

Vibroacoustic coupling of liquid filled piping with rubber hose and elastic supports

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Piping system in power plants, oil supply system and many other industries always undergo heavy vibration and acoustic excitation from pump and valve. Rubber hose and elastic support are commonly used to reduce the pipe vibration. This paper presents a substructure based simulation method for vibroacoustic coupling in liquid-filled piping in frequency domain. In this method, the piping system is first divided into substructures, and then their impedance matrices are obtained by analytic or experimental method. Next, the impedance matrices and exciting forces are assembled into algebraic equations according to consistency and equilibrium conditions at the substructure joints. Finally, the equations are solved, thus the piping response is acquired. Poisson coupling and junction coupling are involved in this method.

After the substructure based modeling method is presented, this paper focuses on the fluid structure interaction behavior of a water filled steel spatial piping. The piping response is measured at three configurations. At first, the piping is hanged by soft rope and excited by an electric shaker. Then it is mounted with elastic supports on steel bases. The piping then divided into two parts, jointed together with a rubber hose, and fastened again on the same supports.

According to the experimented and simulated results on these three piping configurations, several conclusions are drawn. First, the Poisson coupling is of

ignorable relative to the junction coupling at low frequencies. Second, power flow distribution in structure and fluid is mainly subject to excitation source. Most of the energy exchange between structure and fluid is contributed to junction coupling. Third, elastic supports hardly influence the fluid structure interaction in piping system, while rubber hose can significantly reduce the sound power flow transmission to piping structure.

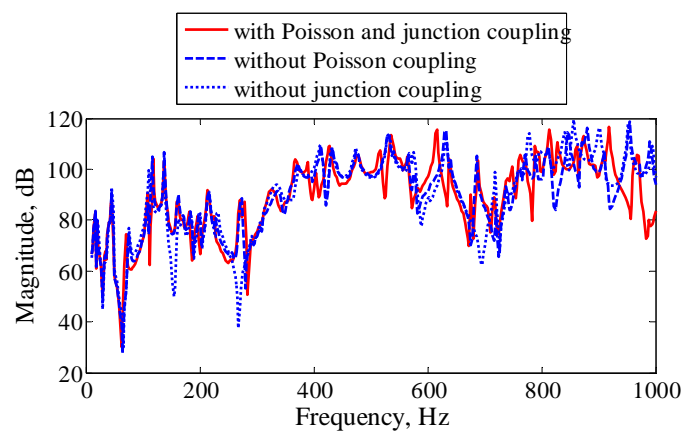


Fig.1 Comparison between the influence of Poisson coupling and junction coupling on piping response

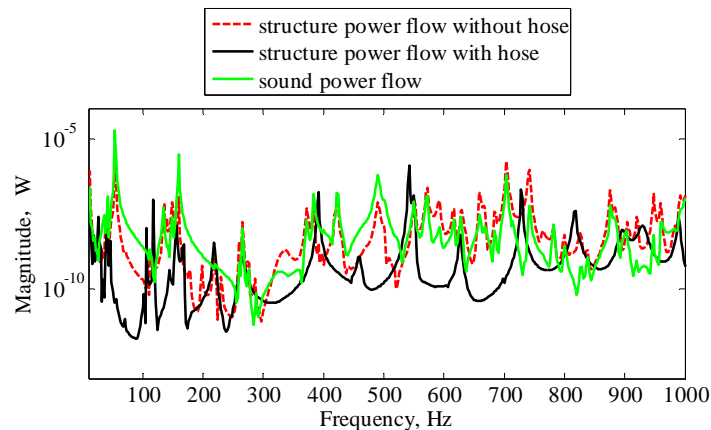


Fig.2 Structure power flow with and without a rubber hose in piping under sound excitation