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1 Overview

Main contractor: Sisk
Architects: RKD Architects
M&E Design team: Axis Engineering
Fit out Design team: JV Tierneys and Co. Consulting Engineers
Mechanical sub-contractor: Leo Lynchs
Electrical sub-contractor: Designer Group
Main Surveyors: Murphy Surveys

1.1 Introduction
Designer Group has employed Building Information Modelling (BIM) since 2010. Our first prefabricated BIM project was delivered in 2011. It enhances the management of construction through simulation within a 3D virtual environment. BIM allows Designer Group to explore, design, analyse and optimally sequence projects within a digital environment. This releases the opportunity to prefabricate building elements within a safe and controlled environment.

Designer Group currently have six employees’ enrolled in a MSc in Applied Building Information Modelling and Management in DIT Bolton Street. The course is a multi-disciplinary programme which includes collaboration of all disciplines including architects, engineers, surveyors, architectural technologists, and construction and facilities managers.

The course is designed to provide professionals with the ability to initiate and lead the integrated process of design, construction, and life-cycle management through the medium of BIM. Designer Group currently have employee’s enrolled in the Electrical discipline, the Mechanical discipline, the Quantity Surveying discipline and the Construction Management discipline.

As well as working with Revit the integration with different software’s is a key fundamental in the BIM platform. Software’s include:

- Autodesk Green Building Studios
- IES
- Navisworks

Designer Group have worked both with the design team and the construction team in various projects and have seen the benefits of BIM first hand.
1.2 Background

The Baggot Street project consisted of a full refurbishment and extension of an existing 1970's seven storey office building located at the heart of Dublin’s commercial district.

The buildings existing concrete structure was retained and extended as part of this redevelopment. The mechanical and electrical (M&E) design proposals had to work within the constraints of the existing buildings mass concrete frame.

The objective was to connect the two building entrances, one on Baggot Street and the other on Flemings Place via a new internal 'street'. This internal ‘street’ would in turn connect each of the three existing blocks and entrances and provide opportunities for multi tenants within the building.

The entire building facade received and overhaul with the installation of new façade cladding system throughout. The new façade was a combination of decorative red sandstone to the primary Baggot Street elevation and coloured horizontal tile cladding to the remaining facades.

The scale of the refurbishment and the limited program presented a major challenge to the project team in Baggot Street. To add to this during the project setup, issues in relation to the building lease prevented the construction team from starting work in line with the program and so a traditional construction approach would not be viable and would not meet program.

The building’s interior was made up of unsymmetrical ceilings, concrete bulkhead grid bay ceilings and un level floors added further challenges to the project team. To audit the building correctly it would have required hand measurements on site, which would have been time consuming and may have also presented in accuracy’s.
2 The Challenge

The key challenge on the Baggot Street Refurbishment project was to deliver a building of the highest standards, within budget, within program and ensuring health and safety excellence within the constraints of the existing 1970’s building.

Building Conditions During Strip Out

The original building construction and concrete frame was designed to facilitate the installation of the M&E infrastructure in the 1970s. This design did not allow for the capacity of services that are currently installed in today’s building. Integrating the new services into an old building was always going to be a challenge from the outset.

The project team investigated the available technologies that could aid in delivering the client’s needs within the strict time frame but also within budget. The client also requested that the project team investigate prefabrication that could potentially reduce time onsite.

With coordination standing out as the main challenge on the project a BIM processes was identified as a potential solution. The aim was to produce a better building with early coordination of the high concentration of services within the BIM model. Even though retrofits are not widely associated with the BIM process it was agreed that it was the best plan of action moving forward.

The next challenge the project team faced was BIM training and experience. Not all staff members had BIM exposure and very few team members had Revit experience.

As a result of the late decision to produce a BIM model, no design intent model existed. This created a number of challenges with such a short time frame to construction, design responsibility and model ownership.
The late adoption of BIM also highlighted the lack of a client Employers Information Requirements (EIR) which proved to be an issue. With no EIR in place and no contract obligation it was difficult to track BIM deliverables and accountability on the project.

Coordinated Section of Concrete Ceiling Bay from BIM Model
3 The Solution

Regardless of the level of BIM knowledge throughout the Project team the decision was made to actively utilise, develop and support the BIM process. This process has increased predictability and improved performance in design and delivery timescales.

The aim was to enhance our team’s technology offering, providing superior service to our client, from conception through the entire life-cycle of an asset, underpinned by the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them.

This lead to the creation of a multi-disciplined in-house BIM team who have worked on a range of different projects. Consisting of BIM coordinators and Revit experts to provide team learning sessions which occurred once a week and on time training which ensured that Site Supervisors & Project Managers engaging with the model and are where capable of viewing and integrating the model, if needed.

Designer Group Staff Collaborating Onsite

To ensure the development of the model occurred right first time and as the site team would require due to the lack of design intent to construction model; the project team would engage the site supervisors to ensure maximum impact on the model at the earliest stage of installation with internal workshops.
3.1 Point cloud

One of the strategies for the project was to utilise point cloud mapping to resolve the issue that arose in relation to lack of as built drawings. Although we rely upon as-built drawings to help us understand the site for our design, their support is as thin as the paper they are printed on. We often price materials, design mechanical systems, and get hardware manufactured only to find, once someone is on site installing the item, that there was a discrepancy between the as-built drawings and the as-built reality.

For this reason alone, retrofits often carry a higher risk and construction cost. The risk can sometimes be so great that we build new buildings because we do not want to deal with the uncertainty of an old building.

Utilizing point clouds to assess existing conditions as part of the renovation project had immense benefits that were identified early and resolved before they become problems in the field. Provided we know the right question, the point cloud is able to answer a multitude of inquiries regarding the conditions of the building at the time of the scan.

3.2 Common Data Environment

The Common Data Environment (CDE) for the main contractor throughout the project was Viewpoint, which was the system of choice that all parties feed into. The tool of communication was generally the PDF to share drawings across the disciplines.

Between the Mechanical and electrical project teams dropbox was also utilised to ensure Revit model uploads occurred on a daily basis in addition to the weekly upload that occurred through viewpoint CDE.

Within our own team we utilised Bluebeam to view, mark and mark-up PDFs in the field or back at the office. This information was held within our own internal CDE which is Google Drive.
3.3 Onsite Collaboration

For clash detection an agreed clash protocol was clearly defined between the different disciplines. This detailed the frequency of clash detection, the services to be clashed and the colours for each discipline within the Navisworks model to be produced.

The project team integrated TVs and tablets onsite to improve project collaboration, viewing of information and of the model in the field provide quicker validation of information with the help of tablets and Bluebeam software. Problems could be raised early and resolved quicker without the need to walk back to the site cabin scan a marked up drawing and then send it to the necessary party.

3.4 Project roles

**BIM Technicians**

Will continually develop the model in Revit and review the Federated model within Navisworks with the BIM Coordinator/site supervisor on a daily basis. This will be done with Revit, Navisworks and Bluebeam.

**BIM Coordinator**

Coordinate any issues on a daily/weekly bases with construction management team (CMT). Review the model progress, submittals and any RFIs that may arise. Ensure all information is shared on time within the EIDA CDE.

**M&E Site Supervisor**

Continually develop the model with the BIM team to ensure the constructability at a weekly workshop. Resolve any issues that make arise onsite during construction with the BIM Team on a daily basis with Navisworks and Bluebeam.

**BIM Manager**

Engage with the BIM Coordinator regularly to review the model and ensure progression of the model and the level of information is constantly being updated.

**CMT**

All BIM reports from weekly workshops with CMT to be resolved within an agreed timeframe.
3.5 Risk Management

In the model, access zones can be inserted within each family to ensure adequate space is given for access and maintenance of equipment. Masses can also be utilized within the model to ensure safe fire evacuation in restricted areas of a building.

Navisworks can be used to virtually walk the site to aid the preparation of method statements. Crane lifts and safety/exclusion zones can be identified in the model and placed in the most advantageous positions.

3.6 4D Scheduling

Using 4D visual aids, the project team effectively managed the site logistic plan ensuring no impact would occur to the services been installed or impact the installation program. The 4D simulation enables positioning of site entrances, site welfare facilities, access and egress. The benefit of these features is the site facilities can be coordinated in line with the construction build.

In terms of H&S 4D simulation enables crane lifts and any difficult installations to be fully simulated. This can provide the H&S team with a clear visualisation of the task ahead enabling identification and elimination of any H&S risks.

4D scheduling allowed the project team to construct the building virtually as many times over, to ensure the correct outcome was achieved. The 4D schedule will tie directly into the project program. The benefits of this include the ability to highlight any logistic, coordination or H&S risks well in advance of the actual construction period.
4 Key Project Outcomes

The key project outcomes include:

- The project was successfully delivered on time and in budget.
- Revit greatly aided in the collaboration process, the creation of construction drawings and the creation of more accurate as built drawings.
- Navisworks clash detection tools greatly aided in the collaboration process between all stakeholders.
- Due to a greater level of coordination of services, less rework was recorded onsite and less waste.
- The installation was generally right first time.
- Increased the awareness of the BIM technologies throughout both Designer Group office and site teams and across the project site to other companies involved in the project.

Federated MEP Model
Screenshots of the Federated BIM Model

Typical Floor Plan

Federated Model

MEP Clash Point
5 Key Learnings

The utilisation of BIM software which included Revit & Navisworks helped to promote greater coordination of services with the very tight ceiling plenum. Rework onsite was also witnessed to be less, aided by the model and productivity of site services staff was greater due to less resolution of issues which generally call for a member from each discipline to engage a senior member of staff and/or a member of the BIM team to review and ensure that both parties are in as per the model.

During a follow up audit of the site less waste also found to have produce compare to a similar retro project that had occur locally.

The use of BIM technologies helped to raise awareness throughout the companies of all the stakeholders and Increased the awareness of the technologies throughout the companies

A CDE within a CDE, within a CDE can cause a number of problems on a big project like the retrofit project in Baggot street. The main contractor had one, M&E utilised another and Designer Group also had their own. This caused loss of information, additional work and also can cause a delay in information.

Lack of project standards which included the BIM Execution Plan (BEP) and Employer's Information Requirements (EIR) was a very big issue that raised its head a number of times throughout the project. Throughout the BIM project it is imperative that these documents are created, implemented and referred to on a regular basis.

Paramount to the success of the project was the cohesive team that collaborated from day one. The team openly communicated and shared information through a variety of mediums including BIM. BIM was a shared responsibility that linked stakeholders together from the architect to engineer, construction manager, down to the trades onsite. Due to the use of the BIM model for the Installation of the building M&E services were generally right first time.

The key learnings from the Baggot Street redevelopment are listed below:

- The benefits of early contractor engagement.
- Collaboration with design team was key to delivering such a complex building.
- Benefits of a point cloud scan were witnessed first-hand with the creating of a BIM model from the point cloud.
- The federated BIM model reduced the number of clashes on site, the number of design queries and time wasted on site.
- Lack of project BIM documentation caused issues with accountability on the project. The need for an Employers Information Requirements, BIM Execution plan and a Master Information Delivery Plan.
• The need to provide on time training to ensure staff have the training and experience to successfully deliver project of this nature with the technology available.