

01

SITework

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1. EARTHWORKS

1.01 ACRONYMS

AASHTO

**American Association of State Highway and
Transportation Officials**

ANSI

American National Standards Institute

ASTM

American Society for Testing Materials

DPWH

Dept. of Public Works and Highways (Phil Govt)

USCS

Unified Soil Classification System

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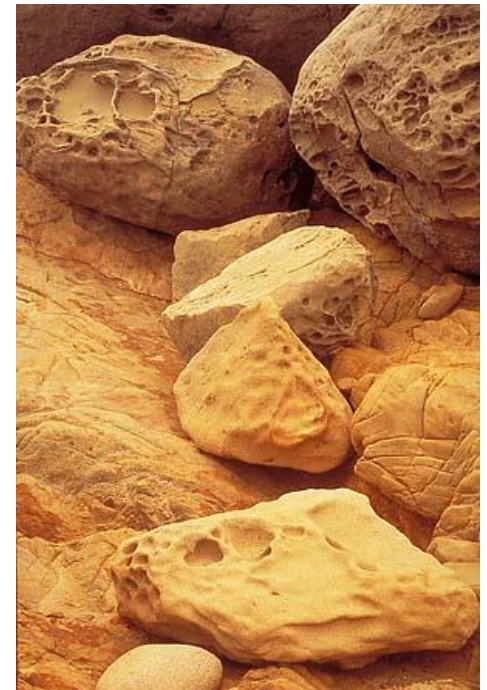
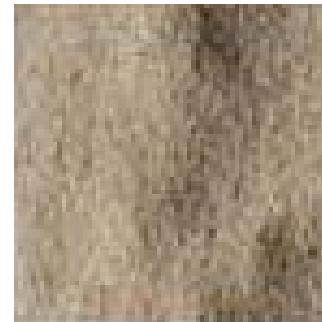
1.02 DEFINITIONS, STANDARD TESTS

AASHTO SOIL CLASSIFICATION SYSTEM

“ classifies inorganic soils for suitability as subgrade materials in terms of good drainage and bearing capacity.

AASHTO defines particle sizes as:

- “ Boulders . above 75mm
- “ Gravel . 75mm to No.10 sieve
- “ Coarse Sand . No.10 to No.40 sieve
- “ Fine Sand . No.40 to No.200 sieve
- “ Silt-Clay Particles . passing No.200 sieve



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ATTERBERG LIMITS are tests performed on soils passing the No.40 sieve to establish the following:

Liquid Limit (LL)

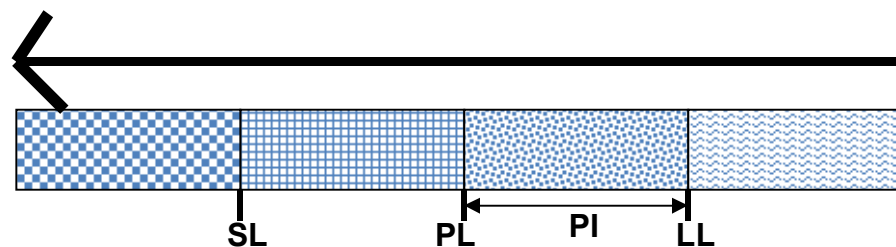
the moisture content at which soil changes from a liquid to a plastic state as moisture is removed. It is measured when soil in a shallow dish flows to close a 12.5 mm groove after 25 drops from 1 cm.

Plastic Limit (PL)

the moisture content at which soil passes from plastic to a semi-solid state as water is removed.

Plasticity Index (PI)

equals Liquid Limit minus the Plastic Limit ($LL - PL = PI$)



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a. **Fill materials** - soil, crushed stone, and sand used to raise an existing grade, or as a man-made-deposit; generally used under footings, pavers, or concrete slabs on grade; classified under the Unified Soil Classification System (USCS) as:

“ GW, GM, GP . Gravels with > 50% retained on No. 200 sieve and > 50% further retained on No.40 sieve.



“ SW, SM . or Sands with > 50% are retained on No. 200 sieve and 50% or more passes No.40 sieve.



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- b. **Granular Fill or Filters** . soil materials with sand equivalent of not less than 50%; used to prevent the movement of fine particles out of soils and other natural materials through which seepage occurs; conforming to ASTM C 33, size 67.



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- c. **Borrow Fill** - selected laboratory-approved pit-run gravel, disintegrated granite, sand, shale, cinders or other similar materials with not more than 35% fraction passing the No. 200 sieve.



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d. Base Course Materials -

hard durable fragments of stone and a filler of sand or other finely divided mineral matter, free from vegetable matter and lumps of clay, complying with the following AASHTO METHODS T-11 and T-26 Grading Requirements:



Sieve Designation U.S. Standard Sieve	Percent Weight Passing Type "B" Base Course
1 - 1/2"	100
1"	85 - 100
No. 4	20 - 45
No. 200	5 - 12

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Local Borrow Fill materials:

BANDA Y BANDA

LASTILLAS

BASE COURSE



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Local Borrow Fill materials:

ESCOMBRO P5,000 per 15 16 cum

ESCOMBRO . BULIK (for Riprap)



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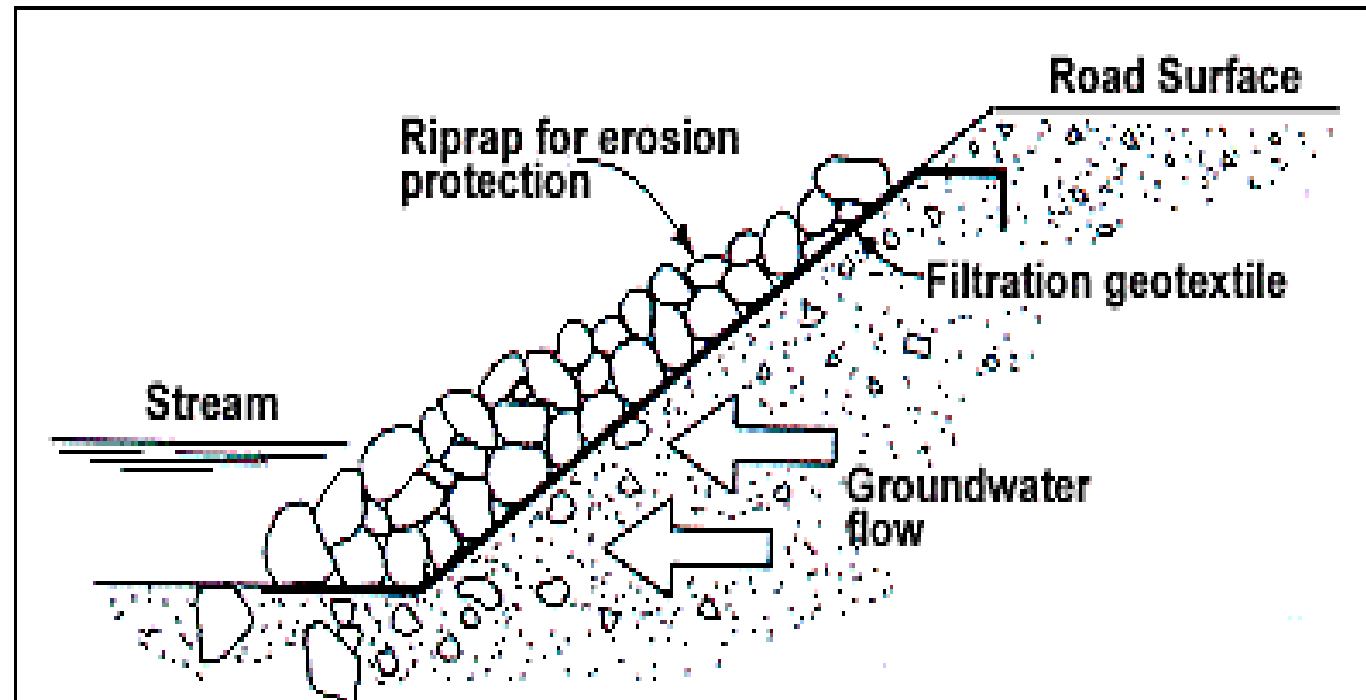
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1.03 RIPRAP (ROCK LINING)

- a constructed layer or facing of stone, placed to prevent erosion, scour or sloughing of a structure or embankment.
- term "riprap" also is frequently defined as the stone used to construct such a lining.



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1.03 RIPRAP (ROCK LINING)

- a special class of very large aggregate. Riprap gradations range in diameter from 50mm (2 inches) to 1148mm (42 inches). Because riprap is subject to significant energy, it is important that it be sound and free from defects or entrained substances such soil shale or organic materials.



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1.03 RIPRAP (ROCK LINING)

- resistance of riprap to displacement of moving water or pressure of soil is a function of the weight, size, and shape of the stone, the geometry of the channel or bank it is protecting, and the filter blanket over which the riprap is placed.



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1.04 GABION SYSTEM

- Wire-enclosed riprap
- consists of mats or baskets fabricated from wire mesh, filled with small riprap, and anchored to a slope.



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1.04 GABION SYSTEM

- Wrapping the riprap enables use of smaller rocks for the same resistance to displacement by water energy as larger unwrapped riprap.



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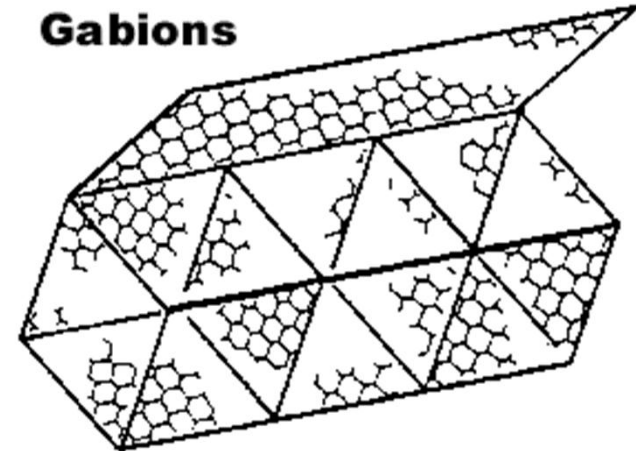
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1.04 GABION SYSTEM

- is particularly advantageous in areas inaccessible to trucks or large construction equipment.
- wire baskets also allow steeper (i.e., vertical) channel linings to be constructed.
- gabion baskets or mattresses can be made from commercially available wire units or from available wire fencing material or may be fabricated from No. 9 or No. 12 galvanized wire.

Gabions



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1.04 GABION SYSTEM

- According to FHA guidance, the thickness of wire mattresses used for channel linings is determined by three factors:
 - the erodibility of the bank soil
 - the maximum velocity of the water, and
 - the bank slope.

Criteria for Gabion Thickness

Bank Soil Type	Maximum Velocity (ft per second)	Bank Slope	Minimum Required Mattress Thickness (inches)
Clays, heavy cohesive soils	10	<1:3	9
	13-16	<1:2	12
	any	>1:2	18+
Silts, fine sands	10	<1:2	12
Shingle with gravel	16	<1:3	9
	20	<1:2	12
	any	>1:2	18+

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1.05 GEOSYNTHETICS

Construction materials consisting of synthetic components made for use with or within earth materials generally are referred to as geosynthetics. Geosynthetics can be further categorized into the following components:

- “ **Geotextiles**
- “ **Geomembranes**
- “ **Geocomposites**
- “ **Geonets and**
- “ **Geocells**

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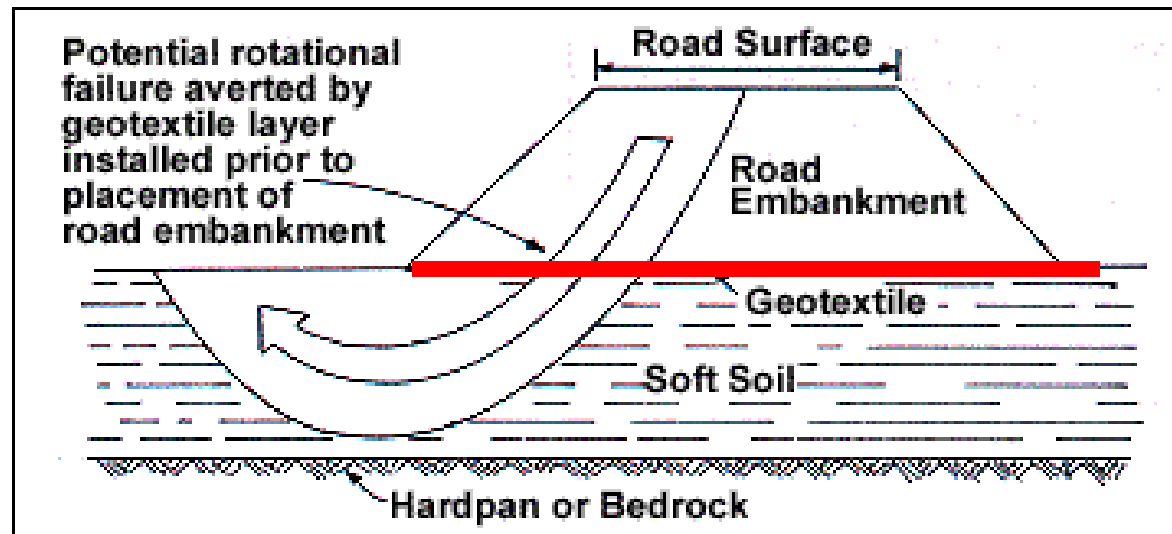
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1.05 GEOSYNTHETICS

- a. **Geotextiles** are the most common geosynthetics, and consist of woven or nonwoven fabric made from polymeric materials such as polyester or polypropylene generally used for reinforcement, separation, filtration, and in-plane drainage.

✓ Reinforcement

when the geotextile fabric lends its strength to low load-bearing soil to increase the overall design strength and decrease the amount of sub-base and base course material.



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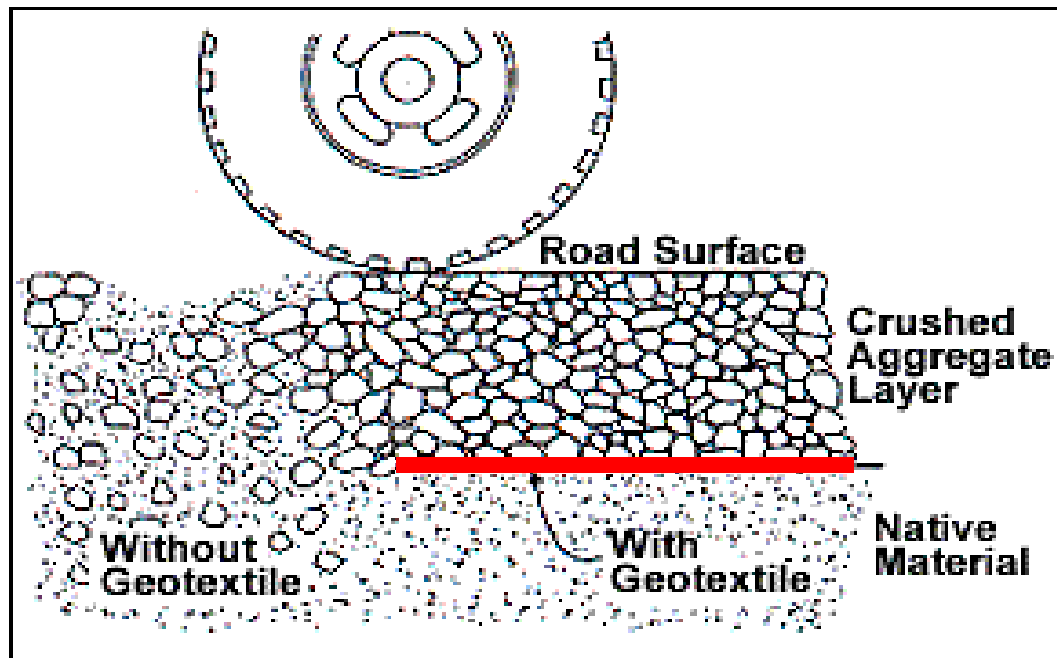
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1.05 GEOSYNTHETICS

a. Geotextiles

✓ Separation

when the geotextile is placed between dissimilar materials to prevent migration of one of the materials into the other.



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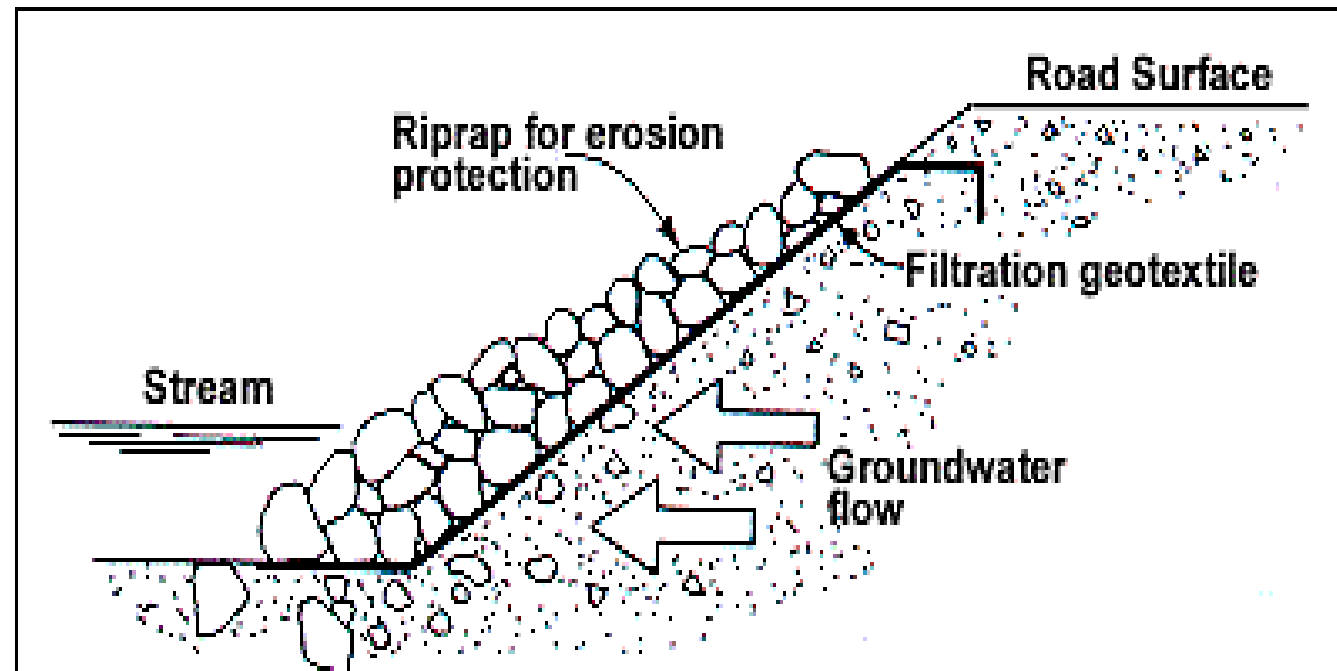
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a. Geotextiles

✓ Filtration

when the geotextile is used to prevent the movement of fine particles from soil through which seepage occurs .



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a. Geotextiles

✓ **Filtration** has three separate categories:

➤ **Subsurface**

those employed in sub-surface drainage applications, such as filters around under-drains or edge drains, or under paving.



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a. Geotextiles

✓ Filtration

➤ Erosion Control

those employed to protect cut slopes or drainage features. When used in conjunction with a stone lining or riprap, they would serve a secondary function of separation.



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a. Geotextiles

✓ Filtration

➤ Sediment Control

are exclusively those used for silt fence applications. While they serve the purpose of "filtering" runoff, the mechanism by which they function is different than subsurface drainage or erosion control applications.



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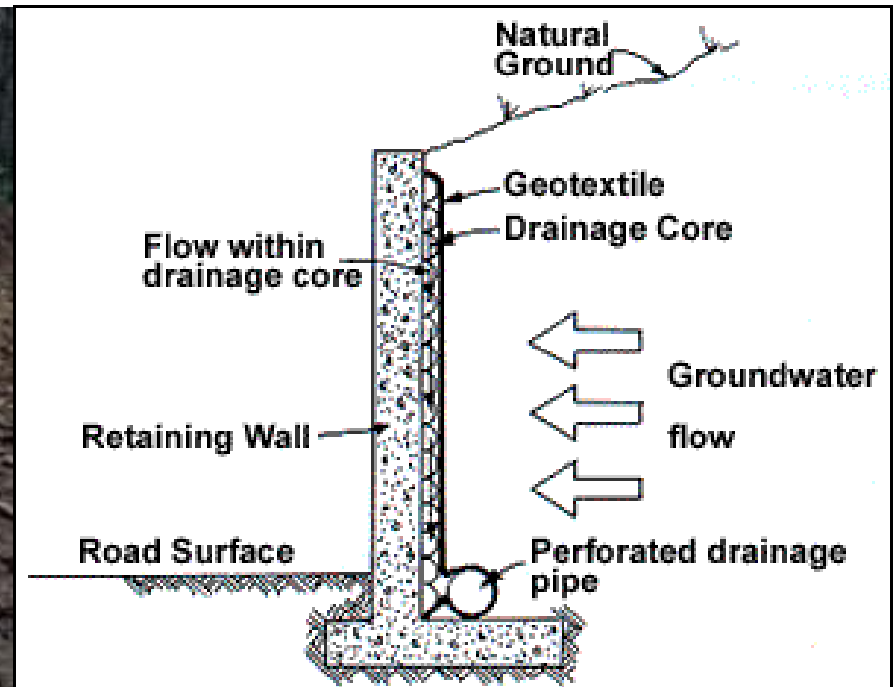
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a. Geotextiles

✓ In-Plane Drainage

particular thick-needled nonwoven geotextiles having sufficient in-plane flow capacity for use as flow conduits in drainage applications.



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b. Chemical
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c. Bait
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b. Base
Course

c. Choker
Aggregate

3.02 Paving
and

Surfacing

a. Concrete

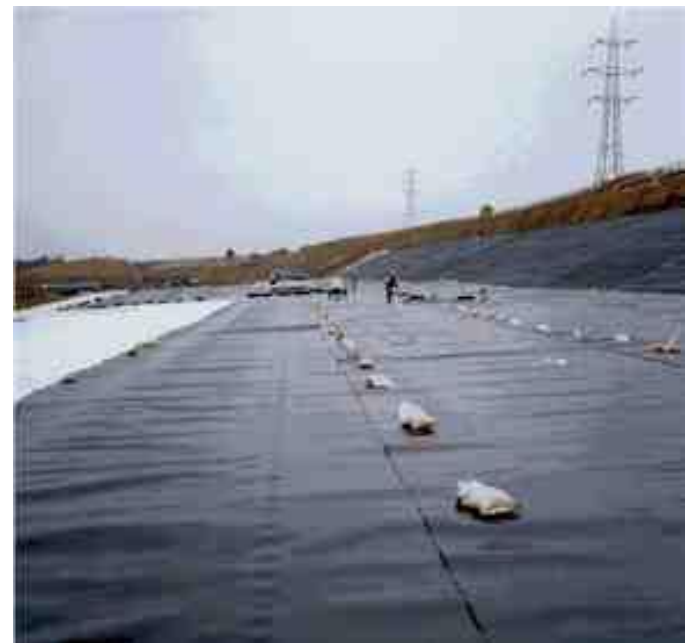
b. Bituminous
Surfacing

1. EARTHWORKS

1.05 GEOSYNTHETICS

b. **Geomembranes** are continuous polymeric sheets that are impermeable. The most frequently used for ground applications are:

- ✓ **thermoplastic products** manufactured from high-density polyethylene (HDPE) and polyvinyl chloride (PVC).
- ✓ **thermoset polymer** Ethylene propylene diene monomer (EPDM) frequently used for membrane roofing applications.



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1. EARTHWORKS

1.05 GEOSYNTHETICS

b. Geomembranes

Different types of geomembranes have significantly different properties including :

- Strength
- Longevity
- resistance to ultraviolet light
- thermal expansion and contraction
- chemical resistance, and
- ease of installation

Geomembranes should not to be subjected to tensile stresses and should be treated gently during installation and subsequent use.

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1. EARTHWORKS

1.05 GEOSYNTHETICS

c. Geocomposites

consist of a combination of geosynthetic components;
are usually sheet or edge drains consisting of a
prefabricated core to which a geotextile filter is bonded.



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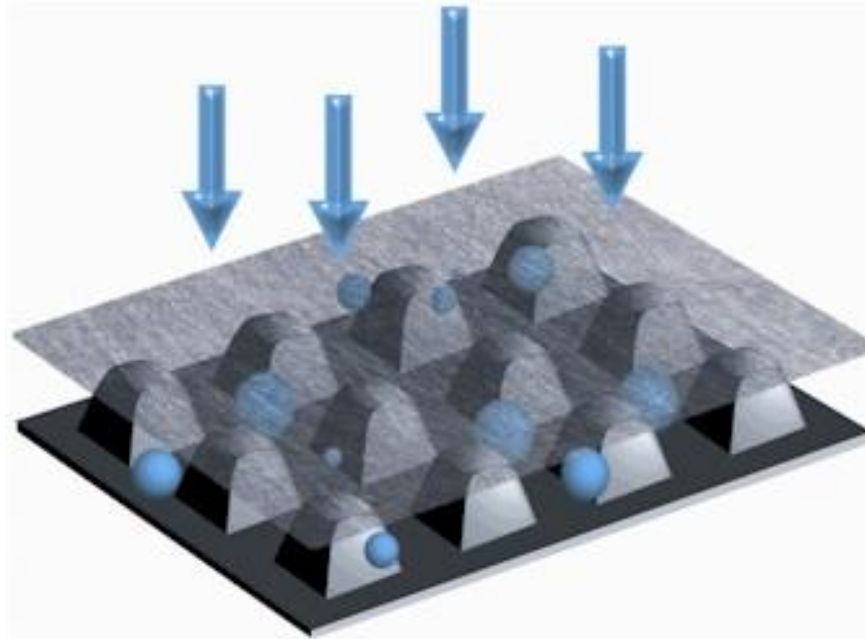
1. EARTHWORKS

1.05 GEOSYNTHETICS

c. Geocomposites

The core provides void space to which water can flow in-plane while the geotextile filter keeps soil from filling the voids created by the core.

Geocomposite sheet drains are available that allow flow in from one or both faces.



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1.05 GEOSYNTHETICS

d. Geonet

is a type of geosynthetic that consists of a continuous extrusion of polymeric ribs that form void space through which provide in-plane flow capacity.

Geonets are available with or without bonded geotextile filters. Geonets with bonded geotextile filters are sometimes referred to as composite drainage nets (CDNs).



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1.05 GEOSYNTHETICS

e. Geocells

are three-dimensional prefabricated polymeric systems ranging from 100 to 200 mm (4 to 8 inches) high. The geocell systems are collapsed for delivery to the site. Upon arrival at a site, they are spread open and filled to form a three-dimensional reinforced mattress.



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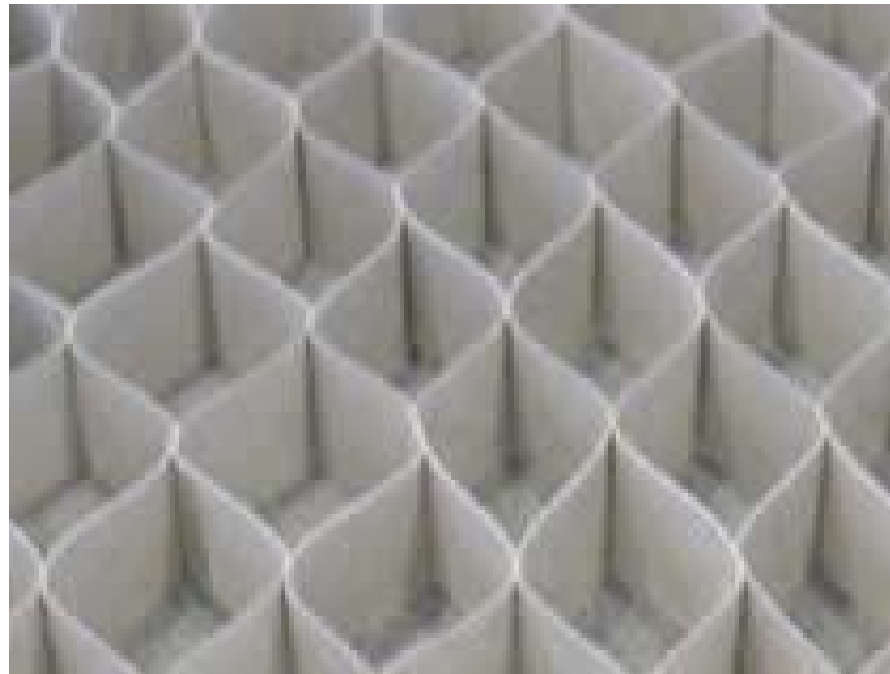
b. Bituminous
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1. EARTHWORKS

1.05 GEOSYNTHETICS

e. Geocells

Originally developed to rapidly stabilize soft subgrades for mobilization of large equipment, they are now frequently used for protection and stabilization of steep slope surfaces and protective linings for channels.



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1. EARTHWORKS

1.06 SLOPE-EROSION PROTECTION MATERIALS

These include materials used for both temporary and permanent erosion protection.

Temporary materials consist of open mesh polymeric systems, biodegradable mesh system (e.g., coir jute), or a combination of polymeric and biodegradable mesh.



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1. EARTHWORKS

1.06 SLOPE-EROSION PROTECTION MATERIALS

The open mesh systems serve as a **semipermanent** mulch, anchoring seeds and soil particles subject to erosive flows in channels. Greater flow rates and volumes usually require denser mesh and more durable construction.



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1. EARTHWORKS

2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING – there are three types:

- a. Physical barriers
- b. Chemical barriers
- c. Colony Elimination (Bait) System

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a. Concrete

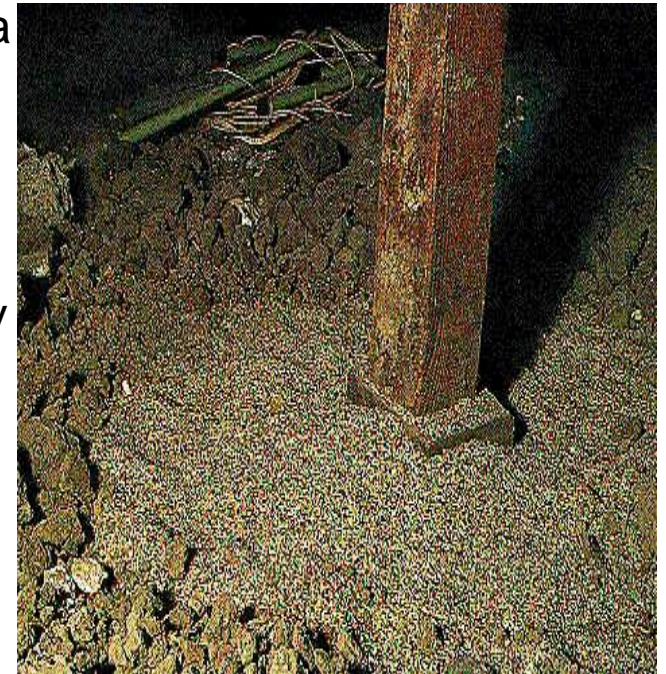
b. Bituminous
Surfacing

2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

a. **Physical barriers:** prevent termites from accessing the wood in a home. There are a variety of methods:

- ✓ **Termite Resistant Sand** - a layer of sand with uniform size particles. The sand must be large enough to prevent the termite from moving through it effectively and of a consistency that prevents its use in "tunnel" construction. Sometimes used around the foundation of a home during construction.



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2. TERMITE AND BUKBOK PROOFING

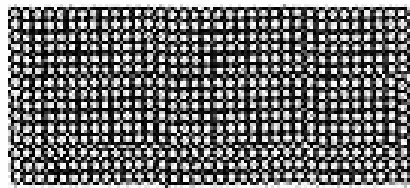
2.01 TERMITE PROOFING

a. Physical barriers:

- ✓ **Termite Mesh** - steel mesh product that is fine enough to keep even tiny termites from passing through it. Termite Mesh is used in slab construction (concrete slabs are poured over or with the mesh). It is also used to wrap pipes and other access areas.

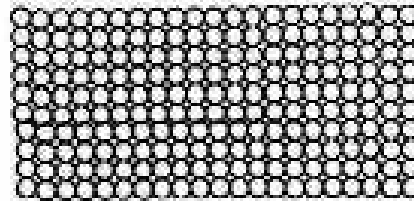
TOO SMALL

(less than 1.0 mm)
Termites can penetrate
by removing particles



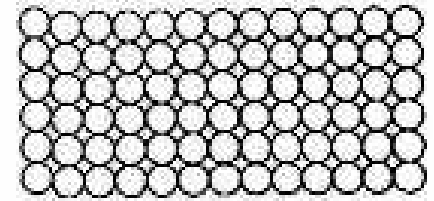
EFFECTIVE BARRIER

(1.0 to 3.0 mm)
Termites cannot
penetrate



TOO LARGE

(more than 3.0 mm)
Termites crawl through
spaces between particles



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a. Concrete

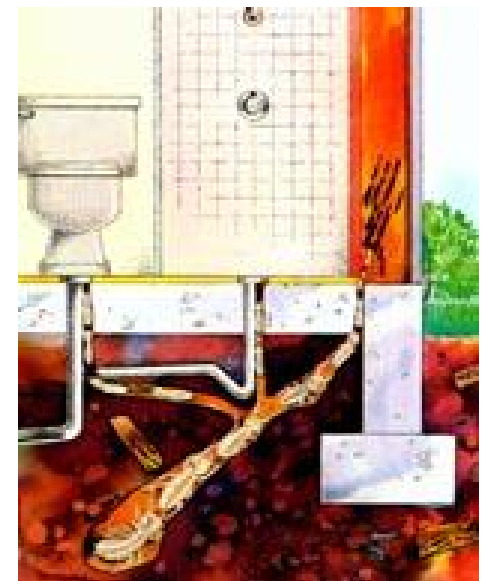
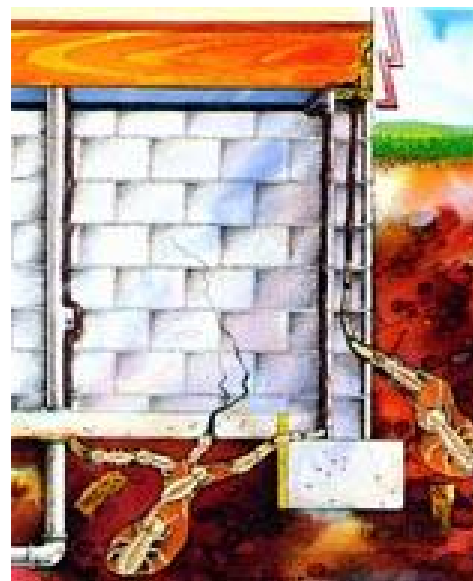
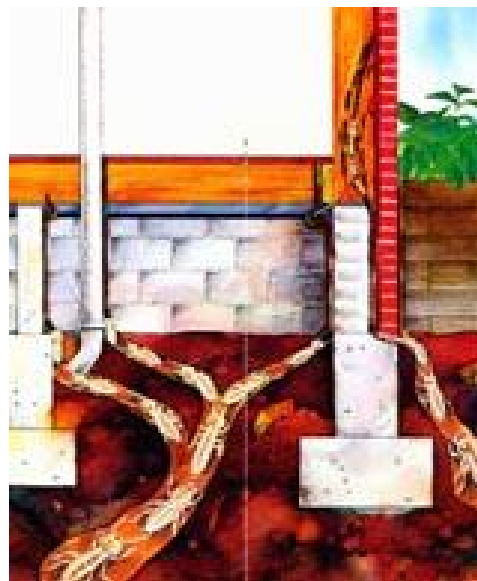
b. Bituminous
Surfacing

2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

a. Physical barriers:

- ✓ **Home Construction** - in particularly high-risk termite environments, homes are sometimes designed on high concrete pillars to physically separate the home from the distance termites can travel from their colony.



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a. Concrete

b. Bituminous
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2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

b. **Chemical barriers:** The objective of this method is to establish a continuous termiticide barrier or treated area between potential soil access routes and the structure to either kill or repel subterranean termites that attempt to reach the structure. A termiticide is a type of chemical used to control termites.

✓ **Pre-construction chemical barriers**

are almost always applied during construction, to the soil and foundation. There are also termite resistant building products, from drywall to floor joists. These are often treated with borates before use in home construction. Pre-construction applications must use enough insecticide (often 100 gallons or more) at a sufficient concentration to erect an adequate barrier.

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2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

b. Chemical barriers

- **Vertical barriers**

are created by applying 4 gallons of termiticide per 3 linear meters by rodding or trenching around the base of foundations, plumbing, utility entrances, expansion joints, and where two slabs will join.

If areas to be treated are more than 300mm (one foot) deep, then each 300mm of depth should receive 16 liters (4 gallons) per 3 linear meters.

Treatment of trenches involves digging a trench, no wider than 150mm (6 inches), applying termiticide to the trench, and mixing with soil as the soil is replaced.

Hollow block voids of foundations should also be treated with 16 liters (4 gallons) of termiticide per 3 linear meters .

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2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

b. Chemical barriers

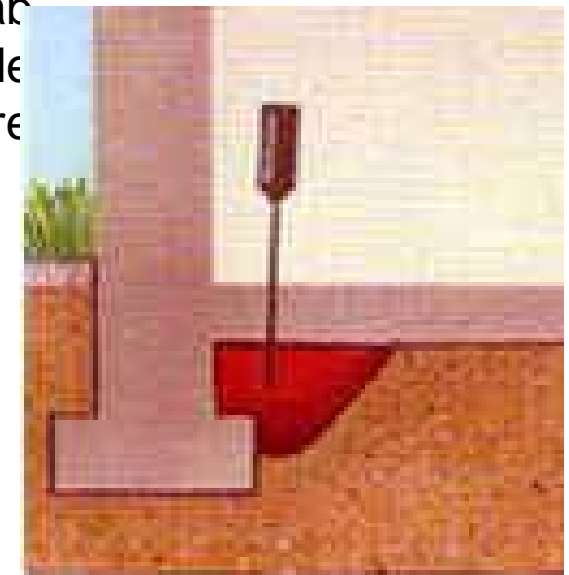
- **Horizontal barriers**

are made by applying 4 liters (one gallon) of termiticide per 3 square meters. The treatment is usually accomplished by applying a coarse spray at low pressure. All termite treatments to slab construction should include horizontal barriers, which are relatively easy to apply.

✓ **Slab treatment** - involves drilling through the slab floor and injecting termiticides into the soil at regular intervals.



Liquid barrier
application



SLAB TREATMENT

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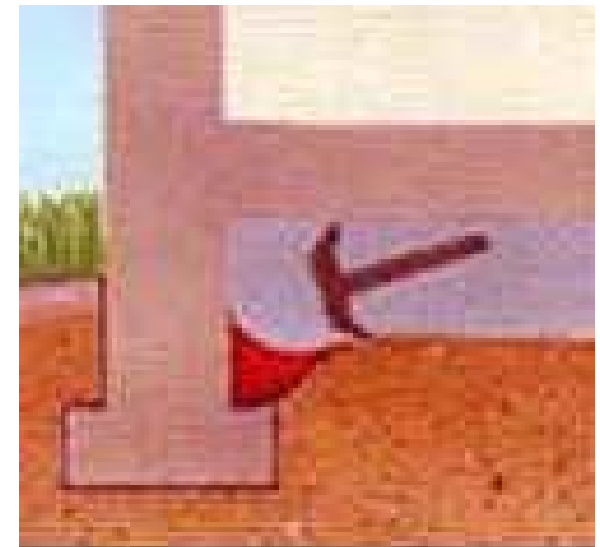
2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

b. Chemical barriers

- Horizontal barriers

- ✓ **Basements and Crawl Spaces** - trenches are dug around the foundation, termiticide applied and the trench filled back in. Chemicals may also be injected into the soil in the crawl space/basement and around the foundation. The walls and foundation of the home are also treated, as well as around piers, pipes, and other access point.



CRAWL SPACES

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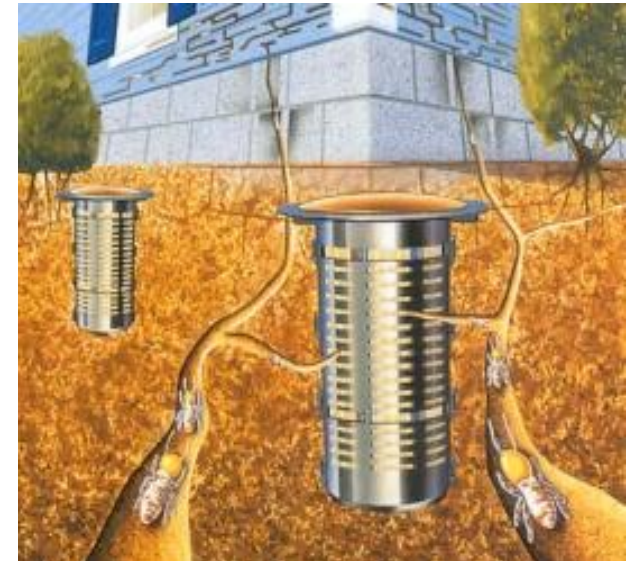
2. TERMITE AND BUKBOK PROOFING

2.01 TERMITE PROOFING

c. Colony Elimination (Bait) System

The objective of this method is to attract the termite workers to forage on a slow-acting insect-growth regulator (IGR) called *hexaflumuron* that will work to eliminate the termite workers population and eventually result in the death of the queen and any subsequent future queens, and therefore the entire colony.

The system employs baiting and monitoring devices, installed where evidence of infestation is found: on the ground outside the house, on walls, floors, ceilings inside the house.



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Surfacing

3. ROADS AND PARKING

3.01 SUBGRADE AND BASE COURSE MATERIALS

- a. Borrow Material
- b. Base Course Material
- c. Choker Aggregate:

A "choker" course is a filter layer of finer material that is installed over a coarse road base material. The purpose of the choker course is to provide a stable foundation of fine-grained aggregate for the construction of a pavement.



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Surfacing

a. Concrete

b. Bituminous
Surfacing

3. ROADS AND PARKING

3.02 PAVING AND SURFACING

a. Concrete (See Div 03 Concrete)

b. Bituminous Surfacing

- ✓ **HOT MIX ASPHALT or ASPHALTIC CONCRETE** . a dark brown to black cementitious material, solid or semi-solid, composed of bitumens which when mixed with graded aggregates is used as paving material by placing, shaping, and compacting while hot over a prepared base.



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3. ROADS AND PARKING

3.02 PAVING AND SURFACING

b. Bituminous Surfacing

- ✓ **COLD MIX ASPHALT OR ASPHALTIC CONCRETE** .
is asphaltic concrete prepared with a relatively light and slow-curing asphalt, placed over a prepared surface without heat. This hardens to a state that is less firm and durable than hot-mix asphaltic concrete.



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a. Concrete

b. Bituminous
Surfacing

3. ROADS AND PARKING

3.02 PAVING AND SURFACING

b. Bituminous Surfacing

- ✓ **ASPHALTIC MACADAM** . paving for roads and other surfaces formed by grading and compacting layers of crushed stone or gravel, then the top layer is bound by asphalt to stabilize the stone, provide a smoother surface, and seal against water penetration.



1. EARTHWORKS

1.01 Acronyms

1.02 Definitions,
Standard
Tests

1.03 Riprap

1.04 Gabion

1.05 Geosynthetics

1.06 Erosion-
Control
Materials

2. TERMITE/BUKBOK PROOFING

2.01 Termite

Proofing

b. Chemical
Barrier

b. Chemical
Barrier

c. Bait
System

3. ROADS & PARKING

3.01 Subgrade
and Base
Course

Materials

a. Borrow
Material

b. Base
Course

c. Choker
Aggregate

3.02 Paving
and

Surfacing

a. Concrete

b. Bituminous
Surfacing

3. ROADS AND PARKING

3.02 PAVING AND SURFACING

b. Bituminous Surfacing

- ✓ **ASPHALT OVERLAY** . when one or more courses or layers of asphalt an asphalt leveling course made of an asphalt and aggregate mixture of variable thickness to correct the contour of existing surface, are placed on existing pavement.



TO

END