Appendix F

Parametric RMS Acceleration Calculations

CONCRETE SHEAR WALL CORE PARAMETRIC RMS ACCELERATION

Project AE 482
Date 4/8/2008
Engr Steve Reichwein

Tall Building Acceleration (Serviceability Limit States Under Wind Load, Griffis)

Equations

$$A_L(Z) = C_L(Z)\frac{U_H^{3.54}}{K_L^{0.77} \times \zeta^{0.5} \times M_L^{0.23}}$$

$$A_D(Z) = C_D(Z)\frac{U_H^{2.74}}{K_D^{0.37} \times \zeta^{0.5} \times M_D^{0.3}}$$

$$A_\theta(Z) = C_\theta(Z)\frac{U_H^{1.88}}{K_\theta^{-0.06} \times \zeta^{0.5} \times M_\theta^{1.06}}\frac{N_\theta B}{U_H} \le 0.25$$

$$A_\theta(Z) = C_\theta(Z)\frac{U_H^{1.88}}{K_\theta^{-0.06} \times \zeta^{0.5} \times M_\theta^{1.06}}, \frac{N_\theta B}{U_H} \le 0.25$$

$$A_\theta(Z) = C_\theta(Z)\frac{U_H^{2.76}}{K_\theta^{0.38} \times \zeta^{0.5} \times M_\theta^{0.62}}, \frac{N_\theta B}{U_H} > 0.25$$

$$C_D(Z) = 0.0116 \times B^{0.26} \times Z$$

$$C_L(Z) = 0.0263 \times B^{-0.54} \times Z$$

$$C_\theta(Z) = 0.00341 \times B^{2.12} \times Z, \frac{N_\theta B}{U_H} \le 0.25$$

$$C_\theta(Z) = 0.00510 \times B^{1.24} \times Z, \frac{N_\theta B}{U_H} > 0.25$$

$$A_R = (A_D^2 + A_L^2 + (B/\sqrt{2} \times A_\theta)^2)^{0.5}$$

$$K = (2\Pi N)^2 \times M$$

Parameters

50 Year Wind Speed		114	mph		
10 Year	U_H	84.36	mph	37.717965	m/s
ETABS	T_θ	1.77	s		
ETABS	T_{TRANS}	3.13	s		
	K_θ	61916501414	N/m		
	K_{TRANS}	65242338.61	N/m		
	ζ (Damping)	0.02			
	M	1110058.97	lb-sec^2/ft	16206861	kg
	MMI	4918511077.50	kg-m^2		
	B	140	ft	42.672	m
	C_D	4.08			
	C_L	0.46			
	C_θ	71.00			
	A_D	0.022	0.00227	g	2.27 μg
	A_L	0.026	0.00267	g	2.67 μg
	A_θ	0.001	0.00009	g	0.09 μg
	A_R	**4.416**	**μg**		
	Design Target	**4.500**	**μg**		

Notes: 10 year wind is equivalent to 0.74 x 50 year wind speed
If accelerations exceed design limit, tuned mass damper may be required
However, calculations are only an approximation and a wind tunnel test will be required to verify

STEEL BRACED FRAME CORE PARAMETRIC RMS ACCELERATION

Project AE 482
Date 4/8/2008
Engr Steve Reichwein

Tall Building Acceleration (Serviceability Limit States Under Wind Load, Griffis)

Equations

$$A_L(Z) = C_L(Z)\frac{U_H^{3.54}}{K_L^{0.77} \times \zeta^{0.5} \times M_L^{0.23}}$$

$$A_D(Z) = C_D(Z)\frac{U_H^{2.74}}{K_D^{0.37} \times \zeta^{0.5} \times M_D^{0.3}}$$

$$A_\theta(Z) = C_\theta(Z)\frac{U_H^{1.88}}{K_\theta^{-0.06} \times \zeta^{0.5} \times M_\theta^{1.06}}\frac{N_\theta B}{U_H} \le 0.25$$

$$A_\theta(Z) = C_\theta(Z)\frac{U_H^{1.88}}{K_\theta^{-0.06} \times \zeta^{0.5} \times M_\theta^{1.06}}, \frac{N_\theta B}{U_H} \le 0.25$$

$$A_\theta(Z) = C_\theta(Z)\frac{U_H^{2.76}}{K_\theta^{0.38} \times \zeta^{0.5} \times M_\theta^{0.62}}, \frac{N_\theta B}{U_H} > 0.25$$

$$C_D(Z) = 0.0116 \times B^{0.26} \times Z$$

$$C_L(Z) = 0.0263 \times B^{-0.54} \times Z$$

$$C_\theta(Z) = 0.00341 \times B^{2.12} \times Z, \frac{N_\theta B}{U_H} \le 0.25$$

$$C_\theta(Z) = 0.00510 \times B^{1.24} \times Z. \frac{N_\theta B}{U_H} > 0.25$$

$$A_R = (A_D^2 + A_L^2 + (B/\sqrt{2} \times A_\theta)^2)^{0.5}$$

$$K = (2\Pi N)^2 \times M$$

Parameters

50 Year Wind Speed		114	mph			
10 Year	U_H	84.36	mph	37.717965	m/s	
ETABS	T_θ	2.9	s			
ETABS	T_{TRANS}	4.3	s			
	K_θ	16977955619	N/m			
	K_{TRANS}	25445426.36	N/m			
	ζ (Damping)	0.02				
	M	817098.66	lb-sec^2/ft	11929640	kg	
	MMI	3620446234.00	kg-m^2			
	B	140	ft	42.672	m	
	C_D	4.32				
	C_L	0.49				
	C_θ	75.11				
	A_D	0.040	0.00412	g	4.12	µg
	A_L	0.061	0.00625	g	6.25	µg
	A_θ	0.002	0.00019	g	0.19	µg
	A_R	**9.369**	**µg**			
	Design Limit	**4.800**	**µg**			

Notes: 10 year wind is equivalent to 0.74 x 50 year wind speed
If accelerations exceed design limit, tuned mass damper may be required
However, calculations are only an approximation and a wind tunnel test will be required to verify