INTISARI

Peredam jembatan efektif dalam mengurangi percepatan struktur selama gempa. Namun, peredam konvensional sering kali tidak praktis dan menggunakan material yang tidak ramah lingkungan, seperti timbal pada *Lead Rubber Bearing Damper* (LRB). Sebagai alternatif, terdapat peredam jenis *Bending Bar Rubber Bearing* (BBRB), yang menggunakan baja tulangan sebagai komponen peredam energi yang lebih ekonomis, ramah lingkungan, dan praktis. Akan tetapi, karakteristik baja tulangan sebagai komponen peredam masih belum banyak diteliti.

Penelitian ini berfokus pada studi karakteristik baja tulangan sebagai komponen peredam energi melalui uji lentur siklik, simulasi numerik, dan formulasi analitik. Variasi diameter baja tulangan adalah 12 mm dan 16 mm, dengan panjang antartumpuan 50 mm, 70 mm, dan 90 mm. Baja tulangan dihubungkan dengan perangkat utama secara las untuk memperoleh kekakuan lebih besar. Uji lentur siklik mengikuti standar AISC 341-16, sementara simulasi numerik menggunakan Abaqus CAE dengan model material *elastic-perfectly plastic,* tipe elemen C3D8R, dan prosedur *static-general*. Formulasi analitik dikembangkan tanpa efek strain hardening. Parameter yang dianalisis meliputi gaya tahanan lateral, deformasi, *dissipated hysteretic energy*, dan *equivalent viscous damping ratio* (EVDR).

Berdasarkan hasil analisis, diperoleh hubungan variasi diameter dan panjang antartumpuan yang berpengaruh terhadap *displacement* maksimum, gaya tahanan lateral, kekakuan elastik, redaman energi, dan rasio redaman. Pengembangan model numerik baja tulangan menunjukkan variasi perbedaan dengan hasil eksperimen. Pada gaya tahanan lateral, perbedaan berkisar 0,6% hingga 82,23%. Untuk kekakuan elastik, perbedaan berkisar 13,16% hingga 63,56%. Pengembangan persamaan analitik juga menunjukkan variasi perbedaan dengan hasil pengujian dan numerik. Untuk gaya tahanan lateral, perbedaan berkisar 1,55% hingga 58,16% terhadap hasil pengujian. Terhadap numerik, perbedaan berkisar 5,34% hingga 38,60%. Untuk kekakuan elastik, perbedaan berkisar 21,29% hingga 83,40% terhadap hasil pengujian. Sedangkan terhadap hasil numerik, perbedaan berkisar 51,88% hingga 76,30%. Baja tulangan menunjukkan potensi sebagai komponen peredam energi. Penelitian lanjutan dan kalibrasi model diperlukan untuk meningkatkan akurasi prediksi performa material ini.

Kata kunci: Peredam Jembatan, Baja Tulangan, Uji Lentur Siklik, Simulasi Numerik, Formulasi Analitik.

ABSTRACT

Bridge dampers are effective in reducing structural acceleration during earthquakes. However, conventional dampers are often impractical and use environmentally harmful materials, such as lead in Lead Rubber Bearing Dampers (LRB). As an alternative, there is the Bending Bar Rubber Bearing (BBRB) damper, which uses steel rebar as an energy dissipation component, offering a more economical, environmentally friendly, and practical solution. However, the characteristics of steel rebar as a damping component have not been extensively studied.

This research focuses on studying the characteristics of steel rebar as an energy dissipation component through cyclic bending tests, numerical simulations, and analytical formulations. The steel rebar varies in diameter (12 mm and 16 mm) and effective length (50 mm, 70 mm, and 90 mm). The rebar is welded to the main apparatus to increase stiffness. The cyclic bending tests follow AISC 341-16 standards, while the numerical simulations use Abaqus CAE with an elastic-perfectly plastic material model, C3D8R elements, and a static-general procedure. The analytical formulations are developed without considering strain hardening effects. The parameters analyzed include lateral resistance force, deformation, dissipated hysteretic energy, and equivalent viscous damping ratio (EVDR).

The results show that variations in diameter and effective length significantly affect maximum displacement, lateral resistance, elastic stiffness, energy dissipation, and damping ratio. The development of the numerical model for steel rebar shows variations in differences from the experimental results. For lateral resistance, the differences range from 0.6% to 82.23%. For elastic stiffness, the differences range from 13.16% to 63.56%. The analytical formulations also show variations compared to the experimental and numerical results. For lateral resistance, the differences range from 1.55% to 58.16% compared to the experimental results and from 5.34% to 38.60% compared to the numerical results. For elastic stiffness, the differences range from 21.29% to 83.40% compared to the experimental results and from 51.88% to 76.30% compared to the numerical results. Steel rebar shows potential as an energy dissipation component. Further research and model calibration are needed to improve the accuracy of predicting this material's performance.

Keywords: Bridge Dampers, Reinforcing Steel, Cyclic Bending Test, Numerical Simulation, Analytical Formulation.