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Empirical Prediction and Evaluation of Construction Vibration Impacts on an FAA Radar Station

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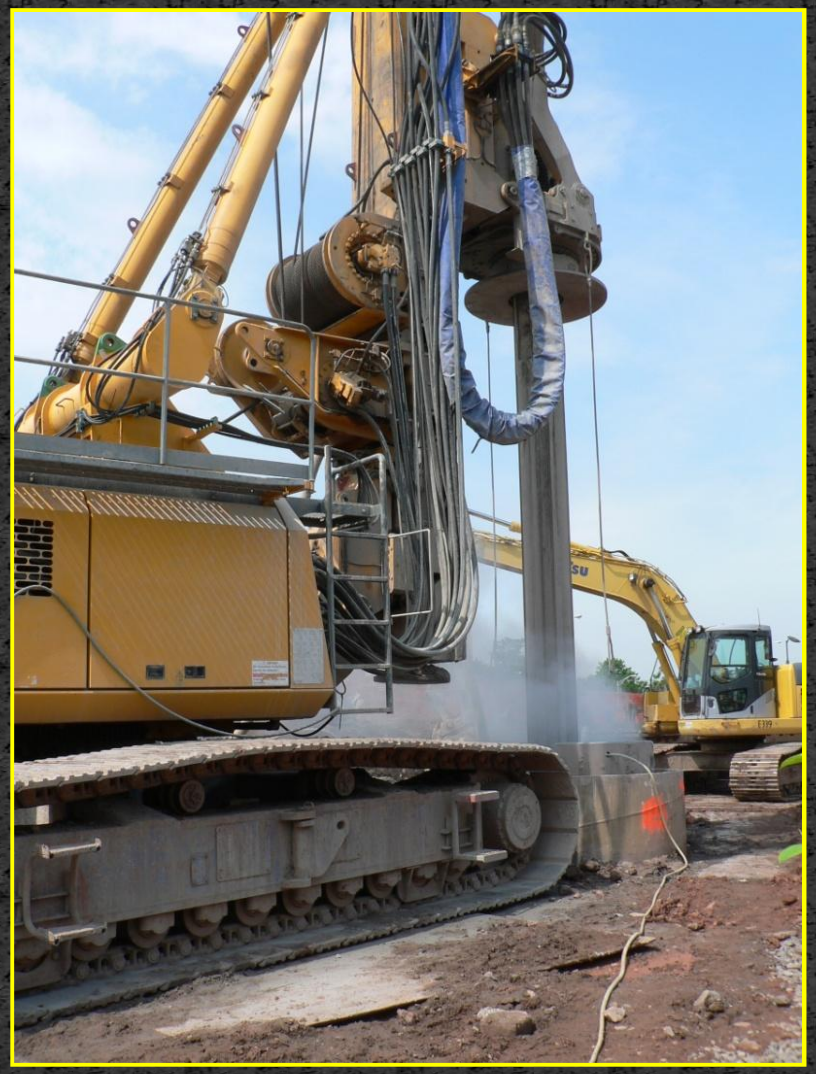
Project Description

- Client's desire to construct access roadway within a large International Airport
- Will involve use of large caisson drill proximal (40 feet) to FAA radar station
- Assignment: Prove construction vibrations will not adversely interfere with radar operations

Project Approach



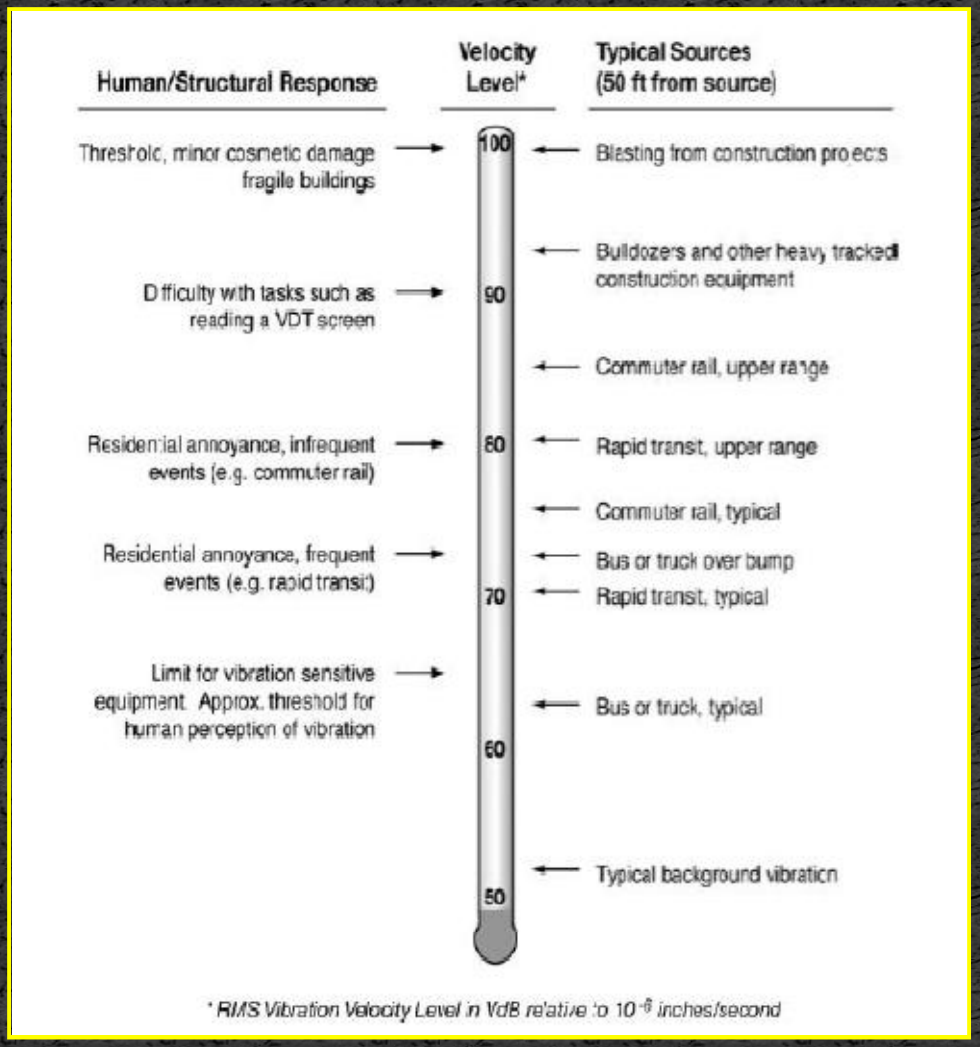
1.) Measure vibration emissions from similar caisson drill operation

2.) Measure vibration transmissibility characteristics of actual ground and radar tower

3.) Superimpose results to predict caisson drill vibration effects on radar

4.) Evaluate consequences

Vibration Terminology



- VdB = RMS vibration velocity level in decibels re: 10^{-6} in/sec. (energy)
- PPV = Peak Particle Velocity in linear units of in/sec. (shock)
- Crest Factor = Peak/RMS
- Third-octave band = limited frequency bandwidth +/- 12% of center frequency in Hz.

Radar Vibration Criteria

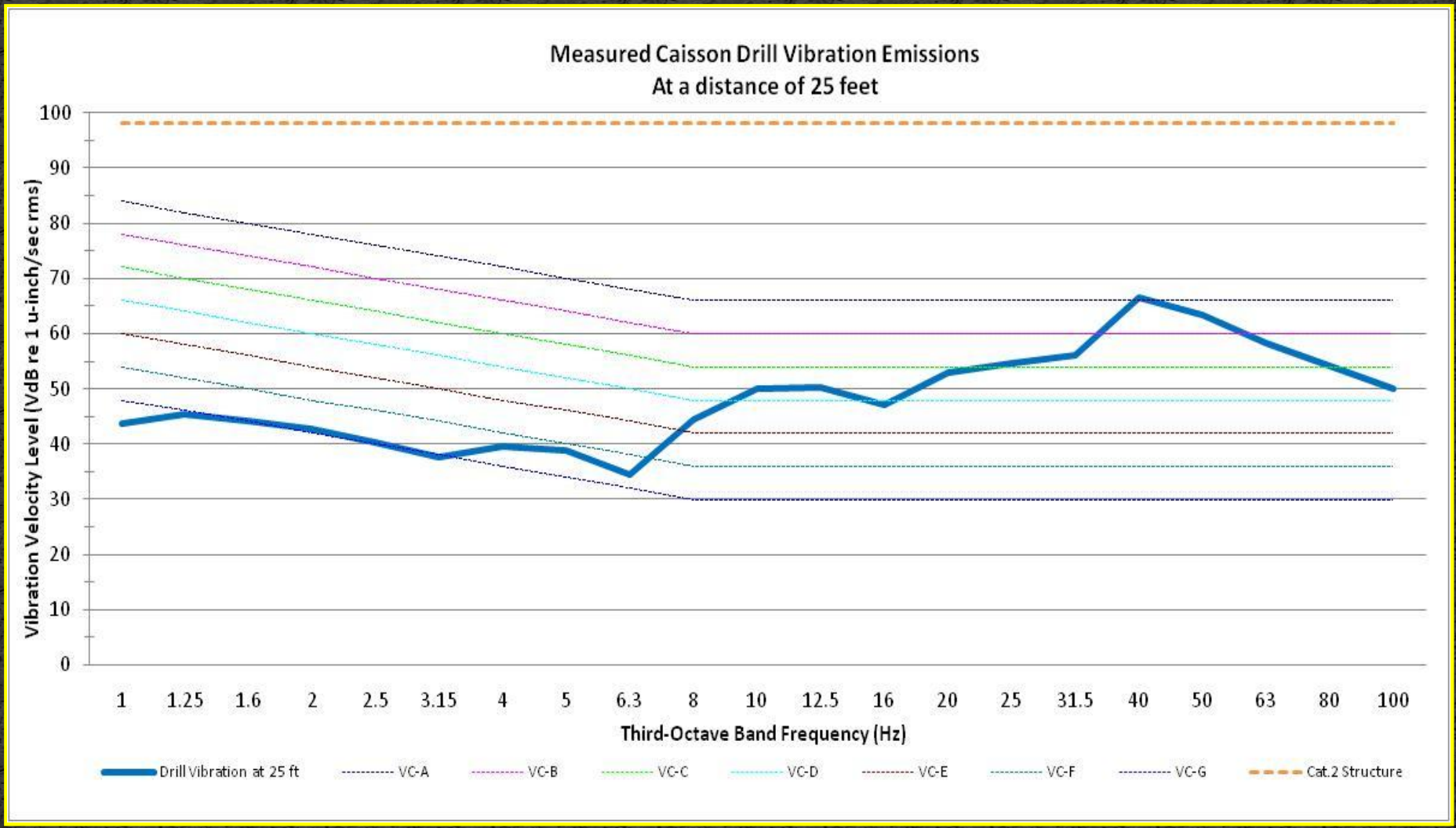
- Radar made by Norden in 1985, now a part of Northrop Grumman
- Neither the manufacturer nor the Airport had a reliable vibration specification limit for this unit
- Built in “vibration” sensor ranged from 0 to 5 (unknown units?)
  ~ But only for eccentricity
- FTA, Swiss SN, CA/T suggested 0.30 PPV (98 VdB with CF of 4) for Cat. 2 structures including steel truss towers. But the radar itself?
- IEST/FTA Guidelines for vibration-sensitive laboratory devices (VC-curves) ~ Likely overly cautious

1.) Caisson Drill Emissions

- Bauer BG 40 with 6½ foot diameter rotary cutting head with down hammer – 20 feet deep rock sockets
- Measured ground vibration in vertical direction 25 feet from caisson drill

Caisson Drill Emissions

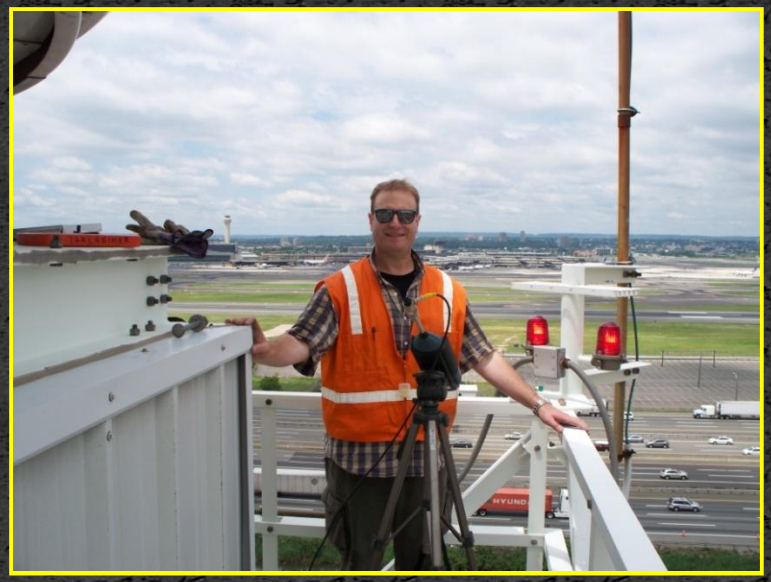
Vibration velocity decibels (VdB) at 25 feet in third-octaves 1 - 100 Hz



2.) Ground/Tower Propagation

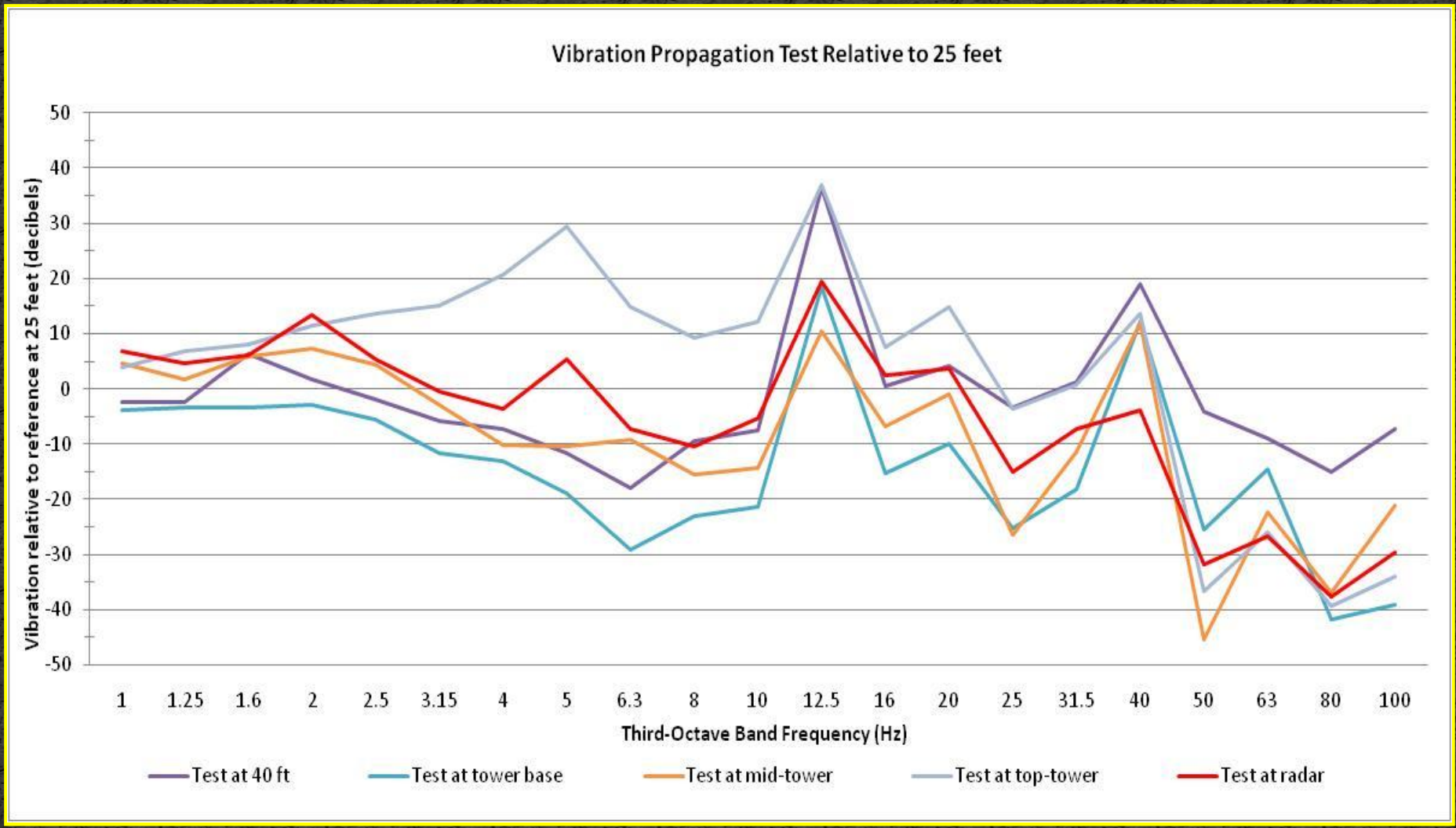
- BoMag BW 211D-40 Vibratory Compactor
- 53,100 lbs centrifugal force at 30 Hz – ideal scale test
- Measured vibration at test points along ground, on the radar tower's foundation, at several platform heights and at radar's pedestal

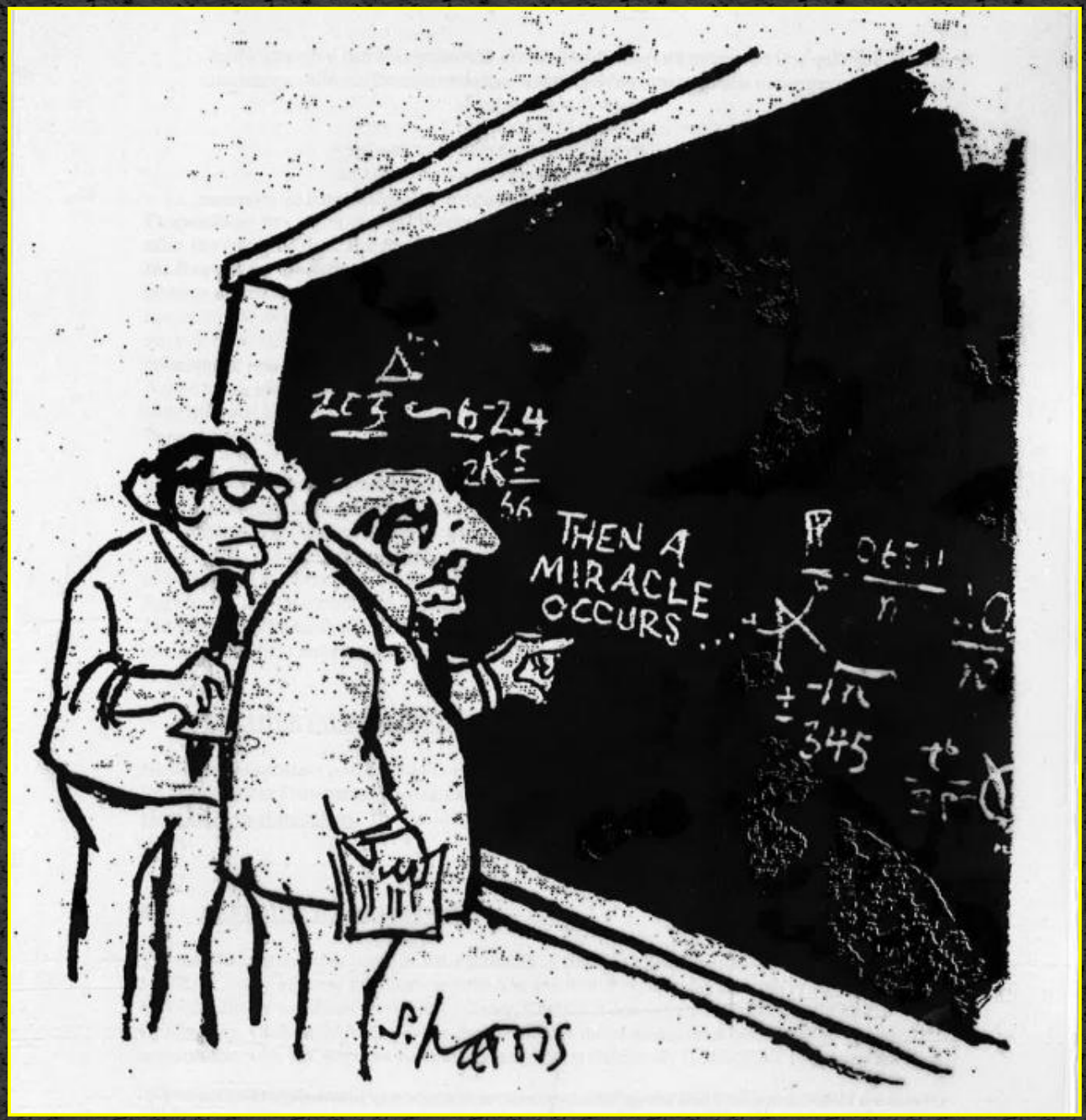
Ground/Tower Measurements



Ground/Tower Transmissibility

Vibration at test points relative to results at 25 feet in third-octaves 1 - 100 Hz

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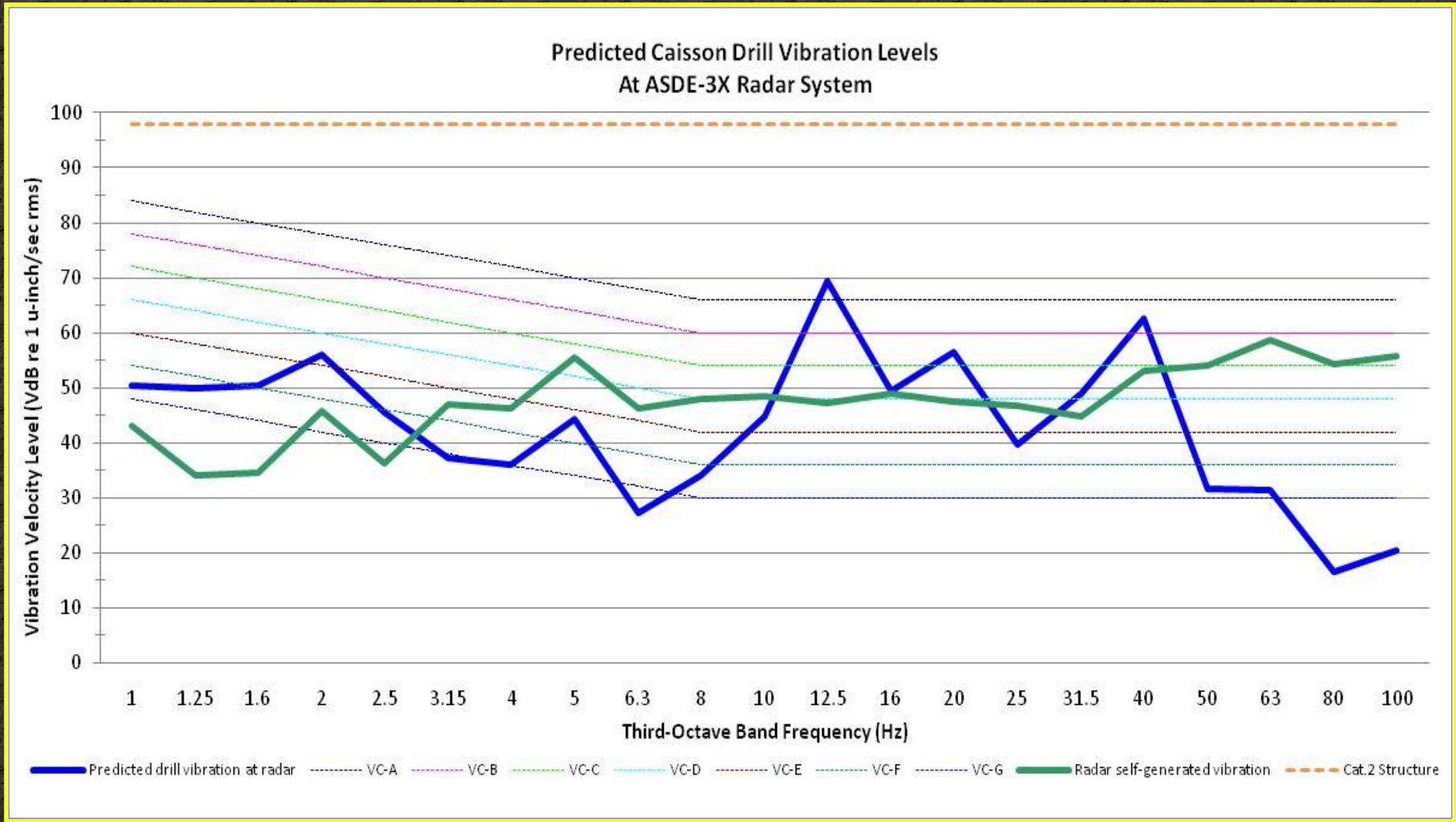
3.) Predicted Results at Radar

Vibration velocity decibels (VdB) at radar pedestal in third-octaves 1 - 100 Hz



4.) Conclusions

- Radar interference or damage not expected
- Suggested safeguards:
  - Pre-excavate top fill
  - No impact equipment
  - Use rotary drill only
  - Monitor vibes not to exceed 0.30 in/sec PPV
- FAA and Airport accepted report's finding
- Work has commenced!