

TABLE 1804.2 UNIFIED SOIL CLASSIFICATION
(Including Identification and Description)

MAJOR DIVISIONS		GROUP SYMBOLS	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 IN. AND BASING FRACTIONS ON ESTIMATED WEIGHTS)			INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA		
1	2	3	4	5			6	7		
SANDS More than half of coarse fraction is smaller than No. 200 sieve size. The No. 200 sieve size is about the smallest visible to the naked eye.	Gravels More than half of coarse fraction is larger than No. 4 sieve size. (For visual classification, the 1/2-in. size may be used as equivalent to the No. 4 sieve size.)	GW	Well-graded gravels, gravel-sand mixture, little or no fines.	Wide range in grain size and substantial amounts of all intermediate particle sizes.			For undisturbed soils add information on stratification, degree of compactness, cementation, moisture condition, and drainage characteristics.	Determine percentage of gravel and sand from grain-size curve. Depending on percentage of fine (fraction smaller than No. 200 sieve size) coarse-grained soils are classified as follows: GW, GP, SW, SP, GM, GC, SM, SC. Borderline cases requiring use of dual symbols.	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
		GP	Poorly graded gravels or gravel-sand mixture, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.					Not meeting all gradation requirements for GW	
		GM	Silty gravels, gravel and silt mixtures.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).			Give typical name; indicate approximate percentages of sand and gravel, maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.		Atterberg limits below "A" line or P ₁ less than 4	Above "A" line with P ₁ between 4 and 7 are borderline cases requiring use of dual symbols.
		GC	Clayey gravels, gravel and clay mixtures.	Plastic fines (for identification procedures see CL below).					Atterberg limits above "A" line with P ₁ greater than 7	
		SW	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain size and substantial amounts of all intermediate particle sizes.			Example: Silty sand, gravelly; about 20% hard, angular gravel particles 1/2-in. maximum size; rounded and subangular sand grains, coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
		SP	Poorly graded sands or gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.					Not meeting all gradation requirements for SW	
	Sands with Fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).			Example: Silty sand, gravelly; about 20% hard, angular gravel particles 1/2-in. maximum size; rounded and subangular sand grains, coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).	Atterberg limits above "A" line or P ₁ less than 4	Limits plotting in hatched zone with P ₁ between 4 and 7 are borderline cases requiring use of dual symbols.	
		SC	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).				Atterberg limits above "A" line with P ₁ greater than 7		
					Identification Procedure on Fraction Smaller than No. 40 Sieve Size.					
					Dry Strength (Crushing Characteristics)	Dilatancy (Reaction to shaking)		Toughness (Consistency near PL)		
SILTS AND CLAYS Liquid limit is less than 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions	Use grain size curve in identifying the fractions as given under field identification.	LIQUID LIMIT PLASTICITY CHART For laboratory classification of fine-grained soils		
									CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	OL	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight					
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to medium					
	CH	Inorganic clays of high plasticity, fat clays.	High to very high	None	High					
	OH	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium					
	Highly Organic Soils		Pt	Peat and other highly organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture				Example: Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)	

Boundary classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GM-GC, well-graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. standard.
Adopted by Corps of Engineers and Bureau of Reclamation, January 1952.

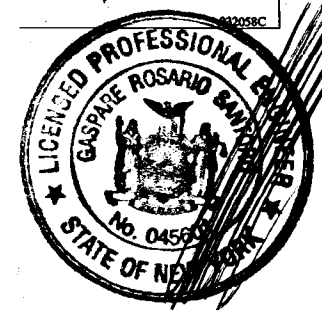
TABLE 1804.1
ALLOWABLE BEARING PRESSURES

CLASS OF MATERIALS (Notes 1 and 3)	MAXIMUM ALLOWABLE FOUNDATION PRESSURE (TSF)	MAXIMUM ALLOWABLE FOUNDATION PRESSURE (kPa)
1. Bedrock (Notes 2 and 7) 1a Hard sound rock—gneiss, diabase, schist 1b Medium hard rock—marble, serpentine 1c Intermediate rock—shale, sandstone 1d Soft rock—weathered rock	60 40 20 8	5,746 3,830 1,915 766
2. Sandy gravel and gravel (GW, GP) (Notes 3, 4, 8, and 9) 2a Dense 2b Medium	10 6	958 575
3. Granular soils (GC, GM, SW, SP, SM, and SC) (Notes 4, 5, 8, and 9) 3a Dense 3b Medium	6 3	575 287
4. Clays (SC, CL, and CH) (Notes 4, 6, 8, and 9) 4a Hard 4b Stiff 4c Medium	5 3 2	479 287 192
5. Silts and silty soils (ML and MH) (Notes 4, 8, and 9) 5a Dense 5b Medium	3 1.5	287 144
6. Organic silts, organic clays, peats, soft clays, loose granular soils and varved silts	See 1804.2.1	See 1804.2.1
7. Controlled and uncontrolled fills	See 1804.2.2 or 1804.2.3	See 1804.2.2 or 1804.2.3

- Notes:
- Where there is doubt as to the applicable classification of a soil stratum, the allowable bearing pressure applicable to the lower class of material to which the given stratum might conform shall apply.
 - The tabulated values of allowable bearing pressures apply only for massive rocks or for sedimentary or foliated rocks, where the strata are level or nearly so, and then only if the area has ample lateral support. Tilted strata and their relation to nearby slopes or excavations shall receive special consideration. The tabulated values for Class 1a materials (hard sound rock) may be increased by 25 percent provided the geotechnical engineer performs additional tests and/or analyses substantiating the increase.
 - For intermediate conditions, values of allowable bearing pressure shall be estimated by interpolation between indicated extremes.
 - Footings embedded in soils shall be in accordance with Section 1805.2 and the width of the loaded area not less than 2 feet (610 mm), unless analysis demonstrates that the proposed construction will have a minimum factor of safety of 2.0 against shear failure of the soil.
 - Estimates of settlements shall govern the allowable bearing value, subject to the maximums given in this table, and as provided in Section 1804.2.
 - The bearing capacity of clay soils shall be established on the basis of the strength of such soils as determined by field or laboratory tests and shall provide a factor of safety against failure of the soil of not less than 2.0 computed on the basis of a recognized procedure of soils analysis, shall account for probable settlements of the building and shall not exceed the tabulated maximum values.
 - Increases in allowable bearing pressure due to embedment of the foundation. The allowable bearing values for intermediate to hard rock shall apply where the loaded area is on the surface of sound rock. Where the loaded area is below the adjacent rock surface and is fully confined by the adjacent rock mass and provided that the rock mass has not been shattered by blasting or otherwise is, these values may be increased 5 percent of the base value for each 1-foot (305 mm) additional embedment, but shall not exceed twice the values. Increases in allowable bearing pressure due to embedment shall not apply to soft rock, clays, silts and soils of Classes 6 and 7.
 - The allowable bearing values for soils of Classes 2, 3, 4, and 5 determined in accordance with Notes three, four and five above, shall apply where the loaded area is embedded 4 feet (1219 mm) or less in the bearing stratum. Where the loaded area is embedded more than 4 feet (1219 mm) below the adjacent surface of the bearing stratum, and is fully confined by the weight of the adjacent soil, these values may be increased 5 percent of the base value for each 1-foot (305 mm) additional embedment, but shall not exceed twice the values. Increases in allowable bearing pressure due to embedment shall not apply to soft rock, clays, silts and soils of Classes 6 and 7.
 - The allowable bearing values for soils of Classes 2, 3, 4, and 5 determined in accordance with this table and the notes thereto, may be increased up to one-third where the density of the bearing stratum below the bottom of the footings increases with depth and is not underlain by materials of a lower allowable bearing pressure. Such allowable bearing values shall be demonstrated by a recognized means of analysis that the probable settlement of the foundation due to compression, and/or consolidation does not exceed acceptable limits for the proposed building.
 - The maximum toe pressure for eccentrically loaded footings may exceed the allowable bearing value by up to 25 percent if it is demonstrated that the heel of the footing is not subjected to tension.

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DRAWING # 4 OF 4