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ANALYSIS AND DESIGN OF BRIDGE CUM VENTED DAM BY VARYING SAFE BEARING CAPACITY OF SOIL

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Abstract - It is true that bridge are constructed to enable the crossing of river in the monsoon. They are required to be designed so that the minimum obstruction is caused to flow during the monsoon structure. The bridge structure can be designed for a limited storage to serve as water retaining structure to ensure irrigation for a small area as well as to meet the need of drinking water animals and human beings. They also serve as an ideal structure to ensure water recharging of the ground. This project focuses on the analysis and design of various components of Bridge cum Vented Dam. The Bridge cum Vented Dam is analyzed under different Safe Bearing Capacity and results are represented in tables and also the graphs for the better understanding. In the current project the structural components are been analyzed and designed and for the safe design the Bridge cum Vented Dam is designed under ultimate loadings using the method of "Limit State under many load and load combinations using Staad Pro Software. The structure is checked for the stability analysis.The structure is tested for serviceability requirements like limitation on Cracking. The approaches to the Vented Dam on left bank and right bank are through road embankments having width of 7.500m. The road shall be Water Bound Macadam road. The bridge is designed for IRC Class-A loading which is severe as the load will be that of the wt. of gate lifted by gantry. Trajectory bucket type of energy dissipating arrangement is designed at the deep channel. Sluice gate and stop logs gate with crane arrangements is provided for the operation of flow of the water.

Key Words**:** *Bridge cum Vented Dam, Safe Bearing Capacity, and Energy Dissipating arrangements.*

1. INTRODUCTION

A Vented is a type of low-head, diversion dam which consists of a number of large gates that can be opened or closed to control the amount of water passing through. This allows the structure to regulate and stabilize river water elevation upstream for use in irrigation and other systems. The gates are set between flanking piers which are responsible for supporting the water load of the pool created.

In the recent developments in irrigation, the concept of building low height dam all along the river was introduced on the downstream of bigger dam, or along the river to store water after rainy season is over so can be used for agriculture purpose as well for drinking.

Bridge cum Vented Dam serves the purpose of both storage and connectivity between the two villages. These dam will servers the purpose of storage for irrigation purposes and serves the connectivity between two places.

The main objective of this study is to Design of Bridge cum Vented dam for the length of 342m, providing 21 no's of Vertical lift gates + 3 Bays of un-gated ogee spillway and 2 nos. of river sluice of 1.0 m x 1.5 m provided in the deep channel portion and Compare the Staad Analysis ouput results of Bridge cum Barrage under the different Soil Condition.

2. Methodology

- To prepare a General Arrangements (GAD) for the Design of Bridge cum Vented Dam
- To study the different components of Bridge cum Vented Dam.
- To study the various loads acting on Bridge cum Vented Dam.
- Analysis of the Bridge cum Vented Dam.
- Comparative study of analysis results for varying Safe Bearing Capacity.
- Design of different components of Bridge cum Vented Dam

  The Bridge cum Vented Dam modelling has been carried out by using STAAD Pro connect edition software. The modelling of structure of Bridge cum Vented Dam are created using quadrilateral plates. Subsequently, the various loads acting on the structure are calculated and applied on the model.

Load and Load Cases:

Following load condition are considered for the design of Bridge cum Vented Dam:

a) CASE 1 : WATER PRESSURE FOR HFL
b) CASE 2 : WATER PRESSURE FOR FRL
c) CASE 3 : WATER PRSSURE FOR FRL (1 GATE CLOSED)
d) CASE 4 : WATER PRESSURE ACROSS FOR THE FLOW HFL
e) CASE 5 : WATER PRESSURE ACROSS FOR THE FLOW FRL
f) CASE 6 : WATER PRESSURE ACROSS FOR THE FLOW FRL (1 GATE CLOSED)

The following loads have been considered for analyzing the model as per standards:

1. Earthquake load +X
2. Earthquake load -X
3. Earthquake load +Z
4. Earthquake load +Z
5. Dead Load –Self weight of the structure.
6. Live Load-Live load on deck slab,Vehicular load.
7. Earth Pressure acting when water is up to HFL
8. Earth Pressure acting when water is up to FRL
9. Hydrostatic pressure for HFL
10. Hydrostatic pressure for FRL
11. Hydrostatic pressure for FRL (1 Gate Closed)
12. Hydrostatic pressure across the flow HFL
13. Hydrostatic pressure across the flow FRL
14. Hydrostatic pressure across the flow FRL (1 Gate closed)

Condition considered for Vented Dam structure are:

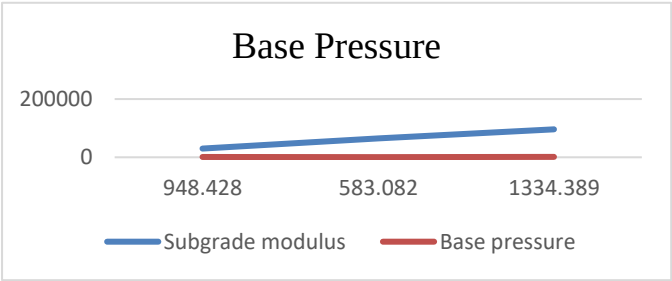
a. The Vented Dam raft is considered as continues raft between two piers and both top and bottom design reinforcement are calculated
b. The piers are designed for worst of the following operation condition
   - With both the gates closed
   - With one gate closed and one gate opened
   - The factor of safety against sliding resistance
c. Un-gated ogee spillway
   - Stability is checked as gravity structure.
   - Since the ogee spillway is Un-gated, the pier is checked for water flowing on both sides
   - The factor of safety against sliding resistance

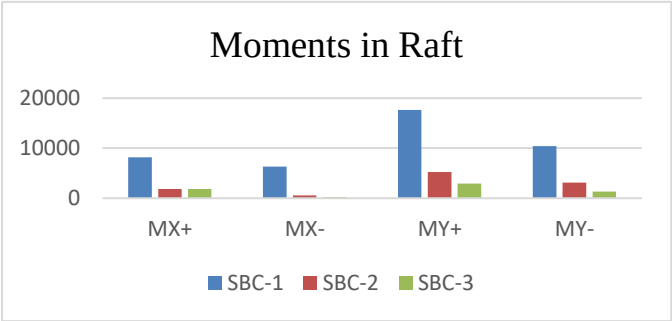
Fig 1: 3D View of Bridge cum Vented Dam

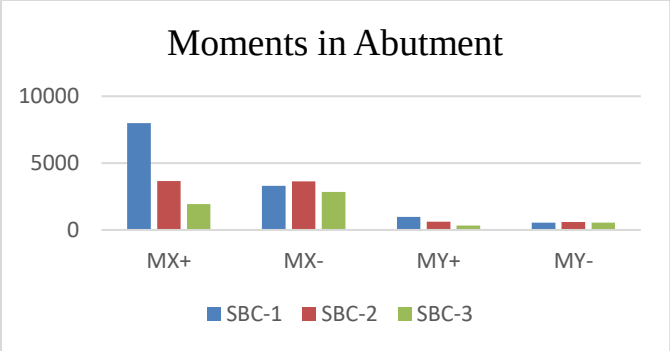
Analyzing model for Various Safe Bearing Capacity

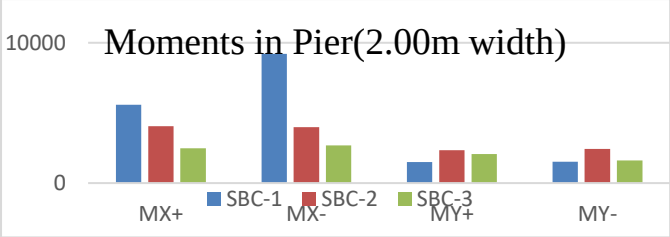
Model is analyzed for a 3 types of Bearing capacities by changing the subgrade modulus in Elastic Mat for 300kN/m^2 and Plastic Mat for 600kN/m^2 and 9600kN/m^2. In the raft foundation to simulate the soil support interaction effect soil subgrade modulus has been provided to all spring supports for raft.

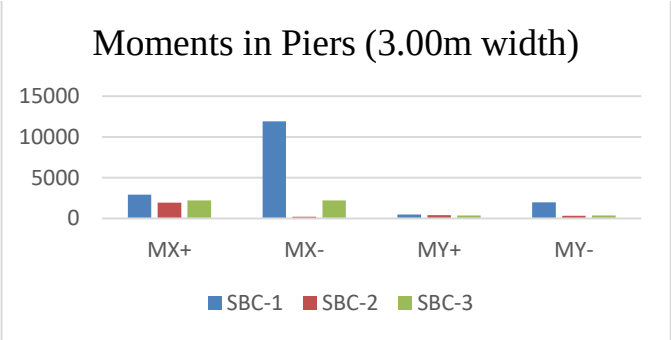
3.Results

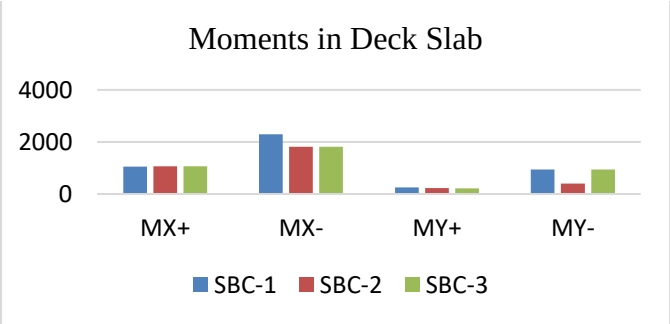


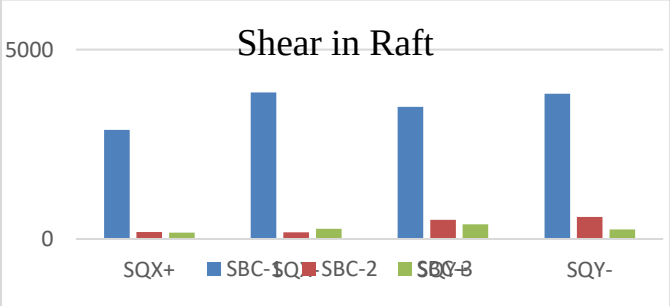


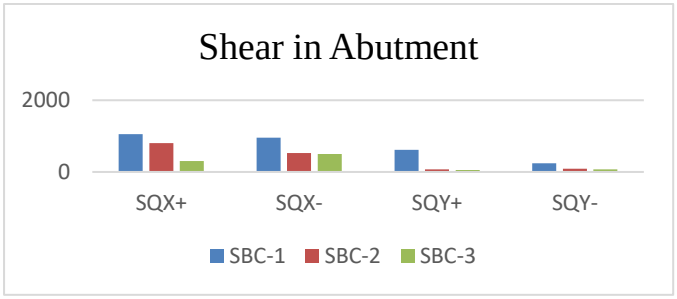


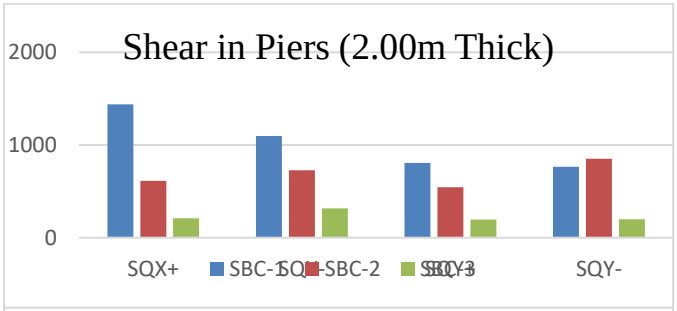


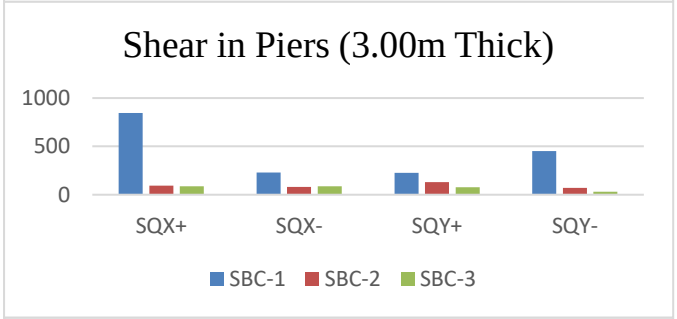


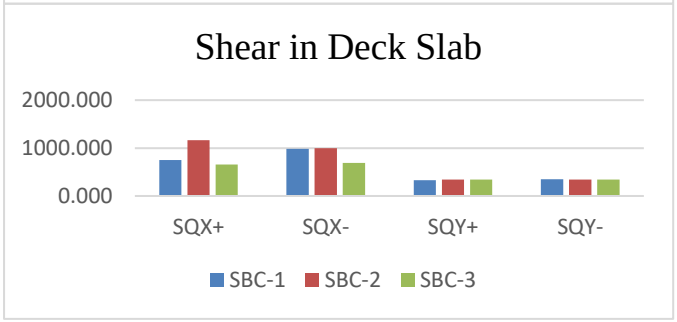












3. CONCLUSIONS

a) Underlaying foundation material plays major role in Stability and Economic design of structure.
b) As per analysis, we can conclude that the base pressure increases with the increase in the subgrade modulus.
c) The structure will be more economical when the available SBC of underlaying foundation material is more than the total pressure coming on it.
d) The size of the raft, pier becomes very large as we go on reducing subgrade modulus.
e) Construction of Bridge cum Vented Dam can also increase the ground water table and more water table and more water availability for irrigation.
f) The same way some contribution can be made to conserve water for a drought for tomorrow.

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