

# Planning for Road Construction Using GIS

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**Abstract:** Building a road requires a plethora of data and tasks to be handled in parallel. Design, construction methods, quantities, unit prices, production rates, etc., are only a few of the many pieces of information that need constant processing and refining. Due to the exponential growth in project sizes in recent years, doing this manually is both laborious and inefficient. Roadway construction planning is greatly facilitated by the use of Geographic Information Systems (GIS), which visually depicts the whole process and allows for the integration and management of many kinds of data. By developing a system that may assist planners in making accurate, efficient, and timely judgments, this study uses GIS to simplify the process of planning highway development.

**Keywords:** Geospatial information system (GIS), roadway, building, procedure, design.

## 1. Introduction

Heavy industrialization, subsequent urbanization and changes in the lifestyle of human beings are all the outcomes of alarming growth in the population of the world. This requires quick & efficient set up of urban infrastructure. Roads are normally called as the measure of the development of any country as for all other forms of infrastructure to be established, we need to construct roads first. Many a times, Roads are the initiators in the process of development of a region. However this kind of development model can be implemented only if the roads are properly planned and their construction is executed in time. For this, skilled workforce & technological advent are required.

In spite of the major technological changes in construction industry, it still remains highly labor intensive, decentralized, and dependent on uncertain economic and working environments. As far as roadway construction is concerned, it is basically a linear type of repetitive project involving number of activities & equal number of crews working on it. Apart from it, huge amount of information regarding design, construction methodology to be followed, quantities, unit costs & production rates, etc. is to be continuously processed & refined with time. Doing this manually by conventional methods is time consuming & cumbersome as the size of the projects today has increased manifold. Also, the sorting & Although the two terms, data and information, are often used indiscriminately, they both have a specific meaning. **Data** can be described as different observations, which are collected and stored. **Information** is that data, which is useful in answering queries or solving a problem. The components of a GIS are pictorially represented in Figure 1.

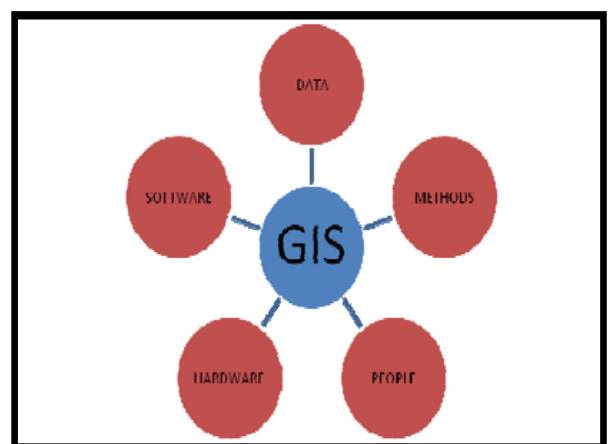


Figure 1: Components of GIS

## 2. Roadway Construction

The major stages involved in the construction of any road can be generalized to clearing and grubbing, removal of unsuitable soil, excavation, dumping of borrow earth, dozing of borrow earth, grading and rolling of the borrow earth, dumping, grading and rolling of granular sub-base, laying and compaction of premix bituminous macadam, application and retrieval of data becomes difficult.

In a developing country like India, where continuous efforts are being made to improve road connectivity as well as improvement in the quality of existing roads through nationwide programmes like Pradhan Mantri Gram Sadak Yojana (PMGSY), GIS based



Geographic Information System (GIS) is a computer based tool which can be used for capturing, storing, analyzing, querying and displaying the geographic information. of tack coat and finally laying and compaction of dense bituminous macadam (DBM) to get the finished surface.

These number of activities have related information in several spatial (drawings, layouts and blueprints) and non-spatial (schedule, cost estimate, specifications, etc.) forms that are maintained separately by various project members using different commercially available tools. The overlaps and lack of consistency among such information may often lead to the construction errors, which results in miscommunications which may be expensive and time-consuming in nature. The softwares from various disciplines

(architecture, construction, structural and civil engineering) are being used to maintain and analyze such information throughout the life-cycle of a construction project. Drafting groups generally use CAD tools; planners use Primavera and Microsoft Project whereas construction and operations group use blueprints or printed paper, etc.

Information flow between various groups working in a project is not through well-defined standards and procedures, which results in an inefficient process characterized by data redundancy, redundant processes and poor information quality. If both, spatial and non-spatial information are maintained in a single environment and changes are made to these documents at one place only, drawings, schedule, cost estimate and specifications of a construction project will be consistent to each other. This is the very aim of development of this application using GIS software, GRAM++ as a platform.

### 3. Method of Development of the Application

The database required for development of this application was referred to from a 30 km long stretch of Pen –Panvel section of NH 17 which is being four laned from Pen to Indapur, Raigad district, Maharashtra.



Figure 2: Study area, Raigad, Maharashtra, India (Source: Feasibility report, NHAI)

The application was developed in GIS software Gram ++. To begin with, the original CAD file was converted into a bitmap image. The geographical co-ordinates of the stretch were known and entered in the software. This image was then imported to the input output module of Gram ++. The entire map is then digitised to get a replica of the same in gram++. This replica forms the basis of the entire development of the application. Now, layers as per the requirement are formed in Map-Edit module of Gram ++ (file is now a .vec file).

Different layers of work are formed so that information of varying nature can be linked to them. The basic operations are then carried out in the vector analysis module. The desired database is then created by using add field and modify field to database options available in Operations menu of vector analysis module. (database file formed is a .mdb file).

It may happen that we need to add certain non-spatial data which cannot be added in the database for e.g maps, cross sections or L-sections etc. In such a circumstance, the child map feature is utilized. Care has to be taken that all our work i.e. vec file, .mdb file and image to be attached (.jpg file) should be in the same single folder.



**Query:**

Tables: bridge\_gider

Fields:

- AREA\_SQ\_M
- basheight
- Gider\_conc
- Gider\_conc\_executed\_qty
- Gider\_concrete
- Gider\_inner\_primercost
- Gider\_inner\_waterproof\_cer
- Gider\_outer\_anti\_carbonatic
- Gider\_outer\_primercost
- Gider\_steel
- Gider\_steel\_cost
- NO\_OF\_SEG
- percentage\_complete**
- PERFIM\_M
- SID
- status
- UID

Enter Condition/Query:

percentage\_complete < 100

Field Values:

- 0
- 100
- 77
- 78
- 72
- 88
- 95

Operators:

- + - \* /
- < > <= >=
- And Or Not

**Save Query** Clear

**OK** Cancel

[illegible][illegible]

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If real time monitoring of the work which can be achieved by linking the actual construction site, the planners office and the graphical interface provided by this application is accomplished, the resultant product will be very helpful not only for construction planning but also for the scheduling and real time monitoring of the project

## References

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With contributions from Abkowitz, Walsh, Hauser, and Minor, L. Geospatial information system adaptation for highway management, ASCE Journal of Transportation Engineering, ISSN 0733-947X/90/0003-0310. In 2008, Prathamesh P. Gawde earned a Bachelor of Engineering degree in civil engineering from K.K. Wagh College of Engineering in Nashik, Maharashtra. He is now a Master of Technology student in Civil Engineering (with a concentration in construction management) at VJTI, Matunga, Mumbai, India, where he will attend classes from 2011 to 2013.

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