# MEMO

## Subject:

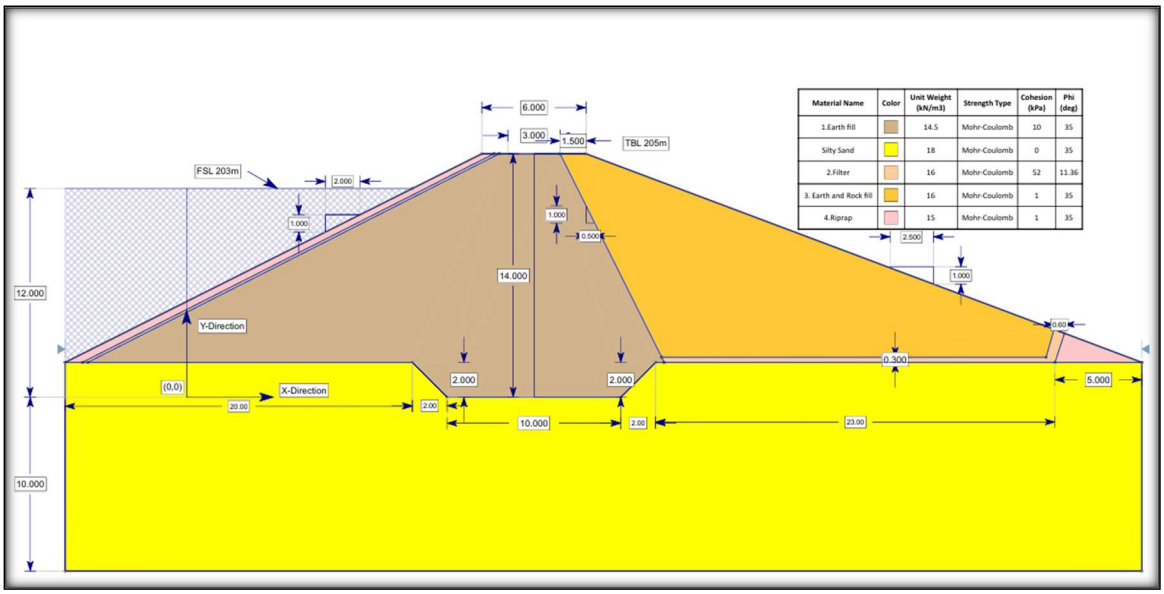
Seepage Analysis of Dam Cross Section

## Purpose:

To communicate the results of the seepage analysis and provide clear recommendations to address potential issues identified in the dam cross section scenario. This memo serves to inform stakeholders and guide decision-making towards enhancing dam stability and performance.

## Background:

The stability and performance of the dam are critical to prevent failures that can lead to catastrophic consequences. A seepage analysis has been conducted to understand the behavior of water through the dam's embankment and foundation. The study aims to assess potential risks and recommend solutions to ensure the dam's safety. **Geometric details have shown in Drawing1**.

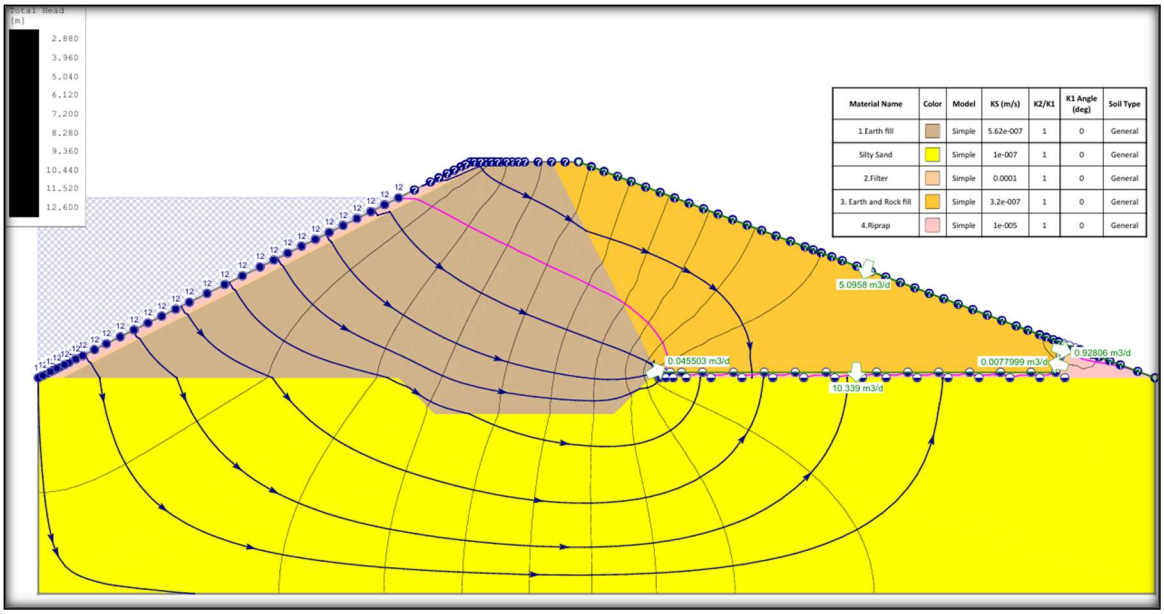



**Drawing1:Geometric details of the Embankment**

## Analysis and Findings:

**The analysis involved several key steps:**

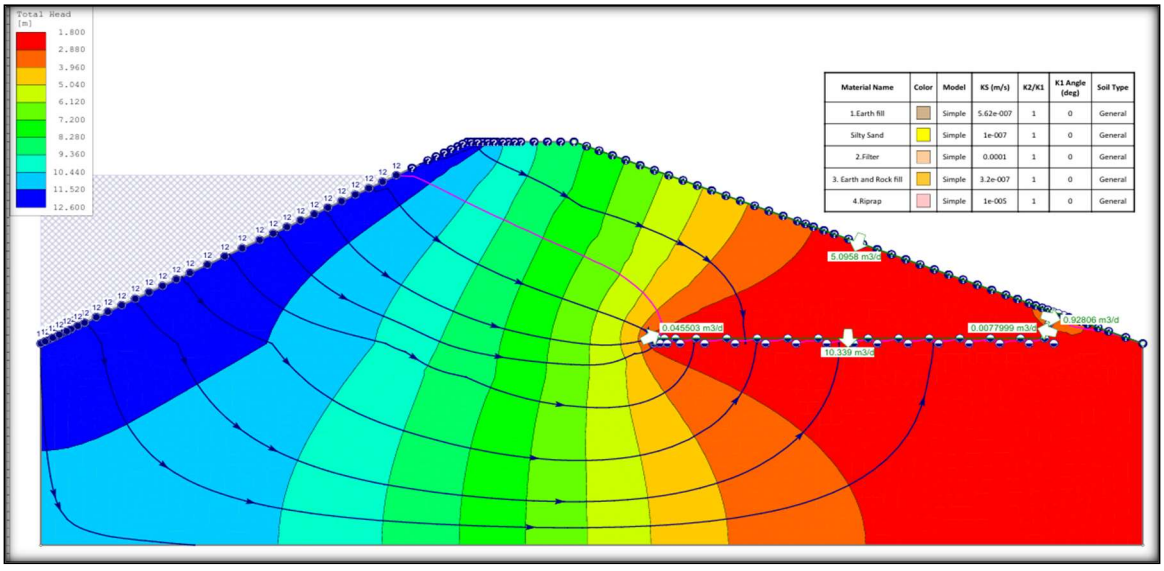
1. Determination of the Phreatic Surface: The phreatic surface through the embankment was identified to understand the water flow within the dam structure. **Shown with the Magenta (Pink) color in the Drawing2.**




**Drawing2: Showing Phreatic Line with the Magenta (Pink color), Stram lines and Equipotential lines**

2. Under-Seepage Flow Through the Foundation: The flow of water through the foundation was measured to evaluate potential seepage that could undermine the dam's stability. **Streamlines and Equipotential lines drawn and hydraulic properties are shown in the Drawing2.**

3. Quantity of Seepage Through the Downstream Base Filter Layer: The amount of water seeping through the downstream base filter layer was calculated to ensure it is within safe limits. **Found that the seepage through Dam with filter is 0.928m$^3$/day as shown in drawing 3.**




**Drawing 3: Showing seepage through Dam with filter is 0.928m$^3$/day**

4. Exit Gradient and Factor of Safety Against Blowout Condition: The exit gradient was determined to assess the risk of soil particles being carried away by seepage, and the factor of safety against blowout conditions was calculated to ensure the dam's integrity.

$$ie = \frac{\Delta h}{L} = \frac{12m}{63.65} = 0.18$$

Safe Exit gradient for sand is 1/5 (0.2) hence the embankment is safe against blowout test.

## Results:

- The phreatic surface was mapped and indicated areas of potential concern where water flow might concentrate.
- Under-seepage through the foundation was quantified, revealing specific zones where mitigation might be necessary.
- The quantity of seepage through the downstream base filter layer was found to be within acceptable limits, but continuous monitoring is recommended.
- The exit gradient analysis showed that the current design maintains a factor of safety above the required threshold, indicating a low risk of blowout under normal operating conditions.

## Recommendations:

1. Regular Monitoring: Implement a regular monitoring program to track changes in the phreatic surface and under-seepage flow.
2. Foundation Improvements: Consider reinforcing the foundation in identified high-risk areas to prevent excessive under-seepage.
3. Enhance Base Filter Layer: Improve the downstream base filter layer to handle potential increases in seepage quantity over time.
4. Safety Margins: Maintain and, if possible, increase the factor of safety against blowout by reinforcing vulnerable sections of the dam.

## Conclusion:

The seepage analysis provides a comprehensive understanding of the water flow dynamics through the dam's structure. While the current design maintains safety, proactive measures and regular monitoring are essential to ensure long-term stability. Implementing the recommended actions will enhance the dam's performance and mitigate potential risks, ensuring its continued safe operation.