

*Transient Thermoelastic Stresses in a Slab**

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Communicated by I. N. SNEDDON

Abstract. The subject of this paper is the thermoelastic stresses which arise in an infinite flat slab of constant finite thickness because of the sudden application of a transient temperature field, that varies through its thickness and along its length. One face of the slab is assumed to be stress-free and the other face is rigidly constrained. To the stress-free face, a spatially varying temperature is suddenly applied while the other face is held at constant temperature.

The quasistatic thermoelastic field equations are solved by means of integral transforms and by complex variable theory. General solutions are expressed as functions of the applied temperature and are numerically evaluated for the case when the temperature is a suddenly applied band loading. Results are presented by means of plots of the normalized elastic field evaluated at successive times.

I. Introduction. In a previous paper [1], the effect of a steady-state temperature distribution on the elastic field in a flat slab of finite thickness and infinite extent was reported. The slab was held rigid and at constant temperature on one face while the other face was stress-free and a temperature band-loading was applied to it.

That model was generated to approximate the elastic field in bonding materials used in missiles and space vehicles. Essentially, bonding materials are used to hold the heat shield to the metallic substructure in such vehicles. It was felt worthwhile to investigate analytically the thermal stresses which might arise in these composite structures. However, the metal structure is usually much more rigid than the bond and heat shields and so we approximated by considering one slab (heat shield) bonded (molecularly) to a rigid substructure.

The steady-state temperature distribution used in [1] could conceivably arise in a long (time-wise) flight but we were further concerned with sudden thermal changes that a vehicle might experience initially as it comes in contact with the temperature. Thus, even though acceleration may be negligible, the

* This Research partially funded under the company—sponsored research program.