Further information for 'Quake shake – will my home collapse?'

The importance of strong foundations in earthquake-prone areas

In Rome, there are two beautiful marble columns which were once identical, the Trajan and the Marco Aurelio columns.

As the first diagram below shows, the Trajan column was built on sandstone bedrock, whilst the Marco Aurelio column was built on poorly-consolidated sediments.

Although Rome has felt many small earthquakes since the building of the columns, the Trajan column still looks perfect. However many of the marble blocks of the Marco Aurelio column have rotated, as shown in the second diagram. As the 'Quake shake' Earthlearningidea shows, buildings on firm foundations are much less likely to be damaged than buildings with poor foundations, and the difference between the columns gives an excellent example of this.

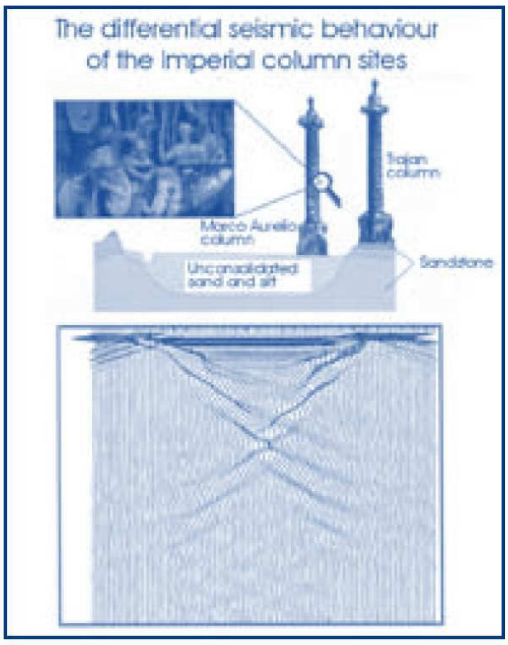

Figure 20 - A synthetic earthquake illustrating the amplification of seismic waves across the site of the Marco Aurelio column

The diagrams and extracts below come from the following field guide: Funiciello,R., Giordano G., Adanti, B., Giampaolo, C., & , Parotto, M. (2004) *The seven Hills: constitution, visible traces and geological evidence: itinerary, profiles and observation points for the shape of the city of Roma and its history*. 32nd International Geological Congress.

Figure 21 - A detail of the dislocation of two sections of the Marco Aurelio column

'… on the eastern side of [the Piazza Venezia} … is … the beautiful Trajan column at the edge of the Trajan Forum. The column is made of 18 pieces of Marmo Bianco di Luni, i.e. the Carrara marble. The importance of this monument will be explained at the next stop, when the perfect integrity of the column, built over the sedimentary bedrock, will be compared with the state of the twin Marco Aurelio column built over the unconsolidated Tiber alluvial sediments.' (Funiciello et al, p 14)

'… The [Marco Aurelio] column is identical to the Trajan column described [above] …. The state of conservation, though, is completely different. The pieces composing the column are dislocated and rotated so that the carvings appear damaged. Originally the sections of the columns were connected with lead joints, but by Mediaeval time these joints had been removed. Without joints, the sections of the columns were free to move in respect to each other during seismic shaking. The different conditions of the two identical columns can be explained by the difference in seismic impedance of the different substrates onto which they were built. Experimental analogue and numerical modelling have shown that the resonance frequencies of both the column and the alluvial sediments filling the Tiber river valley have the same value of 2 Hz. This coincidence explains why the shaking of the ground at the site of the Marco Aurelio column produces an amplification of the shaking of the column, and therefore damage, whereas the same condition is not experienced by the Trajan column which lies on bedrock.' (Funiciello et al, p 14).