

APR1400
Feedback on Response to RAI 255-8285, Question 03.08.05-17, Item 1
Prepared September 2, 2016

The staff requests that the items identified below be clarified regarding Item 1 of the KHNP response provided in Agenda dated 6/15/16 & 7/13/16. For the remaining parts of this RAI, feedback was already provided by the NRC during the audit conducted the week of June 20, 2016.

Item 1)

Based on the KHNP Input provided in the agenda, it appears that the differential displacements per 50 ft presented in Table 1 of the RAI response dated 10/19/15, are based on the differences in settlement between points A and B. Points A and B correspond to the locations having the maximum displacement and the minimum displacement throughout the 50 points shown in Figure 4-5 of Technical Report APR1400-E-S-NR-14006. These points and differential settlements were determined separately for a set of Points A and B, for site profiles S1 through S9 obtained from the SASSI analyses. Then, at each time step, the difference of the settlements at these two points is calculated. These differences over time are enveloped to obtain one maximum differential settlement value for each site profile. Then, the maximum differential settlement per 50 ft is determined by dividing the maximum differential settlement by the distance between the two points and multiplying this by 50 ft. The applicant is requested to confirm that this is the approach which was used to calculate the maximum differential settlement per 50 ft.

KHNP INPUT

The approach explained in Item 1) is equal as that used to calculate the maximum differential settlement per 50ft.

NRC Feedback

The staff requests KHNP to explain what is the purpose of determining the maximum vertical seismic differential displacement and adding it to the static (gravity) load, and how is it used. Based on the KHNP technical report on the Stability Check for NI Common Basemat, the seismic plus static differential settlements were calculated to confirm that the calculated differential settlement is lower than the 0.5 inch per 50 ft differential settlement criterion. However, as discussed in the latest NRC feedback to RAI 03.08.05-7: (1) the settlement criteria should be characterized as maximum vertical settlement, tilt settlement, differential settlement between structures, and angular distortion, unless otherwise justified, (2) settlement should be based on static (gravity) loads not seismic load because the settlements to be monitored during the COL

monitoring program cannot include seismic, (3) using an upper bound of 0.5 inch per 50 ft is unconservative because the design was based on much lower values, and (4) using one value for settlement doesn't capture the bending distortion throughout the basemat.

The staff notes that this approach does not necessarily provide the maximum differential settlement per 50 ft. This may occur because, there may be other points (not point A and B cited above with the maximum and minimum displacement of all points) where the differential settlement is smaller, but when dividing this by the much smaller distance between the two points could lead to a higher differential settlement per 50 ft. Therefore, the applicant should provide the basis for this approach or consider the other variations that might lead to higher differential settlements per 50 ft, such as between adjacent points.

KHNP INPUT

We agree that our approach used for maximum differential settlement does not necessarily achieve the maximum differential settlement. So, the approach is changed to consider other variations that might lead to higher.

New procedure

The new methodology for maximum differential settlement within building is that the difference of combined displacement between adjacent points about all selected points is considered for differential settlement.

a) Organize the vertical displacement corresponding to each seismic excitation (X, Y, Z) by each time step and node. Then, Combine the three vertical displacements by SRSS method per each node and time step.

b) At same time step, the differential settlement under dynamic loading cases was determined by following equation between the points (A, B in the figure 4-5 of technical report, APR1400-E-S-NR-14006-P,Rev.1) obtained for site profiles S1 through S9. The equation is,

$$[\text{Differential settlement}]_{(A-B)} = \frac{(A-B) \times 50}{\text{Distance}}$$

Where,

A: Combined vertical displacement at arbitrary points.

B: Combined vertical displacement at arbitrary points.

Distance: the difference between A and B.

c) Based on results of b), choose the maximum differential settlement at same time

d) Repeat procedure b) ~ c) for each time step.

e) Choose the maximum differential settlement against whole time steps.

f) Repeat the b) ~ e) corresponding to soil profiles (S1 ~ S9) (Total 45,158,400 case)

The maximum differential settlement for EDG and DFOT is calculated by new procedure.

By the procedure above, the maximum differential settlement for seismic category I structure are summarized in Table 1 through 3, respectively.

NRC Feedback

Same feedback provided in Item 1 above.

Table 1 The summary of Maximum differential settlement for NI basemat

NI Basemat				
Soil Case	Max. Differential Settlement per 50ft(inch)	NODE1	NODE2	Time(sec)
S1	1.515E-01	9587	9343	7.535
S2	1.452E-01	9587	9343	7.53
S3	1.121E-01	9587	9343	9.4
S4	1.093E-01	9587	9343	13.54
S5	4.076E-02	9587	9343	9.34
S6	5.232E-02	9957	9819	13.22
S7	4.876E-02	9786	9804	13.18
S8	2.482E-02	9587	9343	9.335
S9	3.189E-02	9587	9343	9.335

Table 2 The summary of Maximum differential settlement for EDG

EDG				
Soil Case	Max. Differential Settlement per 50ft(inch)	NODE1	NODE2	Time
S1	9.917E-02	425	422	7.595
S2	1.100E-01	502	499	7.6
S3	6.774E-02	422	419	8.51
S4	4.473E-02	425	444	7.61

S5	5.211E-02	444	441	10.49
S6	5.776E-02	422	419	10.515
S7	8.579E-02	422	419	6.745
S8	1.035E-02	462	459	10.565
S9	1.585E-02	422	419	10.57

Table 3 The summary of Maximum differential settlement for DFOT

DFOT				
Soil Case	Max. Differential Settlement per 50ft(inch)	NODE1	NODE2	Time
S1	3.442E-02	126	73	7.59
S2	4.512E-02	73	9	14.58
S3	1.028E-02	126	73	15.155
S4	1.293E-02	126	73	7.73
S5	1.029E-02	116	121	10.475
S6	5.504E-03	126	73	15.15
S7	6.433E-03	116	121	13.15
S8	5.462E-03	72	1	6.99
S9	8.013E-03	116	121	8.46