SeabrookLANPEm Resource

From: Greene, Joshua <Joshua.Greene@nexteraenergy.com>
Sent: Tuesday, June 06, 2017 10:33 AM
To: Poole, Justin
Subject: [External_Sender] FW: site visit topics, part 1
Attachments: June2017_siteVisitTopics_part1_001.ppt

From: Ryan M. Mones [mailto:RMMones@sgh.com]
Sent: Tuesday, June 06, 2017 10:04 AM
To: Carley, Edward; Greene, Joshua
Cc: Brown, Brian
Subject: site visit topics, part 1

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attached

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Subject: [External_Sender] FW: site visit topics, part 1
Sent Date: 6/6/2017 10:32:38 AM
Received Date: 6/6/2017 10:36:55 AM
From: Greene, Joshua

Created By: Joshua.Greene@nexteraenergy.com

Recipients:
"Poole, Justin" <Justin.Poole@nrc.gov>
Tracking Status: None

Post Office: nexteraenergy.com

Files	**Size**	**Date & Time**
MESSAGE	606	6/6/2017 10:36:55 AM
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Options
Priority: Standard
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Talking Points for Audit Questions

June 2017

100-40-40, Question 1

Describe how the dynamic soil pressure load (H_e) was calculated and applied to the structure.

- Dynamic soil pressures are calculated based on SD-66 Section 8.2.
- Dynamic soil pressures are combined consistently with seismic inertial loading using 100-40-40.

NRC noted that "*The magnitudes in the two opposite seismic directions are significantly different in some cases*"…

- Dynamic soil pressures are not symmetrical for north/south direction of loading due to presence of soil and penetrations.
- Responses are local and direction-dependent. Reversing the direction of load does not necessarily invert the response.

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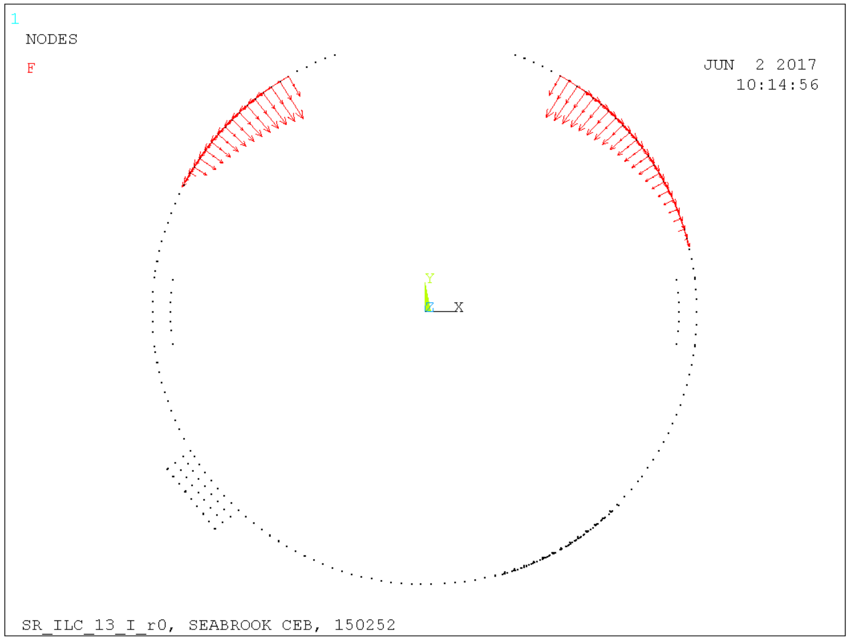
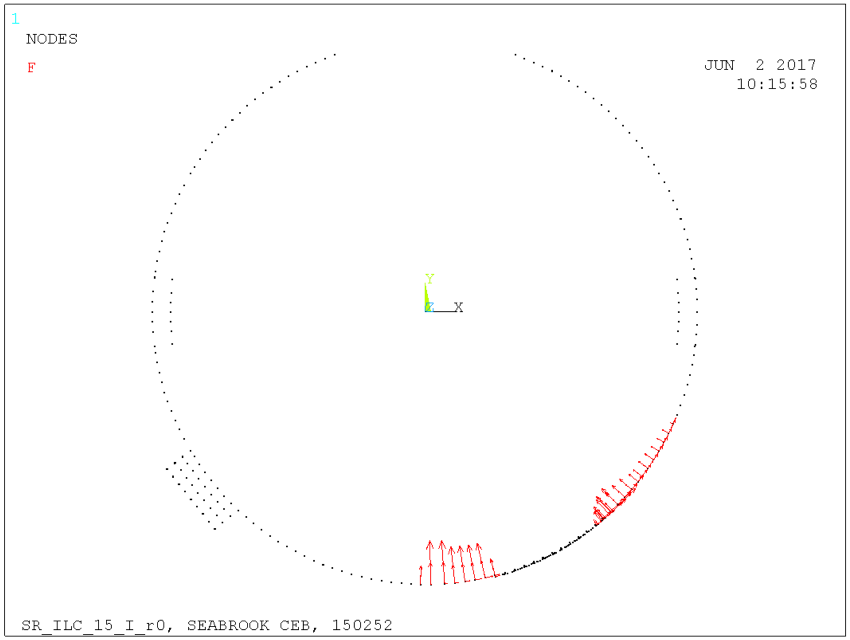
Dynamic Soil Pressures

Pushing South

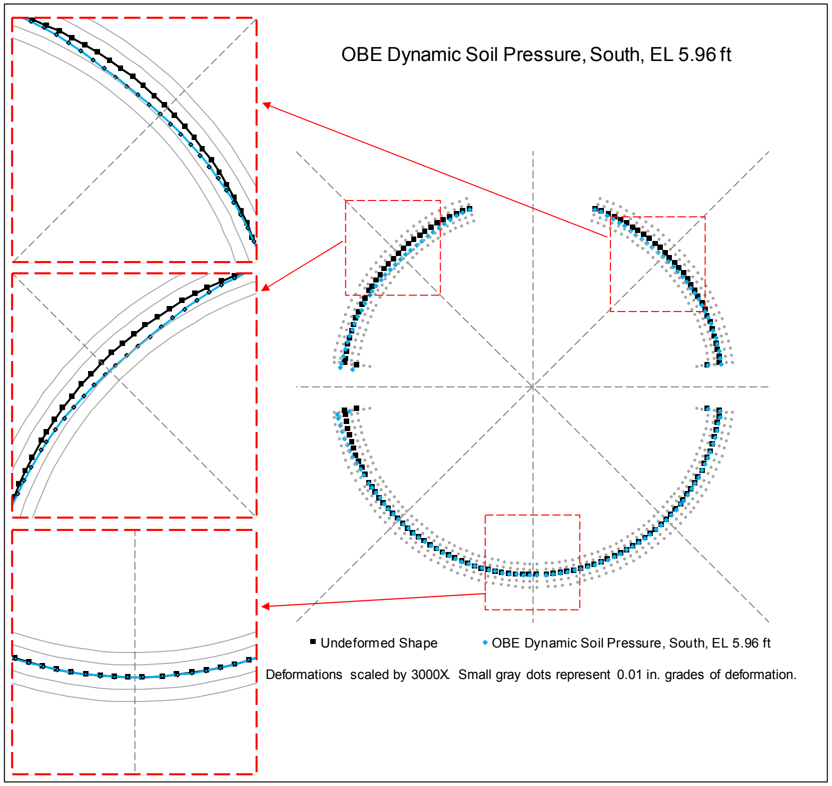


Pushing North

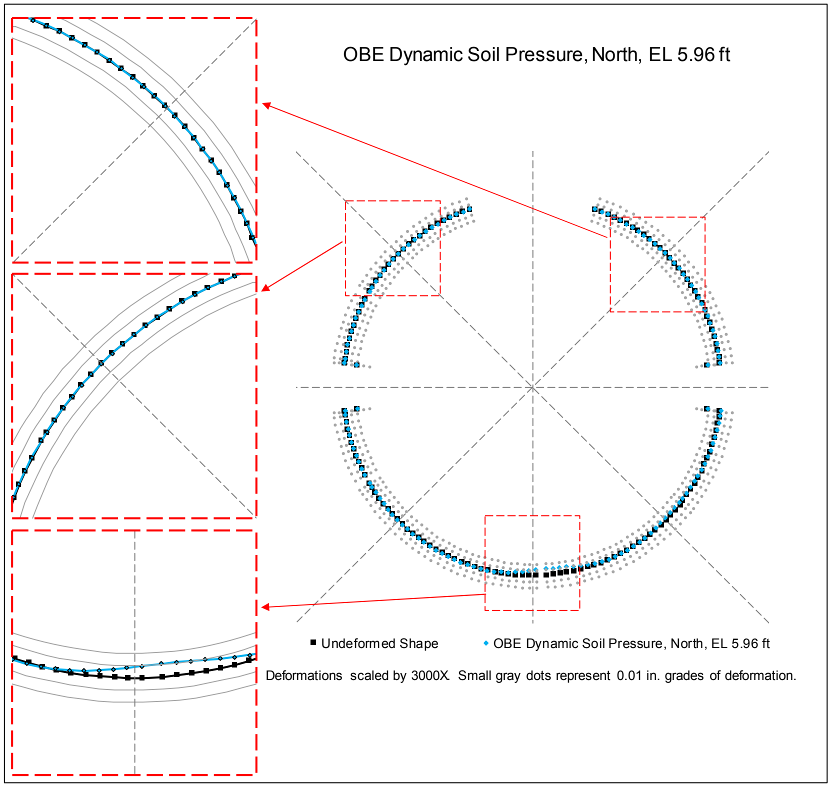


CEB Deformations due to Dynamic Soil Pressures

Pushing South



Pushing North



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100-40-40, Question 2

Provide an example demonstrating how multiple forces (e.g., axial and moment) are combined.

- The CEB evaluation uses the “row” approach for 100-40-40 combination. This approach is supported by ASCE 4-16 (see quoted material).

$$R = \pm[|R_1| + 0.4|R_2| + 0.4|R_2|]$$
$$R = \pm[0.4|R_1| + |R_2| + 0.4|R_2|]$$
$$R = \pm[0.4|R_1| + 0.4|R_2| + |R_2|]$$

- ASCE 4-16 Section C.4.3.3:

“[100-40-40 is performed by] *considering the maximum value of each design parameter together with the values of the other parameters that correspond to the same directional combination.”*

Table from ASCE 4-16

Table C4-1. Application of the SRSS and 100-40-40 Methods

Seismic Load	*P*, kip	*V*, kip	M_{ip}, kip-ft	M_{op}, kip-ft
N-S Earthquake	0	500	10,000	100
E-W Earthquake	0	30	500	500
Vert. Earthquake	400	0	0	0
SRSS	400	501	10,012	510
Factored 1: 100+40+40	160	512	10,200	300
Factored 2: 40+100+40	160	230	4,500	540
Factored 3: 40+40+100	400	212	4,200	240

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<u>ASR Load Factors, Question 1</u>

Explain why the coefficient of variation (COV) for Severity Zone 1 is significantly larger than for the other severity zones.

- The COV is computed as the standard deviation divided by the mean of the distribution. By definition, Severity Zone 1 has a low mean ASR strain. The standard deviation of Severity Zone 1 is not significantly lower than that of other zones. This causes Severity Zone 1 to have a higher COV than the other severity zones.

If* [the Severity Zone 1 COV was] *in line with the other zones (approx. 0.2), how would this affect the calculation of the Severity Zone 1 ASR Load Factor for the static load combination?

- The ASR load factor is controlled by Severity Zone 1 due to its high COV. If Severity Zone 1 had a COV of about 0.2, then the computed load factor for ASR would decrease from 2.0 to about 1.2.

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ASR Load Factors, Question 2

Based on the projected rate of ASR growth in the CEB, how long will it take to use up the margin?

- Since there is limited expansion data available, the length of time for margin to be used is uncertain.
- ASR expansion is a slow process. Threshold monitoring of the CEB is performed every six months. This will give sufficient notice before threshold limits are approached.

What is the next step, once the margin is exhausted?

- If the margin of a structure is exhausted, an AR is generated and a POD is performed.
  - For example, an AR and POD was issued for the CEB and an analysis of measurement techniques for threshold monitoring found that pin-to-pin expansion is more precise than CCI.
- The intent of monitoring is to issue an AR as threshold limits are approached. If needed, analysis can be refined.

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ASR Load Factors, Question 3

The NRC hand calculation suggests lower ASR deformation than indicated by CEB calculation.

- The large penetrations in the CEB causes ASR deformations to be larger than the suggested hand computation. While the effects of the penetrations reduce as you move higher up on the CEB, they do not go away completely.

What is the difference between the displacement calculated in the ANSYS ASR-only analysis and the displacement calculated in the ANSYS unfactored static load combination analysis?

- Plots of deformed shape provide a more comprehensive understanding on the CEB behavior.
- Deformation contributions of individual load cases are tabulated for select locations.

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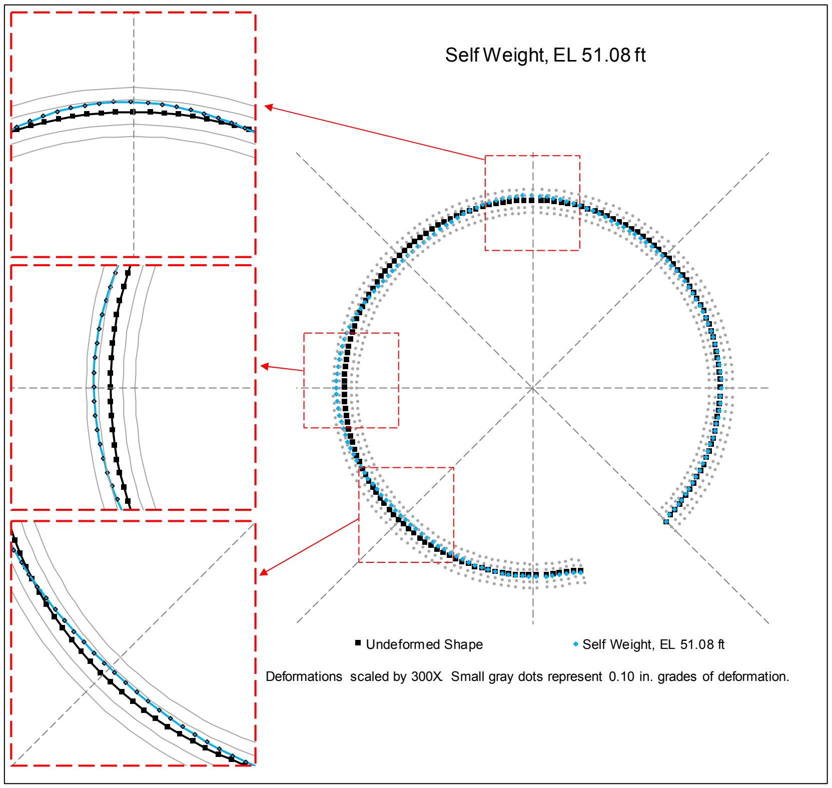
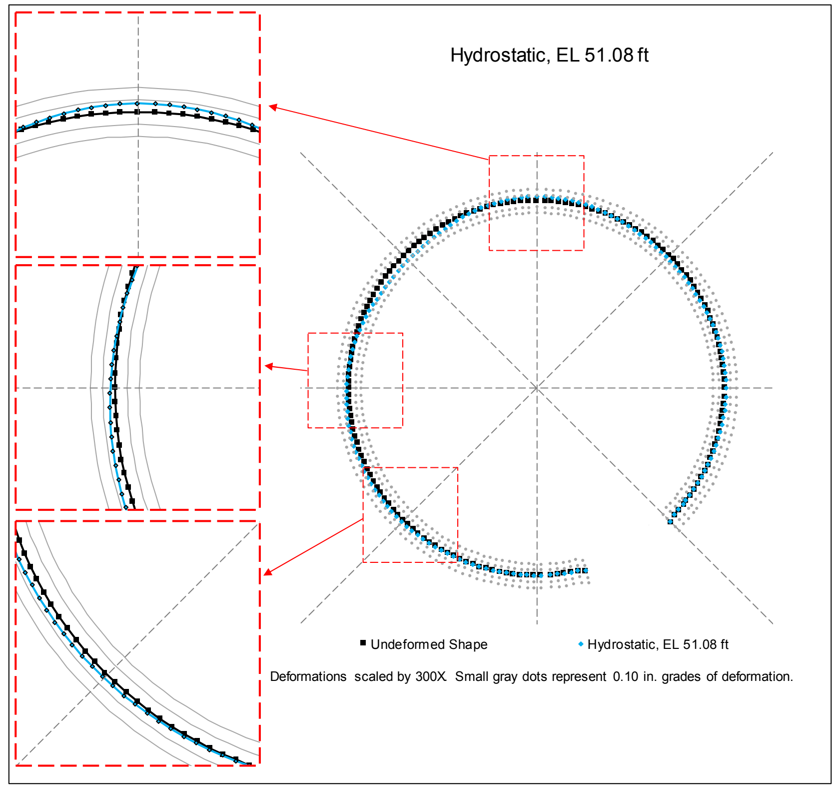
CEB Deformations: Self-Weight & Hydrostatic





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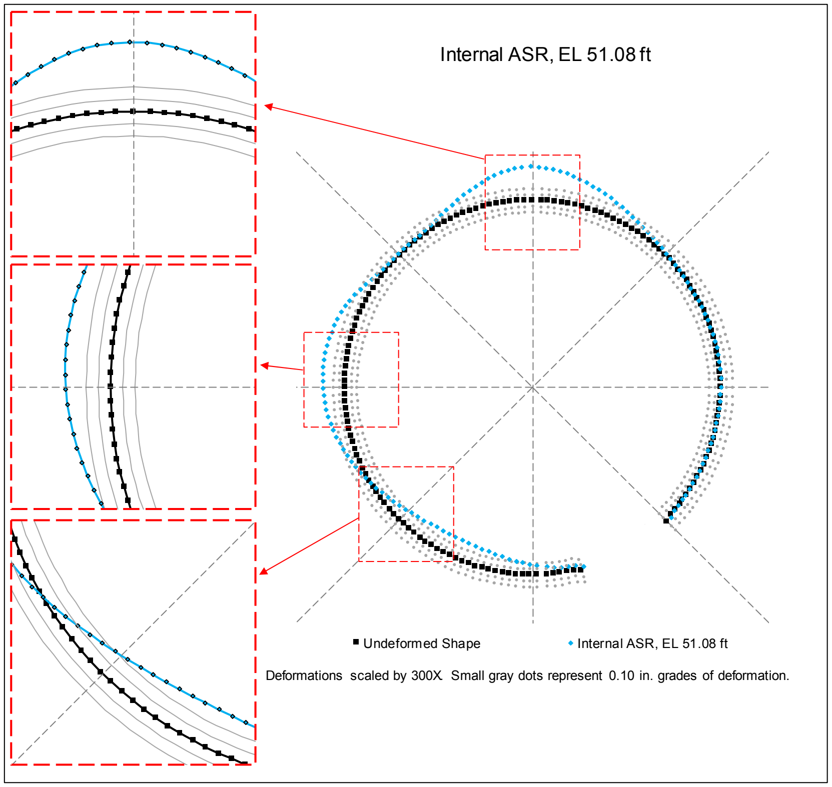
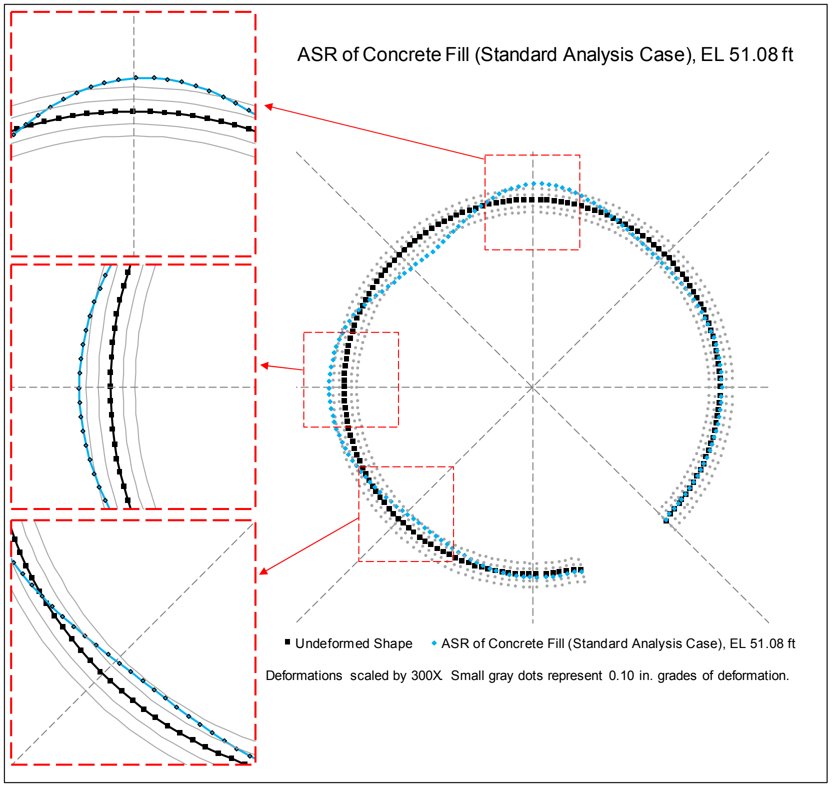
CEB Deformations:
Internal ASR & ASR of Concrete Fill





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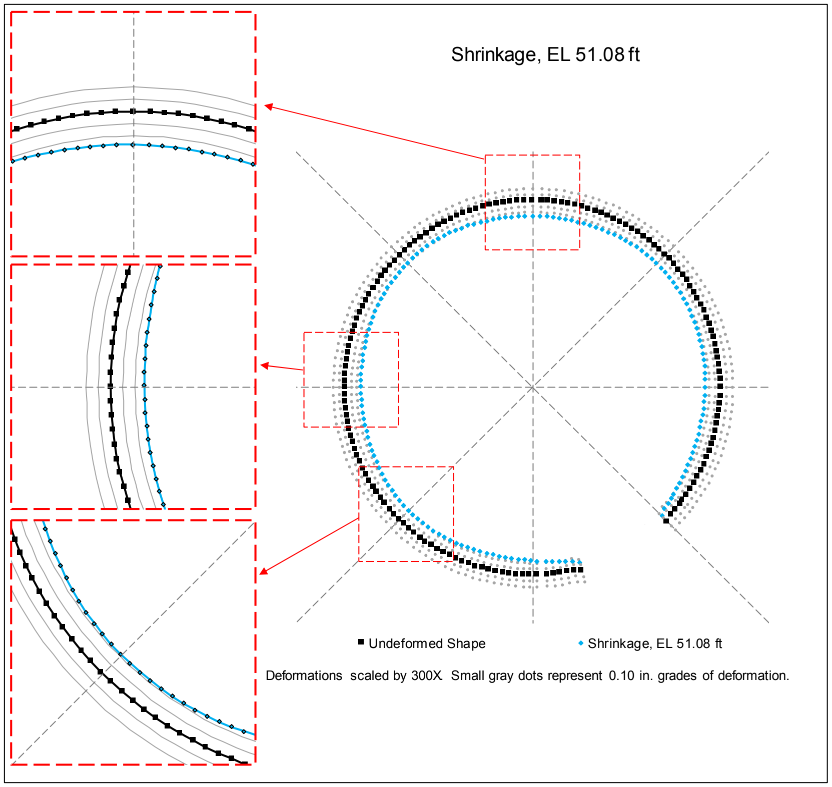
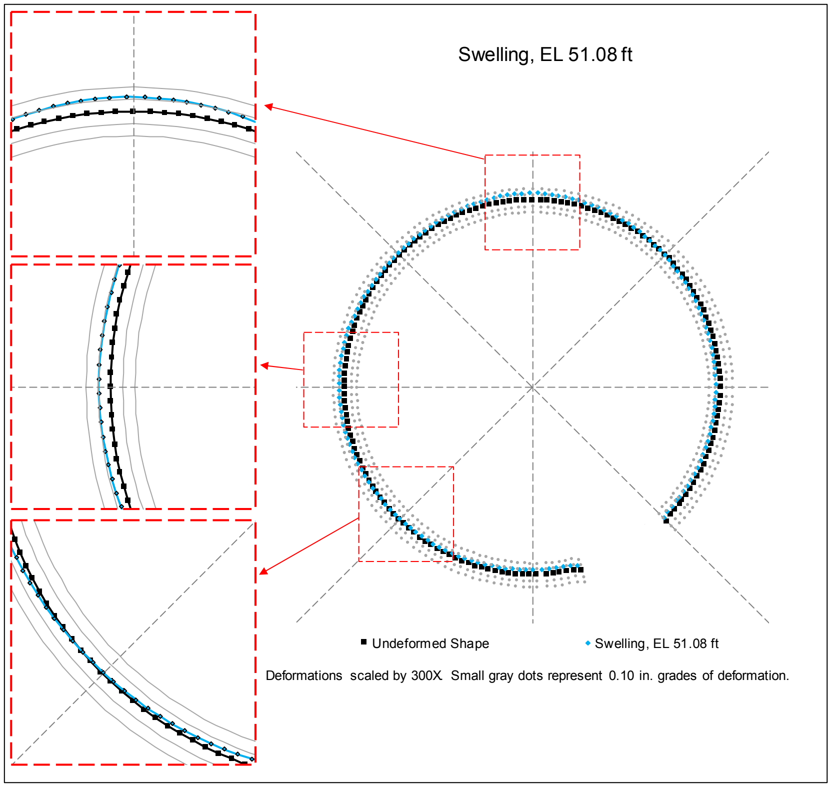
CEB Deformations: Shrinkage & Swelling





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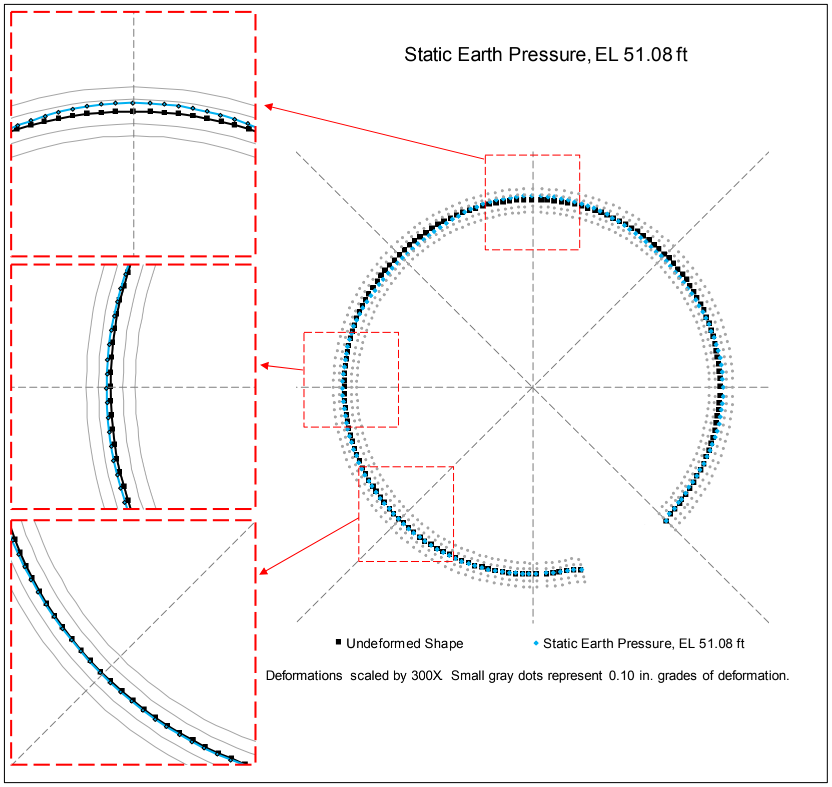
CEB Deformations: Static Earth Pressure



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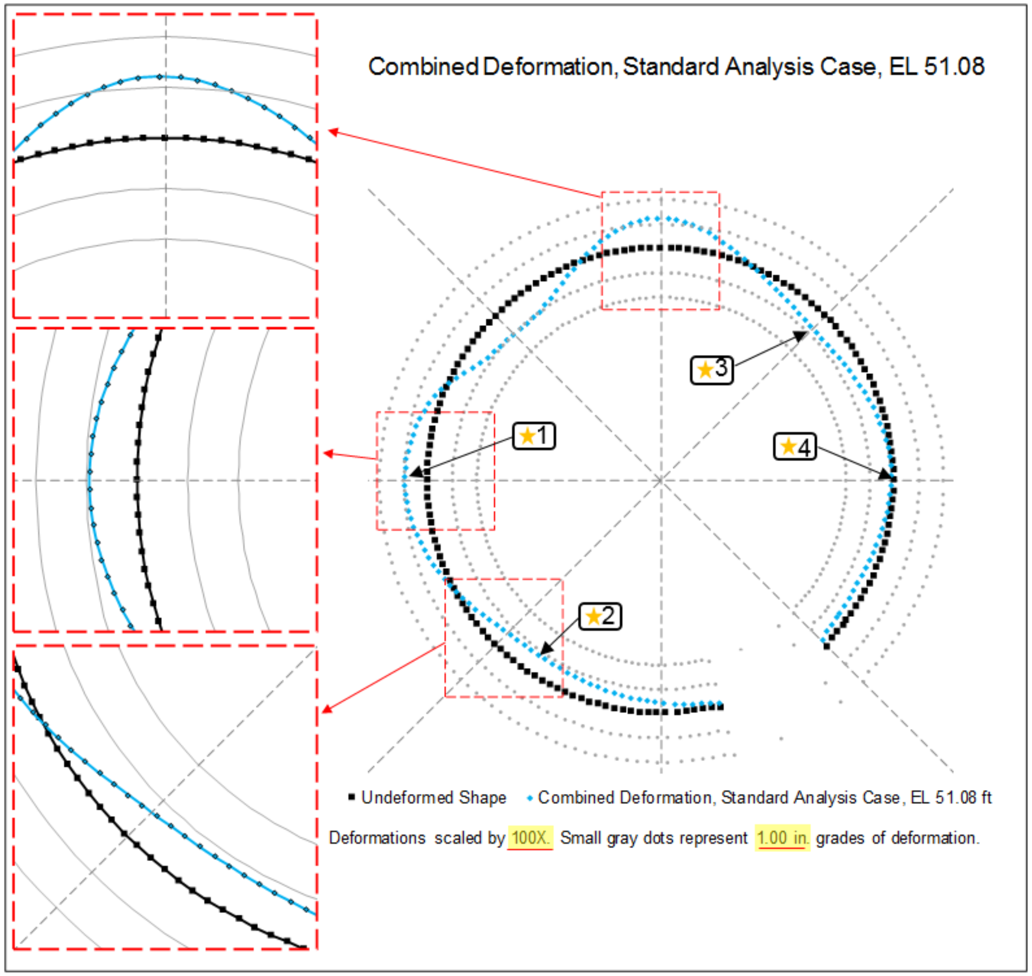
CEB Deformations:
Combined (unfactored static load combination)



Tabulated CEB Deformations: Combined (unfactored static load combination)

1 Node #2200050, AZ 270°, El. +51'

Load Case	Radial Displacement, in.
Self-Weight	0.14
Hydrostatic	0.04
Internal ASR	0.37
ASR of Concrete Fill	0.26
Shrinkage	-0.28
Swelling	0.10
Static Earth Pressure	0.03
Creep	0.28
Total	**0.94**

2 Node #2203812, AZ 210°, El. +51'

Load Case	Radial Displacement, in.
Self-Weight	-0.06
Hydrostatic	0.02
Internal ASR	-0.31
ASR of Concrete Fill	-0.16
Shrinkage	-0.23
Swelling	-0.04
Static Earth Pressure	0.01
Creep	-0.05
Total	**-0.82**

3 Node #2209708, AZ 45°, El. +51'

Load Case	Radial Displacement, in.
Self-Weight	-0.04
Hydrostatic	-0.06
Internal ASR	0.05
ASR of Concrete Fill	-0.13
Shrinkage	-0.21
Swelling	-0.01
Static Earth Pressure	-0.07
Creep	-0.23
Total	**-0.70**

4 Node #2212190, AZ 90°, El. +51'

Load Case	Radial Displacement, in.
Self-Weight	0.01
Hydrostatic	0.03
Internal ASR	0.01
ASR of Concrete Fill	0.02
Shrinkage	-0.26
Swelling	-0.08
Static Earth Pressure	0.05
Creep	0.11
Total	**-0.11**

ASR Load Factors, Question 4

Explain the apparent inconsistencies* [in Report 160268-R-01 Rev. 0] *between the text in Section 1.4.3 and Table 1 for ASR Severity Zones I, II, and III.

- The information in Table 1 of 160268-R-01 is correct.
- Section 1.4.3 of 160268-R-01 should state, "The lowest three zones (Zone I, Zone II, and Zone III) are established to align with the criteria for *Tier 2*: Acceptable with Deficiencies – Qualitative Monitoring Required …"

ASR Load Factors, Question 5

Provide a discussion justifying the use of* [k_{ASR} of] *0.4 as a conservative value. Also, were the actual loads calculated for ASR reviewed to determine whether the use of k_{ASR} = 0.4 is reasonable?

- The average kASR for all evaluation parameters for the completed Severity Zone I evaluation of the Steam Generator Blowdown Recovery Building is 0.36, which compares well with the selected value of 0.4 in the load factor calculation.
- Severity Zone II has average kASR values of 0.64. This compares well with the basis kASR of 0.60 for this Severity Zone. This indicates that kASR increases as ASR strains increase. This gives additional credibility to the use of kASR = 0.4 for Severity Zone I, which is characterized in the load factor calculation by a mean ASR strain significantly smaller than that of Severity Zone II.
- k_{ASR} values for the CEB, which has ASR strains in Severity Zone I, are generally are about 0.4 at typical sections away from concentrations in ASR demands.
- The load factor calculation using kASR assumption was reviewed and accepted by an external peer reviewer with extensive experience in the field of structural reliability.

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Tabulated k_{ASR} from Evaluations

Severity Zone	Average k_{ASR} from values listed in table[A]	Basis k_{ASR}	Number of locations included in average
I	0.36	0.40	18 (One structure)
II	0.64	0.60	18 (3 structures)
III	0.57	0.80	3 (One structure)
IV	(no data)	1.00	0

- Severity Zone I Structure: Steam Generator Blowdown Recovery Building
- Severity Zone II Structures: Condensate Storage Tank Enclosure, Containment Equipment Hatch Missile Shield, Control Room Make-up Air Intake
- Severity Zone III Structure: Containment Enclosure Ventillation Area

Note: k_{ASR} values for the Containment Enclosure Building (CEB) are not tabulated because they tend to vary significantly between sections and are best observed by comparing contour plots of the responses factored ASR load with those for total factored loads.

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ASR Load Factors, Question 6 (1 of 2)

(a) Clarify why the same load factor of 1.4 for S_w is used in all load combinations in Table 5 of the CEB Evaluation Report.

- Table 5 of 150252-CA-02-R0 contains a typo, and swelling loads are given load factors consistent with dead load in the actual computations.

(b) Clarify why Sw is not included as a load in any of the load combinations indicated in UFSAR markup Table 3.8-1, 3.8-14, and 3.8-16.

- Section 3.8.3.3.a.1.a of the revised UFSAR mark-up explains that creep, shrinkage, and swelling are included in load combinations as dead load. Refer to Section 3.8, page 109 of the UFSAR markup in LAR.

ASR Load Factors, Question 6 (2 of 2)

(c) Justify why a load factor of 1.0 associated with the ASR load (S_a) is appropriate for "unusual" load combinations

- Since there is a high certainty that ASR loads exist, ASR loads are included in all concrete load combinations and the degree of uncertainty in ASR loads are accounted for in the factored load combinations. The "unusual" load combinations include loads that have a low probability of occurrence (such as SSE, tornado wind, unusual snow, accident pressure/temperature, flood, and pipe break loads) in addition to "companion" loads that occur coincidentally with the unusual loads. ASR loads are treated as companion loads, and it is traditional for companion loads to be given a load factor of 1.0 in the unusual load combinations (ACI 349-13).

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Question on UFSAR Section 3.8.5

How are foundations evaluated for ASR and why is there no proposed changes to UFSAR Section 3.8.5?

- Foundations of reinforced concrete structures at Seabrook are typically substantially thicker (and therefore stiffer) than the supported structures. Due to this stiffness difference for ASR deformation behavior, the supported structures are not able to significantly restrain or deform the foundations to the extent that further evaluation is required.
- Foundations are explicitly evaluated for ASR loads when their stiffness is comparable to the adjoining walls.
- UFSAR Section 3.8.5.3 (Loads and Load Combinations for Foundations) refers to other sections of the UFSAR which have been revised to account for ASR.

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