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TWO POLE MOTOR VIBRATION DIAGNOSTICS, ANALYSIS AND SOLUTION

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- Conclusion and Recommendation

Problem Statement

- High vibrations observed on motor casing and support frame
- Velocity reading was at 0.5 in/s in May, increased to 0.7 in/s in July.
- Cracks were seen on the grout and concrete foundation
- The support has a x-brace on the outboard end and a pate welded on the inboard end
- Question:
  - What caused the vibration and how to fix it.

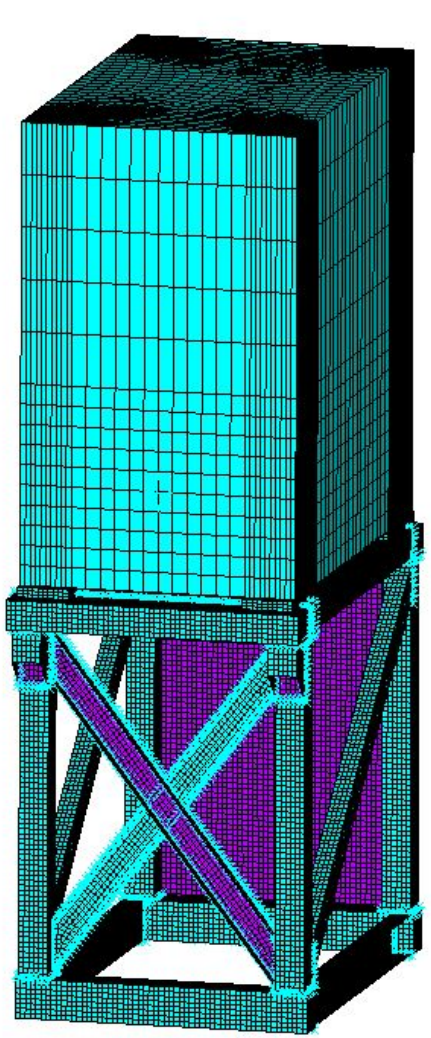
Field Measurement

- 1X dominant
- Found structural mode at 3000 rpm with cracked foundation
- Mode shape is mainly lateral vibration on the drive end, where the crack foundation is – at the anchor bolt location.
- Lose foot was foundation a year before and corrected, alignment done as well. Vibration amplitude unchanged.

Field Measurement

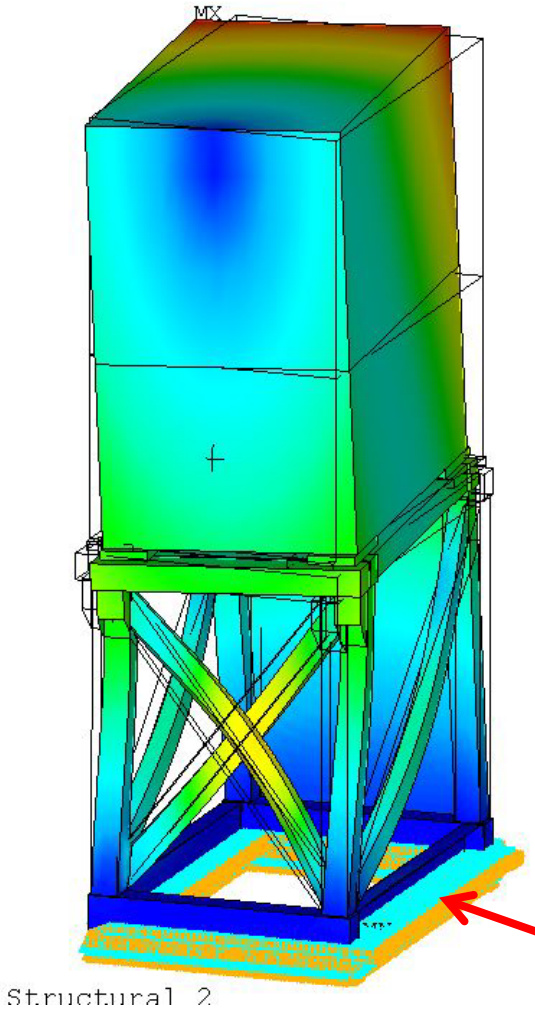
Continue on field measurements

Finite Element Model



Frame--Static Structural 2

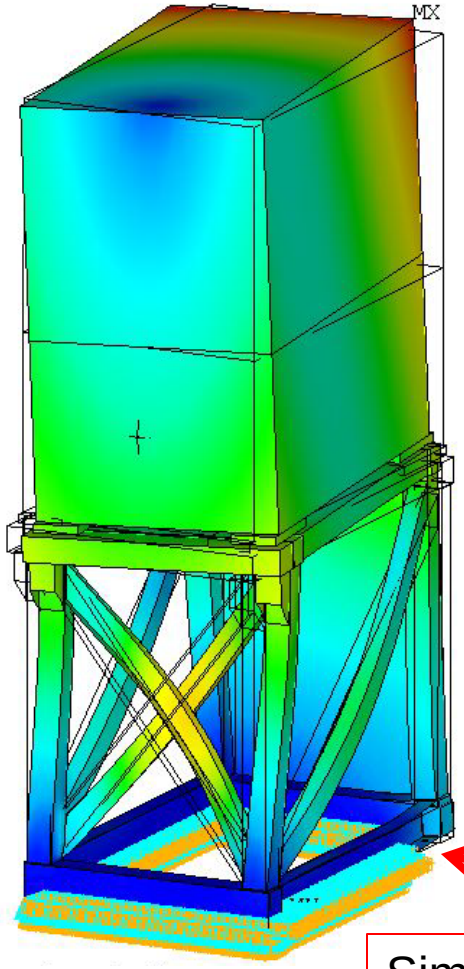
As-Design Condition



- The support has a natural frequency at 57.9 Hz, which is very close to the motor's running speed of 60 Hz
  - This resonance was likely the original cause of the foundation crack
  - Simply fixing the loose foot due to the damaged foundation did not and will not solve the resonance problem
  - This mode must be pushed away from the motor's synchronous excitation

All DOFs fixed on the bottom, no loose foot due to damaged foundation

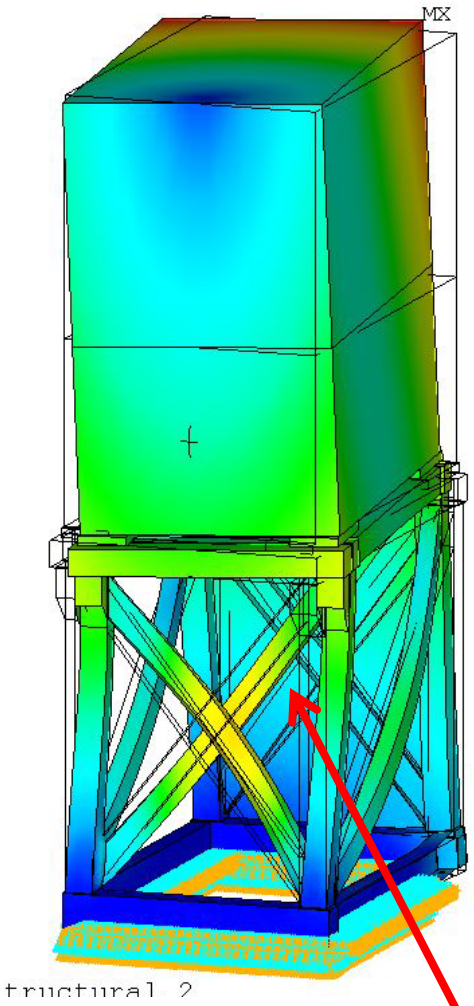
As-Found Condition



- The frequency of the problematic mode is reduce to 52.8 Hz
  - Both the frequency and the mode shape match the field measurements
  - This good correlation validates the FE model
  - Provides a good baseline to investigate solutions
  - The objective is to achieve 20% separation margin

Simulate the loose foot due to the damaged foundation by removing the constraints near the foot

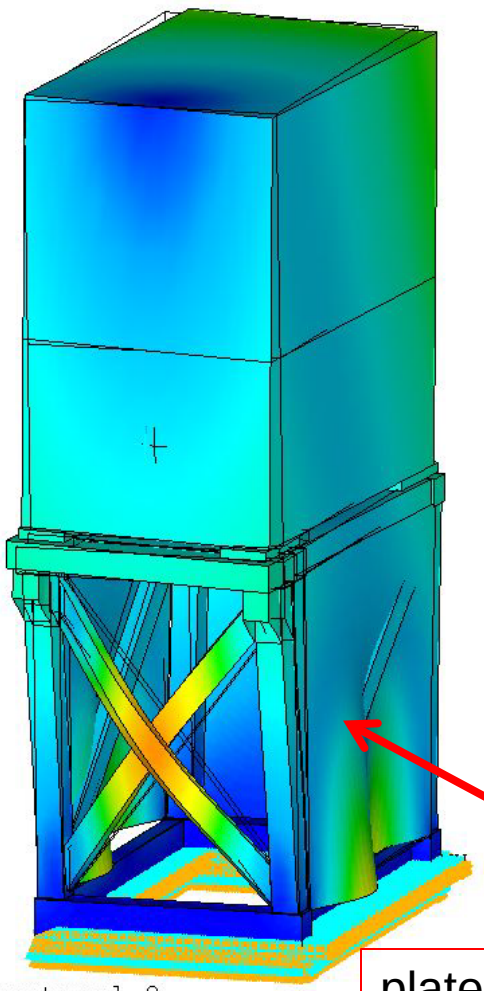
Initial Modification



- The frequency of the mode is increased to 53 Hz
  - Not a solution
  - Since the inboard end shows large displacement, it was intuitive to strengthen this end
  - However, this end is already very stiff due to the plate
    - Further stiffening is not effective
  - Strengthening device should be applied to the area showing the most twist, rather than the area showing the most displacement

X-brace added on the inboard end, loose foot

A Viable Modification



- Plates are added to the side surfaces
- The frequency of the problematic mode is increased to 72.8 Hz
  - 20% SM is achieved
- As a solution
  - Bottom of these plates should be welded as well
  - The plate should also be welded to the X-brace to reduce noise

plate added to both sides

Conclusion & Recommendation

- As designed, the support has a natural frequency at the motor's running speed, causing resonance
- This resonance is likely the cause of the original foundation crack
- To increase the resonance frequency of the support outside the motor operating speed range, stiffening device should be added to areas with the most amount twist, instead of areas with the most displacement
- Based on the FE results, it is recommended that plates of ¾" to be welded to the East and West side of the support structure
- Turnaround team found out soft foot again that was fixed a year ago. Further prove the validity of the analysis and the softfoot was a result but not a solution to the structural resonance issue.