The Estimation of V value of the vibration criteria curve of Void-slabs by the shock of the Impact ball

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INTRODUCTION

Large-span beamless void-slabs in the housing complex have come to be used recently because of less restriction for floor planning. However, the natural frequency of a large-span beamless void-slab has the possibility to fall below 20Hz, and if it is not designed appropriately, there is a possibility of causing the vibration problem. In order to examine a new design method, the vibration experiments was done with the 58 slabs.

PURPOSE OF STUDY

Study of the way for evaluation of habitability to void slab vibration by dropping the impact ball to the slab.

Dynamic characteristic of impact ball

Result of impact power measurement of different height of ball drops.

The impact power characteristic of ball drop is stipulated by JIS(Japanese Industrial standard) A1418-2 at drop height of only 1.0m.
The coefficient of restitution of ball is showed by the regression line in Figure 6.

The impact force of the ball drop is confirmed to be linear with ball drop height within 1.0m.

OUTLINE OF THE EXPERIMENT SITE

The floor vibration experiment was done with the 58 slabs of some general housing complexes. Figure 7 shows one example of the housing complex.

Floor vibration experiment method

The experiment measured the vibration response at the center of the slab for one house unit of the building under construction. Impact source are one man person walking, two person walking, heel impact, ball drop with height 1.0m, 0.5m, 0.2m, 0.1m. The analysis items are peak of the response acceleration, peak of the response frequency, the response acceleration of 1/3 octave band frequency at dynamic response 10msec of the real time analyzer.
Result of floor vibration experiment

Response acceleration of the slab is almost proportionate to the height of ball drop and is shown by the regression curve in Fig.13 and 14.

Relation between the ball drop height and response acceleration

Regression curve of response acceleration of slabs correspond to different height of ball drop

Table 1. The parameter of the house unit, natural frequency of slabs, response acceleration and so on

Frequency characteristic of 1/3octave band response acceleration has a peak at the band of natural frequency of the slab and at the frequency band, peak is seemed to be proportionate to the impact power of source.

Relation between the difference of impact source and 1/3octave band response acceleration spectrum

Response 1/3 octave band acceleration spectrum among all slabs
Correlation between response acceleration of ball drop 1.0m and others
The correlation of the response acceleration of the ball drop 1.0m and one person walking is small ($R^2=0.06$), because impulse power of walking is seemed to be unstable even walker is same person.

Estimation of impulse of ball drop

Equation of conservation of momentum

$$m_z v_2 = (1 + \mu)m_1 v_1 = (1 + \mu) m_1 \times \sqrt{2gh} \quad \text{Equation -1}$$

Estimation of ball drop impulse at height of $h$(m)

$$I = (1 + \mu) m_1 \times \sqrt{2gh} = (1 - 0.0358 \times h + 0.8897) \times 2.5 \times \sqrt{2 \times 9.8 \times h} \quad \text{Equation -2}$$

Estimation of response acceleration of slab by exciting of design impulse $I_r$

$$A_r = A_0 \times \frac{I}{I_0} = A_0 \times \frac{(1 - 0.0358 h + 0.8897) \times \sqrt{h}}{(1 + 0.85) \times 1} \quad \text{Equation -3}$$

**CONCLUSION**

As the impact power(impulse) of ball drop can be reduced, response acceleration of walking and so on can be almost estimated by ball drop 1.0m by equation-3, and used for evaluating the habitability to vibration by V value of AIJ Guide Line.