

ABSTRAK

Penelitian ini bertujuan untuk menganalisis mekanisme kegagalan struktur *boom lattice crawler crane Sumitomo LS-118RM* pada proses pengangkatan blok kapal menggunakan metode elemen hingga (*finite element method*), serta mengevaluasi pengaruh modifikasi struktur pada daerah kritis *boom base*. Kegagalan yang dianalisis terjadi pada bagian *main chord* bawah di daerah *boom base*, sekitar 3,80 m dari *boom foot* dan berada di sekitar sambungan *bracing*. Analisis dilakukan dengan memodelkan struktur *boom* menggunakan perangkat lunak Autodesk Inventor melalui simulasi pembebanan statik. Parameter yang dianalisis meliputi *equivalent (von mises) stress*, total *deformation*, dan *safety factor*. Hasil observasi menunjukkan bahwa mekanisme kegagalan diawali oleh deformasi lokal pada dinding *main chord* yang kemudian berkembang menjadi deformasi plastis, perubahan bentuk penampang, terbentuknya retak, dan berakhir pada patahnya *main chord*. Hasil simulasi FEM pada kondisi existing menunjukkan *equivalent stress* maksimum sebesar 17.468 MPa yang terkonsentrasi pada daerah *boom base*, sedangkan total deformasi maksimum sebesar 1,307 mm terjadi pada ujung *boom*. Nilai *safety factor* minimum sebesar 0,010 menunjukkan bahwa daerah *boom base* merupakan bagian struktur yang paling kritis. Untuk meningkatkan respons struktur, dilakukan *redesign* dengan penambahan *gusset plate* pada daerah *boom base* sebanyak 27 variasi. Model M26, dengan sudut *boom* 70°, ketebalan *gusset plate* 15 mm, dan lokasi pemasangan *gusset B*, menghasilkan *equivalent stress* sebesar 12.783 MPa, total deformasi sebesar 1,243 mm, dan *safety factor* minimum sebesar 0,020. Dibandingkan dengan kondisi existing, *redesign* M26 menghasilkan penurunan *equivalent stress* sebesar 26,8%, penurunan total deformasi sebesar 4,9%, dan peningkatan *safety factor* sebesar 100%. Hasil tersebut menunjukkan bahwa modifikasi pada daerah *boom base* melalui penambahan *gusset plate* memengaruhi distribusi pembebanan dan respon struktur berdasarkan hasil simulasi FEM.

Kata kunci: *Boom lattice crawler crane*, Sumitomo LS-118RM, kegagalan struktur, metode elemen hingga, *gusset plate*.

ABSTRACT

This study aims to analyze the failure mechanism of the boom structure of a Sumitomo LS-118RM lattice crawler crane during ship block lifting using the Finite Element Method (FEM), as well as to evaluate the effect of structural modification in the critical boom base area. The failure analyzed occurred in the lower main chord at the boom base, approximately 3.80 m from the boom foot and near the bracing connection. The analysis was conducted by modeling the boom structure using Autodesk Inventor and ANSYS Workbench through static loading simulation. The analyzed parameters included equivalent (von Mises) stress, total deformation, and safety factor. Field observations indicated that the failure mechanism began with local denting of the main chord wall, which developed into plastic deformation, cross-sectional distortion, crack formation, and eventually main chord fracture. The FEM simulation results for the existing condition showed a maximum equivalent stress of 17.468 MPa concentrated in the boom base area, while the maximum total deformation of 1.307 mm occurred at the boom tip. The minimum safety factor was 0.010, indicating that the boom base was the most critical structural area. To improve the structural response, a redesign was conducted by adding gusset plates to the boom base area with 27 design variations. Model M26, consisting of a 70° boom angle, a 15 mm gusset plate thickness, and gusset location B, resulted in an equivalent stress of 12.783 MPa, a total deformation of 1.243 mm, and a minimum safety factor of 0.020. Compared with the existing condition, the M26 redesign resulted in a 26.8% reduction in equivalent stress, a 4.9% reduction in total deformation, and a 100% increase in the safety factor. These results indicate that modification of the boom base area through the addition of a gusset plate affects the load distribution and structural response based on the FEM simulation results.

Keywords: *Lattice crawler crane boom, Sumitomo LS-118RM, structural failure, finite element method, gusset plate.*