FAILURE OF THE FIRST CARSINGTON EARTH EMBANKMENT DAM IN THE UNITED KINGDOM

SUMMARY

From 1981 to 1984, a UK local water authority erected a 1225m long and 35m long earth-filled embankment in England. The Dam was purposefully built to be the best significant land dams in the United Kingdom. Its reservoir ability was increased to 35 million m3, and the waterproof element was transformed into a laminated clay core with an upstream delay of the formed truss and shoulders of compacted sandstone with approximately 4 meters of horizontal draining layers of crushed limestone and a reduced mortar curtain (Davey and Eccles, 1983).

The downstream slope increased to 1:2.5, while the upstream slope increased to 1:3. The filling began in May 1982 and continued for three summers, with freezing intervals in between. weight of construction Ground fill resumed in April 1984, dropping one meter below the eventual ridge level when the upstream slope slipped on June 4, 1984. (Skempton 1985). Horizontal sections and displacements have been recorded since August 1983. The Carsington Dam was nearing completion in 1984.

However, in early June 1984, a 400-meter piece of the shoulder upstream of the dam plummeted 11 meters and became lost. The embankment was virtually finished at the time of the disaster, with a height of 35m. Horizontal drainage covers were built on the shale fill abutments upstream and downstream. The failure surface penetrated the truss-rolled clay formed in the middle, as well as a very thin layer of soil clay within the dam foundation. Carsington's opportunity study contributed significantly to the essential consideration of the dynamics of major land transfers of this type (Vaughan et al., 1989; dounias et al., 1996).

The Carsington earth embankment dam is analyzed utilizing and applying superior geotechnical engineering assessment equipment and modelling methodologies.

Figure 1 SITE MAP

Figure 2 STUDY AREA MAP

The Bishop approach was used to evaluate the slope stability of the mentioned dam.

INTRODUCTION

The above-mentioned Dam and its foundations have been evaluated and constructed to fail as a result of unstable slopes.

Concerns about loading situations, which can also lead to instability, were taken into account for all possible combinations of the tank and leakage phases, infiltration conditions, both after and during construction, and then three phases were specifically studied creation and/or loading, as follows:

1. Case i: Construction Situation

The primary dangerous scenario to consider is toward the conclusion of the dam's construction, but before the water fills. There may be no groundwater donation in the reservoir and embankment dam body in this case. In this loading instance, general or undrained soil shear strength characteristics are applied.

2. Case ii: infiltration Situation.

The second critical situation to consider is when the reservoir is filled with water and significant state leakage is installed in the dam. Within the context of the embankment dam, a water table under the cohesive infiltration domain is present in this scenario. At an earlier stage, the profile of the aquifer in the reservoir and the form of the dam at Carsington is seen. The cutting power settings are employed in this scenario of load, strong, or weary soils.

3. Case iii: Drawdown Situation

Rapidly reducing the reservoir's water level might jeopardize the stability of the upstream face, owing to the elimination of support water and the development of adverse infiltration forces in the tank's body. In this situation, there is no water in the reservoir, yet there are still water pressures with full pores in the body of the embankment dam. Effective or drained soil shear strength characteristics are also employed in this loading condition.

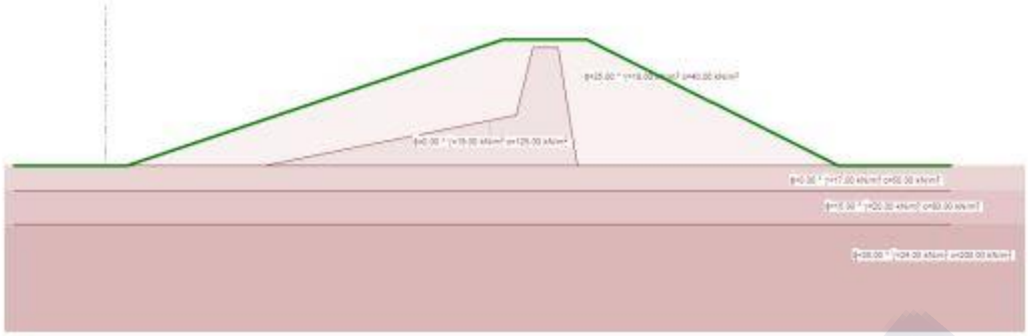
CASE I

Analysis of Slope Stability Immediately Following Construction State

A model representing,

- the form of the dam and its subgrade covers with all functional stresses was used for the analysis.
- As seen in the figure, the model was created utilizing correct measurements at a suitable scale.
- Absence of groundwater in the basin and the embankment dam body
- Soil resistance characteristics to total or undrained shear
- Seismic actions were not considered.

The minimal overall safety stability factor for load scenario I was determined to be 0.96, indicating imminent failure circumstances, immediately after the completion of the Carsington earth dam but before water filling. The findings of the computed analysis are depicted in the figures below.



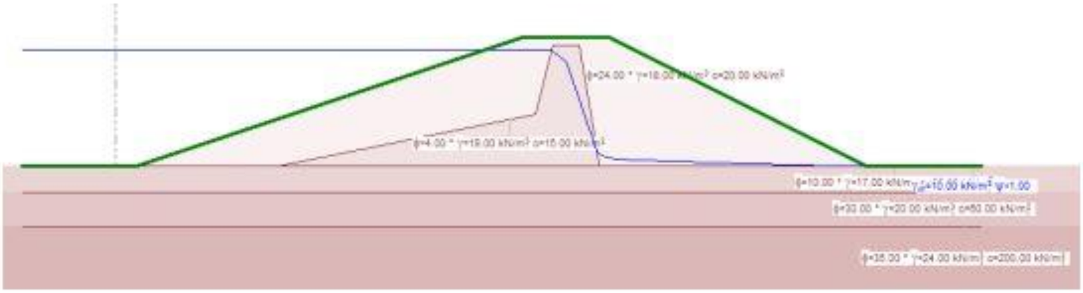
CASE ii

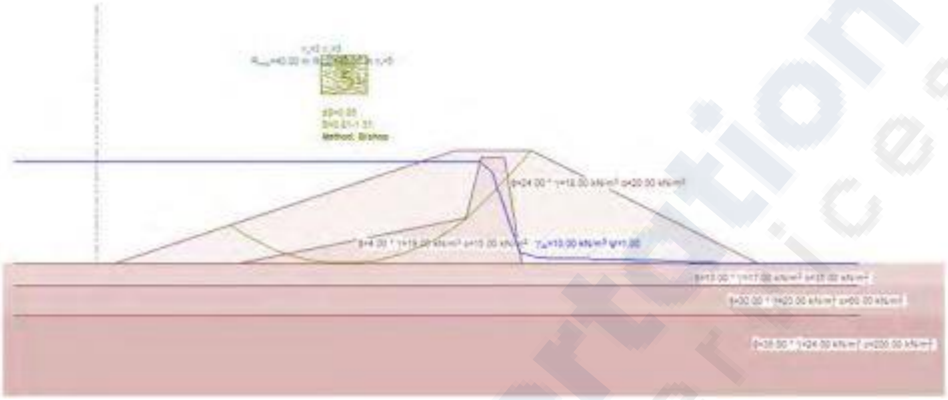
The Results of the Slope's Stability Study for A Given Infiltration Condition

When the tank is full with water and certain stationary permanent infiltrates in the Carsington Earth Embankment Dam are built, the to be investigated is.

A model representing,

- the dam body and its subgrade covers with all practical stresses were used for the analysis.
- As seen in the figure, the model was created utilizing correct measurements at a suitable scale.
- Absence of groundwater in the basin and the embankment dam body
- Soil resistance characteristics to total or undrained shear
- Seismic actions were not considered.
- Soil shear resistance characteristics that are effective or drained



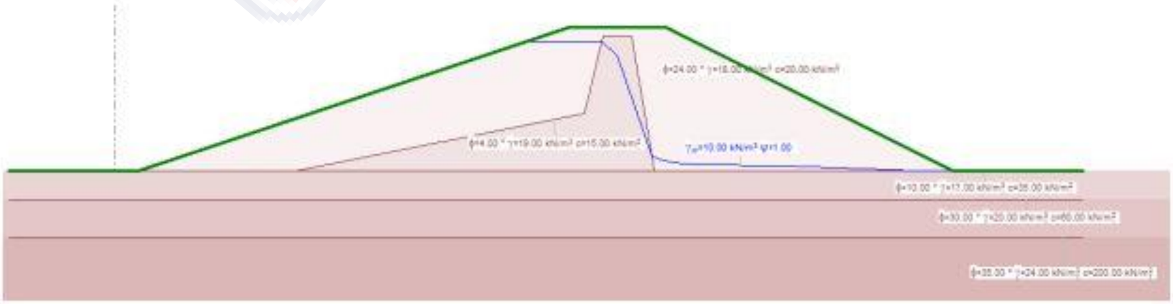


RESULTS

A model representing,

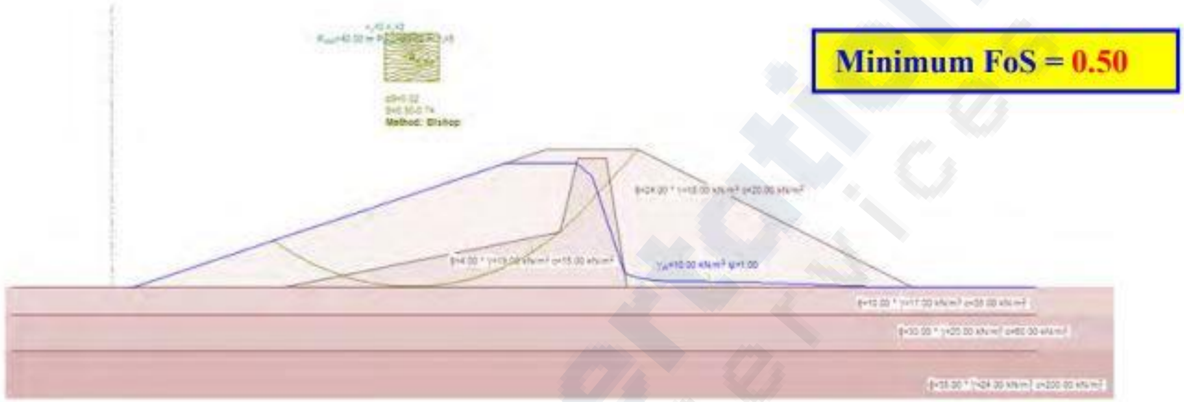
- the dam body and its subgrade covers with all practical stresses were used for the analysis.
- As seen in the figure, the model was created utilizing correct measurements at a suitable scale.
- Absence of groundwater in the basin and the embankment dam body
- Soil resistance characteristics to total or undrained shear
- Seismic actions were not considered.
- Soil shear resistance characteristics that are effective or drained

The Bishop technique is used to analyze slope stability. The minimal overall safety stability factor for load case, i.e. when the tank water level drops rapidly, was determined to be 0.50, indicating absolute and imminent failure circumstances. The findings of the computed analysis are depicted in the figures below.



The shear strength reduction (SSR) analysis method, based on the Finite Element Analysis (FEA) technique, was used to analyze the dam’s slope stability for the load, that is, immediately after the build condition of the dam but before full it with water.

The civil and geotechnical engineering specialized computer program was used to perform the Shear Strength Reduction (SSR) analysis of Carsington immediately after construction on the downstream side of the slope.



ANALYSIS OF THE SLOPE STABILITY BY THE SHEAR RESISTANCE REDUCTION (F.E.A.)

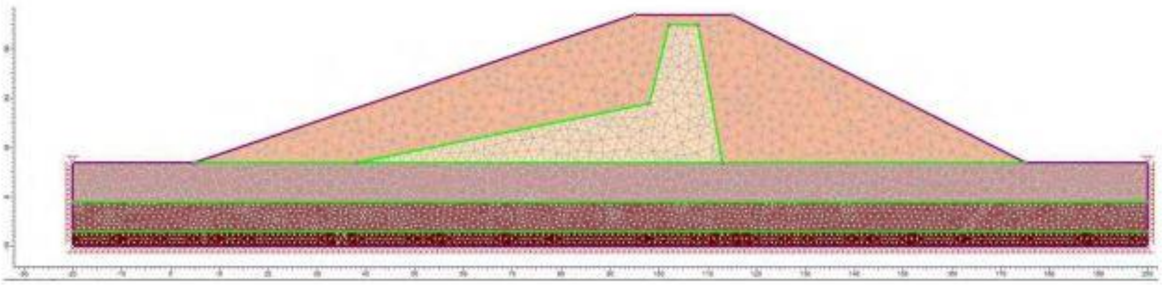
To validate the overall slope stability analysis of the entire dam, a reduction of shear strength (SSR) Method analysis was performed for the load, i.e. immediately after the state of construction of the dam but before the filling of water, using Finite Element Analysis (FEA) technique.

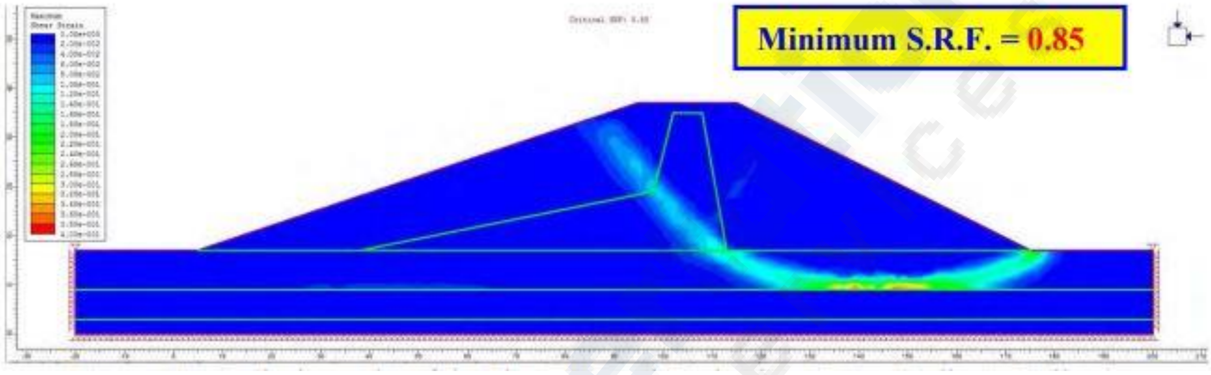
According to the study's conclusions, the downstream slope side of the dam is critical immediately after construction.. According to the Shear Reduction Analysis (SSR) approach, the overall safety factor (FoS) or resistance reduction factor (SRF) for the whole structure of the dam is 0.85, showing the dam's collapse conditions

All Data Input

- Discretization and the Mesh
- Discretization and the Mesh
- The Mesh, as well as the border situations,
- The properties of the material
- The result of S.R.F.

The below figures are about the (S.S.R.) analytical model is briefly presented in the picture below:





LEARNED LESSON

- As more strength and performance data is acquired, the design should be analyzed;
- Design safety components should be checked; and
- Engineering information and assessment should be communicated to the location, the contractor, and the customer as needed.

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