Analysis and Design of Dam Structures

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ABSTRACT
A dam also can be used to acquire water or for garage of water which can be calmly dispensed between places. Dams usually serve the primary reason of retain water; as different systems including floodgates or levees (additionally referred to as dikes) be use to handle or avoid run circulate particular land areas. This study focuses commonly on run-of-the-river hydroelectric systems underneath 5 megawatts (MW) implemented at a current dam.

Keywords: Levees, Dams, Flood and Gates

1. INTRODUCTION
Hydropower makes use of the downward force of water to show mills and generate energy. The dimensions of the hydroelectric plant are at once associated with the amount and surge of water. There are 3 forms of hydropower centers: run-of the river (otherwise known as hydrokinetic or diversion), impoundment, and pumped garage. This consists of new hydroelectric era capability done by multiplied performance or additions of latest ability at an present hydropower undertaking. This additionally includes new electric powered generation tasks that are run-of-the-river initiatives, especially at existing non-energy dams.

2. METHODOLOGY
• Introductions
• Literature review
• Dams
• Power generations
• Design specifications
• Manual design
• Etabs analysis
• Conclusion

3. DAMS

3.1 Dam Definition
A dam is a barrier that prevents or restricts the go with the flow of water or underground Streams. Reservoirs created by means of dams not handiest suppress floods however additionally offer water for sports which include irrigation, human intake, commercial use, aquaculture, and navigability. Figure 1 shows the Arc Dam of the study.
Figure 1 Arc Dam

Figure 2 shows the Gravity Dam.

Figure 2 Gravity Dam

4. DESIGN SPECIFICATIONS

Figure 3 shows the Dam and its Components.

Figure 3 Dam and its Components
Figure 4 shows the Dam-Side View.

Reservoir capacity = 109500 m$^3$
Number of residents in the surrounding areas = 2500
Water demand per capita per day = 0.13 m$^3$.

5. MANUAL DESIGN

5.1 Design of Dam

5.1.1 Given Data
Reservoir capacity = 109500 m$^3$
Breadth of dam = 15 m
Length of dam = 300 m
Elevation of dam = 24 m
Unit weight of masonry $\gamma$ = 20 kN/m$^3$
Unit weight of water = 1000 kg/m$^3$
Permissible shear stress of joint = 14 kg/cm$^3$
Discharge = (Area of region) (Area under curve) / Time
= (4393*1000000) (55,609.67)/(365*24*60*60*1000)
= 7746.5 m$^3$/second
Number of residents in the surrounding areas = 2500
Mass of the dam (W) = $bH\gamma$
$\gamma$ = Density of Masonry
$H$ = Height
$\gamma$ = Density of Masonry
Weight of the dam (W) = 15x24x20
= 7200 kN

5.1.2 Vertical Forces

5.1.2.1 Self weight of the dam

= [(½ x 10*17) + (5x 24)] x 2000
= 410000 kg

5.1.2.2 Uplift pressure

= ½ *15*(10*1000)
= 75000 kg
\[ \sum V = 410000 - 75000 = 335000 \text{ kg} \]

5.1.3 

\[ \sum H = \frac{wh^2}{2} = \frac{1000 \times 24^2}{2} = 288000 \text{ kg} \]

5.2 Moment Calculation about Toe

5.2.1 Moment Appropriate to Self Weight of the Dam

\[ = \{(24 \times 5 \times 2000) \times (2.5)\} + \{(0.5 \times 10 \times 17 \times 2000) \times ((2/3) \times 10) + 5\}\]  
\[= 2582200 \text{ kg-m} \]

5.2.2 Moment Due to Uplift Force

\[ = 335000 \times (2/3) \times 15 \]
\[= 3350000 \text{ kg-m (-ve)} \]

5.2.3 Moment Due to Horizontal Water Pressure

\[ = 288000 \times (24/3) \]
\[= 2304000 \text{ kg-m} \]

\[ \sum M = 2582200 - 3350000 + 2304000 = 1536200 \text{ kg-m} \]

6. ETABS ANALYSIS

The progressive and progressive new ETABS is the closing incorporated software package deal for the structural evaluation and layout of homes. E-TABS afford an unequaled suite of equipment for structural engineers designing buildings, whether or not they're operating on one-tale business structures or the tallest industrial high-rises.

7. ANALYSIS RESULTS

Table 1 shows the Base Reaction of the study.

<table>
<thead>
<tr>
<th>Load Case/Combo</th>
<th>FX kN</th>
<th>FY kN</th>
<th>FZ kN</th>
<th>MX kN-m</th>
<th>MY kN-m</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
<td>-279059</td>
<td>-41858804</td>
<td>3742745</td>
</tr>
</tbody>
</table>

Table 2 shows the Story Results.

<table>
<thead>
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<th>Load Case/Combo</th>
<th>Direction</th>
<th>Max mm</th>
<th>Avg mm</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Story2</td>
<td>Dead</td>
<td>Y</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Story1</td>
<td>Dead</td>
<td>Y</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>Dead</td>
<td>Y</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Story2</td>
<td>Live</td>
<td>Y</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Story1</td>
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<td>0</td>
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<tr>
<td>Base</td>
<td>Live</td>
<td>Y</td>
<td>0</td>
<td>0</td>
<td></td>
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<tr>
<td>Story2</td>
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<td>0.2</td>
<td>1.000036</td>
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<tr>
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<td>1 LOAD CASE 1</td>
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<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>1 LOAD CASE 1</td>
<td>Y</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>
Figure 5 shows the Maximum Stress Diagram

![Figure 5 Maximum Stress Diagram](image)

Figure 6 shows the Minimum Stress Diagram.

![Figure 6 Minimum Stress Diagram](image)

Figure 7 shows the Displacement.

![Figure 7 Displacement](image)
8. CONCLUSION

Hydroelectric energy is green electricity. Not like diesel power plant, or thermal energy plant, which requires diesel and coal, the handiest fuel required in hydroelectric power plants is water. India have set a objective of 10 GW thru small hydro energy plants alone which is workable. Hydropower is an abundant, low cost source of electricity in spite of excessive prematurely building expenses. It is also a bendy and dependable source of strength compared to other renewable options, as it could be stored for use at a later time. Dammed reservoirs that are commonly used in these plants additionally help with flood control and reliable water deliver.

References


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