INTISARI

Penerapan *Building Information Modelling* (BIM) di Indonesia pada era konstruksi modern masih relatif terbatas. Pada umumnya BIM hanya digunakan pada proyek-proyek besar dan pada tahapan pra konstruksi. Namun, untuk melakukan proses evaluasi konstruksi secara menyeluruh membutuhkan BIM dari tahap perencanaan (*design*) hingga pemeliharaan asset. BIM pada seluruh tahapan konstruksi harus saling terintegrasi untuk memastikan kualitas dan keakuratan hasil implementasi BIM pada proyek konstruksi. Hasil pembangunan fisik yang telah dilakukan dapat dinilai dari data BIM pada tahap perencanaan dan pasca konstruksi. BIM pada tahap perencanaan (BIM *design*) dibuat berdasarkan data rencana (*shop drawing*), sedangkan BIM pasca konstruksi (BIM *as-built*) dibuat berdasarkan data objek terbangun (*as-built*) dan telah dilakukan verifikasi lapangan. Posisi penelitian ini berada pada tahap pengecekan internal hasil kerja oleh kontraktor pasca konstruksi sebelum diserahkan dan diperiksa oleh Konsultan Pengawas dan *Owner.* Penelitian ini dilakukan untuk mengevaluasi konstruksi fisik di lapangan (secara geometrik dan semantik) melalui perbandingan BIM *design* dan BIM *as-built*.

Study kasus penelitian ini adalah proyek konstruksi pembangunan *overpass* jalan tol Kayu Agung-Palembang-Betung (KAPB) PT.Waskita Karya. Lokasi ini dipilih karena proses pembanguan konstruksi pada proyek ini masih berlangsung, sehingga sesuai dengan fokus penelitian terhadap evaluasi konstruksi dengan membandingkan BIM *design* dan BIM *as-built*. Proses evaluasi dilakukan dengan terlebih dahulu memodelkan masing-masing BIM. BIM *design* dibuat berdasarkan data perencanaan berupa *shop drawing* dan data topografi awal lokasi konstruksi. Sedangkan BIM *as-built* dibuat berdasarkan kombinasi data foto udara, foto terrestrial, dan pengukuran lapangan. Data fotogrametri diproses secara SfM – MVS untuk menghasilkan data *point cloud*, kemudian dilanjutkan dengan proses pemodelan BIM *as-built*. Pemodelan BIM *design* dan BIM *as-built* menghasilkan bentuk struktur jembatan dan area *main road* beserta kelengkapan fungsional lainnya. Tingkat akurasi pada BIM *as-built* diperoleh berdasarkan kategori (*Level of Accuracy)* LOA dari RMSE hasil verifikasi lapangan terhadap ukuran model. Kelengkapan informasi yang ditampilkan pada BIM *as-built* disesuaikan dengan informasi kenampakan foto objek terbangun dan laporan progress pekerjaan proyek. Hasil BIM *design* dan BIM *as-built* dievaluasi secara geometrik melalui perbandingan dimensi, posisi serta bentuk model. Selain itu, evaluasi juga dilakukan pada aspek semantik melalui perbandingan kelengkapan informasi dari data rencana dan data aktual pembangunan. *Level of Detail* (LoD) dan *Level of Information* (LOI) BIM dari setiap model BIM kemudian ditentukan berdasarkan hasil evaluasi geometrik dan semantik.

Hasil evaluasi menunjukkan bahwa terdapat ketidaksesuaian pada aspek geometrik yaitu ketelitian perbedaan dimensi sebesar 2,4 cm dan ketelitian perbedaan posisi sebesar 10 cm antara BIM *design* dan BIM *as-built*. Sementara itu, evaluasi ketelitian hasil pemodelan BIM *as-built* menghasilkan nilai 1,8cm. Hal ini mengindikasikan bahwa ketelitian perbandingan dimensi lebih rendah daripada ketelitian BIM *as-built.* Ketidaksesuaian aspek geometrik lainnya yaitu kompleksitas elemen struktur secara bentuk visual pada BIM *as-built* memiliki kemiripan sekitar 80% dengan BIM *design*. Hasil evaluasi pada aspek semantik menunjukkan BIM *as-built* memiliki kualitas informasi yang lebih lengkap dan terperinci dibandingkan dengan hasil BIM *design*. Hasil LoD dan LOI berdasarkan evaluasi geometrik dan semantik menunjukkan bahwa LoD BIM *design* dan BIM *as-built* berada pada level yang sama, sedangkan LOI pada BIM *as-built* lebih tinggi 2 tingkat dari BIM *design*.

Kata kunci: BIM, *Shop Drawing*, Data Fotogrametri, LoD, LOI

ABSTRACT

The application of Building Information Modelling (BIM) in Indonesia modern construction era is still relatively limited. In general, BIM is only used in large projects and at the pre-construction stage. However, to conduct a comprehensive construction evaluation process requires BIM from the planning (design) stage to asset maintenance. BIM at all stages of construction must be integrated to ensure the quality and accuracy of the results of BIM implementation in construction projects. The results of physical development that has been carried out can be assessed from BIM data at the planning and post-construction stages. BIM at the planning stage (BIM design) is made based on plan data (shop drawings), while post-construction BIM (BIM as-built) is made based on built object data (as-built) and has been field verified. The position of this research is at the stage of internal checking of work results by post-construction contractors before being submitted and checked by the Supervisory Consultant and Owner. This research was conducted to evaluate physical construction in the field (geometrically and semantically) through comparison of BIM design and BIM as-built.

The case study of this research is the construction project of the Kayu Agung-Palembang-Betung (KAPB) toll road overpass construction of PT.Waskita Karya. This location was chosen because the construction process on this project is still ongoing, so it is in accordance with the research focus on construction evaluation by comparing BIM design and BIM as-built. The evaluation process is carried out by first modeling each BIM. BIM design is made based on planning data in the form of shop drawings and initial topographic data of the construction site. The as-built BIM was based on a combination of aerial photography, terrestrial photography and field measurement data. Photogrammetric data is processed by SfM - MVS to produce point cloud data, then continued with the as-built BIM modeling process. Modeling of BIM design and BIM as-built produces the shape of the bridge structure and main road area along with other functional completeness. The level of accuracy in the as-built BIM is obtained based on the LOA (Level of Accuracy) category from the RMSE of the field verification results against the size of the model. The completeness of the information displayed on the as-built BIM is adjusted to the information on the appearance of the built object photos and project work progress reports. The results of BIM design and BIM as-built are evaluated geometrically through comparison of dimensions, position and shape of the model. In addition, evaluation was also carried out on the semantic aspect through comparison of the completeness of information from the plan data and actual construction data. The BIM Level of Detail (LoD) and Level of Information (LOI) of each BIM model are then determined based on the results of geometric and semantic evaluations.

The evaluation results show that there are discrepancies in geometric aspects, namely the accuracy of dimensional differences of 2.4 cm and the accuracy of position differences of 10 cm between BIM design and BIM as-built. Meanwhile, the evaluation of the accuracy of the as-built BIM modeling results resulted in a value of 1.8cm. This indicates that the accuracy of the dimensional comparison is lower than the accuracy of the as-built BIM. Another geometric aspect discrepancy is the complexity of structural elements in the visual form in the as-built BIM, which is about 80% similar to the BIM design. Evaluation results on semantic aspects show that the as-built BIM has more complete and detailed information quality compared to the BIM design results. The LoD and LOI results based on geometric and semantic evaluation show that the LoD of BIM design and BIM as-built are at the same level, while the LOI in BIM as-built is 2 levels higher than BIM design.

Keywords: BIM, *Shop Drawing*, Photogrametry Data, LoD, LOI