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Special Methods of Seismic Bridge Design in the USSR

Méthodes spéciales de protection antisismique des ponts en URSS

Spezielle Methoden für die Erdbebensicherung von Brücken in der UdSSR

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1. INTRODUCTION

It is known that the seismic loads on a structure are not purely exterior loads, they are generated by the structure during its oscillations. Therefore, two methods are possible to increase seismic resistance of structures: the traditional method consisting of an increase of sections to take the seismic loads and the special method consisting of a purposeful change of dynamic diagram of the structure and reduction of the seismic loads.

2. USE OF SPECIAL PROTECTION FOR BRIDGES

The detailed description of the special methods of seismic protection can be found in paper /2/.These methods can be subdivided into seismic isolation and seismic suppression.

The technical conceptions of seismic isolation have got the most detailed study. The seismic isolation members are usually used at the level of the supporting parts.The seismic isolated bridges (a.c. No.781253) have been constructed in Tashkent for the Metro lines over Ak-Tepe and Salar Canals, the equivalent seismic isolation has been used for the railway bridges at the approach to Bekbade in Uzbekistan.The seismic isolation member for these bridges represents a rubber-made supporting part placed on a steel plate. The friction factor in this case reaches a value of 0.3, i.e. the seismic isolation acts as a reserve and starts working when acceleration of the span becomes greater than 3m/s2 The design displacements of the span relative to the support do not exceed 15 cm even at the most unfavourable real combinations of the horizontal and vertical seismic loads.

The seismic isolated bridges for moter-roads built in Kirgizia have been designed by Frunzensky Polytechnichesky Institute /3/ They used the friction couples on the basis of fluorine plastics with a friction factor of 0.1 - 0.2.Even though the given conception provides for a good effect, the displacements in the seismic isolation interlayer remains significant.

The new technical conceptions for the seismic isolation have been developed now in the NIIBridges according to which the friction is created at the expense of compression of the specially treated steel sheets by means of high-strength bolts. This makes it possible to create a friction connection with adjustable friction force irrespective of the vertical component of the seismic effect.

At present in the USSR there is a software for optimization of the parameters of the seismic isolation systems of different types including two-stage damping and elasto-plastic steps of displacements /4/.

There are two types of seismic suppression systems. The simplest way is the use of various dampers. The original designs of dampers elaborated in the USSR are described in paper /5/. The use of the dynamic vibration absorbers (DVA) for seismic protection is a more complex method. The detailed studies of the absorbers efficiency decribed in paper /1/ have shown that the increase of the damping mass for the stable work of the DVA is a factor. As to the bridges, the mass of the span may be used which is connected with the support by means of elastic constraints - (a.c.No.1162886). Two principal solutions on the elastic constraints are possible.The simplest way is the use of a flexible support of steel pipes for the span. In this case stresses arise due to the horizontal and vertical loads. Therefore, the most reliable way is the use of the ordinary movable supporting parts for the spans which take wholly the vertical load,and the horizontal load is transmitted to the special elastic elements (a.c.No.1335612).

Now we are developing the drawings of a highway bridge with the spans as the DVA supports. Under the leadership of the authors some detailed calculations and experimental studies of the system described in paper /1/ have been carried out.

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