

# Targeting uniform seismic risk for Romania

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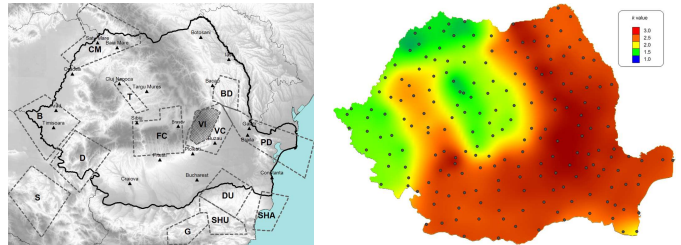
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The purpose of this research is to obtain uniform seismic risk maps for Romania. In this study, seismic hazard curves obtained within BIGSEES national research project (Vacareanu et al. 2016, Pavel et al. 2016) are employed. The slope  $k$  of the hazard curve is controlling the value of the annual probability of failure, higher probabilities of failure corresponding to steeper slopes.

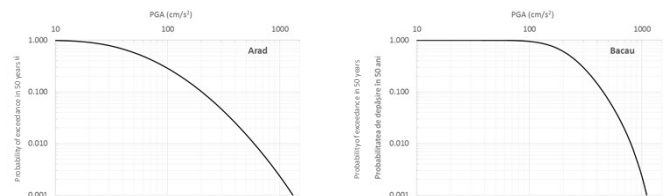
The variability of lognormal fragility curves is considered through the value of the logarithmic standard deviation,  $\beta$ . In this study,  $\beta$  value is 0.6, same as in Luco et al. (2007) for conterminous US and in Silva et al. (2016) for Europe. The  $PGA$  values from hazard curves with 2% exceedance probability in 50 years (2%/50 yrs.) are considered as 0.1 quantile of the lognormal fragility curves.

The target annual probability of collapse / failure in the surveyed literature ranges from  $10^{-4}$  in Luco et al. (2007) and Fajfar & Dolšek (2012), to  $10^{-5}$  in Douglas et al. (2016), down to  $10^{-6}$  in Labbé (2010) and Kennedy (2011). In this study, collapse/failure means the exceedance of the collapse prevention limit state, that is associated with a hazard level expressed as 2%/50 yrs  $PGA$  values. For Romania, we assigned a target annual probability of exceedance of collapse prevention limit state of  $5 \times 10^{-4}$ . The reason for targeting this annual probability of failure is to maintain, in the epicentral area of Vrancea intermediate depth seismic source, design values of  $PGA$  equal to the ones corresponding to 2%/50 yrs.

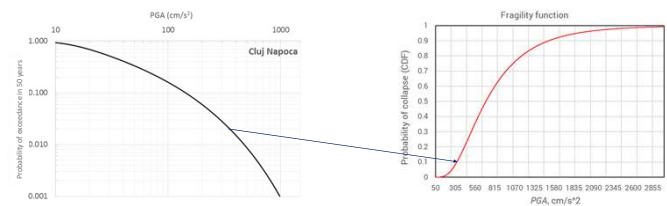
The uniform risk based  $PGA$  values are lower than the uniform hazard based  $PGA$  values as the influence of Vrancea intermediate-depth seismic source is fading away and the crustal seismic sources control the hazard.



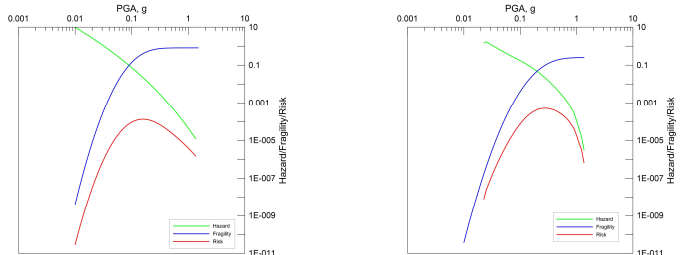
Sources contributing to the seismic hazard of Romania (left) and map of slope parameter  $k$  (right)



Seismic hazard curves for two major cities in Romania; different slopes  $k$  for dominant seismic hazard from shallow sources (left) and intermediate sources (right)



Calibration of fragility curves



$$P_F = - \int_{P_{F,cr}}^{+\infty} P_{F,cr} \cdot \frac{dH_A(a)}{da} da$$

Convolution integral of seismic risk

