Structural Integrity of Pool Bridge of Research Reactor

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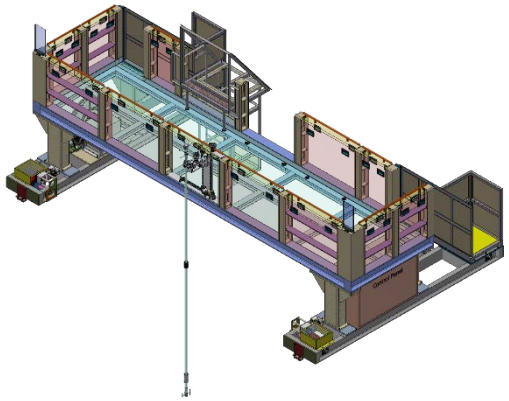
Introduction

- Pool Bridge Design

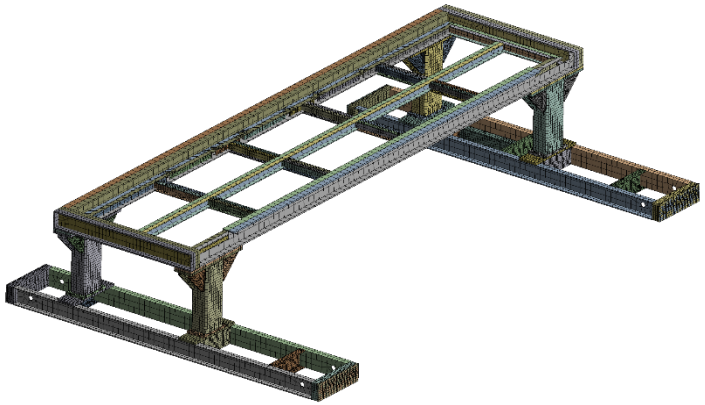
- Moving deck system on the reactor pool
- Operators can access the top of the pool while on the pool bridge.
- Pool bridge travels along the rails from the end of the pool to another end.
- Seismic category II
- KEPIC MCN or ASME NOG-1



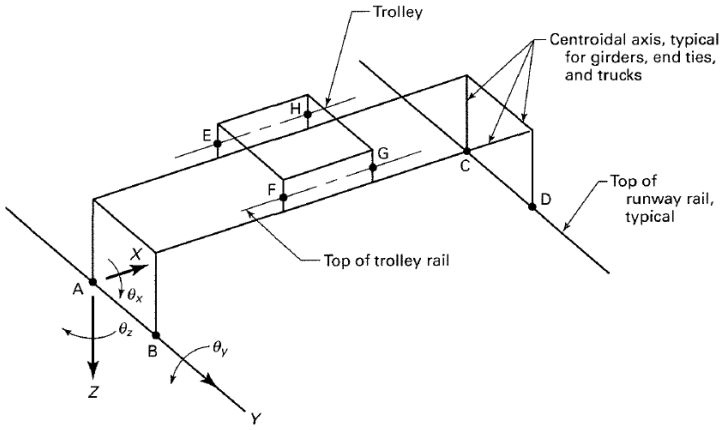
Configuration of the pool bridge

Finite Element Model

- Shell elements for the structural members
- Total number of nodes: 41,261
- Total number of elements: 34,013
- Total mass: 8 tons
- Boundary condition: Restraint condition from ASME NOG-1



Finite element model of the pool bridge



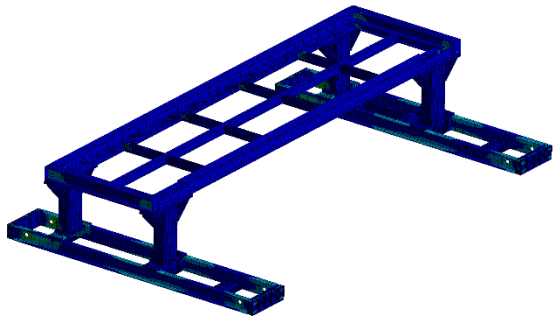
Crane mathematical model for seismic analysis from ASME NOG-1-2004

Static Analysis

- Loads

- Dead Loads: total weight (P_{db})

- Impact Loads: Transverse Horizontal load (P_{ht})



Static results - distribution of von Mises stress

- Load Combinations

- Operational Loads ($P_{c3} = P_{db} + P_{ht}$)

- Allowable Stress

- Operating Condition: $\sigma_a = 0.5\ \sigma_y = 102$ MPa (for Stainless Steel ASTM A240 type 304)

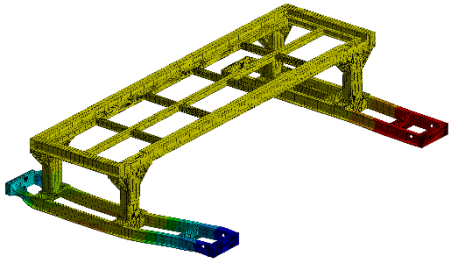
- Results

- Max. stress in structural members: 55 MPa

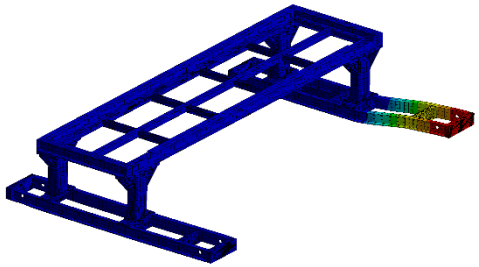
- Max. stress in wheel shaft (55ϕ): 13 MPa

Modal Analysis

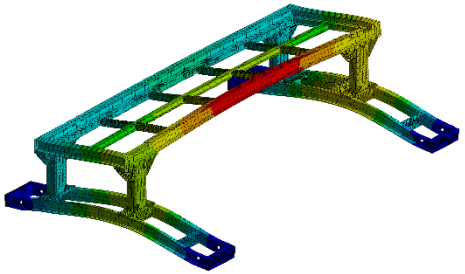
- Total 100 modes are considered in the modal response combination for response spectrum analysis.



1st mode (8.8 Hz)



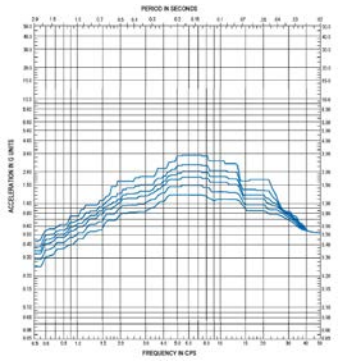
2nd mode (19.8 Hz)



3rd modes (22.8 Hz)

Response Spectrum Analysis

- Response to the safe shutdown earthquake (SSE)
- Total response is evaluated by SRSS.
- Seismic loads from Floor Response Spectrum.



Floor Response Spectrum (FRS)

Response Spectrum Analysis

- Loads

- Dead Loads: total weight (P_{db})

- Seismic and Abnormal Events Loads: Safe Shutdown Earthquake ($P_{e'}$)

- Load Combinations

- Extreme Environmental Loads ($P_{c10} = P_{db} + P_{e'}$)

- Allowable Stress

- Extreme Environmental Condition: $\sigma_a = 0.9\ \sigma_y = 153$ MPa (for ASTM A240 type 304)

- Results

- Max. stress in structural members: 55 MPa

Floor Response Spectrum (FRS)

Crane mathematical model for seismic analysis from ASME NOG-1-2004