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New Structures for Bridge Seismic Isolation

Nouveaux appareils d'appuis pour la protection antisismique des ponts

Neue Erdbebensicherung für Brücken

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1. INTRODUCTION

The NII Bridges have developed new structures for bridge seismic isolation. The seismic isolation elements in the form of a package of steel sheets are placed between the upper supporting sheet of the supportin part and the supporting sheet of the span. The friction force is produced at the expence of compression of the package sheets by means of high-strength bolts passing through the oval hols. The earthquake produces mutual movement of the package sheets. The bolted joints have been designed in the NII Bridges (A. C. nos 1143895, 1168755, 1174616) and are called as movable friction joints (MFJ). The detailed description of the joins can be found in paper [1].

2. DESCRIPTION OF THE SUPPORT STRUCTURES

The supporting part and the seismic isolation elements with MFJ are shown in Fig.1 (A. C. no 1106868) and Fig.2 represents a diagram of the MFJ "force - displacement" at monotonous movement. The principal feature of the structure at issue consists in falling of the friction force during oscillations.

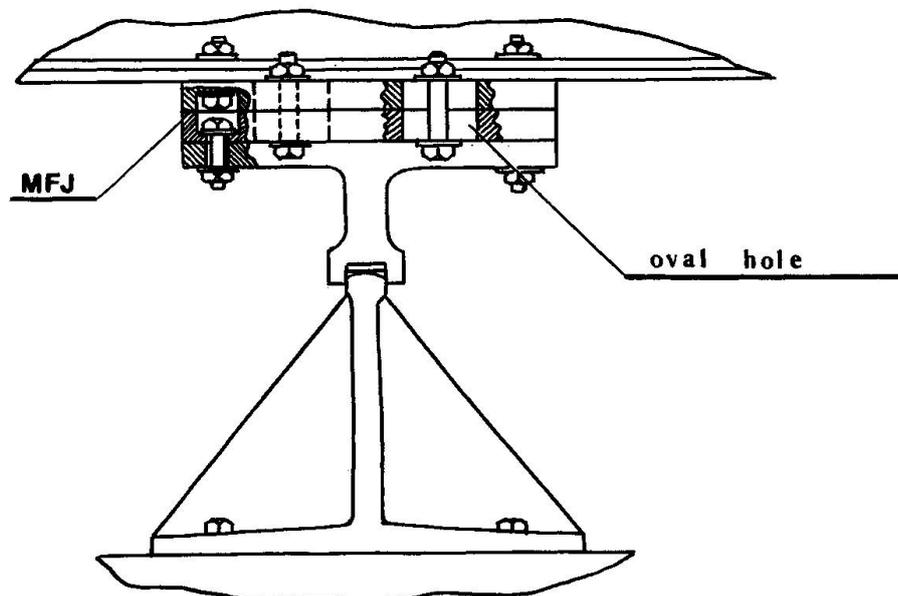


Fig.1. Construction of the supporting part with FMJ

The friction factor K_{fr} in this case is determined by the relationship

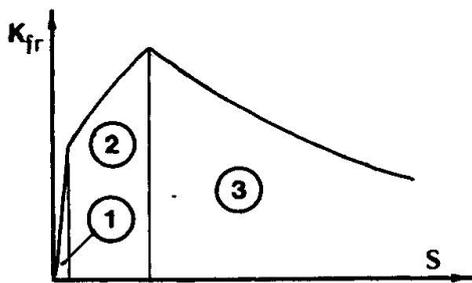
$$K_{fr} = K_{fr}^{(0)} e^{-\partial \epsilon s}$$

where $K_{fr}^{(0)}$ - starting friction factor, $\partial \epsilon$ - degradation factor, s - summary movement in the bolted joint.

The given condition should be considered in determination of the mutual movements of the package sheets which are responsible for the summary length of the oval holes.

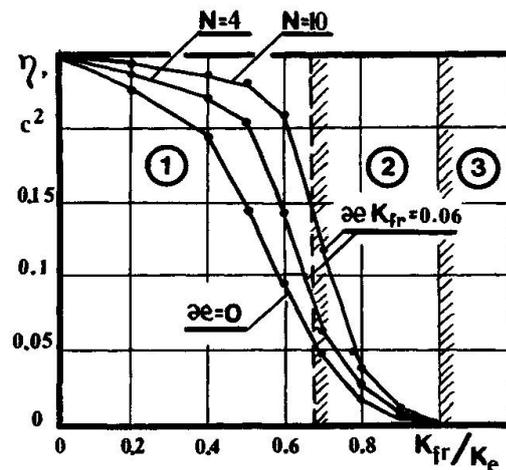
For the influence of the friction force degradation, refer to Fig.3 which shows the relative displacements $\eta = y/K_e g$ of the rigidly supported span under the effect specified by a length of the sine curve $\ddot{y}_0 = K_e g \sin \omega t$ with a various number of waves N (where y - displacement of the span relative to the support, y_0 - displacement of the support top, g - acceleration of gravity). The influence of the friction force degradation reduces under real effects including the support ductility.

The proposed seismic protection structure features high reliability, compactness, simple fabrication and repair after a destructive earthquake.



- 1 - elastic work of the joint;
- 2 - the sheets motion at the bolt heads wedged;
- 3 - the motion of the joint

Fig. 2. Force-displacement diagram for FMJ



- 1 - motion without stops;
- 2 - motion with stops;
- 3 - area of wedging

Fig. 3. Dependence $\eta \left(\frac{K_{fr}}{K_e} \right)$

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