SELF-PROPELLED IMPACT VIBRATION EQUIPMENT AND EVALUATION OF DETERIORATION DEGREE OF BRIDGE SLAB

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1. INTRODUCTION

A lot of fatigue damage of reinforced concrete slabs of highway bridges have been seen in Japan. Most of those bridges were built in the high growth of the Japanese economy period 1965-1980 (Japan road association 1956, 2002). Currently, a number of bridges have been aging passed nearly half a century, it is reality that those bridges have been in service while repeating repair and reinforcement. Therefore, the maintenance of bridges is an important issue[3]. In this paper, SIVE (Self-propelled Impact Vibration Equipment) was developed to evaluate the deterioration degree of slab simply and rationally. It can make small turns by a simple operation using hands. The equipment also can change a mass of a falling weight, a height and a rubber condition used as cushion system. Several investigation concerning those parameters were done and shown.

2. SELF-PROPELLED IMPACT VIBRATION EQUIPMENT

Impact equipment is generally required to have large energy ability and mobility at site, otherwise it becomes difficult to generate an enough vibration to whole highway bridge or slab plate of bridge. Here, developed equipment for this aim is introduced.

Overview of SIVE is shown in Figure.1. It can make small turns by a simple operation using hands. The equipment consist of a large two parts, namely forklift truck to move on floor of bridge and impact equipment to generate vibration. Former is electric truck, which works by in the battery and supplies necessary power to the impact occurrence equipment, the measuring equipment and personal computer.

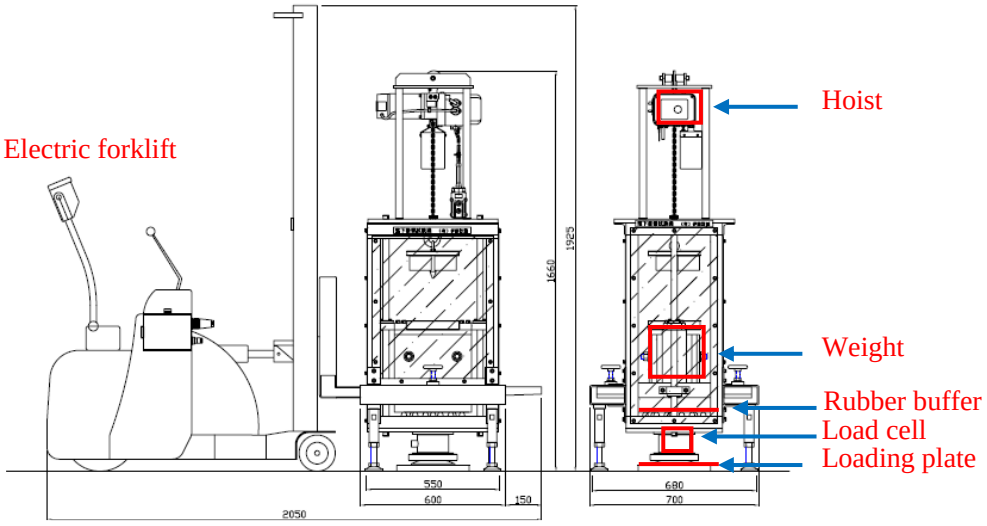


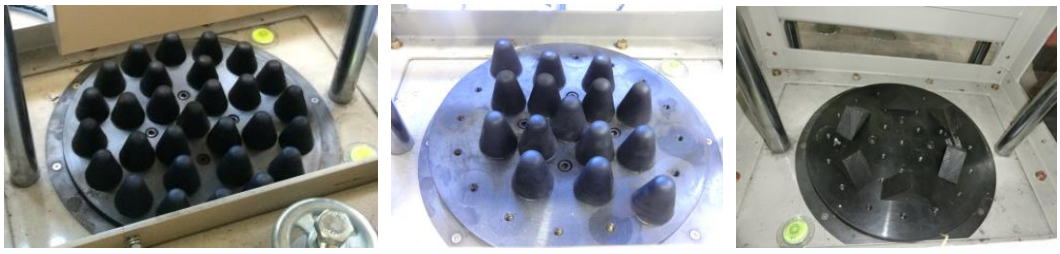
Fig. 1 Overview of SIVE (Self-propelled Impact Vibration Equipment)

The latter equipment consists of the hoist lifting a weight, steel weight, rubber buffer, load cell and loading plate. Maximum mass of weight is 220 kg and maximum falling height is 0.3 m. Capacity of energy and momentum are respectively 0.65 kJ, 0.44 kNs.

3. RESULTS OF EXPERIMENTS

Figure 2 shows rubber buffer Type, A, B and C. In Type A and B, respectively 29 of rubber cone and 15 were arranged.

In Type C, 6 low rebound triangle



Type A Type B Type C

Fig.2 Rubber buffer

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rubbers were arranged.

Fig.3 shows the first impact force and the impulse by first impact for the mass M_w=220 kg, falling height H_f=0.3 m, using buffer Type A. It can been seen that the maximum force and the duration of force are approximately 90 kN and 0.3 s. It was confirmed that weight had repeatedly rebound many times by the influence of the high rebound of the rubber. Fig.4 shows the relationship between falling height and maximum force mass of falling weight 220 kg and 170 kg for cushion Type A. It can be seen that the maximum force F_w increases monotoniously with the falling height in both mass of weight 220 kg, 170kg. It seems that the maximum force is simply proportinal to the mass of weight. Fig.5 shows the relationship between falling height and maximum force mass of falling weight 220 kg and 170 kg for cushion Type B. It also can be seen that the maximum force F_w increases with the falling height in both mass of weight 220 kg, 170kg. However, it seems that The increase rate has increased along with the falling height.

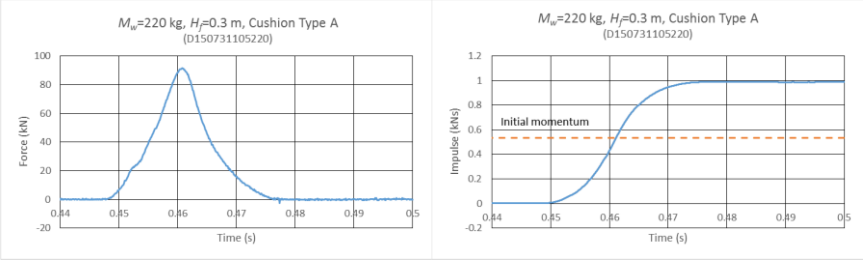

Fig.3 Impact force and impulse (M_w=220 kg, H_f=0.3 m, Type A)

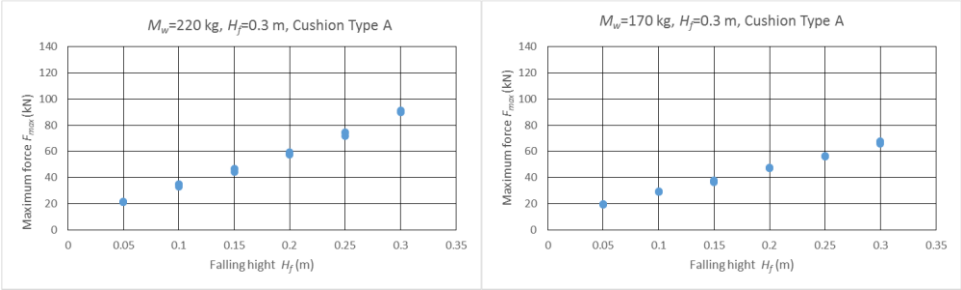

Fig.4 Relationship between falling height and maximum force (Type A)

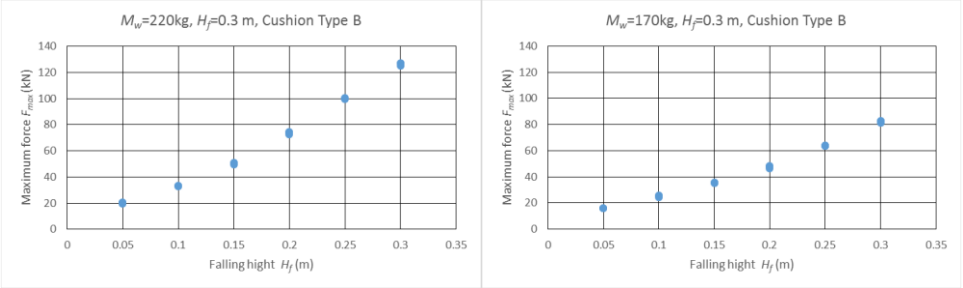

Fig.5 Relationship between falling height and maximum force (Type B)

Fig.6 shows the first impact force and the impulse by first impact for the mass M_w=220 kg, falling height H_f=0.3 m, using low rebound buffer Type C. It can been seen that the maximum force and the duration of force are respectively approximately 90 kN and 0.2 s. The maximum force is almost equal to that of Type A. However, the duration of force is smaller than that of Type A. Therefore, rebound is smaller than that of Type A. It is generally thought that the controle of maximum force ,duration of force and less rebound of drop weight are important for better pursuit of experimant at site.

4. CONCLUSIONS

The resulting conclusions are summarized as follows.

Several investigations concerning some parameters of SIVE (Self-propelled Impact Vibration Equipment) were concretely shown. It became clear that the maximum force and the duration of force are approximately 90 kN and 0.3 s by developed equipment for Type A and B. The method utilizing a low rebound rubber (Type C) is most ideally in the Types shown in here for the impact test.

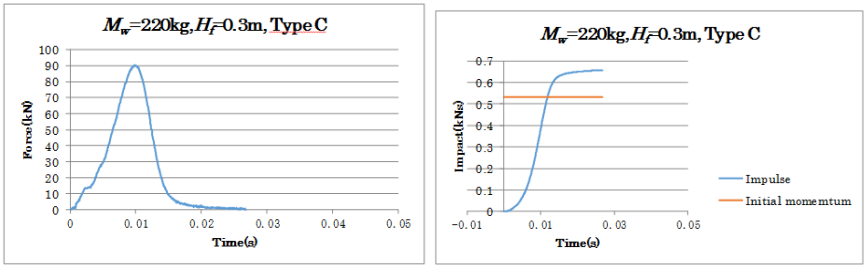

Fig.6 Impact force and impulse (M_w=220 kg, H_f=0.3 m, Type C)

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