TESIS

STUDI EKSPERIMENTAL PERILAKU BAJA KASTELA TERHADAP *MONOTONIC LOAD* DAN *REPEATED CYCLIC LOAD*

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ABSTRAK

STUDI EKSPERIMENTAL PERILAKU BAJA KASTELA TERHADAP MONOTONIC LOAD DAN REPEATED CYCLIC LOAD

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Jembatan menerima beban berulang akibat lalu lintas kendaraan yang berpotensi menyebabkan degradasi struktural progresif. Baja kastela, sebagai alternatif inovatif terhadap profil konvensional, menawarkan efisiensi material melalui peningkatan kapasitas lentur tanpa penambahan berat. Namun, perilakunya di bawah kondisi repeated cyclic load yang merepresentasikan beban aktual jembatan belum terdokumentasi secara komprehensif. Penelitian ini bertujuan mengkaji respons struktural baja kastela terhadap pembebanan monotonic dan repeated cyclic load melalui pendekatan eksperimental. Pengujian dilakukan dengan metode pembebanan bertahap pada spesimen baja kastela untuk menganalisis kapasitas beban ultimit, degradasi kekakuan, daktilitas, dan kapasitas disipasi energi. Hasil pengujian menunjukkan bahwa beban ultimit baja kastela mencapai 59,72 kN pada siklus ke-8, dengan kekakuan awal sebesar 4,60 kN/mm yang mengalami degradasi progresif hingga 1,50 kN/mm pada siklus akhir, atau menurun sebesar 67,43%. Nilai daktilitas sebesar 4,34 mengindikasikan kemampuan deformasi plastis yang memadai, sementara total energi yang terdisipasi selama pengujian mencapai 1.631,57 Joule. Dibandingkan dengan pembebanan monotonic, baja kastela pada kondisi repeated cyclic menunjukkan beban leleh dan beban ultimit yang lebih tinggi, namun daktilitas yang sedikit lebih rendah akibat pengaruh riwayat pembebanan berulang. Secara keseluruhan, baja kastela memperlihatkan perilaku struktural yang stabil dan daktail, menjadikannya material yang potensial untuk aplikasi struktur jembatan.

Kata kunci: baja kastela, repeated cyclic load, degradasi kekakuan, daktilitas, disipasi energi

ABSTRACT

EXPERIMENTAL STUDY ON THE BEHAVIOR OF CASTELLATED STEEL BEAMS UNDER MONOTONIC LOAD AND REPEATED CYCLIC LOAD

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Bridges are subjected to repeated loading from vehicular traffic, which may induce progressive structural degradation. Castellated steel, as an innovative alternative to conventional profiles, offers material efficiency by enhancing flexural capacity without additional weight. However, its behavior under repeated cyclic load conditions representative of actual bridge loading has not been comprehensively documented. This study aims to investigate the structural response of castellated steel beams under monotonic and repeated cyclic loading through an experimental approach. Testing was conducted using incremental loading on castellated steel specimens to analyze ultimate load capacity, stiffness degradation, ductility, and energy dissipation capacity. Results indicate that the ultimate load of the castellated steel beam reached 59.72 kN at the 8th loading cycle, with an initial stiffness of 4.60 kN/mm that progressively degraded to 1.50 kN/mm at the final cycle, representing a reduction of 67.43%. A ductility value of 4.34 indicates adequate plastic deformation capacity, while the total energy dissipated throughout the test reached 1,631.57 Joules. Compared to monotonic loading, the castellated steel beam under repeated cyclic conditions exhibited higher yield and ultimate loads, yet slightly lower ductility due to the influence of cyclic loading history. Overall, the castellated steel beam demonstrated stable and ductile structural behavior, establishing it as a promising material for bridge structure applications.

Keywords: *castellated steel beam, repeated cyclic load, stiffness degradation, ductility, energy dissipation*