

# Importance and Applications of GIS in Engineering

Gomasa Ramesh

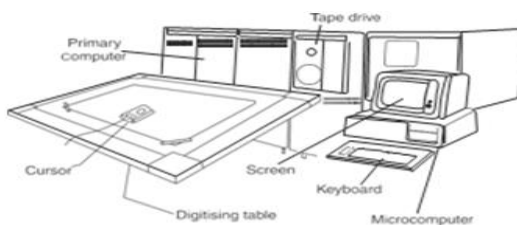


**Abstract:** Site selection is very important for any construction of structure and management. The appropriate site selection gives very good life and durability to the structure. Site selection is also improving quality of the structure and life of the structure. So, site selection is very important in of structures. In this, Geographic information system is a tool used for site selection of structure. Geographic information system is used to analyses and manipulate the spatially referenced data. It is also known as remotely sensed data or information. Geographic information system is giving a better output with in short period of time. So Geographic information system is most widely used now a days around the world. In recent developments attribute data are analysis by using Geographic information system. The selection of site depends on soil conditions, environmental conditions, weathering agencies etc. so proper planning and design of site selection is very important to make a structure in long life and increase the life span of the structure.

**Keywords:** Geographic information system, Data Base, Applications, Engineering, Components of GIS, Subsystems.

## I. INTRODUCTION

Geographic information system is a computer-based information system. Geographic information system is used to capture, store and analyses and display spatially attributed data for solving complex problems, planning and management. Geographic information system is consisting of software and hardware as well. Geographic information system is used to collect the data and analyses data around the globe. Geographic information system is specialized data base and it records the locations of information. The word of Geographic information system has two meanings. These are earth and geographic space. The meaning of first one is subjected to earth's features and resources including the human activities. The meaning of second one is collection of data and solve the problems. Geographic information system involves color maps and images and graphs and tables and other various activities. It is mainly important for industrial site selection process. It is very effective on environmental, social and economic properties of the geographic area. One of important thing in GIS is evaluation of geo environment of industrial site selection. It is helpful for planners and designers for construction of structure. In this paper explains about importance of GIS and selection of a site for construction of structures.



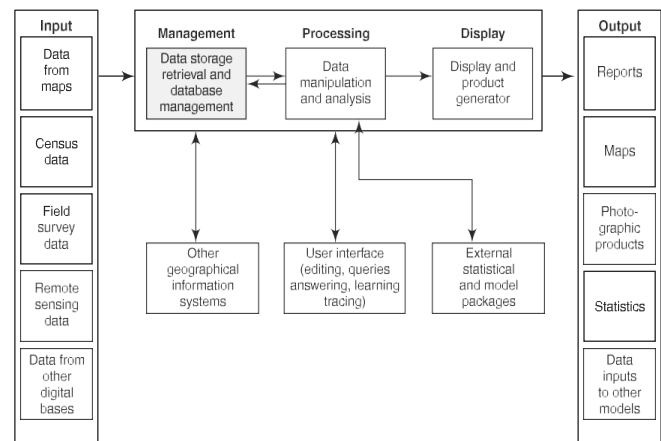
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## II. LITERATURE REVIEW



I. Fig. Components of GIS

## SUBSYSTEM IN GIS

There are 3 important elements in GIS system. They are as follows;

- Computer hardware
- Data
- Computer program
- CPU

There are 5 important sub systems in GIS. They are as follows;

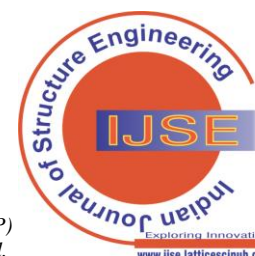
1. Input: image-based Geographic information system
2. Management: storage and management
3. Processing: data classification and manipulation
4. Display: display the results for the problem
5. Output: providing maps, images, figures, tables etc.

## OBJECTIVES

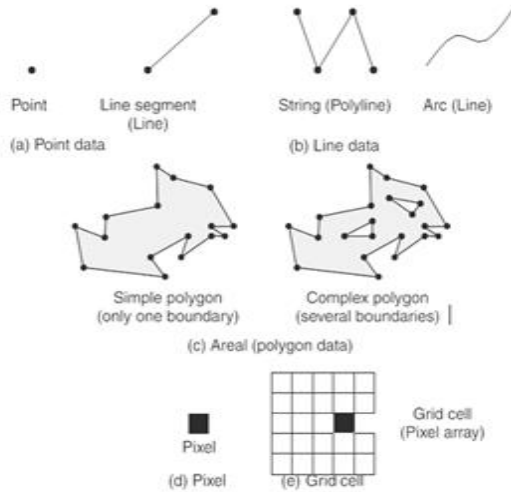
- To collect the data
- Manipulate data
- Support general research
- Decision making based on spatial Data
- To produce maps, images, figures etc.
- Rapidly analysis and display data
- Data processing and information management
- Graphical output

## III. METHODOLOGY

Data can be collected directly from the field. There are different types of data available such as captured data, encoded data, organized data. The data in GIS is classified into two types. They are spatial data and non-spatial data. Spatial data is also known as graphical data. It consists of natural features, lines etc. this data is spatially located in digital form. Non spatial data is also known as attribute data. It represents geographic regions, plans, maps, reports etc. spatial data related to non-spatial attributes.



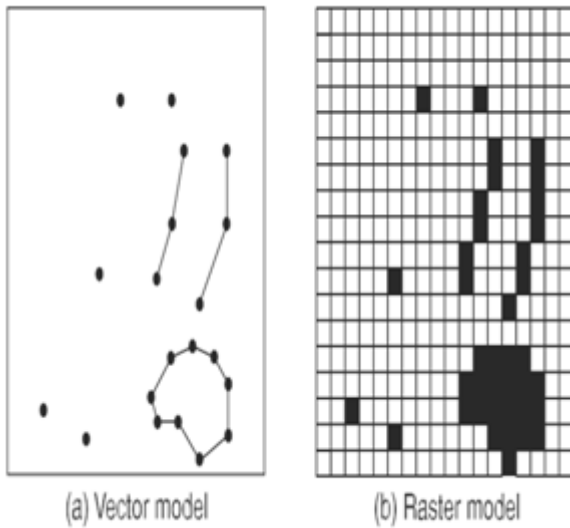
## Representation of features



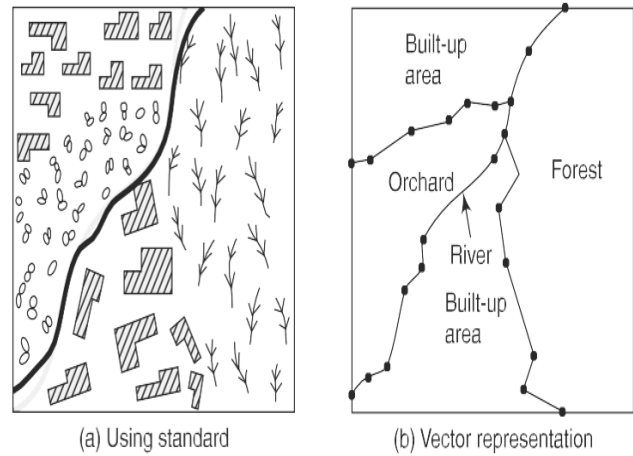
**Fig. Representation of Features**

	(i)	(ii)	(iii)		
	Point identifier	Coordinates	Line identifier	Points	Area identifier
1		$(x_1, y_1)$	a	1,2	I
2		$(x_2, y_2)$	b	2,3	II
3		$(x_3, y_3)$	c	3,4	
4		$(x_4, y_4)$	d	4,1	
Monument, m		$(x_m, y_m)$	e	4,2	

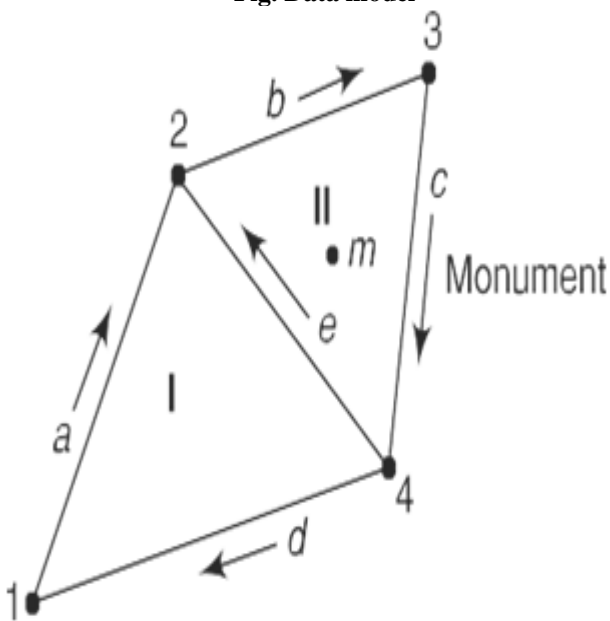
**Fig. Vector representation of Graphical Record**



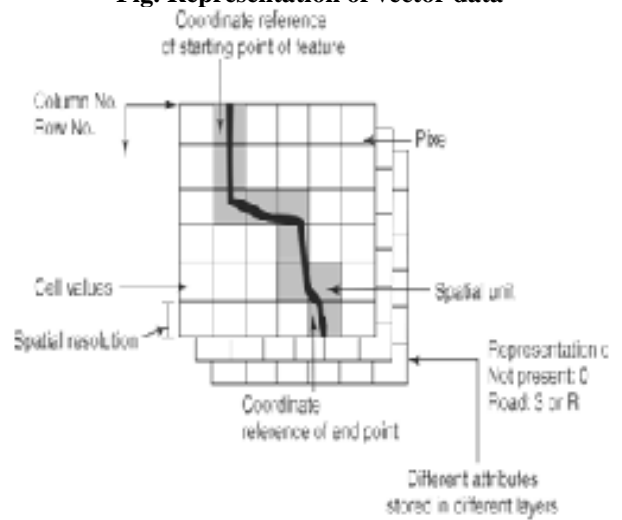
**Fig. Data model**



**Fig. Representation of vector data**



**Fig. Vector representation of graphical record**



**Fig. Characteristic of raster data**

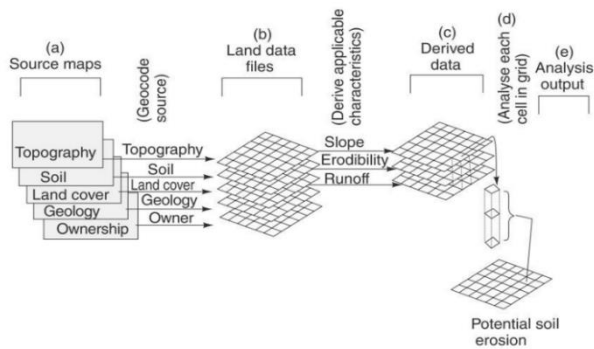


Fig. Analysis procedure of geocoded data

#### IV. GIS BASED MULTI CRITERIA ANALYSIS

As we know that AHP gives the ranking to selected sites, whereas GIS gives best location among the chosen as well as particular areas which are best suited for the best location/site. This is done by GIS multi-criterion analysis which is done either by 1) Suitability analysis using raster's, identifying suitable industrial 2) Suitability analysis using Model Builder Main components of Arc GIS 1) Arc Map = Edit and create features in a feature class 2) Arc Catalog = Create feature class and to originate and manage data 3) Arc tool Box = Analyses and transform data (like in terms of raster data) 4) Arc scene = View data in 3d and performs 3d analysis 5) Arc globe = View data in globe and create animation 6) Model Builder = Create geo-processing models and tool boxes. Arc Tool Box: Contains number of tools. For this operation we need only spatial analyst tool which contains reclassify, raster creation, overlay, distance tools for the performance operation.

#### V. ANALYSIS TECHNIQUES FOR RASTER CALCULATION:

In this study we used many tools and analysis techniques to implement MCDA and to select the best industrial site. The process passed in the following analysis. 1. Euclidean distance analysis 2. Reclassify analysis 3. Surface analysis 4. Weighted overlay analysis 5. Model builder technique for this analysis we used the technique is Model builder technique which uses the concept of weighted average and Reclassify tools.

Data layer over a hill station as follows;

Layer	Code
1. Location of nursing home	1
2. Road	2
3. Agriculture land	3
4. Land use	
(i) Habitat	1
(ii) Water	2
(iii) Agriculture land	4
(iv) Forest	5
5. Hill Station	10

GIS has been successfully applied in many fields outside of the hydrological field. However, the full capabilities of GIS for hydrological field have at to be realized. To move forward, there is a need to identify current applications of GIS concepts and technologies. To study industrial site selection that will provide comprehensive and timely information for management decision support, to review the impacts of implementing GIS on hydrological field.

**Discrete entities:** The space would be seen as occupied with entities that are describe by their properties and can be located on earth using coordinate system. The entities have a clear boundary. Buildings, Roads, Land parcels etc. are the

example of discrete entities.

**Continuous Fields:** The variation of an attribute over the space as a continuous field. No physical boundary can ever be observed in such case. Temperature, Pressure, Elevation etc. across an area are the examples of continuous fields.

A city can be marked as a single point on a world map but would be marked as a polygon on a state map.

**Simple features:** These are easy to create, store and rendered on screen very quickly. They lack connectivity relationships and so are inefficient for modeling phenomena conceptualized as fields.

**Point entities:** These represent all geographical entities that are positioned by a single XY coordinate pair. Along with the XY coordinates the point must store other information such as what does the point represent etc.

**Line entities:** Linear features made by tracing two or more XY coordinate pair.

•**Simple line:** It requires a start and a point.

•**Arc:** A set of XY coordinate pairs describing a continues complex line. The shorter the line segment and higher the number of coordinate pairs, the close the chain approximates a complex curve.

**Raster data model:** Here, geographic space is represented by array of cells or pixels which are arranged in rows and columns. Each pixel has a value that represents information. A point can be represented by a single pixel in raster model. A line is a chain of spatially connected cells with the same value.

**Topological features:** A topology is a mathematical procedure that describes how features are spatially related and ensures data quality of the spatial relationships. Topological relationships include following three Basic elements:

•**Connectivity:** Information about linkages among spatial objects.

•**Contiguity:** Information about neighboring spatial object.

•**Containment:** Information about inclusion of one spatial object with in another spatial object.

**Network:** The topologic relationship between the features is maintained in a connectivity table. Polygons with explicit topological structures: Introducing explicit topological relationships takes care of islands as well 10 as neighbors. The topological structures are built either by creating topological links during data input or using software.

Selection process involves mainly two phases. Those are

- 1) Site Screening
- 2) Site Evaluation

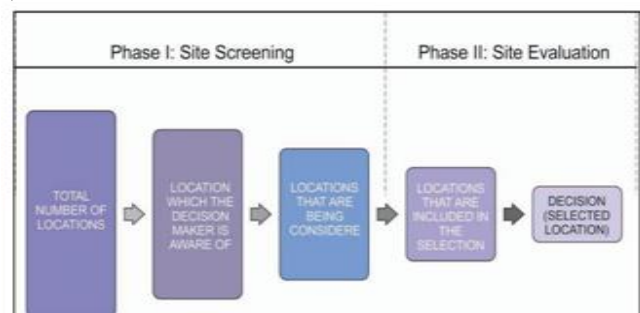


Fig. Site selection process

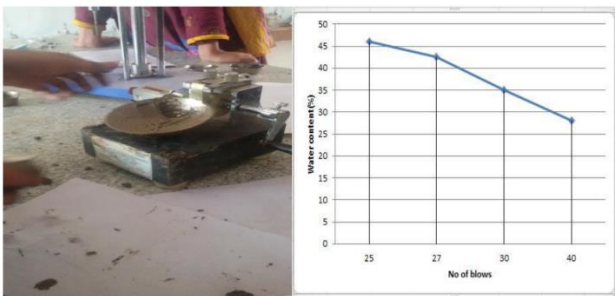
## VI. INTRODUCTION TO PRESENT INDUSTRIAL DEVELOPMENT

The people or companies engaged in a particular kind of commercial enterprise. Industries are many types like manufacturing, metallurgical, mining, textile industries etc..... Industry is more focus on reducing the cost of production and achieving the levels of technical competence. It can stay globally relevant and deal with cut-throat competition. India has been significantly increasing its capacities to achieve self-sufficiency from an industrial point of view. Industries do work on the export and import of the materials. So, industries are very important for the economic growth. Development of industry depends on construction process and its design depends on life time of the project. So, for this site selection is very important for the industry.

## VII. TESTS AND RESULTS



**Fig. Soil and Compaction test**



**Fig. Liquid limit and optimum moisture content**

S. No	Test	Characteristics
1	Texture	Black cotton
2	Optimum moisture content(g/cc)	3.6
3	Plastic Limit (%)	38
4	Liquid Limit (%)	46



**Fig. Industrial water and alkaline test**

S.No.	Test	Characteristics
1	PH	8.609
2	BOD 5 days (mg/lt)	24
3	Alkalinity (mg/lt)	590
4	TDS (mg/lt)	105.4
5	EC (ms)	7.89

Chosen Sites for Industrial site selections

Mittapally is located in Dichpally Mandal, Nizamabad District having latitude 18.5936 and longitude 78.2583. Total area of Mittapally is 868 hectares and population of 2510.

**Table Geographical coordinates of Mittapally**

Control points	Longitude	Latitude
A	78° 14'30.21"E	18° 35'57.41N
B	78° 14'32.91"E	18° 34'51.68"N
C	78° 16'33.66"E	18° 34'49.65"N
D	78° 16'26.41"E	18° 35'57.48"N



Soil characteristics				
Sl No	Soil Test	Takli	Abbapur	Mittapally
1	Texture	Black cotton	Black cotton	Black cotton
2	Liquid limit (%)	59	33	51
3	Plastic limit (%)	46	37.5	40
4	Optimum moisture content(OMC) (%)	10	10	10
5	Maximum dry density (g/cc)	3.45	3.55	3.39

## VII. CONCLUSION

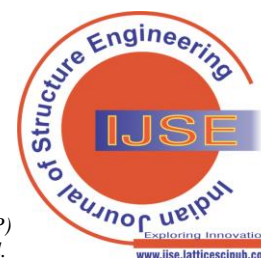
Every structure before built site investigation is important. To know the properties of soil and condition of soil and environmental conditions. So, by using Geographic information system we can select a suitable site for the structures and also, we can collect the data from the area. By using this to make plans, designs and construction. This paper deals with importance of Geographic information system and uses for selection of a suitable site for the structure.

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