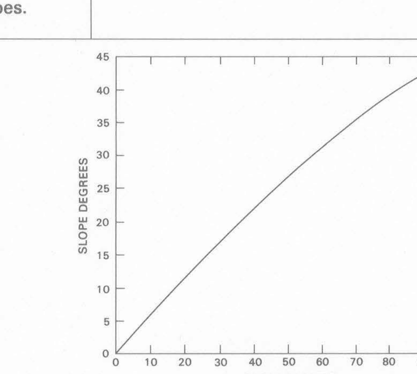
Surface materials unit and symbol (pl. 1)	Description of material	Unified Soil Classification[1]	Total unit weight (kgf/m^3)	Drainage and natural-moisture characteristics		Suitability as compacted material	Excavation properties	Susceptibility to erosion	Shear strength and compressibility characteristics	Allowable bearing pressure (kgf/cm^2)	Slope stability	Road-performance characteristics
				Surface drainage	Internal drainage and natural moisture							
Artificial fill f	Includes large graded areas of engineered highway and railroad fills, trash fills, gravel pits, and areas of major earthworks, such as airfields and dams. Highway and railroad fills are locally derived heterogeneous mixtures of soil and rock moved a short distance from borrow pits and cut sections, and compacted. Trash fills include household refuse, tree stumps, bed springs, and so forth, commonly mixed with earth materials and not compacted; at places, fills are as thick as 10 m. Gravel pits generally have heterogeneous mixtures of uncompacted soil, at places mixed with trash. In urban areas, fills of variable composition and thickness overlie natural materials at many places.	Variable.	Engineered earth fills, 1,450–1,900. Sedimentation ponds, 1,300–1,600. Gravel pits, 1,300–2,100. Uncontrolled trash fills, 800–2,400.	Engineered fills generally well drained. Trash fills and gravel pits commonly poorly drained.	Permeability commonly low to very low in engineered fills, and commonly low in trash fills, gravel pits, and sedimentation ponds. Fine-grained soils in engineered fills generally have natural moisture content near plastic limit. Fine-grained soils in gravel pits and trash fills have highly variable natural-moisture contents, but commonly very wet. Sedimentation ponds commonly extremely wet.	Engineered fills commonly suitable. Natural materials in gravel pits commonly suitable, but trash and wet fill not suitable. Trash fills and sedimentation-pond materials unsuitable because of stumps, boulders, bed springs, and so forth.	Engineered fills commonly can be excavated with light power equipment. In gravel pits and sedimentation ponds, wet soils can make excavation difficult. Trash fills containing stumps, boulders, bed springs, and so forth, are difficult to excavate with light power equipment.	Engineered fills made of silty materials derived from residuum and saprolite commonly highly erodible; engineered fills of Coastal Plain deposits generally contain sufficient clay to prevent serious erosion. Gravel pits and trash fills commonly highly erodible.	Engineered fills typically have stiff or stronger fine-grained soils and compact coarse-grained soils. Sedimentation ponds commonly have very soft soils with extremely high compressibility characteristics. Gravel pits contain highly variable fill material near surface, but natural soils are typically strong and have low compressibility. Trash fills commonly have highly compressible materials such as bed springs, tree limbs, cans, and so forth.	Engineered fills, 2 and higher. Trash fills and sedimentation ponds, none commonly, therefore requiring excavation and recompaction or removal, but generally at least 1 where compacted with T–99 (American Society for Testing and Materials, 1978) specifications, and organic material removed. Gravel-pit materials, highly variable, none to 3; natural materials generally have highest values.	Temporary vertical excavations in engineered fills of clay-rich soils typically stable to 2-m depth; granular; soils stable at angles less than 30.° Long, permanent slopes typically stable at 25°, and steeper at places. Temporary vertical excavations in gravel pits and trash fills commonly unstable at depths greater than 1.3 m. Long, permanent slopes typically stable at angles of 25°, and steeper in places. Temporary vertical excavations in sediment ponds commonly unstable at depths greater than 1–1.3 m. Long permanent slopes commonly unstable at slope angles greater than 15°.	Engineered fills generally dense and have few adverse properties. Trash fills and sediment ponds commonly unsuitable as road foundations, and must be removed and replaced or recompacted. Gravel-pit materials commonly very strong and have no adverse properties when previously dumped granular soils are recompacted.
Alluvium afp	Highly variable deposits of sand, silt, clay, gravel, and boulders which have been transported and deposited by streams or rivers on valley bottoms or in lowlands. Areas of alluvium are subject to periodic flooding. Deposits are typically well to poorly graded and commonly less than 6 m thick. Commonly has layers 0.3–1 m thick which change abruptly vertically and laterally. Generally tends to become coarser with increasing depth, and has organic layers near surface in some places. Fine-grained deposits are commonly strongest near ground surface and become weaker with depth, apparently because of desiccation. Alluvium of streams draining Piedmont derived primarily from crystalline bedrock and saprolite. Fine-grained fractions commonly very micaceous. Pebbles commonly quartz. Some iron-cemented boulders found at base of alluvium. Alluvium of streams draining Triassic Lowland commonly has reddish-brown pebbles and fragments derived from surrounding sedimentary rocks, and is very sandy at base. Alluvium very clay rich and highly plastic at many sites near diabase. Alluvium in or near channels of streams in upland areas of Piedmont and Triassic Lowland is commonly dried and oxidized to some extent, and lighter colored and less rich in organic material than in lowlands. Alluvium of streams draining Coastal Plain commonly derived from sand, silt, clay, and gravel of Coastal Plain sediments and upland-gravel deposits. Pebbles typically well-rounded quartz, quartzite, and chert. Many boulders near Fall Line; further from Fall Line, in swampy areas, alluvium may contain weak organic material.	SM, SW, CL, ML, CH, OH, (SP, GM, OL, Pt)	1,750–2,100	Water commonly at ground surface in swales and lowlands because of low relief, proximity to water table, and fine-grained matrix.	Permeability highly variable laterally and vertically. Single-grain-size sand which commonly occurs in buried channels generally medium to highly permeable. Silty sand and finer grained soils generally have low permeabilities. Soils commonly very wet or saturated near surface in swales and lowlands.	Commonly too wet to be used economically. Highly organic and clay-rich deposits generally unsuitable.	Commonly difficult to excavate in swales and lowlands, because ground water is near surface and soils are weak. Some iron oxide-cemented boulders in Piedmont and Coastal Plain.	Low, because of low relief, except where active stream erosion takes place.	Very soft to stiff clay, silt; organic clay and silt commonly soft to medium. Commonly slightly overconsolidated as much as 0.2 kgf/cm^2 near surface; organic and very weak clay can undergo major long-term deformation, even under very light surcharge; possibility of settling under no additional surcharge at sites underlain by organic soils. Loose to medium compact sands. Some cemented boulders in uplands. Effective friction angle of clays about 20°; sand, 30°.	Fine-grained material, none ordinarily. Coarse-grained material, 2. Alluvium generally unsuitable for heavy structures; commonly requires piles to underlying geologic units, or displacement piles in weak sediments.	Temporary vertical slopes exceeding 1.3 m can fail. Temporary excavations to 2–m depth normally stable at 45°; steeper slopes should be braced in very weak materials. Permanent long slopes generally stable at 35°, but angle must be lower at some places.	High ground-water table throughout much of unit; organic-rich and very soft soils susceptible to densification and differential settlement, even under no embankment load.
Terrace alluvium at	Sand, gravel, silt, and clay deposited by water in abandoned river valley of ancestral Potomac River (Hybla Valley) and Mason Neck or along modern streams as terraces above present-day flood plains. In Hybla Valley and Mason Neck, commonly 15–25 m thick, but can exceed 40 m. Individual layers there 0.3–7 m thick and continue long distances along former direction of flow of ancestral Potomac River. Outside Hybla Valley and Mason Neck, maximum thickness about 5 m. In Coastal Plain, soils near ground surface are very fine grained, wet, weak, and rich in organic material in many places; peat beds as thick as 7 m in places. Outside Coastal Plain, strata typically coarser in texture and better drained.	SM, SW, CL, ML, CH, OH (OL, SP, Pt)	1,600–1,900	In Coastal Plain, water commonly at surface because of proximity to water table, low relief, and fine-grained matrix; generally well drained outside Coastal Plain.	Permeability similar to alluvium in Coastal Plain, generally higher outside Coastal Plain. Commonly very wet or nearly saturated in Hybla Valley and Mason Neck, drier outside Coastal Plain.	Commonly too wet to be used economically in Hybla Valley and Mason Neck; commonly suitable outside Coastal Plain.	Difficult in Coastal Plain, because ground water near surface and soils weak. Few problems outside Coastal Plain.	Same as "Alluvium."	Same as "Alluvium," except no cemented boulders.	Same as "Alluvium."	Same as "Alluvium."	Same as "Alluvium."
Colluvium and lag gravel clg	Colluvium is loose, heterogeneous mass of fine-grained soil, saprolite, and coarse angular rock fragments which accumulate from mass wasting, generally on hillsides or at base of hillslopes. Deposits poorly sorted and crudely stratified, containing angular quartz fragments at many places. Lag gravel similar to colluvium, but is residual accumulation of coarse fragments remaining near surface after finer material removed by erosion or chemical weathering. Commonly less than 3 m thick, but locally as much as 7 m. Although not shown on plate 1, lower parts of most upland slopes (beneath line of contraflexure along slope) in Piedmont have thin colluvium 1–1.7 m thick. This colluvium generally has very silty matrix. Colluvium in Triassic Lowland typically thinner than in Piedmont and has silty to clayey silt matrix. In Coastal Plain, colluvium is commonly sand and gravel, has plastic clay matrix, and commonly is 1.7–3 m thick. Locally, landslide deposits are associated with colluvium.	Outside Coastal Plain: ML, MH, SP Coastal Plain: SP, SM, SC, GP, GC, SP	1,300–1,900	Fairly well to well drained at upper parts of slopes in most places; seeps fairly common at toes of slopes.	Permeability commonly low outside Coastal Plain; commonly very low to low in Coastal Plain because of clay matrix. Natural moisture highly variable, but many deposits above plastic limit at toes of slopes.	Locally suitable, but variability in properties at specific sites makes control difficult; highly micaceous colluvium in Piedmont may be difficult to compact.	Generally few problems but can be very wet. Commonly easy to drain excavations by removing seepage water.	Silty deposits in Piedmont and Triassic Lowland commonly very erodible.	Soft to stiff clay and silt; normally consolidated to slightly overconsolidated in most places; soils of soft to medium consistency may be deformed greatly. Highly micaceous, silty deposits may deform significantly through time under normal foundation loadings. Effective friction angle commonly 25°–30°; may be considerably lower in clay-rich deposits of Coastal Plain.	Fine-grained material, none to 1. Coarse-grained material, 1 to 2. Generally unsuitable for heavy structures; in some places, can be excavated economically to underlying stronger units where spread footings can be used.	Temporary vertical slopes higher than 2–2.7 m occasionally fail, but normally stable. Outside Coastal Plain, material susceptible to creep to about 1–m depth or greater on slopes exceeding 15°–20°. Retaining walls highly susceptible to frost damage on all slopes, but especially on slopes exceeding about 17°.	Shallow ground-water table at many sites; outside Coastal Plain, micaceous and silty soils very susceptible to frost heaving and weakening.
Upland gravel ug	Primarily rounded to subrounded pebbles and cobbles of quartz, quartzite, and chert, and interstitial sand, silt, and clay. Moderately sorted to well sorted. As much as 15 m thick, averaging about 10 m. Typically has lenses of silt and clay commonly less than 1.7 m thick but as much as 3 m, generally not continuous for large distances laterally. Iron oxide and clay cement can form hardpan 0.7–3 m below ground surface.	SM, SC, SW, CL, ML (SP, OL, CH)	1,900–2,200	Hardpan can retain water at or near surface each spring and for many weeks after rainy season; seeps common at contact with underlying Potomac Formation sediments.	Permeability low and internal drainage generally slow above hardpan; generally much higher permeability and better drained below hardpan. Some local perched water tables, generally easily drained. Fine-grained soils commonly near plastic limit, and coarse-grained soils generally drained of free water, except in former channels. Seeping channels commonly extend into underlying Potomac Formation deposits; some of these channels have single-size coarse sand and high permeability.	Commonly makes excellent fill, readily compacted.	Generally few excavation problems, but has some iron oxide-cemented layers near contact with Potomac Formation. Usually easy to drain excavations by removing seepage water	Sand easily eroded where disturbed.	Clay and silt normally stiff to very stiff, rarely medium; typically overconsolidated 1.3 kgf/cm^2, rarely less. Coarse-grained deposits range from medium to very compact, typically compact. Effective friction angle of clay about 25°, sand 30°–38°.	Fine-grained material, commonly 1.5–2.5, can be less or as high as 3. Coarse-grained material, commonly 2–3, can be 1.5 or as high as 4. Commonly used for supporting heavy structures on spread footings. Generally good support for H piles; large boulders can inhibit driving piles.	Temporary vertical slopes higher than 1.3 m commonly require bracing where material is saturated. Long, permanent slopes generally stable at 35° but must be flatter in some places.	Generally very strong, but some gravels crush during compaction; drainage problems where hardpan retains water at surface.
Potomac Formation, predominantly sand ps	Interbedded sequence of fine to coarse, locally pebble sand, with some silt and clay layers and lenses. Sand and gravelly sand beds much more abundant than clay and silt-clay beds. Sand and gravel beds commonly many meters thick but can range from less than 0.3 m to more than 50 m. Clay and silt-clay beds generally much less than 3 m thick. Areal extent of thin beds very limited in places, but thick beds may persist for many hundreds of meters. Sand matrix typically contains 35 percent silt and clay. Unweathered sand at depths greater than 3 m is normally very compact. Clay and silt-clay beds may total as much as 30 percent of unit. Joints and thin, weak shear zones extend into unweathered materials, in places.	SM, SP, SW (GM, CL, CH)	2,000–2,200	Typically dry at surface within few days after rainy period, except where underlain by clay-rich sediments. Seeps on hillsides at many places.	Typically low permeability, but medium in sand-filled channels. Very low in strata containing highly plastic clay. Many local perched water tables. Coarse-grained deposits normally near plastic limit.	Sand-rich facies commonly very easily compacted and makes very strong, low-compressibility fill; typically has enough clay to resist erosion. Locally plastic clay beds are present and must be discarded. Has rare cemented zones that are difficult to excavate.	Generally few excavation problems in weathered zone, but unweathered material may be difficult to excavate with light power equipment where matrix has highly plastic clay, or where unweathered fine-grained materials are present. Some iron-cemented layers as much as 0.3 m thick. Excavations commonly easy to drain by removal of seepage water, except in broad valleys and lowlands, where ground-water table is near surface.	Generally has sufficient clay matrix to prevent serious erosion.	Weathered zone medium compact to compact; unweathered material compact to very compact. Unweathered material commonly overconsolidated 10–15 kgf/cm^2; weathered material can be normally consolidated but generally is somewhat overconsolidated. Peak effective friction angle of sand-rich soils 25°–35° where normally consolidated; residual effective friction angle 22°–30° (5°–8° less than peak where normally consolidated).	Unweathered coarse-grained material, 3–6, as high as 8. Weathered coarse-grained material, higher than 1.5. Unweathered material normally very good support for heavy structures, high bearing capacity for piles and caissons, except where cut by faults which produced weak, soft zones.	Temporary slopes normally stable at 60° to depths of 3 m, except where material is saturated; temporary excavations in unweathered sand commonly stable at steeper slopes to greater depths. Sand having no clay matrix and faulted and jointed sand can be unstable at depths less than 3 m. Long permanent slopes in unweathered zone should be designed using shear strength much less than peak values; possibility of joints and weathered, softened zones should be considered.	Generally strong, except where fine-grained strata present.
Potomac Formation, predominantly clay psc	Interbedded sequence of silt and clay, containing some sand and gravel lenses. Commonly sandy or silty clay, but may be massive. Less than 0.3 m to more than 50 m thick. Areal extent of thin beds commonly very limited, but thick beds may persist for many hundreds of meters. Primary clay montmorillonite, secondary kaolinite. Unweathered clay normally hard but commonly weakened and has many soft zones within upper 3 m, caused by shearing and interaction with ground water. Thin, soft seams may extend much deeper. Sand and silt beds may make up as much as 30 percent of unit. Color range great; commonly gray or greenish brown, but at many places varigated bright red and yellow from iron oxides. At some places, black from carbonaceous matter and wood pieces. Black and greenish-brown deposits commonly contain pyrite nodules.	CL, CH, ML, MH (SM, SP, SW)	Weathered material, 1,600; unweathered material, 2,100.	Water remains at surface until it runs off or evaporates; may remain indefinitely in flat areas. Surface runoff generally high; however, on rolling topography small seeps present on many slopes.	Very low permeability except in sandy strata; water may fill joints and fractures near ground surface. Fractures may extend to great depths. Poor surface drainage may result in water in joints and fractures. Natural moisture content of unweathered zones generally near plastic limit, of weathered zones commonly above plastic limit. Black and greenish-brown deposits containing pyrite commonly weather easily and produce acid ground water (pH 2–3).	Difficult or impossible to compact properly because of highly plastic clay having high shrink-swell potential.	Generally few problems in upper 3 m, but shear zones and joints cause unstable walls especially where water present in fractures and fractures are permitted to open; joint and fracture drainage may be insignificant if drainage begun during construction period. Difficult to excavate with light power equipment, especially in unweathered zones.	Undisturbed highly plastic clay extremely erodible; weathers to thin chips, 1×1×0.3 cm thick. Possibly dispersive.	Weathered zone soft to very stiff; unweathered material very stiff to hard. Unweathered material commonly overconsolidated 10–15 kgf/cm^2; weathered material may be normally consolidated, but generally is somewhat overconsolidated. Peak effective friction angle of clay-rich soils 20°–30° where normally consolidated; residual effective friction angle commonly 15°–25° but may be as low as 8° in some highly plastic clays.	Unweathered fine-grained clay or silt, 2–5, higher where sandy. Weathered fine-grained clay or silt, 0–2. Both weathered and unweathered clay may shrink and swell if foundations not at least 1.3 m beneath ground surface; corrective drainage measures needed, and nearby trees removed. Unweathered clay or silt normally good support for heavy structures, and have high bearing capacity for piles. Unweathered clay or silt suitable for caissons, where not fractured and jointed.	Temporary vertical cuts generally stable to depths of 2.3 m, but some adversely oriented joints can cause large blocks to fall from wall. Water in joints can cause instability. Positive measures should be taken to protect critical excavations. Long, permanent slopes may be unstable at 10° or possibly less in weathered and jointed zones. Jointed and sheared zones should be considered in design of all slopes. Residual parameters, or at least strength values much less than peak values measured on unweathered specimens, should always be used for design of permanent slopes.	Performance commonly poor because of swelling and impermeability of clay. Weakening of clay due to swelling results in low CBR (California Bearing Ratio) values. Highly plastic clay can be stabilized by addition of lime.

[1]The following letters indicate certain soil characteristics. First letter: G, gravel; S, sand; M, silt; C, clay; O, organic; Pt, peat. Second letter: W, well graded; P, poorly graded; M, silty; C, clayey; L, low plasticity; H, high plasticity. The materials are described in terms of major and minor occurrences; minor occurrences are in parentheses.



RELATIONSHIP BETWEEN SLOPE DEGREES AND SLOPE PERCENT

PHYSICAL PROPERTIES AND ENGINEERING CHARACTERISTICS OF NONCONSOLIDATED MATERIALS, FAIRFAX COUNTY, VIRGINIA