

DATE **2007 02 12** TIME **11:35** LOCATION **CIUDAD LINEAL; MADRID**

SourCE *On-site macroseismic survey*

TEXTS **Observer 1** Patrick Murphy

We have felt it clearly on the 4th floor of a four storey RC office building with a 7,2m x 9,0m structural grid.

Sitting in front of the computer, I began to feel a to-and-fro swaying of my upper torso in an E-W direction, with an approximate frequency of about 1.5 Hz, or about three oscillations every two seconds, (worked out later by replaying the experience), which I initially thought was due to an energetic heart beat. The motion was slight but distinct enough to make my chest make rhythmic contact with the desk edge. This motion lasted about four seconds and was immediately followed by a distinct North – South motion (left to right) accompanied by a sudden dizziness, thick headedness or motion sickness, which made us all look up at each other in foggy confusion. The building perceptibly swayed in a N-S direction, making us oscillate visibly in our seats. I suddenly realized what was going on and sputtered out 'earthquake!' And stood up from my seat. My colleagues confirmed the phenomenon and we looked around ourselves, noticing swinging coats on a coat hanger, swirling tea in a cup, and swaying window blind cords. This motion was clearly stronger than the initial phase, but with a slower frequency of maybe 1Hz, lasting about four seconds, followed by a gradually declining motion which phased in and out of perceptibility making us question each other with comments of the sort of; 'It's stopped' – 'No it hasn't, look at the coat hanger moving' – 'Oh yes it's still going on' – 'It's stopped now'. This lasted for about another four or five seconds until we all agreed the building had stopped moving.

Total time estimate would be;

Phase 1 (heartbeat sensation): 4 seconds.

Phase 2 (N-S or left to right swaying motion of the building) 4 seconds. Halfway through this phase I stand up and exclaim 'Earthquake!'.

Phase 3 (Declining coda) 4-5 seconds.

Total: about 13 seconds of perceptible motion.

Observer 2 Sandra Rumori

It all began with a morning sickness sensation in my head....then I turned towards Patrick and saw his lips spell out E A R T H Q U A K E in a slow motion way like in the films, when one is not clear of how much time is going by. The sensation was dreamlike and unreal, almost as if the earthquake was numbing all muscles and feelings...

Observer 3 Mónica Borondo

The first feeling was one of dizziness, a strong pressure feeling upon my forehead as if I was about to fall faint. Then the table and floor shook and swayed, (like the coat hanger) For a few seconds it was strong, and then the same pulsating feeling declined lasting about ten seconds.

Our building sometimes shakes with all the site works nearby, and the first feeling was just like that.

Observer 4 Jacopo Monti

I began to feel a north-south swaying, which I originally thought was due to the site works going on in front, but its rhythmical insistence made me discard that explanation. The physical feeling was one of drunkenness. After about 3 – 4 seconds I thought it might be an earthquake, confirmed in part by Patrick's claims. I looked closely and noticed swaying objects (coat hanger); the contents of my cup of tea; etc. I would say the experience lasted a maximum of 15 seconds.

NOTES

Setting

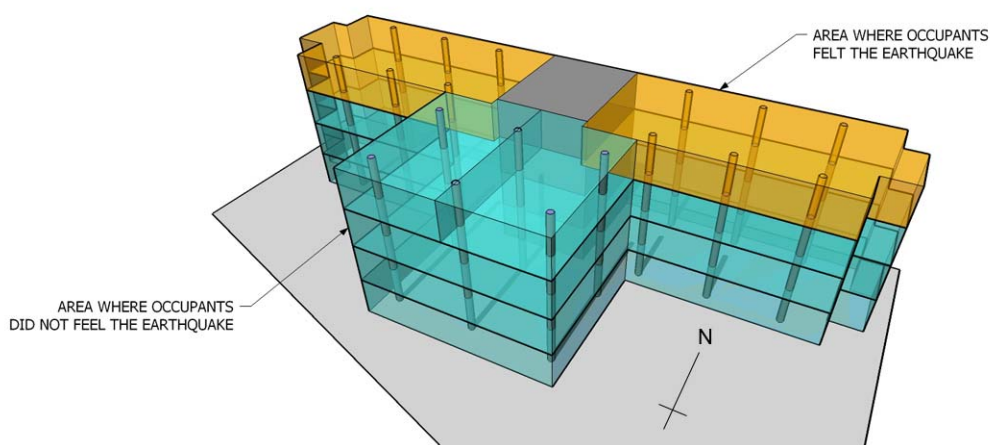
It's a RC office building with a 7,2m x 9,0m structural grid, with two basement floors and four floors above grade, recently built in about the year 2000. The building has no special seismic resistance capacity as Madrid has a hazard value of $a_c=0,04g$ and seismic forces can be ignored.

It is a T-shaped building with a long axis on an E-W direction and a short axis on a N-S direction.

Macroseismic methodology

The building occupants were questioned after the earthquake, to determine where and how the event had been perceived. It was then possible to determine that the earthquake had only been felt on the fourth floor of the building, and in particular in the E-W aligned bar. We were only able to locate one observer who thought he had felt the earthquake on the shorter N-S bar. The earthquake's perceptibility in the building is shown in the following figure.

Fig.1 Areas of the building where the earthquake was felt.



A more detailed analysis was performed in part of the 4th floor, where the distribution of the occupants at the time of the earthquake was able to be accurately determined. We are able to ascertain that practically everyone in the longer E-W bar felt the earthquake, with the exception of a colleague engaged in a telephone call who missed the commotion, despite the fact that a colleague seated immediately to his right felt the earthquake clearly. This information has been drawn onto a plan which also identifies the locations of observed effects on objects, like the swaying coat hanger and oscillating liquids. On the neighboring office on

the same floor, observers reported swaying potted plants and described the motion as 'strong'.

Fig.2 Occupancy of one of the fourth floor offices at the moment of the earthquake.

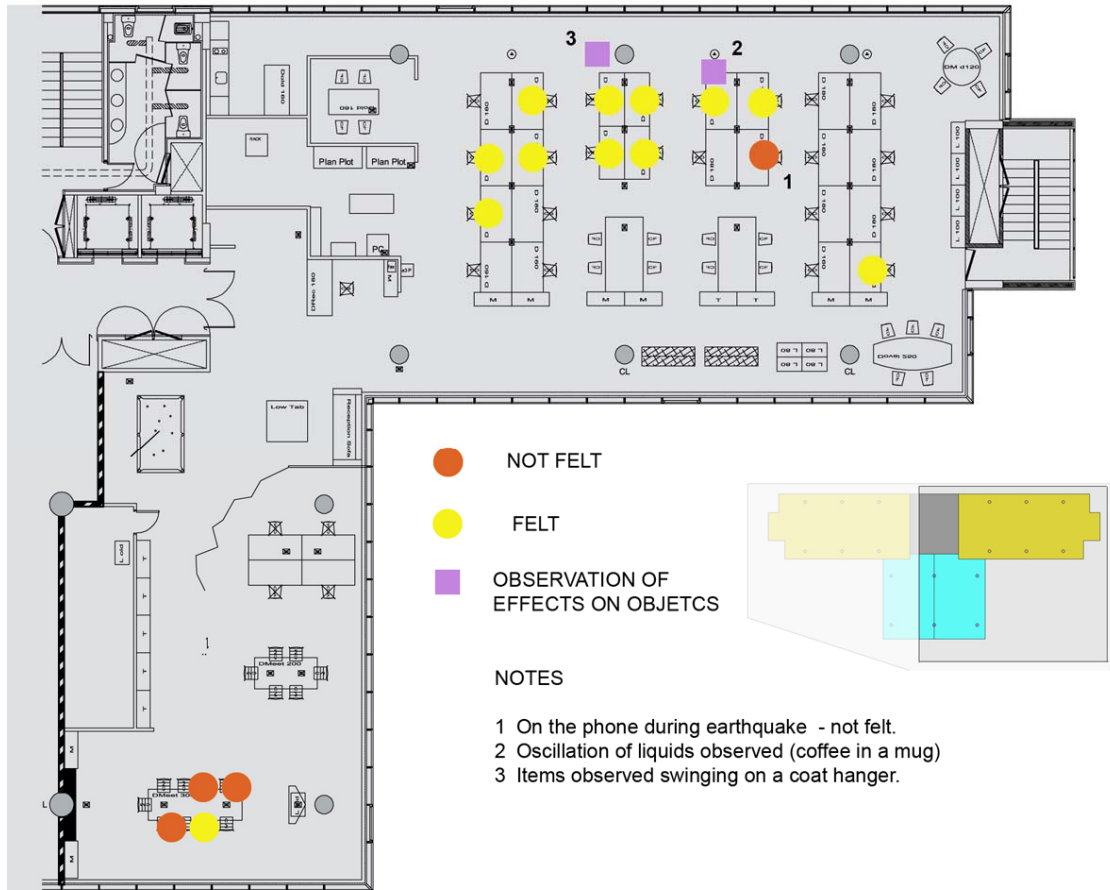


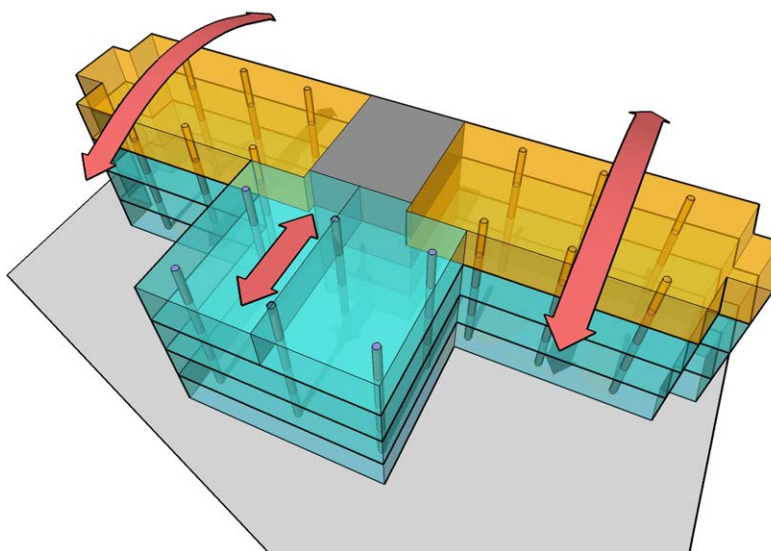
Fig.3 Photograph of the building in Julián Camarillo 42.



Interpretation

We don't think it is a casual circumstance that the earthquake was clearly felt only on the E-W aligned bar. This is also the building area with less stiffness against a perpendicular N-S motion, which was clearly felt by the building occupants. On the other hand, colleagues seated on the shorter and stiffer N-S bar did not generally feel the earthquake. The higher stiffness in that particular direction, as well as being confined by the circulation core, may have considerably limited its degree of freedom. This may explain why it is only in the E-W bar that the earthquake was clearly felt.

Fig.4 Geometric characteristics of building bars condition their stiffness. The longer E-W bars are able to oscillate more freely in a N-S direction than the stiffer bar in the middle, where virtually no one felt the earthquake, in contrast to the concerned occupants in the E-W bars.



Intensity assignment

The building is a diaphanous grid structure with a large open plan layout. The building has no main stiffening element, and although it is only four stories in height, has an estimated natural period of about 0,5 – 1.0Hz. This type of structure will respond favorably to a long period train wave rich in signals of this frequency, particularly in a N-S direction, perpendicular to the long building bars. We do not think the earthquake was perceptible at ground floor in the Madrid area without the enhancement of the signal by a resonating structure, as we believe may have happened in this building.

EMS₉₈ INTENSITY

2₂

QUALITY

QUALITY CRITERIA

Qi₁	<input type="checkbox"/>	Maximum	Effects on people ^A + Effects on objects ^B + damage information ^C + damage or instrumental statistics.
Qi₂	<input checked="" type="checkbox"/>	High	Effects on people ^A + Effects on objects ^B + Damage informations ^C , or detailed partial indicators.
Qi₃	<input type="checkbox"/>	Medium	Partial indicators; (A+B or B+C etc.); Seismogeological or archaeoseismological evidence.
Qi₄	<input type="checkbox"/>	Low	Isolated descriptive, archaeoseismological or seismogeological indicators.