



## Project Summary

### Organization:

CH2M Fairhurst Joint Venture

### Solution:

Roads

### Location:

Glen Garry to Dalraddy, Scotland, United Kingdom

### Project Objective:

- Design and supervise construction for the upgrade of Scotland's A9 trunk road from a single to dual carriageway along the 43-kilometer stretch between Glen Garry and Dalraddy.
- Improve operational performance and safety for A9 travelers by reducing travel time and accidents.

### Products used:

ContextCapture, Descartes, Bentley LumenRT, MicroStation, MXROAD, OpenBridge, OpenRoads, ProjectWise

## Fast Facts

- CFJV used Bentley applications to create 3D visualizations, fly-through videos, and interactive models that explained the design scheme and presented accurate views.
- Reality modeling demonstrated how the road design fit into the landscape of Europe's largest national park and the surrounding community.

## ROI

- Bentley LumenRT reduced time and costs to create real-time, interactive 3D visualizations by 50 percent when compared to traditional methods.
- 3D reality meshes created in ContextCapture allowed the team to visualize the terrain, reducing site visits.
- LiveCubes engaged stakeholders and were essential in delivering such a large-scale scheme within a national park.

# CH2M Fairhurst Joint Venture Designs Safer A9 Dual Carriageway with Reality Modeling

3D Reality Meshes Created in ContextCapture Help CFJV Visualize Roadway through Europe's Largest National Park

## An Historic Transport Initiative

As part of the Scottish Government's Infrastructure and Investment Plan, Transport Scotland is implementing a GBP 3 billion conversion of the 177-kilometer A9 between Perth and Inverness, from a single to dual carriageway. Connecting central Scotland with Inverness and the Highlands, the country's longest trunk road routes through beautiful, remote landscapes, including Cairngorms National Park, and the area is therefore heavily protected by national and international environmental designations. This roadway upgrade will propel operational performance of the A9 by reducing journey times while improving reliability and safety for motorized and non-motorized vehicles, as well as public transport facilities.

Colorado-based global engineering company CH2M Hill has teamed up with the UK's largest engineering consultancy partnership, Fairhurst, in Glasgow, forming a joint venture (CFJV) to design and supervise construction along the 43-kilometer A9 section between Glen Garry and Dalraddy. The project requires numerous junctions and bridges to be incorporated into the design with minimal or no impact to the surrounding environment, communities, and businesses. To address stakeholder concerns about the project's visual and environmental impact, CFJV needed to provide accurate design information in a user-friendly format. Moreover, with a multi-discipline design team dispersed over multiple offices, the team required a collaborative environment to streamline workflows on the most expensive transport project in Scotland's history.

## BIM Methodology Facilitates Optioneering

Relying on an integrated BIM approach throughout the design process, CFJV used ProjectWise® as the central repository to store all models and information created by the various engineering teams. The team developed initial design models in MXROAD® and designed in features such as retaining walls and modeled multiple scenarios for the roadway junctions with OpenRoads. With OpenBridge Modeler®, the bridges group modeled more than 15 bridge options, which were integrated with MXROAD and OpenRoads geometry to automate change management. This capability enabled all roadway design changes to be reflected in the design of the bridges.



*Fully interactive LiveCubes were created in Bentley LumenRT based on actual design models from a single data source.*

As the design progressed, CFJV incorporated all the data from surveyors in OpenRoads to produce a digital terrain model using the digital terrain modeling (DTM) function. Using Descartes, the team created texture material for the digital terrain model to provide a 3D view of the terrain for future use with Bentley LumenRT. The project team combined the aerial images to produce a 3D reality mesh in ContextCapture. Identifying control points as a benchmark, the engineers matched their reality mesh with the digital terrain model used for the design. "Never before were we able to do this. Bentley ContextCapture is becoming standard for our work," commented Krzysztof Ciacka, senior highways design engineer at CH2M.

The designers combined their design and the digital terrain model with the ContextCapture reality mesh into MicroStation®, creating one master DGN file, with everything geo-referenced for proper modeling positioning. From MicroStation, the file was exported into Bentley LumenRT for a fully integrated, interactive 3D reality mesh that was crucial for communication and stakeholder engagement.

## ProjectWise Streamlines Workflows

CFJV used ProjectWise to share information quickly and efficiently throughout the multi-office project team. Bentley's content and collaboration software provided the foundation for a federated BIM approach, enabling access to key information for all disciplines and easy linkage between

*“Bentley’s design, modeling, and visualization tools have greatly contributed to achieving BIM Level 2 requirements as defined by our client. The development of an interactive multi-discipline 3D design model at an early stage in the scheme enabled our project team to work collaboratively to produce an efficient and sustainable design that was environmentally led, a critical factor for success given that the project sits within the highly sensitive Cairngorms National Park.”*

— Neil Stewart,  
Contract Manager,  
A9 Glen Garry to Dalraddy,  
CH2M Fairhurst Joint Venture

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documents and associated models. The initial design models created in MXROAD were stored on ProjectWise and used by drainage, structures, and geotechnical teams to develop solutions at an early stage. This enabled the environmental team to lead the design development by identifying key clashes with sensitive sites and receptors.

ProjectWise not only enhanced collaboration among the entire team, but also facilitated information sharing with the client, Transport Scotland. CFJV arranged access for Transport Scotland through a web server, allowing information and documentation to be managed within the ProjectWise publishing folders, reducing printing requirements and resulting in significant environmental and sustainability benefits. Bentley’s content and collaboration software enabled all design models, drawings, and project documents to be maintained in a controlled, secure environment. Having a single source of truth accessible to all CFJV disciplines and project partners streamlined workflows in accordance with BIM protocol, ensuring accelerated, accurate information mobility.

### **Interactive Visualizations**

Using Bentley’s 3D reality modeling applications for optioneering proved invaluable both for the project team during design development as well as for stakeholder consultations and public exhibitions. At the early stage of the design process, the team developed more than 30 junction and four mainline scenarios, and the team was obligated by the client to share and explain these options at stakeholder meetings and public events. Fully interactive 3D models where different route and junction options could be switched on or off provided a real advantage over engineering drawings, which non-technical stakeholders and the public often find difficult to understand. Using Bentley LumenRT, the team was able to show multiple schemes for the junctions and roadway design in a single LiveCube rather than having to prepare separate LiveCubes for each scenario, saving time and costs, facilitating effective communication, and ultimately optimizing optioneering.

The visualizations also allowed the design team to view the options under development and better understand how the scheme fits into the landscape, the interactions of various elements with the surrounding environment, and other physical constraints. The project team used these 3D interactive visualizations for design reviews and technical or milestone reviews with the client to help explain proposals and address challenges.

Through the use of 3D visualization models, including fly-through videos with explanatory text and interactive models, CFJV could explain a design proposal and demonstrate the view of a proposed road or bridge from a specific location with extreme accuracy. This capability alleviated

stakeholders’ concerns about potential visual impact of the project. The final version of the LiveCube contained the entire design of an 11-kilometer stretch of roadway combined with the digital terrain model and reality mesh, in addition to trees, shrubs, pylons, and buildings added using Bentley LumenRT. The result was not a mere rendering, but a fully interactive 3D model that could be rotated and zoomed, enabling community members and stakeholders to pinpoint an exact location and ask questions, and allowing CFJV to visually provide a comprehensible explanation.

### **Bentley Software Delivers Sustainable Value**

Prior to using ContextCapture and Bentley LumenRT, CFJV relied on more traditional, time-consuming methods to create visualizations that did not offer reliable change management processes. Working in an integrated design environment using Bentley’s BIM advancements enabled the team to perform design changes, add those elements to the combined MicroStation file, and then export only the changes to the project. Using Bentley LumenRT streamlined workflows, saving time and minimizing rework. By shortening the time spent creating the visualization and avoiding rework with every design change, CFJV significantly reduced project costs. Within a 1.5-month period, one designer was able to create an interactive 3D model of the 11-kilometer A9 section containing four junctions and seven different mainline options in only one LiveCube, whereas the company’s previous workflow required at least twice the time to render a visualization without real-time, interactive 3D models.

Finally, using ContextCapture to create high-resolution reality meshes and share them with the team and client proved to be an extremely helpful, collaborative solution. For example, rather than writing out concerns and explanations of proposed changes, one team manager took screenshots from the reality mesh and marked changes to more effectively indicate his issues. The reality mesh resolution also reduced the number of site visits. To visit a number of locations along this remote 43-kilometer section could take upwards of three days with significant associated travel costs. Given the sensitive environmental nature of this project, using the reality model to design and analyze the effects on the surrounding areas in terms of physical footprint and visual impression allowed the design team to optimize the design, landscaping, and landform to blend into the surroundings and minimize long-term impacts. “From the experience of our A9 dualling team, we are in no doubt that the use of Bentley LumenRT and ContextCapture 3D visualization models has been a tremendous step forward in communications and stakeholder engagement. We believe these models will become the norm for major projects in the future,” commented Neil Stewart, Contract Manager, A9 Glen Garry to Dalraddy.