Study of the Dynamic Behaviour of a Marine Main Engine Turbocharger's Support

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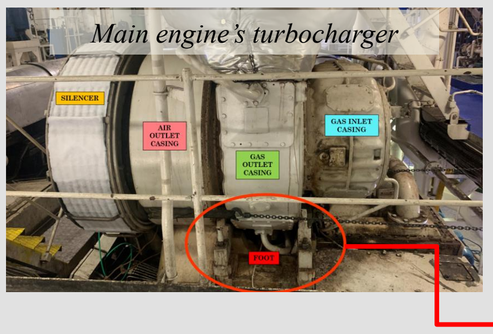
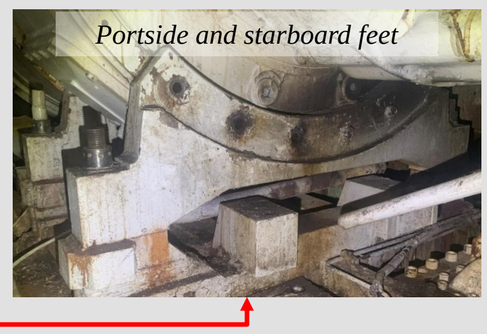
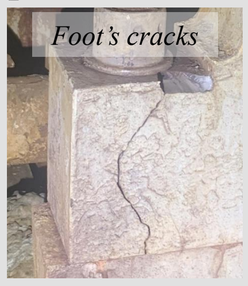
Engine Failure

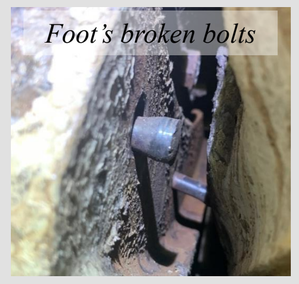
The support structure of the turbocharger of a marine main engine presents several faults



Main engine's turbocharger


Portside and starboard feet


Foot's cracks


Foot's broken bolts

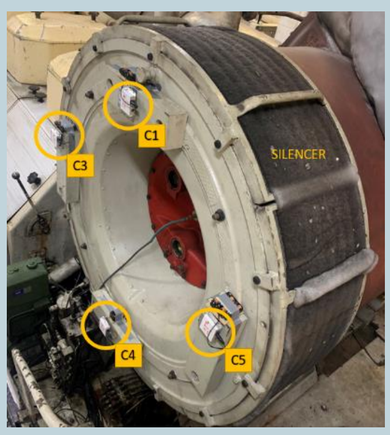

Foot's missing bolts

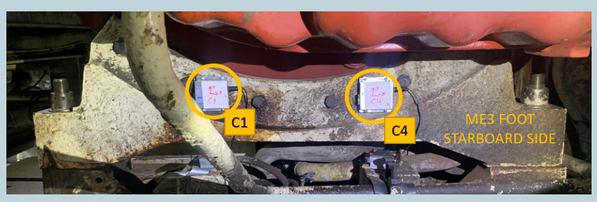
These faults are thought to be caused by the high vibrations of the turbocharger

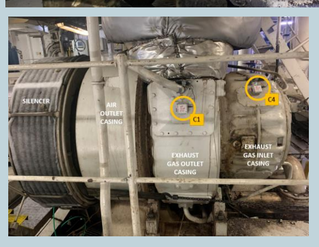
Dynamic Characterization of the Structure

Experimental campaign

The vibrations of the turbocharger are monitored with the use of accelerometers placed along the engine and foot

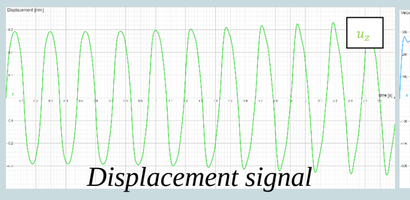




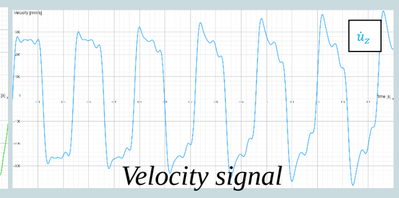


Signal Frequency Decomposition

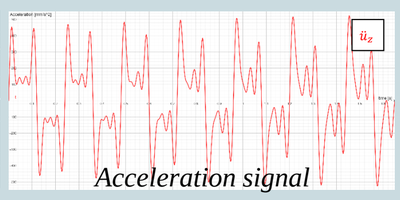
The displacement sinusoidal signals are obtained from the accelerograms and serve as input in the dynamic simulation



Displacement signal

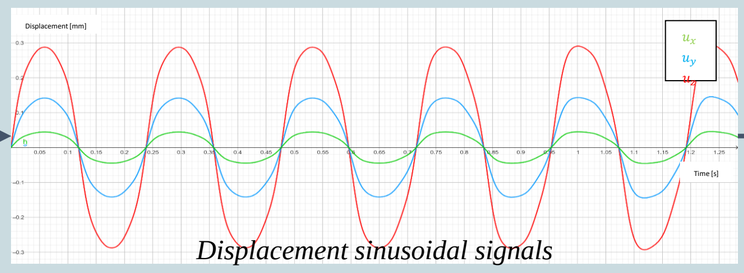


Velocity signal



Acceleration signal

$$u_x(t) = \sum_{i=1}^{3} A_i \sin(w_i t)$$
$$u_y(t) = \sum_{i=1}^{3} A_i \sin(w_i t)$$
$$u_z(t) = \sum_{i=1}^{3} A_i \sin(w_i t)$$

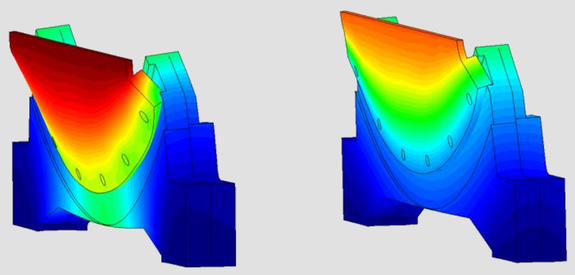


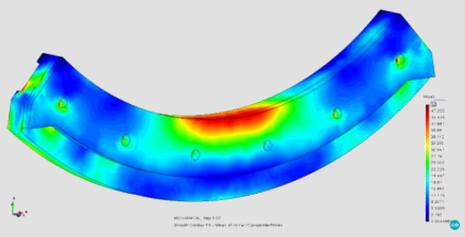
Displacement sinusoidal signals

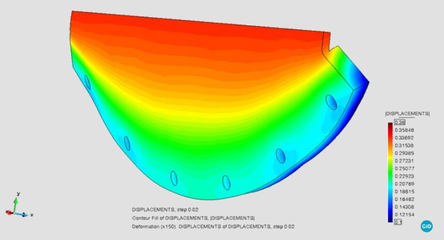
FEM Analysis

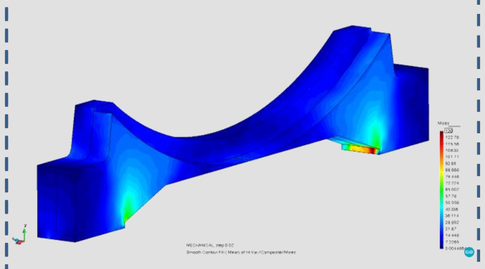
To compare it to the dynamic response, a static load case is analyzed considering self-weight only

Static

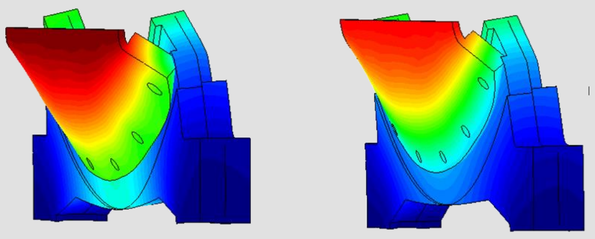

DISPLACEMENT

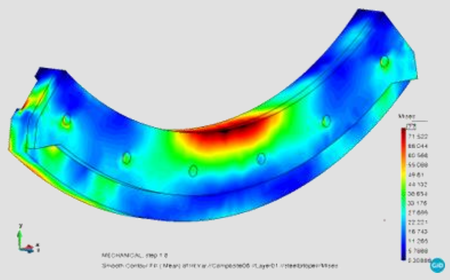

VON-MISES STRESS

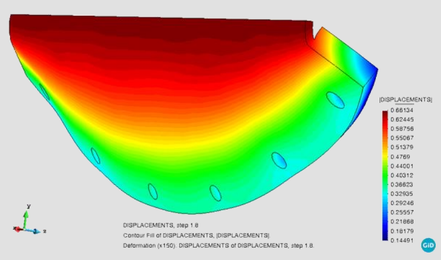

DISPLACEMENT

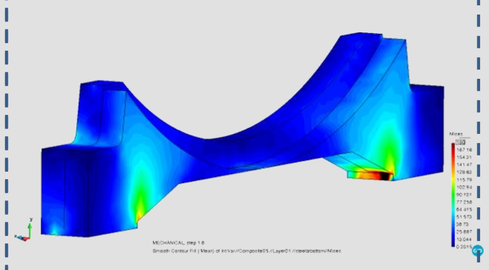

VON-MISES STRESS

Dynamic









It is considered the turbocharger's self-weight and the displacements caused by its vibration

Conclusion

The turbocharger's vibrations amplify the stress of the feet up to 209% from a static condition