

4th Year Civil

Public Works Department

Foundation Engineering

فونڈیشن رابھہ

رُشخالی

2012 - 2013

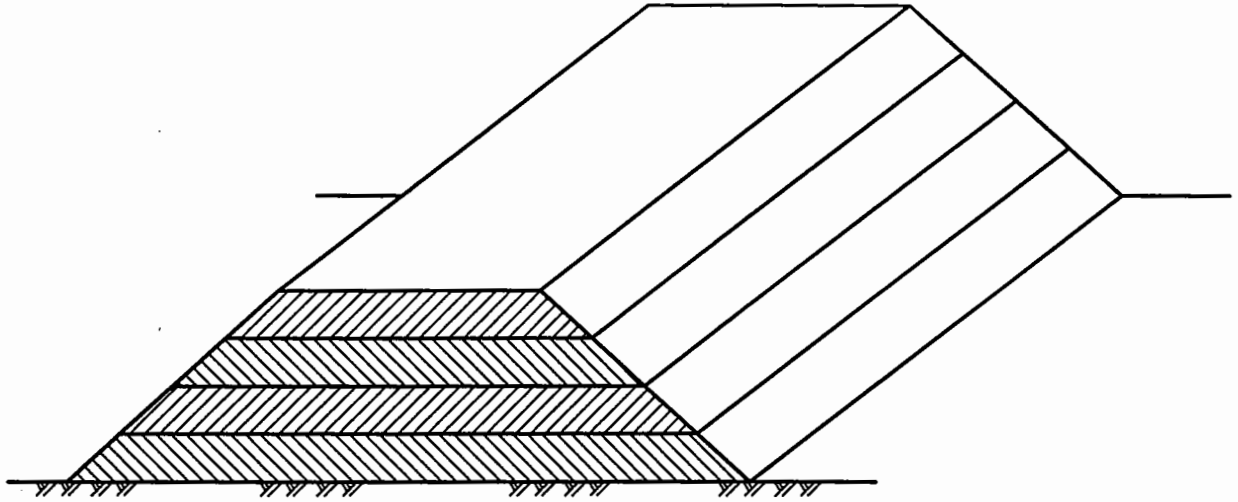
م. محمود فوزی

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Earth Embankment

Earth Embankment



Introduction :

الجسور الترابية هي كمية كبيرة من الردم يتم وضعها فوق التربة على طبقات مع مراعاة دمك كل طبقة حتى نصل للارتفاع المطلوب ويتم عمل ميول جانبية حتى لا يحدث انهيار للجسر .

Earth Embankment is a massive quantity of Fill that is constructed over foundation soil by a compacted layers until reach the required height we have to make side slopes to avoid embankment breakdown

استخدامات الجسور الترابية :

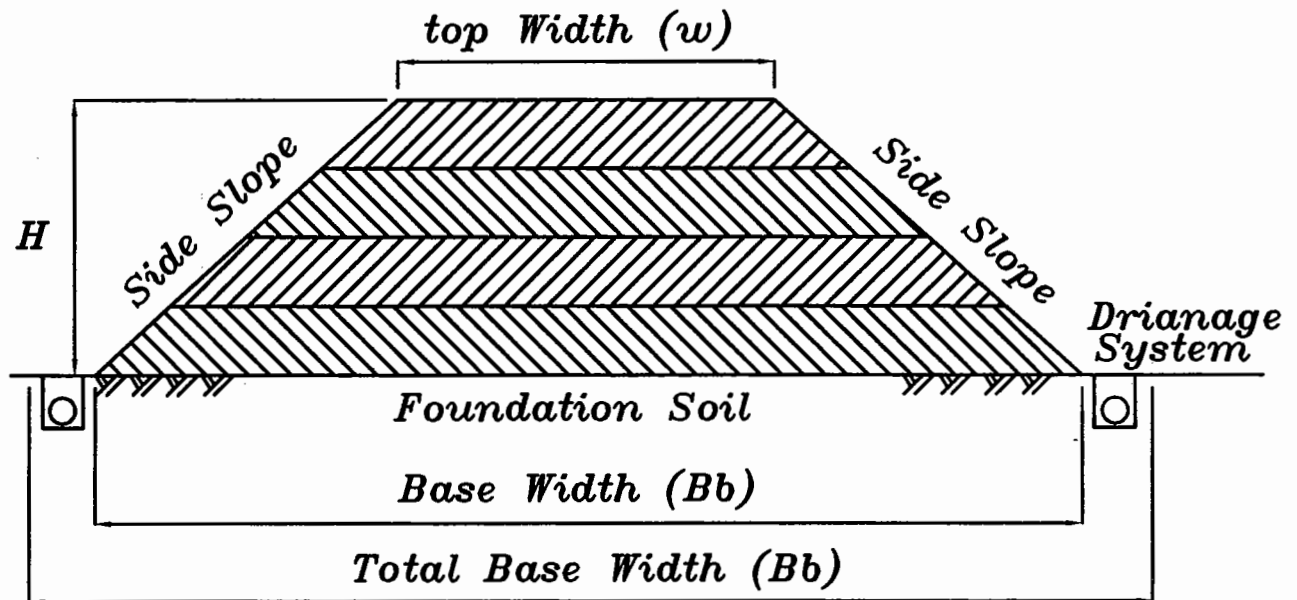
① في حالة تحسين التربة قبل الانشاء يتم وضع كمية من الردم فوق التربة لتحسين خواصها مثل تقليل الهبوط .

① *In case of soil Improvement (preloading) before construction in order to improve soil properities such as decrease settlement.*

② فى مشاريع النقل مثل الطرق و السكك الحديدية .

② In Transportation Projects such as Roads and Railways.

Embankment Geometry :



① Embankment top width (W) :

Top width depends on Road width, traffic requirements and sidewalk width.

② Embankment Height (H) :

Height depends on Road level, Ground level, and loads estimated over the embankment.

③ Embankment Side Slopes :

Side slope depends on Soil Properties (γ, ϕ, c), Foundation soil Properties, Embankment height, Loads on embankment and the total base width.

④ Embankment Base width (B_b) :

Base width depends on Top width, Height and the side slope.

⑤ Embankment total Base width (B_a) :

Total Base width depends on Base width, Drainage system and the allowable width.

Properties of Embankment Soil :

- ① *It's preferred to use Cohesionless Soil (sand or gravel) because of the big Settlement value of the cohesive soil.*
- ② *It's preferred to use well graded Soil because of the low settlement and high shear resistance of the well graded cohesionless soil.*
- ③ *Embankment soil must be free of any organic materials.*
- ④ *In case of using mixture of sand and gravel we have to make compaction test to choose the mixing ratio that achieve the highest density of soil.*
- ⑤ *It's allowed to use Boulders in embankment soil which diameter not more than the layer thickness.*
- ⑥ *The water content (WC) is preferred to be less than the optimum moisture content (OMC) required, then we can add enough water in site to reach the (OMC).*

⑦ If the (WC) increased over the (OMC) we have to let the soil enough time in a fresh air till it get dry.

⑧ soft materials must be not more than 10–15%.

Design stages for Earth Embankment :

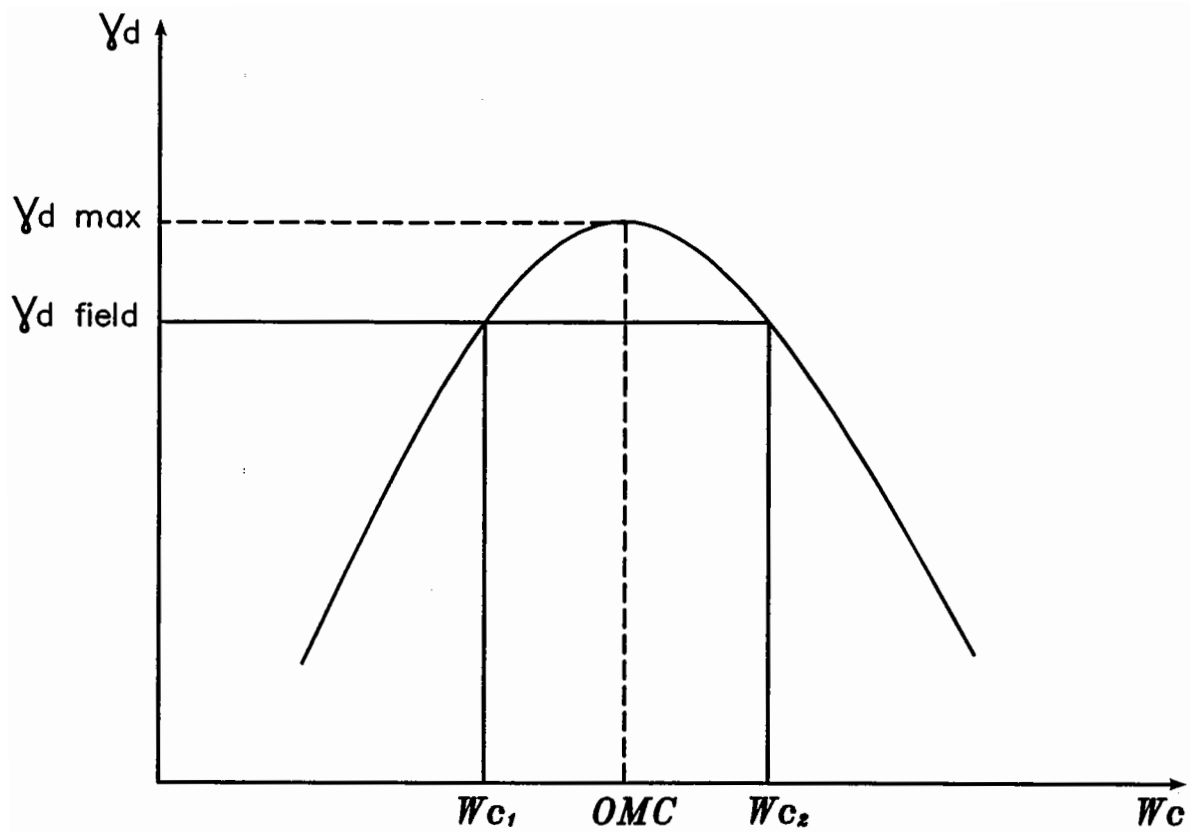
① Pre-Design Stage :

- ① Geological investigation of project area.
- ② Topography Study of project area.
- ③ Weather Conditions study of project area.
- ④ Seismology study of project area.
- ⑤ Subsurface exploration using boreholes.
- ⑥ Field tests of foundation soil.
- ⑦ Determination of loads on Embankment.

② Main Design Stage :

In this stage we have to study the properties of the selected soil of embankment as shown :

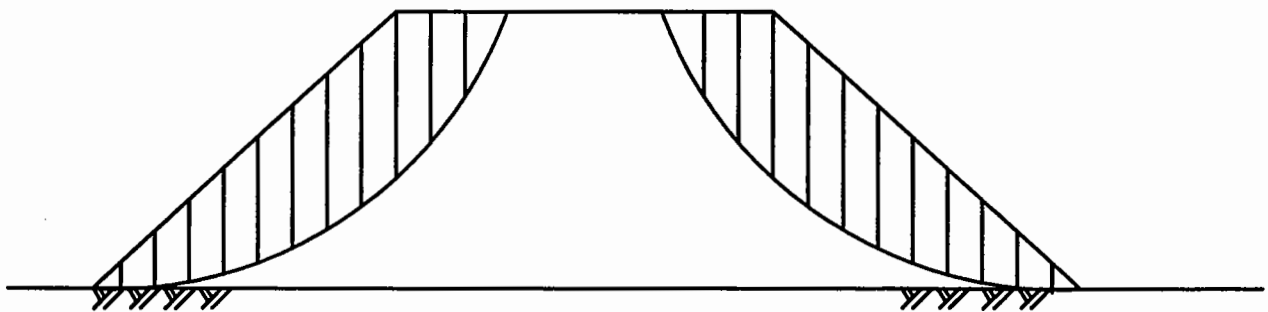
- ① Properties of embankment materials :
Shear strength parameters (C , ϕ).
Compressibility (E , M_v).
- ② Compaction characteristics from proctor test we have to determine The Max Dry Density ($\gamma_d \text{ max}$), Optimum Moisture Content (OMC), Field Dry Density ($\gamma_d \text{ field}$) and the range of water content for field compaction (W_{c1} – W_{c2}).



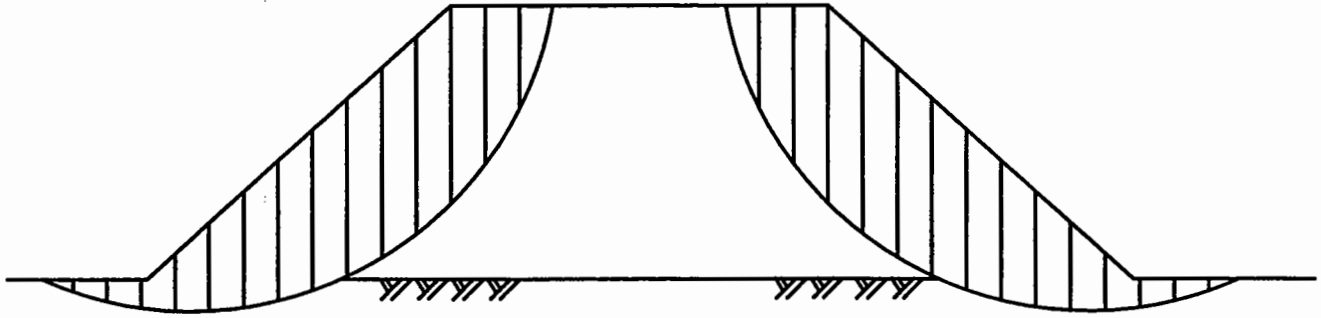
③ Embankment Side Slopes Stability

Two modes of Failure must be considered:

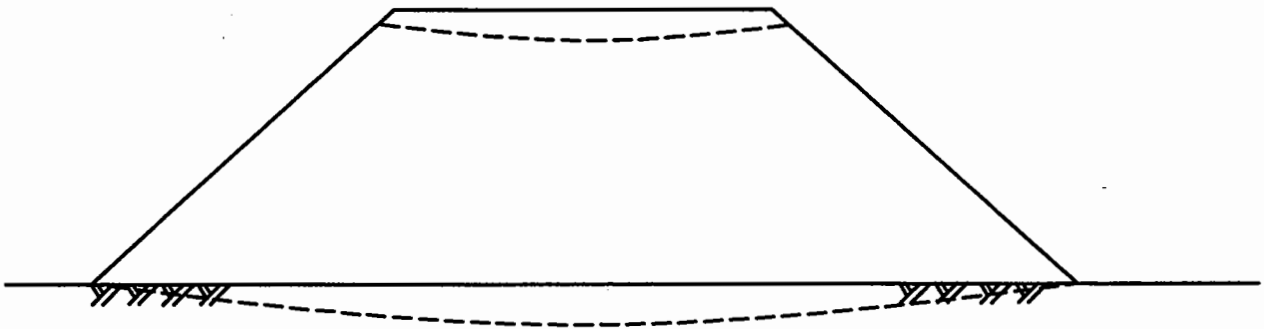
① Toe Failure



① *Base Failure*



④ *Embankment Settlement*



Embankment Settlement due to Foundation soil settlement and embankment material settlement.