

Korosi pada struktur baja merupakan salah satu penyebab utama penurunan kapasitas dan umur layan bangunan industri, khususnya pada bangunan dome penyimpanan batu bara yang beroperasi di lingkungan pesisir dengan tingkat korosivitas tinggi. Degradasi akibat korosi menyebabkan kehilangan ketebalan elemen struktur yang berpotensi menurunkan kinerja dan keandalan bangunan. Penelitian mengenai penilaian korosi pada struktur baja telah berkembang dengan memanfaatkan berbagai metode, termasuk inspeksi visual, *Non-Destructive Testing* (NDT), dan analisis numerik. Namun demikian, sebagian besar penelitian masih mengevaluasi metode-metode tersebut secara terpisah, sehingga belum memberikan gambaran yang komprehensif mengenai hubungan antara kondisi aktual struktur, degradasi elemen, kapasitas struktur, dan sisa umur layan. Oleh karena itu, diperlukan suatu pendekatan yang mengintegrasikan aspek-aspek tersebut untuk mendukung pengambilan keputusan pemeliharaan secara lebih efektif.

Penelitian ini mengkaji kondisi eksisting struktur baja melalui inspeksi visual berdasarkan ASTM D610, dokumentasi menggunakan drone, serta pengujian *Non-Destructive Testing* menggunakan *Ultrasonic Thickness Gauge* dan *Coating Thickness Gauge*. Analisis meliputi pemetaan *Integrated Corrosion Grade* (ICG), evaluasi kehilangan ketebalan, analisis kapasitas struktur menggunakan SAP2000, serta estimasi sisa umur berdasarkan kehilangan ketebalan, kapasitas struktur, dan metode *Remaining Useful Life* (RUL) sesuai faktor modifikasi ISO 15686.

Hasil penelitian menunjukkan bahwa sebagian besar elemen struktur berada pada kategori korosi ringan hingga sedang, sedangkan elemen diagonal (P-3) mengalami degradasi paling tinggi. Kehilangan ketebalan maksimum terjadi pada elemen P-3 sebesar 1,59 mm (25,77%). Estimasi sisa umur berdasarkan kehilangan ketebalan menunjukkan sisa umur elemen berkisar 10–20 tahun, sedangkan evaluasi menggunakan SAP2000 menunjukkan struktur mulai memasuki kondisi kritis pada tahun ke-16 dan semua elemen mulai kritis pada tahun ke-23 akibat peningkatan *PMM ratio*, jumlah elemen *overstress*, dan lendutan. Metode RUL berdasarkan ISO 15686 menghasilkan estimasi sisa umur layan bangunan sekitar 8 tahun. Berdasarkan hasil tersebut, direkomendasikan penerapan pemeliharaan berbasis kondisi (*condition-based maintenance*), inspeksi berkala, dan sistem *coating* yang sesuai untuk mempertahankan keandalan serta memperpanjang umur layan struktur.

**Kata kunci:** korosi; kehilangan ketebalan; laju korosi; pemeriksaan non-destruktif; sisa umur pakai; struktur baja dome

## ABSTRACT

Corrosion of steel structures is one of the primary causes of reduced structural capacity and service life in industrial facilities, particularly arched steel roof structures of coal storage buildings operating in highly corrosive coastal environments. Corrosion-induced degradation leads to thickness loss, which adversely affects structural performance and reliability. Research on corrosion assessment has advanced through various approaches, including visual inspection, Non-Destructive Testing, and numerical analysis. However, these methods are generally applied independently, providing a limited understanding of the relationship between the actual structural condition, thickness degradation, structural capacity, and remaining service life. Therefore, an integrated assessment approach is required to support more effective condition-based maintenance decision-making.

This study employed visual inspection based on ASTM D610, drone-assisted documentation, and Non-Destructive Testing using an Ultrasonic Thickness Gauge and a Coating Thickness Gauge. The collected data were analyzed through Integrated Corrosion Grade (ICG) mapping, thickness loss evaluation, structural capacity assessment using SAP2000, and remaining service life estimation based on thickness degradation, structural capacity, and Remaining Useful Life (RUL) method incorporating the ISO 15686 modification factors.

The results indicate that most structural members exhibited light to moderate corrosion, whereas the diagonal member (P-3) experienced the most severe degradation. The maximum thickness loss was 1.59 mm (25.77%) in member P-3. Thickness loss analysis predicted a remaining service life of 10–20 years for the affected members, while the SAP2000 analysis indicated that the structure would reach its initial critical condition in year 16, with all members becoming critical by year 23 due to increasing PMM ratios, the number of overstressed members, and structural deflections. The ISO 15686-based RUL assessment estimated an overall remaining service life of approximately 8 years. These findings support the implementation of condition-based maintenance, periodic inspections, and appropriate protective coating systems to maintain structural reliability and extend the service life of steel structures.

**Keywords:** corrosion; thickness loss; corrosion rate; non-destructive inspection; remaining service life; steel dome structure