

# When the earth

## Vibrating table tests at ZAG

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The ZAG Ljubljana, Zavod za gradbeni tvo Slovenije, is Slovenia's national Institute for building and civil engineering, where building products are tested and certified.

### Vibrating table tests in the construction laboratory

Building, civil engineering and mechanical engineering structures, their construction elements and assemblies are tested in laboratory and field tests. Together with the earthquake engineering department, the Institute implements tests to evaluate the dynamic and static properties of building structures.



Fig. 1: The model of a two-storey terraced house being prepared for testing

The number of transducers is dependent on the building type.

#### A two-storey terraced house requires:

- Seven inductive displacement transducers W100 and W50 for measuring the movement of the walls and foundation.
- Seven accelerometers B12/200
- Four DD1 strain transducers inside the house to display the first cracks



Fig. 2: Function check before the simulated earthquake

### HBM technology for more than 30 years

The construction laboratory includes a HBM KWS/6T-5 amplifier and an MBS4 magnetic tape recorder that have been in use for more than 30 years. The development of the hydraulic control system was accompanied by computer-based data acquisition which meant that the number of measurement points could be increased. At a later date, more equipment was added, including amplifiers (KWS 6A-5, KWS 3073, KWS 3082 A) and transducers (W200, W 100, W 50, W 20, B 12/200, D 1).

### Vibration tests require extremely high measurement accuracy

All models are tested over several steps with increasing vibrating table movements. The maximum movement in the first step is about 0.6 mm and only the relative movement of the house to the foundation is of interest here. This is normally a maximum of 0.1 mm. The subtraction of two equivalent values (movement of the roof and movement of the foundation) requires very high measurement accuracy so that accurate results can be obtained.

rocks...

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**New technology provides higher quality...**

A new data acquisition and control system was used for the first time at the beginning of 2003: two MGCplus system units with 13 amplifier racks ML55B, transducer WA/200mm, accelerometer B12/200, strain transducer DD1, strain gages, a GP-IB interface and the data acquisition software LabView 6.1, together with a PCI-6052E NI-DAQ unit. The precise calibration of the WA/200 and the advantages of the MGCplus with its high resolution, filtering and simultaneous sampling means that very precise and reproducible results can be achieved, even with very low strength earthquakes.

**...and facilitates test procedures and analysis**

The high resolution of the amplifier means that the measurement range from the beginning (0.1 mm relative movement) to the end of the test (up to 50mm relative movement) does not need to be changed. This facilitates test procedures and analysis, and excludes possible sources of error. Work is also simplified by the filter function provided by the MGCplus. ■



Fig. 3: The last vibration caused by a simulated earthquake

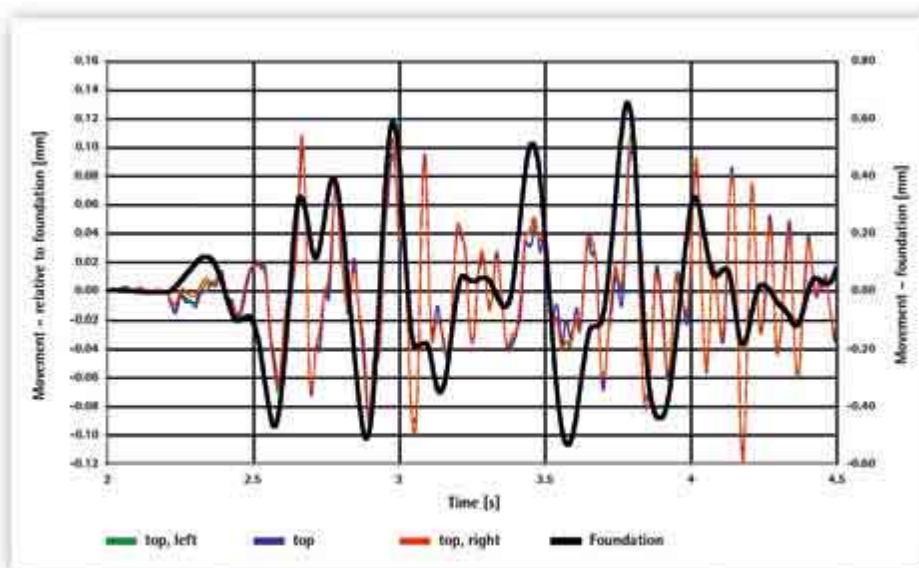


Fig. 4:  
 Result of a vibration table test (strength: 5%) for a two-storey terrace house:  
 The green, blue and red curves represent the reaction of the upper section of the house to the movement of the foundation (black curve)