Development of Floor Vibration Analysis System using aFinite Element Analysis called "Yurayzer3"

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Summary

In this paper we describe a new system floor vibration analysis using a finite element method which makes it easy for users to input data and visualize results. This system is linear elastic vibration analysis software called "Yurayzer3". It comprises a pre-processor unit, a calculation unit and a post-processor unit. The chief innovation of this system is the in-house development of a pre-processor and post-processor that simplifies the numerical inputs of information about nodes and elements. In order to verify the analytical accuracy of this system, the eigenvalue analysis is carried out and compared with measured values. This comparison showed a coefficient of variation about 10%, which is a level of agreement sufficient for the structural design phase.

Keywords: vibration, analysis, finite element method, pre-processor, post-processor, eigenvalue analysis

1. Introduction

In this study we developed the “Yurayzer 3” calculation tool to resolve these problems by using the Galerkin method based on weighted residual procedure. ”Yurayzer3” has three chief components a pre-processor unit, a calculation unit and a post-processor unit.

2. Field measurements of floor vibration

Vibration characteristics of floor slabs in full-scale buildings were measured. Field measurements were carried out using accelerometers set on the floor slab under three types of external force – an impact hammer, heel shock by walking and shock wave oscillation by impact machine. Data was collected from about 20 slabs and compared with calculated results.

3. Modelling of analysis object

When analysis object scale area is too large, it is difficult to calculate the full scale of structure. So a part of the structure is considered – a natural approach to solving a larger-scale problem. However, configuration of the boundary condition affects the calculation result. So two pattern cases of floor span area are considered and compared with the measured results. In the first case, only one floor span is considered; in the second 3×3 spans around target floor span are also considered. These situations are shown in fig1. Typical modal shape of calculated result is shown in fig2.

3.1 Comparison of measurements and calculated results

Comparison of measurements and calculated results are shown in Figure 3 and Table 1. These results suggest the result that variation coefficient is about 10% in these comparisons. This is a good result, at least for structural design stage.

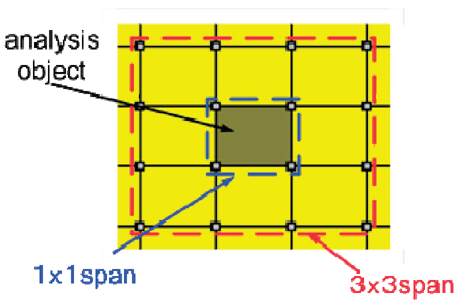

Fig. 1: Modelling of analysis object

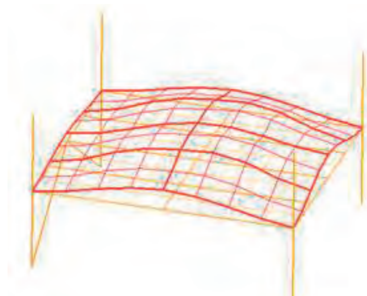

Fig. 2: Sample of 1-st order vibration mode

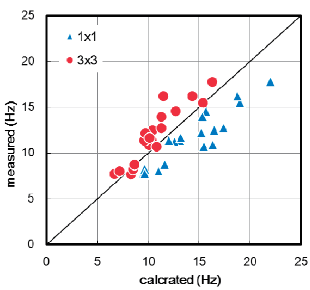

Fig. 3: Comparison with calculated and measured results of 1-st eigenvalue

Table 1: Statistical properties comparison result with calculated and measurement

	1x1	3x3
N	20	20
average	1.22	0.90
standard deviation	0.145	0.088
variation coefficient	**11.9%**	**9.7%**

measurements vs calculated value