ENGINEERING

Stress Equation Devised

➤ BUILDINGS, bridges and heavy machinery of the future may owe their strength to a mathematical equation based on a 110-year-old intuition.

The new equation tells engineers for the first time exactly how far certain kinds of stresses can penetrate into structural members. It is based on an idea suggested by a famous engineer, Barre de St. Venant, in the mid-19th century.

Specifically, the equation expresses the ratio of the elastic energy U(s) stored at some distance (s) beyond the loaded end to the total elastic energy U(o) stored in the entire body.

$$\frac{U(s)}{U(o)} \leq e^{-(s-t)/s_e(t)},$$

where t is the thickness of the cross-sectional slice and s_e is a factor which includes, 1. the lowest vibrational frequency of the slice, 2. density and 3. the maximum elastic modulus. Once the energy has been estimated, it is possible to estimate the stresses at interior points in a body or points near the smooth part of the surface.

A 20th-century mathematician, Dr. Richard A. Toupin of International Business Machines Corporation, worked out the equation by hanging cross-sectional slices of different beams from wires and hitting them with a hammer, like tuning forks. The lowest frequency vibrations in any slice are characteristic of both the material that the beam is made of and the shape of its cross-section.

St. Venant's principle says that when a bar is pinched, twisted or stretched by self-canceling forces, the stresses produced in the bar at some distance away are negligible. However, St. Venant said nothing about the local stresses near where the force is applied. In critical applications such as aircraft, engineers have had to build large, expensive models, or else change the design of the finished structure so that the principle could be used.

Dr. Toupin's mathematical version of St. Venant's principle works for all types of beams and materials, and tells the engineer when he can neglect the effects of local stresses. Dr. Toupin is now working on equations that will let the principle be used for a wider range of shapes than just beams.

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IBM

NEW EQUATION—Dr. Richard A. Toupin explains his equation and demonstrates that the cross-sectional shape of a beam has a great influence on stress decay by suspending a section of a beam and striking it like a tuning fork.

INVENTION

Current U.S. Patents

➤ TRAVELERS can now take the car and leave the driving to an electric eye. An electric-eye device that scans the road ahead can keep a car in the same lane, along the straightaway and around curves without the help of the driver.

The device, designed for use on superhighways when the motorist wants to rest, can be fitted into the front grill or the front of the rear view mirror. The autopilot relies on an electronic memory to guide the car. If the car's position starts to change, an electric motor turns the wheel. If there is an obstacle ahead, an alarm sounds, then the brakes go on.

The device earned patent 3,172,496 from the U. S. Patent Office for Jacob Rabinow, Takoma Park, Md., and William Fischer, Silver Spring, Md.

Automatic Approach System

Hundreds of aircraft land at airports around the country every day with the aid of a newly patented automatic approach system that aims the planes at the runway.

The system has been made part of the Sperry SP 50 autopilot used on the Boeing 727 jet airliner. When the new Douglas DC-9 jet airliner goes into service, it, too, will be equipped with the instrument.

The system smoothly and automatically aligns the plane in the proper approach angle and direction for an instrument landing.

Robert H. Parker and Rowland H. Wagner, Phoenix, Ariz., earned patent 3,172,624 for the system and patent rights were assigned to Sperry Rand Corporation, Great Neck, N.Y.

Auto Safety Cushion

An air-filled cushion attached to the steering wheel or dashboard of an auto can help eliminate "whiplash" neck injuries in an accident or collision.

The cushion, which can be mounted on the hub of a steering wheel, absorbs the impact when a driver is thrown against the wheel, reports inventor Pasquale I. D'Antini, Scarborough, Ontario, Canada. In addition, it can prevent "whiplash" injury by letting the driver recover from the impact gradually, so that the neck does not snap back after the impact.

The cushion, which has been under study by Canada's Highway Safety Council, earned patent 3,172,683.

Golf Practice Device

A net-like golfing target measures would-be 300-yard drives without the golfer ever having to leave his own backyard.

A golfer, standing a few feet away from the device, strikes the ball at the target, The target, positioned on a track, jolts backward on impact. An indicator on the side of the device shows how far the ball would have gone had not the target been there.

Morris L. Slimovitz, Newbern, Tenn., earned patent 3,172,290 for the device.

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PHYSICS

New Laboratory to Study Man-Made Elements

➤ HEAVY, man-made elements, which do not occur in nature and must be created in powerful nuclear reactors or high-energy accelerators, will be studied in a laboratory to be built in Oak Ridge this summer.

The new transuranium research laboratory (TRL), will be located at Oak Ridge National Laboratory, operated for the Atomic Energy Commission by Union Carbide Corporation. Total cost for the project is expected to be about $1,850,000.

The TRL is the third facility being built at ORNL for use in the AEC's transuranium program. Already under construction and nearing completion are the high flux isotope reactor (HFIR), where transuranium elements will be produced, and the transuranium processing plant (TRU), where irradiated material from HFIR will be processed.

Transuranium elements are those above uranium in the periodic table of the elements with an atomic number greater than 92. All 11 known transuranic elements are radioactive and are produced by bombarding heavy elements with neutrons.

Potential uses of transuranium elements include small light-weight power sources for satellites and space vehicles.

Scheduled for completon in 1966, TRL will be a one-story, reinforced concrete structure. The building will contain laboratories for chemical and nuclear studies of the highly active transuranium isotopes, many of which will be available only at ORNL because of their rapid radioactive decay.

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