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January 1993 $3.00

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TENSILE STRENGTH OF ARC PUDDLE WELDS - Wind Uplift Forces on Roof Deck

Steel	Ga.	(1) Visible Weld dia. .5	.625	.75	1.0	(2) Visible Weld dia. .5	.625	.75	1.0	(3) Visible Weld dia. .5	.625	.75	1.0
A446 grade A*	22	230	300	360	480	440	560	680	930	160	210	250	340
Fy = 33 ksi	20	280	350	430	580	520	670	820	1120	200	250	300	410
Fu = 45 ksi	18	360	460	560	760	650	840	1040	1440	250	320	390	530
	16	440	570	690	940	730	1020	1270	1770	310	400	490	660
A446 grade C	22	280	360	440	590	530	690	840	1140	200	250	310	410
Fy = 40 ksi	20	340	430	520	710	630	810	1000	1360	240	300	370	500
Fu = 55 ksi	18	440	560	680	930	790	1030	1280	1760	310	390	480	650
	16	540	690	850	1150	730	1240	1550	2160	380	490	590	810
A446 grade D	22	310	390	480	640	580	750	910	1240	220	280	330	450
Fy = 50 ksi	20	370	470	570	770	690	890	1090	1490	260	330	400	540
Fu = 60 ksi	18	480	610	750	1010	860	1130	1390	1920	340	430	520	710
	16	590	760	920	1260	730	1350	1690	2360	410	530	650	880
A611 grade C*	22	250	310	380	510	470	600	730	990	170	220	270	360
Fy = 33 ksi	20	300	380	460	620	550	710	870	1190	210	260	320	430
Fu = 48 ksi	18	380	490	600	810	690	900	1110	1540	270	340	420	570
	16	470	610	740	1010	730	1080	1350	1890	330	420	520	710
A611 grade D	22	270	340	410	560	500	650	790	1080	190	240	290	390
Fy = 40 ksi	20	320	410	500	670	600	770	940	1290	230	290	350	470
Fu = 52 ksi	18	420	530	650	880	750	980	1210	1670	290	370	450	610
	16	510	660	800	1090	730	1170	1460	2040	360	460	560	760

* Roof deck is generally specified to meet ASTM A446 grade A (galvanized) or A611 grade C (painted).

(1) Single metal thickness values. (2) Double metal thickness values - end laps (3)Edge laps (at supports).

All table values are in pounds (tension) and are **design** values found by the formulas given in the AISI Specification for the Design of Cold-Formed Structural Members(A); the safety factor is 2.5 but the 33% increase for wind loading has been included. The edge lap values (column 3) have been reduced by 30% to adjust for eccentric loading of the weld as recommended by Tensile Strength of Welded Connections(B). AWS procedures for arc puddle welds are to be followed. A minimum electrode strength of 60 ksi is required.

(A) August 19, 1986, Edition with December 11, 1989 Addendum.

(B) R.A. LaBoube and Wei-Wen Yu, Department of Civil Engineering, Center for Cold Formed Steel Structures, University of Missouri--Rolla, Civil Engineering Study 91-3

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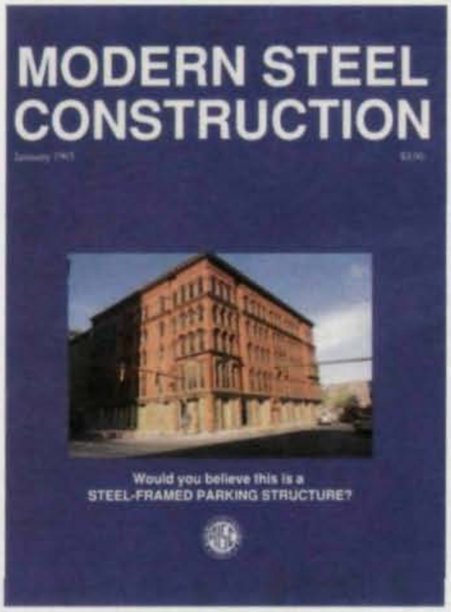
MODERN STEEL CONSTRUCTION

Volume 33, Number 1 January 1993



Only the exterior of this historic Syracuse, NY , structure was retained, while the interior was completely gutted and a new steel-framed parking structure was installed. The story behind this complex construction project begins on page 28.

FEATURES

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NEWS AND DEPARTMENTS

Editorial Staff

Scott Melnick,
Editor and Publisher
Patrick M. Newman, P.E.,
Senior Technical Advisor
Charlie Carter,
Technical Advisor

Editorial Offices

Modern Steel Construction
One East Wacker Dr.
Suite 3100
Chicago, IL 60601-2001
(312) 670-5407

Advertising Sales

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The Man Of Steel

A couple of years ago, before leaving to attend my first National Steel Construction Conference, some friends and I were sitting around the dinner table joking about making a T-shirt I could wear while working the AISC/MSC booth.

We wanted a catchy slogan and an eye-popping graphic. And we hit upon the perfect image: Superman's giant "S" and underneath, the words "They don't call him the Man of Concrete."

Over the years, Superman has slowly changed—from the replacement of a great leaping ability with true flight to a scaling down of Superman's cosmic powers in the late 1980s. At the same time, the steel industry also was changing—from the replacement of rivets with bolts to the evolution from ASD to LRFD.

Well, given my association of Superman with the steel industry, you can imagine my shock when the news came recently that Superman was dead. Yet, in 1992, the imagery was at least partially appropriate. The economy was in the dumps, and we all personally knew a company that had closed its doors and a friend in the industry who was out of work.

Fortunately, just as quickly as word of Superman's demise came, so too did word that DC Comics was going to bring him back. And the latest word is that the construction industry also is beginning to revive. The government is budgeting big bucks for infrastructure work. Retail sales are starting to pick up. Stadiums and convention centers are still being built. Public and private schools are starting to rehab and increase the size of their facilities. Airport construction continues at a healthy clip. Housing starts are up. And the healthcare industry continues to go gangbusters.

Rumor from the writers of several comic Fanzines is that the reborn Superman will be more interesting than the old one. And I like to think that the changes that have recently occurred—and are still occurring—in the steel industry are making construction more interesting. And steel design clearly is improving, starting with the continuing move towards LRFD, to the continued development of new design techniques such as Eccentrically Braced Frames and Partially Restrained Connections. And in the near future, look for the U.S. steel industry to move from a standard of 36,000 psi to 50,000 psi steel.

We even have a reborn slogan: Steel Stands For The Future. **SM**

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.

The following responses to questions from previous Steel Interchange columns have been received:

What can an erector and engineer do when anchor bolts are too short and the nuts are not fully engaged?

There are two common methods available to make a short anchor bolt longer.

The first method consists of utilizing a thin-walled threaded coupler which is screwed onto the top of the anchor bolt and into which is screwed an adequate length of threaded rod. It may be necessary to "crater" the concrete around the anchor bolt in order to engage an adequate thread length. "Adequate" is defined as approximately equal to the bolt diameter.

The second method involves welding an adequate length of threaded to the top of the existing anchor bolt. The threaded rod extension is prepared for welding by machining the contact end to a point (45 degrees). Then the weld is applied using electrodes suitable to the material. A garbled area results, naturally, and it may be necessary to use plate washers of sufficient quantity to allow free rotation of the nuts.

With either of these methods it may be necessary to enlarge the holes in the column base plate. This can be done by burning, which is an acceptable method of enlarging base plate holes. (Chances are if the anchor bolts are set too low, they may also have been offset to the side.)

It is suggested that those interested obtain a copy of *Column Base Plates*, No. 1 of the AISC Design Guide Series. This treats the subject of column base plate design and construction in detail.

David T. Ricker
Payson, AZ

Are both mechanical galvanizing and hot-dip galvanizing appropriate for bolts?

Mechanical galvanizing and hot-dip galvanizing are two methods of applying a sacrificial metal (zinc) to a base metal. The zinc will corrode, or sacrifice itself, to protect the base material. Both methods apply a zinc coating and are appropriate for galvanizing bolts and other hardware items. The difference between the two methods lies in the process itself. Following is a short description of each process as it pertains to hardware items.

HOT-DIP GALVANIZING: The hardware is first degreased and cleaned. This is done with a combination of caustic and acidic solutions. The parts are then rinsed and loaded into a basket. The basket is dipped into a tank of molten zinc for a specific period of time. The basket is then withdrawn and placed in a centrifuge where the excess molten zinc is spun off the parts. This process is more fully described in ASTM A153.

MECHANICAL GALVANIZING: The hardware is cleaned and rinsed as in the hot-dip method. The parts are then loaded into a multi sided barrel that resembles a concrete mixer. Also added to the barrel is a mixture of various sized glass beads and a predetermined amount of water. At various times in the process, as the barrel is turning, small amounts of chemicals and powdered zinc are added. The collisions between the glass beads, zinc and parts causes the zinc to cold weld to the part. Powdered zinc is added until the required thickness is attained. This process is more fully described in ASTM B695.

Mechanical galvanizing has several advantages over the hot-dip process. The following list describes these advantages:

- 1. The process is done at room temperature. There is no detempering of heat treated parts. Low temperature acidic cleaning also reduces the chance of hydrogen embrittlement.
- 2. Zinc is deposited in a generally uniform coating thickness. Coating thickness and uniformity is hard to control with the hot-dip process.
- 3. Because of the added zinc thickness to bolt threads, all galvanized nuts are required to have threads that are tapped oversize before galvanizing. Hot-dipped nuts need to be retapped after dipping to remove zinc from the threads. This step is usually not required with mechanically galvanized nuts.
- 4. Parts that are mechanically galvanized do not stick together as they sometimes do after hot-dip-

ping.

There is one potential problem with the mechanical process. The zinc coating may chip or flake off. Small chips in the coating are usually not a problem because the surrounding zinc protects the exposed area. Excessive chipping or flaking indicates that the parts were not properly cleaned or the process was not performed properly. Another potential problem with the mechanical process is part size. Typically long threaded rods or very heavy pieces are difficult to galvanize with the mechanical process.

Mechanical galvanizing and hot-dip galvanizing are both appropriate methods for depositing a protective layer of zinc on bolts and other small hardware items. Cost and availability is usually the determining factor when deciding what process to use. Part size, shape and quantity are other important considerations when specifying galvanized hardware.

Stephen Davis, P.E.
Moffatt, Nichol & Bonney, Inc.
Portland, OR

Can one weld to an existing structure? How does one determine if the steel is weldable?

My answer to this question would be, "Yes, in most instances." Structure, however, is a broad term referring to buildings, bridges, towers, etc. In some cases especially those involving tension members, dynamic loads or older materials welding may not be appropriate or economically practical. The following are some problems I have encountered that the Design Engineer and Erector should consider prior to using a welded connection.

- 1. What are all the codes and specifications which will govern welding on this particular structure? In some instances (especially involving the Department of Transportation) there may be state codes which are more stringent and supersede nationally recognized codes.
- 2. What are the loading conditions on the member to receive the weld and what will be the effect of heat application? It may be necessary to shore the member or remove the load prior to welding. Also, will the welded connection now be a likely source for future crack development?
- 3. What is the existing material and is it in a condition to be welded to? In older structures the type of material may be in question or may be exhibiting loss of section. Prior to erection the Design Engineer should be aware of the material properties and the Erector of the proper welding procedure. If the material in question is not prequalified by the applicable code it may be necessary to conduct a procedure qualification test. Very often a costly and time consuming process.
- 4. All things considered, is welding the best choice from an economic standpoint? It may be a requirement that an Inspector be present during welding and that the final weld receive nondestructive testing. Both of these items could add significant cost to a welded connection. Additionally there is a much greater chance for error in a welded connection verses a bolted one.

Determining the weldablility of a material is generally a fast and low cost procedure within the capability of most testing laboratories. Provided with a small sample of the material a chemical analysis can be obtained and a welding procedure developed. The American Welding Society is also very helpful in this area.

If the chemical properties are unknown it is likely that the physical properties are also in question. It has been my practice to also recommend a physical analysis so that the Design Engineer will have full knowledge of the material. The number and location of the test coupons would be determined by the scope of the project.

Neal White
Cromwell, Ct

New Questions

Listed below is a question 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.

In regards to the comments on End-Plate Moment Connections in the November 1992 Steel Interchange, in which it is stated that fatigue need not be considered when less than 20,00 load cycles, I have the following question:

Since seismic loading is even less likely to occur than the maximum wind loads, up to what maximum seismic zone level would be recommended that the connection could be used and steel be considered "static"? Also, could this connection be designed using either ASD or LRFD and why?

Raphael A. Marotta P.E.
Gleit Engineering Group, P.C.
New York

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AISC ANNOUNCES

VOLUME II CONNECTIONS MANUAL

A S D / L R F D

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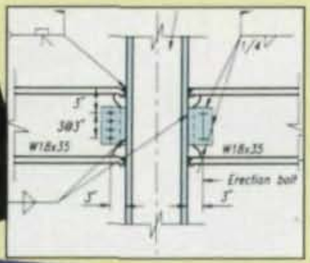

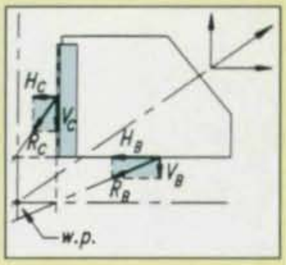

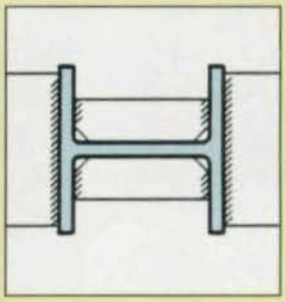

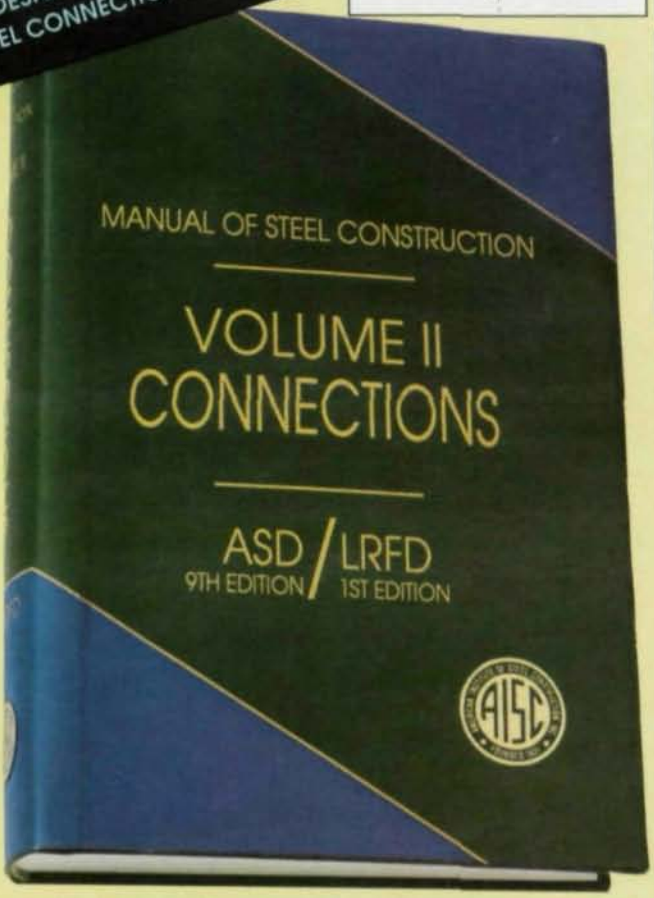

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New Connections Manual

The American Institute of Steel Construction has published the *Manual of Steel Construction, Volume II—Connections*, a 700-page aid to structural steel design. The book is an extension to the *Manual of Steel Construction* (both ASD, 9th Edition and LRFD, 1st Edition) and covers bolted and welded shear, moment and bracing connections.

Rather than simply updating *Engineering For Steel Construction*, the new Manual contains a far more in-depth presentation, including a design examples illustrating most of the covered subjects. It also contains new developments in a wide range of subject matter, such as single plate connections, bracing connections, weak axis column connections, and column stiffening. The focus of the book, which is based on both the ASD and LRFD Specifications, is on the economical design of complex connections.

"The real value of the book is that it addresses the complex cases of connections not specifically treated in the *Manual of Steel Construction*," explained Charlie Carter, AISC Staff Engineer-Structures. "And while most design engineers don't have hands-on experience in steel fabrication, *Volume II* incorporates general design guidance and recommendations for cost effective design from the fabricators/engineers on AISC's Committee on Manuals, Textbooks and Codes."

To help explain the benefit of the new Manual, AISC also has produced an interactive computer disk. Available for $5 (which is then deducted from the purchase price of a Manual), the disk provides examples from each of the Manual's seven chapters. Copies of the Manual are available for $60 + $5 shipping. As an added bonus, an updated copy of the AISC Code of Standard Practice will be sent with each order.

Checks or money orders should be sent to AISC Publications, P.O. Box 806276, Chicago, IL 60680-4124. For telephone orders with a Visa or Mastercard charge, call (312) 670-2400.

Calendar

January 21. **SEAoT Meeting—Houston Chapter.** "Metallurgical Issues for Structural Engineers." Contact: Jim Anders (214) 369-0664.

January 26. **SEAoT Meeting—North Central Texas Chapter.** "Structural Steel Bracing Systems." Contact: Jim Anders (214) 369-0664.

February 11-13. **EERI Annual Meeting,** Seattle. Contact: Linda Noson, Ratti Swenson Perbix & Clark, 1411 4th Ave. Bldg., Suite 500, Seattle, WA 98101 (206) 624-8687.

March 17-19. **National Steel Construction Conference,** Orlando. The only "ALL-STEEL" conference and trade show in the U.S. Sponsored by AISC, and co-sponsored by American Institute for Hollow Structural Sections, AISI, AWS, CISC, MISC, Steel Deck Institute, Steel Service Center Institute, and SSPC. Contact: AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-2400.

In Memory

Henry (Hank) A. Hewett, Jr., former president of AISC-member Capitol Steel & Iron Co. in Oklahoma City, passed away last month. He served on the AISC Board of Directors from 1977-80 and 1982-83. He also served as chairman of the Pre-Engineered Standard Buildings Committee in 1979 and the Membership Committee in 1980.

Shared Connection Design Responsibility Poses Potential Problems

Who should be responsible for the design of connections? While some members of the engineering community increasingly are advocating shared responsibility, many steel fabricators are resisting sharing the liability involved.

The question of design responsibility is not a simple one and it raises many ancillary questions. For example, if the fabricator has been assigned design responsibility, whose opinion controls in the case where there is a disagreement over the design of a connection? Also of crucial importance is the question of liability.

These issues will be thoroughly discussed at a March 17 special session at this year's National Steel Construction Conference in Orlando, FL.

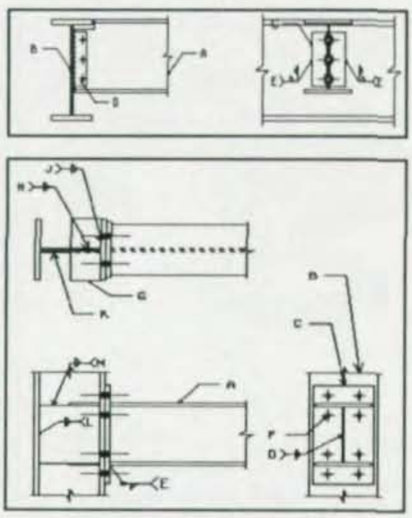
The panel will include a range of well-known authorities representing both sides in this conflict:

- Richard Tomasetti, a principal with the highly respected New York City structural engineering firm of Thornton-Tomasetti Engineers, was a key participant in the preparation of the ASCE "Guide for Quality in the Constructed Project" and is a leading spokesman for the concept of shared connection design responsibility.
- Robert Rubin, Esq., is both a licensed structural engineer and a practicing attorney in New York. Rubin is a Fellow of ASCE and provides legal counsel to that organization. He is involved in litigation currently pending in New York to overthrow the August 20, 1991 New York State Education Department Memorandum regarding unlawful delegation of design responsibility by design professionals.
- A representative of the Coalition of American Structural Engineers (CASE), which in November 1989 issued "National Practice Guidelines for the Structural Engineer of Record," a document which does not appear to recognize the concept of shared responsibility. This document has been endorsed by AISC.
- Leonard E. Ross, P.E., is the immediate past president of the National Institute of Steel Detailers and a very experienced practitioner in the structural steel industry with an intimate knowledge of the "nuts and bolts" of connection design.
- Two active steel fabricator members of AISC—one who favors fabricators assuming responsibility for connection design, and another who opposes shared responsibility.
- Leading representatives of both the underwriting and claims portions of the insurance industry will comment on when fabricators and design engineers enjoy insurance coverage for connection design, and when they don't.
- Representatives of public and private owners.
- Representatives from the building code enforcement agencies and state professional licensing boards will comment on the statutory and regulatory framework in which construction projects are designed and constructed.
- An engineering representative from AISC will discuss those practice aids that currently are available and in development by AISC.

One important question to be addressed is just what does "shared responsibility" mean? From a practical standpoint, do authority and responsibility have to be equal? For example, if the Engineer of Record has the final authority to reject, wouldn't the EOR also have the final responsibility in the event of failure? The question of shared responsibility has a great impact at all levels of design, including design development and shop drawing review and submittal.

Also to be addressed is whether there is additional information that would be needed by a fabricator should shared responsibility be excercised. Likewise, the question of whether this subject is adequately covered in the "Code of Standard Paractice" will be considered.

Because of the importance of the subject matter, AISC is allowing non-attendees of the NSCC to attend this one session for a fee of only $50. For more information, write AISC-National Steel Construction Conference, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 or call (312) 670-5421.



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the TUBE PEOPLE
Committed to Excellence
WHERE SERVICE IS OUR OBSESSION

UNR-LEAVITT
CHICAGO, ILLINOIS

UNR-LEAVITT
BLUE ISLAND, ILLINOIS

UNR-LEAVITT
HAMMOND, INDIANA

UNR-LEAVITT
MADISON, MISSISSIPPI

Since 1962, we've helped
And a lot

Over 200 bridges in Ohio are constructed of weathering steel. Most of it produced by Bethlehem.

They use it for the same compelling reasons the New Jersey Turnpike Authority, Maine, Maryland, and numerous other states do.

That's because weathering steel cuts costs both initially and over the life of the structure. Plus, it's attractive and offers engineers broad design flexibility.

Ohio is particularly enthusiastic about the use of weathering steel for appropriate locations in conjunction with their jointless bridges.

They began the jointless concept in the 1930's. Since then, they've refined their jointless designs to the point where joints have been eliminated not just over the piers, but at the abutments, as well.

As a result, drainage problems associated with jointed bridges, such as failure of joint seals, or clogged drains overflowing onto structural members, have been eliminated.

Bridge lengths have also increased. Initially, the limit was 200 ft. Today, it's been increased to 300 ft., and even greater lengths are being constructed.

Engineers in the Buckeye state began using weatheri

hio save a lot of money.
of paint.

steel in the early 1960's.

Low initial cost and minimum maintenance requirements make it highly competitive with other grades of steel. Also, it's attractive and blends in with its natural surroundings.

Strength is another strong factor. Weathering steel is comparable to ASTM A572 Grade 50 high-strength steel. And with a yield strength that's 38% higher than ASTM A36 steel, weathering steel permits the design of lighter, slimmer, more graceful sections.

hat's more, since it's self-healing, the need for painting is v lly eliminated.

For a copy of our Product Booklet No. 3790, and our latest Technical Bulletin TB-307 on "Uncoated Weathering Steel Structures," contact the Bethlehem Steel sales office, Construction Marketing Division, Bethlehem PA 18016-7699. Or call: **(215) 694-5906.**

You'll discover how we can save you a lot of money. Not to mention a lot of paint.

Bethlehem

Note: Maximum lengths of shapes obtained vary with producer, but typically range from 60' to 75'. Please consult individual producers for unusual length requirements.

Principal Producers Of Structural Shapes

B. Bethlehem Steel Corp.
C. Chaparral Steel
F. Florida Steel Corp.
I. British Steel
M. SMI Steel INc.
N. Nucor-Yamato Steel
S. North Star Steel
T. TradeARBED
U. Nucor Steel
W. Northwestern Steel & Wire
Y. Bayou Steel Corp.

Section, Weight per Ft.	Producer Code	Section, Weight per Ft.	Producer Code
W44x335*	T	W27x129	B, I
W44x290*	T	W27x84-114	B, I, N**, T, W
W44x262*	T	W24x306-492	T
W44x230*	T	W24x207-279	N**, T
W40x324-655	T	W24x192	I, N**, T
W40x294*	I	W24x176	B, I, N**, T
W40x264*	B	W24x104-162	B, I, N, T, W
W40x235*	B	W24x76-94	B, I, N, W
W40x211*	B	W24x68	B, I, C, N, W
W40x199-297	N**, T	W24x55-62	B, I, C, N, W
W40x199-264	B, I, N**, T	W21x182-201	I
W40x211*	T	W21x166	B, I
W40x285*	T	W21x101-147	B, I, N, W
W40x174*	T	W21x83-93	B, I, N, W
W40x149-183	B, I, N**, T	W21x62-73	B, I, C, N, W
W36x920*	T	W21x44-57	B, I, C, N, W
W36x439-848	T	W18x175-311	B,
W36x393	B, T	W18x130-158	B, N**
W36x328-359	B, I, T	W18x76-119	B, N, W
W36x230-300	B, I, N**, T	W18x65-71	B, I, N, W
W36x135-210	B, I, N**, T	W18x50-60	B, I, C, N, W
W33x387-619	T	W18x35-46	B, I, C, N, W
W33x318-354	B, T	W16x67-100	B, N, W
W33x201-291	B, N**, T	W16x57	B, I, N, W
W33x169	B,	W16x36-50	B, I, C, N, W
W33x118-152	B, I, N**, T	W16x26-31	B, I, C, N, W
W30x326-581	B, T	W14x808*	B,
W30x258-292	B, N**, T	W14x455-730	B, I, T
W30x284*	I	W14x311-426	B, I, T
W30x235	B, I, N**, T	W14x283	B, I, N, T
W30x173-211	N**, I, T	w14x145-257	B, I, N, T, W
W30x148	B, I	W14x90-132	B, I, N, T, W
W30x99-132	B, I, T	W14x82	B, N, W
W30x90	B, N**	W14x74	B, I, C, N, W
W27x307-539	T	W14x61-68	B, C, N, W
W27x235-281	N**, T	W14x43-53	B, I, C, N, W
W27x146-217	B, N**, T	W14x38	B, I, N, W
W27x132*	I	W14x30-34	B, I, C, N, W

Notes: *Shapes not currently listed in *Manual of Steel Construction*
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Principal Producers Of Structural Shapes

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M. SMI Steel INc.
N. Nucor-Yamato Steel
S. North Star Steel
T. TradeARBED
U. Nucor Steel
W. Northwestern Steel & Wire
Y. Bayou Steel Corp.

Section, Weight per Ft.	Producer Code
W14x22-26	B, I, C, N, W
W12x210-336	B, T
W12x170-190	B, I, T, W
W12x136-152	B, I, N**, T, W
W12x65-120	B, I, N, T, W
W12x53-58	B, I, C, N, W
W12x50	B, I, C, N, W
W12x40-45	B, C, N, W
W12x26-35	B, C, N, W
W12x14-22	B, C, N, W
W10x88-112	B, I, N, W
W10x49-77	B, I, C, N, W
W10x33-45	B, C, N, W
W10x22-30	B, I, C, N, W
W10x15-19	B, I, C, W
W10x12	B, C, W
W8x31-67	B, I, C, N, W
W8x24-28	B, C, N, W
W8x18-21	B, C, N, W
W8x15	B, C, W, Y
W8x10-13	B, C, M, W, Y
W6x15-25	B, I, C, N, W
W6x12-16	B, C, W, Y
W6x9	B, C, M, W, Y
W6x8.5*	C, M
W5x16-19	B,
W4x13	B, C, M
S 24x80-121	B
S 20x66-96	B
S 18x54.7-70	B
S 15x42.9-50	B
S 12x31.8-50	B
S 10x25.4-35	B, S
S 8x18.4-23	B, C, S
S 6x12.5-17.25	C, S, Y
S 5x10	C, Y
S 4x9.5	C

Section, Weight per Ft.	Producer Code
S 4x7.7	C, Y
S 3x7.5	C
S 3x5.7	C, M, Y
M 12x11.8	C
M 12x10.8	C
M 10x9	C
M 10x8	C
M 8x6.5	C
M 6x4.4	
M 5x18.9	B
M 4x13	C
HP14x73-117	B, I, N, W
HP12x53-84	B, I, N, W
HP10x42-57	B, I, C, N, W
HP8x36	B, I, C, N, W
C 15x40-50	B
C 15x33.9	B, W
C 12x30	B, W
C 12x20.7-25	B, C, S, W
C 10x30	B, S, W
C 10x25	B, S. W
C 10x15.3-20	B, C, S, W
C 9x13.4-15	B, S
C 8x18.75	S, W
C 8x13.75	C, M, S, W
C 8x11.5	C, M, S, W
C 7x12.25	S, W
C 7x9.8	M, S, W
C 6x13	M, S, W, Y
C 6x10.5	C, M, S, U, W, Y
C 6x8.2	C, F, M, W, Y, U
C 5x9	F, M, U, W, Y
C 5x6.7	F, M, U, W, Y
C 4x7.25	F, M, U, W, Y
C 4x5.4	F, M, U, W, Y
C 3x6	F, M, W, Y
C 3x4.1-5	F, M, U, W, Y

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S. North Star Steel
T. TradeARBED
U. Nucor Steel
W. Northwestern Steel & Wire
Y. Bayou Steel Corp.

Section, Weight per Ft.	Producer Code
MC 18x42.7-58	B
MC 13x31.8-50	B
MC 12x31-50	B
MC 12x10.6	S
MC 10x28.5-41.1	B
MC 10x22 & 25	B
MC 10x8.4	S
MC 9-23.9-25.4	B
MC 8x21.4-22.8	B, S
MC 8x18.7-20	B, S
MC 8x8.5	M
MC 7x19.1-22.7	B
MC 6x18	B
MC 6x15.3	B, S
MC 6x15.1-16.3	B, S
MC 6x12	B, S
MC 4x13.8*	S
MC 3x7.1*	S

Section By Leg Length & Thickness		Producer Code
L8x8x	1⅛	B, S
	1	B, S
	⅞	B, S
	¾	B, S
	⅝	B, S
	9/16	B, S
	½	B, S
L6x6x	1	B
	⅞	B, Y
	¾	B, M, Y
	⅝	B, M, Y
	9/16	B, M
	½	B, M, S, Y
	7/16	B, M
	⅜	B, M, S, Y
	5/16	M
L5x5x	⅞	Y
	¾	M, Y
	⅝	M, Y
	½	M, U, W, Y
	7/16	M
	⅜	M, U, W, Y
	5/16	M, U, W, Y
L4x4x	¾	M, Y
	⅝	M, Y
	½	F, M, U, W, Y
	7/16	F, M
	⅜	F, M, U, W, Y
	5/16	F, M, U, W, Y
	¼	F, M, U, W, Y
L3½x3½x	½	F, M, U, W, Y
	7/16	F
	⅜	F, M, U, W, Y
	5/16	F, M, U, W, Y
	¼	F, M, U, W, Y
L3x3x	½	F, M, U, W, Y
	7/16	F
	⅜	F, M, S, U, W, Y
	5/16	F, M, S, U, W, Y
	¼	F, M, S, U, W, Y
	3/16	F, M, U, W
L2½x2½x	½	F
	⅜	F, S, U
	5/16	F, S
	¼	F, S, U
	3/16	F, U
L2x2x	⅜	F, S, U
	5/16	F, S, U
	¼	F, S, U
	3/16	F, S, U
	⅛	F, S, U
L8x6x	1	B, S
	¾	B, S
	9/16	B, S

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T. TradeARBED
U. Nucor Steel
W. Northwestern Steel & Wire
Y. Bayou Steel Corp.

Section By Leg Length & Thickness		Producer Code
	9/16	B, S
	1/2	B, S
	7/16	B, S
L8x4x	1	B, S
	7/8*	B
	3/4	B, S
	5/8*	B
	9/16	B, S
	1/2	B, S
	7/16*	B
L7x4x	3/4	B, Y
	5/8	B
	1/2	B, S, Y
	7/16*	B,
	3/8	B, S, Y
L6x4x	3/4	B, M, W, Y
	5/8	B, M, W, Y
	9/16	B, M, W
	1/2	B, M, S, U, W, Y
	7/16	B, Y
	3/8	B, M, S, U, W, Y
	5/16	B, M, U, W, Y
L6x3½x	1/2	M, W, Y
	3/8	M, U, W, Y
	5/16	M, U, W, Y
L5x3½x	3/4	M, Y
	5/8	M, Y
	1/2	M, U, W, Y
	3/8	M, U, W, Y
	5/16	M, U, W, Y
	1/4	M, U, W, Y
L5x3x	1/2	F, M, U, W, Y
	7/16	F
	3/8	F, M, U, W, Y
	5/16	F, M, U, W, Y
	1/4	F, M, U, W, Y

Section By Leg Length & Thickness		Producer Code
L4x3½x	1/2	F, W, M
	7/16	F
	3/8	F, M, W, U
	5/16	F, M, W, U
	1/4	F, M, W, U
L4x3x	5/8	M
	1/2	F, M, U, W, Y
	7/16	F
	3/8	F, M, W, Y
	5/16	F, M, U, W, Y
	1/4	F, M, U, W, Y
L3½x3x	1/2	W
	3/8	M, W
	5/16	M, W
	1/4	M, W
L3½x2½x	1/2	U
	3/8	U
	1/4	U
L3x2½x	1/2	Y
	3/8	U, W, Y
	5/16	Y, W
	1/4	U, W, Y
	3/16	U
L3x2x	1/2	F
	7/16	F
	3/8	F, S, U
	5/16	F, S
	1/4	F, S, U
	3/16	F
L2½x2x	3/8	S, U
	5/16	S
	1/4	S, U
	3/16	S, U

Notes: *Shapes not currently listed in *Manual of Steel Construction*
**Mill is scheduled to begin rolling these shapes late in 1993

Principal Producers Of Structural Tubing (TS)

A. Acme Roll Forming
B. Bull Moose
C. Copperweld Corp.
D. Dallas Tube & Rollform
E. Eugene Welding Co.
I. Independence Tube Corp.
P. IPSCO Steel
U. UNR-Leavitt, Div. of UNR Inc.
V. Valmont Industries Inc.
W. Welded Tube Co. of America
X. EXLTUBE

30x30x⅝	V*
28x28x⅝	V*
26x26x⅝	V*
24x24x⅝, ½, ⅜	V*
22x22x⅝, ½, ⅜	V*
20x20x⅝, ½, ⅜	V*
18x18x⅝, ½, ⅜	V*
16x16x⅝	V*
16x16x½, ⅜, 5/16	V*, W
14x14x⅝	V*
14x14x½, ⅜	V*, W
14x14x5/16	W
12x12x⅝	B
12x12x½, ⅜	B, V*, W
12x12x5/16, ¼	B, W
10x10x⅝	B,C
10x10x½, ⅜, 5/16, ¼	B, C, P, U, W
10x10x3/16	B, C, P, W
8x8x⅝	B, C
8x8x½	B, C, P, U, W
8x8x⅜, 5/16, ¼, 3/16	B, C, D, P, U, W
7x7x⅝	B
7x7x½	B, C, P, U, W
7x7x⅜, 5/16, ¼, 3/16	B, C, D, P, U, W
6x6x⅝	B
6x6x½	B, C, P, U, W
6x6x⅜, 5/16	B, C, D, I, P, U, W
6x6x¼, 3/16	A, B, C, D, I, P, U, W, X
6x6x⅛	A, B, C, I, P
5½x5½x⅜, 5/16, ¼, 3/16, ⅛	B, I
5x5x½	B, C, P, U, W
5x5x⅜, 5/16	B, C, D, I, P, U, W
5x5x¼	A, B, C, D, I, P, U, W, X
5x5x3/16	A, B, C, D, I, P, U, V, W, X
5x5x⅛	A, B, C, I, P, V, W

4½x4½x⅜, 5/16	I, W
4½x4½x¼, 3/16,	A, B, C, I, P, W, X
4½x4½x⅛	A, B, C, P, I, W
4x4x½	B, C, P, U, W
4x4x⅜, 5/16	A, B, C, D, E, I, P, U, W
4x4x3/16	X
4x4x¼	A, B, C, D, E, I, P, U, V, W, X
4x4x⅛	A, B, C, E, I, U, V, W
3½x3½x5/16	A, B, C, E, I, U, W
3½x3½x¼, 3/16	D, X
3x3x5/16	I, W
3x3x¼, 3/16	A, B, C, D, E, I, P, U, W, X
3x 3x⅛	A, B, C, E, I, P, U, W
2½x2½x5/16	I
2½x2½x¼, 3/16	A, B, C, D, E, I, P, U, V, W, X
2½x2½x⅛	A, B, C, E, I, U, V, W
2x2x5/16	I, V
2x2x¼	A, B, C, D, I, U, V, W, X
2x2x3/16	A, B, C, D, E, I, P, U, V, W, X
2x2x⅛	A, B, C, E, I, P, U, V, W, X
1½x1½x3/16	B, E, P, U, V
30x24x½, ⅜, 5/16	V*
28x24x½, ⅜, 5/16	V*
26x24x½, ⅜, 5/16	V*
24x22x½, ⅜, 5/16	V*
22x20x½, ⅜, 5/16	V*
20x18x½, ⅜, 5/16	W
20x12x½, ⅜, 5/16	W
20x8x½, ⅜, 5/16	W
20x4x½, ⅜, 5/16	W
18x12x½, ⅜, 5/16	V*
18x6x½, ⅜, 5/16	B, W
18x6x¼	B
16x12x½, ⅜, 5/16	V*, W
16x8x½, ⅜, 5/16	B, W
16x4x½, ⅜, 5/16	B, W

Notes: *Size is manufactured by Submerged Arc Welding (SAW) process and are not stocked by steel service centers (contact producer for specific requirements. All other sizes are manufactured by Electric Resistance Welding and most are available from steel service centers.

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P. IPSCO Steel
U. UNR-Leavitt, Div. of UNR Inc.
V. Valmont Industries Inc.
W. Welded Tube Co. of America
X. EXLTUBE

14x12x½, ⅜	V*
14x10x½, ⅜, 5/16	B, W
14x6x⅝	B
14x6x½, ⅜, 5/16, ¼	B, W
14x4x⅝	B
14x4x½, ⅜, 5/16, ¼	B, W
14x4x3/16	B
12x10x½, ⅜, 5/16, ¼	B
12x8x⅝	B
12x8x½, ⅜, 5/16, ¼	B, C, U, W
12x8x3/16	B, C, W
12x6x⅝	B
12x6x½,⅜,5/16, ¼	B, C, U, W
12x6x3/16	B, C, W
12x4x⅝	B
12x4x½, ⅜, 5/16, ¼, 3/16	B, U, W
12x3x5/16, ¼, 3/16	B
12x2x¼, 3/16	B, U
10x8x½, ⅜, 5/16, ¼, 3/16	B, C, U, W
10x6x½,	
10x6x⅜, 5/16, ¼, 3/16	B, C, D, P, U, W
10x5x⅜, 5/16, ¼, 3/16	B, C
10x4x½	B, C, P, U, W
10x4x⅜, 5/16, ¼, 3/16	B, C, D, P, U, W
10x2x⅜, 5/16	D
10x3x¼, 3/16	B, D
10x2x5/16	P, W
10x2x¼, 3/16	B, D, P, U, W
8x6x½	B, C, P, U, W
8x6x⅜, 5/16, ¼, 3/16	B, C, D, P, U, W
8x4x⅝	B
8x4x½	B, C, P, U, W
8x4x⅜, 5/16	B, C, D, I, P, U, W
8x4x¼, 3/16	A, B, C, D, I, P, U, W, X
8x4x⅛	A, B, I, P
8x3x½	C, P, U
8x3x⅜, 5/16	B, C, D, I, P, U, W
8x3x¼, 3/16	A, B, C, D, I, P, U, W
8x3x⅛	A, B, C, I, P
8x2x5/16	I, P, W
8x2x¼, 3/16	A, B, D, I, P, U, W
8x2x⅛	A, B, P, I
7x5x½	B, C, P, U, W

7x5x⅜, 5/16	B, C, I, P, U, W
7x5x⅛	A, B, C, P, I
7x4x⅜, 5/16	B, C, I, P, U, W
7x4x¼, 3/16	A, B, C, I, P, U, W, I
7x4x5/16	A, B, C, I, P
7x3x⅜, 5/16	B, C, I, P, W
7x3x¼, 3/16	A, B, C, I, P, W, X
7x3x⅛	A, B, C, I, P
6x4x½	B, C, P, U, W
6x4x⅜, 5/16	B, C, D, I, P, U, W
6x4x¼	A, B, C, D, I, P, U, W, X
6x4x3/16	A, B, C, D, I, P, U, V, W, X
6x4x⅛	A, B, C, I, P, V, W
6x3x½	P, U
6x3x⅜, 5/16	B, D, I, P, U
6x3x¼	A, B, C, D, I, P, U, X
6x3x3/16	A, B, C, D, I, P, U, W, X
6x3x⅛	A, B, C, I, P, W
6x2x5/16	I, P, W
6x2x¼, 3/16	A, B, C, D, E, I, P, U, W, X
6x2x⅛	A, B, C, E, I, P, U, W
5x4x⅜, 5/16	I, P, W
5x4x¼, 3/16	B, C, I, P, U, W
5x3x½	C, P, U
5x3x⅜, 5/16	B, C, I, P, U, W
5x3x¼, 3/16	A, B, C, D, E, I, P, U, W, X
5x3x⅛	A, B, C, E, I, P, U, W
5x2x5/16	I, P, W
5x2x¼, 3/16	A, B, C, D, E, I, P, U, W, X
5x2x⅛	A, B, C, E, I, P, U, W
4x3x5/16	B, I, P, W
4x3x¼, 3/16	A, B, C, D, E, I, P, U, W, X
4x3x⅛	A, B, C, E, I, P, U, W
4x2x5/16	I, P, W
4x2x¼, 3/16	A, B, C, D, E, I, P, U, W, X
4x2x⅛	A, B, C, E, I, U, W
3x2x5/16	I
3x2x¼, 3/16	A, B, C, D, E, I, P, U, V, W, X
3x2x⅛	A, B, C, E, I, P, U, V, W
2½x1½x¼, 3/16	X

Principal Producers Of Steel Pipe

C. Copperweld Corp.
P. IPSCO Steel
U. UNR—Leavitt, Div. of UNR Corp.
V. Valmont Industries, Inc.
W. Welded Tube Co. of America
X. EXLTUBE

20.000x.500, .375, .250	W
18.000x.500, .375, .250	W
16.000x.500	W
16.000x.375, .250	P, W
16.000x.188	P, V*
16.000x.125	V*
14.000x.500, .438, .375, .250	P, W
14.000x.188	P, V*
14.000x.125	V*
12.750x.500, .406, .375	P, W
12.750x.188, .125	P, V*
10.750x.500, .365, .250	P, W
10.000x.625, .500, .375, .312	C
10.000x.250, .188	C, V
10.000x.125	V
9.625x.500, .375, .312, .250, .188	C, U
8.625x.500	C, P, U
8.625x.375, .322	C, P, U, W
8.625x.250, .188	C, P, U, V, W
8.625x.125	P, V, W
7.000x.500	C, P, U
7.000x.375, .312, .250	C, P, U, W
7.000x.188	C, P, U, V, W
7.000x.125	C, P, V, W
6.625x.500, .432	P, U
6.625x.375, .312, .280	P, U, W
6.626x.250, .188	P, U, V, W
6.625x.125	P, V, W
6.000x.500, .375, .312	W
6.000x.280	X
6.000x.250, .188, .125	V, W
5.563x.375	P, U
5.563x.258	P, U, V, W
5.563x.134	P, V, W
5.000x.500, .375, .312	P, C, W
5.000x.258	X
5.000x.250, .188	C, P, U, V, W
5.000x.125	P, U, V, W
4.500x.237, .188, .125	P, U, V, W
4.000x.250, .266, .188, .125	U, V, W
4.000x.237, .337	
3.500x.318	X
3.500x.300	P, W
3.500x.250, .203, .188, .125	P, U, V, W
3.500x.216	X
3.000x.300, .216	X
2.875x.276	W
2.875x.250, .203, .188, .125	P, U, V, W
2.375x.250, .218, .188	P, V, W
2.375x.154, .125	P, U, V, W

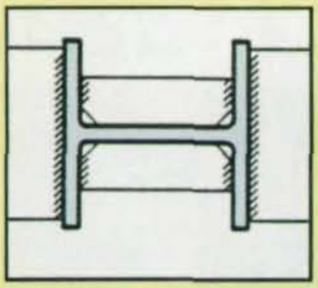
Notes: *Indicates size is manufactured by Submerged Arc Welding (SAW) Process and is typically not stocked by steel service centers. Other sizes are manufactured by Electric Resistance Welding and typically are available from steel service centers. For more information contact the manufacturer or the American Institute for Hollow Structural Sections (412) 221-8880.

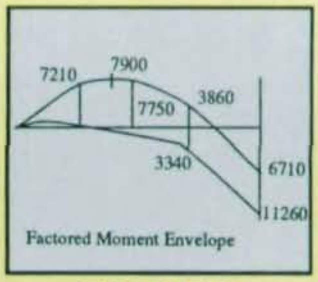
Also, other sizes and wall thicknesses may be available. Contact an individual manufacturer for more details.

STRUCTURAL STEEL DESIGN

SOFTWARE

FROM AISC





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A knowledge-based, menu-driven PC software system for the design of connections in steel framed buildings. All strength limit states are checked and expert advice from long-time fabricator engineers is used to augment the design rules.

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MODULE I:
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9th edition ASD
Version 2.0 **$400**

MODULE II:
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ASD format only **$400**

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(sorry, no 3-1/2"

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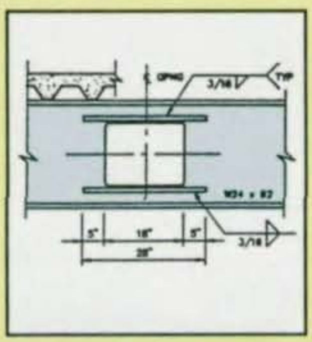
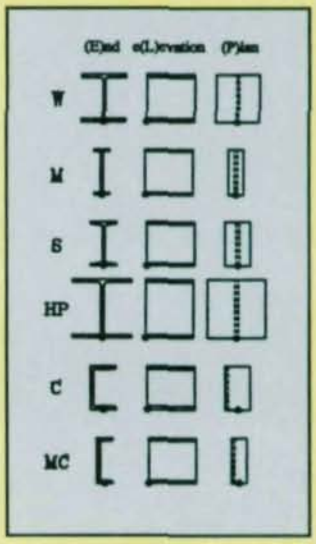
Designed to enable engineers to quickly and economically design beam web openings. Uses state of the art criteria and features a clear and logical data entry system with easy-to-use color coded input windows. Written by practicing engineers *for* engineers, incorporating expert design checks and warning messages which enhance the application of the AISC Design Guide—*Steel and Composite Beams with Web Openings*—to specific design problems.

3-1/2" or 5-1/4" disk. Includes AISC Design Guide **$495.00**





AISC FOR AUTOCAD

Saves time doing detail drawings of structural steel shapes in AutoCAD. Lists properties *corresponding to data in the* most recent LRFD and ASD manuals. Parametrically draws to scale the end, elevation and plan views of common shapes.

3-1/2" or 5-1/4" disk **$120**

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A new sophisticated program for interactively checking structural steel building components for compliance with AISC specification. Checks whether member satisfies all limit states and limitation requirements set by the LRFD Specification and reports which sections are satisfied or violated.

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- Fully interactive MS Windows-based user interface.
- Disk includes ELRFD Check/Browser, AISC Structural Shapes Database and sample problems
- User Guide and Reference Manual.

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AISC DATABASE

Contains the properties and dimensions of structural steel shapes, corresponding to data published in the most recent LRFD and ASD Manuals of Steel Construction. Presented in the ASCII format for W, S, M, HP and other common shapes and channels. Available in U.S. customary units or metric units. May be converted to Lotus 1-2-3 PRN format.

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Top-Down Construction Renews Historic Building

Converting a deteriorated office building into a new parking facility while retaining its elegant exterior required the coordination of the entire building team

The historic Larned Building in downtown Syracuse was reborn as a steel-framed parking structure through an innovative and difficult construction process.

The consensus from the entire building team was that it was one of the most difficult projects on which any of them had worked. Not only was the five-story Syracuse office building being converted into six levels of parking, but at the same time the exterior had to be preserved and restored. Adding to the complexity of the project, the structure's four sides were all of different lengths, with the shortest reaching only 48′ and the longest stretching 150′. And to top it all off, the circa-1868 building was in a highly deteriorated condition.

The original structure featured brick bearing walls and wood joist floor construction. It had not been occupied in several years, and water damage from roof leaks had caused substantial damage. Also, two stairwell fires had all but destroyed the first floor. Normally, a building in such bad condition would have been torn down. But the Larned Building's location in the heart of Upstate New York's first historic district mandated that every effort be made to save it.

"There just wasn't any economical way to renovate the building for office use," stated Daniel Manning, R.A., project architect with JCM Architectural Associates, Syracuse. In addition to its poor layout and horrifying physical condition, the office market in Syracuse during the late 1980s and early 1990s was glutted.

Instead, the Syracuse-based developer, Monahan, Hucko & Co., considered converting it to urban housing, retail or mixed-use space, and also considered tearing it down and building surface parking. "As with many urban areas, there was a great need for parking," according to developer Jim Monahan. Because the Larned building shares a common wall with an existing parking structure, it was determined that the old structure could be converted to parking and could utilize its neighbor's already existing ramps.

However, replacing the inside of the existing building while retaining its exterior proved to be quite a challenge, since exterior bracing would have disrupted too much traffic. Essentially, the plan was to remove one bay around the perimeter and replace it with new steel framing, and then to remove and replace the rest of the structure. The trick was, how do you brace the exterior wall while the new framing was installed?

The structural engineer, John P. Stopin & Associates, Syracuse, started by threading 8 x 8 steel columns down through the existing structure along the perimeter of the wall. At the same time, a line of 8 x 10 steel columns were installed 12' inside the structure. The roof and the fifth floor were then removed and the steel framing for the top level of the parking structure was installed. After the new framing was braced and a concrete deck was poured on top of a galvanized steel deck, the fourth floor of old wood structure removed, and the next level of parking was constructed. "We built the outside bay of the parking garage from the top down while continuously keeping the rest of the wood structure intact to brace the exterior wall," explained Jim Kaplan, P.E., project manager with Stopin & Associates.

Of course, working from the top down had a number of complications. "Dropping in the columns was the easiest part," according to Otis Marshall, project manager with construction manager Hueber-Breuer Construction Co, Inc., Syracuse. "Bringing in the new steel beams was much more difficult, especially as we reached the lower floors."

Since each floor was braced and a new deck installed before the next floor down was demolished, all of the beams had to be brought in through window openings. The beams were primarily W16s and W18s, with the largest being a 40'-long W18 x 119, according to Tom Raulli, vice president with AISC-member Raulli & Sons, Inc., the project's steel fabricator and erector. The project used a total of ap-

The first step was to construct one bay of the new steel frame to brace the exterior walls. Only then was the old wood framing on the building's interior removed.

The steel frame's X-bracing was located so as to not interfere with either parking or vehicular traffic.

proximately 400 tons of steel.

The project used simple connections with X-bracing for lateral loads. The bracing was located 20'-25' on center parallel to the exterior wall.

Once the perimeter bay was constructed, the interior was completely demolished, and the rest of the parking structure was installed using conventional construction practices. Construction time on the 150-space garage was just under one year. The exterior was restored to its original condition with one notable exception. To meet local building codes for an open parking deck, the building's double hung wood windows were replaced by wood screens designed to simulate the appearance of windows.

A second phase of the project now underway involves refacing the adjoining Vanderbilt Parking Garage to better fit in with the historic character of the neighboring structures.

"One of the keys to the success of the project was assembling the building team early," said Monahan. In addition, it was crucial to have the complete support of the project's lender, ONBANK, which has offices located nearby and which had previously demonstrated a commitment to the preservation of the area.

Future Options

The use of a structural steel frame and concrete tees allowed the designers to plan for a future seven-story hotel on top of a four-story garage

A structural steel superframe with untopped precast concrete double tees was the most economical system for a new parking structure at JFK International Airport in New York.

By Nissim Agassi, P.E.

As part of the JFK 2000 Redevelopment Program at John F. Kennedy International Airport in New York, a new 500,000-sq.-ft. garage was designed and built. But this wasn't just a large airport parking project; this 296' x 315' structure was designed to also serve as the base of a future seven-story, 500-room hotel.

The garage has a typical bay of 27' x 58'. The 58' clear span was selected for two reasons. First, the garage primarily serves short-term parkers and there is a high turnover. The 58' span accommodates two 18'-deep, 90 degree stalls separated by 22'-wide one-way access aisles. And second, the span is compatible with a typical double-loaded corridor of a hotel guest floor. The floor-to-floor height of 10'-6", with an actual clearance height of 7'-3".

Architect for the garage was Pei, Cobb, Freed & Partners and consulting engineers were Weidlinger Associates, both of New York. Working drawings were prepared by TAMS/SSVK.

Structural Alternatives

Several schemes were considered for the parking structure during the conceptual phase of the project including:

1. Cast-in-place reinforced concrete;

2. Cast-in-place concrete structure with post-tensioned slabs and beams;

3. All precast concrete structure; and

4. Structural steel superframe with untopped precast concrete double tees.

Cast-in-place reinforced concrete was quickly rejected as it was significantly more expensive than the alternatives. Likewise, an all precast concrete scheme—which is one of the most common designs for a parking structure—was eliminated as being too expensive due to the need to support the hotel above and also to meet seismic considerations.

The remaining two schemes were estimated to have very comparable costs. However, other fac-

The parking structure features a double line of Grade 50 steel columns and beams spaced 3' apart, with the columns ranging in size from W14 x 176 to W14 x 605. The two external spiral ramps allow vertical circulation to each level of the parking garage. Each ramp has a one-way, counterclockwise travel direction.

tors clearly tipped the balance towards the steel superframe with untopped precast concrete double tees.

Clearly, the steel alternative offered greater flexibility for future modifications to the parking facility than would an all-concrete structure. Also, steel columns can be easily reinforced, if required, to accommodate heavier superimposed future loads if a larger-than-anticipated hotel was ever constructed.

But even as designed, substantial reinforcing would have been required to resist volume and temperature changes with the concrete alternative. Depending on the sequence of post-tensioning, this operation would have resulted in additional moments in the structure. This is due to the relatively large plan size of the structure and the large columns required to carry the parking floors and the hotel above. It should be noted that while the post-tensioned structure can be designed to resist the additional moments and forces imposed by the volume and temperature changes, our study showed that the moments developed in the structure under each of these forces are of the same order of magnitude as those resulting from the seismic forces, and therefore were not desirable.

Buildings of this size are at the upper end of the scale of buildings constructed without expansion joints. Introducing additional expansion joints would require such joints to continue through the hotel and retail structure above. Each of the substructures has to stand on its own, i.e., have the capability to resist lateral forces without depending on the lateral stability of the adjacent substructure.

In the selected steel and concrete alternative, such internal forces in the precast floor were relieved by properly designing and constructing control joints in the double tee precast deck. In this way, "cracks" were designed into the deck at predetermined locations. In addition, there is no shrinkage caused by the steel or the precast tees. The precast tees were connected through shear plates spaced 5' on center to form a diaphragm for resisting seismic forces. The steel frame was able to accommodate the design thermal stresses without much difficulty.

A combined steel and precast concrete structure also reduced the amount of field work compared with a cast-in-place structure. In the chosen scheme, the fabrication of the precast tees and of the steel frame is done in the shop under superior quality control conditions. In a parking structure, quality control of the concrete is of great importance to ensure the durability of the deck. Quality control related problems were much more likely to slow down an all-concrete project than a mixed steel/concrete structure.

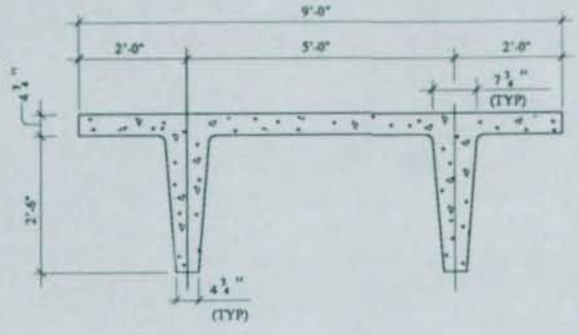
Car Bombs

A final reason for choosing steel is the possibility of terrorism at international airports—particularly in the form of "car bombs". The Port Authority of New York investigated the consequences of such an event and asked the engineer to conduct a progressive collapse analysis. The results of that analysis showed that the damage caused by a car bomb would be local and that progressive collapse was not likely to occur with Scheme 4. With the cast-in-place alternative, however, in order to avoid progressive collapse either the post-tensioning strands had to be continuously bonded or each bay had to be independently post-tensioned. Either method would have slowed down construction and increased the cost of the project.

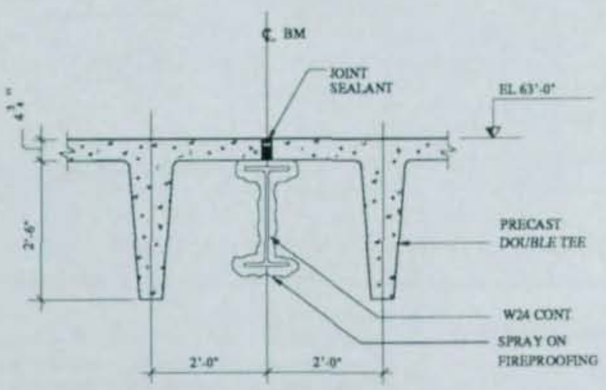
Structural Design

The chosen plan featured a double line of Grade 50 steel columns and beams spaced 3' apart. The columns, moment connected to the pile caps, extend unbraced for the entire height of the garage structure. Columns range in size from W14 x 176 to W14 x 605. The project used a total of approximately 2,637 tons of steel.

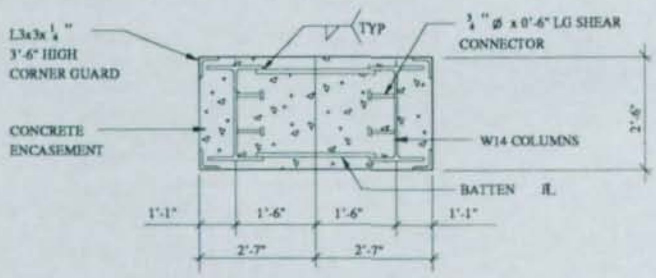
The beams run in the short span direction. Typical beams are W24 x 68 members, with W24 x 104 mem-



TYPICAL SECTION
OF DOUBLE TEE



TYPICAL SECTION
AT ROOF PARKING LEVEL



TYPICAL DOUBLE COLUMN
ENCASEMENT DETAIL

bers for non-typical spans and W24 x 146 members on the roof level.

No beams were provided in the long span direction except at the roof parking level. These beams, together with the double steel columns, form a superframe to resist the lateral loads imposed by the hotel and parking structure. This arrangement minimized the amount of material needed, substantially reduced the number of steel pieces to be erected, and allowed for the continuous erection of both the steel and the precast double tees.

The garage's five levels are connected by two 76'-diameter helical concrete ramps for controlled entry and rapid exit from each floor. Each 15,000-sq.-ft. ramp was designed as a stand-alone structure separated from the garage structure by an expansion/seismic joint. No other expansion/seismic joints were provided in the garage, eliminating the need to continue such large joints through any future overhead building.

The plan size of the structure required consideration of the effect of thermal forces. While the steel frame was capable of resisting the thermal stresses with little difficulty, the precast tees necessitated control joints in the floor deck.

The two external spiral ramps allow vertical circulation to each level of the parking garage. Each ramp has a one-way, counterclockwise travel direction. It is supported on seven columns connected by spiral beams forming the center core of the ramp. A spiral concrete slab tapers and cantilevers approximately 22' from the spiral beams towards the outside.

The impressive-looking open spiral structure provides an unobstructed view of cars on the ramp, thereby increasing traffic safety. The radius to the face of the inside curb of the ramp is 16.5' and to the outside curb 35.5', leaving a 19' pavement width. A 37' radius was provided to the inside face of the outer parapet wall. Safety walks, 1'-6" wide, were provided along both the inner and outer edges of the ramps. The grades on the spiral ramp are 6.3% at the outer curb, 8.6% at the middle of the ramp, and 13.5% at the inner curb.

While the 1,400-car garage was classified as an open parking structure, the future plan to build a hotel on top of it mandated that the garage be fully sprinkled and fireproofed. A two-hour fire-rated steel frame and a 1-½-hour-rated floors were required by code. Durability considerations dictated the use of concrete encasement for the steel columns, while the steel beams were coated with less costly cementitious fireproofing material. Since the columns were being encased in concrete, the designer opted to utilize composite construction and increase the lateral load stiffness of the columns. Therefore, the concrete encasement was connected to the steel columns through shear connectors. To speed erection, batten plates were used to connect the two columns together and brace each other during construction. This allowed for concrete encasement operations to take place at any time after the erection of the steel frames.

The design process involved extensive value engineering and thorough estimating to arrive at the most efficient structure. General contractors on the job were De-Mottis and Hannibal Construction Co.

Nissim Agassi, P.E., is a principal with Weidlinger Associates, a consulting engineering firm headquartered in New York City.

Structural Engineering Software Review

Comparing one software program with another is a very difficult task. Few programs are designed to accomplish the exact same goal, and fewer still require the same inputs. In an effort to get some handle on the performance of the wide range of software programs currently on the market, *Modern Steel Construction* sent the same series of design problems to a large list of software manufacturers.

The project was a four-story medical building with 13' floor-to-floor heights, 50 psf live loads, a metal deck floor slab topped with light-weight concrete (total weight 41 psf), 80 mph wind loads, a stated drift limit, and no seismic loads.

The software manufacturers were asked to perform: A one-bay, composite beam design and a full-floor composite beam design; a single beam, non-composite beam design; a single column, non-composite design; frame analysis and design; and connection design.

Ten software manufacturers returned designs. Several others contacted us but declined to participate. The major reason given for not participating was that a hands-on trial would be the only way to adequately evaluate the program. If you have any questions about the programs themselves, please contact the manufacturer directly.

One Bay, Composite Beam Design & Full Floor, Composite Beam Design

ECOM's input for composite steel design

ECOM Associates SD3C Composite Steel Design

User inputs span length, spacing, all loading, slab thickness, strength of steel, strength of rebar, weight of concrete, strength of concrete, and deck thickness. They also put limits on deflection, decided it would be an unshored composite beam, and chose the ASD 9th Edition method. The user asked for the most economical W10, W12 and W14 depths.

Program calculated critical shears and moments and outputted the most economical W10, W12 and W14 shapes, along with the appropriate stress checks. The required number of shear connectors for full composite action was given and deflections were checked.

To calculate Full Floor, Composite Beam Design, each member is input at the beginning and the output will include information on each beam.

Comments: While the program clearly indicates actual and allowable deflections, it does not clearly indicate actual and allowable stresses. Otherwise, the output is clearly presented and the information is highly useful. This program greatly eases the design of full floors.

Cost: $695

Enercalc Structural Engineering Library

User inputs span length, spacing, all loading, slab thickness, strength of steel, weight of concrete, strength of concrete, deck thickness, shear stud height, and shear stud diameter. Ran program two ways: one with ribs parallel and one with ribs perpendicular. User had the option and chose to allow partial composite action. Calculations were based on the ASD Specification.

Output includes stress and deflection checks. The program chose a member size and output the number of studs required for full composite as well as partial composite action. Also included in output were shear, moment and deflection diagrams.

To calculate Full Floor, Composite Beam Design, each member is individually input and then the output is combined.

Comments: Output is clear, though shear, moment and deflection diagrams seem like overkill.

Cost: $695 for Structural Engineering Library (includes 44 programs).

HESCO HCOMPL

User inputs span length, spacing, all loading, slab thickness, strength of steel, stud length, stud diameter, weight of concrete, strength of concrete, deck thickness, and vibration requirements. Also, cost information for steel, installed studs, and camber is input. The calculations are done using the LRFD Specification for composite members. A sister program, HCOMPA, is an ASD version of this program. Also, the latest version of the program offers SI units.

Program calculates shape needed, camber required, and number of shear studs. Deflections, vibration, and strength requirements are checked. The result is a least weight section, not necessarily the most economical design.

To calculate Full Floor, Composite Beam Design, each member is individually input and then the output is combined.

Comments: Output is brief and does not show the checks that were made; rather only the results are presented. Output is clearly organized and includes some cost information.

Cost: $390 for HCOMPL; $300 for HCOMPA

```
Span information (ft):   I-End (59.00,95.50),  J-End (59.00,125.00)
    Beam Size (Optimum) = W16X26
    Steel Yield Strength    = 36.0 ksi
    Total Beam Length (ft) = 29.50
Composite properties:
    Concrete thickness (in)    Left =     3.25     Right =     3.25
    Unit weight concrete (pcf) Left =   110.00     Right =   110.00
    f'c (ksi)                  Left =     3.50     Right =     3.50
    Decking Orientation        Left = perpend.     Right = perpend.
    Decking type               Left = VERCO W2 Formlok
    Decking type              Right = VERCO W2 Formlok
    Not Shored
    beff (in)          =    88.50     Y bar(in)            =    16.38
    Mnf (kip-ft)       =   289.61     Mn (kip-ft)          =   220.30
    C (kips)           =   105.59     e (in)               =    12.89
    Ieff (in**4)       =   777.82     Itr  (in**4)         =  1072.56
    Stud length (in)   =     4.50     Stud diameter (in) =      0.75
    # of studs:   Full = 29   Partial = 11   Actual = 11
    Number of Stud Rows = 1,   Percent of Full Composite Action = 38.19
```

Ram Analysis' partial output for composite beam design

Ram Analysis RAMSTEEL

User graphically creates a model of the entire structure including grids, columns, beams, slab edges and openings, and floor loads. Slab properties are specified, including strength and weight of concrete, stud length and diameter, and slab thickness. The program also asks for deck orientation and type, which is a shortcut to entering deck properties.

Program calculates floor load distribution, tributary areas, and Live Load Reductions. It also calculates the number of studs required for full and partial composite action. The design can be output for both the LRFD and ASD Specifications. Deflections and strength requirements are checked and it presents the most economical beam.

Various outputs include invidual beam designs, beam design summaries, and beam take-offs for the entire structure. It creates CAD files out of floor framing plans.

Comments: Program runs within Microsoft Windows. Output is not highly detailed but presents the major design information on a single page. The progam also presents shear, moment and deflection diagrams. This program greatly eases the design of full floors.

Cost: $3,500

Structural Analysis, Inc. SAI COMPBM

User inputs span length, spacing, all loading, slab thickness, strength of steel, stud length, stud diameter, weight of concrete, strength of concrete, and deck thickness. Program calculates design based on the ASD Specification. User has choice of cover plated or non-cover plated beams.

Program calculates moments and shears at 10th points, determines stresses and deflections, picks a shape, and gives the number of studs required for fully composite action.

To output a Full Floor, Composite Beam Design, each member needs to be entered individually and then combined.

Comments: Output is brief but complete. Layout of output is tabular; therefore it is slightly difficult to quickly locate desired information.

Cost: $360 for COMPBM or $650 for The Steel Designer, which includes 27 programs

Structural Engineers Inc. Design Advisor SDI Floor Module

User inputs span length, spacing, minimum and maximum beam depth (L/30 minimum; L/22 maximum), concrete depth, all loading, slab thickness, strength of steel, strength of rebar, stud diameter, stud length, weight of concrete, and strength of concrete. The user also inputs the relative cost of steel and shear studs which allows them to come up with a final economical design that is partially composite. The program used the LRFD Specification.

The output goes through all limit state checks required for a composite beam. The program gives eight alternate designs based on the input steel cost and in-place stud cost and gives detailed output on the most economical design. A floor vibration check also was made for the design.

To calculate Full Floor, Composite Beam Design, each member is entered individually and then the output is combined.

Comments: Output is very detailed and clearly presented. It gives the equation, and then the result, as well as any assumptions made by the programmer.

Cost: $295 from the Steel Deck Institute.

Non-Composite, Single Beam

Daystar Software DS-Steel2D

(This program is for the Macintosh computer system)

User inputs steel strength, beam length and loading information.

Program calculates, based on 8th edition ASD Specification, the lowest weight section.

Comments: While this program shows the results of the checks that were made, it only includes strength checks and does not even calculate deflection. This program also is used for column design, so includes axial stress information, which is extraneous for pure beam design.

Cost: $295

Design Data SDS2

User inputs steel strength, beam length and loading information.

Program calculates, based on ASD Specification, least weight beam and deflection. Program also notes camber. User has option to print either allowable or actual stresses. A composite program will be available in 1993.

Comments: Output is brief and only gives allowable stresses, rather than actual stresses. The same program is used for column and frame design, so the brevity of the output saves a substantial amount of space.

Cost: Available on request

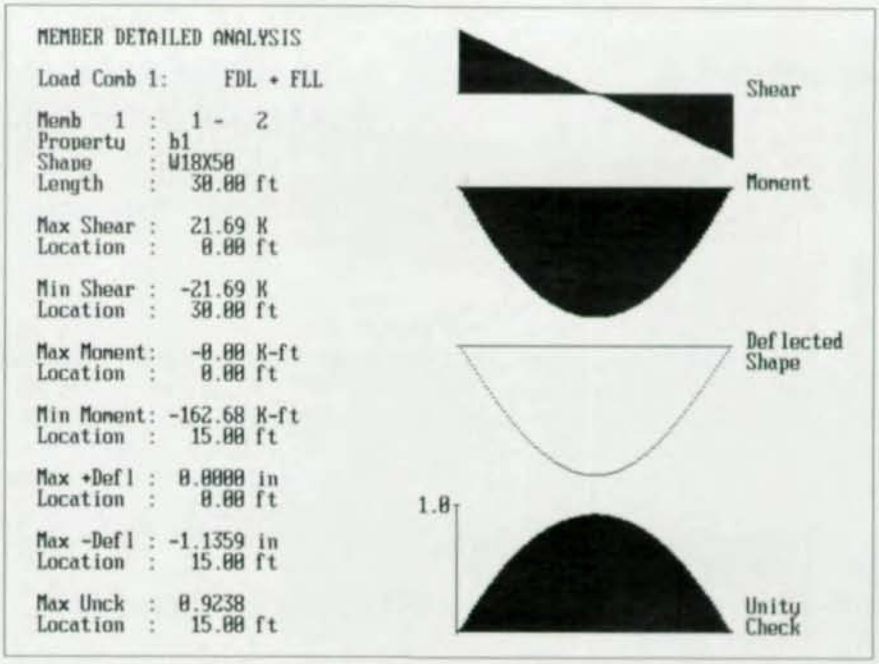
Enercalc Structural Engineering Library

User inputs steel strength, beam length and loading information.

Program calculates, based on ASD Specification, least weight steel section, moment shears and deflections. Output includes steel section data and moment shear and deflection diagrams.

Comments: Output is clear and seems inclusive.

Cost: $695 for Structural Engineering Library (includes 44 programs).



An output page from RISA's non-composite beam design

James J. Jordon Sr. BIGBEAMS

User inputs steel strength, beam length and loading information.

Program calculates, based on ASD Specification, the lowest weight steel beam and checks deflection. It also gives five other sections of greater weight or material strength, which would work for strength and deflection.

Comments: Output is very concise and includes no checks other than deflection. The units that are used are not standard. For example, steel grade is given in psi and moments in inch pounds.

Cost: $96.96

RISA
RISA 2D

User inputs steel strength, beam length and loading information.

Program calculates, based on ASD Specification, five beam options—the lowest weight member along with four heavier sections. It also gives shear moment and deflection diagrams.

Comments: The program's tabular output is difficult to read; however, its diagrams more than make up for this confusion and are very clear and useful. The program designs three different beams at the same time, which is useful when designing an entire floor.

Cost: $495

Ram Analysis
RAMSBEAM

User inputs steel strength, beam length and loading information. Also, user can specify ASD or LRFD Specification.

Program calculates optimum beam size and deflections. Designs composite and non-composite beams.

Comments: Runs within Microsoft Windows. Seems straightforward and complete. Output does not go into great depth, but does provide all of the required information.

Cost: $100

Structural Analysis, Inc.
SAI BEAM

User inputs steel strength, beam length and loading information.

Program calculates, based on ASD Specification, the most efficient shape and deflection.

Comments: Output is difficult to read until the user becomes familiar with SAI's abbreviations and format. Also, the program does not give the checks that are made to arrive at the results. Documentation, however, is very complete.

Cost: $180 for SAI BEAM or $650 for The Steel Designer, which includes 27 programs.

Non-Composite, Single Column

Daystar Software, Inc.
DS-Steel2D

(This program is for the Macintosh computer)

User inputs steel strength, column height, connection conditions and loading information.

Program calculates, based on the 8th edition ASD Specification, lightest column size, including any combined stress checks.

Comments: Output is brief but complete. However, it is unclear where some of the output data originates.

Cost: $295

FLOOR SUPTD	1.4 * DEAD LOADS / 1.2 * D.L + 1.6 * L.L / 1.2*D.L + 0.5*L.L + 1.3*LAT						Pn / Mnx / Mny	Kx / Ky / Cb	Fy / -Pu / AXIAL SHORT.	SIZE / BUILT UP CASE A,B,C WIDTH x THK FLANGE PL. / WEB PLATE
	MAX Pu k	X-Mu k-ft	Y-Mu k-ft	EFF. RAT.	MOMENT MAG. B1x	B1y	k-ft		k & in	
5	75	0	0	.56	1.03	1.57	157	1.00	36	W12 X 26
	95	0	0	.72	1.04	1.86	89	1.00	0	
	0	0	0	.00	.00	.00	24	1.00	.03	
4	180	0	0	.70	1.05	1.53	301	1.00	36	W12 X 40
	216	0	0	.84	1.06	1.72	156	1.00	0	
	0	0	0	.00	.00	.00	50	1.00	.04	
3	285	0	0	.74	1.06	1.34	455	1.00	36	W12 X 53
	337	0	0	.87	1.07	1.42	225	1.00	0	
	0	0	0	.00	.00	.00	87	1.00	.05	
2	390	0	0	.77	1.07	1.23	597	1.00	36	W12 X 65
	458	0	0	.90	1.08	1.29	289	1.00	0	
	0	0	0	.00	.00	.00	132	1.00	.05	

Hesco's tabular output for non-composite, single column design

Design Data SDS2

User inputs steel strength, column height, connection conditions and loading information.

Program calculates, based on ASD Specification, lightest column size. It also tells the user if it is a compact section and presents a series of "allowables": shear; bending stresses; and compressive stress. The user has the option of printing either allowable or actual stresses. A composite design program will be available in 1993.

Comments: Output is brief and only gives the allowable, not the actual, stresses. This is the same output format as used for the beam design program discussed above.

Cost: Available upon request

Enercalc Structural Engineering Library

User inputs steel strength, column height, connection conditions and loading information.

Program calculates, based on ASD Specification, lightest column size. Output includes all stress checks and steel section properties. Also includes a plan and elevation of the column.

Comments: The output is concise and easy to read. The program designed only one section of the multistory frame.

Cost: $695

HESCO Steel Column Design

User inputs steel strength, column height, connection conditions and loading information. Also, base plate information.

Program calculates, based on LRFD Specification, lightest column size and optimum base plate size. Output includes all stress checks. Design is for each section of the multistory column.

Comments: The output is very detailed and extremely well organized. However, it also uses floor-to-floor height, rather than actual member length needed for ease of construction.

Cost: $200

Ram Analysis RAMSTEEL Column Module

Column design information including column lengths, axial loads, unbalanced moments and bracing conditions are calculated directly from the RAMSTEEL model without requiring additional user input. User has the choice of using the LRFD or ASD Specification.

Program calculates the lightest column sizes for the entire length of a multistory column. It also gives the interaction equation that was used as well as stress checks. Output also includes a column take-off sheet of all the columns required in the structure.

Comments: Output is complete, very detailed and easy to read. However, the output shows the floor-to-floor height, rather than the actual member length needed for ease of construction. Progam runs as part of RAMSTEEL within Microsoft Windows.

Cost: $750

Structural Analysis, Inc.
SAI STLCOLX

User inputs steel strength, column height, connection conditions and loading information.

Program calculates, based on ASD Specification, lightest column sizes for the entire length of a multistory column. In the design example of a four-story building, the program showed the column sizes for each floor. Also includes combined stress checks.

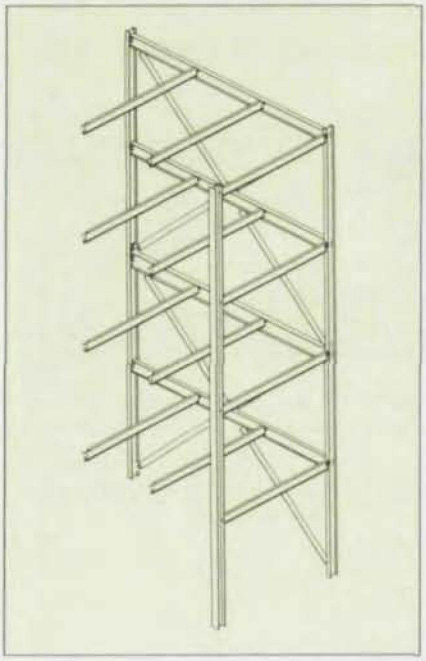
Comments: Output is brief, includes only allowable stresses rather than actual stresses. However, the output shows the floor-to-floor height, rather than including the actual length of each member needed for ease of construction.

Cost: $300

Frame Analysis & Design

Design Data
SDS/2

User inputs the three-dimensional geometry of the frame, loading, and preliminary member sizes. The program, using the ASD Specification, analyzes the frame and designs the members for strength as well as serviceability as required. The analysis includes moments, shears and axial forces, as well as displacements for a range of load combinations. Stresses and deflections are checked for each individ-



An example output from Design Data's frame analysis module

ual member. The output is both tabular and has graphics.

Comments: The graphics are of a very high quality, as befits a program designed to integrate with a detailing program. The tabular output is extensive and complete for each individual member. It is clear and easy to read. All of the required checks are shown—for each member.

Cost: Available upon request

ECOM
FA5C Floor Load Distribution program; CSTRAAD Finite Element Analysis program; & SD4C Beam/Column Design module

User inputs the three-dimensional geometry of the frame, loading, and preliminary member sizes. The loading is calculated by the floor load distribution program; the frame is analyzed and displacements, reactions and moments are calculated by the finite element analysis program; and the members are checked and redesigned by the beam/column design module. The design example returned used the ASD Specification, though LRFD also is available. Output is organized into three distinct groups: loading; analysis; and design. The design output lists the member as well as the governing stress checks. The graphical output is a simple stick drawing that can be used to help the user organize his thoughts.

Comments: The output does not show all of the checks that were made in the design phase. Also, it is difficult to distinguish between beams and columns because all of the data is listed as an "element". The analysis output, however, is very detailed and easy to read.

Cost: $2,595

Enercalc
FastFrame

User inputs into Lotus 1-2-3 the geometry of the frame, loading, and preliminary member sizes.

The program then takes that data and constructs a two-dimensional frame as a model for the rest of the building using the ASD Specification. Then it analyzes displacements and reactions. It then checks all members based on different load combinations and recalculates to determine the least weight design. The output is both tabular and has graphics. It includes all of the members, axial loads, shear and moment, as well as displacements of the nodes and deflections of the beams.

Comments: The graphical output is extremely simplistic and requires massive massaging. It calls all members "beams", including columns, which is very confusing. The definitions used in the tabular output take some getting used to, and until the user becomes familiar with the program, s/he will not be able to fully interpret the output. This is a simple program, but is adequate for small jobs.

Cost: $295 (plus $200 for Lotus 1-2-3 if user doesn't already have it)

RISA
RISA 2D

User inputs the geometry of the frame, loading, and preliminary member sizes.

The two-dimensional program analyzes the frame and designs the members using the ASD Specification. The program analyzes displacements and reactions and checks the design for four different load combinations. The final design includes five alternatives for each member, which gives in-

A I S C - O U T P U T S U M M A R Y

ELEM NO	SHAPE	CODE COMB	Fy	fa / Fa	fbx / Fbx	fby / Fby	STRESS RATIO	GOVN CRIT
			K /In ^2	Lb/In ^2	Lb/In ^2	Lb/In ^2		
1	W10x17		36000.00	71.39	15629.22	7349.32	0.93	H2-1
		1		21600.00	23760.00	27000.00		
1	W12x16		36000.00	69.24	14878.02	18826.37	0.99	H2-1
		2		28800.00	31680.00	36000.00		
1	W14x22		36000.00	54.89	8730.81	4672.07	0.54	H2-1
		1		21600.00	23760.00	27000.00		
2	W10x49		36000.00	5.80	20429.66	1861.20	0.93	H2-1
		1		21600.00	23760.00	27000.00		
2	W12x45		36000.00	6.32	19198.95	2806.82	0.91	H2-1
		1		21600.00	23760.00	27000.00		
2	W14x43		36000.00	6.62	17790.42	3080.05	0.86	H2-1
		1		21600.00	23760.00	27000.00		
3	W10x26		36000.00	58.59	23485.97	72.76	0.99	H2-1
		1		21600.00	23760.00	27000.00		
3	W12x26		36000.00	58.28	19618.52	66.63	0.83	H2-1
		1		21600.00	23760.00	27000.00		
3	W14x22		36000.00	68.70	22595.13	127.07	0.96	H2-1
		1		21600.00	23760.00	27000.00		

Final tabular output from ECOM's Beam/Column Design module creased flexibility to the designer. The output is both tabular and has graphics.

Comments: The graphical output includes member deflections and a loading diagram, which are nice touches. The tabular output is extremely easy to read—clear and concise.

Cost: $495

Structural Analysis, Inc. SAI PLANESTL

User inputs the geometry of the frame, loading, and preliminary member sizes.

The two-dimensional program analyzes the frame and designs the members using the ASD Specification. Design options include choosing the lightest W section or reporting the suitability of the input member. The program analyzes displacements and reactions and checks the design for up to 10 different load combinations. The program does not check the weak axis strength of columns; a separate column program would have to be run to do this. The output is both tabular and has graphics.

Comments: It seems as if a fair amount of hand work must be done before inputting the data. The graphics are very simplistic and not particularly helpful. The tabular output, however, does seem complete and easy to read.

Cost: $360

Connection Design

Design Data SDS/2

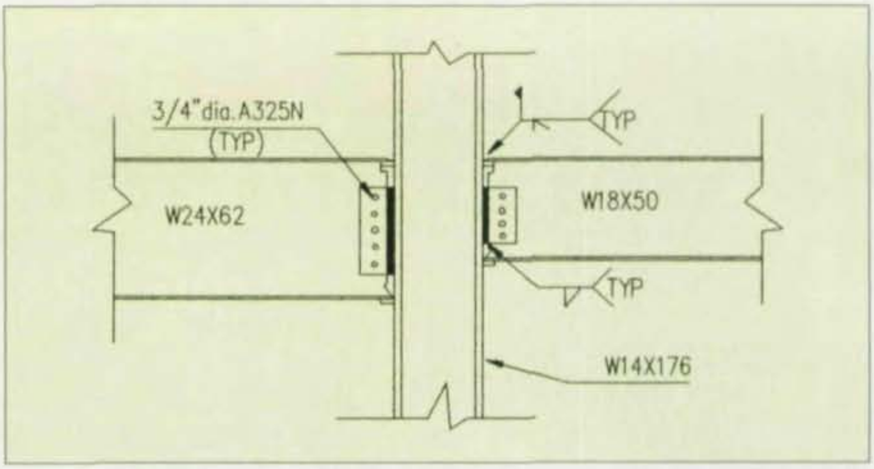
User inputs the member and the reaction, as well as picking the type of connection such as end plate shear connection or standard clip angle. The members and reactions can either be input three-dimensionally as is done in Design Data's frame analysis program or automatically generated from the database that exists from the frame analysis program.

The program designs the connection, including all required bolts and welds. It gives plate dimensions and coping, if required. Limit states are checked as per the ASD Specification. Capacity of the connection is compared to the reaction.

Comments: This is a good program and the text output is very clear and well organized. Again, the graphics are extensive and professional. The allowable load for each limit state is given, along with a Specification reference. However, the equations are not included in the output.

Cost: Available upon request

RISA QuickCONNECT



Typical graphical output from RISA's connection program

User inputs the member and the reaction, as well as picking the type of connection. The example problem used a framed beam connection. The program does both shear and moment connections.

The program designs the connection, including all required bolts and welds. It gives connection material dimensions. Strength requirements are checked to the ASD Specification and appropriate equations are shown. Detailing notes also are given.

Comments: The program is very thorough and the output is complete and extremely well organized. Very nice graphics showing the member and connection materials are included.

Cost: $295

Structural Engineers, Inc. CONXPRT

User inputs the members and the reaction, as well as picking the type of connection such as framing angles, shear plate or shear end plate. Shear connections can be done using either the LRFD or ASD Specification. Moment connections can only be done using the ASD Specification.

The program designs the connection, including all required bolts and welds. It gives connection member and coping, if required. Limit states are checked. Capacity of the connection is compared to the reaction.

Comment: The output is very detailed and easy to read. It includes all of the required checks, as well as references to the appropriate Specification. The simple graphic, though of poor quality, is located within the text output, a nice feature. Both the supported as well as the supporting member are checked for strength requirements.

Cost: ASD Module I (Shear Connections)—$400; LRFD Module I (Shear Connections)—$300; ASD Module II (Moment Connections)—$400

SCADA

The SCADA structural engineering software system represents an integrated design-analysis environment. It also includes a closely coupled 3D finite element structural analysis module. The analysis capabilities include: static and dynamic analysis; geometric and material nonlinearities; contact nonlinearities; buckling; and P-Delta analysis. The element library includes truss, beam, thin plate, thick plate, shell, plane stress, plane strain, axisymmetric and solid elements.

Contact: SCADA Software Corp., 12021 Wilshire Blvd., #676, Los Angeles, CA 90025 (310) 576-1540; fax (310) 576-1541.

CBridge

CBridge is a 3D bridge analysis and design program from Syracuse University designed for 386/486 computers. It is a full function, easy-to-use program that generates design, analysis, or rating of curved or straight girder highway and railroad bridges. The rigorous 3D analysis determines all the forces and moments in every member of the structure, precluding the need for approximate distribution factors as used in 2D analyses. This results in increased accuracy for simple and complex geometries— including continuous structures—with no span limitation. Customized live loading accommodates any highway or rail vehicle with up to 30 axles. An AASHTO code check is performed during design sequence.

For more information and a free demo disk, contact: Telos Technologies, Inc., 1201 E. Fayette St., Syracuse, NY 13210 (315) 471-0113.

RAMSTEEL

Ram Analysis' recently released RAMSTEEL Version 3.0 offers several new features. In addition to composite and non-composite rolled and built-up shapes, the fully integrated floor framing and building design program is now capable of selecting and designating steel joists based on SJI joist designations or user defined tables. Load diagrams may be output, as well as shear, moment and deflection diagrams. The program uses its powerful graphical modeling capabilities to model the entire structure, including beams, columns, slab properties, floor loads, and story data. From this, the distribution of loads, Live Load reductions, and member interactions are automatically determined (per BOCA, SBC, or UBC) and the members optimally sized (per ASD, LRFD, or SJI). A CAD file of each floor framing layout also can be generated.

Contact: Gus Bergsma, Ram Analysis, 55 Independence Circle #201, Chico, CA 95926 (800) 726-7789; fax (916) 895-3544.

ROBOT V6

Metrosoft Inc. has released to the U.S. market Version 1 of ROBOT V6, a structural analysis software package for civil engineers previously available only in Europe. The program allows fast and accurate modelling of structures ranging in size from small 2D frames to large 3D frames with multiple load cases and combinations. Structures with up to 32,500 nodes, 32,500 elements, 32,500 load cases and combinations, 190,000 degrees of freedom, and 1,000 dynamic eigenvalues can be modelled. All data and results can be processed either in text or in full graphic mode. Key features include: menu-driven, CAD-like graphical input; full graphical display of results; high-speed calculations; easy selection of analysis type and method of solution; selection of element properties from standard or user created data bases; design capability according to both the latest U.S. and foreign codes; import/export capability of DXF and HPGL format files; separate selection of unit systems for input and output; load generation; and automatic finite-element mesh generation.

Contact: Metrosoft Inc., 332 Paterson Ave., E. Rutherford, NJ 07073 (201) 438-4915.

LARSA & LTOOLS

Innovative Analysis' LARSA software is an advanced structural and earthquake engineering program consisting of integrated sets of modules for linear and nonlinear static and eigenvalue, response spectra, and time history analysis. L-TOOLS is a new mouse-driven graphical user interface for LARSA. It conforms to Windows guidelines but can run under DOS. All of the geometry and load data can be entered and modified visually. The latest version supports AISC ASD-89, LRFD-86, and the Canadian steel codes.

Contact: Innovative Analysis Inc., 330 West 42nd St., New York, NY 10036 (212) 736-1616.

AutoSTAAD/MAX

Research Engineer's AutoSTADD/MAX software offers model generation, analysis, design, drafting and detailing, all within AutoCAD. Analysis features include 2D/3D static/dynamic/seismic/P-Delta, frame/plate/shell elements, and all loading and support conditions. Extensive load generation capabilities are available, including moving loads, UBC seismic loads, wind loads, and floor loads. Graphics facilities include interactive model generation and elaborate verification capabilities, such as plotting of structure geometry, deflected shapes, bending moment, shear force diagrams, and stress contours. Structural drafting capabilities include generation of framing plans/sections/elevations, foundation plans, and structural details.

For more information, contact: John Putnam, Research Engineers, 1570 N. Batavia, Orange, CA 92667 (714) 974-2500; fax (714) 974-4771.

RISA-2D

RISA Technologies' RISA-2D program provides a fast, truly interactive environment for the solution of a wide range of structural design problems. The program can easily handle the design of elements such as frames, trusses, shear walls, and continuous beams. Static, dynamic, and P-Delta capabilities are included, with full steel design (including member selection). Powerful data generation functions combine with spreadsheet editing and extensive graphics to simplify learning and using the program.

Contact: RISA Technologies, 26212 Dimension Dr., Suite 200, Lake Forest, CA 92630 (714) 951-5815; fax (714) 951-5848.

Bridge Programs

Opti-Mate is marketing two bridge design programs. DESCUS-I is a design and analysis program for curved girder bridge systems. The newly updated Version 4.0 enables the user to specify concentrated loads and segmented uniform loads in any of three stages: dead load; superimposed dead load; and live load. The latest version of Merlin Dash offers powerful elastic support and support settlement options that can handle: beams with fixed or flexible ends for bridges integral with abutments; elastic rotational and translational springs for bridges with integral piers; beam type structures on flexible bents using spring constants; and analysis of continuous structures for user defined settlements.

Contact: Opti-Mate, Inc., P.O. Box 9097, Dept. MS, Bethlehem, PA 18018 (215) 867-4077.

QUICKSPAN

Northridge Engineering Software's QUICKSPAN program analyzes continuous beams up to 10 spans with or without cantilevers and with or without fixed ends. Supports can be pinned or modeled with columns above or below the span. The program will analyze any combination of point load, uniform, and partially or triangular distributed loads. Loads can be separated into dead and live loads, with live loads automatically patterned for determining maximum forces.

Contact: Northridge Engineering Software, Inc., P.O. Box 2014, El Segundo, CA 90245 (800) 637-1677.

Master\Soft

Master\soft has introduced SELAS (single equal leg angle strut), a powerful design program that will eliminate the need for tedious compression member calculations. The program works with both ASD and LRFD.

For more information, contact: Master\Soft, P.O. Box 579, Camp Hill, PA 17001 (717) 763-5772.

Structural Package

Structural Analysis, Inc. (SAI) has introduced a new Mini Power-Structure structural engineering software package. The package contains 49 programs (seven analysis, 16 design, three graphics, and 23 "talk" modules) for use on small to medium jobs. These programs simultaneously analyze and design beams and columns in a variety of materials, as well as analyze trusses and calculate wind and seismic loadings in accordance with the latest codes and Specifications. The $275 package runs on IBM-PC/XT/AT and compatibles. Also available is SAI Draw, a powerful new set of AutoLISP programs that work within AutoCAD to automatically draw and dimension structural beams, columns, footings and walls.

For more information and a free trial program, contact: J. Jeff Davies, Structural Analysis Inc., 555 S. Federal Highway, Suite 210, Boca Raton, FL 33432 (407) 394-4257; fax (407) 391-8614.

Steel Designer

Graphic Magic has introduced Steel Designer, a new addition to its line of structural tools for Macintosh computers. Steel Designer works with Multiframe 3D to automate the process of code checking and design optimization. A structure is modeled and analyzed using Multiframe. The results are then read directly by Steel Designer and checked against the current ASD and AIJ Specifications. Future releases will check against LRFD and Canadian, British and Eurocode codes. The user has control of all aspects of the design process and what clauses are checked, what effective lengths are used, steel grade, and maximum/minimum size.

For information, or to receive a $25 working demo, contact: Graphic Magic, 2-1645 East Cliff Dr., Suite 6, Santa Cruz, CA 95062 (408) 464-1949; fax (408) 464-0731.

Steel Joist Institute

The Steel Joist Institute has created a new computer program to assist structural engineers in determining the probable vibration characteristics of floor systems using open web steel joists. This program is designed for use in conjunction with the Steel Joist Institute's Technical Digest #5, "Vibration of Steel Joist-Concrete Slab Floors."

Contact: SJI, Suite A, 1205 48th Ave. North, Myrtle Beach, SC 29577 (803) 449-0487.

SAP90 & ETABS

Computers and Structures, Inc. has released the latest versions of SAP90 and ETABS. SAP90 Version 5.4, a 3D static and dynamic element analysis program for structures, offers an option for LRFD, in addition to ASD. Sway and non-sway load conditions are differentiated and their moments separately magnified. Also, all frames may be categorized as either moment resisting or braced frames. ETABS Systems Version 5.4 is a series of large capacity programs specifically developed for 3D analysis and design of building structures. ETABS can analyze moment frame, braced frame or shear wall buildings, or combinations of these. Dead, live, wind, static seismic and/or dynamic earthquake load analysis—including time history—all are possible. TIMER, an interactive time history display postprocessor, generates time history traces of displacements, velocities, and accelerations, as well as element forces. STEEL V5.4, a design post-processor program for ETABS, now supports LRFD and ASD.

Contact: Computers and Structures, Inc., 1995 University Ave., Berkeley, CA 94704 (415) 845-2177; fax (415) 845-4096.

Supplier's List

Computers and Structures, Inc., 1995 University Ave., Berkeley, CA 94704 (415) 845-2177; fax (415) 845-4096.

Daystar Software, 8120 Northwest Hillside, Kansas City, MO 64152 (816) 741-4310.

Design Data, 1033 "O" St., Suite 324, Lincoln, NE 68508 (402) 476-8278; (402) 476-8354.

ECOM Associates, Inc., 8324 N. Steven Road, Milwaukee, WI 53223 (414) 365-2100; fax (414) 365-2110.

Enercalc Engineering Software, 3070 Bristol St., Suite 420, Costa Mesa, CA (714) 557-9868.

Graphic Magic, 2-1645 East Cliff Dr., Suite 6, Santa Cruz, CA 95062 (408) 464-1949; fax (408) 464-0731.

HESCO, P.O. Box 30345, Kansas City, MO 64112

James J. Jordan Sr., 5236 Overbrook Way, Sacramento, CA 95841 (916) 332-6610

LARSA, Innovative Analysis Inc., 330 West 42nd St., New York, NY 10036 (212) 736-1616.

Master\soft, P.O. Box 579, Camp Hill, PA 17001 (717) 763-5772

Metrosoft Inc., 332 Paterson Ave., E. Rutherford, NJ 07073 (201) 438-4915.

Northridge Engineering Software, Inc., P.O. Box 2014, El Segundo, CA 90245 (800) 637-1677.

Opti-Mate, Inc., P.O. Box 9097, Dept. MS, Bethlehem, PA 18018 (215) 867-4077.

RISA Technologies, 26212 Dimension Dr., Suite 200, Lake Forest, CA 92630 (714) 951-5815; fax (714) 951-5848.

Ram Analysis, 55 Independence Circle #201, Chico, CA 95926 (800) 726-7789; fax (916) 895-3544.

Research Engineers, 1570 N. Batavia, Orange, CA 92667 (714) 974-2500; fax (714) 974-4771.

SCADA Software Corp., 12021 Wilshire Blvd., #676, Los Angeles, CA 90025 (310) 576-1540; fax (310) 576-1541.

Steel Joist Institute, Suite A, 1205 48th Ave. North, Myrtle Beach, SC 29577 (803) 449-0487.

Structural Analysis Inc., 555 S. Federal Highway, Suite 210, Boca Raton, FL 33432 (407) 394-4257; fax (407) 391-8614.

Structural Engineers, Inc., 537 Wisteria Dr., Radford, VA 24141.

Telos Technologies, Inc., 1201 E. Fayette St., Syracuse, NY 13210 (315) 471-0113.

STEEL MARKETPLACE

Advertiser's Index

Deck Fastening
Anytime, Anywhere.

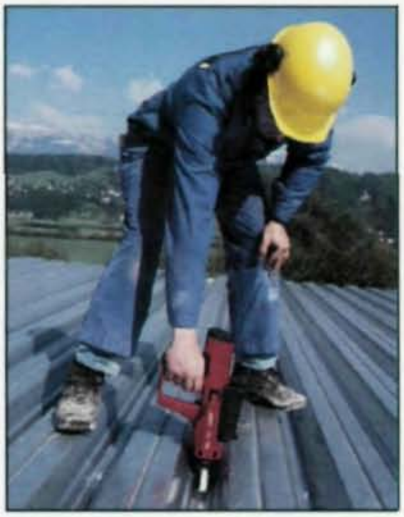
Incorporating new innovative technology, Hilti's DX750 Powder Actuated Fastening System is designed to fasten metal deck to structural steel and bar joist on just about any type of project...large or small, complex or routine.

Engineers for North Dakota's FARGODOME were faced with design and installation challenges due to severe weather conditions when specifying its deck fastening system. Planned as a multi-purpose entertainment and convention facility, the $50 million, 470,000 square foot building stands 125 feet tall with nearly 220,000 square feet of roofing.

"Because the dome's architectural design involves a long, sloping roof of metal decking, welding would have been extremely difficult," said Project Engineer Jack Petersen of Martin/Martin Consulting Engineers of Wheat Ridge, Colorado. "The versatility of Hilti's DX750 made it an ideal choice for the decking application."

Unlike welding, the DX750 system worked well despite cold and wet weather. Using a self-contained power source and a magazine clip of ten fasteners, the DX750 produced fastenings superior to those of a 5/8 inch puddle weld. It eliminated the problem of burn through and was used on coated deck with no retouching needed -- thus reducing labor costs.

Jim Minkkinen, Project Manager for the steel erection and roof deck subcontractor Danny's Construction Company Inc. of Shakopee, Minnesota said, "Given Hilti's



reputation in the industry, I knew we would receive the technical assistance necessary to complete the job. I believe using the DX750 has improved the productivity of our decking crew by at least 50 percent on this project. I'd like to see more structural engineers specify powder-actuated fastenings. It's definitely the best option when installing decking."

If the DX750 can tackle the unique challenges of the FARGODOME, just think what it could do on your next project. It will fasten virtually any deck, anytime, anywhere.

For your copy of the DX750 Specification Kit, including approval, design and technical data, plus success stories from other construction professionals, ask for Hilti's "Deck Tech" at **1-800-879-8000**.

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FARGODOME Engineers Specify the DX750

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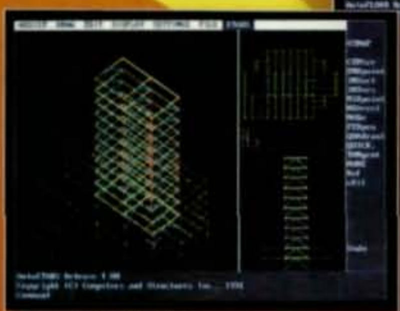
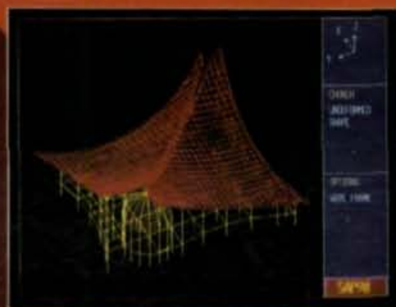
INTEGRATED ANALYSIS & DESIGN SOFTWARE FOR STEEL STRUCTURES

By: Ashraf Habibullah & Edward L. Wilson

Composite Floor Design

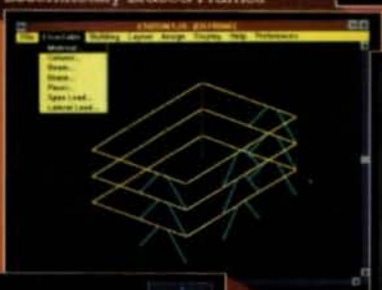


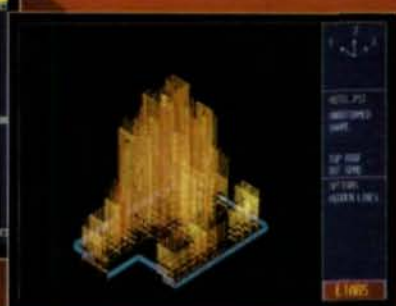
Integrated with CAD



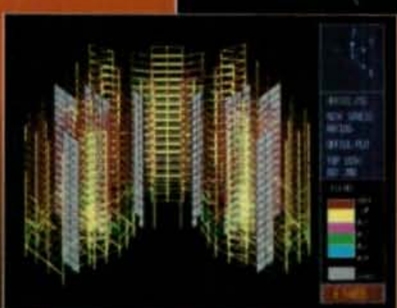
Complex Space Trusses

Eccentrically Braced Frames





Highrise Moment Frames



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For more information:

Computers & Structures, Inc.
1995 University Avenue
Berkeley, California 94704

TEL: (510)845-2177
FAX: (510)845-4096