"TO SCHEDULE DIFFERENT ACTIVITIES BY CAST IN SITU AND PRECAST METHOD IN RUB- LC 82 WORK SITE IN JAIPUR "

A PROJECT

Submitted in partial fulfillment of the requirements for the award of the degree of

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IN

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Under the supervision of

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CERTIFICATE

This is to certify that the work which is being presented in the project title **"TO SCHEDULE DIFFERENT ACTIVITIES BY CAST IN SITU AND PRECAST METHOD IN RUB- LC 82 WORK SITE IN JAIPUR"** in partial fulfillment of the requirements for the award of the degree of Bachelor of technology and submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by Namrata Singh and Choki Zam during a period from July 2015 to June 2016 under the supervision of Mr. Abhilash Shukla (Assistant Professor), Civil Engineering Department, Jaypee University of Information Technology, Waknaghat.

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ABSTRACT

This report aims at scheduling various activities involved in the construction of road under bridge using Primavera software for both cast-in-situ and precast method. Primavera provides a clear network diagram for cast-in-situ as well as precast method along with critical path and dummy activities. Updating can also be done keeping in track with the ongoing site activities in the project network using Primavera. Delays can thus be foreseen and measures can be taken so as to save time and money ensuring completion of project successfully.

Furthermore comparison between cast-in-situ and precast method is done to incorporate the preferred method for construction of road under bridge.

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List of abbreviations and symbols

Abbreviations & Symbols	Description
RCC	Reinforced cement concrete
Mt	Metric tone
Cum	Cubic metre
m^2	metre square
kg	Kilogram
Hr	Hours
r/f	Reinforcement
PCC	Plain cement concrete

CHAPTER 1: INTRODUCTION

1.1 Road under bridge

It is well known that railway tracks have to cross through the roads in and around highly populated, well-built cities and towns so a level crossing is provided in those points but these level crossings may be manned or unmanned, and further causes a traffic jam when a train has to pass by. As both population and traffic are increasing day by day delays and the risk of accidents at the level crossings are also increasing, on Indian Railways. About 30% of consequential train accidents were at level crossings, in terms of causalities it contributes 60%. So Indian Railways has decided to go for road over bridges (ROB's) and road under bridges (RUB's) where ever necessary in populated cities. As the cities are well built the land acquisition for construction of ROB is difficult and sometimes not possible, so under such cases engineers go for RUB's.

Sometimes the railway lines or the roads are constructed in embankment which comes in the way of natural flow of storm water (from existing drainage channels) or city sewages, as such flow cannot be obstructed and some kind of cross drainage works are required to be provided to allow water to pass across the embankment. Culverts are provided to accomplish such flow across the rail lines and roadways; small and major bridges depending on their span which in turn depends on the discharge, if span is small engineers go for box or slab bridges.

To construct RUB's with minimum disruption to train services and road traffic is a challenge to the Engineers. Methods adopted for construction of these structures are 1.Cut and cover method 2.Box pushing method 3.Restricted Height Girder method. Box pushing technique is most widely used because of its numerous advantages over the other conventional method i.e. cut and cover method, box pushing technique is safer to construct in a busy junction of rail and road over conventional method. In Box pushing technique, R.C.C. boxes in segments are cast outside and pushed through the heavy embankments of Rail or Road by Jacking. The required thrust is generated through thrust bed, as well as line and level of precast boxes is also controlled. This underpass RCC Bridge is pushed into embankment by means of hydraulic equipment which is detailed explained in this report, since the availability of land in the city is less such type of bridge utilizes less space for its construction. Hence constructing Underpass Bridge is a better option where there is a constraint of space or Land.

In RUB- 82 & 83 work sites in Jaipur we are using cut and cover method. Scheduling is a mechanical process of formalizing the planned functions assigning the starting and completion dates to each part of the work in such a manner that the whole project proceeds in a logical sequence and in orderly and systematic manner with allocation of resources. So to organize and complete the project in a timely, quality and financially responsible manner we need to schedule the project carefully. Moreover scheduling will help to keep the project on track, set realistic time frames, assign resources appropriately and manage quality to decrease product errors and project cost.

Fig. 1.1 : Real site road under bridge

1.2 Introduction to Primavera

Primavera is an amazing project management software tool which allows for top level planning as well as being ideal for managing the intricate details. This enables project managers, planners, planning controllers and other associated professionals to have instant access to all the project information they require at the touch of a button. It also means that all parties can be kept updated within one system, reducing duplicate information and keeping everyone in the loop. Designed to make managing large or complex projects a piece of cake, Primavera is the ideal tool for anyone who is involved in planning, monitoring and reporting on the progress of any big task, development or venture.

Primavera's software packages include P6, Prosight, Contract Manager, Cost Manager, Permaster, Sure Trak, Evolve and Inspire. The newest addition to the suite of project management solutions is Primavera P6, which is an integrated PPM (Project Portfolio Management) solution that provides a real time view and portfolio performance.P6 also offers what-if scenario modeling, tabular scorecards and capacity analysis.

1.3 Benefits of Primavera

• Better visibility - everything is included in the programme so you can easily see what's going on with a project at any time

•Improved forecasting - having up-to-date information means that you are able to clearly see where there is likely to be overbooked or under utilised resources and can plan accordingly

•Instant access - keeping track of progress with time and resources and getting information whenever you need it

•Quicker access - using only one system which gives you all the information you need means you save time by not having to refer to lots of different tools

•Better monitoring - it makes monitoring projects and costs simple by allowing you to track and report on progress instantly

•Easier project management - becoming a proficient Primavera user makes it easier to manage projects, especially large scale or complex ones.

1.4 Importance of scheduling road under bridge

To organize and complete your projects in a timely, quality and financially responsible manner, you need to schedule projects carefully. Effective project scheduling plays a crucial role in ensuring project success. To keep projects on track, set realistic time frames, assign resources appropriately and manage quality to decrease product errors. This typically results in reduced costs and increased customer satisfaction. Important factors include financial, documentation, management and quality assurance.

Project scheduling impacts the overall finances of a project. Time constraints require project managers to schedule resources effectively. This is particularly true when resources must have highly specialized skills and knowledge in order to complete a task or when costly materials are required. Completing a project in a short time frame typically costs more because additional resources or expedited materials are needed. With accurate project scheduling, realistic estimates and accurate projections prevent last-minute orders that drive up costs.

Project scheduling ensures one task gets completed in a quality manner before the next task in the process begins. By assuring that quality measures meet expectations at every step of the way, you ensure that managers and team members address problems as they arise and don't wait until the end. No major issues should appear upon completion because you've established quality controls from the very beginning of the scheduling process. Effective project managers understand that ensuring quality control involves managing risks and exploiting opportunities to speed up the schedule when possible to beat the competition and achieve or maintain a competitive edge with a more reliable product.

Effective project managers conduct regular meetings to get status reports. They use project scheduling meetings to check in with their team members and prevent costly misunderstandings. These regular meetings ensure that work flows from one process to the next and that each team member knows that he needs to do to contribute the project's overall success.

Creating a comprehensive work breakdown structure allows you to create a chart, such as a Gantt chart, that lists the project tasks, shows dependencies and defines milestones. Management consultant Henry Gantt designed this type of chart to show a graphic schedule of planned work. Its role in business projects is to record and report progress toward project completion. Your project schedule also allows you to assign human resources to the work and evaluate their allocation to ensure you have the appropriate levels of utilization. You may also develop a program evaluation and review technique chart, or PERT chart, to help you analyze project tasks

Following are the objectives of the project :

- To identify the activities involved in scheduling of road under bridge by both cast-in-situ and precast method through discussion with the project manager of the ongoing project.
- To schedule the activities which were identified earlier in the sequential manner whereby productivity for each activity is considered with time. Scheduling of all the activities in road under bridge is done by using Primavera software.
- To compare cast-in-situ and precast method for road under bridge construction using Primavera.

CHAPTER 2: LITERATURE REVIEW

1. Moosavi, S. and Moselhi, O. (2012)[1] Schedule Assessment and Evaluation.

Contractors are frequently required to provide detailed schedules soon after award of contracts. Owners are to evaluate and subsequently approve these schedules. The approved schedules are then used to generate project's baselines; necessary for tracking and progress reporting as well as administration of construction disputes. As such, it is important to insure the goodness of these schedules. This paper provides a structured methodology to assist owners in performing such schedule assessment and evaluation. In essence, the developed methodology serves as a check list that covers a set of overall requirements for good schedules. The methodology is based on integration of scattered knowledge. The developed methodology has been implemented in automated computer application encompassing three tiers of schedule assessment to facilitate effective evaluation of detailed schedules. This is particularly useful in performing schedule assessment of large projects, which have hundreds, if not thousands, of activities and may involve owners' participation in schedule development. This paper provides an overview of the developed system and describes its basic components. An actual project schedule is analyzed to illustrate the essential features of the computer application. The developed application can also be helpful to contractors; serving as guideline and recommended practice in scheduling.

2. Karshenas, S. and Sharma, A. (2010) [2] Visually Scheduling Construction Projects.

This paper presents a simple, flexible and intuitive approach for activity sequencing and project scheduling. Several construction scheduling professionals were consulted during development of this approach. The most important attribute desired by the industry professionals was flexibility to rapidly revise activity definitions and relationships allowing fast schedule modifications and what-if analysis. Considering the needs and suggestions of construction industry professionals and using the latest visualization technology, a graphics application was developed using Microsoft DirectX Graphics Library. The application interfaces with Revit CAD software to extract a building project's geometry and material information which is then used to create a virtual prototype of the project. Users can walk inside the virtual building for visualization of the project and sequencing project activities by selecting tasks and predecessors. The application interfaces with MS Project and provides an intuitive and flexible method to digitally transfer activity information to the schedule. The visual approach presented in this paper attempts to increase scheduling efficiency by incorporating the findings of modern cognitive theories that suggest human brain interacts more effectively with 3D virtual worlds than a long list of project activities and textual content.

3. Hegazy, T. and Kamarah, E. (2008)[3] "Efficient Repetitive Scheduling for High-Rise Construction."

A new scheduling and cost optimization model for high-rise construction is presented in this paper. The model has been formulated with a unique representation of the activities that form the building's structural core, which need to be dealt with carefully to avoid scheduling errors. In addition, the model has been formulated incorporating: (1) the logical relationships within each floor and among floors of varying sizes; (2) work continuity and crew synchronization; (3) optional estimates and seasonal productivity factors; (4) prespecified deadline, work interruptions, and resource constraints; and (5) a genetic algorithms-based cost optimization that determines the combination of construction methods, number of crews, and work interruptions that meet schedule constraints. A computer prototype was then developed to demonstrate the model's usefulness on a case study high-rise project. The model is useful to both researchers and practitioners as it better suits the environment of high-rise construction, avoids scheduling errors, optimizes cost, and provides a legible presentation of resource assignments and progress data.

4. Ugarelli, R. and Di Federico, V. (2010)[4] "Optimal Scheduling of Replacement and Rehabilitation in Wastewater Pipeline Networks."

To fulfill the objective of providing acceptable level of service to customers, the water managers have to plan how to operate, maintain, and rehabilitate the system under budget constraints. The model presented in this paper uses risk cost as an appropriate framework to define the optimal replacement time prediction based on the balance between investment for replacing and expenditures for maintaining the asset. An economic analysis compares the costs associated with maintaining an existing pipe in service, being completely depreciated or not, to the cost of replacing or rehabilitating the pipe. On this basis, the right time in the future to rehabilitate the pipeline can be determined. The costs associated with an existing pipe include direct operational and maintenance costs and indirect costs, such as those associated with risk of failure. The optimal replacement time is identified as the year in which the cost to maintain the existing stock of pipes exceeds the investment to replace it. A dynamic programming tool was developed to search the vast combinatorial solution space of the problem. The model was applied, with the aim of supporting management decisions, to the wastewater network of Oslo in Norway, managed by Oslo Vann ogAvløpsetaten, using available real-world information to estimate expected costs of maintenance and rehabilitation. The results show that a constant value for lifetime should not be applied to all the pipelines in the stock, as currently done by the utility for long-term investment; rather it is wiser to define different values for different cohorts of pipelines to reduce the uncertainties associated with generalizations for simplification. The model has been applied to wastewater pipes but is in principle valid for any aging infrastructure.

5. East, E. (1988)[5] "Knowledge-Based Approach to Project Scheduling System Selection."

Selecting a project scheduling system is one of the most time consuming choices architects, construction managers, and contractors make. Although there are many

different sources of information on scheduling software, they do not explain the importance of specific scheduling system features to construction management practice. Published reviews may also not be effective since reviewers make assumptions which may not be appropriate for a particular office. As a result, many firms purchase systems that do not provide the correct combination of features. Even though, in some cases, the correct system is chosen, it may not be used because office characteristics were not considered prior to purchase. This paper presents an approach to selecting a scheduling system which explains the assumptions behind the selection process and indicates those constraints which will have to be addressed as the program is implemented.

6. Kim, K. and de la Garza, J. (2003)[6] A New Approach to Resource Constrained Scheduling.

This research presents a Resource-constrained Critical Path Method (RCPM) technique that capitalizes on and improves the Critical Path Method (CPM) and Resource-Constrained Scheduling (RCS) techniques. A traditional CPM schedule is not realistic since it assumes unlimited resources, some of which are highly limited in practice. Although traditional RCS techniques can consider resource limitations, they do not provide correct floats and the critical path as CPM does. RCPM can identify real floats and the correct critical path, considering both technological and resource-dependent relationships. A prototype RCPM system is integrated with Primavera Project Planner (P3), so that it reads project information directly from a P3 project, performs necessary RCPM procedures, and updates the P3 project to contain identified resource relationships. To make the system more practical, functions to handle multiple calendars and progressed schedules have been incorporated

7. Syal, M. and Kakakhel, A. (2000) [7] Project Scheduling Aspects of Steel Construction.

This paper presents an understanding of the scheduling aspects of structural steel construction. It is part of an initiative funded by American Institute of Steel Construction (AISC) to develop construction management guidelines for steel construction. The paper includes details of fabrication and erection related activities, activity duration and sequencing, scheduling networks for an example mid-rise case study project, and discussion on various items impacting the schedule.

8. Kim, K. and de la Garza, J (2005)[8] Critical Path Method with Multiple Calendars.

This paper presents the critical path method forward and backward passes with multiple calendars. Multiple calendars are required in many construction projects to effectively represent various project conditions such as work properties, resource availabilities, weather conditions, etc. For this reason, major project management software packages such as P3 and MS-Project provide functions to handle multiple calendars. However, the background theory of handling multiple calendars has not been disclosed, so users of those software packages simply assume without clear knowledge that the time data generated by them are correct.

9. Galloway, P. (2006)[9] Survey of the Construction Industry Relative to the Use of CPM Scheduling for Construction Projects.

While critical-path method (CPM) scheduling has been around since the 1950s, its application in the construction industry has still not received 100% acceptance or consistency in how it is used. Project controls, and CPM scheduling in particular, have gone unchanged in the standards arena with little focus for a common understanding and recognition of what is required for CPM schedule development, implementation, and use. In recent years, little research has been conducted relative to the use of CPM and its benefits. In order to determine how the industry views its applicability and usage, a survey was developed for the stakeholders in the construction industry. This paper summarizes extensive research that was performed of the construction industry relative to the use of CPM scheduling, its applicability and its acceptance in the execution of today's constructed projects. The research obtained the stakeholders' views on the use and effectiveness of CPM scheduling; the necessary qualifications of scheduling personnel and opinions relative to whether standards and/or best practices are necessary. The paper discusses the different views of the stakeholders and recommendations as to how consistency can be obtained in the use of CPM scheduling in order to improve the construction industry.

10. Karumanasseri, G. and AbouRizk, S.(2002)[10] Decision Support System for Scheduling Steel Fabrication Projects.

One of the most important and difficult problems faced by the steel fabrication industry is the planning and scheduling of shop activities. Competitive pressures force fabricators to disrupt schedules in progress to accommodate frequent requests from key customers for changes in design and/or delivery schedules. Capacity management is a complex problem and is key to proper management of manufacturing/fabrication activities. This paper presents a decision support system for planning and scheduling of steel fabrication projects. Although the immediate application of this approach is steel fabrication, its fundamental heuristic approach can be applied to any construction job shop scheduling exercise. Its main advantage over techniques such as CPM is that it is resource driven; its advantages over simulation techniques are its simplicity and overall schedule development time.

CHAPTER 3 : PLANNING

3.1 Methodology

3.1.1 Cast-in-situ method

For road under bridge in lc 82 we are constructing it using cast in situ methodology. Cast in situ methodology is a type of methodology whereby the activities are casted and placed on site. In basic terms, cast-in-situ construction describes a process whereby segments are progressively cast on site in their final positions within the structure. Below are the list of activities which are to be carried out by cast in situ and they are

1. Ground Clearance
2. Excavation
3. Ground improvements in terms of soils and aggregates.
4. Ground improvements in terms of PCC layer.
5. Raft reinforcement.
6. Raft shuttering
7. Raft concreting
8. Raft deshuttering
9. Raft curing.
10. First lift wall reinforcement
11. First lift wall shuttering
12. First lift wall concreting
13. First lift wall deshuttering
14. First lift wall curing
15. Scaffolding
16. Second lift wall reinforcement
17. Second lift wall shuttering
18. Second lift wall concreting
19. Second lift wall deshuttering
20. Second lift wall curing
21. Slab reinforcement
22. Slab shuttering
23. Slab concreting
24. Slab deshuttering
25. Slab curing

3.1.2 Precast method

Cut and cover method

Cut-and-cover is a simple method of construction for shallow tunnels where a trench is excavated and roofed over with an overhead support system strong enough to carry the load of what is to be built above the tunnel. Two basic forms of cut-and-cover tunnelling are available:

- Bottom-up method: A trench is excavated, with ground support as necessary, and the tunnel is constructed in it. The tunnel may be of in situ concrete, precast concrete, precast arches, or corrugated steel arches; in early days brickwork was used. The trench is then carefully back-filled and the surface is reinstated.
- Top-down method: Side support walls and capping beams are constructed from ground level by such methods as slurry walling or contiguous bored piling. Then a shallow excavation allows making the tunnel roof of precast beams or in situ concrete. The surface is then reinstated except for access openings. This allows early reinstatement of roadways, services and other surface features. Excavation then takes place under the permanent tunnel roof, and the base slab is constructed.

Shallow tunnels are often of the cut-and-cover type (if under water, of the immersed-tube type), while deep tunnels are excavated, often using a tunnelling shield. For intermediate levels, both methods are possible.

Large cut-and-cover boxes are often used for underground metro stations, such as Canary Wharf tube station in London. This construction form generally has two levels, which allows economical arrangements for ticket hall, station platforms, passenger access and emergency egress, ventilation and smoke control, staff rooms, and equipment rooms. The interior of Canary Wharf station has been likened to an underground cathedral, owing to the sheer size of the excavation. This contrasts with many traditional stations on London Underground, where bored tunnels were used for stations and passenger access. Nevertheless, the original parts of the London Underground network, the Metropolitan and District Railways, were constructed using cut-and-cover. These lines pre-dated electric traction and the proximity to the surface was useful to ventilate the inevitable smoke and steam.A major disadvantage of cut-and-cover is the widespread disruption generated at the surface level during construction.

In this project we will be using cut and cover method. The activities are listed below.

1. Ground Clearance
2. Excavation
3. Ground improvements in terms of soils and aggregates.
4. Ground improvements in terms of PCC layer.
5. Casting of RCC layer.

6. Laying of RCC bed.
7. Bottom reinforcement fixing of Segment 1 (S 1).
8. Bottom concreting of Segment 1 (S 1).
9. Side reinforcement of Segment 1 (S 1)
10. Side shuttering by short wall method of Segment 1 (S 1).
11. Side shuttering by long wall method of Segment 1 (S 1).
12. Side concreting of Segment 1 (S 1).
13. Scaffolding.
14. Slab reinforcement of Segment 1 (S 1).
15. Slab shuttering by short wall method of Segment 1 (S 1).
16. Slab shuttering by long wall method of Segment 1 (S 1).
17. Slab concreting of Segment 1 (S 1).
18. Side deshuttering of Segment 1 (S 1).
19. Slab deshuttering of Segment 1 (S 1).
20. Curing of Segment 1 (S 1).
21. Bottom reinforcement fixing of Segment 2 (S 2).
22. Bottom concreting of Segment 2 (S 2).
23. Side reinforcement of Segment 2 (S 2)
24. Side shuttering by short wall method of Segment 2 (S 2).
25. Side shuttering by long wall method of Segment 2 (S 2).
26. Side concreting of Segment 2 (S 2).
27. Scaffolding.
28. Slab reinforcement of Segment 2 (S 2).
29. Slab shuttering by short wall method of Segment 2 (S 2).
30. Slab shuttering by long wall method of Segment 2 (S 2).
31. Slab concreting of Segment 2 (S 2).
32. Side deshuttering of Segment 2 (S 2).
33. Slab deshuttering of Segment 2 (S 2).
34. Curing of Segment 2 (S 2).
35. Bottom reinforcement fixing of Segment 3 (S 3).
36. Bottom concreting of Segment 3 (S 3).
37. Side reinforcement of Segment 3 (S 3)
38. Side shuttering by short wall method of Segment 3 (S 3).
39. Side shuttering by long wall method of Segment 3 (S 3).
40. Side concreting of Segment 3 (S 3).
41. Scaffolding.
42. Slab reinforcement of Segment 3 (S 3).
43. Slab shuttering by short wall method of Segment 3 (S 3).
44. Slab shuttering by long wall method of Segment 3 (S 3).
45. Slab concreting of Segment 3 (S 3).
46. Side deshuttering of Segment 3 (S 3).
47. Slab deshuttering of Segment 3 (S 3).
48. Curing of Segment (S 3).

3.2 Plan and section

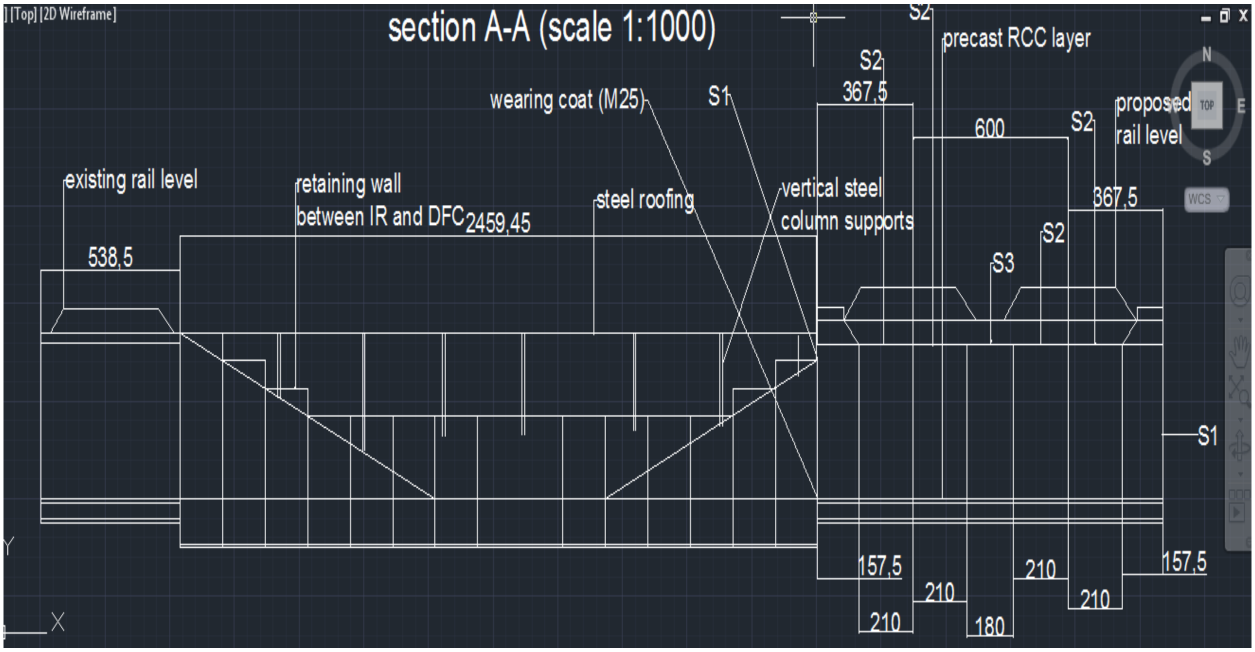


Fig. 3.1 : Section A-A of LC-82

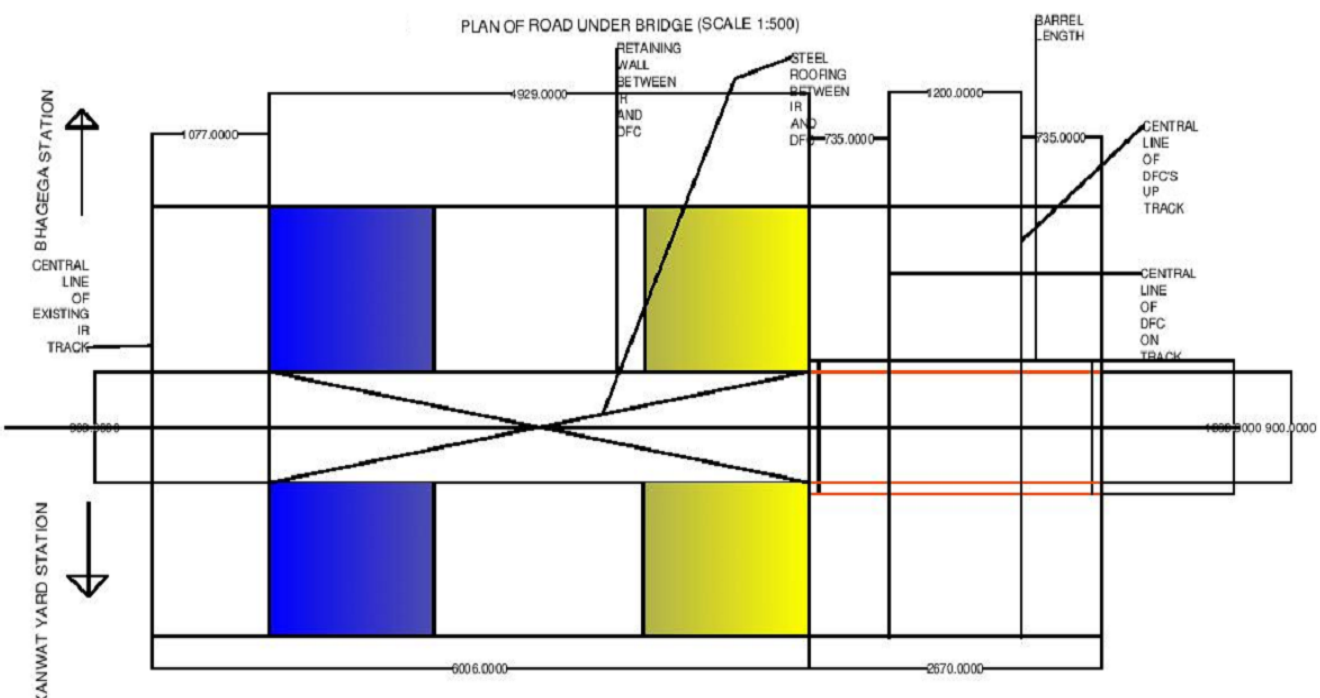


Fig. 3.2 : Plan of road under bridge

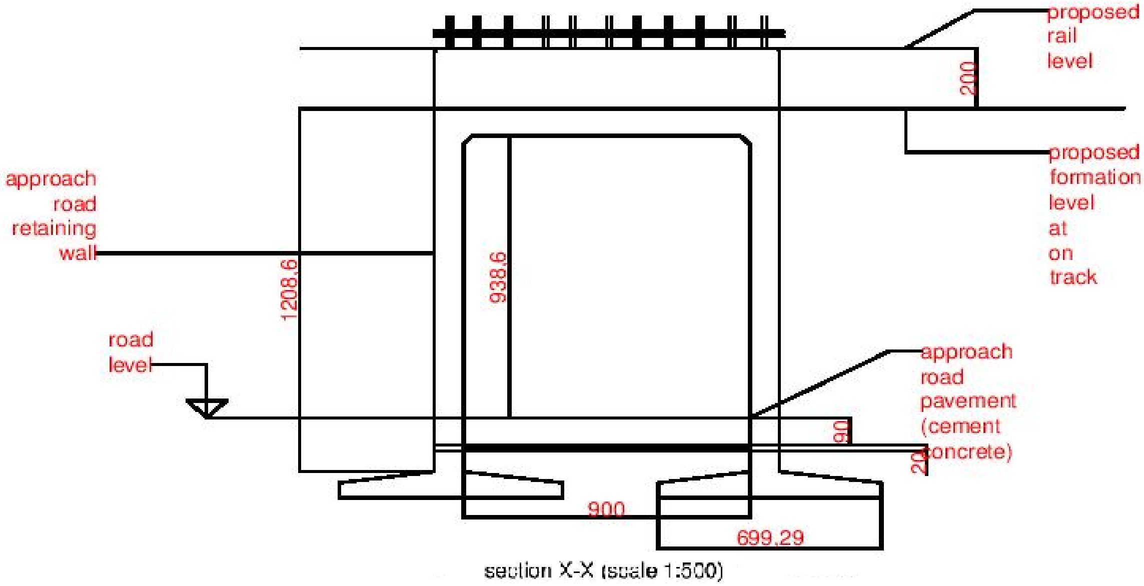


Fig. 3.3 : Plan of section x-x

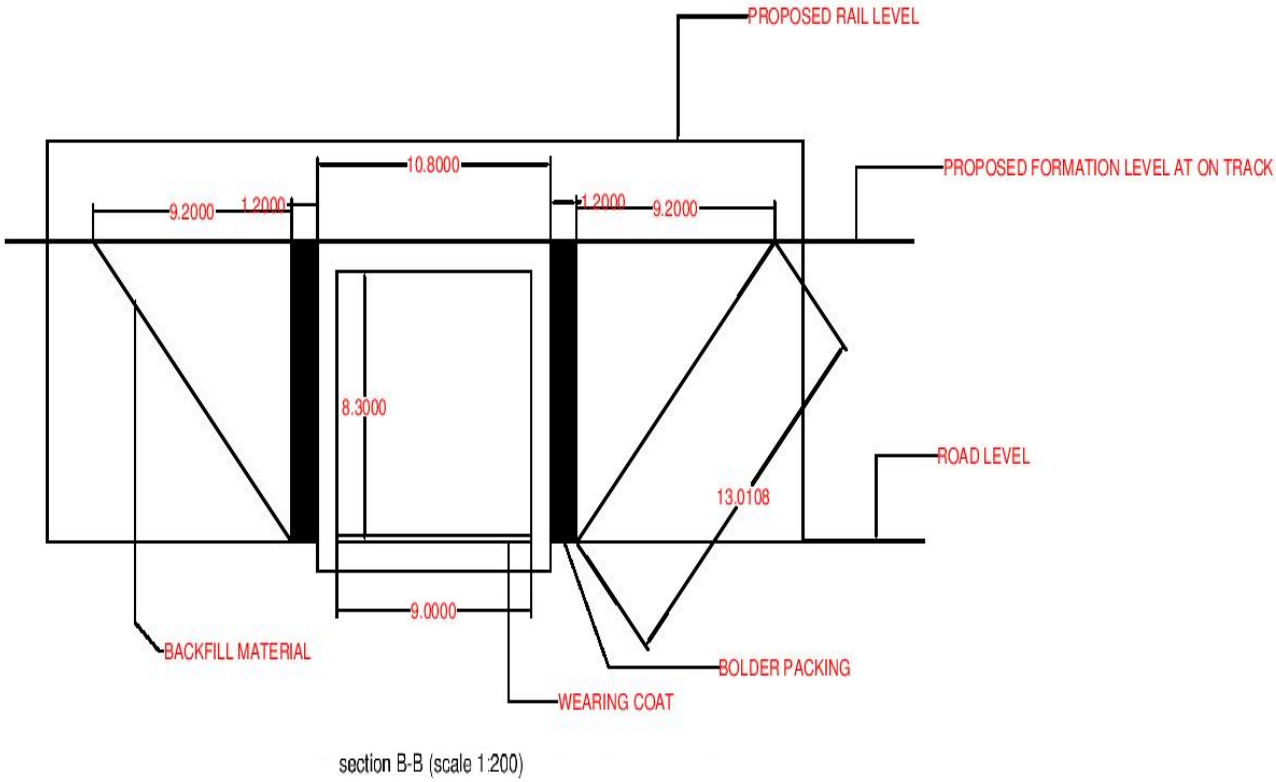


Fig. 3.4 : Plan of section b-b

3.3 DATA BOOK FOR PRODUCTIVITY

Table 3.1 : Productivity norms for formwork

The productivity norm for formwork based on previous data for road under bridge by Larsen and Turbo Limited company are as follows :

Activity	**Task**	**Labor(L) carpenter (man-days)**	**Labor (L) Helper (man-days)**	**Total**
Raft Formwork	Raft-Shuttering and providing support	0.71Man-days / 10 sqm	1.41 Man-days / 10 sqm	2.21Man-days /10 sqm
	Raft- De-shuttering & in-situ stacking	0.42 Man-days /10 sqm	0.84 Man-days /10 sqm	1.26 Man-days /10 sqm
Walls formwork	Walls – Shuttering and providing support	2.22Man-days /10 sqm	2.64Man-days /10 sqm	4.86 Man-days /10 sqm
	Walls - De-shuttering & in-situ stacking	1.32 Man-days /10 sqm	1.76 Man-days /10 sqm	3.08Man-days /10 sqm
Slab Formwork	Slab-Shuttering and providing support	0.71 Man-days /10 sqm	1.41 Man-days /10 sqm	2.21 Man-days /10 sqm
	Slab- De-shuttering & in-situ stacking	0.42 Man-days /10 sqm	0.84 Man-days /10 sqm	1.26 Man-days /10 sqm

Table 3.2 : Productivity norms for reinforcement

The productivity norm for reinforcement based on previous data for road under bridge by Larsen and Turbo Limited company are as follows :

Activity	**Task**	**Labor(L) carpenter (man-days)**	**Labor (L) Helper (man-days)**	**Total**
Raft reinforcement	Raft reinforcement- Placing in position and binding	0.28 Man-days /0.1Mt	0.38 Man-days /0.1Mt	0.66 Man-days /0.1Mt
Walls reinforcement	Wall reinforcement- Placing in position &binding	0.41Man-days /0.1Mt	0.45 Man-days /0.1Mt	0.86 Man-days /0.1Mt
Slab reinforcement	Slab reinforcement- Placing in position and binding	0.28 Man-days /0.1Mt	0.38 Man-days /0.1Mt	0.66 Man-days /0.1Mt
Scaffolding	Scaffolding – Placing			1.5Man-days /10 sqm

3.3 Productivity norms for concreting

We assume productivity in which 5 m^3 of concreting is done in one day and hence we get the number of days for concreting of a particular quantity.

3.4 ACTIVITIES

3.4.1 Cast-in-situ method

1. Ground clearance

The first activity carried out is the ground clearance in which all the obstacle located on the site of construction is being cleared. Whereby if trees are the obstacle, it is being cut and where the land belongs to some common people a compensation being paid for the use of the land upon proper negotiation and consent of the land owner. With the machines and labor we assume ground clearance to take a minimum of 3 days.

2. Excavation

Excavation for road under bridge in lc 82 is carried out using a PC 300 excavator whose capacity is 50 m^3 per hour. We are using one PC 300 excavator and two labors, one for using the excavator and other for supervising and excavation takes a total of 2 days assuming 8 hours of work per day.
It is the preliminary activity of the construction project. It starts from the pits for the building foundations and continues up to the handing over of the project.

3. Ground improvement in terms of PCC layer

Fourthly ground improvement in terms of plain cement concrete with the ratio 1:3:6 is layed so that we get a better base for road under bridge. It has a duration of one day using five number of labors ,one for supervising and four for working

4. Raft reinforcement

For raft foundation firstly the activity of raft reinforcement is carried out whereby the quantity to be reinforced is 4.866075 metric tonne. It has a duration of 6 days and uses a total of 6 labors.

5. Raft shuttering

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In raft shuttering a total quantity of 16.875 m^2 is to be shuttered which takes a duration of 2 days and 2 labors.

6. Raft concreting

Raft concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

7. Raft deshuttering

Raft deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection.Removal of staging in a planned sequence to avoid load accumulation and do not allow FW material to be thrown from height.For deshuttering of raft quantity of 16.875 m^2 and a total of 3 labors are used over a duration of 1 day.

8. Raft curing

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development. Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete

9. First lift wall reinforcement

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility. We take first lift of wall as 2.1 cm in height and make the reinforcement of the wall.

10. First lift wall shuttering

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In 1^{st} lift wall shuttering a total quantity of 115.92 m^2 is to be shuttered which takes a duration of 7 days and 8 labors.

11. First lift wall concreting

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

12. First lift wall deshuttering

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow FW material to be thrown from height. For deshuttering of 1st lift wall quantity of 115.92 m^2a total of 6 labors are used over a duration of 6 days.

13. First lift wall curing

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development. Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete

14. Scaffolding

Scaffolding is a temporary structure for gaining access to higher levels of the permanent structure during construction.

15. Second lift wall reinforcement

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility. We take second lift of wall as 2.05 cm in height and make the reinforcement of the wall.

16 Second lift wall shuttering

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In 2nd lift wall shuttering a total quantity of 113.16 m^2 is to be shuttered which takes a duration of 7 days and 8 labors.

17. Second lift wall concreting

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

18. Second lift wall deshuttering

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow FW material to be thrown from height. For deshuttering of 1st lift wall quantity of 113.16 m^2a total of 6 labors are used over a duration of 6 days.

19. Second lift wall curing

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development. Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete.

20. Slab reinforcement

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

21. Slab shuttering

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In 1^{st} lift wall shuttering a total quantity of 88.965 m^2 is to be shuttered which takes a duration of 8 days and 9 labors.

22. Slab concreting

Concrete slab floors come in many forms and can be used to provide great thermal comfort and lifestyle advantages. Slabs can be on-ground, suspended, or a mix of both. They can be insulated, both underneath and on the edges. Conventional concrete has high embodied energy. It has been the most common material used in slabs but several new materials are available with dramatically reduced ecological impact.

23. Slab deshuttering

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow FW material to be thrown from height. For deshuttering of 1^{st} lift wall quantity of 88.965m^2a total of 6 labors are used over a duration of 2 days.

24. Slab curing

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development. Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete

3.4.2 Precast method

1. Ground clearance

The first activity carried out is the ground clearance in which all the obstacle located on the site of construction is being cleared. Whereby if trees are the obstacle, it is being cut and where the land belongs to some common people a compensation being paid for the use of the land upon proper negotiation and consent of the land owner. With the machines and labor we assume ground clearance to take a minimum of 3 days.

2. Excavation

Excavation for road under bridge in lc 82 is carried out using a PC 300 excavator whose capacity is 50 m^3 per hour. We are using one PC 300 excavator and two labors, one for using the excavator and other for supervising and excavation takes a total of 2 days assuming 11 hours of work per day.
It is the preliminary activity of the construction project. It starts from the pits for the building foundations and continues up to the handing over of the project.

3. Ground improvement in terms of soil and aggregates

After excavation the next activity is ground improvement in terms of soil and aggregates so that a better surface is ensured and hence improve the foundation and life of the structure.We are taking one day duration with three labors.

Ground improvement is the primary application of many geotechnical construction techniques, permitting construction on soils by changing their characteristics.Soil mixing increases shear strength and reduce compressibility and permeability of soft soils.Dynamic compaction permits shallow spread footing construction,collapses voids,and lowers the liquefaction potential. Injection systems improve the characteristics of expansive clays.Rapid impact compaction permits shallow spread footing construction.Vibro compaction,vibro replacement, and Vibro Piers, improve granular soils for higher bearing capacity,reduced settlement,and reduced liquefaction potential.Rigid inclusions reduce settlement and increase bearing capacity of weak underlying stratum.Vibro concrete columns reduce settlement, increase bearing capacity, and increase slope stability. Hayward Baker has experience with the full range of ground improvement techniques to improve soils.

4. Ground improvement in terms of PCC layer

Fourthly ground improvement in terms of plain cement concrete with the ratio 1:3:6 is layed so that we get a better base for road under bridge. It has a duration of one day using five number of labors ,one for supervising and four for working.

5. Casting of RCC layer

Casting of Reinforced cement concrete layer is done on site and all the three segments are casted simultaneously.

6. Laying of RCC bed

For laying of RCC bed it takes a duration of 1 days with 2 number of labors.

7. Bottom reinforcement fixing of segment 1 (S 1)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

8. Bottom concreting of segment 1 (S 1)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion. Concrete has a number of performance characteristics that can improve the sustainability performance of a building or structure and they are as follows.

Acoustics
The issue of sound insulation and acoustic performance of homes has grown in importance.

Flooding
New building works within areas of flood risk are only permitted in exceptional cases where the risks are managed and adequate flood defense measures or flood resistant construction techniques are adopted.

Fire
Concrete does not burn: it cannot be 'set on fire' like other materials in a building and it does not emit any toxic fumes when affected by fire. It will also not produce smoke or drip molten particles. For these reasons, in the majority of applications, concrete can be described as virtually 'fireproof'. Concrete's inbuilt fire resistance maintains airtight construction that stops smoke spreading, and the ability to maintain the building's strength during a fire.

Thermal mass and operational energy efficiency
Thermal mass basically describes the ability of construction materials to absorb, store and release heat; a useful property which helps regulate the temperature in buildings. Heavyweight materials such as concrete provide a high level of thermal mass.

Low carbon construction
Sustainability is more than simply about carbon, and this is recognized in codes and assessment tools. However CO_2 emissions, associated with materials, manufacture, construction, operation and end of use, is an important parameter and the cement and concrete industry is investing

hugely in developing and enabling construction solutions that reduce whole life CO_2emissions as well as embodied CO_2.

Durability and long-life

The full structural capacity of a masonry or concrete wall, with its considerable reserve of strength and ability to accommodate future changes, far exceeds design requirements. It is this inherent robustness that has enabled traditionally built houses to cater for increased loads emanating from alterations and adaptation. Their strength also facilitates the introduction of concrete upper floors which provide clear spans between external walls and will support internal masonry walls. All internal walls below become non-load bearing, producing a design where the layout can be altered to cater for future changes in living requirements, so satisfying the government's requirement for 'lifetime homes'.

9. Side reinforcement of segment 1 (S 1)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

10. Side shuttering by long wall of segment 1 (S 1)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In side shuttering of S 1 a total quantity of 35.88 m^2 is to be shuttered which takes a duration of 3 days and 8 labors.

11. Side shuttering by short wall of segment 1 (S 1)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure.

12. Side concreting of segment 1 (S 1)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

13. Scaffolding of segment 1 (S 1)

Scaffolding is a temporary structure for gaining access to higher levels of the permanent structure during construction. Scaffolding activity is done in a parallel series.

14. Slab reinforcement of segment 1 (S 1)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

15. Slab shuttering by long wall of segment 1 (S 1)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In slab shuttering of S 1 a total quantity of 5.4 m^2 is to be shuttered which takes a duration of 1 day and 9 labors

16. Slab shuttering by short wall of segment 1 (S 1)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure.

17. Slab concreting of segment 1 (S 1)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

18. Side deshuttering of segment 1 (S 1)

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow material to be thrown from height. For deshuttering of S 1 a quantity of 39.39 m^2a total of 6 labors are used over a duration of 3 days.

19. Slab deshuttering of segment 1 (S 1)

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow material to be thrown from height. For deshuttering of S 1 a quantity of 5.4 m^2 a total of 6 labors are used over a duration of 1 day.

20. Curing of segment 1 (S 1)

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development. Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete

21. Bottom reinforcement fixing of segment 2 (S 2)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

22. Bottom concreting of segment 2 (S 2)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

23. Side reinforcement of segment 2 (S 2)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

24. Side shuttering by long wall of segment 2 (S 2)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In side shuttering of S 2 shuttering a total quantity of 46.92 m^2 is to be shuttered which takes a duration of 3 days and 8 labors.

25. Side shuttering by short wall of segment 2 (S 2)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure.

26. Side concreting of segment 2 (S 2)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

27. Scaffolding of segment 2 (S 2)

Scaffolding is a temporary structure for gaining access to higher levels of the permanent structure during construction. Scaffolding activity is done in a parallel series. The importance of scaffolding in construction are :

- To render the industrial standards and protection measures, this tool is considered as one of the most efficient and reliable ones. It keeps the employers involved in the high rise building projects safe and protected from unwanted accidents.
- Often there are situations when it becomes impossible to reach some positions or areas that are impossible without the help of a scaffolding platform or tower. Basically it makes the job easy and simple.
- It is extremely easy to set up, less time consuming and install also move from one place to another.
- It renders absolute flexibility and the convenience to carry out the risky tasks with ease and without any fear.
- Since it is a free standing tool that doesn't require the support from any external help, is perfect for the construction sites and building maintenance programs.

28. Slab reinforcement of segment 2 (S 2)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

29. Slab shuttering by long wall of segment 2 (S 2)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In slab shuttering of S 2 a total quantity of 5.94 m^2 is to be shuttered which takes a duration of 1 day and 9 labors.

30. Slab shuttering by short wall of segment 2 (S 2)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure.

31. Slab concreting of segment 2 (S 2)

Slab concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

32. Side deshuttering of segment 2 (S 2)

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow material to be thrown from height. For deshuttering of S 2 a quantity of 51.51 m^2 a total of 6 labors are used over a duration of 3 days.

33. Slab deshuttering of segment 2 (S 2)

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow material to be thrown from height. For deshuttering of S 2 a quantity of 5.94 m^2 a total of 6 labors are used over a duration of 1 day.

34. Curing of segment 2 (S 2)

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development.Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete

35. Bottom reinforcement fixing of segment 3 (S 3)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

36. Bottom concreting of segment 3 (S 3)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

37. Side reinforcement of segment 3 (S 3)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

38. Side shuttering by long wall of segment 3 (S 3)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In side shuttering of S 3 shuttering a total quantity of 43.06 m^2 is to be shuttered which takes a duration of 3 days and 8 labors

39. Side shuttering by short wall of segment 3 (S 3)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure.

40. Side concreting of segment 3 (S 3)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

41. Scaffolding of segment 3 (S 3)

Scaffolding is a temporary structure for gaining access to higher levels of the permanent structure during construction. Scaffolding activity is done in a parallel series.

42. Slab reinforcement of segment 3 (S 3)

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility.

43. Slab shuttering by long wall of segment 3 (S 3)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure. In slab shuttering of S 3 a total quantity of 5.75 m^2 is to be shuttered which takes a duration of 1 day and 9 labors.

44. Slab shuttering by short wall of segment 3 (S 3)

Shuttering is complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. Formwork includes the surface in contact with the concrete and all necessary supporting structure.

45. Slab concreting of segment 3 (S 3)

Concreting is a process which includes batching, mixing, transportation and compaction of concrete. Whereby concrete is a mixture of cement, coarse aggregrate, fine aggregrate and water in certain proportion.

46. Side deshuttering of segment 3 (S 3)

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow material to be thrown from height. For deshuttering of S 3 a quantity of 43.06 m^2 a total of 6 labors are used over a duration of 3 days.

47. Slab deshuttering of segment 3 (S 3)

Deshuttering is removal of the formwork and it is to be carried out only after concrete attains sufficient strength otherwise it would result in excessive deflection Removal of staging in a planned sequence to avoid load accumulation and do not allow material to be thrown from height. For deshuttering of S 3 a quantity of 5.75 m^2 a total of 6 labors are used over a duration of 1 day.

48. Curing of segment 3 (S 3)

For curing we are considering a minimum duration of 7 days. Curing is very important as poor curing leads to poor strength development. Drying shrinkage and resultant cracks, may be aggravated by high ambient temperature and low Relative Humidity. Poorly segmented capillaries resulting in lower durability of concrete.

The importance of curing are :

- It prevents or replenishes the loss of moisture from the concrete.
- It maintains a favorable temperature for hydration to occur for a definite period.

Table 3.3 : Spreadsheet showing the calculated durations for precast method

Item No	Particulars of items of work	No	(d1+d2)/2	Height	Length	Quantity	Productivity	Time taken	Days	Man days	No of labor	Explanatory notes
			(m)	(m)	(m)	(cum)		(hours)				
1	Excavation		11.2	6.043	14.35	971.23	50	19.42	1.77		2	d1=15.8 d2=6.6
	S1	2	11.2	6.193	1.5	208.08	50	4.16	0.38			
	S2	4	11.2	6.193	2.1	582.64	50	11.65	1.06			
	S3	1	11.2	6.193	1.89	131.093	50	2.62187	0.2384			

Item No	Particulars of items of work	No	Width	Height	Length	Quantity	Productivity	Time taken	Days	Man days	No of labor	Explanatory notes
	Ground improvements											
2	Soil + aggregrates		5.4	0.35	14.35	27.12		24	1.00		3	L=13.35+0.5+0.5=14.35
3	Pcc Layer		5.4	0.1	13.35	7.21		24	1.00		5	B=4.5+0.45+0.45=5.4
4	Casting of RCC layer		5.4	0.15	13.35	10.81		48.00	2.00		5	
5	laying of RCC bed							2.00	0.08		2	
	Casting of segments											
	Segment 1 (S1)											
6	bottom reinforcement fixing					0.54675	6.6	24	0.6014	3.60855	6	assume min r/f = 150kg/cum
7	bottom concreting		5.4	0.45	1.5	3.645	5	24	0.729		12	assume 5 cum of concrete per day
8	side reinforcement					0.9315	8.6	48	1.0014	8.0109	8	productivity=8.6 madays/Mt
9	side shuttering (long wall)	4		4.6	1.5	27.6						
10	side shuttering (short wall)	4	0.45	4.6		8.28						
11	side shuttering (total)					35.88	0.486	72	2.1797	17.43768	8	assume productivity=0.486 mandays/sqm
12	side concreting	2	0.45	4.6	1.5	6.21	5	48	1.242			
13	scaffolding							24	1		4	
14	slab reinforcement					0.45563	6.6	24	0.3759	3.007125	8	6.6 mandays/Mt
15	slab shuttering (long side)	2		0.45	1.5	1.35						
16	slab shuttering (short side)	2	4.5	0.45		4.05						
17	slab shuttering (total)					5.4	0.8	24	0.48	4.32	9	
	slab concreting		4.5	0.45	1.5	3.0375	5	24	0.6075			
18	**Deshuttering**											
19	side					39.39	0.308	72	2.022	12.13212	6	productivity = 0.308 mandays/sqm
20	slab					5.4	0.126	24	0.1134	0.6804	6	productivity = 0.126 mandays/sqm
21	curing							7				
	Segment 2 (S2)											
22	bottom reinforcement fixing					0.76545	6.6	24	0.842	5.05197	6	
23	bottom concreting		5.4	0.45	2.1	5.103	5	24	1.0206			
24	side reinforcement					1.3041	8.6	48	1.4019	11.21526	8	

Continuation

25	side shuttering (long side)	4		4.6	2.1	38.64						
26	side shuttering (short side)	4	0.45	4.6		8.28						
27	side shuttering (total)					46.92	0.486	72	2.8504	22.80312	8	
28	side concreting	2	0.45	4.6	2.1	8.694	5	48	1.7388			
29	scaffolding							24	1		4	
30	slab reinforcement					0.63788	6.6	24	0.5262	4.209975	8	
31	slab shuttering (long side)	2		0.45	2.1	1.89						
32	slab shuttering (short side)	2	4.5	0.45		4.05						
	slab shuttering (total)					5.94	0.8	24	0.528	4.752	9	
33	slab concreting		4.5	0.45	2.1	4.2525	5	24	0.8505			
	deshuttering											
34	side					51.51	0.308	72	2.6442	15.86508	6	
35	slab					5.94	0.126	24	0.1247	0.74844	6	
36	curing							7				
	segment 3 (S3)											
37	bottom reinforcement fixing					0.68891	6.6	24	0.7578	4.546773	6	
38	bottom concreting		5.4	0.45	1.89	4.5927	5	24	0.9185			
39	side reinforcement					1.17369	8.6	48	1.2617	10.09373	8	
40	side shuttering (long side)	4		4.6	1.89	34.776						
41	side shuttering (short side)	4	0.45	4.6		8.28						
42	side shuttering (total)					43.056	0.486	72	2.6157	20.92522	8	
43	side concreting	2	0.45	4.6	1.89	7.8246	5	48	1.5649			
44	scaffolding							24	1		4	
45	slab reinforcement					0.57409	6.6	24	0.4736	3.788978	8	
46	slab shuttering (long side)	2		0.45	1.89	1.701						
47	slab shuttering (short side)	2	4.5	0.45		4.05						
	slab shuttering (total)					5.751	0.8	24	0.5112	4.6008	9	
48	slab concreting		4.5	0.45	1.89	3.82725	5	24	0.7655			
	deshuttering											
49	side					43.056	0.308	72	2.2102	13.26125	6	
50	slab					5.751	0.126	24	0.1208	0.724626	6	
51	curing							168	7			

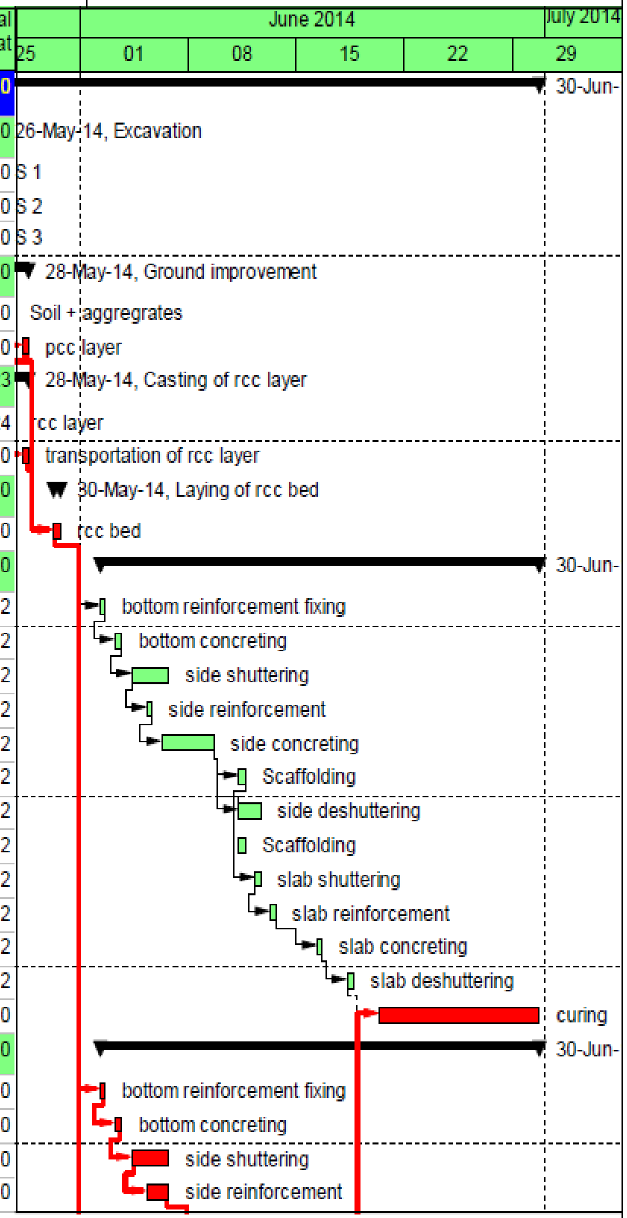
Table 3.4 : spreadsheet showing the calculated durations for cast-in-situ method

Item No	Particulars of items of work	No	(d1+d2)/2	Height	Length	Quantity	Productivity	Time taken	Days	Man days	No of labor	Explanatory notes
			(m)	(m)	(m)	(cum)		(hours)				
1	Excavation		11.2	6.043	14.35	971.23	50	19.42	1.77		2	d1=15.8 d2=6.6
Item No	Particulars of items of work	No	Breath	Height	Length	Quantity	Productivity	Time taken	Days	Man days	No of labor	Explanatory notes
	Ground improvements											
2	Soil + aggregrates		5.4	0.35	14.35	27.12		24	1.00		3	L=13.35+0.5+0.5=14.35
3	Pcc Layer		5.4	0.1	13.35	7.21		24	1.00		5	B=4.5+0.45+0.45=5.4
	Raft foundation											
4	Raft reinforcement					4.87	6.6	128.46	5.35	32.12	6	Assume min r/f = 150 kg/cum
5	Raft shuttering											
	Long side	2		0.45	13.35	12.02						
	Short side	2	5.4	0.45		4.86						
	Total					16.88	0.212	42.93	1.79	3.58	2	
6	Raft concreting		5.4	0.45	13.35	32.44	0.2	155.71	6.49		12	concrete per day (productivity=0.2)
7	Raft deshuttering					16.88	0.126	17.01	0.71	2.13	3	
8	Raft curing								7.00		2	
9	1st lift wall reinforcement					3.78	8.6	97.65	4.07	32.55	8	min quantity is in metric tonne unit
10	1st lift wall shuttering											
	Long side	4		2.1	13.35	112.14						Assume H=2.1
	Short side	4	0.45	2.1		3.78						
	Total					115.92	0.486	169.01	7.04	56.34	8	
11	1st lift wall concreting	2	0.45	2.1	13.35	25.23	0.2	121.11	5.05		12	
12	1st lift wall deshuttering					115.92	0.308	142.81	5.95	35.70	6	
13	1st lift wall curing								7.00		2	
14	Scaffolding	2	1.2	2.1	13.35	67.28	0.15	30.28	1.26	10.09	8	B=1.2
15	2nd lift wall reinforecment					3.69	8.6	95.32	3.97	31.77	8	Productivity= 8.6 mandays/Mt
16	2nd lift wall shuttering											
	Long side	4		2.05	13.35	109.47						2.1=2.05
	Short side	4	0.45	2.05		3.69						
	Total					113.16	0.486	164.99	6.87	55.00	8	
17	2nd lift wall concreting	2	0.45	2.05	13.35	24.63	0.2	118.23	4.93		12	
18	2nd lift wall deshuttering					113.16	0.308	139.41	5.81	34.85	6	
19	2nd lift wall curing								7.00		2	
20	slab reinforcement					4.87	6.6	96.35	4.01	32.12	8	
21	Slab shuttering											
	Long side	2		0.45	13.35	12.02						
	Short side	2	5.4	0.45		4.86						
	Lower face		5.4		13.35	72.09						
	Total					88.97	0.8	189.79	7.91	71.17	9	
22	Slab Concreting		5.4	0.45	13.35	32.44	0.2	155.71	6.49		12	
23	Slab deshuttering					88.97	0.126	44.84	1.87	11.21	6	
24	Slab curing								7		2	

Fig. 3.5 : WBS layout for precast method using Primavera

PC 121636 — Classic WBS Layout — 04-Jun-16 12:01

Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule % Complete	Start	Finish	Total Float
PC 121636		26	26	0%	26-May-14	30-Jun-14	0
Excavation		1	1	0%	26-May-14	26-May-14	0
A1000	S 1	1	1	0%	26-May-14	26-May-14	0
A1010	S 2	1	1	0%	26-May-14	26-May-14	0
A1020	S 3	1	1	0%	26-May-14	26-May-14	0
Ground improvement		2	2	0%	27-May-14	28-May-14	0
A1030	Soil + aggregrates	1	1	0%	27-May-14	27-May-14	0
A1040	pcc layer	1	1	0%	28-May-14	28-May-14	0
Casting of rcc layer		2	2	0%	27-May-14	28-May-14	23
A1380	rcc layer	1	1	0%	27-May-14	27-May-14	24
A1400	transportation of rcc layer	1	1	0%	28-May-14	28-May-14	0
Laying of rcc bed		1	1	0%	30-May-14	30-May-14	0
A1390	rcc bed	1	1	0%	30-May-14	30-May-14	0
Casting of S 1		21	21	0%	02-Jun-14	30-Jun-14	0
A1050	bottom reinforcement fixing	1	1	0%	02-Jun-14	02-Jun-14	2
A1060	bottom concreting	1	1	0%	03-Jun-14	03-Jun-14	2
A1080	side shuttering	3	3	0%	04-Jun-14	06-Jun-14	2
A1070	side reinforcement	1	1	0%	05-Jun-14	05-Jun-14	2
A1090	side concreting	2	2	0%	06-Jun-14	09-Jun-14	2
A1100	Scaffolding	1	1	0%	11-Jun-14	11-Jun-14	2
A1140	side deshuttering	2	2	0%	11-Jun-14	12-Jun-14	2
A1440	Scaffolding	1	1	0%	11-Jun-14	11-Jun-14	2
A1120	slab shuttering	1	1	0%	12-Jun-14	12-Jun-14	2
A1110	slab reinforcement	1	1	0%	13-Jun-14	13-Jun-14	2
A1130	slab concreting	1	1	0%	16-Jun-14	16-Jun-14	2
A1410	slab deshuttering	1	1	0%	18-Jun-14	18-Jun-14	2
A1150	curing	7	7	0%	20-Jun-14	30-Jun-14	0
Casting of S 2		21	21	0%	02-Jun-14	30-Jun-14	0
A1160	bottom reinforcement fixing	1	1	0%	02-Jun-14	02-Jun-14	0
A1170	bottom concreting	1	1	0%	03-Jun-14	03-Jun-14	0
A1190	side shuttering	3	3	0%	04-Jun-14	06-Jun-14	0
A1180	side reinforcement	2	2	0%	05-Jun-14	06-Jun-14	0



Actual Work — Critical Remaining Work — Summary — Remaining Work ◆ — ◆ Milestone

Page 1 of 2

TASK filter: All Activities

Continuation of the layout

PC 121636 | Classic WBS Layout | 04-Jun-16 12:01

Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule % Complete	Start	Finish	Total Float
A1200	side concreting	2	2	0%	09-Jun-14	10-Jun-14	0
A1210	scaffolding	1	1	0%	12-Jun-14	12-Jun-14	0
A1250	side deshuttering	2	2	0%	12-Jun-14	13-Jun-14	0
A1230	slab shuttering	1	1	0%	13-Jun-14	13-Jun-14	0
A1220	slab reinforcement	1	1	0%	16-Jun-14	16-Jun-14	0
A1240	slab concreting	2	2	0%	17-Jun-14	18-Jun-14	0
A1260	curing	7	7	0%	20-Jun-14	30-Jun-14	0
A1420	slab deshuttering	1	1	0%	20-Jun-14	20-Jun-14	0
Casting of S 3		21	21	0%	02-Jun-14	30-Jun-14	0
A1270	bottom reinforcement fixing	1	1	0%	02-Jun-14	02-Jun-14	0
A1280	bottom concreting	2	2	0%	03-Jun-14	04-Jun-14	0
A1300	side shuttering	3	3	0%	05-Jun-14	09-Jun-14	0
A1290	side reinforcement	2	2	0%	06-Jun-14	09-Jun-14	0
A1310	side concreting	2	2	0%	10-Jun-14	11-Jun-14	0
A1320	scaffolding	1	1	0%	13-Jun-14	13-Jun-14	0
A1360	side deshuttering	2	2	0%	13-Jun-14	16-Jun-14	0
A1340	slab shuttering	1	1	0%	16-Jun-14	16-Jun-14	0
A1330	slab reinforcement	1	1	0%	17-Jun-14	17-Jun-14	0
A1350	slab concreting	1	1	0%	18-Jun-14	18-Jun-14	0
A1370	curing	7	7	0%	20-Jun-14	30-Jun-14	0
A1430	slab deshuttering	1	1	0%	20-Jun-14	20-Jun-14	0

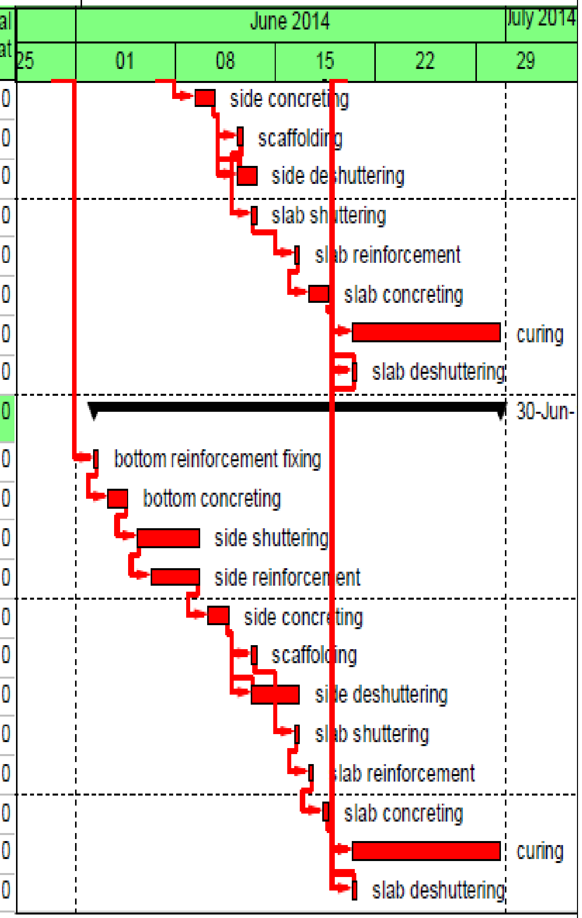


Fig. 3.6 : WBS layout for cast-in-situ method using Primavera

CSI 121637 | Classic WBS Layout | 04-Jun-16 11:21

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
CSI 121637		65	26-May-14	22-Aug-14	0
excavation		3	26-May-14	28-May-14	0
A1000	total excavation	3	26-May-14	28-May-14	0
ground improvement		2	29-May-14	30-May-14	0
A1010	soil + aggregrates	1	29-May-14	29-May-14	0
A1020	pcc layer	1	30-May-14	30-May-14	0
raft foundation		15	31-May-14	20-Jun-14	0
A1030	raft reinforcement	6	31-May-14	05-Jun-14	0
A1040	raft shuttering	2	31-May-14	01-Jun-14	4
A1050	raft concreting	7	06-Jun-14	12-Jun-14	0
A1060	raft deshuttering	1	14-Jun-14	14-Jun-14	0
A1070	raft curing	7	14-Jun-14	20-Jun-14	0
1st lift wall		14	21-Jun-14	10-Jul-14	0
A1080	1st wall reinforcement	4	21-Jun-14	24-Jun-14	3
A1090	1st wall shuttering	7	21-Jun-14	27-Jun-14	0
A1100	1st wall concreting	5	28-Jun-14	02-Jul-14	0
A1110	1st wall deshuttering	6	04-Jul-14	09-Jul-14	0
A1120	1st wall curing	7	04-Jul-14	10-Jul-14	0
A1130	scaffolding	2	04-Jul-14	05-Jul-14	0
2nd lift wall		15	06-Jul-14	25-Jul-14	0
A1140	2nd wall reinforcement	4	06-Jul-14	09-Jul-14	3
A1150	2nd wall shuttering	7	06-Jul-14	12-Jul-14	0
A1160	2nd wall concreting	5	13-Jul-14	17-Jul-14	0
A1170	2nd wall deshuttering	6	19-Jul-14	24-Jul-14	0
A1180	2nd wall curing	7	19-Jul-14	25-Jul-14	0
slab		20	26-Jul-14	22-Aug-14	0
A1190	slab reinforcement	4	26-Jul-14	29-Jul-14	7
A1200	slab shuttering	8	29-Jul-14	05-Aug-14	0
A1210	slab concreting	7	06-Aug-14	12-Aug-14	0
A1220	slab deshuttering	2	14-Aug-14	15-Aug-14	0
A1230	slab curing	7	16-Aug-14	22-Aug-14	0

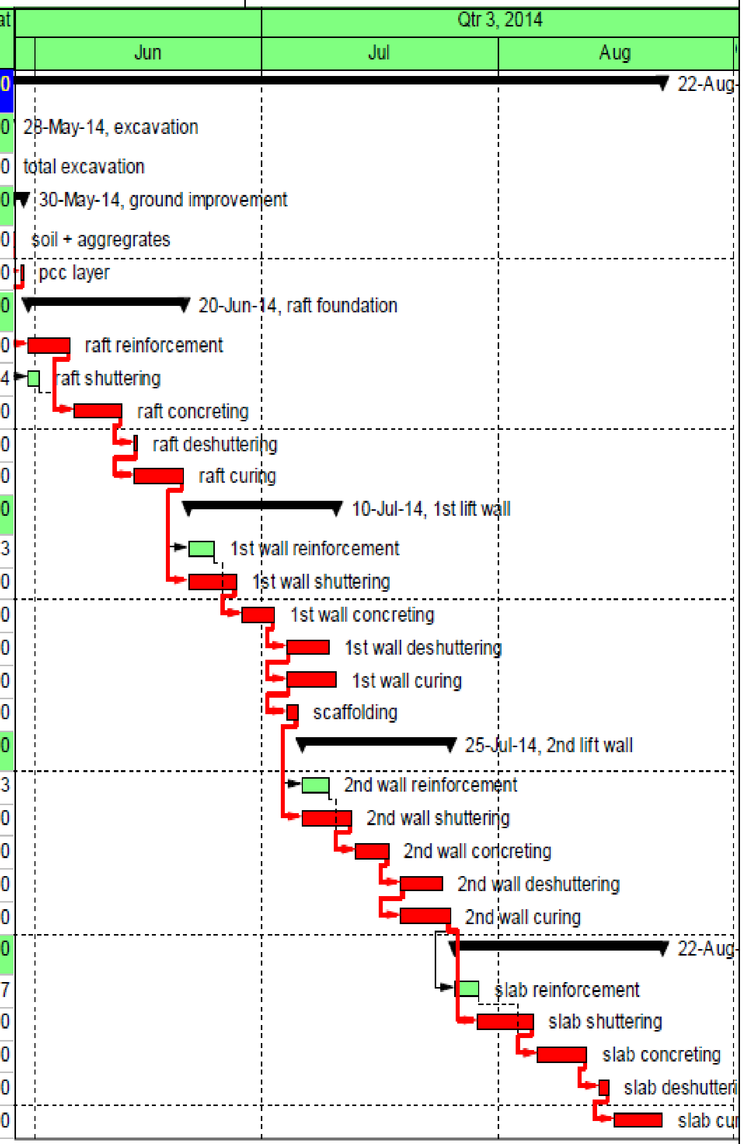
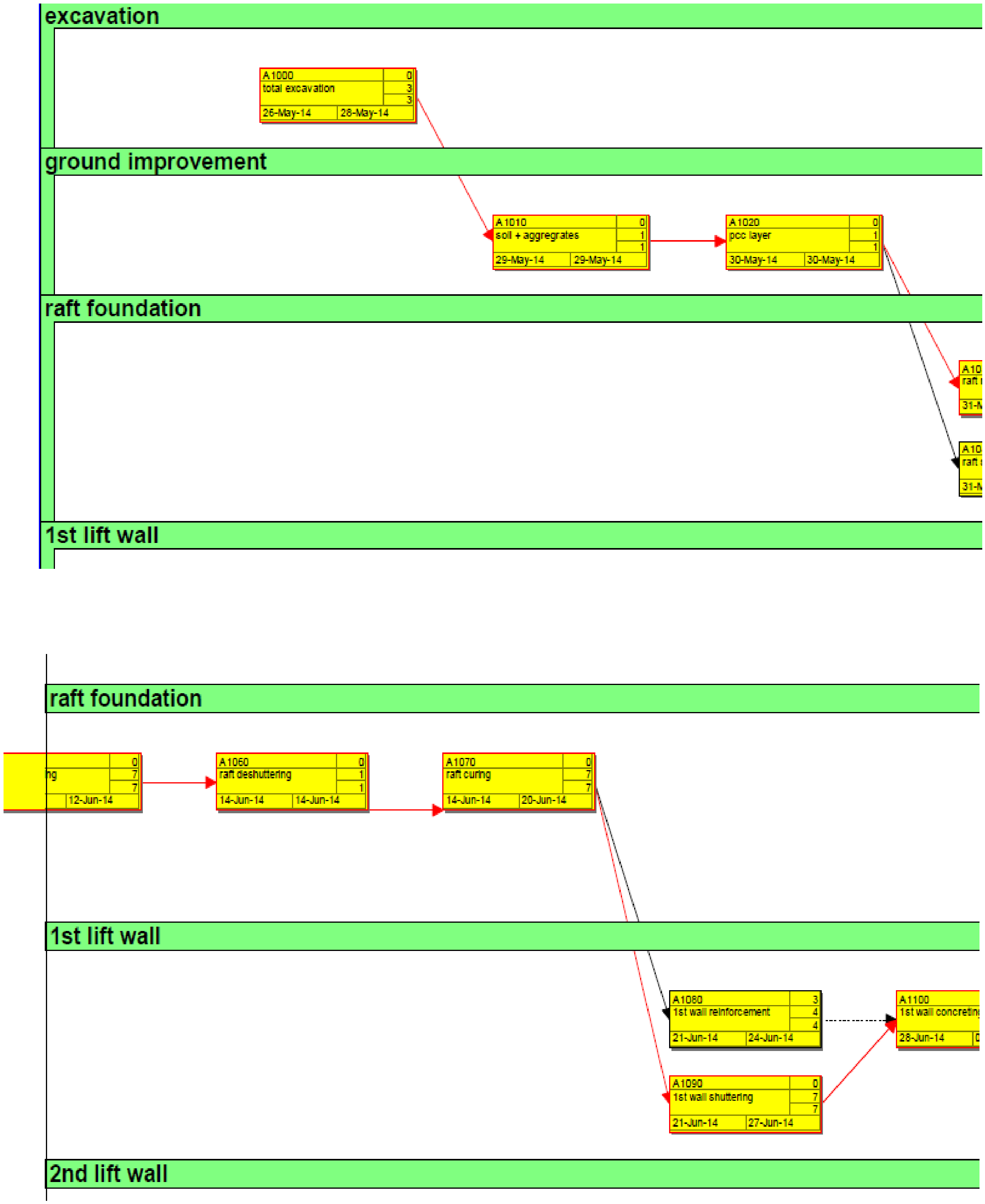
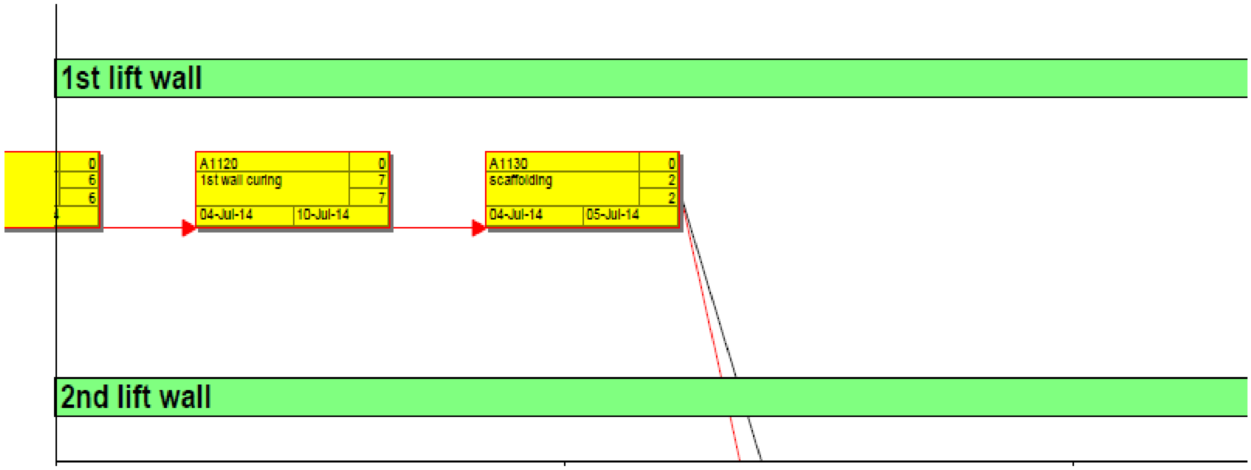
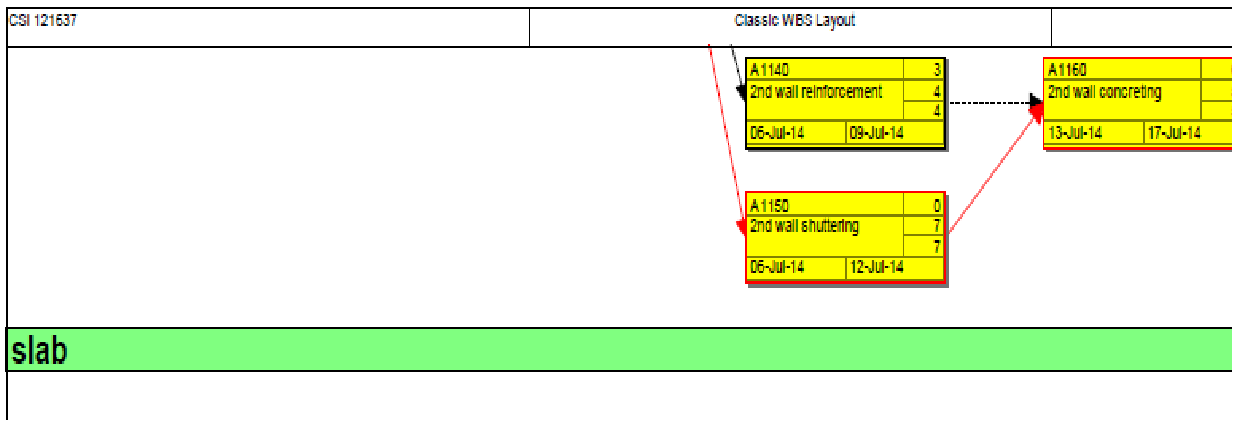
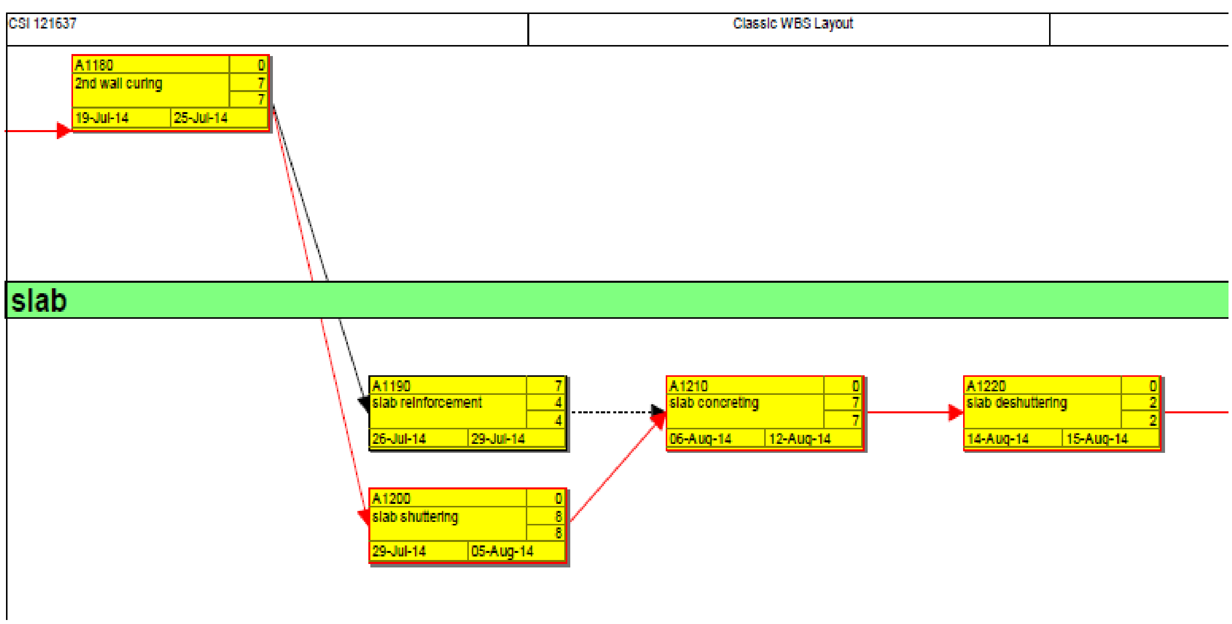


Fig. 3.7 : Network diagram for cast-in-situ method using Primavera




1st lift wall
A1120
1st wall curing
04-Jul-14
10-Jul-14
A1130
scaffolding
04-Jul-14
05-Jul-14
2nd lift wall


CSI 121637
Classic WBS Layout
A1140
2nd wall reinforcement
06-Jul-14
09-Jul-14
A1160
2nd wall concreting
13-Jul-14
17-Jul-14
A1150
2nd wall shuttering
06-Jul-14
12-Jul-14
slab


CSI 121637
Classic WBS Layout
A1180
2nd wall curing
19-Jul-14
25-Jul-14
slab
A1190
slab reinforcement
26-Jul-14
29-Jul-14
A1210
slab concreting
06-Aug-14
12-Aug-14
A1220
slab deshuttering
14-Aug-14
15-Aug-14
A1200
slab shuttering
29-Jul-14
05-Aug-14

CHAPTER 4 : RESULTS & DISCUSSIONS

4.1 RESULTS

- The construction of RUB is a right step in right direction to increase the safety standards of railways as well as the road users.
- About 30% of consequential train accidents were at level crossings, in terms of causalities it contributes 60%.Therefore with construction of road under bridge accidents are prevented in the level crossings in populated cities leading to reduced number of deaths and casualties. Hence construction of road under bridge eliminates the level crossings and increase the safety standards of Railways as well as road users.
- With road under bridge construction the road users won't have to face delay of time as the road users won't have to wait for the train to pass and gate to open after the train passes by. After construction of road under bridge the flow of road traffic will not be stopped hence time is saved and the road user will reach their respective destinations on time.
- Following is the result from the calculation done so far for cast-in-situ method are :

Activities	**Duration(days)**
Excavation	2
Ground improvement	1
PCC layering	1
Raft reinforcement	6
Raft shuttering	2
Raft concreting	7
Raft deshuttering	1
Raft curing	7
First wall reinforcement	4
First wall shuttering	7
First wall concreting	5
First wall deshuttering	6
First wall curing	7
Scaffolding	2
Second wall reinforcement	4
Second wall shuttering	7
Second wall concreting	5
Second wall deshuttering	6
Second wall curing	7
Slab reinforcement	4
Slab shuttering	8
Slab concreting	7
Slab deshuttering	2
Slab curing	7

- Following is the result from the calculation done so far for precast method are :

Activities	**Duration(days)**
Excavation	3
Ground improvement	1
PCC layering	1
Casting of RCC layer	2
Laying of RCC bed	1
Bottom reinforcement fixing of S 1	1
Bottom concreting of S 1	1
Side reinforcement of segment 1	2
Side shuttering of S 1	3
Side concreting of S 1	2
Scaffolding	1
Slab reinforcement of S 1	1
Slab shuttering by of S 1	1
Slab concreting of S 1	1
Side deshuttering of S 1	3
Slab deshuttering of S 1	1
Curing of S 1	7
Bottom reinforcement fixing of S 2	1
Bottom concreting of S 2	1
Side reinforcement of S 2	2
Side shuttering by of S 2	3
Side concreting of S 2	2
Scaffolding	1
Slab reinforcement of S 2	1
Slab shuttering of S 2	1
Slab concreting of S 2	1
Side deshuttering of S 2	3
Slab deshuttering of S 2	1
Curing of S 2	7
Bottom reinforcement fixing of S 3	1
Bottom concreting of S 3	1
Side reinforcement of S 3	2
Side shuttering of S 3	3
Side concreting of S 3	2
Scaffolding	1
Slab reinforcement of S 3	1

Slab shuttering of S 3	1
Slab concreting of S 3	1
Side deshuttering of S 3	3
Slab deshuttering of S 3	1
Curing of S 3	7

Fig. 4.1 : Graph of cast-in-situ method

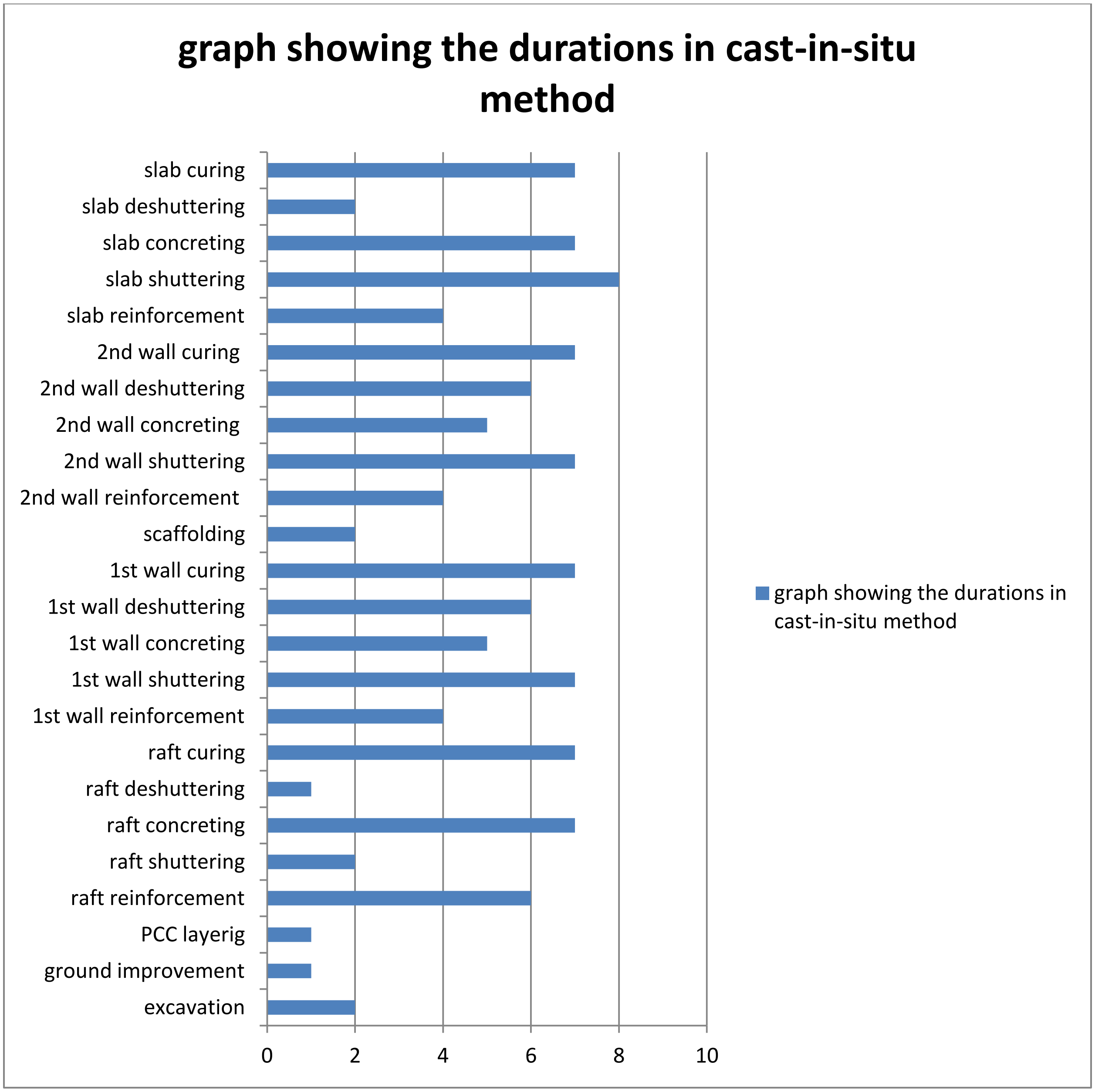
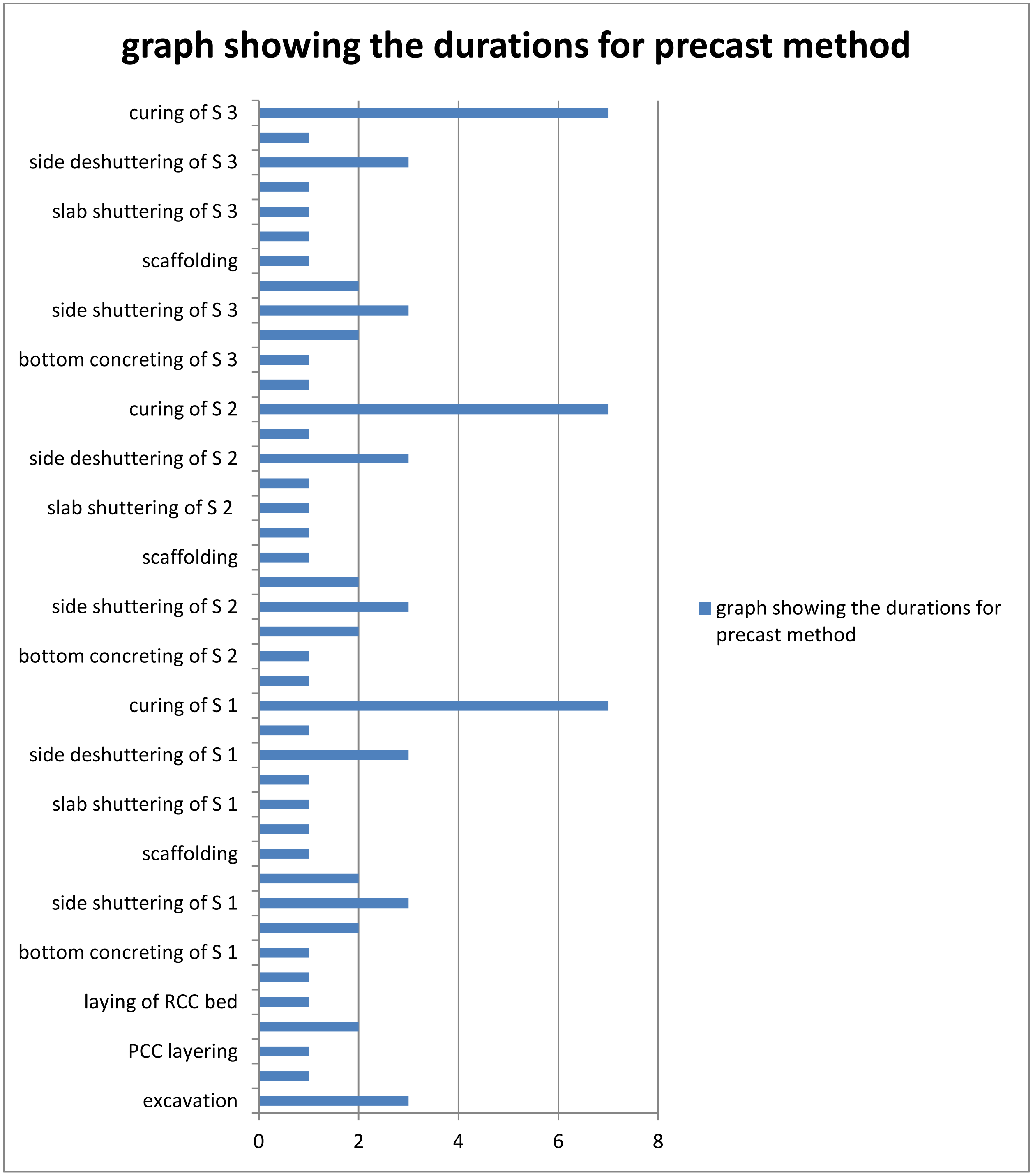


Fig. 4.2 : Graph of precast method



Note : X-axis = duration of activities in days

Y-axis = activities

4.2 DISCUSSIONS

- Precast method is faster when compared to cast in situ and hence takes lesser time.
- Since precast is manufactured in a controlled casting environment it is easier to control the mix, placement, and curing.
- Quality can be controlled and monitored much more easily.
- Since a precaster can buy materials for multiple projects, quantity discounts can lower costs.
- Weather is eliminated as a factor-you can cast in any weather and get the same results which allows you to perfect mixes and methods.
- Less labor is required and that labor can be less skilled.
- On site precast can be installed immediately, there is no waiting for it to gain strength and the modularity of precast products makes installation go quickly.
- Repeatability-it's easy to make many copies of the same precast product; by maximizing repetition, you can get plenty of value from a mold and a set-up.
- Accelerated curing, by heating the precast parts, greatly increases strength gain, reducing the time between casting the part and putting it into service.
- With the ability to so tightly control the process, from materials to consolidation to curing, you can get extremely durable concrete.

CHAPTER 5 : CONCLUSIONS & SCOPE FOR THE FUTURE

5.1 CONCLUSIONS

- Various activities involved in construction of road under bridge are identified for both cast-in-situ method and precast method. Further durations are calculated for both the method using Ms Excel.
- All the activities which were identified earlier are scheduled for the above two methods using Primavera software.
- Cast-in-situ method and precast method are compared. Therefore precast method is preferred as it takes lesser days to complete for construction happens immediately without having to wait for gaining of strength, durability is more since quality control can be done more effectively and it is more economical.

5.2 SCOPE FOR THE FUTURE

The scope of the project was to understand and schedule different activities in road under bridge by both cast in situ method and precast method by using Primavera. With a detailed understanding and practice in Primavera software we can determine the network diagram for the project. Further the critical path and dummy activities can be seen using Primavera. Updating can also be done keeping in track with the ongoing real activities in the project network by using Primavera. We can foresee delays and seek for remedies so as to save time and money ensuring completion of project successfully. We can also notice in the change of critical path incase it occurs after updating and carry forward the project accordingly.

Furthermore from this project we can construct road under bridge by both precast method and cast in situ method and compare the two. After comparing we can see which method is faster and which is cost effective and hence construct road under bridge using the most feasible method from the two.

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