# NASA TECH BRIEF



## ELAS—General Purpose Computer Program for Equilibrium Problems of Linear Structures

ELAS is a general-purpose digital computer program that handles the equilibrium problems of linear structures of one-, two-, or three-dimensional continuum. The program requires as input (1) the coordinates, in an overall coordinate system, of the mesh points of a random one-, two-, or three-dimensional continuum, respectively; (2) the geometrical, topological, material, and loading characteristics of the mesh elements; (3) the list of prescribed deflections and forces at the mesh points; and (4) a few program control parameters. As output it provides (1) the deflections at the mesh points, (2) the stresses at the mesh points, and (3) the listings of the input data.

ELAS generates the governing equations for the unknown deflections of the mesh points that define the stationary point of the total potential energy function associated with the given loading and unknown deflections. If the distribution of the deflections in a mesh element is not known, it is assumed to be linear. Thus the coefficient matrix of the unknown deflections is always positive definite, symmetric, and usually bandwidth limited and sparse. Upon request, ELAS relabels the mesh points internally to decrease the bandwidth of the coefficient matrix. Those coefficients that are in the upper half of the variable band are generated and stored. The system of equations is solved with a special Cholesky algorithm. The computed deflections are then augmented by the prescribed ones, rearranged in the user's labels, and printed out. The stresses are computed upon request. In structures of two- or three-dimensional continuum, the best-fit strain tensors at the mesh points are used in the stress computations. The stresses and the deflections are expressed in the local coordinate systems, and printed out together with the direction cosines of the local axes with respect to the overall axes. The local coordinate systems at the mesh points are different than the overall coordinate system in the case of general shells and shells of revolution, and at the boundary points. When appropriate, the stresses in the overall coordinate system are also provided. The selection of the local coordinate systems is automatic unless otherwise specified.

The number of unsuppressed degrees of freedom that can be handled in a given problem is 500 to 600 for a typical structure, but might far exceed these values for special types of problems.

### Notes:

1. The program is written in Fortran II (99.7%) and FAP (0.3%) for use on the 32K IBM 7094–7044 direct-coupled system.
2. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10187

### Patent status:

No patent action is contemplated by NASA.

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