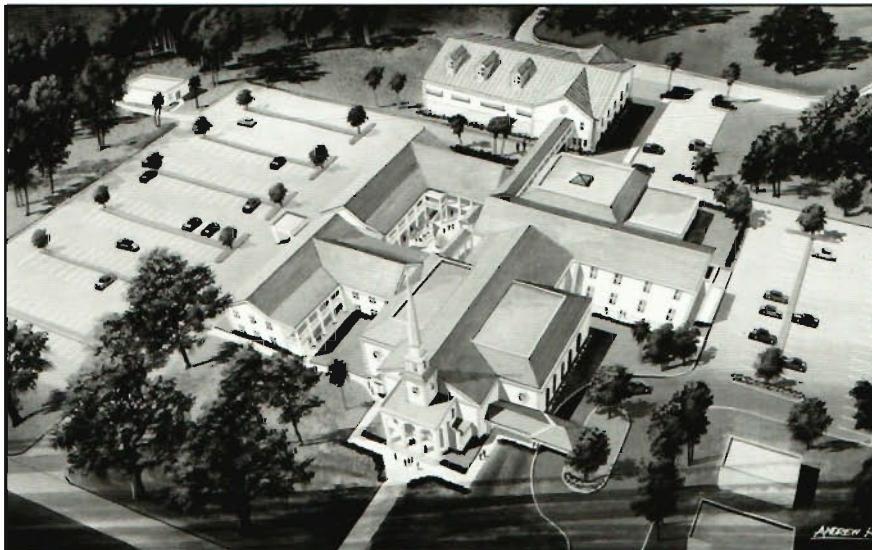


3-D WORLD

March/April 1990
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Renovation and expansion of Southside Baptist Church, Savannah, Georgia, designed by TMA Inc. International, using DataCAD. Artistic rendering by Andrew King.

DataCAD^(R) and DC ModelerTM Help Create Remarkable Success!

Like most eight-year olds, TMA experienced dramatic growth in 1989. In this case, TMA just happens to be Tom Gregory's company, TMA Inc. International of Valdosta, Georgia, a firm that specializes in architectural planning, urban design and construction management. In July 1988, after several years researching CAD systems, Thomas L. Gregory swapped TMA's drafting boards for DataCAD[™] and DC Modeler[™].

TMA's corporate headquarters remain in Valdosta, located 230 miles South of Atlanta, near the state line with Florida. This year the company opened three new divisional offices in Valdosta, Atlanta and Norfolk, Virginia. All of these TMA offices are real production centers with resident Architect/Division Managers, and

all are equipped with DataCAD and DC Modeler. Presently, TMA is electronically linking all of its offices with modems to facilitate working as a team, using DataCAD as the company's standard.

Enthusiastic Supporter

Otis Sanders, TMA's Manager of Corporate Resources and Quality Control, is an *old school* architect with more than 40 years of practical experience in the profession. Otis has been committed to TMA's decision to standardize on DataCAD from the very first hour that he saw DataCAD in operation.

TMA is not only active in the design of industrial and manufacturing facilities, schools and government buildings; the

(Continued on page 2.)

Making it in the '90's

CADKEY, INC. To Participate In Multi-faceted Program At NDES '90

CADKEY, INC. and third-party companies, in association with the American Society of Mechanical Engineers, will participate in four panel-discussion seminars during the National Design Engineering Show '90 at McCormick Place, Chicago, Illinois, February 26 to March 1, 1990. These conferences are in addition to CADKEY's CAD/CAM SOLUTIONS FAIR, Booth #218, at NDES '90.

NDES Session 35, **CAD: Basics of Operations and Applications**, on Wednesday, February 28, will feature two seminars: **From Decision to**

(Continued on page 20.)

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- ▷ Trade Show Update

Remarkable Success

(Continued from page 1.)

firm also specializes in building and renovating churches, from small mission churches to large facilities accommodating 5,000 people and more. "We work with our clients from initial concept and design decisions, through development of the construction documents and supervision of all the construction phases to final occupancy," Tom Gregory said.

Expanded Services

"We are site planners as well as architects," Tom added, "and DataCAD allows us to provide more *professional* services more quickly in both areas."

As part of the Valdosta Division's design team, Braxton Bohannon, Cindy Mills and Howard Whilden contribute key skills to TMA's projects, and DataCAD is now an integral part of each project. Braxton, a registered architect, has rapidly gained experience in three-dimensional master planning. Cindy's 3-D experience focuses on residential and commercial renovation. Howard excels in the detail aspects of a project, both in 2-D and 3-D. "I did not have any real CAD experience before, but I was able to learn the DataCAD software and become productive in a matter of weeks," Braxton Bohannon said.

"We initially design as if in 2-D with a default height of zero," Braxton continued. "Then, with a floor plan or a site plan schematically established, we give entities their actual heights. Now we begin a repetitive process of design and view — going back and forth from plan to perspective. This allows immediate, and uniquely helpful, visual feedback." Howard, TMA's DataCAD expert, pointed out the ease of going from 2-D to 3-D: "If you simply assign the z-base height as you work in the

plan view, then you can do 3-D *walk-throughs* at will." Tom continued, "This 3-D capability accelerates the decision-making process. We can show on the screen 3-D solutions from any angle that would have been impossible without actually building a model. We can walk through the building, around it, or even show an aerial view over it. The ability to model interior spaces three-dimensionally is especially important for church sanctuaries." Howard added that the major benefit of 3-D lies in being able to present realistic alternatives to a church building committee. He emphasized 3-D's importance when proposing renovation or expansion of an



Braxton Bohannon taking a "fly-over" of the masterplan for Southside Baptist Church.

existing church which has historical ties to a place.

Rev. Alan Bosson, Senior Pastor of Southside Baptist Church in Savannah, Georgia, agreed. "Our people were afraid of what might happen to the historic character of their beautiful church," Pastor Bosson said. "Seeing additions to a building that do not yet exist, and walking through them as if you were really there, ... it was quite an experience. TMA took suggestions and made changes in the design on the spot. They gave our building committee

plots of the design to take with us so that we could consider options."

While DataCAD is itself three dimensional, Cindy Mills added, "DC Modeler speeds up your work in 3-D. You can use 3-D entities to create solid blocks and slabs. It speeds up hidden line removal for renderings."

Renderings

Artistic renderings are especially important in TMA's architectural projects, because working with church groups is different from working with corporations. Building churches usually requires *fund raising*. "To get a church's membership committed and excited about fund raising or a stewardship campaign, you need three-dimensional artwork," Tom said. Pastor Bosson concurred, "You have to be excited about what you are doing when you are asking people for a million dollars. TMA's work got us excited."

The accuracy of TMA's three-dimensional hardcopy plots has substantially reduced the cost of the professional renderings that TMA commissions. "Our rendering firm cut its price by half because they did not have to create 3-D drawings from 2-D material," Tom said. "Now we send the 3-D plots marked with notes to indicate colors and materials along with color photographs. The turnaround time now is one third to one half the normal turnaround time."

"We can even do very effective, preliminary renderings in-house with 3-D plots and colored markers," Tom added. TMA has just begun to experiment with DataCAD Velocity™. "Perhaps I shouldn't say this," Tom continued, "but I envision the possibility of almost bypassing professional renderers by using Velocity. Velocity allows us to create renderings in 3-D with the materials, finishes, and colors as

they will actually be. We could put all of this on video tape for a building committee so that they can both walk through and fly around their project."

"We can already show the customers how their project will develop, phase by phase, over several years," Tom continued. "This helps to build a working relationship with the client for future phases of development because all their data is in your computer."

"We feel that we have just scratched the surface of DataCAD's capabilities," Tom concluded. "We are convinced that DataCAD is the right choice for us."

Editor's Note: Velocity is a trademark of Circuit Studios, Inc., Bethesda, Maryland.

Notes From The Editor

Now that **3-D WORLD** has appeared for the first time with advertisements, we noticed that in the media kits which went to third-party software developers beginning in October 1989, we forgot to take into account that the size specifications for the finished form of advertisements must leave 1/8-inch space all around for borders and columns.

Therefore, we must revise the size specifications for the finished form of advertisements:

Full Page: 6 7/8" x 9 15/16".
2/3 Page (Horizontal): 6 7/8" x 6 1/2".
2/3 Page (Vertical): 4 1/2" x 9 15/16".
1/2 Page: 6 7/8" x 4 13/16".
1/3 Page (Square): 4 1/2" x 4 1/2".
1/3 Page (Horizontal): 2 1/8" x 6 7/8".
1/3 Page (Vertical): 2 1/8" x 9 15/16".
1/6 Page (Horizontal): 4 1/2" x 2 1/8".
1/6 Page (Vertical): 2 1/8" x 4 1/2".
1/12 Page: 2 1/8" x 2 1/8".

All advertisements must be black and white, film negatives ONLY, 150 lines per inch, right reading, emulsion-side down, no bleeds.

Make sure that your ad includes your telephone number and FAX number, if you have one.

A CAD-savvy Architect Switches To DataCAD⁽ⁿ⁾

When Ron Torborg, Vice President of Schenkel & Shultz, Architects/Engineers, of Fort Wayne, Indiana, first came upon DataCAD™ in September 1988, he had no intention of changing his company's CAD system. As head of the CAD Department and a member of the Board of Directors, he knew that the company's CAD system had performed satisfactorily. Moreover, Ron believes very firmly that a company's use of a CAD system will only be as successful as the company's commitment to it. Ron Torborg does not change commitments lightly.

However, after buying a single DataCAD system as an experiment, Ron became intrigued with DataCAD's functionality and ease of use. A little more than a year later, on a single day in November 1989, Schenkel & Shultz switched all of the company's production

work from their minicomputer-based CAD system to DataCAD...in spite of the fact that they still had three more years to pay on the lease of their Computervision CADDS4X system!

Schenkel & Shultz is an established architectural and engineering firm, with a branch office in Orlando, Florida, that provides its customers with complete services in architecture, space planning, interior design, construction-related mechanical engineering, electrical engineering, structural, civil and fire-protection engineering.

For six years, Schenkel & Shultz had been using a leased minicomputer-based Computervision 200X™ system, and later Computervision CADDstations™ running CADDS4X™ software, ultimately

(Continued on page 4.)

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CAD-savvy Architect

with six stations in constant daily use. Although there were normal frustrations with the system, work was getting done on time. The company used the CAD system for 90% of its production work. The system had allowed Schenkel & Shultz to replace drafting boards and increase its earnings. And, the company had invested considerable time and talent in creating its own, customized, architectural software modules in house to make the annotation of working drawings easier and faster. Besides, Ron had seen other PC-based, A/E/C CAD systems, and had found them seriously lacking. Furthermore, Schenkel & Shultz had recently initiated new, five-year lease agreements for the latest Computervision equipment.

Time Saved: One Reason To Consider A New System

How did Ron Torborg justify, to himself and to his partners at Schenkel and Shultz, unplugging their original CAD system, storing it in a closet, and replacing it with DataCAD ... especially since the company would still have to pay a \$5,000 monthly fee on its lease for the next three years?

In learning to use DataCAD, Ron got the feeling that DataCAD's functionality and ease of use increased his productivity dramatically. He bought one more DataCAD system and trained one other designer at Schenkel & Shultz to use DataCAD.

To verify whether his perception that DataCAD appeared to make him more productive was really true, Ron did an informal time study comparing routine tasks that occur daily in working with a CAD system. Ron's time study

was not a formal benchmark between the CADDS4X system and DataCAD. Nevertheless, he tracked the following routine tasks:

- Booting the system each morning.
- Accessing and filing drawings.
- Making sub-drawings and symbols.
- System crashes.
- System downtime for maintenance.
- Updating base plans for engineering drawings.
- Zooming on drawings.
- Inserting details.

Ron then calculated the time that would be saved each day by the operators of the six CAD stations in use each day. The study showed that DataCAD would save an average of 16.95 hours of work time per day in comparison with CADDS4X.

Although this statistic began to lead Ron in the direction of thinking about a new CAD system, by itself it was not enough to justify such a move. He had to consider the functionalities and reliability of both CAD systems, and two particularly critical elements in use daily: Schenkel & Shultz's customized modules for annotating working drawings, and plotting at least 40 drawings through the night, in a batch mode, without anyone attending the system. "These two things are critical to us," Ron said.

Functionality And Speed: Two More Reasons To Consider A New System

"DataCAD proved to have functionalities equal to, and in some instances superior to those of the CADDS4X system," Ron continued. "DataCAD was also faster in performing these functions." With respect to reliability, DataCAD proved to be significantly more reliable.

"The single occurrence of a malfunction on the DataCAD system was solved with a single telephone call for technical support," Ron added.

Ron discovered that DataCAD's DCAL™ (DataCAD Applications Language) allowed Schenkel & Shultz easily to rewrite and improve their in-house-developed software modules to facilitate the annotation of working drawings. "DCAL is a truly functional and flexible programming language," Ron said. "We needed a *real* programming language for our annotation modules."

Meeting Specific Needs: Another Reason To Consider A New System

The one area in which CADDS4X appeared to retain an edge over DataCAD was plotting drawings. DataCAD appeared to be slower and could not plot multiple plots without previously having created individual plot files. Schenkel & Shultz uses an electrostatic plotter. To take advantage of the plotter's speed, Schenkel & Shultz needed to be able to plot directly from drawing files, through the night, without having already created plot files, and without anyone attending the system. This operation was critically important.

A telephone conversation with Michael Piekorz, DataCAD Third-party Products Manager, led to the recommendation that Ron try SuperKey™ with DataCAD to plot in batch mode overnight. SuperKey, a product of Borland International of Scotts Valley, California, is a RAM-resident utility that allows a user to create a single-keystroke macro of up to 64K of commands.

Ron tried SuperKey, and it worked. Using DCAL, he wrote a text file of the keystrokes required to plot each drawing according to Schenkel & Shultz's

standards, and listed the names of all the drawings to be plotted that night. The DCAL text file becomes the SuperKey macro. After exiting DataCAD, a DOS batch-file command activates SuperKey and starts the SuperKey macro. Once the plotting had started, he went home. When he came to work the next morning, all of the plots had been successfully completed.

This convinced Ron that Schenkel & Shultz needed to replace their CADDSS4X system with DataCAD. Now he had to figure out how to justify the switch financially.

'DataCAD is easy to use, fast, and reliable.'

Ron Torborg

Money Saved: Still Another Reason To Consider A New System

Returning the leased Computervision equipment was out of the question. Schenkel & Shultz would have to complete the monthly, \$5,000 lease payments. However, by cancelling the \$4,000-per-month maintenance contract on the leased equipment, Ron found the money to pay for six 80386-compatible personal computers and six copies of DataCAD. By paying for the new DataCAD systems with cash, depreciating the investment over five years, and taking into account that DataCAD's speed would allow the firm to get measurably more work done, Ron concluded that the DataCAD systems would cost Schenkel & Shultz \$1,000 less on a monthly basis than the Computervision system's maintenance charges. And, this would be true even if the designers' level of productivity remained the same. Moreover, the actual increase in production due to DataCAD's speed would

offset the monthly lease payments for the system that would no longer be in use.

One Final Need

Now there remained only one problem: how would they be able to access the hundreds of drawings that existed already on the CADDSS4X system? A software translator called PCXI^(*) (pronounced: "pixie"), manufactured by KRB, INC. of Winter Park, Florida, converts data from CADDSS4X's format into DXF format usable by DataCAD. So, they could keep their original system's file server in service and retire the rest of the equipment.

Results

In November 1989, Schenkel & Shultz made the switch. They decided to purchase eight DataCAD systems. Their DataCAD dealer, Entre Computer Center of Fort Wayne, configured and tested all the new systems ahead of time, and installed them all on a single Thursday afternoon. The dealer began the installation at 4:00 p.m. By 4:20 p.m. all eight systems were up and running. At 4:30 p.m., the designers began training on DataCAD. By the following Tuesday, everyone was doing production work on DataCAD. One week later, all of the designers were working as fast or faster than they had ever worked on the original CAD system.

Editor's Note: The DCAL implementation of Schenkel & Shultz's in-house-developed software to make the annotation of working drawings easier and faster, has now become a third-party product called KEYNOTE™, DataCAD MACROS for the Annotation of Working Drawings. For additional information about KEYNOTE, contact Schenkel & Shultz, Inc., Architects/Engineers, 3702 Rupp Drive, Fort Wayne, IN 46815. Telephone: (219) 484-9080. FAX: (219) 483-9313.

CASES TEMPLATES™

Spark Kitchen Remodeling

Ed Wolfstein and his wife, Sally Herschorn, recently bought a home in Burlington, Vermont. One of their first projects has been to remodel the kitchen. Ed and Sally are using DataCAD and CASES TEMPLATES to redesign their kitchen. Ed works as an architect with GHR Architects of Burlington and uses DataCAD^(*). Through Chris Davis, Editor of WindowIn on DataCAD, a newsletter for DataCAD users, Ed learned about CASES TEMPLATES developed by William L. Coppock, AIA, Architect, of Lakewood, Colorado.

CASES TEMPLATES and CASES TEMPLATES-2ⁿ are two large template files containing three-dimensional symbols for most standard cabinets, appliances, and fixtures for architectural kitchen and bath layouts. "These templates let you pop in a cabinet, stove, refrigerator, or other appliance exactly where you want to place it in the kitchen," Ed remarked. "Because the templates are three dimensional, you can easily obtain multiple perspectives and aerial views. For example, you can see what the kitchen will look like from the dining room."

"These templates have actually been very beneficial to both of us," Ed continued. "We rearrange base cabinets or wall cabinets, discuss how it looks, and make changes if we want to. We can play many *what if* scenarios."

"Each template is exactly to scale and is inserted at the proper height," Ed said. "You can work and plan the whole time without having to worry about z coordinates. CASES TEMPLATES has a template for anything in the kitchen or bathroom, even curved cabinets

(Continued on page 6.)

Kitchen Remodeling

(Continued from page 5.)

and cabinets with glass doors."

"The templates are basically generic and plain. Their simplicity minimizes the overall, drawing byte size. That is primarily how I use them in architectural drawings at work to show a client how a kitchen will generally look," Ed continued. "However, you can insert a template *exploded* and modify the template just as you would modify a drawing. So, you can customize your kitchen and experiment."

Ed Wolfstein has gotten so

excited about using CASES TEMPLATES with DataCAD that he has begun to create some templates of his own, which he has shared with William Coppock. Bill Coppock said, "I generated all of these templates using the DC Modeler, but you do not need the DC Modeler to use them. They work perfectly well in DataCAD alone."

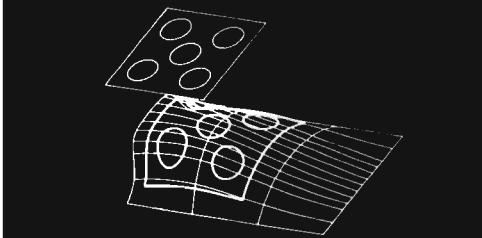
"These templates are building blocks to get into 3-D CAD," Ed Wolfstein added. "It is like getting a Lego[®] set for your birthday. Once you get started, you get encouraged, and start to create on your own. They get you thinking in 3-D."

"To make all the templates by yourself would be very time consuming. I probably would not attempt to make such templates unless I really needed them. But, CASES TEMPLATES are so reasonably priced, they are well worth the investment!" Ed concluded. CASES TEMPLATES sells for \$200, and CASES TEMPLATES-2 sells for \$150. The price for both is \$300.

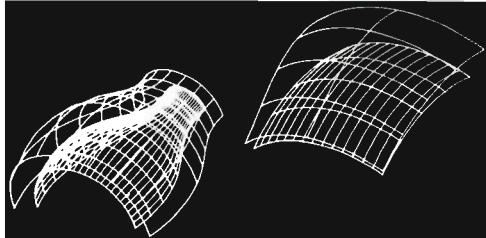
Editor's Note: For additional information about CASES TEMPLATES and CASES TEMPLATES-2, contact William L. Coppock, AIA, Architect, 7170 West Eighth Place, Lakewood, CO 80215. Telephone: (303) 237-7812.

FastSURF

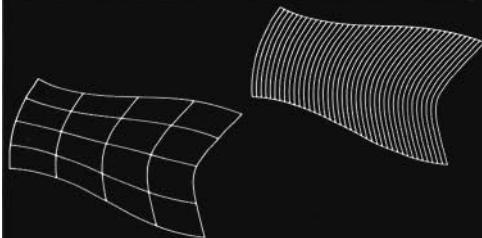
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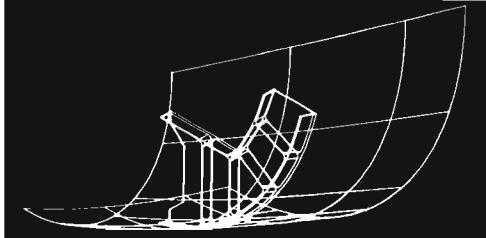
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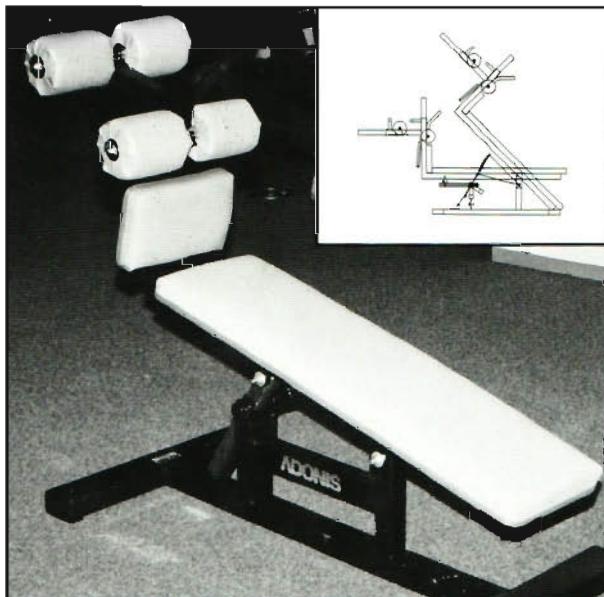
Designed Physical Fitness

Equipment With CADKEY 1!

Steve Tritter's first exposure to CADKEY^(TM) true, 3-D mechanical-design software occurred in 1986-1987, while he was serving as head of the Department of Electrical and Mechanical Technology at New Hampshire Vocational/Technical College, Nashua, New Hampshire. Steve learned to use CADKEY 1 (the educational version) on an 80286 PC-AT compatible without a math coprocessor or a mouse. In 1988, Tritter purchased Adonis^(TM) Fitness Equipment, Inc. in Hudson, New Hampshire, which he heads as President. He has used CADKEY in the design of several of his company's products. He recently designed and added to the Adonis product line a bent-leg, adjustable decline/flat bench.

horizontal rest. "Without true 3-D," Steve said, "it would not have been possible to design this joint with its close tolerances and complex motions." The bench is built of 11-gauge steel tubing (1/8-inch wall thickness), 3/4-inch plywood, and upholstered with the highest quality Naugahyde.

Sophistication of design and ruggedness of construction have made Adonis' benches and fitness equipment, designed or redesigned on CADKEY, into prominent items in corporate fitness centers across the country. U.S. government agencies have been purchasing Adonis fitness equipment on the GSA schedule for three years. Tritter directly credits the better design and stronger products



Bent-leg, adjustable, decline/flat bench designed by Steve Tritter, President of Adonis Fitness Equipment, using CADKEY 1.

The Adonis bench is, so far, unique in the world of fitness equipment because it can be raised from flat to a true 45-degree angle while still maintaining a strong, wobble-free integrity. This feature comes from a unique, telescopic, swivel-joint which doubles as a

that CADKEY helped him to achieve for his increased sales.

September 6, 1989, Steve Tritter donated his personal CADKEY-designed Adonis bench to CADKEY, INC. to express how delighted he is with CADKEY's software.

Students Use CADKEY

To Design Solar-Powered Car For SUNRAYCE USA

by Maribeth Schneider

Fifty undergraduate students at Rose-Hulman Institute of Technology in Terre Haute, Indiana are using CADKEY 3TM to design and build a solar-powered race car that will compete in General Motor's **SUNRAYCE USA** in July, 1990. They will be competing against teams from 31 other universities, including M.I.T. and Stanford, in the 1800 mile, solar-powered car race that will start from General Motor's *World of Motion Pavillion* at the EPCOT CENTER of Walt Disney World in Florida; proceed through the capitals of Florida, Georgia, Tennessee, Kentucky, Indiana, Ohio, and finish at GM's Technical Center outside Detroit, Michigan. The U.S. Department of Energy and the Society of Automotive Engineers have organized this event, in conjunction with GM and its Chevrolet Motor Division, to encourage the development of practical applications for solar energy.

A team of twelve students will be driving the *Solar Phantom* (as the Rose-Hulman vehicle has been officially named) and the computer-equipped chase vehicle during the nine-day race. The cars race from 8:00 a.m. until 5:00 p.m., with a two-hour charge session before and after each day's run. On rainy days, the students have to rely on battery power. Speeds are estimated to average 50 mph with a possible maximum of 90 mph.

Work on the *Solar Phantom* began early last summer with the original cost estimate being
(Continued on next page.)

SUNRAYCE USA

(Continued from page 7.)

\$250,000. A lightweight frame to support the weight of the driver and the solar equipment had to be designed. The team's aerodynamic calculations and the need to minimize the frontal area and to maintain a low coefficient of drag, placed constraints on the vehicle's design according to Scott Zion, the student who is Senior Mechanical Engineer of the project. Another student on the project, Bob Burger, developed a computer program to approximate the power available from the car's array of solar panels due to the position of the panels, location of the vehicle, time of day and amount of cloud cover.

Using a super efficient motor, rather than highly efficient but very expensive solar cells, the team achieved a substantial reduction in cost. CADKEY part files of the finished design will be used with stereolithography to make a physical model of the car in plastic. This model (one fourth the size of the finished car) will take 4-6 weeks to produce and will serve as the model for constructing the vehicle.

After the race, the Indiana State Government plans to put the *Solar Phantom* on a tour of high schools and junior high schools throughout the state to promote the use of alternate sources of energy. We'll let you know how the Rose-Hulman team and the *Solar Phantom* do in a later issue of **3-D WORLD**.

Editor's Note: See the article, **Using Stereolithography With CADKEY In Product Development**, on page xx.

Using Stereolithography With CADKEY In Product Development

by Tom Mueller

Editor's Note: Tom Mueller is Executive Vice President of PROTOTYPE EXPRESS, INC. of Arlington Heights, Illinois. Mr. Mueller will participate with CADKEY in conference session 35B at the National Design Engineering Show '90, Wednesday, February 28. See the related story, **Making it in the '90's**, on page 1 of this issue. **3-D WORLD** is pleased to offer this article as a taste to whet your appetites for the main course at NDES '90.

Anyone who has been involved in product development over the last several years has noticed some significant changes in market factors that influence product development.

— **Product Life Cycle** - The length of time that a product is viable in the market has decreased dramatically. No longer can a company count on having five years of sales for a product model before a new model must be designed. Continuing improvements in technology have resulted in significantly shorter, product life cycles, making it important that new products get to market in a timely manner.

— **Quality** - Improved product

quality is increasingly no longer a sales feature, but a minimum requirement to compete in the marketplace.

— **Price** - Selling prices are feeling continuing pressure from both domestic and foreign competitors.

To meet these market challenges successfully, several changes in product development are required.

- A. Products must be developed faster so that market introductions can be done as soon as possible after an opportunity arises. Especially in areas that technology is changing rapidly, old product development methods may get a new product to market just as it is made obsolete by a new advance in the underlying technology.
- B. Quality-related issues must be addressed early in the product design.
- C. To lower the selling price, both direct product cost and development costs must be reduced.

The introduction of improved

QUIZ: Which input method offers greater productivity?

| | | | | | |
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CAD/CAM/CAE tools over the last few years has not only improved design productivity, but has provided the means to address these challenges. One of the most significant tools developed, as well as one of the most exciting, is a process called stereolithography.

Overview of Stereolithography

Stereolithography is a means of creating plastic parts directly from a CAD model, in a matter of a few hours, without tooling. The process was invented and patented by UVP, Inc. of San Gabriel, California, and licensed by UVP to 3-D Systems, Inc. of Valencia, California.

The core of the process of stereolithography is a liquid plastic called a photopolymer. A photopolymer is a natural or synthetic substance that is

sensitive to certain wavelengths of light, and that is composed of giant molecules formed from smaller molecules of the same substance, often with a definite arrangement of components in the giant molecule. A polymer has physical properties that are different from the properties of a smaller simpler molecule of the substance from which it is made.

The photopolymer contains initiating elements that cause a polymerization reaction (that is, a joining of two or more like molecules to form a more complex molecule of the same substance) to begin when it is exposed to a particular wavelength of ultraviolet light. The liquid plastic solidifies wherever it is exposed to ultraviolet light. Stereolithography takes advantage of this property by using a computer-controlled ultraviolet laser to solidify the plastic selectively.

To build a part, a CAD model of the part is translated into a format that can be read by the stereolithography system. Cross sections of the part are calculated at small increments of height. One at a time, the cross sections are solidified on the surface of the liquid plastic by using the laser to trace the boundaries of the cross section, and then to crosshatch the interior portion of the cross section. When the layer is finished, it is lowered by an elevator into the vat of liquid to allow fresh photopolymer to wash over the top. The laser then traces the next cross section, solidifying it and bonding it to the layer below it. This process is repeated, layer after layer, until the part is completed.

After all layers have been

(Continued on page 12.)

• • • PS Quick Change • • •

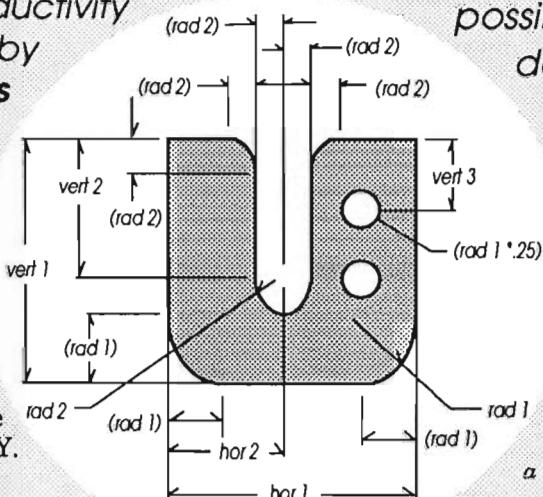
Introducing Parametric Solution!

A powerful new productivity tool brought to you by
Parametric Solutions
& Cadkey Chicago!

Parametric Solution (PS) is a unique utility for creating parametric parts inside CADKEY.

Using CADL, PS generates a parametric program for use with the parts that you have designed in CADKEY.

With PS there are unlimited possibilities for altering the design of your parts.



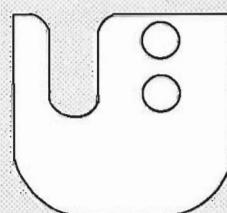
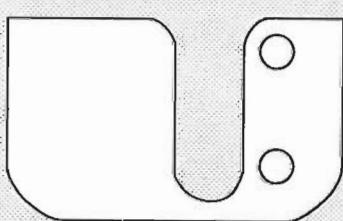
PS is easy to use. You don't need to understand the CADL program, you only need the ability to draw and dimension in CADKEY. PS will set up a parametric program for each of your parts that will allow you to design any permutation that you might need to create.

You can purchase this valuable software program for \$395.00, a small price - and well worth it.

CADKEY
CHICAGO

2525 oakton suite c 33
arlington heights 60005
phone 1-708-640-1853

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THIRD-PARTY NEWS

Two Developers Independently Introduce Dimensioning and Tolerancing Programs for CADKEY 3 (Version 3.5)

3rd DIMENSIONS™

ALLAN CAD Tools of Portland, Oregon, introduces 3rd DIMENSIONS™, a menu-driven, dimensioning enhancement utility for CADKEY 3™ (Version 3.5). Written in CADL™ (CADKEY Advanced Design Language), 3rd DIMENSIONS supplements CADKEY 3's dimensional features and streamlines the user interface by allowing all options to be changed *on the fly*. 3rd DIMENSIONS offers a user the flexibility of creating dimensions per ANSI standards, as well as according to the user's *company in-house* standards.

3rd DIMENSIONS runs under both the DOS and UNIX versions of CADKEY 3 (Version 3.5). The program's menus work just like CADKEY's menus and will work with a keyboard, mouse, or data puck.

3rd DIMENSIONS creates its dimensions using CADKEY's generic dimensions (GENDIM in CADKEY 3's masking menu). Generic dimensions appear in a part file much like regular dimensions in that they are singular entities, and they are view dependent, that is, they appear only in the view in which they were created.

However, generic dimensions afford a greater degree of flexibility than regular dimensions do. A generic dimension can include up to nine line segments. This allows a user to create dimensions with multiple leaders and/or broken witness lines. A generic dimension can be selected on any of its elements. And, because a generic dimension is under the complete control of a CADL

GEODraft™

HLB Technology of Blue Ridge, Virginia, creator of CADJET™ enhancement products for CADKEY 3™, announce GEODraft™, a geometric-tolerancing and drafting-symbol utility for CADKEY 3 (Version 3.5). Written in CADL™ (CADKEY Advanced Design Language), GEODraft features on-screen, pop-up, icon-based menus to create ANSI Y14.5M geometric tolerancing symbols.

GEODraft operates in the CADL subdirectory and works with both the DOS and UNIX versions of CADKEY 3 (Version 3.5). Users can use keyboard, mouse, or digitizing tablet and data puck. Using GEODraft with the

3rd DIMENSIONS (Continued)

program (unlike a regular dimension), parameters, such as leader and witness margins, or lead and tag text, can be added, or new dimension types, such as dual and offset dimensions, can be created. 3rd DIMENSIONS incorporates all of these features plus many more.

In addition to generating a rich array of dimensions through the use of generic dimensions, 3rd DIMENSIONS contains several other detailing features as well. These include the ability to *explode* any dimension, regular or generic, into its individual elements (e.g., for trimming) and the ability to create automatic centerlines, balloons, and section lines.

Jon Allan, owner of ALLAN CAD TOOLS, indicates that
(Continued on the next page.)

CADJET digitizer overlay further increases performance.

"What we would like to show users," said Harold Bowers, President of HLB Technology, "is that even if they are accustomed to using the menus, this new CADJET graphical interface is faster, more effective and easier to use. Because the library is integrated directly into CADKEY, it can be *tied* to a key on the keyboard, your mouse, digitizer, or your CADJET Master Template for instant activation."

When a user selects an icon from the screen (e.g., concentricity), a question appears at the bottom of the screen. It reaffirms the selection that the person made and asks for data. Each icon has its own unique path for constructing each symbol. Some paths are similar but no two paths are the same. "If you have ever worked with these symbols," Bowers said, "you know that some can be drawn the wrong way if you construct each one piece meal. After you have picked an icon, the paths that you can choose will let you construct that symbol ONLY the way that it can be constructed. I don't think any GEO tolerancing program on the market today, for any system, has this feature," he concluded.

GEODraft sells for \$249 plus \$5 for shipping and handling. A real, working demonstration copy is available (however, you cannot save or print).

For additional information about GEODraft, contact HLB Technology, Inc., P.O. Box 527, Blue Ridge, VA 24064. Telephone: (703) 977-6520. FAX: (703) 977-6531.

3rd DIMENSIONS (Continued)

3rd DIMENSIONS is currently available, and a geometric tolerancing module, GEO DIMENSIONS will be available in the second quarter of 1990.

Both 3rd DIMENSIONS and GEO DIMENSIONS sell for \$149 separately or together for \$225. A demo disk is available.

For additional information, contact ALLAN CAD TOOLS, P.O. Box 22204, Portland, OR 97222. Telephone: (503) 659-9935.

CADL CORNER

TBOX.CDL: An Easy Way To Create Or Modify a Title Block

One of a designer's more tedious tasks is to write and place text in title blocks so that everything looks good.

TBOX.CDL allows you to write text into pre-defined locations in a title block. To do this, you create a template file that defines the field name, text size, text height, aspect ratio, font, and pen number for each one of the fields in the title block. The template file is an ASCII file stored in the CADKEY's main directory.

TBOX.CDL displays a menu that offers you selections among five options: Create Template, Append Field, Modify Field, Write Field, and Write Template.

Create Template allows you to define the field positions, widths, and text attributes.

Append Field allows you to append new fields to a template file.

Modify Field allows you to modify parameters in a single field of a template file.

Write Field allows you to write

(Continued on page 19.)

TRAINING SCHEDULE AT CADKEY, INC.

We have Training dates scheduled through April, 1990. Please call Lisa Varvelli in the Product Support Department to register (203) 647-0220.

| Course | Mar. | Apr. |
|-----------------------------|-------|-------|
| Introduction to CADKEY | 12-14 | 2-4 |
| Advanced Geometric Modeling | 15-16 | 5-6 |
| Introduction to CADL | 5-7 | |
| CADKEY SOLIDS | | 19-20 |

CADKEY/DataCAD Training In U.S. & Canada

Many authorized CADKEY and DataCAD Training Centers have scheduled courses in addition to the training available at CADKEY's world headquarters here in Manchester, CT. The following is a list of who is doing what, where, and when:

| State | CTC | Location/Contact | Course | Dates |
|--------|-----------------------------------|---|---|--|
| Ala. | Jacksonville State University | Jacksonville, AL Dr. P.S. Yeh (205) 231-5781 (205) 231-5229 | Intro. to CADKEY | Apr. 18-20 |
| Calif. | CAD Micro-Systems | 11936 W.Jefferson Blvd. Culver City, CA Monica Hunter (213) 391-7226 | Intro. to CADKEY Advanced CADKEY SOLIDS CADL | Mar. 7-9 Apr. 10-12 Mar. 14-15 Apr. 24-25 Apr. 17 Apr. 19 |
| | Golden West College | 15744 Golden West St. Huntington Beach, CA Jack North (714) 895-8209 | Intro. to CADKEY | Mar. 16-18 |
| | Consulting Services International | 7311 Van Nuys Blvd. Van Nuys, CA Bob Messamer (818) 994-8881 | Intro. to CADKEY Advanced CADKEY | 3rd wk. each mo. |
| | Evergreen Valley College | 3095 Yerba Buena Rd. San Jose, CA Loren Fromm (408) 274-7900 | Intro. to CADKEY | Scheduled on request. |
| | Poelman's Design Service | 901 Campisi Way, #360 Campbell, CA Mike Poelman (408) 377-3585 | Intro. to CADKEY SOLIDS | Mar. 27-29 Apr. 24-26 |
| | Ukiah High School | 1000 Low Gap Rd. Ukiah, CA Jim Howlett (707) 463-5253, x284 | Intro. to CADKEY | Mar. 2-4 |
| Colo. | University of Colorado at Denver | 1200 Larimer St. Denver, CO Andreas Vlahinos (303) 556-2370 | Intro. to CADKEY CADL | Mar. 19-21 Mar. 22-23 |

CADKEY/DataCAD Training in U.S. & Canada (continued)

| State | CTC | Location/Contact | Course | Dates |
|--------------|--------------------------------------|---|--|--|
| Conn. | Central Connecticut State University | 1615 Stanley Street New Britain, CT Paul Resetarits (203) 827-7262 | <i>Intro. to CADKEY</i> <i>Advanced CADKEY</i> | Mar. 19-21 May 21-23 Mar. 22-23 May 24-25 |
| | Datamat Programming Systems | 9 Mott Avenue Norwalk, CT Matt Reuben (203) 855-8102 | <i>Intro. to CADKEY</i> | Feb. 26 to Mar. 2 Apr. 2-6 |
| | Hartford Graduate Center | 275 Windsor St. Hartford, CT Paula DiMauro (203) 548-2474 | <i>Intro. to CADKEY</i> | Mar. 5-7 |
| | University of Hartford | S.I. Ward College of Pharmacy W. Hartford, CT Don Debonne (203) 243-4763 | <i>Intro. to CADKEY</i> | <u>Mon. Wed.</u> May 21 to July 12 |
| | Waterbury State Technical College | 750 Chase Pkwy. Waterbury, CT Stephen Colwell (203) 575-8084 | <i>Intro. to CADKEY</i> | Apr. 25-27 |
| | Republic Research Training Center | 1911 N. Ft. Myer Dr. Arlington, VA Gregg Kendrick (703) 525-9014 (800) 476-4454 | <i>DataCAD I</i> <i>DataCAD II</i> On DC Modeler request. <i>DCAL</i> | |
| | University of D.C. | Bldg. 42, Rm. 112 4200 Connecticut Av. Washington, DC Harold Goldstein (202) 282-7349 | <i>Intro. to CADKEY</i> | Mar. 26-28 |
| | Gateway Computers | 10901 Roosevelt Blvd. St. Petersburg, FL Patricia Murphy (813) 576-0549 | <i>Intro. to CADKEY</i> <i>Advanced CADKEY</i> <i>CADKEY</i> <i>SOLIDs</i> <i>CADKEY</i> <i>Free Demo</i> | Mar. 12-14 On request On request Mar. 21 |
| | Indian River Comm. College | 3209 Virginia Ave. Fort Pierce, FL Dean Zirwas (407) 468-4700 Ext. 4269 | <i>Intro to CADKEY</i> | Mar. 16-18 May 7, 9-14, 16 |
| | PFB Concepts, Inc. | 2525 E. Oakton Av. Arlington Heights, IL Bob Konczal (708) 640-1853 | <i>Intro. to CADKEY</i> <i>Advanced CADKEY</i> <i>CADKEY</i> <i>SOLIDs</i> | Mar. 7-9 Apr. 10-12 May 9-11 Jun. 6-8 Apr. 25-27 May 23-25 Jun. 20-22 May 17-18 |

Stereolithography and CADKEY

(Continued from page 9.)

completed, the part is removed from the system, and any liquid polymer clinging to the part is removed. The part is then finish cured for 10-15 minutes in an ultraviolet oven and sanded lightly to remove the supports.

Application Areas

Parts built using stereolithography can be used in a variety of ways in a product-development effort both to reduce the time required to get a new product to market, and to reduce development costs. Practical application areas include: creation of model parts, verification of the CAD model, mold making, and numerical control machining.

Model Parts

Model parts of a new design can be invaluable, and are sometimes essential, in trying to communicate design features to customers, marketing personnel, or company management. No rendering, engineering print, or shaded image can provide the same level of understanding of a design as holding a part in your hand. Design problems are often readily apparent in a finished model that would not be obvious in a print. The ability to generate a model of the design easily, quickly, and early in the development process can identify problems that would otherwise become apparent only after significant investments in time and money have been made in tooling. Consequently, large redesign and rework expenses can be avoided.

Stereolithography is an excellent way to create model parts quickly, inexpensively, and accurately. Parts can be created in a matter of days rather than weeks or months, and they can

be painted to resemble finished parts. Models can also be built at different scales without changing the original CAD model. Half-scale models of large parts, or larger-scale models of very small parts can be very effective at communicating design details.

Verification of CAD Model

In a company that effectively uses CAD/CAM/CAE tools in product development, the CAD model of a part is the definition of the design used in several subsequent operations. For example, it may be used in the creation of finite-element meshes for analysis; to create toolpaths to machine the part; to design tooling; to create toolpaths to machine the tooling, or for a variety of other tasks. These subsequent operations may represent several hundreds of man-hours and several months of time before the end results are seen. Any error in the CAD model could be propagated into several subsequent operations before it is discovered, resulting in long delays and rework expenses. To avoid such problems, many companies take steps to verify the accuracy of the CAD model.

Stereolithography is an excellent means to verify the data in a CAD model for several reasons:

- Stereolithography provides a visualization of the design that can be used to ensure that it conforms to the expectations of its designers.
 - Because the stereolithographic model is built directly from the CAD model, there is no human interpretation of design information that can either introduce error or smooth over errors existing in the model.
 - Because stereolithography
- (Continued on page 14.)

CADKEY/DataCAD Training in U.S. & Canada (continued)

| State | CTC | Location/Contact | Course | Dates |
|--------------|---|--|---|--|
| Ill. | PFB Concepts, Inc. (Continued) | 2525 E. Oakton Av. Arlington Heights, IL Bob Konczal (708) 640-1853 | CADL (Weekend) PageMaker & CADKEY | Scheduled on request. Mar. 29-30 & Jun. 14-15 |
| | Triton College Employee Development | 2000 Fifth Av. River Grove, IL Peggy Hosty (312) 456-0300, x539 | Intro. to CADKEY | <u>Saturdays</u> Mar. 10-31 <u>Fri. eve.</u> Apr. 20- May 25. May 16-18 |
| Iowa | Iowa Lakes Comm. College | 300 South 18th St. Estherville, IA Roger Patocka (712) 362-2604 | Intro. to CADKEY | Mar. 6 (3 weeks) |
| Mass. | Springfield Technical Community College | 1 Armory Square Springfield, MA William White (413) 781-7822 | Intro. to CADKEY | Mar. 19-21 Jun. 11-13 |
| | Worcester Polytechnic Institute | 100 Institute Rd. Worcester, MA Pat Scavone (508) 831-5633 | Intro. to CADKEY | Mar. 6-7 |
| Md. | Catonsville Comm. College | 800 South Rolling Rd. Catonsville, MD Tom Barrett (301) 455-4298 | Intro. to CADKEY | Apr. 23-27 |
| | | | Advanced CADKEY | May 23-25 |
| Mich. | Future Solutions | 35455 Schoolcraft Livonia, MI Paul Zwarka (313) 397-2486 | Intro. to CADKEY | Mar. 6-8 Apr 3-5 May 1-3 May 29-31 Jun. 26-27 |
| | | | Advanced CADKEY | Mar. 13-14 Apr. 10-11 May 8-9 Jun. 4-5 Jul. 10-11 |
| | Lansing Comm. College | 419 N. Capital Ave. Lansing, MI Jim Perkins Steve Pohl Jerry Flore (517) 483-1356 | Intro. to DataCAD Advanced DataCAD | Mar. 31 to Jun. 15 Mar. 31 to Jun. 15 |
| | Western Michigan University | Kalamazoo, MI Michael Atkins (616) 387-6522 | Intro. to CADKEY Advanced CADKEY | Mar 12-14 Apr. 2-4 |
| Minn. | Albert Lea Technical Institute | 2200 Tech Dr. Albert Lea, MN Larry Gilderhus (507) 373-0656 | Intro. to CADKEY | Scheduled on request |

CADKEY/DataCAD Training in U.S. & Canada (continued)

| State | CTC | Location/Contact | Course | Dates |
|--------------|------------------------------|--|--|---------------------------------------|
| Minn. | Anderson-O'Brien | 2575 N. Fairview Ave. St. Paul, MN Gail Lenzmeier (612) 636-2869 | <i>Intro. to CADKEY</i> | Mar. 6 -9 Apr. 10-13 |
| | Anoka Ramsey Comm. College | 11200 Mississippi Blvd. Coon Rapids, MN George Heron (612) 427-2600 | <i>Intro. to CADKEY</i> <i>Advanced CADKEY</i> | Evening classes scheduled on request. |
| | Moorhead State University | Moorhead, MN Wade Swenson (218) 236-2466 | <i>Intro. to CADKEY</i> | Feb. 28 to Mar. 2 Jun. 6-8 |
| | St. Paul Technical Institute | 235 Marshall Av. St. Paul, MN Michael Haffner (612) 221-1307 | <i>Intro. to CADKEY</i> | Call for schedule. |
| | Mo. Country Computer | 810 East Marshall St. Charleston, MO Bill McNear (314) 683-3383 | <i>Basic DataCAD</i> | Feb. 7-9 |
| Mt. | Montana Tech | W. Park St. Butte, MT (406) 496-4452 | <i>Advanced CADKEY</i> | May 17-18 |
| N.C. | Rockingham Comm. College | P.O. Box 38 Wentworth, NC Jim Putnam (919) 342-4261 | <i>Intro. to CADKEY</i> | Mar. 21-23 May 2-4 |
| | Wake Technical Comm. College | 9101 Fayetteville Rd. Raleigh, NC Brian Matthews (919) 772-0551, x172 | <i>Intro. to DataCAD</i> (11-week, eve. course) | Fall, Winter, Spring, Summer. |
| N.J. | Glassboro State College | Glassboro, NJ John Humbert (609) 863-6203 | <i>Intro. to CADKEY</i> | Apr. 23-25 |
| | Entre Computer Center | 400 Route 17, South Ridgewood, NJ Pat Neary (201) 445-6333 | <i>DataCAD, the Basics</i> | Jan. 15-19 |
| N.Y. | Onondaga Comm. College | Onondaga Hill Campus Syracuse, NY Paul Rice (315) 469-7741, x520 | <i>Intro. to CADKEY</i> | Apr. 16 thru May (evenings) |
| | Iona College | 715 North Ave. New Rochelle, NY Flory Netsch (914) 235-1360 | <i>Intro. to CADKEY</i> <i>Intermed. CADKEY</i> | Apr. 13 Jul. 12 May 29 |
| Ohio | CAD CAM, Inc. | 2844 East River Rd. Dayton, OH Stephen Bishop (513) 293-3381 | <i>Intro. to CADKEY</i> | Mar. 19-21 Apr. 16-18 |

Stereolithography and

CADKEY

(Continued from page 13.)

requires a complete definition of the design to build the part, if any information is missing, either the part will not build, or the error will be readily apparent in the finished part.

Applications in Manufacturing Process Development

There are several ways that stereolithography can be used, in combination with other techniques, to speed the movement of a part design to manufacturing while reducing development costs. The particular combination of techniques used will depend on the process that will ultimately be used to manufacture the part.

Applications in Injection Molding

Injection molding is a means of producing high volumes of plastic parts at an extremely low cost per part. Getting to production, however, can be a very expensive process. A multi-cavity injection mold can cost tens of thousands of dollars, and require several months to produce. Because the adequacy of the design cannot be confirmed until the first part is molded, the cost and time required to get the tooling is invested at the risk of a design error. Many companies lower that risk by first creating a prototype mold. The prototype tool, however, is not without its own risks. The tooling typically costs \$5,000 to \$10,000, and may have lead times of two or three months. Consequently, even though the risk is lowered, the time and cost to get the new product to market is increased.

Stereolithography can be used to shorten the process of getting

injection-molded parts into production:

— **Soft Tooling** - The part created through stereolithography can be used as a pattern to create a silicon rubber mold that can, in turn, be used to make copies of the part in a polyurethane material. There is a wide range of polyurethane materials available, from very soft elastomeric-like materials to very tough rigid materials. Molds typically take a day or two, and copies can be created at rates of one-to-five parts per day thereafter. This can eliminate the need for a prototype tool and still lower the risk of design error.

— **Temporary Tooling** - If parts need to be created in the end material, a temporary mold can be made from the stereolithographic part, by processes using epoxy or molten metal and epoxy, to injection-mold limited numbers of copies. Although both of these processes are limited in their ability to handle complex geometries and tight tolerances, they do allow molds to be created quickly, and avoid the time and expense of prototype tooling.

— **Hard Tooling** - Production tooling can be made directly from stereolithographically created models of a cavity and core through a powder-metal process. Although there are some limitations on the complexity of the design and tolerances to be held, tooling created in this manner can usually be delivered in 5-6 weeks at significantly less cost than that of a prototype tool. Several companies have obtained *mold lives* exceeding one million shots

(Continued on page 16.)

CADKEY/DataCAD Training in U.S. & Canada (continued)

| State | CTC | Location/Contact | Course | Dates |
|--------------|-----------------------------------|---|-------------------------------------|--|
| Ohio | CAD CAM Inc. (Continued) | 2844 East River Rd. Dayton, OH Stephen Bishop (513) 293-3381 | Advanced CADKEY | Mar. 1-2 Mar. 22-23 Apr. 19-20 |
| | Progressive Computing Corporation | 6964 Spinach Dr. Mentor, OH Mark Orzen (216) 255-0460 | Intro. to CADKEY | Mar. 6-7 |
| | | | Advanced CADKEY | Mar. 14-15 |
| | | | CADL | Mar. 22, 28 |
| | | | Adv. CADL | Mar. 29 |
| Oklahoma | Oklahoma State University | 301 Cordell South Stillwater, OK Gerald McClain (405) 744-5709 | Intro. to CADKEY | Mar. 5 |
| | | | Intermed. CADKEY | Mar. 6-7 |
| Pa. | Micro Control Inc. | 390 Middletown Blvd Langhorne, PA Marion Homan (215) 752-5510 | Intro. to CADKEY | Mar. 13-16 |
| | North Hampton County Comm. | 3835 Green Pond Rd. Bethlehem, PA Wanda Gruppo (215) 861-5300 | Intro. to CADKEY | Mar. 13-14 |
| | | | Advanced CADKEY | Mar. 19-21 |
| | Penn. State Univ. at Erie | Station Road Erie, PA. Behrend College | CADL CADKEY SOLID S | Mar. 1-2 May 31 to June 1 |
| R.I. | Entre Computer Center | 385 S. Main St. Providence, RI Carlos Kiamco (401) 831-7280 | Intro. to CADKEY | Mar. 19, 22 26, 29 Apr. 16, 19 23, 26 |
| | | | Intro. to DataCAD | Mar. 5, 8 12, 15 Apr. 2, 5, 9, 12 |
| S.D. | Northern State College | Box 705 Aberdeen, SD Jerry Sauer (605) 622-2571 | Intro. to CADKEY | May 28-29 |
| Tenn. | Southern College | Box 370 Collegedale, TN John Durichek ((615) 238-2862 | Intro. to CADKEY | Mar. 4-6 |
| Texas | MLC CAD Systems | 5316 Highway 290 West Austin, TX Pat Stutz (512) 892-6311 | Intro. to CADKEY Advanced CADKEY | Mar. 28-30 Apr. 25-27 Scheduled on request |

CADKEY/DataCAD Training in U.S. & Canada (continued)

| State | CTC | Location/Contact | Course | Date |
|-------|---------------------------------------|--|---|--|
| Texas | Texas A&I University | Campus Box 203 Kingsville, TX Herchel Kelley (512) 595-2608 | Intro. to CADKEY | Mar. 14-16 |
| | Texas Tech University | P.O. Box 4200 Lubbock, TX Mary Bentancourt (806) 742-3451 | Intro. to CADKEY | Mar. 20-22 May 15-17 May 15-17 Aug. 21-23 |
| Utah | Salt Lake Comm. College | 4600 S. Redwood Rd. Salt Lake City, UT Gary Poulsen (801) 967-4303 | Intro. to CADKEY | Mar. 19-21 <u>Mon., Wed.</u> afternoons: May 2 to June 6. |
| | Va. Republic Research Training Center | 855 West Main St. Charlottesville, VA Gregg Kendrick (804) 296-9747 (800) 476-4454 | DataCAD I DataCAD II DC Modeler DCAL | Feb. 26-28 May 21-23 Jan. 29-30 Jun. 18-19 Jan. 11-12 Mar. 26-27 April 23-24 On request |
| | Virginia Tech | 144 Smyth Hall Blacksburg, VA Allen Bame (703) 231-6480 | Advanced CADKEY | Mar. 12-14 |
| Wash. | Everett Community College | 801 Wetmore Avenue Everett, WA Dave Utela (206) 259-7151 | Intro. to CAD/CAM for educators | Mar. 22-23 |
| | WallaWalla College | 204 S. College Av. College Place, WA Robert Noel (509) 527-2082 | Intro. to CADKEY | Mar. 19-21 |
| Wis. | North Central Technical College | 1000 Campus Dr. Wausau, WI Michael Clark (715) 675-3331 | Intro. to CADKEY | May 29-31 Additional courses on request. |
| Wyo. | University of Wyoming | 3085 Engineering Bldg. P.O. Box 3295 Laramie WY Donald Polson (307) 766-6450 | Intro. to CADKEY | May 23-25 July 25-27 Aug. 20-22 |

CANADA

| Prov. | CTC | Location/Contact | Course | Dates |
|-------------|-------------------------------------|---|-------------------------------------|------------------------|
| Nova Scotia | Technical University of Nova Scotia | P.O. Box 1000 Halifax, N.S. Gary Bustin (902) 420-7764 | Intro. to CADKEY Advanced CADKEY | Mar. 26-28 Apr. 2-3 |

Stereolithography and CADKEY

(Continued from page 15.)

(injections) with this process.

Applications in Investment Casting

The development of investment-cast parts is often similar to that of injection-molded parts in that an injection mold may be required to mold wax patterns. Consequently, many of the same costs, lead times and risks involved in injection-molded parts apply. In many cases, stereolithography can often be used to reduce significantly the time and cost required to get into production. Specific areas in which it can be applied include:

— **Soft Tooling** - As in the creation of urethane copies, a silicon rubber mold can be made using the stereolithographic part as a pattern. In this case, however, copies are created in casting wax to prove the design. If a few copies of the part are required, this process can be used to avoid the creation of hard tooling altogether.

— **Pattern Creation** - If the design is sufficiently complex that a silicon rubber mold cannot be created, stereolithography can be used to create a pattern directly. Although the stereolithographic part is plastic rather than wax, it can be used as a pattern for investment casting with some precautions. This can be an excellent way to create custom parts or single copies of a design.

Applications in Sand Casting

As with injection-molded and investment-cast parts, sand-cast parts usually require a

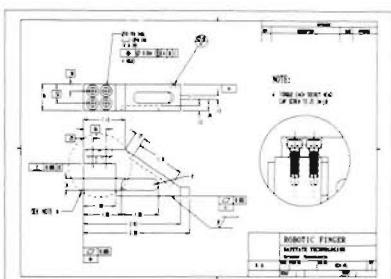
(Continued on page 18.)

Announcement of Training Dates

If you are a CADKEY/DataCAD Training Center and would like the dates of your scheduled training courses to appear in **3D-WORLD**, contact Peter Mancini, Educational Programs, CADKEY, INC., 440 Oakland Street, Manchester, CT 06040-2100. Telephone: (800)654-3413, or (203) 647-0220. FAX: (203) 646-7120.

| Prov. | CTC | Location/Contact | Course | Dates |
|---------|---|--|---|--------------------------|
| Ontario | C.A.T.E. Ryerson Polytechnical Institute | 350 Victoria St. Toronto, Ontario Brian Whelton (416) 979-5106 | <i>Intro. to CADKEY</i> | Apr. 26-27 |
| | Algonquin College | 200 Lees Ave. Ottawa Peter Casey (613) 594-3888 x5904 | <i>CADKEY System Custom- ization</i> | Mar. 12- Apr. 4 |
| | JB Marketing Associates | 82 Spruceside Cresc. Fonthill, Ontario John Bradford (416) 892-8025 | <i>DataCAD I</i> Scheduled <i>DataCAD II</i> on request. | |
| | Naylor- McLeod Group | 1425 Bishop St. Cambridge, Ontario Brian Naylor (519) 622-4495 | <i>Intro. to CADKEY</i> | Scheduled on request. |
| | JB Marketing Associates | 82 Spruceside Cresc. Fonthill, Ontario John Bradford (416) 892-8025 | <i>DataCAD I</i> Scheduled <i>DataCAD II</i> on request. | |
| | Naylor- McLeod Group | 1425 Bishop St. Cambridge, Ontario Brian Naylor (519) 622-4495 | <i>Intro. to CADKEY</i> | Scheduled on request. |

Why you should contact your CADKEY Dealer...



DRAFT-PAK™

"A CADKEY® Integrated Enhancement"

If you are a mechanical designer or engineer you need DRAFT-PAK. Don't take our word for it, your CADKEY dealer can show you first hand how to become more productive with your CAD system.

DRAFT-PAK will save you valuable design and detailing time, with CADKEY, through powerful 2D and 3D parametric programs, built right into the CADKEY menu. Several of DRAFT-PAK's functions are listed below:

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for a demo or further details.*

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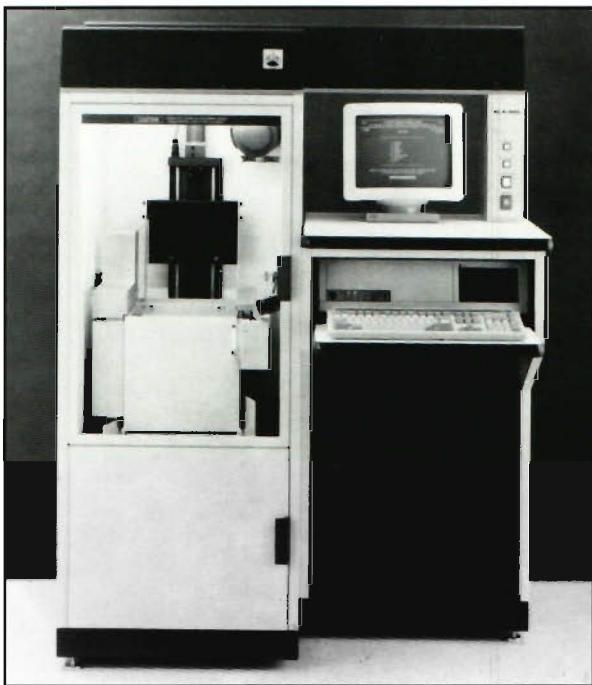
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Stereolithography and

CADKEY

(Continued from page 16.)

significant investment of both time and money in tooling a pattern before the first part can be produced. A stereolithographic model of the pattern can be used to generate accurate copies of the pattern in a more durable material, a tough urethane or metal. This process can be fast and inexpensive compared to conventional pattern-making methods.



Stereolithography Apparatus, Model SLA-250, manufactured by
3D systems, inc. of Valencia, California.

Applications in NC Machining

The creation of NC toolpaths from a CAD model can be a relatively long process, especially for a complex design. Several days, if not weeks, can be required to define completely the toolpaths necessary to machine the design. Stereolithography can add value to this process in two ways:

— Model Verification -

Creating a stereolithographic model of the part before beginning the generation of toolpaths will ensure that the CAD model is complete and

without error. This will minimize the need for reworking toolpaths that were generated from a faulty model.

— **Part Verification** - Having an accurate model of the part to which to refer while generating toolpaths can be extremely valuable to the operator, especially when the operator is not the designer of the part. And, it can significantly improve productivity.

solid model with CADKEY SOLIDS.

2. **Position the Model in Positive Space** - No part of the geometry can extend into a region of 3-D space where one or more of its coordinates would be negative. If necessary, move the model so that all points on the model have positive coordinates.

The model is now ready for stereolithography.

Summary

Stereolithography is a new technology that is causing a significant change in the process of product development. It is a means to create model parts more quickly, accurately, and inexpensively than conventional means. In addition, when used in combination with other techniques, it can significantly reduce the time and cost of getting new products to market, as well as lower the risk inherent in product development.

Editor's Note: Tom Mueller will present a more in-depth presentation of stereolithography in the NDES'90 issue of **CADKEY CHICAGO OUTPUT**, a newsletter published by PFB Concepts, Inc., 2525 East Oakton, Arlington Heights, IL 60005. Telephone: (708) 640-1853. FAX: (708) 640-1868. Contact PFB Concepts, also known as CADKEY CHICAGO for a copy of the newsletter.

You may contact Tom Mueller directly at PROTOTYPE EXPRESS, INC., 415 West Golf Road, Suite 25, Arlington Heights, IL 60005. Telephone: (708) 640-6444. FAX: (708) 640-6496.

3-D WORLD will feature a follow-up article on stereolithography and CADKEY in our next issue, May/June, 1990.

Preparing a CADKEY Model for Stereolithography

CADKEY 3™ and CADKEY SOLIDS™ are excellent packages for creating stereolithographic parts. In general, the procedure for preparing the model is as follows:

1. **Create the Solid Model** - Stereolithography requires a complete definition of the part's geometry. To create the solid model, you must begin by creating a 3-D wireframe model in CADKEY 3, and then converting it into a

CADKEY 3 User Offers Design and CADL Services

New Age Engineering & Design of Granada Hills, California, is providing their mechanical-engineering and design capabilities with CADKEY 3™ and CADKEY SOLIDS™ as a contract service to businesses that have design workloads exceeding in-house capacity. New Age Engineering & Design specializes in the design and analysis of products, tooling, and equipment at any stage of development.

This new service allows a business to get a *hot* project moving almost immediately, without having to wait for personnel recruitment or computer-equipment procurements. It is ideal for short and medium-term projects where permanent expansion of in-house design and engineering capacity cannot be justified. Businesses currently using

CADKEY 3 can be confident that no surprises will occur in the translation of part files.

New Age Engineering & Design also provides CADL™ (CADKEY Advanced Design Language) and MACRO programming services. Many businesses can enhance their productivity with routines designed to meet their unique requirements. Most repetitive design tasks can be streamlined with CADL and/or MACROS. In many cases, ASCII data from other programs can be used as design parameters, too.

New Age Engineering & Design uses CADKEY 3 and CADKEY SOLIDS exclusively to provide the maximum design productivity for their clients. The result is a high-quality, design and engineering service that delivers on time. All work performed conforms with

applicable customer specifications and industry standards. Non-disclosure agreements for proprietary information are available.

For additional information, contact Mike Swatek, New Age Engineering and Design, 17221 Chatsworth, Suite 112, Granada Hills, CA 91344. Telephone: (818) 368-1627.

CADL CORNER

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a single field to the title block.

Write Template writes the entire title block using the default text in each one of the fields of the template file.

How to use: FILES - CADL-EXECUTE, enter: tbox

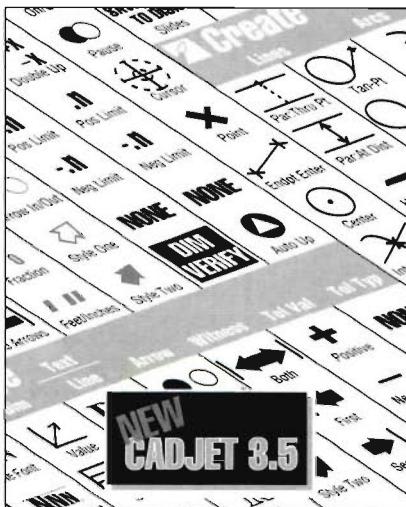
An efficient way to use TBOX.CDL is to edit the default text fields in the template file, and then to write the entire title block using the Write Template option.

Exceed The Speed Limit,

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NDES '90

(Continued from page 1.)

Drawing Board (9:00 to 9:55 a.m.) and **CAD Applications During the Design-Engineering Process** (10:00 to 11:00 a.m.).

NDES Session 36, **Integrating CAD into Corporate Operations**, also on Wednesday, February 28, will also feature two seminars: **Design to Manufacturing: the Translation** (2:00 to 3:20 p.m.) and **The Corporate Decision: Converting to CAD** (3:30 to 5:00 p.m.).

All of these conferences will give attendees opportunities to address their questions directly to industry leaders.

Session 35A, **From Decision to Drawing Board**, will present a discussion about the use of different operating systems in the initial stages of design and prototyping. Steve Malisewski, Director of Applications and Marketing at COMPAQ CORPORATION will lead the discussion of **DOS in Computer-aided Design**. Silicon Graphics, Inc. will present **UNIX in Computer-aided Design**. Livingston Davies, Co-founder and President of CADKEY, INC. will

discuss **CAD versus Conventional Design**.

Session 35B, **CAD Applications During the Design-Engineering Process**, will explore the uses and advantages of CAD and CAE in pre-production. Peter Smith, CADKEY's Co-founder and Chairman of the Board, will address **Low-end Modeling Techniques**. Doug Curry, Director of Sales and Marketing at MODERN COMPUTER-AIDED ENGINEERING, INC., will discuss **Model Analysis**. Prototyping will be addressed from two perspectives. Pixar, Inc. will present rendering as **Soft-Prototyping**. And, Tom Mueller, Executive Vice President of PROTOTYPE EXPRESS, INC., will talk about **Stereolithography**.

Session 36A, **Design to Manufacturing: the Translation**, will feature Mark Craig, President of APPLIED COMPUTER SOLUTIONS, INC., on the subject of **Pre-Production Model Analysis**. Gary Magoon, Director of Manufacturing Systems at CADKEY, INC., will discuss **Translators and IGES**. OLMSTEAD ENGINEERING will examine the **CAM Advantage**. Anne Bernhardt, President of PLASTICS & COMPUTER, INC. will discuss

Injection Molding

Peter Smith of CADKEY INC. will open Session 36B, **The Corporate Decision: Converting to CAD, with a discussion of Two Dimensionality versus Three Dimensionality**. Joel Orr, President of the National Computer Graphics Association, as well as President of ORR AND ASSOCIATES, will discuss **Selecting the Right CAD Program**. **Scanning as an Initiation** will also be addressed. Bringing the conference to a down-to-earth conclusion, Vector Aeromotive Corporation will illustrate **Theory in Practice**.

For admission tickets to the conferences and seminars at NDES '90, contact Customer Service, Cahners Exposition Group, P.O. Box 3833, 999 Summer Street, Stamford, Connecticut 06905. Telephone: (800) 255-7798 or (203) 964-0000.

For discounted admission tickets to the exhibit areas of NDES '90, contact Danielle Cote, CADKEY's Events Manager. Telephone (800) 654-3413 or (203) 647-0220. Admission to the exhibit areas does not include admission to NDES '90's conferences and seminars.

(See related story about **Stereolithography and CADKEY** on page 8.)

TRADE SHOW UPDATE

See CADKEY 3 and DataCAD at these trade shows in early 1990:

FOSE '90, Mar. 19-22, Washington Convention Center, Washington, DC, Booth #G3831.

NCGA '90, Mar. 19-22, Anaheim Convention Center, Anaheim, CA, Booth #1052.

ITEA '90, Apr. 2-5, Indianapolis Convention Center, Indianapolis, IN, Booth #410.

AIA '90, May 19-22, George Brown Convention Center, Houston, TX Booth #1153.

AEC Systems '90, Jun. 12-15, Georgia World Congress Center, Atlanta, GA, Booth #1848.

International Trade Shows

CeBIT '90, World Center "Office-Information-

Communication," Mar. 21-28, Hannover Fair, Hannover, Fed. Rep. of Germany, SOFT-TECH.

CAD/CAM '90, CAT and AEC Show, Mar. 27-29, Birmingham, U.K., ECSL-CADKEY and SPIRIT AEC Software Technology, Ltd. (Booth #129).

CAT '90, May 29 to June 1, Stuttgart, Fed. Rep. of Germany, SOFT-TECH.

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