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A Study on Noise and Vibration Characteristics of a 1200 kW Class Marine Reduction Gears

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1. Introduction

Gear noise and vibrations usually originate from gear components' fabrication and assembly error including tooth profile modification error. Such cases are diesel engines of higher power rating utilizing marine reduction gears which are subjected to severe torque variation. For this reason and due to tooth flank load fluctuation and excitation, hammering occurs. Flexible coupling and helical gears are employed to minimize the vibrations between diesel engine and marine gearbox however rotor vibration remains significant. Generated gear vibrations are transmitted to gear casing through the shaft, bearing and other elements; hence it is doable measuring and analyzing gear vibration characteristics using velocity sensor and accelerometer. In this paper, noise and vibration measurement was performed on a 1,200kW class marine reduction gear of Wooyang-friend vessel after her dry dock repair in waters off Busan. Velocity sensor and microphone were fitted on the marine gear box, likewise propulsion system torsional vibration and power measurement were carried out.

2. Experimental details

Table 1 Main engine and gear specifications

Main Engine	Model		6L28/32-V
	Stroke		4
	Output at MCR		1,715 ps
	Speed at MCR		775 rpm
Marine Gear box	Model		MGN2844V
	Gear ratio		3.69
	Number of teeth	Wheel	118
		Pinion	32

Table 1 shows the main engine and marine gear box specification subject for measurement. Fig. 1, 2, and 3 illustrate measurement arrangement schemes. Fig. 1 shows noise and vibration measurement equipment application whereas Fig. 2 locates sensor position for noise and vibration test of the reduction gear. Fig. 3 shows the actual measuring point on reduction gear box MGN2844V. The test was carried out on a sweeping mode at 460~685 rpm speed range. The EVAMOS (**E**ngine **V**ibration **A**nalysis and **MO**nitoring **S**ystem) software, developed by Dynamics Lab. of Mokpo National Maritime University, was used for analysis of structural vibration measurement.

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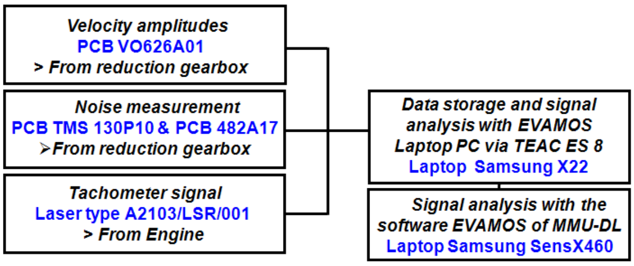

Fig.1 Scheme for noise and vibration test of reduction gear

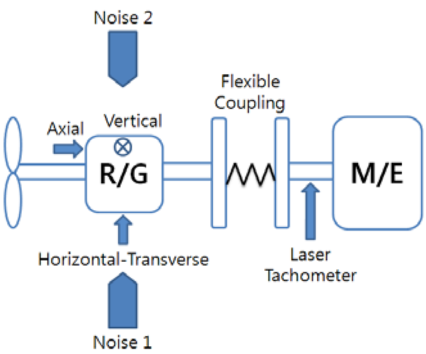

Fig.2 Reduction gear noise and vibration test sensor position

Fig.3 The 1,200kW marine reduction gear (MGN2844V)

3. Experimental results

3.1 The characteristics of vibration

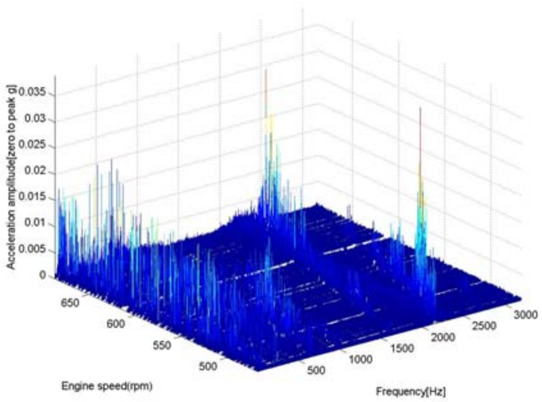

Fig. 4 Axial direction waterfall

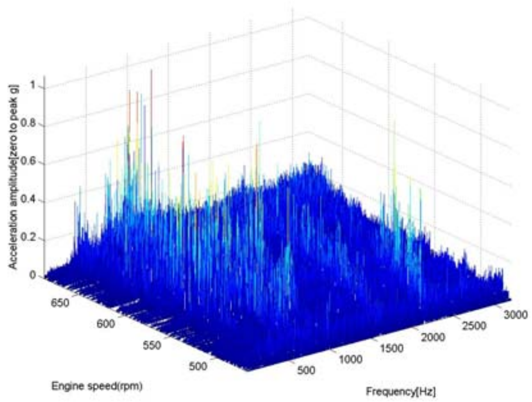

Fig. 5 Horizontal-transverse direction waterfall

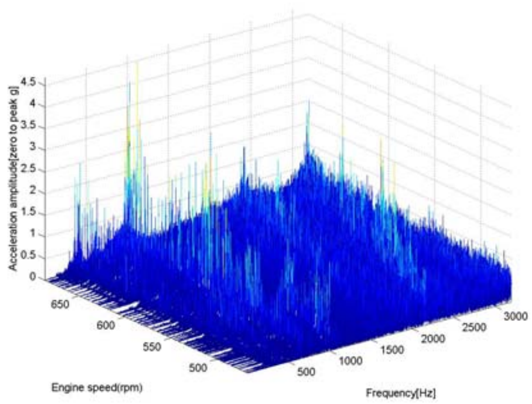

Fig. 6 Vertical direction waterfall

Fig. 4, 5, and 6 shows the vibration characteristics of the marine gear box presented by a waterfall graph for axial, horizontal (transverse) and vertical directions respectively. The GMF (**G**ear **M**esh **F**requency) did not appear highly in this measurement, but only GMFx4 can be found about 0.54 g (0.082 g lower than the highest value at Hor. direction between 560~575 rpm). Otherwise vibrations were structural largely. The highest amplitude was occurred at Ver. direction near 674, 579 rpm, about 2.55 g with structural vibration. Both Hor. and Ver. direction were dominant as GMFx2.65. Axial vibration had the smallest value. The highest value of axial direction was about 0.028 g (GMFx0.15, or 5th order of engine speed) near 628 rpm speed with also structural vibration. The peak value of near 2300 Hz can be considered as the structural vibration.

3.2 The characteristics of noise

Fig. 7 shows the noise level at engine speed 674 rpm of the vertical vibration maximum point. As a result, gear vibration did not give influences to noise. In this figure, the noise was dominant at center frequency of 1 kHz and 2 kHz and was estimated the gear assembly and shaft vibration condition as a criterion.

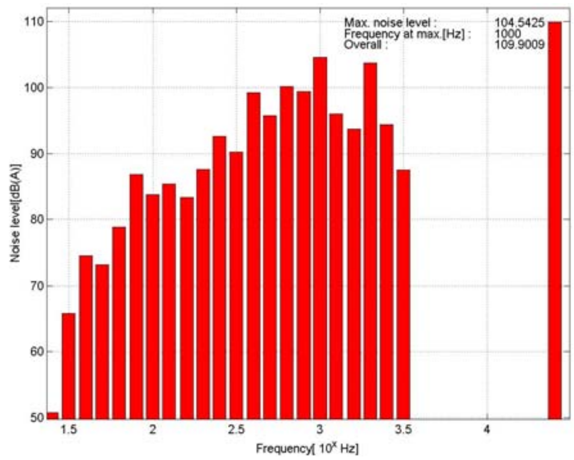

Fig. 7 Octave analysis result at noise measurement position 1

4. Conclusion

The regulation of gear vibration, but these cannot apply with whole fields. In this study, vibration and noise as well as torsional vibration and power were measured by checking of Wooyang-friend ship finished dry dock repair in order to check the characteristics of marine gearbox vibration during sea trial after finish building.

As a result, structural vibration, especially GMFx2.65 at Hor. and Ver. direction, was higher than GMF. The noise of the highest amplitude among directions was dominant at 1 kHz and 2 kHz and did not take influences from gear vibration. The structural vibration and gear noise should be handled separately. Authors will continue the study through field measurement with theoretical way.