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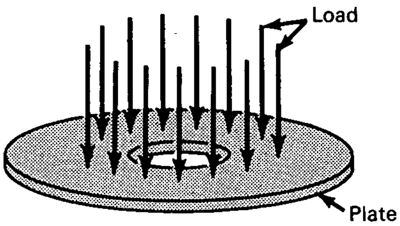
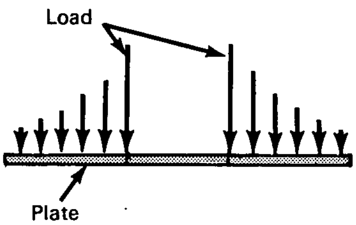
Equations Provide Tabular Information on Effects of Uniform and Variable Loads on Thin, Flat, Circular Plates





The problem:

To determine the deflection, slope, and moments for thin, flat, circular plates subjected to either a uniform or a symmetrical variable load. Information of this type is valuable when the plate thickness is to be minimized.

The solution:

A series of equations describing six cases of uniform load and six cases of varying symmetrical load on thin, flat, circular plates. To simplify the determination of deflection, slope, and moments when only one or two calculations are required, various dimensionless terms in the derived equations have been computed, organized in tabular form, and graphically depicted.

The uniform load (left figure) results from a constant, uniform force which acts in a concentric circle on the thin, flat, circular plate. The figure on the right depicts a varying load distribution in which a constant, symmetrical force, varying by the quotient of the force divided by the radial distance squared, acts over the entire plate, with the greatest force nearest the center of the plate, and the least force at the farthest boundary of the load from the center of the plate.

The equations for both types of force are developed for six boundary conditions: (1) outer edge supported and fixed, inner edge fixed; (2) outer edge simply supported, inner edge free; (3) outer edge simply supported, inner edge fixed; and (4) outer edge supported and fixed, inner edge free. In the two remaining cases for a uniform load, a solid plate is considered; and in the two remaining cases for a varying load, a solid plate is considered with the load bounded by circles of an inner radius and an outer support-load radius. In these cases the boundary conditions include: (5) fixed, supported outer edge, and (6) simply supported outer edge.

Notes:

1. The system of units used in the derivation of the equations is the unit-mass system, since it provides a compromise between the absolute and gravitational systems, and because it is automatically a self-containing reference system.
2. The presentation includes particularly useful graphical information. These analytical solutions can be easily read from the graphs, and can be useful in all phases of mechanical design, particularly to the stress analyst and machine designer.

(continued overleaf)

3. Additional details are contained in the following technical reports: (a) "Bending of Circular Plates under a Variable Symmetrical Load," by J. C. Heap, ANL-6882, Argonne National Laboratory, April 1964; and (b) "Bending of Circular Plates under a Uniform Load on a Concentric Circle," by J. C. Heap, ANL-6905, Argonne National Laboratory, April 1964. These reports are available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151; price $3.00 each.

4. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B66-10601

Source: J. C. Heap
Particle Accelerator Division
(ARG-151 & 152)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
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