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3-Dimensional visualization and animation of a construction schedule of a single storey building – 2021

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ABSTRACT

Construction sector needs proper scheduling, planning and management procedure for any project which leads to improve the general optimization of the time, cost and resources. The planner utilizes the 2-dimensional drafting tools and follows the contents of the illustrations with respect to exercises of the construction schedule for which Primavera and Microsoft Project for the scheduling process and AutoCAD for drafting plan and to visualize, decision making of various construction activities are used. It involves multi environment for managing construction activities and time consuming too which in turn affect in clarifying the status of the project to the customer making it exceptionally tedious and troublesome. With this process the customer and store manager will not have the idea of the specialized terms used in the graphical representation and schedule. Thus the construction company necessitates an implement which can impact the 3 dimensional components and the schedule in particular individual environment from multi environment. Majority of commercial software's used to generate a 4-Dimensional model but they don't have the important functions like creation and modification of the created model in a single environment. Apart from using trivial methods of project schedule sheets and manual drawings, one can combine both in a single environment to generate the 4-Dimensional model in the GIS software. The objective of the current study was to create 4D model (3D geospatial model + time component) in a single platform using GIS for single storey residential building. The dynamic linkage between the drawings and respective scheduled activities in the GIS software helps in visualizing construction sequence and identifying logical errors that can occur in schedule. The proposed GIS based methodology can be used as replacement to many trivial manual techniques to take out the data from the accessible database and can easily maintain and modify majority of the information in the digital format.

Keywords- GIS, Planning AND Scheduling, 4D Model, Construction Industry

1. INTRODUCTION

Construction industry constitute a significant part in the improvement of any nation. It is one among the biggest business in India and provides highest number of employments. The development of this industry differs from one nation to other nation as it is more dependent on development of cities. Proper planning, viable working pattern of crew, Movement of resources whenever needed are the key elements making a construction project successful. Each one of these components can at last prompt ideal expense and time usage. The principle point and objective of project management is to forestall any building collapse or to recognize factors that can expand project cost or its consummation time as early as possible, which is accomplished by gathering suggestions from project supervisory crew and furthermore discussing it for possible solutions.

GIS (Geographic information system) is a PC framework for gathering, recording, quarrying, investigating and showing geographic information. GIS is a unique class of information system which is divided into 4 components involving: computer system, GIS programming, human master and the information.

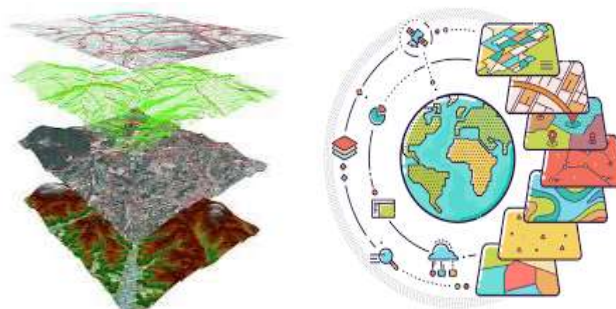


Fig. 1: GIS (image source -google)

Correct planning and scheduling of activities leads to effective execution of the construction project. This effective execution of project brings advancement in expense and time. Progress observations acts as security stage in Construction industry which alarms and informs the associations regarding event of building failures and postponements. It incorporates a way towards gathering, dissecting, and recording data in regards to the undertaking. A portion of the customary strategies which are generally utilized by the Project chiefs for planning are bar graphs, critical path method, and program evaluation and review technique. Digital project scheduling instruments, for example, Microsoft Project (MSP) and PRIMAVERA are utilized for the arrangement of project schedule. These planning instruments can't have the option to give advanced data (drawings) for the particular building segments and Major Construction works which are recognized in the scheduling software. For greater comprehension of Construction activities and for giving good perception of the building works progress organizer utilizes 2D drawings and coordinates it with their relating part plans for GIS programming. New headways in navigable GIS programming are utilization of time segment which aid organizers in portraying certifiable segments. Utilizing CPM schedules and 3-D model as sources of info, interlinking both of them has been made conceivable in GIS to build up a 4D model. GIS thus is a platform where both nonspatial and spatial information, that is, drawing parts and their action plans, are incorporated for effective execution of the work by giving great representation. Progressed visualization procedures, for example, 4-D meaning 3-D geospatial + time segment and computer-generated reality ought to be used for more compelling assessment and correspondence of project schedule data.

Along these lines, it turns out to be not difficult to track down consistent errors present in schedule, and little activities may be finished immediately. This 4-D GIS gives neat representation of a Construction undertaking and makes the planning process and execution clearer and permits an organizer to imagine the Construction cycle in the manner it would really be fabricated. Conceivability in the venture schedule will diminish the expected errors and clashes in the schedules during the process of construction. Building plan with the comparing topics identified with rise as a shape record utilizing GIS programming was associated with the schedule for Construction activities created utilizing PRIMAVERA project organizer and synchronized something very similar with time.

Part of GIS in Construction Management.

These days Geographical information systems are generally utilized in Construction enterprises. The impediments of a schedule created in PRIMAVERA and MSP constrained analysts to consolidate it with CAD drawings. The Construction business needs a product instrument which can undoubtedly create, control, approve, and links individual 3-D particular drawings with schedule in a solitary screen. The fundamental job of navigable GIS is to build up a solid GIS stage for consistent mix of information bases created across the ventures with satellite images. Connecting among GIS and CAD with information base administration framework can possibly take care of Construction issues with the assistance of CPM schedule and 3-D models. Work utilizing GIS gives 4D perception progress of undertaking alongside planned amounts put away in data set administration. The significant point of this investigation was to utilize GIS for planning and linking it with 3-D drawings gives better representation of Construction sequences.

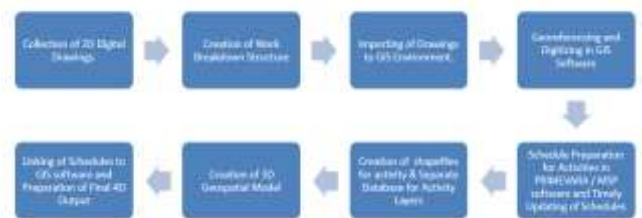
4D GIS Model

GIS software can be utilized as an interface in which all venture related data or records can be utilized to store and refresh according to prerequisites. Utilizing GIS programming and building information modelling (BIM). 4D models with some reasonable interface can be created to arrangement information base administration framework for all periods of building Construction. GIS and Construction schedule can be interlinked to help project administrators in controlling and following Construction progress for better agreement and straightforwardness in dynamic. By making between connection among activities and their individual 3D components, it can likewise assist with discovering errors in plan progress and plan of construction by using 3D parts in discrete layer. Incorporated 4D model can be created utilizing BIM-GIS for understanding progression of materials, accessibility of resources and guide of separate Construction store network the board.

GIS offers help for taking care of archives viewing Construction project, for example, site layout, structural and non-structural drawings, sub surface details, super structure details, construction specifications, emergency evacuation plans, safety rules through efficient methodology. GIS model stores data about execution grouping, building site design, and every day plan and can assist us with foreseeing unsafe circumstance in order to take important early careful steps.

2. METHODOLOGY

On a residential house, the suggested technique of interlinking Primavera and ArcGIS is used primarily for Scheduling, overseeing and tracking the construction progress. The current study's methodology will be built by using a GIS tool to create inter-relationships between 3D structural components and project schedules. Both AutoCAD and Microsoft Project were used for 2D drawings and activity scheduling, and both were incorporated into ArcGIS.



Assortment of 2D Digital Drawings

Many of the schematic drawings, structural details and 2-D plans for the structure that is now being planned must be gathered. It is necessary to provide designs and 2-D plans at various phases of the building progress in order to achieve better results. Computerized platform such as AutoCAD is used to produce these drawings. More precise 2D drawings result in a more precise three -dimensional model of structure.

Drawings are done using acad iso template in AutoCAD software. Units is set to meters and decimal precession to 2 digits also the limits were set to 1000 units by 1000 units. 2D plans created at 13 different layers for the current project such base concrete,first footing,second footing , plinth wall, plan above plinth wall , plan above sill level , lintel, plan above lintel , beams and columns , slab , parapet wall , door and window frame sections ,doors and windows .All the above files are saved seperately in .dwg format to import into the ArcGIS software.

Formation of Work Breakdown Structure

Different building activities should be defined in light of the form of construction project. For the defined tasks, a work

breakdown structure (WBS) has to be created. WBS planning involves a specific approach with various outcomes. WBS is designed to make the project knowledgeable and easy to handle. Scheduling cannot be done until a WBS is structured. The WBS acts as a standard platform for other activities, including scheduling, planning, financial projections, money management, testing, documenting and project management. The WBS's objective is to have specific deliverables to crews and sub-contractors to communicate the building process that are going to be used to generate the deliverables. Specify quality management and test approval requirements and include performance checkpoints.

Bringing in of Drawings to GIS Environment.

The drafted drawing plans generated in AutoCAD in the .dwg format is transferred to ArcGIS .GIS programme will establish the spatial information of the layers as defined with in drawing. The ploygon and polyline features are grouped before being exported to the GIS platform.The projected coordinate system WGS 84 UTM ZONE 43N was chosen for inserting CAD drawings into the ArcGIS.

Georeferencing and Digitizing in GIS Software

Obtained digitally drafted plans are geographically referenced and decoded into needed form by making shape files with unique co-ordinates on each line.Shape files are an easy ,non spatial way to save geometrical position and geographical feature attribute data. The user can apply various colors to data themes and shape files to differentiate between the various themes. In shape files, the spatial information and attribute record have an unique relationship. The data from the attribute table serves to highlight the respective geographical element and vise - versa.After georeferencing ,the CAD drawings are translated into shape files like polygon,lines and points. After digitalising shape files are then converted into vector data.

Schedule Preparation for Activities in Work Breakdown Structure.

The undertaking will be planned relying upon activities which are recorded in the Work Breakdown Structure. Venture the executives programming PRIMAVERA will be utilized for arrangement of schedule which shows start dates and end dates, alongside critical path(s) and the action successions and interrelation between activities can likewise be appeared. Names for the activities are given same in Primavera programming and GIS to interlink.

Generating Database for Activity Layers.

Shapefiles created by that of the cycle of digitization process ought to have different information base that records information about every operation in database and this can be updated as an when required.Information such as FID (unique number) and many other things are being added in attribute table.

Making of 3D Geospatial Model.

The 3D perspective on the undertaking is made in ARCSCEne which is another module of GIS software. The movement layers which are made before are changed over into 3D layers in ARCSCEne. The 3D document created ought to have a similar asset information as like in plan.

Connecting of Schedules and Creation of 3D Geospatial Model.

Schedule arranged for the different events of structure and the 3-D model generated must be incorporated into ArcGIS programming to interlink with each other. Export function in the PRIMAVERA software is used to get the arranged schedule data

into ArcGIS which was earlier stored in the format of Excel. As the format of excel losses some of the data while transferring from one software to another software. Comma-separated values format allows the data to be transferred without missing any information from one software. At every point of the project, this schedule can be revised. Schedules revised in planning software after development need to be connected to GIS software.Titles of the activities and their FID's should be identical with tasks to be associated with schedules and drawings. In ARCSCEne, a component of GIS software, the 3-D perspective of the building is developed. The previously generated operation layers are transformed from ARCSCEne into 3D layers.The established 3-D file ought to have a similar resource information as like in Schedule.

Study Area and Implementation

On a residential house, the proposed technique of linking PRIMAVERA and ArcGIS is used primarily for scheduling, overseeing, and tracking the construction progress of the project. WBS's 2D drawings of the building at various stages of construction and various events are imported into ArcGIS software.

Assortment of 2D Digital Drawings.

The structure's 2D plans, which were drafted in AutoCAD for a particular mission, were gathered in the proper configuration. The structure activities' Work Breakdown Structure (WBS) has been completed. Foundation work, structural work, brickwork, and completions are all examples of construction activities. More accurate 2D plans result in a more accurate 3D model of the structure.

Preparation of schedule in PRIMAVERA Software.

Construction project preparation and scheduling are critical for reduced and less frequent postponements of the project. To follow the undertaking during its execution, proper activity scheduling is required. A warning system that can alert the Construction company to its potential success as well as failures in the venture must be available. The main goal of this examination unit is to use PRIMAVERA programming to set up, schedule, screen, and monitor a residential building, as well as to understand the results generated and to recommend which technique is best for a residential structure. (CPM) organisations, PERT organisations, and bar graph techniques are the most commonly used plan scheduling strategies in construction projects. It includes the calculation of the first and later start of activities, slack periods, and float of activities, as well as the optimal resource allocation for activities that are on the project schedule. Because of some of the flaws in the bar chart diagram system, the CPM method tends to set the schedule and monitor the project. The CPM technique reduces the amount of time taken to complete tasks and provides a muddled warning about potential issues. Factors such as the total budget, task durations, early and late completion times of operations, earliest and late start times of activities, and the project's overall financial plan have a significant effect on the project's success.

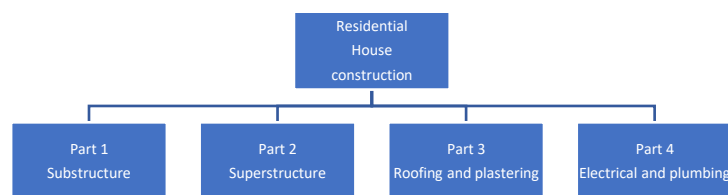


Fig. 2: Work Breakdown Structure for a private structure.

As a result, CPM anticipates previous experience with similar role works from which the relations between assets and occupation times can be accessed. Various types of tasks in a task organised by the CPM network are linked to further extra components of a venture. There are two phases to creating a project schedule.

I Determining the Work Breakdown Structure (WBS) for various activities

(ii) Schedule preparation and implementation for defined activities.

The WBS is designed to make the project efficient and manageable. Base floor, Base progresses, Columns, Beams, Back face divider, Front face divider, Exterior left divider, Exterior right divider, Interior left divider, Interior right divider, Middle divider, Slab, Windows, Lintels, Windows, and Doors are all construction tasks that should be included in PRIMAVERA for structure design. Figure 3 shows produced plan dependent on the determined information, time, and prerequisites of work.

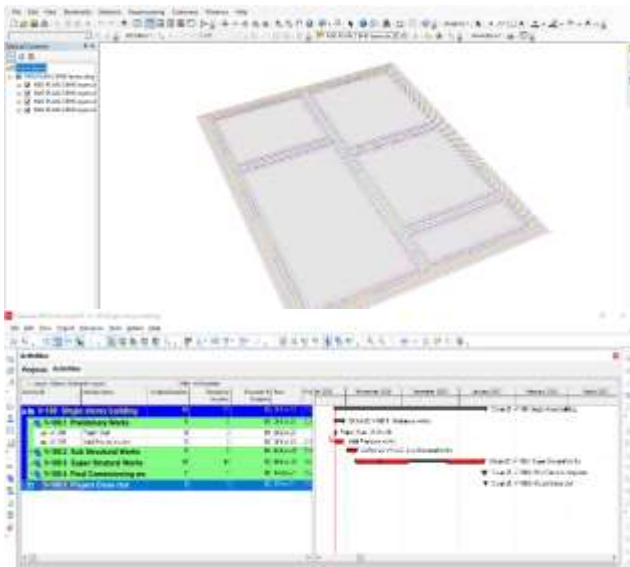


Fig. 3: Schedule of preliminary works



Fig. 4: Schedule of Sub structure works

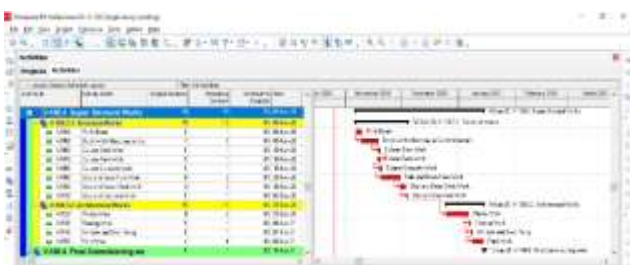


Fig. 5: Schedule of Super structure works

Modelling of 2D view to 3D in GIS Software.

The main goal of this progression is to extrude the previously created activity layers into 3D using ARCMAP. This is a breakthrough in ARCSCENE programming. ARCSCENE is a

three-dimensional perception application that operates by elevating spatial data into three dimensions. The following are the steps involved in extrusion of 2D components to 3D in ARCSCENE:

(I) After digitising the part to the required form, the topology is recreated, converting the feature classes to polygons.

(ii) Once the topology has been developed, the shapefile is imported into the ARCSCENE programme, which separates each component function class into three measurements.

(iii) In ARCSCENE software, the building shapefile is extruded into a 3D model by giving each activity layer a base height. From the building's base level to the floor level, all of the elements are extruded based on their normal elevation value.

Figure 3-Isometric view of plan

(iv) Figure 3 shows 2D arrangement of the structure opened in ARCSCENE in Isometric view.

(v) Figure 8 shows the total 3D raised perspective on the structure alongside their primary parts.

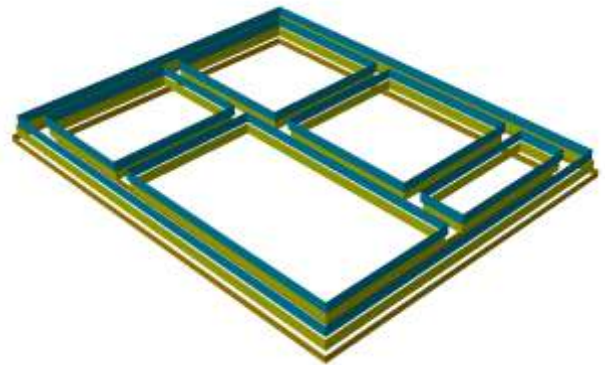


Fig. 4: 3d model up to foundation

Bringing in of Schedule to ArcGIS Software

The schedule for the structure's operations must be imported into ArcGIS programming in order to be linked to the 3D model. The prepared plan was saved in MS Excel format and sent out with the help of PRIMAVERA's export option. The schedule generated in PRIMAVERA programming is transferred to the GIS platform and saved. If the Excel document is imported to the GIS programming in Excel exercise manual setup, the unique details in the document will be lost. The CSV (comma-delimited) format allows you to transfer data from one programme to the next without losing any information. This imported schedule can be changed at any time during the project.

Organizing of 4D View by Integration of Schedule and Drawings

This is a significant step forward in the project's overall development. This phase combines 3D drawings created and extruded in GIS with a schedule created in PRIMAVERA to provide a clearer understanding of the project's construction progress. This important connection aids in identifying inadequacies and sensible errors in project ventures.

A time section is given for each operation in the project. Only if the action layer names and IDs for operations are identical will there be interlinking between Schedule details and drawings. Only the coordinating with records in both computerised and expected details will be held. For each of the excess fields in the property table, the records that do not fit will be left as invalid qualities. The time line slider is also assigned to the 4D drawing, which demonstrates the easy removal of each component according to their predetermined schedules. The time line slider, which is related to the 3D parts before, raises them regularly according to their different schedules.

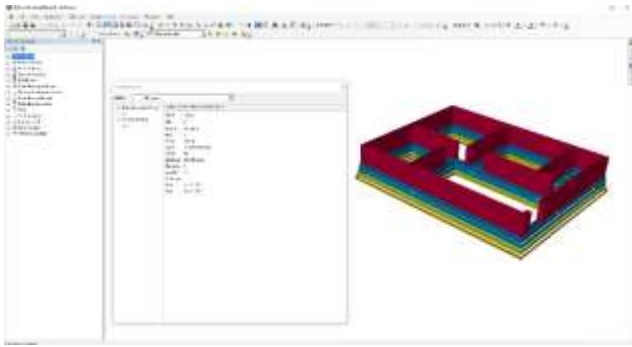


Fig. 6: 4d model up to sill level

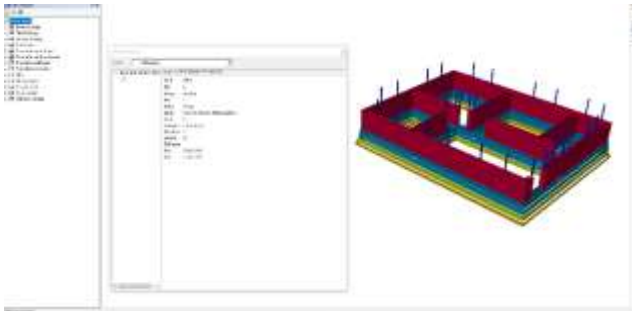


Fig. 7: 4d model with door and window frames

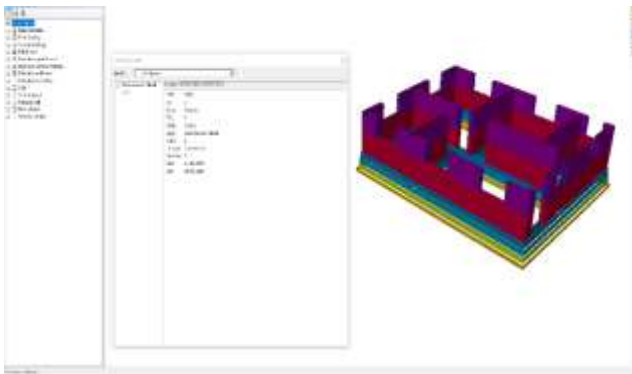


Fig. 6: 4d model up to lintel

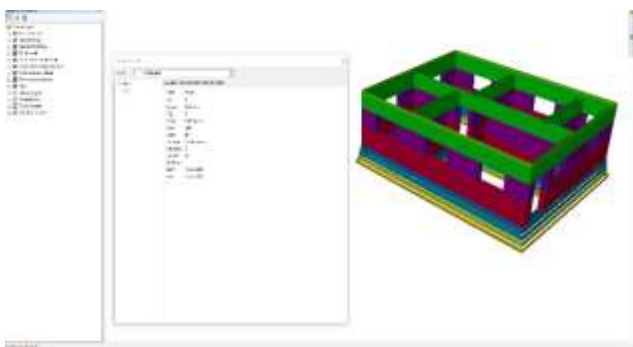


Fig. 7: 4d model up to slab level

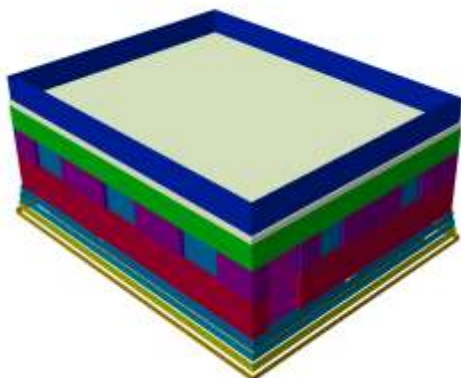


Fig. 8: 3d model of the building

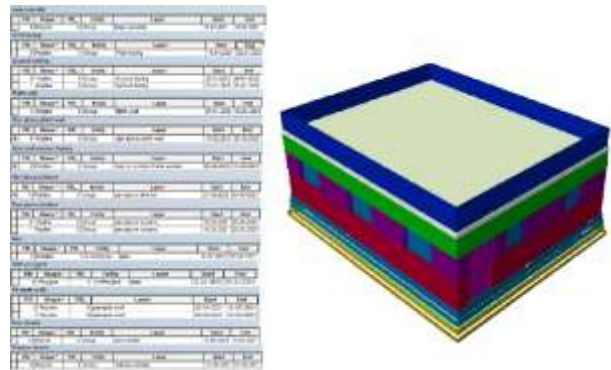


Fig. 9: Complete 4d model of the building

Impediments and ideas for future work

According to the CPM strategy, activity adds the most important section to the presentation. In comparison to a single fundamental section, an engineer must create multiple segments for various time spans to imagine the Construction. As a keyframe, the different segments, as opposed to a single fundamental component, should be linked to the specific track at a reasonable time. The shape addition would take place between two shapes that are adjacent to one another. As a result, demonstrating the construction of a section in an animation is a time-consuming interaction. To visualise a Construction project at the operation stage, it is necessary to include hardware, personnel, materials, and temporary structures in addition to the actual parts required to build it, creating a perplexing cycle. The organisational level representation involves seeing the connections between various assets as they put the item together. The suggested solution lacks activity level replication, making it difficult to track down complete elective Construction strategies. Even though parts produced in AutoCAD can be used/modified in ArcGIS, the drafting capabilities of ArcGIS are not comparable to those of AutoCAD. This approach employs its own Schedule software, which differs from existing preparation tools such as Primavera and Microsoft Project in terms of capabilities. Currently, the suggested solution involves using a work space, which necessitates the development of a worker/electronic GIS environment that includes multiple participants from different fields. 3D GIS is still in its early stages, and the majority of business GIS programming uses a 2.5D approach to handle 3D objects, necessitating additional research to address complex 3D objects. Furthermore, since the majority of business GIS programming projects support spatial investigation capabilities in 2D, more research is needed to support spatial inspection in 3D.

Discussion and Conclusions

This proposed philosophy in this project highly encourages the approach of 4-Dimensional GIS idea to incorporate and represent space and non-space knowledge such as project drawing, materials, specifications and timelines developed in a solitary platform. PRIMAVERA and GIS have been integrated in order to create a 4-dimensional model that gives a clearer overview of the development in project design. The link between drawings and corresponding activities of the schedule in the ArcGIS aids in the identification of phases of construction and detection of basic inconsistencies in the schedule of the project. The 4-Dimensional GIS framework have several benefits which are increasingly adopted for integrating geospatial connections and also for visualizing and analyzing structure over time. In places where Geospatial data is required in order to anticipate component over time, 4-Dimensional GIS framework is becoming incredibly significant. In addition to 4-Dimensional GIS framework, the other tools used in the building sector are unable, through early identifying issues, such as time spacing

conflict, security risks, and job constraints, to have a spatial connection between building works and not to monitor cost surpluses.

Most of these could be dealt with 4-Dimensional GIS framework. As a digital framework that not only provides current event tracking, but also can collect and anticipate what can happen as a predictable platform, the 4-D GIS needs are progressively increasing in these areas. The incorporation of PRIMAVERA and ArcGIS mostly allows all building staff to make decisions since they are able to view all these space plans and non-spatial data in a single workspace.

The 4D GIS tool gives building checking which needs to examine where and when weaknesses may emerge in building because of exhaustion or incidents. The approach in the current study is valuable for productive scheduling of significant activities of venture. The 4-D GIS methodology assists information in combining building technology, investigations and gives an intend to graphically addressing the general Construction measure, and works with all members in project for better decisionmaking measure. This system gives great perception of Construction activities as well as gives ideal extrusion of every part alongside the schedules. Significant measure of revamp in an undertaking is kept away from advance warning of issues with activity layers in 4-D perspectives on the building venture. The current technique needs cautious arranging of scheduled works and its connecting alongside plans. The investigation emphasises on the significance of 3-D visualization of the underlying activities with the exception of electrical, flooring, inside completions and carpentry work, etc. Despite the fact that the proposed approach assists with understanding schedule by envisioning Construction

successions, it cannot be used as an alternative for Critical Path Method. This methodology depends intensely on the connecting of Schedules of CPM and 3-D components, CPM is an basic requirement for all this. An amateur consumer can recognise issues not seen in the schedule of CPM because of its proven animation of construction progress. This CPM transmits just 'what' is fabricated 'when', while created activities and animation passes on 'what' component has to be constructed at specific place and time.

For further development of current project, The provided modules can also be used for quantity estimation and for cost estimates the generated database is utilized.

3. REFERENCES

- [1] V.K. Bansal *, Mahesh Pal, "Construction plan survey in GIS with a safe 3D liveliness of task activities", 17 July 2008. Elsevier Ltd and IPMA
- [2] V.K. Bansal *, Mahesh Pal, "GIS based ventures data framework for Construction the board", 2006 ASIAN JOURNAL OF CIVIL
- [3] V.K. Bansal *, Mahesh Pal, "Capability of geographic data frameworks in building cost assessment and representation", 2006. Elsevier Ltd and IPMA
- [4] Chaitanya Kumar, T. Reshma, "4D Applications of GIS in Construction Management", 2017 Hindawi Advances in Civil Engineering.
- [5] Chowdary Mohanlal, Nagarajan Karthik, Narwade Raju, "Utilizations of 4D GIS Model in Construction Management", July 10, 2019 International Journal of Innovative Technology and Exploring Engineering.