Georgia-Pacific's Technology and Development Center focuses on "performance packaging"

"Global marketing has become our customers' biggest challenge," says Tom Santelli, G-P director of technology and development. "It thus became our biggest challenge."

SUSAN M. CLITES

"Form follows function...." When Boston-born architect Louis Henri Sullivan first uttered his quotable quote in 1896, he probably had little idea that his observation would become a fundamental design principle that would transcend decades and industries. That principle is the foundation on which Georgia-Pacific Corp. (G-P) constructed its 28,000-ft^2 packaging design and testing facility in Norcross, GA.

The center, part of G-P's Containerboard and Packaging Division, affirms that the corrugated container industry is maturing.

"Global marketing has become our customers' biggest challenge," said Tom Santelli, G-P director of technology and development. "It thus became our biggest challenge."

To keep pace with the demands of international trade, G-P's goal is to develop "performance packaging" that can measure up to international RESY and UN DOT certifications. The Technology and Development Center will help G-P reach its goal.

Fifteen engineers, designers, and support personnel staff the Technology and Development Center, which houses a design lab, a package test lab, an environmental lab, and a materials test lab.

The US$ 5.5 million facility that opened in June 1992 also houses a CAD training center for G-P employees and customers that includes a conference area with rear-projection screens for slides and a video system that is integrated with G-P's computer system to incorporate computer-generated graphics into training.

"Ninety-five percent of our test equipment is microprocessor controlled and we have computer data acquisition and analysis," said David Le Butt, package testing laboratory manager.

Soon the entire building will be networked together, noted James F. Perry, Technology and Development Center project manager. "So I will be able to work on a design in my office while another one's being cut out in the CADCAM room.

"I'll also be able to send Dave a materials test report that he might need," said Perry. The network will also enable them to check the environments in multiple buildings without leaving their offices.

Package design

With technology as the conduit, customer interaction is the spark that fuels the development of each new package. The customer and design team begin by defining the parameters of the product that will be packaged. What stack pattern will be used? How long will the product be stacked? Will it be subject to humidity? By answering such questions, the team can select the optimum paperboard combination and determine the box specifications.

Using a CADCAM system, the team creates a three-dimensional drawing of the package. The specifications are fed into a computer-controlled roller bed diecutter that cuts the design into a sheet of corrugated board. From the pattern, the design team creates a working model of the package.

"There may be some materials questions, problems, changes that need to be made and we do a lot of interlaboratory correlation work with the sample materials testing laboratory," said Perry.

Staff in the center's materials testing laboratory can run standard tests on paper and paperboard samples including ring crush, edge crush, moisture content, and basis weight tests.

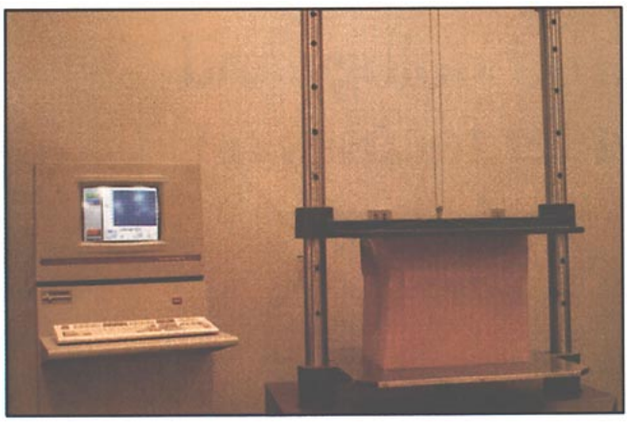
G-P also invested US$ 2.5 million to upgrade the testing facilities in its box plants. In addition, "we run a link to our paper mills to make sure that at the box plant level, we get the runnability, container performance, and all of the attributes they need," said Perry.

"The total quality process starts in the mill," said Le Butt. "In our box plants we try to maintain as consistent a raw material as we possibly can. Then the only variables left are how we convert the paper to corrugated board and how we convert the corrugated board to a specific box design."

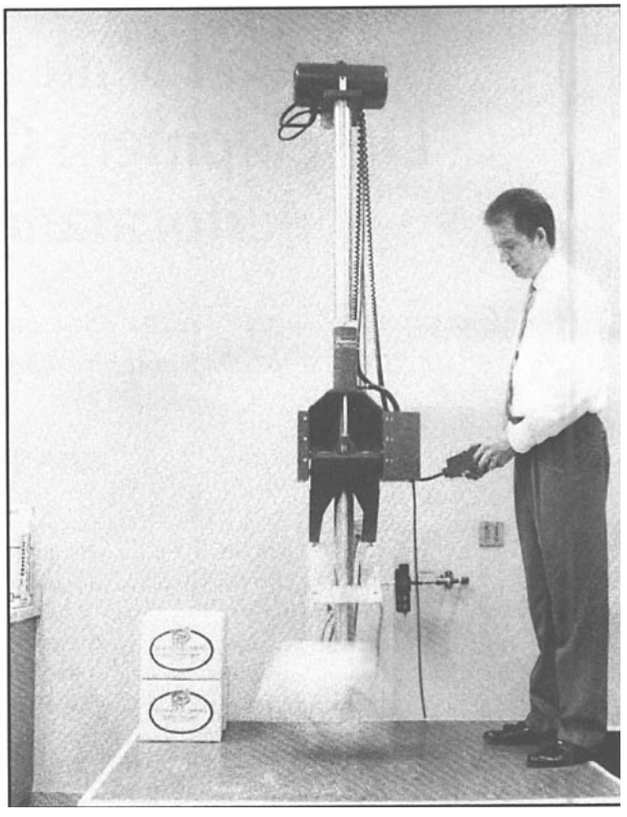
Twenty-one of G-P's 39 box plants have CADCAM systems. Modem hookups connect them directly to the center's CAD engineering area.

"The communication is from the plant to the center and also from the center to the plant," said Le Butt. "That's how we link up with...our 39 box plants."

The package test lab's vibration test system is capable of vibrating single packages and pallet loads up to 3000 lb.



Dave Wimmer, packaging systems engineer, demonstrates the precision drop tester that is used for manual handling simulations.



A design could be generated within a box plant, modemed to the center to be reviewed and modified, and cut on the sample table so that it can be sent to a customer. Conversely, the design can be created at the center and modemed to the box plants in the areas where the design will be manufactured.

The box plants' CalComp Plotters can plot full-size drawings, and the drawings can be transmitted directly to the die-maker that makes the cutting dies that would be used in the box plants to make the specific parts.

The prototype is assembled and undergoes some initial tests to confirm that the design is on track. Does the product actually fit in the package? Will the package's size and shape enable it to be transported and stacked efficiently?

If design changes are needed, the team can recall the design on the CADCAM system, modify it, send it to the diecutter system, and create a new working model in a fraction of the time it would take to make the revisions by traditional methods.

Testing as a science

After the design team confirms that the package meets the initial size and shape criteria, the package is sent to the center's package test lab. This lab contains some fairly large equipment; each piece tests how well the package stands up to various shipping conditions.

Many of the tools that are used to test packaging today "are adaptations of the engineering disciplines of shock and vibration that we use in the aerospace industry," noted Le Butt.

The compression testers are the most-used pieces of equipment in the lab, said Le Butt. "They're well utilized because we are so closely associated with the design team in our facility that we're able to analyze designs via compression tests very quickly."

This expedience enables the staff to make design changes or materials changes on a prototype that deliver test results in the area of what the customer has either specified or needs. While some of the lab's compression testing is associated with transportation, the bulk of the testing focuses on storing goods in a corrugated box in a pallet load in a warehouse.

The lab's two compression testers can test loads up to 50,000 lb and can accommodate single packages or pallet loads. The platens of the larger compression tester can open more than 7 ft.

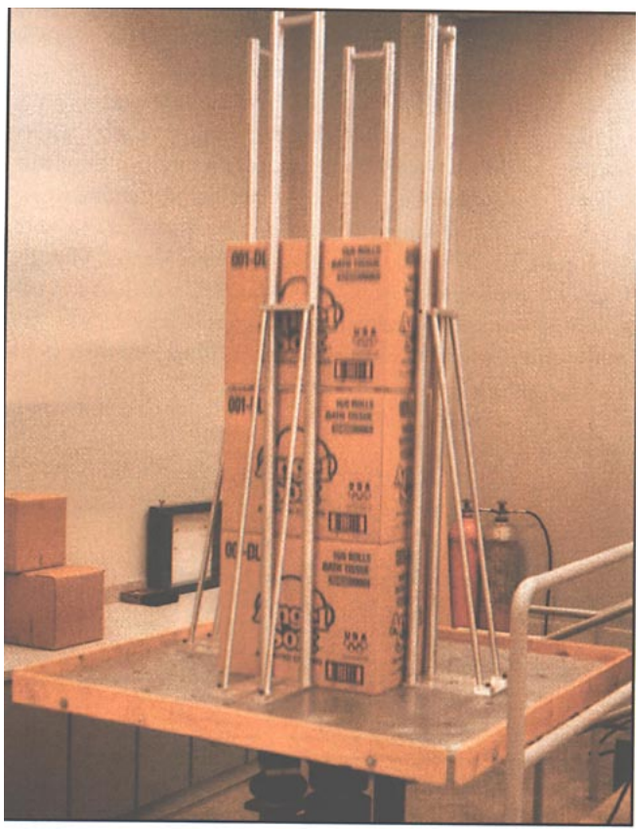
Both compression testers can be programmed to apply a constant load over time. Both will record what goes on in the package and in the load under those conditions. The machines are also used to conduct force deformation tests on individual boxes and on occasion, on pallet loads. "These compression tests are used then in our evaluations to recommend packing material that can be used to enhance the performance of a package," said Le Butt. "They're used to recommend designs that can enhance the performance of a package, and they're used to recommend what we would call safe stacking heights in normal warehousing for our customers."

The lab's vibration test system is capable of vibrating single packages and pallet loads up to 3000 lb. According to Le Butt, it's also used to vibrate individual products if the staff suspects that there may be something that can be done with the product rather than to the package. "On several instances, you can make a very minor product change and solve a problem," he said.

"We can design vibration tests for specific needs depending on what the customer situation is. We can run a discrete analysis of frequencies so we're looking for a specific resonant frequency or multiples of that resonant frequency for a package, for a column of packages, for a pallet load of packages," Le Butt said.

The staff can also program the machine to deliver a spectrum of

This compression tester, one of two in the package test lab, can test single packages or pallet loads up to 50,000 lb.



vibration frequencies and levels of intensity that occur in various transportation vehicles or various modes of transportation. The machine can also simulate other kinds of vibration testers and other kinds of test procedures.

The center is National Safe Transit Association (NSTA) certified and UN DOT certified as well as RESY certified.

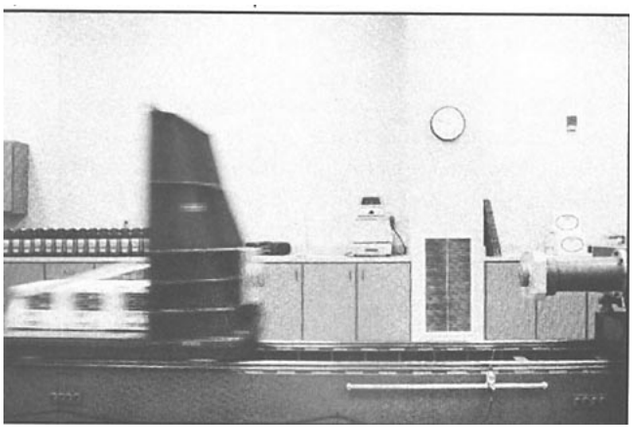
"For example," said Le Butt, "National Safe Transit Association has a repetitive shock type of test requirement and in that instance, you have to set the machine up to a specific fixed amplitude and then make adjustments in frequency and/or acceleration level to provide the same kind of a test that you would get on a mechanical vibration system."

The lab's random vibration programs are the standard programs published by the American Society for Testing and Materials (ASTM).

"We call these *default programs,* and they're what we use when we have no other knowledge of a specific customer's shipping environment," said Le Butt. "They are basically a conglomeration of all of the measurements that have been made by a variety of different companies throughout the United States and then an analysis of that to come up with an average spectrum that will match a typical tractor trailer in an over the road transportation or will match a typical rail car transportation situation," he said.

"We can program specific programs into the random vibration system and we do that for some customers who have their own

The Horizontal Impact Test System can be programmed to deliver specific shock pulses that more closely simulate what happens in railroad operations than an incline impact tester.



spectra defined for the shipping environment that they believe that their particular packages go through."

Le Butt noted that the staff also designs special tests when necessary. "There is no specification that spells out in ASTM a hand hold test method. It was tried; 20 years later it was dropped because there was never a consensus on how it should be done."

The lab also houses two drop testers: a precision drop tester permanently installed in the laboratory and a drop tester mounted on a portable base.

The precision drop tester is used for any kind of a manual handling simulation that the staff may want to duplicate. "We use it for specified drop tests such as the United Nations requirements for hazardous materials and the National Safe Transit Association requirements for certification of their packages," said Le Butt.

The portable drop tester can be moved into different environments. "It could be put into the high humidity room, and we could run tests on containers at elevated moisture contents," Le Butt pointed out.

The Horizontal Impact Test System, or HITS machine as it is more commonly called, is the largest piece of equipment in the lab, and, according to Le Butt, it replaces the old Confer Tester or incline impact tester that is prevalent in many laboratories.

"The difference between this and the old system is that we program this for specific shock pulses that more closely simulate what really happens in railroad switching and humping operations," he said.

"ASTM has a standard practice, D4169, that references a certain type of test method that should be used for railroad switching and humping operations, and this machine is programmable to duplicate that test procedure."

The test simulates the impact that might occur during a switching operation, and measures impact velocity and reload velocity. Le Butt pointed out that incline impact testers are associated with a 10° incline, and many of them position the product that is being tested in a 10° incline pattern. This setup has an obvious effect on the results. The HITS machine positions the item that is being tested in a level position as it would sit in a vehicle, unless the vehicle is going downhill.

Staff also use a programmable shock machine to test an individual product and determine its strength characteristics before it is packaged.

"Sometimes the best package means a redesigned product," said Perry.

"Once we know how strong the product is, in other words what critical velocity it has and what fragility rating it has, then we can use that information to go to cushion design curves and pick out a specific cushioning device or material to protect that product for a specified drop, generally specified by the customer," said Le Butt.

"As an example, I might take a product, a widget, and I'll test the widget to find out how strong it is. The first thing I'll do is find out what kind of a free-fall drop height will that widget survive," Le Butt explained.

Le Butt would then determine the widget's fragility. "I might end up then with a product that has a critical velocity change that is associated with a 15-in. drop onto a nonyielding surface. It has a critical acceleration of 15 G's. These two numbers build for us what we call a 'damage boundary curve' for that product.

"Then, if all our customer wants to do is to survive a 12-in. drop, we do not have to be concerned with the package with respect to impact protection for the product. But if the customer wants a 30-in. drop, we've already shown that the item, the widget, will only survive up to 15 in.

"So that means we know we have to do something from a cushioning standpoint to that widget in order to get it to survive the customer's 30-in. drop environment," he said.

In the environmental lab, staff have two temperature- and humidity-controlled chambers that they can use to subject a test package to different environmental conditions. By simulating different environmental conditions, staff can determine how a product and its packaging will react together in various situations.

Through its Technology and Development Center, Georgia-Pacific expects to provide some 4000 "turnkey" solutions annually to its customers. By focusing on the science of packaging, G-P is working in partnership with its customers to address their global marketing challenges. TJ

Susan Clites is associate editor,* Tappi Journal, *P.O. Box 105113, Atlanta, GA 30348.