Experimental Study on Use of Construction and Demolition Waste in Bituminous Pavement

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Abstract— Demolition waste is waste debris from destruction of a construction. Construction industry in India generates about 10-12 million Tons of waste annually. While Retrievable items like bricks, wood, metal, titles are recycled in India, Concrete and masonry waste (>50% of total waste) are not recycled. A defined manual is not available with regulatory authorities for effective management of Construction and Demolition (C & D) waste. Authorities sometimes make rules but often fail in implementing them. This report is expected to be a pilot study towards preparation of such a manual. The objective of this study is to compile relevant literature which will give an insight into demolition waste management strategies of different countries and role of regulatory authorities in demolition waste management. The paper also studies the properties of demolition waste, its hazardous effects and suggests safe recycling/reuse/disposal methods. Based on the study, A C & D Waste management plan was formulated. For effective use of C & D, it essential that the local governing bodies make the submission and implementation of this plan mandatory. This would go a long way in the reduction of Environmental Pollution due to Construction and Demolition waste.

Keywords: C&D Waste, Demolition Waste, Marshal Stability, Density, Optimum Binder Content

I. INTRODUCTION

Demolition waste is waste debris from destruction of a building. Certain components of demolition waste such as plasterboard are hazardous once land filled as it is broken down in landfill conditions releasing hydrogen sulfide, a toxic gas. Waste from individual houseconstruction or demolition,

- Find its way into nearby municipal bin/vat/waste storage depots, making themunicipal waste heavy
- Degrade quality of municipal waste and makes it difficult for further treatment likecomposting.
- About 10-20 % finds its way into surface drains, choking them.

Projections for building material requirement of the housing sector indicate a shortage of aggregates up to 55,000 million m^3. Additional 750 million m^3 would be required for achieving the targets of the road sector. Recycling of aggregate material from constructionand demolition waste may reduce the demand-supply gap in both these sectors. Government or local authorities should make rules to sort the C & D waste before it is hauled away to landfills or other waste treatment facilities. Hazardous materials may not be moved before the demolition is begun or before the authorities have ascertained that Safety guidelines and restrictions have been followed for handling and disposal of toxicelements as lead, asbestos or radioactive materials.

A. Indian Construction Industry and Wastes Generated

Central Pollution Control Board has estimated current quantum of solid waste generation in India to the tune of 48 million Tons per annum of which waste from Construction Industry accounts for 25%. Construction waste is bulky, heavy and is mostlyunsuitable for disposal by incineration or composting. The growing population in the country and requirement of land for other uses has reduced the availability of land for waste disposal. Re-utilization or recycling is an important strategy for management of such waste. Above all, the fast depleting reserves of conventional natural aggregate has necessitated the use of recycling/ re-use technology in order to be able to conserve the conventional natural aggregate for other important works. Apart from mounting problems of waste management, other reasons which support adoption of reuse/ recycling strategy are reduced extraction of raw materials, reduced transportation cost, reduced capital investment on raw materials, improved profits and reduced environmental impact.

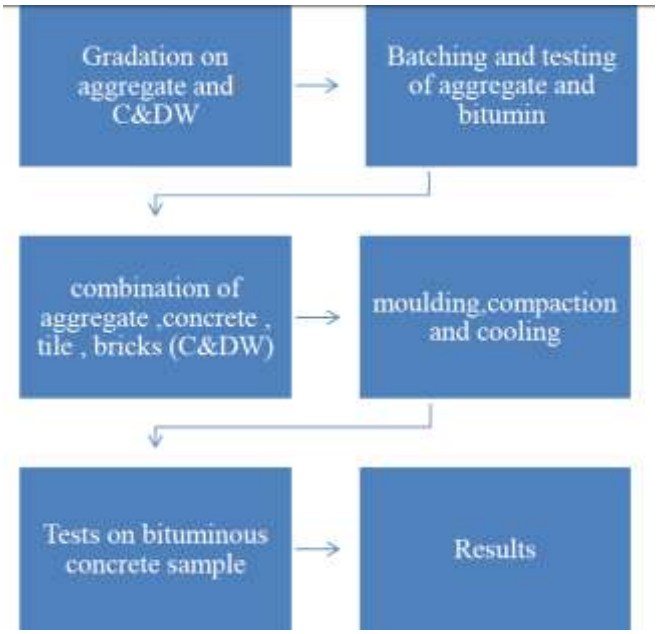
B. Construction and Demolition Waste

Concrete, tile, brick, metal, glass, and other materials are examples of C&D waste.[13]. A part of this waste is disposed of in the municipal waste. This waste contains large materials like bricks, tiles, concrete blocks, wooden items, metal items.([8] Baker, 2018).The C&D waste is mainly generated from renovation, demolition and from new construction. Renovation and demolition are the two major reasons behind construction and demolition waste generation.

According to reports Indian construction sector generates 11-12 million tons of construction waste per year. Some reports says in India there is chance of shortage of naturalaggregates due to this rapid construction.

Concrete and masonry waste, which account for more than half of construction and demolition waste, is not recycled in Asian countries. But in some developed countries this type of waste is recycled with proper guidance. ([9] Bassani, 2019).

II. METHODOLOGY



TEST ON MATERIALS

1) TESTS ON NATURAL AGGREGATES

Gradation on aggregate
Impact test
Crushing test
Los Angeles Abrasion Test
Specific Gravity and Water Absorption Test

2) TESTS ON CONSTRUCTION AND DEMOLITION AGGREGATES

Impact test
Crushing test
Los Angeles Abrasion Test

3) TESTS ON BITUMEN

Penetration Test
Flash and Fire Test
Softening
Specific Gravity
Ductility test

III. MARSHALL STABILITY TEST

Sl. No.	Test	CWD	Natural Aggregates
1	Aggregate Impact Test	11.33%	7.01%
2	Crushing Value Test	20.76%	16.35%
3	Water Absorption Test	1.24%	0.51%
4	Los Angeles Abrasion Test	19.23%	15.85%

Table 1: Aggregate Test Results

Bitumen Test	Value
Penetration Test For Bitumen	66.43mm
Softening Point Test For Bitumen	46.34C
Ductility Test For Bitumen	51.43mm
Specific Gravity Test	1.121

Table 2: Bitumen Test Results (Viscosity Grade 30)

A. *Marshall Mix Design*

Marshall Stability is high for the C&D mix .Bricks and tiles in rubble require more bitumen to be gently coated, so as the proportion of rubble increases, the flow value decreases. Since the specific density of debris is lower than that of normal aggregate, the specific gravity is also small.

We get the highest value of Marshall Stability at 30% which is 12.97. By Performing Marshall Mix Design We gets the flow value, percentage air voids value and VFB value which is shown in the table below. The C&D waste percentage is taken as 20, 25 and 30. The bitumen percentage is steady at 5.5% of the C&D samples.

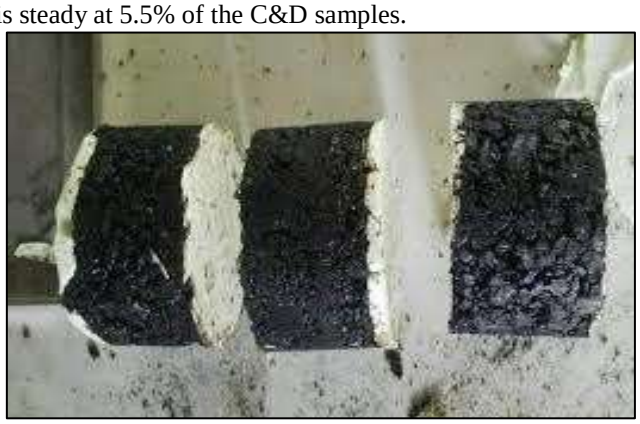


Fig. 1: preparation of Marshall Stability mould

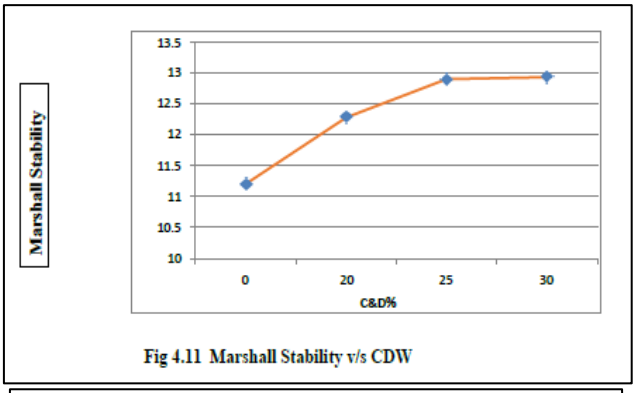
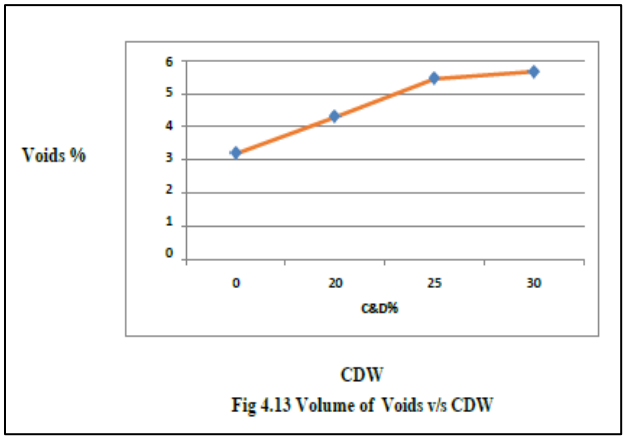


Fig 4.11 Marshall Stability v/s CDW



CDW

Fig 4.13 Volume of Voids v/s CDW

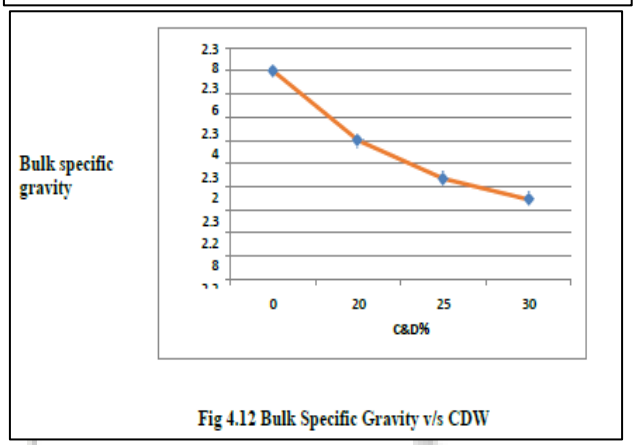
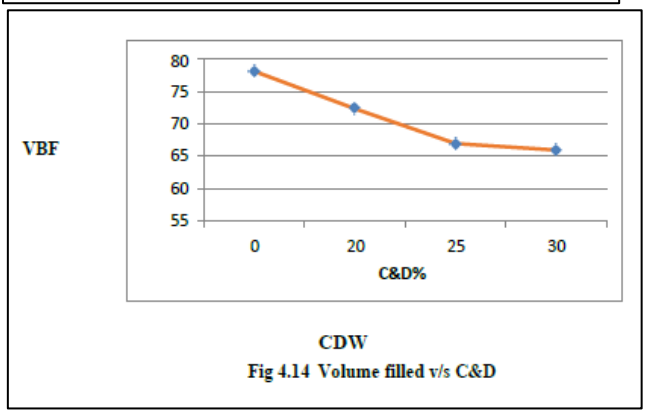


Fig 4.12 Bulk Specific Gravity v/s CDW



CDW

Fig 4.14 Volume filled v/s C&D

Trial No.	CD W (%)	Stability Value (KN)	Flow Value (mm)	Bulk Specific Gravity (Gm)	Percent Air Voids%	Volume of bitumen %	Void filled with bitumen %
1	0	11.15	3.14	2.32	3.23	12.465	79.145
2	0	11.27	3.24	2.34	3.18	12.357	79.20
3	0	11.24	3.27	2.362	3.162	12.553	79.17
Avg.		11.19	3.21	2.353	3.190	12.458	79.171
1	20	12.25	3.16	2.27	4.231	11.433	72.143
2	20	12.27	3.18	2.288	4.345	11.344	72.243
3	20	12.33	3.12	2.32	4.384	11.267	72.434
Avg.		12.28	3.153	2.319	4.32	11.348	72.274
1	25	12.4	2.85	2.257	5.35	11.167	66.876
2	25	12.56	2.93	2.263	5.40	11.132	66.765
3	25	12.87	2.87	2.287	5.43	11.154	66.944
Avg.		12.643	2.883	2.271	6.393	11.151	66.861
1	30	12.70	2.67	2.231	5.765	10.878	65.986
2	30	12.56	2.87	2.234	5.786	10.675	65.876
3	30	12.97	2.65	2.263	5.878	10.576	65.933
Avg.		12.743	2.73	2.252	5.809	10.709	65.931

Table 4.17: Marshall Mix design test results

IV. CONCLUSIONS

1) The aggregated test performed is within the limits of IRC. Test results show that the Marshall stability of the modified structure and demolition mixture is greater than thatof the normal mixture. Bricks and tiles are less dense than traditional combinations, further reducing their relative bulk density.
2) The results of ITS (Indirect tensile strength) test results show some positive outcome and are showing some improvement. At 0% C&D waste, the indirect tensile strength is 0.540 N/mm2, while at 30% replacement, it is 0.701 N/mm2. However, there's a decrease in its quantitative relation which implies a risk of wetness.

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