TECHNICAL EVALUATION REPORT

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FRC PROJECT C5506

FRC ASSIGNMENT 6

FRC TASK 583

MASONRY WALL DESIGN

TOLEDO EDISON COMPANY
DAVIS-BESSE UNIT 1

TER-C5506-583

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

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FOREWORD

This Technical Evaluation Report was prepared by Franklin Research Center under a contract with the U.S. Nuclear Regulatory Commission (Office of Nuclear Reactor Regulation, Division of Operating Reactors) for technical assistance in support of NRC operating reactor licensing actions. The technical evaluation was conducted in accordance with criteria established by the NRC.

1. INTRODUCTION

1.1 PLANT-SPECIFIC BACKGROUND

In response to IE Bulletin 80-11 [1], Toledo Edison (TED) Company submitted documents regarding the safety related masonry walls at Davis-Besse Unit 1 to the U.S. NRC [2-9]. Franklin Research Center (FRC) has been retained by the NRC to review the submittals prepared by Davis-Besse Unit 1. As a result of this review, a technical evaluation report was prepared to summarize FRC review findings [10]. Based on FRC's report, the NRC staff issued their Safety Evaluation Report (SER) [10], which found the Licensee evaluation acceptable for 95 walls and the remaining 74 walls qualified by the energy balance technique were unacceptable without further confirmation of the methodology. The SER identifies three approaches that could be used to reevaluate these affected walls. They are summarized as follows.

1. Implement modifications so that the walls can be qualified relying on the SGEB criteria [12]
2. Develop a rigorous nonlinear analysis techniques, supplemented with a confirmatory testing
3. Validate the energy balance technique with a comprehensive test program.

On March 12, 1985, the NRC issued an Information Request pursuant to 10CFR 50.54 (f) (Log No. 1716) requesting the Licensee-planned actions and schedules to implement the NRC staff position concerning those 74 affected walls.

In a meeting on April 25, 1985 and subsequent submittals [13, 14], the Licensee provided a reanalysis method using working stress method to qualify these walls.

The Licensee's reanalysis method has been reviewed, and the results of that review are presented in this report.

1.2 WALL CONSTRUCTION

Of the 74 affected walls, 73 walls are located in the auxiliary building and one wall is in the intake structure. The construction details of these walls are as follows:

Masonry Units	ASTM C-90 Grade N-1
Mortar	ASTM C-476 Type PM
Grout	ASTM C-476
Reinforcing Steel	ASTM A 615 Grade 40
Vertical Reinforcing	2 # 5 at 16 in
Horizontal Reinforcing	Dur-O-Wall Extra Heavy Truss Type per ASTM A-82 spaced at 8 in

Typical construction details are illustrated in Figures 1 and 2.

All reinforcing is anchored at the wall boundaries. At concrete/steel interfaces, vertical rebars are anchored with self-drilling expansion sleeves, as shown in Figure 1. At steel beams, vertical bars are secured by sleeve nuts welded to the beam. Horizontal reinforcing is lapped and secured by self-drilling expansion sleeves at concrete boundaries, as shown in Figure 2.

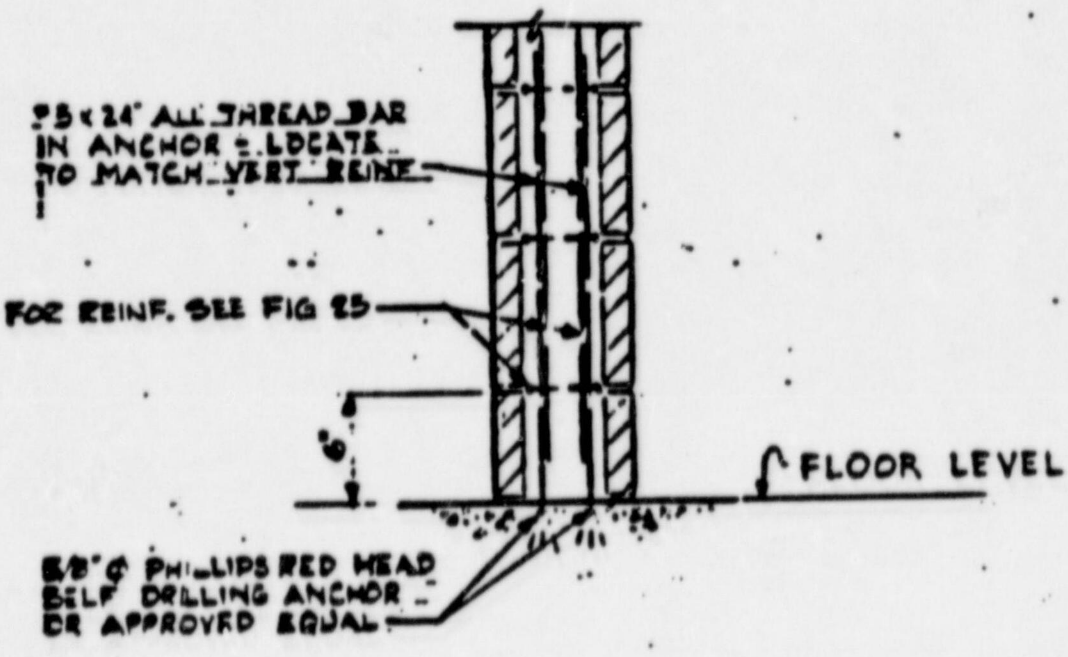


Figure 1. Section at Floor Level

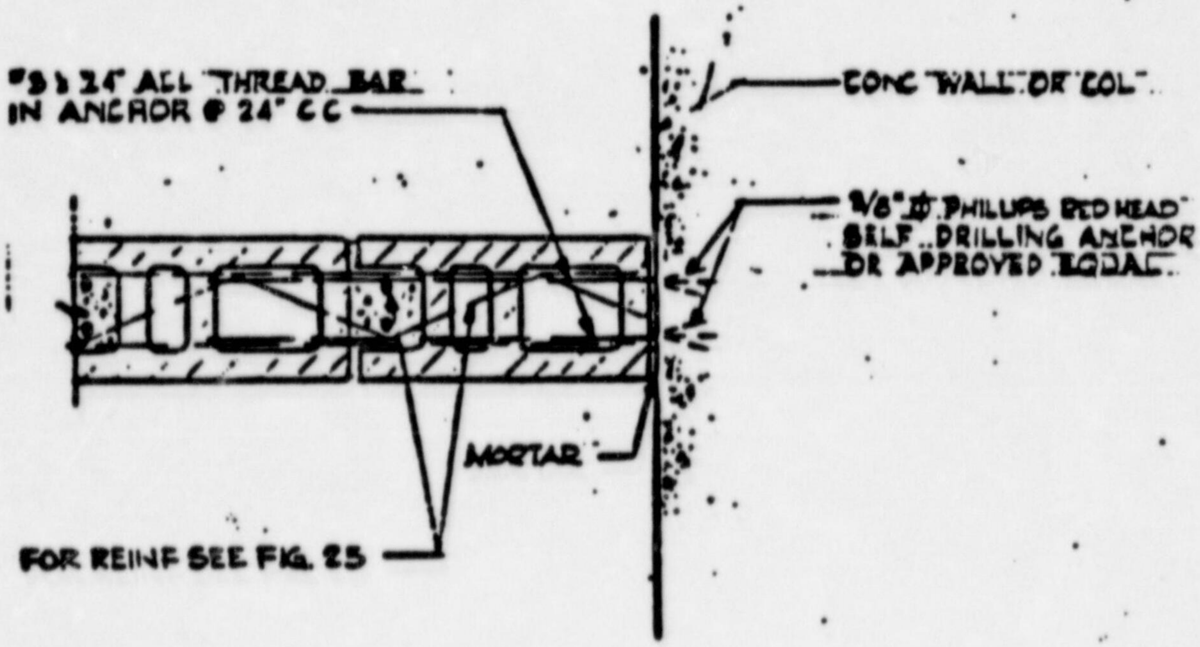


Figure 2. Plan at Concrete Wall or Column Intersection

2. REANALYSIS METHOD

The basic philosophy behind the reanalysis method is to identify and quantify various known sources of conservatism included in the original analysis. These sources are included in the original analysis of the structures housing the masonry walls and in the analysis of the walls themselves. Discussion of these sources of conservatism follows.

2.1 CONSERVATISM OF THE ORIGINAL STRUCTURAL ANALYSIS

The original seismic analysis of Davis-Besse Unit 1 was based on the 1935 modified Helena, Montana, time history, which enveloped the modified Newmark Spectrum. As shown in Figure 3, the time history exhibits conservatism at various frequencies compared with the modified Newmark Spectrum, which resulted in a conservative estimate for the floor response spectra. This conservative estimate is particularly obvious in the areas of the spectra away from the structure's natural frequencies.

To illustrate this source of conservatism, a comparison of the floor response spectra from the original analysis with the analysis performed later in 1980 is shown in Figure 4. It is noted that even for an increase in g level from 0.15 g to 0.2 g the Regulatory Guide 1.60/1.61 response is less than that obtained from the original analysis. The spectrum of the synthetic time history used to generate the floor response spectra is shown in Figure 5. The amount of reduction varies for different locations of structures and floor levels. Detailed results of the two analyses are shown in Table 1.

2.2 CONSERVATISM OF THE WALL'S ANALYSIS

A number of sources of conservatism have been identified by the Licensee and are discussed below.

Boundary Conditions

In the previous analysis, pinned conditions were assumed for the walls except for some cantilevered walls where a fixed condition was assumed. The Licensee indicated that, in a typical wall, at least partial restraint exists on all sides. Based on the Licensee's analysis, at least 20% of the maximum

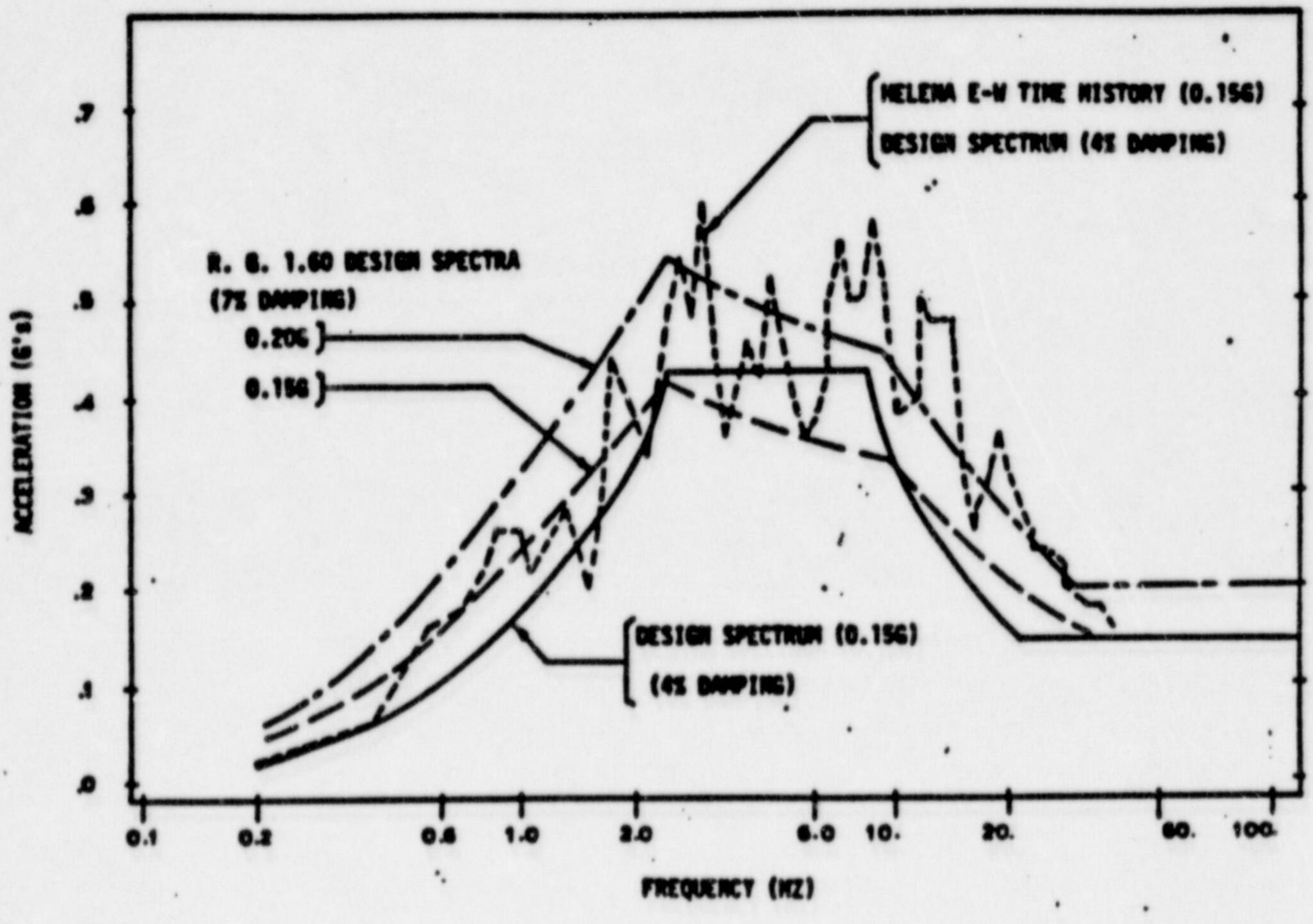


Figure 3. Davis-Besse Horizontal Acceleration Design Spectra

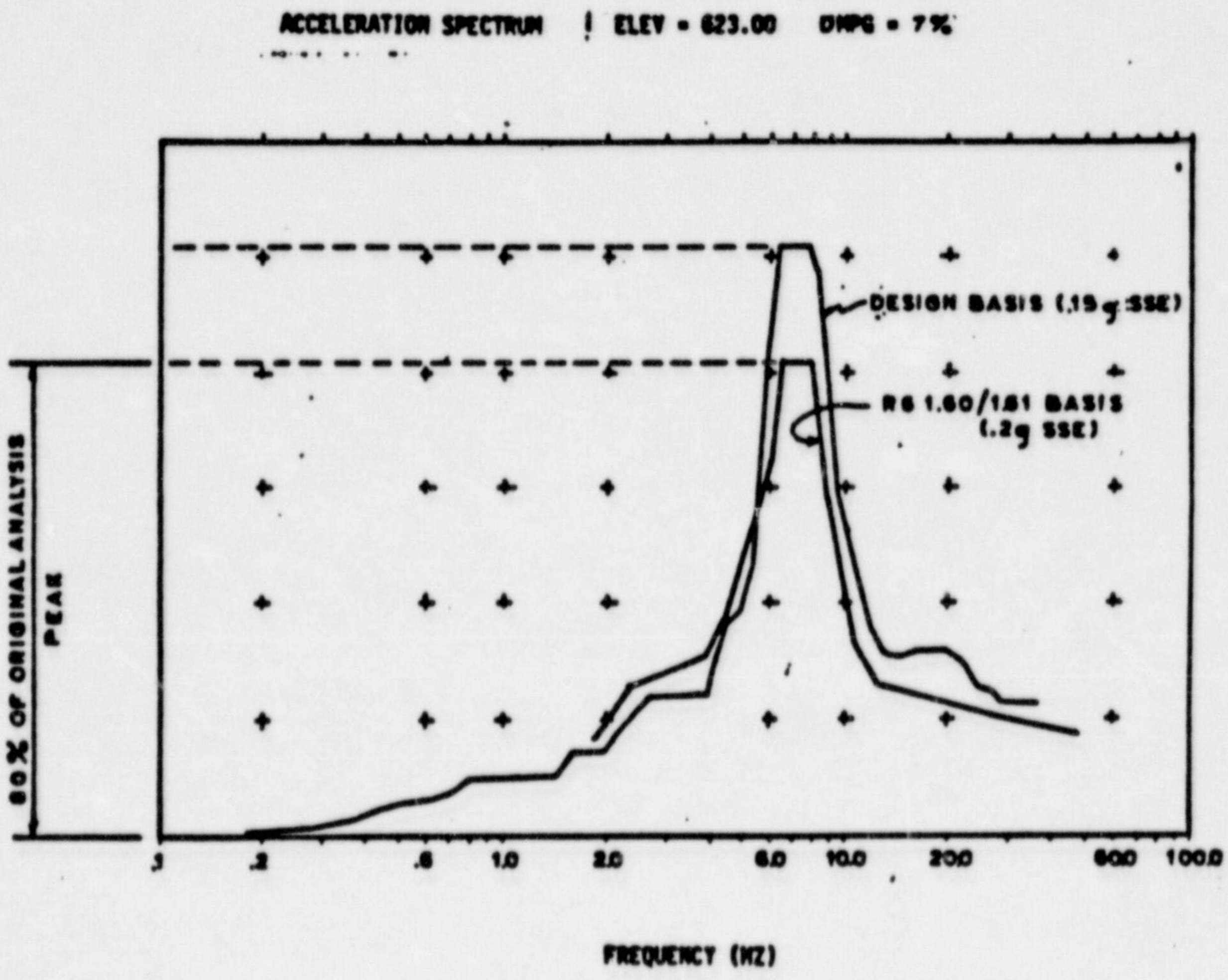


Figure 4. Davis-Besse Unit 1 Auxiliary Building Area 7
Newmark Spectrum Floor Response Spectra

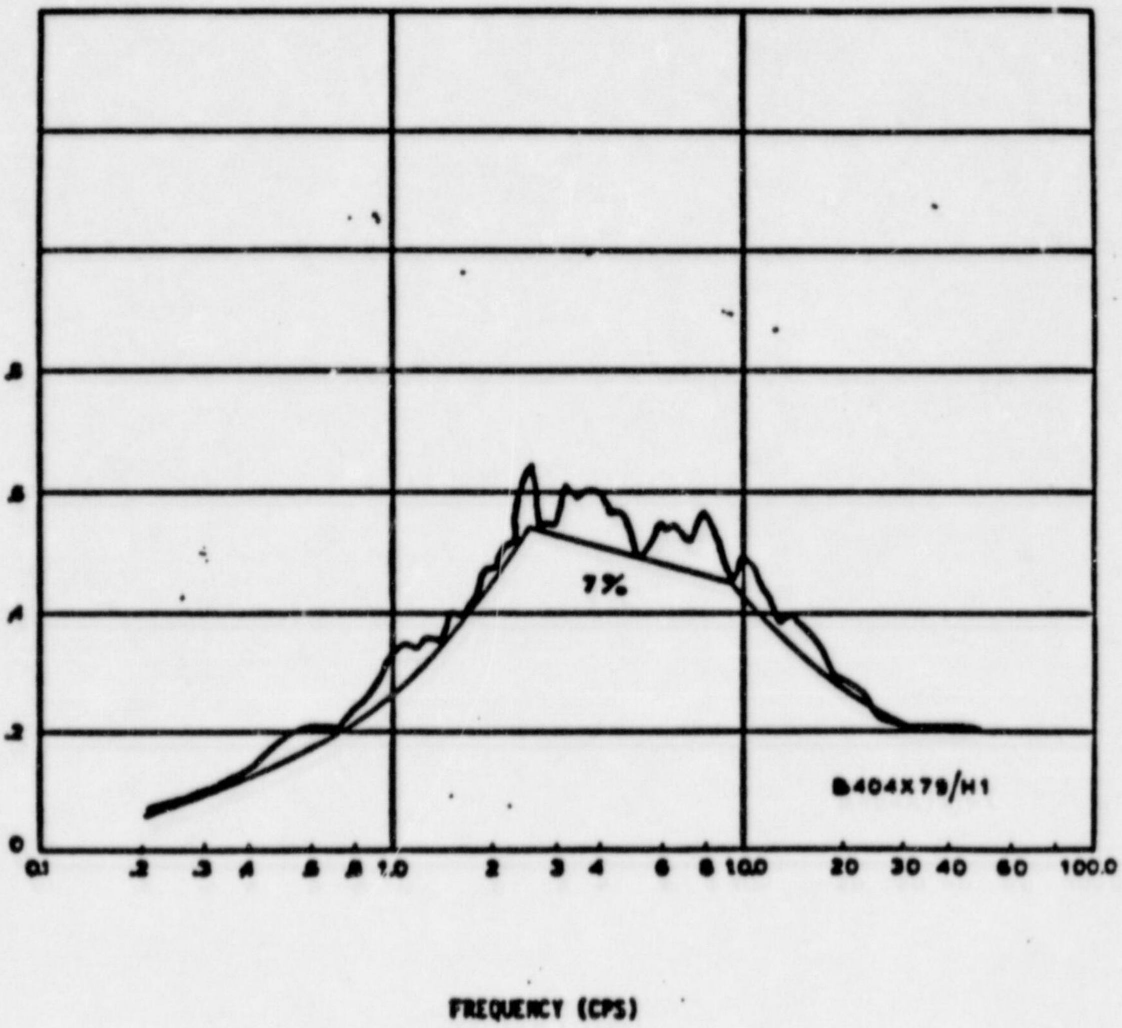


Figure 5. Regulatory Guide 1.60 Time History

Table 1. Seismic Loads

REDUCTION FACTORS FOR USE OF REGULATORY GUIDE 1.60 (.2g) TIME HISTORY

AREA	DIRECTION	PEAK NATURAL FREQUENCY	REDUCTION FACTOR
6	N-S	6.7	0.8
	E-W	6.8	0.6
7	N-S	7.0	0.8 (1)
	E-W	5.2	1.0
8	N-S	9.1	0.6 (2)
	E-W	11.2	0.6 (3)

(1) REDUCTION FACTOR OF 0.85 FOR 1XXX AND 2XXX LEVEL WALLS

(2) REDUCTION FACTOR OF 0.9 FOR 1XXX AND 2XXX LEVEL WALLS

(3) REDUCTION FACTOR OF 0.8 FOR 1XXX AND 2XXX LEVEL WALLS

(4) 7% DAMPING USED FOR REGULATORY GUIDE 1.60 ANALYSIS

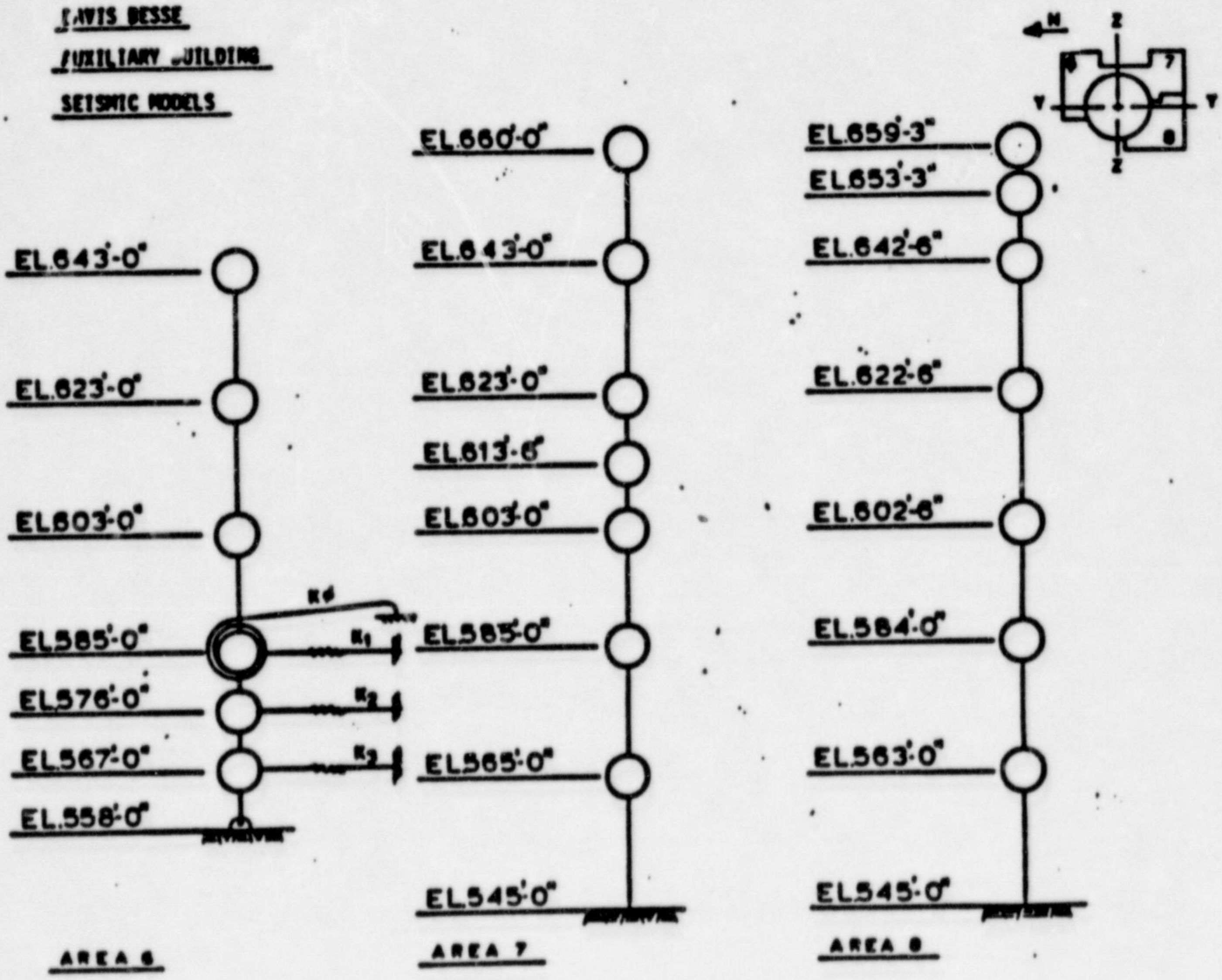


Figure 6. Auxiliary Building Seismic Models

moment at the center of the wall will be transferred to the top and bottom supports for as-built conditions along the boundary. The Licensee also stated that both top and bottom connections were checked to assure that the connections details were able to absorb 20% of the maximum moment.

For the horizontally spanned wall, the horizontal reinforcing steel is either anchored into existing concrete walls by lapping with 3/8-inch-diameter by 2-foot-long all-thread bars inserted into expansion shields or into existing masonry walls by lapping with "Z" type rigid steel anchors. The Licensee's analysis showed that these connection details resulted in a reduction of as much as 67% of the original moment is experienced and the maximum moments occur at the boundaries rather than the mid-span of the wall. Figure 7 summarizes the above discussion.

Material Properties

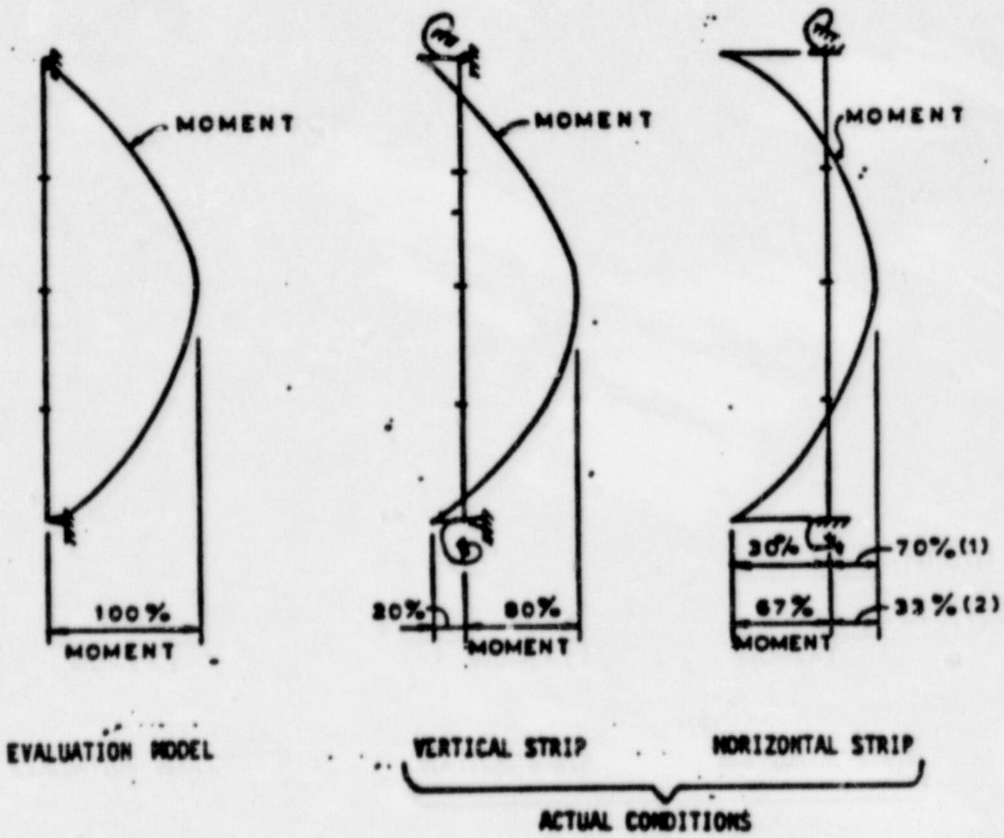
The Licensee identified conservatisms that exist in the reinforcing steel.

Vertical Rebar

A summary of yield and tensile strengths taken from certified material test results for the No. 5 rebar is given in Table 2a. It can be seen that the minimum yield strength is 50.6 ksi, compared with the minimum specified yield strength of 40 ksi that was used in the original analysis. Wall 5367 is the only one that has No. 3 rebar, and the Licensee stated that certified material test results for No. 3 reinforcing bar show a minimum yield strength of 53.6 ksi (Table 2b). Based on the results indicated above, the Licensee reanalyzed the walls using a minimum yield strength of 53.6 ksi for wall 5367 and a value of 50.6 ksi for all other walls.

Horizontal Reinforcement

Joint reinforcement was installed at every course, and typical connection details are illustrated in Figure 2. The joint reinforcing at Davis-Besse Unit 1 is Dur-O-Wall consisting of 3/16-inch-diameter longitudinal deformed wire with No. 9 gage plain web. The Licensee introduced test results on Dur-O-Wall performed by Wire Reinforcement Institute [15, 16], and these



(1) Anchorage is two 3/8" Ø inserts with two 3/8" Ø all-thread rods lapped with each layer of Dur-o-wall.

(2) Anchorage is one "Z" type rigid steel masonry anchor lapped with each layer of Dur-o-wall.

Figure 7. Wall Modeling Techniques Boundary Conditions

Table 2a. Mill Test Reports for Masonry Walls No. 5 Reinforcing Bars

ASTM SPECIFICATION	YIELD (KSI)	TENSILE (KSI)	QUANTITY OF STEEL REPRESENTED (TONS)
A-615 Grade 40	70.0	113.2	41.9
A-615 Grade 40	50.6	79.7	41.9
A-615 Grade 40	51.0	80.0	15.6
A-615 Grade 40	54.8	86.5	19.8
A-615 Grade 40	56.8	88.4	20.3
A-615 Grade 40	55.5	90.6	20.9
A-615 Grade 40	55.5	87.1	10.4
A-615 Grade 40	54.2	88.4	41.7
A-615 Grade 40	51.0	76.1	31.3
A-615 Grade 40	56.8	88.4	31.3
		TOTAL	275.1 TONS

Table 2b. Mill Test Reports for Masonry Walls No. 3 Reinforcing Bars

ASTM SPECIFICATION	YIELD (KSI)	TENSILE (KSI)		QUANTITY OF STEEL REPRESENTED (TONS)
A-615 Grade 40	53.6	81.6		0.3
A-615 Grade 40	53.6	81.6		0.9
			TOTAL	1.2 TONS

results are given in Figures 8 and 9. These curves indicated that the steel strength has yielding in excess of 60 ksi.

Further discussion on this subject is provided in Section 4.

Plate Action

To quantify the conservatism resulting from one-way action (as opposed to two-way behavior), the results of 30 walls that were originally analyzed by both strip and plate method were compared. Table 3 shows the results of this comparison. The moments obtained from plate analysis range from 3% to 84% of these obtained from one-way action. The Licensee indicated that a reduction of at least 15% to 20% can be realized due to the redistribution of loads to all four wall boundaries.

Damping Values

Some of the affected walls were originally analyzed using damping values lower than those specified in Regulatory Guide 1.60 (2% for OBE and 4% for SSE as opposed to 4% and 7% by Reg. Guide 1.60). The reanalysis used the values specified by NRC.

Other Conservatisms

The sources of conservatism described above were used by the Licensee in the reanalysis. In addition, the Licensee identified other conservatisms that existed in the original analysis of the walls but were not included in the reanalysis; they are summarized below:

- A modified floor response spectra: The floor response spectra were modified so that the peak acceleration was used for all frequencies below the peak frequency. Figure 10 illustrates this modification.

- Moment combination: The maximum external moment and maximum seismic inertial moment are combined as an absolute sum regardless of their location on the wall.

- Conduit loads: A significant portion of the external loads are the results of seismic consideration from conduit supports. The original analysis conservatively assumed that all conduits were loaded to maximum allowable fill.

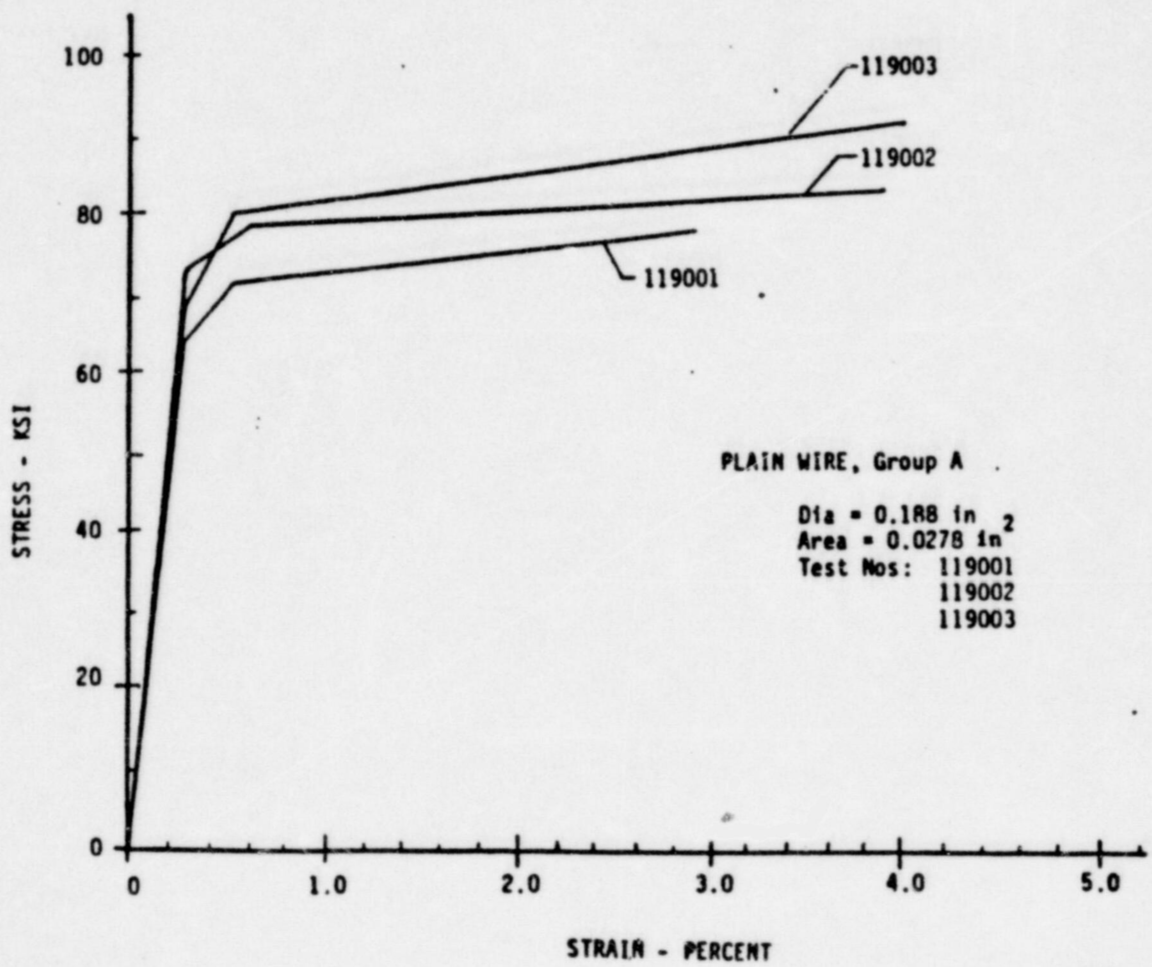


Figure 8. Typical Stress-Strain Curves for Plain Wire [15]

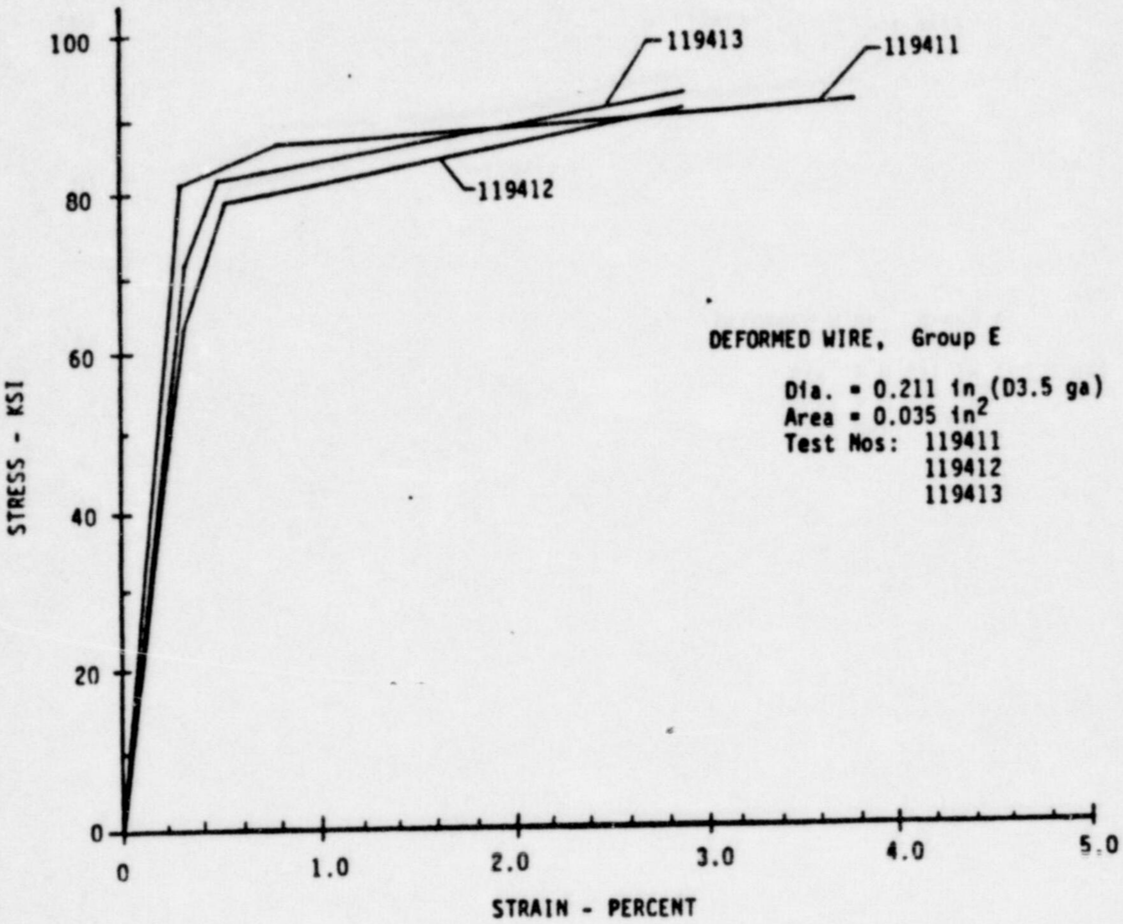


Figure 9. Typical Stress-Strain Curves for Deformed Wire [16]

Table 3. Comparison of Plate to Strip Analysis

WALL NO.	HEIGHT/WIDTH	REDUCTION FACTOR*
1068	0.76	0.60
2207	1.27	0.36
2217	1.10	0.06
306D	1.10	0.19
308D	2.44	0.07
309D	2.55	0.08
310D	2.44	0.08
3247	1.49	0.84
3357	0.64	0.79
338D	2.61	0.08
4046	1.85	0.09
4137	0.65	0.03
5137	2.32	0.04
6037	1.90	0.27
6097	4.54	0.27
3016	1.29	0.41
3026	2.68	0.41
3036	1.27	0.41
3287	2.10	0.30
4036	1.38	0.29
4786 4906	2.68	0.42
4796 4886 4896	1.43	0.18
5207	0.74	
311D	2.26	0.06
3237	1.57	0.72
2297	0.81	0.21
4026	1.62	0.60

*The original analysis (strip analysis) results are multiplied with these factors to obtain results based on a plate analysis.

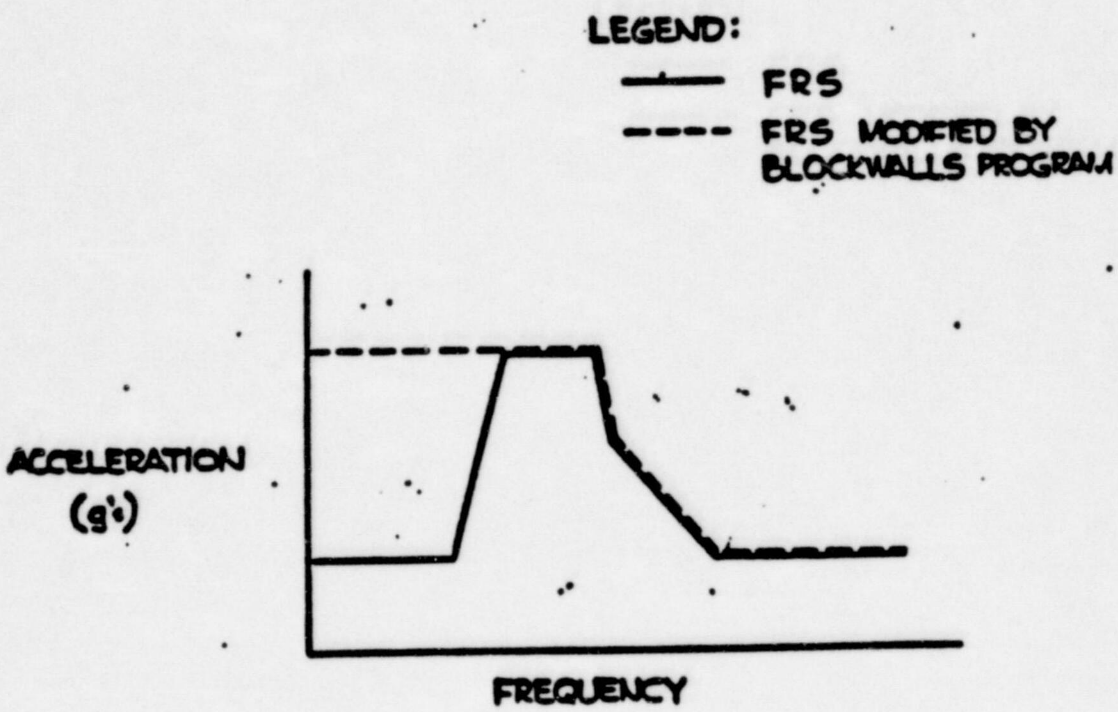


Figure 10. Representative Floor Response Spectra

3. REANALYSIS RESULTS

The Licensee performed a reanalysis using the above identified sources of conservatism. Basically, the ratio of the calculated reinforcing stress and the allowable stress obtained based on the energy balance technique was modified by factoring appropriate percentages of conservatism (from each category specified above) into this ratio. The results are presented in Tables 4, 5, and 6. The last column in each table shows the new ratio. Table 4 shows the results along with appropriate reduction factor for walls analyzed by a vertical strip analysis. Table 5 is for walls analyzed by a horizontal strip analysis, and Table 6 is for walls analyzed by a two-way action.

It is noted that, except for five walls, all other walls have a ratio less than or equal to 1. For these five walls, in addition to a two-way action analysis, the reevaluation considered the following:

- The floor response spectra based on Regulatory Guide 1.60 and 1.61 (0.2g) were used
- The minimum yield strength (vertical rebar) of 50.6 ksi was used for walls 1038, 2371, 5157, and 5197 and 53.6 ksi for wall 5367
- More precise attachment loads were calculated for wall 2371
- Modal response were combined in a SRSS fashion.

The results of this reanalysis are given in Table 7.

Table 4. Summary of Vertical Strip Analysis

			REDUCTION FACTORS							
WALL NO.	fs(3) / Fall	SEISMIC ORIENT	ADJUSTMENT TO MATCH ACCEPTANCE CRITERIA DAMP.	ADJUSTMENT TO MATCH ACCEPTANCE CRITERIA SSE	SEISMIC TIME HISTORY	BOUND COND.	MAT PROP.	PLATE ANALYSIS	PRODUCT	REDUCED fs / Fall
2237	0.78	E	-	-	-	.8	.8	-	.64	0.50
307D	0.85	N	-	-	.8	.8	.8	-	.51	0.43
1428	0.91	N	.75	-	-	.9	.8	-	.54	0.49
2067	1.02	N	.7	.7	.85	.8	.8	-	.29	0.30
1087	1.03	N	.7	.7	.85	Cant.	.8	-	.31	0.32
1147	1.03	N	-	-	-	.8	.8	-	.64	0.66
1337	1.05	E	-	-	-	.8	.8	-	.64	0.67
2247	1.07	E	-	-	-	.8	.8	-	.64	0.68
2317	1.11	N	-	-	-	.8	.8	-	.64	0.71
2177	1.19	E	-	-	-	.8	.8	-	.64	0.76
2107	1.22	N	-	-	.85	.8	.8	-	.54	0.66
1348	1.26	E	.75	-	-	.8	.8	-	.48	0.60
2337	1.28	N	-	-	.85	Cant.	.8	-	.68	0.87
1197	1.30	E	-	-	-	.8	.8	-	.64	0.83
305D	1.46	E	-	-	-	.8	.8	-	.64	0.93
6087	1.46	E	-	-	-	.8	.8	-	.64	0.93
2277	1.48	N	.7	.7	.85	.8	.8	-	.27	0.40
2447	1.55	E	-	-	-	.8	.8	-	.64	0.99
5147	1.56	E	-	-	-	.8	.8	-	.64	1.00
4917	1.58	E	-	-	-	.8	.8	0.84	.54	0.84
2018	1.60	N	-	-	.9	.8	.8	-	.58	0.93
2087	1.65	N	.7	.7	.85	.8	.8	-	.29	0.44
3367	1.69	N	-	-	.8	.8	.8	-	.51	0.86
2057	1.72	E	.7	.7	-	.8	.8	-	.29	0.54
2367	1.77	E	-	-	-	.8	.8	0.84	.54	0.95
3257	1.84	E	.7	.7	-	.8	.8	-	.31	0.57
2257	1.88	N	-	-	.85	.8	.8	0.84	.46	0.86
3227	1.90	E	-	-	.97(2)	.8	.8	0.84	.52	0.99
1227	1.95	E	.75	-	-	.8	.8	-	.48	0.94
1267	1.97	E	.75	-	-	.8	.8	-	.48	0.95
5127	1.97	N	-	-	.8	.8	.8	0.84	.43	0.85
313D	2.02	N	.7	.7	.8	.8	.8	-	.25	0.51
5017	2.03	E	-	-	.93(2)	.8	.8	0.84	.50	1.02
3267	2.07	N	-	-	.8	.8	.8	0.84	.43	0.89
2147	2.21	N	.7	.7	.85	.8	.8	-	.29	0.59
5197	2.21	E	-	-	.93(2)	.8	.8	0.84	.50	1.10(1)
5187	2.25	N	-	-	.8	.8	.8	0.84	.43	0.97
3407	2.39	E	-	-	.68(2)	.8	.8	0.84	.37	0.87
5277	2.42	N	-	-	.79(2)	.8	.8	0.84	.42	1.01
3307	2.49	E	-	.7	-	.8	.8	0.84	.38	0.87
1038	2.58	E	-	-	-	.8	.8	0.84	.54	1.39(1)
2371	2.79	N	-	-	.8	.8	.8	0.84	.43	1.19(1)
1237	3.49	N	.7	.7	.85	.8	.8	-	.27	0.93
5157	3.07	N	-	-	.8	.8	.8	0.84	.43	1.32(1)

1. See Table 7.
2. Reduction based on comparison of floor-specific response spectra.
3. This ratio was obtained from the original analysis where fs = calculated stress and Fall = allowable stress (0.9 fy = 36 ksi).

Table 5. Summary of Horizontal Strip Analysis

			REDUCTION FACTORS							
WALL NO.	fs / Fall	SEISMIC ORIENT	ADJUSTMENT TO MATCH ACCEPTANCE CRITERIA DAMP.	SSE	SEISMIC TIME HISTORY	BOUND COND.	MAT PROP.	PLATE ANALYSIS	PRODUCT	REDUCED fs / Fall
4106	0.77	E	-	.7	.6	.7	-	-	.29	0.23
3347	0.86	N	-	-	-	.7	-	-	.7	0.60
1157	0.91	E	-	-	-	.7	-	-	.7	0.64
2427	0.97	E	-	-	-	.7	-	-	.7	0.68
3177	0.98	E	-	-	-	.7	-	-	.7	0.69
3167	1.03	N	-	-	-	.7	-	-	.7	0.72
3187	1.07	N	-	-	-	.7	-	-	.7	0.75
2267	1.10	N	-	-	-	.7	-	-	.7	0.77
2227	1.17	N	-	-	.85	.7	-	-	.6	0.70
2077	1.29	E	-	-	-	.7	-	-	.7	0.90
4647	1.40	E	-	-	-	.7	-	-	.7	0.98
2167	1.91	N	-	-	.85	.7	-	.84	.5	0.97
3417	2.00	N	.75	-	-	.7	-	.84	.44	0.89
3397	2.35	E	.7	.7	-	.7	-	-	.34	0.80
5367	3.16	E	-	-	-	.7	-	.84	.59	1.99 (1)
6107	3.39	E	.7	.7	-	.7	-	.84	.29	0.97

(1) See Table 7

Table 6. Summary of Two-Way Analysis

				REDUCTION FACTORS							
WALL NO.	CRITICAL DIRECTION	fs / Fall	SEISMIC ORIENT.	ADJUSTMENT TO MATCH ACCEPTANCE CRITERIA DAMP.	SSE	SEISMIC TIME HISTORY	BOUND COND.	MAT PROP.	REDUCTION FOR PLATE ANALYSIS	PRODUCT	REDUCED fs / Fall
3277	H	1.04	E	-	-	-	.8	-	-	.8	0.83
3287	H	1.06	E	-	-	-	.8	-	-	.8	0.85
3357	H	1.09	N	-	-	-	.8	-	-	.8	0.87
4046	V	1.16	E	-	-	.6	.8	-	-	.48	0.56
4867	H	1.26	N	-	-	-	.8	-	-	.8	1.01
3036	V	1.39	N	-	-	.8	.8	.8	-	.51	0.71
311D	H	1.54	N	.7	.7	.8	.8	-	-	.45	0.69
3297	H	1.61	E	-	-	.75	.8	-	-	.6	0.97
4796 4886 4896	V	2.21	N	-	-	.8	.8	.8	0.84	.43	0.95
4036	V	2.34	N	-	-	.8	.8	.8	0.84	.43	1.00
304D	H	2.62	E	-	.7	.6	.8	-	-	.34	0.88

Table 7. Summary of Review of Specific Walls by Plate Analytical Techniques

WALL NO.	VERTICAL SPAN		HORIZONTAL SPAN	
	MAX. REBAR STRESS (KSI)	MAX. MASONRY STRESS (KSI)	MAX. REBAR STRESS (KSI)	MAX. MASONRY STRESS (KSI)
1038	0.15	0.01	2.47	0.01
2371	19.87	0.48	20.79	0.16
5157	1.05	0.09	11.62	0.09
5197	16.47	0.40	10.07	0.08
5367	6.63	0.16	38.68	0.36

4. EVALUATION OF THE LICENSEE'S REANALYSIS

Based on the information provided by the Licensee, the following assessments are made:

- Boundary Conditions

  Since the walls are vertically and horizontally reinforced and anchored along the boundaries, it is expected that the connections at the boundary are able to transfer some amount of moments. The calculated moments obtained based on simply supported conditions in the original analysis will result in a conservative estimate. The Licensee also indicated that these supports were checked to verify their structural capacity; therefore, the Licensee's approach is considered adequate and satisfactory.

- Material Properties

  Vertical Rebar: As indicated by the Licensee, the test results of the vertical rebars demonstrated that the steel yield strength is higher than the minimum specification. In a number of other nuclear plants, the test results also showed somewhat similar results. It is judged that the minimum test value used in the reanalysis is reasonble.

  Dur-O-Wall: Stress-strain curves provided in Figures 8 and 9 show that the steel strength has yielding in excess of 60 ksi. It is noted that for reinforced walls meeting the minimum reinforcement requirements of ACI 531-79 codes, the joint reinforcement can be used as a tensile-resisting element. However, the analysis should follow the working stress design method, and stress in joint reinforcement should remain within 30 ksi.

  The major concern associated with joint reinforcement is the lack of applicable test data to determine ductility, bond and anchorage capacity, and strength degradation of joint reinforcement.

  Based on the reanalysis results provided by the Licensee, it was learned that a total of 21 walls were qualified with stress in the Dur-O-Wall higher than 30 ksi.

  Eight walls have stresses that vary between 30 ksi and 40 ksi, 8 walls have stresses that vary between 41 ksi and 50 ksi, and 5 walls have stresses that vary between 51 ksi and 54 ksi. All of these walls have vertical reinforcement (2 #5 at 16 in) and Dur-O-Wall at every course. The walls are either fully or partially grouted. Physical restraints exist all around the walls. The walls are considered to be well constructed and anchored.

  Since the walls are well constructed and anchored and the test results show a steel yield strength in excess of 60 ksi with indication of some ductility, it can be concluded that the use of joint reinforcement as a tensile-resisting element in Davis-Besse Unit 1 reinforced mansonry walls meets the intent of the SGEB criteria and that the concerns associated with joint reinforcement have been resolved.

- Plate Actions

  It is expected that the actual walls (where restraints exist around the wall's boundaries) will experience a two-way action, and therefore, the one-way assumption will result in a conservative estimate. It is therefore reasonable to account for this in the reanalysis.

- Seismic Input

  As discussed in Section 2, the floor response spectra generated from the seismic analysis of the main structures were conservative and therefore the original analysis of the wall also resulted in a conservative estimate. In addition, for a wall frequency lower than the frequency of the peak spectra, the peak spectra were used in the analysis. It is judged that the removal of the conservatism associated with input motion is acceptable.

- Damping Values

  As discussed in Section 2, in the reanalysis, damping values specified in Regulatory Guide 1.61 were used (instead of lower damping values used in the original analysis). Since these values are in accordance with the Regulatory Guide 1.61, they are in compliance with the SGEB criteria.

5. CONCLUSIONS

The Licensee's reanalysis of a total of 74 walls originally qualified by the energy balance technique has been reviewed. Based on the information provided by the Licensee, the following sources of conservatism have been identified and used to reduce the stress levels in the walls:

- o Boundary conditions
- o Material properties
- o Two-way action vs. one-way action
- o Seismic input
- o Damping values.

The working stress method has been used in the reanalysis, and stress results have been significantly reduced. Therefore, the energy balance technique is no longer needed.

Each of the above items has been reviewed and judged to be adequate (as discussed in Section 4).

With regard to the joint reinforcement, as discussed in Section 4, a total of 21 walls were qualified with stress in the Dur-O-Wall in excess of 30 ksi. These walls have vertical reinforcement (2 #5 at 15 in) and Dur-O-Wall at every course. The walls are either fully or partially grouted and well anchored all around the boundary. In addition, test results show that the steel yield strength is in excess of 60 ksi with indication of some ductility. Therefore, it is concluded that the use of joint reinforcement as a tensile-resisting element in Davis-Besse Unit 1 reinforced masonry walls meets the intent of the SGEB criteria and the concerns associated with joint reinforcement have been resolved.

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