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MODERN STEEL CONSTRUCTION

February 1991

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944030
Pamela Brent
Secretary
American Inst. of Steel Constn.
One East Wacker Drive #3100
Chicago, IL 60601-2001

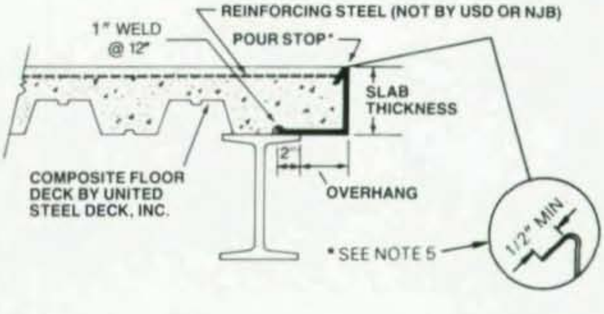
UNITED STEEL DECK, INC. DECK DESIGN DATA SHEET No. 1

POUR STOP SELECTION CHART

SLAB DEPTH (Inches)	OVERHANG (INCHES)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
						POUR STOP TYPES							
4.00	20	20	20	20	18	18	16	14	12	12	12	10	10
4.25	20	20	20	18	18	16	16	14	12	12	12	10	10
4.50	20	20	20	18	18	16	16	14	12	12	12	10	10
4.75	20	20	18	18	16	16	14	14	12	12	10	10	10
5.00	20	20	18	18	16	16	14	14	12	12	10	10	
5.25	20	18	18	16	16	14	14	12	12	12	10	10	
5.50	20	18	18	16	16	14	14	12	12	12	10	10	
5.75	20	18	16	16	14	14	12	12	12	12	10	10	
6.00	18	18	16	16	14	14	12	12	12	10	10	10	
6.25	18	18	16	14	14	12	12	12	12	10	10		
6.50	18	16	16	14	14	12	12	12	12	10	10		
6.75	18	16	14	14	14	12	12	12	10	10	10		
7.00	16	16	14	14	12	12	12	12	10	10	10		
7.25	16	16	14	14	12	12	12	10	10	10			
7.50	16	14	14	12	12	12	12	10	10	10			
7.75	16	14	14	12	12	12	10	10	10	10			
8.00	14	14	12	12	12	12	10	10	10				
8.25	14	14	12	12	12	10	10	10	10				
8.50	14	12	12	12	12	10	10	10					
8.75	14	12	12	12	12	10	10	10					
9.00	14	12	12	12	10	10	10						
9.25	12	12	12	12	10	10	10						
9.50	12	12	12	10	10	10							
9.75	12	12	12	10	10	10							
10.00	12	12	10	10	10	10							
10.25	12	12	10	10	10								
10.50	12	12	10	10	10								
10.75	12	10	10	10									
11.00	12	10	10	10									
11.25	12	10	10										
11.50	10	10	10										
11.75	10	10											
12.00	10	10											

TYPES	DESIGN THICKNESS
20	0.0358
18	0.0474
16	0.0598
14	0.0747
12	0.1046
10	0.1345

This chart is a repeat of our first DECK DESIGN DATA SHEET; the format has been revised to make the type (gage) selection easier.



NOTES: THE ABOVE SELECTION TABLE IS BASED ON THE FOLLOWING CRITERIA:

1. NORMAL WEIGHT CONCRETE (150PCF).
2. HORIZONTAL AND VERTICAL DEFLECTION IS LIMITED TO 1/4" MAXIMUM FOR CONCRETE DEAD LOAD.
3. DESIGN STRESS IS LIMITED TO 20 KSI FOR CONCRETE DEAD LOAD TEMPORARILY INCREASED BY ONE-THIRD FOR THE CONSTRUCTION LIVE LOAD OF 20 PSF.
4. POUR STOP SELECTION TABLE DOES NOT CONSIDER THE EFFECT OF THE PERFORMANCE, DEFLECTION, OR ROTATION OF THE POUR STOP SUPPORT WHICH MAY INCLUDE BOTH THE SUPPORTING COMPOSITE DECK AND/ OR THE FRAME.
5. VERTICAL LEG RETURN LIP IS RECOMMENDED FOR TYPE 16 AND LIGHTER.
6. THIS SELECTION IS NOT MEANT TO REPLACE THE JUDGEMENT OF EXPERIENCED STRUCTURAL ENGINEERS AND SHALL BE CONSIDERED AS A REFERENCE ONLY.

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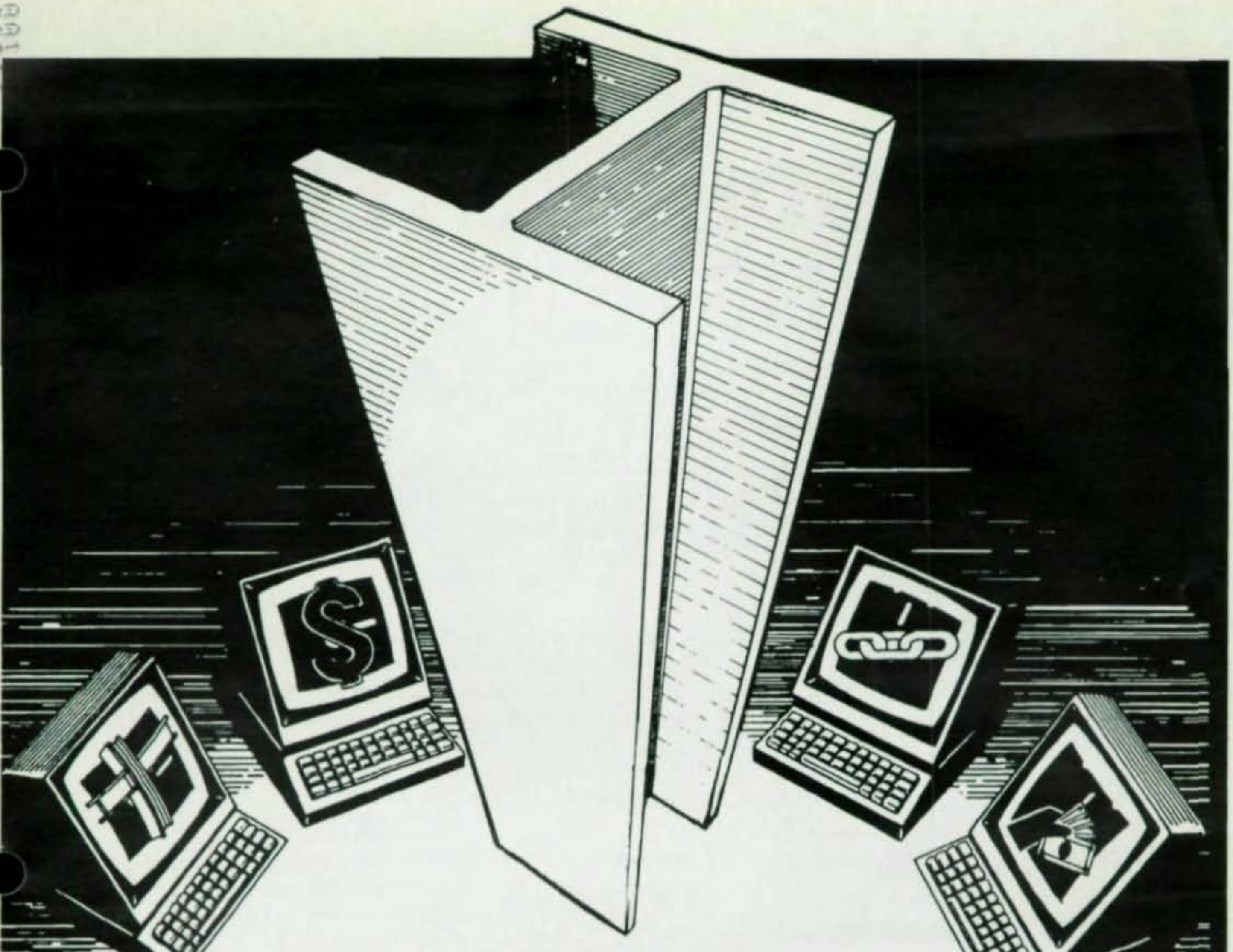

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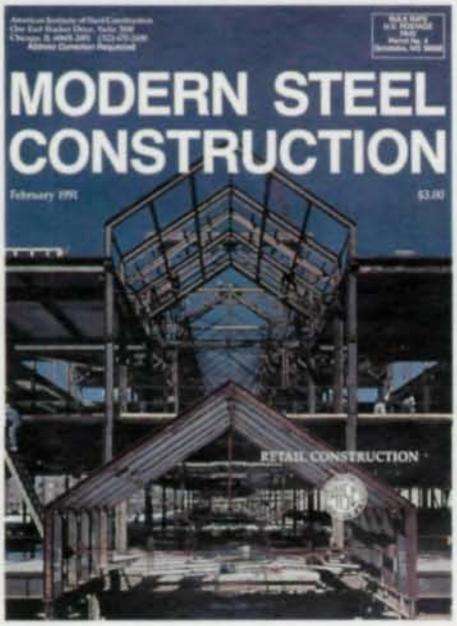
MODERN STEEL CONSTRUCTION

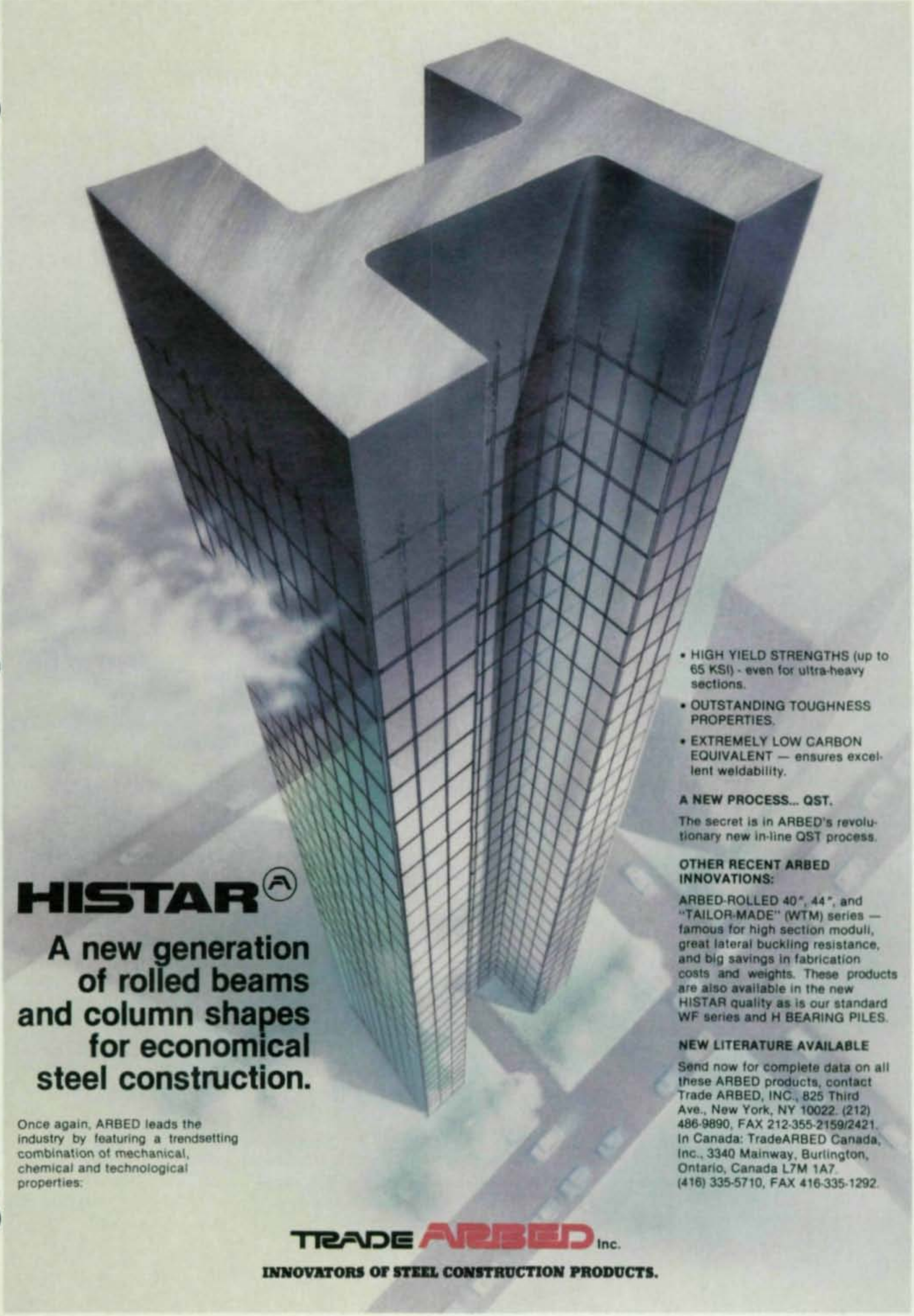
Volume 31, Number 2 February 1991



In order to meet a tight schedule and open in time for the Christmas shopping season, CambridgeSide Galleria's below-grade parking structure utilized a steel frame, which allowed work on the retail portion to proceed at an accelerated rate. The story of this innovative project begins on page 22.

FEATURES

NEWS AND DEPARTMENTS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Boom Or Bust?

For years, economists have examined the real estate market and expounded on its cyclic nature—a pattern reinforced by the minimum three-plus year lag time between a project's inception and its completion.

The first part of this decade is shaping up as the downside of the construction boom-bust cycle. But its a downside with a twist.

Since this issue is devoted to shopping centers, the retail market provides an appropriate example. Everyone involved in design and construction knows that the retail market is saturated. Dollars spent on design and construction should be down substantially in 1991.

But according to the latest figures from Cahners Economics, spending on retail construction is actually expected to increase slightly, from $31.2 billion in 1990 to $32.2 billion in 1991. Why? Because the renovation market is growing by leaps and bounds.

"New construction is declining," according to Daryl Delano, a senior economist with Cahners Economics, the forecasting arm of Cahners Publishing. "Our forecast for the retail market implicitly assumes growth on the renovation side."

The retail market is an extreme example of the growth of renovation. Styles change rapidly in that market, and smart architects and engineers have always designed their structures to be adaptable. But its not the only area in which flexibility is crucial. Health care is another obvious example, as is manufacturing. But even office buildings need to be flexible enough both to adapt to changes in technology and the need for growth and expansion.

How fast is renovation growing? A decade ago, less than 20% of building construction activity was renovation. Today, according to the Federal Government, more than half of the dollars spent in the building construction market are spent renovating old buildings.

Designers can capitalize on this trend in two ways.

First, it's important that young designers are trained in, or made aware of, historical practices. What type of structural systems are likely to be found in a 60-year-old building? And what kind of loads can those systems handle? It's feasible that engineering firms may soon find themselves following the model used in some architectural firms of having a principal devote himself exclusively to renovation projects—and thereby establishing his firm's expertise in that area.

Second, it's important that designers of new buildings realize that in the future—and that future may be only five or six years away—their designs will be renovated. The day isn't far away when a major criteria in judging the success of a design will be its inherent flexibility and consequentially its ability to readily and economically adapt to the needs of the owner now and in the future. **SM**

As Workloads Decline, Marketing Efforts Shrink

As workloads begin their cyclic decline, design firm marketing expenditures are starting to suffer, according to a new financial performance survey.

"Marketing expenditures as a percent of total revenue have been declining for several years," according to Howard Birnberg, president of Birnberg & Associates, a respected consulting firm that conducts an annual financial survey. "High levels of work in recent years may have discouraged designers from investing in this area. Unfortunately, with declining workloads, many firms may regret this decision. It's self defeating."

Birnberg did note, however, that while the percentage of revenues spent on marketing in recent years was on the decline, the absolute amount spent on marketing had risen, since total revenues were up. Rising expenditures on marketing seems to have ended in 1989, however.

Designers spent 5.5% of their annual total revenues on marketing in 1984, 4.4% in 1988, and only 3.6% in 1990. Net profit on total revenues has declined to 7.0% in 1990, from 8.1% in 1989 and 1988.

The "1990 Financial Performance Survey of Design Firms" compiled data from 165 firms, of which 52.2% were engineers and 26.1% were architects.

Anecdotal evidence about marketing efforts shows mixed activity, according to Birnberg. "I've worked with a couple of larger firms that have begun in the past few years to pay much greater attention to both project management and marketing. It's no longer a question of a principal taking care of the marketing effort in his spare time. It's more structured. On the other hand, I'm aware of other large firms that have substantially cut, or even eliminated, their marketing departments as their work has declined."

Net Profit On Total Revenues
(before taxes and distributions)

Year	Percent
1990	7.0
1989	8.1
1988	8.1
1987	7.1
1986	7.9
1985	6.8
1984	5.5
1982	7.1

Average Collection Period

Year	Days
1990	67
1989	69
1988	77
1987	76
1986	72
1985	60
1984	64
1982	69
1980	64
1978	72

Overhead Rates
(before distribution)

Year	Percent
1990	150
1989	149
1988	135
1987	149
1986	143
1985	151
1984	156
1982	140

Marketing To Total Revenues

Year	Percent
1990	3.6
1989	3.8
1988	4.4
1987	4.4
1986	4.7
1985	4.6
1984	5.5
1982	5.0

Another measure of the problem that design firms will face in the early 1990s is climbing overhead rates, which reached a record low in 1988. "Part of this increase can be attributed to the declining workload in firms," Birnberg explained. "Much overhead in design firms is fairly fixed. Reducing these costs is a difficult and time consuming process. Compounding the problem is the rising level of technical staff time charged to overhead areas as workload falls. Unless a firm's managers aggressively reduce technical staff, increase direct chargeable labor time, or cut overhead costs, the overhead rate will rise.

An overhead rate ratio can be calculated by dividing total firm overhead by total firm direct labor. The overhead rate before distributions for bonuses and profit fell to an all-time low of 135% in 1988, before climbing to 149% in 1989 and 150% in 1990.

Errors and omissions insurance accounted for, on average, 5.77% of total overhead before distributions. The average coverage was $1,328,280, while the average deductible was $69,800. After distributions, errors and omissions insurance was only 5.12% on average, with a median response of 4.68%

The American Consulting Engi-

Continued on page 11

AISC 1991 Prize Bridge Competition

Eligibility
To be eligible, a bridge must be built of fabricated structural steel, must be located within the United States (defined as the 50 states, the District of Columbia, and all U.S. territories), and must have been completed and opened to traffic from July 1, 1986 through May 1, 1991.

Judging Criteria
Will be based primarily upon aesthetics, economics, design and engineering solutions. Quality of presentations, though not a criterion, is important.

Award Categories
Entries will be judged in one or more categories, but may receive only one award.

Long Span One or more spans over 400 ft. in length.

Medium Span, High Clearance Vertical clearance of 35 ft. or more with longest span between 125 and 400 ft.

Medium Span, Low Clearance Vertical clearance less than 35 ft. with longest span between 125 and 400 ft.

Short Span No single span greater than 125 ft. in length.

Grade Separation Basic purpose is grade separation.

Elevated Highway or Viaduct Five or more spans, crossing one or more traffic lanes.

Movable Span Having a movable span.

Railroad Principal purpose of carrying a railroad, may be combination, but non-movable.

Special Purpose Bridge not identifiable in one of the above categories, including pedestrian, pipeline and airplane.

Reconstructed Having undergone major rebuilding.

Entry Requirements
All entries must contain an entry form, photographs and a written description of the project.

1. *Entry form:* All information requested on the form must be completed in full.

2. *Photographs:* Professional quality 8x10 color prints of various views showing the entire bridge, including abutments. 35 mm slides should also be submitted if available. All photographs must be cleared for use by AISC.

3. *Description:* Explanation of design concept, problems and solutions, aesthetic studies, project economics and any unique or innovative aspect of the project. Include no larger than 11x17 drawings showing elevation, framing system and typical details.

Method of Presentation
Each entry should be submitted in an 8½" x 11" binder, containing transparent window sleeves for displaying inserts back to back. The entry form included in the brochure must be easily removable, so that the identification of the entry can be concealed during judging. All information requested on the entry form must be included.

Awards
The winners will be notified shortly after the June judging. Public announcements of the winners will be made in the September issue of *Modern Steel Construction* magazine. Award presentations will be made to the winning designers during the National Steel Bridge Symposium, September 16, 1991, in St. Louis, MO.

Deadline for Submission
Entries must be postmarked on or before ***May 24, 1991****, and addressed to: American Institute of Steel Construction, Inc., Attn: Awards Committee, One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001. For further information, call 312/670-2400.*

AISC 1991 Prize Bridge Competition

Entry Date__________

Name of Bridge__________ Completion Date__________

Location__________ Date opened to traffic__________

Category in which entered__________ Approx. total cost__________

Span lengths__________ Roadway widths__________ Steel wt./sq. ft. of deck__________

Vertical clearance__________ Steel tonnage__________ Painted: Yes__________ No__________

Structural system(s) (describe briefly here)__________

Innovative Concepts__________

Descriptive data: Attach separate sheets (see entry requirements)

No. of photographs enclosed: Color prints__________ 35 mm slides__________

Design Firm:__________ Phone

Address:__________ Street: City and State Zip

Person to contact:__________ Title

Consulting Firm (if any):__________ Phone

Address:__________ Street City and State Zip

Person to contact:__________ Title

General Contracting Firm:__________ Phone

Address:__________ Street City and State Zip

Person to contact:__________ Title

Steel Fabricating Firm:__________ Phone

Address:__________ Street City and State Zip

Person to contact:__________ Title

Steel Erecting Firm:__________ Phone

Address:__________ Street City and State Zip

Person to contact:__________ Title

Owner:__________ Phone

Address:__________ Street City and State Zip

Person to contact:__________ Title

This entry submitted by:

Name:__________ Title

Firm:__________ Phone

Address:__________ Street City and State Zip

(ADDITIONAL ENTRIES MAY BE SUBMITTED ON COPIES OF THIS FORM)

Survey, Cont.

neers Council in their "1990 Professional Liability Survey" reported similar findings. According to the ACEC report, insurance as a percent of billings dropped to 3.98% in 1990, compared with 4.21% in 1989 and 4.5% in 1988.

However, the ACEC also found that the percent of uninsured firms climbed to 21.6% from 19% in 1989.

Structural engineers had the highest insurance costs as a percent of total billings at 6.82%. However, only 16% of structural engineers were uninsured. Civil engineers had relatively low insurance costs at 3.5% of total billings, as did architectural/engineers at 3.1% of total billings.

Insurance As A Percent Of Total Billings

Year	Percent
1990	3.98
1989	4.21
1988	4.50
1987	5.07
1986	4.11
1985	2.87

Insurance Costs By Firm Size

Employees	Percent
1-5	6.25
6-10	4.52
11-25	3.69
26-100	2.82
101-500	2.18
Over 500	1.38

"Although the liability crisis may be leveling off, it is still at a point where many engineers can't afford the high cost of claims and liability insurance," according to William Lewis, ACEC president. Lewis also expressed concern about the large number of uninsured firms. "The simple truth is tht large numbers of firms are risking bankruptcy by going bare."

Firm size is the major determining factor of whether a company carries insurance with 43% of firms with one-to-five employees going bare compared with only 1.38% of firms with more than 500 employees.

The ACEC survey reported that 39% of claims are "frivolous", while the other 61% result in some type of payment to the claimant. However, the survey also showed that the number of claims made against the profession is declining, from 43 claims per 100 firms in 1989 to 40 per 100 firms in 1990.

One bright spot in the Birnberg survey was the decline in the average collection period for collections on accounts receivable. The collection period fell to 67 days in 1990, compared with 69 days in 1989 and 77 days in 1988.

A copy of the 70-page report is available for $47.80 (including shipping) from: Birnberg & Associates/The Profit Center, 1227 West Wrightwood Ave., Chicago, IL 60614 (312) 664-2300.

For more information on the ACEC, contact Jeanne Quick at (202) 347-7474.

New Lightweight Steel Framing Specification

Changes are underway in the AISI "Specification for the Design of Cold-Formed Steel Structural Members". This Specification covers members cold formed from carbon or low-alloy steel sheet, strip and plate.

One of the most prominent changes will affect the design of shaped web openings. Previous versions of the Specification dealt only with circular holes. A new version will deal with other shapes.

Continued on page 12

SSRC Holds Session On Inelastic Behavior

The featured presentation at the 1991 Annual Technical Session of the Structural Stability Research Council (SSRC) will be "Inelastic Behavior & Design of Frames." The meeting will be April 16-17 in Chicago.

Council task groups as well as practicing engineers and research workers present their latest findings on a wide range of topics related to the stability of metal structures.

In addition, a special theme session on inelastic behavior will be held on April 16 and chaired by Wai Fah Chen of Purdue University. Speakers and topics include:

- Michael Ackroyd, First Principals Engineering: "Design Needs From Inelastic Analysis";
- Russell Q. Bridge, The University of Sydney: "Design Using Advanced Analysis";
- William McGuire, Cornell University: "Refining The Plastic Hinge Concept";
- David A. Nethercot, University of Nottingham: "Test Results For The Verification Of Three-Dimensional Inelastic Second Order Analysis Of Flexibly Connected Frames";
- Udo Vogel, University of Karlsruhe: "A Practical Approach To The Inelastic Analysis/Design Of Unbraced Steel Frames By Second Order Plastic Hinge Theory";
- Donald W. White, Purdue University: "Consideration Of Inelastic Stability In Frame Design".

The session will be followed by an evening panel discussion on "Inelastic Design Of Frames", moderated by Jerome S. B. Iffland of Iffland, Kavanagh, Waterbury, P.C., New York. Panelists will include: Navin Amin, Skidmore, Owings & Merrill, San Francisco; Leo Argiris, Weiskopf & Pickworth, New York; and Richard Parmelee, Alfred Benesch & Co., Chicago.

For more information, contact: SSRC Headquarters, Fritz Engineering Laboratory #13, Lehigh University, Bethlehem, PA 18015 (215) 758-3522/3519. In the Chicago area, contact: Nestor R. Iwankiw (312) 670-5415.

Spec., Cont.

Other changes deal with through-fastened flanges, applicable steels, diaphragm construction, wall stud strength, and lateral buckling strength. In addition, 15 technical articles are planned to be added to the Specification's bibliography.

To obtain a copy of the upcoming new Specification, including revisions from the current edition, contact: American Iron & Steel Institute, 1133 15th St., N.W., Washington, DC 20005.

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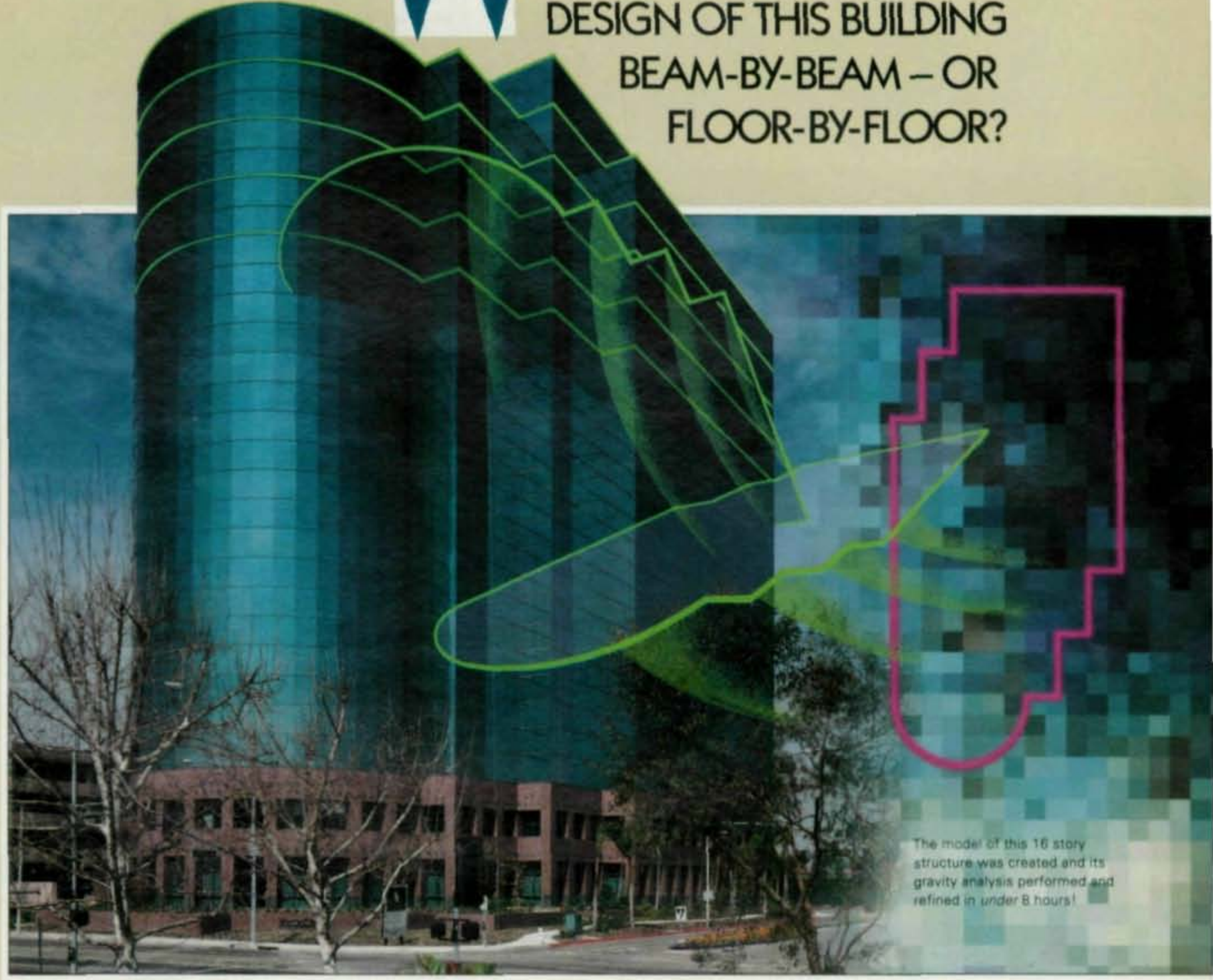

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ECOM Associates' Steel Beam Program

By W. Britson, P.E., and B. Haley, P.E.

According to the program's documentation: "The ECOM Composite Steel Beam Design Program (SD3C) provides the ability to design or check composite steel beams comprised of standard shapes. This program determines critical moments, shears and deflections of prismatic beams and designs or checks the members using a database of structural elements. This database can be the ASD9 database supplied with the program or may be a user defined database created with the Section File Editor And General Section Properties Program (GS1C)."

Engineer's familiar with menu-driven software should have no problem running Ecom's Composite Beam Design Program.

In addition to this, it should also be noted that this program will design/check for load cases with end moments and/or cantilevers.

The program was reviewed in five areas: system requirements; ease of loading the program onto a computer; documentation clarity; performance of stated function; and ease of use for practicing engineers. Each area was ranked from 1 to 5, using the following criteria:

5: This is a great program and I'd like to buy a copy.

4: This is a very effective, very useful program.

3: The program performs its stated goals adequately.

2: The program could be useful but needs to be improved.

1: The program is inadequate.

System Requirements

Rating: 5.0

The ECOM software package is written for use on most currently used IBM-compatible systems. These hardware requirements include the PC (8086-based), XT (8088-based), AT (80286-based), and the PS-2 (80386-based) machines with or without a math co-processor.

The computers require a minimum of 640K RAM and a 20 MB hard disk. The required operating system is MS-DOS or PC-DOS versions 3.0 or higher. A host of printers are compatible with the software.

Unlike many structural software packages, ECOM has very few hardware-related restrictions. The copy received for review contained only 3½" floppy disks, but 5¼" are available. Anyone purchasing this program should make sure they specify the required disk size.

Loading

Rating: 2.0

Installation of the software is an easy task. Once the software installation is complete, however, terminal installation begins.

Terminal installation is a unique feature to the ECOM software. This is very useful if the machine is networked with other machines, but is cumbersome for stand-alone personal computer users. Terminal installation requires the user to possess a knowledge of the computer hardware. Note, though, that installing the terminal is a process that normally done rarely.

Documentation

Rating: 4.0

The documentation for the Composite Steel Beam program is divided into the following chapters:

Chapter 1. Introduction

Chapter 2. Keyboard Definitions & Software Installation

Chapter 3. Terminal Installation & Program Narrative

Chapter 4. Setting I/O Units and Defaults

Chapter 5. Example Problems

The Introduction includes sections describing Minimum System Requirements, an Input/Output synopsis, and a short description of the Design Procedure. The Input/Output synopsis visually explains what will be expected for input variables and the restrictions as far as loading is concerned. The description of the Design Procedure is too general to be of any practical value. We would rather have the detailed description of the design procedure and all program procedures included with the Program Examples.

The Keyboard Definitions and Software Installation are succinct and clear.

The Terminal Installation narrative well describes the procedure of installing different types of systems varying from an IBM PC to a DEC VT100. The general procedure is well documented for the practiced computer user, but novices may require more detail. For more information, the installer is referred to Chapter 4, but unfortunately, no further information is provided in that chapter.

The Program Narrative uses screen printout illustrations to explain each section of input. This is a very useful technique and saves time for the user by reducing the amount of reading material. Users should pay special attention to the sign convention. The sign convention for loads is gravity loads with a negative sign. This is typical for comprehensive frame programs, but atypical for individual steel utility programs. Because the typical engineer uses a program first and refers to the manual only after encountering a difficulty, we feel that the sign convention should be boldly emphasized throughout this narrative.

The chapter on Setting the I/O Units and Defaults also makes use of screen printouts and actually is self explanatory within each menu.

The final chapter offers Example Problems with manual calculations and computer printouts for each of the two examples. Screen printout shows how all of the input would look on the users screen. This is an excellent method of offering a tutorial on the input as well as a way of verifying calculation methods and the program. There is an example for the AISC 9th Edition (ASD) Manual of Steel Construction as well as for the AISC 1st Edition (LRFD) Manual of Steel Construction. We noted, however, that both example problems are for the simplest of problems (uniform loading) encountered in practice. It would have been helpful if additional, more comprehensive examples were offered.

Program Functioning

Rating: 4.5

To determine the ability of the program to function, we devised a set of typical composite beam designs. The test included beams that would test most aspects of the input, loading, span, and analysis of the program. We found the program to function as described in its documentation. The accuracy of the results for the test problems was sufficient.

The ability of the program to function effectively is dependent on the user. In this case, users must be familiar with menu-based software and remember the menu branching. A flow chart would enhance the documentation.

As mentioned above, significant difficulty arises from the loading sign convention. Typical sign conventions used on member design programs is a positive for gravity loads. ECOM has adopted a convention consistent with the coordinate system. This is not a functional problem, but could lead to user error. In addition to emphasizing this point in the program's documentation, it should be highlighted in the menu.

Conclusions And Recommendations

Overall Rating: 3.5

The program is well prepared and executed. Drawbacks revolve around the use of menus and filing systems. The algorithms appear to give solutions that are correct for the selected examples, which is a big advantage over many packages that we have found to be carelessly written and distributed without quality control.

The filing system used in this program is cumbersome. Files for a particular project/problem/user are stored and deleted in a method over which the user has little control. Files in PC-based machines should be user controllable. In other programs, this is done by allowing the user to save (from hard drive to floppies for permanent storage) and delete files (from the hard drive at the user's discretion).

The menus are tedious to use. Perhaps in the next revision ECOM could combine many of the menus so the user can make decisions on the direction in which he/she would like to input information.

We would recommend this program for a heavy user. Casual users may find that the menus are hard to remember, confusing, or even aggravating and prone to cause user input errors. ECOM Associates is an established firm that seems to be committed to accuracy and improvement of their software.

Wes Britson is vice president and deputy director of structural engineering at HTB, Inc., Oklahoma City, OK. Blake Haley is a structural engineer with HTB, Inc.

We would recommend this program for a heavy user. Casual users may find the menus hard to remember, confusing, or even aggravating.

Florida Garden

Steel and glass combined to create an interior garden for a new mall near Palm Beach

The Gardens of the Palm Beaches takes its name very seriously—interior plantings and waterways are used to create a garden-like atmosphere. Far right photo by Balthazar Korab Ltd. The compression ring for the large skylights in the building's courts was supported by a large crane while a second crane installed trusses.

Shopping center design in the 1980s all too often seemed like the construction of interchangeable cogs in a giant machine. Pick up a center in Texas and drop it in Connecticut; no one would notice the difference.

But from its inception, the 1.3 million-sq.-ft., two-level The Garden of the Palm Beaches in Palm Beach Gardens, FL, was different. "Despite my firm's location in Michigan, I'm personally very familiar with this area of Florida," explained James P. Ryan, AIA, president of James P. Ryan Associates Architects and Planners in Farmington Hills. "We set out to design the quintessential Florida shopping center." To Ryan and the project's owner, Fobres/Cohen Properties, Inc., that meant translating the center's name into reality and creating an indoor garden.

"We talked about arboretums and researched the European garden-type spaces from the 19th Century. Building one today would be very labor intensive and expensive," Ryan said. However, the old European glass houses provided a starting point for a design that could be simplified and translated into modern materials.

The center is designed as a mostly rectangular, 1,200'-long, two-story building with five anchors spaced around the perimeter. In front of each anchor tenant is a large court, with the largest court of all—the focal point of the entire development—located at the project's midpoint.

From floor to ceiling, the main court features a myriad of both tactile and visual images. "The coup de grace of the center is the space itself," Ryan stated. "Some of the finishes are reminiscent of Art

The design of the center reflects Art Deco influences but is still manages to capture the unique spirit of Florida in both color and style. Photos by Balthazar Korab.

Deco detailing, but there's also a strong Florida influence."

And despite its huge size, the space also is humancentric. "We wanted to break the space down, make it more habitable and inviting." Towards that end, the open expanses are interrupted with waterways and plantings. Even the floor tile provides a visual richness, Ryan stressed. "We used six colors of floor tile. We'd start with three colors at each end of the center, and as we'd proceed, one color would drop out and another would be added. It's a philosophy of color that made the space more interesting."

In each court is a piece of sculpture selected for its surroundings by the architect. The pieces are all by American sculptors and some date back almost to the turn-of-the-century. "I selected pieces that were not contemporary, pieces that are romantic and realistic rather than abstract," Ryan said. The budget for the five pieces of art was approximately $1 million.

But what ties all of the elements together and makes the center work is its steel frame.

"There's not another material that would give us the light and airy feeling we wanted," Ryan explained. Additionally, the steel could support the extensive network of skylights necessary to keep the center's many plants and trees alive.

In the courts, the steel was left exposed and served as an architectural element. The steel theme also was picked up by the exterior entryways and by railings throughout the center.

Structural Design

Structural steel framing was selected as the primary structural frame to provide for a column-free mall and efficient retail spaces. The upper floor utilizes a composite steel frame, while the roof framing system is a structural steel frame with open web bar joists and a galvanized metal roof decking. The high wind loads of the Palm Beach area are resisted through a combination moment resistant steel frame and shear wall design.

The design of the retail portion of the center is a conventional steel frame with 30′ x 30′ bays. The floor on the upper level is composite construction supported on large A572 wide flange sections 30" to 33" in depth and spanning up to 70′ across the mall. The roof has mostly long-span trusses up to 100′ in length with a depth from 8′ to 10′. The retail portion has either beams and joists or joists and joist girders at the roof line.

The project used 2,800 tons of A36 steel, 355 tons of A572, and 36 tons of tubular steel, according to AISC-member Kline Iron & Steel Co., Inc., Columbia, SC, the project's fabricator and erector.

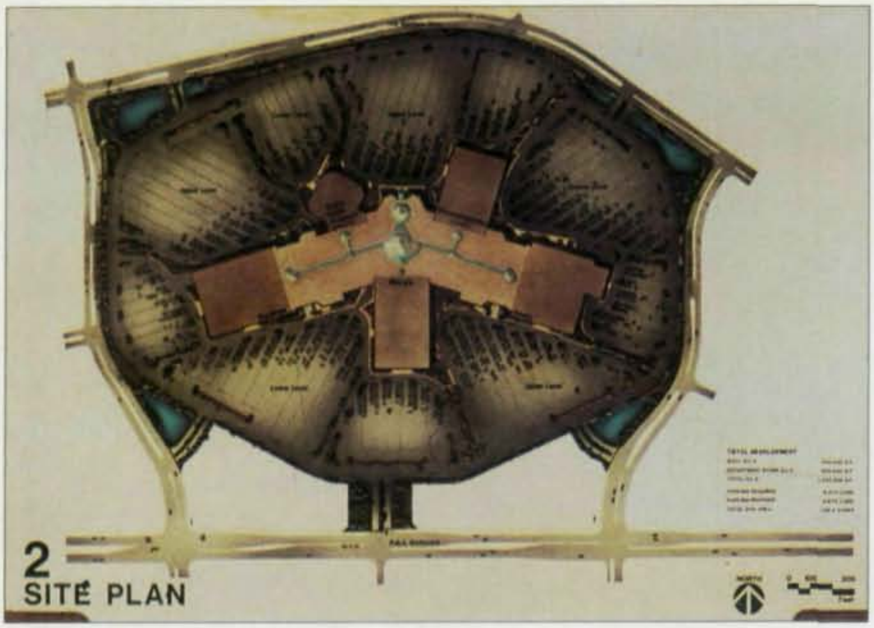
Exposed Steel

"Within the courts, we made extensive use of exposed steel," explained George Ehlert, P.E., president of Ehlert/Bryan, Inc., Southfield, MI. "All of the courts have a similar design, though the configurations vary."

In the center part of each court is a compression ring fabricated from segmented wide flanges or plate girders, depending on the size of the trusses supporting the ring. The trusses, which vary in size from 30" to 4′ deep, are framed from a column or the long-span trusses discussed above. The exposed trusses have a sloping top chord and curved bottom chord, the latter primarily for aesthetics. The chords are composed of WT sections and the webs are either single or double angles.

"At the compression rings, large decorative holes were cut into the webs to allow in more light," Ehlert said. The entire chord system was analyzed using the Images 3D software package from Celestial Software in Berkeley, CA. "We modeled each element separately as a series of multiple connected elements," he explained.

Most of the connections were field bolted, except for the compression ring segments, which have full penetration welds. Gen-



The use of bands of greenery in the parking areas reinforces the garden-like design of the center's interior. Each of the anchor stores is fronted by a skylit court featuring a unique piece of sculpture.

eral contractor was The Pepper Companies, Inc., Chicago.

Because the steel is exposed it had to be fabricated to precise tolerances, and a great deal of care was taken during erection. "Most of the courts were installed using two cranes, one holding the compression ring while the other installed the trusses," Ehlert explained.

The large center court, however, required three cranes. "Throughout the lifting operation, the center crane's loads were continuously monitored to ensure that as the steel trusses were installed the loads were dissipating properly." During the erection, the load on the central crane from the weight of the compression ring decreased from 18,000 lbs. to less than 8,000 lbs. "When the crane was removed, the compression ring only deflected 1/8"."

The Grand Court design included a computerized model with in excess of 200 elements, subjected to a combination of 19 various load cases. Due to the lack of symmetry at the Grand Court, emphasis was placed on the response of this system to 120-mile-per-hour wind loads.

The steel work was simplified by the chosen paint system, according to Ryan and Ehlert. The steel was painted with an aqua-colored, one-coat system from AISC-member Tnemec. After the steel was erected, workers could simply spot finish any mussed areas. "After the erection was complete, the contractor didn't have to worry about painting any inaccessible areas," Ehlert said.

Added Ryan: "The workmen reported that they found the light-colored steel easier to erect. The aqua color helped visibility and gave a psychological boost."

The non-exposed steel was cleaned to an SP7 level while the exposed architectural steel was cleaned to SP6. On the composite beams, the top flanges were left unpainted.

Roof System

One of the challenges in constructing the center was the integration of the various building components into the roof system. Due to the exposed nature of the steel, the system needed to accommodate not only the skylights and the structural steel, but also lighting, smoke evacuation systems, and fire protection systems. In addition, the large volume of the courts required that special attention be paid to the space's acoustical performance.

A field-assembled insulated metal roofing sandwich panel was selected as the material for the walls and roofs of the courts, and was placed between sections of skylights. Custom designed light fixtures were supported on the internally reinforced panels. Custom colored perforated liner panels were selected not only to blend in with the mall design, but also to provide acoustical relief. Smoke evacuation louvers were installed sideways to blend with the metal liner panel and concealed behind the exposed steel trusses.

Above the Grand Court is a catwalk system that was integrated within the exposed trusses to provide for theater lighting during fashion shows and other events held in the court.

The center's extensive skylight system enlivens the space. The 40,000 sq. ft. of glazing has a mirror-like outer surface and a clear inner surface. "We had to have enough light to allow the plants to grow, but enough reflective surface to keep down heat gain," Ryan explained.

"The overall concept of the center is to provide a level of experience for the shopper not presently available in any retail center in the area," Ryan stated. And in doing so, the designer has created a new definitive Florida mall. □

Innovative Scheduling Saves A Shopping Season

Replacing concrete columns with steel in a three-level below-grade parking structure allowed the shopping center on top to be built more quickly

By Gene Sisco

The $120 million CambridgeSide Galleria was one of the most ambitious retail projects undertaken in New England in recent years. Located just across the Charles River from Boston's Beacon Hill, the 1.7 million-sq.-ft. facility already has attracted a large following from an urban population eager to shop in a state-of-the-art retailing environment.

The Galleria is the first phase of a 10-acre mixed-use project being developed by New England Development, Newton, MA. The mall consists of a 3-story, 800,000-sq.-ft. retail area built over three levels of below-grade parking for 1,800 cars.

The mall is unusual in its layout and layering. Normally, anchor stores are situated at either end of a suburban mall with many small stores sandwiched in between. Not so at CambridgeSide. The first floor consists solely of small stores, creating a "festival market" linking two marvelous public spaces at either end—the triangular Charles Park to the south and Lechmere Canal, a lively water feature to the North.

Placed above the urban market is, in effect, a two-story suburban mall with three strong anchors: Filene's, Lechmere, and Sears. Consistent with keeping the ends open to the park and canal, the anchors are pushed off to the side. The entire three-tiered shopping structure is visually tied together by a breathtaking 80'-high-by-600'-long arcade.

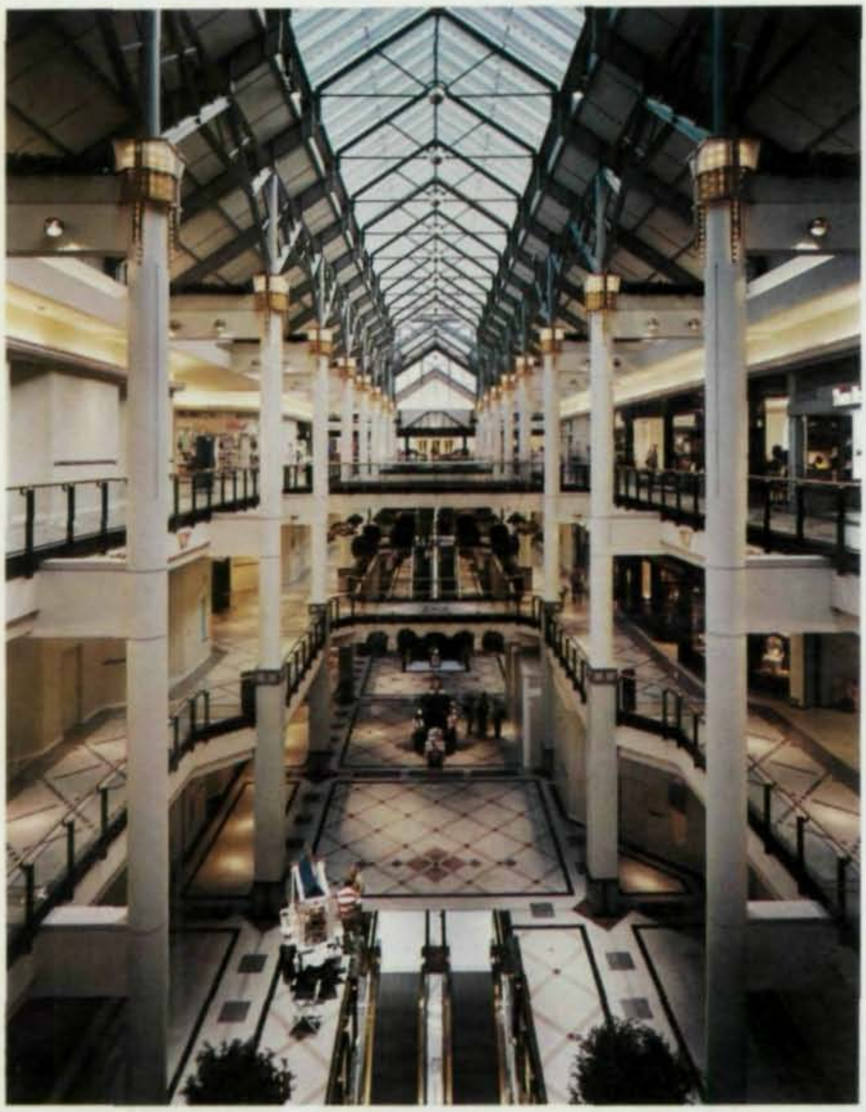
Towering overhead are 21 architectural steel gables that frame a continuous skylight band. At either end of the skylight "nave" sit massive 90' square cupolas supported by delicate diamond-pat-

terned trusses. Looking up at all of this order and harmony, the shopper discerns nothing of the scheduling obstacles that faced the project's contractor, Beaver Builders, Newton, MA.

Soon after the start of construction in late May 1988, it became apparent to Steve Karp, New England Development's chairman, that a February 1991 opening was going to be too late. The developer could not afford to miss the lucrative Fall/Christmas 1990 shopping season. According to Karp: "Timing is everything. You have to hit the market at the right time during one of three shopping seasons. If you miss a season you don't open up the next day as with an office building or condominium project. Instead, you have to wait until the next season. Sometimes that can make the difference between a project making it or not; not only from the point of view of the cost of money, but also from how well the stores start and how the public perceives the center."

Therefore, Karp set the team to work with a goal of opening the project by Mid-September 1990, chopping five months off the original schedule.

The CambridgeSide Galleria is an architecturally stunning retail center with 800,000 sq. ft. of retail area built over three levels of below-grade parking. Photo by Robert E. Mikrut



Three-story "stilt" columns support the mall structure. Garage levels were added later. Top photo by Robert E. Mikrut; photo at right by Charles Field

"Our task was to get the skin and roof on the building ahead of schedule, by New Years of 1990, so that we could proceed with our mechanicals and interiors work unimpeded by winter weather," explained Doug Goodnow, Beaver Builder's construction superintendent.

Given that the job used more than 7,000 tons of steel, it was quite an undertaking. Working with its scheduling consultant, Dataline Management Group, Beaver Builders met with its steel supplier and erector, AISC-members Montague-Betts, Lynchburg, VA, and United Steel Erectors, Everett, MA, to see if the goal could be achieved.

A comparative analysis by the team revealed that the stacking of two different structural systems as originally specified—precast for the below-grade parking and steel for the mall above—would eat up valuable time in the delivery, sequencing and erection process.

Precast had originally been chosen for the parking structure due to its fire protection characteristics. However, the design team quickly realized they could meet their needs with steel columns fireproofed with concrete, which presented a tremendous opportunity. By using steel columns throughout the structure, construction could proceed at a much faster pace.

Beaver Builders recommended that the design team not think of the project as a conventional steel mall above a precast garage which was being built sequentially floor-by-floor. Instead, their concept was to erect a three-story structural steel frame and composite steel mall "in the air." Erection would be directly off of the mat foundation, 32′ below grade with the mall supported by three-story steel stilt columns.

In this manner a rolling crane could work off the mat, setting six-story steel bay-by-bay as it moved. No added cost would be incurred to support the crane on the garage structure. Then, once the first floor mall decking was placed on the steel beams, work could safely proceed on the lower parking levels without impacting the schedule: Garage cast-in-place concrete floors were thereby taken off the critical path.

Up-Up Construction

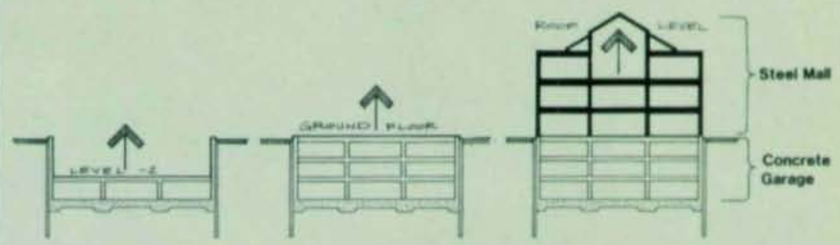
This erection process was named "up-up" construction by the structural engineers, according to Steven Varga, P.E., principal with Weidlinger Associates. Adds his associate, Steve Highfill: "We have all heard of up-down construction whereby construction originates at grade level and proceeds at grade level and proceeds simultaneously up and down, digging as you go. The up-up construction utilized at CambridgeSide acknowledges that we started out at the basement level initially and that we took a giant leap to get up to the mall level. We skip areas that slow us down."

Weidlinger designed the 32'-high stilt columns with welded angle seats located where each cast-in-place flat slab would tie into it. They also designed the below-grade columns to be free-standing. In doing so, it was necessary to pay a premium in order to accommodate the unbraced length. However, this insured freedom of movement for the mat level construction.

Steel construction above the first floor of the mall was conventional. Bracing for the structure included a knee-braced moment frame in one direction and conventional bracing in the other direction.

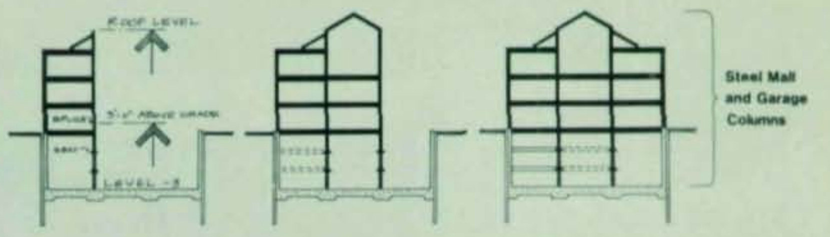
Having determined schedule, system, and steel design, the contractor and his subs set out to produce an aggressive plan for supply and erection of steel. The project would demand the placing of a critical 5,000 tons of a total of 7,100 tons within six months.

The 10-acre site was divided into phases consisting of 32 divisions in which the steel erection would flow from south to north. "Before the steel arrived we determined a pace for ourselves to complete the mat foundation well ahead of the steel erection so there would not be



Conventional Construction

Figure 1



Up-Up Construction

Figure 2

With "up-up" construction, the steel frame for the entire structure was erected, with the slabs for the garage levels added later. This type of construction method saved five months off the construction schedule compared to traditional construction where a concrete garage would be built, and then the steel retail center would be added on top.

Steel fabricator for the CambridgeSide Galleria was Montague-Betts and steel erector was United Steel Erectors, Inc. Photo by Brian Neudorfer

an interruption to the flow," explained John Monaghan, Beaver Builder's project manager. This involved pouring 10,000 sq. ft. of mat surface area per week, much of it during winter months. By producing the mat early, large workable steel lay-down areas became available, thus mitigating urban site constraints.

With the mat ahead of the steel, Montague-Betts had to provide Beaver Builder's capacity requirements in order to get enough product to the site in order to keep erection output on schedule. With the assistance of two computerized drill lines in each of their Virginia plants, they were able to accommodate a demanding fabrication schedule. Deliveries average 200 tons per week, with some up to 500 tons. Shop drawings were turned around in two weeks despite the normal changes that arise in any fast-tracked job.

With an eye towards completing

the structure by November and the roof deck by January 1990, United Steel Erectors recommended using three cranes plus one cherry picker on the project.

An 82-ton crane worked steel from the foundation to the first floor while two 165-ton tower cranes erected mall steel to the roof and cupolas.

"On steel delivery days, we were determined not to interrupt the tower cranes from their primary task of erecting steel," according to Bernie Macinnis, a superintendent with United Steel Erectors. "So we used a cherry picker strictly to unload the trucks and to shake out steel."

It was very important that all earth ramps for crane access to the hole be placed over an existing mat foundation. In this manner, as soon as each crane worked its way out, dirt could be removed from a fully prepared foundation below. Thus, the building's structure could be completed without stopping to place concrete foundations.

In order to realize the construction schedule, the erector was allowed to work 10 hour days and on Saturdays during the summer of 1989. As managers, Beaver Builders realized that spending additional resources on one key subcontractor—the steel erector—would create a ripple effect that would help the entire job.

"Many developers tend to underestimate the importance of the construction schedule and concentrate too much on the budget," explained Karp. "Time is money and sometimes you can spend more money on construction while saving it on the other end."

A mall can earn 30% of its annual revenues during the Christmas season. Beaver Builders was not only able to shorten the duration on the construction loan by five months on the $120 million project, but was able to earn earlier

rental revenues for the developer. This was only possible due to the selection of steel over precast in the parking structure and an aggressive construction schedule.

Gene Sisco, AIA, is vice president of planning and development for Beaver Builders, Inc., Newton, MA. □

Extending Retail Up And Down

Photo credits: Above—Kristin Hawkins; Opposite—Balthazar & Christian Korab

Minneapolis' skyway system deposits shoppers on the second floor and creates retail space above and below the main level

It's an axiom in multi-level shopping center design that the street level will house the prime retail space. Unless, of course, you're building in Minneapolis.

In response to its climate, downtown Minneapolis' city planners designed an extensive skybridge system that links most major buildings. And because of that bridge system, the second floor of the new Gaviidae Common shopping mall is the prime level, rather than the first floor.

Gaviidae Common is a 315,000-sq.-ft. specialty retail center with five levels of retail and two-and-a-half levels of below-grade parking. One end of the center is anchored by a Saks Fifth Avenue store, which occupies four floors.

Dignified Exterior

The center's exterior is clad in a warm beige French limestone to complement Norwest Center, a large office building which the center abuts on its south end. The main entrance is marked by a patterned glass wall flanked by stone piers inset with decorative light poles. As with other retail centers,

The exterior of Gaviidae Common features limestone cladding and other highly detailed finishes, creating a very dignified appearance. The pedestrian bridge connecting to Minneapolis' skyway system picks up many of the themes used on the interior. The atrium vault (opposite) is painted with blue "spikes" that direct the eye towards the skylight. The blue color, combined with gold leaf inlays, is reminiscent of a sparkling sky without being immitative. Photos by Balthazar & Christian Korab

the first floor features large glass display windows. In addition, two-story-high display windows are situated on the second floor in response to the second-story orientation of much of the pedestrian traffic in Minneapolis.

The limestone exterior, combined with the wonderfully detailed storefronts, present a highly dignified mien to the public. The inside, however, while equally dignified, is much more playful.

Dramatic Atrium

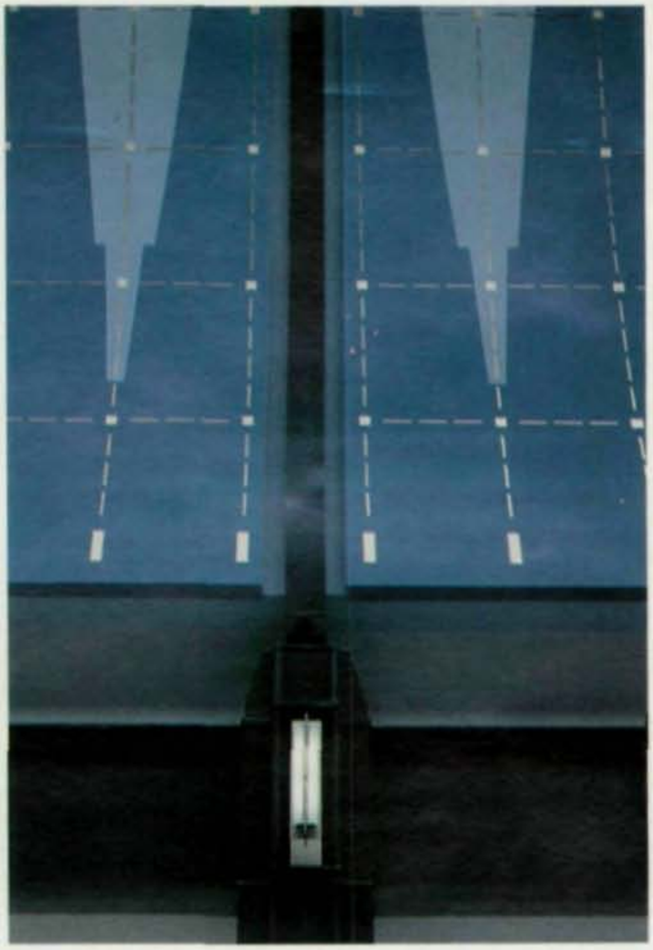
The interior features a dramatic five-story, 300'-long, 42'-wide atrium defined by a dark blue gird of exposed structural steel. A barrel vault rises above it and is decorated with a geometrical blue pattern with gold leaf accents. A skylight at the center of the vault brings natural light into the space. The column lines that are visible in the exterior are continued on the interior.

"We left the steel exposed to reinforce the rhythm of the design," explained Kristin Hawkins, an associate with Cesar Pelli & Associates, New Haven, CT, the project's architect. "We wanted the vault to appear delicate, and the exposed structure reinforces this feeling. Thin columns of steel mix a feeling of toughness with a feeling of delicateness." Associate architect on the project was Lohan Associates, Chicago.

Because of its position as the prime retail level, the second floor protrudes 14'-2" into atrium on all four sides. This presented a problem, though, of creating a potentially gloomy first floor. "To keep the first floor from feeling dark, we put glass block in the floor of the second level," Hawkins said. When the floor slab was cast, slots were left open to accommodate the glass block, explained William O'Neal, P.E., principal with Martin/Martin, Wheat Ridge, CO, the project's structural engineer.

Vertical Integration

Visually joining the two spaces are structural steel columns on the perimeter of the overhang that



emerge into the second floor space as light poles. And the glass-block theme is carried over into a connecting stairway between the two levels made with etched glass block steps and risers.

"The owner was concerned about the surface being slippery, but the sand-blasted surface is slip resistant even when wet," Hawkins said. In addition to the stair, the retail center has the usual escalators.

Unique Pattern

Rather than using signage to draw shoppers attention upward, the designers opted to utilize the structure itself. "The exposed steel columns start your eyes moving upward. We capitalized on that by creating a spiked blue pattern on the barrel vault that continues the visual movement until you reach the skylight," Hawkins explained.

"A lot of thought went into the pattern on the vault. It was important that it not mimic the idea of the sky, but still be reminiscent of it. And the gold leaf squares etched over the pattern catch the light and give life to the space."

Suspended from the vault is a large sculpture of a common loon, the state bird of Minnesota. Gaviidae, incidentally, is the Latin word for "common loon."

That playful touch, along with an abundance of natural light creates a visually varied and interesting space that complements the exterior while still blending in with the overall nearby buildings.

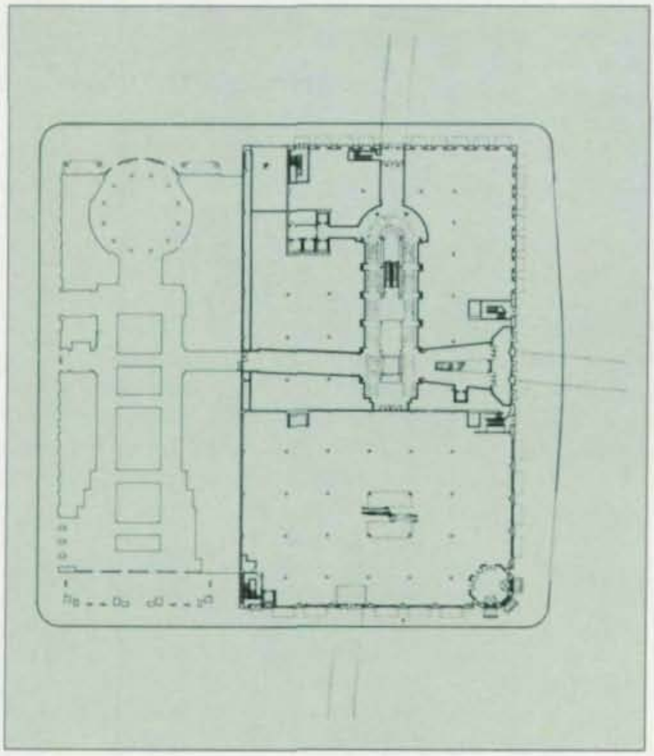
Before choosing a design for the exposed steel columns, the architect examined a wide variety of shapes, O'Neal reported. "The architect wanted a specific shape. The typical floor column is made up of four W10 x 30 wide flanges to form a cruciform."

Lightweight Structure

While the use of steel was important to the designer's desire to visually reveal the structure and the owner's preference for tenant flexibility, it was important to the engineer's need to reduce the structure's weight.

"There's a large loading dock beneath the structure and one of the reasons we used a steel frame was to reduce the load," explained O'Neal. To create the needed open space for delivery trucks, loads are transferred on four plate girders and a large truss.

The plate girders, which are 6' deep and 60' long, are located over the loading dock and the top flanges form the floor of the occupied space. The 20'-deep x 60'-long truss, however, is buried in a wall separating the mechanical room



A unique feature of the center is a glass block staircase (above left) that connects the first and second floors. The exposed connections (above and top) were carefully chosen by the architect to present a specific shape—in this case, a cruciform.

from the rest of the floor. "The truss supports exterior columns and carries a much greater load than do the plate girders," O'Neal said.

A deep space between the loading dock and the first floor was originally intended as cafeteria/formal function space for a tenant in an adjacent office building. However, when those plans fell through, the space was converted into two-and-a-half levels of parking.

"Because of the high floor heights, we were able to slip another level in and a mezzanine," O'Neal said. To satisfy fire codes, the steel beams in the parking garage were encased in concrete.

From the ground floor to the roof, the center has a braced frame with composite floors consisting of 3¼ lightweight concrete on 2" metal deck.

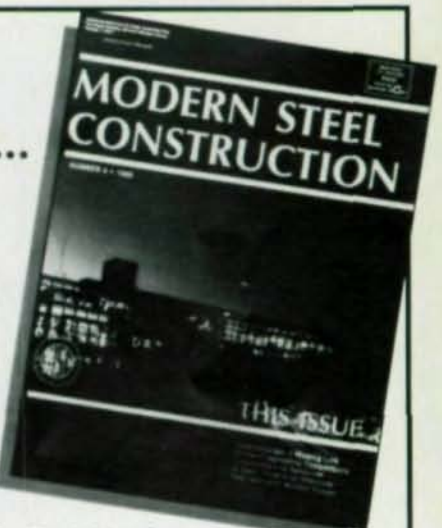
The bracing consists of a 17' 9" concrete shear wall on the north face and steel X-bracing in two locations in the north-south direction and in the south wall. "Because Norwest Center rises off the south end of the building, there is a minimal wind load on the south face," O'Neal said.

The project used 1,100 tons of A572 Grade 50 steel. General contractor was a joint venture of Kraus Anderson/PCL, both of Minneapolis.

Pedestrian Skyway

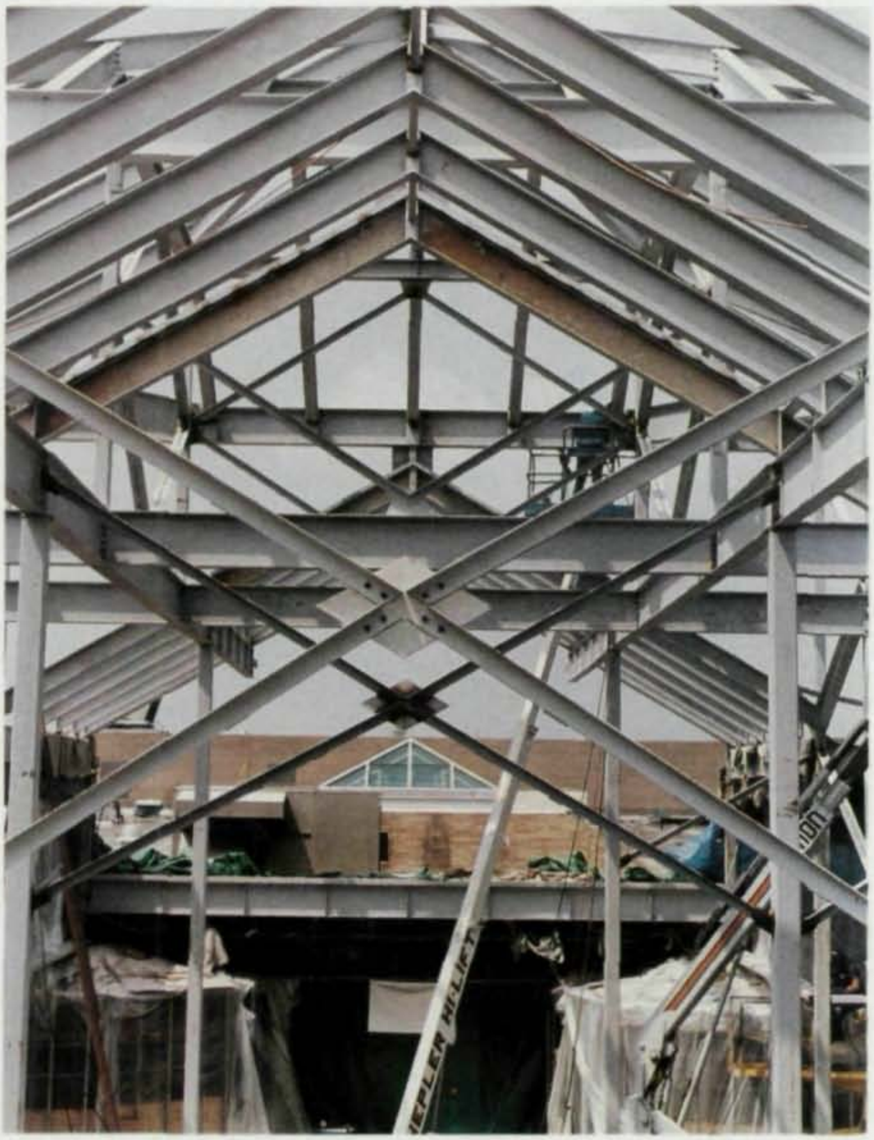
A skybridge over Nicollet Avenue connects Gaviidae Common with City Center, and was designed as public art by Cesar Pelli in collaboration with Siah Armajani, an internationally renowned artist from Minneapolis.

"The pedestrian bridge shares the same sensibilities as the building," Hawkins said. "The detailing is very similar with its richness of color and exposed bolted connections. And the end that connects to the building has a panel of frosted glass that relates to the use of glass block on the inside." □



Exposed Transformation

New skylights on an exposed structural system helped transform a tired mall into a bright, modern center



The renovated Oglethorpe Mall in Savannah, GA, utilizes exposed structural steel to create a slender, tall space and a sense of open, coastal architecture. Photo above: Henry W. Spiker; photo opposite: Gabrial Benzur

Oglethorpe Mall in Savannah, GA, was typical of centers built in the late 1960s. "It was rather dark, with not a lot of natural light. It had dark flooring. There was not a lot of specialness about it," explained Henry W. Spiker, AIA, a senior associate with Thompson, Ventulett, Stainback & Associates, Inc., Atlanta, the project's renovation architect.

Although in an ideal location, the center's tired- and dated-looking physical condition caused the owner some concern about a possible loss of customers. In addition, the construction of a new mall nearby created worries about whether the center could retain its tenants and achieve optimum market rents.

"The mall seemed gloomy, with ineffective skylights and scattered 2x4 fluorescent lights," according to Spiker. "The quarry tile floor was dark, the ceiling structure exposed in many areas, and the natural piers between tenant storefronts were in disrepair or missing altogether."

In addition, interior landscaping was minimal and the store fronts were dark and uninviting. "The mall's exterior entrances were heavy and fortress-like, with massive overhangs. The mall's logo also was dated and lacked imagination to the point where there was little in the way of a positive recognizable mall identity."

But despite these problems, studies showed that a majority of customers had a strong affection

The old entrances to the mall (top) were cave-like and uninviting. The new entrances (above and left) present a more open image, while also picking up elements of the renovated interior space. Top photo: Henry W. Spiker; above and left photos: Gabrial Benzur

for the mall and referred to it as either "our" mall or simply "the" mall. With new competition on the way, the owner, U.S. Prime Property Inc., New York City, and manager, Dusco Property Management, Inc., Lancaster, PA, decided to redesign the 92,500 sq. ft. of common area in the mall to help maintain this customer loyalty. Included in the renovation were four courts and the corridors connecting them.

"Our goal was to stay within budget but still get as much impact as possible," Spiker explained. "Therefore we focused on the interior courts."

The mall was a steel building with bar joists and metal decks. To open up the space and admit more light, much of the bar joist construction in the courts was removed and replaced with a skylight assembly and wood decking, which was elevated above the former roof line to create a more spacious feeling. Louvered wall panels were added both to brighten the space and create a Southeastern feeling. And new landscaping and flooring were installed.

Unfortunately, the existing structural system was inadequate to support the new roof structure and the louvered wall panels, which were to be hung from beams, explained Walid Nannis, P.E., president of Nannis & Associates, Inc., Atlanta, the project's structural engineer.

For example, the Center Court features white-painted exposed structural steel supporting a dramatic 40' x 40' structural pyramid skylight, a 20' x 90' gabled skylight, and three 20' x 25' gabled skylights.

"We utilized an exposed steel structure to create a slender, tall space and create the sense of an open, coastal architecture," Spiker said. "There's not another material that would have lent itself to this approach." White paint was chosen to create a warm, comfortable feeling. The project used 26 tons of tubular steel for columns, ridge trim and skylight framing, and 262 tons of A36 steel for columns, beams, skylight frames and entrance framing.

The top of the pyramid skylight is 54′ above the ground floor level and 23′ above the old roof line. As a result, this skylight assembly required substantial modification of a section of the roof about 160′ x 90′ in area, as well as two rows of new columns and bent beams spaced 5′ on center. Small crossed beams were added purely for aesthetics and are not structural. However, the diamond pattern created as a result of the addition of these beams was picked up and repeated in the new signage for the center. All of the renovation work was done without shoring to minimize any interruptions to the mall activities.

The existing wall beams were inadequate to support the new louvered wall system, so new beams were introduced on top of the old beams.

Prior to being renovated, the interior of the mall seemed gloomy, with ineffective skylights and scattered 2x4 fluorescent lights. Also, the quarry tile floor was too dark.

"We used welded steel plates to combine the existing beams and new spandrel beams," Nannis said. The beams were supported on existing columns, which in several cases had to be strengthened. "For six or eight columns we had to add welded plates to beef them up."

Other areas of the mall also required substantial modification. In the J.C. Penney Court, for example, the addition of a new center pyramid skylight approximately 45′ square and two 20′ x 20′ gabled skylights resulted in the modification of an almost 130′ x 65′ roof area. That roof structure in that part of the mall included trusses, which were kept, though additional bracing was added to replace the bar joists that were removed.

Thirteen individual new skylights were added between the various courts. These skylights required the cutting of several existing sloped roof frames, restructuring and strengthening adjacent existing frames without shoring any of the existing roof structure. Other skylights with a 20′ square area were installed above the existing roof with only penetration at the four corner columns. The roof structure was then removed from below. This procedure was necessary so as not to interfere with the operation of the mall.

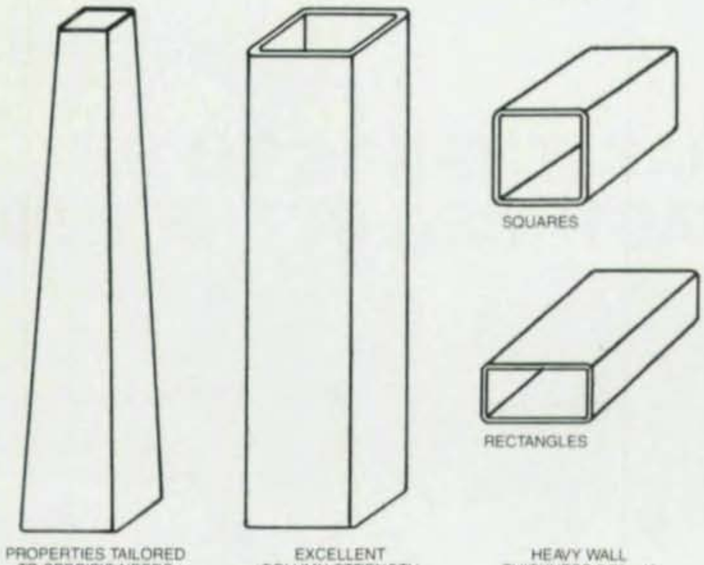
Towards that same end, all of the erection for the entire renovation project was performed between 9:30 p.m. and 8:30 a.m.

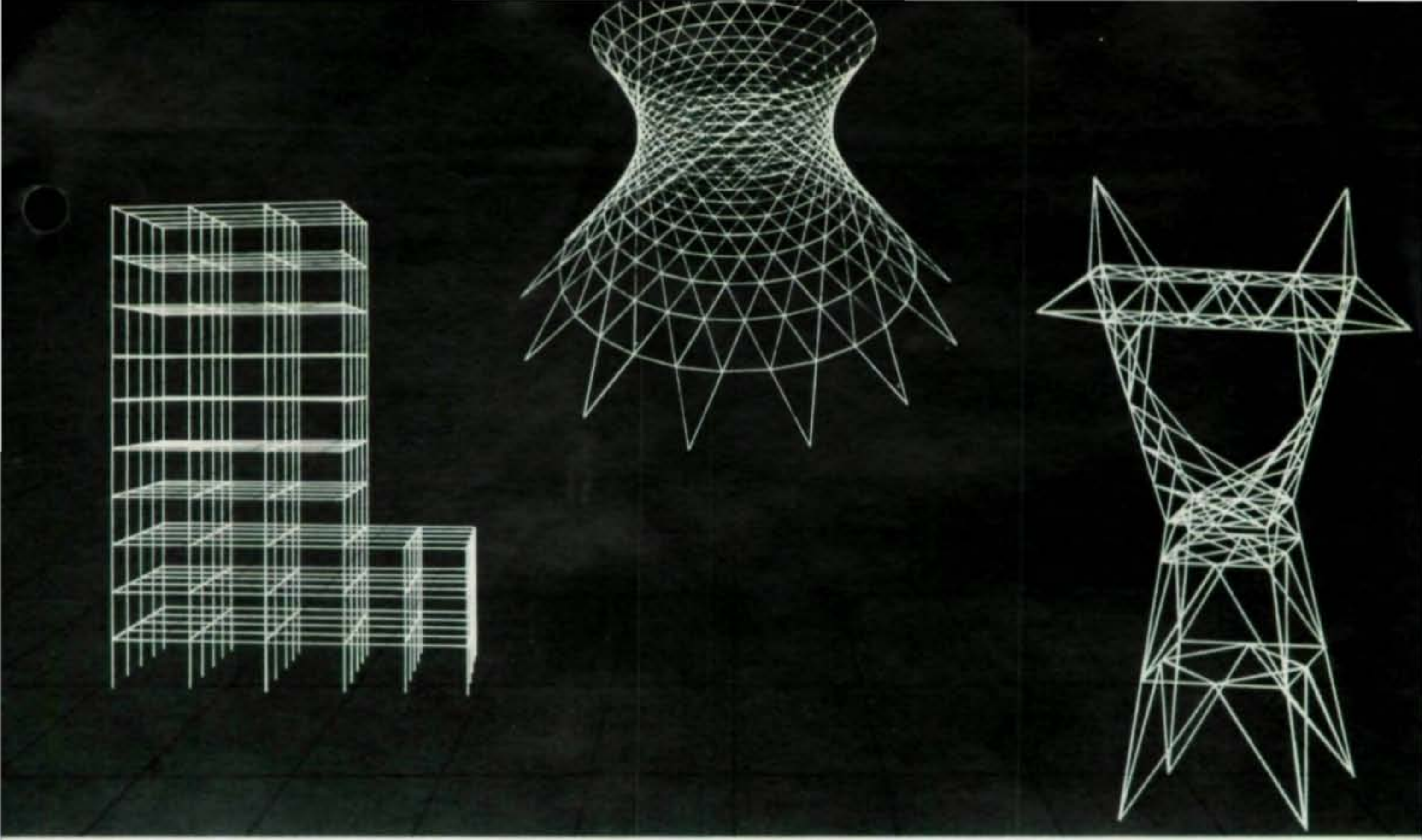
"One of the major factors that made the renovation process difficult was that there were no contract drawings to work from," Nannis said. "The only available drawings were some incomplete structural steel shop drawings."

In addition to renovating the interior common elements, the designers also renovated the mall's five entrances. The extent of the renovation varied, however, by the expected usage of the entrance. Four of the entrances now feature exposed structural steel and skylights, while the fifth entrance was covered at the request of the anchor tenant in that location.

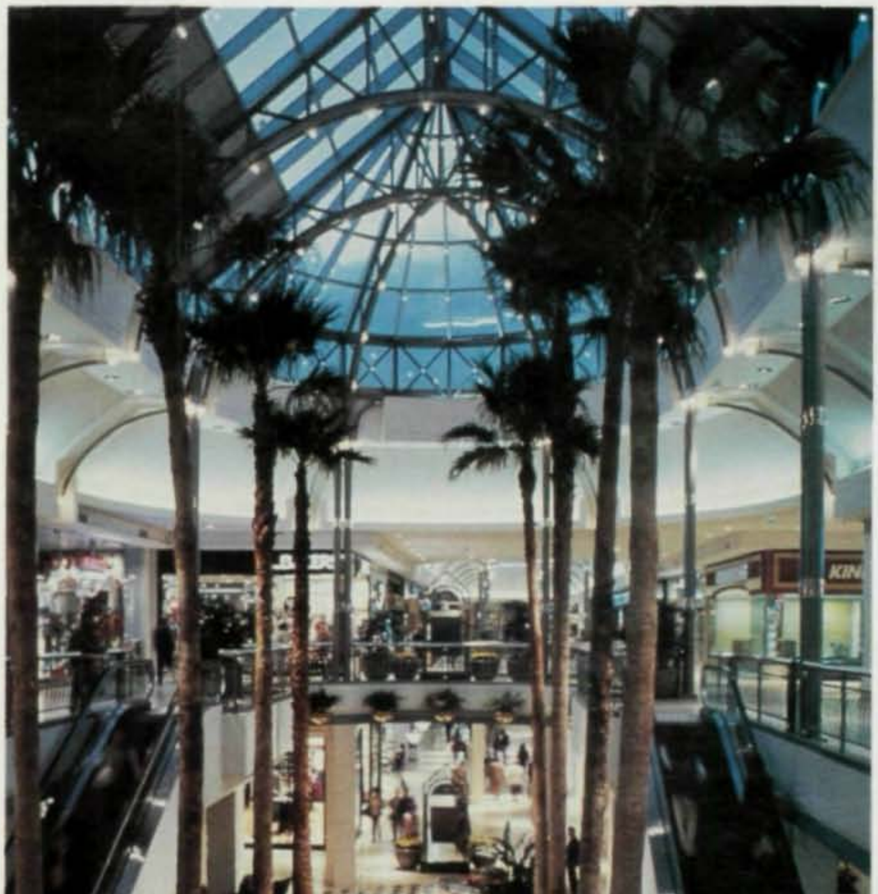
"The stucco-like entrance relates to the rest of the exterior of the mall, though we also picked up some of the diamond motif that was created with the steel," explained Spiker. "The steel entrances pick up the interior concept. The diagonal bracing becomes an architectural element in addition to a structural element."

The renovation cost $68 per gross enclosed sq. ft. "It transformed a 20-year-old plain, uninspiring mall into one with it's own special identity and sense of place," said Nannis. The transformation was so successful that it was the only renovation project to win a 1990 Design Award from the International Council of Shopping Centers. □





Vertical Retail Expansion



Tysons Corner Center in McLean, VA, doubled its leasable area in part by expanding downward into an existing basement area. Photo by Hedrich-Blessing

By expanding downward rather than up, Tyson's Corner Center in McLean, VA, economically doubled its leasable space

By Robert Knight, P.E.

The retail construction boom of the 1960s and 1970s has come full circle: A major component of some architectural firms' practices is now retail renovation.

Despite excellent locations, older centers just can't project the same up-to-date image as their newer competitors and often don't have the gross leasable area (GLA) to offer the diversity and number of stores customers have come to expect. By upgrading and expanding their facilities, developers are regaining market share, attracting high-end shops, and consequently increasing sales per square foot.

A highly successful example is RTKL Associate's renovation and expansion of Tysons Corner Center, an already prosperous shopping mall in the affluent Washington, DC, suburb of McLean, VA.

Built in 1968, the original two-level structure provided retail space only on the upper level. The full below-grade basement was used for storage, loading docks, offices and various tenant back-of-house functions. By providing new skylights and floor openings as

well as excavating the area around the perimeter foundation wall, the existing basement level was economically converted to a new retail floor with space for 100 new shops.

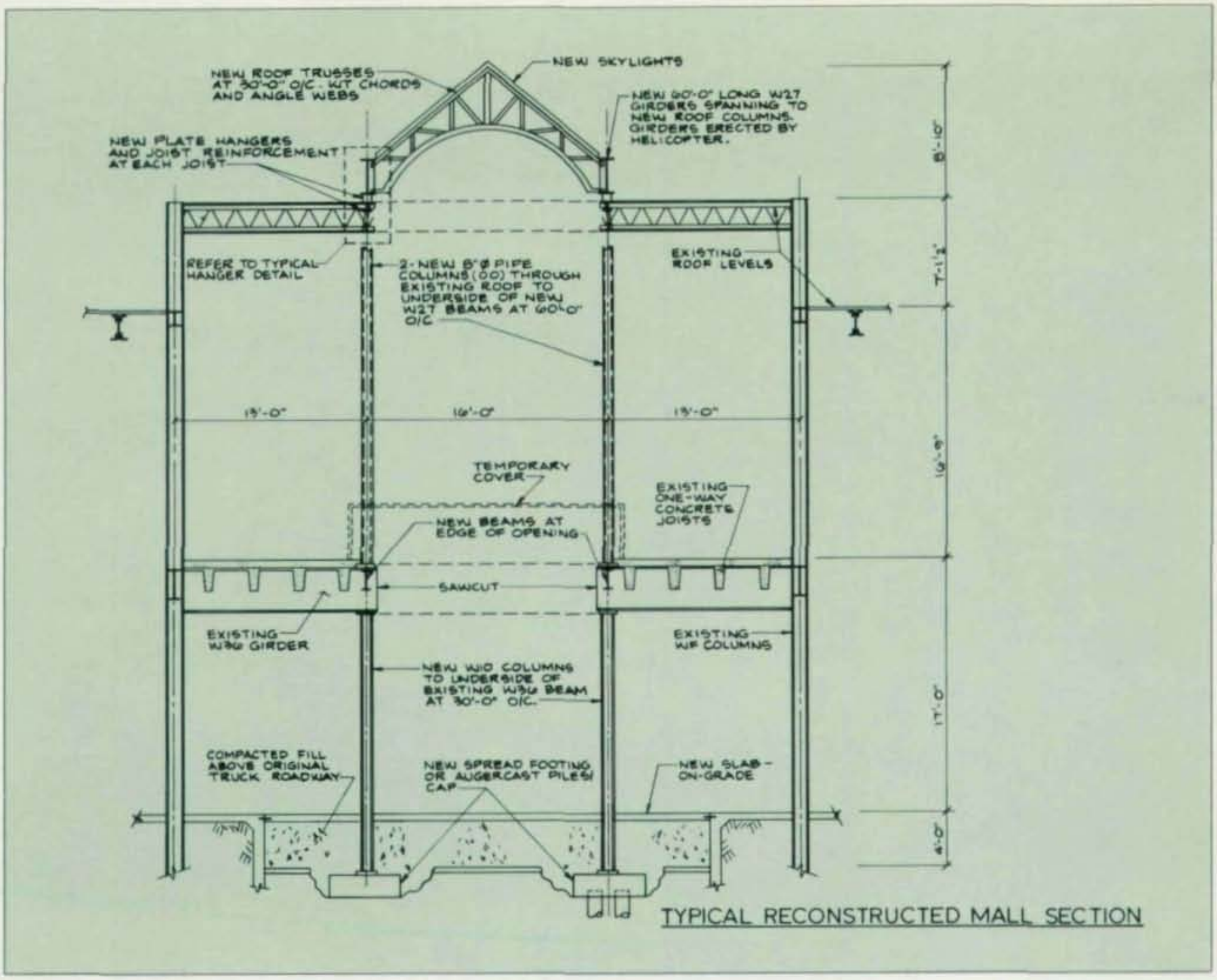
In addition to renovating the existing mall, the project master plan included two lateral mall expansions totaling 40,000 sq. ft., the construction of two new anchor department stores (Nordstrom and Lord & Taylor), and the addition of four new parking decks with space for nearly 6,000 cars.

Expansion Options

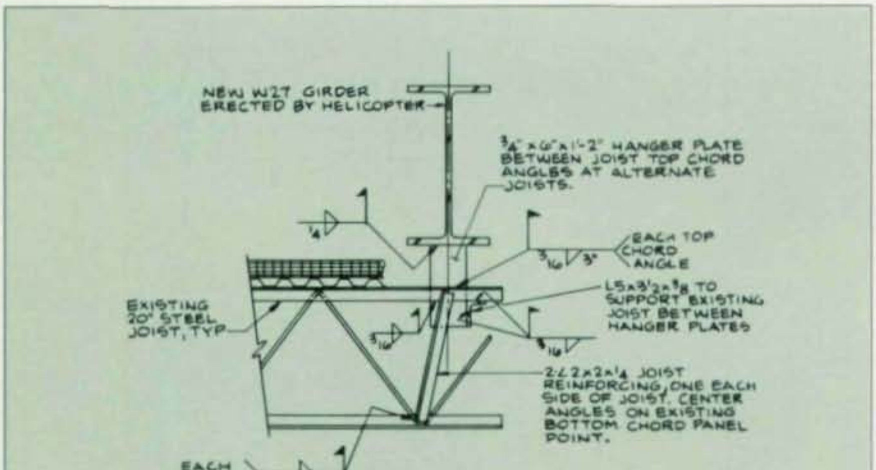
The decision to expand into the existing basement level was not the only option considered by owner Lehndorff Management (USA) Ltd., Inc., architect/engineer RTKL, and construction manager Whiting-Turner Contracting Company.

The design team conducted pre-

The original structure, which was built in 1968, only had one level of retail space. Skylights became an especially important feature in brightening the new retail level and creating a feeling of spaciousness. Top photo by Hedrich-Blessing



TYPICAL RECONSTRUCTED MALL SECTION



TYPICAL HANGER SUPPORT DETAIL
AT EXISTING ROOF JOISTS

The renovation sequence involved adding a new roof above the existing roof before removing the old roof. This sequence eliminated the need for any special weather protection. The work was complicated by the need to cut through a concrete slab to open up the lower level.

liminary studies on the feasibility of adding a new level above the existing roof, and several structural schemes were reviewed in conjunction with the "upwards-expansion" proposal. Various structural proposals were considered to deal with the problem of the existing mall columns and foundations not having the additional capacity required to support new floor and roof level.

One scheme for upwards-expansion involved reinforcing existing steel columns and spread footings. However, this option was complicated by the fact that a significant portion of the existing building columns are supported by belled caissons that extend through relatively poor fill materials. Increasing the capacity of these deep foundations would have been difficult and costly.

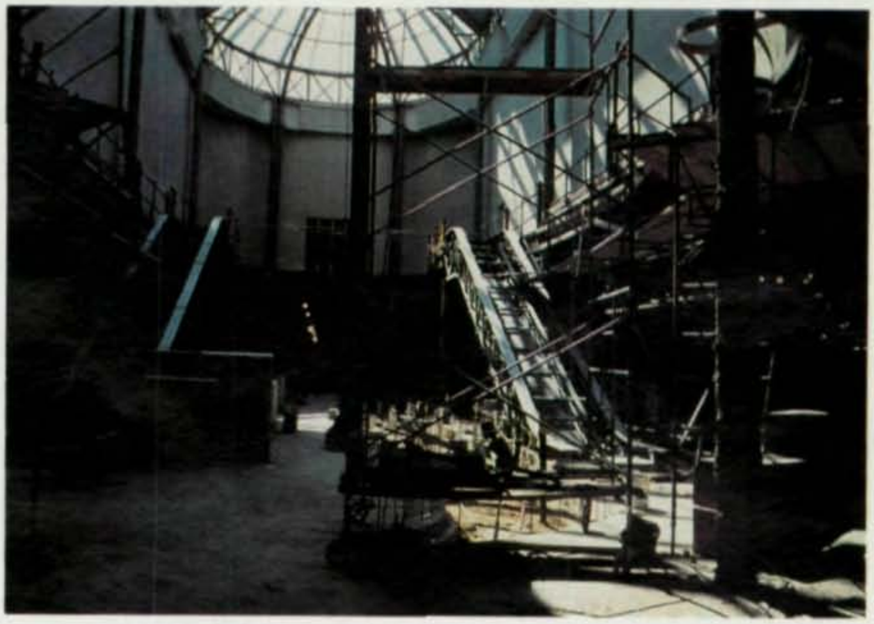
A second structural solution considered was to provide new columns and foundations between existing grid locations. Although conceptually simple, disadvantages of this scheme included the need to install new deep foundations in the confined basement area and the disruption of upper-level retail tenants due to the installation of new columns.

An additional complication surrounding the addition of a new floor level related to the structural requirements for resisting increased lateral loads due to wind. A solution involving numerous full height steel trusses threaded through the existing structure was considered, but it would have required temporary store closings and a loss of leasing flexibility.

Downward Expansion

Although presenting a separate set of challenges, a downward expansion into the existing basement level was clearly the best choice both for minimizing construction costs and disruption of existing retail tenants.

The new two-level mall was created by removing approximately 32,000 sq. ft. of existing floor structure and 47,000 sq. ft. of roof for the installation of new skylights.



Approximately 32,000 sq. ft. of floor structure was removed during the renovation, and virtually all of the work was performed during the night shift.

An initial design plan called for removing the entire 42'-wide section of roof above the existing common mall. However, this scheme would have required provisions for temporary weather protection. While a clear spanning fabric structure or temporary weatherproof pedestrian walkways would have been feasible, both would have been extremely expensive.

Instead, to keep the mall common areas dry throughout the entire renovation process, the contractor installed the new skylights and support structure prior to demolishing the existing roof. The demolition and renovation sequence developed by the building team was implemented without requiring even a temporary closing of any mall tenant. RTKL's design for the typical mall section called for the removal of a 15'-wide strip of floor and roof structure and the installation of new adjacent full height steel columns. The existing roof structure was hung from the new skylight support framing, eliminating the need for temporary protection as well as reducing the amount of needed new roof construction.

The existing mall construction was typically steel bar joists, wide-flange girders, and columns supported on either shallow spread footings or belled caissons. An exception to this was at the existing upper-level common mall area where one-way concrete joists spanning parallel to the mall length are supported by 42'-long W36 girders. Unfortunately, virtually all of the floor demolition occurred within the areas of concrete construction which resulted in higher construction costs. An existing steel-framed floor would have offered more flexibility for demolition and renovation operations while reducing costs and saving time.

New Foundations

The first step in the renovation was to construct foundations for the new mall columns. Shallow spread footings or augercast piles and caps were provided in the basement truck tunnel that paralleled the 1,500' length of the existing mall above. A custom low-overhead clearance rig was required to install 120 14"-diameter pressure grouted piles of lengths

The renovation provides space for 100 additional shops, as well as two new anchor department stores (top photo by Hedrich-Blessing). The skylights are supported by 60'-long, W27x146 girders that were set in place by helicopter. These members are designed to support both the new skylights and the existing roof framing.

ranging from 15' to 30'. New W10 columns were then erected between the foundations and the underside of the existing W36 girders.

The next step in the renovation sequence was to erect two 8" pipe columns at 60' on center through the existing roof structure. These columns bear on the existing W36 floor members directly above the new lower level columns. Existing roof bar joists were temporarily shored, cut, and then permanently connected to the new roof columns where interference occurred. Temporary weather protection was provided at new column penetrations through the existing roof.

With new support points in place above the existing roof, 60'-long W27x146 girders were set in place by helicopter. These members were designed to support the new skylight as well as existing roof framing. Wind load is transferred from the skylight to the existing roof level through torsional resistance of the W27 girder. A three-dimensional computer model of a typical 60' bay was created to facilitate analysis of the longspan girders under combined gravity and wind loading requirements.

Roof Erection

The next major step was to erect the architectural/structural roof trusses at 30' on center between W27 girders. After assembling and dismantling the roof trusses in the shop to check for fit-up, components were reassembled in place. These trusses feature exposed structural steel members. Chord members are WT4x89 with a curved bottom chord while web members are typically L2½x2½x¼. Skylights were then erected and sealed above the new support framing.

The existing roof segments that remained were essentially hung from the new W27 girders. A ¾"-thick plate hanger was installed between alternate existing steel joist top chord angles and welded in place. Diagonal web reinforcement for existing joist members was provided to eliminate excessive top chord bending. With the existing structure supported and the new roof/skylight section complete and watertight, a 15′-wide section of existing roofing, deck, and joists was removed and dropped through chutes to the truck tunnel below.

Roof removal was followed by floor demolition. Temporary shoring towers and beams were erected tight to the underside of the existing floor structure. After isolating by sawcutting, the 15′ widths of concrete construction were broken up and dropped to the tunnel floor. Immediately following floor demolition, a temporary cover was installed above each new opening to meet fire, dust and noise protection requirements. Construction of new bulkheads and handrails was completed below the temporary structure.

New Courts

In addition to the renovation of mall common area, four new department store courts and two feature mall courts were carved out of the existing structure. Large circular floor openings and pyramid skylights are featured in the department store courts. Typically used as columns, W12 beams as large as W12x170 were required to support the existing structure at the new department store openings in order to maintain desired ceiling heights and relatively column-free spaces.

The 60′ x 125′ feature courts required all new roof and skylight structure due to complexities with the existing high and sloping roof framing. Perimeter sections of new roof were first constructed below the existing roof. The installation of a two-story temporary vertical barricade surrounding the court center completed a watertight enclosure for mall pedestrian traffic. The existing roof could then be demolished from above. Floor demolition and construction of new roof trusses and skylights completed the basic renovation sequence. The 36′-long arched court trusses were constructed of exposed structural steel members, WT6 chords and L3x3 web members.

Virtually all demolition and structural renovation work was performed during the night shift. Although construction documents required the verification of existing dimensions and field conditions, access to many areas was limited up until a short time before commencement of work. For this reason, most new steel connections interfacing existing construction were provided with horizontal and sometimes vertical adjustment capability.

Robert Knight, P.E., is an associate principal with RTKL Associates, Inc., Baltimore, one of the nation's largest A/E firms with an international portfolio of retail, office, hospitality, mixed-use, health sciences and planning projects.

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Available Literature:

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