

# PROJECT REPORT

Date	18 February 2026
Team ID	LTVIP2026TMIDS57846
Project Name	Civil Engineering Insight Studio

## 1. INTRODUCTION

### 1.1 Project Overview

The **Civil Engineering Insight Studio** is an AI-powered web application that analyzes images of civil engineering structures and automatically generates detailed technical descriptions.

The system uses the multimodal capabilities of Gemini to interpret images and provide structured insights such as:

- Structural type
- Materials used
- Dimensions (estimated)
- Construction methods
- Structural components
- Engineering challenges

The application is deployed using **Streamlit**, enabling real-time user interaction.

### 1.2 Purpose

The purpose of this project is to:

- Reduce manual effort in structural documentation
- Improve consistency in engineering reports
- Support project monitoring
- Assist civil engineers in decision-making

## 2. IDEATION PHASE

### 2.1 Problem Statement

Civil engineers often manually analyze construction images to describe structural components, materials, and progress. This process is:

- Time-consuming
- Subjective
- Prone to inconsistencies

There is a need for an automated AI-based tool to generate reliable structural descriptions from images.

### 2.2 Empathy Map Canvas

**Target Users:**

- Site Engineers
- Project Managers
- Structural Consultants
- Construction Supervisors

## Empathy Map

Think	Feel
Need accurate reports	Overloaded with documentation work
Want quick structural analysis	Frustrated by manual effort
See	Do
Construction sites daily	Take photos for documentation
Structural components	Prepare reports manually

## 2.3 Brainstorming

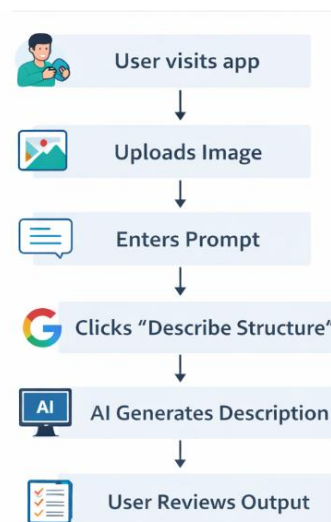
Ideas considered:

- Manual annotation system
- Rule-based detection
- AI-based image interpretation
- Integration with generative AI for structured reporting

Final idea: Use Gemini Vision model for multimodal image + text analysis.

# 3. REQUIREMENT ANALYSIS

## 3.1 Customer Journey Map



## 3.2 Solution Requirement

### Functional Requirements

- Upload image (JPG/PNG)
- Accept user prompt
- Analyze structure using AI
- Generate detailed description

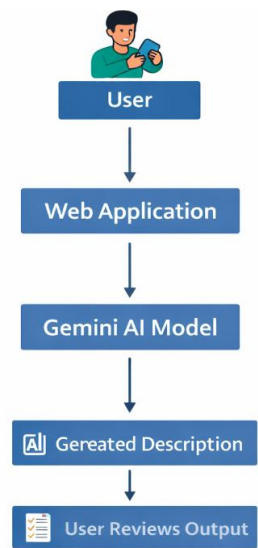
- Display output clearly

**Non-Functional Requirements**

- Fast response time
- Secure API key storage
- User-friendly interface
- Reliable AI processing

**3.3 Data Flow Diagram (DFD)**

**Level 0 DFD**



**3.4 Technology Stack**

Layer	Technology
Frontend	Streamlit
Backend	Python
AI Model	Gemini
Environment	python-dotenv
Image Processing	PIL

**4. PROJECT DESIGN**

**4.1 Problem Solution Fit**

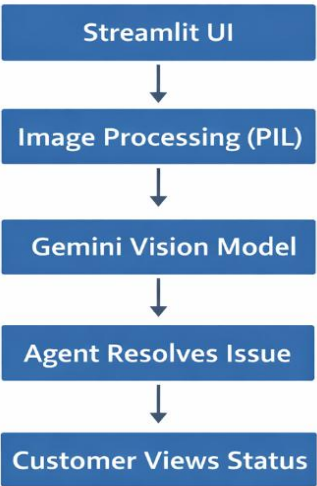
Problem	Solution
Manual reporting	Automated AI description
Inconsistent analysis	Structured AI-generated output
Time-consuming documentation	Instant image interpretation

## 4.2 Proposed Solution

The proposed system:

- 1. Accepts image input
- 2. Sends image + prompt to Gemini Vision model
- 3. Generates structured structural analysis
- 4. Displays insights on web interface

## 4.3 Solution Architecture



# 5. PROJECT PLANNING & SCHEDULING

## 5.1 Project Planning

Phase	Activity	Duration
Phase 1	Requirement Analysis	2 Days
Phase 2	API Setup	1 Day
Phase 3	Model Integration	3 Days
Phase 4	UI Development	2 Days
Phase 5	Testing	2 Days
Phase 6	Documentation	2 Days

# 6. FUNCTIONAL AND PERFORMANCE TESTING

## 6.1 Performance Testing

Test Case	Result
Image Upload	Success
AI Response Generation	Success
Invalid File	Handled
No Image Upload	Warning Displayed
Response Time	Within acceptable limits

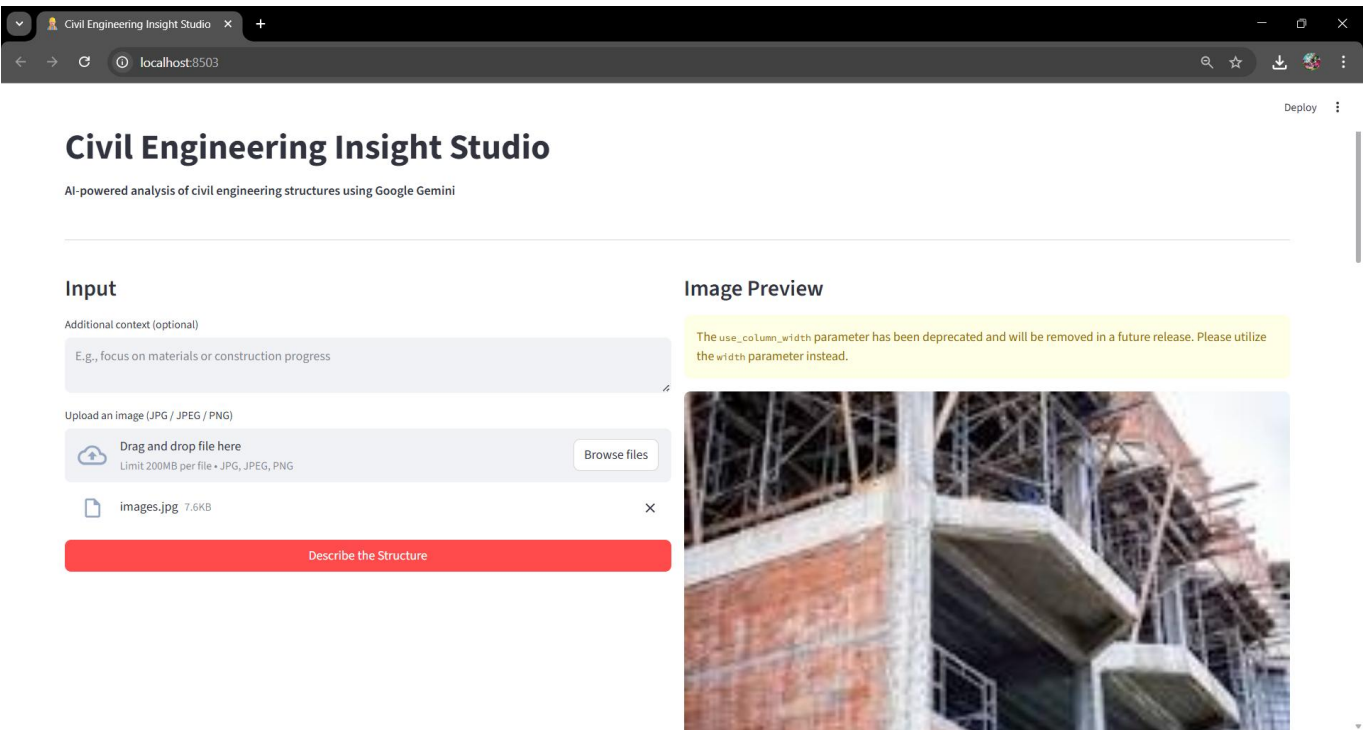
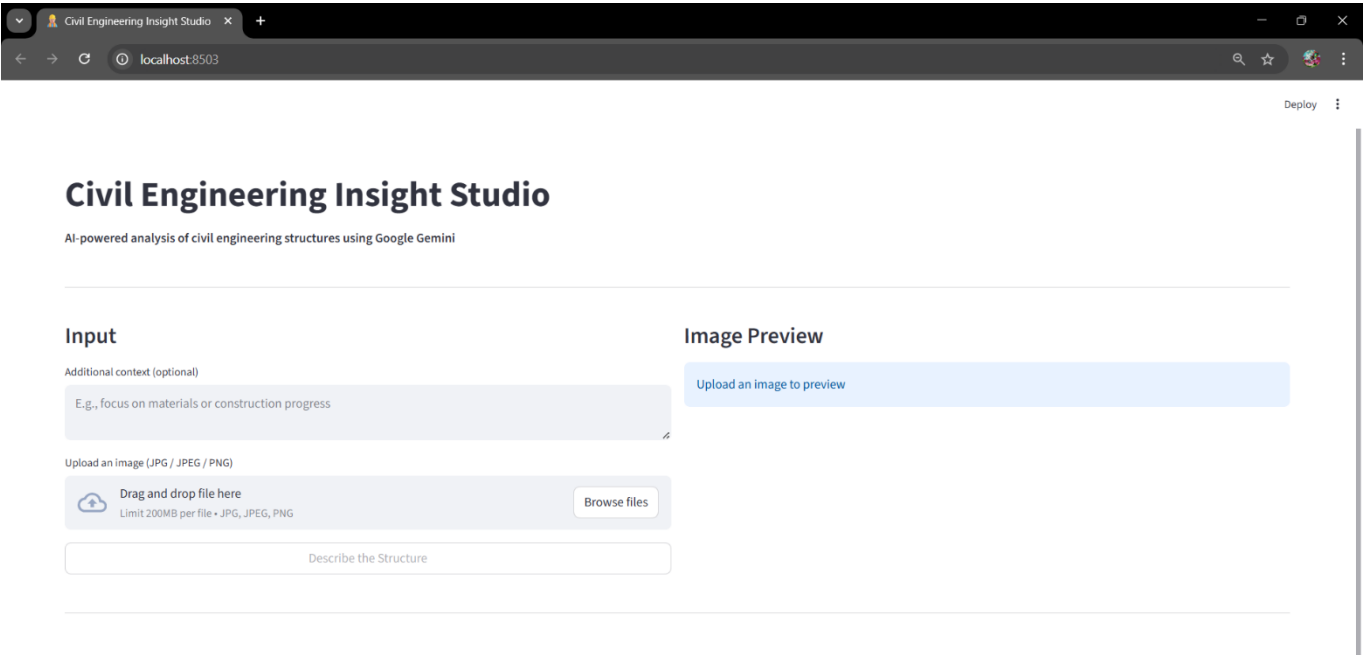
System successfully generates structured descriptions for various civil structures like buildings and bridges.

# 7. RESULTS

The system successfully:

- Identified construction materials
- Recognized structural components
- Documented project progress
- Generated structured engineering descriptions

## 7.1 Output Screenshots



Analysis Complete

Engineering Description

This image depicts a multi-story building currently under construction, utilizing a conventional reinforced concrete frame system.

Engineering Description

1. Structure Type: The structure is a **Reinforced Concrete (RC) Moment Resisting Frame Building**. This is evidenced by the prominent concrete columns and slabs forming a grid, designed to resist both vertical (gravity) and lateral (wind, seismic) loads through rigid connections. Given its multi-story nature and visible infill walls, it likely serves as a residential, commercial, or mixed-use development.
2. Construction Materials:
- Reinforced Concrete (RC):** The primary structural material, clearly visible in the columns, floor slabs, and cantilevered balcony/slab edges. Its grey, monolithic appearance indicates its cast-in-place nature.
  - Brick Masonry:** Used as non-load-bearing infill walls on the lower completed floors. The reddish-brown, segmented texture is characteristic of fired clay bricks.
  - Steel Reinforcement (Rebar):** Not directly visible in completed concrete, but its presence is inherent in "reinforced concrete," providing tensile strength to the concrete members.
  - Timber/Plywood Formwork:** Extensively used on the upper floors to contain and shape the wet concrete during pouring and curing. Visible as wooden planks and plywood sheets forming temporary molds.
  - Steel Scaffolding/Shoring:** A dense network of steel pipes and couplers supports the formwork for the upper concrete slabs and beams, transferring the load of wet concrete and fresh structural elements to lower, cured sections.
  - Steel Handrails/Guardrails:** Visible on the lowest completed balcony, providing safety.
3. Estimated Dimensions (Approximate): Based on typical construction practices and visual scaling relative to assumed human proportions:
- Floor-to-Floor Height:** Approximately 3.0 to 3.5 meters (10-11.5 feet) per story.
  - Visible Height:** The image shows at least 4-5 stories under construction or partially complete, suggesting a current structural height of 15-20 meters.
  - Column Dimensions:** Main structural columns appear to be in the range of 300mm x 300mm to 450mm x 450mm in cross-section.

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  - Slab Thickness:** Difficult to precisely estimate, but typical for such structures, likely between 150mm and 250mm.
  - Overall Footprint:** Not determinable from the partial view, but it appears to be a section of a larger building structure.
4. Construction Methodology: The project employs a **cast-in-place reinforced concrete construction methodology** progressing vertically.
- Foundation & Groundwork:** (Not visible, but implied) Foundations would have been laid, followed by ground floor slab and columns.
  - Vertical Progression:** The structure is built story-by-story. For each floor:
    - Column Reinforcement & Formwork:** Steel rebar cages for columns are erected, followed by formwork.
    - Slab & Beam Formwork & Shoring:** Timber/plywood formwork for slabs and beams is erected, supported by a comprehensive system of steel scaffolding/shoring from the floor below.
    - Reinforcement Placement:** Steel rebar is placed within the slab and beam formwork as per design.
    - Concrete Pour:** Concrete is poured (likely pumped) into the column, beam, and slab formwork.
    - Curing:** The concrete is allowed to cure and gain sufficient strength.
    - Stripping:** Once sufficient strength is achieved, the formwork and shoring are carefully removed (stripped).
  - Infill Masonry:** After a structural frame floor is cured and stripped, non-load-bearing brick masonry infill walls are constructed between columns and slabs.
  - Sequential Trades:** Finishing trades (MEP rough-ins, plastering, window installation) typically follow a few floors below the active structural work, as seen with the railings on the lowest visible floor.
5. Project Progress:
- Completed:** The structural frame (columns, slabs) for the lowest 2-3 visible floors appears complete and cured. Infill brick masonry for the lowest visible floor is largely complete, and some railings are installed.
  - In Progress:** The structural frame for the middle-upper visible floors (e.g., 3rd and 4th story) is actively under construction, with extensive formwork and scaffolding in place, indicating recent concrete pours or preparation for upcoming pours.
  - Pending:** Significant work remains, including the completion of upper structural floors (if more are planned), full architectural enclosure (windows, doors, facade cladding), MEP systems installation, internal partitions, finishes (flooring, painting, plastering), and external works.
  - Overall Assessment:** The project is in the **mid-stage of its structural framing phase**, likely 30-50% complete overall when considering all trades from groundbreaking to handover.
6. Notable Engineering Features or Challenges:
- Structural Redundancy & Stability:** The RC frame design provides inherent redundancy and robustness against localized failures. Careful detailing of beam-column connections is crucial for moment resistance.

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Deploy

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6. **Notable Engineering Features or Challenges:**

- **Structural Redundancy & Stability:** The RC frame design provides inherent redundancy and robustness against localized failures. Careful detailing of beam-column connections is crucial for moment resistance.
- **Formwork and Shoring Design/Execution:** The extensive use of temporary works highlights the critical engineering required for falsework design, ensuring stability, load transfer, and timely stripping without compromising structural integrity or safety. Premature stripping can lead to structural failure.
- **Concrete Quality Control:** Maintaining consistent concrete quality (mix design, slump, compaction, curing) is vital for achieving design strength and durability.
- **Verticality and Alignment:** Ensuring the plumbness of columns and levelness of slabs across multiple stories is a continuous challenge requiring precise surveying and formwork erection.
- **Construction Sequencing & Logistics:** Efficient coordination of rebar delivery and placement, concrete pours, formwork erection/stripping, and subsequent masonry work is critical for project schedule and resource management.
- **Progressive Collapse Mitigation:** Design should consider continuity and ductility to prevent disproportionate collapse in the event of an isolated column failure.
- **Worker Safety at Height:** Given the multi-story nature and scaffolding, fall protection, edge protection, and safe access are paramount safety challenges.

7. **Recommendations:**

- **Comprehensive Formwork & Shoring Inspection Program:** Implement a rigorous inspection schedule by a competent person for all temporary works before and during concrete pours, ensuring compliance with design and safety standards.
- **Concrete & Rebar QA/QC:** Maintain a robust quality assurance and control program for concrete (mix design verification, slump tests, cylinder/cube breaks, proper curing) and rebar (grade, sizing, spacing, cover, lap lengths) to ensure structural integrity.
- **Structural Monitoring:** Consider implementing real-time monitoring of formwork deflections or concrete temperatures, especially for critical pours or during extreme weather conditions.
- **Safety Management System Enhancement:** Conduct regular, independent safety audits focusing on fall protection, scaffold stability, access ways, and material handling procedures to mitigate inherent risks of high-rise construction.
- **Interface Coordination:** Enhance coordination between structural, architectural, and MEP teams, especially for penetrations, embedded items, and infill wall attachments, to prevent rework and clashes.
- **Environmental Management:** Implement measures for dust control, noise reduction, and waste segregation to minimize environmental impact, particularly in urban settings.
- **Progress Tracking & Reporting:** Utilize digital tools for detailed progress tracking against the baseline schedule to identify potential delays and resource bottlenecks proactively.

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# Civil Engineering Insight Studio

AI-powered analysis of civil engineering structures using Google Gemini

## Input

Additional context (optional)

short notes on this image

Upload an image (JPG / JPEG / PNG)

Drag and drop file here

Limit 200MB per file • JPG, JPEG, PNG

Browse files


download.jpg

8.4KB

Describe the Structure

## Image Preview

The use\_column\_width parameter has been deprecated and will be removed in a future release. Please utilize the width parameter instead.





Analysis Complete

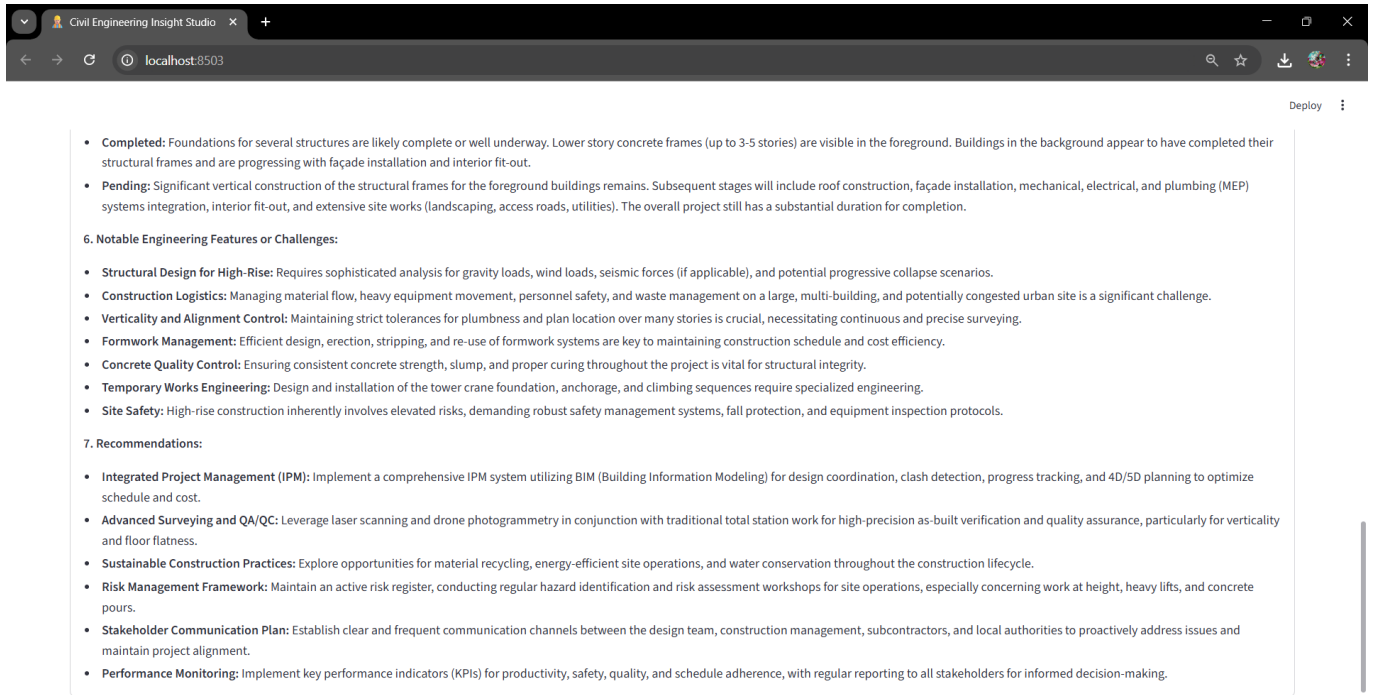
Engineering Description

## Engineering Site Analysis: Multi-Story Building Development

This analysis provides a professional engineering description of the observed civil engineering project, focusing on insights valuable to project stakeholders.

1. **Structure Type:** The image depicts an active construction site for a **multi-story commercial or residential building complex**. Multiple structures are visible at varying stages of completion, indicating a large-scale urban development project rather than a singular isolated building. The presence of a tower crane strongly suggests a project targeting significant vertical integration.
2. **Construction Materials:**
  - **Reinforced Concrete (RC):** Clearly visible as the primary structural material. Exposed reinforcing steel bars (rebar) protrude from foundational elements and partially constructed columns/slabs in the foreground, awaiting subsequent concrete pours. The grey tones of poured concrete are evident in the lower levels of the structures.
  - **Structural Steel:** Primarily observed in the tower crane's mast and jib, essential for heavy lifting and material handling during high-rise construction. While not part of the building's permanent structural frame (based on visible elements), steel is integral to the construction process.
  - **Glass and Façade Elements:** The buildings in the background, which appear further along in construction, show indications of curtain wall systems or large window installations, implying the use of glass, aluminum, or composite panels for architectural finishes.
  - **Aggregates and Earthwork Materials:** The ground shows disturbed soil, aggregate bases, and general site fill, indicative of ongoing earthwork and foundation preparation.
3. **Estimated Dimensions (Approximate):**
  - **Height (Current):** The structures in the immediate foreground appear to be at various stages, from ground level foundations up to approximately 3-5 stories. The buildings in the background exhibit greater verticality, likely reaching 10-20+ stories or more, suggesting the ultimate height for the entire complex.
  - **Height (Potential):** The tower crane, a significant piece of equipment, has a working height capable of constructing structures well over 50 meters (150 feet), reinforcing the projection of high-rise development.

- reaching 10-20+ stories or more, suggesting the ultimate height for the entire complex.
- **Height (Potential):** The tower crane, a significant piece of equipment, has a working height capable of constructing structures well over 50 meters (150 feet), reinforcing the projection of high-rise development.
  - **Footprint/Scale:** Given the presence of multiple buildings and a large tower crane, the overall project site likely spans a considerable area, potentially several hectares, indicating a substantial urban land development.
4. **Construction Methodology:**
  - **Cast-in-Place Reinforced Concrete Construction:** The predominant method for the structural frame, involving the erection of formwork, placement of rebar, and pouring/curing of concrete for foundations, columns, beams, and slabs.
  - **Vertical Material Handling with Tower Crane:** The prominent tower crane is central to lifting formwork, rebar cages, concrete buckets, and other construction materials to various heights.
  - **Precision Surveying and Layout:** The presence of a surveyor operating a total station, supported by another individual reviewing plans, highlights the critical role of precise geometric control for establishing building corners, column lines, and ensuring verticality and alignment for multi-story structures.
  - **Phased Construction:** The varying completion stages of multiple buildings across the site indicate a planned, phased approach to construction, optimizing resource allocation and project timelines.
  - **Sequential Story Construction:** Standard for multi-story buildings, involving the repetitive process of erecting one floor level after another.
5. **Project Progress (Completed vs. Pending):**
  - **Completed:** Foundations for several structures are likely complete or well underway. Lower story concrete frames (up to 3-5 stories) are visible in the foreground. Buildings in the background appear to have completed their structural frames and are progressing with façade installation and interior fit-out.
  - **Pending:** Significant vertical construction of the structural frames for the foreground buildings remains. Subsequent stages will include roof construction, façade installation, mechanical, electrical, and plumbing (MEP) systems integration, interior fit-out, and extensive site works (landscaping, access roads, utilities). The overall project still has a substantial duration for completion.
6. **Notable Engineering Features or Challenges:**
  - **Structural Design for High-Rise:** Requires sophisticated analysis for gravity loads, wind loads, seismic forces (if applicable), and potential progressive collapse scenarios.
  - **Construction Logistics:** Managing material flow, heavy equipment movement, personnel safety, and waste management on a large, multi-building, and potentially congested urban site is a significant challenge.
  - **Verticality and Alignment Control:** Maintaining strict tolerances for plumbness and plan location over many stories is crucial, necessitating continuous and precise surveying.
  - **Formwork Management:** Efficient design, erection, stripping, and re-use of formwork systems are key to maintaining construction schedule and cost efficiency.
  - **Concrete Quality Control:** Ensuring consistent concrete strength, slump, and proper curing throughout the project is vital for structural integrity.
  - **Temporary Works Engineering:** Design and installation of the tower crane foundation, anchorage, and climbing sequences require specialized engineering.
  - **Site Safety:** High-rise construction inherently involves elevated risks, demanding robust safety management systems, fall protection, and equipment inspection protocols.



## 8. ADVANTAGES & DISADVANTAGES

### Advantages

- Reduces manual documentation effort
- Improves reporting speed
- User-friendly interface
- AI-powered automation
- Secure API handling

### Disadvantages

- Depends on image quality
- Requires internet connection
- AI estimation is not a replacement for structural calculations

## 9. CONCLUSION

The **Civil Engineering Insight Studio** demonstrates how generative AI can transform civil engineering documentation processes.

By integrating image analysis with multimodal AI capabilities, the system enhances efficiency, consistency, and communication in construction and structural engineering workflows.

## 10. FUTURE SCOPE

- BIM integration
- PDF auto-report generation
- Multi-image comparison
- 3D structural modeling
- Damage detection module
- Load estimation analytics

## 11. APPENDIX

### Source Code

<https://drive.google.com/drive/folders/1wtXTm69V1rxn9t7yiZYl8cONQBkAkdXt?usp=sharing>

Main components:

- API initialization
- Image processing function
- Gemini response function
- Streamlit UI integration

Image links:

<https://drive.google.com/file/d/1pHnuhTHAVhnhzhotMaVmRorMKkp7Ptv8I/view?usp=sharing>

[https://drive.google.com/file/d/13A3SMqWGZsKWHLWz0va2e9qCwfXC\\_fZI/view?usp=sharing](https://drive.google.com/file/d/13A3SMqWGZsKWHLWz0va2e9qCwfXC_fZI/view?usp=sharing)

### Dataset Link

This project does not use a predefined dataset.  
Images are provided dynamically by users.

### GitHub & Project Demo Link

GitHub Repository: <https://github.com/nandhu-2514/Civil-Engineering-Insights-Studio>

Project Demo: [https://drive.google.com/file/d/1vSLeFHYryofow\\_rPOyAw1HbaGlcVs7-N/view?usp=sharing](https://drive.google.com/file/d/1vSLeFHYryofow_rPOyAw1HbaGlcVs7-N/view?usp=sharing)