# Use of Construction and Demolition Waste as Replacemnet of Fine Aggregate in Concrete Paving Block

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***Abstract*: *India is beetle of both reclamation sites and landfill space for the disposal of construction and demolition (C&D) waste. It is important for India to adopt a strategy to reduce, reuse and recycle C&D waste. One of the ways to achieve this is using C&D waste in paving blocks as partial replacement of fine aggregate, reducing the quantity of C&D waste as well as the cost of fine aggregate in concrete. Different mix proportions were prepared for 0%, 20%, 40%, 60%, 80% replacement of C&D wastes fine aggregate. The compressive strength of paving block was measured. The results showed that maximum strength is achieved between the ranges of 40% to 60% replacement of fine aggregate with C&D waste fine aggregate, saving 3.28% cost of concrete. The study indicated that the C&D waste can effectively replace fine aggregate with little increase in strength. It is clearly beneficial in savings of virgin materials, often energy and $CO_2$ emissions.***

***Keywords*: C&D waste, Compressive Strength, Paving Blocks, Partial replacement of sand**

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## I. INTRODUCTION

C&D waste generates during the construction, renovation, and demolition of building, roads, and other structures. C&D materials often contain materials that include concrete, asphalt, wood, metals, gypsum, plastics, and salvaged building components. It is a challenging task to handle C&D waste because it is bulky, heavy, and inert and mixture of various materials of different characteristics. It is also difficult to choose any suitable disposal method, for example, it cannot be incinerated due to its high density and inertness. With the advent of sustainable practices in the construction industry, C&D waste generation and handling issues have been in focus to achieve the sustainable goals for our common future. Reduce, Reuse, Recycle philosophy is incredibly useful in handling of C&D waste. The better practice to handle C&D waste is to minimize generation of C&D waste, but sometimes it is unavoidable due to various issues such as change-orders or demolition requirements for redevelopment. It was also mentioned that exceedingly small percentage of waste from construction industry is reused or recycled, the majority being deposited or used as landfill. Like other developing countries, India is also enjoying construction boom. With the rapid growth in construction activities of India it is appropriate to link the generation of C&D waste with the growth of construction industry and related issues. It is also essential to study C&D waste generation and handling to develop accurate data and establish.

## II. OBJECTIVE

To find the properties of recycled fine aggregates by performing tests related to aggregates and casting the interlocking concrete paving blocks of M30 grade and perform the tests as per IS 15658:2006

## III. STUDY AREA PROFILE

Surat is a city located on the western part of India in the state of Gujarat. It is 2nd largest city of Gujarat in terms of Area and Population. India's 8th most populous city. It is the 73rd largest urban area in the world. Surat has fastest growth rate due to immigration from various part of Gujarat and other states of India. It is one if the cleanest city of India.

Surat city is situated at latitude 21°12'N and longitude 72°52'E on bank of river Tapi having coastline of Arabian Sea on its West. General terrain of the city is 13 Mt above the MSL. It is situated in a well-developed region of the Southern Gujarat. It is located 306 km south to the state capital, Gandhinagar. Surat Municipal Corporation (SMC) has practiced Zonal systems for public administration, following a functional decentralization approach of services management. The whole Surat city has been divided into 8 zones. Demographic details shown in Table 1.

Table 1. DEMOGRAPHY

| | |
|---|---|
| Total Area | 326.515 Sq. Km. |
| Total Population | 44,66,826 (as per census 2011) |
| No. of Households | 1,14,429 |
| Population Density | 13680 Persons/Sq. Km. |

It is estimated that 337 tonne/day generation of construction and demolition waste in Surat City. SMC has designed 10 locations for C&D waste collection within corporation limit. It has infrastructure of recycling facility plant of 300 TPD located in Kosad.

## IV. METHODOLOGY

In this experimental project, we have presented the concept of effective and sustainable use of construction and demolition waste in concrete which can be reuse in manufacturing of interlocking paver blocks. Materials for casting interlocking concrete paver blocks were collected from 300 TPD recycling plant located in Kosad, Surat In this experiment, the thickness of paver block as 60 mm having 10 mm top layer thickness and 50 mm bottom layer thickness. Recycled aggregates were collected from the nearby construction and demolition recycling management facility centre. The blocks were 200×100×60 mm in dimension and were produced to get fair idea. Recycled aggregates were used in proportions of 0, 0.20, 0.40, 0.60, and 0.80 to replace fine aggregate. The Best proportion for percentage replacement of C&D waste fine aggregate was decided based on compressive strength of paving block that was tested experimentally.

### *A. Mix Design*

The Paving Blocks usually of precast cement concrete units require dry , low slump mixes. Mix Design is carried out from M30 grade of concrete by using IS10262: 2009. Five different mixes were prepared using fine aggregate replaced C&D waste fine aggregate at varying percentage of 0, 20, 40, 60 and 80. Mix Design as shown in Table.1 as below:

Table 2. MIX DESIGN

| % Replacement of C&D Waste FA | 0% | 20% | 40% | 60% | 80% |
|---|---|---|---|---|---|
| Cement (Kg.) | 416 | 416 | 416 | 416 | 416 |
| Water (Kg.) | 262 | 262 | 262 | 262 | 262 |
| Fine Aggregate (Kg.) | 1019 | 815 | 611 | 407 | 203 |
| Fine C&D Aggregate (Kg.) | 0 | 176 | 354 | 531 | 708 |
| Coarse Aggregate (Kg.) | 928 | 928 | 928 | 928 | 928 |

### *B. Casting of Interlocking Paver Block*

The interlocking concrete block specimens of 200 mm×100 mm with thickness of 60 mm were cast according to mix proportion in a rubber mould of red coloured in Milano shape.

## V. EXPERIMENTAL RESULTS

### *A. Compressive Strength*

The compressive strength values at 28 days of the casted interlocking concrete paver block in 0%, 20%, 40%, 60% and 80% partial replacement of natural fine aggregates with manufactured sand were presented in figure.1

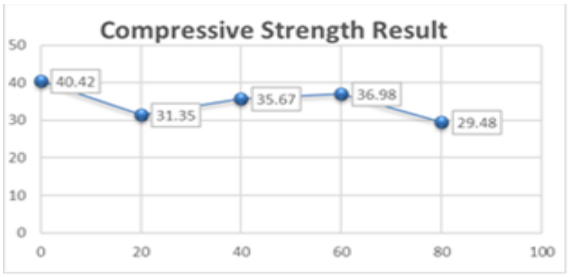


Figure 1. Figure Showing Variation in Compressive Strength at 28 days

### *B. Flexural Strength*

The flexural strength values of the casted concrete paver block are shown in figure.2 Result of flexural strength for concrete paving block was in satisfactorily which is greater than 4.5 Mpa. Hence, It is satisfied the minimum requirement.

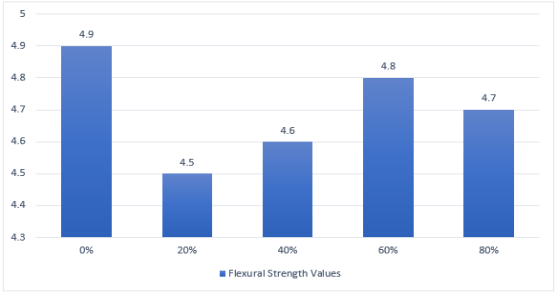


Figure 2. Flexural Strength

### *C. Tensile Splitting Test*

Result of split tensile strength for concrete paving block was 3.8 Mpa greater than 3.6 Mpa, hence satisfied minimum requirement. Results for Tensile Splitting Test is shown in figure.3

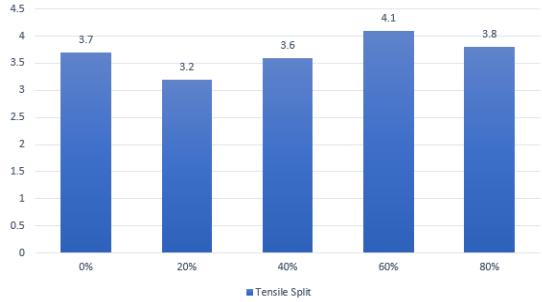


Figure 3. Tensile Splitting

### D. Abrasion Resistance Test

Sample taken to determine the abrasive value of paver blocks with constant replacement of fine aggregate by recycled fine aggregates. Test Results for Abrasion Resistance Values at 28 days of casted interlocking concrete paver block shown in figure.4

| Age Days | Variation of % replacement of FA | | | | |
|---|---|---|---|---|---|
| | 0 | 20 | 40 | 60 | 80 |
| 28 | 2.31 | 2.31 | 2.32 | 2.31 | 2.32 |

Figure 4. Abrasion Resistance Value

## VI. ANALYSIS

Higher compressive strength was achieved when 60% fine aggregate was replaced by C&D waste fine aggregate. The characteristics split tensile strength were satisfied. Water absorption by the paving block was within permissible limit. The characteristics flexural strength was satisfied. The abrasion was within permissible limit. The clear benefit is the natural resources savings, often energy and $CO_2$ emissions savings.

## VII. CONCLUSION

Higher compressive strength was achieved when 60% fine aggregate was replaced by C&D waste fine aggregate. All testing parameters were satisfied with the required results. The clear benefit is the natural resources savings, often energy and $CO_2$ emissions savings. Gainful utilization of this material provides eco-friendly and economical constructions. Utilization of recycled products from processed C&D waste helps relieve pressure on natural resources by reducing extraction of virgin materials like sand.

By the above results, it has been concluded that by effective utilization of construction and demolition waste for manufacturing paver blocks which is sustainable and cost effective. This way the C&D waste can be utilization effectively helps in reducing the exploitation of the natural resources which will help in achieving the sustainable development goals in construction industry. Construction and Demolition Waste about 100-150 tonne/day could be the greater opportunity for reuse in manufacturing of concrete paver block for flexible pavement in Surat City by implementing strategies for C&D waste management.

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