MODERN STEEL CONSTRUCTION

April 1992

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No. 16

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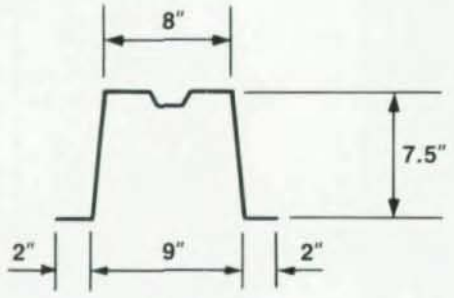
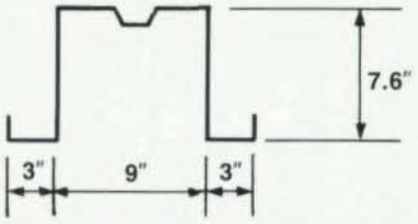
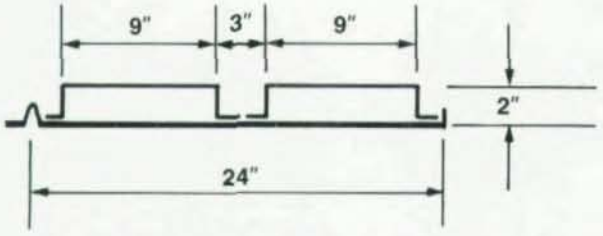


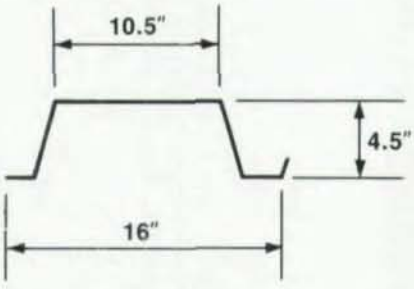
16 GAGE FORM DECK — USED TO BUILD A PIER WITH AN 18" SLAB.



12 GAGE 28' LONG DECK WAS USED TO ROOF AN EXISTING TANK. 15" SLAB; 6" WIDE RIBS USED AS REINFORCED CONCRETE JOISTS AT 15" CENTERS.



12 GAGE TOP AND 16 GAGE BOTTOM CELLULAR DECK USED TO SPAN BETWEEN BOTTOM BEAM FLANGES IN A POWERPLANT. VERY THICK SLAB — FLAT UNDERSIDE LEFT EXPOSED.



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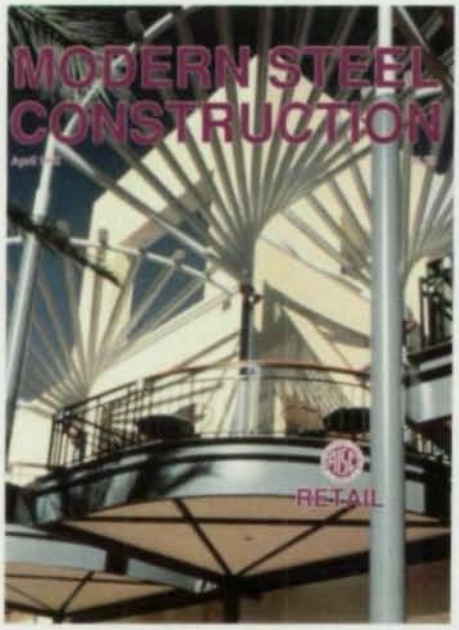
MODERN STEEL CONSTRUCTION

Volume 32, Number 4 April 1992



A series of scalloped trellises provide visual interest and shade for visitors to Arizona Centre in downtown Phoenix. (Photo by Timothy Hursley.)The story behind this exciting retail project begins on page 26.

FEATURES

Modern Steel Construction (Volume 32, Number 4). Published monthly by the American Institute of Steel Construction, Inc. (AISC), One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

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Putting The Cart Before The Horse

Last year in this space, I exhorted everyone who has a serious interest in steel design and construction to attend the National Steel Construction Conference. And nearly 1,000 of you did.

But what about the other 34,000 *MSC* subscribers? The most common reason I've heard for not attending the industry's premier conference and trade show is that the weak economy has resulted in drastically reduced travel budgets. To me, that type of thinking is backwards.

It is especially important in hard times to attend serious trade shows and conferences.

Let's get one thing straight. I'm not talking about "party" shows, where attendees are more interested in the evening activities than the seminars. No, I'm talking about the type of show where attendees can take solid knowledge back to their firm—knowledge that can be used to enhance their professional practice; knowledge that can make one designer or fabricator standout from the crowd; knowledge that can help an engineer win a contract. And that's what the National Steel Construction Conference is all about: Providing professionals with valuable information on the latest design trends.

Each year, the General Sessions prove invaluable. Start with the T.R. Higgins lecture on Wednesday. This talk will tackle the tough subject of an engineer's responsibility in an increasingly computer-driven industry. Thursday's two General Sessions deal with connection design and metric conversions, while Friday's two General Sessions cover steel construction in Great Britain and low-rise construction.

Of even greater interest are the technical sessions. These 17 seminars cover such subjects as: legal issues; marketing; connections; shop safety; bolts; economical welding; painting; connection design responsibility; steel parking decks; short span steel bridges; building codes; and research.

In addition, more than 100 exhibitors will be showcasing products for the structural steel industry.

Registration forms are contained in the pullout section in the center of this magazine. I look forward to seeing you June 3-5 at the National Steel Construction Conference in Las Vegas. **SM**

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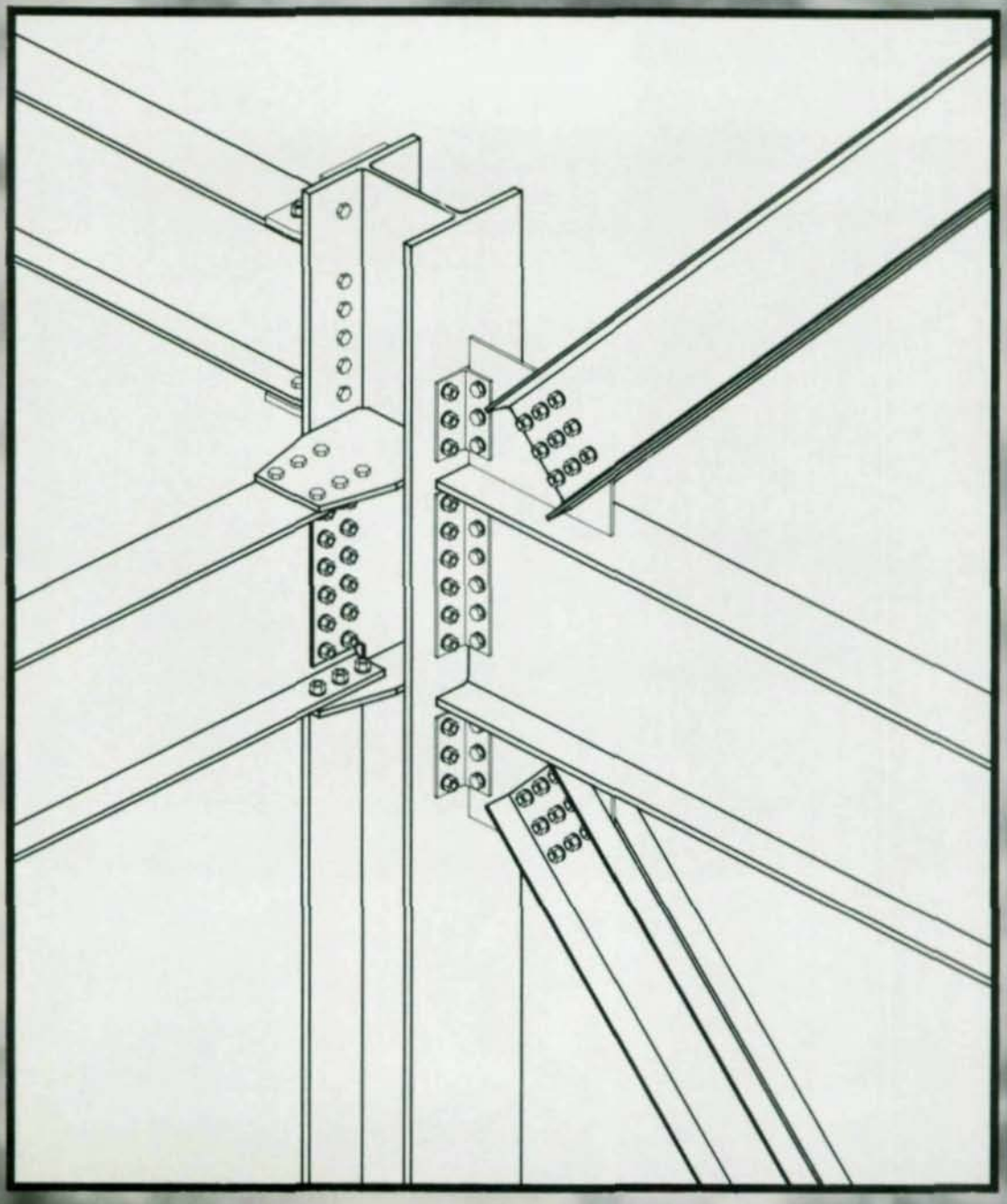

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2. Name _____
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3. Name _____
(First) (Middle Initial) (Last) (Professional Suffix-Degree)

Invitation/Call For Papers

The 1993 National Steel Construction Conference will be held at the Orlando Convention Center, March 17-19, 1993. Participants include structural engineers, fabricators, erectors, educators, and researchers. Potential authors may submit abstracts of papers on design, fabrication and erection of steel structures for buildings and bridges. Topics of interest include:

- Practical application of research;
- Advances in steel bridge design and construction;
- Composite members and frames;
- Buildings designed by LRFD;
- Heavy framing connections;
- Steel-framed high-rise residential buildings;
- Partially restrained connections and frames;
- Economical fabrication and erection practice;
- Quality assurance and control;
- Case studies of unique projects;
- Computer-aided design and detailing;
- Case studies of unique projects;
- Computer-aided design and detailing;
- Material considerations;
- Fire Protection;
- Coatings and material preparation;
- Structural systems.

Guidelines for Abstract Proposals

Abstracts for papers must be submitted before June 15, 1992. They should be approximately 250 words in length, and submitted on a separate sheet of 8 1/2" x 11" white paper attached to this form.

Authors will be informed of the Organizing Committee's decisions by September 1, 1992. Successful authors must submit their final manuscripts for publication in the 1993 Conference Proceedings by December 15.

Preparation of Paper

Final manuscripts for publication in the official 1993 Conference Proceedings are expected to be approximately 20 pages in length. Copy (including photographs) must be camera-ready. Complete instructions will be forwarded to authors upon acceptance of Abstract Proposals.

Poster Session

Papers not accepted for presentation at the Conference may, at the author's expense, be presented at the Conference Poster Session. Guidelines for the Poster Session will be provided upon request.

Return your abstract with this submission form before June 15, 1992 to:
American Institute of Steel Construction, Inc., One East Wacker Drive, Suite 3100
Chicago, IL 60601-2001 Attention: 1993 NSCC Abstracts
Phone 312/670-5400 Fax: 312/670-5403

Steel Interchange

Steel Interchange is an open forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine. If you have a question or problem that your fellow readers might help to solve, please forward it to *Modern Steel Construction*. At the same time feel free to respond to any of the questions that you have read here. Please send them to:

Steel Interchange
Modern Steel Construction
1 East Wacker Dr.
Suite 3100
Chicago, IL 60601

Answers and/or questions should be typewritten and double spaced. Submittals that have been prepared by word-processing are appreciated on computer diskette (either as a wordperfect file or in ASCII format).

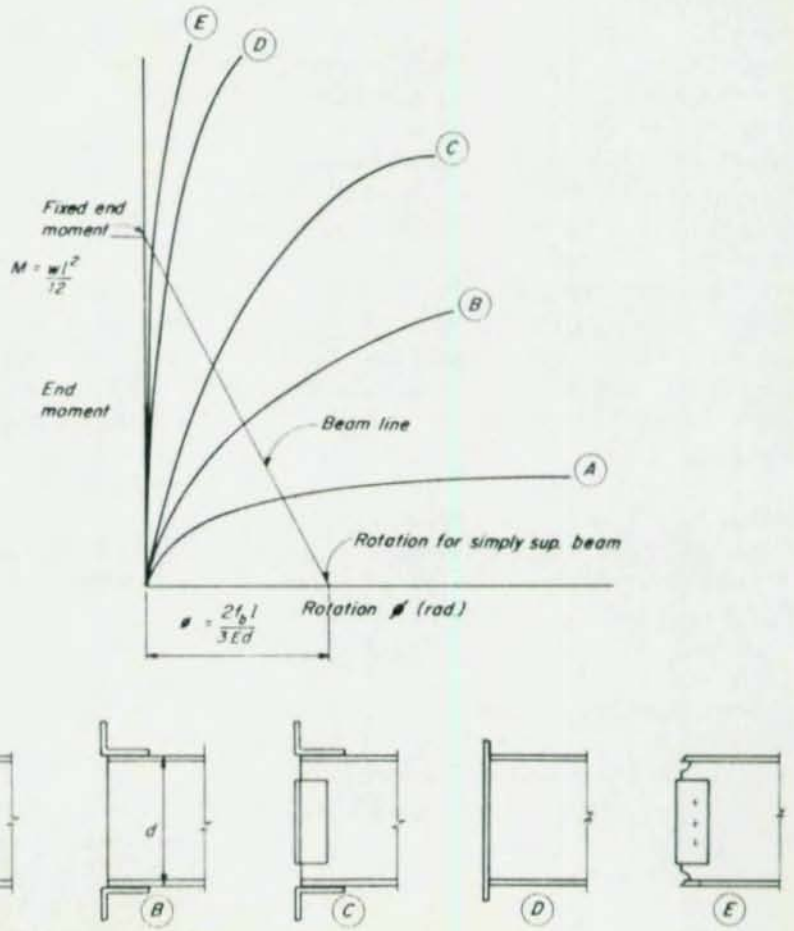
The opinions expressed in *Steel Interchange* do not necessarily represent an official position of the American Institute of Steel Construction, Inc. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.

Information on ordering AISC publications mentioned in this article can be obtained by calling AISC at 312/670-2400 ext. 433.

In the AISC Manual, section 4, there is some information on moment connections. Several different types are shown. One opinion interprets them as "Fully Rigid" connections, able to make a rigid bent or frame. The opinion of the other side holds that they are intended to be "Semi-Rigid" connections intended for wind applications, etc., only. The first group cites the bolted end plate connection in the manual as being fully rigid. The other connections are welded and therefore must be rigid also. What is the intent of the moment connections in the AISC Manual?

(Answer appears on following page.)

FIGURE 1: MOMENT ROTATION CURVES



Steel Interchange

The AISC publication *Manual of Steel Construction: Volume II - Connections* is a very helpful source in explaining the connection design terminology used by AISC. This publication will be available from AISC in the fall of 1992.

Simple shear connections are used when the frame is designed assuming that the members are unrestrained or free ended, that the ends of the beams are connected for shear only, and that the ends are free to rotate under gravity loading. Rigid frame, moment frame or continuous construction, identified as Type 1 in ASD and fully restrained in LRFD, assumes that the beam-column members are connected with sufficient rigidity to transfer the design moments with little or no rotation of the members relative to each other. The AISC Specification also allows semi-rigid framing, this type of construction assumes that the connections of beam-to-column members have a "dependable and known moment capacity intermediate in degree between rigid and simple construction".

In the real world that we all live in there probably is not a fully rigid connection nor is there a fully flexible connection. Figure 1 (previous page; this chart is reprinted from the AISC Manual) shows moment rotation curves for different types of connections. Type A is considered "simple" with little fixity; Types B and C are considered "semi-rigid"; and Types D and E, "rigid", are close to complete fixity.

The simple connections are connected for shear only, while the rigid connections normally would be developed for the indicated axial force in the flange areas on the basis of 100 percent fixity and would have a web or seat connection to develop the shear force.

The AISC Manual section on connection includes both simple shear connections and moment connections. It is the intent of the manual that the connections that are listed as simple be designed for shear; these are considered to be flexible connections. These connections would fall into Type A in Fig. 1. The connection section also labels some connections as moment connections. These connections are considered to be fully rigid and the design of them should be accordingly. These moment connections fall into Types D and E in Fig. 1.

As mentioned in the initial question, there also are "wind" connections. These connections are not fully rigid nor are they completely flexible. These connections are a simple, reliable and economical method of design. This type of connection is designed as if it were a simple shear connection in that the beam-to-column connection is assumed to be pinned and the members are sized for gravity loads. An independent lateral load analysis is next made, with certain connections assumed to be rigid. The selected connections are then designed for the calculated moment capacities.

The advantages of this design are: (1) simplified calculations and analysis; (2) beams and girders are designed on the basis of simple shear construction for gravity loads; and (3) the columns are designed as axially loaded members with applied wind moments.

The AISC *Engineering Journal* has published several articles on this type of connection including: "Wind Connections with Simple Framing" by Robert O. Disque in July of 1964 and "Simplified Frame Design of Type PR Construction" by Michael Ackroyd in the 4th quarter of 1987. The *Manual of Steel Construction: Volume II - Connections* will also include discussion and design examples of this type of connection.

New Questions

Listed below are some questions that we would like the readers to answer or discuss. If you have an answer or suggestion please send it to the Steel Interchange Editor. Questions and responses will be printed in future editions of Steel Interchange Also if you have a question or problem that readers might help solve, send these to the Steel Interchange Editor.

1. What procedures should be followed when assessing steel that has been exposed to a fire?

2. How has the recent specification change allowing snug-tight high-strength bolting for certain types of shear/bearing connections affected your projects?

3. How do you decide when to use doubler plates and when to increase the size of the column?

4. What is a good "wind" connection for the top of a column?

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Reducing Fabrication Costs

Dear Editor:

Congratulations on an excellent February issue of *Modern Steel Construction*. However, I did notice some disparities between Bill Thornton's and my articles to which you should be prepared to respond in case someone else spots them. For instance, when assigning equivalent pounds of steel we list the following:

	Thornton	Ricker
One pair fillet welded stiffeners	200#	250#
One pair groove welded stiffeners	400#	1000#
One doubler plate	280#	500#
One column splice	500#	600#
Four pairs of stiffeners + four doubler plates	1900#	—
Four pairs of stiffeners + two doubler plates	—	2000#

You will note that in general Bill's equivalents are lower than mine. This may reflect the differences in material and labor costs between the high cost New England area where I am from and the lower cost deep South area where Bill works. Also, I am not sure when he last up-dated his company cost index. Mine is very current.

Our biggest differences are in groove welded stiffeners and doubler plates. I cannot speculate on the reason for this big disparity except he may have figured "best case" conditions versus my "average case" conditions.

Sincerely,
David T. Ricker, P.E.
Retired Vice President,
The Berlin Steel Construction Co.

Dear Editor:

Your "Special Report: How Design Engineers Can Cut Fabrication Costs" provides useful advice on the subject. To fully encourage the implementation of these suggestions, however, some changes in the larger picture are required.

First, engineers and owners must believe that any savings available from improved details are accurately included in the steel bid. Although some estimators consider the actual connection details in their estimate, engineers suspect that most bids include only an approximate, rule-of-thumb mark-up on the actual steel cost for connection. Using such a method, the bid will change when the engineer uses simplified connections. If engineers have confidence that certain details will reduce bids, they will be more likely to use those details.

Second, structural designs must not be judged by weight of steel per area of finished structure. Currently, the construction industry considers pounds of steel per square foot as the prime indicator of a design's efficiency. Magazines, including *Modern Steel Construction*, often list this value for projects, reinforcing the importance of this statistic. However, as it is clear from your report, design engineers should strive to minimize **cost** rather than steel **weight**. If the construction industry would place more emphasis on cost rather than weight, design engineers would be encouraged to implement the cost saving suggestions in your report.

In summary, design engineers will be more likely to consider options to reduce fabrication costs if they are sure that the reductions will result in lower costs to the **owner** and if they know that these reductions will be included in whatever statistic the industry uses to judge structural designs.

Sincerely,
Richard A. Cameron, P.E.,
Associate,
RTKL Associates, Inc.,
Baltimore

Dear Editor:

I read with great interest your recent article titled "Value Engineering And Steel Economy." Please be aware of two exciting commercial realities relative to your comments under point number 4, or "Select a proper mix of A36 and high strength steel." These realities are:

- A572 Grade 50 is now no more expensive than ASTM A36 on virtually all structural sections up to W24x76. Our company and selected competitors recently eliminated grade extras for A572 steels in the very popular "Chaparral range." You might also be surprised at today's economical structural steel prices.
- ASTM A572 Grade 50 is not necessarily 35% stronger than modern ASTM A36 sections. Please check recent A36 mill certifications from a variety of mill suppliers. State-of-the-art electric furnace mills have been producing very strong A36 steels for many years now. (This is due to the nature of scrap-based steel making.) In fact, Chaparral and certain other mills can now even "multi-certify" many sections to achieve the specifications of American A36, A572 Grade 50 and Canadian 44W, 50W on one mill certification!

We strongly support your efforts to reduce fabrication costs during the design stage. Please continue to help us spread the word about "structural steels' strengths."

Sincerely,
James L. Wroble
General Sales Manager
Chaparral Steel

(For information on reprints of MSC's "Special Report: How Design Engineers Can Cut Fabrication Costs," contact: Editorial Department, Modern Steel Construction,One East Wacker Dr., Suite 3100 Chicago, IL 60601 (312) 670-2400.)

Eliminate Sexist Language

Dear Editor:

As a member of the American Institute of Steel Construction, I enjoy reading the AISC monthly publication, *Modern Steel Construc-*

tion. My attention has been drawn to [the] advertisement called "Men of Steel" [from the Structural Steel Association & Advancement Fund of NJ] which has appeared in the February 1992 issue as well as earlier issues.

The title "Men of Steel" sends a clear message to me and other women that [the Structural Steel Association of NJ] does not acknowledge women structural engineers and excludes their participation.

This type of advertising is a disservice to the women practicing in this profession.

Sincerely,
Karen L. Hefler, P.E.,
Structural Engineer,
Harriman Associates,
Auburn, ME

How To Choose Software

Dear Editor:

I read with interest your computer survey in the February issue of *Modern Steel Construction.*

Nearly one-quarter of the article was devoted to evaluating software packages. In addition to the good points made by several vendors interviewed, one additional question the evaluator should ask is whether or not the vendor provides an unconditional money-back guarantee. The best way to evaluate software is to use it on a real project. The presence of such a guarantee allows verification of claims made by the vendors' sales literature and program documentation.

With an unconditional money-back guarantee the prospective buyer gets an honest chance to investigate the program without risk.

For a software vendor, this guarantee amounts to putting your money where your mouth is!

Sincerely,
Rory Rottschalk, S.E.,
Vice President,
Culp & Tanner,
Structural Engineers
Chico, CA

(Culp & Tanner is the parent company of Ram Analysis, the authors of the RAMSTEEL software program.)

STEEL CALENDAR

April 1. **Structural Vibrations**, Lehigh University, Bethlehem, PA. Full-day course includes presentations on vibrations in bridges as well as Thomas Murray's T.R. Higgins Lecture on floor vibrations. Contact: Indra Ghosh, BASE Engineering Inc., 1044 N. Quebec St., Allentown, PA 18013 (215) 437-0978.

April 1. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Orlando. 45 minute description of changes since the issuance of the 1985 High-Strength Bolt Spec. Also includes a review of installation methods for high-strength A325 and A490 bolts.

April 2. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Tampa (See April 1 listing).

April 6-7. **Welding Structural Design** two-day seminar, Detroit. Contact: AWS, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, FL 33135 (800) 443-9353.

April 6-8. **Structural Stability Research Council** (SSRC) Annual Meeting, Pittsburgh. Sessions will revolve around earthquake stability problems in Eastern North America. Contact: Lesleigh G. Federinic, SSRC, Fritz Engineering Laboratory #13, Lehigh University, Bethlehem, PA 18015 (215) 758-3522 or Prof. Reidar Bjorhovde (412) 624-9876.

April 8. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Norfolk, VA. Will include design criteria, Type 2 Connections, tube-to-tube connections, design guides, practical recommendations and application examples.

April 9. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Richmond, VA (see April 8 listing).

April 9. **Southeast Steel Bridge Forum**, New Orleans. Contact: Camille Rubeiz, Steel Bridge Forum, c/o AISI, 1101 17th St., N.W., Suite 1300, Washington, DC 20036 (202) 452-7190.

April 12-16. **ASCE Structures Congress**, San Antonio, TX. Four plenary sessions and more than 70 technical sessions. Contact: American Society of Civil Engineers, 345 East 47th St., New York, NY 10017 (800) 548-ASCE; Prof. James R. Morgan (409) 845-4394.

April 14. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Miami (see April 1 listing).

April 15. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in West Palm Beach, FL (see April 1 listing).

April 16. **Seismic Resistant Eccentrically Braced Frames** (co-sponsored by AISC and Houston/Gulf Coast Chapter SEAoT) dinner meeting in Houston. Contact: Mahdi Kasir, Lichliter/Jameson (713) 561-5199.

April 16. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Melbourne, FL (see April 1 listing).

April 16. **Eccentric Braced Frames**, Houston/Gulf Coast Chapter, SEAoT, Dinner Meeting in Houston. Prof. Michael Englehardt, University of Texas-Austin. Contact: Jim Anders, (214) 369-0664.

April 28. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Memphis (see April 1 listing).

April 28. **Current Trends in Steel Making**, dinner meeting co-sponsored by Texas Structural Steel Institute and North Central Chapter of SEAoT. Featuring Ted Temple, Chapparal Steel. Contact: Jim Anders, (214) 369-0664.

April 29. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Nashville (see April 1 listing).

April 29-30. **International Symposium on Steel Bridges**, Paris. Four sessions will consist of 32 papers presented by speakers from 10 countries. Contact: Micheline Roos, Voyages Pluriel, 39, Rue de Paradis, 75010 Paris, FRANCE (1) 40 22 08 87.

April 30. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Knoxville, TN (see April 1 listing).

May 5. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Raleigh, NC (see April 8 listing).

May 5. **Structural Computer Expo** (sponsored by Structural Engineers Association of Northern California) in San Francisco. Contact: Mark Middlebrook at (510) 547-0602.

NSCC Scheduled For June 3-5

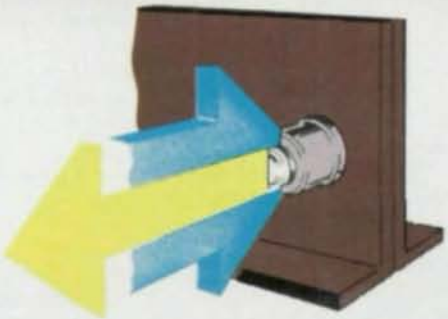
More than 45 sessions are scheduled for this year's National Steel Construction Conference in Las Vegas from June 3-5. Also, more than 100 exhibitors will showcase products for the fabricated structural steel industry.

Topics include: codes and specifications; computerized design; research; project and shop management; inspection and safety; and fabrication and erection procedures.

Contact: David G. Wiley, AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-5422.

HERE'S THE HUCK DIFFERENCE.

TENSION/TENSION

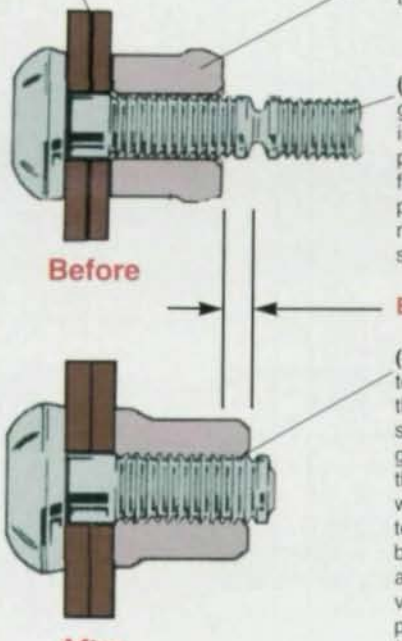


Huck Lockpin & Collar fastening is secured by applying direct, straight-line tension to a grooved fastener against a metal collar to pull workpieces together. This collar is then swaged ("squeezed") to cold flow the metal into the grooves and elongated in the process to create a precise clamp load.

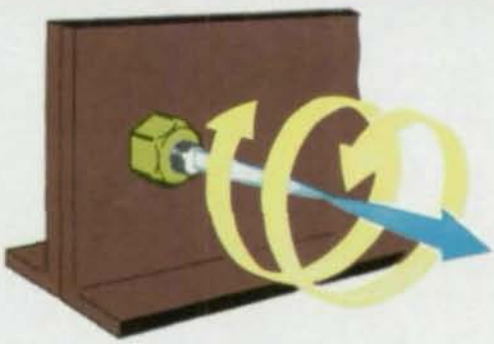
The Huck Lockpin & Collar fastener has a controlled predetermined clamp force that is built into the design of the fastener and cannot be altered by the installer.

Workpieces are pulled together and clamped during the swaging action without applying torque. On completion of collar swage, the gripping pintail separates, leaving a permanent, vibration resistant fastener. Huck Lockpin & Collars are fully capable of being snugged to remove gap prior to final swaging.

Lockpin & Collar fastening is a well-known, modern concept which is gaining added acceptance in many tough applications for its simple, accurate installation, dependability, and performance.



TORQUE/TENSION



A nut and bolt is installed by applying torque to the nut; first, the torque to pull the workpieces together, then tension is added by torquing to create clamp force.

A torque wrench does not read tension. It indicates torque of the nut against a surface friction.

In addition, torque/tension sufficient to create proper clamp force creates a torque stress in the bolt, in varying degrees, dependent upon size, application and surface condition.

The thread of the bolt also provides a ready back-off path for the nut in any vibratory environment.

Nut and bolt fastening is a familiar, traditional method which is not reliable or permanent.

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The Ten Commandments Of Marketing

Richard Weingardt, P.E., is president of Richard Weingardt Consultants, Inc., a consulting structural engineering firm based in Denver. In its 25 years of existence, his firm has completed more than 2,000 projects worldwide. Weingardt is a vice president of the American Consulting Engineers Council, past president of the Consulting Engineers Council of Colorado, and past president of the Society for Marketing Professional Services/Colorado.

By Richard Weingardt, P.E.

When I first opened my office, I hung out my shingle, sat back, and, because I was a good engineer, waited for clients to beat a path to my door. I waited, and waited...and waited. Nothing happened. That is, nothing happened until I went out and developed client relationships—starting with a high-quality company brochure.

Marketing attitudes have changed dramatically within the design community during recent years as a result of an industry-wide slump, increased competition, more sophistication on the part of clients, and an unraveling of the "old-boy" network. Even the most reluctant professionals now are being forced to develop marketing programs.

According to Ted Levitt, Harvard Business School marketing professor and widely acclaimed marketing expert, in his book *The Marketing Imagination*, the purpose of business is to get and keep a customer. To do that, you have to do those things that will make people want to do business with you. And then you must direct all of your energies toward that end.

> A carefully targeted rifle beats the scatter-gun method

What follows are specific guidelines for marketing. I like to call them the Ten Commandments of Marketing for Design Professionals. Only I didn't find them etched in stone on a mountain; rather, I developed them through trial-and-error during the more than 25 years my firm's been in business.

Understand Your Firm's Capabilities.

Know who you are and what you can do well. Don't just talk about your strengths; put down in writing what you do, what you're good at, and what your weaknesses are.

Be specific about your capabilities. For example, my firm doesn't waste time chasing large sewage-treatment plants because we simply don't have the in-house expertise—nor the desire—to expand in that direction. On the other hand, we are good at designing buildings, parking garages, bridges and roadways. Knowing these strengths helps us to focus our energies on proposals that are worthwhile and it helps us to feel confident that we are the best designers for a job.

Perhaps the most effective marketing you can have is confidence. Besides, as every hunter knows, a carefully targeted rifle beats the scatter-gun method: We would rather take sure aim with the weapons we know, and hit a higher percentage of targets.

Know The Market And Its Geographical Area.

Today, design firms increasingly are looking at the global economy as their market. As John Naisbitt stressed in his book *Megatrends*, the

United States is becoming more and more a service economy and we need to export our expertise.

However, when scouting far-flung markets, it often is useful to find a local partner. This partner should be familiar with local rules and codes, as well as having established contacts in the region. Make sure when shopping for foreign markets that you are dealing with a country with convertible currency—you don't want to be paid in vodka or beets.

Not all marketing is geographically oriented. Parking structures, for example, are the same throughout the world.

Also, narrow down your market to those jobs that fit both your short-term and long-term goals—five to ten years—and that they relate to the kinds of work that you want to do. Conversely, you must be sensitive to burgeoning markets and aware of outdated areas.

Establish A Marketing Plan.

While this may seem obvious, many firms don't develop a program, budget and marketing procedure. It also is important to designate a marketing team and commit a principal or partner to oversee it.

Marketing is costly. Typical marketing budgets are 5-7% of gross billings, with one-third going to direct costs and two-thirds for people costs. It requires dedication by a principal to a serious plan of action tailored to your firm. This plan should emphasize the importance of repeat clients, referrals and doing good work.

To start a marketing program, do a couple of surveys: an in-house survey to find out your mix of clients and what projects are most profitable; and a client/potential client survey to find out their views of your firm and your competition. You may discover, for example, that while you think everyone is aware of your expertise in hospital design, in reality most potential clients are unaware of your capabilities.

In our company, we took those responses and parlayed them into a plan of action that would let clients know all they needed to about us. We broke our marketing group into two teams. The first group helps look after on-going clients. The second group is a pro-active marketing team made up of extroverts. They make cold calls, presentations and sales. Currently, we have six people, including three partners, in this second group.

Our most effective communications tool has been our office newsletter. We publish it twice a year and mail it to about 4,000 people. It has been extremely effective. We get a hundred or more calls from each issue. It helps to get new clients and lets old clients know about our new services and projects. We send it to individuals, not to firms, which forces us to continuously update our computer mailing list and ensures that we're aware of changes in our potential client base.

> You are in the business to make money. It doesn't help to turn out award-winning projects if every job loses money.

Get Everyone In Your Office Involved.

An architect once told me the story of one of his employees who belonged to a church that was planning a new building. Every Sunday he'd listen to sermons about fund raising. Eventually, an architect was hired—one of his competitors! By the time his firm had heard about the project, it was too late. The architect's response to his supervisors was: "I've been here five years and have always worked on commercial projects. I didn't know we could design churches." This person should have been, but wasn't, involved in his firm's marketing effort.

Everyone, from the receptionist to upper management, should participate in your marketing plan. Keep all of your people informed and enthusiastic, and let them know that the market develops an opinion about your company from contact with each member of the company.

At our office, we try to get our people to say "we", "our team," "our firm", instead of "me", "you" or "they".

A cruel, hard thing to realize about your employees is that if they don't fit into your marketing concept and your philosophy of providing service, the only thing to do is get rid of them.

According to Tom Peters, co-author of *A Passion For Excellence*, John McConnell, the chairman of one of the best-run steel companies, doesn't have any elaborate corporate procedure books. Instead, his company's stated philosophy is: "Take care of your customers and take care of your people and the market will take care of you." This type of thinking has earned McConnell's company a spot on Peter's list of America's Best Run Companies.

Bullet = Remember Your Profession Also Is A Business.

You are in business to make money. It doesn't help to turn out award-winning projects if every job loses money. Many designers choose their careers for the satisfaction of their accomplishments. However, to stay in business, you need to make money.

Likewise, a good businessman relates to his client's needs, is aware of his costs, and helps him get the most value for his construction dollar. Let him know that you are not just a design professional, but also a business professional.

Be Selective In Choosing Projects.

Again, take only those projects for which you are qualified and

that can be financially and professionally rewarding. As many design firm's learned in the '70s, growth for growth's sake can be damaging to a company's reputation and bottom line.

Positive growth allows you to compete for more desirable—and better paying—projects. An added benefit is that stable growth creates a work environment that attracts and motivates young, bright employees that are aware that the company is providing new opportunities.

Keep Strong Ties With Past And Present Clients.

If any of these rules should be etched in stone, this is it. I can't emphasize enough the value of referrals in our profession. Remember though, your competition may try to undercut your fees or steal your good employees if they think that will get them a client. By staying in touch, you'll keep those clients happy, and keep them as clients.

A marketing budget should be balanced between attracting new clients and maintaining those you have. Keep on-going client relationships, don't just market for new projects.

Follow Through On Leads And Problems.

Studies show that 80% of first contacts don't get followed-up. The initial time and cost is lost. This wastes money. Failure to follow-up on leads, proposals and presentations or to deal fully with client questions and problems is a surefire formula for losing business.

Keep calling potential clients on a timely basis—but without becoming a pest. Learning the right timing and frequency comes with experience. Be quick to smooth the "ruffled feathers" of a good client—but do it tactfully.

Be Prepared For Your Presentations.

As a professional, your brochures, newsletters, direct mail releases and news releases should be first-class. But these are just tools. The bottom line is to obtain that commission. And you can only do that with developed, refined and perfected proposals and presentations.

We sometimes videotape "dry-run" or practice interviews. It's surprising for a lot of people to see themselves on a TV screen. Some do things like roll up their ties, chew their pencils or rock their chairs. Videos help eliminate these distractions before the marketer makes the real presentation.

There's a lot of competition out there. Don't wait until you're short-listed to work on refining presentations.

Don't Neglect The Value Of Good Publicity.

Your firm may win awards and have the most talented people in the country. But you won't get clients if they don't know about you.

We regularly submit press releases on office changes, personnel promotions, and outstanding projects, and include a 5x7, black-and-white photo with it. We make a point of contacting editors and finding out what type of news stories they want for their publications.

With longer articles, editors like exclusive use of your submittals. Before submitting longer articles, send a query letter. (For *Modern Steel Construction*, query letters can be sent to: Scott Melnick, Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001).

Our company also tries to be active on civic and community organizations. We have successfully sponsored design seminars. At these seminars we discuss the impact of design on a community, and several of these received television and other media coverage. Our discussions involved people and people issues. And while these and our other marketing efforts cost money, it helps to make the community familiar with us. Again, people do business with people they know.

We all want to do good work. But to do so, designers must first get the commission. And a well-developed marketing plan is the key.

LRFD For Welded Box Section Trusses

Information on designing hollow structural sections with the LRFD Specification is contained in a paper published in the latest issue of AISC's *Engineering Journal*.

"Load and Resistance Factor Design of Welded Box Section Trusses", reports on the recent international consensus obtained for LRFD design of statically-loaded, welded connections involving structural tubes in planar trusses. Also included in the paper is welding information incorporated into the current (13th) edition of AWS D1.1.

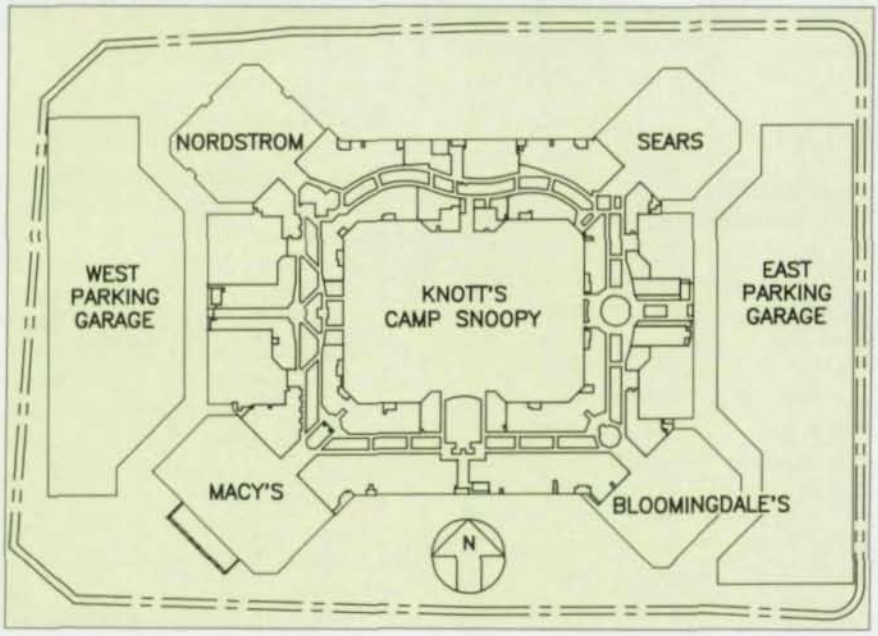
Other papers in this issue of *Engineering Journal* include: "Forces on Bracing Systems," which proposes a simple technique for determining the required stiffness of braces designed to prevent buckling; "An Equivalent Radius of Gyration Approach to Flexural-Torsional Buckling for Singly Symmetric Sections," and "The Significance and Application of C_b in Beam Design."

Subscriptions to the quarterly *Engineering Journal*, the only U.S. technical magazine devoted exclusively to the design of steel structures, cost $15 for one year and $36 for three years ($18 & $45 for foreign subscriptions). Single copies cost $5 ($6 foreign), with back issue availability limited to the previous year. To order a subscription, send payment to: American Institute of Steel Construction, Inc., P.O. Box 806276, Chicago, IL 60680-4124.

A free copy of an index of *Engineering Journal* articles and subjects also is available from the address listed above.

Copies of individual articles can be ordered from University Microfilm International, phone: (313) 761-4700 ext. 533 or 534; fax: (313) 665-7075.

Mega-Mall Creates New Shopping Experience



At 4.2 million sq. ft., the 930' x 1,230' Mall of America in Bloomington, MN, will be the nation's largest retail complex. Photograph by Bordner Aerials.

The developers of a giant mall near Minneapolis plan to attract patrons by offering a multi-purpose destination

By Thomas L. Shenberger, P.E., and Gordon R. Baker, P.E.

Minnesota was the home of America's first enclosed shopping mall. Now, 35 years later, the state will house the nation's largest: the Mall of America.

In choosing a site, the developers, Melvin Simon & Associates, Indianapolis, and Triple Five Corporation, Ltd., Edmonton, heeded the old real estate adage of "location, location, location" and acquired the 78-acre former site of the Metropolitan Stadium in Bloomington, a suburb of Minneapolis/St. Paul. The site is five minutes from the airport; has its own access ramps to the interstate system; and is in a large metropolitan area accessible to more than 28 million people living within a one-day drive.

The former home field of the Minnesota Vikings and Twins seems particularly appropriate as the location for the state's newest—and largest—attraction. The 4.2 million-sq.-ft. mega-mall will feature four major anchors (Bloomingdale's, Sears, Macy's,

and Nordstrom), 400 specialty shops, a 14 theater cinema, nightclubs, restaurants, Golf Mountain, Lego Showplace and Knott's Camp Snoopy—an enclosed seven-acre family theme park.

Construction manager on the project is PCL Construction Services Inc., Denver. Design architect is the Jerde Partnership, Venice Beach, CA, while documents architect is HGA/KKE, Minneapolis. Coordinating architect is Plus 4 Architects, Indianapolis. Structural engineer for the mall structure and Bloomingdale's is Shenberger and Associates, Cleveland. Heading the construction team and keeping the project on track to open August 11 of this year is Joseph R. Talentino, vice president-director of construction for Melvin Simon.

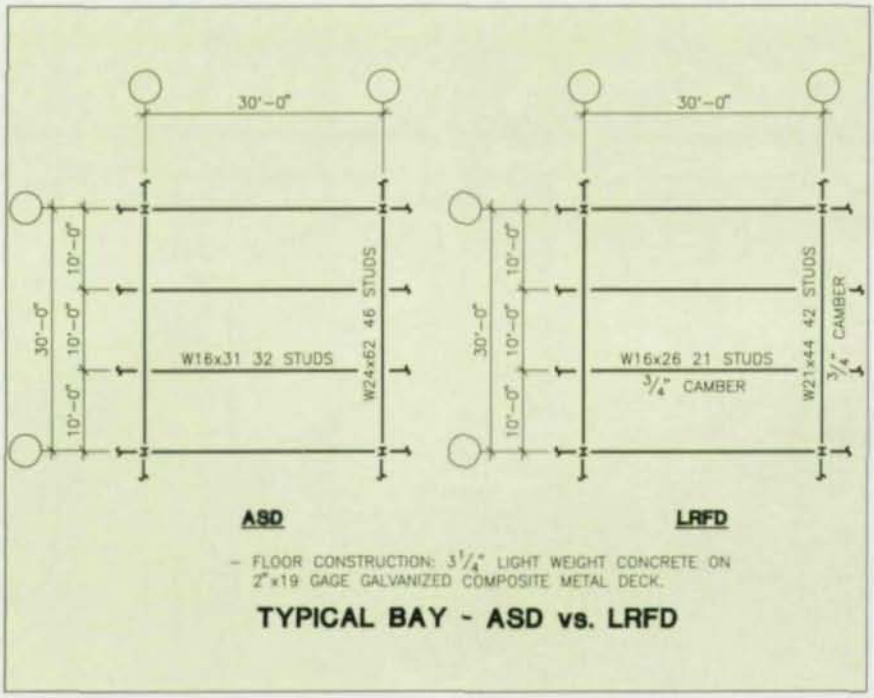
In plan, the mall is a rectangle approximately 930′ x 1,230′ with truncated corners to receive the department store anchors. Three, four and five stories of steel structure surround Camp Snoopy. Structurally, expansion joints divide the mall into 10 sections and separate the mall from the anchor stores and Camp Snoopy. The basic construction of the mall has 30′ x 30′ bays with wide flange columns, composite steel girders and beams for the floors, with joists and joist girders for the roof. The fire ratings conform to Type I construction. The roof over Camp Snoopy is composed of steel trusses supported by 80′-tall Vierendeel columns on a 120′ column grid.

Steel was chosen for the nation's largest enclosed mall to satisfy the project's budget, accept the architect's aesthetics, and meet the contractor's aggressive construction schedule and need for construction flexibility.

Economy

Since the mall structure is so large, all typical details, repetitive bays, and member sizes have a substantial impact on the cost of the structure. The engineers conducted in-depth economic studies to determine the most cost effective structure system for the mall. All aspects of the mall's structure and function were considered, including bay

The bow trusses in West Market street will be exposed as an integral part of the architecture. The steel roof trusses in Knott's Camp Snoopy frame into the Vierendeel columns with moment connections in both directions providing lateral stability. Photographs by Peter Renerts.



TYPICAL BAY - ASD vs. LRFD

size, roof construction, floor construction, fire ratings, and lateral resistance system.

A 30′ column grid was selected with respect to leasing requirements, geometrical restrictions and cost considerations. Several roof construction schemes were considered and the most economical was selected. It consists of 1½" x 22 gage galvanized metal roof deck supported by steel joists at 5′ on center and joist girders at 30′ on center. The joists, joist girders and metal deck received sprayed-on fireproofing to meet the required one-hour fire rating.

The selection of the floor framing system was crucial to the project's budget. In addition to performance, the frame's weight, required camber and fireproofing were all factors in this decision. All of the systems studies needed to provide a floor fire rating of two hours and a primary frame rating of three hours.

The studies narrowed the choice of floor framing systems to three:

- Steel composite construction using the Load and Resistance Factor Design (LRFD) method.
- Steel composite construction using the Allowable Stress Design (ASD) method.
- Steel joists and joist girders.

The LRFD system was chosen as the most economical. The final system has 3¼" lightweight concrete

on 2" x 19 gage galvanized composite metal deck supported by W16 x 26 composite beams at 10′ on center and W21 x 44 composite girders at 30′ on center. The beams and girders received sprayed-on fireproofing while the metal deck is unprotected.

The ASD alternative has identical deck construction but W16 x 31 beams at 10′ on center and W24 x 62 girders at 30′ on center. The LRFD scheme resulted in a savings for floor framing of 21% compared with the ASD scheme and a total savings of $1.6 million for the mall project.

The engineers performed vibration and deflection studies of the LRFD composite system and found that the structure is in the slightly perceptible range on the modified Reiher-Meister scale for heel drop vibration. The deflections for the typical steel beams are L/320 for the total load and L/650 for live load.

LRFD, an ultimate design method, is economical and meets the service requirements for this project. LRFD design was easy to learn and has become the standard for composite beam design for Shenberger and Associates. *This engineer believes that LRFD is a more accurate analysis of steel beam capacity and will eventually replace the ASD method throughout the industry just as ultimate design in reinforced concrete replaced working stress design more than two decades ago.*

The lateral resistance system has vertical cross bracing in one direction and simple-frame Type 2 moment frames in the opposite direction. Angles connect the top and bottom flange of the girders to the column flanges to form moment connections. Neither the girder or column sizes were increased over the gravity load design since an increase in allowable stress is permitted for load combinations with wind.

Several schemes for the roof construction over Camp Snoopy were considered, including a fabric structure, a space frame structure and a structural steel truss scheme with skylights. The final choice for the 640′ x 480′ roof is twin 12′-deep steel trusses spanning 120′ at 40′ on center. The twin trusses are supported by twin jack trusses spanning to Vierendeel columns. The 80′ high columns consist of four 12"-diameter extra strong steel pipes (Grade 50) placed in corners of a 10′ square. Horizontal members spaced 10′ on center connect the four pipe columns to form the Vierendeel columns—a shape the architects preferred to a smaller solid column. The Vierendeel columns with the trusses form moment frames in two directions for lateral resistance. Using structural steel trusses saved $3.1 million compared with the space frame or fabric alternatives.

Aesthetics

Exposed steel is an integral part of the architecture throughout the mall concourses.

Four different theme streets surround Camp Snoopy. North Garden has exposed joists, joist girders,

Exposed steel is used throughout the project, as illustrated in this model photograph (bottom). West Market, for example, will feature expsoed steel bow trusses, joists and joist girders supporting a barrel vault metal roof deck.

steel trusses and skylights in a raised roof area that is intended to make shopping a "summer's day" experience year round.

West Market is reminiscent of an international marketplace with exposed steel bow trusses, joists and joist girders supporting a barrel vault metal deck roof.

South Avenue has a cosmopolitan flair with exposed steel over the large gallery area that opens into Camp Snoopy.

East Broadway is upbeat and contemporary.

Scheduling

The decision to use steel as the main construction material had a tremendous positive effect on the construction schedule. The critical path for construction was to develop an extensive structural preliminary in the summer and fall of 1989 that would serve as the structural bid set while the architectural drawings were still only in the schematic design stage.

After the steel bid was awarded, the building was divided into four quadrants plus Camp Snoopy's roof. Construction documents were developed for each quadrant so that construction could start on one quadrant while the others were still in the design stage. The structural construction documents were produced and released while architectural and mechanical documents were still being developed. The steel erection began on April 19, 1990, and the structure was topped out February 4, 1991. Coordination and teamwork were key elements in the success of an aggressive schedule.

Flexibility

Since the structural documents were developed before the mechanical and architectural documents, the structure had to have the flexibility to change and accommodate mechanical and architectural design changes.

The mechanical design underwent several major changes that delayed the development of mechanical drawings. For example, in the first quadrant, the structure was built with no mechanical openings

in the floor. Steel enabled economical and practical placement of mechanical openings after the structure was built.

Typically, retail space in a shopping mall is leased during and after the construction of the structure. Some tenants that eventually lease space in the mall require special floor loading over the code live load requirements of 75 psf. The cost of designing the entire structure for a heavy loading that may or may not occur is uneconomical and unnecessary. A steel structure enables the floor capacity to be increased by adding cover plates and structural tees to beams, girders and columns for special loadings.

Coordination

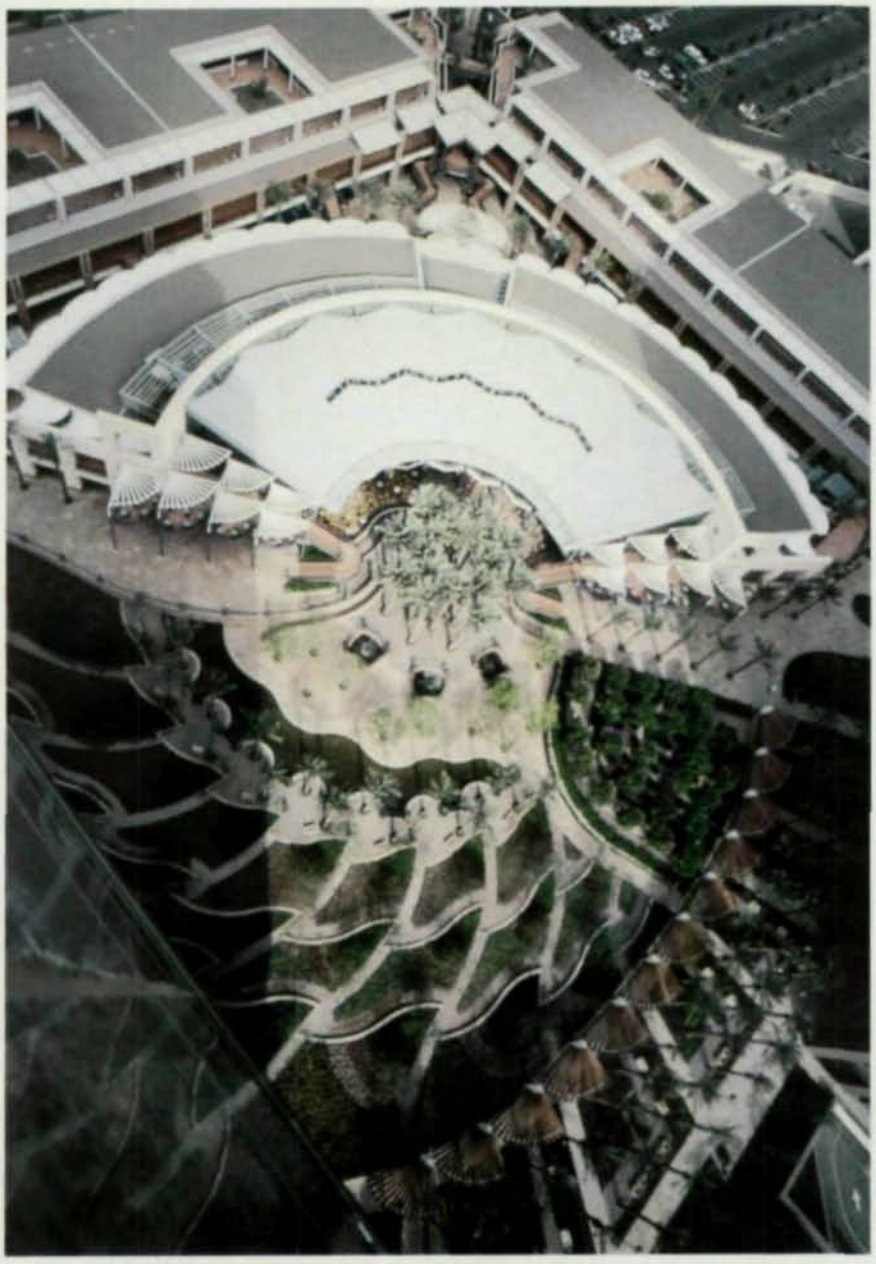
To help maintain coordination between the design team members and contractors, Melvin Simon & Associates set up a design office at the site so all team members could work under one roof. For example, Shenberger and Associates transferred a project coordinator to the site design office for a two-year period to attend meetings, coordinate with the other design consultants, and perform field observations.

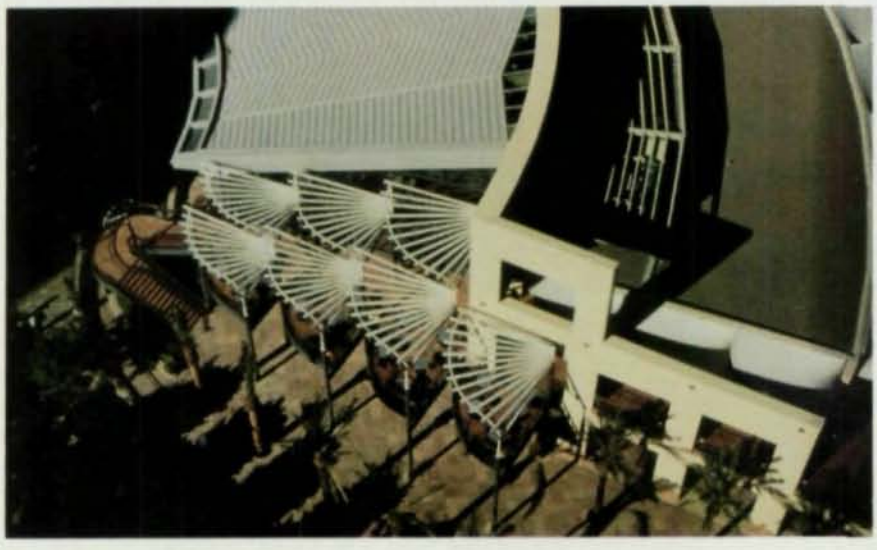
Melvin Simon also decided early on that all construction plans were to be created on CAD and a system was installed in the design office with 21 networked workstations running AutoCAD. The engineers in their Cleveland office produced more than 100 structural documents using AutoCAD and DCA Structural Software. These drawings were sent to Bloomington and incorporated in the master library of documents in Melvin Simon's system. A consistent CAD system helped the design consultants coordinate the large amount of information needed to construct a project of this size.

And no doubt about it, the project is huge. It required overwhelming quantities of construction materials, including 13,300 tons of structural steel and three million sq. ft. of metal deck. More than four miles of handrail protect the public at the edges of the mall concourse floor openings. Mechanical requirements also were massive; 33 90,000-lb. roof top mechanical units each covering 1,500-sq.-ft. are supported by a 6" concrete slab on steel beams and girders.

Steel construction for the Mall of America was a good choice for the deisgners, developers and the project itself. The use of steel gave the owner's an economical structure that was flexible enough to change throughout the construction process and flexible in changing for future tenant requirements. The LRFD design method had a great impact on the cost of the structure and should be considered by other design firms for composite floor design.

Thomas L. Shenberger, P.E., is president and Gordon R. Baker, P.E., is vice-president with Shenberger and Associates, Inc., a structural engineering consulting firm headquartered in Cleveland. ■





Urban Oasis

The Rouse Company's newest retail development created a new urban center to help rehabilitate Phoenix's downtown

While the Rouse Company is best known for rehabilitating old buildings into "themed" shopping/entertainment meccas, Phoenix's lack of a strong historical context meant starting from scratch.

However, the company did not completely abandon its formula of success; rather, Rouse created a full-blown urban context where one did not before exist. Whereas Boston, New York, Baltimore and even Tarpon Springs, FL, all share a proximity to the ocean, Phoenix is located in a desert region and the developer adopted an "oasis" theme.

The heart of the project is a landscaped garden complete with a beautiful pond. And if that wasn't enough of an attraction, the park-like setting is edged on one side by more than 150,000 sq. ft. of shopping and entertainment space. Currently completing the planned development are two office buildings (see November 1991 *MSC*), though ultimately the plan calls for four more office buildings and a 600-room hotel.

Melding Site And Climate

As an isolated design, the retail portion of Arizona Centre would be odd, with an L-shaped building nestled against a C-shaped build-

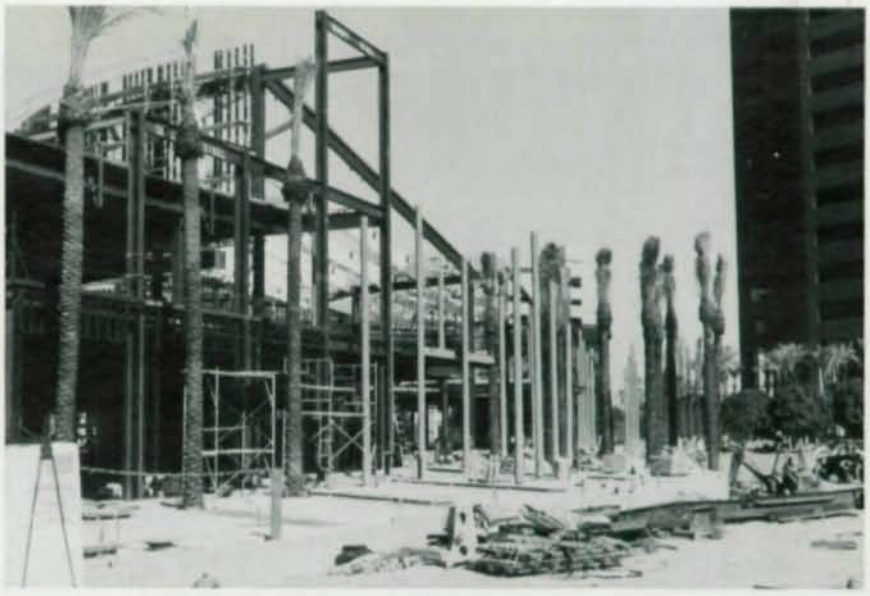
ing. But when viewed against the backdrop of the entire development, the design is strikingly beautiful and wondrously site-responsive.

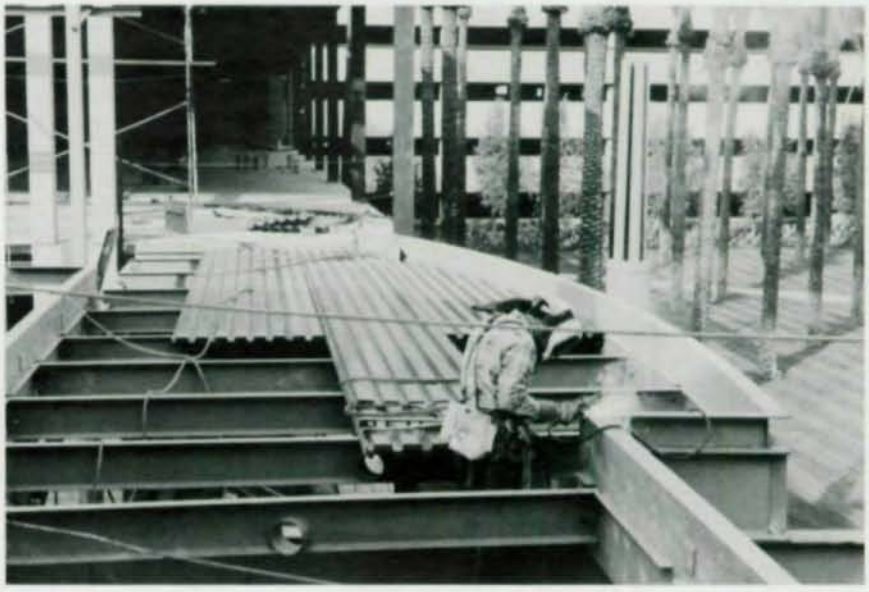
"Rouse already had a master plan for the area which included the garden oasis and the office buildings," explained Carol Shen, AIA, principal-in-charge for ELS/Elbasani & Logan Architects, the Berkeley, CA, architects for the retail portion. "The L-shaped building frames the garden and provides an edge to the street, while the C-shaped building creates a breezeway and central building and is in direct response to the shape of the garden." The unusual massing of the project allows an urban context to spring forth fully developed.

Because the developer wanted the feel of an open-air market despite Phoenix's desert-like climate, the structure features a number of overhangs and various shaded areas, including a series of scalloped steel canopies. "We wanted to avoid the "Tex-Mex" look," Shen said. Instead of a traditional Southwestern Adobe-style design, the structures are a modern blend of stucco and steel. "In addition to their practical uses, the shading elements provided visual interest and created a human scale.

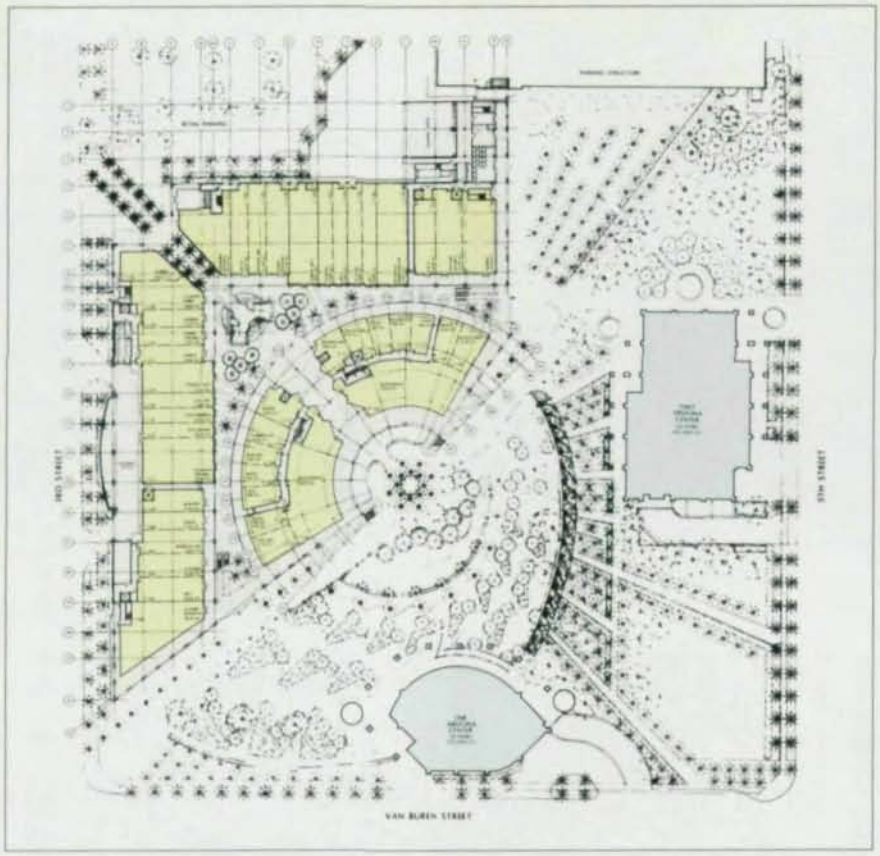
To provide the required amount of retail space, the structure has two levels. "Attracting customers to third level space is always an issue, and we handled it by locating the food court on the second level as a destination point," Shen said. In addition to its restaurants, the food court has a series of shaded balconies overlooking the garden, which is a big draw in Phoenix, Shen said.

As a low-rise element surrounded by high-rises, the retail portion had to look as good from above as it does from the ground. "We designed a herringbone roof and the scalloped trellises to complement the design of the garden," Shen said. "The project's architecture and landscaping are totally integrated." The landscape designer was SWA Associates.





Arizona Centre includes shopping, entertainment, and office space as well a beautifully landscaped garden. Because the framing material needed to be strong to support a series of overhangs and also dimensionally compact to have a minimal impact on the leasable retailing space, the designers chose structural steel. Finished photography by Timothy Hursley.



Structural Considerations

The need to minimize the size of structural members so as not to interfere with retail selling space, combined with the desire to leave part of the structure exposed, meant that steel was the obvious choice for structural framing.

The L-shaped building is fairly simple in design and features W12 x 72 columns, W16 x 57 girders spaced 30′ on center, and W24 x 62 beams spaced 5′ on center. In addition, some joist framing was used for roof framing. The project was designed to meet Rouse's national standards, which include 100 psf live loads so all of the space can handle any type of retail tenant.

The project's many overhangs are supported by 10" x 4" rectangular tubes that cantilever out over the balconies and frame back to interior beams, according to E. Malcom Plummer, P.E., principal with E.M. Plummer Consulting Engineers, Scottsdale, AZ, the

project's structural engineer. "Since the framing was being left exposed, the tubes more economically met the architectural requirements," he explained.

To maximize the project's openness, a moment resisting frame was used in both directions, Plummer said. "There are no shear walls or diagonal bracing in the project," he explained. Both welded and bolted connections were used as needed. All of the steel was A36.

The curvature of the C-shaped building resulted in a more complicated design, though it too has moment connections in both directions. Columns are typically W12 x 79, while girders are W24 sections with weights as high as 110 lbs. Joists were used for the floor framing.

"The structure is designed as a wedge shape with an 18 degree angle between each series of bents," Plummer said. Most of the calculations for the curved framing were done on in-house computer programs.

The central portion of the structure has a metal deck roof supported on wood framing into steel girders. The choice of wood was dictated by architectural considerations, Plummer said. The girders frame into wide flange sections.

In response to the need for shade from the hot Phoenix sun, the architect designed a series of scalloped canopies. "The shape, in large part, reflects the landscaping of the garden," Shen explained. The canopy system is supported on 6" round tubes.

Depending on location, the canopies either consisted of tedlar fabric stretched across the tubes or steel plates extending from the tubes. The steel plates were cut and rolled to create a slight curve and then painted to resemble wood. "A lot of people think they actually are wood, but wood wouldn't stand up to the sun and heat the way steel does," Shen explained.

The project was an immediate success when it opened and nearly all reviews have been positive. The shops remain open until 9:30 p.m. and the bars and restaurants until 1 a.m., so the center has become a mecca for the downtown workforce. ■

Windows Of Opportunity

A dramatic sloped atrium created a new identity for an aged Oklahoma City building

By Michael Johnston

Nightmares—in the form of building codes—are common to all architects and engineers, though especially to those working on renovation projects. But in the case of Robinson Renaissance, an office and retail building in Oklahoma City, the nightmare provided the impetus for a creative solution.

The landmark structure first opened its doors in 1927 and embraced all of the standard design mandates of that era, including a U-shape. The first three floors of the structure were enclosed, while the upper nine levels were built around an open-air atrium. Back then, air conditioning came in the form of an electric fan; on the hot, humid days of an Oklahoma summer, windows were not an executive perk but rather a necessity and every office had one.

It was occupied continuously for nearly 60 years until, in the oil-boom years of the early 1980s, it was scheduled for demolition to make room for a new retail center. But with the abrupt end to the boom, the plan fell apart. Finally, in 1985, McKinley Properties of Scottsdale, AZ, bought the building and created a new development plan that involved converting the bottom levels of the 175,000-sq.-ft. building into 30,000 sq. ft. of retail space while leaving the upper floors for office leasing.

Code Compliance Required

Because of the extent of the renovation, the building needed to be brought into compliance with the current building code, which created the problem of dealing with dead-end corridors on each floor created by the U-shape. "We initially considered two solutions," explained Doug Hyde, P.E., the chief structural engineer on the project. "We could either cut openings for new stairs at the ends of each corridor or we could connect the corridors and create a rectangular building."

Unfortunately, neither solution was ideal. Cutting stair openings would have been expensive and would have resulted in the loss of leasable space. But connecting the

corridors would create a mundane space—the city already had enough rectangular buildings with central atriums. Larry J. Keller, AIA, HTB's chief design architect, desired a more dramatic solution, one which would enhance the art-deco style he had chosen to convey in the redesign while also creating a "light area" theme.

The solution finally arrived at by HTB's architectural and structural engineering was twofold.

First, the third level roof between the building's wings was removed, as were parts of the floor framing of the second and first levels to create a more open retail environment. It was also the simpler part of the renovation and essentially involved cutting openings in concrete slab and doing some very minor reinforcing of the concrete structure with new steel members.

The more complex part of the renovation involved dealing with the dead-end corridors. HTB's solution was to connect each wing with a crosswalk but instead of stacking the crosswalks on atop the other, the designers stepped back each crosswalk, which also served as the framing for a 70 degree, sloped-glass atrium.

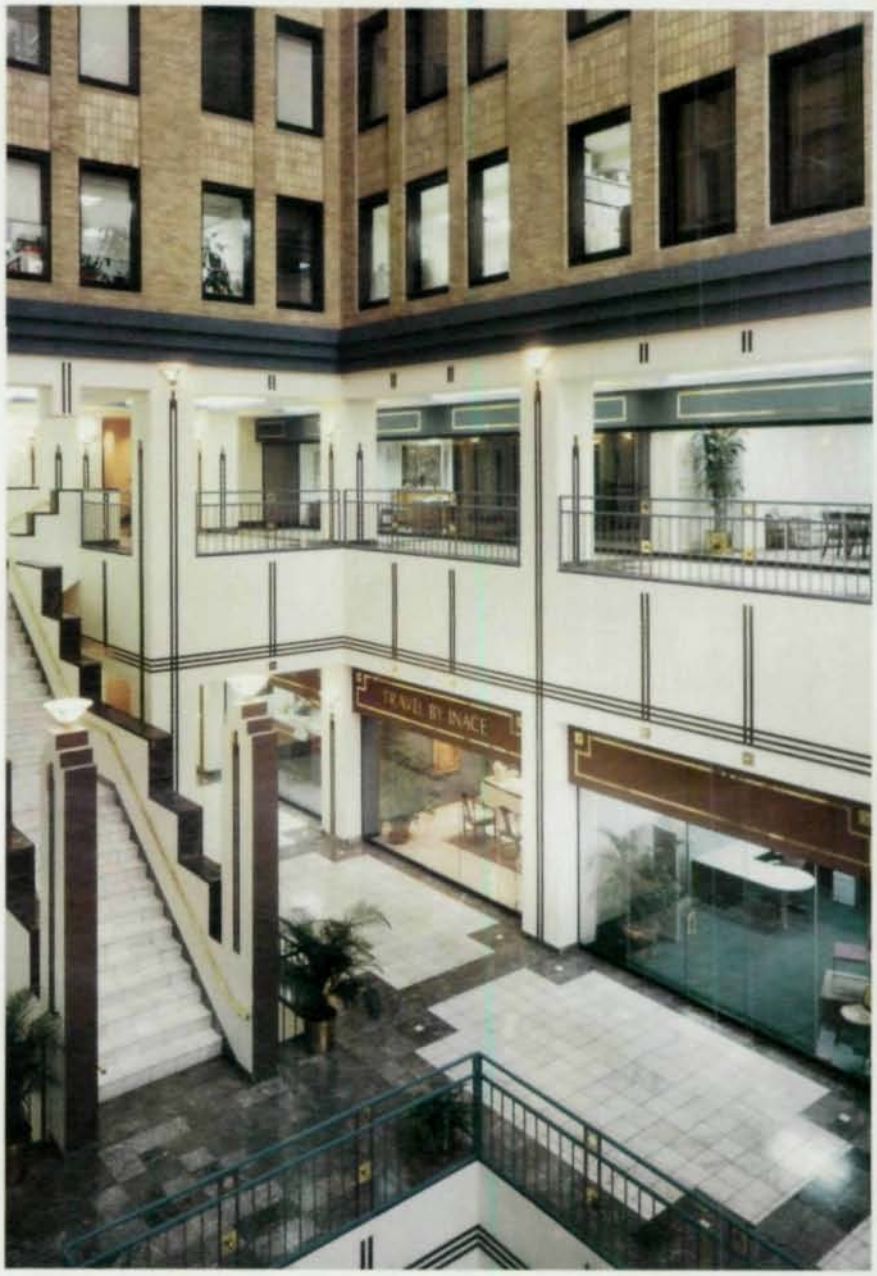
Sloping Atrium

The atrium extends from a setback over the street-level entry and extends upward, 12 floors to the roof. The design includes an additional lobby roof at the third floor to help integrate the office and retail portions of the project.

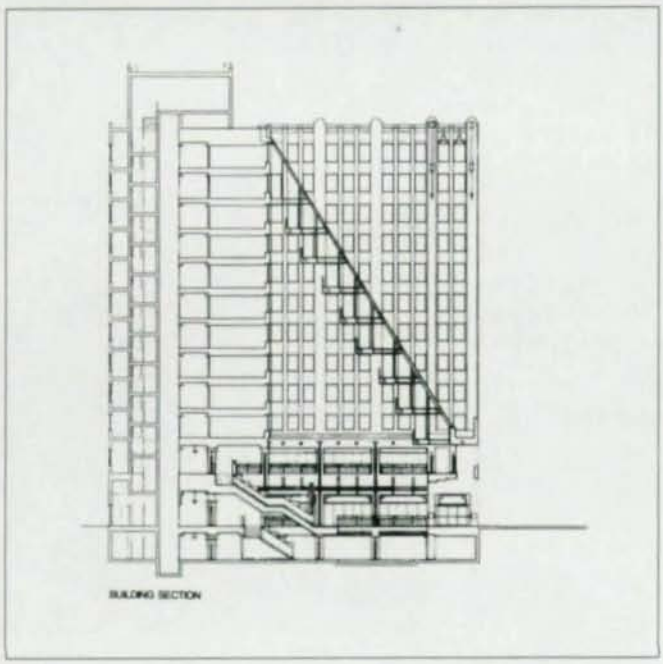
The crosswalks are supported on a framework of 4" x 4" steel tubes with varying thicknesses. The tubes were left exposed and also support the glazing.

"Tubular steel columns not only provided us with the necessary lightweight structure, but visually added to the designer's efforts of an airy feeling," Hyde explained. "The existing structural conditions of the cast-in-place concrete frame prevented heavy loads, so the use of steel was dictated."

Two horizontal tubes are connected to the glazing mullions at each level, according to Hyde. These connecting points transfer



The renovation project included removing the third-floor roof and creating a full-height sloped-glass atrium, with the lower floors housing retail space and the upper floors containing office space. Finished photography by Jon B. Petersen Photography, Inc.



The atrium extends from a setback over the street-level entry and extends upward 12 floors to the roof. Tubular steel members support the glazing and transfer the loads back to the existing building structure. Photography by Jon Petersen Photography, Inc.

the horizontal load from the glazing to the tubes, which in turn transfer the load back to the building structure. A teflon connection between the tubes and the aluminum mullions allow frictionless vertical movement. "The bridge plays a hidden role by transferring loads in a diaphragm action," according to Hyde.

Vertical tubes transfer the vertical loads and are rigidly connected. "Lateral movement is accommodated through the flexibility of the tube itself," Hyde explained. The tubes were built up in the shop into sections consisting of one vertical member and two horizontals. "It allowed us to have shop control of the welding at the intersections." Every weld was visually inspected and one in ten were examined using ultrasound.

The walkways are composite steel construction consisting of W16x50 members spanning 39', metal deck and a lightweight concrete topping. They frame into the existing structure through end plate connections and epoxy anchors into concrete. Steel fabricator was AISC-member Shawnee Steel.

For the most part, the existing structure had enough excess capacity to handle the added weight of the new walkways. However, on the 11th floor, where the topmost bridge framed into the existing structure, the concrete beams were reinforced with steel plates to resist the negative moment imparted by the added load.

Monumental Stair

The final step in the renovation was the creation of a new stairway connecting the three retail levels. In keeping with the architects desire for an open appearance, the stair was designed with no supports underneath it. Instead, the stair was supported on each floor. The stair stringers are W18x40 steel members spanning 36'-8". "We designed a saddle beam to hang the stair from the structure above," Hyde explained. The saddle beam is a W14x26 section.

The project's construction cost of $37 per sq. ft. included all new interiors, a magnificent atrium, an exterior plaza, all new mechanical/electrical systems, elevators, windows and roof. And it gave the building's new tenants some of the best views in downtown Oklahoma City.

Michael Johnston is a chief estimator with HTB, Inc., in Oklahoma City and a freelance writer. ■

Framing A Carousel

A carousel theme carries throughout the inside and outside of a new restaurant at the Saratoga Racetrack in Upstate New York.

A gossamer of steel members helped a new restaurant capture the charm of an adjacent turn-of-the-century racetrack

By David Wittes, P.E.

Matching the Victorian character and flair of the venerable Saratoga Racetrack in Saratoga Springs, NY, was essential in designing a new restaurant for the facility. For the architect, Ewing Cole Krause (the sports division of Ewing Cole Cherry), Haddonfield, NJ, and Philadelphia, the solution was a carousel-shaped building with a partially exposed structural steel framework and extensive metal ornamentation.

However, the intricate shape of the structure did present a challenge for the structural engineer, Wittes and Associates, Philadelphia. Because the architects desired a light, gossamer framing system, the engineers turned to steel framing with its great strength-to-weight ratio. Consistent with the carousal concept, the engineer and architect developed a semi-circular spider web of steel roof and floor framing above a second level bar and restaurant and the ground level teletheater. The partially exposed framing visually articulates the structure to complement the carousel theme.

The roof framing consists of W10, W12, W16, W18, and W21 members in a wide variety of planes. Adding further complexity, the as-built foundations—which were placed five years earlier—pre-

determined the position of all columns. Since the roof consisted of pie-shaped sloping segments, special girders had to be designed to receive the multiple ridge beams that supported each segment. To avoid protrusions above the roof, the top flanges of these girders were cut and re-welded to conform to the roof planes they crossed (see Detail 1).

The framing's intricate, radial design dictated a heavy traffic of skewed, sloping and canted members arriving from many directions and intersecting at each column. This detail was efficiently and easily accomplished by using 12"-round pipe columns with shop welded single plate connections receiving the many beams at different angles and elevations. This solution met both the architect's aesthetic criteria and the project's budget since connecting the radial sloping members the more graceful round columns would be no more expensive than connecting to a typical wide flange column.

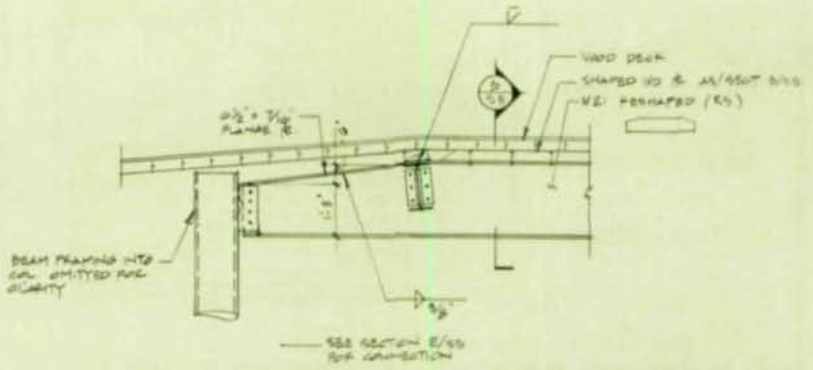
The design of these simple connections was based on research conducted by the Department of Civil Engineering at the University of California at Berkeley (see "Design of Single Plate Shear Connections" by Abolhassan Astaneh, Steven M. Call and Kurt M. McMullin, Engineering Journal, 1st Quarter 1989) and is now included in the *AISC Manual of Steel Construction, ASD—Ninth Edition* and *AISC Manual of Steel Construction, LRFD—First Edition.*

The simplicity of this type of connection permitted the use of a single detail with a small schedule to cover all column connections.

The architect designed a 16'-diameter cupola above the main roof to provide ventilation and natural light into the enclosed areas of the upper level restaurant and bar. This required the fabrication of a tree-like assembly of bracketed limbs extending from a 16" pipe stem set in the center of the semicircular building. This assembly marks the center and creates a focal point for the "carousel bar".

Full and partial penetration welds were carefully inspected by

Detail One: Roof Framing



Since the roof consists of pie-shaped sloping segments, special girders were designed to receive the multiple ridge beams that supported each segment .

Empire Testing Company to assure the integrity of the whole assembly. As part of the quality control process, the inspection company qualified the welders working on the project. Only one welder was qualified to weld the tubular intersections without back-ups; all other welders had to use back-ups where full penetration was required. To accomplish this, in many critical and difficult locations pieces of tube were cut and tack welded to the inside of the tubes to act as back-ups. The careful qualification tests completed before work began resulted in very few rejections and assured sound welds throughout while also speeding up the steel erection. Rosch Brothers Inc., Latham, NY, the project's general contractor, reported no difficulty in completing this fast-track project in time for the summer racing season.

As mentioned previously, the footings for the structure were poured five years earlier as part of a first phase dining patio. Exposed base plates were mounted flush with the surrounding concrete slab on grade. Because of the potential tripping hazard, the base plates could not include protruding anchor bolts. To permit the safe erection of the columns without anchor bolts, special T clips were designed that stabilized each column while stud bolts were set on

three sides of each column and later removed after each column was fully welded to the existing base plates.

To protect this open structure from the expected weather extremes of Upstate New York, the concrete surface of the restaurant deck received a fluid applied urethane floor coating. The exposed steel received a shop applied five mil thick polyethylene primer and a compatible polyacryl anhydride enamel field coat.

David Wittes, P.E., is a senior associate with Wittes & Associates, Inc., a consulting structural engineer located in Philadelphia. ■

The restaurant features a "teletheater" (top) for patrons to veiw the races on a large-screen, closed-circuit screen. Shown above is a picture of some of the ornamentation that reflects the Victorian character of the Saratoga Restaurant. A 16'-diameter cupola (opposite page) above the main bar has wooden slots at the top to provide ventilation and natural light into the enclosed areas of the upper level restaurant and bar.

Tightening Bolts—Which System Is Best For You?

By Don Shell, Brandt Dahlberg, and Wayne Wallace

(This article is based on a demonstration of major fastening systems scheduled for the National Steel Construction Conference in Las Vegas from June 3-5. For more information on the conference, contact: David G. Wiley, AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-5422.)

The consequences of incorrectly tensioning bolts range from vibratory loosening to bolt fatigue and catastrophic failure of dynamically loaded connections. To deal with this problem, a number of locking devices or processes have been developed, including: Lockpin & Collar Fasteners; Tension Control Bolts; Load Indicator Washers; and Turn-Of-Nut Method.

Turn-Of-The-Nut Method. This method essentially involves tightening a bolt to a snug-tight condition, marking its location, and then tightening it with an impact wrench between ⅓ to one full turn, depending on the size of the bolt and its disposition of outer face of bolted parts.

According to the ninth edition AISC *Manual of Steel Construction (Allowable Stress Design)*, "Snug tight is defined as the tightness that exist when the plies of the joint are in firm contact. This may be attained by a few impaces of an impact wrench or the full effort of a man using an ordinary spud wrench." The additional nut rotation is given in Table 5 on page 5-275 of the Manual.

Lockpin & Collar Fastening System. By virtue of their design, swaged lockpin & collar fastening systems provide an economical solution that ensures the achievement of consistent and high clamp force by application of direct tension. The lockpin & collar fastener has shallow, streamlined annular lockgrooves instead of threads, a pintail beyond the lockgrooves with pull grooves and a singular breakneck groove between the two. The breakneck groove is used to separate the pintail from the fastener once it has served its purpose.

During installation, the installation tool "holds onto" the pintail and applies a tension load on the lockpin and, in turn, a compressive load on the smooth bore swage collar. It takes a specific intitial push load of the sage anvil on the collar to initiate swaging. This "stand-off" load removes all joint gaps before swaging commences. The swaging action of the anvil is a combined elastic/plastic action and it progressively flows the collar material into the locking grooves on the lockbolt. At the same time, it is causing the collar to grow in length via extrusion. It is this collar lengthening that develops the final clamp load.

The swaging action continues until the swage load equals the breakneck load and the pintail breaks away from the fastener. The operator releases the tool trigger at this point to cause the tool to reverse and push the swage anvil off the collar to complete the installation. All control for the fastener clamp has been built into the fastener.

Swage lock fasteners can be installed by unskilled operators and installed fastener values cannot be influenced by operator technique when basic installation procedures and design standards are followed. Since they can be visually inspected, they require significantly less supervision than other systems.

High Strength Tension Control Bolting. This type of system falls under the category of structural bolt-nut-washer assemblies and all control is built into the bolt assembly. Essentially, the bolt is calibrated to assure proper tension when the tip is twisted off during installation.

The bolt features three rotating friction areas: bolt head to material; material to washer; and washer to nut. A special non-impacting wrench applies rotation between the nut and tip (clockwise at nut and counterclockwise at tip). Since the bolt head and washer face are equal areas, there is high friction and rotation resistance. The nut face, however, has 50% less area and in addition is lubricated; therefore it has the lowest friction and rotation occurs.

The nut is driven clockwise by an equal counterforce against the tip, which is not rotating due to the higher friction on the tip, which assures that all bolts are pulled into direct tension. Tip counterforce increases as the bolt is tightened, finally resulting in tip break-off at the shear groove when the bolt reaches the proper tension.

Neither wrench nor operator affects the installation characteristics or installed tension value; rather, the tension is controlled by the preset bolt manufacture characteristics.

Direct Tension Control Indicators. This type of system also falls under the category of structural bolt-nut-washer assemblies and all control is built into the bolt assembly.

Originally a British system, Direct Tension Indicators have been "Americanized". The system features quenched and tempered mechanical load cells that are manufactured with a predictable load/gap relationship. When correctly installed on a bolt, they provide a reliable indication of bolt preload.

Inspection involves judging the residual gap with a feeler gage, and is visually possible on 100% of installed bolts.

NSS Industries

Rapid Tension Bolts from NSS Industries are a type of structural bolt-nut-washer assembly where the proper tension is indicated when the spline has been separated from the bolt. Installation is achieved by first assembling the bolt, washer & nut into the connection hole and tightening by hand until snug. Next, the 12-point socket of the installation tool is engaged. Rapid tension is achieved by simply pressing the trigger of the installation tool; while the outer socket rotates clockwise, the inner socket rotates counterclockwise, ensuring a snug fit.

Contact: NSS Industries, 9075 General Dr., Plymouth, MI 48170 (800) 221-5126.

Bristol Machine Co.

The TS Fastening System is a high-strength tension control indicating system and is designed for the installation of high-strength A325 and A490 bolts. The bolt design incorporates a button head configuration for an increased load bearing area under the head of the bolt. The threaded end of the bolt incorporates a spline drive with a break-neck groove adjacent to the spline. In service, the tension set bolt is installed through the structure, a mating washer and nut are engaged on the threaded end of the bolt and finger tightened. An installation tool engages the splined end of the fastener and the nut. The plenetary gear drive of the tool turns the nut and preloads the fastener assembly. When the assembly has been fully installed, the spine drive end shears at the break-neck groove, resulting in a properly installed and torqued fastener assembly.

Contact: Bristol Machine Company, 19844 Quiroz Court, Walnut, CA 91789 (800) 798-9321.

Mid-South Bolt & Screw Co.

Specializing in meeting the needs of structural steel fabricators, this company provides a wide range of products including anchor bolts, tie rods, studs, crane rail bolts, U-bolts, J-bolts, swedge bolts, eye bolts, structural hex bolts, tension control bolts, load indicator washers, concrete anchors, weld studs, threaded studs, plastic sleeves, clevises, turnbuckles and all types of nuts, screws, bolts and washers. Three locations offer next- or second-day delivery to two-thirds of the U.S.

Contact: Mid South Bolt & Screw Co., Inc., 499 Cave Road, Nashville, TN 37210 (800) 251-3520.

Fairchild Fastener Group

Nova-Hex Torque Controlling Nuts allow users to apply precise torque control to nut and bolt assemblies using the Nov-Hex ball socket and ordinary driving tools. Torque is controlled by the ball socket, not the driving tool. A visible, permanent installation signature clearly and quickly identifies to inspectors that assemblies have the proper torque. Paint, dirt or grime will not obscure the identification. From the outside, the assemblies appear as ordinary hex sockets. But inside, there is a circular internal wall in which six carbide balls are arranged in a uniform, hexagonal pattern. Continued application of torque causes the socket balls to first brinell, then penetrate deeper into the lobes of the nut. Finally, the socket balls break through the resistance of the lobes to achieve a uniform, high level of torque control while leaving distinctive signature grooves.

Contact: Fairchild Fastener Group, One Civic Plaza, Suite 500, Carson, CA 90745 (310) 522-0700.

LeJeune Bolt Co.

The LeJeune Tension Control Bolting System provides a calibrated bolt, nut and washer assembly that installs at the proper tension for that particular size and grade of bolt. A non-impacting electric wrench drives the nut against the bolt tip. This contains the counter forces within the wrench and tightens each bolt to the required tension and then automatically causes the tip to shear-off, indicating proper installation. A-325 Type I and III, as well as A-490, Grades are available in ¾", ⅞", and 1⅛" diameters.

Contact: LeJeune Bolt Co., 8330 West 220th St., Lakeville, MN 55044 (800) 872-2658.

Huck Manufacturing

The C50L Huckbolt fastener is a swaged lockpin & collar fastening system. The system is designed to be installed without torquing, multiple impacts or heat. It includes a fastener, nose assembly, hydraulic installation tool, and hydraulic unit. Inspection involves simply verifying that the fastening pin has separated near-flush with the top of the collar.

Contact: Huck Manufacturing Co., P.O. Box 8117, 8001 Imperial Dr., Waco, TX 76714-8117 (800) 388-4825.

Nucor Fastener

With the passage of H.R. 3000, Congress has mandated that fasteners must conform to the specifications to which they are represented to be manufactured and that they have the inspection, testing and certification to prove it.

Nucor Fastener has been adhering to these standards since it opened in 1986. Nucor uses 100% domestically melted and rolled raw material. All fasteners are identified with a lot number on each container that allows traceability to materials, dimensions, processing and testing.

Contact: Nucor Fastener, P.O. Box 6100, St. Joe, IN 46785 (800) 955-6826.

J & M Turner, Inc.

Direct Tension Indicators from J & M Turner assure correct tensioning of high-strength bolts. The Direct Tension Indicator is a specially hardened washer with

protrusions on one face. The DTI is usually placed under the bolt head, and the protrusions create a gap. As the bolt is tensioned, the clamping force flattens the protrusions, reducing the cap. Correct bolt tension is evaluated by observing the remaining gap. The advantage is both accuracy and consistency.

Contact: J & M Turner, 1310 Industrial Blvd., Southampton, PA 18966 (800) 525-7193.

St. Louis Screw & Bolt Co.

The company makes a full range of structural fasteners, including Types I and III A325 bolts and ASTM A307 bolts. In addition, St. Louis Screw & Bolt will manufacture fasteners to a customers individual specifications. All materials are traceable to steel melted and manufactured in the U.S., with each production run traceable to a heat lot of steel. All bolts are certified to meet ASTM specifications.

Contact: St. Louis Screw & Bolt Co., 6900 N. Broadway, St. Louis, MO 63147 (314) 389-7500.

Struct-Fast, Inc.

Three new products are now available for fastening of secondary steel items, such as bar grating, steel plate and other beams, to the main steel frame without welding or drilled the frame. All of the products—Grate-Fast, Floor-Fast, and Beam-Fast, offer dramatic labor savings and a significant portion of labor is done off-site where both quality and costs are better controlled.

Contact: Struct-Fast, Inc., 20 Walnut St., Suite 101, Wellesley Hills, MA 02181 (617) 431-7940.

Lewis Bolt & Nut Co.

This company has been manufacturing bolts in 1927 and specializes in A-449 and A-325 fasteners in diameters of ½" or greater and lengths of 6" and longer. Products are made to order and rush orders are welcome. Certification and lot tracking are offered on all orders and all bolts are manufactured in the U.S. with domestic materials.

For more information, contact: Lewis Bolt & Nut Co., 504 Malcom Ave., S.E., Minneapolis, MN 55414 (800) 328-3480.

Lohr Structural Fasteners, Inc.

Lohr offers a wide range of domestic bolts. The product line is mill certified, fully assembled and tested, and of the highest quality available.

Contact: Lohr Structural Fasteners, Inc., P.O. Box 1387, Humble, TX 77347 (800) 782-4544.

Haydon Bolts, Inc.

Haydon Bolts has been serving structural steel fabricators for more than 125 years, manufacturing anchor bolts and tie rods up to 4" in diameter and using materials such as ASTM A36, A449, A325, and A588. A complete line of standard and special sizes of ASTM A325 and A490 are available in hexagon heads as well as button head shear bolts.

Contact: Haydon Bolts, Inc., Adams Avenue & Unity Street, Philadelphia, PA 19124 (215) 537-8700.

TC Construction Fasteners

A wide range of products are available from this company, including: swaged anchors; high-strength A325 and A490 bolts; studs; crane rail anchors; hook anchors; sleeve anchors; hook anchors; tie rods; square and round bend U's; double expansion shields; bent tie-rods; eye bolts; drift pins; washers; turnbuckle and clevis assemblies; wedge type anchors; and arc weldments. A variety of coating and heat treatments are available.

Contact: TC Bolt Supply Co., Inc., P.O. Box 197, Forest Road, Greenfield, NH 02047 (603) 547-6371.

Magni Industries

Dorrlmate, an inherently black, zinc-rich coating is now available. A dry-to-the-touch finish, the coating is ideal for all construction fasteners requiring corrosion resistance, consistent torque tension, and bi-metallic protection. The coating is applied over a zinc phosphate and sealed with an epoxy topcoat and is cost-effective compared with traditional electroplating.

Contact: Magni Industries, Inc., 255 South Woodward, Suite 300, Birmingham, MI 48009 (313) 647-4500.

ITW Buildex

The Autotraxx ICH Deck Fastening System is used to attach steel deck in a stitch or structural steel application. The system has two components: a stand-up tool that includes a screwgun, special fastener guidance system, depth sensitive nosepiece and unique drive socket; and Traxx fasteners with an ICH (Internal Cone Head) design.

The fasteners have either a Traxx/1 point for stitch applications or a Traxx/5 point for structural attachments. The design allows the tool drive pin to engage securely with the fastener for consistent drilling.

For more information, contact: ITW Buildex, 1349 West Bryn Mawr Ave., Itasca, IL 60143 (708) 595-3549.

AISC

Two 120-page books from AISC contain design aids for shear connections. Presented in easy-to-use tabular form, the books include designs for double-angle web bolted connections, structural tee single shear connections and single-angle connections welded to the support. The books are available in both ASD and LRFD formats.

Contact: Publications Dept., AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601 (312) 670-2400 ext. 433.

Bulletin No. 1
June, 1989

Research Council On Structural Connection Education Committee
"Counterfeit" High-Strength Bolts

Trouble-free construction using high-strength bolts begins with the Engineer's project specifications, which contain provisions to assure fasteners of the specified strength are supplied and that they are installed by procedures that assure the reliable performance in the completed structure. The following are suggested provisions to be incorporated in the project specifications.

MATERIAL STANDARDS

The publications listed below form a part of this Specification to the extent they are referenced. Publications are referred to in the text by basic specification designation only.

American Society for Testing and Materials
- ASTM A325-86A—*High-strength Bolts for Structural Joints.*
- ASTM A490-85—*Heat-treated Steel Structural bolts, 150 ksi Minimum Tensile Strength.*

Research Council on Structural Connections
- *Specifications for Structural Joints Using ASTM A325 or A490 bolts*, dated November 13, 1985. Endorsed by the American Institute of Steel Construction, Inc.

EVIDENCE OF CONFORMITY

The supplier shall certify that bolts, nuts and washers furnished comply with all of the appropriate requirements of the applicable specifications, and shall provide complete manufacturer's mill test reports (Manufacturer's Inspections Certificate). For Fasteners to be accepted, certification numbers must appear on the product containers and correspond to the identification numbers on the mill test reports (Manufacturer's Inspection Certificate). Manufacturer's symbol and grade markings must appear on all bolts and nuts.

FIELD ERECTION AND SHOP ASSEMBLY

1. High-strength bolt installation and tightening shall be in accordance with Section 8 of the *Specification for Structural Joints Using ASTM A325 or A490 Bolts*, dated November 13, 1985.

2. Regardless of installation requirements for the project, whenever high-strength are to be installed, not less than three bolt, nut and washer assemblies from each lot supplied shall be tested in a tension measuring device at the job site at the beginning of bolting start-up to demonstrate that the bolts and nuts, when used together, can develop tension not less than that provided in Table 4 for the size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier should be present, if required by the Engineer of Record, to assure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specification requirements.

INSPECTION

Inspection procedures shall be in accordance with Section 9 of the *Specification for Structural Joints Using ASTM A325 or A490 Bolts*, dated November 13, 1985. The inspector shall confirm that the materials meet the project specification and that they are properly cared for. He shall confirm that the faying surfaces have been properly prepared before the connections are assembled. He shall observe the specified job site testing and calibration, and shall confirm that the procedure to be used does provide the required tension. He then shall monitor the work to assure the tested procedures are routinely followed on the joints that are specified to be fully tensioned.

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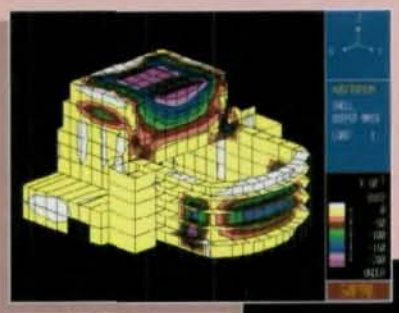

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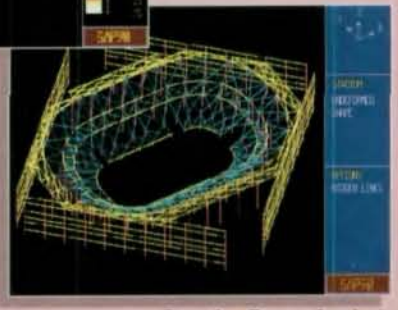

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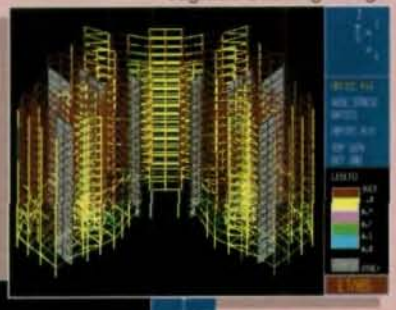

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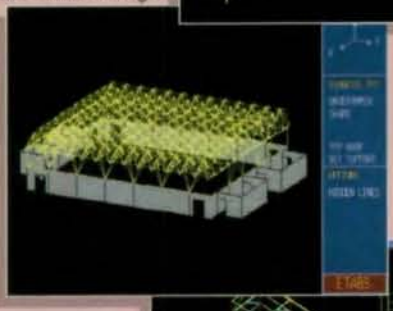

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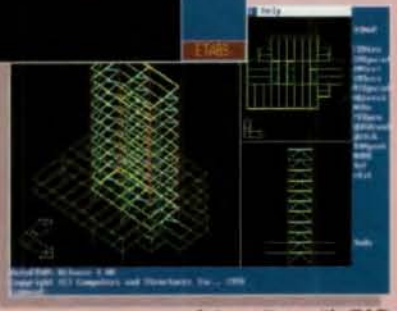

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