Prepared Discussion : 1A

For No.9

Engineering Lessons Tought by Earthquakes
by Berg and Hanson

From M. Izumi, Japan

Authers point out, ' flexible first storey system is dangerous'. It seems to me, however, that both the flexible first storey and rigid first story system are dangerous unless they are carefully designed. Ordinary RC frame structures can not make flexible storeys as they can not be deformed without significant damage. And it is evident that there are cases where earthquake input energy to structures is decreased much caused by the deformation of the ground or the defomation of structures. When that defomation does not cause the severe damage of the structures.

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# ENGINEERING LESSONS TAUGHT BY EARTHQUAKES

by

Glen V. Berg[I] and Robert D. Hanson[II]

Discussion by M. Izumi, Japan:

Authors point out, ' flexible first story system is dangerous.' It seems to me, however, that both the flexible first story and rigid first story systems are dangerous unless they are carefully designed. Ordinary reinforced concrete frame structures can not make flexible stories as they can not be deformed without significant damage. And it is evident that there are cases where earthquake input energy to structures is decreased much caused by the deformation of the ground or the deformation of structures. When that deformation does not cause the severe damage of the structures.

Response by the authors:

The authors agree that any abrupt change in stiffness in the building will require careful design. However, the soft story is more critical than the rigid story. Some buildings have large parking and service areas just below a plaza level which may be one story above the ground. This creates a rigid first story and makes the plaza story the soft story. Experience and analytical computations have shown little trouble with the rigid story, rather the damage moves up to the plaza story.

The engineer must be careful to distinguish between flexibility (i.e. stiffness) and ductility (i.e. ability to deform without loss of strength). A flexible first story which also has good ductility characteristics may decrease the earthquake energy input to the structure for one earthquake, but for a slightly more severe earthquake this same flexible first story may cause a collapse of the entire building. Experience should have taught us to avoid the soft story.

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