MODERN STEEL CONSTRUCTION

February 1992

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Special Report: How Design Engineers Can Cut Fabrication Costs

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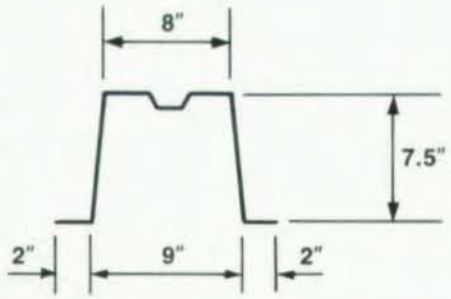
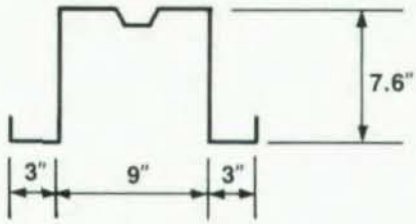


16 GAGE FORM DECK — USED TO BUILD A PIER WITH AN 18" SLAB.



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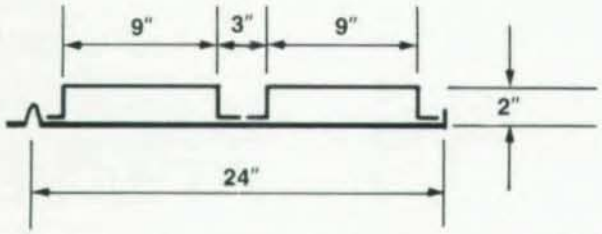
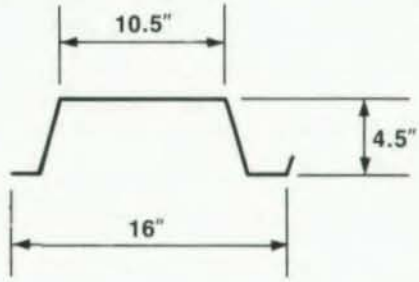


12 GAGE TOP AND 16 GAGE BOTTOM CELLULAR DECK USED TO SPAN BETWEEN BOTTOM BEAM FLANGES IN A POWERPLANT. VERY THICK SLAB — FLAT UNDERSIDE LEFT EXPOSED.



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MODERN STEEL CONSTRUCTION

Volume 32, Number 2 February 1992

A Special Report beginning on page 12 in this month's issue offers suggestions on how structural engineers can reduce the overall cost of a steel building by creating an initial design that minimizes fabrication costs.

FEATURES

SPECIAL REPORT:
How Design Engineers Can Cut Fabrication Costs

NEWS AND DEPARTMENTS

Modern Steel Construction (Volume 32, Number 2). Published monthly by the American Institute of Steel Construction, Inc. (AISC), One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

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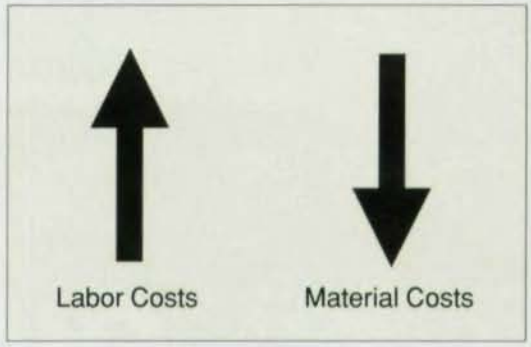
Cutting Costs

As steel material costs continue to tumble, engineers are discovering they need to change their design approach to create economical structures.

In the past, most efforts concentrated on steel weight reduction as the most effective means of lowering frame costs, with little or no regard to the effect this had on shop costs. But as the price of steel has declined and the cost of labor has increased, the situation has reversed. For example, designers are finding that it often pays to slightly increase member size if it means that a stiffener can be eliminated.



In his article beginning on page 12, Bill Thornton, Ph.D., P.E., chief engineer with AISC-member Cives Steel Co., discusses how the careful selection of connections can reduce the fabrication and erection costs on many steel construction projects. He makes the point that the use of a more efficient connection can yield substantial savings—in the magnitude of more than $50,000 on a 40-story building with eight bracing connections per story. Likewise, eliminating stiffeners and doublers can save as much as $180 per connection. By reducing the number of stiffeners and doublers on a recent 30-story building from 4,500 locations to just a few dozen, approximately $500,000 was saved.

Following Thornton's article is a compendium of 35 tips by David Ricker, P.E., the retired vice president of engineering for The Berlin Steel Construction Co., Inc., on value engineering for design engineers. Ricker deals with a variety of topics, from the selection of floor beams to the design of welded and bolted connections.

Rounding out this special report on reducing fabrication costs is a compilation of suggestions from seven experienced engineers and fabricators. In speaking with fabricators, the one item that comes up over-and-over again is that fillet or partial penetration welds should be used instead of full-penetration welds whenever practical. Included on page 28 is a chart showing the cost difference between a partial and full-penetration weld.

If any engineer, fabricator or erector has anything to add to this list, send it to me, along with supporting documentation showing alternate methods and costs. **SM**

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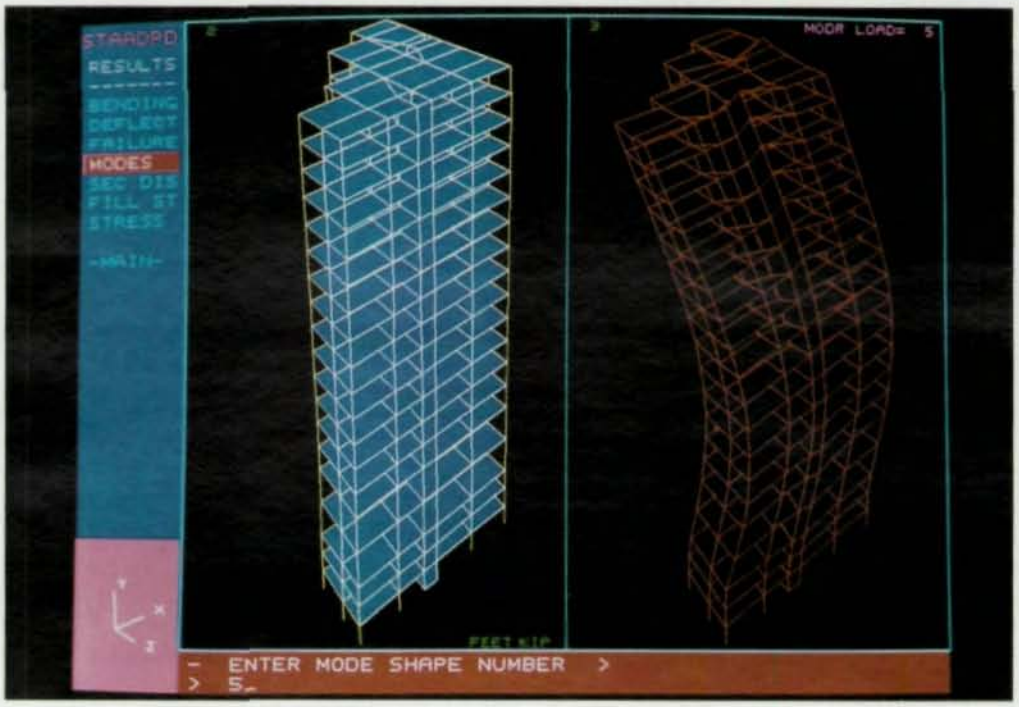

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Correspondence

Dear Editor:

Your recent article (November 1991) on LRFD clearly demonstrates its ability to save structural steel. LRFD savings appears to be approximately 1 to 1.5 lbs./sq. ft. or about $1/sq. ft. This is small as compared to $25 to $30/sq. ft. tenant improvement cost which have a life of only 10 to 15 years.

The deflection criteria [used in the article] was established when buildings used thick regular weight concrete floors, column spacings of 20' to 25', and the building had plenty of damping with concrete or masonry exterior walls, floor-to-floor partitions, and concrete fire proofing. Today's 35' to 45' spans, thin light-weight concrete floors, etc., are producing, in my opinion, unsatisfactory buildings. I suggest AISC and other engineers review the allowable DL and TL floor deflection criteria and bring it in line with today's materials and spans.

This office uses a DL and LL deflection criteria of L/360 up to ¾" maximum deflection, regardless of span. The initial DL deflections presented in Table 2 in Culp and Mather's article were so large that, in my opinion, beam camber would not be a practical solution to correct the initial deflections greater than 1½". I recommend using a minimum floor beam live load of 100 lbs./sq. ft. Girder LL can be reduced to the minimum allowed by Code and checked for deflection. I believe the old standard "rule of thumb" minimum beam size of ½" of beam depth per ft. of span is still appropriate, especially with long span beams.

The above criteria costs more than some of the designs currently used. The cost per sq. ft. is nominal and generally results in flatter, stronger and vibration-free floors. This office considers that it's a good building investment, especially if the tenant is a doctor or lawyer who wants to install a radiology film file system or a law library.

I'd appreciate a response from other offices regarding their design criteria.

Alvin Geller, S.E.
Alvin Geller Associates
Los Angeles

New Literature

The American Welding Society has published the latest revision of its *Structural Welding Code-Steel* (ANSI/AWS D1.1-92) The newly updated code is essential for engineers, erectors and fabricators working with statically or dynamically loaded steel structures and tubular structures.

It includes detailed welding requirements, allowable unit stresses, structural details, workmanship, inspection procedures, and acceptance criteria. It also incorporates extensive clarification of the Code features.

Significant revisions include several major Code changes, as well as various new requirements. As an example, alternative methods to ultrasonically inspect groove welds are presented. Also, new box tube design roles for both ASD and LRFD, new notch toughness criteria for heavy tubular sections, and a new revised appendix E—Form For Welding Procedure Specification.

The Code also features nine new tables, 20 new figures, 10 revised tables, and seven revised figures.

To purchase a copy of the $120, 435-page Code, contact: American Welding Society, Order Department, P.O. Box 351040, Miami, FL 33135 (800) 334-9353.

STEEL CALENDAR

February 5-6. **SSPC tutorial on lead paint removal** in Houston. Contact: Rose Mary Surgent, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 (412) 268-2980.

February 9-12. **National Association of County Engineers**, Frankenmuth, MI. Annual meeting, management and technical conference, and trade show. Contact: NACE, 440 First St., N.W., Washington, DC 20001 (202) 393-5041.

February 18-19. **SSPC tutorial on lead paint removal** in Louisville, KY. Contact: Rose Mary Surgent, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 (412) 268-2980.

February 20-21. **SSPC tutorial on lead paint removal** in Atlanta. Contact: Rose Mary Surgent, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 (412) 268-2980.

March 3. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Atlanta. 45 minute description of changes since the issuance of the 1985 High-Strength Bolt Spec. Also includes a review of installation methods for high-strength A325 and A490 bolts.

March 11-12. **SSPC tutorial on lead paint removal** in Minneapolis. Contact: Rose Mary Surgent, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 (412) 268-2980.

March 12. **Northeast Steel Bridge Forum**, Boston. Contact: Camille Rubeiz, Steel Bridge Forum, c/o AISI, 1101 17th St., N.W., Suite 1300, Washington, DC 20036 (202) 452-7190.

March 18. **Earthquake Design** (breakfast meeting), St. Louis. Sponsored by AISC Regional Advisory Missouri/Southern Illinois Committee. Contact: Phil Stupp, Stupp Bros. Bridge & Iron Co., 3800 Webber Road, St. Louis, MO 63125 (314) 638-5000.

March 24. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Greenville, SC. Will include design criteria, Type 2 Connections, tube-to-tube connections, design guides, practical recommendations and application examples.

March 24-26. **American Welding Society Show and Exposition**, Chicago. Contact: AWS, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, FL 33135 (800) 443-9353.

March 25. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Columbia, SC (see March 24 listing).

March 26. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Charlotte, NC (see March 24 listing).

March 27. **Tubular Sections in Building Construction** (co-sponsored by AISC and VCSSFA) breakfast meeting in Greensboro, NC (see March 24 listing).

March 31. **Bolting Update** (co-sponsored by AISC and SASF) breakfast meeting in Jacksonville, FL (see March 3 listing).

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

NSCC Scheduled For June 3-5

More than 45 seminars and meetings are scheduled for this year's National Steel Construction Conference in Las Vegas from June 3-5. Also, more than 100 exhibitors will showcase products for the design, fabrication and construction community.

Sessions focus on the specific needs of structural steel fabricators, engineers, architects, contractors, owners, public officials, erectors, detailers, researchers and educators. Topics include: codes and specifications; computerized design; research; project and shop management; inspection and safety; and fabrication and erection procedures. Workshop sessions get down to basics: the nuts-and-bolts details of designing, fabricating and erecting steel structures.

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

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Fabricator: Seibel Modern Manufacturing and Welding Co., Lancaster, NY
General Contractor: J. H. Maloy, Inc., Albany, NY
Outlet Road Bridge: (right)
Owners: Saratoga County, State of New York
Fabricator: Seibel Modern Manufacturing and Welding Co., Lancaster, NY
General Contractor: Schultz Construction Inc., Round Lake, NY
Consulting Engineer: Greenman-Pedersen Inc., Albany, NY
Inverset Licensee: The Fort Miller Company, Inc., Schuylerville, NY
Weathering Steel Supplier: Bethlehem Steel Corporation, Bethlehem, PA

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SPECIAL REPORT

Careful selection of connections can substantially reduce the fabrication and erection costs on many steel construction projects

Designing For Cost Efficient Fabrication

By W.A. Thornton, Ph.D., P.E.

Especially in today's climate of reduced construction activity, it is important to do everything possible to reduce costs. Through the careful design of structural connections, fabrication and erection costs can be reduced.

Bracing Connections

Bracing connections constitute an area in which there has been much disagreement concerning a proper method for design. Research conducted during the past decade is just now being distilled into a consistent method of designing connections based on equilibrium models for the gusset, beam, and column that require that yield not be exceeded globally on any gusset edge or section, and also on any section in the column or beam.

While there are many possible equilibrium models, three are presented here and then applied to the design of a connection to determine their cost-effectiveness.

- **Model 1.** This is the most common and simplest of all equilibrium models. The force distribution on the gusset, beam, and column are shown in Figure 1. As with all equilibrium models, this model guarantees that the gusset, beam, and column are in equilibrium under the brace load P. If the work point coincides with the gravity axes of the members, equilibrium is achieved with no connection induced couples in the beam, column, or brace. Model 1 has been referred to sarcastically as the "KISS" method (Keep It Simple, Stupid).
- **Model 2 (AISC Model).** This model is one of several adopted by AISC based on the research during the past decade. The force distributions for the gusset, beam, and column are shown in Figures 2 and 3, and

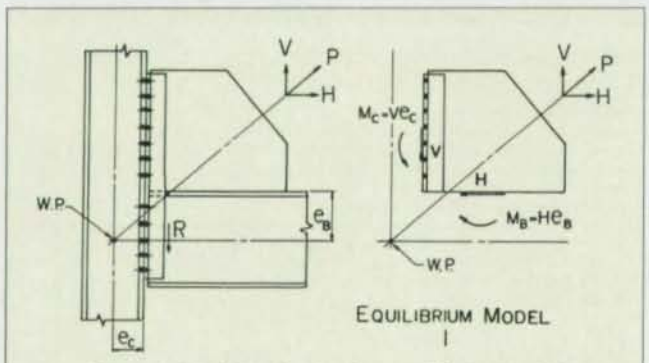


Figure 1: Model 1, the simplest equilibrium model

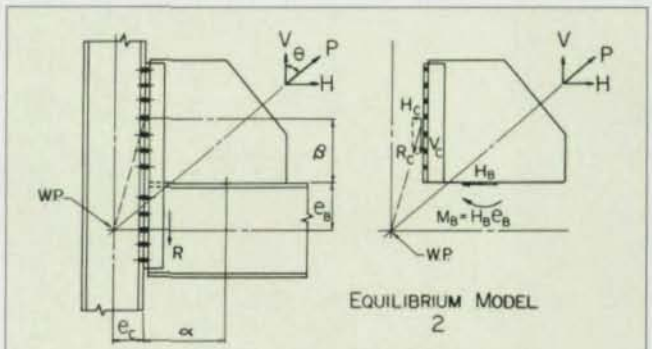


Figure 2: Model 2, one of several AISC Models

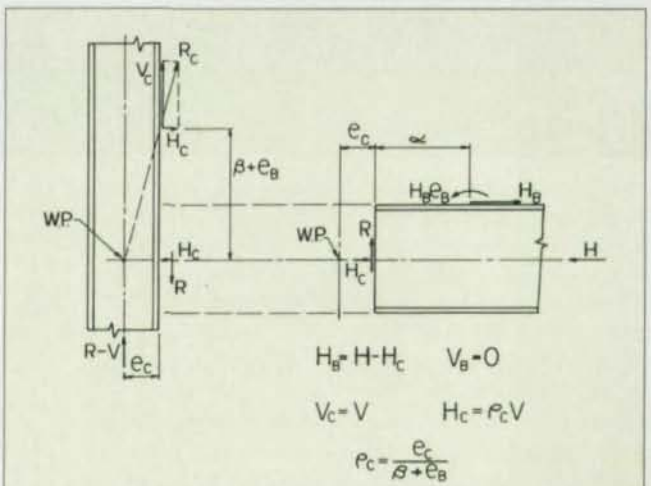


Figure 3: Force Distributions for Model 2

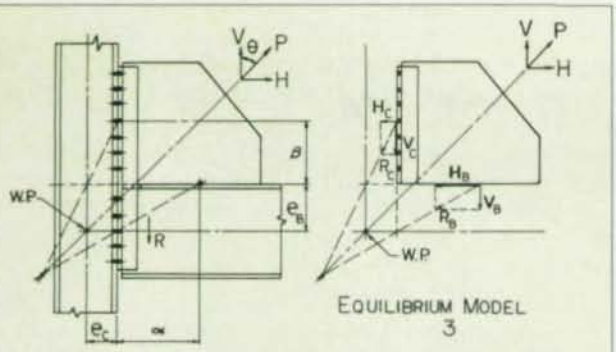


Figure 4: Model 3, an equilibrium model with no couples

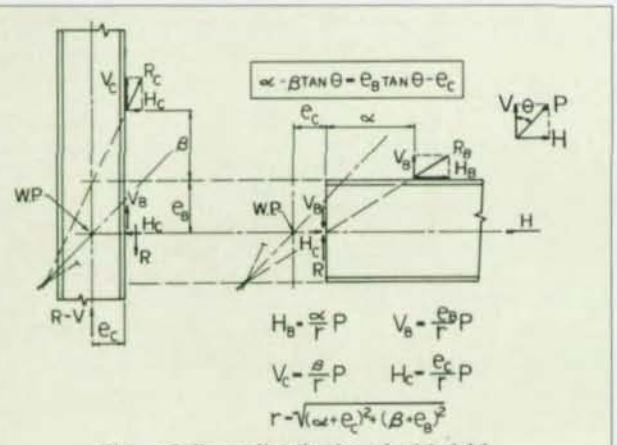


Figure 5: Force distributions for Model 3

as with Model 1, these force distributions guarantee that the gusset, beam, and column are in equilibrium under the brace load P. If the work point coincides with the member gravity axes, equilibrium is achieved with no connection induced couples in the beam, column, or brace. Model 2 is a little more complex for calculations than Model 1, but it yields less expensive designs.

- **Model 3.** This model is the result of the author's search for an equilibrium model for bracing connections that achieves equilibrium for all components of the connection with linear forces only, i.e., no couples. It is the most efficient—it yields the least expensive designs—of the three models presented here but is also the most complex in terms of calculations required. Note, however, that this is not a serious problem because a computer program makes the calculation aspect of all three models of little importance. The force distributions for the gusset, beam, and column of Model 3 are given in Figures 4 and 5.

The beam shear R in Figures 4 and 5 is shown applied to the beam-to-column connection, If the shear is large, it may be desirable to distribute it to the gusset-to-column connection as well. In this case the gusset serves as a haunch and the gusset-to-beam forces must be adjusted to effect the desired distribution of R.

Figure 6 provides an example. The column is a W14x605, the beam a W18x106, and the brace a W12x65 with 450 kips.

Figures 7, 8, and 9 give the completed designs for

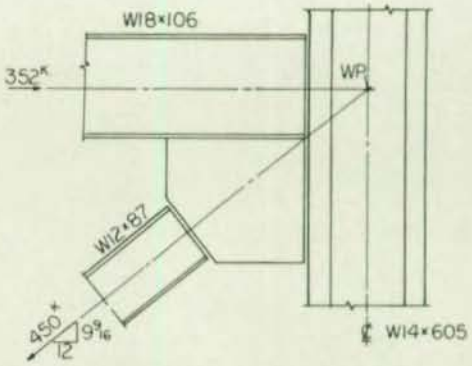


Figure 6: Data for illustrative example connection

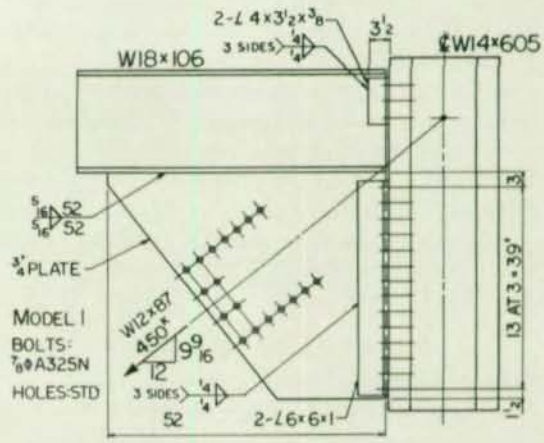


Figure 7: Solution to example connection using Model 1

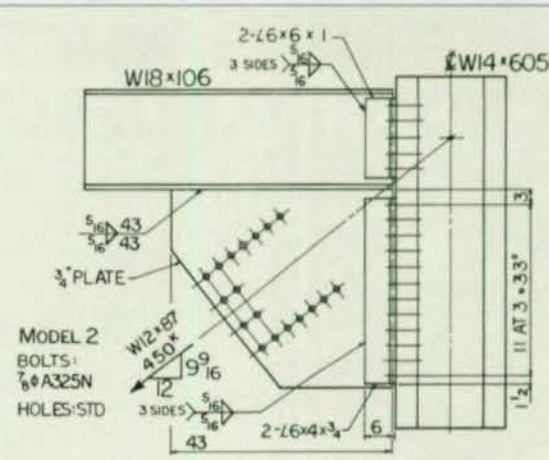


Figure 8: Solution to example connection using Model 2

Models 1, 2, and 3, respectively. A cost comparison shows that Model 3 gives the most economical design, while Model 1, the "KISS" method, gives a design that costs approximately 28-30% more and Model 2 gives a design that costs approximately 13% more. Using a lighter column section, a W18x119, to assess the effect of drilling the heavy flange of the W14x605 reveals similar results.

To see the effect on a project of using Model 1

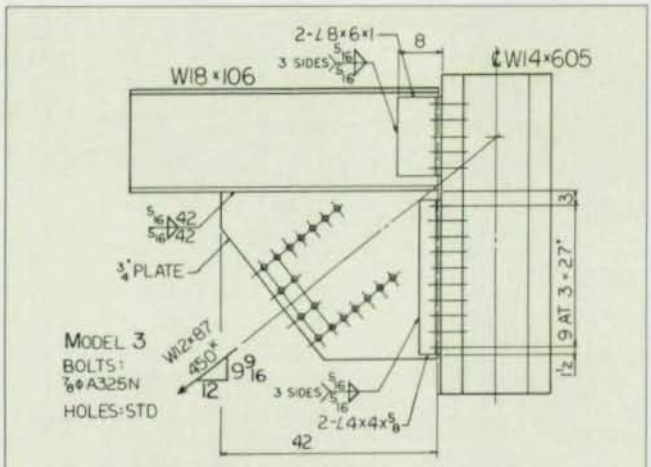


Figure 9: Solution to example connection using Model 3

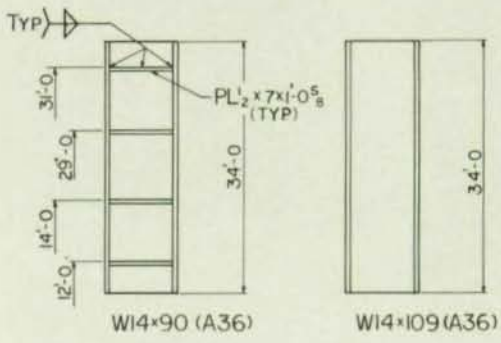
rather than Model 3, consider a 40-story building with eight bracing connections per story. If all these connections were similar to those shown in Figure 6, the cost of using Model 1 rather than Model 3 would be **(840-658) x 8 x 40 = $58,240**. This is assuming one bay of bracing on each of the four faces. If two bays per face were used, the extra cost of Model 1 would be about $116,000.

Moment Connections

Columns, when part of an unbraced frame, are designed for bending moment as well as axial force. The designer uses a rigid frame analysis computer program, which also possibly does a code check using the beam column interaction equations or he performs the latter operation manually. What the designer generally does not consider in his column design is the "panel zone" between the column and the transverse framing beams and this can be a costly oversight.

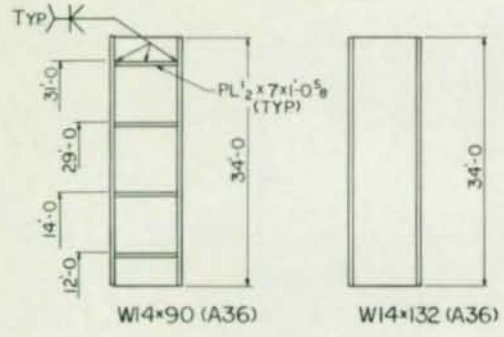
Figure 10 shows a W14x90 column 34'-long with fillet welded stiffeners and a same cost W14x109 with no stiffeners. However, if a W14x99 column will work, a

Figure 10: Same cost stiffened and unstiffened column
No transverse beams



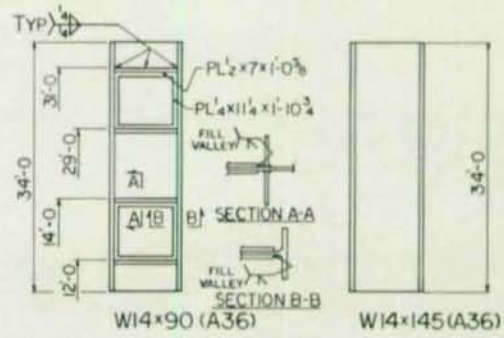
One pair stiffeners = 200 lbs. steel
(Fillet welds)

Figure 11: Same cost stiffened and unstiffened columns
No transverse beams



One pair stiffeners = 400 lbs. steel
(Full penetration welds)

Figure 12: Rules of thumb: same cost columns
no transverse beams



4 doubler plates + 4 pairs of stiffeners = 1900 lbs steel
(Fillet welds)

less expensive job will result. The W14x109 also may be less expensive if extra erection costs associated with beams framing to the weak axis of the W14x90 due to the stiffeners are considered. Figure 11 shows the same W14x90 column as Figure 10, but here the designer has specified full penetration groove welds of the stiffeners to the column. This doubles the cost of the stiffeners and means that an unstiffened W14x132 will cost about the same as the stiffened W14x90. Now, looking at the sections between W14x90 and W14x132, we see that we have available a W14x99, a W14x109, and a W14x120, all of which will yield a less expensive design if they satisfy the beam column design equations.

Figure 12 shows the "fabricators nightmare" of stiffeners and doublers. A clean W14x145 costs no more than the stiffened and doubled W14x90, and all of the W14 Sections in between will give less expensive designs if they satisfy the beam-column equations.

For the convenience of designers, Figure 13 gives the cost in lbs. of steel, as well as the cost of column splices. Column weights can be increased by approximately the amounts shown here without increasing costs because, as previously mentioned, the stiffeners

Figure 13:

Rules Of Thumb

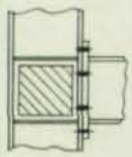
One Pair Stiffeners = 200 lbs steel (fillet welded)

One Pair Stiffeners = 400 lbs steel (full penetration welded)

One Pair Doubler Plates = 550 lbs steel

One Doubler Plate = 280 lbs steel

One Column Splice = 500 lbs steel



4 Stiffeners
2 Doublers
No Weak Axis Beam Connections

Length of column tributary to connection with stiffeners and doublers	Increase in weight per foot with no increase in cost of "clean" column	
	Stiffeners Fillet Welded	Stiffeners Groove Welded
10	95	135
12	79	113
14	68	96
16	59	84
18	53	75
20	48	68

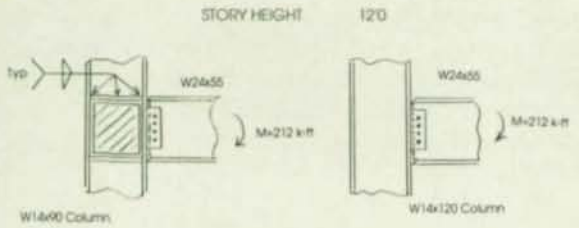
Figure 14: Column Selection Design Aid

and the doublers will tend to increase erection costs. (Note that erection costs are not included in Figures 10 through 13.)

Figure 14 takes a different view. here the connection with the stiffeners and doublers is given per tributary length of column. As an example, Figure 15 presents a W24x55 framing to a column flange. The design moment is M = 212k-ft, which is just slightly less than the full strength moment of the W24x55(A36), which is 226k-ft. The W14x90 column, which is determined to be adequate for M = 212k-ft and the design axial load, requires stiffeners and doublers. The W14x120, which is also adequate for the design moment and axial force, requires no stiffeners or doublers. Since 120 - 90 = 30 lbs, which is less than the 79 lbs from figure 14, the W14x120 is the more economical choice. As Figure 15 shows, $180 is saved per connection. If there were 1,000 similar connections on the job, savings would be approximately $180,000.

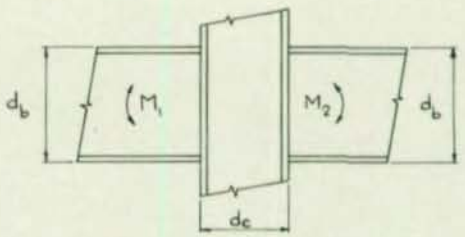
The stiffeners and doublers of the column cost studies previously discussed are the result of requirements for beam-to-column moment connections, especially when full-strength moment connections are specified, as in Figure 16 for doublers. Since stiffeners and doublers can add significant costs to a job, design engineers should not specify full-strength moment

Figure 15: Example of use of column selection design



Since 120 - 90 = 30 lbs. < 79 lbs.,
Saved 79 - 30 = 49 lbs./ft. x $.30/lb. = $15 /ft.
Therefore, per 12' of column, $15 x 12 = $180 saved
Building with 1,000 locations = $180,000 saved

Figure 16: Design for the full strength of the beams



$$t_{wREQD} = \frac{32(M_1 + M_2)}{F_y d_b d_c}$$

$M_1 \& M_2$ FULL STRENGTH MOMENTS

Doubler Plates
Commonly Seen Requirements

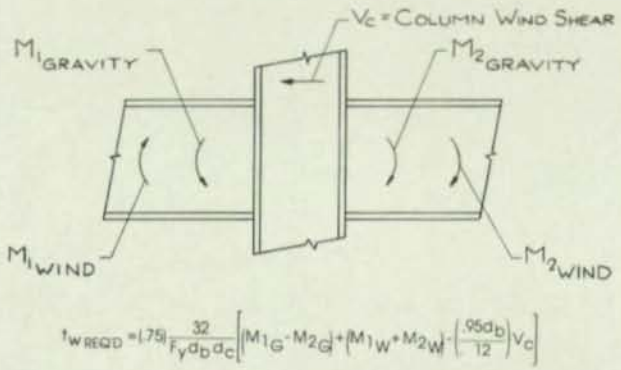
connections unless they are required by loads or codes, e.g., ductile moment resisting frames for high seismic loads.

For wind loads and for conventional moment frames where beams and columns are sized for stiffness (drift control) as much as for strength, full strength moment connections are not required. Even so, many design engineers will specify full strength moment connections, adding to the cost of a structure.

Designing for actual loads has the potential, without any increase in column weight, to drastically reduce the stiffener and doubler requirements. On one recent 30-story building, a change from full moment connections to a design for actual loads combined with using Figure 17 for doublers reduced the number of locations where stiffeners and doublers were required to several dozen from 4,500 locations with an estimated cost savings of approximately $500,000.

Figure 17: Design for the actual loads

Doubler Plates



$$t_{w\,REQD} = (.75)\frac{32}{F_y d_b d_c}\left[(M_{1G} - M_{2G}) + (M_{1W} + M_{2W}) - \left(\frac{.95 d_b}{12}\right)V_c\right]$$

Will often eliminate doubler requirement

Single Angles And UDL

The uniform design load (UDL) is a great crutch of the engineer because it allows him to issue design drawings without putting the beam reactions on the drawings. Instead, often the fabricator is told to design the beam end connections for one-half UDL, or some other percentage to account for composite design, unless greater reactions are shown. Unless concentrated loads are located very near the beam ends, UDL reactions are generally very conservative. Because the reactions are too large, extremely strong connections, such as double framing angles, will often be required.

Single angles, because the bolts are in single shear, will have about half the strength of double clips for the same number of rows of bolts. But if actual reactions are given, it will almost always be found that a single angle connection will work, perhaps with a couple of extra rows of bolts.

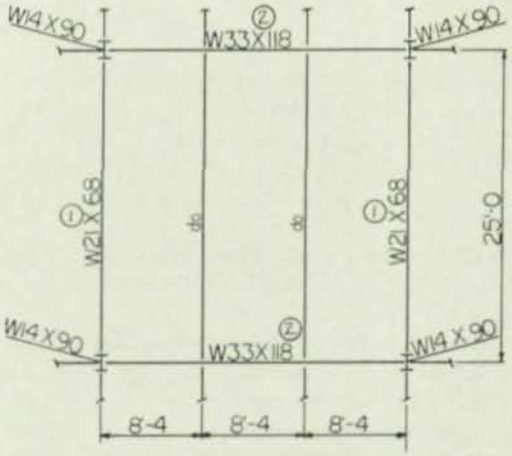
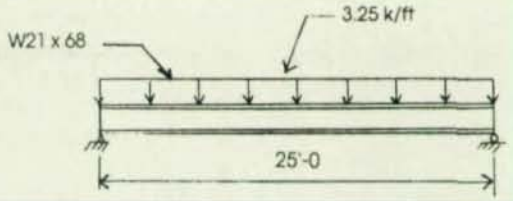


Figure 18: Partial plan of industrial building floor

Figure 19: Comparisons for Beam 1



Beam	Section	Loads			Reactions		Connections					
		Uniform	Conc.	Total	Actual	½ UDL	Double Clips				Single Clip	
		kips/ft.	kips	kips	kips	kips	min. # of rows	CAP (kips)	max # of rows	CAP (kips)	# of rows	CAP (kips)
1	W21x68	3.25	0	82	41	45	4	81	6	116	5	52

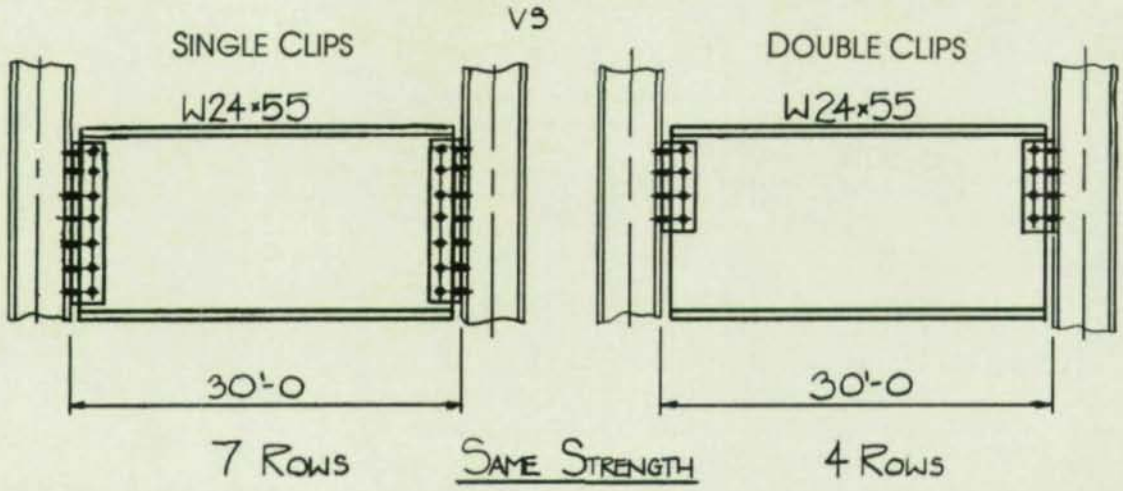
Bolts 7/8∅ A325N, Clips 4 x 3½ x 3/8, Welds ¼" fillet

Figure 18 is part of an industrial building with dead load of 140 psf and live load of 250 psf. Beam 1 of Figure 18 is shown in Figure 19. The total load on Beam 1 is 82 kips and the actual reactions are thus 41 kips. The one-half UDL reaction is 45 kips, which is pretty close. Now look at the connections. The minimum double clip connection on this coped beam has four rows and is good for 81 kips, almost twice the actual reaction. Many designers routinely require "full depth" connections, i.e. six rows. The six row double clip connection is good for 116 kips, almost three times the actual reaction. However, a five row single angle is good for 52 kips, which is okay for the actual and the one-half UDL reactions.

As this example illustrates, single angles will work even in heavy industrial applications, and they are much less expensive than double clips, especially for erection. In Figure 20, the connections for this W24x55 beam have the same strength and have a differential cost of $10 for fabrication. But, including erection, the single angle beam costs approximately $25 less than the double clip beam. For a 30-story building 200' x 200' with 25' bays and 200 beams per floor with tabs, there is a savings of 200 x 30 x 25 = $150,000.

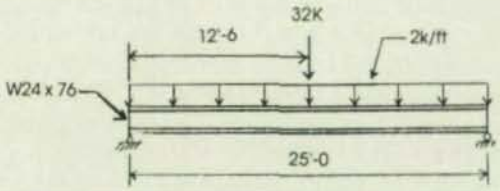
Returning to Figure 18, suppose Beam 1 is subjected to the same load of 82 kips total, but 32 of the 82

Figure 20: Cost of same strength single and double clips



Fabrication - $10 per beam less for single clips; Erection - $15 per beam less for single clips
Total Cost Reduction - $25 per beam using single clips

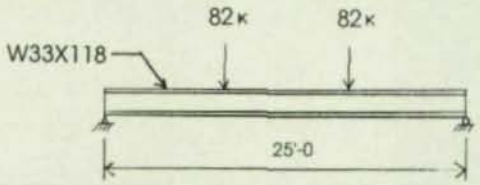
Figure 21: Comparisons for Beam 1 (prime)



Beam	Section	Loads			Reactions		Connections					
		Uniform	Conc.	Total	Actual	½ UDL	Double Clips				Single Clip	
		kips/ft.	kips	kips	kips	kips	min. # of rows	CAP (kips)	max. # of rows	CAP (kips)	# of rows	CAP (kips)
1 (prime)	W24x76	2	32	82	41	56	4	83	7	137	5	52

Bolts 7/8Ø A325N, Clips 4 x 3½ x 3/8, Welds ¼" fillet

Figure 22: Comparisons for Beam 2



Beam	Section	Loads			Reactions		Connections					
		Uniform	Conc.	Total	Actual	½ UDL	Double Clips				Single Clip	
		kips/ft.	kips	kips	kips	kips	min # of rows	CAP (kips)	max. # of rows	CAP (kips)	# of rows	CAP (kips)
2	W33x118	0	82	164	82	114	6	150	9	210	8	92

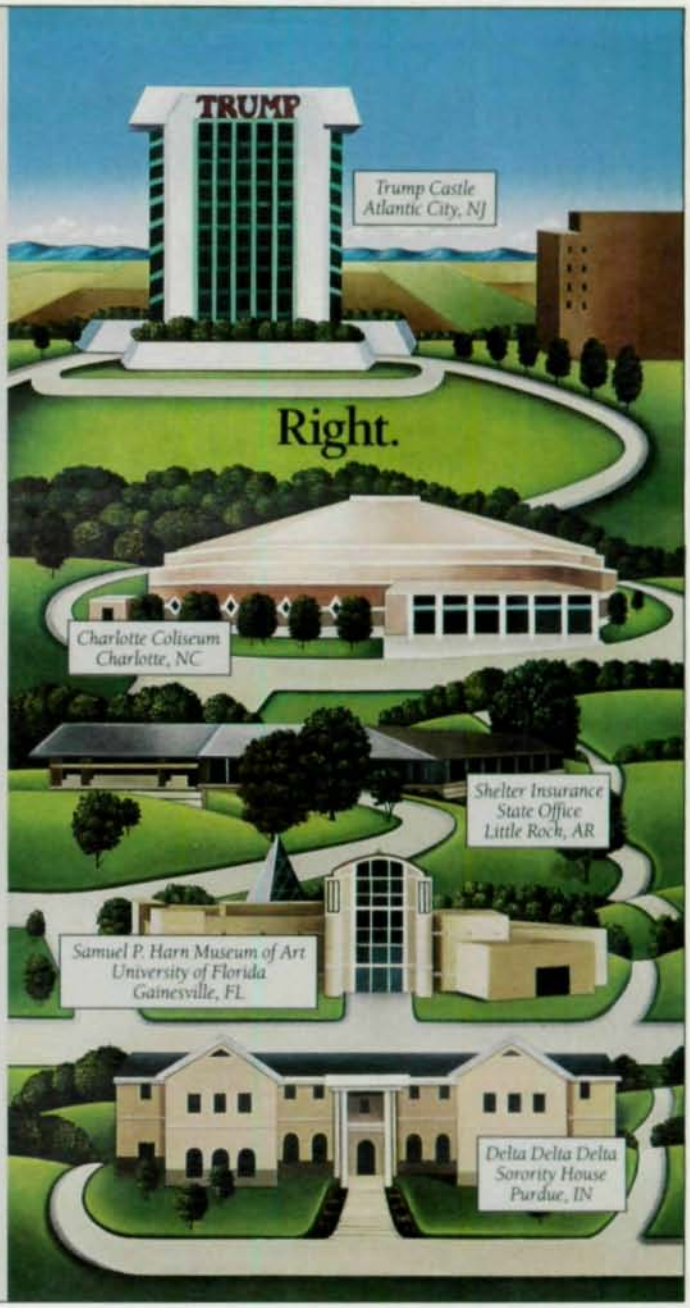
Bolts 7/8Ø A325N, Clips 4 x 3½ x 3/8, Welds 5/16" fillet

is a concentrated load located at mid-span, such as from a vessel. Figure 21 shows the actual reaction of the beam, now a W24x76, is still 41 kips, while the one-half UDL reaction is 56 kips—which is 37% greater than the actual reaction. This means while a five row single angle connection is okay for the actual reaction, a six row connection with a capacity of 66 kips would be required for the one-half UDL reaction.

Figure 22 shows the disparity between actual and one-half UDL reactions for Beam 2. Again, single angles are sufficient.

This article was adapted from a paper presented by W.A. Thornton, Ph.D., P.E., chief engineer with AISC-member Cives Steel Co., at the National Steel Construction Conference in 1991.

Steel joist buildings have their place. Right?



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SPECIAL REPORT

An experienced engineer and fabricator offers 35 tips on reducing fabrication costs during the design stage

Value Engineering And Steel Economy

By David T. Ricker, P.E.

We've all heard the aphorism, "There's more than one way to skin a cat." This expression is especially applicable to steel design and the steel construction industry, where many alternate approaches will result in a safe and economical building. Designers often have several choices as to how to approach a given design task. Likewise, steel fabricators/erectors have choices of such items as connection types, fastening methods and fabricating processes.

Some methods appeal more to one group than the other, and it is up to the design engineer to apply common sense and engineering judgement in choosing the best solution for a specific project. This article includes tips and suggestions for engineers to design safe and economical steel structures.

1. Keep abreast of current costs of various steel products used in structural design. A steel fabricator can supply current base prices upon request. Designers should also be aware of where the money is spent on steel construction: one-third on material; one-third on fabrication; and one-third on erection.

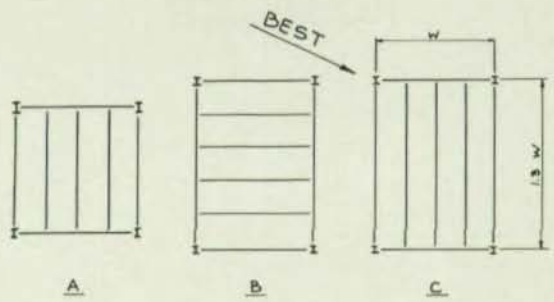
2. Take advantage of allowable stress increases permitted by AISC Specification A5.2 for temporary loads such as earthquake and wind.

3. Take advantage of live-load reductions if governing codes permit.

4. Select a proper mix of A36 and high-strength steels. High strength steels are advantageous when strength is the major design criteria. While A572 Grade 50 is more expensive than A36 steel, it also is more than 35% stronger. However, when deflection, stiffness or some other serviceability criteria governs, the nod still may go to A36 because the heavier sections required will generally have a higher moment of inertia. With the gradual narrowing of the cost difference between A572 and A36, the added strength often will outweigh the modest cost premium.

5. Avoid odd sections that may not be readily available or which are seldom rolled. These could result in costly delays. Fabricators can assist in identifying troublesome sizes and shapes.

Figure 1: Select the optimum bay size



6. Consideration should be given to the use of partial composite design of floor beams—something in the range of 50% to 75%. Full composite design is inefficient. The cost of one shear stud in place equals the cost of approximately 7 lbs. of steel. Unless this ratio can be attained, the addition of more studs will prove uneconomical.

7. Select optimum bay lengths. An exhaustive study by John Ruddy, P.E. (AISC Engineering Journal, Vol. 20, #3, 1983) indicated that a rectangular bay with a length-to-width ratio of approximately 1.25 to 1.50 and a bay area of about 1,000 sq. ft. was the most efficient. The filler members should span in the long direction (see figure 1).

8. Space floor beams so as to avoid the necessity for shoring the deck during the concrete pour. The cost of shoring is relatively expensive and can be easily offset by varying the span, gage, or depth of the floor deck.

9. Tailor the surface preparation and painting requirements to the project conditions—do not underdo nor overdo the coating requirements. Also con-

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If reserving rooms by phone, advise hotel you are attending the **AISC National Steel Construction Conference** and wish the conference rate.

All Conference activities take place at the Las Vegas Hilton Hotel, 3000 Paradise Road, Las Vegas, NV 89109 Phone: (702) 732-5111.

Room Rates: Single $79.00*
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*Note: Rate quoted is plus 7% tax.

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The hotel will honor and guarantee reservations received by May 15, 1992. Reservations received after this date will be on a space available basis. So mail this form promptly. Reservations are subject to cancellation at 4:00 p.m. if not guaranteed. **Failure to cancel your reservation 14 days prior to arrival will result in forfeiture of your one night's deposit.** (Note: Reservations and deposits are not transferable.) Please reserve the accommodations indicated above for:

Guest Name: _____ #Adults: _____ #Children: _____

Or sharing room (dividing bill) with: _____

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(For information only, call David G. Wiley, Phone: (312) 670-5422)

Vegas-Bound

The 1992 National Steel Construction Conference (NSCC), the only "all steel" conference and trade show produced in the U.S., will be held June 3 - 5, 1992 at the Las Vegas Hilton Hotel.

From the illumination of the casino strip to the tranquil beauty of the Nevada desert, Las Vegas has something for everyone! Deemed the "Entertainment Capital of the World", the city offers unparalleled selections in five-star dining, entertainment, shopping and more.

Unique in all the world is this famous spa in the high desert. Unique, in that it is a city of cultural pursuits, educational aspirations, natural phenomenon, man-made engineering marvels, lovely recreational areas and home to the world's most respected gambling casinos, posh resort hotels and lavish star-studded entertainment.

If you like to eat, there is no need to worry about finding food to tantalize your taste buds—Vegas has more than 800 dining establishments. From some of the world's most eloquent cuisine, to the $2.95 buffet, let your stomach be your guide through a menu of international eateries.

Many recreational areas and points of interest are close at hand for the Las Vegas visitor. Hoover Dam, 100-mile long Lake Mead, Valley of Fire, 12,000 ft Mt. Charleston, Red Rock Canyon, Lake Mojave and several museums and historical sites afford pleasant and informative excursions.

Climate/Clothing

Temperatures range from a high of 90˚ plus, to a low of 50˚. The weather in this desert resort is mild most of the year. Casual clothes are fine "around the clock", but women seem to favor cocktail dresses for evening wear; pantsuits are okay too. Men may choose to wear sports clothes or jacket and tie. Shorts, bathing suits and sundresses can be worn in June. The style is really up to the individual!

Local Travel

Las Vegas offers a variety of local travel options:

Bus service operates along the Strip to and from the downtown hotels, including the Las Vegas Hilton. Fare is $1.15. Also operating is a "Strip Trolley" with a fare of $1.

Taxis: Taxis are readily available.

Rental: All major national car rental companies also are represented, as are dozens of local firms.

Official Airlines

United Airlines is the official carrier for NSCC attendees.

Special discount air fares are available between May 30 and June 9. These features are:

Five percent bonus discount on any published restricted round-trip fare, and 40 percent off any unrestricted fare.

To obtain tickets:

1. Call the United toll-free number **1-800-521-4041** between 6 a.m and 12 p.m. Central Time.
2. Refer to AISC account #440KZ.
3. Tickets may be purchased through your travel agent using the number in Step #2 or mailed directly from United Airlines.
4. If you do not have a local travel agent, you may wish to call AISC's travel agency, Mayfair Variety Travel at 1-800-488-4148. Be sure to mention you are attending the AISC Las Vegas meeting.

Note: Airplane seats to Las Vegas book quite quickly. In order to save money, be sure and book early!!

Airport Transportation

The Las Vegas International Airport is approximately three miles from the Las Vegas Hilton Hotel and five miles from the downtown area. Note: Be sure to mention the Las Vegas Hilton as there are two Hiltons in Vegas.

Taxis: There are plenty of taxis available. Rates to the hotel range from $8 to $10 and are subject to change.

Gray Line Airport Shuttle and Bell Transportation both offer shuttle service to the Las Vegas Hilton. Their rate is currently $3.25 (not including tip), but is subject to change.

Seminars and Technical Program

Special sessions focus on the specific interests of structural steel fabricators, engineers, architects, owners, contractors, public officials, erectors, detailers, researchers and educators.

The Conference continues to be the premier meeting place for engineering professionals and the best place to obtain the most information about buildings and bridges.

Workshop sessions get down to basics, the nuts-and-bolts details of designing, fabricating and erecting structural steel. Every aspect of the construction process from concept to completion receives attention:

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computerized design, codes and specifications, research, shop and project management, inspection and safety, and fabrication and erection procedures.

The focus is on practical solutions to common problems. The Conference has also been a major forum for introducing the latest research on structural steel design, recent code changes and technological advances.

Poster Session

Once again, a Poster Session will be offered at the NSCC. Anyone interested in having their technical paper displayed should contact Cynthia Zahn at 312/670-5416.

Exhibit Booth Space Available

The National Steel Construction Conference offers an ideal marketplace for those who provide products and services to the structural steel industry. In addition to display booths, exhibitors also will be given an opportunity to conduct a Product/Service Workshop. These special sessions offer a forum where exhibitors can share, at no charge, the latest technological advances in specialized fields, conduct demonstrations or question-and-answer dialogues, or introduce new or updated equipment and programs. These workshops will be conducted during specific time periods not in conflict with regular Conference sessions, and the schedule will be included as part of the Official Conference Program.

Information on exhibit space at the NSCC is now available from AISC headquarters; call David G. Wiley (312-670-5422).

Pre-Conference Events

This year's Schedule of Events (see enclosed Preliminary Schedule) includes an Educator Meeting, concentrating on subjects of interest to those who teach structural steel design courses at colleges and universities, and an AISC Professional Member Forum for structural engineers interested in current/future programs and publications available from AISC. Other organizations or associations who would like to schedule pre-conference activities to take advantage of the expected high concentration of industry representatives should contact David G. Wiley at AISC (312-670-5422).

Spouses Program

Those registering for the COMPLETE Spouses Program will receive tickets to A or B and C and D. Anyone wishing to register for any one or more of these events INDIVIDUALLY, may do so by selecting Events A, B, C and/or D on the Conference Registration form.

There will be no charge for fully registered spouses attending the AISC Welcome Reception Wednesday evening in the Exhibit Hall (Hilton Pavilion).

All tours will use a modern, fully equipped passenger bus that includes licensed tour guides. If your tour requires an admission fee, this is included in the price of the tour. Unless otherwise noted, lunch is on your own. All tours leave from the East Tower Lobby of the Las Vegas Hilton and will conclude there.

A

Wednesday, June 3: 1:00-4:30 p.m

City Highlights Tour

This exclusive tour takes you along the "Las Vegas Strip" to the downtown Casino Center. "Glitter Gulch" is the center for millions of bright, colorful lights.

All the major hotels and casinos will be pointed out, and your private tour guide will describe the transformation from a dusty railroad watering stop at the beginning the century to the "Entertainment Capital of the World".

Your tour also includes Ripley's Believe It or Not and the famous Ethel "M" Chocolate Factory, which features one of the world's finest botanical cactus gardens.

Price $25.

B

Wednesday, June 3: 1:30-5:00 p.m.

Red Rock Canyon Adventure

Experience the thrill of discovering the 150-million year old Red Rock Canyon with its majestic sandstone cliffs, soaring 2,000 ft above the valley floor. The orange-red glow of its steep slopes at sunrise and the small streams that fall through rock crevices and scattered boulders, have long inspired painters, photographers and poets. It's fossilized sand dunes have grown by a third of its former size to an official 83,000 acres of conservation area.

The 13-mile long Scenic Loop is a good introduction to the canyon, but wandering the trails, climbing the mountains, or resting within its solitude are even more rewarding. There will be several stops

Spouses' Program & Optional Events

In addition to the technical program, the Conference also will include a special program for spouses and guests of those registering to attend. A schedule of planned evening and pre- and post-conference activities is also included as part of this pamphlet.

MSC To Publish Special Show Issue

Modern Steel Construction, the official publication of the AISC, will publish a special show issue in June 1992. The four-color, monthly magazine has a circulation of 35,000 structural engineers, steel fabricators, architects and other professionals involved in the structural steel industry.

The issue will include both product information from show exhibitors and reprints of the most exciting papers to be presented at the NSCC.

Advertising information can be obtained from Marci Lynn Costantino (East), Dan Ramage (Midwest) and Chris Luke (West) at the Pattis Group, 7161 N. Cicero Ave., Lincolnwood, IL 60646-1622, (708) 679-1100.

Join Us

Join us in Las Vegas June 3-5 for what promises to be an exciting, innovative event that you won't want to miss!

along the way allowing you to take pictures of this natural showcase.

Comfortable walking shoes and appropriate outdoor clothing for higher elevation is recommended. Includes soft drink and souvenir book.

Price $25.

C

Thursday, June 4: 9:00-4:00 p.m.

Hoover Dam/Lake Mead Deluxe Tour

Selected as one of Seven Modern Civil Engineering Wonders, Hoover Dam rises 726-ft above bedrock, is 660-ft thick at its base, 45-ft thick at its crest and stretches 1,244 ft across Black Canyon joining Nevada and Arizona. You will tour the inner workings of this mighty dam (completed in 1936) and see the spillways and powerful generators in action and a film showing the construction.

Then you board an old-fashioned paddle wheel boat for a mid-day, 1-1/2 hour cruise to Lake Mead's scenic points that also affords you the opportunity to see the dam from the water. During your cruise you will receive a special souvenir book and enjoy a leisurely lunch prepared especially for you.

Price $48.

D

Friday, June 5: 9:00-1:00 p.m.

Life Behind the Curtain

You're off to the Liberace Museum where you will view more than 5,000 square feet of display space featuring many of Liberace's outlandish autos, several rare and antique pianos and much of Liberace's personal jewel collection.

Ever wondered what it would be like to be a Las Vegas showgirl? Why not live the fantasy backstage of the world-famous Bally's review "Jubilee", voted extravaganza "show of the year". Jubilee is the most lavish, expensive and spectacular show ever staged in Las Vegas! The show was produced at a cost of $10 million and features more than 100 dancers and signers. Find out what goes on behind the scenes as a Jubilee showgirl takes you on a personal tour of the 75' deep x 75' wide stage with nine elevators, running four stories deep, and 15 stories high. Also, see the breathtaking simulation of the "Sinking of the Titanic".

"Peek Into the Life of a Las Vegas Showgirl"

Finally, you will be treated to a program that will reveal the secrets of the Las Vegas showgirl. Entering in unpretentious street clothes, as if by magic, she will transform herself into a beautiful showgirl. This is a one-of-a-kind performance. There will be time for questions — bring your camera.

Price $55.

Complete spouses program (includes A or B, C & D) $115

Preliminary Schedule of Events

MONDAY, JUNE 1

11:00-5:00 p.m. Exhibitor Move-In - continues until 1:00 p.m. Wednesday

TUESDAY, JUNE 2

8:00-4:00 p.m. **Optional Event #1: Grand Canyon Deluxe Tour**

Noon-5:00 p.m. **AISC Committee on Research Meeting/Luncheon**

4:00-8:30 p.m. **Partners in Education/Committee on Education Meeting**
A joint meeting of university and steel industry leaders to review current teaching practices.

WEDNESDAY, JUNE 3

8:30-10:00 a.m. **AISC Professional Member Forum**
Session for structural engineers interested in future programs and publications available from AISC.

8:30-1:00 p.m. **ASCE Committee on Steel Building Structures**

8:30-10:00 a.m. **Steel Educator Program — Session I**
Session concentrating on subjects of interest to those who teach structural steel design courses at colleges and universities.

9:00-1:00 p.m. **AISC Safety Task Force Committee Meeting/Luncheon**

10:30-Noon **Steel Educator Program — Session II**

1:00-4:30 p.m. **Spouses Optional Event A: City Highlights Tour**

1:30-5:00 p.m. **Spouses Optional Event B: Red Rock Canyon Adventure**

1:00-1:15 p.m. **Welcome: Stephen E. Egger**, AISC Chairman
Egger Steel Company
Sioux Falls, SD
Introductions: Hollis L. (Pat) Hance, Jr.,
Co-Chairman NSCC
Southern Engineering Company
Charlotte, NC
Robert H. Woolf, Co-Chairman NSCC
Cives Steel Company
Roswell, GA

1:15-2:00 p.m. General Session:
T. R. Higgins Lecture — winner to be announced
Presiding: Robert F. Lorenz,
AISC, Chicago, IL

2:00-3:00 p.m. **KEYNOTE ADDRESS:**
Presiding: Robert H. Woolf, Co-Chairman NSCC
"Why Steel is a Better Buy"
Moderator: Jerry L. Milligan,
Falcon Steel Company, Inc. Fort Worth, TX
Speaker: Alford B. Johnson (Andy),
AISC Marketing, Inc., Chicago, IL
Today, more than ever, steel is a sensible choice of building material whether viewed from the vantage point of the owner, architect or engineer. Tried and true advantages, plus surprising new developments make it a truly exciting product to work with. The various benefits to all parties will be explored in an innovative way to set the theme for the conference. Interested in steel? Be there!

3:00-5:30 p.m. **Exhibits Open (Hilton Pavilion)**

5:45-6:30 p.m. **Exhibitor Workshops (A-G)**
These special sessions offer a forum where companies share the latest technological advances in their specialized fields, conduct demonstrations or question-and-answer dialogues, and introduce new or updated equipment and programs.

6:30-8:00 p.m. **AISC Welcome Reception**
All conference attendees and spouses are invited to attend this fun-filled event in our Exhibit Hall (Hilton Pavilion).

THURSDAY, JUNE 4

7:00-8:00 a.m. **Speaker Breakfast**

7:00-8:00 a.m. **Southern Association of Steel Fabricators Educator Breakfast**

7:00-8:00 a.m. **Virginia/Carolinas Structural Steel Fabricators Educator Breakfast**

7:30-8:15 a.m. **Exhibitor Workshops (H-N)**

8:30-9:30 a.m. General Session:
Presiding: Robert H. Woolf, Co-Chairman NSCC
"Eliminating the Guesswork in Connection Design — The Role of the Fabricator and Design Engineer"
Moderator: Philip Levine, Roll Form Products, Newton, MA
Speakers: William A. Thornton, Cives Steel Co., Roswell, GA
Martin E. Hursey, CRS Sirrine Architects, Greenville, SC
Thornton will discuss the information needed by the connection designer for efficient and economical designs from the point of view of a fabricator. *Hursey*, a professional engineer with a design firm, will present similar information from the viewpoint of the engineer. This presentation will help all parties involved in connection design and improve structural steel connection design.

9:00-4:00 p.m. **Spouses Optional Event C: Hoover Dam/Lake Mead Deluxe Tour**

9:30-10:00 a.m. General Session:
Presiding: Robert H. Woolf, Co-Chairman NSCC
"Progress Report on Metric Conversion"
Speaker: Geerhard Haaijer, AISC, Chicago, IL
An update on AISC's involvement in the conversion to the S.I. units of measurement required by the Omnibus Trade and Competitiveness Act of 1988. It sets 1992 as the deadline for each government agency to convert to this system.

10:00-3:00 p.m. **Exhibits Open**
Lunch will be served from Noon-2:00 p.m. in the Exhibit Hall (Hilton Pavilion)

10:45-12:15 p.m. **Technical Sessions**
(See Technical Seminars section for description)
1. What the Fabricator Needs to Know About Marketing
8. Developments in Painting Fabricated Structural Steel
10. Tieing It All Together — Integration of Designs, Detailing and Production Systems
11. Steel Parking Decks
15. Research in Progress
16. Building Code Update

12:30-2:00 p.m. **Poster Session** (Exhibit Hall/Hilton Pavilion)
An exhibition of technical papers will be displayed throughout the conference. Authors of papers will be available during this time period for discussion of the papers' contents.

2:00-3:30 p.m. **Technical Sessions**
4. The Right Connections for Mating Tubular and Wide-Flange Shapes
5. Improving Your Shop Safety Program
9. Connection Design Responsibility
12. Short Span Steel Bridges

3:40-5:10 p.m. **Technical Sessions**
2. Practical Solutions to Connections: The Do's and Don'ts for Fabricators and Engineers
3. *Fabricator's Legal Rights Under the Code of* Standard Practice
6. Tightening Bolts — Which System is Best for You
13. Airport Expansion: The International Facility at Chicago O'Hare International Airport
14. Research Implementation
17. Repair and Retrofit

5:15-6:00 p.m. **Exhibitor Workshops (O-U)**

6:00-10:30 p.m. **Optional Event #3:**
City Lites Dinner Show

FRIDAY, JUNE 5

7:30-8:15 a.m. **Exhibitor Workshops (V-BB)**

8:30-9:15 a.m. **General Session:**
Presiding: Hollis L. (Pat) Hance, Jr., Co-Chairman NSCC
"The Resurgence of Steel Frame Construction in the United Kingdom"
Speaker: Robert Latter, British Steel PLC, United Kingdom
This presentation will explore the reasons for the increased share of steel frame construction in buildings of more than one story in the United Kingdom. The market share for steel frames has increased from about 30 percent of floor area to more than 50 percent in the past decade.

9:00-1:00 p.m. **Spouses Optional Event D:**
Life Behind the Curtain

9:15-10:00 a.m. **General Session:**
Presiding: Hollis L. (Pat) Hance, Jr., Co-Chairman NSCC
"High-Rise Steel Frame"
The 45-minute film deals with the fabrication and erection of 14,000 tons of structural steel for a 60-story office building in a major metropolitan area. It follows the progress of the structural steel, from the delivery of the mill material, through final installation at a crowded, downtown site. It provides excellent coverage of the challenges faced by ironworkers in completing the very hazardous work under widely varying conditions.

10:00 -2:30 p.m. **Exhibits Open**
Lunch will be served from 12:15-1:45 p.m. in the Exhibit Hall

10:45-12:15 p.m. **Technical Sessions**
6. Repeat: Tightening Bolts — Which System is Best for You
7. Designing Economy into Welded Structures
9. Repeat: Connection Design Responsibility
15. Repeat: Research in Progress

1:45-3:15 p.m. **Technical Sessions**
3. Repeat: Fabricator's Legal Rights Under the Code of Standard Practice
4. Repeat: The Right Connections for Mating Tubular and Wide-Flange Shapes
10. Repeat: Tieing It All Together — Integration of Designs, Detailing and Production Systems
13. Repeat: Airport Expansion: The International Facility at Chicago O'Hare International Airport
14. Repeat: Research Implementation
17. Repeat: Repair and Retrofit

2:30 p.m. **Exhibits Close**

3:25-4:55 p.m. **Technical Sessions**
5. Repeat: Improving Your Shop Safety Program
7. Repeat: Designing Economy into Welded Structures
8. Repeat: Developments in Painting Fabricated Structural Steel
11. Repeat: Steel Parking Decks
12. Repeat: Short Span Steel Bridges
16. Repeat: Building Code Update

6:30-7:30 p.m. **Reception** (Cash Bar) Location TBA

7:30-1:00 a.m. **Optional Event #4:**
Conference Dinner/"Jubilee!" Package

7:30-9:30 p.m. **Optional Event #5:**
Conference Dinner Only

9:30-1:00 a.m. **Optional Event #6:**
"Jubilee!" Only

SATURDAY, JUNE 6

8:00-4:00 p.m. **Optional Event #2:**
Grand Canyon Deluxe Tour

8:00-3:00 p.m. **Optional Event #7:**
River Raft Adventure

8:00-12:30 p.m. **Optional Event #8:**
Hoover Dam Tour

8:30-Noon **Optional Event #9:**
Red Rock Canyon Adventure

Technical Seminars

1 What the Fabricator Needs to Know About Marketing

Moderator: Jerry L. Milligan, Falcon Steel Company, Inc., Fort Worth, TX
Speaker:
Panelists to be announced
Today we are faced with a shrinking construction market, more competition and not very bright prospects for the immediate future. In order to survive, fabricators must be able to get a larger piece of a smaller pie. This workshop will show the fabricator how to make the biggest impact on the owner, architect and engineer. It will present take-home information on how to present the message of steel as well as the specific message of the individual fabricator firm. The session will also show what tools can be used to put the fabricator out in front. Panelists to be announced.

2 Practical Solutions to Connections — The Do's and Don'ts for Fabricators and Engineers

Moderator: Philip Levine, Roll Form Products, Newton, MA
Speakers:
William A. Thornton, Cives Steel Co., Roswell, GA
Martin E. Hursey, CRS Sirrine Architects, Greenville, SC
Practical design as well as fabrication information needed by the connection designer to allow efficient design and economical fabrication will be discussed. This session will help all parties involved in connection design eliminate the guesswork. The speakers will cover the do's and don'ts for fabricators and engineers.

3 Fabricator's Legal Rights Under the Code of Standard Practice

Moderator: Robert H. Woolf, Cives Steel Company, Roswell, GA
Speaker:
David B. Ratterman, Goldberg & Simpson, Louisville, KY
The AISC Code of Standard Practice is the most universally accepted set of general conditions utilized in steel construction in the United States. This presentation will discuss specific rights and obligations under the AISC Code.

4 The Right Connections for Mating Tubular and Wide-Flange Shapes

Moderator: David T. Motyll, Welded Tube Co. of America, Chicago, IL
Speakers:
Gene Heathcock, FabArc Steel Supply, Inc., Anniston, AL
James M. Fisher, Computerized Structural Design, Milwaukee, WI
Despite the many benefits of structural tubing some designers are hesitant to use tubing because of perceived difficulties with connections. This session will dispel those myths. Heathcock will discuss a five story building that used wide-flange beams and tube columns. Fisher will concentrate on the connections for an all tube structure.

5 Improving Your Shop Safety Program

Moderator: S. W. Blaauw, Paxton & Vierling Steel Co., Omaha, NE
Speakers:
Brad Johnson, Paxton & Vierling Steel Co., Omaha, NE
E. J. Harris, Central Texas Iron Works, Inc., Waco, TX
Fabricating shop safety programs vary from plant to plant. This session will discuss different shop safety programs and present information useful in a fabricators day-to-day operations. Bring some of your own ideas and share them too.

6 Tightening Bolts — Which System is Best for You

Moderator: William G. Ashton, Egger Steel Co., Sioux Falls, SD
Speakers:
Jim Schiele, St. Louis Screw & Bolt Co., St. Louis, MO
Wayne Wallace, J & M Turner, Inc., Burlington, ONT
Don Shell, Huck Mfg. Co., Waco, TX
Brandt Dahlberg, LeJuene Bolt Co., Lakeville, MN
Representatives from each manufacturer will give a practical demonstration and answer questions about their product. Load indicator washers, turn of nut method, lockpin and collar fasteners, as well as, tension control bolts will be presented.

7 Designing Economy into Welded Structures

Moderator: R. Philip Stupp, Jr., Stupp Bros. Bridge & Iron Co., St. Louis, MO
Speakers:
A. Rex Fronduti, Trinity Industries, Montgomery, AL
Duane K. Miller, Lincoln Electric Co., Cleveland, OH
An efficient welded design is one that is not only safe but is economical. Through a variety of cost-saving ideas that begin at the design stage and carry through to inspection, the welded steel structure can be economically constructed.

8 Developments in Painting Fabricated Structural Steel

Moderator: W. H. Reeves, Carolina Steel Corp., Greensboro, NC
Speakers:
Bill Smith, Garbe Iron Works, Inc., Aurora, IL
Other speaker to be named later.
This session will include two speakers who will cover the latest developments in painting of structural steel. Discussion on low solvent paints will be included. The latest technology and use of water-based paints for fabricated steel will be extensively covered. The speakers will also discuss the mechanization of the painting process for the fabrication industry.

9 Connection Design Responsibility

Moderator: Terry Peshia, Garbe Iron Works, Inc.
Speakers:
Henry A. Fernandez, New York State Education Dept.
Design Engineer to be named later
The authority and responsibility for connection design has been hotly debated over the past several years. In the past we have discussed the topic from the perspective of contract scope, cost, insurance

coverage and liability. During 1991, the State of New York, in conjunction with professional associations and trade groups, reviewed the status of shop drawing approvals and reminded the licensed design professionals "that delegation of design responsibility to unauthorized firms constitutes unprofessional conduct." Our workshop topic is intended to stimulate debate between the factions on both sides of the question.

10 Tieing It All Together — Integration of Designs, Detailing and Production Systems

Moderator: Robert Abramson, Interstate Iron Works Corp., Whitehouse, NJ

Speakers:

Dick Hendricks, E.I. Dupont Engineering, Newark, DE

Larry Cox, Steel Service Corp., Jackson, MS

Jim Stevers, Globe Iron Construction Co., Norfolk,VA

The interface of computer systems and information from design engineers directly to the fabricator will be discussed. Design interface will include down loading to detailing, production control systems and generation of CNC shop equipment programs. The ability to integrate these systems will greatly reduce repetitive tasks within fabricators organizations, and increase the competitiveness of structural steel through reduction of overhead.

11 Steel Parking Decks

Moderator: William F. McEleney, AISC Marketing, Inc., Providence, RI

Speakers:

Michael Jolliffe, Zaldastani Associates, Inc., Boston, MA

David L. Weaver, AISC Marketing, Inc., Pittsburgh, PA

Jolliffe will focus on the development of a building system for parking decks combining the use of structural steel and precast concrete components which can be rapidly erected. Specifically, the system is designed to respond to the harsh environment encountered in such facilities. *Weaver* will introduce a Parking Deck Brochure. The information presented includes the design of concrete floor slabs for long term serviceability on a steel frame, paint systems for structural steel to provide long service life, basic fire protection information from the model building codes, estimating steel requirements for common parking deck layouts and comparisons of ASD and LRFD designs.

12 Short Span Steel Bridges

Moderator: Roy L. Mion, AISC Marketing, Inc., Pittsburgh, PA

Speakers:

James Montgomery, Bethlehem Steel Corporation, Hershey, PA

Stanley J. Grossman, Grossman and Keith Engineering Co., Norman, OK

J.H. (Ted) Temple, Chaparral Steel, Midlothian, TX

Montgomery: This presentation will cite steel's advantages for use in short span bridges, such as its relative light weight, ease of inspection and repair, and strong aesthetic potential. Viable options available to the engineer and owner will be emphasized as they pertain to substructure, superstructure, decks and cost competitiveness. *Grossman* and *Temple* will discuss a system where composite steel-concrete bridge units cast upside down prestress the steel beams so that the range of elastic behavior is extended. Recent applications in Oklahoma, Texas and New York demonstrate the economic advantages of this construction method.

13 Airport Expansion: The International Facility at Chicago O'Hare International Airport

Speakers:

David E. Eckmann, Perkins & Will, Chicago, IL

David McKenzie, Havens Steel Company, Kansas City, MO

The structural engineer and the fabricator of this 3 level, 1.1 million square foot terminal will highlight some of its interesting features, and construction and fabrication problems and solutions. The facility, currently under construction, is comprised of 15.3 thousand tons of structural steel including composite floors. The architectural design required a floor framing system capable of supporting airplane loads above a below-grade federal inspection facility. Exposed steel is used extensively. Exposed double pipe frames support the 50-ft. high vaulted ceiling of the 700-ft. long ticketing pavilion, as well as a curved Galleria and skylight roofs above the federal inspection area. This will be an important structure in both its use and expression of diverse applications of structural steel systems.

14 Research Implementation

Speakers:

Joseph A. Yura, University of Texas, Austin, TX

"Bracing Design Manual"

T.V. Galambos, University of Minnesota, Minneapolis, MN

"Design of Unsymmetric Members"

Yura: This manual on bracing design gives design recommendations for bracing of beams, columns, frames and trusses. Emphasis is placed on simplicity and practicality. New formulations are given that not only define the strength and stiffness requirements for full bracing, but also give the column or beam strength when less than full bracing is present. Additional topics of discussion will include the importance of brace location and attachment details and new formulas for C_b factors for continuous beams with the top flange braced.

Galambos: Unsymmetric members such as angles, tees and built-up shapes are always a challenge to the structural designer because of the unfamiliar types of limit states which need not be considered in the design of wide-flange members. The provisions of the AISC Specification for such members, as well as the tables and design aids will be reviewed.

Technical Seminars

15 Research in Progress

Speakers:
R. Richard Avent, Louisiana State University, Baton Rouge, LA
"Designing Heat Straightening Repairs"
Hassan Astaneh, University of California, Berkeley, CA
"Behavior and Design of Base Plates for Gravity and Seismic Loads"
Avent: A comprehensive set of experiments was conducted on heavily damaged steel plates and rolled shapes which had been subjected to heat straightening. Effects of the repair process on the tensile properties and residual stresses in the reqaired steel were experimentally determined. Based on the results, rational decisions can be made concerning the use of heat straightening and its limitations.
Astaneh: Moment-rotation behavior of steel column base plates under gravity as well as seismic loads was investigated. The study indicated that thick base plates generally remained elastic and large forces were developed in the anchor bolts. Whereas, in thinner base plates, plates yielded and devloped an actual pin at the base of the column, relieving base plate and foundation from carrying undesirable moments. The author will discuss the behavior and design recommendations.

16 Building Code Update

Speakers:
Del Boring, American Iron and Steel Institute, Washington D.C.
"Building Codes in the 1990s"
Egor Popov, University of California, Berkeley, CA
"Development of Seismic Steel Codes in the U.S."
Boring: The current trend is for most states and major cities to enforce one of the model building codes, while previously, the dominant building codes in the United States were locally developed. The significance of this transition and its impact on steel construction will be explored. Recent building code initiatives of interest, including fire protection, will be discussed.
Popov: The seismic design problem has been receiving increasing national attention during the past two years. The work of the Building Seismic Safety Council on the update of its National Earthquake Hazards Reduction Program Provisions has accelerated the adoption of new requirements in the BOCA, SBCCI, and UBC model codes, and ASCE load standard. The main differences and similarities in their seismic load and design criteria are reviewed. In addition, the seismic detailing requirements for steel moment resisting frames, concentrically braced frames, and eccentrically braced frames will be discussed.

Optional Events

All tours will use a modern, fully equipped passenger bus and include licensed tour guides. If your tour requires an admission fee, this is included in the price of the tour. All tours leave from the East Tower Lobby of the Las Vegas Hilton and will conclude there. Note: A tour may be canceled if AISC does not receive a sufficient number of registrations by May 15. In this case, you will be notified and a full refund will be issued after the Conference. — Although we are featuring City Lites & Jubilee, there is other entertainment available. We will have information at the AISC Registration Desk.

1 Tuesday, June 2: 8:00-4:00 p.m.

Grand Canyon Deluxe Tour

The seventh natural wonder of the world features incredible colors and vistas that took nature more than nine million years to create, can be viewed as you soar alongside the canyon mouth, gorges and volcanoes.

You will have 2 hours of sightseeing on your own. You'll have plenty of time to enjoy the view, the Visitors Center, the exciting IMAX Theater and a delicious buffet meal.

Your tour includes all transportation, airfare, taxes, admission fees, IMAX Theater and a lunch. Note: This is an air and ground tour. There are no minimum numbers for this tour. It will not be canceled!

Price $175

2 Saturday, June 6: 8:00-4:00 p.m.

Grand Canyon Deluxe Tour

The same tour as #1, only offered on Saturday instead of Tuesday.

Price $175

3 Thursday, June 4: 6:00-10:30 p.m.

City Lites Dinner Show

Staged at the Flamingo Hilton, City Lites is a dazzling revue featuring incredibly staged numbers, ice extravaganzas and superb novelty acts, all put together in a well-placed, exciting show. Includes: show, dinner, tips and transportation.

Price $55

17 Repair and Retrofit

Speakers:

Joseph J. Pullaro, A.G. Lichtenstein & Associates
"Post-Tensioning of the Walnut St. Bridge Over the Tennessee River"

Predrag L. Popovic, Wiss, Janney, Elstner Associates, Inc., Northbrook, IL
"Structural Repairs and Strengthening of a 360,000 Square Foot Warehouse"

Pullaro: The Walnut Street Bridge crossing the Tennessee River in the city of Chattanooga, Tennessee is a pin-connected Camelback Pratt Truss, built in 1891. Rehabilitation of the structure to serve as a pedestrian bridge and linear park is to be completed in Summer 1992. Inspection of trusses showed losses due to rusting and pitting at the eye bar heads. A system of post-tensioning the trusses with straight and deflected strands was selected to relieve the eye bars of a large portion of their existing dead load and also to introduce redundancy in the tension members by providing an alternate load path via the strands.

Popovic: This 15 year old masonry warehouse had experienced numerous roof failures and various structural roof and wall distress. Repairs included reinforcing masonry pilasters with steel columns, addition of steel vertical wind bracing, modifications of expansion joint details at steel beam splices and bar joist bearings to accommodate temperature movements, and the addition of stiffeners at beam-column connections. Strengthening retrofits were installed at bottom chord end connections of all typical steel joists.

4 Friday, June 5: 7:30-1:00 a.m.

Conference Dinner/"Jubilee!" Package

The evening begins with our Annual Conference Dinner at the Las Vegas Hilton, where you have a chance to visit your friends from all around the country.

Following dinner, it is on to the world famous "Jubilee" in the Ziegfeld Theater at Bally's. "Jubilee" is the most lavish, expensive (produced at a cost of $10 million) and spectacular show ever staged in Las Vegas, featuring more than 100 dancers and singers. Includes Conference Dinner, premium seating at "Jubilee", tips, taxes and transportation.

Price $89

5 Friday, June 5: 7:30-9:30 p.m.

Conference Dinner Only

Same as #4, only without Jubilee stage show.

Price $49

6 Friday, June 5: 9:30-1:00 a.m.

"Jubilee!" Only

Same as #4, only without the Conference Dinner, includes premium seating at the show, taxes, tips and transportation.

Price $49

7 Saturday, June 6: 8:00-3:00 p.m.

River Raft Adventure

Eleven exciting miles of rafting adventure on the Colorado River awaits you. In one of the most beautiful canyons of the Colorado, you will drift and float through the waterfalls, geological formations, moss-covered beaches and breathtaking beauty.

Enjoy three hours of floating bliss down the lazy river, which contains neither rapids nor white water. Tour includes a delicious lunch.

Price $75

8 Saturday, June 6: 8:00-12:30 p.m.

Hoover Dam Tour

Same as #C, without lunch or a paddle wheel cruise of Lake Mead.

Price $26

9 Saturday, June 6: 8:30-12:00 p.m.

Red Rock Canyon Adventure

Same as #B

Price $25

Registration Form

1992 NATIONAL STEEL CONSTRUCTION CONFERENCE
LAS VEGAS HILTON
JUNE 3-5

Registration Fee:
(please circle appropriate fees).

AISC Member Fee: $290.00 (on or before April 17)
$335.00 (after April 17)
(Includes AISC Active, Associate & Professional Members.)

Non-Member Fee: $340.00 (on or before April 17)
$385.00 (after April 17)

Educator Fee: $100.00
(Employed full-time at accredited architectural or engineering college or university.)

Student Fee: $75.00
(Letter from faculty advisor or equivalent required.)

Exhibitor, in Booth: No charge

Added Exhibitor: $85.00

Spouse's Fee: $100.00*
*Includes: Reception, A or B, C & D
Choose One: Tour A _____ or Tour B_____

Partial Registration Fees
(You may also pre-register for one day or half-day.)
Circle your choice below:

Half Day Sessions: (Lunch not included)

Wednesday Afternoon:	$ 55.00	11
Thursday Morning:	$ 70.00	12
Thursday Afternoon:	$ 70.00	13
Friday Morning:	$ 70.00	14
Friday Afternoon:	$ 70.00	15

One Day Sessions:

Thursday (includes lunch):	$160.00	20
Friday (includes lunch):	$160.00	21
Exhibit Floor Pass: (included in full & partial registrations)	$ 5.00	22

Total Of Partial Registration Fees: $_____

Registration Fees Include: General Sessions; workshops; seminars; coffee breaks; luncheons Thursday and Friday; the Get-Acquainted Cocktail Reception Wednesday evening; and a printed, bound copy of the Proceedings. Exhibitors are entitled to one registration for each 10 ft. x 10 ft. exhibit space reserved. "Added Exhibitor" fee is payable **ONLY** if in excess of one person per 10 ft. x 10 ft. exhibit space.

Registration Cancellation Policy: For cancellations received on or before May 15, 1992, 100% of pre-paid registration fees will be refunded; after May 15, 50% will be refunded. (Those cancelling after May 15 will receive a copy of the Conference Proceedings.) Refunds will be sent after the Conference.

Registration for Optional Events

Event No.	Tickets		Total Price
#1—Grand Canyon Deluxe Tour (Tues. 8:00 a.m.)	____	@175.00	$_____
#2—Grand Canyon Deluxe Tour (Sat. 8:00 a.m.)	____	@175.00	$_____
#3—City Lites Dinner Show (Thurs. 6:00 p.m.)	____	@ 55.00	$_____
#4—Conference Dinner/"Jubilee!" Package *(Fri. 7:30 p.m.)*	____	@ 89.00	$_____
#5—"Jubilee!" Only (Fri. 9:30 p.m.)	____	@ 49.00	$_____
#6—Conference Dinner Only (Fri. 7:30 p.m.)	____	@ 49.00	$_____
#7—River Raft Adventure (Sat. 8:00 a.m.)	____	@ 75.00	$_____
#8—Hoover Dam Tour (Sat. 8:00 a.m.)	____	@ 26.00	$_____
#9—Red Rock Canyon Adventure (Sat. 8:30 p.m.)	____	@ 25.00	$_____
#A—City Highlights Tour (Wed. 1:00 p.m.)	____	@ 25.00	$_____
#B—Red Rock Canyon Adventure (Wed. 1:30 p.m.)	____	@ 25.00	$_____
#C—Hoover Dam/Lake Mead Deluxe Tour (Thurs. 9:00 a.m.)	____	@ 48.00	$_____
#D—Life Behind the Curtain (Fri. 9:00 a.m.)	____	@ 55.00	$_____
Total Optional Event Fees			$_____

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Figure 2: Snow-drift loading

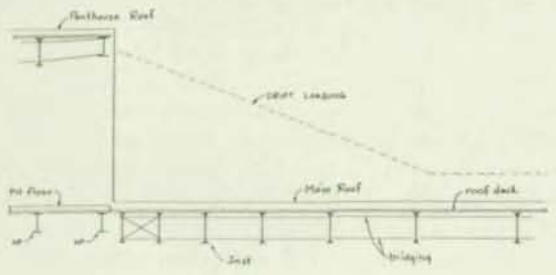
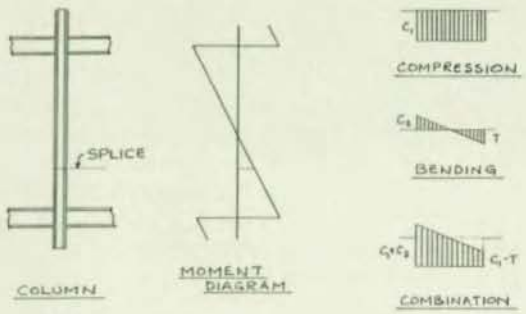


Figure 3: Column splice location



sider the appropriate treatment of connections.

10. Show all necessary loads on the design drawing to avoid costly over-designing of connections or dangerous under-designing. This is an AISC specification requirement. In addition to gravity loads, torsional loads, axial loads, and moments should be given, and when columns are influenced by gravity and lateral moments, these moments should both be given.

11. Indicate who is responsible for "grey area" items such as loose lintels, masonry anchors, elevator sill angles, elevator sheeve beams, fastenings for precast concrete spandrel panels, etc. Unless the responsibility is specifically delegated, it is likely that the cost of these items will be included in the bids of two or more trades, meaning the client may pay more than once for the same article.

12. Don't require the steel subcontractor to perform other work that should be done by other trades such as installing masonry anchors, ceiling hangers, lateral bracing for interior wall, toilet partition supports, window wall supports, and the like. Information required to perform this work often is slow to develop, resulting in needless delay for the steel fabricator, who should be allowed to proceed without delay and unnecessary encumbrances.

13. Consider the use of cantilevered rafters and purlins to save weight on roof design.

14. In areas of roof that are subject to snow drift loading, arrange the purlins parallel to the drift and vary the spacing of the purlins so the same gage of roof deck and same size purlins can be used throughout the area (figure 2).

15. Do not design for minimum weight alone. Such a design may require more pieces and more connections and will be more labor intensive in both the shop and the field, and in all likelihood will be more expensive.

16. Excessively stringent mill fabrication and erection tolerances, beyond state-of-the-art practices, will probably reduce the number of bidders and raise the cost to the owner. ASTM A6 tolerances and those established by the ANSI, AWS, and AISC have served the industry well and should be adhered to except under extraordinary circumstances.

17. Designate the proper type of high strength bolt value. The correct application of each type is well documented in the current bolt specifications. Do not specify slip-critical values for the purpose of obtaining an extra factor of safety.

18. Allow the use of tension control (twist-off) high strength bolts. These bolts are as reliable as are other methods of measuring bolt tension and reduce labor costs.

19. Specify fillet welds rather than groove welds, wherever possible. Groove welds are generally more costly because of the joint preparation required and the greater volume of weld deposited.

20. Indicate fillet welds that can be made in one pass, wherever possible. When using the shielded metal arc welding process in the horizontal and flat positions, the maximum practical one-pass fillet weld is 5⁄16".

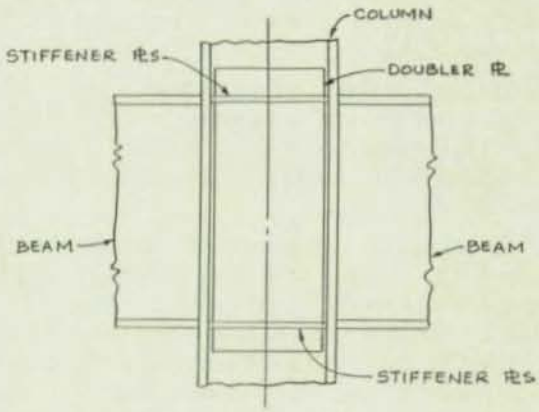
21. Favor the horizontal and flat welding positions. These welds are easier and quicker to make and are generally of a higher quality.

22. Don't call for more weld than is necessary. Over-welding creates excessive heat, which may contribute to warping and shrinkage of the members resulting in costly straightening expense.

23. Grant the fabricator the option of eliminating some column splices, wherever possible. The cost of one column splice equals the cost of about 600 lbs. of A36 steel. However, the fabricator should study the situation carefully before deciding to omit the column splice and running the heavier shaft up to the next splice—the resulting column may be too long for erection.

24. Avoid designing column splices at mid-story height. These are often too high for the erector to reach without rigging a float or scaffold. If the splice can be located no higher than 5' above the tops of the steel beams, it will save the expense of the extra rig-

Figure 4: Heavier column shaft eliminates stiffeners



ging and still be in a region of the column where bending forces are relatively low (figure 3).

25. Do not design column splices to "develop the full bending strength of the smaller shaft." Seldom is the splice located at the point of maximum bending and seldom do the bending stresses result in a condition that would require a full strength splice. The column has axial compressive stresses. The excess capacity is allotted to bending stresses that occur as compression in one flange and tension in the other flange. The compression forces are added to each other at one flange while at the other flange the tension force is subtracted from the compression force. Seldom does this other side of the column ever go into tension and never into full allowable tension of the magnitude that would require a full strength splice. Once in a while, lateral loads on a structure will result in some small net tension stress, but not to the extent to justify a full strength splice (figure 3).

26. Consider using a heavier column shaft or high strength steel to eliminate the need for web doubler plates and/or column stiffeners opposite the flanges of moment connected beams. One pair of stiffeners installed costs approximately the same as 250 lbs. of A36 steel if the stiffeners are fillet welded. If they must be groove welded, the cost skyrockets to the equivalent of 1000 lbs. of A36 steel. The cost of one installed doubler plate is about the same as 500 lbs. of A36 steel (figure 4). Considering that for an average two-floor column there could be as many as four pair of stiffeners and two doubler plates, at least 2,000 lbs. of A36 steel (about 1,900 lbs. of A572 Grade 50) could be sacrificed in order to save the time and expense of making the lighter shaft work.

Figure 5: Stiffener Location

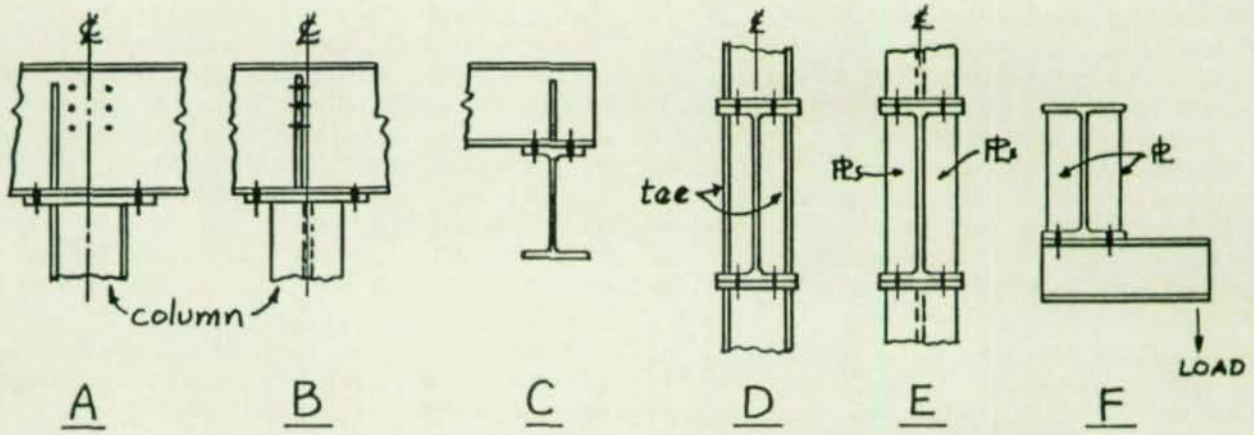
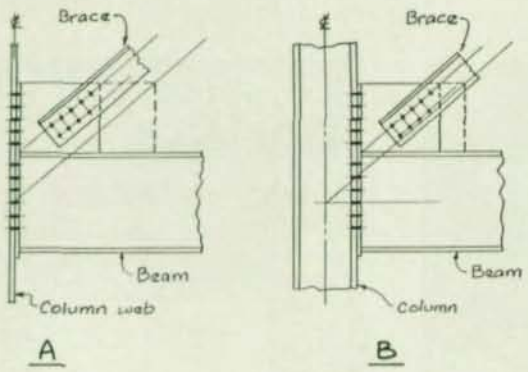


Figure 6: Bracing Work Points



27. Avoid designing heavy or awkward members in remote hard-to-reach portions of the structure. This may eliminate the need for larger, more expensive hoisting equipment.

28. Reinforce beam web penetrations only where necessary. Several software programs, including AISC's *Webopen, help identify and design web penetrations* that do not require reinforcing. Also, it may be less costly to use a beam with a heavier web, to move the opening to a less critical location, or to change the proportions of the opening to something less demanding.

29. For heavy bracing, where advantageous allow the fabricator to translate the bracing work points so that they lie on the intersection of the flange faces rather than the centerline of members (figure 6). Generally, this will result in a more compact, efficient connection (see AISC Engineering Journal, Vol. 21, 3rd Quarter 1984).

30. Allow the prudent use of oversized holes and slots to facilitate fit-up costs and erection. They may *eliminate or reduce the need for costly reaming of* holes or re-fabrication.

31. Avoid the indiscriminate use of stiffeners. Stiffeners are required to prevent local deformation and/or to transfer load from one part of a member to another (figure 5). If the main members are capable of taking care of themselves then the cost of stiffeners can be saved. Use partial depth stiffeners where possible; full depth stiffeners can cost twice as much as partial depth stiffeners.

32. Avoid the catch-all specification that reads

something like this: "Fabricate and erect all steel shown or implied necessary to complete the steel framework." The bids will undoubtedly be inflated to cover whatever might be "implied". This is unfair to the client.

33. Avoid the nebulous specification that calls for stiffeners as required, roof frames as required, reinforcing of beam web penetrations as required, etc. During the estimating and pricing phases, the fabricator/erector rarely has enough time to determine what is and what is not required, and will therefore include in the bid an allowance for the questionable items whether or not they are eventually needed. The client may end up paying for something that is not supplied. Spell out known stability and tolerance problems applicable to the specific project.

34. Avoid the overly restrictive specification. The more restrictions listed in the steel specifications the greater the chances that no one will be able to meet them all. This will eliminate some of the competition and often result in higher bids.

35. Prepare complete designs. A goodly portion of the fabricator's overhead expense is spent on estimating. For every job he gets he may make 10 to 20 unsuccessful attemps. Some project specifications are written in such a way as to require the fabricator to complete significant portions of the steel design in order to prepare an accurate cost estimate. But requiring fabricators to complete significant portions of the steel design in order to prepare an accurate cost estimate wastes time and boosts estimating costs, which will in turn be passed on to the client. If eight fabricators are pursuing a project, this design work must be duplicated eight times. The fabricator who elects to bypass the necessary design investigations may end up in deep trouble with a bid and job that are less than they should be. But if he loads his bid to cover the "worst case" conditions, the chances are he will not get the job. When a fabricator has to determine loads via analysis of the member, the results will often be unrealistic. Whether the member is designed based on stiffness, aesthetics, minimum thickness requirements, or deflection is not normally known by the fabricator.

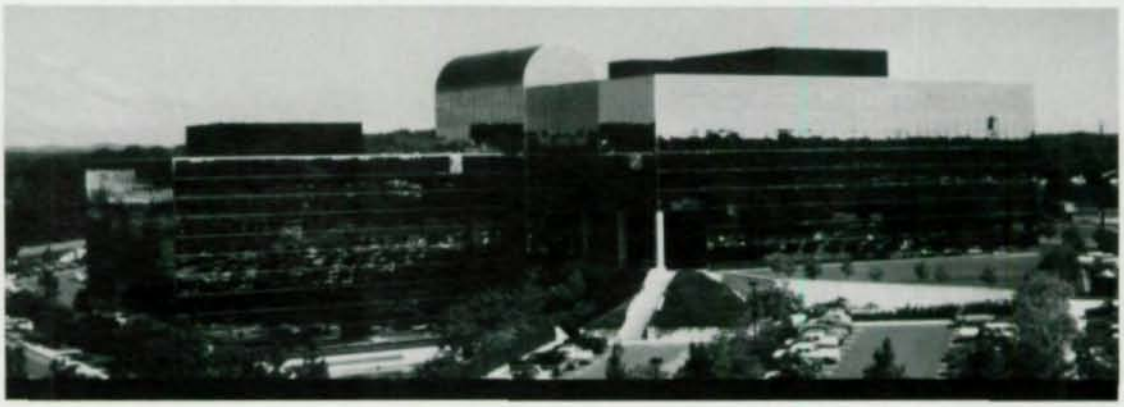
A complete design is the best assurance that those who must use that design will accurately interpret the intent of the designer. There will be far less chance for ambiguities, misinterpretations, errors and/or omissions. Design shortcuts can only hurt the other members of the construction team. A complete design benefits everyone in the long run, including the designer and the client.

David T. Ricker, P.E., is a retired vice president of engineering with AISC-member The Berlin Steel Construction Co., Inc, and is now living in Arizona.

#3 IN A SERIES

THE MEN OF STEEL

Charles S. Cheskin, P.E., Structural Engineer
Charles S. Cheskin Associates
Bloomfield, NJ



In envisioning Mack Centre III, a 220,000 square foot office building in Paramus, architect Mitchell E. Hersh, AIA, designed two visually distinct towers interconnected by a dramatic 60′ x 120′ seven-story skylit atrium.

To achieve the architect's desire for minimal visual disruption, Charles S. Cheskin Associates engineered a two-hinged arch system of narrow A572-Grade 50 steel to span the lower South Tower to the higher North Tower, taking into consideration the asymmetrical reactions to the supporting steel girders.

Hackensack Steel Corporation of Carlstadt then fabricated sixteen 120′ long welded rectangular plates bent to form continuous arches that maintained the integrity of the architect's vision.

In total, Hackensack Steel Corporation fabricated and erected 2000 tons of steel as the project's primary framing material.

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SPECIAL REPORT

A compilation of comments from experienced fabricators across the country

What Design Engineers Can Do To Reduce Fabrication Costs

The following comments represent the views of the quoted individuals and do not necessarily represent the views of AISC. Note also that in some cases, regional variations will create differences of opinion. If you have any questions, please contact the editor.

Bill Dyker, manager of engineering, and John D. Smith, vice president of sales, with AISC-member Garbe Iron Works, Inc., Aurora, IL:

When welding base plates to columns in the shop or field, designs should not show "all-around" fillet welds unless the weld is required to resist a moment or a large uplift. Usually, welds as shown on Page 4-130 of the *AISC Manual of Steel Construction, ASD—Ninth Edition* are adequate. Similar consideration should be given to attaching cap plates to columns.

Designs, especially CAD generated issues—should be reviewed to ascertain that all pieces can be erected without undue restraints. Also, the reviewer should be alert to avoiding framing conditions that cause deep copes at the ends of beams. This solution occurs especially when relatively shallow beams support deep beams and both beams may or may not be at the same elevation. The cost for a few extra pounds of steel per foot for a deeper beam often will be easily offset by the savings from not having to design and fabricate special connections and cope reinforcements.

Avoid framing conditions that cause deep copes at the ends of beams. The cost for a few extra pounds of steel per foot for a deeper beam often will be easily offset by the savings from not having to design and fabricate special connections and cope reinforcements

If beam-column moment connections require doubler plates in the column web, consider increasing the column size to eliminate the need for such plates. The costs to design, detail, approve and fabricate doubler plates could be offset by the cost of a heavier column.

Designs should not arbitrarily call for stiffeners in webs of columns at moment connections. With the variety of computer programs available, (e.g. AISC's CONXPRT program), the designer should be able to describe on the drawings which columns require stiffeners and the stiffener sizes. Again, perhaps a slight increase in the unit weight of a column would offset all the costs—detailing through fabrication—associated with web stiffeners. These costs really begin to escalate when doubler plates are needed along with stiffeners. Further complicating the situation and adding to costs is when connections must be provided for beams attaching to column webs in the vicinity of stiffeners.

Designers should not arbitrarily call for beam connections that virtually fill the "T" distance of beam webs when lesser connections will accommodate the loads.

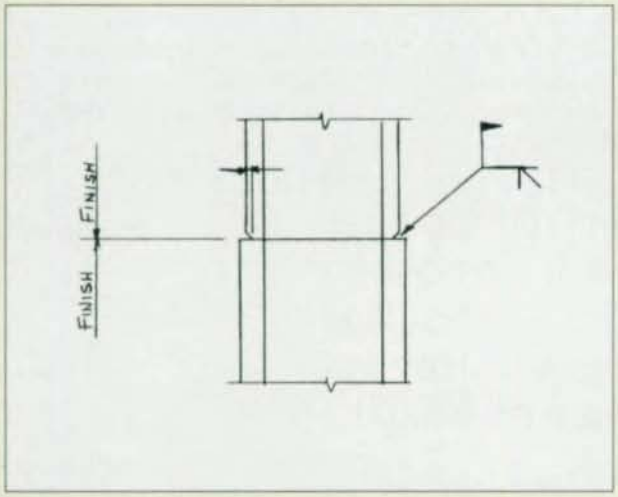
When designers run into an uncommon framing condition, they should consult a fabricator for ideas on how to solve the problem.

Designers should not call for A325-SC bolts unless they are meeting the criteria for the use of such bolts as listed in the ASTM A325 Specification. In its publications, AISC is placing more emphasis on using bearing type connections. This will be reflected in the forthcoming revised *Engineering For Steel Construction.*

Galvanizing should be limited to members whose exposure to the elements could result in structure failure from excessive rusting and/or where painting is impractical. Whether or not it is the intent of Masterspec, its wording in regards to galvanizing calls for pieces to be galvanized which do not fit the aforementioned conditions. Galvanized steel requires special fabrication and has an inherently higher cost.

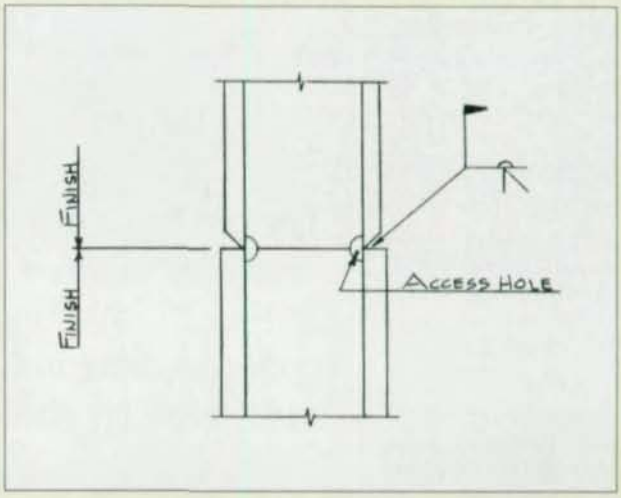
Designers should not arbitrarily include Masterspec or other standard specification sections in the design documents, as many times such sections

Partial Penetration Groove Weld



Total Cost Per Weld
$145

Full Penetration Groove Weld



Total Cost Per Weld
$350

Amount of weld in partial-penetration weld calculated using $\sqrt{t}/6 + 1/8$.
Costs include: preparation; root pass; backup bar or back gouge; cleaning of welds between passes; cut-off of run-out tab; weld material; and inspection.
Average wage rates calculated at $60/hr.

Source: Drawings courtesy of Garbe Iron Works; calculations courtesy of American Bridge

conflict with the drawings. Similarly, when designers prepare their standard details and job notes, they should present information pertinent to the project. Standard job notes should be updated periodically to reflect current industry practice.

Keep base plates and column sizes as uniform as possible without grossly oversizing.

Do not specify high strength steel "here and there"—keep it in groups, e.g. "columns" or "main girders".

Keep connections, angles, and plates as standard as possible with the fabricator allowed to choose bolted or welded.

Show steel plainly on structural drawings without blending it into the architectural design.

Thomas Schlafly, Director of Fabricating Operations & Standards, AISC:

A few sample connections should be sized at the same time that beams are sized to avoid problems such as requiring more bolts than the connection can handle.

Consider and note construction tolerances on design drawings and provide adjustments in appropriate details. For example, make embedded plates 6" to 8" larger than the beam and connect with long slots to accommodate concrete tolerances. This will allow the steel to remain in plumb even if the concrete is slightly off and will simplify curtainwall erection. Another example would be to put curb plates on in the field or to provide other means of adjustment.

Shade the pieces coming out of the page in sketches to catch interferences and difficulties with members in the "third" dimension.

A good rule of thumb to remember is that the more pieces in a detail, the more expensive it is to fabricate. ***Also, a pound of weldment is worth about $30 to $60.*** Likewise, expansion joints are very expensive and should be avoided if possible.

Rafters should be run up hip roofs rather than horizontally, if possible, because the geometry is much simpler.

Larry L. Mednick, president, with AISC-member Globe Iron Construction Co., Inc., Norfolk, VA:

Structural and architectural drawings should be co-

ordinated so they agree (e.g. on details and dimensions).

Develop details that work to minimize the required coordination between trades, such as those found in AISC's *Load and Resistance Factor Design of Simple Shear Connections* and *Allowable Stress Design of Simple Shear Connections* (for more information, call 312/670-2400 ext. 433).

Don't hesitate to ask a fabricator for alternate connection types and details that work best and minimize costs and still meet AISC-accepted procedures.

Bob Petroski, P.E., vice president/general manager/chief engineer with AISC-member Hercules Steel Co., Inc., Fayetteville, NC:

We sometimes find big discrepancies between where the architect and the engineer show steel. It is very important that drawings be coordinated dimensionally between the architect and engineer.

Too many addenda in the job stage create headaches for the fabricator. We like to see a current set of drawings when the job is issued; not a bid set of drawings with a series of addenda.

Engineers need to be realistic when it comes to welding. Don't call for full penetration welds if they're not needed. Don't call for continuous welds if you can use intermediate welds. Remember, when there's a lot of welding on light pieces, it can result in distortion.

> Try not to use a lot of different size sections to save a small amount of steel. It may cost more to buy and track the different section sizes than is saved by the reduced weight.

Engineers should show non-typical connections on the drawings so all fabricators are bidding on the same design.

I don't believe in using a lot of different size sections to save a minimal amount of steel. It sometimes costs more to buy and track the different section sizes than is saved by the reduced weight.

Eugene Miller, retired structural engineer, formerly with AISC-member American Bridge Co. and AISC-member Trinity Industries, Houston:

Don't call for full penetration welds when partial or fillet welds will do the job.

Incomplete design drawings should not be released simply to meet a schedule. In the long run, it will cause more delays as the fabricator is forced to check the designs and the detailer has to stop and ask questions.

Designers should consult with fabricators when using a special type of weldment.

When design drawings are revised, the changes should be properly highlighted on a design document, rather than presented in sketch form.

Computers shouldn't have the last word in the selection of member sizes. Designs should be pragmatically reviewed to avoid ill-working solutions, such as where a W31 frames into a W12.

Designers should write specifications for individual projects rather than simply using hurriedly adopted off-the-shelf specs.

Incomplete design drawings should not be released simply to meet a schedule. In the long run, it will cause more delays as the fabricator is forced to check the design.

Barry L. Barger, Vice President-Production, AISC-member Southern Iron Works, Inc., Springfield, VA: (these comments are excerpted from his paper, "Practical Engineering In Shop Fabrication And Erection—How It Can Benefit The Owner," presented at the 1991 National Steel Construction Conference)

Noted below are items typically shown or noted on contract drawings that severely limit or prohibit a full range of connections or may force the exclusive use of framing angles even if the fabricator is allowed to choose the types of simple shear connections for a project. In all instances, the problem can simply be overcome by showing the required reaction for the members on the contract drawings:

- Requiring 7/8"-diameter bolts when 3/4"-diameter are sufficient.
- Requiring uniformly loaded beams to carry 125% of the end reaction.
- Using friction bolts (slip-critical) when bearing bolts are adequate.
- Specifying the minimum number of double rows of bolts for each section size.
- Listing unrealistically high reaction multiplication factors on composite beams.

While it must be remembered that the engineer of

record is at liberty to be as conservative as he wishes, the above requirements will always significantly add to the project's cost and may not be in the best interest of the owner.

I would also like to give a few tips that may either make a job go easier and avoid problems. Most of them are just simple common sense, but are often forgotten.

- For erection stability, if using leveling nuts, do not use less than four anchor bolts.
- Place column splices 4' above the top of steel so that perimeter safety cables may be attached before the next floor is erected.
- If skewed hole patterns are required, try to skew them in the connection material rather than the main member.
- When a job is designed in A572 Grade 50, list the small beams (W8x10, etc.) that can use A36 so the fabricator can take them from stock.
- If making last minute changes, design in A36 so that material may be located quickly from warehouses.
- Stop stiffeners short where you can so they do not have to be fitted.

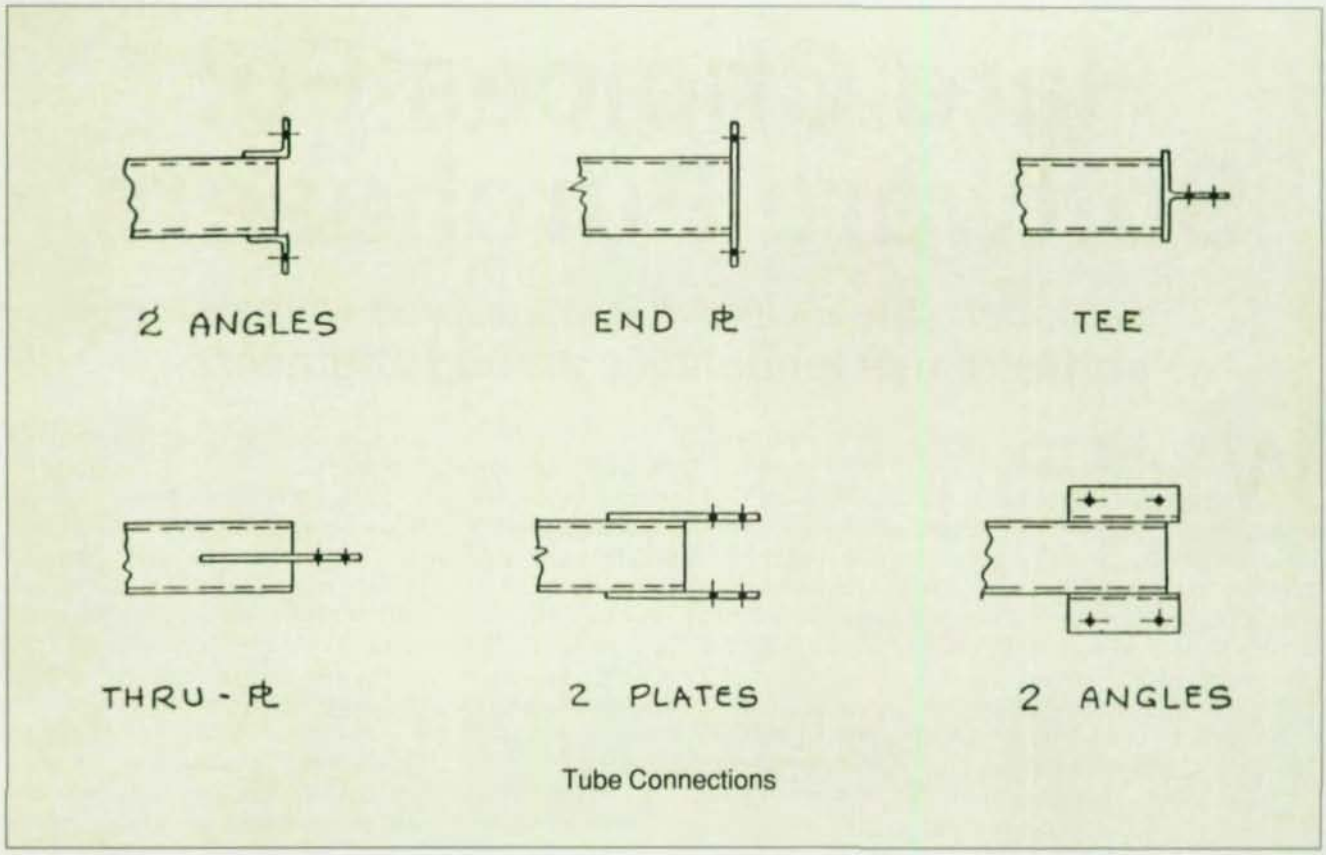
David T. Ricker, retired structural engineer, formerly with AISC-member The Berlin Steel Construction Co., Inc., Berlin, CT:

Tubes and pipes make economical column members. They are an excellent choice when stiffness about both axes is required.

They can be used as hollow members or filled with concrete. However, there is no great advantage to filling small tubes or pipe with concrete. A TS3x3x1/4 x 10' has a capacity of 37 kips when filled with concrete and 33 kips when unfilled. For larger columns, there is an advantage, though. For example, a pipe 8" standard column 12' long has a capacity when filled with 3,000 psi concrete of 217 kips, whereas the unfilled capacity is only 155 kips.

Hollow structural sections have a number of ad-

Tubes and pipes make economical column members. They are an excellent choice when stiffness about both axes is required. And they have less surface area than equivalent wide flange members.



Tube Connections

vantages over wide flange shapes:

- Tubes and pipes have less surface area than equivalent wide flange members. For example, listed here for comparison are the surface areas per linear foot of three common sizes:

W8x31 = 3.89 sq. ft.
TS8x8x¼ = 2.65 sq. ft.
pipe 8 std = 2.26 sq. ft.

This can be a significant cost factor if the members require an exotic surface coating or fire proofing.

- Tubes offer excellent resistance to torsional forces and can be used to support eccentric loads such as relieving angles for brick veneer, stone, or precast concrete.
- Tubes also make efficient bracing members. They also can be combined with other structural shapes to produce some startling aesthetic effects.
- In recent years, tube and pipe prices have become more competitive. Availability, however, is sometimes a questionmark—a fabricator or supplier should be consulted.

Flagging Changes. Changes on all plans and shop drawings issued subsequent to the date of the contract should be flagged so that revisions can be easily located. Designers, fabricators and erectors alike should observe this suggestion.

Tolerances. It is essential that erected toleraces are compatible with systems and materials being supported by the steel frame so that adjustment for the trades that follow is possible. The published fabrication and erection tolerances will usually accomplish this. However, if special tolerances are required, they must be clearly indicated on the plans.

Multiple details. Shop bolting and welding on the same beam increases material handling, an important element in fabrication cost.

Fillet welds. If possible, fillet welds should be 5⁄16" maximum, or a size that can be made in one pass. Oversized welds add unnecessarily to the cost of fabrication and erection and also may cause distortion.

Bolt uniformity. Minimizing the number of diameters and types of bolts on a given job lessens the chance for a mixup in the shop or field and allows more efficiency in drilling or punching operations.

Anchor bolts. The possibility of foundation errors will be reduced when the fewest anchore bolt and base plates sizes are used and when anchor bolt spacing is kept uniform throughout the job.

Partial depth stiffeners. Consider using partial-depth beam and column stiffeners where they are adequate rather than full-depth fitted stiffeners.

Composite beams. To make composite beams economical, at least 6 to 7 lbs. of total beam weight per stud should be saved.

Relieving angles. The thickness of relieving angles is normally 5⁄16" or 3⁄8". If calculations indicate a greater thickness than this, the basic design assumptions should be reviewed and perhaps a different approach attempted.

Odd sections. Before specifying odd sections, the designer should contact a local fabricator to determine their availability.

Hard Choices For Software Purchasers

A *Modern Steel Construction* survey reveals software use tendencies among engineers

With plummeting hardware costs adding impetus to the loudening demand for a computer on every desk, choosing the best possible software is becoming more and more critical. And unfortunately, there is no simple way to go about purchasing such an important tool.

A good place to start, however, is to invest $15 and buy a copy of ASCE's *Guide For Evaluating Engineering Software*. Though it tends to be long-winded, the 121-page softcover book more than adequately covers the many facets that must be considered before buying a software package and is a must-read for every engineering software purchaser (to order a copy, call 800-548-ASCE).

A very interesting—and all too often ignored—subject covered in the *Guide* concerns the organizational impact of the software purchase within a company. To start with, a company needs to consider why its purchasing the software. Is it to improve productivity, improve designs, allow the firm to compete for larger projects, or a combination of reasons? Also, decisions about staff responsibilities need to be made. Who will be trained to use the software? What procedures will be set up to deal with a computer hardware or software failure?

While waiting for the *Guide* to come in the mail, a prospective software purchaser should begin evaluating their own needs: For what will the software be used, and who will be using it? While this sounds like an obvious and simple task, in reality it is neither. "The user should develop a list of the types of structures and subclasses of structures they wish to use the software on," said Randall C. Corson, S.E., an engineer with Computers & Structures, Inc., manufacturer of the popular SAP90 and ETABS programs. "A program developed for the full three-dimensional analysis of a bridge structure will certainly have different operational characteristics than a program developed to size individual floor beams in a building."

> Why are you buying new software? To Improve productivity? Improve designs? Increase work scope?

Before purchasing software, it's also useful to formulate long-term plans. "The user should have some idea of the long-term role they wish the computer to play in their firm's growth," Corson said. "Is their goal to integrate all the functions they perform in the design process into a computer environment? How well do the programs they are investigating communicate with other computer software? Do they accommodate any "defacto" standards like MS-DOS Windows or AutoCAD?"

The next step, however, is simple. You need to obtain a list of potential programs. Review magazine ads and check out listings such as the one that follows this article.

Then comes the most daunting task: Evaluating the many products currently on the market. While manufacturer's literature will provide you with a brief synopsis of a program's major features, that should only be a starting point. "We try to borrow or buy the manuals first when we're considering purchasing a program," said Michael A. Grubb, assistant manager of bridge engineering with AISC Marketing, Inc., Pittsburgh. "It gives you a general feel for the technical competence of the programmers and tells you what to expect in terms of input requirements and output. And if you're very interested in the program, get a working demo version."

Amrit Das, president of Research Engineers, the producer of the popular STAAD-III program, agrees with Grubb. "Take a demo of a program in-house and see what it does. Not everyone does the same work, so the same software is not appropriate for everyone."

"The program documentation, such as the user's manual, is generally a good indicator of the quality of the software," stated Ashraf Habibullah, S.E., president of Computers & Structures, Inc. "Good documentation addresses most of the problems encountered by typical users."

Obtaining a copy of the manual also will provide valuable information about how the software is

documented. "Programs often don't tell you what processes they are using to arrive at a result," explained David L. Weaver, a building engineer with AISC, Marketing, Inc. "What assumptions are being made? What are the internal modelling assumptions? It's hard to do hand calculations to verify a program's results without knowing the processes," he said. Habibullah agreed: "The program description should clearly explain the assumptions that are built into the solution algorithms of the software, specifically, in software dealing with structural design, where it is possible for different engineers to have different interpretations of the building codes."

Similarly, an examination of the output format is helpful. A good output will provide enough information so that the input can be determined by a reviewing engineer.

The section headings in the ASCE *Guide* provide a general checklist of considerations: software purpose and intent; hardware requirements; software copy protection; ease of use; error notification and recovery; qualifications of software developer; base verification; graphical display; available user assistance; and, of course, software performance.

For structural engineering, Das believes that several specific features are extremely important. Foremost is compatibility with a CAD package. "Check if files can be loaded to a CAD package to automatically generate drawings," he stated. "It's also important that the interface work both ways so the drafting can be done first and then analyzed." Another important feature, according to Das, is whether the program checks deflection in addition to stress. Also, can the engineer use different loadings (wind, seismic, floor, moving, etc.) with the software?

Computer Use By Practicing Engineers

Modern Steel Construction recently conducted a non-scientific survey of software use and performance among its readers. Since the survey was printed in the magazine, the responses were not obtained from a random sampling, which means the results are not intended to be representative of the general readership of the magazine. Instead, the survey results are intended to be indicative of trends in the industry.

The survey garnered 386 usable responses, with the majority coming from firms with fewer than 50 employees (see Table 1). However, 28 firms with at least 1,500 employees (primarily the engineering departments of large utilities) replied. Excluding these very large firms, the average responding firm had 107 employees, including 24 engineers, 12 draftsmen and 10 architects. The composite median response was from a firm with 26 employees, including 11 engineers, five draftsmen and one architect.

Not unexpectedly, the vast majority of the respondents used IBM compatible computers. Most of these are 80386-based machines, though 80486 machines are on the increase, particularly with smaller firms who can more easily update their smaller quantity of equipment. Eight percent of the respondents (23) used Macintosh computers. While the question wasn't

Table 1: Size of surveyed firms

	Employees	Engineers	Draftsmen	Architects
1500 or more employees	664.1	86.3	33.2	19
fewer than 1500 employees	107.4	23.5	12.1	10.9
median	26	11	5	1

Table 2: Analysis programs

Bridge & Building Analysis		
Program	Rating	# of Responses
STAAD-III	3.49	128
GTSTRUDL	4.33	100
Enercalc	4.0	63
SAP90	3.73	59
ETABS	4.21	46
ECOM	3.89	27
RISA	4.0	24
Images3D	3.11	19
SAI	2.92	14
CAST	3.67	12

Table 3: Member design programs

Member Design		
Program	Rating	# of Responses
Enercalc	3.9	133
RISA	3.98	97
ECOM	3.54	24
SAI	3.54	24
RAMSTEEL	4.45	11

Table 4: Specialty programs

Specialty Areas		
Program	Rating	# of Responses
CONXPRT	3.33	15
Webopen	3.18	11

asked, many of the MS-DOS users said they networked their systems, primarily through a Novell Network. Vax-based systems also were popular, and some respondents reported they were using Apollo, Sun, and Intergraph systems.

In raw numbers of users, AutoCAD was the overwhelming favorite CAD program, with the chief competition coming from Intergraph. Respondents who stated they had Release 11 generally were more satisfied with AutoCAD then those who said they had an earlier version. This may be attributable to improvements in Release 11 or it may be that people happier with the program are more likely to upgrade it. Respondents gave AutoCAD an average rating of 4.03 on a scale of 1 to 5 and Intergraph received a 3.97. Other programs that received multiple responses included: GDS; VersaCAD; Prime; Autotrol; CADAM; GenericCAD; and AutoSketch. While not specifically inquired about, a number of respondents noted that they use a Softdesk system in conjunction with their AutoCAD system, and most were very satisfied with that system.

For building analysis, five programs dominated the responses: STAAD-III; GTSTRUDL; FastFrame; SAP90; and ETABS (Table 2). However, it should be noted that for both GTSTRUDL and Enercalc (the developer of FastFrame), the responses were increased by an independent mailing from those companies. Also, GTSTRUDL was the most popular program with large utility companies, while Enercalc's program was most popular with firms with large architectural components. Of the five programs, GTSTRUDL was rated the highest at 4.33, followed by ETABS at 4.21, Enercalc at 4.0, SAP90 at 3.73 and STAAD-III at 3.49. Other programs that received a large number of responses included: ECOM FA1C-7C (3.89); RISA-2D (4.0); Images 3D (3.11); SAI (2.92); and CAST (3.67).

The most popular Macintosh program was FRAMEmac, which was rated at 4.0. Other manufacturers or programs that received multiple responses included: Micaplus; SCADA; Algor; StruCad; Cosmos/M; Autosteel; and PFrame.

For member design, the responses were dominated by Enercalc's Structural Library and RISA (Table 3). Interestingly, a large number of respondents who use RISA programs also use Enercalc. RISA was rated at 3.98, while Enercalc received a 3.9. Also, a large number of SAP90 and GTSTRUDL users indicated they use the program for both building analysis and member design, but these responses were not separated (Enercalc's responses were separated because many respondents listed distinctly different programs from the manufacturer in each category). Other popular programs for member design included: ECOM SD1C-4C (3.54); SAI (3.54); and Ram (4.45).

Other manufacturers or programs that received multiple responses included: Hesco and Algor.

Most of the respondents were more involved in building design than bridge design. The two most popular bridge programs were Merlin, which was rated 3.33, and Simon, which was rated 4.0. Other bridge programs include MDX and SEISAB (for seismic bridge design).

The survey also asked about Specialty Areas/Connections, but this category garnered few responses (Table 4). The most frequently mentioned programs were CONXPRT, which received a 3.33 rating, and Webopen, which received a 3.18 rating. Also mentioned was Stemfire.

Listed below are the software programs mentioned in the survey, followed by a compilation of new engineering software products:

CONXPRT
Stemfire
Webopen

AISC Software
One East Wacker Dr.,
Suite 3100
Chicago, IL 60601-2001
312-670-5434

ALGOR FEA System

ALGOR Interactive Systems, Inc.
260 Alpha Dr.
Pittsburgh, PA 15238
412-967-2700

SCADA

American Computers & Engineers
11726 San Vicente Blvd., Suite 212
Los Angeles, CA 90049
213-820-8998

M-STRUDL

CAST
P.O. Box 14676
Fremont, CA 94538-4676
415-226-8857

Images 3D

Celestial Software
2150 Shattuck Ave., Suite 1200
Berkeley, CA 94704
415-843-0977

FRAMEmac

COMPUneering
113 McCabe Crescent
Thornhill, Ontario L4J 2S6
CANADA
416-738-4601

SAP90

ETABS
Computers & Structures, Inc.
1995 University Ave.
Berkeley, CA 94704
415-845-2177

ECOM FA1C-7C

ECOM SD1C-4C
ECOM Associates
8324 Steven Road
Milwaukee, WI 53223
414-365-2100

FastFrame

Structural Library
Enercalc Engineering Software
3070 Bristol Street,
Suite 640
Costa Mesa, CA 92626
714-557-9868

Autosteel

Engineering Design Automation
1930 Shattuck
Berkeley, CA 94704
415-848-7080

GTSTRUDL

GTICES Systems Laboratory
Georgia Institute of Technology
Atlanta, GA 30332-0355
404-894-2260

Hesco

Haris Engineering Software Co.
13839 SW Freeway #128
Sugar Land, TX 77478
713-545-9820

SEISAB

Imbsen & Associates
9833 Horn Road, Suite C
Sacramento, CA 95827
916-366-0632

MDX bridge programs

MDX
1412 Ridgemont Court
Columbia, MO 65203
314-446-3221

Merlin Dash

Opti-Mate
P.O. Box 9097, Dept. A
Bethlehem, PA 18018
215-867-4077

STAAD-III/ISDS

Research Engineers, Inc.
1570 N. Batavia St.
Orange, CA 92667
800-367-7373

RAMSTEEL

Ram Analysis
55 Independence Circle, Suite 201
Chico, CA 95926
800-726-7789

RISA

RISA Technologies
17900 Sky Park Circle, Suite 106
Irvine, CA 92714
800-332-7472

Softdesk for AutoCAD

Softdesk
7 Liberty Hill Road
Henniker, NH 03242
603-428-3199

P-Frame

Softek
314 East Holly
Suite 106H
Bellingham, WA 98225
604-732-3763

SAI

Structural Analysis, Inc.
555 S. Federal Highway, Suite 210
Boca Raton, FL 33432
407-394-4257

Cosmos/M

Structural Research & Analysis Corp.
161 Lincoln Blvd., Suite 200
Santa Monica, CA 90404
213-452-2158

StruCAD

Zentech
8582 Katy Freeway, Suite 205
Houston, TX 77024
713-984-9173

Structural Software

Bridge Analysis

The SAP90 Bridge Analysis Module from Computers and Structures, Inc., enables the SAP90 program to analyze bridge structures for the weight of moving vehicle loads. The user only needs to specify the types of vehicle loads, the geometry of the traffic lanes and the desired combination of traffic loads with static and seismic loads. The program will generate influence lines for each frame element, and will automatically determine the most severe element forces throughout the structure due to placement of different vehicle loads in different traffic lanes. Influence lines and the maximum-minimum envelope of element forces for each load case may be plotted; the maximum-minimum envelope for the combination of all case loads also may be displayed.

For more information, contact: Computers and Structures, 1995 University Ave., Berkeley, CA 94704 (415) 845-2177.

LRFD Design

The latest release of P-STEEL from Softek Services, Ltd., allows the design of steel structures using either the LRFD or ASD Specification. A structural model is first analyzed using the company's 2D package, P-FRAME, and then the members may be code checked and sized using P-STEEL. The engineer has complete control over all design criteria, including the range of database sections to investigate for each member or group of members.

For more information, contact: Softek, 314 East Holly, Suite 106H, Bellingham, WA 98225 (604) 732-3763.

Structural Analysis

A wide range of software products for structural engineers are offered by SAI. CONTBEAM analyzes continuous beams having up to 20 spans. Girder moments and shears are computed and may include the effects of up to 100 loadings. STEELCOL designs steel columns for biaxial gravity and wind loadings. Various combinations of wind or seismic and gravity loads are automatically calculated. BEAMANAL analyzes single span beams—with or without cantilevers—for transverse loadings and applied end moments.

For more information, contact: Structural Analysis, Inc., 555 S. Federal Highway, Suite 210, Boca Raton, FL 33432.

Metal Building Design

A new Productivity Program from Metal Building Software provides for the complete design, detailing and drafting of metal buildings. The complete pro-

Structural Software

cess takes less than 10 minutes of computer time for a simple building and less than an hour for a complex combination of buildings. The program runs on a PC within a "point-and-click" environment, making the program simple to operate.

For more information, contact: Metal Building Software, 2927 Edgemont St., Fargo, ND 58102 (701) 293-6471.

Structural Steel Library

An extensive brochure package from CAD Technology Corp. outlines more than 35 CAD application design data-base libraries, including a complete structural steel library of all AISC steel shapes. All of the libraries are available in either 2D or 3D formats.

For more information, contact: CAD Technology Corp., P.O. Box 034089, Indialantic, FL 32903 (407) 773-5142.

Structural Analysis

Intergraph's UNIX workstation-based MicaPlus is a comprehensive structural analysis, design, and drawing production family of software that includes MicaPlus Design, Analysis and ModelDraft. Engineering with the program is based on the physical model—a sophisticated 3D graphics and non-graphics database that contains complete data on each phase of the workflow. Modules may be purchased separately or as a single integrated package. The Analysis module provides capabilities for physical frame modeling and finite element-based analysis, permitting unlimited review of load cases and combinations. The Design module evaluates analysis results to design or code check structural steel and concrete members. The ModelDraft module generates engineering drawings and material reports.

For more information, contact: Intergraph Corporation, LR24A3, Huntsville, AL 35824-0001 (800) 826-3515.

Truss Analysis

Version 4.2 of TRAP-jr., an MS-DOS-based product for truss rating and analysis is now available from the University of Maryland's Bridge Engineering Software (BEST) Center. The program will perform an analysis or rating group loading of a simply

supported or continuous span truss having up to six spans, in accordance with the 1983 AASHTO Specifications and the 1984-88 Interims. Live load is automatically performed and a general truck configuration having up to 20 axles may be input for a special posting rating analysis. The program's output contains a verification of truss geometry and loading input, and includes member, cable and panel point data, truss heights, and geometric data for all members.

For more information, contact: Pat Johnson, The BEST Center, Dept. of Civil Engineering, Univ. of Maryland, College Park, MD 20742 (301) 405-2011.

Houston Instruments Driver For Windows 3.0

Houston Instruments is offering a plotter driver for Microsoft Windows 3.0 that makes all of its plotters and cutter/plotters compatible with the graphics interface program.

For more information, contact: Houston Instrument, 8500 Cameron Road, Austin, TX 78753 (512) 835-0900.

Hercules Driver For Windows 3.0

Hercules Computer Technology has released a driver for Microsoft Windows 3.0 that displays 32,768 colors on their Graphics Station line of ISA and Micro Channel video cards. The driver provides three to four times the speed of SuperVGA 15-bit color Windows drivers.

For more information, contact: Hercules Computer Technology, 921 Parker St., Berkeley, CA 94710 (510) 540-6000.

Seismic Design

AutoDesign, a PC- and workstation-based software program from Structural Analysis Technologies, integrates the complete design process, from the conceptual/preliminary design stage to final design and drafting. It includes an AISC module for the design of steel structures along with design optimization capabilities for the minimization of weight and cost. Either an interactive or automated design mode can be used. The program also includes a module for earthquake hazard analysis and development of earthquake motions at a specific site utilizing databases of earthquake faults and past earthquake history. The earthquake motions so developed can be input directly into the program for simulation of structural behavior and design. The earthquake loading criteria with respect to code requirements also can be automatically developed. The earthquake analysis portion consists of five separate modules: seismic hazard evaluation; analysis of seismic impact on a structure; structural design modifications; design optimization for minimum cost and weight; and on-line expert advice.

For more information contact: Structural Analysis Technologies, 4677 Old Ironsides Dr., Suite 250, Santa Clara, CA 95054 (408) 496-1120.

AutoCAD Enhancement

A new family of software products from Softdesk consists of modules that operate independently inside AutoCAD. The first two modules offered are: Facilities, a program that stores information linked to any graphic entity in the standard dBASE.dbf file format, allowing access to data from within AutoCAD or externally; and Estimating, a program that allows any AutoCAD user to design inside AutoCAD, directly across information from AutoCAD drawings, perform cost estimates, and incorporate necessary revisions in one integrated process.

For more information, contact: Lucy Lynch, Softdesk, 7 Liberty Hill Road, Henniker, NH 03242 (603) 428-3199.

Precise Dimensions From Plans

A software program from Bright Systems Inc. allows engineers and architects to take dimensions and data directly from plans. It uses a precision mouse provided as part of the system. Linear, area and volume measurements are calculated in imperial or metric scales. The system's $495 price tag makes it a viable alternative to more expensive digitizer systems.

For more information, contact: Bright Systems, 1453 Tallevast Road, Sarasota, FL 34243 (813) 359-3065.

Designing In Windows 3.0

The PC-based RAMSTEEL program from Ram Analysis is a specialized structural program that automatically automates steel building analysis and design and operates within a Windows 3.0 environment. Starting at the roof and working to the base using either the ASD or LRFD Specifications, the program integrates the results of the analysis of each successive floor. For complete state-of-the-art analysis of all lateral elements, the program can automatically interface with ETABS or can supply a tabularized printout of all gravity loads to members of the lateral frame. Also, the program has an automatic interface with AutoCAD and other CAD software to generate floor framing plans.

For more information, contact: Ram Analysis, 55 Independence Circle, Suite 201, Chico, CA 95926 (800) 726-1402.

Structural Software Products

Finite element analysis

The Georgia Institute of Technology's GTSTRUDL program provides interactive finite element analysis and structural design. Analysis includes both linear and nonlinear static, and linear dynamic structural analysis. More than 100 finite element types, including conventional, isoparametric, transition, axisymmetric and hybrid formulations are available. Nonlinear analysis includes transient, response spectrum, steady state, and harmonic analysis. Nonlinear analysis includes the ability to solve cable-stayed and cable net structures, tension or compression only members, non-linear spring supports, nonlinear geometry, and boundary contact problems.

For more information, contact: Michael T. Lee, Georgia Institute of Technology, GTICES Systems Laboratory, Atlanta, GA 30332-0355 (404) 894-2260.

Structural Analysis

Research Engineer's integrated structural analysis and design/drafting program offers: 2D/3D frame/plate/shell/spring elements; offset/release; UBC/moving load generation; master/slave capabilities; 2D/3D static/dynamic/P-Delta Analysis with forces/displacements at and between nodes; integrated steel/concrete/aluminum/wood design per American and Foreign Codes; and interactive graphics for model generation and post processing.

For more information, contact: Research Engineers, Inc., 540 Lippincott Dr., Marlton, NJ 08053(609) 983-5050.

Connection Drawings

Designed to meet the needs of the structural engineer, this program from ASG provides built-in standard sizes and engineering standards to ensure the drawing of accurate structural connections. The programs symbol library includes: foundation plans; structural frames; rolled steel shapes; miscellaneous steel members; metal decking; and other structural materials. Special features include: automatic weld notes; layer management; and electronic manufacturers information.

For more information, contact: ASG, 4000 Bridgeway, Suite 309, Sausalito, CA 94965-1451 (415) 332-2123.

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

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- Material considerations;
- Fire Protection;
- Coatings and material preparation;
- Structural systems.

Guidelines for Abstract Proposals

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

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

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

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

Return your abstract with this submission form before June 15, 1992 to:
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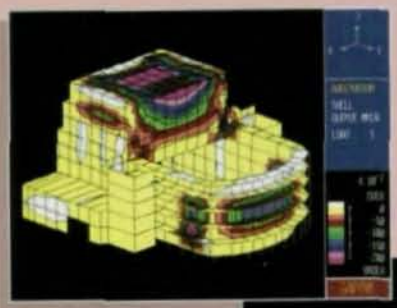

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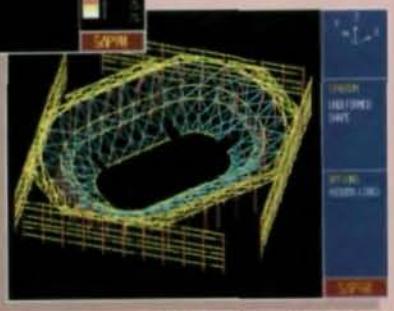
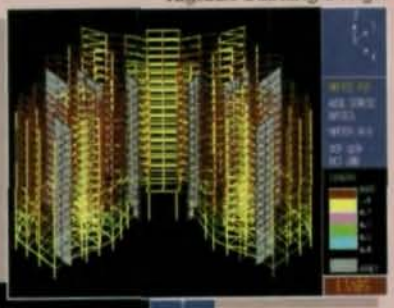


Complex Frame Analysis



Highrise Building Design

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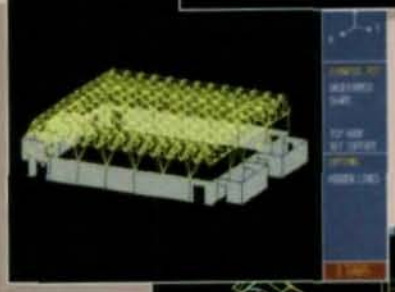

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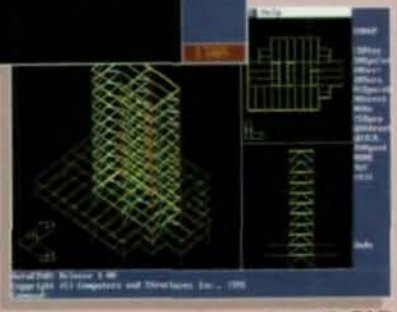

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