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Dynamic Analysis of Tile Waste and Bamboo Reinforced Concrete Structure

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ABSTRACT:Ceramic tile wastes are found to be suitable for usage as substitution for fine and coarse aggregates in concrete in concrete production. Bamboo as a building material has high compressive strength and low weight and thus has been one of the most used building materials as support for concrete, especially in those locations where it is found in abundance. Bamboo as a building material is used for the construction of scaffolding, bridges structures, and houses. When tile waste and bamboo are combined together in a structure, there arises a new sustainable structure.Bamboo has outstanding tensile properties, replacing steel reinforcement in reinforced structural concrete with bamboo is of high interest. The reuse of ceramic tile waste as coarse aggregates helps in reducing the over-quarrying of coarse aggregates and leads to proper management of waste in urban areas. In this project, the aptness of bamboo used as reinforcement in RC beam of a structure and ceramic tile waste as partial replacements for coarse aggregates will be checked out by carrying out dynamic analysis on the sustainable structure using Etabs 2016 analysis.

KEYWORDS: Ceramic Waste, Bamboo Reinforcements,Dynamic Analysis, Sustainable Structure, Scaffolding.

I. INTRODUCTION

1.1GENERAL

A sustainable building is the outcome of a design philosophy which focuses on increasing the efficiency of resource use energy, water and materials while reducing building impacts on animals, human health and environment during the building's life cycle, through better sitting, design, construction, operation, maintenance and removal.A sustainable structure is constructed so that the total impact on the society is minimal. In this project the coarse aggregates are replaced with tile waste and steel reinforcement will be replaced with bamboo reinforcements.The combination of these two in a structure will make it sustainable to some extent.The usage of tile aggregates as replacement to coarse aggregate in concrete has the benefits in the aspects of cost reduction and reducing pollution caused by construction industries.The most important quality of bamboo is its environmentally friendly quality and light weight.It is renewable and bamboo forests can be grown in a few years. It has a natural waxy surface that does not require painting, making it safe from health hazards caused by paints which contain toxic substances.Bamboos can be grown in a variety of climates and the houses made using bamboo do not require additional materials like concrete, steel etc. Pesticides and other chemicals need not be used while cultivating bamboo, making it more eco-friendly.In this project,a dynamic analysis will be done in the whole sustainable structure in which the tile wastes will be used as partial replacements for coarse aggregates and the bamboos will be used a substitutes for steel reinforcements.The same analysis will be done in a conventional building.The results will give us the aptness and effectiveness of such a sustainable structure in the field of civil engineering.

OBJECTIVES

- To analyze the aptness,suitability and effectiveness in using tile waste and bamboos as alternatives for coarse aggregates and steel reinforcement.
- To compare the strength and performance of the predicted model with a conventional one in a structure.

II. MATERIALS USED

Cement: Cement is a fine powdered substance which provides strength to the concrete.In this project,we used OPC 53 grade cement of Dalmia cement company by following the IS:12269.This is available in local markets.

Fine Aggregate:The fine aggregates are those aggregates whose range varies from 4.75 mm to

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150 microns.Sand is used here as it has silica (SiO2), usually available in the form of quartz.It is chemically inert and considerably hard which makes it the most common weathering resistant minerals.

Coarse Aggregates: The crushed aggregates of size ranging from 10mm to 12.5mm were chosen.The required sizes were chosen by sieving the aggregates. The aggregates were tested for their physical requirements such as water absorption, specific gravity and bulk density following the code IS: 2386-1963.

Tile aggregate: Broken tiles were collected from the construction industries and demolished building wastes.The waste tiles were crushed into small pieces manually.The required size of crushed tile aggregate waste were separated and were used as partial replacement for coarse aggregates.

Water: Water from the local water sources satisfying the requirements for concreting and curing as per IS: 456-2000 was used in the project.

2.1.MATERIAL PROPERTIES

Table 2.1: Physical Properties of cement

PROPERTY	RESULT
Specific gravity	3.23
Consistency	290 m^2/Kg
Initial setting time	30 mins

Table 2.2: Properties of fine aggregate

PROPERTY	TEST RESULT
Specific gravity	2.79
Fineness modulus	2.84
Bulk density	1650kg/m^3

Table 2.3: Properties of coarse aggregate

PROPERTY	TEST RESULT
Specific gravity	2.74

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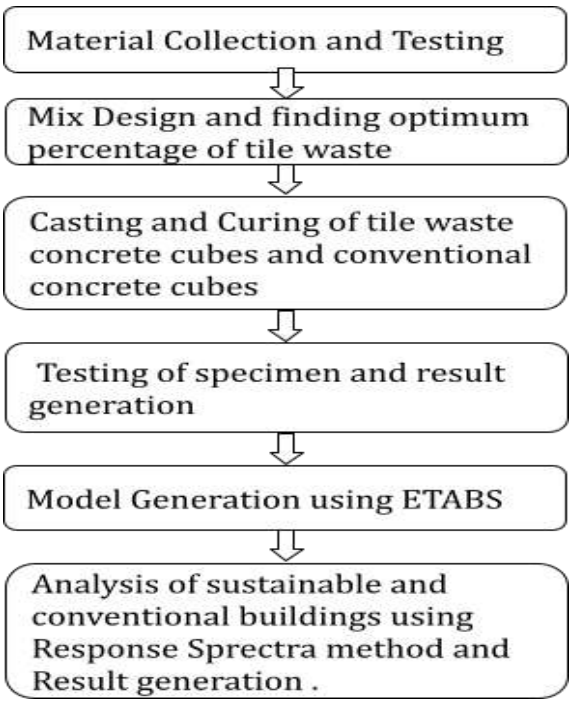
Bulk density	1436kg/m^3
Water absorption	0.21%

Table 2.4: Properties on tile Waste

PROPERTY	TEST RESULT
Bulk density	1402kg /m^3
Aggregate crushing value	12.76
Water absorption	0.21

III. METHODOLOGY



3.1MIX PROPORTION

The mix proportion of 1: 0.75: 1.5 by weight was arrived at for M30 concrete with the conventional aggregates. It was found that the minimum water content required for the mix was fixed using IS 10262. Keeping this water content as constant, mix proportions were arrived for the ceramic tile waste. The mix proportions for M30 grade tile waste concrete as per IS 10262 is 1:0.95:2.45.

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3.1.2Compressive strength

The compressive strength of a conventional cube is 40.88 N/mm^2. The compressive strength of a concrete cube made with ceramic tile is 37.55 N/mm^2.

IV. ANALYSIS OF MODEL

Dynamic analysis (Linear Dynamic Response Spectrum Analysis) is carried out in order to perform the seismic analysis and design of the structure, the actual time history record of the particular place is required. It is not possible to have such records at each and every location. Further, the seismic analysis cannot be carried based on the peak value of the ground acceleration. To overcome the above difficulties, the earthquake response spectrum is the most popular tool in the seismic analysis of the structure.

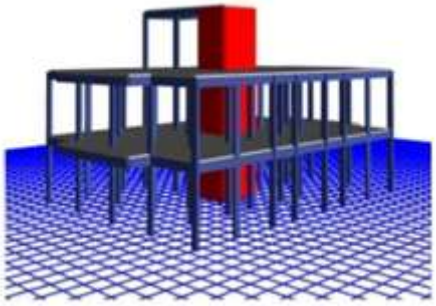

Fig 4.1: 3D rendered view

V. RESULTS AND DISCUSSIONS

5.1CONVENTIONAL BUILDING-RESULTS

Fig 5.1: The overturning moment of the conventional building

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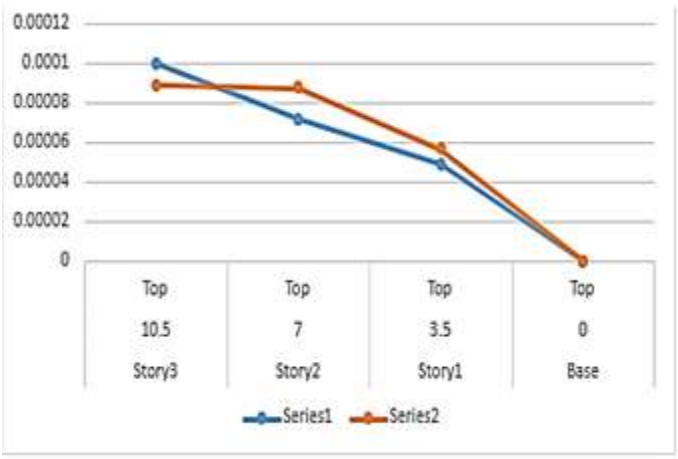

Fig 5.2: Maximum Storey Displacement of conventional building

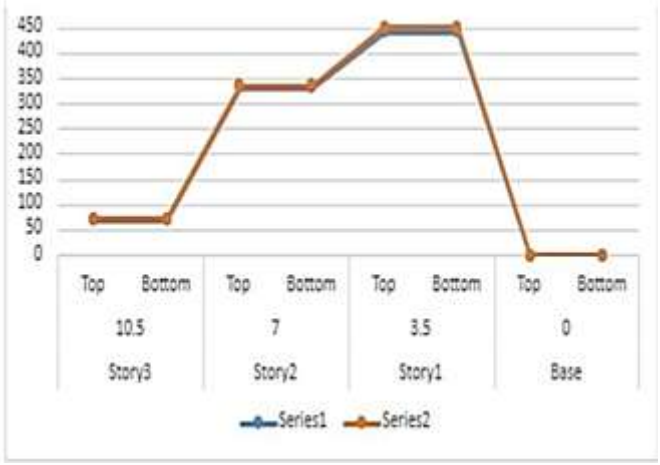

Fig 5.3: Maximum Storey Drift of conventional building

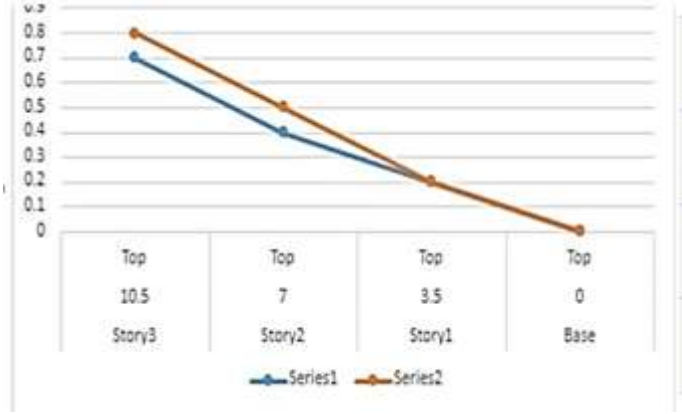

Fig 5.4: Storey Shear of conventional building

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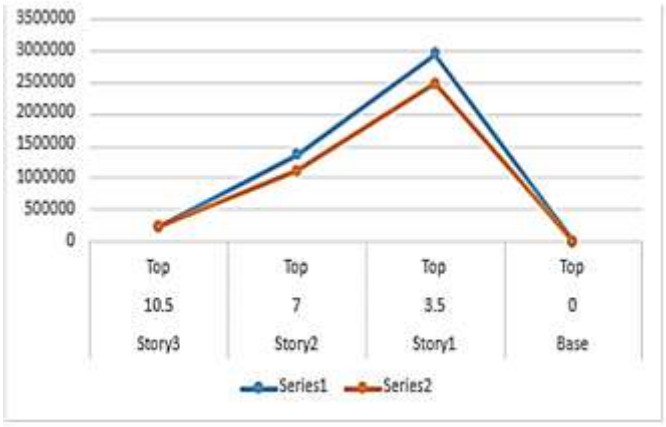

Fig 5.5: Storey Stiffness of conventional building

5.2SUSTAINABLE BUILDINGS-RESULTS

Fig 5.6: Overturning Moment of sustainable building

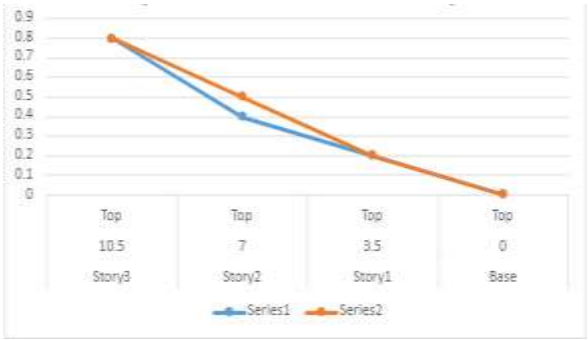

Fig 5.7: Maximum Storey Displacement of sustainable building

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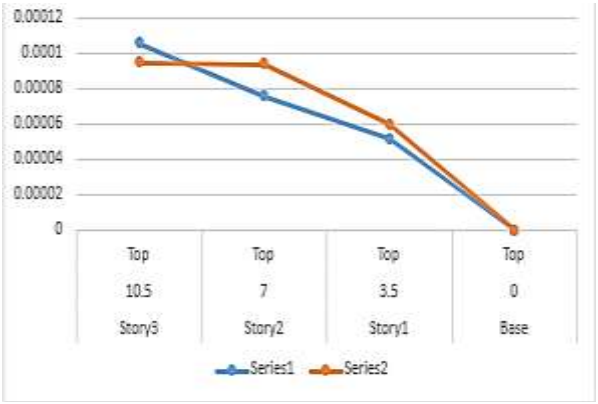

Fig 5.8: Maximum Storey drift of sustainable building

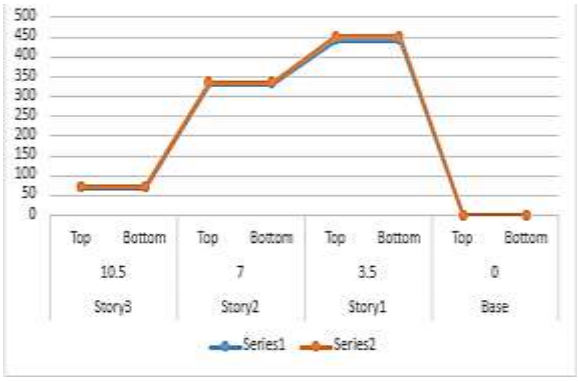

Fig 5.9:Storey Shear Of Sustainable

Building

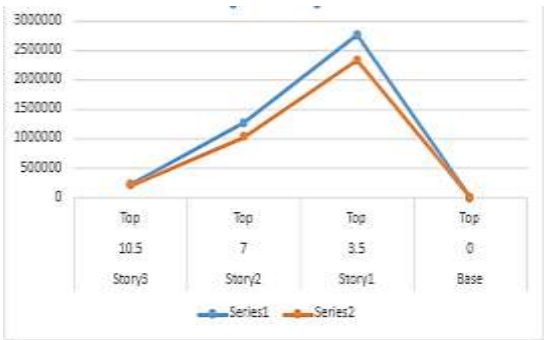

Fig 5.10: Storey stiffness of sustainable structure

VI. CONCLUSIONS

This project has discussed the methodology to be adopted to understand the dynamic response of a sustainable structure. This gave a comparative analysis of the specified v/s conventional structure. From this project, it can be concluded that use of tile waste and bamboo reinforcement can be use in buildings up to three storeys safely. The replacement of tile waste can be done up to 30%. The density of tile waste is 1402kg/m^3. The dead load of the sustainable building is low due to which the building becomes less vulnerable to earthquake. Thus, they can be provided with wider sections which can increase

the load bearing capacity of the structure. The properties like drift and displacement of the sustainable building are low. The structure is also stiffer and can resist loads. The storey shear and overturning moment values of the sustainable building has slight difference when compared to conventional building. But, these kinds of sustainable buildings can be constructed for less than three storeys. The use of bamboo with ceramic tile waste as coarse aggregates will help to achieve both economy and sustainability.

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