ENGINE ROOM COATING APPLICATION REPORT

Prepared By Mert Doganli, Ph.D.

Istanbul Technical Uni. & Texas Tech Uni.

Summary

This report is prepared to show the efficiency of coating application with regards to vibrations and noise.

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info@novosim.com

www.novosim.com

1. Introduction:

Impact tests are done on different parts of vessels in order to understand the response of the structure for a given load. This data in general is called a 'transfer function`. Since the output levels (acceleration in our case) is normalized to applied force, the graph shows the sensitivity of the part under testing for different frequencies.

With this information, all possible resonances of the structure are known and they are independent of the applied load, meaning that a unit input is given and the response is formed only by the dynamic characteristics of the part under study.

This report is an extension to the first report "Impact_Testing_Report_10122018.pdf". The main development is to illustrate the efficiency of the application in the engine room.

A 3 dimensional accelerometer is mounted on the bulkhead with and without Temp Coat-SR-1000 application. Also, in another run, a 3D accelerometer is mounted on the engine mounting structure to identify critical frequencies which may end up causing structure-borne noise in the target locations.

Please check the following Figure (Fig.1) for the impact testing on a coated wall.

Figure 1. Impact testing in longitudinal direction of the yacht.

Figure 2 shows the impact testing to identify the lateral direction sensitivity.

Figure 2. Impact testing in lateral direction of engine support structure.

2. **Results**:

Figure 3 shows the results of “transfer functions” for the coated and uncoated wall up to 1000 Hz. In general structure-borne noise is estimated to be up to 250-300 Hz. Therefore, the critical region is highlighted in the chart.

As shown in the figure (Fig. 3), a drastic improvement is achieved in reducing the vibration levels in x-direction due to a unit input. This means, when the input from the engine takes place, the unit input will raise to a certain level (will depend on mount stiffness, locations and orientation and engine power) , and the acceleration levels will change according to the inputs.

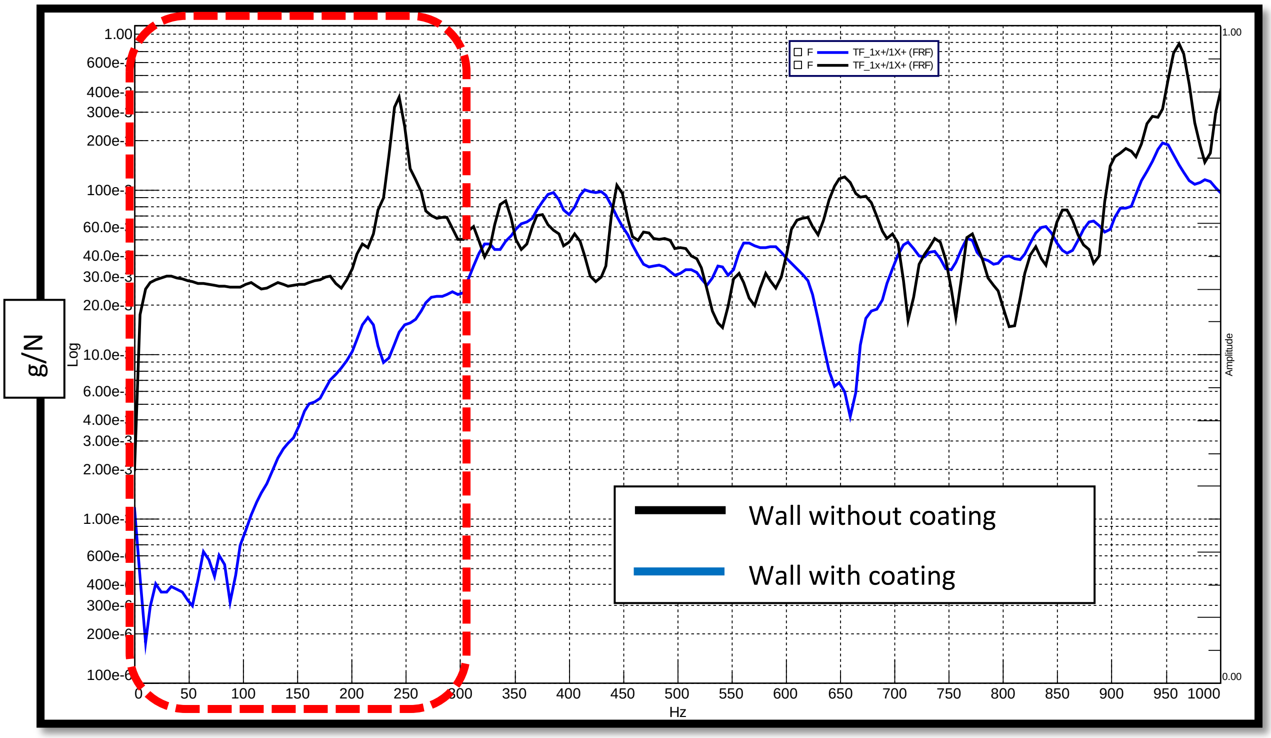

Figure 3. Impact Testing Results for Coated and Uncoated Walls.

Next step during testing was to understand the noise levels generated due to the impacts. Figure 4 shows the results of noise levels measured to due the impact. Under normal measurement conditions, calculation of reverberation time would provide a better insight about the effectiveness of the coating. The doors were not mounted at the time of measurement but in any case the results were shared to have a back to back comparison.

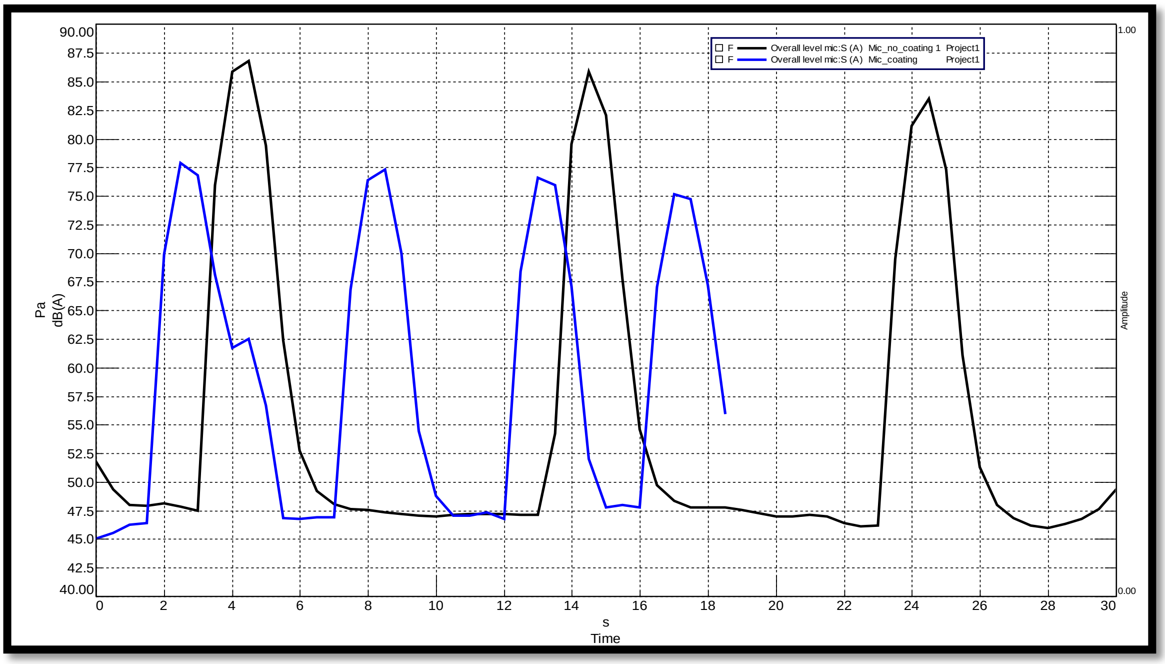

Figure 4. Sound Pressure Levels during Impact Testing.

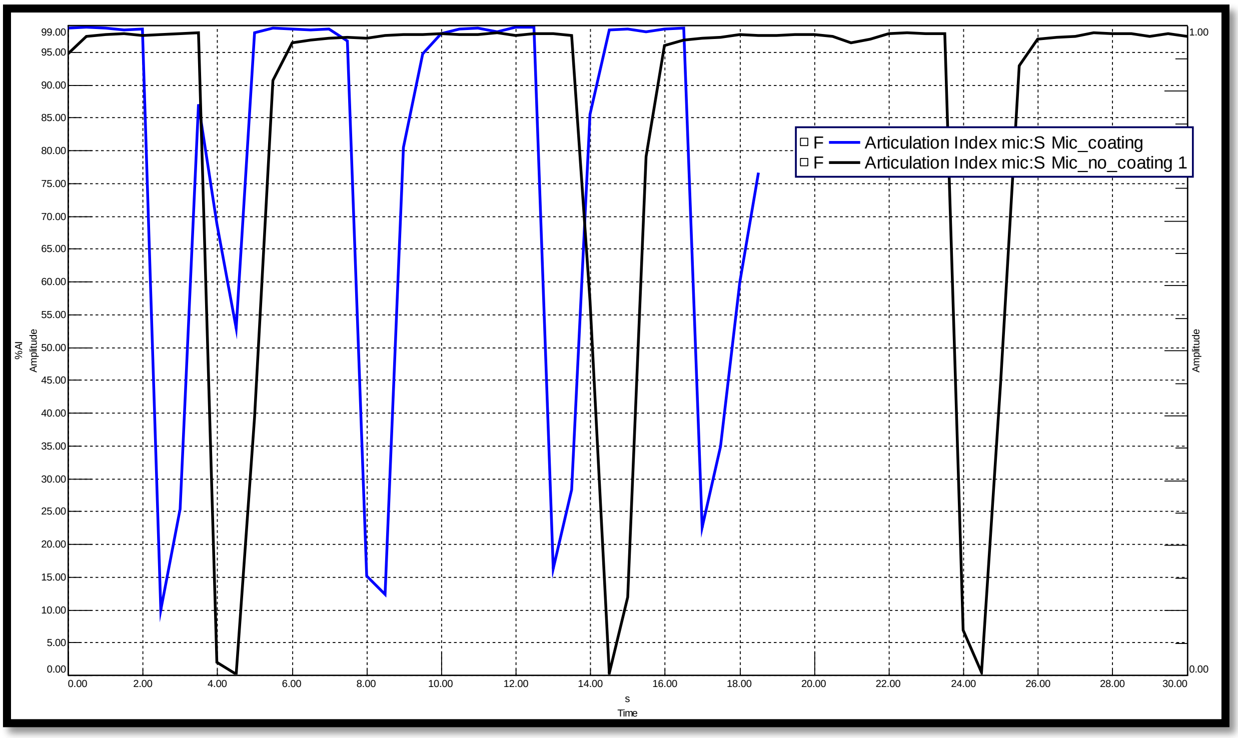

Figure 5. Articulation Index during Impact Testing (Higher Better).

Articulation index is a psycho acoustical metric which is used to understand the intrusion of noise during listening and talking. In some cases, even though the levels may be similar, when people try to talk to each other in the cabins, the frequency of the noise may match with the hearing frequencies and may end up in a poor sound quality.

Another important metric which should be considered is the “reverberation time T60”. Reverberation time is an important metric which is used to show the absorption level of materials used in the room. With a better absorption, reverberation times decreases. Since the doors were not mounted, the initial calculations are shared to give some idea. The calculation is based on the duration of the signal to decrease 60 dB s. In general, the levels will reduce by 25-30 dB s and with the help of an extrapolation, Reverberation Time T60 can be calculated. Please check Figure 6 for rough calculations. These levels should be recalculated for closed rooms.

Type	30 dB	60 dB
Not Coated	1 sec.	2 sec.
Coated	0.91 sec.	1.82 sec.

Figure 6. Reverberation Level Initial Calculations.

Final stage is to highlight any sensitivity which may arise due to engine mounting structure. Lateral direction seems to be the weakest direction and the results for this direction are shared (Figure 7).

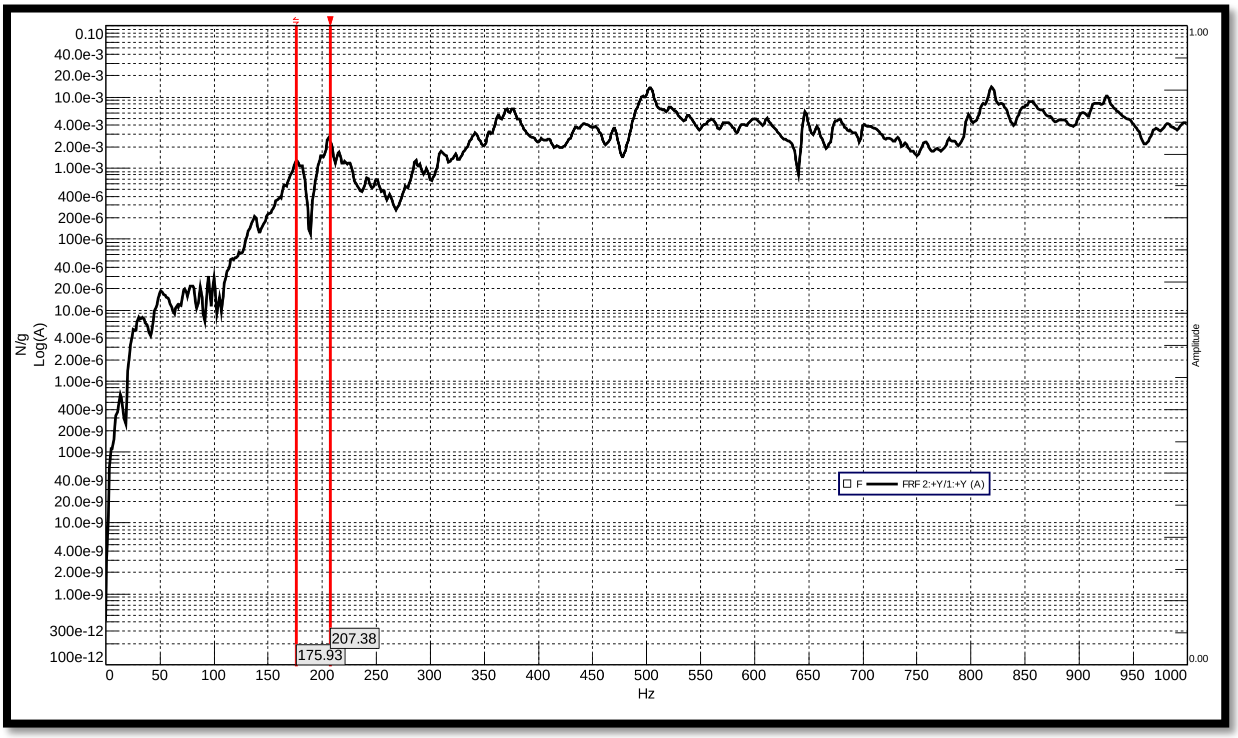

Figure 7. Engine Mounting Structure Sensitivities.

Figure 7 shows the results for possible vibration levels during motor operation. Since, engine is a 6 cylinder inline engine, dominant orders will be 3 and 6. Depending on the max. rpm – (estimated 2400 rpms) , maximum frequency excited will be 240 Hz (for 6th order). Therefore, a structural problem or an extra vibration level may be observed due to engine vibration.

3. **Conclusions**:

1) Transfer functions seem to be improve in critical frequency ranges with the application of coating.
2) AI and Reverberation Time calculations should be repeated to have a better understanding of the system when all enclosures are mounted. Rough, initial calculations are shared.
3) Engine housing structure have resonances in operation range which may cause durability (fatigue related) problems and higher vibration levels.

Customer : Volony Group

Project : Motor Yacht 30 mt

Location : Tuzla -İstanbul /TURKEY