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### CSM玻璃钢层间剪切断裂

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### INTERLAMINAR SHEAR FRACTURE OF CSM-GRP

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摘要

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**摘要** 本文对CSM-GRP层间剪切断裂用实验与分析方法进行了研究。用英国标准BS4994规定的双槽试件拉剪法测量了层间剪切强度(ILSS)。用有限元法计算了应力分布、损伤扩展和复合型应力强度因子。并讨论了BS4994规定的这一试验方法的可靠性。

**关键词:**

**Abstract:** Interlaminar shear fracture of chopped strand mat glass fibre reinforced polyester laminates (CSM-GRP) was studied both experimentally and analytically. The double grooved specimens were used to measure the interlaminar shear strength (ILSS). The length of the shear surface of the specimen was found to have a significant effect on the experimental results of ILSS. Compression-shear specimens gave larger ILSS than tension-shear specimens. The panels with lower mass fraction of fibres tended to have lower ILSS. 2-dimensional 8-node quadrilateral isoparametric elements were adopted in the FEM analysis. The stress distributions along the shear surface were calculated using normal elements. The results indicated that there were large stress concentrations of both shear stress and transverse normal stress at the corners of the two notches. It is the occurrence of these stress concentrations that causes the damage, cracking and failure of the materials. This explains the effect of the shear surface length on the measured ILSS. The damage initiation and extension were predicted with FEM using two different failure criteria; the maximum stress criterion and the distortional energy criterion. The distortional energy criterion predicted an earlier failure. By making use of the collapsed triangular quarter point singular elements, the mixed-mode stress intensity factors  $K_I$  and  $K_{II}$  were calculated. Then, the critical stress intensity factors  $K_{IC}$  and  $K_{IIC}$  were estimated through the combination of calculated results of  $K_I$  and  $K_{II}$  and test results of the critical crack length  $a_c$  and fracture load. Finally, the suitability of the test method specified by BS 4994, 1973 for measuring ILSS of CSM-GRP was evaluated.

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