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Alemagna motorway, Venezia-Munich: Dynamic behaviour of Fadalto viaduct

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ABSTRACT: Dynamic seismic non linear behaviour of a major bridge of an Italian motorway is studied. The feature regards the influence of the thin walls on the top of r.c. piers that act as an ad hoc energy dissipation device. The pier base remains elastic, the walls have plastic behavior. The energy dissipation mechanism is studied.

1. INTRODUCTION

The close to completion motorway from Vittorio Veneto to Belluno is an important european link connecting Adriatic coast with the most gorgeous resort of the Dolomites area and finally with Austria and Germany. It cross an important italian seismic area of medium intensity.
Fadalto viaduct (fig.1) is an hyperstatic continous bridge with piers 80 m high and spans 115 m long. The piers have hysteretic concret top walls acting as energy dissipation devices.The designer is ing. Furlanetto, Italstrade, and builder is Condotte D'Acqua, Italy.

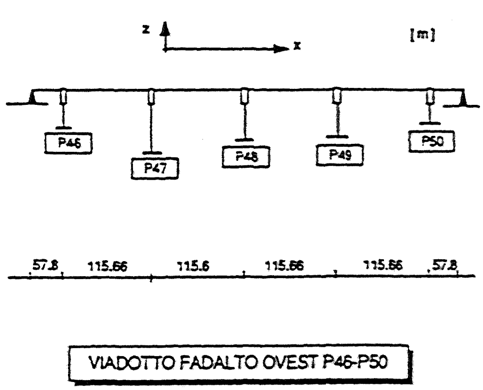

Fig 1. Schematic view of Fadalto viaduct

In fig. 2 the feature of one pier is shown. It must be noted the abrupt change in flexibility in the top part of the structure. This change is clearly intended as an energy dissipation device. It is made of two prestressed walls designed with particular care regarding detailing.In fact the low required ductility level justify this non conventional approach. Some additional questions depend on the column, not beam, plastic hinges.

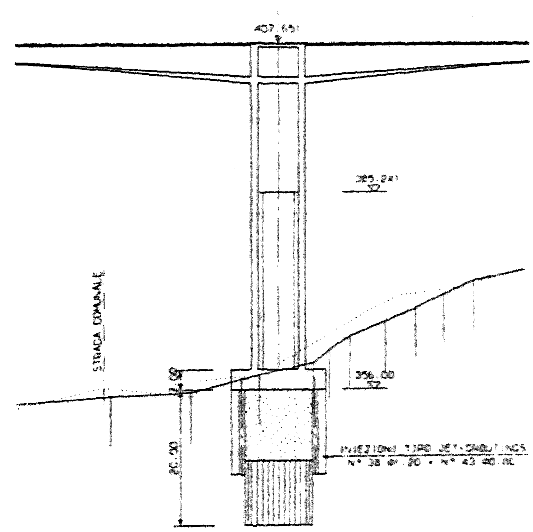

Fig.2 Particular view of piers with elastoplastic device

2. METHODS

The structure is semplified as a non linear (2 DOF) elastoplastic structure under seismic excitation.(fig.3) An ad hoc computer program was written in order to study ductility and energy demands.

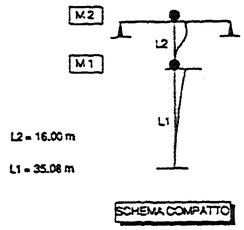

Fig.3. Computer model

Non linear behaviour may be developed at the bottom of the pier and at the top (the walls).
Fig.4 a,b, shows the N-M interaction diagram for r.c. sections of pier and walls.

Fig. 5 a,b, shows the non linear calculated force displacement relationship for the bridge.

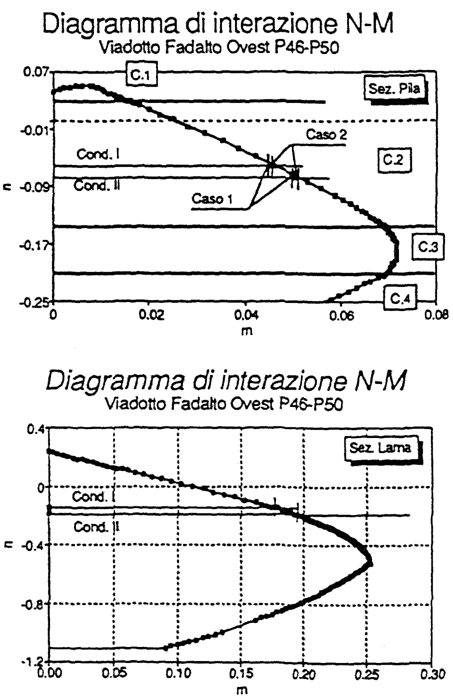

Fig.4 a,b M-N interaction diagrams for piers and walls

3. RESULTS

The phase diagrams (displacement vs velocity) of the two degrees of freedom is shown in fig. 6a,b,.under El Centro record.
In fig. 7 is shown the required ductility level for pier and wall, for different values of ground excitation. Columns remain elastic.
The walls are plastic, for values of acceleration very low.
The required ductility is, up to .3 g , quasi linear with acceleration; from .3g to .6g the increse of ductility demand is very slow.
In fig. 8 is shown the ductility level for a design without the abrupt change in flexibility of the pier.
It may be seen that the pier base is plastic for value of .3g. The ductility depends quasi linearly on acceleration

In fig. 9 different types of energies are plotted
It can be seen that the energy dissipation for damping and plasticity is similar at the end of excitation.

4. CONCLUSIONS

The abrupt change of piers flexibilty (together with a particular detailing) can be seen as an ad hoc elastic plastic dissipation device.

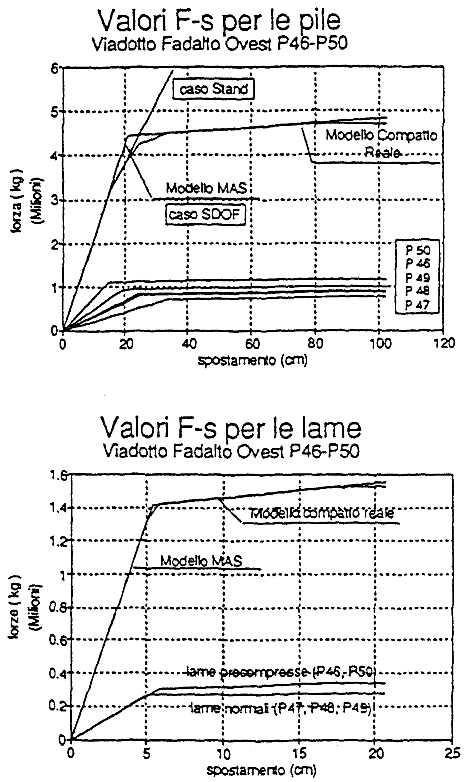

Fig.5 a, b Force dispalcement relationships for the single pier, the walls and the bridge

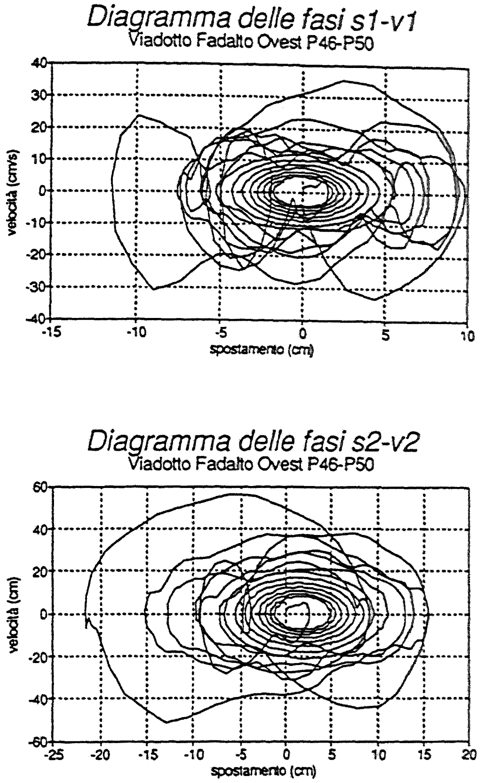

Fig.6a,b Phase diagrams (velocity vs displacement) for the two degrees of freedom.

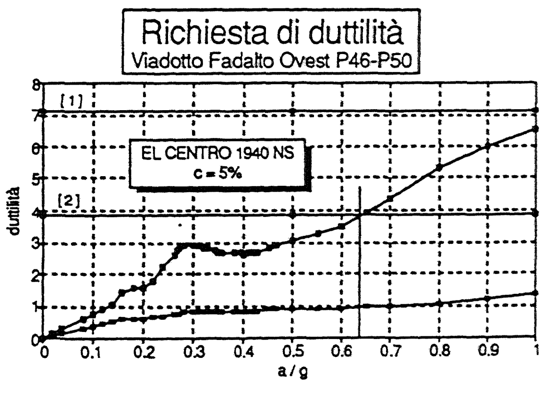

Fig. 7 Ductility demand for piers and walls vs ground acceleration

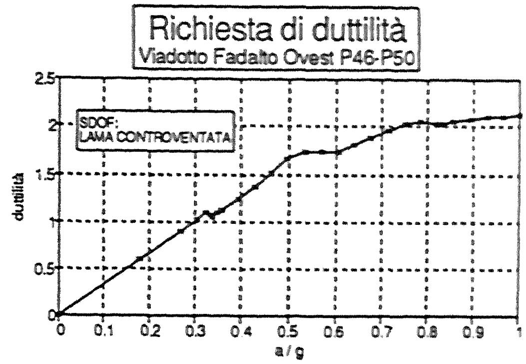

Fig.8 Ductility demand for the design without dissipation devices

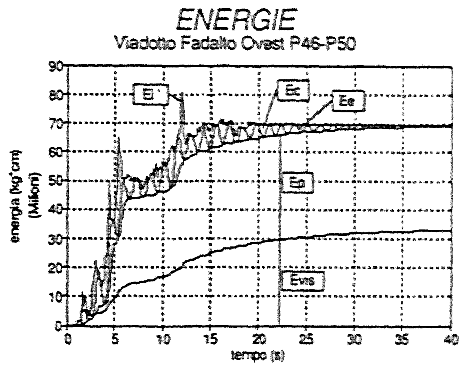

Fig. 9. Various types of energies vs time

The computer analysis shows that the ductility demand is low, and the piers remain elastic also under a strong seismic motion.
In the author opinion some care must be taken regarding the real behaviour of the walls and the difficulty of reabilitation after a seismic motion.

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