International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.4, July-Aug 2012 pp-1914-1919 ISSN: 2249-6645

DESIGN OF RING ROAD FOR ERODE DISTRICT USING GIS

T.SUBRAMANI[1] P.MALAISAMY[2]

[1]Professor & Dean, Department of Civil Engineering, VMKV Engg. College, Vinayaka Missions University,
[2]PG Student of Environmental Engineering, Department of Civil Engineering,
VMKV Engg. College,Vinayaka Missions University, Salem, India

Abstract: Design of ring road deals with the development of a comprehensive plan for Construction and operation of transportation facilities. In order to develop efficient and better transport facility, it is necessary to have a proper procedure transport movement. This ring road helps to a great extent in improving the safe and fast movement of both human and goods traffic, thereby increasing the economy of the City.This improved economy contributes the growth of the country. The first and foremost step is reducing the traffic for the particular route by diverting the density of the vehicles to enhance the safe transport and environmental pollution. This project deals with the traffic problem of the erode city and provides better transportation.In this project GIS is used for surveying, for preparing Contour maps, for developing three dimensional Digital Elevation Models, for various types of route alignments and for estimation of cutting and filling volumes.

The purpose of this study was to develop a tool to locate a suitable less route between two points. The GIS approach using ground parameters and spatial analysis provided to achieve this goal. Raster based map analysis provide a wealth of capabilities for incorporating terrain information surrounding linear infrastructure. Costs resulting from terrain, geomorphology, land use, drainage and elevation resulting low cost estimation for implementing the shortest routes for the study area .Finally Ring road for Erode city of 22 kms all around which connect the major roads of byepass was formulated.

Keywords: Design, ring road,Erode district,Using gis

I. INTRODUCTION

Determining the best route through an area is one of the oldest spatial problems. This problem has recently been solved effectively using GIS and Remote Sensing technologies. During the last decade, a few attempts have been made to automate the route-planning process using GIS technology. A review of a number of papers suggests that the methodology is still at an exploratory stage (Saha et al., 2005). Anumber of research have already been performed in pipeline route design using GIS which include optimal routing for pipeline selection of best route for expansion and road network, this will achieve by using high resolution remote sensing image. In this context, physical, environmental, political, social, economical and legal processes was considered and implemented for road and pipeline routing determination (Rylsky 2004, Saha, V.D 2005, Delevar and Naghibi 2003, Yusof and Baban 2004, Glasgow vd. 2004, Berry 2000, Çevik and Topal 2003, Luettingearve Clark 2005). Multiple factors were considered using GIS techniques for road, highway, forest roads and bike roads routing determination (Mackenzie and Walker 2004, Malpica ve Pedraza 2001). GIS based route determination for railway (Ashish and Dhingra 2005, Kov vd. 2005, Gipps vd. 2001), irrigation/drainage channels (Yusof and Baban 2000, Smith 2006), power line (Cheng and Chang 2001) have already been implemented.

The present study was initiated to demonstrate the use of various data from different sources, GIS analysis and raster network analysis techniques for developing a least cost pathway for linear civil engineering structures. This is probably the most asked question posed to those in the Geographic Information Systems (GIS) field and is probably the hardest to answer in a succinct and clear manner.

1.2 SOFTWARE

Different software packages are important for GIS. Central to this is the GIS application package. Such software is essential for creating, editing and analyzing spatial and attribute data, therefore these packages contain a myriad of GIS functions inherent to them. Extensions or add-ons are software that extends the capabilities of the GIS software package. Component GIS software is the opposite of application software. Component GIS seeks to build software applications that meet a specific purpose and thus are limited in their spatial analysis capabilities. Utilities are stand-alone programs that perform a specific function. For example, a file format utility that converts from on type of GIS file to another. There is also web GIS software that helps serve data through Internet browsers.

1.2.1 Data

Data is the core of any GIS. There are two primary types of data that are used in GIS. A geodatabase is a database that is in some way referenced to locations on the earth. Geodatabases are grouped into two different types: vector and raster. Vector data is spatial data represented as points, lines and polygons. Raster data is cell-based data such as aerial imagery and digital elevation models. Coupled with this data is usually data known as attribute data. Attribute data generally defined as additional information about each spatial feature housed in tabular format. Documentation of GIS datasets is known as metadata. Metadata contains such information as the coordinate system, when the data was created, when it was last updated, who created it and how to contact them and definitions for any of the code attribute data.

1.2.2 Remote sensing system

With the background treatise on remote sensing we have made so far, it would now be easier make an analysis of the different stages in remote sensing.

- Origin of electromagnetic energy.

- Transmission of energy
- Intervening of energy or self emission
- Detection of energy
- Transmission or coding of the sensor output
- Collection of ground truth
- Data analysis and interpretation

1.2.3 Remote sensors

The instrument used to measure electromagnetic radiation reflected or emitted by the radiation either emitted or reflected from the earth is called passive sensors, sensors which carry electromagnetic radiation to illuminates the earth's surface are called active sensors.

1.2.4 Platforms

Sensor system need to be placed on suitable observation platforms and need to be a pre-defined altitude .Platforms can be stationary or mobile depending on the needs of the observation mission and the constraints. Geo-stationary ,which are about 3600km above earth second is sun synchronous satellites which are nearer to earth.

1.2.5 Digital Processing Techniques

Digital facilitates quantitative analysis, make use of full spectral information and avoid individual bias. Simultaneous analysis of multi-temporal and multi sensor facilitated in digital methods. The computer analysis the signature ,so as to associates each pixel with a particular feature of imagery.

1.2.6 Generation of DEM and slope

Slope map was generated using the elevation information derived from ancillary topographical and GIS techniques. ARCGIS's TOPOGRID functions were used to generate DEM and slope maps. A sampling method was used to extract representative points to build a surface model that approximates the actual surface. The contour map, was prepared from the SOI topographic.

1.2.7 Shortest Path Analysis

The inputs required for shortest path analysis are a source and a destination raster, cost raster surface, cost weighted distance, direction raster. After preparing all the required inputs Spatial Analyst is used to generate the shortest path and the results for analysis.

1.2.8 Global Positioning System

The **Global Positioning System** (**GPS**) is a space-based global navigation satellite system (GNSS) that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver. The GPS project was started in 1973 to overcome the limitations of previous navigation systems,[1] integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. GPS was created and realized by the U.S. Department of Defense (USDOD) and was originally run with 24 satellites. It became fully operational in 1994. In addition to GPS, other systems are in use or under development. The Russian global navigation Satellite System (GLONASS) was in use by the Russian military only until it was made fully available to civilians in 2007. There are also the planned Chinese Compass navigation system and the European Union's Galileo positioning system.

1.2.9 How GPS Work

The Global Positioning System (GPS) is a technical marvel made possible by a group of satellites in earth orbit that transmit precise signals, allowing GPS receivers to calculate and display accurate location, speed, and time information to the user. By capturing the signals from three or more satellites (among a constellation of 31 satellites available), GPS receivers are able to use the mathematical principle of **trilteration** to pinpoint your location. With the addition of computing power, and data stored in memory such as road maps, points of interest, topographic information, and much more, GPS receivers are able to convert location, speed, and time information into a useful display format. GPS was originally created by the United States Department of Defense (DOD) as a military application. The system has been active since the early 1980s, but began to become useful to civilians in the late 1990s. Consumer GPS has since become a multi-billion dollar industry with a wide array of products, services, and Internet-based utilities.GPS works accurately in all weather conditions, day or night, around the clock, and around the globe. There is no subscription fee for use of GPS signals. GPS signals may be blocked by dense forest, canyon walls, or skyscrapers, and they don't penetrate indoor spaces well, so some locations may not permit accurate GPS navigation.

1.2.10 Types of GPS for Driving, Outdoors, Sports

Imagine never being lost or needing to ask for directions as you drive. Imagine going out for a run or bike ride and capturing all of your speed, distance, elevation change and heart rate data and uploading it to a training log or an online map you can share. Imagine going hiking and always knowing the way back to camp. Imagine playing golf and always knowing the exact distance to the pin. These scenarios and many more are reality with the use of Global Positioning System (GPS) receivers.

II. Aim And Scope Of Investigation

- To establish shortest path for road network.
- To minimize the traffic in the city.
- To provide a better and comfortable for updating the traffic and other related information in road administration.
- To reduce travelling time.
- To prepare various thematic maps.
- To find paths /routes/places for laying eco-friendly ring road.
- To reduce the pollution rate in the city.

III. Study Area - Erode City

Erode is a city, a municipal corporation and the headquarters of Erode district in the South Indian state of Tamil Nadu. It is situated at the centre of the South Indian Peninsula, about 400 kilometres (249 mi) southwest from the state capital Chennai and on the banks of the rivers Cauvery and Bhavani, between 11° 19.5" and 11° 81.05"

North latitude and 77° 42.5" and 77° 44.5" East longitude. As per Census 2011 alignments. It has population around 156,953.Erode Local planning Area extends up to 54sq.km. Within the city, and will be extended to 109 km^2. The roadway connects all the parts of the state and nearby states such as Kerala, Karnataka and Andhra Pradesh with the city. The City has both local (City) and mofussil (city-to-city) bus services with connections to nearby towns and villages. Plenty of city buses are ply to connect all parts of the city. One can get buses from Erode to almost any part of the state. NH connecting Salem – Coimbatore – Cochin passes through Erode and Bypasses the city via Bhavani (Lakshminagar by-pass), Chithode, Perundurai, which is the major National Highway connectivity for the city.SH 79 connecting Rasipuram - Tiruchengode - Pallipalayam – ErodeSH-15 connecting Erode – Gobi – Sathy – Ooty .NH-67A connecting Karur – Erode – Sathy – MysoreAnother planned from Erode (Bhavani) – Anthiyur – Bangalore. Figure.1 shows the study area details.

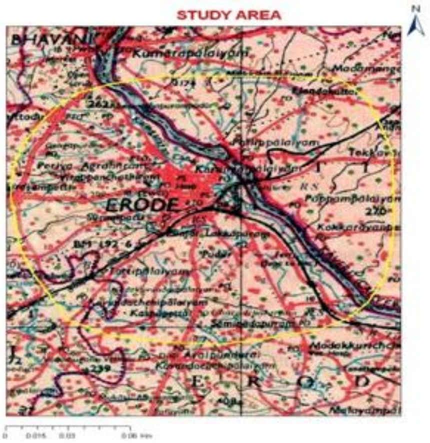

FIGURE.1 ERODE CITY MAP

IV. Data Base Generation

4.1 DATA COLLECTION

Survey of India Toposheet No. 58 E /12

4.2 LAND SAT (MSS) DATA 2007

Maps, field work and remote sensing techniques are necessary for proposed road design and construction. Topographic maps, geomorphology, Land use/Land Cover, Drainage, DEM, road, Slope and Contour maps were used for this proposed route. The favorable path analysis, using various data and GIS analysis, was intended to confirm the best transport route within this site.

4.3 DATA PROCESS AND ANALYSIS

In this implementation, the best route is found for a new road. The steps to find possible path are outlined below. Path is identified by using ArcGIS 9.1 Spatial Analysis Module.

Create Source, Destination and Datasets

Generate different Thematic Maps (Classify and Weight age)

Perform Weighted Distance

Create Direction Datasets

Identified Shortest Path with Distance and Direction Datasets

Figure.2 shows Satellite Image For Erode

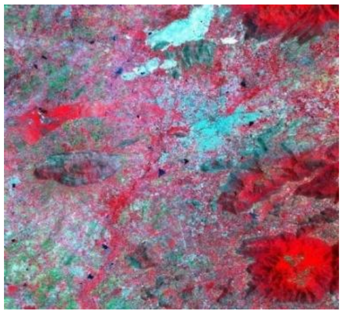

FIGURE.2 SATELLITE IMAGE FOR ERODE

V. Design Guide Lines

5.1 PLANNING OF ROAD IN PLAIN AREAS

Planning of roads in plain area is somewhat different from hill areas. In hill areas alignment of roads has to be circuitous and is primarily governed by the topography. In the plain area we should find the elevation and depression by the survey. The elevation areas should be leveled by removing the upper surface of the earth and this soil can be used for filling up the low lying areas.The roads in our country in plain areas, they have been classified as National Highways , State Highways, Major District Roads, Other District Roads and Village Roads according to specification , traffic needs , and socio-economic, administrative or strategic consideration. Some National Highways are point to point which will connect the state boundaries. State. Highways will connect all the National Highways. Major District roads will connect all the State Highways .Other District Roads and Village Roads will connect the Major District Roads however from topographical considerations; these can be broadly divided into arterial roads and link roads. Arterial roads will include national/state highways and major district roads. Link roads take off from arterial roads to link villages/production areas in small/sub-valleys. These will comprise other district roads and village roads.

5.2 HIGHWAY ALIGNMENT

The position or layout of the centre line of the highway on the ground is called alignment. In general the alignment is of two types,

- Horizontal alignment
- Vertical alignment

5.2.1 Requirements

The basic requirements of ideal alignments between two terminal stations are

- Short – A straight line alignment would be the, though there may be several practical considerations which would cause the deviation from the shortest path.
- Easy – The alignment should be such that it is easy to construct and maintain with minimum problems.
- Safe – The alignment should be safe enough for construction andmaintenance from the view point of stability of natural hill slopes,embankments, cut slopes.
- Economical – The alignment is considered economical only if the total cost including the initial cost, maintenance cost.

5.2.2 Factors controlling alignment

For an alignment to be shortest, it should be straight between two terminals which are not always possible due to practical difficulties such as intermediate obstructions and topography. A shortest route may have very steep gradients and hence not easy for operations. Similarly there will be construction and maintenance problems along the route which may be otherwise short and easy. Canals are often deviated from the shortest route in order to cater for intermediate places of importance or obligatory points.

5.2.3 Obligatory points

These are control points governing the alignment of a canal . These control points may be broadly divided into two categories,

- Points through which the alignment is to pass.
- Points through which alignment should not pass.

Obligatory points through which alignment has to pass may cause alignment to often deviate from the shortest or easiest path.

5.2.4 Geometric design

Geometric design factors gradient, radius of curvature govern the final alignment. As far as possible while aligning a canal, the gradient should be gradually increasing. It may be necessary to make adjustments in horizontal alignment of canal keeping in view the minimum radius of curvature and the gradient.

5.2.5 Slope stability

While aligning canal, special care should be taken to align along the side of the hill which is stable. A problem in doing this is that of the landslides. The cutting and filling to construct the canal on the hill side causes steepening of existing slopes and effects its stability

5.2.6 Engineering surveys for Highway Alignment

Before canal alignment, engineering surveys are to be carried out. The surveys may be completed in four stages; first three stages consider all possible alternate alignment keeping in
view the various requirements .Four stages of engineering surveys are,

- Map study
- Reconnaissance
- Preliminary survey
- Final location and detailed survey

5.2.7 Horizontal Alignment

The horizontal alignment should be fluent and blend well with the surrounding topography. The horizontal alignment should be co-ordinate carefully with the longitudinal profile. Breaks in horizontal alignments at cross drainage structure and sharp curves at the end of long tangents/straight sections should be avoided.Short curves gives appearance of kinks, particularly for small deflections angles should be avoided. The curves should be sufficiently long and have suitable transitions to provide pleasing appearances. Curve length should be at least 150m for a deflection angle of 5 degrees and this should be increased by 30m for each degree deflection angle. Reverse curves may be needed in difficult t errain by very sparingly used. It should be ensured that there is sufficient length between the two curves for introduction of requisite curves. Curves in same direction separated by short tangents, known as broken back curves, should be avoided as far as possible in the interest of aesthetics and replaced by a single curve.

5.2.8 Minimum Curve Radii

On a horizontal, the centrifugal force is balanced by the combined effect of super elevation and side friction. Basic equation for this condition of equilibrium is as follows:

$v^2/g R=e + f$

$R=v^2/127(e + f)$

Where v = vehicle speed in meter/second

V = vehicle speed in km/hr

g = acceleration due to gravity in meter/s^2

e = super elevation in meter

f = coefficient of side friction between vehicle type and pavements (taken as 0.15)

r = radius in meter

5.2.9 Vertical Alignment

Broken back grade lines, i.e. two vertical curves in the same direction separated by a shorttangent, should be avoided due to poor appearance, and preferably replaced by a single curve.Decks of small cross drainage structures should follow the same profile as the flanking road section with no break in the grade line.

5.2.10 Co-ordination of Horizontal and Vertical Alignment

The overall appearance of a highway can be enhanced considerably by judicious combination ofhorizontal and vertical alignment. Plan and profile of the road should not be designedinterpedently but in unison so as to produce appropriate three dimensional effect.

VI. Methodology

The base (study area) map, Drainage, Slope and Contour maps were prepared with help of SOI Toposheet (on 1:50,000 scale). High resolution LANSAT satellite data of 2007 was used and by using Digital Image Processing techniques the following thematic maps such as geomorphology, Land use / Land Cover were generated. The Digital Elevation Model (DEM) was generated using various GIS based analysis, such as overlay, raster network analysis. The DEM is used in order to understand the terrain condition, environmental factors and social economic status in this study area. Finally, possible / feasible route was identified based on various physical and cultural parameters and their inherent properties. The cost reduction analysis was also done for substantiating the formation of ring road. Figure.3. Shows the flow diagram.

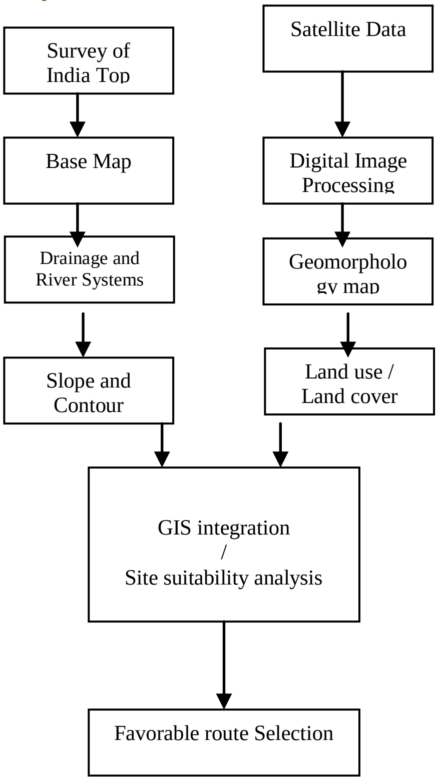

FIGURE.3 FLOW DIAGRAM

VII. TOPOGRAPHY

Topographic and geologic data of the proposed road network area were prepared in a GIS ready format and used as input to the GIS database. The locations of roads, railways, wetland, forests and drainage features were derived from the topographic map layer. The map that produced by SOI is the base for national topographic database and has a number of features for instance location of roads, railways ,wetland ,forests , drainage features, elevation points (Figure. 4). In this proposed project, digital elevation model (DEM) was prepared from the elevation data. It was used as input to the least cost and shortest pathway analysis.

VIII. Geomorphology

Different landforms present in the area are depicted in Figure.5. This geomorphic unit were extracted from the satellite image by digital data interpretation and incorporated into the GIS database. These geomorphic units were classified into Plateau, Scarp face, Debris slope, bazada, residual hill and pediments (deep, shallow & moderate).

FIGURE.4 TOPOSHEET 58 E/12

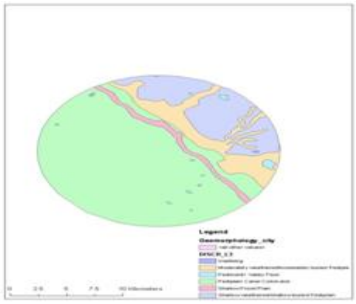

FIGURE.5 GEOMOR PHOLOGY MAP

IX. DRAINAGE PATTERN

Erode district is drained by Cauvery and Ponnaiyar river basin. The Cauvery River forms the western and south-western boundary of the district. The domestic and industrial usage of water is being satisfied by Cauvery river water. As far as the drainage fabrication of the study area is concerned, it is covered by third order and fifth order streams in the North and Northeast part.. These streams are seasonal and become dry during summer season and the main stream which is passing through this area of interest is Thirumanimuttar (Figure.6)

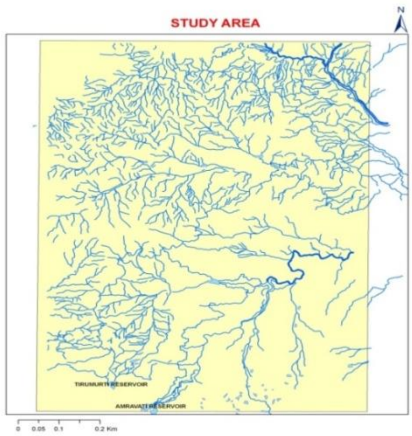

FIGURE.6 DRAINAGE PATTERN

X. LOCATION FOR BRIDGES

In the study area, it is advisable that to construct necessary bridges in the study area where there is crossing of streams that are higher order (more than 3rd order). And the culvert is used for the streams that are lower order (less than 3rd order) (Figure.7).

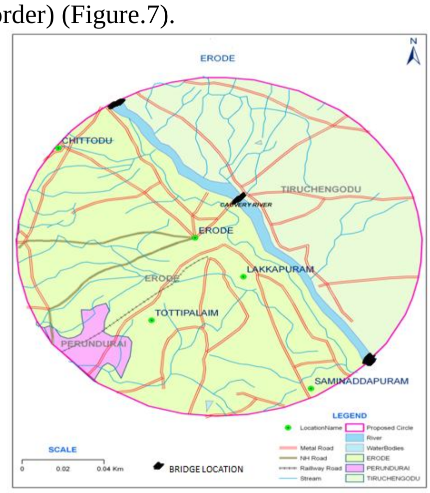

FIGURE.7. LOCATION FOR BRIDGES

XI. LAND USE / LAND COVER

The land use map was prepared from Digital LAN SAT 2007 satellite data and the features were classified as per Integrated Mission for Sustainable Development (NRSA,1995) classification system and following land use pattern were identified as agricultural land, forests, mining area, water body, plantations, barren rock area and urban areas. Most of the area is being occupied by fallow land. Hills/barren rocky area is located in the northern and southern part of the study area. Besides these two major categories, the crop land is also sporadically distributed in the study area. (Figure.8).

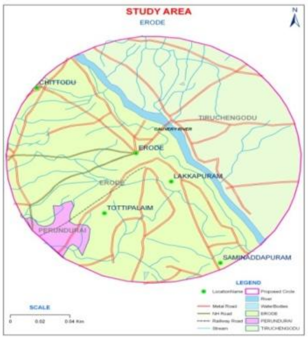

FIGURE.8. LAND USE / LAND COVER

XII. OVERVIEW OF SOFTWARE- Arcgis

ArcGIS is a suite consisting of a group of geographic information system (GIS) softwareproducts produced by Esri. There are also server-based ArcGIS products, as well as ArcGIS products for PDAs.Extensions can be purchased separately to increase the functionality of ArcGIS.

ArcGIS 8.x

In late 1999, Esri released ArcGIS 8.0, which ran on the Microsoft Windows operatingsystem. ArcGIS combined the visual user-interface aspect of ArcView GIS 3.x interfacewith some of the power from the Arc/INFO version 7.2 workstation. This pairing resulted in a new software suite called ArcGIS, which included thecommand-line ArcInfo workstation (v8.0) and a new graphical user interface applicationcalled ArcMap (v8.0) incorporating some of the functionality of ArcInfo with a moreintuitiveinterface, as well as an ArcGIS file management application called ArcCatalog(v8.0). The release of the ArcGIS suite constituted a major change in Esri's software offerings,aligning all their client and server products under one software architecture known asArcGIS, developed using Microsoft Windows COM standards.One major difference is the programming (scripting) languages available to customize orextend the software to suit particular user needs.

In the transition to ArcGIS, Esri droppedsupport of its application-specific scripting languages, Avenue and the ARC MacroLanguage (AML), in favor of Visual Basic for Applications scripting and open access toArcGIS components using the Microsoft COM standards. ArcGIS is designed to store data in a proprietary RDBMS format, known asgeodatabase.ArcGIS 8.x introduced other new features, including on-the-fly map projections, andannotation in the database. Updates of ArcView 3.x extensions, including 3D Analyst andSpatial Analyst, came later with release of ArcGIS 8.1, which was unveiled at the EsriInternational User Conference in 2000.

XIII. CONCLUSION

The purpose of this study was to develop a tool to locate a suitable less route between two points. The GIS approach using ground parameters and spatial analysis provided to

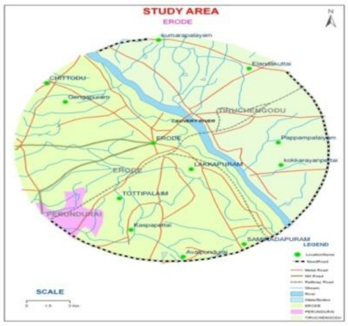

FIGURE.9 FINAL RING ROAD FOR ERODE CITY

achieve this goal. Raster based map analysis provide a wealth of capabilities for incorporating terrain information surrounding linear infrastructure. Costs resulting from terrain, geomorphology, land use, drainage and elevation resulting low cost estimation for implementing the shortest routes for the study area. The Figure.9 shows the final ring road for erode city of 22 kms all around which connect the major roads of byepass.

Reference

[1]. **Ashish, V., Dhinga, S., L., 2005,** Integrated Framework Using Geographical InformationSystem, Journal of urban planning and development, urban public transportation world Review: challenges and innovations. Vol: 131 no: 2, pp: 98-111

[2]. **Berry, K., J., 2000,** Optimal Path Analysis and Corridor Routing: Infusing StakeholderPerspective in Calibration and Weighting of Model Criteria.

[3]. **Cheng, M., Y., Chang, G., L., 2001**, Automating Utility Route Design and Planning Through GIS, Vol: 10, N: 4, pp. 507-516(10).

[4]. **Çevik, E., Topal T., 2003,** GIS-Based Landslide Susceptibility Mapping for a Problematic Segment of the Natural Gas Pipeline, Hendek (Turkey), Environmental Geology, and Vol: 44, pp: 949-962.

[5]. **Delevar, R., M., Naghibi, F., 2003**, Pipeline Routing Using Geospatial Information System Analysis.

[6]. **Gipps, G., P., Kevin, Q., G., Held, A., Barnett, G., 2001**, New Technologies for TransportRoute Selection, Transportation Research Part C, Vol: 9 pp:135-154..

[7]. **Glasgow, J., French, S., Zwick, P., Kramer, L., Richardson, S., Berry, K., J., 2004**, AConsensus Method Finds Preferred Routing.

[8]. **Kov, K., C., Chowdhury, R., Flentje, P., 2005**, Hazard and Risk Assessment of Rainfall –Induced Land sliding Along a Railway Line.