AMBENT VIBRATION MEASUREMENT OF LARGE SPAN ROOF

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Abstract

Full-scale measurement of a large-span roof structure was conducted and the dynamic characteristics such as natural frequency, mode shape, damping ratio were identified by FDD.

1 Introduction

In order to evaluate dynamic responses of buildings, their dynamic characteristics such as natural frequencies, vibration modes and damping ratios should be accurately known. It is well known that a dynamic structure can be damped by mechanisms with different internal and external characteristics: friction between atomic/molecular or different parts, impacts, air/fluid resistance, and so on. In this paper, full-scale measurement was carried out on a large-span roof structure to identify the dynamic characteristics.

2 Outline of Field Measurement

Ambient response measurements were performed on a large-span roof 42.8m high, 108m wide, and 49m deep in cantilever form, as shown in Photo 1. Servo-type accelerometers were installed on top of a roof beam to measure the vertical acceleration. Three accelerometers were set as reference measurement points and the other 12 accelerometers were set as moving measurement points. The ambient response measurements were carried out for 4 setups, and a total of 51 measurement points were obtained, as shown in Fig. 1. The sampling rate was set at 100Hz, and the ambient responses were measured for 1 hour in 1 setup.

3 System Identification by FDD

Figure 2 shows the SVD plot of large span roof obtained by FDD\textsuperscript{1,2}. There were many peaks of less than 10Hz, and it was possible to obtain up to the 15th mode below 6Hz. The mode shapes up to the 15th mode obtained by the FDD method are shown in Fig. 8. Mode shapes could be
estimated very clearly in spite of the ambient response measurements. The natural frequencies obtained by the FEM analysis and field measurement are shown in Table 2. The five modes are compared with the natural frequency corresponding to them. By comparing the FEM and FDD results, we find that the natural frequency obtained from the field measurements is about 10% higher than that obtained from the FEM analysis. This is considered to be due to stiffness of the secondary member \[3\], which is not estimated by the FEM model.

![Fig. 2 SVD plot obtained by FDD](image)

![Fig.21 Mode shape obtained by FDD](image)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Natural Frequency (Hz)</th>
<th>Difference (%)</th>
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<tr>
<td>1st</td>
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### 4 Conclusion

Full-scale measurement of a large-span roof structure was conducted and the dynamic characteristics such as natural frequency, mode shape, damping ratio were identified by FDD. As the results, it was possible to obtain up to the 15th mode shape below 6Hz.

### 5 References

