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Implementation of Role of Circular Economy Principles in Sustainable Construction Practices

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ABSTRACT: The principles of circular economy in sustainable construction focus on designing, building, and managing structures in ways that minimize waste, reduce resource consumption, and extend the lifespan of materials and buildings. The goal is to create a system that mirrors natural processes, where everything is reused or recycled, reducing the need for new resources and mitigating environmental impacts. Construction waste (C.W.) management involves four hierarchical steps reduce, reuse, recycle and recover. This research explores the pattern of C.W. generation and its relationship with physical, organizational, and behavioural aspects in the construction process as a whole. It argues that current C.W. management practices are linear, where architectural interventions can play a significant role in adopting a Circular Economy (C.E.) based approach for environmental sustainability.

KEYWORDS: Construction Waste, Circular Economy, Sustainable Construction, Environmental Sustainability

I. INTRODUCTION

The construction industry is one of the significant contributors to the global economy that significantly contributes to a country's development process providing necessary public infrastructure and structures for residential, various productive activities such as services, commerce, industries, and other utilities. On the other hand, building and infrastructural facilities and subsequent construction activities consume excessive mineral resources. The depletion of natural resources by the building industry is a matter of grave concern as most of the recyclable material from building sites ends up in landfill sites. Thus, optimization of materials consumption and generation of waste by construction activities is indispensable to sustainable development. Construction waste (C.W.) management involves four hierarchical steps reduce, reuse, recycle and recover.

This research explores the pattern of C.W. generation and its relationship with physical, organizational, and behavioural aspects in the construction process as a whole. It argues that current C.W. management practices are linear, where architectural interventions can play a significant role in adopting a C.E. based approach for environmental sustainability. Construction & Demolition Waste in India has major components.

Figure 1 show the percentage distribution of various constituents of C&D waste in India in 2000.

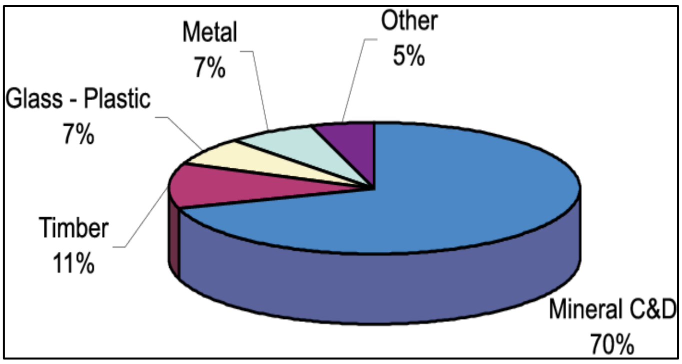

Fig 1 Different constituents of C & D Waste

Table 1 show the percentage distribution and tonnage of various constituents of C&D waste in India in 2000

Constituent	Million Tonnes/Yr
Soil, Sand and gravel	4.20 to 5.14
Bricks and masonry	3.60 to 4.40
Concrete	2.40 to 3.67
Metals	0.60 to 0.73
Bitumen	0.25 to 0.30
Wood	0.25 to 0.30
Others	0.10 to 0.15

Table 1 Quantity of various constituents generated per year C&D waste estimation

II. METHODOLOGY

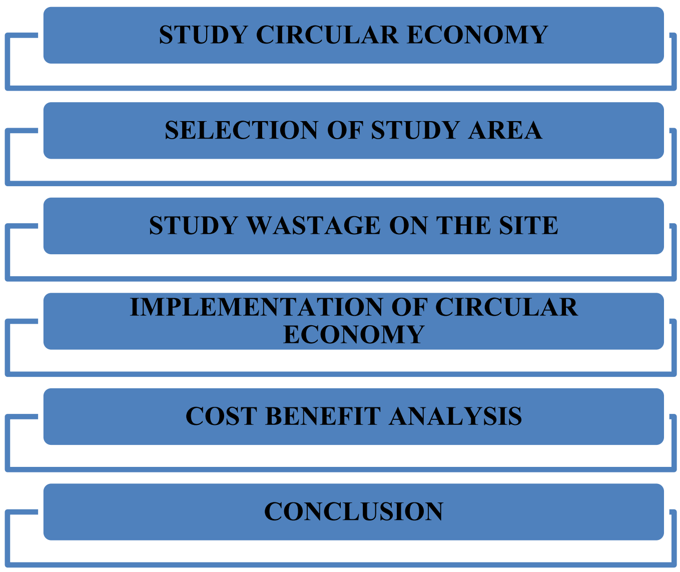

Fig 2 Methodology

III. RATE ANALYSIS

A. Rate Analysis Of Brick

Rate analysis of brick masonry used of reference book IS Code 1200 part 3(IS Code 1200 part 3 used for measurement), IS Code 2212, and CPWD Part 1

Table 2 Rate Analysis of Brick

Sr No.	Description	Qty	Unit	Rate	Cost
A.	Material				
1	Bricks (Size of brick = 190 mm x 90 mm x 90 mm)	33269	No	4	133076

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	Wastage of brick 5% Extra	5%			6654
2	Cement	85	Bag	370	31450
	Wastage of cement 2% Extra	2%			629
3	Sand	6.27	Brass	7000	43890
	Wastage of sand 2% Extra	2%			877.8
B.	**Labor Charges**				
1	Mate	15	No	350	5250
2	Mason	25	No	700	17500
3	Helper	15	No	500	7500
4	Coolie	10	No	350	3500
C.	**Total Cost**				250327
	Scaffolding 1% Extra	1%			2503
	Add for Water Charge @ 1% on Items Market	1%			2503
	Add for Contractor's Profit @10% on Items Marked	10%			25033
Total Cost of 66.54 Cu.m.					280366

B. Rate Analysis Of Pte Bottles

Table 3 Rate Analysis of PTE Bottles

Sr No.	Description	Qty	Unit	Rate	Cost
A.	**Material**				
1	PTE Bottle	2554	No	2	76620
2	Cement	92	Bag	370	34040
	Wastage of cement 2% Extra	2%			680.8
3	Sand	6.77	Brass	7000	47390
	Wastage of sand 2% Extra	2%			947.8
B.	**Labor Charges**				
1	Mate	15	No	350	5250
2	Mason	15	No	700	10500
3	Helper	20	No	500	10000
4	Coolie	15	No	350	5250
		65			

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C.	**Total Cost**				119167
	Add for Water Charge @ 1% on Items Market	1%			1192
	Add for Contractor's Profit @10% on Items Marked	10%			11917
Total Cost of 66.54 Cu.m.					132275

IV. COST COMPARISON

Table 4 Cost Comparison of Brick and PTE Work

COST COMPARISON	
BRICK WORK	280366
PTE WORK	132275

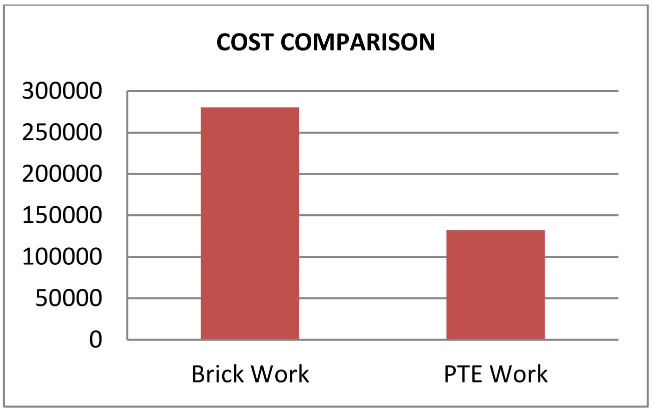

Fig 3 Cost Comparison of Brick and PTE Work

Above graph shows the cost comparison of brick work and PET work, its conclude that PET work are economical financially its differ aprox 1.48L rs per floor

V. ANALYSIS IN ETABS

Wall Load calculation	**F to F Height - Depth Of beam x Width of wall x Density of Brick**
Floor to Floor Height	3 m
Depth of Beam	0.45 m
Density of brick	18 kN/m3
Density of Soil	22 kN/m3
Wall Load With Brick Masonry kN/m	6.89
Wall Load With PET Masonry kN/m	8.42

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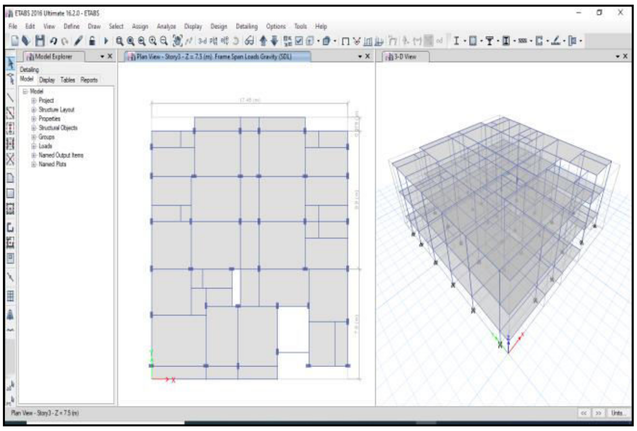

Fig 4 Modeling in ETABS

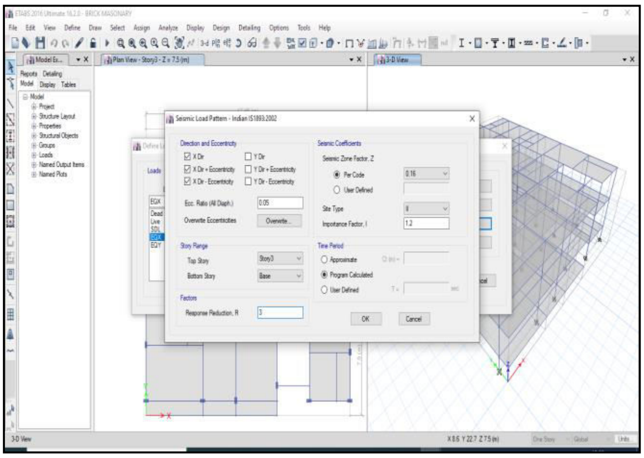

Fig 5 Add seismic force in ETABS

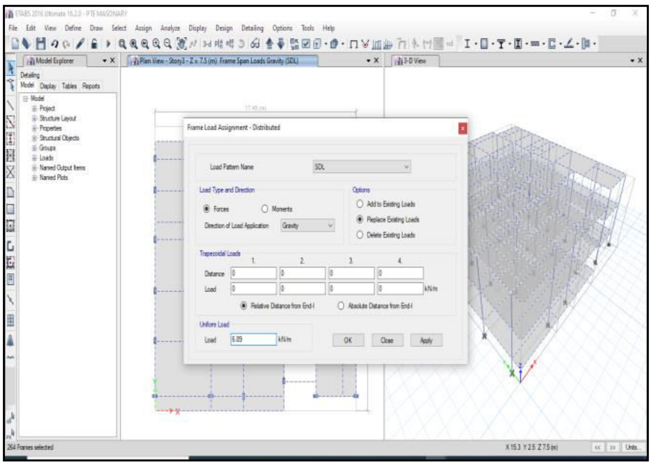

Fig 6 Add wall load of Brick in ETABS

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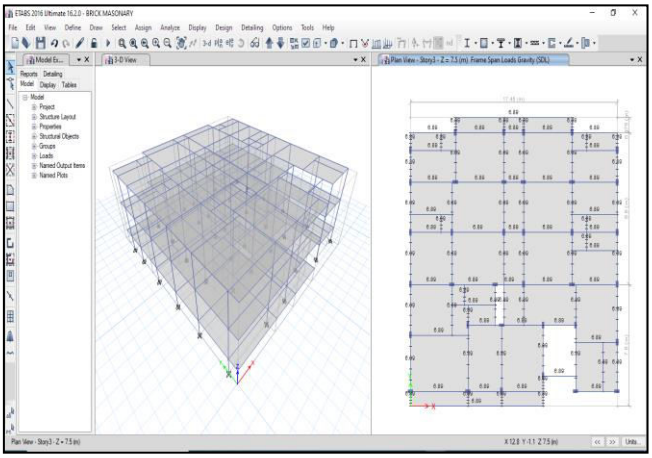

Fig 7 wall load of Brick in ETABS

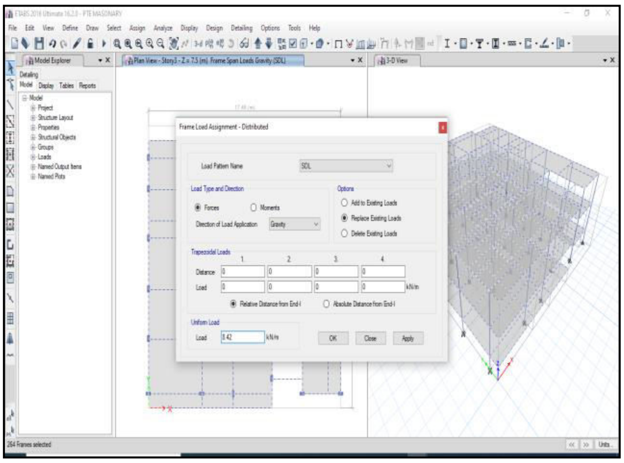

Fig 8 Add wall load of PET in ETABS

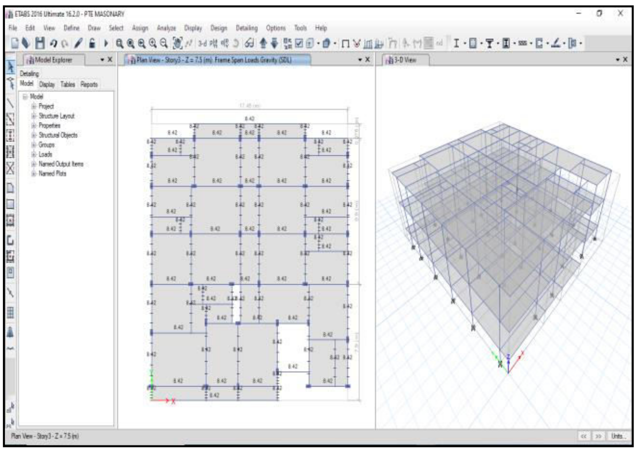

Fig 9 wall load of PET in ETABS

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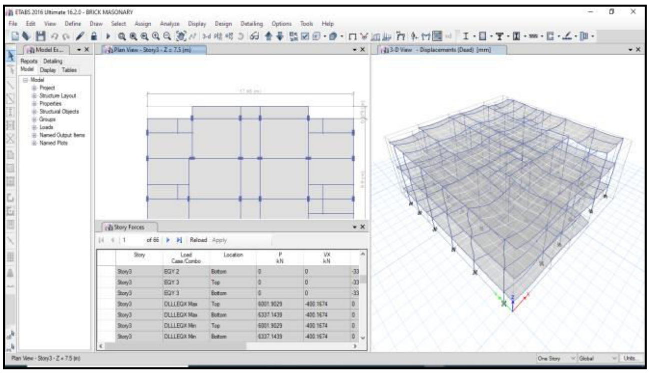

Fig 10 Story Force Brick Masonry

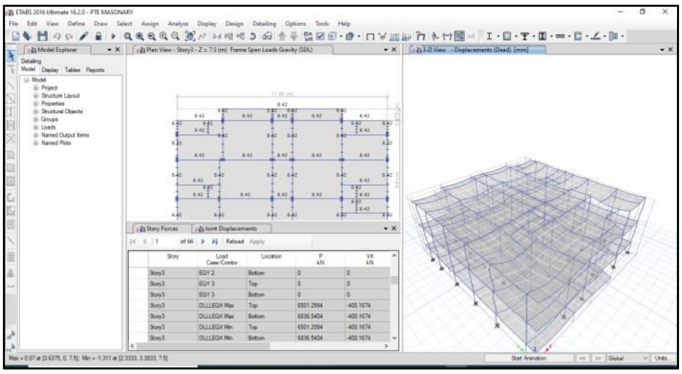

Fig 11 Story Force PET Masonry

VI. CONCLUSION

For the study we study G+1 storey structure of a building located in Punavale, Pune with 3 m floor to floor height and calculate Quantity and loads of Brick masonry and Plastic Bottle masonry of R.C.C Buildings and analyze in ETABS software in zones III. The structure has been analyzed for earthquake forces. Hard soil condition has been selected for the structure. And find the cost feasibility and seismic effect of the structure. The final conclusion are conclude that the PET bottles are economical than brick masonry in financially and stability too. The conclusion are conclude from the following points

- Use of innovative materials with sustainable application such as plastic bottles can have considerable benefits including finding the best optimization in energy consumption of the region, reducing environmental degradation.
- Reusing the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks in walls and reducing the CO2 emission in manufacturing the cement by reducing the percentage of cement used. Plastic bottles wall have been less costly as compare to bricks and also they provide greater strength than bricks.
- Plastic bottles are considered as a kind of indecomposable junk which can have substantial dangerous impact on environment. On the other hand using the non-renewable resource cannot lead to sustainable development and causes to the resource depletion which can bring a destructive concern for the future generation. It has been demonstrated that the plastic bottles can be used in some parts of building construction such as walls, roof and etc
- The cost comparison of brick work and PET work, its conclude that PET work are economical financially its differ aprox 1.48L Rs per floor
- The base shear of the building for each story and for the better seismic performance building with having high base shear is economic and in that case building with having PET masonry having high base shear than brick masonry by 5-10%. So its conclude for stability PET masonry are economical for Seismic performance.

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