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STUDY ON FACTORS INFLUENCING LABOUR PRODUCTIVITY IN RESIDENTIAL BUILDINGS IN INDIAN SCENARIO

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Abstract:

The construction sector is diverse as it contains contractors, consultants, designers, owners and others. Poor productivity of construction workers is one of the causes of cost and time overruns in construction projects. As construction is a labour-intensive industry, this paper focuses on labour productivity in the construction industry and to identify factors affecting labour productivity at building construction project. The performance of labour is affected by many factors and is usually linked to the performance of time, cost, work pressure, safety measures and quality. The questionnaires were distributed to supervisors, project Engineer, labourers, the top 35 factors were identified, categorized into 3 different groups, using SPSS tool, which is analytical software, the factors were analyzed and ranked considering relative importance index were calculated. And also calculated actual productivity for Brick Masonry is taken from sites. The result shows the factors considered which most affects the labour productivity loss in residential buildings and actual productivity versus expected productivity the brick masonry work were calculated.

Keywords: *Labour Productivity; Importance Index; Factors.*

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1. Introduction

Productivity has been generally defined as the ratio of outputs to inputs. In the construction industry, productivity is usually taken as mean labour productivity, that is, units of work placed or produced per man-hour. The inverse of labour productivity, man-hours per unit (unit rate), is also commonly used. Sunil and Sharad (2013) stated that productivity was the ratio of output to all or some of the resources used to produce that output. Construction projects are mostly labour based with basic hand tools and equipment, as labour costs comprise 30 % to 50 % of overall project cost. Prabhu and Ambika (2013) identified that human resource was an important factor

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in the development of the construction industry, Shehata and El-Gohary (2011) therefore understood the labour behaviour was very much important to improve the efficiency of production. Thomas and Sudhakumar (2014) mentioned that lack of safety, lack of skills, lack of quality of materials, lack of wages, communication barriers like that had mainly creating psychological stress to the labours. It totally affects the labour production efficiency.

Labour Productivity = Output / Work hour

Productivity is defined as the ratio of earned to actual hours. The problem with this concept is in establishing reliable norms, for setting standards. It also depends on the method used to measure productivity, and on the extent to which account is taken of all the factors which affect it.

Mohammad et al. (2016) noticed that the top three ranked dimensions were Productivity increases as experience increases, Financial incentives increase productivity, and Trust with communications between management and workers increase productivity. Isaac and Godwin (2014) concluded that when the two project locations are similar, labour management practices and productivities was not varied. It was recommended to improve labour management practices like (recruiters and engaging competent supervisors, showing concern in addressing labourer's personal problems etc.,) so that the potent productivity was improved in construction labour.

Soekiman et al. (2011) discussed the factors affecting construction labour productivity. The factors were categorized as supervision factors, material factors, execution plan factors and design factors. It was noticed that the equipment factors influenced the labour productivity when compared to other factors. Shehata and El-Gohary (2011) studied the construction labor productivity definition, aspects, issues, productivity techniques, measuring and modeling techniques. Thomas and Sudhakumar (2014) found the top five factors identified as having a significant impact on productivity: (i) timely availability of materials at the work site, (ii) delayed material delivery by the supplier, (iii) strikes called by political parties, (iv) frequent revisions of drawings/design, resulting in additional work/rework and (v) timely availability of drawings at the work site. Vignesh and Janagan (2015) studied the factors such as Lack of construction knowledge for supervisors and Non – Availability of skill training are the other reasons that affect the productivity.

2. Significance of Productivity

Enshassi et al. (2007) described that labor productivity constitutes a significant part of production input for construction projects. In the construction industry, many external and internal factors are never constant and are difficult to anticipate. This factor led to a continuous variation in labor productivity. Idiake and Bala (2008) observed that it was necessary to make sure that a reduction in productivity does not affect the plan and schedule of the work and does not cause delays. The consequences of these delays could result in serious monetary losses. Further, considerable cost can be saved if productivity is improved because the same work can be done with less manpower, thus reducing overall labor cost. The scope of the present study concentrates to improve labour productivity and to predict productivity problems. It predicts the normal production of two different sites by regression analysis.

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The main consideration for a present study is to collect reliable data through surveying to identify the various factors, affecting labour productivity. Logic-based questions were avoided because they could cause respondent frustration and increase the drop-out rate. A study was done to find any serious loopholes and if the questions were truly answerable.

This study was intended to identify the causes of probable factors affecting labor productivity in residential building construction. This study was investigated all possible factors through a structured questionnaire administered. The survey results are subjected to analysis using SPSS software, and the ranking of factors is calculated using the Relative Important Index.

3. Preparation of Questionnaire and Analysis of Result

Questions in the respondent profile were created to collect information such as job position, the experience of the respondent, the locations of the current and/or previous works and contact information. The next questions were targeting the factors affecting labor productivity in the three different groups. It included factors affecting labor productivity.

In order to facilitate the study, after the literature review and the focus interviews, a plan was formulated for collecting field information and creating an evaluation process and numerical values Ranking of the various factors according to their significance, and calculating their Relative Importance Index (RII) [1], [2]. The Relative Importance Index (RII) was used to decide various professional's opinions of the RII in construction projects. RII is

$$\boldsymbol{RII} = (\boldsymbol{\Sigma W / A}) \times \mathbf{N}$$

W is the weight given to each factor by the respondents and ranges from 1 to 4.
W ranges (1. Not applicable, 2. Does not affect it, 3. Somewhat affects it, 4. Directly affects it) × Number of respondents for each degree
A is the highest weight = 4. N is the total number of responders.

3.1. Manpower Factors Affecting Labor Productivity

Table 1 explains the ranking of the various factors in the manpower group. A lack of labor experience was ranked first in the manpower group; with an RII value of 0.787 Lack of labor experience has a great influence on productivity.

Table 1: Manpower factors

Factors	**RII**	**RANK**
Lack of experience	0.787	1
Absenteeism	0.751	2
Age	0.730	3
Misunderstanding among laborers	0.680	4
Accidents	0.650	5
Personal problems	0.610	6

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3.2. Resource Factors Affecting Labor Productivity

Table 2 presents the ranking for factors of the resource group. For example A lack of required construction material was ranked first in the resource group, with an RII of 0.780. An increase in the price of material was ranked 9th in the resource group, with an RII of 0.55. The relative important index is high for lack of material, which affects the labour productivity in a worst manner. Present scenario of shortage of river sand, lead to severe impact in labour productivity. Similarly, the other factor like lack of tools, equipment's and poor site condition also have the higher RII and its values are 0.760 and 0.751 respectively.

Table 2: Resource factors

Factors	**RII**	**RANK**
Lack of required construction material	0.780	1
Lack of required construction tools/equipment	0.760	2
Poor site condition	0.751	3
Material storage location	0.700	4
Poor access within construction site	0.680	5
Violation of safety laws	0.640	6
Quality of required work	0.610	7
Inadequate transportation facilities for workers	0.569	8
Increase in the price of the material	0.550	9
Differing site conditions from the plan	0.526	10

4. Miscellaneous Factors Affecting Labor Productivity

Figure 1 shows the ranking factors for the miscellaneous group. A shortage of water and/or power supply was ranked 5th in the miscellaneous group, with an RII of 650. Weather conditions were ranked 3rd in the miscellaneous group, with an RII 700.

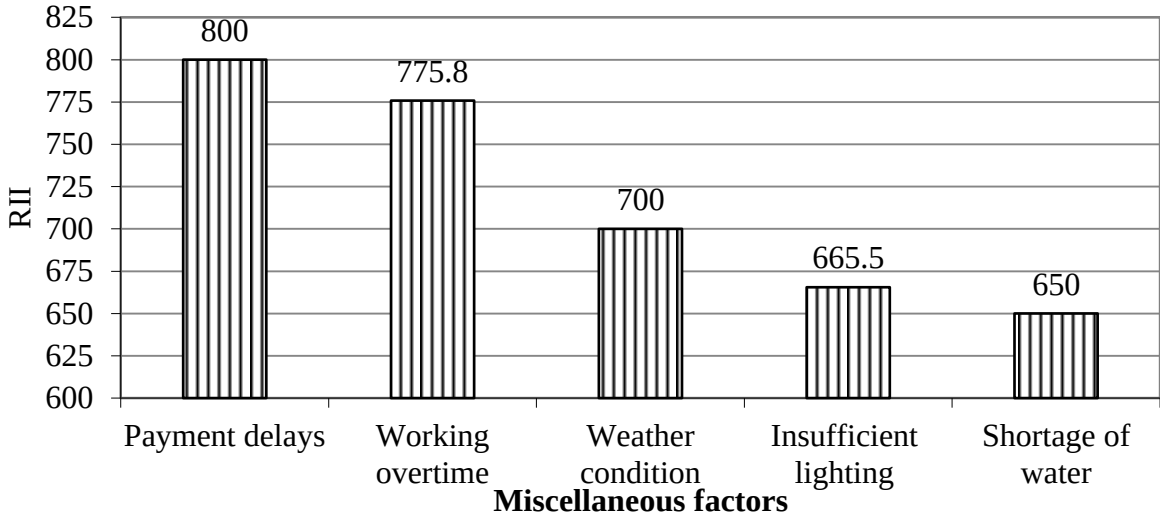

Figure 1: Miscellaneous factors

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4.1. SPSS Analysis

SPSS Statistics are software package used for statistics analysis. SPSS is among the most widely used programs for statistics analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, and others. The original SPSS manual has been described as one of "sociology's most influential books" for allowing ordinary researchers to do their own statistical analysis .In addition to statistical analysis, data management.

4.2. Frequency Statistics

The Frequencies procedure provides statistics and graphical displays that are useful for describing many types of variables. To create a table of frequencies (number of occurrences of given categories), by analyzing by means of descriptive Statistics, the frequency in the required variables would be calculated. Figure 2 shows about select the variables to be depicted in the frequency table by moving them from the left- to the right-hand box. SPSS provides the user additional options, including statistics, charts, and format.

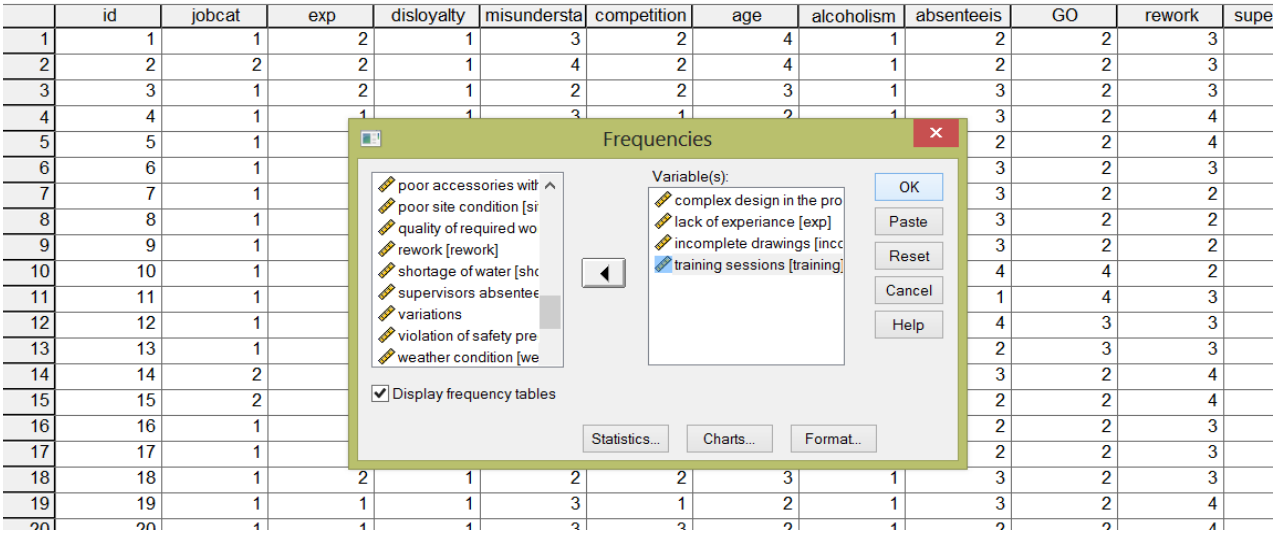

Figure 2: Creating a new SPSS window

4.3. Complex Design in the Provided Drawing

For a frequency report and a pie chart, and arrange the distinct values in ascending or descending order, or you can order the categories by their frequencies**.** The frequency report can be suppressed when a variable has many distinct. Figure 3. shows frequency pie chart with percentage of corresponding respondents given standard rating value of complex design factor with respected to the frequency table. Figure 4. shows SPSS provided a pie chart depicting these frequency results, the pie chart is displayed in the frequencies statistics percentage of weight given by respondents range from 1 to 4 for affecting the lack of experience. It is noticed that the complex design affects the project by 30 and somewhat affects by 40%. Similarly the other parameter like lack of experience of labour affects the productivity by 53%.

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4.4. Masonry Labour Productivity on Site Report

The present study involves the construction of the burnt brick masonry for the structures. The operations involved are preparation of mortar, transportation of bricks, laying of bricks, checking horizontality and verticality, spreading mortar, filling, joints with mortar and finishing. Both the structures were constructed by a local contractor by using a non-uniform work force available locally. The site staff consisted of a single project supervisor.

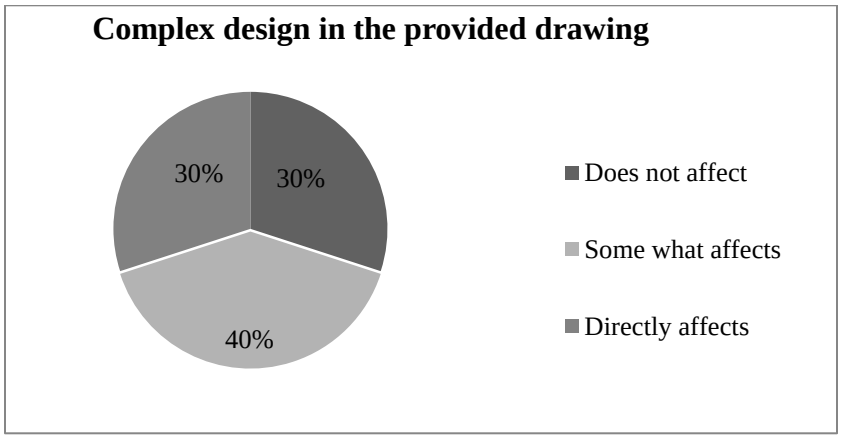

Figure 3: Complexity in design with its impact

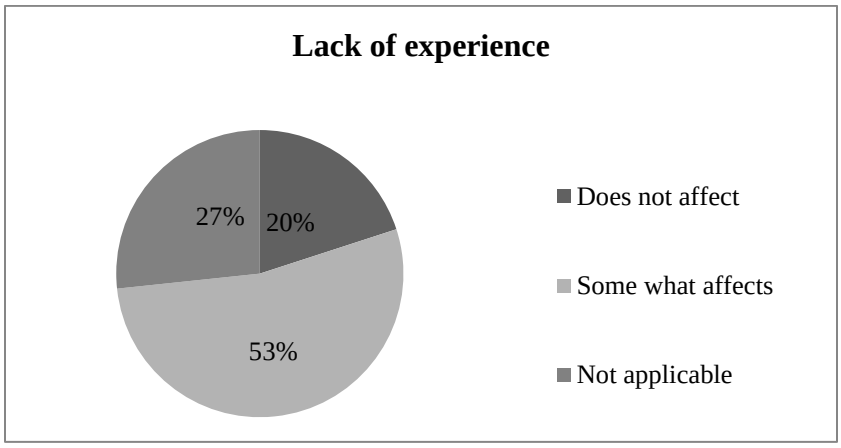

Figure 4: Lack of experience with its impact

- **Project A:** The case study project is a three storied residential-building with 12 Flats and car parking at ground floor constructed in the Kunradhur area of Chennai city, Tamil Nadu, India. The building consists of a R.C.C. frame and brick facade. The total Built up area is 557.303 Sq m. The area available for the storage of construction material was limited. For Project A, the construction of burnt brick Masonry activity lasted 20 days and required 160 work-hours.
- **Project B:** The project B is also a three- storied residential building with 12 Flats and car parking at ground floor constructed on a corner plot of ion the Kunradhur area of Chennai city, Tamil Nadu, India. The building consists of R.C.C. frame and brick facade. Total built-up area is 850 Sq m. The area available for storage of construction material is more

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as compared to Project A. The procedure used to calculate work- hour losses involve a comparison between the productivity on those days when factors affecting productivity were presented and the expected productivity had there been no factors affecting productivity presented. Table 3 shows the daily productivity and cumulative productivity it's depending upon the daily productivity on site from project B.

5. Results and Discussion

It was considered Project A, the construction of burnt brick masonry activity on 20 days and required 144 work-hours. Table 3 shows the comparison between project A & B for Masonry labour Productivity. The total working hour's loss and the percentage of ineffective days out of 20 days, which affects labour productivity were calculated. Work overran was obtained by the percentage of unused work hours to total work hour. Similarly the ineffective working days for both the projects were calculated and the values are 40% and 35% for Project A and Project B.

Table 3: Comparison between project A & B for Masonry labour Productivity

Description	**Project-A**	**Project-B**
Activity Duration (Days)	20	20
Total Work-Hours	144	158
Total Lost work-hours	11.76	9.7
Work-hour over run = (Total Lost Work-Hours)/ (Total Work-Hours)*100 (%)	(11.76/144)x100 = 8.17	(9.7/158)x100= 6.14
Percentage of Ineffective days (%)	Out of 20 days 8 days are ineffectively used. (8/20)x100 = 40	Out of 20 days 7 days are ineffectively used. (7/20)x100= 35

5.1. Comparison of Masonry Labour Productivity

Figure 5.shows the RII for resource factors. Material storage plays the major role which directly affects the productivity. Figure 6.represents the RII for other resource factors. In addition, the resource factor and its impact over he productivity is varying from place to place. The RII factors are varying from 0.78 to 0.68. However, the lack of construction material occupies the highest rank than the other resource factors.

6. Conclusion

In today's world the construction industry is rated as one of the key industry. It helps in developing and achieving the goal of society. Updating the knowledge of construction productivity are very important because they cause losses to the governing agencies and also influence the economics of the construction industry. Prior knowledge of labor productivity during construction can save money and time. Investments for these projects are very high and because of the complexity in construction, various factors can highly affect overall productivity, thus the project can end up adding even more time and money in order to be completed.

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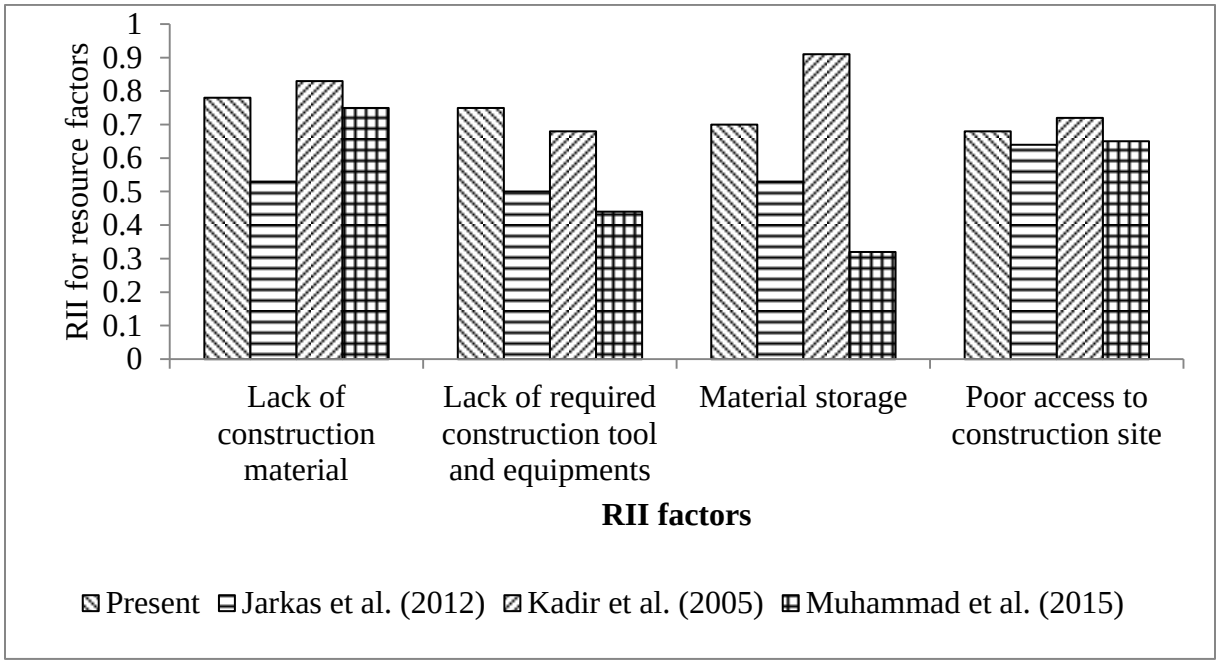

Figure 5: RII factors

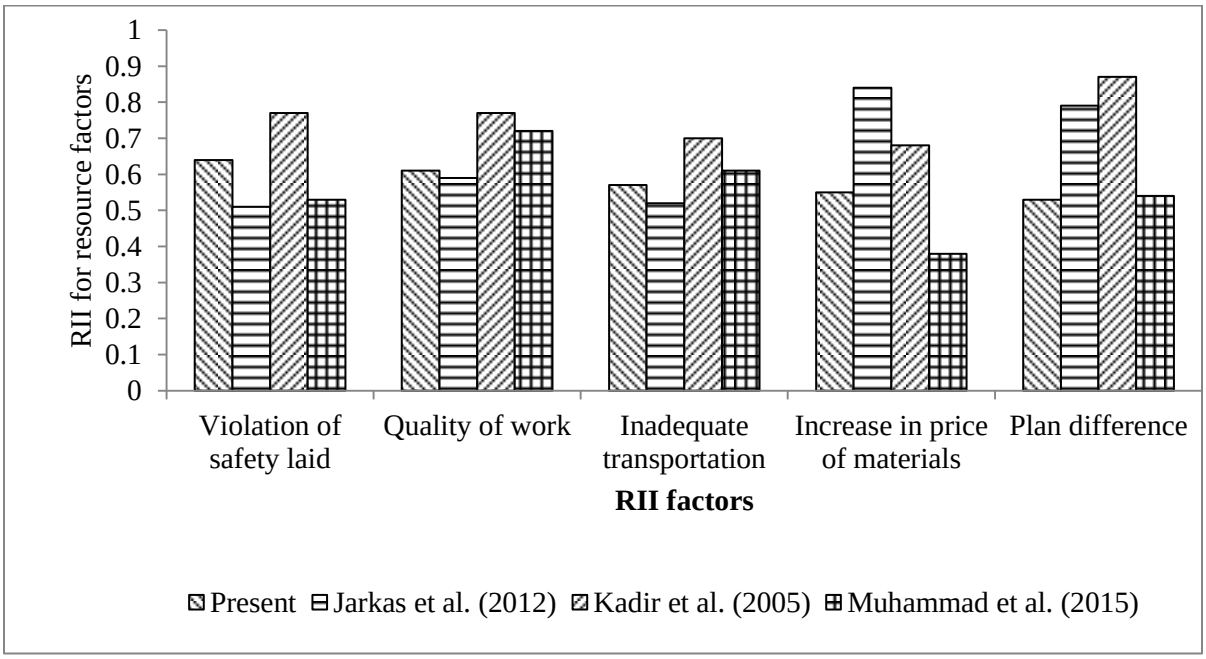

Figure 6: RII for other resource factors

The target groups in this study were residential building construction. Because project engineers, supervisor, labour have experience in residential building construction, their adequate experiences were a proper suggestion to study about the various residential building construction factors affecting labor productivity. From the current investigations, the factors affecting improvement in labour productivity, especially in brick masonry are noticed in the following reasons:

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- Exhaust of material supply, and crew were sent to another project.
- The lack of materials interrupted the normal pattern of the crew and resulted in the crew stretching the work.
- Little or no work available which slows down the work.
- Absenteeism, Lack of experience and Lack of materials
- Poor site condition
- Material storage location
- Poor access within construction site
- Violation of safety laws

Productivity of the residential buildings (Project A& Project B) was studied. Overrun in working hours were ranging from 6.14% to 8.17% out of 20 days, the percentage of ineffective days were ranging from 35% to 40%. The linear equation is obtained with a regression co-efficient of 0.94 for a masonry labour productivity. From the study it was noticed that the major factors which affects the productivity are lack of material and lack of construction tools and their RII is 780 and 760 respectively.

The labour productivity of resource factor is not always constant and uniform from place to place. The impact over the resource factors and its ranking are varying from project to project. However, material shortage, an increase in the price of materials and plan difference are the leading resource factor, which will have to higher impact on labour productivity of construction project.

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