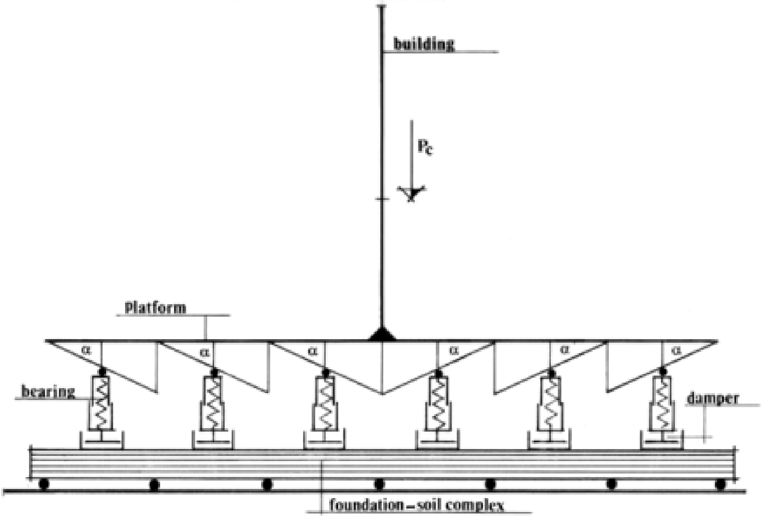
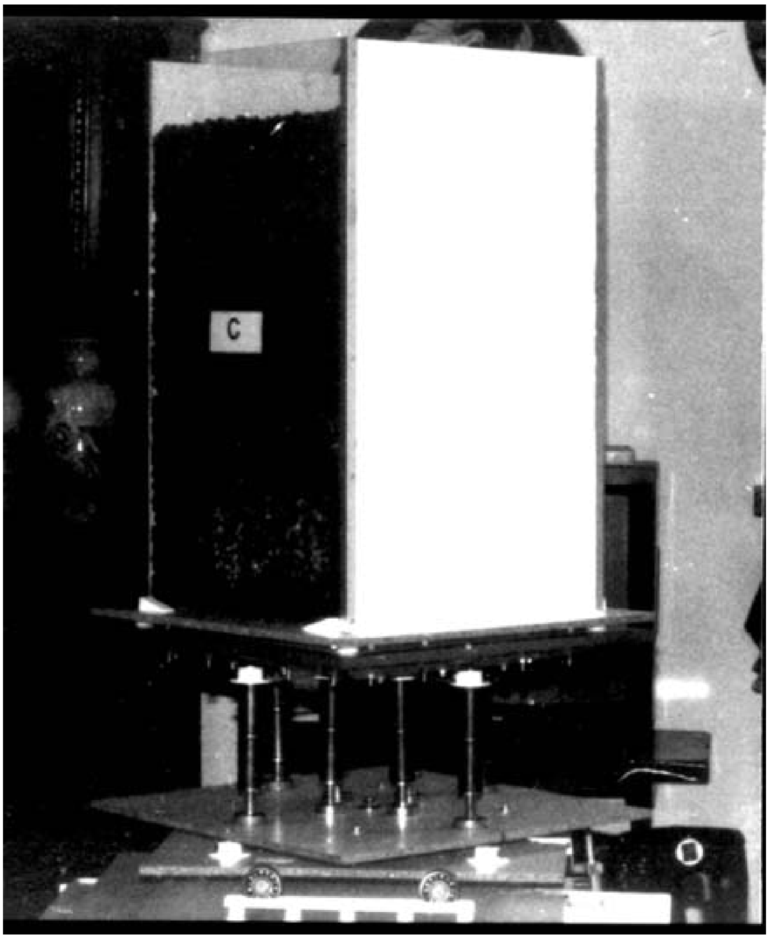
Elastic Bearing with Hydraulic Dampers

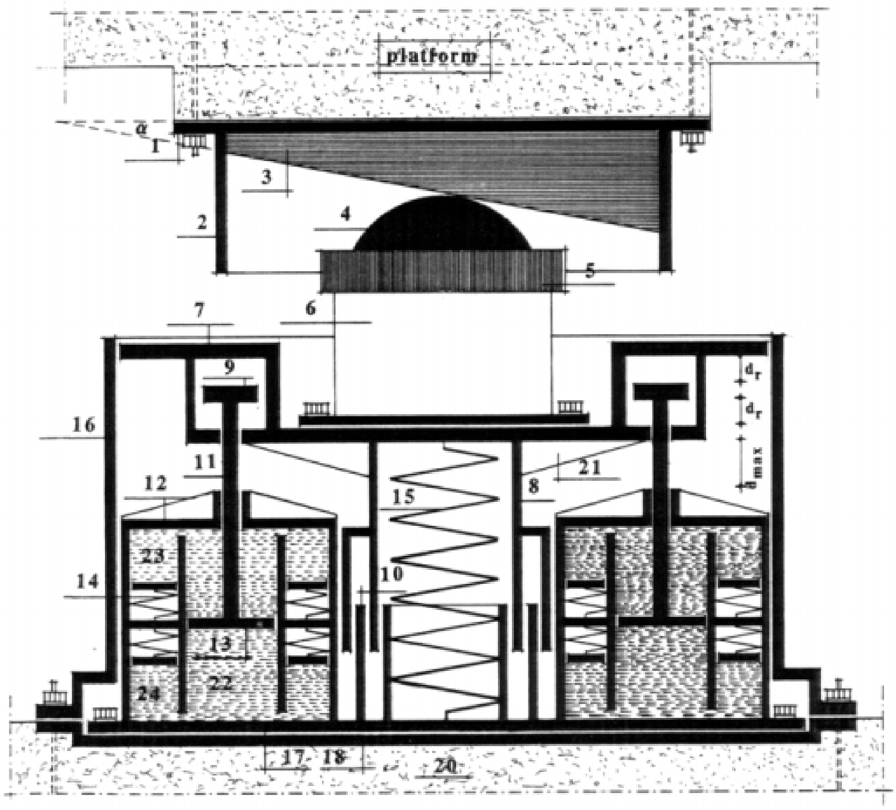
Figures



Vertical section of the system



Photograph of the rudimentary model



The bearing

<u>Constitution</u>

The bearing consists of two devices, one of which is fixed and the other is movable to the horizontal and vertical translations of the soil.

Fixed device

It consists of:

- square steel plate (1), connected to the overhanging platform by means of an anchoring bolt;
- perimetric steel spandrel (2), soldered to the plate (1). It delimits the cavity containing the steel sliding surface (3).

Movable device

It consists of the real bearing, placed in the central position, with four springs and four hydraulic dampers, placed perimetrically.

1 <u>Real bearing</u>

It consists of:

- a steel ball (4) or, alternatively, a surface in PTFE (pure teflon);
- cavity for containing the ball (4), connected to the underlying plate (7) by screws;
- rubber protection (5) of the cavity (6), placed perimetrically.

2 Spring (15)

It has the function compensating, by means of his own vertical strain, the variation of rigid deflection relative to support during the horizontal translation of the foundation-soil complex. It is placed into two circular and coaxial pipes, one of which (10) is fixed and connected to the lower plate (17), while the other pipe (8) is movable in relation to the vertical translation and is soldered to the overhanging plate (7). The spring also buckles because of the vertical component of the motion.

3 Dampers

They progressively reduce the vertical displacement of the building in correspondence with the emergency interval. Each of them, connected lover down to the plate (17) and laterally delimited by the diaphragms (12), consists of three chambers, one of which is central (22) and two are lateral. The lateral chambers are subdivided by rigid horizontal baffles into four equal chambers, two of which are higher up (23) and two are lower down (24). In each of the lateral chambers there is a piston, connected to the horizontal baffle by means of one pre-stressed spring (14).

Communication between the central chamber (22) and the lateral ones (23) and (24) takes place by means of valves placed at the higher and lower ends of the vertical baffles. The liquid contained in all chambers and the movable piston (11), which expands with the mass (13) lower down and the mass (9) higher up, complete the damper. The mass (19) is contained in a cavity where it has the possibility of translating vertically only for a vertical displacement of the building corresponding to the emergency frequency.

Operating principle

In the state of rest the spring (15) buckles vertically because of the load on the bearing (static strain). During an earthquake the spring (15) is subjected to a further strain (dynamic strain). This is partly caused by the horizontal component of the motion and it compensates the variation of rigid deflection, due to the inclination of the sliding surface (3). The remaining part of the dynamic strain is caused by the vertical component of the motion.

The movable pistons (11) of the dampers are stressed only when the dynamic strain of the spring (15), caused by the sub-undulatory shock, has the value of $\underline{d_r}$, which is the vertical displacement of the building at the vertical seismic frequency corresponding to the emergency one. In this situation, discarding the contribution to the strength offered by the spring (15), the pistons (11) are stressed by the whole load on the bearing, due to the weight of the building and the vertical inertial force.

The load is transmitted from the pistons (11) to the liquid in the chambers (22), which is pushed progressively through the valves, into the lateral chambers (24) or (23), compressing the pre-stressed springs (14). Once the emergency danger terminates, the pistons (11), stressed by the elastic reaction of the springs (14), return to the initial configuration of rest. After the earthquake, because of the eventual residual displacement of the soil, the building may have a minor eccentricity with respect to the foundation-soil complex. The centring of the building is automatic and it occurs by means of the sloping sliding surface (3) of the bearing.

N.B. The bearing needs accurate experimental tests