OLD RENTON
CITY HALL

TIER 2
SEISMIC EVALUATION

COFFMAN ENGINEERS

Structural
Mechanical
Electrical
Civil
Corrosion Control
Program and Construction Management

January 2, 2008

Mr. Ryan Haines, Associate
Gensler
1524 Fifth Avenue, Suite 300
Seattle, WA 98101

Re: Results of Tier 2 Seismic Evaluation
Old Renton City Hall

Dear Ryan:

This report summarizes the findings of the Tier 2 seismic evaluation of Old Renton City Hall. Enclosed please find a narrative summary of our findings from the completed Tier 2 analysis, plan sketches of a concept approach for seismic retrofit, and reference calculations.

The evaluation confirmed the deficiencies noted in the Tier 1 review and verified the concepts we discussed for seismic retrofit. Specifically, additional concrete shear walls, in combination with strengthening of existing concrete shear walls and some additional foundation construction, provides a reasonable approach and significant improvement of the predicted response of the building.

Please let me know if you have any comments or questions regarding these findings. We would be happy to meet with you and the City to discuss as appropriate.

Thank you for the opportunity to provide this analysis and report. We look forward to working with you on a final design package if we may be of service.

Respectfully Submitted,

Karl G. Kolb

Karl G. Kolb, P.E., S.E.
Principal

KARL G. KOLB
STATE OF WASHINGTON
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PROFESSIONAL ENGINEER
EXPIRES 1/29/08

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Executive Summary:

This report summarizes the findings of the Tier 2 structural analysis of Old Renton City Hall. The need for this analysis was confirmed after the preliminary Tier 1 review was completed and given the desire to improve and strengthen the building as a valuable asset for the City.

The Tier 2 analysis confirmed the results of the Tier 1 evaluation that the existing shear walls are overstressed when subjected to forces resulting from a design seismic event. A major cause of the deficiency is the grouping of the existing shear walls near the south side of the floor plan, creating a twisting or torsion effect.

A concept approach is presented for a seismic retrofit that strengthens the building and provides new shear walls to reduce the torsion under earthquake loads. New cast-in-place or shotcrete concrete walls are added in the east-west direction near the north side of the building. In addition, existing concrete shear walls at the stairs and elevator core are strengthened with fiber-reinforced polymer wrap, commonly referred to as FRP or "Fiber Wrap." Additional spread footing foundations are also added to support the new walls and the existing, strengthened walls.

The concept approach is shown on the included plan sketches. Further refinement is necessary to develop the final solution in conjunction with the architectural scheme and renovated building systems for mechanical, electrical, and plumbing.

Introduction:

The purpose of this report was to determine the adequacy of the lateral force resisting system of Old Renton City Hall and to develop a concept for retrofit. The adequacy of the lateral force resisting system was determined using the analysis procedures of a Tier 2 evaluation as outlined in ASCE 31-03, *Seismic Evaluation of Exiting Buildings*. The Tier 2 evaluation was conducted using a three dimensional model of the building and by performing a linear dynamic analysis.

Old Renton City Hall is an eight-story cast-in-place concrete structure constructed circa 1968. The floor structure is primarily a waffle slab system with pan joists at the lower levels. This floor system is supported by concrete columns and concrete walls. The building has plan dimensions of 96 feet by 96 feet from the ground floor to the second floor. Above the second floor, the building has plan dimensions of 76 feet by 76 feet. The extra 10 feet of floor structure around the perimeter at the second floor and below is supported by tube steel columns at 6'-0" on center.

The existing lateral force resisting system consists of concrete shear walls which are located around the elevators and stairs. The elevators and stairs are in the southern portion of the building. There is also a shear wall in the northern portion of the building that runs from the east to the west along grid C. This shear wall along grid C stops below the second floor. Because of this arrangement the shear walls are unbalanced with respect to east-west motion, which makes the building susceptible to twisting or torsion during a high seismic event. This torsional motion can damage structural elements, such as columns that were not originally designed as part of the lateral force resisting system, and can increase the shear forces in the existing shear walls to unacceptable levels.

Tier 2 Evaluation:

The completed Tier 1 evaluations using the ASCE 31-03 standard recommendations indicated deficiencies in the lateral force resisting system. It suggested that the building is likely to perform poorly during a major seismic event (please refer to the previous Tier 1 "Structural Evaluation Report"). These deficiencies were part of the basis for conducting a Tier 2 evaluation of the structure.

The other basis for conducting a Tier 2 evaluation is the height limitations per Table 3-3 ASCE 31-03. This table shows that a Tier 2 evaluation is required when a concrete shear wall structure with a "life-safety" occupancy category and in an area of high seismicity exceeds 6 stories in height. Because Old Renton City Hall is an 8-story concrete shear wall building, has a life safety occupancy category, and is in an area of high seismicicty, a Tier 2 evaluation was required even if the Tier 1 evaluation had a satisfactory result.

The analysis methods required for a Tier 2 evaluation are either the Linear Static Procedure (LSP) or the Linear Dynamic Procedure (LDP). For a Tier 2 evaluation a LSP analysis is conducted unless an LDP is required. The requirements for an LDP are for buildings over 100 feet in height and buildings with mass, stiffness, or geometric irregularities.

For this building, the seismic mass of the second floor exceeds the seismic mass of the third floor by more than 50 percent. This results in a mass irregularity which requires the LDP per the ASCE 31-03 criteria. The LSP procedure considers only the primary mode effects on the structure and is based on the building having no mass irregularities. A structure with mass irregularities may have significant contributions from higher modes that will affect its dynamic response. Therefore, an LDP is required to determine the distribution of forces and concentrations of demand on the structure.

If a building is torsionally irregular and the ratio of the maximum displacement to average displacement exceeds 1.5 then a three-dimensional model is also required for the Tier 2 analysis. The average displacement is defined as the average of the maximum and minimum displacements parallel to the ground motion. Considering the unbalanced arrangement of the shear walls and the mass irregularity, the LDP using a three-dimensional model of the building was performed for the Tier 2 analysis.

Linear Dynamic Procedure:

To perform the required LDP a detailed finite element model of the building was constructed using the computer program RAM Advanse. A site-specific response spectrum was created using the Basic Safety Earthquake 1 (BSE-1) to analyze the dynamic response characteristics of the structure. ASCE 41-06 *Seismic Rehabilitation of Existing Buildings* defines the BSE-1 as the lesser of the ground shaking for a 10 percent probability of exceedance in 50 years or two-thirds of the Basic Safety Earthquake 2 (BSE-2). The BSE-2 is defined in ASCE 41-06 as the ground shaking based on the Maximum Considered Earthquake (MCE). The MCE is defined in ASCE 41-06 as an extreme earthquake hazard level defined by MCE maps which are based on a combination of mean 2 percent probability of exceedance in 50 year probabilistic spectra and 150 percent of median deterministic spectra at a given site.

From the LDP the dynamic characteristics of the building were used to determine the seismic forces acting on the structure. These forces, and the resulting displacements, are used to determine if the lateral force resisting system is adequate per the requirements of a Tier 2 evaluation.

Results:

The building's first mode of vibration results from a combination of east-west translation motion and torsion. For east-west motion this is the primary mode of vibration, and the associated period is 1.25 seconds. The building's second mode of vibration results from north-south translational motion. For north-south motion this is the primary mode of vibration, and the associated period is 0.82 seconds.

As noted, the Tier 2 analysis confirms that the building has a torsional irregularity in its lateral force resisting system in the current configuration. This torsional irregularity causes the shear walls around the elevators and stairs to be overstressed, and also causes elements that are not a part of the lateral force resisting system, such as the columns along gridline C, to be overstressed.

A Tier 2 evaluation defines a building as torsionally irregular if the ratio of the maximum displacement to average displacement exceeds 1.5. The average displacement is defined as the average of the maximum and minimum displacements parallel to the ground motion. For this building, the ratio was exceeded for floors above the second level, with the worst case being a ratio of 1.74.

Recommendations:

A preliminary analysis using ASCE 41-06 as its basis was conducted to determine a strategy for rehabilitating the lateral force resisting system of Old Renton City Hall. The results of that analysis are presented as conceptual recommendations for a seismic retrofit of the building. These recommendations are schematic in nature. A final analysis will need to be conducted to determine that exact rehabilitation requirements for the lateral force resisting system, to develop specific details, and to coordinate with architectural, mechanical, and electrical design requirements. Please refer the plan drawings included as part of this report. They show schematically the structural elements described.

First, we recommend that the existing concrete shear wall along gridline C be demolished and replaced with a new 10 inch concrete shear wall. This new concrete shear wall extends from the foundation level up two floors to the underside of the second floor. From the second floor up, the wall continues as a new wall that reduces in overall length as we get further up the building. The wall provides needed lateral capacity and will help reduce the torsional effects caused by the unbalanced arrangement of the existing concrete shear walls.

The plans also show locations where fiber reinforced polymer laminate (FRP) should be added to increase the shear strength of the existing walls. FRP, also known as "Fiber Wrap", is a fiberglass or carbon laminate that can be applied to the walls in a minimally invasive manner. FRP does not intrude into the usable space and continuity can be provided between floor levels without coring through the floor diaphragms.

If FRP is not used in the seismic retrofit of the structure we would recommend applying shotcrete to the existing shear walls to increase their shear strength. However, our experience suggests that FRP is most likely the best option for use in a seismic retrofit of Old Renton City Hall. Several local contractors are capable and qualified to do the work.

The foundation plan shows areas where new footings should be added. These areas include the new concrete shear wall along grid C, and the existing concrete shear walls around the elevators and stairs. Other approaches could include the strengthening or supplementing existing foundations with drilled

"micro piles" or similar technique. These options would need to be compared on a cost, schedule, and other impact basis with simple spread footing construction.

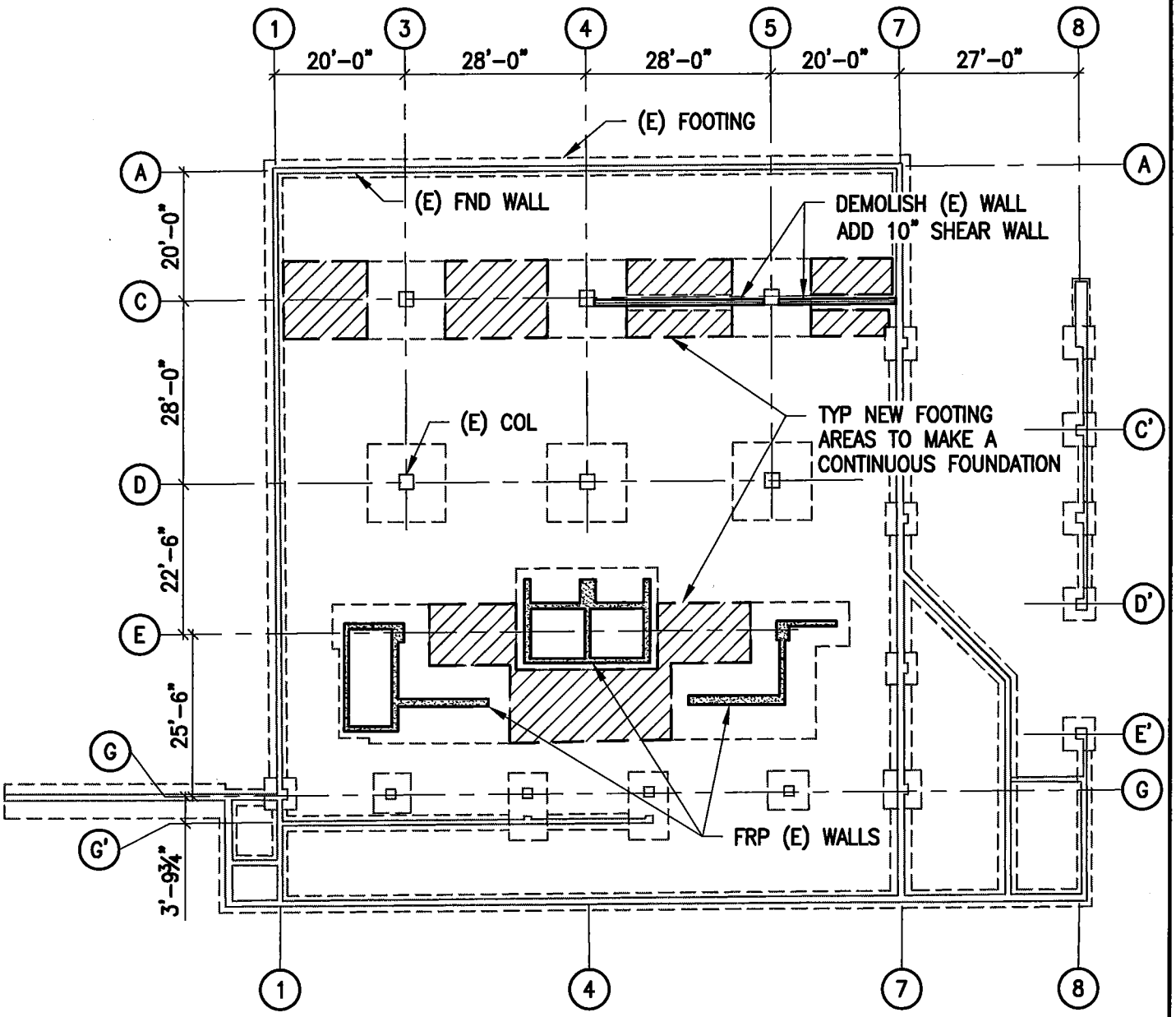
Previous studies for the building done by others have recommended that the columns along grid C should be retrofitted using steel jackets. These studies confirm our findings regarding the torsional irregularity and the high demands placed on the columns near the north side of the building. It is not known if the steel jackets were ever installed as the existing architectural treatment obscures the columns. If installed the jackets would have to be removed in several locations in order to complete the shear wall construction proposed by this analysis.

Conclusion:

As stated earlier, these results are schematic in nature and the extent of work may be more or less than what has been presented in this report. As the full renovation scope becomes clearer, specific analysis and detail design will be required to work within other requirements for architectural, mechanical, electrical, and other elements.

GENERAL NOTES:

1. INDICATES NEW FOOTING AREAS TO MAKE A CONTINUOUS FOOTING.
2. INDICATES NEW 10" SHEAR WALL.
3. INDICATES (E) WALLS REINFORCED WITH FIBER REINFORCED POLYMER LAMINATE (FRP).



FOUNDATION PLAN

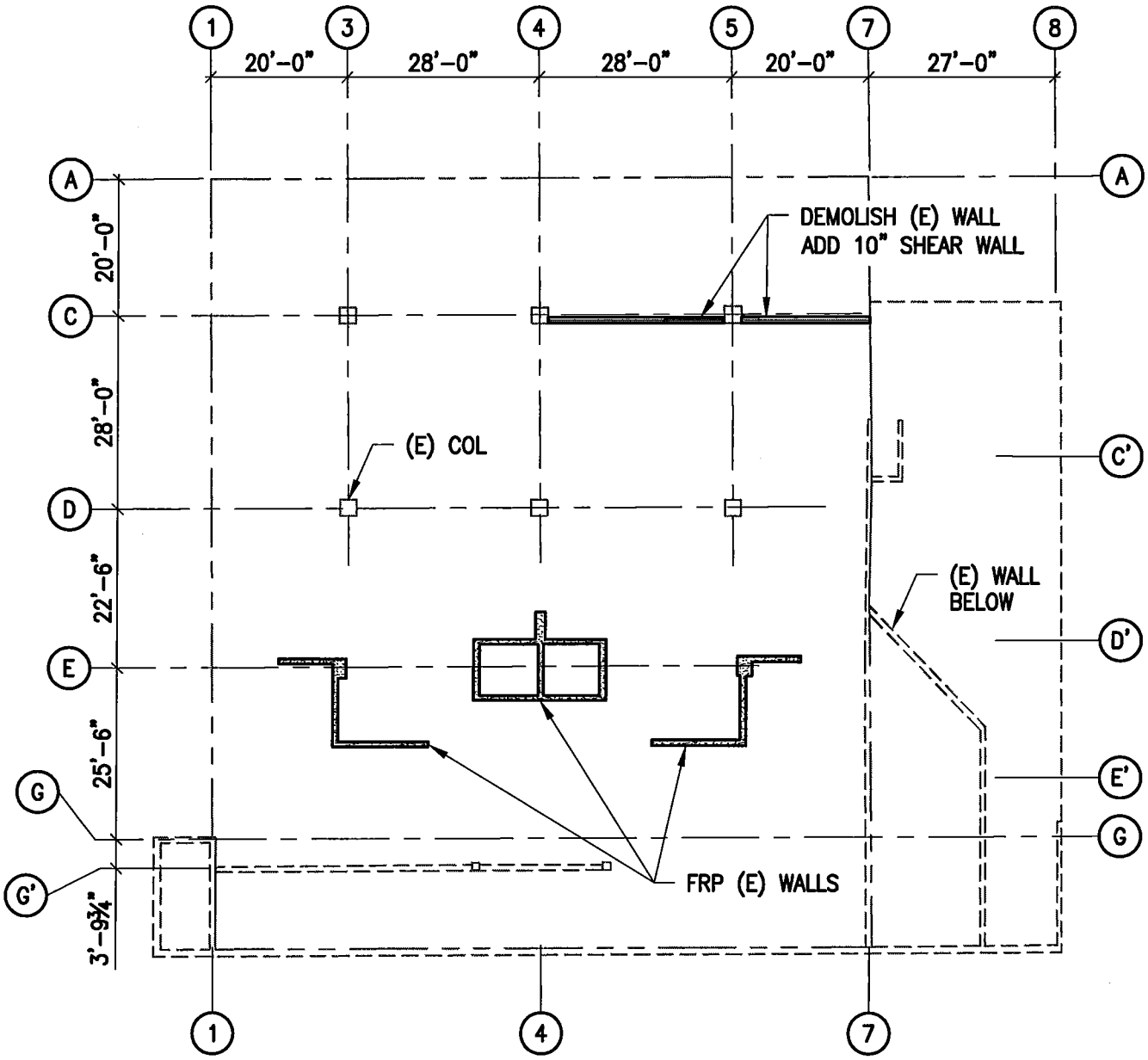
COFFMAN ENGINEERS
10 N. Post Street Suite 500
Spokane, Washington 99201
509 328 2994 Fax 509 328 2999

project OLD RENTON CITY HALL	by ANW	sheet no. S1
location RENTON, WA	date 1/2/08	
client	checked	job no.
FOUNDATION PLAN	date 1/2/08	

GENERAL NOTES:

1. INDICATES NEW 10" SHEAR WALL.

2. INDICATES (E) WALLS REINFORCED WITH FIBER REINFORCED POLYMER LAMINATE (FRP).



1st FLOOR FRAMING PLAN

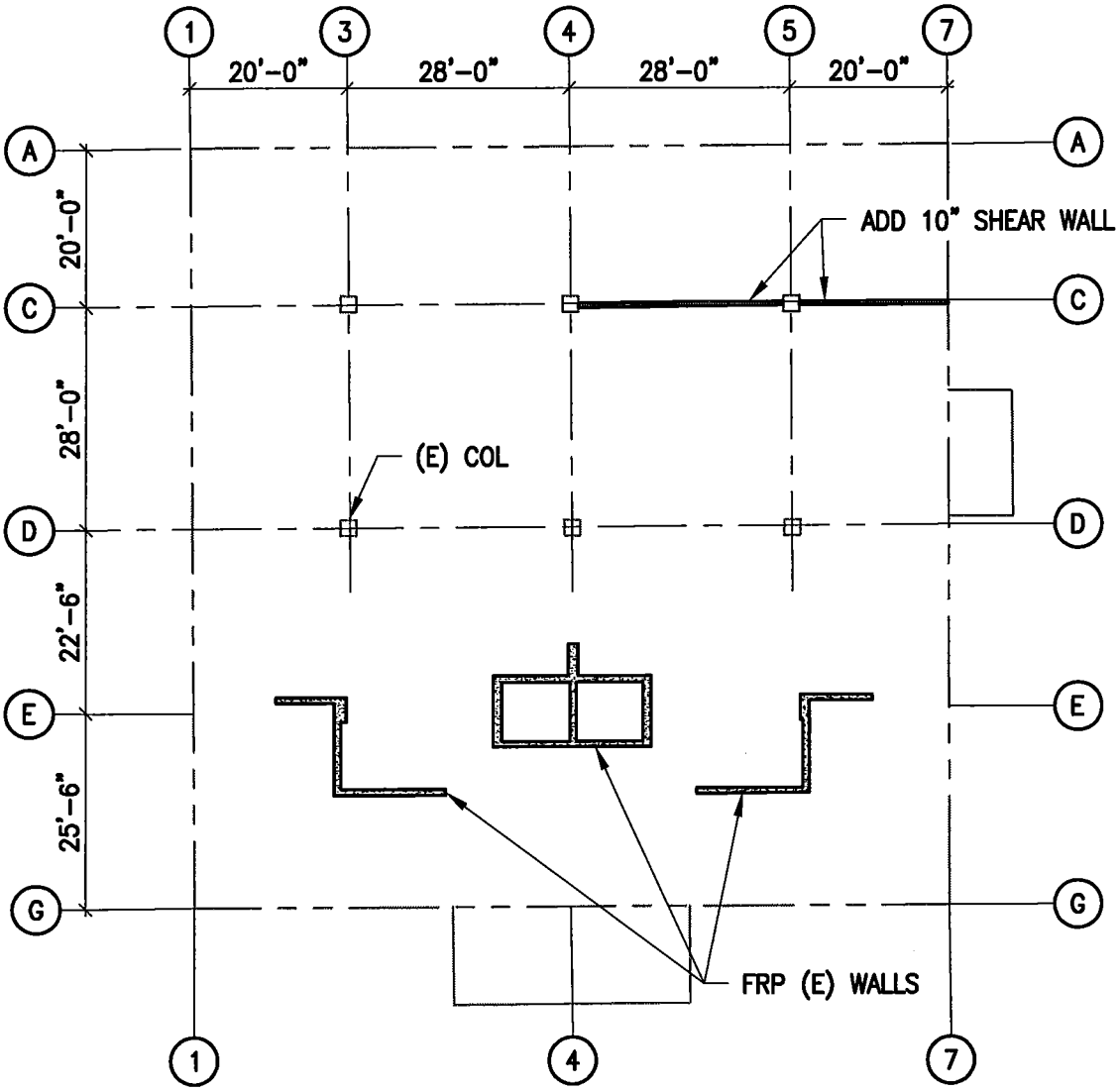
COFFMAN ENGINEERS
10 N. Post Street Suite 500
Spokane, Washington 99201
509 328 2994 Fax 509 328 2999

project OLD RENTON CITY HALL	by ANW	sheet no. S2
location RENTON, WA	date 1/2/08	
client	checked	job no.
1st FLOOR FRAMING PLAN	date 1/2/08	

GENERAL NOTES:

1. INDICATES NEW 10" SHEAR WALL.

2. INDICATES (E) WALLS REINFORCED WITH FIBER REINFORCED POLYMER LAMINATE (FRP).



2nd FLOOR FRAMING PLAN

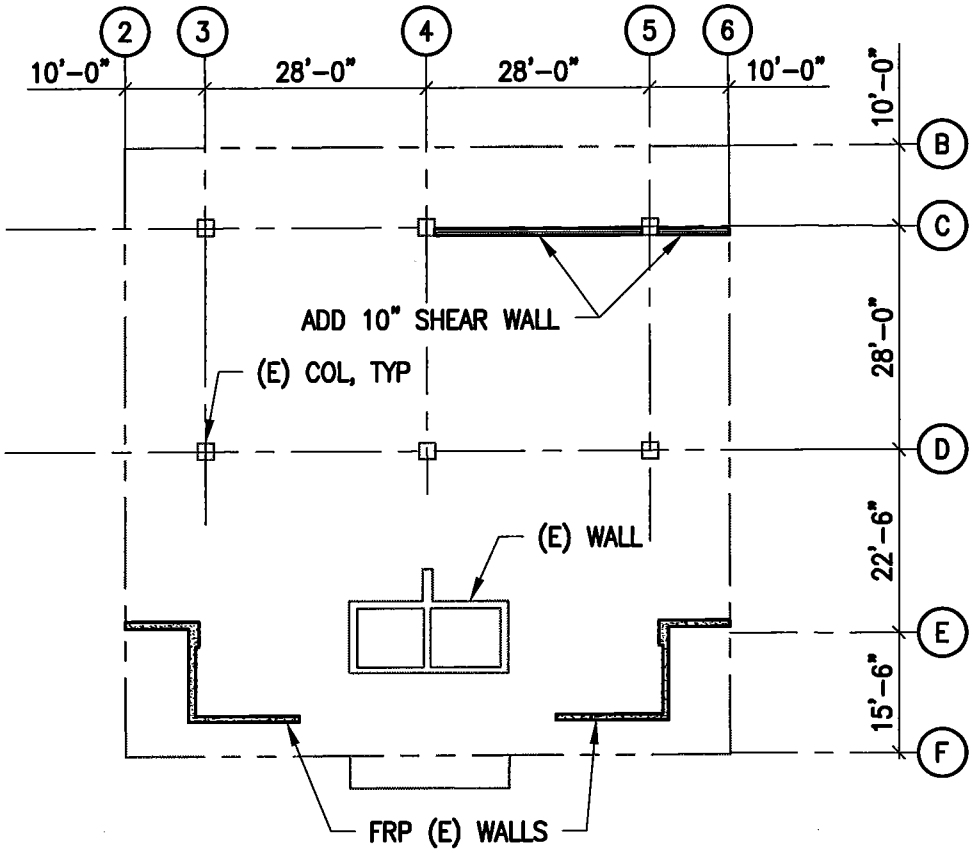
COFFMAN ENGINEERS
10 N. Post Street Suite 500
Spokane, Washington 99201
509 328 2994 Fax 509 328 2999

project OLD RENTON CITY HALL	by ANW	sheet no. S3
location RENTON, WA	date 1/2/08	
client	checked	job no.
2nd FLOOR FRAMING PLAN	date 1/2/08	

GENERAL NOTES:

1. INDICATES NEW 10" SHEAR WALL.

2. INDICATES (E) WALLS REINFORCED WITH FIBER REINFORCED POLYMER LAMINATE (FRP).



3rd FLOOR FRAMING PLAN

COFFMAN ENGINEERS
10 N. Post Street Suite 500
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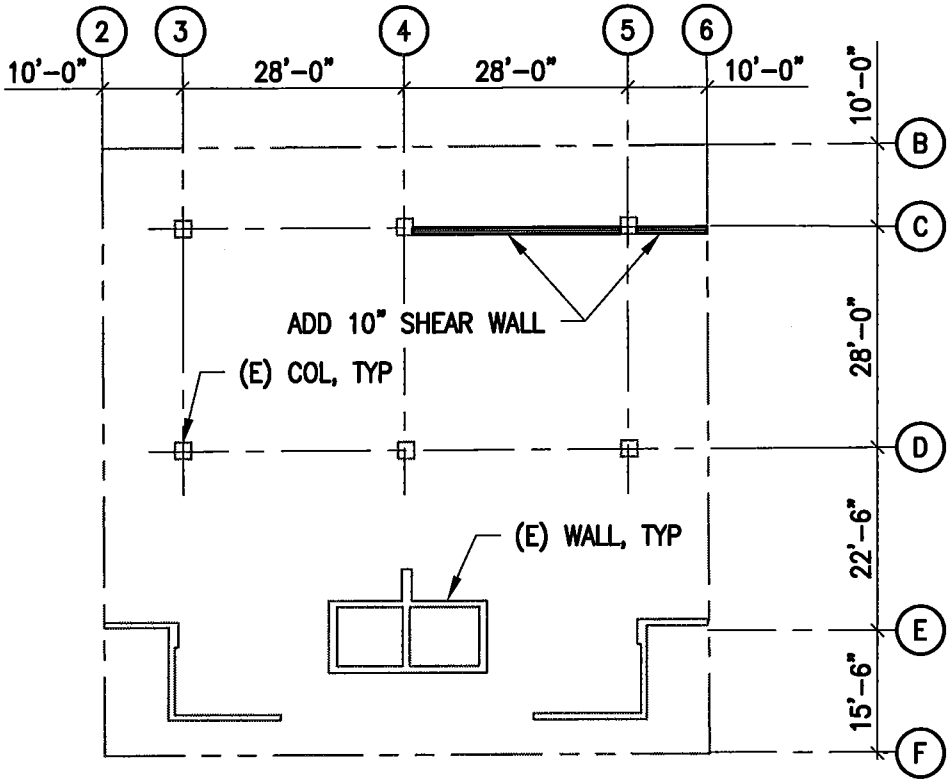
project OLD RENTON CITY HALL	by ANW	sheet no. S4
location RENTON, WA	date 1/2/08	
client	checked	job no.
3rd FLOOR FRAMING PLAN	date 1/2/08	

GENERAL NOTES:

1. ▭ INDICATES NEW 10" SHEAR WALL.



4th FLOOR FRAMING PLAN

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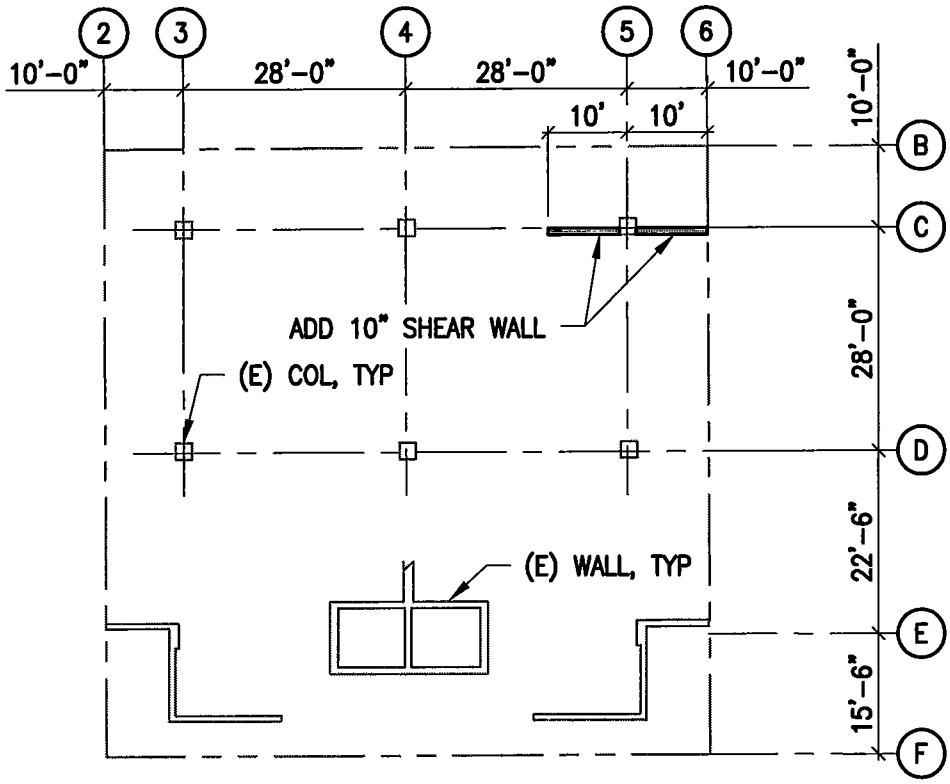
10 N. Post Street Suite 500
Spokane, Washington 99201
509 328 2994 Fax 509 328 2999

project OLD RENTON CITY HALL	by ANW	sheet no. S5
location RENTON, WA	date 1/2/08	
client	checked	job no.
4th FLOOR FRAMING PLAN	date 1/2/08	

GENERAL NOTES:

1. ▭ INDICATES NEW 10" SHEAR WALL.



5th & 6th FLOOR FRAMING PLAN

COFFMAN ENGINEERS
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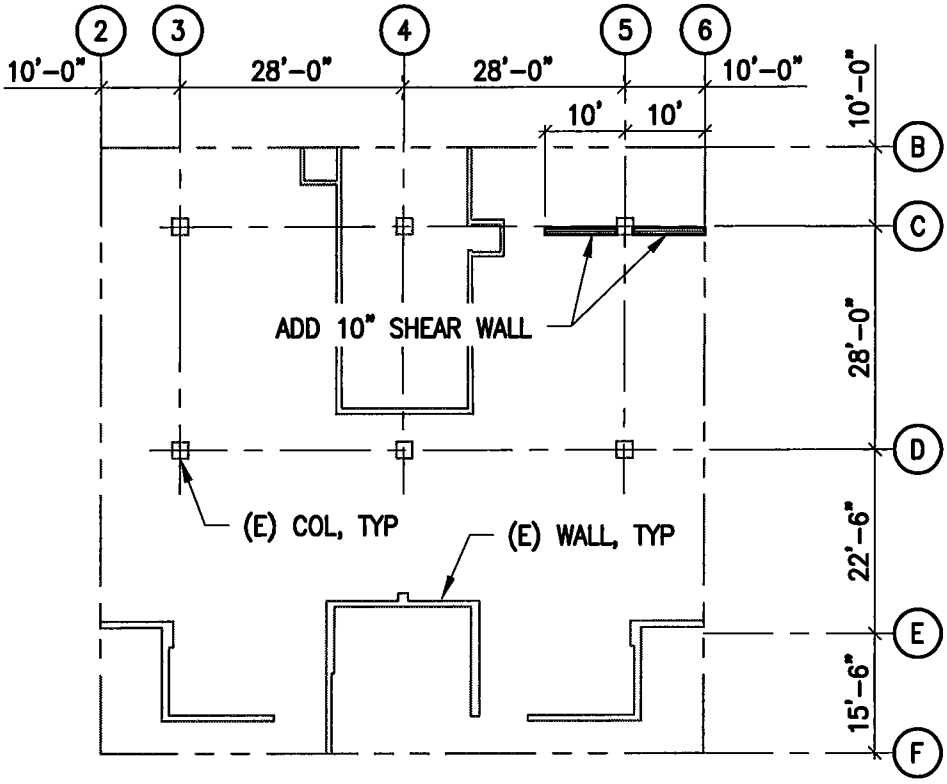
project OLD RENTON CITY HALL	by ANW	sheet no. S6
location RENTON, WA	date 1/2/08	
client	checked	job no.
5th & 6th FLOOR FRAMING PLAN	date 1/2/08	

GENERAL NOTES:

1. ▭ INDICATES NEW 10" SHEAR WALL.



7th FLOOR FRAMING PLAN

COFFMAN ENGINEERS
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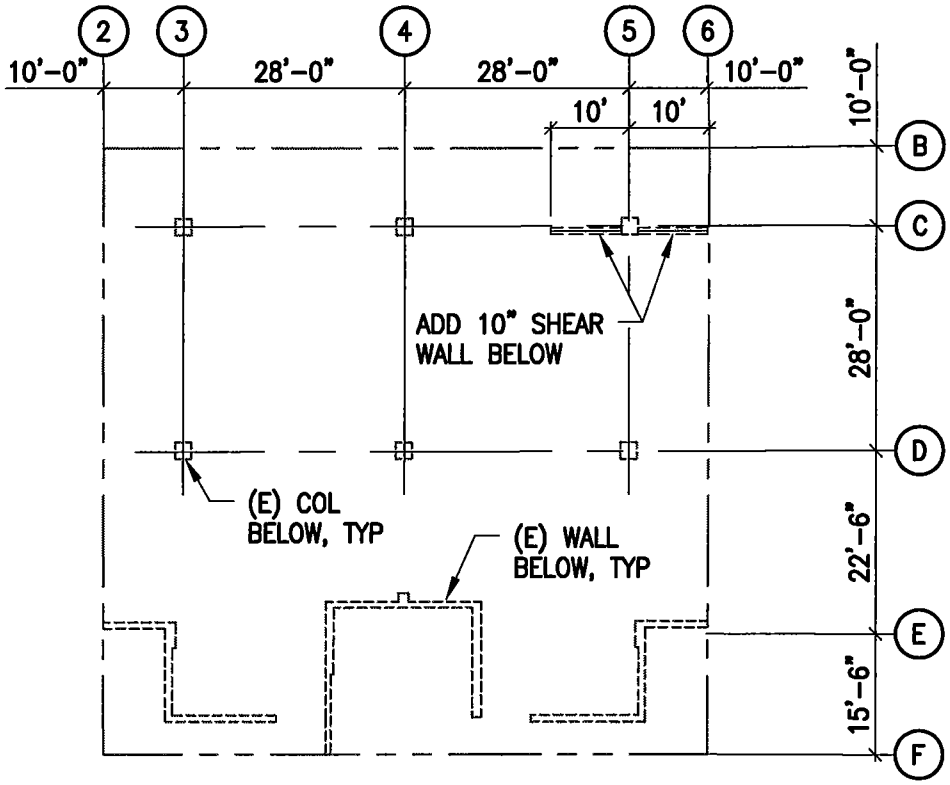
Spokane, Washington 99201
509 328 2994 Fax 509 328 2999

project OLD RENTON CITY HALL	by ANW	sheet no. S7
location RENTON, WA	date 1/2/08	
client	checked	job no.
7th FLOOR FRAMING PLAN	date 1/2/08	

GENERAL NOTES:

1. ▭▭▭▭ INDICATES NEW 10" SHEAR WALL.



ROOF FRAMING PLAN

COFFMAN ENGINEERS
10 N. Post Street Suite 500
Spokane, Washington 99201
509 328 2994 Fax 509 328 2999

project OLD RENTON CITY HALL	by ANW	sheet no. S8
location RENTON, WA	date 1/2/08	
client	checked	job no.
ROOF FRAMING PLAN	date 1/2/08	

COFFMAN ENGINEERS

OLD RENTON CITY HALL

SEISMIC RETROFIT

STRUCTURAL CALCULATIONS

November, 2007
JOB NO. 07230

Coffman Engineers, Inc.
16133 Ventura Blvd., Suite 1010
Encino, CA 91436
Phone: (818) 285-2650
Fax: (818) 285-2651

SUMMARY

The Old Renton City Hall, constructed in 1968, is located at 200 Mill Avenue South, in Renton, WA. The building structure is generally a seven-story cast-in-place concrete structure with concrete walls and columns supporting concrete waffle slabs. The completed evaluations using the ASCE 31-03 standard recommendations indicated serious deficiencies and suggest that the building is likely to perform poorly during a major seismic event (please refer to the previous Tier 1 "Structural Evaluation Report").

A detailed finite element model of the building was constructed using RAM Advanse. The Linear Dynamic Procedure (LDP) was applied to analyze its dynamic characteristics subject to the site-specific BSE-1 response spectrum. In its current condition, the building's first mode of vibration is a combination of transition at East-West and torsion at a period of 1.25 seconds and second mode of vibration is translational of North-South at a period of 0.82 seconds. Based on the preliminary analysis, the proposed retrofit scheme are summarized as follows,

1) To cure the considerable torsional irregularities in the building, new 10" concrete walls are added along Grid Line C and between Grid Line 4 ~ 7 (see the preliminary wall elevation sketch). Alternatively, along GL C new concrete walls can be added to GL 4 ~ GL 5 at all floors.

2) The building could be strengthened with FRP (Fiber Reinforced Polymer) around overstressed shear walls to increase shear capacity in order to accommodate the results of the dynamic analysis force distribution. The suggested strengthening locations are preliminary (all existing shaft walls at the first 3 floors, see the attached mark-up on the plan); hence alterations and refinements are likely during the design phase.

   In the event that a wall(s) is deemed insufficient and requires retrofitting, every attempt will be made to consider architectural features and minimize disruption of existing conditions. In an attempt to do that, two possible seismic retrofit schemes were considered. One involves addition of shotcrete and the other involves fiber-wrap to increase shear wall capacity. FRP (Fiber Reinforced Polymer, also known as "Fiber Wrap", essentially a fiberglass or carbon-fiber laminate) reinforcement of the existing overstressed shear walls is most likely the least costly and invasive method. FRP takes up less usable space and does not require coring through the existing floor diaphragms to provide reinforcement continuity for shotcrete application. Overall, FRP is the best retrofit solution for the overstressed shear walls. FRP strengthening of the existing shear walls offer an increase in seismic resistance at reasonable cost with relatively limited impact on architectural finishes and usable space.

3) Footings for the new concrete walls and the existing shaft walls need modifications (see the worse case draw-up on the foundation plan). – Require further study in design phase.

4) Due to building drift and limited ductility of existing columns, possible FRP strengthening of gravity columns are required. – Require further study in design phase.

5) It is appears that the existing diaphragm are adequate, however, some local strengthening may be required. – Require further study in design phase.

DESIGN LOADING CRITERIA

COFFMAN ENGINEERS

PROJECT Old Renton City Hall JOB NO. 07230

MADE BY SL DATE _____ PAGE _____.

STRUCTURAL DESIGN CRITERIA:

BUILDING CODE USED FOR DESIGN : ASCE/SEI 41-06

FOUNDATION CRITERIA:

Allowable Soil Bearing Pressure	_____ psf
Active Earth Pressure	_____ pcf
At-Rest Earth Pressure	_____ pcf
Passive Earth Pressure	_____ pcf
Coefficient of Friction	_____
Soil Profile Type- sand clay	

Min. Footing Depth below final finish grade _____

WIND CRITERIA:

_____ _____

SEISMIC CRITERIA USED FOR DESIGN:

Linear Dynamic Procedure (LDP) - Response Spectrum

Site-Specific BSE-1 Spectral Response:

the smaller of 10% 50Yrs & 2/3 BSE-2 (MCE)

LATERAL FORCE RESISTING SYSTEM: **Shear Wall**

GRAVITY LOADS:

Roof:	Superimposed DL =	20	psf
	LL =	40	psf
Typical Floor:	Superimposed DL =	20	psf
	LL =	100	psf
Exterior Walls:	Dead Line Load =	180	plf

MATERIALS:

(E) Concrete, Slab/Beam/Column	f'_c =	3.75	ksi
(E) Concrete, Shear Wall	f'_c =	3	ksi

$$(E_c)_{CRACKED} = 50\% * (E_c)_{GROSS}.$$

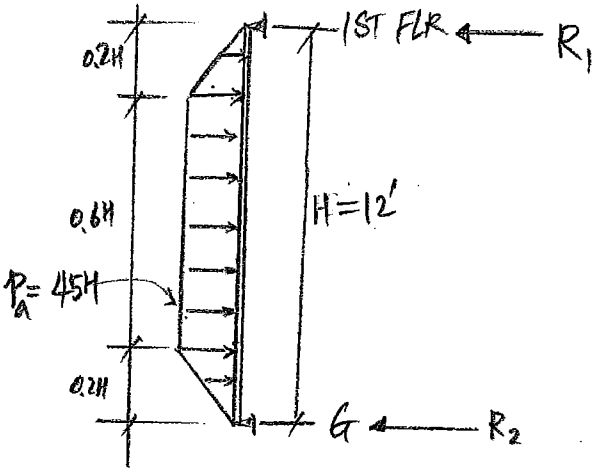
$$(E_c)_{GROSS} = 57{,}000\sqrt{f'_c}$$

COFFMAN ENGINEERS

PROJECT OLD RENTON CITY HALL JOB NO. 07230

MADE BY SL DATE _____ PAGE ____ OF ____

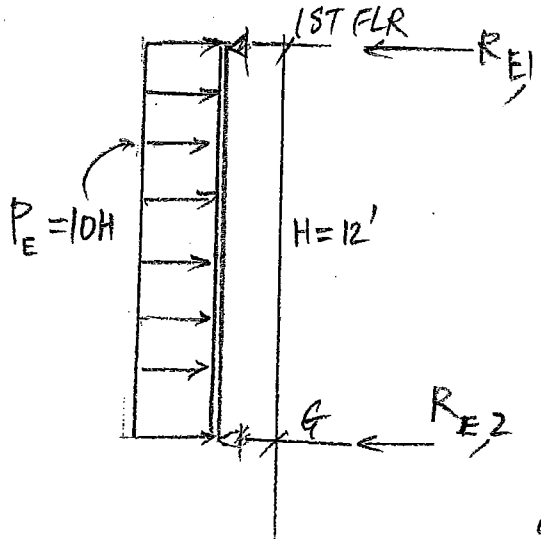
SOIL ACTIVE PRESSURE @ SOUTH OF BLDG



$$R_1 = R_2 = \frac{1}{2}(0.6H \times 45H + 0.2H \times 45H)$$
$$= \frac{1}{2} \times 0.8H \times 45H$$
$$= 0.4 \times 12' \times 45^{PCF} \times 12'$$
$$= 2592 \text{ PLF}$$

APPLYING LINE LOAD $R_1 = 2592$ #/,
@ 1ST FLR EDGE (SOUTH SIDE)

INCREMENTAL SOIL SEISMIC LOADING @ SOUTH OF BLDG



$$R_{E,1} = R_{E,2} = \frac{1}{2} \times 10H \times H$$
$$= 5H \times H$$
$$= 5 \times 12 \times 12$$
$$= 720 \text{ PLF}$$

APPLYING SEISMIC LINE LOAD
$R_{E,1} = 720$ #/,
@ 1ST FLR EDGE (SOUTH SIDE)

ASCE/SEI 41-06

site-specific spectra that represent the BSE-2 Earthquake Hazard Level shall be mean spectra at the 2%/50-year probability of exceedance. Deterministic BSE-2 site-specific spectra shall be taken as 150% of the median spectra for the characteristic event on the controlling fault.

1.6.2.1.4 Site-Specific BSE-2 Spectral Response Acceleration Parameters The site-specific response acceleration parameters for the BSE-2 Earthquake Hazard Level shall be taken as the smaller of the following:

1. The values of the parameters from mean probabilistic site-specific spectra at the 2%/50-year probability of exceedance; or
2. The values of the parameters from 150% of median deterministic site-specific spectra.

1.6.2.1.5 Site-Specific BSE-1 Spectral Response Acceleration Parameters The site-specific response acceleration parameters for the BSE-1 Earthquake Hazard Level shall be taken as the smaller of the following:

1. The values of the parameters from mean probabilistic site-specific spectra at the 10%/50-year probability of exceedance; or
2. Two-thirds of the values of the parameters determined for the BSE-2 Earthquake Hazard Level.

1.6.2.1.6 Site-Specific Response Acceleration Parameters Where a site-specific response spectrum has been developed and other sections of this standard require the design response acceleration parameters, S_{XS}, S_{X1}, and T_S they shall be obtained using the site-specific response spectrum in accordance with this section. Values of the design response acceleration parameter at short periods, S_{XS}, shall be taken as the response acceleration obtained from the site-specific spectrum at a period of 0.2 sec, except that it shall not be taken as less than 90% of the peak response acceleration at any period. In order to obtain values for the design spectral response acceleration parameter S_{X1}, a curve of the form $S_a = S_{X1}/T$ shall be graphically overlaid on the site-specific spectrum such that, at any period, the value of S_a obtained from the curve is not less than 90% of that which would be obtained directly from the spectrum. The value of T_S shall be determined in accordance with Eq. 1-11.

Table 1-6. Level of Seismicity Definitions

Level of Seismicity[1]	S_{XS}	S_{X1}
Low	<0.167	<0.067
Moderate	≥0.167	≥0.067
	<0.500	<0.200
High	≥0.500	≥0.200

[1]The higher level of seismicity defined by S_{XS} or S_{X1} shall govern.

1.6.2.2 Acceleration Time Histories

Time history analysis shall be performed with no fewer than three data sets (each containing two horizontal components or, if vertical motion is to be considered, two horizontal components and one vertical component) of ground motion time histories that shall be selected and scaled from no fewer than three recorded events. Time histories shall have magnitude, fault distances, and source mechanisms that are consistent with those that control the design earthquake ground motion. Where three recorded ground-motion time history data sets having these characteristics are not available, simulated time history data sets having equivalent duration and spectral content shall be used to make up the total number required. For each data set, the square root of the sum of the squares (SRSS) of the 5%-damped site-specific spectra of the scaled horizontal components shall be constructed. The data sets shall be scaled such that the average value of the SRSS spectra does not fall below 1.3 times the 5%-damped spectrum for the design earthquake for periods between $0.2T$ and $1.5T$ (where T is the fundamental period of the building).

1.6.3 Level of Seismicity

The level of seismicity shall be defined as High, Moderate, or Low as defined in Table 1-6.

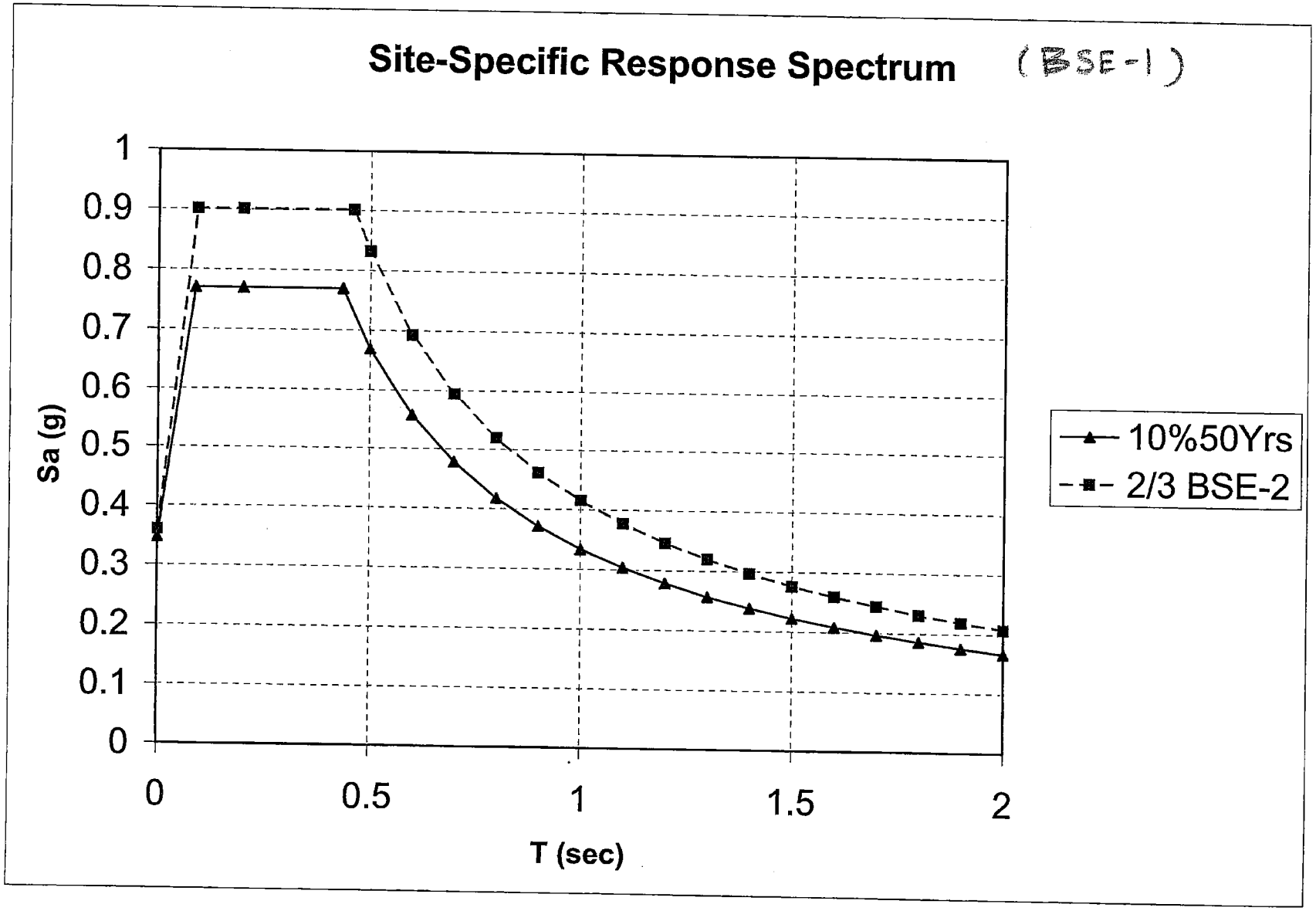
The values of S_{XS} and S_{X1} used to determine the Level of Seismicity shall be two-thirds of the BSE-2 values defined in Section 1.6.1.1.

2.0 GENERAL REQUIREMENTS

2.1 SCOPE

This chapter sets forth general requirements for data collection, analysis procedures, methods, and strategies for the design of seismic rehabilitation projects.

Section 2.2 specifies data collection procedures for obtaining required as-built information on build-


Site-Specific Response Spectrum
(BSE-1)
Sa (g)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
T (sec)
10%50Yrs
2/3 BSE-2

Conterminous 48 States
FEMA 356, Prestandard for Seismic Rehab of Bldgs
Ss and S1 for 10% PE in 50 years
Latitude = 47.481000
Longitude = -122.203000
Ss and S1 = Mapped Spectral Acceleration Values
Site Class B - Fa = 1.00, Fv = 1.00
Data are based on a 0.1 deg grid spacing.

Period (sec)	Sa (g)	
0.2	0.683	Ss, Site Class B
1.0	0.210	S1, Site Class B

Conterminous 48 States
FEMA 356, Prestandard for Seismic Rehab of Bldgs
Spectral Response Accelerations SMs and SM1
Latitude = 47.481000
Longitude = -122.203000
SMs = FaSs and SM1 = FvS1
Site Class C - Fa = 1.13, Fv = 1.59
Data are based on a 0.1 deg grid spacing.

Period (sec)	Sa (g)	
0.2	0.770	SMs, Site Class C
1.0	0.334	SM1, Site Class C

Conterminous 48 States
FEMA 356, Prestandard for Seismic Rehab of Bldgs
Site Modified Response Spectra for Site Class C
Latitude = 47.481000
Longitude = -122.203000
SMs = FaSs and SM1 = FvS1
Site Class C - Fa = 1.13, Fv = 1.59
Data are based on a 0.1 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.347	0.000
0.087	0.770	0.057
0.200	0.770	0.301
0.435	0.770	1.420
0.500	0.669	1.634
0.600	0.557	1.961
0.700	0.478	2.287
0.800	0.418	2.614
0.900	0.372	2.941
1.000	0.334	3.268
1.100	0.304	3.594
1.200	0.279	3.921
1.300	0.257	4.248
1.400	0.239	4.575
1.500	0.223	4.901
1.600	0.209	5.228
1.700	0.197	5.555
1.800	0.186	5.882
1.900	0.176	6.208
2.000	0.167	6.535

governs

Conterminous 48 States
FEMA 356, Prestandard for Seismic Rehab of Bldgs
Ss and S1 for MCE Ground Motion
Latitude = 47.481000
Longitude = -122.203000
Ss and S1 = Mapped Spectral Acceleration Values
Site Class B - Fa = 1.00, Fv = 1.00
Data are based on a 0.1 deg grid spacing.

Period (sec)	Sa (g)	
0.2	1.351	Ss, Site Class B
1.0	0.469	S1, Site Class B

Conterminous 48 States
FEMA 356, Prestandard for Seismic Rehab of Bldgs
Spectral Response Accelerations SMs and SM1
Latitude = 47.481000
Longitude = -122.203000
SMs = FaSs and SM1 = FvS1
Site Class C - Fa = 1.00, Fv = 1.33
Data are based on a 0.1 deg grid spacing.

Period (sec)	Sa (g)	
0.2	1.351	SMs, Site Class C
1.0	0.624	SM1, Site Class C

Period (sec)	Sa (g)	
0.2	0.901	2/3 SMs, Site Class C
1.0	0.416	2/3 SM1, Site Class C

Conterminous 48 States
FEMA 356, Prestandard for Seismic Rehab of Bldgs
Design Response Spectra for Site Class C
Latitude = 47.481000
Longitude = -122.203000
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class C - Fa = 1.00, Fv = 1.33
Data are based on a 0.1 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.360	0.000
0.092	0.901	0.075
0.200	0.901	0.352
0.461	0.901	1.875
0.500	0.832	2.031
0.600	0.693	2.437
0.700	0.594	2.843
0.800	0.520	3.250
0.900	0.462	3.656
1.000	0.416	4.062
1.100	0.378	4.468
1.200	0.346	4.874
1.300	0.320	5.281
1.400	0.297	5.687
1.500	0.277	6.093

1.600	0.260	6.499
1.700	0.245	6.906
1.800	0.231	7.312
1.900	0.219	7.718
2.000	0.208	8.124

LDP ANALYSIS

(RETROFIT MODEL)

BENTLEY **Coffman Engineers**

Current Date: 11/1/2007 12:02 PM
Units system: English
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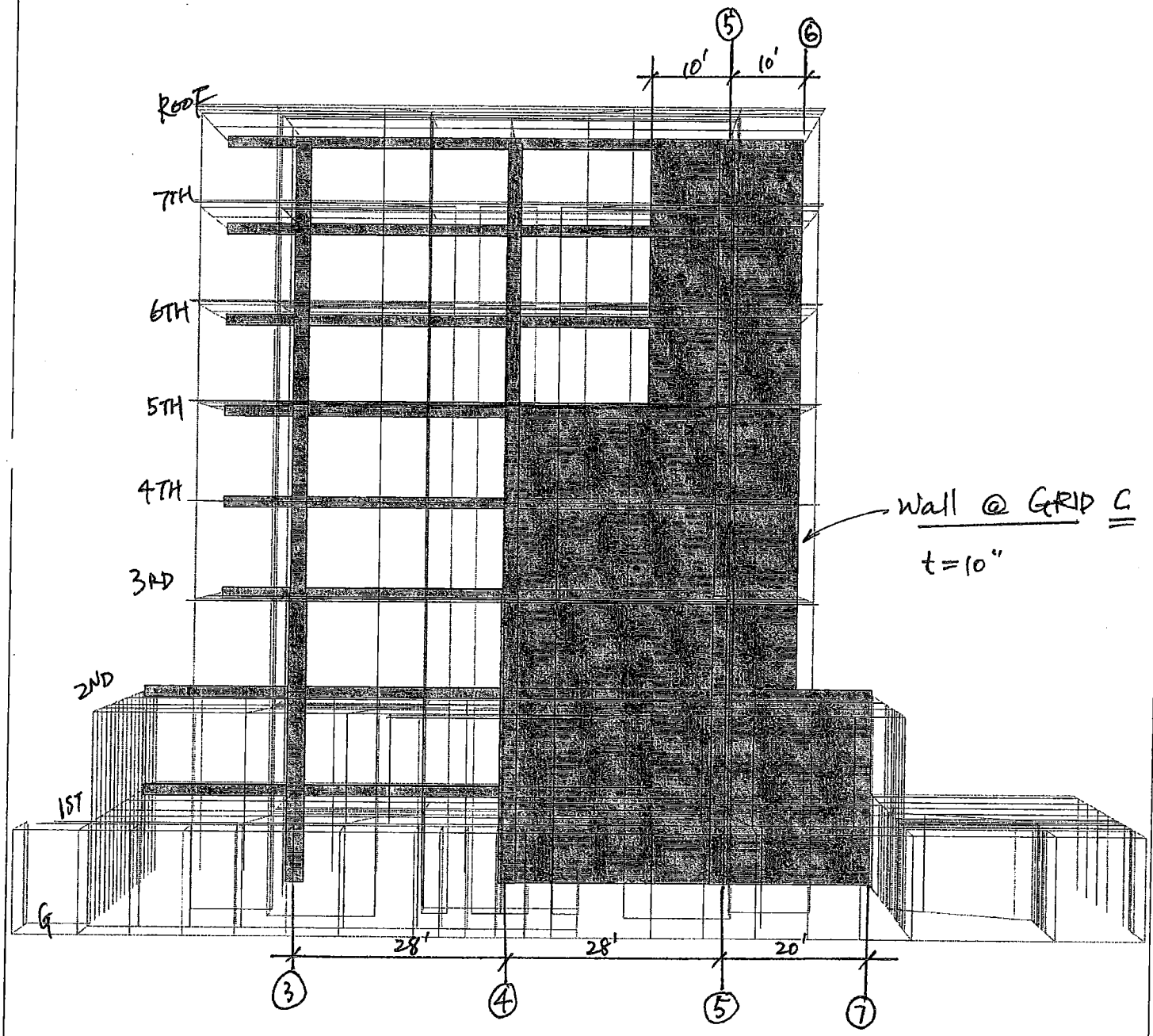
Z X

RETROFIT SCHEME (NEW CONC. WALL)



BENTLEY Coffman Engineers

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Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

Seismic analysis

Modal analysis

MASSES:

Node	Mass X [Lb]	Mass Y [Lb]	Mass Z [Lb]	MMI.xx [Lb*in2]	MMI.yy [Lb*in2]	MMI.zz [Lb*in2]
1213	2339222.00	0.00	2339222.00	0.00	7.86426E11	0.00
1214	1557194.00	0.00	1557194.00	0.00	3.655321E1	0.00
1215	1037423.00	0.00	1037423.00	0.00	1.474771E1	0.00
1216	1032512.00	0.00	1032512.00	0.00	1.468911E1	0.00
1217	1032512.00	0.00	1032512.00	0.00	1.468911E1	0.00
1218	1052867.00	0.00	1052867.00	0.00	1.475042E1	0.00
1219	1032512.00	0.00	1032512.00	0.00	1.468911E1	0.00
1220	1011347.00	0.00	1011347.00	0.00	1.466461E1	0.00

MODE FREQUENCIES

MODE	W [RAD/SEC]	T [SEC]
1	5.18	1.21190
2	9.38	0.67009
3	10.05	0.62496
4	24.40	0.25752
5	30.18	0.20822
6	46.51	0.13510
7	52.47	0.11975
8	63.27	0.09931
9	80.88	0.07769
10	90.56	0.06939
11	92.46	0.06795
12	110.34	0.05694
13	125.08	0.05023
14	133.00	0.04724
15	141.31	0.04446
16	144.37	0.04352
17	148.95	0.04218
18	164.47	0.03820
19	166.56	0.03772
20	198.78	0.03161
21	202.48	0.03103
22	230.72	0.02723
23	249.36	0.02520
24	283.49	0.02216

TRANS. @ Z-DIR.

MASS PARTICIPATION PERCENTAGE

MODE	Modal participation Part.X	Part.Y	Part.Z	Rot.X	Rot.Y	Rot.Z
1	0.01	0.00	56.01	0.00	0.00	0.00
2	32.58	0.00	0.00	0.00	12.91	0.00
3	20.29	0.00	0.00	0.00	25.89	0.00
4	0.12	0.00	17.65	0.00	0.11	0.00
5	14.58	0.00	0.04	0.00	6.57	0.00
6	7.04	0.00	0.00	0.00	10.22	0.00
7	0.11	0.00	7.68	0.00	0.36	0.00
8	7.60	0.00	0.01	0.00	7.20	0.00
9	0.00	0.00	4.05	0.00	0.07	0.00
10	0.43	0.00	0.01	0.00	5.56	0.00
11	5.89	0.00	0.00	0.00	0.34	0.00
12	0.02	0.00	3.32	0.00	0.09	0.00
13	1.07	0.00	1.62	0.00	2.86	0.00
14	0.33	0.00	6.06	0.00	0.17	0.00
15	1.82	0.00	0.39	0.00	0.06	0.00
16	0.22	0.00	1.39	0.00	0.08	0.00
17	0.49	0.00	1.04	0.00	2.26	0.00
18	0.00	0.00	0.03	0.00	0.00	0.00
19	0.70	0.00	0.59	0.00	4.49	0.00
20	0.11	0.00	0.00	0.00	0.26	0.00
21	0.14	0.00	0.02	0.00	1.40	0.00
22	6.30	0.00	0.09	0.00	18.73	0.00
23	0.16	0.00	0.00	0.00	0.36	0.00
24	0.00	0.00	0.00	0.00	0.01	0.00
TOTAL:	100.00	0.00	100.00	0.00	100.00	0.00

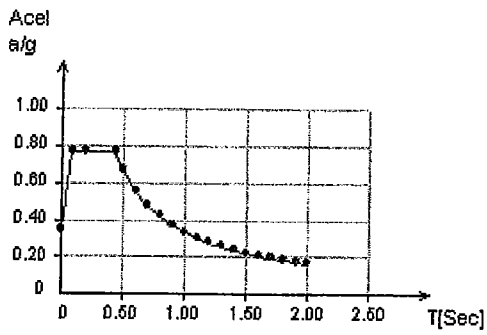
TOTAL MASS

DOF	Total mass [Lb/in*Sec2]
TX	26166.12
TY	0.00
TZ	26166.12
RX	0.00
RY	5.272467E0
RZ	0.00

SEISMIC RESPONSE SPECTRUM

T[Sec]	a/g
0.00000	0.35
0.08700	0.77
0.20000	0.77
0.43500	0.77
0.50000	0.67
0.60000	0.56
0.70000	0.48
0.80000	0.42
0.90000	0.37
1.00000	0.33
1.10000	0.30
1.20000	0.28
1.30000	0.26

1.40000	0.24
1.50000	0.22
1.60000	0.21
1.70000	0.20
1.80000	0.19
1.90000	0.18
2.00000	0.17



Condition	= **eqx=seismic in x**
Scale Factor	= 1.00
Damping factor	= 5.00

COMPUTED SPECTRAL VALUES

MODE	W [RAD/SEC]	T [SEC]	a [in/Sec2]
1	5.18	1.21190	106.64
2	9.38	0.67009	193.54
3	10.05	0.62496	207.30
4	24.40	0.25752	297.09
5	30.18	0.20822	297.09
6	46.51	0.13510	297.09
7	52.47	0.11975	297.09
8	63.27	0.09931	297.09
9	80.88	0.07769	279.62
10	90.56	0.06939	264.04
11	92.46	0.06795	261.36
12	110.34	0.05694	240.70
13	125.08	0.05023	228.11
14	133.00	0.04724	222.51
15	141.31	0.04446	217.29
16	144.37	0.04352	215.52
17	148.95	0.04218	213.01
18	164.47	0.03820	205.55
19	166.56	0.03772	204.65
20	198.78	0.03161	193.18
21	202.48	0.03103	192.09
22	230.72	0.02723	184.97
23	249.36	0.02520	181.15
24	283.49	0.02216	175.46

Condition	= **eqz=seismic in z**
Scale Factor	= 1.00
Damping factor	= 5.00

COMPUTED SPECTRAL VALUES

MODE	W [RAD/SEC]	T [SEC]	a [in/Sec2]
1	5.18	1.21190	106.64
2	9.38	0.67009	193.54
3	10.05	0.62496	207.30
4	24.40	0.25752	297.09
5	30.18	0.20822	297.09
6	46.51	0.13510	297.09
7	52.47	0.11975	297.09
8	63.27	0.09931	297.09
9	80.88	0.07769	279.62
10	90.56	0.06939	264.04
11	92.46	0.06795	261.36
12	110.34	0.05694	240.70
13	125.08	0.05023	228.11
14	133.00	0.04724	222.51
15	141.31	0.04446	217.29
16	144.37	0.04352	215.52
17	148.95	0.04218	213.01
18	164.47	0.03820	205.55
19	166.56	0.03772	204.65
20	198.78	0.03161	193.18
21	202.48	0.03103	192.09
22	230.72	0.02723	184.97
23	249.36	0.02520	181.15
24	283.49	0.02216	175.46

MODAL SHAPES

Normalized displacements to Phi*M*Phi=1

Modal shapes : 1

W = 5.18 [RAD/SEC] **PERIOD** =1.21190 [SEC]

DISPLACEMENTS

Node	Trans.X [phi]	Trans.Y [phi]	Trans.Z [phi]	Rot.X [phiRot]	Rot.Y [phiRot]	Rot.Z [phiRot]
1213	-2.71E-05	0.00E+00	1.12E-04	0.00E+00	8.78E-08	0.00E+00
1214	-4.02E-05	0.00E+00	1.14E-03	0.00E+00	8.78E-08	0.00E+00
1215	-4.90E-05	2.54E-04	2.67E-03	-1.80E-06	8.78E-08	-3.25E-07
1216	-5.38E-05	3.04E-04	4.37E-03	-1.99E-06	8.78E-08	-3.93E-07
1217	-5.82E-05	3.41E-04	6.22E-03	-2.01E-06	8.78E-08	-3.60E-07
1218	-6.56E-05	0.00E+00	8.15E-03	0.00E+00	1.04E-07	0.00E+00
1219	-7.42E-05	3.91E-04	1.01E-02	-1.62E-06	1.22E-07	-1.96E-07
1220	-7.94E-05	3.56E-04	1.18E-02	2.85E-07	1.40E-07	1.72E-08

INTER-STORY DRIFT

TORSION CHECK (A_x)

COFFMAN ENGINEERS

PROJECT Old Renton City Hall JOB NO. 07230

MADE BY SL DATE _____ PAGE _____.

DISPLACEMENTS / INTERSTORY-DRIFT

Node	X [in]	lc	Z [in]	lc	INTER-STORY DRIFT X [in]	Z [in]		X-max [in]	Z-max [in]	INTER-STORY RATIO X	Z
ROOF							max=	0.759	0.866	0.55%	0.63%
996 Max	3.54	eqx	5.73	eqz	0.759	0.866					
1002 Max	3.54	eqx	5.67	eqz	0.759	0.856					
1165 Max	2.98	eqx	5.73	eqz	0.449	0.866					
1170 Max	2.98	eqx	5.67	eqz	0.449	0.856					
7TH							max=	0.786	0.925	0.55%	0.64%
995 Max	2.78	eqx	4.86	eqz	0.786	0.925					
1001 Max	2.78	eqx	4.81	eqz	0.786	0.918					
1171 Max	2.53	eqx	4.86	eqz	0.483	0.925					
1176 Max	2.53	eqx	4.81	eqz	0.483	0.918					
6TH							max=	0.676	0.918	0.47%	0.64%
994 Max	1.99	eqx	3.94	eqz	0.676	0.918					
1000 Max	1.99	eqx	3.89	eqz	0.676	0.912					
1177 Max	2.05	eqx	3.94	eqz	0.48	0.918					
1182 Max	2.05	eqx	3.89	eqz	0.48	0.912					
5TH							max=	0.463	0.879	0.32%	0.61%
993 Max	1.31	eqx	3.02	eqz	0.404	0.879					
999 Max	1.31	eqx	2.98	eqz	0.404	0.878					
1183 Max	1.57	eqx	3.02	eqz	0.463	0.879					
1188 Max	1.57	eqx	2.98	eqz	0.463	0.878					
4TH							max=	0.422	0.807	0.29%	0.56%
992 Max	0.91	eqx	2.14	eqz	0.353	0.807					
998 Max	0.91	eqx	2.10	eqz	0.353	0.805					
1189 Max	1.11	eqx	2.14	eqz	0.422	0.807					
1194 Max	1.11	eqx	2.10	eqz	0.422	0.805					
3TH							max=	0.364	0.742	0.25%	0.52%
991 Max	0.56	eqx	1.34	eqz	0.294	0.735					
997 Max	0.56	eqx	1.30	eqz	0.294	0.742					
1195 Max	0.69	eqx	1.34	eqz	0.364	0.735					
1200 Max	0.69	eqx	1.30	eqz	0.364	0.742					
2TH							max=	0.3	0.52	0.21%	0.36%
751 Max	0.26	eqx	0.60	eqz	0.179	0.515					
767 Max	0.26	eqx	0.56	eqz	0.179	0.509					
848 Max	0.32	eqx	0.60	eqz	0.3	0.512					
783 Max	0.32	eqx	0.56	eqz	0.3	0.52					
1ST							max=	0.084	0.088	0.06%	0.06%
734 Max	0.08	eqx	0.09	eqz							
750 Max	0.08	eqx	0.05	eqz							
908 Max	0.07	eqx	0.04	eqz							
282 Max	0.02	eqx	0.09	eqz							
279 Max	0.02	eqx	0.04	eqz							

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Units system: English
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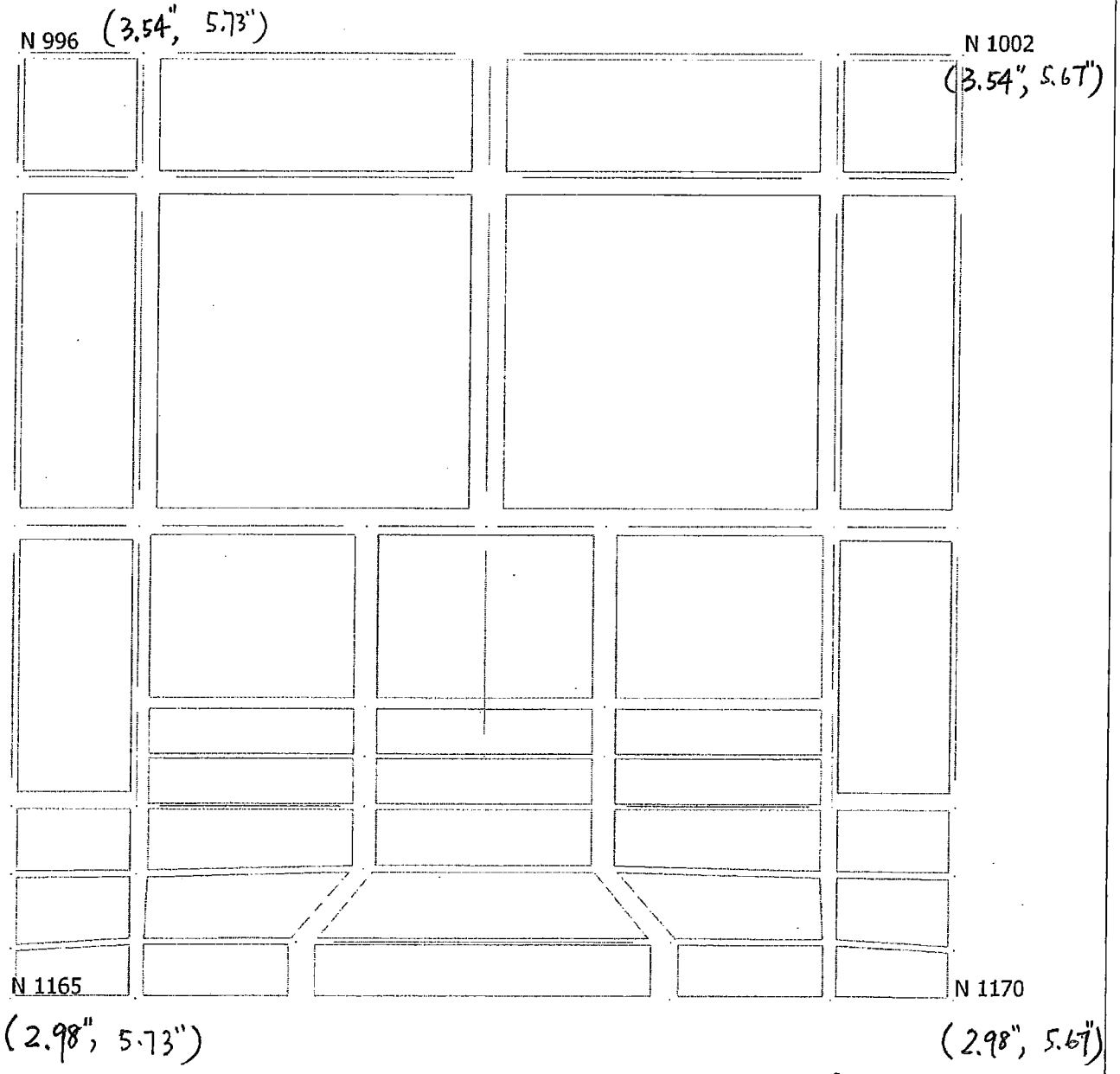
X
Z

DISPLACEMENTS (δ_x, δ_z).
(in).

ROOF
$h = 11.5'$



@ X-DIR: $A_x = \left[\dfrac{3.54''}{1.2 \times \left(\frac{3.54'' + 2.98''}{2}\right)}\right]^2 = 0.82 < 1$

@ Z-DIR: $A_z = \left[\dfrac{5.73}{1.2 \times (5.73 + 5.67)/2}\right]^2 = 0.71 < 1$

BENTLEY **Coffman Engineers**

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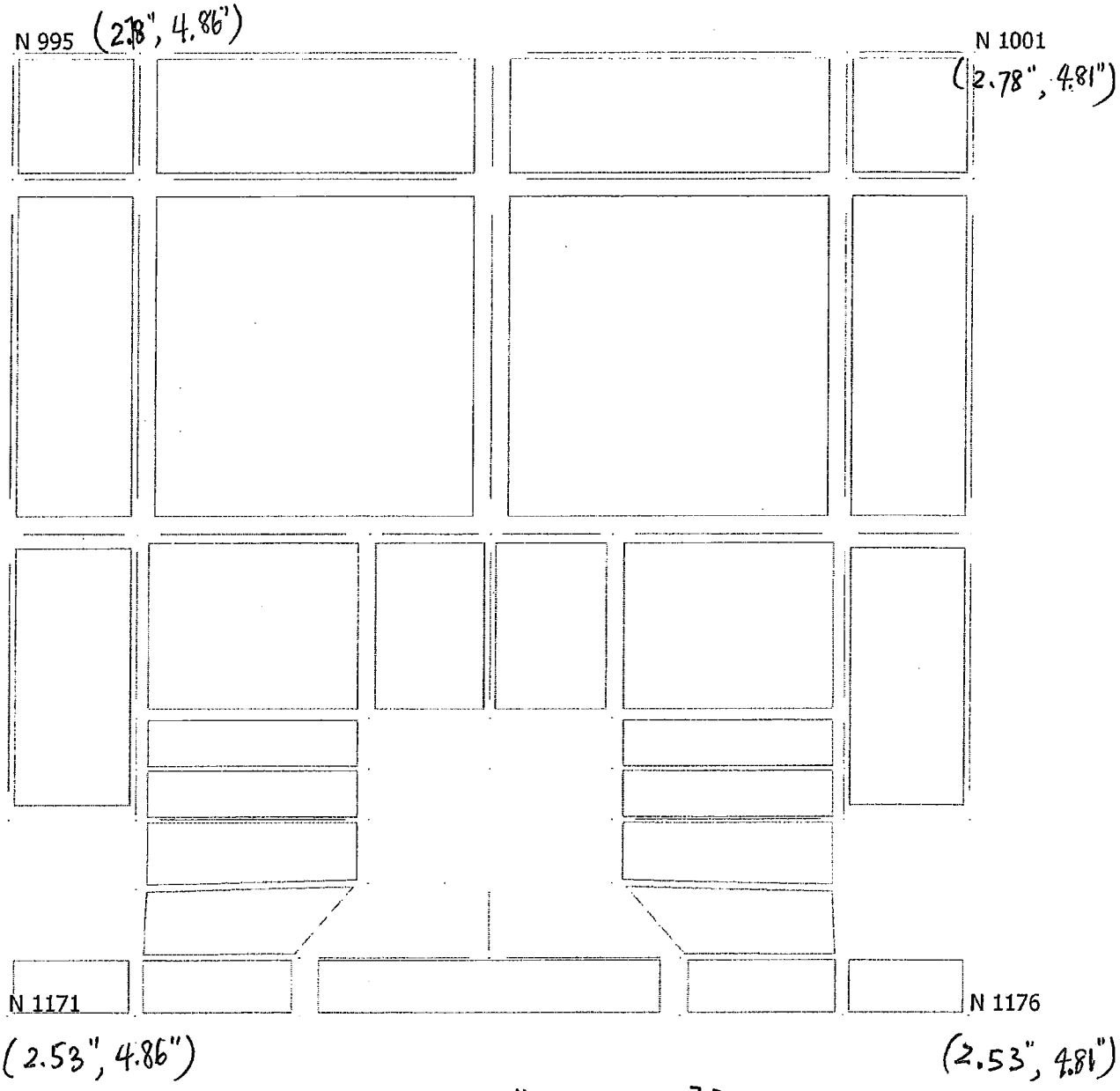
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

X

Z

7TH FLR

h=12'



@ X-DIR: $A_x = \left[\frac{2.78''}{1.2 \times (2.78'' + 2.53'')/2}\right]^2 = 0.76 < 1$

@ Z-DIR: $A_z = \left[\frac{4.86}{1.2 \times (4.86 + 4.81)/2}\right]^2 = 0.70 < 1$

BENTLEY **Coffman Engineers**

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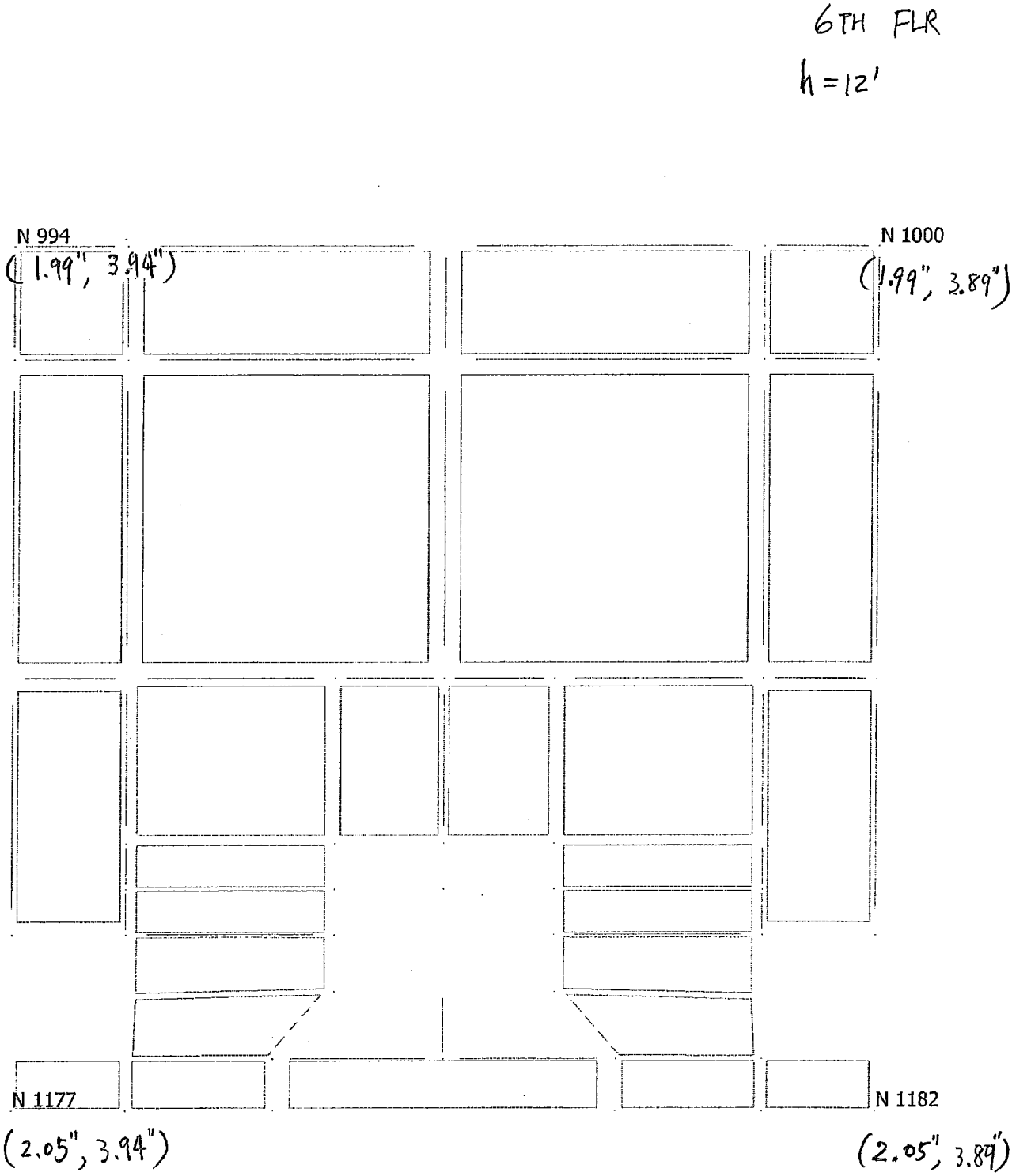
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

6TH FLR

$h = 12'$



@ X-DIR: $A_x = \left[\frac{2.05}{1.2 \times (2.05 + 1.99)/2}\right]^2 = 0.72 < 1$

@ Z-DIR: $A_z = \left[\frac{3.94}{1.2 \times (3.94 + 3.89)/2}\right]^2 = 0.71 < 1$

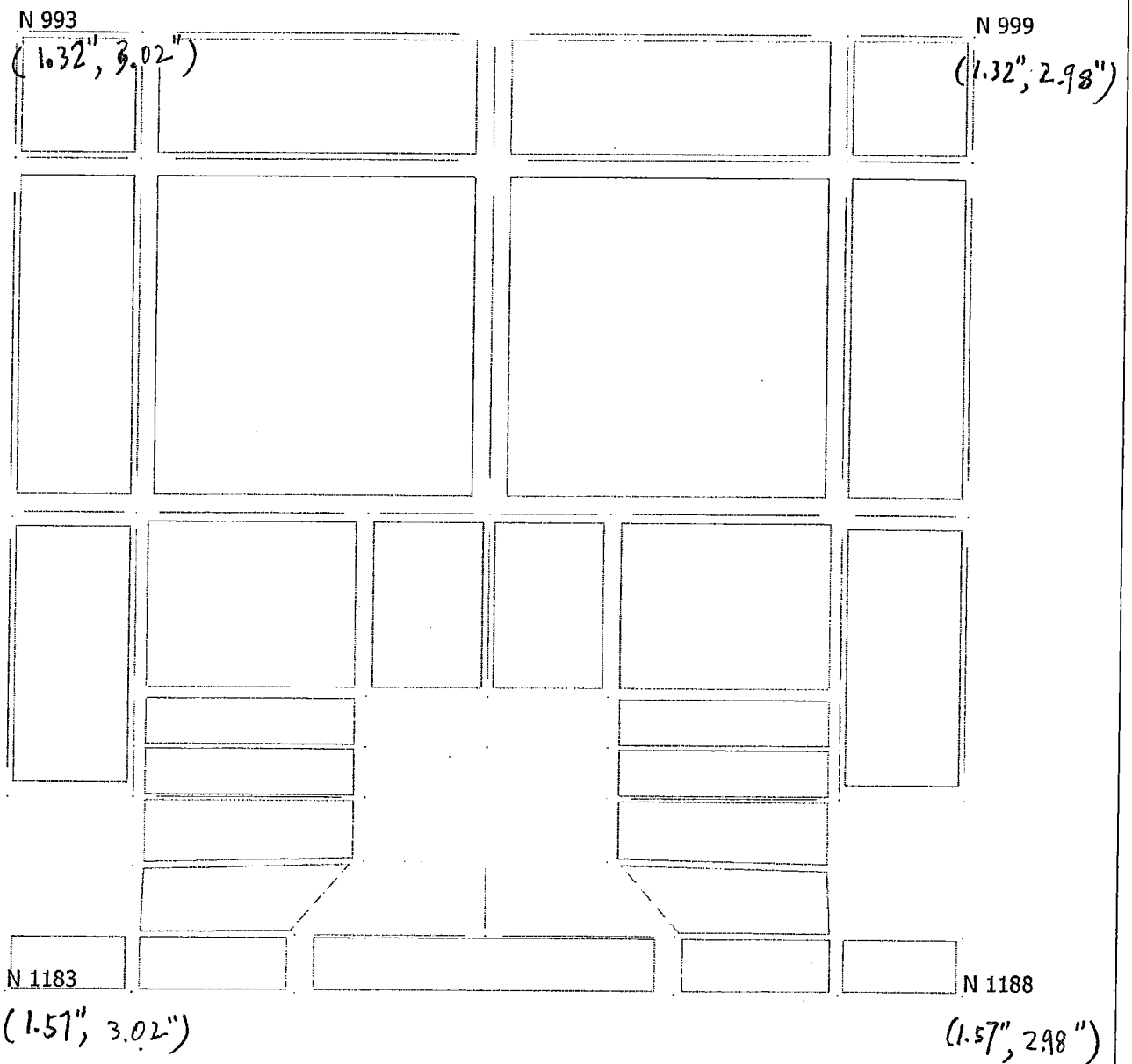
BENTLEY **Coffman Engineers**

Current Date: 11/2/2007 4:37 PM
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

X
Z

5TH FLR

h = 12'



@X-DIR: $A_x = \left[\frac{1.57}{1.2 \times (1.57 + 1.32)/2}\right]^2 = 0.82 < 1$

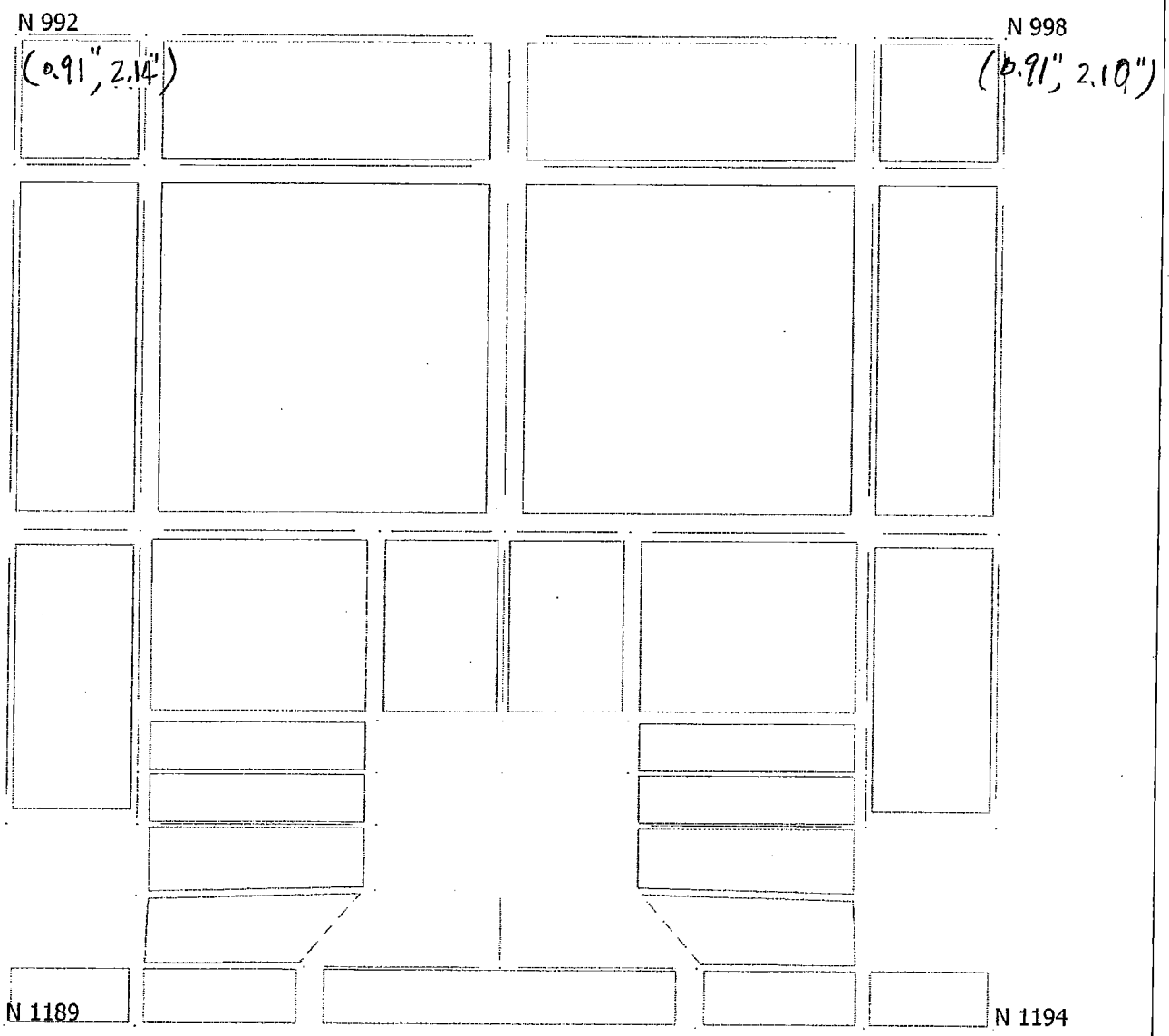
@Z-DIR: $A_z = \left[\frac{3.02}{1.2 \times (3.02 + 2.98)/2}\right]^2 = 0.71 < 1$

BENTLEY **Coffman Engineers**

Current Date: 11/2/2007 4:36 PM
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

X
Z

4TH FLR
h = 12'



@X-DIR: $A_x = \left[\frac{1.11}{1.2 \times (1.11 + 0.91)/2}\right]^2 = 0.84 < 1$

@Z-DIR: $A_z = \left[\frac{2.14}{1.2 \times (2.14 + 2.10)/2}\right]^2 = 0.71 < 1$

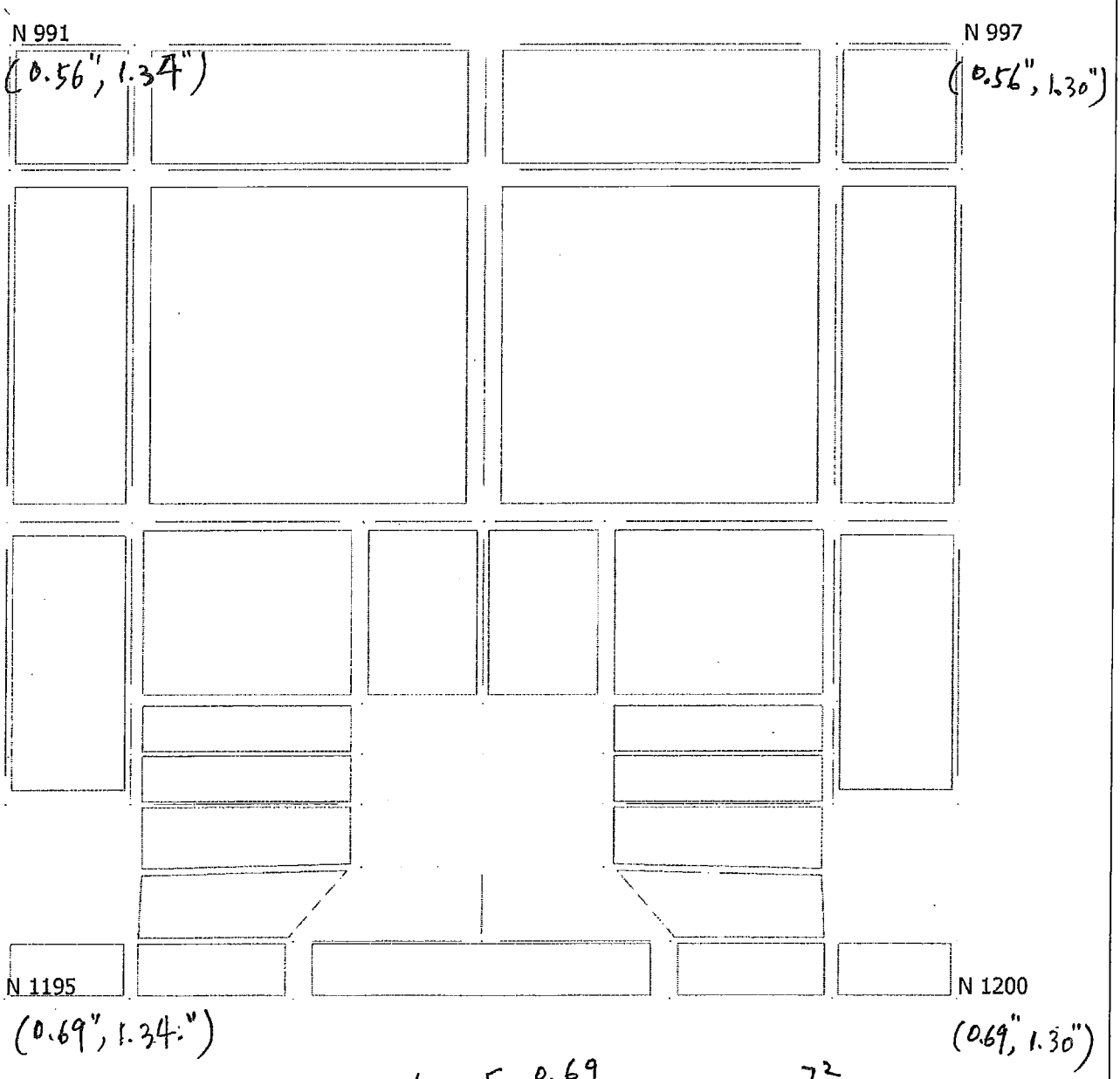
BENTLEY **Coffman Engineers**

Current Date: 11/2/2007 4:36 PM
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

X
Z

3RD FLR

h = 13'



@ X-DIR: $A_x = \left[\frac{0.69}{1.2 \times (0.69+0.56)/2}\right]^2 = 0.85 < 1$

@ Z-DIR: $A_z = \left[\frac{1.34}{1.2 \times (1.34+1.30)/2}\right]^2 = 0.72 < 1$

BENTLEY **Coffman Engineers**

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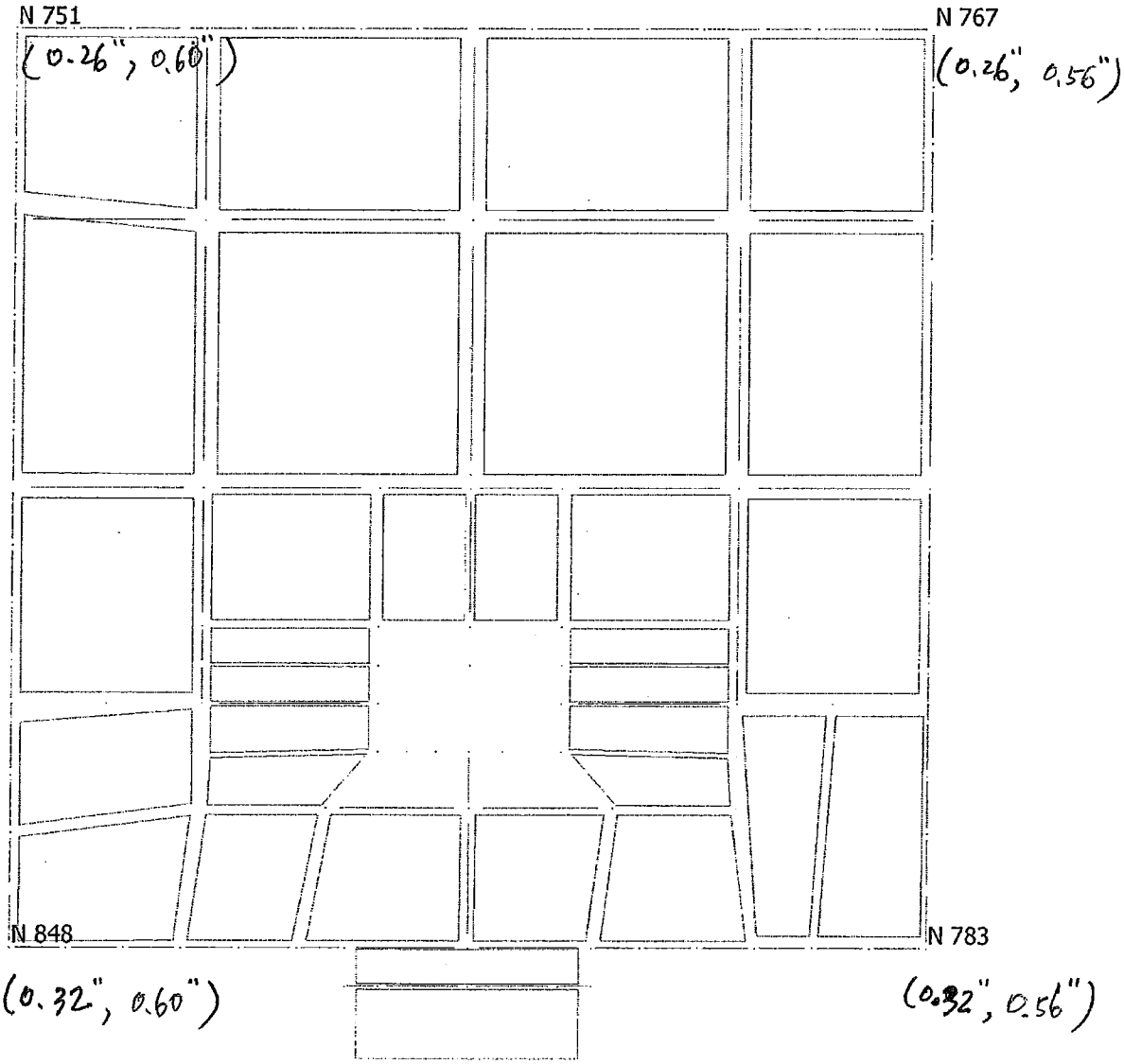
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

X
Z

2ND FLR

h = 13'



@ X-DIR: $A_x = \left[\dfrac{0.32}{1.2\times(0.32+0.26)/2}\right]^2 = 0.85 < 1$

@ Z-DIR: $A_z = \left[\dfrac{0.60}{1.2\times(0.60+0.56)/2}\right]^2 = 0.75 < 1$

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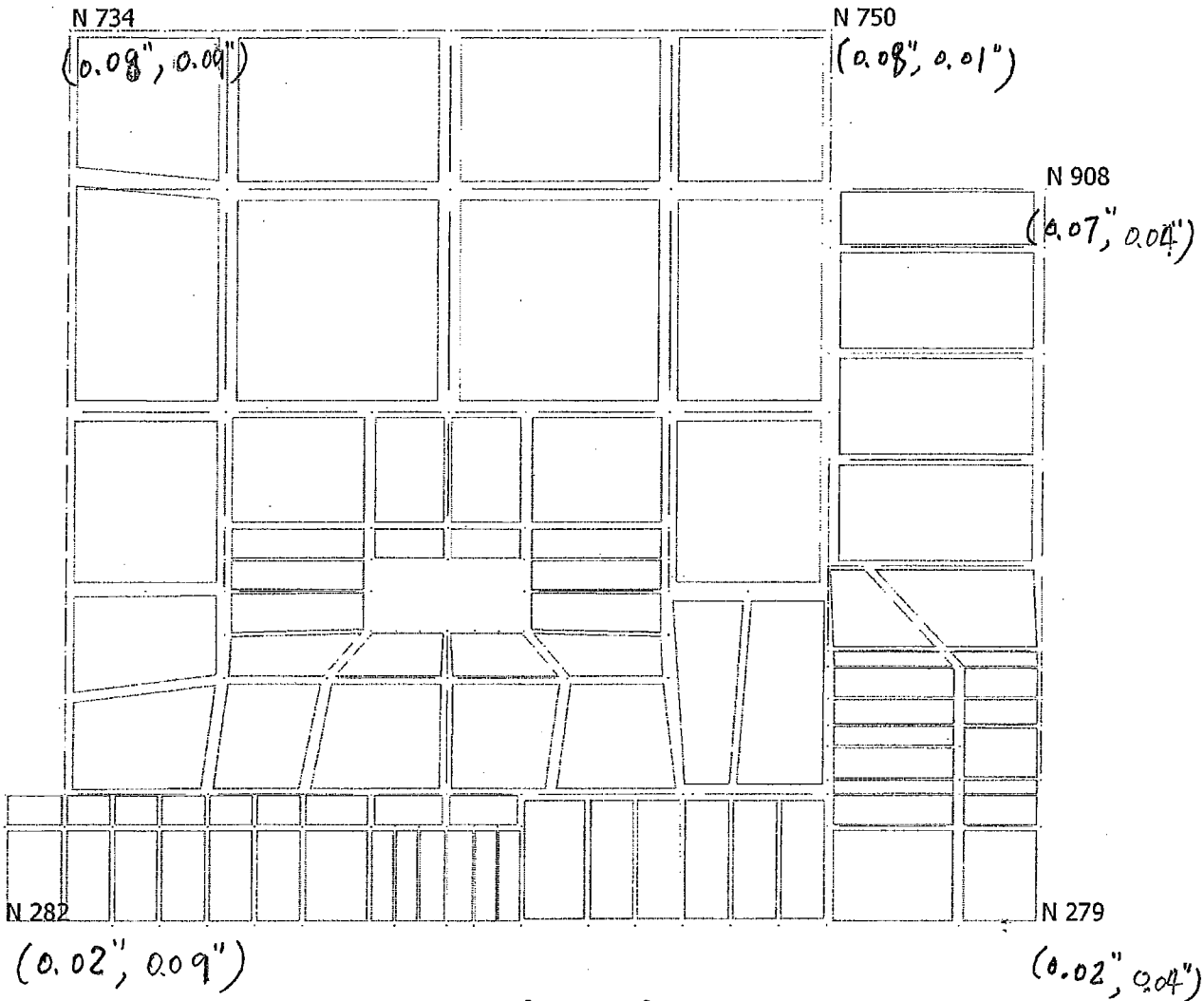
X
Z

1ST FLR.

h = 12'



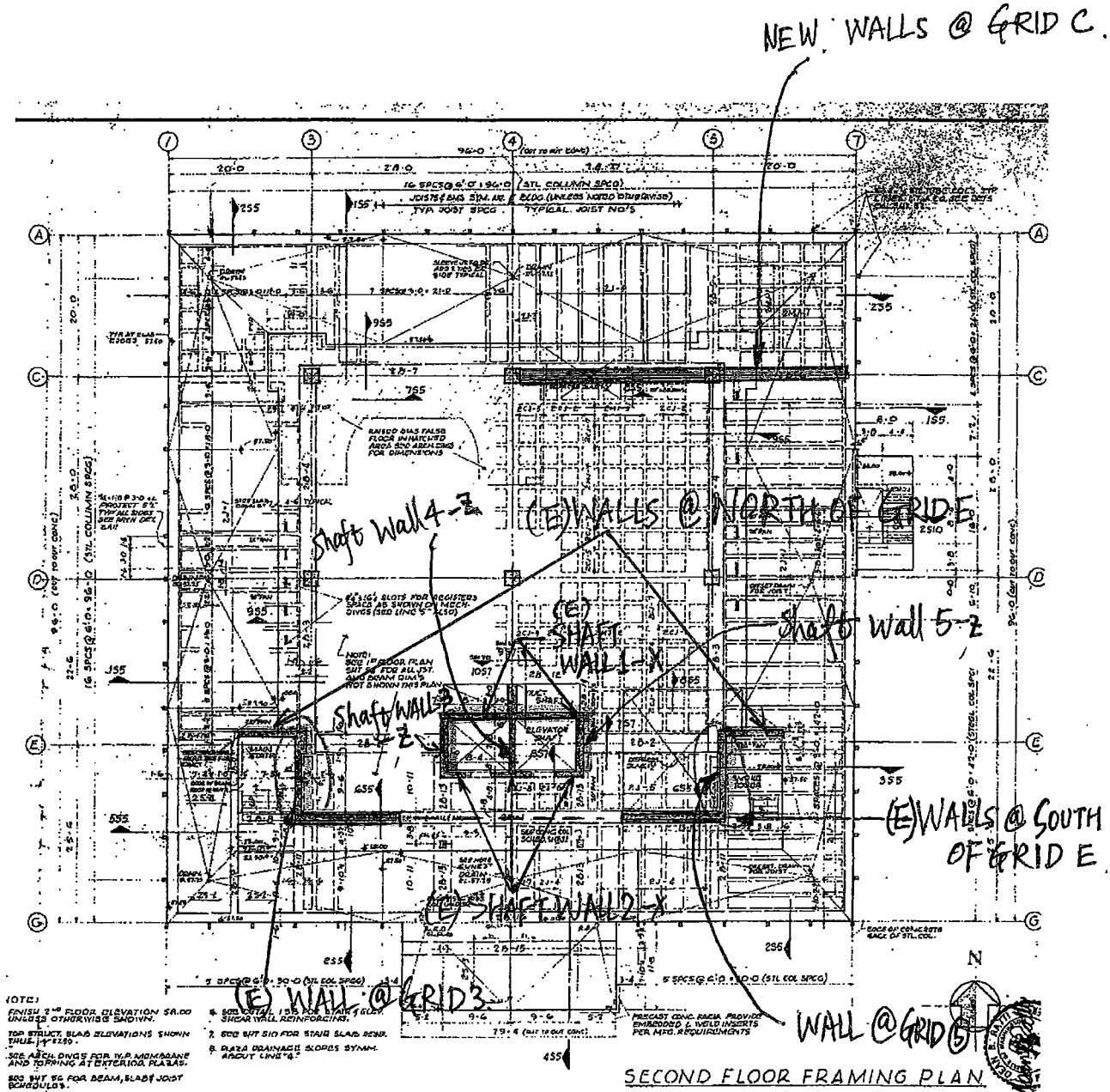
@ X-DIR : $A_x = \left[\frac{0.08}{1.2 \times (0.08+0.02)/2}\right]^2 = 1.78$ *

@ Z-DIR: $A_z = \left[\frac{0.09}{1.2 \times (0.09+0.04)/2}\right]^2 = 1.33$ *

SHEAR WALL

CHECK / DESIGN

WALL ID / PLAN LAYOUT.



NOTES

1. MASONRY, GROUT & MORTAR SHALL CONFORM TO THE SPEC'S.
2. SEE ARCH. DWGS FOR WALL LAYOUT AND DIMENSIONS.
3. ALL EXTERIOR WALLS SHALL BE REINFORCED WITH #4 @ 48" VERT. IN FILLED CELLS AND 1/4" WIRE OR EQUAL HORIZONTAL @ 16" o.c. WITH BOND BEAMS AT EACH (2-#4 CONT.) OR AS SHOWN IN DETAILS. PROVIDE CORNER BARS AT BOND BM INTERSECTION AND 1-#4 VERT. EACH JAMB EACH OPENNING.
4. ALL INTERIOR PARTITIONS SHALL BE REINFORCED WITH 1-#4 VERTICAL IN FILLED CELLS EACH SIDE OF EACH OPENNING AND AT EACH WALL INTERSECTION OR END. PROVIDE BOND BEAMS AND SPECIAL VERT. REINF. AS SHOWN DETS "A" & "B". USE 1/4" WIRE OR EQUAL HORIZONTAL @ 16" o.c.
5. ALL WALLS AND PARTITIONS SHALL DOWELLED AT THEIR BASE WITH #4 BARS EMBEDDED 12" INTO FILLED CELLS AT 48" o.c. MAX. UNLESS SHOWN OTHERWISE ON DWGS.
6. PROVIDE DOVETAIL ANCHOR SLOTS WITH MASONRY ANCHORS AT 12" o.c. WHERE MASONRY WALL JAMBS ABUTT CONCRETE.
7. SEE SECTION 5511 FOR SPECIAL REINFORCING AND ANCHORS AT 8" BRICK WALL ON MECH. FLOOR.
8. DUCT SHAFT WALLS AT ELEVATORS SHALL BE REINFORCED AS INTERIOR PARTITION WITH 4" BOND BEAM (2-#4 CONT.) LOCATED AT CEILING HEIGHT.
9. LINTELS SHALL BE 4" BOND BEAMS WITH 1-#5 BOTTOM EXTENDING 6" PAST JAMBS EACH SIDE.
10. MASONRY WALL HEADS SHALL BE ANCHORED TO THE STRUCTURE WHERE THE HORIZONTAL SPACING OF INTERSECTING MASONRY WALLS EXCEEDS 12'-0 DISTANCE AS LISTED BELOW.
   A. BASEMENT PARTITIONS STOPPED AT CEILING - USE DETAIL "A" AS REQ'D.
   B. BASEMENT WALLS & PARTITIONS - USE DETAIL "B" AS REQUIRED.
   C. BASEMENT EXTERIOR WALL LINE "B" - TIE TO 1ST FLOOR BEAM PER SECTION 9/S4 AND PROVIDE BOND BEAM AT TOP, 1-#4 CONT.
   D. FIRST FLOOR PARTITION AND VAULT WALLS - USE DET. "B" AS REQ'D.
   E. MAIN STAIR WALLS (1ST & 2ND FLR) - USE DET "D", & "A" AS REQ'D.
   F. 2ND FLOOR INTERIOR PARTITION - USE REQ'D "B"
   G. 2ND FLOOR EXTERIOR WALLS - USE DET. "C" OR SECT. 1/S7, 2/S7 & 4/S7 AS APPROPRIATE.
   H. MECH. FLOOR "C" WALLS - USE DET. "B" WHERE WALL HEADS TO CONC. OVER

ONRY WALL DETAILS

1/S5

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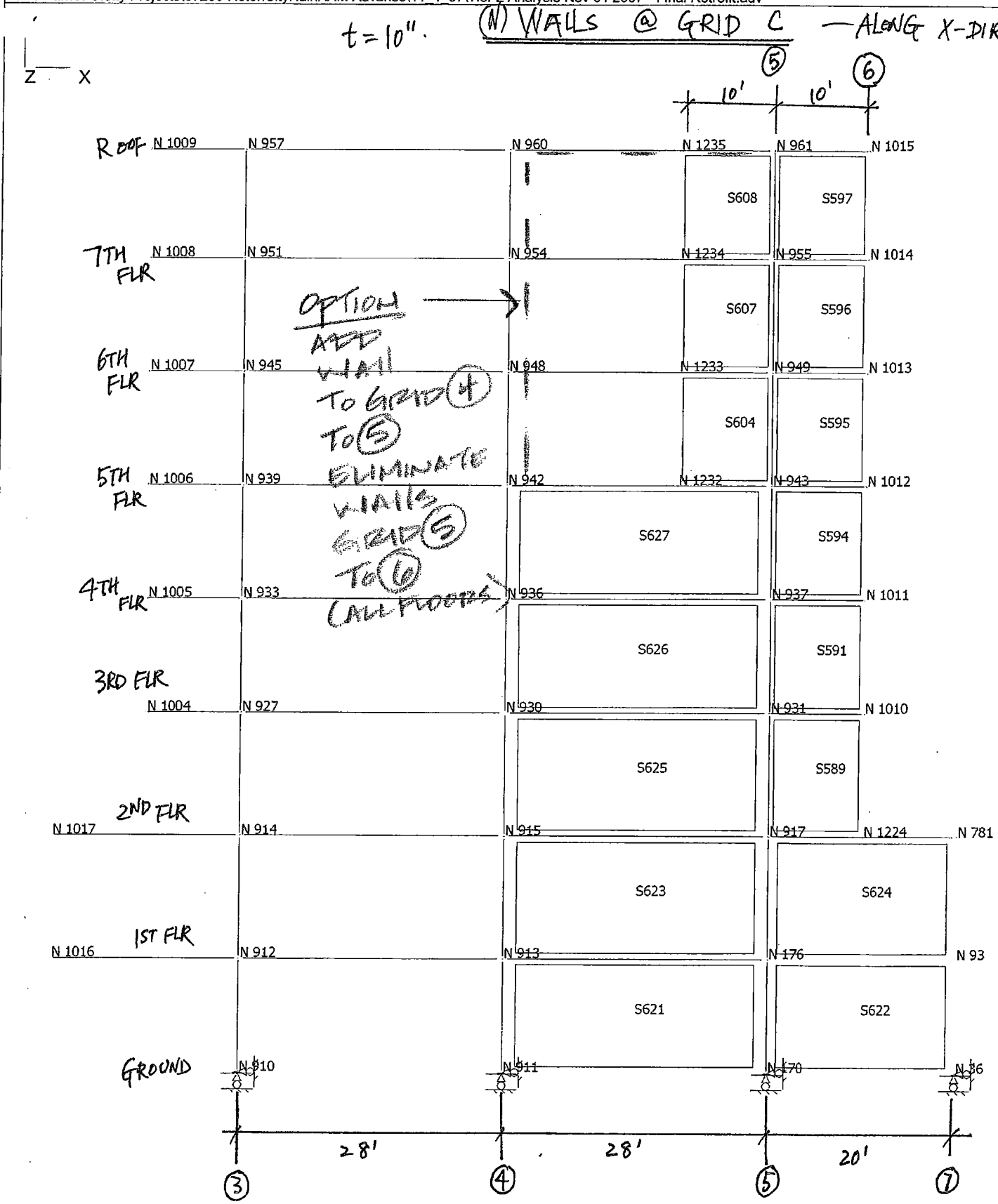

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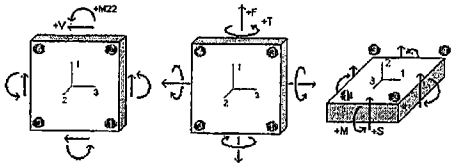

Shear Wall Forces (Walls @ Grid C)

Wall ID	DL			LL			EQ-x			EQ-z			EQ-z (Soil Seismic)			Soil Active Pressure-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 621																		
911-170	-1297.4	-14.1	-1448.6	-581.4	-14.7	-938.1	1987.6	716.7	10681.9	364.8	398.4	86.1	1.01	-5.74	19	3.63	-20.65	68.39
Shell 622																		
170-36	-427.3	-69.0	-723.9	-146.5	-25.0	-317.3	1786.0	686.4	-1510.3	332.4	273.3	-732.5	-4.12	-3.1	24.57	-14.84	-11.17	88.47
Shell 623																		
913-176	-1163.4	92.6	-1524.8	-515.8	32.4	-984.1	2021.5	871.1	9117.1	131.1	103.1	-79.6	0.21	-0.63	4.4	0.75	-2.25	15.85
Shell 624																		
176-93	-339.3	-59.3	-947.9	-98.0	-8.9	-467.3	2115.5	1244.5	-3746.8	110.9	58.8	-38.6	-0.11	0.23	-5.6	-0.4	0.82	-20.17
Shell 625																		
915-917	-1006.8	42.9	-1085.8	-434.0	13.2	-784.1	1963.5	1171.2	7005.9	118.4	77.4	17.1	-0.02	-0.07	0.54	-0.06	-0.25	1.96
Shell 589																		
917-1224	-288.8	-35.9	120.8	-82.0	-9.4	-1.8	1698.8	514.4	-1913.1	56.3	22.0	-13.0	0.03	0.04	-0.39	0.13	0.16	-1.41
Shell 626																		
930-931	-866.6	12.5	-901.7	-369.0	0.9	-702.5	1737.5	1319.7	5180.4	103.1	57.3	53.3	-0.04	-0.01	-0.05	-0.15	-0.03	-0.19
Shell 591																		
931-1010	-243.5	-11.3	-40.2	-71.5	-4.3	-29.3	1227.8	248.5	-204.5	53.4	16.4	9.0	0.01	0.01	-0.06	0.03	0.03	-0.21
Shell 627																		
936-937	-661.7	6.7	-605.3	-277.6	-1.1	-527.4	1975.5	1587.6	2727.7	108.4	77.9	57.4	-0.04	0	-0.11	-0.13	0.01	-0.41
Shell 594																		
937-1011	-199.7	-0.2	-58.3	-58.0	0.1	-32.9	1076.3	239.4	-119.9	57.3	21.5	4.7	0.01	0	-0.02	0.02	0	-0.08
Shell 604																		
1232-943	-252.0	27.6	-211.1	-93.5	7.9	-91.3	1304.4	553.4	4742.7	63.3	29.0	181.1	-0.02	0	-0.03	-0.06	0.01	-0.12
Shell 595																		
943-1012	-162.2	-14.4	-31.8	-46.9	-7.1	-15.9	1219.1	320.8	-1382.7	73.1	23.9	-56.6	0.01	0	-0.02	0.02	0	-0.07
Shell 607																		
1233-949	-161.7	-0.2	-3.8	-51.1	-5.3	17.4	681.2	334.6	2005.6	51.9	27.3	134.0	-0.01	0	-0.02	-0.04	0.01	-0.07
Shell 596																		
949-1013	-105.4	0.8	-74.6	-27.0	0.1	-31.8	664.0	291.9	-960.1	58.3	26.0	-60.2	0	0	-0.02	0.02	0.01	-0.06
Shell 608																		
1234-955	-79.1	-11.7	38.7	-12.4	-9.4	44.8	227.4	177.4	623.5	33.4	22.9	98.6	-0.01	0	-0.01	-0.02	0.01	-0.05
Shell 597																		
955-1014	-51.6	11.0	-66.2	-8.5	2.1	-20.4	224.5	140.9	-274.8	34.5	20.8	-51.5	0	0	-0.01	0.01	0.01	-0.05

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Shear Wall Analysis and Design (Based on ASCE41-06)

New Walls @Grid C $\phi =$ 0.6
f'c = 3 ksi
fy = 60 ksi
(N) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(100%Ex+30%Ez)/2 +1.6H+100%Esoil/2

(N) Walls				Shear Design		
Wall ID	Length	Thickness	A_v/ft	ϕVn	V_u	DCR
Face	ft	in	in^2/ft	kips	kips	
Shell 621						
911-170	28	10	**0.62**	845.8	483.6	0.57
Shell 622						
170-36	20	10	**0.62**	604.1	505.9	0.84
Shell 623						
913-176	28	10	**0.62**	845.8	592.2	0.70
Shell 624						
176-93	20	10	**0.88**	791.3	707.5	0.89
Shell 625						
915-917	28	10	**0.62**	845.8	659.4	0.78
Shell 589						
917-1224	10	10	**0.88**	395.7	310.5	0.78
Shell 626						
930-931	28	10	**0.88**	1107.9	683.3	0.62
Shell 591						
931-1010	10	10	**0.62**	302.1	143.9	0.48
Shell 627						
936-937	28	10	**0.62**	845.8	811.7	0.96
Shell 594						
937-1011	10	10	**0.62**	302.1	123.0	0.41
Shell 604						
1232-943	10	10	**0.88**	395.7	320.1	0.81
Shell 595						
943-1012	10	10	**0.62**	302.1	187.6	0.62
Shell 607						
1233-949	10	10	**0.62**	302.1	177.4	0.59
Shell 596						
949-1013	10	10	**0.62**	302.1	150.8	0.50
Shell 608						
1234-955	10	10	**0.62**	302.1	115.3	0.38
Shell 597						
955-1014	10	10	**0.62**	302.1	87.9	0.29

* PROVIDE #6 @ 12" O.C. HORIZ. EA. FACE.

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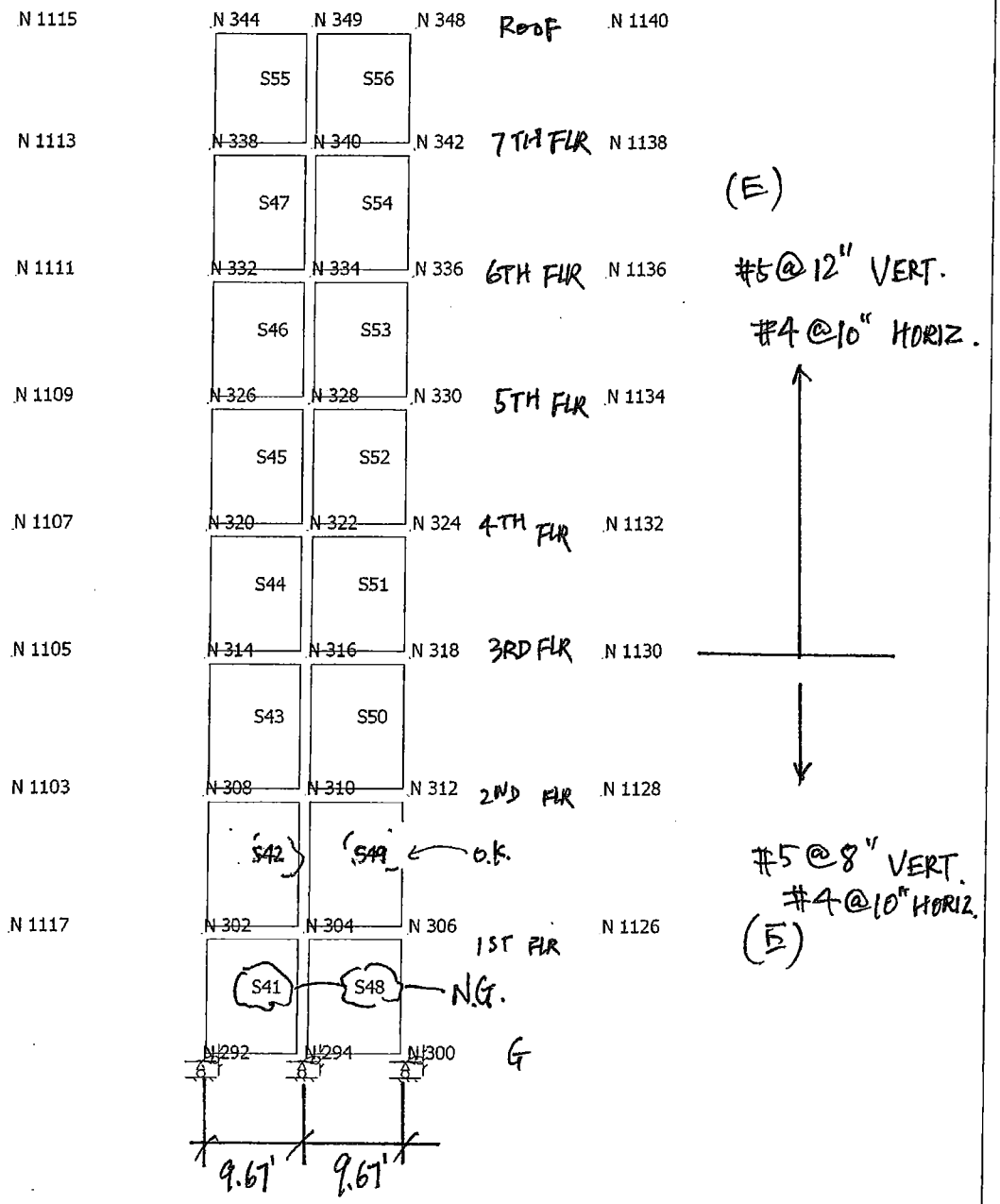
Z — X

(E) SHAFT WALL 1 @ X-DIR.

t = 8"



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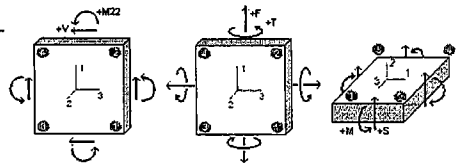

(E) Shaft Wall1 -x Forces

Wall ID	DL			LL			EQ-x			EQ-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 41												
292-294	-265.5	22.5	44.8	-93.8	7.2	11.5	303.0	187.1	501.4	739.8	256.8	-53.4
Shell 48												
294-300	-244.1	-24.8	-74.5	-80.6	-8.6	-29.7	367.3	207.5	-288.2	761.0	267.6	664.8
Shell 42												
302-304	-255.9	31.7	-87.9	-90.8	11.6	-31.0	465.3	176.8	1332.8	870.6	169.6	923.9
Shell 49												
304-306	-228.8	-6.8	-4.6	-73.9	1.5	-22.6	446.7	173.7	-652.4	869.3	167.7	298.2
Shell 43												
308-310	-220.9	16.0	-37.6	-76.6	5.4	-10.0	385.9	196.3	1080.1	641.9	120.2	498.7
Shell 50												
310-312	-205.5	-3.0	-7.6	-66.2	2.1	-18.8	369.2	196.8	-497.0	641.6	118.5	420.0
Shell 44												
314-316	-183.6	9.1	-19.6	-62.7	2.6	-2.0	309.9	174.6	806.8	462.6	88.5	372.7
Shell 51												
316-318	-172.9	-2.5	-7.4	-55.0	2.1	-17.5	293.4	176.3	-343.4	465.1	86.1	295.5
Shell 45												
320-322	-148.0	6.4	-11.5	-50.0	1.9	0.8	261.4	152.0	630.6	350.3	69.1	290.8
Shell 52												
322-324	-138.3	1.1	-17.0	-43.2	3.7	-21.3	242.7	152.9	-272.0	357.8	68.0	213.2
Shell 46												
326-328	-113.7	2.1	-3.1	-38.1	0.3	4.6	223.7	235.9	555.5	250.4	47.2	199.5
Shell 53												
328-330	-104.7	2.8	-19.4	-32.1	4.2	-21.5	208.6	235.0	-356.2	261.8	54.8	139.9
Shell 47												
332-334	-77.7	0.5	2.5	-23.8	0.3	9.6	186.0	246.2	338.5	144.4	32.5	107.8
Shell 54												
334-336	-72.7	10.4	-26.1	-21.1	7.1	-23.7	178.3	246.3	-175.7	155.4	35.8	68.8
Shell 55												
338-340	-53.4	-1.9	23.5	-13.6	0.6	15.6	133.4	200.3	90.5	67.7	38.4	34.3
Shell 56												
340-342	-50.3	17.8	-54.1	-12.1	7.8	-31.3	133.7	203.5	4.8	72.4	23.4	40.5

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Shaft Wall1 @ x-dir	ϕ =	0.6	
	f'c =	3	ksi
	fy =	60	ksi

V_u =1.1(DL+LL)+(100%Ex+30%Ez)/2

(E) wall stiffness = 50% of Gross Stiffness

(E) Walls				Shear Design			
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	
Face	ft	in	in^2/ft	kips	kips		
Shell 41							
292-294	9.67	8	**0.24**	144.6	164.8	***1.14***	N.G.
Shell 48							
294-300	9.67	8	**0.24**	144.6	180.7	***1.25***	
Shell 42							
302-304	9.67	8	**0.24**	144.6	161.5	***1.12***	O.K.
Shell 49							
304-306	9.67	8	**0.24**	144.6	117.8	0.82	
Shell 43							
308-310	9.67	8	**0.24**	144.6	139.8	0.97	
Shell 50							
310-312	9.67	8	**0.24**	144.6	117.2	0.81	
Shell 44							
314-316	9.67	8	**0.24**	144.6	113.5	0.78	
Shell 51							
316-318	9.67	8	**0.24**	144.6	101.4	0.70	
Shell 45							
320-322	9.67	8	**0.24**	144.6	95.5	0.66	
Shell 52							
322-324	9.67	8	**0.24**	144.6	91.9	0.64	
Shell 46							
326-328	9.67	8	**0.24**	144.6	127.6	0.88	
Shell 53							
328-330	9.67	8	**0.24**	144.6	133.5	0.92	
Shell 47							
332-334	9.67	8	**0.24**	144.6	128.9	0.89	
Shell 54							
334-336	9.67	8	**0.24**	144.6	147.8	***1.02***	
Shell 55							
338-340	9.67	8	**0.24**	144.6	107.3	0.74	
Shell 56							
340-342	9.67	8	**0.24**	144.6	133.4	0.92	

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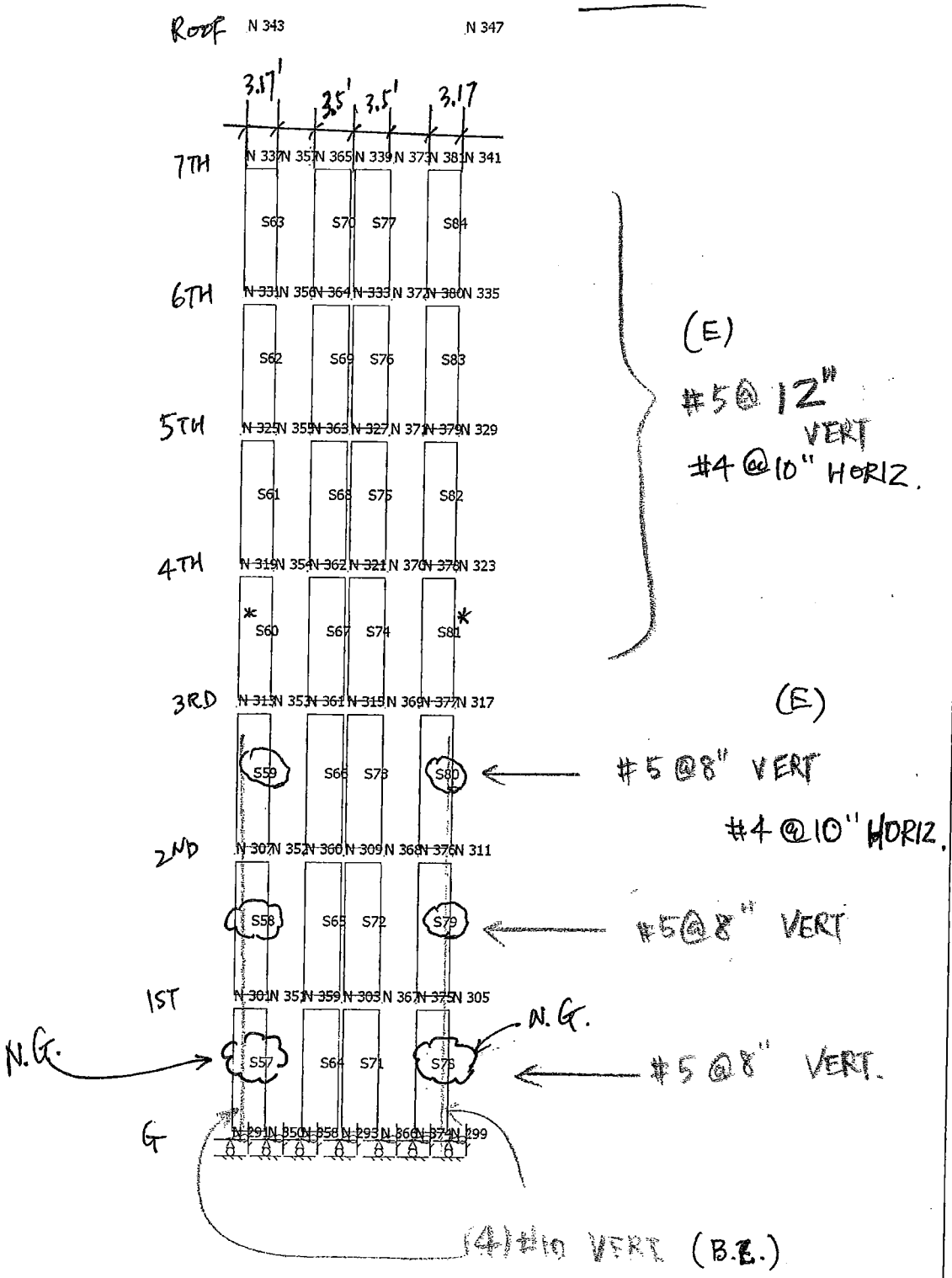
(E) SHAFT WALL 2 @ X-DIR.

Z X

t = 8"



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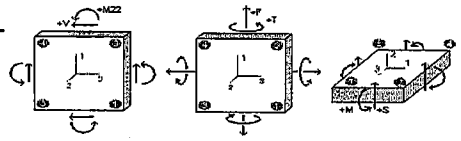

(E) Shaft Wall2 -x Forces

Wall ID	DL			LL			EQ-x			EQ-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 57												
291-350	-56.6	-2.9	1.5	-19.9	-1.3	0.8	244.4	123.2	8.2	331.6	156.5	36.0
Shell 64												
358-293	-55.7	4.2	-4.4	-16.4	1.1	-1.2	66.2	33.7	9.1	399.0	192.7	62.0
Shell 71												
293-366	-53.1	-5.3	4.8	-14.9	-1.7	1.4	46.4	27.5	-0.6	382.2	182.9	-4.6
Shell 78												
374-299	-39.7	2.3	-1.8	-9.3	0.9	-0.9	204.9	101.6	1.5	324.3	153.3	3.7
Shell 58												
301-351	-34.0	0.4	-1.7	-11.1	0.4	-1.1	164.5	60.1	71.6	447.4	158.2	39.9
Shell 65												
359-303	-28.3	4.6	-16.6	-5.2	2.0	-8.8	106.3	39.5	99.1	452.1	158.6	99.5
Shell 72												
303-367	-21.6	-2.9	9.7	-1.4	-1.1	4.8	114.8	42.9	-68.5	459.0	160.7	24.9
Shell 79												
375-305	-19.4	-0.1	-3.2	-1.8	-0.2	-1.8	183.9	67.3	-32.9	443.2	157.3	61.7
Shell 59												
307-352	-29.7	-0.1	1.0	-11.5	-0.1	0.9	173.3	74.8	31.1	306.3	108.5	14.2
Shell 66												
360-309	-14.7	3.2	-13.8	-1.3	1.4	-6.8	43.5	10.9	38.2	348.6	122.3	97.1
Shell 73												
309-368	-15.9	-3.5	15.2	-1.8	-1.6	7.5	54.8	14.6	-20.9	348.2	122.0	5.3
Shell 80												
376-311	-15.4	-0.8	0.7	-1.9	-0.4	0.0	188.2	79.6	0.6	305.4	108.2	62.9
Shell 60												
313-353	-24.1	0.3	0.3	-9.8	0.0	0.6	154.2	70.6	26.2	221.4	81.4	15.7
Shell 67												
361-315	-11.9	2.3	-11.9	-1.9	1.0	-5.9	33.0	9.0	26.6	252.0	85.3	70.5
Shell 74												
315-369	-11.5	-2.5	12.0	-1.5	-1.2	5.9	41.7	11.5	-14.1	252.2	85.4	9.3
Shell 81												
377-317	-13.4	-0.9	-0.3	-2.3	-0.4	-0.6	166.2	74.3	3.4	217.7	80.1	39.2

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PROJECT Old Renton City Hall JOB NO. 07230

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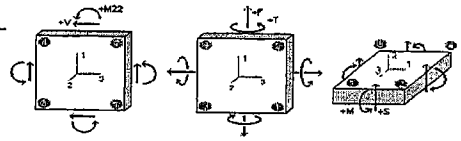

(E) Shaft Wall2 -x Forces

Wall ID	DL			LL			EQ-x			EQ-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 61												
319-354	-20.3	0.3	0.1	-8.3	0.0	0.5	139.9	68.9	18.2	174.8	66.2	12.7
Shell 68												
362-321	-8.6	2.5	-13.0	-1.4	1.3	-6.6	26.4	8.4	16.6	191.4	63.9	50.7
Shell 75												
321-370	-7.4	-2.3	11.9	-0.6	-1.2	6.0	34.2	9.7	-3.8	191.1	63.8	10.9
Shell 82												
378-323	-11.9	-0.7	-0.7	-2.4	-0.3	-0.8	151.4	72.4	12.3	167.8	64.1	31.5
Shell 62												
325-355	-15.8	0.5	0.3	-6.4	0.1	0.5	125.5	67.9	24.8	134.1	52.5	10.8
Shell 69												
363-327	-3.3	2.2	-12.5	0.3	1.2	-6.5	30.7	10.1	27.9	136.2	45.2	38.4
Shell 76												
327-371	-3.0	-2.4	12.6	0.6	-1.3	6.4	40.2	12.9	-16.9	133.9	44.4	8.0
Shell 83												
379-329	-9.4	-0.9	-0.4	-2.0	-0.5	-0.5	135.6	70.9	4.6	124.5	49.4	26.9
Shell 63												
331-356	-11.3	-0.7	1.9	-4.9	-0.5	1.4	81.1	56.1	0.0	87.3	37.2	-2.6
Shell 70												
364-333	1.4	2.0	-12.7	1.8	1.2	-6.6	11.9	4.9	9.6	70.6	22.8	23.7
Shell 77												
333-372	2.6	-1.8	11.6	2.4	-1.1	6.0	18.3	6.8	-7.0	69.1	22.3	2.6
Shell 84												
380-335	-6.4	-0.2	-2.2	-1.8	-0.1	-1.5	89.2	58.4	28.4	79.2	34.4	31.5

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PROJECT Old Renton City Hall JOB NO. 07230

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Shaft Wall2 @ x-dir ϕ = 0.6
f'c = 3 ksi
fy = 60 ksi
(E) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(100%Ex+30%Ez)/2

(E) Walls				Shear Design			
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	Add'l As
Face	ft	in	in^2/ft	kips	kips		in^2
Shell 57							
291-350	3.17	8	**0.24**	47.4	89.7	***1.89***	
Shell 64							
358-293	3.5	8	**0.24**	52.3	51.5	0.98	
Shell 71							
293-366	3.5	8	**0.24**	52.3	48.9	0.93	
Shell 78							
374-299	3.17	8	**0.24**	47.4	77.3	***1.63***	
Shell 58							
301-351	3.17	8	**0.24**	47.4	54.6	***1.15***	
Shell 65							
359-303	3.5	8	**0.24**	52.3	50.8	0.97	
Shell 72							
303-367	3.5	8	**0.24**	52.3	49.9	0.95	
Shell 79							
375-305	3.17	8	**0.24**	47.4	57.6	***1.22***	
Shell 59							
307-352	3.17	8	**0.24**	47.4	53.9	***1.14***	
Shell 66							
360-309	3.5	8	**0.24**	52.3	28.8	0.55	
Shell 73							
309-368	3.5	8	**0.24**	52.3	31.2	0.60	
Shell 80							
376-311	3.17	8	**0.24**	47.4	57.3	***1.21***	
Shell 60							
313-353	3.17	8	**0.24**	47.4	47.8	***1.01***	
Shell 67							
361-315	3.5	8	**0.24**	52.3	20.9	0.40	
Shell 74							
315-369	3.5	8	**0.24**	52.3	22.6	0.43	
Shell 81							
377-317	3.17	8	**0.24**	47.4	50.5	***1.07***	
Shell 61							
319-354	3.17	8	**0.24**	47.4	44.7	0.94	
Shell 68							
362-321	3.5	8	**0.24**	52.3	18.0	0.34	
Shell 75							
321-370	3.5	8	**0.24**	52.3	18.3	0.35	
Shell 82							
378-323	3.17	8	**0.24**	47.4	47.0	0.99	
Shell 62							
325-355	3.17	8	**0.24**	47.4	42.5	0.90	

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PROJECT Old Renton City Hall JOB NO. 07230

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Shaft Wall2 @ x-dir	ϕ =	0.6	
	f'c =	3	ksi
	fy =	60	ksi

(E) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(100%Ex+30%Ez)/2

(E) Walls				Shear Design			
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	Add'l As
Face	ft	in	in^2/ft	kips	kips		in^2
Shell 69							
363-327	3.5	8	**0.24**	52.3	15.6	0.30	
Shell 76							
327-371	3.5	8	**0.24**	52.3	17.2	0.33	
Shell 83							
379-329	3.17	8	**0.24**	47.4	44.4	0.94	
Shell 63							
331-356	3.17	8	**0.24**	47.4	34.9	0.74	
Shell 70							
364-333	3.5	8	**0.24**	52.3	9.3	0.18	
Shell 77							
333-372	3.5	8	**0.24**	52.3	9.8	0.19	
Shell 84							
380-335	3.17	8	**0.24**	47.4	34.6	0.73	

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(E) SHAFT WALL 3@ Z-DIR.

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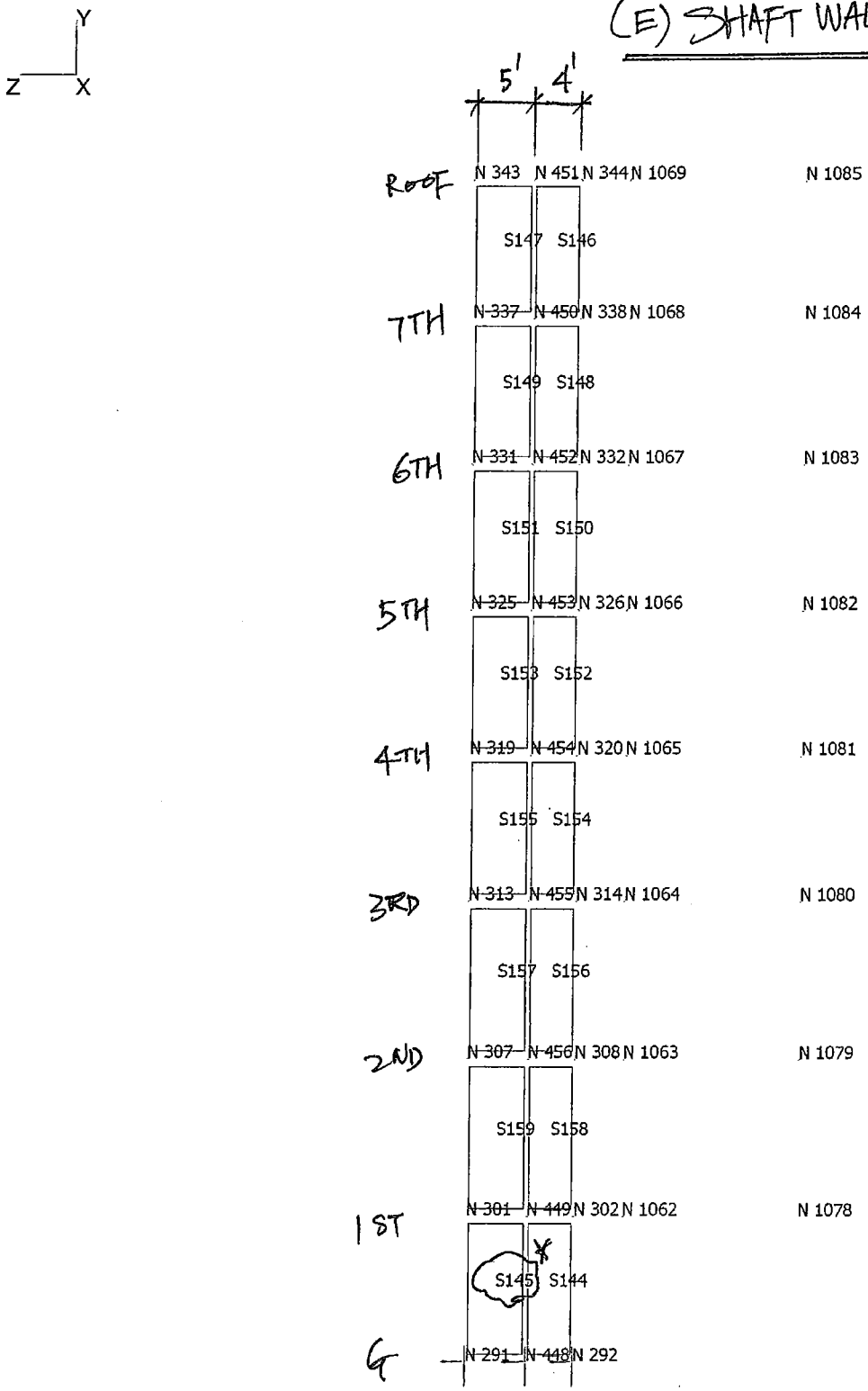

(E)
#6 @ 8" o.c.
VERT.
EA. FACE.

#4 @ 12" o.c.
HORIZ.
E.F.

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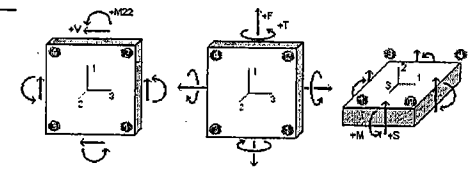

Shaft Wall3 -z Forces

Wall ID	DL			LL			EQ-x			EQ-z			EQ-z (Soil Seismic)			Soil Active Pressure-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 145																		
448-291	-103.8	-17.6	-8.8	-37.6	-7.3	-4.1	413.0	179.7	175.1	271.1	157.9	66.0	1.6	1.67	4.08	5.78	6	14.67
Shell 144																		
292-448	-117.9	-5.6	4.0	-43.2	-2.5	0.7	348.6	131.7	76.6	166.5	109.4	26.8	-1.08	1.31	2.96	-3.88	4.72	10.65
Shell 159																		
449-301	-80.2	-5.9	4.5	-29.3	-1.5	3.6	402.5	125.3	167.5	403.6	152.0	533.6	-0.28	-0.09	-0.46	-1.02	-0.34	-1.65
Shell 158																		
302-449	-97.4	1.8	18.6	-34.9	-0.1	4.8	370.6	138.7	17.1	263.4	118.7	-165.9	0.26	-0.02	-0.15	0.95	-0.07	-0.54
Shell 157																		
456-307	-63.5	-4.1	6.3	-23.5	-1.6	2.6	347.5	104.8	178.3	281.6	105.0	350.3	-0.11	-0.04	-0.12	-0.41	-0.16	-0.44
Shell 156																		
308-456	-77.1	3.1	15.4	-26.3	0.1	2.2	299.0	110.1	55.3	178.1	84.1	-88.2	0.03	-0.03	-0.08	0.1	-0.11	-0.28
Shell 155																		
455-313	-51.9	-2.3	7.7	-19.7	-1.2	2.4	293.7	87.0	166.1	208.3	79.9	248.6	-0.07	-0.02	-0.07	-0.27	-0.07	-0.25
Shell 154																		
314-455	-62.5	4.3	14.0	-20.6	0.3	0.9	241.7	89.8	47.7	129.5	66.5	-65.2	0.01	-0.01	-0.04	0.04	-0.05	-0.14
Shell 153																		
454-319	-42.7	-2.2	5.0	-16.3	-1.3	1.3	253.4	76.9	139.0	166.5	64.5	199.1	-0.04	-0.01	-0.04	-0.16	-0.04	-0.14
Shell 152																		
320-454	-49.2	3.2	9.9	-15.8	-0.3	-0.8	204.2	80.1	28.3	102.7	54.5	-51.8	0.01	-0.01	-0.02	0.03	-0.03	-0.09
Shell 151																		
453-325	-32.5	-1.2	5.0	-12.3	-0.8	1.6	228.5	73.5	193.9	132.1	55.2	165.1	-0.03	-0.01	-0.03	-0.11	-0.02	-0.09
Shell 150																		
326-453	-36.9	2.9	7.4	-11.3	-0.3	-1.6	165.4	67.3	71.8	83.6	46.5	-36.5	0.01	0	-0.01	0.02	-0.01	-0.05
Shell 149																		
452-331	-23.3	-1.9	2.8	-8.9	-0.8	1.3	142.8	63.2	157.2	93.1	47.5	120.9	-0.02	-0.01	-0.02	-0.07	-0.02	-0.07
Shell 148																		
332-452	-24.2	1.1	2.3	-5.9	-1.1	-3.9	112.1	59.5	78.5	68.2	41.1	-16.0	0	0	-0.01	0.01	-0.01	-0.03
Shell 147																		
450-337	-18.0	0.1	1.9	-7.6	-0.7	-2.0	88.3	48.8	115.2	89.5	39.0	126.5	-0.02	0	-0.02	-0.09	-0.02	-0.09
Shell 146																		
338-450	-13.8	2.9	2.9	-1.2	-1.3	-4.8	74.4	53.0	46.3	49.2	33.9	2.8	0	0	-0.01	0.01	-0.01	-0.03

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PROJECT Old Renton City Hall JOB NO. 07230

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Shaft Wall3 @ z-dir ϕ = 0.6
f'c = 3 ksi
fy = 60 ksi
(E) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(30%Ex+100%Ez)/2
+1.6H+100%Esoil/2

(E) Walls				Shear Design		
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR
Face	ft	in	in^2/ft	kips	kips	
Shell 145						
448-291	5	12	**0.4**	119.3	143.7	***1.20***
Shell 144						
292-448	4	12	**0.4**	95.5	91.5	0.96
Shell 159						
449-301	5	12	**0.4**	119.3	103.5	0.87
Shell 158						
302-449	4	12	**0.4**	95.5	82.1	0.86
Shell 157						
456-307	5	12	**0.4**	119.3	74.7	0.63
Shell 156						
308-456	4	12	**0.4**	95.5	62.3	0.65
Shell 155						
455-313	5	12	**0.4**	119.3	56.9	0.48
Shell 154						
314-455	4	12	**0.4**	95.5	51.8	0.54
Shell 153						
454-319	5	12	**0.4**	119.3	47.7	0.40
Shell 152						
320-454	4	12	**0.4**	95.5	42.5	0.45
Shell 151						
453-325	5	12	**0.4**	119.3	40.9	0.34
Shell 150						
326-453	4	12	**0.4**	95.5	36.2	0.38
Shell 149						
452-331	5	12	**0.4**	119.3	36.2	0.30
Shell 148						
332-452	4	12	**0.4**	95.5	29.5	0.31
Shell 147						
450-337	5	12	**0.4**	119.3	27.6	0.23
Shell 146						
338-450	4	12	**0.4**	95.5	26.6	0.28

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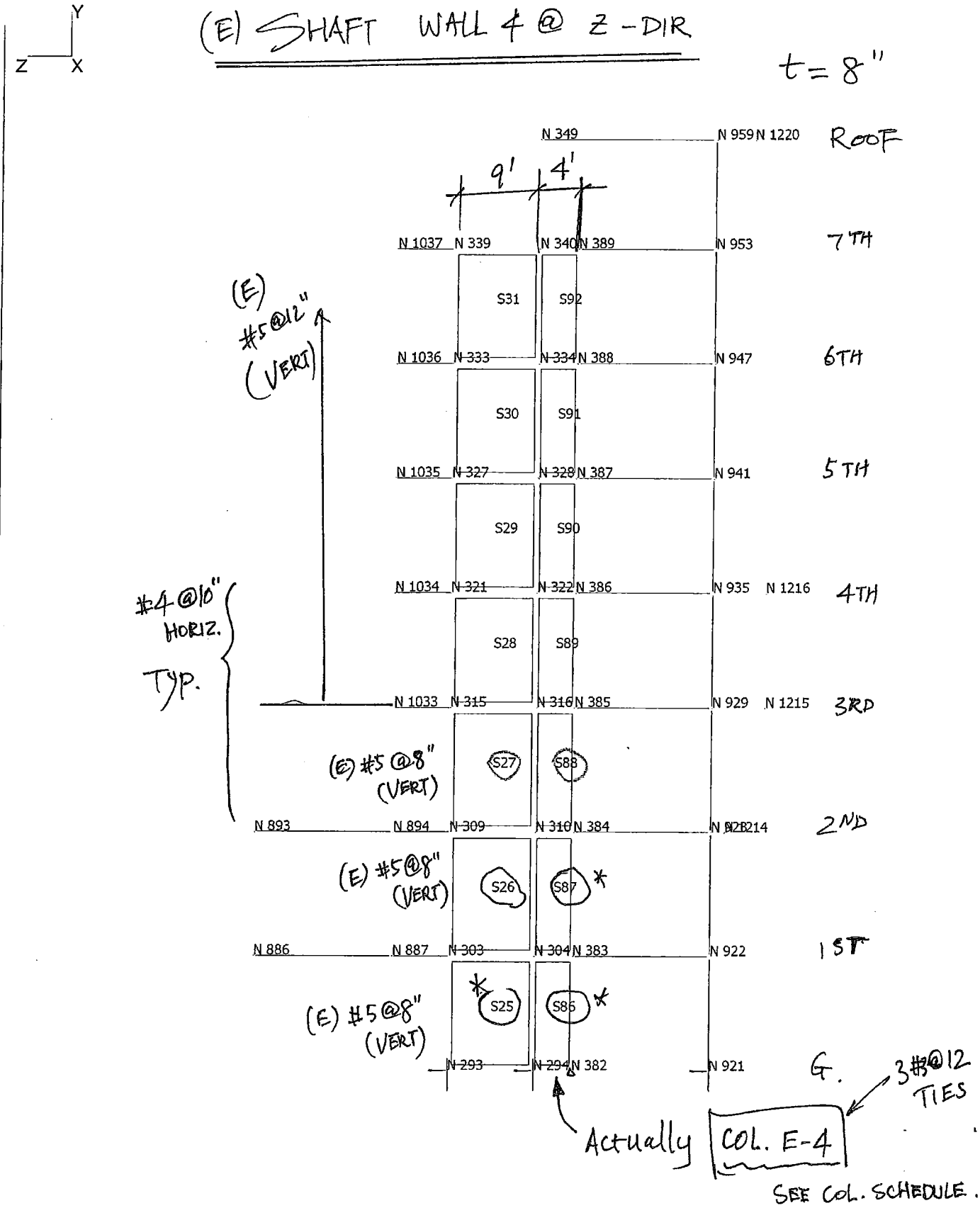

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PROJECT Old Renton City Hall JOB NO. 07230

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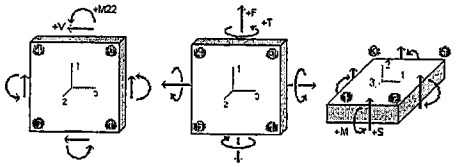

(E) Shaft Wall4 -z Forces

Wall ID	DL			LL			EQ-x			EQ-z			EQ-z (Soil Seismic)			Soil Active Pressure-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 25																		
294-293	-168.0	-20.2	88.9	-53.9	-8.4	31.8	56.9	68.0	6.9	268.5	244.9	97.4	0.25	3.74	10.25	0.9	13.45	36.89
Shell 86																		
294-382	-55.2	29.4	120.2	-19.0	10.4	41.3	9.2	5.9	-11.7	274.7	210.8	-377.2	-0.52	0.19	1.16	-1.87	0.67	4.18
Shell 26																		
304-303	-153.1	-4.6	52.2	-51.4	-0.6	11.9	24.1	23.1	32.4	511.3	265.3	811.4	-0.17	0.16	0.05	-0.63	0.57	0.19
Shell 87																		
304-383	-110.0	-5.3	-22.1	-36.2	0.2	-2.2	27.5	11.3	28.8	610.9	277.4	427.4	0.55	0.2	0.71	1.97	0.73	2.57
Shell 27																		
310-309	-137.9	2.6	36.1	-47.1	0.8	1.2	18.8	20.9	13.7	398.2	261.2	441.5	-0.02	-0.09	-0.63	-0.07	-0.31	-2.27
Shell 88																		
310-384	-96.7	-2.4	-20.6	-30.4	1.5	-4.5	14.9	11.4	11.6	423.7	226.5	228.5	0.16	0.01	0.08	0.58	0.03	0.3
Shell 28																		
316-315	-117.1	4.5	28.2	-41.2	0.2	-3.2	16.5	15.0	21.8	285.2	197.1	338.8	-0.01	-0.05	-0.35	-0.02	-0.18	-1.27
Shell 89																		
316-385	-79.8	-1.6	-16.7	-24.1	2.0	-3.5	17.3	10.3	12.0	309.4	241.2	229.5	0.08	0	0.04	0.29	-0.02	0.15
Shell 29																		
322-321	-97.5	3.7	8.3	-35.2	-0.7	-12.2	17.3	12.7	23.8	216.8	153.1	255.1	-0.01	-0.03	-0.23	-0.02	-0.12	-0.83
Shell 90																		
322-386	-62.2	0.5	-11.8	-17.8	2.9	-2.2	19.1	10.8	12.8	244.0	270.1	267.1	0.05	0	0.03	0.18	-0.02	0.12
Shell 30																		
328-327	-75.9	2.5	-9.2	-28.2	-1.4	-18.8	15.6	12.2	19.5	160.6	135.9	180.1	0	-0.03	-0.17	-0.01	-0.1	-0.6
Shell 91																		
328-387	-45.7	1.9	-7.9	-12.3	3.5	-1.1	18.0	11.8	12.5	183.4	279.8	285.1	0.03	0	0.03	0.1	-0.02	0.1
Shell 31																		
334-333	-51.6	4.4	-19.0	-20.4	-1.1	-22.1	13.1	15.9	9.7	121.2	144.1	85.1	0	-0.02	-0.11	0.02	-0.07	-0.38
Shell 92																		
334-388	-24.1	3.1	-3.4	-3.1	5.0	2.2	12.7	13.3	14.3	113.3	294.5	295.1	0.01	-0.01	0.02	0.03	-0.02	0.06

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PROJECT Old Renton City Hall JOB NO. 07230

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Shaft Wall4 @ z-dir	ϕ =	0.6	
	f'c =	3	ksi
	fy =	60	ksi
(E) wall stiffness = 50% of Gross Stiffness			

V_u =1.1(DL+LL)+(30%Ex+100%Ez)/2 +1.6H+100%Esoil/2

(E) Walls				Shear Design		
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR
Face	ft	in	in^2/ft	kips	kips	
Shell 25						
294-293	9	8	**0.24**	134.5	187.4	***1.39***
Shell 86						
294-382	4	12	**0.66**	132.9	173.3	***1.30***
Shell 26						
304-303	9	8	**0.24**	134.5	165.3	***1.23***
Shell 87						
304-383	4	12	**0.66**	132.9	169.3	***1.27***
Shell 27						
310-309	9	8	**0.24**	134.5	160.9	***1.20***
Shell 88						
310-384	4	12	**0.66**	132.9	139.3	***1.05***
Shell 28						
316-315	9	8	**0.24**	134.5	129.3	0.96
Shell 89						
316-385	4	12	**0.66**	132.9	145.9	***1.10***
Shell 29						
322-321	9	8	**0.24**	134.5	105.1	0.78
Shell 90						
322-386	4	12	**0.66**	132.9	163.8	***1.23***
Shell 30						
328-327	9	8	**0.24**	134.5	94.3	0.70
Shell 91						
328-387	4	12	**0.66**	132.9	170.9	***1.29***
Shell 31						
334-333	9	8	**0.24**	134.5	101.5	0.75
Shell 92						
334-388	4	12	**0.66**	132.9	181.6	***1.37***

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BENTLEY **Coffman Engineers**

Current Date: 11/2/2007 11:04 AM
Units system: English
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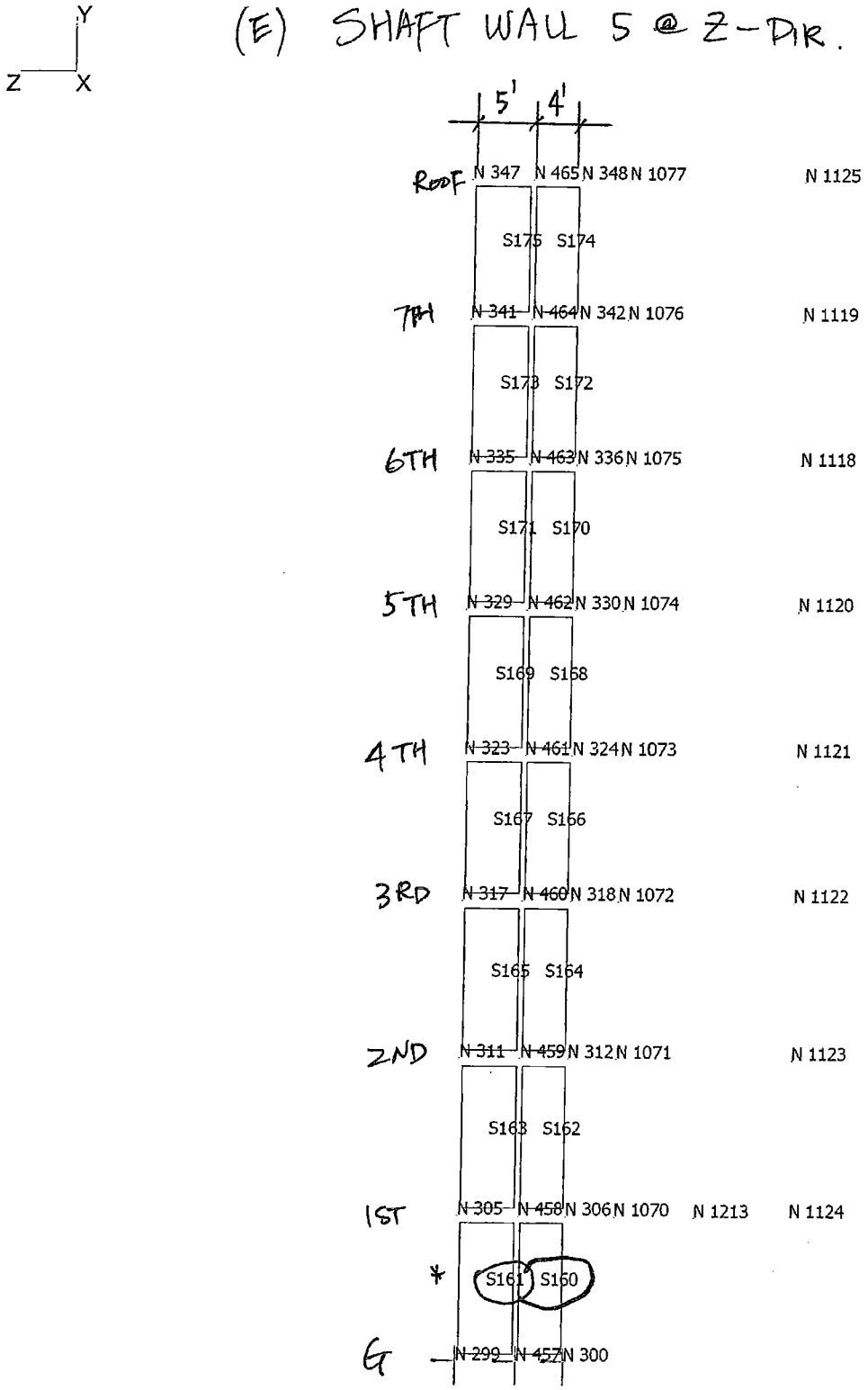
(E) SHAFT WALL 5 @ Z-DIR.

t = 12"



(E) #6 @ 8" O.C (VERT.) EA - FACE.

#4 @ 12" O.C. HORIZ. EA. FACE.

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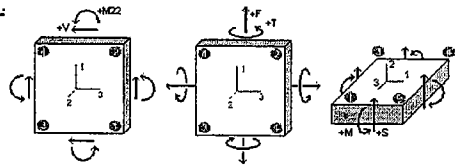

(E) Shaft Wall5 -z Forces

Wall ID	DL			LL			EQ-x			EQ-z			EQ-z (Soil Seismic)			Soil Active Pressure-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 161																		
457-299	-75.3	-16.2	-8.2	-19.9	-6.4	-3.6	381.5	162.6	65.8	242.2	154.2	33.8	1.12	1.48	3.67	4.05	5.32	13.2
Shell 160																		
300-457	-93.0	-7.0	1.4	-27.8	-3.3	-0.8	380.9	148.8	2.0	190.3	122.9	41.1	-1.53	1.1	2.75	-5.49	3.94	9.92
Shell 163																		
458-305	-49.7	-1.0	16.8	-10.3	0.9	10.2	419.0	132.1	190.3	402.7	150.8	540.3	-0.27	-0.11	-0.43	-0.96	-0.39	-1.55
Shell 162																		
306-458	-72.9	4.6	19.5	-19.6	1.0	4.5	360.9	134.0	23.5	258.7	115.6	-162.2	0.29	-0.07	-0.27	1.03	-0.24	-0.99
Shell 165																		
459-311	-43.2	-0.6	14.0	-9.7	0.6	7.7	359.6	108.8	193.7	278.0	103.1	354.2	-0.1	-0.05	-0.15	-0.36	-0.18	-0.53
Shell 164																		
312-459	-62.2	5.5	18.6	-16.4	1.4	3.9	295.1	109.8	60.2	176.9	82.6	-86.4	0.06	-0.04	-0.09	0.21	-0.13	-0.33
Shell 167																		
460-317	-35.5	0.4	14.3	-8.2	0.6	7.1	304.2	90.9	178.0	202.2	77.8	252.3	-0.05	-0.02	-0.07	-0.2	-0.06	-0.25
Shell 166																		
318-460	-51.8	5.6	15.8	-13.1	1.2	2.1	238.6	89.9	52.0	130.2	65.4	-64.0	0.03	-0.01	-0.04	0.1	-0.05	-0.14
Shell 169																		
461-323	-28.7	0.6	11.7	-6.6	0.6	5.9	263.3	80.1	151.2	156.0	62.2	198.6	-0.03	-0.01	-0.04	-0.11	-0.03	-0.14
Shell 168																		
324-461	-39.6	4.8	11.5	-9.1	0.9	0.4	200.5	79.3	34.0	106.5	54.6	-53.2	0.02	-0.01	-0.02	0.07	-0.02	-0.07
Shell 171																		
462-329	-21.6	0.9	9.7	-4.9	1.0	5.4	237.5	77.0	205.8	117.4	51.4	151.6	-0.02	0	-0.02	-0.07	-0.02	-0.09
Shell 170																		
330-462	-28.4	4.0	8.0	-5.7	0.8	-0.5	161.4	66.3	78.5	87.0	45.9	-41.5	0.01	0	-0.01	0.05	-0.01	-0.04
Shell 173																		
463-335	-14.0	1.1	9.2	-3.1	1.1	5.2	150.1	66.8	170.6	81.2	42.4	102.2	-0.01	0	-0.02	-0.04	-0.02	-0.06
Shell 172																		
336-463	-18.5	4.4	6.8	-2.6	1.3	-0.5	107.8	61.6	87.7	66.6	37.7	-23.5	0.01	0	-0.01	0.03	0	-0.02
Shell 175																		
464-341	-12.27	3.85	11.87	-4.55	1.28	3.18	97.04	52.43	126.67	81.49	34.96	110.83	-0.02	0	-0.02	-0.07	-0.01	-0.08
Shell 174																		
342-464	-10.21	7.32	7.99	0.71	1.03	-2.14	80.04	57.34	46.61	44.37	29.7	-2.6	0	0	0	0.01	0	-0.02

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Shaft Wall5 @ z-dir	ϕ =	0.6	
	f'c =	3	ksi
	fy =	60	ksi
(E) wall stiffness = 50% of Gross Stiffness			

V_u =1.1(DL+LL)+(30%Ex+100%Ez)/2 +1.6H+100%Esoil/2

(E) Walls				Shear Design		
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR
Face	ft	in	in^2/ft	kips	kips	
Shell 161						
457-299	5	12	**0.4**	119.3	135.5	***1.14***
Shell 160						
300-457	4	12	**0.4**	95.5	104.3	***1.09*** *
Shell 163						
458-305	5	12	**0.4**	119.3	104.6	0.88
Shell 162						
306-458	4	12	**0.4**	95.5	93.3	0.98
Shell 165						
459-311	5	12	**0.4**	119.3	77.1	0.65
Shell 164						
312-459	4	12	**0.4**	95.5	74.5	0.78
Shell 167						
460-317	5	12	**0.4**	119.3	62.9	0.53
Shell 166						
318-460	4	12	**0.4**	95.5	62.9	0.66
Shell 169						
461-323	5	12	**0.4**	119.3	53.7	0.45
Shell 168						
324-461	4	12	**0.4**	95.5	54.7	0.57
Shell 171						
462-329	5	12	**0.4**	119.3	48.6	0.41
Shell 170						
330-462	4	12	**0.4**	95.5	47.4	0.50
Shell 173						
463-335	5	12	**0.4**	119.3	43.0	0.36
Shell 172						
336-463	4	12	**0.4**	95.5	43.7	0.46
Shell 175						
464-341	5	12	**0.4**	119.3	40.2	0.34
Shell 174						
342-464	4	12	**0.4**	95.5	41.9	0.44

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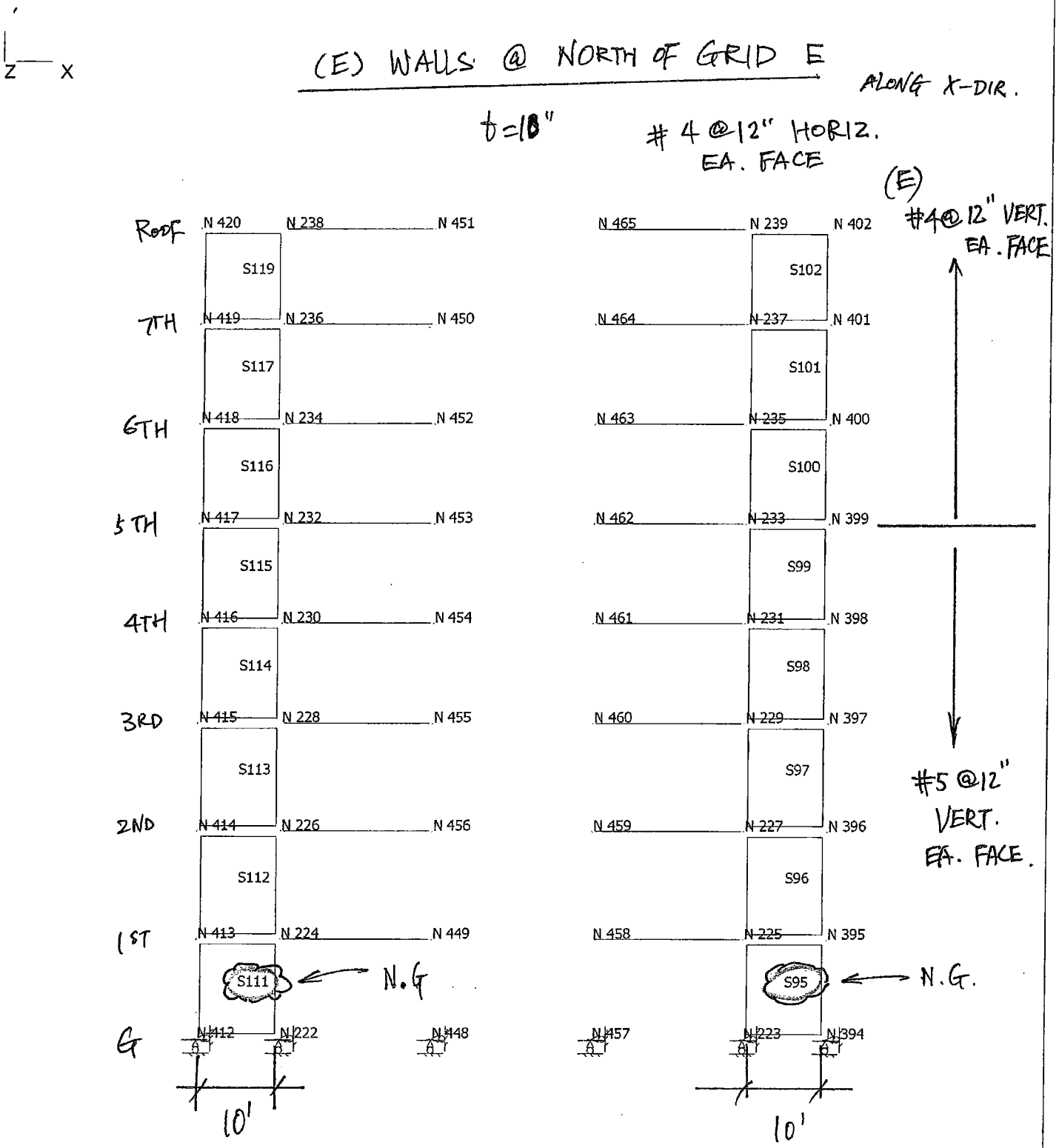

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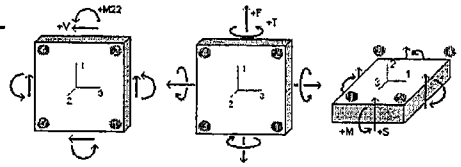

(E) Walls -x @ North of Grid E

Wall ID	DL			LL			EQ-x			EQ-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 111												
412-222	-419.0	-31.9	-51.9	-177.2	-18.0	-22.3	823.4	457.3	811.8	1232.0	673.3	453.9
Shell 112												
413-224	-377.2	-20.2	175.7	-142.7	-12.8	111.8	1005.6	185.0	2141.3	1462.7	279.1	868.3
Shell 113												
414-226	-327.2	2.9	27.0	-112.9	2.5	12.3	794.2	148.4	1598.5	1158.4	239.9	995.6
Shell 114												
415-228	-276.6	5.4	-40.5	-95.0	4.1	-35.8	576.1	121.9	1125.8	868.8	190.3	735.9
Shell 115												
416-230	-221.8	6.2	-49.0	-74.1	4.6	-39.4	399.6	95.3	771.2	658.9	151.2	529.3
Shell 116												
417-232	-167.3	4.8	-38.7	-53.1	4.2	-34.0	331.9	106.0	371.4	480.5	115.3	361.8
Shell 117												
418-234	-111.1	4.9	-51.4	-30.7	4.5	-39.9	174.6	88.0	180.9	309.2	85.0	258.7
Shell 119												
419-236	-57.2	5.5	-45.3	-9.5	1.5	-34.0	86.3	69.5	85.4	148.7	77.0	174.3
Shell 95												
223-394	-470.8	-21.2	-57.9	-190.7	-8.0	-26.0	954.7	531.9	-104.7	1385.4	764.6	380.6
Shell 96												
225-395	-379.1	3.9	-14.8	-144.2	6.0	-24.2	988.8	201.7	-789.1	1431.2	278.1	1235.4
Shell 97												
227-396	-328.4	-2.5	10.1	-112.5	0.2	-12.4	768.7	155.0	-396.0	1140.3	241.5	692.7
Shell 98												
229-397	-279.0	-5.7	25.4	-97.5	-4.1	21.8	554.9	119.8	-173.7	855.1	187.3	542.0
Shell 99												
231-398	-224.5	-4.4	19.2	-76.9	-3.7	19.4	391.1	95.2	-53.7	644.9	148.1	420.5
Shell 100												
233-399	-169.2	-5.4	29.8	-55.2	-4.6	25.8	336.0	106.5	225.0	462.7	112.4	275.0
Shell 101												
235-400	-115.14	-4.37	17.78	-33.11	-4.03	22.08	185.32	88.89	214.7	293.67	83.89	153.85
Shell 102												
237-401	-59.31	-4.12	23.29	-10.47	-1.25	27.44	95.08	71.65	142.15	139.89	74.95	57.77

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Walls-x @	ϕ =	0.6	
North of Grid E	**f'c =**	3	ksi
	fy =	60	ksi

(E) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(100%Ex+30%Ez)/2

(E) Walls				Shear Design			
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	Add'l As
Face	ft	in	in^2/ft	kips	kips		in^2
Shell 111							
412-222	10	10	**0.4**	222.9	384.5	***1.73***	
Shell 112							
413-224	10	10	**0.4**	222.9	170.6	0.77	
Shell 113							
414-226	10	10	**0.4**	222.9	116.1	0.52	
Shell 114							
415-228	10	10	**0.4**	222.9	99.9	0.45	
Shell 115							
416-230	10	10	**0.4**	222.9	82.2	0.37	
Shell 116							
417-232	10	10	**0.4**	222.9	80.1	0.36	
Shell 117							
418-234	10	10	**0.4**	222.9	67.1	0.30	
Shell 119							
419-236	10	10	**0.4**	222.9	54.0	0.24	
Shell 95							
223-394	10	10	**0.4**	222.9	412.8	***1.85***	
Shell 96							
225-395	10	10	**0.4**	222.9	153.4	0.69	
Shell 97							
227-396	10	10	**0.4**	222.9	116.2	0.52	
Shell 98							
229-397	10	10	**0.4**	222.9	98.8	0.44	
Shell 99							
231-398	10	10	**0.4**	222.9	78.7	0.35	
Shell 100							
233-399	10	10	**0.4**	222.9	81.1	0.36	
Shell 101							
235-400	10	10	**0.4**	222.9	66.3	0.30	
Shell 102							
237-401	10	10	**0.4**	222.9	53.0	0.24	

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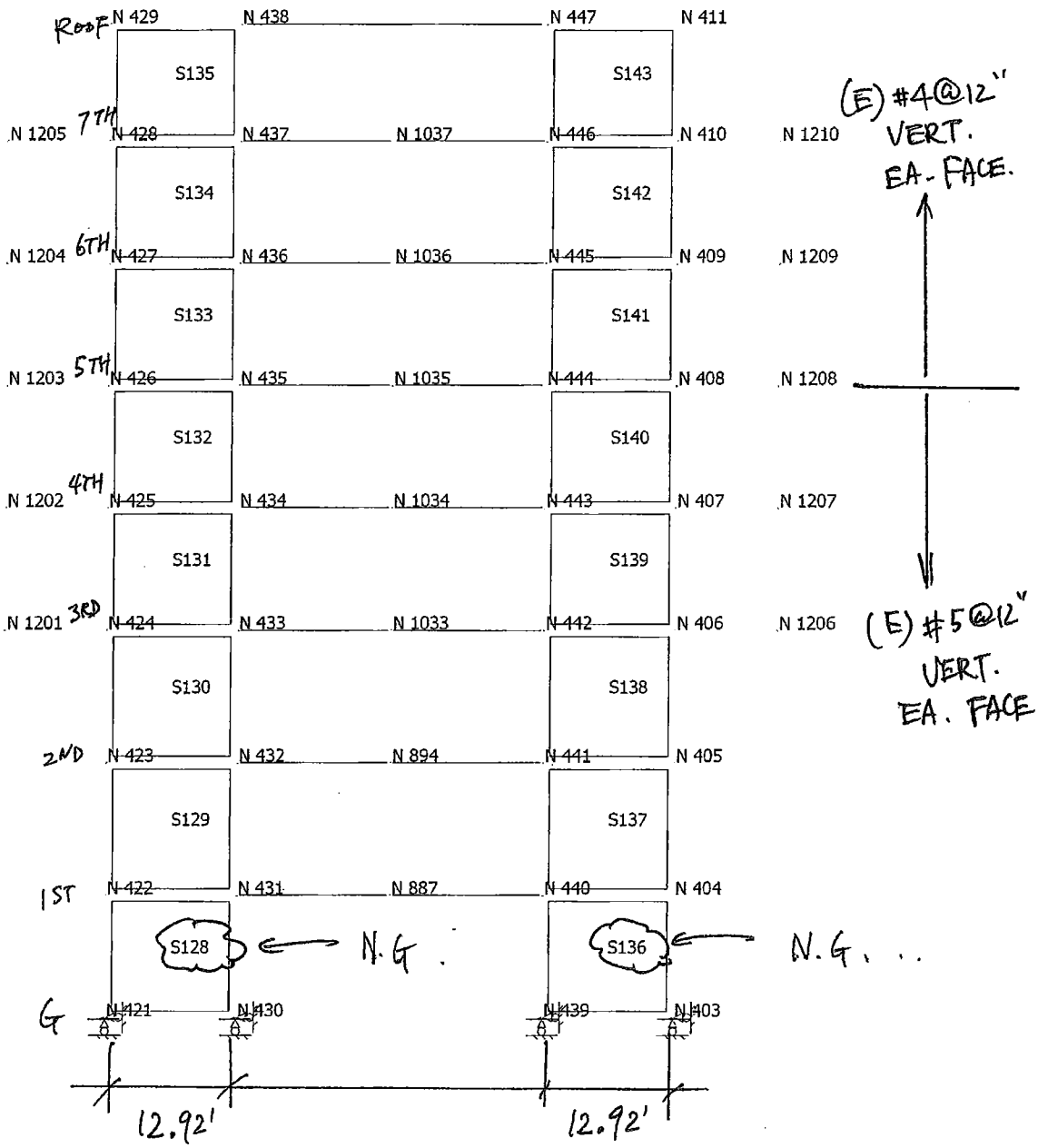
Z X

(E) WALLS @ SOUTH OF GRID E

ALONG X-DIR.

t = 10"

(#4@12" HORIZ. EA. FACE)



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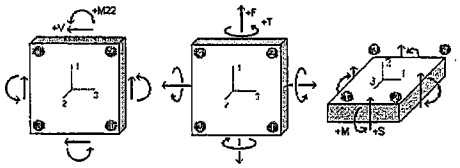

(E) Walls -x @ South of Grid E

Wall ID	DL			LL			EQ-x			EQ-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 128												
421-430	-285.7	-7.0	-81.5	-122.2	-2.5	-39.2	937.9	465.1	-1242.5	1674.6	660.6	406.7
Shell 129												
422-431	-223.9	11.0	-100.4	-91.3	8.2	-67.7	1111.8	370.8	-2446.1	1792.5	458.3	1097.9
Shell 130												
423-432	-177.3	10.9	-38.1	-70.2	7.3	-24.4	852.5	326.3	-1598.6	1455.7	373.5	481.0
Shell 131												
424-433	-142.2	8.5	-34.8	-56.0	4.0	-18.5	608.2	282.4	-1038.8	1111.0	266.3	377.1
Shell 132												
425-434	-113.4	10.2	-49.4	-43.3	4.9	-24.8	452.3	252.7	-510.8	842.0	206.5	329.3
Shell 133												
426-435	-84.6	10.8	-42.3	-30.5	5.3	-20.4	391.3	208.9	146.9	603.9	162.6	268.3
Shell 134												
427-436	-59.3	11.5	-48.5	-19.9	5.5	-23.9	239.9	164.6	114.0	378.5	134.9	154.6
Shell 135												
428-437	-30.8	18.8	-43.6	-7.4	5.4	-23.6	110.0	133.2	27.1	179.2	117.5	66.2
Shell 136												
439-403	-356.8	19.4	103.6	-144.6	5.3	28.2	919.6	449.9	1673.1	1772.7	718.8	444.1
Shell 137												
440-404	-235.0	13.8	-120.5	-91.5	4.4	-46.6	1098.3	370.0	3122.2	1759.7	446.6	422.4
Shell 138												
441-405	-166.7	-4.4	22.0	-59.2	-3.3	20.0	834.3	323.1	2037.2	1434.6	364.1	752.4
Shell 139												
442-406	-128.9	-9.5	22.2	-44.8	-5.0	10.5	599.8	278.7	1291.7	1092.3	261.0	643.2
Shell 140												
443-407	-101.0	-9.7	20.4	-33.3	-5.0	6.9	457.8	250.4	684.2	821.1	201.0	486.7
Shell 141												
444-408	-75.1	-9.9	26.4	-22.9	-5.4	10.3	408.7	209.5	103.0	576.5	157.2	382.2
Shell 142												
445-409	-47.65	-11.89	17.15	-12.7	-5.82	8.66	262.01	164.93	144.27	355.08	131.18	286.46
Shell 143												
446-410	-23.65	-18.2	22.89	-3.57	-5.66	18.43	127.71	137.29	221.69	166.19	111.92	161.92

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Walls-x @	ϕ =	0.6	
South of Grid E	**f'c =**	3	ksi
	fy =	60	ksi

V_u =1.1(DL+LL)+(100%Ex+30%Ez)/2

(E) wall stiffness = 50% of Gross Stiffness

(E) Walls				Shear Design			
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	Add'l As
Face	ft	in	in^2/ft	kips	kips		in^2
Shell 128							
421-430	12.92	10	**0.4**	288.0	342.0	***1.19***	0
Shell 129							
422-431	12.92	10	**0.4**	288.0	275.3	0.96	
Shell 130							
423-432	12.92	10	**0.4**	288.0	239.2	0.83	
Shell 131							
424-433	12.92	10	**0.4**	288.0	194.9	0.68	
Shell 132							
425-434	12.92	10	**0.4**	288.0	173.8	0.60	
Shell 133							
426-435	12.92	10	**0.4**	288.0	146.5	0.51	
Shell 134							
427-436	12.92	10	**0.4**	288.0	121.2	0.42	
Shell 135							
428-437	12.92	10	**0.4**	288.0	110.8	0.38	
Shell 136							
439-403	12.92	10	**0.4**	288.0	359.9	***1.25***	0
Shell 137							
440-404	12.92	10	**0.4**	288.0	271.9	0.94	
Shell 138							
441-405	12.92	10	**0.4**	288.0	224.6	0.78	
Shell 139							
442-406	12.92	10	**0.4**	288.0	194.5	0.68	
Shell 140							
443-407	12.92	10	**0.4**	288.0	171.4	0.60	
Shell 141							
444-408	12.92	10	**0.4**	288.0	145.1	0.50	
Shell 142							
445-409	12.92	10	**0.4**	288.0	121.6	0.42	
Shell 143							
446-410	12.92	10	**0.4**	288.0	111.7	0.39	

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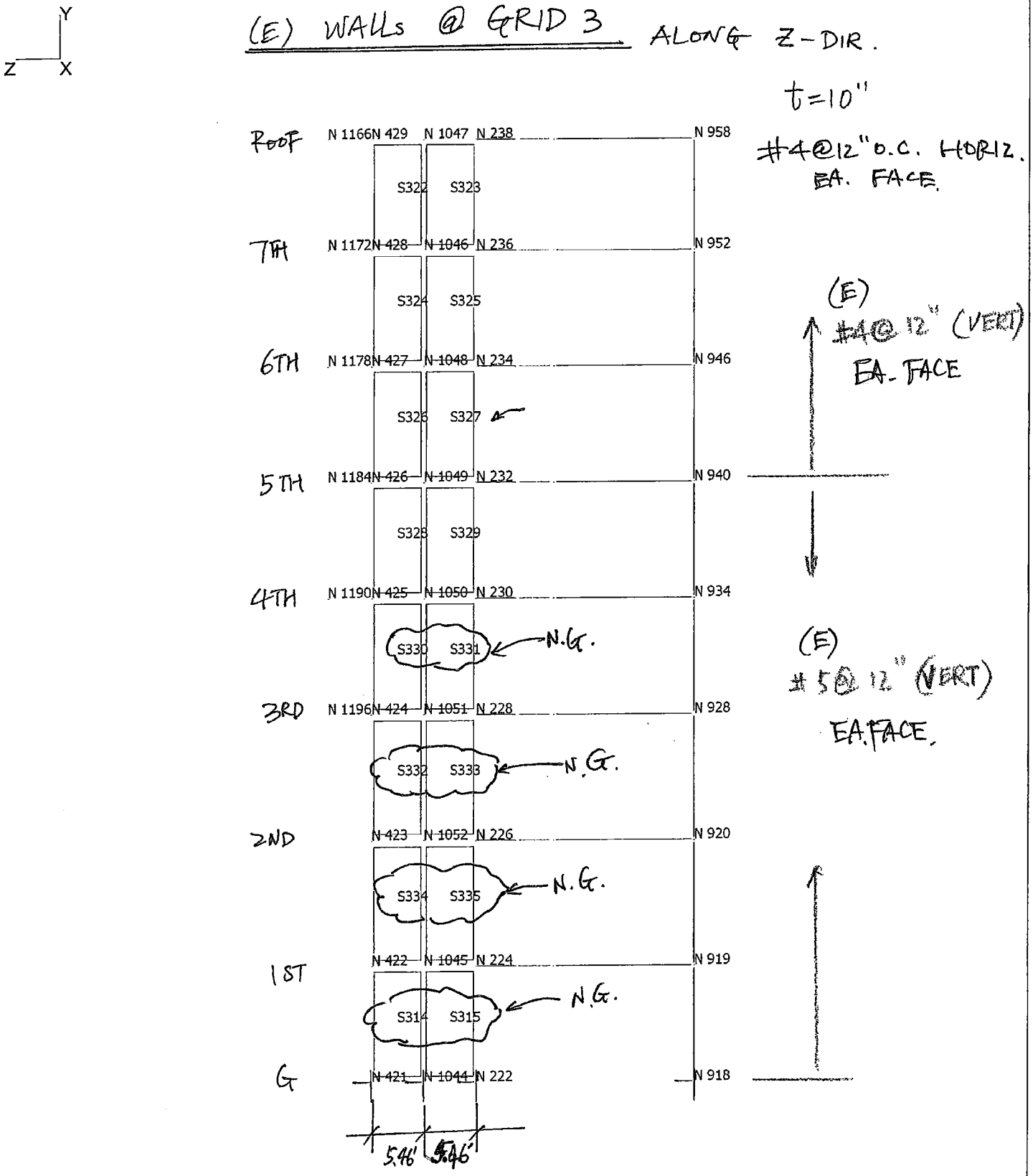

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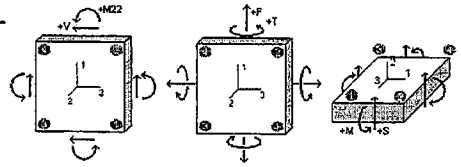

(E) Walls -z @ Grid 3

Wall ID	DL			LL			EQ-x			EQ-z			EQ-z (Soil Seismic)			Soil Active Pressure-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 314																		
421-1044	-171.6	27.3	11.9	-72.3	10.8	5.3	159.1	113.4	-110.4	327.9	217.5	-97.4	2.01	-2.61	-6.5	7.23	-9.39	-23.41
Shell 315																		
1044-222	-236.9	13.9	-24.5	-97.6	5.5	-10.4	231.5	121.2	29.1	463.9	258.9	263.0	-2.48	-2.54	-6.74	-8.93	-9.14	-24.27
Shell 334																		
422-1045	-135.8	8.9	-7.7	-56.1	1.0	-7.6	156.6	112.9	149.9	536.0	258.0	-429.4	-0.47	-0.07	0.32	-1.69	-0.24	1.16
Shell 335																		
1045-224	-190.1	-3.8	-37.5	-76.3	-2.6	-16.9	180.8	119.1	203.1	548.9	272.1	736.9	0.45	-0.05	0.41	1.63	-0.19	1.47
Shell 332																		
423-1052	-100.4	4.1	-18.6	-37.3	-0.1	-11.5	159.2	116.7	97.1	423.8	234.8	-277.7	-0.09	-0.02	0.03	-0.32	-0.06	0.11
Shell 333																		
1052-226	-155.2	-5.3	-41.1	-56.2	-1.7	-17.7	162.7	119.0	187.3	422.4	252.6	472.0	0.1	-0.02	0.04	0.34	-0.05	0.15
Shell 330																		
424-1051	-85.5	-0.1	-16.2	-32.6	-1.1	-5.8	136.4	112.3	84.7	324.2	194.2	-192.8	-0.03	0	0.04	-0.12	0	0.14
Shell 331																		
1051-228	-126.7	-8.3	-38.2	-43.1	-2.3	-11.4	134.3	113.2	122.8	318.7	219.7	333.3	0.06	0	0.06	0.22	0.01	0.22
Shell 328																		
425-1050	-70.3	-0.2	-12.3	-26.1	-1.0	-4.4	153.7	136.6	104.6	256.2	159.0	-151.8	-0.02	0.01	0.05	-0.08	0.04	0.18
Shell 329																		
1050-230	-101.0	-6.0	-30.1	-33.4	-1.5	-9.2	149.0	130.8	26.3	253.8	192.4	275.4	0.05	0.01	0.06	0.18	0.04	0.23
Shell 326																		
426-1049	-53.0	-4.4	-16.7	-18.8	-3.3	-7.5	144.6	71.4	-53.0	202.7	137.3	-118.3	-0.01	0.01	0.05	-0.05	0.05	0.17
Shell 327																		
1049-232	-77.4	-7.2	-28.7	-24.6	-2.6	-10.1	162.6	96.5	221.1	204.8	176.1	241.0	0.04	0.01	0.06	0.14	0.05	0.21
Shell 324																		
427-1048	-38.0	-3.7	-11.0	-12.9	-3.1	-5.4	94.7	62.9	-28.2	152.1	116.8	-71.2	-0.01	0.02	0.04	-0.04	0.06	0.15
Shell 325																		
1048-234	-49.8	-3.5	-16.5	-13.6	-1.2	-5.5	106.9	86.0	143.5	154.4	162.2	191.3	0.03	0.01	0.05	0.1	0.05	0.18
Shell 322																		
428-1046	-19.45	-5.23	-11.23	-5.93	-2.24	-3.13	51.26	45.93	-3.89	113.23	100.51	-30.65	-0.01	0.03	0.05	-0.03	0.09	0.18
Shell 323																		
1046-236	-25.5	-2.13	-9.76	-3.67	0.88	-0.99	59.54	66.86	76.94	112.43	150.1	139.31	0.02	0.02	0.06	0.06	0.09	0.2

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Walls-z @ Grid 3 $\phi =$ 0.6
f'c = 3 ksi
fy = 60 ksi
(E) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(30%Ex+100%Ez)/2 +1.6H+100%Esoil/2

(E) Walls				Shear Design				
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	Add'l As	
Face	ft	in	in^2/ft	kips	kips		in^2	
Shell 314								
421-1044	5.46	10	**0.4**	121.7	183.9	***1.51***		NG
Shell 315								
1044-222	5.46	10	**0.4**	121.7	185.3	***1.52***		NG
Shell 334								
422-1045	5.46	10	**0.4**	121.7	173.2	***1.42***		NG
Shell 335								
1045-224	5.46	10	**0.4**	121.7	177.3	***1.46***		NG
Shell 332								
423-1052	5.46	10	**0.4**	121.7	155.6	***1.28***		NG
Shell 333								
1052-226	5.46	10	**0.4**	121.7	168.1	***1.38***		NG
Shell 330								
424-1051	5.46	10	**0.4**	121.7	131.6	***1.08***		NG
Shell 331								
1051-228	5.46	10	**0.4**	121.7	154.8	***1.27***		NG
Shell 328								
425-1050	5.46	10	**0.4**	121.7	117.6	0.97		NG
Shell 329								
1050-230	5.46	10	**0.4**	121.7	140.3	***1.15***		NG
Shell 326								
426-1049	5.46	10	**0.4**	121.7	104.1	0.86		O.K.
Shell 327								
1049-232	5.46	10	**0.4**	121.7	129.6	***1.06***		O.K.
Shell 324								
427-1048	5.46	10	**0.4**	121.7	91.6	0.75		
Shell 325								
1048-234	5.46	10	**0.4**	121.7	115.5	0.95		
Shell 322								
428-1046	5.46	10	**0.4**	121.7	81.7	0.67		
Shell 323								
1046-236	5.46	10	**0.4**	121.7	102.8	0.84		

BENTLEY **Coffman Engineers**

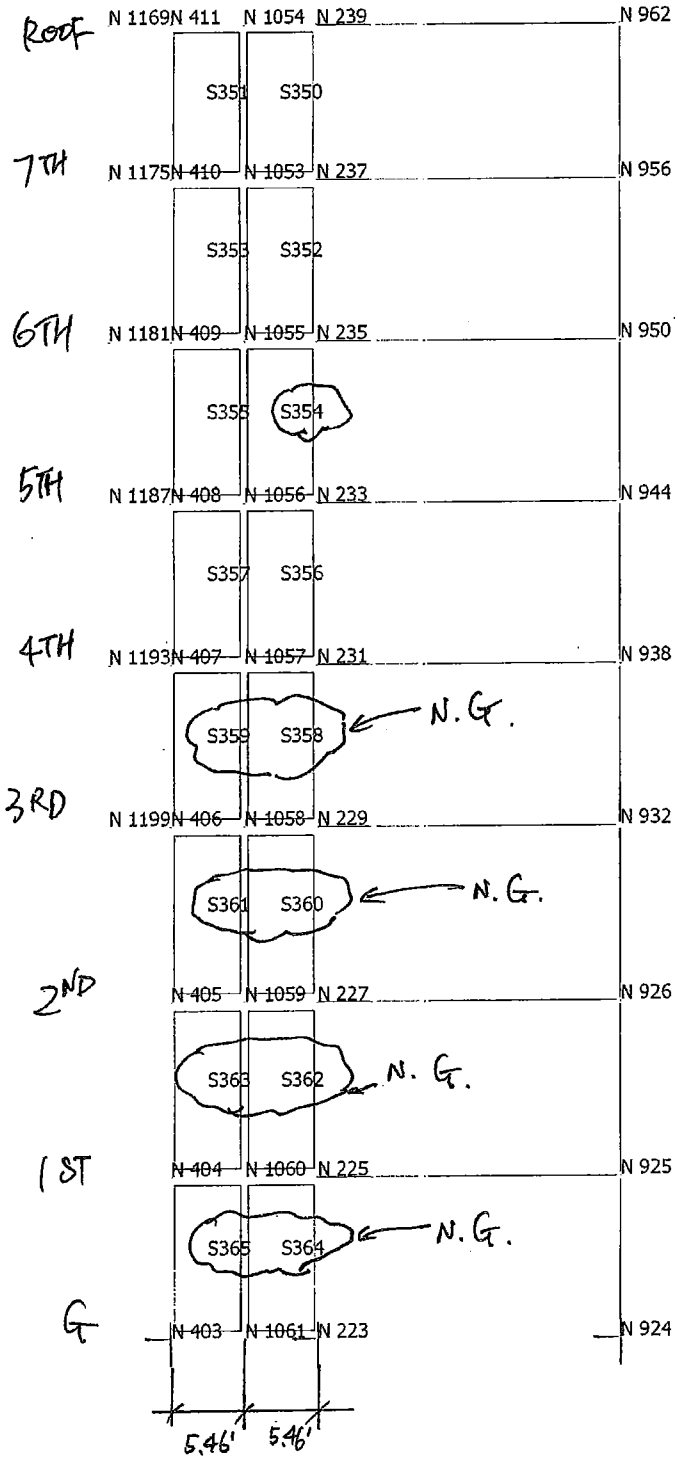
Current Date: 11/2/2007 3:04 PM
Units system: English
File name: C:\My Projects\07230 RetonCityHall\RAM Advanse\11_1_07\Tier 2 Analysis Nov 01 2007 - Final Retrofit.adv

Y
Z X

(E) Walls @ GRID 5 ALONG Z-DIR.

t = 10"

#4@12" O.C. HORIZ. EA. FACE.



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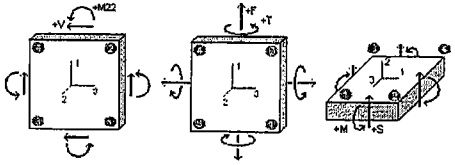

(E) Walls -z @ Grid 5

Wall ID	DL			LL			EQ-x			EQ-z			EQ-z (Soil Seismic)			Soil Active Pressure-z		
Face	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22	F	V	M22
	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]	[Kips]	[Kips]	[Kip*ft]
Shell 365																		
1061-403	-90.2	-88.0	-276.8	-35.8	-35.7	-111.1	106.4	159.7	184.3	134.6	355.4	94.3	1.45	1.82	5.01	5.21	6.54	18.05
Shell 364																		
223-1061	-111.3	47.0	286.1	-44.5	17.8	113.4	127.2	103.1	-204.9	205.9	310.2	-81.6	-1.56	1.87	5.34	-5.63	6.73	19.22
Shell 363																		
1060-404	-106.6	-16.1	-3.3	-41.7	-6.7	-1.6	170.9	116.0	-42.3	516.8	245.9	703.7	-0.13	0.23	0.32	-0.48	0.82	1.15
Shell 362																		
225-1060	-172.7	1.7	43.7	-68.2	-1.8	13.8	172.7	125.5	-85.2	530.5	264.3	-465.5	0.05	0.23	0.3	0.18	0.81	1.09
Shell 361																		
1059-405	-99.5	-8.8	4.7	-38.5	-3.4	1.5	165.7	116.9	-27.8	418.0	229.2	505.2	-0.05	0.05	0.06	-0.18	0.16	0.22
Shell 360																		
227-1059	-152.5	2.6	34.1	-57.2	-1.1	10.2	164.3	120.3	-89.5	417.1	249.7	-329.2	0.04	0.04	0.02	0.16	0.14	0.07
Shell 359																		
1058-406	-80.6	-0.5	19.0	-29.2	1.2	9.3	138.0	110.0	-30.7	319.3	190.9	385.6	-0.03	0.01	-0.02	-0.1	0.02	-0.09
Shell 358																		
229-1058	-131.2	8.4	45.0	-47.4	2.6	16.5	135.3	112.0	-46.7	313.2	216.2	-224.8	0.05	0	-0.05	0.19	0.01	-0.18
Shell 357																		
1057-407	-64.6	2.3	20.3	-22.2	2.5	10.0	154.3	133.3	-51.0	250.6	157.4	306.9	-0.02	-0.01	-0.05	-0.08	-0.04	-0.17
Shell 356																		
231-1057	-106.8	8.1	40.2	-37.8	2.9	16.1	151.9	129.0	21.9	246.8	189.7	-152.6	0.05	-0.01	-0.06	0.17	-0.04	-0.23
Shell 355																		
1056-408	-49.7	1.7	15.0	-16.2	2.7	8.6	156.6	76.5	156.2	190.3	131.6	225.6	-0.01	-0.01	-0.05	-0.05	-0.05	-0.16
Shell 354																		
233-1056	-80.5	4.9	29.2	-27.2	2.1	12.5	175.5	102.9	-163.4	188.8	170.5	-84.0	0.04	-0.01	-0.06	0.14	-0.05	-0.21
Shell 353																		
1055-409	-32.4	5.4	18.5	-9.8	4.7	10.4	106.1	68.5	101.7	140.9	110.0	142.0	-0.01	-0.02	-0.04	-0.04	-0.06	-0.15
Shell 352																		
235-1055	-57.3	5.5	27.2	-17.7	2.9	12.3	119.1	92.2	-113.9	140.8	156.4	-19.6	0.03	-0.01	-0.05	0.1	-0.05	-0.19
Shell 351																		
1053-410	-16	9.05	19.64	-4.54	4.21	6.88	65.11	57.42	39.27	104	92.71	70.73	-0.01	-0.03	-0.05	-0.03	-0.09	-0.18
Shell 350																		
237-1053	-30.67	5.85	20.86	-5.73	1.06	6.31	71.49	77.56	-37.86	103.25	143.8	26.63	0.02	-0.02	-0.06	0.06	-0.09	-0.21

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(E) Shaft Wall Shear Check (Based on ASCE41-06)

Walls-z @ Grid 5 ϕ = 0.6
f'c = 3 ksi
fy = 60 ksi
(E) wall stiffness = 50% of Gross Stiffness

V_u =1.1(DL+LL)+(30%Ex+100%Ez)/2 +1.6H+100%Esoil/2

(E) Walls

				Shear Design				
Wall ID	Length	Thickness	A_s/ft	ϕVn	V_u	DCR	Add'l As	
Face	ft	in	in^2/ft	kips	kips		in^2	
Shell 365								
1061-403	5.46	10	**0.4**	121.7	349.1	***2.87***		NG
Shell 364								
223-1061	5.46	10	**0.4**	121.7	253.6	***2.08***		
Shell 363								
1060-404	5.46	10	**0.4**	121.7	166.9	***1.37***		NG
Shell 362								
225-1060	5.46	10	**0.4**	121.7	152.5	***1.25***		
Shell 361								
1059-405	5.46	10	**0.4**	121.7	145.8	***1.20***		NG
Shell 360								
227-1059	5.46	10	**0.4**	121.7	144.8	***1.19***		
Shell 359								
1058-406	5.46	10	**0.4**	121.7	112.8	0.93		NG.
Shell 358								
229-1058	5.46	10	**0.4**	121.7	137.0	***1.13***		
Shell 357								
1057-407	5.46	10	**0.4**	121.7	104.1	0.86		O.K.
Shell 356								
231-1057	5.46	10	**0.4**	121.7	126.3	***1.04***		
Shell 355								
1056-408	5.46	10	**0.4**	121.7	82.2	0.68		
Shell 354								
233-1056	5.46	10	**0.4**	121.7	108.4	0.89		
Shell 353								
1055-409	5.46	10	**0.4**	121.7	76.4	0.63		
Shell 352								
235-1055	5.46	10	**0.4**	121.7	101.4	0.83		
Shell 351								
1053-410	5.46	10	**0.4**	121.7	69.7	0.57		
Shell 350								
237-1053	5.46	10	**0.4**	121.7	91.3	0.75		