SYNCHRONISING TENDER DRAWINGS AND DOCUMENTS AS AN AID FOR DISCREPANCIES

Izzny Ismail[1,a], Azman Zainonabidin[2] , Teh Zahariah Nassaruddin[3] and Rodzyah Mohd Yunus[4]

[1, 2] *Department of Architecture, Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA Campus Seri Iskandar, 32610 Perak, Malaysia*
[3]*Department of Quantity Surveying, Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA Campus Seri Iskandar, 32610 Perak, Malaysia*
[4]*Department of Architecture, Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA Campus Shah Alam, 54000 Selangor, Malaysia*

Abstract. This paper recommends an aid to control discrepancies between drawings and documents in a project. The synchronisation may assist to better project's preparation and documentations. The causes of discrepancies that found out during the contract stage may lead to ineffectiveness of construction cost. The controlling process initiated from the tendering stage as to minimize the causal by any of the consultants which some items may left behind or possibly not describe fully without the thorough affiliation of coordination. The method to reduce discrepancies between drawings and documents is identified through Case Study based on 'hands on' project. The case study is focused on the preparation of architectural detailing. Therefore, the relationship of 2-Dimensional (2-D) Tender Drawings and bills of quantities is compared with the Elements of Building Works by Malaysian Standard Method of Measurement of Building Works Second Edition (SMM). The relationship study will simplify and supersede any unnecessary detailing. Thus, the application of the synchronisation method will result effectiveness of documentation during the contract stage by reducing discrepancies.

1 Introduction

Discrepancies of Tender Drawings and Documents are identified during contract stage. The process involved contractor's findings when he plans the carrying out of constructional works. According to PAM Contract 2006 [1], during the planning and subsequent execution of the works, the contractor needs to notify the architect in writing when they find any discrepancies between documents. Hence, with the notification architect shall enable to issue written instructions in sufficient time before any commencement of works regarding discrepancies. It nevertheless encourages contractor not to request further instruction at the very last minute to avoid delays. To the same degree, PWD Form 203A [2], stated that the contractor shall immediately notify the Superintending Officer (S.O.) a written notice for any discrepancy and divergence as for the S.O. to issue instructions.

Discrepancies happen among consultants' documentations [3]. Thus, discrepancies involved neither architectural and engineering drawings, nor engineering and engineering drawings, nor architectural drawings and bills of quantities, nor engineering drawings and bills of quantities. In accordance with the documentation, client's requirements are complex nowadays [4]. In supporting to the complexity, a great deal of coordination is required to avoid delay , especially for public projects [5].

Many researchers have studied on the effects and causes of delays and cost overrun and all suggested early detection and planning. Sambasivan and Soon [6] recommended that practitioners to better understand the dynamics of project management and make an effort to reduce delays, whereas and academicians can conduct similar studies to identify causes and effects of delays. At the preliminary stage of the project, it is essential that effective decisions on design specifications, project financing, contractual systems, and methods of construction are all taken at the right time [7]. Odeh and Battaineh [8] listed that one of the causes of delay is contract factors include changed orders and mistakes with discrepancies in contract documents. Actions are taken to control the causes of delay and cost overruns right away from the planning to the implementation and management stages [5]. Analysis has been made by Cheng [9] cost impact factor and contract dispute highlighted on construction drawings are unclear with ambiguous specifications. The study made by [4] ranked that one of the factor influencing cost variance during construction is incomplete design drawings and specification. Thus, understanding the relationship between drawings and documents is crucial in achieving synchronization. This paper is organized as follows. Section 2 deals on explanation on drawings and

[1] Izzny Ismail: izzny813@perak.uitm.edu.my

documents. Section 3 explains on the methodology and conceptual framework of the research. Section 4 discusses the analysis of findings. Section 5 presents the conclusion and recommendation.

2 Literature review

2.1 Understanding the relationship of drawings and specifications

Drawings and specifications always been treated as different means of resources. Rosen and Regener [10] recommended the relationship should be complementary with no duplication or conflict between drawings and documents. Arditi and Gunaydin [11] described that it is critical that drawings and specifications be clear, concise, and uniform; the project must be constructible from those retained to build the project; design professionals must be familiar with construction materials and techniques that constructors will be using in the project. Contract documents contained specifications, as written instructions, are frequently judged by the courts as having greater importance than drawings when these documents are in conflict, with judgments based usually on what is contained in the specifications. This means that specifications should be carefully prepared by knowledgeable people [10] . On the other hand, Connell and Flegal [12] identified that drawings depict the work graphically and the specifications provide a written description, while addenda and modifications are official changes to both. Quality project built by a contractor is directly related to the quality of plans and specification [13]. The authors suggest that a relationship of drawings and specifications are uniform without duplication of information as for the purpose of contractors fulfilling their obligations. Thus, if the resources are well prepared, discrepancies can be avoided and lessen wastage of time and cost.

2.1.1 Information and graphic for 2-dimensional (2-D) drawings

The drawings illustrate a series of information that describes in graphics. Drawings are the only documents given to the constructor that show the design concept, size and scope of the job [11]**.** Another author described that drawings present series of pictures of a project to be constructed that indicate size, form, location and arrangement of various elements [10].

2.1.2 Measurement for specifications

Specifications complement the drawings that provided for each project. Rosen and Regener [10] distinguished that the purpose of specifications should describe the type and quality of every work; quality of workmanship; requirements for fabrication, erection, application, installation and finishing; applicable regulatory requirements; overall and components dimension; specific descriptions and procedures for allowance of unit prices ;specific descriptions and procedures for product options; and specific requirements for administration of contract for construction. According to PAM Contract 2006 [1], clause 12., measurement of building works relating to the quality and quantity of the work included in the Contract Sum shall be deemed to be those which are set out in the Contract Bills and unless otherwise expressly stated, shall be prepared in accordance with the Principles of the Standard Method of Measurement of Building Works (SMM) sanctioned by the Institution of Surveyors Malaysia (ISM) and currently in force. However Harbans and Kandan [14] recognized the uncertainty of measurement the contractual provisions, methods for measuring the varied work applying SMM for building works and CESMM for civil engineering works, but to the contrary mechanical and electrical works there are no accepted norms in the measurement process. Despite of that, Connell and Flegal [12] mentioned the use of standards is extremely important.

Jaafar, Lim, and Yahaya [15] explained that elementary estimating for building works, during the preliminary design stage, project estimation is prepared and estimation involves measuring and pricing. The author clarified that measuring is the process of abstracting Standard Method of Measurement (SMM) and the quantity of each building element will be compiled as Bills of Quantity. On the other hand, pricing is the process of calculating the cost of each building element stated in the Bills of Quantity. The actual building estimation is based on detailed drawings such as layout plans, elevations, sections and supported by a specific list of building elements.

Table 1 . Elements of building works by Malaysian standard method of measurement of building works second edition (SMM)

Building Elements	**Role by Consultant**
Preliminaries	All Consultants
Demolitions	All Consultants
Excavation and Earthwork	Civil Engineer
Piling and Diaphragm Walling	Structural Engineer
Concrete Work	Structural Engineer
Brickwork and Blockwork	Architect
Underpinning	Civil Engineer
Masonry	Architect
Waterproofing and Asphalt work	Architect
Roofing	Architect and Structural Engineer
Woodwork	Architect
Structural Steelwork	Structural Engineer
Metalwork	Architect
Plumbing and Mechanical Engineering Installations	Architect and Mechanical Engineer
Electrical Installations	Electrical Engineer
Floor, Wall and Ceiling Finishings	Architect
Glazing	Architect
Painting and decorating	Architect
Drainage	Civil Engineer
Fencing, Turfing and Planting	Architect

2.3 Coordination of 2-dimensional (2-D) drawings and specification

Coordination plays the role of the team player in a project. Rosen and Regener [10] emphasized that to improve coordination between drawings and specifications, standardization of information should be appearing in them. Coordination is one of the factors to minimize discrepancies. The list comprises of:

(1) Closer consultant coordination is required at design stage;
(2) Closer consultant coordination and utilization of an experienced consultant to produce a concluding design, working drawings, and contract drawings at the tender stage;
(3) Checking and reviewing the contract documents;
(4) Develop a clear scope of work for the parties that involved on the project;
(5) Integrated project scheduling and management techniques;

The coordination factors numbered (1)-(4) suggested on closer coordination, thorough checking, and develop clear technical detailing that integrated with conclusive design. Whereas factor numbered (5) is a suggestion during the construction stage. Coordination before tendering stage is important due to making sure the documents and drawings are described conclusively. Simply to avoid some items may leave out or possibly not describe fully. The coordination process will get more tedious, according to the complexity of the project. It is a careful process of making sure the documentation final.

3 Methodology and conceptual framework

This research involved qualitative mode of research. Love, Lopez, Edwards, and Goh [16] recommended that a case study approach based upon analytic induction is used to further examine the underlying dynamics that may contribute to design error production. Furthermore, the research is guided by De Massis and Kotlar [17] suggested for choosing the case study design, identify the unit analysis (case), selecting the cases (sampling), collecting information, and analysing information. Implementing the guideline, the case study design is a descriptive case study that used to convince a phenomenon that is relevant, as referring to "Synchronise drawings and documents can be an aid for discrepancies". The purpose is to understand project in depth regarding ways or method in minimizing discrepancies. The unit analysis is focusing on a project within the firm with an experienced individual. It involved 'hands on' case studies for research approach that involved five (5) years of experienced in handling multiple projects. Sampling of the case study is by a single case for aiming straightforward information related to architectural detailing and specifications. The case studies are based on projects in Perak, Malaysia that involve the building type of an office building. The information is gathered from tender drawings and documents which consist of research techniques are from observations and appropriate written documents. The information is analysed through two steps, firstly by comparison and to be followed by synchronizing data.

Chart 1. The framework of methodology

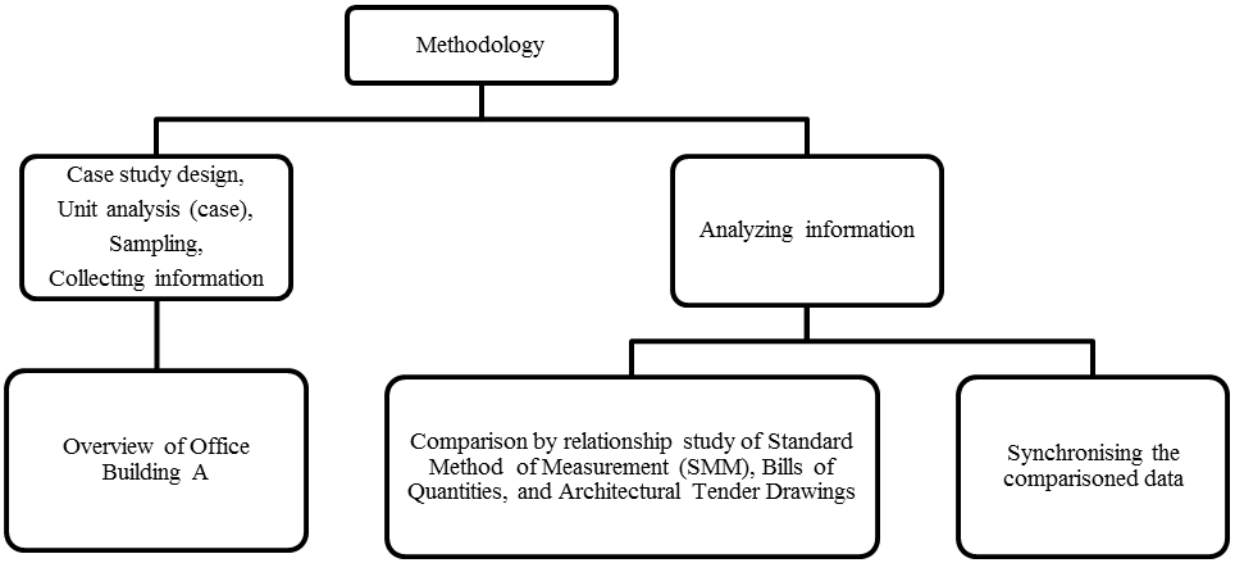

Figure 1. Perspective of Office Building A

4 Findings and discussion

4.1 Overview of Office Building A

A single case study is identified based on a project in Perak, Malaysia. The case study building type is a government office building that approximately cost RM 2,500,000 (Ringgit Malaysia Two Million and Five Hundred Thousand. The project is managed by a project architect with five (5) years of project handling experience. The observations are dominantly from the architectural side of the input. The client of the project follows the project phases by following the submission plan approval timeline and just then proceed to the next stage after gain all approvals. The time allocation is carefully planned and follows as this is the first implementation by the client to bind the work programme part of the Memorandum of Agreement (MOA) between the client and each of the consultants. This means that the client can claim damages towards some late progress of the consultants because the work programme has been legalized. This policy already implemented by the government in minimizing delays in the consultant's scope of work. All progress between client and consultants has been clarified with clear brief, close coordination, detailed forecast, clear communication, careful budgetary consideration, and conclusive documents and drawings for quality assurance.

4.2 Relationship between Standard Method of Measurement (SMM) with bills of quantities and architectural tender drawings.

The comparison is to identify the relationship between the building element of Standard Method of Measurement (SMM) with bills of quantities (gathered information from quantity surveyor) and architectural tender drawing (gathered information from architect).The bills of quantities provided is prepared in accordance of SMM. From this comparison, some of the elements in the bills repeated as to follow the elements of SMM. For example the staircase element in bills of quantities has been repeated under building element concrete works, metal works, and floor, wall, and ceiling finishings. The assortments of drawings and documents are identified through the comparison with SMM.

4.3 Relationship between bills of quantities with Standard Method of Measurement (SMM) and architectural tender drawings.

In accordance with the comparison of table 2, another related study is taken. The comparison is done on the elements of building works of bills of quantities between architectural tender drawings and building elements of Standard Method of Measurement (SMM). This comparison simplifies the elements in the bills of quantities. Besides, multiple building elements are grouped related to one element in the bills of quantities. For example relationship between the staircase element in the bills of quantities to be compared with Detail Staircase comprises building elements of concrete work, metalwork, and floor, wall and ceiling finishings. Some of the architectural tender drawings are repeated under different building works element in the bills of quantities. Hence, the relationship between architectural tender drawings and SMM is cluttered, but to be compared with bills of quantities, the architectural tender drawings are in order. However, the relationship has to be simplified further.

4.4 Corresponding between bills of quantities with architectural tender drawings

In relation to the table 3, the bills of quantities, elements are simplified by omitting the elements to be measured under different bills and not required in the design. However, there is still repeating Architectural Tender drawing in accordance to the element in the bills of quantities. For example the element between Internal Doors and Windows and External Doors and Windows, the architectural drawings of Detail Door, Detail Window, and Detail ironmongery are repeated. This synchronization is not conclusive as it will bring difficulty during managing architectural drawings.

4.5 Corresponding between architectural tender drawings with bills of quantities

In relation to table 4, tabulation is made in synchronizing between the architectural drawings and bills of quantities. Each of the elements already been clarified as to improve the outcome of the recommended model of synchronizing drawings and documents. Architectural tender drawings are identified relating to the elements in the bills of quantities as for easier coordination purposes.

Table 2. Comparison between building elements of SMM with bills of quantities and architectural tender drawings for office building A

Building Element-SMM	Bills of Quantities	Architectural Tender Drawings
A Preliminaries	*To be measured under different bill	Preliminaries Item
C Demolition	*Not required in the design	* No design provided
D Excavation and Earthwork	*To be measured under different bill	* Not under scope of work
E Piling and Diaphragm Walling	Work Below Lowest Floor Finish	* Not under scope of work
F Concrete Work	Frame	* Not under scope of work
	Staircase	Detail Staircase (Concrete works)
	Staircase	Detail Apron, Ramps, Steps And Perimeter Drain (Steps)
	Apron Ramps and Perimeter Drain (Ramp)	Detail Apron, Ramps, Steps And Perimeter Drain (Ramp)
	Upper Floor Construction	* Not under scope of work
	Builders Work in Connection	Detail Ablution
	Roof (flat roof)	Scupper Drain Detail (flat roof)
G Brickwork and Blockwork	External Wall	Detail External & Internal Wall
	Internal Wall and Partition	Detail External & Internal Wall
	Builders Work in Connection	Detail Sanitary Fitting (Ablution)
H Underpinning	*Not required in the design	* Not under scope of work
J Masonry	*Not required in the design	* No design provided
K Waterproofing and Asphalt Work	Builders Work in Connection	Detail Ablution
	Roof (flat roof)	Scupper Drain Detail (waterproofing)
L Roofing	Roof	Detail Roof
	Roof (flat roof)	Scupper Drain Detail (flat roof)
M Woodwork	External Doors and Windows	Detail Door
	External Doors and Windows	Detail Window
	External Doors and Windows	Detail Ironmongery
	Internal Doors and Windows	Detail Door
	Internal Doors and Windows	Detail Window
	Internal Doors and Windows	Detail Ironmongery
N Structural Steelwork	*Not required in the design	* Not under scope of work
P Metalwork	External Doors and Windows	Detail Door
	External Doors and Windows	Detail Window
	Internal Doors and Windows	Detail Door
	Internal Doors and Windows	Detail Window
	Staircase	Detail Staircase (Railing)
	External Wall	Detail Louvres
Q Plumbing and Mechanical Engineering Installations	Sanitary Fittings	Detail Sanitary Fitting
	Sanitary Fittings	Sanitary Fitting Schedule
	Builders Work in Connection	Detail Ablution
	Cold Water and Sanitary Plumbing	* Not under scope of work
	*To be measured under different bill (Mechanical)	* Not under scope of work
R Electrical Installations	*To be measured under different bill (Electrical)	* Not under scope of work
S Floor, Wall and Ceiling Finishings	Internal Floor Finishes	Detail Internal Floor Finishes
	Internal Floor Finishes	Detail Skirting Finishes
	Internal Wall FInishes	Detail Wall Finishes
	Internal Ceiling Finishes	Detail Internal Ceiling Finishes
	External Finishes	Detail Wall Finishes
	External Finishes	Detail Feature Wall
	Staircase	Detail Staircase (Finishes)
T Glazing	*Not required in the design	*No design provided
U Painting and decorating	*To be measured with finishes	* Details provided under finishes
V Drainage	Apron Ramps and Perimeter Drain (Drain)	Detail Apron, Ramps, Steps And Perimeter Drain (Drain)
W Fencing, Turfing and Planting	*Not required in the design	*No design provided
*Others	Flag Pole (Provisional Item)	Detail Flag Pole

[1] Iznny Ismail: iznny813@perak.uitm.edu.my

Table 3. Comparison of elements of building works between bills of quantities of building works, architectural tender drawings and SMM for office building A

Bills of Quantities	Architectural Tender Drawings	Building Element-SMM
*To be measured under different bill	Preliminaries Item	A Preliminaries
Work Below Lowest Floor Finish	* Not under scope of work	E Piling and Diaphragm Walling
Apron Ramps and Perimeter Drain	Detail Apron, Ramps, Steps And Perimeter Drain (Apron & Ramp)	F Concrete Work
	Detail Apron, Ramps, Steps And Perimeter Drain (Drain)	V Drainage
Frame	* Not under scope of work	F Concrete Work
Upper Floor	* Not under scope of work	F Concrete Work
Staircase	Detail Staircase (Concrete works)	F Concrete Work
	Detail Staircase (Railing)	P Metalwork
	Detail Staircase (Finishes)	S Floor, Wall and Ceiling Finishings
	Detail Apron, Ramps, Steps And Perimeter Drain (Steps)	F Concrete Work
		S Floor, Wall and Ceiling Finishings
Roof	Detail Roof	L Roofing
Roof (flat roof)	Scupper Drain Detail (flat roof)	F Concrete Work
		L Roofing
		K Waterproofing and Asphalt work
External Wall	Detail External & Internal Wall	G Brickwork and Blockwork
	Detail Louvres	P Metalwork
Internal Wall and Partition	Detail External & Internal Wall	G Brickwork and Blockwork
External Doors and Windows	Detail Door	M Woodwork
		P Metalwork
	Detail Window	M Woodwork
		P Metalwork
	Detail Ironmongery	M Woodwork
Internal Doors and Windows	Detail Door	M Woodwork
		P Metalwork
	Detail Window	M Woodwork
		P Metalwork
	Detail Ironmongery	M Woodwork
Internal Floor Finishes	Detail Internal Floor Finishes	S Floor, Wall and Ceiling Finishings
		U Painting and decorating
Internal Wall Finishes	Detail Wall Finishes	S Floor, Wall and Ceiling Finishings
		U Painting and decorating
Internal Ceiling Finishes	Detail Internal Ceiling Finishes	S Floor, Wall and Ceiling Finishings
		U Painting and decorating
Internal Floor Finishes	Detail Skirting Finishes	S Floor, Wall and Ceiling Finishings
		U Painting and decorating
External Finishes	Detail Wall Finishes	S Floor, Wall and Ceiling Finishings
		U Painting and decorating
	Detail Feature Wall	S Floor, Wall and Ceiling Finishings
		U Painting and decorating
Sanitary Fittings	Detail Sanitary Fitting	Q Plumbing and Mechanical Engineering Installations
	Sanitary Fitting Schedule	Q Plumbing and Mechanical Engineering Installations
Cold Water and Sanitary Plumbing	* Not under scope of work	Q Plumbing and Mechanical Engineering Installations
Builders Work in Connection	Detail Ablution	F Concrete Work
		G Brickwork and Blockwork
		K Waterproofing and Asphalt work
		Q Plumbing and Mechanical Engineering Installations
Flag Pole (Provisional Item)	Detail Flag Pole	*Others

Table 4. Synchronized bills of quantities of building works with architectural tender drawings based on the elements of building works for office building A

Bills of Quantities	Architectural Tender Drawings
*To be measured under different bill	Preliminaries Item
Apron Ramps and Perimeter Drain	Detail Apron, Ramps, Steps And Perimeter Drain (Apron & Ramp)
	Detail Apron, Ramps, Steps And Perimeter Drain (Drain)
Staircase	Detail Staircase (Concrete works)
	Detail Staircase (Railing)
	Detail Staircase (Finishes)
	Detail Apron, Ramps, Steps And Perimeter Drain (Steps)
Roof	Detail Roof
Roof (flat roof)	Scupper Drain Detail (flat roof)
External Wall	Detail External & Internal Wall
	Detail Louvres
Internal Wall and Partition	Detail External & Internal Wall
External Doors and Windows	Detail Door
	Detail Window
	Detail Ironmongery
Internal Doors and Windows	Detail Door
	Detail Window
	Detail Ironmongery
Internal Floor Finishes	Detail Internal Floor Finishes
	Detail Skirting Finishes
Internal Wall Finishes	Detail Wall Finishes
Internal Ceiling Finishes	Detail Internal Ceiling Finishes
External Finishes	Detail Feature Wall
Sanitary Fittings	Detail Sanitary Fitting
	Sanitary Fitting Schedule
Builders Work in Connection	Detail Ablution
Flag Pole (Provisional Item)	Detail Flag Pole

Table 5. Synchronized architectural tender drawings with bills of quantities of building works based on the elements of building work for office building A

Architectural Tender Drawings	Bills of Quantities	Clarification
Preliminaries Item	*To be measured under different bill	Drawings for preliminaries item provide in architectural tender drawings set. Information inclusive of hording material, sign board, and temporary office
Detail Apron, Ramps, Steps And Perimeter Drain	Apron Ramps and Perimeter Drain	The steps detail should be in Staircase drawings.
Detail Staircase	Staircase	The staircase detail should indicate of material used whether it is concrete works, woodwork or metal work; finishes; and railing.
Detail Apron, Ramps, Steps And Perimeter Drain (Steps)	Staircase	The detail should be separated and titled under steps detail.
Detail Roof	Roof	The detail pertaining roof should indicate the type of roof . For example slate , tiled or concrete flat roof.
Scupper Drain Detail (flat roof)	Roof (flat roof)	Scupper Drain detail should be inclusive in roof detail.
Detail External & Internal Wall	External Wall Internal Wall and Partition	Indication of Internal wall and external can be done by just indicating ust ‘wall’ . This is because identification can be varies by different QS.
Detail Louvres	External Wall	The louvres detail should be in External and Internal wall
Detail Door	External Doors and Windows Internal Doors and Windows	The door, window, and ironmongery is ideally separated for easier quantification.
Detail Window		
Detail Ironmongery		

Table 5 (continued)

Architectural Tender Drawings	**Bills of Quantities**	Clarification
Detail Internal Floor Finishes	Internal Floor Finishes	No modification
Detail Skirting Finishes		
Detail Wall Finishes	Internal Wall Finishes	No Modification
Detail Internal Ceiling Finishes	Internal Ceiling Finishes	No Modification
Detail Wall Finishes	External Finishes	No Modification
Detail Feature Wall		
Detail Sanitary Fitting	Sanitary Fittings	No Modification
Sanitary Fitting Schedule		
Detail Ablution	Builders Work in Connection	No Modification
Detail Flag Pole	Flag Pole (Provisional Item)	No Modification

Table 6. Recommended model of Synchronized Architectural Tender Drawings and Bills of Quantities of Building Works Based on the Elements of Building Works

Architectural Tender Drawings	**Bills of Quantities**	Clarification
Preliminaries Item	*To be measured under different bill	Information of hording material, sign board, and temporary office
Detail Apron, Ramps, and Perimeter Drain	Apron Ramps and Perimeter Drain	Indicate the location in the proposed building
Detail Staircase	Staircase	Indicate location of staircase and steps, with specifying the material, railing , finishes
Detail Roof	Roof	Indicate the type of roof, inclusive Scupper drain information
Detail External & Internal Wall	External Wall Internal Wall and Partition	Indication of type of wall, example brickwork, and partition wall
Detail Louvres	External Wall	Indicate the location and material
Detail Door	External Doors and Windows Internal Doors and Windows	The door, window, and ironmongery is ideally separated for easier quantification
Detail Window		
Detail Ironmongery		
Detail Internal Floor Finishes	Internal Floor Finishes	Indicate floor and skirting finishes
Detail Skirting Finishes		
Detail Wall Finishes	Internal Wall Finishes	Indicate wall finishes
Detail Internal Ceiling Finishes	Internal Ceiling Finishes	Indicate internal ceiling finishes
Detail External Ceiling Finishes	External Finishes	Indicate external ceiling finishes
Detail Wall Finishes	External Finishes	Indicate Wall Finishes
Detail Feature Wall Finishes		
Detail Sanitary Fitting	Sanitary Fittings	Indicate sanitary fittings
Sanitary Fitting Schedule		
Detail Ablution	Builders Work in Connection	Indicate detail that contain the information of material used, sanitary fitting, and finishes
Detail Flag Pole	Flag Pole (Provisional Item)	Indicate detail that contains information of material used and finishes.

5 Conclusion and recommendation

The purpose of the study is to have documents mutually explanatory of each other in the case of any discrepancy. Love et al. [16] identified that the use of 'time boxing' practices to meet schedule demands may contribute to audits, reviews and verifications being omitted, thus allowing design errors to materialize during construction. Therefore, the proactive measure that found under this study is to simplify coordination even though consultants had limited time to revise documents.

The study found out that the discrepancies of documents can be minimized by synchronizing drawings and documents. The study by Jha and Iyer [18] analysed that influencing coordination activities that related to this study, are that preparation of a project quality plan in line with contract specifications and arrangement of required inputs like drawings, specifications and technical details. Twort and Rees [19] suggested that specification for workmanship and materials of civil engineering works is by listing trades in the ICE Standard method of billing quantities (CESMM) in order which construction normally proceeds, to help drafting and make sure matters are not missed. This similar method has drawn the comparison process between building elements of Standard Method of Measurement, building works elements in the bills of quantities and architectural drawings in table 5. The required architectural detailing is identified based on building elements that already stated

in the Standard Method of Measurement (SMM). Finally, as shown in table 6, the recommended method to produce 2-D architectural drawings is based on elements of building works that the bills of quantities in used. However, the addition of other detail will be based on design requirements. For example the usage the element demolition, architectural drawings will be provided accordingly.

Love et al. [16] suggested that error prevention should be viewed as a continuous process, rather than a product of certain activities or behaviors, as it involves an exploration of people, organisations and project systems. Thus, the recommended model can be taken into further account by diversifying the unit analysis into implementation of multiple projects for observation contrasting patterns in data, considering the design requirement and complexity.

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