

A Reinhold Publication





The new Oliver Wendell Holmes Junior High School in Colorado Springs, Colorado, sits in the shadow of the Rockies. The sleek, modern lines of the building contrast beautifully with the rugged, ages-old mountains. **Architect:** Higginbotham-Nakata and Muir, Colorado Springs. **General Contractor:** Bruce Hughes, Colorado Springs. **Flooring Contractor:** Denver Building Supply Company, Denver, Colorado.

The real test of any floor is how good it looks with little maintenance. Experience in all kinds of buildings around the country proves that Armstrong Excelon Tile stays sparkling clean and beautiful with minimum care.

建筑



# The floor plan of a junior high



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The ground rules: a budget-priced floor that **SChool.** The architects' choice: Armstrong Excelon® Tile. Cover photo: American Iron and Steel Institute



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## STEEL

A roundup of developments in steel and steel design over the past decade is a guide to current steel technology and its use by some of the country's oustanding architects and engineers. 134

THIS MONTH

Progressive Architecture® October 1969

**MODERN STRUCTURAL STEEL:** Within the past 10 years a proliferation of new structural steels has appeared. P/A describes what the new steels are, their characteristics, advantages, and properties. **136** 

SHEET AND STRIP STEEL: Described are qualities and general characteristics of: sheet and strip steel; hot-rolled carbon steel sheet and strip; cold-rolled carbon steel sheets; tempers; high strength-low alloy sheet and strip; alloy sheet and strip; stainless steel hot- and cold-rolled sheet; cold-rolled stainless steel strip finishes; and steel in homes. 138

**TRUSSES AND SPACE FRAMES:** The recent use of exterior wind bracing for high-rise buildings effectively transforms entire vertical planes into trusses. Three case histories—a sugar storage shed in Baltimore, an outdoor auditorium near Akron, Ohio, and an exhibition hall in Denver—illustrate some of the imaginative uses to which truss- and space-frame concepts have been applied. 147

**BRINGING STEEL OUT OF WRAPS:** A recently developed system of fireproofing — water-filled framing — provides a new solution for architects who feel structural members should remain exposed. Also described is the use of steel cables as part of the structural system for both high-rise and large columnfree spaces, as well as weathering steel, hybrid steel design, and pre-engineered construction systems. 162

## THE COPPER FAMILY

A review of copper metals provides data on the basic technology of copper, brass, and bronze. A comprehensive chart, listing the chief alloys used in architecture and relevant data concerning each, is followed by discussions of joining, brazing, soldering, welding, finishes, and form. Recent developments and applications are illustrated with four case histories. **167** 

## LEAD

A report on the contemporary uses of lead in architecture includes analysis of: the development of new machinery to manufacture lead foil and sheet; a review of traditional uses of lead as sound isolation to keep vibration noise out of buildings over tracks, highways, etc.; updating X-ray protection shielding; new developments in lead laminates with plywood, particle board, and with urethane and vinyls for acoustically treated curtains; details of installation as sound insulation in various applications; and a presentation of the first lead-clad building at Marina City, Chicago. 174

### ALUMINUM

A technical description of aluminum includes: windowwall system aluminum; cladding tested aluminum; wind and rain resistance; cladding specifications; welding aluminum; anodizing and other finishes; and current trends and future predictions for the use of aluminum in construction. Case histories of several buildings that make use of substantial quantities of aluminum are presented. 184



#### Metals Review p. 132

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(ABC)

ABP



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The functional and highly decorative band which terminates Agudath Sholom Synagogue (left and above) in Stamford, Conn., is an excellent example of a typical copper fascia. Architects: Davis, Brody & Associates.



Copper's workability and light weight, plus its affinity for redwood, commended it to Callister, Payne and Rosse for both roof and fascia on the University of California's Field House at Santa Cruz.



Hugh Stubbins & Associates counterpoint the smooth, uniform surface of copper roof and fascia against the rugged texture of brick on the Dana Hall School's Senior Residence, Wellesley, Massachusetts.



## YOUR POINT OF VIEW

#### **Progress in Oklahoma**

Dear Editor: In reference to your recent articles concerning student unrest (July, August 1969 P/A), I would like to bring to your attention certain recent events at the University of Oklahoma's School of Architecture.

Approximately 18 months ago, in response to certain existing conditions within the school, a group of 12 architecture students decided to bring about some changes. Beginning with a schoolwide petition pointing up deficiencies in administrative policies, curriculum, and student-faculty relationships, we eventually pressed for a general forum with the dean, the faculty, and president of the University. As a result of this action, we severed ourselves from the College of Engineering, had our former chairman replaced by Dr. Murlin Hodgell, and ultimately succeeded in bringing about a new School of Environmental Design.

In the past year, two groups of 4th year thesis students plugged themselves into nearby Black and Indian communities in an effort to assist them in planning their respective communities. An attempt is now being made to set up a permanent urban/rural workshop in the Oklahoma City area. In addition, several months ago, students from OU, OSU, Kansas University, and Nebraska met at Kansas with Taylor Culver, Bruno Leon, Whitney Young, and Ed Goff from the Watts Urban Workshop to discuss student involvement in urban ghetto areas.

As you can see, OU's School of Architecture has been making at least as much, if not more, progress as many other schools.

MARK HINSHAW 5th Year School of Architecture, University of Oklahoma

#### Mexican Man Hole

Dear Editor: I congratulate you on the beautiful coverage of "Everyman's Mexican Home" (June 1969 P/A). But, as in another architectural publication (Forum, March 1969) your photo of the hotel's entry court is without any people, and is most deceiving in scale.

Are those openings in the white walls for mice or men?

PAUL W. TELFER Ottawa, Ontario

#### More on May

Dear Editor: I recently had an opportunity to read your editorial and the section on the "New Environmental Professionals" (May 1969 P/A) in connection with an appearance that my father and I made at California State College, Los Angeles.

I found the material most penetrating and thought provoking, but had one serious reservation that I wanted to share. In the third paragraph of the editorial, and also at the top of page 126, you indicate that "... most architects are rather poor businessmen. Under these circumstances, if an architect cannot handle his own business affairs, clients may be disinclined to commission him for nontraditional services such as financial analysis or construction estimate." In this connection, reference is made to the recent AIA study on the "Economics of Architectural Practice," which showed that architects are in a profit "squeeze."

What concerns me is that the conclusion of the AIA study is not that this problem is one resulting from the poor business acumen of architects, but rather that their tendency may be to overlook making the maximum of profits in the interest of their clients! The study goes on to outline how greater profits can be planned for and what should be done to overcome the "profit squeeze."

come the "profit squeeze." While I recognize that our society is profit oriented and that no one but a "success" is admired, it would seem to me that in attempting to fairly present both sides of any given situation, you do a disservice to both the AIA and the profession not to point out that perhaps "profits" are not the primary motive of the design professional, but rather to serve his client well.

Perhaps as an antidote to your editorial you might care to publicize another recent AIA publication entitled. "Vital Questions: An Architect's Odyssey: Case Study in Rehabilitating Housing." It tells the story of an architect in Washington D. C. who became interested in the problems of attempting to rehabilitate ghetto housing after some existing FHA legislation. He found that the compensation available to the architect was a fraction of what would be required even in his wildest estimates, and as he got further involved he found that a great multiple of time and energy was required compared to what had originally been expected, most of which was outside of his control. As a result, he practically had to martyr himself in order to finish the program.

Much is mentioned in this publication about "donation for a cause" and the same is true of architects subsidizing the actual cost of rehabilitating our cities. These are public spirited and public service sentiments and when balanced against "profits" made on other types of commissions, may result in a "loss" for the year in an architect's books.

Does this mean that since architects are poor businessmen, they do not merit the confidence of potential clients?

> DION NEUTRA Richard and Dion Neutra Architects and Associates Los Angeles, Calif.

Dear Editor: Congratulations on a comprehensive, knowledgeable, and truthful article "The New Environmental Professionals Challenge Traditional Practice" (May 1969 P/A). You have accomplished what none of the professional organizations have had the courage to do. By this one article you have probably done more to re-orient architects than anything the profession has done since 1945.

One vital service remains to be done and done immediately. I believe you can do it better than (Continued on page 16) Daniel, Mann, Johnson & Mendenhall solved the space design problem at the Leeward Community College with specifications like those below.

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9

# the beautiful world of reinforced concrete is a climate of excitement



Excitement for all seasons is planned in Kansas City. In reinforced concrete. This new Jackson County sports complex, created by architect Charles Deaton, is a spectacular for spectators inside and out. Both stadiums offer every fan an unencumbered view of the action. Football stadium seats 75,000. The baseball structure holds 45,000. The graceful sight lines and sculptured beauty of the Deaton design demonstrate why the trend to reinforced concrete grows bigger by the day. There's new utility, flexibility and economy in this medium. New design freedom. A greater opportunity to run with bold concepts and score. New high-strength reinforcing steel is one of the reasons why. It offers 50% greater yield strength. Faster, more practical construction. Almost limitless design possibilities. New high-strength reinforcing steel makes everything your mind's eye can imagine build better in reinforced concrete.

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Jackson County Sports Complex, Kansas City, Mo. designed by Charles Deaton, Architect, in association with Kivett and Myers, Project Architects. Sketch of rebar placement at one of the oject Architects. Sketch of rebar placement at one of the major bents supporting stadium seating (structures similar in both). All bars to be lap spliced. Rebar assemblies "prefabricated into cages". Approximately 8,000 tons of Grade 60 high-strength reinforcing steel will be used. Completion scheduled for 1971.

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Notre Dame Athletic and Convocation Center, South Bend, Indiana. 176 Kawneer doors in Permanodic Bronze No. 28 hard color finish. Architects: Ellerbe Architects, St. Paul, Minn. Contractor: Schumacker, South Bend, Ind.



#### (Continued from page 6)

anyone. Your article has described the external conditions affecting architectural practice as we have been conducting it, suggests logical objectives to which the architect must direct himself to survive, and describes some important tools by which he can help himself. But neither your article nor any other source to date has come to grips with the development of detailed forms of business organizational structure, detailed fee schedules, and detailed methods of using the tools to accomplish the systems technique.

To illustrate. Exactly what is the Turner Construction Company's "Turner Management Contract" and fixed fee schedule? This concept is probably one of the simplest and most appealing that can be presented to a client. Possibly Turner will never divulge it exactly. But will they col-



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laborate with you in generalities and enable you to deduce specifics?

And how does a small architectural office (and 90 percent of them are very small) start out to survive? How exactly does it use the tools available? The small architectural office of Stuart Werner in Washington D.C. (14 people in 1968) has developed a remarkable computer-based system for writing specifications, programming, accounting, and billing based on an hourly rate schedule, project scheduling, and other uses. He uses a team system based on collaboration with other specialists rather than a total inhouse capability. Exactly how does he do it? Exactly how do you set out to establish a business organizational structure and a team? Exactly how can you use computers? Exactly what should the contract for turn-key projects be between client and the systems team? Exactly how do you develop a fee schedule to accommodate the systems approach and what should it be?

If you tackle this you will have made a decision that will put every architect and engineer, except possibly the very largest in this country, in your everlasting debt. And remember, almost everything, that has been written, including your article, almost exclusively describes the giants. Try one for the majority in the professions.

> RICHARD K. LENCI Richard Lenci Associates Inc.

Dear Editor: The May issue of P/A is indeed an exciting document and may well spearhead a true awareness of the rapid era of change the total construction industry is facing.

R. H. Rodlun Boise, Idaho

### Anti-Radical

Dear Editor: Your advocation and idolizing of the radical element of so-called students (July 1969 P/A) who wish to be teachers before they have completed their studies (?) brand your publication as totally irresponsible. This apparently holds true for the A.I.A. and therefore I desire to no longer support in any way this unrealistic movement.

> T. E. Wible Mount Pleasant, Penna.

> > OCTOBER 1969 P/A

# TURN MY ICE SKATING RINK INTO A THEATER EVERY MONTH?

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American Airlines Terminal Building, Washington National Airport. Architect: Giuliani Associates, Washington, D. C. Precast concrete panels: Tecfab, Inc., Beltsville, Md. Stainless steel frames: Habgood Co., Philadelphia, Pa.

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All Saints Episcopal Church Palo Alto, California

■ ARCHITECT: William Guy Garwood, AIA ■ ENGINEER: Edwin A. Verner ■ CONTRACTOR: Rudolph & Sletten

Striking proof of the broad design capabilities using concrete made with ChemComp cement is seen in All Saints Episcopal Church in Palo Alto, California. Architect William Guy Garwood specified ChemComp cement concrete to minimize or eliminate drying shrinkage cracks, especially in the roof. To make all surfaces reflect the same color, ChemComp cement concrete was also used in the floors, walkways, walls, columns, structural bents and bell tower. The final result is impressively beautiful. ChemComp cement is produced by leading manufacturers of superior quality portland cements and is available nationwide.

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Holiday Inns, Inc. has chosen GE Zoneline air conditioning units for many of their latest Inns; 10,000 rooms, from Rochester to Miami, from Hartford to Honolulu.

One good reason—GE Zoneline gives Holiday Inns a lot of choices. Over 3000, in fact, and all will fit a standard 42" opening.

There are models with cooling only. Or cooling, and heating with electric heat. Or cooling, and heating with a heat pump.

Why should you choose GE instead of some other zonal system?

For one thing, GE service is nearby...a comforting thought to any inn keeper.

And you can keep a spare Zoneline unit on hand for instant "do-ityourself" replacement. It's easy.

Now consider the outstanding GE features.

The GE rotary compressor, for instance, is much quieter than the reciprocating type generally used. Quiet enough to save a weary motel manager a midnight complaint because of noisy air conditioning. For quietness, too, GE has a special lowspeed blower.

Also nice to know, the unique GE spine-fin coils use continuous tubing to eliminate many of the brazed joints found in most air conditioners. Every brazed joint is a potential refrigerant leak. Who needs headaches like this?

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There are many more GE features that Holiday Inns like. The attractive grille, the washable air filter, the unique interior baffle, the positive seal air vent and so on.

Maybe the same features are what you're looking for in your next motor inn.

Find out. Spend a night with Zoneline and see. Your GE Central Air Conditioning distributor will

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Steel makes the difference

Steel in another inspired form-structural steel tubingmakes use of the remarkable supporting strength of the tubular steel form to accept more building weight. In addition, this unusual strength permits walls to be even lighter, to offer economies of construction and greater flexibility of design.

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Steel construction products, as infinitely flexible as space - products of Republic customers made for construction speed and economy today - made to adapt quickly and economically to the changing needs of tomorrow. Republic Steel Corporation, Cleveland, Ohio 44101.

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On Readers' Service Card, Circle No. 437 Illustrated, Britain's 4,000-year-old Stonehenge-"the place of the hanging stones."




# anywhere ceiling



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The COOKSON Company. 700 Pennsylvania Ave., San Francisco, California 94107 On Readers' Service Card, Circle No. 347

# Let's take it from the top







## CITY WATER BOARD, CENTRAL HEATING/COOLING PLANT

San Antonio, Texas "HemisFair"

Five cells: 30,000 GPM 96°F-86°F-78°F Bernard Johnson Engineers, Inc. Houston, Texas An outstanding example of a well-planned Central Chilling and Heating Plant. The top view shows the cooling tower as an integral part of the structure. At left is *entrance side of* plant and transformer yard, enclosed by arched walkway to the Ceramic Cooling Tower on opposite side of building. View at right is the Ceramic Cooling Tower which is the south wall of the plant. The series of arches serve as a single air-inlet with falling water in the background which is lighted at night. The cooling tower structure is monolithic concrete for water tightness and permanency. Brick, stone, and mission tile furnish a pleasing esthetic interpretation of functional Spanish architecture. The owners, City Water Board of San Antonio, are proud of this installation and invite inspection.

# ...otherwise you'll never find it!

The fan assembly stack is the only tip-off that the building on the left is not just another building . . . but a Ceramic Cooling Tower integrated into a unique heating/cooling facility.

The other buildings shown here also incorporate Ceramic Cooling Towers and are outstanding examples of well planned, totally integrated designs that are possible only with Ceramic.

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Ceramic Cooling Towers are certified by the Cooling Tower Institute in accordance with C.T.I. Certification Standard STD-201.



THE ONLY PERMANENT COOLING TOWER



NATIONAL CASH REGISTER San Diego, California Four cells: 12,000 GPM 95°F-85°F-72°F Frank L. Hope & Associates, Architects San Diego, California Geo. W. Dunn & Associates, Engineers San Diego, California

The Ceramic Tower is one wall of this Central Chilling Plant. The plant is designed to serve a new complex for this progressive concern. As their needs grow, so will this tower. Currently the capacity is projected to be doubled to 8,000 tons.



TEXAS TECHNOLOGICAL COLLEGE Central Heating & Cooling Plant Lubbock, Texas

Two cells: 18,400 GPM 105°F-85°F-73°F Pitts, Mebane, Phelps & White, Architects and Engineers Beaumont, Texas Zumwalt & Vinther, Consulting Engineers Dallas, Texas

After six separate refrigeration plants were installed with Ceramic Towers, campus growth projections indicated the feasibility of a Central Plant which would supply chilled water and steam through tunnels to the entire campus. The first phase of 6,000 tons is now projected to 18,000 tons. The Ceramic Cooling Tower is an integral part of the plant, requiring minimum operating and maintenance personnel.





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Inland-Ryerson 1-5/8" NF Celluflor offers 66% more space per cell than standard profile 1-1/2" electrified floor deck. It can handle today's expanded electrification needs with a healthy reserve for tomorrow. The greater cell size permits wide 4" hand-holes which more easily accept large diameter communication cables.

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Below, Dyfoam Ventboard. It's composed of Dyfoam expanded polystyrene boards sandwiched between laminating material. The insulating concrete combined with Dyfoam Ventboard gives you economical U values down to .03.

**3** Vents are built right into the Dyfoam Ventboard. Water vapor passes through the laminating material into the vents, and is channeled out to the edges of the roof.

No joints, no tape, no adhesives, no vapor barrier are needed. A thin slurry of Zonolite insulating concrete serves as the bonding agent between deck and structure.

Zonolite roof decks can only be applied by trained, approved applicators. Upon completion, the decks are certified to meet specifications.

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The Bauhaus: Weimar Dessau Berlin Chicago 700 pages 200 documents 800 illustrations 24 color plates Special pre-publication offer \$42.50-\$55.00 after December 31, 1969 The MIT Press Cambridge, Mass.



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Versatile Mirawal insulated panels are ideal for modern school use-one panel can serve as the complete wall with porcelain enamel on both the outside surface and the floorto-ceiling chalkboard inside.

Choose from a wide array of contemporary colors. Surface finishes include full-matte, semi-matte, or gloss porcelain. For more de-

tails, see Sweet's Architectural File, Section 20b, or write Kaiser Aluminum Mirawal Prod-ucts, P.O. Box 38, Port Carbon, PA 17965.

#### MIRAWAL PRODUCTS



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MIRAWAL used as both exterior wall surface and unique interior floor-to-ceiling chalkboards in the Leo J. Muir Elementary School, Bountiful, Utah. Architect: Harold Beecher Associates.



# THE LARGE SCALE REVOLUTION IN CERAMIC TILE JUST STARTED. RIGHT HERE. RIGHT NOW.

## INTRODUCING ...

## New 12" x 12" x 1/2" sculptured tiles for floors and walls

You're looking at an actual-size photo of a nominal 12" x 12" x ½" Terra Vitra tile, including an allowance for a joint approximately 1/4" wide. This is one of the 15 beautiful designs in American Olean's new line of large scale relief tiles.

Look closely. Here is the beauty of light playing over richly textured surfaces. Here is the soft glow of deep, translucent glazes. Here is a revolution in ceramic tile.

Terra Vitra gives you complete creative freedom. There are six high relief designs for walls, nine low relief designs for walls and light duty floors. And there's a palette of eight matte glaze colors. That means 120 color and design combinations to

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See for yourself the design possibilities of Terra Vitra. Send for our full-color booklet. It shows the entire Terra Vitra line and gives you complete specifications and technical information. Write: American Olean Tile Co., 1280 Cannon Avenue, Lansdale, Pa. 19446.

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#### COLORED SPLIT BLOCK WITH MEDUSA WHITE

Color Samples: Chas. Svec, Inc., Cleveland, Ohio





Split block of Medusa White assures walls of ageless distinction ... walls that are attractive to Marriott guests. These handsome, soft textured concrete units capture light and shadows for a variety of changing effects. They are economical and fireproof.

The true white color of Medusa White Portland Cement also assures more accurate results when color pigments are used (see samples at left).

Whatever or wherever your building project . . . consider split block walls of Medusa White for greater beauty and economy. Write for brochure. Medusa Portland Cement Company, P.O. Box 5668, Cleveland, Ohio 44101.

MARRIOTT HOTEL, Crystal Plaza, Arlington, Virginia. Architects: Weihe, Black, Kerr & Jefferies, Washington, D.C. Owners & Gen. Contractor: Charles E. Smith, Inc., Washington, D.C. Split Block Producer: ("Random Rock" A-65) Nitterhouse Concrete Products, Inc., Chambersburg, Pa.





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#### Architecture, here, is as changeable as the weather

The glass is slightly tilted to reflect the ever-changing sky. The L-O-F hi-performance glass, used here, does much more. It's Thermopane® insulating glass with Vari-Tran®/Chrome '114, a reflective coating that reduces visible light transmission to a nominal 14 percent. Softens sky brightness and reduces solar heat gain. Improves interior comfort. Reduces heating and air-conditioning costs. Provides privacy for employees, too. During the daytime they can see out but passersby can't see in. Architects Olsen & Urbain, AIA, Chicago, designed this unusual facade for the ADS Anker Corporation building in Oak Brook, Illinois. L-O-F has developed many kinds of hi-performance glass. We now offer such variety in appearance and function that a look at Sweet's is hardly enough. Why not get in touch with an L-O-F Architectural Construction Specialist? Libbey-Owens-Ford Company, Toledo, Ohio 43624.



L-O-F HI-PERFORMANCE GLASS



Zellerbach Hall, Univ. of California, Berkeley. Architects: Vernon DeMars, FAIA, and Donald Hardison, FAIA. A joint venture of the firms: DeMars & Wells and Hardison & Komatsu.

#### LCN Overhead Concealed Door Closers

are well known for a variety of qualities: They look great. They control doors efficiently. They are easily and permanently adjusted for two closing speeds and cushioning of the opening swing. Their basic excellence assures maximum control with minimum service which means lowest long-run cost. Write LCN Closers, Princeton, Illinois 61356. On Readers' Service Card, Circle No. 382







City Hall by Kallmann, McKinnell & Knowles; Campbell, Aldrich & McNulty



Daniel Reed Library by I.M. Pei & Partners

### **PCI** Awards

A question was posed in the October 1966 P/A: Whether exposed concrete, coming in with a bang and dominating the architectural construction scene in volume since the turn of the century, will go out with a whimper. The question remains. Concrete construction has peaked and leveled off. Steel runs a close second. Concrete - strong, heavy, bulky, malleable, indestructible - will probably continue in its present usage for a long time because most architects believe its potential is virtually untapped. The Prestressed Concrete Institute continues to encourage designs utilizing concrete in many ways, the most influential being through a program of awards.

This year there were 12 winners characterized by a wide variety of building types. Among the winners are a city hall, a university library, a science center, a bank, an exhibit hall, a manufacturing plant, and an industrial storage building. The five-man jury, headed by George Kassabaum, past president of the AIA, (Continued on page 56)



Cowell Hall of the California Academy of Sciences by Milton T. Pflueger & Associates



Prestressed Concrete Manufacturing Plant by Graves & Toy





Potrero Hill Wall by the California Division of Highways Bridge Department

(Continued from page 55) included Frank H. Newman Jr., Louis A. Bacon, Robert F. Hastings, and Ray Afflek. They judged the entries on the criteria of aesthetic expression, function, and economy.

Winners are the new Boston City Hall, Boston, Massachusetts, a joint venture of Kallman, McKinnell & Knowles; Campbell, Aldrich & Nulty; and LeMessurier Associates, Inc: Daniel Reed Library, State University of New York College at Fredonia, New York, I.M. Pei & Partners; Cowell Hall, California Academy of Sciences, Golden Gate Park, San Francisco, California, Milton T. Pflueger; Port Clinton National Bank, Port Clinton, Ohio, Lawrence-Hawver Associates; Prestressed Concrete Manufacturing Plant, Forest Park, Georgia, Graves & Toy; Cement Clinker Storage Building, Lyons, Colorado, Kaiser Engineers; Mill Plain Substation, Vancouver, B.C., Washington, Stanton, Boles, Maguire and Church; Lane Sub-Danebo Sub 115 kv Double Circuit Joint Use Transmission Line, Eugene, Oregon, Eugene Water & Electric Board; Potrero Hill Wall, San Francisco, California, California Division of Highways, Bridge Department; Pont Romeo Lorrain Bridge, Notre-Dame-Du-Laus, Comte de Papineau, Quebec, Canada, Roy, Bergeron, Gariepy & Associates.



Ontario Science Center by Raymond Moriyama



Port Clinton National Bank by Lawrence-Hawver Associates

# Bright idea

#### Beautiful way to cut building costs: Bradley Washfountains!

Bradley Washfountains come in a wide variety of attractive colors and compositions. But the real beauty of Washfountains is the money they save. For example, Washfountains serve up to 8 people with one set of plumbing connections, cutting installation costs as much as 80%. They use less space than ordinary fixtures (up to 25% less). They reduce water consumption 45-80%. And they cut maintenance costs, too. Wherever you specify Washfountains—offices, schools, plants, institutions, public and commercial buildings of all types—you secure a handsome saving! See your Bradley representative. And write today for complete information. Bradley Washfountain Co., **9141** Fountain Boulevard, Menomonee Falls, Wisconsin 53051.

Bradley .

On Readers' Service Card, Circle No. 338





#### Flexibility Stressed in Research Center Development

The second building is under construction in Cleveland's University Circle Research Center project, a proposed development in the expanding scientific and educational community of the Cleveland University area. The research center buildings are to provide rental space for industrial firms and corporations engaged in scientific research and development and are expected to encourage a freer interplay between the tenant's research activities and personnel and those of the academic community.

Instead of the usual spreadout type of development common to industrial parks, William A. Gould and Associates, architects and city planners, have designed a cohesive and highly coordinated yet extremely flexible scheme. The plan Gould developed accounts for the construction of space to eventually accommodate 7,500 people with a total investment exceeding \$100 million. The site plan stresses the most efficient use of land, and calls for multi-tenant construction aesthetically and functionally related to the University Circle area.

The buildings have built-in flexibility for both horizontal or vertical expansion of facilities. Since research procedures constantly change, the building module does not limit current research activity in any way. The plan consequently can be divided into functional categories such as wet and dry laboratories, office and administrative facilities, and pilot plant development space. The modular design achieves any combination of these activities, and offers the capability of locating walls and partitions to achieve any multiple of room sizes required in all the categories mentioned.

The exterior of the buildings achieves a homogeniety of over-all appearance desirable in a "campus" atmosphere such as this. The proximity of the three multifaceted structures to the technical and academic institutions of the University Circle provides a creative atmosphere due to tenant interaction.



#### The Possibilities of A Warehouse in Shambles

When the handsome brick Empire stores (c. 1846), typical of the warehouses that once lined Brooklyn, New York's water-

front, were chosen as the site for the borough's meat market, local residents protested vigorously and succeeded in defeating the proposal. The Brooklyn Heights Association and the Municipal Arts Society of New York have now formulated a plan for the site's development. Their program, worked out with the help of Gruzen & Partners, preserves a large part of the arcaded structure with boutiques and restaurants located within, similar to San Francisco's Ghiradelli Square. When completed, green enclaves would separate the building from an extended promenade at the water's edge. The total complex, including housing and recreation areas, would be linked by a green strip to downtown Brooklyn, now land-locked by poor planning. Financing for the project, which includes preservation of several nearby Greek Revival houses and a cast-iron facade, would be sponsored jointly by the city and the Consolidated Edison Company.

#### Competitions

Twenty-four awards totaling \$50,000 are being offered by The James F. Lincoln Arc Welding Foundation to engineers, designers, consultants, architects, and others for papers describing the use of arc welded steel in modern structures. The paper must describe how welded design benefited the planning, fabrication, function, erection, or appearance of the complete or component parts of a building, bridge, or other structure. Closing date for entries is January 5, 1970. For details, write to: The James F. Lincoln Arc Welding Foundation, P.O. Box 3035, Cleveland, Ohio, 44117.... March 16, 1970 is the deadline for the Portland Cement Association Architectural Scholarship Awards Program. Building design solutions must make use of concrete or cement. For details: write to Architectural Scholarships, Portland Cement Association, Old Orchard Road, Skokie, Ill. 60076.

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Or on Readers' Service Card circle No. 300.



#### P/A NEWS REPORT



#### 200 Moore Shopping Centers

Two hundred shopping centers designed by Charles F. Moore and Ronald D. Factor — each resembling a bedouin camping ground, breathing a looseness typical of nomadic life, are to be built under the auspices of a real estate investment firm, Decor Developers, Inc., and the Distributive Education Corporation of America (DECA). Each center is to have a student work-study program, instituted by DECA, in which high school seniors will work three hours a day at jobs for which they have been trained.

Each Decor-300 center will cost \$2.5 million and will have fifty shops. Ten of the shops will be owned and leased by DECA. Under DECA's supervision, students will totally man these ten shops.

Pedestrian passage, a major problem of shopping complexes, is solved in the design of the Decor models. Numerous interstices and apertures work with the masses to provide ample walking space and are designed so as to be neither obvious nor confusing.

The Moore-Factor design and model has been handed over to architects, James A. Bishop and Associates, who are preparing the working drawings and a system of Supergraphics.

The centers will appear in three sizes — the Decor-300, Decor-200, and Decor-100. The first eight will be the Decor-300 and will occupy these sites: Three in Pasadena, California, and Houston, Texas; and one in each of the following: St. Paul-Minneapolis, Minnesota; Tyson-Corner, Maryland; Ft. Lauderdale, Florida; Wichita, Kansas; and Tulsa, Oklahoma. Construction on these sites will begin simultaneously early in 1970 and they are expected to be built by the close of that year.

#### Thoroughly Modern Harem Rooms

TUNIS, TUNISIA Native labor and traditional Arab construction techniques will be used in a thoroughly modern, 110-room Sheraton resort hotel being built at Hamamet, 40 miles north of Tunis. Cost of the project, planned by the firm of Ahrens Di Grazia Frizzell of New York and Rome, is estimated at \$1,800,000.

Architect William Kenneth Frizzell said the complex was designed to create the effect of a North African village, with entrance to the rooms via one- and two-story terraces off the beach. The balconies will be staggered about 45° to give maximum privacy and assure each room a view of the sea.

The project, which calls for

eventual expansion to 210 rooms, will include tennis courts, a swimming pool, outdoor dining terraces and a re-landscaping of the beach to bring it directly to the entry courts of the ground floor rooms.

Frizzell noted that décor of the white-washed brick rooms will give a feeling of being in harem rooms. Headboards will be replaced by tile panels made by local artisans; native fabrics and sheepskins will be used for bed coverings and rugs; cushion-covered stone benches will be used instead of chairs in the three dining rooms, and light fixtures will be rough carved stone boxes.

Barry Doll is the firm's project manager in its Rome office.



#### Harlem "Space"

This simulated nylon moonscape was one of the results of a competition sponsored by WestPoint-Pepperell, Inc. this spring at Pratt Institute. Students were asked to design fabric structures that would help city dwellers find summer living more pleasant. Richard Zyne, a first year student at Pratt, designed the 2700 sq ft moonscape which was stretched over the asphalt paving of a cityowned vest pocket park on a block in East Harlem once termed by sociologists as the "worst block in New York." The 75 by 35 ft moonscape is supported by poles, cable, and wire, and is dotted with holes up to 16 feet in diameter resembling moon craters.



The control of air pollution is an important consideration in industrial design. Electrostatic precipitators provide designers with solutions to this critical environmental problem.

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The Southern California headquarters building of the Equitable Life Assurance Society is the tallest structure on Los Angeles' Wilshire Boulevard. It towers 34 stories from a 2½-acre landscaped plaza and retail shopping area. The building's height is accentuated by projecting fins of precast beige concrete embedded with Texas limestone aggregate.

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Winning Western Homes

The jury at the 1969-70 AIA/Sunset Magazine Western Home Awards was composed of Charles W. Moore, Peter Walker, A. Quincy Jones, Hector Mestro, John M. Morse, Ezra Stoller, and Proctor Mellquist. They picked five Honor Award winners: Campbell and Hoover; Hall and Goodhue; Kahn, Kappe, Lotery; Donald E. Olsen; Claude Oakland.

One of these winners is the custom-built vacation house shown in the photo. Designed by architects Campbell and Hoover of San Francisco this natural wood structure perches on a jetty of rocks at Lakewood on the Nevada side of Lake Tahoe. The house matches the ruggedness of the boulder-surrounded site in both material and design. The exterior is exposed wood—rough timber posts and diagonal cedar boards. Use of the rocky site was carried on inside the house as boulders thrust up through the floor to form seats and resting places.

Innovation was not lacking in the remaining entries. For instance, one mountain house has a motorized, disappearing metal skin; one has a free-standing suntrap wall; and several houses have experimental roof windows.

#### The Final Chapter of the AIA Headquarters Building Controversy?

As the beginning of the concluding chapter of a now familiar story, an AIA Committee, headed by Max Urbahn, has announced that The Architects Collaborative is to succeed Romaldo Giurgola as architect for the AIA's new headquarters building in Washington, D.C. The job has been given to TAC, of Cambridge, Mass., according to George Kassabaum, AIA president, "on the basis of TAC's outstanding building design: its sensibility to different architectural problems; and its capabilities for handling this problem."

The AIA building project is headed by TAC principal, Norma L. Fletcher.

AIA's new headquarters is to be constructed at the site of the present headquarters in Washington, including the adjacent site now occupied by the Lemon Building. Design work will begin immediately.

#### Awards

AIA, New York Chapter, has announced the winner of the Brunner Scholarship Award: Walter H. Kilham, Jr., for his book on Raymond Hood. Runner-up: Francis Fergusen for his study of planning and architecture. The Award of Merit and honorary AIA membership has been presented to Governor Nelson E. Rockefeller in recognition of his contribution as master builder and creative leader in the use of architecture, painting, and sculpture to preserve and enhance New York State's natural resources. . . . The City Club of New York has pre-sented its annual Bard Awards for excellence in civic architecture and urban design in New York City. First Honors: Riverbend Houses by David, Brody & Associates; 9-G Cooperative by Edelman & Salzman. Merit Awards: Exodus House by Smotrich & Platt: the Exhibition Building for Nocturnal Animals at the Bronx Zoo by Morris Ketchum, Jr. & Associates. . . . The \$25,000 R. S. Reynolds Memorial Award has been presented to Boyd Augur. London architect, for his design of the Gyrotron structures housing the major entertainment ride for the "Man and His World Exposition," originally Expo 67.... The Michigan Society of Architects' Annual Award has been given to Tarapata-MacMahon-Paulsen Associates, Inc., Bloomfield

(Continued on page 68)

#### P/A NEWS REPORT

#### (Continued from page 67)

Hills, Mich., for the design of a two-building complex at Grand Valley State College, Grand Rapids, Mich. . . . "Modern Manufacturing Magazine" has named the facility for Lawry's Foods, Inc., in Des Plaines, Ill. a "Top Ten Manufacturing Plant," honoring architects Ralph Stoetzel, Inc., Chicago, Ill. and Calvin Straub. Phoenix, Ariz... At the National Seminar on Urban Transportation for Tomorrow, Denver, Colo. (sponsored by the Center for Urban Affairs of the University of Colorado and the U.S. Department of Transportation), Cita-tions for Achievement in Urban Transportation: James D'Orma Bramau, urban systems and environment, U.S. Department of Transportation; Michael Rapuano, engineer and landscape architect, New York, N.Y.; and the Wisconsin Department of Transportation. . . . The 1969 "Laboratory of the Year Award," sponsored by Industrial Research, Inc., has been given to the Richard King Mellon Hall of Science, Duquesne University, Pittsburgh, Pa., designed by Ludwig Mies van der Rohe. . . . New York State Awards for Artistic Achievement have been distributed to 13 institutions. One of the recipients: The Everson Museum of Art, Syracuse, designed by I.M. Pei & Partners, New York, N.Y. . . . At the 30th National Conference on Religious Architecture announcement was made of the winners of the annual honor awards. The twelve recipients included the renowned Swiss architect, Dr. Justus Dahinden of Zurich who was honored for three of his churches. Other winners are Burks & Landberg, St. John's Episcopal Church, Sullivan, Mo.; Curtis & Davis, Queen of Heaven Catholic Church, Lake Charles, La.; Davis, Fenton, Strange, Darling, First Plymouth Congregational Church, Lincoln, Neb; Guy Vincent Prisco, St. Catherine's Church, Genoa, Ill.; Progressive Design Associates, St. Jude's Catholic Church, Grand Rapids, Mich.; Russel-Gibsen-von Dohlen; Church of the Resurrection, Wallingford, Conn.; Sinclair Associates, First Congregational Church, Melrose, Mass.; Smith & Entzeroth, Inc., Trinity Lutheran Church, St. Louis, Mo.; Harold E. Wagoner & Associates, Beth-El Synagogue, Cherry Hill, N. J. ... H. Morgan Rogers, president of Lockwood Green Engineers, Inc., New York, was named Engineer of the Year by the South Carolina Society of Professional Engineers at their annual convention.... Dr. Glenn A. Fry, Regents Professor and former Director of the School of Optometry, Ohio State University, received the Gold Medal and Certificate of The Illuminating Engineering Society.... Lewis N. Wolff, chairman of the board of **Development Research Associates** and president of San Jose Center Corporation, has been awarded the Member, Appraisal Institute.



#### High in Portland's Sky

Oregon, an architectural tabula rasa, has been the site of much freehanded building, most of it in the way of skyscrapers. The low rambling skyline of Oregon has, of late, been punctured by soaring structures such as the 30-story Georgia-Pacific building, the 50story Seattle-First National Bank and the 24-story Panorama Apartments building. Another bud in this skyscraper-sprouting block of downtown Portland is First National Bank of Oregon's 40-story tower and adjacent operations center.

Designed by Los Angeles based Charles Luckman Associates, who designed the new Madison Square Garden, the \$40 million bank complex, in its entirety, is intended to mirror Northwest culture.

The bank, occupying an 80,000 square foot site, will rise out of three basic materials: marble, bronze-tinted glass, and bronze anodized aluminum. The tower structure will be ribbed on four sides with marble columns, splaying out in graceful fins at top and bottom, and reaching a width of 15 feet at ground level. These columns are not merely ornamental as they play an important role in the interior design of the main banking floors. At the same time, they provide an innovative strucural system to handle seismic forces.

The adjacent operations center, like the tower, will display a facade of bronze-tinted glass. The upper floors will be supported by 20 columns on the four sides of the building, and will house the central cash vault, an employee cafeteria and the bank's data processing department.

Interiors of the two buildings will represent Northwest attitudes by featuring furniture made from wood native to the state and Oregon artifacts and paintings will be displayed.

#### Schools

The Faculty of Architecture of the University of Manitoba, Canada, has announced the appointment of Kum-Chew Lye, M.R.A.I.C., as Head, Department of Architecture. . . Richard E. Farson has been appointed Dean of the School of Design of the new California Institute of the Arts.

... An Environmental and Urban Systems Division has been added to Virginia Polytechnic Institute's School of Architecture. ... Maurice D. Kilbridge, Professor of Business Administration at Harvard, is serving as Acting (Continued on page 73)

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#### (Continued from page 68)

Dean of Harvard's Graduate School of Design following the resignation of Jose Luis Sert. . . . James Fitsgibbon is joining the faculty at Washington Universities School of Architecture. . . . Architectural students at the University of Virginia have designed plans to help Richmond, Va., develop the commercial and recreational potential of the James River. . . . A center for the development of building concepts that could lead to such things as cities beneath the sea and buildings that move has been established at the University of Virginia. Lev Zetlin is Director of the center. . . . Expansion continues at Rice University's School of Architecture. Anderson Todd, professor at Rice for 20 years, will become director; William W. Caudill, former director, will continue to fill the William Ward Watkin Chair. Two Houston businessmen have donated \$500,000 to establish another professorship. The preceptorship program is being expanded to include full-year, as well as the current two-week, internships for students. For the year 1969-70, 12 architectural firms (from California to Paris, France) will participate. . . Two Princeton University professors, David Billington and Robert Mack of Princeton's Department of Civil and Geological Engineering, have been selected to develop a long-range program to integrate the humanities with engineering curricula undergraduate and graduate research. A \$25,000 grant from the National Endowment for the Humanities, Washington, D.C., will support the program. By increasing the understanding of the relationship of architecture, planning, and engineering to man's life today, it is hoped that human dislocations and aesthetic monstrosities will be avoided. . . . Carnegie-Mellon University has named Delbert Highlands head of the department of architecture. The 34year-old architect-artist has been an associate professor in the department. . . . Vincent J. Scully,

Jr., professor of the history art at Yale University and a leading architectural critic, has been named Master of Morse College. the undergraduate residential college at Yale.... A department devoted to the advancement of art in architecture is being developed at The Brooks Institute School of Fine Art. Santa Barbara. Calif.. under the direction of Dr. Joseph L. Young, Los Angeles artist-author-educator. As planned, the program will offer BFA and MFA degrees. Emphasis will be placed on young artists, architects, and candidates from business and industry working together on actual projects in progress. . . . California State Polytechnic College announces that Axel R. Dennis has received the Dorman/Munselle Associates' Scholarship of \$500 for outstanding achievement during his third year of study in the School of Architecture.... The Program for Advanced Study. sponsored by Bolt Berenek & Newman Inc., will offer graduate level courses in advanced technology for architects, engineers, and city planners in October. Courses will be available in Cambridge, Mass.; New York, N.Y.; Philadelphia, Pa.; Washington, D.C.; Chicago, Ill.; Dallas, Tex.; and Los Angeles, Calif. Information: Dr. Walter Koltun, BB&N Inc., 50 Moulton St., Cambridge, Mass.... The Junior Draftsman Training Program (the 16-week course sponsored by Eggers & Higgins, architects, and the Vocational Foundation Inc.) has graduated its second class at City Hall, New York, N.Y. Six of the ten graduated were placed in jobs immediately....



#### Happenings at the Old Curiosity Shop, London

Built in 1567, and made famous by Charles Dickens in *The Old Curiosity Shop*, which serves as the background for many a fine photo, is having its pulse taken in order to insure its sustained life.

Highly sensitive vibration sensors have been installed in the cellar of the shop in order to make sure the old building, which trembles to the crash of pile drivers next door, does not collapse. It was thought that new foundation work for an adjacent cancer research center might endanger the little old building's own foundation, thereby causing the already somewhat tilted structure to tumble. To avoid this possibility, six vibration sensors and plumb lines have been placed inside to record any shift in the shop. If any shift is detected, work can be immediately halted.





### **Rudolph Creates a Living Organism**

In the continuing success story of Paul Rudolph designs, comes a sensuous set of plans for Burroughs Wellcome & Co., Research Triangle Park, North Carolina, a firm dedicated to pharmaceutical research. Rudolph is always astonishingly creative in his search for an individuality appropriate to the function of each building.

The S-shaped complex, with one curve of the S wrapping around the main entry court and the other around a service court, considered by Rudolph as an extension of the site, gives the impression that it rises from the ridge climaxing in a dramatic effect of symmetry and geometric order. A series of terrace-like skylights and inward-slanting windows will put light deep into the interior.

The \$10 million building will not follow standard or traditional lines. The front and rear walls slope inward toward the roof, following a 22.5 degree angle of the building's modified A-frame support members. In keeping with the natural contours and color of the land, the lobby will be ter-raced and the whole building will be finished with beige limestone chips. Overall, the building will appear as a light, floating object rising from its site.

Research will occupy the left wing of the complex. A library, information center, auditorium, cafeteria, and the administrative offices will be in the center section and in the right wing. To the far right will be a covered parking lot. Rudolph feels the building will impart a sense of being a living organism rather than a boxlike form. This living, probing, cerebral community is scheduled to begin its life in 1979.



#### The Oceanic Forms of Chayo Frank

Snipps, and snails, and puppy dog tails, these are things architecture is made of (see photo).

"A fun place to visit, but I don't know if I'd like to. . . ." But you don't have to, it is a woodworking shop for Amertec Associates in Hialeah, Florida.

Designed by Chayo Frank, a former student of architect Bruce Goff, in association with structural engineer O. J. Jordensen, the building was constructed of steel reinforcing rods and concrete. The concrete was sprayed over the rods using a special process developed by the Vin-Lox Company, the contractor for the job, who claims his process can create in concrete anything the architect desires.

The designer, the son of Amertec's president, states that the design was influenced by the tropical atmosphere of Florida. The building, with 2,500 sq ft of interior space on two floors, is painted in brilliant blues, greens, and reds.

#### 1970 P/A Design **Awards Judged**

Six hundred and seventy entries, arranged in nine categories, faced the Design Awards jury from September 15 to 17. The jury, composed of William Brubaker. Bruce Graham, William Mouton, Robert Venturi, and Thomas Vreeland (Graham replaced James Stirling, who was unable to attend), knocked out the very good to find the best - a top award, five awards, thirteen citations.

The projects, chosen by the 17th annual awards jury, will be published in January, 1970.


Under construction: Northwestern National Bank Building, Saint Paul, Minnesota Housing and Development Authority of the City of Saint Paul, sponsors L. J. Sheridan & Company, developers/Capital Centre Associates, owners Northwestern National Bank, major leaseholder Grover Dimond Associates, Inc., architects-engineers Naugle Leck, Inc., general contractor

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Ceco developed and manufactured a "strip" curtainwall system for the tower portion. Vertical sight lines are created by strip windows and panels alternating with precast stone panels. Steel mullions and insulated panels surround

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#### **Capitol Improvements**

Perhaps with some sort of empathy for the strained social structure of America, the West wall of the Nation's Capitol is crumbling. With needed repairs long overdue, all that can be done at the moment is some dramatic shoring up.

While everyone agrees that something must be done — and quickly — the controversy is over whether the West facade should be restored as is, or extended to house offices, restaurants, a visitor's center, and committee rooms for Congress.

The AIA, which vehemently opposes the extension idea, feels that the proposed 4.5 acre, \$45 million extension would "bury forever the last remaining walls of the Capitol that date back to the founding of the Republic."

In letters to all members of Congress and in testimony before a House Appropriations Committee a subcommittee of the AIA said corrective measures can be taken with speed to insure the safety and structural integrity of the present West Front, which faces the Washington Monument.

Francis Lethbridge, AIA Vice President, testified that the extension would erase the work of those "great pioneers of Federal architecture — William Thorton, Benjamin Latrobe, and Charles Bulfinch" — just as it would alter the "noble terraces" planned by Frederick Law Olmstead.

AIA charges that the proposed West Front extension is being advocated without an adequate study of Congress' future space needs. As an alternative to the extension, they suggest that it might be better to include more room for Congress in other buildings rather than destroy the Capitol.

The problem is expected to come to a head at the end of September when the House is expected to consider an appropriation of \$2 million to develop detailed architectural drawings for the extension.

#### Among the Rubble

Signs of utter destruction etched the city of Gulfport, Mississippi after hurricane Camille tore through the coastal area with winds up to 205 mph leveling almost everything in its path. One building, just completed in April, escaped Camille's vengeance with only minimal damage. A little bit

of luck was involved but there also had been a lot of forethought in the design and construction of the building. The Mississippi Power Company building, designed by Curtis and Davis, suffered only a few blown out windows - incidentally, guaranteed to withstand only winds up to 150 mph - and lost a few panels around the air conditioning equipment on the roof. No movement of the building was evident because there was no detection of interior plaster cracking or flaking, and leakage was insignificant.

Designed with hurricane wind and water in mind, everything was doubly reinforced.



The aftermath of hurricane Camille.



#### An Elementary Team-Teaching Cluster

With maximum flexibility and expansion in mind, architect Joseph Pierz, of Stecker and Colavecchio, designed the Bethany Elementary School addition in Bethany, Connecticut. The one-story school for 420 pupils will have an academic unit containing 12 regular classrooms clustered in groups of three with movable partitions to permit team teaching or group instruc-

tion from a single point. The coreunit will contain a full-size gymnasium with a movable partition, library, cafetorium, kitchen, administrative offices and a materials instruction center. This coreunit has been designed to serve an additional 14 classroom pod which will be added in the future.

The new addition will have a steel frame structure with a brick

and wood exterior complementary in color to the existing buildings which have copper fascias and shed roofs. The interior will be done in brick, concrete block and will have tackboard walls, carpeted floors, acoustical ceilings and electric forced-air heating. The new wing will also have education facilities with observation areas separated by one-way glass.



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#### Stains, Waxes, Seals in One Operation

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Cabin on Mt. Rainier, Wash.; Architect: Liddle & Jones, Tacoma, Wash.; Cabot's Stain Wax throughout.

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## Construction Users form a Roundtable to counter Labor Unions' inflationary wage demands

#### BY E. E. HALMOS, JR.

Probably the most important construction development of recent months occurred outside of Washington, as the industry worried along into early fall under uncertain conditions of ever-higher costs, leveling out of volume, labor and racial troubles, new government regulations. The development was the formation in Pittsburgh (under leadership of former U.S. Steel Chairman Roger Blough) of the "Construction Users Anti-inflation Roundtable."

Stated objective is to foster research and better understanding of construction's problems and practices by the people who put up the money for big private work. Real purpose (among others) : To help stiffen contractors' resistance to excessive wage and working condition demands of labor unions — among other things, by less insistence on strict completion dates, easing last-minute changes in design.

This was the first flowering of a trend that began to be clear more than a year ago — when the U.S. Chamber of Commerce assembled a group of owners and construction men to discuss industry problems. At those sessions, top officials of big construction buyers repeatedly warned that costs were getting so far out of hand that they would be forced to look elsewhere — possibly to aircraft manufacturers and other massproducers of components - for answers to their building needs. At that time, warnings were based on what owners saw as a need for architects, engineers, and contractors to re-establish firm control of their own operations. Now it seems that some of the owners have concluded that they must back up the industry.

There was ample reason for

owners — and the whole industry — to be concerned:

• The respected Bureau of Public Roads Construction Cost Index showed a huge rise of 5.3 per cent for the second quarter of 1969 — to come within two percentage points of an all-time record. Principle reason: wage rates.

• In the same period, the Federal Water Pollution Control Administration's construction cost index climbed upward another 1.33 per cent (it has not declined in more than four years).

• The Census Bureau reported that the pace of general construction, for the third straight month, remained virtually unchanged (at about a \$92 billion annual rate).

• The housing field — plagued also by high costs of financing — continued to show a steady decline in number of units. In July, starts were running at a pace of 1.336 million units, against 1.464 million in June and 1.505 in May.

 Most significant was the report of the Associated General that construction Contractors wage settlements are now averaging a whopping 15.1 per cent increase - with some recent settlements in urban areas running as high as 25 per cent. That compares to a national average of 11 per cent increase last year; 9.2 per cent in 1967, and 8.4 per cent in 1966. Labor chieftains were obviously trying to get their newest demands nailed into two- or threeyear contracts, ahead of any antiinflationary move that the Federal Government may be forced to take.

Moves now contemplated by the Federal Government could either help or hinder this situation, depending on the viewpoint.

The President's proposal for a real beginning in tax-sharing

with the states is not likely to win approval at this session of Congress: the idea is popular, the mechanics are extremely complex. But if some such scheme is worked out, it might cut some red tape, put more money in the hands of local governments without Federal restrictions.

On the other hand, that tax reform bill passed by the House (but needing Senate action as Congress got back to work) could be a serious blow to municipal financing programs. The bill does not remove tax exemption from local bonds — but, as passed by the House, it would force bond-holders to "allocate" their income between tax-free and taxable securities (thus lessening the attraction of tax-free bonds), and would permit local governments to issue taxable bonds, with the Federal Government making up the interest differential.

The Equal Employment Oportunities Commission threw its own wrench into the labor picture by declaring that most laws now governing the employment of women (concerning such things as lifting weights, late hours, and the like) are no longer valid, will not be considered as defense against charges of discrimination because of sex. It could open the doors for applications from women for jobs as machine operators, carpenters, others on the site.

The President's proposal for a \$10 billion, 12-year urban transit program (embodied in S. 2821 and other bills) would pump new money into the economy — but it is already under fire because it does not provide trust fund financing, will depend on the biennial appropriations instead. (Reason: Treasury Department argues there is no easily identifiable group — as higbway users — who could be taxed to support urban transit).

The industry did get one bit of recognition — its own safety law (PL 91-54) — which represents a victory for contractor groups who demanded and got provisions for (Continued on page 80)





# There's a new dimension in design on the horizon... and "new dimension" door hard-ware to meld perfectly. From Glynn-Johnson.

Bold, new plans, new building materials, new techniques, and new architectural concepts have produced marvels of construction beauty and function. And new and exciting challenges to suppliers' design and engineering facilities.

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Those factors, plus a reputation for service and dependability, led to the selection of Glynn-Johnson hardware for Chicago's magnificent new First National Bank Building. A special oxydized bronze finish (US 10B) was specified; hardware including heavy duty overhead holders, wall and door bumpers and door stops were installed.

Architect, specification writer and contractor agreed on "new dimensions" hardware. Ours.

ARCHITECTS: C. F. Murphy Associates & The Perkins & Will Partnership GENERAL CONTRACTOR: Gust K. Newberg Construction Company CONTRACT HARDWARE DEALER: Midwest Hardware Company

GJ-70

On Readers' Service Card, Circle No. 459



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#### (Continued from page 78)

full judicial review of Labor Department rulings in this field. Note that this bill is separate from a general industrial safety bill called for by President Nixon (S. 2788 and HR 13373), which would cover all other industry.

Elsewhere — with both Congress and the President out of town for several weeks — the pace of activity in Washington slowed to a dead walk.

But there were a number of developments that were of interest to architects: 1. In a somewhat unusual action, the Federal Trade Commission forced the United States of America Standards Institute Inc. (USASI) to change its name — to "American Standards Institute, Inc." (ASI). Reason: FTC contended that the former unwieldy title implied that the privately-financed Institute — which publishes voluntary standards and sometimes certified particular products — had some connection with the Federal Government.

2. The American Road Builders Association's board of directors adopted a tentative scheme (to be ratified at ARBA's March, 1970 convention in New York) to align the organization with an integrated transportation system — including mass transit and airways; and change its name to "Transportation Builders of America."

3. The Internal Revenue Service decided it would bow to court decisions. Henceforth "in general" it would "concede" that organizations of professionals under state professional association acts should be taxed as corporations.



California Institute of the Arts by Ladd & Kelsey

#### **Neo-Renaissance**

The days of the Renaissance, though long gone, are being renewed in spirit by a movement at the California Institute of the Arts. In reaction to the specialized space age, Cal Arts new campus by Ladd & Kelsey is intended to be a community of the arts under a single shelter, by fall 1970, in which men of all skills and wide imagination inspire creativity in each other in a central environment.

What then of the environment for this intellectual connoisseur? It must contribute to his ends and educate his taste. Therefore, Cal Arts had to be designed to include a living experience exposing art students to every major artistic discipline. The architects remarked that designing the Institute was a little like trying to cast a building in a human image the image of the complete artistic man.

Two basic requirements in the philosophy of the design had to be fulfilled: the structure had to be free enough to encourage communication, and restrained enough not to end up in cacophony. The result is a sprawling 525,000 sq. ft, three level mega-building with 150 major spaces, eight theatres of various sizes and uses. It also houses studios, workshops, galleries, and other technical facilities, all with an aery simplicity and lots of working space.

#### **Personalities**

Christopher Z. Wzacny and Clarence C. Bentley, staff members of Tarapata-MacMahon-Paulsen Associates, Inc., Bloomfield Hills, Mich., have become Registered Community Planners. Michigan, the only state which offers planner registration, has approved approximately 300 planners from other states and Canada.... T. J. Kent, Jr., professor of city planning at the University of California, has been elected president of the American Society of Planning Officials.... Kenneth E. Schwartz, administrative department head in the School of Architecture, California State Polytechnic College, has been elected Mayor of City of San Luis Obispo, Calif. Schwartz has served eight years on the City Planning Commission. . . . Architect Eliot Noyes was the recipient of an Honorary Doctor of Fine Arts Degree at Carnegie-Mellon University's commencement. Noyes' architectural practice covers a wide range: office building, laboratories, schools, World Fair pavilions, and houses. In industrial design, his work includes computers, typewriters, dictating machines, and diesel engines. . . . Bernard J. DeVries, president of DeVries Associates, Inc., architect and engineer, Muskegon, Mich., has been elected president of the Michigan Society of Planning Officials, which he founded in 1943 and which now has 1200 members.

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#### **Bronze Coating of Aluminum**

A new method has been developed for bronze coating aluminum. The process, said to use a principle different from anodizing, requires inexpensive, easy to build equipment, and is recommended for extrusions and/or aluminum sheet metal. A coating using the fastand simple-to-apply process, will last indefinitely and will not fade due to the alkaline nature of the process (unlike anodizing). Recodizing Corp., No. Hollywood, Calif. Circle 103, Readers' Service Card

(More products on page 88)







Packaged Bathroom for Special People

A "packaged bathroom" design for hospitals is for ambulatory or wheelchair patients. The unit is actually a complete room with walls, floor, ceiling, and all bathroom facilities made of fiberglassreinforced plastic with a sanitary gel-coat finish. Molded in four sec-



#### Constructivist Cocktail Table

Two thick slabs of Calacata marble slip into each other in an "X" shape to form the base of this 16"-high cocktail table. The 36" square glass top allows a complete view of the constructivist design aspects as well as the strong pattern in the stone. Habitat Inc., 341 E. 62nd St., New York, N.Y. 10021

Circle 105, Readers' Service Card

tions that are bolted together onsite, it is adaptable to any type of construction, including above-thefloor roughed-in plumbing installations. Public Relations. Crane Co., 300 Park Ave., New York, N.Y. 10022 Circle 104, Readers' Service Card

#### **Futuristic Vinyl Covering**

A futuristic concept in vinyl appears in "Silver Glow" patterns. Five variations on the silver theme can be used for wall covering, windowshades, parsons tables, and upholstery. The vinyl is 53" wide, cloth-backed and washble. Gilford, Inc., 387 Park Ave. South, New York, N.Y. 10016 Circle 106, Readers' Service Card

#### Golden Reflective Glass

Manufacturer's expanded line of coated reflective glass includes three golden colors. Coatings are said to reduce solar heat gain by reflecting the sun's energy and reduce light transmission to 8, 14, and 20 percent respectively, as well as diminish interior glare and brightness. Libbey-Owens-Ford Co., Press Relations Dept., 811 Madison Ave., Toledo, Ohio Circle 107, Readers' Service Card

#### **Electric Latch Strike is** Smaller but Stronger

Three series of electrically released latch strikes accommodate installation in aluminum, hollow metal, and wood doors. A simplified locking mechanism is combined with a heavy one-piece steel case and a solenoid to improve tamper-resistance and electrical reliability. Also fits USA standard jamb cutout for non-electric latch strikes and radius-faced versions for 134" narrow stile of paired aluminum doors. AC and DC voltages and a choice of trim finishes. Architectural Products Div., Adams Rite Manufacturing Co., 1425 Grand Central Ave., Glendale, Calif.

Circle 108, Readers' Service Card

#### **Tankless Toilet Operates Electro-Mechanically**

New concept in toilets eliminates toilet tank. Unit is built around a "life-time" valve that utilizes solid-state circuitry and operates electro-mechanically by a 115V or 24V power supply. For existing locations, the tank is replaced by an 8" x 12" box. For new locations, the circuitry is built into the wall. Other features include manual operation in case of outside electrical failure. Nelson Knapp, Knapp Enterprises, 7728 Eton Ave., Canoga Park, Calif. Circle 109, Readers' Service Card

#### **Automatic Water-Flow Sink**

the Aquatron "Electric With Flow Control" sink, water flows automatically when hand is placed below water spigot and stops when hand is pulled away from flow. Control is actuated by a 24v solid state electronic system. Sink basins available in white and colored vitrous china, porcelainized cast iron or stainless. Sales Dept., Creative Products, Div. of Scope: West, Inc., 11753 Wilshire Blvd., Los Angeles, Calif. 90025 Circle 110, Readers' Service Card

(More products on page 90)

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(Continued from page 88)



#### **Sculptured Plastic Grillework**

Area dividers are said to eliminate traditional framing methods. Panels are suspended in space or supported on pedestals. Floor-toceiling types are available with spring loaded pressure supports or with adjustable bases ready to fasten in place. Free-standing types may be fastened to floor for permanent installation. Composed of tough, impact-resistant and washable plastic units, panels are furnished in antique white matte finish, black, metallics, or custom colors. Variety of widths and heights. Harvey Design Workshop, Inc., 74 N. Prospect Ave., Lynbrook, N.Y. 11563 Circle 111, Readers' Service Card

#### Oak Desks and Cabinets Collection

"Executive Oak/Phase 1" desks are available with single or double pedestal and with secretarial runoffs in three sizes. The collection includes coordinating executive cabinets with a variety of file, drawer, and storage arrangements. Each offers a choice of black or brown vinyl tops and back panels. Harvey Probber, Inc., 979 Third Ave., New York, N.Y. 10022 Circle 112, Readers' Service Card



#### Motorized Moveable Shelving Units

A series of track-mounted enclosed shelves mounted between fixed end units are moved for access by utilizing an electric motor with push button controls. Space is required for only one aisle, as the units slide to create their own moving aisle. Safety feature insures that anyone within the aisle will be protected against inadvertent closure. Hall, Haerr, Peterson & Harney, Inc., Advertising, Lehmann Bldg., Peoria, Ill. Circle 113, Readers' Service Card

#### **Three-Handle Kitchen Faucet**

Three-handle faucet for countertops is designed to provide hard well water, plus hot and cold soft water. Available in curved "Hydramold" or tubular spout, metal or lucide handles, and with or without aerator and spray. Milwaukee Faucets, Inc., 4250 N. 124th St., Milwaukee, Wis. Circle 114. Readers' Service Card

#### **Rough-Sawn Mahogany Siding**

Rough-sawn Philippine Mahogany siding for interior or exterior use, can be stained or left to weather naturally. It is said to be durable, maintenance-free, and resists surface checking and grain raising from weathering. Available in six different textures, the panels are 4' x 8', 4' x 9', 4' x 10', sizes, and  $\frac{3}{8}$ " and  $\frac{5}{8}$ " thicknesses. Publicity Manager, Boise Cascade Building Products, P. O. Box 7727, Boise, Idaho 83707 Circle 115, Readers' Service Card

#### **New Wrinkle in Tapestries**

Designers may specify tapestries custom-woven by hand in any size, color, or design, ancient or modern, at prices said to be less than those of ready-made tapestries of equivalent quality and size. Tapestries as large as may be required are translated by Aubusson (France) craftsmen from small color originals or reproductions, and "are woven from the finest wool in color-fast hues." Art Vivant, Inc., 173 Highridge Rd., New Rochelle, N.Y. 10804 Circle 116, Readers' Service Card

#### **Heavy Duty Tufted Carpet**

Indoor-outdoor tufted carpet for heavy duty commercial use is made of solution-dyed Acrilan acrylic fiber. Called the Oakhurst Series, it is available in four solidcolor patterns and four two-color patterns. The  $\frac{5}{64}$ " carpet can be specified in either 12- or 15-ft widths, and in face weights of 42 oz for heavy traffic, 34 oz for medium traffic, and 26 oz for light traffic. Primary backing is Typar and latex, and secondary backing can be either polypropylene or  $\frac{3}{16}$ -in. high-density foam. Hal Lawrence Inc., Town & Country Village, Palo Alto, Calif, 94301 Circle 117, Readers' Service Card

#### Fire Retardant Cedar Shingle

A roofing system with a UL "class B" rating makes it possible to use natural cedar shingle roof in buildings designed for the innerfire zone areas of most major cities. The system uses fire retardant red cedar shingles over roof deck covered with a plastic coated steel foil underlayment applied from 27-in. rolls. The material is tucked under and then overlapped at roof deck seams for added protection. The shingles are pressure-impregnated with a fire-retardant compound designed for exposure to all weather conditions. Koppers Company, Inc., Pittsburgh, Pa. 15219

Circle 118, Readers' Service Card (More products on page 92)



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(Continued from page 90)



#### Airport Baggage Handling System is Computer-Controlled

A computer-controlled baggage handling system permits rapid movement of baggage within an airline terminal complex, with all storage, handling, and sorting under computer control. The system transports baggage in individual cars made of thermoplastic, and powered by linear motors. The cars travel on two aluminum rails that can be mounted on the floor, mounted in a cantilever position, or suspended from the ceiling. To use the Telecar System, a passenger places his baggage in a Telecar. By inserting a baggage claim stub into a terminal he sends the Telecar automatically to the proper loading gate. Deplaning passengers claiming baggage insert their claim checks into readers at the desired location, and the Tele-





car automatically brings the baggage. In addition to the Telecar Baggage System, the manufacturer offers the Docuteller Currency Dispenser, an automated teller station device for banks. Thomas Tierney & Associates, Inc., 6th-Floor-Mercantile Dallas Building, Dallas, Tex. 75201 Circle 119, Readers' Service Card

#### Mobile Study Carrel System

A system of portable study carrels composed of various size units to fit existing tables and desks, boasts economy and flexibility. All models have anodized aluminum edge protection of the plastics panel surface and fold easily to store in a minimum space. Carts to both store and mobilize the system are included. EIDCO, P.O. Box 867, Cupertino, Calif. 95014

Circle 120, Readers' Service Card

#### Vaulted Ceiling Panels Reduce Noise Pollution

An acoustical ceiling system based on 5' x 5' modules incorporates sound absorption, heating, lighting and air conditioning. The airsupply track of the system is said to handle up to 150 cfm with a noise coefficient of 39 at the 150 cfm level. The air deflectors are fully adjustable from horizontal to vertical. The Celotex Corp., 1500 N. Dale Mabry, Tampa, Fla. 33607

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#### Versatile Waterproof Nylon Compound

A ready-mixed roof and wall coating called FLEXLON is suitable for interior or exterior waterproofing. Composed of nylon, polymers, silicones and asbestos, it is applied with brush, roller, or spray equipment to wood, metal, or masonry. It can be used as a new roof over plywood or masonry decks and is said to be effective in stopping leaks through old asphalt or asbestos roofs. It can be used as a skidproof, non-cracking deck surface and is said to eliminate dampness in walls, fungus and mildew. Flexlon Polymer Coatings Div., Flexco of Florida, Inc., 2529 Okeechobee Rd., Fort Pierce, Fla. 33450 Circle 123, Readers' Service Card (More products on page 95)



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(Continued from page 92)

#### The Systems Approach to **Ceiling Construction**

Ceiling "Total Environmental System" incorporates sound, light, and air control. Basically a coffer design, it is offered in three structural patterns: single skin, sandwich laminated, and horizontally installed. All three structures utilize metal face and back plates with sound absorbing blanket between. Sound absorption is provided by density-controlled glass fiber elements and sound isolation is achieved through the use of solid metal back plates. Lighting fixtures can be recessed, suspended, ceiling mounted, or the entire coffer can provide incandescent or flourescent light. Air can be introduced and returned, using the lighting fixture for air return and maximum heat exchange. Air selection can be made from ducted lighting fixture supply, pressurized plenum air bar, or ducted linear air bar. Soundlock Sales and Engineering Office, 2004 Breckenridge Dr., N.W., Atlanta, Ga. 30329 Circle 124, Readers' Service Card

#### **Special Showers for Special** People

Shower units for geriatric or special patient use include a hand spray, thermometers, adjustable sliding bars, and vacuum breakers. Each unit includes a non-scald mixing valve. Tandem Safety Mates, Symmons Engineering Co., 445 "C" St., Boston, Mass. Circle 125, Readers' Service Card

#### Floral and Shield Designs in **Carved Doors**

Three new hand-carved, nine-panel doors, claimed to be among the lowest priced carved doors on the market, are produced in stained solid fur or hemlock. Based on architectural detail of the Florentine Renaissance, the doors are for interior or exterior use. Simpson Timber Co., 2000 Washing-ton Bldg., Seattle, Wash. 98101 Circle 126, Readers' Service Card

Rada thermostat valve for shower and tub filling features built-in temperature and flow controls. It operates on static pressure differentials of up to 5 to 1, and a builtin limit-stop prevents accidental selection of excess temperatures. Four assemblies provide a choice of fixed height or flexible tube outlets for the shower compartment. and two assemblies feature press button switching from shower to tub. Richard Fife Inc., 1140 Broadway. New York. N.Y.

Circle 127, Readers' Service Card

#### **Portable Room Makes** Sound Sense

A portable sound isolation room provides a completely private cubicle for any activity requiring sound isolation, such as a practice room for music students or a conference room in a noisy industrial plant. The portable unit is demountable and can be assembled or removed with ordinary hand tools. It is available in three sizes and is completely lighted and ventilated. Transparent doors and windows allows for easy supervision. Wenger Corp., 4P Wenger Bldg., Owatonna, Minn. 55060 Circle 128, Readers' Service Card

#### Mini-Stat Thermo Control

A miniature pneumatic thermostat for commercial buildings is said to be the smallest in the industry. Made of high-impactstrength Lexan polycarbonate resin, it is claimed to act twice as fast as conventional thermostats because of reduced mass and a bimetal temperature sensitive sensing element; also, the plastic case serves as an insulator against the effects of wall temperature. It snaps in place and has half the number of moving parts as conventional thermostats. Public Relations, Robert Shaw Controls Co., 1701 Byrd Ave., Richmond, Va. 23226 Circle 129, Readers' Service Card

#### **Contract Specifications Service**

A new contract specifications department has been formed by Armstrong Cork Co. to offer professional recommendations to major commercial specifiers of the company's complete line of flooring and floor covering products. Armstrong Cork Co., Lancaster. Pa.

Circle 130, Readers' Service Card

#### Felt-Backed Teak Flooring

A series of moderately priced genuine teak floor patterns boast fine sanded, eased edges and are completely prefinished, kiln dried and felt-backed. "Majestic" and "Haddon Hall" patterns have  $\frac{5}{16}$ " x 12" x 12" panels and is available in walnut and natural finishes. "Mosaic Finger" pattern is 5/16" x 9" x 9" and is available in natural finish only. Feature and starter strips included. Plywood International Corp., 205 Bush St., Brooklyn, N.Y. 11231

Circle 131, Readers' Service Card

#### New Uses for Aluminum

Thin-walled aluminum building facades called "Alumicast," said to be distributed in the U.S. for the first time, is designed as an aesthetic and functional element for reinforcement of high-rise structures. Available in almost unlimited patterns, shapes, sizes, textures, colors, and finishes. Bevel & Winthrop, Inc., 306 Lexington Ave., New York, N.Y. 10017

Circle 132, Readers' Service Card

#### **Cubique Lounge Chair**

Basic seat shell is molded plastic with a thick foam padding and is fully encased in a removable, zippered stretch fabric cover. Square construction allows chair to be used in rows, or back to back. Chrome steel strut base, light in scale but very sturdy. Available in rose or orange. Hank Loewen-stein, Inc., 3105 S. W. Second Ave., Ft. Lauderdale, Fla.

Circle 133, Readers' Service Card

## MFRS' DATA

#### Study Aids for Architectural License Seminars

Architectural License Seminars, an organization that provides a variety of study aids for the State Board and NCARB examinations. offers an examination handbook designed to complement their specialized correspondence courses and crash seminars. The handbook includes simulated questions on all seven subjects which appear on the State Boards and NCARB exams: history and theory, site planning, architectural design, building construction, structural design, professional administration, and building equipment. In addition to the annual handbook, a complete program of individual correspondence courses and one-day crash seminars, held periodically in selected cities across the country, offer a review of all subjects appearing on the examinations. Letterhead request. Architectural License Seminars. P. O. Box 64188, Los Angeles, Calif. 90064

Circle 200, Readers' Service Card

#### **Two-Story Building Systems**

4-page folder describes two-story applications of the manufacturers steel building system constructed from pre-engineered steel components. Contains loading considerations, available floor spans, building heights and bracing and floor-opening design of two-story structures for business and industrial facilities. Folder B15369. Armco Steel Corp., Metal Products Div., Middletown, Ohio 45042 Circle 201, Readers' Service Card

#### **Residential Garage Doors**

28-page catalog shows a wide variety of styles and types of residential garage doors in wood and aluminum. Illustrations include doors matched with architectural styles of homes, and layouts of driveways and turn-a-rounds. Frantz Manufacturing Co., Sterling, Ill.

Circle 202, Readers' Service Card

#### **Rectangular Beam Floodlight**

A prewired integral ballast floodlight utilizing a 1000 watt metallic vapor lamp is explained in a 4-page brochure. The light has 14 different beam spreads and many optional shield and mounting accessories and is said to give exceptional color rendition because it has 50% higher lumen per watt efficiency than standard mercury lamps. Infranor, Inc., Berlin, Conn. 06037

#### Circle 203, Readers' Service Card

#### **Copper Tubes and Pipes**

Manufacturer offers a 40-page illustrated brochure on the application of copper water tube and red brass pipe for all types of commercial and residential construction. Includes specs, installation techniques, photos and detail drawings. Desk A, Advertising Dept., Revere Copper and Brass Inc., 230 Park Ave., New York, N.Y. 11017 Circle 204, Readers' Service Card

#### **Swimming Pool Filters**

Brochure describes the Perflex **Commercial Diatomite Swimming** Pool Filters and provides application data on systems with flow rates from 60 to 2000 gallons per minute. Advantages of the filter and photos of various installations included. Per Corp., PO Box 305, Orange, N.J. 07051 Circle 205, Readers' Service Card

#### **Expandable Space-Frame System**

The UNISTRUT space-frame, a structural roofing and canopy system, is described in a 12-page bulletin. A self-aligning 48" Module, the space-frame consists of five basic parts that boast simplicity and speed of erection. Bulletin contains detail drawings, load bearing charts and application illustrations. Unistruct Corp., 4118 South Wayne Rd., Wayne, Mich. 48184

Circle 206, Readers' Service Card

#### **Three-Dimensional Plotter**

2-page data sheet describes a fully automatic 3-dimensional plotter that makes possible the construction of permanent 3-D models from either punched-paper tape or IBM compatible magnetic tape. In addition, ground related data, such as air pollution, and geological information can be plotted directly over a map of the area involved, and several sets of data can be displayed over a common area to show correlation. Spatial Data Systems, Inc., 108 A Aero Camino, Coleta, Calif. 93017 Circle 207, Readers' Service Card

#### **Hospital Bed Control**

The "Medi-Scan 220", an information system using alpha numeric displays to provide updated data to key hospital departments such as admitting office, dietary etc., is explained in a 4-page brochure. The system is controlled from each floor nursing station. Brochure No. 9298. Motorola Communications and Electronics, Inc., 1301 E. Algonquin Rd., Schaumburg, Ill. 60172 Circle 208, Readers' Service Card

#### **Plastic Light Louvers**

Three different light diffusing louvers in acrylic plastic are described in individual brochures containing photometric data for fluorescent fixture and luminous ceiling installations. MSL Plastics, Inc., 10500 Seymour Ave., Franklin Park, Ill. 60131 Circle 209, Readers' Service Card

#### **Pre-Wired Power Outlets**

A 16-page catalog describing manufacturers complete line of prewired power outlet boxes, includes multiple pre-wired power outlet boxes for industry, institutional school and home laboratory use. Waber Electronics, Inc., 2000 N. 2nd St., Philadelphia, Pa. 19122

Circle 210, Readers' Service Card (More data on page 98) "you wouldn't want to live in this house, yet it could prove indispensable to you"



## The Allenco Hose & Hydrant House!



So when you specify Allenco fire protection for industry, don't forget an Allenco "house for their yard".

There's a style for every requirement. Select construction of steel, aluminum or wood. Finished in gray, or red oxide primer; or red enamel, plus fiberglass roof on some models. Also available in aluminum that needs no finishing. Free standing styles, and cabinet types for mounting on legs or building wall. Both provide immediate accessibility of fire protection equipment in factory or yard. F/M approved and designed to accommodate hydrant/fire hose/nozzles/ spanners/axes/lanterns/and more.

Write or call W. D. Allen for complete specifications and prices



W. D. ALLEN MANUFACTURING CO. 2200 W. 16th St. Broadview (Chicago), III. 60153 Telephone: 312/345-0230



(Continued from page 96)

#### Pad-Mounted Transformer

Bulletin describes a low-profile. dry-type pad-mounted URT transformer that features a modular encapsulated cast coil and cast epoxy accessory block. Designed to be easily hidden or camouflaged, it is 16 in. high and uses no flammable liquids. Sorgel Electric Corp., 838 W. National Ave., Milwaukee, Wis. 53204 Circle 211, Readers' Service Card

#### **Protective Coatings**

Four-page illustrated folder includes properties, recommended applications, and application techniques of DEL protective coatings. The line includes floor and masonry coatings, anti-corrosive coatings for industry, and a series of primers. David E. Long Corp., 1855 Imperial Ave., New Hyde Park, N.Y. 11040 Circle 212, Readers' Service Card

#### **Built-Up Roofing Specs**

20-page catalog contains data on double-coated felts, Fiberock asbestos felts, Carey-tred (built-up roof walkway and protective course), roofing emulsions and all weather plastic roofing cement. Featured are general requirements with data on decks, applications, material specs, and spec diagram and flashing and construction details. Form 6875. Philip Carey Corp., 320 South Wayne Ave., Cincinnati, Ohio 45215 Circle 213, Readers' Service Card

#### Aluminum **Roofing and Siding System**

The "Zip-Rib" roofing and siding system for new and re-roofing applications is featured in a 20-page brochure. Includes illustrations and photos of typical installations and applications, as well as manufacturers standard industrial roofing and siding products. Kaiser Aluminum & Chemical Corp., Rm 858, Kaiser Center, Oakland, Calif. 94604

Circle 214, Readers' Service Card

#### **Control of Concrete Properties**

Eight-page catalog gives basic data on Pozzolith water-reducing, set-controlling admixture; Masterplate dry-shake material for iron-armored heavy-duty floors; and Embeco non-shrink grouts. mortars, and concrete. Graphs and charts give performance information, estimating data, and specs. Master Builders, Cleveland. Ohio 44118

Circle 215, Readers' Service Card

#### **Cold Storage Doors**

16-page catalog features urethaneinsulated doors "to meet any cold storage requirement. Contains photos, illustrations, diagrams, and information on installations with requirements ranging from cool zone to -65° F freezers. Manual or power operated Cold Storage doors are available with facings of galvanized steel, aluminum or dent-resistant "KAYON" plastic. J.M. Kesslinger & Assoc., Advertising, 37 Southbrook Pl., Newark, N.J. 07102 Circle 216, Readers' Service Card

#### Permanent-Split **Capacitator Motors**

Type CX and CM permanent-split capacitator motors are described in a 6-page bulletin that contains sectional drawings a design and construction details. Application, mechanical variations, electrical characteristics and dimensions included. Bulletin 130. Century Electric Co., 1806 Pine St., St. Louis, Mo. 63166

Circle 217, Readers' Service Card

#### **Custom Metal Doors and** Frames

Four-page brochure describes engineering principles and recommended construction and application practices for hollow doors and door frames fabricated from steel. Specifications included. Naof Association Architional tectural Metal Manufacturers. 228 N. LaSalle St., Chicago, Ill. Circle 218, Readers' Service Card

#### **Ceramic Tile Bible**

**INTERPACE** Catalog containing manufacturers wide range of ceramic building products, includes specs, installation data, technical drawings and color palettes. Stan Gaskins, 102 North Brand, Suite 322, Glendale, Calif, 91203 Circle 219, Readers' Service Card

#### **Movable Cabinets Provide** Visual Barriers for Classrooms

A movable cabinetry system that includes visual barrier hutch cabinets, removable connecting pivot panels, movable base cabinets, adjustable ledges, and special purpose portable cabinets, is described in a 12-page brochure. Includes drawings of typical assemblies, construction details, specs and options. The cabinets, recommended for classroom use, are constructed of steel and available in 21 colors. Grade-Aid Corp., 46 Bridge St., Nashua, N.H. 03060 Circle 220, Readers' Service Card

#### Shockfree Carpeting for Computer Rooms

The feasibility of utilizing shockfree carpeting in computer room installations is explored in a bulletin that also describes "Brunsmet," a recently developed stainless steel textile fiber that is said to be softer than wool and finer than silk. Bulletin No. 2-031. Technical Products Div., Brunswick Corp., 69 W. Washington St., Chicago, Ill. 60602

Circle 221, Readers' Service Card

#### **Resilient Floors**

A 16-page full-color illustrated catalog features the manufacturer's complete line of resilient flooring products that includes vinyl asbestos tile, asphalt tile, feature strip, and cove bases in numerous colors and patterns. Information on sizes, gage uses, installation, light reflectance valves, and brief specifications included. Azrock Floor Products, P.O. Box 531, San Antonio, Texas 78206

Circle 222, Readers' Service Card (More data on page 102)

# OUTSIDE-IN 2000

Bayley vertically-pivoted windows cut maintenance costs—let you wash both sides from the inside. Simply turn the window around. Locks positively in position. Windows also offer natural ventilation hoppers for weather too cool for air conditioning yet too warm for heating.

Attractive design, 2" aluminum construction, optional Bayco finish for color control make these windows ideal for hospitals and important buildings. Write The William Bayley Company, Springfield, Ohio 45501.

BAYLEY

ł

- 201

# Soft new beauty in Nature-tone



These bank buildings show the beautiful new look in porcelain-enameled steel . . . the soft, subdued aura of Nature-tone colors.

For the Republic Tower, the architects chose muted gold curtain wall panels to express the verticality of a high-rise structure. The Wells Fargo Bank building features embossed spandrel panels in a soft olive-gray.

Twenty-four Nature-tone hues have been created by color experts, in collaboration with leading architects. This helps you to develop a projection of Nature in porcelain enamel. They are fully in tune with the low-chroma values of contemporary design.

The colors are permanent, the finish is durable. Porcelain finishes resist dirt, weather, and atmospheres. Panels can be designed in a wide variety of textures and embossed patterns.

Bethlehem supplies Bethnamel steel sheets to fabricators who form and coat Nature-tone architectural panels. We are enthusiastic about the aesthetic possibilities of Nature-tones, and will gladly send you the Porcelain Enamel Institute's brochure. Address your request to Room 1047, Bethlehem Steel Corporation, Bethlehem, PA 18016.



Republic Tower, Baton Rouge, La. Architects: Lewis P. Manson and Associates, A.I.A., Baton Rouge; Porcelain enameled panels: Rittiner Industrial Enameling Inc., Bay St. Louis, Miss.



# porcelain-enameled steel







Wells Fargo Bank, Sacramento, Calif. Architects: Harry J. Devine, Inc., Sacramento, Calif. Porcelain enameled panels: Ferro Enameling Co., Oakland, Calif.



(Continued from page 98)

#### **Instant Stairs**

Catalog features "Stair builder" prefabricated steel stair forms for concrete or terrazzo stairs welded into rigid one-piece units. Describes various types of riser and stringer designs available, and explains how standard, curved, flaired, and circular stair units are made and installed. American Stair Corporation, H. James Seegers, Rt. 66, McCook, Ill. 60525 Circle 223, Readers' Service Card

#### Industrial Arts and Vocational Shop Equipment

Catalogue of school shop equipment includes drawing tables, wood and metal working benches, tool, storage and wardrobe cabinets, electrical and electronic test benches, science furniture. Parent Metal Products, Inc., 6800 State St., Philadelphia, Pa. 19135 Circle 224, Readers' Service Card

#### Aluminum Structural Shapes Offer Improved Section Properties and Lighter Weight

The Aluminum Association offers a 6-page brochure that lists dimensions, weights, and section properties for a series of redesigned aluminum I-beams and Channels. Includes an interchangeability chart indicating how to substitute the new shapes for the older designs. The Aluminum Assoc., 420 Lexington Ave., New York, N.Y. 10017 Circle 225, Readers' Service Card

#### Valance Heating and Cooling Systems

Rating and spec folder gives information on valance heating/ cooling systems that provide silent, draftless conditions. Valance construction and automatic temperature control is described and illustrated. 4 pages. Caroe Marketing, Inc., P. O. Box 305, 1133 Pleasantville Rd., Briarcliff Manor, N.Y.

Circle 226, Readers' Service Card

#### Double-Flow Packaged Cooling Towers

6-page data sheet on the series NC cooling tower provides information on hoisting, supporting structure and installation. Specs compare features among all 14 series NC models, and provide generalized data common to all models. Dimensions and performance data included. Valentine-Radford Public Relations, 1100 Commerce Tower, Kansas City, Mo. 64199 Circle 227, Readers' Service Card

#### Air Pollution Control Equipment

11 page catalog illustrates and describes manufacturers complete line of wet scrubbers, gas absorption equipment and systems accessories. Includes detailed information about the companies venturi, impingement and cyclonic scrubbers, crossflow packed bed, and the counterflow packed bed, and the counterflow packed tower. Arco Industries Corp., 12550 Beech-Daly Rd., Detroit, Mich. Circle 228, Readers' Service Card (More data on page 108)



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#### On Readers' Service Card, Circle No. 407

## WITH OUR COMPLIMENTS

An Authoritative, Non-selling Guidebook To Good Weatherstripping



On Readers' Service Card, Circle No. 403

OCTOBER 1969 P/A On Readers' Service Card, Circle No. 448

# Eljer's Ultima...today's ultimate in brass design and technology.

Ultima . . . a completely new concept in brass fittings. Brass handles that have no visible screw or index button. A concealed brass spring locks the handle in place. To remove, depress the spring and lift from the adapter. This unique attachment method discourages vandals.

Your clients will like Ultima's smart appearance and easier maintenance. Smooth tops wipe clean with a touch of a cloth. And replacement parts are front accessible for quick servicing.

Durable construction is another benefit. Ultima's Star-Fire is made of brass and finished with a triplecoating of copper, nickel and chrome. For clients wanting the gold look, specify moderately priced polished brass Sun-Glow. Sun-Glow has an exclusive new protective coating *four* times more durable than other coatings commonly used for this purpose.

For more information, contact your Eljer representative or write Eljer, Dept. PA, Three Gateway Center, Pittsburgh, Pa. 15222.

ELJER

New Sun-Glow polished brass available with amber-tinted translucent handles. Clear handles available with Star-Fire.



Eljer Plumbingware Division / Wallace-Murray Corporation



# High, wide and handsome with insulating glass by Thermoproof.

Beautiful-and functional.

A stately office building for the Commonwealth of Virginia. A tall limestone tower beautifully balanced on exposed granite columns around a podium base.

Compatible with the use of stone, aluminum and the overall modular design, architects Hayes-Seay-Mattern & Mattern of Roanoke specified over 1000 insulating glass units. And practical; these units help control heating and air conditioning costs.

This building is one more way insulating glass by Thermoproof is made more ways to fit more of your ideas in a big way!

On Readers' Service Card, Circle No. 426

Full color insert in Sweets  $\frac{4a}{Th}$ 

Insulating glass by Thermoproof Glass Company subsidiary of Shatterproof Glass Corporation 4815 Cabot Avenue, Detroit, Michigan 48210



## THAT'S YOUR ASSURANCE THAT ALBINA WINDOW WASHING SYSTEMS ARE REALLY SAFE!

Hi-Climber Window Washing Systems made by Albina Engine and Machine Works meet the country's most stringent safety regulation. The Albina Hi-Climber carries New York state's BSA Approval Number 5525. Climbers and Super Hi-Climbers also carry a BSA approval. So you know they're safe!

What's more, these light weight systems won't scratch or mar exterior surfaces. Washing platforms are designed to suit window and mullion spacings. And only nonmarking poly-urethane rollers touch walls and roof. Other features include: safety chain tie down. Exclusive level wind mechanisms and grooved drum. All aluminum platform. When not in use, the entire system can be rolled out of sight or stored.

Albina will provide a complete general description and engineering data for whatever project you're designing.

Cost? Fully competitive with other systems. So it costs no more to play it safe! Write for complete details.



On Readers' Service Card, Circle No. 436



# in Pella sliding glass doors



First Class Permit No. 1

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BUSINESS REPLY MAIL No Postage Stamp Necessary If Mailed in the United States

Postage Will Be Paid By Addressee

ROLSCREEN COMPANY PELLA, IOWA 50219

## The Pella look is the look of inspired design and expert craftsmanship.

If you like the look of PELLA Wood Sliding Glass Doors, just wait 'til you see how much comfort, efficiency and convenience they offer!

PELLA mates slim wood frames with welded steel to insulate against heat and cold, yet be warp-free and extra strong. Condensation is minimized. Stainless steel and woven pile weatherstripping seal out moisture and drafts.

PELLA doors glide quietly on sealed ball bearings. Screens are self-closing ... and can't jump out of their track. If you want special effects, specify regular or diamond-shaped muntins that snap in and out with ease, or doors with lower half panels of wood.

Standard glass widths are 33", 45" and 57", but you can get custom sizes, too. Unit types are: O, OX, XO, OXO and OXXO. All exterior surfaces are factory-primed. Paint or natural-finish the inside.

For more information on PELLA products, mail the card below, or phone your PELLA Distributor (look under DOORS in the Yellow Pages), or see SWEET'S Architectural or Light Construction File. **ROLSCREEN COMPANY, PELLA, IOWA 50219** 

PELLA MAKES QUALITY WOOD WINDOWS, WOOD FOLDING DOORS & PARTITIONS AND WOOD SLIDING GLASS DOORS



## WOOD SLIDING GLASS DOORS

Yes, via first class mail, rush me more color photos and information about the following PELLA wood products:

Sliding	Sliding Glass Doors				
Folding	Doors and Par	titions		V	
Windows:	Casement	Double-Hung	Awning		

Name		
Firm		
Address		
City	State	Zip
I want fast local	service. Telephone:	
Also available throu	Printed in U.S.A.	
K 1 2 3		



Designer: Lee D. Pruitt • Builder: Lee Pruitt Co.



Designer: Jos. D. Travis, Jr. • Builder: Jos. D. Travis and Sons Co. Architect: Bertram Weber, A.I.A. • Decorator: Mrs. Jane Newmark, A.I.D.





## o eliminate water problems in our next design, specify Gacoflex quid waterproofing membrane.

two-part, self-priming compound, Gacoflex waterproofg compound system is readily applied cold in the field by oray or broom. Contractors like working with Gacoflex quid waterproofing membrane because it can be applied practically any temperature to almost any surface. Stone, oncrete, brick, mortar, wood, metal and asbestos are all itable. On Readers' Service Card, Circle No. 359 After curing, Gacoflex liquid waterproofing membrane becomes a chemical resistant rubber sheet approximately 60 mils thick that is serviceable from  $-92^{\circ}F$  to  $150^{\circ}F$ .

Suitable for above or below grade use, Gacoflex liquid waterproofing membrane provides a permanent barrier to water. Write for complete details and sample specifications on UWM-28.





(Continued from page 102)

#### **Quick-Change Partitions**

12-page illustrated catalog describes "Quick-change" movable partitions consisting of anodized aluminum framing members and s a n d w i c h panels. Application photos illustrate the variety of wood-grained hardboard, solid color and vinyl-surfaced panels available. Form 6909, partitions. Masonite Corp., Box B, Chicago, Ill. 60690

Circle 229, Readers' Service Card

#### **Snap-in-Place Curtain Walls**

The Transitop Snap-in System for industrial curtain walls is described and illustrated in a 6-page brochure. Sectional diagrams and installation photos are featured. No. IAC-80A. Johns-Mansville, Box 290-B1, Murry Hill Station, New York, N.Y. 10016 Circle 230, Readers' Service Card

#### Louver Ceiling System

Seven types of suspended louvered ceilings are described in 8 fact sheets that include charts and lighting data on a variety of metal and plastic louvers of different finishes, shapes and textures. Louvers are said to be suitable for use under sprinkler systems and where a ceiling installation with an open light shield requiring minimum maintenance and plenum movement of air is desired. Includes data on louver lens, crenelated, parahex and parabolic, aluminum, vinyl, acrylic and polystyrene plastic. Harper Square Press, Div. of Artcrest Products Co., Inc., 5649 South Harper Ave., Chicago, Ill. 60637 Circle 231, Readers' Service Card

#### Vinyl Wallcoverings

8-page color guide features 24 of the more than 60 Vicrtex patterns and their color ranges. Location photos and swatches included. L.E. Carpenter Co., 350 Fifth Ave., New York, N.Y. 10001 Circle 232, Readers' Service Card

#### Entry Protection and Exit Control Systems

Details and specifications for exit and entry control equipment as well as key system components, including battery-operated or AC-operated exit alarms, door switches, and remote indicating panels. Vertical rod assemblies and other supplemental equipment are also described. Catalog. 12-pages. Detex Corp., 55 Park Place, New York, N.Y. 10007 Circle 233, Readers' Service Card

#### Planning Water Display Systems

Design guide provides practical information about performance characteristics and splash factor conditions for water displays. Advantages of certain water displays, and information about spray devices for special conditions is explained. History of fountains, catalog selections, accessories and engineering data are included. Letterhead request. Roman Fountains, Inc., P. O. Box 10190, Albuquerque, N.M. 87114

## VERY DEPENDABLE & PRECISE ENVIRONMENTAL CONTROL FOR EXPENSIVE & SENSITIVE COMPUTERS



Computers require precise, constant control of temperature and humidity for efficient operation with minimum down time. Units for this application must handle heat loads up to 95% sensible and 5% latent heat generated by computers and maintain 40%-60% RH levels to keep tapes from becoming brittle. Site Environment Systems perform these tasks precisely and reliably.

*Reliable*—Engineered and built to operate continuously. Light and alarm bell indicate need for service. Dual circuits and dual condensers give fail-safe protection.

*Precise*—Automatic Controls filter, warm or cool, humidify and dehumidify room air to maintain environment within narrow tolerances.

Adaptable—Completely self-contained units in a complete range of sizes, 3, 5,  $7\frac{1}{2}$ , 10 and 15 tons for use singly or in combination.

*Flexible*—Available in water or glycol cooled, aircooled, or chilled water models. Easily altered to duct air up or down through ductwork or floating floors.

*Economical*—Quality engineering reduces need for maintenance. Easy access from front cuts service time.

Write for complete specification information:

## FLOATING FLOORSINC

A Subsidiary of National Lead Company

S400 NOTIT Detroit Avenu

5400 North Detroit Avenue Toledo, Ohio 43612

#### **All-Metal Construction Products**

Manufacturer's factory fabricated all-metal products, including gravel stops, fascia panels, mansard batten panels, reglets, cap flashings and through-wall flashings are described in a 12-page catalog. Illustrations, color chips, detail drawings and specs are included. Cheney Flashing Co., 623 Prospect St., Trenton, N.J. Circle 234, Readers' Service Card

#### Weathering Steel

Brochure outlines characteristics of COR-TEN weathering steel. COR-TEN is available in three grades, with minimum yield strengths up to 60,000 psi; and is said to form its own surface-oxide coating. Brochure covers properties, advantages, limitations, suggests structural applications, and welding and fabrication practices. Inland Steel Co., 30 W. Monroe St., Chicago, Ill.

Circle 235, Readers' Service Card

#### Impact and Airborne Noise Control

A 12-page bulletin describes systems for controlling impact and airborne noise in mechanical equipment areas, music buildings, auditoriums, pedestrian malls, and laboratories. Illustrated. Bulletin No. 13. Consolidated Kinetic Corp., 249 Fornof La., Columbus, Ohio

Circle 236, Readers' Service Card

#### **Coating Materials Versus Corrosive Agents**

A coating resistance guide for fans rates 19 paints, special metals, and coating or lining systems, and their resistance to 59 corrosive agents. It also rates the 19 coating materials by reference to relative cost and maximum temperature and describes composition and characteristics of common coating materials. 6 pages. Barry Blower Company, 99 77th Way N.E., Minneapolis, Minn. Circle 237, Readers' Service Card

#### **Steel Roof Deck Design** Manual

The Steel Deck Institute has assembled in one manual all their data on roof design. Contains new standard tables for narrow, intermediate and wide rib decks, details on latest fire ratings from 1 to 2 hrs, and latest revisions of basic design specs and SDI Code of Recommended Practice. Steel Deck Institute, 9836 W. Roosevelt Rd., Westchester, Ill. 60153 Circle 238, Readers' Service Card

#### New Ribbed-Steel Web Girder

Manufacturer's brochure describes the new PANLWEB girder for light-to-medium construction. The girder consists of top and bottom cold-formed steel flanges and a ribbed light-gauge sheet steel web. It is designed to reduce weight without sacrificing strength. 6 pages. Macomber Inc., Subsidiary of Sharron Steel Corp., P.O. Box 830, Canton, Ohio Circle 239, Readers' Service Card

(More data on page 116)

## THE ULTIMATE IN ACCESS/AIA PLENUM FLOOD SYSTEMS FOR EXPENSIVE & SENSITIVE COMPUTERS



Elevated Floors provide full access to cables and ducts and a pressurized plenum for efficient, flexible, draft-free air distribution. Choose the best. A lightweight, aluminum panel, precision engineered, maintenance-free floor with all the reserve strength you'll ever need, from Floating Floors, Inc.

Precision-made—Floating Floors panels fit perfectly, with complete interchangeability.

Strong-Unique combination of die cast panels and pedestals provide all the reserve strength you'll ever need, without stringers.

Maintenance-free—Corrosion-resistant aluminum panels never need painting . . . are grounded for continuous, worry-free operation.

Cleaner environment-With aluminum panels, no iron oxide particles or paint flakes can get into the computer room environment.

Total Access-Lightweight aluminum panels simply lift out to allow complete access.

Flexible Air Distribution-The cavity beneath Floating Floors serves as plenum to deliver air. Re-arrangement is by moving louvered panels.

Write for complete specification information:

## FLOATING FLOORSINC

5400 North Detroit Avenue Toledo, Ohio 43612 A Subsidiary of National Lead Company On Readers' S ervice Card Circle No. 356



Burdine's Dadeland Store, Greater Miami, Florida; Architect: Herbert H. Johnson Associates, Miami; Structural Engineer: H. J. Ross Associates, Inc., Miami; General Contractor: Frank J. Rooney, Inc., Miami.

# Cars up. Costs down.
# Concrete is good for you

Construction costs: rising. Land costs: rising. Real estate taxes: rising. The inevitable answer: roof deck parking.

The logic of this simple concept is overpowering. Less land is needed. Therefore land costs are cut. The need to build large parking areas is eliminated.

Therefore total construction costs are cut.

There is less improved land. Therefore taxes are cut. There are other advantages as well.

Greater employee and customer convenience.

Lower fire insurance rates. A stronger, sturdier building in which concrete is the basic material.

You see, concrete is good for you.

For complete information on the roof parking concept, write us. Portland Cement Association, Dept. PA-10, Old Orchard Road, Skokie, III. 60076.

PCA -- IMPROVING AND EXTENDING THE USES OF CONCRETE

PORTLAND CEMENT



# Now you can put up a glass-walled building in Miami and forget about the heat.

# Mutual of Omaha did. With PPG Performance Glass.

PPG's Solarban<sup>®</sup> Bronze Twindow<sup>®</sup> made possible an open building design for Mutual of Omaha's new Regional Home Office in Miami and enabled the architects to reduce the size and cost of the building's cooling system.

The building's HVAC system is a single-duct air system with radiant



heating and cooling panels in the ceiling. The Solarban Twindow units offer a reflective coating which turns back much of the solar radiant energy, rather than permitting it to become a load on the cooling system. And this same lowemissivity reflective film enables Solarban Twindow, an insulating glass unit with 1/2'' airspace, to perform like triple glazing in reducing the conducted heat loss during Florida's winter months. Combined with PPG's Solarbronze plate glass in the Solarban Twindow unit, the reflective coating reduces the overall light transmission to 12%, thus much of the outdoor brightness is

shaded with no obstruction to the occupant's view.

Other factors influenced the selection of *Solarban Bronze Twindow*. Its excellent insulating capabilities permit higher, more comfortable humidity levels to be maintained without condensation. This heat-strengthened glass also



This diagram is illustrative of relationships for a given specialized set of conditions.

On Readers' Service Card, Circle No. 406

meets strength requirements, and its color complements the bronze tone of the exterior metals.

The new structure has eight floors with over 93,000 square feet of space. Building costs were \$27.22 a square foot. Usable floor area is 80% of the total square footage.

Put the financial advantages of PPG Performance Glass to work for your clients. Contact a PPG Architectural Representative for technical data or write: PPG Industries, One Gateway Center, Pittsburgh, Pa. 15222.

Architect: Houstoun, Albury, Baldwin & H. Maxwell Parish, Miami Interior Design: Houstoun & Parish, Miami Consulting Design Architect: Leo A. Daly Co., Omaha

Consulting Engineer: Breiterman, Jurado & Associates, Miami

PPG is Chemicals, Minerals, Fiber Glass, Paints and Glass. So far.



### The most exciting ideas take shape in plywood.

of a series presented by members of the American Wood Counc







This church is a brilliant demonstration of plywood's compatibility with contemporary design, other materials and a stringent budget. The modified folded plate sweeps up to a skylight and a spire soaring 103 ft. above the altar. The plywood deck, substrate for General Electric's silicone rubber roofing, is over T&G planking supported by giant laminated beams. Plywood was specified not only for its adaptability to the unusual roof shape, but also because a metal roof system would have cost twice as much. For more information on plywood and plywood structural systems, write us at Dept. PA, Tacoma, Washington 98401. (USA only, please.)



Tubular aluminum spire

Immaculate Conception Church, East Weymouth, Mass. / Holmes & Edwards, Inc., Architects

On Readers' Service Card, Circle No. 441



# 25% more light thanks to U.

Keene's new family of 24" or 30" square fixtures gives you 25% more light than similar units using straight fluorescents. You get high light output with complete interior design freedom. Reason: our truly one-of-akind fixture that uses any major manufacturer's 40-watt U-shaped lamps...the ones with the 6" leg spacing or the  $3\frac{1}{2}$ " leg spacing.

Recessed models feature a hinged assembly that puts all electrical components on one side. There are 3 types available: surface, air and non-air, recessed. Want us to shed more light on our new fixture family?



Lighting D (Formerly 4990 Acoma Denver, Co Send Info	s por arton, ivision, Sechrist Mfg. Street, lorado 80216	. Co.), Me.
Name		
Company_		a france
Address		2
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MFRS' DATA

(Continued from page 109)

#### Letting the Air Out

"Air Moving Equipment" is the title of a bulletin that includes data on direct drive, reversible panel, tube-axial, vane-axial and centaxial fans; mancoolers; automatic door air heaters; materials handling fans; high pressure blowers; roof ventilators; adjustable pitch propellers; gas-fired and steam air make-up units; filtered air supply units and industrial air heaters. General Products Bulletin G-69. Aerovent Fan Company, Inc., Piqua, Ohio 45350

Circle 240, Readers' Service Card

#### **Precise Environmental Control**

"Total Environmental Conditioning System" designed for data processing centers, research laboratories, electronic equipment rooms, and other areas that require precise control of temperature and humidity, is the subject of a 6-page booklet. Outlined are advantages of the completely selfcontained, air-cooled conditioning system that also includes an optional split system with remote aircooled condenser. Typhoon Air Conditioning Co., 505 Carroll St., Brooklyn, N.Y. 11215 Circle 241, Readers' Service Card

#### Low Voltage Equipment Catalog

"Spring '69 BUY LOG", a 228page low voltage equipment catalog includes dimensions, pricing, ratings and selection guides on the following lines of protective and distribution equipment: enclosed molded case circuit breakers, circuit breaker and fusible service entrance equipment, safety switches, fusible disconnect switches, wireway, panelboards, switchboards, grouped metering equipment, busway, general-purpose controls, transformers, and wiring devices. Pub. no. GEC-1100M. Distribution Unit, General Electric Co., Plainville, Conn. 06062

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#### SYMONS DEEP GROOVE STRIATED FORM LINER

Symons Deep Groove Striated Form Liner leaves a soft, handsome effect to exposed concrete surfaces. Of prime benefit to the architect is the manner and ease of finishing the deep groove striations, reducing the exposure of any imperfections that may be present due to rock pockets, honeycombs and bug holes.

Normal size of the liner is  $4' \times 8'$ , but can be ordered in any size up to  $4' \times 16'$ . It is made entirely of a wood composite, which can be easily attached to the forming surface.

Striated form liner may be used in conjunction with Symons Rustication Strip, illustrated below. Ties are inserted through the Rustication Strip, leaving the tie hole in the impression, and not in the face of the concrete. Complete details about the striated form liner and rustication strip are available upon request.



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Incline High School, Washoe County School District, Washoe County, Nevada

Architect: Edward S. Parsons, A.I.A., Reno, Nevada

# Safety is your first big plus with Plexiglas all-purpose glazing

Plexiglas acrylic plastic is the preferred safety glazing material because it gives you the breakage resistance you need plus added benefits.

Solar control, for example. In addition to colorless sheets, Plexiglas is available in five densities of transparent gray or bronze tints, and a variety of thicknesses that do not vary in color value. Choose any combination of solar heat reduction, glare control and breakage resistance you need.

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Plexiglas meets the performance specifications for safety glazing established by the United States of America Standards Institute and has broad building code approval.

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Design objective: In bathroom for two-bed hospital patient room, install high quality stainless steel equipment... for contemporary appearance... maximum utilization of space... safety and convenience of patients... easy servicing.

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Provide convenient wash basin storage for two patients sharing room.	B-57492 Storage Cabinet attaches to console unit; holds two wash basins.
Additional storage facilities for individual bed pan, urinal and measuring cup for two patients.	B-510 recessed Storage Cabinet (right of console) holds two bed pans, two urinals and two measuring cups.
Provide safe, heavy-duty, securely anchored towel bar and robe hook.	B-205 Stainless Steel Towel Bar; B-211 solid brass Robe Hook, matching finish.
Provide adequate support for patients entering, using or leaving shower.	B-5687 two-way grip, extra heavy-duty 1¼″ diam. Stainless Steel Grab Bar.
Provide seat in shower for added safety, ease and comfort of patients.	B-508 Corner Shower Seat; hinged to raise up, out of way, when not in use.
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for your designs. Think Armco Steel for your designs. Think Armco

# Think Armco Steel for your designs



We'd be happy to send you our new bulletin on constructional steels. It offers cost and strength comparisons as well as information on tensile properties, composition, welding characteristics, plate and bar sizes, and applications. If your office or firm would like this bulletin, write to Armco Steel Corporation, Department W-299, P. O. Box 723, Houston, Texas 77001.

Armco Steels for Construction						
ASTM designation	Armco designation	Yield Point psi minimum	Tensile Strength psi			
A 36	A 36	36,000	*58,000 to 80,000			
A 242 and A 588	High-Strength A	* 42,000 to 50,000	*63,000 to 70,000			
A 441 and A 242	High-Strength B	* 40,000 to 50,000	*60,000 to 70,000			
A 572	High-Strength C	42,000 to * *70,000	* * * 60,000 to 85,000			
A 440	High-Strength D	* 42,000 to 50,000	*63,000 to 70,000			
A 514	SSS® 100	* 90,000 to 100,000	* 105,000 to 135,000			

\*depending on thickness.

\*\*exceeds maximum yield strength of 65,000 psi covered by A 572.

\*\*\* exceeds maximum tensile strength of 80,000 psi covered by A 572.





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Marquette Manor, Cincinnati, Ohio; H. M. Garriott & Assoc., Arch.; Frank Messer & Sons, Inc., Gen'l Cont.; The Nurre Co., Dist. (all in Cincinnati, Ohio)

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You save it by engineering the system around a Caterpillar Power Package.

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CATERPILLAR



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# Keene announces the instant-access ceiling.

#### New Accesso<sup>™</sup> Concealed Suspension System for acoustical tiles and pans

Just tilt a tile up and lift it out. Then slide it back in again. It's that easy with the new Accesso fully concealed suspension system.

There's no need to strong-arm tiles down with a tool, Or force fragile tile end joints. Or anchor tiles into a grid so rigid the ceiling has to be dismantled for servicing overhead utilities. No need for special access panels, either—*every* Accesso tile is an instantaccess panel.

And because Accesso members aren't locked permanently, you're not locked into the building module. You have absolute freedom to locate lighting fixtures and air-handling devices wher-

ever you like—then relocate them as building needs change.

What's more, the Accesso system—exclusively—can also be used to suspend metalpan ceilings in kitchens, laundries and other high-humidity areas. You can specify just one ceiling system for the entire building!

Any standard tile can be used in the new Accesso system, with no special machining. But for instant beauty to match instant access, specify richly fissured Styltone or other acoustical tiles from Keene. For full details, write Keene Corporation, Sound Control Division, Box 458, Trenton, New Jersey 08602.



SOUND CONTROL DIVISION





Heublein, Inc. selected an Accesso "instant-access" ceiling system for this modern corporate headquar-

ters building in Hartford, Connecticut.

Tiles fit snugly to form a smooth, almost seamless ceiling with Accesso concealed suspension. The design here called for 12"x24" tilles, but 12" squares are equally convenient in the Accesso system. Note that overhead systems can be serviced easily without interrupting office operations. Just push a tile up and lift it out. No tools needed with the Accesso system. And every tile is an access panel!



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#### PROGRESSIVE ARCHITECTURE OCTOBER 1969

#### EDITORIAL

IN A TECHNOLOGICALLY ADVANCED SOCIETY it would seem that new building materials would generate new structural systems. We have been told, time and again, that our structural constraints are gone. Yet, compared to the structural advancement, new material development, and mechanical environmental ingenuity of space exploration the structural constraints seem still to be very much with us. The most efficient use of materials and the future of building design, the engineers say, lies in the con-

cept of integrated systems: that is the interaction of building elements as a whole. This is presently impossible. The contradiction between the dream of aero

space technology applied to the building process and the nightmare of existing chaotic piecemeal building assembly is the direct result of the design process. When an architect undertakes the design of a single

building he becomes in effect four separate and distinct specialists.

The exterior of the building is designed by the exterior architect; the structure of the building by the structural engineer; the mechanical system by the mechanical engineer; the interiors by the interior architect. The architect is at present ethically responsible for design only, in spite of the fact it is only one of his responsibilities.

The proposed change in ethics of the AIA is a recognition of this fact. The proposals are aimed at recognizing and increasing architectural involvement in the building process thus helping to integrate the four specialists and pave the way for development of materials and systems integration in the construction fields.

There is, however, some strange wording in the AIA proposals for ethical change. The architect is to devote himself to technical developments of materials and construction methods, acting in a manner ... "that brings honor and dignity to the profession of architecture and the construction industry." However, he is not required to share his designs, sketches, or professional work with others engaged in the design of the physical environment. Rather he is admonished to advance the construction industry by making available technical information of general applicability.

How the architect can bring honor and dignity to an activity that shortly before and even now he is enjoined against participation in by present AIA ethical standards is another matter. Perhaps the key word of the new ethics is disclosure-disclosure of what some architects have been doing, others have wanted to do, and many plan to begin. An architect who has not been allowed to engage directly in the building process can hardly have a great deal of technical information to share. There seems an inversion of thinking here. What should be shared with the builders is the architect's design, knowledge, his ingenuity, his inventiveness, his partiality for human spaces, in short the things that his ethics permit him to contribute to the environment now. What he will benefit most from a pooling of knowledge with all the others involved in the building process is, economic, technological, management, and building expertise. We need an integration of the building process not a holding back of the architect's particular expertise, design.

Farrest Wilson



# METALS REVIEW

Although there have been no major breakthroughs in the evolving technologies of metals used for construction in recent years, there nevertheless have been refinements in metallurgy and architectural applications that are of interest and value to the professional reader. In this report some of the significant developments in the primary metals designed and specified by architects — steel, aluminum, the copper family, and lead — are discussed.

The editors are indebted to many sources for help in gathering and evaluating this material, including the American Iron and Steel Institute, Aluminum Association, Copper Development Association, and the Lead Industries Association.







# STEEL

Steel is the spine of the cityscape — indeed it is the bones and sinew of the entire construction industry. Without it, the 20th-Century architectural environment would not exist. The following report documents the evolution of steel over the past ten years, and explores new technologies and design patterns that are developing around its basic strengths.

Photo: Courtesy of Bethlehem Steel Corp.

# **Modern Structural Steel**

W ith the demise of A7 steel in 1967, once the mainstay of the structural framing, a proliferation of new steels has appeared. Today's architect can choose between structural steels with yield strengths from 24,000 to 100,000 psi and tensile strengths between 50,000 and 135,000 psi minimum. He can choose between maximum bulk and rigidity when desired, and maximum lightness. He can select steels for bolting or steels especially suited to welding. He can specify steels with varying degrees of corrosion resistance. He can include in his designs steels that protect themselves by weathering and are virtually maintenance free.

Although the general specification, ASTM A36, covers a multitude of uses and is the most economical for many purposes, today's architect should consider the other steels available — or combinations that will do the best job (see pull-out chart).

A36, once called "improved carbon steel" because it had 10 per cent better strength than A7, is now the standard structural steel. The carbon family itself has been expanded to include more formable and higher strength carbons. Where strength-to-weight ratios are not important or where bulk for rigidity is important, A36 is the preferred steel. It is easily welded or bolted, and is available in many shapes and thicknesses.

Not all structural steels are available in the thickness and shape variety of A36. The higher strength carbon A529, which has a minimum yield strength of 42,000 psi, is available in plates only to  $\frac{1}{2}$  in. thick and shapes in Structural Group 1. Improved toughness carbon, A573, is essentially a plate material for welded structures, such as vessels, at atmospheric temperatures where improved notch toughness is important.

A283 is a lower-strength carbon structural steel supplied in great tonnages to machine and equipment manufacturing industries because of its good formability. For the architect, it offers a material that can be easily shaped and welded after delivery at a job site. Grades A, B, and C, for example, can be bent flat on themselves in thicknesses up to <sup>3</sup>/<sub>4</sub> in. A283, Grade D, corresponds generally to the old A7 designation.

When strength-to-weight ratios become important to the architect, he has many steels from which to choose. These offer various strength levels, shape and thickness availability, weldability, etc. For recognition, the architect can specify ASTM-designated color markings for each. On plates, these colors are vertical stripes. On structurals, the color is on one cut end or across the rolled face of one flange or leg, adjacent to the cut end.

High strength-low alloy steels offer the architect comparable strength levels, any of which will increase the strength-to-weight ratio of structures. When strength is the primary consideration, good economy is afforded by A440 and A441. One difference between these two is the addition of vanadium in A441 which makes it more weldable. For a bolted or riveted structure, A440 is best. For a welded structure, A572 or A441 is preferred. Both A440 and A441 have corrosion resistance about double that of A36.

For even greater corrosion resistance, the architect can consider A242 or A588. These steels have about four times the corrosion resistance of A36 without copper. Both A242 and A588 are also available in weathering grades. The weathering grade must be specified, however, as certain combinations of alloying elements are necessary to produce this effect. Weathering steel seals itself against corrosion in time while weathering to an attractive brown col-

In the conceptual design below, stainless steel column covers act integrally with high strength, low alloy flanges. The hourglass shape, by placing material away from the neutral axis, produces a column section with good stiffness in the weak direction. And the curved webs (also of stainless) increase critical buckling stresses. Columns could be filled with water using a new method of fireproofing exposed steel.



or. The architect should provide a means of draining away the early stain products, unless he wishes to use the stain product with the general design.

A588, often used for bridge construction, is available in greater thicknesses than A242 and holds a higher strength level in thicker sections.

The new A572 specification, a non-weathering steel, offers an unusual degree of selectivity. Six separate grades are available with varying strength, thickness, and structural shape availability. Welding requires greater attention as strength levels increase, and greater care is required with the higher grades 55, 60, and 65. The higher strength grades are also available in more limited thicknesses and shapes. But because of the increasing popularity of this specification, a greater selection of thicknesses and shapes will be available in the future.

A570 is structural strip, a thin (under  $\frac{1}{2}$  in. thick) high-strength material which is becoming increasingly popular for industrial, residential, and commercial buildings. It is included here with structural steels because it is often rolled in a wide range of structural shapes that the architect can use as framing members.

There are many thin steels the architect can choose for structural support. These include galvanized sheets of structural quality (A446), carbon sheets of structural quality (A245), high strengthlow alloy cold-rolled sheets and strip (A374), and high strength-low alloy hot-rolled sheets and strip (A375).

The architectural design of structures using these thin structural steels is becoming increasingly important. The ease of handling, openness of framing systems, speed of construction, and the strength of steel make it competitive in cost with wood or concrete.

The greatest strength levels are available with ASTM A514, quenched and tempered alloy steel. This material is commonly available as plates, but is available in specially designed shapes from some manufacturers. The 100,000 psi yield strength of A514 offers extensions of design freedom, particularly for high-rise construction. As familiarity with the material and its applications increases, its use is expected to grow significantly. Building codes are now being revised to include the industry's newer steels.

Stainless steel is a prominent part of the steel evolution. It is being re-designed to meet the severe structural demands being put on all materials by architects. The trend to long-span, lightweight struc-



tures has required new steels that can be incorporated into the new structural systems. One such steel is stainless.

Traditionally, stainless steel has been considered an architectural metal, but one to be used only for corrosion resistance or appearance. It was hard to work and difficult to weld. The architect rarely exploited the high strengths of the material.

Now stainless is being used in structural applications. As a comparison, stainless achieves strength levels higher than those specified for the highstrength structural steels of ASTM A514.

A significant contribution to the accelerating use of stainless as a structural material was the publication in 1968 of a design specification by American Iron and Steel Institute entitled "Design of Light Gage Cold-Formed Stainless Steel Structural Members." This specification is based on research performed at Cornell University and pertains to annealed and strain-flattened material.

Additionally, structural tests on beams and columns using ¼ hard stainless steel have been completed. The term "¼ hard," refers to material with minimum yield strengths of 75,000 psi. It is intended to put results into a supplementary design specification.

## **Sheet and Strip Steel**

Most steel building components are fabricated from sheets <sup>1</sup>/<sub>4</sub> in. thick or less and are made of carbon steel, high strength-low alloy steel, full alloy steel, or stainless steel. Carbon steel offers the greatest economy and stainless the best corrosion resistance and bare appearance.

There are many ways to protect and enhance sheet steel. It can be galvanized, aluminized or chromized, prepainted or precoated with almost any of the paints, plastics, or woods available. It can be embossed, expanded or textured. It can be plated with brass or gold or almost any metal between the two. It can be porcelainized or finished with other ceramic materials.

#### **Physical Properties of Sheet and Strip**

Sheet and strip are the thinner steels (but not as thin as foil or perforated "see through" steel). While the dimensional ranges are slightly different for various steel families, sheet and strip are generally thinner than  $\frac{1}{4}$  in. (<sup>23</sup>/<sub>100</sub> in. for most) and thicker than  $\frac{1}{20}$ in. Strip is normally narrower than sheet, with the dividing line usually, but not always, at 12 or 24 in., depending on the steel family and the rolling mill. Dimensions sometimes overlap between sheet and strip, with the "strip" designation being employed for the material with special edges or special finishes. Sheet is available in widths to about 80 in.

At one time, steels were divided between carbon and alloy. With the growing emergence of high-chromium nickel steels having exceptional corrosion resistance, the stainless steels were born. Later another family emerged with high strengths, but low amounts of alloying elements (thus more economical), which have become the high strength-low alloy steels (HSLA). All are now available in sheet and strip form.

In any family, cold-rolled strip is the premium product, with closer tolerances, more and better finishes, better controlled physical properties, and better edges.

Hot-rolled sheet is the most economical, especially hot-rolled carbon. The hot-rolled products come out of the mill with coating — mill scale — which may be removed by pickling in a diluted solution of sulphuric acid and then rinsed. Sheet and strip may be ordered in coils for maximum economy or in cut lengths for maximum convenience.

When choosing a sheet steel for structural applications, the architect should consider its special properties. When strength or maximum lightness in construction are the primary considerations, the high strength-low alloy sheets and strip offer high yield strengths and improved corrosion resistance with material economy. In other words, the cost is a little more, but less steel is required.

For higher strength, stain, mar, and corrosion resistance, full alloy steel sheets are available to the architect. The premium material, of course, is stainless, used often in its bare form for its effect.

Table 2 shows the most commonly specified sheet and strip steels. These are general family specifications which can serve either as a complete description to a steel supplier, or as a starting point for even more detailed requirements.

In the carbon steels, note the increasing variety from hot-rolled to cold-rolled, from sheet to strip. Some have quality designations only, corresponding to their end use. Some have quality and finish, or temper and finish designations. Others are commonly available in expanded, textured, embossed, pattern rolled, precoated, and prepainted forms. Galvanized steel is available in carbon or high strength low alloy forms.

#### Hot-rolled Carbon Steel Sheet and Strip

The term "quality" in a steel specification generally refers to properties imparted to the product by steel mill manufacturing operations. These properties often have a direct bearing on how the steel will be fabricated and used. Hot-rolled sheets have four principal qualities:

• Commercial Quality (CQ). Specified when surface finish and ductility are of secondary importance, as in architectural products such as simple framing members.

• Drawing Quality (DQ). Used for specific, identified end products requiring a high degree of formability in their manufacture. Applications include moderately formed architectural products.

• Drawing Quality, Special Killed (DQSK). Used for the most difficult forming jobs, this quality offers the ultimate in a drawing quality steel. While often used for deep drawing, this quality also finds use in complex shapes, where forming requires optimum ductility in every direction.

• Physical Quality (PQ). Specified when specific mechanical properties are required for items such as structural tubing, tubular frames, and similar load-bearing members.

#### **Cold-rolled Carbon Steel Sheets**

Cold-rolled sheets are smoother than hot-rolled sheets. In fact, cold-rolled sheets begin as hot-rolled coils that are pickled, cold reduced to the desired thickness, and then either temper rolled or roller leveled providing stronger and more accurate sections.



#### **P/A** STRUCTURAL STEEL DATA

		Grade			Maximum	ASTM		Strength, KSI			and the state of the second state of the	
	ASTM No.	or Type	Color Code	Form	Thickness Inches	Structural Shape Group	Thickness Inches	Yield	Tensile	Joining	Remarks	Designation
CARBON STEEL	A36		None	Plates Shapes Bars Sheet Strip Rivets Bolts Nuts Tubing	All	All		36	58-80	Rivet Bolt Weld	For buildings and general structures. Available in high toughness grades.	Structural Carbon
	A283	A B C D	None Orange	Plates Shapes Piling Bars	All	All		24 27 30 33	45-55 50-60 55-65 60-72	Rivet Bolt Weld	For general application.	Low and Intermediate Tensile Strength Carbon
	A328	А		Piling				38.5	70	Rivet Bolt		Carbon Steel Piling
	A529			Plates Bars Shapes	1/2	1		42	60-85	Rivet Bolt Weld	For buildings and similar construction.	42 KSI Min. Yield
	A573	65 70		Plate	11/2			35 38	65-77 70-85	Weld	For unusual temperatures where toughness is important	Improved Toughness Carbon
	A242	1 2	Blue	Shapes Plates Bars	4	All	11/2-4 3/4-11/2 to 3/4	42 46 50	63 67 70	Rivet Weld Bolt	Lightweight and added durability. Weathering grades available.	Low Alloy
	A328	В		Piling				50	70	Rivet Bolt Weld	For welded corners, tees, etc.	HSLA Piling
' STEEL	A440		Brown	Shapes Plates Bars	4	All	11⁄2-4 3⁄4-11⁄2 to 3⁄4	42 46 50	63 67 70	Rivet Bolt	Lightweight and superior corrosion resistance.	High Strength
STRENGTH LOW ALLOY	A441		Yellow	Shapes Plates Bars	8	All	4-8 1½-4 ¾-1½ to ¾	40 42 46 50	60 63 67 70	Rivet Bolt Weld	Primarily for lightweight welded buildings and bridges.	HSLA Manganese- Vanadium
	A572	42 45 50 55 60 65	Green & White Green & Black Green & Yellow Green & Brown Green & Gray Green & Blue	Shapes Plates Piling Bars	4 1½ 1 ½	All 1 and 2		42 45 50 55 60 65	60 60 65 70 75 80	Rivet Bolt Weld	Lightweight high toughness for buildings, bridges and similar structures.	Columbium-Vanadium
нісн	A588		Blue & Yellow	Shapes Plates Bars	8	All	5-8 4-5 to 4	42 46 50	63 67 70	Weld Rivet Bolt	Lightweight, durable in high thicknesses. Weathering grades available.	50 KSI Min. Yield to 4-in. Thick
	A570	ABCDE		Strip	1⁄4	Special Beams Bores Angles Hats, Etc.		25 30 33	45 49 52	Nail Screw Rivet	For residences and one and two-story commercial buildings.	Hot Rolled Structural Sheet and Strip
CHED AND IPERED Y STEEL	A514	A B C D		Plate	11⁄4							
		F	Red	Certain Shapes	4		21/2-4 to 21/2	90 100	105-135		Strength varies with thickness and type.	High Yield, Quenched and Tempered Allov Plate
		H			2				110 100		and the start of t	i inporta rinoj riato
0		K L			2							

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Cold-rolled sheets have surface characteristics that allow their use in siding, panels, metal furniture, and numerous other end uses requiring a quality surface suitable for painting.

The four common quality designations for coldrolled sheets are similar in meaning to those for hotrolled sheets and strip. These qualities include the "CQ," "DQ," "DQSK" and "PQ" designations described above.

Cold-rolled sheets have three standard levels of finish, as well as some proprietary finishes available from individual steel mills. The three standard finishes include:

• Matte Finish. Produced on specially finished rolls to various degrees of roughness, depending on end use requirements. With some surface preparation this finish is suitable for painting but not for electroplating.

• Luster Finish. High quality finish produced by ground rolls and suitable for decorative pointing. Used for plating if buffed and polished by the fabricator.

• Bright Finish. High quality finish produced by ground and polished mill rolls. Requires extreme care in processing inspection. Suitable for electroplating.

Cold-rolled sheets in cut lengths sometimes are graded according to other surface considerations. This grading system includes:

• Cold-Rolled "Sheets." May contain surface imperfections that can be removed with a reasonable amount of metal finishing by the fabricator.

• Cold-Rolled "Primes." Sheets in cut lengths that have been inspected to meet specific surface requirements on one side without metal finishing by the fabricator. (The surface quality of cold-rolled "sheets" has improved over the years, and the cold-rolled "prime" grade is seldom required today.)

Cold-rolled sheets also can be supplied with expanded, textured, embossed or pattern-rolled finishes. These finishes are used widely for decorative and functional surfaces, both coated and uncoated, on architectural, industrial, and consumer products.

#### **Cold-Rolled Carbon Steel Strip**

Cold-rolled steel strip has been called the "jewelry" of flat-rolled carbon products. It is produced to closer dimensional tolerances than any other flat-rolled product, the primary purpose being to ensure tight dimensional tolerances in the end product as well as to minimize processing variables in high-speed stamping operations used to produce that product. Cold-rolled strip also has three special factors — finish, temper and edge — that set it apart from all other flat-rolled steels. The four standard qualities available in other flatrolled products *are not* applicable to cold-rolled carbon steel strip. Temper designations are used instead. Selection of temper is a function of the design and manufacturing method and usually is determined in consultation with the steel supplier.

Surface finishes for cold-rolled carbon steel strip range from matte to mirror-like. For most uses, the finish of only one side of the strip is important. Three standard finishes are available, in addition to proprietary finishes from some individual strip producers. The standard finishes include:

• No. 1 Finish. This is a non-lustrous surface produced by rolls that have been deliberately roughened by chemical etching or shot blasting. This finish is suitable for zinc coating and improves adhesion for lacquer or paint.

• No. 2 Finish. This is a smooth, bright finish produced by rolls having a moderately smooth surface, and is the finish most often specified for strip. It is not generally used for plating unless polished and buffed by the user.

• No. 3 Finish. This finish meets the need for a mirror-like, lustrous metal for plating. Specially ground rolls are used to produce this finish. It also requires extreme care in processing and extensive inspection. No buffing or polishing is required before most plating operations.

#### Tempers

"Pinch" rolling changes the mechanical properties of steel strip, producing different combinations of hardness, strength, and ductility. Temper is the result of controlling the various degrees of cold reduction and pinch rolling, along with heat treatment (when needed) and chemical composition. In other words, "temper" is a composite measure of the strip's toughness, strength, hardness, and formability.

Five temper numbers for cold-rolled carbon steel strip have become widely recognized. Each number is associated with the ability of the strip to withstand certain degrees of cold forming.

When strip is required for exceptionally deep draws, or when it is to be stored for long periods of time before fabrication, special killed steel often is specified in combination with the No. 4 or No. 5 Temper.

#### High Strength-Low Alloy Sheet and Strip

Frequently the architect turns to HSLA steels for additional structural strength and improved corrosion resistance. For structural considerations, the ASTM-A570 structural grades covered in the section

#### COMMONLY SPECIFIED SHEET & STRIP STEELS

#### **Hot Rolled Carbon Sheet and Strip**

Commercial Quality Drawing Quality Drawing Quality, Special Killed Physical Quality

#### **Cold Rolled Carbon Sheet**

Commercial Quality Drawing Quality Drawing Quality, Special Killed Physical Quality Matte Finish Luster Finish Bright Finish Expanded Textured Embossed Pattern Rolled Precoated Prepainted

#### **Cold Rolled Carbon Strip**

#1 Hard Temper
#2 Half Hard Temper
#3 Quarter Hard Temper
#4 Skin Rolled Temper
#5 Dead Soft Temper
#1 Dull Finish
#2 Regular Bright Finish
#3 Best Bright Finish
Embossed
Textured
Pattern Rolled
Precoated
Prepainted

Hot Rolled High Strength Low Alloy Sheet and Strip Regular Surface

Special Surface

Cold Rolled High Strength Low Alloy Sheet

#### **Cold Rolled High Strength Low Alloy Strip**

#1 Dull Finish #2 Regular Bright Finish #3 Best Bright Finish

#### Alloy Sheet and Strip

Regular Quality Drawing Quality

#### **Stainless Steel Hot and Cold Rolled Sheet**

1/4 Hard Temper 1/2 Hard Temper 3/4 Hard Temper Full Hard Temper Unpolished #1 Finish #2D Finish #2B Finish Polished #3 Finish #4 Finish #6 Finish #8 Finish

#### **Stainless Steel Cold Rolled Strip**

 ¼ Hard Temper

 ½ Hard Temper

 ¾ Hard Temper

 Full Hard Temper

 #1 Finish

 #2 Finish

 Bright Annealed Finish

on structural steels, offer the architect the best selection.

These are supplied either hot-rolled with minimum yield strength of 50,000 psi, or cold-rolled with minimum yield strength of 45,000 psi. The regular surface of hot-rolled sheet and strip could be oxide or scale coated or could be acid pickled to remove the oxide.

All cold-rolled HSLA sheet and strip has a smooth, matte finish suitable for painting. Besides special edges available in the cold-rolled strip form, three separate finishes are also available.

• No. 1 Dull Finish. Especially suitable for lacquer or paint adhesion — a finish without luster.

• No. 2 Regular Bright Finish. Produced by rolls having a moderately smooth finish. It is suitable for many purposes, but not generally applicable to plating.

• No. 3 Best Bright Finish. Has a high luster produced by selective rolling practices, and is particularly suited for electroplating.

Weathering steel is also available in HSLA sheet and strip. Weathering grade must be specified by the architect.

#### Alloy Sheet and Strip

Compared to carbon and low alloy steel, high alloy steels offer generally improved strength, hardness, toughness, abrasion, corrosion and fatigue resistance. In making alloy steel sheet and strip, chemistry and heat treatment are combined to give varying physical and mechanical properties to the steel. There are fewer than 100 high alloy steels normally made available in sheet and strip form (American Iron and Steel Institute currently lists 86 compositions, of which 19 are most readily available through steel mills and steel service centers).

No special finishes are normally specified for coldrolled alloy steel sheet and strip since they are usually heat treated. The regular finish on alloy steel strip is moderately smooth.

AISI lists seven quality designations for alloy steel sheet and strip, two of which are of interest to the architect:

• Regular Quality. Where normal surface defects are not objectionable and good finish is not the prime requirement, regular quality may be specified. These products are normally furnished to designated chemical grades. Grain size and tensile and bend test requirements can also be specified. In 1964, American Society for Testing and Materials issued Specification A506-64, covering this material.

• Drawing Quality. For architectural products involving severe cold plastic deformation, drawing quality alloy sheet and strip is normally specified. ASTM Specification A507-64, which covers this material, calls for it to be spheroidize annealed.

#### Stainless Steel Hot- and Cold-Rolled Sheet

Of the 38 standard types of stainless steel, six are of primary importance to the architect. They are AISI Types 201, 301, 302, 304, 316, and 430. These are discussed in the order of importance to architects.

Type 302 is an austenitic alloy, containing 18 per cent chromium and 8 per cent nickel (often known as "18-8"), that has been used on building exteriors since the late 1920's.

Type 304, a low-carbon variation of Type 302 having generally similar properties but improved weldability, now largely has replaced Type 302 in architectural applications. It is often used where Type 302 formerly was specified and is the type most readily available in many forms. Because the two are essentially similar, the designation "Type 302/304" commonly is used to indicate that either is acceptable.

Type 301 is a modification of Type 302, having slightly less chromium and nickel. This reduction does not impair its corrosion resistance or ductility, but it does increase its work-hardenability. Type 301 can be cold-rolled to very high tensile strengths.

Type 316 contains more nickel than Type 302/304, as well as 2 to 3 per cent molybdenum, added to improve corrosion resistance. In locations exposed to a severe marine environment or to extremely corrosive industrial atmospheres, Type 316 should be considered.

Type 201 is a more recently developed austenitic alloy containing chromium, nickel, and manganese. It is similar in most of its properties to Type 301/302 but is stronger, harder, and does involve more spring-back during fabrication.

Type 430 is a ferritic chromium alloy which is somewhat less resistant to corrosion than the austenitic 200 and 300 series.

#### Finishes

No. 1 Finish. Hot-rolled, annealed, and descaled. Produced on hand sheet mills by hot rolling followed by annealing and descaling. Generally used in industrial applications, such as for heat or corrosion resistance, where smoothness of finish is not important.
No. 2D Finish. A dull cold-rolled finish produced on either hand sheet mills or continuous mills by cold rolling, annealing, and descaling. The dull finish may result from the descaling operation or may be developed by a final light cold-roll pass on dull rolls. The dull finish is favorable for the retention of lubricants on the surface in deep drawing operations. This finish is generally used in forming deep drawn articles which may be polished after fabrication.

• No. 2B Finish. A bright cold-rolled finish commonly produced the same as No. 2D, except that the annealed and descaled sheet receives a final light cold-rolled pass on polished rolls. This is a general purpose cold-rolled finish. It is used for all but exceptionally difficult deep drawing applications. It is more readily polished than No. 1 or No. 2D Finish.
No. 3 Finish. A polished finish obtained with abrasives approximately 100 mesh, and which may or may not be additionally polished during fabrication.

• No. 4 Finish. General purpose polished finish widely used for restaurant equipment, kitchen equipment, store fronts, dairy equipment, etc. Following initial grinding with coarser abrasives, sheets are generally finished last with abrasives approximately 120 to 150 mesh.

• No. 6 Finish is a dull satin finish having lower reflectivity than No. 4 Finish. It is produced by Tampico brushing No. 4 Finish sheets in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undersirable; it is effective when used to contrast with brighter finishes.

• No. 7 Finish has a high degree of reflectivity. It is produced by buffing of finely ground surfaces, but the "grit" lines are not completely removed. It is used chiefly for architectural and ornamental purposes. A new development: stainless steel is now being worked in a hydrogen atmosphere, which prevents oxidation and permits the economic production of surfaces equivalent to No. 7.

• No. 8 Finish is the most reflective finish that is commonly produced. It is obtained by polishing with successively finer abrasives and buffing extensively with very fine buffing rouges. The surface is essentially free of grit lines from preliminary grinding operations. This finish is used for press plates, as well as for small mirrors and reflectors.

Sheets can be produced with one or two sides polished. When polished on one side only, the other side may be rough ground to obtain the necessary flatness.

#### Cold-Rolled Stainless Steel Strip Finishes

The two numbered finishes represent categories of finishes with variations in appearance and smoothness, depending upon composition, thickness, and method of manufacture. Generally, the thinner the strip, the smoother the surface.

• No. 1 Finish. Appearance varies from dull gray matte finish to a fairly reflective surface.

• No. 2 Finish. Smoother and more reflective than No. 1, the final finish is produced by a light cold roll pass, generally on highly polished rolls.

• Bright Annealed Finish. This is a bright and highly reflective finish produced by final annealing in controlled atmosphere furnace.

In addition to the AISI standard mill finishes, many proprietary finishes are available from individual producers. Some of these are rolled finishes resembling the standard polishes in appearance; others are matte finishes.

# **Designing in Steel**

The search for economy, either of materials or money or both, have led to the development of hybrid and plastic designs. Hybrid gets the most out of the material by designing a set of structural systems, each member of the set being for a specific part of a high-rise building. Plastic design exploits the plastic theory in calculating the load-carrying ability of a continuous steel-framed multi-story building. And in Houston, low-rise steel framing has proved an economy of money.

#### **Plastic Design**

Efforts are under way to better utilize existing framing techniques and exploit the full strength of structural steel. In the past, continuous steel-framed multi-story buildings could only be designed on the basis of the elastic theory. It was assumed that the loadcarrying capability of a steel member was reached when a single portion surpassed its yield stress. However, the maximum strength of members in continuous frames is not actually reached until after a mechanism is formed by 3 plastic hinges. This occurs when loading is substantially greater than that causing initial yielding, and results in a transfer of stresses to other less highly stressed points of the frame. This is possible because of steel's ductility. Plastic design utilizes this characteristic in calculating the load-carrying ability of the frame.

The first application of steel plastic design concepts — where a structure was proportioned for a consistent load factor, based on the true *ultimate* strength of steel members rather than workingstress methods (which may result in overdesign, adding 10 to 15 per cent to the weight of steel) — was in an 11-story apartment building in Bladensburg, Maryland.

Since then, several additional structures have been designed with the plastic design concept. One of the major proponents of plastic design is the structural engineering firm of Allison & Meyer of Rockville, Maryland. The firm has designed several apartment and office buildings using this technique which is finding acceptance in building codes across the country.

The pioneering use of the concept in Bladensburg on the 158-unit Stevenson apartment building saved about ½ lb of steel per sq ft in the 166,000-sq ft building. This meant saving about 10 per cent in steel, or some 40 tons less, worth about \$12,000. Only 6.3 lb of steel were used per sq ft. According to Horatio Allison of the engineering firm, the inherent economy of plastic design, together with soaring costs of other materials, is expected to direct much future construction to steel.

Allison's firm has been designing welded-steel frame buildings for about nine years. In this time, he

says, "we have become convinced that a steel frame properly designed and properly detailed *can compete* with poured-in-place concrete. It seems to us that many engineers, bogged down in complicated analyses of steel buildings, are reluctant to make the simplifying assumptions that they will readily make for other materials.

"The introduction of plastic design in steel will eliminate the necessity for complicated analyses of frames and therefore should foster the design of continuous steel structures which we feel is a 'must' for economy."

#### **Steel In Homes**

Three townhouses that opened in Houston, Texas, in January 1969 during the National Association of Home Builders convention illustrated that a contemporary structure can be economically designed around the logical use of steel. Often the steel cannot be seen; it is installed only where the cost of construction would be equal to or less than other materials, or where steel has definite design advantages. Comparative costs have been calculated for the construction of three townhouses:

#### Townhouse "A" - 2216 sq ft

Lumber Labor	\$3000 2300	vs.	Steel Frame (weight-8¼ tons)			
Total	\$5300		Erected: \$5125			
	Townhouse	"в" —	1535 sq ft			
Lumber	\$1750		Steel Frame			
Labor	1700	vs.	(weight-51/4 tons)			
Total	\$3450		Erected: \$3260			
	Townhouse	"C" —	2732 sq ft			
Lumber	\$2750		Steel Frame			
Labor	2664	VS.	(weight-7 tons)			
Total	\$5414		Erected: \$4370			

These estimates were prepared early in January 1969. According to The Wall Street Journal (2/21/69), lumber costs had increased from \$86 per 1000 bd ft in February 1968 to \$132 in late December 1968 (the prevalent prices at the time of estimates).

One of the most promising residential and light commercial uses of steel is in wall studs fabricated from galvanized steel sheet. These studs are being used for two principal reasons:

**Material cost:** The current rise in prices of other materials has made steel studs attractive on cost alone. Recent cost quotations on a standard eight ft 2 x 4 wood stud used for interior studding showed prices from 92 to 95 cents. This is considerably higher than that of a steel stud of the same size. Load-bearing steel studs are closely competitive as well.

Installation time: A simple installation procedure has meant a 50 per cent saving in installation time.

Structural-grade steel strip framing system (right) is used by nursing home "chain."



PARTIAL WALL FRAMING ELEVATION

#### **Hybrid Steel**

The concept of hybrid steel design has recently been applied to The Houston Power and Light Company Building in Houston. Three different strengths of steel and four types of columns were combined in the major supports of this 27-story structure. The principal framing for the structure is in a central service core with only peripheral supports. The core is offset from the center to provide an area  $45 \times 175$  ft and another  $25 \times 175$  ft on every floor for column-free office arrangement.

Floor beams span more than 45 ft and frame into the exterior columns. At the core there are fewer columns with correspondingly heavier loads. The high strengths of carbon and alloy steels met the architects', Wilson, Morris Crain & Anderson, specification that column size be limited to a maximum of  $20\frac{5}{8} \times 22\frac{14}{4}$  in., including fireproofing. Four different structural cross sections were used in the lower part of the columns to provide the strength required for the 386-ft high structure.

High-strength columns in the structure range up to 14 WF 550 — the heaviest ever rolled in A514 steel (100,000 psi yield strength up to  $2\frac{1}{2}$  in. thick; 90,000 psi for thicker sections). Some columns have web or flange plates added. Box columns were constructured of A514 plates as large as  $3\frac{1}{2} \ge 16$  in.

A514 was used for the lower part of 48 of the 62 columns. All but eight columns used some A441 (50,000 or 46,000 psi) for moderate loads at midheight, with A36 (36,000 psi) for the remainder of the frame. The most common column configuration was 14 WF 219 or 14 WF 550 in one of the three previously mentioned shapes.

Loads on individual columns at the central core of the structure range up to 6.2 million lbs. Typical base sections were 14 WF 550 members in A514 steel rising to the 13th floor. There, some columns change to A441 modified, and A36.

Hybrid design combines three strengths of steel and four column types in Houston high rise.


### **Trusses and Space Frames**

After almost a century of underworking the structural qualities of steel — years when city skylines were wholly dominated by the post-and-beam skeletons of skyscrapers under construction — architects are beginning to better utilize the tension-compression potential of the material.

The recent use of exterior wind bracing for highrise buildings effectively transforms entire vertical planes into trusses; the space-frame enclosure of large spaces, such as auditoriums, is an efficient way to create column-free spaces. And, farther in the future, architect-planners look forward to entire cities webbed together in continuous truss- or dome-like structures.

The following case histories illustrate some of the imaginative uses to which truss- and space-frame concepts have been put.

#### Sugar Storage Shed

Structural engineer William Mouton, of New Orleans, is one of today's major designers of space frames. "Generally, space frames have not provided the capabilities and economy predicted," explains Mouton, "because the large number of single members and joints are not economical to fabricate and erect. But prefabricated welded-pipe trusses eliminate the expensive joint." Mouton has used such prefab trusses in his parabolic arch space frame for a sugar storage shed in Baltimore. The basic unit, a 7.8-ft wide "delta" arch truss developed by Mouton, was shop-welded and prefabricated in three-dimensional jigs with left- and right-hand components. The 40-ft long left- and right-hand sections come off the production line as two-dimensional trusses, and are

Partially prefabbed delta arch trusses form sugar storage shed designed by structural engineer William Mouton.





joined at the construction site with pipe struts running perpendicular to the bottom chords.

Three truss sections are then joined to make up one-half of a single, 120-ft long, curved parabolic arch. Sections are joined at the crown and bolted to a 17-in. thick reinforced concrete abutment extending around the perimeter of the building.

1<sup>1</sup>/<sub>2</sub>-in. pipe web members provided self-contained scaffolding for the splicing and bolting of the arch trusses, and later served for erection of the roofing.

Designed with consulting engineers Goldreich, Page & Thropp, the \$400,000 structure is 85 ft high, 351 ft long and 180 ft wide. The weight of the structure is less than 5 psf and the cost (excluding decking) was \$1.50 per sq ft.

The building was fabricated from  $3 \ge 2 \ge \frac{1}{4}$ -in. A36 steel angles and  $\frac{1}{2}$ - and 2-in. A53 steel pipe.

The continuous fabrication method is an advance over conventional piece-by-piece production, and the use of three-dimensional jigs brings mass production to steel-pipe space frames.

The end walls are a series of triangular trusses rising straight up from the low concrete wall or abutment. These end trusses are constructed of steel bar. They intersect the roof on a bias and they are joined by steel angles.

The roofing, which acts as part of the structural support, consists of 22-gage, 1<sup>1</sup>/<sub>2</sub>-in. ribbed galvanized steel decking. The decking spans the 7.8 feet between the top chords of the pipe framework without purlins or sag rods, and actually completes the three-dimensional geometry of the structure by providing a stiff horizontal top chord diaphragm.









#### **Blossom Music Center**

The summer home of the Cleveland Symphony Orchestra near Akron, Ohio, is roofed with latticework of trusses anchored to a steel arch tilted  $16^{\circ}$  from the horizontal. The arch, fabricated from  $1\frac{1}{2}$ -in. weathering steel plate is supported in its inclined position by columns slanting outward from the arch.

Architects, Schafer, Flynn & Van Dijk, of Cleveland, designed the structure to eliminate sound distortion and provide column-free space over the entire pavilion. A network of 21 long-span steel-pipe trusses set in a radial pattern was used.

The pipes range in size from 3 in. to 12 in. nominal, and in wall thicknesses from .250 to .500 in. The assembled trusses measure 72 ft to 210 ft over-all and extend from the arch outward.

The trusses not only hold up the roof and steady the arch, but also serve as auxiliary support to withstand wind forces and uplift pressures. Another advantage of the pipe, according to R. M. Gensert Associates, structural engineers, is that angular or flat trusses would bounce sound off in echoes.



**Denver Exhibition Hall** 

The Denver Exhibition Hall is 680 by 240 ft, roofed by a 14 ft-6 in.-deep space frame that covers 10,000 sq ft of column-free exhibition space. Muchow, Ream & Larson, Architects, and Ketchum-Konkel-Barrett-Nickel-Austin, Consulting Engineers, designed the roof frame of tetrahedrons that were assembled on the ground in four sections (170 x 240 ft). When each roof section was completed, it was raised 46 feet by hydraulic jacks on threaded high-strength rods located on lifting towers, and held in place while four permanent columns were constructed below.

There are 6000 joints in the all welded structure that was fabricated from angle ranging in size from  $2 \times 2 \times \frac{1}{4}$  in. to  $4 \times 4 \times \frac{1}{2}$  in. Each of the four roof sections weighed 350 tons and contained 10,000 linear feet of welds.

The exposed roof frame, painted white, contrasts with the brown weathering steel facade of building.



#### **McCormick Place**

The reconstructed McCormick Place complex will consist of two buildings set on a platform and covered by a single roof that forms a protected pedestrian and vehicular mall between the buildings. The roof structure is a two-way steel truss system painted black, with columns spaced 150 feet on cen-

ter and a 75-foot cantilever on the perimeter of the building providing protection for the loading areas.

The project will contain approximately 600,000 sq ft of exhibition area, 100,000 sq ft of meeting rooms, 42,000 sq ft of restaurant and cafeteria facilities, and a 4451-seat theater.



#### **Exterior Framing**

Instead of supporting roofs on top of a structural frame, architects for the following two projects hung their roofs from frames outside the buildings.

At Phillips Exeter Academy in New Hampshire, architects Kallman & McKinnell with engineers William Le Messurier Associates designed physical education facilities that are supported from an exterior truss and column system. The series of 15 massive steel-pipe trusses are supported by perimeter columns and by a concrete spine that extends the length of the structure. They are suspended between steel saddles on the 700-ft long by 62-ft high spine, and provide an interior clear span of 120 feet.

The triangular trusses are 17 feet deep and 10 feet across, fabricated of weathering steel pipe of various sizes and wall thicknesses. Steel beams are attached to special truss tubes, and light structurals span the flange to form roof framing. The system is expected to provide substantial savings in heating costs since primary structural members and the space they occupy are not heated or ventilated.

Houston's Miller Memorial Theatre is enclosed by a folded-plate roof supported by exterior structural members. Architects Eugene Werlin & Associates, and structural engineers Walter P. Moore & Associates, designed with weathering steel "not only," as they put it, "for its low maintenance, but for its increased strength and favorable appearance."

"From a structural standpoint," the designers ex-



Ladder columns and concrete spine (background) support trusses at Phillips Exeter Academy.



Truss and column system (above) makes strong structural exterior at Phillips Exeter physical education facilities. Exterior spider web frame supports folded-plate roof of Miller Memorial Theatre (below); entire system is of weathering steel.



plain, "the most interesting part of the Miller theatre is the shell-type roof. It was chosen to expose the steel framing above the metal deck. The roof actually consists of three sloping planes with the roof decking fastened beneath the structural framing members. The roof rests on two main supports which utilize the universal joint concept as well as two secondary supports which are box columns 38 feet tall. In addition, there are numerous minor supports for the roof in the dressing room areas. The span of the roof between main supports is 195 feet, and the height of the apex of the roof is approximately 76 feet above the finished stage floor.

"The degree of indeterminancy of the structure and the uncertainty of the loading condition indicated a computer solution. After considering the various alternatives, the STRESS program was chosen for solution on the IBM 7094 computer. The roof structure was idealized as a three-dimensional space frame. The frame contained 79 points, of which 36 were supports, and 123 members. Although the structure is symmetrical, nonsymmetrical loading conditions were considered, making it necessary to consider the entire frame.

"The results from the analysis showed clearly that torsional stresses and deformations were significant for the members along the plane boundaries. Therefore, the main frame members were made into tapered box sections in order to provide some torsional rigidity for the frame.

"In order to allow the principal frame members to taper down to a relatively small size at the two main supports, it was necessary to produce a moment-free condition. Since the problem is a three-dimensional one, it was decided to use a giant universal joint. The main supports chosen for the structure were 30 in. outside diameter hollow spheres,  $2\frac{1}{2}$  in. thick. The spheres were welded to a base plate and the main framing members were attached to the spheres by six claws at each support. These claws encircle and rotate on the sphere. However, the claws must encircle the sphere sufficiently to resist the tremendous uplift created by several of the loading conditions."



#### The Vertical Space Frame

Several prominent high-rise projects have recently been designed to incorporate wind bracing into the framing of exterior walls, a system that claims the advantages of savings in over-all steel tonnage and column-free floor space in buildings of substantial height.

The Boston Company Building is one such building now under construction in Boston. Designed by architects Pietro Belluschi and Emery Roth & Sons, it rises on four tapered corner columns that support "K-type" windbracing. There are three "K's" on each exterior wall of the structure. The lowest brace is 13 stories high, the middle one is 15 stories, and the top one is 12 stories.

The wind-bracing is also load-bearing. The load carried by each brace is transferred to the four tapered corner columns at the 4th, 17th and 31st floor levels. Thirteen columns in each wall of the structure terminate in the huge 24-ft high truss on the fourth and fifth floors.

According to Leo Plofker and Murray Shapiro, consulting structural engineers of the Office of James Ruderman, who designed the K-brace system, the exterior columns are under compression and with wind would relax and absorb tension stresses. This permits the maximum utilization of the inherent strength of the steel.

The apex of the bottom bracing rises to the 17th floor where it helps support two  $6 \times 70$  ft plate girders which are erected end to end. A similar pair of girders is located at the 31st floor level and form the base of the top bracing system. In the completed

Wind bracing: John Hancock Center in Chicago (below) and Boston Company Building (facing page).



building, the wind braces will be partially obscured by mullions which extend about 18 in. beyond the surface of the structural walls. Computer analysis has shown that the inter-relationship of the loadbearing components in the frame of the structure is such that an entire "wind unit" — comprising a K-brace with columns and floor beams — must be completed before all of the concrete is poured upon the cellular flooring. This is said to be no handicap because of the speed with which the steel walls and column-free floors are erected.

The frame of the Boston Building is fastened with high-strength bolts. Elements of the huge columns, which are cruciform in cross section and measure 8 ft-2 in. in each direction, are shop-welded and assembled on the site.

Chicago's 100-story John Hancock Center by Skidmore, Owings & Merrill, will accommodate both office and apartment spaces in a tapering structure that reduces the amount of wall space subject to wind pressure, an important factor on the Chicago lake front.

Economics, however, was also an important design factor.

Faced with the problem of designing an economical steel frame 100 stories high, Fazlur R. Khan, SOM engineering partner, conceived the idea of combining into the classic post and beam exterior wall, a bearing-wall concept which had been used in the 1963 IBM Building in Pittsburgh. In that structure the external walls are designed with intersecting diagonals rather than parallel vertical columns in order to give the frame structural strength, and to permit the weight of the floors to be borne by the walls and by the central core of the building without the need for intervening floor columns.

Khan's idea involved a tapering tower with bearing walls stiffened by diagonals in the form of huge 18-story high steel "X's" that became integral with the columns and gave the Khan concept the name, "diagonally-braced exterior column system." Khan says that by using the diagonals in the walls, rather than utilizing a conventional post-and-beam "steel cage," he was able to save \$15 million.

After the original idea of a 100-story pyramidal form had been conceived, the total "design" was completed in only nine months by five engineers with two computers. A small IBM 1620 was used for the preliminary analysis of the behavior of the outer frame, and a more exact analysis of the entire structure was conducted by means of a large IBM 7094. Participating in these computer studies were Purdue University, the University of Illinois, and Massachusetts Institute of Technology.

Next, a model of the building was constructed and subjected to tests in a wind tunnel, and wind pressures were measured at 208 locations on the structures and the 7000 test data were automatically recorded and analyzed by a computer. The test results confirmed the advantages of the tapering shape and were used for the design of the building.



## **Cable-Supported Structures**

aking another page from the bridge designers book, architects are using steel cables as part of the structural systems for both high-rise and large column-free spaces.

#### **Sports Stadium**

The Forum, as the Inglewood Colosseum is called, is a 17,500-seat sports stadium ringed by massive columns and topped by a 404-ft diameter steel cable roof. Designed by Charles Luckman Associates and structural engineers Johnson & Nielsen of Los Angeles, the 40 3-in. diameter A586 structural strands radiate outward from a 32-ft diameter steel tension ring to a cast-in-place concrete compression ring. The single row of cables forms the roof's lower chord with structural steel trusses above them.

The steel cable connections were made with a threaded nut at the compression ring and a 6-in. diameter pin and clevis socket at the tension ring. The catenary cables support the roof frame and, in turn, carry the roof deck as well as resist flutter and take care of unbalanced live loads.

To keep the roof as light as possible (weight, including cables, runs less than six psf) a minimum of mechanical equipment was installed. Equipment was limited to lighting at the cable lines, some electrical transformers, and catwalks.

The spiderweb of cables and structural steel beams was left exposed, cables painted white, steel black.



#### Vancouver Office Building

A core-supported office building now under construction in British Columbia, the Westcoast Office Building, was designed by the Vancouver architectural firms of Rhone & Iredale and Bogue B. Babicki and Associates, Structural Engineers, Vancouver. The 37-ft square central core of the 15-story structure supports a 110 ft square projection by means of twelve primary sets of steel cables strung over castin-place crowns at the top of the core. The cables provide the perimeter of the building, giving unbroken office space from the central core to the exterior walls on all floors.

"We weren't trying for anything spectacular," explains Rhone & Iredale's project manager Errol Bullpitt. "We were very much concerned with cost and space economics." An agreement had been signed between the general contractor and the client to contruct the tower for \$24.00 per square foot.

The structure's ability to withstand earthquake shock was also an important consideration since Vancouver is astride earthquake zone three — the zone running from Alaska to San Francisco.

Though other buildings have used cables as the sole support for perimeter loads, a heavy truss section, usually occupying all of the top floor area, has normally been used to anchor the individual supporting cables. In the Westcoast Building, by using the same principle employed in suspension bridges, no top floor truss or anchoring is required. Offsetting floor weights from opposite sides of the core on a common cable do the job, eliminating the weight, cost and space loss of the truss.

The design and construction of the central core is conventional. The reinforced concrete structure is 37 ft-2 in. square and has a wall thickness of 14 in. through the first floor; it reduces to 10 in. to the 12th (top) floor. Because of the relatively larger moments of compression developed through the suspended weight on the cables bending over beam ends at this floor, wall thickness is increased to 14 in.

Although there are 12 pairs of steel cables providing support separated by one-third the distance around the perimeter, a third cable is added to each set from the crown to the 12th floor beams. The  $2^{1}/_{4}$ in. diameter, A586 structural cables support the additional components of stress at that floor. The center cables are  $2^{7}/_{8}$  in. diameter galvanized structural strand, while the corners are  $2^{3}/_{4}$  in. diameter. These cables have a minimum yield strength of 240,000 psi.

The cast-in-place crown members over which these cables run have several radii to eliminate shear and to equally distribute load forces. The cables, after being fireproofed with a coating of vermiculite plaster, will be enclosed in channels extending slightly out from the glass facing of the building.

In plan, the structural steel layout for each floor is a truss, or series of trusses, with a single diagonal beam reaching out from each corner of the core. Additional primary beams extend out from the face of









ROOF PLAN

SECTION B.B







the core. The core ends of the beam are secured to  $1\frac{1}{4}$ -in. high tensile anchor bolts cast in the core, while the exterior ends of the beams are clamped to their supporting cables with friction-type cable clamps. A perimeter, or curtain-wall beam, and secondary tie beams complete the floor structure.

Primary beams for the top floor are noticeably heavier than similar members on the lower floors. The diagonal beams for the top floor are  $36 \times 16$  in. box girders: for the lower floors they are 16 WF 45 rolled sections. The straight beams on the top floor are 36 WF 201, while those on lower floors are 16WF 45.

The relatively light construction of these floorand-beam sections is possible in large part because of the absence of conventional vertical structural columns and their associated bracing. It has made possible a building with a structural steel weight of only 7.5 psf and a total structural steel cost saving of close to 20 per cent.

The suspension cable sets are spaced 36 feet apart around the building. The primary beams on the top floor over which these cables pass are modified with a box end sheave-type cable clamps.

"It is a design that seems to be working out well in every respect," sums up Bullpitt. "We're making the best possible use of the two prime materials by having the concrete in compression and the steel in tension. And we're learning that this method of construction can be very fast indeed."

## **Bringing Steel Out of Wraps**

he nature of the 20th Century material and the nature of the 20th Century architect have been at odds for some years. Because of fireproofing and corrosion problems, steel, until a few years ago, required a protective covering. But one of the most compelling tenets of design philosophy during the past 50 years has been the honest expression of materials. With the "discovery" of weathering steel by Eero Saarinen and John Dinkeloo, the corrosion problem was solved. And a recently developed system of fireproofing provides a new solution for architects who feel that structural members should remain exposed.

#### Liquid-Filled Framing

Appropriately enough the new fireproofing system — filling columns with water — was developed for U.S. Steel's new headquarters, now under construction in Pittsburgh. The concept has been carried one step further by architects Riley & Bissell and structural engineer Robert Lawson, whose design for a four-story building (below) in Newport Beach, California, calls for water in both girders and columns. The cooling system keeps surface temperatures low enough to prevent buckling for the required fire rating, and cost estimates by the architect indicate that the design will be less expensive than conventional fireproofing. In cold climates an appropriate anti-freeze should be employed.

Rigid bents (53 ft wide by 50 ft high, spaced 24 ft apart) consist of two opposing exterior columns and a single roof girder. The interior framing above the first floor is supported by exterior box sections which carry only vertical loads. Wind and seismic loads are carried by towers at the end of the building.

The frames are filled with clean water to a level of 6 in. below the top of the girder. The box sections in each segment of the frame are interconnected to permit the water to flow between girders and columns. The frames are also interconnected to adjacent frames at grade and roof levels with 2½-in. diameter steel pipe underground, and 4-in. pipe in the other areas. Each girder has a pressure relief valve, set at 3 psi, which permits evaporation during a fire. The heat will leave the system as heat of evaporation or be transferred by circulation to cooler parts of the structure.

Although the original requirements were for a one-hour rated fire protection system, code authorities later asked for a four-hour rating. It was found that the additional water required to give the columns a four-hour rating was already within the roof



girders that serve as storage tanks for the columns. The exposed structural frame (spandrels and columns were exaggerated for purely design reasons) is weathering steel.

#### Weathering Steel

No discussion of the developments in steel since 1960 can ignore weathering steel, first used in Eero Saarinen's John Deere Building in Moline, Illinois. Instead of being a gimmick, as some designers suspected, it has become a substantial addition to the architectural vocabulary.

It takes 12 to 48 months (depending on the climate, air quality, and degree of exposure) for the protective oxide coating to form. During that period there are problems of uniform weathering and rust staining adjacent materials from rain run-off.

In order to insure a prompt, uniform weathering, the steel must be handled with as much care as any finished architectural product — kept free from grease, oil, chalk marks, paints and concrete spatter. Soilage can mark the steel for extended periods of time until the foreign material has washed or fallen off, or has been removed mechanically. This may require years and leave unsightly smears on the metal for extended periods. The alternative to careful handling is the thorough cleaning of the steel after erection by sand blasting or similar means.

John Dinkeloo, who supervised the original research on weathering steel for Saarinen, found that the accumulation of moisture around bolt and rivet heads tended to produce streaking. Welding was, therefore, chosen since the welding process sufficiently alloys the weld metal with the parent metal to produce a combination that will attain approximately the same color and corrosion resistance as the parent materials. It is also necessary to eliminate water pockets at connections.

Although rust staining subsides after the patina forms, a mild amount of stain is likely to continue and must be taken into account by overhangs, drip plates, or conventional gutters and down spouts. As some water run-off could be expected to flow over the concrete plaza outside of the Deere Building, the designers used dark cement and washed aggregate mixed with dark trap rock.

Other dark paving materials also, of course, can be used successfully — dark red granite or Belgian Brick, for example. Columns can terminate in dark gravel catch basins. Adjacent materials, such as glass, also can be dark and/or recessed in shadow. And the entire facade except for the steel itself, should be designed so that it may be washed.



## **Pre-Engineered Systems**



t has been said that the population explosion will require not only the maintenance of all existing buildings, but also the duplication of every structure in the country by the year 2000. Many look to preengineered buildings to fill the need:

Pre-engineered construction features fast on-site erection of frame, wall, and roof components fabricated in the factory. Reduced erection time cuts costs of financing and on-site labor. And the variety of pre-engineered building components has a remarkable potential for solving mass-housing problems.

One recent innovation in steel components is the virtually flat roof available in slopes as low as  $\frac{1}{8}$  to  $\frac{1}{4}$  in. per foot — just enough slope for efficient drainage. The almost-flat-roofs are achieved by using roof beam trusses and truss purlins made of tubular steel connected to "T" sections at the top and bottom. It is reported that this new system matches the efficiency of bar joists but weighs only three-fifths as much.

On-the-job installation of the roof is a self-propelled, roll-forming machine which joins the edges of the steel roof panels under pressure into a watertight double seam.

A typical panel of color-formed galvanized steel is manufactured with partially formed edges 24 in. wide. The panel edge serves as a track along which the electrically powered unit operates, completing the seam at a speed of 15 fpm.

The roof is fastened to the supporting structure by a special clip assembly which is rolled into the seam during the sealing operation. To help provide for thermal expansion and contraction of the roof membrane, each clip is free to move slightly along the seam line. Expansion and contraction at right angles to the seam is achieved by the bellows-like section of each of the standing seam shoulders. There are no holes in the working area of the roof — in contrast to the 10,000 fasteners usually punched through a 20,000 square foot roof.

Pre-engineered space-frame systems expand design potential, and modular systems of integrated structural and mechanical parts free buildings from fixed walls. Computers are speeding the design of pre-engineered buildings, and they are preparing shop drawings and performing other jobs which have taken a major part of the time required to fill an order for a building in the past. If labor and design problems can be solved, perhaps the industry will have a chance of meeting that apocryphal deadline only 30 years away.

Space frame domes — a recent addition to the pre-engineered building vocabulary.

## **Steel Scene Miscellany**



#### Stainless-Coated Roofing is Maintenance Free

Roofing alloy of 80 per cent lead and 20 per cent tin is coated on both sides with 304 nickel-chrome stainless steel and weathers to a uniform dark grey. The Rehabilitation Center of the Buffalo State Hospital (above) in Buffalo, New York, by architects Milstein, Wittek, Davis & Hamilton will have 50,000 sq ft of standing seam roofing in the maintenancefree material.



#### **Tubular Steel Sun Screen**

Although the tubular members above are primarily decorative, they also provide a certain amount of protection from the Louisiana sun. For the medical clinic facade, architect Charles Colbert used rust steel pipe (not weathering steel) that was wire brushed and coated with a flat varnish. Colbert finds the color variations of rust steel particularly handsome.

### **Steel Scene Miscellany**





#### MIT System Used in Housing for Elderly

Recently completed housing project in St. Paul, Minnesota by architects Bergstedt, Wahlberg & Wold, Inc., is first to use staggered truss system developed at the Massachusetts Institute of Technology. The 9 ft-6 in. high by 50-ft long trusses were prefabbed in pieces in special jigs — welded on one side, then flipped and welded on the other. The 17-story building is reported to have reduced steel requirements by 20 per cent.





## COPPER

These non-ferrous metals, some of which were worked in antiquity, have many applications in today's architectural construction. Although the chief copper alloys found in contemporary architecture are not new, a review of their content and uses is considered useful. Basic technology of copper, brass, and bronze — color, form, joining, and finishes — and recent developments that the industry considers most interesting to the architect are discussed and illustrated.

## **The Copper Family**

After 60 centuries of use, copper, brass, and bronze remain among the most contemporary of materials. In today's architecture the copper metals are specified for the same reasons architects have always selected these metals. They are attractive and require a minimum of maintenance. They not only endure, they improve with age.

Increasingly, architects are finding a solution to the monotony of the familiar curtain-wall style in the diversity of copper, brass, and bronze. In fact, nowhere is the architect more successful in his role of innovator than in the use of these, the world's oldest metals. Architect Felix Candela has summed up the case for the copper metals in explaining his choice of an all-copper roof for the massive Mexico City Sports Palace. Says Candela: "It is a noble, elegant, and majestic material. We wanted a natural material, one that would last forever."

#### Basic Technology of Copper, Brass, and Bronze

Architects can choose from a variety of copper alloys. Selection will be made on the basis of desired properties, end use, and aesthetics. A listing of the chief alloys used in architecture, followed by relevant data concerning each of these alloys, is shown, see listing.

#### Colors

An impressive range of colors is one of the architect's best advantages in working with copper, brass, and bronze. The basic colors of copper and its alloys are inherent in the metals themselves, and can be treated and retreated to achieve an almost infinite variety of tones ranging from soft pink to graywhite.

#### Form

Copper alloys are commonly available in the form of sheet, strip, tubing, and extrusions. Sheet, strip, and tubing are available in stock sizes and gages from all manufacturers. To select economical shapes in extrusions, a few simple rules should be observed.

The greatest diagonal dimension in the cross section of an extruded piece should generally not exceed six inches. A good thickness for the average-size architectural bronze extrusion is  $\frac{1}{8}$  in., the economical range being about .093 in. to .156 in. Trough or channel sections are quite common in extruded shapes and, in general, the depth of the channel should not be greater than its width. The section that is of uniform thickness will extrude best. If the section is to have webs and flanges of different thicknesses, the ratio of thick to thin should not exceed two to one. **Soldering.** A common method of joining copper-alloy architectural metals is soldering. However, soldered joints, to provide adequate strength should be reinforced mechanically. Often strengthening is obtained from short pieces of angles and flats spanning the joints on the reverse side; they are pressed into the molten solder and held until the joints are cooled to be sure they are firmly attached. Sometimes round or flat headed rivets or exposed screw fastenings are employed for architectural effect; however, flush rivets are not favored because they eventually tend to show hairline circles.

**Brazing.** Silver alloy brazing is widely employed with excellent results since it is done without melting the base metals, thus avoiding the problems of porosity often encountered in welded joints. To produce hairline joints that are not considered objectionable, it is necessary to cut and fit parts accurately and hold them in suitable fixtures while brazing to prevent movement and excessive distortion. Mechanical reinforcing, as in the case of soldering, is sometimes necessary on thin sections.

Welding. Depending on the alloys selected and the degree of color match required, a variety of welding techniques such as oxyacetylene, inert gas, tungsten arc, carbon arc, or resistance welding can be used.

#### **Finishes**

In their natural state, the copper metals are extremely resistant to corrosion. Many architects prefer to leave copper and bronze in an "as-fabricated" state and let the surface age naturally. However, when a specific type of visual appeal is desired, copper alloys can be finished in many ways. These finishes range from the simple and inexpensive mill finishes to the more complex and handsome porcelain-enameled finishes. In the past it was accepted that the bright, natural color of bronze was the more appealing architecturally. Currently, the trend has been in the direction of oxidized or weathered bronze for exteriors, and a bright-finish bronze for interiors.

#### **Developments and Applications**

Innovative design and a trend to the use of natural building materials is bringing about a renaissance of copper and its alloys in architecture. Also contributing to a growing sense of excitement about the copper metals in the building construction industry are the continued efforts of the copper and brass industry to develop new applications. The following examples were selected to relate the new relevance of copper alloys to the world of tomorrow.



#### Bridgeport Holiday Inn, Bridgeport, Conn.

Architects: Fletcher Thompson Inc.

Recently installed as a dominant design element on a prototype Holiday Inn is the first major application of a copper/plywood laminated fascia system. It is the forerunner of all types of roofing systems using copper laminated to a variety of substrates. The mansard fascia capping the new inn uses textured panels of 5 oz. copper laminated to <sup>3</sup>/<sub>4</sub> in. exterior grade AC plywood.

Among the advantages of a roofing system laminating copper to a substrate is that it permits a lighter weight of copper than normally is required in sheet metal applications of this type, resulting in a substantial cost savings both in material and installation. Because there is 100% adhesion, the builder is able to achieve the desired architectural effect of straight, crisp lines, eliminating the "oil canning" effect frequently found in this type of installation.







PARTIAL TYPICAL ELEVATION



VERTICAL SECTION AA : BULKHEAD, HORIZONTAL MULLION

#### The First National Bank Building, Chicago, Ill.

Architects: C. F. Murphy Associates and The Perkins & Will Partnership

The bold use of bronze on the sloping exterior walls of this Chicago landmark create the feeling of richness and security associated with the banking community. The interior, finished with bronze in a light statuary finish, completes and compliments one of the most handsome bronze buildings to be designed in recent years.

The fabricator working with the architects and brass mills coordinated size and shape design so as to economically produce a mullion which is a combination of brake-formed and extruded shapes. This type of cooperation usually results in cost savings at no sacrifice to the architects design.





JAMB SECTION B.B



PLAN SECTION AT CORNER (THRU BASE)

TYP VERTICAL SECTION



#### U.S.P.O., Franklin D. Roosevelt Station, New York, N.Y.

Architects: The Office of Max O. Urbahn

Extensive use of bronze repeated in a fluted section for wall surfacing dictated the use of roll formed sections rather than extrusions. This is an excellent example of how cooperation between a fabricator and the architect can solve a design problem economically.

If the fluted sections, which were repetitive in nature, were in the form of extrusions a thickness of .125 in. bronze would have been required. In roll forming, a gage reduction to .040 in. material was achieved representing a vast saving in material cost. In a fluted extrusion the polishing and cleaning of the metal prior to applying a statuary finish would have been costly and extremely difficult. By using a roll forming technique, the metal was polished and finished in coils prior to forming the sections for onethird the projected cost of finishing the extrusions.

#### CHIEF COPPER ALLOYS USED IN ARCHITECTURE

Alloy 220, Commercial Bronze. 90% copper, 10% zinc. Not an extrudable alloy, it is produced in sheets, rods, bars, tubes, and in drawn or rolled shapes. Its bronze-copper color is often pre-ferred for architectural appearance.

Alloy 655, Silicon Bronze. 97% copper, 3% silicon. This is a high-strength, corrosion-resistant alloy. Its color is one of the most attractive of all metals, making it a logical choice where its natural appearance will be maintained.

Alloy 745, Nickel Silver. 65% copper, 25% zinc, 10% nickel. Available in all forms including extrusions, it is an excellent imitation of real silver. Its architectural uses are unlimited.

Alloy 110, Copper. 99.9% copper. While other materials become soiled and gray on exposure, copper weathers to brown and then takes on a permanently light green patina.

Alloy 260, Cartridge Brass. 70% copper, 30% zinc. Yellow in color, it is preferred for interior architectural work. It has been used extensively for light-fixtures and finish hardware.

Alloy 280, Muntz Metal. 60% copper, 40% zinc. Its color is approximately that of Alloy 385, Architectural Bronze. Produced in sheet and plate, it is commonly used for panels and spandrels.

Alloy 385, Architectural Bronze. 57% copper, 3% lead, 40% zinc. The companion alloy to Muntz Metal Architectural Bronze is used for extrusions such as moldings, rods, and bars.

Alloy 230, Red Brass. 85% copper, 15% zinc. Known for its color, it weathers to an elegant "statuary bronze" shade. Red Brass is popular in window walls where it is used as a facing material in tubular or bent form placed over structural framing.



**One-pipe Self-venting System** 

Unimet Apartments, Richmond, California

Designed for high-rise buildings, this is a new engineered copper plumbing system — one-pipe and selfventing. It is not only more efficient, but also economically competitive with conventional systems. Called Sovent — a contraction of "soil" and "vent" — the new copper plumbing system consists of special fittings and Type DWV copper drainage tube. Sovent handles the same drainage load as a two-pipe system but without the need of two stacks for each battery of fixtures. First U.S. installation of the new copper plumbing system was in the Unimet apartment building in Richmond, Calif., in 1968.

The system consists of a single stack with a special "mixer fitting" located at each floor level and a similar "de-aerator fitting" at the bottom of the stack. This arrangement of fittings and stack make up a system which will handle at least the same drainage load as a conventional stack of the same diameter — but without the need for the separate vent stack.

How Sovent functions: The mixer fitting performs two unique functions which make it possible to eliminate the separate vent stack. The geometry of the fitting is such that the waste which enters the stack from a horizonal branch at any floor level mixes so quickly and efficiently with the air and falling waste in the stack that there is no chance for the waste to fill the entire cross section of the stack and thereby cause pressure (and vacuum) fluctuations that could disturb the fixture traps in the horizontal branches at that floor level, or at lower floors.

The offset in the stack at each floor level, which is built into the fitting, is also a key part of the system design and performs the second vital function. It slows the velocity of the falling water in the stack at each floor level, just before the falling waste mixes with any water entering the stack at that floor level.

The de-aerator fitting at the foot of the stack, just above the building drain, vents the relatively small volume of air which moves down the stack with the waste.

# LEAD

Lead is no longer the heavy of the building trades industry — lead has been tamed. The long illustrious history of lead is undergoing profound changes. It is less than ten years since lead first came into general use as an acoustical material. And now new alloying and methodology may bring lead onto the stage as a structural material. ► OR A WHILE it looked as though the long illustrious history of lead as a building material might come to an end. Lead pipes, used by the Romans, had long ago been abandoned for general architectural use as too expensive. Nevertheless, as recently as mid-1969, lead bends — 20,000 of them — were being installed in Co-Op City, the enormous middle-income apartment complex in New York City, and one million pounds of lead were being used in the mile upon mile of bell and spigot soil pipe. Even this, though, is nothing but a particularly large installation of lead plumbing units.

Compared with the architectural use of the three other metals covered in this issue - aluminum, copper, steel — it might seem that lead would be relegated to a minor position particularly since the use of lead in paint pigments has declined steadily since the 30's. But lead is not dead. In fact, at the rate things are going, lead may become much more important as a building material than it ever was in the past. The renaissance began early in the 60's and is now only in its earliest phase. Lead has always been recognized as the best protection against radiation hazards of all kinds, but the consumption of lead is rising today because of its growing use as an acoustical barrier. As far as is known, the first time lead was used for sound insulation was in France in 1935. Between then and the early 60's installations were few, but with the development of modular partitioning systems in place of plaster and lath or tile walls, things changed. The chart herewith shows dramatically how effective lead is as a sound insulator. The seven wall materials listed are rated according to the thickness in inches that would be required for a very quiet office.

Today, sheet lead for sound insulation applications is available in standard weights and thicknesses. Weights, based on pounds per square foot of sheet, range from  $\frac{1}{2}$  lb to 4 lb. As a rule of thumb, the thickness of sheet lead is  $\frac{1}{64}$  in. for each pound per square foot of weight. Thus  $\frac{1}{2}$  lb. sheet is  $\frac{1}{128}$  in. thick. The complicated-looking machine shown here (1) is used for casting thin lead sheets. This development, and the concomitant development of laminates combining lead with non-metallic materials such as plastics and wood, make effective lead-bearing sound insulation feasible.

One of the most vexing modern living problems is noise pollution. Entering a modern air conditioned, automated hotel at 3 A.M. one feels as though he had walked into a machine. Huge pulsations accompanied by the clickering of elevatoring systems and the clanking of mechanical equipment give one the impression of what the inside of the womb of mother IBM might be like. These sounds are only noticeable, however, because the cacophony of the rest of the environment is largely diminished at such an hour and therefore does not mask the building's bowel rumblings that actually go on day and night. There is

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no need to recount here the many sources of airborne noise in the modern city. The automobile and truck — prime offenders — have, in fact, effectively noised up the suburbs and countryside as well.

#### Lead Clad Building

So aware was architect Bertrand Goldberg of this problem that he designed the first lead-clad building in the world (2). The building is a center for the Performing Arts and a studio for WFLD-TV next to the towers in Marina City in Chicago, Illinois. It is well known that sound, like cold, will enter any available opening. Goldberg solved this by doing away with openings to the outside (access is gained from below). Ventilators through the roof are especially sound treated. How the roof and side walls were designed is described on page 182. Goldberg felt that the soft gray patina of lead, when weathered, would



1 Machinery for the manufacture of sheet lead.

2 Facing page and below. The first lead-clad building of its kind, at Marina City in Chicago, was designed by Bertrand Goldberg.



serve as a welcome counterpoint to the great expanse of concrete used in the other buildings of the complex. If architect Goldberg's enthusiasm over the effectiveness of this solution is any indication, there is little question but that we will begin to see more lead clad buildings in the near future.

#### Lead for Roofing

Lead has, of course, been employed as a roofing material in the past but its excessive weight and cost was not conducive to extensive use this way. The availability of the metal in thin (and naturally, therefore much less heavy) sheets may spell a renaissance of the lead roof as well. A lead roof is now quite simple to install and jointing is, if we may mix a simile, a lead pipe cinch.

#### **Noise Reduction**

The isolation of sound from outside is only half of the noise pollution problem, of course. Offices today, with their electric typewriters, adding machines, computers, and people, are noisy all by themselves. Add to this the fact that space costs have risen, often making it necessary to crowd 60 people into a space that might normally be thought capable of handling 55 or 56, and a new noise problem, emanating from 4 or 5 more persons is added. Then add the same new building-produced noise as is found in hotels and it is clear the problem is compounded many times over. In factories the noise problem has become so acute that Federal legislation was instituted. The Walsh-Healy Public Contracts Act affects most manufacturers who sell under contract to government. It includes a



3 Typical lead plenum barrier installation.

provision which will eventually restrict permissible noise levels to 85 db "A" scale.

Limp lead sheet makes an ideal sound insulating material because it cannot be set in motion by impinging sound waves and it is a very dense material. Because it cuts readily and forms with ease, installation around obstructions such as conduits, pipes, and ductwork is simplified. A typical plenum with a lead acoustical barrier is shown here (3).

Described below are several recent examples of how limp lead foil sheets have been employed as sound insulation. The J. B. Williams Company leased office space in the General Motors Building in New York City. The interior layout is the work of architect Richard Gascoyne whose aim was to provide the lowest possible noise levels within the private offices. He accomplished this by specifying a 2<sup>1</sup>/<sub>4</sub> in. thick wall with sheet lead plenum barriers to block the flanking paths left between the slab and the suspended acoustical ceiling. The 1-lb lead sheets were hung vertically above the partitions between all the offices on the 44th and 45th floors.

Lead plenum barriers were also used in the Library and Humanities Building of the Newark College of Engineering in Newark, New Jersey by Epple and Seaman, Architects. In addition to the reference and reading rooms, there are a number of private study rooms for the use of students. A stepby-step photo sequence of the installation is shown in the eight photos at right (4).

#### **Isolating Machine Floors**

Amply thick concrete floors with carpeting above and acoustical ceiling below usually effectively deadens sound between stories. However, many of today's high-rise buildings include mechanical floors at regular intervals. When architects D'Astous & Pothier designed Le Chateau Champlain, the 3rd, 19th and 34th floors were set aside for mechanical and electrical equipment. The noise problem resulting was solved by Goodfriend Ostergaard Associates, the architects' consulting engineers in acoustics, with a specially designed ceiling. To isolate the guest floors from the machine floors' a suspended acoustical ceiling was hung from the structural concrete machinery floor slab above. It was constructed of steel channels to which gypsum lath and plaster were affixed. Over the top of the lath, 3-lb sheet lead was laid. To cut off flanking paths, the lead was turned up and fitted snug against the perimeter walls. A lap of 1-in. was made on adjacent sheets. Around the periphery, glass fiber strip was calked into place. To damp the resonance within the plenum itself, a 2-in. thick mat of glass fiber was laid on top of the lead around the perimeter walls. The ceiling was suspended on spring and rubber vibration isolators (5). The effectiveness of the sound insulation system is evidenced by the fact that there has not been a single guest complaint about noise emanating from the machinery floors.





5 Hanging ceiling plenum.

#### Materials and Methods

Modular partitions, once so popular as a means of providing flexibility in office spaces, are coming under increasingly suspicious scrutiny these days, their vaunted flexibility often proving to be more theoretical than practical. The need to move walls did not, somehow, occur as frequently as the architectural programmer thought it might. By the time the electrical and telephone connections had been handled it also often seemed that a conventional wall might have been just about as easy to move. In addition, any attempt to provide real privacy, or even merely a halfway quiet space in which to work, was beyond the realm of possibility. As a result of all this in many new buildings in Australia, which is experiencing a high-rise building boom, the use of modular walls is giving way to old fashioned site erected stud walls. In such a wall, wire reinforced continuous cast sheet lead has been found to be useful because the lead can be hung freely down the studs.

One important new material is thin sheet lead sandwiched between layers of polyurethane foam. It is available with a choice of either one, two, or three layers of sheet lead. This type of material permits the lead to remain limp, one of the two major qualities — the other being mass — that makes lead preeminent in attenuating airborne sound. The foam layer on one side acts as a vibration isolator while the layer on the opposite side serves to absorb sound. The floating lead septum between the layers blocks the passage of sound. The material can be adhesive bonded to plywood, gypsum board, Masonite and similar rigid building boards without losing its ability to insulate against sound transmission. Lead poly-



6 Comparative sound control properties of standard building components — with and without lead sheet.

urethane sandwich material is available with 10-oz and 1-lb sheet lead septums. It is laminated to building boards with contact-type cements. It is also readily formable, a property that engineers and architects have found an asset when a barrier is required for irregular surfaces.

Unfortunately, the lamination of lead to rigid materials results in loss of limpness. However, it remains an effective barrier to the passage of sound when sandwiched in wallboards. As a comparison between walls containing sheet lead and those that do not, tests have been made of a wall constructed using 1<sup>5</sup>/<sub>8</sub>-in. steel studs with  $\frac{1}{2}$ -in. wallboard on each side. The construction without lead had a STC\* of 36. When the test was repeated using one wallboard with a 1-lb. lead sheet laminated to it and the other without, a STC of 44 resulted (6). Tables I and II are guides to recommended transmission loss factors required for different types of applications and STC ratings for various types of construction. When thin sheet lead is laminated or sandwiched between layers of polyvinyl chloride or polyurethane foam materials, it is much more effective. This is because the foam decouples the vibrating structure from the lead plenum and retains the septum's limpness.

Where sheet lead and conventional construction cannot be employed, flexible lead powder-filled vinyl sheet is available for sound insulating problems. Standard grades of lead filled vinyl range from  $\frac{1}{2}$  lb to 3 lb. They are either self-supporting, backed with glass or Nylon cloth, cotton duck, or glass cloth sandwiched between two thin layers of vinyl. Choice of types and styles include colors, textures, printed designs, self-adhesive backings, self-adhesive foam backings, and plain foam backings. The effectiveness

\*Sound Transmission Class.

TABLE I TRANSMISSION LOSS FACTORS FOR VARIOUS CONSTRUCTIONS

_				
	FRAME OR CORE	ONE FACE	OTHER M	RANS-
	Wood Stud Walls			
	2" x 4" wood studs	1/2-in. gypsum board	1/2-in. gypsum	38
	2" x 4" wood studs	<sup>1</sup> /2-in. gypsum board 1 lb lead (stapled)	1/2-in. gypsum board	41
	Charles Charles Martin			
	15%-in. steel studs	1/2-in. gypsum board	1/2-in. gypsum	36
	1%-in. steel studs Fiberglass in cavity	<sup>1</sup> / <sub>2</sub> -in. gypsum board 1 lb lead*	1/2-in. gypsum	44
	21/2-in. steel studs	1/2-in. gypsum board	1/2-in. gypsum board	37
	2 <sup>1</sup> / <sub>2</sub> -in. steel studs Fiberglass in cavity	<sup>1</sup> / <sub>2</sub> -in. gypsum board 1 lb lead*	1/2-in. gypsum board	48
_	Steel Office Destitions			
	Paper honeycomb	22 ga steel	22 ga steel	35
	Eiberglass core	22 ga steel	22 ra steel	20
	Fiberglass core	22 ga steel	22 ga steel	43
		1 lb lead*		
	Fiberglass core	22 ga steel	22 ga steel	46
	Eiberglass core	2 ID lead*	22 ga stool	52
	Fiberglass core	3 lb lead*	ZZ ga steel	52
	Doors			
	Hollow core wood (tested as panel)	1/8-in. plywood	1/8-in. plywood	21
	Hollow core wood (tested as panel)	<sup>1</sup> /8-in. plywood 2 lb lead*	1/8-in. plywood	32
	Hollow core wood	1/8-in. plywood	1/8-in. plywood	35
	(tested as panel)	2 ID lead*	2 ID lead*	29
	(gasketed-fully operable)	20 ga steel	20 ga steel	23
	Hollow metal (gasketed-fully operable)	20 ga steel 2 lb lead*	20 ga steel	39
	Lead Laminates		C. States	
	2" x 4" wood studs	1/2-in, gypsum board		28
	2" x 4" wood studs	1/2-in. gypsum board		33
		1 lb lead*		
	frame	1/2-10. fir plywood		24***
	Wood perimeter frame	<sup>1</sup> /2-in. fir plywood 1 lb lead*		30***
_				
	T-bar grid	Low density	21 db****	
	(suspended 30-in.)	ceiling panels		
2	(suspended 30-in.)	ceiling panels with	41 dD****	
		1 lb lead plenum		
		barrier between		
	T-bar grid	areas.	36 db****	
	(suspended 30-in.)	ceiling panels with	50 00	
	Shall Ball	1 lb lead blanket over both areas.		
	Manhaninal Room Collings (field test)			**
	Slab only	ings (neiu test)	Attenuation	
	With vibration		34 UD	
	Isolated ceiling			
	1/2-in. gypsum board.		52 db	
	NOTES: All tests con	ducted in accordance	e with ASTM F9	0-66T
	except as noted.		S MILL AGIN ES	
	*Lead is bonded to backside of facing.			
**Averaged over 9 frequencies.				
***Denotes tests on single 4' x 8' panels only.				Lab
	atory.	nou by Geiger and F	anime Acoustical	Lab-

of the material is directly related to the amount of lead powder in the vinyl. For example, free hanging leaded vinyl sheet weighing 3 lb and approximately  $\frac{1}{8}$ -in. thick has a STC of 34. A thinner sheet about .035-in. thick and weighing approximately  $\frac{1}{2}$  lb has a STC of 19. The frequency curves (7) show the transmission loss for four widely used weights. Another type of laminate is a combination of 10-oz or 1-lb sheet lead sandwiched between two  $\frac{1}{8}$ -in. thick sheets of closed-cell polyvinyl chloride foam. Such an



7 Frequency curves show transmission loss for four widely used weights.

TABLE II				
Typical applications	Hearing Conditions	Transmission Loss Sound Transmission Class		
		Back- ground 25 db	Back- ground 35 db	
Privacy not required, Partitions used only as space dividers.	Normal speech can be understood quite easily and distinctly through the wall.	35 or less	30 or less	
Suitable for dividing noncritical areas. Provides fair degree of freedom from distraction.	Loud speech can be understood fairly well. Normal speech can be heard but not easily understood.	35 to 40	30 to 35	
Provides good degree of freedom from distraction. Suitable for junior executives, engineers, etc.	Loud speech can be heard, but not easily intelligible. Normal speech can be heard only faintly, if at all.	40 to 45	35 to 40	
Provides a confiden- tial degree of speech privacy. Suitable for doctors, lawyers, senior executives, etc.	Loud speech can be faintly heard but not understood. Normal speech is inaudible.	45 to 50	40 to 45	
Suitable for dividing private offices from noisy areas contain- ing typewriters, telex, computers, etc.	Very loud sounds, such as loud singing, brass musical instruments, or a radio at full volume can be heard only faintly or not at all.	50 or more	45 or more	

installation as a rug underlayment under wall-towall carpet, reduces noise transmission between floors and also deadens impact noise. The various lead acoustical materials are listed and explained in Table III on page 180.

#### Machine Noise, Partitions, Doors

The laminated materials make much simpler the confinement of machine noise within rooms. Such was the case when the Solar Division of International Harvester installed a 750KW gas turbine generator. The air intake of the unit — a howling 11,000 cubic feet per minute — was the worst source of noise. To provide for slight movement and isolate vibration, a flexible connection was required between the air intake and the generator. Lead-loaded sheet



8 Drawing of a bellows formed of flexible lead vinyl.

vinyl, similar to that being used extensively by the aircraft industry in jets for sound insulation, was formed into a bellows and used as the connection between the manifold and the generator (8). The same material was used inside the generator cover backed by compressed glass fiber mats and held in place by metal screening. Other ways to solve the machinery enclosure problem are to sandwich lead between two layers of urethane foam or, if an enclosing shroud around a machine is impractical, to isolate it in a "tent" made from leaded vinyl curtains.

The lead-loaded vinyl curtain makes an acoustically effective flexible room divider possible. Architect Joseph Tuchman of Tuchman and Canute, Akron, Ohio, used the curtain technique to good advantage in the Harvey S. Firestone High School in Akron. He designed a curtain that could be raised and lowered to provide privacy for separate classes in the gymnasium. The curtain itself consists of two electrically operated independently controlled leaves separated by a 12-in. air space. The material is leaded vinyl on a durable fabric backing and has sufficient mass to block sound. The finish side of the material has an embossed pattern.

Successful acoustic treatment of doors makes it possible to keep other sound insulation effective. In Le Chateau Champlain in Montreal the 120 connecting doors were built with a sheet of 1-lb lead laminated under each face ply of the doors. This provided sound attenuation equal to that of the walls themselves. The flanking paths around the doors were sealed with weatherstrip material.

In the Sheraton-Chicago Hotel an ingenuous system of removable, lead-lined wood walls was developed to convert large halls to small units and maintain privacy between the rooms. These walls are made up of hollow wooden panels lined with 1-lb sheet lead as an internal sound barrier. The void in the panel is filled with a sound absorbing material. The ten-foot-high panels are held together with a series of locks. Flanking paths are sealed on the top and both sides by a TABLE III - LEAD MATERIALS FOR ACOUSTICAL USE

Material	Description	Principal Uses	Availability
Lead sheet and foil	usual thickness for acoustical work are 0.001 to $\frac{3}{32}$ in.	sheet lead is used alone and in laminates as a barrier.	sheet & laminates commercial
		foil has been used with viscoelastic cements for damping.	experimental
Lead asbestos anti- vibration pads	hermetically sealed lead envelope with asbestos and lead or steel sandwich fill. Size from a few inches to 6 x 10 feet and larger. Usual thicknesses are 1 to 3 in.	in building foundations, machinery mounts, wherever a vibration path through a structure must be blocked.	commercial
Flexible leaded plastic sheet	with or without fabric reinforcement. From 0.005 to more than 1/8-in. thick. Vinyl and	self-adhesive and cemented types as damping materials in office equipment.	commercial
	in tinted, embossed, or printed finish.	free-hanging or laminated as barriers.	commercial
Damping tiles	usually $1' \ge 1' \ge 1/2''$ weighing 4 to 5 lb. Epoxy or urethane with lead or galena loading	damping structural steel and heavy machinery.	commercial
Casting compounds	epoxy loaded with lead or galena	potting, filling complex voids.	commercial
Trowelling compounds	epoxy, neoprene, urethane loaded with lead or galena	damping structures, surfaces, resonant members, rattling panels.	commercial
		sealing cracks in noise barriers, closing openings for wiring, piping, etc.	commercial
Damping paint	fine lead powder in hypalon vehicle. Compatible with selected finishing topcoats.	reducing "boingging" in large areas of light sheet metal.	commercial
Miscellaneous	acoustic curtains and doors	general architectural.	commercial

tongue-and-groove construction that fits against soft leaded rubber or foam gaskets. To bring the seals up tight and make the joints all but invisible, each panel is locked to the next by concealed locking fasteners as the wall is being put up. The base is sealed with a resilient pad.

#### **Vibration Isolation**

When a column, beam, concrete slab, or wall of a building vibrates, it radiates audible sound and, if it vibrates with sufficient intensity, it can be felt. Radiating sound of a vibrating structure can be heard at lower frequency than it can be felt. Vibrating energy in the 20–75 Hz, 75–150 Hz, 150–300 Hz frequency bands is of most concern to the architect. The higher frequencies are more easily absorbed within the structure before they are transmitted any great distance, but railways and subways produce lower frequency rumbling sounds that can be heard in buildings that are connected by structural paths to the tracks. Many structures along New York's Park Avenue are built over the tracks of the Penn Central Railroad and have this problem.

Although the use of lead to solve this problem is well documented it is interesting to examine a few recent examples which presented quite difficult conditions. The new Madison Square Garden Center, built on the site of the old Pennsylvania Station in New York, is one good example. Designed by Charles Luckman Associates, the center is comprised of the sports arena and a 29-story office building. The some 650 trains that enter and leave the station plus the trains that roar in and out of the Seventh and Eighth Avenue express subway stations at either end of the complex greatly complicated the problem. The answer was in the use of lead asbestos anti-vibration pads, 325 of which were utilized in the building's construction.

Highways also, obviously, transmit noise caused either by vibrations through the frame or airborne low frequency sound. In the John F. Kennedy Center for the Performing Arts now under construction in Washington, D. C., a total of 82 of these anti-vibration pads were specified. In this case the architectural firm of Edward Durell Stone specified the pads to keep the vibrations originating in any of its three main performing halls from entering any of the others. Vibrations coming from the Rock Creek and Potomac Parkway, which passes under the building's cantilevered terrace, are also kept from entering the building (9).

Anti-vibration pads are also used to deaden the vibration created by heavy reciprocating machinery. The new home of the Newark Star Ledger in Newark, New Jersey, houses business and editorial offices as well as the huge press that turns out 1,000 copies of a 56-page edition every minute. This press would thunder out more than newspapers if it were not for the foundation design. The power and inertia of the press is such that a separate foundation was provided for it apart from that of the building itself. Since both go down to bedrock, it was necessary to isolate the press mounts from the foundation. The architects, William Ginsberg Associates, specified lead anti-vibration pads as the sole break in the vibration path. The pads are approximately  $1\frac{1}{2}$  in. thick and fit between two steel billet plates. The press is supported by 44 of these pads that measure about 24 x 30 in. and each bears about 150 pounds per square inch.

Another interesting comparative study was made between Carnegie Hall and Philharmonic Hall of Lincoln Center for the Performing Arts in New

York. Both buildings are adjacent to the tracks of the Seventh Avenue subway, but Carnegie Hall is not protected by pads. Vibrations from the subway can definitely be heard in Carnegie Hall (10). The curves show measurements taken in an establishment known as Harvey's Bar which occupied the corner of the present site of Philharmonic Hall near the Seventh Avenue subway. The upper shaded area gives the vibration levels taken at a wall and floor position in the bar's basement which is about 53 feet from the subway tracks. The lower shaded area gives the range of vibration levels measured in Philharmonic Hall not more than 10 ft from where the original measurements were made in Harvey's Bar. The measurements made in Philharmonic Hall range from 25 to 30 db lower than the Harvey measurements yet the distance from the subway tracks is essentially the same. The lead asbestos pads used at Philharmonic Hall are thicker than the standard 1-in. pads. They varied in thickness from two 1<sup>1</sup>/<sub>2</sub>-in. pads for columns nearest to the subway and tapered off in <sup>1</sup>/<sub>4</sub>-in. steps for each 30 feet farther from the subway.

#### **Pools, Planters and Waterproofing Membranes**

Another area where lead continues to perform is as a waterproofing agent. Recent changes in zoning requirements, setback laws, and building codes in various parts of the country make it possible for the ar-



9 John F. Kennedy Center for the Performing Arts.



10 Comparative vibration study between Carnegie Hall and Philharmonic Hall of New York's Lincoln Center.

chitect to include open space and landscaping as a part of the over-all planning concept. Reflecting pools, fountains, and planters are becoming a part of the building's design. One such example is the William James Hall of Behavioral Sciences at Harvard University in Cambridge, Massachusetts, by Minoru Yamasaki and Associates. The building is set back from the street 60 feet and flanked by two expansive reflecting pools between which the building's entrance is located. The forecourt and the pools make up a roof over an underground area that contains examination, research, utility, and storage rooms. Here both pools were lined with 6-lb sheet lead. All joints were burned to assure that none of the water from the pools would enter the subterranean areas. In constructing the pools, the sheet lead was laid over asphalt impregnated building felt. The top surfaces of the lead were painted with a cold applied brush coat, 12-to 14-mils thick, of a bituminous coating compound which is standard protection against temporary corrosive attack of free lime found in all fresh cementitious materials. The sheets were carried up the sides of the pools and into reglets cast into the walls. The edges of the sheets were secured to the reglets by lead wool calked into place.

The new John F. Kennedy Plaza in Philadelphia, Pennslyvania is a block square area, with an 800-car underground garage and pedestrian passageway to the subway and Pennsylvania Railroad Suburban Station. It is topped by a park and a 90-ft diameter pool that was conceived by the architectural firm of Vincent G. Kling & Associates. Dominating this pool is a gigantic fountain that sends streams of water up into the air and down on a grav granite splash block that is 16 feet in diameter. In the construction of the pool, a sheet lead lining was selected because of the need to keep the water out of the garage and passageways below. First, 30-lb felt was placed over the concrete substrate. On top of this, the 6-lb sheet lead. burned at the joints, was laid and then covered with a cold applied layer of protective coating. Finally it was covered with a poured cement coating that was followed by a 1<sup>1</sup>/<sub>2</sub>-in. thick setting bed to hold ceramic tiles.

Because of the increasing use of lead as a waterproofing agent the lead industry helped develop a new lead alloy which holds forth new horizons in pool design and construction. With this technique, lead can be used as a top layer rather than an interlaying membrane. A newly developed expansion joint absorbs the cycling of the sheet lead due to wide swings in surface temperature and prevents cracking of the membrane. The new lead alloy, which contains 4 per cent antimony and 0.08 per cent arsenic, gives the sheet better elastic properties than common lead.

To test the new system, the Lead Industries Association built a representative pool  $30 \ge 35$  ft using both the new alloy and the new expansion joint (11). When the 6-lb lead was laid, 3-in. spaces were left between the sheets for the expansion joints. The



11 Detail of the new expansion joint taken at the batten.

joints consisted of 1 x 2 in. redwood battens that were covered along the edges with ½-in. thick strips of neoprene foam rubber. The foam was employed to take up any movement when the sheets expanded. These inserts were then covered with a cap of lead made of the same alloy as the large sheets and burned to their surface. Before the lead was installed, 30-lb roofing felt was placed over the substrate to prevent corrosive action between the lead and the free lime. Joints in the roofing felt were butted and taped. This test has been underway through four summers and three winters and so far shows no evidence of creep or buckling.

The reconstruction of the staircase of the Missouri State Capitol Building at Jefferson City, Missouri was made necessary by the more than 50 years of weathering and constant use that left them and the promenades in a bad state of repair. The use of an antimonial sheet lead waterproofing membrane provided large additional areas of air conditioned office and dry storage space below the stairs. Previously

#### CHART I

Approximate thickness of single, simple partitions to meet permissible transmission loss requirement.

	and the second	and the second		-	
Material	Thickness required in inches				
	Moderately		Very		
Desire and the second	noisy	Quiet	quiet		
	office	office	office		
Fir plywood	3.67	6.67	13.33		
Sand plaster	.20	4.45	8.9		
Glass	.13	4.70	9.3		
Dense concrete	.14	4.85	12.2		
Aluminum	.13	5.7	11.3		
Steel	.045	.20	7.0		
Lead	.030	.135	.54		

The stepped line indicates the break between those materials which are limp enough to use their weight efficiently (below the line) and those which are stiff enough to lose the effectiveness of their weight (above the line). the reclaimed area had remained unoccupied because of dampness and mildew. The architect for the reconstruction was Bernard McMahon of Clayton, Missouri.

For the membrane, 8-lb sheet was used. Before laying the lead, the concrete substrate was painted with a bituminous coating compound. All joints were burned to preserve the integrity of the membrane. Reglets were cut into the column bases and the sheet lead flashed into them. Existing dowels, which came through the former steps were capped with lead sleeves and used to hold the stringers in place. Concrete stringers were poured directly over the top of the sheet lead waterproofing after it was painted with a bituminous compound. Treads and risers rested directly on these after the placement of the mortar setting bed. They were held in place by the dowels and restraining angles set at intervals.

#### Flashing, Roofing and Siding

Normal practice employs 3-lb hard lead for flashing and gutter linings, ridges, hips, valleys, copings, base flashings, and where large areas are involved or the exposure is severe. For small areas,  $2\frac{1}{2}$ -lb hard lead will suffice.

One reason Architect Goldberg (page 110) specified lead for his new building in Marina City was that the movement expected in the structure could be compensated by the flexibility of sheet lead. The saddle shaped roof was installed over a Lamella type steel truss. More than 5,000 separate panels of 3-lb antimonial sheet lead were used. Each piece measured approximately 24 in. wide by 48 in. long. They were locked together along the 48-in. length by standing seams. These seams were run the long way of the building and the locks were rolled in the direction of slope to prevent moisture from entering the seam on the upper side. On the short edges, sheets were joined by flat locks in a staggered pattern, again folded in the direction of the slope (12).

Seam details for the walls are identical but with standing seams running vertically. The panels were preformed to a continuous 16-oz copper cleat which in turn had been nailed to wood grounds in the cement plaster substrate with copper clad nails. All lock seams were weatherproofed with a bead gun grade plastic calking compound on the preformed bend before finally interlocking the mating parts. Standing seams were similarly treated with plastic calking material before the last fold was dressed down tight.

The roof of the Kresge Auditorium at Massachusetts Institute of Technology in Cambridge is in the form of an eighth of a sphere with a minimum thickness at the apex of  $3\frac{1}{2}$  in. The fact that its shape changed due to thermal expansion with variations of the weather created a problem that resulted in a new concept in sheet lead roofing.

Originally, the concrete slab was covered first by a vapor barrier and then with a 2-in. layer of in-


12 Lead roofing being installed. In forming standing seams roll is in the direction of flow down the roof surfaces.

sulation. Next came a layer of cinder fill for acoustic purposes and, finally, a finish coating made of a clear acrylic containing a stone mix for texture. As the insulation and fill layers were not secured to the structural slab, movement between them set up stresses that ruptured the topping, creating cracks as wide as  $\frac{1}{2}$  in.

To solve the leakage problem, tests of a series of materials were made on the roof's surface, and as a result it was decided to use sheet lead for a new roof. In this case the cinder fill was cut through on 48-in. centers in both directions. At each of the intersections, <sup>3</sup>/<sub>8</sub>-in. diameter steel studs were anchored in the structural slab. They projected <sup>3</sup>/<sub>8</sub> in. above the fill surface and 4-in. square stainless steel shields were slipped over the studs and welded into place, tying the topping to the slab but permitting it to crack along the saw cuts.

To the top of the studs, a grid of <sup>3</sup>/<sub>8</sub>-in. diameter stainless steel wires were welded in a diagonal pattern on 2-ft centers. Where they cross each other, they were also welded. On this grid, 2-ft square sheets of 6-lb lead were slipped under the lower "V" created by the grid wires and over the "V" at the top. In company with the next sheet, it locked in a continuous wire support. The sheets were lapped 2-in. and all joints were burned.

### Terne

Another traditional roofing material, terne, is enjoying a resurgence in contemporary architecture. This lead alloy coated steel makes it possible for architects to design roofs that add accents and strong patterns with such devices as batten seams, deep eaves, and steep pitches. David W. Anderson of the architectural and engineering firm of Drummey Rosane Anderson, Inc., of Newton Lower Falls, Massachusetts, utilized the material very successfully in the design of a residence for an Amherst professor. In his design, a mansard roof was used, eaves came halfway down the outside walls. The roofs are wrapped like shawls around what appears to be three separate buildings joined by a low arcade. The terne is painted a warm copper color to harmonize with the exterior brick walls. Mr. Anderson claims that the terne was more adaptable than copper to use and a good deal less expensive. The lead coating on the steel, in addition to adding corrosion resistance to the substrate, provides an excellent base for paint.

Sheet lead to be used as a roofing material is usually a relatively light gage. This is because of the method of application. A roof is laid up using loose locks for joints to allow for thermal expansion. Ordinarily, 3-lb hard antimonial lead  $\frac{3}{64}$ -in. thick is specified for roof installations.

### **Radiation Shielding**

Most architects need not worry about specifying an effective barrier against high energy radiation. There is, however, a good chance of involvement in the design of rooms and structures for protection against x-rays. Since x-rays can cause physical damage upon overexposure, the source must be enclosed with a material that is resistant to penetration. Lead, the densest of all commonly available materials, provides the greatest protection per unit of thickness. Factors to consider are intensity of the x-rays, direction or directions the equipment will be pointed, hours during the day the machine will be used, and duration of exposure at any one time. After the selection of the proper thickness of sheet lead, it is essential to make sure that the shielding is effective so that not even the most minute space exposed to the rays is left unshielded. Pure lead itself will not become radioactive even upon long exposure, but other metals could become small secondary radiation sources if not properly covered. It is also necessary to cover nails or screws with lead which is then usually spot soldered or burned to the surface of the shield. Even after these safeguards are followed, however, it is essential that a qualified radiologist check them. And, of course, in most instances, the local board of health or the state labor department will need to approve the designs also.

### The Future of Lead

Another possible building material in the future may be lead-concrete which would have the advantage of both lead and concrete as sound insulators. Other alloys may be developed and more sophisticated bonding techiques may also make new types of sound insulated wall panels and doors practical.

A finely divided lead oxide particle mixture (dispersion strengthened lead) has almost doubled the strength of soft lead, thus opening up a wider range of architectural applications that are currently being investigated. This development has made it possible to use lead structurally. Future developments will undoubtedly help to maintain the role lead has played in the building field through the centuries.

# ALUMINUM

A discussion of current trends and predictions for the future of aluminum in architecture is followed by a review of typical characteristics and applications of aluminum alloys, finishes, and detailed presentations of this metal in some of our most recent architectural construction.

Photos: Harvey Shaman, courtesy The Aluminum Association

# **Alloys and Anodizing**

oday's market for architectural aluminum exceeds two billion pounds per year — more than four times the amount used in 1950 — and up substantially from that used just a few years ago. Industry estimates predict that the 1970's will see even more architectural use of the material, and they forecast that by the 1980's Americans will be hard pressed to find any major structure that does not take substantial advantage of this metal, either in its basic design, renovation, or as a component.

The growth in the use of architectural aluminum can be credited to three factors: economy, quality, and aesthetics. Properly employed, aluminum readily competes on an initial-cost basis with all alternate materials. Thoughtfully applied, the inherent qualities of aluminum — its high strength-to-weight ratio, corrosion resistance, and easy formability — lead to the design of an enduring structure with low maintenance requirements and high resale value. And creatively used, aluminum, with its many finishes, colors, and possible forms, lends itself to the design of attractive structures without sacrificing efficiency or economy to achieve the desired result.

### **Current Trends, Future Predictions**

The aluminum industry is currently working hand in hand with architects and designers in developing lightweight components for integral construction units. They include entire bath rooms, hotel rooms, kitchens, and even hospital patient rooms. In addition, a number of sandwich-wall panel designs with insulated, prewired, preplumbed panel features are completely shop-fabricated and finished.

Still another advancement is the use of extruded aluminum as a combination structural and finished material. The development is useful in portable housing for temporary relocation during urban renewal projects, for example, as well as in permanent structures such as schools, lowrise buildings, and shopping centers.

One of aluminum's greatest potentials, of course, lies in its ability to replace a complicated architectural detail built up of many parts, calling for several different materials, and using the labor of different tradesmen. All of these can sometimes be replaced by a single aluminum extrusion. Inevitably this can result in a satisfactory, yet less expensive building, and one that can be quickly erected, can last longer, and yield more for less.

Since the end of World War II, many far-reaching advances have been made in the formulation and production of aluminum and its alloys. Alloys commonly used in architectural applications, their nominal composition, mill forms, characteristics, and typical applications are listed on the pull-out chart. Producers offer numerous proprietary variations of these compositions and quite a few special alloys developed to provide special finishes or to solve specific corrosion, metalworking, and application problems.

The metallurgy of aluminum production can now be finely controlled on a mass-production basis.

Through the proper selection of alloy, pretreatment, anodizing cycle, and postanodizing treatment, a tailored coating with one or more of the following characteristics can be obtained :

- Clear and transparent
- High dielectric
- Transparent chromatic
- Near diamond-hard, abrasion resistance
- Variegated, multicolored, or multitextured
- Specific capacitance value
- Opaque colors, with a specific chromatic attribute
- Highly corrosion-resistant
- Integral color

### Welding Aluminum

There was a time when aluminum, generally, was considered difficult to weld. However, with the perfection of gas tungsten arc or gas metal arc welding, to name just two modern welding techniques, this is no longer true. The myth persists, however, so a few words on the welding of aluminum are in order.

The aluminum alloys are no more difficult to weld than the ferrous alloys. But, as with the ferrous alloys, the welding technique utilized must be tailored to the alloy at hand, i.e. one would never expect to weld the high chromium-nickel ferrous alloys by the same techniques employed in welding mild carbon steel.

Every metal alloy or family of alloys exhibits its own metallurgical reaction to the application of heat, plastic flow, cooling, resolidification, etc. Some are more prone to develop detrimental effects from the absorption of tramp elements during the welding cycle than others. Still others require pre-and/or post-welding procedures such as special cleaning, thermal treatment, etc. to develop the desired weld characteristics. And *all* of the corrosion resistant metal alloys demand welding techniques which take into account the corrosion resistance of the base metal, the filler metal, and the subsequent corrosion resistance of the completed weld. Why then, should fabricators expect the aluminum family of alloys to be any different?

The architectural aluminum alloys can be readily butt- lap- or seam-welded by a variety of welding techniques with readily available equipment in either the shop or the field. The architect-engineer should keep in mind, however, that as with any other alloy, the specification of joining by welding must be made by selecting the proper alloy to do the job, thus insuring the desired results.

One breakthrough in the area of aluminum production can be credited to the perfection of the process computer. By converting production to computer control, human error is virtually eliminated, and it tends to closer tolerances, both chemical and physical.

Although interest in how the aluminum industry has improved an alloy to facilitate extrusion may seem far removed from the primary interests of architects, the production costs of the extruder, which include die costs, scrap loss, power factors, set-up time, and downtime, to name but a few, bear very close relation to the final cost of an aluminum extrusion.

All work done on the aluminum producer's level to provide an alloy such as AA 6063, which not only lends itself to extrusion but also is nominally identical to all the other 6063 produced, greatly simplifies the extruder's problems; it also permits him to schedule longer runs, to reduce scrap, and to lengthen die life. This results in a general reduction in extrusion costs that in the end can be passed on to the architect in the form of a reduction in his construction cost estimate.

Since structures are not commissioned on design alone, the architect's construction cost trade record is also taken very much into account. Just as important is his ability to translate aesthetics into a practical cost-conscious design.

Aluminum Finishes: If corrosion resistance was the only reason for applying a finish to an architectural material, aluminum could always be used in its natural, bright form. Natural finish aluminum alloys are available that can withstand even the most corrosive industrial or sea water atmospheres, although changes in appearance may take place, since all aluminum surfaces have a protective film of hard aluminum oxide that forms as soon as the metal is exposed to air and forms again to "heal" the surface if it is damaged.

Architectural aluminum finishes can be divided into two general categories: (1) those that produce integral changes in the texture and color of the metal itself, and (2) those that produce the changes by applying a coating of some kind over the metal. Integral changes can be produced by mechanical, chemical, and electrochemical processes. Coatings include organic paints, lacquers and enamels, laminated plastics, and vitreous porcelain enamels. Mechanical process such as grinding, polishing, buffing, or embossing, and chemical processes such as etching, brightening, and electroplating can be used to achieve textural effects on aluminum. These processes can be applied singly or in combination. They also can be used prepare the surface for another to treatment — anodizing — the currently popular method

Photo: Courtesy, Olin Corporation



Aluminum billet entering an extrusion press

for producing integral finishes on architectural aluminum, particularly for exterior use.

Anodizing: The development of continuous coil-anodizing and the perfection of fade-free integral colors have made possible the specification of a much broader range of finishes and colors with assurance of long life, color match, and manufacturing repeatability.

The process of anodizing is similar to electroplating where the metal is made the cathode. In anodizing, the metal treated is made the anode in the electrolyte bath. And unlike plating, where metal is deposited on the surface and grows outward, in anodizing, oxygen combines with the aluminum surface under the oxide deposit and the new oxide continues to form under the coating. The process, therefore, produces much thicker layers of aluminum oxide than would form naturally, and, in addition, permits the producer to control color and color shade. The thickness and other characteristics of aluminum's oxide layer depend on several variables, but basically on treatment time.

Two classes of anodized coatings may be specified for architectural use. Class I, for use on unmaintained exterior surfaces, must be not less than 0.7 mils (seven ten-thousandths of an inch); Class II, for maintained exteriors and most interior applications, calls for a minimum of 0.4 mils. By way of comparison, the natural oxide film on aluminum is less than a millionth of an inch deep.

The oldest (and still widely used) anodizing treatment for architectural aluminum is the conventional sulfuric acid process. Another type of anodizing that is important, utilizes one of several organic acids, rather than sulfuric acid, as the major component in the electrolyte bath.

Anodized Aluminum Coloring: When aluminum alloys are anodized by the conventional sulfuric acid process, a clear, colorless film of oxide is produced. To produce color, several approaches can be taken: (1) The alloy's film can be impregnated with a water-solution of an organic dye or by coloring with mineral pigments before sealing. This is the oldest and original method for providing color. Of the colors achievable from conventional anodizing, only one has proved sufficiently colorfast to be recommended for external use. This one is gold, produced by a ferric ammonium oxatate solution. (2) A newly developed process which electrolytically deposits stable pigments in films produced by conventional sulfuric acid anodizing offers lightfast colors in the same range as integral color anodizing. (3) Colors derived from the characteristics of the aluminum alloys employed are "integral" colors and are extremely lightfast and durable. Called "hardcoat colors," they are produced by high voltages and current densities and rigid temperature control. These finishes are called

"hardcoat" because of their dense, hard surfaces and excellent corrosion resistance. They are 0.7 mil thick or thicker and fall into the Architectural Class I coatings category.

Multicolor effects on aluminum can also be obtained. This is accomplished by masking different areas and varying the anodizing conditions. It can also be obtained by the use of dyes. While an anodized aluminum coating is hard and resistant to atmospheric corrosion and abrasion, and presents a surface to which soiling agents do not readily adhere, it *is* vulnerable to alkali attack. When anodized aluminum is used in exteriors in conjunction with concrete or mortar, it usually is protected from alkali in those materials with a thin coating of clear lacquer, applied after anodizing.

### **Other Color Finishes**

The general group of applied finishes — including paints, enamels, lacquers, laminated plastic films, and porcelain enamels — provides the architect with the fullest possible selection of colors and textures for both exterior and interior design. Although the appearance of these finishes applied to aluminum is much the same as on any other material, the aluminum base can still be bent or formed to a considerable degree even after the application of the finish. Another advantage is that damage to the finish, should it occur, does not spread through rusting or moisture admission. In addition, uncoated cut edges will not corrode and precipitate damage to the finished surfaces.

The decision on whether to specify a paint, enamel, or lacquer on aluminum depends on the following: (1) the shape of the surface to be finished, which determines how it can be coated; (2) whether there will be further fabrication after finishing; and (3) final use.

Multiple parts formed from strip, sheet, or extrusions may be most economically coated before final forming or cut-off. The enamels used for these applications are highly flexible.

Also affecting the decision of what type of coating to specify are: the degree of exposure anticipated, the atmospheric conditions, the amount of maintenance the surface will receive, and the expected life of the surface. Epoxy-base paints are highly corrosion-resistant, although silicones are used where high temperatures will be encountered. In some cases, where exteriors are exposed to severe weathering conditions, laminated plastic films may be the choice, since some have life spans of 10 years or longer. Porcelain enamel, however, is considered a permanent finish, and is expected to last the life of a building.



## P/A TYPICAL CHARACTERISTICS AND APPLICATIONS OF ALUMINUM ALLOYS

			CHARACTERISTICS (2)				2)	
АОТТА	NOMINAL COMPOSITION, %	COMMERCIAL FORMS (1)	Corrosion Resistance	Machinability	Weldability (3) <	Maximum Strength (4)	Annealed Strength (5)	TYPICAL APPLICATIONS
1100	99.00 Al min, 0.12 Cu	STEBWFO	A-A	D-C	A-A	24	13	Sheet metal work; spun hollow ware — Internal
3003	1.2 Mn, 0.12 Cu	All Forms	A-A	D-C	A-A	30	16	Flashing, general sheet metal work, piping
3004	1.2 Mn, 1.0 Mg	S	A-A	D-C	A-A	41	26	Corrugated, ribbed roofing and siding
5005	0.8 Mg	SWO	A-A	D-C	A-A	30	18	Sheet application where closer anodized appearance match with 6063 extrusions is desired
5050	1.4 Mg	STPO	A-A	D-C	A-A	32	21	Same characteristics as 5005 but higher strength
5052	2.5 Mg, 0.25 Cr	STBWPO	A-A	D-C	A-A	42	28	Higher strength application
6061	0.6 Si, 0.25 Cu, 1.0 Mg, 0.20 Cr	STPEBWF	A-A	D-C	A-A	45	18	Structural application
6063	0.4 Si, 0.7 Mg	TPE	A-A	D-C	A-A	42	13	Windows, doors, architectural extrusions

(1) B-bar or rod; E-extrusions; F-forgings or forging stock; O-foil; P-pipe; S-sheet or plate; T-tube; W-wire.

(2) Relative ratings in decreasing order of merit-A, B, C, D. Where applicable, ratings for both annealed and hardest tempers are given (for example, A-C).

(3) Weldability: A-generally weldable; B-weldable with special techniques for specific applications; C-limited weldability; D-not weldable. Ratings are given for arc welding. Gas welding and brazeability ratings are the same or differ by only one.

(4) Typical maximum tensile strength in kips per square inch, for fully work-hardened condition or heat-treated to highest strength level. (Multiply by 0.703 to convert to kilograms per square millimeter.)

(5) Typical annealed tensile strength in kips per square inch. (Multiply by 0.703 to convert to kilograms per square millimeter.)

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When considering paint, enamel, or lacquers, an architect must remember the following: (1) enamels are generally preferred to paints. They may be either of the air-drying type (usually force-dried with heated air), or baking enamels, which achieve the hardest finishes. The latter, probably the most versatile of the finishes available, may be applied to any product or assembly and cured under carefully controlled conditions. (2) Lacquer, most often used only as a temporary protective coating, is also specified to prevent discoloration and staining of anodic finishes alkaline building materials. (3)by Plastic films — that is, vinyl sheets — when properly laminated to aluminum, can be drawn, bent, stamped, or sheared without separating from the aluminum backing. The plastic may be textured to simulate any desired surface, and may be obtained in any desired color. (4) Porcelain enamels are a group of finishes that have a glass-like composition. Fused to aluminum, they provide many of the surface properties of a hard glass. They are obtainable in many colors and degrees of glossiness. Porcelain-enameled aluminum can be sawed, drilled, and punched, and can even stand some bending.

### **Specifying Aluminum Finishes**

Until quite recently, each prime producer of aluminum had an individual system for specifying finishes. This led to a bewildering assortment of unrelated designations which was confusing to architects, designers, engineers, and fabricators. Now, a uniform system of finish designations has been established not only to cover all the various types of finishes presently available, but also to take care of those developed in the future. It works this way: If an architect wishes to specify an anodized finish with a smooth surface and an integral color, for example, he would refer to the Aluminum Association's Finishes Designation Table and would use the designation "AA-M21-C22-A42, of color to fall within approved color range." The first two digits - AA - identify it as an Aluminum Association finish. The next three digits — M and two numbers — specify the mechanical finish, in this case, "M21" indicates mechanical finish, buffed, smooth specular. The next three digits - C and two numbers - specify the chemical treatment or conversion coating; "C22" designates Chemical finish, medium matte. And the last three digits — A and two numbers — specify the anodic coating; "A42" signifies Anodic coating, Class I Architectural, integrally colored, films thicker than 0.7 mil. The phrase "of color to fall within approved color range" refers to the range of color samples selected and submitted to the contractor at the time of bidding.

Anodic color can be controlled within a reasonably close range, but some variation does occur. To avoid noticeable color variation on his buildings, an architect may specify that the elements to be used will be graded and sorted so that adjoining elements will exhibit as little variation as possible. He may also break up his design, using projections or deep reveals at panel joints to reduce or eliminate the appearance of variations.

### **Standards of Anodic Finishes**

Architects should specify that the following ASTM Standards be used in testing the properties of anodic coatings:

- B136–45: Sealing of Anodically Coated Aluminum
- B137–45: Weight of Coating on Anodically Coated Aluminum
  B244–56: Measuring Thickness of Anodic Coatings on Aluminum by Means of the Filimeter
- B110–45: Dielectric Strength of Anodically Coated Aluminum
  B117–61: Salt Spray (Fog) Testing.

He also may specify one of the Aluminum Association's tests spelled out in "Standards for Architectural Aluminum."

### **Designating Organic and Vitreous Finishes**

The industry's system of designating organic and vitreous finishes is planned to function like that for anodic coatings; however the organic and vitreous coatings themselves have not been categorized or given designations at this writing. Instead, they are designated R10 (unspecified) and R1X (to be specified). Resinous (paint, enamel, and lacquer) coatings are designated V1; vitreous coatings are designated L1O and L1X. Following the "X," in each case, an architect adds his own or an adopted specification indicating the paint, enamel, lacquer, laminate, or porcelain enamel coating to be used.

While field-applied coatings can — and probably should — be designated completely, a full description of both methods and materials for a factory finish may limit competitive bidding to a very few producers or fabricators. An architect probably is better advised to make reference in his specifications to a proprietary finish with a qualifying "or approved equal" appended.

### **For Painted Sheet Colors**

Color for painted sheet may be specified using Aluminum Association standard color designations based on the widely used Munsell Color Notation System.





# **Aluminum Curtain**

Chicago's Lake Point Tower — the tallest reinforced concrete structure in the world — is a 645-ft high, 70-story apartment building. Designed by Schipporeit & Heinrich, Architects, and Graham, Anderson, Probst & White, Architects, along with William Schmidt as structural engineer, Lake Point Tower's three-winged "triform" plan, as the architects call it, is keyed to a roughly triangular, reinforced concrete core. The core wall is 4 ft thick at its base and tapers to a 12-in. thickness at the 59th-floor slab. This core takes all horizontal and rotational wind forces, preventing transfer of the wind movements to the columns.

According to architect John Heinrich, the core design was selected principally because it eliminates lengthy, privacy-robbing corridors and the "stretchedout" room arrangements that are commonly associated with large buildings of rectangular design. Further, the core arrangement gives each floor a small "lobby" or waiting area at the elevators.

### Window Wall System Aluminum

The window wall into which the HVAC units are integrated has bronze-tinted, 1-in. thick glass units with a  $\frac{1}{2}$ -inch air space, and medium bronze-colored, hard-coat finished aluminum. Each window unit was prefabricated and crane installed, "greatly cutting construction costs and time," John Heinrich notes. "Our design theory, which led to the specification of aluminum," Heinrich continues, "was to come up with an aesthetically pleasing window wall unit which, at the same time, could be multiplied into as many exactly identical components as possible. There are over 11,000 identical pieces of glass in Lake Point Tower. With this approach, we could take advantage of the cost saving available through mass production of the window wall units, a cost reduction which materially controlled the cost per sq ft of the finished structure."

Schipporeit & Heinrich feel an affinity to metal curtain wall design and construction. Says Heinrich, "In the past, an architect's visual consideration was shade and shadow — a sculptured design."

There is much to be said for Heinrich's reflectivity and color on Lake Point Tower. Depending upon the time of the day and year, the cloud conditions, and the angle from which it is viewed, the building visually changes — its basic bronze turning blue, green, gold, or picking up pin points of other colors from the myriad lights of Chicago. "There are those who may not like metal-clad structures," Heinrich concludes, "but if the architect takes proper care in the placement of the structure and in planning its immediate surroundings, no one can say that a reflective aluminum structure is visually boring."



Photos: Hedrich-Blessing, courtesy Ganster & Henninghausen

# **Structural Aluminum**

A t the Gertrude M. Carman Elementary School in Waukegan, Illinois, architects Ganster & Henninghauser specified aluminum load-bearing columns that are composite-extrusions. There, the properties of the metal permit the columns to be exposed.

The structural columns are 1<sup>3</sup>/<sub>4</sub> in. thick and 6 in. deep, spaced 20 in. on centers. They are of standard 606-3T6 aluminum featuring a 30-minute anodized finish conforming to the Aluminum Association's designation A31-C22 — that is, the finish is Architectural Class II, clear and etched to produce a medium matte surface.

In the column detailing, provision is made by appropriate top and bottom bolting for carrying both roof and wind loads. Load transfer to the columns is through roof and floor joists via an 8 in. channel. The composite-extrusion columns are also designed to accommodate snap-on glass stops in the narrowed middle section. Horizontal members are similar but are slightly reduced in size.





V8" THICK FORMED ALUMINUM COPING WITH CONCEALED JOINTS

rf=

WOOD BLOCKING BOLTED TO CONC. BLOCK PARAPET

# **Protective Anodizing**

Near the metals and heavy industry capital of Pittsburgh, Cox's Department Store, in McKeesport, Pennsylvania, has recently been expanded and renovated by the architectural firm of Celli-Flynn. The store is two blocks from a major steel mill - a massive complex of blast furnaces, Bessemer converters, open hearths, rolling mills, and acid pickling tanks. And it is only a few miles down river from Clairton, Pennsylvania, famed for its huge coke-and-coal chemical works with effluents ranging from acids to hydroxides. Architects Celli-Flynn specified proven, anodized, hard-coated aluminum with an equally proven bronze finish to modernize the front of Cox's existing building and to face the attached new structure. They specified insulated aluminum panels 12 ft high by 4 ft wide. Each panel was crane-erected to cover the height of the second floor of the windowless, two-story, air-conditioned building.

If one were to choose a difficult test site for any architectural material or finish, McKeesport, would be a logical spot. If one were to point to an excellent example of the applicability of architectural aluminum in an industrial atmosphere, Cox's Department Store is such an example.

Before selecting aluminum for the project, however, Celli-Flynn ran a materials study taking into account durability, color, aesthetics, and costs.

The architects state that "speed of erection was a factor in our considerations, since remodeling had to be accomplished without closing the store."

The architects designed sloping spandrel recesses to make the exterior self-cleaning and, wherever possible, eliminated elements that could provide repositories for standing moisture or chemical laden dust. Joints between panels are zipper type and sealed with a neoprene gasket.

Photo: Harvey Shaman, courtesy of the Aluminum Association



VERTICAL WALL SECTION

# **Aluminum Protects Steel**

Chicago's John Hancock Building, the world's largest structure housing both offices and residences, required just 29.7 pounds of structural steel per square foot of floor area whereas most large buildings need a minimum of 45 to 50 pounds of steel to achieve the same end, according to Richard Lenke of Skidmore, Owings & Merrill, Architects. The use of aluminum for the cladding of the building was a major factor in making this possible.

The building is 100 stories tall; it stands 1,107 feet above ground level, and 1,125 feet above the depressed concourse level. In addition, the structure is topped by twin TV antennae that add another 344 feet to its height.

Approximately 2<sup>1</sup>/<sub>2</sub> million pounds of aluminum, enough to cover 12 football fields, were utilized in the more than 4200 insulated cladding units which provide sheathing and temperature isolation for the building. "Without the insulating effect of the cladding, the 'growth' or 'shrinkage' of the building with temperature change would create excessive mechanical stress," the architects state.

Materials evaluation carried out by the architects included consideration of aluminum, steel, limestone, brick, and precast concrete. The weight factors associated with a structure of this height, however, quickly eliminated all materials except aluminum

Aluminum was chosen only after the architects were convinced that it offered a good combination of properties and potentialities. Considered were: durability; strength-to-weight ratios; ease of fabrication, erection, and maintenance; compatability with the building's architecture and governing codes; and aesthetics.

Once aluminum was decided upon, the next consideration was finish, including the proviso that the finish chosen must have a service life of at least ten years. Most shades from light bronze through black were considered. A black anodized finish was selected for the column cover cladding and bronze for the window framing.

### **Cladding Tested**

Because the John Hancock Building "works" only when the insulated cladding retains its capability to maintain beam center temperature at  $69\pm1F$  in the face of an 85F differential (72F inside and -13F outside) a procedure was established by the cladding unit fabricator to test the insulating capability of the cladding, under the most adverse conditions.

A test chamber was set up and equipped with strain and linear gages to determine the "shrinkage" or "growth" of a sample column under applied temperature, wind, and humidity differentials. Urethane, foamed-in-place insulation in 2–4 in. thicknesses (depending upon the location of the column cover on the building) proved satisfactory.

### Wind and Rain Resistance

NAAMM a familiar dynamic test — Type C-2 was employed to assure the cladding's resistance to rain and wind. In order to simulate wind velocities of up to 135 mph and the effects of a rain storm far more severe than Chicago is ever likely to experience, a WW II Navy Corsair (minus its tail and most of its wings) was anchored in front of the test chamber. The chamber was then sealed by a sample John Hancock Building panel assembly, and the Corsair's 2100 hp engine driving a  $12\frac{1}{2}$  foot tipto-tip three-bladed propeller was revved up to drive air against the aluminum-and-glass curtainwall mock up.

As wind speeds of approximately 100 mph hit the panel, jets of water were turned on, creating a hurricane-force rain storm. Then the throttle of the Corsair was advanced farther, building up sustained wind velocities of up to 135 mph.

After each test, technicians entered the sealed chamber behind the test wall to examine and record data from strategically placed electrical and mechanical strain gages, monitoring critical points on the curtain wall. The success with which each assembly withstood the test was determined by data analysis. The inner surface of the curtain wall was examined under spotlight to assure absence of leaks. Each of the panels tested passed this exacting test with only minimal changes in sealant placement required.

Still, John Hancock Building architects and Cupples engineers were not satisfied, so tests to simulate other types of wind loading were ordered. In order to test the type of wind loading that can result in a



major pressure differential between the outside and inside air of a building, the test chamber, once again sealed with a panel assembly, was partially evacuated with a vacuum pump. Ability to withstand resulting stresses were again gaged.

Next, the chamber was pressurized, forcing the curtain wall to bow outwards as it would when winds race parallel to the building surface, creating a negative pressure area by a venturi effect. Here also, each panel passed the test.

### **Cladding Specifications**

The aluminum curtain wall units utilized on the Chicago John Hancock Building vary in size, depending on their locations. Aluminum column covers at the base of the building are 4 ft-6 in. wide and 18 in. deep. At the top, they are 2 ft.-6 in. wide and  $5\frac{1}{2}$  in. deep. The typical office floors from the 4th floor through the 36th floor are 12 ft-6 in. Apartment floors above the 46th floor are an average of 9 ft.-3 in. The longest column covers were used on the 44th floor which is the "sky lobby," where they are 15 ft-

### 10 in. long.

Column-cover weight varied considerably, with size. Cladding panels from the 2nd floor to the 21st floor are of  $\frac{3}{16}$ -in. thick sheet aluminum. The remainder of the covers from the 21st floor through the 100th floor are  $\frac{1}{8}$ -in. thick sheet. The column covers for the 5th floor (complete with insulation, closure extrusions, and window-cleaner track) each weigh approximately 430 lb. Covers for the 98th floor, made of  $\frac{1}{8}$ -in. sheet in smaller size but including the same window cleaner track and closure extrusions, weigh only 215 lb.

At the upper end of each of the covers the sheet material was offset  $\frac{9}{16}$  in. to provide an overlapping joint into the cover above. This joint was designed to include a double sealing tubular vinyl extrusion and a primary sealant. On each side of the column cover are conventional threaded connectors and extruded adapters to accept the window and spandrel units.

On the face of each vertical column cover is a large aluminum window-cleaner track extrusion, which was attached after the anodic finish was applied to both the track and the column cover.









# **Light-and-Color Cladding**

One of the world's unusual hotels, the circular 40story Washington Plaza in Seattle consumed nearly 400,000 pounds of aluminum in various shades of gold and bronze tones on the hotel's exterior columns, window panels and frames, balcony railings, and store fronts.

The location of the Washington Plaza Hotel in

Seattle is ideal for a circular structure in that it is situated at the center of a hub of streets radiating out from the structure in all directions, yet Joseph Moodie, managing architect for John Graham & Company, architects of the Washington Plaza Hotel reports that "after careful consideration and numerous comparisons of both aesthetics and cost, we de-



PLAN SECTION AT TYPICAL FLOOR, TYPICAL BAY (B.B)





Façade and façade close-up of the Washington Plaza Hotel in Seattle, Washington.

cided on the use of aluminum for the skin of the building."

Ground was broken for the Washington Plaza Hotel in December of 1967; steel work began to go up in January 1968 with the aluminum people right behind the ironworkers. Eighteen months later, including a two-month strike delay, the 40-story hotel was completed.

The skin on Washington Plaza includes column shaft cover panels, eight feet long, assembled from three pieces. Corrugated to add pattern and strength, they have a light gold finish. The lighting shields have a medium bronze aluminum anodized finish, and the window frames and railings are dark bronze. As a highlight, the extruded aluminum balcony fascia over the windows is a natural aluminum color.

Topping off the exterior of the Washington Plaza Hotel is a "crown" — a parapet of formed aluminum that curves out above the building.

# A beautiful way to work with smog.

This building is faced with precast exposed aggregate concrete. Its soft-textured surface invites the eye. It also invites trouble because, nine months of the year, the Los Angeles air is laden with floating dust and chemically-active hydrocarbons. Rains and dampness turn the mixture into a dirty mess on many buildings. Surface friction, gravity, porosity, high winds, bright sun and erratic drying all work together to create ugly patterns and stains.

But this building stays clean. Reason? 1210 gallons of Chemstop masonry waterproofing. Chemstop goes on with a low-pressure spray. It is not a coating, but penetrates beneath the surface to provide long-lasting protection against moisture, moisture-borne dirt, freezing and thawing. Because Chemstop is non-silicone, you can paint it, stain it - or, because it's clear and non-yellowing, just leave it alone. It works beautifully on all masonry. For additional information on six Chemstop waterproofing and stain products, contact Chemstop Manufacturing Corp., 2928 Empire Avenue, Burbank, Calif. 91504. Chemstop products are available from distributors and dealers throughout the U.S. and Canada. Eastern and Mid-western states marketed through Tamms Industries Co., 8000 W. Joliet Rd., Lyons, Illinois 60534.

34-story Equitable Plaza, located at 3435 Wilshire Boulevard in Los Angeles. ARCHITECT: Welton Becket & Associates, Los Angeles. The building's 2,632 precast aggregate panels were produced and spray-treated with Chemstop masonry waterproofing before installation by Rockwin Prestressed Concrete Corporation of Santa Fe Springs, California.





# The Future of Specifications Writing—Part II

This is the second of a two-part article by Harold J. Rosen, Chief Specifications Writer for Skidmore, Owings & Merrill, New York City. Part I appeared in the September issue.

It seems that several areas must be pursued simultaneously in order to bring about an improvement in the production of quality specifications. No concerted effort has been made to encourage and develop the teaching of specifications writing at the undergraduate level. Few schools of architecture have courses in the science of building materials that are utilized in construction. The AIA has sponsored a program for the professional development of practicing architects through a series of seminars that include a one or two day workshop on specifications writing. Several CSI chapters and several universities are engaged in offering short seminars on specifications writing principles on the continuing educational level. These areas should be augmented to bring about a more enlarged body of individuals who will be competent in this sphere of professional ability. At this moment, other than at the New York Chapter of CSI, there is no course in materials that is given at the undergraduate level or at the continuing education level that is comprehensive in its scope or in its presentation.

It is quite apparent that a major effort must be brought to bear upon the schools of architecture as well as on the professions to encourage the development of new courses of study to prepare individuals in the fundamentals of specifications writing and in the science of building materials.

There is also a short term approach that might be used to bridge the gap until additional specifications writers are created and can support the need. That is to create master specifications, as the AIA is preparing to do now, and to utilize the computer to help in the production of project specifications.

The goal is simply stated, but its implementation is much more difficult. How can a small group of specifications consultants evolve a master specifications that will suit the requirements and demands of a rather large segment of the architectural profession? Certainly not all prospective users of this service will find all things to their liking. However, if the user exercises some judgment he will be able to tailor the master specifications to his needs. Even if he cannot utilize 100 per cent of the AIA master, he will still have something to work with. Not only will the master specifications require many options for a user to select from, but also it will require instructions to the draftsman to include certain information on the drawings, and to the individual who is editing the master, since he may not be a specifications writer to choose the right options or to fill in some pertinent information. Obviously a well documented master specifications and a computer program for its mechanical production will reduce the time to be spent by an individual in the preparation of a project specifications, so that he can concentrate on those areas of the specifications only that are peculiar to the project and are not necessarily covered by the master specifications.

It may be possible for sub-professionals to be utilized in the preparation of project specifications from masters written by professional specifications writers. It might be worthwhile to explore the possibility of utilizing the two-year community colleges as a vehicle for the creation of a sub-professional program in specifications writing. If this can be achieved through the creation of a specially designed curriculum, then these persons could be taught how to utilize and edit master specifications for project specifications.

However, the specifications writer of yesterday, with glue pot and scissors, will have to be replaced by a materials analyst of the future. The growing increase in manmade materials, the advances in metallurgy, and the advent of systems design and construction will necessitate the creation of a specialist on the design team who is versed in the science of materials, in the interrelationship of components, and in the techniques of construction. Such an individual will require an undergraduate degree with emphasis on basic elements of chemistry, physics, metallurgy, laboratory testing procedures, and a comprehensive course in materials utilized in building construction. By taking advantage of the computer and by proper programming, the professional materials analyst will be able to prepare master specifications. These masters will then be edited by the sub-professional who has had a two-year community college course in principles of specifications writing and other ancillary courses of sufficient scope to render this service.

Major changes in the development of properly qualified individuals must be undertaken if the needs of the profession are to be met. If specifications are not to be broken by manufacturers and contractors, they will have to be prepared by individuals who are equal to the task. For too long the professions have neglected this vital area which is reflected in increased number of cases of errors and omissions. Only the profession and the schools of architecture can remedy the situation. WALK JONES/MAH & JONES, INC., architects • HENRY C. DONNELLY, mechanical engineer • S & W CONSTRUCTION CO., general contractor GEORGE WILSON & CO., plumbing contractor • CRANE SUPPLY COMPANY, plumbing wholesaler • CRANE COMPANY, fixture manufacturer



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# **Architect's Certificate of Payment**

P/A's legal team discusses a recent case in which a general contractor refused payment to a subcontractor on the grounds the architect had also failed to approve such payment.

One of the duties of a supervising architect or engineer is to approve payments to contractors and to issue certificates of payment. Occasionally, the contract documents provide for approval by the architect of payments by contractors to subcontractors. The legal consequence of the issuance by the architect of a certificate of payment, or his refusal to certify payment, is often a subject of controversy. Many states – Indiana is one — do not accept a determination of an architect as binding upon the parties concerned on the ground that the courts may not be ousted of jurisdiction. Decisions in other states hold that an architect's certificate will be binding in the absence of fraud or collusion.

The Court of Appeals of New York, the highest court of the state, has recently considered this subject in the case of Arc Electrical Construction Co., Inc., vs. George A. Fuller Co., Inc., 24 NY 2d 99. The plaintiff in this case was the electrical subcontractor for the construction of a sugar refinery. It had instituted action against the general contractor, contending that it had not been paid for work performed. The contract between the contractor and subcontractor provided for two different methods of determining payments to the subcontractor. Article XXXI of the contract provided for regular monthly progress payments in the amount of 90 per cent of the sum payable to the subcontractor for work performed during the preceding month, with the balance of the 10 per cent to be retained pending completion of the project. In order to be eligible for a monthly progress payment, the electrical subcontractor was required to submit a requisition to be approved by the contractor and by the architect. The other method of payment was set forth in Article XXXIII of the contract, which provided, in the event the contractor terminated the subcontractor prior to completion, that the subcontractor was to be paid the entire amount due at the time of termination. This provision did not contain any requirement for the architect's approval.

The first eight requisitions submitted by the subcontractor totaling about \$1,400,000 were approved by the contractor and by the architect, and were paid. The next five requisitions, although approved by the contractor's project manager, were not approved by the architect and the subcontractor did not receive any payments on account for these requisitions. Prior to the completion of the work, the contractor terminated the contract of the subcontractor and the latter instituted suit to recover the sums reflected in the unpaid requisitions, together with the 10 per cent retainage that had been withheld from prior payments.

It was the contention of the general contractor that, in the absence of the architect's approval, he was not required to pay the subcontractor, and that the requirement in Article XXXI calling for the architect's approval must be read into the provisions of Article XXXIII in respect to the fee payable upon the termination of the subcontract. The general contractor further argued that if the architect was withholding approval of the subcontractor's work for defective work, the subcontractor should not be entitled to receive payment in full, because the subcontract was terminated. The trial court ruled in favor of the subcontractor, concluding that the architect's approval was not a condition of payment. Upon appeal, this judgment was affirmed.

The Court of Appeals ruled that if the architect failed to approve a progress payment for the electrical subcontractor, the subcontractor was still in the position to make any changes or corrections that were necessary. However, concluded the Court, once the contract is terminated, the subcontractor is not in the position to cure any defects, and therefore it is reasonable to construe the contract as entitling the subcontractor to payment for all work performed, even without the architect's approval.

The Court further asserted that if Article XXXIII had specifically contained a requirement providing for the architect's approval of payment to the subcontractor upon termination of his contract, it would not be enforcable. The Court stated that it was the general contractor's own act of terminating the subcontract that rendered it impossible for the subcontractor to take the steps to satisfy the architect. "The law looks with disfavor," said the Court, "on contractual provisions that would allow one party. by its own unilateral act, to avoid its obligations by preventing or hindering the other party from fulfilling one of the conditions to the contract."

The Court further held that there was no showing of any defect of performance on the part of the subcontractor that could have justified the architect's failure to approve its request. The applicable rule, the Court said, was that, if the work were substantially and satisfactorily performed, the refusal of the architect to issue a certificate of payment was unreasonable and therefore would not bar payment.



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# **BOOK REVIEWS**

# Pevsner's Progress

### **BY LEONARD K. EATON**

STUDIES IN ART, ARCHITEC-TURE AND DESIGN by Nikolaus Pevsner. Walker & Co. New York. 544 pp., illust., \$30. The reviewer is Professor of Architecture at the University of Michigan (Ann Arbor).

"As an inveterate reader of book reviews," writes Professor Nikolaus Pevsner, "I know that books of essays collected years after they have been written get almost without exception a bad press. The reasons are not far to seek. Try as hard as he may, the author cannot perfectly blend into a whole what had been written over a period of many years and for a variety of purposes." Professor Pevsner, however, need have no fears about the reception of these two well-illustrated, handsomely produced volumes. They are outstanding contributions from one who has contributed as much to the history of architecture as any man of his generation, as well as revealing commentaries on the development of an exceptional career. They might, indeed, be subtitled "Pevsner's Progress."

The first volume, From Mannerism to Romanticism, begins with three welcome translations of essays on 16th- and 17th-Century painting that can be characterized as neo-Wolfflinin in approach. They reveal the author's early interest in defining the concept of mannerism, a problem that he also treated in its purely architectural manifestations.

When Pevsner moved to England in 1930, he began investigating the development of English art, a subject that had hitherto received little attention from continental art historians. His studies ultimately flowered in a delightful book entitled The Englishness of English Art (London, 1965), originally delivered as the Reith lectures for the B.B.C. The essays in Part Two of the first volume on "Romanticism and Classicism," which seem to be a byproduct of these studies, deal with such topics as "The Genesis of the Picturesque," "Uvedale Price," and "Humphrey Repton." The pair on "The Doric Revival," and "The Egyptian Revival" were written in collaboration with S. Lang. Perhaps the most interesting aspect of the entire series is what Pevsner himself calls "the shedding of abracadabra." Since he was writing largely for readers of the Architectural Review, he was able to drop the scholarly apparatus required for such journals as the Repertorium für Kunstwissenschaft and the Wiener Jahrbuch für Kunstgeschichte. That this was done without loss of scholarly integrity is a major accomplishment. He also learned to write a decisive and supple English, a skill all too rare among art historians of any nationality. Although none of the essays pretends to offer a definitive statement of its topics, all contribute excellent insights.

The second volume. "Victorian and After," will probably be of greater interest to readers of this journal. Peysner was, of course. one of the first to treat Victorian art and architecture seriously, and the first few essays deal with such topics as "High Victorian Design," "William Morris and Architecture," and "Art Furniture of the 1870's." Two of the most noteworthy ventures into the late 19th Century are biographical sketches of Arthur H. Mackmurdo and Charles F. Annesley Voysey. These pieces are particularly valuable, since material on Mackmurdo and Voysey is generally buried in rather inaccessible places. The only other recent work on Voysey, for example, is John Brandon Jones' article in the Journal of the Architectural Association (1957, pp. 239-262), and yet all the evidence indicates that he was one of the truly significant innovators of 20th-Century design. His importance was recognized by Herman Muthesius in his comprehensive Das Englische Haus (Berlin, 1908), and he may very well have been one of the

very few European designers to have influenced the early work of Frank Lloyd Wright. Although Voysey's best houses of about 1900 display an astonishing purity of line, he was less a revolutionary than, as Pevsner remarks, "an intrepid innovator." He felt himself deeply grounded in English tradition and, in an interview with Pevsner in 1939, near the end of his life, expressed great reservations about the directions being taken by contemporary work.

Pevsner's profound concern with 20th-century design problems is equally revealed in an affectionate tribute to the late Frank Pick, guiding genius of the London Passenger Transport Board and a close personal acquaintance. Pevsner admits some dictatorial qualities in Pick's nature but argues that he was "... the greatest patron of the arts whom this century has so far produced in England, and indeed the ideal patron of our age." In view of the increasing importance attached by historians to problems of patronage, sketches of the great architectural patrons on this side of the ocean would be similarly valuable. Who, for example, was responsible for the phenomenally high quality of TVA design during the 1930's? This sort of study is long overdue.

Two sharply critical essays with American references conclude the second volume. The first, a short and highly sensible address given at the opening of the Yale School of Art and Architecture in 1963, remarks in a damning postscript that: "In 1965, Paul Rudolph left to concentrate on private practice, leaving his school, designed to fit him and him only, to another head." The other essay on "The Return of Historicism," which was delivered in 1961 before the R.I.B.A., ought to be required reading in all American architectural schools. It provides a most convincing demonstration of the manner in which (Continued on page 218)

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### (Continued from page 210)

contemporary architects have been reviewing the early phases of the Modern Movement. Thus, in a group of startling illustrations (59 in 15 pages), we are confronted with neo-Art Nouveau, neo de Stijl, neo-School of Amsterdam, and, perhaps most amazingly, neo-Gaudí. Although he admits that a revolt against the formal rigidity and the uniformity of the 1930's was inevitable, Pevsner argues against strange and eccentric exterior effects. "The answer," he says, "lies in planning, in siting, in landscaping, and so on. The individual building must remain rational. If you keep your buildings square, you are not therefore necessarily a square."

These two volumes are related to the totality of Pevsner's work as is the visible portion of an iceberg to its total bulk. Several important pieces have been omitted that should certainly be included in future collections. Although, for example, a fair amount of work has been done on the subject since it was published, the 1938 essay on "Frank Lloyd Wright's Peaceful Penetration of Europe" (Architect's Journal, May 4, 1939) is still valuable. So, too, is the essay on "Humphrey Repton: Florilegium" in the Architectural Review (February 1948, pp. 53– 59).

A combination of deep humanity and sound scholarship characterizes everything that Pevsner writes. He should have no fears about the reception of these two fine books but should proceed to the collection and editing of his other occasional works.

# Bauhaus Graphics and De Stijl Polemics BY STANLEY ABERCROMBIE

GRAPHIC WORK FROM THE BAUHAUS. By Hans M. Wingler. New York Graphic Society, Ltd., Greenwich, Conn., 1969. 168 pp., illust., \$12.50. PRINCIPLES OF NEO-PLASTIC ART. By Theo van Doesburg. New York Graphic Society, Ltd., Greenwich, Conn., 1968. 73 pp., illust., \$7.50. The reviewer is a senior designer with John Carl Warnecke & Associates, and is a registered architect in New York State.

On March 20, fifty years ago, the Staatliches Bauhaus Weimar was founded; on April 1, Gropius was appointed its director; six months later, the graphic printing shop was opened. Now, the New York Graphic Society has published Graphic Work from the Bauhaus and republished the sixth book in the fourteen-book Bauhausbucher series (1925–1930), Theo van Doesburg's Principles of Neo-Plastic Art.

Graphic Work from the Bauhaus, primarily a picture book, is edited by Hans M. Wingler, author of the comprehensive Das Bauhaus (English edition, Cambridge, Mass., 1968). The book is interesting and worthwhile as far as it goes, but could be a disappointment to anyone misled by the title into expecting a general survey of Bauhaus graphic work. Missing, for example, is the first item of such work, Feininger's

(Continued on page 222)

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(Continued from page 218) woodcut for Gropius' First Proclamation. Ignored are the typographical designs of Johannes Itten and Moholy-Nagy, the photograms and photomontages, the use of letters and numerals as abstract design elements divorced from their denotative meanings, the experimental use of graphics in exhibition technique, the posters, postcards, birthday cards, banknotes, book jackets, and magazine covers, Oskar Schlemmer's costume and stage-set designs, the elimination in Herbert Baver's typography workshop first of serifs, then of upper-case letters (a more radical step in German, of course, than in English). Missing is any work of the Bauhaus students.

What the book presents instead, and presents thoroughly, are the five portfolios of prints titled *New European Graphics* printed at the Bauhaus between 1921 and 1924. The emphasis, therefore, is on work actually printed in the Bauhaus workshop, even though the work of non-Bauhaus artists, rather than on Bauhaus work, much of which was printed elsewhere.

The New European Graphics were conceived to earn money for the school (the contributors were not paid) and to demonstrate the strength of support of the Bauhaus among unaffiliated artists. The former aim was unfulfilled because of the runaway inflation Germany suffered at the time; the latter aim, we assume, was greatly successful, for the series included prints by almost every artist of the time whose reputation remains bright (the most obvious exceptions being Picasso, Braque, Matisse, and Mondrian, who were not included). The catholicity of the portfolios also speaks eloquently for the breadth of interest by the Bauhaus in the art of its time. As originally planned, the first of the five portfolios was devoted to work of the Bauhaus masters — two prints each by Feininger, Itten Klee, Marcks, Muche, Schlemmer, and Schreyer. The second, originally intended to represent the Latin countries, was devoted instead to French artists and was never completed. The third and fifth portfolios were of non-Bauhaus (Continued on page 232)

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The Springfield Skating Rink, Springfield, Massachusetts

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232 Book Reviews

(Continued from page 222)

German work, and the fourth of Italian and Russian (including a print by Kandinsky, who had not yet joined the Bauhaus). All 56 of the published prints are reproduced, 11 in color, along with the pages of text hand-printed by Feininger for each portfolio and photographs of the portfolio covers designed by Feininger, Klee, Hirschfeld, and Albers. Descriptions of relevant documents and brief biographies of all the participating artists and craftsmen are included.

The van Doesburg volume is an interesting one to consider together with the book devoted to the Bauhaus portfolios, for van Doesburg is one of the prominent artists of the time omitted from them, a fact that brings to mind his puzzling relationship to the School. He was certainly attracted by the activity there, and moved to Weimar in 1921, where he was invited to lecture, but not teach. He found the Bauhaus students under the spell of Itten's mystical teachings and emphasis on intuition, whereas he felt, as he wrote in 1923, that "The new spirit . . . is opposed to animal spontaneity (lyricism), to nature's domination, to artistic flummery and cookery." He must certainly have regarded as "cookery" the curious and intricately handcrafted house of logs designed by Gropius in 1921 for the timber merchant Adolf Sommerfeld. Championing what he called "the mechanical aesthetic" in contrast to handicraft, van Doesburg was even driven, in his magazine de stijl, to call the Bauhaus "a parody of the new creativity."

The effect on the Bauhaus of van Doesburg's agitation has been the subject of much speculation, both by van Doesburg and by others. Certainly around 1923, the Bauhaus did turn from expressionism to the classicism of asymmetrical elements for which it is now famous. Van Doesburg was probably less the cause of this shift of emphasis, however, than was his friend Moholy-Nagy, who replaced Itten. Probably most important of all was the guiding master Gropius himself, whose Fagus Factory and Werkbund Exhibition, years earlier than the Sommerfeld house, had demon-(Continued on page 236)



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#### (Continued from page 232)

strated not just sympathy but an originating genius for the "mechanical aesthetic."

It is obvious, at least, that Gropius was broad-minded enough to publish van Doesburg's book. The substance of the book is a justification of abstract art in general and of de Stijl in particular, exemplified in the statement that "The aesthetic value of a work of art depends upon the degree of distinctness of the aesthetic accents." For van Doesburg, the strict limitations of de Stijl were means to that desired distinctness, while earlier art, combining ethical, emotional, and social experiences with purely aesthetic experiences, was scorned as "preexact."

In addition to van Doesburg's polemic, "dedicated to friends and enemies," the present edition offers a new introduction by Hans Wingler, a postscript by H.L.C. Jaffe, and a color reproduction of van Doesburg's design for the original dust jacket. Best of all, the heart of the book reproduces the original typography and layouts designed by Moholy-Nagy. Reading these pages, with their innovations and bold contrasts of type faces, extreme but fresh, is a delight. The layouts, moreover, demonstrate some of the dynamic Bauhaus creativity we sought in vain in Graphic Work from the Bauhaus.

### A Man of His Own Time

#### BY SANDRA BLUTMAN

CHARLES RENNIE MACKINTOSH. By Robert Macleod. Country Life Books, The Hamlyn Group, Hounslow Road, Felthan, Middlesex, England, 1969. The reviewer is an architectural historian in London, England.

Writing about Mackintosh in 1963, John Summerson pointed out the limited way in which his work has been viewed and his importance assessed since his "discovery" by historians of the modern movement. "It is by virtue of hindsight that we award Mackintosh such a special place in the British architecture of his time, a place which his contemporaries did not award him. It is because we study him in relation to our own prepossessions that we exalt him above nearly all his fellows... it is a limited and possibly even a temporary estimate." Robert Macleod has set himself the task of looking at Mackintosh as a man of his own time, as a great 19th Century architect, and his book enables us to see another aspect of this fascinating and elusive genius.

Last year was the centenary year of Mackintosh's birth. To celebrate this, a large exhibition of drawings, posters, furniture, and other objects designed by Mackintosh and other members of the Glasgow School was organized and shown at the Edinburgh Festival and at the Victoria and Albert Museum, London. No book on Mackintosh has appeared since Thomas Howarth's excellent biography in 1952, Charles Rennie Mackintosh and the Modern Movement. Macleod's book, although by no means all inclusive. is really a long essay that attempts to show Mackintosh in his own historical environment, emerging from the Gothic tradition of men like Pugin and Bodley. He proves that "there is a much more clearly defined Victorian ideological progression than has been generally acknowledged, and that Mackintosh stands clearly within."

Macleod discusses and re-evaluates Mackintosh's major works, including the Glasgow School of Art, the tearooms for Miss Cranston, and the early houses. There are good sections on his later work, particularly the interesting interiors of the house at 78 Derngate, Northampton, designed in 1915 for Basset-Lowke in a sort of early "jazz modern." He also discusses Mackintosh's own writings, which exist in the form of diaries and lecture notes. These are shown to be a paraphrase of Lethaby's philosophy. The book is beautifully written, and a joy to look at as well as to read. The many illustrations are excellent and unusual in their depiction of detail or point of view. The color photographs are remarkable, particularly in a book of such modest price.

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#### (Continued from page 236)

mentioned above, one feels that perhaps Macleod underestimates Margaret Macdonald Mackintosh's talent, which, he claims, Mackintosh must only have appreciated through a "myopia of love." Her work, along with that of the other two members of the group, Herbert McNair and Frances Macdonald, is extremely interesting and would make a rewarding study.

Certainly this new book, more readable if less scholarly than Howarth's indispensable biography. will be appreciated by all those who are fascinated by the work of Mackintosh and by the many aspects of Art Nouveau. Macleod shows us how interesting Mackintosh was as a person — not just as a forerunner of the modern movement.

#### **Books Received**

Greater New York Art Directory. Published by the Center for Urban Education, 105 Madison Ave., New York, N.Y. 314 pp., \$1.00.

New Architectural Drawings, Helmut Jacoby, Frederick A. Praeger. New York. 101 pp., illus., \$14.00.

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DAVID HYUN ASSOCIATES, 240 E. First St., Los Angeles, Calif. 90012.

K & J DESIGNS, interiors and space planning firm, 521 Fifth Ave., New York, N. Y. 10017.

FRED L. LIEBMANN, Architect, 271 Madison Ave., New York, N. Y. 10016.

MAN/TAYLOR/MURET, Landscape Archi-(Continued on page 254)

OCTOBER 1969 P/A

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of high-density living situations. In an enlarged plan, the archi-tects suggested the possibilities of extending the plan, and in-cluded convenient aerial foot bridges to other similar com-plexes, schools and shopping

Given these numerous possibi-Given these numerous possibi-lities, all within the limits of present building techniques, the main point the architects make is that what the urban housing crisis needs most of all is the wherewithal to pursue sound architectural concepts.

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(Continued from page 240) tects and Site Planners, 209-1039 17th Ave., S. W. Calgary 3, Alberta, Canada.

UNTHANK & UNTHANK, Architects, Suite 4, 3100 Building, 3100 "O" St., Lincoln, Neb. 68510.

WARE, LEWIS PARTNERSHIP, Architects, Engineers, Planners, Suite 104A, Building A, 4915 Highway 55 North, Jackson, Miss. 39206.

#### **NEW FIRMS**

BRENT/GOLDMAN ASSOCIATES, Architects, Planners and Interior Designers, 447 So. Robertson Boulevard, Beverly Hills, Calif.

CAMPBELL & ROCCHIA & ASSOCIATES, Architects and Interior Planners, 198 Francisco St., San Francisco, Calif. 94133.

G. KENT HAWKS, Architect, 333 Old Tarrytown Rd., White Plains, N. Y. 10603.

HAYES, SMITH, TROCKEY & BLAIR, Architects and Planners, 70 Broadway, San Francisco, Calif.

KIDD & WHEELER, Architects, 30 Church St., Birmingham, Ala. 35213.

KLING-LEOPOLD, INC. (merger of Vincent G. KLING & ASSOCIATES, Architects, and CHARLES S. LEOPOLD, INC., mechanical and electrical engineers) 1401 Arch St., Philadelphia, Pa.

LANIER, SHERRILL & BOURG, Architects and Planners, 149 Natoma St., San Francisco, California. Joseph L. Bourg has become a partner.

ARTHUR L. PEREIRA, Architect, 5514 Wilshire Boulevard, Los Angeles, Calif.

POD, LANDSCAPE ARCHITECTS, 34 Plaza Square, Orange, Calif. 92666.

QUENELL/GAFFNEY, Landscape Architects and Architects, 946 Massachusetts Ave., Cambridge, Mass. 02139.

#### **NEW PARTNERS, ASSOCIATES**

BURKE, KOBER, NICOLAIS & ARCHU-LETA, Los Angeles-based architectural and engineering firm, have named five associates: JON ADAMS JERDE, IRVING RECTOR, MELVIN MAHLER, IMMANUEL VORRATH and ALAN SCHLATER.

DE KANTER & HOLGATE, Architects, Portland, Ore., have added three associate partners: JAMES W. HOGUE, GARY L. MORRIS and ROBERT W. SHAW.

FLETCHER-THOMPSON, INC., Architects and Engineers, Bridgeport, Conn., have promoted 12 to Associates: EVERETT C. (Continued on page 266)
# Robertshaw research tackles rising installation and servicing costs







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