AN EXPERIMENTAL INVESTIGATION ON BUCKLING BEHAVIOUR OF COLUMN FILLED WITH RUBBER AND GRAPHITE POWDER

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Abstract— - In this paper the main objective is to reduce the dead load and to determine the strength of column using concrete filled with rubber and graphite powder. At present the disposal of waste tyres is becoming a major waste management problem in the world. It is estimated that 1.2 billions of waste tyre rubber produced globally per year. In this 11% of post consumer tyres are exported and 27% are sent to landfill, stockpiled or dumped illegally and only 4% is used for civil engineering projects. Several studies have been conducted to examine various applications of recycled tire rubber. Crumb rubber is a waste material that is ideal for use in concrete applications. It reduces the usage of natural aggregates in the production of concrete. An experimental investigation is carried out on a concrete containing waste chipped rubber & graphite filled pvc pipe. The specimens were casted, tested and compared with conventional concrete in terms of workability and strength. The standard size of 1000*150*150 mm were used with a curing period of 28days to determine the buckling strength of concrete.

***Keywords*- buckling strength, rubberpowder, graphite powder, pvc pipe**

I. INTRODUCTION

Cement and aggregate, which are the most important constituents used in concrete production, are the vital materials needed for the construction industry. This inevitably led to a continuous and increasing demand of natural materials used for their production. Parallel to the need for utilization of natural resources emerges a growing concern for protecting the environment and a need to preserve natural resources, such as aggregate, by using alternative materials that are either recycled or discarded as a waste.

Waste tyres have presented a pressing global issue for the environment, as a result of a growing use of road transport vehicles. Discarded waste tyres often create 'black pollution' because they are not readily biodegradable and pose a potential threat to the environment. Several means of reusing or recycling tyre rubber have been proposed, including the use of lightweight fill in the asphalt pavement, fuel for cement kilns, and the feedstock for making carbon black, and the artificial reefs in marine environments.Recycled waste tyre rubber is a promising material in the construction industry due to its lightweight, elasticity, energy absorption, sound and heat insulating properties. In this paper the buckling strength of concrete utilizing waster tyre rubber has been investigated.Waste tire rubbers are materials that do not decompose and disintegrate in the nature; so they are considered as environment

1.1 Research scope

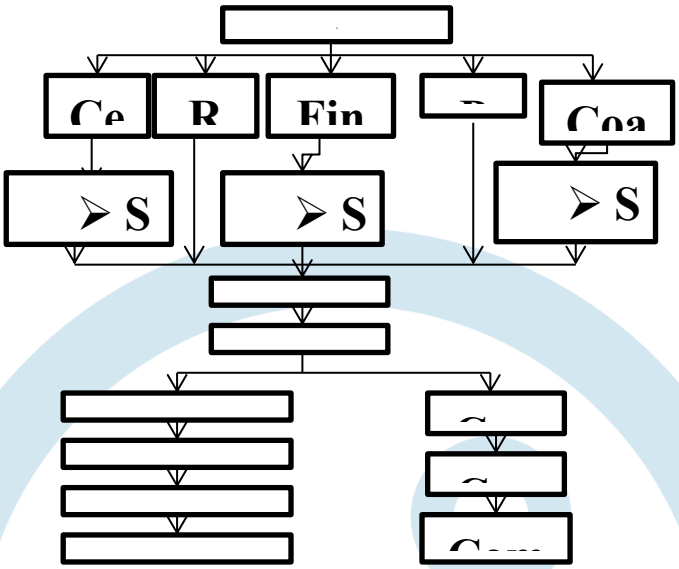
The first rubberized concrete was introduced and explored for potential engineering applications in the early 1990s (Kaloush et al. 2005; Allen 2004). Although combining recycled rubber and concrete aggregates for making conventional concrete was an innovative idea, it was found that the resulting rubberized concrete had lower strength (Khatib & Bayomy 1999; Sgobba et al. 2010; Bewick et al 2010; Ling et al. 2009; Khaloo et al. 2008) and this was not preferable especially for structural applications (Ho et al. 2009). However, rubberized concrete has been found to be preferable for paving applications, where lower range of strengths are including in design.

1.1 Research objectives

Although much research has been conducted thus far on the concept of using recycled rubber in cementitious composites, very limited studies have been performed on the application of crumb rubber concrete (CRC) for pavements. The term of rubberized concrete is a general term, which involves all the types and sizes of recycled rubber. The aim of this research is to reduce the dead load and to determine the strength of column in structures.

- To determine the performance of rubber powder and graphite powder as in cement concrete.
- To minimize the overall environmental effects of concrete production using rubber powder and graphite powder as partial replacement.
- To study the strength development of hardened concrete with rubber powder and graphite powder as fine aggregate.

II. METHADOLOGY



III. MATERIAL PROPERTIES

A.CEMENT

Cement is a basic binder substance used for construction purpose. It can be also used to bind sand and gravel. Mortar is produced by mixing fine aggregate with the cement. Cement is a widely used as a binding material which is in existence. The most commonly used cement is Portland cement.

B.FINE AGGREGATE

Aggregates are widely used as inert granular materials .They are sand, gravel or crushed stone which is mixed with water and Portland cement to produce concrete. Fine aggregates are passing through 9.5mm and retained on 75micron.They are used to fill the voids in coarse aggregates and act as a good workability agent. This aggregate is an economic factor to reduce cracks and imparts strength to the concrete.

C.COARSE AGGREGATE

Coarse aggregates are important material for construction. Coarse aggregates are obtained from rock quarries or dredging from river beds. They can be characterized as smooth, rounded or angular. Various characteristics that are used to describe the behavior of coarse aggregate includes relative density, bulk density and absorption. Relative density is used to describe the density of coarse aggregates. These particles are retained on 4.75mm sieve and passes through 3-inch screen and are referred to as coarse aggregate.

D. RUBBER POWDER

Crumb rubber concrete is the concrete made out of piece elastic tire chips and scr**ap elastic where utilized** supplant mineral today in cement. The common use of waste rubber specifically tire chips have been in highway asphalt mixes. Material characterization experiments have been conducted to determine the practicality of using rubber in concrete.

E.GRAPHITE POWDER

Thermal storage performance of concrete as a thermal storage media was compared to a hybrid concrete graphite material. The result shows that mixing concrete and graphite produces higher performance material compared to using concrete only. The average temperature attained by the hybrid material was 5.54% higher than using concrete only and the charging time of the hybrid material was 25% lower than using concrete. The concrete graphite material had 62.5%more thermal capacity than the concrete and a volumetric space reduction is of 86.4%. the good performance is due to the improved effective thermal conductivity and volume heat capacity brought about by the addition of graphite to the concrete.

F. PVC PIPE

1.Durability: PVC is resistant to weathering, chemical rotting, corrosion, shock and abrasion. It is therefore the preferred choice for many long-life and outdoor products

2.Flame Retardancy: Because of its high chlorine content, products are self- extinguishing. Its oxidation index is ≥45. Antimony trioxide has been used extensively, usually in combination with phosphate ester plasticizers, giving excellent fire performance and mechanical properties.

3.Cost/Performance Ratio: PVC has good physical as well as mechanical properties and henc provides excellent cost-performance advantages. It has long life span and need low maintenance

4.Mechanical Properties: PVC is abrasion-resistant, lightweight and tough

5.**Chemical Resistance**: PVC is resistant to all inorganic chemicals. It has very good resistance against diluted acids, diluted alkalis and aliphatic hydrocarbons

IV.MATERIAL IMAGES

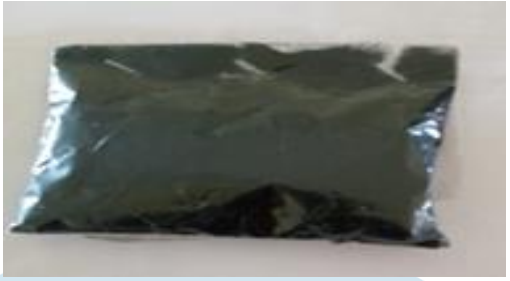


Fig 1 Rubber powder

Fig 2 Graphite powder

Fig 3 Pvc pipe

V. MIX DESIGN OF CONVENTIONAL CONCRETE

Slump value = 100mm
Grade of concrete = m20
Mass of cement in kg/m^3=437.78 kg/m^3
Mass of water in kg/m^3 =197 lit/m^3
Mass of fine aggregate in kg/m^3=657.02 kg/m^3
Mass of coarse agg in kg/m^3=1104.96 kg/m^3
Volume of concrete = 0.0225m^3
Water cement ratio =0.45
Mass of cement = 9.851 kg
Mass of fine agg = 15.171 kg
Mass of coarse agg = 24.46 kg
Water content = 4.432 lit
Mix ratio = 1:1.287:2.31

VI. MIX DESIGN OF PVC PIPE FILLED WITH GRAPHITE AND RUBBER POWDER

Volume of pipe = 0.000271m^3
Volume of concrete = 0.02223m^3
Percentage of volume reduction = 1.21%
Mass of cement = 9.731 kg

Mass of fine aggregate = 14.605 kg
Mass of coarse aggregate = 24.56 kg
Water content = 4.38 lit
Mass of rubber powder = 298 grams
Mass of graphite powder = 339 grams

Table 1 Compressive strength

SP NO	AGE OF CUBES	CROSS SECTIONAL AREA(mm^2)	LOAD (KN)	COMPRESSIE STRENGTH (N/mm^2)	AVG COMPRESSIVE STRENGTH (N/mm²)
SP1	7 days	150*150 = 22500(mm^2)	320	14.22	14.58
SP2			331	14.71	
SP3			333.15	14.8	
SP4	14days	150*150 = 22500(mm^2)	407.25	18.1	18.23
SP5			414	18.4	
SP6			409.275	18.19	
SP7	28 days	150*150 = 22500(mm^2)	440.55	19.58	19.49
			436.275	19.39	
			438.75	19.5	

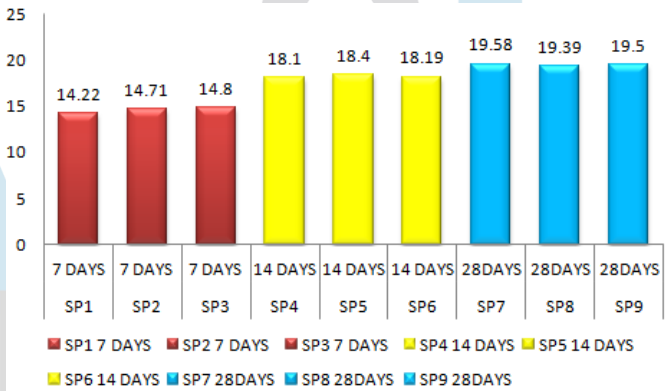


Fig 4 Compressive Strength

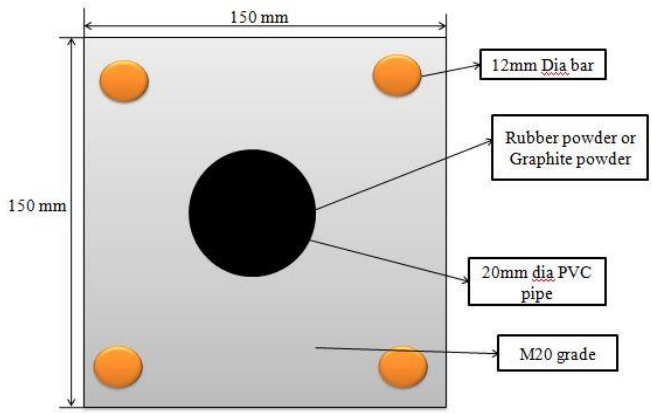


Fig 5 TOP VIEW

Table 2 Conventional column compressive strength

Specimen No	Load (kN)	Compressive strength(N/mm²)	Deformation(mm)
Column 1	676.125	30.5	5.29
Column 2	716.85	31.86	5.32
Column 3	706.5	31.4	5.1

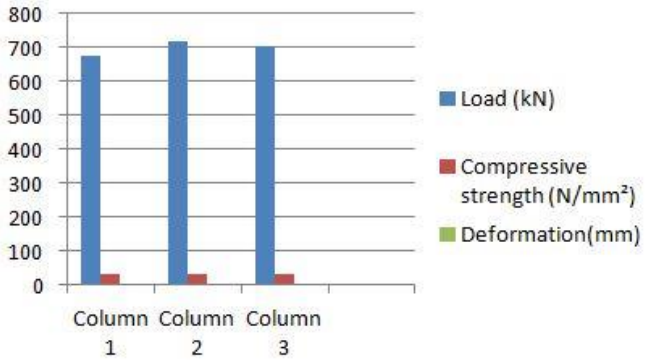


Fig 6 Conventional column compressive strength

Table 3 PVC pipe filled with Rubber Powder

Specimen No	Load (kN)	Compressive strength(N/mm²)	Deformation(mm)
Column 1	740.25	32.9	7.12
Column 2	751.5	33.4	6.96
Column 3	761.85	33.86	6.89

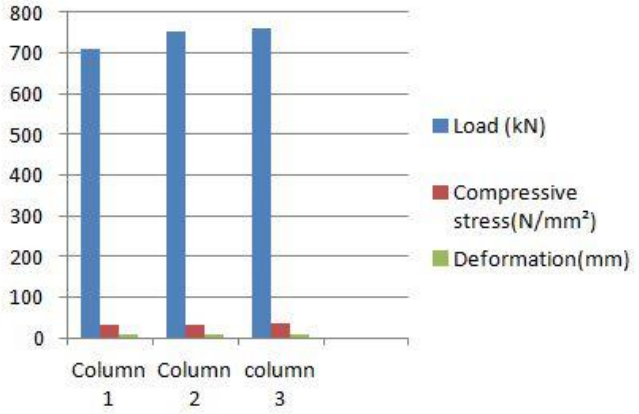


Fig 7 PVC pipe filled with Rubber Powder

Table 4 PVC pipe filled with Graphite powder

Specimen No	Load (kN)	Compressive strength(N/mm²)	Deformation(mm)
Column 1	728	32.35	6.3
Column 2	735.32	32.68	6.87
Column 3	729.4	32.42	6.43

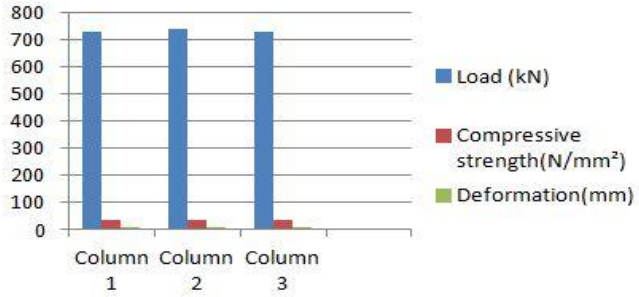


Fig 8 PVC pipe filled with Graphite powder

Table 5 PVC pipe filled with Rubber and Graphite powder

Specimen No	Load (kN)	Compressive strength(N/mm²)	Deformation(mm)
Column 1	981	43.6	7.42
Column 2	992.25	44.1	7.51
Column 3	1050.75	46.7	7.29

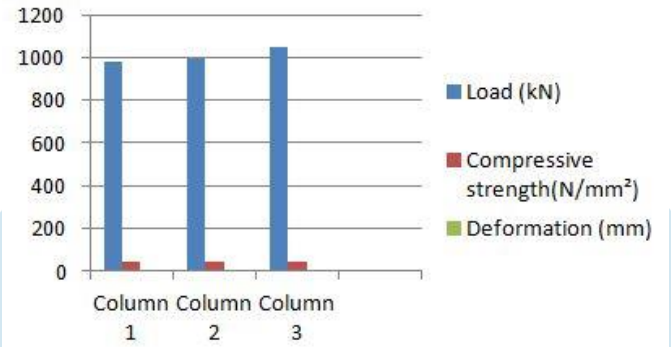


Fig.9 PVC pipe filled with Rubber and Graphite powder

Table 6 Compare the all types of column

COLUMN TYPE	LOAD(kN)	COMPRESSIVE STRENGTH(N/mm²)	DEFORMATION(mm)
Conventional Column	699.825	31.253	5.24
PVC filled with Rubber powder	751.2	33.39	6.99
PVC filled with Graphite powder	730.91	32.483	6.53
PVC filled with Rubber and Graphite powder	1008	44.8	7.41

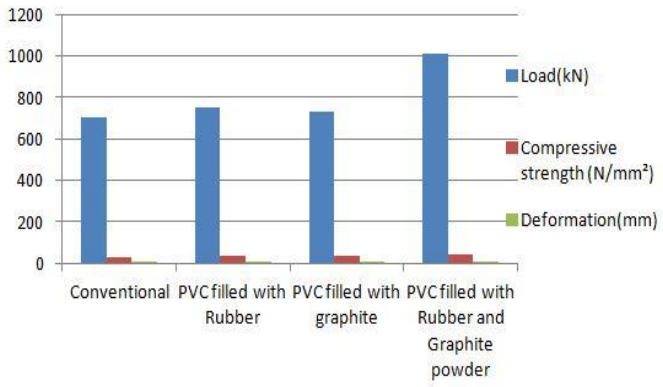


Fig 10 Compare the all types of columns

IV. RESULT AND DISCUSSION

Buckling strength

Buckling strength is the important property which shows the sudden deformation or a form of deformation in a large structure. Due to slight increase of the axial load . the structure undergoes failure or deformation known as buckled. The results is obtained is the buckling behaviour of both rubber and graphite powder and hybrid powder casted in a column.

V. CONCLUSION

According to the test conducted following conclusion are made.

i. The buckling performance of column containing hybrid powder gives better strength than the column containing rubber and graphite powder.

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