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GIS for Civil Engineers

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Abstract—*Civil Engineering is the discipline that deals with the design, construction and maintenance of the physical and naturally built environment this profession is about developing and sustaining infrastructure. Many areas of interest and a wide assortment of expertise are covered by this profession due to which civil engineers work with the copious data from variety of sources, therefore to create, manage, analyse and visualise the data associated with developing and managing infrastructure Geographical Information System provide the apropos tools. To communicate the data with the others, Geographic information system allows engineers to store manage and share the data and turn it into the explicit reports and visualization that can be analysed. This data can be related to the project as well as the factor of its broader geographic context. Geographical information system is the computer based tool used to solve engineering problem related to spatial data and civil engineers use spatial data effectively in many of applications, this encourages additional study and also lead to understand coordinate systems, datum, digital 3D data, and spatial data accuracy issues in the context of geographical information system and global spatial data model (GSDM). Geographical information system have the potential to solve transportation network problems quickly with great precision since with such networks many parameters like speed, turning movement, travel time, road resistance, are connected and for such big networks the optimal route from one origin to many other destinations is determined by Geographical information system software. Thus geographical information system supports at all phases of the infrastructure life cycle and playing an increasingly important role in civil engineering Profession.*

Keywords*: Geographical information system, spatial data, digital 3D data, GSDM.*

1. INTRODUCTION

A country's infrastructure represents development stage of country, but at the same time highly developed countries are facing higher complexities of building which causes problems in maintenance of physical and naturally built environment. In this regard civil engineering society is having a hard time and critical issues which can be minimized by using the geographical information system(GIS) technology.

GIS provides apropos tool to work in many fields of civil engineering for the input, storage and management of geographic data and output of information after retrieval. GIS is being employed as a computer based tool to analyze, design and implement effective and efficient solutions. The information in the GIS relates the characteristics of areas with other geographical features, in fact the location of thing or the identification about what is located at a given location. The term GIS has different meaning in different context, it can relate to both the overall system of hardware and software or the package of software used to work with spatial data. GIS functionalities have been used in civil engineering projects to assist in analysis, selection prioritization and implementation. There is well establishment of the applications of GIS to a diverse range of problems in transportation engineering; it is a powerful tool for solving important problems of transport networks. fast shortest path algorithm on extensive road networks can be explored using GIS (Zhan,1996) and evaluation of optimization possibilities can be done to determine travel time, distance, optimum routes as well as cost for defined paths and optimum paths for some transport services. Here a study on the different issues and suitability of using GIS technology to help in broad scale application in civil engineering practice is presented.

2. VIEWS OF GIS.

GIS combines three fundamental aspects or views:

2.1 The geodatabase view. A GIS manages geographic information. One way to think of a GIS is as a spatial database containing datasets that represent geographic information in terms of a generic GIS data model— features, rasters, attributes, topologies, networks, and so forth.

GIS datasets are like map layers; they are geographically referenced so that they overlay onto the earth's surface. In many cases, the features (points, lines, and polygons) share spatial relationships with one another. For example, adjacent features share a common boundary. Many linear features connect at their endpoints. Many point locations fall along linear features (e.g., address locations along roads).

2.2 The map view. A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Various map views of the underlying geographic information can be constructed and used as windows into the geographic database to support query, analysis, and editing of geographic information. Each GIS has a series of two-dimensional (2D) and three-dimensional (3D)

map applications that provide rich tools for working with geographic information through these views.

2.3 The geoprocessing view. A GIS is a set of information transformation tools that derive new information from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets. Geoprocessing involves the ability to string together a series of operations so that users can perform spatial analysis and automate data processing—all by assembling an ordered sequence of operations.

There are numerous spatial operators that can be applied to GIS data. The ability to derive new information within a GIS analysis process is one of the fundamental capabilities in GIS.

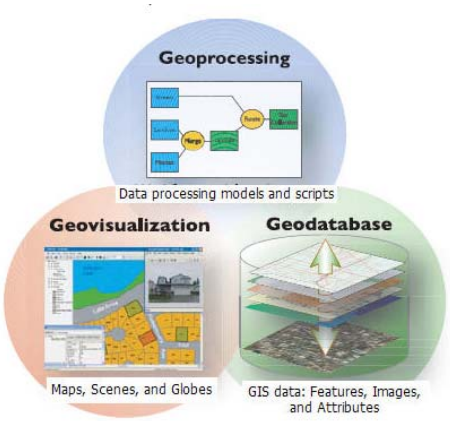


Fig. 1: Geoprocessing,geovisualization and geodatabase.

3. USE OF GIS IN ALL PHASE OF CIVIL ENGINEERING PROJECTS.

3.1 Planning: It contain the pertinent planning for

- Site selection,
- Environmental impact,
- Risk management,
- Information regarding use of natural resources,
- Sustainability issues,
- Traffic management,
- Road routing and
- Routing of pipelines etc.

3.2 Data collection: GIS is equipped with almost all those tools and functions that enable user to acquire the precise data within reasonable time.

3.3 Analysis: analysis supports our design by guiding us about the compatibility and correctness of design. Some analysis such as: water distribution analysis, soil load analysis, traffic capacity, volume calculation, site feasibility, temperature and humidity analysis can be performed by GIS.

3.4 Construction: On this stage all the layout plans and paper work design come into existence, to keep the construction economic and frame in schedule GIS guide us and helps to understand the affecting factor to cost and time.

3.5 Operation: It includes the model of site data and comparison with the base line prepared in planning phase. Models may be in the form of raster images or CAD drawings. Ongoing activities can be tracked to enhance the timely operations. GIS allows visualizing the activities in the form of thematic maps which helps in the analysis of rate, completed operations and pending operations.

4. DATA INTEGRATION AND MANAGEMENT.

GIS can be used for the combination and interpretation of different format data, It integrates the CAD drawings, satellite imagery and parcel maps to create project in visual form and turn it into explicit report.

Use of GIS in different branches of Civil Engineering.

GIS and remote sensing have the potential to solve many critical problems of civil engineering; it correlates different spatial data and their attribute data. The branches are as follows: Surveying, Mineral mapping, mapping of geographical features, Hazard assessment, Site selection, Environmental impact assessment, Urban development, Resource management.

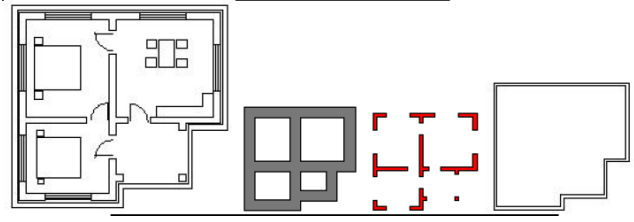
GIS in Construction Management.

In construction management GIS can be used as

- Construction progress Monitoring.
- Data comparison
- Layers from AutoCAD to ArcGIS may be merged on the basis of activities in schedule, generated in MS Excel shown in fig.

schedule

	A	B	C	D	E	F	G	H
1	ID	Name	Activity Duratio	ES	EF	LS	LF	TF
2	1	Earthwork in Excavation	1.0	0	1	0	1	0
3	2	Base Concreting	7.0	1	8	1	8	0
4	3	Footing	2.0	8	10	8	10	0
5	4	Damp Proofing Course	1.0	10	11	10	11	0
6	5	Backfilling of Trenches	1.0	10	11	11	12	1
7	6	Erection of the Door Frames	1.0	11	12	11	12	0
8	7	Brickwork in Superstructure	5.0	12	17	12	17	0
9	8	RCC Slab	15.0	17	32	17	32	0
10	9	Perapet Wall Construction	7.0	32	39	32	39	0



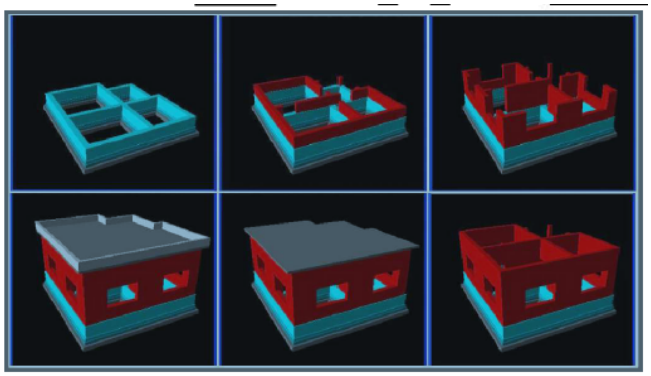


Fig. 2: linking the schedule with spatialaspects of the construction activities.

5. GIS APPLICATION IN TRANSPORTATION ENGINEERING.

GIS technology influenced the development in the transportation models and implementation at several different levels.

- Route selection.
- Mass Haul Diagram.
- Real time assessment of design viability.
- Road design(alignment).

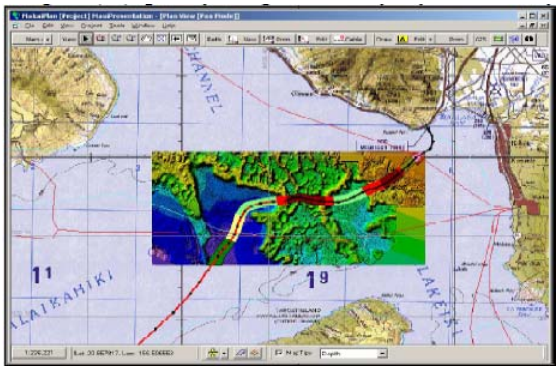


Fig. 3: Picture referenced into GIS database, enhance the quality of information available on site.

- Features line to the road.

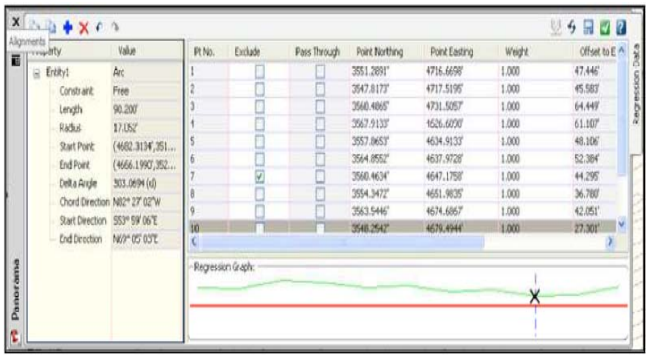


Fig. 4: feature line naming and management.

6. CONCLUSION

The advantages of GIS in civil engineering is the conspicuous fact. There are ample evidences of applying the recent advances in satellite based GIS technology and remote sensing in various fields of civil engineering. GIS and simulation models have employed for the identification and evaluation of potential solutions. GIS have expanded the number of way of information visualization and presentation and there by extended their accessibility. There are lot of advantages for using GIS in transportation engineering such as ability to provide tools to develop customize maps and tables and effective road networks.

National space programs are ensuring the continuous availability of remotely sensed data and launching satellites carrying high spatial and spectral resolution sensors to provide useful information required for civil engineering applications. It is important to enhance and develop the system for teaching GIS techniques as these are very useful in acquiring the essential information which any civil engineering project needs.

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