NCHRP 24-31

LRFD DESIGN SPECIFICATIONS FOR SHALLOW FOUNDATIONS

Final Report
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APPENDIX E
UML-GTR RockFound07 Database

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National Cooperative Highway Research Program
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Table E-1 Rock quality details for database UML/GTR RockFound07 cases used for foundation capacity evaluation

Source of Data	No. of Cases	No. of Sites	Case No.	Rock Type	Type of Load Test	Rock Description					Site	Location
						RMR[1]	Average RMR	Class No.[2]	Description[2]	Discontinuity spacing from Rock-Mass Quality[1] s' (ft)		
Abu-Hejleh and Attwooll (2005)	8	1	1	Weathered Claystone	Rock Socket	70	70	II	Good rock	3 – 10	Denver, Colorado	USA
		1	2	Blue and sandy claystone, thinly bedded, very hard	Rock Socket	70	70	II	Good rock	3 – 10	Denver, Colorado	USA
		1	3	Blue and clayey sandstone, well cemented, very hard	Rock Socket	85	85	I	Very good rock	3 – 10	Denver, Colorado	USA
		1	4	Blue and clayey sandstone, well cemented, very hard	Rock Socket	70	70	II	Good rock	3 – 10	Denver, Colorado	USA
		1	5	Blue claystone with occasional interbeds of sandstone and siltstone	Rock Socket	82	82	I	Very good rock	3 – 10	Denver, Colorado	USA
		1	6	Pierre shale, very well cemented, very hard	Rock Socket	70	70	II	Good rock	3 – 10	Trinidad, Colorado	USA
		1	7	Claystone, weathered	Rock Socket	70	74	II	Good rock	3 – 10	Adams County, Colorado	USA
			8	Claystone, unweathered	Rock Socket	78						
Aurora and Reese (1977)	4	1	9	Clay-shale	Rock Socket	70	70	II	Good rock	3 – 10	Montopolis, Texas	USA
			10	Clay-shale	Rock Socket	70						
			11	Clay-shale	Rock Socket	70						
		1	12	Clay-shale	Rock Socket	75	75	II	Good rock	3 – 10	Dallas, Texas	
Baker (1985)	1	1	13	Hardpan (hard-bearing till). Till has a q_u comparable to that of rock	Rock Socket	70	70	II	Good rock	3 – 10	Union Station 2, Chicago	USA
	1	1	14	Till	Rock Socket	68	68	II	Good rock	3 – 10	One Park Place	USA
	1	1	15	Hardpan (hard-bearing till). Till has a q_u comparable to that of rock	Rock Socket	80	80	II	Good rock	3 – 10	Univ. of Chicago	USA
Burland and Lord (1970)	1	1	16	Grade IV chalk, rubbly, partly-weathered chalk with bedding and jointing. Joints 0.4 - 2.4 in apart, open to 0.8 in and sometimes infilled with fragments	Plate Load Test (Emb)	20	20	IV	Poor rock	0.17 – 1	Mundford, Norfolk	UK
	3	1	17	Grade V chalk, structureless remoulded chalk containing small lumps of intact chalk	Plate Load Test (Emb)	15	15	V	Very poor rock	< 0.17	Mundford, Norfolk	UK
			18	Grade IV chalk, rubbly, partly-weathered chalk with bedding and jointing. Joints 0.4 - 2.4 in apart, open to 0.8 in and sometimes infilled with fragments	Plate Load Test (Emb)	15						
			19	Grade III chalk, rubbly to blocky unweathered chalk. Joints 2.4 - 7.87 in apart, open to 0.12 in and sometimes infilled with fragments	Plate Load Test (Emb)	15						

[1]AASHTO (2007) based on Hoek-Brown (1988) Table 10.4.6.4-4

Rock socket refers to end-bearing only
Emb = Embedded below surface

[2]AASHTO (2007) Table 10.4.6.4-3

Table E-1 continued

Source of Data	No. of Cases	No. of Sites	Case No.	Rock Type	Type of Load Test	Rock Description: RMR[1]	Average RMR	Class No.[2]	Description[2]	Discontinuity spacing from Rock-Mass Quality[1] s' (ft)	Site	Location
Butler and Lord (1970)	5	1	20	Lower grey chalk marl	Plate Load Test (Emb)	15	54	III	Fair rock	1 – 3	Cambridge	UK
			21	Lower grey chalk marl	Plate Load Test (Emb)	72						
			22	Lower grey chalk marl	Plate Load Test (Emb)	60						
			23	Lower grey chalk marl	Plate Load Test (Emb)	55						
			24	Lower grey chalk marl	Plate Load Test (Emb)	70						
	10	1	25	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	68	40	IV	Poor rock	0.167 – 1	Norwich	UK
			26	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	35						
			27	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	35						
			28	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	35						
			29	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	40						
			30	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	50						
			31	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	50						
			32	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	35						
			33	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	35						
			34	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Plate Load Test (Emb)	15						
Carruba (1997)	3	1	35	Marl, intact, RQD = 100%	Rock Socket	75	57	III	Fair rock	1 – 3	Rosignano, Tuscany	Italy
			36	Diabase breccia, highly fractured, RQD = 10%	Rock Socket	20						
			37	Limestone, intact, RQD = 100%	Rock Socket	75						
Evdokimov and Sapegin (1964)	4	1	38	Diabase	Footing	68	68	II	Good rock	3 – 10	Moskva-Leningrad	Russia
			39	Diabase	Footing	60						
			40	Diabase	Footing	65						
			41	Diabase	Footing	80						
Glos and Briggs (1983)	2	1	42	Sandstone, horizontally bedded, shaley, RQD = 74%	Rock Socket	55	58	III	Fair rock	1 – 3	Farmington, New Mexico	USA
			43	Sandstone, horizontally bedded, shaley, with some coal stringers, RQD = 88%	Rock Socket	60						
Goeke and Hustad (1979)	1	1	44	Clay-shale, with occasional thin limestone seams	Rock Socket	78	78	II	Good rock	3 – 10	Southeastern, Oklahoma	USA
Hummert and Cooling (1988)	1	1	45	Shale, thinly bedded with thin sandstone layers	Rock Socket	65	65	II	Good rock	3 – 10	Fort Collins, Colorado	USA

[1]AASHTO (2007) based on Hoek-Brown (1988) Table 10.4.6.4-4

Rock socket refers to end-bearing only
Emb = Embedded below surface

[2]AASHTO (2007) Table 10.4.6.4-3

Table E-1 continued

Source of Data	No. of Cases	No. of Sites	Case No.	Rock Type	Type of Load Test	Rock Description					Site	Location
						RMR[1]	Average RMR	Class No.[2]	Description[2]	Discontinuity spacing from Rock-Mass Quality[1] s' (ft)		
Jubenville and Hepworth (1981)	1	1	46	Shale, unweathered	Rock Socket	65	65	II	Good rock	3 – 10	Denver, Colorado	USA
Ku, Lee and Ta-si (2004)	1	1	47	Gray silty mudstone, sedimentary, soft, poor cementation	Rock Socket	70	70	II	Good rock	3 – 10	Shinchu County	Taiwan
Lake (1970)	1	1	48	Grade V chalk, completely weathered, structureless remoulded chalk containing small lumps of intact chalk	Plate Load Test (Emb)	70	70	II	Good rock	3 – 10	Welford Theale	UK
Lake and Simons (1970)	3	1	49	Chalk	Plate Load Test (Emb)	90	87	I	Very good rock	3 – 10	Berkshire	UK
			50	Chalk	Plate Load Test (Emb)	80						
			51	Chalk	Plate Load Test (Emb)	92						
Leung and ko (1993)	6	1	52	Gypsum mixed with cement is used as pseudorock	Rock Socket (CentriFootinguge model)	70	70	II	Good rock	3 – 10	Univ. of Colorado, Boulder	USA
			53	Gypsum mixed with cement is used as pseudorock	Rock Socket (CentriFootinguge model)	70						
			54	Gypsum mixed with cement is used as pseudorock	Rock Socket (CentriFootinguge model)	70						
			55	Gypsum mixed with cement is used as pseudorock	Rock Socket (CentriFootinguge model)	70						
			56	Gypsum mixed with cement is used as pseudorock	Rock Socket (CentriFootinguge model)	70						
			57	Gypsum mixed with cement is used as pseudorock	Rock Socket (CentriFootinguge model)	70						
Lord (1997)	2	1	58	Chalk, Grade C, medium high density	Plate Load Test	15	15	V	Very poor rock	< 0.17	Mundford, Luton, Dunstable Eastern Bypass	UK
			59	Chalk, Grade C, medium high density	Plate Load Test	15						
	2	1	60	Chalk, Grade B & C, low density	Plate Load Test	15	17	V	Very poor rock	< 0.17	Mundford, Luton, Dunstable Eastern Bypass	UK
			61	Chalk, Grade B & C, low density	Plate Load Test	18						
	1	1	62	Chalk, Grade D, structureless or remoulded mélange, < 35% comminuted chalk matrix, > 65% coarse fragments	Plate Load Test	20	20	IV	Poor rock	0.17 – 1	Mundford, Luton, Dunstable Eastern Bypass	UK
Maleki and Hollberg (1995)	1	1	63	Marlstone with shorite crystals	Plate Load Test	62	62	II	Good rock	3 – 10	Green River basin, Wyoming	USA
Mallard (1977)	1	1	64	Chalk,weak, weathered, fractured with open fissures, joints 0.2 to 0.66 ft apart, open to 0.01 ft	Plate Load Test (Emb)	80	80	II	Good rock	3 – 10	Purfleet	UK
McVay, Ko and Otero (2006)	2	1	65	Limestone	Rock Socket	70	70	II	Good rock	3 – 10	Univ. of Florida	USA
			66	Limestone	Rock Socket	70						
Nitta, Yamamoto, Sonoda and Husono (1995)	1	1	67	Granite, weathered	Plate Load Test	80	80	II	Good rock	3 – 10	Innoshima, Hiroshima	Japan

[1]AASHTO (2007) based on Hoek-Brown (1988) Table 10.4.6.4-4

Rock socket refers to end-bearing only
Emb = Embedded below surface

[2]AASHTO (2007) Table 10.4.6.4-3

Table E-1 continued

Source of Data	No. of Cases	No. of Sites	Case No.	Rock Type	Type of Load Test	Rock Description: RMR[1]	Average RMR	Class No.[2]	Description[2]	Discontinuity spacing from Rock-Mass Quality[1] s' (ft)	Site	Location
Orpwood et al. (1989)	3	1	68	Till. Till has a q_u comparable to rock.	Rock Socket		78	II	Well graded	N/A	Bloor St., Toronto	Canada
Orpwood et al. (1989)	3	1	69	Till. Till has a q_u comparable to rock.	Rock Socket		75	II	Well graded	N/A	Leaside, Toronto	Canada
Orpwood et al. (1989)	3	1	70	Till. Till has a q_u comparable to rock.	Rock Socket		75	II	Well graded	N/A	Elington, Toronto	Canada
Pellegrino (1974)	5	1	71	Tuff	Plate Load Test	70	70	II	Good rock	3 – 10	Naples	Italy
Pellegrino (1974)	5	1	72	Tuff	Plate Load Test	72	70	II	Good rock	3 – 10	Naples	Italy
Pellegrino (1974)	5	1	73	Tuff	Plate Load Test	70	70	II	Good rock	3 – 10	Naples	Italy
Pellegrino (1974)	5	1	74	Tuff	Plate Load Test	75	70	II	Good rock	3 – 10	Naples	Italy
Pellegrino (1974)	5	1	75	Tuff	Plate Load Test	65	70	II	Good rock	3 – 10	Naples	Italy
Pells & Turner (1979 & 1980)	8	1	76	Strong sandstone, medium to strong - core sections can be broken by hand with difficulty and lighly scored with a steel knife, slightly fractured	Footing	65	65	II	Good rock	3 – 10	Site 1, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	77	Strong sandstone, medium to strong - core sections can be broken by hand with difficulty and lighly scored with a steel knife, slightly fractured	Footing	65	65	II	Good rock	3 – 10	Site 1, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	78[3]	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Footing	70	74	II	Good rock	3 – 10	Site 2, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	79	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Rock Socket	70	74	II	Good rock	3 – 10	Site 2, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	80	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Rock Socket	70	74	II	Good rock	3 – 10	Site 2, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	81[3]	Very Weak sandstone - rock structure is evident but frequent zones of sugary sandstone - crumbled by hand, highly weathered and fractured	Footing	80	74	II	Good rock	3 – 10	Site 2, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	82[3]	Very Weak sandstone - rock structure is evident but frequent zones of sugary sandstone - crumbled by hand, highly weathered and fractured	Footing	80	74	II	Good rock	3 – 10	Site 2, Sydney	Australia
Pells & Turner (1979 & 1980)	8	1	83	Fresh shale	Rock Socket	95	95	I	Very good rock	3 – 10	Westmead Hospital, Sydney	Australia
Pells & Turner (1979 & 1980)	4	1	84	Hawkesbury sandstone - study conducted using model footing	Footing (Model Footing)	90	90	I	Intact rock	no disc.	Hawkesbury, Sydney	Australia
Pells & Turner (1979 & 1980)	4	1	85	Sandstone - study conducted using model footing	Footing (Model Footing)	90	90	I	Intact rock	no disc.	Hawkesbury, Sydney	Australia
Pells & Turner (1979 & 1980)	4	1	86	Sandstone - study conducted using model footing	Footing (Model Footing)	90	90	I	Intact rock	no disc.	Hawkesbury, Sydney	Australia
Pells & Turner (1979 & 1980)	4	1	87	Limestone - study conducted using model footing	Footing (Model Footing)	90	90	I	Intact rock	no disc.	Hawkesbury, Sydney	Australia

[1]AASHTO (2007) based on Hoek-Brown (1988) Table 10.4.6.4-4

Rock socket refers to end-bearing only
Emb = Embedded below surface

[2]AASHTO (2007) Table 10.4.6.4-3

[3]Cases omitted in final review due to a clay seen within the bearing zone

Table E-1 continued

Source of Data	No. of Cases	No. of Sites	Case No.	Rock Type	Type of Load Test	Rock Description: RMR[1]	Rock Description: Average RMR	Rock Description: Class No.[2]	Rock Description: Description[2]	Rock Description: Discontinuity spacing from Rock-Mass Quality[1] s' (ft)	Site	Location
Radhakrishna and Leung (1989)	1	1	88	Silstone, medium-hard, fragmented	Rock Socket	60	60	III	Fair rock	1 – 3	Pile 430, Port of Singapore	Singapore
Spanovich & Garvin (1979)	3	1	89	Shale	Footing	60	60	III	Fair rock	1 – 3	Allegheny County, Pennsylvania	USA
			90	Shale	Footing	70						
			91	Shale	Footing	50						
Thorne (1980)	4	1	92	Shale	Rock Socket	0.03	50	III	Fair rock	1 – 3	Westmead Hospit-al, Sydney	Australia
		1	93	Sandstone	Rock Socket	0.03	50	III	Fair rock	1 – 3	Newcastle	Australia
		1	94	Sandstone, fresh, defect free	Rock Socket	0.03	70	III	Fair rock	1 – 3	Sydney	Australia
		1	95	Shale, occasional recemented moist frac-tures and thin mud seams, intact core lengths 75-250 mm	Rock Socket	0.03	50	III	Fair rock	1 – 3	Ottowa	Canada
Ward and Bur-land (1968)	4	1	96	Grade I chalk, hard and brittle	Plate Load Test (Emb)	40	24	IV	Poor rock	0.167 – 1	Mundford, Nor-folk	UK
			97	Grade II chalk, medium-hard chalk, joints more than 0.66 ft apart and closed	Plate Load Test (Emb)	20						
			98	Grade III chalk, unweathered chalk, joints 0.2 - 0.66 ft apart, open up to 0.01 ft	Plate Load Test (Emb)	20						
			99	Grade IV chalk, weathered chalk with bed-ding and jointing, joints 0.033 - 0.2 ft apart and open up to 0.066 ft	Plate Load Test (Emb)	15						
Webb (1976)	1	1	100	Diabase, highly weathered	Rock Socket	60	60	III	Fair rock	1 – 3	Academic Hospit-al, Johannesburg	South Africa
Williams (1980)	20	1	101	Mudstone, moderately weathered	Rock Socket	70	89	I	Very good rock	no cavities	Melbourne	Australia
		1	102	Mudstone, moderately weathered	Footing	81						
		1	103	Mudstone, moderately weathered	Footing	81						
		1	104	Mudstone, moderately weathered	Footing	90						
		1	105	Mudstone, moderately weathered	Footing	100						
		1	106	Mudstone, moderately weathered	Rock Socket	85						
		1	107	Mudstone, moderately weathered	Rock Socket	95						
		1	108	Mudstone, moderately weathered	Rock Socket	88						
		1	109	Mudstone, moderately weathered	Rock Socket	100						
		1	110	Mudstone, moderately weathered	Rock Socket	100						
		1	111	Mudstone, moderately weathered	Rock Socket	100						
		1	112	Mudstone, moderately weathered	Rock Socket	85						
		1	113	Mudstone, moderately weathered	Rock Socket	70						
		1	114	Mudstone, moderately weathered	Rock Socket	95						
		1	115	Mudstone, moderately weathered	Rock Socket	95						
		1	116	Mudstone, moderately weathered	Rock Socket	90						
		1	117	Mudstone, moderately weathered	Rock Socket	92						
		1	118	Mudstone, moderately weathered	Rock Socket	90						
		1	119	Mudstone, moderately weathered	Rock Socket	90						
		1	120	Mudstone, moderately weathered	Rock Socket	90						

[1]AASHTO (2007) based on Hoek-Brown (1988) Table 10.4.6.4-4

Rock socket refers to end-bearing only
Emb = Embedded below surface

[2]AASHTO (2007) Table 10.4.6.4-3

Table E-1 continued

Source of Data	No. of Cases	No. of Sites	Case No.	Rock Type	Type of Load Test	Rock Description: RMR[1]	Average RMR	Class No.[2]	Description[2]	Discontinuity spacing from Rock-Mass Quality[1] s' (ft)	Site	Location
Wilson (1976)	1	1	121	Weak clayey mudstone, cretaceous, bedding planes dipping at only a few degrees and occasional vertical jointing	Rock Socket	50	50	III	Fair rock	1 – 3	Port Elizabeth	South Africa
Wyllie (1979) - Test done by Saint Simon et al. (1999)	1	1	122	Sandstone	Plate Load Test	75	75	II	Good rock	3 – 10	Peace River, Alberta	Canada

[1]AASHTO (2007) based on Hoek-Brown (1988) Table 10.4.6.4-4

Rock socket refers to end-bearing only
Emb = Embedded below surface

[2]AASHTO (2007) Table 10.4.6.4-3

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Table E-2 Capacity evaluation for database UML-GTR RockFound07 cases using Carter and Kulhawy's (1988) method

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure: m[1]	s[1]	$q_{ult\ (calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\ (concrete)}/3$ (ksf)	q_{ult} (ksf)	Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\ (calculated)}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	Weathered Claystone	Abu-Hejleh and Attwooll (2005)	RS	> 1	13.10	40	0.821	0.00293	11.46	245.75	11.46	55	4.80
2	Blue and sandy claystone, thinly bedded, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	16.80	40	0.821	0.00293	14.70	245.75	14.70	53	3.60
3	Blue and clayey sandstone, well cemented, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	41.00	40	3.43	0.082	152.37	245.75	152.37	236	1.55
4	Blue and clayey sandstone, well cemented, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	219.00	40	0.821	0.00293	191.65	245.75	191.65	318	1.66
5	Pierre shale, very well cemented, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	480.00	20	0.821	0.00293	420.06	245.75	245.75	550	1.31
6	Blue claystone with occasional interbeds of sandstone and siltstone	Abu-Hejleh and Attwooll (2005)	RS	6	25.20	40	3.43	0.082	93.65	245.75	93.65	145	1.55
7	Claystone, weathered	Abu-Hejleh and Attwooll (2005)	RS	2	10.00	20	0.821	0.00293	8.75	245.75	8.75	47	5.37
8	Claystone, unweathered	Abu-Hejleh and Attwooll (2005)	RS	2	23.00	20	0.821	0.00293	20.13	245.75	20.13	105	5.22
9	Clay-shale	Aurora and Reese (1977)	RS	-	29.66	20	0.821	0.00293	25.95	245.75	25.95	114.87	4.43
10	Clay-shale	Aurora and Reese (1977)	RS	-	29.66	20	0.821	0.00293	25.95	245.75	25.95	116.96	4.51
11	Clay-shale	Aurora and Reese (1977)	RS	-	29.66	20	0.821	0.00293	25.95	245.75	25.95	125.31	4.83
12	Clay-shale	Aurora and Reese (1977)	RS	-	12.95	20	0.821	0.00293	11.33	245.75	11.33	84.15	7.43
13	Hardpan (hard-bearing till). Till has a q_u comparable to that of rock	Baker (1985)	RS	>1	28.82	40	0.821	0.00293	25.22	245.75	25.2	121.97	4.84
14	Till	Baker (1985)	RS	3	11.90	40	0.821	0.00293	10.42	245.75	10.42	47.83	4.59
15	Hardpan (hard-bearing till). Till has a q_u comparable to that of rock	Baker (1985)	RS	5	23.18	40	0.821	0.00293	20.29	245.75	20.29	100.04	4.93
16	Grade IV chalk, rubbly, partly-weathered chalk with bedding and jointing. Joints 0.4 - 2.4 in apart, open to 0.8 in and sometimes infilled with fragments	Burland (1970)	PLT	1	13.72	20	0.041	3E-06	0.59	245.75	0.59	12.29	20.97
17	Grade V chalk, structureless remoulded chalk containing small lumps of intact chalk	Burland and Lord (1969)	PLT	>1	18.59	20	0.069	0.000003	1.31	245.75	1.31	10.44	7.94

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988)

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure: m[1]	s[1]	$q_{ult\ (calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\ (concrete)}/3$ (ksf)	q_{ult} (ksf)	Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\ (calculated)}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
18	Grade IV chalk, rubbly, partly-weathered chalk with bedding and jointing. Joints 0.4 - 2.4 in apart, open to 0.8 in and sometimes infilled with fragments	Burland and Lord (1969)	PLT	>1	23.71	20	0.069	0.000003	1.68	245.75	1.7	12.53	7.47
19	Grade III chalk, rubbly to blocky unweathered chalk. Joints 2.4 - 7.87 in apart, open to 0.12 in and sometimes infilled with fragments	Burland and Lord (1969)	PLT	>1	26.11	20	0.069	0.000003	1.85	245.75	1.85	12.53	6.79
20	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.80	20	0.069	0.000003	1.33	245.75	1.3	9.98	7.51
21	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	17.16	20	0.821	0.00293	15.02	245.75	15.02	69.97	4.66
22	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	17.13	20	0.821	0.00293	14.99	245.75	14.99	50.13	3.34
23	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	17.13	20	0.041	3E-06	0.73	245.75	0.73	20.89	28.54
24	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	17.13	20	0.041	3E-06	0.73	245.75	0.73	19.99	27.31
25	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	11.49	20	0.041	3E-06	0.49	245.75	0.49	19.99	40.72
26	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	12.53	20	0.041	3E-06	0.54	245.75	0.5	24.02	44.85
27	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	12.74	20	0.183	0.00009	2.45	245.75	2.45	30.39	12.39
28	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	12.11	20	0.183	0.00009	2.33	245.75	2.33	33.63	14.42
29	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	10.44	20	0.041	3E-06	0.45	245.75	0.45	23.18	51.95
30	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	11.07	20	0.041	3E-06	0.47	245.75	0.47	21.6	45.66

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988)

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure: m[1]	s[1]	$q_{ult\ (calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\ (concrete)}/3$ (ksf)	q_{ult} (ksf)	Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\ (calculated)}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
31	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	18.80	20	0.029	3E-06	0.58	245.75	0.58	9.61	16.63
32	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.80	20	0.183	0.00009	3.62	245.75	3.62	43.19	11.94
33	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.80	20	0.183	0.00009	3.62	245.75	3.62	41.77	11.54
34	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.17	20	0.821	0.00293	15.90	245.75	15.90	73.10	4.60
35	Marl, intact, RQD = 100%	Carruba (1997)	RS	1	18.80	40	0.821	0.00293	16.45	245.75	16.45	110.69	6.73
36	Diabase breccia, highly fractured, RQD = 10%	Carruba (1997)	RS	1	313.28	20	0.069	3E-06	22.16	245.75	22.16	185.88	8.39
37	Limestone, intact, RQD = 100%	Carruba (1997)	RS	1	52.21	40	0.575	0.00293	32.85	245.75	32.85	185.88	5.66
38	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	160	1.395	0.00293	15.74	245.75	15.74	43.86	2.79
39	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	160	0.311	0.00009	3.48	245.75	3.48	29.24	8.40
40	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	160	1.395	0.00293	15.74	245.75	15.74	39.68	2.52
41	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	160	1.395	0.00293	15.74	245.75	15.74	62.66	3.98
42	Sandstone, horizontally bedded, shaley, RQD = 74%	Glos and Briggs (1983)	RS	>1	174.60	20	0.275	0.00009	49.67	245.75	49.67	210.94	4.25
43	Sandstone, horizontally bedded, shaley, with some coal stringers, RQD = 88%	Glos and Briggs (1983)	RS	>1	193.40	20	0.275	0.00009	55.02	245.75	55.0	273.6	4.97
44	Clay-shale, with occasional thin limestone seams	Goeke and Hustad (1979)	RS	>1	16.92	40	0.821	0.00293	14.80	245.75	14.80	97.95	6.62
45	Shale, thinly bedded with thin sandstone layers	Hummert and Cooling (1988)	RS	-	79.78	20	0.821	0.00293	69.82	245.75	69.82	194.86	2.79
46	Shale, unweathered	Jubenville and Hepworth (1981)	RS	7	22.56	40	0.821	0.00293	19.74	245.75	19.74	62.24	3.15
47	Gray silty mudstone, sedimentary, soft, poor cementation	Ku, Lee and Tasi (2004)	RS	1	20.49	40	0.821	0.00293	17.93	245.75	17.93	91.93	5.13
48	Grade V chalk, completely weathered, structureless remoulded chalk containing small lumps of intact chalk	Lake (1970)	PLT	1	9.71	20	0.821	0.00293	8.50	245.75	8.50	50	5.88
49	Chalk	Lake and Simons (1970)	PLT	34	21.72	40	3.43	0.082	80.72	245.75	80.72	256	3.17
50	Chalk	Lake and Simons (1970)	PLT	34	21.72	20	0.821	0.00293	19.01	245.75	19.01	110	5.79

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988)

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength		Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure					Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\ (calculated)}$
				No of Tests	q_u (ksf)		m[1]	s[1]	$q_{ult\ (calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\ (concrete)}$/3 (ksf)	q_{ult} (ksf)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
51	Chalk	Lake and Simons (1970)	PLT	34	21.72	40	3.43	0.082	80.72	245.75	80.72	308	3.82
52	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	43.86	40	0.821	0.00293	38.38	245.75	38.38	135.96	3.54
53	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	139.93	40	0.821	0.00293	122.46	245.75	122.46	336.26	2.75
54	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	87.72	40	0.821	0.00293	76.77	245.75	76.77	227.65	2.97
55	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	112.78	40	0.821	0.00293	98.70	245.75	98.70	327.9	3.32
56	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	177.53	40	0.821	0.00293	155.36	245.75	155.36	480.36	3.09
57	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	236.01	40	0.821	0.00293	206.54	245.75	206.54	578.53	2.80
58	Chalk, Grade C, medium high density	Lord (1997)	PLT	85	6.55	20	0.029	0.000003	0.20	245.75	0.20	6.27	31.15
59	Chalk, Grade C, medium high density	Lord (1997)	PLT	85	19.30	20	0.029	0.000003	0.59	245.75	0.59	10.44	17.60
60	Chalk, Grade B & C, low densi-ty	Lord (1997)	PLT	85	5.00	20	0.029	0.000003	0.15	245.75	0.15	5.22	33.97
61	Chalk, Grade B & C, low densi-ty	Lord (1997)	PLT	85	11.60	20	0.029	0.000003	0.36	245.75	0.36	10.44	29.29
62	Chalk, Grade D, structureless or remoulded mélange, < 35% comminuted chalk matrix, > 65% coarse fragments	Lord (1997)	PLT	85	10.44	20	0.041	0.000003	0.21	245.75	0.45	10.44	23.40
63	Marlstone with shorite crystals	Maleki and Hollberg (1995)	PLT	6	288.22	40	0.821	0.00293	252.23	245.75	245.75	417.71	1.66
64	Chalk,weak, weathered, frac-tured with open fissures, joints 0.2 to 0.66 ft apart, open to 0.01 ft	Mallard (1977) - Test done by D.J. Palmer (Lind Piling Ltd) (1960)	PLT	1	19.05	20	0.821	0.00293	16.67	245.75	16.67	104.43	6.26
65	Limestone	McVay, Ko and Otero (2006)	RS	1	40.00	40	0.575	0.00293	25.17	245.75	25.17	94.28	3.75
66	Limestone	McVay, Ko and Otero (2006)	RS	1	177.00	40	0.575	0.00293	30.17	245.75	111.36	120	1.08
67	Granite, weathered	Nitta, Yamamoto, Sonoda and Husono (1995)	PLT	1	22.28	20	2.5	0.00293	56.90	245.75	56.90	375.94	6.61
68	Till. Till has a q_u comparable to rock.	Orpwood et al. (1989)	RS	1	14.62	20	0.921	0.00293	14.26	245.75	14.26	83.54	5.86

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988)

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength		Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure					Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\,(calculated)}$
				No of Tests	q_u (ksf)		m[1]	s[1]	$q_{ult\,(calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\,(concrete)}/3$ (ksf)	q_{ult} (ksf)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
69	Till. Till has a q_u comparable to rock.	Orpwood et al. (1989)	RS	1	16.92	20	0.821	0.00293	14.80	245.75	14.80	86.67	5.85
70	Till. Till has a q_u comparable to rock.	Orpwood et al. (1989)	RS	1	20.89	20	0.821	0.00293	18.28	245.75	18.28	114.87	6.28
71	Tuff	Pellegrino (1974)	PLT	18	98.58	20	2.1	0.00293	207.62	245.75	207.62	219.83	1.06
72	Tuff	Pellegrino (1974)	PLT	18	84.17	20	2.1	0.00293	177.27	245.75	177.27	208.85	1.18
73	Tuff	Pellegrino (1974)	PLT	18	84.17	20	2.1	0.00293	177.27	245.75	177.27	233.15	1.32
74	Tuff	Pellegrino (1974)	PLT	18	70.00	20	2.1	0.00293	147.43	245.75	147.43	250.63	1.70
75	Tuff	Pellegrino (1974)	PLT	18	41.77	20	2.1	0.00293	87.97	245.75	87.97	123.64	1.41
76	Strong sandstone, medium to strong - core sections can be broken by hand with difficulty and lighly scored with a steel knife, slightly fractured	Pells & Turner (1980)	F	>1	292.40	40	1.2	0.00293	335.51	245.75	375.77	1578.95	4.20
77	Strong sandstone, medium to strong - core sections can be broken by hand with difficulty and lighly scored with a steel knife, slightly fractured	Pells & Turner (1980)	F	>1	242.40	40	1.2	0.00293	224.39	245.75	375.77	1520.47	4.05
78[2]	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Pells & Turner (1980)	F	>1	208.66	20	1.2	0.00293	169.90	245.75	268.41	522.14	1.95
79	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Pells & Turner (1980)	RS	>1	125..31	20	1.2	0.00293	145.21	245.75	161.04	288.22	1.79
80	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Pells & Turner (1980)	RS	>1	125.31	20	1.2	0.00293	67.10	245.75	161.04	160.19	0.99
81[2]	Very Weak sandstone - rock structure is evident but frequent zones of sugary sandstone - crumbled by hand, highly wea-thered and fractured	Pells & Turner (1980)	F	>1	6.27	20	1.2	0.00293	8.05	245.75	8.05	93.98	11.67

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988) [2]See comment #3 in Table E-1

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure: m[1]	s[1]	$q_{ult\ (calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\ (concrete)}$ /3 (ksf)	q_{ult} (ksf)	Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\ (calculated)}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
82[2]	Very Weak sandstone - rock structure is evident but frequent zones of sugary sandstone - crumbled by hand, highly weathered and fractured	Pells & Turner (1980)	F	>1	6.27	20	1.2	0.00293	8.05	245.75	8.05	78.32	9.73
83	Hawkesbury sandstone - study conducted using model footing	Pells & Turner (1980)	FM	>1	553.47	40	15	1	8848.74	245.75	8855.47	6088.14	0.69
84	Sandstone - study conducted using model footing	Pells & Turner (1980) - Data by Wagner and Schumann (1971)	FM	>1	2151.20	40	15	1	34419.20	245.75	34,419.38	21512.11	0.63
85	Sandstone - study conducted using model footing	Pells & Turner (1980) - Data by Rehnman and Broms (1971)	FM	>1	939.84	40	15	1	15037.51	245.75	15,037.59	8459.00	0.56
86	Limestone - study conducted using model footing	Pells & Turner (1980) - Data by Rehnman and Broms (1971)	FM	>1	1566.41	40	15	1	25062.52	245.75	25,062.66	14097.67	0.56
87	Fresh shale	Pells & Turner (1979)	RS	>1	730.99	20	0.183	0.00009	140.71	245.75	140.71	492.20	3.50
88	Siltstone, medium-hard, fragmented	Radhakrishna and Leung (1989)	RS	1	187.97	20	0.183	0.00009	36.18	245.75	36.18	273.60	7.56
89	Shale	Spanovich & Garvin (1979)	F	100	30.28	20	0.183	0.00009	5.83	245.75	5.83	92.73	15.91
90	Shale	Spanovich & Garvin (1979)	F	100	30.28	20	1	0.00293	26.50	245.75	26.50	138.26	5.22
91	Shale	Spanovich & Garvin (1979)	F	100	30.28	20	0.2	0.00009	5.83	245.75	5.83	72.47	12.43
92	Shale	Thorne (1980)	RS	1	710.10	20	0.2	0.00009	136.69	245.75	136.69	584.79	4.28
93	Sandstone	Thorne (1980)	RS	>1	261.07	20	0.3	0.00009	74.27	245.75	74.27	292.4	3.94
94	Sandstone, fresh, defect free	Thorne (1980)	RS	1	574.35	40	1.2	0.00293	738.11	245.75	245.75	1044.27	1.41
95	Shale, occasional recemented moist fractures and thin mud seams, intact core lengths 75-250 mm	Thorne (1980)	RS	1	1148.70	20	0.2	0.00293	272.39	245.75	245.75	580.62	2.13
96	Grade I chalk, hard and brittle	Ward and Burland (1968)	PLT	> 1	43.27	20	0.041	3E-06	1.85	245.75	1.8	23.70	12.82

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988) [2]See comment #3 in Table E-1

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure: m[1]	s[1]	$q_{ult\,(calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\,(concrete)}/3$ (ksf)	q_{ult} (ksf)	Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\,(calculated)}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
97	Grade II chalk, medium-hard chalk, joints more than 0.66 ft apart and closed	Ward and Burland (1968)	PLT	> 1	33.35	20	0.041	3E-06	1.43	245.75	1.43	20.89	14.66
98	Grade III chalk, unweathered chalk, joints 0.2 - 0.66 ft apart, open up to 0.01 ft	Ward and Burland (1968)	PLT	> 1	19.05	20	0.041	3E-06	0.81	245.75	0.81	15.66	19.24
99	Grade IV chalk, weathered chalk with bedding and jointing, joints 0.033 - 0.2 ft apart and open up to 0.066 ft	Ward and Burland (1968)	PLT	> 1	11.97	20	0.029	3E-06	0.37	245.75	0.37	8.35	22.72
100	Diabase, highly weathered	Webb (1976)	RS	16	10.86	20	0.311	0.00009	3.48	245.75	3.48	27.67	7.95
101	Mudstone, moderately weathered	Williams (1980)	F	-	23.81	20	1	0.00293	20.84	245.75	20.84	76.86	3.69
102	Mudstone, moderately weathered	Williams (1980)	F	-	11.28	40	3	0.082	41.91	245.75	41.91	94.19	2.25
103	Mudstone, moderately weathered	Williams (1980)	F	-	11.90	40	3	0.082	44.24	245.75	44.2	104.01	2.35
104	Mudstone, moderately weathered	Williams (1980)	F	-	12.53	40	3	0.082	46.57	245.75	46.57	150.38	3.23
105	Mudstone, moderately weathered	Williams (1980)	RS	-	9.19	40	3	0.082	34.15	245.75	34.15	220.76	6.46
106	Mudstone, moderately weathered	Williams (1980)	RS	-	13.58	40	3	0.082	50.45	245.75	50.45	107.77	2.14
107	Mudstone, moderately weathered	Williams (1980)	RS	-	15.66	40	3	0.082	58.21	245.75	58.21	193.4	3.32
108	Mudstone, moderately weathered	Williams (1980)	RS	-	13.99	40	3	0.082	52.00	245.75	52.00	101.71	1.96
109	Mudstone, moderately weathered	Williams (1980)	RS	-	11.90	40	3	0.082	44.24	245.75	44.24	260.65	5.89
110	Mudstone, moderately weathered	Williams (1980)	RS	-	9.40	40	3	0.082	34.93	245.75	34.93	212.82	6.09
111	Mudstone, moderately weathered	Williams (1980)	RS	-	10.86	40	3	0.082	40.36	245.75	40.36	273.39	6.77
112	Mudstone, moderately weathered	Williams (1980)	RS	-	40.31	40	3	0.082	149.80	245.75	149.80	188.39	1.26
113	Mudstone, moderately weathered	Williams (1980)	RS	-	29.24	20	0.821	0.00293	25.59	245.75	25.59	70.80	2.77
114	Mudstone, moderately weathered	Williams (1980)	RS	-	62.24	40	3	0.082	231.30	245.75	231.30	678.15	2.93
115	Mudstone, moderately weathered	Williams (1980)	RS	-	38.22	40	3	0.082	142.04	245.75	142.04	611.53	4.31

[1]AASHTO (2007) Tables 10.4.6.4-4 based on Hoek-Brown (1988)

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-2 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength		Presumptive Values at the SLS[2] (ksf)	AASHTO (2007) Semiempirical Procedure					Interpreted Foundation Capacity q_{L2} (ksf)	Ratio of q_{L2} to $q_{ult\ (calculated)}$
				No of Tests	q_u (ksf)		m[1]	s[1]	$q_{ult\ (calculated)}$ (ksf) (Carter and Kulhawy, 1988)	$q_{u\ (concrete)}/3$ (ksf)	q_{ult} (ksf)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
116	Mudstone, moderately weathered	Williams (1980)	RS	-	47.41	40	3	0.082	176.19	245.75	176.19	490.6	2.78
117	Mudstone, moderately weathered	Williams (1980)	RS	-	44.28	40	3	0.082	164.55	245.75	164.55	558.48	3.39
118	Mudstone, moderately weathered	Williams (1980)	RS	-	31.95	40	3	0.082	118.76	245.75	118.76	212.82	1.79
119	Mudstone, moderately weathered	Williams (1980)	RS	-	45.74	40	3	0.082	169.98	245.75	169.98	375.31	2.21
120	Mudstone, moderately weathered	Williams (1980)	RS	-	41.14	40	3	0.082	152.91	245.75	152.91	283.62	1.85
121	Weak clayey mudstone, cretaceous, bedding planes dipping at only a few degrees and occasional vertical jointing	Wilson (1976)	RS	8	22.77	20	0.183	0.00009	4.38	245.75	4.38	100.04	22.83
122	Sandstone	Wyllie (1979) - Test done by Saint Simon et al. (1999)	PLT	1	83.54	40	1.231	0.00293	107.36	245.75	107.36	334.17	3.11

[1]AASHTO (2008) Tables 10.4.6.4-4 based on Hoek-Brown (1988)

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test

Table E-3 Capacity Evaluation for Database UML/GTR RockFound07 Cases using Goodman's (1989) method

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method: N_f	AASHTO (2007) Analytical Method: q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	Weathered Claystone	Abu-Hejleh and Attwooll (2005)	RS	> 1	13.10	C	3.5	55.00	6.50	1.86	29.30	3 – 10	2.92	23.11	2.38
2	Blue and sandy claystone, thinly bedded, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	16.80	C	4	53.00	6.50	1.62	29.30	3 – 10	2.92	26.41	2.01
3	Blue and clayey sandstone, well cemented, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	41.00	C	3.5	236.00	Fract.	Fract.	29.30	3 – 10	2.92	160.59	1.47
4	Blue and clayey sandstone, well cemented, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	219.00	C	4.5	318.00	9.00	2.00	29.30	3 – 10	2.92	411.28	0.77
5	Pierre shale, very well cemented, very hard	Abu-Hejleh and Attwooll (2005)	RS	> 1	480.00	C	4	550.00	7.00	1.75	25.00	3 – 10	2.46	798.66	0.69
6	Blue claystone with occasional interbeds of sandstone and siltstone	Abu-Hejleh and Attwooll (2005)	RS	6	25.20	C	2.6	145.00	9.00	3.46	30.00	3 – 10	3.00	73.90	1.96
7	Claystone, weathered	Abu-Hejleh and Attwooll (2005)	RS	2	10.00	C	2.5	47.00	8.00	3.20	30.00	3 – 10	3.00	27.57	1.70
8	Claystone, unweathered	Abu-Hejleh and Attwooll (2005)	RS	2	23.00	C	2.5	105.00	Fract.	Fract.	30.00	3 – 10	3.00	92.00	1.14
9	Clay-shale	Aurora and Reese (1977)	RS	-	29.66	C	2.43	114.87	Fract.	Fract.	23.50	3 – 10	2.33	98.65	1.16
10	Clay-shale	Aurora and Reese (1977)	RS	-	29.66	C	2.59	116.96	Fract.	Fract.	23.50	3 – 10	2.33	98.65	1.19
11	Clay-shale	Aurora and Reese (1977)	RS	-	29.66	C	2.46	125.31	Fract.	Fract.	23.50	3 – 10	2.33	98.65	1.27
12	Clay-shale	Aurora and Reese (1977)	RS	-	12.95	C	2.92	84.15	Fract.	Fract.	23.50	3 – 10	2.33	43.07	1.95
13	Hardpan (hard-bearing till). Till has a q_u comparable to that of rock	Baker (1985)	RS	>1	28.82	C	4.2	121.97	10.00	2.38	35.00	3 – 10	3.69	63.66	1.92
14	Till	Baker (1985)	RS	3	11.90	C	6.3	47.83	6.50	1.03	35.00	3 – 10	3.69	12.28	3.89
15	Hardpan (hard-bearing till). Till has a q_u comparable to that of rock	Baker (1985)	RS	5	23.18	C	2.5	100.04	6.00	2.40	35.00	3 – 10	3.69	51.58	1.94
16	Grade IV chalk, rubbly, partly-weathered chalk with bedding and jointing. Joints 0.4 - 2.4 in apart, open to 0.8 in and sometimes infilled with fragments	Burland (1970)	PLT	1	13.72	C	3	12.29	2.00	0.67	28.00	1 – 3	2.77	8.82	1.39
17	Grade V chalk, structureless remoulded chalk containing small lumps of intact chalk	Burland and Lord (1969)	PLT	>1	18.59	C	2.83	10.44	2.00	0.71	28.00	1 – 3	2.77	12.78	0.82

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method: N_f	AASHTO (2007) Analytical Method: q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
18	Grade IV chalk, rubbly, partly-weathered chalk with bedding and jointing. Joints 0.4 - 2.4 in apart, open to 0.8 in and sometimes infilled with fragments	Burland and Lord (1969)	PLT	>1	23.71	C	2.83	12.53	2.00	0.71	28.00	1 – 3	2.77	16.30	0.77
19	Grade III chalk, rubbly to blocky unweathered chalk. Joints 2.4 - 7.87 in apart, open to 0.12 in and sometimes infilled with fragments	Burland and Lord (1969)	PLT	>1	26.11	C	2.83	12.53	2.00	0.71	30.00	1 – 3	3.00	17.98	0.70
20	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.80	C	0.47	9.98	0.17	0.36	28.00	< 0.17	2.77	4.77	2.09
21	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	17.16	C	0.47	69.97	1.00	2.14	28.00	3 – 10	2.77	33.92	2.06
22	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	17.13	C	0.46	50.13	1.00	2.18	30.00	3 – 10	3.00	34.65	1.45
23	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	17.13	C	0.46	20.89	1.00	2.18	30.00	0.166 – 1	3.00	34.65	0.60
24	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	17.13	C	0.46	19.99	1.00	2.18	30.00	0.166 – 1	3.00	34.65	0.58
25	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	11.49	C	0.46	19.99	1.00	2.18	30.00	0.166 – 1	3.00	23.24	0.86
26	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	5	12.53	C	0.46	24.02	1.00	2.18	30.00	0.166 – 1	3.00	25.35	0.95
27	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	12.74	C	0.46	30.39	1.00	2.18	30.00	1 – 3	3.00	25.78	1.18
28	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	12.11	C	0.46	33.63	1.00	2.18	30.00	1 – 3	3.00	24.51	1.37
29	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	10.44	C	0.46	23.18	1.00	2.18	30.00	0.166 – 1	3.00	21.13	1.10
30	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	11.07	C	0.46	21.60	1.00	2.18	30.00	0.166 – 1	3.00	22.40	0.96

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method: N_f	AASHTO (2007) Analytical Method: q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
31	Occasional hard lumps of intact chalk and flintstones in a weathered chalk matrix	Butler and Lord (1970)	PLT	7	18.80	C	0.46	9.61	0.17	2.18	30.00	< 0.17	3.00	5.16	1.86
32	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.80	C	0.47	43.19	1.00	2.14	28.00	1 –3	2.77	37.14	1.16
33	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.80	C	0.47	41.77	1.00	2.14	28.00	1 –3	2.77	37.14	1.12
34	Lower grey chalk marl	Butler and Lord (1970)	PLT	3	18.17	C	0.47	73.10	1.00	2.14	28.00	3 – 10	2.77	35.91	2.04
35	Marl, intact, RQD = 100%	Carruba (1997)	RS	1	18.80	C	3.94	110.69	Fract.	Fract.	30.00	3 – 10	3.00	75.19	1.47
36	Diabase breccia, highly fractured, RQD = 10%	Carruba (1997)	RS	1	313.28	C	3.94	185.88	2.00	0.51	35.00	1 – 3	3.69	145.83	1.27
37	Limestone, intact, RQD = 100%	Carruba (1997)	RS	1	52.21	C	3.94	185.88	9.00	2.29	37.00	3 – 10	4.02	112.06	1.66
38	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	S	22.97	43.86	Fract.	Fract.	36.60	3 – 10	3.95	53.79	0.82
39	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	S	22.97	29.24	Fract.	Fract.	36.60	1 – 3	3.95	53.79	0.54
40	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	S	22.97	39.68	Fract.	Fract.	36.60	3 – 10	3.95	53.79	0.74
41	Diabase	Evdokimov and Sapegin (1964)	F	1	10.86	S	22.97	62.66	Fract.	Fract.	36.60	3 – 10	3.95	53.79	1.16
42	Sandstone, horizontally bedded, shaley, RQD = 74%	Glos and Briggs (1983)	RS	>1	174.60	C	2	210.94	2.00	1.00	30.00	1 – 3	3.00	174.49	1.21
43	Sandstone, horizontally bedded, shaley, with some coal stringers, RQD = 88%	Glos and Briggs (1983)	RS	>1	193.40	C	2	273.60	2.00	1.00	30.00	1 – 3	3.00	193.27	1.42
44	Clay-shale, with occasional thin limestone seams	Goeke and Hustad (1979)	RS	>1	16.92	C	2.49	97.95	10.00	4.01	24.00	3 – 10	2.37	52.98	1.85
45	Shale, thinly bedded with thin sandstone layers	Hummert and Cooling (1988)	RS	-	79.78	C	1.51	194.86	4.00	2.65	25.00	3 – 10	2.46	185.12	1.05
46	Shale, unweathered	Jubenville and Hepworth (1981)	RS	7	22.56	C	1.02	62.24	6.50	6.39	40.00	3 – 10	4.60	116.80	0.53
47	Gray silty mudstone, sedimentary, soft, poor cementation	Ku, Lee and Tasi (2004)	RS	1	20.49	C	3.94	91.93	Fract.	Fract.	26.50	3 – 10	2.61	73.99	1.24
48	Grade V chalk, completely weathered, structureless remoulded chalk containing small lumps of intact chalk	Lake (1970)	PLT	1	9.71	C	0.46	50.00	6.50	14.18	28.00	3 – 10	2.77	77.25	0.65
49	Chalk	Lake and Simons (1970)	PLT	34	21.72	C	0.46	256.00	6.50	14.15	38.50	3 – 10	4.30	209.66	1.22

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength No of Tests	Uniaxial Compressive Strength q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method N_f	AASHTO (2007) Analytical Method q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
50	Chalk	Lake and Simons (1970)	PLT	34	21.72	C	0.46	110.00	6.50	14.15	38.50	3 – 10	4.30	209.66	0.52
51	Chalk	Lake and Simons (1970)	PLT	34	21.72	C	0.46	308.00	6.50	14.15	38.50	3 – 10	4.30	209.66	1.47
52	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	43.86	C	3.49	135.96	10.00	2.86	20.00	3 – 10	2.04	104.95	1.30
53	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	139.93	C	3.49	336.26	10.00	2.86	20.00	3 – 10	2.04	334.83	1.00
54	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	87.72	C	3.49	227.65	10.00	2.86	20.00	3 – 10	2.04	209.89	1.08
55	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	112.78	C	3.49	327.90	10.00	2.86	20.00	3 – 10	2.04	269.86	1.22
56	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	177.53	C	3.49	480.36	10.00	2.86	20.00	3 – 10	2.04	424.78	1.13
57	Gypsum mixed with cement is used as pseudo rock	Leung and ko (1993)	RS/CF	1	236.01	C	3.49	578.53	10.00	2.86	20.00	3 – 10	2.04	564.71	1.02
58	Chalk, Grade C, medium high density	Lord (1997)	PLT	85	6.55	C	2.84	6.27	2.00	0.70	30.00	1 – 3	3.00	4.51	1.39
59	Chalk, Grade C, medium high density	Lord (1997)	PLT	85	19.30	C	2.84	10.44	2.00	0.70	30.00	1 – 3	3.00	13.28	0.79
60	Chalk, Grade B & C, low density	Lord (1997)	PLT	85	5.00	C	2.84	5.22	2.00	0.70	30.00	1 – 3	3.00	3.44	1.52
61	Chalk, Grade B & C, low density	Lord (1997)	PLT	85	11.60	C	2.84	10.44	2.00	0.70	30.00	1 – 3	3.00	7.98	1.31
62	Chalk, Grade D, structureless or remoulded mélange, < 35% comminuted chalk matrix, > 65% coarse fragments	Lord (1997)	PLT	85	10.44	C	2.84	10.44	2.00	0.70	30.00	1 – 3	3.00	7.18	1.45
63	Marlstone with shorite crystals	Maleki and Hollberg (1995)	PLT	6	288.22	C	0.5	417.71	6.50	13.03	28.00	3 – 10	2.77	2163.88	0.19
64	Chalk,weak, weathered, fractured with open fissures, joints 0.2 to 0.66 ft apart, open to 0.01 ft	Mallard (1977) - Test done by D.J. Palmer (Lind Piling Ltd) (1960)	PLT	1	19.05	C	1.46	104.43	8.00	5.49	30.00	3 – 10	3.00	79.36	1.32
65	Limestone	McVay, Ko and Otero (2006)	RS	1	40.00	C	9	94.28	6.50	0.72	40.00	3 – 10	4.60	28.51	3.31
66	Limestone	McVay, Ko and Otero (2006)	RS	1	177.00	C	9	120.00	6.50	0.72	40.00	3 – 10	4.60	126.15	0.95
67	Granite, weathered	Nitta, Yamamoto, Sonoda and Husono (1995)	PLT	1	22.28	C	0.98	375.94	6.00	6.10	41.30	3 – 10	4.88	112.20	3.35

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method: N_f	AASHTO (2007) Analytical Method: q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
68	Till. Till has a q_u comparable to rock.	Orpwood et al. (1989)	RS	1	14.62	C	2.5	83.54	Fract.	Fract.	40.00	N/A	4.60	81.85	1.02
69	Till. Till has a q_u comparable to rock.	Orpwood et al. (1989)	RS	1	16.92	C	2.5	86.67	Fract.	Fract.	34.00	N/A	3.54	76.76	1.13
70	Till. Till has a q_u comparable to rock.	Orpwood et al. (1989)	RS	1	20.89	C	2.5	114.87	Fract.	Fract.	36.00	N/A	3.85	101.33	1.13
71	Tuff	Pellegrino (1974)	PLT	18	98.58	C	0.98	219.83	6.50	6.60	29.83	3 – 10	2.98	470.25	0.47
72	Tuff	Pellegrino (1974)	PLT	18	84.17	C	0.98	208.85	6.50	6.60	29.83	3 – 10	2.98	401.51	0.52
73	Tuff	Pellegrino (1974)	PLT	18	84.17	C	0.98	233.15	6.50	6.60	29.83	3 – 10	2.98	401.51	0.58
74	Tuff	Pellegrino (1974)	PLT	18	70.00	C	0.98	250.63	6.50	6.60	29.83	3 – 10	2.98	333.93	0.75
75	Tuff	Pellegrino (1974)	PLT	18	41.77	C	0.98	123.64	6.50	6.60	29.83	3 – 10	2.98	199.26	0.62
76	Strong sandstone, medium to strong - core sections can be broken by hand with difficulty and lighly scored with a steel knife, slightly fractured	Pells & Turner (1980)	F	>1	292.40	C	0.25	1578.95	6.50	26.42	34.00	3 – 10	3.54	4152.18	0.38
77	Strong sandstone, medium to strong - core sections can be broken by hand with difficulty and lighly scored with a steel knife, slightly fractured	Pells & Turner (1980)	F	>1	292.40	C	0.18	1520.47	6.50	36.69	34.00	3 – 10	3.54	5286.07	0.29
78[3]	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Pells & Turner (1980)	F	>1	208.86	C	0.5	522.14	6.50	12.95	28.00	3 – 10	2.77	1560.99	0.29
79	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Pells & Turner (1980)	RS	>1	125.31	C	0.95	288.22	6.50	6.83	28.00	3 – 10	2.77	598.70	0.48
80	Weak sandstone - core sections break easily and may be heavily scored or cut with a steel knife, fractured	Pells & Turner (1980)	RS	>1	125.31	C	0.95	160.19	3.00	3.15	27.00	3 – 10	2.66	335.73	0.48
81[3]	Very Weak sandstone - rock structure is evident but frequent zones of sugary sandstone - crumbled by hand, highly weathered and fractured	Pells & Turner (1980)	F	>1	6.27	C	2.02	93.98	10.00	4.96	27.00	3 – 10	2.66	23.49	4.00

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47 [3]See comment #3 in Table E-1

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method: N_f	AASHTO (2007) Analytical Method: q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
82[3]	Very Weak sandstone - rock structure is evident but frequent zones of sugary sandstone - crumbled by hand, highly weathered and fractured	Pells & Turner (1980)	F	>1	6.27	C	1.23	78.32	8.00	6.50	27.00	3 – 10	2.66	28.53	2.75
83	Hawkesbury sandstone - study conducted using model footing	Pells & Turner (1980)a	FM	>1	553.47	C	0.1	6088.14	Fract.	Fract.	42.50	no disc.	5.17	3412.15	1.78
84	Sandstone - study conducted using model footing	Pells & Turner (1980) - Data by Wagner and Schumann (1971)	FM	>1	2151.20	C	0.1	21512.00	Fract.	Fract.	42.50	no disc.	5.17	13262.24	1.62
85	Sandstone - study conducted using model footing	Pells & Turner (1980) - Data by Rehnman and Broms (1971)	FM	>1	939.84	C	0.07	8458.60	Fract.	Fract.	42.50	no disc.	5.17	5794.18	1.46
86	Limestone - study conducted using model footing	Pells & Turner (1980) - Data by Rehnman and Broms (1971)	FM	>1	1566.41	C	0.07	14097.67	Fract.	Fract.	42.50	no disc.	5.17	9656.97	1.46
87	Fresh shale	Pells & Turner (1979)	RS	>1	730.99	C	1.36	492.25	2.00	1.47	27.00	1 – 3	2.66	1048.69	0.47
88	Siltstone, medium-hard, fragmented	Radhakrishna and Leung (1989)	RS	1	187.97	C	2.31	273.60	2.00	0.86	32.00	1 – 3	3.25	161.97	1.69
89	Shale	Spanovich & Garvin (1979)	F	100	30.28	C	1.51	92.73	3.00	1.99	36.00	1 – 3	3.85	57.41	1.62
90	Shale	Spanovich & Garvin (1979)	F	100	30.28	C	2	138.26	5.00	2.50	36.00	3 – 10	3.85	69.95	1.98
91	Shale	Spanovich & Garvin (1979)	F	100	30.28	C	2.49	72.47	5.00	2.01	36.00	3 – 10	3.85	57.85	1.25
92	Shale	Thorne (1980)	RS	1	710.10	C	1.48	584.79	2.00	1.35	27.00	1 – 3	2.66	947.45	0.62
93	Sandstone	Thorne (1980)	RS	>1	261.07	C	1.48	292.40	2.00	1.35	34.00	1 – 3	3.54	349.61	0.84
94	Sandstone, fresh, defect free	Thorne (1980)	RS	1	574.35	C	1.48	1044.27	3.00	2.03	34.00	3 – 10	3.54	1105.16	0.94
95	Shale, occasional recemented moist fractures and thin mud seams, intact core lengths 75-250 mm	Thorne (1980)	RS	1	1148.70	C	-	580.62	2.00	0.50	27.00	1 – 3	2.66	502.41	1.16
96	Grade I chalk, hard and brittle	Ward and Burland (1968)	PLT	> 1	43.27	C	2.82	23.70	1.00	0.35	30.00	0.166 – 1	3.00	10.87	2.18
97	Grade II chalk, medium-hard chalk, joints more than 0.66 ft apart and closed	Ward and Burland (1968)	PLT	> 1	33.35	C	2.82	20.89	1.00	0.35	30.00	0.166 – 1	3.00	8.38	2.49

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47 [3]See comment #3 in Table E-1

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength: No of Tests	Uniaxial Compressive Strength: q_u (ksf)	Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method: N_f	AASHTO (2007) Analytical Method: q_{ult} (ksf) (Goodman, 1989)	Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
98	Grade III chalk, unweathered chalk, joints 0.2 - 0.66 ft apart, open up to 0.01 ft	Ward and Burland (1968)	PLT	> 1	19.05	C	2.82	15.66	2.00	0.71	27.00	1 – 3	2.66	13.15	1.19
99	Grade IV chalk, weathered chalk with bedding and jointing, joints 0.033 - 0.2 ft apart and open up to 0.066 ft	Ward and Burland (1968)	PLT	> 1	11.97	C	2.82	8.35	2.00	0.71	27.00	1 – 3	2.66	8.26	1.01
100	Diabase, highly weathered	Webb (1976)	RS	16	10.86	C	2.02	27.67	2.00	0.99	35.00	1 – 3	3.69	10.76	2.57
101	Mudstone, moderately weathered	Williams (1980)	F	-	23.81	C	0.98	76.86	6.50	6.60	35.00	3 – 10	3.69	120.47	0.64
102	Mudstone, moderately weathered	Williams (1980)	F	-	11.28	C	1.97	94.19	10.00	5.08	30.00	no cavities	3.00	44.35	2.12
103	Mudstone, moderately weathered	Williams (1980)	F	-	11.90	C	3.28	104.01	10.00	3.05	30.00	no cavities	3.00	31.59	3.29
104	Mudstone, moderately weathered	Williams (1980)	F	-	12.53	C	0.33	150.38	6.00	18.29	30.00	no cavities	3.00	124.21	1.21
105	Mudstone, moderately weathered	Williams (1980)	RS	-	9.19	C	0.33	220.76	10.00	30.48	29.00	no cavities	2.88	126.18	1.75
106	Mudstone, moderately weathered	Williams (1980)	RS	-	13.58	C	0.98	107.77	8.00	8.13	31.00	no cavities	3.12	76.60	1.41
107	Mudstone, moderately weathered	Williams (1980)	RS	-	15.66	C	0.33	193.40	7.00	21.34	33.00	no cavities	3.39	185.71	1.04
108	Mudstone, moderately weathered	Williams (1980)	RS	-	13.99	C	0.98	101.71	8.00	8.13	31.00	no cavities	3.12	78.95	1.29
109	Mudstone, moderately weathered	Williams (1980)	RS	-	11.90	C	0.33	260.65	8.00	24.38	30.00	no cavities	3.00	144.20	1.81
110	Mudstone, moderately weathered	Williams (1980)	RS	-	9.40	C	0.33	212.82	7.00	21.34	29.00	no cavities	2.88	101.19	2.10
111	Mudstone, moderately weathered	Williams (1980)	RS	-	10.86	C	0.33	273.39	3.00	9.14	30.00	no cavities	3.00	65.81	4.15
112	Mudstone, moderately weathered	Williams (1980)	RS	-	40.31	C	1.97	188.39	7.00	3.56	37.00	no cavities	4.02	125.83	1.50
113	Mudstone, moderately weathered	Williams (1980)	RS	-	29.24	C	3.28	70.80	8.00	2.44	36.00	3 – 10	3.85	66.15	1.07
114	Mudstone, moderately weathered	Williams (1980)	RS	-	62.24	C	0.33	678.15	6.00	18.29	39.00	no cavities	4.40	742.31	0.91
115	Mudstone, moderately weathered	Williams (1980)	RS	-	38.22	C	0.33	611.53	8.00	24.38	37.00	no cavities	4.02	548.03	1.12
116	Mudstone, moderately weathered	Williams (1980)	RS	-	47.41	C	0.33	490.60	6.00	18.29	38.00	no cavities	4.20	555.06	0.88

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

Table E-3 continued

Case No.	Rock Type	Reference	Type of Load Test	Uniaxial Compressive Strength		Shape	Dia. or Width B (ft)	Interpreted Foundation Capacity q_{L2} (ksf)	Disc. Spacing s (ft)	s/B	f[1]	Disc. Spacing from Rock-Mass Quality[2] s' (ft)	AASHTO (2007) Analytical Method		Ratio of q_{L2} to AASHTO (2007) Analytical Capacity
				No of Tests	q_u (ksf)								N_f	q_{ult} (ksf) (Goodman, 1989)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
117	Mudstone, moderately weathered	Williams (1980)	RS	-	44.28	C	0.33	558.48	7.00	21.34	37.00	no cavities	4.02	572.86	0.97
118	Mudstone, moderately weathered	Williams (1980)	RS	-	31.95	C	0.33	212.82	1.00	3.05	36.00	no cavities	3.85	87.29	2.44
119	Mudstone, moderately weathered	Williams (1980)	RS	-	45.74	C	0.98	375.31	8.00	8.13	38.00	no cavities	4.20	282.06	1.33
120	Mudstone, moderately weathered	Williams (1980)	RS	-	41.14	C	0.98	283.62	7.00	7.11	37.00	no cavities	4.02	225.52	1.26
121	Weak clayey mudstone, cretaceous, bedding planes dipping at only a few degrees and occasional vertical jointing	Wilson (1976)	RS	8	22.77	C	2.2	100.04	3.00	1.36	45.00	1 – 3	5.83	30.84	3.24
122	Sandstone	Wyllie (1979) - Test done by Saint Simon et al. (1999)	PLT	1	83.54	C	0.23	334.17	Fract.	Fract.	30.00	3 – 10	3.00	334.17	1.00

[1] Literature and AASHTO (2007) Table 10.4.6.4-1 [2] AASHTO (2007) Table 10.4.6.4-3 A-47

RS = Rock Socket PLT = Plate Load Test F = Footing RS/CF = Rock Socket Centrifuge Test C = Circular S = Square Frac. = Fractured

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