THE ROGLIDER – A SLIDING BEARING WITH AN ELASTIC RESTORING FORCE

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ABSTRACT

The research on a number of new approaches to seismic isolation continues with the development of a RoGlider capable of supporting both light and high vertical loads with an effective co-efficient of friction of ~11% together with an appropriate elastic restoring force. Preliminary tests on prototype RoGliders have been promising.

INTRODUCTION

Internationally, 'Seismic Isolation' is now an accepted method for reducing the forces transmitted to a structure during an earthquake as illustrated by ASSISI conferences held every two years [1] and is applicable to both old [2] and new structures [3]. 'Seismic Isolation' reduces the forces transmitted to the structure by first increasing the flexibility of the support thereby increasing the structures natural period beyond the peak of the earthquake and secondly by adding damping thus reducing the energy transmitted to the structure [4, 5].

Ideally, each seismic isolator should consist of two components, an elastic restoring force component plus a damping term. A good example is the lead rubber bearing (LRB) where the rubber/steel layers provide the elastic restoring force and support the structure while the lead plug produces the required damping. In addition the LRB has an estimated lifetime of more than 100 years and excellent fire resistance [6]. Our aim is to develop the RoGlider™so that it can be considered as an alternative to the LRB and also be used for light loads and large displacements where it often becomes very difficult to use the LRB. We are continuing to develop other isolators such as the RoBall™ which is suitable for light loads [7].

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DESCRIPTION AND PRELIMINARY TESTS OF THE ROGLIDER

The RoGlider™ is a sliding bearing which includes an elastic restoring force. The actual configuration is dependant on the details of the structure being isolated and the expected earthquake. The RoGlider we present is a double acting unit with the restoring force provided by two rubber membranes (Fig. 1).

This double acting RoGlider™ consists of two stainless steel plates with a PTFE ended puck sitting between the plates. Two rubber membranes are attached to the puck with each being joined to the top or bottom plates. When the top and bottom plates slide sideways with respect to each other, diagonally opposite parts of the membrane undergo tension or compression.

The tension components provide the restoring force between the plates while the compression parts buckle (Figs. 2 - 4) and provide little or no restoring force.

The particular double acting RoGlider we have tested has a maximum displacement of ±600 mm, a maximum vertical load of 1 MN, with an outside diameter of ~900 mm and a coefficient of friction at ~0.5 m/s of ~11%. Following this particular membrane approach we expect to be able to increase the elastic stiffness by a factor four or more times using our latest designs.

The RoGlider was tested in our test rig capable of providing a vertical force of up to 6 MN, horizontal force of up to 700 kN and maximum displacement of 600 mm.

The effect of vertical force on the force displacement curves is illustrated in figure 5, at 850 kN, and figure 6, where the vertical load is 110 kN. For both of these vertical forces the horizontal stiffness is ~100 kN/m.

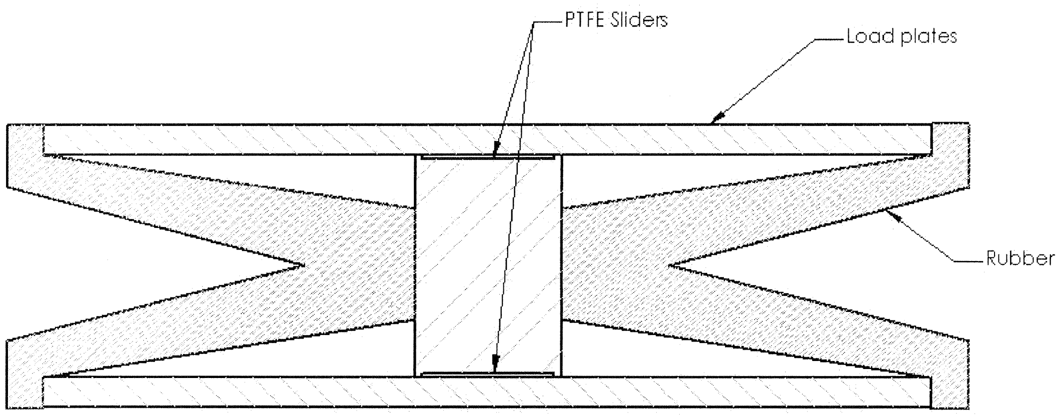

Figure 1. RoGlider Section

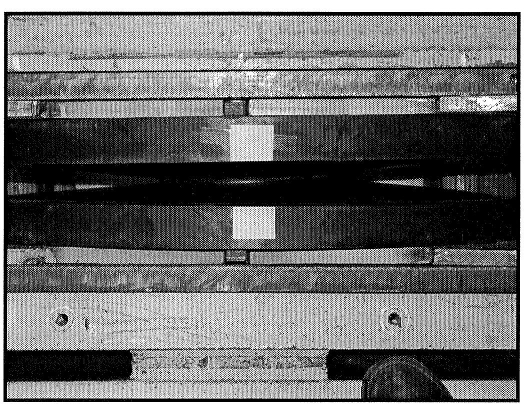

Figure 2. RoGlider ready for testing
Displacement 0 mm, vertical force of 850 kN.

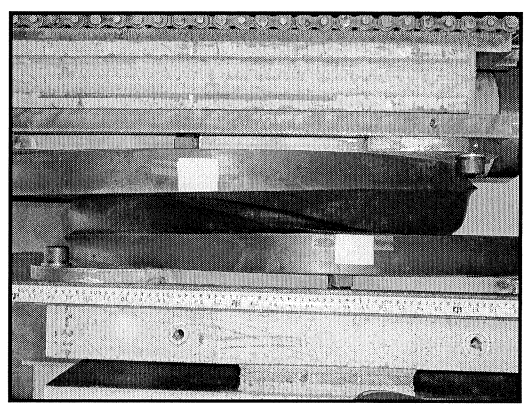

Figure 3. RoGlider during Test
Displacement –150 mm, vertical force of 850 kN.

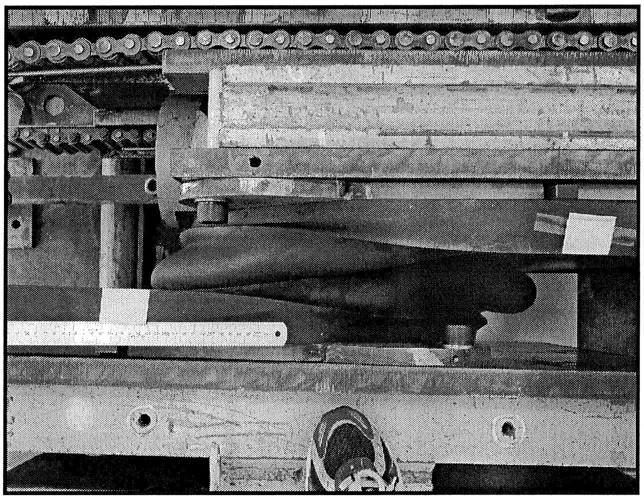

Figure 4. RoGlider during Test
Displacement +575 mm, vertical force of 110 kN.

ROGLIDER

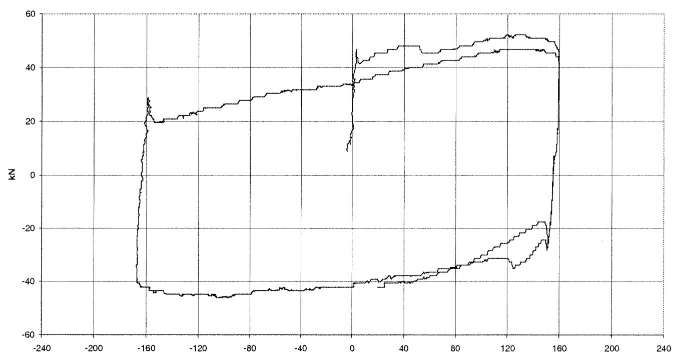

Figure 5. RoGlider Force Displacement Curve – Vertical force of 850 kN.

ROGLIDER

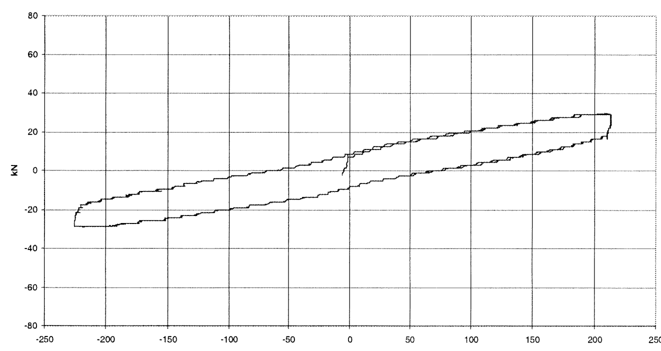

Figure 6. RoGlider Force Displacement Curve – Vertical force of 110 kN.
Note that the stepped nature of the loops is due to the resolution of the load-cell and is not a characteristic of the RoGlider.

CONCLUSIONS

The RoGlider [8] which the authors have presented represents one of many possible configurations we are developing. At this stage this version of the double acting RoGlider is a promising candidate for a commercially viable seismic isolator for both high and low vertical loads.

The model of the RoGlider tested has an effective coefficient of friction at ~0.5 m/s of ~11% together with an elastic restoring force of ~ 100 kN/m.

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