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Advancing Infrastructure



## Project Summary

### Organization

VYOM Consultants

### Solution

Structural Engineering

### Location

Vadodara, Gujarat, India

### Project Objectives

- To design an aesthetically pleasing building to meet expectations of Vadodara's business elite.
- To address structural design challenges while maintaining a cost-effective design.

### Products Used

STAAD<sup>®</sup>

## Fast Facts

- K10 Grand is a pioneer office building that is defining new standards of commercial spaces in Vadodara, Gujarat, India.
- After analyzing the design structure in STAAD, VYOM decided to connect the four separate buildings for a more economical design.
- VYOM identified a high-tension zone on the ninth floor with STAAD, making it necessary to adjust the design.

## ROI

- The entire building design with drawings were completed within one month with STAAD.
- STAAD saved significant time during the design stage, allowing for nearly 70 design iterations to be performed for both design approaches and the final design.
- STAAD reduced the time to design and analyze these iterations while allowing them to adhere to IS code in a user-friendly environment.

# VYOM Designs Unique Office Building in Western India

STAAD Helped Create Cost-efficient, Optimized Design Set to Withstand Structural Tensions

## Designing an Innovative Office Space

Situated in the prime location of Sarabhai, K10 Grand is a pioneer office building that is defining new standards of commercial spaces in Vadodara, Gujarat, India. The area has seen rapid growth of commercial buildings due to its closeness to the local airport and train station. K10 retained VYOM as the structural consultant on the project and tasked them to design a building that meets and exceeds the highest expectations of Vadodara's business elite.

VYOM was founded in 2011, starting with mostly residential and commercial projects. Now, the organization offers expertise in structural solutions, architectural and preconstruction services, and project and site management. Since their inception, VYOM has worked on projects in India, Nepal, Tanzania, and the Ivory Coast.

This INR 1.2 billion project consists of a basement and 12 floors, totaling an area of 200,000 square feet. Most buildings in the area are mixed use, with office spaces above other businesses. However, K10 wanted to bring something new to the area, so K10 Grand will only be used for offices. This setup would limit the disruption of office life for the inhabitants.

## Overcoming Design Issues to Create Column-free Space

To design this impressive structure, VYOM needed to overcome many challenges. Because of the elevation and the internal architectural planning of the building, there were structure design issues that the organization needed to address. The project team wanted to create a building with three towers and a core structure in the middle. The structure bulges outward for the bottom six floors and then tapers upward for the top six floors. Arrangement of columns and shear walls was difficult because of this unique shape. Also, the architect and developer insisted on having a column-free space in the entrance foyer. The center core needed to house all utilities, and it was difficult to have an earthquake-resistant design because the shape of the building was attracting more lateral forces. Finally, the foundation of the building was a combined and raft foundation, making

it necessary to carefully evaluate the structure before construction. Currently in the construction phase, the building is expected to become a landmark for the area.

## Connecting Structures for More Economical Design

When designing the building, the original plan was to create four separate buildings: three towers and one core structure. However, when VYOM began analyzing the design in STAAD, the project team realized that this initial design proposal was not economical. Instead, the team used STAAD to create a new, optimized design to be more cost efficient. The project team decided to connect all the buildings together, saving money and time. It was critical for the team to make this change before the construction phase.



*VYOM used STAAD to arrange the columns so that the lateral force will rest completely on the center of the building.*

With this design in place, VYOM then decided where to put structural support columns. STAAD showed the project team that the shape of the building curves considerably from the ninth floor upward, making typical straight columns impossible because they would go through the plane of the building. Stub columns would not have worked either because they would have significantly lowered the ceilings and ruined the office space plans. Instead, VYOM suggested straight columns for the first nine floors and inclined columns from the ninth to twelfth floors. This plan would maintain the architecture while staying within IS code requirements.

*“By using STAAD, we completed the entire building design with drawings in one month. STAAD allowed for nearly 70 design iterations to be performed for both design approaches and final design within the month.”*

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### **Implementing Beams and Columns for Equal Tension**

Another feature that helped VYOM create the unique space was using post-tensioned beams. The beams could not be very deep, as the architect wanted the highest possible ceilings. Also, the plan required that the ducts run along the beam. These beams, coupled with columns and shear walls, prevented torsion in the building, allowing the center of mass and stiffness to be adjacent. VYOM arranged the columns so that the lateral force will rest completely on the center of the building. All the shear walls, lift walls, and columns were arranged so that they can resist 70% of the lateral force. To provide column free space in the foyer, VYOM used 20-foot cantilever beams and slabs for the rest of the floors in the building.

Using STAAD, VYOM realized that there was still a high-tension zone in the building. This zone occurred on the ninth floor due to the ranking columns spacing. The ninth floor carries a high load, so it was necessary to adjust the design. Once the project team realized this situation, team members managed the directional force away from the beams on the ninth floor with reinforcement and cables put into the same beams.

### **Saving Design Time for a Workplace of the Future**

By using STAAD, VYOM completed the entire building design with drawings in one month. STAAD saved the project team significant time during the entire design stage, allowing for nearly 70 design iterations to be performed for both design approaches and final design within the month. STAAD reduced the time needed to design and analyze these iterations. The application also allowed these iterations and design changes to adhere to IS code in a user-friendly environment.

The design met all the requirements of the architect and developer, with construction now in progress. The highly anticipated building looks identical to the 3D model, and the commercial spaces are useful without any obstructions. Being located at the center of the city, K10 Grand will allow occupants to have everything they need nearby, including shopping malls, hospitals, grocery stores, and restaurants. The space will include a rooftop deck, shared conference spaces, a lounge, gym, and coffee shop, making it a workplace of the future.