INTISARI

Sistem pemeliharaan jaringan air bersih dan air limbah pada gedung bertingkat memiliki kompleksitas tinggi karena terdiri dari banyak elemen yang saling terhubung sehingga kerusakan sering kali sulit terdeteksi. Meskipun demikian, pemeliharaan jaringan perpipaan ini sangat penting untuk menunjang kinerja bangunan. Kendala saat ini adalah belum tersedianya digitalisasi data kondisi jaringan perpipaan sehingga berpotensi menghambat respon terhadap kerusakan, sebagaimana dialami oleh Gedung *Smart and Green Learning Center* (SGLC), Fakultas Teknik, Universitas Gadjah Mada (UGM) yang menjadi objek penelitian ini. Oleh karena itu, penelitian ini bertujuan mengembangkan model penilaian kondisi dan membangun sistem pemeliharaan dengan mengintegrasikan data penilaian kondisi ke dalam platform *Building Information Modelling* (BIM).

Model penilaian kondisi dikembangkan dengan pendekatan metode *Analytical Hierarchy Process* (AHP) untuk memperoleh bobot prioritas setiap bagian jaringan, yang kemudian diintegrasikan ke dalam model 3D BIM. Proses penelitian meliputi pengumpulan data perpipaan dan pemodelan 3D, wawancara dengan pengelola fasilitas hotel dan rumah sakit untuk mendapatkan hierarki jaringan, inventarisasi kerusakan, dan bobot jaringan menggunakan AHP, dan penyusunan data pemeliharaan. Seluruh data tersebut kemudian diintegrasikan ke dalam model 3D BIM melalui Dynamo agar kondisi jaringan dapat diamati secara visual.

Hasil penelitian mencakup struktur hierarki jaringan, inventarisasi kerusakan perpipaan, bobot jaringan perpipaan, nilai kondisi jaringan, dan model 3D BIM. Dengan metode AHP, diperoleh bobot jaringan perpipaan di Gedung SGLC 12 lantai sisi utara sebesar 0,833, sedangkan bobot di Gedung SGLC 3 lantai sisi selatan sebesar 0,167 yang menunjukkan gedung utara perlu lebih diprioritaskan pemeliharaannya daripada gedung selatan. Dengan menggunakan data kerusakan dan bobot tersebut, diperoleh indeks kondisi jaringan perpipaan Gedung SGLC sebesar 99,47 dari skala tertinggi 100, yang mengindikasikan kondisi baik. Kondisi perpipaan tersebut divisualisasikan dengan warna pada BIM untuk mempermudah pemantauan dan menjadi dasar pengambilan keputusan tindakan pemeliharaan. Model penilaian ini berkontribusi dalam peningkatan efektifitas dan efisiensi pemeliharaan sistem perpipaan gedung bertingkat pada umumnya, terutama pada Gedung SGLC serta mendukung transformasi sistem manajemen pemeliharaan gedung berbasis digital melalui integrasi AHP dan BIM.

KATA KUNCI: Penilaian kondisi; perpipaan; pemeliharaan; *Analytical Hierarchy Process* (AHP); *Building Information Modelling* (BIM)

ABSTRACT

The maintenance system for clean water and black water pipelines in high-rise buildings presents a high level of complexity due to the numerous interconnected components, which often makes damage difficult to detect. Nevertheless, proper maintenance of these piping systems is crucial to support overall building performance. A key challenge currently faced is the lack of digitalized condition data, which can hinder timely responses to failures, a situation exemplified by the *Smart and Green Learning Center* (SGLC) Building, Faculty of Engineering, Universitas Gadjah Mada (UGM), the subject of this study. Therefore, this research aims to develop a condition assessment model and establish a maintenance management system by integrating condition assessment data into a Building Information Modeling (BIM) platform.

The condition assessment model was developed using the Analytical Hierarchy Process (AHP) method to determine the weighted priority of each pipeline section, which was then integrated into a 3D BIM model. The research process involved: collecting pipeline data and creating a 3D model; conducting interviews with facility managers of hotels and hospitals to define network hierarchy, damage inventory, and pipeline weightings using AHP; and compiling maintenance-related data. All data were integrated into the 3D BIM model using Dynamo to allow visual observation of pipeline conditions.

The results include a hierarchical structure of the pipeline network, damage inventory, component weightings, condition scores, and a 3D BIM model embedded with maintenance data. Using the AHP method, the piping network in the 12-story north wing of the SGLC Building obtained a priority weight of 0.833, while the 3-story south wing received a weight of 0.167, indicating that maintenance efforts should prioritize the north wing over the south. Based on damage data and these weights, the piping network condition index for the SGLC Building was calculated at 99.47 on a maximum scale of 100, signifying a good overall condition. The piping network status was visualized through color coding within the BIM environment to facilitate monitoring and serve as a basis for maintenance decision-making. This assessment model contributes to enhancing the effectiveness and efficiency of piping system maintenance in high-rise buildings, particularly for the SGLC Building, while also supporting the digital transformation of building maintenance management through the integration of AHP and BIM.

KEYWORDS: Condition assessment; piping network; manintenance; Analytical Hierarchy Process (AHP); Building Information Modelling (BIM)