Resonance Problem in Multistage Pump: By the Resonance Institute

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https://www.resonanceinstitute.co/%C3%A7ok-kademeli-pompa-rezonans

Problem Detection:

- The Resonance Institute team visited a factory for a vibration measurement task, which houses the following equipment:
- Hot rolling mill Descale Pumps
- Critical to production
- Working at 3000RPM fixed speed, load variable
- Pump excessive vibration in horizontal direction at 1X frequency. Almost 7-8 times the 1X vibration observed in vertical direction
- Due to high vibration, a failure occurs every 3-4 months.
- The fact that the horizontal vibration is much higher than the vertical vibration is among the symptoms of a mechanical looseness problem.
- In addition, the presence of a bulge - noise floor below the 1X frequency in the velocity spectrum taken from the horizontal brought the resonance problem to the analyst's mind.

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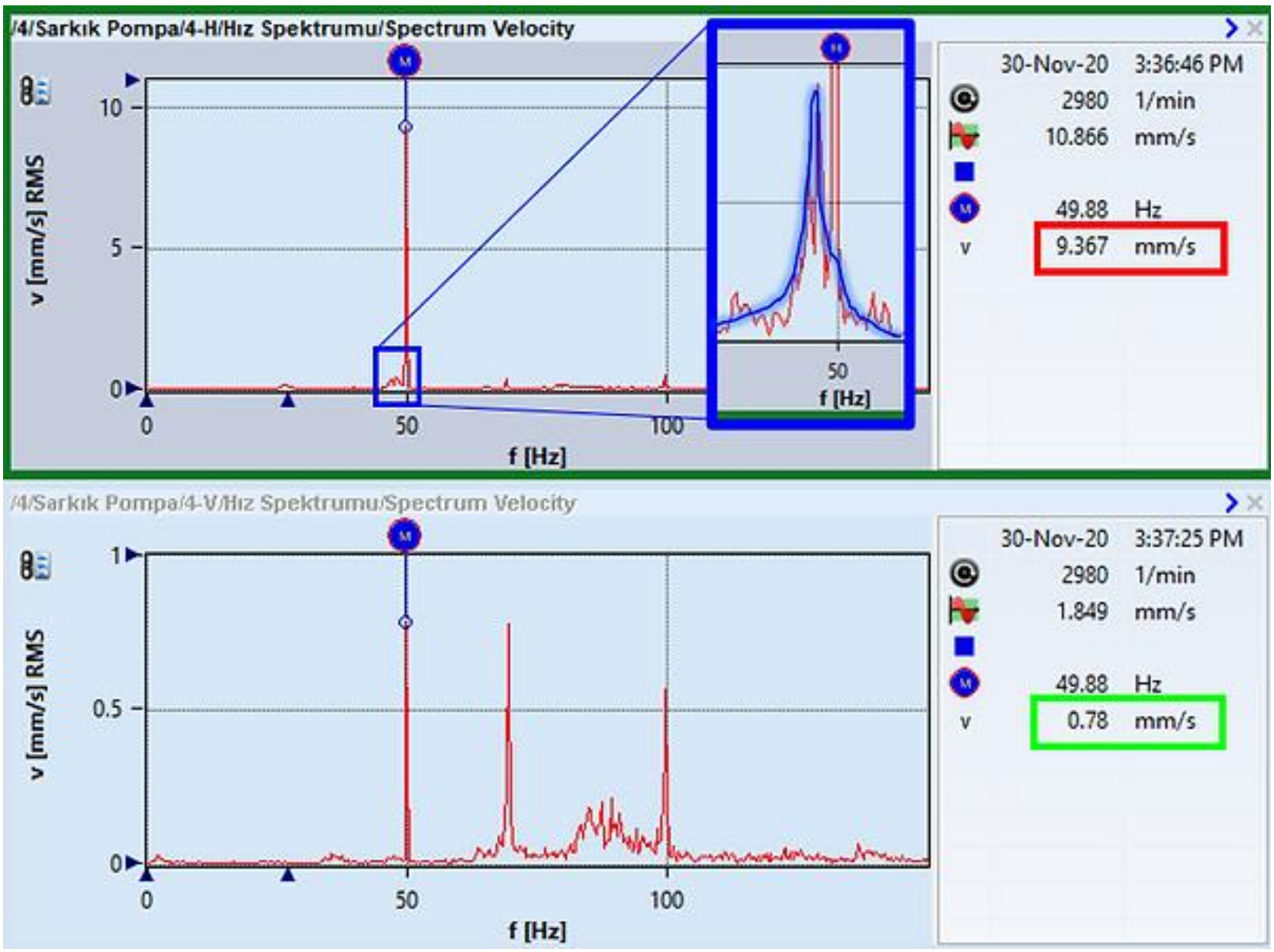

Modal Testing:

- Based on the suspicion of resonance, it was decided to perform the Modal Test measurement.
- Thanks to this measurement, the existence of a possible natural frequency condition in the machine and/or its base can be proven.
- The equipment is stopped during the measurement and shaken at certain points with a “modal hammer” containing a force sensor. At this stage, simultaneous vibration data is collected with the help of accelerometers.
- Force input is given with modal hammer, vibration output is measured with accelerometers. The transfer function in between provides information about the structure dynamics (natural frequency regions, amount of damping, etc.)

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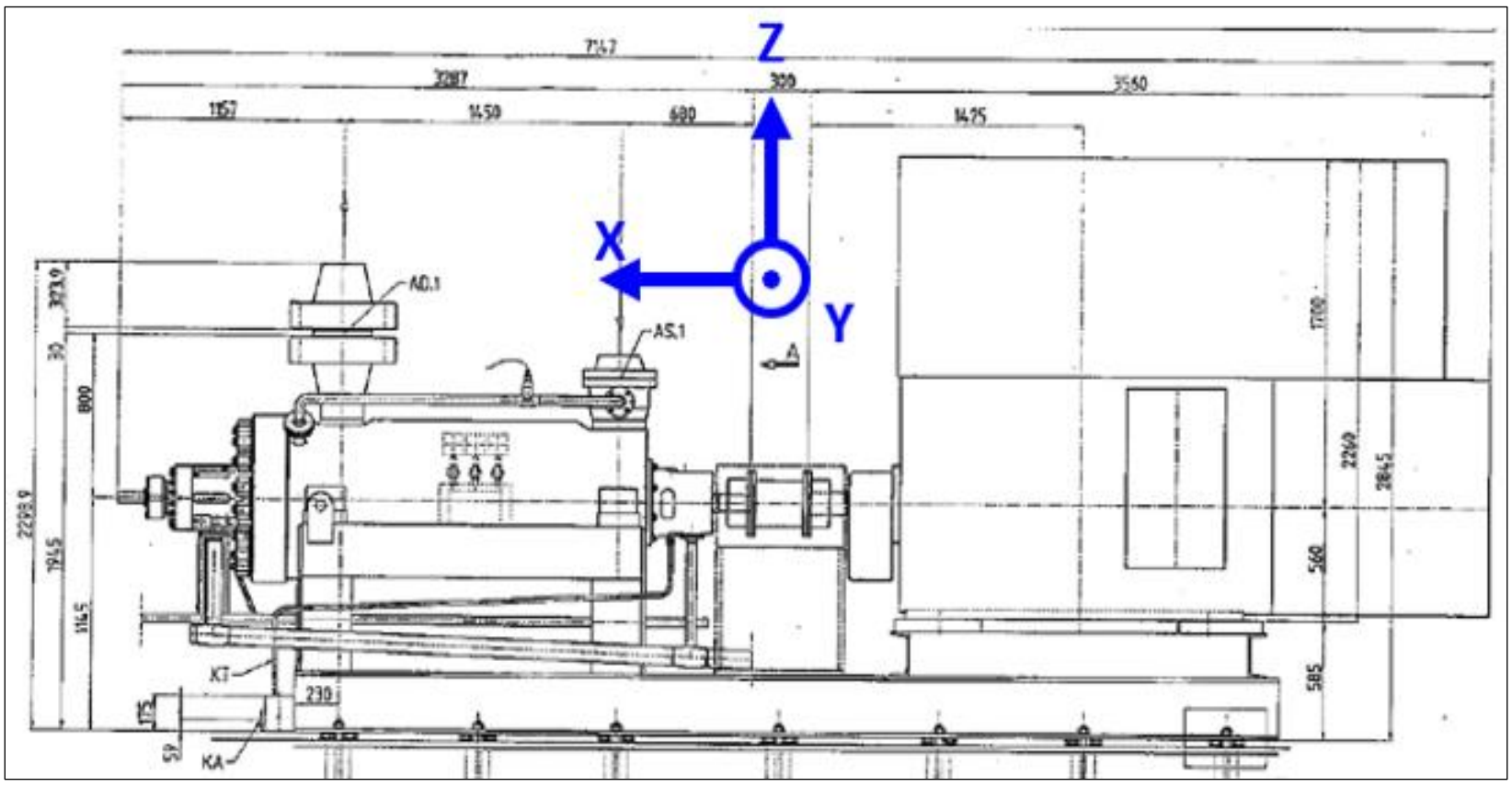
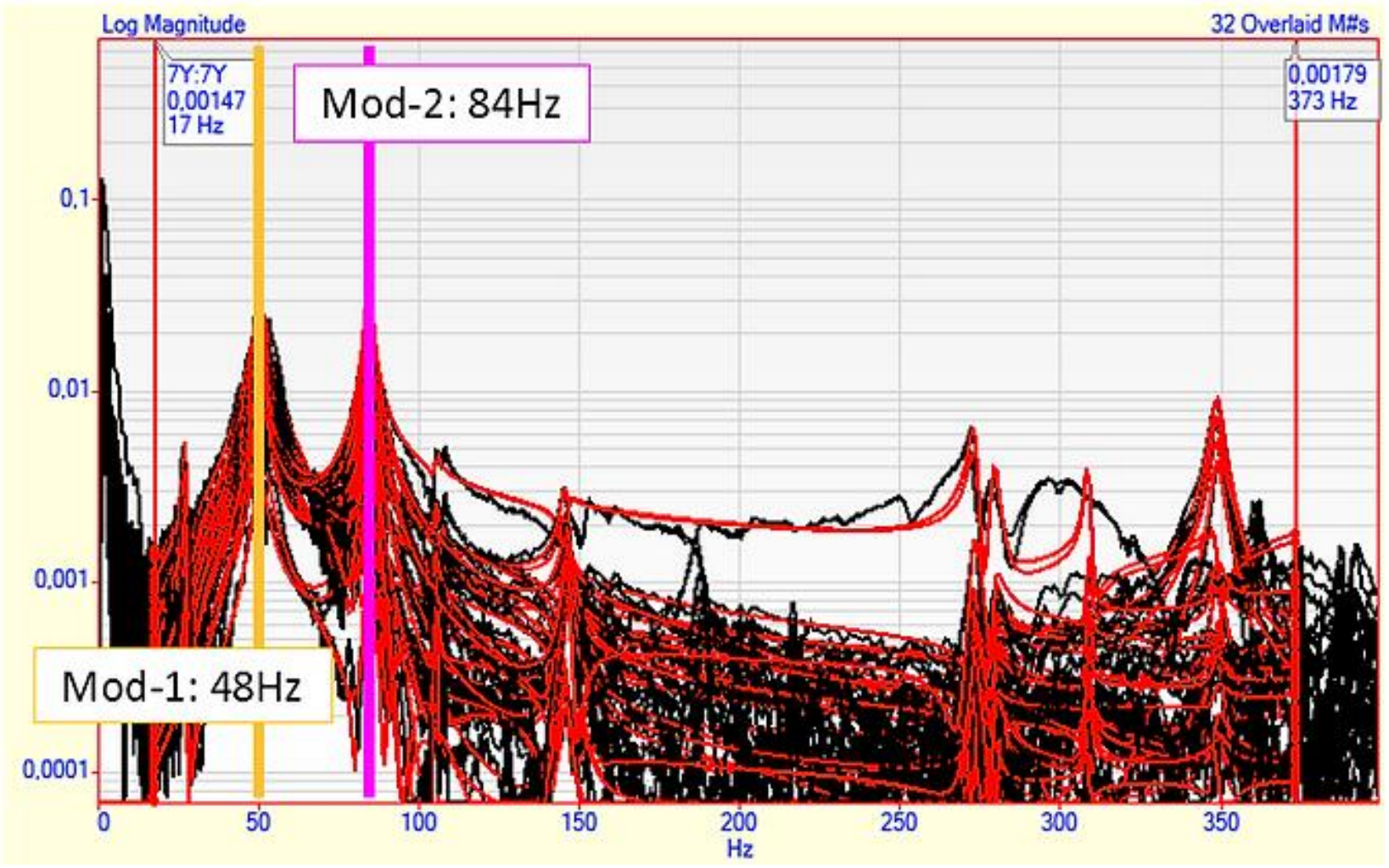


Pump

Engine



- As a result of the Modal Test study, an effective natural frequency in the horizontal direction was determined just below the 1X frequency (48Hz).
- In addition, the existence of another effective natural frequency in the 84 Hz region has also been proven.
- It has been determined that the natural frequencies observed at 48 Hz and 84 Hz are the horizontal 1st and 2nd modes of the pump. The mode shapes of these modes are as seen in the animations below.

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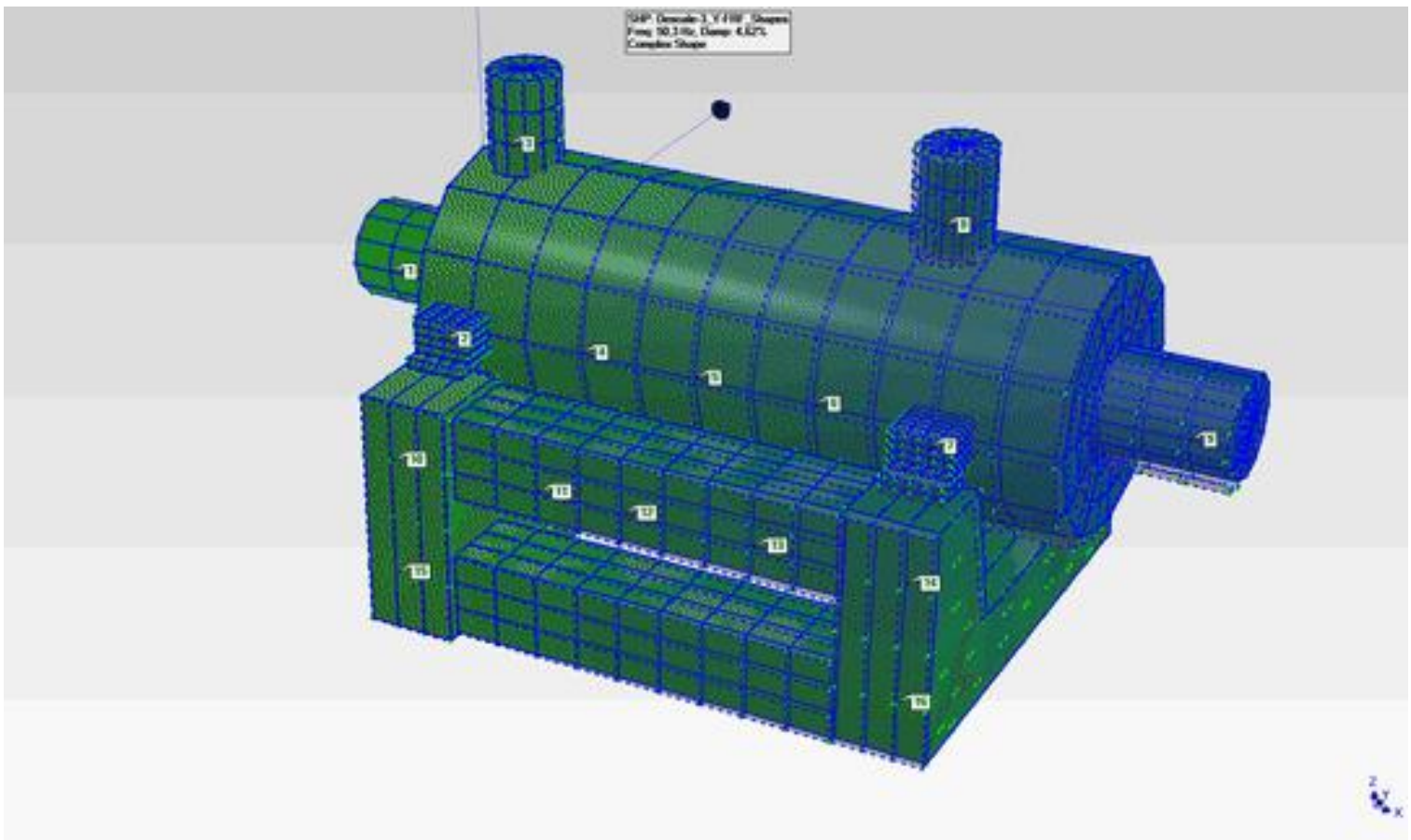
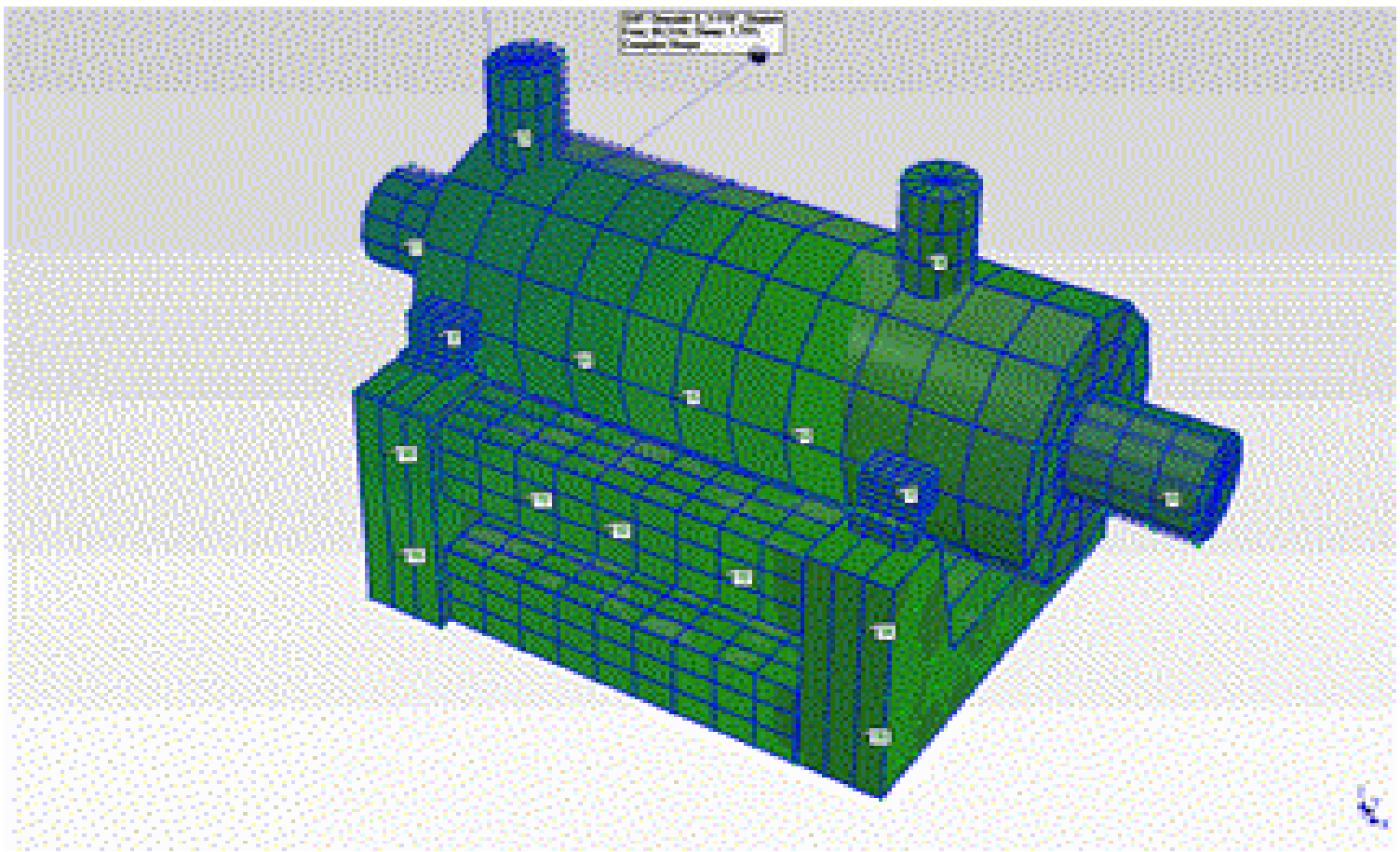
Mode Shapes:

- The mode shapes of the first mode (48Hz) and the second mode (84Hz) are shared on the right.
- By looking at these mode shapes, it is clearly seen that natural frequency regions need to be supported from suitable places in the horizontal direction in order to be moved safely to other frequency ranges.
- The proposed horizontal support work and the actual support structures are as shown below.



Mode-1: 48Hz



Mode-2: 84Hz

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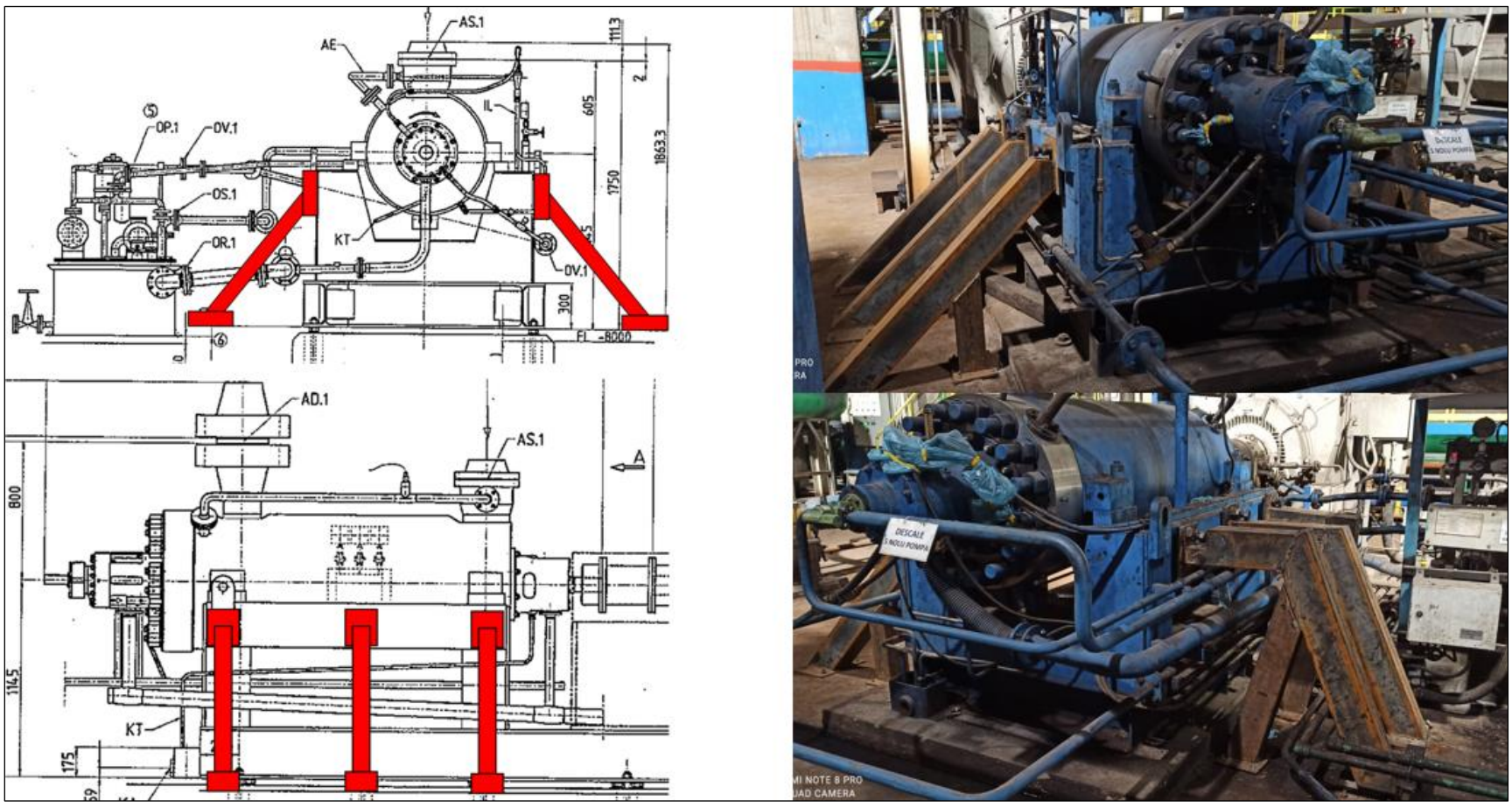
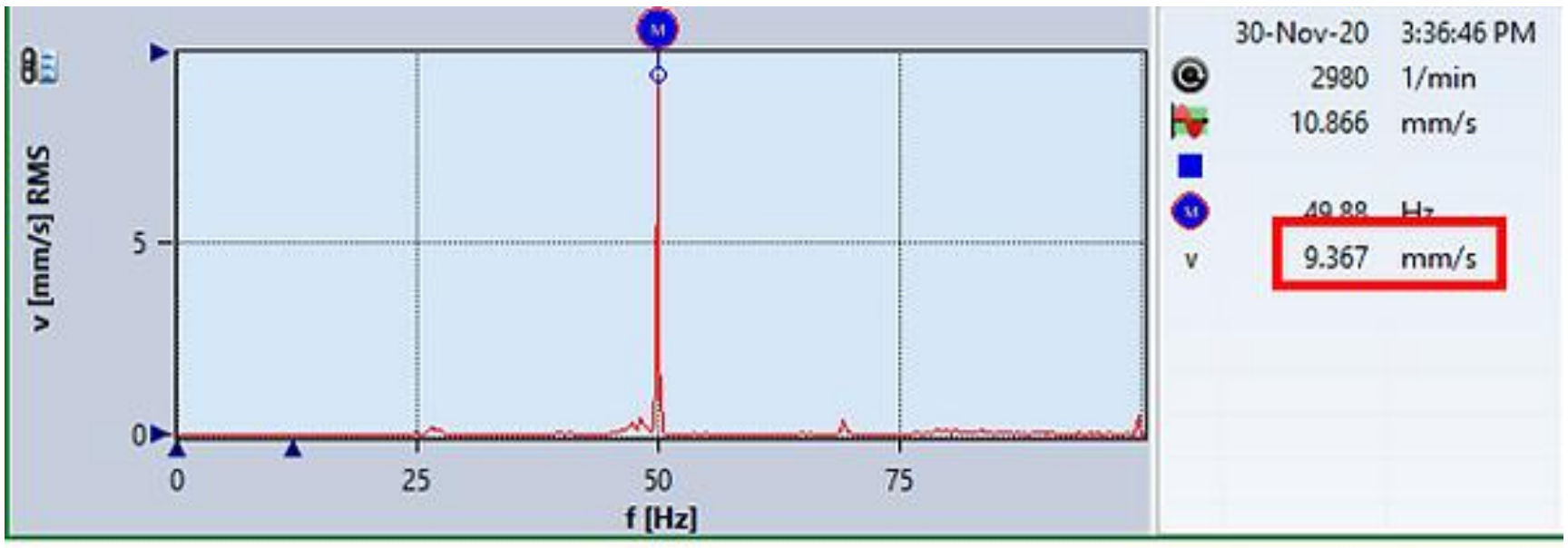
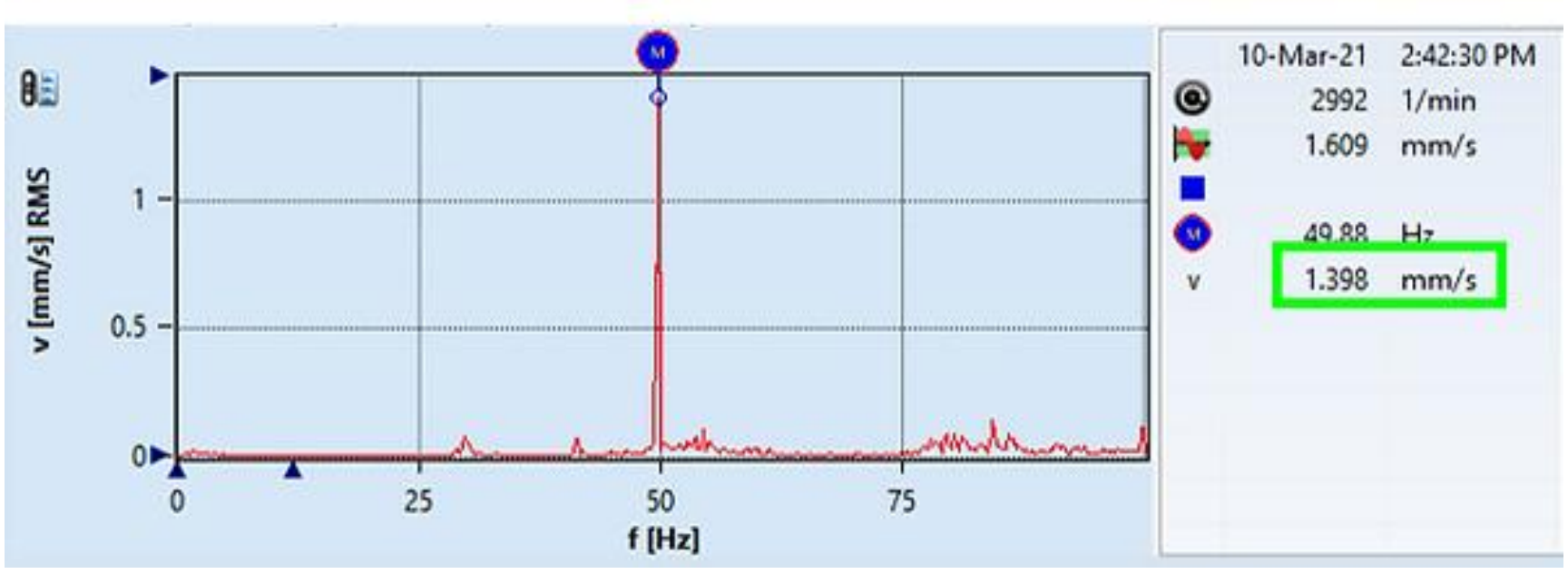
Corrective Actions:



Conclusion:





Pre

Post

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- As a result of supporting the pump horizontally, some shifting (still not enough) occurred in the natural frequency regions and a large reduction in vibration levels was observed (85% improvement).
- It has been observed that the natural frequency in the 48 Hz region, which affects 1X and causes the resonance situation, has shifted to the 54 Hz frequency, thus decreasing the vibrations to some extent.
- Ideally, the natural frequency should be 20% away from the forced vibration frequency (in this case above 60 Hz or below 40 Hz).
- Reducing vibration levels dramatically reduces the likelihood of failure.