Project Design Phase
Solution Architecture

Date	9 February 2026
Team ID	LTVIP2026TMIDS62350
Project Name	Civil Engineering Insight Studio
Maximum Marks	4 Marks

Solution Architecture:

Solution architecture bridges the gap between the business problem (manual structural documentation) and the technological implementation (AI-powered structural analysis). It defines how the system components interact to deliver automated engineering insights.

Architecture Goals

- Provide an automated AI-based solution for analyzing civil engineering structures from images.
- Define modular components (UI, Application Logic, API Integration, Infrastructure).
- Ensure scalability, reliability, and maintainability.
- Deliver structured engineering documentation efficiently.
- Enable seamless deployment in local or cloud environments.

Layered Architecture Overview

The Civil Engineering Insight Studio follows a four-layer architecture:

1️⃣ Client Layer – Civil Engineer or Site Supervisor interacting with the web application.
2️⃣ Presentation Layer – Streamlit Web Interface handling user interaction and display.
3️⃣ Application Layer – Python application logic managing input validation, prompt construction, Gemini API integration, report formatting, and error handling.
4️⃣ Infrastructure Layer – Deployment environment (Local Machine / Streamlit Cloud / Cloud Hosting) and external integration with Google Gemini API.

Application Layer Components

- Input Validation Module – Ensures image and text input are valid before processing.
- Prompt Construction Module – Constructs structured engineering prompts for Gemini API.
- Gemini API Integration Module – Sends image + structured prompt to Gemini Vision model and retrieves analysis.
- Report Formatting Module – Formats AI response into structured engineering documentation.
- Error Handling Module – Handles API failures and invalid inputs gracefully.

Data Flow Description

- Step 1: User uploads construction image and enters analysis request.
  Step 2: Streamlit interface forwards input to application logic.
  Step 3: Input validation and prompt construction occur.
  Step 4: Structured prompt and image are sent to Google Gemini Vision API.
  Step 5: AI-generated structural analysis is received.
  Step 6: Report is formatted and displayed to the user.
  Step 7: Optional report download or session storage.

Solution Architecture Diagram: