EnkaTech *Note*

Subsurface Drainage Factors

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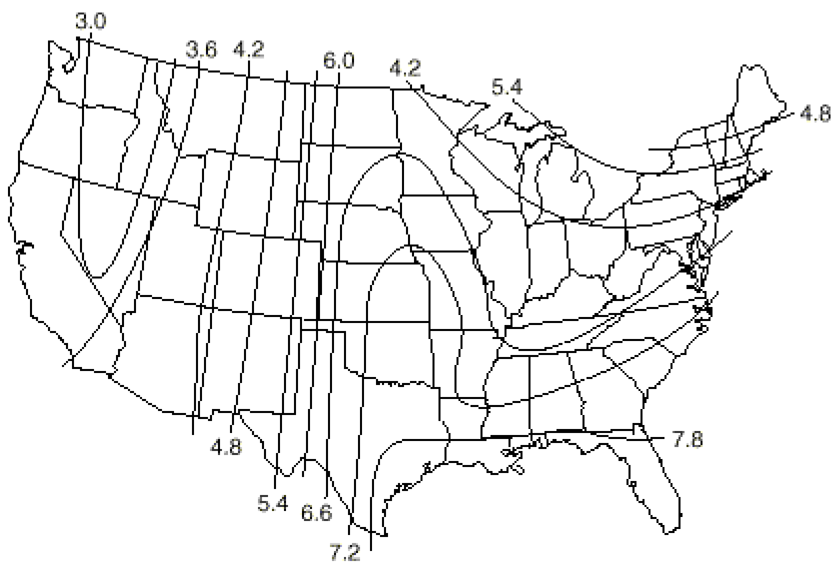
There are three factors that have the greatest effect on subsurface drainage. The first is the actual amount of water and the rate at which it reaches the geocomposite drain. The second factor, which is very closely related, is the infiltration rate or permeability of the soil. The third factor is the pressure of the soil on the geocomposite drain and the effect that would have on its ability to drain. The actual pressures that occur both horizontally and vertically have been greatly exaggerated by many in the industry, and a clear understanding of realistic pressures will aid in properly selecting a suitable geocomposite drain.

Amount of Water

The greatest rainfall amounts in the US are along the southeast costal areas. The highest rate, based on the greatest rainfall in a 5 minute period, is 7.8 inches per hour.



Map of Rainfall Intensity *Inches/Hour 10 year storm*

Rainfall Calculations

This is based on storms expected once every 10 years. A record storm could double that amount. Using that doubled amount, 15.6 inches per hour is the maximum water that would ever need to be handled by a subsurface foundation or horizontal drain that equals 2246 cubic inches or 1.3 cubic feet.

$$1.3 \text{ cubic ft.} \times 7.479 = 9.7227 \text{ gallons}$$

This is the amount of water that would fall on one square foot of area in a one hour period. Dividing by 60 would convert to the amount of water falling per minute.

$$9.7227 \text{gal/hr} \div 60 \text{ min} = 0.162 \text{ gal/min/ft}^2$$

Practically speaking, this means that a foundation drain that flows as little as 2 gal/min/ft has a safety factor 12.34 times the amount of water generated in a worst case storm in the area of the United States with highest rainfall averages.

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Infiltration Rate

The second factor, the infiltration ratio, is based on the amount of natural or impervious surfaces around the building. Because of this, the actual amount of water reaching the geocomposite drain would be even less. Using the highest infiltration rate (the rate for natural ground cover), the potential water reaching the drain mat is further reduced as follows:

$$0.162\ gal/min/ft^2 \times 50\% = 0.081\ gal/min/ft^2$$

In urban areas with more built area, where 35-50% of the land is covered with impervious materials, the potential water reaching the drain mat is again further reduced.

$$0.162\ gal/min/ft^2 \times 35\% = 0.0567\ gal/min/ft^2$$

In this case, a foundation drain that flows only 2 gal/min/ft has a safety factor 35.27 times the projected water flow. Refer to an Enkadrain data sheet flow rates and you can easily determine the safety factor for your project.

Ground Cover	Runoff	Evapotranspiration	Shallow Infiltration	Deep Infiltration	Total Infiltration
Natural	*10%*	*40%*	*25%*	*25%*	*50%*
10-20% Impervious	*20%*	*38%*	*21%*	*21%*	*42%*
35-50% Impervious	*30%*	*35%*	*20%*	*15%*	*35%*
75-100% Impervious	*55%*	*30%*	*10%*	*5%*	*15%*

Vertical Soil Pressures

The third factor to consider is the pressure of the soil on the geocomposite drain. Basically, geocomposite drains can be evaluated for horizontal applications such as plaza drains, roof gardens or green roofs, or vertical applications such as foundation or retaining walls.

The active earth pressure (Pa) can be determined by multiplying the unit weight of the soil (γ) by the Coefficient of Earth Pressure (k) by the height of the wall (h) as shown in this formula:

$$P_a = \gamma \times k \times h$$

Unit Weight of Soil

The unit weight of the soil (γ) is found on the Soils Report for the project. Typical soils will range from 90 lb/ft^3 for loose sand, up to about 130 lb/ft^3.

Height of Wall

The height of the wall (h) is measured in feet from the top of the finished grade to the bottom of the wall.

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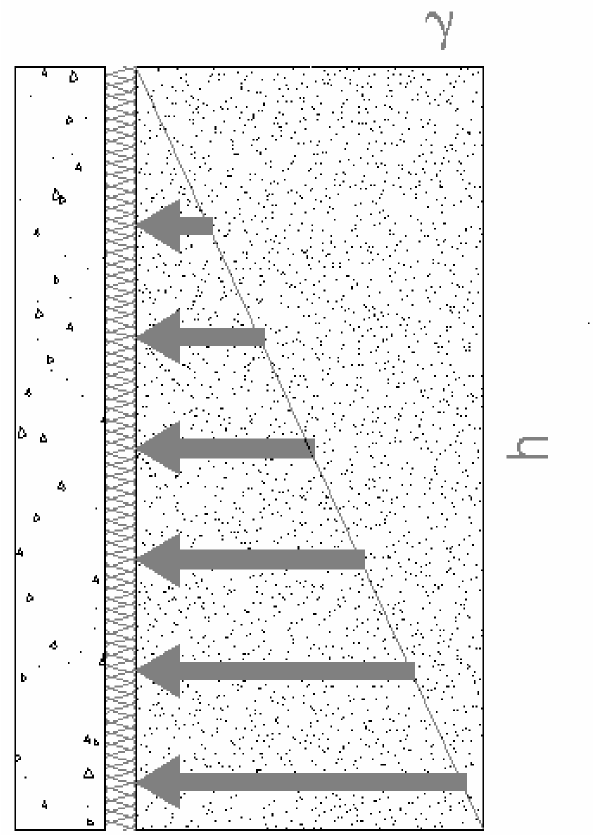
Coefficient of Earth Pressure

The Coefficient of Earth Pressure is based on different soil types. Soils that are very cohesive have a higher Coefficient of Earth Pressure because the soil particles stick together and less lateral loads are placed on the wall. Soils that are more sandy are more cohesion-less and transfer more loads to the retaining wall. The Coefficient of Earth Pressure for basic soil types are as follows:

Soil Type	Coefficient (k)
Sands	*.25*
Silty Sands	*.33*
Clayey Sands	*.42*

Soil Type	Coefficient (k)
Sandy Clay	*.56*
Silty Clay	*.67*
Clay	*.83*

Wall Diagram



Example

If we assume a clayey sand soil (coefficient of .42), with a unit soil weight of 110 lb/ft^3 and wall height of 30 feet, the maximum pressure at the base of the wall can be determined as follows:

$$P_a = 110\ lb/ft^3 \times .42 \times 30\ ft$$

$$P_a = 1386\ lb/ft^2$$

Using the Enkadrain data sheet, you can determine the anticipated water flow based on a very good estimation of the realistic soil pressures that can be expected.

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Subsurface Drainage Factors

Horizontal Soil Pressures

The formula for horizontal soil pressures is even simpler.

The active earth pressure (Pa) for horizontal applications can determined by multiplying the unit weight of the soil (γ) by the thickness of the soil cover (t) as shown in this formula:

$$P_a = \gamma \times t$$

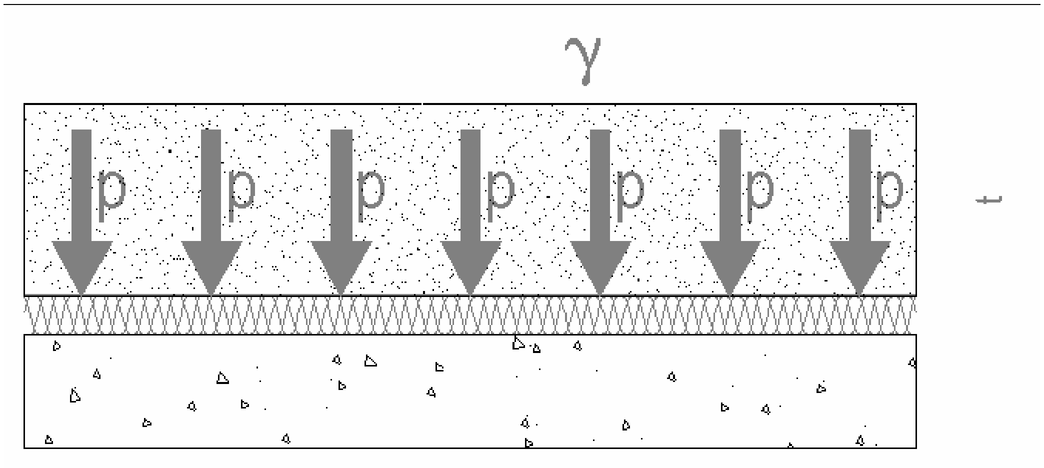
Unit Weight of Soil

The unit weight of the soil (γ) is again found on the Soils Report. Typical soils range from 90 lb/ft^3 for loose sand, up to about 130 lb/ft^3.

Thickness of Soil

The thickness of the soil cover (t) is measured in feet from the top of the drainage composite to the top of the finished grade.

Slab Diagram



Example

If we assume a unit soil weight of 110 lb/ft^3 and soil cover thickness of 2 feet, the maximum pressure at the slab can be determined as follows:

$$P_a = 110\ lb/ft^3 \times 2\ ft$$

$$P_a = 220\ lb/ft^2$$

Using the Enkadrain data sheet, you can determine the anticipated water flow based on a very good estimation of the realistic soil pressures that can be expected.

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