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MODERN STEEL CONSTRUCTION

August 1991

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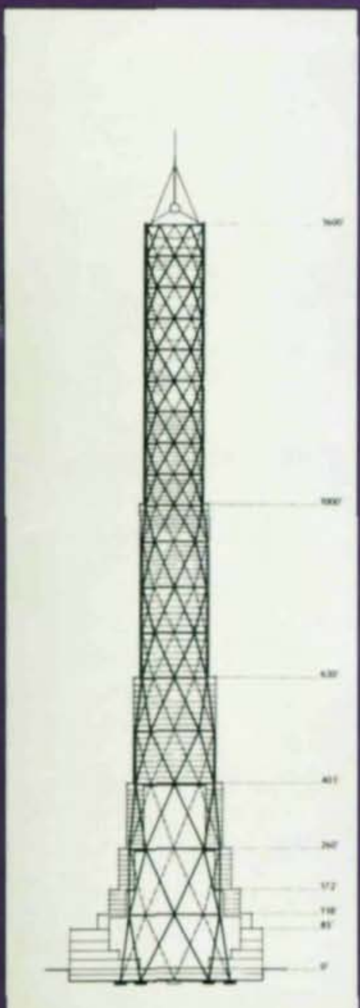
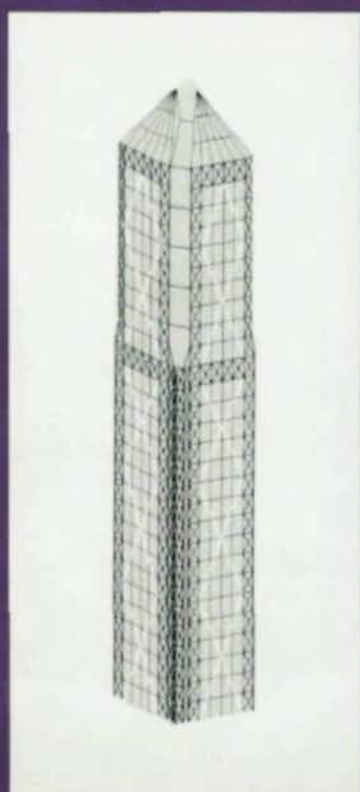
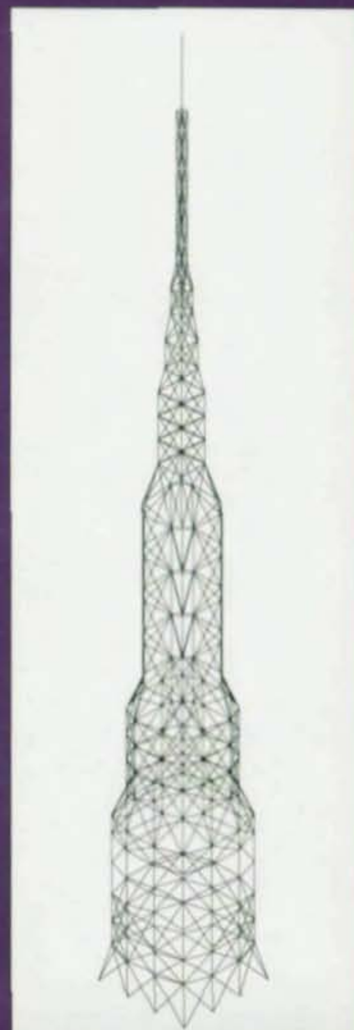


SKYSCRAPERS

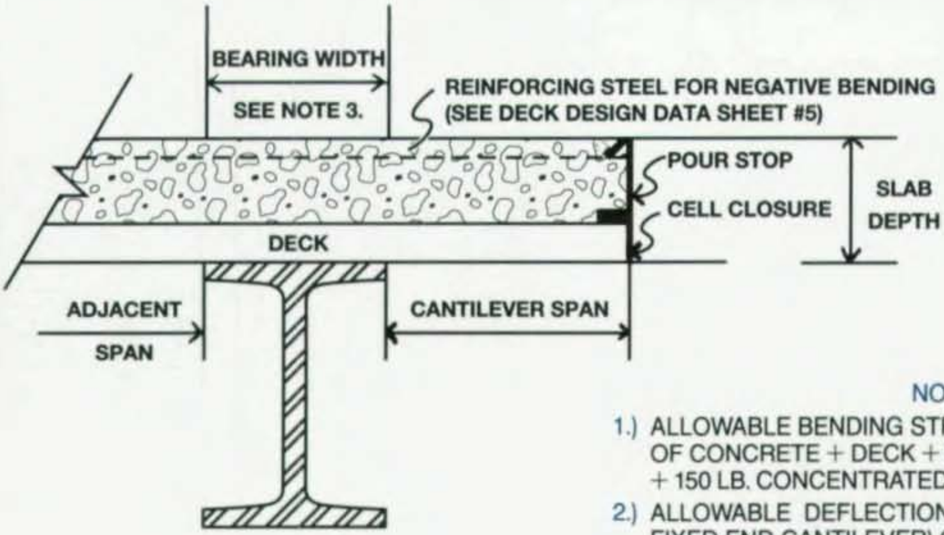




UNITED STEEL DECK, INC. DECK DESIGN DATA SHEET No. 7

MAXIMUM FLOOR DECK CANTILEVERS

FOR UNITED STEEL DECK, INC.



NOTES:

1.) ALLOWABLE BENDING STRESS OF 20 KSI WITH LOADING OF CONCRETE + DECK + 20 PSF OR CONCRETE + DECK + 150 LB. CONCENTRATED LOAD, WHICHEVER IS WORSE.
2.) ALLOWABLE DEFLECTION OF FREE EDGE (BASED ON FIXED END CANTILEVER) OF 1/120 OF CANTILEVER SPAN UNDER LOADING OF CONCRETE + DECK.
3.) BEARING WIDTH OF 3½" ASSUMED FOR WEB CRIPPLING CHECK — CONCRETE + DECK + 20 PSF OVER CANTILEVER AND ADJACENT SPAN: IF WIDTH IS LESS THAN 3½"; CHECK WITH SUMMIT, NEW JERSEY OFFICE.
4.) CALL NICHOLAS J. BOURAS, INC. ANYTIME YOU NEED DECK INFORMATION.

FLOOR DECK CANTILEVERS

NORMAL WEIGHT CONCRETE (150 PCF)

	UNITED STEEL DECK, INC. DECK PROFILE															
	1.5 IN B-LOK				1.5 IN LOK-FLOOR				2.0 IN LOK-FLOOR				3.0 IN LOK-FLOOR			
Slab Depth	22	20	18	16	22	20	18	16	22	20	18	16	22	20	18	16
4.00"	1' 11"	2' 3"	2' 10"	3' 4"	1' 11"	2' 4"	3' 0"	3' 6"								
4.50"	1' 10"	2' 2"	2' 9"	3' 3"	1' 10"	2' 3"	2' 10"	3' 4"	2' 6"	2' 11"	3' 8"	4' 3"				
5.00"	1' 10"	2' 2"	2' 8"	3' 2"	1' 10"	2' 3"	2' 9"	3' 3"	2' 5"	2' 10"	3' 6"	4' 1"	3' 8"	4' 3"	5' 3"	6' 0"
5.50"	1' 9"	2' 1"	2' 7"	3' 0"	1' 9"	2' 2"	2' 9"	3' 2"	2' 4"	2' 9"	3' 5"	4' 0"	3' 7"	4' 1"	5' 0"	5' 9"
6.00"	1' 9"	2' 0"	2' 6"	2' 11"	1' 9"	2' 1"	2' 8"	3' 1"	2' 3"	2' 8"	3' 4"	3' 10"	3' 5"	3' 11"	4' 10"	5' 7"
6.50"	1' 8"	2' 0"	2' 6"	2' 11"	1' 9"	2' 1"	2' 7"	3' 0"	2' 3"	2' 8"	3' 3"	3' 9"	3' 4"	3' 10"	4' 8"	5' 5"
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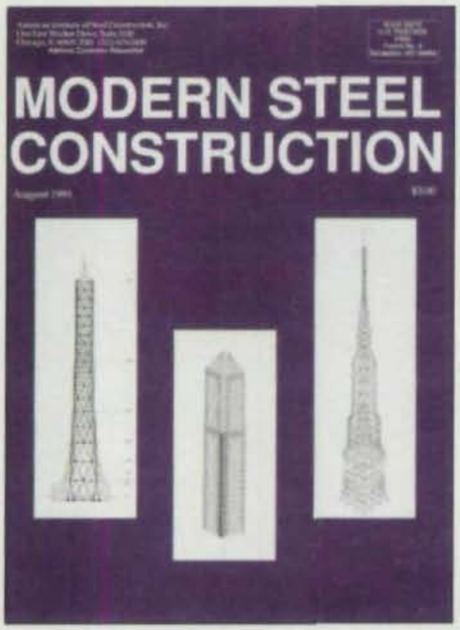
MODERN STEEL CONSTRUCTION

Volume 31, Number 8 August 1991



This month's issue of Modern Steel Construction *examines the state-of-the-art in tall building design. The story behind the newest generation of skyscrapers begins on page 11.*

FEATURES

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Criticizing Steel

It's rare to attend an AISC conference and listen to a speaker begin his talk by criticizing the Institute and the steel industry. But that's what Peter I. Yanev, president of EQE Engineering, did. And quite frankly, he has a good point.

"The steel industry has done a terrible job of promoting steel for earthquake design," Yanev stated.

EQE and Yanev have investigated more than 30 earthquakes during the past 20 years. His talk at the National Steel Construction Conference focused on buildings that have survived earthquakes—and those that haven't. He showed slide after slide of collapsed *REINFORCED* concrete structures. And he showed adjacent steel buildings—built during the same time, to the same codes—that survived with essentially no damage.

One of his favorite pictures was taken in Japan, and showed a partially collapsed reinforced concrete structure. It was only partially collapsed because it was leaning against a neighboring *UNDAMAGED* steel building.

"The Japanese have done a much better job of understanding that steel will always outperform concrete in an earthquake," Yanev said. "They have a more long-term outlook and realize that first cost is only one consideration. A building has to be judged by life cycle costs as well, and that includes what will happen in an earthquake."

And, Yanev continued, it is essential for building owners to remember the giant business costs in shutting an operation for days—or even months. Yes, concrete buildings can sometimes be repaired. But, as was the case with a building in Whittier, CA, the repair process can leave a building unusable for nine months.

And more often, concrete buildings—even if they avoid collapse—must be demolished. During his talk, Yanev showed slides of a ductile reinforced concrete hospital in Chile that exceeds the current California seismic code by 50%. Yes, it stayed up during an earthquake, but had to be torn down immediately afterward—a tremendous waste of money in an impoverished country.

"If you want to go beyond code without paying for it, go steel. What is the only building designed for Zone 2 that can survive a Zone 4 earthquake? Steel. The typical steel midwestern and eastern structures are the only ones that will handle the expected New Madrid earthquake. I'd rather be in an old steel building during an earthquake than in quite a few newer concrete structures," Yanev stated.

He concluded his talk with a very specific recommendation: "Design with steel and make it stiffer than the code requires."

It sounds like awfully good advice. **SM**

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Steel Industry Capitalizes On Recycling

Newspapers in Chicago recently reported that 5,000 tons of scrap steel from the demolition of old Comiskey Park are being recycled into new wide flange sections. While the media acted as though recycling steel was unusual, in fact it is commonplace to the point that almost all old steel in this country finds its way back to a mill. And a conservative estimate states that more than 60% of the 5 million tons of structural steel produced annually in this country comes from recycled material.

The steel from old Comiskey Park is being recycled into new wide flange sections.

Nucor/Yamato Steel Co., which is recycling the Comiskey steel in its Blytheville, AR, plant, essentially produces all of its steel from scrap metal. "In our Blytheville plant alone, we use 1.3 million tons of scrap," said Bob Johns, a sales manager at Nucor/Yamato.

Nucor/Yamato produces structural steel in an electric arc furnace, as does Lukens Steel, Chaparral Steel and Northwestern Steel and Wire Co.—which means essentially all of the structural product produced by these companies is from recycled scrap. USS, a division of USX Corp., produces nearly 500,000 tons of structural shapes in an electric arc furnace, though it uses a basic oxygen furnace for its plate steel. And even its basic oxygen furnace uses about 25% scrap metal. Bethlehem Steel Co. produces its structural steel in a basic oxygen furnace and reports that approximately 30% of its input is recycled scrap steel.

"When a building is torn down, the steel is reused," explained John Risser, USS' manager of recycling, tin mill products. "Can scrap is another good cost of low-cost scrap."

So-called "tin cans", which actually only contain 4 lbs. of tin per ton of cans, are actually composed of very high quality steel. Likewise, old automobiles and household appliances are considered excellent sources of scrap metal for steel production.

"Electric furnaces are a good way of cleaning up the landscape," Johns reported. "The increased emphasis by municipalities on recycling has been a boon for the steel industry."

According to the Steel Can Recycling Institute, the steel industry (including both structural products and other steel goods such as appliance manufacturers and can makers) is the single largest recycler in America. The steel industry consumes two times the amount of recycled material of all other industries combined—double that of paper, non-ferrous metals (aluminum, copper, lead, zinc, etc.), glass and plastics combined. During the past decade more than 500 million tons of steel scrap have been recycled—which reportedly has extended the life of the nation's landfills by more than three years.

Another little realized fact is that steel producers also recycle aluminum cans. "We've always bought aluminum wire to use during steel production, and now we're using recycled cans for part of the process," Risser reported.

The energy cost of producing steel also is declining. In 1989, the energy consumption of steel was 21.5 BTU/lb., a 36% decrease since 1972, according to the Steel Can Recycling Institute. And energy conservation is expected to continue to increase both due to increased use of cogeneration and improvements in steel making technology.

Steel Seismic Isolators Protect Against Earthquake Damage

Steel seismic isolators were recently installed in a four-story apartment building located in San Francisco's Marina District. The building had suffered extensive damage as a result of the October 1989 Loma Prieta earthquake and building repairs resulted in the construction of a new steel frame at the ground level.

"The apartment building's owner wanted to minimize building damage during future earthquakes," explained Victor Zayas, P.E., of Earthquake Protection Systems, the project's engineer and seismic consultant. "Seismic isolation was the best available means of satisfying this need without greatly increasing construction costs."

Friction Pendulum seismic isolated were installed at the bases of the new steel columns. Each Friction Pendulum isolator consists of two steel plates. Attached to one plate is a short steel column with a pivoting slider. When strong ground motions occur during an earthquake, the slider moves back and forth on the concave surface of the opposing plate in a pendulum-type motion.

Simply strengthening the building to meet current San Francisco building code levels would have protected the building in a moderate earthquake, but would have exposed the upper levels to risk in the event of an earthquake of a greater magnitude. "With the addition of seismic isolators, the building can withstand earthquake shaking four to five times stronger than the strengthened building could without the isolators," Zayas said.

In the Marina District apartment building, the isolators were designed to accommodate earthquakes of up to a Magnitude 8. Computer analyses were performed to determine the earthquake resisting capacity of the isolated building compared to the strengthened building without isolators. "Addition of the isolators reduced the damaging building distortions by 90%," Zayas said.

The isolators act as shock absorbers that decouple the building from the damaging earthquake forces. By controlling the movement of the buildings and absorbing an earthquake's energy, damage to the building is substantially reduced, both to its structure and its cladding. In the case of the four story San Francisco building, the addition of isolators meant that very little strengthening of the upper levels was required.

The 32 isolators, plus the engineering design for the isolators, represented approximately 10% of the $500,000 budget for the retrofit.

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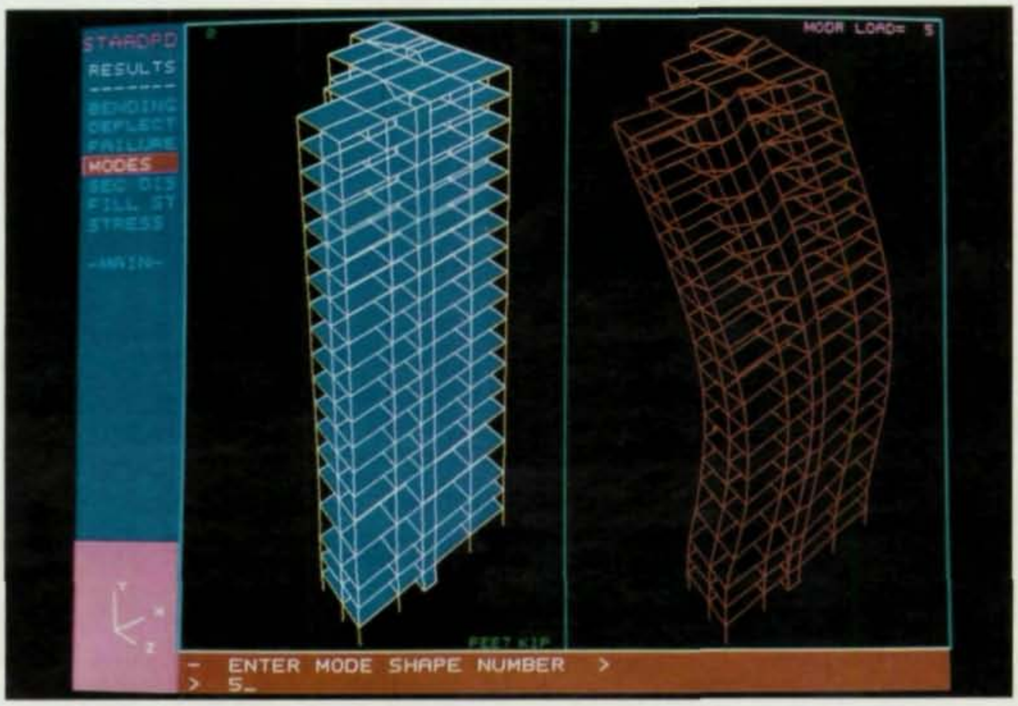

A recent (October, 1990) ENR/McGraw Hill survey of the Architecture/Engineering/Construction industry ranks STAAD-III/ISDS, from Research Engineers, as the #1 structural engineering software today.

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SKYSCRAPERS

What do Chicago, New York, Hong Kong, Los Angeles, and Houston have in common? They're the only cities in the world to boast buildings at least 1,000′ high.

Of those five cities, only Chicago and New York have broken the 100-story mark, and the last time that happened was with the opening of the Sears Tower in 1974.

A lot has happened to both engineering design and materials science during the past two decades and the next generation of supertall buildings are expected to exploit these changes. These new skyscrapers won't look like the old ones. They'll have smaller floor plates, discontinuous facades, and curved shapes.

The previous generation of tall buildings primarily boasted perimeter bracing—and that concept quickly filtered down to the design of many mid-rise buildings. And when the next generation of supertall skyscrapers are finally built, it is just as likely that many of those engineering designs will also find themselves adapted for shorter structures.

The following four articles describe some of the techniques engineers are considering for supertall buildings. The first two articles deal with buildings, one 150-stories and one 137-stories, that were designed but never built.

The third article describes a 2,000′-tall structure that is still under consideration. And the fourth article describes a 55-story composite structure—an example of the use of the next generation of skyscraper technology already put to use.

(For more information on tall buildings, contact: ASCE Committee on Tall Buildings, c/o James S. Notch, Notch + Associates, 2603 Cypress Hills Ct., Suite 200, Arlington, TX 76006-4006 or the Council on Tall Buildings and Urban Habitat, Lehigh University, Building 13, Bethlehem, PA 18015.)

SKYSCRAPERS

Mega-Structure

A New Concept For Supertall Buildings

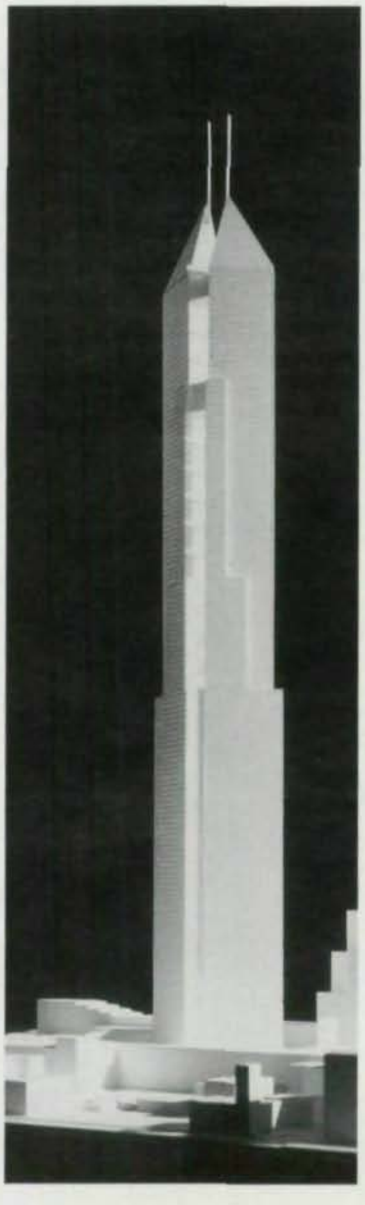
By Nabih Youssef, S.E.

Architects and engineers are planning a new generation of supertall buildings in many cities around the world—from New York to Bangkok. But the structure for this new generation of buildings should not just be an extension of the systems used in the 1970s.

Instead, these new buildings should take advantage of the latest technology for structural energy dissipation and control systems, which are capable of predicting, controlling and modifying building motion/response, and of advancements in construction technology through automated control for the fabrication and erection of large steel sub-assemblages.

150-stories

In early 1990, Albert C. Martin & Associates (ACMA) proposed a design for a 150-story, steel-framed, mixed-use project for a six block site in the mid-Wilshire district of Los Angeles. The design team was challenged in many ways by this complex project: first and foremost the architectural and engineering design for such a structure, but also by the task of developing an appropriate master plan for the multiple uses and addressing the many urban design issues generated by the juxtaposition of a supertall structure in a predominantly mid-rise commercial and residential district. Heading the design team was David C. Martin, AIA, partner-in-charge of design at ACMA and myself.



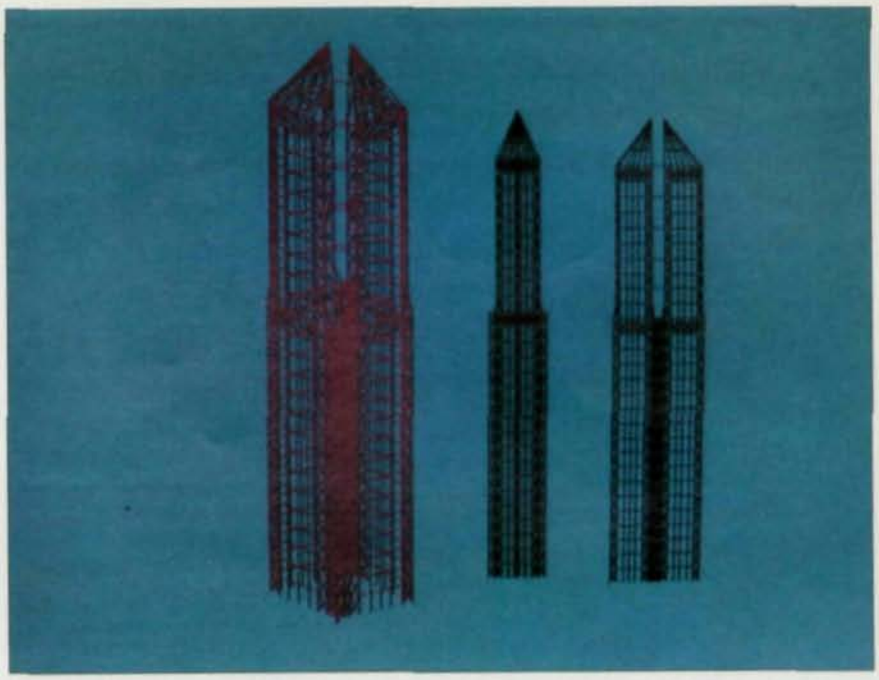
After a series of brainstorming sessions, the design team realized that this 150-story mixed-use project could set the stage for a new approach that would challenge the traditional limits of systems, materials and pre-conceived traditional forms and tower shapes. These traditional designs are represented by such well-known projects as:

- The 110-story Sears Tower in Chicago, a series of steel stepped square bundle tubes;
- The 110-story World Trade Center in New York City, a series of steel tube systems stiffened with large bracing supplemented by viscoelastic dampers;
- The 100-story John Hancock Tower in Chicago, a perimeter rectangular steel frame tube braced by large diagonals;
- The 77-story Bank of China in Hong Kong, a complete composite steel and concrete structure of triangular forms and the tallest structure in Asia.

The Next Generation

In contrast to most of these structures, the next generation of supertall buildings will be characterized by: lightness, resulting in reduced massing; slenderer structural forms, which results in reduced stiffness; and reduced natural damping.

Early in the design process a series of forms were evaluated for wind response. Obviously the design team also was concerned with earthquake safety; however, at this



tower's 2,000' height, it would be the strong "Santa Ana" winds from the desert that would govern the serviceability, human comfort, and curtain wall design of this structure.

After much review, a diamond-shaped (rhomboid) plan was developed. The genesis of the final scheme came from the idea that such a large structure need not have a rectangular plan, but might have a non-rectilinear geometric form. A single triangle, although stable, was not as strong as a four-legged structure. Thus, a diamond form was created by abutting two triangles.

Vortex Shedding

During the development of the final form, a serious concern was how to suppress the potentially severe cross-wind motion due to vortex shedding excitation so that supplemental damping values would not be required. Several methods were developed and incorporated into the final design, including:

- Altering the dynamic properties of the structure, such as its mass, stiffness and damping along the height of the building, and the change of major stiffness axes from the main axis of the building shape.
- Changing the shape and/or cross-sectional dimensions of the building towards the top to disrupt the organization of vortices and consequently reducing the lift induced response.
- Designing a series of holes/gaps/slots through the building height to disrupt the organizations of vortices, along wind gaps and across wind gaps.

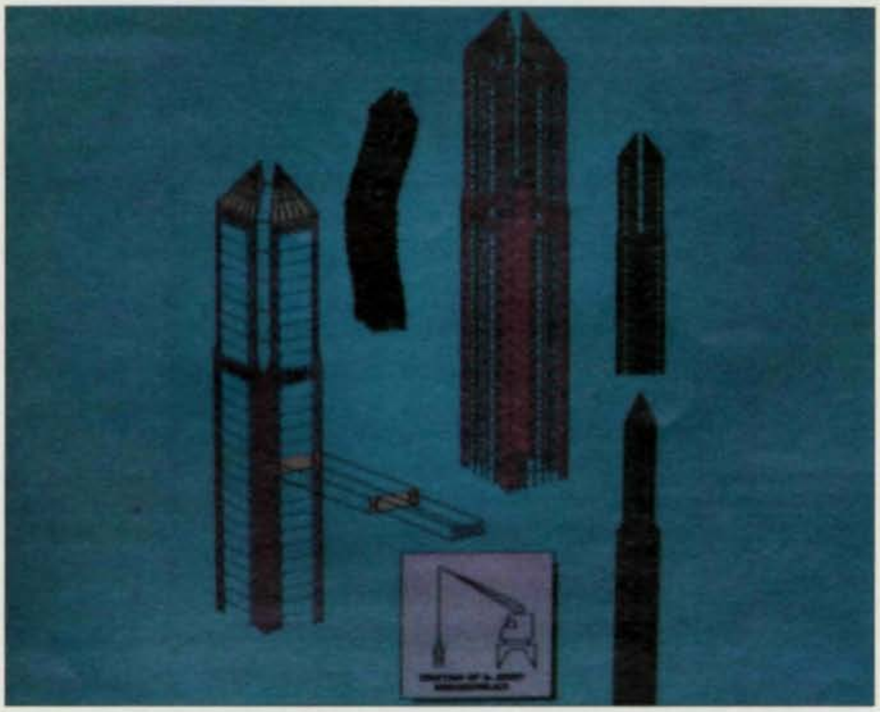
The first 100 stories of the diamond-shaped tower are used for offices. At the 100-floor level—the point of transition from office to residential use—the scheme splits to form two triangles. This splitting has the advantage of enhancing views from the residential units, as well as improving the aerodynamics of the tower. The twin-tower arrangement above the base tower offers the opportunity for viscoelastic damping elements in the connecting links every 10 floors between the towers, where maximum relative displacements between the towers are likely to occur. Finally, the scheme terminates in the form of a bisected pyramid to form a dramatic observation area.

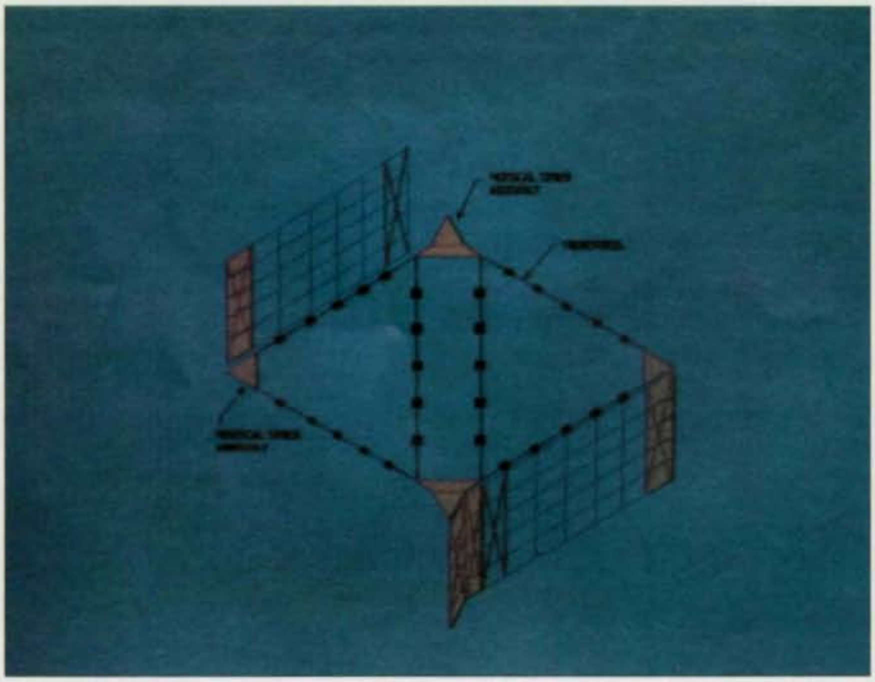
Structural Anomaly

For a structure of this size, the vertical carrying elements (columns) are of such a large magnitude that they are capable of housing a useable space/function inside their boundaries—for example, latticed column piers. The structural team's vision was of the Eiffel Tower, at least in concept rather than profile. For a 150-story tower, we expanded upon this concept of large lace/braced columns encompassing functions such as elevators, stairs and ventilation shafts and placed them on the exterior corners of the diamond shaped plan.

With the requirements of multiple-use functions in this project—including public and ceremonial spaces such as the large urban plaza, an equally large retail area at the base, a hotel with associated hospitality functions, major office space, plus the upper floor of residential space and an observation deck, it was essential to develop a global structural system that could capture the essential structural elements that have continuity through these functions and provide the global stability and housing for the different appropriately designed and fitted substructures.

This concept of global framing would allow different architectural functions and occupancies to be designed with the appropriate planning sub-module, bay size and grids, different story heights and suitable structural materials. And it allows for the possibility of a more appropriate curtain wall system. For instance, the design of the curtain wall system in the tower could be fitted with viscoelastic dampers between the frame and the wall where maximum relative movement is expected to dissipate wind and undesirable energy, with the result of a more comfortable human environment. While similar systems have been conceived analytically, methods for expedit-





ing their construction have not been completely developed.

Improved Constructability

It was of paramount concern that the global frame system not just be a response to load demands and analytical/engineering system optimization, but would also improve the structures constructability. The idea was to develop the global frame as self-stable, so that it could be erected in half the time of other tall-building systems. The Mega-Structure approach will allow for the early construction of the entire spine element that supports the vertical transportation system, as well as the incremental sky-lobbies throughout the tower.

During this initial erection phase, the infill sub-elements are fabricated and erected in the appropriate slots afterward. By setting the permanent elevators in the corners, the cost of man lifts is saved, and there is the added advantage of speeding up the movement of construction personnel and facilitating construction materials handling. The main frame will actually serve as a "rig": vertical lifting mechanisms will be integrated and the large assembly will provide staging and work platforms at different levels for the erection and construction of the sub-assemblage components.

Structural System

Five-story high construction units for the three dimensional steel truss assemblies at each corner of the Mega-Structure are initially created by rigidly tying together the truss assemblies with 80 ksi steel girders spaced five stories apart and by pretensioned diagonal bracing.

A five-story-high sub-assemblage rigid-frame Vierendeel of 50 ksi steel girders and vertical stubs is fitted and welded at the joints between the vertical three-dimensional truss assemblies in both directions (major and minor axis) provides several major functions:

- Transmits vertical and horizontal (wind and earthquake) loads applied at each level to the panel joints of the Mega-Structure.

- Supplements the local stiffness of the five-story assembly as the sequential load during construction builds up. The upper Vierendeel frame does not transfer vertical loading to the one below; it carries the gravity loads and seismic forces and transmits them to the Mega-Structure at the corners.
- Vierendeel frames transverse across the minor axis to balance the stiffness in both the major and minor directions.
- Provides an envelope to restrain the buckling of the compression members of the corner truss assembly by the shear resistance of the frame.
- Vierendeel frames exhibit a high level of energy-absorption capacity through flexural and shear yielding of vertical stubs while maintaining a stable inelastic response under severe earthquake motions.

A system of belt-trusses runs along the perimeter of the large rhomboid plan just below the setback (platform level for the upper two-towers) at the 100-story level and at the 150-story level, which is the base of the bisected pyramid at the top of the two towers.

The belt truss systems in their critical locations couple and mobilize the axial stiffness of the corner truss assemblies, which have proved to be very effective in controlling overall building sway. The lateral shears, overturning moments, and torque from wind are optimized in the structure.

Decreased Acceleration

The bisected pyramid at the top of the structure framed with the hat-trusses were designed to restrain the structural frame and increase the effective mass modal contribution at the top so as to decrease the acceleration at the upper residential floors below 15 milli-G's.

The Mega-Structure concept drives its efficiency by optimizing a dual system through integration of their best attributes, resulting in a pure three-dimensional global

Viscoelastic Dampers

Vibrational motion of tall buildings and structures can be effectively damped by the employment, at appropriate places, of mechanical dampers as nonload carrying (static) elements. Dampers are designed so that part of the mechanical energy of building motion is converted into heat, which results in a reduction of the amplitude of vibratory motion. The medium in which this transfer of energy takes place is generally either a liquid or a viscoelastic material.

In the former case, liquid is transferred from one reservoir to another through a small opening in a short time, thus generating an appreciable amount of heat and consequently absorbing and dissipating dynamic energy. The operation of this type of damper is quite dependent on the rate of loading and in general is suitable as shock absorbers.

Viscoelastic dampers are quite efficient and in most high energy damping applications are superior to other types, based on weight, economics, and size.

There are basically three methods of employment of viscoelastic material as a damping medium.

One is the direct application of viscoelastic layer to the vibrating part, such as plates or beams, where damping is accomplished by extensional deformation of the viscoelastic layer.

The second type is an extension of the first, but by adding another layer of a rigid material on top of the viscoelastic part, a constraint layer is formed. Thus, the viscoelastic material will experience both extensional and shear deformation. The damping achieved is mostly due to shear deformation rather than extensional displacement.

The third type of damper is one where nearly all of the deformation is in the shear. While all three types have some advantages and disadvantages, generally, when amounts of viscoelastic material are equal, this third type is the most efficient and is most suitable where large amounts of energies are to be damped.

(This information on viscoelastic dampers is based on a paper by Parviz Mahmoodi, Ph.D., senior research specialist at the Central Research laboratories, 3M Company.)

truss with axially stiff chords and a Vierendeel infill with highly flexural and shear yielding energy absorption capacity.

By maintaining a global load path in the Mega-Structure that transfers a large share of the floor gravity forces to the three-dimensional corner trusses that keep these elements under axial compression, we reduce/eliminate tension uplift force due to overturning (from wind or earthquake), which optimizes the cost of the frame and resolves uplift foundation problems.

A sequential load analysis is essential for this type of structure with a hierarchy of assemblies: for accurate load predictions in different system levels; design of connections; proper analysis for relative axial shortening; in-plane vertical deflections of principal elements, especially from the standpoint of serviceability performance of architectural envelopes; and, above all, for an understanding of the load path.

Preliminary Dynamic Eigen-Value analysis indicates that the structural system has a fundamental period of 16 seconds in the transverse/short direction and 12 seconds in the longitudinal direction. Also, interestingly, this structural system as laid out efficiently suppresses torsional modes until the 5th mode with insignificant mass participation.

Serviceability

A great challenge for the designers of this type of structure is meeting the serviceability criteria for human comfort while also meeting wind and earthquake resistance performance—all with no added premium. While additional damping will improve the residential top floors acceleration response, a variety of passive dampers were examined in addition to the visco-elastic. They include pendulum, tuned massing, and viscous dampers. We concluded that the active control of the building is not viable and instead proposed a series of tuned mass dampers installed at strategic locations. The number of isolators, their locations, and the mass ratios to achieve the optimum structure performance are currently being studied.

The concept of a Mega-Structure for supertall buildings not only optimizes efficiency by streamlining load path, but facilitates construction—and it does so with a positive impact on schedule and cost while improving quality and serviceability performance.

Nabih Youssef is director of structural engineering at Albert C. Martin & Associates, Los Angeles, and president of Nabih Youssef & Associates, Los Angeles. Consulting contractor was Peck/Jones , Los Angeles (Jerve Jones and Michael Randolph). □

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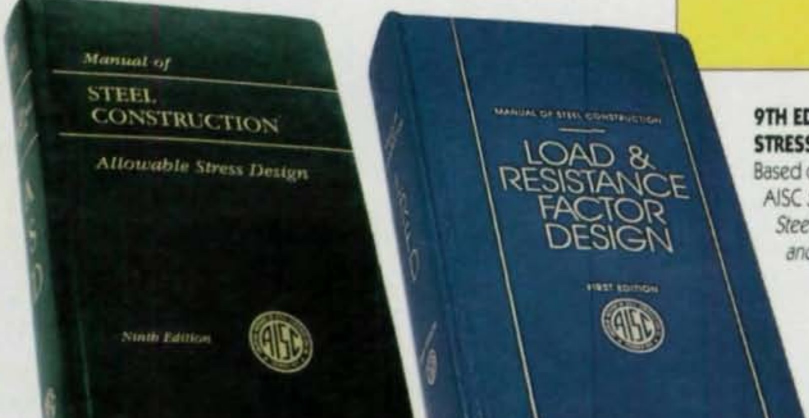

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SKYSCRAPERS

Rocketing To New Heights

Eli Attia's proposal for the old Coliseum site in New York City would have produced the world's tallest building

Is New York ready to reclaim the distinction of having the World's Tallest Building? If architect Eli Attia had his way, New York would already have wrested that title from Chicago, but unfortunately his vision was not shared by everyone, including the jury choosing from among 15 proposals for redeveloping the old Coliseum site in the heart of Manhattan.

Attia's plan was for a 137-story, mixed-use tower that would rise from its site like a rocket. The design was intended to reflect the significance of the site, which Attia called "one of the most suitable in New York for a major urban statement of civic significance and pride." And he wasn't exaggerating. In addition to its location at the convergence of major residential, commercial and cultural centers, the site also is situated in the geometric center of the city.

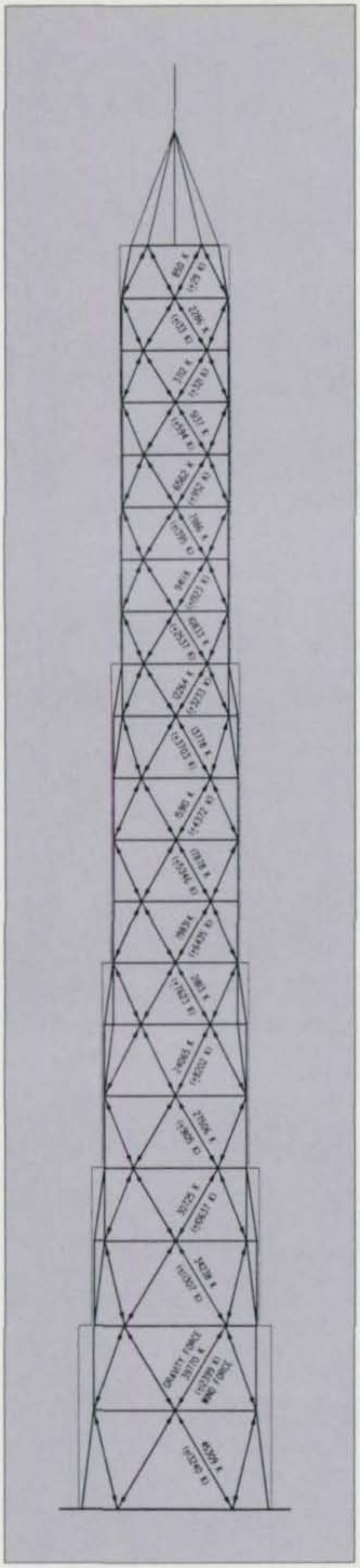
"The tower is composed of two major elements: an 85'-high arcaded granite base that covers the full site and a decagonal tower of polychrome glass that steps back to rise to a height of 1,600'. It is through these elements that the building relates to both the immediate environs and the greater urban context," Attia explained.

More important than the building's skin is its shape—a decagon, which minimizes the wind pressure loading, according to Joseph T. Colaco, P.E., president of CBM Engineers, Inc., Houston, the project's structural engineers. "The tower's profile, based on the Golden Section, is a series of seven setbacks articulated by piers and buttresses at the corners and setbacks," Attia said. The setbacks are designed so that the height of one section equals the height of the two previous sections combined, and the height of any section divided by the immediately preceding section equals 1.618.

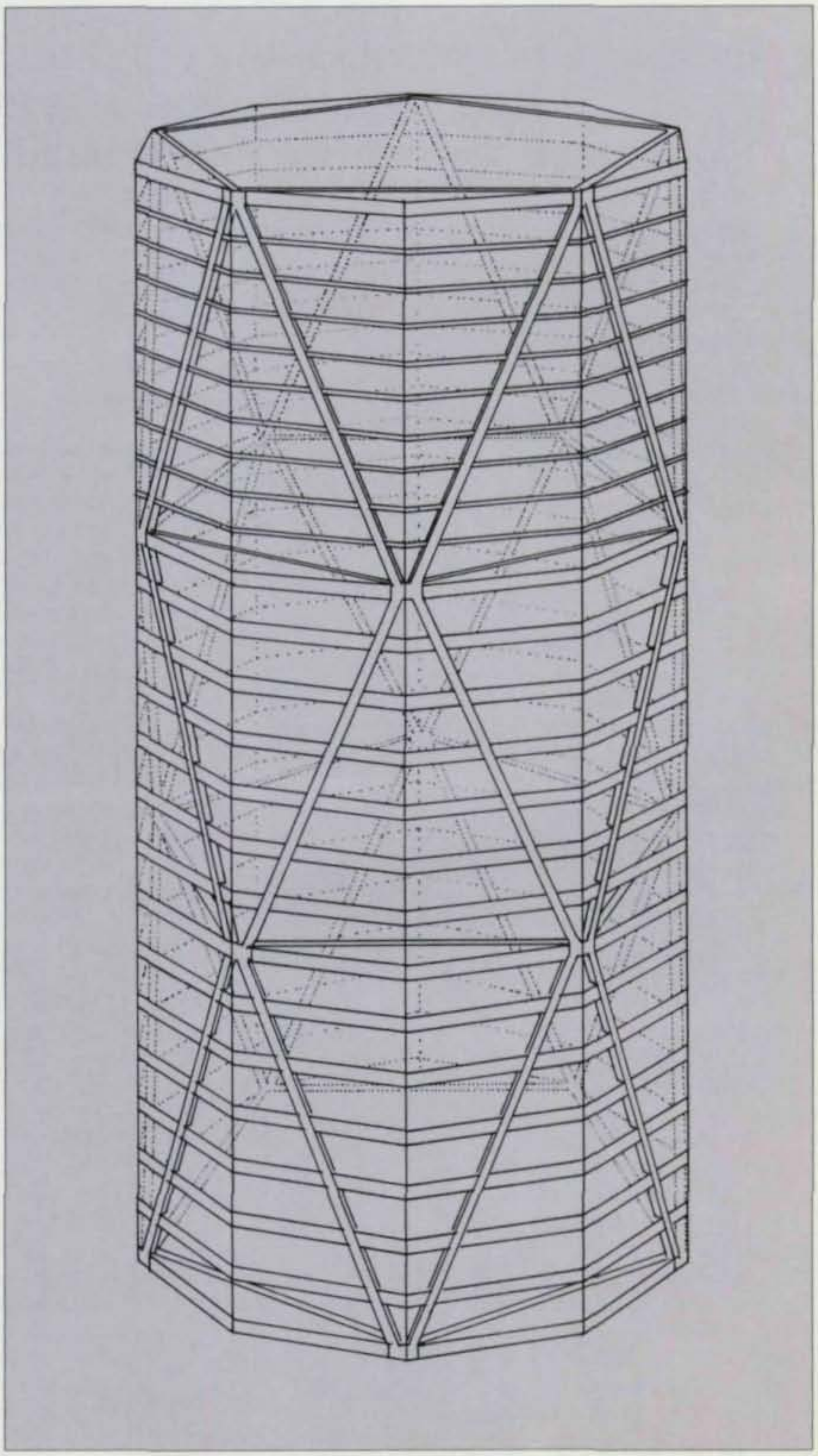
When the wind impinges on a building, it *creates wind pressures* which are defined by:

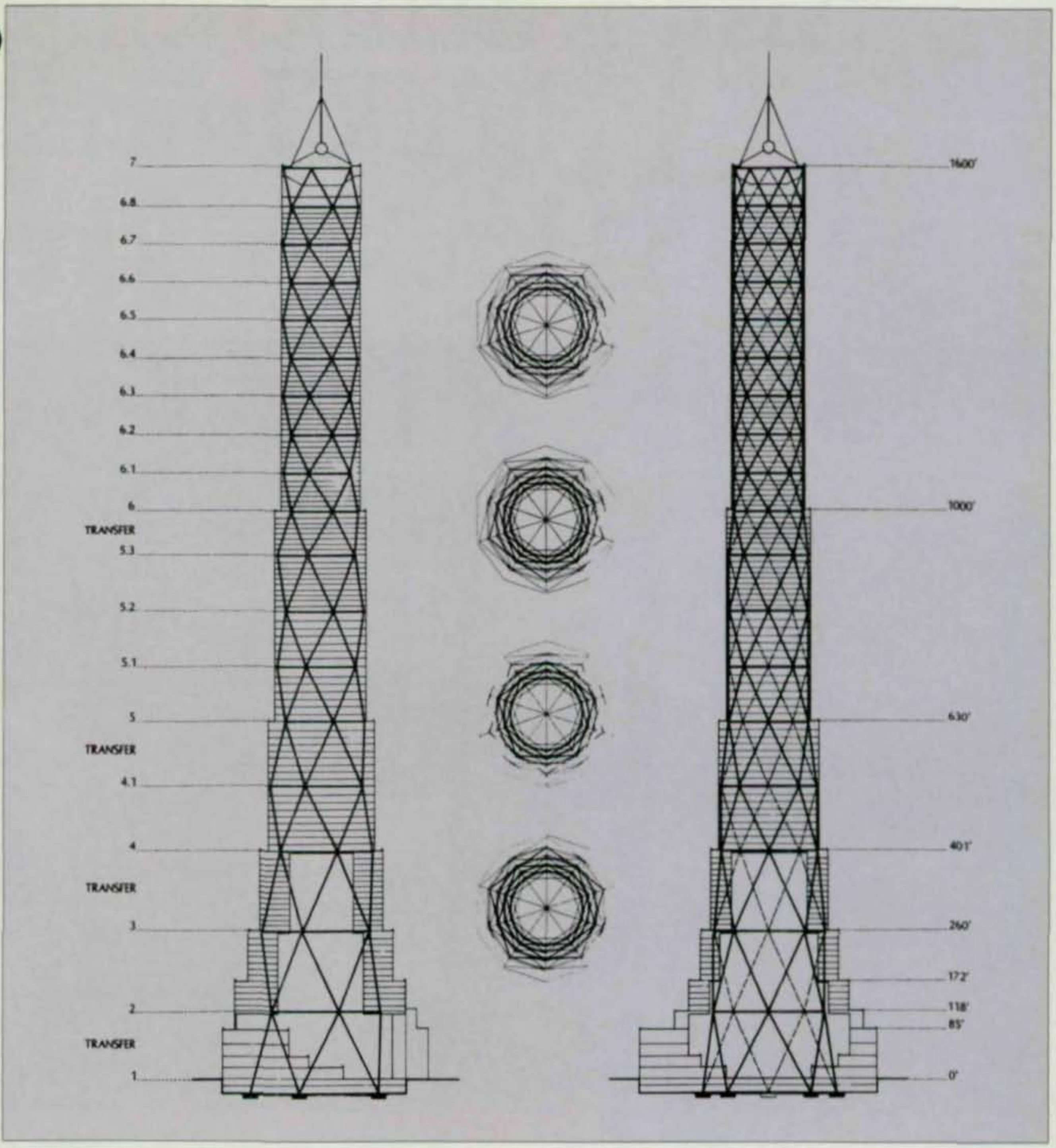
$$P = 0.00256V^2C_d,$$

where C_d is the drag coefficient and V is the wind velocity, Colaco explained. "A round cylindrical shape has a drag coefficient of approximately 0.7, whereas a rectangular shape has a drag coefficient of 1.4. This means that a round cylindrical shape has 50% of the wind load of a rectangular building."



The space truss system is composed of a series of rhomboid, or diamond, shapes.





And as a result, a less stiff structure can be designed than if it was rectangular.

Another advantage of the design of this tower is that the projected diameter of the tower is smaller at the top where the wind load is the greatest and bigger at the bottom where the wind load is least, Colaco added. "This naturally produces the lowest wind load profile."

The main structure is a peripheral three-dimensional steel truss system. "This system consists only of diagonal and horizontal members," Colaco said. Horizontal and vertical forces are resolved in diagonal peripheral members that are self-balancing by their own form. It is a very efficient method of resisting both vertical loads due to the

Continued on page 24

The height of each zone, divided by the height of the preceding zone equals 1.618 (the height of the first zone is 33.4368', the second zone is 54.1019', the third is 87.5388', the fourth is 141.6407', the fifth is 229.1726', the sixth is 370.8204', and the seventh is 600').

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weights of the floors and the wind load, which acts horizontally.

Another advantage of the space truss system is that it eliminates the need for transfer girders. All of the vertical steel members are arrange so that the entire structure comes straight down to the foundation without any removal of column at the lower levels. "Most tall buildings have some of the columns removed at the lower levels in order to have entries into the building," Colaco said. "This structural system does not have any transfer girders at all."

The system will also enhance the flexibility of the building's use. Since the location of floors is not critical to the overall structural stability, a wide variety of floor-to-floor heights can be accommodated. Likewise, future modifications are more easily accomplished.

The structure would have a conventional core, with intermediate truss floor to transfer the loads from the core to the perimeter space truss. The localized floor transfers would occur at the setbacks and would house mechanical floors.

65,000 Tons Of Steel

The initial design called for approximately 65,000 tons of fabricated structural steel, or approximately 42 lbs. per sq. ft., which compares favorably with other proposed super-skyscrapers, according to Colaco.

"Since the building is a decagon in shape, there are a great many repetitions of steel members on the floors. This will result in some economy in the fabrication of the steel members. The fewer steel pieces also will speed the erection of the tower," Colaco added.

The proportions of the building are such that building does not need devices such as tuned mass dampers to achieve a good serviceability performance. Further, with the diagonal geometry being arranged in a decagon fashion, there is no uplift of the columns at the base, and therefore the foundations are greatly simplified. □

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The 1992 National Steel Construction Conference will be held at Las Vegas Hilton Hotel June 5-8 1992. Participants will 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.

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Looking Down At The Sears Tower

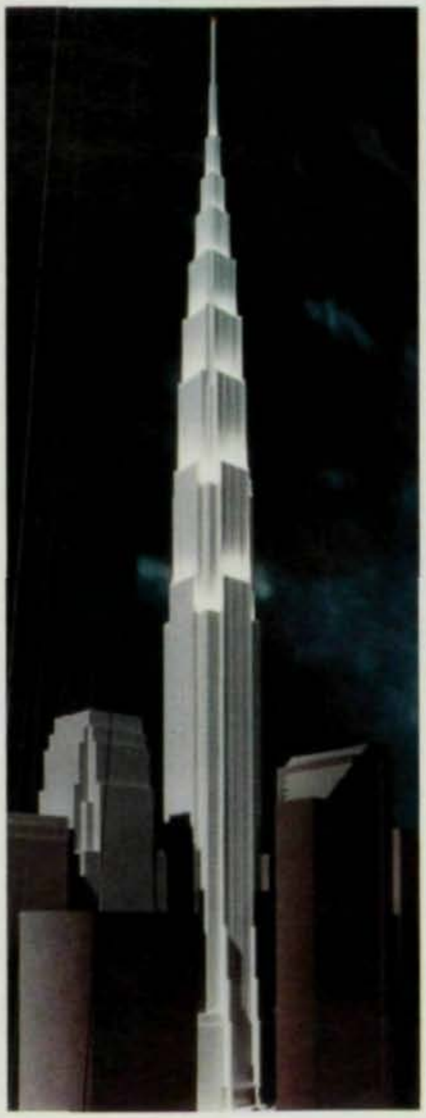
SKYSCRAPERS

An 1,486'-high observation deck in the Miglin-Beitler Tower will enable visitors to look down at the 1,454' Sears tower

By Charles H. Thornton, P.E.; Udom Hungspruke; and Robert P. DeScenza, P.E.

At 1,999'-11½" to the tip of its spire, the Miglin-Beitler Tower will provide a new cap for Chicago's skyline—while establishing new records for both the world's tallest building and the world's tallest non-guyed structure.

A simple and elegant integration of building form and function has emerged from close cooperation of architectural, structural and development team members. The resulting cruciform tube scheme offers structural efficiency, superior dynamic behavior, ease of construction, and minimal intrusion of leased office floors for this 125-story office building. But what really distinguishes it from its existing brethren in the very small family of 100+ story buildings is its relatively small plates that will enable smaller-sized firms to rent entire floors.



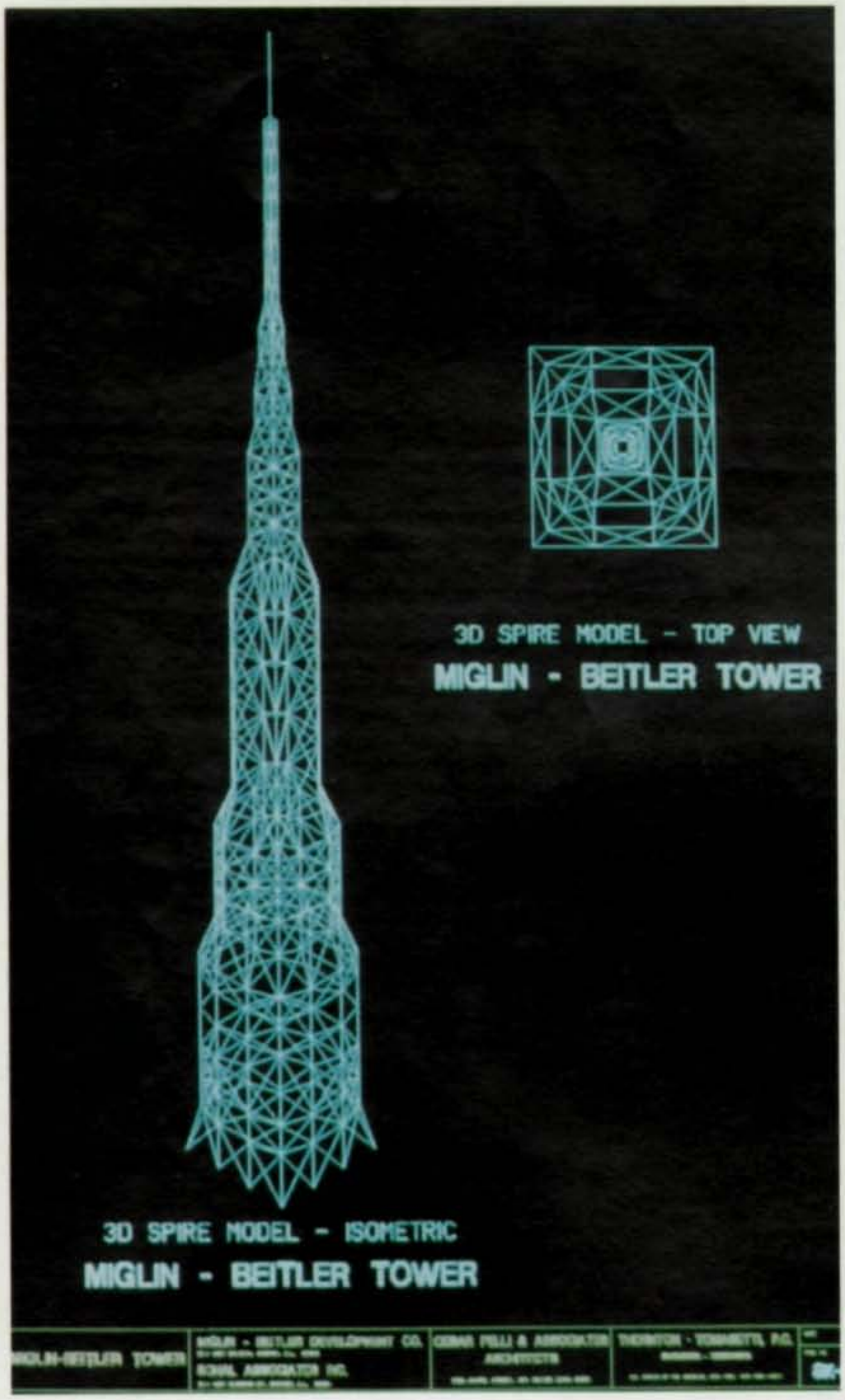
Structural System

The challenge to the design team was creating an economic and buildable structural frame capable of resisting vertical and lateral loads for a supertall building with a relatively small footprint. The challenge was met with a composite system exploiting the advantages of both steel and concrete. The stiffness of high-strength concrete was combined with the advantages of a steel floor system, including its inherent strength, speed of construction, and flexibility to allow tenant changes.

The cruciform tube structural system has six major components:

- A 62'-6" x 62'-6" concrete core with walls of varying thickness. The interior cross walls of the core are generally not penetrated with openings. This contributes significantly to the lateral stiffness.
- Eight cast-in-place concrete fin columns are located on the faces of the building and extend up to 20' beyond the 140' x 140' tower footprint. They vary in dimension from 6'-6" x 33' at the base to 5'-6" x 15' at the middle to 4'-6" x 13' near the top.
- Exterior steel Vierendeel trusses consisting of horizontal spandrels and two vertical columns are located at each of the 61'-wide faces on the four sides of the building between the fin columns. Exterior steel vierendeel trusses are used to pick up each of the four cantilevered corners of the building. These vierendeel

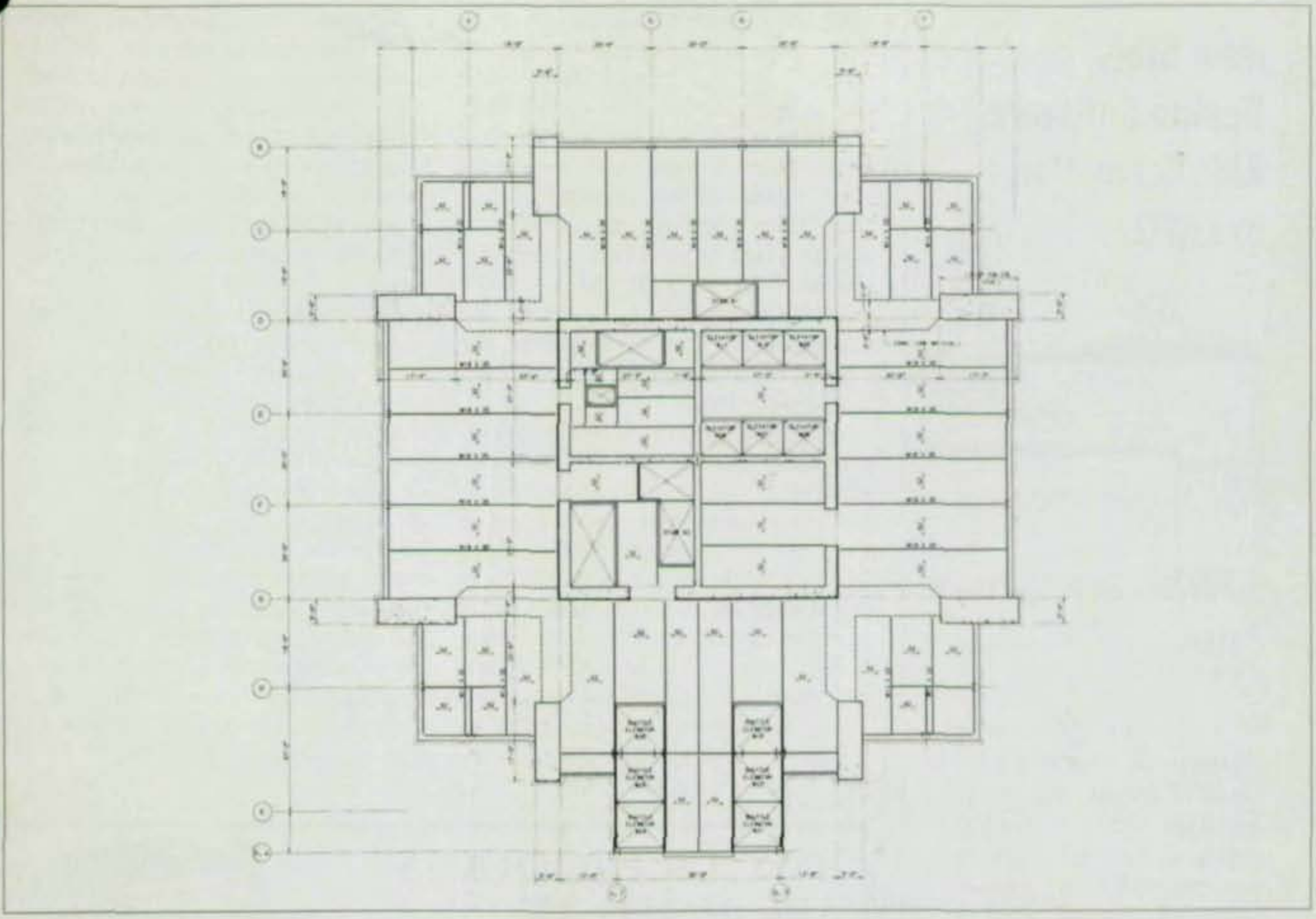
trusses provide additional resistance to lateral forces as well as improving the resistance of the entire structural system to torsion. In addition, the trusses transfer dead load to the fin columns to eliminate tensile and uplift forces in the fin columns. All corner columns are eliminated providing for corner offices with undisturbed views. Connections between the steel vierendeel trusses and the concrete fin columns are typically simple shear connections, which minimizes construction costs and expedites erection.



- Eight link beams connect the four corners of the core to the eight fin columns at every floor. These reinforced concrete beams are haunched at both ends for increased stiffness and reduced in depth at mid-span to allow for passage of mechanical ducts. By linking the fin columns and core they enable the full width of the building to act in resisting lateral forces. In addition to link beams at each floor, sets of two-story-deep outrigger walls are located at levels 16, 56, and 91. These outrigger walls enhance the interaction between exterior fin and columns and the core.
- The conventional structural steel composite floor system has 18"-deep rolled steel beams spaced at approximately 10' on center. A slab of stone concrete topping spans between the beams. The steel floor system is supported by the cast-in-place concrete elements.
- A 600'-tall steel framed tower tops the building. This braced frame will house observation levels, window washing equipment, mechanical equipment rooms, and an assortment of broadcasting equipment.

Lateral Forces

The proposed building and structural system has undergone extensive wind tunnel testing at RWDI in Guelph, Ontario. Pressure tap models, pedestrian level studies, high frequency force balance



and aeroelastic models have been used to determine the static and dynamic behavior of the project under wind loadings.

In addition to providing ample resistance to all expected wind loads, the design has received a superior performance rating in its ability to virtually eliminate occupant perception of wind movements and accelerations.

Three separate computer programs, EASE-II, SAP90, and ETABS provided parallel checks on the accuracy and adequacy of 16 independent two-dimensional and three-dimensional static and dynamic computer analyses. The parallel sets of models were compared to validate computer approaches. Static displacements and dynamic mode shapes from the two sets of analyses were in very close agreement. Overall displacements, modal shapes and natural frequencies differed by less than 10%.

Although only UBC Zone 1 is applicable, the structural system was investigated for the effects of a UBC Zone 2 earthquake and was found satisfactory.

Foundations

The foundation system proposed for this project uses caissons varying from 8'-6" to 10'-6" in diameter. Each 95'-long caisson has a straight shaft and a rock socket a minimum of 6' into competent rock. The caissons are tied together with a series of grade beams. Passive pressure on the edge of these lugs and on the projected side surfaces of the caissons provides the base shear resistance for the tower.

Steel Vierendeel Trusses

On each of the four faces of the building, steel vierendeel trusses are employed to frame the 61' clear opening between the fin columns. The trusses consist of a W36 horizontal beam at each level with two W36 verticals. To eliminate stresses produced by creep and shrinkage strains in the concrete fin columns, the verticals in the truss are provided with vertical slip connections. This has the added benefit of channeling all of the gravity loads on each of the building faces out to the fin columns to help eliminate uplift forces on the foundations.

The steel face Vierendeels are to be shop fabricated as horizontal trusses 12'-6" tall by 61' long. Field connections are simple bolted connections. This system allows for all of the welded connections to be shop fabricated, which results in an economical and elegant solution.

At each of the corners of the Miglin-Beitler Tower, the floor slabs protrude beyond the fin columns by up to 26'. Again, it was desirable to channel the gravity loads from these areas to the fin columns to help eliminate uplift in the foundations due to lateral loads.

An added challenge was to frame the corners without having a vertical element at the corner, thus allowing the corner offices unobstructed views. The solution to this problem was a vierendeel truss, similar to the face vierendeels. The corner Vierendeels are to consist of a horizontal steel beam at each level with a vertical steel beam at the center of each face, thus allowing the corners of the building to be column free. Unlike the face vierendeels, all of the vertical connections are not slip connections. This is to allow the corner vierendeels to resist unbalanced floor loads.

Topping the tower will be a 600'-tall steel-framed spire. The main structural framing consists of 12 exterior columns that cascade out at each of the setback levels. Each level of the spire contains horizontal bracing that stabilizes the structure. In addition, each of the elevations is typically x-braced, with the exception of a three-story segment at the observation levels, where the design team desired to take advantage of the views.

Several steel vierendeel frames were analyzed to come up with an optimal solution that would minimize obstructions to the 360198 view. Topping off the spire is a section of 8'-diameter steel tube. The tube is to be perforated with openings that allow for the installation of a wide range of broadcast equipment.

Charles H. Thornton is chairman and principal of the New York City-based consulting firm of Thornton-Tomasetti Engineers, New York City. Udom Hungspruke is a vice president and Robert P. DeScenza is an Associate. Associate structural engineer on the project is Cohen-Barreto-Marchertas Inc., Chicago. Design architect for this project are Cesar Pelli & Associates, Inc., New Haven, CT, and the architect of record is HKS, Inc., Dallas. Construction manager is Schal Associates, Chicago, and MEP engineers is Environmental Systems Design Inc., Chicago.

UPDATED LRFD/ASD

Computer DATA BASE for Structural Shapes

The AISC Computer Data Base has been updated to contain properties and dimensions of structural shapes, corresponding to data published in Part 1 of the 1st Edition, AISC *LRFD Manual of Steel Construction* as well as the 9th Edition, AISC *ASD Manual of Steel Construction*.

LRFD related properties, such as X1, X2 and torsional properties, are included in addition to ASD related values contained in the previous AISC data base version.

PROGRAM PACKAGE

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Composite Design Creates Slender Structure

A 794'-tall building features cut-out corners gradually tapering in to create a more elegant structure

When the Office of Irwin G. Cantor, New York City, began the structural engineering for the 55-story Mellon Bank Center, they quickly encountered a problem.

"The results of the wind tunnel tests showed us that the building had a vortex shedding problem," explained Jeffrey Smilow, P.E., a Cantor vice president. "The cross wind structural response was 50% larger than the forces stated in the building code. Consequently, stiffening of the building structure was required."

Both Cantor's office and the owner wanted the advantages inherent in a steel-framed structure. A comparison of various options for stiffening and/or damping the structure were studied by Cantor's office and it was concluded that the use of a composite structural system would be the most economical for this structure. In addition to stiffening the frame, the composite design reduced the need for fireproofing of steel members.

Cantor's office utilized finite element analysis to study the interaction of the concrete and steel in the beam column joints. Furthermore, additional information was obtained from a series of papers on the behavior of steel beams interacting with composite columns, presented at the 1988 National Steel Construction Conference in Miami Beach, Smilow reported. For more information on these papers, contact Patrick Newman, senior staff engineer, AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-5417.

Architectural Considerations

The design of the $160 million structure is primarily rectangular, with cut out corners tapering in. "The vertical face of the tower doesn't slope," explained William Louie, AIA, a partner with architect Kohn Pederson Fox Associates, P.C., New York City. "Instead, the corners taper in. A purely square tower would be a very chunky building. Also, the cut-out corners allow eight corner offices instead of only four."

The 794'-high building—Philadelphia's third tallest—is obelisk-like in form and is intended to relate to the form of the nearby City Hall. "We didn't want the building to rise straight up from the street," Louie said.

"We designed a six-story base to create a street identity. And since most of the surrounding buildings are either stone or masonry, we used granite for the base of the building." For the next four stories, granite is used in the corners of the building and glass curtainwall is introduced in the center. Above that point, the building is setback, the cut-out corners begin and the granite is replaced with a glass curtainwall. The building is topped with a protruding cornice and a pyramid hat. The pyramid conceals the buildings cooling towers and provides a sharp point in contrast to the flat buildings on either side of it. The tower portion of the building is 154' x 154'.

A construction photo of the sixth floor of the Mellon Bank Center in Philadelphia (above) reveals the sloping columns and trusses necessary to create column-free space. Shown at left are the upper floors of the 55-story building under construction.

Composite Columns

The building's lateral system is formed by the composite perimeter columns spaced 9'-8" on centers, forming a perimeter tube. Typical composite column schemes utilize the steel columns solely for erection purposes, with the bulk of the vertical load carried by the concrete. In this structure, however, restrictions in the overall size of the columns required the use of a truly shared composite system, with the concrete encasement and the steel columns both carrying significant portions of the vertical load, Smilow said.

Because Philadelphia had not yet adopted the Load & Resistance Factor Design (LRFD) Specification when this structure was designed, the composite column design was based on *A Specification for the Design of Steel-Concrete Columns*, written by the Structural Stability Research Council and published in the AISC Journal (4th Quarter 1979).

Complicating the project was that none of the 52 columns in the tower portion of the structure continues directly to the ground level. Instead, all of the perimeter columns are either sloped or picked up by trusses. The sloped column system enabled the columns to transfer into new positions allowing for the enlargement of the lower floor sizes and still maintaining column free lease space.

Depending upon the different architectural constraints, groups of columns slope at different floors, according to Smilow. "The sloped columns always form a symmetrical system whereby sloped columns on opposite sides of a floor balance out the overturning forces resulting from the slope."

In numerous cases, columns are terminated upon pick-up trusses that also are linked with their repositioned supporting columns.

A unique sloped column system occurs between the 10th and 13th floors, where the four inside corner columns are picked up on a "two-legged tripod." Each "two-legged tripod" generates significant lateral forces that are all balanced out by again balancing one corner against the opposite end. The floor diaphragm, being the link between all columns, plays a key role in transferring these balancing forces across the floor, Smilow said. "The most critical diaphragms are the 5th and 6th floor diaphragms where in addition to supporting most of the sloped columns, the lateral wind forces are transferred

A unique sloped column system occurs between the 10th and 13th floors of Mellon Bank Center, where the four inside corner columns are picked up on a "two-legged tripod." Each "two-legged tripod" generates significant lateral forces that are all balanced out by balancing one corner against the opposite end.

from the perimeter to the core vertical truss," he explained.

With some sloped columns generating 450,000 lbs. in lateral force, the designers chose to place a 44'-deep steel horizontal truss within the floor diaphragm. These trusses help transfer the wind forces to the core while passing the sloped column forces around the core to the opposite sloped columns.

A vertical super truss is located at the core that extends from the foundation up to the 6th floor. The super truss is constructed of steel wide flange shapes with the four corner columns being encased in 10' x 10' x 2' thick L-shaped concrete shear walls, thereby forming a composite steel and concrete super truss.

The super truss is divided into two part: a large 45'-high truss between levels three and six; and a single X truss on each face of the core, extending from the 3rd level down to the foundation.

"The transfer of lateral loads out

of the perimeter and into the core at the 6th floor from an optimum combination of the core and perimeter systems," Smilow said. "Transferring the wind lateral forces to the core at the 6th floor results in zero uplift forces upon the foundations."

Sloped-Columns

Further complicating the design are sloped columns throughout most of the tower portion. Because the cut-out corners taper in above the tenth floor, 12 columns per floor—three at each corner—slope about 3" per floor.

To reduce erection time and minimize field welding, the columns were fabricated as trees by AISC-member Owen Steel Co. The fabricator used AISC-member Lincoln Electric's Verti-Shield system to substantially cut welding time. The Verti-Shield system deposited 40 lbs. of weld metal an hour and allowed the fabricator to create vertical welds in one pass.

Perimeter column sizes ranged from W14 x 400 wide flange shapes at the base to W24 x 76 wide flange shapes near the top. Beginning at the 6th floor, the engineer used WTM22 shapes from TradeARBED. The shapes vary in weight but average 24" in depth. "The deeper the member, the better the bending capability, which is why we chose to use the TradeARBED shapes instead of conventional W14 shapes," Smilow said. The WTM22 shapes averaged between 182 and 269 lbs. per ft. With conventional steel members, the same weight member would only have been 16" in depth. "By using the WTM22 shapes, we had the same weight but a greater depth, thereby increasing the bending strength."

Steel floor framing was used because of the building's 44' clear spans and the anticipated large number of tenant modifications. "A lot of the space was not leased prior to construction. After construction was complete, we came back and did a lot of tenant modifications such as interconnecting stairs between floors," Smilow said. The project used 16,000 tons of steel.

The pyramid at the top of the structure is made up of steel hollow structural sections. The tubes vary from 12" x 12" to 16" x 16", with some 12" x 16" tubes. "The design is a series of triangles with a localized interior triangle, in essence a three-dimensional truss," Smilow said. The structure was then covered with a metal panel system.

Mellon Bank Center was the first use of composite column construction in the Northeast. "The innovative structural system met our requirement for column-free tenant space and minimized core areas," explained Everett W. Custer, development director for Richard I. Rubin & Co., the project's developer. "The successful completion of the Mellon Bank Center adds a dramatic new dimension to the skyline of Philadelphia." □

NEW PRODUCTS

Pipe Cutting

Vernon Tool employs a basic IBM-AT processor to tackle complex cutting requirements. The electronic control of this simple, field-proven machine features closed-loop servo drive and encoder feedback for unerring precision. Accurate fit-up reduce time spent on manual measurement, grinding, and filling. The microprocessor control offers on-line and off-line programming, from 2- to 6-axes controls, and full data display for easy programming.

For more information, contact: Jim Blackburn, Vernon Tool Company, 503 Jones Road, Oceanside, CA 92054 (619) 433-5860.

Acoustical Plaster

GRACE has introduced a new fire-rated spray-applied acoustical plaster, Acoustikote Type AK-1. The product offers excellent noise reduction characteristics and has a light reflectivity value in excess of 80%. Its fireproofing quality can be used to obtain hourly fire ratings to meet all fire resistance code requirements on structural steel. In addition, Acoustikote, being cementitious, has excellent durability and in-place physical properties. The product is designed for applications in areas where a continuous, monolithic textured ceiling finish is desired, such as in convention centers, hotels, auditoriums, schools, correctional facilities, and transportation terminals.

For information, contact: Marketing Communications Depart., GRACE Construction Products Division, 62 Whittemore Ave., Cambridge, MA 02140 (617) 876-1400.

Detailing Software

Design Data has upgraded several components of its SDS/2 computer-aided system for the structural steel industry. The updated Estimating Modules provides an enhanced multing program allowing more control when satisfying material requirements and multing items with camber, straightening, and mill ends. Also, the user can control report format, choosing to display, direct to a disk file, and/or print a report. Version 5.1X of the Detailing Module provides support of WT and channel members used in vertical framing, enhanced project sequencing, and expanded setup parameters to allow greater control and flexibility. Also, an automated stair program was added. Also updated are the Production Control Module and CNC Interface Module. The company also is offering DesignLink, which is capable of downloading engineering data, including building geometry, member size, rotation and loads to the SDS/2 fabrication package.

For more information, contact: Design Data, 1033 O St., Lincoln, NE 68508 (800) 443-0782.

Portable Punches

E.G. Heller's Son, Inc., has introduced a new line of portable punches. Instead of having to transport a steel beam, angle or plate to a hydraulic punch, the portable punch can be moved to the beam. The punch capabilities include: maximum punch diameter of 1 1/16"; maximum plate thickness of 11/16"; output of 48 tons; punching stroke of 1"; throat depth of 4.33"; punch time of 8 seconds; and automatic or manual operation. The portable punch offers quick changes from one diameter to another and a suspension spring for a crane hook to assist in moving the punch.

For more information, contact: E.G. Heller's Son, 18330 Oxnard St., Tarzana, CA 91356-1502 (818) 881-0900.

Engineering Calculator

Jobber Instruments is offering an all new dimensional engineering calculator that works in feet, inches and sixteenths and converts to decimal or metric. The patented 0 to 15 keyboard is the key to easy operation, allowing a user to add, subtract, multiply in feet, inches and fractions without converting decimals. Jobber III has many new features, including: built in trig functions in all three modes; five additional memories; direct triangle solutions; retains all data when calculator cuts off; and metric conversions.

For more information, contact: Jobber Instruments, P.O. Box 4112, Sevierville, TN 37864 (800) 635-1339.

Steel Punches

A complete new line of punches, dies and shear blades for Angleline, Beamline, and Portable punches is being offered by the American Punch Co. Standard punches with matching dies are offered in round sizes from 1/8" to 1 1/2" in 1/32 increments. Oblong, square, hex and rectangular shapes also are available. All are produced from the finest quality tool steel, heat treated and precision machined to close tolerances.

For more information, contact: The American Punch Co., 685 South Green Road, Cleveland, OH 44121 (800) 243-1492.

Steel Tubes

The largest selection of custom tubing sizes just got larger. Valmont/Tulsa has increased the size range of their Jumbo Twin Weld (SAW) Tubing line. Now available are all the odd, even, and in-between sizes from 12" x 8" x .313" wall to 30" square x .750" wall. Furthermore, most tubing sizes are now available in lengths to 60', without a splice. The company specializes in producing unusual tubing sizes and shapes.

For more information, call Valmont/Tulsa, Jumbo Twin Weld Department, (800) 331-3002.

NEW PRODUCTS

Steel Detailing

Computer Detailing Corp. announces the release of Version 4.0 of BEAMS and COLUMNS, a program for detailing structural steel with AutoCAD. Almost all of the original routines have been revised. Some of the new features include a drawing management system and a Bill of Material generator that can be used as a stand-alone program. All fittings are created parametrically, complete with dimensions. In addition to creating fabrication drawings of structural members, the program can be used by Miscellaneous Metal Fabricators for detailing stair stringers and other building components.

For more information, contact: Computer Detailing, 1310 Industrial Blvd., Southampton, PA 18966 (215) 355-6003.

Structural Design

AutoDesign, a new integrated structural analysis program from Structural Analysis Technologies for PC and Workstation platforms, incorporates Artificial Intelligence into the design process. It is the first software that contains an ADS-based module for the development of a structural analysis module from inside AutoCAD. Iterative cycles of structural analysis and design can be automatically carried out, with interactive design and optimization (weight minimization) capabilities. The program includes an AISC module for the design of steel structures along with design optimization capabilities for minimization of weight and cost. An interactive or automated mode can be used. It also includes a unique module for earthquake hazard analysis.

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

Direct Drive Blast Wheel

Pangborn has introduced a new 240-DD direct drive Rotoblast wheel. Reported to give 6-13% higher abrasive velocity for faster cleaning, this new blast wheel contains only five wear plates in its solid manganese housing. It also uses newly patented Rotoflare vanes for broader abrasive coverage on the work. This wheel is available on new equipment as well as a retrofit to most blast machines currently in operation.

For more information, contact: Debbi Price/Sandy Huntsberger, Pangborn Corp., P.O. Box 380, Hagerstown, MD 21741-0380 (800) 638-3046.

Structural Analysis

Softdesk, Inc., has released a new software product, the Structural Modeler, which provides an interactive environment for developing structural analysis models inside AutoCAD. The Modeler creates completely defined models with members, supports, properties, and loads. It provides a bi-directional communications link with the STAAD III analysis packages. Interfaces with two other analysis packages, SAP90 and AutoSTEEL are in development.

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

Flux Recovery System

Weld Engineering has introduced the new Mighty-Might AS-4 flux recovery system. The product is an inexpensive, rugged and powerful submerged arc flux recovery system. It mounts easily onto most automatic submerged arc welding equipment. It is a versatile system with quick attach options.

For more information, contact: Weld Engineering Co., 6 Depot St., South Grafton, MA 01560 (508) 839-9875.

Pipe Notching Machines

Almi Jancy pipe notching machines allow inexpensive productive notching of all types of pipe and tubing while ensuring that the pipe is notched quickly and accurately the first time. With this system, filing and grinding become unnecessary. It is available in manually operated and electrically driven models. The notchers are portable and a single unit can notch several diameters of pipe with no changes or attachments.

For more information, contact: Jancy Engineering, P.O. Box 3098, 4616 Kimmel Dr., Davenport, IA 52808 (319) 326-6251.

Tube Steel

Welded Tube Co. is expanding its production of tube steel. The company produces structural tubing in both squares (2" through 16") and corresponding rectangles (10" to 20 " N.H.T.). The company's KleenKote product is designed to reduce the cleaning and paint preparation stage of manufacturing. The tube is cleaned and primer coated with weldable, non-toxic paint.

For more information, contact: Welded Tube Company of America, 1855 East 122nd St., Chicago, IL 60633 (800) 733-5683.

70 KSI Steel

USS, a division of USX Corp., has introduced the new USS COR-TEN B-QT Steel (ASTM A-852), quenched and tempered to provide 70 ksi (480 MPa) minimum yield strength. This new steel grade was developed by USS to close the

NEW PRODUCTS

gap between the 100 ksi and 50 ksi yield strength steels used in plate for bridge construction. COR-TEN B-QT is weldable utilizing shop and field methods similar to those required by 50 ksi COR-TEN B Steel (ASTM A-588, Grade A). COR-TEN B-QT is a weathering steel with greater atmospheric corrosion resistance than carbon steel. By following the FHWA guidelines for the use of uncoated weathering steel, it virtually eliminates the need for painting, which potentially provides substantial cost savings.

For more information, contact: USS, a division of USX Corp., P.O. Box 86, Pittsburgh, PA 15230-0086.

AISC For AutoCAD

This program runs in AutoCAD (Release 10 and above) and draws structural steel shapes and lists their properties corresponding to data published in Part 1 of the 1st Edition, *AISC LRFD Manual of Steel Construction*, as well as the 9th Edition, AISC *ASD Manual of Steel Construction*. The program will draw to full scale the end, elevation, and plan views using the design dimensions of the following shapes: W, S, M, and HP Shapes; American Standard Channels (C); Miscellaneous Channels (MC); Structural Tees cut from W, M, and S Shapes (WT, MT, ST); Single Angles; Structural Tubing; and Pipe.

Other software offered for sale by AISC include: AISC Database, which contains the properties and dimensions of all the structural shapes corresponding to data published in Part 1 of the AISC *LRFD Manual of Steel Construction* as well as the 9th Edition *ASD Manual of Steel Construction*; CONXPRT, a knowledge-based PC software system for the design of steel building connections; WEBOPEN, a program for designing web openings in steel and composite beams; and Stemfire, which determines safe and economical fire protection for steel beams, columns and trusses.

For more information, contact: AISC Software, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-5434.

Steel Deck Attachment

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

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

The Third National Symposium on Steel Bridge Construction is a program that offers eminently qualified speakers presenting current practices dealing with steel bridge construction. More importantly, it will deal with the co-relation of design techniques, fabrication, detailing and erection principles. The theme is: "To create a dialogue between owners, designers and builders to enhance the economy, quality and reliability of steel bridges."

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For more information:

Complete this form and send it to: The American Institute of Steel Construction, Inc., One East Wacker Dr., Suite 3100, Chicago IL 60601-2001, Attn: Lewis Brunner.

Name: ____________________

Affiliation: ____________________

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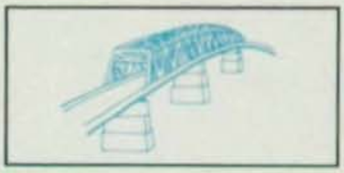
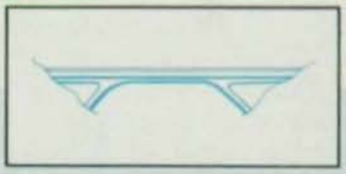
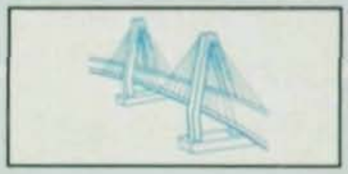
Or call Lewis Brunner at (312) 670-5420.







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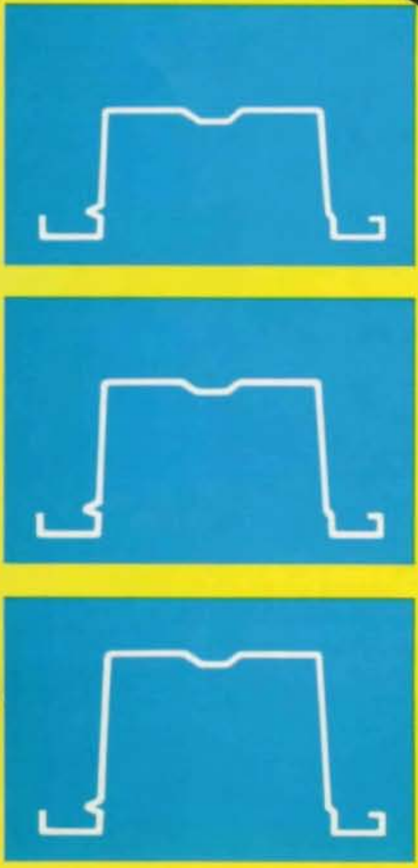

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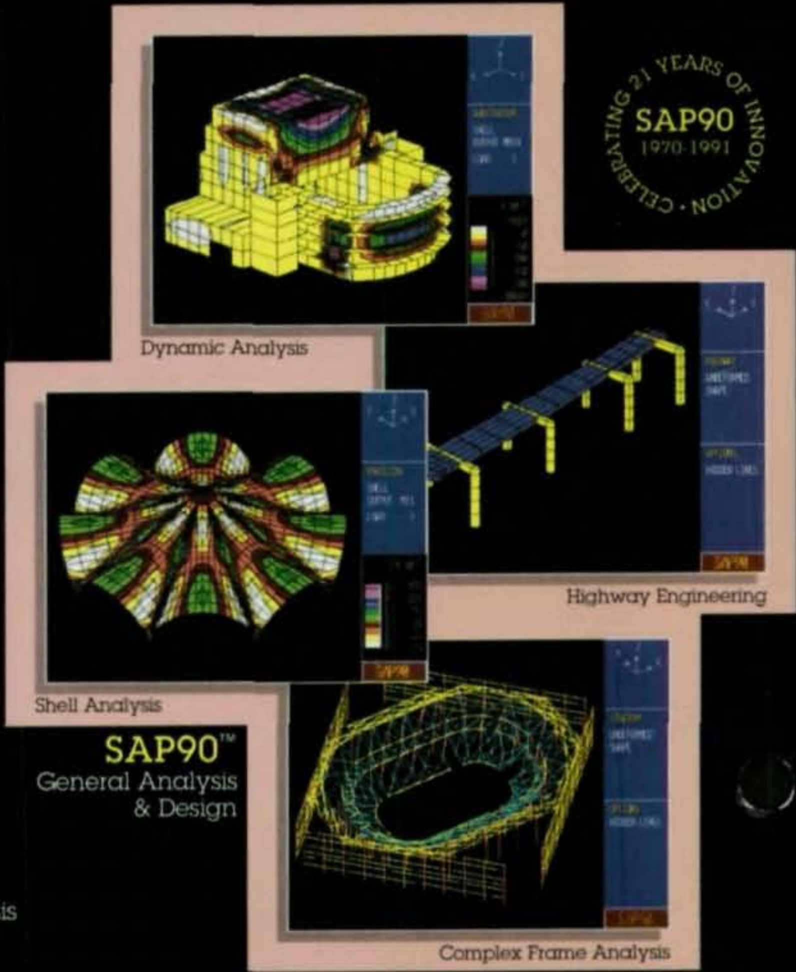

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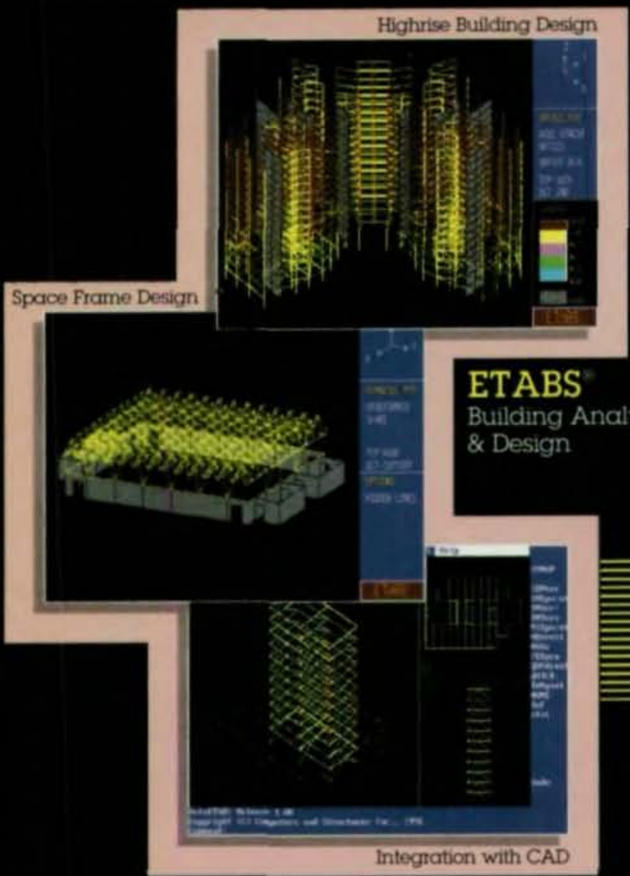

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