

Construction Scheduling Using Critical Path Method And Location Based Management System

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ABSTRACT

In project management, a schedule is enumeration of a project's milestones, activities, and deliverables, usually with intended start and finish dates. Those items are often estimated in terms of resource allocation, budget and duration, linked by dependencies and scheduled events. A schedule is commonly used in project planning and project portfolio management parts of project management. Elements on a schedule may be closely related to the work breakdown structure terminal elements, the Statement of work, or a Contract Data Requirements List. This project aims at comparing the most widely used scheduling technique i.e. Critical Path Method and an emerging technique i.e. Location Based Scheduling Method. The CPM is executed using CANDY platform and LBMS is done using VICO Schedule Planner. A small residential element is taken as the specimen for scheduling and both scheduling techniques are applied, duly optimized by mathematical modelling.

Keywords— *Critical path method ,CANDY Software, location based management system, VICO Schedule planner.*

INTRODUCTION

Project Management is an integral part of any Construction process. It is from this concept that the subsidiaries like efficient use of resources, cost management and sustainable management were sired. Any project management process consist of three main components:

1. Planning
2. Scheduling
3. Controlling

Planning consists of a brief set of eight steps:

- a) Define
- b) Establish
- c) Develop
- d) Determine
- e) Test
- f) Choose
- g) Decide

There are various methods for scheduling of which the most popular are the PERT and CPM. The project controlling aims at three things i.e. ensuring that project is completed in minimum time applying the minimum cost and with best optimal quality. According to various researchers controlling is the main part of a project, even above planning or scheduling. Scheduling of activities are of utmost importance when starting a new project whatever scale it might be on. It is done to ensure the resources are used efficiently and in most cost effective way. No manager will want rework as it will require additional usage of resources and wastage of money which is harmful for the growth of project.

REVIEW OF LITERATURES

A. Activity based scheduling

Activity Based Scheduling can again be divided into two major concepts in the field of construction management and technology i.e. deterministic (CPM approach) and probabilistic (PERT approach). For Location Based Methods, the division is into unit production and location production. (Kenley et al., 2009).The Critical Path Method (CPM) is one of several related techniques for doing project planning. CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities.

The essential technique for using CPM is to construct a model of the project that includes the following:

1. A list of all activities required to complete the project (typically categorized within a work breakdown structure),
2. The time (duration) that each activity will take to complete,
3. The dependencies between the activities and,
4. Logical end points such as milestones or deliverable items.

Using these values, CPM calculates the longest path of planned activities to logical end points or to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are "critical" (i.e., on the longest path) and which have "total float" (i.e., can be delayed without making the project longer). In project management, a critical path is

the sequence of project network activities which add up to the longest overall duration, regardless if that longest duration has float or not. This determines the shortest time possible to complete the project.

B. location based scheduling

Location Based Management is the concoction of a Location Based Schedule and a 3D computer model, popularly known as the 4 D models. The concept of location based management was explained in another way by Wong et al., 1993, stating that the above mentioned technique is basically a CPM integrated with a linear schedule. Location Based Scheduling is an alternative methodology based on tracking the continuity of crews working on production tasks.

This method is usually suited for projects of repetitive in nature and usually keep resources continuously at work. There is limited data on the practical implication of LBS but the customers enjoy nearly 10% schedule compression with no subsequent increase in project risk. The initiative to establish the LBS technique as the best among other scheduling techniques is taken by Finnish contractors who used this method in their project and found that it was much better in conservation of resources and lowering the cost.

Large complex construction projects present severe resource management problems for contractors, particularly in the fit-out phase following construction of the structure. In particular, the complexity of hospital projects can easily allow a construction team to apparently lose control of the works, resulting in very tight deadlines, resource discontinuities and rushes to complete work on time.

RESEARCH OBJECTIVE

To analyze real time projects and devise an optimal technique of scheduling between CPM and Location Based Management System (LBMS).

To find the consistency of the techniques using Analytical Hierarchical Process.

1. Preliminary schedule using CANDY platform.
 - a) A preliminary schedule was made using CANDY which consisted of basic activities for a G+20 structure.
2. Acquiring a model of G+20 high rise building.
3. Detailed scheduling using CPM and LBMS.
 - a) CPM Scheduling will be done using CANDY platform and LBMS will be done using Schedule Planner (VICO Control)
4. Comparing the CPM and LBMS technique.
5. Optimization using mathematical modelling and Validation of result.

METHODOLOGY

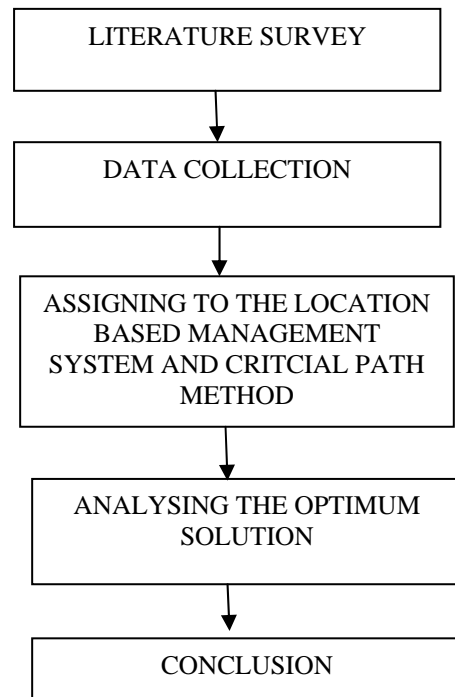


Fig.1 Methodology

SOFTWARE USED FOR SCHEDULING

A. VICO Software

Vico Software, Inc. provides construction software and services to the commercial building industry. Building owners, general contractors, and construction managers use our BIM software and our services to reduce risk, manage costs, and optimize schedules on complex building projects. Vico's 5D Virtual Construction solutions pioneered the category of BIM for Construction, and they remain the industry's most integrated approach to coordination, quantity take off, cost estimation, project scheduling, and production control. The benefits of our solutions and services have been proven on hundreds of building projects to date.

B. CANDY Software

Candy is a modern software suite focused on project control in the construction industry, a field in which we have gained enormous experience. We have specifically targeted the contractor's software requirements, from taking-off, pricing and planning a project, controlling at site level, through to the final certificate. We have a wide international client base which exposes us to a variety of local requirements and new techniques. These are continually included into the software.

RESULTS AND DISCUSSION

Preliminary Research

The research started with the CPM scheduling of G+20 Structure. Network diagram is as shown below.

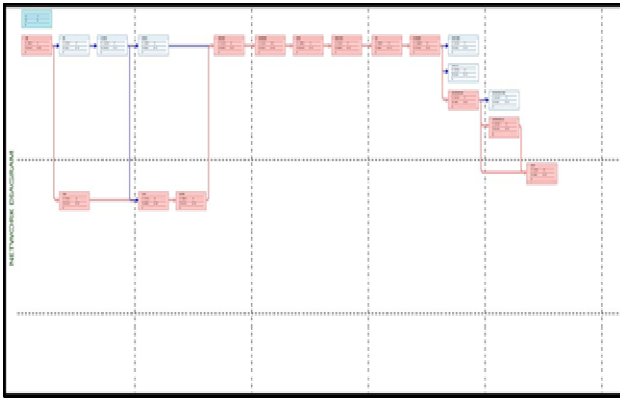


Fig. 2 CPM Schedule

The schedule in CANDY software is given below:

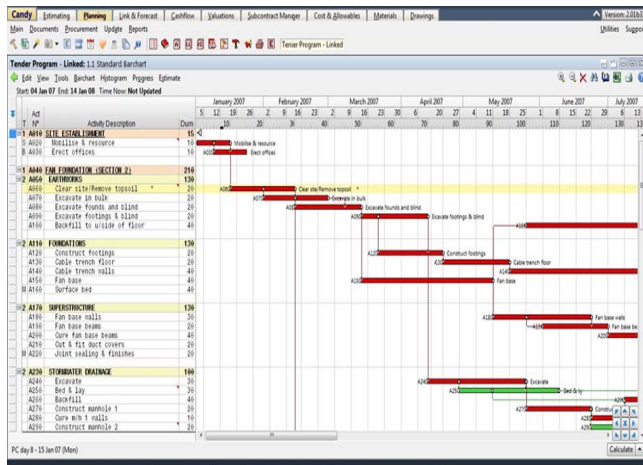


Fig.3 Activity list/ Bar chart

The Gantt chart was prepared using the activities mentioned in BOQ and using the concept of critical path method.

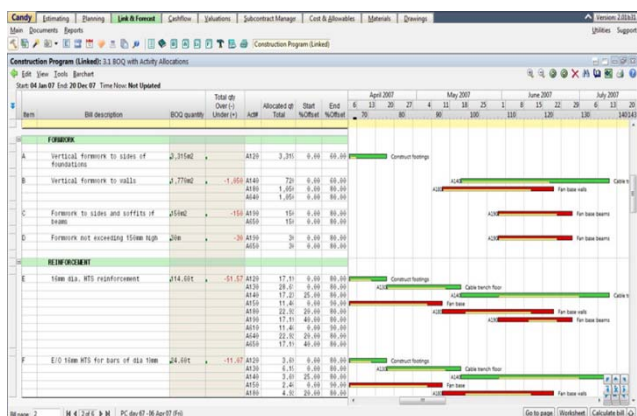


Fig.4 Bill of Quantities Combined with Activity Allocations

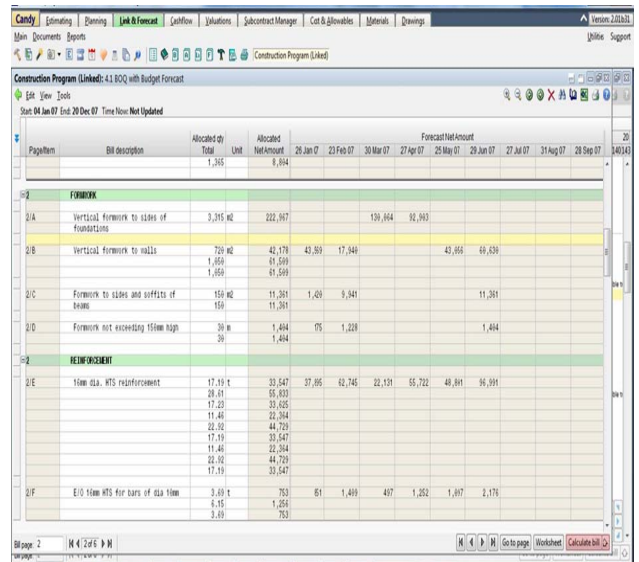


Fig.5 Budget Forecast

The critical path is shown in red and the non-critical path has been highlighted as grey.

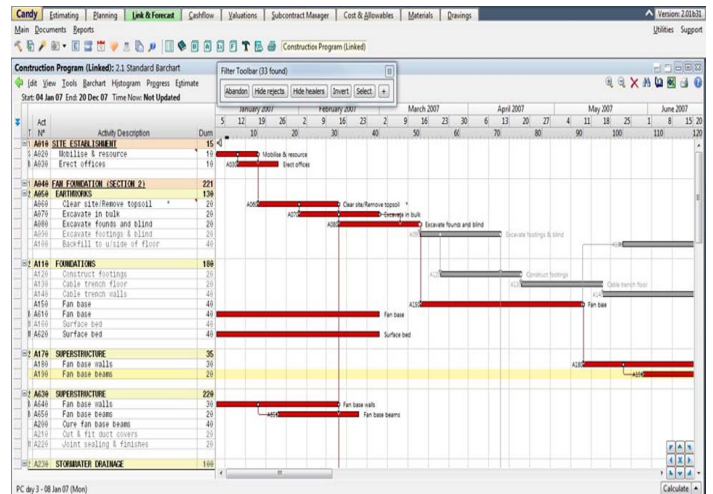


Fig.6 Critical Path

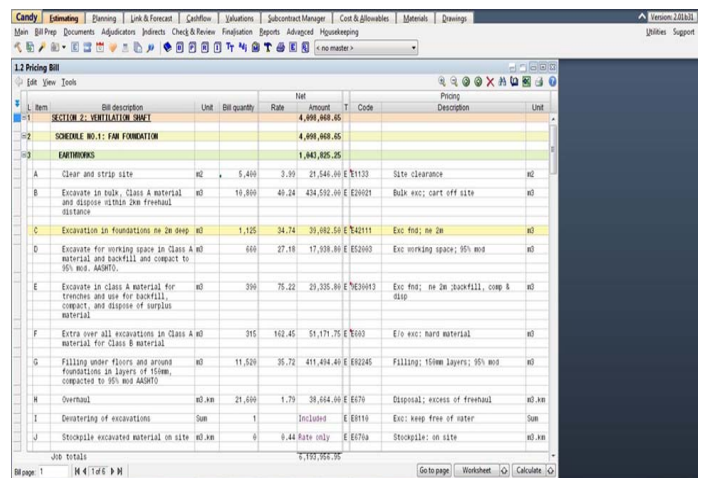


Fig.7 Bill of Quantities

For G+20 structure, the bill of quantities for below plinth level was prepared. After entering the per unit cost of each activity (each element of BOQ), the

CPM SCHEDULING

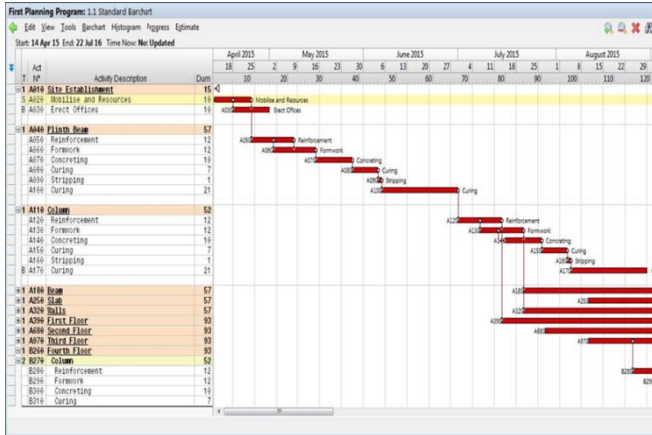


Fig.12 CPM Schedule of G+20 Structure

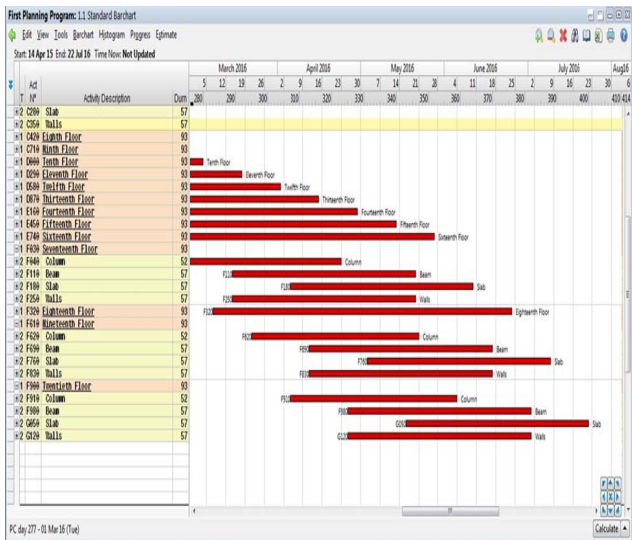


Fig.13 CPM scheduling

LOCATION BASED SCHEDULING

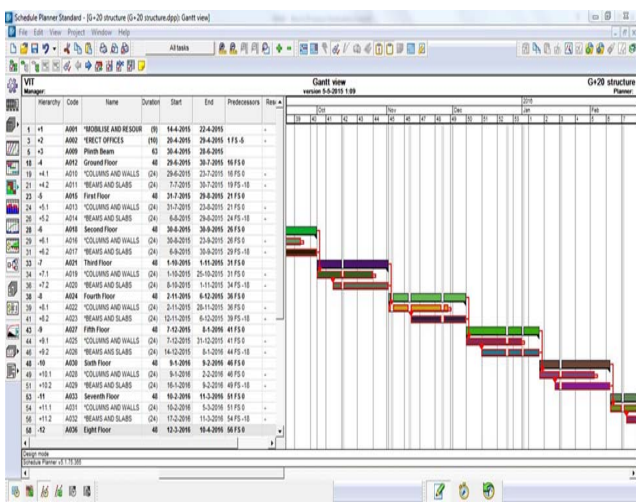


Fig.14 Gantt Chart View

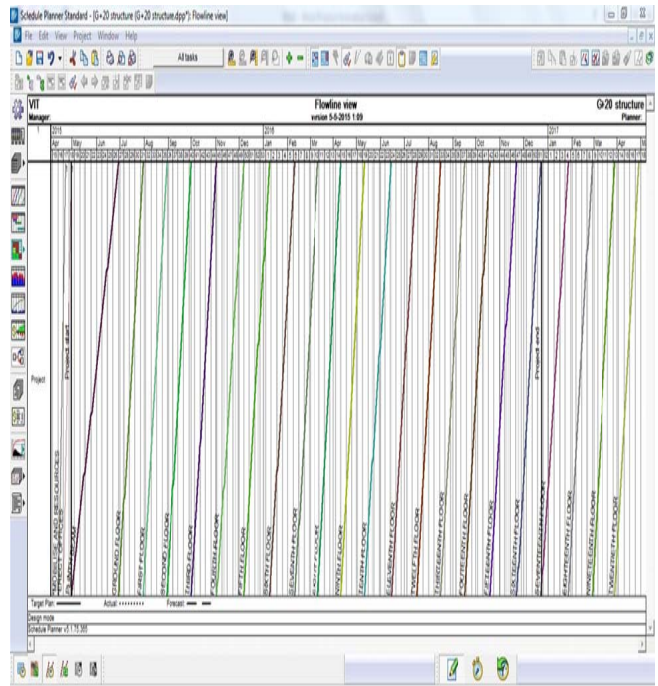


Fig.15 Flowline view

The consistency ratio obtained using Location Based Management System was 0.36% which is far greater than the consistency ratio obtained using CPM which was 3.27%.

CONCLUSION

G+20 structure was taken as a reference for making the schedule. The scheduling was done using the logic of Critical Path Method using the CANDY software manufactured by CCS enterprises. The following schedule i.e. the Location Based Management System has been prepared in VICO Control platform (Schedule Planner Standard). The following were optimized using Analytical Hierarchical Process.

It was found that Location Based Schedule provided a project with lesser duration than the CPM schedule, as the activities in Location Based Management were grouped location – wise and the activities could be started and advanced concurrently. Hence, there was no need to dedicate resources to different locations separately.

Both the schedules were analyzed using Analytical Hierarchical Process. In this process, lesser the value of consistency better the schedule. If the consistency ratio loco notes above 10% then the schedule becomes inconsistent. According to Annexure D and E it was found that the consistency ratio for LBMS was far lesser than the consistency ratio for CPM schedule. Hence, scheduling using Location Based Management System (schedule planner standard) is more efficient than the Critical Path Method Schedule.

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