Casement Park – BIM Award Entry Team

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1. Synopsis

Mott MacDonald was lead consultant for the delivery of this new 38,000 seat multi-sport stadium in Belfast, responsible for project management, cost consultancy, architecture and all engineering services.

The Casement Park Stadium project deserves to win the Mott MacDonald BIM award, as from the bid proposal through to the delivery of the RIBA Stage E tender documentation; a full multidisciplinary, intercompany BIM approach has been successfully adopted.

Considering the technical challenges imposed by the site, the very low project budget in comparison to an aspirational client brief, the onerous contractual damages with unlimited liability, combined with a very fast track delivery programme and a fee some 30% lower than any stadium project previously delivered by Mott MacDonald, this job was always going to need a different approach to bring it safely across the line.

Through the use of a multi-disciplinary, highly developed BIM process from the outset we have managed to meet all the programme, budgetary, performance and commercial criteria placed on the project team and in doing so we have developed a new methodology for the delivery of stadia that shall become the blueprint for future projects across the Mott MacDonald Group.
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**Casement Park Stadium Visualisation**

The existing stadium was opened in 1953 and includes a dug-down pitch with standing terraces.

The site is tightly constrained by houses on three sides and the busy highway on Andersontown Road to the North.

From the outset there would be a challenge to build a modern and much larger stadium on such a constrained site.

The final scheme has managed to sensitively fit a modern, large and vibrant stadium into the residential setting through using BIM to balance the numerous competing requirements.

Visual of the proposed new Casement Park Stadium (proposed from BIM model)
Federated Multidisciplinary (Level 2) BIM Model
Federated Multidisciplinary (Level 2) BIM Model – Common Data Environment & Central Activities
Federated Multidisciplinary (Level 2) BIM Model - Architectural

- £20,000 saved on fly-through video production through direct use of design model
- Daylight analysis
- Direct from BIM model...
- “Right to light” studies
- STEPS people flow and crowd modelling to meet required escape time of under 8 mins while optimising site footprint
- Architectural visualisations
Federated Multidisciplinary (Level 2) BIM Model – Building Services

Building Services Model

Re-use of BIM families and building on workflows from previous stadium and arena projects to save 30% on design time.

Truss feature lighting studies.

Sports floodlighting analysis.

Intelligent properties added to rooms and spaces to efficiently produce simple early stage design drawings.

MEP design took full advantage of the capabilities of Revit for use in early stage design. 3D modelling of plant areas and main distribution routes to appropriate detail for each design stage (LOD200 for Stage E) enabled effective collaboration with the design team without producing abortive detail too early while fundamental architectural and structural decisions were being finalised.
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Federated Multidisciplinary (Level 2) BIM Model - Structural
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Federated Multidisciplinary (Level 2) BIM Model – Civil Infrastructure

Civil Infrastructure Model

The accurate modelling of the site, shared among the geographically remote design team was essential to plan on the physically constrained site.

Earthworks quantities were scheduled off the 3D model to gain accurate quantities.

Model exported to Autotacks for vehicle movement calculations.

Earthworks drawing issued for tender. Produced from 3D model.

Approximate Earthwork Quantities 30 April 2013

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<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
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<tr>
<td>Earthworks</td>
<td>10,000 m³</td>
<td>Using BIM for accurate measurements.</td>
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<tr>
<td>Excavation</td>
<td>5,000 m³</td>
<td>Detailed analysis for earthworks.</td>
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<td>Filling</td>
<td>2,000 m³</td>
<td>Strategic planning for earthworks.</td>
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<tr>
<td>Groundworks</td>
<td>1,500 m³</td>
<td>Advanced BIM for groundworks.</td>
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<td>Miscellaneous</td>
<td>500 m³</td>
<td>Additional earthworks for planning.</td>
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2. Collaboration

2.1 Common Data Environment

Collaboration started at the very first bid strategy meeting when it was agreed with all project partners that a common cross-discipline BIM delivery methodology would be adopted.

Upon project award Mott MacDonald led the development of a project wide BIM Execution Plan with defined communication, hosting, collaboration and coordination protocols in accordance with BS 1192.

Through the use of a Mott MacDonald hosted common data environment (Bentley Projectwise) all disciplines, including the Client and government stakeholders, were able to constantly access a federated BIM model created using the entire Autodesk Revit suite of Architecture, MEP and Structure as well as Civil 3D. The exchange of data by all project team members, internal and external was carried out using Bentley Projectwise.

This provided efficient and effective collaboration for the design team who were working across a number of Mott MacDonald offices and Divisions (Belfast, Birmingham, Brighton, Manchester, Croydon, London & Norwich) and external design team offices across the UK (G+T Glasgow, Populous London, GAA Armagh, RPS Belfast) have been able to access shared information more efficiently compared to traditional methods.

Process Maps from Project BIM Execution Plan
2.2 Design Review and Coordination

Using the central BIM models, cross collaboration was enhanced and the designs were reviewed and updated more efficiently prior to bi-weekly design team meetings. From these updates, all design changes to individual disciplines would be shared with the rest of the team to ensure all disciplines were working to the latest information.

This was especially important when the civil team detected different levels across the site; the Civil 3D model was imported into Revit and the whole design team were then all working to the correct levels. In addition to collaborative design reviews these shared models were used to perform clash detection studies, which enabled the rapid ongoing resolution of clashes avoiding costly abortive work being incurred if discovered down programme.
2.3 Improved Process

Due to the complexity of the roof structure and the geometrical changes that would occur throughout the iterative design, it was decided to model the roof using Autodesk Robot software. A clear limitation to this process is the limited interoperability from Robot to Revit.

Through previous BSE pioneered relationships with a software designer in Johannesburg, an information flow using Rhino and the IFC link from Geometry Gym was used to import the model into Revit. This workflow has since been used by other Divisions on multiple projects and disseminated through Mott MacDonald via a technical paper.

The resolution of this issue has culminated in a shared learning working group to improve the interface between REVIT and ROBOT. This group including representatives from Hong Kong and Power meet with industry specialists to improve the interface and in-turn communicate this to the group, and the residual issues have formed the basis of a user requirements development brief to be sent to Autodesk.

To ensure maximum compatibility between the BIM authoring tools and the cost consultancy software ViCO, an elemental object based naming convention had to be implemented. This need was identified during the BIM kick off meeting and was captured early within the BIM execution plan to maintain an efficient information exchange.

Using our experiences on this project, a technical note regarding 5D BIM and object base naming conventions has been produced and been disseminated through the Group.

The MEP model process built upon, adapted and improved and pulled together workflows and families from previous BIM projects to take full advantage of the capabilities of Revit. The use of appropriate levels of detail in the model, particularly during the early stages of design led to efficient production of MEP design documentation and design team collaboration in a drastically reduced programme for a project of this size.
2.4 Adding Value

Through a need to implement BIM to stand a chance of meeting the project programme, budget and site constraints, we were able to realise and improve the efficiencies associated with BIM in our proposal to the Client and offer a competitive fee structure.

A comparison of the Casement Stadium project to other similar stadia delivered by the same team clearly demonstrates the 52% programme and 38% fee savings delivered through, in part, the use of BIM.
2.5 4D and 5D Modelling

2.5.1 4D
During the Public Consultation process a concern was raised to the NI Minister for Sport over crane movements lifting heavy objects across neighbouring properties. Through the use of 4D Construction Modelling, Mott MacDonald was able to convince local residents that cranes would not overhang their gardens.

The model was also used to inform planners and transport authorities the proposed construction traffic movements.

2.5.2 5D
Working with PCM utilising our specialist 5D BIM software, we have been able to reduce time required to produce construction-calibre quantity extraction by 70% compared with traditional techniques.

Time saved throughout this process has enabled us to focus on delivering a better value stadium for our client without the traditional completion of design followed by significant value engineering stages.

This real time feedback against the emerging design allowed constant value engineering in parallel with the emerging design, this avoiding abortive work and programme prolongation.

Throughout the RIBA Stages C – F, due to the optimisation and use of BIM, Project Estimates had a variance of less than 1% throughout and as a result of accurate quantification and close collaboration with the Design Team, Project Contingencies had also been reduced to less than 1%.

Programme comparison between various stadium projects
3. Interoperability

In order to maximise the benefits of using BIM on this project, it is essential that there is consistency in how teams collaborate, consistency in how tasks are approached and consistency in how information is shared.

The BIM execution plan aligned minor-level with group design to ensure design output is functional and compatible across disciplines, whilst also meeting the high level delivery and contractual requirements of the project.

The Casement Park design teams selected Revit as the central platform due to the interoperability of cross collaboration through each disciplines preferred software as can be seen in the federated BIM model.
4. Client Relationships

"The design team’s use of BIM processes has assisted us to better understand the design proposals through production of clear visuals and simulated venue performance from the outset. Overall the team has developed our understanding of BIM and the value it can bring to us as a Client."

Stephen McGeehan, Project Sponsor, Ulster GAA (Client)

The project to date has been a great example of how BIM can be used to deliver against challenging project technical, programme and commercial requirements.

Through using a BIM enabled tool chain to deliver project success, it has also acted as a platform to showcase Mott MacDonald’s BIM capability and demonstrate us as market leaders to all involved with the project.

Using our level 2 BIM models we produced a video fly through of the scheme to assist with very challenging public consultations.

"The delivery programme for the Casement Park project was shorter than any similar stadium that we have done before and BIM was essential to achieving the project milestones and adding value.

Mott MacDonald was definitely the right partner to work with to ensure a smooth design process using BIM for all disciplines."

Mike Trice, Principal, Populous Architects

We have set up our models to enable downstream client/contractor operational uses and as such, these items have been built into the contractors tender documentation.

Projectwise was opened up to the Client and public funding body to keep them informed so that that general document storage, transfers and reviews could take place in the same environment.

Regular workshops and benchmarking managed the expectations and kept the geographically distant client informed.
5. Leadership

As a project team we are making a difference across the Mott MacDonald Group and wider industry by inspiring and leading change.

This is evidenced not only by the proven programme, cost and quality benefits provided through using BIM on this project but also by the BIM engineering working groups, 5D BIM naming convention, exemplar BIM Execution Plan and technical notes provided.

A lecture associated with Casement Park has been selected for presentation at the prestigious Autodesk University 2013 in Las Vegas, which is the leading international BIM conference attended by upwards of 10,000 people.