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January 28, 1983

NUCLEAR PRODUCTION DEPARTMENT

U. S. Nuclear Regulatory Commission
Office of Nuclear Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
License No. NPF-13
File 0260/0277/L-860.0
Category I Masonry Walls
Reference AECM-82/29
AECM-83/51

Mississippi Power & Light (MP&L) submitted an evaluation of I&E Bulletin 80-11, via letter AECM-82/29, dated January 19, 1982. The Nuclear Regulatory Commission (NRC) Staff provided informal questions on the above evaluation to MP&L in May of 1982. MP&L's responses to those questions were presented to Structural Engineering Branch in a meeting at the office of Bechtel Power, Gaithersburg, Maryland on July 16, 1982. This letter documents MP&L's responses to the NRC informal questions. NRC questions presented in this attachment reference sections in the MP&L evaluation as provided by AECM-82/29.

Yours truly,

L. F. Dale
Manager of Nuclear Services

GMG/JGC/JDR:sap
Attachment

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cc: Mr. N. L. Stampley (w/a)
Mr. R. B. McGehee (w/o)
Mr. T. B. Conner (w/o)
Mr. G. B. Taylor (w/o)

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(cc: continued next page)

MISSISSIPPI POWER & LIGHT COMPANY

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1. Reference: "Report on the Re-Evaluation of CMU Walls" Section 5.0, "Results of Evaluation" states that all walls, with safety related equipment attached or in proximity, were designed to resist SSE loading.

Concern:

1.a. Were the walls also designed for OBE using load combination equations contained in the SEB criteria?

Response:

The walls were designed to meet Category I requirements. All load combinations in our design criteria, including OBE, SSE and tornado depressurization were addressed.

Concern:

1.b. Since all the other walls were designed for UBC earthquake loadings, how were the SEB load combination equations incorporated in the design?

Response:

Other walls with no safety-related equipment attached or in proximity are not subject to the provisions of IE Bulletin 80-11 and are therefore not required to meet NRC SEB load combinations.

2. Reference: Appendix B - Criteria for the Re-Evaluation of Concrete Masonry Walls.

Concern:

2.a. Paragraph 6.1.2. - Describe in more details how inertia load on the wall and modes of vibration other than the fundamental mode due to its acceleration have been considered.

Response:

As noted in Paragraph 6.1.2 (Modes of Vibration) in Appendix B of the reference report, the effects of modes of vibration higher than the fundamental mode were considered. Two alternative approaches were used. In some cases a modal analysis was performed. Alternatively, the fundamental mode frequency is determined, and the corresponding acceleration is increased by 20% (determined by engineering judgement) to account for the effects of higher modes. The resulting bending moments average approximately 15% greater than those determined by the "BLOCK WALLS" Program multi-modal analysis (See Table I).

Concern:

2.b. Paragraph 6.1.4 - Consideration of average acceleration for a wall between two floors is not in accordance with the requirements of "SEB Interim Criteria for Safety-Related masonry Wall Evaluation," July 1981, paragraph 4(d). The acceptable method of analysis is described in the SRP, Section 3.7.3.II.2.i.

Justify this apparent deviation from the Regulatory staff position and demonstrate that the conservatism of the method used in the analysis of masonry walls at Grand Gulf is comparable to that which would have been obtained if the walls between two floors were analyzed using the method stated in the SRP.

Response:

During the July 16, 1982 meeting with the NRC, MP&L provided a generic methodology justifying the use of average accelerations in the seismic analysis of CMU walls between two floors (methodology provided as Attachment I). In addition, at the request of the NRC, MP&L committed to provide additional information to support this justification. In order to demonstrate the level of conservatism in the Grand Gulf CMU wall analysis methods, sample walls were selected and re-evaluated with the appropraite enveloping response spectra.

Selection of Sample Walls

A total of 26 representative walls (approximately 9% of all safety-related CMU walls at Grand Gulf) were selected for re-analysis with the enveloping response spectra. Walls were chosen from both the Control and Auxiliary Buildings. For each building, those selected included walls analyzed for horizontal and for

vertical span. For each span direction, walls were chosen to represent those in the uncracked and cracked conditions by existing analysis. Walls in the uncracked state having the grout tension stress nearest the design allowable were chosen and walls in the cracked state having masonry and/or reinforcing steel stresses nearest the design allowables were selected. Where several walls fit this criteria, those included in the sample were located at floor elevations where the enveloping floor response spectra exceeded the average floor response spectra by the greatest amount.

Discussion of Results

Stresses increased for the majority of CMU walls re-evaluated with the enveloping floor response spectra. In no case were design allowable stresses exceeded. Table II summarizes the results of the re-evaluation of representative walls.

Of the walls re-evaluated, some were found to have lower stresses when analyzed with the enveloping response spectra. This occurred when the enveloping response spectrum fell below the average response spectrum for the wall's fundamental frequency, and was due to a conservative graphical technique used in the development of the average response spectra.

Stresses also decreased for some walls which were on the verge of cracking by existing analysis and which cracked when evaluated with the enveloping response spectra. Walls on the verge of cracking have a grout tension stress close to the design allowable. When this stress is exceeded, the wall analysis is performed assuming cracked section properties. Stresses can decrease for a cracked section SSE analysis because the wall is evaluated with more highly damped response spectra (accelerations lower for given frequencies) in the cracked state than in the uncracked state (Ref. "Report on the Re-Evaluation of Concrete Masonry Walls," Appendix B, Section 5.3).

Conclusion

The CMU walls selected for re-evaluation with the enveloping response spectra included those with various design configurations and having stresses nearest design allowables by existing analysis. None of the walls re-evaluated had stresses exceeding design allowables. Based on this re-evaluation, it is concluded that the use of average accelerations in the seismic analysis of CMU walls between two floors (ref. "Report on the Re-Evaluation of Concrete Masonry Walls," Appendix B, Section 6.1.4) is adequate.

Table I: Comparison of Multi-modal and Factored Fundamental Mode Analysis

Wall No.	Governing Load Comb.	Effective Width	Accelerations 1st Mode	2nd Mode	3rd Mode	Multi-Modal Seismic Moment	$1.2 \times a_1$	Factored Fundamental Mode Seismic Moment	% Diff	Remarks
C-133-002	SSE	16"	0.751g	0.364g	0.351g	19.2 in-k	0.901g	22.4 in-k	+16.7%	Vert. Span
C-148-014	SSE	12"	0.750g	0.413g	0.389g	9.8 in-k	0.900g	11.3 in-k	+15.3%	Horiz. Span
C-166-049	SSE	12"	0.720g	0.453.g	0.450g	13.0 in-k	0.864g	14.8 in-k	+13.8%	Vert. Span
C-177-030	SSE	46"	0.787g	0.482g	0.481g	20.5 in-k	0.944g	23.7 in-k	+15.6%	Horiz. Span

TABLE II. COMPARISON OF WALL STRESSES OBTAINED W/AVERAGE RESPONSE SPECTRA TO THOSE OBTAINED W/ENVELOPING RESPONSE SPECTRA (SEE NOTE 1)

Wall No.	Direction	Span	Load Comb.	Grout Tension Stress	Masonry Axial Comp. Stress	Masonry Comp Bending Stress	Masonry Shear Stress	Tensile Steel Stress	Comments
A-119-005	NS	Vert.	SSE	0.300 See Note 2 See Note 2	0.710 0.013 0.013	1.114 0.543 0.575	0.053 0.006 0.006	48.0 17.5 18.6	
A-139-006	EW	Vert.	SSE	0.300 0.300* 0.304*	0.671 0.008 0.008	1.114 0.486 0.499	0.543 0.004 0.004	48.0 11.8 12.1	*See Note 3
A-166-002 (Case 1)	NS	Vert.	SSE	0.300 0.274 0.301*	0.718 0.012 0.012	1.114 0.514 0.564	0.053 0.006 0.006	48.0 16.1 18.2	*See Note 3
A-166-002 (Case 2)	NS	Vert.	SSE	0.300 0.275 0.302*	0.718 0.012 0.012	1.114 0.516 0.566	0.053 0.007 0.008	48.0 16.7 18.3	*See Note 3
A-166-004	NS	Vert.	SSE	0.300 See Note 2 See Note 2	0.714 0.013 0.013	1.114 0.641 0.570	0.053 0.007 0.008	48.0 20.7 12.4	

TABLE II. Continued
(See Note 1)

Wall No.	Direction	Span	Load Comb.	Grout Tension Stress	Masonry Axial Comp. Stress	Masonry Comp Bending Stress	Masonry Shear Stress	Tensile Steel Stress	Comments
A-208-001	EW	Horiz.	SSE	0.300 N/A N/A	0.753 N/A N/A	1.114 0.154 0.180	0.053 0.024 0.028	60.0 25.7 30.0	
A-245-001	EW	Horiz.	SSE	0.300 N/A N/A	0.753 N/A N/A	1.114 0.205 0.213	0.053 0.034 0.035	60.0 34.1 35.3	
A-245-002	NS	Vert.	SSE	0.300 See Note 2 See Note 2	0.706 0.009 0.009	1.114 0.646 1.112	0.053 0.006 0.014	48.0 20.8 24.2	
C-093-006	EW	Horiz.	OBE	0.300 N/A N/A	0.296 N/A N/A	0.446 0.183 0.182	0.0404 0.0179 0.0178	30.0 23.6 23.4	
C-111-012 (Case 4)	EW	Horiz.	OBE	0.300 See Note 2 See Note 2	0.284 N/A N/A	0.446 0.381 0.341	0.0404 0.0049 0.0044	24.0 14.9 13.3	
C-111-015	EW	Horiz.	OBE	0.300 See Note 2 See Note 2	0.291 N/A N/A	0.446 0.441 0.387	0.0404 0.0073 0.0064	24.0 17.2 15.1	

TABLE II. Continued
(See Note 1)

Wall No.	Direc- tion	Span	Load Comb.	Grout Tension Stress	Masonry Axial Comp. Stress	Masonry Comp Bending Stress	Masonry Shear Stress	Tensile Steel Stress	Comments
				0.300	0.722	1.114	0.0525	48.0	
C-111-018	EW	Vert.	SSE	0.285	0.021	0.561	0.0061	20.3	
				0.276	0.021	0.542	0.0059	19.6	
				0.300	0.292	0.446	0.0404	30.0	
C-133-001	NS	Horiz.	OBE	N/A	N/A	0.181	0.0167	23.3	
				N/A	N/A	0.173	0.0160	22.3	
				0.300	0.289	0.446	0.0404	30.0	
C-133-004	EW	Horiz.	OBE	N/A	N/A	0.191	0.0157	24.6	
				N/A	N/A	0.204	0.0168	26.2	
				0.300	0.653	1.114	0.0525	48.0	
C-148-001	NS	Vert.	SSE	See Note 2	0.010	0.723	0.0055	26.0	
				0.290	0.010	0.346	0.0053	12.4	
				0.300	0.292	0.446	0.0404	30.0	
C-148-002	NS	Horiz.	OBE	N/A	N/A	0.211	0.0178	27.2	
				N/A	N/A	0.224	0.0190	28.8	
				0.300	0.655	1.114	0.0525	48.0	
C-148-003	NS	Vert.	SSE	See Note 2	0.011	1.043	0.0057	37.5	
				0.290	0.011	0.347	0.0053	12.5	

TABLE II. Continued
(See Note 1)

Wall No.	Direction	Span	Load Comb.	Grout Tension Stress	Masonry Axial Comp. Stress	Masonry Comp Bending Stress	Masonry Shear Stress	Tensile Steel Stress	Comments
C-148-005	EW	Vert.	SSE	0.300 See Note 2 See Note 2	0.643 0.006 0.006	1.114 0.927 1.028	0.0525 0.0102 0.0113	48.0 33.3 36.9	
C-148-007	EW	Vert.	SSE	0.300 0.287 0.287	0.636 0.009 0.009	1.114 0.495 0.496	0.0525 0.0036 0.0036	48.0 16.7 16.8	
C-148-011	EW	Vert.	SSE	0.300 0.284 0.282	0.679 See Note 4 0.009	1.114 0.491 0.486	0.0525 0.0041 0.0040	48.0 18.9 16.5	
C-166-004	EW	Vert.	SSE	0.300 0.261 0.287	0.720 See Note 4 0.010	1.114 0.311 0.342	0.0525 0.0046 0.0051	48.0 11.2 12.3	
C-166-022	EW	Horiz.	SSE	0.300 N/A N/A	0.745 N/A N/A	1.114 0.339 0.388	0.0525 0.0387 0.0443	60.0 43.8 50.1	
C-166-022	EW	Horiz.	OBE	0.300 N/A N/A	0.298 N/A N/A	0.446 0.196 0.217	0.0404 0.0224 0.0246	30.0 25.3 28.0	

TABLE II. Continued
(See Note 1)

Wall No.	Direction	Span	Load Comb.	Grout Tension Stress	Masonry Axial Comp. Stress	Masonry Comp Bending Stress	Masonry Shear Stress	Tensile Steel Stress	Comments
				0.300	0.711	1.114	0.0525	48.0	
C-166-025	NS	Vert.	SSE	0.254	See Note 4	0.303	0.0043	10.9	
				0.281	0.010	0.336	0.0047	12.1	
				0.300	0.745	1.114	0.0525	48.0	
C-166-047	EW	Vert.	SSE	0.270	See Note 4	0.353	0.007	15.6	
				0.296	0.015	0.387	0.008	17.1	
				0.300	0.705	1.114	0.0525	48.0	
C-166-050	EW	Vert.	SSE	0.293	See Note 4	0.347	0.0048	12.7	
				See Note 2	0.009	0.307	0.0042	11.0	
				0.300	0.687	1.114	0.0525	48.0	
C-177-031	EW	Vert.	SSE	See Note 2	See Note 4	0.605	0.0056	23.3	
				See Note 2	0.010	0.798	0.0073	30.7	
				0.300	0.300	0.446	0.0404	30.0	
C-177-040	EW	Horiz.	OBE	N/A	N/A	0.162	0.0211	27.0	
				N/A	N/A	0.176	0.0229	29.3	

NOTES:

1. Explanation of Wall Number:

   Letter: A - Auxiliary Bldg.
   C - Control Bldg.

   1st 3 digit number: Floor Elevation

   2nd 3 digit number: Unique Wall No.

   Stresses are listed as follows:

   Upper Value: Allowable (KSI)
   Middle Value: w/Avg. Response Spectra (KSI)
   Lower Value: w/Enveloping Response Spectra (KSI)

2. Grout tension stress allowable exceeded, analysis assumes a cracked section.

3. Grout tension stress within tolerance limits, analysis assumes an uncracked section.

4. Stress not calculated.

Concern:

2.c. Indicate whether the seismic motion in the vertical direction is accounted for and, if so, how has it been incorporated in the analysis of masonry walls. Otherwise, demonstrate that neglecting the response in vertical direction does not significantly affect structural integrity of the masonry walls.

Response:

The effects of vertical seismic motion was confirmed as having a negligible effect on wall stresses and was therefore not considered in the individual calculations of CMU wall stresses. (See Table III).

Concern:

2.d. Paragraph 5.2.1 - Compare the reinforcing bar lap splices of 30 bar diameters to the corresponding criteria in the governing Code, ACI-531-79 and demonstrate that this provision satisfies the criteria of the Code.

Response:

As discussed in GGNS FSAR Sections 3.8.4.1.1.1 and 3.8.4.4.5, the design of block walls is in accordance with the NCMA code, which has the same provisions for lap splices as in the NRC SEB interim criteria.

Concern:

2.e. Paragraph 6.2.2 - You stated that plastic theory was used for analysis of two-way bending in the walls. The SEB Interim Criteria for Safety-Related Masonry Wall Evaluation (Appendix D, Attachment I) are based on elastic behavior of material. Modify your position or comply with the NRC criteria or justify this apparent discrepancy.

Response:

This was a typographical error, the theory used was elastic and not plastic.

Table III: Masonry Axial Compressive Stresses Due to Vertical Earthquake

		OBE Loading				SSE Loading			
Elev.	Vert. Span	Accel.	Masonry Axial Comp. Stress	Allowable	% of Allowable	Accel.	Masonry Axial Comp. Stress	Allowable	% of Allowable
111'-0"	10'-0"	0.128g	0.00136 ksi	0.285 ksi	0.48%	0.257g	0.00273 ksi	0.713 ksi	0.38%
133'-0"	13'-6"	0.136g	0.00077 ksi	0.258 ksi	0.30%	0.272g	0.00155 ksi	0.645 ksi	0.24%
177'0"	12'-0"	0.143g	0.00072 ksi	0.272 ksi	0.27%	0.286g	0.00145 ksi	0.680 ksi	0.21%

3. Ref. Appendix C - Commentary on Criteria for the Re-Evaluation of Concrete Masonry Walls.

Concern:

3.a. Paragraph 5.4 - The expression for modulus of rupture is applicable to concrete only. State the corresponding allowable stresses in grout or mortar and explain their relation to the allowable stresses which are defined in the governing Code.

Response:

Cell grout, as specified in the Specification 9645-A-004.2, consists of Type II portland cement, coarse aggregates conforming to ASTM C33 and fine aggregate conforming to ASTM C144. It qualifies as normal weight concrete. The expression for the modulus of rupture for concrete is, therefore, applicable to cell grout.

Concern:

3.b. State if and where tension in grouted cells is allowed in the masonry walls design. Provide a basis for the formula of the allowable tension stresses for cell grout stated in Paragraph 5.1.3. Relate the allowable tension to the provisions of the SEB Criteria, paragraph 3(c) and (d) which states that all tension is to be carried by reinforcement.

Response:

All safety-related masonry walls at Grand Gulf are reinforced. Tension is allowed in the grout only until the tensile stress in the grout exceeds the allowable grout tension stress stated in paragraph 5.1.3 of the Grand Gulf Design Criteria (2.5 $\sqrt{f'c}$ for normal loads; 1.67 x 2.5 $\sqrt{f'c}$ for accident loads). Based on a grout modulus of rupture of 6.0 $\sqrt{f'c}$, the grout tension allowables of 2.5 $\sqrt{f'c}$ (normal loads) and the 1.67 x 2.5 $\sqrt{f'c}$ (accident loads) represent factors of safety of 2.40 and 1.44, respectively.

If the allowable grout tension stress is exceeded, all tension is carried by the reinforcement.

As indicated in the response to Question 3.a, the cell grout is considered to be normal weight concrete, and the assumed modulus of rupture of 6.0 $\sqrt{f'c}$ is conservative.

Concern:

c. Paragraph 6.2 - Provide a basis for the criteria of distribution of concentrated loads as related to thickness of the wall and distance between the concentrated loads.

Response:

For CMU walls constructed in running bond, the use of an effective beam width of six times the wall thickness for concentrated loads is specified in NCMA-1970, Section 3.10.10.3 as well as in UBC-1979, Section 2418(f) (also in ACI 531-79, Section 9.4.6.1). All CMU walls at Grand Gulf are constructed in running bond.

For each wall, a design width encompassing the worst loading conditions was selected for analysis. Attachment loads on the order of 100 pounds and greater were treated as concentrated loads. Resulting bending moments were determined using beam theory and an effective width of not greater than six times the wall thickness. Other attachment loads (on the order of 100 pounds and less) were converted to equivalent uniform loads per unit width and distributed across the span of the CMU wall beam model.

Concern:

3.d. Paragraph 6.2 - Provide some results of the interstory drift analysis and explain how they were incorporated in the analysis of the masonry walls and justify your statement in the Report, paragraph 5, that the interstory drift resulted in very low stresses and has no effect on the analysis of the walls.

Response:

From Section 5.0 of MP&L's evaluation (AECM-82/29):

> Interstory drift effects were considered in the analysis. The differential seismic deflections and the related masonry wall strains were found to result in very small stresses, and, therefore, have no adverse effect on wall integrity.

In-plane strains due to interstory drift have been calculated, and the results summarized in Table IV. The in-plane strain criteria for interstory drift effects is intended to insure that cracking detrimental to the out of plane strength of the walls will not occur. This type of cracking is controlled by diagonal tensile stresses. The point at which cracking is initiated is measured by the modulas of rupture of the block, which is approximately 300 psi for the Grand Gulf masonry units. The maximum principal in-plane tensile stresses, produced by interstory drift, is 81 psi. This maximum value is less than one third of that required to initiate cracking. Thus it is determined that interstory drift will not adversely effect wall integrity.

Table IV: Strains Due to Interstory Drift

Allowable $\Delta/H = 0.0008$

Floor Elev.	N-S SSE		E-W SSE	
	Δ/H	% of Allow.	Δ/H	% of Allow.
111'-0"	0.00009	11.3%	0.00015	18.8%
133'-0"	0.00011	13.8%	0.00015	18.8%
150'-0"	0.00008	10.0%	0.00013	16.3%
166'-0"	0.00009	11.3%	0.00013	16.3%
189'-0"	0.00010	12.5%	0.00012	15.0%

4. Reference Appendix D- Comparison of the Grand Gulf CMU Wall Design Criteria with Revision 1 of NRC's "SEB Interim Criteria for Safety Related Masonry Wall Evaluation," (July 1981).

Concern:

4.a. In General Requirements you stated that design and allowable stresses of masonry walls are governed by the National Concrete Masonry Association and ACI-531-79 codes. The use of these codes is acceptable to the staff. The position of the staff is, however, that if the provisions of these codes are less conservative than the requirements of the Uniform Building Code (UBC) - 1979 and of the "SEB Interim Criteria" their use should be justified on a case-by-case basis. Clarify if the compliance with this position is observed in the design, testing, construction and inspection of masonry walls at the Grand Gulf plant.

Response:

The design, testing and construction of masonry walls are governed by the requirements of NCMA-70. Inspection of CMU walls is subject to the provisions of Specification 9645-A-004.2, "Technical Specification for Furnishing, Delivery and Erection of Concrete Masonry Units."

The load combinations and the design allowable stresses used are those specified in the SEB Interim Criteria, Rev. 1, Section 3. Supplemental allowable stresses are given in the Grand Gulf Design Criteria. Allowable stress increase factors used for accident/abnormal loads are those specified in the SEB Interim Criteria.

As indicated in the response to Question 4.b, masonry wall construction at Grand Gulf meets the requirements of the SEB interim criteria. The inspection and testing criteria used for wall construction are outlined in the response to Question 4.d.

Concern:

4.b. In paragraph 3(b) you made a statement that the construction of CMU walls for Grand Gulf Units 1 & 2 "generally" complies with the requirements of ACI-531-79 and the SEB Interim Criteria. This statement implies that there are areas of deviation from the Interim Criteria which you did not specify. You are requested to identify these deviations and provide a justification for review by the staff.

Response:

As stated in Appendix D of MP&L's evaluation (AECM-82/29), Paragraph 3(b) reads as follows:

> The analysis of concrete masonry walls at Grand Gulf uses the ACI 531-79 allowable stresses associated with special inspection during construction. Based on QA/QC records and the requirements of Specification 9645-A-004.2 (Appendix E), the construction of CMU walls for Grand Gulf Units 1 and 2 generally complies with the requirements of ACI 531-79 and the SEB Interim Criteria.

The referenced paragraph requires some clarification. ACI 531-79 was applied in the Grand Gulf design for allowable stresses only. The SEB Interim Criteria specify that construction comply with the requirements of UBC-79.

Based on a comparison of UBC-79 with NCMA-70 and the Grand Gulf construction requirements, the masonry wall construction at Grand Gulf meets the requirements of the SEB Interim Criteria. The following comparison includes applicable construction requirements.

Item 1

UBC-79

General Construction Requirements

Sec. 2416.(a) Cold Weather Construction. No masonry shall be laid when the temperature of the outside air is below 40°F, unless approved methods are used during construction to prevent damage to the masonry. Such methods shall include protection of the masonry for a period of at least 48 hours where masonry cement or Type I portland cement is used in the mortar and grout and for a period of at least 24 hours where Type III portland cement is used. Materials to be used and materials to be built upon shall be free from ice or snow.

NCMA-70

4.7 Cold Weather Requirements

When the air temperature is below 40°F, masonry shall not be erected unless means approved by the architect or engineer are provided to precondition the masonry materials and protect the completed work.

4.1. Preparation of Materials

4.1.1 Concrete masonry units shall be protected against wetting prior to use. Such units and precast concrete lintels, sills, and coping units shall be free from soil, ice, and frost when laid in the wall.

Grand Gulf Construction Requirements

Masonry shall be erected only when the temperature can be maintained above 40°F during installation and for 48 hours after installation. Therefore, Grand Gulf meets the above General Construction Requirements of UBC-79.

Item 2

UBC-79

General Construction Requirements
Section 2416

(e) Minimum Bar Spacing. The minimum clear distance between parallel bars, except in columns, shall not be less than the diameter of the bar except that lapped splices may be wired together. The center-to-center spacing of bars within a column shall be not less than two and one-half times the bar diameter.

NCMA-70

4.3.3.1 Minimum Bar Spacing - The minimum clear distance between parallel bars except in columns shall be equal to the nominal diameter of the bar.

Grand Gulf Construction Requirements

Masonry columns are not used in the Grand Gulf design. However, Grand Gulf does incorporate the above requirements of NCMA-70 regarding minimum bar spacing. Therefore, Grand Gulf meets the applicable portions of the above UBC-79 requirements.

Item 3

UBC-79

General Construction Requirements
Section 2416

(g) Protection for Reinforcement. All bars shall be completely embedded in mortar or grout. Joint reinforcement embedded in horizontal mortar joints shall have not less than 5/8-inch mortar coverage from the exposed face. All other reinforcement shall have a minimum coverage of one bar diameter over all bars, but not less than 3/4 inch except where exposed to weather or soil in which cases the minimum coverage shall be 2 inches.

NCMA-70

4.3.3.3 Protection for Reinforcement - All bars shall be completely embedded in mortar or grout. All reinforcement shall have a coverage of masonry not less than the following:

3 inch for bottom of footings
2 inch on vertical members where masonry is exposed to action of weather or soil for bars larger than 5/8 inch and 1½ inches for bars 5/8 inch or less.
1½ inch for all reinforcement in columns.
1½ inch on the bottom and sides of beams or girders.
3/4 inch from the faces of all walls not exposed to action of weather or soil.
1-bar diameter over all bars, but not less than 3/4 inch at the upper faces on any member, except where exposed to weather or soil in which cases the minimum coverage shall be 2 inches or 3 inches respectively.

Reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have not less than 5/8 inch mortar coverage at exposed face of wall.

Grand Gulf Construction Requirements

In that Grand Gulf incorporates NCMA-70 requirements, the above requirements of UBC-79 are met.

Item 3

UBC-79

General Construction Requirements
Section 2416

(g) Protection for Reinforcement. All bars shall be completely embedded in mortar or grout. Joint reinforcement embedded in horizontal mortar joints shall have not less than 5/8-inch mortar coverage from the exposed face. All other reinforcement shall have a minimum coverage of one bar diameter over all bars, but not less than 3/4 inch except where exposed to weather or soil in which cases the minimum coverage shall be 2 inches.

NCMA-70

4.3.3.3 Protection for Reinforcement - All bars shall be completely embedded in mortar or grout. All reinforcement shall have a coverage of masonry not less than the following:

3 inch for bottom of footings
2 inch on vertical members where masonry is exposed to action of weather or soil for bars larger than 5/8 inch and 1½ inches for bars 5/8 inch or less.
1½ inch for all reinforcement in columns.
1½ inch on the bottom and sides of beams or girders.
3/4 inch from the faces of all walls not exposed to action of weather or soil.
1-bar diameter over all bars, but not less than 3/4 inch at the upper faces on any member, except where exposed to weather or soil in which cases the minimum coverage shall be 2 inches or 3 inches respectively.

Reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have not less than 5/8 inch mortar coverage at exposed face of wall.

Grand Gulf Construction Requirements

In that Grand Gulf incorporates NCMA-70 requirements, the above requirements of UBC-79 are met.

Item 4

UBC-79

Reinforced Grouted Masonry
Section 2414

(b) Construction. The thickness of grout or mortar between masonry units and reinforcement shall be not less than 1/4 inch, except that 1/4-inch bars may be laid in horizontal mortar joints at least ½ inch thick and steel wire reinforcement may be laid in horizontal mortar joints at least twice the thickness of the wire diameter.

NCMA-70

Section 4.3.3.3

The thickness of grout or mortar between masonry units and reinforcement shall be not less than ¼ inch except that ¼ inch bars may be laid in ½ inch horizontal mortar joints, and No. 6 gage or smaller wires may be laid in 3/8 inch horizontal joints. Vertical joints containing both horizontal and vertical reinforcement shall be not less than ½ inch larger than the sum of the diameters of the horizontal and vertical reinforcement contained therein.

Grand Gulf Construction Requirements

Horizontal joint reinforcement for walls at Grand Gulf is Ladur type manufactured by Dur-O-Wal - fabricated from 3/16" dia. longitudinal rods.

For the joint reinforcement used at Grand Gulf, the requirements of UBC-79, section 2414(b) are met, as the thickness of the mortar joint specified on the design drawings is 3/8".

Item 5

UBC-79

Section 2415

(b) Low-lift Grouted Construction. Units may be laid to a height not to exceed 8 feet. If the height exceeds 4 feet, cleanouts must be used.

Grand Gulf Construction Requirements

Walls at Grand Gulf were constructed in lifts six courses high (4') with grout pumped into masonry cells. Cleanouts were not required.

The low-lift grouted construction requirements of UBC-79 have been met.

Concern:

4.c. Paragraph 4(d) - You stated that the seismic analysis of concrete masonry walls for Grand Gulf conforms to the commitments in the FSAR, Section 3.7. Although FSAR has been reviewed and approved by the staff it is supplemented by the positions of the Regulatory staff, generated during the review process.

Indicate if the conformance of the seismic analysis of the safety-related masonry walls is extended also to the NRC positions generated during the review of the Grand Gulf plant, and, if not, justify the lack of such a conformance.

Response:

The seismic analysis of the safety-related masonry walls is consistent with the current Grand Gulf licensing basis.

Concern:

4.d. Paragraph 4(j) - The statement that QA/QC information is available upon request is not satisfactory. In accordance with the requirements of the SEB Interim Criteria (Appendix D, Attachment I of your report) the key information of QA/QC for the walls, if available, should be provided with the report for review by the staff.

Response:

Inspection of CMU walls was subject to the requirements of Specification 9645-A-004.2, "Furnish, Delivery and Erection of Concrete Masonry Units." Representative samples of the QA/QC information presently available are shown in Attachment 2 and include:

1) CMU wall inspection checklists assuring subcontractor compliance with Specification 9645-A-004.2.

2) Certificates of compliance for concrete masonry units

3) Material test reports on cement used in masonry mortar mixes

4) Certificates of compliance for sand/aggregate used in masonry mortar mixes

5) Certificates of compliance for horizontal joint reinforcement

6) Material test reports of samples taken from mortar and grout mixes used in CMU wall construction.

Reinforcing bars and non-shrink grout were supplied by Bechtel and were taken from Q-material stock piles on site.

5. Reference - Appendix J

Concern:

5.a. Provide the necessary information to justify and review the geometry of the transformed sections (cracked and uncracked) used in the analysis such as the missing dimensions on the sketches and explain their origin. Also provide explanation of the calculation of the effective areas used for axial and shear and shear alone.

Response:

Clarification of dimensions and explanation of the calculation of effective axial and shear areas are presented in Figure I.

Justification for use of Branson's ec ation for equivalent moment of inertia is presented below.

The applicability of Branson's equation in masonry wall analysis is substantiated by comparing deflections calculated using the effective moment of inertia generated by this equation with actual test results. The tests used for comparison are those reported by J. C. Scrivener in the paper entitled "Face Load Tests on Reinforced Hollow-Brick Non-Load-Bearing Walls" (published in New Zealand Engineering, July 15, 1969). These tests were chosen because they provided the material properties required to employ Branson's equation.

Figure II shows the typical masonry unit used for testing. The section of wall for which the effective moment of inertia was calculated is shown in Figure III. The assumed uncracked and cracked sections used in the analysis are shown in Figures IV and V, respectively.

Deflections were calculated for two different loadings and were compared with Scrivener's test data in Table V.

This comparison demonstrates the ability of Branson's equation to conservatively predict deflections in masonry walls.

Concern:

5.b. Provide representative examples of the results of the critical masonry walls analysis in terms of the actual stresses and the allowable stresses for different loading conditions.

Response:

See Tables VI-A through VI-E for sample wall stress results. The walls selected represent those having the highest masonry and/or reinforcement stresses for various design spans and loading conditions. Additional results for other highly stressed walls are given in Table II.

Concern:

5.c. It has been noticed that the yield stress of reinforcing bars listed in the paragraph 4 of the Appendix B (Design Criteria for Concrete Masonry Walls in Category I Structures) is 60,000 psi while the value used in the computer program analysis is 40,000 psi. Explain this apparent discrepancy.

Response:

The computer program analysis in Appendix J is used only as an example to help explain the block walls program. The input values do not reflect those used in the Grand Gulf masonry wall analysis.

Table VI-A

Wall #C-111-012(4)

Governing Load Combination: OBE

Stress	Actual	Allowable	% of Allowable
Masonry Axial Compressive	-	0.284 ksi	-
Masonry Comp Bending	0.381 ksi	0.446 ksi	85.4%
Tensile Steel	14.9 ksi	24.0 ksi	62.1%
Masonry Shear	0.0049 ksi	0.0404 ksi	12.1%

Remarks: Horizontal Span Considered

Table VI-B

Wall #C-148-005

Governing Load Combination: SSE

Stress	Actual	Allowable	% of Allowable
Masonry Axial Compressive	0.0058 ksi	0.643 ksi	0.9%
Masonry Comp Bending	0.927 ksi	1.114 ksi	83.2%
Tensile Steel	33.3 ksi	48.0 ksi	69.4%
Masonry Shear	0.0102 ksi	0.0525 ksi	19.4%

Remarks: Vertical Span Considered

Table VI-C

Wall #C-166-002

Governing Load Combination: OBE

Stress	Actual	Allowable	% of Allowable
Masonry Axial Compressive	NA	0.298 ksi	-
Masonry Comp Bending	0.161 ksi	0.446 ksi	36.1%
Tensile Steel	20.7 ksi	30.0 ksi	69.0%
Masonry Shear	0.0212 ksi	0.0404 ksi	52.5%

Remarks: Horizontal Span Considered

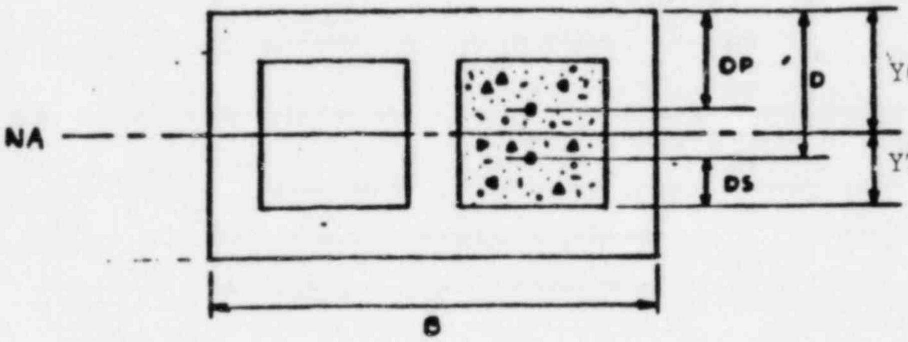
Table VI-D

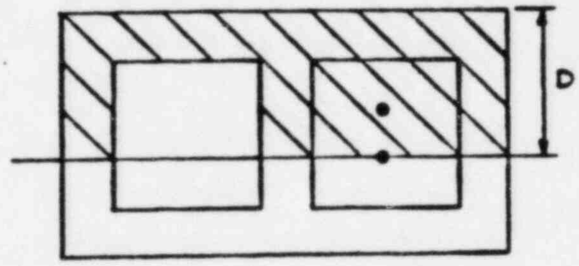
Wall #C-177-040

Governing Load Combination: OBE

Stress	Actual	Allowable	% of Allowable
Masonry Axial Compressive	NA	0.300 ksi	-
Masonry Comp Bending	0.162 ksi	0.446 ksi	36.3%
Tensile Steel	27.0 ksi	30.0 ksi	90.0%
Masonry Shear	0.0211 ksi	0.0404 ksi	52.2%

Remarks: Horizontal Span Considered



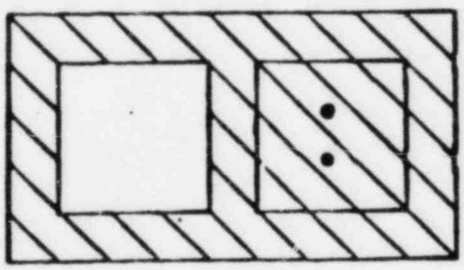


Shear Area

Shear Area

= (Shaded Masonry Area)

+ (Shaded Grout Area) x (Modular Ratio)



Axial Compressive Area

Axial Compressive Area

= (Net Masonry Area)

+ (Grout Area) x (Modular Ratio)

Fig. I Masonry Shear and Axial Compressive Areas

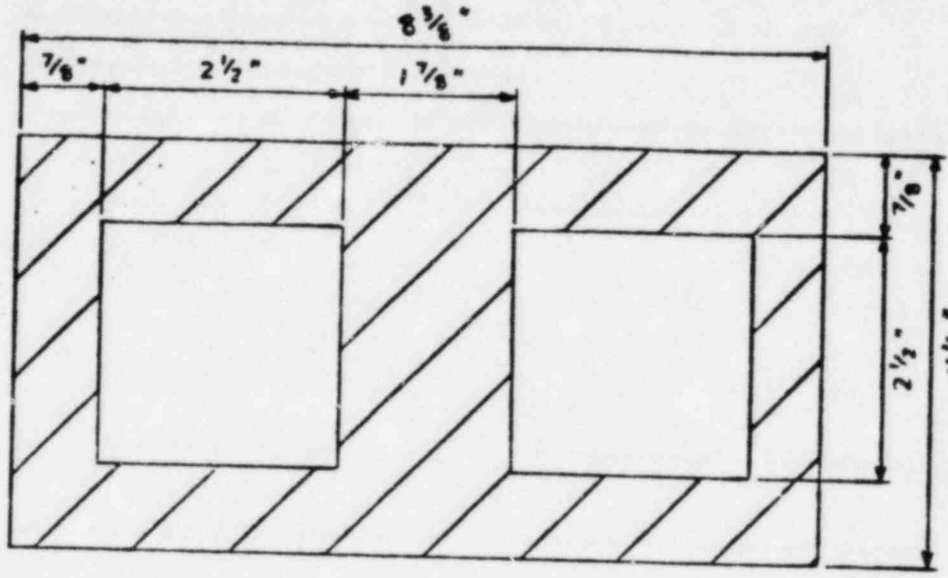


Fig. II Typical Masonry Unit

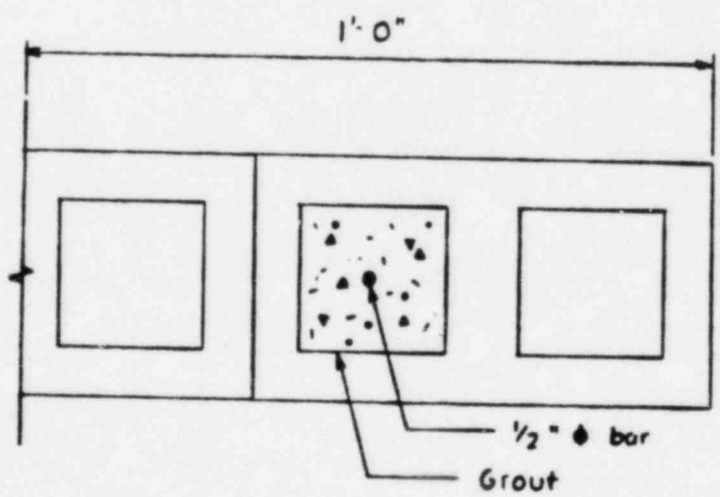
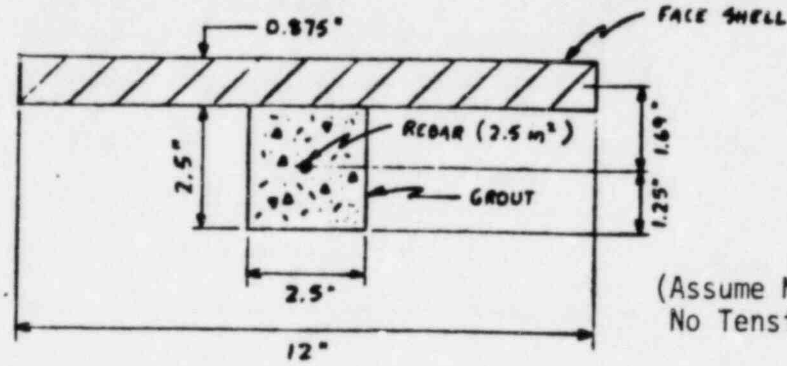


Fig.-III Typical Wall Section



(Assume Mortar Takes
No Tension)

Figure IV Uncracked Section

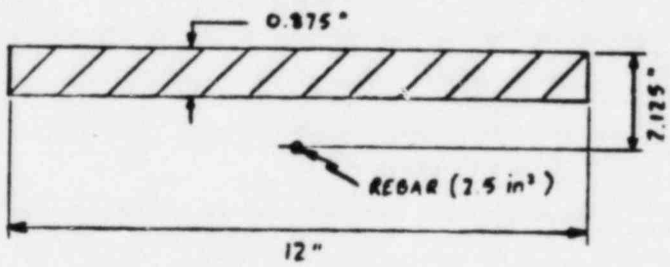


Figure V Cracked Section

Table V Comparison of Calculated Deflections With Test Results

Load	Calc	Test
130 psf	1.31 in	1.25 in
120 psf	1.21 in	1.05 in

JUSTIFICATION OF USING APPROXIMATION METHOD TO DETERMINE MAXIMUM WALL PANEL RESPONSES TO SEISMIC MOTION

The evaluations herein demonstrate that: (1) The use of the average floor acceleration response spectra to calculate the response of the wall panel is appropriate, and (2) The use of uniform inertia load with magnitude equal to the average spectral acceleration for the fundamental mode, in calculating the maximum seismic responses is a good approximation, even considering the higher mode effect.

For the purposes of this evaluation, the seismic response of a simply-supported, uniform beam simulating a strip of the wall panel with unit width is considered, as shown in Figure 1.

(1) Use of Average Spectra

The equation of motion of an undamped, simply-supported beam can be written in terms of the total displacement with respect to some fixed reference axis as:

$$m \frac{\partial^2 u}{\partial t^2} + EI \frac{\partial^4 u}{\partial x^4} = 0 \qquad (1)$$

Where m and EI are the mass density and flexural rigidity of the beam. Denote the seismic excitations at the ends of the

the beam as U_a and U_b. Then the total displacement u(x,t) can be expressed in terms of the two seismic motions and the relative displacement to the seismic motions as:

$$u(x,t) = (x/L)\ U_b + (1 - x/L)\ U_a + r(x,t) \tag{2}$$

Where L is the length of the beam. The relation expressed by the above equation is shown in Figure 2. The relative displacement r(x,t) needs to satisfy the following simply-supported conditions:

$$r(o,t) = r(L,t) = 0 \tag{3}$$

$$\left.\frac{\partial^2 r}{\partial x^2}\right|_{x=o} = \left.\frac{\partial^2 r}{\partial x^2}\right|_{x=L} = 0 \tag{4}$$

Substitute Equation 2 into Equation 1, the equation of motion in terms of relative displacement r(x,t) can be expressed as:

$$m\frac{\partial^2 r}{\partial t^2} + EI\frac{\partial^4 r}{\partial x^4} = - m(x/L)\ \ddot{U}_b - m(1 - x/L)\ddot{U}_a \tag{5}$$

The eigen-function solutions for the homogeneous equation associated with Equation 5 that satisfy the boundary conditions specified by Equations 3 and 4 are:

$$\sin \frac{n\pi x}{L}, \quad n = 1, 2, 3, \ldots,$$

and the corresponding frequencies of vibration are:

$$\omega_n = n^2 \pi^2 \sqrt{\frac{EI}{mL^4}} \qquad n = 1, 2, 3, \ldots \tag{6}$$

So, the solution of Equation 5 can be expressed as:

$$r(x,t) = \sum_{n=1}^{\infty} a_n(t) \sin \frac{n\pi x}{L} \tag{7}$$

Substitute Equation 7 into Equation 5, and multiply the latter by $\sin \frac{n\pi x}{L}$, and then integrate it with respect to x over the full length of the beam, the equation of motion can be transformed into modal equations of motion as:

$$\ddot{a}_n + \omega^2_n a_n = \Gamma_n\left(\frac{\ddot{U}_a + \ddot{U}_b}{2}\right) \qquad n = 1, 3, 5, \cdots \tag{8a}$$

and

$$\ddot{a}_n + \omega^2_n a_n = \Gamma_n\left(\frac{\ddot{U}_a - \ddot{U}_b}{2}\right) \qquad n = 2, 4, 6, \cdots \tag{8b}$$

where Γ_n = participation factor

$$= \frac{4}{n\pi} \tag{9}$$

If damping in the form of modal damping ratio is included, Equations 8a and 8b becomes:

$$\ddot{a}_n + 2\xi_n\omega_n\dot{a}_n + \omega^2_n a_n = \Gamma_n\left(\frac{\ddot{U}_a + \ddot{U}_b}{2}\right) \quad n = 1,3,5,\ldots \tag{10a}$$

and

$$\ddot{a}_n + 2\xi_n\omega_n\dot{a}_n + \omega^2_n a_n = \Gamma_n\left(\frac{\ddot{U}_a - \ddot{U}_b}{2}\right) \quad n = 2,4,6,\ldots \tag{10b}$$

Where ξ_n is the damping ratio of the n^{th} mode.

Equation 10a means that the odd-number modes which are symmetrical about the mid-span of the beam will be excited by the average of the two seismic excitations; while equation 10b means that the even-number modes which are antisymmetrical about the mid-span of the beam will be excited by half of the difference between the two seismic excitations.

Expressing the maximum modal displacement response in equations 10a and 10b in terms of absolute acceleration response spectra gives:

$$|a_n|_{max} < |\Gamma_n| \left[\frac{S_a(\xi_n, \omega_n)}{2\omega^2_n} + \frac{S_b(\xi_n, \omega_n)}{2\omega^2_n} \right]$$

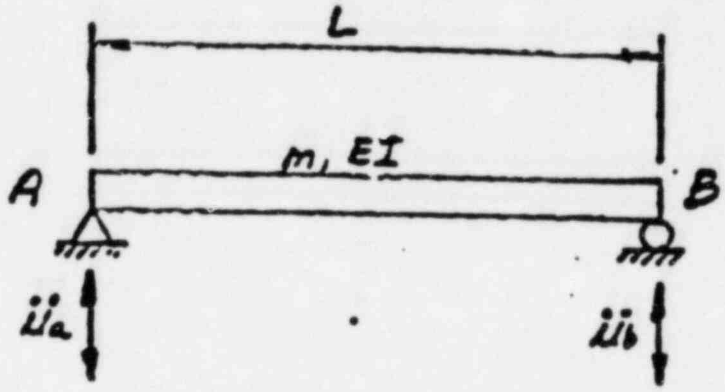
$$< \frac{4mL^4}{n^5 \pi^5 EI} \left[\frac{S_a(\xi_n, \omega_n) + S_b(\xi_n, \omega_n)}{2} \right] \qquad (11)$$

$$n = 1,2,3,...$$

This illustrates that the use of the average of two floor acceleration response spectra to calculate the modal response of a wall panel is appropriate.

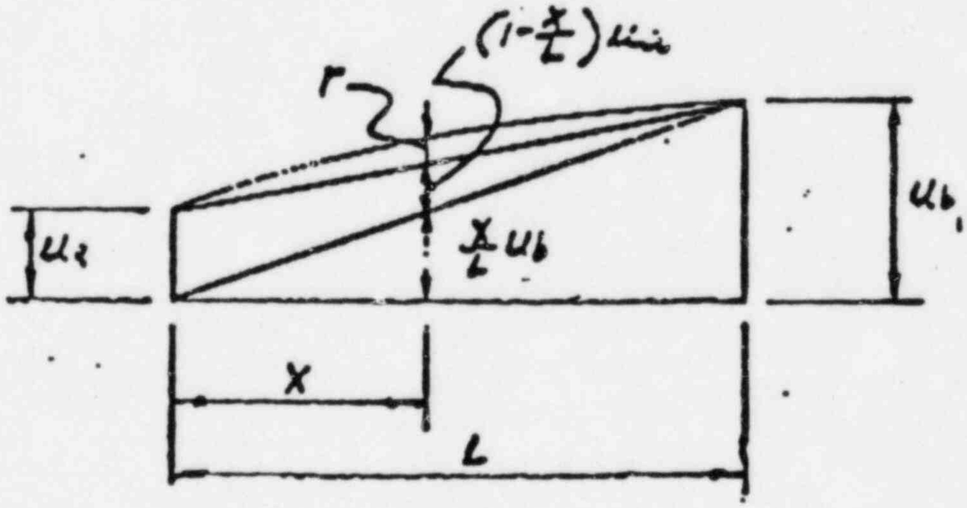
rC-5

T 03652



IDEALIZED SIMPLY-SUPPORTED UNIFORM BEAM

FIGURE NO. 1



RELATION BETWEEN SEISMIC EXCITATION
AND RELATIVE DISPLACEMENT

FIGURE NO. 2

Attachment 2

C.M.U. WALL

INSPECTION CHECKLIST

BUILDING	ELEVATION	AREA	ROOM NUMBER	WALL
Control	166'	25A	HVAC Chase on E/wall	All

ITEM	DESCRIPTION	INSPECTED (INITIAL & DATE)			
8.1.1	Preparation	[illegible]			
8.1.2	Layout	[illegible]			
8.2 MASONRY CONSTRUCTION					
8.2.1	Undamaged	[illegible]	[illegible]	7/3/80	
8.2.2	Dry	[illegible]	[illegible]	7/3	
8.2.3	Temperature	[illegible]	[illegible]	7/3	
8.2.4	Mortar Mixing				
8.2.5	Anchors& Bond Beams	[illegible]	[illegible]	7/3	
8.2.6	Erection	[illegible]	[illegible]	7/3	
8.2.7	Erection	[illegible]	[illegible]	7/3	
8.2.8	Racking back	X	[illegible]		
8.2.9	Highlift Grouting	X			
8.3 REINFORCING					
8.3.1	Rebar condition	[illegible]	[illegible]	7/3/80	
8.3.2	Dowel placement	[illegible]	[illegible]	7/3	
8.3.3	Rebar placement	[illegible]	[illegible]	7/3	
8.3.4	Bolts, Anchors, Sleeves,etc.	[illegible]	[illegible]	7/3	
6.9.1&8.3.5	Wire & placement	[illegible]	[illegible]	7/3	
8.4 GROUT					
8.4.3	Placement	[illegible]	[illegible]	7/3/80	
8.4.4	Hollow wall placement	[illegible]	[illegible]	7/3	
8.4.6	Rebar Inspection	[illegible]	[illegible]	7/3	

Attachment 2

C.M.U. WALL

INSPECTION CHECKLIST

ITEM	DESCRIPTION	INSPECTED (INITIAL & DATE)			
8.5 WELDING					
8.5.1	Channel slots	[illegible]	[illegible]	[illegible]	
8.6 EXPANSION BOLTS					
8.6.1	Installation	[illegible]	[illegible]	[illegible]	
9.0 POINTING AND CLEANING					
9.1	In progress	[illegible] 6/16/80	[illegible] 6/26/80	[illegible] 7/3/80	
9.2	Completion		[illegible]	[illegible] 7/3	
9.3	Stains	[illegible] 6/16/80	[illegible] 6/26	[illegible] 7/3	
9.4	Clean - up	[illegible] 6/16/80	[illegible] 6/26	[illegible] 7/3	
11.2 INSPECTION					
11.2.a	Specified block	[illegible] 6/16/80	[illegible] 6/26	[illegible] 7/3	
11.2.b	Rebar & grout materials	[illegible] 6/16/80	[illegible] 6/26	[illegible] 7/3	
11.2.c	Rebar & grout placement	[illegible] 6/16/80	[illegible] 6/26	[illegible] 7/3	
11.2.d	Cleanliness	[illegible] 6/16/80	[illegible] 6/26	[illegible] 7/3	

Attachment 2

Central Testing & Control, Inc.

2266 Mou_x Road · P.O. Box 20334
Jackson, Mississippi 39209 · Phone 601/922-5565

Materials & Soil Testing · Asphalt & Concrete Designs · Foundation Investigations · Engineering Reports & Recommendations

V. C. Johnson, Jr., President

Howard W. Stringfellow, P.E., Vice-Pres.

Job No.: 477-039

May 23, 1977

H. P. GIBSON COMPANY, INC.
Route 5, Box 108-A
Jackson, Mississippi 39212

Re: MISSISSIPPI POWER AND LIGHT CO.
GRAND GULF NUCLEAR STATIONS
Units 1 and 2
Grand Gulf, Mississippi

Gentlemen:

This is to certify that hollow, load bearing, lightweight concrete masonry units manufactured by Jackson Stone Company and furnished to the above referenced project are in conformance with project specification No. 9645-A-004.2, section 6.1.1.

Yours very truly,

CENTRAL TESTING & CONTROL, INC.

Victor C. Johnson, Jr.

Victor C. Johnson, Jr.

VCJ,JR:sp

Attachment 2

JACKSON STONE COMPANY
INCORPORATED

JACKSON, MISSISSIPPI 39216

M. P. Gibson Co.
P. O. Box 208-A
Jackson, MS 39212

Re: Mississippi Power and Light
Grande Gulf Nuclear Stations
Units 1 and 2
Grande Gulf, Mississippi
Contract 9645-A-004.2

Gentlemen:

This letter is to certify that lightweight hollow loadbearing concrete masonry units furnished on the above job conforms with ASTM C-90 specifications including linear shrinkage of not more than .065 percent when tested according to ASTM C-423.

Very truly yours,

JACKSON STONE COMPANY

Don Gill

Don Gill

DLG/ds

Best Copy Available

Paragraph reads: "This letter is to certify that lightweight hollow loadbearing concrete masonry units furnished on the above job conforms with ASTM C-90 specifications including linear shrinkage of not more than .065 percent when tested according to ASTM C-423."

Attachment 2

Central Testing & Control, Inc. 2266 Moo... Road · P.O. Box 20334
Jackson, Mississippi 39209 · Phone 601/922-5565

Materials & Soil Testing · Asphalt & Concrete Designs · Foundation Investigations · Engineering Reports & Recommendations

V. C. Johnson, Jr., President May 23, 1977 Howard W. Stringfellow, P.E., Vice-Pres.

Job No.: 477-039

May 23, 1977

M. P. GIBSON COMPANY, INC.
Route 5, Box 108-A
Jackson, Mississippi 39212

Re: MISSISSIPPI POWER AND LIGHT CO.
GRAND GULF NUCLEAR STATIONS
Units 1 and 2
Grand Gulf, Mississippi

Gentlemen:

This is to certify that normal weight, 100 percent solid, shielding concrete masonry units manufactured by Jackson Stone Company and furnished to the above referenced project are in conformance with project specification No. 9645-A-004.2, section 6.1.2.

Yours very truly,

CENTRAL TESTING & CONTROL, INC.

Victor C. Johnson, Jr.

Victor C. Johnson, Jr.

VCJ,JR.:sp

Attachment 2

... TEXAS

Bechtel Power Corporation
P.O. Box 41
Port Gibson, Miss. 39150

SPECIFICATION
PORTLAND CEMENT
TYPE II
A.S.T.M. C150-72 ....
FEDERAL SS-C-192 g.....
AASHO M 85-72 I ....

Reported to:

SAMPLE NUMBER	S.M.43.6-00-319M	CEMENT TEMPERATURE	100
CAR/TRUCK NUMBER	CE-		
CWT. BAGS	480		
DATE OF SHIPMENT	10-27-77		

CHEMICAL REQUIREMENTS	SPECIFICATIONS ASTM	FED	AASHO	TEST RESULTS		
SILICA OXIDE MINIMUM %	21.0	21.0	21.0	21.8		
ALUMINA MAXIMUM %	6.0	6.0	6.0	5.5		
IRON OXIDE MAXIMUM %	6.0	6.0	6.0	4.8		
MAGNESIA MAXIMUM %	5.0	5.0	5.0	1.0		
SO_3 C_3A LESS THAN 8% MAXIMUM %	3.0	3.0	3.0	2.8		
LOSS ON IGNITION MAXIMUM %	3.0	3.0	3.0	.4		
INSOLUBLE RESIDUE MAXIMUM %	.75	.75		.14		
TRICALCIUM SILICATE MAXIMUM %			55			
TRICALCIUM ALUMINATE MAXIMUM %	8.0	8.0	8.0	6.5		

PHYSICAL REQUIREMENTS		SPECIFICATIONS ASTM	FED	AASHO	TEST RESULTS	
SPECIFIC SURFACE WAGNER AVG. VALUE MINIMUM		1600		1600	2000	
SPECIFIC SURFACE BLAINE AVG. VALUE MINIMUM		2800	2800	2800	3230	
GILMORE SET	MINUTES MINIMUM	60	60	60	2:40	
	HOURS MAXIMUM	10	10	10	4:30	
VICAT SET	MINUTES MINIMUM	45		45	1:40	
	HOURS MAXIMUM	8			3:30	
AIR CONTENT, VOL. % MAX.		12.0	12.0	12.0	8.5	
AUTOCLAVE EXP. MAX. %		.80	.80	.50	.028	
COMPRESSIVE STRENGTH—P.S.I.						
3 DAY MIN.		1000	1000	1000	2170	
7 DAY MIN.		1800	1600	1800	2970	
28 DAY MIN.			3500			

OPTIONAL CHEMICAL REQUIREMENTS	SPECIFICATIONS ASTM	FED	AASHO	TEST RESULTS		
SUM OF C_3S & C_3A MAX %	58	58	58	44.7		
TOTAL ALKALIES MAX. % Na_2O EQUIVALENT	.60	.60	.60	.43		

OPTIONAL PHYSICAL REQUIREMENTS	SPECIFICATIONS ASTM	FED	AASHO	TEST RESULTS	
FALSE SET — FINAL PENETRATION MIN. %	50	50	50	69	
COMPRESSIVE STRENGTH—P.S.I.					
28 DAY MIN.	3500		3500		
3 DAY MIN.	800	800	800		
7 DAY MIN.	1440	1440	1440		
28 DAY MIN.	2800	2800	2800		
HEAT OF HYDRATION					
7 DAY MAX. CAL./G	70	70	70		
28 DAY MAX. CAL./G	80	80	80		

STATE OF Texas
COUNTY OF Ellis } ss

J. S. Radney, being duly sworn deposes and says: that he is Chief Chemist of Texas Industries, Inc., Cement Division, who prepared the above tests and that the same is true and correct.

Subscribed and sworn to before me this 5 day of December, 1977

NOTARY PUBLIC

J S Radney

Tm 7/74 ...

Attachment 2

JACKSON STONE COMPANY
INCORPORATED
ARCHITECTURAL PRECAST CONCRETE • CAST STONE • LIGHTWEIGHT MASONRY UNITS
ARCHITECTURAL PRECAST CONCRETE • BLOCK • 601-366-8441 • P. O. BOX 5308 • ENGINEERING • ACCOUNTING • CAST STONE• 601 355 647
JACKSON, MISSISSIPPI 39216

May 11, 1977

M. P. Gibson Co.
Rt. 5, Box 108-A
Jackson, MS 39212

Re: Mississippi Power and Light
Grande Gulf Nuclear Stations
Units 1 and 2
Grande Gulf, Mississippi
Contract 9645-A-004.2

Gentlemen:

This letter is to inform you that masonry sand supplied on the above job meets ASTM C-144-70 specifications pursuant to your submittals to Bechtel Power Corp. of January 17, 1977.

Very truly yours,

JACKSON STONE COMPANY

Dan Gill

Dan Gill

DLG/ds

Attachment 2

Central Testing & Control, Inc.
2266 Maddox Road · P.O. Box 20334
Jackson, Mississippi 39209 · Phone 601/922-5565

Materials & Soil Testing · Asphalt & Concrete Designs · Foundation Investigations · Engineering Reports & Recommendations

V. C. Johnson, Jr., President
Howard W. Stringfellow, P.E., Vice-Pres.

24 January 1978

Job No.: 477-039

M. P. GIBSON COMPANY, INC.
Route 5, Box 108-A
Jackson, Mississippi 39212

Re: MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATIONS
Units 1 and 2
Grand Gulf, Mississippi

Gentlemen:

This is to certify that aggregate for masonry mortar supplied by Jackson Stone Company and furnished to the above referenced project is in conformance with ASTM C 144-70 specifications.

Yours very truly,

CENTRAL TESTING & CONTROL, INC.

Victor C. Johnson, Jr.

Victor C. Johnson, Jr.

VCJ,JR.:slp

Attachment 2

H-06

JACKSON STONE COMPANY
INCORPORATED

ARCHITECTURAL PRECAST CONCRETE • CAST STONE • LIGHTWEIGHT MASONRY UNITS

SALES • ARCHITECTURAL PRECAST CONCRETE • BLOCK • 601-366-8441 • P. O. BOX 5398 • ENGINEERING • ACCOUNTING •
JACKSON, MISSISSIPPI 39216

RECEIVED
FIELD SUBCONTRACTS
JOB NO. 9645

APR 4 1977

1 April 1977

M. P. Gibson Co.
Rt. 5, Box 108-A
Jackson, MS 39212

Re: Mississippi Power and Light
Grande Gulf Nuclear Stations
Units 1 and 2
Grande Gulf, Mississippi
Contract 9645-A-004.2

Gentlemen:

This letter is to certify that horizontal masonry reinforcing as manufactured by AA Wire Products of Chicago, Illinois, conforms to ASTM A-82 as specified on the above job.

Very truly yours,

JACKSON STONE COMPANY

Dan L. Gill

Dan L. Gill

DLG/ds

	F.Y.I.	Action
F. C. MGR.		
Ast. F.C. Mgr.		
SER. COORD.		
PROJ. SUPT.		
PROJ. F. E.		
F & ACCT.		
F. C. A.		
Q. CONT.		
Q. ASSUR.		
CE/P & S		
Procurement		
MPWR. DEV.		

MEMBER
Mo-Sai
INSTITUTE, INC.

45 Years

11,336

Attachment 2

H-001.2 - File 10

WIRE PRODUCTS COMPANY
Manufacturing Plants:
CHICAGO • DALLAS • TORONTO

6100 SOUTH NEW ENGLAND AVE. / CHICAGO, ILL. 60638 / PHONE (312) 586-6700 / CABLE "AAWFCO"

CERTIFICATE OF COMPLIANCE

Date MAY 31, 1979

This is to certify that AA WIRE PRODUCTS COMPANY, CHICAGO, ILLINOIS
(Name of Manufacturer)

does have a record of satisfactory performance in the manufacture of
TXHDG BLOK-TRUS, CORNERS & PARTITIONS MASONRY WALL REINFORCEMENT
(3/16 X 3/16 GA.)

over a period of not less than 2 years and which will be supplied by
JACKSON STONE COMPANY, JACKSON, MISSISSIPPI

for use in GRAND GULF NUCLEAR POWER STATION, PORT GIBSON, MISSISSIPPI
(Title of Contract)
M. P. GIBSON CO. - CONTR.

To further certify that the above mentioned product does comply with all the requirements of the following applicable specifications.

Applicable Specifications

ASTM A82

ASTM A116, CLASS 1

Signature [signature]

Signer's Title PRESIDENT

Subscribed and sworn to before me this 31ST day of MAY, 19 79.

Notary Public [signature]

SEAL

MASONRY WALL REINFORCEMENTS & TIES

BLOK-LOK® | ECONO-LOK® | CAVITY-LOK® | ECONO-CAVITY-LOK® | PARTITION-LOK® | CORNER-LOK® | FLEX-O-LOK® | Z-BARS | RECTANGULAR TIES | TITEWALL®

Attachment 2
Best Copy Available

PITTSBURGH TESTING LABORATORY

Order Number: PC-17032
Client's Number: 9645
Method of Test: C 109-71

Reported to: Bechtel Power Corp.
Project: Grand Gulf Nuclear Site
Project Spec: 9645-C 191.0

GROUT CUBE COMPRESSION TEST REPORT

Date of Report: MAR 18 1977
Report Number: MPG-3?? 1

Concrete Placement Number: N/A

Concrete Placement Location: Control Bldg. Elev. 1?? (Grout) (Masonry)

Date Cast: 2-16-77 Grout Class: Gibson PSI Requirement @ 28 days: 2500

Air Content: N/A %
Concrete Temperature: N/A °

Nominal Area = 4.0 square inches

Sample Number	Date Tested	Age	Total Load	Compressive Strength PSI	Length/Width in	Actual Area	Area Used
SET 1	2-23-77	7	12,050	3010	2.02 x 1.99	4.01	4.00
"	"	7	12,150	3040	1.98 x 2.01	3.97	4.00
"	"	7	13,150	3290	1.99 x 2.00	3.98	4.00
SET 2	3-16-77	28	25,850	6460	1.98 x 2.02	4.00	4.00
"	"	28	25,700	6430	1.98 x 2.02	4.00	4.00
"	"	28	27,550	6890	1.97 x 2.02	3.98	4.00

If the actual area of the specimen is greater than 4.06 sq in or less than 3.94 sq in use the actual area for calculating the unit load.

[X] Test specimen results comply with specified mix design strength.

[ ] Test specimen results do not comply with specified mix design strength requirement and [ ] does [ ] does not comply with criteria as outlined in ACI 318, para 4.3.3.

Test machine used: PTL # 27 Tested by: Brent Level: I

Form C-109b

RECORD COPY

Royle Roberts
(Review Level II ANSI N45.2.6)

Attachment 2

Best Copy Available

PITTSBURGH TESTING LABORATORY

Established 1881

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Order Number: N O 4479

Client's Number: N/A

Method of Test: C 109-71

Reported to: M P Gibson Masonary

Project: Grand Gulf Nuclear Site

Project Spec: A 004.2

GROUT CUBE COMPRESSION TEST REPORT

Date of Report: APR 8 1977

Report Number: MPM-4

Concrete Placement Number: N/a

Concrete Placement Location: Control Bldg. Elev. 148

Date Cast: 3-9-77 Grout Class: Mortar PSI Requirement @ 28 days: 25

Concrete Temperature: 60

Air Content: N/a %

Nominal Area = 4.0 square inches

Sample Number	Date Tested	Age	Total Load	Compressive Strenght PSI	Length/ Width In	Actual Area	Area Use
SET #1	3-16-77	7	7250	1810	2.02x2.00	4.04	4.00
"	"	7	7350	1840	2.01x2.02	4.06	4.00
"	"	7	7350	1840	2.01x2.01	4.04	4.0
SET #2	4-6-77	28	12,200	3050	2.00 x 2.00	4.00	4.
"	"	28	12,500	3130	2.00 x 2.00	4.00	4.
"	"	28	12,300	3230	2.00 x 2.00	4.00	4.

If the actual area of the specimen is greater than 4.06 sq in or less than 3.94 sq in use the actual area for calculating the unit load.

[X] Test specimen results comply with specified mix design strength.

[ ] Test specimen results do not comply with specified mix design strength requirem

and [ ] does [ ] does not comply with criteria as outlined in ACI 318, para 4.3

Test machine used: PTL # 27 Tested by: Sturgill Level: 1

Angelo Cocluto

(Review Level II ANSI N45.2.6)