Код: 10938

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Monitoring the Loads Inside Adhesive Joints by Fiber Bragg Sensors

Дрезден, Германия, 2012 год

8 стр; формат: 23,5 x 16 см; библиографический список: 9 единиц

In this work we propose to incorporate fiber Bragg gratings inside adhesive joints in order to measure compressive strains / stresses to which they are subjected. Since the only possible embedding geometry is in-plane (that is transverse to the direction of compressive and tensile loading), this is the geometry we investigate.

The joints examined were of the butt joint type, (Ultem 1000 adherents and epoxy adhesive - Epon 815C/Versmid 140) in which fibers with Bragg gratings were embedded. After curing, the joints were loaded by several compressive loads and the gratings' signals were studied.

The possibility to multiplex several gratings on one fiber was also examined, when five FBG sensors were incorporated inside each sample on a single fiber to estimate the stress and strain distributions in the adhesive plane. Linear correlation was found between the Bragg shifts and loads. The resulting outputs from the sensors were compared with a Finite Element Analysis (FEA) and reasonable agreements were demonstrated.

In addition, the influence of the embedded fiber on the adhesive strength was examined, resulting in no noticeable influence.

Our conclusions are that FBG sensing might be an excellent method for monitoring loads inside adhesive joints, as part of an all-inclusive structural health monitoring system.

Доклад. 6-я Европейская конференция по мониторингу технического состояния сооружений, 2012. Редакция Кристиана Боллера.

Ключевые слова:

Содержание