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Structural Analysis Report

G+3, Commercial

Executive Summary

This report details the comprehensive structural design and analysis process for our project on G+3 story commercial space for a client based in Lucknow (3500 sq.ft. floor area). It outlines the methodologies, materials, and technologies employed in ensuring the structural integrity, safety, and efficiency of the design. This serves as a foundational document to engage potential clients in understanding our capabilities and approach to structural engineering projects.

Introduction

The structural design and analysis of any construction project are critical stages that ensure the safety, functionality, and longevity of the structure. This report provides detailed insight into the structural design approach, analysis methods, material selection, and technological innovations applied in our recent project.

Design Methodology

Project Brief

- Location: Urban area with moderate seismic activity.
- Structure Type: G+3-story commercial building.
- Key Features: Office spaces, Rooms, energy-efficient and sustainable design.

Design Criteria

- Load Considerations: Dead loads, live loads, wind loads, seismic loads.
- Serviceability: Deflection limits, vibration control.
- Durability: Corrosion resistance, weatherproofing.
- Sustainability: Use of recycled materials, precast concrete, energy-efficient design.

Design Process

1. Conceptual Design: Initial sketches and 3D models developed using BIM software to visualize spatial configurations and load paths.

2. Preliminary Design: Assessment of structural systems (e.g., steel frame, reinforced concrete) to determine the most efficient solution.
3. Detailed Design: Finalization of structural components, connections, and detailing using CAD software, ensuring compliance with local building codes and standards.

A well analysed design of a structure helps project completion in a timely manner and with minimum cost for the effort needed. The engineering properties of soil like water content, density and SBC are calculated by conducting tests in laboratory. The structural plan is prepared using AUTOCAD.

For analysis, the material property of concrete is *M25* and steel is of grade *Fe415*. The size of structural components (beams, columns, and slabs) are taken as per the project requirements. The design of structural elements was done as per *IS 456:2000* guidelines.

The tests conducted for soil investigation are core cutter method (bulk density), oven dry test (water content), and direct shear test.

BEAM SIZE	
Beam 1	230x450mm
Beam 2	230x600mm
Beam 3	230x750mm

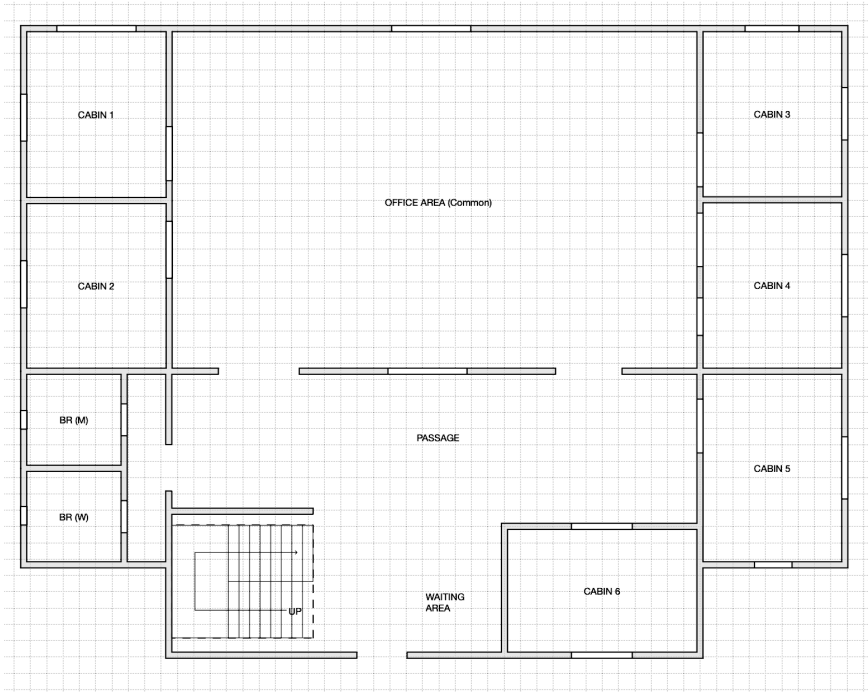
COLUMN SIZE	
Column 1	230x450mm
Column 2	230x600mm
Column 3	230x750mm

SLAB DATA	
Material	M25 Concrete
Slab Type	Membrane
Slab Thickness	150mm

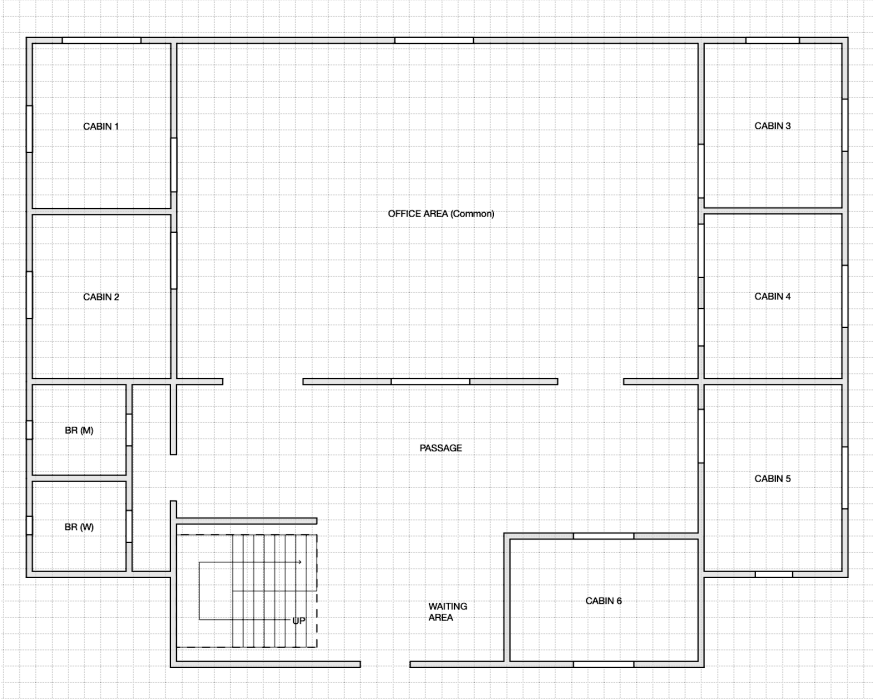
The Load Cases defined are as:

Dead Load of wall (230mm thick) = 13.8 KN/m
Live Load = 4 KN/m²
Floor Finish = 1.5KN/m²

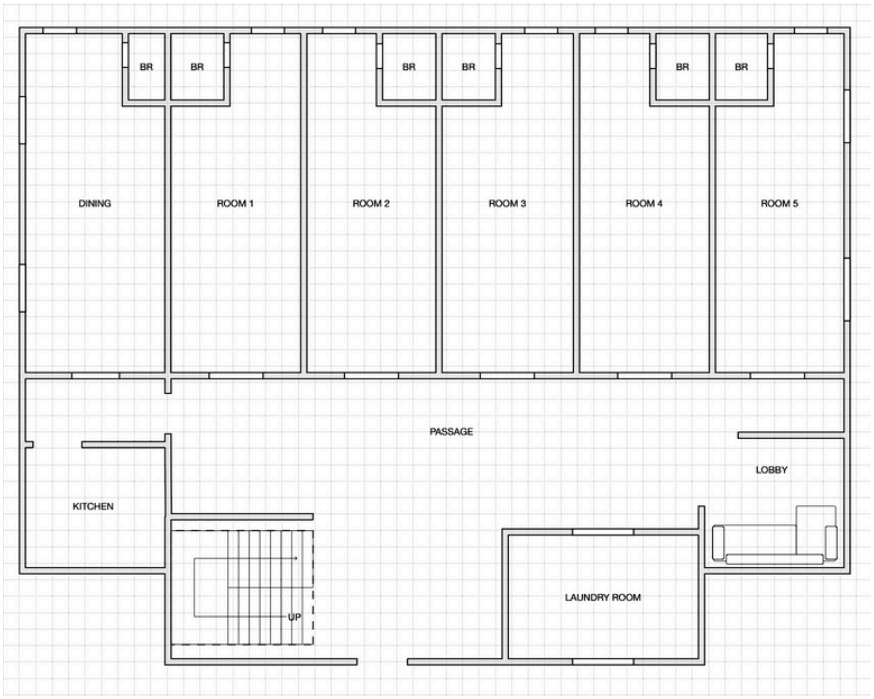
2D Floor Plans



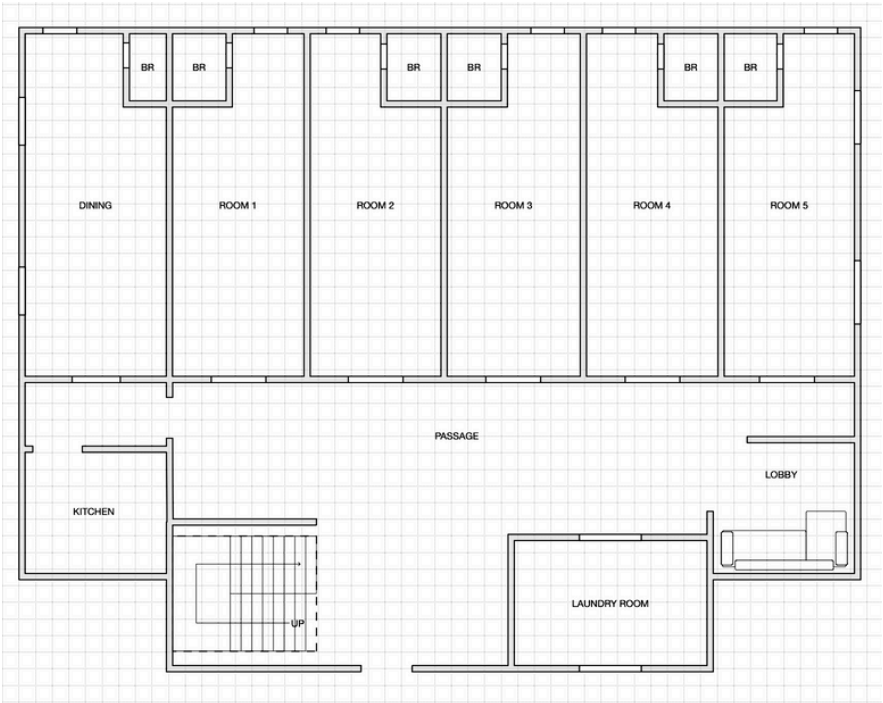
GROUND FLOOR



FIRST FLOOR



SECOND FLOOR



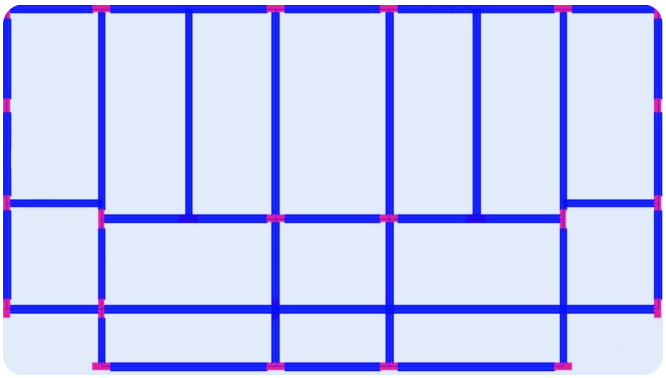
THIRD FLOOR

Structural Analysis

Analysis Techniques

- Finite Element Analysis (FEA): Used to simulate and analyze the response of structures under various load conditions.
- Dynamic Analysis: Evaluated seismic performance using time-history analysis and response spectrum methods.
- Wind Load Analysis: Conducted using computational fluid dynamics (CFD) to predict wind pressures and their effects on the structure.

3D Modelling and Analysis

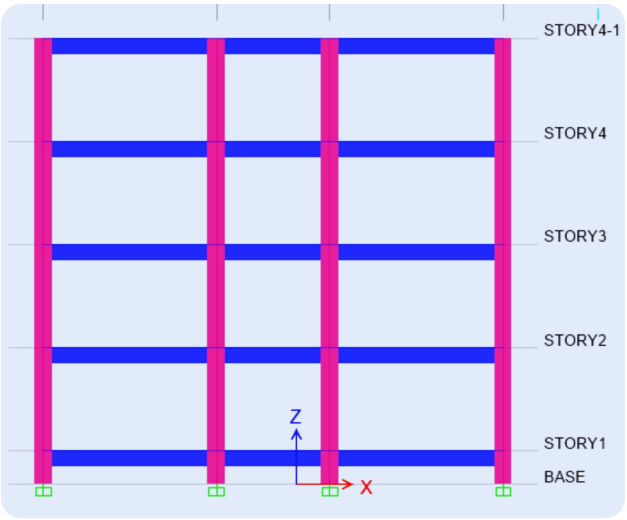


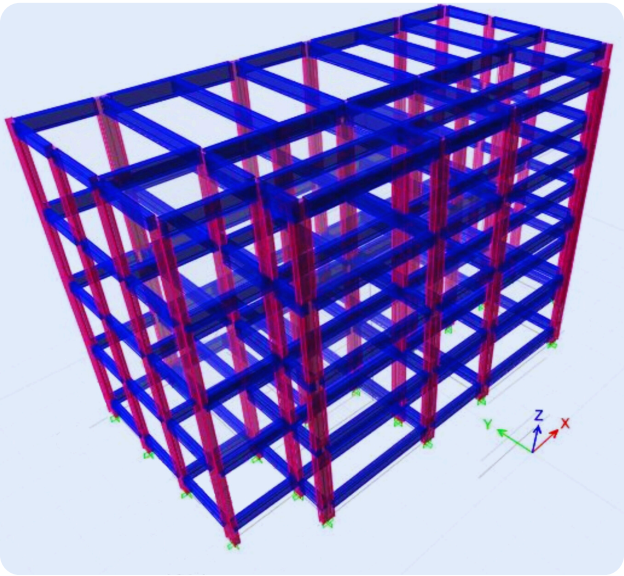
MODEL TOP VIEW

The model provides a comprehensive layout of the structure from an aerial perspective. This schematic representation includes the detailed placement of columns, beams, and other structural elements.

MODEL ELEVATION

The 3D elevation model offers a vertical orthographic projection of the building's exterior. It includes details like beams, columns, slab on different levels of the building.



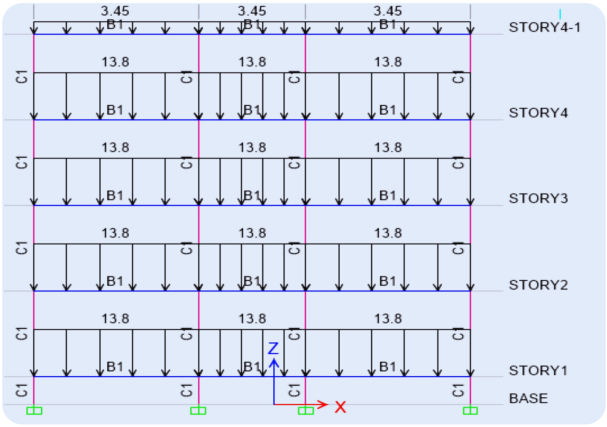


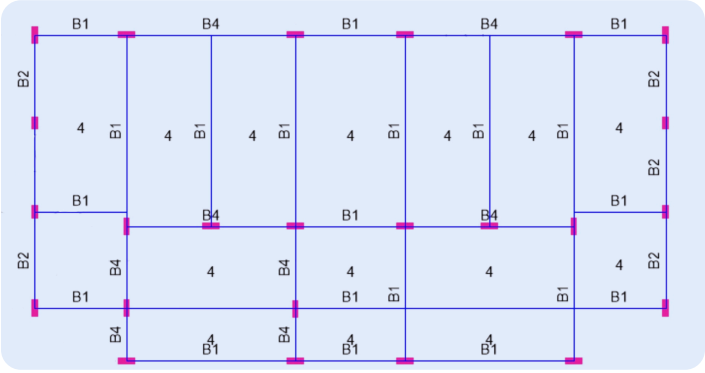
MODEL 3D VIEW

The 3D view of the building model integrates both the top view and elevation, providing a realistic visualization of the structure. This perspective allows stakeholders to examine the spatial relationships and volumetric proportions of the building.

WALL LOAD ON BEAMS

The analysis considers factors such as dead load, floor finish, wall material, thickness and height, ensuring that the beams are designed to withstand these forces effectively.





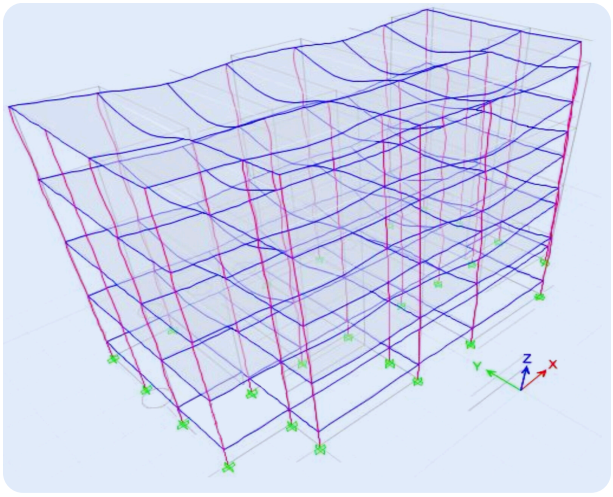
SLAB ON SLAB LOAD

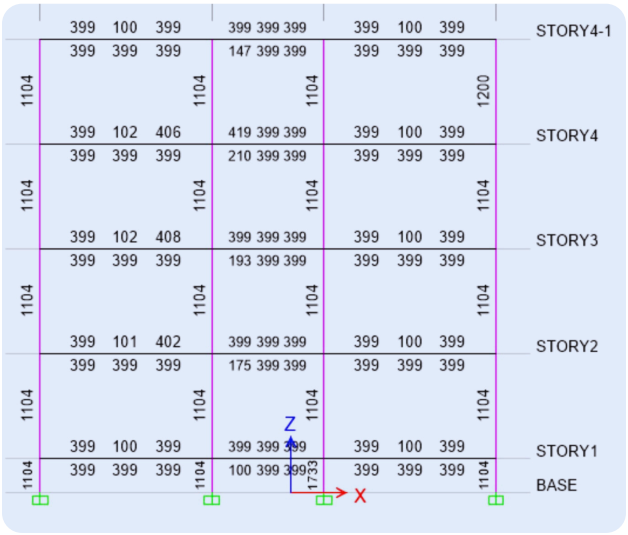
This representation is the distributed load that one slab imposes on another in the system. This analysis accounts for factors such as live loads and any imposed loads due to occupancy or equipment.

Results & Significance

3D ANALYSIS VIEW

This a post analysis 3D visualization of the building model which is an invaluable tool for understanding the project's technical feasibility in the conditions and suggestions on structuring.



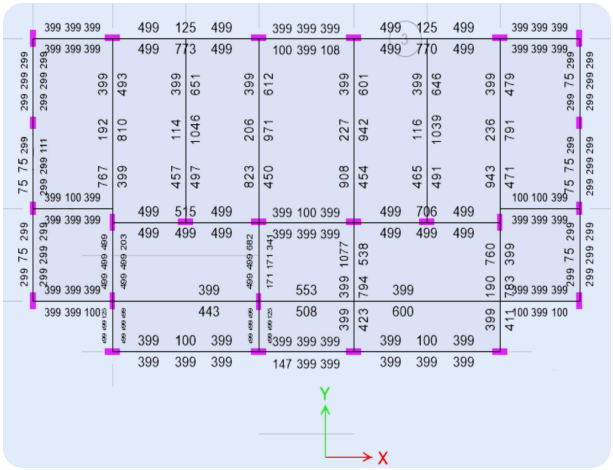


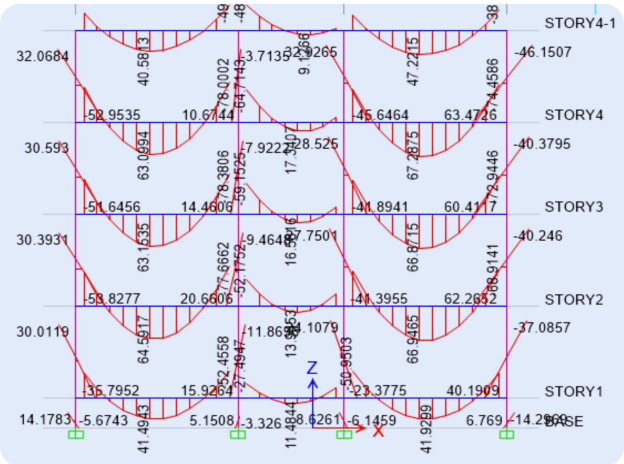
ANALYSIS RESULTS OF COLUMNS

The design values for columns after analysis provide the calculated dimensions and reinforcement requirements for columns based on the structural analysis. These values ensure that columns can safely support the loads imposed upon them, including axial loads, bending moments, and shear forces. The design values are derived from rigorous analysis and comply with relevant building codes and standards.

ANALYSIS RESULTS OF BEAMS

The design values of beams after analysis detail the specifications for beam dimensions and reinforcement. These values are critical for ensuring that beams can adequately support the expected loads without excessive deflection or failure. The design considers factors such as span length, load conditions, and material properties to optimize the beam's performance.



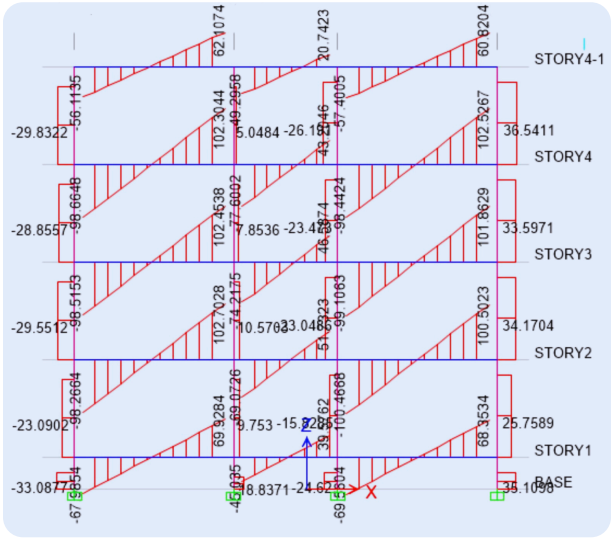


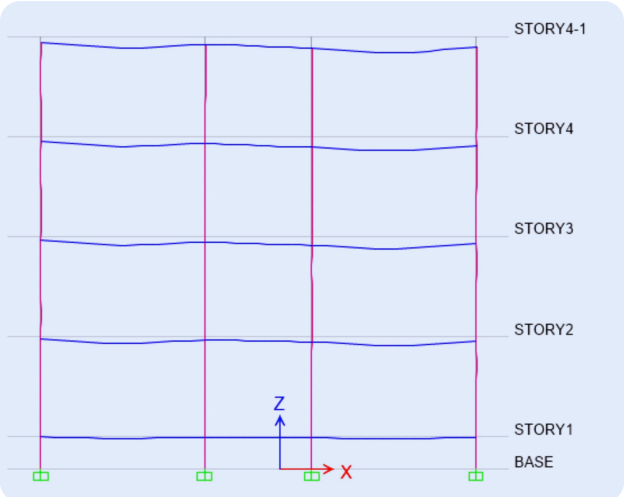
BENDING MOMENT DIAGRAM

The bending moment diagram graphically represents the bending moment distribution along the length of a structural element, such as a beam. This diagram is essential for identifying the points of maximum moment, which are critical for the design and reinforcement of the element. Understanding the bending moment distribution aids in optimizing material usage and ensuring structural safety.

SHEAR FORCE DIAGRAM

The shear force diagram illustrates the variation of shear force along a structural element, typically a beam. This diagram is crucial for identifying the sections of the beam that experience maximum shear stress. Accurate determination of shear forces is necessary for the proper design and reinforcement of beams to prevent shear failure.





POST ANALYSIS ELEVATION

The elevation after analysis reflects any modifications or optimizations made to the building's design based on structural analysis. This updated elevation ensures that the architectural and structural elements are aligned with safety standards and aesthetic considerations. It serves as a final check for compliance with design intentions and regulatory requirements.

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Technological Innovations

- BIM Integration: Facilitated seamless collaboration among design teams and stakeholders.
- 3D Laser Scanning: Employed for accurate site measurements and quality control.
- Smart Sensors: Proposed for installation to monitor structural health in real-time.

Conclusion

The structural design and analysis outlined in this report demonstrate our commitment to delivering safe, efficient, and sustainable structures. By leveraging advanced technologies and adhering to rigorous design standards, we ensure that our projects meet the highest expectations of reliability and performance.

This report serves as a comprehensive overview of our structural design capabilities. We welcome discussions with potential clients to explore how our expertise can meet their specific project requirements.