Implementing GIS using a digital elevation model for MRVC railway project

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Abstract—

The geographical information system (GIS) is a tool used generally for any computer based capability for manipulating geographical data. The hardware and software functions of GIS include data input, data storage, data management (data manipulation, updating, changing, exchange) and data reporting (retrieval, presentation, analysis, combination, etc.)

A digital elevation model (DEM) is a digital model or 3D representation of a terrain's surface created from terrain elevation data.

This paper appraises the GIS implementation in any organization. It identifies the reasons for its present failure and suggests ways for a successful implementation that could be more generally applicable, especially in developing countries.

Index Terms— Geographical Information System (GIS), Digital elevation model (DEM), Triangular irregular network (TIN), Global positioning systems (GPS)

I. INTRODUCTION

The Mumbai Rail Vikas Corporation Limited (MRVC) has undertaken plans on railway project in between Mumbra and Kalva so that there is a separate corridor for express, mail and suburban trains.
The project which was undertaken was fully manual, which leads to wastage of time, money and man power. So in order to avoid this we suggest using digital elevation model using ARCgis software. To understand what is digital elevation model and ARCgis software the following content includes definition, types and uses and also problems which are involved in this project and solution suggested for various problems.

The term digital elevation model or DEM is frequently used to refer any digital representation of a topographic surface however most often it is used to refer specifically to a raster or regular grid of spot heights.
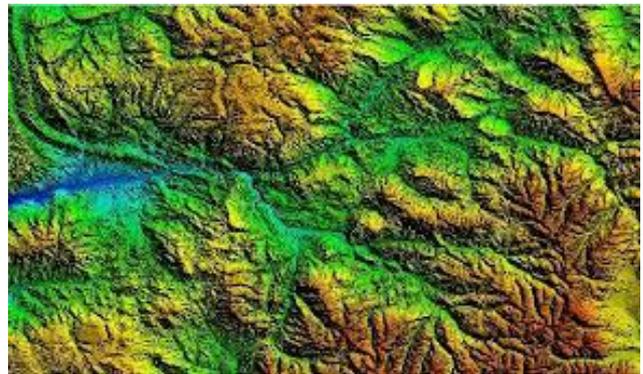
Types of DEM:

A DEM is represented in two types 1)Raster(a grid of squares also known as height map when represented elevation) 2) Vector based triangular irregular network (TIN).The TIN DEM dataset is also referred to as primary(measured) DEM, whereas the raster DEM is referred to as secondary(computed) DEM. The Dem can be achieved through techniques such as photogrammetry, lidar, IFSAR, land surveying. DEMs are commonly constructed using techniques such as remote sensing and they can also be constructed from land surveying. DEMs are the basis for digitally produced relief maps which is often used in geographic information system.

Uses:

- Modeling water flow for hydrology or mass movement (for example avalanches and landslides)

- Creation of relief maps

- Rendering of 3D visualizations.

- Rectification of aerial photography or satellite imagery

- Terrain analysis
in geomorphology and physical geography

- Engineering and infrastructure design

- Global positioning systems (GPS)

ArcGIS:

ESRI's ArcGIS is a geographical information system. It is used for working with maps and geographic information. It is also used for using and creating maps, analyzing mapped information, compiling geographic data, discovering and sharing geographic information in a database. In order to make maps and geographic information available throughout an organization, through web and across community, system avails with infrastructure.

ArcGIS includes the following windows desktop software:
1) •   Arc Reader, which allows one to view and query maps created with the other ArcGIS products;
•   ArcGIS for Desktop, which is licensed under three functionality levels:
•   ArcGIS for Desktop Basic which allows one to view spatial data, create layered maps, and perform basic spatial analysis;
•   ArcGIS for Desktop Standard, which in addition to the functionality of Arc View, includes more advanced tools for manipulation of shape files and geodatabases.
•   ArcGIS for Desktop Advanced which includes capabilities for data manipulation, editing, and analysis.
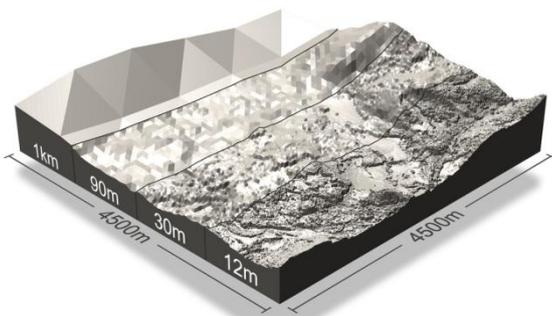
II. METHOD & PROCEDURES

Problem Definition:

Manual & long term processes

- Manual process is one of the long term processes to survey or analyses Mumbra to Kalva area for railway project.

- For construction of new railway project between Mumbra and Kalva It is necessary to survey area on which development plan has been done.

- Mumbra to Kalva railway project has preferred manual process to survey particular land surface.

- Flat land surface can be analyzed, but in case of obstacle such as buildings, mountains or any water bodies, analysis of particular area for this railway project become more complicated.

- It is possible to survey small area but it is complicated to cover large geographical area between Mumbra to Kalva.

Time Consuming processes:

- Manual analysis always takes a long time period to survey area covered in railway project.

- Manual process took a lot of time to find out which land surface is flat, which region is come under eco friendly region, which region come under river and pond, mountain region etc.

- Too much large area of railway project takes too much time to survey or analysis.

- For this project most of their time was wasted for analysis of land surface manually rather than development of project.

- Problem of accuracy arises in calculating or collecting data about this project.

Man power:

- Lot of man power is required for such a long survey process.

- It is also so difficult to find elevation in land surface manually.

Economical Problem:

- More Economy is unnecessarily wasted for analysis of land surface involved in this project.
- Lake of technical aspects make the process time consuming and complex.

Solution to the problem:

With this project there were many disadvantages
So arc gis is software through which we get solution to the problem.

Solution to the Manual and long term process:
- Automated process for analysis of land surface between Mumbra to kalwa.
- Any kind of surface area including flat, mountain and water bodies can be analyzed easily using arc gis.
- Other area affected by this project can also be analyzed.

Solution to time consuming process:

- Quick analysis of area between Mumbra to kalwa is possible within short time.
- Mountainous region between Mumbra and kalwa can be analyzed quickly.
- Elevation occurring between railway project can be calculated accurately in less time

Solution to the manpower:

- Survey of land area of railway project can be automatically done through arcgis software.
- No man power requires analyzing that area.

Solution to Economical Problem:

- Less money is utilized for project as analysis project is automated.
- Only cost regarding to software is included in project rather than extra charges.
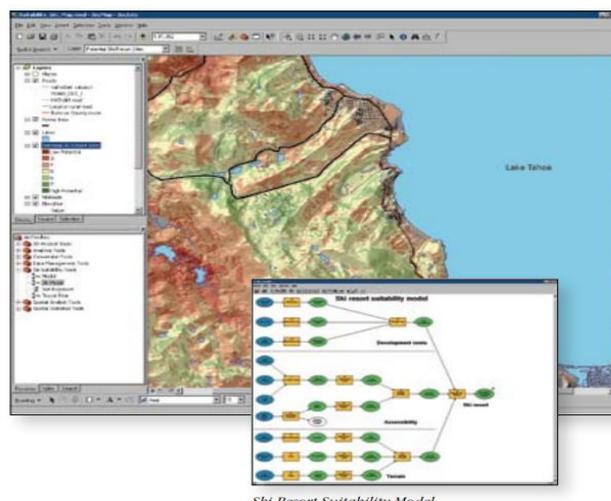
ArcGIS Spatial Analyst

ArcGIS Spatial Analyst, an optional extension to ArcGIS Desktop provides powerful tools for comprehensive, raster-based spatial analysis. With ArcGIS Spatial Analyst, users can employ a wide range of data formats to combine datasets, interpret new data, and perform complex raster operations such as terrain analysis, surface modeling, surface interpolation, hydrologic analysis, statistical analysis, and much more.

For doing advanced raster analysis, Spatial Analyst provides an integrated environment within ArcGIS Desktop. To build Mumbra rail way project ArcGIS Spatial Analyst is used which Analyst include digital elevation model (DEM) generation, wild land modeling, site location analysis, and more.

Density Analysis

Retail Model
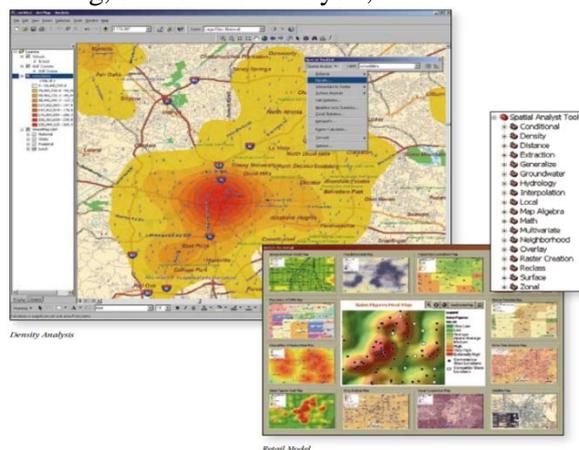
With ArcGIS Spatial Analyst, You Can
• Create, query, map, and analyze cell-based raster data.
• Derive additional information about your data.
• Calculate complex terrain attributes.
• Find suitable locations based on multiple attributes.

*Ski Resort Suitability Model*

ArcGIS Spatial Analyst Is Used To
• Perform terrain analysis.
• Find the best store location.
• Perform land use analysis.
• Determine areas of high value.

Modeling and Analysis:

ArcGIS spatial analyst provides more than 150 tools and functions that user can access in the same environment and analyst is fully integrated with ARC gis desktop.

Suitability Modeling:

A suitability model typically answers the question, "Where is the best location?"—whether it involves finding the best location for Mumbra and Kalva railway project. For instance Mumbra railway project may take into consideration distance to railway station then combine the results with land use to decide on the best location.
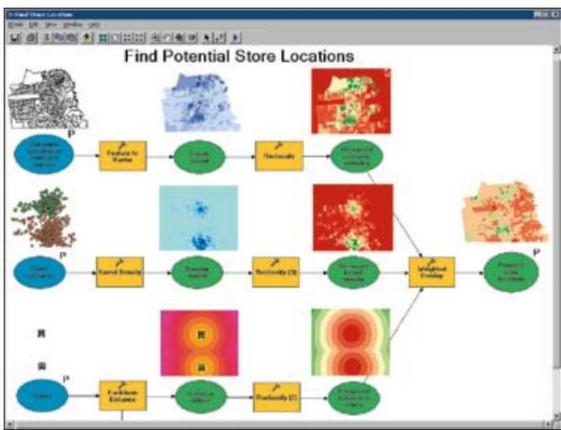
Site Selection Modeling

Surface Creation:

Deriving new estimated surface values spatial interpolation is used to take known values and interpolate them into a surface. ArcGIS Spatial Analyst uses Inverse Distance Weighted (IDW) method to estimate elevation. Using these methods, railway project members can create surfaces from sampled locations without having to visit every location of a study area, saving time and effort. For example they can measure phenomena at strategic location in order to derive a surface.

Dynamic Modeling and Advanced Visualization

Surface Analysis:

With ArcGIS Spatial Analyst, users can build and analyze complex surfaces to identify patterns or features within the data. Many patterns that are not readily apparent in the original data can be derived from the existing surface. These include contours, angle of slope, aspect, hill shade, view shed, curvature, cut/fill, and solar radiation modeling.

Slope Analysis

Measure elevation height:

Press identify button from toolbar and click anywhere on image to find out elevation in that point. It helps to find out elevation height from ground level.
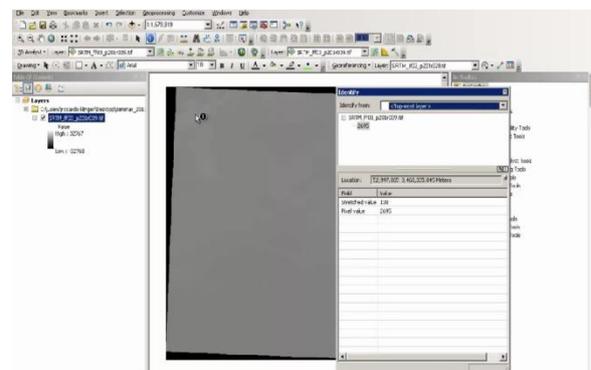
Color and property:

To show raster image in identifiable format various color combinations are used to identify maximum and minimum elevations.
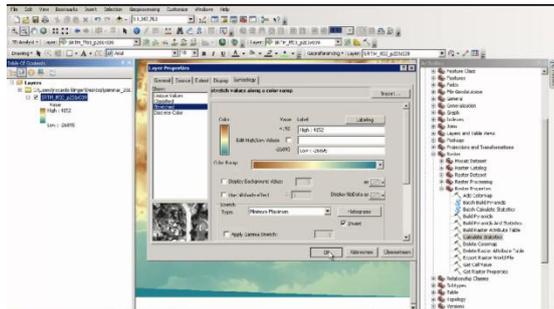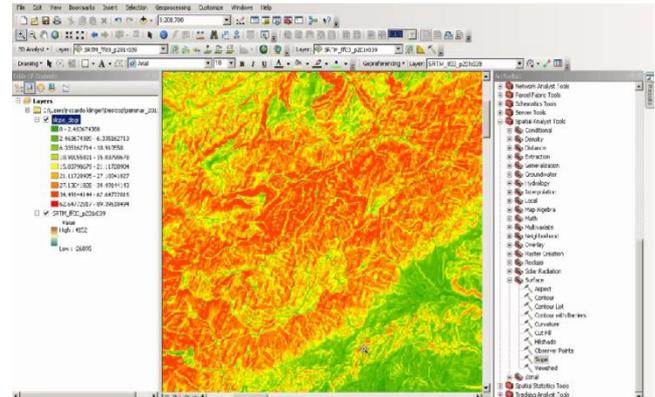
Actions performed are as follows:

Step1:

Arc toolbox->Calculate raster->Raster properties->Calculate statics->select input raster dataset->Enter ignore value->Click on ok
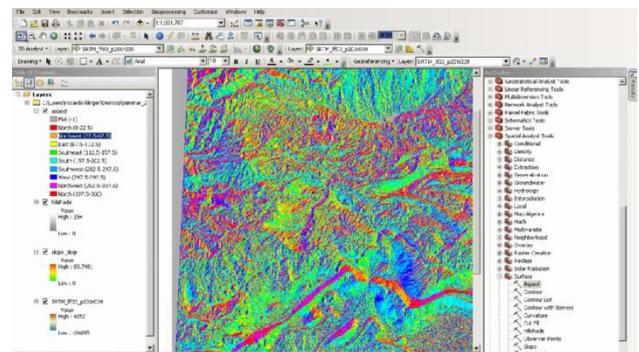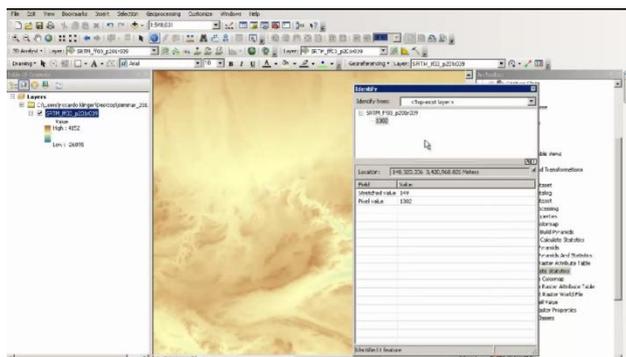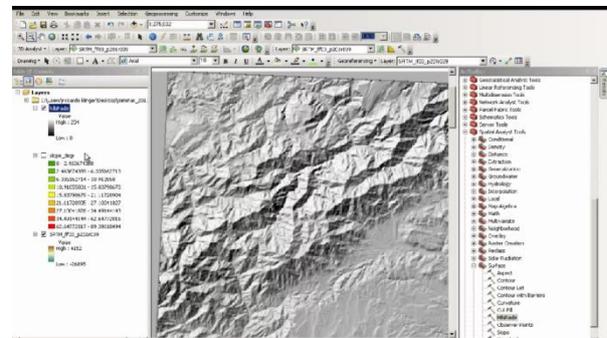
Step 2:

Result->Current session->output raster dataset->right clicks and select add display after this it will generate black and white raster image. Now to show image in various color format click on color in table of content and choose color combination. To check properties click on layer properties symbology->Strech type: Standard deviation. It will show color full raster image as shown below

Slope, Hill shed and aspect:

To find out slope in particular areas following steps are carried out:

Step1:

In Arc toolbox choose spatial analysis tool->Select surface->choose slope->drag image into input raster->choose degree->click on ok

Step2:

Click on result->slope->right click on output raster->Add to display

Step3:

Click on identify to calculate slope degree in particular area. It shows lowest and highest slope values.

Same actions are performed for hill shed and aspect by selecting respective tools from spatial analysis tools.

III. CONCLUSION

In this paper we proposed a method to find out elevations in particular area by implementing ArcGis using digital elevation model. In this images are converted into raster format and measures of elevation are shown in meters.

Identity control is used to show elevation height in particular point from ground level. Raster images are shown in various color combination

to show various elevation levels in particular area. Spatial analysis tools are used to find out hill sheds, slope, terrain and aspect.

This method provides fastest, efforts less and convenient way to analyze area which saves time as well as money.

IV. REFERENCES

[1] Arcgis-tutorial-data.software.informer.com
[2] www.esri.com
[3] en.wikipedia.org/wiki/arcgis
[4] Getting to know arc objects-Robert burke.
[5] Introduction to geographical information system-Kang sung Chang, TMH, fourth edition.

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