

Bentley[®]
Advancing Infrastructure



Project Summary

Organization

Voyants Solutions Private Limited

Solution

Buildings and Campuses

Location

Gwalior, Madhya Pradesh, India

Project Objectives

- Develop an iconic design to complement the existing historic Gwalior Railway Station that will serve as a tourist attraction and transportation hub for the city.
- Generate a comprehensive master infrastructure plan that meets design and construction requirements.
- Deliver a 3D model of a sustainable conceptual design within a tight timeline.

Project Playbook

MicroStation[®], OpenBuildings[™] Designer, STAAD[®], STAAD.Pro[®]

Fast Facts

- Voyants implemented a coordinated 3D digital approach to design the iconic USD 61.23 million Gwalior Railway Station.
- MicroStation and OpenBuildings Designer facilitated parametric modeling and streamlined workflows.
- Integrating STAAD.Pro for structural design and analysis enabled the team to optimize use of the limited space and ensure platforms remain operational during construction.

ROI

- Working in Bentley's digital integrated design platform saved 30% in resource hours and achieved a 500% return on investment.
- Bentley's interoperable applications industrialized BIM workflows to deliver a high-quality, cohesive, and sustainable design.
- Voyants' sustainable design solution reduced heat gain of the building by 40%.

Voyants Implements Collaborative Digital Workflows to Design Iconic Station for Indian Railways

Bentley's BIM Applications Resolve Project Constraints and Save 30% in Resource Hours

An Integrated Urban Railway Redevelopment

As part of its redevelopment initiatives, Indian Railway Stations Development Corporation Ltd. (IRSDC) selected Gwalior Railway Station in central India as one of the rail stations to be renovated to serve as a transportation hub and enhance passenger-related amenities. The existing railway station sits in front of the historic Gwalior Fort between the old city of Gwalior to the west and the new settlement to the east, and the new design had to reflect a connection between these areas. IRSDC hosted an international design competition to develop and submit a 3D model of proposed designs to win a contract. Voyants Solutions Limited Partnership entered its submission and won the Gwalior station project with an iconic design that complemented the existing station and served as a tourist attraction.

The USD 61.23 million railway redevelopment project required segregating pedestrian and traffic movement and multimodal integration to encourage sustainable transit and commercial growth. Specifically, the proposed design needed to integrate the heritage of the old station with a contemporary design to embrace both the traditional and modern aspects of Gwalior City. In addition to meeting the conceptual design requirements, Voyants faced technical and site constraints within a short timeline. The multidiscipline team needed to ensure that all platforms along the rail line remained fully operational throughout construction. Additionally, the design needed to accommodate the existing, fixed track alignment and utilities.

Optimizing Conceptual Design

Voyants used building information modeling (BIM) workflows to optimize building design and incorporate existing structures. The proposed conceptual design retains the existing building, extended wings, and prominent arched architectural style, using the arch as a basis for adding a lightweight, shell structure. The new concept captures the historical character of the old station, which remains a focal point, while bringing new light to the railway complex through the modular system of three-dimensional symmetrical arches. A subtle backdrop to the old station, the design scheme

creates a new identity for the entire facility using cantilevers and open spaces, and it enhances passenger access and connectivity. An optimum combination of design and structure, "the design is seen as a melting pot of old and new and responds to the same in architectural style," explained Upendar Rao Kollu, managing director at Voyants Solutions.

To prepare its 3D design submission, Voyants used Bentley's interoperable BIM and analysis applications. The team designed the structure in MicroStation and STAAD.Pro and used OpenBuildings Designer to construct a comprehensive digital engineering model. Using the parametric modeling, analysis, and simulation features of Bentley's technology simplified design intent to optimize design based on the requirements. The interoperability of MicroStation made it possible to have plug-ins for third-party applications to create the 3D arches. Bentley's integrated design applications facilitated a high-quality, 3D deliverable with a cohesive scheme within the limited time frame. The team rendered 3D animations, generated walkthroughs, and extracted the 3D physical printed model from the BIM model.

Overcoming Site Constraints

As design consultants, Voyants was responsible for designing a structure and development plan that specifically accommodated the challenging requirement of keeping the existing station fully operational during construction. The team used STAAD to formulate the design, considering the limited space and time available for the columns and foundations that had to be constructed on existing platforms. Using the software, Voyants determined that it could meet these specifications and overcome site constraints with a framed structure, where multiple components could be fabricated offsite and placed in position with the help of cranes. The construction team would cast the pile foundations in-situ, using auger boring and self-compacting concrete.

To optimize structural integrity, the team performed structural analysis and extracted reinforcement details, considering the dynamic effects of railway track vibration. Relying on STAAD's global design standards and specifications ensured

“Innovative designs need innovative applications. Bentley applications have allowed the multidiscipline team to work on a single platform and create iconic designs.”

*– Upendar Rao Kollu,
Managing Director,
Voyants Solutions*

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compliance with local fire codes. STAAD facilitated design, modeling, and analysis and, as part of the BIM workflow, enabled designers to accommodate technical challenges and site constraints. The team is taking 3D BIM on the project further into 4D construction scheduling and management for seamless coordination with the site.

Advanced BIM Workflows Deliver Benefits

Voyants implemented an integrated BIM approach based on a digital design platform using Bentley technology to streamline workflows and optimize design. With multiple engineering disciplines working from various offices throughout India, using Bentley’s collaborative modeling solution simplified data sharing, analysis, and design modifications through real-time coordination and automated deliverables. In one month a team of five designers at Voyants prepared the conceptual designs, set the plan, and created the 3D model for this project. “Had it not been for [Bentley’s] digital tools, a team of at least 15 professionals would have been required to [submit the design proposal],” stated Kollu.

Using Bentley software saved an estimated 30% in labor hours and helped achieve a 500% return on investment (ROI). The interoperability of MicroStation, OpenBuildings Designer, and STAAD industrialized BIM workflows to successfully overcome the project challenges, meet the design requirements, and win the design contract for the Gwalior Railway Station. Working in an open, connected data environment with a comprehensive 3D BIM model facilitated

visual coordination with the modelers and animation team to create accurate and lifelike 3D animations of the project.

Digital Solution Facilitates Sustainable Infrastructure

Sustainability was a key feature of the design. Using Bentley’s digital applications and building energy modeling, Voyants simulated the ratio of openings and optimized cantilever depth to reduce heat gain while achieving maximum use of sunlight. The floor-to-floor glass building façade provides optimum sunlight exposure throughout the day while preventing excessive heat from entering the building. Bentley’s interoperable design and analysis software facilitated the design combination of the lightweight shell, vaulted arches, and perforated stone that shaded the platforms, yet allowed for natural light to enter the building. This integration of large overhangs, shading features, and natural ventilation reduced heat gain of the building by 40%.

Maximizing natural resources and reducing environmental impact were primary considerations throughout the design. As part of the master plan, Voyants provided separate waste collection points and combined a sprinkler-and-drip irrigation system to minimize the amount of water required to support the surrounding landscape. Using digital 3D BIM workflows, the firm developed a sustainable design solution both environmentally and economically as the new railway infrastructure is expected to generate tourism and employment opportunities that will facilitate growth of the local Gwalior City community.