EFFECTS OF STRAINING RATE ON DEFORMATION AND FRACTURE OF REINFORCED CONCRETE MEMBERS.

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Unexpectedly severe damages of reinforced concrete buildings and structures have consecutively occured in recent destructive earthquakes, though they are supposed to be prudently designed with the modern knowledge of structural engineering. It is crucially important to solve these new plobleems on the dynamic design of reinforced concrete structures (RCS).

This paper deals with the effects of straining rate (or loading rate) on the deformation and fracture of RCS which are ascertained experimentally by the authors that they are an important factor the materialization of the dynamic behaviors of RCS during severe earthquakes, though they have usually been desregarded hithorto. The authors' conclusions as follows:

(1) In the dynamic design of RCS for earthquakes resistance, the responses of RC members should be determined by the consideration of the effects of dynamic load application on them.

(2) The effects of dynamic loading on RC members consist of the next three: the effects of stress waves generated by the collision between structures, etc.: the effects of straining rate on the mechanical properties of the constituents of the members (rate effects): the variation of failure mode and failure criterion of the members.[1] On the these effects, long serial experiments have been carried out by the authors.[2]

(3) The stress strain curves and the failure criteria of several kinds of concrete were obtained under compressive and tensile loads in both uniaxial and triaxial conditions over the wide ranges of loading rate higher than that of static tests.[3]

(4) The remarkable result on the dynamic shearing strength of concrete, which indicated clearly smaller value in the displacement rate of about 20 cm/sec than that lower displacement rate of about 0.2cm/sec, was obtained.[3] In the test of RC beams in $a/D=(M/Vd)\times(d/D)=2.0$, the loads, when diagonal tension crack occured, showed the similar tendency as mentioned above.

(5) The rate effect obtaied on the upper yield stress of reinforcements was larger than those not only on the lower yield stress and ultimate strength of reinforcements, but also on concrete under compressive and tensile loads.[4] This tedency is considered as the powerful factor on the transitions of the stiffness, response and failure mode (from ductile to brittle mode), etc. of RC members under dynamic loadings which were found in the dynamic tests of RC beams and frames.[4]

(6) RC beams tested under concentrated loads, in a/D of 3.8, failed with the concrete fracture in dynamic loadings, though they came with the yield of reinforcements in static conditions.[4] The dynamic behaviors are able to be deduced from the dynamic data obtained on the concrete and reinforcement. In the similar test in a/D of 2.0, the apparent dowel actions of reinforcements observed and violent brittle failure occured in dynamic loadings.[4]

REFERENCES

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