Seismic Calculations for Charleston, SC

Conterminous 48 States
2003 NEHRP Seismic Design Provisions
Latitude = 32.795
Longitude = -79.943
Spectral Response Accelerations Ss and S1
Ss and S1 = Mapped Spectral Acceleration Values
Site Class D - F_a = 1.0 ,F_v = 1.67
Data are based on a 0.05000000074505806 deg grid spacing

Period (sec)	Sa (g)
0.2	1.487 (S_S, Site Class D)
1.0	0.365 (S_1, Site Class D)

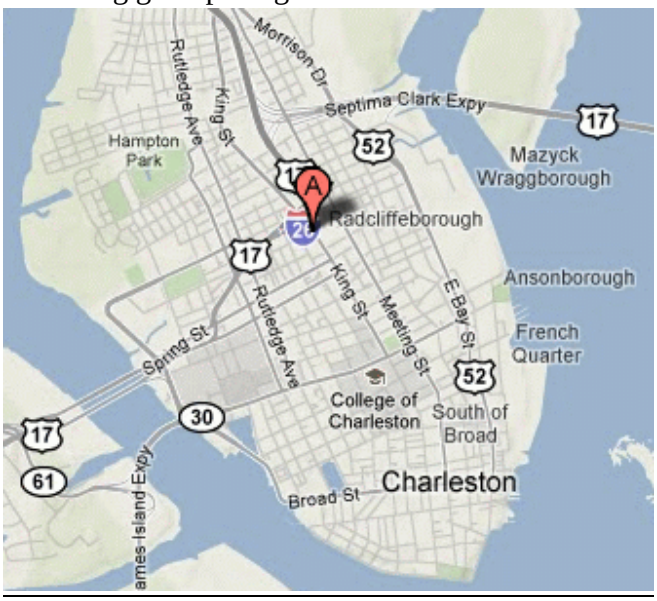
$S_{MS} = F_a \times S_S$ and $S_{M1} = F_v \times S_1$

0.2	1.487 (S_{MS}, Site Class D)
1.0	0.609 (S_{M1}, Site Class D)

$S_{DS} = 2/3 \times S_{MS}$ and $S_{D1} = 2/3 \times S_{M1}$

0.2	0.991 (S_{DS}, Site Class D)
1.0	0.406 (S_{D1}, Site Class D)

earthquake.usgs.gov/research/hazmaps/design



Occupancy Category	- II
Importance Factor	- 1.0
Response Mod. Factor	- 6 (Table 12.2-1)
T_L	- 8 (Figure 22-15)
Seismic Design Category	- D (Table 11.6.1,2)

$T_s = S_{D1} / S_{DS} = 0.406 / 0.991 = 0.4097$

$T_a = C_t * h_n^{(x)}$
$= 0.02 (171.67)^{(0.75)} = 0.949$

$C_t = 0.02$ (Table 12.8-2)
$x = 0.75$
$h_n = 171.67'$

$C_u = 1.457$ (Tab 12.8-1)

$T_n = C_u T_a$
$= 1.457*0.950 = 1.382$ sec

The approximate fundamental period, Ta, in s for masonry or concrete shear wall structures is permitted to be determined from Eq. 12.8-9 as follows:

$$T_a = \frac{0.0019\, h_n}{\sqrt{C_w}} \qquad (12.8\text{-}9)$$

where h_n is as defined in the preceding text and C_w is calculated from Eq. 12.8-10 as follows:

$$C_w = \frac{100}{A_B} \sum \left(\frac{h_n}{h_i} \right)^2 \frac{A_i}{1+0.83\left(h_i / D_i \right)^2} \qquad (12.8\text{-}10)$$

where

A_B = area of base of structure, ft²

A_i = web area of shear wall "*i*" in ft²

D_i = length of shear wall "*i*" in ft

h_i = height of shear wall "*i*" in ft

x = number of shear walls in the building effective in resisting lateral forces in the direction under consideration.

East-West (Walls D & E)

$C_w = 0.0650$

$T_a = 1.2792$

$T = C_u T_a = 1.457*1.2792 = 1.8638$

$$Cs = \min \begin{cases} \frac{S_{DS}}{(R/I)} = \frac{0.991}{(6/1)} = 0.1652 \\ \frac{S_{D1}}{T\,(R/I)} = \frac{0.406}{1.8638(6/1)} = 0.0363 \\ \frac{S_{D1}\,(T_L)}{T^2\,(R/I)} = \frac{0.406(8)}{1.8638^2(6/1)} = 0.1558 \end{cases}$$

Base Shear:

$V = C_s * W_{TOTAL}$

$= 0.0363 * 17230.2 = 625.45$ K

85% = 531.64 K

North-South (Walls 3,4,5)

$C_w = 0.0143$

$T_a = 2.7302$

$T = C_u T_a = 1.457*2.7302 = 3.9779$

$$Cs = \min \begin{cases} \frac{S_{DS}}{(R/I)} = \frac{0.991}{(6/1)} = 0.1652 \\ \frac{S_{D1}}{T\,(R/I)} = \frac{0.406}{3.9779\,(6/1)} = 0.0170 \\ \frac{S_{D1}\,(T_L)}{T^2\,(R/I)} = \frac{0.406\,(8)}{3.9779^2(6/1)} = 0.0342 \end{cases}$$

Base Shear:

$V = C_s * W_{TOTAL}$

$= 0.0170 * 17230.2 = 292.91$ K

85% = 249.00 K

Weight = 17230.2 K

$T_n < 3.5T_s$? FALSE - Equivalent Lateral Force Method not permitted.

Modal Response Spectrum Analysis required.

Conterminous 48 States
2003 NEHRP Seismic Design Provisions
Latitude = 32.795
Longitude = -79.943

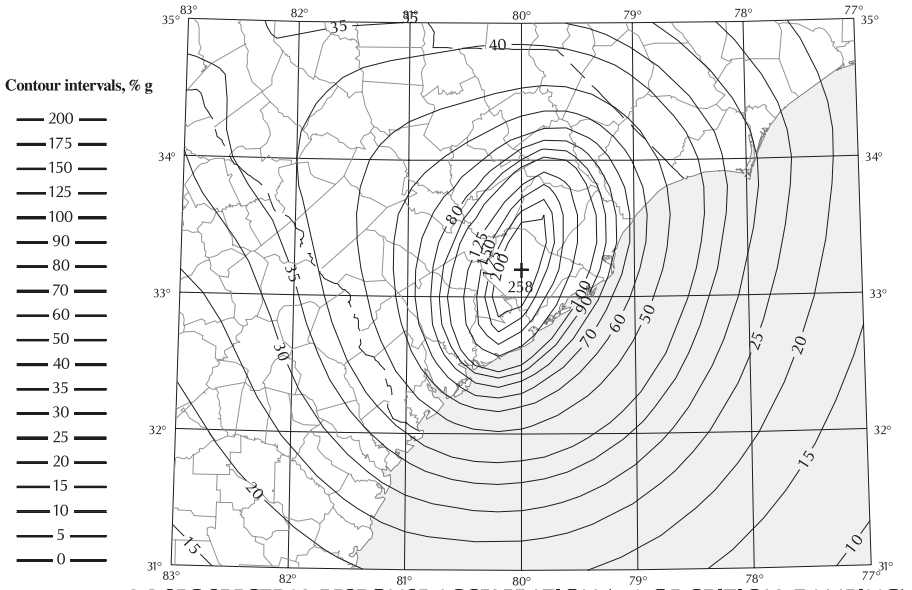
Site Modified Response Spectrum
SMs = FaSs and SM1 = FvS1
Site Class D - Fa = 1.0 ,Fv = 1.67

Period (sec)	Sa (g)	Sd (inches)
0.000	0.595	0.000
0.082	1.487	0.098
0.200	1.487	0.581
0.410	1.487	2.438
0.500	1.218	2.976
0.600	1.015	3.571
0.700	0.870	4.166
0.800	0.761	4.761
0.900	0.677	5.356
1.000	0.609	5.951
1.100	0.554	6.547
1.200	0.508	7.142
1.300	0.469	7.737
1.400	0.435	8.332
1.500	0.406	8.927
1.600	0.381	9.522
1.700	0.358	10.117
1.800	0.338	10.712
1.900	0.321	11.308
2.000	0.305	11.903

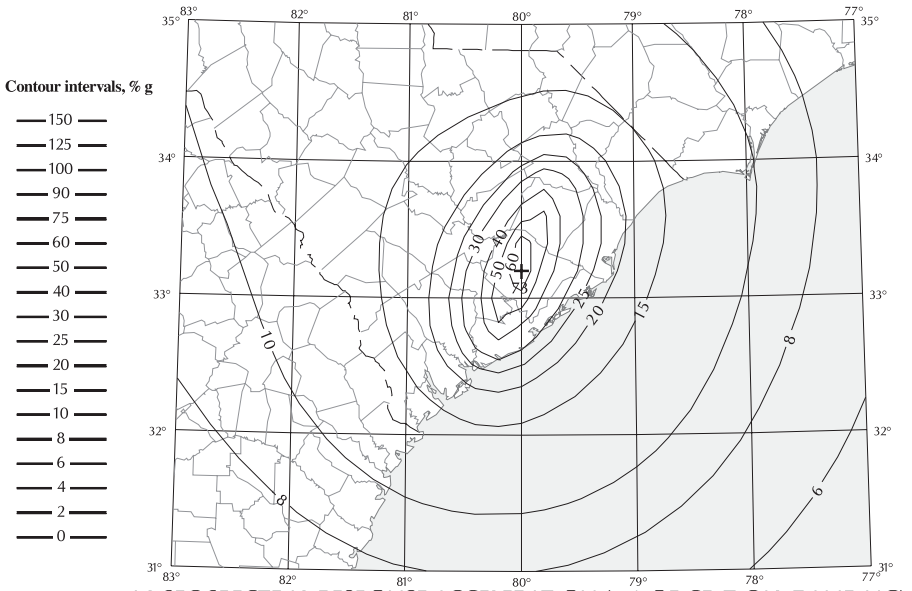
Design Response Spectrum
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class D - Fa = 1.0 ,Fv = 1.67

Period (sec)	Sa (g)	Sd (inches)
0.000	0.397	0.000
0.082	0.991	0.065
0.200	0.991	0.387
0.410	0.991	1.625
0.500	0.812	1.984
0.600	0.677	2.381
0.700	0.580	2.777
0.800	0.508	3.174
0.900	0.451	3.571
1.000	0.406	3.968
1.100	0.369	4.364
1.200	0.338	4.761
1.300	0.312	5.158
1.400	0.290	5.555
1.500	0.271	5.951
1.600	0.254	6.348
1.700	0.239	6.745
1.800	0.226	7.142
1.900	0.214	7.538
2.000	0.203	7.935

FIGURE 3.3-9 MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 4 OF 0.2 AND 1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B



0.2 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING)



1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING)

100 0 100 MILES

100 0 100 KILOMETERS

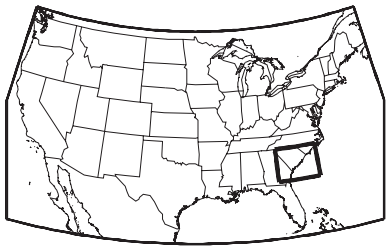
Explanation

+ 6.2 — Point value of spectral response acceleration expressed as a percent of gravity

10 — Contours of spectral response acceleration expressed as a percent of gravity. Hachures point in direction of decreasing values.

DISCUSSION

Refer to the maps of Maximum Considered Earthquake Ground Motion for the Conterminous United States of 0.2 and 1.0 sec Spectral Response Acceleration (Figures 3.3-1 and 3.3-2) for discussion and references.



Index map showing location of study area