ANALYSIS AND DESIGN OF FLOOD BARRIER MODEL OF FABRICATED MATERIAL

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Abstract - Flooding is a very serious type of disaster occurs due to geological factor or the uneven distribution of water which cause the serious effect on the society, costing lives, damaging buildings and property, disrupting livelihoods etc. We are studying about the temporary and removable flood protection structure which is constructed on the weir or canal. To increase the temporary storage to handle the flush flood water during heavy rains and to increase the temporary height or capacity of weir or canal. The structure we are constructing are made up of steel frame and fibre and these are connect together by bolt and glue

Key Words: steel, Fabrication, Barrier, Canal.

1. INTRODUCTION

A flood is an overflow of water that submerges land that is usually dry. In the sense of "flowing water", the word may also be applied to the inflow of the tide. Floods are an area of study of the discipline hydrology and are of significant concern in agriculture, civil engineering and public health.

1.2 Causes of Floods

- Heavy rainfall
- Highly accelerated snow melt
- Severe winds over water
- Unusual high tides
- Tsunami
- Failure of dam
- Levees, retention ponds

1.3 Effects of Floods

Flooding has many impacts. It damages property and endangers the lives of humans and other species. Rapid water runoff causes soil erosion and concomitant sediment deposition elsewhere (such as further downstream or down a coast). The spawning grounds for fish and other wildlife habitats can become polluted or completely destroyed. Some prolonged high floods can delay traffic in areas which lack elevated roadways. Floods can interfere with drainage and economical use of lands, such as interfering with farming. Structural damage can occur in bridge abutments, bank lines, sewer lines, and other structures within floodways. Waterway navigation and hydroelectric power are often impaired. Financial losses due to floods are typically millions of dollars each year, with the worst floods in recent U.S. history having cost billions of dollars.

1.4 Benefits of Flooding

There are many disruptive effects of flooding on human settlements and economic activities. However, flooding can bring benefits, such as making soil more fertile and providing nutrients in which in many ways it is deficient. Periodic flooding was essential to the well-being of ancient communities along the Tigris-Euphrates Rivers, the Nile River, the Indus River, the Ganges and the Yellow River, among others. The viability for hydrologically based renewable sources of energy is higher in flood-prone regions.

1.5 Types of Flood Protection Systems

There are three main types of flood protection systems:

- Temporary
- Demountable
- Permanent

For systems of similar scales, the extent of operational activities generally decreases from temporary through demountable to permanent flood protection systems. Temporary defenses would normally require the most Operational activities in their deployment however temporary systems are the most Versatile and able to be used in previously undefined locations and situations making Temporary systems ideal for use within incident response scenarios.

- **Temporary**

A temporary flood protection system is formed by removable flood protection Products that are wholly installed during a

flood event and removed completely.

Reasons for this include:

- Insufficient economic justification for a permanent or demountable system;
- Management of flood risk above the permanent standard of protection;
- Stop-gap during the development and construction of a permanent or demountable System;

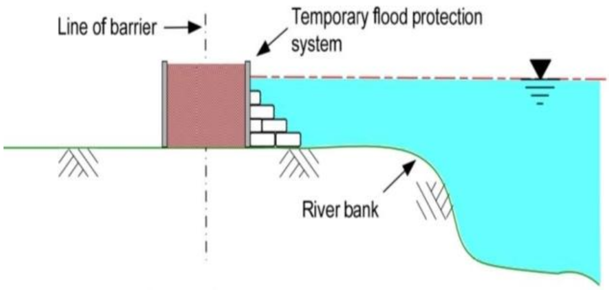

Fig. no: 1 Temporary flood protection system

- **Demountable**

A demountable flood protection system is a moveable flood protection system that is fully pre-installed and requires operation during a flood event, or a system that requires Part-installation into pre-installed guides or sockets within a pre-constructed foundation.

Reasons for this include:

Dual use of function such as the need for access through a flood protection System, but where defense can be part of fully pre-installed;

- The temporary and permanent elements;
- The foundations, seals and joints within the structure;
- The connections between the structure and the underlying surface;

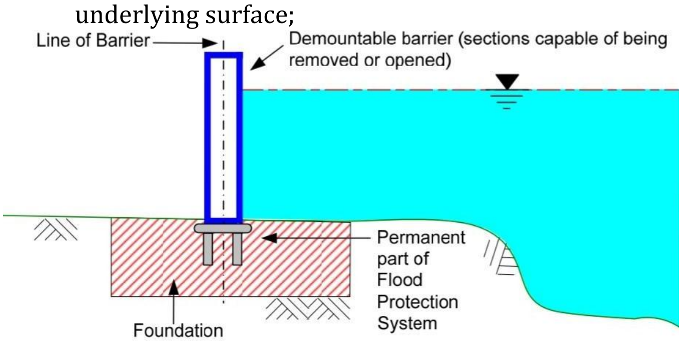

Fig. no: 2 Demountable flood protection system

- **Permanent**

In this Guide, a 'permanent' flood protection system is one that is fully in place and does not require operation during a flood event in order to close the pathway for Flooding. Common examples of permanent flood protection infrastructure include flood banks and flood walls. A flood Embankment has a similar function to the flood wall, but in most cases without a cut-off Barrier as the width of a flood bank at its base is usually sufficient to prevent significant Seepage and uplift pressure except in very porous soils. A soak dyke, which is often provided close to the landward toe of an embankment, helps to collect any seepage Close to the surface.

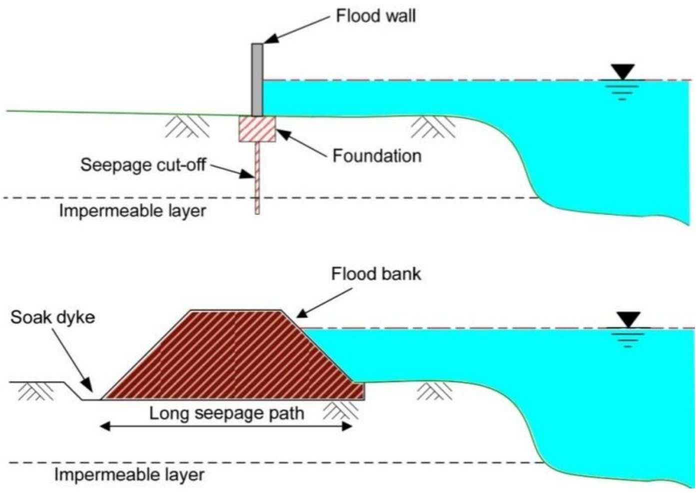

Fig. No. : 3 Permanent flood protection system

1.6 Aim and Scope of the work

The present study is aimed at analysis and design of flood barrier using steel and fabricated materials.

1.To increase the temporary height or capacity of weir or canal

2.To provide a portable system that can be assembled during flood.

3.To increase temporary storage, to handle flush water during heavy rains.

4. To the study of structure and to increase of water storage capacity of check dam

2. LITRATURE REVIEW

Lyle R. Rowland et al., A frame structure is constructed an end support frame comprising a horizontal member, aback support member, and a plate support member and are joined together to create the entire end support. The back support member connects to the plate support member substantially at the middle of the plate support member. This support are joined by welding, bolt, machines, clips, mechanical fasteners, the end support frame and middle support frame is made from material such as metal or reinforced plastics, such fibreglass. In one embodiment the end support frame is made from a material that is corrosion resistant such as galvanized steel or aluminum. The angle between two membrane supports is 45 degree and each membrane support plate is 100 lbs. in Weight. This application incorporates by references the entirety of Canadian application no.CA 2628067, filed on Apr.2, 2008. This system has some advantages is rapid developments, but is offset by disadvantage in sliding on the weir bed due to hydrostatic pressure when the water level is high and seepage underneath the elastomer Tube

LP frederica et al., Flooding events can be precipitated by natural and man-made inputs. These events can be particularly challenging for building and infrastructure located at or a near a body of water. Severs storms with high

Tidal surges or flash flood, rising sea levels, and seismic activity are some of the challengers posed by nature. Hurricane sandy was particularly devastating to New York City in 2012 because a significant portion of the subway system was flooded economic losses were unprecedented. There are many type of mitigation wall systems available commercially. And that we are use flood control barrier. These wall system are also labor under threat of a storm when personnel are busy many tasks.

Textile and membrane based flexible flood mitigation walls offer significant benefits over the existing wall devices. The wall is deployed by first removing the cover its storage container which is attached to a perimeter wall or building adjacent to the opening. the fabric wall, which is attached and sealed to the anchor post, is then extended and attached to the received post the ground skirt is positioned against the ground and the wall is ready to remain fluid pressure.in that the intermediate support preinstalled bollard can be used. The extendible flexible flood barrier can also be used as a containment device that keeps a fluid inside an area and prevents its escape. This could be in the form of a deployable wall around a location where hazardous materials are used and spills are required to be contained. The extendible flexible flood barrier is comprised of a textile and membrane wall that is attached to vertical anchor post, a receiver post that the membrane wall is attached to when extended, and a storage container that is integral with the anchor past and holds the wall when stowed. The flexible wall also has a ground skirt extension which lies horizontally on the ground and has integral seals that are compressed by water weight and ballast or clamping bars to seal against the ground. Additional posts may be added to the wall to facilitate extension of its length to seal larger openings. This is comprised, of the flexible wall with a Deadman assembly, being captured by a clamp on the post. The Deadman is a flexible assembly that the gap between the post and therefore will not slip between the post and is therefore fully captured. Face seals on the posts in this area prevent leakage past the joined wall sections.

Juraj Ondruska et al., The structure of the development anti-flood barriers from recycled plastics is composed from metal and plastic sources. When designing the geometry and constructing the barrier, the first stage was to design a structure based on the shape of unified blocks made from PP and PE. The last generation of metal construction was construction ally optimized by renowned producer KONSTRUKTA-Industry, as.. Unified plastic blocks were designed in Slovakia at Chemosvit Environchem, a.s. in cooperation with Chemosvit; the focus was to produce blocks made from recycled materials and their subsequent application for beneficial use.

If the barriers are installed on firm ground, then a rubber seal is placed below the horizontal parts of both water barriers. In the case that the barriers are located on uneven or soft ground, then anchoring pikes are used on the horizontal parts. Connecting of the vertical parts is done by using attachment bars. To obtain greater stability, the vertical parts are mounted to each other in a pattern (long to short to long etc.…) and are connected with bars

The designed modular flood barrier structure consists of an angled and horizontal part. In this design, the water acts on the barrier from the outside, where the connecting braces are loaded in compression. The hydrostatic pressure of the water on the sloped surface ensures adequate anchorage to prevent its movement.

The angle configuration of the sloped part is adjustable by the length of the braces and the position of their attachment point. The modular structure allows for a change in the length of the sloped parts. The technical advantages of the modular structure are evident in the effects induced externally.

3. METHODOLOGY

Constructing the structure on the canal or weir where the flood condition is occured Due to quick flood flush water and this flood water harmful to living things and causing disaster which leads to tangible and intageble losses of society in the form of life, permanent structures and agricultural land. To built a structure which is fairly similar and easy to assemble within a short time period which leads to store more water for perticular season and also help to avoid a damage due to this flood water

4. MATERIALS AND METHODS

4.1 Components of structure

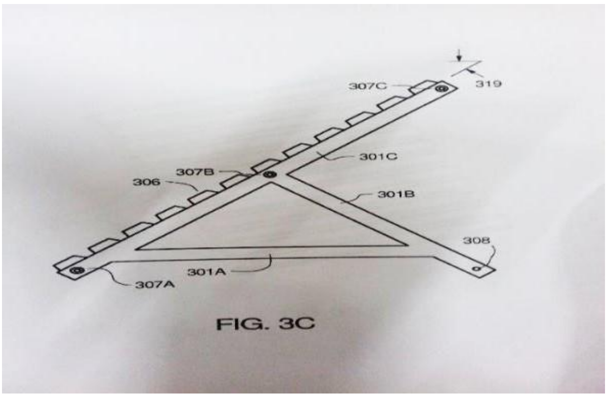

Fig. No. : 3 Steel Frame

1. 306- A Membrane supporting plate faces body of water
2. 301 A - Horizontal member
3. 310 B - Back support member
4. 301 C – plate support member 1,2 and 3 are joined together to create the entire end support.
5. 307 A C E – are used to joint the support together
6. 308 – A hole in the end is useful for the field stabilization of the support and also for connecting to additional

support to the earth, such as spike, rod, telescoping leg or foot pad.

7. 319 – Angle between two support is 45 degree.

4.2 Basic Information of the Component

1. Geometric similarity:-

For geometric similarity to exist between the model and prototype, the ratio of corresponding lengths in the model and in the prototype must be same and the included angles between two corresponding sides must be the same.

2. Kinematic similarity:-

Kinematic similarity is the similarity of motion. If at the corresponding points in the model and in the prototype, the velocity or acceleration ratios are same and velocity or acceleration vectors point in the same direction, the two flows are said to be kinematically similar.

3. Dynamic similarity:

Dynamic similarity is the similarity of forces. The flows in the model and in prototype are dynamically similar if at all corresponding points, indentical type of forces are parallel and bear the same ratio.

4.3 Details of Fibre.

Features: waterproof, fireproof, heat resistant, UV resistance etc. Assembly: Nut and Bolt.
Brand: Texsys Color: white Marerial: Fibre Built type: Modular
Temperature resistance: -30 to 70 deg. C Pole finishing: Powder coated
Frame Material: Mild steel Appox. Price: Rs 425 /- square feet.

Fig. no.5:- Fibre sheet shed

4.4 PROPOSED DESIGN

We have construct the temporary structure on weir or canal where the temporary water can be store and this structure is made up of steel frame and fibre and these are connect together by bolt and glue.

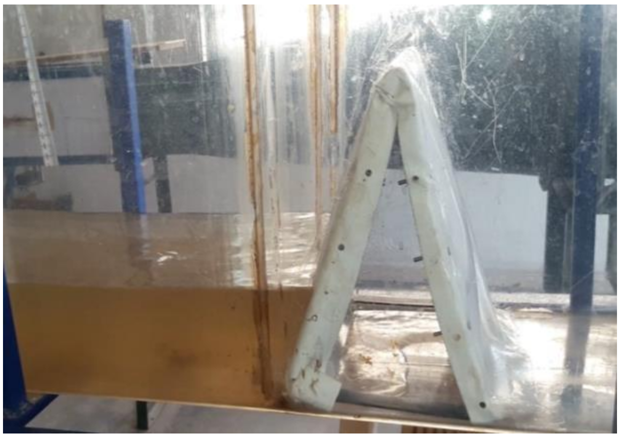

Fig. No. 6: - Steel frame with fibre

4.5 Calculation of Pressure

Pressure: continuous physical force exerted on or against an object by something in contact with it.

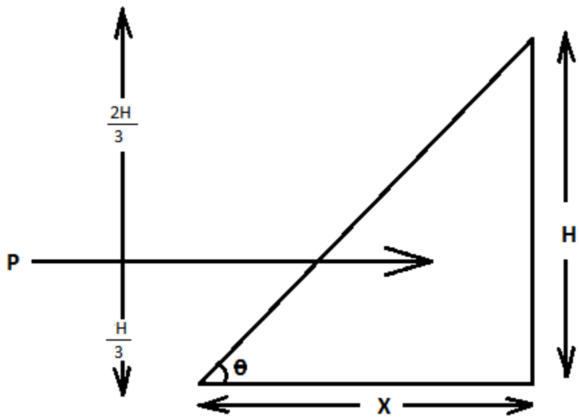

Fig. no.7:- Hydrostatic Pressure on Structure.

PRESSURE =1/2*Y*h2
= 1/2*9.81*12
=4.905Kn.

Calculation of base=tan =h/b tan30=1/x
x =1.732m.

Calculation of pressure =1/2 *x*9.81
= ½*1.732*9.81
=8.495Kn.

4.6 Calculation of Pressures of Varying Angles

Reno	Pressure (Pe)	W30°	W45°	W60°	W75°	Pe-W
1.	4.905	8.495	4.905	2.831	5.257	-3.59 0 2.074 -0.352
2.	11.036	19.115	11.036	6.371	2.957	-8.079 0 4.665 8.079
3.	19.62	33.98	19.62	11.327	5.257	-14.36 0 8.293 14.363
4.	30.656	53.098	30.656	17.699	8.214	-22.442 0 12.957 22.442
5.	44.145	76.461	44.145	25.487	11.828	-32.316 0 18.658 32.317

Table no 1. Pressure of Varying Slope angle

4.7 Calculation Of Deflection By Macula's Method

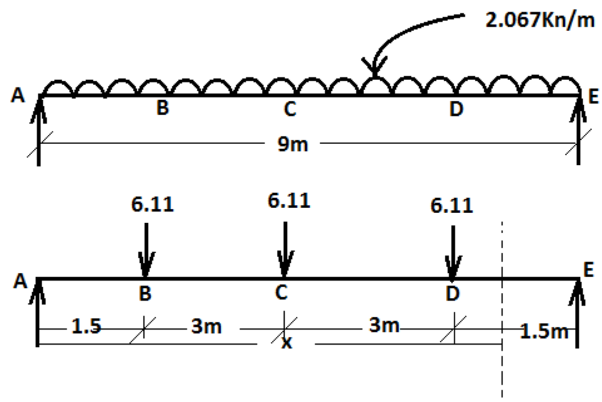

Fig. no.7 :- Load on the Beam.

(A) Reaction Calculation

€MA=0 (Clockwise +ve/ Anticlockwise -ve) (6.11*1.5)+(6.11*4.5)+(6.11*7.5)-(VE*9)=0 VE

=9.165kN

€Fy=0 (Upward+ve/ Downward-ve) VA-6.11-6.11-6.11+VE=0 VA

=9.165kN

(1) CONSIDER PART (XA) (Boundary Condition) X@A=0

X@B=1.5 X@C=4.5 X@D=7.5 X@E=9

Bmx=EI d2y/dx2=[(9.165*x)-(6.11*(x-1.5))-6.11*(x-4.5)-6.11*(x-7.5)] .... (1)

Integrating with respect to x

EI dy/dx = 9.165*X2 /2 -6.11*(X-1.5)2 /2-6.11*(X-4.5)2/2-6.11*(X-7.5)2 /2+C1 ....(2)

Again integrating with respect to x

EIy = 9.165*x3/6-6.11*(x-1.5)3 /6-6.11*(x-4.5)3 /6-6.11*(x-7.5)3 /6+C1 x +C2 ....(3)

(2) To Find C1 Andc2 (Applied Boundary Conditions)

Put X=0 And Y=0 put in equation (3)

EIy=C2=0

Put x=9 and y=0 In equation (3)

EIy = 9.165*93 /6 -6.11*(9-1.5)3 /6 -6.11(9-4.5)3 /6-6.11(9-7.5)3 /6+C1 *9+0 C1=--65.3

Put the values of C1 And C2 in equation (2) and (3)

EIdy/dx =9.165*x2 /2-6.11*(x-1.5)2 /2-6.11(x-4.5)2 /2-6.11(x-7.5)2/2-65.3-------------------------**(slope equation)**

EIy=9.165x3/6-6.11(x-1.5)3/6-6.11*(x-4.5)3/6-6.11*(x-7.5)3/6-65.3*x+0-----------------------**(deflection equation)**

(3) TO FIND DEFLECTION AT B PUT X=1.5 IN DEFLECTION EQUATION

EIyB =9.165*1.53/6-6.11*(1.5-1.5)3/6-6.11*(1.5-4.5)3/6-6.11(1.5-7.5)3/6-65.3*1.5+0

EIyB=-92.7974/EI mm (downward)

(4) TO FIND DEFLECTION AT C put x=4.5 IN DEFLECTION EQUATION EIyC= 9.165*4.53/6-6.11*(4.5-1.5)3/6-6.11(4.5-4.5)3/6-6.11(4.5-7.5)3/6-65.3*4.5

EIyC=-182.152/EI mm (downward)

(5) TO FIND DEFLECTION AT D PUT x=7.5 IN DEFLECTION EQUATION EIyD =9.165*7.53/6-6.11*(7.5-1.5)3/6-6.11*(7.5-4.5)3/6-6.11(7.5-7.5)3/6-65.3*7.5 EIyD=-92.795mm (downward)

Deflection at B = -92.7974/EI mm Deflection at C = -182.152/EI mm Deflection at D = -92.795/EI mm

Sr. no.	(Pe-W)	At point B	At point C	At point D
A.	2.074	-92.7974/EI	-182.152/EI	-92.795/EI
B.	4.665	-162.69/EI	-267.637/EI	37.473/EI
C.	8.293	-378.82/EI	-741.63/EI	-377.635/EI
D.	12.957	-590.363/EI	-1158.853/EI	-590.365/EI
E.	18.658	-850.073/EI	-1668.643/EI	-850.017/EI

Table no.: 2 Deflection value at points

4.8 DESIGN OF PURLINE

(A)Given Data Spacing =3m Spaced=0.5m
= 60°
Load + Self weight = 2.074+ 0.5=2.574 Total dead load = 2.574*1.5 =3.861 kN
= 3.861*1000
=3861 N/m

(2) Assume wind load=We=0 Total load= We+Wcos
= 0+3861cos60°
= 1930.5 N

(3) Components of dead load along the roof
= Wsin
=3861 sin 60°
=3343.72 N

(4)Maxium bending moment about z-z axis = Total load *Spacing 2 /10
=1930.5*32/10
=1737.45 Nm

(5) Factored moment=MZ=1.5*1737.45 = 2606.175 Nm

(6) Maximum bending moment about y-y axis =component of dead load along the roof
*spacing2/10
=3343.72*32/10= 3009.34Nm

(7) Factored moment =MY= 3009.34*1.5=4514.022

(8) Try channel section= ISJC 200
Zpz= Zxx*1.14= 116.1*1.14=132.354*103 mm3
Zpy=2*(tf*b2/tw)+[(overall depth-Iyy)*(tw2/tw)] Zpy= 2*(7.1*702/4.1)+[(200-84.2)*(4.12/4.1)]
= 17.445*103mm3
Mdz= Fy*Zpz/Ymo=500*132.354*103/1.10
=60160.90 Nm
Mdy=Fy*Zpy/Ymo =500*17.445*103/1.10
=7929.54Nm

(MZ/Mdz) + (MY/Mdy)=
(2606.175/60160.90)+(4514.022/7929.54)
= 0.612<1
Hence Ok

4.9 DESIGN OF ROOF ANALYSIS

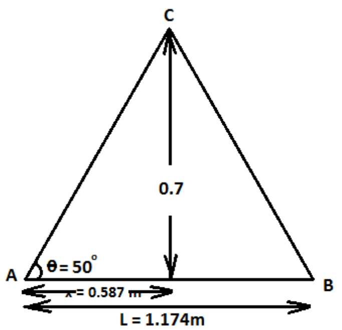

Fig. no.8 :- Design of roof

(A) (1) Rise= 0.7 tan 50°= 0.7/x x=0.587 L=0.587*2=1.174
(2) Length of principle rafter= R2+√L/22
0.72+ √0.582
=0.9135 m.

(3) Half span area = L/2*Span Of Roof Truss

= 0.587*1.174 =0.689m.

(4) Half slope area =length of principle rafter *Spacing of roof truss

= 0.9135*1.174
=1.072

(5) Dead load = 28.737kN (Net load+self weight*factor of safety)

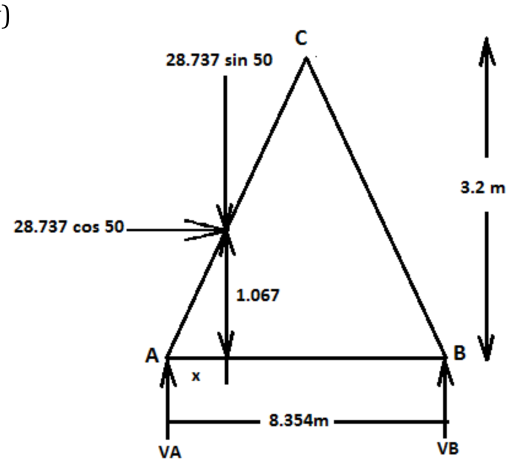

Fig. no.9 :- Forces on roof

tan 50°=0.233/x

x = 0.1955
€fx =0 +ve -ve 28.737 cos50-HB=0
HB=18.471 kN

€MA=0 +ve -ve
(28.737sin50*0.1955)+(28.737cos50*0.233)-(VB*1.826)=0
VB= 4.713kN

€FY=0 +ve -ve VA-28.737sin 50+VB=0
VA=17.021kN

€Fx=0 +ve -ve
-HBCcos50-VBA-HB=0
VBA=-14. 516kN

€FY=0 +ve -ve VB+HBC sin50=0
HBC=-6.152Kn

4.10 Design of the principle rafter

9Force in principle rafter =14.5 kN

App. Safe compressive stress =100N/mm2 Area required =

14*103/100

= 140mm2

Let us try ISA 20*20*4mm on area 145mm2 Effective length = 0.85*1.826*103mm

= 1552.1mm

Radius of gyration =5.8mm (l/r)=(1552.1/5.8)

=267.60mm2

Safe compressive stress corres =101N/mm2 Safe compressive force =101*145

= 14.64kN>14.516kN

Hence ok

4.11 Design of Tension member

Force in tension member=14.28 kN Safe stress in tension =125N/mm2 Area required =14.28*103/125
= 114mm2
Assume d =12mm Ag=113.09mm2 An =0.78*Ag
An= 88.215mm2

Bolt value = Vdsb =fub/√3*Yml*(Nn*An)

= 400/√3*1.15*(1*88.215)

= 17.715kN

No. of bolts = 14.28/17.715

= 0.806 = 1Nos.

Model analysis

Scale ratio Lr=1/20
(1) for length (Spacing between two frames)
(1/20)=(x/3*100)
X=15cm

(2) for inclined

For 0.7 height (1/20)=(x/1.174*100) X=5.87cm

For 1.2 height (1/20)=(x/2.01*100) X=10.05cm

For 2.2 height (1/20)=(x/3.692*100) X=18.46cm

For 1.7 height (1/20)=(x/2.852*100) X=14.26cm

For 2.7 height (1/20)=(x/4.531*100) X=22.655cm

For 3.2 height

Case 1:

The practical is performed with steel frame design as per the scale ratio connected with the bolt and frame is covered with the plastic sheet.

This practical is performed without any base support to the steel frame due to this chances of overturning is there.

In this practical side leakages are found more due to improper packing of side frame.

Fig no.7 shows that frame is stable when the normal pressure is applied.

Fig no.7 shows that overturning is occurred when pressure is increased.

Fig. no.7 :- Steel frame with plastic.

Case 2 :

This practical is performed with the different size of frame as compared to the first without any base support .design as per scale ratio.

Frame is covered with the fibre sheet by using bolt.

In this practical due to fibre sheet is connected with the bolt chances of leakages is more through these bolt holes.

Hence some amount of leakages is observed through these bolt holes and side leakages also

In this case overturning is not happened because height of frame is small and good quality fibre is used

Fig. no.7 :- Steel frame with fibre.

Case .3 :

This practical is performed with another different size frame design as per the scale ratio.

In this Base support is provided to avoid the overturning of the structure.

Bolt hole and sides of this frame is well packed with fibre sheet and plastic tape to avoid the leakages.

Due to this leakages are well controlled as compared to first two test.

Overturning is not happened in this test.

Fig. no.7 :- Steel frame with fibre with base support.

5. RESULT

1. For Case 1: If the base support is not provided chances of overturning is more.
2. For Case 2: when the height of prototype is redused and good quality fibre is used chances of overturning is prohibited.
3. For Case 3: due to provision of base support and well packed side frame overturning and side leakages are prohibited.

6. CONCLUSION

Due to provision of base support and well packed side frame overturning and side leakages are prohibited. Flooding is a very serious type of disaster occur due to geological factor or the uneven distribution of water which cause the serious effect on the society, costing lives, damaging buildings and property, disrupting livelihoods etc. We have studied about the temporary and removable flood protection structure which is constructed on the weir or canal. To increase the temporary storage to handle the flush flood water during heavy rains and to increase the temporary height or capacity of weir or canal. The structure we are constructing are made up of steel frame and fibre and these are connect together by bolt and glue.

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