SHOCK ABSORBERS WITH VISCOUS SHEAR RESISTANCE AND ITS EXPERIMENT

by

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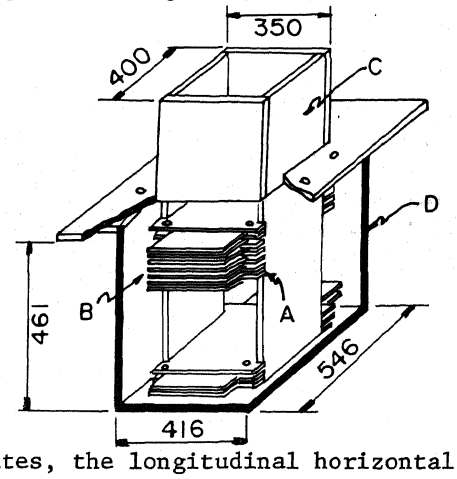
Shock absorbers called "stopper" have been used with movable shoes at the supports of prestressed concrete railway bridges in Japan. There are over one hundred bridges with such stoppers. The stopper with viscous damping effects yield the longtitudinal horizontal force to all piers at a controlled rate during an earthquake. But it doesn't offer resistance to slow movements such as contraction of girders due to creep, drying shrinkage and temperature change. Such movement amounts to 20 cm in the case of a P.C. girder spanning up to 250 m between fixed and end point. By using stoppers, a long multi-span continuous girders can be constructed in seismic zones. The other effects and the constitution of the stopper are shown in the Referense 1. The basic composition of the present type stopper is simple, but the relation between the resistance force and the relative velocity or the displacement is complex. Particularly as for the big size stopper the relation is uncertain.

Considering the fact mentioned above, we divised a new type stopper which consists of two groups of plates with narrow gaps (see Figure). Plate "A" is fixed at the rod "C" and Plate "B" is attached to the box "D". The viscous material filling the gap resists against a dynamic load by the viscous shear.
We made a model experiment of the stopper as seen in the Figure. Resistance force is not effected by the relative displacement but only the relative velocity. It is given as the following formula.

$$F=5\cdot\exp\left(-0.055(T+40)\right)\cdot S\cdot d^{-0.5}\cdot v^{0.5}$$

where F: Resistance force (kg)
v: Relative velocity (cm/sec)
T: Temperature (°C)
S: Total area of the plates (cm^2)
d: Gap between the plates (cm)



By adjusting gap and area of the plates, the longitudinal horizontal force can be distributed uniformly even to the piers with various stiffness. Such a stopper is easily changeable to a type of stopper which is movable to any direction to work as an energy absorption divice.

Reference 1. T. Kitta, J. Kodera, K. Ujiie, H. Tada "A New Type Shock Absorber and its Effects on the Response of the Bridge to the Earthquake" Proc. 5WCEE

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