IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

Construction Waste Control: A case study

Mahesh H [1] & Manish D Mata[2]

Civil Engineering Department

1 & 2, Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal, MS, India.

Abstract:

Construction industry is a material and money intensive industry. Hence a very precise control over the material management is required mismanagement can lead to the wastage of material. This in turn can lead to estimate over runs and consequently financial crises. Apart from this, material loss leads to environmental damage also.

The present work is a case study of Srinivas constructions, Bhusawal (India). A multistoried shoping complex cum residential building project is going on there. The project cost is estimated to be Rs 6178383/- which has gone up to Rs 7632400/-, that is a rise of more than 23%. In order to curb this rise, suggestions are given for better material management.

1. Introduction:

Waste materials in true sense are debris generated during the process of construction, renovation, and demolition of structures of civil engineering including buildings, roads, and bridges etc. They are typically termed as C & D waste. C&D materials refers to group of materials like salvaged building components, wood, concrete, asphalt, metals, gypsum, plastics etc. It is not an easy task to handle C&D waste owing to its bulkiness, weight and non-degradability. It is an inert mixture of various materials of different characteristics. Conventional solid waste management methods are not suitable for disposal of this material. It cannot be incinerated as it is very dense and inert. With the rising demand of sustainable practices in the construction industry, the issue of C&D waste generation and handling has in center our common future to achieve the sustainable goals. Reduce, Reuse, Recycle (3Rs) is the emerging philosophy in handling of C&D waste. The history of recycling of construction waste goes back to the time of Second World War. Germany is a practical example where reuse of most of the concrete demolished during war took place for construction purposes. Yet many countries, especially developing countries have not well appreciated the potential of 3Rs. Thus landfills appear them to be the most preferred method for C&D waste disposal. However the better practice to take care of C&D waste is to minimize generation of the same. Total elimination of C&D waste is not

IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

possible due to certain reasons like order changes or requirement of demolition for redevelopment. It is estimated that the global building waste production is of the order of 2 to 3 billion tons per year. In this, 30-40 % is concrete [1].

The developing countries are transiting towards boom of construction. Thus the issue of C&D becomes more important for them. For instance, a total of 27.7 million tons of construction waste had to be carried out from different construction sites in the capital city of UAE in 2007 [2]. This growth is tremendous. It is equivalent to 163 % of the waste generated in 2006 [2]. Vilas and Guilberto [1] mentioned that many countries in Asia do not have specific regulations pertaining to C&D wastes, though in the solid waste management regulations some countries have include this issue. Developed countries generate C & D waste in the higher range of 500 to 1000 kg per capita per year. The estimation for European Countries is 175 million tons/year. It was also mentioned that relatively lesser proportion of waste generated by construction industry is reused or recycled. The major proportion being deposited or used as landfill. Like other developing countries, India is also enjoying construction boom. The construction activities in India are rapidly increasing. They can be linked with the generation of C&D waste appropriately. with the growth of construction industry and related issues. It is also essential to study C&D waste generation and handling. Such an study will develop accurate data and consequently establish sustainable methods to construction waste manage.

2. Indian Construction Industry

The second largest sector in India in terms of magnitude is the construction industry. Significant are the multiplier effects of construction industry on our Indian economy. Right now around 27,770 enterprises are involved directly in the construction sector thereby making it to be one of the country's largest. Blend of both organized and unorganized entities characterized it. The employment potential has got doubled from 14.6 million in 1995 to 31.46 in 2005 showing a steep rise. The data comprises all categories including engineers, technicians, foremen, clerical staff, and skilled as well as unskilled workers. There were ambitious projects in the 11^{TH} plan for construction and the demand for manpower has risen at a consistent pace of 8% –9%. Alternatively it refers to an annual accretion of around 2.5 million persons [3].

The construction industry is a foremost advancement for economical growth in the country. This sector had a business of over 100 US dollars. The private sector contributed to 32.7 per cent of this investment. Recently the Government of India has gone for 100% foreign direct investment in real estate development projects [4]. This is going to be a major boost for this sector. The construction share in total GDP is as shown in Figure 1 [5]. Total construction work during 2006-2011 amounts to $847 billion [5].

IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

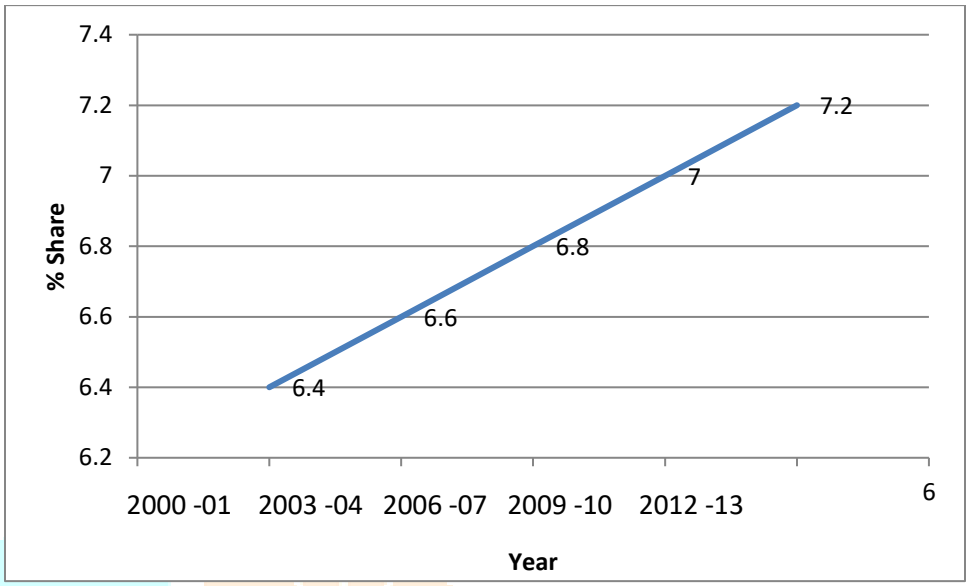

Fig 1: Construction industry' share in Indian GDP.

In construction industry the importance of materials cost could be well explained from the fact that the 40% – 60% of the project cost is due to. The Indian construction industry is highly material intensive. It consumes material such as stone, clay, lime as well as synthetic resources [4]. Table 1 gives the proportions of various building materials used in Indian construction Industry.

Table 1

Percentage contribution of various components in building industry

	Materials %	Construction equipment %	Labor %	Finance %	Enabling Expenses %	Admin. Expenses %	Surplus %
Building	58-60	4-5	11-13	7-8	5.5-6.5	3.5-4.5	5-6
Roads	42-45	21-23	10-12	7-8 5.	5-6. 5	3.5-4.5	5-6
Bridges	46-48	16-18	11-13	7-8	5.5-6.5	3.5-4.5	5-6
Dams, etc	42-46	21-23	10-12	7-8	5.5-6.5	3.5-4.5	5-6
Power	41-43	21-24	10-12	7-8	5.5-6.5	3.5-4.5	5-6
Railway	51-53	6-8	16-18	7-8	5.5-6.5	3.5-4.5	5-6
Mineral plant	41-44	20-22	12-14	7-8	5.5-6	3.5-4.5	5-6
Transmission	49-51	5-7	19-21	7-8	5.5-6.5	3.5-4.5	5-6

IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

3. Environmental Legislations Pertaining to Indian Construction Industry

The Eleventh Five Year Plan [3] has mentioned that the sustainable development concepts could be applied to the various aspects of construction projects like design, construction, and operation. This can improve both the economic level and the environmental status of communities. Ministry of Environment and Forest (MOEF) has made it mandatory to conduct Environmental Impact Assessment before constructions projects of large size are approved. Environment Protection Act 2006 and the Energy Conservation Act 2001 provide further provisions for ensuring adherence to international standards and regulations. Few interdisciplinary organizations are also set up to take care of the issues of environmentally friendly and energy efficient technologies in building materials. Central and State Pollution Control Board (CPCB) is authorized to approve, monitor, and regulate projects from construction sector too, keeping in view their environmental impact. According to Municipal Solid Wastes (Management and Handling) Rules of 2000, it is mandatory to independently collect C&D wastes or debris [6].

4. Construction & demolition waste in India

In India C&D waste has two components [5]:

Major components: Cement concrete, Brick material, Cement based plaster, Steel (obtained from RCC, frames of door – window, roofing, staircase railing etc.), Rubble, Stone (like marble, granite, sand stone), Timber/wood (generally obtained from demolition of old structures).

Minor components: Conduits of materials like iron, plastic etc, Pipes made of GI, iron, plastic, Electrical fixtures made of metals like copper or aluminum, wiring, wooden baton, switches, wire insulation, Panels (wooden, laminated), Others (glazed tiles, glass panes).

Their proportion is as given in table 2:

Table 2

Relative proportion of various C & D waste in Indian construction Industry

Constituents	Million tons/year
Soil, Sand and gravel	4.20 to 5.14
Bricks and masonry	3.60 to 4.40
Concrete	2.40 to 3.67
Metals	0.60 to 0.73
Bitumen	0.25 to 0.30

IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

Wood	0.25 to 0.30
Others	0.10 to 0.15

5. C&D waste handling

In India, contractors play crucial role in C&D waste management. There are provisions according to which the Contractor has to dispose off demolition wastes at his cost. C &D wastes generally arrive of new construction, repair and renovation of structures, demolition of an old building/structure etc. Demolition contractors are hired when an old building has to be demolished owing to its deterioration or to create space for construction of a new building [5]. According to TIFAC study, the items which are recovered in the process of demolition are sold in the market at lower rates. Items that cannot be re-used, are disposed to landfill sites. Some municipal corporations allow the waste coming from construction and demolition in their landfills, while others restrict it. Contractors are reluctant to segregated different constituents prior to disposal. Builders/owners bear the cost of transportation. It is also observed that though guidelines are there regarding disposal of waste into landfills, the penal action against violators is generally not taken.

6. Case study for Shrinivas Construction Bhusawal:

Although the standard references are available for estimation of C&D waste generated during a construction project, its quantity and quality various temporally and spatially. This is due to the complexity involved in the process of assessment. In fact the quantity and quality of waste generation is a complex function of interwoven parameters which are difficult to be modeled. In such cases probably thumb rules are better than the models. Such thumb rules are developed by practical experiences and regressive surveys. Case studies are the foundation over which the experience relies.

Keeping this is view a case study has been conducted for the construction site of Shrinivas Constructions, Bhusawal, MS. Here a four storied residential building is being constructed. The floor plans of the buildings are given in figure 2 – 3.

IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

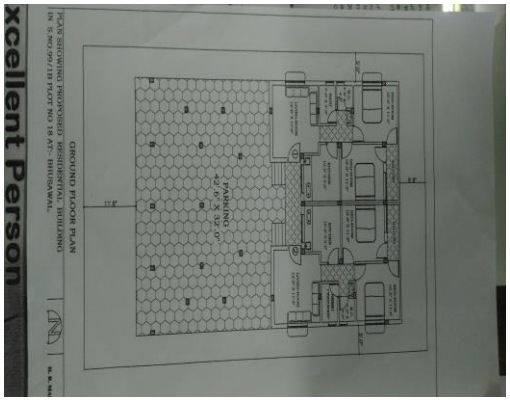

Figure 1: Ground floor plan of Shrinivas Constructions.

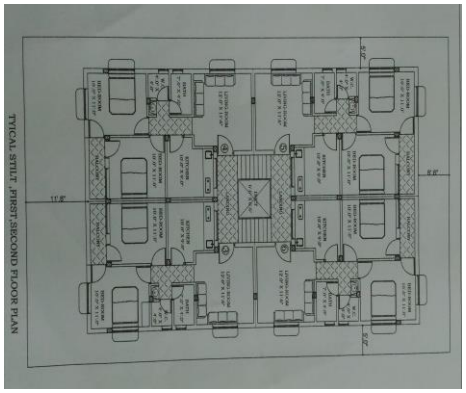

Figure 2: First and second floor plan of Shrinivas Constructions.

The project is quite huge in size. The overall construction is 10000 square feet. Total cost of the project is estimated to be 7317000/- Rs. As a case study, the cost of major constituents in a building project is estimated theoretically. The same is compared with the actual consumption, available from inventory record. The observations are summarized in table 3.

Table 3

Comparison between theoretically estimated and actually used quantity of material

SN	Material	Cost in Rs of theoretically estimated quantity of material	Cost in Rs actually used quantity of material
1	Steel	1756080/-	1819000/-
2	Cement	1170720/-	1287000/-
3	Sand	899910/-	926400/-
4	Gravel	541458/-	580000/-
5	Fittings	1682910/-	1755000/-
6	Finishers	1207305/-	1265000/-
Total		6178383/-	7632400/-

It can be seen that the total cost has exceeded by 23.80%. In fact if the cost varies by more than 5%, the re-estimation is recommended. Hence the actual variation is not at all in the acceptable range.

The case study directly indicates that there is a tremendous scope for application of waste minimization techniques and to save material. This will lead to the economic benefits as well as environmental benefits too.

IJCRT Publish Paper record is available at DOI: http://doi.one/10.1727/IJCRT.17199

7. Suggestions for wastage control:

The following suggestions cane be given for the waste control and consequent economy in the project:

- Broken bricks can be used for water proofing
- Coarse sand can be used for flooring
- Broken tiles can be used in ramps in front of main doors.
- Pieces of steel can be used as cut bars (cross reinforcement)
- Marble pieces can be used in clear cover of slabs.
- Recycled aggregates can be used in filling preferably
- The material inventory should be maintained precisely.
- The material procurement should be rationalized.
- The material storage guidelines must be followed.

These suggestions have practical significance. They can greatly reduce the losses at the construction site and in turn they can lead to increased profit of the contractor. They also lead to environmental benefit as minimum wastage means minimum utilization of natural resources.

References:

[1] Vilas and Guilberto (2007). "Construction and Demolition Waste Management: Current Practices in Asia." International Conference on Sustainable Solid Waste Management, Chennai, India.

[2] Al-Hajj, Assem; Iskandarani, T. Reducing Waste Generation on the UAE Construction Sites, Heriot-Watt University Research Gateway, available on https://pureapps2.hw.ac.uk/ws/portalfiles/portal/1955378.

[3] Government of India (2007). "11th Five Years Plan (2007-2012)." Planning commission, India. www.planningcommission.nic.in/Plans/Planrel/Fiveyr.

[4] Market research. (2006). "Construction Materials in India." www.internationalbusinessstrategies.com.

[5] TIFAC, Ed. (2000). "Utilization of Waste from Construction Industry." Department of Science & Technology, New Delhi.

[6] Laskar, A. and Murty, C.V.R. (2004). "Challenges before Construction Industry in India." www.iitk.ac.in/Nicee/Rp/2004_Challenges_Construction_Industry_Proceedings.Pdf.