

# EXHIBIT 19

DATA BOOK FOR CIVIL ENGINEERS

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# DESIGN

THIRD EDITION

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With special acknowledgment to  
MORTON C. SIMMONS

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JOHN WILEY AND SONS, Inc.

New York · Chichester · Brisbane · Toronto · Singapore

# SOILS - FACTUAL DATA

TABLE A - SLOPES OF REPOSE

KIND OF EARTH	SLOPE OF REPOSE	
	NON-SUBMERGED	SUBMERGED
Sand, clean	1 on 1.5	1 on 2
Sand and clay	1 on 1.33	1 on 3
Clay, dry	1 on 1.75	
Clay		1 on 3.5
Clay, damp plastic	1 on 3	
Gravel, Clean	1 on 1.33	1 on 2
Gravel and clay	1 on 1.33	1 on 3
* Gravel, sand, and clay	1 on 1.5	1 on 3
Soft, rotten rock	1 on 1	1 on 1
Hard, rotten rock	1 on 1	
Hard rock, riprap		1 on 1
Bituminous cinders	1 on 1	
* River mud		1 on 3 to 1 on 20
Anthracite Ashes	1 on 1.5 to 1 on 2	
Rule of thumb for submerged excavated slopes:		
Sand -	1 on 2	Clay - 1 on 1.5 to vertical
Stiff mud -	1 on 1 to vertical	Sluiced Mud - 1 on 10 to 1 on 20

TABLE D - SOIL SHEAR VALUES

KIND OF EARTH	COHESION, %	ANG. OF INT. FR.
Clay - liquid†	100	0°
- very soft	200	2°
- soft	400-500	4°
- Firm	1000	6°
- stiff	2000	12°
- very stiff	2000-4000	14°
Sand wet	0	10°-15°
Sand dry or unmoved	0	34°
Silt	0	20°
Cemented Sand & Gravel - Wet	500	34°
- Dry	1000	34°

TABLE G - WEIGHT OF SOLIDS SUBMERGED IN SEA WATER

MATERIAL	POUND PER CUBIC FOOT		
	MAXIMUM	MINIMUM	AVERAGE
Gravel and Marl		42.0	62.9
Gravel and Sand	73.0	42.0	62.4
Sand	66.0	42.0	58.3
Gravel, Sand and Clay	80.9	51.2	70.0
Stiff Clay	64.8	38.4	47.8
Stiff Clay and Gravel	70.3	44.8	52.6

\* C.B.R. = California Bearing Ratio.

† For Classification see page 9-30 (N.Y.C. Code)

TABLE B - UNIT WEIGHT OF SOILS

KIND OF EARTH	UNIT WEIGHTS - lb./cu. ft.
Moist Soils	110
Medium or stiff clay	120
Saturated earth	110 + % voids × 62.5 = say 132
Submerged earth	132 - 62.5 = say 70
Soft clay or mud	100

TABLE C - UNIT WEIGHTS AND C.B.R. VALUES FOR COMPACTED SOILS

SOLIDS AT OPTIMUM COMPACTION	WELL GRADED		NOT GRADED	
	UNIT WT.	C.B.R.*	UNIT WT.	C.B.R.
Sand and Silt	120	-	105	3-30
Sand and Clay (Binder)	125	20-60	105	3-30
Sands	120	20-60	100	10-30
Gravel	130	>50	115	25-60
Silts inorganic	-	-	100	6-25
Organic Silts	-	-	90	3-8

TABLE E - ROUGH DATA FOR EQUIVALENT FLUID PRESSURES OF SOILS

MULTIPLY UNIT WEIGHT BY "K"	
KIND OF EARTH	"K"
Granular Sand	0.33
Mixtures of Clay and Granular Soils	0.50
Soft Clays, Silts, Organic Soils	1.00
Stiff Clays	1.00

TABLE F - EQUIVALENT FLUID PRESSURES FOR SOILS SUBMERGED IN SEA WATER\*\*

SLOPE OF REPOSE OF EARTH	WEIGHT W' OF SUBMERGED EARTH LB./CU. FT.							
	40	44	48	52	56	60	64	68
1 on 1/2	662	664	667	669	671	673	676	677
1 on 3/4	682	689	693	698	702	707	711	714
1 on 1	709	716	722	729	736	743	750	754
1 on 1 1/4	732	742	751	760	769	779	788	794
1 on 1 1/2	754	766	777	789	800	812	823	831
1 on 1 3/4	775	788	802	815	829	842	856	868
1 on 2	793	808	823	839	854	869	884	901
1 on 2 1/4	823	842	860	878	897	915	933	951
1 on 3	848	869	889	910	931	952	972	994
1 on 3 1/2	868	890	913	936	959	982	1000	1021
1 on 4	884	908	933	957	981	1010	1030	1051
1 on 5	909	936	963	990	1020	1040	1070	1091
1 on 6	1040	1080	1120	1160	1200	1240	1280	1320

To obtain equivalent fluid pressure for a given slope of repose, say 1 1/4:1, get the weight of the submerged soil from table G, say 60, enter table F of column marked nearest to this value. Obtain equivalent weight, 84.2 from row of given slope of repose.