FirstEnergy

CALCULATION

NOP-CC-3002-01 Rev. 03

CALCULATION NO.	INITIATING DOCUMENT	[ ] VENDOR CALC SUMMARY
C-CSS-099.20-055	ECP-10-0458	VENDOR CALCULATION NO.

☐ BV1	☐ BV2	☒ DB	☐ PY

Title/Subject:
II/I Evaluation for Architectural Flute Shoulder

Category	☐ Active	☐ Historical	☒ Study
Classification	☐ Tier 1 Calculation	☒ Safety-Related/Augmented Quality	☐ Nonsafety-Related
Open Assumptions?	☐ Yes ☒ No	If Yes, Enter Tracking Number	
System Number	N/A		
Functional Location	N/A		
Commitments:	None		
(Perry & Davis-Besse Only)	Calculation Type: N/A	Referenced In Atlas? ☐ Yes ☒ No	
(Perry Only)	Referenced In USAR Validation Database ☐ Yes ☐ No		

Computer Program(s)

Program Name	Version / Revision	Category	Status	Description
MathCAD	15.0	C	Active	Analysis and Documentation

Revision Record

Rev.	Affected Pages	Originator *(Print, Sign & Date)*	Reviewer/Design Verifier *(Print, Sign & Date)*	Approver *(Print, Sign & Date)*
00	All	Yueh-Hua Tsai (Bechtel) Yueh-Hua Tsai 10/31/2011	Shen Wang (Bechtel) [signature] 10/31/11	Hongchun Liu (Bechtel) [signature] 10/31/11
	Description of Change: Initial Issue			Initiating Document: ECP-10-0458
	Describe where the calculation will be evaluated for 10CFR50.59 applicability. ~~See Note 1 on Page ii~~ NA FOR STUDY CALC [initials] 10/31/11			
Rev.	Affected Pages	Originator *(Print, Sign & Date)*	Reviewer/Design Verifier *(Print, Sign & Date)*	Approver *(Print, Sign & Date)*
	Description of Change:			Initiating Document:
	Describe where the calculation will be evaluated for 10CFR50.59 applicability.			
Rev.	Affected Pages	Originator *(Print, Sign & Date)*	Reviewer/Design Verifier *(Print, Sign & Date)*	Approver *(Print, Sign & Date)*
	Description of Change:			Initiating Document:
	Describe where the calculation will be evaluated for 10CFR50.59 applicability.			
Rev.	Affected Pages	Originator *(Print, Sign & Date)*	Reviewer/Design Verifier *(Print, Sign & Date)*	Approver *(Print, Sign & Date)*
	Description of Change:			Initiating Document:
	Describe where the calculation will be evaluated for 10CFR50.59 applicability.			

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CALCULATION

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CALCULATION NO. C-CSS-099.20-055	[ ] VENDOR CALC SUMMARY VENDOR CALCULATION NO.

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NOTES:

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CALCULATION NO. **C-CSS-099.20-055**		**[ ] VENDOR CALC SUMMARY** **VENDOR CALCULATION NO.**

OBJECTIVE OR PURPOSE:

The purpose of this calculation is to demonstrate that during a seismic event, with the development of the crack in the architectural flute shoulder, the capacity of rebar(s) can still provide adequate anchorage thus prevent cracked concrete piece from falling, and therefore Seismic II/I condition can be maintained.

SCOPE OF CALCULATION/REVISION:

During the seismic event, a crack is assumed to be developed to the point of tendency for the architectural flute. In order to satisfy the Seismic II/I condition, not to allow the concrete to fall off from the Shield Building, under the Safety Shutdown Earthquake (SSE) load condition, the shear-friction / tensile capacity of the rebar(s) would have to provide the capacity to prevent the collapse of the concrete under the worst case scenario so the function and structural integrity of Seismic Category I structure, system, and component in the vicinity will not be affected.

SUMMARY OF RESULTS/CONCLUSIONS:

This calculation evaluates the potential crack of the concrete for architectural flute shoulder. In this evaluation, conservative scenarios are considered to include the effect of dead load, vertical seismic load and horizontal seismic load for the load combination (D + E'). It was shown that the shear-friction / tensile capacity of the #8 rebar provides required reinforcement for the concrete so that the collapse of the flute shoulder concrete is prevented and II/I condition of SB will be maintained.

LIMITATIONS OR RESTRICTIONS ON CALCULATION APPLICABILITY:

The use of this calculation is limited to Davis-Besse Shield Building for SGRP.

IMPACT ON OUTPUT DOCUMENTS:

Not applicable

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CALCULATION

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CALCULATION NO. C-CSS-099.20-055	[ ] VENDOR CALC SUMMARY VENDOR CALCULATION NO.

DOCUMENT INDEX

DIN No.	Document Number/Title	Revision, Edition, Date	Reference	Input	Output
1	Updated Safety Analysis Report (USAR) for Davis-Besse Nuclear Power Station No. 1	Rev. 28	☒	☐	☐
2	Davis-Besse Nuclear Power Station Unit 1 Design Criteria Manual	Rev. 20	☒	☐	☐
3	NRC Reg. Guide 1.29, Seismic Design Classification	Rev. 3	☒	☐	☐
4	Drawing No. 7749-C-110, Shield Building Roof Plan Wall Section & Details	Rev. 6	☐	☒	☐
5	American Concrete Institute (ACI) 318-05, Building Code Requirements for Structural Concrete and Commentary	August, 2005	☒	☐	☐
6	FENOC Original Calculation NO. VS01/B01-03, Seismic Analysis of the Containment Structure	10/4/1976, Rev. 0	☐	☒	☐
7	FENOC Original Calculation NO. VS21/B01-01, Shield Building Seismic Analysis	6/4/1981, Rev. 1	☐	☒	☐

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List of Figures

1.0 PURPOSE

The purpose of this calculation is to demonstrate that during a seismic event, with the development of the crack in the architectural flute shoulder, the capacity of rebar(s) can still provide adequate anchorage thus prevent cracked concrete piece from falling, and therefore Seismic II/I condition can be maintained.

See the following Seismic II/I definition stated in Ref. 2: "Seismic Category II/I structures, systems and components are defined as those structures, systems and components (or portions thereof) which are not classified as Seismic Category I but whose failure due to a seismic event could affect the function of a Seismic Category I structure, system or component."

2.0 METHODOLOGY

During the seismic event, a crack is assumed to be developed to the point of tendency for the architectural flute. In order to satisfy the Seismic II/I condition, not to allow the concrete to fall off from the Shield Building, under the Safety Shutdown Earthquake (SSE) load condition, the shear-friction / tensile capacity of the rebar(s) would have to provide the capacity to prevent the collapse of the concrete under the worst case scenario so the function and structural integrity of Seismic Category I structure, system, and component in the vicinity will not be affected.

3.0 ASSUMPTIONS

There are no unverified assumptions used in this calculation. Assumptions and engineering judgment used are identified in the body of the calculation with appropriate justification.

4.0 ACCEPTANCE CRITERIA

Due to Seismic Category II/I condition for SB, the calculation is evaluated in accordance with ACI 318-05 (Ref. 5).

5.0 DESIGN INPUTS / REFERENCES (Design inputs are annotated with an asterisk *)

1. Updated Safety Analysis Report (USAR) for Davis-Besse Nuclear Power Station No. 1, Rev. 28
2. Davis-Besse Nuclear Power Station Unit 1 Design Criteria Manual, Rev. 20
3. NRC Reg. Guide 1.29, Seismic Design Classification, Rev. 3
4. * Drawings: 7749-C-110, Rev. 6, "Shield Building Roof Plan Wall Section & Details"
5. American Concrete Institute (ACI) 318-05, Building Code Requirements for Structural Concrete and Commentary
6. * Original Design Calculations: VS01/B01-03, Approval Date 10/4/1976, Rev. 0, "Seismic Analysis of the Containment Structure"
7. * Original Design Calculations: VS21/B01-01, Approval Date 6/4/1981, Rev. 1, "Shield Building Seismic Analysis"

6.0 CALCULATION

6.1 Description of Architectural Flute and Potential Crack

On the cylindrical wall of the Shield Building, there is architectural flute at every 45° as shown in Figure 6.1. A potential crack (red line shown in Figure 6.2) is considered from the point of tangency to the area near the center of flute as shown in Figure 6.2. One set of "L" shape rebar has two legs crossing the potential crack surface. Since the leg near the point of tendency is too close to the potential crack path, the leg is treated only as stability support. Also, since the spacing of #8 rebar in height is 12", only one rebar per foot is considered for the loading from a piece of flute shoulder. Therefore, shear-friction / tensile capacity provided by the leg is calculated.

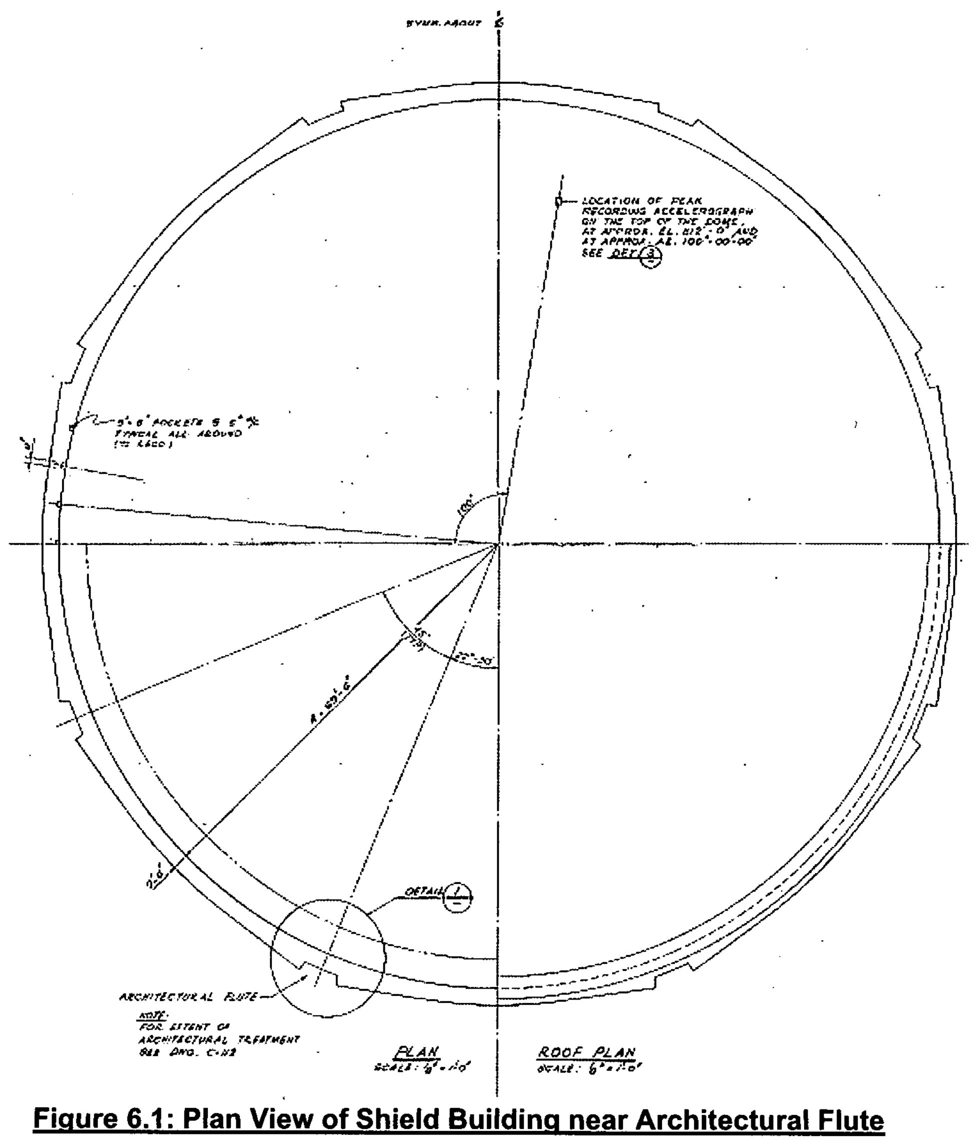

Figure 6.1: Plan View of Shield Building near Architectural Flute

6.2 Loading Calculation

Conservatively, vertical and horizontal seismic responses (Ref. 6) at the top of the cylindrical wall are applied for the seismic loads. Weight of the concrete outside of the potential crack path is considered as the dead load.

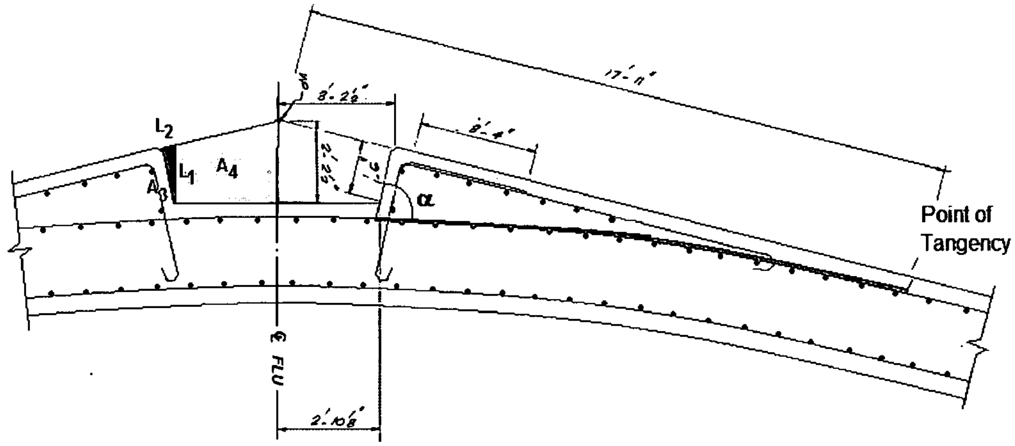

Figure 6.2: Potential Crack Path

Angles between shear plane and rebar legs:

$$\alpha := \operatorname{acos}\left[\frac{(3ft + 2.5in) - (2ft + 10.125in)}{1ft + 6in}\right]\cdot\left(\frac{180}{\pi}\right) = 75.93$$

Lines for small triangular area:

$$L1 := \frac{(1ft + 6in)}{\cos\left[\frac{(90 - \alpha)}{180}\cdot\pi\right]} = 1.55ft$$

$$L2 := (1ft + 6in)\cdot\tan\left[\frac{(90 - \alpha)}{180}\cdot\pi\right] = 0.38ft$$

Small triangular area:

$$A_3 := \frac{(1ft + 6in)\cdot L2}{2} = 0.28ft^2$$

Quadrilateral area:

$$A_4 := \frac{L1 + (2ft + 2.5in)}{2}\cdot(2ft + 10.125in) = 5.34ft^2$$

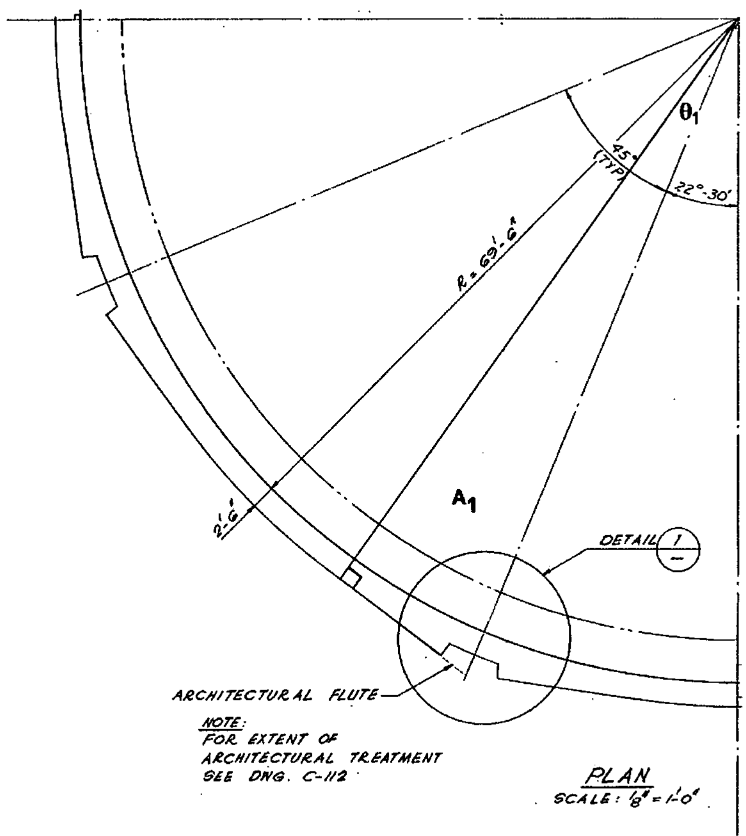

Figure 6.3: Diameter of Shield Building

Angle between point of tangency and the centerline of the flute:

$$\theta_1 := \operatorname{atan}\left[\frac{(17ft + 11in)}{(72ft)}\right]\cdot\frac{180}{\pi} = 13.97$$

Approximated potential crack length:

$$L := \pi\cdot\frac{\theta_1}{180}\cdot(71ft + 9in) - (2ft + 10.125in) = 14.66ft$$

Based on Impulse Response testing, the actual crack length is 10 to 12 feet long.

Entire triangular area based on the angle θ_1:

$$A_1 := \frac{72ft\cdot(17ft + 11in)}{2} = 645ft^2$$

Circular area based on the angle θ_1:

$$A_2 := \frac{\theta_1}{360}\cdot\pi\cdot(71ft + 9in)^2 = 627.78ft^2$$

Total concrete area:

$$A_{conc} := A_1 - A_2 - A_3 - A_4 = 11.6ft^2$$

Total volume of the concrete:	$Vol_{conc} := A_{conc} \cdot 1ft = 11.6 \cdot ft^3$	
Total weight of the concrete:	$W_{conc} := Vol_{conc} \cdot 0.150 \left(\frac{kip}{ft^3}\right) = 1.7402 \cdot kip$	
Rebar yield stress:	$f_y := 60ksi$	
Rebar area:	$A_{vf} := 0.79in^2$	
Vertical seismic acceleration at Elev. 812.77' (g):	$Acc_{vert} := 0.289$	[Ref. 6]
Horizontal seismic acceleration at Elev. 812.77' (g):	$Acc_{horiz} := 0.605$	[Ref. 6]
Vertical seismic force:	$E_{vert} := W_{conc} \cdot Acc_{vert} = 0.5 \cdot kip$	
Horizontal seismic force:	$E_{horiz} := W_{conc} \cdot Acc_{horiz} = 1.05 \cdot kip$	
Reduction factor for shear-friction:	$\phi := 0.75$	
Normal weight concrete:	$\lambda := 1$	
Coefficient of friction:	$\mu := 0.6 \cdot \lambda$	[Conservative]
Dead load:	$D := W_{conc} = 1.74 \cdot kip$	
Modulus of elasticity of reinforcement	$E_s := 29000ksi$	
Moment of Inertia of rebar:	$I_{bar} := \frac{\pi \, (1in)^4}{64} = 2.37 \times 10^{-6} ft^4$	

Estimation for seismic amplification factor:

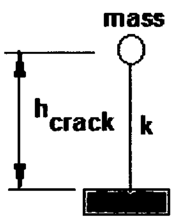

Figure 6.4: Model for Frequency Estimation

Assumed of crack width: $h_1 := 0.01\text{in}$ $< h_{crack} <$ $h_2 := \frac{1}{4}\text{in}$

Lateral stiffness considered from a single rebar:

$$k_1 := \frac{3 \cdot E_s \cdot I_{bar}}{h_2^{\,3}} = 2.73 \times 10^5 \cdot \frac{\text{kip}}{\text{in}} \quad < k < \quad k_2 := \frac{12 \cdot E_s \cdot I_{bar}}{h_1^{\,3}} = 1.71 \times 10^{10} \cdot \frac{\text{kip}}{\text{in}}$$

Frequency:

$$f_1 := \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{k_1}{\frac{W_{conc}}{g}}} = 1239 \cdot \text{Hz} \quad < f < \quad f_2 := \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{k_2}{\frac{W_{conc}}{g}}} = 309840\,\text{Hz}$$

Axial stiffness considered from a single rebar:

$$k_3 := \frac{E_s \cdot A_{vf}}{h_2} = 9.16 \times 10^4 \frac{\text{kip}}{\text{in}} \quad < k < \quad k_4 := \frac{E_s \cdot A_{vf}}{h_1} = 2.29 \times 10^6 \frac{\text{kip}}{\text{in}}$$

Frequency:

$$f_3 := \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{k_3}{\frac{W_{conc}}{g}}} = 718 \cdot \text{Hz} \quad < f < \quad f_4 := \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{k_4}{\frac{W_{conc}}{g}}} = 3588 \cdot \text{Hz}$$

Since the frequency is beyond the cut-off frequency (100Hz from Ref. 7), the amplification due to the SSE load is not required.

Vertical force: $F_{vert} := D + E_{vert} = 2.24 \cdot \text{kip}$

Horizontal force: $F_{horiz} := E_{horiz} = 1.05 \cdot \text{kip}$

6.3 Loading Combination under Different Scenarios

Horizontal seismic force perpendicular or parallel to the potential crack path is evaluated.

- Case 1: Horizontal seismic load normal to the potential crack path of the leg (seismic force out of SB)

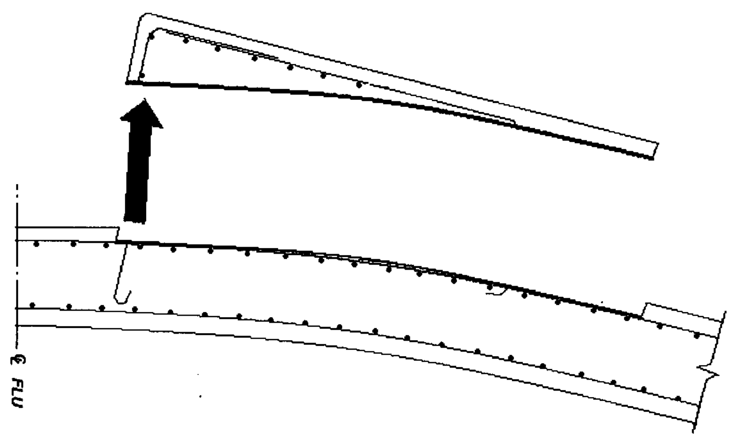

Figure 6.5: Horizontal Seismic Normal to the Crack Path

Net tension across shear plane: $N_{u1} := F_{horiz} = 1.05 \cdot kip$

Direct shear transfer force along shear plane: $V_{vert\_u} := F_{vert} = 2.24 \cdot kip$

$V_{horiz\_u} := 0$

$V_{u1} := \sqrt{V_{horiz\_u}^2 + V_{vert\_u}^2} = 2.24 \cdot kip$

Reinforcement to resist net tension: $A_{n1} := \dfrac{N_{u1}}{\phi \cdot f_y \cdot \sin(\alpha)} = 0.046 \cdot in^2$

Shear-friction reinforcement to resist direct shear transfer. $A_{vf1} := \dfrac{V_{u1}}{\phi \cdot f_y \cdot (\mu \cdot \sin(\alpha) + \cos(\alpha))} = 0.043 in^2$

Total area of required reinforcement: $A_{s1} := A_{vf1} + A_{n1} = 0.089 \cdot in^2$

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- Case 2: Horizontal seismic load parallel to the potential crack path of the leg

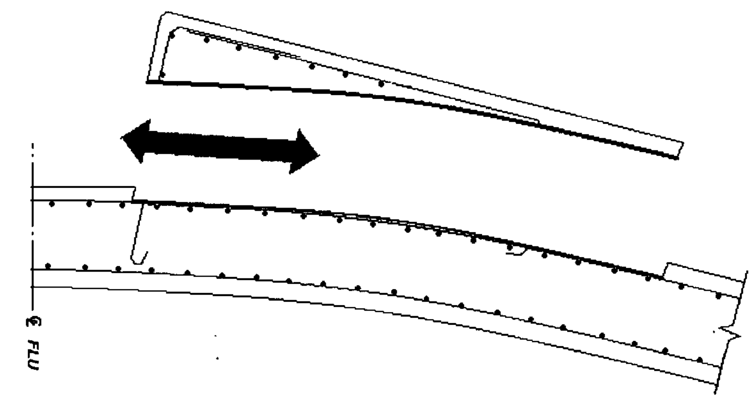

Figure 6.6: Horizontal Seismic Parallel to the Crack Path

Net tension across shear plane: $N_{u2} := 0$

Direct shear transfer force along shear plane: $V_{vert\_u} := F_{vert} = 2.24 \cdot kip$

$V_{horiz\_u} := F_{horiz} = 1.05 \cdot kip$

$V_{u2} := \sqrt{V_{horiz\_u}^2 + V_{vert\_u}^2} = 2.48 \cdot kip$

Reinforcement to resist net tension: $A_{n2} := \frac{N_{u2}}{\phi \cdot f_y \cdot \sin(\alpha)} = 0 \cdot in^2$

Shear-friction reinforcement to resist direct shear transfer. $A_{vf2} := \frac{V_{u2}}{\phi \cdot f_y \cdot (\mu \cdot \sin(\alpha) + \cos(\alpha))} = 0.047 \cdot in^2$

Total area of required reinforcement: $A_{s2} := A_{vf2} + A_{n2} = 0.047 \cdot in^2$

Concrete compressive Strength: $f_c := 4000psi$

Rebar diameter: $d_b := 1in$

For normal weight concrete: $\psi_e := 1$ [Ref. 5, Sect. 12.5]

$\lambda_e := 1$

Required development length: $$L_{dh} := \max\left(8 \cdot d_b, 6in, \frac{0.02 \cdot \psi_e \cdot \lambda_e \cdot \frac{f_y}{1psi} \cdot d_b}{\sqrt{\frac{f_c}{1psi}}}\right) = 1.58ft$$

Judging from the drawing (Ref. 4), the required development length should be satisfactory. However, a reduction factor of 50% is used for provided reinforcement to cover possible inadequate development length.

Total area of required reinforcement: $A_{s\_req} := \max(A_{s1}, A_{s2}) = 0.089 \cdot in^2$

Provided reinforcement: $A_{s\_prov} := (50\%) \cdot 0.79in^2 = 0.4 \cdot in^2$

Factor of safety: $$FOS := \frac{A_{s\_prov}}{A_{s\_req}} = 4.46$$

The provided reinforcement is almost 4.5 times of the required reinforcement under conservative assumptions and scenarios.

7.0 CONCLUSION

This calculation evaluates the potential crack of the concrete for architectural flute shoulder. In this evaluation, conservative scenarios are considered to include the effect of dead load, vertical seismic load and horizontal seismic load for the load combination (D + E'). It was shown that the shear-friction / tensile capacity of the rebar provides required reinforcement for the concrete so that the collapse of the flute shoulder concrete is prevented and II/I condition of SB will be maintained.

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DESIGN VERIFICATION RECORD

NOP-CC-2001-01 Rev. 00

SECTION I: TO BE COMPLETED BY DESIGN ORIGINATOR		
DOCUMENT(S)/ACTIVITY TO BE VERIFIED: II / I Evaluation for Architectural Flute Shoulder, C-CSS-099.20-055 Rev 000		
☒ SAFETY RELATED	☐ AUGMENTED QUALITY	☐ NONSAFETY RELATED
SUPPORTING/REFERENCE DOCUMENTS		
Refer to the body of the calculation.		
DESIGN ORIGINATOR: *(Print and Sign Name)* Yueh-Hua Tsai [signature]		DATE 10/31/2011
SECTION II: TO BE COMPLETED BY VERIFIER		
VERIFICATION METHOD *(Check one)*		
☒ DESIGN REVIEW *(Complete Design Review Checklist or Calculation Review Checklist)*	☐ ALTERNATE CALCULATION	☐ QUALIFICATION TESTING
JUSTIFICATION FOR SUPERVISOR PERFORMING VERIFICATION:		
APPROVAL: *(Print and Sign Name)*		DATE
EXTENT OF VERIFICATION: Verified using Calculation Review Checklist		
COMMENTS, ERRORS OR DEFICIENCIES IDENTIFIED? ☐ YES ☒ NO		
RESOLUTION: *(For Alternate Calculation or Qualification Testing only)*		
RESOLVED BY: *(Print and Sign Name)*		DATE
VERIFIER: *(Print and Sign Name)* Shen Wang [signature]		DATE 10/31/11
APPROVED BY: *(Print and Sign Name)* Hongchun Liu [signature]		DATE 10/31/11

FirstEnergy

CALCULATION REVIEW CHECKLIST

NOP-CC-2001-04 Rev. 05

CALCULATION NO. C-CSS-099.20-055
REV. 0
ADDENDUM NO. N/A
UNIT: Davis-Besse 01

QUESTION	NA	Yes	No	COMMENTS	RESOLUTION
GENERAL 1 Does the stated objective/purpose clearly describe why the calculation is being performed?		☒			
2. Are design input / output documents and references listed and clearly identified in the document index, including edition and addenda, where applicable?		☒			
3. Were verbal inputs from third parties properly documented?	☒				
4. Are design input parameters, such as physical and geometric characteristic and regulatory or code and standard requirements, accurately taken from the design input documents and correctly incorporated, including tolerances and units?		☒			
5. Are the design inputs relevant, current, consistent with design/licensing bases and directly applicable to the purpose of the calculation, including appropriate tolerances and ranges/modes of operation?		☒			
6. Are all design inputs retrievable? If not, have they been added as attachments?		☒			
7. Are preliminary or conceptual inputs clearly identified for later confirmation as open assumptions?	☒				
8. Where applicable, were construction and operating considerations included as input information?		☒			
9. Were design input / output documents properly updated to reference this calculation?		☒			
ASSUMPTIONS 10. Have the assumptions necessary to perform the analysis been clearly identified and adequately described?		☒			
11. Are all assumptions for the calculation reasonable and consistent with design/licensing bases?		☒			
12. Have all open assumptions needing later confirmation been clearly identified on the Calculation cover sheet, including when the open assumption needs to be closed?	☒				
13. Has an SAP Activity Initiation Form been created for open assumptions?	☒				
14. Have engineering judgments been clearly identified?	☒				
15. Are engineering judgments reasonable and adequately documented?	☒				
16. Is suitable justification provided for all assumptions/engineering judgements (except those based upon recognized engineering practice, physical constants or elementary scientific principles)?		☒			
METHOD OF ANALYSIS 17. Is the method used appropriate considering the purpose and type of calculation?		☒			
18. Is the method in accordance with applicable codes, standards, and design/licensing bases?		☒			
IDENTIFICATION OF COMPUTER CODES (Ref: NOP-SS-1001) 19. Have the versions of the computer codes employed in the design analysis been certified for this application?		☒			
20. Are codes properly identified along with source (vendor, organization, etc.)?		☒			

QUESTION	NA	Yes	No	COMMENTS	RESOLUTION
21. Is the code applicable for the analysis being performed?		☒			
22. Is the computer program(s) being used listed on the FENOC Usable Software List for the site?		☒			
23. Does the computer model, that has been created, adequately reflect actual (or to be modified) plant conditions (e.g., dimensional accuracy, type of model/code options used, time steps, etc.)?		☒			
24. Did the computer output generate any ERROR or WARNING Messages that could invalidate the results?	☒				
25. Is the computer output reasonable when compared to inputs and what was expected?		☒			
COMPUTATIONS 26. Are the equations used consistent with recognized engineering practice and design/licensing bases?		☒			
27. Is there a reasonable justification provided for the uses of any equations not in common use?	☒				
28. Were the mathematical operations performed properly and the results accurate?		☒			
29. Have adjustment factors, uncertainties, empirical correlations, etc., used in the analysis been correctly applied?		☒			
30. Is the result presented with proper units and tolerance?		☒			
31. Has proper consideration been given to results that may be overly sensitive to very small changes in input?		☒			
CONCLUSIONS 32. Is the magnitude of the result reasonable and expected when compared to inputs?		☒			
33. Is there a reasonable justification provided for deviations from the acceptance criteria?	☒				
34. Are stated conclusions justifiable based on the calculation results?		☒			
35. Are all pages sequentially numbered and marked with a valid calculation and revision number?		☒			
36. Is all information legible and reproducible?		☒			
37. Is the calculation presentation complete and understandable without any need to refer back to the Originator for clarification or explanations?		☒			
38. Is calculation format presented in a logical and orderly manner, in conformance with the standard calculation content of NOP-CC-3002 (Attachment 1)?		☒			
39. Have all changes in the documentation been initialed (or signed) and dated by the author of the change and all required reviewers?	☒				
DESIGN/LICENSING 40. Have all calculation results stayed within existing design/licensing basis parameters?		☒			
41. If the response to Question 40 is NO, has Licensing been notified as appropriate? (i.e. UFSAR or Tech Spec Change Request has been initiated).	☒				
42. Is the direction of trends reasonable?		☒			

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CALCULATION REVIEW CHECKLIST

NOP-CC-2001-04 Rev. 05

CALCULATION NO. C-CSS-099.20-055
REV. 0
ADDENDUM NO. N/A
UNIT: Davis-Besse 01

QUESTION	NA	Yes	No	COMMENTS	RESOLUTION
43. Has the calculation Preparer used all applicable design information/requirements provided?		☒			
44. Did the calculation Preparer determine if the calculation was referenced in design basis documents and/or databases?		☒			
45. Did the Preparer determine if the calculation was used as a reference in the UFSAR?	☒				
46. If the calculation is used as a reference in the UFSAR, is a change to the UFSAR required or an update to the UFSAR Validation Database, if applicable, required?	☒				
47. If the answer to Question 46 is YES, have the appropriate documents been initiated?	☒				
48. Has the applicability of 10CFR50.59 to this calculation been considered and documented?		☒			
ACCEPTABLE 49. Does the calculation meet its purpose/objective?		☒			
50. Is the calculation acceptable for use?		☒			
51. What checking method was used to review the calculation? Check all that apply.					
• spot check for math					
• complete check for math		☒			
• comparison with tests					
• check by alternate method					
• comparison with previous calculation					
52. If the calculation was prepared by a vendor, does it comply with the technical and quality requirements described in the Procurement Documents? Reference the Purchase Order number or other procurement document number in the Comments Section of this question.	☒				
53. Have Professional Engineer (PE) certification requirements been addressed and documented where required by ASME Code (if applicable).	☒				

Review Summary:

Technical Review *(Print and Sign Name)*	Date	**Owner's Acceptance Review** *(Required for calculations prepared by a vendor)*	
		Reviewer *(Print and Sign Name)* N/A	Date
Design Verification *(Print and Sign Name)* Shen Wang [signature]	Date 10/31/11	Approver *(Print and Sign Name)* N/A	Date

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NOP-CC-2003-18 Rev. 01

OWNER'S ACCEPTANCE REVIEW

DOCUMENT (S)	REV. 0	UNIT 1	VENDOR
Calculation C-CSS-099.20-055			Bechtel

QUESTION	NA	Yes	No	COMMENTS	RESOLUTION
1. Is the purpose or objective of the activity clear, appropriate and well documented?		X			
2. If there is a split in work scope between the Vendor and Owner, has this been fulfilled to ensure the whole scope is completed?	X				
3. Were Owner-supplied inputs for the activity used and documented appropriately?		X			
4. Are the source documents for all inputs documented and are the sources credible as appropriate (including Owner-supplied inputs)?		X			
5. Are assumptions and use of engineering judgment appropriate?		X			
6. Are there any open assumptions, which need later confirmation?		X			
7. If Question 6 is yes, are the open assumptions tracked properly?		X			
8. If Question 6 is yes, have holds (e.g., on field implementation) been adequately imposed and tracked?		X		Mode 6 Holds on CRs 11-03996 & 11-04402	
9. Are appropriate design and licensing bases complied with and documented as such?	X			This analysis is performed to demonstrate operability of the Shield Building	
10. Are computer codes certified as required? Identify if certified to Owner or Vendor's program.		X			
11. Are methodologies, design/acceptance criteria and considerations proper, documented and consistently applied to the activity?		X			
12. Have all pertinent design interfaces been considered and documented?	X				
13. Have all affected documents/programs been properly identified for follow-up action?	X				
14. Are testing requirements specified where appropriate?	X				
15. Have the appropriate procedures been followed for generation of the product?		X			
16. Has the product been properly checked internally by the Vendor?		X			
17. Are the results reasonable compared to the inputs?		X			
18. Has the purpose or objective been met, and is the product acceptable for use?		X			
19. Is the readability/clarity of the document acceptable?		X			
20. Does the product comply with the installed plant configuration (i.e., the product will not create a nonconforming condition)?		X		Ref. CR 11-03346	
21. Has an Owner's Acceptance walkdown been completed as appropriate? If no, provide justification.		X		Owners review of core bores & Impulse Response test information	

FirstEnergy

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OWNER'S ACCEPTANCE REVIEW

DOCUMENT (S) Calculation C-CSS-099.20-055	REV. 0	UNIT 1			VENDOR Bechtel	
QUESTION		NA	Yes	No	COMMENTS	RESOLUTION
22. Does the product comply with the technical and quality requirements described in the procurement documents?			X			

COMPLETED BY: (Print and Sign Name)	DATE	IF CHECKLIST IS REVIEWED BY MORE THAN ONE REVIEWER, SIGN BELOW:	
		ADDITIONAL REVIEWER (Print and Sign Name)	DATE
R. BAIR [signature]	10/31/11	R. BAIR FOR M. ADER PER TELECON [signature]	10/31/11

JON G. Hook [signature] 10/31/11