

# ANALYSIS AND DESIGN OF GLASS FIBER PLATES FOR WEIR GATES

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**Abstract :** Weir is a barrier across the horizontal width of river that alters the flow characteristics of the water and usually results in change in the height of the river level. They have been constructed for diverting flows to provide power to water-mills; creating a deliberate obstruction to allow fish to be caught; as a means of channelling water for its use in potable water supplies and electricity generation. . To store water for the above purposes we need to block the flow of water by weir having few gates made up of mild steel or any other metallic plate. The size of this steel plate is 2.2m×0.6m×0.006m with approximate weight 66 kg which is very heavy; also the working condition of this plates is underwater so, corrosion will happen and it becomes less durable. So, for overcoming this all problems we need to use different type of material for gate which gives a more strength, less weight and water proof nature. hence we are introducing glass fibre plate as a weir gate. GLASS FIBERS are among versatile industrial materials known today. Glass fibre also called fiberglass. It is material made from extremely fine fibres of glass. Fiberglass is a lightweight, extremely strong, and robust material. Although strength properties are somewhat lower than carbon fibre and it is less stiff, the material is typically far less brittle, and the raw materials are much less expensive.

**Keywords-** K. T. Weir, Glass Fiber, Glass Fiber Reinforced Concrete (GFRC).

## INTRODUCTION

Water management and conveyance are a critical component of human civilization. As infrastructure ages and development continues, the need for hydraulic structures continues. With regards to spillways, many are found to require rehabilitation or replacement due to a greater emphasis placed on dam safety and from revised and increased probable maximum flood flows. Weirs are a common and useful hydraulic structure for a wide range of applications (e.g., canal, ponds, rivers, reservoirs, and others). Flow control in many existing spillways is being done through one or other type of weir. Weir raises the level of water in a river on the upstream side, and spills the surplus water over its entire crest length on to the downstream side. Unlike a dam having a small spillway portion, a weir spills over its entire crest length, which is usually the width of the stream itself. For the overall safety of the hydraulic structure, weirs play a predominant role. Also, the weirs contribute a significant portion of the overall project cost. Weirs can be of different types based on the shape of opening, the crest shape, effect of side openings on nappe formation and based on discharge conditions. Weirs have formed one of the fundamental means of controlling rivers for centuries. They have been constructed for diverting flows to provide power to water-mills; creating a deliberate obstruction to allow fish to be caught; as a means of channelling water for its use in potable water supplies and electricity generation; or simply as a means to create increased depth to allow navigation. When weirs have occasionally been introduced solely for conservation purposes, it has generally been in the upper river valley to vary habitat by creating longer glides and pools, or on lowland rivers to reduce the impact of low flows and to retain wetland. To store water for the above purposes we need to block the flow of water by weir having few gates made up of mild steel or any other metallic plate. The size of this steel plate is 8×2 feet and 7.5 mm with approximate weight between 25 to 30 kg which is very heavy; Also the working condition of this plates is underwater so, corrosion will happen and it becomes less durable. So, for overcoming this all problems we need to use different type of material for gate which gives a more strength, less weight and water proof nature. The following material is used for this purpose. Glass fiber is also called as fiberglass. It is the material made from extremely fine fibres of glass. Fiberglass is a lightweight, extremely strong, and robust material. Although strength properties are somewhat lower than carbon fiber and it is less stiff, the material is typically far less brittle, and the raw materials are much less expensive. Its bulk strength and weight properties are also very favourable when compared to metals, and it can be easily formed using moulding processes. Glass is the oldest, and most familiar, performance fibre. Fibres have been manufactured from glass since the 1930s. Glass fiber is made of different type of composition and its type is like E- glass fiber, S- glass fiber. Therefore we are using E-glass fiber as the replacement of M.S.plate.

Table 1 Properties of E-glass and S-glass Fibers

PROPERTY	E-GLASS	S-GLASS
Density	2.54 g/cm <sup>3</sup>	2.49 g/cm <sup>3</sup>
Tensile strength	3448 MPA	4585 MPA
Young's modulus	72.4 GPA	85.5 GPA
Range of diameter	3-20 μm	8-13μm
Coefficient of thermal expansion	5×10 <sup>-6</sup> /°c	2.9×10 <sup>-6</sup> /°c

**PROBLEM STATEMENT**

- K.T. Weir / River Bridge under plates are used for blocking the water for storage purpose. This plate is made up of Mild Steel and hence it is very difficult to handle.
- The weight of this plate is more, also working condition is in under water and the plate may be exposed for corrosion as shown in fig 1. hence the life of plate decrease and its less durable,
- Transportation problem with these MS plates.

For solving this entire problem we need to change the material of the plate and find the best material for the plate which provides us a more strength and light weight in nature.

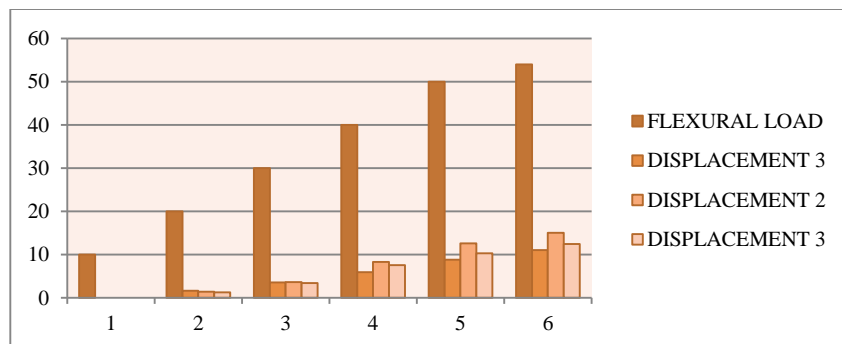


Fig. 1 M.S. Plates

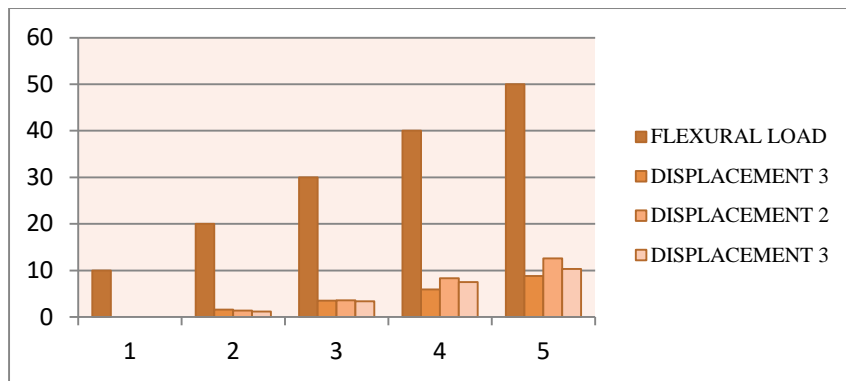
**ANALYTICAL RESULT**

Tests on Specimen

Specimen	Size
Three samples of E-glass fiber plate	15×15cm and 20 mm thick
Three samples of steel plate	15×15cm and 6 mm thick



Graph 1 E-Glass Fiber plate sample 1,2,3



Graph 1 E-Steel plate sample 1,2,3

**RESULT**

## 1. Glass Fiber Plate Samples

Average displacement in Glass fiber plate is 12.8mm (While applying maximum load of 52.66 KN)

## 2. Steel Plate Sample

Average displacement in steel plate is 26.8mm. (While applying maximum load of 27.46 KN)

Table 2 Comparison between Steel Plate and E- Glass Fiber Plate

Sr. no.	Description	Steel plate	E-Glass fiber plate
1.	Density	7932 kg/m <sup>3</sup>	2.54 gm/cm <sup>3</sup>
2.	Tensile strength	400 MPA	3448 MPA
3.	Young's modulus	200 GPA	72.4 GPA
4.	Corrosion	More	No corrosion
5.	Erosion	More	Less
6.	Durability	5-6 years	More than 50 years
7.	Initial cost	Less expensive	More expensive
8.	Maintenance cost	More	Less
9.	Manpower	More	Less
10.	Weight	Heavy weight	Light weight
11.	Poisons ratio	0.29	0.21
12.	Thermal expansion	10.4×10 <sup>-6</sup> /°c	5×10 <sup>-6</sup> /°c

This Report Presents suitability of glass fiber plate over steel plate for K. T. Weir.

Following are the major concluded points:

- Density of E-glass fiber plate is less than steel plate therefore glass fiber plate comparatively light in weight than steel plate and hence glass fiber plate requires less manpower to handle it.
- Tensile strength of E-glass fiber plate is more than steel plate hence it can carry maximum water pressure than steel plate.
- Young's modulus of glass fiber plate is comparatively less than steel plate but its strength is more than steel plate.
- E- Glass fiber plate is highly corrosion resistance and hence it is more durable than steel plate.
- Due to highly corrosive nature of steel plates it causes more erosion and water losses in K. T. weir.
- Initial cost of E-glass fiber plate comparatively more than steel plate but maintenance cost is less than steel plate.

On the basis all the above points we conclude that E- glass fiber plate is more suitable than steel plate for K. T. Weir gate

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#### CONCLUSION

As per our research and test results we conclude E-Glass Fibre plate have better result on the basis of strength, durability, corrosion resistant nature, and maintenance cost as compare to steel plate while using this plate as a gate in K. T. Weir.

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