.00
15	DC1 (Top)	0.00	100440.00	0.00
16	DC1 (Top)	0.00	200880.00	0.00
17	DC1 (Top)	0.00	200880.00	0.00
18	DC1 (Top)	0.00	200880.00	0.00
19	DC1 (Top)	0.00	200880.00	0.00
20	D3 (Top)	304455.40	453600.00	0.67
21	D3 (Bottom)	47794.55	100440.00	0.48
22	DC1 (Top)	0.00	200880.00	0.00
23	DC1 (Top)	0.00	100440.00	0.00
24	DC1 (Top)	0.00	200880.00	0.00
25	DC1 (Top)	0.00	100440.00	0.00
26	DC1 (Top)	0.00	200880.00	0.00
27	D3 (Top)	11583.21	100440.00	0.12
28	DC1 (Top)	0.00	200880.00	0.00
29	DC1 (Top)	0.00	100440.00	0.00
30	DC1 (Top)	0.00	200880.00	0.00
31	D3 (Bottom)	285819.70	301320.00	0.95
32	D3 (Bottom)	33341.52	100440.00	0.33
33	D3 (Top)	48120.96	200880.00	0.24
34	DC1 (Top)	0.00	100440.00	0.00
35	DC1 (Top)	0.00	167400.00	0.00
36	DC1 (Top)	0.00	100440.00	0.00
37	DC1 (Top)	0.00	200880.00	0.00
38	DC1 (Top)	0.00	100440.00	0.00
39	DC1 (Top)	0.00	167400.00	0.00
40	DC1 (Top)	0.00	100440.00	0.00
41	DC1 (Top)	0.00	167400.00	0.00
42	D3 (Bottom)	216414.20	301320.00	0.72
43	D3 (Bottom)	48120.60	200880.00	0.24
44	DC1 (Top)	0.00	167400.00	0.00
45	DC1 (Top)	0.00	200880.00	0.00
46	DC1 (Top)	0.00	167400.00	0.00
47	DC1 (Top)	0.00	167400.00	0.00
48	D3 (Top)	152985.10	301320.00	0.51
49	DC1 (Top)	0.00	100440.00	0.00
50	D3 (Top)	5852.32	200880.00	0.03
51	DC1 (Top)	0.00	100440.00	0.00
52	DC1 (Top)	0.00	167400.00	0.00
53	DC1 (Top)	0.00	100440.00	0.00
54	DC1 (Top)	0.00	200880.00	0.00
55	DC1 (Top)	0.00	100440.00	0.00

56	DC1 (Top)	0.00	167400.00	0.00
57	DC1 (Top)	0.00	100440.00	0.00
58	DC1 (Top)	0.00	167400.00	0.00
59	D3 (Bottom)	122791.10	167400.00	0.73
60	D3 (Top)	8638.16	100440.00	0.09
61	D3 (Top)	76522.60	167400.00	0.46
62	D3 (Bottom)	12611.46	100440.00	0.13
63	DC1 (Top)	0.00	167400.00	0.00
64	DC1 (Top)	0.00	100440.00	0.00
65	DC1 (Top)	0.00	167400.00	0.00
66	DC1 (Top)	0.00	100440.00	0.00
67	DC1 (Top)	0.00	167400.00	0.00
68	DC1 (Top)	0.00	100440.00	0.00
69	DC1 (Top)	0.00	167400.00	0.00
70	D3 (Top)	58070.73	167400.00	0.35
71	D3 (Bottom)	76522.08	167400.00	0.46
72	DC1 (Top)	0.00	167400.00	0.00
73	DC1 (Top)	0.00	167400.00	0.00
74	DC1 (Top)	0.00	167400.00	0.00
75	DC1 (Top)	0.00	167400.00	0.00
76	D3 (Bottom)	250896.40	511920.00	0.49
77	D3 (Top)	134943.40	267840.00	0.50
78	D3 (Top)	91779.74	267840.00	0.34
79	D3 (Top)	36149.13	267840.00	0.13
80	D3 (Top)	52667.02	167400.00	0.31
81	DC1 (Top)	0.00	167400.00	0.00
82	DC1 (Top)	0.00	511920.00	0.00
83	DC1 (Top)	0.00	100440.00	0.00
84	D3 (Bottom)	134940.30	267840.00	0.50
85	DC1 (Top)	0.00	100440.00	0.00
86	D3 (Bottom)	91777.81	267840.00	0.34
87	DC1 (Top)	0.00	100440.00	0.00
88	D3 (Bottom)	36149.02	267840.00	0.13
89	D3 (Bottom)	5512.83	100440.00	0.05
90	D3 (Bottom)	52665.10	167400.00	0.31
91	D3 (Bottom)	13768.78	100440.00	0.14
92	DC1 (Top)	0.00	167400.00	0.00

Shear

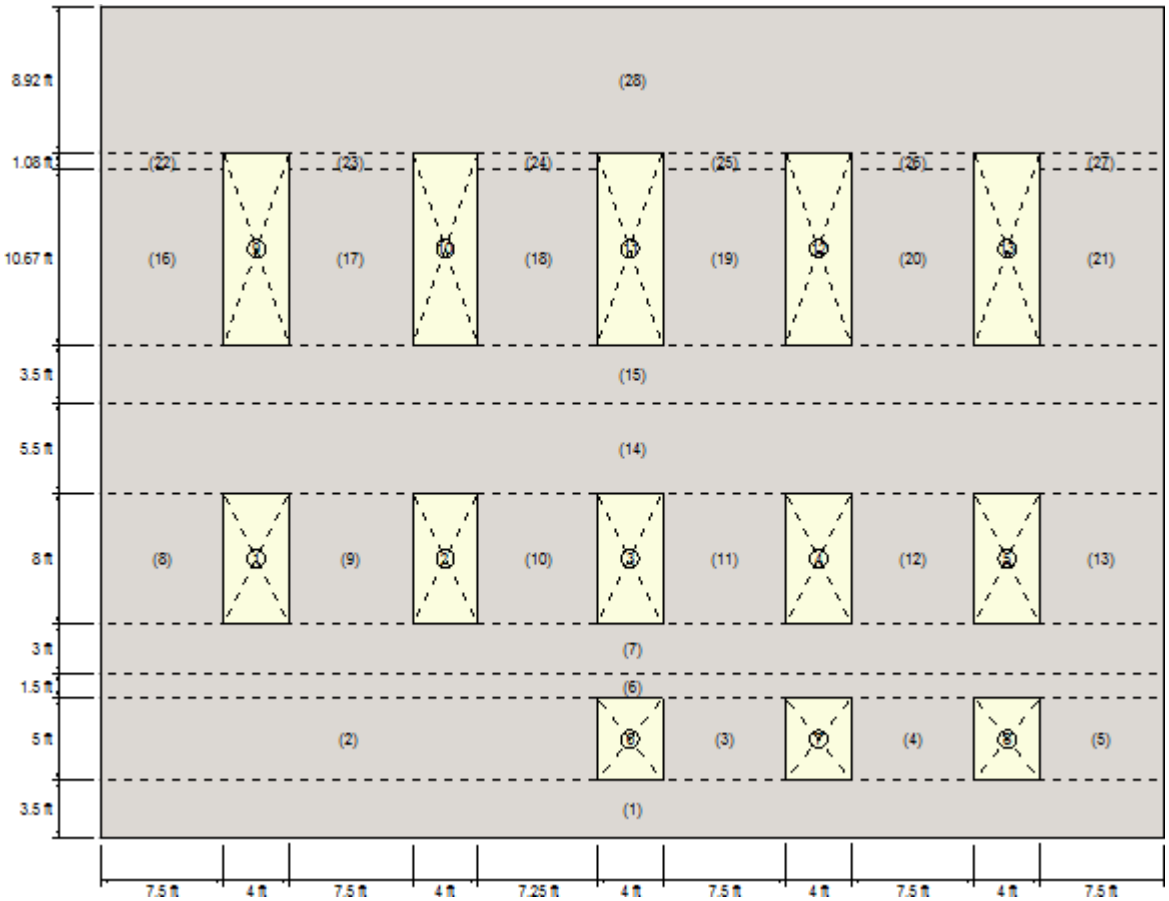
Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	DC1 (Top)	0.000	137902.410	0.00
2	DC1 (Top)	0.000	74245.091	0.00
3	DC1 (Top)	0.000	139209.550	0.00
4	DC1 (Top)	0.000	74245.091	0.00
5	DC1 (Top)	0.000	134569.230	0.00
6	DC1 (Top)	0.000	74245.091	0.00
7	DC1 (Top)	0.000	139209.550	0.00
8	DC1 (Top)	0.000	74245.091	0.00
9	DC1 (Top)	0.000	139209.550	0.00
10	DC1 (Top)	0.000	74245.091	0.00
11	DC1 (Top)	0.000	139209.550	0.00
12	DC1 (Top)	0.000	137902.410	0.00
13	DC1 (Top)	0.000	74245.091	0.00
14	DC1 (Top)	0.000	139209.550	0.00
15	DC1 (Top)	0.000	74245.091	0.00
16	DC1 (Top)	0.000	134569.230	0.00

17	DC1 (Top)	0.000	139209.550	0.00
18	DC1 (Top)	0.000	139209.550	0.00
19	DC1 (Top)	0.000	139209.550	0.00
20	DC1 (Top)	0.000	136595.280	0.00
21	DC1 (Top)	0.000	73547.954	0.00
22	DC1 (Top)	0.000	137902.410	0.00
23	DC1 (Top)	0.000	73547.954	0.00
24	DC1 (Top)	0.000	133305.670	0.00
25	DC1 (Top)	0.000	73547.954	0.00
26	DC1 (Top)	0.000	137902.410	0.00
27	DC1 (Top)	0.000	73547.954	0.00
28	DC1 (Top)	0.000	137902.410	0.00
29	DC1 (Top)	0.000	73547.954	0.00
30	DC1 (Top)	0.000	137902.410	0.00
31	DC1 (Top)	0.000	86924.270	0.00
32	DC1 (Top)	0.000	46359.611	0.00
33	DC1 (Top)	0.000	86924.270	0.00
34	DC1 (Top)	0.000	46359.611	0.00
35	DC1 (Top)	0.000	84026.794	0.00
36	DC1 (Top)	0.000	46359.611	0.00
37	DC1 (Top)	0.000	86924.270	0.00
38	DC1 (Top)	0.000	46359.611	0.00
39	DC1 (Top)	0.000	86924.270	0.00
40	DC1 (Top)	0.000	46359.611	0.00
41	DC1 (Top)	0.000	86924.270	0.00
42	DC1 (Top)	0.000	86924.270	0.00
43	DC1 (Top)	0.000	86924.270	0.00
44	DC1 (Top)	0.000	84026.794	0.00
45	DC1 (Top)	0.000	86924.270	0.00
46	DC1 (Top)	0.000	86924.270	0.00
47	DC1 (Top)	0.000	86924.270	0.00
48	DC1 (Top)	0.000	86924.270	0.00
49	DC1 (Top)	0.000	46359.611	0.00
50	DC1 (Top)	0.000	86924.270	0.00
51	DC1 (Top)	0.000	46359.611	0.00
52	DC1 (Top)	0.000	84026.794	0.00
53	DC1 (Top)	0.000	46359.611	0.00
54	DC1 (Top)	0.000	86924.270	0.00
55	DC1 (Top)	0.000	46359.611	0.00
56	DC1 (Top)	0.000	86924.270	0.00
57	DC1 (Top)	0.000	46359.611	0.00
58	DC1 (Top)	0.000	86924.270	0.00
59	DC1 (Top)	0.000	66010.160	0.00
60	DC1 (Top)	0.000	35205.419	0.00
61	DC1 (Top)	0.000	66010.160	0.00
62	DC1 (Top)	0.000	35205.419	0.00
63	DC1 (Top)	0.000	63809.821	0.00
64	DC1 (Top)	0.000	35205.419	0.00
65	DC1 (Top)	0.000	66010.160	0.00
66	DC1 (Top)	0.000	35205.419	0.00
67	DC1 (Top)	0.000	66010.160	0.00
68	DC1 (Top)	0.000	35205.419	0.00
69	DC1 (Top)	0.000	66010.160	0.00
70	DC1 (Top)	0.000	66010.160	0.00
71	DC1 (Top)	0.000	66010.160	0.00
72	DC1 (Top)	0.000	63809.821	0.00
73	DC1 (Top)	0.000	66010.160	0.00
74	DC1 (Top)	0.000	66010.160	0.00
75	DC1 (Top)	0.000	66010.160	0.00
76	DC1 (Top)	0.000	62742.330	0.00

77	DC1 (Top)	0.000	66010.160	0.00
78	DC1 (Top)	0.000	63809.821	0.00
79	DC1 (Top)	0.000	66010.160	0.00
80	DC1 (Top)	0.000	66010.160	0.00
81	DC1 (Top)	0.000	66010.160	0.00
82	DC1 (Top)	0.000	64049.462	0.00
83	DC1 (Top)	0.000	35205.419	0.00
84	DC1 (Top)	0.000	66010.160	0.00
85	DC1 (Top)	0.000	35205.419	0.00
86	DC1 (Top)	0.000	63809.821	0.00
87	DC1 (Top)	0.000	35205.419	0.00
88	DC1 (Top)	0.000	66010.160	0.00
89	DC1 (Top)	0.000	35205.419	0.00
90	DC1 (Top)	0.000	66010.160	0.00
91	DC1 (Top)	0.000	35205.419	0.00
92	DC1 (Top)	0.000	66010.160	0.00

SHEAR WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	64.75	3.50
2	0.00	3.50	30.25	5.00
3	34.25	3.50	7.50	5.00
4	45.75	3.50	7.50	5.00
5	57.25	3.50	7.50	5.00
6	0.00	8.50	64.75	1.50
7	0.00	10.00	64.75	3.00
8	0.00	13.00	7.50	8.00
9	11.50	13.00	7.50	8.00
10	23.00	13.00	7.25	8.00
11	34.25	13.00	7.50	8.00
12	45.75	13.00	7.50	8.00
13	57.25	13.00	7.50	8.00
14	0.00	21.00	64.75	5.50
15	0.00	26.50	64.75	3.50
16	0.00	30.00	7.50	10.67
17	11.50	30.00	7.50	10.67
18	23.00	30.00	7.25	10.67
19	34.25	30.00	7.50	10.67
20	45.75	30.00	7.50	10.67
21	57.25	30.00	7.50	10.67
22	0.00	40.67	7.50	1.08
23	11.50	40.67	7.50	1.08
24	23.00	40.67	7.25	1.08
25	34.25	40.67	7.50	1.08
26	45.75	40.67	7.50	1.08
27	57.25	40.67	7.50	1.08
28	0.00	41.75	64.75	8.92

Reinforcement:

Reinforcement layers : 2

	Vertical reinforcement			Horizontal reinforcement		
Segment	Bars	Spacing [in]	Ld [in]	Bars	Spacing [in]	Ld [in]
1	7-#7	14.00	33.89	3-#5	18.00	25.17
	3-#5	16.00	33.89	3-#5	18.00	25.17
	6-#5	16.00	33.89	3-#5	18.00	25.17
	3-#5	16.00	33.89	3-#5	18.00	25.17
	6-#5	16.00	33.89	3-#5	18.00	25.17
	3-#5	16.00	33.89	3-#5	18.00	25.17
	6-#5	16.00	33.89	3-#5	18.00	25.17
	3-#5	16.00	33.89	3-#5	18.00	25.17
	6-#5	16.00	33.89	3-#5	18.00	25.17
	3-#5	16.00	33.89	3-#5	18.00	25.17
	6-#5	16.00	33.89	3-#5	18.00	25.17
2	7-#7	14.00	33.89	4-#5	18.00	25.17
	3-#5	16.00	33.89	4-#5	18.00	25.17
	6-#5	16.00	33.89	4-#5	18.00	25.17
	3-#5	16.00	33.89	4-#5	18.00	25.17
	6-#5	16.00	33.89	4-#5	18.00	25.17
3	6-#5	16.00	19.36	4-#5	18.00	25.17
4	6-#5	16.00	19.36	4-#5	18.00	25.17
5	6-#5	16.00	19.36	4-#5	18.00	25.17
6	7-#7	14.00	33.89	1-#6	18.00	30.21
	3-#5	16.00	33.89	1-#6	18.00	30.21
	6-#5	16.00	33.89	1-#6	18.00	30.21
	3-#5	16.00	33.89	1-#6	18.00	30.21

	6-#5	16.00	33.89	1-#6	18.00	30.21
	3-#5	16.00	33.89	1-#6	18.00	30.21
	6-#5	16.00	33.89	1-#6	18.00	30.21
	3-#5	16.00	33.89	1-#6	18.00	30.21
	6-#5	16.00	33.89	1-#6	18.00	30.21
	3-#5	16.00	33.89	1-#6	18.00	30.21
	6-#5	16.00	33.89	1-#6	18.00	30.21
7	9-#5	10.00	19.36	2-#5	18.00	25.17
	3-#5	18.00	19.36	2-#5	18.00	25.17
	6-#5	16.00	19.36	2-#5	18.00	25.17
	3-#5	18.00	19.36	2-#5	18.00	25.17
	5-#5	18.00	19.36	2-#5	18.00	25.17
	3-#5	18.00	19.36	2-#5	18.00	25.17
	6-#5	16.00	19.36	2-#5	18.00	25.17
	3-#5	18.00	19.36	2-#5	18.00	25.17
	5-#5	18.00	19.36	2-#5	18.00	25.17
	3-#5	18.00	19.36	2-#5	18.00	25.17
	5-#5	18.00	19.36	2-#5	18.00	25.17
8	9-#5	10.00	19.36	6-#5	18.00	25.17
9	6-#5	16.00	19.36	6-#5	18.00	25.17
10	5-#5	18.00	19.36	6-#5	18.00	25.17
11	6-#5	16.00	19.36	6-#5	18.00	25.17
12	5-#5	18.00	19.36	6-#5	18.00	25.17
13	5-#5	18.00	19.36	6-#5	18.00	25.17
14	9-#5	10.00	19.36	4-#5	18.00	25.17
	3-#5	18.00	19.36	4-#5	18.00	25.17
	6-#5	16.00	19.36	4-#5	18.00	25.17
	3-#5	18.00	19.36	4-#5	18.00	25.17
	5-#5	18.00	19.36	4-#5	18.00	25.17
	3-#5	18.00	19.36	4-#5	18.00	25.17
	6-#5	16.00	19.36	4-#5	18.00	25.17
	3-#5	18.00	19.36	4-#5	18.00	25.17
	5-#5	18.00	19.36	4-#5	18.00	25.17
	3-#5	18.00	19.36	4-#5	18.00	25.17
	5-#5	18.00	19.36	4-#5	18.00	25.17
15	5-#5	18.00	19.36	3-#5	18.00	25.17
	3-#5	18.00	19.36	3-#5	18.00	25.17
	5-#5	18.00	19.36	3-#5	18.00	25.17
	3-#5	18.00	19.36	3-#5	18.00	25.17
	5-#5	18.00	19.36	3-#5	18.00	25.17
	3-#5	18.00	19.36	3-#5	18.00	25.17
	5-#5	18.00	19.36	3-#5	18.00	25.17
	3-#5	18.00	19.36	3-#5	18.00	25.17
	5-#5	18.00	19.36	3-#5	18.00	25.17
	3-#5	18.00	19.36	3-#5	18.00	25.17
	5-#5	18.00	19.36	3-#5	18.00	25.17
16	5-#5	18.00	19.36	7-#5	18.00	25.17
17	5-#5	18.00	19.36	7-#5	18.00	25.17
18	5-#5	18.00	19.36	7-#5	18.00	25.17
19	5-#5	18.00	19.36	7-#5	18.00	25.17
20	5-#5	18.00	19.36	7-#5	18.00	25.17
21	5-#5	18.00	19.36	7-#5	18.00	25.17
22	6-#8	16.00	38.73	1-#6	14.00	30.21
23	8-#5	12.00	19.36	1-#5	18.00	25.17
24	8-#5	12.00	19.36	1-#5	18.00	25.17
25	8-#5	12.00	19.36	1-#5	18.00	25.17
26	5-#5	18.00	19.36	1-#5	18.00	25.17
27	5-#5	18.00	19.36	1-#5	18.00	25.17
28	6-#8	16.00	38.73	6-#5	18.00	25.17
	3-#5	18.00	38.73	6-#5	18.00	25.17
	8-#5	12.00	38.73	6-#5	18.00	25.17
	3-#5	18.00	38.73	6-#5	18.00	25.17
	8-#5	12.00	38.73	6-#5	18.00	25.17
	3-#5	18.00	38.73	6-#5	18.00	25.17

8-#5	12.00	38.73	6-#5	18.00	25.17
3-#5	18.00	38.73	6-#5	18.00	25.17
5-#5	18.00	38.73	6-#5	18.00	25.17
3-#5	18.00	38.73	6-#5	18.00	25.17
5-#5	18.00	38.73	6-#5	18.00	25.17

Intermediate results for axial-bending

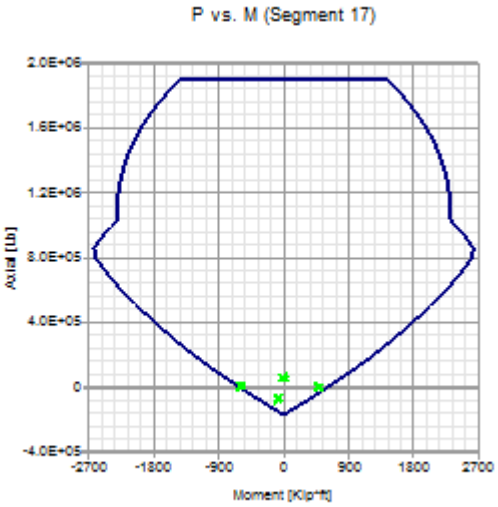
Segment	Condition	c [in]	d [in]
1	D3 (Bottom)	49.09	621.60
2	D3 (Bottom)	15.61	290.40
3	D3 (Max)	6.95	72.00
4	D3 (Max)	8.87	72.00
5	D3 (Bottom)	12.43	72.00
6	D3 (Top)	45.23	621.60
7	D3 (Bottom)	56.99	621.60
8	D3 (Max)	2.45	72.00
9	D3 (Bottom)	3.56	72.00
10	D3 (Max)	6.39	69.60
11	D3 (Max)	8.65	72.00
12	D3 (Max)	9.96	72.00
13	D3 (Max)	12.04	72.00
14	D3 (Max)	55.37	621.60
15	D3 (Bottom)	57.68	621.60
16	D3 (Max)	5.00	72.00
17	D3 (Max)	5.06	72.00
18	D3 (Max)	5.78	69.60
19	D3 (Top)	7.00	72.00
20	D3 (Max)	7.74	72.00
21	D3 (Max)	7.85	72.00
22	D3 (Max)	4.28	72.00
23	D3 (Top)	3.72	72.00
24	D3 (Top)	5.28	69.60
25	D3 (Top)	7.18	72.00
26	D3 (Top)	3.06	72.00
27	D2 (Max)	8.69	72.00
28	D3 (Max)	64.69	621.60

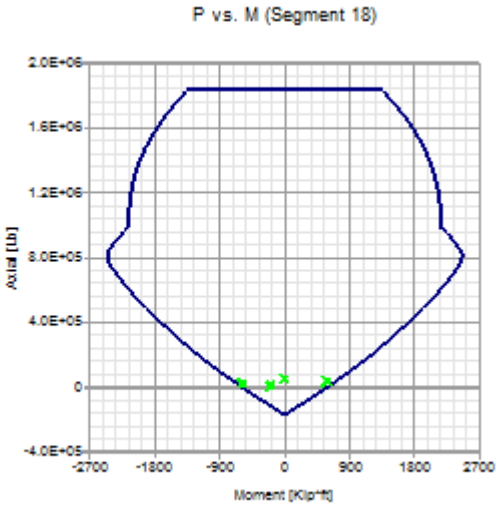
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	D3 (Bottom)	889406.30	-33271.24	80158.43	0.42
2	D3 (Bottom)	-137603.80	-7922.32	10534.86	0.75
3	D3 (Max)	188671.80	-378.47	1375.56	0.28
4	D3 (Max)	288047.00	-330.13	1702.78	0.19
5	D3 (Bottom)	480500.00	-367.07	2287.81	0.16
6	D3 (Top)	668337.40	-26461.90	73745.02	0.36
7	D3 (Bottom)	494602.40	-23917.05	62547.40	0.38
8	D3 (Max)	-186425.00	-303.89	420.28	0.72
9	D3 (Bottom)	-47789.99	-354.50	554.70	0.64
10	D3 (Max)	83190.94	-416.06	859.12	0.48
11	D3 (Max)	127547.40	356.66	1148.04	0.31
12	D3 (Max)	206232.60	-348.92	1288.78	0.27
13	D3 (Max)	277863.90	217.93	1510.64	0.14
14	D3 (Max)	432366.00	-12640.27	60791.42	0.21
15	D3 (Bottom)	217700.50	-11017.48	52286.10	0.21
16	D3 (Max)	967.99	412.93	606.15	0.68

17	D3 (Max)	2626.72	-577.73	611.99	0.94
18	D3 (Max)	22481.02	-584.89	655.50	0.89
19	D3 (Top)	55891.22	601.77	790.05	0.76
20	D3 (Max)	76404.05	-531.91	857.93	0.62
21	D3 (Max)	79425.65	-170.23	867.93	0.20
22	D3 (Max)	-243422.80	771.54	973.27	0.79
23	D3 (Top)	-134856.50	415.52	481.62	0.86
24	D3 (Top)	-91701.76	475.30	611.44	0.78
25	D3 (Top)	-36063.03	229.72	815.73	0.28
26	D3 (Top)	-52581.04	331.73	417.70	0.79
27	D2 (Max)	102587.40	314.92	944.57	0.33
28	D3 (Max)	75646.73	-2651.33	55175.43	0.05

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Top)	1317794.00	3.081279E07	0.04
2	DC1 (Max)	633673.70	1.438827E07	0.04
3	D2 (Bottom)	232905.40	3570335.00	0.07
4	D2 (Max)	332079.60	3570335.00	0.09
5	D2 (Max)	536895.50	3570335.00	0.15
6	DC1 (Bottom)	1246162.00	3.081279E07	0.04
7	DC1 (Top)	870145.40	2.052218E07	0.04
8	DC1 (Max)	130535.50	2372002.00	0.06
9	DC1 (Max)	137636.30	2376935.00	0.06
10	DC1 (Max)	128943.50	2299019.00	0.06
11	D2 (Bottom)	166238.80	2376935.00	0.07
12	D2 (Max)	236019.10	2378579.00	0.10
13	D2 (Bottom)	378134.20	2378579.00	0.16
14	D1 (Bottom)	790784.30	2.052218E07	0.04
15	DC1 (Bottom)	425402.70	1.641084E07	0.03
16	DC1 (Max)	66577.31	1901219.00	0.04
17	DC1 (Bottom)	62373.29	1901219.00	0.03
18	D1 (Max)	57214.86	1837571.00	0.03

19	D2 (Max)	79621.21	1901219.00	0.04
20	D2 (Bottom)	103600.30	1901219.00	0.05
21	D2 (Bottom)	164232.80	1901219.00	0.09
22	DC1 (Bottom)	35638.72	2180075.00	0.02
23	D2 (Bottom)	138355.30	1896286.00	0.07
24	D2 (Bottom)	118803.30	1832638.00	0.06
25	D2 (Bottom)	117488.10	1896286.00	0.06
26	D2 (Bottom)	115555.20	1901219.00	0.06
27	D2 (Bottom)	104885.90	1901219.00	0.06
28	DC1 (Max)	188584.40	1.637912E07	0.01

Axial tension

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	DC1 (Top)	0.00	1960200.00	0.00
2	D3 (Bottom)	137603.80	1056240.00	0.13
3	DC1 (Top)	0.00	200880.00	0.00
4	DC1 (Top)	0.00	200880.00	0.00
5	DC1 (Top)	0.00	200880.00	0.00
6	DC1 (Top)	0.00	1960200.00	0.00
7	DC1 (Top)	0.00	1707480.00	0.00
8	D3 (Bottom)	216041.90	301320.00	0.72
9	D3 (Bottom)	47789.99	200880.00	0.24
10	DC1 (Top)	0.00	167400.00	0.00
11	DC1 (Top)	0.00	200880.00	0.00
12	DC1 (Top)	0.00	167400.00	0.00
13	DC1 (Top)	0.00	167400.00	0.00
14	DC1 (Top)	0.00	1707480.00	0.00
15	DC1 (Top)	0.00	1506600.00	0.00
16	D3 (Top)	57922.67	167400.00	0.35
17	D3 (Bottom)	75999.34	167400.00	0.45
18	DC1 (Top)	0.00	167400.00	0.00
19	DC1 (Top)	0.00	167400.00	0.00
20	DC1 (Top)	0.00	167400.00	0.00
21	DC1 (Top)	0.00	167400.00	0.00
22	D3 (Bottom)	250720.10	511920.00	0.49
23	D3 (Top)	134856.50	267840.00	0.50
24	D3 (Top)	91701.76	267840.00	0.34
25	D3 (Top)	36063.03	267840.00	0.13
26	D3 (Top)	52581.04	167400.00	0.31
27	DC1 (Top)	0.00	167400.00	0.00
28	D3 (Bottom)	163288.60	2152440.00	0.08

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	D3 (Max)	1095764.600	2881994.300	0.38
2	D3 (Top)	686260.590	1266837.800	0.54
3	D3 (Bottom)	166513.060	347706.240	0.48
4	D3 (Bottom)	165721.370	355436.630	0.47
5	D3 (Top)	108892.750	380756.420	0.29
6	D3 (Max)	1214400.100	3268409.200	0.37
7	D3 (Max)	880788.570	2229816.500	0.40
8	D2 (Max)	89680.504	226037.020	0.40
9	D3 (Bottom)	210709.890	242464.630	0.87

10	D3 (Max)	212940.790	253790.660	0.84
11	D3 (Max)	196563.130	268765.230	0.73
12	D3 (Max)	148280.160	280568.010	0.53
13	D3 (Max)	75599.348	291312.710	0.26
14	D3 (Max)	920547.760	2220020.900	0.41
15	D3 (Max)	579024.700	1950808.800	0.30
16	D2 (Max)	123887.750	224174.780	0.55
17	D3 (Bottom)	99231.186	210626.600	0.47
18	D3 (Max)	115270.290	217997.770	0.53
19	D3 (Top)	114940.850	230410.180	0.50
20	D3 (Top)	88483.144	233759.150	0.38
21	D3 (Max)	48088.750	233940.350	0.21
22	D3 (Bottom)	265758.950	276475.630	0.96
23	D2 (Max)	111751.550	205707.730	0.54
24	D3 (Max)	122438.440	212561.840	0.58
25	D3 (Max)	126186.450	235799.570	0.54
26	D3 (Max)	96612.219	216345.510	0.45
27	D3 (Max)	49553.466	236408.300	0.21
28	D3 (Max)	228997.600	1928175.800	0.12

Notes:

* Pu = Axial load
* Pn = Nominal axial load
* Mu = Section moment
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force
* ld = Embedment length
* As = Effective cross sectional area of reinforcement

Schematic Shear Wall Design for Gridline 3

Current Date: 8/4/2016 3:33 PM
Units system: English
File name: C:\ProgramData\Bentley\Engineering\RAM Elements.en\Data\SPOE GL 3.cwd\

Design Results

Concrete Wall

GENERAL INFORMATION:

Global status : N. G.

Design code	:	ACI 318-05

Geometry:

Total height	:	53.50 [ft]
Total length	:	23.00 [ft]
Base support type	:	Continuous
Wall bottom restraint	:	Pinned
Column bottom restraint	:	Fixed
Rigidity elements	:	Columns

Materials:

Material	:	C 6-60
Steel tension strength (Fy)	:	60 [Kip/in2]
Concrete compressive strength (fc)	:	6 [Kip/in2]
Steel elasticity modulus (Es)	:	29000 [Kip/in2]
Concrete modulus of elasticity (E)	:	4415.2 [Kip/in2]
Concrete unit weight	:	0.149818 [Kip/ft3]

Number of stories: 4

Story	Story height [ft]	Wall thickness [in]
1	10.00	18.00
2	16.50	12.00
3	15.00	12.00
4	12.00	10.00

Openings:

Reference	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
Lower left	9.50	0.00	3.00	7.00
Lower left	17.50	10.00	3.00	10.00
Lower left	10.00	26.50	3.00	10.00
Lower left	10.00	41.50	3.00	10.00

Columns:

Distance [ft]	Width X [in]	Width Z [in]	Position Z
1.25	30.00	18.00	Centered
21.75	30.00	18.00	Centered

Load conditions:

ID	Comb.	Category	Description
DL	No	DL	Dead Load
EQ	No	EQ	Seismic
SC1	Yes		DL
DC1	Yes		1.4DL
D1	Yes		1.4DL
D2	Yes		1.2DL+EQ
D3	Yes		0.9DL+EQ

Concentrated loads:

Story	Condition	Direction	Magnitude [Lb]	Eccentricity [in]	Distance [ft]
1	DL	Vertical	14400.00	0.00	0.00
1	DL	Vertical	14400.00	0.00	23.00
2	DL	Vertical	13700.00	0.00	0.00
2	DL	Vertical	13700.00	0.00	23.00
3	DL	Vertical	13100.00	0.00	0.00
3	DL	Vertical	13100.00	0.00	23.00
4	EQ	Horizontal	384714.00	0.00	0.00
3	EQ	Horizontal	407204.00	0.00	0.00
2	EQ	Horizontal	205059.00	0.00	0.00
1	EQ	Horizontal	140022.00	0.00	0.00

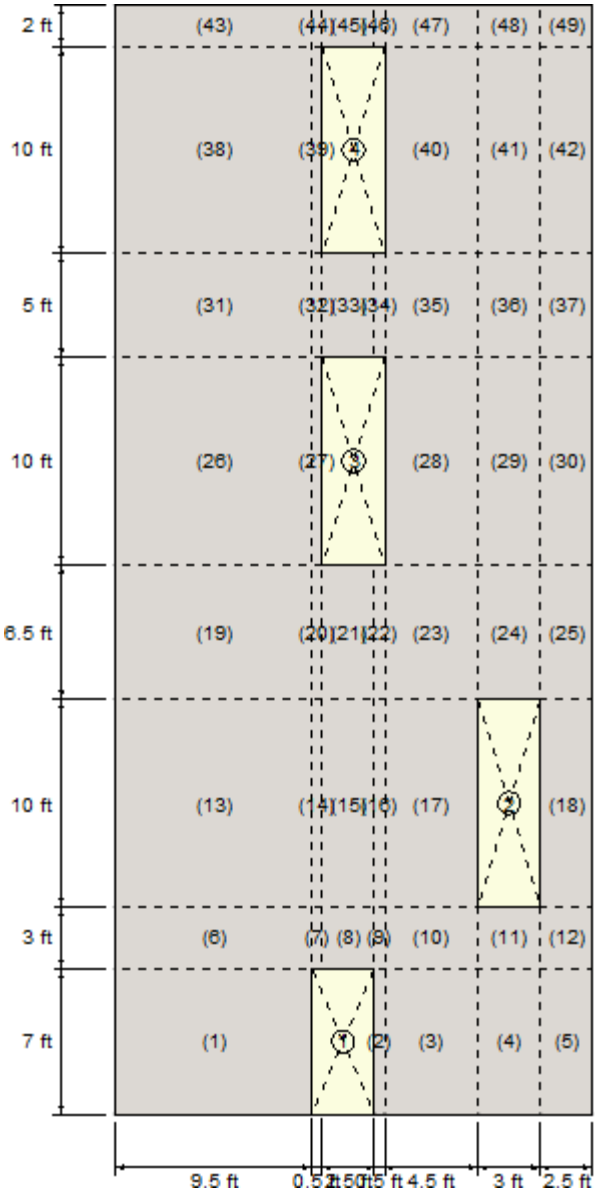
Distributed loads:

Consider self weight : DL

Story	Condition	Direction	Magnitude [Lb/ft]	Eccentricity [ft]
4	DL	Vertical	1640.00	0.00
3	DL	Vertical	1710.00	0.00
2	DL	Vertical	2700.00	0.00
1	DL	Vertical	2970.00	0.00

BEARING WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	9.50	7.00
2	12.50	0.00	0.50	7.00
3	13.00	0.00	4.50	7.00
4	17.50	0.00	3.00	7.00
5	20.50	0.00	2.50	7.00
6	0.00	7.00	9.50	3.00
7	9.50	7.00	0.50	3.00
8	10.00	7.00	2.50	3.00
9	12.50	7.00	0.50	3.00
10	13.00	7.00	4.50	3.00
11	17.50	7.00	3.00	3.00
12	20.50	7.00	2.50	3.00
13	0.00	10.00	9.50	10.00
14	9.50	10.00	0.50	10.00
15	10.00	10.00	2.50	10.00
16	12.50	10.00	0.50	10.00

17	13.00	10.00	4.50	10.00
18	20.50	10.00	2.50	10.00
19	0.00	20.00	9.50	6.50
20	9.50	20.00	0.50	6.50
21	10.00	20.00	2.50	6.50
22	12.50	20.00	0.50	6.50
23	13.00	20.00	4.50	6.50
24	17.50	20.00	3.00	6.50
25	20.50	20.00	2.50	6.50
26	0.00	26.50	9.50	10.00
27	9.50	26.50	0.50	10.00
28	13.00	26.50	4.50	10.00
29	17.50	26.50	3.00	10.00
30	20.50	26.50	2.50	10.00
31	0.00	36.50	9.50	5.00
32	9.50	36.50	0.50	5.00
33	10.00	36.50	2.50	5.00
34	12.50	36.50	0.50	5.00
35	13.00	36.50	4.50	5.00
36	17.50	36.50	3.00	5.00
37	20.50	36.50	2.50	5.00
38	0.00	41.50	9.50	10.00
39	9.50	41.50	0.50	10.00
40	13.00	41.50	4.50	10.00
41	17.50	41.50	3.00	10.00
42	20.50	41.50	2.50	10.00
43	0.00	51.50	9.50	2.00
44	9.50	51.50	0.50	2.00
45	10.00	51.50	2.50	2.00
46	12.50	51.50	0.50	2.00
47	13.00	51.50	4.50	2.00
48	17.50	51.50	3.00	2.00
49	20.50	51.50	2.50	2.00

Vertical reinforcement:

Reinforcement layers : 2

Segment	**Bars**	**Spacing** [in]	**Ld** [in]
1	12-#10	10.00	49.19
2	1-#8	10.00	38.73
3	6-#8	10.00	38.73
4	4-#8	10.00	38.73
5	2-#6	18.00	23.24
6	12-#10	10.00	49.19
7	1-#8	10.00	38.73
8	3-#8	10.00	38.73
9	1-#8	10.00	38.73
10	6-#8	10.00	38.73
11	4-#8	10.00	38.73
12	2-#6	18.00	23.24
13	12-#9	10.00	43.69
14	1-#9	12.00	43.69
15	3-#9	12.00	43.69
16	1-#9	12.00	43.69
17	5-#9	12.00	43.69
18	3-#5	12.00	19.36
19	12-#9	10.00	43.69
20	1-#9	12.00	43.69
21	3-#9	12.00	43.69

22	1-#9	12.00	43.69
23	5-#9	12.00	43.69
24	3-#7	14.00	33.89
25	3-#5	12.00	19.36
26	10-#7	12.00	33.89
27	1-#9	18.00	43.69
28	3-#7	18.00	33.89
29	2-#7	18.00	33.89
30	2-#5	18.00	19.36
31	10-#7	12.00	33.89
32	1-#9	18.00	43.69
33	2-#6	18.00	23.24
34	1-#8	18.00	38.73
35	3-#7	18.00	33.89
36	2-#7	18.00	33.89
37	2-#5	18.00	19.36
38	7-#5	18.00	19.36
39	1-#6	18.00	23.24
40	5-#5	12.00	19.36
41	3-#5	12.00	19.36
42	2-#5	18.00	19.36
43	7-#5	18.00	19.36
44	1-#6	18.00	23.24
45	2-#5	18.00	19.36
46	1-#5	18.00	19.36
47	5-#5	12.00	19.36
48	3-#5	12.00	19.36
49	2-#5	18.00	19.36

Intermediate results for axial-bending

Segment	Condition	c [in]	d [in]
1	DC1 (Top)	2.76	15.62
2	DC1 (Top)	3.06	16.00
3	DC1 (Top)	2.10	16.00
4	DC1 (Top)	2.02	16.00
5	DC1 (Top)	1.38	16.25
6	DC1 (Top)	2.70	15.74
7	DC1 (Top)	2.49	15.88
8	DC1 (Top)	1.92	15.88
9	DC1 (Top)	2.58	15.88
10	DC1 (Top)	2.11	15.88
11	DC1 (Top)	1.89	15.88
12	DC1 (Top)	1.43	16.13
13	DC1 (Top)	2.08	9.94
14	DC1 (Top)	3.20	9.94
15	DC1 (Top)	2.04	9.94
16	DC1 (Top)	3.21	9.94
17	DC1 (Top)	2.02	9.94
18	DC1 (Top)	1.23	10.31
19	DC1 (Top)	2.11	9.81
20	DC1 (Top)	3.22	9.81
21	DC1 (Top)	1.97	9.81
22	DC1 (Top)	2.99	9.81
23	DC1 (Top)	2.02	9.81
24	DC1 (Top)	1.53	9.94
25	DC1 (Top)	1.20	10.31
26	DC1 (Top)	1.40	10.19
27	DC1 (Top)	3.11	10.06
28	DC1 (Top)	1.17	10.06
29	DC1 (Top)	1.16	10.06

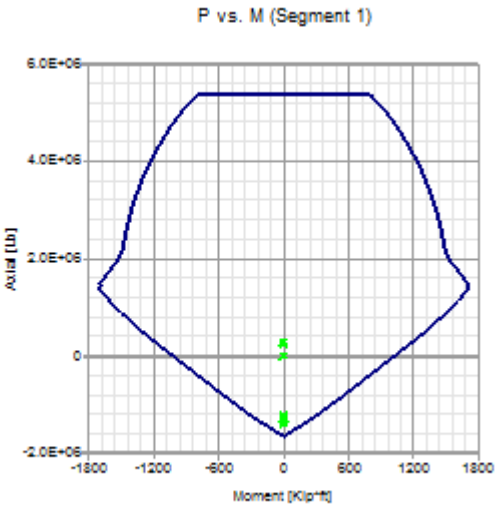
30	DC1 (Top)	0.84	10.31
31	DC1 (Top)	1.39	10.19
32	DC1 (Top)	2.98	10.06
33	DC1 (Top)	0.98	10.25
34	DC1 (Top)	2.17	10.13
35	DC1 (Top)	1.13	10.19
36	DC1 (Top)	1.13	10.19
37	DC1 (Top)	0.85	10.31
38	DC1 (Top)	0.65	8.31
39	DC1 (Top)	1.52	8.25
40	DC1 (Top)	0.94	8.31
41	DC1 (Top)	0.86	8.31
42	DC1 (Top)	0.68	8.31
43	DC1 (Top)	0.65	8.31
44	DC1 (Top)	1.50	8.25
45	DC1 (Top)	0.70	8.31
46	DC1 (Top)	1.28	8.31
47	DC1 (Top)	0.92	8.31
48	DC1 (Top)	0.86	8.31
49	DC1 (Top)	0.68	8.31

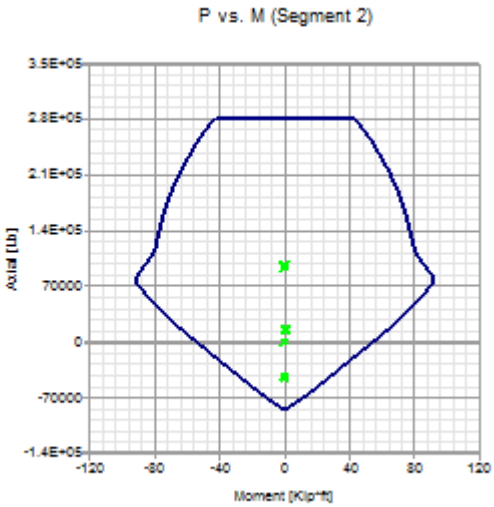
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	DC1 (Top)	260548.50	0.00	1172.79	0.00
2	DC1 (Top)	16923.93	0.00	64.08	0.00
3	DC1 (Top)	116145.10	0.00	405.46	0.00
4	DC1 (Top)	60015.73	0.00	259.69	0.00
5	DC1 (Top)	73309.55	0.00	116.08	0.00
6	DC1 (Top)	232612.00	0.00	1164.81	0.00
7	DC1 (Top)	8755.71	0.00	58.94	0.00
8	DC1 (Top)	42787.28	0.00	194.11	0.00
9	DC1 (Top)	10623.43	0.00	60.05	0.00
10	DC1 (Top)	116662.50	0.00	403.42	0.00
11	DC1 (Top)	21443.36	0.00	235.10	0.00
12	DC1 (Top)	78227.43	0.00	119.11	0.00
13	DC1 (Top)	145141.20	0.00	559.85	0.00
14	DC1 (Top)	7471.25	0.00	42.62	0.00
15	DC1 (Top)	37528.17	0.00	141.28	0.00
16	DC1 (Top)	7799.75	0.00	42.72	0.00
17	DC1 (Top)	84258.79	0.00	245.46	0.00
18	DC1 (Top)	48079.33	0.00	66.26	0.00
19	DC1 (Top)	146351.00	0.00	554.55	0.00
20	DC1 (Top)	7895.83	0.00	42.24	0.00
21	DC1 (Top)	13141.83	0.00	131.56	0.00
22	DC1 (Top)	6067.94	0.00	41.70	0.00
23	DC1 (Top)	69069.70	0.00	238.06	0.00
24	DC1 (Top)	39760.80	0.00	100.19	0.00
25	DC1 (Top)	41404.03	0.00	63.63	0.00
26	DC1 (Top)	81338.36	0.00	313.23	0.00
27	DC1 (Top)	5657.18	0.00	42.57	0.00
28	DC1 (Top)	39242.60	0.00	106.04	0.00
29	DC1 (Top)	25108.03	0.00	70.28	0.00
30	DC1 (Top)	21415.16	0.00	41.55	0.00
31	DC1 (Top)	72216.32	0.00	309.75	0.00
32	DC1 (Top)	2891.20	0.00	41.74	0.00
33	DC1 (Top)	6537.92	0.00	47.57	0.00
34	DC1 (Top)	2042.20	0.00	33.99	0.00
35	DC1 (Top)	31035.86	0.00	102.86	0.00

36	DC1 (Top)	21053.18	0.00	68.71	0.00
37	DC1 (Top)	22735.57	0.00	42.13	0.00
38	DC1 (Top)	22560.98	0.00	101.51	0.00
39	DC1 (Top)	2126.49	0.00	16.52	0.00
40	DC1 (Top)	15138.01	0.00	69.68	0.00
41	DC1 (Top)	7073.63	0.00	41.80	0.00
42	DC1 (Top)	3577.27	0.00	27.81	0.00
43	DC1 (Top)	20729.06	0.00	100.83	0.00
44	DC1 (Top)	1327.86	0.00	16.29	0.00
45	DC1 (Top)	5687.15	0.00	28.59	0.00
46	DC1 (Top)	1331.90	0.00	12.25	0.00
47	DC1 (Top)	11154.14	0.00	68.37	0.00
48	DC1 (Top)	7368.77	0.00	41.90	0.00
49	DC1 (Top)	3642.05	0.00	27.83	0.00

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Bottom)	284811.10	5361071.00	0.05
2	D2 (Top)	97250.59	282225.80	0.34
3	D2 (Top)	691491.70	2552603.00	0.27
4	D2 (Bottom)	640930.70	1701735.00	0.38
5	D2 (Bottom)	851800.80	1427412.00	0.60
6	DC1 (Bottom)	261003.60	5361071.00	0.05
7	DC1 (Bottom)	11287.48	282225.80	0.04
8	D2 (Top)	82821.37	1419510.00	0.06
9	D2 (Bottom)	97249.70	282225.80	0.34
10	D2 (Top)	824170.60	2552603.00	0.32
11	D2 (Bottom)	469796.20	1701735.00	0.28
12	D2 (Bottom)	632274.20	1427412.00	0.44
13	D1 (Bottom)	170224.40	3564288.00	0.05
14	D2 (Top)	7888.62	185640.00	0.04
15	D2 (Bottom)	62552.25	938808.00	0.07
16	D2 (Bottom)	43359.49	185640.00	0.23

17	D2 (Bottom)	826920.30	1691976.00	0.49
18	D2 (Bottom)	530666.20	949787.30	0.56
19	DC1 (Top)	146351.00	3564288.00	0.04
20	D2 (Top)	73977.00	185640.00	0.40
21	D2 (Top)	94463.16	938808.00	0.10
22	D2 (Bottom)	13985.04	185640.00	0.08
23	D2 (Bottom)	127768.20	1691976.00	0.08
24	D2 (Top)	198711.60	1136117.00	0.17
25	D2 (Bottom)	506228.10	949787.30	0.53
26	D1 (Bottom)	97685.62	3596112.00	0.03
27	D2 (Bottom)	97244.89	185640.00	0.52
28	D2 (Top)	279085.00	1708949.00	0.16
29	D2 (Bottom)	186084.30	1139299.00	0.16
30	D2 (Bottom)	325271.00	951431.50	0.34
31	DC1 (Bottom)	81338.35	3596112.00	0.02
32	D2 (Top)	67817.54	185640.00	0.37
33	D2 (Top)	112662.10	950052.50	0.12
34	D2 (Bottom)	108658.00	186753.80	0.58
35	D2 (Bottom)	279075.50	1708949.00	0.16
36	D2 (Bottom)	96631.69	1139299.00	0.08
37	D2 (Bottom)	120960.80	951431.50	0.13
38	D1 (Bottom)	35707.53	3011770.00	0.01
39	D2 (Bottom)	101621.40	156786.20	0.65
40	D2 (Top)	57151.39	1423859.00	0.04
41	D2 (Bottom)	77046.47	949787.30	0.08
42	D2 (Bottom)	77322.54	792311.50	0.10
43	D2 (Top)	134460.50	3011770.00	0.04
44	D1 (Bottom)	2123.57	156786.20	0.01
45	DC1 (Top)	5687.15	792311.50	0.01
46	D2 (Bottom)	50699.92	157475.80	0.32
47	D2 (Bottom)	57122.15	1423859.00	0.04
48	D1 (Top)	7368.77	949787.30	0.01
49	D2 (Bottom)	6690.05	792311.50	0.01

Axial tension

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Top)	1398847.00	1645920.00	0.85
2	D3 (Bottom)	45669.07	85320.00	0.54
3	DC1 (Top)	0.00	511920.00	0.00
4	DC1 (Top)	0.00	341280.00	0.00
5	DC1 (Top)	0.00	95040.00	0.00
6	D3 (Bottom)	1388692.00	1645920.00	0.84
7	D3 (Bottom)	65291.29	85320.00	0.77
8	DC1 (Top)	0.00	255960.00	0.00
9	DC1 (Top)	0.00	85320.00	0.00
10	DC1 (Top)	0.00	511920.00	0.00
11	DC1 (Top)	0.00	341280.00	0.00
12	DC1 (Top)	0.00	95040.00	0.00
13	D3 (Bottom)	1198945.00	1296000.00	0.93
14	D3 (Bottom)	15694.37	108000.00	0.15
15	DC1 (Top)	0.00	324000.00	0.00
16	DC1 (Top)	0.00	108000.00	0.00
17	DC1 (Top)	0.00	540000.00	0.00
18	DC1 (Top)	0.00	100440.00	0.00
19	D3 (Bottom)	596583.10	1296000.00	0.46
20	DC1 (Top)	0.00	108000.00	0.00

21	DC1 (Top)	0.00	324000.00	0.00
22	D3 (Top)	76003.78	108000.00	0.70
23	D3 (Top)	156544.60	540000.00	0.29
24	DC1 (Top)	0.00	194400.00	0.00
25	DC1 (Top)	0.00	100440.00	0.00
26	D3 (Bottom)	329212.00	648000.00	0.51
27	D3 (Top)	89084.59	108000.00	0.82
28	D3 (Bottom)	183041.60	194400.00	0.94
29	DC1 (Top)	0.00	129600.00	0.00
30	DC1 (Top)	0.00	66960.00	0.00
31	D3 (Bottom)	260301.30	648000.00	0.40
32	D3 (Bottom)	89077.07	108000.00	0.82
33	D3 (Bottom)	85572.20	95040.00	0.90
34	D3 (Top)	71153.38	85320.00	0.83
35	D3 (Top)	72021.66	194400.00	0.37
36	DC1 (Top)	0.00	129600.00	0.00
37	DC1 (Top)	0.00	66960.00	0.00
38	D3 (Bottom)	38416.96	234360.00	0.16
39	D3 (Top)	40190.58	47520.00	0.85
40	D3 (Bottom)	115054.50	167400.00	0.69
41	DC1 (Top)	0.00	100440.00	0.00
42	DC1 (Top)	0.00	66960.00	0.00
43	DC1 (Top)	0.00	234360.00	0.00
44	D3 (Bottom)	40094.73	47520.00	0.84
45	D3 (Bottom)	34644.66	66960.00	0.52
46	DC1 (Top)	0.00	33480.00	0.00
47	D3 (Top)	5042.40	167400.00	0.03
48	DC1 (Top)	0.00	100440.00	0.00
49	DC1 (Top)	0.00	66960.00	0.00

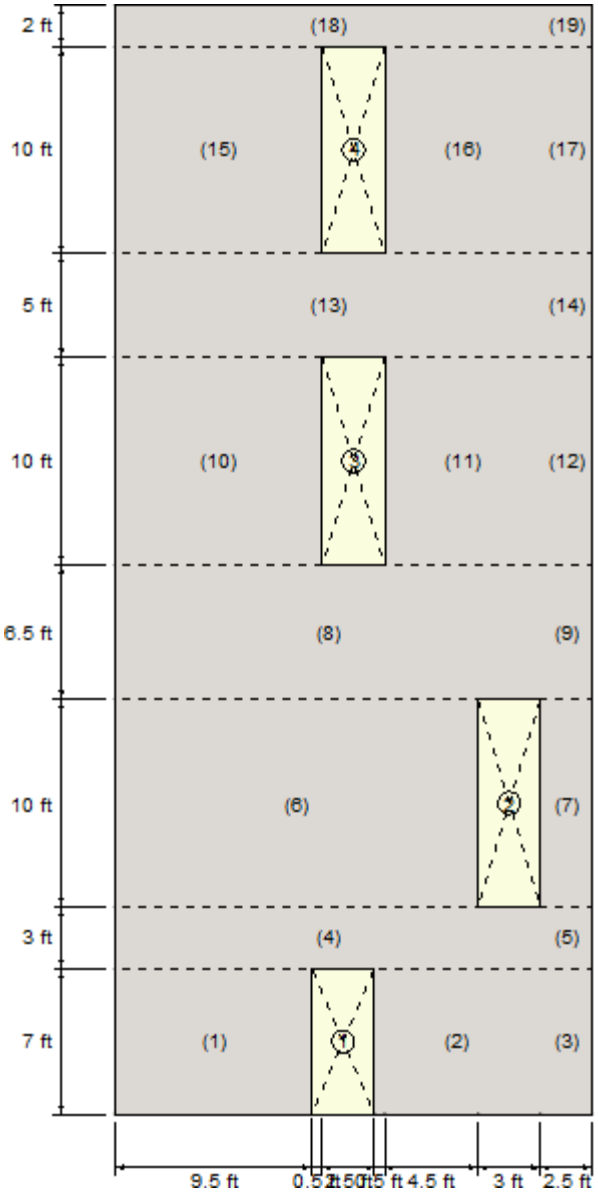
Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	DC1 (Top)	0.000	206830.090	0.00
2	DC1 (Top)	0.000	11154.192	0.00
3	DC1 (Top)	0.000	100387.730	0.00
4	DC1 (Top)	0.000	66925.152	0.00
5	DC1 (Top)	0.000	56642.381	0.00
6	DC1 (Top)	0.000	208485.790	0.00
7	DC1 (Top)	0.000	11067.050	0.00
8	DC1 (Top)	0.000	55335.250	0.00
9	DC1 (Top)	0.000	11067.050	0.00
10	DC1 (Top)	0.000	99603.449	0.00
11	DC1 (Top)	0.000	66402.299	0.00
12	DC1 (Top)	0.000	56206.671	0.00
13	DC1 (Top)	0.000	131608.310	0.00
14	DC1 (Top)	0.000	6926.753	0.00
15	DC1 (Top)	0.000	34633.766	0.00
16	DC1 (Top)	0.000	6926.753	0.00
17	DC1 (Top)	0.000	62340.779	0.00
18	DC1 (Top)	0.000	35946.127	0.00
19	DC1 (Top)	0.000	129952.610	0.00
20	DC1 (Top)	0.000	6839.611	0.00
21	DC1 (Top)	0.000	34198.056	0.00
22	DC1 (Top)	0.000	6839.611	0.00
23	DC1 (Top)	0.000	61556.500	0.00
24	DC1 (Top)	0.000	41566.794	0.00

25	DC1 (Top)	0.000	35946.127	0.00
26	DC1 (Top)	0.000	134939.580	0.00
27	DC1 (Top)	0.000	7013.895	0.00
28	DC1 (Top)	0.000	63134.470	0.00
29	DC1 (Top)	0.000	42089.647	0.00
30	DC1 (Top)	0.000	35946.127	0.00
31	DC1 (Top)	0.000	134939.580	0.00
32	DC1 (Top)	0.000	7013.895	0.00
33	DC1 (Top)	0.000	35728.271	0.00
34	DC1 (Top)	0.000	7058.512	0.00
35	DC1 (Top)	0.000	63918.749	0.00
36	DC1 (Top)	0.000	42612.499	0.00
37	DC1 (Top)	0.000	35946.127	0.00
38	DC1 (Top)	0.000	110104.080	0.00
39	DC1 (Top)	0.000	5751.380	0.00
40	DC1 (Top)	0.000	52154.562	0.00
41	DC1 (Top)	0.000	34769.708	0.00
42	DC1 (Top)	0.000	28974.757	0.00
43	DC1 (Top)	0.000	110104.080	0.00
44	DC1 (Top)	0.000	5751.380	0.00
45	DC1 (Top)	0.000	28974.757	0.00
46	DC1 (Top)	0.000	5794.951	0.00
47	DC1 (Top)	0.000	52154.562	0.00
48	DC1 (Top)	0.000	34769.708	0.00
49	DC1 (Top)	0.000	28974.757	0.00

SHEAR WALL DESIGN:

Status : N. G.
- Insufficient combined axial-flexural resistance, ØMn < Mu (Segment 1)
- Insufficient shear strength (Segment 10)



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	9.50	7.00
2	12.50	0.00	8.00	7.00
3	20.50	0.00	2.50	7.00
4	0.00	7.00	20.50	3.00
5	20.50	7.00	2.50	3.00
6	0.00	10.00	17.50	10.00
7	20.50	10.00	2.50	10.00
8	0.00	20.00	20.50	6.50
9	20.50	20.00	2.50	6.50
10	0.00	26.50	10.00	10.00
11	13.00	26.50	7.50	10.00
12	20.50	26.50	2.50	10.00
13	0.00	36.50	20.50	5.00
14	20.50	36.50	2.50	5.00
15	0.00	41.50	10.00	10.00
16	13.00	41.50	7.50	10.00

17	20.50	41.50	2.50	10.00
18	0.00	51.50	20.50	2.00
19	20.50	51.50	2.50	2.00

Reinforcement:

Reinforcement layers : 2

	Vertical reinforcement			Horizontal reinforcement		
Segment	**Bars**	**Spacing** [in]	**Ld** [in]	**Bars**	**Spacing** [in]	**Ld** [in]
1	12-#10	10.00	49.19	7-#8	12.00	50.35
2	1-#8	10.00	38.73	6-#6	16.00	30.21
	6-#8	10.00	38.73	6-#6	16.00	30.21
	4-#8	10.00	38.73	6-#6	16.00	30.21
3	2-#6	18.00	23.24	7-#5	12.00	25.17
4	12-#10	10.00	49.19	2-#7	18.00	44.06
	1-#8	10.00	49.19	2-#7	18.00	44.06
	3-#8	10.00	49.19	2-#7	18.00	44.06
	1-#8	10.00	49.19	2-#7	18.00	44.06
	6-#8	10.00	49.19	2-#7	18.00	44.06
	4-#8	10.00	49.19	2-#7	18.00	44.06
5	2-#6	18.00	23.24	2-#6	18.00	30.21
6	12-#9	10.00	43.69	12-#6	10.00	30.21
	1-#9	12.00	43.69	12-#6	10.00	30.21
	3-#9	12.00	43.69	12-#6	10.00	30.21
	1-#9	12.00	43.69	12-#6	10.00	30.21
	5-#9	12.00	43.69	12-#6	10.00	30.21
7	3-#5	12.00	19.36	7-#5	18.00	25.17
8	12-#9	10.00	43.69	5-#7	16.00	44.06
	1-#9	12.00	43.69	5-#7	16.00	44.06
	3-#9	12.00	43.69	5-#7	16.00	44.06
	1-#9	12.00	43.69	5-#7	16.00	44.06
	5-#9	12.00	43.69	5-#7	16.00	44.06
	3-#7	14.00	43.69	5-#7	16.00	44.06
9	3-#5	12.00	19.36	5-#5	18.00	25.17
10	10-#7	12.00	43.69	8-#5	16.00	25.17
	1-#9	18.00	43.69	8-#5	16.00	25.17
11	3-#7	18.00	33.89	10-#6	12.00	30.21
	2-#7	18.00	33.89	10-#6	12.00	30.21
12	2-#5	18.00	19.36	7-#5	18.00	25.17
13	10-#7	12.00	43.69	4-#5	16.00	25.17
	1-#9	18.00	43.69	4-#5	16.00	25.17
	2-#6	18.00	43.69	4-#5	16.00	25.17
	1-#8	18.00	43.69	4-#5	16.00	25.17
	3-#7	18.00	43.69	4-#5	16.00	25.17
	2-#7	18.00	43.69	4-#5	16.00	25.17
14	2-#5	18.00	19.36	4-#5	18.00	25.17
15	7-#5	18.00	23.24	7-#5	18.00	25.17
	1-#6	18.00	23.24	7-#5	18.00	25.17
16	5-#5	12.00	19.36	7-#5	18.00	25.17
	3-#5	12.00	19.36	7-#5	18.00	25.17
17	2-#5	18.00	19.36	7-#5	18.00	25.17
18	7-#5	18.00	23.24	2-#5	18.00	25.17
	1-#6	18.00	23.24	2-#5	18.00	25.17
	2-#5	18.00	23.24	2-#5	18.00	25.17
	1-#5	18.00	23.24	2-#5	18.00	25.17
	5-#5	12.00	23.24	2-#5	18.00	25.17
	3-#5	12.00	23.24	2-#5	18.00	25.17
19	2-#5	18.00	19.36	2-#5	18.00	25.17

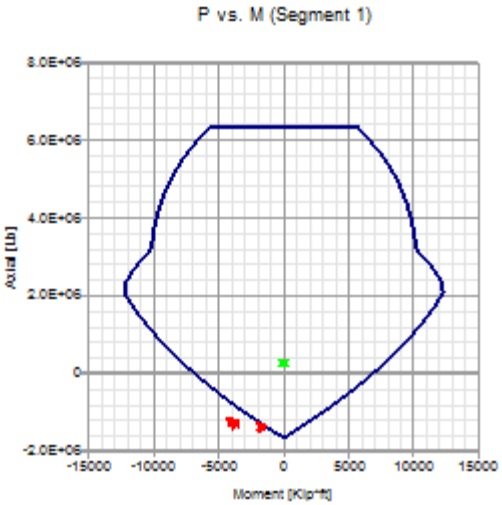
Intermediate results for axial-bending

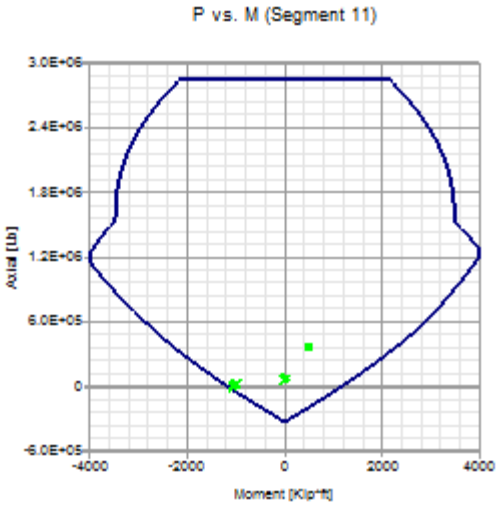
Segment	Condition	c [in]	d [in]
1	D3 (Bottom)	2.47	91.20
2	D3 (Bottom)	21.96	76.80
3	D2 (Bottom)	19.62	24.00
4	D3 (Bottom)	29.53	196.80
5	D2 (Top)	10.27	24.00
6	D3 (Bottom)	32.02	168.00
7	D3 (Bottom)	18.16	24.00
8	D3 (Bottom)	33.50	196.80
9	D2 (Bottom)	17.70	24.00
10	D3 (Bottom)	10.51	96.00
11	D3 (Bottom)	6.33	72.00
12	D3 (Max)	7.81	24.00
13	D3 (Bottom)	26.35	196.80
14	DC1 (Top)	1.55	24.00
15	D3 (Max)	10.04	96.00
16	D3 (Max)	4.92	72.00
17	DC1 (Bottom)	1.43	24.00
18	D3 (Top)	20.18	196.80
19	D2 (Top)	1.37	24.00

Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	D3 (Bottom)	-1282484.00	-4021.46	1689.87	2.38
2	D3 (Bottom)	911917.80	-1737.16	5936.78	0.29
3	D2 (Bottom)	851795.20	-124.72	582.92	0.21
4	D3 (Bottom)	-213627.60	-17009.73	21814.26	0.78
5	D2 (Top)	584622.50	-117.00	641.03	0.18
6	D3 (Bottom)	-311840.60	-11960.10	15317.15	0.78
7	D3 (Bottom)	519064.00	-68.12	391.51	0.17
8	D3 (Bottom)	-399172.50	-5442.01	17432.18	0.31
9	D2 (Bottom)	504983.70	58.69	392.36	0.15
10	D3 (Bottom)	-233414.30	-1826.76	2759.89	0.66
11	D3 (Bottom)	-3183.32	-1059.12	1142.46	0.93
12	D3 (Max)	286182.00	-27.62	359.62	0.08
13	D3 (Bottom)	34082.24	-3754.41	10835.18	0.35
14	DC1 (Top)	22757.29	-7.28	106.54	0.07
15	D3 (Max)	91241.66	-1024.16	1912.30	0.54
16	D3 (Max)	-68001.73	-568.44	694.11	0.82
17	DC1 (Bottom)	4730.59	6.49	85.15	0.08
18	D3 (Top)	115340.20	848.14	6765.51	0.13
19	D2 (Top)	1234.85	-1.45	81.07	0.02

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Bottom)	284817.80	6312047.00	0.05
2	D2 (Top)	1257185.00	5078820.00	0.25
3	D2 (Bottom)	851795.20	1427412.00	0.60
4	DC1 (Bottom)	468671.00	1.328979E07	0.04
5	D2 (Bottom)	632875.30	1427412.00	0.44
6	DC1 (Bottom)	319601.80	7939152.00	0.04
7	D2 (Bottom)	530657.30	949787.30	0.56
8	D1 (Max)	291138.60	9187589.00	0.03
9	D2 (Bottom)	504983.70	949787.30	0.53
10	D1 (Max)	105773.20	3781752.00	0.03
11	D2 (Top)	376002.80	2848248.00	0.13
12	D2 (Bottom)	325089.10	951431.50	0.34
13	D1 (Bottom)	155126.90	7766806.00	0.02
14	D2 (Bottom)	120871.00	951431.50	0.13
15	D2 (Max)	99234.94	3168557.00	0.03
16	D2 (Top)	61219.60	2373646.00	0.03
17	D2 (Bottom)	77268.07	792311.50	0.10
18	D2 (Top)	125540.20	6491990.00	0.02
19	D2 (Bottom)	6648.93	792311.50	0.01

Axial tension

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Top)	1399985.00	1645920.00	0.85
2	DC1 (Top)	0.00	938520.00	0.00
3	DC1 (Top)	0.00	95040.00	0.00
4	D3 (Top)	235680.30	2925720.00	0.08
5	DC1 (Top)	0.00	95040.00	0.00
6	D3 (Top)	415863.90	2376000.00	0.18
7	DC1 (Top)	0.00	100440.00	0.00
8	D3 (Bottom)	399172.50	2570400.00	0.16

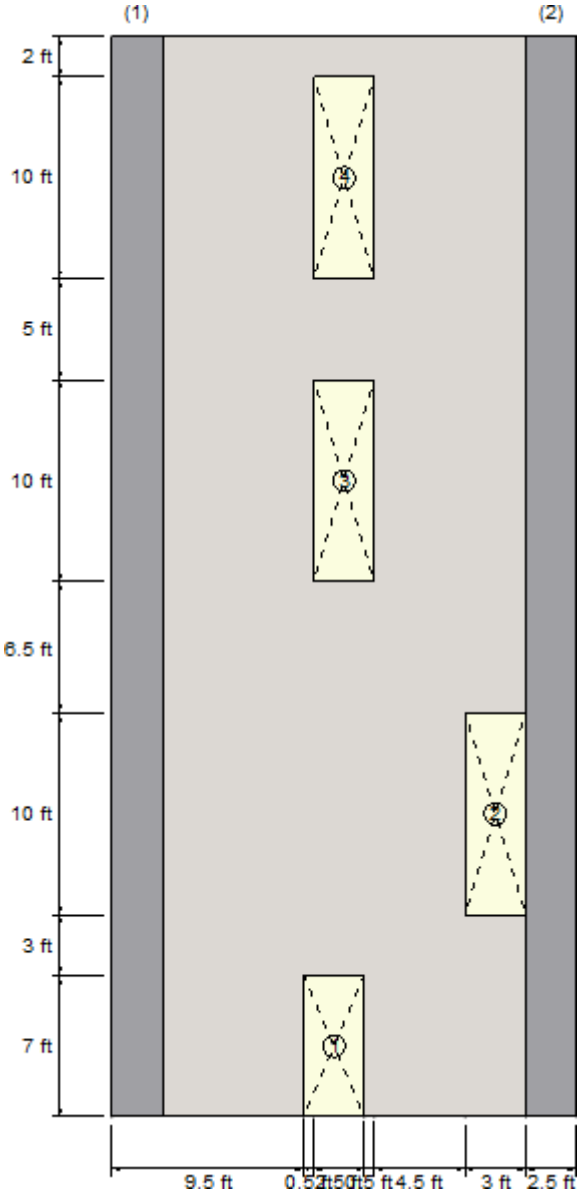
9	DC1 (Top)	0.00	100440.00	0.00
10	D3 (Top)	349683.40	756000.00	0.46
11	D3 (Bottom)	3183.32	324000.00	0.01
12	DC1 (Top)	0.00	66960.00	0.00
13	DC1 (Top)	0.00	1260360.00	0.00
14	DC1 (Top)	0.00	66960.00	0.00
15	D3 (Top)	65382.03	281880.00	0.23
16	D3 (Max)	68001.73	267840.00	0.25
17	DC1 (Top)	0.00	66960.00	0.00
18	DC1 (Top)	0.00	650160.00	0.00
19	DC1 (Top)	0.00	66960.00	0.00

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	D3 (Max)	504127.930	540360.000	0.93
2	D3 (Top)	635761.070	637467.790	1.00
3	D2 (Bottom)	138912.750	250969.320	0.55
4	D3 (Max)	1199322.400	1247917.500	0.96
5	D2 (Max)	33174.943	186556.730	0.18
6	D3 (Top)	970568.140	989393.180	0.98
7	D2 (Top)	49053.144	167312.880	0.29
8	D3 (Bottom)	1021687.500	1057072.800	0.97
9	D3 (Top)	58056.823	142451.860	0.41
10	D3 (Bottom)	355908.040	353240.860	1.01
11	D3 (Bottom)	386656.530	402762.250	0.96
12	D3 (Max)	73069.916	135340.540	0.54
13	D3 (Max)	781515.310	801259.660	0.98
14	D3 (Bottom)	28806.128	109855.490	0.26
15	D3 (Bottom)	230635.170	342287.250	0.67
16	D2 (Bottom)	201654.930	244542.660	0.82
17	D3 (Max)	29229.797	91740.926	0.32
18	D3 (Bottom)	333888.080	685848.340	0.49
19	D2 (Max)	11308.695	83729.518	0.14

COLUMN DESIGN:

Status : Warnings
- Every longitudinal bar shall have lateral support provided by the corner of a tie, Section 7.10.5.3 (Column 7)



Geometry:

Column	Distance [ft]	Position Z	Width X [in]	Width Z [in]	Height [ft]
1	1.25	Centered	30.00	18.00	53.50
2	21.75	Centered	30.00	18.00	53.50

Reinforcement:

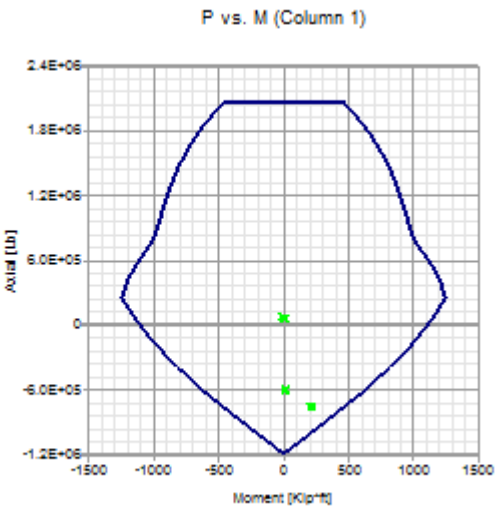
	Longitudinal reinforcement			Transverse reinforcement	
Column	Bars	As [in2]	Ld [in]	Bars	Spacing [in]
1	14-#11	21.84	54.61	#3	3.00
2	14-#11	21.84	54.61	#3	3.00
3	10-#11	15.60	54.61	#3	6.00
4	10-#11	15.60	54.61	#3	6.00
5	8-#11	12.48	54.61	#3	6.00
6	8-#11	12.48	54.61	#3	6.00
7	8-#11	12.48	54.61	#3	6.00

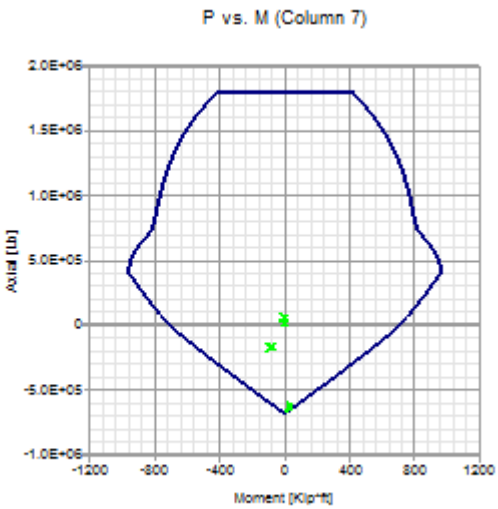
8	6-#11	9.36	54.61	#3	6.00

Combined biaxial flexure

Column	Condition	Pu [Lb]	Mc [Kip*ft]	ϕMn [Kip*ft]	Mc/(ϕ*Mn)
1	D3	756912.00	213.45	458.22	0.47
2	D2	-780071.30	211.94	1008.93	0.21
3	D3	551101.20	37.63	321.73	0.12
4	D2	-754743.30	95.40	610.66	0.16
5	D3	573364.40	39.72	114.74	0.35
6	D2	-756238.30	90.45	552.18	0.16
7	D3	631879.10	31.47	50.55	0.62
8	D2	-751682.70	71.41	495.26	0.14

Interaction diagrams, P vs. M:





Axial tension

Column	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/(ϕ*Pn)
1	D3	756912.00	1179360.00	0.64
2	SC1	0.00	1179360.00	0.00
3	D3	645929.80	842400.00	0.77
4	SC1	0.00	842400.00	0.00
5	D3	573364.40	673920.00	0.85
6	SC1	0.00	673920.00	0.00
7	D3	631879.10	673920.00	0.94
8	SC1	0.00	505440.00	0.00

Axial compression

Column	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/(ϕ*Pn)
1	DC1	-75467.38	-2055568.00	0.04
2	D2	-780071.30	-2055568.00	0.38
3	DC1	-65003.31	-1877429.00	0.03
4	D2	-754743.30	-1877429.00	0.40
5	DC1	-59425.70	-1788359.00	0.03
6	D2	-756238.30	-1788359.00	0.42
7	DC1	-62332.29	-1788359.00	0.03
8	D2	-751682.70	-1699289.00	0.44

Shear along X direction

Column	Condition	Pos	Vu [Lb]	Vc [Lb]	Vs [Lb]	ϕ*Vn [Lb]	Vu/(ϕ*Vn)
1	D3	At bot...	72213.238	0.000	180972.000	135729.000	0.53
2	D2	At bot...	81943.213	131689.580	180972.000	234496.190	0.35
3	D2	At bottom	6442.217	0.000	60324.000	45243.000	0.14
4	D3	At top	18890.013	128758.930	60324.000	141812.200	0.13
5	D2	At bot...	15338.773	0.000	60324.000	45243.000	0.34
6	D3	At top	19628.335	128846.370	60324.000	141877.780	0.14
7	D3	At bot...	41215.485	28882.740	60324.000	66905.055	0.62
8	D2	At top	21399.343	129679.720	60324.000	142502.790	0.15

Shear along Z direction

Column	Condition	Pos	Vu [Lb]	Vc [Lb]	Vs [Lb]	ϕ*Vn [Lb]	Vu/(ϕ*Vn)
1	SC1	At top	0.000	71665.684	203544.000	206407.260	0.00
2	SC1	At top	0.000	71665.684	203544.000	206407.260	0.00
3	SC1	At top	0.000	71665.684	84810.000	117356.760	0.00
4	SC1	At top	0.000	71665.684	84810.000	117356.760	0.00
5	SC1	At top	0.000	71665.684	67848.000	104635.260	0.00
6	SC1	At top	0.000	71665.684	67848.000	104635.260	0.00
7	SC1	At top	0.000	71665.684	50886.000	91913.763	0.00
8	SC1	At top	0.000	71665.684	50886.000	91913.763	0.00

Notes:

* Pu = Axial load
* Pn = Nominal axial load
* Mu = Section moment
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force
* ld = Embedment length
* As = Effective cross sectional area of reinforcement

Schematic Shear Wall Design for Gridline 6

Current Date: 8/4/2016 3:31 PM
Units system: English
File name: C:\ProgramData\Bentley\Engineering\RAM Elements.en\Data\SPOE GL 6.cwd\

Design Results

Concrete Wall

GENERAL INFORMATION:

Global status : N. G.

Design code	:	ACI 318-05

Geometry:

Total height	:	53.50 [ft]
Total length	:	23.00 [ft]
Base support type	:	Continuous
Wall bottom restraint	:	Pinned
Column bottom restraint	:	Fixed
Rigidity elements	:	Columns

Materials:

Material	:	C 6-60
Steel tension strength (Fy)	:	60 [Kip/in2]
Concrete compressive strength (fc)	:	6 [Kip/in2]
Steel elasticity modulus (Es)	:	29000 [Kip/in2]
Concrete modulus of elasticity (E)	:	4415.2 [Kip/in2]
Concrete unit weight	:	0.149818 [Kip/ft3]

Number of stories: 4

Story	Story height [ft]	Wall thickness [in]
1	10.00	18.00
2	16.50	12.00
3	15.00	12.00
4	12.00	10.00

Openings:

Reference	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
Lower left	4.00	0.00	3.00	7.00
Lower left	17.00	0.00	3.00	7.00
Lower left	2.00	10.00	3.00	10.00
Lower left	8.00	26.50	3.00	10.00
Lower left	2.25	41.50	2.75	10.00
Lower left	7.25	41.50	3.00	10.00

Columns:

Distance [ft]	Width X [in]	Width Z [in]	Position Z
1.00	24.00	18.00	Centered
21.75	30.00	18.00	Centered

Load conditions:

ID	Comb.	Category	Description
DL	No	DL	Dead Load
EQ	No	EQ	Seismic
SC1	Yes		DL
DC1	Yes		1.4DL
D1	Yes		1.4DL
D2	Yes		1.2DL+EQ
D3	Yes		0.9DL+EQ

Concentrated loads:

Story	Condition	Direction	Magnitude [Lb]	Eccentricity [in]	Distance [ft]
1	DL	Vertical	14400.00	0.00	0.00
1	DL	Vertical	14400.00	0.00	23.00
2	DL	Vertical	13700.00	0.00	0.00
2	DL	Vertical	13700.00	0.00	23.00
3	DL	Vertical	13100.00	0.00	0.00
3	DL	Vertical	13100.00	0.00	23.00
4	EQ	Horizontal	384714.00	0.00	0.00
3	EQ	Horizontal	407204.00	0.00	0.00
2	EQ	Horizontal	205059.00	0.00	0.00
1	EQ	Horizontal	140022.00	0.00	0.00

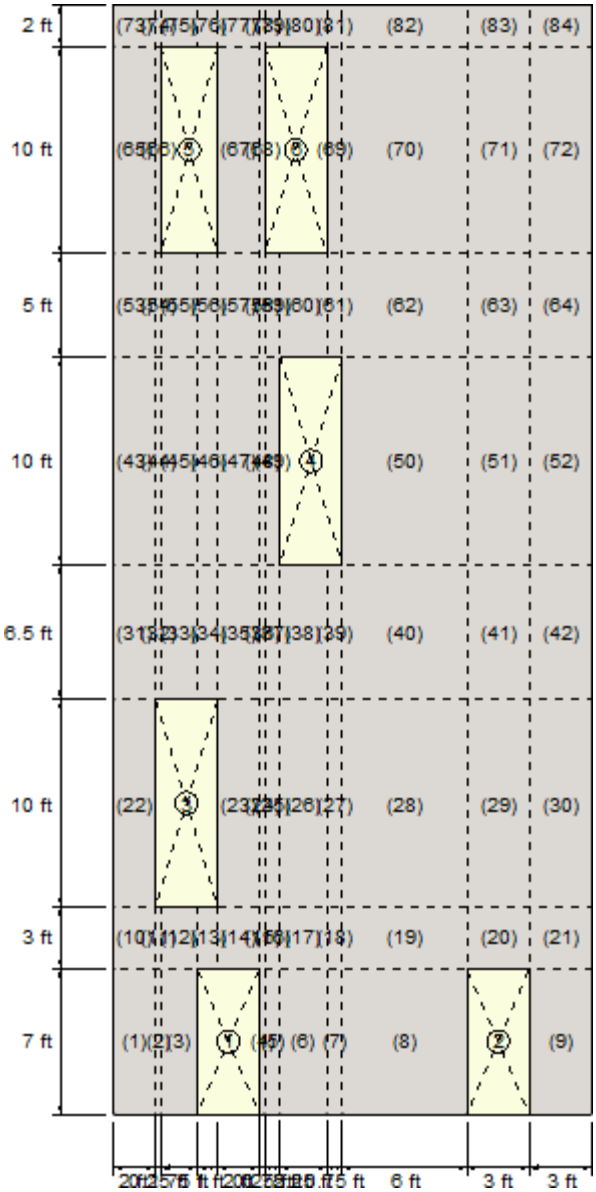
Distributed loads:

Consider self weight : DL

Story	Condition	Direction	Magnitude [Lb/ft]	Eccentricity [ft]
4	DL	Vertical	1640.00	0.00
3	DL	Vertical	1710.00	0.00
2	DL	Vertical	2700.00	0.00
1	DL	Vertical	2970.00	0.00

BEARING WALL DESIGN:

Status : N. G.
- Insufficient axial tension strength (Segment 1)



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	2.00	7.00
2	2.00	0.00	0.25	7.00
3	2.25	0.00	1.75	7.00
4	7.00	0.00	0.25	7.00
5	7.25	0.00	0.75	7.00
6	8.00	0.00	2.25	7.00
7	10.25	0.00	0.75	7.00
8	11.00	0.00	6.00	7.00
9	20.00	0.00	3.00	7.00
10	0.00	7.00	2.00	3.00
11	2.00	7.00	0.25	3.00
12	2.25	7.00	1.75	3.00
13	4.00	7.00	1.00	3.00
14	5.00	7.00	2.00	3.00
15	7.00	7.00	0.25	3.00
16	7.25	7.00	0.75	3.00

17	8.00	7.00	2.25	3.00
18	10.25	7.00	0.75	3.00
19	11.00	7.00	6.00	3.00
20	17.00	7.00	3.00	3.00
21	20.00	7.00	3.00	3.00
22	0.00	10.00	2.00	10.00
23	5.00	10.00	2.00	10.00
24	7.00	10.00	0.25	10.00
25	7.25	10.00	0.75	10.00
26	8.00	10.00	2.25	10.00
27	10.25	10.00	0.75	10.00
28	11.00	10.00	6.00	10.00
29	17.00	10.00	3.00	10.00
30	20.00	10.00	3.00	10.00
31	0.00	20.00	2.00	6.50
32	2.00	20.00	0.25	6.50
33	2.25	20.00	1.75	6.50
34	4.00	20.00	1.00	6.50
35	5.00	20.00	2.00	6.50
36	7.00	20.00	0.25	6.50
37	7.25	20.00	0.75	6.50
38	8.00	20.00	2.25	6.50
39	10.25	20.00	0.75	6.50
40	11.00	20.00	6.00	6.50
41	17.00	20.00	3.00	6.50
42	20.00	20.00	3.00	6.50
43	0.00	26.50	2.00	10.00
44	2.00	26.50	0.25	10.00
45	2.25	26.50	1.75	10.00
46	4.00	26.50	1.00	10.00
47	5.00	26.50	2.00	10.00
48	7.00	26.50	0.25	10.00
49	7.25	26.50	0.75	10.00
50	11.00	26.50	6.00	10.00
51	17.00	26.50	3.00	10.00
52	20.00	26.50	3.00	10.00
53	0.00	36.50	2.00	5.00
54	2.00	36.50	0.25	5.00
55	2.25	36.50	1.75	5.00
56	4.00	36.50	1.00	5.00
57	5.00	36.50	2.00	5.00
58	7.00	36.50	0.25	5.00
59	7.25	36.50	0.75	5.00
60	8.00	36.50	2.25	5.00
61	10.25	36.50	0.75	5.00
62	11.00	36.50	6.00	5.00
63	17.00	36.50	3.00	5.00
64	20.00	36.50	3.00	5.00
65	0.00	41.50	2.00	10.00
66	2.00	41.50	0.25	10.00
67	5.00	41.50	2.00	10.00
68	7.00	41.50	0.25	10.00
69	10.25	41.50	0.75	10.00
70	11.00	41.50	6.00	10.00
71	17.00	41.50	3.00	10.00
72	20.00	41.50	3.00	10.00
73	0.00	51.50	2.00	2.00
74	2.00	51.50	0.25	2.00
75	2.25	51.50	1.75	2.00
76	4.00	51.50	1.00	2.00
77	5.00	51.50	2.00	2.00
78	7.00	51.50	0.25	2.00
79	7.25	51.50	0.75	2.00
80	8.00	51.50	2.25	2.00

81	10.25	51.50	0.75	2.00
82	11.00	51.50	6.00	2.00
83	17.00	51.50	3.00	2.00
84	20.00	51.50	3.00	2.00

Vertical reinforcement:

Reinforcement layers : 2

Segment	Bars	Spacing [in]	Ld [in]
1	3-#10	10.00	49.19
2	1-#10	10.00	49.19
3	2-#10	10.00	49.19
4	1-#10	12.00	49.19
5	1-#10	12.00	49.19
6	3-#10	12.00	49.19
7	1-#10	12.00	49.19
8	6-#10	12.00	49.19
9	4-#8	10.00	38.73
10	3-#10	10.00	49.19
11	1-#10	10.00	49.19
12	2-#10	10.00	49.19
13	1-#10	10.00	49.19
14	3-#10	10.00	49.19
15	1-#10	12.00	49.19
16	1-#10	12.00	49.19
17	3-#10	12.00	49.19
18	1-#10	12.00	49.19
19	6-#10	12.00	49.19
20	4-#8	10.00	38.73
21	4-#8	10.00	38.73
22	3-#10	10.00	49.19
23	3-#10	10.00	49.19
24	1-#6	12.00	23.24
25	1-#7	18.00	33.89
26	3-#6	12.00	23.24
27	1-#9	18.00	43.69
28	6-#6	12.00	23.24
29	3-#6	12.00	23.24
30	3-#6	12.00	23.24
31	3-#10	10.00	49.19
32	1-#6	18.00	23.24
33	2-#7	18.00	33.89
34	1-#5	10.00	19.36
35	3-#10	10.00	49.19
36	1-#6	12.00	23.24
37	1-#7	18.00	33.89
38	3-#6	12.00	23.24
39	1-#9	18.00	43.69
40	6-#6	12.00	23.24
41	3-#6	12.00	23.24
42	3-#6	12.00	23.24
43	3-#8	10.00	38.73
44	1-#8	14.00	38.73
45	2-#8	14.00	38.73
46	1-#8	14.00	38.73
47	2-#8	14.00	38.73
48	1-#8	14.00	38.73
49	1-#10	10.00	49.19
50	4-#6	18.00	23.24

51	3-#5	14.00	19.36
52	3-#5	14.00	19.36
53	3-#8	10.00	38.73
54	1-#8	14.00	38.73
55	2-#8	14.00	38.73
56	1-#8	14.00	38.73
57	2-#8	14.00	38.73
58	1-#8	14.00	38.73
59	1-#10	10.00	49.19
60	3-#6	12.00	23.24
61	1-#9	18.00	43.69
62	4-#6	18.00	23.24
63	3-#5	14.00	19.36
64	3-#5	14.00	19.36
65	2-#7	18.00	33.89
66	1-#7	18.00	33.89
67	2-#9	18.00	43.69
68	1-#9	18.00	43.69
69	1-#10	10.00	49.19
70	5-#6	16.00	23.24
71	3-#6	16.00	23.24
72	3-#6	16.00	23.24
73	2-#7	18.00	33.89
74	1-#7	18.00	33.89
75	2-#6	16.00	23.24
76	1-#6	16.00	23.24
77	2-#9	18.00	43.69
78	1-#9	18.00	43.69
79	1-#8	18.00	38.73
80	2-#6	16.00	23.24
81	1-#10	10.00	49.19
82	5-#6	16.00	23.24
83	3-#6	16.00	23.24
84	3-#6	16.00	23.24

Intermediate results for axial-bending

Segment	Condition	c [in]	d [in]
1	DC1 (Top)	3.24	15.49
2	DC1 (Top)	7.85	15.49
3	DC1 (Top)	2.60	15.49
4	DC1 (Top)	8.13	15.74
5	DC1 (Top)	3.07	15.74
6	DC1 (Top)	2.95	15.74
7	DC1 (Top)	2.94	15.74
8	DC1 (Top)	2.43	15.74
9	DC1 (Top)	2.18	16.13
10	DC1 (Top)	3.53	15.86
11	DC1 (Top)	7.59	15.86
12	DC1 (Top)	2.14	15.86
13	DC1 (Top)	2.08	15.86
14	DC1 (Top)	3.15	15.86
15	DC1 (Top)	7.71	15.86
16	DC1 (Top)	2.77	15.86
17	DC1 (Top)	2.85	15.86
18	DC1 (Top)	2.87	15.86
19	DC1 (Top)	2.27	15.86
20	DC1 (Top)	1.99	16.00
21	DC1 (Top)	2.10	16.00
22	DC1 (Top)	3.18	9.99
23	DC1 (Top)	3.15	9.74

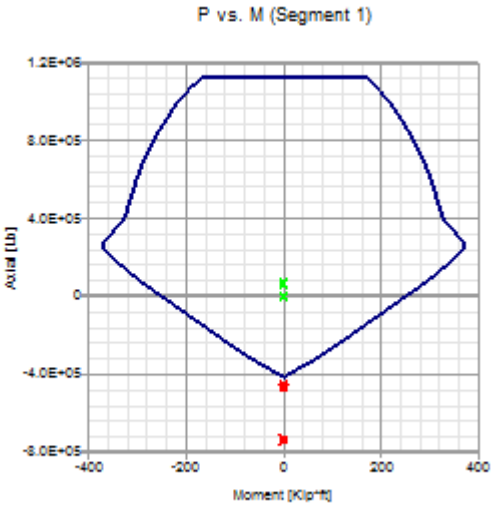
24	DC1 (Top)	2.92	10.00
25	DC1 (Top)	1.74	9.94
26	DC1 (Top)	1.52	10.00
27	DC1 (Top)	2.19	9.81
28	DC1 (Top)	1.35	10.00
29	DC1 (Top)	1.34	10.00
30	DC1 (Top)	1.33	10.00
31	DC1 (Top)	3.12	9.99
32	DC1 (Top)	2.83	10.25
33	DC1 (Top)	1.51	10.19
34	DC1 (Top)	1.08	10.31
35	DC1 (Top)	3.07	9.99
36	DC1 (Top)	2.91	10.25
37	DC1 (Top)	1.64	10.19
38	DC1 (Top)	1.31	10.25
39	DC1 (Top)	2.04	10.06
40	DC1 (Top)	1.28	10.25
41	DC1 (Top)	1.27	10.25
42	DC1 (Top)	1.28	10.25
43	DC1 (Top)	1.93	10.00
44	DC1 (Top)	4.67	10.00
45	DC1 (Top)	1.70	10.00
46	DC1 (Top)	1.61	10.00
47	DC1 (Top)	1.61	10.00
48	DC1 (Top)	4.68	10.00
49	DC1 (Top)	2.47	9.86
50	DC1 (Top)	0.99	10.25
51	DC1 (Top)	0.97	10.31
52	DC1 (Top)	0.97	10.31
53	DC1 (Top)	1.89	10.13
54	DC1 (Top)	4.58	10.13
55	DC1 (Top)	1.57	10.13
56	DC1 (Top)	1.53	10.13
57	DC1 (Top)	1.56	10.13
58	DC1 (Top)	4.66	10.13
59	DC1 (Top)	2.32	9.99
60	DC1 (Top)	1.28	10.25
61	DC1 (Top)	2.00	10.06
62	DC1 (Top)	0.94	10.25
63	DC1 (Top)	0.95	10.31
64	DC1 (Top)	0.98	10.31
65	DC1 (Top)	1.30	8.19
66	DC1 (Top)	3.48	8.19
67	DC1 (Top)	1.70	8.06
68	DC1 (Top)	5.08	8.06
69	DC1 (Top)	2.32	7.99
70	DC1 (Top)	0.98	8.25
71	DC1 (Top)	1.09	8.25
72	DC1 (Top)	1.08	8.25
73	DC1 (Top)	1.29	8.19
74	DC1 (Top)	3.45	8.19
75	DC1 (Top)	1.18	8.25
76	DC1 (Top)	1.08	8.25
77	DC1 (Top)	1.68	8.06
78	DC1 (Top)	5.04	8.06
79	DC1 (Top)	1.68	8.13
80	DC1 (Top)	1.01	8.25
81	DC1 (Top)	2.27	7.99
82	DC1 (Top)	0.97	8.25
83	DC1 (Top)	1.09	8.25
84	DC1 (Top)	1.08	8.25

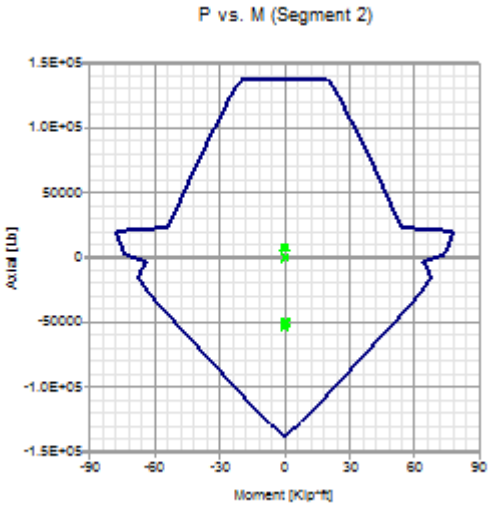
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	DC1 (Top)	62277.51	0.00	284.96	0.00
2	DC1 (Top)	6671.15	0.00	74.84	0.00
3	DC1 (Top)	43128.81	0.00	195.56	0.00
4	DC1 (Top)	9589.81	0.00	76.88	0.00
5	DC1 (Top)	23745.09	0.00	99.08	0.00
6	DC1 (Top)	63432.86	0.00	292.90	0.00
7	DC1 (Top)	20905.08	0.00	97.50	0.00
8	DC1 (Top)	178246.00	0.00	629.37	0.00
9	DC1 (Top)	96843.64	0.00	283.85	0.00
10	DC1 (Top)	68161.01	0.00	293.94	0.00
11	DC1 (Top)	3998.15	0.00	76.08	0.00
12	DC1 (Top)	11146.82	0.00	180.42	0.00
13	DC1 (Top)	10692.40	0.00	94.21	0.00
14	DC1 (Top)	44007.62	0.00	281.03	0.00
15	DC1 (Top)	5215.26	0.00	76.41	0.00
16	DC1 (Top)	17255.18	0.00	96.16	0.00
17	DC1 (Top)	57629.80	0.00	291.82	0.00
18	DC1 (Top)	19539.92	0.00	97.46	0.00
19	DC1 (Top)	150938.80	0.00	617.04	0.00
20	DC1 (Top)	53432.04	0.00	255.68	0.00
21	DC1 (Top)	78728.03	0.00	271.10	0.00
22	DC1 (Top)	39685.27	0.00	167.86	0.00
23	DC1 (Top)	39229.82	0.00	163.90	0.00
24	DC1 (Top)	4352.28	0.00	19.56	0.00
25	DC1 (Top)	12721.90	0.00	31.77	0.00
26	DC1 (Top)	35891.26	0.00	76.24	0.00
27	DC1 (Top)	11793.56	0.00	45.76	0.00
28	DC1 (Top)	94625.20	0.00	168.02	0.00
29	DC1 (Top)	46494.04	0.00	83.69	0.00
30	DC1 (Top)	45039.51	0.00	83.12	0.00
31	DC1 (Top)	34684.67	0.00	166.30	0.00
32	DC1 (Top)	3451.40	0.00	19.71	0.00
33	DC1 (Top)	23840.39	0.00	64.81	0.00
34	DC1 (Top)	13869.22	0.00	21.77	0.00
35	DC1 (Top)	30408.38	0.00	164.97	0.00
36	DC1 (Top)	4287.68	0.00	19.99	0.00
37	DC1 (Top)	12593.88	0.00	32.04	0.00
38	DC1 (Top)	12980.92	0.00	67.77	0.00
39	DC1 (Top)	6800.27	0.00	45.00	0.00
40	DC1 (Top)	94441.51	0.00	167.81	0.00
41	DC1 (Top)	43290.54	0.00	82.38	0.00
42	DC1 (Top)	46582.86	0.00	83.66	0.00
43	DC1 (Top)	17515.37	0.00	108.03	0.00
44	DC1 (Top)	2016.41	0.00	29.12	0.00
45	DC1 (Top)	13630.89	0.00	75.30	0.00
46	DC1 (Top)	7654.90	0.00	38.68	0.00
47	DC1 (Top)	16353.26	0.00	77.74	0.00
48	DC1 (Top)	2020.36	0.00	29.12	0.00
49	DC1 (Top)	7976.11	0.00	54.45	0.00
50	DC1 (Top)	56617.53	0.00	115.48	0.00
51	DC1 (Top)	24655.79	0.00	58.16	0.00
52	DC1 (Top)	24121.87	0.00	57.93	0.00
53	DC1 (Top)	21674.91	0.00	110.54	0.00
54	DC1 (Top)	978.38	0.00	27.90	0.00
55	DC1 (Top)	2064.53	0.00	71.45	0.00

56	DC1 (Top)	5481.49	0.00	38.02	0.00
57	DC1 (Top)	17113.24	0.00	78.32	0.00
58	DC1 (Top)	1815.39	0.00	28.79	0.00
59	DC1 (Top)	3311.35	0.00	53.50	0.00
60	DC1 (Top)	6536.95	0.00	65.30	0.00
61	DC1 (Top)	4987.64	0.00	44.34	0.00
62	DC1 (Top)	44291.26	0.00	109.98	0.00
63	DC1 (Top)	20834.25	0.00	56.49	0.00
64	DC1 (Top)	24972.07	0.00	58.30	0.00
65	DC1 (Top)	3481.79	0.00	47.14	0.00
66	DC1 (Top)	802.39	0.00	18.51	0.00
67	DC1 (Top)	10387.28	0.00	72.97	0.00
68	DC1 (Top)	1975.36	0.00	19.98	0.00
69	DC1 (Top)	3327.58	0.00	41.83	0.00
70	DC1 (Top)	16735.67	0.00	96.58	0.00
71	DC1 (Top)	7377.09	0.00	55.68	0.00
72	DC1 (Top)	4550.04	0.00	54.75	0.00
73	DC1 (Top)	2343.29	0.00	46.80	0.00
74	DC1 (Top)	528.69	0.00	18.37	0.00
75	DC1 (Top)	4116.85	0.00	36.14	0.00
76	DC1 (Top)	1483.40	0.00	18.24	0.00
77	DC1 (Top)	5558.82	0.00	71.62	0.00
78	DC1 (Top)	661.48	0.00	18.94	0.00
79	DC1 (Top)	1862.17	0.00	28.09	0.00
80	DC1 (Top)	5399.76	0.00	37.87	0.00
81	DC1 (Top)	1843.54	0.00	41.42	0.00
82	DC1 (Top)	14529.76	0.00	95.85	0.00
83	DC1 (Top)	7286.44	0.00	55.65	0.00
84	DC1 (Top)	4990.11	0.00	54.90	0.00

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Bottom)	68609.59	1125456.00	0.06
2	D1 (Bottom)	7937.38	136471.90	0.06
3	DC1 (Bottom)	53760.83	988983.80	0.05
4	D1 (Top)	9589.81	136471.90	0.07
5	DC1 (Bottom)	26056.88	422887.90	0.06
6	DC1 (Bottom)	71344.30	1268664.00	0.06
7	DC1 (Bottom)	23368.14	422887.90	0.06
8	D2 (Bottom)	920404.30	3396576.00	0.27
9	D2 (Top)	1075170.00	1701735.00	0.63
10	D1 (Top)	68161.01	1125456.00	0.06
11	D1 (Bottom)	6671.15	136471.90	0.05
12	D1 (Bottom)	43128.57	988983.80	0.04
13	DC1 (Bottom)	14386.78	566095.90	0.03
14	DC1 (Top)	44007.62	1125456.00	0.04
15	DC1 (Bottom)	9589.33	136471.90	0.07
16	DC1 (Bottom)	23745.06	422887.90	0.06
17	D1 (Bottom)	63432.85	1268664.00	0.05
18	DC1 (Bottom)	20905.08	422887.90	0.05
19	D2 (Bottom)	343013.60	3396576.00	0.10
20	D2 (Top)	335399.60	1701735.00	0.20
21	D2 (Bottom)	1064372.00	1701735.00	0.63
22	DC1 (Bottom)	43350.15	743567.80	0.06
23	D1 (Top)	39229.82	743567.80	0.05
24	D1 (Bottom)	4528.32	93138.24	0.05
25	DC1 (Bottom)	13917.84	283233.60	0.05
26	DC1 (Bottom)	45852.53	852246.70	0.05
27	D1 (Bottom)	15946.59	281112.00	0.06
28	D2 (Bottom)	203317.90	2277325.00	0.09
29	D2 (Bottom)	348154.60	1138663.00	0.31
30	D2 (Bottom)	700026.00	1138663.00	0.61
31	DC1 (Bottom)	39685.17	743567.80	0.05
32	D1 (Top)	3451.40	93138.24	0.04
33	DC1 (Top)	23840.39	661939.20	0.04
34	D2 (Bottom)	43902.71	380243.80	0.12
35	D2 (Top)	59591.82	743567.80	0.08
36	D2 (Top)	22220.31	93138.24	0.24
37	D2 (Top)	93839.09	283233.60	0.33
38	D2 (Top)	116532.40	852246.70	0.14
39	DC1 (Bottom)	11793.55	281112.00	0.04
40	D2 (Bottom)	97687.82	2277325.00	0.04
41	D2 (Bottom)	275335.20	1138663.00	0.24
42	D2 (Bottom)	444063.70	1138663.00	0.39
43	D1 (Top)	17515.37	751205.50	0.02
44	D1 (Bottom)	2520.56	91281.84	0.03
45	D1 (Bottom)	17439.78	659923.70	0.03
46	D1 (Bottom)	10166.87	377697.80	0.03
47	D2 (Bottom)	38647.77	755395.70	0.05
48	D2 (Bottom)	18951.63	91281.84	0.21
49	D2 (Bottom)	124732.60	279679.90	0.45
50	D2 (Top)	187804.20	2281993.00	0.08
51	D2 (Bottom)	210917.60	1140731.00	0.18
52	D2 (Bottom)	334895.80	1140731.00	0.29
53	D2 (Top)	39224.23	751205.50	0.05
54	D2 (Top)	10068.08	91281.84	0.11
55	D2 (Top)	93387.15	659923.70	0.14
56	D1 (Bottom)	7654.89	377697.80	0.02
57	DC1 (Top)	17113.24	755395.70	0.02

58	D2 (Top)	18017.07	91281.84	0.20
59	D2 (Top)	82243.12	279679.90	0.29
60	DC1 (Top)	6536.95	852246.70	0.01
61	D2 (Bottom)	102687.60	281112.00	0.37
62	D2 (Bottom)	187800.70	2281993.00	0.08
63	D2 (Bottom)	101170.10	1140731.00	0.09
64	D2 (Bottom)	175341.60	1140731.00	0.15
65	D2 (Bottom)	46966.72	630115.20	0.07
66	D2 (Bottom)	12069.24	76377.60	0.16
67	D2 (Top)	43749.91	625872.00	0.07
68	D2 (Bottom)	42138.66	74256.00	0.57
69	D2 (Top)	31327.85	231943.90	0.14
70	DC1 (Bottom)	28101.92	1897771.00	0.01
71	D2 (Bottom)	88326.27	947718.70	0.09
72	D2 (Bottom)	113077.10	947718.70	0.12
73	D2 (Top)	103446.60	630115.20	0.16
74	D2 (Top)	8419.44	76377.60	0.11
75	DC1 (Top)	4116.85	552252.50	0.01
76	D2 (Bottom)	81969.57	315906.20	0.26
77	D2 (Top)	26262.21	625872.00	0.04
78	D1 (Bottom)	1235.62	74256.00	0.02
79	D1 (Top)	1862.17	234489.80	0.01
80	D2 (Bottom)	118183.10	711372.50	0.17
81	D2 (Bottom)	31242.56	231943.90	0.13
82	DC1 (Bottom)	16735.67	1897771.00	0.01
83	D2 (Bottom)	9410.09	947718.70	0.01
84	D2 (Bottom)	9848.44	947718.70	0.01

Axial tension

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Bottom)	741282.40	411480.00	1.80
2	D3 (Bottom)	52475.38	137160.00	0.38
3	D3 (Top)	391767.80	274320.00	1.43
4	D3 (Bottom)	113000.70	137160.00	0.82
5	D3 (Bottom)	263927.00	137160.00	1.92
6	D3 (Bottom)	401984.00	411480.00	0.98
7	D3 (Bottom)	56486.14	137160.00	0.41
8	DC1 (Top)	0.00	822960.00	0.00
9	DC1 (Top)	0.00	341280.00	0.00
10	D3 (Bottom)	476445.20	411480.00	1.16
11	D3 (Bottom)	50751.55	137160.00	0.37
12	D3 (Bottom)	391764.40	274320.00	1.43
13	D3 (Bottom)	244618.90	137160.00	1.78
14	D3 (Top)	409183.50	411480.00	0.99
15	D3 (Top)	13723.91	137160.00	0.10
16	D3 (Bottom)	63068.09	137160.00	0.46
17	D3 (Bottom)	187192.90	411480.00	0.45
18	D3 (Bottom)	31546.55	137160.00	0.23
19	DC1 (Top)	0.00	822960.00	0.00
20	DC1 (Top)	0.00	341280.00	0.00
21	DC1 (Top)	0.00	341280.00	0.00
22	D3 (Top)	411438.40	411480.00	1.00
23	D3 (Bottom)	424731.30	411480.00	1.03
24	D3 (Bottom)	23638.32	47520.00	0.50
25	D3 (Bottom)	53564.13	64800.00	0.83
26	D3 (Bottom)	86446.13	142560.00	0.61

27	D3 (Top)	14518.90	108000.00	0.13
28	DC1 (Top)	0.00	285120.00	0.00
29	DC1 (Top)	0.00	142560.00	0.00
30	DC1 (Top)	0.00	142560.00	0.00
31	D3 (Bottom)	411436.90	411480.00	1.00
32	D3 (Bottom)	46251.05	47520.00	0.97
33	D3 (Top)	117295.00	129600.00	0.91
34	D3 (Top)	23218.89	33480.00	0.69
35	DC1 (Top)	0.00	411480.00	0.00
36	D3 (Bottom)	2727.26	47520.00	0.06
37	D3 (Bottom)	9765.39	64800.00	0.15
38	D3 (Bottom)	39404.28	142560.00	0.28
39	D3 (Top)	95839.67	108000.00	0.89
40	D3 (Top)	135712.70	285120.00	0.48
41	DC1 (Top)	0.00	142560.00	0.00
42	DC1 (Top)	0.00	142560.00	0.00
43	D3 (Bottom)	222719.30	255960.00	0.87
44	D3 (Bottom)	25396.11	85320.00	0.30
45	D3 (Bottom)	118583.50	170640.00	0.69
46	D3 (Bottom)	29192.14	85320.00	0.34
47	D3 (Top)	97012.41	170640.00	0.57
48	D3 (Top)	20432.88	85320.00	0.24
49	D3 (Top)	160638.90	137160.00	1.17
50	D3 (Bottom)	168753.80	190080.00	0.89
51	DC1 (Top)	0.00	100440.00	0.00
52	DC1 (Top)	0.00	100440.00	0.00
53	D3 (Bottom)	75045.96	255960.00	0.29
54	D3 (Bottom)	4914.92	85320.00	0.06
55	D3 (Bottom)	21454.44	170640.00	0.13
56	D3 (Top)	48706.37	85320.00	0.57
57	D3 (Bottom)	97012.51	170640.00	0.57
58	D3 (Bottom)	20432.73	85320.00	0.24
59	D3 (Bottom)	160620.60	137160.00	1.17
60	D3 (Bottom)	130039.50	142560.00	0.91
61	D3 (Top)	96069.13	108000.00	0.89
62	D3 (Top)	23176.96	190080.00	0.12
63	DC1 (Top)	0.00	100440.00	0.00
64	DC1 (Top)	0.00	100440.00	0.00
65	D3 (Top)	56653.27	129600.00	0.44
66	D3 (Top)	2356.26	64800.00	0.04
67	D3 (Bottom)	77390.71	216000.00	0.36
68	D3 (Top)	54269.46	108000.00	0.50
69	D3 (Bottom)	141006.60	137160.00	1.03
70	D3 (Top)	36632.00	237600.00	0.15
71	DC1 (Top)	0.00	142560.00	0.00
72	DC1 (Top)	0.00	142560.00	0.00
73	D3 (Bottom)	56652.94	129600.00	0.44
74	D3 (Bottom)	2356.17	64800.00	0.04
75	D3 (Bottom)	82284.85	95040.00	0.87
76	DC1 (Top)	0.00	47520.00	0.00
77	D3 (Bottom)	8189.16	216000.00	0.04
78	D3 (Bottom)	27782.71	108000.00	0.26
79	D3 (Bottom)	71926.16	85320.00	0.84
80	D3 (Top)	13479.47	95040.00	0.14
81	DC1 (Top)	0.00	137160.00	0.00
82	D3 (Bottom)	36631.96	237600.00	0.15
83	DC1 (Top)	0.00	142560.00	0.00
84	DC1 (Top)	0.00	142560.00	0.00

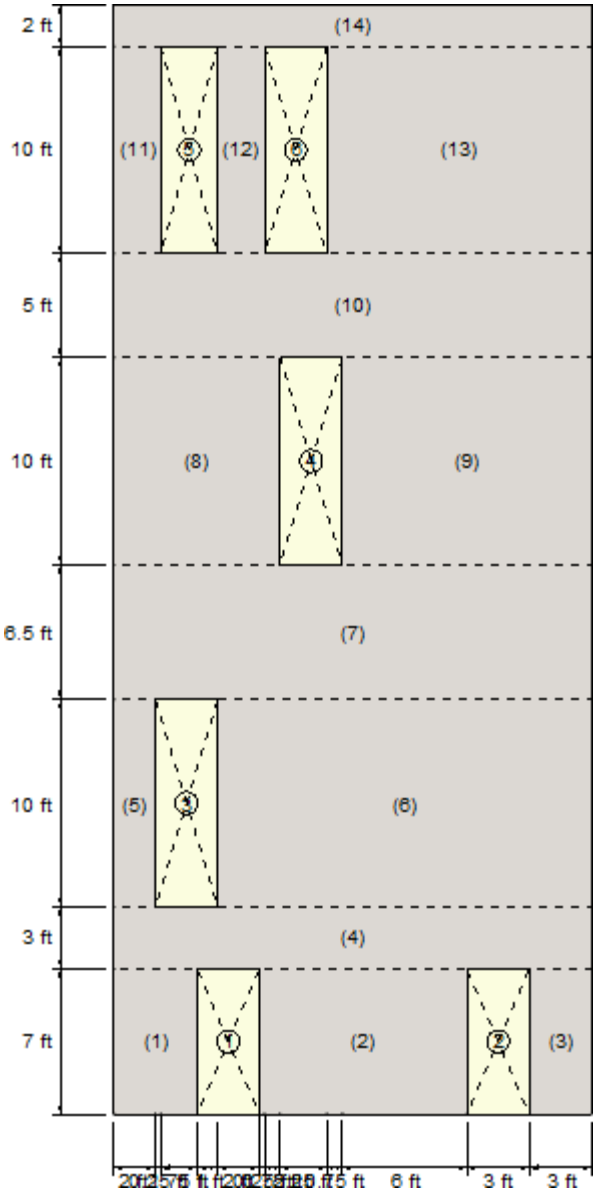
Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	DC1 (Top)	0.000	43186.243	0.00
2	DC1 (Top)	0.000	5398.280	0.00
3	DC1 (Top)	0.000	37787.963	0.00
4	DC1 (Top)	0.000	5486.468	0.00
5	DC1 (Top)	0.000	16459.405	0.00
6	DC1 (Top)	0.000	49378.214	0.00
7	DC1 (Top)	0.000	16459.405	0.00
8	DC1 (Top)	0.000	131675.240	0.00
9	DC1 (Top)	0.000	67448.005	0.00
10	DC1 (Top)	0.000	44240.314	0.00
11	DC1 (Top)	0.000	5530.039	0.00
12	DC1 (Top)	0.000	38710.275	0.00
13	DC1 (Top)	0.000	22120.157	0.00
14	DC1 (Top)	0.000	44240.314	0.00
15	DC1 (Top)	0.000	5530.039	0.00
16	DC1 (Top)	0.000	16590.118	0.00
17	DC1 (Top)	0.000	49770.353	0.00
18	DC1 (Top)	0.000	16590.118	0.00
19	DC1 (Top)	0.000	132720.940	0.00
20	DC1 (Top)	0.000	66925.152	0.00
21	DC1 (Top)	0.000	66925.152	0.00
22	DC1 (Top)	0.000	27857.595	0.00
23	DC1 (Top)	0.000	27160.458	0.00
24	DC1 (Top)	0.000	3485.685	0.00
25	DC1 (Top)	0.000	10391.698	0.00
26	DC1 (Top)	0.000	31371.165	0.00
27	DC1 (Top)	0.000	10259.417	0.00
28	DC1 (Top)	0.000	83656.440	0.00
29	DC1 (Top)	0.000	41828.220	0.00
30	DC1 (Top)	0.000	41828.220	0.00
31	DC1 (Top)	0.000	27857.595	0.00
32	DC1 (Top)	0.000	3572.827	0.00
33	DC1 (Top)	0.000	24857.291	0.00
34	DC1 (Top)	0.000	14378.451	0.00
35	DC1 (Top)	0.000	27857.595	0.00
36	DC1 (Top)	0.000	3572.827	0.00
37	DC1 (Top)	0.000	10653.125	0.00
38	DC1 (Top)	0.000	32155.444	0.00
39	DC1 (Top)	0.000	10520.843	0.00
40	DC1 (Top)	0.000	85747.851	0.00
41	DC1 (Top)	0.000	42873.926	0.00
42	DC1 (Top)	0.000	42873.926	0.00
43	DC1 (Top)	0.000	27885.480	0.00
44	DC1 (Top)	0.000	3485.685	0.00
45	DC1 (Top)	0.000	24399.795	0.00
46	DC1 (Top)	0.000	13942.740	0.00
47	DC1 (Top)	0.000	27885.480	0.00
48	DC1 (Top)	0.000	3485.685	0.00
49	DC1 (Top)	0.000	10315.885	0.00
50	DC1 (Top)	0.000	85747.851	0.00
51	DC1 (Top)	0.000	43135.352	0.00
52	DC1 (Top)	0.000	43135.352	0.00
53	DC1 (Top)	0.000	28234.049	0.00
54	DC1 (Top)	0.000	3529.256	0.00
55	DC1 (Top)	0.000	24704.793	0.00

56	DC1 (Top)	0.000	14117.024	0.00
57	DC1 (Top)	0.000	28234.049	0.00
58	DC1 (Top)	0.000	3529.256	0.00
59	DC1 (Top)	0.000	10446.598	0.00
60	DC1 (Top)	0.000	32155.444	0.00
61	DC1 (Top)	0.000	10520.843	0.00
62	DC1 (Top)	0.000	85747.851	0.00
63	DC1 (Top)	0.000	43135.352	0.00
64	DC1 (Top)	0.000	43135.352	0.00
65	DC1 (Top)	0.000	22831.237	0.00
66	DC1 (Top)	0.000	2853.905	0.00
67	DC1 (Top)	0.000	22478.486	0.00
68	DC1 (Top)	0.000	2809.811	0.00
69	DC1 (Top)	0.000	8355.187	0.00
70	DC1 (Top)	0.000	69016.563	0.00
71	DC1 (Top)	0.000	34508.282	0.00
72	DC1 (Top)	0.000	34508.282	0.00
73	DC1 (Top)	0.000	22831.237	0.00
74	DC1 (Top)	0.000	2853.905	0.00
75	DC1 (Top)	0.000	20129.831	0.00
76	DC1 (Top)	0.000	11502.761	0.00
77	DC1 (Top)	0.000	22478.486	0.00
78	DC1 (Top)	0.000	2809.811	0.00
79	DC1 (Top)	0.000	8496.357	0.00
80	DC1 (Top)	0.000	25881.211	0.00
81	DC1 (Top)	0.000	8355.187	0.00
82	DC1 (Top)	0.000	69016.563	0.00
83	DC1 (Top)	0.000	34508.282	0.00
84	DC1 (Top)	0.000	34508.282	0.00

SHEAR WALL DESIGN:

Status : N. G.
- Insufficient combined axial-flexural resistance, ØMn < Mu (Segment 1)
- Insufficient axial tension strength (Segment 1)



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	4.00	7.00
2	7.00	0.00	10.00	7.00
3	20.00	0.00	3.00	7.00
4	0.00	7.00	23.00	3.00
5	0.00	10.00	2.00	10.00
6	5.00	10.00	18.00	10.00
7	0.00	20.00	23.00	6.50
8	0.00	26.50	8.00	10.00
9	11.00	26.50	12.00	10.00
10	0.00	36.50	23.00	5.00
11	0.00	41.50	2.25	10.00
12	5.00	41.50	2.25	10.00
13	10.25	41.50	12.75	10.00
14	0.00	51.50	23.00	2.00

Reinforcement:

Reinforcement layers : 2

	Vertical reinforcement			Horizontal reinforcement		
Segment	**Bars**	**Spacing** [in]	**Ld** [in]	**Bars**	**Spacing** [in]	**Ld** [in]
1	3-#10	10.00	49.19	7-#9	12.00	56.79
	1-#10	10.00	49.19	7-#9	12.00	56.79
	2-#10	10.00	49.19	7-#9	12.00	56.79
2	1-#10	12.00	49.19	7-#7	12.00	44.06
	1-#10	12.00	49.19	7-#7	12.00	44.06
	3-#10	12.00	49.19	7-#7	12.00	44.06
	1-#10	12.00	49.19	7-#7	12.00	44.06
	6-#10	12.00	49.19	7-#7	12.00	44.06
3	4-#8	10.00	38.73	7-#5	12.00	25.17
4	3-#10	10.00	49.19	2-#6	18.00	30.21
	1-#10	10.00	49.19	2-#6	18.00	30.21
	2-#10	10.00	49.19	2-#6	18.00	30.21
	1-#10	10.00	49.19	2-#6	18.00	30.21
	3-#10	10.00	49.19	2-#6	18.00	30.21
	1-#10	12.00	49.19	2-#6	18.00	30.21
	1-#10	12.00	49.19	2-#6	18.00	30.21
	3-#10	12.00	49.19	2-#6	18.00	30.21
	1-#10	12.00	49.19	2-#6	18.00	30.21
	6-#10	12.00	49.19	2-#6	18.00	30.21
	4-#8	10.00	49.19	2-#6	18.00	30.21
	4-#8	10.00	49.19	2-#6	18.00	30.21
5	3-#10	10.00	49.19	8-#5	16.00	25.17
6	3-#10	10.00	49.19	7-#7	18.00	44.06
	1-#6	12.00	49.19	7-#7	18.00	44.06
	1-#7	18.00	49.19	7-#7	18.00	44.06
	3-#6	12.00	49.19	7-#7	18.00	44.06
	1-#9	18.00	49.19	7-#7	18.00	44.06
	6-#6	12.00	49.19	7-#7	18.00	44.06
	3-#6	12.00	49.19	7-#7	18.00	44.06
	3-#6	12.00	49.19	7-#7	18.00	44.06
7	3-#10	10.00	49.19	7-#5	12.00	25.17
	1-#6	18.00	49.19	7-#5	12.00	25.17
	2-#7	18.00	49.19	7-#5	12.00	25.17
	1-#5	10.00	49.19	7-#5	12.00	25.17
	3-#10	10.00	49.19	7-#5	12.00	25.17
	1-#6	12.00	49.19	7-#5	12.00	25.17
	1-#7	18.00	49.19	7-#5	12.00	25.17
	3-#6	12.00	49.19	7-#5	12.00	25.17
	1-#9	18.00	49.19	7-#5	12.00	25.17
	6-#6	12.00	49.19	7-#5	12.00	25.17
	3-#6	12.00	49.19	7-#5	12.00	25.17
	3-#6	12.00	49.19	7-#5	12.00	25.17
8	3-#8	10.00	49.19	10-#6	12.00	30.21
	1-#8	14.00	49.19	10-#6	12.00	30.21
	2-#8	14.00	49.19	10-#6	12.00	30.21
	1-#8	14.00	49.19	10-#6	12.00	30.21
	2-#8	14.00	49.19	10-#6	12.00	30.21
	1-#8	14.00	49.19	10-#6	12.00	30.21
	1-#10	10.00	49.19	10-#6	12.00	30.21
9	4-#6	18.00	23.24	7-#5	18.00	25.17
	3-#5	14.00	23.24	7-#5	18.00	25.17
	3-#5	14.00	23.24	7-#5	18.00	25.17
10	3-#8	10.00	49.19	4-#5	18.00	25.17
	1-#8	14.00	49.19	4-#5	18.00	25.17
	2-#8	14.00	49.19	4-#5	18.00	25.17
	1-#8	14.00	49.19	4-#5	18.00	25.17

	2-#8	14.00	49.19	4-#5	18.00	25.17
	1-#8	14.00	49.19	4-#5	18.00	25.17
	1-#10	10.00	49.19	4-#5	18.00	25.17
	3-#6	12.00	49.19	4-#5	18.00	25.17
	1-#9	18.00	49.19	4-#5	18.00	25.17
	4-#6	18.00	49.19	4-#5	18.00	25.17
	3-#5	14.00	49.19	4-#5	18.00	25.17
	3-#5	14.00	49.19	4-#5	18.00	25.17
11	2-#7	18.00	33.89	7-#5	18.00	25.17
	1-#7	18.00	33.89	7-#5	18.00	25.17
12	2-#9	18.00	43.69	7-#5	18.00	25.17
	1-#9	18.00	43.69	7-#5	18.00	25.17
13	1-#10	10.00	49.19	7-#5	18.00	25.17
	5-#6	16.00	49.19	7-#5	18.00	25.17
	3-#6	16.00	49.19	7-#5	18.00	25.17
	3-#6	16.00	49.19	7-#5	18.00	25.17
14	2-#7	18.00	49.19	2-#5	18.00	25.17
	1-#7	18.00	49.19	2-#5	18.00	25.17
	2-#6	16.00	49.19	2-#5	18.00	25.17
	1-#6	16.00	49.19	2-#5	18.00	25.17
	2-#9	18.00	49.19	2-#5	18.00	25.17
	1-#9	18.00	49.19	2-#5	18.00	25.17
	1-#8	18.00	49.19	2-#5	18.00	25.17
	2-#6	16.00	49.19	2-#5	18.00	25.17
	1-#10	10.00	49.19	2-#5	18.00	25.17
	5-#6	16.00	49.19	2-#5	18.00	25.17
	3-#6	16.00	49.19	2-#5	18.00	25.17
	3-#6	16.00	49.19	2-#5	18.00	25.17

Intermediate results for axial-bending

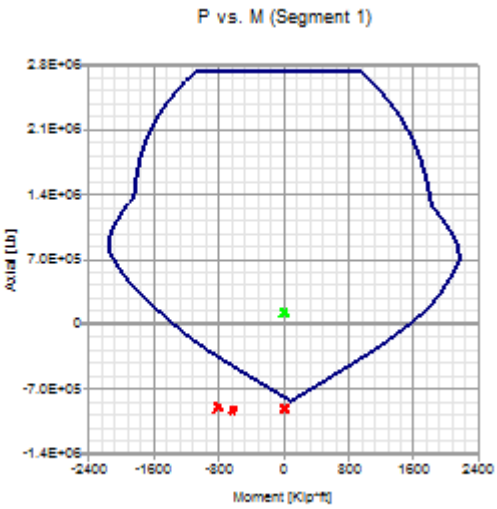
Segment	Condition	c [in]	d [in]
1	D2 (Top)	48.00	38.40
2	D3 (Bottom)	15.65	96.00
3	D2 (Bottom)	25.01	28.80
4	D3 (Bottom)	38.81	220.80
5	D3 (Top)	24.00	19.20
6	D3 (Max)	26.20	172.80
7	D3 (Bottom)	32.67	220.80
8	D3 (Bottom)	12.52	76.80
9	D3 (Bottom)	16.84	115.20
10	D3 (Bottom)	29.50	220.80
11	D3 (Top)	1.51	21.60
12	D3 (Top)	3.03	21.60
13	D3 (Max)	13.21	122.40
14	D3 (Bottom)	31.60	220.80

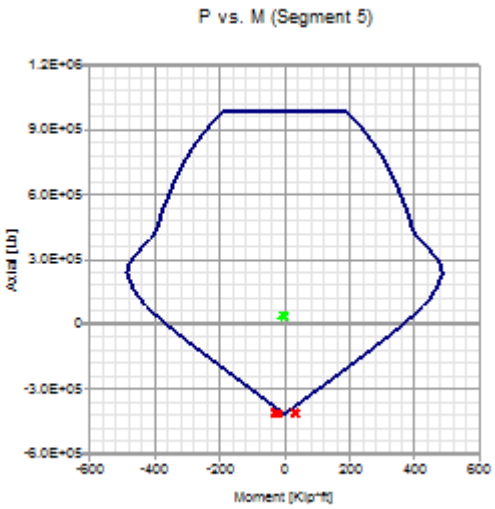
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	D2 (Top)	-891665.40	5.36	0.00	NPC
2	D3 (Bottom)	43405.83	-6190.26	6545.87	0.95
3	D2 (Bottom)	1073930.00	-421.09	842.55	0.50
4	D3 (Bottom)	43914.33	-23713.56	32083.27	0.74
5	D3 (Top)	-412064.70	30.97	0.00	NPC
6	D3 (Max)	530048.10	-11197.42	11677.99	0.96
7	D3 (Bottom)	280269.30	-11516.79	17142.59	0.67

8	D3 (Bottom)	-221277.40	-1404.48	2763.38	0.51
9	D3 (Bottom)	364849.20	-2983.08	4156.05	0.72
10	D3 (Bottom)	29252.09	-5163.58	11518.46	0.45
11	D3 (Top)	-59114.34	-69.88	188.37	0.37
12	D3 (Top)	-12764.60	179.17	222.80	0.80
13	D3 (Max)	-26736.70	-1880.21	3267.43	0.58
14	D3 (Bottom)	-38880.69	-1068.34	12625.36	0.08

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Bottom)	130306.10	2726400.00	0.05
2	D1 (Bottom)	324362.10	6598463.00	0.05
3	D2 (Max)	1082751.00	1701735.00	0.64
4	DC1 (Bottom)	547553.10	1.513124E07	0.04
5	D1 (Bottom)	43337.45	981311.80	0.04
6	D2 (Top)	803628.30	7584829.00	0.11
7	D2 (Max)	367225.40	9823142.00	0.04
8	D1 (Max)	84769.28	3578674.00	0.02
9	D2 (Top)	464638.00	4563456.00	0.10
10	DC1 (Bottom)	175963.00	8703281.00	0.02
11	D2 (Bottom)	58719.27	818812.80	0.07
12	DC1 (Max)	16506.39	887328.00	0.02
13	D2 (Top)	56260.11	4025153.00	0.01
14	D2 (Top)	135682.90	8113154.00	0.02

Axial tension

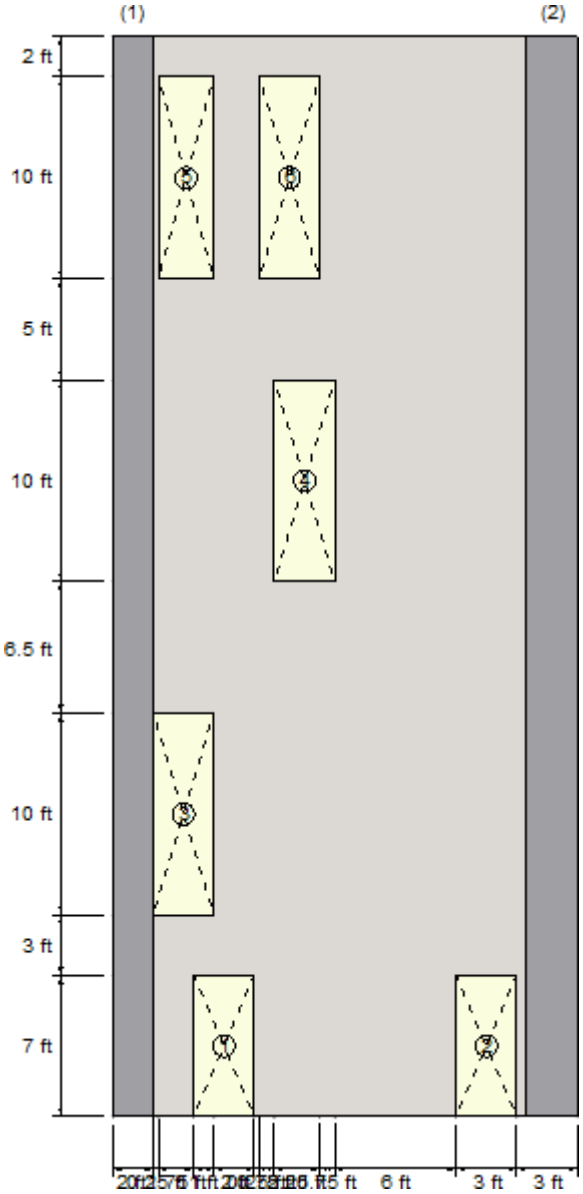
Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Max)	936498.90	822960.00	1.14
2	DC1 (Top)	0.00	1645920.00	0.00
3	DC1 (Top)	0.00	341280.00	0.00
4	DC1 (Top)	0.00	3700080.00	0.00
5	D3 (Max)	416815.70	411480.00	1.01
6	DC1 (Top)	0.00	1344600.00	0.00
7	DC1 (Top)	0.00	1966680.00	0.00
8	D3 (Top)	395683.50	990360.00	0.40
9	DC1 (Top)	0.00	390960.00	0.00
10	DC1 (Top)	0.00	1631880.00	0.00
11	D3 (Top)	59114.34	194400.00	0.30
12	D3 (Bottom)	35436.88	324000.00	0.11
13	D3 (Max)	26736.70	659880.00	0.04
14	D3 (Max)	46630.33	1501200.00	0.03

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	D3 (Top)	258870.160	288000.000	0.90
2	D3 (Max)	746225.730	770358.730	0.97
3	D2 (Top)	164925.030	301163.190	0.55
4	D3 (Max)	1241294.600	1257350.000	0.99
5	D3 (Top)	31996.023	33480.000	0.96
6	D3 (Max)	978157.920	995442.610	0.98
7	D3 (Bottom)	1034596.500	1063362.300	0.97
8	D3 (Top)	361848.480	370769.880	0.98
9	D3 (Max)	450698.340	494155.060	0.91
10	D3 (Max)	808084.830	854937.870	0.95
11	D3 (Top)	10111.923	44350.119	0.23
12	D3 (Bottom)	42602.299	50379.289	0.85
13	D3 (Top)	373912.960	431757.800	0.87
14	D3 (Bottom)	419794.390	759709.480	0.55

COLUMN DESIGN:

Status : N. G.
- Mu > phi*Mn (Column 1)
- Stirrups: adopted spacing < calculated spacing (Column 7)



Geometry:

Column	Distance [ft]	Position Z	Width X [in]	Width Z [in]	Height [ft]
1	1.00	Centered	24.00	18.00	53.50
2	21.75	Centered	30.00	18.00	53.50

Reinforcement:

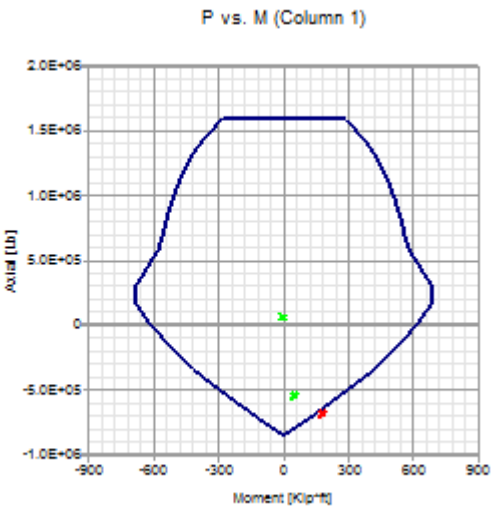
	Longitudinal reinforcement			Transverse reinforcement	
Column	Bars	As [in2]	Ld [in]	Bars	Spacing [in]
1	10-#11	15.60	54.61	#3	3.00
2	6-#8	4.74	38.73	#3	3.00
3	8-#11	12.48	54.61	#3	5.00
4	6-#8	4.74	38.73	#3	5.00
5	8-#11	12.48	54.61	#3	6.00
6	6-#8	4.74	38.73	#3	6.00
7	8-#11	12.48	54.61	#3	8.00

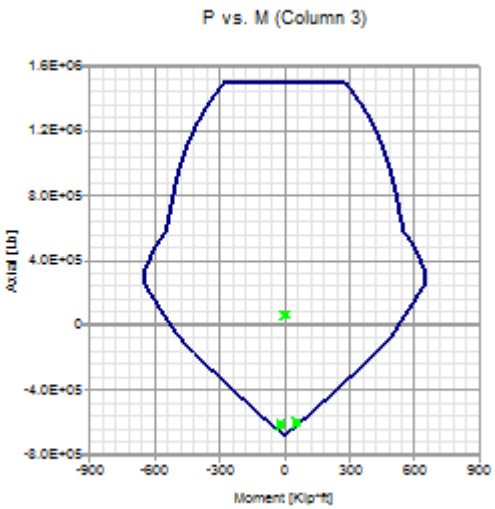
8	6-#8	4.74	38.73	#3	8.00

Combined biaxial flexure

Column	Condition	Pu [Lb]	Mc [Kip*ft]	ϕMn [Kip*ft]	Mc/(ϕ*Mn)
1	D3	680375.00	179.40	144.58	1.24
2	D2	-963945.30	294.32	650.55	0.45
3	D3	605225.40	51.27	63.86	0.80
4	D2	-826196.40	107.80	412.00	0.26
5	D3	616747.10	3.92	53.54	0.07
6	D2	-694643.00	81.36	418.95	0.19
7	D3	609739.10	28.05	59.82	0.47
8	D2	-801824.10	76.17	412.96	0.18

Interaction diagrams, P vs. M:





Axial tension

Column	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/(ϕ*Pn)
1	D3	680375.00	842400.00	0.81
2	SC1	0.00	255960.00	0.00
3	D3	617420.20	673920.00	0.92
4	SC1	0.00	255960.00	0.00
5	D3	616747.10	673920.00	0.92
6	SC1	0.00	255960.00	0.00
7	D3	609739.10	673920.00	0.90
8	SC1	0.00	255960.00	0.00

Axial compression

Column	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/(ϕ*Pn)
1	DC1	-66574.30	-1591013.00	0.04
2	D2	-963945.30	-1567398.00	0.61
3	DC1	-67487.23	-1501943.00	0.04
4	D2	-826196.40	-1567398.00	0.53
5	DC1	-63061.11	-1501943.00	0.04
6	D2	-694643.00	-1567398.00	0.44
7	DC1	-65578.05	-1501943.00	0.04
8	D2	-801824.10	-1567398.00	0.51

Shear along X direction

Column	Condition	Pos	Vu [Lb]	Vc [Lb]	Vs [Lb]	ϕ*Vn [Lb]	Vu/(ϕ*Vn)
1	D3	At bot...	61544.090	0.000	94248.000	70686.000	0.87
2	D2	At bot...	64807.420	145789.390	121550.000	200504.550	0.32
3	D3	At bot...	12936.392	0.000	56548.800	42411.600	0.31
4	D3	At top	7408.679	123304.340	72930.000	147175.760	0.05
5	D2	At bot...	12520.433	0.000	47124.000	35343.000	0.35
6	D3	At top	8820.298	125687.230	60775.000	139846.670	0.06
7	D3	At top	9093.273	0.000	35343.000	26507.250	0.34
8	D3	At top	9887.398	133265.540	45581.250	134135.090	0.07

Shear along Z direction

Column	Condition	Pos	Vu [Lb]	Vc [Lb]	Vs [Lb]	ϕ*Vn [Lb]	Vu/(ϕ*Vn)
1	SC1	At top	0.000	57332.547	169620.000	170214.410	0.00
2	SC1	At top	0.000	72618.438	103125.000	131807.580	0.00
3	SC1	At top	0.000	57332.547	40708.800	73531.010	0.00
4	SC1	At top	0.000	72618.438	61875.000	100870.080	0.00
5	SC1	At top	0.000	57332.547	33924.000	68442.410	0.00
6	SC1	At top	0.000	72618.438	51562.500	93135.703	0.00
7	SC1	At top	0.000	57332.547	25443.000	62081.660	0.00
8	SC1	At top	0.000	72618.438	38671.875	83467.735	0.00

Notes:

* Pu = Axial load
* Pn = Nominal axial load
* Mu = Section moment
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force
* ld = Embedment length
* As = Effective cross sectional area of reinforcement

Schematic Shear Wall Design for Gridline C

Current Date: 8/4/2016 4:07 PM
Units system: English
File name: C:\ProgramData\Bentley\Engineering\RAM Elements.en\Data\SPOE GL C.cwd\

Design Results

Concrete Wall

GENERAL INFORMATION:

Global status : OK

Design code	:	ACI 318-05

Geometry:

Total height	:	53.50 [ft]
Total length	:	22.50 [ft]
Base support type	:	Continuous
Wall bottom restraint	:	Pinned
Column bottom restraint	:	Fixed
Rigidity elements	:	Columns

Materials:

Material	:	C 6-60
Steel tension strength (Fy)	:	60 [Kip/in2]
Concrete compressive strength (fc)	:	6 [Kip/in2]
Steel elasticity modulus (Es)	:	29000 [Kip/in2]
Concrete modulus of elasticity (E)	:	4415.2 [Kip/in2]
Concrete unit weight	:	0.149818 [Kip/ft3]

Number of stories: 4

Story	Story height [ft]	Wall thickness [in]
1	10.00	15.00
2	16.50	12.00
3	15.00	12.00
4	12.00	10.00

Openings:

Reference	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
Lower left	6.33	10.00	3.00	10.00
Lower left	2.75	26.50	3.00	10.00
Lower left	2.75	41.50	3.00	10.00

Columns:

Distance [ft]	Width X [in]	Width Z [in]	Position Z
1.25	30.00	15.00	Centered
21.25	30.00	15.00	Centered

Load conditions:

ID	Comb.	Category	Description
DL	No	DL	Dead Load
EQ	No	EQ	Seismic
SC1	Yes		DL
DC1	Yes		1.4DL
D1	Yes		1.4DL
D2	Yes		1.2DL+EQ
D3	Yes		0.9DL+EQ

Concentrated loads:

Story	Condition	Direction	Magnitude [Lb]	Eccentricity [in]	Distance [ft]
1	DL	Vertical	14400.00	0.00	0.00
1	DL	Vertical	14400.00	0.00	22.50
2	DL	Vertical	13700.00	0.00	0.00
2	DL	Vertical	13700.00	0.00	22.50
3	DL	Vertical	13100.00	0.00	0.00
3	DL	Vertical	13100.00	0.00	22.50
4	EQ	Horizontal	155742.00	0.00	0.00
3	EQ	Horizontal	285628.00	0.00	0.00
2	EQ	Horizontal	281225.00	0.00	0.00
1	EQ	Horizontal	162498.00	0.00	0.00

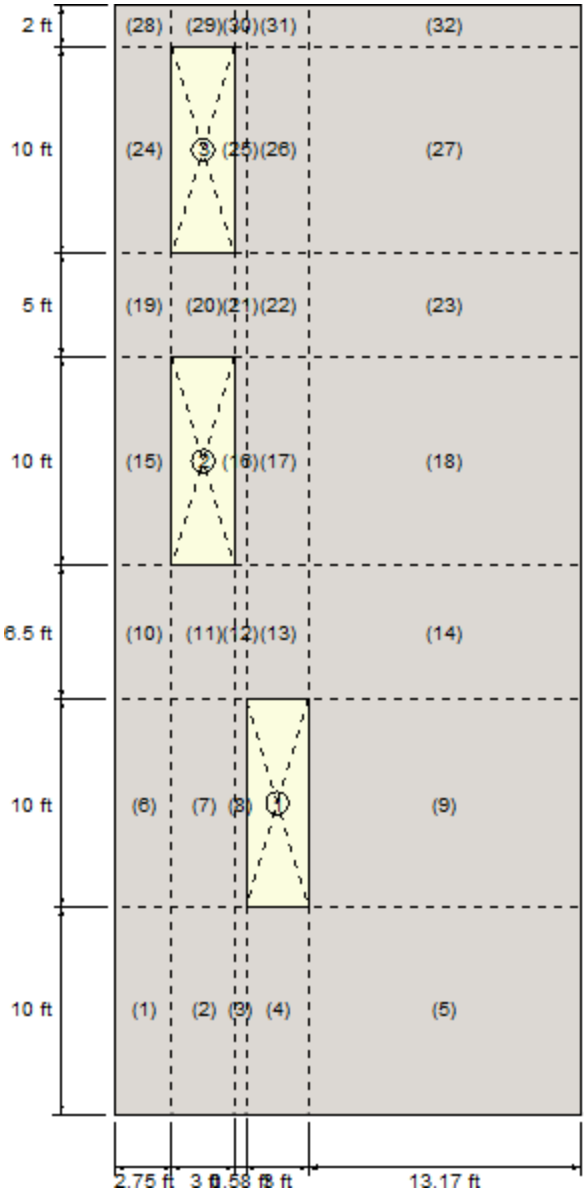
Distributed loads:

Consider self weight : DL

Story	Condition	Direction	Magnitude [Lb/ft]	Eccentricity [ft]
4	DL	Vertical	1640.00	0.00
3	DL	Vertical	1710.00	0.00
2	DL	Vertical	2700.00	0.00
1	DL	Vertical	2970.00	0.00

BEARING WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	2.75	10.00
2	2.75	0.00	3.00	10.00
3	5.75	0.00	0.58	10.00
4	6.33	0.00	3.00	10.00
5	9.33	0.00	13.17	10.00
6	0.00	10.00	2.75	10.00
7	2.75	10.00	3.00	10.00
8	5.75	10.00	0.58	10.00
9	9.33	10.00	13.17	10.00
10	0.00	20.00	2.75	6.50
11	2.75	20.00	3.00	6.50
12	5.75	20.00	0.58	6.50
13	6.33	20.00	3.00	6.50
14	9.33	20.00	13.17	6.50
15	0.00	26.50	2.75	10.00
16	5.75	26.50	0.58	10.00

17	6.33	26.50	3.00	10.00
18	9.33	26.50	13.17	10.00
19	0.00	36.50	2.75	5.00
20	2.75	36.50	3.00	5.00
21	5.75	36.50	0.58	5.00
22	6.33	36.50	3.00	5.00
23	9.33	36.50	13.17	5.00
24	0.00	41.50	2.75	10.00
25	5.75	41.50	0.58	10.00
26	6.33	41.50	3.00	10.00
27	9.33	41.50	13.17	10.00
28	0.00	51.50	2.75	2.00
29	2.75	51.50	3.00	2.00
30	5.75	51.50	0.58	2.00
31	6.33	51.50	3.00	2.00
32	9.33	51.50	13.17	2.00

Vertical reinforcement:

Reinforcement layers : 2

Segment	**Bars**	**Spacing** [in]	**Ld** [in]
1	4-#10	10.00	49.19
2	3-#9	16.00	43.69
3	1-#8	16.00	38.73
4	3-#8	16.00	38.73
5	10-#8	16.00	38.73
6	4-#8	10.00	38.73
7	4-#8	10.00	38.73
8	1-#9	18.00	43.69
9	12-#5	14.00	19.36
10	4-#8	10.00	38.73
11	4-#8	10.00	38.73
12	1-#9	18.00	43.69
13	3-#6	16.00	23.24
14	12-#5	14.00	19.36
15	3-#6	14.00	23.24
16	1-#9	18.00	43.69
17	4-#5	10.00	19.36
18	9-#5	18.00	19.36
19	3-#6	14.00	23.24
20	2-#5	18.00	19.36
21	1-#9	18.00	43.69
22	4-#5	10.00	19.36
23	9-#5	18.00	19.36
24	2-#5	18.00	19.36
25	1-#5	18.00	19.36
26	2-#5	18.00	19.36
27	9-#5	18.00	19.36
28	2-#5	18.00	19.36
29	2-#5	18.00	19.36
30	1-#5	18.00	19.36
31	2-#5	18.00	19.36
32	9-#5	18.00	19.36

Intermediate results for axial-bending

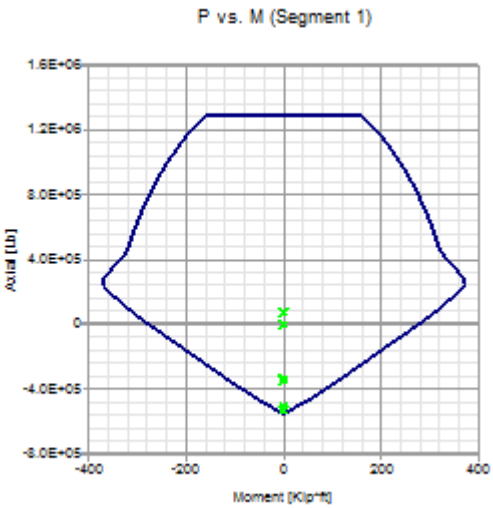
Segment	Condition	c [in]	d [in]
1	DC1 (Top)	3.26	12.99
2	DC1 (Top)	2.00	13.06
3	DC1 (Top)	2.44	13.13
4	DC1 (Top)	1.57	13.13
5	DC1 (Top)	1.61	13.13
6	DC1 (Top)	2.01	10.00
7	DC1 (Top)	1.93	10.00
8	DC1 (Top)	2.85	9.94
9	DC1 (Top)	1.09	10.31
10	DC1 (Top)	1.99	10.13
11	DC1 (Top)	1.72	10.13
12	DC1 (Top)	2.71	10.06
13	DC1 (Top)	1.26	10.25
14	DC1 (Top)	1.06	10.31
15	DC1 (Top)	1.26	10.25
16	DC1 (Top)	2.53	10.06
17	DC1 (Top)	1.14	10.31
18	DC1 (Top)	0.75	10.31
19	DC1 (Top)	1.25	10.25
20	DC1 (Top)	0.60	10.31
21	DC1 (Top)	2.41	10.06
22	DC1 (Top)	1.13	10.31
23	DC1 (Top)	0.73	10.31
24	DC1 (Top)	0.65	8.31
25	DC1 (Top)	1.21	8.31
26	DC1 (Top)	0.62	8.31
27	DC1 (Top)	0.61	8.31
28	DC1 (Top)	0.63	8.31
29	DC1 (Top)	0.60	8.31
30	DC1 (Top)	1.19	8.31
31	DC1 (Top)	0.60	8.31
32	DC1 (Top)	0.61	8.31

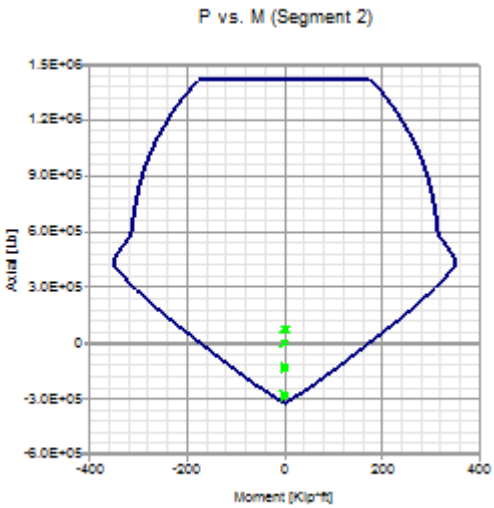
Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	DC1 (Top)	72322.90	0.00	308.45	0.00
2	DC1 (Top)	76457.18	0.00	209.93	0.00
3	DC1 (Top)	14859.32	0.00	51.60	0.00
4	DC1 (Top)	23929.53	0.00	151.79	0.00
5	DC1 (Top)	326526.90	0.00	644.68	0.00
6	DC1 (Top)	46349.71	0.00	152.82	0.00
7	DC1 (Top)	50719.01	0.00	155.99	0.00
8	DC1 (Top)	10129.61	0.00	44.41	0.00
9	DC1 (Top)	231670.20	0.00	290.72	0.00
10	DC1 (Top)	50432.94	0.00	155.80	0.00
11	DC1 (Top)	17350.82	0.00	145.03	0.00
12	DC1 (Top)	8888.88	0.00	44.53	0.00
13	DC1 (Top)	41306.17	0.00	81.61	0.00
14	DC1 (Top)	197382.30	0.00	277.05	0.00
15	DC1 (Top)	28575.35	0.00	75.73	0.00
16	DC1 (Top)	6614.26	0.00	43.79	0.00
17	DC1 (Top)	25898.13	0.00	72.19	0.00
18	DC1 (Top)	108734.60	0.00	194.55	0.00
19	DC1 (Top)	25265.89	0.00	74.45	0.00
20	DC1 (Top)	7954.37	0.00	35.97	0.00
21	DC1 (Top)	3806.96	0.00	42.80	0.00

22	DC1 (Top)	22017.58	0.00	70.67	0.00
23	DC1 (Top)	98055.88	0.00	189.85	0.00
24	DC1 (Top)	6490.07	0.00	29.04	0.00
25	DC1 (Top)	2556.30	0.00	12.92	0.00
26	DC1 (Top)	9460.40	0.00	30.30	0.00
27	DC1 (Top)	30865.26	0.00	131.77	0.00
28	DC1 (Top)	4432.46	0.00	28.27	0.00
29	DC1 (Top)	7759.58	0.00	29.66	0.00
30	DC1 (Top)	1357.60	0.00	12.56	0.00
31	DC1 (Top)	7472.68	0.00	29.55	0.00
32	DC1 (Top)	29611.33	0.00	131.30	0.00

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D1 (Bottom)	78019.47	1285796.00	0.06
2	DC1 (Top)	76457.18	1416168.00	0.05
3	D2 (Top)	45717.73	272678.60	0.17
4	D1 (Bottom)	66632.92	1419510.00	0.05
5	D2 (Bottom)	1374426.00	6244930.00	0.22
6	D1 (Top)	46349.71	1033431.00	0.04
7	DC1 (Bottom)	63030.18	1128903.00	0.06
8	D2 (Bottom)	56436.29	216191.00	0.26
9	D2 (Top)	823522.30	5009734.00	0.16
10	D1 (Top)	50432.94	1033431.00	0.05
11	D1 (Bottom)	50718.88	1128903.00	0.04
12	D1 (Bottom)	10129.02	216191.00	0.05
13	D1 (Top)	41306.17	1138663.00	0.04
14	D2 (Bottom)	823497.20	5009734.00	0.16
15	DC1 (Bottom)	30959.39	1043191.00	0.03
16	D2 (Top)	50175.51	216191.00	0.23
17	D2 (Top)	30769.50	1139087.00	0.03
18	D2 (Bottom)	521197.70	5014667.00	0.10
19	D2 (Top)	31152.39	1043191.00	0.03

20	D2 (Bottom)	30422.98	1142376.00	0.03
21	D2 (Bottom)	50172.69	216191.00	0.23
22	D2 (Bottom)	30769.38	1139087.00	0.03
23	D2 (Bottom)	213364.80	5014667.00	0.04
24	D2 (Bottom)	23655.84	871871.50	0.03
25	D2 (Top)	16954.16	182935.00	0.09
26	D1 (Bottom)	14010.21	951431.50	0.01
27	D2 (Bottom)	135624.20	4176423.00	0.03
28	D2 (Top)	45855.46	871871.50	0.05
29	D2 (Bottom)	19069.74	951431.50	0.02
30	D2 (Bottom)	16947.02	182935.00	0.09
31	D1 (Bottom)	9460.39	951431.50	0.01
32	D2 (Bottom)	31122.67	4176423.00	0.01

Axial tension

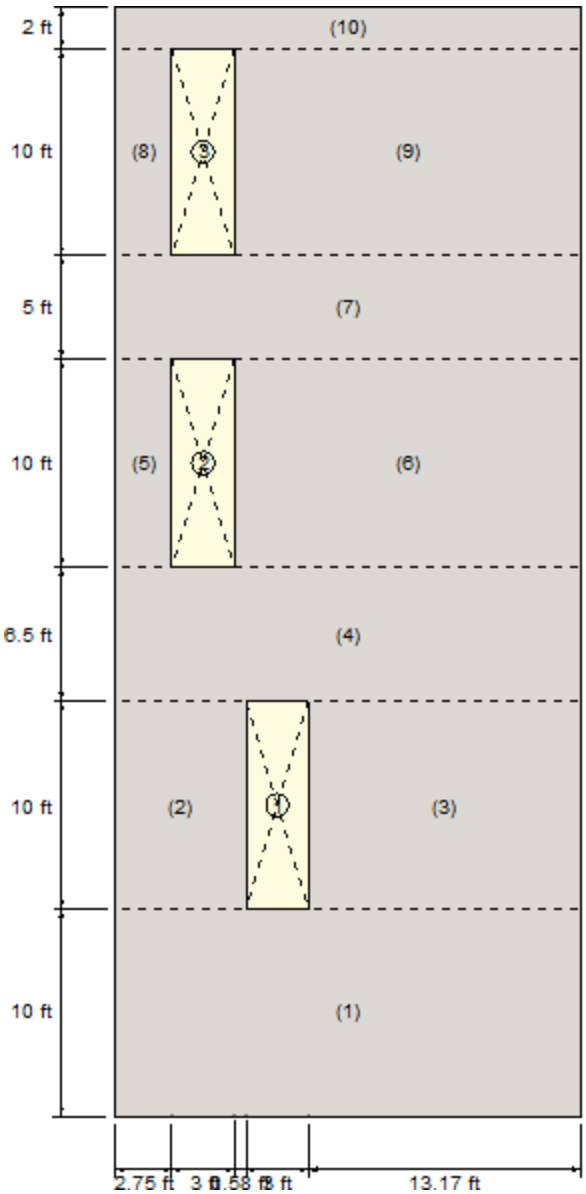
Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	D3 (Bottom)	525146.30	548640.00	0.96
2	D3 (Bottom)	291899.40	324000.00	0.90
3	D3 (Bottom)	35289.87	85320.00	0.41
4	D3 (Bottom)	111799.00	255960.00	0.44
5	DC1 (Top)	0.00	853200.00	0.00
6	D3 (Bottom)	334036.90	341280.00	0.98
7	D3 (Top)	270261.60	341280.00	0.79
8	D3 (Top)	95033.16	108000.00	0.88
9	DC1 (Top)	0.00	401760.00	0.00
10	D3 (Bottom)	176859.00	341280.00	0.52
11	D3 (Bottom)	270260.70	341280.00	0.79
12	D3 (Bottom)	95027.25	108000.00	0.88
13	D3 (Top)	140352.20	142560.00	0.98
14	DC1 (Top)	0.00	401760.00	0.00
15	D3 (Top)	121511.80	142560.00	0.85
16	D3 (Bottom)	93752.45	108000.00	0.87
17	D3 (Bottom)	133139.90	133920.00	0.99
18	DC1 (Top)	0.00	301320.00	0.00
19	D3 (Bottom)	121511.10	142560.00	0.85
20	DC1 (Top)	0.00	66960.00	0.00
21	D3 (Top)	19911.96	108000.00	0.18
22	D3 (Top)	26187.20	133920.00	0.20
23	DC1 (Top)	0.00	301320.00	0.00
24	D3 (Top)	40598.62	66960.00	0.61
25	D3 (Bottom)	31361.62	33480.00	0.94
26	D3 (Bottom)	24732.38	66960.00	0.37
27	DC1 (Top)	0.00	301320.00	0.00
28	D3 (Bottom)	43934.11	66960.00	0.66
29	D3 (Top)	863.96	66960.00	0.01
30	DC1 (Top)	0.00	33480.00	0.00
31	D3 (Bottom)	5138.35	66960.00	0.08
32	DC1 (Top)	0.00	301320.00	0.00

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	DC1 (Top)	0.000	49806.953	0.00
2	DC1 (Top)	0.000	54631.838	0.00
3	DC1 (Top)	0.000	10613.911	0.00
4	DC1 (Top)	0.000	54899.539	0.00
5	DC1 (Top)	0.000	241008.980	0.00
6	DC1 (Top)	0.000	38342.535	0.00
7	DC1 (Top)	0.000	41828.220	0.00
8	DC1 (Top)	0.000	8035.034	0.00
9	DC1 (Top)	0.000	189364.200	0.00
10	DC1 (Top)	0.000	38821.817	0.00
11	DC1 (Top)	0.000	42351.073	0.00
12	DC1 (Top)	0.000	8136.119	0.00
13	DC1 (Top)	0.000	42873.926	0.00
14	DC1 (Top)	0.000	189364.200	0.00
15	DC1 (Top)	0.000	39301.099	0.00
16	DC1 (Top)	0.000	8136.119	0.00
17	DC1 (Top)	0.000	43135.352	0.00
18	DC1 (Top)	0.000	189364.200	0.00
19	DC1 (Top)	0.000	39301.099	0.00
20	DC1 (Top)	0.000	43135.352	0.00
21	DC1 (Top)	0.000	8136.119	0.00
22	DC1 (Top)	0.000	43135.352	0.00
23	DC1 (Top)	0.000	189364.200	0.00
24	DC1 (Top)	0.000	31872.232	0.00
25	DC1 (Top)	0.000	6722.144	0.00
26	DC1 (Top)	0.000	34769.708	0.00
27	DC1 (Top)	0.000	152639.020	0.00
28	DC1 (Top)	0.000	31872.232	0.00
29	DC1 (Top)	0.000	34769.708	0.00
30	DC1 (Top)	0.000	6722.144	0.00
31	DC1 (Top)	0.000	34769.708	0.00
32	DC1 (Top)	0.000	152639.020	0.00

SHEAR WALL DESIGN:

Status : OK



Geometry:

Segment	X Coordinate [ft]	Y Coordinate [ft]	Width [ft]	Height [ft]
1	0.00	0.00	22.50	10.00
2	0.00	10.00	6.33	10.00
3	9.33	10.00	13.17	10.00
4	0.00	20.00	22.50	6.50
5	0.00	26.50	2.75	10.00
6	5.75	26.50	16.75	10.00
7	0.00	36.50	22.50	5.00
8	0.00	41.50	2.75	10.00
9	5.75	41.50	16.75	10.00
10	0.00	51.50	22.50	2.00

Reinforcement:

Reinforcement layers : 2

Segment	Vertical reinforcement Bars	Spacing [in]	Ld [in]	Horizontal reinforcement Bars	Spacing [in]	Ld [in]
1	4-#10	10.00	49.19	8-#5	16.00	25.17
	3-#9	16.00	49.19	8-#5	16.00	25.17
	1-#8	16.00	49.19	8-#5	16.00	25.17
	3-#8	16.00	49.19	8-#5	16.00	25.17
	10-#8	16.00	49.19	8-#5	16.00	25.17
2	4-#8	10.00	43.69	8-#6	16.00	30.21
	4-#8	10.00	43.69	8-#6	16.00	30.21
	1-#9	18.00	43.69	8-#6	16.00	30.21
3	12-#5	14.00	19.36	7-#5	18.00	25.17
4	4-#8	10.00	43.69	5-#5	18.00	25.17
	4-#8	10.00	43.69	5-#5	18.00	25.17
	1-#9	18.00	43.69	5-#5	18.00	25.17
	3-#6	16.00	43.69	5-#5	18.00	25.17
	12-#5	14.00	43.69	5-#5	18.00	25.17
5	3-#6	14.00	23.24	7-#5	18.00	25.17
6	1-#9	18.00	43.69	7-#5	18.00	25.17
	4-#5	10.00	43.69	7-#5	18.00	25.17
	9-#5	18.00	43.69	7-#5	18.00	25.17
7	3-#6	14.00	43.69	4-#5	18.00	25.17
	2-#5	18.00	43.69	4-#5	18.00	25.17
	1-#9	18.00	43.69	4-#5	18.00	25.17
	4-#5	10.00	43.69	4-#5	18.00	25.17
	9-#5	18.00	43.69	4-#5	18.00	25.17
8	2-#5	18.00	19.36	7-#5	18.00	25.17
9	1-#5	18.00	19.36	7-#5	18.00	25.17
	2-#5	18.00	19.36	7-#5	18.00	25.17
	9-#5	18.00	19.36	7-#5	18.00	25.17
10	2-#5	18.00	19.36	2-#5	18.00	25.17
	2-#5	18.00	19.36	2-#5	18.00	25.17
	1-#5	18.00	19.36	2-#5	18.00	25.17
	2-#5	18.00	19.36	2-#5	18.00	25.17
	9-#5	18.00	19.36	2-#5	18.00	25.17

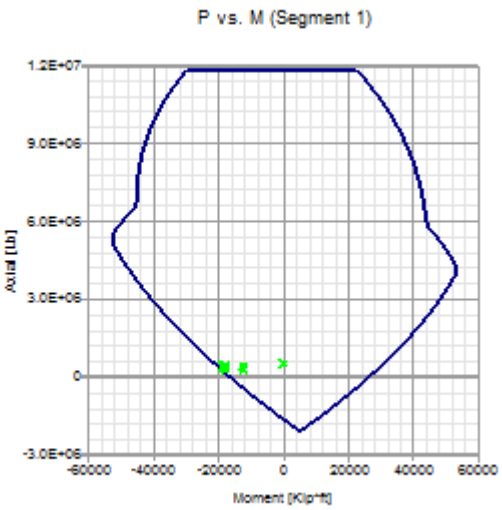
Intermediate results for axial-bending

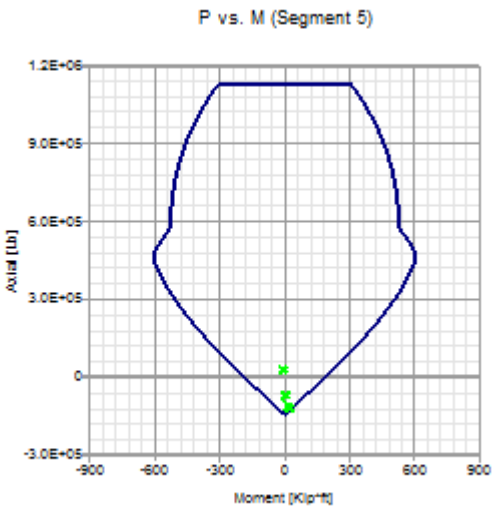
Segment	Condition	c [in]	d [in]
1	D3 (Bottom)	29.07	216.00
2	D3 (Bottom)	4.65	60.77
3	D3 (Bottom)	24.27	126.43
4	D3 (Bottom)	24.84	216.00
5	D3 (Top)	0.37	26.40
6	D3 (Bottom)	15.70	160.80
7	D3 (Bottom)	19.70	216.00
8	D3 (Top)	0.52	26.40
9	D3 (Bottom)	11.82	160.80
10	D3 (Bottom)	15.01	216.00

Combined axial flexure

Segment	Condition	Pu [Lb]	Mu [Kip*ft]	ϕ*Mn [Kip*ft]	Mu/ϕ*Mn
1	D3 (Bottom)	339041.80	-18436.09	19461.58	0.95
2	D3 (Bottom)	-426857.20	-705.27	1154.06	0.61
3	D3 (Bottom)	686676.70	-4385.82	6291.00	0.70
4	D3 (Bottom)	197225.20	-8558.96	10881.03	0.79
5	D3 (Top)	-121633.50	24.47	27.91	0.88
6	D3 (Bottom)	265412.90	-3357.70	5168.06	0.65
7	D3 (Bottom)	170354.10	-2108.06	8225.36	0.26
8	D3 (Top)	-40623.36	-14.68	35.06	0.42
9	D3 (Bottom)	68198.10	-803.93	3599.71	0.22
10	D3 (Bottom)	11781.59	-419.66	5767.70	0.07

Interaction diagrams, P vs. M:





Axial compression

Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	DC1 (Bottom)	563115.50	1.183342E07	0.05
2	D1 (Bottom)	125397.20	2835294.00	0.04
3	D2 (Top)	823723.10	5009734.00	0.16
4	D1 (Bottom)	346000.90	9298187.00	0.04
5	DC1 (Max)	31389.14	1125559.00	0.03
6	D2 (Bottom)	302289.20	6369945.00	0.05
7	D2 (Bottom)	207474.90	8555511.00	0.02
8	D2 (Bottom)	23713.79	871871.50	0.03
9	D2 (Bottom)	83119.73	5310789.00	0.02
10	D2 (Top)	77720.55	7134092.00	0.01

Axial tension

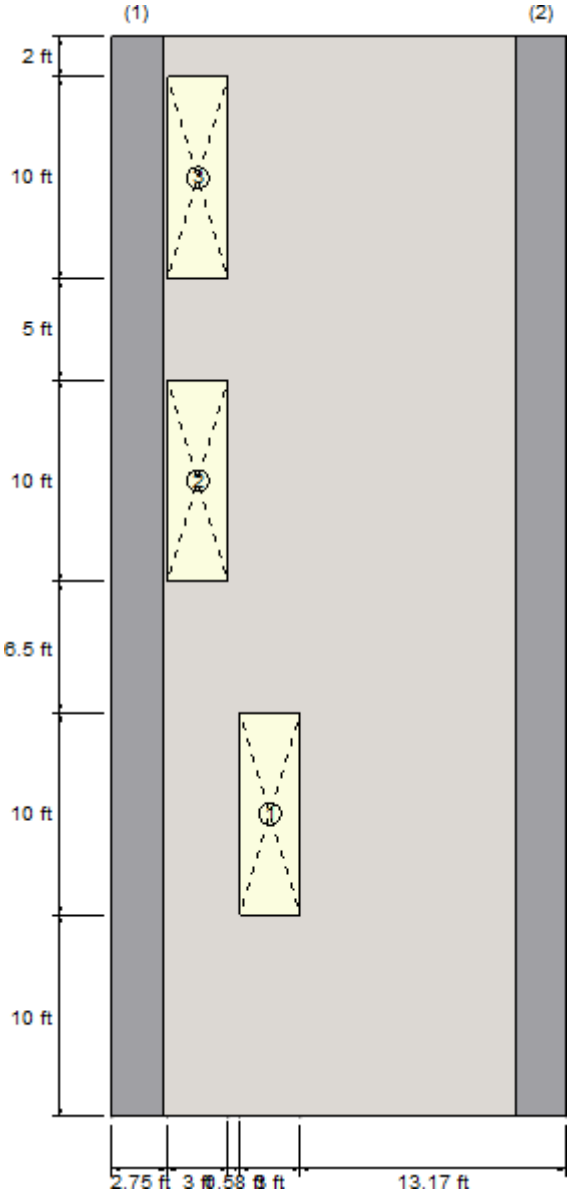
Segment	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/ϕ*Pn
1	DC1 (Top)	0.00	2067120.00	0.00
2	D3 (Top)	547943.20	790560.00	0.69
3	DC1 (Top)	0.00	401760.00	0.00
4	DC1 (Top)	0.00	1334880.00	0.00
5	D3 (Top)	121633.50	142560.00	0.85
6	DC1 (Top)	0.00	543240.00	0.00
7	DC1 (Top)	0.00	752760.00	0.00
8	D3 (Top)	40623.36	66960.00	0.61
9	DC1 (Top)	0.00	401760.00	0.00
10	DC1 (Top)	0.00	535680.00	0.00

Shear

Segment	Condition	Vu [Lb]	ϕ*Vn [Lb]	Vu/ϕ*Vn
1	D3 (Max)	895880.770	1047646.800	0.86
2	D3 (Bottom)	183283.760	191868.440	0.96
3	D3 (Max)	544926.060	584385.500	0.93
4	D3 (Max)	760473.730	865399.520	0.88
5	D3 (Top)	14151.324	83409.546	0.17
6	D3 (Max)	439574.060	654905.820	0.67
7	D3 (Max)	454120.590	854680.510	0.53
8	D2 (Max)	8861.921	92289.943	0.10
9	D3 (Top)	163547.650	563706.860	0.29
10	D3 (Bottom)	163689.930	750666.620	0.22

COLUMN DESIGN:

Status : OK



Geometry:

Column	Distance [ft]	Position Z	Width X [in]	Width Z [in]	Height [ft]
1	1.25	Centered	30.00	15.00	53.50
2	21.25	Centered	30.00	15.00	53.50

Reinforcement:

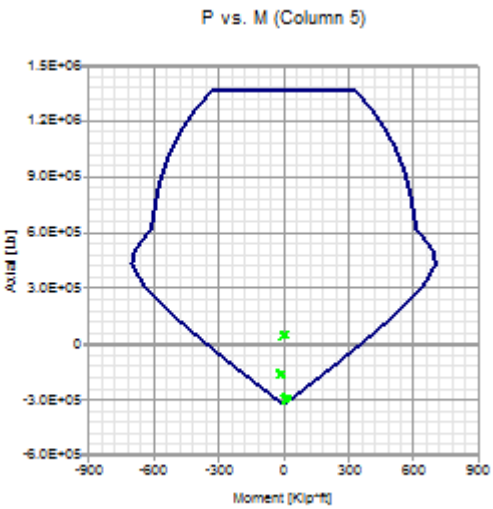
	Longitudinal reinforcement			Transverse reinforcement	
Column	Bars	As [in2]	Ld [in]	Bars	Spacing [in]
1	12-#11	18.72	54.61	#3	6.00
2	6-#8	4.74	38.73	#3	6.00
3	6-#11	9.36	54.61	#3	6.00
4	6-#8	4.74	38.73	#3	6.00
5	6-#9	6.00	43.69	#3	6.00
6	6-#8	4.74	38.73	#3	6.00
7	6-#10	7.62	49.19	#3	6.00

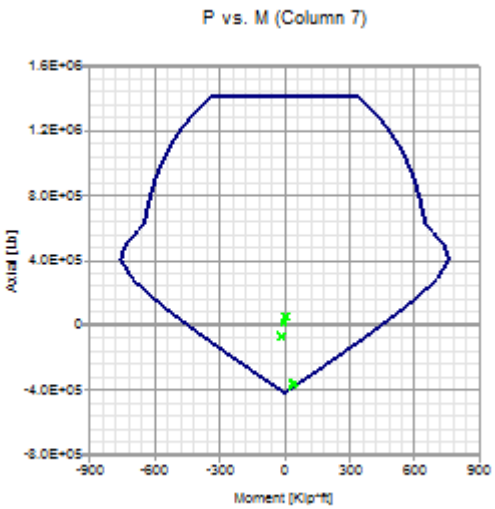
8	6-#8	4.74	38.73	#3	6.00

Combined biaxial flexure

Column	Condition	Pu [Lb]	Mc [Kip*ft]	ϕMn [Kip*ft]	Mc/(ϕ*Mn)
1	D3	450756.70	123.01	576.18	0.21
2	D2	-579805.10	129.95	606.75	0.21
3	D3	389548.50	27.26	130.29	0.21
4	D2	-475790.30	57.07	316.74	0.18
5	D3	299835.80	13.23	29.81	0.44
6	D2	-398411.40	42.89	306.72	0.14
7	D3	365782.90	39.12	53.86	0.73
8	D2	-461616.70	40.39	317.54	0.13

Interaction diagrams, P vs. M:





Axial tension

Column	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/(ϕ*Pn)
1	D3	450756.70	1010880.00	0.45
2	SC1	0.00	255960.00	0.00
3	D3	389548.50	505440.00	0.77
4	SC1	0.00	255960.00	0.00
5	D3	299835.80	324000.00	0.93
6	SC1	0.00	255960.00	0.00
7	D3	365782.90	411480.00	0.89
8	SC1	0.00	255960.00	0.00

Axial compression

Column	Condition	Pu [Lb]	ϕ*Pn [Lb]	Pu/(ϕ*Pn)
1	DC1	-68935.27	-1727819.00	0.04
2	D2	-579805.10	-1328718.00	0.44
3	DC1	-58392.10	-1460609.00	0.04
4	D2	-475790.30	-1328718.00	0.36
5	DC1	-52119.34	-1364688.00	0.04
6	D2	-398411.40	-1328718.00	0.30
7	DC1	-55348.73	-1410936.00	0.04
8	D2	-461616.70	-1328718.00	0.35

Shear along X direction

Column	Condition	Pos	Vu [Lb]	Vc [Lb]	Vs [Lb]	ϕ*Vn [Lb]	Vu/(ϕ*Vn)
1	D3	At bot...	41639.642	0.000	60324.000	45243.000	0.92
2	D2	At bot...	45847.216	105550.710	60775.000	124744.280	0.37
3	D2	At top	12441.704	0.000	60324.000	45243.000	0.27
4	D3	At top	6733.372	88652.359	60775.000	112070.520	0.06
5	D2	At top	15708.790	0.000	60634.200	45475.650	0.35
6	D3	At top	6913.367	91837.866	60775.000	114459.650	0.06
7	D2	At top	4573.118	0.000	60478.000	45358.500	0.10
8	D3	At top	6266.016	96293.506	60775.000	117801.380	0.05

Shear along Z direction

Column	Condition	Pos	Vu [Lb]	Vc [Lb]	Vs [Lb]	ϕ*Vn [Lb]	Vu/(ϕ*Vn)
1	SC1	At top	0.000	57722.944	40986.000	74031.708	0.00
2	SC1	At top	0.000	58675.698	41662.500	75253.648	0.00
3	SC1	At top	0.000	57722.944	40986.000	74031.708	0.00
4	SC1	At top	0.000	58675.698	41662.500	75253.648	0.00
5	SC1	At top	0.000	58378.253	41451.300	74872.164	0.00
6	SC1	At top	0.000	58675.698	41662.500	75253.648	0.00
7	SC1	At top	0.000	58048.274	41217.000	74448.956	0.00
8	SC1	At top	0.000	58675.698	41662.500	75253.648	0.00

Notes:

* Pu = Axial load
* Pn = Nominal axial load
* Mu = Section moment
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force
* ld = Embedment length
* As = Effective cross sectional area of reinforcement