A SIMPLIFIED SOIL-TYPE DEPENDENT SEISMIC HAZARD ASSESSMENT FOR NORTH-EASTERN ITALY

The influence of the site effects in the ground-shaking experienced during an earthquake is well known. It is interesting, then, to introduce somehow the local geological conditions in the standard probabilistic seismic hazard assessment (PSHA). In the present study, local soil conditions, roughly summarised by considering a reference soil for each municipality of NE Italy, are introduced into probabilistic seismic hazard estimates by considering different attenuation relations. More precisely, three soil types were considered according to the Ambraseys et al. (1996) classification for defining attenuation relationships. In this way, different propagation properties can be introduced in the PSHA procedure, and maps referring to different soil typologies can be obtained. The subdivision has been proposed on the basis of the lithological characteristics (prevailing lithotype class) of the soil in the 30 surficial metres, as can be defined from bibliography and geological surveys (Briseghella, personal communication; Peruzza et al., 2001). The definition of a municipality’s typical soil is not trivial because, obviously, different soils are present in the same municipality, even in very close districts. Considering that PSHA will never be able to take site effects into account, a rough working assumption has been used before detailing more homogeneous portions of the territory: the mean soil, where the majority of the buildings are located, has been taken as the typical municipality soil.

In the standard probabilistic seismic hazard assessment, seismic sources are modelled as seismogenic zones (SZs) where the earthquakes can occur randomly. The seismogenic zonation of NE Italy used in this study derives from the seismogenic zonation of Italy (Meletti et al., 2000) used for the hazard assessment of the national territory (Slejko et al., 1998): the homogeneous active areas were identified in greater detail (Rebez et al., 2001) obtaining 10 SZs. Entering into detail, the subdivision between External and Internal Dinarides of Meletti et al. (2000) is maintained with limited changes. The Friuli region is divided into five SZs, two of which collect the major seismicity. In the northeastern part of the region, a new wedge-shaped SZ connects the Alpine domain to the Dinaric one and represents a possible link to the Vienna basin (Slejko et al., 1989). Westwards, the transverse Belluno SZ of Meletti et al. (2000) is enlarged to gather all the instrumental hypocenters of the 1936 Cansiglio sequence.

The regional PSHA has been done according to the standard approach of Cornell (1968) by the computer formulation of Bender and Perkins (1987). As it is known, this approach needs the following input data: the SZ space definition; the seismicity rates (in terms of average number of earthquakes per magnitude interval); the attenuation relation of the chosen parameter of motion. The seismogenic zonation previously described has been used without considering the uncertainties in the location of the SZ boundaries because the zonation is rather detailed and the SZs contain specific tectonic structures and follow main geological features.

Ambraseys et al. (1996) calibrated attenuation relations for three different soil types, namely rock, stiff, and soft soil, but the empirical curves corresponding to stiff and soft soils are very similar. Separate computations were performed for PGA on rock, stiff soil, and soft soil. The hazard maps have been computed for a 475-year return
period: this is a standard practice in seismic design. The uncertainty of the attenuation relations has been taken into account by introducing their standard deviation in the computation.

The final seismic hazard map (Fig. 1) aggregates the previous results taking into account the specific terrain at each municipality (Peruzza et al., 2001). This aggregation refers to the geographical coordinates of the main centre in each municipality. PGA no longer shows the regular pattern of the usual hazard maps, but emphasises the areas with amplification due to the presence of softer terrains. This influence is evident especially in the northern mountain sector, where, along the valleys, a patchwork of higher values has been obtained because of sharp soil variations.

![Soil-type dependent PGA with a 475-year return period with $\sigma$ of the attenuation relations.](image)

**Fig. 1** - Soil-type dependent PGA with a 475-year return period with $\sigma$ of the attenuation relations.

**REFERENCES**


