

# Effective Implementation on JIT for Material Management in Construction Industry in India

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**ABSTRACT:** Just in time philosophy has lot of Potential for managing movement of construction material from manufacturing yard to construction site. The traditional approach to material delivery has been used in construction industry for many years. It is imbedded in the corporate structure as the way to procure materials. Major Construction Industries have been trying to adopt new business initiatives in order to stay alive in the new competitive market place. Companies must strive to create high quality, and Low cost products that can get to the customers in the shortest time possible. Just-in-time production system is one of these initiatives that focus on cost reduction by eliminating non-value added activities. This Report Deals with Implementing Just in Time Inventory Control Approach on Road Construction. To be more responsive to customers, Better communication among departments and suppliers, more flexible and to achieve better quality results with low cost. Increasing the organization's ability to compete with others and remain competitive over the long run. The Competitiveness of the firms is increased by the use of JIT process as they can develop a more optimal process for their firms. To Increase efficiency within the construction process. Efficiency is obtained through the increase of productivity and decrease of cost. Major Construction Industries have been trying to adopt new business initiatives in order to stay alive in the new competitive market place. Companies must strive to create high quality, and Low cost products that can get to the customers in the shortest time possible. Just-in-time production system is one of these initiatives that focus on cost reduction by eliminating non-value added activities. This Report Deals with Implementing Just in Time Inventory Control Approach on Road Construction. JIT has Tremendous Effect on Material Delivery Operation. During Implementation of JIT Organization is required, to put desired efforts on all levels of the work. In this project proposed system is compare with conventional approach of Road Construction through Case study (**SP Construction Karvenagar Pune**).

**KEYWORDS:** Just In Time, Cost Reduction, None value added activity.

## I. INTRODUCTION

### 1.1 General

India is a developing country and construction industry plays a vital role in its economy. The competition in this field is at its peak. The construction environment has changed drastically over the span of last three decades. All the departments in construction industry also need to cope up with the change.

### 1.2 Motivation

JIT emphasizes on quality, which is essential for a JIT system. The defects not only produce construction waste but they can also grind the construction process to a halt. Since there is no inventory to cover up for mistakes, perfect quality is required by a JIT system. A JIT system is designed to expose errors and get them corrected rather than covering them up with inventory.



Sr. No	Traditional	JIT
1	Higher Quality is Expensive.	Higher quality save money and increase profit.
2	Some defects are acceptable.	No defects acceptable.
2	Buy from lowest bidder.	Buy quality and reliability.
3	Separate Inspection Department.	Build inspection into each phase of production.
4	Quality control department is responsible for insuring quality.	Everyone is responsible for quality.
5	Quality Engineering department is Responsible for Solving quality problems.	Everyone is Responsible for Solving quality problems.

### 1.3 Background

Increasing Global competition has forced the Construction Industries to look for some new techniques to face the challenges in Construction Industry. During last two or three decades, all over the world construction environment has experienced more changes, particularly, the construction environment has become prominent factor in creating the value added contents for the products and service. [4] The conventional approach to material delivery used in construction projects for many years. The approach created lot of problem to construction industry.

### 1.4 Problem Statements

The Just in Time philosophy has a lot of potential for material management system is being implemented in construction industry worldwide. To increase the base of application of JIT over conventional approach of material management in Indian Construction Industry, It is crucial to demonstrate the usefulness of JIT. Also the barriers during implementation should be suggestive measures to eliminate them are required to be presented.

### 1.5 Objectives

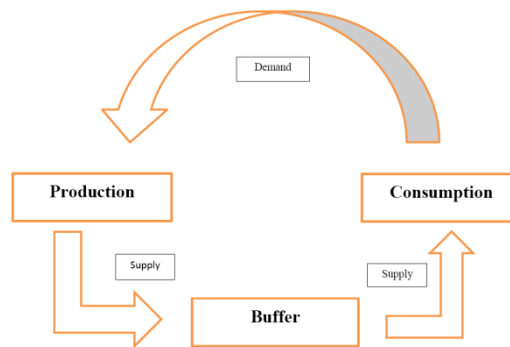
- 1 To understand the detail philosophy of JIT for Construction Industry in India.
- 2 To be more responsive to customers, Better communication among departments and suppliers, more flexible and to achieve better quality results with low cost.
- 3 Increasing the organization's ability to compete with others and remain competitive over the long run. The Competitiveness of the firms is increased by the use of JIT process as they can develop a more optimal process for their firms.
- 4 To Increase efficiency within the construction process. Efficiency is obtained through the increase of productivity and decrease of cost.
- 5 To reduce wasted materials, time and effort. It can help to reduce the costs.
- 6 To develop a reliable relationship between the suppliers. A good and long-term relationship between organization and its suppliers helps to manage a more efficient process in inventory management using JIT.

### 1.6 Scope of the Project

1. JIT requires visit set ups, shipments and receipts.
2. The JIT framework must work effectively and worker must carry out their activity right.
3. JIT depends on participation and trust between individuals, specialists, supervisors, providers, clients and so on.
4. The idea of JIT must be seen completely in a similar importance by all concerned and after that endeavor usage.

### 1.7 Concept of JIT

Just in Time (JIT) production is a manufacturing philosophy which increases speed of production. JIT Concept is, "Company produces only what is needed, when it is needed and in the quantity that is needed". The company produces only what the customer requests, to actual orders, not to forecast. JIT can also be defined as producing the necessary units, with the required quality, in the necessary quantities, at the last safe moment. It means that company can manage with their own resources and allocate them very easily.



**Fig No1: Shows JIT Concept Various Steps in Implementation of JIT**

Source identification: Just in Time means produce right quantity of material at right time. Not before or after the work. Large company has their own source but small construction industry is facing problems in material management. Vendor analysis: vendor is a organization who supplies material to company. Vendor may be single or more it's depending upon company.

## II. LITERATURE SURVEY

**Mohd Arif Marhani et al.** Lean construction (LC) is excellent in managing the construction process and achieving the project goals by eliminating waste. The objectives of this report are to provide with fundamental knowledge of LC and highlight the barriers of its implementation. The literature reviews has been conducted through relevant databases. It was found that there is a need for more holistic approaches to be adopted in LC implementation such as health and safety, and six sigma.

**D.T. Matt et al.** While in the automotive or aerospace industry the use of automation technology and processes and the application of lean manufacturing methods are common nowadays, the construction industry is lagging behind these developments. In this context, with the help of value stream design, largely known in mass production but recently also in variant intensive manufacturing.

**N.B. Kasim et al.** A key factor adversely affecting project performance is the improper handling and management of materials on site. Materials management is particularly problematic on fast-track projects where design and procurement decisions are made concurrently with construction activities. This report reports on the early stages of research which is developing a new ICT-based approach to managing materials on fast-track schemes.

**Usama Hamed Issa et al.** The construction projects involve various risk factors which have various impacts on time objective that may lead to time-overrun. This study suggests and applies a new technique for minimizing risk factors effect on time using lean construction principles. The lean construction is implemented in this study using the last planner system through execution of an industrial project in Egypt. Evaluating the effect of using the new tool is described in terms of two measurements: Percent Expected Time-overrun (PET) and Percent Plan Completed (PPC).

**Glenn Ballard et al.** The acronym JIT has been highly visible since the late 1980's, as manufacturing attempted to meet competitive challenges by adopting newly emerging management theories and techniques, referred to by some as Lean Production (1). What is JIT? What is its relevance for the development and implementation of Lean Construction theory and practice (2)? Manufacturing JIT is a method of pulling work forward from one process to the next "just-in-time"; i.e. when the successor process needs it, ultimately producing throughput. One benefit of manufacturing JIT is reducing work-in-process inventory, and thus working capital.

**M. Muya1 et al.** Materials supply logistics plays a significant part in meeting the project delivery goals of cost, quality and time. Customer service is the key element that holds together all supply logistics activities, thus, the effectiveness in selecting suppliers should begin with evaluating characteristics that are deemed necessary for a supplier to provide a pre-requisite level of customer service. Such factors, or enablers, provide indications as to whether a given supplier will be able to meet key materials delivery objectives.

**Ricardo Antunes et al.** The building construction industry faces challenges, such as increasing project complexity and scope requirements, but shorter deadlines. Additionally, economic uncertainty and rising business competition with a subsequent decrease in profit margins for the industry demands the development of new approaches to construction management. However, the building construction sector relies on practices based on intuition and experience, overlooking the dynamics of its production system. Furthermore, researchers maintain that the construction industry has no history of the application of mathematical approaches to model and manage production.

**SVEN BERTELSEN et al.** normally building materials are transported to the building site as a part of the purchase, and the price quoted is 'as delivered in whole truckloads'. This tempts the purchase organization to save a few cents, which are easily lost by an unsuitably form of delivery. Studies of logistics show that a substantial increase in productivity can be obtained by delivering building materials on conditions laid down by the construction site, i.e 'just in time' and 'packed for the work process'. The additional cost by this approach can easily be covered by the savings gained on the construction site.

### III. RESEARCH METHODOLOGY

#### 3.1 Application of JIT in Construction Industry

Much had been discussed on raising the productivity level of the construction industry which consistently lagged behind other sectors of the economy. The use of buildable designs was singled out as a means to improve productivity.

#### 3.2 Factors That Influence Housing Developers to use JIT concept in Construction Industry

The successful implementation of JIT is dependent on the suppliers' flexibility, users' stability, total management and employee commitment as well as teamwork. Through the elimination of waste, JIT aims to improve product quality and productivity.

##### (a) Elimination of waste

The fundamental philosophy of JIT is to eliminate waste and under the JIT concept, construction waste can be classified into the following categories:

1. Waste from over-production
2. Waste from delays
3. Waste from transportation
4. Waste from unnecessary processing
5. Waste from excess inventory
6. Waste from unnecessary motion
7. Waste from defects.

##### 3.2.1 Types of Construction Buffers

There are two types of inventories that can serve the function of buffering downstream construction processes from flow variation. The most familiar type is piles of stuff; materials, tools, equipment, manpower, etc.

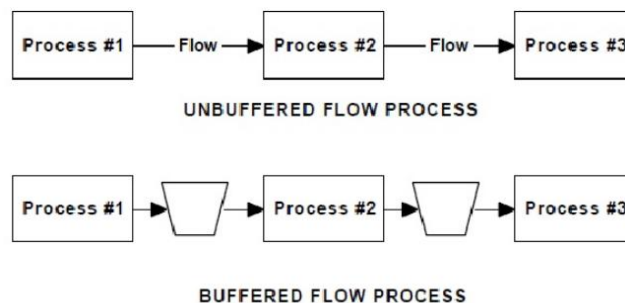


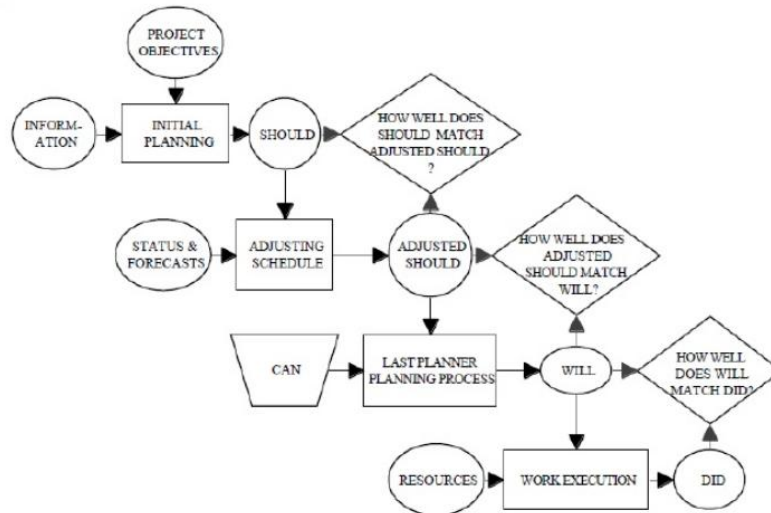
Figure2. Construction Buffers

##### 3.2.2 Functions of Schedule Buffers

In the construction of process plants (petroleum, chemical, food processing, pulp and paper, etc.), projects are frequently fast track; i.e. construction begins before design is completed.

**3.2.3 Functions of Plan Buffers**

Schedule buffers do not replace plan buffers. Plan buffers are necessary even when schedule buffers are in place because having a pile of pipe does not provide piping crew with workable assignments. Pipe spools must match with valves, controls, hangers, etc. Structures for supporting the pipe must be in place.



**Figure3. Functions of Plan Buffers**

**(b) The Kanban or Pull System**

Methods of production can generally be organized in two ways, namely the pull and the push system. In the pull system, organizations produce on demand whereas in the push system, organizations forecast the demand or maintain stock level.

**(c) Uninterrupted workflow**

Uninterrupted workflow means that the schedule for the final assembly must be smooth flowing. Hence, rationalization and simplification of the production processes necessary. Every process should be reduced to its simplest form before considering mechanization or automation and the aim is to replace a complex and expensive process with one that is simple and cheap.

**(d) Total Quality Control (TQC)**

In order to achieve zero inventories, errors and defective components must be eliminated in each task. Under TQC, all workers are responsible for ensuring that their work is defect-free before proceeding to the next stage of operation.

**(e) Employee involvement**

As noted earlier, the success of JIT implementation is dependent to a great extent on the teamwork and commitment of every employee. Each employee should be given adequate training and responsibilities in various areas like timeliness of production and quality assurance. Employees should be able to set up and maintain various type of machinery. Involvement can be extended to suggestion schemes and participation in quality improvement teams.

**(f) Supplier relations**

Building a good supplier-user relation is no longer a choice but a necessity. The quality of the supplies purchased is a critical factor to the quality of an organization’s finished products. Hence, an organization must treat supplier’s long-term business partners so that the quality of materials delivered will always is maintained at a high standard. This would greatly reduce paperwork, inventory levels and storage space.

**(g) Continuous improvement**

An organization should not remain content with its status quo. To maintain its competitiveness, it should continuously strive to improve operations and the ways in which activities are carried out. Audits and benchmarking are some of the tools which an organization can adopt to ensure that its operations are improved continuously.

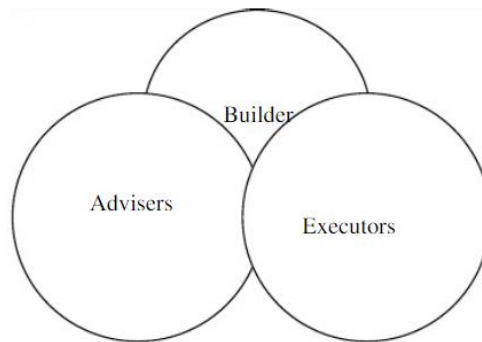
### 3.3 Challenges in Implementing JIT in Construction

In reality the application of JIT on construction differs from manufacturing industry due to its characteristic. The different characteristics exist for the both industries are in context of different types of production, and because of the greater complexity and uncertainty of construction. There are several reasons why the construction industry becomes uncertain and complex.

### 3.4 Problem Areas in Construction Industry

From the presentation paper by Veiseth, Rostad and Andersen (2003) the actors that they have interviewed have identified several problem-areas. In this paper we will focus on three of them:

- The problems in the interface between the builder, the advisers and the executors. This problem is often referred to as “early phase- problems” that emphasize the whole project.
- Logistics problems for building materials and other products used during the construction process.
- Problems in the construction project planning and management.



**Figure4: Problem area; the interface between the builder, the advisers and the executors**

In their opinion they interfaces are of a special interest because much of the premises for the ensuing productivity and logistics are created here.

## IV. RESULT AND DISCUSSION (CASE STUDY)

### 4.1 Introduction about company:

Place: Karvenagar Pune.

Type of work: Road Construction

Type of Road: Black Top Road (Flexible Pavement)

Length of Road: 3KM and Cost of Project: 7Cr.

Name of Company: SP Construction Pune

State-Maharashtra, Dist.-Pune, Country-India

Name of in charge: Mr. PankajMarathe.

### 4.2 JIT Implementation Process:

One of the major objectives in implementing a JIT System is to achieve a common goal of the whole company. First step is identification of material delivery problem in company and provide solution to company.

#### ABC Analysis:

A class items required tight inventory control, A class tem have high consumption value. Special care must be taken because consumption value is high and Wastage Creates more economical loss to the company.



Table No 1: Shows ABC Analysis

Item	Cost	Annual consumption	Total cost	% Cum	Category
GSB	1039.80	32445	3,37,36,311	23.66	A
BM	5399.70	5775	3,11,83,267.5	45.54	A
WMM I&II LAYER	1117.50	26460	2,95,69,050	66.28	A
MURUM	362	71820	2,59,98,840	84.52	B
SDBC	7639.60	2887.5	2,20,59,345	100.00	C
<b>TOTAL COST</b>			<b>14,25,46,813.5</b>		

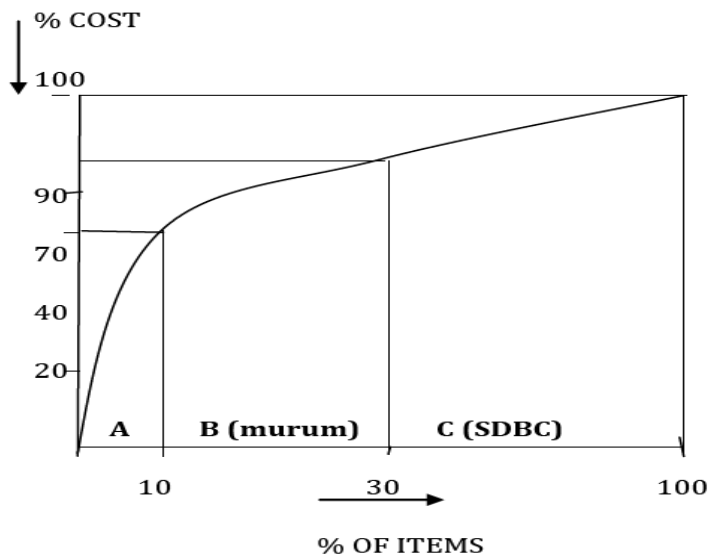


Figure5: Shows ABC Analysis Graph

### 4.3 Equipment productivity calculation

#### I. Hindustan front end loader Production

$$\begin{aligned} \text{Loader Output} &= \frac{3600 * Q * F * E * V.C.}{T} \\ &= \frac{3600 * 3.1 * 0.95 * 0.85 * 1}{86} = 104.78 \text{ m}^3/\text{hr} \end{aligned}$$

#### II. Tipper Production

$$\begin{aligned} \text{No. of bucket loads} &= \frac{\text{Tipper volume}}{\text{bucket volume} * \text{Fil factor}} \\ &= \frac{13.44}{3.1 * 0.95} = 4.56 \sim 5 \text{ buckets} \end{aligned}$$

Loading time = Loader cycle time X No of Buckets = 86 X 5 = 430 sec = 7.16 min

Cycle time = Loading Time = 7.16 min



+ Haul Time = 31 min  
 +Dump Time = 2 min  
 +Return Time = 18.84 min

Cycle Time = 59 min

$$\text{Output} = \frac{\text{Tipper volume} \times 60}{\text{Tipper cycle time}} = \frac{13.44 \times 60}{59} = 13.40 * e = 13.40 * 0.76 = 10.38 \text{m}^3/\text{hr}$$

**III. Grader**

$$= \frac{\text{no of passes} \times \text{distance}}{\text{Speed} \times \text{efficiency}}$$

$$= \frac{6 \times 0.385 (\text{mile})}{2.3 \times 0.84}$$

=1 hour =34 cum

**IV. Paver:**

$$= \frac{\text{Quantity} \times 60}{\text{Time}}$$

$$= \frac{13.44 \times 60}{22.4}$$

=36 cum

**Table No: 2 Shows Equipment Productivity Calculation**

EQUIPMENT	EFFICIENCY	EQUIPMENT PRODUCTIVITY	Capacity of Tipper
Volvo-930(Grader)	84.33%	34	
Paver	84.33%	36	
Hywa-1	63.85%	8.44	13.44
Hywa-2	60.24%	8.04	13.44
Hywa-3	84.33%	11.25	13.44
Hywa-5	63.85%	8.46	13.44
Hywa-6	87.95%	11.65	13.44
Hywa-7	87.95%	11.65	13.44
Hywa-8	87.95%	11.65	13.44
Hywa-9	60.24%	8.04	13.44
Hywa-10	51.80%	6.83	13.44

**4.4 Monthly Consumption of each item**

Total monthly target= 3.5 km

GSB required for 1 km = 660 cum. (lxbxh)

For 3.5 km G.S.B required = 3.5x660=2310 cum.

WMM required for 1 km=979 cum.

For3.5kmWMM Required=979X3.5=3426.5

BM required for 1 km=297 cum.

For 3.5 km WMM Required=297X3.5=1039.5 cum





**4.5. Economic Analysis between Conventional Method and JIT Method**

**1. JIT Method Cost**

**Table No: 3 Shows Material Consumption cost**

item	Quantity (cum)	Cost per (cum)	Total cost
GSB	2310	1039.80	24,01,938
WMM	3426.5	1117.50	38,29,113.75
BM	1039.5	5399.70	56,12,988.15
Total cost=			1,18,44,039.5

**Table No: 4 Equipment cost**

Type of item	Type of equipment	Cost per hour/day	Total cost
GSB	GRADER	1500	1,05,000
WMM	GRADER	1500	1,26,000
BM	PAVER	1500	42,000
ALL 3 MATERIAL	HYWA	4000(PER DAY)	4,16,000
TOTAL COST=			6,89,000

**2. Conventional Method Cost**

**Table No: 5 Shows Material Consumption cost**

item	Quantity (cum)	Cost per (cum)	Total cost
GSB	2310	1039.80	24,01,938
WMM	3426.5	1117.50	38,29,113.75
BM	1039.5	5399.70	56,12,988.15
Total cost=			1,18,44,039.5

**Table No: 6 Shows Equipment cost**

Type of item	Type of equipment	Cost per hour/day	Total cost
GSB	GRADER	1500	1,89,000
WMM	GRADER	1500	2,31,000
BM	PAVER	1500	73500
ALL 3 MATERIAL	HYWA	4000(PER DAY)	920000
TOTAL COST=			14,13,500

- **JIT Method Total Cost for 3.5 km required =**

$1, 18, 44,039.5+6, 89,000 = 1, 25, 33039.5$

- **Conventional Method Cost saving by using just in time method=**

$1, 18, 44,039.5+14, 13,500 =1, 32, 57,539.5$

**Total Cost Saving BY using JIIT method is**

$1.32, 57,539.5-1, 25, 33,039.5=724500$

**To complete 3.5 km target per month:**

Conventional method requires 47 days and for just in time it requires 26 days.



4.6 MONTHLY MATERIAL PROCUREMENT PLAN

Table No: 7 Shows Material Procurement Plan (3.5Km)

Name Of Item	Quantity of Item (CUM)	Month	Vendor name	Equipment required
GSB	231	June	Paranjape company	HYWA-6 13.44(CAPACITY ALL)
GSB	231	June	Paranjape company	HYWA-6
GSB	231	June	Paranjape company	HYWA-6
GSB	231	June	Paranjape company	HYWA-6
GSB	231	June	Paranjape company	HYWA-6
WMM	285.54	June	Paranjape company	HYWA-6
WMM	285.54	June	Paranjape company	HYWA-6
WMM	285.54	June	Paranjape company	HYWA-6
WMM	285.54	June	Paranjape company	HYWA-6

Developing procurement plans – when to buy, from where and how much Monitoring flow of materials, delivery and consumptions.

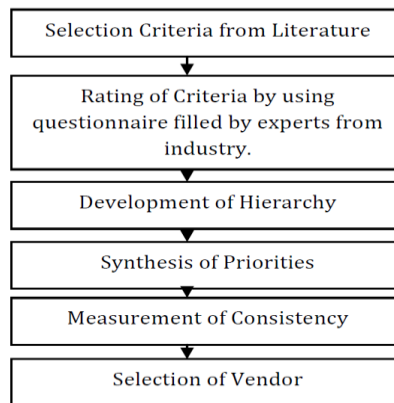


Figure6: Shows AHP Process:

Description of item	Date	Time of delivery of material	Quantity (cum.)	Place (chainage)	Equipment Required
GSB	1.6.2018	9:00 TO 1:00 2.00 TO 5:30	124.2 108.2	2+400 To 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1
GSB	2.6.2018	9:00 TO 1:00 2.00 TO 5:30	124.2 108.2	2+400 To 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1
GSB	3.6.2018	9:00 TO 1:00 2.00 TO 5:30	124.2 108.2	2+400 To 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1
GSB	4.6.2018	9:00 TO 1:00 2.00 TO 5:30	124.2 108.2	2+400 To 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1

Table No: 8 Shows JIT Implementation Plan (3.5Km)

#### Study of causes of delay in material delivery on site:

Problem: Improper Communication between site engineer, plant supervisor and vendor we observed improper communication between plant supervisor and engineer during Construction Work. This is a first reason about late material delivery. We suggest to engineer and vendor, prepare plan and according to that communicate each other. Second Problem is poor fleet management. There is no proper special staff for fleet management. Managers not maintain record of inspection and maintains of fleet. Manager not careful about fuel purchasing system.

#### V. CONCLUSION

As one can see, various research reports proposed different strategies for implementing JIT in Construction Industry. From this literature survey one can conclude that even if manufacturing industries and construction firms are different kinds of production systems but a JIT technique can also be applicable to construction. Hence it can be concluded that, in various construction projects, use of just-in-time technique will improve project's productivity, improve work flow, and project durations will shorten. Successful implementation and execution of just-in-time technique would be able to diminish a few elements such as stock level, capacity space and generation costs. By using JIT principle, we can maintain quality of the entire project and increase efficiency of the workers. From the above case study author conclude that JIT Method used to complete 3.5 Km. as per plan The Completion of 3.5 Km Road Construction work JIT Method required 26 days. Conventional Method takes 47Days to Complete Same Target. JIT Method Saves 5% Cost of Construction. No of Tipper used During JIT Application 104. No Of Tipper Used during Conventional Method 230. JIT Method Helps to Reduce equipment Required. During JIT Application Material Production was 100% as per target. But Conventional affects material production. As Per Conventional Method Material Production was only 50% as per Target.

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