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Errata for "Summary of the Abrahamson and Silva NGA ground-motion relations" by Abrahamson, N. A. and W. J. Silva (2008).

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Errors in the Standard Deviation Equations

There are two errors in the equations for the model of the standard deviation in Abrahamson and Silva (2008): in eq. 24, the first term should be σ_B^2 instead of σ_0^2; in eq. 26, the numerator of the second term should be $b(T)P\hat{G}A_{1100}$ instead of 1.

Eq 24 should read:

$$\sigma(T,M,P\hat{G}A_{1100},V_{S30}) = \left[\begin{array}{l} \sigma_B^2(M,T) + \sigma_{Amp}^2(T) + \left(\frac{\partial \ln Amp(T,P\hat{G}A_{1100},V_{S30})}{\partial \ln PGA_{1100}} \right)^2 \sigma_B^2(M,PGA) \\ \\ + 2\left(\frac{\partial \ln Amp(T,P\hat{G}A_{1100},V_{S30})}{\partial \ln PGA_{1100}} \right) \sigma_B(M,T)\sigma_B(M,PGA)\,\rho_{\varepsilon/\sigma}(T,PGA) \end{array} \right]^{1/2}$$

Eq 26 should read:

$$\frac{\partial \ln Amp(T,P\hat{G}A_{1100},V_{S30})}{\partial \ln PGA_{1100}} = \begin{cases} 0 & for\ V_{S30} \geq V_{LIN} \\ \\ \dfrac{-b(T)P\hat{G}A_{1100}}{P\hat{G}A_{1100}+c} + \dfrac{b(T)P\hat{G}A_{1100}}{P\hat{G}A_{1100}+c\left(\dfrac{V_{S30}}{V_{LIN}}\right)^n} & for\ V_{S30} < V_{LIN} \end{cases}$$

Modification to the Hanging Wall Taper

The hanging wall term in the AS08 model is mainly controlled by two earthquakes: 1994 Northridge (EQID 127) and the 1999 Chi-Chi (EQID 137). The Chi-Chi

earthquake had a dip of 30 degrees and the Northridge earthquake had a dip of 40 degrees. These two earthquakes each had 9 recordings located on the hanging wall directly over the rupture and also had recordings at short distances on the footwall. There were only two other earthquakes with magnitude greater than 6.5 that had recordings over the hanging wall: The 1992 Cape Mendocino earthquake (EQID 123 , dip of 14 degrees) had 2 recordings over the hanging wall and the 1989 Loma Prieta earthquake (EQID 118, dip of 71 degrees) had just 1 recording over the hanging wall.

The hanging wall effect should decrease as the dip increases to 90 degrees. In the AS08 model, a taper on dip was applied to the hanging wall factor so that the factor becomes zero at a dip of 90 degrees; however, the empirical data provide very little control the taper for dips between 45 and 90 degrees. The AS08 model used a taper, T_5, over than range of 70 to 90 degrees as shown in Equation (4).

$$T_5\,(dip) = \begin{cases} 1 - \dfrac{dip - 70}{20} & for\ dip \geq 70 \\ 1 & for\ dip < 70 \end{cases} \qquad (4)$$

Starting the taper at 70 degrees was based on the hanging wall recordings from the 1989 Loma Prieta earthquake which showed a significant hanging wall scaling term; however, the Loma Prieta earthquake had only 1 recording over the hanging wall and only 2 other recordings within 10 km on the hanging wall side of the rupture, so this data did not provide a robust constraint on the dip taper.

Over the past year, applications of the AS08 model for large faults with dip angles in the range of 50 to 80 degrees have found that the AS08 leads to much larger hanging wall scaling than other NGA models and also larger scaling than seen in a some of the numerical simulations developed for the NGA project (see Collins et al., 2006). We believe that the AS08 model overstates the hanging wall scaling in this range of dip angles. Based on these evaluations, we recommend revising the T_5 term to taper the hanging wall effect over the range of dips of 30 to 90 degrees. The revised T_5 taper is given by

$$T_5\,(dip) = \begin{cases} 1 - \dfrac{dip - 30}{60} & for\ dip \geq 30 \\ 1 & for\ dip < 30 \end{cases} \qquad (5)$$

In general, modifying one term of the ground motion model would require recomputing the other terms; however, because this change in the taper affects only a few recordings, there is not a significant effect on the other coefficients in the

model. Using the revised T_5 term with the existing coefficients, we found that the mean residual changed by less than 1% at all spectral periods. Therefore, we conclude that the T_5 term can be revised without updating the other parameters of the model.

As noted in AS08, the hanging wall scaling is one of the more poorly constrained parts of our model. Additional evaluations of the hanging wall scaling using numerical simulations and recent data are planned in the next year.

References

Abrahamson, N. A. and W. J. Silva (2008). Summary of the Abrahamson and Silva NGA ground-motion relations, Earthquake Spectra, 24: 67-97

Collins, N., R. Graves, and P. Somerville (2006). Revised analysis of 1D rock simulations for the NGA-E project, Final report prepared for the Pacific Earthquake Engineering Research Center, April 2006.