DYNAMIC TESTS ON AN ACTUAL BUILDING
MOUNTED WITH A NEW DAMPER SYSTEM.

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Abstract

A new structural system mounted with visco-elastic butyl blocks has been constructed near Paris. The structure, a four stories high apartment building, was tested by applying a 5 000 N impulse force at the top. The instantaneous measurements of the free movements were recorded by sismographs in order to analyse and compute all characteristics of the structural response. This paper presents briefly the description of the test on the building, and the corresponding observations and data of the mechanical response are also given. A good energy dissipation was observed so also a high performance of the damping system. The visco-elastic butyl blocks were seen to increase the damping of the vibration from 2 to 6 % of the critical damping value. This performance clearly demonstrates that in modern trend in design and fabrication of structures and buildings erected in seismic zones, an extension of this low cost system should provide a better safety to a given seismic load.

Purpose of the investigation.

The purpose was to test mechanical oscillating behaviour of a real building, constructed according to an entirely new concept. It was particularly intended to prove the efficiency of visco-elastic butyl blocks regarding structural damping. The complete structure was brought in oscillation by applying a 5 000 N impluse force. The movement was controlled with type A0.300 sismographs installed at each level. The analysis brought all characteristics of the mechanical response : frequencies, amplitudes and damping.

The building.

The apartment building has four floors. It is a steel structure with horizontal as well as vertical bracing system consisting of diagonal tension members. The building has a cross-form shape ; thus, the rigidity is fairly uniform in all directions (Fig. 1).

The steel frame is closed with light curtain walls and the floors are made of dry wood plates. In addition, the floor system has visco-elastic blocks between the floor and the frame. This feature was recently introduced by CTICM (*).

The floor is supported on rows of blocks spaced at 0.60 m which are glued on the upper flanges of the joists. The joists are in turn supported on another set of row blocks (Fig. 2).

Test results.

The structural response was recorded simultaneously (Fig. 3) for the four levels and the analysis of the results showed following observations and data :

- the energic spectrum showed very clearly a good dissipation of the vibration energy (Fig. 4) and the maximum value is obtained as 3,69 Hz.
- the high frequency showed the importance of the rigidity of this type of structure.
- the computation of the damping fiven for the four levels is showed in table Fig. 5
- the coherence of vibration was checked at a given level and a rapid damping of the secondary vibration was noticed in the direction away from the excitation point (Fig. 6).

(*) Patented system CTICM C_{II}

Conclusion.

From the analysis of the test results taken on this building, the following conclusions can be made :

This light structure with a good distribution of the masses and a high stiffness is itself a good example of antisismic building. The introduction of visco-elastic material, such as butyl blocks, separating the floor and the structure, improved considerably the damping of the vibration as in earthquakes. For classical steel structures, the damping may be taken as 2% of the critical damping. For this particular tested structure it was found to be more favourable : more than three times higher.

It would be really interesting to develop this low cost system and to adapt it to the stronger vibrations with larger amplitudes.

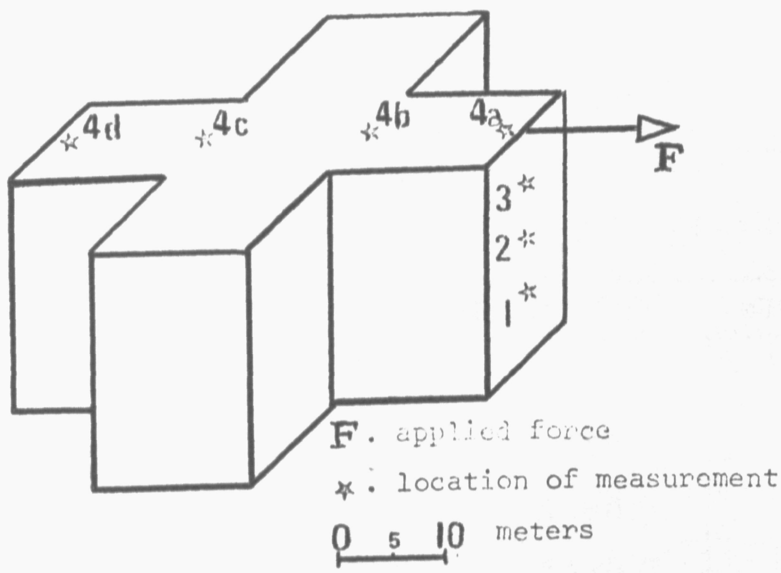

Figure 1. GENERAL SCHEME OF THE TESTED BUILDING

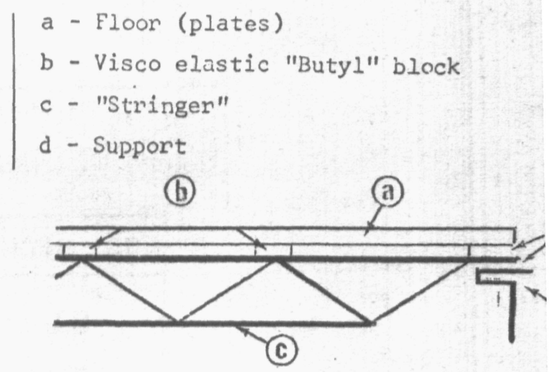

Figure 2. DETAIL OF THE FLOOR SYS

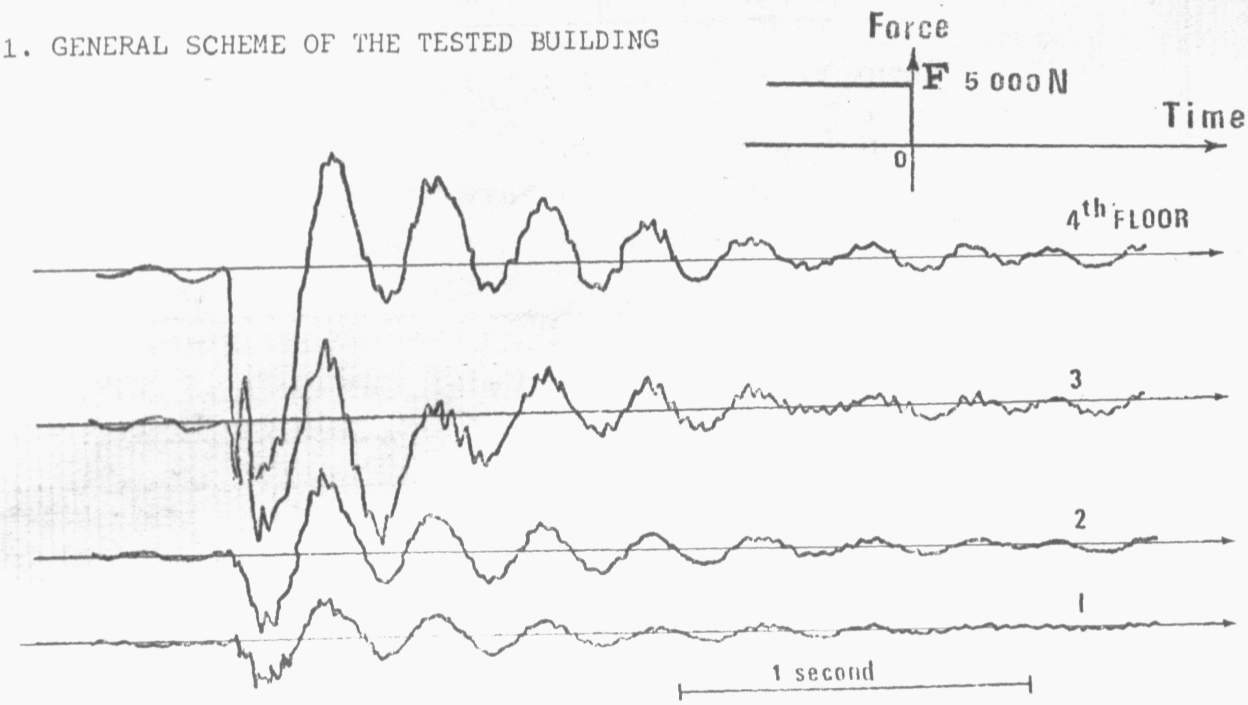

Figure 3. ACCELEROGRAMMS OF THE FOUR FLOORS

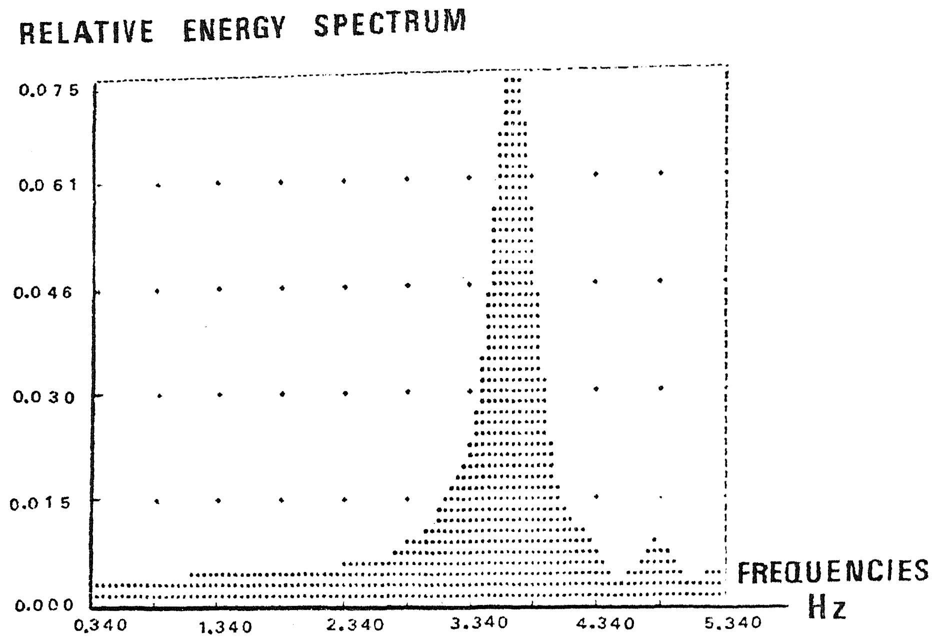

Figure 4. RELATIVE ENERGY SPECTRUM

LOG. DECREMENT	CRITICAL DAMPING	
0.0970	0.0709	7,1 %
0.1010	0.0738	7,4 %
0.0864	0.0632	6,3 %
0.0881	0.0644	6,4 %

Figure 5. COMPUTED DAMPING VALUES

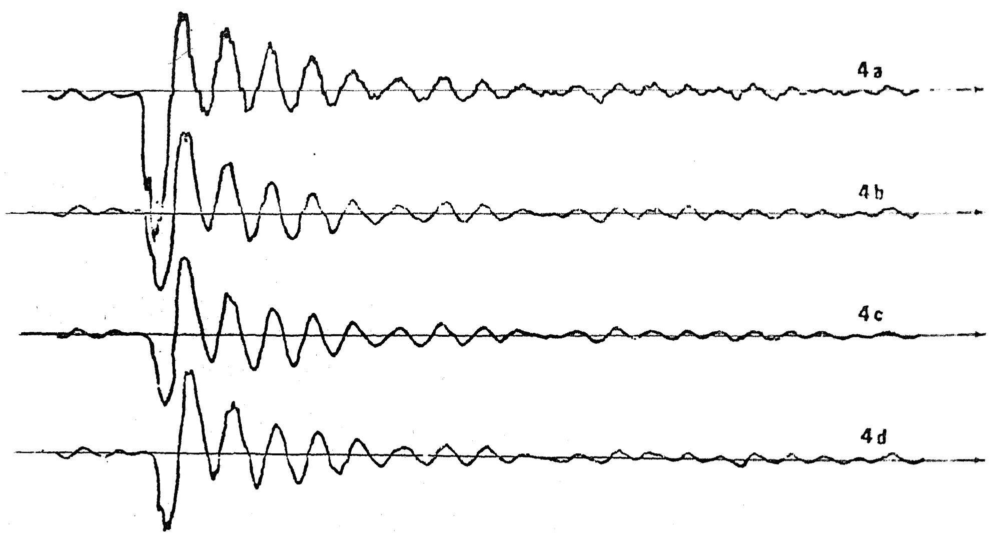

Figure 6. ACCELEROGRAMM RECORDED AT THE 4th FLOOR