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Project Summary

Organization:
Ineco

Location:
United Kingdom

Project Objective:

- Preliminary design of the Birmingham Delta Junction – the new HS2 high-speed rail line connecting London, Birmingham, Manchester, and Leeds at a maximum speed of 400 kph.
- Allow movement of trains in all possible directions every three minutes – at a commercial speed of 350 kph on the mainline and 230 kph on the turnout – without interfering with each other.
- Enable a geographically distributed team of engineers and designers to collaborate efficiently on one of Europe's most important ongoing railway projects.

Products used: ProjectWise, MicroStation, Bentley Rail Track, and AssetWise

Fast Facts

- MicroStation allowed engineers to create terrain models using LiDAR information down to 20-centimeter precision from each of the 94 flights made.
- ProjectWise played a vital role in helping team members manage all documentation generated by both HS2 and Ineco.
- ProjectWise and Bentley Rail Track enabled Ineco's distributed team to adhere to standards, and deliver the high quality demanded by the client.

ROI

- MicroStation and Bentley Rail Track's visualization capabilities made it easy for Ineco to communicate the design to all stakeholders.
- Bentley software increased employee efficiency, enabling Ineco to reduce the resources used by 30 percent.

Ineco Designs Complex Birmingham Delta Junction for HS2 Rail Project Using Bentley Software

Firm Works Faster, Smarter, and More Effectively with Bentley's Rail Solution

From the start, it was clear that the design of the Birmingham Delta Junction for the United Kingdom's High Speed Two (HS2) railway project would be a complex endeavor. HS2, a new high-speed line ultimately connecting London, Manchester, Birmingham, and Leeds, will offer more seating capacity, 50 percent shorter journeys between cities, a better passenger experience, positive environmental effects, and significant economic benefits including job opportunities and regeneration across the U.K.

"The project involves the preliminary design of a double track capable of a maximum speed of 400 kph and a commercial speed of 350 kph, as well as a large delta junction with many intersections," explained Fernando Tejedor, senior project manager and railway team leader at Ineco, a global leader in transport engineering and consultancy awarded the project by HS2.

Ineco used Bentley software to model the terrain, design the optimal track alignment, integrate its geographically distributed design team for efficient collaboration, and generate the required documentation for this key project, within the challenging six-month time period.

A Complex, Multi-stage Project

The HS2 rail project is arguably the most important ongoing railway project in Europe. HS2 will be designed and constructed in three phases: 1) the development of a London-Birmingham connection, 2) further connections to Manchester and Leeds, and 3) connections to Glasgow and Edinburgh. The design of the Birmingham Delta Junction is particularly complex due to the fact that the main line needs to connect with branches to Birmingham and Leeds at this location.

In addition, the junction had to address each of the 21 points of conflict with associated infrastructure that include five motorway crossings, various high voltage power lines, river and canal crossings, plus minor roads and an existing conventional railway. "From a technical point of view, the Birmingham Delta Junction is the most complex corridor of the first phase of HS2," explained Tejedor. "These connections produce a

very complex operation scheme, allowing the movement of trains in all possible directions every three minutes – and at 400 kph – without interfering with each other."

Ineco conducted two studies to develop innovations critical to the new railway:

- the design of a rail turnout that allows speeds of 400 kph by mainline and 230 kph for the turnout, and
- a dimension of a ballast section that supports speeds of 400 kph.

To complete this project, Ineco leveraged its experts located in London, Wales, Madrid, and Seville. "One of the biggest challenges facing the project team was coordinating the various working groups and enabling them to share data and collaborate efficiently while working remotely," added Tejedor. "This required an engineering information management system and environment that could ensure each team member, regardless of where they sat in the world, was able to access the latest version of the data, as well as templates to enable design standardization, and related applications."

Enabling Efficient Collaboration and Design Modeling

Ineco turned to Bentley software to support all aspects of its work on the HS2 project, including ProjectWise®, MicroStation®, Bentley Rail Track, and AssetWise (formerly known as eB).

At the highest level, ProjectWise supported global collaboration and provided the internal document version control required, complete with auto-updates of references between documents, while Bentley's AssetWise allowed Ineco to create a file delivery portal for the client, and enforce document control across all its locations working on the project.

MicroStation enabled information modeling, generation, and manipulation of graphics, plus creation of guidelines used to develop route alignment options. "MicroStation allowed our engineers to create terrain models from LiDAR information provided from 94 flights at a 20-centimeter precision," stated Francisco Luque, civil engineer and alignment designer at Ineco.

“Bentley Rail Track gave designers total freedom and the versatility to handle complex sections that included retaining walls, platform junctions, culverts, catenary masts, and sleepers.”

—Francisco Luque, civil engineer and alignment designer, at Ineco

“Bentley software does not just provide a set of tools to do the job, it provides the only feasible environment to develop such a complex project.”

—Pablo Ramos, U.K. country manager, Ineco

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Contact Bentley

1-800-BENTLEY (1-800-236-8539)
Outside the US +1 610-458-5000

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“Information was imported into Bentley Rail Track where a single digital terrain model was created and used to develop the junction design, in a process that included investigation of some 160 different alignment options and 190 proposed turnouts, in order to find the optimal solution.”



The Birmingham Delta Junction is the most complex corridor of the first phase of HS2.

Following horizontal and vertical alignment design according to HS2's standards, turnouts were designed and located using Bentley Rail Track's switch placement feature. Ineco used the feature's Turnout Generator where standard switches did not meet the 230 kph design criteria for the junction. Ineco then developed multiple templates to streamline and standardize the design of the railway formation, giving designers total freedom and the versatility to handle complex sections that included retaining walls, platform junctions, culverts, catenary masts, and sleepers.

“Using Bentley software and the common data environment it provides meant we could easily incorporate 3D models for all the different technical disciplines involved, consider

environmental factors for the project, and ensure data from other sources was handled with ease,” said Luque.

The outputs of this design and information modeling process included plans, profiles, cross sections, and 3D views, depending upon user requirements. The visualization capabilities offered by MicroStation and Bentley Rail Track made it easy for Ineco to communicate the design to all stakeholders – for example, providing a real-life visualization of the proposed design that clearly showed how it would integrate with the existing physical environment at various intersecting points.

Realizing the Benefits

Using Bentley Rail Track, MicroStation, and ProjectWise, Ineco's distributed team was able to work faster, smarter, and more effectively. Bentley software enabled Ineco to streamline some tasks to the extent that only one person was needed to achieve the same result that would have required multiple people using other vendors' software. “This meant efficiency gains were significant, and we were able to reduce the amount of resources used on the project by up to 30 percent,” added Tejedor. ProjectWise played a vital role in helping team members manage all documentation generated by both HS2 and Ineco consultants, while ProjectWise's delta file transfer functionality enabled secure and efficient transfer of information, with access optimized and controlled in real time.

“It was a magnificent tool for sharing and exchanging files,” stated Pablo Ramos, Ineco's U.K. country manager. “The integration of ProjectWise and Bentley Rail Track enabled Ineco to easily deploy project preferences across the distributed team, ensure engineers and designers adhered to standards consistently across all offices, and deliver the same high standards of quality demanded by the client.” Ramos concluded: “Bentley software does not just provide a set of tools to do the job, it provides the only feasible environment to develop such a complex project.”