Flood Risk Assessment using BIM and GIS Integration at Neighbourhood Scale

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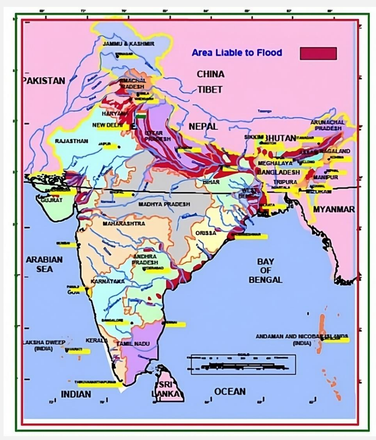
Introduction

Flood is an overflow of water that submerges the land that is usually dry.

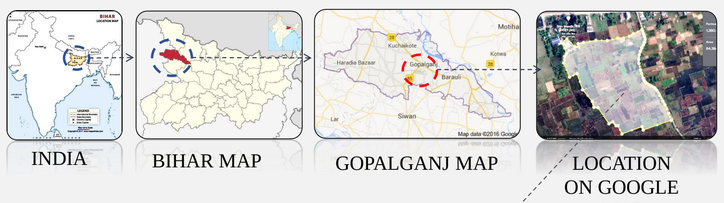
- India is highly vulnerable to floods.
- Geographical area- 40/329 mha is flood-prone.
- **Problem:** There are many factors like land use, topography, etc. but climate change, making it more important than ever to assess and mitigate flood risks.
- **Solution-** building information modeling (BIM) and geographic information systems (GIS) can be used to conduct flood risk assessment at the neighborhood scale.



Advantages:

- BIM focuses on information related to buildings whereas, GIS focuses on information related to spatial configuration.
- Together, BIM and GIS can provide a highly detailed and holistic picture of a project.

Study Area



Co-ordinates :
Latitude: 26°28'20"N,
Longitude: 84°25'23"E
Elevation: 91-94 m

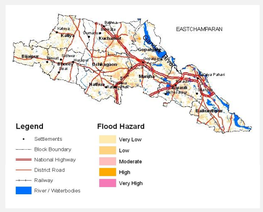
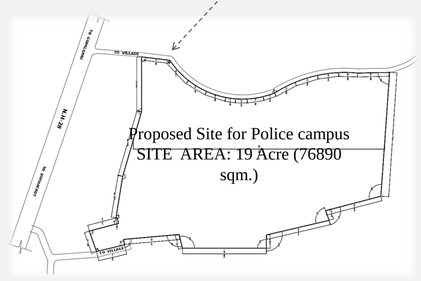


Figure: Flood Hazard Map of Gopalganj



Reasons:

- Heavy rainfall
- Flash flood
- Ganga overflow
- Poor drainage
- water logging

Flood Risk Assessment

Flood Risk Assessment (FRA):

- It is the process of evaluating the potential adverse effects of flooding on human health, safety, the environment, and property.
- There are several factors to evaluate FRA and FDA is one of them.

Flood Damage Assessment (FDA):

- It is the process of evaluating and quantifying the potential damages to infrastructure, property, and the environment caused by flooding events.

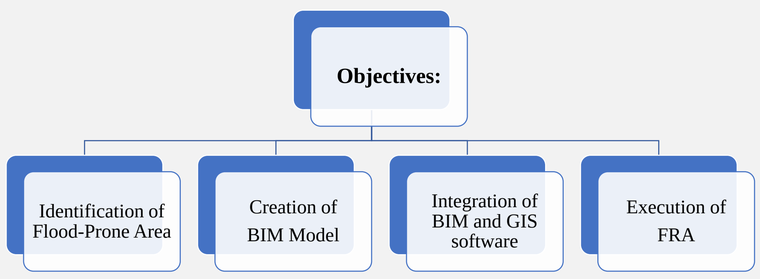
1. Extraction of Site information
2. Data integration: using BIM (Revit) and GIS (ArcGIS Pro) software
3. Flood simulation in Hec-Ras and extraction of the flood parameters
4. Calculation of water depth inside the house
5. Physical damage assessment of the site
6. 3D visualization and reporting

Figure: The framework for the FDA in a building

Figure: Integrated BIM (Revit model) in ArcGIS Pro.
Added additional ArcGIS Online data to understand flood parameters.

Aim and Objectives

Aim: To conduct **Flood Risk Assessment** (FRA) using the integration of **Building Information Modeling** (BIM) and **Geographic Information Systems** (GIS) software at the neighborhood scale.



Software used:
GIS software: Esri ArcGIS, ArcGIS Pro, ArcGIS Online, ArcGIS Living Atlas of the World, etc.
BIM software: Autodesk Revit
Others: HEC-RAS, Google Earth Pro, etc.

Methodology

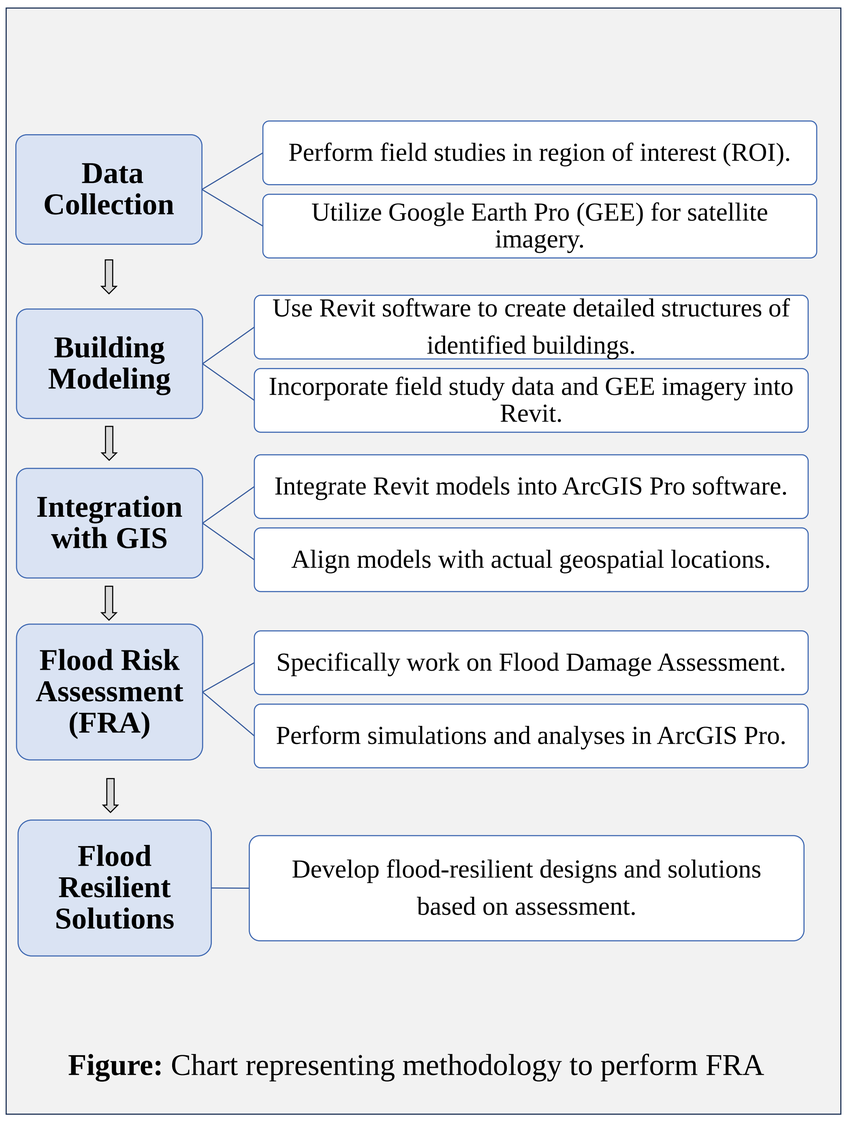


Figure: Chart representing methodology to perform FRA

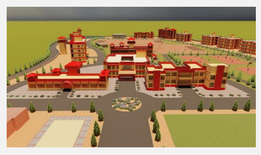
Integrated BIM-GIS model

3D models in BIM software

MAJOR REQUIREMENTS:

1. **Reserve Office Building**
2. **Armories Building**
3. **Store Building**
4. **Training Classroom**
5. Major Sargent Residence
6. Guest House
7. Officer's Quarter
8. **male Barrack**
9. **female Barrack**
10. **6 U.S Quarter**
11. **12 L.S Quarter**
12. **12 Menials Quarter**
13. Hospital (16 bedded)
14. **Primary School**
15. Vehicles Garage
16. 4- Dog Kennel
17. Toilet
18. Parking area
19. Obstacle course
20. **Playing ground**
21. **Parade ground**
22. **Watch Tower 20 Ht.**

Figure: 3D model of site in Revit software

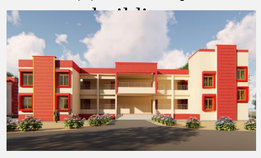


(a) Main

(b) Reserve office

(c) Armoury

(d) Store



(e) Training Classroom

(f) L.S. Quarter

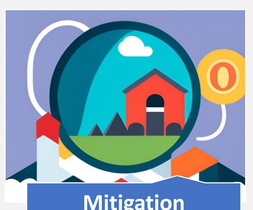
Figure: 3D model of buildings in Revit software

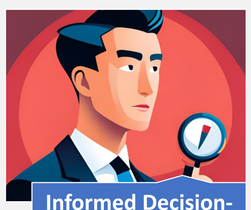
BIM and GIS Integrated Model

Figure: Integrated Revit model in ArcGIS Pro.

Key Features

Utilizing integrated BIM and GIS data for flood risk assessment we can get:





Conclusion

- **Area Selection:** Gopalganj city in Bihar.
- **BIM Model Creation:** Utilized Revit software.
- **BIM and GIS Integration:** Explored various software options for BIM and GIS integration and found ArcGIS Pro as the optimal tool for direct integration with Revit (version 2016-2021).
- **Flood Risk Assessment (FRA):** Studied factors affecting flooding on the site.
- **Flood Simulation:** Performed flood simulation using Hec-Ras software with available data.
- **Flood Damage Assessment (FDA):** FDA can be calculated to get overall loss that could occur.
- **Flood Risk Assessment (FRA):** total risk can be evaluated by considering FDA as one of the major factor.

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