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On the importance of fault modelling for seismic risk estimate

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In Central Italy more than 393 thousands people live in villages and towns located at less than 5 km distance from a known, mapped, active fault, capable of generating Mw>6 earthquake. Improving seismic risk estimates in such places requires the use of (i) informative databases of active faults and (ii) the implementation of appropriate building-codes.

The current level of knowledge regarding activity of active faults in Central Italy has been stored in a recently compiled database (160 slip rates estimates for 88 faults). Given the complex nature of fault ruptures, we adopted a multi-fault rupture approach (SHERIFS) that accounts for both individual ruptures and multi-fault complex ruptures, involving more than one seismogenic fault section. Our earthquake rupture forecast model includes 1249 possible combinations of fault ruptures with lengths ranging from 7 to 42 km. Slip rates and associated errors are used to estimate recurrences of the ruptures assuming a Gutenberg-Richter frequency-magnitudedistribution. The computed distribution is validated against the CPT115 catalogue.

The multi-fault model approach and a seismogenic area approach are used to estimate damages based on published typological fragility curves for typical building classes derived from 30 years of data in Italy (Rota et al., 2006) assuming earthquake occurrence for the faults follows a Poisson time-independent process. Two fragility curves are considered here: one for reinforced concrete designed according to seismic regulations and one for masonry with irregular layout and without tie rods and tie beams, a typical typology for the region. Expected levels of damage for 150 villages and towns in Central Italy are computed for all damage states considering a 50 years risk target period.

Results obtained with the fault approach show a much higher variability of the estimated risk depending on the location of the village/town w.r.t. the fault system and the hanging-wall/footwall location. The probability of collapse in 50 years for a typical masonry building ranges between 0.01 and 0.07 in the fault approach and 0.01 and 0.04 for the area approach. For both approaches, the probability of collapse for reinforced concrete buildings is ~90 % less than that for typical masonry structures. Even if this can be considered obvious, it must be underlined that most buildings in Italy were built before 1975 (before the first applicative decree of the seismic Italian law No. 64 of

1974). Thanks to the availability of the detailed database of active faults a strategy to prioritize resources for seismic risk reduction could be adopted.

Rota, M., Penna, A. & Strobbia, C. (2006). Typological fragility curves from Italian earthquake damage data. First European Conference on Earthquake Engineering and Seismology Geneva, Switzerland, 3-8 September 2006 Paper Number: 386