



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA COMPUTER PROGRAM AIDS AMERICAN DESIGNERS

More than 70 industrial firms, universities, laboratories and government agencies are now using NASTRAN, a NASA-developed computer program, to solve their structural engineering problems.

The program is presently being used in more than 185 different applications, ranging from suspension units and steering linkages on automobiles to the design of power plants and skyscrapers. At least 55 more uses of NASTRAN are currently planned.

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NASTRAN (NASA's Structural Analysis Computer Program) is a general purpose digital computer program originally designed to analyze the behavior of elastic structures in the space program. One of its major uses by the National Aeronautics and Space Administration has been in the design of the Space Shuttle.

Since it was first made publicly available in November, 1970, more than 600 engineers have become acquainted with the use of NASTRAN. The computer program is now considered virtually indispensable by many structural and design engineers, who estimate that two-thirds of the projects in which it has been applied would not have been attempted without it.

Primary industrial users include aerospace companies, automobile manufacturers, consulting engineering firms and the construction industry.

Examples of their applications of NASTRAN include the design and analysis of:

- Aircraft fuselages, wings and tail assemblies;
- Automobile frames and other motor vehicle components;
- High Speed railroad tracks;
- Turbine engines; and
- Space vehicles and related launch facilities.

The engineering division of a major automobile manufacturer using NASTRAN in the design of its 1973 line of light trucks reports a 60 percent improvement in predicting the behavior of components under stress and a time saving of two-thirds in achieving such calculations. Similar savings in time and effort have been reported by most industrial users.

Firms using the new analysis program predict many improvements in product safety, reliability and quality, as direct benefits to their customers.

NASA spent more than \$3 million to develop the program at the Goddard Space Flight Center. The Langley Research Center spends about \$400,000 annually to update the program for NASA uses and to help new users apply it and learn its possibilities. A survey of 23 users outside the Space Agency indicates that assistance provided by the Langley Center has already saved them more than \$2.5 million in start-up costs and other expenses associated with using the computer program.

The NASTRAN program is now being distributed under contract to NASA by the Computer Software Management and Information Center (COSMIC) at the University of Georgia. The program is user-oriented and organized to do much of its work automatically. Written in a versatile computer language, NASTRAN can be used on a variety of computers. A complete set of program tapes and documentation can be purchased through COSMIC for an average \$1,700, depending on the options required.

The program's capabilities include the analysis of:

- (a) static response to various loads, thermal expansion and deformation;
- (b) dynamic response to transient loads, harmonic loads and random stresses; and
- (c) solutions for vibration, dynamic stability and elastic stability analysis.

NASA-developed computer programs have proved one of the most important spinoff benefits from the space program. Besides NASTRAN, several hundred other programs are publicly available to United States users as part of the Space Agency's Technology Utilization Program. Only modest charges are made to meet the cost of evaluation, processing and distribution.

Further information on NASTRAN and other computer program tapes and documentation is available from NASA's Computer Software Management and Information Center (COSMIC), Barrow Hall, University of Georgia, Athens, Ga., 30601; telephone: AC404/542-3265.

Organizations reported as users of NASTRAN are:

Aerojet Solid Propulsion Company	Sacramento, Calif.
A. O. Smith Corporation	Milwaukee, Wisc.
Argonne National Laboratory	Argonne, Ill.
Atlantic Research Corporation	Costa Mesa, Calif.
AVCO, Lycoming Division	Stratford, Conn.
Bell Aerospace Company	Buffalo, N.Y.
Bell Helicopter	Fort Worth, Tex.
Bell Telephone Laboratory	Whippany, N.J.
Boeing Aerospace Company	Seattle, Wash.
Boeing Computer Service	Kent, Wash.
CHI Corporation	Cleveland, O
Computer Sciences Corporation	Richland, Wash.
Computer Sciences Corporation	Los Angeles, Calif.
COMSAT Laboratory	Clarksburg, Md.
Control Data Corporation	Minneapolis, Minn.
Control Data Corporation	Chicago, Ill.
COSMIC	Athens, Ga.
Esso Production and Research	Houston, Tex.
Fairchild Industries	Germantown, Md.
Ford Motor Company	Dearborn, Mich.
Franklin Institute	Philadelphia, Pa.
General Dynamics/Convair	Fort Worth, Tex.
General Dynamics/Convair	San Diego, Calif.

General Dynamics Corporation	Pomona, Calif.
General Motors Research Laboratory	Warren, Mich.
Georgia Institute of Technology	Atlanta, Ga.
Goodyear Aerospace Corporation	Akron, O.
B. F. Goodrich	Akron, O.
Grumman Aerospace Company	Bethpage, N.Y.
Hercules	Magna, Utah
Hercules	Cumberland, Md.
Itek Corporation	Lexington, Mass.
JET Propulsion Laboratory	Pasadena, Calif.
Johns Hopkins University	Silver Spring, Md.
Lockheed Georgia Company	Marietta, Ga.
Lockheed California Company	Burbank, Calif.
Louisiana Tech. University	Ruston, La.
Los Alamos Scientific Laboratory	Los Alamos, N.M.
LTV Aerospace Corporation	Dallas, Tex.
MacNeal - Schwendler	Hampton, Va.
Martin-Marietta Corporation	Denver, Colo.
McDonnell-Douglas Aircraft Corp.	St. Louis, Mo.
McDonnell-Douglas Automation Co.	St. Louis, Mo.
McDonnell Douglas	Huntington Beach, Calif.
McDonnell Douglas	St. Louis, Mo.
NASA Goddard	Greenbelt, Md.
NASA Ames	Moffett Field, Calif.
NASA Houston	Houston, Tex.
NASA Lewis	Cleveland, O.
NASA MSFC	Huntsville, Ala.
NASA Kennedy	Cape Kennedy, Fla.
NASA Langley	Langley, Va.
Naval Air Development Center	Warminster, Pa.

Naval Ship Research and Development Center	Washington, D.C.
North American Rockwell Space Div.	Downey, Calif.
Northrop Services Incorporated	Huntsville, Ala.
Old Dominion University	Norfolk, Va.
Perkin Elmer Corporation	Danbury, Conn.
Pioneer Services Incorporated	Chicago, Ill.
Pratt & Whitney Aircraft	West Palm Beach, Fla.
Raytheon Company	Sudbury, Mass.
Research Analysis Corporation	McLean, Va.
Sandia Laboratories	Albuquerque, N.M.
SCI-Tech.	Wilmington, Dela.
Sperry Rand	Huntsville, Ala.
Structural Dynamics Research Corp.	Cincinnati, O.
Teledyne Brown	Huntsville, Ala.
Teledyne Ryan	San Diego, Calif.
Teledyne Computer Center	Toledo, O.
Texas Instruments	Dallas, Tex.
TRW Systems	Redondo Beach, Calif.
United Aircraft Sikorsky Division	Stratford, Conn.
Watervliet Arsenal	Watervliet, N.Y.
Westenhoff & Novick	Chicago, Ill.
Westinghouse Telecomputer	Pittsburgh, Pa.
Westinghouse Defense and Space Center	Baltimore, Md.
Westinghouse, Research and Development Center	Pittsburgh, Pa.