현장 타설용 고분자 감쇠재의 탄성 계수를 측정하기 위한 실험 기법

Dynamic Test method to Determine Modulus of Elasticity of Sound Insulating Coat

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Abstract

The main purpose of this paper is to present the dynamic test method developed for measuring the elastic modulus of sound insulating coat. The test setup was devised based on the theoretical natural frequency of a simply-supported beam subject to free transverse vibration. A stainless steel beam was tested and the result showed a good compliance with the standard value listed in literatures. The result indicates that the test set up can serve as a quick, economical and suitable scheme to test non self-supporting materials.

키 워 드 : 동적탄성계수, 감쇠재, 횡진동
Keywords : dynamic modulus of elasticity, sound insulating coat, transverse vibration

1. Introduction

Stiffness is an important property of material that is designed to insulate noise and vibration of structure. To determine the elastic modulus of material, static and dynamic tests can be performed. However, dynamic method is not conventional and requires special equipments. In previous study, Chunhui et al. measured the dynamic modulus of elasticity (E_d) of woods by transversely vibrating cantilever beam and recording its transverse displacement at the free end using a laser sensor[1]. However, the varying angle at the free end of the cantilever beam, during vibration, can result in erroneous displacement measurements by laser sensor. Hence, in this study, an alternative test setup was prepared for a simply-supported beam such that the slope of the beam at the mid-span, the location of sensor reading, remains constant.

2. Theoretical Background

The vibration beam technique is hinged upon the modal characteristics of the beam. The expression relating the first mode (fundamental natural frequency) of a freely vibrating simply-supported beam and dynamic elastic modulus of the beam is given by equation (1)[2].

$$f_{1n} = \frac{1}{2\pi}\left(\frac{3.1416^2}{l^2}\right)\sqrt{\frac{E_d I}{m_u}} \qquad (1)$$

Where f_{1n} is the fundamental natural frequency of the simply supported beam(Hz), E_d is the dynamic elastic modulus of the beam (N/m^2), I is the moment of inertia of the beam(m^4), m_u is mass per unit length of the beam (Kg/m) and l is the free length of the beam (m).

3. Experimental Apparatus and Test Procedure

The test setup consists of the following components: motion controller, personal computer(PC), motor drivers, power supply, motors, steel disc, gears, laser sensor, data logger and a mounting frame. The steel discs were mounted to the left and right of the specimen and slide against the edge of the specimen to trigger the free vibration of the specimen. The two discs were

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driven by the motors. The mid-span transverse displacements of the vibrating specimen were measured by the laser sensor positioned at the mid-span and all data were recorded by dynamic data logger at a sampling rate, much greater than the expected natural frequency.

The test procedure is as per the flow chart shown below:

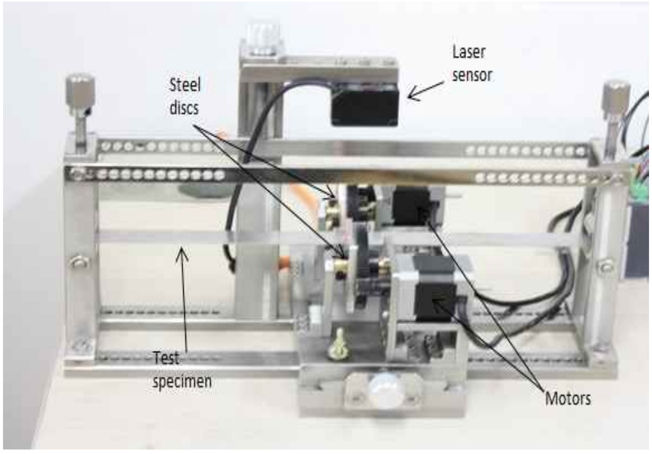

Figure. 1. Test setup

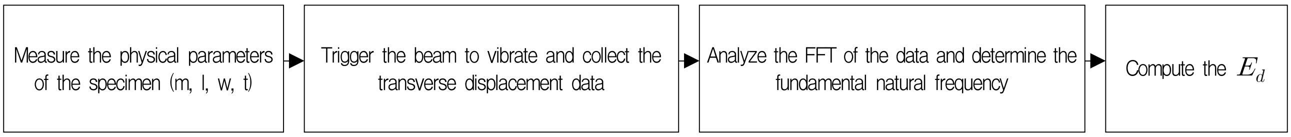

Figure. 2. Test procedure flow chart

4. Test result

A test was conducted on stainless steel specimen with three different lengths to verify the experimental method. The mean dynamic modulus of the steel was found to be 209.67GPa.

Table 1. Test result

Specimen	Mass(Kg)	Length(mm)	Width(mm)	Thickness(mm)	E_d(GPa)
1	73.41	325	25	1.14	211
2	76.86	340	25	1.14	210
3	79.89	355	25	1.14	208

5. Conclusion

The obtained test result was found to be satisfactory with the standard modulus value reported for steel. The results suggested that the devised set up suitable to be used to test non self-supporting materials such as the sound insulating coat as a composite beam.

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