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Coordination of Building Services: A Review

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Abstract - *Building Services are specialized systems that are implemented in structures to make them more functional, safe, comfortable, and efficient. Building services have evolved from simple mechanical, electrical, and plumbing systems to include fire protection, HVAC, security systems, and telecommunication systems. The building services design that is prepared to be accommodated in architectural and structural design that is difficult. The design coordination procedure resolves the disputes and conflicts in accommodating the MEP system. The design coordination process, which is carried out on a light table using the sequential overlay comparison process (SCOP), has major flaws. The goal of the research is to better understand the traditional design coordination process and the issues that arise as a result of it. The research will also look into the benefits of using BIM for design coordination over the traditional process.*

***Key Words*: :** MEP System, Design Coordination, Construction Management, MEP Structure

1. INTRODUCTION

Modern buildings with more complicated structures have replaced previous ones with simple structures. The increasing need for building services by its occupants has increased the complexity of buildings. The application of new technology to buildings, such as the Internet of Things, solar wind energy production, and so on, adds to the complexity. The architecture and building services' intricacy create difficult coordination issues.

1.1 Problem statement

According to numerous studies, faults in the design phase tend to increase the cost and duration of a construction project. [4] discovered through their research that the design development phase is responsible for the majority of rework in a construction project, resulting in project time and expense overruns as compared to other stages. Conflicts in the building phase are also attributable to ineffective design phases, according to the study. [4]

The project's financial performance is largely dependent on the building services, which account for 25-40percent of the total value. Even though building service design coordination is difficult, good coordination results in decreased project costs, time, disagreements, and rework. This study will look into the issues of building service coordination during the design development stage.

The research will contribute to a better understanding of the current state of design coordination in the industry. Finally, comprehend the significance of BIM (Building Information Modelling) in design coordination.

1.2 Objective of Study

The following are the objectives of the study:

1. To study the managerial prospects of the different engineering elements of the projects.
2. To manage the coordination between the engineers of different technicalities and maintain the pace of the project.
3. To enhance an understanding about the challenges during coordination of the different building services.

1.3 Need of foamed concrete brick

Foamed concrete (FC) brick can be a viable replacement for normal concrete, since it minimizes dead loads on structures and foundations, helps energy conservation, and cuts manufacturing and labor costs during construction and shipping. Foamed concrete brick fills all cavities, spaces, and seams over a large distance without requiring vibration or compaction. It has a quick and easy installation process, as well as strong heat insulation and air content. It offers strong thermal insulation, freeze/thaw qualities, and fire resistance. Hardened foamed concrete brick, unlike certain synthetic light-weighted materials, is resistant to hydrocarbons, bacteria, and fungus, as well as insects and rodents.

1.4 Objective of Study

The objectives of the study are listed below:

1. To study the behaviour of sawdust and waste glass powder incorporating foamed concrete.
2. To evaluate the characteristics of foamed concrete brick based on physical and mechanical properties.
3. To produce a sustainable foamed concrete brick for construction need.

2. Literature Review

The purpose of the literature study is to acquire information in order to understand the report's goal, which begins with the industry's design process. The management framework for building services in accordance with design coordination that exists in construction projects will be covered in this part.

2.1 Building construction process

Fadamiro & Bobadoye, (2006) The effectiveness of the construction process is strongly linked to the success of the construction project, according to Far. This procedure has a significant impact on the flaws in structures constructed as a result of poor management system. Architects, project managers, structural engineers, and services engineers are among the professions involved in the design process. [5]

2.2 Building service system

The Chartered Institution of Building Services Engineers (CIBSE), (2020) The Construction Process Building Services are the systems that are put in buildings to make them functional, safe, efficient, and comfortable for their users, [6] Building services engineering, according to CIBSE, "truly brings buildings to life." According to the CIBSE Data Sheet, the cost of life for a building, i.e., Building Services, ranges from 25 to 40 percentage for a new project. [7]

Gomeseria, (2016) The electro-mechanical system of the HVAC system, storm water drainage system, lighting and power, vertical transportation, fire services, fire prevention system, public announcement system, closed circuit television (CCTV), and the building communication system are all active building services. The Mechanical, Electrical, and Plumbing (MEP) System brings together these disparate systems. [8]

2.3 Coordination of building service

Lee & Kim, (2014) Design coordination is an iterative process for detecting design errors and conflicts among interdependent architectural components like doors, structural beams and columns, ducts, walls, pipes, and lighting. Moving one component of the structure to resolve the disagreement creates a new difficulty, making design coordination a difficult and complex process. The procedure is named design coordination because the primary point of design coordination in a construction project is the coordination of MEP elements. [9]

Riley, et al., (2005) Building services is a difficult component of the construction industry since it is a multidisciplinary trade involving various specialists. Coordination is a procedure that requires coordinating actions that are intertwined. [2],[3]

Designing Building Wiki, (2020) While design is the process of modeling a solution for a project brief and documenting that solutions for construction, design coordination is a broader term that describes the consolidation of separately created designs into a single entity for a clash-free construction.[10]

3.0 Elements of the Building Service Systems

Building Services is a multidisciplinary industry that encompasses a diverse group of experts that work on a project from conception to completion. The mechanical, electrical, and plumbing industries are all classified as building services, as previously indicated.

3.1 HVAC System

A building's heating, ventilation, and air-conditioning (HVAC) system is designed to fulfil the residents' environmental needs. HVAC's objective is to maintain a comfortable thermal environment inside the building based from the outside environment, air quality, and relative humidity. (Seyam, 2018)

3.2 Plumbing System

The sewage and storm water systems are set up to work with gravity. Another significant part of the plumbing system is drain fixture venting. The submersible pump, overhead tanks, and fire tanks factor for the building design and the water pipes design. (World Plumbing Council and World Health Organization, 2006).

3.3 Electrical System

The electrical system is an essential component of building service and plays an important role in its design.

3.4 Vertical Transportation

Innovative systems for moving people and commodities from one level to the next have arisen as the amount of high-rise buildings increases.

4.0 BIM in Construction management

Participants in the construction process are continually pressed to complete effective projects despite limited resources, manpower, tight timelines, and inadequate or contradictory information.

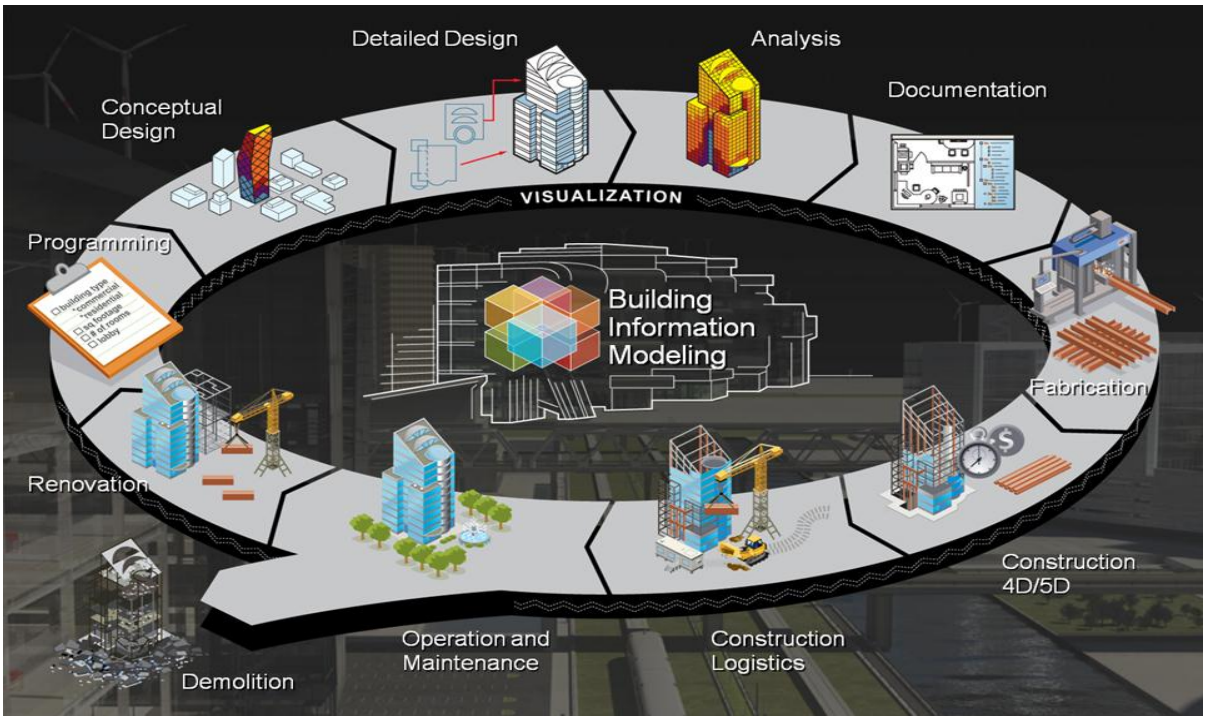

Fig-1 Stages of BIM

Work scope can be broken down and defined. Systems, assembly, and sequence can be displayed at a relative scale with the entire facility or group of facilities.

4.1 MEP Coordination

During the pre-construction stage, BIM gives buildings a visual capacity (via 3D modelling) and communicates about the proposed structure. Because communication and cooperation begins during in the 3D modeling stage, using technology to aid design coordination has various advantages. BIM ensures a clear communication channel for specialist trade (MEP) experts as technology is used in design. This aids in the early resolution of project conflicts and collisions.

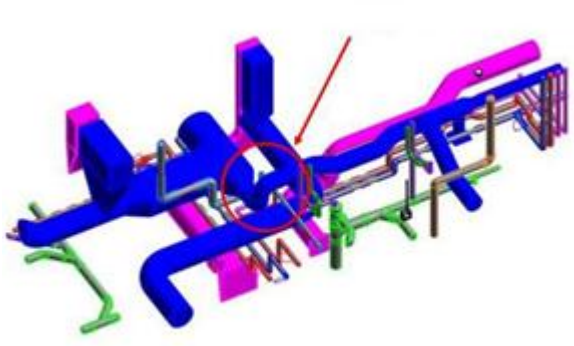

Fig.2 Coordinated Models with Design Clashes

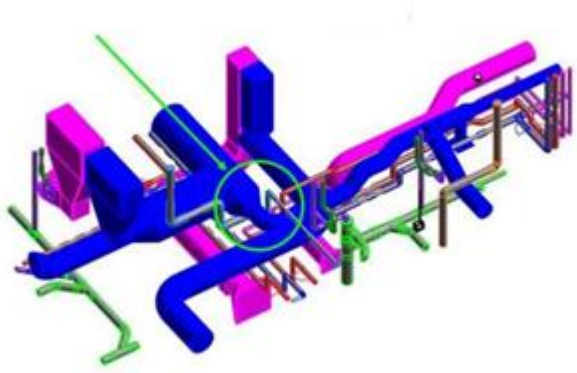

Fig.3 Design to Remove Clashes

Collision detection is a major benefit of BIM in design coordination, which helps to just save cost during the design and construction stages of a project.

4.2 Stages in Coordination of MEP structure

MEP collaboration often begins with conceptual design and continues through construction documentation. MEP design coordination is often handled by the general contractor, who has discussions with all trade relationship and reviews the conflict analysis to ensure that the product is commutative.

4.3 SCOP

Usually, the MEP coordination process starts after all of the building systems have indeed been designed and routed. When all components (e.g., conduits, pipe, HVAC duct) have been sized, engineering calculations have been completed, and schematic drawings have been created, the design is complete.

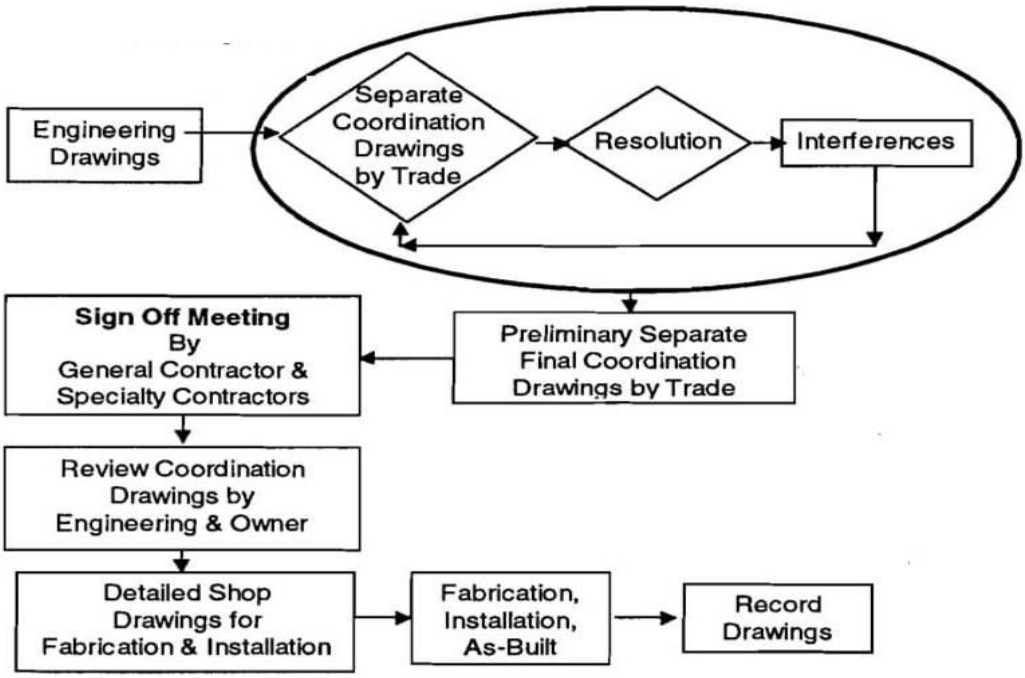

Fig.4 SCOP process chart

System (in priority order)	Priority/Special Notes
Mechanical (HVAC Dry)	usually first due to large size of components
Mechanical (HVAC Wet)	follows HVAC Dry due to interdependency of these systems
Plumbing (gravity driven systems)	design criteria for slope essential for system performance
Plumbing (pressure driven systems)	lower priority because less difficult to re-route
Process piping	takes first priority if critical to manufacturing process
Fire Protection	flexible routing within safety and architectural requirements
Electrical	most flexible routing, especially small diameter conduit
Control systems	flexible routing but must limit bend radius for pneumatic tubes
Telephone/Datacom	flexible routing but must limit bend radius for fiber optic cables

Table-1 sequential comparison priority order

The architect and structural plans confine this route, which is directed by the engineer's diagrammatic drawings and chosen by the contractor based on lower cost. It rarely takes into account other systems.

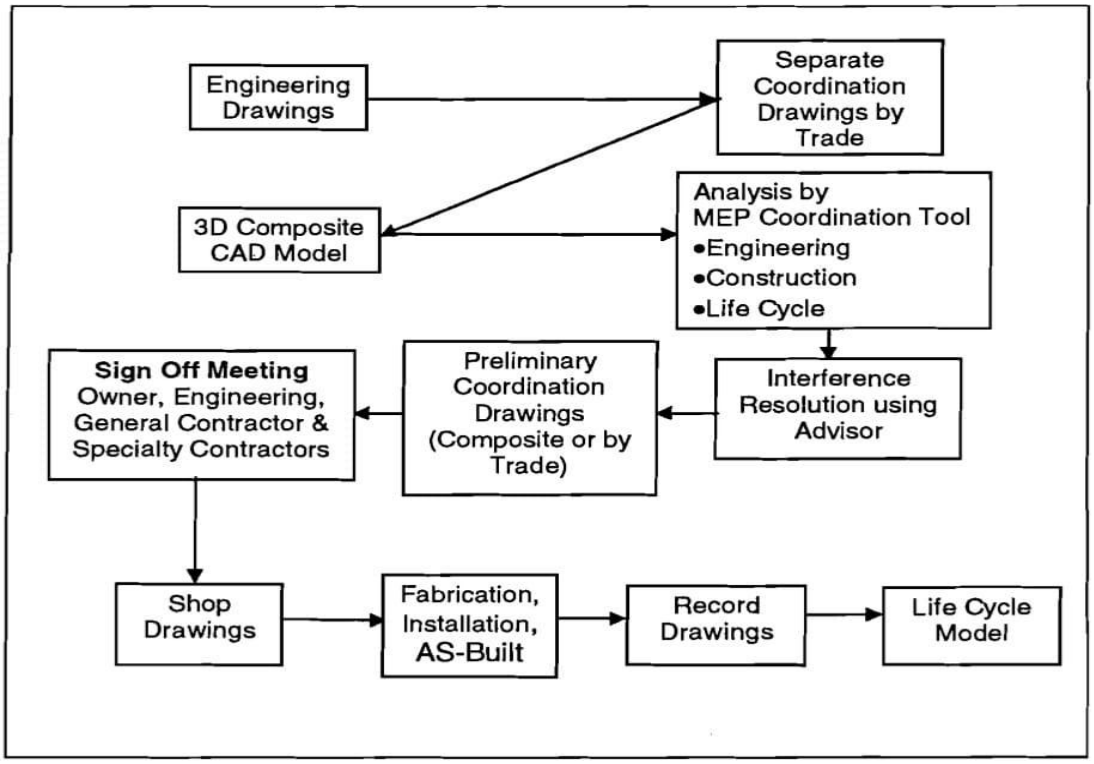

Fig.5 Tool for MEP coordinating

The coordination process begins with all of the specialist contractors bringing their early drawings to a conference, as shown in Figure. The contractor's recommended routing or path for each branches of the system to reach desired destinations and execute important services is shown in these drawings. This indicates that There is no defined routing. During this phase, the HVAC and plumbing systems are usually sized. Design. Other trades, such as electrical and fire protection, aren't, thus some of the systems aren't up to par. Others are drawn as lines with reference to component sizes, while others are drawn to scale.

5.0 Conclusion

Following are the conclusions from the review study:

1) Traditional collaboration is time-consuming and tiresome recognizing and resolving dispute.
2) There is some possibility for automation in the process.
3) Collaboration is feasible from the start with BIM.
4) BIM dimensions aid documentation.
5) Project cost and time savings due to well-coordinated designs.
6) BIM allows for collision avoidance and detection.

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