Proponent Hanging Wall Model from SWUS

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NGA East Workshop
October 30, 2014

Motivation for Application to NGA East

• Empirical data from study region are insufficient to quantify hanging wall (HW) effects
• Can use “better calibrated” models to develop a distribution of models for HW effect
• Apply these HW models to region appropriate models developed without HW effects
HW Factor Model

- Three NGA-West2 used numerical simulations to constrain HW effects
- Compute HW factor from ASK2014, CB2014, and CY2014 for a range of dips for $M$ 6.5, 7.0, and 7.5 earthquakes for $R_{JB} = 0$ sites and $Z_{TOR} = 0$
- Fit predictions with common form
- Represent uncertainty in HW factor with simple discrete distribution – “HW scaled backbone”
- Develop average magnitude, distance ($R_{JB} > 0$), and $Z_{TOR}$ tapers

Common Form for $Z_{TOR} = 0, R_{JB} = 0$ Sites

\[ HWF = C_1 \cos(dip) \times \left[ C_2 + (1 - C_2) \tanh \left( \frac{C_3 R_X}{W \cos(dip)} \right) \right] \times \]

\[ \left[ 1 + C_4 (M - 7) \right] \times \]

\[ T_1(R_{JB}, R_{RUP}) \times T_2(M) \times T_3(Z_{TOR}) \]
Model Fits to HW Factors (1 of 2)

Model Fits to HW Factors (2 of 2)
**T₁ - Attenuation of HW Effect with R_{JB} > 0**

- CB14 and CY14 have similar behaviors, ASK is approximately similar
- Use form that approximates CB14 and CY14

\[ HW_1 T_1(R_{JB}) = 1 - \frac{R_{JB}}{R_{RUP}} + 0.1 \]

**T₂ – Effect of Magnitude**

- ASK14 and CB14 applied the assumption that HW effect goes from full effect at M 6.5 to 0 at M 5.5
- CY14 use a geometry based formulation in which the HW is related to the size of the rupture – smaller M → smaller RW → smaller HW effect
- Simulations conducted for M < 6.5 showed significant HW effects
- Extrapolate HW factors for based on M ≥ 6.5 for ASK14, CB14, and CY14 (for R_{JB} = 0) to M < 6.5 - T₂(M) = 1
T₃ - Attenuation of HW Effect with ZTOR > 0

- Three models have different behavior
- Approximate average behavior with linear decrease with increasing ZTOR

\[ HW_{-}T₃(Z_{TOR}) = 1 - \frac{\min(Z_{TOR}, 12km)}{12km} \]
Simulation Results (2 of 3)

Figure 5.3.4.3 Comparison of proposed SWUS hanging wall term simulations (EXSIM green, G&P blue, SDSU red) for Ztor values of 0.0 and 7.0 km.

Simulation Results (3 of 3)

Figure 5.3.4.3 Comparison of proposed SWUS hanging wall term simulations (EXSIM green, G&P blue, SDSU red) for fault dip values of 30, 45, and 60 degrees.

Figure 5.3.4.3 Comparison of proposed SWUS hanging wall term simulations (EXSIM green, G&P blue, SDSU red) for the M6.5, dip=45 degrees, Ztor=0.0, 7.0 cases.