HOMELITE®

COMPACTOR BASICS

Is Compaction New?

Our early ancestors quickly learned the value of compaction when they built dams and earthen buildings. Both would have washed away without some attempt at tamping the soil. The Romans, however, made full use of compaction and advanced the art. Roman roads, some of which are still in existence today, were built with thorough compaction of the base soil to provide a foundation for their cut stone surfaces.

Today precise compaction specifications are written into every road building project. Confined area compaction (involving the use of portable vibratory plates and rammers) has become both practical and common. The value—in terms of added life to foundations and overall stability—is beyond question.

What is Compaction?

Compaction is the application of mechanical energy to disturbed soil to drive out air voids and excess moisture.

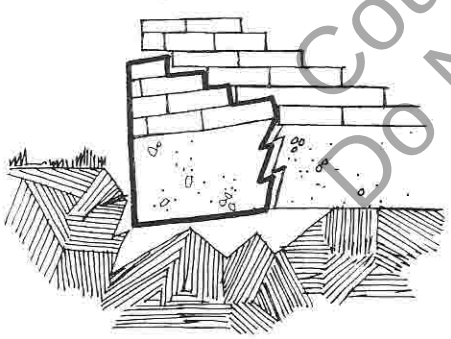
What is The Result?

Through compaction the soil is consolidated and its load bearing capacity is greatly increased.

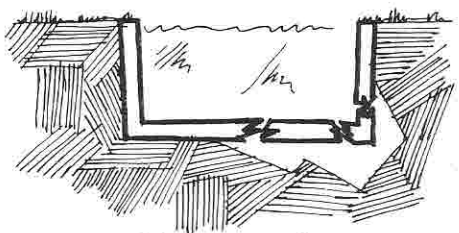
Why Compact?

To insure a long life for the project and eliminate later expense

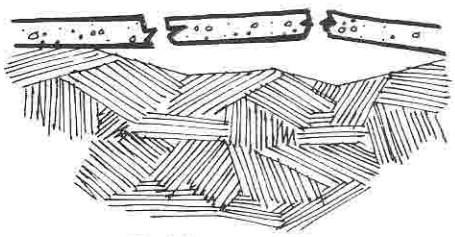
Refer to the following illustrations:



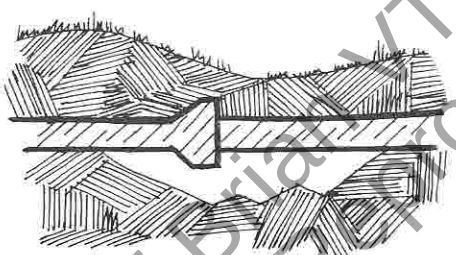
FOUNDATION EROSION



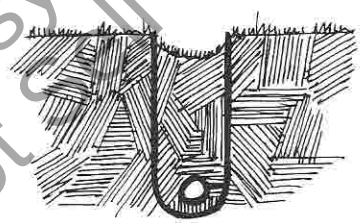
BASEMENT & POOL CRACKS & LEAKS



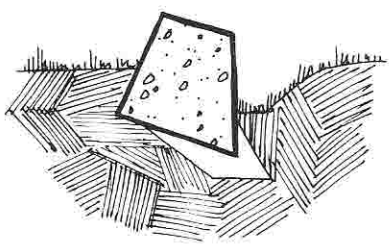
SLAB CRACKS



PIPE LEAKAGE & BREAKS



UTILITY TRENCH SETTLING



EROSION GULLIES UNDER ABUTMENTS

Types of Soil

You must have an understanding of the basics of compaction to intelligently recommend the equipment required for the project.

Granular—Consists of mineral grains down to .002 inches. May be coarse or fine, but is always granular.

Cohesive—Mixture of fine sand and clay—lumpy when dry—run together when wet.

Clay—Made up of the finest particle size of any soil—less friction between particles—naturally plastic and cohesive.

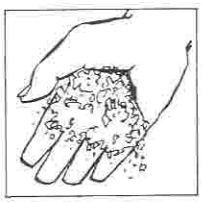
Moisture and Compaction

Moisture content of the soil is vital to proper compaction. Too little moisture prevents adequate compression—too much and moisture will separate soil particles, leave water filled voids and weaken the load bearing characteristics of the soil.

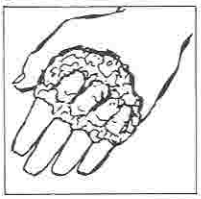
How much moisture is "just right"? The quantity that will produce the greatest soil density per cubic foot with the application of a specified amount of energy.

Use this simple procedure as a guide—referred to as "hand test".

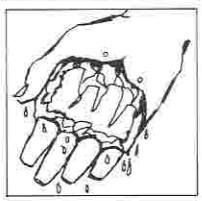
Pick up a handful of soil — squeeze in your hand. Open your hand —if soil is powdery and will not retain the form given it by hand, it is too dry. If it shatters when dropped-it is too dry.



If the soil is moldable by hand and breaks into only a few pieces when dropped, it has the right moisture content for compaction.

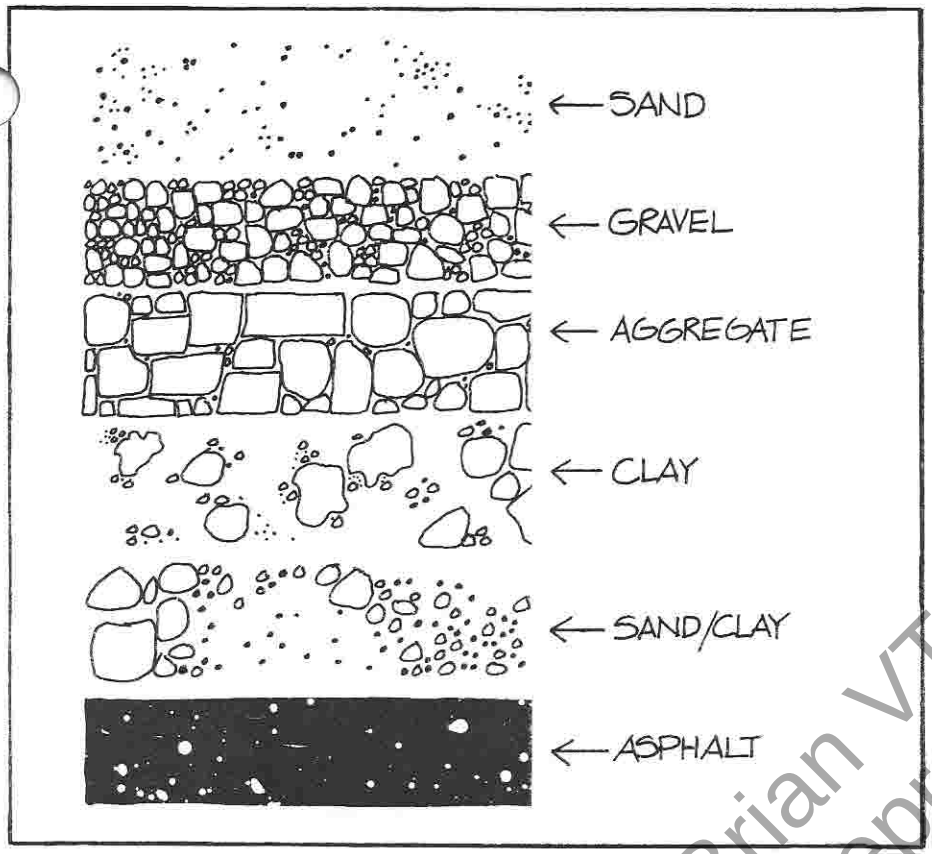


If the soil is plastic in the hand and leaves traces of moisture on the fingers and stays in one piece when dropped, it has too much moisture.



"Not too much moisture—not too little moisture—but just enough in the soil to give lubrication between soil particles".

Matching Compactor With Soil



Most soils requiring compaction range from almost pure sand, through various mixtures of sand and clay, to almost pure clay.
The type of soil composition determines the type of compaction equipment to recommend.

Granular soils can be compacted quickly and easily with a vibratory **plate** compactor.

Sandy loam and silt loam—even though broadly classified as a cohesive soil—have a soft, fluffy feel. When wet, these loams run together in puddles and moist casts can be handled without breaking—this indicates they can be effectively compacted. Either by **plate or rammer** equipment.

Clay (cohesive) must be compacted with a **rammer** type compactor.
Note: Different types of soil will act in different ways—each yard of soil may contain many types—mixed in any proportion. Sand can be compacted to fill voids, but it will not stay in place unless soil is mixed with the sand. Cohesive clay or silt with fine particles will tend to flow and best compaction is obtained if mixed with a granular soil. High clay content soils will need a compactor with high amplitude and lower frequency. Asphalt requires lower amplitude and higher frequency.
Travel speed, ground coverage and lift can vary greatly on different types of soil, gravel or other material.
"Performance is proven by demonstration—not from a performance chart."

Specifications and Testing

There are two basic standard specifications written for compaction.

1. Method Specification—defines the lift, number of passes and type of equipment to be employed.
2. End Result Specification—Most popular. A typical specification may say—"The contractor may use any type of Compaction Equipment he deems necessary to obtain the desired density".
Soil density is specified in terms of a laboratory standard.

Testing methods have been developed and serve as a guide to compaction.

Proctor Test [Percent Compaction] The dry weight per cubic weight of soil as compared to a laboratory test on the same soil. The Proctor Test is a density test used to determine the degree of compaction. From a comparison of the density of the soil with the maximum density, a % Proctor or % Compaction is calculated.

Sand Cone Test—is widely used. Soil is removed from compacted ground, dried and then weighed. The hole is filled with sand of pre-determined weight per cubic foot. Then the weight of the sand is converted to the volume of the hole. The dry density of the compacted soil is related in pounds per cubic foot.
Water Balloon Test—Uses same procedure as sand cone test, except a balloon is filled with water under a plate covering the hole. The apparatus used to fill the balloon automatically indicates the volume of water used. The dry density of the compacted soil is pounds per cubic foot.
Nuclear Testing—Provides great accuracy. Provides information on aggregate sizes, is much faster and does not interfere with construction activity. Gamma and Neutron rays are projected into ground—some are absorbed, some reflected. Reflected rays are measured with a Geiger tube and shown on a gauge.
Standard Tests—as described above—are controlled in the laboratory by Engineers. They are used as a means of checking performance against specifications.

Glossary

AASHO—American Association of State Highway Officials.

AGGREGATE (COARSE)—Crushed rock, or gravel of screened sizes; used as fill material in base courses.

AGGREGATE (FINE)—Sand or fine crushed stone for filling voids in coarse aggregate.

ASTM—American Society for Testing Materials.

BACKFILL—Material used in refilling a cut or other excavation, or the act of such refilling.

BALLAST—Heavy material, such as water, sand, or metal which has no function in a machine except to increase its weight.

BANK—A mass of soil rising above an average level. Generally, any soil which is to be dug from its natural position.

BANK GRAVEL—A natural mixture of cobbles, gravel, sand, and fines.

BANK YARDS—Yards of soil or rock measured in its original position, before digging.

BASE—The course or layer of materials in a roadway section on which the actual pavement is placed. It may be of any different types of materials ranging from selected soils to crushed stone or gravel.

BERM—An artificial ridge of earth, generally side-slopes of a roadbed.

BINDER—Fines which fill voids or hold gravel together when it is dry.

BORROW PIT—An excavation from which fill material is taken.

BPR—U.S. Bureau of Public Roads.

BUREC—U.S. Bureau of Reclamation.

CLAY—A heavy soil composed of particles less than 1/256 mm. in diameter.

CLEAN—Free of foreign material, in reference to sand or gravel means lack of binder.

COHESION—The quality of some soil particles to be attracted to like particles, sticking together.

COHESIVE MATERIAL—A soil having properties of cohesion.

COMPACTED YARDS—Measurement of soil or rock after it has been placed and compacted in a fill.

CORE—A cylindrical piece of an underground formation, cut and raised by a rotary drill with a hollow bit. The impervious center of an earthfill dam.

CROWN—The elevation of a road surface at its center above its elevations at its edges, to encourage drainage.

DATUM—Any level surface taken as a plane of reference from which to measure elevations.

DENSITY—The ratio of the weight of a substance to its volume.

EMBANKMENT—A fill whose top is higher than the adjoining natural surface.

FINES—Clay or silt particles in soil.

FINISH GRADE—The final grade required by specifications.

FOOT—In tamping rollers, one of a number of projections from a cylindrical drum (the base of).

FROST LINE—The greatest depth to which ground may be expected to freeze in a given location.

GRADE—Usually the elevation of the surface of the ground at points where it meets a structure. Also, surface slope.

GRAIN SIZE CURVE—A graph of the analysis of a soil showing the percentage size variations by weight.

GRANULAR MATERIAL—A sandy type of soil whose particles are coarser than cohesive material and which do not stick to each other.

IMPERVIOUS—Resistant to movement of water.

IN SITU—The natural undisturbed soil in place.

LIFT—A layer of fill as spread or as compacted.

LIQUID LIMIT—The water content at which the soil passes from a plastic to a liquid state.

LOAM—A soft, easily worked soil containing sand, silt, clay, and decayed vegetation.

OPTIMUM MOISTURE CONTENT—That percent of moisture at which the greatest density of a soil can be obtained through compaction.

PASS—A working trip or passage of an excavating, grading, or compaction machine.

PROCTOR—A method developed by R.R. Proctor for determining the density-moisture relationship in soils. It is almost universally used to determine the maximum density of any soil in order that specifications may be prepared properly for field construction requirements.

PROCTOR, MODIFIED—A moisture-density test of more rigid specification than Proctor. The basic difference is the use of heavier weight being dropped from a greater distance in laboratory determinations. It is used principally by the Corps of Engineers and a few highway departments.

QUICKSAND—Fine sand or silt that is prevented from settling firmly together by upward movement of underground water.

SILT—A soil composed of particles between 1/256 mm. and 1/16 mm. in diameter.

SOIL—The loose surface material of the earth's crust.

STABILIZE—To make soil firm and to prevent it from moving.

SUBBASE—The layer of selected material placed to furnish strength to the base of a road. In areas where construction goes through marshy, swampy, unstable land, it is often necessary to excavate the natural materials in the area of the roadway and replace with more stable materials. The material used to replace the unstable natural soils is generally called subbase material, and when compacted is known as the subbase.

SUBGRADE—The surface produced by grading native earth, or cheap imported materials which serve as a base for a more expensive paving.