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Internal forces of steel-concrete-steel sandwich beams are compared to their theoretical analysis.

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Abstract:*Researchers conduct experiments to determine if the ideas of full and partial contact hold up under axial or shear stresses on steel plates. stud connections, as well as frictional forces between steel plates and concrete on the supports and load sites, are all included in the partial interaction research. The partial interaction theory is used to compare the results of DSC beam experiments with theoretical expectations. The findings suggest that the theoretical approach may be used with confidence for the analysis of basic supported DSC beams of any shape."Sandwich beams," "double skin composite construction," and "shear connections" are among the terminology used to describe building techniques*.

INTRODUCTION

Structures made of welded shear connections and steel plates sandwiched between two layers of concrete are known as DSC structures. Even though its construction is equal to that of double-reinforced concrete components, a more flexible connection allows for more displacement. You can get a lot more benefits out of this kind of building than you can with other options.

A large number of steel–concrete composite structures use steel as a key component. Steel plate, concrete, and reinforcing steel were used to build this construction. When steel and concrete are combined, shear connections are often used to get the desired result. Steel-concrete composites have a high degree of mechanical interlocking in shear connections.

Steel-concrete contact affects the flow of shear and the distribution of strain. Strength, stiffness, and failure mode are all influenced by the changes. It is possible to have entire, partial, or no interaction between steel and concrete (Veljkovic, 1996; Oehlers et al., 2000). Assumptions may influence structural performance in specific situations. It is possible to enhance predictions of behaviour by using a partial interaction assumption. Due to shear connection deformation and interface slippage under applied loads, steel–concrete composite components often encounter partial-interaction (Johnson, 1994; Dogan, 1997; Roberts and Dogan, 1998; Oehlers and Bradford, 1999; Jeong et al., 2005; Ranzi et al., 2006; Gara et al., 2006; Queiroza et al., 2007; Ranzi and Bradford, 2007; Jeong, 2008).

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In the year of our Lord, 2010 (Sousa Jnr. and colleagues, 2010).Because it is so little, slippage in steel-concrete composite systems may go unnoticed (that is, full interaction). When shear connections are not needed, connections with lower stiffness or fewer connections may be necessary. Slides may have a substantial impact on a system's stiffness under certain circumstances (that is, partial interaction). To move and distort, a composite beam needs strong connections. Shear joints' stiffness may be measured using push-shear tests.

Tests conducted by Newmark et al. have shown that (1951). In order to evaluate the deflection of concrete and steel T-beams, analysis might be employed. According to the notion, the two places were only partially connected. A second-order differential equation may be used to explain the connection between longitudinal forces transmitted from the concrete slab and applied bending moment. Yam was the first to use the strategy subsequently perfected by Newmark et al.

Non-linear material and shear connection behaviour were the focus of publications by Yam (1968) and Chapman (1968, 1971). (1981). Composite beams' ultimate flexural strength was measured after solving the non-linear differential equations repeatedly.

Johnson (1975, 1981) reworked Newmark's equations as interface slip and provided updated versions. For short-span composite constructions, these equations were utilised to study the loss of contact.

With partial contact composite beams may be researched in a unique manner, according to Roberts (1985). This methodology uses layer displacements to describe the equilibrium and compatibility equations that are crucial to this method. Differential equations generated from finite difference equations may be solved at the same time. Al-Amery and Roberts came up with this method by combining non-linear material with shear connection behaviour (1990). Nonlinear differential equations are solved using finite difference techniques.

It is a kind of composite beam, according to Wright and others, which has two layers sandwiched between another layer. Comparing Dogan's experiments with the basic idea on DSCs.

Dogan made changes to Oduyemi's design (1991). (1997). The partial interaction study has taken into account the frictional forces between concrete and steel. The outside supports and load zones of the buildings were determined to be made of steel plates (Dogan et al. 1997; Dogan et al. 2010). Is it possible that Dogan's theoretical assumptions are not reflected in the actual results? (1997). Steel plates and studs are subjected to tensile and shear stresses. The axial strains in DSC beams were studied by Dogan (1997).

Governing differential equations

Full interaction

The DSC beam interaction analysis is based on assumptions at every level, from the simplest to the most complicated. For those who don't already know, steel and concrete are both very durable materials. Linearly elastic materials subjected to tensile stress testing. The weight can no longer be maintained because to the collapse of the strain. A shear force connects the concrete and steel. The right balance of stiffness and plane ensures that there is minimum slippage.. Each component is at the same height at any given time throughout the puzzle. This is taken into account while trying to estimate the strain. Bent portions are shown in Figure 1. As shown in Figure 1b, the steel plates and concrete represent the predicted circumstance. Axial forces make it possible to create perfect contact between steel plates.

$$F_{sc} = \rho_1 M \tag{1}$$

$$F_{st} = \rho_2 M \tag{2}$$

In Figure 1a, Fsc is the compression force in a steel compression plate, and Fst is the tension force in a steel tension plate.

$$\rho_1 = \frac{E_{sc} A_{sc}}{\Sigma EI (1 + \alpha)} \left(d_{cu} + \frac{t_{sc}}{2} \right) \tag{3}$$

$$\rho_2 = \frac{E_{st} A_{st}}{\Sigma EI (1 + \alpha)} \left(d_c - d_{cu} + \frac{t_{st}}{2} \right) \tag{4}$$

When the steel plate is in tension, its Young's modulus is Est, while when steel plate is compressed, its Young's modulus is Asc. These variables are used to calculate a number that stands for the stiffness of the steel plate in compression, which in turn is used to calculate the depth of the concrete section that is uncracked. Finally, the uncracked depth of the concrete section is used to calculate the value of dcu (Dogan, 1997, 2010).

There are two factors that determine the axial force change in the steel plates: qsc and qst per unit length (Figure 2a).

$$q_{sc} = -\frac{dF_{sc}}{dx} \tag{5}$$

$$q_{st} = -\frac{dF_{st}}{dx} \tag{6}$$

Interaction that is just partial

We are correct, and Oduyemi (1991) provided a partial interaction approach that takes into account the influence of other people. between concrete and the surrounding environment's frictional forces Steel plates are used to support and distribute the weight. The following simplification principles are applicable to partial interactions.

The linear properties of steel and concrete make them natural candidates for comparison.

Elastic materials, small deflections, and shear are all examples of (a).

Concrete and steel plates are held together by a shear connection, making deformations in any material negligible.

In other words, it runs the whole length of the beam. alone in the woods Smeared connections between two places are made possible through connectors (e) Each layer of a beam is subjected to a linear strain distribution over its depths, resulting in a linear connection. The curvature of each layer is the same as the curvature of the other layers. Because each layer deflects the same amount, there is no buckling. or if the layers separate, the concrete is left open to exposure to Cracking occurs when the material is exposed to tensile strain, making it ineffective in resisting the load. and I keep the neutral axis' depth constant, which is linked to the beam's shape and the substance's properties. A universal solution to the problem of partial axial strains in steel plates has been discovered. interaction is made possible because to

$$F_{SC} = A_1 \cosh\sqrt{m_1}\, x + A_2 \sinh\sqrt{m_1}\, x + A_3 \cosh\sqrt{m_2}\, x + A_4 \sinh\sqrt{m_2}\, x + g_1 M + g_2 D^2 M \tag{7}$$

$$F_{st} = A_1 g_3 \cosh\sqrt{m_1}\, x + A_2 g_3 \sinh\sqrt{m_1}\, x + A_3 g_4 \cosh\sqrt{m_2}\, x + A_4 g_4 \sinh\sqrt{m_2}\, x + g_5 M + g_6 D^2 M \tag{8}$$

The beam's material and section properties are described by coefficients m1, m2, and g1 to g6, while boundary conditions provide constants A1 to A4. connections between the studs (Dogan, 1997; Roberts and Dogan, 1998; Roberts and Dogan, 1998; Roberts and Dogan, 1998; Roberts and Dogan 2010). There are two types of shear forces: qsc and qst. There is no difference between the partial interaction equations 5 and 6.

Material attributes and assumptions

Numerous assumptions are used in whole and partial interaction analysis because the behaviour of DSC beams is so complex. previously indicated, the mechanism will be sped up. In order to discover solutions for a basic supported beam as shown in Figures 1 - 3, with a point load in the midspan, the spacing between the symmetrical loads is set to zero. Various The stiffness of the shear is one of the properties that is being investigated. A filling of concrete occurs between the steel plates and their frictional forces. Figures 1–3 show the applied force on the beam. As a consequence, only half of the beam has to be considered. All of the beams were found to have a frictional coefficient g of around 0.25. Findings in both theory and practise were in agreement. experiment's findings The research was affected by the presence of outside studs. Tension steel plate was used to model the supports' axial tensile force in light of the results of tests at a suitably applied load level. Full and partial beams are compared using the assumed geometry. The length L = 1400 mm and the width b = 200 mm are just partial hypotheses. A steel plate on the top and bottom of a 150-mm-deep concrete core.

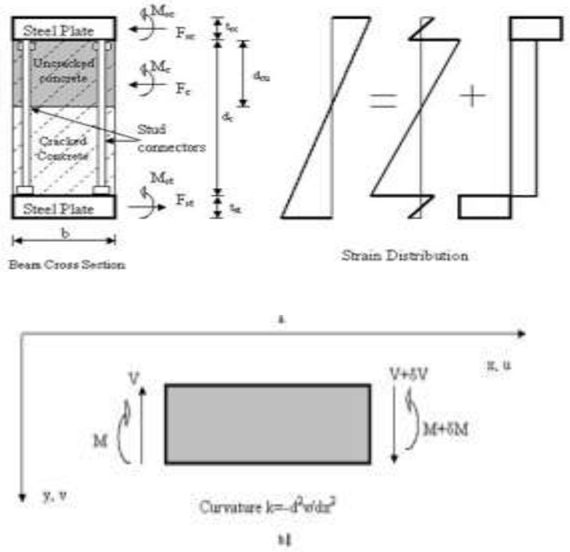

Figure 1. a. Internal forces and strain distribution over the depth of a DSC section for full interaction. b. The assumed positive sign conventions for displacements u and v in x and y directions.

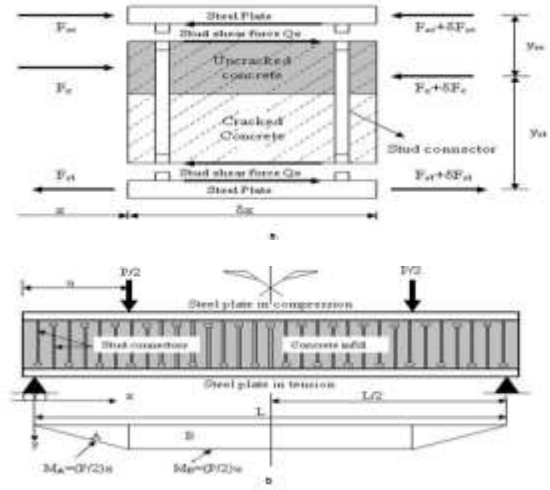

Figure 2. a. Interface shearing forces of a DSC beam. b. Support, loading and bending moment diagram.

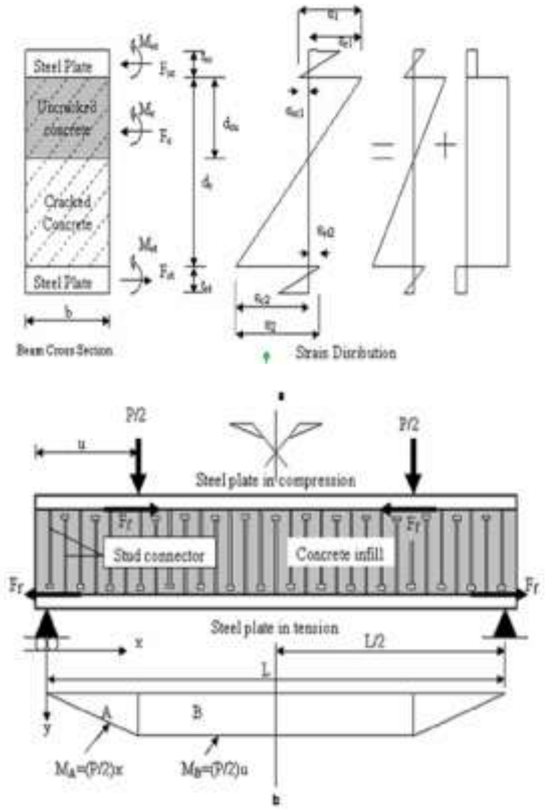

Figure 3 a. Internal forces and strain distribution over the depth of a DSC section for partial interaction.

b. Support, loading and frictional forces Ff at the supports and load points.

The stud spacing (st) is 200 millimetres, and the thickness (ts) is 8 millimetres on both plates. The Young's modulus of Es steel was evaluated at 210 kN/mm2. In the equation 67, the Young's modulus of concrete Ec is affected by changes in concrete compressive strength.

The compressive strength of a concrete cube in N/mm2 is given by Fcu, whereas the compressive strength in kN/mm2 is given by Ec. Ec ranged from 25.2 to 30.2 kN/mm2 in this experiment. The estimated concrete strength of the test beams was used to divide them into four distinct categories. There are four groups of Young's modulus (B1 and B2 with Ec = 25.2 kN/mm2, Group 2: B3 through B6 with Ec = 28.3 kN/mm2, Group 3: B7 and B8 with Ec = 27.1 kN/mm2, and Group 4: B9 and B10).

RESULTS

As DSC beams' behaviour is exceedingly complicated, many assumptions are made in whole and partial order to describe it.

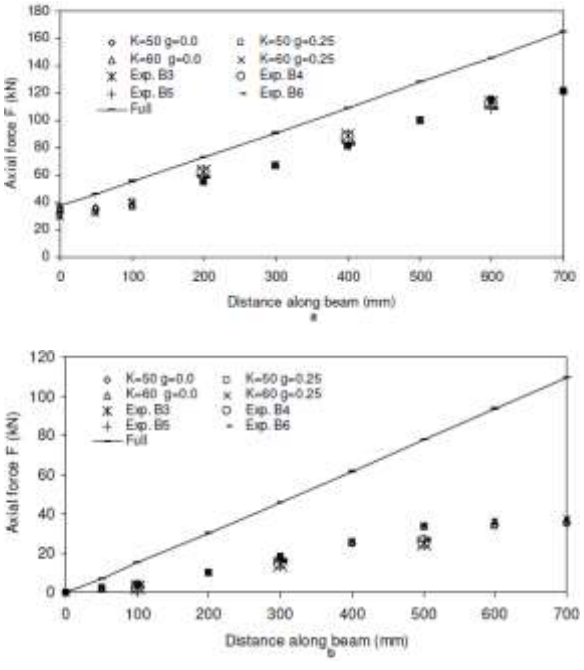

Figure 4. a. Comparison of experimental tension plate axial forces for the second group of beams B3-6

(P = 50 kN). b. Comparison of experimental compression plate axial forces for the second group of beams B3-6 (P = 50 kN)

Using interaction analysis, the system may be simplified. When comparing the theoretical findings with real results, the system geometry and material characteristics used were the same as those published by Dogan (1997).

Full and partial interaction models are studied here, with one neglecting friction between layers at the supports and the other including frictional forces. Test results at different applied loads are also compared. Axial forces in steel plates and shear forces in studs are studied, and the findings are presented here.

Axial pressures on steel plates

With and without frictional forces between the layers at the supports, Figures 4–6 illustrate axial forces in tension and compression steel plates along beams B3–10 with connection stiffness K = 50 and 60 kN/mm. These forces grow with increasing shear connection stiffness until they reach levels consistent with full interaction theory, which is when the shear connection stiffness approaches infinity.

Based on partial interaction theory, theoretical results are quite similar to experimental observations.

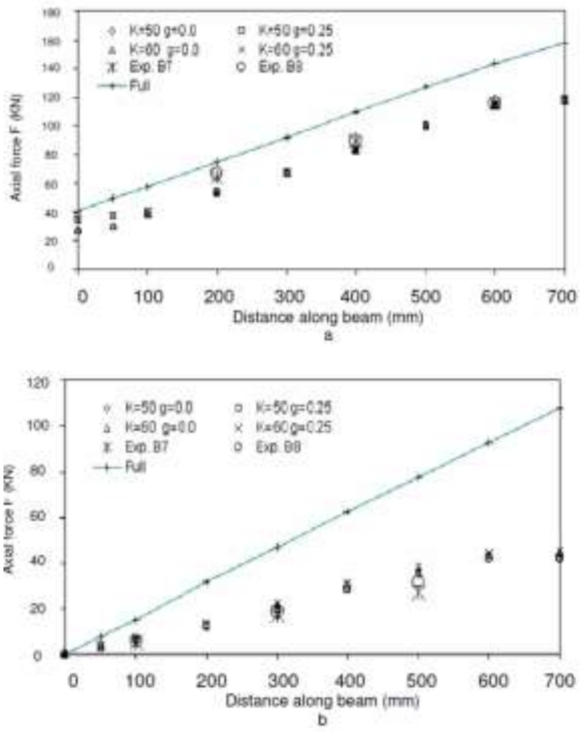

Figure 5. a. Comparison of experimental tension plate axial forces for the third group of beams B7-8 (P = 50 kN). b. Comparison of experimental compression plate axial forces for the third group of beams B7-8 (P = 50 kN).

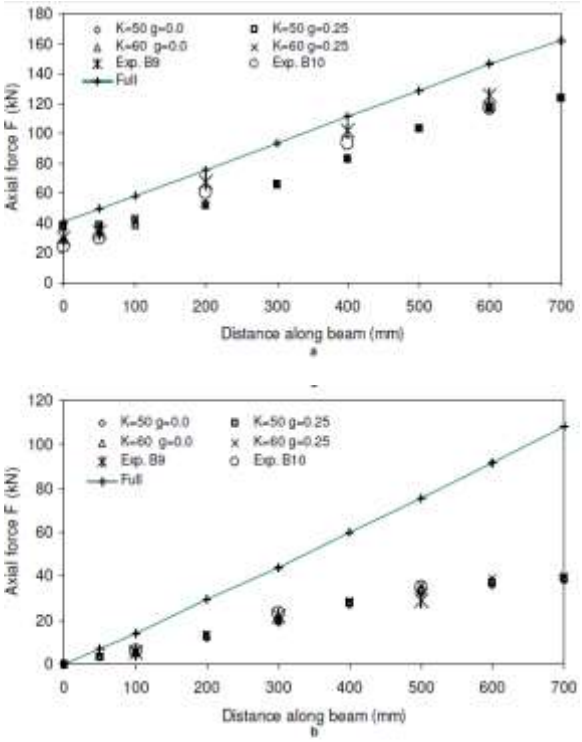

Figure 6. a. Comparison of experimental tension plate axial forces for the fourth group of beams B9-10 (P = 50 kN). b. Comparison of experimental compression plate axial forces for the fourth group of beams B9-10 (P = 50 kN).

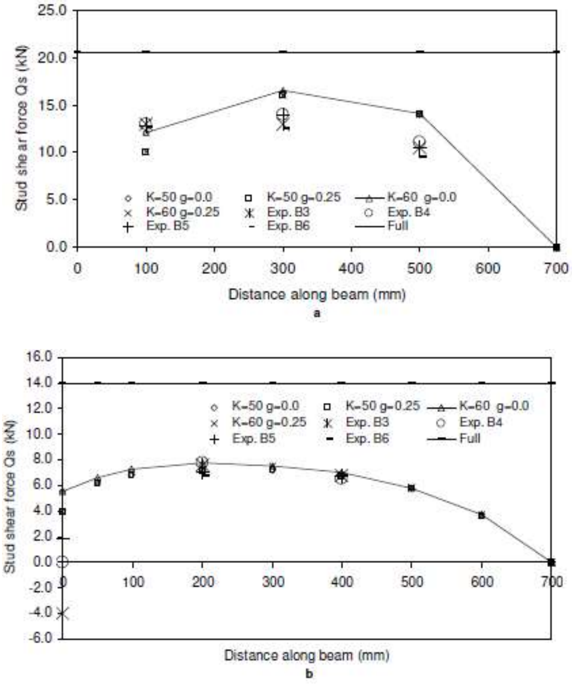

Figure 7.a. Comparison of experimental tension plate stud shear forces for the second groupof beams

B3-6 (P = 50 kN). b. Comparison of experimental compression plate stud shear

forces for the second group of beams B3-6 (P = 50 kN). For both tension and compression plates, interaction theory predicts stronger axial forces.

Shear pressures in studs

In Figures 7–9, theoretical and experimental stud shear forces along beams B3–10 at a load level of 50 kN for connection stiffness K = 50 and 60 kN/mm, with and without frictional forces at the supports, for values of K = 50 and 60 kN/mm, with or without frictional forces. Tension and compression plate shear forces are expected to grow as the stiffness of the connection increases. based entirely on interaction theory Overall, theoretical and experimental results agree.

CONCLUSIONS AND DISCUSSION

Comparing actual results with theoretical predictions of DSC beam behaviour was done using a combination of total and partial interaction analysis. Because of the disparities in concrete cube strength and elastic modulus, the test beams were divided into four groups, and axial forces and stud shears were compared for each group.

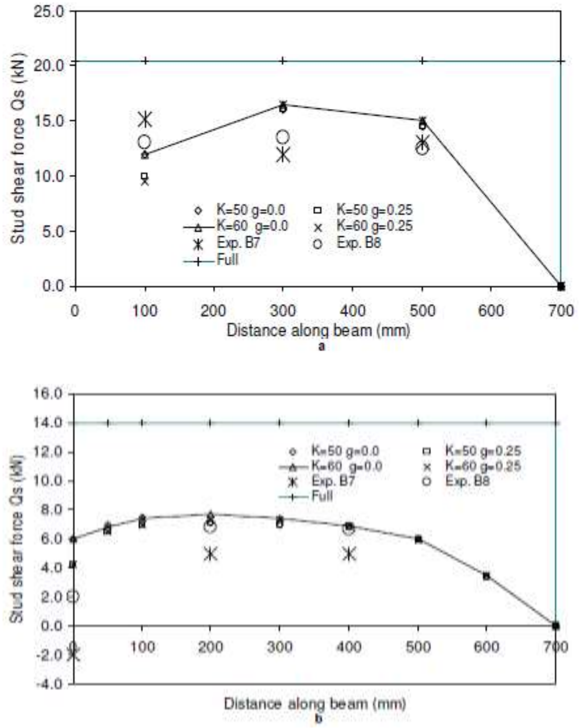

Figure 8. a. Comparison of experimental tension plate stud shear forces for the third group of

beams B7-8 (P = 50 kN). b. Comparison of experimental tension plate stud shear forces for the

third group of beams B7-8 (P = 50 kN). Forces are shown.

Concrete fracture depths along the beams and the distance between the tension steel plates and concrete infill caused the experimental results to differ from those expected. Because of local concrete cracking, shear forces were redistributed and the distribution of shear forces was interrupted at the end of the beam. axial force in the steel plates decreased as the fracture depth increased, resulting in a rise in the moment lever-arm. Partially interacting beams have a significant influence on their behaviour due to frictional forces at and around their supports and studs.

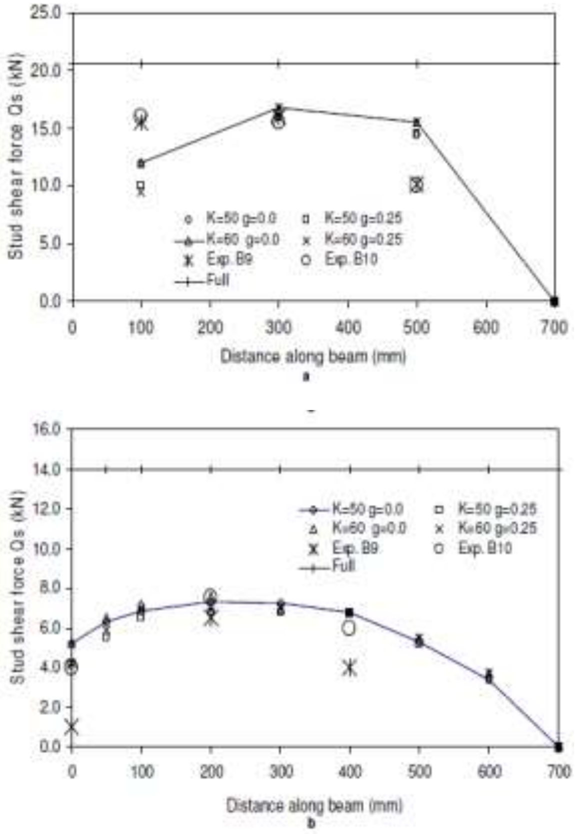

Figure 9. a. Comparison of experimental tension plate stud shear forces for the fourth group of beams

B9-10 (P = 50 kN) b. Comparison of experimental compression plate stud shear forces for the fourth group of beams B9-10 (P = 50 kN).

Thetheoreticalresultsbasedonpartialinteractiontheory, assumingrealisticmaterialandshearconnectorpropertiesandincorporatingtheinfluenceofinterfacefrictionalforces,showsatisfactorycorrelationwithtest result.

Subscripts

A	cross-section area of steel plate
c	concrete core
cu	uncracked concrete core
f	frictional force
p	partially interactive section
s	fully interactive section
sc	steel plates in compression
st	steel plates in tension

NOTATION

A	cross-section area
b	width of beam section
d	depth of concrete
e	strain difference at steel-concrete interface
E	Young's modulus
EA	axial rigidity
EI	flexural rigidity
F	axial force in steel plates
f	ultimate strength of concrete
g	coefficient of friction at steel-concrete interface
I	second moment of area
k	curvature
K	stiffness of shear connector
L	span of beam
M	bending moment
n	number of connectors across the beam
P	applied point load on beam
p	longitudinal pitch of connectors
q	shear force (shear flow) per unit length between concrete infill and steel plate
Q	shear force on one connector
s	stud spacing
t	thickness of steel plate
u	distance of point load from support
V	transverse shear force
x, y	co-ordinate axes
x	distance along beam from support
y	moment lever arm
v	deflection
α	composite stiffness factor
ε	strain

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Tests of M30 and M40 concrete were conducted, with copper slag replacing part of the fine aggregate and eggshell powder taking the place of the cement.

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Abstract:

In the past, concrete was thought to be weaker and less durable than it is now. Furthermore, concrete's primary benefits over other building materials must be preserved. Ability to fabricate almost anyplace, ability to build the shape dictated by a mould, and minimal component and production costs are all advantages. Concrete performance advancements have been spurred by these variables for years and will continue to do so. The increasing demand for concrete, coupled with concerns about environmental effect, has led to the increased usage of alternative material components.Copper slag will be used as a partial substitute for fine aggregates in the concrete mix design for an experimental examination. Copper slag (CS) and Egg shell powder (ESP) will be used in varying proportions to determine the compressive strength and split tensile strength of concrete of M30 and M40 grades. Various durability tests will be conducted to determine the compressive strength and split tensile strength of these concretes. Thereafter, the findings will be compared with ordinary concrete, in order to learn about the qualities of copper slag-based concrete.Compressive strength, split tensile strength, eggshell powder, copper slag are some of the key terms.z

INTRODUCTION

In the construction industry, industrial waste or secondary resources may be used to produce cement and concrete. Byproducts and waste materials are generated by a variety of businesses. Processing or disposing of waste materials leads to problems with the environment and public safety. Reusing and recycling construction and demolition debris is consequently an excellent business opportunity. These byproducts have been considered waste items for many years now. Fuel, chemical, and submarine constructions all employed concrete built with these components because it worked better and lasted longer than ordinary concrete. Recent decades have seen an increase in study into all feasible methods of recycling. It has been established that many locations have approved the use of construction waste, explosive furnace ash, slag of steel, coal fly ash and low ash as raw materials for the creation of conventional Portland cement (Teikthyeluin et al 2006).Copper slag is a byproduct of the copper manufacturing process. Each tonne of copper produced generates around 2.2 tonnes of copper slag. Slag from the world's copper industry is predicted to total 24.6 million tonnes (Gorai et al 2003). Since abrasive tool production and sand blasting employ copper layer, the remainder of it is discarded without any further recycling or usage. As a component replacement for Portland cement or an aggregate substitute for the material to be used in concrete, the copper layer is mechanically and chemically defined. Slag is an excellent choice for combined usage because of its outstanding soundness and abrasion resistance. It also has a long history of being stable (Gorai et al 2003). In addition to its pozzolanic properties, copper slag also has low CaO content. NaOH may activate the cement to reveal its cemented qualities, which can be utilised to partly or totally replace Portland cement. Because it may be used to replace Portland cement or serve as a main ingredient, copper slag has the added advantage of lowering the cost of concrete while also decreasing waste disposal expenses.

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Literature review

The experimental studies of Gowsika et al. (2014) on powdered eggshell (ESP) as partial replacement for cemented concrete. At 28 days of curing time ESP was substituted in 5, 10, 15,20, 25,30 percent by weight of cement and a mixing proportion of 1:3 by a chemical composition and strength properties of ESP in cements mortier. For compression, over and above 5 percent of ESP replacement, admixtures such as saw dust ash, fly ash and microsilica have been utilized to pump up the power. In contrast with traditional concrete, it was found that replacement of 5 percent ESP with 10 percent micro silica leads to the high strength of hard concrete. The properties of eggshell concrete powder as cement substitute were investigated by Amaranth Yerramala et al., (2014). During 7th and 28thday curing times 5, 10, 15% of ESP for cement and tests were determined for specific characteristics of hardened concrete. The findings suggest that adding flyash along with ESP is positive up to 15 percent over the control of concrete. The absorption property has decrease with the reduction in permeable vacuum. The absorption has decreased with force and increased with water absorption. This paper substitutes partial volume of cement with powder from the fused cement, as at the end of 28 days it is noted that a 5 percent rise in weight and strength of up to 30%. In order to obtain the force which decreased by over 5%, some mineral admixtures, such as fly ash, silica and saw dust must be strengthened by replacement. This scenario shows that the strength properties of concrete are improved by 5% ESP with 10% micro silica, ash fly, replacing dust. The ESP has been replaced by 10 % , 20% and 30% of the ESP has been replaced by 5 % , 10% and 15% by the ESP, and studies on seventy-four days and twenty-eight days have been carried out for well-healed specimens. [3]Praveene Kumar et al. ,(2015) experimentally tested on partial cement replacement with eggshells. The strength also increases by up to 15 per cent without the application of silica fume, but economically speaking, ESP is necessary to achieve a stronger strength.The comparative research on Eggshell cement with partial cement replacement with Fly Ash was submitted by Dhanalakshmi and others(2015). Two wastes are used as a partial replacement for cement here and different materials have been obtained. The application of fly ash to maximum ESP concrete has demonstrated improved density and workability. [5] [5] [5]

The substitution of cement by eggshell powder was examined by Mohamed Ansari et al. , (2016). The characteristics were substituted by 10, 15 and 20 percent ESP replacement in cement for concrete. Results show that ESP replacement is successful at about 10 to 15% and further intensity is reduced. [6]Monisha et al . (2016) have experimentally researched eggshell powder and polypropylene fiber concrete. The following paper offers the substitution of fine aggregates of ESP 20% and polypropylene fiber in the range of 0, 0.2 and 0,4%. Similar to standard concrete 7, 14 and 28 days of curing time, the strength properties are obtained. The test results indicate that 20% of fine aggregates substituted by ESP have adequate resistance and 0.2% of polypropylene fiber by concrete weight have been reached by grade M20. The mechanical features of concrete with the use of eggshell ash and rice ash as a partial substitute for cement have been studied by the

Objective of the study

Since copper slag and egg shell power is seen as a waste product and the land that can be dumped every day has a major effect on the environment, therefore, we use copper slag in building. Copper slag has many applications in relation to its use in building but is just a little percentage point.

The principal aim is to research how copper slag can be used in concrete as a fine aggregate. It includes the knowledge of the strength parameters of concrete including compressive strength, division of tensile strength, flexural strength in which fine adds copper slag and egg shell powder are substituted by 0% (5% +5%), (15% +10%), (15% +15%), +20% (25% +20%) and (30% +30%)

Methodology

One of the main aims of examining the various properties of concrete and hardened concrete materials is the development of a concrete technologist for a specific strength and durability of a concrete mix. Because of the wide varying material properties, the conditions at the site , particularly the exposure condition, and the condition required for a particular task for which mix is designed, the design of the concrete mix is not a simple task. Concrete mixing design requires a full understanding of different characteristics of the various component materials, their effect on the site, their effect on hardened concrete and the dynamic inter-relationships between the variables in cases of alteration of these conditions. All these complicate and complicated the task of mix design. In addition to knowledge of material properties and properties of plastic concrete, the design of the concrete mix also requires broader expertise and concreting experience. Even then, the proportion of concrete materials found in the lab requires changes and adjustments according to the field conditions.

Mix design can be defined as the process of selecting the correct concrete ingredients and of determining their relative proportions as economically as possible with a concrete producing object of some minimum strength and durability. Secondly, the minimum strength and reliability listed are to be archived. The second goal is to make concrete the most cost-effective method. The cost depends primarily on two factors: material costs and material costs. As cement costs much more than other materials, we primarily concentrate on the use of cement as small as possible, which is compatible with strength and durability.

4.1 **Mix Design of Conventional Concrete (M30)**

The next step is the design of the concrete

Step 1 :Target Mean Strength

$$f'_{ck} = f_{ck} + 1.65 \times \sigma = 30 + 8.25$$

$$= 38.25$$

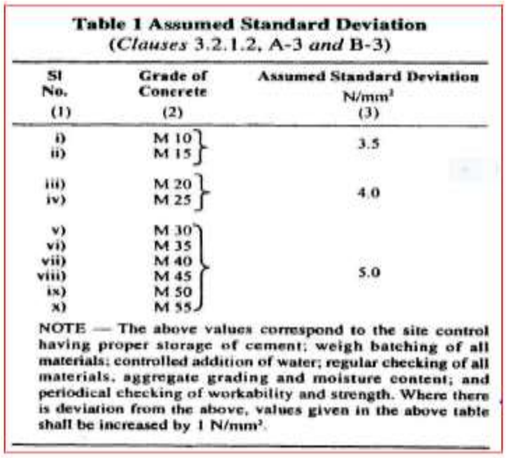


Table 1 Assumed Standard Deviation
(*Clauses* 3.2.1.2, A-3 *and* B-3)

Sl No. (1)	Grade of Concrete (2)	Assumed Standard Deviation N/mm^2 (3)
i)	M 10	3.5
ii)	M 15	
iii)	M 20	4.0
iv)	M 25	
v)	M 30	5.0
vi)	M 35	
vii)	M 40	
viii)	M 45	
ix)	M 50	
x)	M 55	

NOTE — The above values correspond to the site control having proper storage of cement; weigh batching of all materials; controlled addition of water; regular checking of all materials, aggregate grading and moisture content; and periodical checking of workability and strength. Where there is deviation from the above, values given in the above table shall be increased by 1 N/mm^2.

Phase 2: Ratio of W / C

- For 25 N / mm2 concrete compressive strength the graph defined in IS10262,w / c shall be taken as 0.46.
- For mild condition, the w / c ratio from Table 5 of Is 456 is 0.45
- Hence the ratio is 0,45 as w / c, at least of two values. •

Stage 3: Value for Water

From Table 2 of IS10262, conclude that the 20 mm of the total volume is used. Accordingly, the maximum water content is 186 kg.

$$\text{Water content} = 186 \times 1.06 = 197.16$$

Table 4.2: Water Content

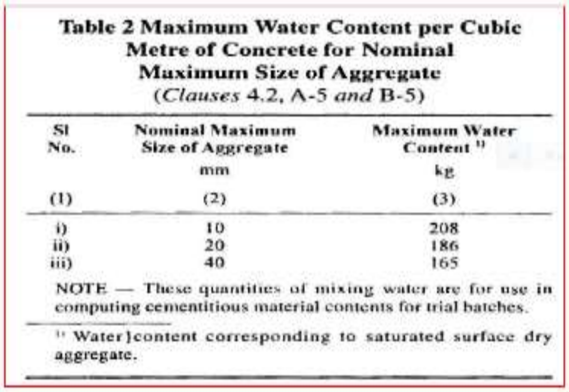


Table 2 Maximum Water Content per Cubic Metre of Concrete for Nominal Maximum Size of Aggregate
(*Clauses* 4.2, A-5 *and* B-5)

Sl No. (1)	Nominal Maximum Size of Aggregate mm (2)	Maximum Water Content 1) kg (3)
i)	10	208
ii)	20	186
iii)	40	165

NOTE — These quantities of mixing water are for use in computing cementitious material contents for trial batches.

1) Water}content corresponding to saturated surface dry aggregate.

4.2 Calculation Of Coarse Aggregate And Fine Aggregate

The region of the fine aggregate has been assigned Zone 1 of IS10262 and the corresponding coarse aggregate volume of 20 mm is 0,62 if the w / c is 0,5; our w / c is 0,46 and the effective coarse aggregate volume is 0,6, with the coarse aggregate volume 0,608 for w / c 0,42.

and hence volume of fine aggregate is 1 - 0.608 = 0.392

Table 4.2: Zone classification

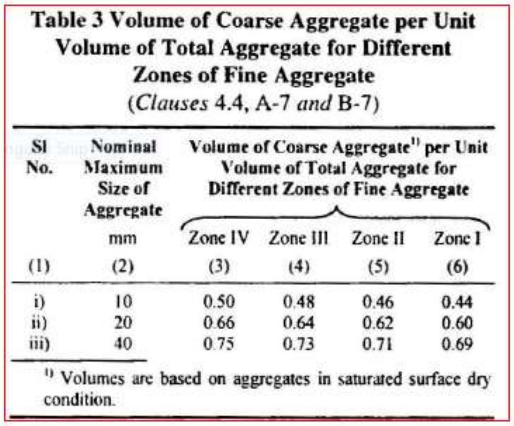
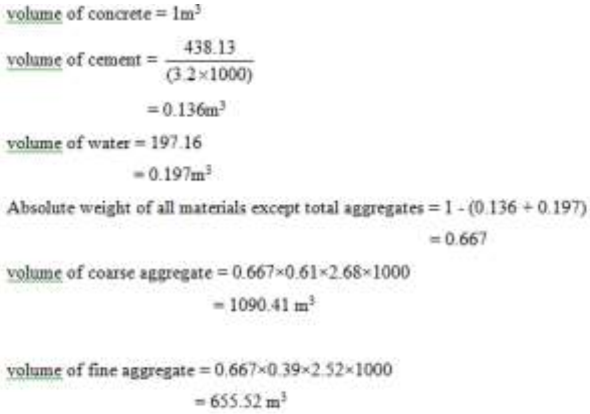


Table 3 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate
(*Clauses* 4.4, A-7 *and* B-7)

Sl No.	Nominal Maximum Size of Aggregate mm	Volume of Coarse Aggregate1) per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone IV	Zone III	Zone II	Zone I
(1)	(2)	(3)	(4)	(5)	(6)
i)	10	0.50	0.48	0.46	0.44
ii)	20	0.66	0.64	0.62	0.60
iii)	40	0.75	0.73	0.71	0.69

1) Volumes are based on aggregates in saturated surface dry condition.

Step 6 : Mix Proportion



volume of concrete = 1m^3

$$\text{volume of cement} = \frac{438.13}{(3.2\times1000)}$$

$$= 0.136\text{m}^3$$

volume of water = 197.16

$$= 0.197\text{m}^3$$

Absolute weight of all materials except total aggregates = 1 - (0.136 + 0.197)

$$= 0.667$$

volume of coarse aggregate = $0.667\times0.61\times2.68\times1000$

$$= 1090.41\ \text{m}^3$$

volume of fine aggregate = $0.667\times0.39\times2.52\times1000$

$$= 655.52\ \text{m}^3$$

Data analysisMaterials used

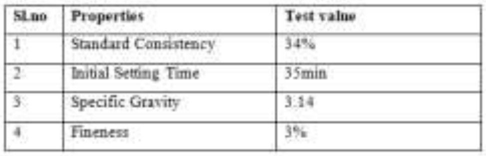
5.1 Cement:

Cement is the important required material for the construction of concrete. Cement is a well-known construction material and has engaged a vital place in construction work. There is a change of cement obtainable in market and each type is used under convinced illness due to its singular properties such as colour and arrangement of cement.

The physical properties of cement, chemical composition of cement are shown in Table-1 and Table-2 respectively.

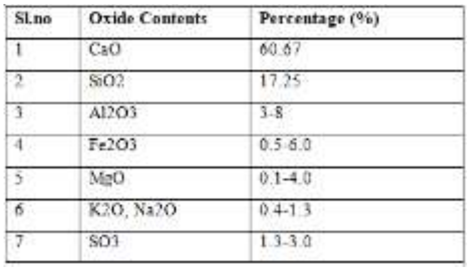
Figure 5.1- Ordinary Portland cement 53 grade

Table 5.1 Physical Properties of cement



Sl.no	Properties	Test value
1	Standard Consistency	34%
2	Initial Setting Time	35min
3	Specific Gravity	3.14
4	Fineness	3%

Table 5.2 Chemical Properties of Cement



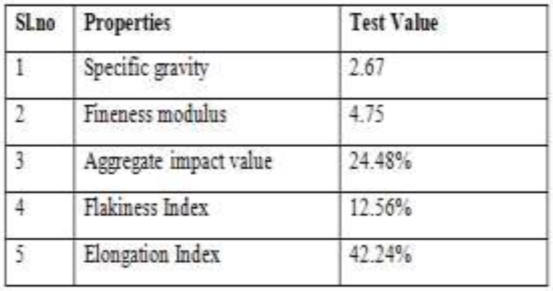
Sl.no	Oxide Contents	Percentage (%)
1	CaO	60.67
2	SiO2	17.25
3	Al2O3	3-8
4	Fe2O3	0.5-6.0
5	MgO	0.1-4.0
6	K2O, Na2O	0.4-1.3
7	SO3	1.3-3.0

5.3 Coarse Aggregate:

The coarse mixture is that the largest part of concrete. It's with chemical stable material. It reduces the drying shrinkage and different dimensional changes occurring on account of movement of moisture. The Rigid broken granite stones were used as coarse aggregate in concrete. The nearby quarry is brought with crushed stone aggregate 20 mm in size. Sizes of more than 20 mm are divided by sieves. Tests are performed to test the properties of aggregate

Figure 5.3- Coarse aggregate

Table 5.3 Physical properties of Coarse aggregate



Sl.no	Properties	Test Value
1	Specific gravity	2.67
2	Fineness modulus	4.75
3	Aggregate impact value	24.48%
4	Flakiness Index	12.56%
5	Elongation Index	42.24%

5.4 Fine aggregate

The most significant function of the aggregate is to assist in manufacturing workability and regularity in mixture. The fine mixture additionally assists the cement paste to carry the coarse aggregate particle in suspension. This action helps plasticity in the mixture and avoids the possible segregation of paste and coarse aggregate.

Figure 5.4-Fine aggregates

Table 5.4 Physical Properties of Fine aggregate

Sl.no	Properties	Test value
1	Specific gravity	2.7
2	Fineness Modulus	4.72
3	Bulking of fine aggregate	52%

5.5Copper slag

Copper slag is by result of the production of copper. Huge measure of copper slag is created as waste overall amid the copper refining process. River Sand is regular type of fine aggregate utilized in the cement production. Be that as it may, as a result of expanded expense and enormous scale exhaustion of sources choices for river sand are being considered. There have been numerous elective materials with comparable physical and synthetic properties of Sand discovered (Marble powder, lime stone waste, heater slag and welding slag, stone residue and so forth.) and research have been completed to check the reasonableness of its utilization as incomplete substitution of sand.

Figure5.5-Copper slag

5.6 Egg shell powder

The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries. The food indulgence industry is in need of investigation to find another methods for processing and using egg shells waste in an ecological friendly way. There is a need to find a low cost solution. Removal of egg shell waste are usually not income centers but cost centers. Therefore, the least cost of removal is most necessary.

Figure 5.6- Egg shell powder

Table 5.6 Physical Properties of Egg shell powder

Sl.no	Properties	Test value
1	Specific gravity	2.44
2	Standard Consistency	39%
3	Initial setting time	38 min

Results and Discussion

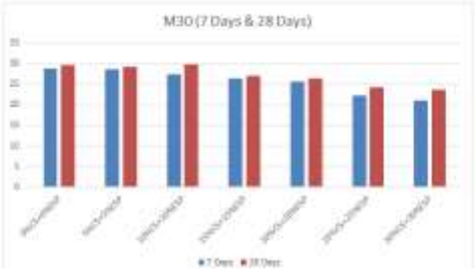
6.1 Introduction

The following chapter describes the compressive test results, preparing cubes from various blends that were previously mentioned, creating six cubes per blend, allowing compression testing on two cubes to be conducted on 7 days, 14 days and 28 days, while the average compression value is used as a compressive power.

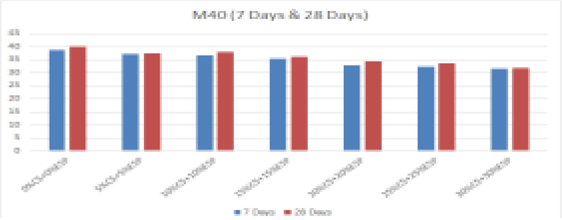
Test results

Table 6.1 Compressive strength results

Sl.no	Type of concrete	M30(7 Days)	M30(28 Days)	M40(7 Days)	M40(28 Days)
1	0%CS+0%ESP	28.84	29.60	38.60	39.86
2	5%CS+5%ESP	28.60	29.20	37.24	37.44
3	10%CS+10%ESP	27.40	29.80	36.60	37.90
4	15%CS+15%ESP	26.40	27.00	35.40	36.20
5	20%CS+20%ESP	25.60	26.40	32.80	34.22
6	25%CS+25%ESP	22.20	24.20	32.20	33.45
7	30%CS+30%ESP	21.00	23.60	31.60	31.62



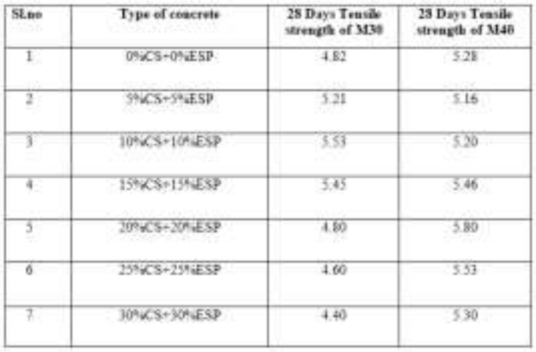
Graph 6.2 – 7 & 28 Days strength of different proportions of M30 grade concrete



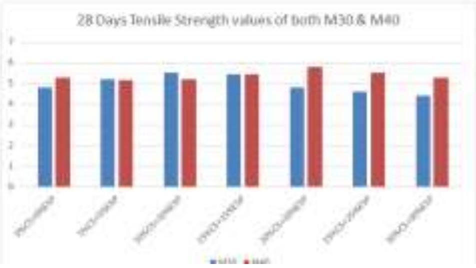
Graph 6.3 – 7&28 Days strength of different proportions of M40 grade concrete

6.3 Tensile Strength

Table 6.2 Tensile Strengths



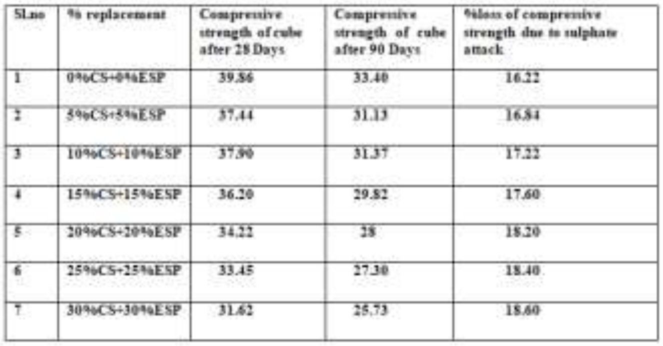
Sl.no	Type of concrete	28 Days Tensile strength of M30	28 Days Tensile strength of M40
1	0%CS+0%ESP	4.82	5.28
2	5%CS+5%ESP	5.21	5.16
3	10%CS+10%ESP	5.53	5.20
4	15%CS+15%ESP	5.45	5.46
5	20%CS+20%ESP	4.80	5.80
6	25%CS+25%ESP	4.60	5.53
7	30%CS+30%ESP	4.40	5.30



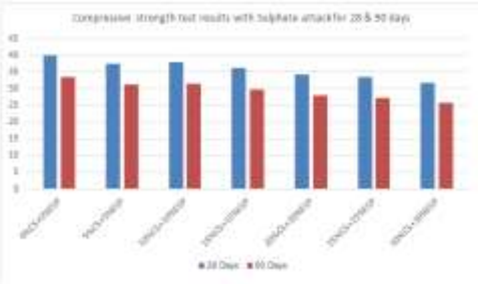
Graph 6.4-28 Days Tensile strength of different proportions of M30 & M40 grade concrete

6.4 Compressive strength test with Sulphate attack

Table 6.3 Compressive strength test with Sulphate attack



Sl.no	% replacement	Compressive strength of cube after 28 Days	Compressive strength of cube after 90 Days	%loss of compressive strength due to sulphate attack
1	0%CS+0%ESP	39.86	33.40	16.22
2	5%CS+5%ESP	37.44	31.13	16.84
3	10%CS+10%ESP	37.90	31.37	17.22
4	15%CS+15%ESP	36.20	29.82	17.60
5	20%CS+20%ESP	34.22	28	18.20
6	25%CS+25%ESP	33.45	27.30	18.40
7	30%CS+30%ESP	31.62	25.73	18.60



Graph 6.5- Compressive strength test results with Sulphate attack for 28 & 90 days

Conclusion

It is possible to utilise the materials for testing since the cement, fine aggregates, and gross aggregates meet IS code specifications within tolerable limitations.As the proportion of copper slag in copper slag concrete declines, the concrete fails to perform properly.The compaction factor of copper slag concrete decreases as the degree of copper slag increases.The best benefit of 7 days of treatment and 28 days of treatment is a copper layer replacement of 20% overall in the concrete compressive force.

Clamping strength for cylindrical specimens is best achieved after 28 days of 20% copper slag replenishment.Increased carbonation and reduced permeability may be achieved by using egg coating powder on the mixture's surface. The carbonation cycle in the mixture must thus be thoroughly studied.7. Concrete workability was found to be reduced when the ESP and Copper Slag between 14% ESP and 20% Copper Slag. Maximum bending strength is achieved at a maximum of 28 days at 14% ESP and 20% Copper Slag.Maximum split tensile reached with a duration of 28 days and a duration of 40% coffee slag.

For better strength values in concrete grade M30 the substitution of 20 percent copper slack is usually useful.

Concrete of the M30 strength grade may benefit from copper slag replacement in amounts ranging from 20% to 40%..

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