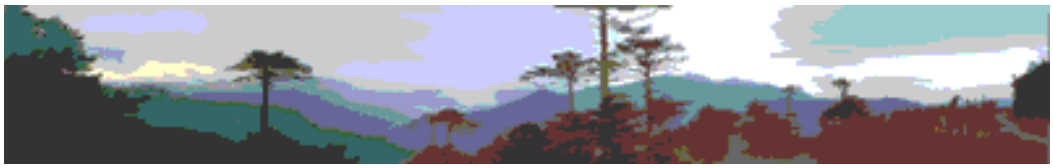
GIS & REMOTE SENSING BASED SUSTAINABLE MODEL PLAN. (NORTH-EASTERN HILLS OF INDIA)



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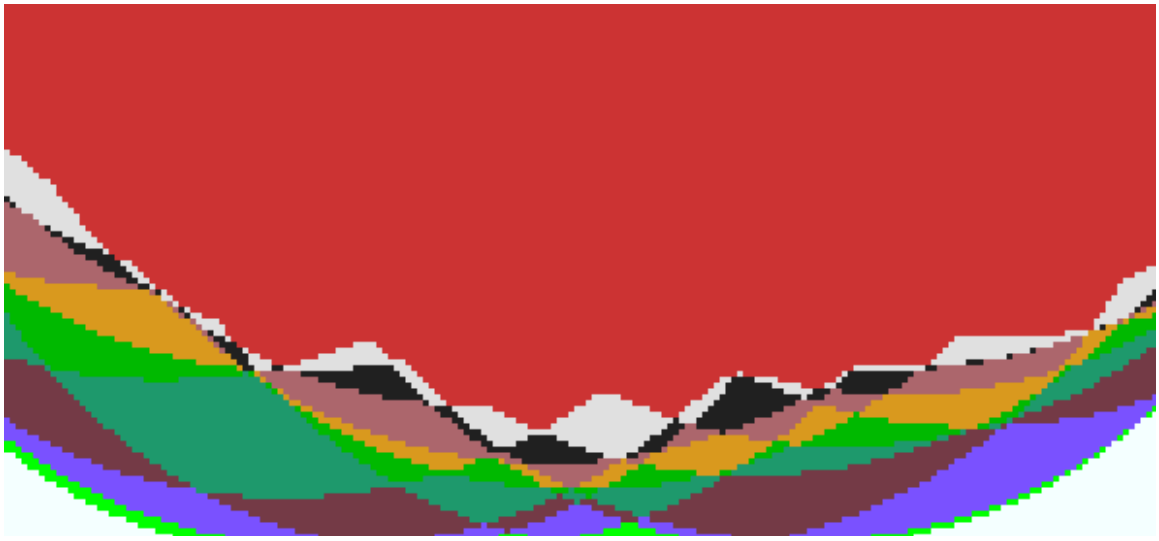
INTRODUCTION:

It is observed that the relocation of an existing service is not only difficult but not viable economically also (especially in Indian context). But if some rational criterion such as demand weight distance is followed for additional locations geographical accessibility and efficiency level of services can be improved. Here we want to show the distribution of services and proposed additional services.



TERRAIN ANALYSIS OF STUDY AREA.

Roads of North-Eastern Hills has been tentatively identified on map of SOI & by remote sensing satellite the same needs to be confirmed or suggest other alternative alignment, road elevation near villages. The

road will have to negotiate along high hills to arrive at south facing hills tentative alignment proposed on map is as follows:

- On feasible, evaluate earthwork and draw the road alignment on a map drawn to a suitable scale.
- Contour map at different interval considering gradients of 1:15 to 1:20, (a tentative alignment has been drawn on map.)

IMAGE IDENTIFICATION

SCOPE:

A) Assessment and feasibility of road alignment through North-Eastern hills by interpreting the Remote Sensing Images (IRS-Id pan & Liss) data.

B) Slope and Terrain analysis of the proposed road alignment on a map drawn to a suitable scale for development project.

C) Preparation of Contour Map at 2-meter interval.

D) Ground control points to be determined and verified with the Clint's representative by field survey / ground survey.

E) Estimation of Bio-Mass & Local utilization ratio in those areas.

F) Preparation of logistic Master plan for those areas.

INPUTS:

1) Topo Maps, Block Maps and Base line information on Road.

2) Remote Sensing Data (images). To collect various data for individual Block level information on Project area, it is required 5m resolution images in black and white and 20m (Liss) resolution images in color to determine Forest cover, Digital Terrain Model (DEM) and various Physical data by Image Processing methodology.

3) If required Topographical maps (1:50,000 scale), cadastral (block) maps to be provided be prepared. (Available maps can be taken from the department).

4) High-density base line information.

5) Existing road map of the area.

METHODOLOGY

Why Surveying is important?

Surveying is an important aspect of Road Network due to the following:

The objective is to optimize the cost of network based on following considerations:

- Shortest route calculation
- Minimum number of crossing
- Accessibility i.e. from approachability for maintenance as well as from law and order point of view.
- Selection of optimum foundations based on following information
    - Type of soil
    - Type of terrain: Benching requirements, requirements of Road extensions.
    - Loose hills especially in young Himalayan region, areas prone to landslides
    - Area of submergence as well as prone to river meandering

    It helps in ensuring the statutory clearances with respect to following:

- Power line crossings, Railway crossings, road crossings etc.
- Clearances from habitation
- Environmental clearances
    - Minimum forests, minimum forests density
    - Historically important areas and monuments
    - National Parks and wild life sanctuaries

PROJECT STAGE:

After system planning studies and identifying suitable State Road systems, Reports for the network are to be suggested. At the project stage, detailed elaboration of the project is done for the technical details.

Presently, reconnaissance involving the following types of surveys is carried out prior to submission of reports:

- Map study
- Walkover survey and / or
- Preliminary survey

Cadastral survey maps with following benefits:

- Maintenance & additional construction cost can be brought to the minimum.
- Material Estimation and procurement can be done fairly on realistic basis.
- Any possible delay/hindrance likely to come during the execution of the work can be avoided after taking due care of various statutory provisions during the course of selecting route alignment.
- Proper planning can be done for networks keeping provision for future routs etc.
- Approvals from Railways, Civil Aviation, Forest authorities etc. can be obtained faster.
- Preparation of Master Network and fixing construction/erection targets can be done on realistic basis, which will help in the judicious planning of materials flow, cash flow and manpower requirements.
- Appreciable time can be saved during construction & maintenance of roads, if selection of Rivers, route along hill sections and power line etc., are properly made.

MAP STUDY:

After drawing various routes of road network within the cadastral maps, a comparative study is done on the basis of the following data:

- Route length.
- Nos. and type of important road points in each indicating route of each road as measured on the map.
- Nature and number of major crossings.
- Mapping the industrial installations, structures, important places for identification of Roads.
- Approach to the line in general for construction & maintenance.
- Reaches through protected or Reserved Forests
- Continuously long stretches in paddy fields.
- Close parallelism with Railway lines.

Walk-over survey is carried out on these routes. Walk over survey means going over the area associated with the routes and collecting features observed other than those existing on the map. In addition the indications on following features are also checked:

- Communication lines
- Power lines
- Expanding villages and towns
- Rich gardens and plantations
- Reserved forests and high tree areas
- National Parks & Wild life sanctuaries
- Archaeological monuments
- Aerodromes, radar centers etc.
- Steep sloping terrain, Areas prone to land slides, soil instability etc.
- Prohibited areas declared under statutory regulations

Preliminary survey: On completion of walkover survey proposal of the most suited route is further studied before taking preliminary survey. The main objective of preliminary survey is to understand the route to the ground with such deviations as may be necessary as per field constraints. It involves generally fixing of important points of the route, identification of major crossings, general classifications of soils, measurement of route length etc. The preliminary survey will include detailed investigations for locations along the route.

PROJECT EXECUTION STAGE:

On completion of preliminary survey and approval of Feasibility report, the detailed survey of the route is carried out. The detailed survey consists of accurately determining the number and types of roads along with extensions, special road required, number and types of important crossings, special road required etc. It generally involves the following actions:

- Leveling
- Plotting and profiling on a scale of 1:25,000
- Final and pegging of locations
- Trial pit excavations
- Detailed soil investigations wherever required

The final output of the detailed survey is in the form of tower schedule showing the type of tower with associated angle of deviation, span length, wind and weight spans, associated foundations along with its classifications, geological and geotechnical, data and any crossing involved in that span.

Limitations of Conventional methods of map study/ surveying

Apart from the considerable time involved, the following limitations are generally associated with conventional methods of surveying:

- The topographical maps used for walkover survey and preliminary survey can be very old and do not contain recent changes in inhabitation pattern, vegetation coverage and water bodies etc.
- The process of elimination is done at the ground itself which increases the number of angle towers and length of line.
- The surveying staffs do not have bird's eye view of the present ground condition this may particularly result in large inaccuracies in estimation of civil works (benching and revetment) quantities in terrain involving large undulations.
- There is every possibility of error in recording the ground data and subsequent transfer on the route map

ROUTE PLANNING AND FIXING OF MIS CAN BE ACHIEVED THROUGH THE FOLLOWING PROCEDURE:

- Data Input: Survey of India maps, Satellite data, railway maps, land use maps, settlement maps etc are used as input for data base preparation

- Above inputs through GIS are used to update the maps. Other specific maps may also be created.
- Using computer run algorithms or linear programming techniques optimal transmission line route may be finalized.
- On this output from GIS domain post field work is done and location latitude and longitude of the deviation points are identified on ground using Geographical position system (GPS).

Further in terrain having large undulations, stereoscopic satellite imageries may be used selectively to interpolate the contours and digital terrain model can be used to select the route in hilly regions.

DETAILED SURVEY:

Satellite images can be used as a reliable tool to record the precise elevations and plan measurements of the selected route. This may involve taking following actions

- Transferring of Images to studios for processing and detailed measurements
- Authentication through ground verification

It is said that camera never speaks lie. That is precisely the greatest advantage of satellite images in detailed survey application i.e. traditional methods. Further once the ground profile in digital form is obtained the estimation of various types of earthworks involved viz. Benching, revetments etc. can be made using software.

Appropriate techniques for obtaining soil conditions, sub soil conditions, water tables, treacherous terrain conditions etc for accurate estimation of civil works need to be explored.

There may be some error involved in using satellite imagery for preliminary survey due to the "shadow effect". In the above case it was found sometimes difficult to differentiate between forests and other greenery. Thus exact boundaries of forests could not be demarcated

- Resolution plays an important part in interpreting satellite images. Higher resolution may improve the visual content may reveal ground realities more closely.
- Ground profile and subsoil data cannot be accessed through satellite imageries.
- Digitization of complete zonal maps rather select features would provide a complete replica in integrated environment.
- Satellite data of resolution of 1 or 5.8 meter will be preferable. However the overall cost economics shall have to be worked out since this data will be more costly but will completely avoid field works.
- Symbols of physical features in satellite imageries are not easily recognizable by transmission line engineers.

SPATIAL ANALYSIS APPLICATION:

Maps are a powerful medium for planning, analysis and monitoring for a large number of applications. Satellite images, cadastral maps, political boundaries, contours, networks and location analysis are handled

on a day-to-day basis by decision-makers in numerous organizations. The data of cadastral survey forms the basis for generation of any accurate higher level map. Spatial analysis applications are of two types:

MICRO LEVEL PLANNING AND DEVELOPMENT:

Micro level planning generally involves ground study and evaluation of data of a specific area of interest. For e.g., rural development schemes, irrigation, ground water development, town planning, mining, Road logistics etc. require a study of maps and data pertaining to small zones.

MACRO LEVEL PLANNING AND DEVELOPMENT:

Macro level planning generally involves study and evaluation of data of a large geographic zone. For e.g., statewide policies, excise, fiscal analysis, logistics (like road, railway etc). are macro level applications. Spatial analysis applications, especially at the micro level, are a natural progression from land management applications, as the maps are directly used or derived from cadastral survey data and the land profile and usage information is available in land registers.

USE OF REMOTE SENSING IMAGE IN MAPPING THE SURFACE OF THE EARTH:

Remotely sensed images contain both spectral and spatial information. The spectral information provides various properties and characteristics about the surface cover at a given location or pixel (that is, vegetation and/or soil type). The spatial information gives the distribution, variation, and topographic relief of the cover types from pixel to pixel. Therefore, the main characteristics that determine a pixel's brightness/reflectance and, consequently, the digital number (DN) assigned to the pixel, are the physical properties of the surface and near surface, the cover type, and the topographic slope. In this application, the ability to detect and map lineaments, especially those related to fractures and faults, is critical. Therefore, the extraction of spatial information from the digital images was of prime interest.

USE OF GIS IN DRAWING MAPS:

WITH GIS TECHNIQUES, MAPS ARE PRODUCED THAT ARE SIMILAR IN APPEARANCE TO HAND-DRAWN MAPS; TO THE EYE, EACH ELEVATION MAP MAY APPEAR TO NOT CONFLICT WITH THE ELEVATION MAPS OF OTHER STRATIGRAPHIC UNITS. HOWEVER, TO DEVELOP A TRULY INTERNALLY CONSISTENT SET OF MAPS, THE MAPS ARE PROCESSED INTO A VECTOR (GRIDDED) FORMAT. THE TOPO SURVEY MAPS ALWAYS PROVIDE SOME BENCHMARK AND ARE THEREFORE VERY USEFUL IN CONTOUR PREPARATION EITHER MANUALLY OR ELECTRONICALLY. TOPOGRAPHICAL MAPS OF INDIA MADE BY SURVEY OF INDIA WERE STARTED MORE THAN HUNDRED YEARS AGO. SINCE THEN THE LAND INFORMATION IS BASED ON THE TOPO MAPS OF SURVEY OF INDIA FOR VARIOUS PURPOSE. BUT THERE IS SOME CONSTRAINT IN TOPO MAPS AS INFORMATION IS LITTLE BIT OLDER. SO TOPO MAPS COULD BE VERY HELPFUL TO READ WITH THE REMOTE SENSING IMAGES, WHICH IS TODAY'S SCENARIO.

Micro-Land Use Planning:

- GIS Application to visualize the Land use and Land Cover with various information/ data as stated above on respective area at block & village level.
- Digital Resource Model (DRM) preparation to visualize the unapproachable area.
- Determination of the slope in project area for preparation of proposed road plan.
- Preparation of proposed master planning map.
- Correction, if any, of the said maps after field verification and submission of the same to the department as final output.

CONFLICTS AREAS:

THE FOLLOWING INFORMATION SHOULD BE RECORDED FOR EACH IDENTIFIED CONFLICTS.

A) THE ACTOR INVOLVED.

B) BRIEF DESCRIPTION.

C) CATEGORY OF CONFLICT.

D) BRIEF HISTORY.

E) IMPACT OF THE CONFLICT ON SPECIES, LSES (LAND SCAPE ELEMENTS) AND USER GROUP.

CONSERVATION STRATEGY AND ACTION PLAN:

THE FOLLOWING POINTS SHOULD BE NOTED DOWN FOR THE ACTION PLAN -

A) BRIEF REPORTS OF THE GRAMSABHA.

B) DECISIONS TAKEN AT THE GRAMSHAVA MEETINGS.

C) SPECIES, LSES AND USER GROUPS INVOLVED IN THE DECISION.

D) PROGRESS MADE ON THE ACTION PLAN

E) CURRENT STATUS OF DEVELOPMENTAL PROGRAMME.

Conclusion:

Computer mapping requires two types of databases interacting with each other. One is cartographic database showing, for example, coast lines, administrative boundaries, roads, rivers, location and shape of houses and buildings. The information sources for acquiring these types of data are satellite and other remote sensing data, existing maps, and land survey data.

The other database is an attribute or thematic database. It may include the names of places and buildings, statistical data such as demographic information, land use classification, and others. These types of data are supplied in various forms such as printed statistical reports, digital tape data, or CD- ROM.

The advantages of computer mapping are the reduced time and costs of data updating and management. Initial data creation and input to develop the geographic database requires long hours of work. We have researched the latest equipment and technology available to produce a workflow system for higher efficiency and improved accuracy.

In order to acquire data directly from satellite data, we use a suite of various hardware and software components to operate systems: such as high-resolution precision photo-scanner and soft-copy-ortho-photo mapping system. Other software and hardware components control digitizing tables used to convert existing paper maps into digital form. Other systems process land survey data from GPS and Total Stations, which collect land, survey data. Original image enhancement and geometric correction of image data are performed with the aid of an image processing system to meet requirements in the latter phase of mapping works.

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