

GEOGRAPHIC INFORMATION SYSTEM FOR CONSTRUCTION SAFETY OF INFRASTRUCTURE PROJECTS

Presentation

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ORGANIZATION OF PRESENTATION

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INTRODUCTION



INTRODUCTION

Indian Construction industry

- is second biggest industry of the country after agriculture (Seetharaman, 2009) and has significant economic importance.
- is essential contributor to infrastructural developments that are the basis for improving standards (Kulkarni, 2007).

INTRODUCTION

The infrastructural developments projects

- are employment spinner.
- are more labour-intensive than the developed countries, involving 2.5-10 times more workers per activity.
- Generates demand of skilled and semi-skilled labour.
- employment is generally temporary in nature.

INTRODUCTION

Workers

- Unskilled workers migrate in groups for employment.
- Communication problems tend to inhibit safety on the work sites (Koehn et al., 1995).
- The Indian construction labour is 7.5% of the world labour force but it contributes to 16.4% of fatal global occupational accidents (Kulkarni, 2007).

INTRODUCTION

Accident Cost

- Accidents during infrastructural projects costly in human and financial terms.
- Expenses include health care, litigation, wastage of management's time and workers compensation. transportation costs, workers productivity loss, cost of fixing or replacing damaged equipments or materials, and the cost of hiring new workers (Hinze, 1992).

INTRODUCTION

Reasons for safety

- Reasons for safety include humanitarian concern, economic reasons, laws and regulations and organisational image (Seetharaman, 2009).
- effective safety program increases profits, improve reputation and image, and reduction in insurance premiums. Most importantly there shall be a decrease in accidents on the job site (Koehn et al., 1995).

INTRODUCTION

Safety awareness

- In addition to respecting deadlines and high quality work, safety during the construction of infrastructural projects must be of primary importance.
- Construction safety includes the safety of the facility to be constructed as well as safety in process of constructing the facility (John et al., 1999)



2. GEOSPATIAL TECHNOLOGIES

Geospatial technology is spatial information technology which includes three different systems: Global Positioning Systems (GPS), Remote Sensing (RS), and GIS.

all are related to mapping features on or near the earth's surface, and thus in environments within which humans live or act.

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- **GPS system for the rapid and accurate measurements of location to millimetre accuracy.**
 - **RS technology useful in transmitting images of ground.**
 - **GIS, a software package capable of performing a wide range of manipulations on geospatial information, including analysis, modelling, storage, visualization, and many other operations.**
 - **GIS is capable of performing any conceivable operation on geospatial information (Goodchild, 2011).**

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- **Geospatial technologies are essential for the routing and scheduling of delivery vehicles for keeping track of distributed assets**
 - **In government, essential in support of planning, data-gathering, and assessment.**
 - **In future, GIS to know the complete state of the world at all times (Goodchild and Janelle, 2004).**

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- **GIS is a computer-based tool for *mapping* and *analyzing* things and events that exist and happen on Earth (Lo and Yeung, 2002).**
 - **GIS divided into four components involving a computer system, GIS software, human expert, and data.**
 - **GIS activities grouped into spatial and attribute data management, data display, data exploration, data analysis, and spatial modeling (Clark, 2001).**

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- Spatial and attribute data files are synchronized so that both can be queried, analyzed and displayed (Chang, 2002).
 - GIS capabilities involve the integration and analysis of large volumes of spatial and attribute data from variety of sources (Jeljeli et al., 1993).



**3. GIS APPLICATIONS IN
CONSTRUCTION SAFETY**

Various IT applications like 4D CAD and BIM etc used in construction safety planning of infrastructure projects fail to consider the topographic features.

GIS based 4D safety planning of infrastructure project along with site conditions assist safety planner in examining what safety measures are required when, where and why.

SAFETY MONITORING OF HILLSIDES

Cheng and Ko (2002) developed a computer-aided decision support system for safety monitoring of hillsides.

- × Assists engineers to collect and manage data, infer slope stability, and failure types. uses checklists/instrumentations
- × based on fuzzy set theory which is entirely based on the knowledge and experience of geotechnical engineers therefore prediction may be different for different experts.
- × Research use of GIS based database management system can improve display monitoring conditions graphically.

SAFETY MONITORING DURING EXCAVATION

Cheng et al., (2002) developed GIS based decision support system to monitor and control the excavation conditions.

- × construction sites and instruments are represented in various data layers that are integrated with GIS based Relational Database Management System (RDBMS).
- × System integrates locational and thematic information, improves the graphical display of monitoring conditions, and helps in database queries.

4D GIS CONSTRUCTION SAFETY

- × GIS may be used for retrieving the information from safety database and linking with the activities of schedule (Bansal,2011).
- × The safety database along with 4D modelling and topographical conditions in single environment assist safety planner in examination of what safety measures are required when, where, and why.
- × GIS based navigable 3D animations in construction safety planning process can facilitate easy understanding of construction sequence and shall be useful in prediction of spots of adverse conditions.
- × GIS based safety planning along with geospatial analysis can facilitates the perception of construction along with surroundings.

GIS BASED ANALYTICAL APPROACH

Manase et al., (2011) explored of various analytical capabilities of GIS.

- × GIS capabilities enhance the analysis of fragmented construction environment information and ease the understanding of various factors in construction industry for mitigation of accidents.
- × GIS for Accident Prevention (GISAP) integrate different and varied datasets to give an overall picture of happenings around a region geographically.
- × It helps in predicting future accident trends along with visual identification of potential accidents spots.

DEVELOPMENT OF SAFE SITE LAYOUT

Spatial operations of GIS such as proximity tools is used to determine if a given point, line, or area lies within a certain distance of another point, line, or polygon.

Karan and Ardeshir (2008) suggested that GIS is an effective tool for safety assessment and for quantifying various hazards coupled with the construction site layout.



4. CASE STUDY

CASE STUDY

1

- Jawahar Lal Nehru Government Engineering College, Sundernagar has been established by Himachal Pradesh State Government in 2006.
- The institute is located on Chandigarh-Manali NH-21.

2

- The institute is located at $29^{\circ}56'24''$ N latitude and $76^{\circ}48'36''$ E longitude.
- In its short journey of 6 years college has witnessed continuous developments in its infrastructure.

3

- The institute is developing its own campus at Bechhnadar, on a hill top. Three building blocks (A, B, and C) have been completed and the construction of another block D has been started.
- As the infrastructural developments of JNGEC Sundernagar are coming up at hill top where topography of area play a great role in selection of site and orientation of building.

**INTEGRATED MODEL OF JNGEC
GIVING INSIGHT OF TOPOGRAPHY AND SURROUNDING**





5. Conclusion

Infrastructure projects are major contributor of employment but are vulnerable to various hazards.

workers safety during construction of infrastructure projects should be considered for achieving the optimum benefit of three vital objectives of time, cost, and safety.

This paper discusses the role of GIS in construction safety planning of infrastructural projects.

GIS provides ways and means to manage spatial data such as geometric shapes and topographical relationship, and facilitates in performing spatial analysis which may be helpful in planning safe construction.

