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# COMPARISON OF SEEP/W SIMULATION WITH OBSERVED SEEPAGE IN EARTHEN DAM

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## ABSTRACT

The present research work is designed to compare the seepage of earthen dam using finite element based software GEOSTUDIO subproduct SEEP/W with field observed seepage through earthen dam. GEOSTUDIO software is capable to perform analysis such as, stress-strain, seepage, slope stability, dynamic analysis. SEEP/W ,a subproduct of GEOSTUDIO is a finite element software which can simulate the movement and pore-water pressure distribution within porous materials like soil and rock. In present work the seepage of water through earthen portion of Ujjani dam ,an earthfill cum masonary dam in Maharashtra is computed and phreatic line is simulated for single chainage. The observed actual field results of seepage are compared with results obtained by GEOSTUDIO software sub product SEEP/W.

**KEYWORDS**: *seepage, numerical simulation, Finite element Method, groundwater, SEEP/W, earthen dam*

## INTRODUCTION

Any dam failure or accident to dam can cause potential hazard to property and lives of millions of people who dwell downstream of the dam. The life of a dam can be threatened by natural phenomena such as floods , rock slides, earthquake and deterioration of the foundation and construction materials. The records of failures of dams indicate that earth fill have involved in the largest number of failures followed by gravity dams, rock fills and multiple and single arches. Each type of dam has its own characteristic mode of failure. A gravity dam may collapse only in the section which is over stressed. A buttress dam may fail like a pack of cards through the successive collapse of its buttresses. The rupture of an arch may be sudden and complete. Failure of an embankment may be relatively slow with erosion progressing laterally and downward and accelerating as the flood tears through the breach. The dams are national property constructed for the development of national economy and in which large investments and other resources are deployed. The safety of the dams is very important aspect for safeguarding the national investment and the benefits derived by the nation from the project. In present study ,seepage analysis of Ujjani dam ,an earthfill cum masonary dam in Solapur district ,Maharashtra has been performed using element based software "GEOSTUDIO". The sub product of GEOSTUDIO ie.SEEP/W has been used for seepage analysis through earthen dam portion of dam.

## MATERIALS AND METHODS

Ujjani dam is built on the Bhima River. Bhima is a tributary of the Krishna River . It originates in Bhimashankar of the Western Ghats and forms the Bhima Valley with its tributary located near Ujjani village of Madha Taluka in Solapur district of the state of Maharashtra. Ujjani dam is an earthfill cum Masonry gravity dam. About twenty-two dams built on Bhima river of which the Ujjani Dam is the terminal dam on the river . It is the largest in the valley that intercepts a catchment area of 14,858 $km^2$ (which includes a free catchment of 9,766 $km^2$. In present study earthen crossection of dam at CH.1950 is selected for seepage modeling using SEEP/W.

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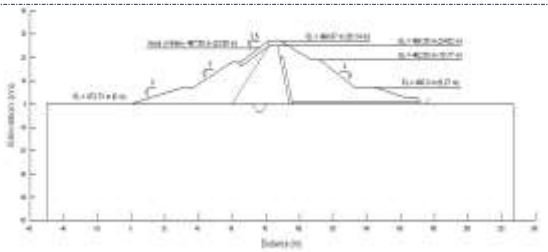

*Fig 1 : Crossection Of Ujjani Dam At CH :1950*

**SEEP/W Software**

A numerical model is nothing but mathematical simulation of a real physical process. SEEP/W is a numerical model that can mathematically simulate the real physical process of water flowing through a particulate medium. SEEP/W is sub product of GEOSTUDIO software. It is finite element based software . finite element analysis consist of three main parts : 1) creating the numerical domain, including the selection of an appropriate geometry and creating the discretized mesh, 2) specification of material properties to the various sub-regions of the domain,3) specification of the appropriate boundary conditions. 4) comparisons of field data and simulated seepage 5) model validation and calibration.In present research work a computer model has been developed for Ujjani dam at different reservoir level ranging from FRL to LWL using above steps of SEEP/W modeling. The table I shows the actual field values of seepage and simulated one for different reservoir levels of dam.

## RESULTS

**Calibration of Material Properties**

For calibration of material properties for the earthen section of the Ujjani dam, initially identical guess values were specified for all the sections. These guess values for different types of materials used in the dam are presented below in Table 1. Calibration of the material properties is made on the basis of minimization of error while comparing observed discharge with the simulated one.

*Table 2.Material Properties*

| Sr. No | Material Type | Hydraulic Conductivity (m/Sec) |
|---|---|---|
| 01 | Foundation | $10^{-4}$ to $10^{-6}$ |
| 02 | Shell | $10^{-5}$ to $10^{-6}$ |
| 03 | Core | $10^{-7}$ to $10^{-8}$ |
| 04 | Murum | $10^{-5}$ x $10^{-6}$ |
| 05 | Filter Blanket | $10^{-2}$ |

Source: Water Resources Dept., Maharashtra
(Guess values)

*Table 2.Calibrated Values Of Material Properties*

| Sr. No | Material type | Hydraulic conductivity (m/sec) |
|---|---|---|
| 01 | Foundation | $9.189 \times 10^{-6}$ |
| 02 | Shell | $7.268 \times 10^{-5}$ |
| 03 | Core | $6.096 \times 10^{-8}$ |
| 04 | Murum | $9.572 \times 10^{-5}$ |
| 05 | Filter Blanket | $4.475 \times 10^{-2}$ |

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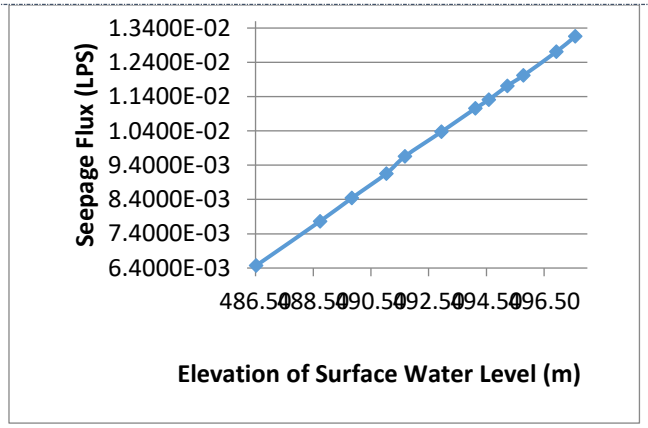


*Fig 2: Simulated Seepage Flux Vs. Surface Water Level For Selected Cross Section At CH:1950*

*Table 3.Computed Seepage Flux At Different Reservoir Levels*

| Sr. No | Distance from U/S Ground Level to Water Surface Level | Simulated Seepage Flux ($m^3$/sec/m) | Actual observed Seepage Flux ($m^3$/sec/m) |
|---|---|---|---|
| 1 | 497.58 | 1.31570E-05 | 1.289E-05 |
| 2 | 496.92 | 1.27070E-05 | 1.258E-05 |
| 3 | 495.78 | 1.20150E-05 | 1.214E-05 |
| 4 | 495.22 | 1.17090E-05 | 1.136E-05 |
| 5 | 494.58 | 1.13050E-05 | 1.108E-05 |
| 6 | 494.12 | 1.10560E-05 | 1.083E-05 |
| 7 | 492.94 | 1.03720E-05 | 1.027E-05 |
| 8 | 491.68 | 9.65740E-06 | 9.851E-06 |

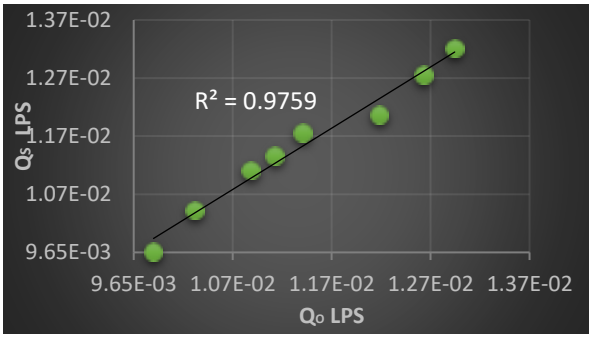


*Fig 3 : Relationship Between Observed And Simulated Seepage Flux At Different Hydraulic Heads*

## CONCLUSION

- The seepage flux is maximum (1.31X $10^{-5}m^3$/s/m) at MWL and it is minimum (9.851 x$10^{-6}m^3$/s/m) at almost LWL.
- There is insignificant maximum relative error between the observed and computed seepage discharges.
- Hence this implies that SEEP/W can be efficiently used for seepage modelling.

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