DYNAMICS AND EARTHQUAKE RESISTANCE OF PRE-STRESSED REINFORCED CONCRETE STRUCTURES

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ABSTRACT

Reports have appeared dealing with dynamics of bridges. The results may be used for drawing a general scheme of behaviour for pre-stressed reinforced concrete under earthquakes. Detailed investigations were conducted in Zurich on twenty bridges. Similar large scale investigations have been carried out in the Soviet Union. This research is not here reviewed in detail, but general observations are made.

Dynamic coefficients of beam span structures made of pre-stressed concrete exceed those for usual reinforced concrete, coming close to values for metal bridges. The greater rigidity of pre-stressed concrete due to better materials and lack of cracks is offset by the smaller sections used. The character of oscillations in the absence of cracks gives lower damping.

Seismic forces are influenced by rigidity and plastic deformation. The rigidity of spatial constructions only slightly depends on changes of rigidity in separate parts. Therefore pre-stressing does not exert any considerable influence on the rigidity of the whole. Further, reliable connections are achieved between the parts. Also, flexibility of deformations facilitates more accurate calculation for considerable oscillation amplitudes.

The faults of pre-stressed concrete lie in the high resistance to the development of plastic deformations, and the diminished oscillation decrement. Some reason may be produced that these are not of importance when compared with reinforced concrete. The requirement is to completely prevent damage only in case of inconsiderable earthquakes; and for heavy earthquakes, which do not occur too often, only to eliminate the possibility of collapse which might endanger life or valuable property.

With pre-stressed concrete the resistance to the development of plastic deformations and formation of cracks is much higher than in plain reinforced concrete. This results in better resistance to inconsiderable earthquakes. In heavy earthquakes cracks form and pre-stressing disappears, which comes close to the behaviour of usual reinforced concrete. Thus elimination of factors occurs which increase dynamic loads on structures made of pre-stressed concrete. With due consideration of all other advantages of pre-stressed reinforced concrete, the use of the latter in high seismicity areas may be considered expedient.

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