INTISARI

Bambu laminasi telah banyak diterapkan pada beberapa elemen struktur bangunan. Pada bagian sudut atau tepi balok bangunan bertingkat, balok yang menopang pelat kanopi tidak hanya mengalami momen lentur tetapi lebih dominan beban geser. Pada pembebanan konstan jangka panjang (*long term*), balok tersebut mengalami *creep* geser. *Creep* sangat penting dalam desain struktur bambu laminasi. Efek *creep* geser memiliki potensi akan mempengaruhi umur layan (*service life*) pada struktur bangunan.

Pada penelitian ini telah dikaji pengaruh waktu dan level beban terhadap perilaku *creep* geser bambu laminasi sejajar serat. Waktu ditetapkan minimal 90 hari, level beban uji *creep* geser adalah 20%, 30% dan 40% beban ultimit, uji *creep* torsi dan pelat sambung 30% beban ultimit. Pengujian *creep* dilakukan di ruangan dengan temperatur (T) 28±3 ^{0}C, kelembaban relatif (RH) 72±5% dikontrol dengan *micro-controller* yang terhubung dengan *Humidifier*, *Dehumidifier* dan sensor RH. Dari analisis data pengujian *creep* dapat ditentukan parameter viskoelastik model Burger, Burger Modifikasi Usulan, Power Law bambu laminasi dan mengimplementasikan pada *subroutine CREEP* program ABAQUS CAE.

Hasil penelitian *creep* geser menunjukkan bahwa level beban berpengaruh terhadap perilaku *creep* geser bambu laminasi, semakin besar level beban maka deformasi, regangan dan laju *creep* juga semakin meningkat. Tahap *primary (transient) creep* pada level beban 20%, 30% dan 40% adalah 16, 18 dan 35 hari. Laju *creep* awal pada level beban 20%, 30% dan 40% adalah 0,04 mm/hari 0,064 mm/hari dan 0,056 mm/hari, selanjutnya menurun seiring dengan bartambahnya waktu. Parameter viskoelastik geser model Burger G_1, G_2, η_1, dan η_2 adalah 17,188 MPa, 44,335 MPa, 8736,334 MPa/Hari, dan 863,333 MPa/Hari, sedangkan parameter Power Law A, n, m adalah 7,09E-04, 0,091, -0,728. Hasil penelitian *creep* torsi menunjukkan tahap *primary (transient)* 4 hari, laju *creep* awal geser 0,00088 μs/hari, selanjutnya menurun seiring dengan bartambahnya waktu. *Creep* faktor torsi (C_r atau k_{def}) rata-rata bambu laminasi hingga hari ke 90 adalah 1,585. Parameter viskoelastik torsi model Burger G_1, G_2, η_1, dan η_2 adalah 919,312 MPa, 1680,041 MPa, 194417,272 MPa/Hari, dan 8798,713 MPa/Hari, sedangkan parameter Power Law A, n, m adalah 1,79E-04, 0,027, -0,913. Hasil penelitian *creep* pelat sambung menunjukkan tahap *primary (transient)* 12 hari, laju *creep* awal adalah 0,7 mm/hari, selanjutnya menurun seiring dengan bartambahnya waktu. *Creep* faktor pelat sambung (C_r atau k_{def}) bambu laminasi hingga hari ke 90 adalah 0,86. Hasil pengembangan model Burger menjadi model Burger Modifikasi diimplementasikan pada *subroutine CREEP* pada program ABAQUS dapat memprediksi perilaku *creep* torsi bambu laminasi, dimana nilai koefisien determinasi model Burger Modifikasi Usulan (R^2 = 0,97) sedangkan model Burger (R^2 = 0,94), ini berarti model Burger Modifikasi Usulan memiliki tingkat keakuratan lebih baik dibandingkan dengan model Burger.

Kata Kunci : bambu laminasi, beban jangka panjang, *creep* geser, *creep* torsi, *creep* pelat sambung, model Burger Modifikasi Usulan

ABSTRACT

The glued-laminated bamboo has been applied to many parts of building structures. In peripheral, edge beams part of the multi-storey buildings and beams supporting canopy slabs are not only subjected to bending moment but more dominant shear load. Long-term constant loading, the glued-laminated bamboo beams cause shear creep. The creep is critical to structural design of glued-laminated bamboo structures. The shear creep effect has the potential to affect service life on building structures.

The research was conducted the influence of time and load level on shear creep behavior of glued-laminated bamboo parallel to the grain. The time was set at least 90 days and applied load levels were 20%, 30% and 40% of the ultimate load. In the torsional creep test and connection plate applied load level were 30% of the ultimate load. The creep test was carried out in a room with temperature (T) 28±3 ^0C and relative humidity (RH) 72 ± 5% controlled by a micro-controller connected to the Humidifier, Dehumidifier and RH sensor. Based on the analysis creep test data, viscoelastic parameters of Burger, Modification Burger proposed and Power Law model of the glued-laminated bamboo can be determined and implemented the Burger and Modification Burger proposed model using the CREEP subroutine on the ABAQUS CAE software.

The research results of the shear creep test shown that the load level influences behavior shear creep of the glued-laminated bamboo, as the load level increases, deformation, strain and creep rate also increase. The primary (transient) stage at load level of 20%, 30% and 40% are 16, 18 and 35 days. The initial creep rate at load level of 20%, 30% and 40% are 0,04 mm/day, 0,064 mm/day and 0,056 mm/day and the creep rate decreased by increasing time. The parameters viscoelastic shear parameters Burger model G_1, G_2, η_1, and η_2 are 17,188 MPa, 44,335 MPa, 8736,334 MPa/day, and 863,333 MPa/day respectively and the parameters Power Law A, n, m are 7,09E-04, 0,091, -0,728 respectively. The research results of the torsional creep shown that the primary (transient) stage 4 days, the initial creep shear rate 0,00088 μs/day furthermore the creep rate decreases with increasing of time. The torsional creep factor (Cr or k_{def}) until the 90th day reached 1,585. The viscoelastic torsional parameters Burger model G_1, G_2, η_1, and η_2 are 919,312 MPa, 1680,041 MPa, 194417,272 MPa/day, and 8798,713 MPa/day respectively and the parameters Power Law A, n, m are 1,79E-04, 0,027, -0,913 respectively. The research results of the connection plate creep shown that the primary (transient) stage 12 days, the initial creep rate 0,7 mm/day, then the creep rate decreases by the time increasing. The connection plate creep factor (Cr or k_{def}) until the 90th day reached 0,86. The development of the Burger model into the Modification Burger proposed model, then implemented on CREEP subroutine in the ABAQUS softwares able to predict the torsional creep behavior of the glued-laminated bamboo, where the coefficient of determination of the Modification Burger Proposed model (R^2 = 0,97) while the Burger model (R^2 = 0,94), this means that the Modification Burger proposed model has a better level of accuracy compared to the Burger model.

Key words: glued-laminated bamboo, long term load, shear creep, torsional creep, connection creep, Modification Burger proposed model