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Imaging Software in Construction Management

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***Abstract*— The scheduling and imaging are used for efficient and economical ways of construction, there are several developing and designing software in construction. Virtual reality is now an emerging idea which is used in various areas. In the paper we could use developed modern software of GIS like 4D (3D geospatial + time component) in combination with AutoCAD to visualize the problems and eliminate various errors due to logic, time etc. Since we use 4D which is most effective and useful in analyzing, along with ARCMAP 10.2 which is used for finding the location and coordinates of the project providing digitized way of construction management. This is very useful for time management and easy understanding of various issues and errors in construction project visually.**

Keywords— *GIS, AUTOCAD, ARCMAP, Virtual Reality.*

I. INTRODUCTION

The key part of construction is planning and execution along checking which are now done with more advanced developing software in the industry we must digitize the process which consumes time. The imaging software are used for better understanding and rectification of errors, the scheduling software like primavera and MS project are basically used by all construction they aim at reducing work and providing better time management in the industries. Project monitoring acts as safety step in construction of projects for reducing irrecoverable losses. Which alerts and advices the organizations about occurrence of construction failures, delay and the progress of the work. It includes the process of collecting, analyzing, and recording information regarding the project. Some of the conventional methods which are widely used by the construction managers for scheduling are bar charts, critical path method (CPM), and program evaluation and review technique (PERT). Construction scheduling tools such as Microsoft Project (MSP) and PRIMAVERA are used for the preparation of construction schedule. These scheduling tools cannot be able to provide digital information (drawings) for the respective construction components and construction activities which are identified in scheduling software. For better understanding of construction sequence and for providing better visualization of the construction progress the planner can make use of 2D drawings, by integrating or combining them with their corresponding component schedules in GIS software and by using 3D models and CPM schedules. , the linkage between the two has been made possible in ARCMAP and ARCSCENE is to develop a 4D model.

Advanced GIS visualization techniques such as 4D (3D geospatial + time component) and virtual reality should be utilized for more effective evaluation and communication of construction project schedule information. Therefore, it becomes easy to find errors in schedule, and small activities can also be completed without any delay. This 4D GIS view provides better visualization progress of a construction project and makes the planning sequence and execution easier to understand and allows a planner to visualize the construction process in the way it would actually be built.

II. OBJECTIVES

4D GIS tool has various advantages which have been widely used to not only incorporate spatial relationships but also analyze and visualize space across time.

4D GIS has become particularly essential in areas where GIS is needed for predicting dimensions across time and capable of providing spatial relationship between construction activities and can control cost overruns of the projects by early identification of problems, like time space conflicts, safety concerns, and working place restrictions, and so forth.

Along with these some of the advanced construction management software can be used instead of PRIMAVERA.

III. ROLE OF GIS IN CONSTRUCTION

Nowadays Geographical data system applications are mostly used in construction industries. The job of GIS is to collect read record and interrupt the data to be presented. Mostly it is used for live monitoring of hazardous and study areas. The limitations of a schedule generated in PRIMAVERA and Microsoft Project are explaining them which forced researchers to combine it with CAD drawings which leads to 4D GIS model created using ARCSCENE. However in 4D model technologies number of researches are increasing rapidly which demonstrates that these models are not easier to use in construction industry and the visualization provided by them is not easily customized. This demonstrates that 4D models in construction industry hinder the collaboration between the contractors and subcontractors. Koo and Fischer state that the construction industry needs a software tool which can easily generate, manipulate, validate, and interlinks the schedules with respective to 3-dimensional drawings in a single screen. The main role of GIS is to develop a strong GIS platform for seamless integration of databases generated across the projects along with satellite imagery which demonstrates that linking between GIS and CAD can be done with database management system has the potential to solve construction problems with the help of 3D models and CPM schedules. Basic concepts regarding this particular work are referred by following the above literatures stated and based on them work is carried out by making some new advancements in the procedures of the working. This work using GIS provides 4D visualization progress of project along with scheduled quantities stored in database management. The major aim of this study is to make use of GIS for scheduling activities and interlinking it with 3D drawings provides better visualization of construction progress.

A. 4D GIS MODELLING AND APPLICATION

A four-dimensional geographic system (4D-GIS) is employed as both spatial and non-spatial data processing platform. 4D-GIS effectively integrates, manages, and analyses spatial information and non-spatial information, outlined as 4D information (2D, 3D, and time amendment data). 4D modelling tool is a dominant tool that provides good visualization, simulation, and communication which gives concurrent access to style and to schedule information. Visualizing construction progress in 3-dimensional view along
with CPM generated schedule which helps the construction manager in a project with an automatic view of project sequence. 4D visualization helps the project planners in viewing the progress of construction activities in a project at any level. The occurred 4D GIS view provides better visualization progress of a construction project and makes the planning sequence and execution easier to understand. This 4D GIS model reduces cost overruns of the projects by early identification of problems, such as time space conflicts, safety concerns, and working place restrictions.

B. Methodology of managing software

- **Collection of 2D Drawings:** All structural drawings and 2D plans of the building which is being constructed have to be collected. For getting better output, it is mandatory to have the plans at different stages of construction project. These drawings can be generated in digital environment like AutoCAD.
- **Create Work Breakdown Structure:** Based on the type of construction project, various construction activities have to be defined. A Work Breakdown Structure (WBS) has to be prepared with the defined activities. Preparation of WBS involves a unique approach for various outcomes.
- **Importing of Drawings to GIS Environment:** The digital drawing files are exported to GIS software environment. The topological structure of the layers can be created in GIS software as identified in the drawings.
- **Geo-referencing and Digitizing in GIS Software:** Imported drawings are georeferenced with respective coordinates on all sides and digitized into required shapes by creating shape files.
- **Schedule Preparation for Activities in Work Breakdown Structure:** The project will be scheduled depending on activities which are listed in the Work Breakdown Structure. Project management software PRIMAVERA has been used for preparation of schedule which shows start dates and end dates, along with critical path(s) and the activity sequences and interrelation between activities can also be shown. Task names for the activities are given same in project management software and GIS for the purpose of interlinking.
- **Timely Updating of Schedules:** The schedules like start date, end date, and so forth created in planning software have to be updated periodically.

- **Creation Database for Activity Layers**: Shape files which are created by the process of digitization should have separate database which stores data about each activity in it.
- **Linking of Schedules** : Schedules which are updated after creation in planning software have to be linked with GIS software. Activity names and IDs for activities in which drawings and schedules are to be interlinked should be same.
- **Creation of 3D Geospatial Model:** The 3D view of the project is created in ARCSCENE which is another module of GIS software. The activity layers which are created earlier are converted into 3D layers in ARCSCENE. The 3D file developed should have the same resource data as like in schedule.
- **Preparation of Final 4D Output:** The concluding step in this process is integration of 3D drawings with their respective schedules prepared from planning software PRIMAVERA. Both drawings and schedules should contain same feature classes and same names for activity layers for the purpose of integration. Final result can be viewed in rendered 3d simulation along with the displayed time line slider. The developed GIS based application in planning and scheduling can be used for repeated tasks of works. In this step the drawings are provided in 3D view along with the respective schedules of each activity which provides better visualization of the construction project and provides the better understanding of the activity sequence in the project. The final output is termed as 4D drawing, that is, 3D view along with time component.

Figure1: flowchart for methods of GIS

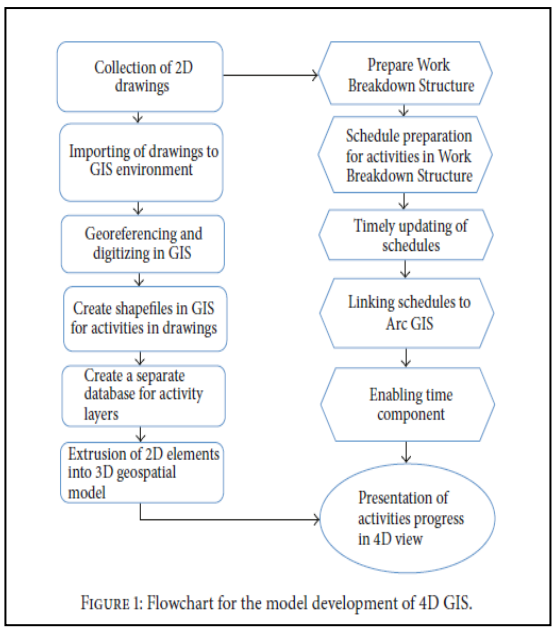


FIGURE 1: Flowchart for the model development of 4D GIS.

IV. SCHEDULING OF STRUCTURE

Scheduling is the process of allocation of resources for the activities identified in WBS which are required to complete the project in a stipulated time. The initial proposal of the study involves scheduling being done in the project management tool PRIMAVERA. This tool enables the effective scheduling related to work to be handled and it results in providing critical path for the project.

Steps involved in developing schedule are
(1) Estimation of time required for completion of each activity in a project;
(2) Setting out time intervals to each activity for start and finish;
(3) Adding logical relationship to activities.
The various scheduling methods used are

A. Critical Path Analysis

This method was used as basic analysis of construction procedure where the starting and ending dates are recommended in the corresponding CPM calendar excluding the holidays.
This method was basic and is used to analyze small residential buildings CPM method provides minimum amount of time needed for completing of activities and provides a complicated warning regarding issues that may occur. Variables such as activity durations, earliest start times, late start times, early late completion times of activities, and total budget of the project have direct effect on completion of construction project. Thus CPM assumes previous expertise with similar project works from that the relationships between resources and job times are made available. Different type's activities in a project prepared by CPM network are associated with more additional elements of a project.

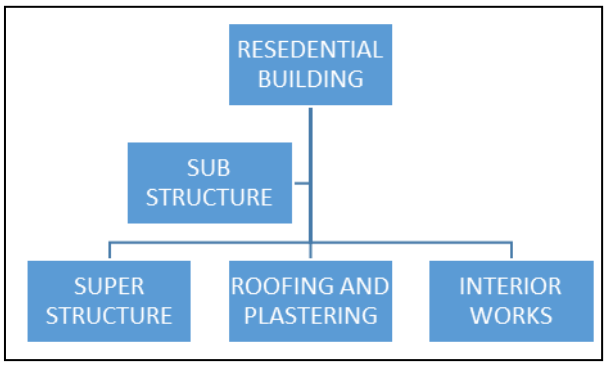
B. PERT

The method was used when there is to be a decision making process involving engineers mind and used for analysing various critical factors such as environmental, labour equipment failures and their results.

C. Work Breakdown Srtucture

The WBS is used widely in all the fields now a days in construction field they are used for arranging the works by distinguishing and classifying them according to their priority strength, time of construction etc.

Figure 2: Work Breakdown Structure for a residential building.



V. STEPS INVOLVED IN PROCESS

A. Modelling of 2D View to 3D in ARCSCENE:

The main objective of this step is to extrude the activity layers which has been created earlier in ARCMAP into 3D. This decisive step is in ARCSCENE software. ARCSCENE is a 3D visualization tool which facilitates in elevating spatial data into three dimensional. Steps involved in extrusion of 2D elements to 3D in ARCSCENE are as follows:

(i)After digitizing the drawing to the required shape, it is then replicated to topology which converts feature classes to polygons.

(ii)After creation of topology the shape file is imported to ARCSCENE environment for the purpose of extruding each feature class into 3 dimensions.

(iii)For projecting the image into 3D the coordinate system must be projected properly from geographic coordinate system to projected coordinate system, these coordinate systems are for the particular region where study area is located.

(iv) Building shape file in ARCSCENE is extruded into 3D model by giving elevation value to each activity layer. All the features of a building are extruded based on their standard elevation value from base level to floor level depending on its service.

(v) 2D plan of the building opened in ARCSCENE in Isometric view.

(vi). Complete 3D elevated view of the building along with their structural components.

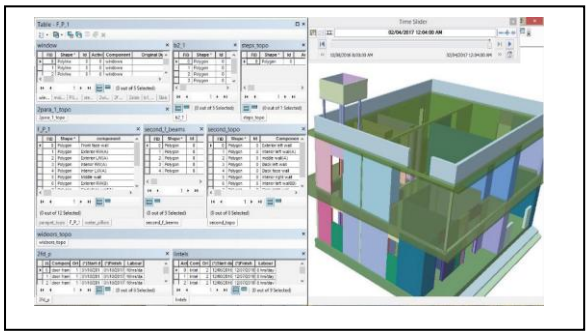
B. Importing of Schedule to ArcGIS Software:

Detailed schedule prepared for the activities of the building has to be imported to ArcGIS software for the purpose of interlinking it with the 3D simulation output. The prepared schedule was saved in Excel format and it is exported with the help of exporting option in PRIMAVERA. The detailed schedule which is prepared in PRIMAVERA software is exported and stored in GIS database. The attribute data in the Excel file may get lost if it is imported to the GIS software in Excel workbook format. CSV (comma-delimited) format is able to transfer data from one application to another application without losing any data. This imported schedule can be updated at any stage of the project.

C. Staging of 4D View by Integration of Schedule and Drawings:

This is the crucial step in overall simulation of the project. This step involves the integration of 3D drawings which are created and extruded in GIS and schedule prepared in PRIMAVERA to provide better visualization of construction progress of the project. This dynamic linkage helps in detecting deficiencies and logical errors in scheduled project. Every activity in the project is provided with time component. Interlinking between scheduled data and drawings will be done only if the activity layer names and IDs for activities are the same. It will keep only the matching records in both digital data and scheduled data. Unmatched records will be left as null values for all the remaining fields in the attribute table. After interlinking of both spatial and non-spatial data of the building 4D view of the building is presented in a single screen environment, which shows the complete 4D view of building along with their respective schedule for each component. Time line slider is also assigned to the 4D drawing which shows the timely extrusion of each component with respect to their derived schedules. 3D components are elevated periodically with their respective schedules by time line slider which are linked to them earlier, the simulation of the construction planning process along with time line slider for first floor of the building, the timely extrusion of structural components of second floor of the building along with the prepared schedule on a single screen. Final output shows the overall details of a project from beginning to end along with the schedule information being seen in a single environment in 4D view which provides good visualization of construction project.

Figure 3:Final view of the project along with its scheduling anddetails.



Conclusion

The use of these integrated software provides new ways to analyze and program construction works and make it easy to coordinate as it is by image processing and they also help us to computerize the programs which is easy to store and retrieve also it helps to provide easy understanding for beginners and reduces time spent on explaining and increases on checking and improving the efficient way of working.

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