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Monitoring the Construction Project by 4D Application of GIS

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Abstract: ***Construction technology is more important for project management, as it influences on construction schedules and monitoring. The construction commerce requires a very perfect preparation of planning, development of schedule and monitoring the construction process of the plan exertion which permits the complete optimization of the rate, spell and incomes. The paper promoting the 4D GIS concepts and integration technique and representation of non-spatial and spatial information's such by means of drawing, resource, and prepared schedules in same GIS environment. s Instead of using the older, traditional methods of auto CAD drawings and schedule sheets, one can integrate them on a stage to create a 4D view of the project using GIS. The project presenting a 4D application of GIS in construction technology and management, by introducing Microsoft project (MSP) and ARCGIS or ARCMAP, which integrates schedules, 3D model of Building plan and resources composed through 4 Dimensional skill to deliver 3Dimensional + 1 Dimensional =4Dimensional Graphical picturing ability for monitoring the construction project site. In this project a G+1 building has been selected for the research in which all the working drawing are converted into 3D plan and according to it schedules are prepared in MSP software then they are imported into ArcGIS environment to get 4D output. This 4D output provides better visualization of construction work progress by which the engineers can trace the technical error of the project by taking better decision and can monitor the delay of work to reduce the cost overrun of project and rework can be avoided by early notification.***

Index Terms**: Auto CAD, Microsoft project, ARC GIS, ARCMAP,**

I. INTRODUCTION

The construction project will not be successful without proper scheduling, proper planning and proper monitoring of the work activities. Thus proper monitoring of the construction activities will overcome the cost overrun and time, which alerts the project team about delay and construction failures [1]-[2].

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Such proper monitoring construction project system are required to complete the work in planed time and in a estimated cost by which accurate work and productivity of the work improves [3].

Currently for g+1 typical building project, the proposed construction work is communicated with civil contractor through 2D CAD working drawings in a paper grounded format. The contractor should have capability to understand the working drawing and it is his responsibility is to make decision with his planning team how and when to implement this plan with the schedules. Thus the planning team follow-ups the plan and schedules by working on drawing. The planner not only concentrate on the work which has to be implemented but also he looks after needs like equipment's, plants and other facilities which are required to complete the work in given time. For the planning team to take action towards the time line scheduling for working drawing and all plans are put into a time frame [4]. The traditional techniques like CPM, PERT, bar charts etc, are used for scheduling process by project managers. These are used for planning hence it became a disadvantage in choice making as tshey fail in providing the required spatial thing and data. If the proper monitoring fails then there will be pressure on the project managers to reduce the project delivery time and reduce the project cost by this process without effecting the project hand over time and project quality [6]. The above tools are not able to give clear digital information like drawings for working activities. Hence, the planner gives good information of providing 4D output for better visualization of the building construction. Project planner uses the working drawing to get 3D output and linking it with planed schedules in GIS software [1]. The 4D modeling is all about four dimensional demonstrating, that refers to three dimensions of working project model and one dimension of work time table [7].The network analyses and bar charts we can get beneficial on the traditional tools , it provides construction scheduling and 3d CAD model of building to get 4D visual by combining both plan and scheduling.4D-Planner is a imagining, imitation and communication instrument that delivers simultaneous admission to drawing and timetable data. 4D view provides a graphical view of the working plan which brings identification of problems in early stage. The advantage of 4D technique also helps in collecting the required things for construction work planning [8]. Progressive visualization methods such as 4D (one time component+3D drawings) and simulated realism should be used for actual assessment , statement of construction work project and timetable information. Hence, it becomes easy to bargain out mistakes in schedule, and small works can also be constructed without any delay.

This 4D view in GIS gives good imaging progress of a construction work and makes the execution easier. It also helps in planning sequence to identify and allows an organizer to visualize the construction process in actual way [3]. Unambiguousness in the work project timetable will reduce the potential mistakes during the construction work. Building work plan with required picture related to building elements as a shape file using ARCGIS software which help to connect with schedule prepared in MSP software and combining it with drawing to get 4D outputs. Hence project becomes very easy in spotting the errors in the timetables without taking much time. The four dimension view of GIS has provided a better propose in construction project and planning process and allow the organizer to view the work process of construction the way it should be actually built. The building plan with required themes easy to evaluate the shape file by using the GIS software that is mainly connected with construction schedule activities.

1.1 BACKGROUND OF PROJECT

A. Role of GIS in monitoring construction site

The usage of geographical data system application has become more now a day in construction industries. The limitations in usage of the Microsoft project in research are to include CAD drawings that leads to 4D GIS model. In the 4D model technologies, the research is increasing rapidly. However, the model is not so easy to use in the construction process because it is not so customized. The construction industry requires software tools that can easily generate manipulate, validate and links the schedules. The main importance of GIS is to develop a strong GIS for integrating the database that are generated over the project with satellite imagery. This working by usage of GIS provides 4D visual progress of the project with quantities stored in data base management. The main aim in this study is to make usage of GIS for the scheduling and give a better visualization of progress in construction work.

B. 4D GIS Modeling

The 4d dimensional geographic system (4D GIS) is described as spatial and non-spatial data process platform. The 4D GIS mainly helps in integrating, monitoring, analyzing the spatial information, non-spatial information that is lined in 4d modeling. The 4d information includes the 2D, 3D time amendments data. The tool is very much dominant that give many number of access to design and schedule the information. The 4D tool provides knowledge in construction technique regarding the collaboration. The 4D tool for planning helps the planners in minimizing the schedule conflicts, constraints analysis and different way in construction evaluation. The visualization of a construction in 3D view with CPM generates the schedules that help the manager of construction in a project with an automatic view of project sequence. The help of 4D visuals in planning the project and viewing the construction progress activity in any level. The advantages of linear scheduling and 4D visualization are use of different scheduling techniques, link activities and information schedule that provides data information and reduce the incompleteness in information. The spatial data is drawing that are directly related to the geometry of GIS layer. The GIS 4D view gives visualizing progress of construction project work and sequence planning and easy execution to understand. The 4D GIS model helps in reducing the cost of projects by early identification of the problems like time conflicts, safety, and restriction in work space.

II. METHODOLOGY

The methods have been developed for integrating the GIS preparation of 4D construction schedules. There are some methodology that is being developed for the purpose of integrating schedule and 3d plan in the GIS and preparing the 4D schedule constructions. The flow chart diagram explains the several steps involved in development of model.

a. Collection of 2D plan: The building plan that has been drawn by using CAD is collected. It is compulsory in getting the output, we have to plan a different construction project stages. Using the digital environment like auto cad different drawing can be generated.
b. Create work breakdown structure of project: The preparation of a WBS has to be done with respective of defined work activities. There is a unique approach for verities of outcomes which included in preparation of WBS.
c. Importing of CAD drawing to GIS software: The exporting of digital drawing files to the GIS software environment is done. The layer structure can be created in GIS software are defined in drawings.
d. Creation of shape files in GIS software: The geo referencing of imported drawings are done with co-ordination of all the sides and digitized into an shape by means of shape file creations.
e. Preparation of schedule for activities in work breakdown structure: The project is scheduled with respect to activates that is listed in work breakdown structure and the name for the tasks for activities is given the same in management of project software and GIS for the interlinking.

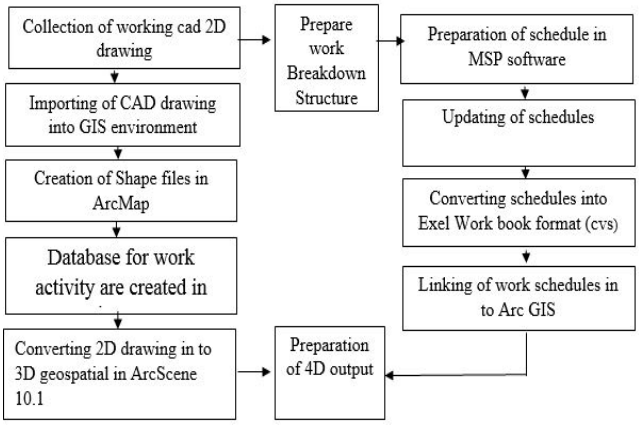

Fig 1: General Methodology [1].

A. Time to time updating of schedule: The schedules includes the work project start and work end date and so far are generated in software planning and have to be updated time to time.

B. Creation of Database for Activities: The method of creating the shape flies for the digitization need to have an separate the database that can store the data about the each and every activity into it.

C. Schedules Linking: Schedules that are updated after creating the plan that need to be linked with the GIS software. Name of activities and identity for the activities in which the timetable and drawings are to be interlinked should be same.

D. Preparation of 3D geospatial model: The construction work project 3 dimension view is prepared in an ARCSCENE that is other different model of GIS software.

E. The prepared layers of activities are converted into 3D layers by ARCSCENE. The resource data that are present in schedule should be same in the developed 3D file.

F. Preparation of final 4D outputs: The schedules and drawings should have the same feature class and same name for activity layers for integration. At the end the result can be seen in the form of 3D simulation with a display of time line slides. The GIS application in scheduling and planning can be used for varieties of tasks that are repeated in works. 3D view drawings are given better visuals of construction project and give a good understanding about the sequence of activities in project. The final output is called as 4D drawing that means the 3D view with a time component.

III MODEL DEVELOPMENT AND APPLICATION

A.Creation of Architectural Drawings: The first step is the creation of the plan of the project. For a better model, it is required to have the plan of the project. The CAD plans of the building which are drafted for particular project were collected for the G+1 building Work Breakdown Structure activities has been prepared out. The construction step constitute cleaning of site, lineout marking, ground structural work, structural work, brickwork and plastering. More accurate CAD plans will help to get more accurate G+1 building 3D model.

Fig 2: Plan Of G+1 Building

B. Work Breakdown Structure: The procedure of identification of the work breakdown structure includes a different method for different construction projects. For the present G+1 project, the stages of work identified for work breakdown structure are: PCC, Foundation work, Pedestal work, Plinth Beam work, Columns work, Wall work and the Roof work. These stages are to be identified based on the raises of the project components. FIG 3. shows the formation of effort analysis construction of the plan. work breakdown structure that are essential to wide spread the construction plan work in a required time, Creating work break down structure remained whole to make the construction work plan manageable. The principal amount includes sub structure work, i.e. doings associated to mine basis pit, foundation footing concrete work, foundation plinth beam work, back filling, and concrete base block. In another portion includes construction, i.e. actions connected to column work and masonry walls and interior partition walls, doors, windows and flooring. Portion three includes actions relating toward building rooftop construction work and part four involves electrical work and plumbing work etc. The same process is repeated for 1st Floor. Every of these measures are checked as a dissimilar understanding in module of ArcGIS Software.

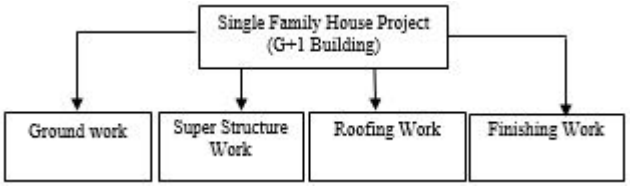

Fig 3: Work break down structure

C. Scheduling Process: Programmer Training in MSP Software. Appropriate preparation and preparation of structure plans are essential for respectable building results then abridged price then lessen postponements of the edifice scheme.

Appropriate development of travels stands compulsory toward pathway the exertion growth of the edifice scheme. The foremost aim of this structure development stays towards well-known up, calendar, tube, and path the housing G+1 development through popularization of MSP software then kind of fallouts engendered. Cutting-edge building plans exertion, (CPM) nets, PERT networks and bar chart systems are most common preparation used for preparation of schedule which helps in showing the start date and completion time, locating the critical path of happenings, viewing the preparation then interrelationships among the different work activities. The activities are identified based on the WBS for the project scheduling .The early start of project and early finish of project will give the income of the work project, hence early start and late finish project will give the loss statement. Work break down structure is very important for groundwork of schedule of work project. The schedule includes the cleaning of work site, lineout marking of footing, excavation of footing pit, plinth beam or Tie beam, shuttering and concreting column work, wall construction work, slab shattering work, RCC, casting of slab, flooring work etc. Based on the project detail calculation, the labor requirement and work progress (PR) scheduling is done. The projected Schedule of the project is given in table. The Steps elaborated in developing schedule are (1) approximation of period obligatory aimed on conclusion of each construction movement fashionable exertion plan ;(2)established obtainable spell breaks towards

D. each motion aimed at labor jerk and slog quality;(3)calculation common-sense rapport toward doings. Toward brand the scheme well-organized then wieldy WBS remains shaped.

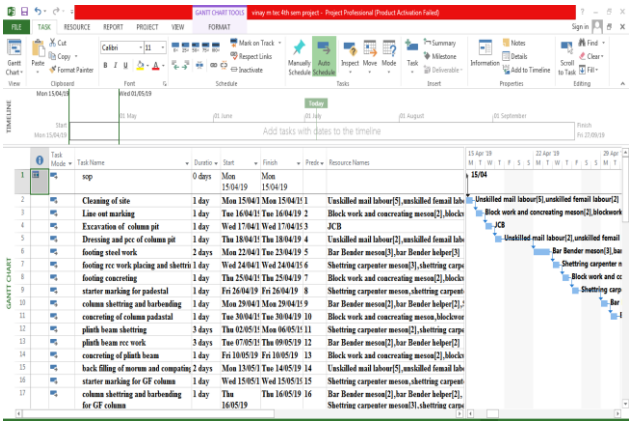

Fig 4: Preparation of Schedule in MSP Software

E. Modelling 3D View in ARCGIS: To draw3D drawing, we have to export the 2D drawing plan drawn in ARCMAP to ARCSCENE. The main objective of the exporting to ARCSCENE is to assessment the 2D plan into 3D drawing hence ARCSCENE is a tool used for visualization of 3D view of plan. The steps involved in preparation of 3D drawing. Thereafter, export to CAD or Photoshop, the 2D drawing can be drawn in the ARCMAP by setting the polygon classes. Later, creating topology shape file of the 2D drawing background. Then creation of shape file, we have to save the file in any of the drive. Then export topological shape file into ARCSCENE. Environment for developing 3D drawing. For the development of 3D image first we have to select the proper coordinate system in geographical coordinate system to project system. In geographical coordinate system, WGS1984 and project coordinate system is UTMZONE44N.Coordinate system is for the particular reference for a study area location. For modeling 3D image we have to enter the elevation value for each activity layer of the building shape file, for every element or layer are formed for each layer, according to the required height elevation value are given depending on the requirement.

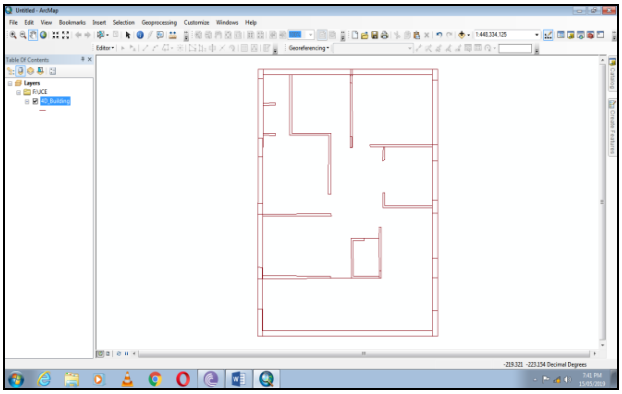

Fig 5: 2D drawing in ARCGIS

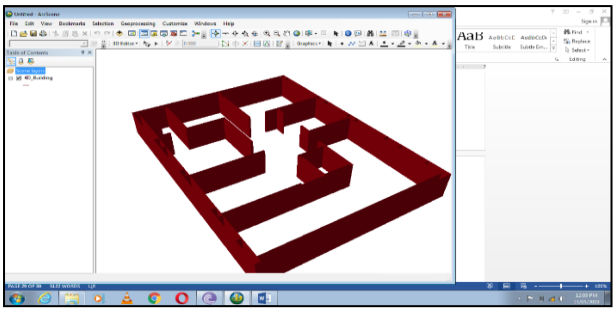

Fig.6: 3D plan in ARCGIS

E. Importing of Schedule to ArcGIS Software: Complete schedule arranged for the activities of the building project has to be imported to ArcGIS software for the purpose of interlinking it with the 3D model output. The ready schedule which is saved in Excel format and it is exported with the help of exporting option in MSP. The complete schedule which is ready in MSP software is exported and stored in GIS database. The specific data in the Excel file may get lost if it is imported to the GIS software. The CSV Format is able to transfer data from one bid to another application without losing any data. This introduced schedule can be updated at any stage of the work project.

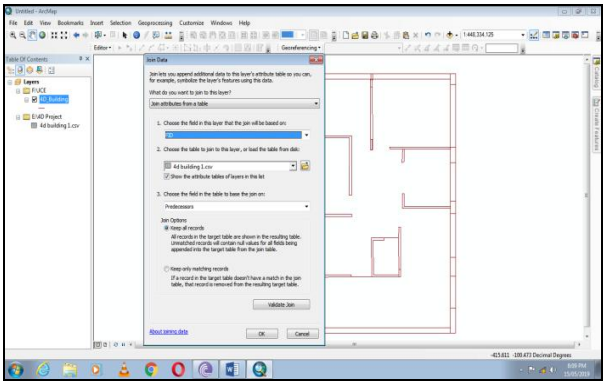

Fig. 7 : Importing of Schedule to GIS

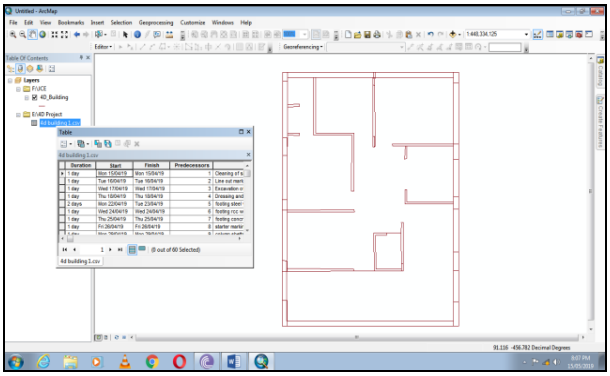

Fig. 8: After Importing of Schedule to GIS

G. Staging of 4D View by Integration of Schedule and Drawings: This remains the serious step in overall simulation of the project work. Present step includes the integration of 3dimension drawings which are completed and extruded in GIS and schedule prepared in MSP to give good visualization of construction work progress of the project. This active linkage helps in noticing logical errors and deficiencies in planned work project. Every action in the project is provided with time component. Interlinking between planned data and 3 dimension drawings will be completed only if the present layer IDs and names should be same. The software will keep only the matching data in both scheduled data and digital data. The unmatched data are said to be null hence they left in table. After doing interlinking step of both three-dimensional and non-three-dimensional data of the building, we will get 4D view of the building project in a single software screen. 3D parts of the building are elevated and they are linked with schedules prepared for that element of the building. Finally, the figure give the complete details of a building project from starting of building project to last step of the work project along with the schedule in one software screen. 3D+1D view which give good visualization of work in building project.

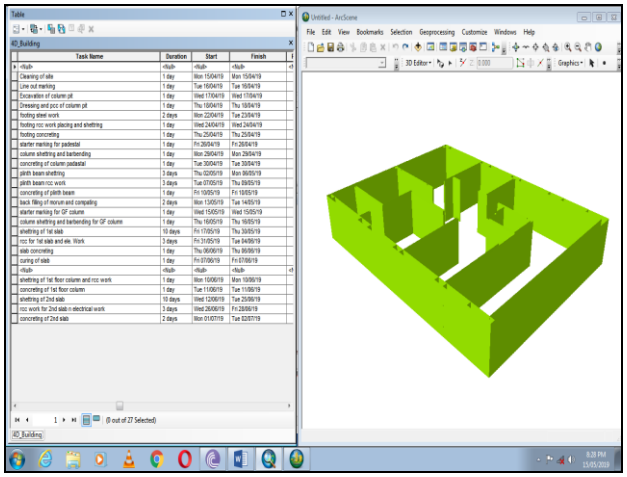

Fig. 9: 4D out put

IV CONCLUSION

The method proposed in this paper is to promote the monitoring the construction project by 4D GIS concepts and integration and representation of non-spatial and spatial information's such by means of drawing, resource, are prepared schedules in same environment. Integrating of MSP and GIS is being done in the development of 4D model that gives the good visualization about the progress in construction of projects. The links between the activities scheduled and drawings in GIS helps in the identification of steps in construction and the finding of errors logically that arrives in schedule project. The 4D GIS is becoming the major important in areas where GIS is required for determining the dimension of space other than 4 dimension GIS technique. This method needs a proper plans of activities and the linking of drawings. Hence, this considers as only 3D visual activities except the flooring, electrical, finishing work carpenter work and so forth.

This 4D output help the project manager to monitor the construction site to take hold on the work progress of the project and keep the up to date information about project progress. It mainly helps in handling and controlling the sites of big project. It keep tracking and understanding the cost incurred during the construction progress. As per project progress goes on , the project manager gets a track for checking the time estimates involved and helps in reducing the time required for decision making as all about the information of project will be in single environment.

Hence, the site engineer gets main help from 4D output in controlling the project site by knowing the work progress of the project. 4D GIS make it easier or possible for decision making for capturing the information about funds or materials. It makes site engineer easier in checking the required materials for construction. It mainly provides an assistance in decreasing the material wastage and ordering the required amount of materials according to work progress.

As client plays a main role in the project. 4D GIS assist him role in the current status of the project. It helps in knowing the 3dimensional view of project work progress and helps in understanding the cost estimates.

As customers are the main source for investment, this 4D output of GIS gives them knowledge about the actual progress of the project site without going to see the site, that which makes the customers to save lots of their precious time.

The methods in the paper are not only gives the better visuals of construction, it also gives the extraction of component with schedule. The rework can be avoided by early notification of the problem through layer wise 4d views of project.

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