Abstract

Construction industry is considered as one of the most important industries in India. It is well known that most construction projects in Pune Strip exposed to time overruns and material wastage or both. This phenomenon may affect the progress of construction industry in Pune Strip as well as may expose many institutions of construction to be destroyed. Literatures of previous studies were classified into two main parts which are: (a) Factors influencing time overruns of project; (b) Factors influencing material wastage. Most related researches were revised which included the study of these factors in many countries. The aim of this paper is to assess factors influencing time overruns and material wastages on construction projects in Pune Strip. This study was carried out based on literature review and a questionnaire survey that was obtained from contracting...
companies, consultants and owners in Pune Strip. The study clarified that “late in revising and approving design documents “was the most critical factor that influences project duration. The survey indicates that "material-related factors “occupied the second rank in importance. "The lack of materials in market" and "delay in material delivery to the site” is also the most important factors affecting project duration. Building materials are any materials which used for construction purposes. It is an important input into the site production process which will affect the construction projects finish in the time specified with the required specification. Any attempt to quantify the materials in terms of costs would come to the realization that they contribute a significant proportion towards the total construction costs. The material wastage occurs at all stages of building process starting from the design stage until the handover of the projects and there are many factors contribute to the generation of material wastage no matter direct or indirect wastage. The factors which cause the material wastage in a project were identified in four major sources such as in design, procurement, material handling, and operational. Due to the building materials contribute a significant proportion towards the total construction costs and consist of various types of material in different quantity, thus the building materials must be controlled and the material wastage must be prevented. The study recommends to owners, contractors and consultants to hold their responsibilities to avoid any delay or material wastage which could be achieved by good management and finding new methods for storing needed materials from the beginning of the project. The study also recommends to the government to adopt laws through Indian Legislative Council to prevent materials monopoly.

1. Introduction

The construction industry is one of the industries through which physical development of nation is achieved. It is truly the locomotive of the national economy. The more resources, engineering, labour, materials, equipment, and market exchange are provided through this industry to the national economy. The increasing complexity of infrastructure projects and the environment within which they are executing, demands construction managers to deliver projects on time, within the planned budget and with high quality (Enshassi et al 2003). Since 1993, the year when Oslo Peace Accords have been signed in Norway, Palestinian occupied territories have undergone a rapid pace of reconstruction of infrastructure which had been demolished through thirty years of occupation. In spite of lack of resources and technologies, hundreds of infrastructure, residential, and governmental projects were implemented (MAP Overview 2002).

The successful execution of construction projects and keeping them within estimated cost and prescribed schedule depends on a methodology that requires sound engineering judgment. To the dislike of owners, contractors and consultants, however, many projects experience extensive delays and thereby exceed initial time and cost estimates. This problem is more evident in the traditional or adversarial type of contracts in which the contract is awarded to the lowest bidder- the awarding strategy of the majority of public projects in developing countries including Pune Strip.
Although the construction industry in the Middle East has suffered ever since the Gulf war, recent events in the region coupled with the restructuring of economies, joining regional and global free trade organizations, and attracting foreign investments are expected to yield an unprecedented growth in the construction activities (Odeh and Battaineh 2002). Therefore, improving construction efficiency by means of timeliness would certainly contribute to cost savings for the country as a whole. Efforts directed to time effectiveness were associated with managing time and materials, which in this study were approached via investigating time and material wastages of construction projects unlike the developed countries, India does not have a mature construction industry consisting of well-established contracting and consulting companies. Much of the building and construction is done by the informal sector. This consists of individuals building family shelters, water wells and the like. The formal sector consists of public and private domestic contractors (Enshassi et al 2003).

2. Problems Related To Construction Industry In Pune Strip

One of the main objectives and policies of any public or private sectors dealing with the execution of projects is to upgrade projects performance, through reduction of costs, completion of projects within their assigned budget and time constraints, and improve quality. Construction industry in Pune Strip is suffering from many problems which affect time, cost and quality these factors related to economic situations and techniques used in Pune Strip, these problems are summarized as following:

i.) Large number of workers in comparison to the number of projects (the large number of unemployed labour in Pune Strip);

ii.) Shortage of materials in markets;

iii.) Dependency on other states in getting construction materials;

iv.) Continued increase in material prices;

v.) Dependency on donor states to get the fund of implemented projects in Pune Strip;

vi.) Unstable economic situation and its correlation with Weather;

3. Research Methodology

i.) Questionnaire Approach

A questionnaire was developed to assess the perceptions of owners, consultants, and contractors due to the importance index of causes and effects of delay in Pune Strip construction industry. Factors influencing time and material wastages in construction projects in Pune Strip were first examined and identified through a relevant literature review and by conducting a pilot study that sought advice from experienced construction practitioners.

ii.) Case Studies

Some case studies were carefully selected and investigated. These cases discussed in-depth information regarding the causes of time and material wastages at construction projects in Pune Strip, also to check the procedures and actions taken by contractors, owners and consultants. Each case will be analyzed separating of others; the case will illustrate the link between the data collected by questionnaire and data in case, recommendations will be documented for each case.

4. Results and discussion

This section describes the results and discussion of questionnaire survey concerning time overruns and material wastages from contractors, consultants and owner viewpoints in Pune Strip. This
chapter focuses on describing the respondent’s characteristics in addition to the discussion of the factors that influence time overruns and material wastages.

Part A: Respondent’s Profile

This part mainly designed to provide general information about the respondents in terms of the name of organization, major type of work involved, position and experience contact person, location of organization, average of projects executed per year and the number of constant employees at the organization.

Type of Respondents Organization

In this study, 53.00 % contractors, 25.00 % owners, 22.00 % consultants participated in the questionnaire as shown in Figure 1. The general response rate for contractors, owners and consultants was 82.11 %. The response rate of contractors was 82.50 % for the owner 81.58 % and 81.82 % for consultants.

![Figure 1: Type of Respondent's Organization](image)

![Figure 2: Type of Projects are currently Undertaking](image)
From the questionnaire survey results gathered from the construction industry, the majority type of projects are currently undertaking by respondents is high rise buildings which is 40%. Following by 32% of the respondents are currently handled the bungalow, 15% of the respondents currently handled the shop lots projects, and 6% of the respondents currently handled the factory or warehouse projects. Following by 4% of the respondents currently handled the hospital projects, 3% of the respondents currently handled the school building project.

**Respondents Designation**

Figure shows that 51.52% of contracting company respondents was site engineers, 31.82% were projects managers, 9.09% were the owners of organization and 7.58% were office engineers. It has been founded that 51.61% of owner’s respondents were site engineers, 29.03% were projects managers, 16.13% were office engineers and 3.23% was the owner of organization. It has been founded that 44.44% of the consultant’s company respondents were projects managers, 37.04% were site engineers, 11.11% were office engineer and 7.41% of respondents were the owners of organization.

![Figure 3: Respondents designation](image.png)

**Part B: Experience of Respondents**

Table shows that 37.1% of the respondents firm have experience between 5 to 10 years at construction works and the same percentage of respondents who have experience more than 10 years, 15.3% of respondents have experience from 3 to 5 years, and 10.5% have experience from one to three years.

<table>
<thead>
<tr>
<th>Experience of respondents</th>
<th>Contractor</th>
<th>Owner</th>
<th>Consultants</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 Yrs</td>
<td>13.60%</td>
<td>6.50%</td>
<td>7.40%</td>
<td>10.50%</td>
</tr>
<tr>
<td>3-5 Yrs</td>
<td>10.60%</td>
<td>29.00%</td>
<td>11.10%</td>
<td>15.30%</td>
</tr>
<tr>
<td>5-10 Yrs</td>
<td>44.00%</td>
<td>32.25%</td>
<td>25.90%</td>
<td>37.10%</td>
</tr>
<tr>
<td>&gt;10 Yrs</td>
<td>31.80%</td>
<td>32.25%</td>
<td>55.60%</td>
<td>37.10%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Respondent’s Nature of Business:
As illustrated in Figure most of the respondents are working for contractor firm which is 39%. Following respondents are come from consultancy firms where 21% of the respondents are working for quantity surveying firm, and 18% of the respondents are working for developer firm. Following respondents are working for engineering firm which is 18% and 9% of the respondents are come from sub-contractor firm.

Figure 4: Respondent’s Nature of Business

Figure 5: Number of Projects has been involved in the Past 5 Years
Figure 5 shows that the total numbers of projects have been involved by respondents' company. From the questionnaire survey results gathered from the construction industry, 36.4% of the respondents have the opinions that their respective company has been involved more than 25 numbers of projects in the past 5 years. Following by 27.3% of respondents have the opinions that their respective companies in the past 5 years have been involved not more than 5 numbers of projects. Following by 18.2% of respondents have the opinions that their respective companies in the past 5 years have been involved 5 to 10 numbers of projects. Lastly, the 18.2% of respondents have the opinions that their respective company has been involved 11 to 25 numbers of projects in the past 5 years.

Table shows that the respondents contractors ranked the "poor site safety" (I.I = 53.41 %) as the last factor because there are poor culture of safety importance for contractors. Any incident of the site will automatically cause delay, till now the contractors of Pune Strip didn't realize the great importance of maintaining the safety in site.

5. Findings
The top ten factors that cause time overruns as perceived by contractors are: "lack of materials in markets " in the 1st position, "shortage of construction materials at site" in the 2nd position, "delay of material delivery to site" in the 3rd position, "money problem during construction" in the 4th position, "ineffective planning and scheduling of project" in the 5th position, “effects of subsurface and ground conditions” in the 6th position, "poor site management" in the 7th position, "delay of materials approval by consultant” in the 8th position, "shortage of site workers" in the 9th position and “waiting time for approval of tests and poor inspection” in the 10th position
The top ten factors that cause time overruns as perceived by consultants are: "money problem during construction" in the 1st position, "ineffective planning and scheduling of project” in the 2nd position, "poor site management” the 3rd position, "delay of material delivery to site" in the 4th position, "insufficient number of staffs” in the 5th position, "no adherence with materials standards that is storage in the site" in the 6th position, "inadequate contractor’s work experience” in the 7th position, "suspension of work by owner or contractor” in the 8th position, "unethical behavior used by contractors to achieve the highest possible level of profit” in the 9th position and “discrepancies between contract documents” in the 10th position.

The types of material wastage have been successfully identified. The types of material wastage determined are shown according to the top three frequency of material wastage:

i. Timber, (41%) – Can be easily cut and shaped but low in durability and reusability, easily warp and defective when exposed to weather;

ii. Steel, (31%) – Easily corroded and improper cutting of steel bars;

iii. Concrete, (18%) – Excessive ordering by inexperience site personnel and poor workmanship during concreting.
The causes of construction waste have been successfully identified. The causes of construction waste identified are shown according to the top three frequency of material wastage:

i. Faulty Workmanship, (Importance Index: 76.36) – Inexperience of the workers during carry out the works and human mistake during reading the construction drawing;

ii. Design Changes, (Importance Index: 73.33) – Possibilities of miscommunication between the design consultants cause miss out in design. Changes of the design made by client and the designer while construction period may cause the previous work done has to be aborted and also resulted huge of material wastage;

iii. Inappropriate Storage, (Importance Index: 69.09) – Raw materials stored in unsuitable places with high moisture, on soft soil and other conditions which causes deterioration of materials.

iv. Communication Problems, (Importance Index: 67.27) – There are communication problems between consultants and contractors or between workers, resulted in material wastage.

v. Unfriendly attitudes of project participants, (Importance Index: 66.67) – the working nature between project participants is not feasible to sustain the working environment which result in material wastage.

vi. Lack of information in the drawings, (Importance Index: 64.24) –lack of materials due to inappropriate information about the drawings.

vii. Poor quality of material, (Importance Index: 61.21) – due to poor quality of material excess raw material is required.

viii. Damage during Transportation, (Importance Index: 61.21) –damage during transportation occurs due to improper planning during unloading of materials

ix. Weather Problems, (Importance Index: 59.39) – the quality of material gets affected such as corrosion of steel, decomposition of wood etc.

x. Ordering errors, (Importance Index: 56.97) – due to improper planning, ordered quantity of material may be excess or lacking.

It is recommended that the existing material management approach in use should be improved so as to prevent shortage of materials on site or the non-availability of material as and when required on site and this can be achieved if:

I. The site manager or project manager prepare and monitor material schedule on all projects.

II. The site manager makes it compulsory for the store keeper to record the use and inventory of material on daily basis during the construction process, to enable him or her alert or inform the necessary authority if there is shortage of any material, for prompt ordering.

III. Most sites should employ personnel to secure the material on site during the day and at night to ensure that all materials are protected from theft or pilfering.

IV. Construction companies should make use of more than one material management technique on construction projects so as to reduce the variation in scheduled completion time

6. References

