



An Initiative For Green Highway In Bharatmala Project

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Abstract: Day by day everything in our lives have changed. And with this change one important thing that is required to sustain our lives that had been adversely affected is the greenery. And a large extent of biomass is being affected in the construction of roads but equivalent number of plants are not planted to meet the deficit.

The rapid rise in population led to rapid increase in vehicle density and industries, and the air is being highly polluted, which led to rise in various disease and problems among the living beings on earth and subsequently affecting the environment. But keep a pace with modern development the highways are in a need to be converted into a smart highway.

In this article, we are going to propose a model, that will club together greenery with technologies in an innovative way to convert our traditional highways into a green and smart highway with the main objective to reduce pollution in a natural way. The article includes implementation of city trees (consist of mosses), along with some green energy harvesting devices with a provision for good revenue generation through advertisement space and surplus electricity generation in the proposed model.

Key Words: Bharatmala, green, highway, moss, pollution, energy, smart.

I. INTRODUCTION

Highway are the links between the cities/states of India. And a good road communication is an important factor for the developing nation like India. But with the construction of new highways, the plant biomass is being affected due to cutting down of a large number of plants. But to sustain in this world we need both highways as well as the plants. And with the rapidly growing vehicle density on road, increases the pollution in the environment. Moreover, due to increase in population and rapid development of technologies there is a massive demand for energy, and to produce this energy, we are exploiting our non-renewable resources and a large number of pollutants are evolved in the atmosphere which in turn is polluting the environment.

To address these issues, there is a need for a revolutionary change in the framework of Indian highways. In this article we will be proposing a model that will reduce air pollution and as an added advantage we will implement some green energy harvesting technologies to address this issue indirectly.

II. DISCURSION

With reference to NGHM, in this article we are going to propose an innovative green highway initiative which will be an added advantage to ongoing green highway projects. This project is focused on maximum reduction of pollution and with an aim to increase oxygen content in air. In our approach we had also thought of some futuristic views with an objective to reduce pollution in some other ways with a scope for revenue generation through this project.

1.1 Overview

National Green Highways Mission focuses on plantation of trees along the national highway, but in this article, we are going to add an innovative proposal that can be installed on the medians of the national highway. So, let us get deeper into our project by observing the diagrammatic representation of our project in the figure 1.1 shown below.

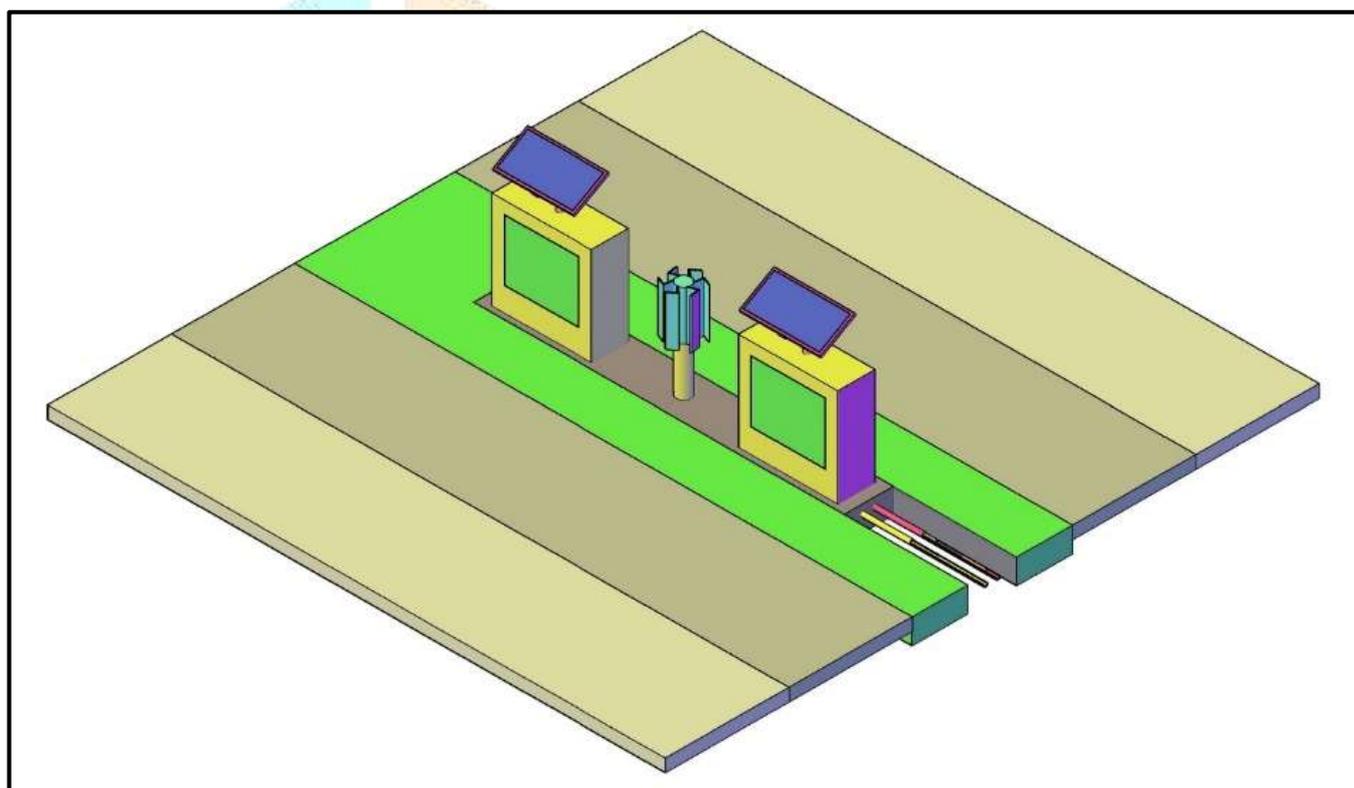


Fig. 1.1: City trees with green energy harvesting devices on highway medians.

As shown in figure 1.1, our project consists of an innovative model that mould the greenery with technology in a smart way. The set shown in the figure consist of two city trees, two solar panels, one traffic turbine in the middle of two city trees. Our project will consist of such sets projected to be installed in the median of the national highways with an interval of few meters. Here, with an approximation we can assume that the set need a space requirement of 10m x 1.5m (approx.) which can easily fit in the median. Now, let is understand each part of the set individually.

1.2 City tree

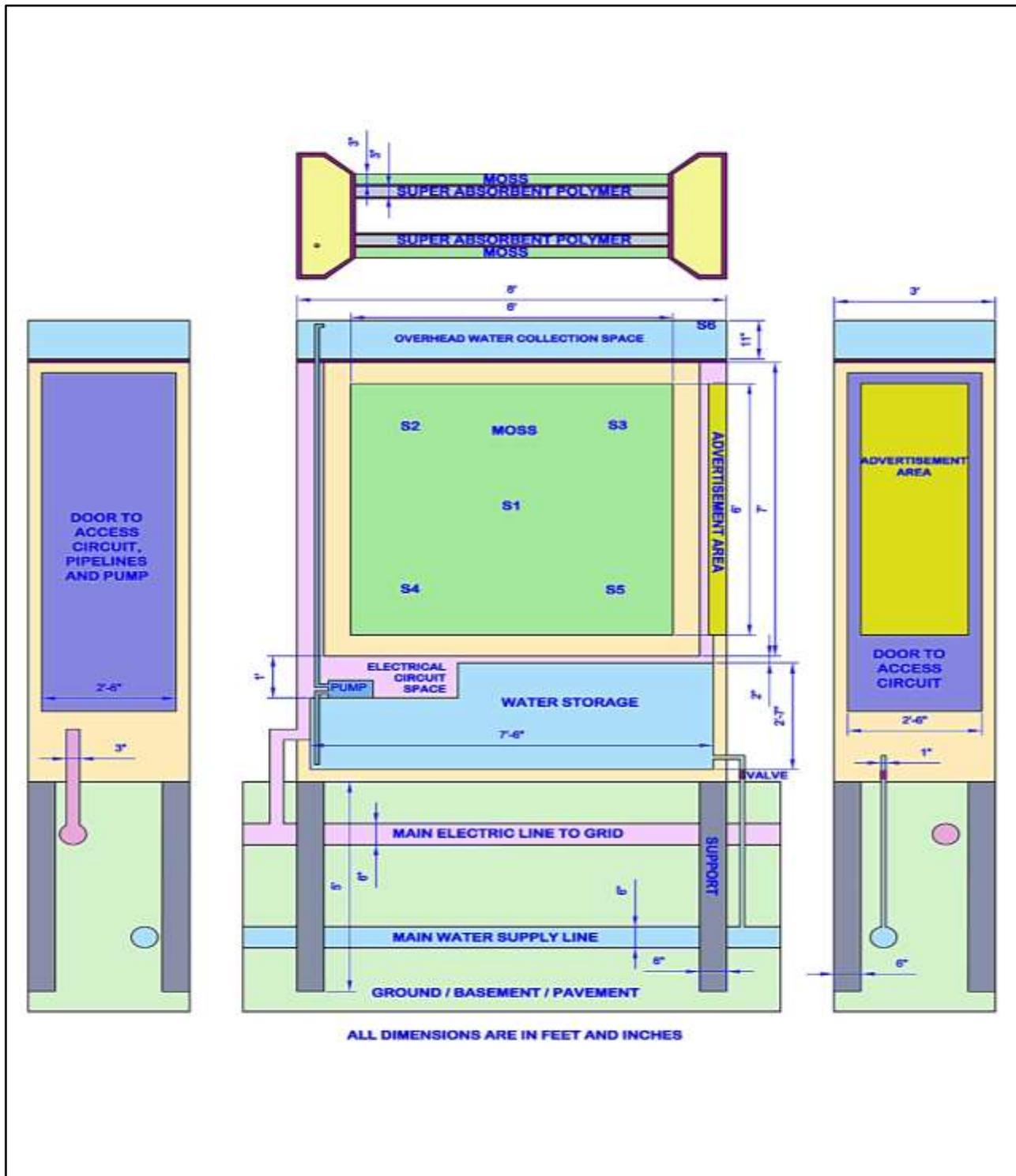


Fig. 1.2: City tree (front, side view) with cross section at the moss region.

The most important part of the set is the city tree which will directly help in reduction of the pollution in atmosphere. The city tree consists of numerous mosses which are arranged in a particular way in order to face the mosses' leaves towards the lane. The mosses are accompanied by systems to keep the moss wet and full of moisture to keep them alive. There are sensors that detect the moisture content and detect the level of water in the overhead collection space. The city tree structure can be constructed using recycled plastics which will reduce cost as well as it will be resistance from degrading and can be a long-lasting structure with least maintenance.

The figure 1.2, shows a diagrammatic view with approximate dimensions of a city tree. Let us now discuss each part of the diagram. Diagram to the extreme left is the view of the city tree from one side, while the extreme right diagram is the view of the city tree from the other side. And middle diagram represents the front side and back side of the city tree, and the diagram at the top shows the cross section of the city tree at the

region where mosses are placed.

As shown in the diagram, the mosses are arranged in a case where blocks of mosses can be slide down facing the lanes on either side. Next to the moss on going inside if the city tree as shown in cross section, there will be a passage for super absorbent polymer which will store water for mosses and supply it throughout the day, to keep the mosses wet.

There will be space for advertisement on one side of the city tree which is the side not facing the traffic turbine, so that it can be visible at a distance to the passenger travelling in the vehicles on the road. On the other side there will be door to access the wiring and pipelines that supply water from the water storage to the overhead water collection space.

Below the structure, lies there two important lines, one is the main electric line which will power the pump and lighting arrangements for the advertisement space and the other line is the main water supply line which will provide water to the water storage whenever it tends to dry. The main electric line is connected to grid and with all the green energy harvesting devices installed on highway median.

There will be two vents on the side of the city tree. One for overflow of water in storage space at the basement of city tree and the other vent will be on top corner above the advertisement space to draw circuit from the solar panel installed on the city tree.

There will be arrangements of various sensors with technologies that can record data and send it to information center regarding temperature, water level, moistures, etc.

1.2.1 Moss – the natural fine dust filter

Mosses require less space comparatively to trees, but the benefits of moss with respect to natural fine dust filter is number of times better than trees. A series of mosses are stacked on either side of the city tree, which can easily be replaced if any of the blocks gets damaged.

There are a large number of varieties of mosses that are found easily, but only a few can be grown under sun. Thorough research is required by the botanist to select the perfect species of mosses that had high efficiency of fine dust filtration, which are easily available and suitable for this purpose.

1.2.2 Irrigation system for moss

Mosses are species which need a wet environment to survive, but we intend to plant the mosses on the national highway which will be facing a dry weather condition. So, the city tree needs a proper irrigation system which will be providing a continuous flow of water throughout the day.

As we can see in figure 1.2, there is some setup for the irrigation system for the mosses inside the city tree. Now let us discuss the total irrigation system. Starting from the pump, which pump the water from the water storage at the base of the city tree to the overhead water collection space. The pump motor will work automatically by the help of the programmed circuit board installed in the space allotted for the circuits. The IC based programmed circuit board will work based on the moisture level, sensed by the sensors (i.e., S1, S2, ..., S12). In total 10 sensors (i.e., S1, S2, ..., S11 except S5) at different locations on the front and back moss setup region to track the moisture level and send signals to circuit board to start the pump and supply water. While one sensor (i.e., S6 as shown) will instruct the pump to stop water supply. And one sensor (i.e., S12) is located in the water storage space. This will work when the water level in water storage space falls below the critical level then, the sensor will send signals to the information center to supply water through the main water supply line from any nearby pumping station.

From the overhead water collection space, there present a series of holes which points towards the super absorbent polymer underneath. The water then dipped on the supper absorbent polymer (a material which can store water in it for a long period of time, and are ideal for these mosses to survive), which store the water for the mosses throughout the day and mosses absorbs the water through the membrane in between the mosses and the absorbent. Whenever the absorbent dries up, the sensor will send signals to start the pump and let the super absorbent absorb and store water. And as soon as the absorbent is filled with moisture the sensors will send signals to stop the pump and the excess water in the overhead water collection space will dip down to the water storage underneath.

While raining some amount of water will also get collected in the overhead space which will be stored in the water storage space this will reduce cost due to water supply to the city tree during rainy season.

There will be two vents on the side of the city tree. One for overflow of water in storage space at the basement of city tree and the other vent will be on top corner above the advertisement space to draw circuit from the solar panel installed on the city tree.

1.3 Smart highway

City tree will surely reduce pollution, but to reduce pollution to the best extent is to use green energy instead of non-renewable energy sources which in turn creates pollution. But with the rapid development of technologies, evolutions of electric vehicles are coming to market, and rapid market growth can be easily noticed. To meet the rapid growing energy demand, along with the city tree, we had also suggested some implementations which will help to meet energy demands without causing pollution.

As shown in figure 1.1, there are provisions for green energy harvesting devices within the set which will produce energy using renewable resources. The set consist of two solar panels installed on each of the city tree and a traffic turbine installed in the middle of the two city trees. And the energy harvested through these devices will be transferred to the grid through the main electric line underneath the city trees.

With future ready concept some provisions can be kept for charging of vehicles wirelessly through some futuristic technologies.

1.3.1 Solar panel

As shown in figure 1.1, a solar panel can be fixed on the city tree using adjustable solar side pole mount bracket.

The pole can be made of the same material as of the city tree structure, but there must be a provision for detachment of the pole from the city tree.

We suggest a 6.5' x 3.3', 72 cells monocrystalline solar PV module for this purpose which will easily fit on the city tree. And though there is a cheaper alternative named polycrystalline solar panels instead of monocrystalline solar panel, but we would suggest monocrystalline solar panel because polycrystalline solar panels are less efficient than monocrystalline solar panel as monocrystalline solar panel are lower temperature coefficient than polycrystalline solar panel. Moreover, monocrystalline solar panel has better lifespan than polycrystalline solar panels.

And in market, monocrystalline solar panel are slightly costlier than polycrystalline solar panels which stands nowhere based on its advantages.

1.3.2 Traffic turbine

As shown in figure 1.1, a traffic turbine is proposed to be installed in between the two-city tree. A traffic turbine is a green energy harvesting device which harvest energy by utilizing the wind turbulence generated due to the movement of vehicles. Placing the traffic turbines (vertical axis wind turbine) in the median will capture wind draft from each side of the road in opposite direction.

Along with the traffic turbine a solar panel is also installed which can be an added advantage. Suggestions are not made for it and is kept for future scope.

1.4 Advertisement space

One additional part of our project includes this advertisement space on the city tree. This is not our objective but implementing this part will bring a good amount of revenue throughout the year.

We had allotted a 2' x 6' feet space for advertising hoarding on one side of the city tree. The hoarding will be on the side of the city tree which is not facing the traffic turbine as shown in figure 1.1 and figure 1.2. The hoarding will be facing opposite to the movement of the vehicle, so that it is easily visible to the passengers in the vehicles. In short advertisement space will be on the side facing away from the full set.

1.5 Financial assumptions

As we had already said that there is a requirement of a thorough research before implementation of the said project, and the diagrams are for illustration purpose. But just for an idea about the cost and benefit from the project some assumed financial data are been discussed below to give an idea of the expenditure and subsequent revenue that can be earned by implementing the project.

1.5.1 Approximate expenditure

Table I: List of approximate expenditures for the said project each set.

SL. NO.	PARTICULARS	RATE	Q	AMOUNT
1	City tree	₹ 16,789	2	₹ 33,578
2	Solar panel	₹ 12,210	2	₹ 24,420
3	Traffic turbine	₹ 22,010	1	₹ 22,010
4	Underground main electric line	Not estimated		
5	Underground water supply line	Not estimated		
	Total One Time Expenditure			₹ 80,008
	Maintenance cost	Not estimated		

1.5.2 Expected revenue

Table II: List of expected yearly revenue for the said project each set.

SL. NO.	PARTICULARS	RATE	Q	AMOUNT
1	Rent from advertisement space	₹ 28,800	2	₹ 57,600
2	Excess energy feed to grid (in kwh)	₹ 6	2124	₹ 12,744
	Total Yearly Revenue			₹ 70,344

1.5.3 Remarks

With approximate one-time investment of ₹ 80,008.00 excluding underground main electric line and water supply line and yearly maintenance cost, we can expect a yearly revenue of ₹ 70,344.00 per set as shown in figure 1.1. So, we can conclude that our project had a good cost benefit perspective along with an enormous social cost benefit perspective in terms of good human health (since our project will reduce pollution and this will result to decrease in pollution caused diseases) and sustainable environment.

III. ADVANTAGES

This project had an immense number of advantages as listed below:

- First & foremost is reduction of pollution in environment in due to the purifying nature of the mosses which will act as a major element of our project.
- A huge amount of oxygen will be liberated due to photosynthesis taking place in the mosses and as a result the decrease in oxygen concentration will be controlled to a large extent.
- Green energy generated will meet some of our energy demand resulting in conservation of non-renewable resources and in turn will reduce pollution caused due to burning of fuels.
- We can experience a lot of greenery around us, and we can breathe in pollution free air, and moreover global warming will also be reduced as an added advantage.
- And last but not the least, a good amount of revenue will be generated from the advertisement which will help government to utilize the funds in other welfare activities in the country.

IV. DRAWBACKS & RISKS

With every positive side there remains a negative side too, likely with advantages there are disadvantages too. Some possible risks and drawbacks of our project is listed below:

- In our project, there is an extensive use of electrical and electronics components and there require proper regular maintenance, otherwise there are chances that some malfunction may happen.
- Though irrigation systems are installed but there are chances that some mosses blocks may get damaged due to some reasons, so proper observation should be taken to remove the damaged mosses and get replaced before the other nearby mosses gets damage.
- Solar panels installed can get a layer of dust which will affect its efficiency, some measures must be taken to overcome such circumstances. If proper oiling of the moving parts in traffic turbine are not done then it will reduce the efficiency of the traffic turbine, so proper maintenance must be taken to improve the efficiency of electricity generation.
- The dimensions and green energy harvesting devices shown or discussed in the given figures are just for illustration purpose, a thorough analysis and designing must be done before implementation, otherwise some problems may arise.

V. CONCLUSION

The pollution level in the Indian environment is going adverse day by day. And to counter this problem, many initiatives had been taken by government but none of them could make a noticeable impact on the pollution level. And from the daily newspaper, it is noticeable that the pollution level is going too adverse, and as a result, the visibility is reduced, which had led to numerous accidents, delay in train and flight schedule.

To address the pollution issue, there are a requirement of a major initiative which will bring a noticeable change in the pollution level. This project has brought about an innovative idea that would work similar to that of a tree but in large scale. And this will not only reduce the pollution level but will also help in carbon reduction and increase in oxygen concentration in the atmosphere. The mosses will help directly to reduce air pollution and green energy will be led to reduction of burning of fuels to harvest energy, hence reducing pollution. And as a result, the air quality will improve and health issues due to pollution will decrease to a

noticeable quantity.

Along with the main objective to reduce air pollution, this project also suggests implementation of green energy harvesting devices on the medians of the national highways to harvest energy and meet a portion of total energy demand. Moreover, this project had also suggested with a slight modification in design of the model, that is to allot a space for advertisement as a good source of revenue for the government throughout the year.

And finally, to conclude that this project will not only reduce pollution in various ways but also it will generate good revenue and employment opportunities will be created in order to maintain the project.

VI. FUTURE SCOPE

The selection of mosses is the vital part of the project, and thorough research is required to find the most suitable moss species for this purpose and select mosses accordingly in order to fit best in the Indian region based climatic conditions. The irrigation system shown is a very simple system but there is a vast future scope improvement. The structural design is just for illustration purpose, proper analysis needs to be done and experts must be consulted before implementation of the project.

The discussed project is based on a futuristic approach but there lies an extensive future scope in the means of emerging technologies. The smart highway is a vast concept and that can be worked on with this project. There is an enormous future scope to do some implementations regarding charging of electric vehicles wirelessly with the use of green energy harvested in the project. There is scope for implementation of sensor that will turn on and off the street lights on roads that are rarely used.

Selection of appropriate solar panels and designs of traffic turbines need extensive research to get maximum energy from sun and lower gust of wind respectively. And many for future scope is there for this project.

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