Building Information Modelling (BIM) as an UAV Information Processor for Generating an ‘As Built Drawing’

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Abstract. The heritage building is a valuable asset to humans and countries due to the grandeur symbolization and the dignity representation of a country. However, the dramatic changes on the historical building physical feature has been documented poorly. Subsequently, the depletion of the building information has making the maintenance works intricate. On site surveying might difficult due to the safety issue that putting manpower into risky circumstances. Advance technology may allow many to obtain information using aid of remote sensing, photogrammetry, geographic information system (GIS) and 3D laser scanning. The projection of the As Built Drawing might possible without utilisation of BIM as an analyser for the raw information congregated. Thus, the objective of this research is to develop an ‘As Built Drawing’ for heritage building using Building Information Modelling (BIM) as an information processor. The methodology involved the Unmanned Aerial Vehicle (UAV) application and Terrestrial Laser Scanner, photogrammetry image then been analysed using BIM. The identification of design properties of heritage building was obtained which consisted of architectural properties and structural properties. Therefore, the development of ‘As Built Drawing’ will be produced completely using BIM and in the other hand solving the problem on facilities management on the historical building.

1 Building Modelling Information (BIM) as an Information Processor for Generating an ‘As Built Drawing’

The importance of ‘As Built Drawing’ (ABD) in present day creates adequate task control and fundamental action plan for heritage building. Handling a construction mission involves the usage physical information inclusive of architecture, engineering, production, and operation (AECO) raw information [5]. Due to the changes of time, depletion of information on existing building are one of the hurdle the maintenance
work delayed for majority vast of the conservation projects. Nowadays, BIM Software provides an extensive data extraction that covers from the actual constructing strategies all through until the optimum life cycle span of the building. BIM software layout information shields the architectural and structural, that crucially required to assist the photogrammetry data rose from the unmanned on site building surveying [2], [3]. Despite the accuracy of BIM projecting the measurement of the building, the precision properties of BIM Software were highly acclaimed by architects or engineers, that revving continuously to be implement when the freshness of the data contained can be synchronized with the continued building system. A BIM is thus prone to being ‘blind and deaf’ to ongoing construction processes, whilst an ‘as-built’ version can extra reliably and usefully assist information exchange and decision-making in the course of the project life-cycle [1], [2] & [4]. Conceptual framework highlighting the theoretical perspective of bridging BIM and building, which connecting the implying records contained in BIM with bodily constructing techniques to make BIM reflecting actual-lifestyles situations. Such an instrument ought to help summarize information work in a building, which has evolved in a piecemeal fashion to date. It is able to additionally make it viable to theorize a constructing as a cluster of data [3], [5]; currently accomplished through distinctive information and communication technologies (ICTs), has virtually become a general research question at the fore of information management for decision-making in present-day project management and major conservation project. Similarly, an integrated conceptual framework could assist structure strategic development directions in this area, allowing future research on bridging BIM and building to proceed on a greater stable footing [4].

2 Research Methodology

The process of gathering the data ignited with Stage 1: Planning, which comprised of planning the location of the study. Masjid Alwi in Kangar was built in 1931, considering it is a heritage building that required a preservation act in Malaysia. Stage 2: Data Collection portrayed the Unmanned Aerial Vehicle (UAV) and Terrestrial Laser Scanner (TLS) application flight take off to provide a photogrammetry data. Then, Stage 3: Data Extraction and Processing which is the crucial of this research where the software used to process the photogrammetry image for this study is Pix4D Mapper, Civil Design Software, ArcMap and AutoCAD 2014 software and BIM Software in order to achieve the objective. Later the output presented in Stage 4: Results. Fig.1 explained the flow of the research.
3 Results and Discussion

In BIM Processing Code of Conduct; the initial processing, Pix4Dmapper first computes key points on the images. It uses these key points to find matches between the images. From these initial matches, the software runs an Automatic Aerial Triangulation (AAT) and Bundle Block Adjustment (BBA). If initial processing has already been done and is restarted, the software uses the existing key points and matches and starts the AAT and BBA. If from one processing to another the project type has changed, additional matches might be computed as the matching procedure is different for each project type. Before proceed using TLS scanner to scan the internal and external of Alwi Mosque, traversing is a must in order to determine the coordinate and station point of the scanner. There are at least 28 points that had been marked for the external site of the mosque. A total of 32 points also had been marked for the internal site of the mosque. Most of the marking point indicate the scanner place throughout the scanning process.

An Automatic by default one ground sampling distance is selected. One can also easily change the resolution to multiples of the ground sampling. Use Noise Filtering: The generation of the Point Cloud can lead to noisy and erroneous points. The noise filtering corrects the altitude of these points with the median altitude of the neighbouring points. Geo - reference file obtained. For most projects, the Topographic Elevation is split into several tiles and one geo – reference file is generated per tile. The method used for Raster Topographic Elevation generation. The method will affect the processing time and the quality of the results.
Later, the Topcon GLS 2000 use its latest point cloud processing software named Magnet Collage. All the related point cloud data capture during the scanning process has been transferred into the software. The data capture has been categorized into three differences site: - internal scanning, external scanning and combine both internal and external. Combination of internal and external scanning data using Terrestrial Laser Scanner has produces astounding 3D mesh model of Masjid Alwi. However, there are some modifications needed to restructure the pillars, windows, doors also the inside structure of the mosque. So, the point cloud has been export into the Autodesk Revit for BIM modifications. Using Revit can alter and develop much better 3D model for Masjid Alwi (See Fig.2). After finishing the modifications, the as-built drawing layout plan can be produced with detail dimensions of Masjid Alwi. The final output of this project is the integration of both unmanned and scanner data of Alwi Mosque in the form of 3D point cloud format. The as-built drawing of Alwi Mosque also has been produced in order to achieve the objective of this research.

![Fig.2 3D Model Using BIM Software.](image)

Existing 3D model input provides information on the Alwi Mosque built in 1931, with wall thickness of 37.50 centimeters and enlarged the building to the right of the mosque with a wall thickness of 25.00 and 30.00 centimeters. The thickness wall of mosque, Brickwall Set A is 37.50 centimeter, Brickwall Set B are 30.00 centimeter and a Brickwall Set B are 25.00 centimeter. The architectural design properties and physical changes of Masjid Alwi recorded and tabulated in Table. 1.
| BIM Software Processing (Physical Changes) | Architecture | Remarks | Structural | Remarks |
|------------------------------------------|--------------|---------|------------|---------|
| Brick wall                               | /            | The types of brick wall has a significant changes which portray an evolution of Middle Eastern brick wall masonry design influence to Malaysia | / | Difference types of dimension and sizing of the brick wall, that differs from the Prayers Area, Ceremony Area, and Utilities Room |
| Column                                   | /            | The pillar used Roman Style, required preservation of the column style, to maintain and match the original column types for conservation works | / | Deterioration in Roman pillar in Open Area, and Toilets (Wet Area) may cause structurally sound for the function ability of the Masjid |
| Roof                                     | /            | Minor deterioration of dome structure, making the architectural prestige value decreased | / | Open Area Roof exposed to windy weather may causing fatality to the occupants. |
| Window                                   | /            | Obsolete design of the Window may cause difficulties to find the finishing accessories in current market | X | Physical Changes subjected to not affecting structural properties |
| Door                                      | /            | Obsolete design of Door may causing door parts required custom design | X | Physical Changes subjected to not affecting structural properties |

The mosque is constructed of 33 concrete columns such as 16 round columns is 32 cm in diameter and 17 rectangular columns is 8 columns in size (30 X 30 cm), 3 columns in size (50 X 50 cm), 3 columns (50 X 37 cm), 2 numbers of columns (15 X 25 cm) and 1 column (15 X 15 cm). In addition, there are 117 roman column used at the entrance and for the corridor.

The ‘As Built Drawing’ was successfully generated using BIM Software that has optimum usage in maintenance work of the heritage building. The drawing help local agencies such as the Fire Department, Construction Team, and Building Surveyors to plan a framework to tackle issues in heritage building to ensure the novelty still be
preserved, the function ability of the building, and business generation from the heritage building will be safeguarded.

![Fig.3 As Built Drawing Process by BIM Software](image)

4 Conclusion

Processing a photogrammetry data gathered from the UAV flights were impossible to deliver the widespread ‘As Built Drawing’ deprived of the deployment of BIM Software as the main instrument and novel analyser to scan the heritage building holistically.

References

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