"DESIGN AND CONSTRUCTION OF HOLLOW FOOTPATHS USING PLASTIC WASTE"

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ABSTRACT

The quantum of plastic is increasing due to increase in population, urbanization, development activities and changes in life style leading in widespread littering on the landscape. Thus disposal of waste plastic is a menace and become a serious problem globally due to their non-biodegradability and unaesthetic view. Since these are not disposed scientifically & possibility to create ground and water pollution. Generation of plastics is rapidly increasing world-wide due to the heavy consumerism culture of modern societies. The disposal of single-use packaging products imposes a substantial toll on the environment. A large fraction of this waste ends up in landfills causing pollution in both marine and land environments. Sustainable applications of utilizing such waste material which can reduce the landfill requirement for plastic wastes acquires global attention. Various researches have been done for replacing conventional pavement materials by plastic in some quantity. Here, we will be trying to completely eliminate other materials required for footpath construction and only recycled plastic is used. In this project, recycled plastic waste (RPW) will be used to construct a complete plastic made prefabricated hollow footpath module which can also act as substantial water storage components in the required regions

Key Words: Waste Plastic, prefabricated hollow footpath, recycled plastic waste, substantial water storage components

1. INTRODUCTION

Plastic is the most widely used material in the present times. It is light in weight, moisture resistant, flexible and very inexpensive. These qualities increase our propensity towards plastic and hence making its use very common. Worldwide, over 350 tons of plastics are used every year with a large proportion of this being disposed of in landfill or by incineration. The Plastic footpaths creates a highvalue second life for plastic waste by recycling it and using to build roads, creating a durable outlet for excess plastic waste. The Plastic footpath pilot contains a significant amount of recycled plastic but the end goal is to use 100% recycled plastic. The Plastic footpath will allow for footpaths to be built faster with less impact on the surroundings and less CO2 emissions. The improved drainage will also help to build resilience against heavy rainfall and reduce flooding. In this project we are going to take the above problems in consideration and design hollow footpaths totally made up of plastic waste like ABS/PP scrap.

1.1 OBJECTIVES

- To highlight the severity of plastic waste.
- To replace traditional footpaths by prefabricated hollow plastic footpaths.
- To increase the reuse of plastic
- To decrease the amount of plastic waste.
- To allow rainwater harvesting by using hollow footpaths.

- To reduce the construction cost of footpaths.
- To make footpaths more durable.
- For easy maintenance of pavements

2.WORKING PRINCIPLE OF MODEL

The working of our hollow plastic footpath is a simple mechanical process. The camber of the road is given a certain degree of slope for the water to drain out. Similarly, our footpath will also be given a slight degree of slope so that the water will flow from its surface to the attached gutter or drainage system provided. The footpath will be provided with two drainages along both sides of the footpath. The water flowing through the road as well as the footpath will be collected in the same drainage which is connected to both the road and the footpath. The drainage/gutter will be provided with the inlets that will allow the water from the drainage to flow in the hollow spaces of the fabricated plastic footpath.

The inlets will be operated mechanically and opened when the drainage is filled. This will result in collection of rainwater in the hollow spaces of the fabricated plastic footpaths during heavy rains that will prevent the flooding of roads in cities where there is no room for the water to percolate. Once the drainage/gutter gets filled the water will then transport to the hollow spaces of the fabricated plastic footpaths where it can be stored for a required amount of time. The hollow structure of the footpath allows a lot of water to be stored during rainy season as well as during any flood situation. Once the hollow spaces of the footpath have reached its maximum capacity the inlets will be closed. Now, once the water is filled and stored inside the hollow space of the footpath, it can be used for various purposes. In order to transport this stored water, the water will be allowed to flow from hollow space to the drainage on the other side, which is at the extreme end of the footpath by mechanically operated outlets provided on the plastic wall adjacent to the extreme end drainage/gutter. Once the outlets are opened, the water will flow from hollow space into the other drainage. Now this drainage will be provided with a piping system so that the collected water can be transported with ease to the filtration plants where the water will be further treated and can be used for various purposes.

Thus, the ability of hollow plastic footpaths and its simple mechanism will make it one of the major sources of rain water harvesting.

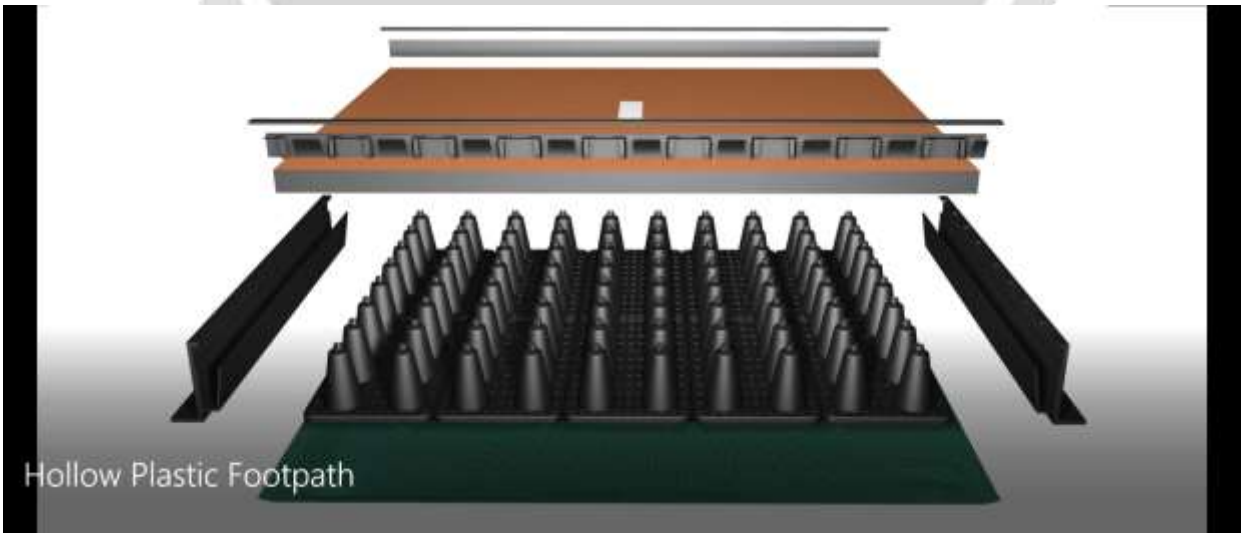

Fig. 1

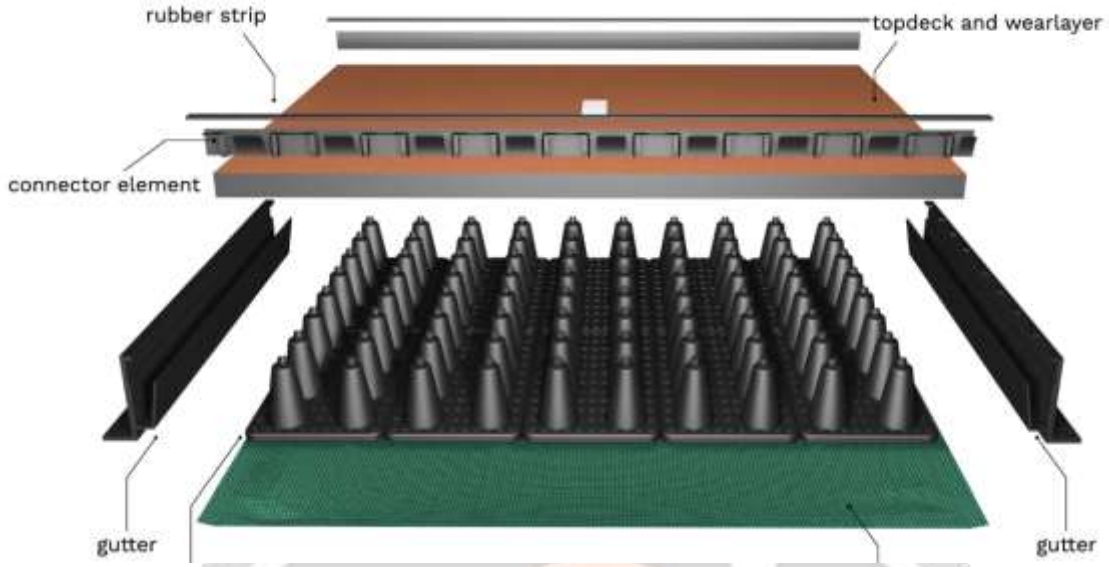
rubber strip
topdeck and wearlayer
connector element
gutter
gutter

Fig. 2

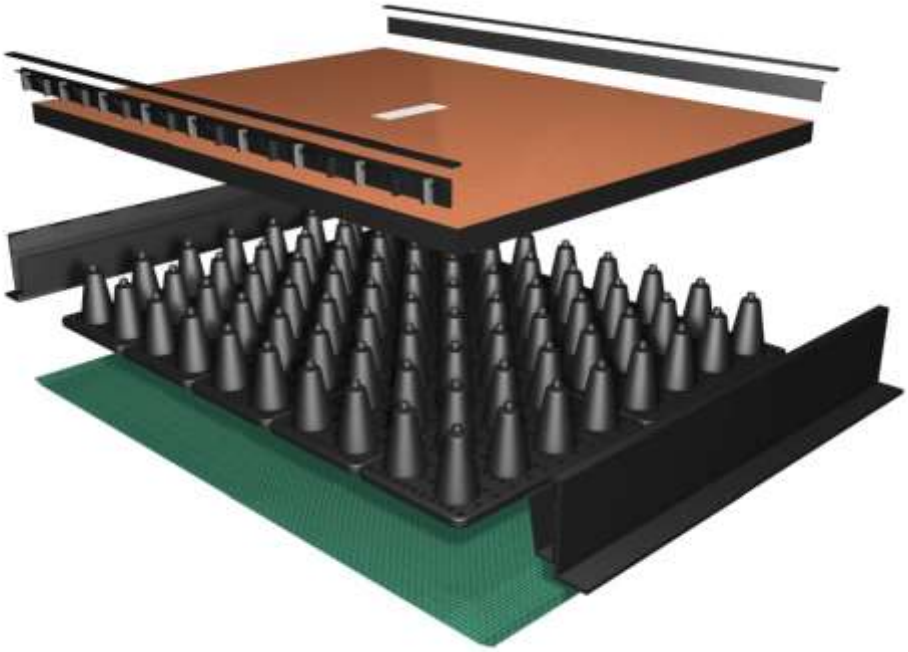

Fig. 3

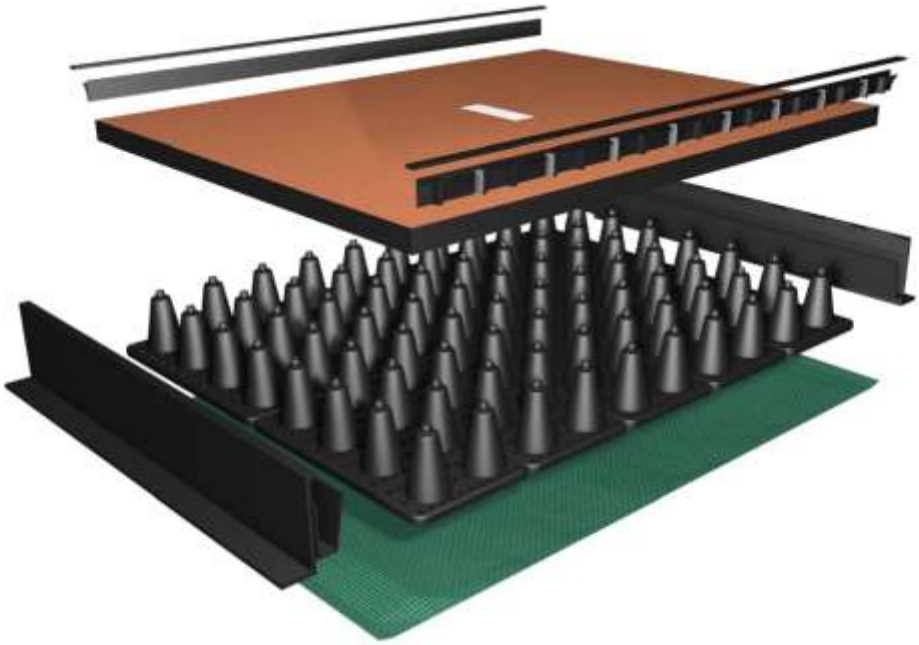

Fig. 4

2.1 MATERIAL USED FOR MODEL

- Waste Plastic
- Plywood
- Drainage pipes
- Cock

2.2 WATER STORAGE AND ESTIMATION

2.2.1 STORAGE CAPACITY OF ACTUAL FOOTPATH

The proposed hollow plastic footpath with water storage capacity will have the following dimensions:

Length-6 ft.

Width-6 ft.

Depth-1.5 ft.

The upper surface of the footpath will be supported by the hollow conical shaped structures having the diameter of one feet.

The hollow conical shaped structures supporting the upper surface will be spaced at a distance of six inches from each other. The height of the cone will be 1 ft.

In order to find the volume of water that can be stored in the hollow footpath can be made by the following calculations:

Length of the footpath (L)-6 ft.

Width of the footpath (W)-6 ft.

Depth of the footpath (H) -1.5 ft.

Thickness of the plastic walls (T) -3 in

Height of the hollow conical support (h -1 ft.

Therefore, volume of water that can be stored in the hollow footpath can be determined by using the formula:

$V=(L-2T)\ (W-2T)\ (H-2T) -25(\pi rrh/3)$

$= (72-6)\ (72-6)\ (18-6) -25(\pi.36)$

$= 66*66*12-2827.43$

= 29,444.57 cubic inch

= 482.51 Liter

Hence, 482.51 liters of water can be stored in a single fabricated hollow plastic footpath having a length and width of 6 ft. each and depth of 1.5 ft.

By above calculations, we can clearly state that to lay a footpath over a one km distance, we will need 547 individual components. So the amount of water that can be stored in those fabricated hollow plastic footpath components over a distance of 1 km will be given by:

$=482.51*547$

=2,63,932 liters

So the amount of water that can be stored in those fabricated hollow plastic footpath components over a distance of 1 km is 2,63,932 liters.

2.2.2 STORAGE CAPACITY OF MODEL

In order to demonstrate the working of our proposed Prefabricated hollow plastic footpath, we have built a model having

Length(L)-2 ft. 8 in

Width9W)-2 ft. 2 in

Depth(H)-1 ft. 5.3 in

Diameter of the conical supports(D)-2 ft. 5 in

Height of the cone(h)- 1 ft. 5 in

Thickness of walls(T)-0.3 in

Therefore, volume of water that can be stored in the model of hollow footpath can be

determined by using the formula:

V= (L-2T) (W-2T) (H-2T) -25(πr.r.h/3)

= (32-0.6) (24-0.6) (6.5-0.6) -72(π*1.25*1.25*6.5/3)

= 4335.76 -765.76

= 3570 cubic inch

=58.50 liters

Hence, 58.50 liters of water can be stored in a single fabricated hollow plastic footpath

model having a length 2 ft. 11 in width of 2 ft. 2 in ft. each and depth of 6.5 in.

3.COST ANALYSIS OF ACTUAL FOOTPATH

The costing of the proposed Fabricated Hollow Plastic Footpath will include the costs right from the melting process of the waste plastic to the maintenance of the footpath once they are completed. The total cost of the manufacturing of a single fabricated component will include the following: A single fabricated hollow plastic footpath component requires 20 kg of plastic to be melted .A melting plant of capacity 1000 kg can be constructed in a capital of 12 lakhs. This is the installation cost of the plastic melting plant. Once the plant is raised, the operation cost of the equipment and other charges like electricity and manpower comes in place. So the melting of plastic will not cost more once the plant is erected. The second job which comes into play is mold making. Mould making can be done in various ways. Here we have used injection molding as shown previously. To manufacture elements of fabricated hollow plastic footpaths, we need two molds. The first one is for the manufacturing of the hollow conical supports and the second one is for the manufacturing of plastic walls having thickness 3 inches and length and width of 6 ft. each. The cost of mold making goes around 3 lakhs. Once the molds are made, the hollow conical supports and the plastic walls will be manufactured by the process of Injection Moulding. The production of these elements will be cost saving and economical in mass production. Once those elements are manufactured, they are to be assembled by using machines and a single prefabricated hollow footpath component will be constructed which will be made of only plastic. These components will be provided with connectors on the either sides so as to connect those components with each other to form a footpath of required distance.

These pre-fabricated components will be transported from the factory to the site. Aft.er being transported to the site, the individual components will be attached to each other with the help of connectors on either side to lay a footpath of required distance. This is how the construction of a footpath over a given distance will be completed economically. These footpaths are highly durable and have a service life of approximately 40 years which makes them get an upper hand over the conventional footpaths in terms of money, life and efficiency. Also, the maintenance of these footpaths will be easy and economical because if an individual component fails due to any reason, it can be immediately replaced by the other component. So if the manufacturing of Prefabricated hollow plastic roads with water storage capacity will be adopted in the future, the mass production will bring the cost of manufacturing and laying those footpaths lower than what the conventional concrete footpaths and paver blocks costs with added durability, water storing capability.

4.ADVANTAGES

● LIGHT WEIGHT: A lightweight application in road construction. As the sections can be placed directly on the soil bed, there is no need to construct a conventional first foundation. Thanks to their low weight, there is less subsidence. This also make Plastic footpath exceptionally well suited for areas with soft. soil.

● FAST, EASY AND EFFICIENT: Thanks to the modular structure of Plastic footpath prefab elements, their light weight and detachable links, both construction and repairs are notably easier, more efficient and faster than that with traditional road structures. The components snap connectors mean that they can be installed and replaced as easily as Lego bricks. Positioning an element can be done in as little as one minute.

● MULTIPURPOSE: Plastic footpath can literally give you more space. The hollow space just beneath the road surface can be used for water storage and to put up sensors and other measuring equipment. Ideal for absorbing extreme precipitation, or when you are required to create sufficient water storage in a new residential neighborhood – where space oft.en comes at a premium. The circular structure offers room for an endless array of technical applications: from sensors, cables and pipelines to charging facilities for electric vehicles.

● LOW MAINTENANCE: The Plastic Footpath is virtually maintenance-free. In the event of incidental damage, broken or worn parts are easy to replace or repair separately.

● QUICK AND EASY: Up to 80% fewer transport runs and up to 75% reduction in consumption of raw materials. Plastic footpath witness swift. construction minimizes nuisance for local residents and businesses. Moreover, its installation requires far less digging – both during and aft.er construction. Since the substrate remains easy to access, cables and pipelines can always be quickly located.

● SOLUTION TO PLASTIC WASTE: Plastic footpath forms a solution for the major issue of plastic waste. Much of the plastic that is currently still processed as waste, incinerated, dumped or exported can now be re-used in a far higher

5.CONCLUSION

Every year millions of tons of plastic are thrown in the oceans and out of which 55% of all plastic waste is burnt. Plastic Footpaths can give this waste a new life by recycling and reuse.

1. It gives a fresher and sustainable environment along with substantial reduction in carbon emissions.
2. The production process is cleaner and the transportation during installation is cut by a significant amount compared to regular footpaths.
3. The modular design of Plastic Footpaths considerably cuts the maintenance time and its lifespan is longer than that of conventional ones. In addition, the prefabricated footpath parts are ready to use as soon as they are installed.
4. Hence, from this project we can conclude that Prefabricated hollow plastic footpath with water storage capacity are more durable, efficient, economical, sustainable than the conventional footpaths contributing to a cleaner and healthier environment.

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