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Seismic risk factors: Case example from an historical centre of a town in Southern Italy

E. Esposito & S. Porfido
Gruppo Nazionale per la Difesa dai Terremoti, CNR, Italy
S. M. Petrazzuoli
Osservatorio Vesuviano, Naples, Italy

The little town of San Lorenzello (Benevento District) is located in a complex active tectonic area of the Southern Apennines chain. By means of analysis of historical documents it has been shown that the historical centre of San Lorenzello was heavily hit by the 1688 earthquake of Southern Italy which intensity has been valued X degree on the MCS scale. Following historical earthquakes of 1694, 1702, 1732 and 1805, have been estimated VII-VIII MCS degree in the town of San Lorenzello. Sources that provided information on the effects of the historical seismicity have been found locally, and the damages have been accurately identified. Recent seismic activity, like the strong earthquake of November 23rd 1980, hit the centre with moderate intensity.

the June 5th 1688, July 26th 1805 and November 23rd 1980 earthquakes have been defined (fig. 1).

The damage pattern of the June 5th, 1688 in San Lorenzello was localized into the Middle Ages urban area and all the buildings suffered great damages and underwent partial or total collapse. The damage increased due to a large rock fall.

Churches and notable houses suffered the maximum damage caused by the July 26th 1805 events.

The November 23th 1980 earthquake was felt in the town with an intensity of VI degree on the MSK scale. The damage map, that evidences just little damage, shows a clear concentration of damages in the zone of urban area based on detrital deposits, while the buildings

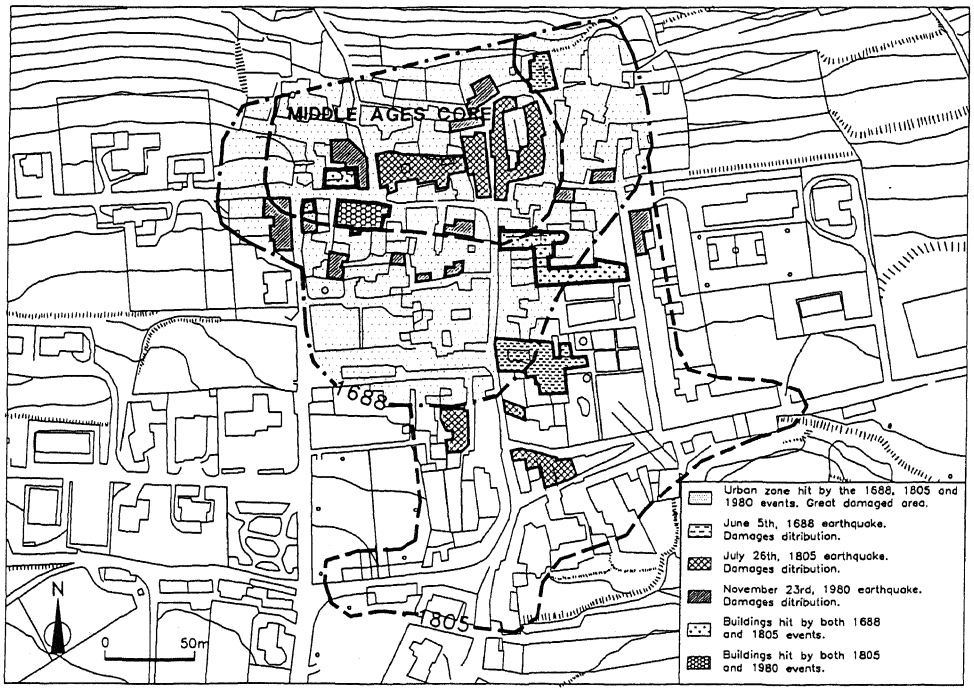

Fig. 1 Damages distribution of 1688, 1805 and 1980 earthquakes.

based on the volcanic tuff suffered minor damages.
All the reconstructions show that the most damaged area is always the same. The highest and largest buildings underwent major damages, as churches and important buildings.
The Middle-Ages core of the town is placed on a slope detritic deposits progressively thinning towards the calcareous slope behind the town (fig.2). The younger area of the historical centre is localized on a 20 metres thick layer of volcanic tuff floating on alluvial-detritic and slope-detritic deposits of sand and pebbles. Down hole geophysical surveys show that velocities of S waves(Vs) are very similar in both alluvial-detritic and slope-detritic rocks. Hence, the local seismic attenuation in the post-Middle Ages centre has been supposed to depend on the presence of the tuff layer. A numerical simulation was carried out. The amplification ratio H(T) between the acceleration response spectra of points A and B(fig.3), for a structural damping of 5%, is shown in figure 4. H(T) was evaluated making use of the SHAKE computer program (Schnabel et al., 1972) under the following conditions:
-linear elastic behaviour of soil;
-splitting of the layer in ten sublayers;
-constant G value (shear modulus) for each sublayer;
-damping ratio of soil equal to 5%.
The diagram shows a remarkable amplification of seismic motion in the situation A respect to the situation B, in

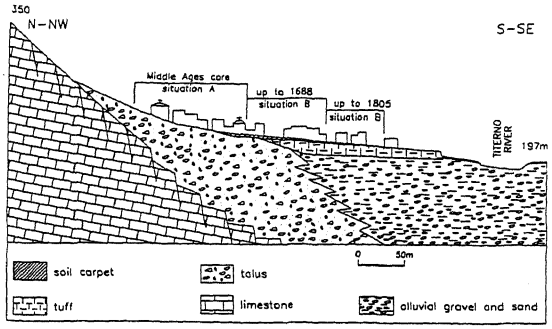

Fig.2 Geological setting of San Lorenzello and urban development from XV to XIX century.

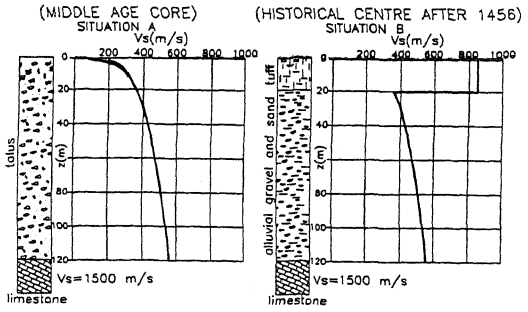

Fig.3 Stratigraphic situations and velocity of S waves.

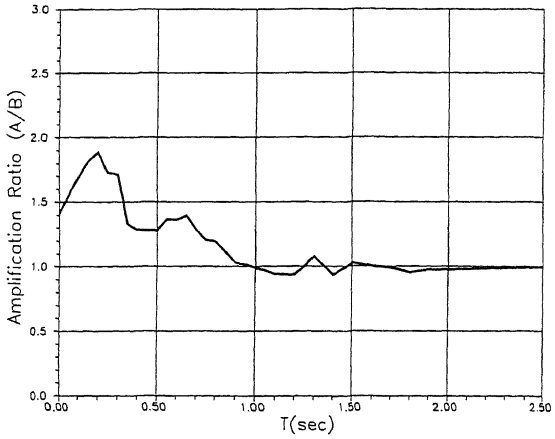

Fig.4 Amplification between the acceleration spectra of situation A and B, for a structural damping of 5%.

the range 0-0.5 sec. This range accounts for an increase of damages suffered by monumental buldings.
Therefore the analytical model shows that the superficial tuff layer is responsible for a significant attenuation of seimic motion at surface.
This work emphasizes the importance of historical data for the evaluation of local sesmic response even for a little town.

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