

# Pavement design

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**ASSIGN  
BUSTER**

Proposal to Perform Geotechnical Engineering Services for the Construction Flexible Pavements for a parking area Function of a Structural Number A critical element of the flexible pavement equation is the Structural Number, which represents the overall structural requirement needed to sustain the traffic loads anticipated in the design. The required Structural Number depends on a combination of existing soil support, total traffic loads, pavement serviceability, and environmental conditions.

AASHTO design equation for flexible pavements. The Structural Number is indicated as SN.

Although design equations can be used in different ways depending on the inputs available, one of their most common applications is effectively to solve for the Structural Number. Once the value of the Structural Number is defined, this can then be used to determine appropriate thicknesses for each of the pavement layers.

#### Relationship to Pavement Layers

The Structural Number is a value that applies to the overall pavement structure, but for a complete design it is a prerequisite to get from this value to the individual layer thicknesses. This is handled using an equation of the type shown:

$$SN = a_1D_1 + a_2D_2M_2 + a_3D_3M_3 + \dots$$

This formula is indicating the relationship of the structural number to pavement layer characteristics,

and can be adapted to any number of pavement layers, since each expression (such as  $a_2D_2M_2$ ) in the formula corresponds to a single layer, so that the variables in the expression correspond to the characteristics of that layer. The subscript number used in the expression simply indicates which

layer is meant, with the numbering beginning at the top of the pavement structure. The variables represent the following:

$a$  = a layer coefficient that represents the relative strength of the material

$D$  = layer thickness in inches,  $M$  = a drainage coefficient

The layer and drainage coefficients are values that should reflect characteristics of the material used to construct that pavement layer. The thicknesses of the individual layers are effectively what is used to design equation, and the Structural Number, to figure out.

#### Layer Coefficient

Since the layer coefficient represents the strength of the material, this is the primary variable that factors in the type of material to use for each layer. For design purposes, layer coefficients are typically determined empirically based on the performance of the material. Agencies often set specific layer coefficient values for commonly used materials as a standard design policy. Some typical layer coefficient values are: Hot mix asphalt – 0.44, road mix (low stability) – 0.20, aggregate base – 0.13, engineered fill – 0.10

Since the layer coefficient can be affected by material properties as well as the position of the layer in which the material will be used, in some cases different values might be appropriate for local conditions.

#### Drainage Coefficient

A drainage coefficient is a value assigned to a pavement layer that represents its relative loss of strength due to drainage characteristics and exposure to moisture saturation. Layers that drain slowly or are often saturated would have a lower drainage coefficient, while layers that drain quickly and almost never become saturated would have a higher drainage coefficient. For most pavement designs, it is probably simplest and best to

set the drainage coefficient equal to 1, which indicates normal drainage characteristics.

A permeable base layer placed with a geotextile barrier to improve drainage.

Another point to keep in mind is that because the Structural Number is being used to solve for layer thickness, changing a drainage coefficient will only have an impact on the thickness of the pavement layers. It will not make any layer denser or otherwise address a fundamental drainage problem that would significantly impact the service life of the pavement. If there is an actual drainage problem with one of the layers, it is better to tackle that directly by designing a drainage system, or by increasing layer density to minimize water infiltration.

### Thickness

Once appropriate layer and drainage coefficients are plugged in, one can then work out suitable thicknesses for each of the pavement layers. Using the AASHTO method for evaluating existing pavements as well as the design of new pavement structures. For example, when considering a pavement in need of rehabilitation, the existing layer thicknesses could be plugged in to determine a Structural Number for the pavement in place; comparing this with the Structural Number required for the updated design would give an indication of the type and thickness of rehabilitation treatment needed.

Further, It is worth noting that determining the Structural Number, does not automatically dictates a single correct answer for pavement layer thickness.

Assuming there is more than one structural layer, there will normally be different combinations of layer thickness that could achieve the required Structural Number. However, based on the relative costs of materials for

different layers, along with practical construction considerations (such as not making any one layer excessively thick or thin), it is likely that defining the Structural Number will steer the work to a particular combination of layer thicknesses

Table 1: THE LOG OF TEST BORING

Client: \_\_\_\_\_

Architecture: \_\_\_\_\_

Project Name: \_\_\_\_\_

Project Location: \_\_\_\_\_

Boring: \_\_\_\_\_ Job: \_\_\_\_\_

\_\_\_\_\_

Drawn By: \_\_\_\_\_ Approved By: \_\_\_\_\_

\_\_\_\_\_

Date started: \_\_\_\_\_ Completion Date: \_\_\_\_\_

\_\_\_\_\_

Drill Foreman: \_\_\_\_\_ Inspector: \_\_\_\_\_

\_\_\_\_\_

Boring method: \_\_\_\_\_ Hammer weight: \_\_\_\_\_

\_\_\_\_\_

Hammer Drop: \_\_\_\_\_ Spoon Sampler O. D. \_\_\_\_\_

\_\_\_\_\_

Rock Core Distance: \_\_\_\_\_ Shelby Tube O. D. \_\_\_\_\_

\_\_\_\_\_

#### SOIL CLASSIFICATION

Stratum depth

Depth Scale

Lithology

Sample number Standard penetration test ( )Blows/ft)

Unconfined Compression strength (T/ft<sup>2</sup>)

Pocket penetrator (T/ft<sup>2</sup>)

Natural Dry Penalty (lbs/ft<sup>3</sup>)

Water content (%)

After-bury Limit LL-Liquid limit PL-Plastic Limit

SURFACE ELEVATION – 535. 0

Top Soil

0. 7

-

-

-

-5in.

-

-

-

-10in.

-

-

-

-15in.

-

-

1

2

3

4

5

SS

SS

SS

SS

SS

5

6

6

9

8

22. 3

23. 6

25. 9

28. 9

41. 8

LL= 46 PL= 24

Reddish Brown and brown Silty clay, moist, soft

Reddish Brown silty clay, with trace fine sand, moist, medium stiff

With Limestone rock fragments in Sample number 5

3. 0

15. 0

Test boring discontinued at 15. 0 ft

The Non-cohesive soils (Silt, Sand, Gravel and Combinations)

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## DENSITY

Very loose – 5blows/ft or less

Loose – 6 to 10 blows/ft

Medium Dense – 31 to 51blows/ft

Very dense – 51blows/ft or more

## PARTICULAR SIZE IDENTIFICATION

Boulders – 8 inch diameter or more

Cobbles – 3 to 8 inch diameter

Gravel – Coarse (1 to 3inches), Medium (1/2 to 1inch) and Fine (1/4 to 1/2inch)

Sand – Coarse (0. 6mm to 1/4inch), medium (0. 2mm to 0. 6mm) and Fine (0. 05 to 0. 2mm)

Silt – 0. 06mm to 0. 002mm

## RELATIVE PROPORTIONS

Descriptive Term

Percentage (%)

Trace

1 - 10

Little

11 - 20

Some

21 - 35

And

36 - 50

## COHESIVE SOILS (Clay, Silt and Combinations)

Consistency

<https://assignbuster.com/pavement-design/>



Very Soft – 3blows/ft or less

Soft – 4 to 5 blows/ft

Medium Stiff – 6 – 10blows/ft

Very Stiff – 16 – 30blows/ft

Hard – 31blows/ft or more

Plasticity

Degree of Plasticity

Plasticity Index

Low

0 -7

Medium

8 – 22

High

Over 22

Classification: Based on the logs made by the visual inspection in accordance with United Classification

Standard Penetration Test: Driving a 2. 0' O. D. 13/8' I. D., Sampler a distance of 1 foot in to the undisturbed soil with a 140 pound hammer free falling a distance of 30. 0 inches.

Ground Water – Porosity of the soil strata, site topology, weather conditions among other factors may cause alterations in the water levels recorded in the logs.

Reference

Handy R. L, (n. d.), Geotechnical engineering Soil and Foundation Principles, ed. 5. Retrieved from: [www. geotechnical info. com](http://www.geotechnicalinfo.com), on retrieved May 6, 2015

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