

Analysis of the Cost Effective Construction Waste Management Plan

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Abstract: Construction industry has been swiftly developing around the world from last three decade especially in India the rate of developing of this industry is very high. There is a lot of capital investment, is invested in this sector as well as this industry become second largest industry after agriculture in India in perspective of capital investment as well as employment generation. This industry directly related with GDP of nation. The bigger construction projects have been launched in power, infrastructure, building sector in recent year. The 60 to 70% expenditure of the any construction project spend on construction materials. And it is found that huge quantity of wastage of material take place on site during the construction phase. Wastages of material has major problem in construction industry which must be recognize very efficiently. Effective control on wastages of material saves money, so that organizations profit margin will increase. More specifically, it has main impact on construction cost, construction productivity, time, and environment aspect. At such circumstance reduction of wastage of material during the construction phase contribute major role in economy of that construction project. Impact on environment is also serious issue because due to wastages of material the natural resources which are used for production of that construction material also wasted. The majority of this wastage of material can be avoided by competent and firm control over supervision of site, flow of construction material and strict labour supervision. To laid the waste management plan this paper identifies sources for wastages of construction material and critical factor causing wastages of material for those sources by using Delphi techniques and detailed questionnaires analysis.

Keywords: Construction industry, Construction materials, Wastage of material, Impact, Cost, Sources of waste, Critical factor, Waste Management Plan

1. INTRODUCTION

The Indian construction sector is a fundamental part of the nation and is developing for due to industrialization, The construction industry has been

growing at 10-11% year on year, mainly due to the increased home and international manufacturing activities and industrial development. There have also been increased levels of investment - especially by the Government - in infrastructure and real estate projects. The Planning Commission in its Twelfth Five Year Plan Document (2012-17) expects investments in infrastructure projects to be worth US \$ 1 trillion over the five years of the Plan. Total investment as a percentage of GDP is expected to be in the range of 7-9 percent.

Industrial and infrastructure sectors, together account for majority of construction sector opportunities in India.

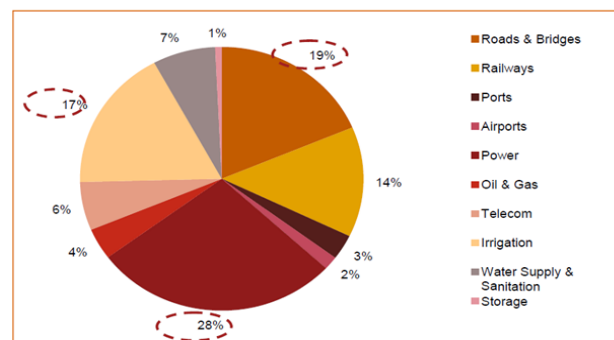


Fig 1: (Distribution of Capital in 12th five year plan)

Source: Planning commission of India.

The construction sector employs approximately 31 million people, accounts for some 6-8% of GDP and, after agriculture, is the largest employment sector in the country. Construction industry only sector in that skilled and unskilled workers are required.

Financial Year	Total (Man-year)	
	Lower Bound	Upper Bound
2013-2014	107,000	126,000
2014-2015	108,000	137,000
2015-2016	105,000	132,000
2016-2017	107,000	137,000
2017-2018	101,000	122,000
2018-2019	105,000	126,000
2019-2020	100,000	130,000
2020-2021	102,000	130,000
2021-2022	103,000	129,000
2022-2023	97,000	128,000

Fig 2: Overall Manpower Required In Construction Industry (Source: Indian HRD Ministry)

A. Building Construction Materials

Building construction are composed of different types of materials. These materials are either called building materials or materials of construction. It is very vital for a builder may be an architecture or engineer or contractor, to become familiar thoroughly with these building materials. The knowledge of different types of materials their properties and uses for different purposes provides and important tool in the hands of the builders in achieving economy in material cost. The material cost in a building ranges 60 to 70% cost of the total cost construction. Reduction of wastage to material achieves economy, the correct use of material results in better structural strength, functional efficiency and aesthetic appearance.

Table 1: Percentage Cost Distribution in Construction Industry (Source:TIFAC 2013)

	Materials %	Construction Equipments %	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	5.5-6.5	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

B. Wastage of Construction Materials

Construction waste can be defined as any materials by product of human and industrial activity that has no residual value. Waste is a product or material that is unwanted. Wastage of construction material directly affects on economy and developing rate of project. It is very important to find out the source of generation of wastage of material.

During the use of material in construction and demolition of buildings lot of construction waste generated specifically India

Table 2: Tones of C and D Waste (Source: TIFAC, 2013)

Constituent	Million tones/yr
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
Wood	0.25 to 0.30
Others	0.10 to 0.15

2. PROBLEM STATEMENT

The 60 to 70% expenditure of any construction project spend on construction materials and it is found that

huge quantity of wastage of materials takes place on site during the construction phase. Wastage of material has major problem in construction industry which must be recognize very efficiently.

It is very important to find the sources of wastages of material during construction phase of building .and also to analysis the critical factor of these sources.

3. METHODOLOGY

As the Pune City is most developing city in housing construction sector. There are number of bigger construction projects are run around the Pune city. By keeping this view these projects are consider for this research study. By using Delphi techniques and detailed questionnaires analysis this study carried out.

The interviews are taken the personalities which are related to construction sector like General Manager, Project Managers, Senior Engineers, Building material suppliers, Labour Contractors, Equipment operators, Government officers, Quality Engineers, Material manager, Store keeper etc.

The detailed questionnaires are circulated on various building construction site, total 124 number of questionnaires are circulated out of that 90 are returned.

Table 3: Details of Responders for questionaries

Sr No	Responders Categories	Numbers
1	Site Engineers	30
2	Project Mangers	09
3	Material Managers	04
4	Store Keepers	07
5	Architects	08
6	Structural Engineers	10
7	RCC Contractors	07
8	Labour Contractors	11
9	Quality Engineers	04

4. RESULT AND DISCUSSION

A. Types of Wastage Materials.

From the interviews and questionnaires survey the sources of Wastages of Construction materials are categorized as follows.

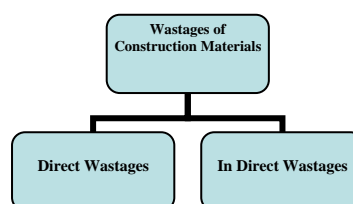


FIG 3: Type of Wastages of Materials

(i) Direct Wastages: Direct wastages of construction materials are those materials which are waste in actual process of construction.



Fig 4: Wastages of Concrete (Source: Veda Construction)



Fig 5: Wastages of Steel (Source: Veda Construction)

(ii) In Direct Wastages: In direct wastages of construction materials are those materials which are waste due to store handling and other factors.



Fig 6: Wastages due to Improper Storage

Source: Veda Construction

B: Sources of Wastages of Construction Materials.

1. Planning

In this Source following Factors are considered

- Frequent design changes
- Design errors
- Lack of design information
- Poor design quality
- Slow drawing distribution

- Incomplete contract
- Complicated design
- Inexperienced designer
- Last minute client requirement
- Interaction between various specialists
- Poor coordination of parties during design stage

Remedies: The wastage which occurs in planning stage due to above reasons can be reduce by proper communication and circulation, distribution of designs. Poor coordination in between personnel at site mistakes occurs in implementation of design to avoid this communication in between then should be proper. Complications occurring in the design should be clarified through the experienced designer so that the further mistakes in construction due to complicated design can be avoided. To avoid mistakes due to design complications designs should be of such that all details are stated clearly.

2. Lifting and Handling

In this Source following Factors are considered

- Wrong material storage
- Poor material handling
- Poor quality of materials
- Equipment failure
- Delay during delivery
- Material supplied in loose form
- Inefficient methods of unloading
- Unsuitable tools are used

Remedies: Proper material storage is important to reduce wastage of material as if it is not done then materials get damaged which we cannot use in further construction activities. Materials stored in loose form generally get waste in more quantity to reduce that their storage should be done in such a way that it will get minimized. Delivery of right materials should be at right time with good quality so that construction activity will be followed smoothly if not then unnecessarily material wastage occurs. Tools used for handling material should be proper so that waste will be reduced.

3. Labours

In this Source following Factors are considered

- Worker's mistakes during construction
- Insufficient training for workers
- Lack of experience
- Shortage of skilled workers
- Lack of awareness among workers
- Poor workmanship

Remedies: Worker should be well trained to reduce the wastage of material and time also. To avoid wastage because of workers proper distribution of workers as per different activities going on construction site should be done with providing proper training of work which they are going to do.

4. Administration

In this Source following Factors are considered

- Scarcity of equipment
- Poor information quality
- Inappropriate construction methods
- Poor supervision
- Poor site management
- Poor controlling
- Poor planning
- Rework
- Lack of knowledge about construction
- Non availability of equipment
- Outdated equipment
- Communication problems
- Lack of waste management

Remedies: Poor management of various things on construction site causes major waste on site. To reduce wastage planning, controlling, supervision of various activities going on site should be done effectively. Effective communication plays important role in management to reduce wastage on construction site.

5. Purchase

In this Source following Factors are considered

- Wrong material delivery
- Ordering errors
- Waiting for replacement

- Frequent variation orders
- Supplier errors

Remedies: Procurement means acquisition of materials as per required standard, quality and quantity at right time. To reduce wastage due to procurement errors proper communication with supplier is required. While ordering any material verification of required quantity, quality and standard should be done before ordering it to supplier.

6. Site Circumstance

- Unforeseen ground conditions
- Leftover materials on site
- Lighting problem
- Difficulties accessing construction site
- Poor site condition
- Congestion of site

Remedies: Site should be well maintained so that all movement of man and material should be free. There should be well prepared site layout; to avoid confusion Proper light arrangement should be done on site

7. External factor-

- Effect of weather
- Accidents
- impulsive local conditions

Remedies: Site should be clean and Hygienic and alert about accident with preventive measures.

5. CONCLUSION

Construction sector rapidly developing around the India, especially in building sector huge amount of capital investment and maximum share of this capital spend on materials which are used for construction. But there is lack of effective management and awareness about the wastages of materials during construction phase of project. This causes the wastages of money and delay of construction project. And also this wastages of material adversely affects on environment. Finding out the sources of wastages and their critical factors really challenging work for engineers but that significantly control on the wastages of material and this is very use full to developing cost effective waste management plan As well as this accumulate the money, time and saves natural resource which is used for manufacturing of construction material.

From the research we can conclude that

1) It is very important to find out the sources of wastages of material for effective control on wastage of materials. This study conclude that planning, lifting and handling, labours, Administration purchase, site circumstance and external factors are main sources of wastages of materials.

2) It is also equally important to find out the critical factor among these sources for focus controlling on wastages of materials.

3) From the planning source the 80% respondents are agreeing on proper communications should be in all levels of executions of work.

4) From the labour source more than 95% respondents highlighted that proper distribution of work among labour can reduces the wastages of materials.

5) From the study we can conclude that right quality of material can avoid the duplication of work

6) This study gives suggestions by considering the 76% respondents guidelines that site layout should be proper and site should be clean and maintain hygienic

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