Analytical study on Self Closing Flood Barrier using ANSYS

L. Krishnan[1], A. Mugesh[1], S. Pradeep Kumar[2],R. Manivannan[3]
[1]Assistant Professor, Department of Civil Engineering, Knowledge Institute of Technology, Salem
[1]Student -UG, Department of Civil Engineering, Knowledge Institute of Technology, Salem
[2]Assistant Professor, Department of Civil Engineering, Knowledge Institute of Technology, Salem
[3]Associate Professor, Department of Mechanical Engineering, AVS Engineering College, Salem

***Abstract*— Almost every decades extreme high flood events were randomly occurred in our Country which caused the loss of human lives, land values and infrastructures that created a negative impact on human being such as discomfort living and threat to survival of existence. In order to mitigate the effects that arises during flooding and provoke a preventive system to safeguard the properties a Self Closing Flood Barrier (SCFB) has to be implemented in flood risk areas. The objectives of the present paper work are (i) To create awareness among people about SCFB (ii) To create Analytical model using ANSYS by choosing aluminium metal as barrier on compare with steel. The barrier was modeled using solid work ANSYS work-bench and hydraulic pressure were given on to the SCFB to stimulate the stress strain behavior. It was found that ANSYS is capable of simulating the actual experimental test procedures in better way and it minimize the cost of testing, electicity and manpower to great extent.**

Index Terms*—Self Closing Flood Barrier, ANSYS, Aluminium metal, Hydraulic pressure.

1. INTRODUCTION

Since over the past decades several techniques have been proposed by many researchers regarding the flood defence system but none of the techniques have proven to be highly effective .Because of their own inherent limitations associated with each technique. The Self Closing Flood Barrier (SCFB) overcomes all the issues associated with these are older-generation flood defences. In operational use globally since 1998 the SCFB is acclaimed as the world's most effective flood protection system [1].It gains importance to surround low lying buildings like pumping station and to protect critical infrastructure like power stations. Also, it extends its applicability to a roadway for heavy traffic loads and entrance of underground cark parks which prevent the entry of extreme flood level. The stress analysis in the field of structural mechanics is invariable complex and for the many engineering problems and is extremely difficult and tedious to obtain analytical solution. In this situation, most of the practical problems are solved by numerical methods, which provide approximate but acceptable solution. With the advent of computers, one of the most powerful techniques that has emerged from the realm of engineering analysis is the finite element method. In modern design practice, with the advent of large and fast modern digital computers and advancement in numerical techniques, solutions to various static and dynamic problems has become fast and efficient.

2 SIGNIFICANCE

- Infallible.
- Fully automatic deployment.
- Instant deployment just prior to threat of floodwater.
- No human intervention and save man power.
- Zero operational cost.
- No need of power source.
- Minimal maintenance.
- Permanently on site.

3 MATERIALS USED

Aluminum metal is preferred which gives economic design and is light weight. The operation of the wall in a riverside is by means of a rubber gasket. The aluminum lid closes off the basin to prevent any inflow of waste or debris Supported by welded support plates on the exterior [2]. The flood wall itself is made from polyester, with a thickness of 4 – 8 mm. It is laminated in a climate controlled hall with permanent humidity and temperature control to guarantee a consistent lamination process. In order to minimize collision damage by flotsam, the flood wall is protected by Kevlar with high impact strength. The flood wall is reinforced by laminated strips[6], and is filled with a polyurethane foam core which forms an extremely strong and impact resistant construction.

4 THEORETICAL STUDY

A site survey will be necessary for quotation purposes and in the event of a project going ahead, a more detailed survey should be undertaken for manufacturing and installation details. Initially a layout drawing will be prepared to show the location and the overall dimensions of a proposed SCFB for quotation purposes. Where the project involves a riverside location it may be possible to use gravity. ` The Drainage is to empty and the service pit when flooding recedes. This will depend on the relative levels of the normal water level and the adjacent ground level. The SCFB sections are in standard lengths of 1 meter which may be linked together. The use of pillars can facilitate changes of direction or deviations from a straight line in the run of the barrier. The fig.1 represents the section view of the barrier with concrete basin.

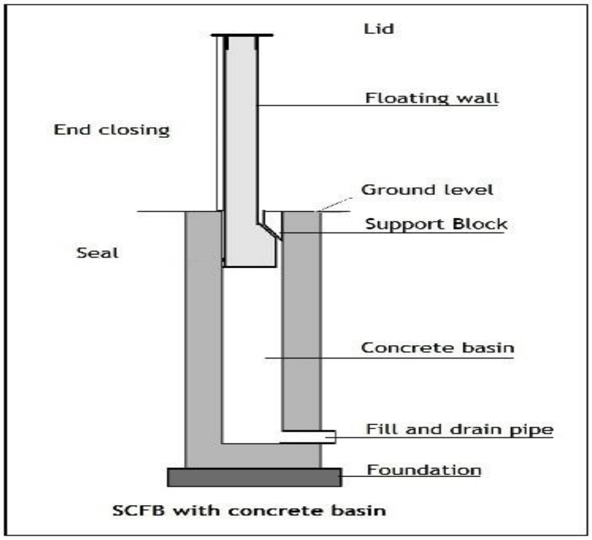

Fig. 1 Section view of the barrier with service pit

The route of the barrier therefore needs to be defined and divided into suitable section lengths up to 50 linear meter. Where a barrier is to protect a building entrance or drive-way. Top of the barrier installation will be at ground level when not in use. The service pit will require pumped drainage with a built-in pumping system, associated level switches and alarms if required. The fig.2 represents barrier installation in the underground surface. For these projects, datum level sand gradients are important in ensuring that the installation provides full protection against flood conditions.

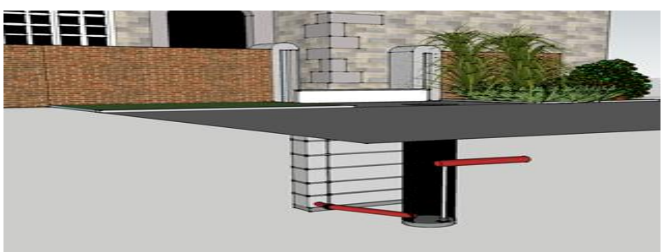

Fig.2 Barrier installation in the underground surface.

4.1 Principle of working

Following installation and in non-flood conditions all operational parts of the barrier are invisibly concealed in the ground inside its basin. When floodwater rises to within 10 cm below the pre-flood level enclosed basin, which houses the floating wall starts to fill up through an inlet pipe from the adjacent flood pit. The fig.3 represents the normal water level with flood barrier recessed in ground.

The flood wall floats and rises. When the basin is totally filled, into position making it watertight. The fig.4 shows the flood water fills chamber.

The floodwater can now continue to rise without flooding the protected area. As the water level subsides back to its normal level, the flood water in the basin is drained by a pump located the flood [3]. As the water leaves the basin, wall returns to its rest in position within the basin. In its closed resting position, the lid of the barrier seals to prevent the in flood waste or debris. The Fig.5 shows Hydrostatic ensures the barriers stay in until flood subsides

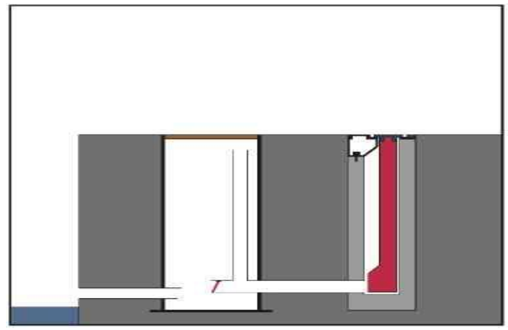

Fig.3 Normal water level with flood barrier recessed in ground.

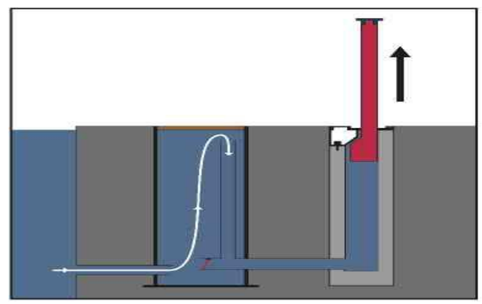

Fig.4 Flood waters fill chambers and force flood barrier to raise pressure

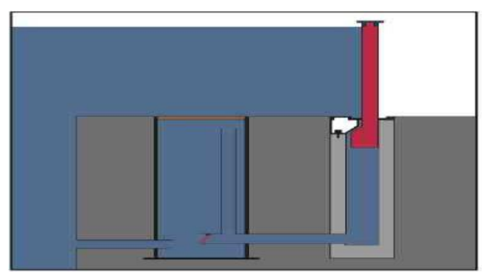

Fig.5 Hydrostatic ensures the barriers stay in until flood subsides.

5 ANALYTICAL STUDY

Based on the theoretical investigation studied, SCFB has been modeled using ANSYS work bench version 13 which follows the principle of Finite Element Analysis. The hydrostatic pressure are given on the structure which is taken from standard data[flood data]. The structure is analyzed for maximum hydrostatic pressure about 80 N/mm^2 and fluid density is kept as 1000 kg/m^3 . The corresponding stress strain characteristics were studied. The barrier are made with aluminium alloy material[8] corresponding behavior were depicted using ANSYS. The SCFB model is shown in fig.6 The dimension details are shown in table 1.

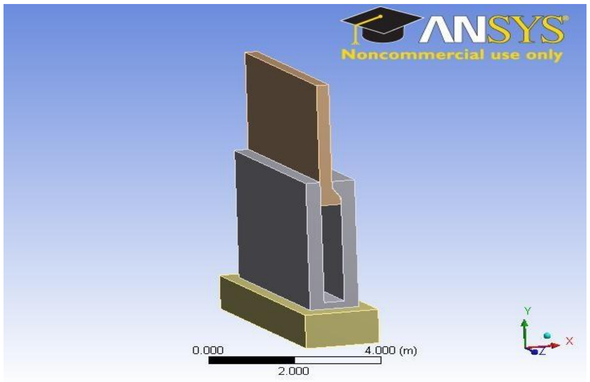

Fig.6 SCFB Model

Table 1. Dimension details of SCFB

S.No	Length in (m)	Direction co-ordinates
1	1.8 m	x
2	7.6961 m	Y
3	6. m	z

4.1ANSYS Analysis

The SCFB was analysed by considering the boundary condition of bottom surface as rigid[7]. The barrier is modeled as frictionaless. The Aluminium alloy material was used for barrier and the corresponding deformation and stress strain behavior were studied. The fig.7 shows the meshed test specimen of SCFB.

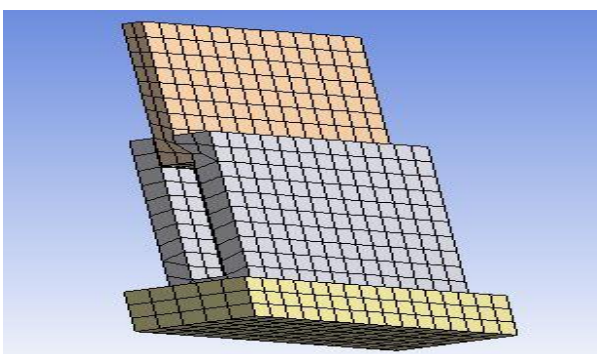

Fig. 7 Meshed Test Specimen of SCFB

The test specimen was analysed by considering static structural analysis system. Since the hydrostatic pressure are peak at bottom of barrier which was required to raise the structure such that the pressure was given at bottom surface of barrier. Also after the barrier got closed, the water remain at the top surface and the corresponding deformation and stress-strain behavior were studied from ANSYS. It was found that the barrier has attained full raised position after giving 80 MPa and barrier got locked and the total deformation and stress concentration were measured.

6 RESULTS AND DISCUSSION

The SCFB was tested for critical hydrostatic pressure and the deformation and stress –strain characterstics were studied. It was found that aluminium alloy made SCFB has attained a maximum total deformation as 1.4 mm and the maximum total strain was 4 x 10^{-3} .The maximum stress was observed about 24.5 N/mm^2. The fig.8 shows the maximum total deformation characterstics and the fig.9 shows the maximum total stress recorded and the fig.10 shows the maximum strain occurred.

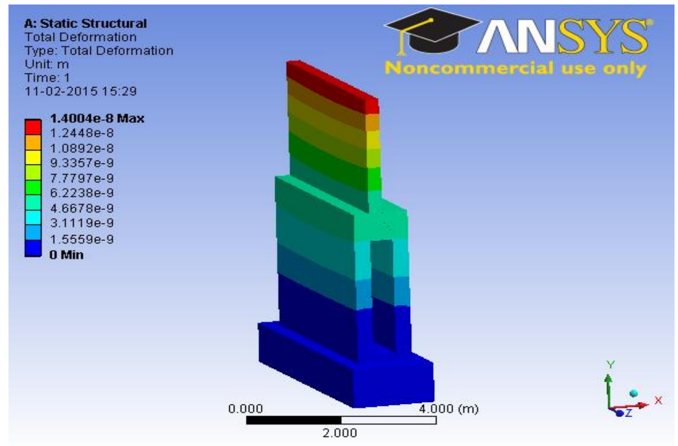

Fig. 8 Maximum total deformation of SCFB (Aluminium alloy)

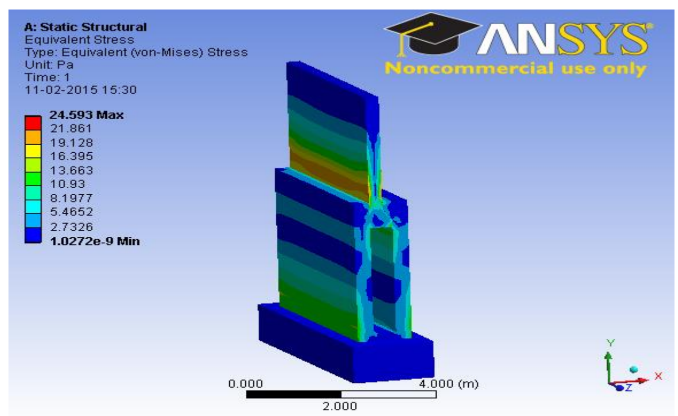

Fig. 9 Maximum total stress in SCFB (Aluminium alloy)

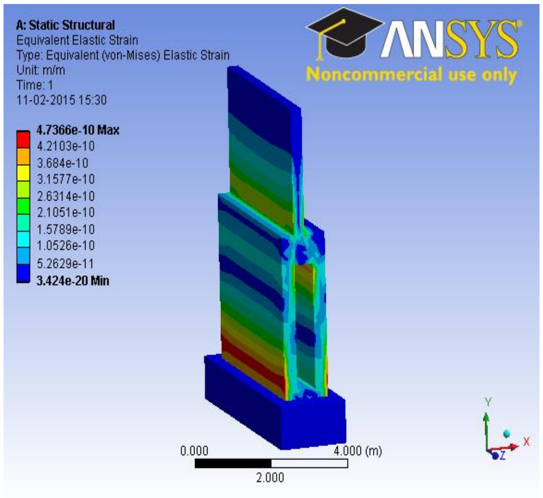

Fig. 10 Maximum total strain in SCFB (Aluminium alloy)

7 CONCLUSION

An analytical investigation has been made on SCFB by considering the aluminium alloy metal as barrier. The SCFB has been analysed using ANSYS work bench with theoretical background and the following conclusions were drawn.

- The SCFB has the capacity to withstand a hydrostatic pressure of 80 N/mm^2 and works without the use of manpower and electricity.
- The maximum deformation recorded on SCFB was 1.4 mm and maximum stress – strain values are 24.5 N/mm^2 and 0.0004.
- The aluminium metal being less economic than steel has been utilized and this construction techniques would help to safeguard human lives in coastal and flooded areas by providing optimum protection against extremt high flood events.
- Thus ANSYS is capable of stimulating the actual behavior and save the time and cost of realtime experiments to bring results in better way.

8 ACKNOWLEDGEMENT

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