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ECONOMICS OF CONSTRUCTION AND DEMOLITION WASTE UTILIZATION IN ROAD CONSTRUCTION

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Abstract— Construction & Demolition (C & D) waste is serious problem in any construction site. In India, the development business produces heaps of development squander which caused critical effects on the earth and excited developing open. These is caused by Lack of Awareness in the Industry, Lack of interest from clients, Lack of proper training and education, Lack of skilled labour. So there is need awareness about it. Thus, the minimisation of construction wastes has become a pressing issue. So based on an involved construction waste generation and composition as well as reuse and recycling in the Road construction. It is also analysed the economic feasibility of waste minimisation such as reusing and recycling of construction waste materials in Road Construction. It also studies how Benefit derived and Cost incurred in the project can be worked out. Thus Benefit- Cost ratio is to be studied in addition to technical feasibility and economical viability.

Keywords— Sub-Base course; construction and demolition waste; recycled materials; cost-benefit ratio.

I. INTRODUCTION

In Surat city of India, data related to demolition waste generation is unreliable and unaccountable. One of the main reasons of unaccountability is people, contractors and developers are not forced by law to inform the municipal corporation before starting demolition, renovation activity. The unaccountability of demolition waste produced within the city limit causes poor management of waste, unauthorized dumping and illegal land filling. Therefore, there is a necessity to quantify the amount of demolition waste produced by the demolition of a building unit. This will act as a benchmark to estimate the demolition waste produced within the boundary of Surat municipal corporation (SMC). This will also help in the control and maintenance of the recycling operation and formulate the sustainable solution for managing the building-related waste.

As per the Ministry of Environment, Forest and Climate Change, Government of India (GOI), In the Gazette of India, Part-II, Section-3, Sub-section (ii), (March, 2016), Construction and demolition waste is defined as the waste comprising of building materials, debris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure. The CPCB New Delhi has estimated solid waste generation in India to be around 48 million tons per annum of which the construction industry accounts for approximately 25 percentages i.e. 12 million tons per year (TIFAC, 2015). However, the Ministry of Urban Development (MoUD India, 2000) estimated that the Indian construction industry generates about 10 -15 million tons per year. The estimates given by TIFAC and MoUD are outdated and not reliable to quantify the generation of the demolition waste at the regional level. In addition, old standards are used in making national policies, rules and regulation for managing CDW. Due to inadequate policies, the absence of regulations and underestimated recycling facilities leads to unauthorized dumping of C&D waste in low lying areas, open spaces, roadsides or water bodies. Special attention must be given to avoid the problem of the scarcity of landfill space for disposal and its damaging potential to the environment and human life if not managed properly.

The scope of present study is limited up to problems in existing unplanned C & D waste materials of Surat city only. The purpose of this study is to Reuse and Recycling the construction and demolition waste in road construction. Necessity of this project is Proper C & D waste material management and economics of road construction using C & D waste. The Objectives of Study is to check current status of practice of C & D waste in Surat. To provide proper management ways for C & D waste material. To Find Economics of road construction by utilization of C & D waste

II. LITERETURE REVIEW

Mohsen Aboutalebi Esfahani (2018) Suggested That road construction, part of the large amount of aggregates used in pavements can be provided from recycled construction and demolition (C&D) Waste. Each material was passed through a crusher and a 25mm sieve. The segregated materials were then mixed and technical specifications of the mixture were controlled against AASHTO standards. In this study, compaction and CBR tests showed that the obtained mixture is suitable for use in base and sub base layers but minimum requirements of resilient modulus for the base course are not met. Alterations in mixture components resulted in a significant reduction in C&D content for the base course. Therefore, it is recommended that C&D is used only in sub base layers of pavements.

Del Rey and et.all (2012) Suggested That the recycled materials most commonly produced in construction and demolition waste (CDW) treatment plants is a mixture with around 75% of fine recycled aggregates (called FRA), with 5–8 mm nominal maximum size. The intent of this paper is to study the feasibility of using cement-treated granular materials (CTGM) made with fine recycled aggregates (FRA) as road base layer. It suggests that it is feasible to produce CTGM with 0–8 mm RA (SC20) from CDW for that purpose. In addition, CTGM with FRA have better mechanical properties and dimensional changes than CTGM with coarse recycled aggregates (SC40).

Rosario Herrador and et.all (2012) has given suggestion on The need to manage construction and demolition waste (CDW) has led to environmentally-friendly actions that promote the reuse and recycling of this type of waste. The main priority is to foment sustainable construction work, which has the advantage of avoiding the deposit of large quantities of construction waste at landfills and greatly reducing the use of borrow material in construction projects. The aim of this research study is to verify the technical viability of using construction waste as material for the base pavement layers of road surfaces. In line with the results obtained by Poon and Chan (2006) regarding recycled aggregate composed of concrete and ceramic material, this study found that recycled aggregate made of concrete, ceramic material, and asphalt also had a lower density than natural aggregate. It was also observed that the load-bearing capacity improved with the application of successive pavement layers.

Cesare Sangiorgi and et.all (2015) suggested that in this paper authors find that One of the applications of recycled aggregates from construction and demolition processes is the construction of embankments, Sub bases and foundations for roads where unbound materials are used in replacement for natural aggregates. This work focuses on studying the development of the stiffness of recycled materials during construction, as well as how it modifies over time. The results show that recycled aggregates perform well when properly compacted and may show some positive self-cementing properties**.**

III. METHODOLOGY

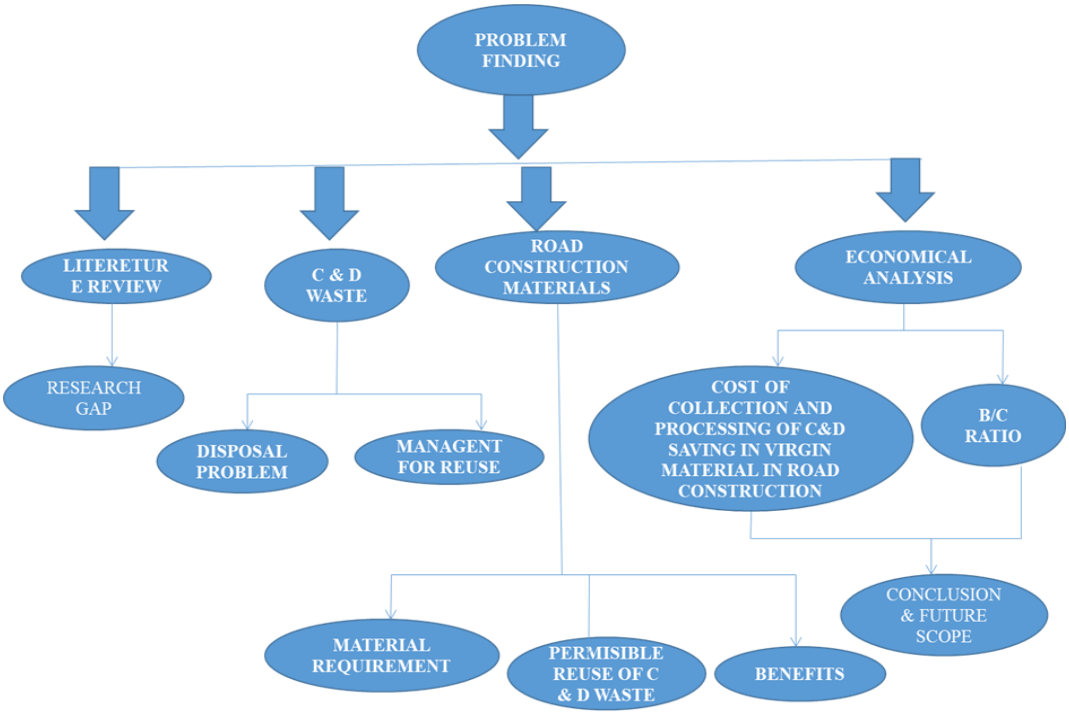

Fig: 1 Methodology

Problem Finding: The first step was to understand the construction and demolition waste and its management for the Surat city. The brief background for the study, objectives, scope and significance of the present dissertation work was getting through this phase.

Literature review: From literature we know about condition and solution about construction and demolition waste and its management. and get knowledge about different area.

Study area profile: Urban growth profile, demography and brief of the trend of population growth, municipal solid waste growth was discussed for the Surat city.

C & D Waste: From C & D waste we get Sources of waste, Problem of disposal, current management of C & D waste.

Data collection: Use of site interview, municipal collections we get Data of types of waste material, current management of C & D waste.

Road Construction: Here we reuse C & D waste in road construction so we get some data like types of material, permissible reuse of C & D waste, its benefits.

Economical Analysis: Here we will find Cost of collection and Processing of C & D saving in virgin material in road construction.

IV. RESULT AND ANALYSIS

REUSE OF C & D WASTE IN ROAD CONSTRUCTION

It is proposed to use the C& D waste in sub base course and shoulders of flexible road construction. A typical cross section of a flexible pavement is shown in Figure

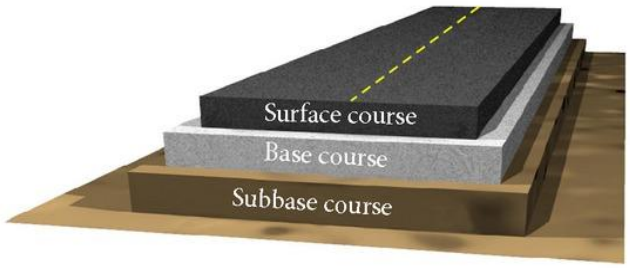

Fig: 2 Typical Cross Section of a Flexible Pavement

There are different three type of components in road
1) Surface Course.
2) Base Course.
3) Sub base Course.
It is proposed to use the C & D waste in sub base course. It is also proposed to use 100 % C & D waste in shoulders.

RATE ANALYSIS FOR C & D WASTE. (MARKET VALUE).

1) Collection cost = 0 RS/m3 (Differs from city to city).
2) Processing cost/sorting using machinery = 60 RS/m3.
3) Storage cost = 20 RS/m3.
4) Labour Cost = 30 RS/m3.
5) Electricity Cost= 20 RS/m3.
6) Land fill / Disposal unused material = 40 RS/m3.
7) Revenue generated from material usable for other purpose =20 RS/m3.
Total Rate 150/cum

TABLE: I
SPECIFICATION FOR SUB BASE AND SHOULDER

Sub base	Constructing of granular sub-base Gr-I by providing course graded B.T. machine crushed material satisfying MOST specification of grading I including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.
Shoulder	Supplying, Stacking, Spreading & rolling of Quarry spall on road side for hard side shoulder of work as per specification including filling the measure boxes of standard size etc. complete.

TABLE: II
RATE OF MATERIAL

SR NO.	Item of work	Quantity	Unit	Rate
1	Material used in sub base (As per PWD)	1	Cum	507.00
2	Material used in shoulder (As per PWD)	1	Cum	364.00
3	Material avalible from CDW site.(As per Rate analysis)	1	Cum	150.00

COST OF SUB BASE

Here we consider for 1 km of Road
So Quantity of 1 km of shoulder is 1080 Cum

Where length of Road = 1000m
width of Road= 7.2m
depth of road = 0.15m
1000*7.2*0.15= 1080 cum

TABLE: III
COST OF SUB BASE (Rs.)

% OF C & D WASTE USED	NEW MATERIAL		C & D WASTE		TOTAL COST	SAVINGS	% SAVINGS
	QTY	COST	QTY	COST			
0	1080	547560	0	0	547560	0	0
10	972	492804	108	16200	509004	38556	7.041420118
20	864	438048	216	32400	470448	77112	14.08284024
30	756	383292	324	48600	431892	115668	21.12426036
40	648	328536	432	64800	393336	154224	28.16568047
50	540	273780	540	81000	354780	192780	35.20710059
60	432	219024	648	97200	316224	231336	42.24852071
70	324	164268	756	113400	277668	269892	49.28994083
80	216	109512	864	129600	239112	308448	56.33136095
90	108	54756	972	145800	200556	347004	63.37278107
100	0	0	1080	162000	162000	385560	70.41420118

So here is the Graph of the % of use of C & D Waste with Respect to % of Saving

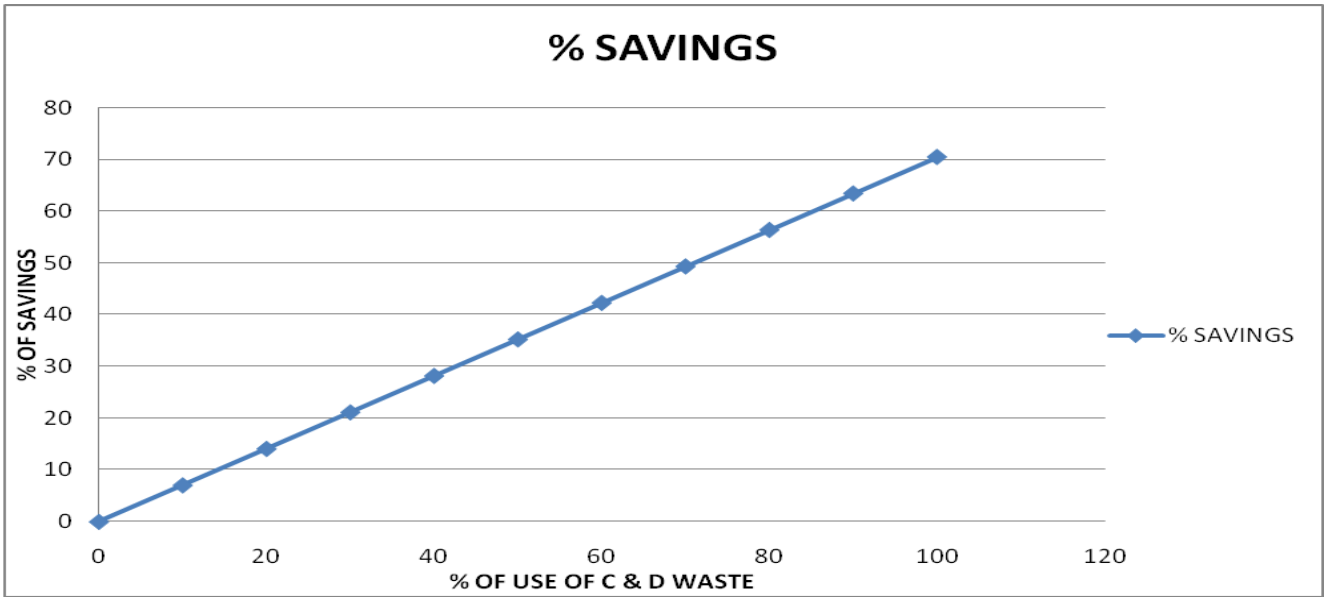

Fig: 3 Graph of the % of use of C & D Waste with Respect to % of Saving

COST OF SHOULDER

Here we consider for 1 km of Road
So Quantity of 1 km 0f shoulder is 300 Cum
Where Length= 1000 m
No of Shoulder= 2 Nos
Width = 1 m
Depth = 0.15 m
2*1000*1*0.15=300 Cum

TABLE: IV
COST OF SHOULDER (Rs)

NEW MATERIAL		C & D WASTE		TOTAL COST	SAVINGS	SAVINGS %
QTY	COST	QTY	COST			
300	109200	0	0	109200	0	0
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879
0	0	300	45000	45000	64200	58.79120879

TABLE: V
COST OF SUB BASE + SHOULDER (Rs)

% C & D WASTE USED	NEW MATERIAL			C & D WASTE			TOTAL COST	SAVINGS	% SAVINGS
	SUB BASE	SHOULDER	TOTAL COST	SUB BASE	SHOULDER	TOTAL COST			
0	547560	109200	656760	0	0	0	656760	0	0
10	492804	0	492804	16200	45000	61200	554004	102756	15.64589804
20	438048	0	438048	32400	45000	77400	515448	141312	21.51653572
30	383292	0	383292	48600	45000	93600	476892	179868	27.3871734
40	328536	0	328536	64800	45000	109800	438336	218424	33.25781107
50	273780	0	273780	81000	45000	126000	399780	256980	39.12844875
60	219024	0	219024	97200	45000	142200	361224	295536	44.99908642
70	164268	0	164268	113400	45000	158400	322668	334092	50.8697241
80	109512	0	109512	129600	45000	174600	284112	372648	56.74036178
90	54756	0	54756	145800	45000	190800	245556	411204	62.61099945
100	0	0	0	162000	45000	207000	207000	449760	68.48163713

Here the graph of Total cost of sub base + shoulder

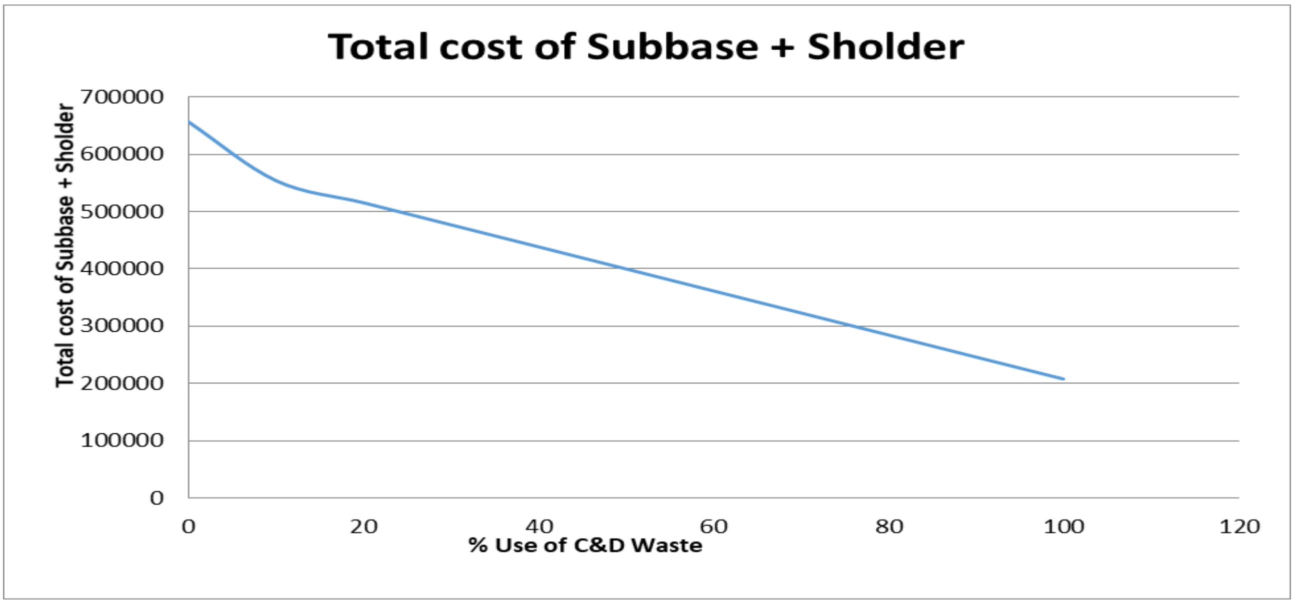

Fig: 4 Total cost of Subbase +Shoulder using C & D waste

Here comparison graph of Total cost of new material + total cost of C & Waste + Total cost of sub base + shoulder.

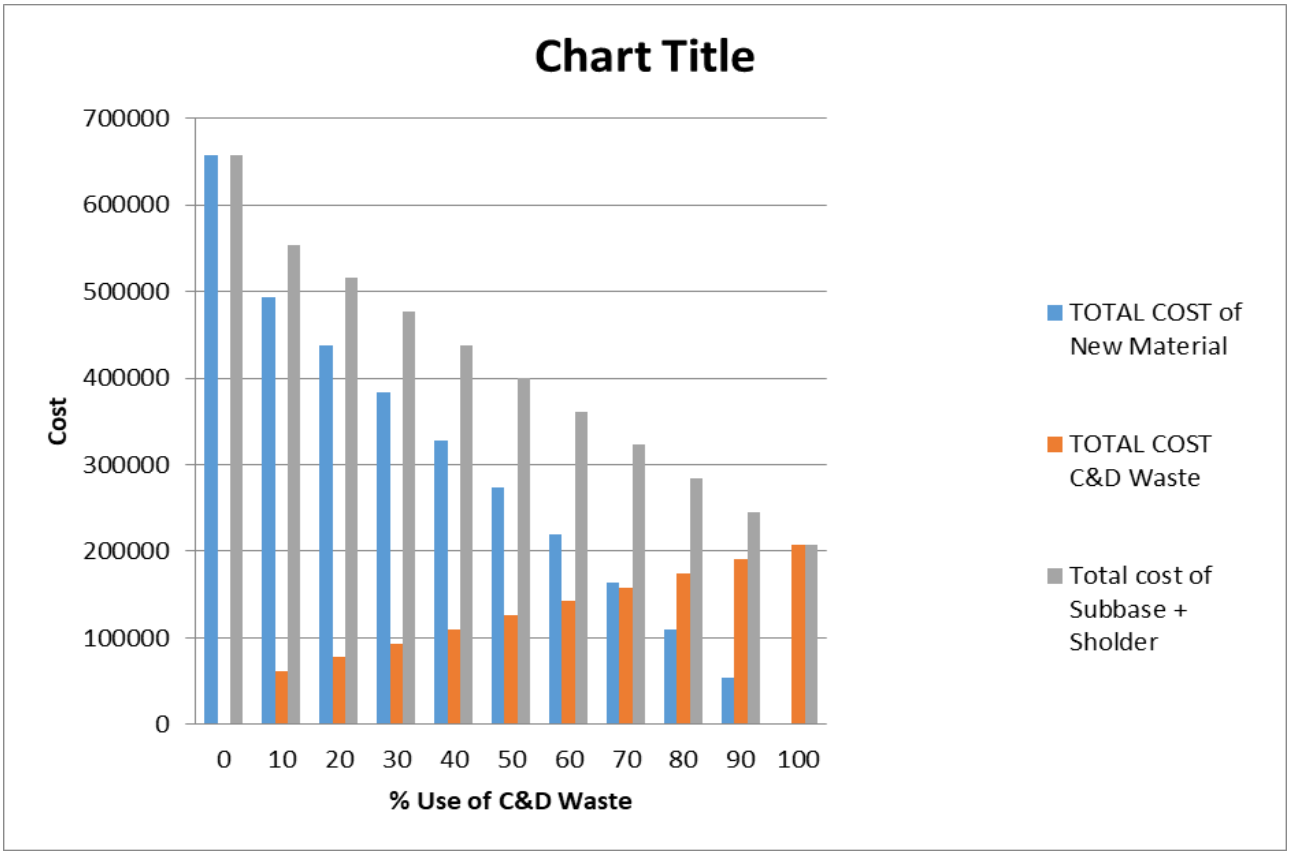

Fig: 5 Comparison Graph of use of C & D waste to Total cost

V. **CONCLUSION**

Development and destruction squander (C&D) is created amid the development, remodel, and devastation of structures or structures. Building materials represent about portion of all materials utilized and about a large portion of the strong waste created around the world. Present study introduces the reuse & recycling of C & D waste. The Case study of Surat City is taken as a Dumping as well as Working area. Present study discloses the cost and material saving for the road construction. Study suggests that up to 100% of the waste material can be used for Road construction. In this study we proposed C & D waste in sub base and shoulder of 1 km Road of Surat city. If 10 % of the waste material material replaced than 7.04 % cost can be saved. At same time 100 % of C & D waste in sub-base than 70 % cost can be saved in road construction. Generally, in shoulder we can use 100 % of the C & D waste and saved 58 % cost will be saved. From the study it is recommended to use the C & D waste materials in road construction and it is advantageous also.

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