

# USE OF LEAN CONSTRUCTION TECHNIQUE FOR WASTE CONTROL & TIME MANAGEMENT AT CONSTRUCTION SITE

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**Abstract-**Wastage of material and time is common in the construction industry. The purpose of current project work is to study causes of material waste and time waste and the impact of material waste and time waste on the project cost. Also importance and plan to reduce wastage by adopting the lean construction technique, here efforts are made to recognize and minimize the wastage. In this study, the research method is used to collect data, analyze data and report on outcomes. The methodology selected is questionnaire survey, In this survey the data is collected by collecting feedback from various clients, contractors and consultants. Relative importance index method is used to analyze the data and pie chart is drawn by the five highest reasons for the wastage. Few suggestions are made to minimize the time and material wastage. The conclusion is provided based on the data analysis and the results.

**Key words:** Lean Technique, Relative importance index (RII), time wastage, material wastage.

## 1. INTRODUCTION

The method to plan construction order to reduce time consumption, effort and materials to achieve the determined standards is lean construction. It reduces the start to finish time by excluding the cause of waste in the work flow is basic of lean enterprise

### 1.2 Fundamental principles of lean construction are:

1. Describe the importance by clients view.
2. Realize the value chain of all the stages in procedure used to produce the end product.
3. Minimize waste.
4. Guarantee the easy movement of value added actions.
5. Manufacture and adaptable building arrangements.

### 1.3 Problem statement

1. The application of lean construction is openly related to progress of performance and efficiency in construction. The main aim of lean construction is to realize the waste in every process and separate them.
2. Waste restricts value: waste will not only add in the cost and also reduce the worth, efficiency and fulfillment of the owner.

3. Normally all the companies target prime quality project, punctual and under the budget completion.

4. Transport: unnecessary movement of tool and products which not necessity support the production. Supply inventory in excess- tie up money. Extern step taken by people automobiles inefficient process taken. Waiting – waste time and adds no value.

5. Excess processing: Unwanted steps, reprocessing, handling twice, extra communication, checking twice.

6. Excess manufacturing: extra producing and storing before its needed which leads to increase in cost.

## 1.4 OBJECTIVES

1. To review the lean construction technique.
2. To investigate time and material wastage in construction.
3. To reduce time and material wastage using lean construction technique.

## 1.5 SCOPE OF STUDY

After having conversation regarding lean construction problems with specialists and referring journal papers it has concluded that lean method has many advantages for construction industry but now current status of lean is not acceptable in Indian construction industry and wants consideration of researchers for improvement. There are only little research are done regarding lean application in Indian situations.

## 2. METHODOLOGY

### 2.1 GENERAL

The present study is prepared by referring previous studies which based on delay analysis (Time wastage) and Material wastage at construction sites and their roots and effects on project. Later there are many reasons and their effects during project execution hence the study involves the importance of causes and their effects on project meanwhile the precautions that can be adopted during the project execution are suggested to minimize time wastage and material wastage.

Questionnaires are prepared to get the feedback from owner, consultant, contractors and clients deeply study the roles and reasons for the time and material wastage during the project. Then the study is made by analyzing the feedback in general and results are drawn. The feedback taken will generally give the details of the delay reasons and the actions that can be taken to reduce the delay and material wastage.

**2.2 Following are some points considered while preparing of Questionnaire:**

- 1) Time wasted in transportation.
- 2) Construction equipment used on site.
- 3) Accidents and Mishandling of equipment.
- 4) Funds available for carrying out works and payments.
- 5) Lack of lean culture in organization.
- 6) Material storage.
- 7) Wastage of material during construction.
- 8) Use of labor for construction.
- 9) Site management.
- 10) Project duration.
- 11) Order of material on site.
- 12) Site conditions.
- 13) Weather conditions.

**2.3 Relative importance index (RII):**

A five point scale is used by the collection of the information for the questionnaire then converted to relative importance indices (RII).

$$RII = \frac{\sum W}{AXN}$$

(AXN)

Where, W = respondent’s response, A = maximum reply, N = Numbers of respondents.

RII varies from 1 to 5, if the value of RII is greater then the factor is more important and if the RII is lesser then the factor is less important. These RIIs will be used for the analysis of the respondent’s responses. The entire three group’s replies will be differentiated based on the replies. The same process is also used for the analysis of effects.

**3 QUESTIONNAIRE SURVEY & ANALYSIS REPORTS**

**3.1 CALCULATION OF R.I.I.**

From received responses, the collected information from each individual cause’s RII is observed by the respondents is figured the total analysis.

**3.1.1 Calculation of RII for overall responses of Causes of Delays (Time wastage):**

1. Delay in material supply.

$$RII = \frac{5(70)+4(100)+3(23)+2(10)+1(10)}{5(70+100+23+10+10)} = 0.797$$

2. Inspecting and supervising time.

$$RII = \frac{5(53)+4(80)+3(40)+2(35)+1(5)}{5(53+80+40+35+5)} = 0.732$$

3. Transportation time.

$$RII = \frac{5(50)+4(65)+3(85)+2(10)+1(3)}{5(50+65+85+10+3)} = 0.738$$

4. Mishandling or error in construction installations.

$$RII = \frac{5(10)+4(40)+3(80)+2(53)+1(30)}{5(10+40+80+53+30)} = 0.550$$

5. Accidents on site.

$$RII = \frac{5(50)+4(80)+3(50)+2(20)+1(13)}{5(50+80+50+20+13)} = 0.724$$

6. Labor distribution for work.

$$RII = \frac{5(107)+4(53)+3(30)+2(12)+1(11)}{5(107+53+30+12+11)} = 0.818$$

7. Type of construction equipment used for work.

$$RII = \frac{5(140)+4(25)+3(22)+2(13)+1(13)}{5(140+25+22+13+13)}$$

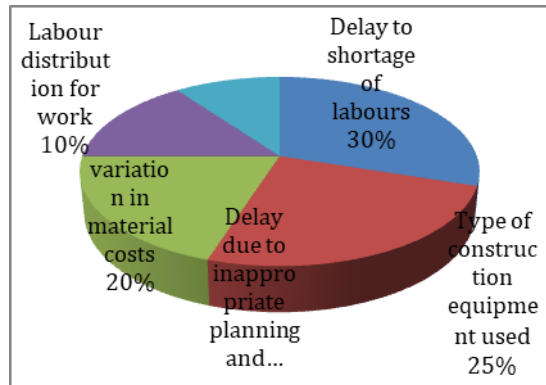
- 5(140+25+22+13+13)  
= **0.848**
8. Change in material prices.  
 $RII = \frac{5(104)+4(70)+3(23)+2(13)+1(3)}{5(104+70+23+13+3)}$   
= **0.842**
9. Late bill payments to contractor.  
 $RII = \frac{5(30)+4(31)+3(88)+2(45)+1(19)}{5(30+31+88+45+19)}$   
= **0.606**
10. Resting time for workers during work.  
 $RII = \frac{5(26)+4(47)+3(73)+2(51)+1(19)}{5(26+47+73+51+19)}$   
= **0.607**
11. Standardize construction process.  
 $RII = \frac{5(40)+4(60)+3(83)+2(16)+1(14)}{5(40+60+83+16+14)}$   
= **0.690**
12. Absence of lean culture in organization.  
 $RII = \frac{5(53)+4(97)+3(43)+2(19)+1(1)}{5(53+97+13+19+1)}$   
= **0.810**
13. Lack of long term philosophy.  
 $RII = \frac{5(53)+4(97)+3(43)+2(20)+1(0)}{5(53+97+43+20+0)}$   
= **0.770**
14. Delay due to inappropriate planning and scheduling of the project.  
 $RII = \frac{5(82)+4(89)+3(33)+2(7)+1(2)}{5(82+89+33+7+2)}$   
= **0.827**
15. Delay in project due to shortage of equipment.  
 $RII = \frac{5(30)+4(141)+3(29)+2(12)+1(1)}{5(30+141+29+12+1)}$   
= **0.774**
16. Delay due to shortage of labors.  
 $RII = \frac{5(126)+4(60)+3(16)+2(10)+1(1)}{5(126+60+16+10+1)}$   
= **0.881**
17. Delay in getting permission from government consultants.  
 $RII = \frac{5(3)+4(29)+3(8)+2(61)+1(112)}{5(3+29+8+61+112)}$   
= **0.364**
18. Delay due to weather effects on construction.  
 $RII = \frac{5(53)+4(56)+3(93)+2(7)+1(4)}{5(53+56+93+7+4)}$   
= **0.584**
- 3.1.2 Calculation of RII for overall responses of Causes of Material wastage:**
1. Poor storage of materials.  
 $RII = \frac{5(50)+4(124)+3(44)+2(21)+1(3)}{5(50+124+44+21+3)}$   
= **0.762**
2. Placing of concrete.  
 $RII = \frac{5(78)+4(62)+3(92)+2(8)+1(2)}{5(78+62+92+8+2)}$   
= **0.770**
3. Shifting of materials i.e. (bricks, cement etc)  
 $RII = \frac{5(72)+4(100)+3(41)+2(29)+1(2)}{5(72+100+41+29+2)}$   
= **0.775**
4. Poor approach for waste minimization.  
 $RII = \frac{5(71)+4(133)+3(23)+2(12)+1(3)}{5(71+133+23+12+3)}$

- $5(71+133+23+12+3)$   
 $= 0.812$
5. Cutting of steel bars  
 $RII = \frac{5(74)+4(93)+3(59)+2(6)+1(13)}{5(74+93+59+6+13)}$   
 $= 0.760$
6. Over order of concrete.  
 $RII = \frac{5(81)+4(85)+3(48)+2(24)+1(4)}{5(81+85+48+24+4)}$   
 $= 0.777$
7. Cutting of timber required for formwork whose size do not fit,  
 $RII = \frac{5(26)+4(100)+3(88)+2(20)+1(8)}{5(26+100+88+20+8)}$   
 $= 0.695$
8. Damage of material during supply.  
 $RII = \frac{5(78)+4(62)+3(92)+2(8)+1(2)}{5(78+62+92+8+2)}$   
 $= 0.770$
9. Lack of supervision or incorrect decision by management.  
 $RII = \frac{5(139)+4(80)+3(15)+2(4)+1(4)}{5(139+80+15+4+4)}$   
 $= 0.885$
10. Frequent design changes in specification.  
 $RII = \frac{5(50)+4(154)+3(28)+2(8)+1(2)}{5(50+154+28+8+2)}$   
 $= 0.800$
11. Incomplete contract document.  
 $RII = \frac{5(7)+4(83)+3(113)+2(33)+1(6)}{5(7+83+113+33+6)}$   
 $= 0.642$
12. Wrong material storage.  
 $RII = \frac{5(66)+4(100)+3(43)+2(17)+1(16)}{5(66+100+43+17+16)}$   
 $= 0.751$
13. Delay during delivery of material.  
 $RII = \frac{5(68)+4(91)+3(43)+2(32)+1(8)}{5(68+91+43+32+8)}$   
 $= 0.740$
14. Malfunction or breakdown of equipment.  
 $RII = \frac{5(28)+4(48)+3(144)+2(17)+1(5)}{5(28+48+144+17+5)}$   
 $= 0.660$
15. Scarcity of water for construction activities.  
 $RII = \frac{5(76)+4(40)+3(83)+2(41)+1(2)}{5(76+40+83+41+2)}$   
 $= 0.660$
16. Wastage due to unskilled labor.  
 $RII = \frac{5(70)+4(113)+3(53)+2(3)+1(3)}{5(70+113+53+3+3)}$   
 $= 0.801$
17. Poor site management.  
 $RII = \frac{5(127)+4(75)+3(31)+2(6)+1(3)}{5(127+75+31+6+3)}$   
 $= 0.861$
18. Long project duration.  
 $RII = \frac{5(58)+4(120)+3(44)+2(17)+1(3)}{5(58+120+44+17+3)}$   
 $= 0.734$
19. Poor co-ordinated documents.  
 $RII = \frac{5(100)+4(57)+3(33)+2(47)+1(5)}{5(100+57+33+47+5)}$   
 $= 0.765$
20. Time pressure.

$$\begin{aligned}
 RII &= \frac{5(83)+4(79)+3(43)+2(33)+1(4)}{5(83+79+43+33+4)} \\
 &= 0.768
 \end{aligned}$$

21. Poor site conditions.

$$\begin{aligned}
 RII &= \frac{5(57)+4(117)+3(43)+2(20)+1(5)}{5(57+117+43+20+5)} \\
 &= 0.768
 \end{aligned}$$



Pie Chart for Time Wastage

#### 4. RESULTS & DISCUSSIONS

##### SUMMARY OF RESULTS

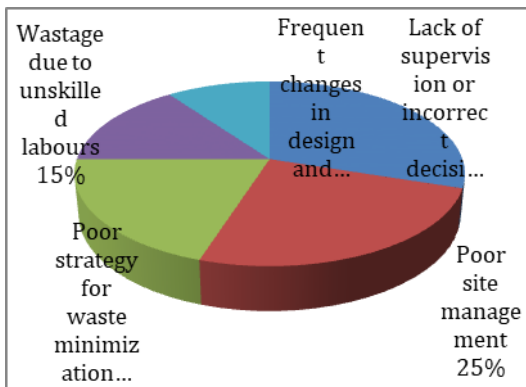
The information collected by the study and analysis can be summarized by following table 1 and 2:

**Table 1: Summary of time wastage**

Causes of time wastage	RII	Rank
1. Delay in material supply.	0.797	07
2. Inspecting and supervising time	0.732	11
3. Transportation time	0.738	10
4. Mishandling or error in construction installations.	0.550	17
5. Accidents on site.	0.724	12
6. Labor distribution for work.	0.818	05
7. Type of construction equipment used for work.	0.848	02
8. Variation in material costs.	0.842	03
9. Late bill payments to contractor.	0.606	15
10. Resting time for workers during work.	0.607	14
11. Standardize construction process.	0.690	13
12. Absence of lean culture in organization.	0.810	06
13. Lack of long term philosophy.	0.770	09
14. Delay due to inappropriate planning and scheduling of the project.	0.827	04
15. Delay in project due to shortage of equipment.	0.774	08
16. Delay due to shortage of labours.	0.881	01
17. Delay in getting permission from government consultants.	0.364	18
18. Delay due to weather effects on construction.	0.584	16

**Table 2: Summary of material wastage**

Causes of material wastage	RII	Rank
1. Poor storage of materials	0.762	11
2. Placing of concrete	0.770	08
3. Shifting of material i.e.(bricks, cement etc.)	0.775	07
4. Poor approach for waste minimization	0.813	03
05. Cutting of steel bars	0.760	12
6. Over order of concrete	0.777	06
7. Cutting of timber required for formwork whose size do not fit	0.695	16
8. Damage of material during supply	0.770	08
9. Lack of supervision or incorrect decision by management	0.885	01
10. Frequent design changes in specifications	0.800	05
11. Incomplete contract document	0.642	19
12. Wrong material storage	0.751	13
13. Delay during delivery of material	0.740	14
14. Malfunction or breakdown of equipment	0.660	17
15. Scarcity of water for construction activities	0.660	18
16. Wastage due to unskilled labours	0.801	04
17. Poor site management	0.861	02
18. Long project duration	0.734	15
19. Poor co-ordinated documents	0.765	10
20. Time pressure	0.768	08
21. Poor site conditions	0.768	08



Pie Chart for Material Wastage

## 5. CONCLUSIONS

The study of Causes and effects of Time wastage and material wastage are largely involved in the study of the construction projects for its developments and change in the schedule of daily works so that it will not disturb the project by the cost and time waste. The aim is to make the project Manager, Site engineer more clear about the reasons, effects and steps to reduce the effects of Time wastage and material wastage on the total completion of the project.

In the above study we have studied the basic of the reasons for the Time and Material Wastage and the effects. To collect the data from the well-known and experienced engineers the questionnaire was prepared and tried to understand the main problem in the Time and Material wastage while executing the projects. From all the feedback we have concluded the data with RII to identify factors affecting utmost.

- Reasons for time wastage and material wastage Inappropriate Planning and Scheduling of the Project, change in material prices, construction equipment used, Shortage of labor and improper distribution, lack of supervision, poor site management, poor waste minimization strategy, financial instability, use of unskilled labours.
- Time and material wastage can be reduced using of skilled labor, Proper site management, Proper order of materials, Production of materials
- The experts may realize the possibility of the problem of the project while executing and adopt proper measures reduce the causes of the delays (Time wastage) and material wastage in the executions.

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