

# Flood Protection Work by Terramesh Wall

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*Abstract*— Flood events are a part of nature. Flood, caused by overflow from a river, wind induced surges, tides, or other many factors are normal events of the earth's hydrosphere. Some of them occur regularly, like floods arising from spring melting of snow accumulated during winter, while others are occasional.

The Aim of this paper is to reduce the flood effect through flood protection work. There are different types of method for flood protection work, in these; the terramesh wall structure is flexible & suitable for steep slope and vertical wall. This method is economic and no more skilled labor is required. It absorbs large load without any damage.

## I. INTRODUCTION

There are few places on Earth where people need not be concerned about flooding. Any place where rain falls is vulnerable, although rain is not the only impetus for flood. Flood events are a part of nature. Flood, caused by an overflow from river, wind induced surges, tides, or many factors are normal events of the earth's hydrosphere. Water is the most important factor to growth of all living things, and there by also one of the most important factors controlling all living organisms.

When it rains or snows, some of the water generated is retained by the soil depending on the degree of dryness of the soil, some is absorbed by vegetation, some evaporates, and the remainder, which reaches stream channels, is called runoff. Floods occur when soil and vegetation cannot absorb all the water; water then runs off the land in quantities that cannot be carried in stream channels or retained in natural ponds and constructed reservoirs.

The role and significance of floods in nature are diverse. Floods induce the information of specific ecosystem with high productivity and biodiversity, in vast floodplain. During inundation, water flows carry a great amount of dissolved and suspended material, including nutrients. Hydrological cycle plays a vital role for depicting the circulation of water in various forms, from land to atmosphere as vapor and once again to land in the form of rain. The flood always causing damage not only to the properties, farms, industrials area, housing estate, transportation system near by the river side, but also causing damage to the river bank. Bank erosion is an ongoing problem, as are flooding and erosion related sedimentation problem. Flood can be occurred due to many reasons and it also have wide range of influence toward mankind, geology, ecology, sociology and many other field. River floods are part of the natural hydrologic cycle and may occur several times per year, caused by heavy downpours and snowmelt. The threat of flood to human life and prosperity is not

mitigated by our growing knowledge about the phenomena and its causes or rapidly advancing technologies and techniques of modern society. Hence people permanently strive to improve their protection from negative effect of flood. Such measures are diverse and even those used by primitive people are stilled applied.

## II. TYPES OF FLOOD

### A. Flash Flood

Flash floods occur due to excessive rain or after a substantial snowmelt. This type of flood most commonly occurs in steeply sloping valleys, but flash floods can also occur along small waterways in urban environments.

### B. Coastal Flood

Coastal flood occurs when the sea floods onto land. These floods have their origins in tropical storms and hurricanes, which drive massive amounts of water towards the shore.

### C. Urban Flood

Heavy concentration of buildings, road surfaces and paves parking lots Heavy concentration of buildings, road surfaces and paves parking lots prevent rain water from being absorbed into the ground in urban areas. During heavy rainfall, water flows across these surfaces, often in board sheets that cause sheet erosion.

### D. Riverine Flooding

The flooding of river is a natural event and normally occurs seasonally when the melting of winter snows combine with spring rains.

### E. Arroyo Flooding

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## III. CAUSES OF FLOOD

### A. Geography

Areas near river and other water bodies or areas at low levels relative to the surrounding terrain can be prone to flooding. When water rises too much it can flood over its banks or shores and into adjacent areas.

### B. Weather

Hurricanes, tsunamis and even severe rain storms can cause flooding in areas that have certain geographical features. Flash floods, which are distinguished from other in that they occur in a matter of hours, are often the result of heavy rain in low-lying areas.

### C. Technological failure

Occasionally, permanent structures such as dams and temporary floods walls or sandbags prove inadequate to hold back water. In permanent dams, this can be because of design flaw or slow, extensive wear over time from water pressure and other erosive elements.

## IV. FLOOD PROTECTION WORK

Flood protection is a method or a set of measures to prevent damage and eliminate loss of life in future floods. Protection measures are planned, they require means are selected, and their economic expediency is determined based on forecasting potential damage. It depends on floods power and population and property at risk.

Flood protection is not often thought about until an emergency occurs. Flood protection methods are different ways to slow the flow of water or completely block it from coming through. It can apply to cities, towns, and even for home use. Different methods are described below.

### A. Sandbags

The first more common method known is using sandbags. Sandbags are simply bags that are filled with sand. The bags are usually made of a burlap material. They can typically be used to stop flooding by arranging a group of them in a particular trouble area. If they are used during a flood, and the bags are soaked, it is best to discard them. Take the soaked sandbags to a local dumping place. Sandbags are bought as an empty bag, and must be filled with the sand in order to use them.

### B. Barrier

Barriers are a method that can be used for businesses, but can also be used for the home. The purpose of these glass panels is to keep the flood waters out. Typical barriers must be put up each time a flood threat appears, and installation could be bothersome, and sometimes costly. Glass storefront barriers are permanent, reducing the stress of constantly putting up barriers. They appear as normal windows and look very nice. Glass barriers are typically quoted depending on the area that you need protected.

### C. Flood Gate

Flood gates are not a fashionable solution, but a durable one. They are used to protect from the damage of violent flood waters. Flood gates can be used commercially and for the home, and are recommended for installment in front of a walkway/doorway. Flood gates are sturdy enough to hold up against strong winds and waters in order to protect possessions that may be on the other side.

### D. Levee

A levee is a type of flood protection usually used by a town or city with a river. A levee is a more natural solution where a sloped wall is made to maintain the waters of a river. It can also be manmade, using sandbags or other means to build a type of wall to ensure that if water levels become too high, the waters will not overflow. A levee is also not completely foolproof. It is also known as flood embankment.

### E. Revetment

Revetments are sloping structures placed on banks or cliffs in such a way as to absorb the energy of incoming water. They are structures, again sloped, formed to secure an area from artillery, bombing, or stored explosives. River or coastal revetments are usually built to preserve the existing uses of the shoreline and to protect the slope, as defense against erosion. Many revetments are used to line the banks of freshwater rivers, lakes, and manmade reservoirs, especially to prevent damage during periods of floods or heavy seasonal rains. Many materials may be used: wooden piles, loose-piled boulders or concrete shapes, or more solid banks.

### F. Retaining wall

A retaining wall is a structure designed and constructed to resist the lateral pressure of soil when there is a desired change in ground elevation that exceeds the angle of repose of the soil. A basement wall is thus one kind of retaining wall. But the term usually refers to a cantilever retaining wall, which is a freestanding structure without lateral support at its top. These are cantilevered from a footing and rise above the grade on one side to retain a higher level grade on the opposite side. The walls must resist the lateral pressures generated by loose soils.

## V. FLOOD PROTECTING STRUCTURE

### A. Terramesh wall

Terramesh is a soil reinforcement system which consists of panels of double twist hexagonal woven heavy zinc and PVC coated wire mesh used for stabilizing steep slopes and vertical walls. A Terramesh unit comprises a continuous horizontal panel of mechanically woven steel wire mesh or Paralink with an integral gabion fascia unit. The fascia unit is filled with hard durable rock-fill, identical to a gabion, and the wire mesh/ Paralink tail is then sandwiched between layers of compacted granular backfill. Layers of Terramesh units are then constructed to form reinforced soil retaining structures of the required height. Terramesh has the aesthetics of a gabion structure, with the reassurance and robustness of soil reinforcement system. The ParaLink in the lower half of the structure provides high strength to eliminate the risk of deep seated slips. For durability, the zinc coated wire mesh is protected by a polymeric barrier made of PVC. Terramesh System consist of three part first is gabion, second is mattress, third is soil reinforcement which is described below.

### B. Gabion



Fig. 1: gabion cage

A gabion is a cage, cylinder, or box filled with rocks, concrete, or sometimes sand and soil for use in civil engineering, road building, and military applications. For erosion control, caged riprap is used. For dams or in foundation construction, cylindrical metal structures are used. In a military context, earth- or sand-filled gabions are used to protect artillery crews from enemy fire.

Gabions are rectangular baskets fabricated from a hexagonal mesh of heavily galvanized steel wire. The baskets are filled with rock and stacked atop one another to form a gravity-type wall. Gabions depend mainly on the interlocking of the individual stones and rocks within the wire mesh for internal stability, and their mass or weight to resist hydraulic and earth forces. Gabions are a porous type of structure that can sometimes be vegetated. Gabions are considered to be a "hard" structural solution that has minimal habitat and aesthetic value.

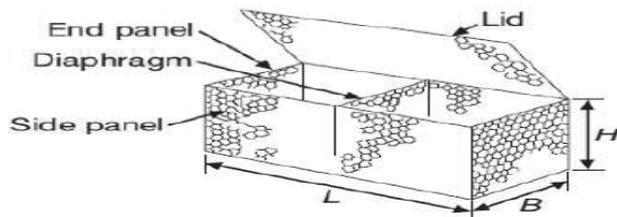


Fig. 2: gabion

### C. Mattress

The Mattress is a structure with a large area and a small thickness made from double twist hexagonal wire mesh with mechanical properties. These elements are adopted mainly for the protection of banks and embankments and they have a "substantial structural importance" based on the high risk of collapse of the soil works protected. The Mattresses are filled with stones on site to create a flexible, permeable and monolithic structure to be used for river and canal bank protection works.

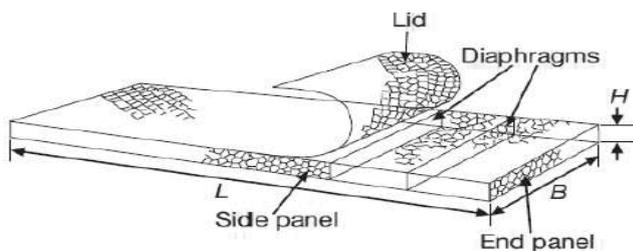


Fig. 3: Mattress

### D. Soil Reinforcement

Soils have relatively low strength so that they are not able to transfer all of forces arising in a structure when it is loaded. The tensile forces created can be transferred using geosynthetic material, geogrids, geotextiles or geocomposites, the geosynthetic products used as a reinforcing element, hence the term reinforced soil.

To ensure satisfactory performance of the reinforcement, a low elongation under stress and good design with respect to a type of soil being reinforced is essential. Geogrids are more suitable for grainy and non-cohesive materials (sand and gravel) while woven geotextiles or reinforcing geocomposites are better for cohesive, fine-grained soils (clay, loess).

The face of retaining wall can be made of gabions or concrete elements (prefabricated blocks, panels, segments) where geosynthetics materials are used as horizontal reinforcement. It can be also made as a soft face (by so called wrapped-around method). The face of the structure is formed by geosynthetics material itself in this case; dropping fine-grained filling material out through the apertures of the Paralink can be prevented by adding nonwoven or erosion control geosynthetics in the face. Only in the cases when the angle of internal friction of soil exceeds the slope inclination, it is not necessary to make reinforced face. However, the slope surface should be protected against effects of erosion using e.g. erosion control ParaLink.

Terramesh is rapid to construct, and can even reuse site won materials provided they meet our recommendations. This reuse of materials embraces sustainability of scarce resources, reducing taking unwanted materials from site as well as polluting truck movements. A gabion front with an integral mesh panel keyed into the backfill which allows high strength stabilization without using high mass stone fills. High walls with heavy loading can be designed.

A = Main Terramesh® System unit of double twisted hexagonal mesh  
B = Diaphragm made with double twisted hexagonal mesh

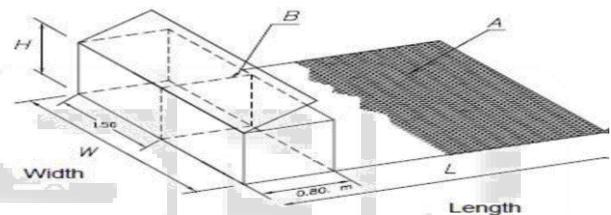


Fig. 4: Terramesh wall

## VI. CHARECTERISTIC OF TERRAMESH WALL

### A. Flexibility

It permits to tolerate differential settlement without fracture. The property of the flexible structure is especially important when a structure is on unstable ground or in an area where scour from currents can undermine it.

### B. Strength

It is also utilized to with stand absorb the forces generated by retained earth or flowing water.

### C. Permeability

Because of the permeable nature, hydrostatic heads do not develop behind gabion structure.

### D. Economy

Gabion mattress installation are more economical than rigid or semi rigid structures for a numbers of reasons.

### E. Durability

It is a heavy monolithic gravity unit able to with stand earth trust. Its efficiency increases instead of decreasing with age since further consolidation takes place as silt and soil collect in the void and vegetation establishes itself.

F. Ecology

Because gabion permits the growth of vegetation and maintains the existing environment, provides attractive and natural building blocks for decorative landscaping.

VII. GENERAL SPECIFICATION

The Gabions shall be zinc or zinc/polymer coated, or Galfan or Galfan/polymer coated. Gabions of the sizes as per design drawings, fabricated of steel wire mesh of the size and type and selvedge as specified below. Each Gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the Gabion plus 100 mm, or otherwise as stated on the drawings.

A. Steel wire zinc coating and Galfan wire coating

All wire used in the fabrication of the Gabions and in the wiring operations on site shall be zinc coated in accordance with EN 10244-2: 2001. The minimum mass of the zinc coating or galfan wire shall be in accordance with the values listed in Table.

Wire diameter(mm)	Mass of zinc coating (g/m <sup>2</sup> )
3.4	265
3.0	255
2.7	245
2.4	230
2.2	230
2.0	215

Table 1: Minimum mass of zinc coating or Galfan wire coating

B. Polymer coating

Characteristics of the polymer coating prior to such exposure.

- 1) Specific gravity shall be  $\leq 1.5$  g/m<sup>3</sup> in accordance with ISO 1183-1: 2004.
- 2) Hardness (Shore D) shall be  $\geq 38$  in accordance with ISO 868: 2003
- 3) Tensile strength shall be  $\geq 17$  MPa in accordance with ISO 527-2: 1993.
- 4) Elongation shall be  $\geq 200\%$  in accordance with ISO 527-2: 1993.

The polymer coating shall be grey in color.

C. Gabion size

Gabion type	Unit Dimension			Mesh size
	Length (m)	(mm)	Width (m)	Height (m)
M	2	80 x 100	0.5	0.5
2 x 0.5 x 0.5	2	80 x 100	0.5	0.5
2 x 1 x 0.5	2	80 x 100	1	0.5
4 x 1 x 0.5	4	80 x 100	1	0.5
1 x 1 x 1	1	80 x 100	1	1
2 x 1 x 1	2	80 x 100	1	1
4 x 1 x 1	4	80 x 100	1	1
2 x 1.5 x 1	2	80 x 100	1.5	1
6 x 2 x 0.5	6	80 x 100	2	0.5

Table 2: Gabion Unit Size

D. Terramesh system

Standard parameter

Reinforcement		
Length	Width	Height
(m)	(m)	(m)
3	2	0.5 or 1
4	2	0.5 or 1
5	2	0.5 or 1
6	2	0.5 or 1
7	2	0.5 or 1
8	2	0.5 or 1

Table 3: Reinforcement size

Mesh wire				
Type	D	Tolerance	Internal wire Dia	External wire Dia
(mm)	(mm)		(mm)	(mm)
80 x 100	80	+ 16% / - 4%	2.70	3.70

Table 4: Wire mesh / ParaLink

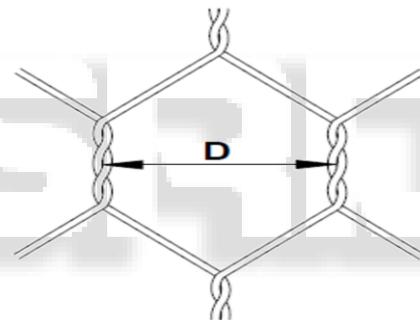


Fig. 5: Opening of wire mesh

Wire diameter			
		Mesh Wire	Selvedge Wire
Internal wire diameter	$\phi$ mm	Int.2.7/Ext.3.7	Int.3.4/Ext.4.4
Wire Tolerance	( $\pm$ ) $\phi$ Mm	0.06	0.07
Min. Qty. Of PVC coating	gr/m <sup>2</sup>	245	265

Table 5: Wire size

VIII. PROPERTIES OF TERRAMESH WALL

- 1) Terramesh walls are permeable and will not permit hydrostatic pressure to build behind the wall.
- 2) Where cohesive materials like clay, very fine particles like lithomarge soils built very high hydrostatic pressure behind retaining wall in submerged conditions. In order to reduce the hydrostatic pressure due to clogging- The geotextiles fabric may be used
- 3) High Engineering structure with long service life.

- 4) It absorbs large load without damages, since these loads are uniformly distributed through the double twist over the entire surface of the netting.
- 5) Any stone material size with density of more than 1700kg/cum. is used for filling the gabions porosity  $n=0.3-0.4$  is obtained

#### IX. CONCLUSION

From the above different types of method for flood protection work, Terramesh wall is a flexible structure, which is suitable for steep slope and vertical walls. Terramesh wall is easy to construct and no skilled labor is required. Terramesh wall have flexibility enabling the structure to tolerate differential ground settlement without compromising structural integrity.

#### X. REFERENCE

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