Proponent Hanging Wall Model from SWUS

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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

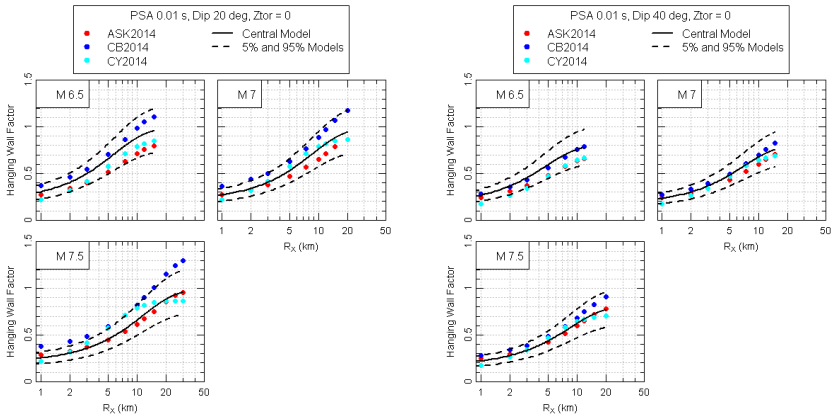
HW Factor Model

- 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

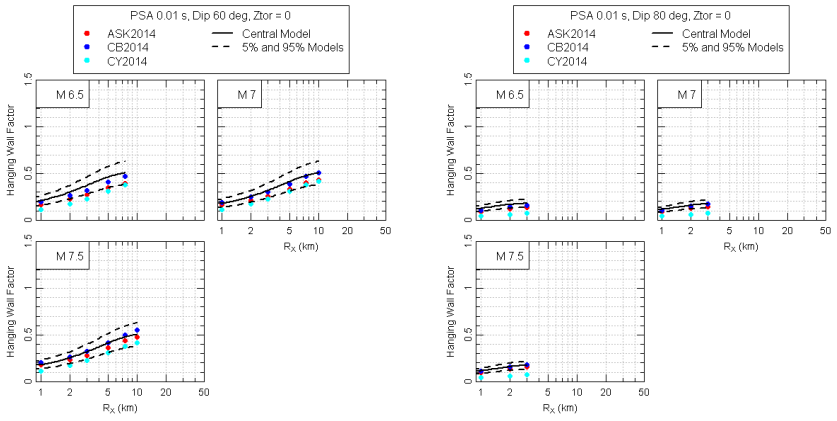
Common Form for Z_{TOR} = 0, R_{JB} = 0 Sites

$$HWF = C_1 \cos(dip) \times \left[C_2 + (1 - C_2) \tanh\left(\frac{C_3 R_X}{W \cos(dip)} \right) \right] \times \left[1 + C_4 \left(M - 7 \right) \right] \times T_1(R_{JB}, R_{RUP}) \times T_2(M) \times T_3(Z_{TOR})$$

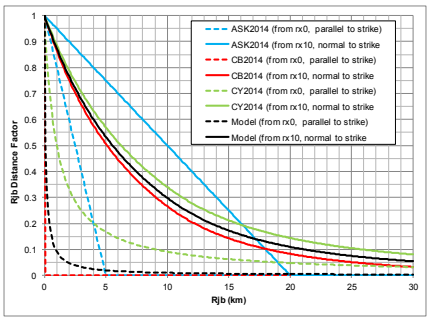
Model Fits to HW Factors (1 of 2)



Model Fits to HW Factors (2 of 2)



T_1 - Attenuation of HW Effect with $R_{JB} > 0$



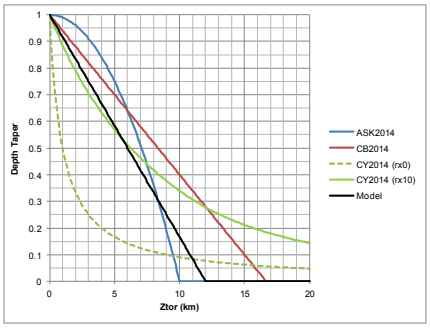
- CB14 and CY14 have similar behaviors, ASK is approximately similar
- Use form that approximates CB14 and CY14

$$HW\_T1(R_{JB}) = 1 - \frac{R_{JB}}{R_{RUP} + 0.1}$$

T_2 – 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 - T_2(**M**) = 1

T_3 - Attenuation of HW Effect with $Z_{TOR} > 0$



- Three models have different behavior
- Approximate average behavior with linear decrease with increasing Z_{TOR}

$$HW\_T_3(Z_{TOR}) = 1 - \frac{\min(Z_{TOR}, 12km)}{12km}$$

Simulation Results (1 of 3)

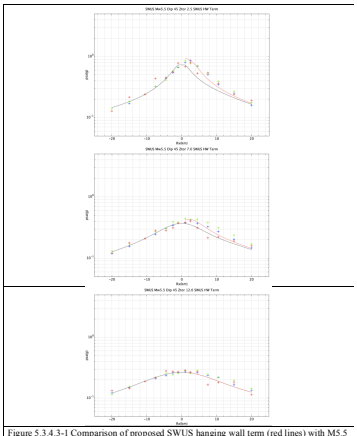


Figure 5.3.4.3-1 Comparison of proposed SWUS hanging wall term (red lines) with M5.5 simulations (EXSIM: green; G&P: blue; SDSU: red) for Ztor values of 2.5, 7.0 and 12.0 km.

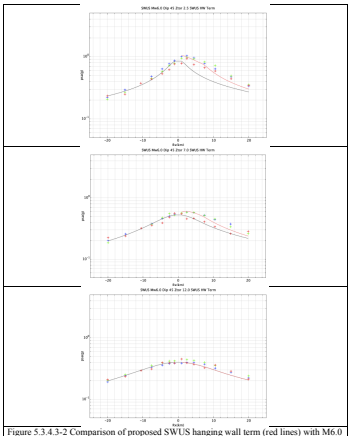


Figure 5.3.4.3-2 Comparison of proposed SWUS hanging wall term (red lines) with M6.0 simulations (EXSIM: green; G&P: blue; SDSU: red) for Ztor values of 2.5, 7.0 and 12.0 km.

Simulation Results (2 of 3)

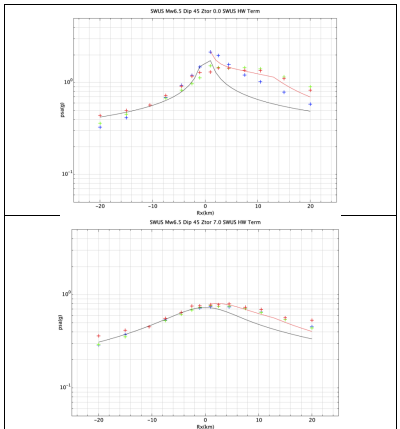


Figure 5.3.4.3-3 Comparison of proposed SWUS hanging wall term (red lines) with M6.5 simulations (EXSIM: green; G&P: blue; SDSU: red) for Ztor values of 0.0, and 7.0 km.

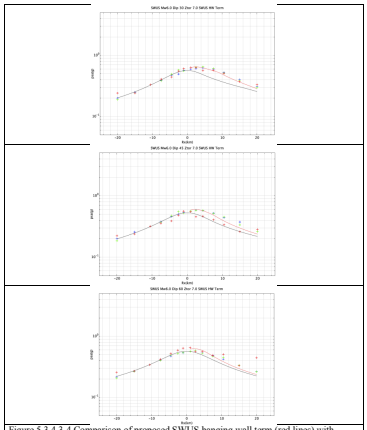


Figure 5.3.4.3-4 Comparison of proposed SWUS hanging wall term (red lines) with M6.0, Ztor=7 km simulations (EXSIM: green; G&P: blue; SDSU: red) for fault dip values of 30, 45 and 60 degrees.

Simulation Results (3 of 3)

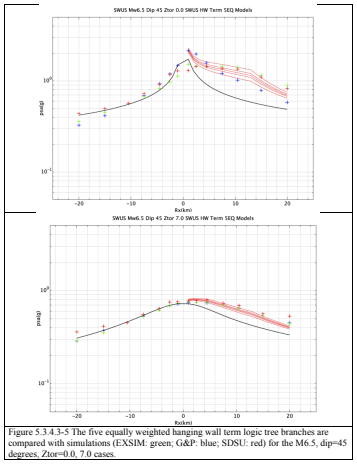


Figure 5.3.4.3-5 The five equally weighted hanging wall term logic tree branches are compared with simulations (EXSIM: green; G&P: blue; SDSU: red) for the M6.5, dip=45 degrees, Ztor=0.0, 7.0 cases.