RAI 255-8285 – Q03.08.05-7
Construction Sequence Analysis Procedure for NI Building

The construction sequence analysis for the NI common basemat is described in Technical Report Section 5.0 (APR 1400-E-S-NR-14006-P, Rev.1). The construction sequence analysis model consists of foundation media (soil layer model) and NI common basemat (up to EL.78ft for the RCB and EL. 55ft for Auxiliary Building, as shown in Figure 5-2 in the TeR and Figure 1 below).

The procedures for the construction sequence analysis are discussed below:

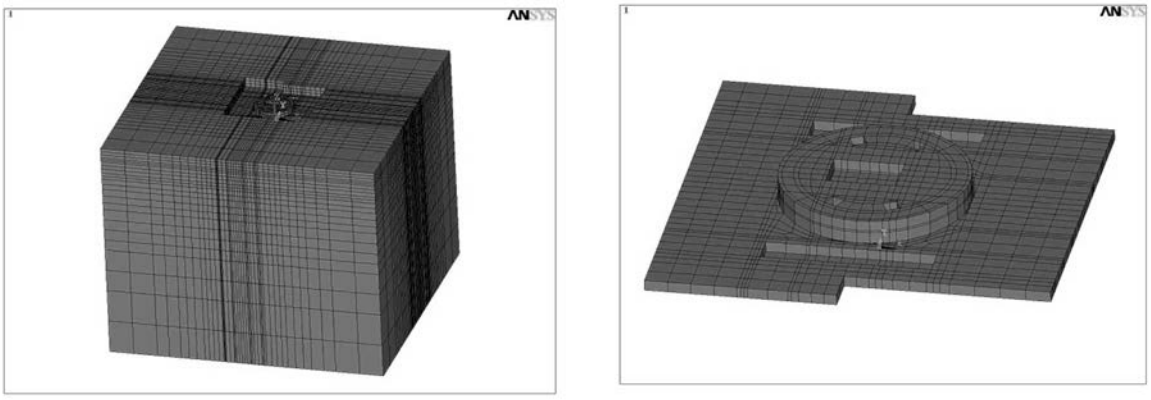
1) The concrete used in this analysis is normal weight concrete with a compressive strength of 5,000 psi at 91 days. The concrete strength is assumed at the three hardening conditions to consider the change of the strength due to the concrete pouring sequence.

2) The relation between the age and the strength of the concrete complies with the relationship for moist-cured concrete made with normal Portland cement proposed by ACI Committee 209. The modulus of elasticity for concrete is calculated by the equation, 57,000 $\sqrt{f'_c}$, as given in ACI 349. The table below summarizes the properties.

Material		Elastic Modulus (ksf)	Poisson's Ratio	Weight Density (pcf)	Remarks
Concrete	H1	4.7506E+05	0.17	150	at 0.67·f'_c
	H2	5.3827E+05	0.17	150	at 0.86·f'_c
	H3	5.8032E+05	0.17	150	at 1.00·f'_c

3) Based on the construction techniques, the mat foundation is divided by concrete pour zones (see Figures 2 and 3 below). The segments of concrete block are added to the construction-site according to the order of the prescribed concrete pouring. The concrete pour sequences and hardening condition of each segment are considered. Construction sequence analysis will be performed by a computerized finite element method. The number of analyses will be the number of concrete pouring stages and an additional 3 analyses to consider the completion of hardening of all the concrete segments.

4) After hardening of all basemat concrete segments, the construction sequences analysis of superstructures, such as the containment building, internal structures, and auxiliary building, will be conducted. The superstructures are also divided by each concrete segment.



(a) Soil Model **(b) NI Common Basemat**

Figure 1 - Construction Sequence FE Model

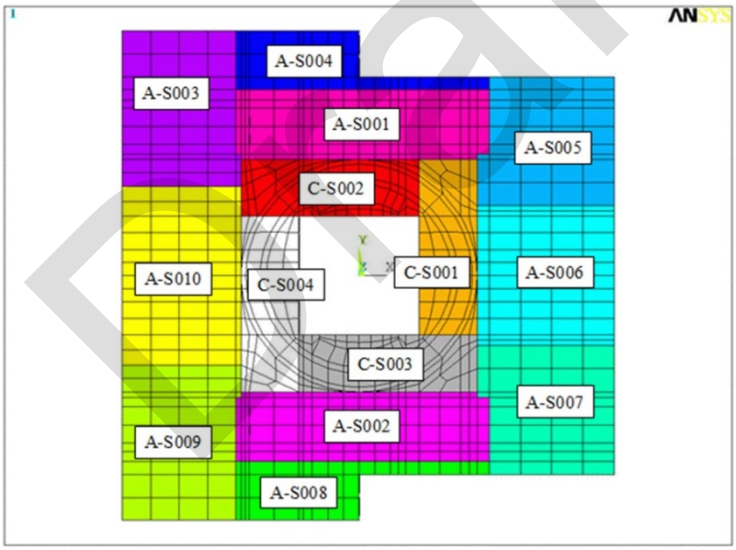
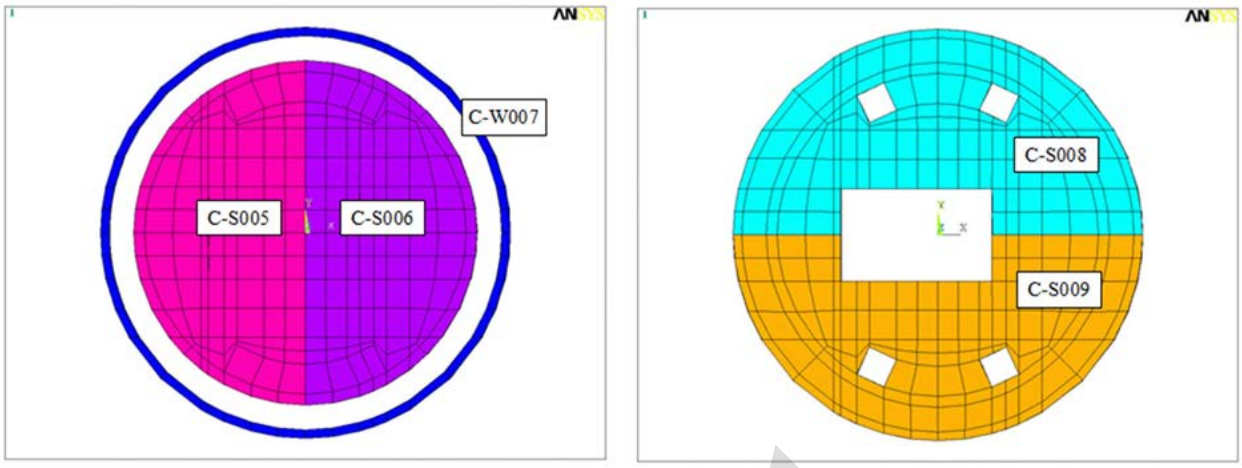


Figure 2 - Individual Segments of Basemat below RCB and AB(El. 35′-0″ ~ El. 55′-0″)



a) RCB Area (El. 55′-0″ ~ El. 68′-0″) **(b) RCB Area (El. 68′-0″ ~ El. 78′-0″)**

Figure 3 - Individual Segments of Basemat below RCB (El. 55′-0″ ~ El. 78′-0″)

5) The construction sequence analysis including NI building structure will be performed based on the preliminary simplified construction sequence as summarized in the Table below. Figure 4 depicts the location of Regions A-E.

Stage	Region A	Region B	Region C	Region D	Region E
1	20%	-	-	-	-
2	20%	Up to level 1 ceiling	-	-	-
3	20%	-	Up to level 1 ceiling	-	-
4	20%	-	-	Up to level 1 ceiling	-
5	20%	-	-	-	Up to level 1 ceiling
6	20%	Up to level 1 ceiling	Up to level 1 ceiling	-	-
7	20%	-	-	Up to level 1 ceiling	Up to level 1 ceiling
8	20%	Up to level 1 ceiling	-	Up to level 1 ceiling	-
9	20%	-	Up to level 1 ceiling	-	Up to level 1 ceiling
10	20%	Up to level 1 ceiling	Up to level 1 ceiling	Up to level 1 ceiling	-
11	20%	Up to level 1 ceiling	Up to level 1 ceiling	-	Up to level 1 ceiling
12	20%	Up to level 1 ceiling	Up to level 1 ceiling	Up to level 1 ceiling	Up to level 1 ceiling

Stage	Region A	Region B	Region C	Region D	Region E
13	20%	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 bottom slab
14	40%	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 bottom slab
15	40%	Up to level 2 ceiling	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 bottom slab
16	40%	Up to level 2 bottom slab	Up to level 2 ceiling	Up to level 2 bottom slab	Up to level 2 bottom slab
17	40%	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 ceiling	Up to level 2 bottom slab
18	40%	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 bottom slab	Up to level 2 ceiling
19	40%	Up to level 2 ceiling	Up to level 2 bottom slab	Up to level 2 ceiling	Up to level 2 bottom slab
20	40%	Up to level 2 bottom slab	Up to level 2 ceiling	Up to level 2 bottom slab	Up to level 2 ceiling
21	40%	Up to level 2 ceiling	Up to level 2 ceiling	Up to level 2 ceiling	Up to level 2 bottom slab
22	40%	Up to level 2 ceiling	Up to level 2 bottom slab	Up to level 2 ceiling	Up to level 2 ceiling
23	40%	Up to level 2 ceiling	Up to level 2 ceiling	Up to level 2 ceiling	Up to level 2 ceiling
24	40%	Up to level 3 bottom slab	Up to level 3 bottom slab	Up to level 3 bottom slab	Up to level 3 bottom slab
25	60%	Up to level 3 bottom slab	Up to level 3 bottom slab	Up to level 3 bottom slab	Up to level 3 bottom slab
26	60%	Up to level 3 bottom slab	Up to level 3 ceiling	Up to level 3 bottom slab	Up to level 3 ceiling
27	60%	Up to level 3 ceiling	Up to level 3 bottom slab	Up to level 3 ceiling	Up to level 3 bottom slab
28	60%	Up to level 3 bottom slab	Up to level 3 bottom slab	Up to level 3 ceiling	Up to level 3 ceiling
29	60%	Up to level 3 ceiling	Up to level 3 ceiling	Up to level 3 bottom slab	Up to level 3 bottom slab
30	60%	Up to level 3 ceiling	Up to level 3 ceiling	Up to level 3 ceiling	Up to level 3 ceiling
31	60%	Up to level 4 bottom slab	Up to level 4 bottom slab	Up to level 4 bottom slab	Up to level 4 bottom slab
32	60%	Up to level 4 bottom slab	Up to level 4 ceiling	Up to level 4 bottom slab	Up to level 4 ceiling
33	60%	Up to level 4 ceiling	Up to level 4 bottom slab	Up to level 4 ceiling	Up to level 4 bottom slab
34	60%	Up to level 4 bottom slab	Up to level 4 bottom slab	Up to level 4 ceiling	Up to level 4 ceiling
35	60%	Up to level 4 ceiling	Up to level 4 ceiling	Up to level 4 bottom slab	Up to level 4 bottom slab
36	60%	Up to level 4 ceiling	Up to level 4 ceiling	Up to level 4 ceiling	Up to level 4 ceiling
37	60%	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 bottom slab

Stage	Region A	Region B	Region C	Region D	Region E
38	80%	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 bottom slab
39	80%	Up to level 5 ceiling	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 bottom slab
40	80%	Up to level 5 bottom slab	Up to level 5 ceiling	Up to level 5 bottom slab	Up to level 5 bottom slab
41	80%	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 ceiling	Up to level 5 bottom slab
42	80%	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 bottom slab	Up to level 5 ceiling
43	80%	Up to level 5 ceiling	Up to level 5 bottom slab	Up to level 5 ceiling	Up to level 5 bottom slab
44	80%	Up to level 5 bottom slab	Up to level 5 ceiling	Up to level 5 bottom slab	Up to level 5 ceiling
45	80%	Up to level 5 ceiling	Up to level 5 ceiling	Up to level 5 ceiling	Up to level 5 ceiling
46	80%	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to level 6 bottom slab
47	80%	Up to roof slab	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to level 6 bottom slab
48	80%	Up to level 6 bottom slab	Up to roof slab	Up to level 6 bottom slab	Up to level 6 bottom slab
49	80%	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to roof slab	Up to level 6 bottom slab
50	80%	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to roof slab
51	100%	Up to roof slab	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to level 6 bottom slab
52	100%	Up to level 6 bottom slab	Up to roof slab	Up to level 6 bottom slab	Up to level 6 bottom slab
53	100%	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to roof slab	Up to level 6 bottom slab
54	100%	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to roof slab
55	100%	Up to level 6 bottom slab	Up to level 6 bottom slab	Up to roof slab	Up to roof slab
56	100%	Up to level 6 bottom slab	Up to roof slab	Up to roof slab	Up to roof slab
57	100%	Up to roof slab	Up to roof slab	Up to roof slab	Up to roof slab

Note: Concrete pouring sequence shown in the table is the preliminary planned sequence for analysis.

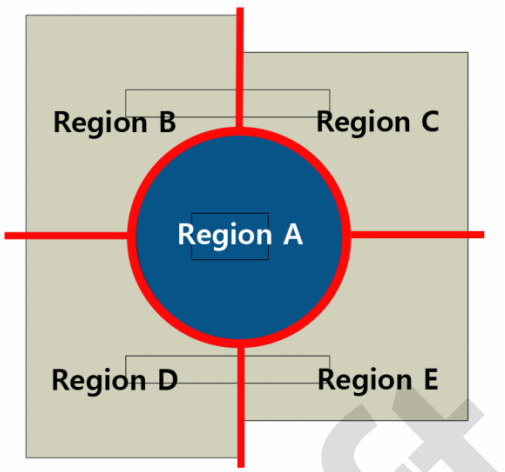


Figure 4 - Individual Region Segments of Building Structures

6) The stress or member forces of each construction stage shall be checked for the integrity of concrete structure during construction, and the stress or member forces of final stage shall be calculated to include in the design. Figure 5 is a schematic of the construction stages for analysis/

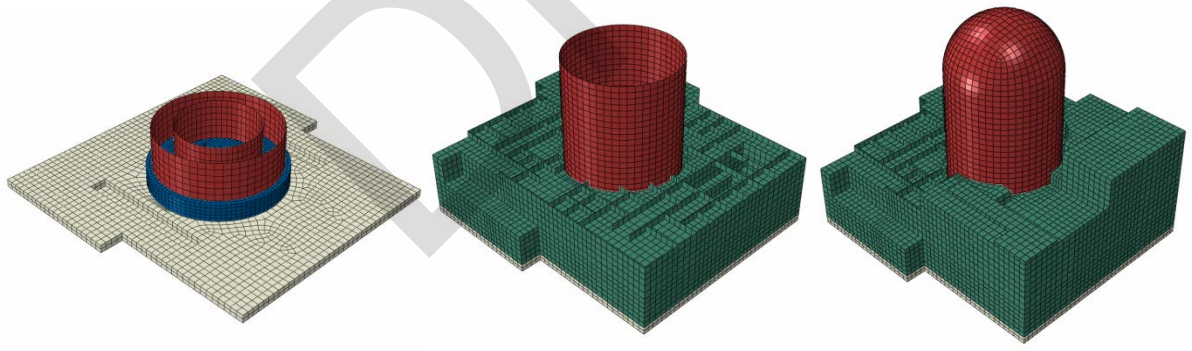


Figure 5 - Construction Stage Schematic