

CPT-Based Liquefaction Field Case Histories from the 1995 Hyogoken-Nambu (Kobe) Earthquake, Japan

by

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Introduction

This report documents CPT-based field case histories from the 1995 Hyogoken-Nambu (Kobe) Earthquake in Japan. These case histories are proprietary and were acquired by Mr. Y. Suzuki of the Kajima Corporation under the supervision of Prof. K. Tokimatsu of Tokyo Institute of Technology.

Each case history is composed of two pages, one page of vital statistics and one page showing the CPT trace with the assumed critical layer delineated. Field performance of each site was assessed by Mr. Y. Suzuki as well as the performance assessments published in Akai et al. (1995).

The liquefaction and non-liquefaction data that were used in the subsequent liquefaction triggering analysis (Moss, 2003) are summarized in the accompanying Table 1. Figure 1 is a map of the greater Kobe Port region that shows the approximate locations of these CPT field case history sites (which have a three letter designation corresponding to the trace), superimposed over SPT field case history sites (which have number designation corresponding to the log) and PGA contours, the latter two are from Cetin et al. (2000).

This report is intended only as a compilation of the Hyogoken-Nambu (Kobe) data, details on interpretation and processing of the data are presented in Moss (2003).

Acknowledgements

The acquisition of CPT data was funded by the Kajima Corporation, and this support is gratefully acknowledged. The processing and compilation of the data was funded by the NSF-sponsored Pacific Earthquake Engineering Research Center (PEER) Lifelines Program via California Department of Transportation, the California Energy Commission, and Pacific Gas and Electric, under PEER Lifelines Task 3D02, and this support is gratefully acknowledged.

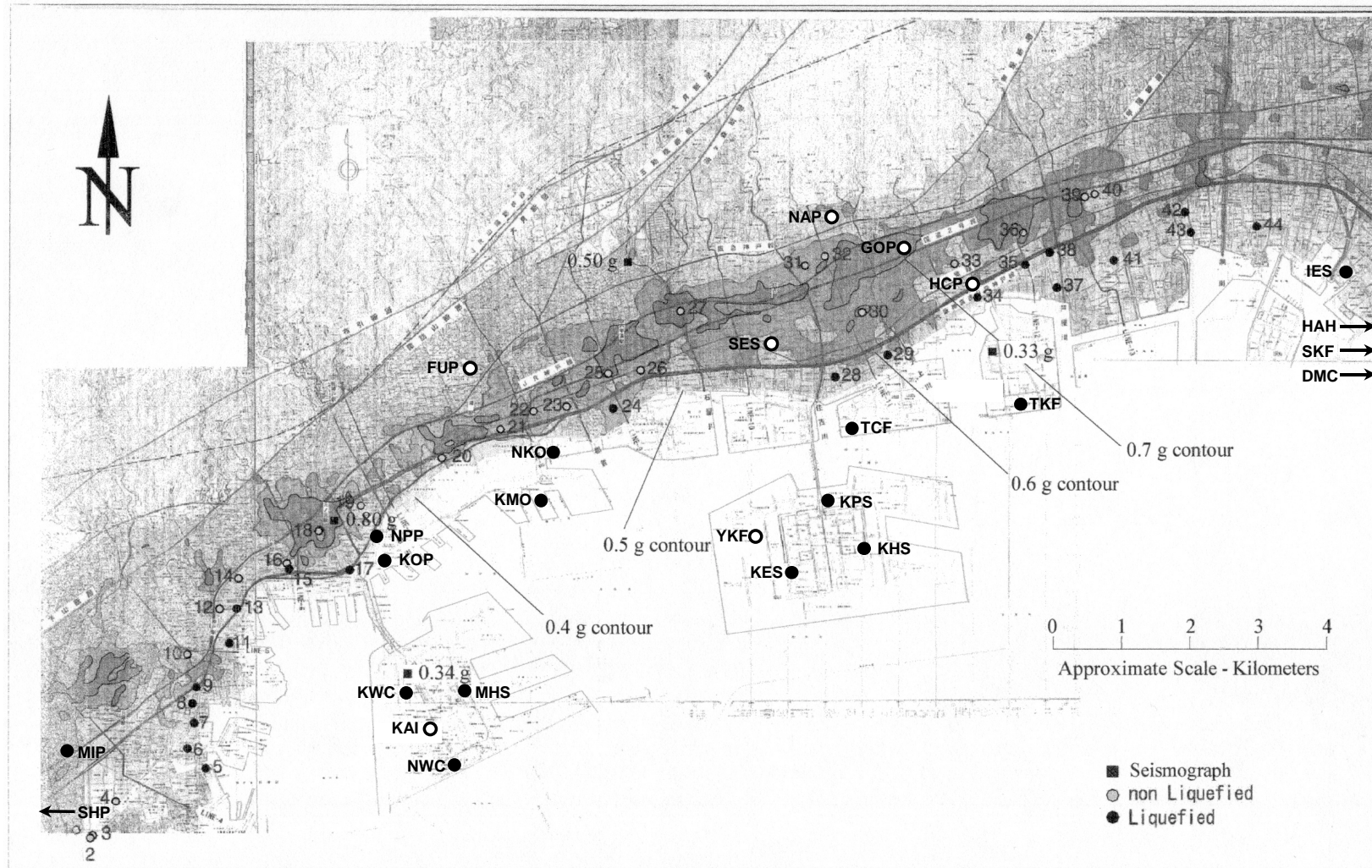
References

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- Cetin, K.O., Seed, R.B., Moss, R.E.S., Der Kiureghian, A., Tokimatsu, K. Harder, L.F. Jr., and Kayen, R.E. (2000). "Field Case Histories for SPT-Based In Situ Liquefaction Potential Evaluation." Geotechnical Engineering Research Report No. UCB/GT-2000/09.
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Table 1: Summary of CPT Field Case Histories from the 1995 Hyogoken-Nambu (Kobe) Earthquake.

EVENT		M _w	±															
1995 Hyogoken-Nanbu		7.20	0.11															
SITE DESCRIPTION	LIQ?	DATA CLASS	CRIT LAYER (m)	MEDIAN (m)	±	w.t. (m)	CSR	±	q _{c,1} (MPa)	±	R _f (%)	±	c	σ _v ' (kPa)	±	q _{c,1,mod} (MPa)	CSR*	
Dust Management Center	Y	B	6 to 8	7.00	0.33	2.00	0.31	0.11	7.83	2.53	0.49	0.20	0.64	70.45	4.92	7.83	0.29	
Imazu Elementary School	Y	C	8.0 to 12.0	10.00	0.67	1.40	0.40	0.17	0.80	0.19	0.80	0.34	0.90	101.43	7.23	1.14	0.37	
Koyo Junior High School	Y	B	6.5 to 7.5	7.00	0.17	4.00	0.28	0.10	8.03	0.54	1.24	0.87	0.50	95.07	3.96	8.76	0.27	
Kobe Customs Maya Office A	Y	B	4 to 9	6.50	0.17	1.80	0.45	0.16	2.93	0.34	0.40	0.13	0.78	75.24	3.97	2.93	0.43	
Kobe Customs Maya Office B	Y	B	3 to 6	4.50	0.17	1.80	0.48	0.15	6.98	0.73	0.87	0.17	0.54	55.86	3.12	7.41	0.45	
Kobe Port Const. Office	Y	B	3 to 5	4.00	0.13	2.50	0.42	0.13	5.99	1.15	0.29	0.11	0.76	55.79	2.91	5.99	0.40	
Koyo Pump Station	Y	B	5 to 6	5.50	0.17	2.60	0.33	0.11	2.38	0.57	1.75	0.82	0.65	71.00	3.41	3.68	0.31	
Kobe Wharf Public Co.	Y	B	4.0 to 5.5	4.75	0.25	2.10	0.35	0.12	6.03	0.74	0.78	0.40	0.65	60.33	3.41	6.33	0.33	
Koyo Elementary School	Y	B	6.5 to 7.0	6.75	0.17	4.20	0.28	0.10	2.93	1.44	2.17	1.50	0.54	94.01	3.91	4.56	0.26	
Mizukasa Park	Y	C	6.9 to 7.9	7.40	0.17	2.00	0.45	0.16	1.63	0.60	0.99	0.48	0.75	85.33	4.36	2.19	0.43	
Shiporex Kogyo Osaka Factory	Y	B	4.0 to 7.0	5.50	0.33	1.50	0.37	0.12	3.93	2.18	0.41	0.24	0.74	54.71	4.44	3.93	0.34	
Hamakoshienn Housing Area	Y	B	2.5 to 5.0	3.75	0.42	2.00	0.38	0.13	7.00	1.51	0.65	0.22	0.59	49.96	3.85	7.16	0.36	
Taito Kobe Factory	Y	B	3.2 to 4.2	3.70	0.17	1.60	0.39	0.13	4.85	0.86	0.39	0.12	0.75	42.13	3.38	4.85	0.36	
Tokuyama Concrete Factory	Y	B	4.0 to 4.8	4.40	0.13	2.00	0.40	0.13	2.55	0.88	0.40	0.19	0.80	50.98	3.48	2.55	0.38	
Nisseki Kobe Oil Tank A	Y	B	4.8 to 6.1	5.45	0.22	2.40	0.43	0.14	5.30	1.31	0.61	0.36	0.72	69.15	3.53	5.42	0.41	
Nisseki Kobe Oil Tank B	Y	B	5.0 to 6.0	5.50	0.17	2.40	0.43	0.14	6.25	1.34	0.74	0.27	0.70	69.64	3.42	6.53	0.41	
New Port No. 6 Pier	Y	B	3.5 to 5.5	4.00	0.33	2.50	0.42	0.14	9.47	1.60	0.43	0.11	0.70	55.79	3.55	9.47	0.40	
Minatojima Junior High	Y	B	4.0 to 4.5	4.25	0.08	2.70	0.32	0.10	4.71	1.35	0.94	0.42	0.65	59.57	2.91	5.16	0.30	
New Wharf Const.Offices	Y	B	3.2 to 3.8	3.50	0.10	2.60	0.31	0.10	3.56	0.81	0.93	0.64	0.64	51.62	2.78	4.00	0.29	
Fukuzumi Park	N	C	11.0 to 12.5	11.75	0.33	3.10	0.35	0.18	17.09	3.45	1.42	0.57	0.40	115.94	6.85	18.06	0.33	
Honjo Central Park	N	B	4.0 to 6.0	5.00	0.33	2.50	0.48	0.16	17.30	3.75	0.60	0.25	0.56	70.48	3.98	17.42	0.45	
Kobe Art Institute	N	B	3.5 to 3.8	3.65	0.05	3.00	0.32	0.10	13.64	5.38	1.90	1.31	0.33	57.62	2.86	15.08	0.30	
Yoshida Kogyo Factory	N	B	3 to 5	4.00	0.33	3.00	0.33	0.11	9.43	7.22	2.71	2.73	0.34	59.19	3.64	11.72	0.31	
Shimonakajima Park	N	B	3.0 to 4.5	3.75	0.17	2.00	0.50	0.16	19.49	0.80	0.73	0.43	0.53	46.11	3.38	19.77	0.47	
Sumiyoshi Elementary	N	B	2.4 to 3.2	2.80	0.13	1.90	0.43	0.14	17.35	4.20	0.66	0.31	0.54	38.09	3.15	17.53	0.41	
Nagashi Park	N	B	1.1 to 1.8	1.45	0.12	1.00	0.49	0.16	14.51	4.31	1.05	0.49	0.51	21.59	2.32	15.16	0.46	

Figure 1: Map Showing CPT Field Case History Locations from the 1995 Hyogoken-Nambu Earthquake, in relation to SPT Case History Locations and PGA Contours from Cetin et al. (2000).



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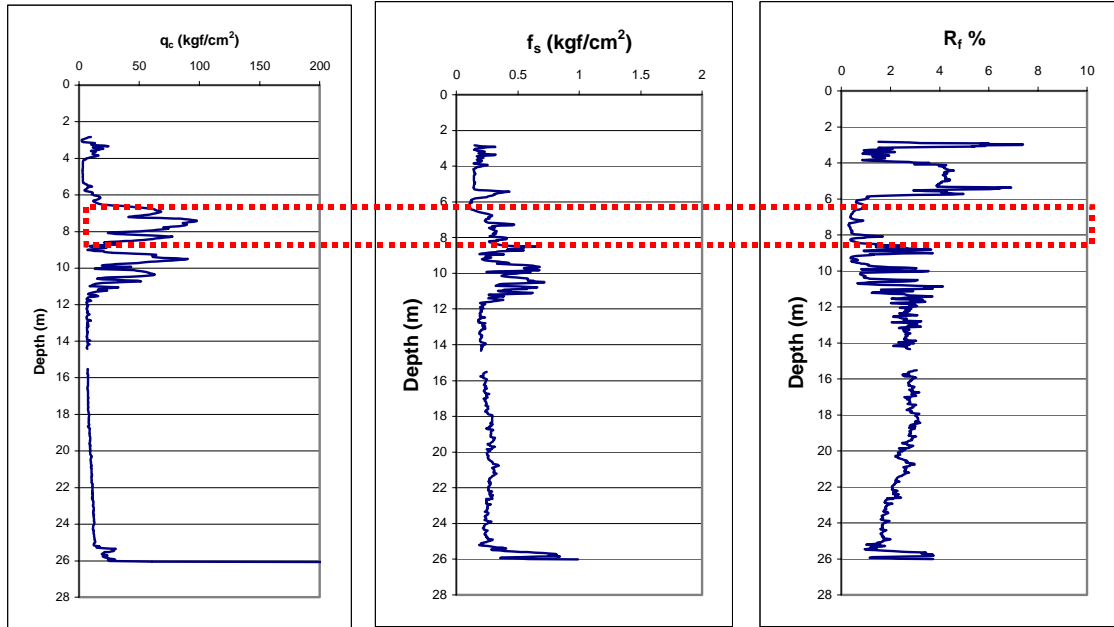
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Dust Management Center, Amagasaki City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	6 to 8	%Fines	
Median Depth (m)	7.00	%PI	
st.dev.	0.33		
Depth to GWT (m)	2.00		
st.dev.	0.30		
σ_v (kPa)	119.50	q_c (MPa)	6.25
st.dev.	6.72	st.dev.	2.02
σ_v' (kPa)	70.45	f_s (kPa)	30.80
st.dev.	4.92	st.dev.	7.64
a_{max} (g)	0.37	norm. exp.	0.64
st.dev.	0.11	C_q, C_f	1.25
r_d	0.76	C_{thin}	1.00
st.dev.	0.12	f_{s1} (kPa)	38.53
M_w	7.20	st.dev.	9.56
st.dev.	0.11	q_{c1} (MPa)	7.83
CSR_{eq}	0.31	st.dev.	2.53
st.dev.	0.11	R_{f1} (%)	0.49
C.O.V.-CSR	0.35	stdev	0.20

1995 Hyogoken-Nambu (Kobe), Japan
DMC



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_W=7.2$
Location: Fukuzumi Park, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

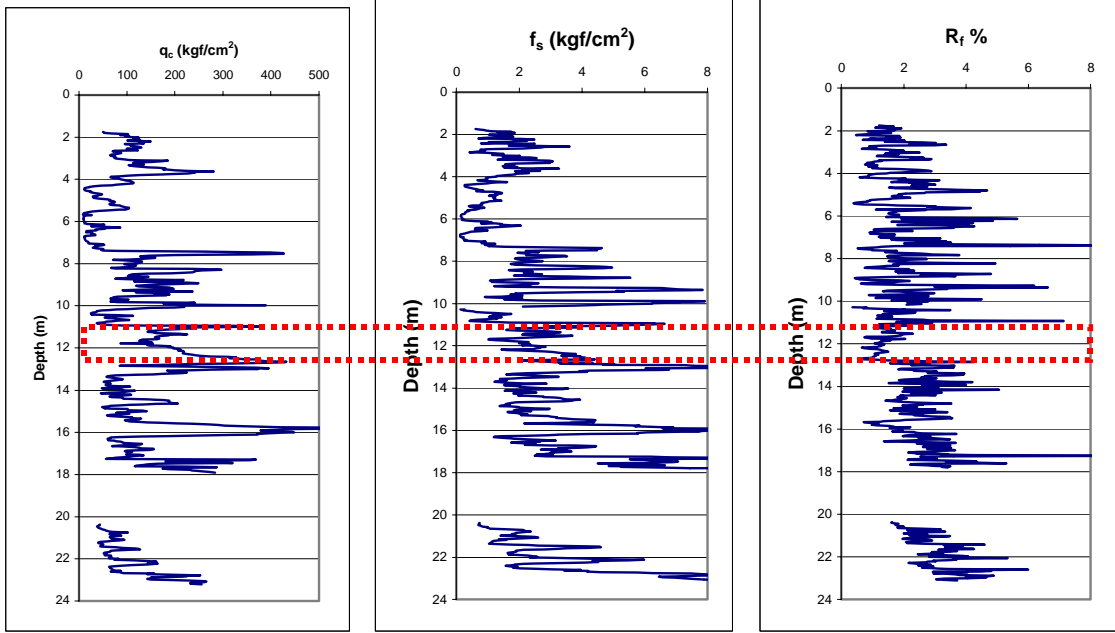
a_{max} estimated 0.6-0.7 from contour map and nearby SMA's

nearest to Cetin (2000) SPT 22

Summary of Data:

Stress		Strength	
Liquefied	N		
Data Class	C	Soil Class	
Critical Layer (m)	11.0 to 12.5	$D_{50(mm)}$	
Median Depth (m)	11.75	%Fines	
st.dev.	0.33	%PI	
Depth to GWT (m)	3.10		
st.dev.	0.30		
σ_v (kPa)	200.80	q_c (MPa)	18.13
st.dev.	8.24	st.dev.	3.66
σ_v' (kPa)	115.94	f_s (kPa)	257.04
st.dev.	6.85	st.dev.	88.38
a_{max} (g)	0.65	norm. exp.	0.40
st.dev.	0.20	C_q, C_f	0.94
r_d	0.48	C_{thin}	1.00
st.dev.	0.19	f_{s1} (kPa)	242.28
M_w	7.20	st.dev.	83.30
st.dev.	0.11	q_{c1} (MPa)	17.09
CSR_{eq}	0.35	st.dev.	3.45
st.dev.	0.18	$R_{f1}(\%)$	1.42
$C.O.V._{CSR}$	0.51	stdev	0.57

1995 Hyogoken-Nambu (Kobe), Japan
FUP-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Gotanda Park, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments: Omitted from Subsequent Liquefaction
 Triggering Analysis (Moss, 2003)

Summary of Data:

Stress

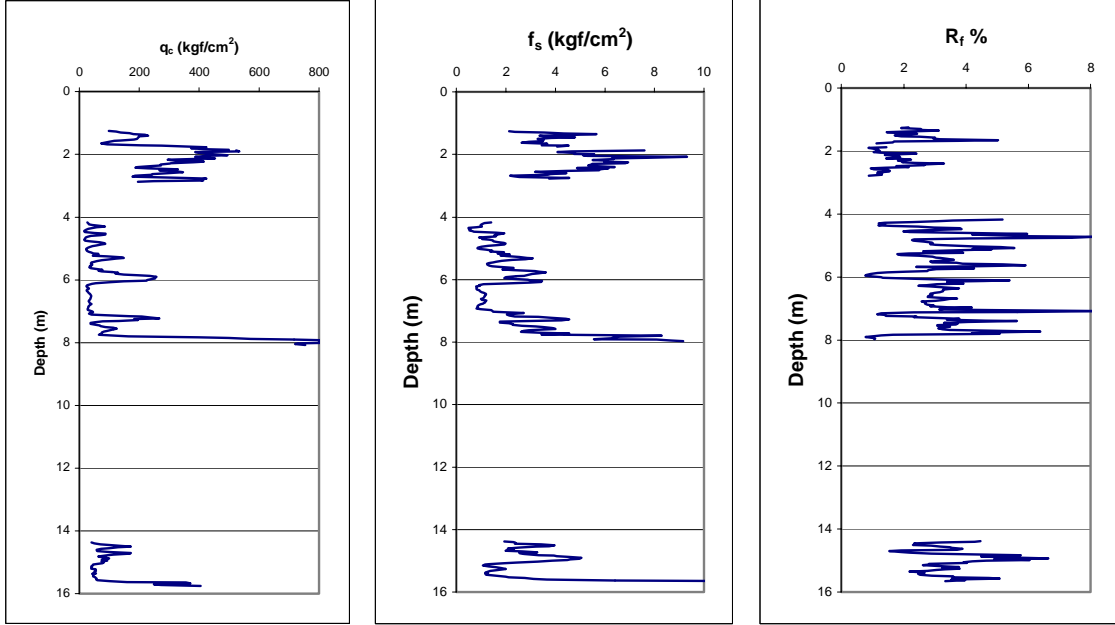
Liquefied
 Data Class
 Critical Layer (m)
 Median Depth (m)
 st.dev.
 Depth to GWT (m)
 st.dev.
 σ_v (kPa)
 st.dev.
 σ_v' (kPa)
 st.dev.
 a_{max} (g)
 st.dev.
 r_d
 st.dev.
 M_w
 st.dev.
 CSR_{eq}
 st.dev.
 $C.O.V._{CSR}$

Strength

Soil Class
 $D_{50(mm)}$
 %Fines
 %PI

 q_c (MPa)
 st.dev.
 f_s (kPa)
 st.dev.
 norm. exp.
 C_q, C_f
 C_{thin}
 f_{s1} (kPa)
 st.dev.
 q_{c1} (MPa)
 st.dev.
 $R_{f1}(\%)$
 stdev

1995 Hyogoken-Nambu (Kobe), Japan
GOP-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Hamakoshienn Housing Area, Nishinomiya City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

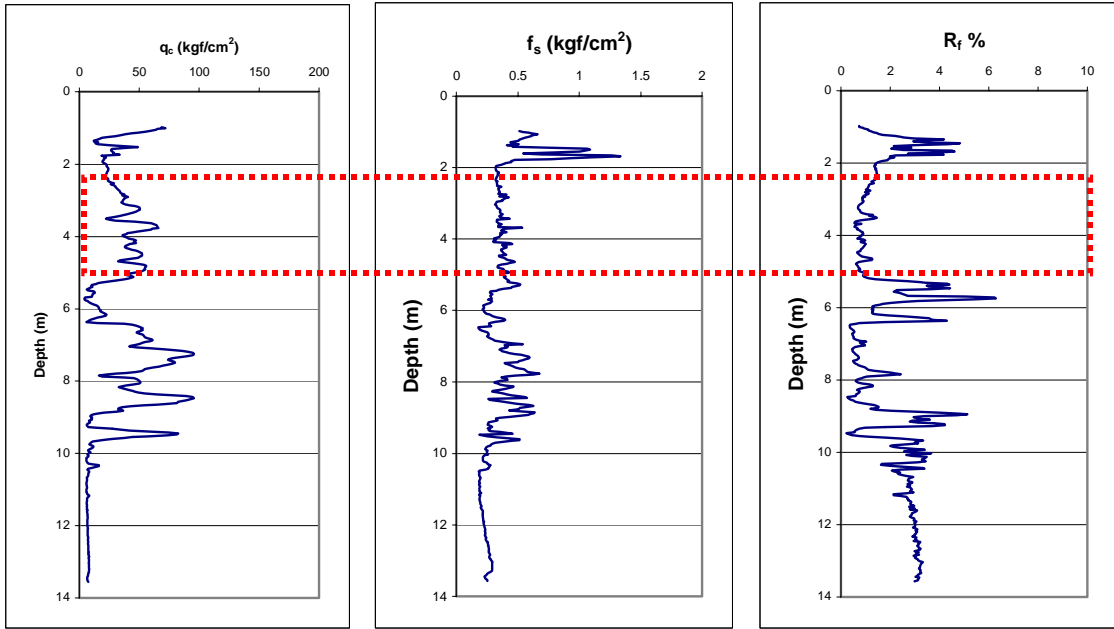
similar and near to IES

crit. Depth correlates with Cetin (2000) SPT 44

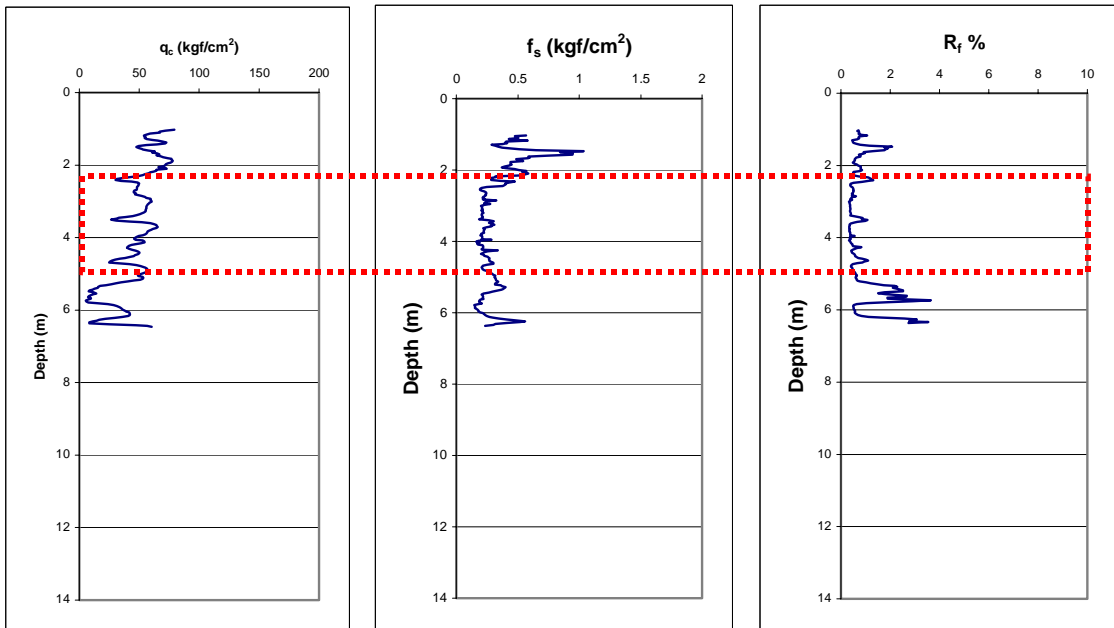
Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	2.5 to 5.0	%Fines	
Median Depth (m)	3.75	%PI	
st.dev.	0.42		
Depth to GWT (m)	2.00		
st.dev.	0.30		
σ_v (kPa)	67.13	q_c (MPa)	4.65
st.dev.	8.35	st.dev.	1.01
σ_v' (kPa)	49.96	f_s (kPa)	30.19
st.dev.	3.85	st.dev.	7.68
a_{max} (g)	0.50	norm. exp.	0.59
st.dev.	0.15	C_q, C_f	1.51
r_d	0.88	C_{thin}	1.00
st.dev.	0.07	f_{s1} (kPa)	45.47
M_w	7.20	st.dev.	11.57
st.dev.	0.11	q_{c1} (MPa)	7.00
CSR_{eq}	0.38	st.dev.	1.51
st.dev.	0.13	R_{f1} (%)	0.65
C.O.V.-CSR	0.34	stdev	0.22

1995 Hyogoken-Nambu (Kobe), Japan
HAH-1



HAH-2



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Honjyo Central Park, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

estimated $a_{max} > 0.7$ from contour map

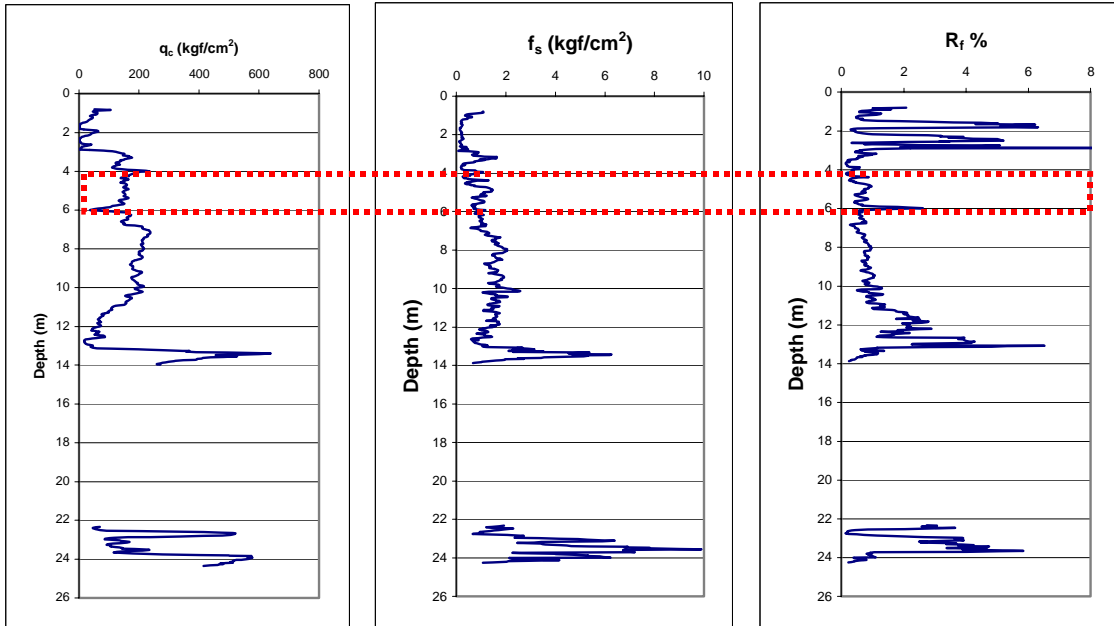
nearest Cetin (2000) SPT 32 & 30

crit. Depth correlates w/ SPT 32

Summary of Data:

Stress		Strength	
Liquefied	N	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	4.0 to 6.0	%Fines	
Median Depth (m)	5.00	%PI	
st.dev.	0.33		
Depth to GWT (m)	2.50		
st.dev.	0.30		
σ_v (kPa)	95.00	q_c (MPa)	14.22
st.dev.	7.25	st.dev.	3.08
σ_v' (kPa)	70.48	f_s (kPa)	85.41
st.dev.	3.98	st.dev.	30.20
a_{max} (g)	0.70	norm. exp.	0.56
st.dev.	0.21	C_q, C_f	1.22
r_d	0.78	C_{thin}	1.00
st.dev.	0.09	f_{s1} (kPa)	103.90
M_w	7.20	st.dev.	36.73
st.dev.	0.11	q_{c1} (MPa)	17.30
CSR_{eq}	0.48	st.dev.	3.75
st.dev.	0.16	R_{f1} (%)	0.60
C.O.V.-CSR	0.34	stdev	0.25

1995 Hyogoken-Nambu (Kobe), Japan
HCP-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Imazu Elementary School, Nishinomiya City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

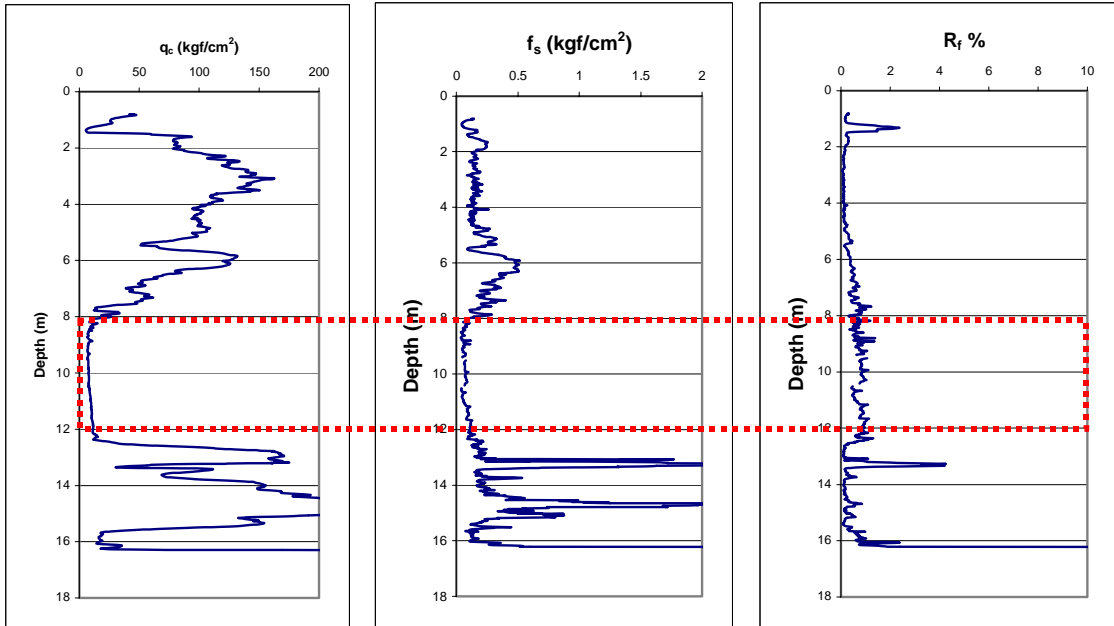
estimated $a_{max}=0.4-0.6$ from contour map

nearest Cetin (2000) SPT 44

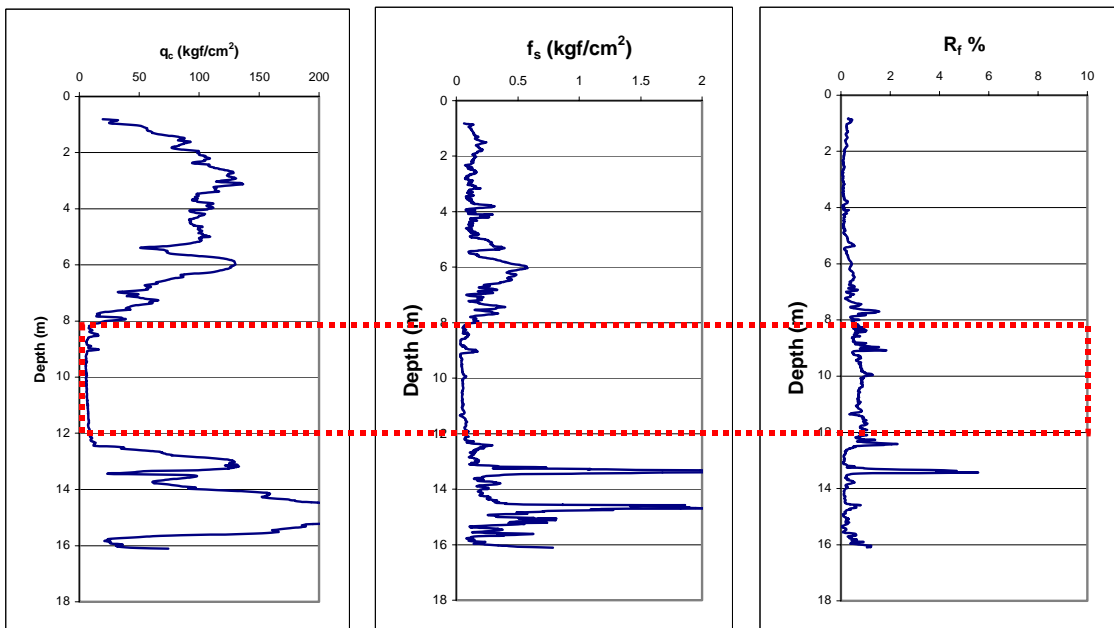
Summary of Data:

Stress		Strength	
Liquefied	Y		
Data Class	C	Soil Class	
Critical Layer (m)	8.0 to 12.0	$D_{50(mm)}$	
Median Depth (m)	10.00	%Fines	
st.dev.	0.67	%PI	
Depth to GWT (m)	1.40		
st.dev.	0.30		
σ_v (kPa)	185.80	q_c (MPa)	0.81
st.dev.	13.87	st.dev.	0.20
σ_v' (kPa)	101.43	f_s (kPa)	6.51
st.dev.	7.23	st.dev.	2.28
a_{max} (g)	0.60	norm. exp.	0.90
st.dev.	0.18	C_q, C_f	0.99
r_d	0.56	C_{thin}	1.00
st.dev.	0.17	f_{s1} (kPa)	6.43
M_w	7.20	st.dev.	2.25
st.dev.	0.11	q_{c1} (MPa)	0.80
CSR_{eq}	0.40	st.dev.	0.19
st.dev.	0.17	R_{f1} (%)	0.80
C.O.V. _{-CSR}	0.44	stdev	0.34

1995 Hyogoken-Nambu (Kobe), Japan
IES-1



IES-2



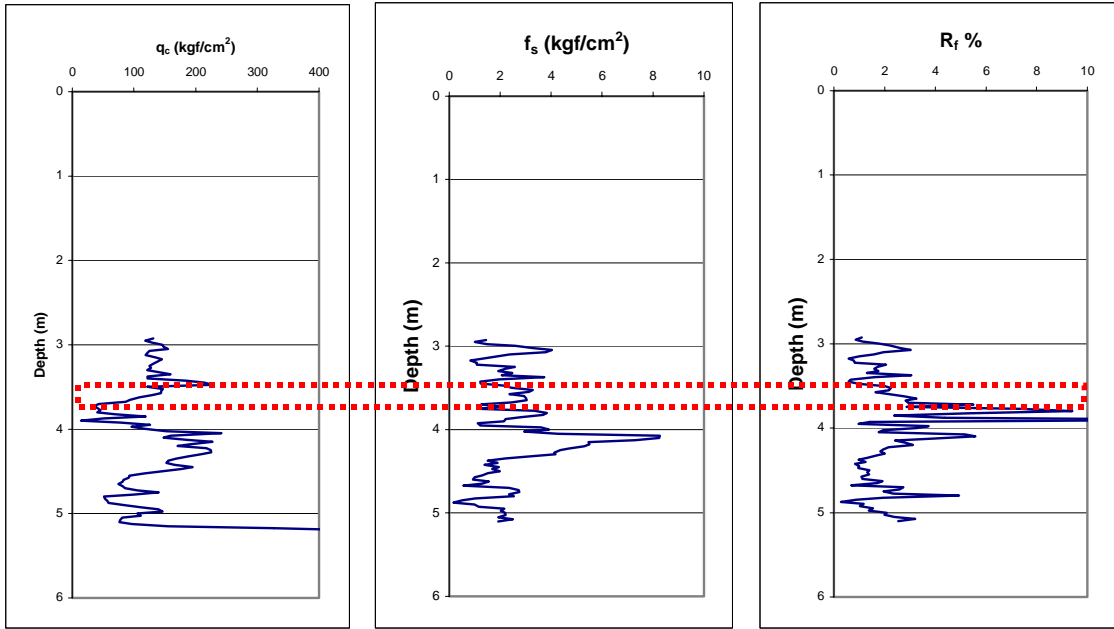
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Kobe Art Institute, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

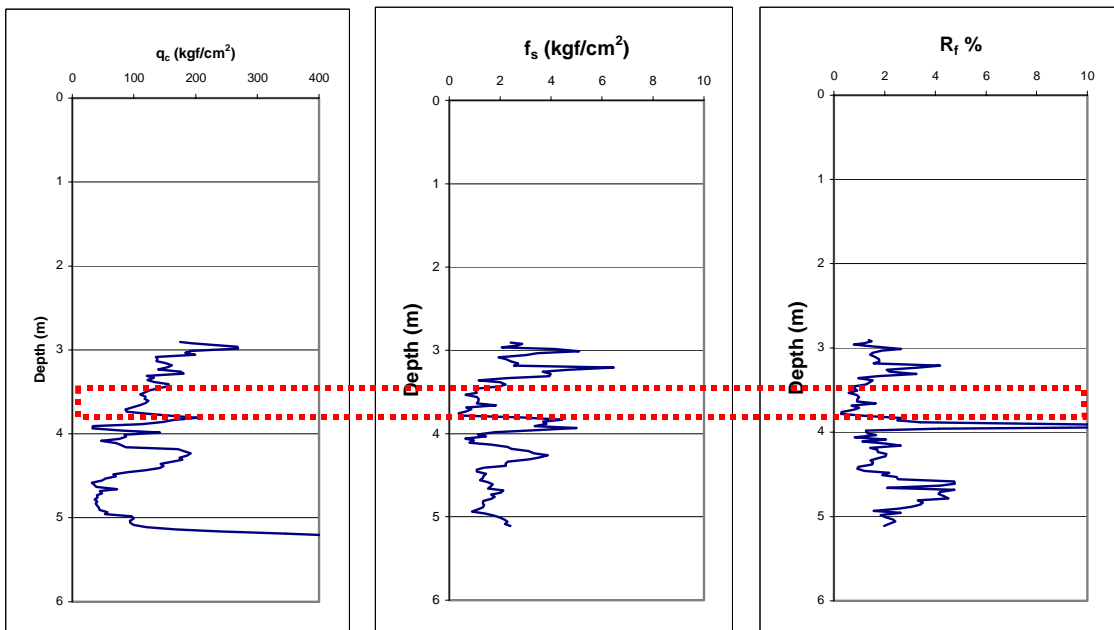
Summary of Data:

Stress		Strength	
Liquefied	N	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	3.5 to 3.8	%Fines	
Median Depth (m)	3.65	%PI	
st.dev.	0.05		
Depth to GWT (m)	3.00		
st.dev.	0.30	q_c (MPa)	11.38
σ_v (kPa)	64.00	st.dev.	4.48
st.dev.	2.38	f_s (kPa)	216.23
σ_v' (kPa)	57.62	st.dev.	121.64
st.dev.	2.86	norm. exp.	0.33
a_{max} (g)	0.50	C_q, C_f	1.20
st.dev.	0.15	C_{thin}	1.00
r_d	0.88	f_{s1} (kPa)	259.37
st.dev.	0.07	st.dev.	145.90
M_w	7.20	q_{c1} (MPa)	13.64
st.dev.	0.11	st.dev.	5.38
CSR_{eq}	0.32	$R_{f1}(\%)$	1.90
st.dev.	0.10	stdev	1.31
C.O.V.-CSR	0.32		

1995 Hyogoken-Nambu (Kobe), Japan
KAI-1



KAI-2



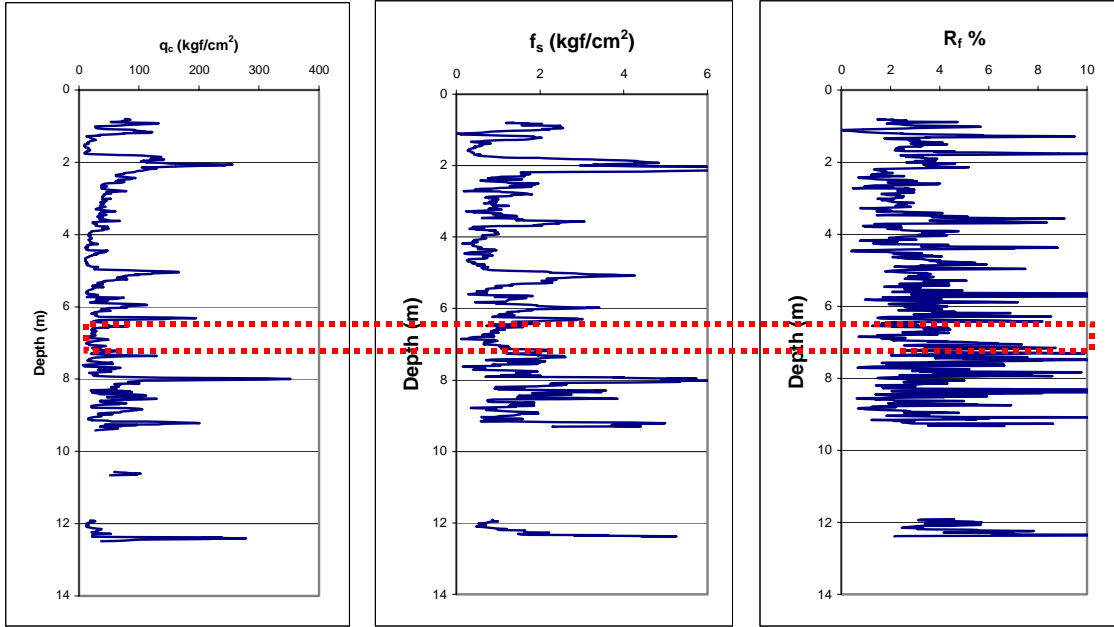
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Koyo Elementary School, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Marginal, edge of liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	6.5 to 7.0	%Fines	
Median Depth (m)	6.75	%PI	
st.dev.	0.17		
Depth to GWT (m)	4.20		
st.dev.	0.30		
σ_v (kPa)	119.03	q_c (MPa)	2.84
st.dev.	4.61	st.dev.	1.39
σ_v' (kPa)	94.01	f_s (kPa)	61.63
st.dev.	3.91	st.dev.	29.94
a_{max} (g)	0.45	norm. exp.	0.54
st.dev.	0.14	C_q, C_f	1.03
r_d	0.75	C_{thin}	1.00
st.dev.	0.12	f_{s1} (kPa)	63.72
M_w	7.20	st.dev.	30.96
st.dev.	0.11	q_{c1} (MPa)	2.93
CSR_{eq}	0.28	st.dev.	1.44
st.dev.	0.10	R_{f1} (%)	2.17
C.O.V.-CSR	0.34	stdev	1.50

1995 Hyogoken-Nambu (Kobe), Japan
KES-1



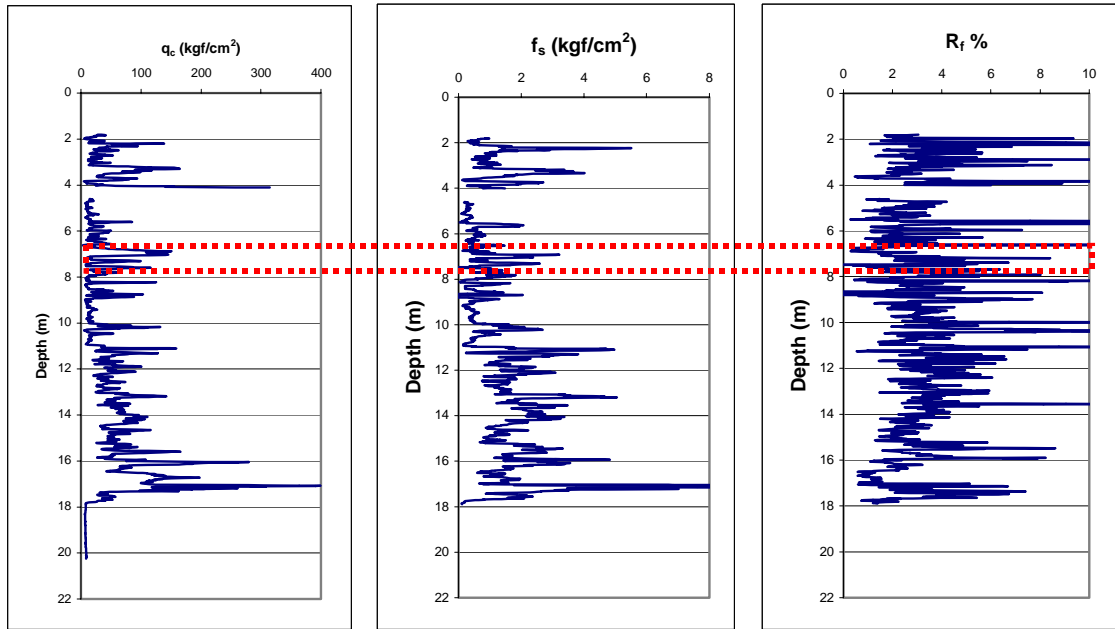
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Koyo Junior High School, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Marginal, Edge of Liquefaction

Comments:

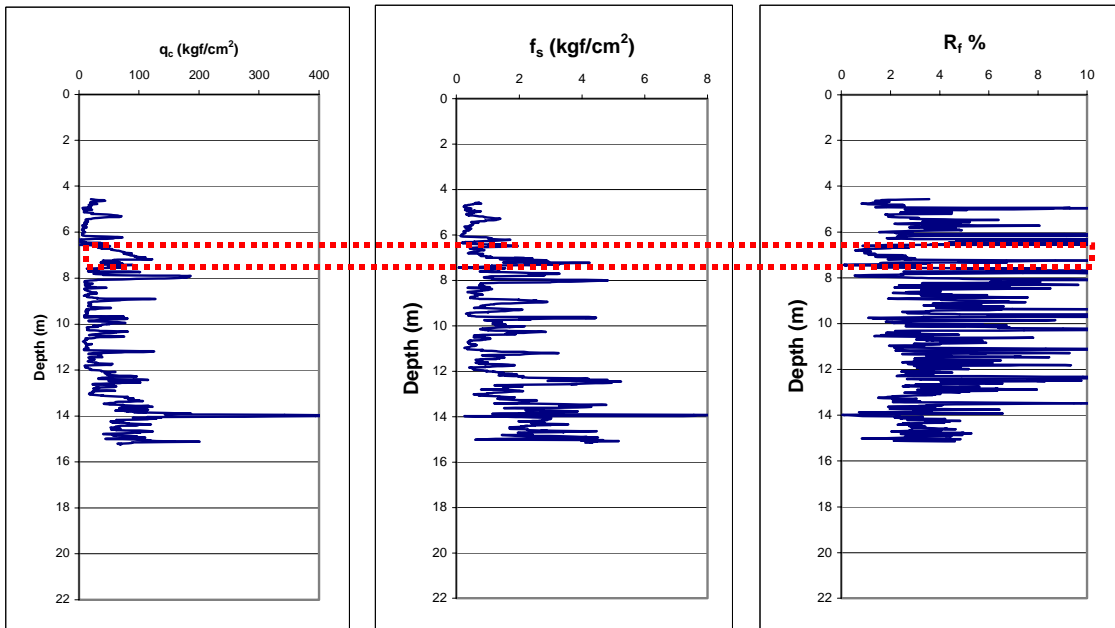
Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	6.5 to 7.5	%Fines	
Median Depth (m)	7.00	%PI	
st.dev.	0.17		
Depth to GWT (m)	4.00		
st.dev.	0.30		
σ_v (kPa)	124.50	q_c (MPa)	7.83
st.dev.	4.65	st.dev.	0.53
σ_v' (kPa)	95.07	f_s (kPa)	97.46
st.dev.	3.96	st.dev.	68.07
a_{max} (g)	0.45	norm. exp.	0.50
st.dev.	0.14	C_q, C_f	1.03
r_d	0.74	C_{thin}	1.00
st.dev.	0.12	f_{s1} (kPa)	99.95
M_w	7.20	st.dev.	69.81
st.dev.	0.11	q_{c1} (MPa)	8.03
CSR_{eq}	0.28	st.dev.	0.54
st.dev.	0.10	R_{f1} (%)	1.24
C.O.V.-CSR	0.35	stdev	0.87

1995 Hyogoken-Nambu (Kobe), Japan
KHS-1



KHS-2



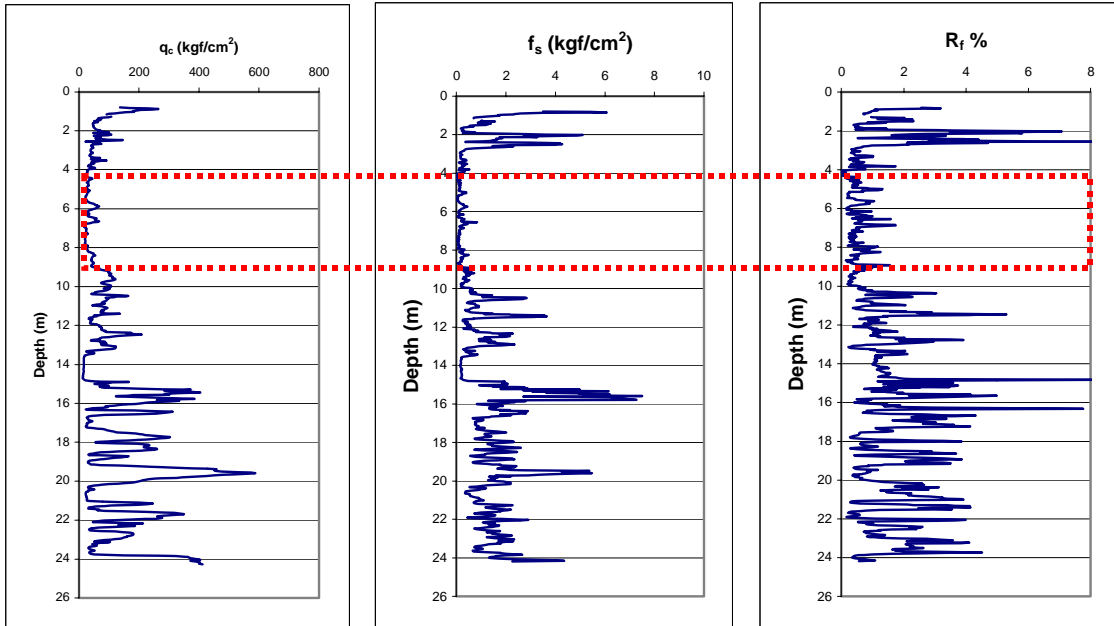
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Kobe Customs Maya Office Site A, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	4 to 9	%Fines	
Median Depth (m)	6.50	%PI	
st.dev.	0.17		
Depth to GWT (m)	1.80		
st.dev.	0.30		
σ_v (kPa)	121.35	q_c (MPa)	2.35
st.dev.	4.66	st.dev.	0.27
σ_v' (kPa)	75.24	f_s (kPa)	9.38
st.dev.	3.97	st.dev.	2.87
a_{max} (g)	0.60	norm. exp.	0.78
st.dev.	0.18	C_q, C_f	1.25
r_d	0.72	C_{thin}	1.00
st.dev.	0.11	f_{s1} (kPa)	11.71
M_w	7.20	st.dev.	3.59
st.dev.	0.11	q_{c1} (MPa)	2.93
CSR_{eq}	0.45	st.dev.	0.34
st.dev.	0.16	R_{f1} (%)	0.40
C.O.V. _{-CSR}	0.35	stdev	0.13

1995 Hyogoken-Nambu (Kobe), Japan
KMO-A



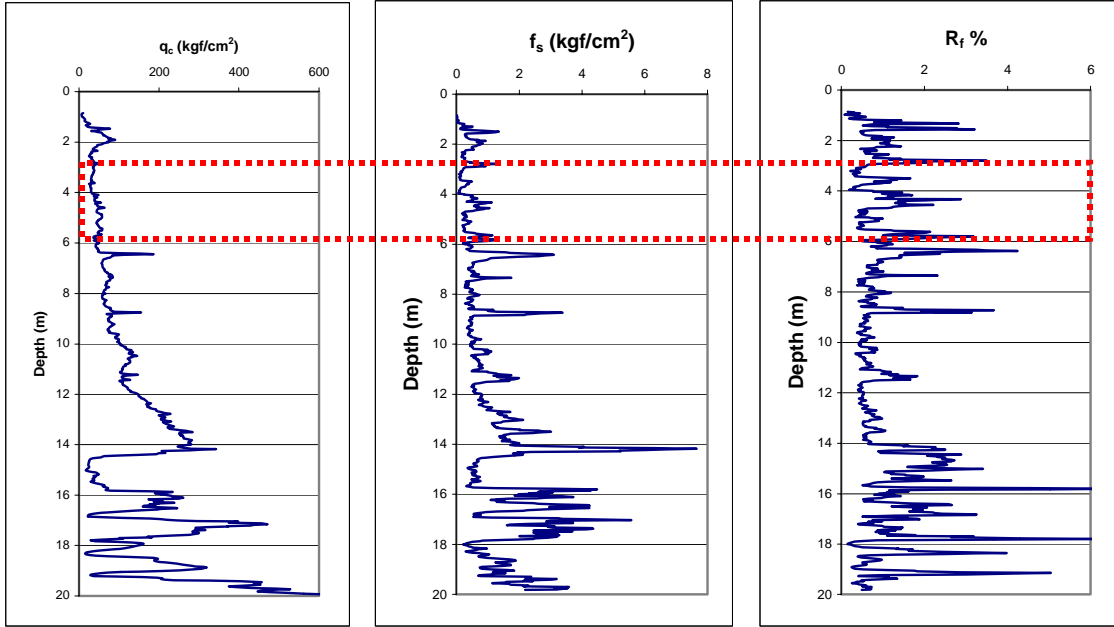
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Kobe Customs Maya Office Site B, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	3 to 6	%Fines	
Median Depth (m)	4.50	%PI	
st.dev.	0.17		
Depth to GWT (m)	1.80		
st.dev.	0.30		
σ_v (kPa)	82.35	q_c (MPa)	5.09
st.dev.	3.96	st.dev.	0.53
σ_v' (kPa)	55.86	f_s (kPa)	44.37
st.dev.	3.12	st.dev.	7.14
a_{max} (g)	0.60	norm. exp.	0.54
st.dev.	0.18	C_q, C_f	1.37
r_d	0.83	C_{thin}	1.00
st.dev.	0.08	f_{s1} (kPa)	60.76
M_w	7.20	st.dev.	9.78
st.dev.	0.11	q_{c1} (MPa)	6.98
CSR_{eq}	0.48	st.dev.	0.73
st.dev.	0.15	R_{f1} (%)	0.87
C.O.V.-CSR	0.32	stdev	0.17

1995 Hyogoken-Nambu (Kobe), Japan
KMO-B



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Kobe Port Construction Office, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

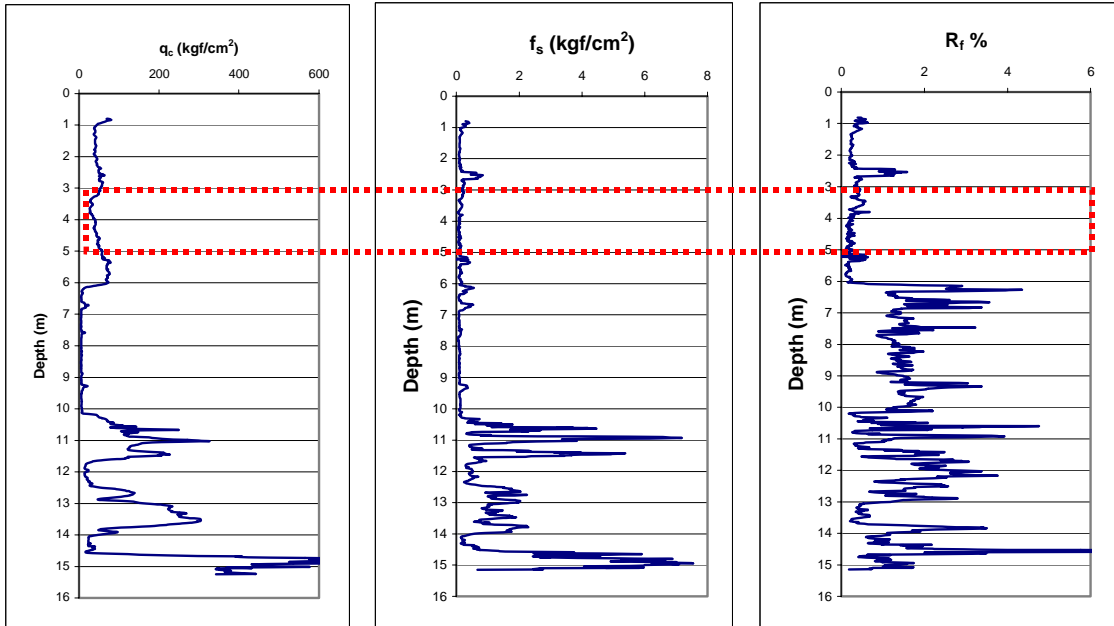
estimated $a_{max}=0.4-0.5$ from contour map

v. close to Cetin (2000) SPT 17
crit. depth correlates with SPT

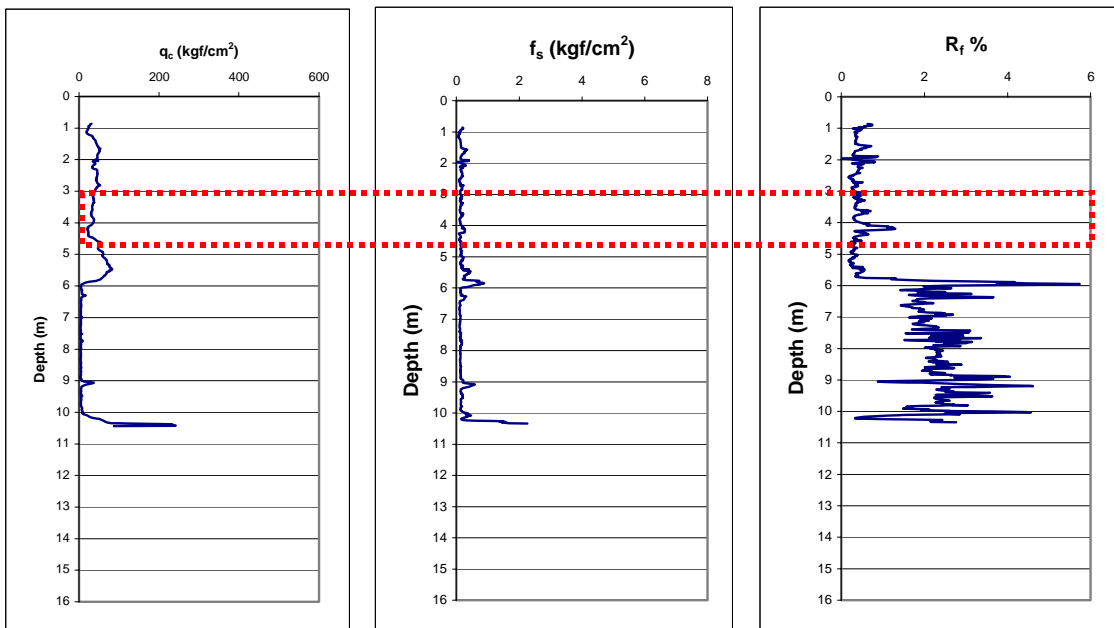
Summary of Data:

Stress		Strength	
Liquefied	Y		
Data Class	B	Soil Class	
Critical Layer (m)	3 to 5	$D_{50(mm)}$	
Median Depth (m)	4.00	%Fines	
st.dev.	0.13	%PI	
Depth to GWT (m)	2.50		
st.dev.	0.30		
σ_v (kPa)	70.50	q_c (MPa)	3.84
st.dev.	3.32	st.dev.	0.74
σ_v' (kPa)	55.79	f_s (kPa)	11.24
st.dev.	2.91	st.dev.	3.68
a_{max} (g)	0.60	norm. exp.	0.76
st.dev.	0.18	C_q, C_f	1.56
r_d	0.85	C_{thin}	1.00
st.dev.	0.08	f_{s1} (kPa)	17.51
M_w	7.20	st.dev.	5.73
st.dev.	0.11	q_{c1} (MPa)	5.99
CSR_{eq}	0.42	st.dev.	1.15
st.dev.	0.13	R_{f1} (%)	0.29
C.O.V.-CSR	0.32	stdev	0.11

1995 Hyogoken-Nambu (Kobe), Japan
KOP-2



KOP-3



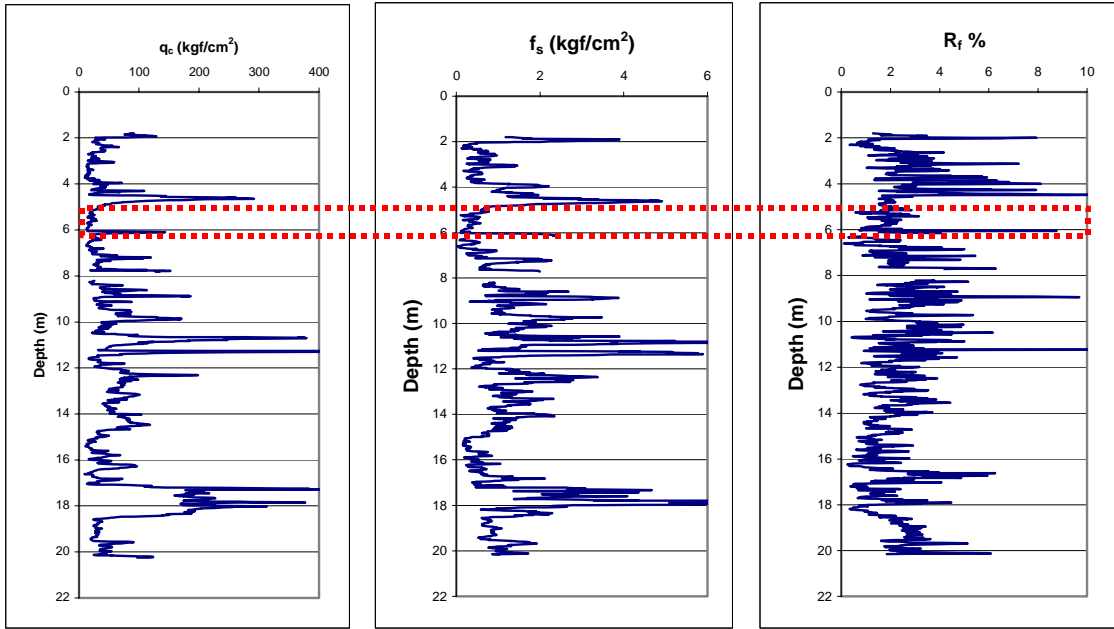
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Koyo Pump Station, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	5 to 6	%Fines	
Median Depth (m)	5.50	%PI	
st.dev.	0.17		
Depth to GWT (m)	2.60		
st.dev.	0.30		
σ_v (kPa)	99.45	q_c (MPa)	1.90
st.dev.	4.19	st.dev.	0.46
σ_v' (kPa)	71.00	f_s (kPa)	33.32
st.dev.	3.41	st.dev.	13.36
a_{max} (g)	0.45	norm. exp.	0.65
st.dev.	0.14	C_q, C_f	1.25
r_d	0.81	C_{thin}	1.00
st.dev.	0.10	f_{s1} (kPa)	41.62
M_w	7.20	st.dev.	16.69
st.dev.	0.11	q_{c1} (MPa)	2.38
CSR_{eq}	0.33	st.dev.	0.57
st.dev.	0.11	R_{f1} (%)	1.75
C.O.V.-CSR	0.33	stdev	0.82

1995 Hyogoken-Nambu (Kobe), Japan
KPS-1



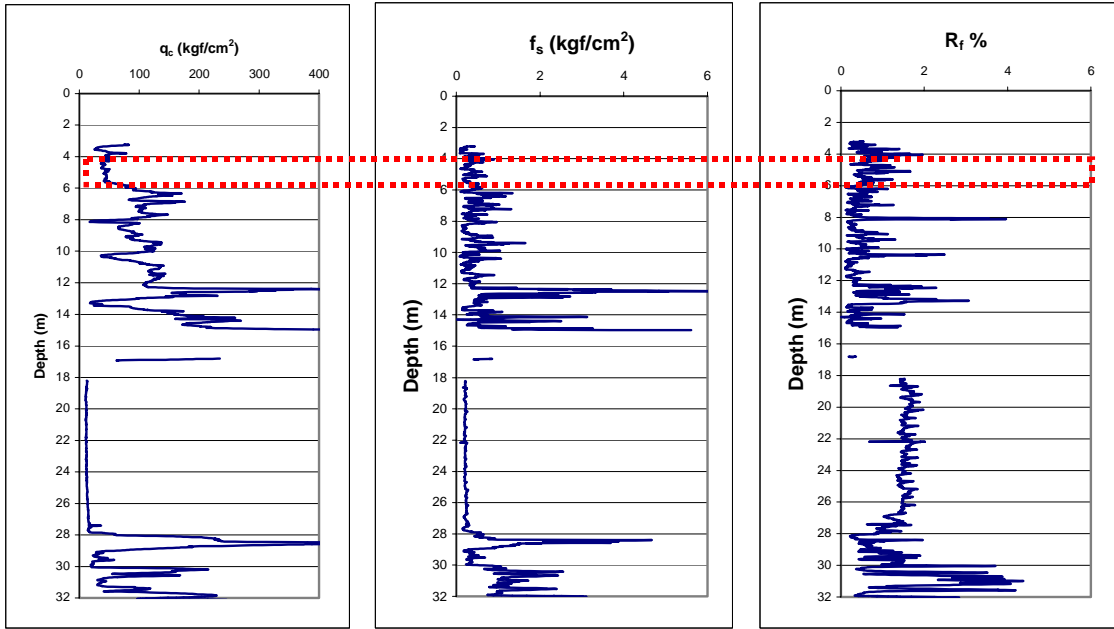
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Kobe Wharf Public Company, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	4.0 to 5.5	%Fines	
Median Depth (m)	4.75	%PI	
st.dev.	0.25		
Depth to GWT (m)	2.10		
st.dev.	0.30		
σ_v (kPa)	86.33	q_c (MPa)	4.34
st.dev.	5.41	st.dev.	0.53
σ_v' (kPa)	60.33	f_s (kPa)	33.73
st.dev.	3.41	st.dev.	16.88
a_{max} (g)	0.45	norm. exp.	0.65
st.dev.	0.14	C_q, C_f	1.39
r_d	0.84	C_{thin}	1.00
st.dev.	0.09	f_{s1} (kPa)	46.84
M_w	7.20	st.dev.	23.44
st.dev.	0.11	q_{c1} (MPa)	6.03
CSR_{eq}	0.35	st.dev.	0.74
st.dev.	0.12	R_{f1} (%)	0.78
C.O.V.-CSR	0.33	stdev	0.40

1995 Hyogoken-Nambu (Kobe), Japan
KWC-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Minatojima Junior High School, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

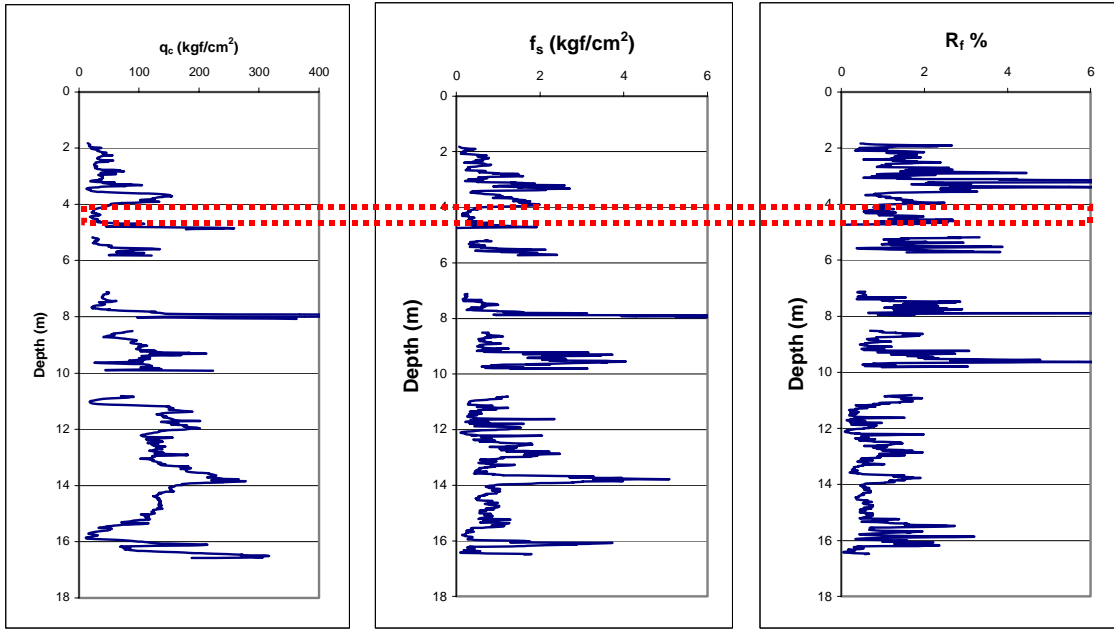
Stress

Liquefied	Y
Data Class	B
Critical Layer (m)	4.0 to 4.5
Median Depth (m)	4.25
st.dev.	0.08
Depth to GWT (m)	2.70
st.dev.	0.30
σ_v (kPa)	74.78
st.dev.	2.72
σ_v' (kPa)	59.57
st.dev.	2.91
a_{max} (g)	0.45
st.dev.	0.14
r_d	0.86
st.dev.	0.08
M_w	7.20
st.dev.	0.11
CSR_{eq}	0.32
st.dev.	0.10
C.O.V. _{-CSR}	0.32

Strength

Soil Class	
$D_{50(mm)}$	
%Fines	
%PI	
q_c (MPa)	3.37
st.dev.	0.97
f_s (kPa)	31.52
st.dev.	10.78
norm. exp.	0.65
C_q, C_f	1.40
C_{thin}	1.00
f_{s1} (kPa)	44.14
st.dev.	15.10
q_{c1} (MPa)	4.71
st.dev.	1.35
$R_{f1}(\%)$	0.94
stdev	0.42

1995 Hyogoken-Nambu (Kobe), Japan
MHS-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Mizukasa Park, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

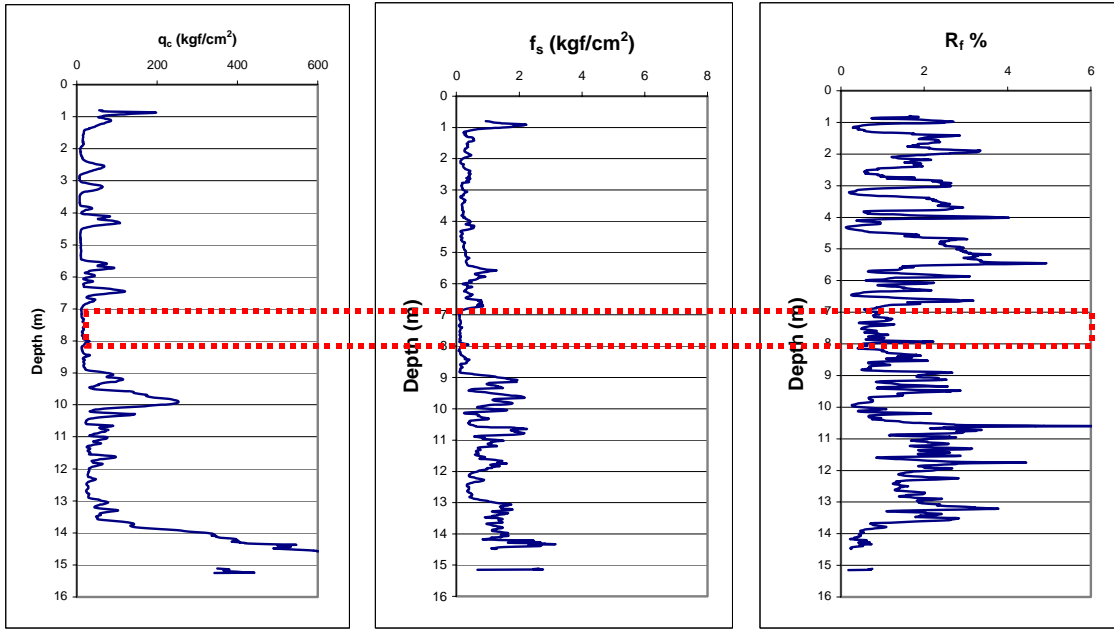
estimated $a_{max}=0.5-0.6$ from contour map

nearest Cetin (2000) SPT 1,2 & 3
crit. Depth correlates to SPT

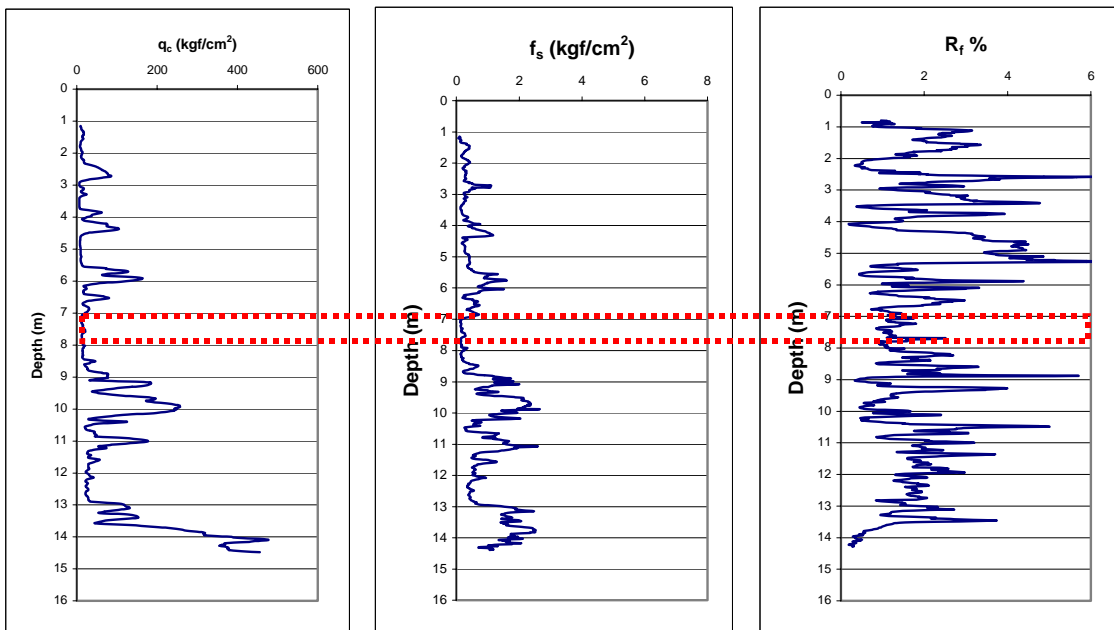
Summary of Data:

Stress		Strength	
Liquefied	Y		
Data Class	C	Soil Class	
Critical Layer (m)	6.9 to 7.9	$D_{50(mm)}$	
Median Depth (m)	7.40	%Fines	
st.dev.	0.17	%PI	
Depth to GWT (m)	2.00		
st.dev.	0.30		
σ_v (kPa)	138.30	q_c (MPa)	1.44
st.dev.	5.00	st.dev.	0.53
σ_v' (kPa)	85.33	f_s (kPa)	14.25
st.dev.	4.36	st.dev.	4.61
a_{max} (g)	0.65	norm. exp.	0.75
st.dev.	0.20	C_q, C_f	1.13
r_d	0.66	C_{thin}	1.00
st.dev.	0.13	f_{s1} (kPa)	16.05
M_w	7.20	st.dev.	5.19
st.dev.	0.11	q_{c1} (MPa)	1.63
CSR_{eq}	0.45	st.dev.	0.60
st.dev.	0.16	R_{f1} (%)	0.99
C.O.V.-CSR	0.36	stdev	0.48

1995 Hyogoken-Nambu (Kobe), Japan
MIP-1



MIP-2



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Nagashi Park
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

estimated $a_{max}=0.5-0.7$ from contour map

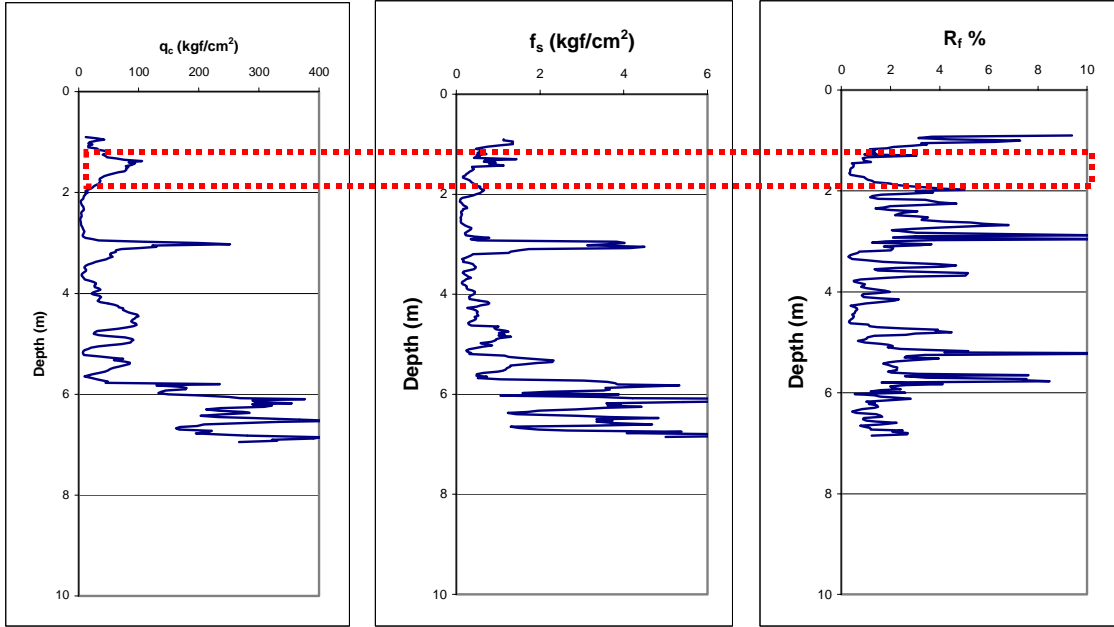
nearest Cetin (2000) SPT 32

thin layer correction applied

Summary of Data:

Stress		Strength	
Liquefied	N	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	1.1 to 1.8	%Fines	
Median Depth (m)	1.45	%PI	
st.dev.	0.12		
Depth to GWT (m)	1.00	q_c (MPa)	6.04
st.dev.	0.30	st.dev.	2.15
σ_v (kPa)	26.00	f_s (kPa)	63.38
st.dev.	2.60	st.dev.	30.38
σ_v' (kPa)	21.59	norm. exp.	0.51
st.dev.	2.32	C_q, C_f	2.00
a_{max} (g)	0.65	C_{thin}	1.20
st.dev.	0.20	f_{s1} (kPa)	126.76
r_d	0.95	st.dev.	60.77
st.dev.	0.03	q_{c1} (MPa)	14.51
M_w	7.20	st.dev.	4.31
st.dev.	0.11	$R_{f1}(\%)$	1.05
CSR_{eq}	0.49	stdev	0.49
st.dev.	0.16		
C.O.V.-CSR	0.33		

1995 Hyogoken-Nambu (Kobe), Japan
NAP-1



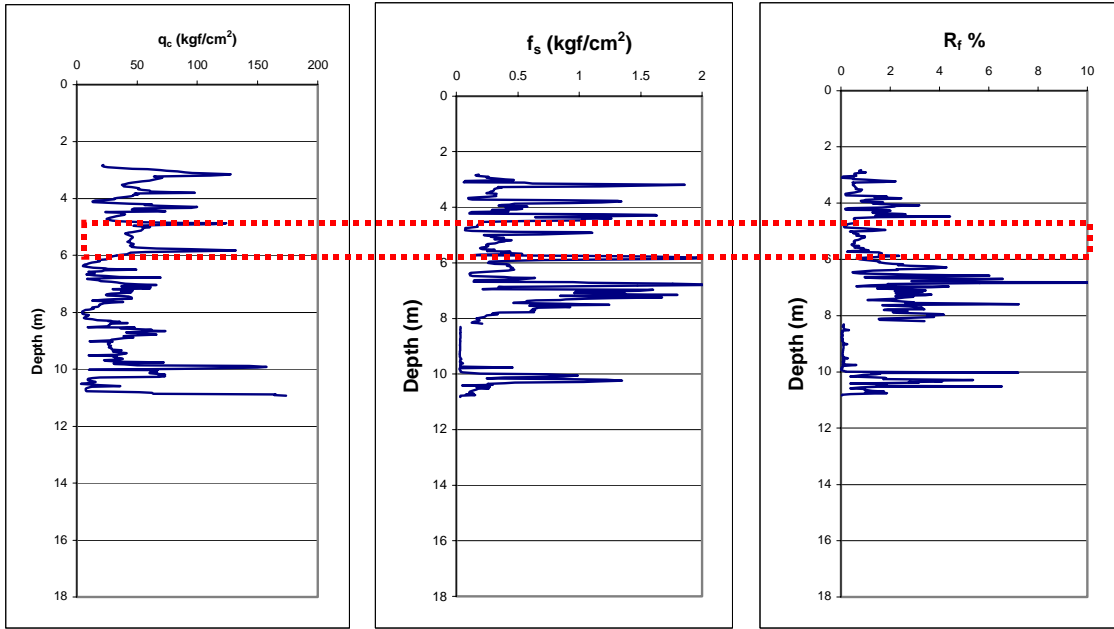
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Nisseki Kobe Oil Tank Site A, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

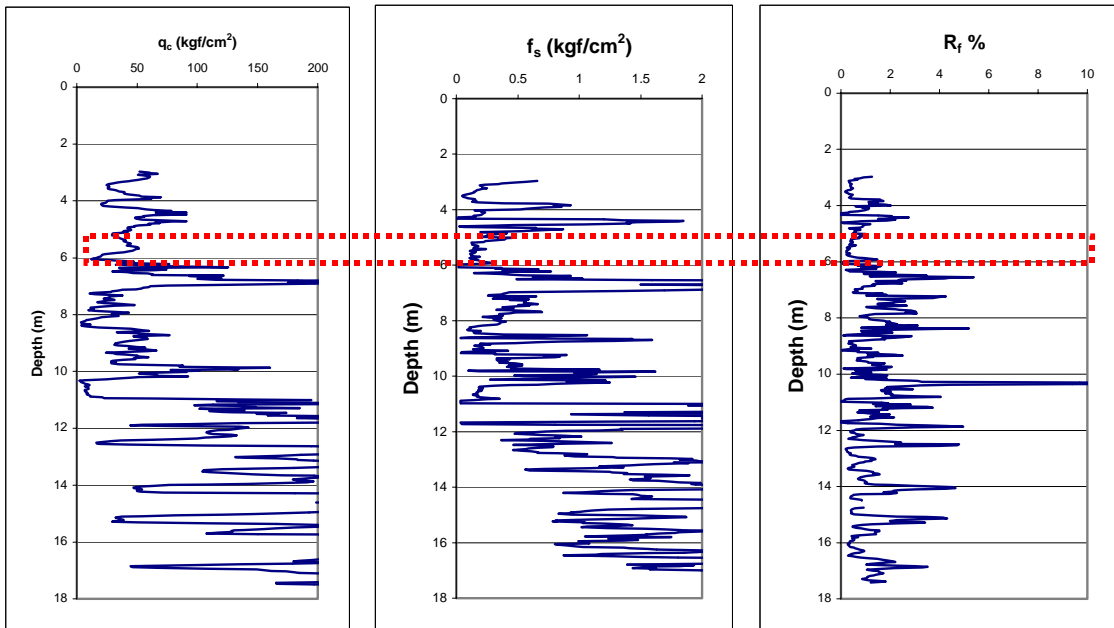
Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	4.8 to 6.1	%Fines	
Median Depth (m)	5.45	%PI	
st.dev.	0.22		
Depth to GWT (m)	2.40		
st.dev.	0.30		
σ_v (kPa)	99.08	q_c (MPa)	4.07
st.dev.	4.98	st.dev.	1.00
σ_v' (kPa)	69.15	f_s (kPa)	24.66
st.dev.	3.53	st.dev.	13.53
a_{max} (g)	0.60	norm. exp.	0.72
st.dev.	0.18	C_q, C_f	1.30
r_d	0.78	C_{thin}	1.00
st.dev.	0.10	f_{s1} (kPa)	32.16
M_w	7.20	st.dev.	17.65
st.dev.	0.11	q_{c1} (MPa)	5.30
CSR_{eq}	0.43	st.dev.	1.31
st.dev.	0.14	R_{f1} (%)	0.61
C.O.V.-CSR	0.33	stdev	0.36

1995 Hyogoken-Nambu (Kobe), Japan
NKO-1



NKO-2



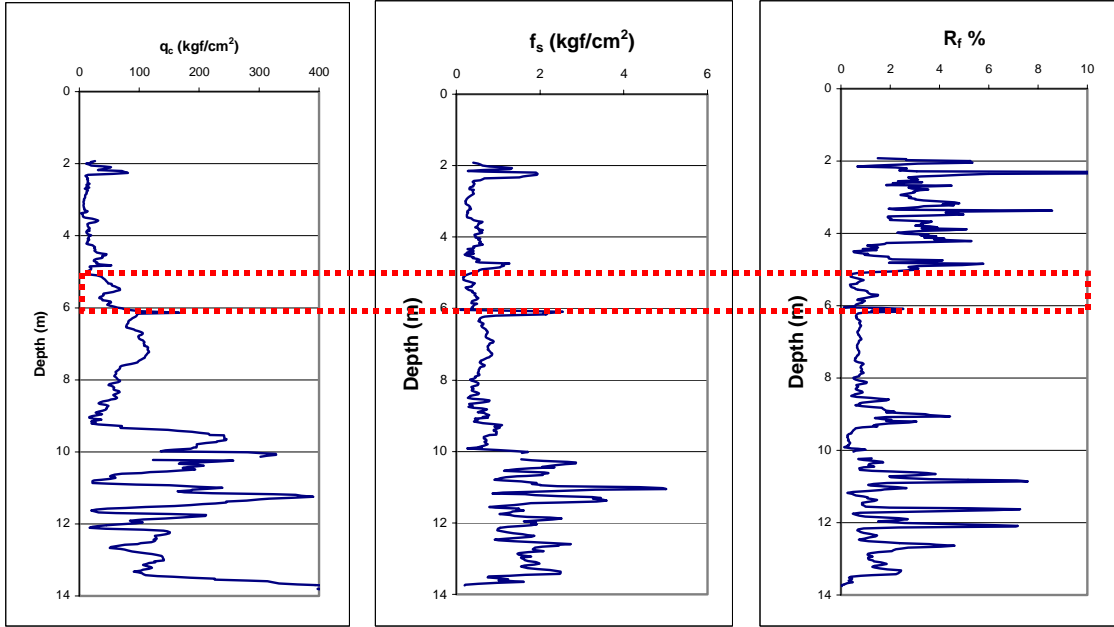
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Nisseki Kobe Oil Tank Site B, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	5.0 to 6.0	%Fines	
Median Depth (m)	5.50	%PI	
st.dev.	0.17		
Depth to GWT (m)	2.40		
st.dev.	0.30		
σ_v (kPa)	100.05	q_c (MPa)	4.85
st.dev.	4.20	st.dev.	1.04
σ_v' (kPa)	69.64	f_s (kPa)	35.84
st.dev.	3.42	st.dev.	10.41
a_{max} (g)	0.60	norm. exp.	0.70
st.dev.	0.18	C_q, C_f	1.29
r_d	0.78	C_{thin}	1.00
st.dev.	0.10	f_{s1} (kPa)	46.18
M_w	7.20	st.dev.	13.41
st.dev.	0.11	q_{c1} (MPa)	6.25
CSR_{eq}	0.43	st.dev.	1.34
st.dev.	0.14	R_{f1} (%)	0.74
C.O.V. _{-CSR}	0.33	stdev	0.27

1995 Hyogoken-Nambu (Kobe), Japan
NKO-3



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: New Port No. 6 Pier
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

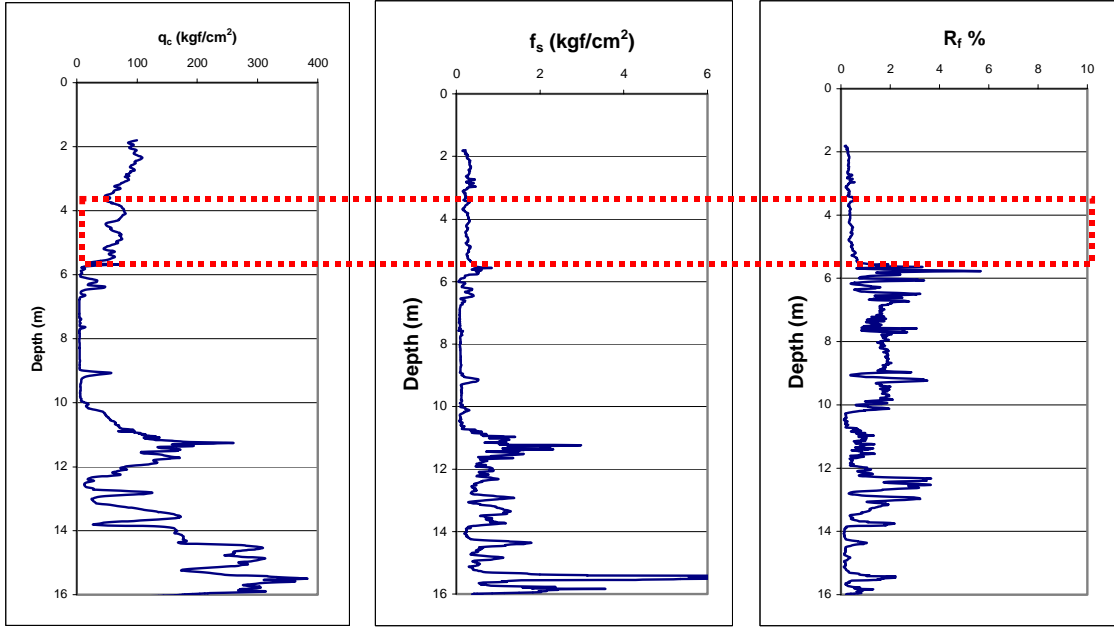
estimated $a_{max}=0.4-0.5$ from contour map

v. close to Cetin (2000) SPT 17
crit. Depth correlates to SPT

Summary of Data:

Stress		Strength	
Liquefied	Y		
Data Class	B	Soil Class	
Critical Layer (m)	3.5 to 5.5	$D_{50(mm)}$	
Median Depth (m)	4.00	%Fines	
st.dev.	0.33	%PI	
Depth to GWT (m)	2.50		
st.dev.	0.30		
σ_v (kPa)	70.50	q_c (MPa)	6.29
st.dev.	6.82	st.dev.	1.06
σ_v' (kPa)	55.79	f_s (kPa)	27.13
st.dev.	3.55	st.dev.	5.03
a_{max} (g)	0.60	norm. exp.	0.70
st.dev.	0.18	C_q, C_f	1.50
r_d	0.85	C_{thin}	1.00
st.dev.	0.08	f_{s1} (kPa)	40.81
M_w	7.20	st.dev.	7.57
st.dev.	0.11	q_{c1} (MPa)	9.47
CSR_{eq}	0.42	st.dev.	1.60
st.dev.	0.14	R_{f1} (%)	0.43
C.O.V.-CSR	0.33	stdev	0.11

1995 Hyogoken-Nambu (Kobe), Japan
NPP-1



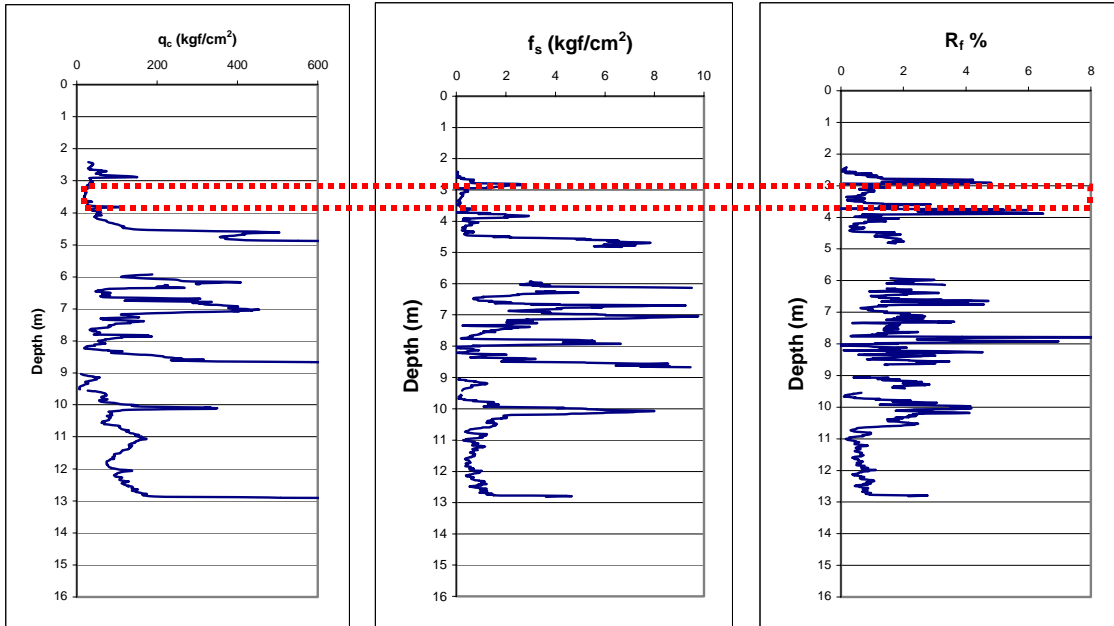
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: New Wharf Construction Offices
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

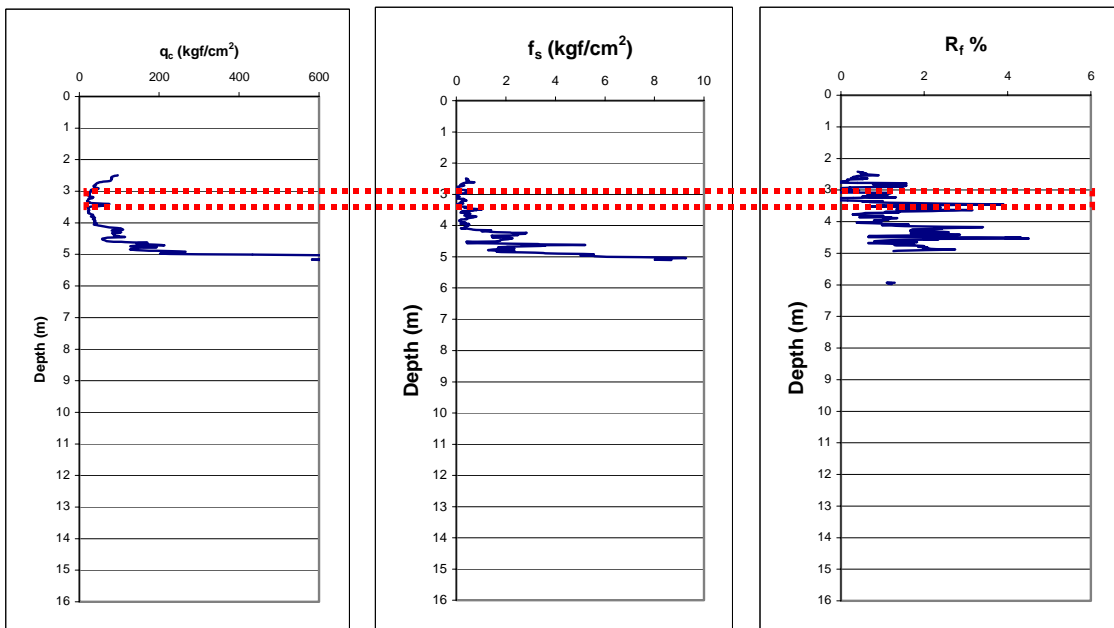
Summary of Data:

Stress		Strength	
Liquefied	Y		
Data Class	B	Soil Class	
Critical Layer (m)	3.2 to 3.8	$D_{50(mm)}$	
Median Depth (m)	3.50	%Fines	
st.dev.	0.10	%PI	
Depth to GWT (m)	2.60		
st.dev.	0.30		
σ_v (kPa)	60.45	q_c (MPa)	2.33
st.dev.	2.78	st.dev.	0.53
σ_v' (kPa)	51.62	f_s (kPa)	21.81
st.dev.	2.78	st.dev.	14.10
a_{max} (g)	0.45	norm. exp.	0.64
st.dev.	0.14	C_q, C_f	1.53
r_d	0.89	C_{thin}	1.00
st.dev.	0.07	f_{s1} (kPa)	33.31
M_w	7.20	st.dev.	21.52
st.dev.	0.11	q_{c1} (MPa)	3.56
CSR_{eq}	0.31	st.dev.	0.81
st.dev.	0.10	R_{f1} (%)	0.93
C.O.V. _{-CSR}	0.32	stdev	0.64

1995 Hyogoken-Nambu (Kobe), Japan
NWC-1



NWC-2



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Sankyu Delivery Center
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments: Omitted from Subsequent Liquefaction
 Triggering Analysis (Moss, 2003)

Summary of Data:

Stress

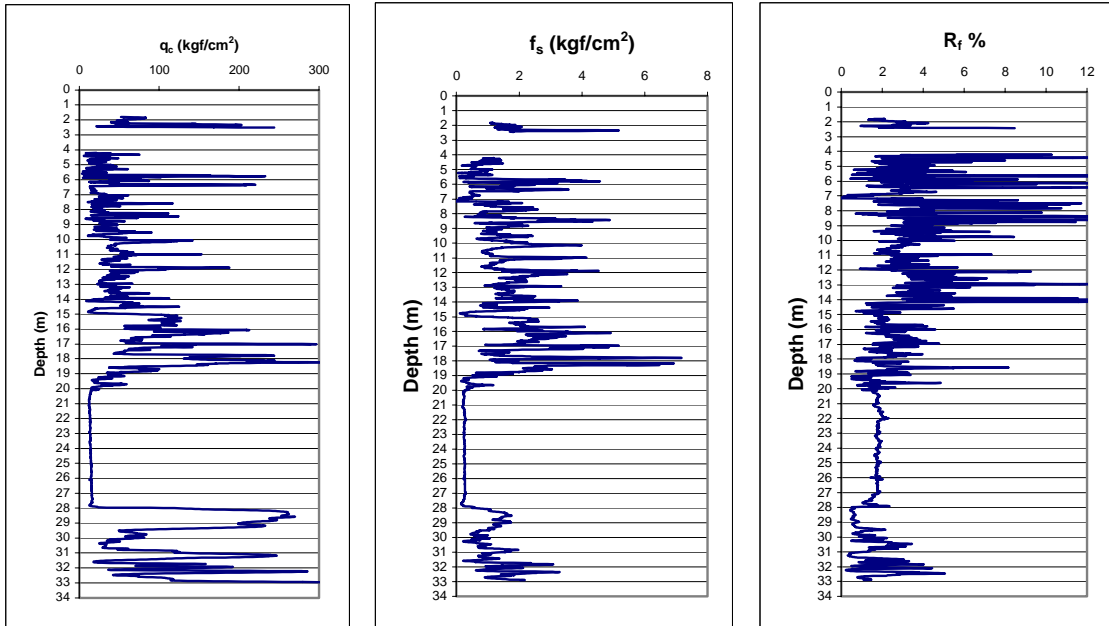
Liquefied
 Data Class
 Critical Layer (m)
 Median Depth (m)
 st.dev.
 Depth to GWT (m)
 st.dev.
 σ_v (kPa)
 st.dev.
 σ_v' (kPa)
 st.dev.
 a_{max} (g)
 st.dev.
 r_d
 st.dev.
 M_w
 st.dev.
 CSR_{eq}
 st.dev.
 $C.O.V._{CSR}$

Strength

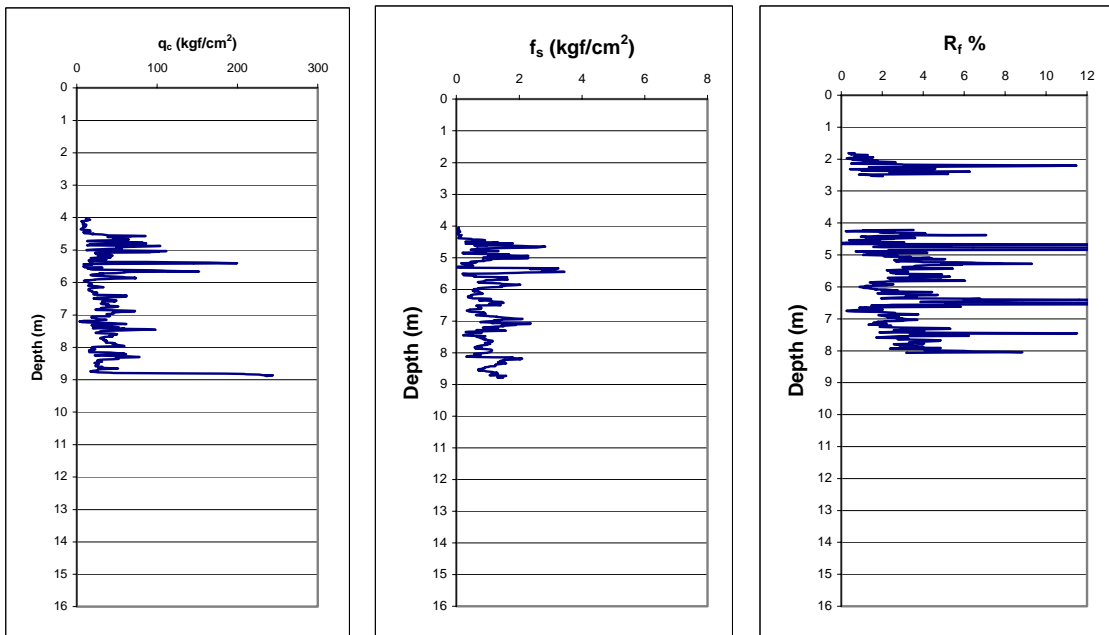
Soil Class
 $D_{50(mm)}$
 %Fines
 %PI

 q_c (MPa)
 st.dev.
 f_s (kPa)
 st.dev.
 norm. exp.
 C_q, C_f
 C_{thin}
 f_{s1} (kPa)
 st.dev.
 q_{c1} (MPa)
 st.dev.
 $R_{f1}(\%)$
 stdev

1995 Hyogoken-Nambu (Kobe), Japan
SDC-1



SDC-2



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Sumiyoshi Elementary School
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

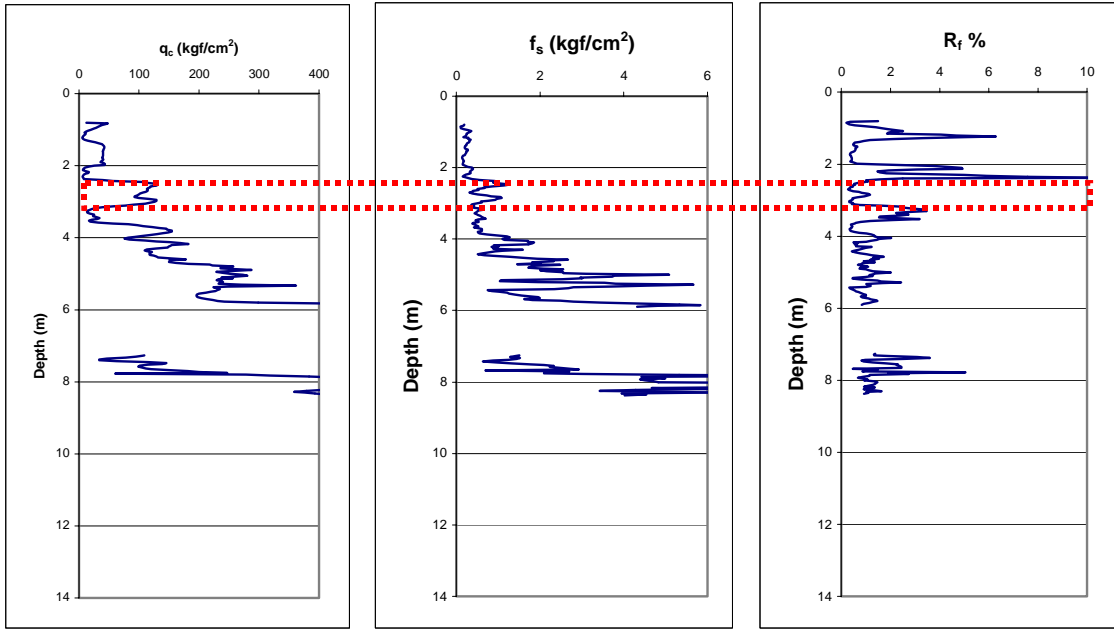
estimated $a_{max}=0.5-0.7$ from contour map

nearest Cetin (2000) SPT 31 & 28
crit. Depth correlates with SPT 31

Summary of Data:

Stress		Strength	
Liquefied	N	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	2.4 to 3.2	%Fines	
Median Depth (m)	2.80	%PI	
st.dev.	0.13		
Depth to GWT (m)	1.90		
st.dev.	0.30		
σ_v (kPa)	46.92	q_c (MPa)	10.30
st.dev.	2.68	st.dev.	2.50
σ_v' (kPa)	38.09	f_s (kPa)	67.98
st.dev.	3.15	st.dev.	27.76
a_{max} (g)	0.60	norm. exp.	0.54
st.dev.	0.18	C_q, C_f	1.68
r_d	0.91	C_{thin}	1.00
st.dev.	0.06	f_{s1} (kPa)	114.48
M_w	7.20	st.dev.	46.75
st.dev.	0.11	q_{c1} (MPa)	17.35
CSR_{eq}	0.43	st.dev.	4.20
st.dev.	0.14	$R_{f1}(\%)$	0.66
C.O.V. _{-CSR}	0.32	stdev	0.31

1995 Hyogoken-Nambu (Kobe), Japan
SES-1



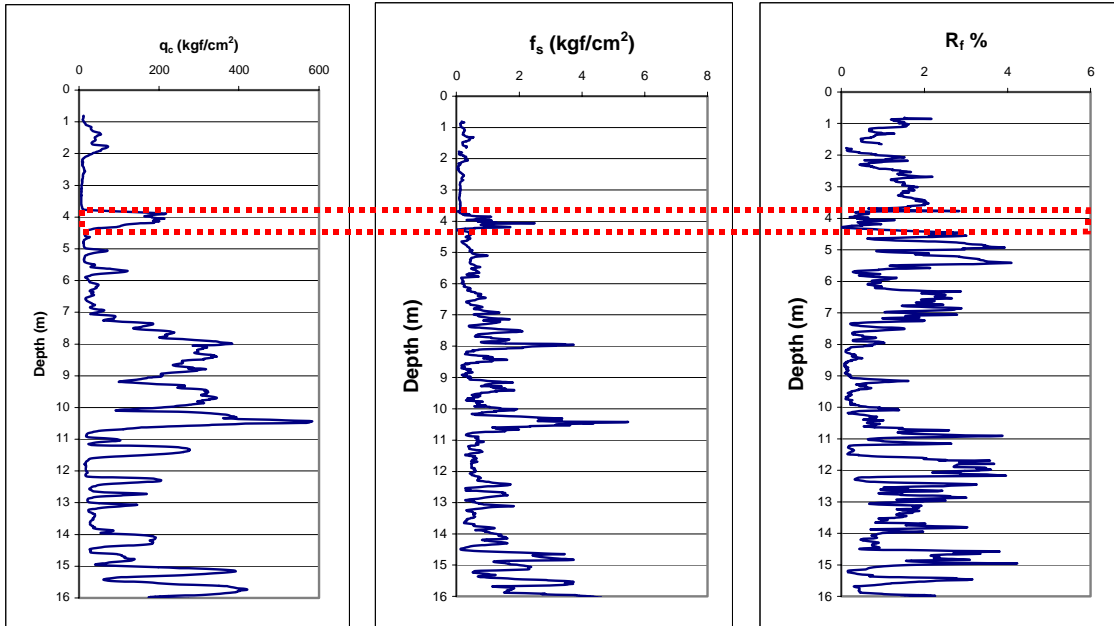
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Shimonakajima Park
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

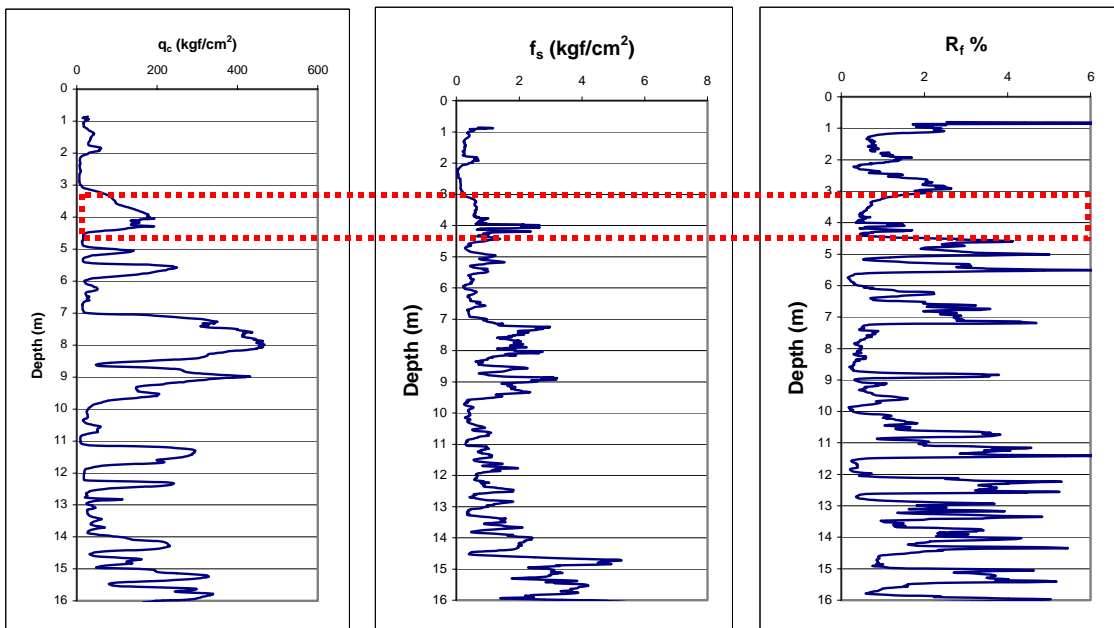
Summary of Data:

Stress		Strength	
Liquefied	N	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	3.0 to 4.5	%Fines	
Median Depth (m)	3.75	%PI	
st.dev.	0.17		
Depth to GWT (m)	2.00		
st.dev.	0.30		
σ_v (kPa)	63.28	q_c (MPa)	12.93
st.dev.	3.36	st.dev.	0.53
σ_v' (kPa)	46.11	f_s (kPa)	94.75
st.dev.	3.38	st.dev.	55.98
a_{max} (g)	0.65	norm. exp.	0.53
st.dev.	0.20	C_q, C_f	1.51
r_d	0.86	C_{thin}	1.00
st.dev.	0.07	f_{s1} (kPa)	142.82
M_w	7.20	st.dev.	84.38
st.dev.	0.11	q_{c1} (MPa)	19.49
CSR_{eq}	0.50	st.dev.	0.80
st.dev.	0.16	R_{f1} (%)	0.73
C.O.V. _{-CSR}	0.32	stdev	0.43

1995 Hyogoken-Nambu (Kobe), Japan
SHP-1



SHP-2



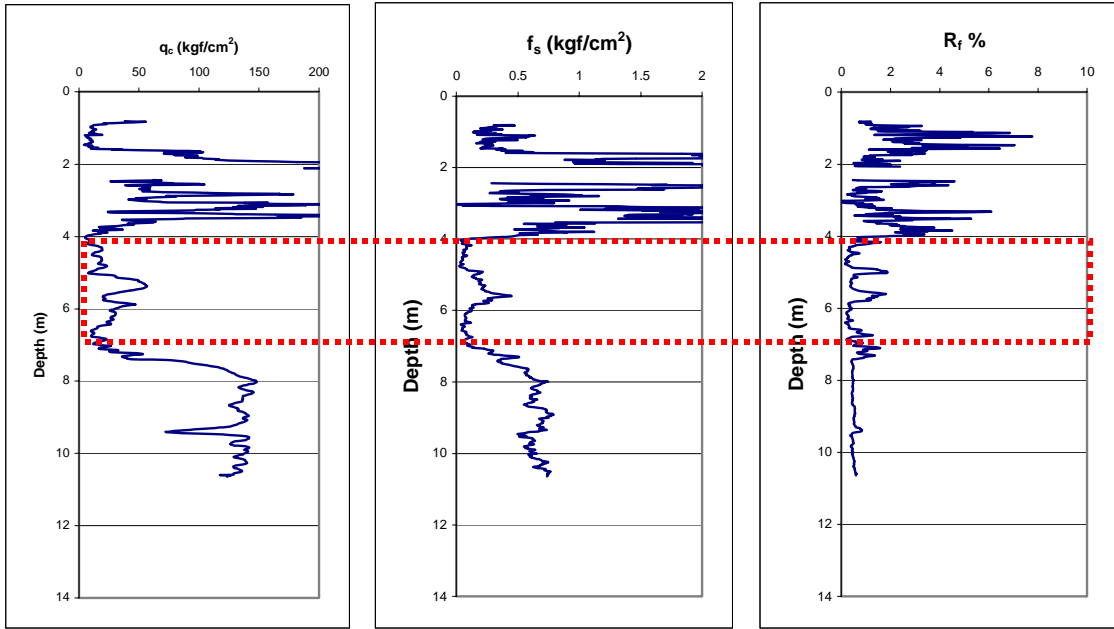
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Shiporex Kogyo Osaka Factory, Amagasaki City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

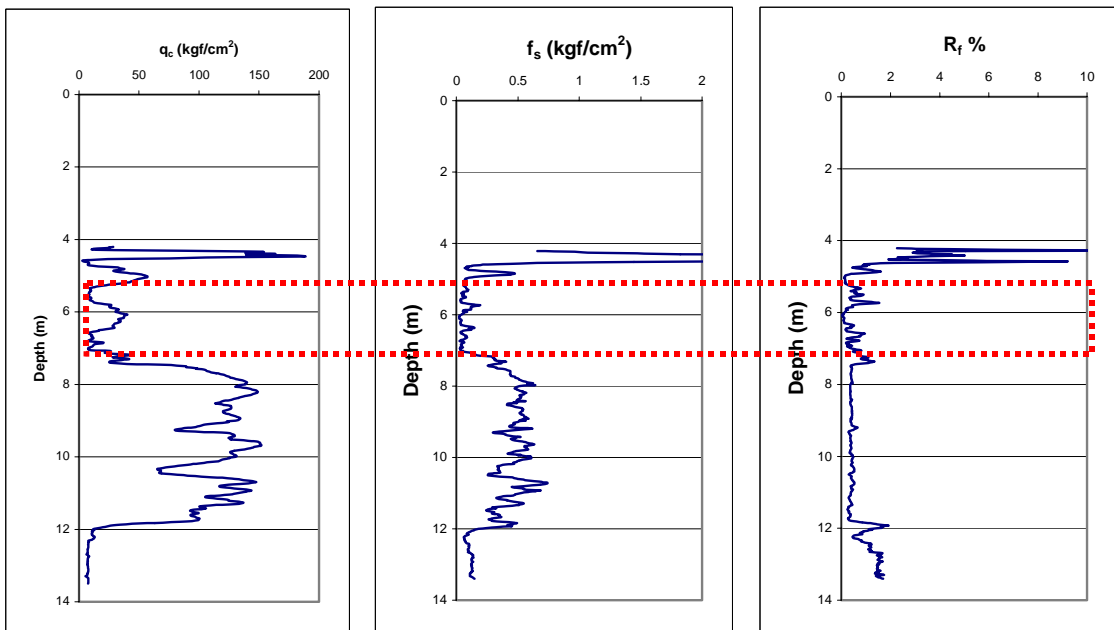
Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	4.0 to 7.0	%Fines	
Median Depth (m)	5.50	%PI	
st.dev.	0.33		
Depth to GWT (m)	1.50		
st.dev.	0.30		
σ_v (kPa)	93.95	q_c (MPa)	2.51
st.dev.	6.39	st.dev.	1.39
σ_v' (kPa)	54.71	f_s (kPa)	10.42
st.dev.	4.44	st.dev.	1.91
a_{max} (g)	0.40	norm. exp.	0.74
st.dev.	0.12	C_q, C_f	1.56
r_d	0.82	C_{thin}	1.00
st.dev.	0.10	f_{s1} (kPa)	16.28
M_w	7.20	st.dev.	2.99
st.dev.	0.11	q_{c1} (MPa)	3.93
CSR_{eq}	0.37	st.dev.	2.18
st.dev.	0.12	R_{f1} (%)	0.41
C.O.V.-CSR	0.34	stdev	0.24

1995 Hyogoken-Nambu (Kobe), Japan
SKF-1



SKF-2



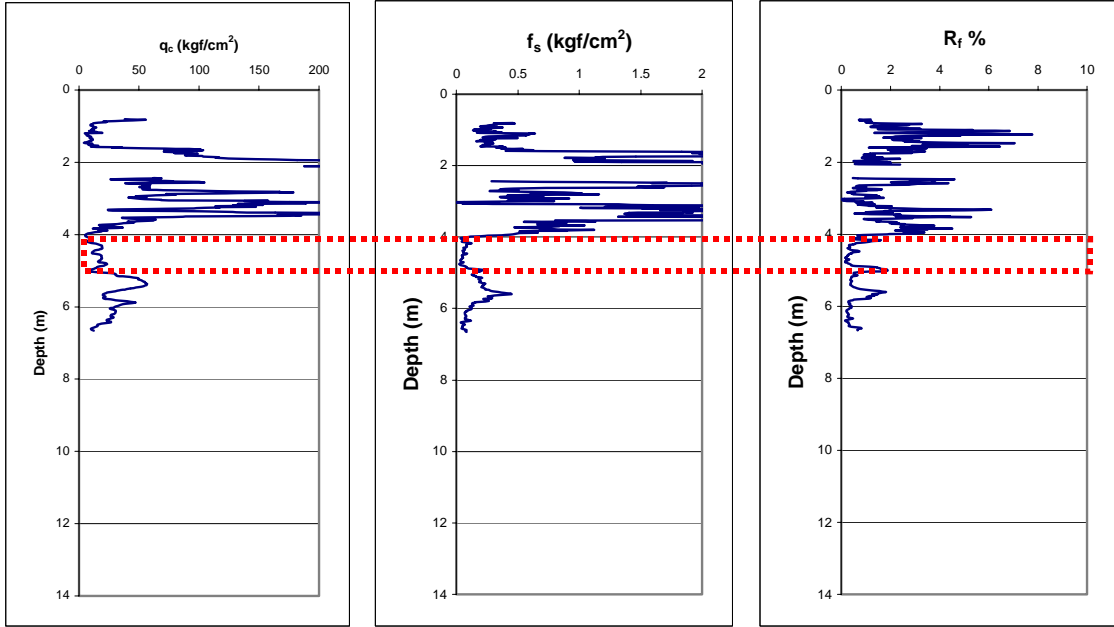
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Tokuyama Concrete Factory
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	4.0 to 4.8	%Fines	
Median Depth (m)	4.40	%PI	
st.dev.	0.13		
Depth to GWT (m)	2.00		
st.dev.	0.30		
σ_v (kPa)	74.52	q_c (MPa)	1.49
st.dev.	3.06	st.dev.	0.51
σ_v' (kPa)	50.98	f_s (kPa)	5.91
st.dev.	3.48	st.dev.	2.02
a_{max} (g)	0.50	norm. exp.	0.80
st.dev.	0.15	C_q, C_f	1.71
r_d	0.85	C_{thin}	1.00
st.dev.	0.08	f_{s1} (kPa)	10.13
M_w	7.20	st.dev.	3.46
st.dev.	0.11	q_{c1} (MPa)	2.55
CSR_{eq}	0.40	st.dev.	0.88
st.dev.	0.13	R_{f1} (%)	0.40
C.O.V. _{-CSR}	0.32	stdev	0.19

1995 Hyogoken-Nambu (Kobe), Japan
TCF-1



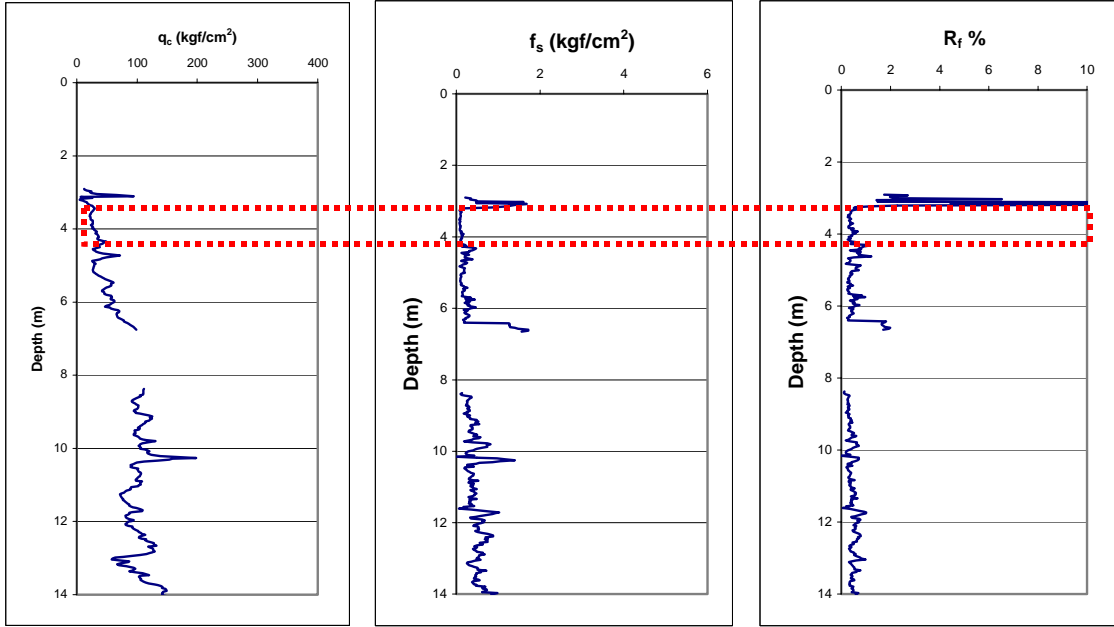
Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Taito Kobe Factory, Kobe City
References: Tokimatsu & Suzuki (2002)
Nature of Failure: Liquefaction

Comments:

Summary of Data:

Stress		Strength	
Liquefied	Y	Soil Class	
Data Class	B	$D_{50(mm)}$	
Critical Layer (m)	3.2 to 4.2	%Fines	
Median Depth (m)	3.70	%PI	
st.dev.	0.17		
Depth to GWT (m)	1.60		
st.dev.	0.30		
σ_v (kPa)	62.73	q_c (MPa)	2.53
st.dev.	3.35	st.dev.	0.45
σ_v' (kPa)	42.13	f_s (kPa)	9.98
st.dev.	3.38	st.dev.	2.49
a_{max} (g)	0.45	norm. exp.	0.75
st.dev.	0.14	C_q, C_f	1.91
r_d	0.89	C_{thin}	1.00
st.dev.	0.07	f_{s1} (kPa)	19.08
M_w	7.20	st.dev.	4.77
st.dev.	0.11	q_{c1} (MPa)	4.85
CSR_{eq}	0.39	st.dev.	0.86
st.dev.	0.13	R_{f1} (%)	0.39
C.O.V.-CSR	0.32	stdev	0.12

1995 Hyogoken-Nambu (Kobe), Japan
TKF-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Unchuu Elementary School
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments: Omitted from Subsequent Liquefaction
 Triggering Analysis (Moss, 2003)

Summary of Data:

Stress

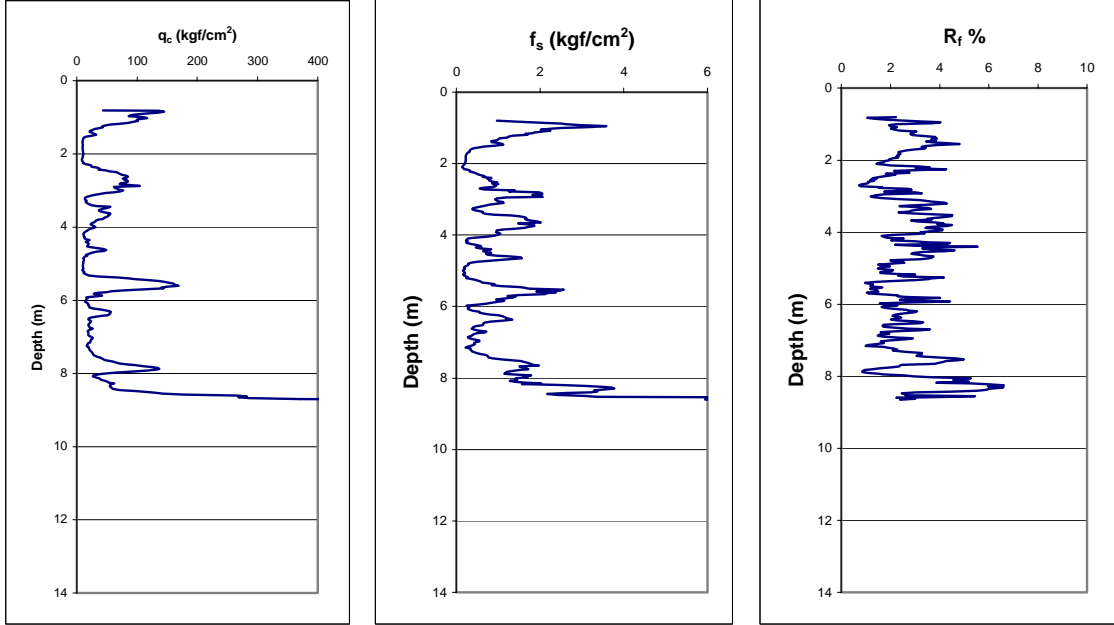
Liquefied
 Data Class
 Critical Layer (m)
 Median Depth (m)
 st.dev.
 Depth to GWT (m)
 st.dev.
 σ_v (kPa)
 st.dev.
 σ_v' (kPa)
 st.dev.
 a_{max} (g)
 st.dev.
 r_d
 st.dev.
 M_w
 st.dev.
 CSR_{eq}
 st.dev.
 $C.O.V._{CSR}$

Strength

Soil Class
 $D_{50(mm)}$
 %Fines
 %PI

 q_c (MPa)
 st.dev.
 f_s (kPa)
 st.dev.
 norm. exp.
 C_q, C_f
 C_{thin}
 f_{s1} (kPa)
 st.dev.
 q_{c1} (MPa)
 st.dev.
 $R_{f1}(\%)$
 stdev

1995 Hyogoken-Nambu (Kobe), Japan
UES-1



Earthquake: 1995 Hyogoken-Nambu (Kobe), Japan
Magnitude: $M_w=7.2$
Location: Yoshida Kogyo Factory
References: Tokimatsu & Suzuki (2002)
Nature of Failure: No Liquefaction

Comments:

Summary of Data:

Stress

Liquefied	N
Data Class	B
Critical Layer (m)	3 to 5
Median Depth (m)	4.00
st.dev.	0.33
Depth to GWT (m)	3.00
st.dev.	0.30
σ_v (kPa)	69.00
st.dev.	6.87
σ_v' (kPa)	59.19
st.dev.	3.64
a_{max} (g)	0.50
st.dev.	0.15
r_d	0.87
st.dev.	0.08
M_w	7.20
st.dev.	0.11
CSR_{eq}	0.33
st.dev.	0.11
C.O.V.-CSR	0.33

Strength

Soil Class

$D_{50(mm)}$	
%Fines	
%PI	
q_c (MPa)	7.89
st.dev.	6.04
f_s (kPa)	214.05
st.dev.	139.15
norm. exp.	0.34
C_q, C_f	1.20
C_{thin}	1.00
f_{s1} (kPa)	255.83
st.dev.	166.32
q_{c1} (MPa)	9.43
st.dev.	7.22
R_{f1} (%)	2.71
stdev	2.73

1995 Hyogoken-Nambu (Kobe), Japan
YKF-1

