Interpreting Infrared Thermal Images of Repair Sites

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ABSTRACT

Composite repair requires that the repair zone be heated to a specific temperature and maintained at that temperature for an extended period. Heating can be provided by electrical heating blankets, hot air, or infrared heaters. Regardless of the source of heat, heat pathways or insulating zones on the underside of the repair zone will upset the desired isothermality, leading to degradation of the repair bonds. Accommodating these thermal effects on the underside requires non uniform heat application. The question is where should the extra heat be provided, for how long, and with what intensity. One way to answer these questions is to instrument a surrogate patch and measure its time history. This is both expensive and time consuming. Another choice is to put the final patch in place, but without bonding agents, and to take infrared pictures during short time heating. While these images will identify local areas of concern, visual examination does not tell us what the heating density should be.

The paper describes an analysis approach involving decomposing the images into fundamental patterns. Each one of these fundamental patterns can be associated with specific thermal behavior, e.g., showing the effects of subsurface heat losses or insulating effects. The analysis determines the contribution of each pattern to the entire heating pattern and thus gives an indication of the magnitude of the effect. Using this information, one can estimate the local variation of heating needed. Results from experiments with a flat panel with enhanced insulation and heat losses are described. In addition, numerical simulations are used to explore the extension of this method to non planar repair sites.