

A Case Study of the Otterspool Railway Station, UK to Measure the Benefit of BIM

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Abstract— BIM (Building Information Modeling) being an advanced supporting tool for AEC industry, by understanding its value and importance many developed countries like UK, USA, Germany, etc. have made the BIM design as mandatory for maximum of the public project. Even though it is well practiced in a few developed countries, in many developing countries like India, it doesn't make BIM mandatory in public projects. This paper highlights on the benefits of using BIM in AEC industry, also will address a few problems facing in the absence of BIM, and how it can be resolved by application of BIM concept into AEC industry. This paper, through light on the different phases of construction, like pre-construction phase, construction phase, post-construction phase in which how the BIM could be implemented and the benefits of implementing BIM. This paper presents a live example of BIM implementation in an Otterspool Railway station project, UK. For effective implementation and outcome of the project the basic planning strategy is used. The data of that project are presented with 5D of BIM before execution starts. After execution, documentation is done at the level of LOD 500. By implantation of BIM, they have acquired about 70% higher accuracy in cost prediction, 85% improved the schedule by proper allocation of resources, reduced error in construction by 85%, avoided rework and wastage of construction material and also provided a better level of understanding for client and workers. This research finding case study stating that, there is a higher potential for BIM benefits of the AEC industry, which has to be realized by the Government of India and must take the steps for implementation of BIM in all levels of projects for the benefit of the client, contractor, design team and other teams involved in it.

Keywords— BIM (Building Information Modeling), AEC industry, higher potential for BIM, Pre-construction phase, construction phase, post-construction phase

1. INTRODUCTION

BIM not only attracts Academic circle, but also having greater impact on the industrial circle too. Building Information Modelling(BIM) is a concept which provided solution for various problem faced by AEC industries and its team by various implementations of advancement in technologies. BIM is not a usual 3D modeling tool, but it also provides a platform for the users to embed the default physical, mechanical and functional property of the 3D elements; also it provides facilities for users to create/ modify the properties of 3D element. This 3D element bundled with its property can be analyzed/ simulated for various performance analysis and data prediction in various

phases of work like plan, design, manufacture, services and demolition. BIM data emerge with different level of dimensions like 3D, 4D, 5D, 6D and 7D. Where 3D is the existing model with length, breadth and depth of the model. In case of 4D, project phasing simulation has been integrated with 3D data. 5D is the presenting model with estimation documents integrated with 4D data model. 6D brings the model with its sustainability data like energy analysis, stability of structure, environmental sustainability, etc.. added with 5D data model. 7D of BIM contains facility management like its life cycle operation and maintenance strategy added with 6D data.

1.1 List of Nomenclature

BIM :	Building Information Modelling
AEC :	Architecture, Engineering and Construction
R&R:	Repair & Re-habitation
O&M:	Operation & Maintenance
GoI :	Government of India
MEP:	Mechanical Electrical Plumbing
LOD:	Level of Development
LOI :	Level of Information
7D :	Refers 6D + Facility Management
6D :	Refers 5D + Sustainability
5D :	Refers 4D + Estimation
4D :	Refers 3D + Project Scheduling

2. BENIFTS OF BIM IN OTTERSPOOL RAILWAY STATION PROJECT

The benefits of BIM over conventional technology where countless. In this paper, let few benefits has been discussed which are tasted in the Otterspool Railway Station project.

2.1. Pre-Construction Phase

This pre-construction phase involves acquisition of land, surveying, soil testing, Planning, Designing, Pre-construction documentation, EIA report preparation, Approval from corresponding authority, etc. This paper will explain few about it, in which BIM created its footprint for this project.

2.1.1 Surveying

Initial Surveying is done using the ArcGIS application. Site selection, area coverage of the project has been investigated with higher accuracy and coordinates of the boundary points are acquired. It helps in redefining points on the site. Preliminary calculation was completed by

ArcGIS data. It also provides clear picture about total land area acquiresed, area of green cover in it, contour of the site, net cut-fill value for the site.

2.1.2 Planning

Planning of layout involves various stages like conceptual plan, development design plan, Design plan, IFC plan, GFC plan. Also planning has to be done for various services such as building architecture, landscaping architecture, building structure, HVAC, water supply, drainage, electrical, firefighting, etc.. For preparation of all levels of plan to all services, AutoDesk Revit has been used. It easily bridges the different level of plan among various service providers. It provides an easy development and modification platform for the improvement of plan from lower level to a higher level. Also, this BIM application provides data with higher accuracy and reduce time consumption throughout the entire process.

2.1.3 Design

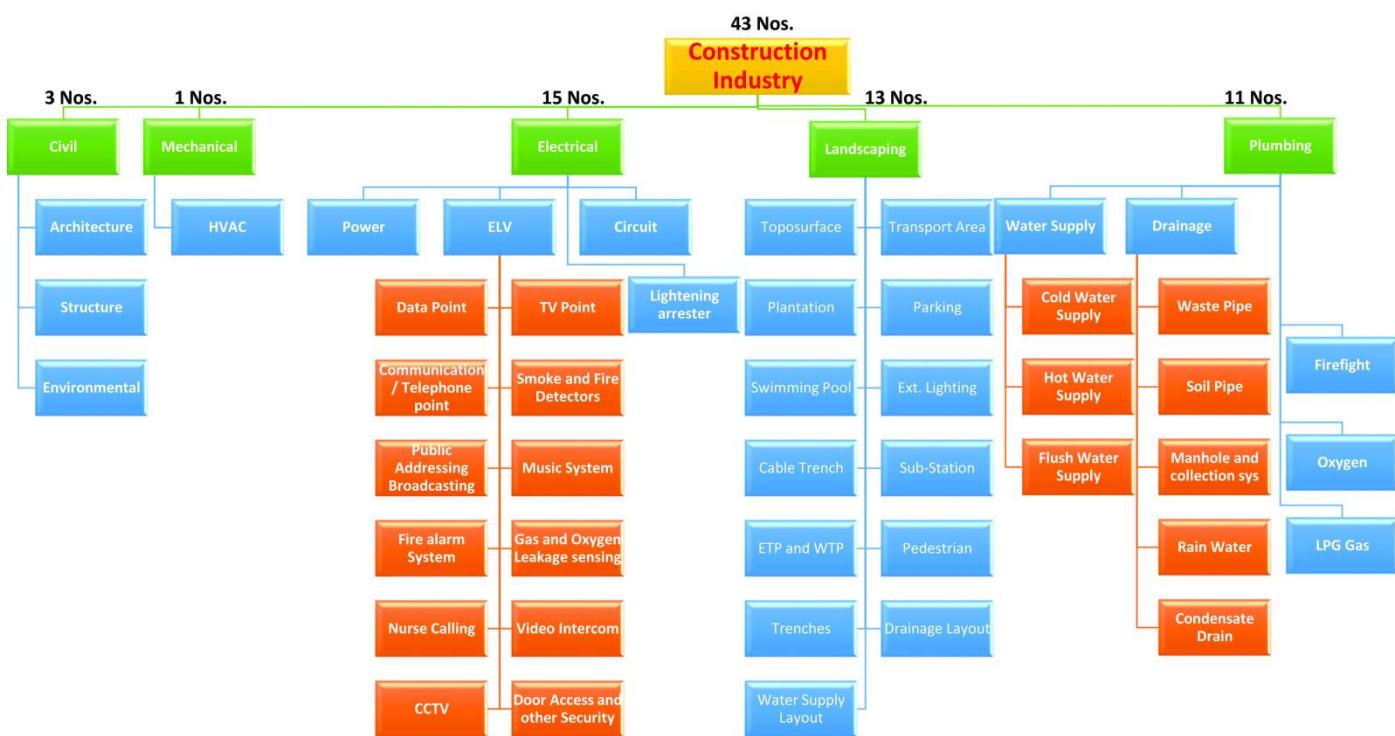
Design involves Civil design and MEP design. Civil Design involves analysis and design of building structure to provide higher stability and life period. To perform this analysis and design STAAD Pro V8i is used in which design standard codes of various country are provided in-built. This application provides an interactive platform to analyze and design the building structure. Whereas MEP major design includes HVAC and electrical design. HVAC

design is done by considering various natural and man-made environmental factors to provide the ton rating of Air Conditioner, size and shape of the duct. In case of electrical design load of each circuit has to be maintained, load balancing among the various phases to be balanced. These HVAC and electrical are performed using AutoDesk Revit. Being an interactive and intelligent program this application helps lot in time saving and making the work easier with auto calculation using inbuilt formulas, which makes the design process much simpler.

2.1.4 Synchronizing all MEP services

In AEC industry Civil Engineering Services, Mechanical Engineering services, Electrical Engineering Services and Plumbing Engineering Services all together have about 40 sub-services, which will be presented in the Figure No. 1. During synchronization and coordination of all services together, there may be clashed between services of same discipline or with the services of other discipline. The Clashes/ Interference has to be identified and resolved. This will reduce conflict, delay in execution and improves coordination among the engineers during the execution phase. So, clash detection and resolving of clashing playing a major and vital role in BIM Services. For Identification of Clashes AutoDesk Revit had been used.

Figure No. 1: Different Disciplines and its services of AEC Industry



2.2 Construction Phase

Construction phase is the more reality phase, where well experience engineer, technician, foreman and uneducated labors joins together for complete the common goal called project. BIM can transfer the content for all levels of employee with clear documentation and

presentation. In which BIM act as a major communication bridge among all levels of employees.

2.2.1 Coordination between Services

As we discussed in the session 2.1.4, Coordination between various disciplines and services plays a major role in construction phase. As coordination is done in design

stage itself, with help of coordination drawing it is easy for site coordinators to execute and coordinate all those services. Coordination drawing used in this stage is prepared using AutoDesrn Revit application.

2.2.2 Revisions in Drawing

During execution, due to practical difficulties and client request there are few changes occurred. These changes are easily updated to Client, Design engineer of various disciplines by Site coordinator using BIM 360 Application. As per the requested changes, the plan will be modified in the same application by the design engineer immediately. The schedules, BOQ and calculation will be updated automatically by the application and will be verified by the design engineer. This revised drawing with updated schedules, BOQ and calculation can be instantly accessed by the client and site coordinator.

2.2.3 Resource Management

Resource management includes 3M management, which is Men, Money and Material Management. All these resources are created in database of MS Project. Using this application, the tasks are well planned and sequencing of tasks is done by the Project Manager before execution starts. Also, the material and human resource is pre-allocated for each day's task, which help the material procurement team and the human resource procurement team a lot to schedule their work on proper time. Using this process time and cost was controlled at a higher rate.

2.3 Post-Construction Phase

In post construction phases, various documentation had been done for the future O&M process. The documentation had been done by following the BIM standards.

2.3.1 As-built and Post-Documentation

As-built and post-documentation is most important documentation process. The as-built follows the LOD 500 standard. These had been prepared using AutoDesrn Revit and MS Office Applications. This LOD stands Level of Development, which is the combination of Level of Detailing and Level of Information (LOI).

3. SUMMARY

BIM being an advanced tool, support all phases of work in the AEC industry and improves the performance and productivity of an industry. As far as this project, BIM has dominated the conventional methodology with higher accuracy and productivity.

Table No. 1 shows the matrix, that's how BIM influences different entity of people during various phases/stages of construction on this project.

Table No. 1: Impact of BIM through the project's life cycle

Phases	Pre-Construction			Const ruct.	Post Construction		
	P l a n i n g	D e s i g n t u r u l	P r e c o n s t r u c t i o n		P o st - C o n s t r u c t i o n	O & M	De mo liti on
Phases / Entity	P l a n i n g	D e s i g n t u r u l	P r e c o n s t r u c t i o n	C o n s t r u c t i o n	P o st - C o n s t r u c t i o n	O & M	De mo liti on

				c t i o n D o c u m e n t a t i o n			ti o n D o c u m e n t a t i o n	
Client / Owner / Developer	H i g h	L o w	H i g h		Hig h	H i g h	L o w	Lo w
Engineers (Archi, Structure & MEP)	H i g h	H i g h	H i g h		Hig h	L o w	H i g h	Hi gh
Builders & other Service provider	L o w	L o w	M o d e r a t e		Hig h	L o w	H i g h	Mo der ate

From the above table it has been proved that in major phases of construction, for all entity of people, BIM act as a vital role for effective completion of task.

In Table no.2, BIM application used in different phases of construction for the construction of this Otterspool railway station has been summarized.

Table no.2: BIM application for Different phases

Phase	Task	BIM Application Used	User
Pre-Construction	Surveying	ArcGIS	Design Er. Planning Er.
	Planning	AutoDesrn Revit	Planning Er.
	Civil Engg. Design		Civil Design Er.
	MEP Design	AutoDesrn Revit	MEP Design Er.
	Synchronizing all services	AutoDesrn Revit	Coordination Er. Design Er.
Construction	Coordination between Services	AutoDesrn Revit	Site Coordinator Design Er.
	Revisions in Drawing	BIM 360	Client Design Er. Site Coordinator Procurement Team
	Resource Management	MS Project	Material Procurement Team HR Procurement Team Site Er.

Po st- Co nst ru cti on	As-built and Post-Documentation	AutoDesk Revit and MS Office	Client R&R Team O&M Team
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4. CONCLUSION

The above case study report of Otterspool Railway station proves that, BIM makes the AEC industry to work with higher accuracy with low cost and time. By implantation of BIM, they have acquired about 70% higher accuracy in cost prediction, 85% improved the schedule by proper allocation of resources, reduced error in construction by 85%, avoided rework and wastage of construction material and also provided a better level of understanding for client and workers. This may reduce the risk and burden of client and construction industry team. Adopting BIM in AEC industry, making greater level of difference and improving the productivity at all services. As discussed before many of the developed countries have implemented BIM in most of the sectors in public and private projects. In few parts of India many private industries have been updated with BIM concept, beyond that our GoI has to implement BIM as mandatory for all levels of project in all service sectors for the benefit of client and industry.

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