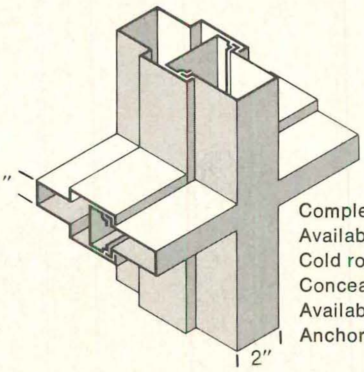
Progressive Architecture

September 1973 A Reinhold publication

Lighting design



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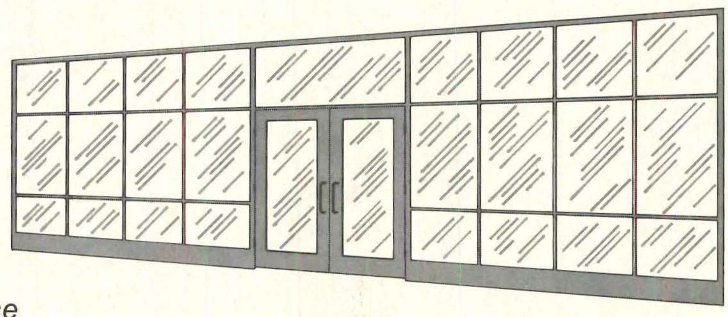

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ABP

September 1973

Progressive Architecture

Lighting design, as viewed by the designers, some engineers and an MD

Departments

Cover: Spotlight on an architectural vision by Giuseppe Galli Bibiena (1696–1756). For a reproduction of this engraving to view under more uniform lighting conditions, see *Architectural and Perspective Designs* by Bibiena (Dover Publications, Inc., New York, 1964).
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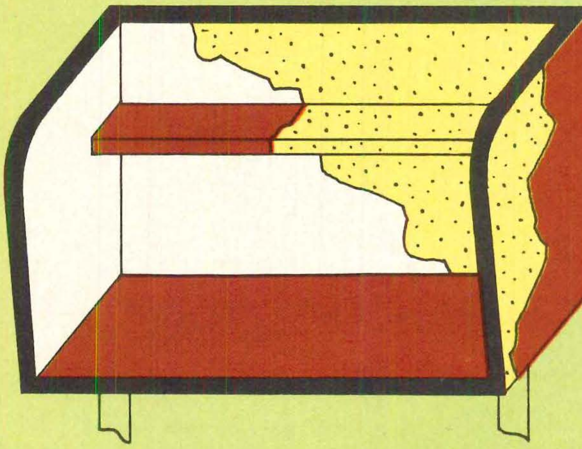

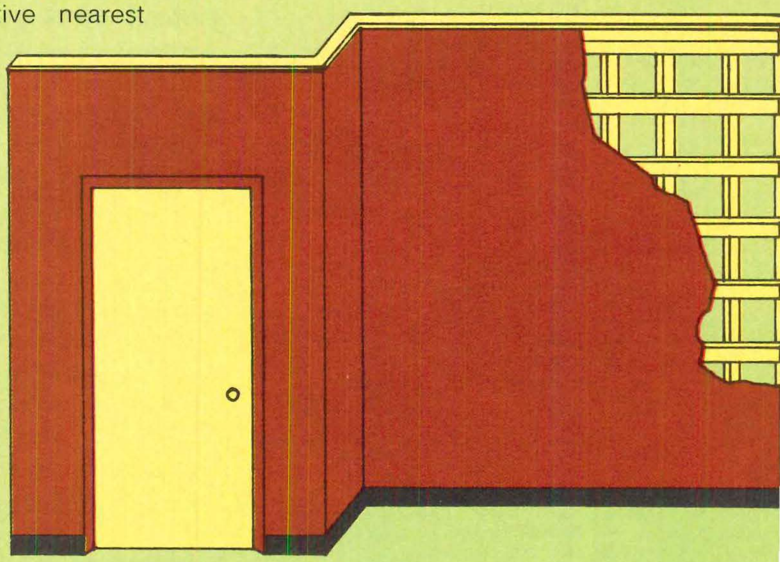

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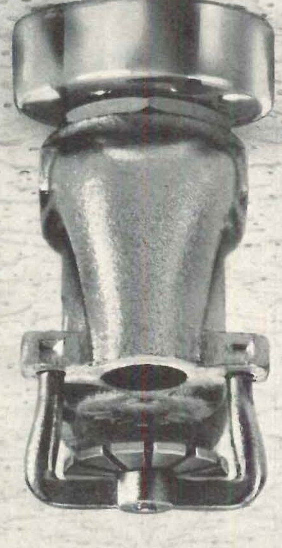

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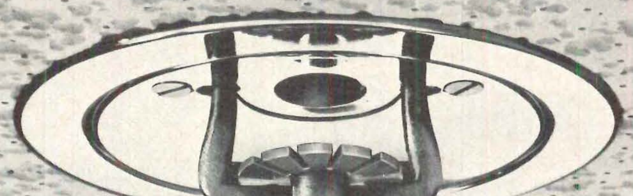

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s from readers

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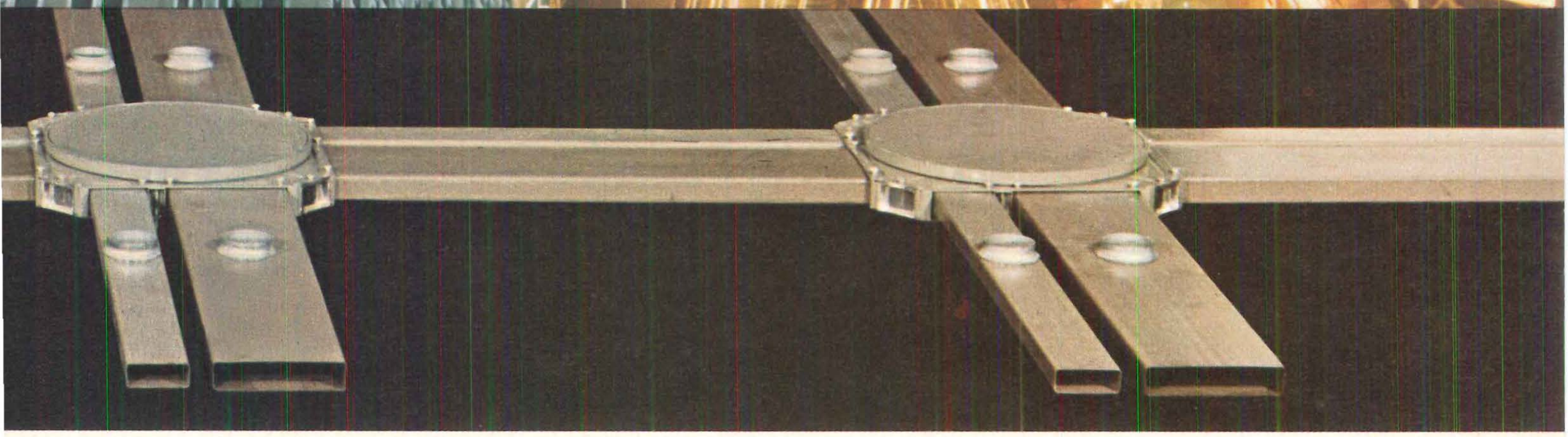
ng costs
ly I do not comment on magazine ar- but "Building costs: myths and reali- n July needs great praise because it lown to facts that are greatly needed an be used. Let's hear more from Mr. n and others with usable facts for our ssion.
Cantwell
land Hills, Calif.

owen's recent article "Building costs: and realities" was excellent. It out- n concise terms what we also feel to basic direction that should be pur- n the development of meaningful nformation.
ord Perkins
e-Berger-Mansueto, Inc.
York, N.Y.

ratulations for commencing a needed am, the Building Cost File series. This uction may well trigger a reaction r to the great specification format de- of a decade or so ago.
stop at only presenting a frame- What is impressive about this initial avor and its proposed format, in addi- the obvious relationship to design, openendedness to accommodate a and correlated format for *outline* ications. These are now required by governmental agencies and corpora- and are provided by many firms as ther documents" referred to in the ard AIA agreement between owner rchitect for the schematic design and n development phases of the archi- basic services as defined in this ment.
ddition, your basic numerical index, posed to the alphanumeric one of the lian Institute of Quantity Surveyors JNY, can be readily adaptable to uter data base management systems. al significant considerations are ble to you in the possible develop- and marketing of collateral items of e to the architect. Consider expand- Building Cost File to include an an- d "Elemental" or "Systems" outline cation of each list *and* its unit cost t an integrated information system
ued on page 11]

Circle No. 373, on Reader Service Card →

If you've only been to the Statue of Liberty, Empire State Building and Times Square, you don't know where it's at in New York.



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Views continued from page 7

may become an indispensable cross-referenced resource and tool for project cost control. . . .

The concept you have developed thus far can become the nucleus of a larger system and a more powerful design tool than just the Building Cost File alone. Please don't curtail its potential. What you have started is too viable to stop here. Good luck on this new venture; it has been long overdue.

Denis Charles Schmiedeke, AIA
Ypsilanti, Mich.

Another Pruitt-Igoe?

Your coverage of the Scattered Site Housing Project in Ithaca, N.Y. (May 1973) was disturbing to us. In our opinion, the development is inconsistent with the fabric of Ithaca. The relationship between project and town is forced in much the same way as the huge Pruitt-Igoe project was forced into the city of St. Louis. The intent (we thought) of the Scattered Site Housing Program was to find scattered locations for low-income housing developments of very few units. Such would more readily be absorbed into a community than a development containing 235 dwelling units. Mr. Liebman of the New York State Urban Development Corporation has, according to your report, been hiring good architects in order to do a good job. However, his formula for achieving a good job is mainly based on return on investment. Similar economic parameters were employed in the Pruitt-Igoe project which is known as a colossal failure. You may remember that Pruitt-Igoe was designed by talented people who also had to yield to economic pressure.

You noted in your article some of the amenities of the development, which had to be deleted due to budget limitations. Mr. Liebman eliminated the Central East-West Connection, the Playground, the Lawn-Picnic Area and other things originally planned until the "Project" fit the dollars which had been pre-allocated for the predetermined number of dwelling units per acre. Instead of the amenities, why not eliminate a few dwelling units and make the project more attractive from a living standpoint? It is sad to see that we have not become more sophisticated in dealing with the planning of living accommodations for families of low income.

Nowhere in the article did we note any reference to consultants in the fields of sociology, interior space planning, or landscape design. Each of these disciplines seem to us to be capable of providing important inputs into the planning of a living environment. Further, we question if the State of New York or any other state, is the right group to plan low-income housing.

Maybe we could see to it that the low-income families had a few more dollars to spend so that they might be given an opportunity to make a decision as to where they would prefer to live and how they might prefer to live.

Then again, there is the question of the architecture. The Ithaca project may be criticized as a billboard on the hillside which points out the stigma of being poor—but that's another story.

Ron and Carolyn Nuetzel
St. Louis, Mo.

The architect replies

It is inconceivable to me that anyone could compare Pruitt-Igoe and the Elm Street project. The factors that caused the disaster in Pruitt-Igoe are so complex that it is rather presumptuous of the letter writer to arrive at conclusions that provide a basis for useful criticism, particularly when one surmises that the correspondents are not familiar with the location of the Ithaca project or its context. The solution was definitely not a thoughtless and arbitrary imposition on Ithaca. The generating ideas for the solution derive from the unique conditions of the site and the particular hillside features of Cornell, Ithaca College, the Morse Chain factory, the old GLF offices, and the physical aspects of the Elmira valley. In respect to site coverage, though the actual boundaries of the site are shown on the site plan, the property includes in addition, a beautiful parcel of City of Ithaca property at the northeast end of the site that remains as a natural park. The planted slope at the bottom of the hill will remain and provide a green buffer to the plain of the City of Ithaca proper. At the bottom of the hill is the Cayuga inlet which will be extensively landscaped. It is obvious that no two sets of conditions could be more dissimilar than Pruitt-Igoe and Elm Street.

The title, Scattered Site Housing, is perhaps a misnomer, though the project consisted originally of three sites, of which one had to be abandoned because of poor soil conditions. The second site, on Maple Ave., is being completed at this time. The two sites are on opposite hills and can be seen from each other. It is hard to believe that there are more attractive sites any-

[continued on page 14]


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Views continued from page 11

where that have been used for middle-income housing, and with as much benefit of both proximity to the city and idyllic landscape setting. Never was the Ithaca housing thought of as housing for any particular class of people, but only in terms of providing a beautiful place to live.

It seems arrogant for the correspondents to assume knowledge of the motive of building the project. That it is not truly a philanthropic project, however, is obvious, though very few projects have received as much personal attention from the owner as has Elm St. The owner is managing the project and has taken a very personal interest in the well-being of the tenants by providing special educational programs, supervision of small children and other socially directed advantages.

The information about the deletion of the amenities is incorrect. The playground, including a play shelter, an amphitheater and water play, as well as another area with active play equipment, is under construction. Furthermore, a basketball area and picnic paraphernalia are included in this contract. It might be of interest to know that the owner and my office are planning an opening day with a variety of activities for the tenants, upon completion of the central play area.

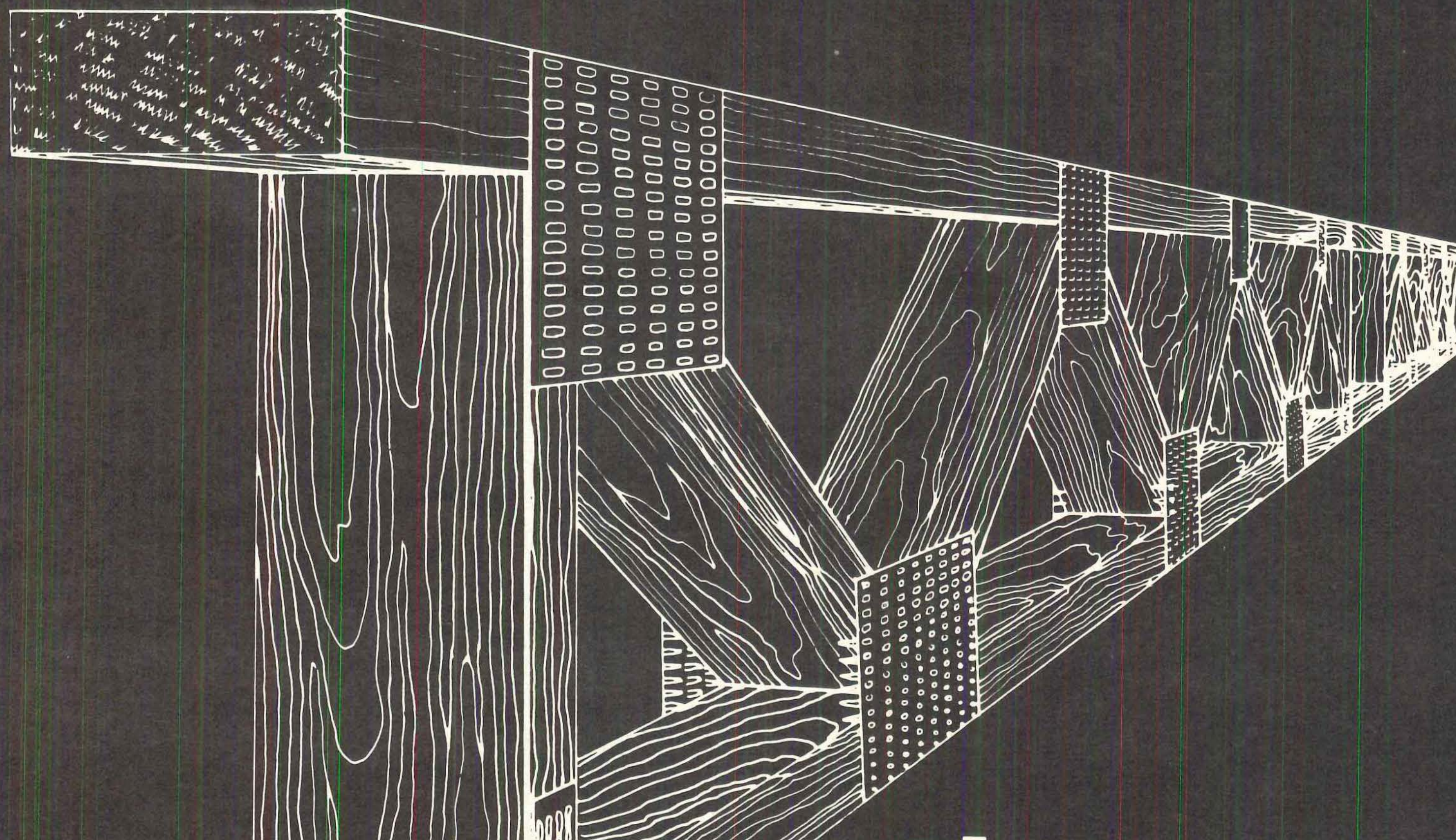
The east-west connection described in the article must mean the north-south connection. This was originally a lane for garbage and fire trucks only. The Citizen's Advisory Committee, however, demanded that this be made into a parking lot to limit the distance from car to front door to circa 75 ft maximum. However, much of the landscaping has been retained.

While we did not engage a sociologist or interior space planner for the project, the design underwent considerable scrutiny in these areas from the staff of UDC, which has expertise in these areas.

Credit to the landscape architect, Harold Schumm & Associates, was omitted from the article.

As my last comment, I would like to present two photographs of Neubuehl in Switzerland as published in 1929 without greenery, and as it exists today with mature planting. Nobody would have thought in 1929, on seeing the published pictures, that it would become one of the truly fine places to live. Perhaps Elm Street has a chance.

Werner Seligmann
Courtland, N.Y.



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In senior citizens housing

Conventional, steel-framed high-rise apartment "beats" HUD guidelines by $100,000.

Owner: Manchester Housing Authority; architect: Isaak, Moyer Walsh & Dudley; structural engineer: Albert Goldberg & Associates, Inc.; fabricator: Lyons Iron Works, Inc.; erector: Concrete Erectors, Inc.; general contractor: Davison Construction Company, Inc.

Generally speaking, Pariseau Apartments in Manchester, New Hampshire, is a plain, ordinary apartment building. The high-rise residential home provides low-rent housing for the elderly. Its construction was federally funded under The Housing and Urban Development program.

What makes the structure distinctive is the fact that it was built within the budget. None of the construction principals could think of another HUD structure in their area with a similar budget record. They lauded the fact that the building was constructed using conventional contracting methods as opposed to the more common "turnkey" method.

$100,000 within HUD guidelines

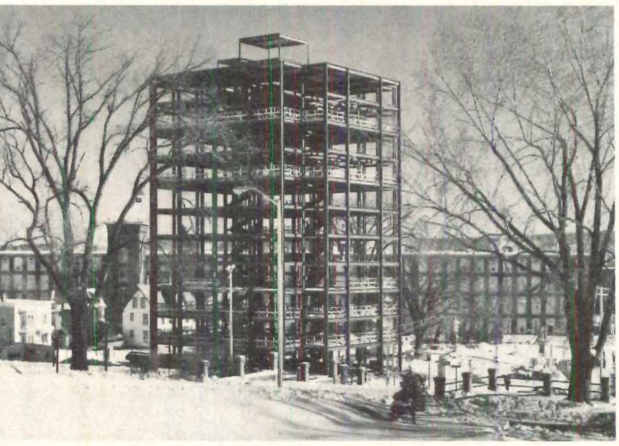
Said the architect, "all the others were 'turnkey' projects. This was one of the first HUD high-rise projects to be handled by a conventional contracting method that comes well within the budget. We estimate that we stayed within the HUD guidelines by more than $100,000. We accepted a challenge" he said, "and decided on the most economical, practical design."

The Housing Authority home for the elderly is part of a larger $3.5-million development known as the Flatiron Urban Renewal Project located on 21.6 acres in Manchester. Pariseau Apartments occupies 1.7 acres in the project. The structure incorporates 100 apartments surrounding a central core flanked by two stairways. There are 58 efficiency (studio-type) apartments in the building, 41 one-bedroom apartments, and 1 two-bedroom unit.

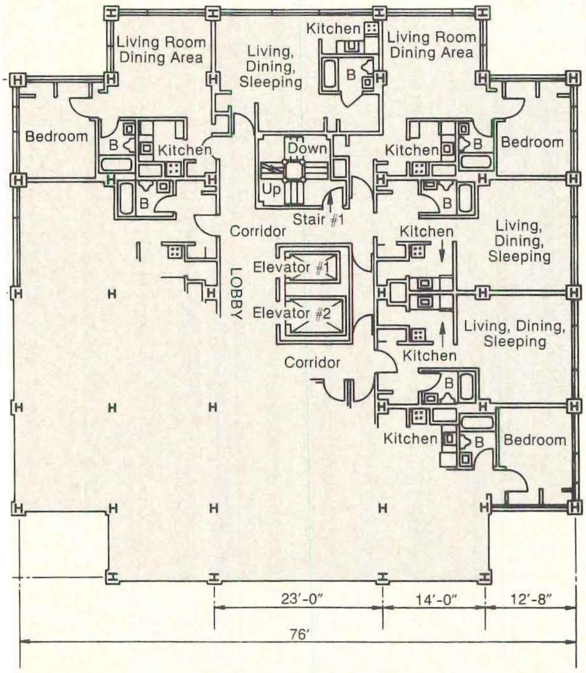
The 11-story structure measures 76 by 79 ft. Floor to floor heights are as follows: ground floor—12 ft; floors 2 through 11—9 ft, 8 in.; floor to ceiling height is typica 8 ft. The structure encompasses 61,548 sq ft. Ove costs are $2 million, but the basic construction costs $1,787,800, about $29.00 per sq ft.

Explains housing director Paul Lamie, "HUD allov prototype costs, and we came within the limitatio These limitations varied per unit. This is a good b building with no frills."

Steel framework required approximately 310 tons of structural teel—all Bethlehem, and all ASTM A36. A single crane erected the framework operating from one side of the building. Typical columns in the framing system are W16 members ranging from 96 to 31 plf. Three- and 4-story columns were used. The long columns helped speed the overall project. Their use meant that ver floors could be turned over faster to the other building trades.



On a typical floor, girders are W14 sections; tie beams and spandrels are W12 and W14 members. An additional 75 tons of open web steel joists and some 60,000 sq ft of permanent steel orms are included in the building. The 28 gage steel centering, 9/16-in. deep, is used to support the 2-1/2-in. reinforced concrete floor slab. Design live loads are 40 psf for the floors and roof; dead loads are 60 psf.



structure incorporates 100 apartments surrounding a central e flanked by two stairways. There are 58 efficiency idio-type) apartments in the building, 41 one-bedroom irtments, and 1 two-bedroom unit.

Conventional contracting favored over "turnkey"

The apartment building is designed as a rigid frame in both directions and primarily incorporates end-plate moment connections. No vertical bracing is used in the framework. In the opinion of the fabricator, "It's an economical structure—easy to fabricate and erect, with few alignment problems. With the use of end-plate, high-strength (ASTM A325) field-bolted connections, we gained economies over welded column connections.

"In a project like this everyone knows exactly what the costs are," he added. "We can compare 'apples and apples' as opposed to the 'turnkey' type of project where it's conceivable that some costly items may be present which are not essential."

The steel framework required approximately 310 tons of structural steel—all Bethlehem, and all ASTM A36. An additional 75 tons of open web steel joists and some 60,000 sq ft of permanent forms are included in the building. During construction, 28 gage steel centering, 9⁄16-in. deep, was used as a permanent form for the 2½ in. reinforced concrete floor slab.

Although the framing system looks relatively simple, it required a good deal of analysis to evaluate theoretical seismic and wind forces, especially in relation to the end connections of the framework and subsequent transmittal of forces to tied spread footings. "The construction site is near the Laurentian Fault," commented the structural engineer, "so the structure is designed for Zone 2 Seismic conditions. The foundation required ties so we used spread footings tied together with reinforced concrete tie beams."

Benefits of steel framing praised

The housing director noted that about 80 per cent of his elderly tenants live on social security payments. Rents for public housing are limited to 25 per cent of individuals' incomes. "And that isn't much," commented Lamie. "Lack of funding is a critical problem. In projects like ours, steel framing benefits can provide a meaningful contribution to economy. The time factor is important. Because steel frames go up faster than alternate framing systems, a housing authority can look forward to earlier occupancy."

The Manchester Housing Authority operates 1,396 units including 916 for the elderly and 480 for family and general occupancy. Perhaps steel framing can provide economies for your next construction project. Call your local Bethlehem sales engineer, or write: Bethlehem Steel Corporation, Bethlehem, Pa 18016.

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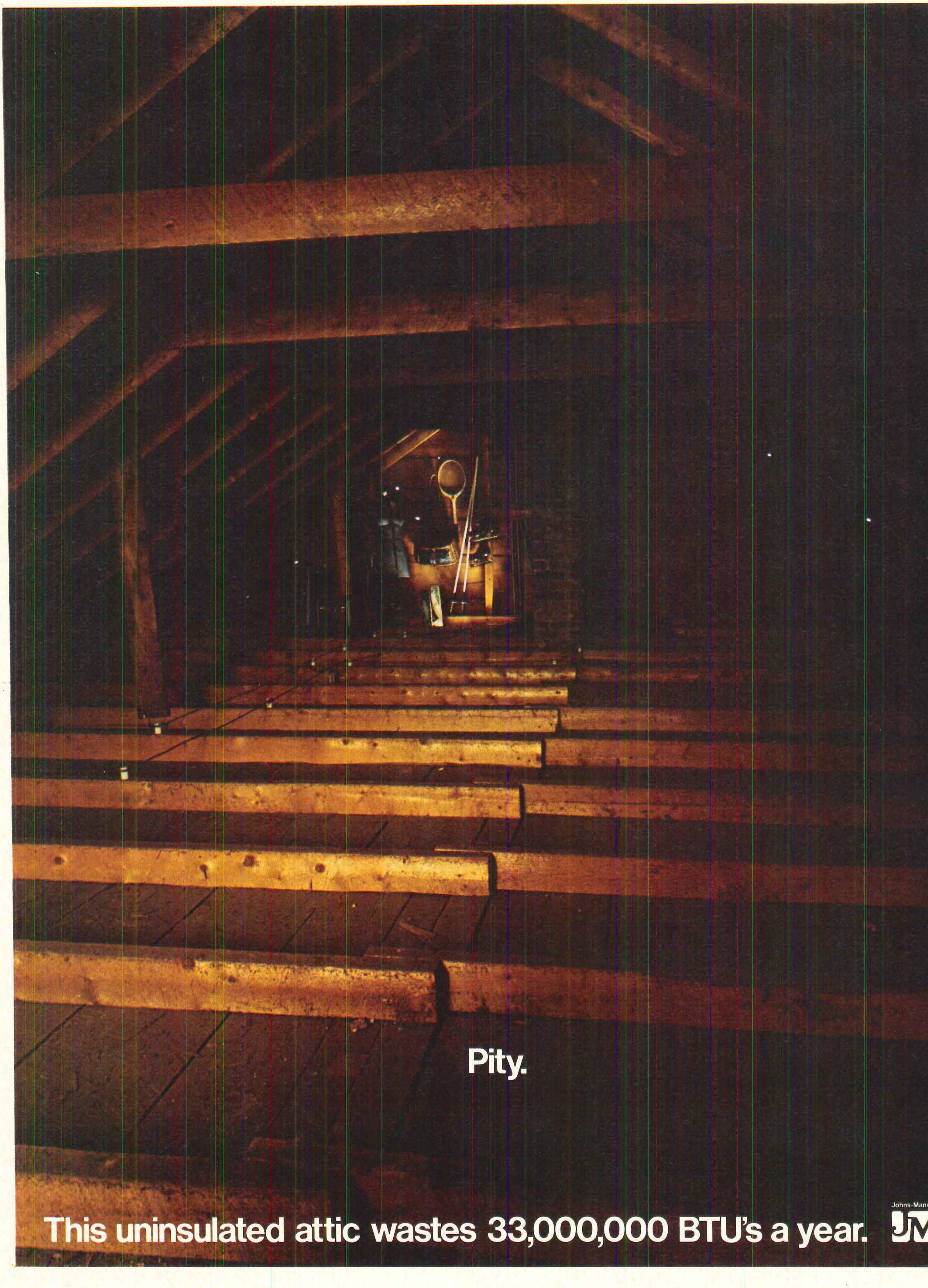
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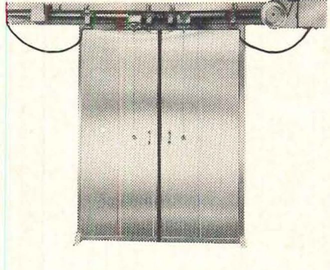

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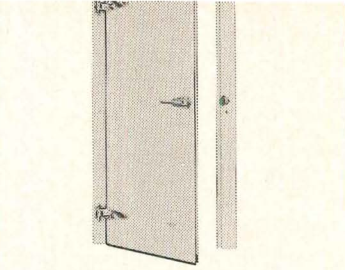

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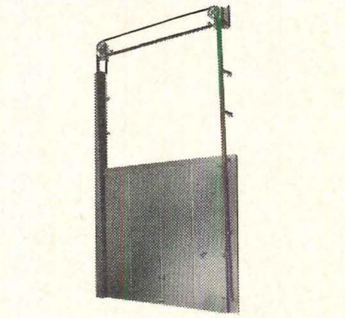

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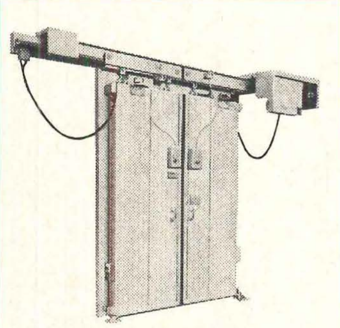

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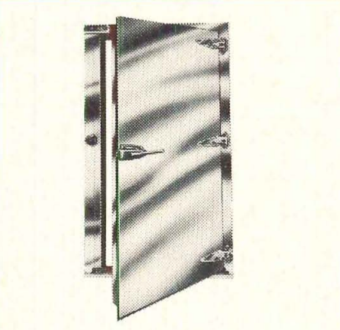

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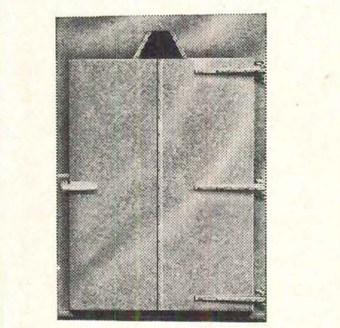

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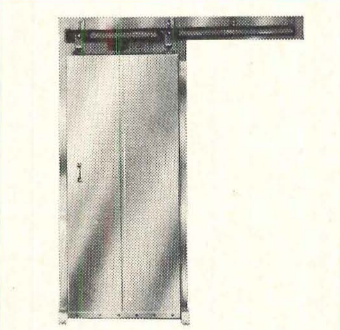

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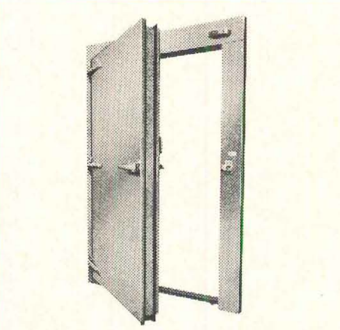

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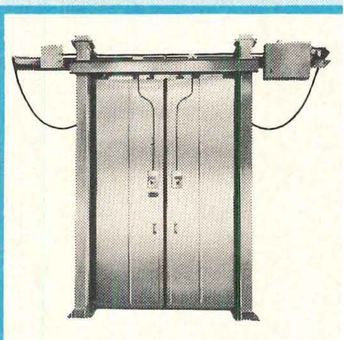

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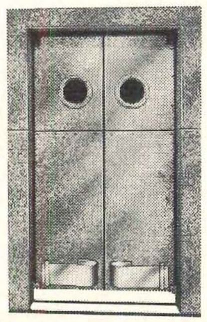

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Contents

News report

Chicago 21: no little plan, indeed

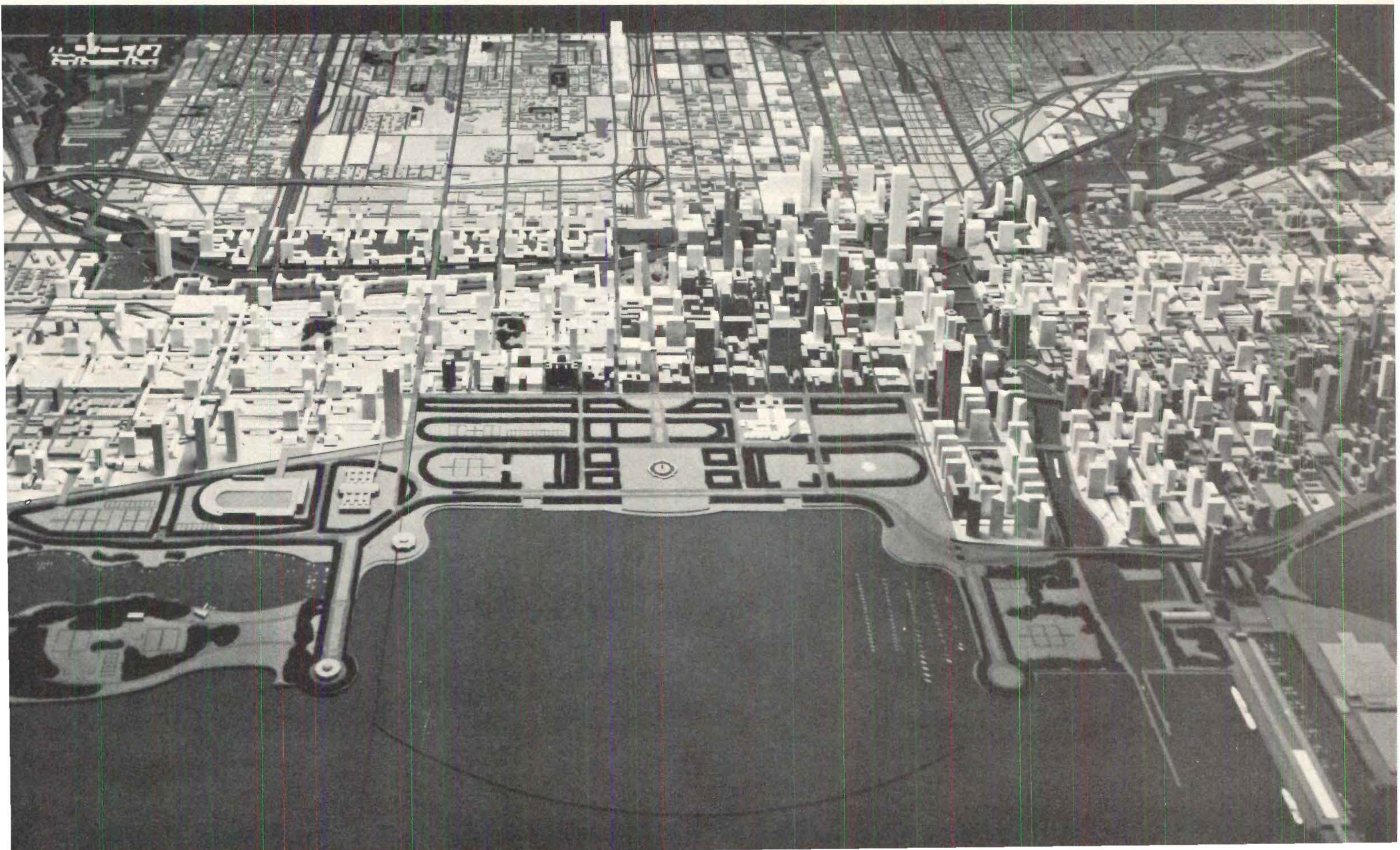
Daniel Burnham would be pleased: Chicago 21, recently unveiled by the Chicago Central Area Committee, is no little plan. Prepared by Skidmore, Owings & Merrill, Chicago 21 focuses on 11 square miles of Windy City real estate, calling for improvements in existing residential neighborhoods and construction of new communities, better transportation systems and more open space.

High priority is given to three projects proposed in the plan. Two of them—a distributor subway to the north, west and south edges of the central business district, linking John Hancock Center, Chicago Circle Campus and McCormick Place, and the Franklin Street Connector, a roadway project—have been part of city planning efforts for some time and are already listed in the current Capital improvement program.

The other high priority item is also one of the more dramatic elements of the new plan. South of the Loop lies 650 acres of unused railroad property; the plan proposes a new town-in-town development that could, by 1985, house 60,000 people, with an eventual maximum population of twice that.

Other highlights of the plan include the limited expansion of the central business district to the south edge of the Loop and across the river to the north and west; improvements in public housing, with one project, Cabrini-Green, serving as a test case in converting apartments to owner-occupied units; continued development of Illinois Center, with 53 of the 83 acres of land being devoted to parks and plazas; replacement
[continued on page 30]

New town (light area, middle left) for area south of Loop is key part of Chicago 21



News report: P/A survey

Lighting rated 'fair' by architects

A P/A survey of architects shows what they think about lighting design, criteria, experience and sources of information, education and the current state of the art

The state of the luminous environment in the U.S. is rated as "fair" by a P/A survey of architect readers, who nevertheless rated their own projects as "good." This rating was consistent throughout the list, whether the respondent's firm relies on in-house designers, in-house engineers, design consultants or consulting engineers. In fact, of the approximately 150 replies, only five rated their own firm's quality below the general level.

Overwhelmingly, they called for better education of architects in perception and lighting criteria, as well as in lighting design itself. The majority felt that an academic center for environmental studies should be established to coordinate research, develop educational programs and dispense advice.

Several architects commented that "recommended lighting levels are too high," citing the need for "quality rather than quantity" of illumination or the need to conserve energy. A middle-of-the-road architect wrote, "Lighting criteria from the IES, as used by bad designers, engineers and architects, give bad results." "IES's problem is the same as everybody else's," wrote another. "We don't fully understand the nature of perception, and we must accept the condition that a given lighting environment is directed toward the *average* response, and will never satisfy all individual needs or preferences."

Slightly more than half of the respondents had used a lighting design consultant, and of these, 75 percent said they would do so again. One enthusiast commented, "I think people like [name withheld] should be used on every project, if for nothing else than concept. The quality of our firm's projects has improved since we've been using him."

Comments in italics accompanying the survey results are by Walter Benz, director of Reinhold Research, who compiled the survey.

1 What is your opinion on the present state of the luminous environment?

Bad	Poor	Fair	Good	Excellent
7	27	85	33	3

The state of the luminous environment is considered to be fair; very few seeing it either as bad or excellent.

2 How do you rate the quality of light in your firm's proje

Bad	Poor	Fair	Good	Excellen
1	9	49	86	11

About three out of every five rate the quality of light in thei firms' projects as good to excellent. Of the others, four out of every five rate this as fair.

3 Who designs the lighting for your firm's projects?

[a] In-house designers	43
[b] In-house engineers	19
[c] Design consultants	10
[d] Consulting engineers	60

a and d = 14
a and c = 4
a and b = 5
a and b and d = 1

Nearly half state that lighting for their firms' projects is designed by consulting engineers solely or in conjunction w their in-house designers; largely by the consulting enginee alone. Three out of every five state that in-house designers or engineers, mostly the designers, are involved or are full responsible for the lighting for their firms' projects.

4 At what stage is lighting first seriously considered?

Programming	9
Schematic design	39
Design development	91
Contract documents	21

Four out of every five architects state that lighting is first seriously considered in the design stage; nearly three out every five of these architects cite the design development stage.

5 By circling one number from 1 to 9 *(1 being the most influential)*, **please rank the following factors according to their influence on your lighting design criteria.**

	1	2	3	4	5	6	7	8	9	Influ (F
Your own design sense and experience	65	29	24	16	7	1	5	4	3	Ye
Electrical engineers	22	33	35	15	21	11	8	4	3	Ye
IES recommendations	9	6	15	21	35	17	13	10	14	N
Legal requirements	14	12	12	18	36	10	16	16	18	N
Owner's specifications	17	22	27	23	27	10	11	7	7	N
Lamp manufacturers	5	3	12	10	22	23	22	23	24	N
Electric utilities	8	1	3	11	11	8	18	29	55	N
Light fixture manufacturers	4	10	15	19	36	23	22	15	6	N
Lighting consultants	19	33	13	9	13	8	9	7	31	Y

Far greatest influence on the lighting design criteria is the architect's own design sense and experience. Second and third most influential are the electrical engineers and ligh consultants, respectively. Electric utilities are shown to be the least influential, with lamp and lighting fixture manufacturers only a bit more influential (see question 8).

6 How often do you use the following process aids?

	Always	Often	Seldom	Never
Field trips	12	77	62	3
Statements of qualitative objectives	13	77	45	12
Models	7	31	63	50
Mock-ups	5	32	60	54
Criteria other than horizontal footcandles	23	81	37	7

Field trips and statements of qualitative objects are equally the process aids most often used. Models and mock-ups are not used half as often.

Seven out of every ten state that criteria other than horizontal footcandles are usually used; three out of every ten indicate horizontal footcandles are the standard.

7 The IES:

	Definitely	Fairly so	No
Is it an impartial source of information?	25	75	15
Does your engineer consider it a creditable source?	55	61	1
Are IES recommendations valid?	21	83	10
Does the IES represent a profession or the light and power industry?*	23	38	10

*Profession underscored: 4
Industry underscored : 13

Engineers are shown to have a higher regard for the IES than do architects, who seem to have some doubt as to whether IES represents a profession or the light and power industry.

8 Other sources:

	Definitely	Fairly so	No
Are the public utilities a creditable source of information?	11	91	46
Are lamp manufacturers a creditable source of design criteria?	28	100	21
Aside from emergency lighting codes, is there need for strictly enforced lighting codes within buildings to protect the health and welfare of the public?	50	32	65
Can you recall any experience where health was affected by lighting?	51	6	90

While utilities and lamp manufacturers have been said to exert comparatively little influence on lighting design criteria, these are thought to be nonetheless creditable sources of information and design criteria. Nearly seven out of every ten consider public utilities as creditable sources of information, and fairly close to nine out of every ten consider lamp manufacturers to be creditable sources of design criteria. Aside from emergency lighting codes, no strong need is seen for strictly enforced lighting codes within buildings to protect the health and welfare of the public. Two out of every five see no need. The number who see a definite need is the same as the number who recall an experience where health was affected by lighting.

Have you taken college level courses in:

	Yes	No
. lighting?	11	43
. lighting design (beyond calculations)?	56	93
. principles of vision and perception?	77	72

10 Did your school experience include lighting models?
Yes 42 *(27.3%)* No 112 *(72.7%)*

11 Does the electrical engineer have a better education in lighting criteria and design than the architect?
Yes 78 *(56.5%)* No 60 *(43.5%)*

12 On a scale of 1 to 5 *(1, bad; 2, poor; 3, fair; 4, good; 5, excellent)* **please rate the following proposals to improve the art of lighting.**

	1	2	3	4	5	Good/excel. (rank)
a. Elimination of legal footcandle requirements	44	30	30	22	18	No
b. Establishment of an academically based, government or foundation-financed center for environmental studies which would coordinate research and develop educational programs. The center would be open to architects and public officials in need of advice	17	13	25	39	54	Yes (2)
c. Better education of architects in perception and lighting criteria	2	2	7	52	87	Yes (1)
d. Better education of architects in detailed lighting design and hardware to the degree that architects could do their own lighting design and use electrical engineers only for the electrical specifications	15	25	25	32	56	Yes (3)
e. Availability of more lighting consultants	6	19	51	45	27	Yes (4)

(c) Somewhat more than nine out of every ten feel that better education of architects in perception and lighting criteria is a good or excellent proposal.
(a) About half present a negative attitude on a proposal to eliminate legal footcandle requirements. A third sees this as a good or excellent proposal.
(b & d) Three out of every five feel that proposals for purposes of furthering education are good or excellent.
(e) There is a fairly strong feeling toward the need for availability of more lighting consultants.

13 With better education and better rules, will it be possible to improve the quality of the luminous environment as well as reduce the amount of energy presently used for lighting?
Yes 144 *(93.5%)* No 10 *(6.5%)*

14 Have you ever used a lighting design consultant?
Yes 81 *(52.3%)* No 74 *(47.7%)*
If "Yes," have you done so again?
Yes 56 *(75.7%)* No 18 *(24.3%)*
(No answer: 7)

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News report continued from page 25

of the Loop and Ravenswood elevated line with a subway, and the relocation of another line; building outlying commuter parking lots; and creation of recreational and open space along the riverfront, complete with esplanades and parks, along with expansion of lakefront open space.

It is, all-in-all, a challenge to suburbia, where some 21,000 Chicago residents have moved over the past 10 years. And while the area the plan hopes to turn into a magnet accounts for 7000 acres of land, or about 5 percent of the city's area, it is indeed large in other ways. It constitutes about one-third of the city's assessed valuation, provides about 43 percent of its jobs, and it is the heart and nerve center, symbolic as well as real, of the whole region.

The big question, of course, is "Will it go?" Probably; the signs and portents seem good. "You have to look at the history of planning in Chicago," one CCAC spokesman pointed out. The last downtown plan was done up in 1958, and something like 70 percent of that one has been implemented already. "From Burnham to now," says the spokesman, "all plans have been taken seriously." Certainly Mayor Richard Daley takes this one seriously, and enthusiastically, and that can't hurt its chances. Added to the clout factor of his being pretty squarely behind Chicago 21 is the fact that he just might see the plan as his memorial.

Getting it all together in Providence

Interface is a "now" word signifying the surface at which different things comes together, and in many ways it is a pretty good word to apply to a downtown area, or to suggest, as a group of students at Rhode Island School of Design have done, what one might become. The downtown area in question is the central business district of Providence, and their plan for the area would result in a pedestrian-oriented city with all transportation systems coming together (interfacing) in one central terminal.

That is something that doesn't happen now, the students contend. They found through their research that as much as 1500 ft can separate one form of transportation from another in downtown Providence, and that the automobile, predictably, is taking over the city. Parking lots take up some 75 percent of the area.

The size of the central business district makes it ideal for foot travel—it's about 3800 ft from side to side according to the students, or about 15 minutes walking time. But right now pedestrians have to compete with drivers for the right of way.

What the students propose is simple. Almost ideally located in the pedestrian-scaled downtown is Union Station, built in 1890 and still structurally sound. Refurbished and remodeled, it could be the central point for a variety of transportation systems eventually serving some 36,500 users of high-speed rail, bus and personal rapid transit. To handle the auto traffic, the students propose a three-lane one-way ring road around the central business district; it would take less time, they say, to drive around it than to drive across the area. Long- and short-term parking facilities would be tied in with the ring road.

Nontransportation parts of the plan include reconstituting the Old Cove, completely filled in in 1889, as a body of fresh water (aiding in flood control and helping purify the air) and a

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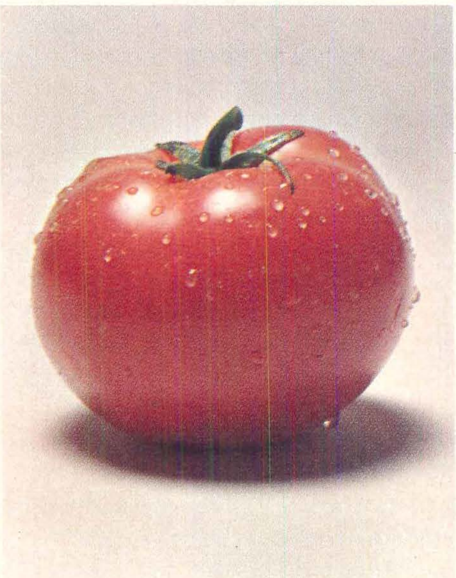
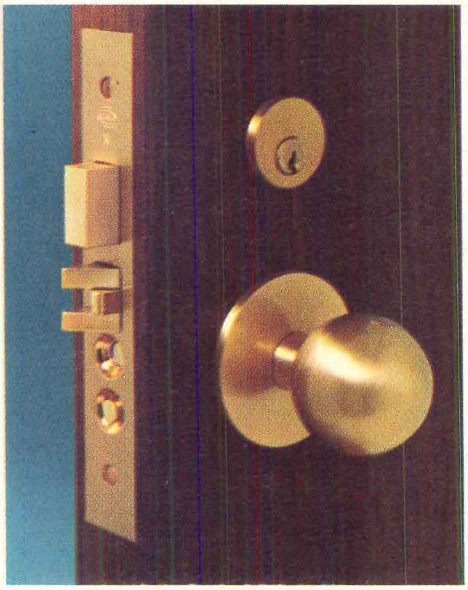
Corbin locks in flavor.





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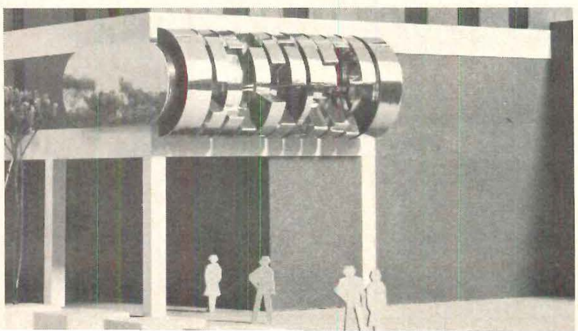
Citicorp Center: tower, plus church, plus shopping plus plaza

Prize winning stainless steel sculpture



50-acre park in front of the State House. Other parts of town would gain tree-filled green spaces.

The student proposals have attracted a lot of local interest. The mayor of Providence, appearing with some of the student planners on a local television show, said the plan was "futuristic," which is not necessarily a condemnation, and mentioned tremendous obstacles. He also said that "Interface: Providence" could provide a blueprint for the city's future.

New York City: one for the East Side

This summer seems to be the season for spectaculars in New York City. Following the announcement of John Portman's hotel for Times Square comes news of a complex for the East Side of Manhattan that is only slightly less dramatic. The project is Citicorp Center, to be built by First National City Corp., a multi-use complex that includes an office tower, a church, a low-rise building, a sunken plaza and a shopping mall and galleria.

It is the design of the tower that makes that diverse mixture possible: its starts 10 stories, or 112 ft, above ground, resting on a platform supported by four massive "super columns" about 24 ft square. The area under the platform, except for the space taken up by the elevator core, will be open. Above the platform will be 46 stories of office space, a total of more than 1 million sq ft.

The site for the project is the block bounded by Lexington and Third Avenues and 53rd and 54th Streets. The corner of Lexington and 54th has been the site, since 1902, of St. Peter's Lutheran Church, and a new free-standing, not yet designed, church will be built on the same corner next to the tower. A low-rise building will run from Third Avenue to 54th Street; from a height of eight stories it will step down in terraces to nestle under the tower. A sunken plaza at the corner of 53rd and Lexington will include sculpture, fountains and landscaping, and the center of the block will be taken up by a three-level shopping area wrapping around three sides of a 70′ x 80′ galleria.

As designed by Hugh Stubbins & Associates, (Emery Roth & Sons are associate architects), the tower will be steel framed and clad in reflective glass and bright aluminum. The structural design, by a joint venture of LeMessurier Associates, Inc. and the Office of James Ruderman, uses steel bracing the form of giant chevrons on the inside of the exterior walls to resist wind loads and transmit gravity loads to the four giant columns. The chevron bracing will also reduce the number of structural columns needed within the building. Other features include cellular steel floors topped with concrete.

Energy conservation has also been considered in the design. Double glazing is to be used all around, and mechanical systems are to be set up for efficient energy use, with outside air to be used for cooling during intermediate seasons. Special light fixtures that will cut down on power consumption are being considered.

Boston building gets prize winning sculpture

About the middle of this month a stainless steel wall sculpture will be hung on the RKO General Building in Boston. The three-dimensional construction is the work of architects Anthony C. Belluschi and Crain D. Roney, and it won them the $25,000 commission in competition with 100 other entries.

The sculpture is a series of 11 semicircles of highly pol-

[continued on page 36]

Phipps Plaza Shopping Mall, Atlanta

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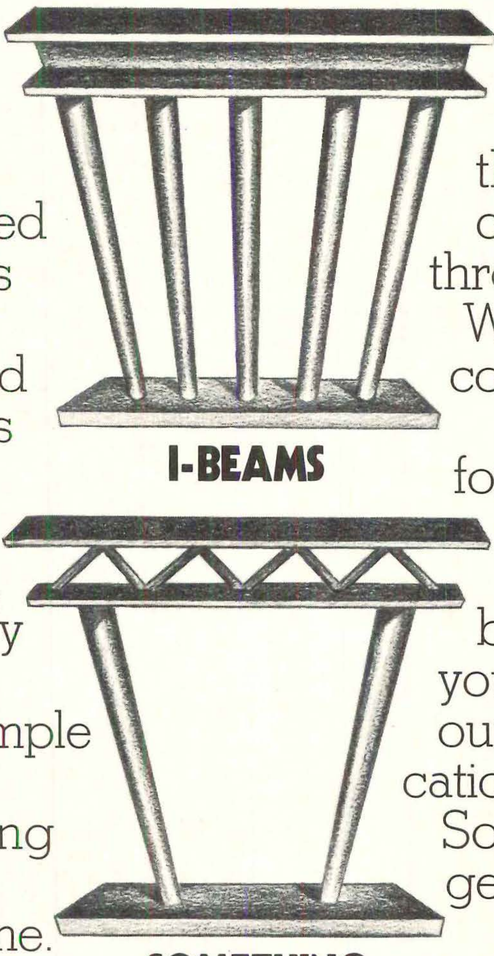

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News report continued from page 32

ished stainless steel 10 ft high; joining them to the building on the street side is a stainless steel oblong with rounded ends. The semicircles have an assortment of wedges cut out of them, and the inside of the front curvatures, according to the designers, will be painted in reds, oranges and yellows. A series of large incandescent lamps will light each half circle.

The competition was run by the Institute of Contemporary Art for the Boston Redevelopment Authority and RKO General. BRA regulations call for an expenditure of 1 percent of the project cost for public art for new buildings on urban renewal sites.

Washington report

Phase IV, fuel are late summer concerns

With Congress out of town until after Labor Day, the usual hot, muggy weather having settled in, and everybody immersed in general preoccupation with political investigations, "dog days" really descended on Washington in August, at least so far as the construction industry and its members were concerned. For the moment, interest focused on regulations, rather than legislation: specifically, for instance, on "Phase IV" economic controls that went into effect August 13.

Under these regulations, apparently, most architects, engineers and other professionals (including contractors acting as construction managers) will continue to be exempt from specific controls imposed on the construction industry in general. Reason: A-E's were ruled not to be part of the construction industry under "Phase II" almost a year ago, since activities such as preparation of designs and specifications, inspection and even supervision are expressly omitted from the Davis-Bacon Act definition of "construction" which was picked up verbatim for Phase II, and has been used again for Phase IV. What's more, firms that do both design and construction, and those with overseas operations, may also be exempt, if they can separate these activities into design and construction (or overseas and domestic) categories.

There are some general regulations which do apply, however: A firm with more than 60 employees, grossing $50 million a year or more is subject to general restrictions as to prices charged, wages paid and the like; firms doing less than $50 million, but with more than 60 employees are considered "Category III" organizations, and wage raises must be limited to 5.5 percent (they may charge more than previously—but only on a dollar-for-dollar basis to recover added costs, without raising their profit margins).

All firms (including contractors) will also be subject to "redetermination" (read that re-negotiation) of contracts of $500,000 or more, if the owner feels that excessive profits have been made because of wage rollbacks during the period of the contract. (But there's a holdback here: Contractors can also claim more money, in such negotiations, to recover excess costs incurred during the contract period.)

There were worries over fuel shortages and their effect on construction progress and costs: Contractors marched up to Capitol Hill to report that many of them had experienced fuel price rises of 50 percent or more, had been completely cut o

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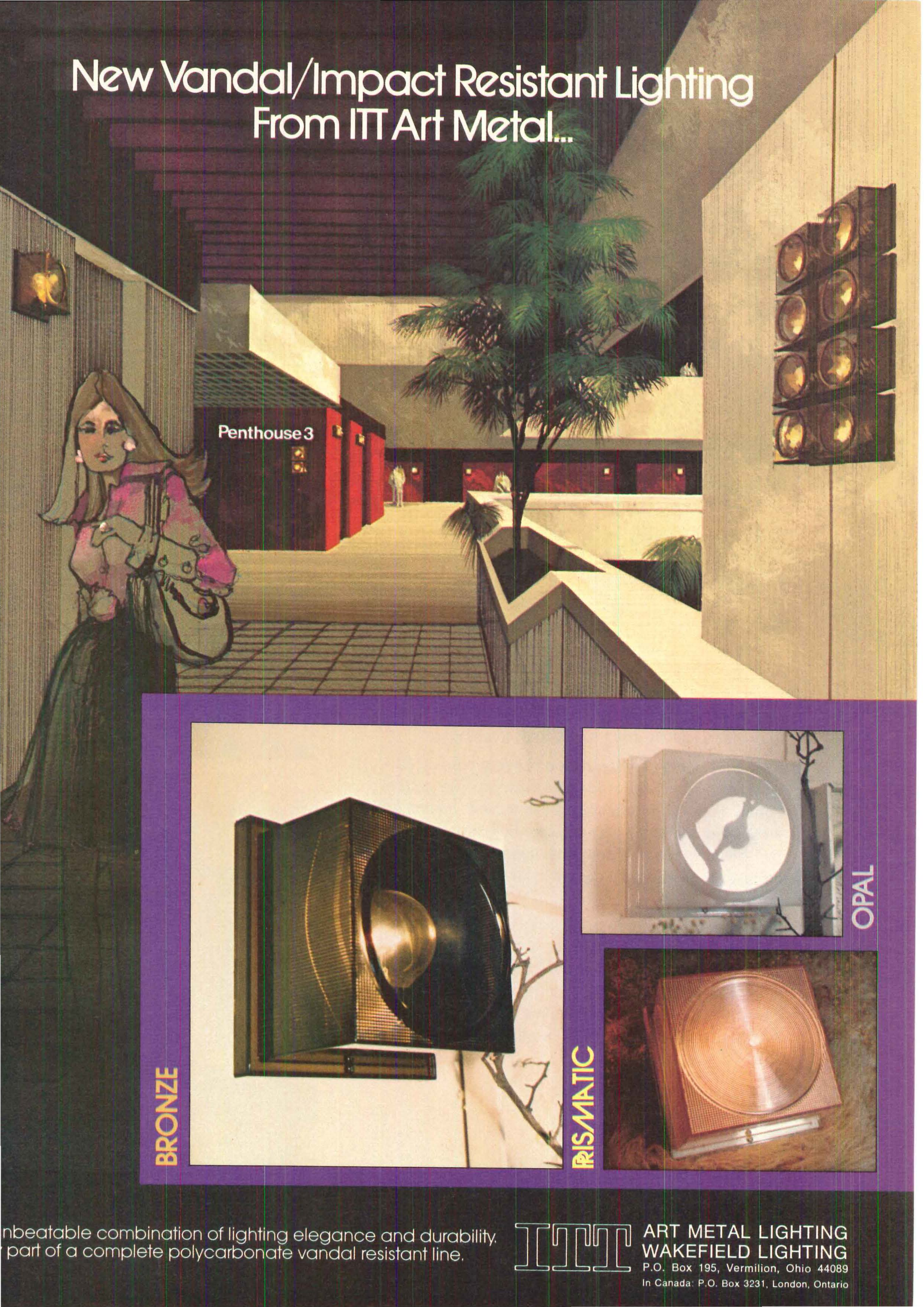

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Architect: Langdon & Wilson
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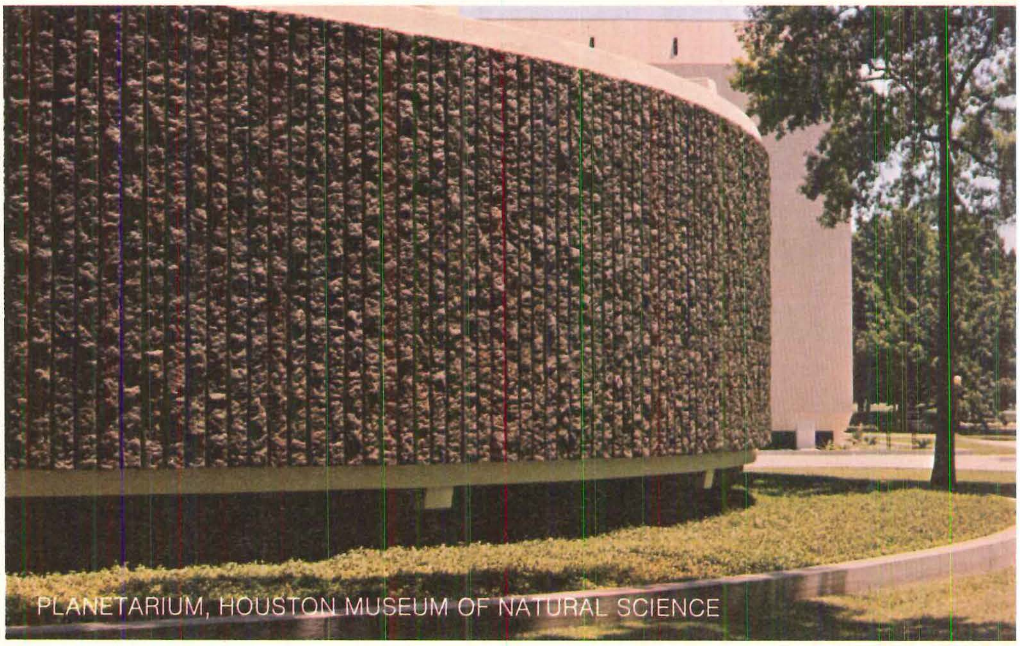
Bank of America Domestic Branch, San Francisco
Architects: Wurster, Bernardi & Emmons, Inc., Skidmore, Owings & Merrill

AMERICA DOMESTIC BRANCH

CNA BUILDING



PLANETARIUM, HOUSTON MUSEUM OF NATURAL SCIENCE

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from assured fuel supplies for on-going projects, and couldn't get commitments for new work. They wanted special status under any allocation plan for fuels and lubricants, whether voluntary or not. Their plans were part of a welter of complaints and suggestions before Congress, ranging from consideration of the effects of construction of three or four offshore terminals to handle huge tankers, to cries for divestiture of marketing and transportation functions of major oil companies. Congress, incidentally, seemed more interested in finding a scapegoat for the fuel shortage than in coming up with any real remedies.

There was even a small victory in the long fight against extension of the West Front of the U.S. Capitol: The Senate rejected a House-approved $58 million appropriation for the extension, in favor of $18 million for restoration of the existing wall and $15 million (picking up an idea advanced by the AIA) for an underground office building on the Capitol grounds.

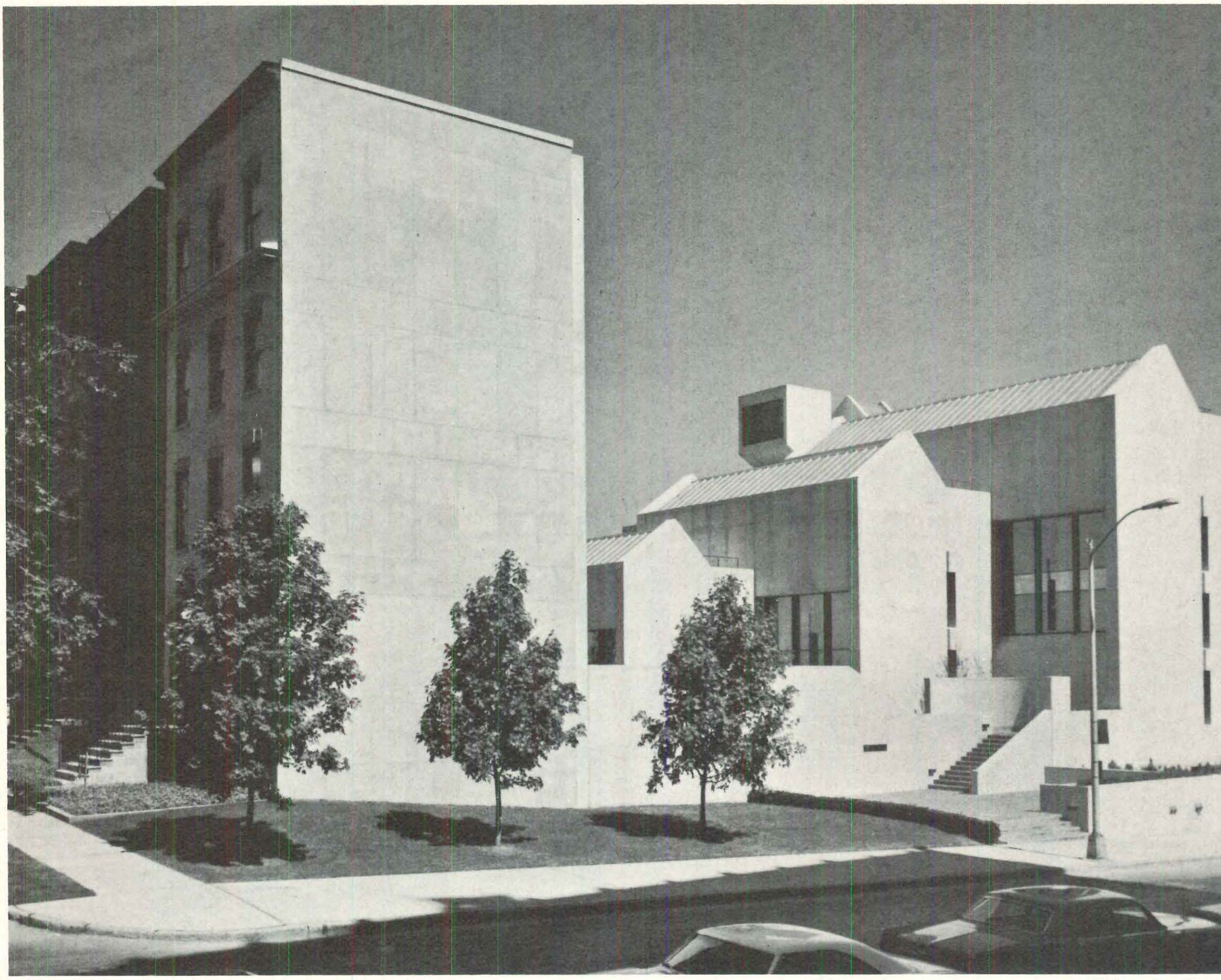
There was prospect of a renewed fight over bidding for professional services, despite the passage last session of the long-sought "Brooks Bill" which outlawed such actions. A new bill was before the House, and it had the powerful backing of Rep. Chet Hollifield (D. Calif.) and Rep. Frank Horton (R. N.Y.)—both of whom opposed the Brooks bill. The wording that worried professionals: ".... contracts . . . [for professional services] shall be made by competitive negotiation as far as practicable. The primary evaluation factors shall be professional competence, technical merits including costs of construction. . . . The proposed fee shall not be a dominant factor, and shall be significant only when proposals otherwise are approximately equivalent. . . ." Hollifield, as chairman of the House Government Operations Subcommittee (which okayed the Brooks bill last year over his objections) started hearings on the proposal (and similar ones) in mid-July.

There was, finally, a compromise on the hard-fought highway bill (a three-year measure) which made bows both in the direction of transit and highway advocates. In the first year, it permits no diversion from the Trust Fund for transit purposes, but says that cities can spend for rolling stock, etc. by returning shares of their Urban Highway allotments and getting money from the General Fund; in the second year, they can spend up to $200 million (of $800 million) for such purposes, in the third year, all urban money (except $20 million) can be spent for transit. But no money is to go for operating deficits, any money "saved" to the Trust Fund must go back into the Fund for other highway uses.

There was a new "Antiarchitectural Barriers Act" (by Rep. W.S. Cohen, R. Me.) that would provide tax incentives to encourage owners of commercial buildings and transportation facilities to remove existing obstacles from the paths of the aged and disabled. (The bill is identical to one introduced in the Senate some months ago by Republican Senators Percy and Dole).

Finally, the construction industry seemed to continue its booming pace, though the pace might be slowing a little. Significant factor: Census Bureau reported that the price of an average, new, one-family house rose again in the first quarter of 1973, to $32,800—a $1200 increase over the last quarter of 1972. [E.E. Halmos]

[continued on page 44]



News report continued from page 40

Personalities

P/A Editor **John Morris Dixon, AIA** has been elected to serve on the Corporation Visiting Committee for the School of Architecture and Planning of MIT.

Herbert H. Swinburne, FAIA, Nolen & Swinburne Partnership, Philadelphia, has been appointed chairman of the Building Research Advisory Board of the National Research Council.

Harlyn Thompson, AIA has been named the first dean of the new School of Architecture at Newark College of Engineering.

Donald D. Hanson has been named dean of the School of Architecture, University of Tennessee.

Richard K. Chalmers has been appointed acting dean of the School of Architecture and Environmental Design at the State University of New York at Buffalo.

Roland A. Gallimore, AIA, IDC, Geddes Brecher Qualls Cunningham, PC, Philadelphia and Princeton, N.J., has been elected chairman of the Interior Design Council, Philadelphia. **Herbert W. Kramer, IDC,** Interspace Incorporated, Philadelphia and Washington, D.C., was elected vice chairman and treasurer.

Calendar

Through Sept. 10. "The Arts and Crafts Movement in America 1876–1916," Renwick Gallery of the Smithsonian Institution, Washington, D.C.

Through Sept. 23. Exhibition of drawings and prints by Ettore Sottsass, Jr. and Superstudio, Walker Art Center, Minneapolis.

Sept. 1. Deadline for abstracts of papers for the third international symposium on lower-cost housing problems, Montreal.

Sept. 4–14. Ninth triennial meeting of the International Organization for Standardization, Sheraton-Park Hotel, Washington, D.C.

Sept. 6–7. National seminar co-sponsored by the American Concrete Institute on the use of concrete in housing, Statler Hilton, Dallas.

Sept. 7. Deadline for entries to annual awards program of the New York Society of Architects.

Sept. 8–11. Annual convention and exhibit of National Office Products Association, Conrad Hilton Hotel and McCormick Place, Chicago.

Sept. 9–12. Conference on legal aspects of zoning sponsored by the Pennsylvania State University College of Arts and Architecture, University Park.

Sept. 9–13. Fourth annual apartment conference of the National Association of Home Builders, Regency Hyatt House, Atlanta.

Sept. 13. Design seminar on use of glued laminated timber for structural framing and decking in buildings sponsored by the American Institute of Timber Construction, Western Forestry Center, Portland, Ore.

Sept. 14–18. National convention of the American Institute of Interior Designers, Fairmont-Roosevelt Hotel, New Orleans.

Sept. 15–20. International Public Works congress and equipment show, Currigan Hall, Denver.

Sept. 15–Oct. 7. The Design Necessity Exhibit, illustrating performance criteria of effective design discussed at the First Federal Design Assembly, Tennessee Arts Commission, Nashville.

Sept. 18–21. Third conference on psychology and the built environment, University of Surrey, Guildford, Surrey, England.

Sept. 19–21. Fall meeting of the Electrical Generating Systems Marketing Association, "Our Power Future," Mayflower Hotel, Washington, D.C.

Sept. 20–21. Recycling cities conference sponsored by the Metropolitan Association of Urban Designers and Environmental Planners, Inc. in conjunction with Design & Environment magazine, New York City.

Sept. 23–27. Prestressed Concrete Institute convention, Palmer House, Chicago.

Sept. 29–Oct. 4. Congress for Recreation and Parks, sponsored by National Recreation and Parks Association, Washington, D.C.

Sept. 30–Oct. 3. National conference of the National Association of Housing and Redevelopment Officials, Chalfonte-Haddon Hall, Atlantic City, N.J.

Oct. 1. Deadline for entries to Decade '70 National Housing Award competition for excellence in open space planning sponsored by Better Homes and Gardens magazine and the National Association of Home Builders.

Oct. 1–4. Fiftieth annual international conference of the Council of Educational Facility Planners, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 8–12. Business Equipment Show, New York Coliseum.

Oct. 8–12. American Concrete Institute convention, Ottawa, Ontario, Canada.

Oct. 11–13. Eighth congress of the International Council of Societies of Industrial Designers, Kyoto International Conference Hall, Kyoto, Japan.

Oct. 13–21. San Francisco International Design Show, the Showplace.

Oct. 14–17. Fifty-fifth annual convention of the American Gas Association, San Francisco.

Oct. 15–18. Fifty-second annual meeting of the Producers' Council, Inc., Carrousel Inn, Cincinnati.

Oct. 20–Nov. 11. The Design Necessity Exhibit, Crown Center Redevelopment Corp., Kansas City, Mo.

Oct. 21–25. Fifty-sixth annual conference of the American Institute of Planners, "Planning and the New Federalism," Regency Hyatt House, Atlanta.

Oct. 21–26. Sixteenth annual meeting of the Association of Engineering Geologists "Geology, Seismicity-Environmental Impact," Sheraton Universal Hotel, North Hollywood, Calif.

Oct. 23–25. Interface 73 sponsored by the Industrial Designers Society of America, San Diego, Calif.

Oct. 27–Nov. 21. Exhibit of the Italian Art and Landscape Foundation Inc., Fogg Museum, Cambridge, Mass.

Oct. 29–Nov. 1. American Society of Civil Engineers annual and national environmental engineering meeting and exposition, Americana Hotel, New York City.

Nov 1. Annual construction conference sponsored by the Cleveland Engineering Society, Cleveland Engineering and Scientific Center.

Nov. 1–2. Thirteenth annual Construction Contracts and Specifications Institute, presented by the University of Wisconsin-Extension and Region 7 of the Construction Specifications Institute, Madison campus.

Nov. 5–9. National plastics exposition and conference, sponsored by the Society of the Plastics Industry, Inc., McCormick Place, Chicago.

Nov. 14–24. Thirty-fifth International Building and Construction Exhibition (Interbuild), London, England.

Nov. 15–16. Conference on landscape assessment: values, perceptions and resources, University of Massachusetts, Amherst.

Nov. 15–18. National convention of the Society of American Registered Architects, Fairmont Hotel, San Francisco.

[continued on page 48]

ord revisited 8 years later!

oneer carpet glue-down installation th Jute backing unqualified success

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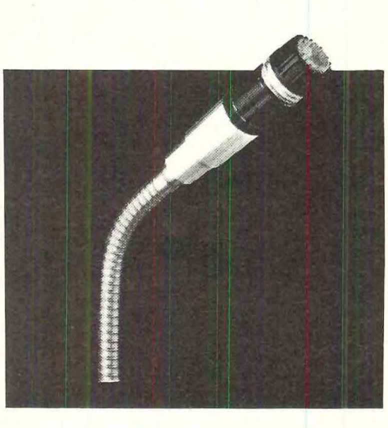

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News report continued from page 44

Specifications Clinic author sets up shop

Harold J. Rosen, author of the P/A Specifications Clinic for the past 17 years, has established his own practice as a construction specifications consultant. His services will include materials investigations, development of master specifications and computerized specifications; he will also serve as a consultant to manufacturers on product literature.

Rosen has been chief of the specifications department of the New York office of Skidmore, Owings & Merrill for the past eight years; before that he held the same position with Gruzen & Partners. He is a Fellow of the Construction Specifications Institute, a member of the American Society for Testing and Materials and the American Concrete Institute. He has served on the NCARB committee on examinations and was formerly an instructor in the Department of Architecture at Pratt Institute in Brooklyn.

Yonkers unveils new downtown plan

Development plans for downtown Yonkers have taken a new tack. Instead of seeing the downtown as a potential regional shopping mecca, the city's development department now sees the Getty Square area (P/A, Sept. 1971, p. 154) as a "busy, attractive, financially rewarding community-retail and government center." One reason for the change of direction is that the two department stores that were supposed to move into Getty Square Plaza decided not to.

With the new shift in emphasis comes a new downtown plan, which calls for a slightly less ambitious shopping and civic area focusing on Getty Square, which would become the center of a new pedestrian facility resembling a European town square. Nearby would be a commercial superblock, offering about 184,000 sq ft of retail space plus parking for 800 cars. A tree-lined walkway would lead into the Getty Square area, and another major parking structure is planned for a few blocks away. Housing, some 900 units in all, is already under construction in the area; the terraced structure would wrap around courts and a new elementary school.

One large part of the new plan is a city center containing a new library and auditorium, city offices, police facilities and plenty of parking. The dominating feature of the city center, according to a plan prepared by L.M. Pei & Partners, and now before the Yonkers city council, would be a 600-ft-long, 55-ft-wide municipal administration center spanning the city's main east-west arterial road. In it will be city courts and offices and the 400-seat municipal auditorium. At four stories high, it would be lower than the present city hall, which stands on a rocky knoll. The library, a semi-circular structure separate from the administration center, would be linked to it by an underground passage. The police command center (not shown in the accompanying rendering) would include space for 50 police vehicles.

Parking for 710 cars will be provided in a multi-level garage. On the highest level will be an overlook-terrace extending the present park around City Hall; at the street level will be about 8500 sq ft of retail space. The entire center will be landscaped, paved, grassed and planted, with a variety of internal and external pedestrian hookups. Construction is scheduled to start in January of 1975.

[continued on page 56]


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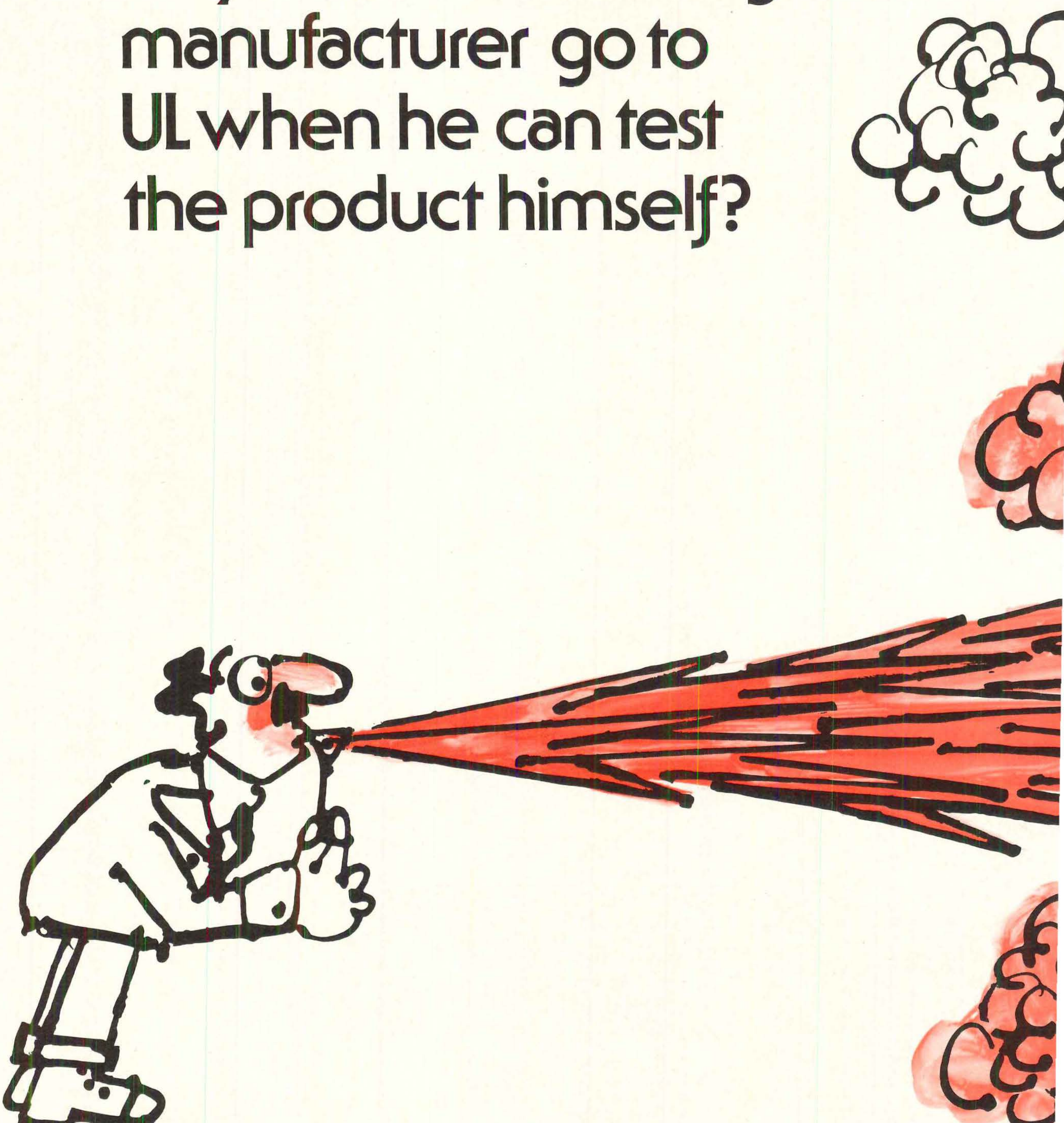

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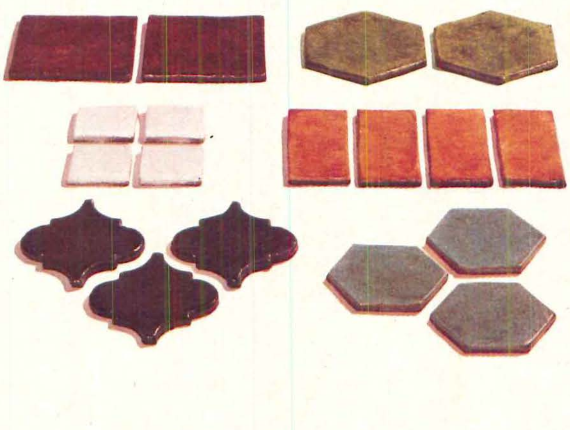

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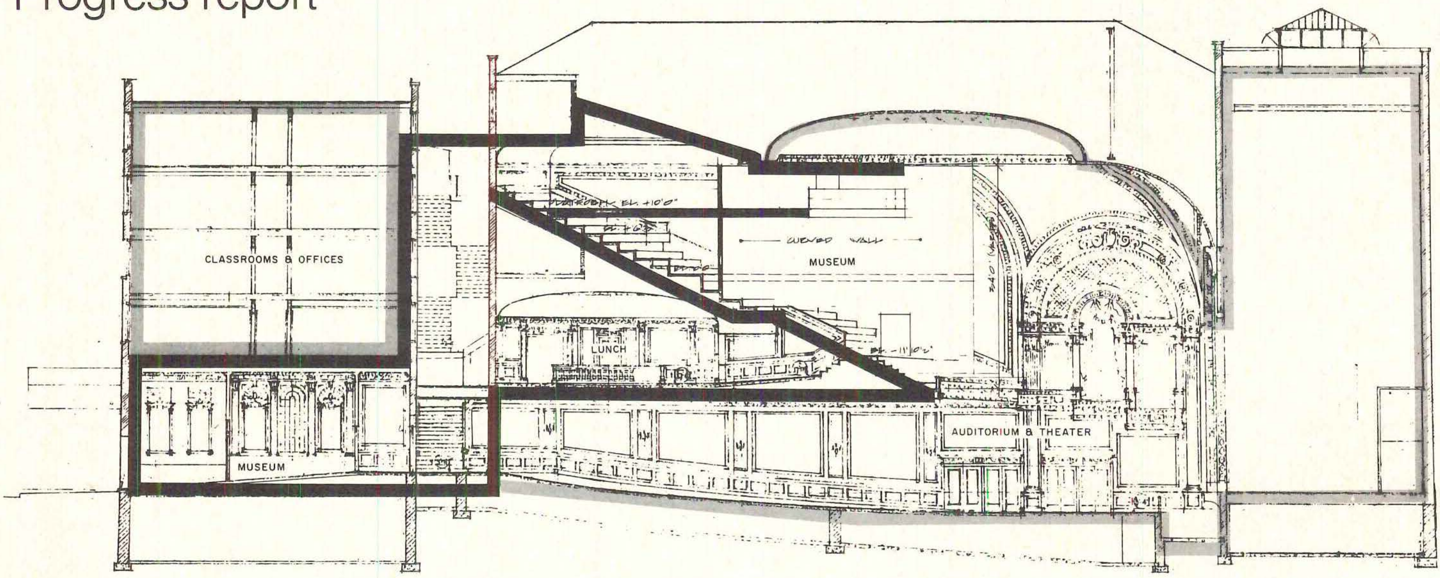
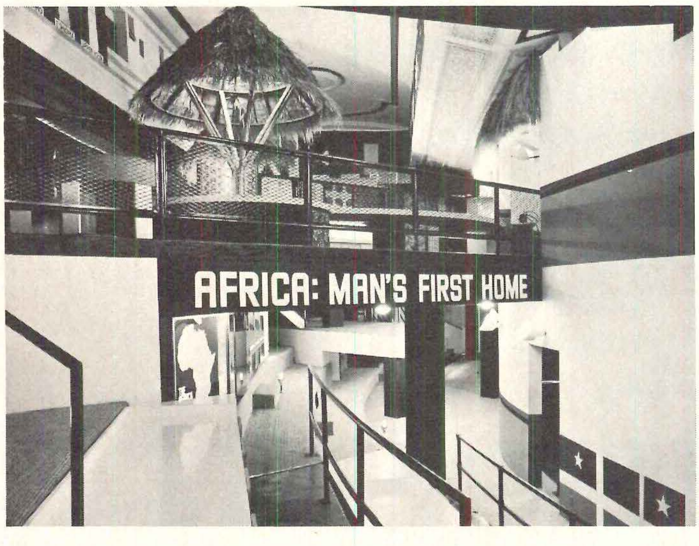
Progress report



Museum on balcony levels of Fairmont Theater is first step in creation of cultural/educational center. Photos: Norman McGrath



Another route to learning

As if it weren't difficult enough to build "traditional" educational facilities in New York City, try convincing state and city funding bodies to finance a cultural heritage museum in the Bronx. And try telling them that it will occupy the balcony of an abandoned movie theater in one of the highest crime areas in the city. But, then, after meeting Dr. Edythe Gaines and hearing her educational philosophy, it is doubtful if anyone would expect her to pursue ordinary solutions. Teamed with architects Hardy Holzman Pfeiffer Associates, the former superintendent of the Bronx Community School District 12 fought long and hard for her museum—and go it. She would be the last to take credit for the achievement, however. "There'll be no 'thank you ma'am, for giving us this museum' from the community—it's *their* museum, and there is an ownership there that came out of gut work," she declares. She also gives ample credit to the architects, and to her staff and community leaders, for making the whole center possible.

Such concepts had not been that common to state education administrators in Albany, however. It was necessary to search hard for funds for the district center. Even when the money was raised, it reverted back to the state several times under a one year spend-it-or-lose-it restriction. Even though the project funds were administered by the state, the district's proposal still had to be acted upon by New York City school officials, a slow process at best, and one that could not proceed before allocation of the state funds. This financial/approval merry-go-round defied project completion within a year and a whole new request had to be filed each time Albany reclaimed its money. Each time, the architects and the District got faster at the submissions game, and finally succeeded.

The museum is only a part of the overall district center notion, and only one manifestation of Dr. Gaines' larger philosophy. "Schooling and education are not synonomous," she notes, "but one is a subset of the other. Even if a school were perfect, it would not provide all of the educational experience needed by an educated man. Those other educative experi-

[continued on page 62]

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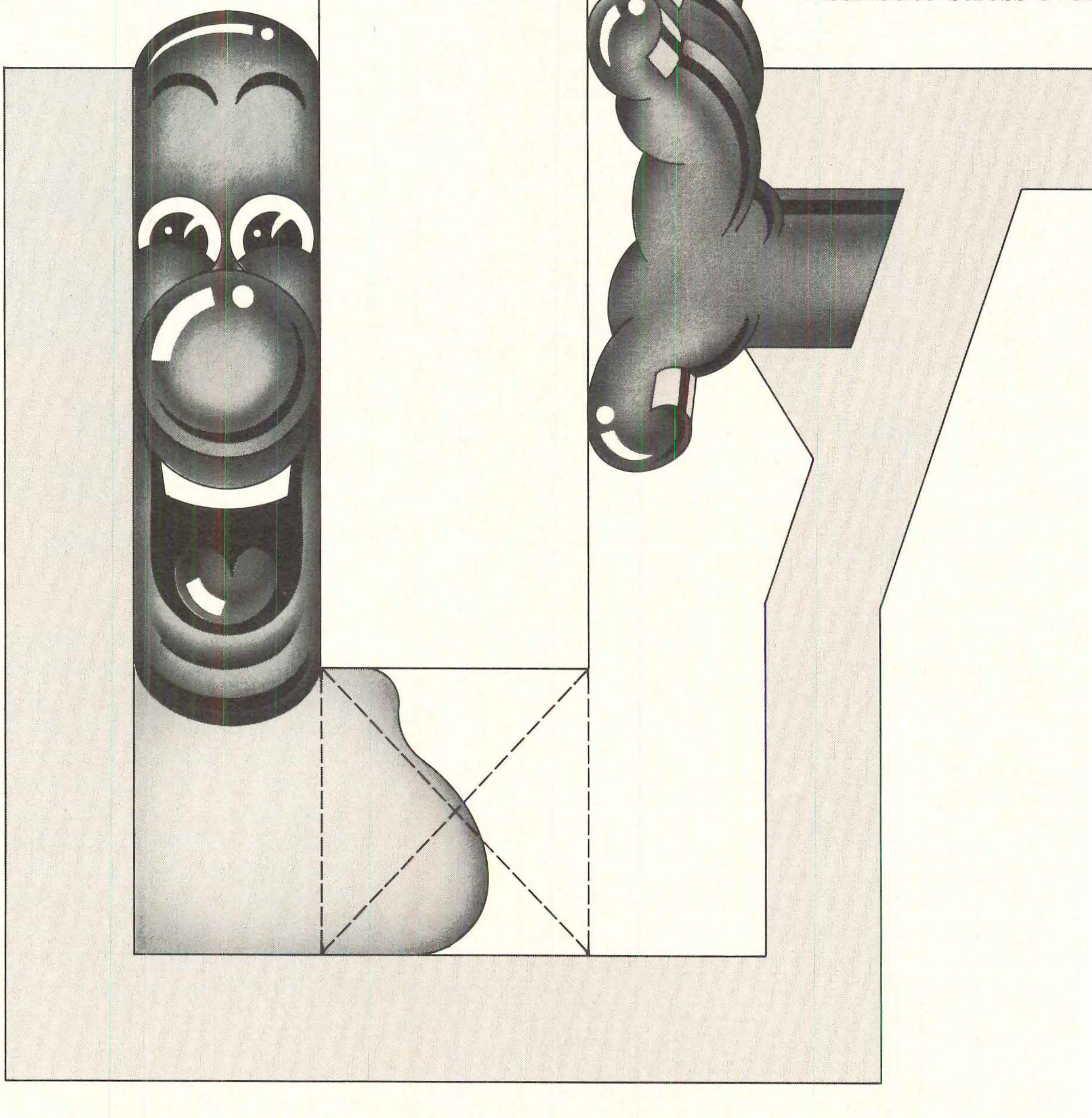

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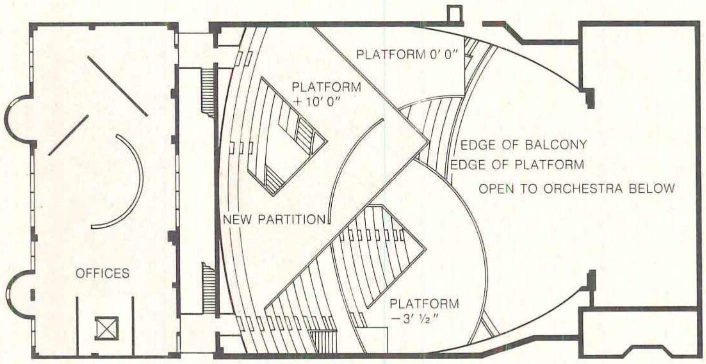

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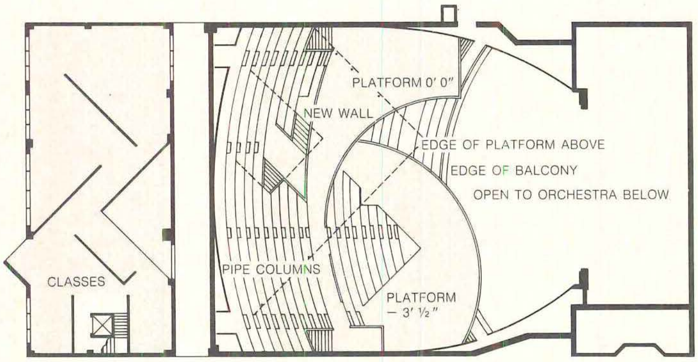

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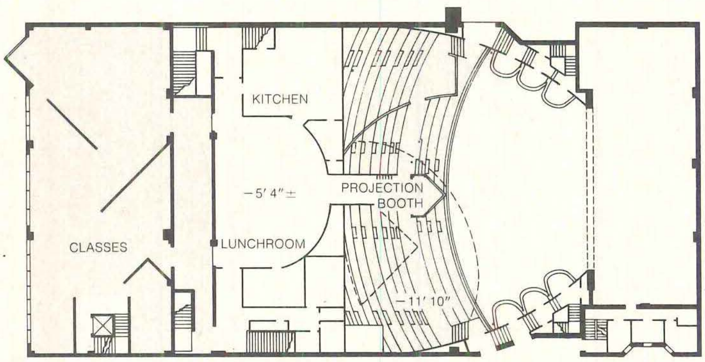

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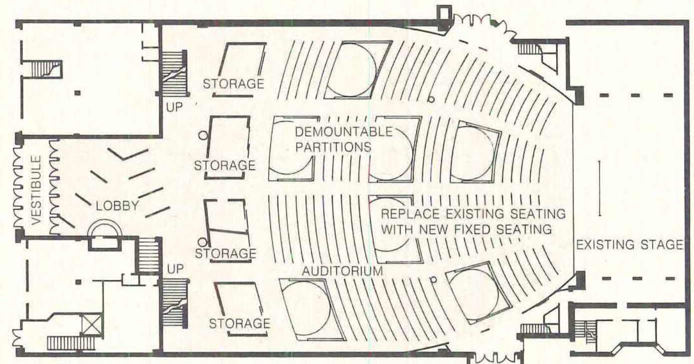

MULTI-USE AUDITORIUM
0 16'

ences are outside of school, and will never work well with the school unless you have an organic relationship between in-school and out-of-school experiences through some linkage mechanism." She feels, for instance, that taking children to the Philharmonic is almost as unsatisfactory as forcing the Philharmonic to perform in the school auditorium. Some common meeting ground, a neutral place, should be established on which neither institutional system feels dominated by the other's "turf" or codes. The museum, and indeed the whole district center, is planned to provide what Dr. Gaines calls "new guidelines that are more amenable to real learning."

Dr. Gaines and her staff discovered the empty Fairmont Theater while seeking alternate space for their administrative offices, which were taking up badly needed school space. (With the prospect of 15,000 children on short sessions, District 12 accounted for 50 percent of New York City's tremendous school overcrowding dilemma.)

While the old movie house had the office space needed, it held far more potential. Along Dr. Gaines' line of thinking, it could start life as an office combined with an open plan school. Then the "alternative routes to education" could be established within the theater spaces. The museum was the first of those, and the architects designed the facility without any program. Going on past experiences, and on the imposed limits of the existing balcony, they set out to make the best use of the stepped slope and the vast volume beyond. They have done that, and as Dr. Gaines remarks, "the strong physical statement is the motivation." The spatial experience of the areas under, between and beyond the new platforms makes it impossible to resist the urge to explore.

The arrangement of the science portion of the museum also stems from the balcony's level changes, allowing a vertical progression from sea exhibits up through the earth to the sky. The cultural heritage sections stress the African and Puerto Rican country traditions. "We really didn't say that we were going to do a black and Puerto Rican thing," Dr. Gaines points out. "It was, instead, a way of saying that everyone is rooted in his heritage and that gives him strength; that strength is useful in school, and as part of his education. The museum is a try at dealing with that component—the kind of environment that makes schools larger than schools and into something we call education instead."

Since completion of the museum, design emphasis has shifted to the other components of the center, especially the multiuse theater space beyond the balcony. It has been broadly described as a flexible envelope for a wide range of activities, including theater, music, dance, lectures, discussions and others. It will be adapted to varied uses by means of removable seating and portable semi-enclosures. Like the museum, there is no set program for this facility. Its uses will be determined by the same process that shaped the center's directions already: allow and provide for cultural/educational opportunities for the people of District 12. When finally completed, the center will be announced by revised façade treatment and graphics, and entered through a remodeled lobby.

Dr. Gaines admits that at first, the Fairmont Theater had "a face only a mother could love," but she persisted, predicting that someday there would be a museum and a theater there. "We started with a dream, and then we said, 'it doesn't have to be a dream, can't the lollipops *be there* when you wake up?' " Well, they're there on Tremont Avenue, and more are coming all the time.

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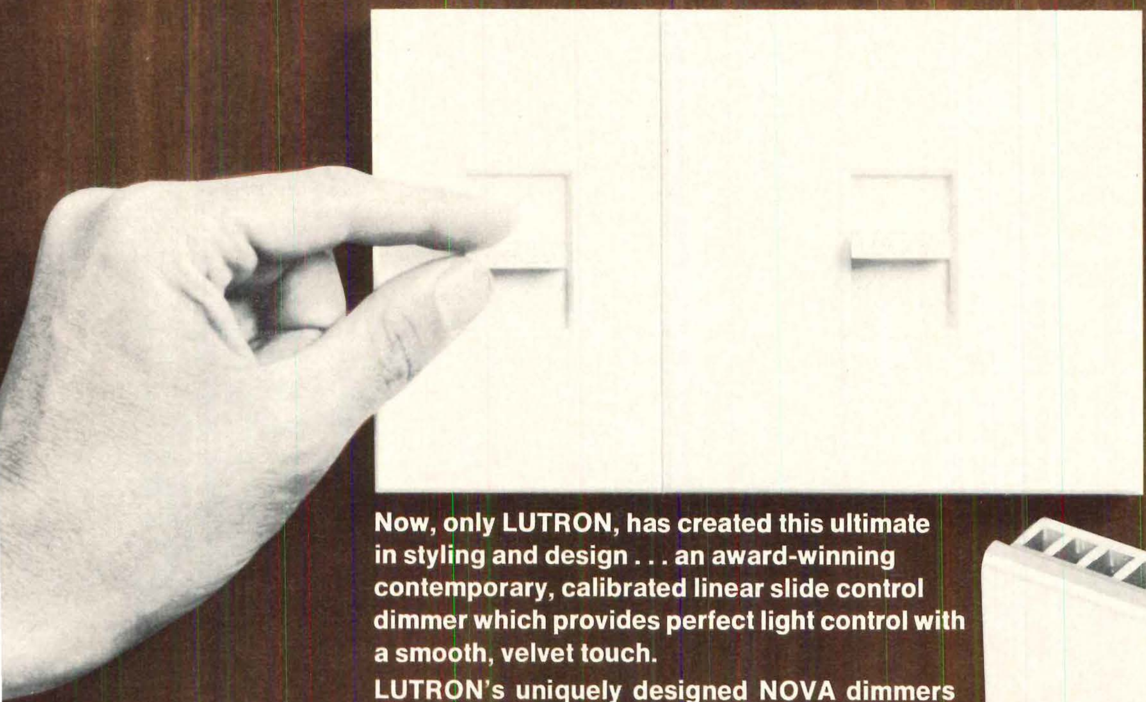

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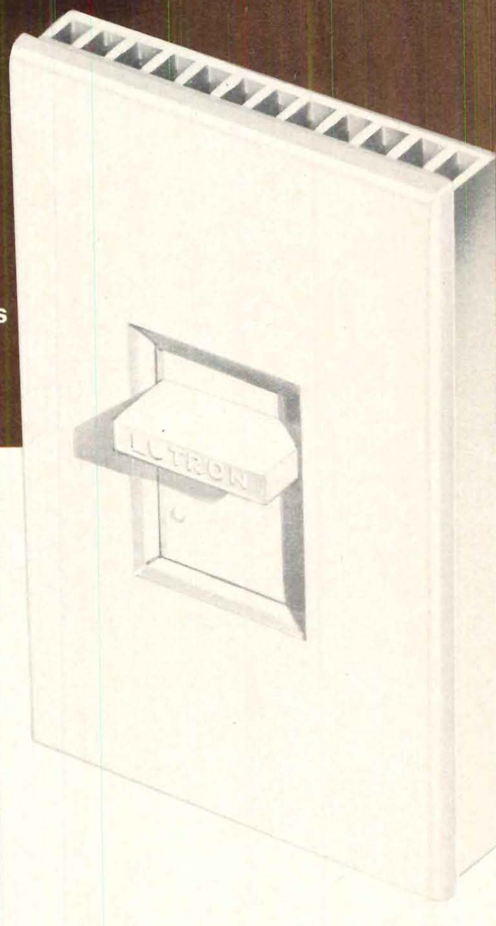

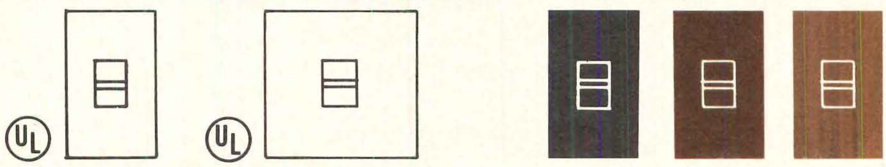

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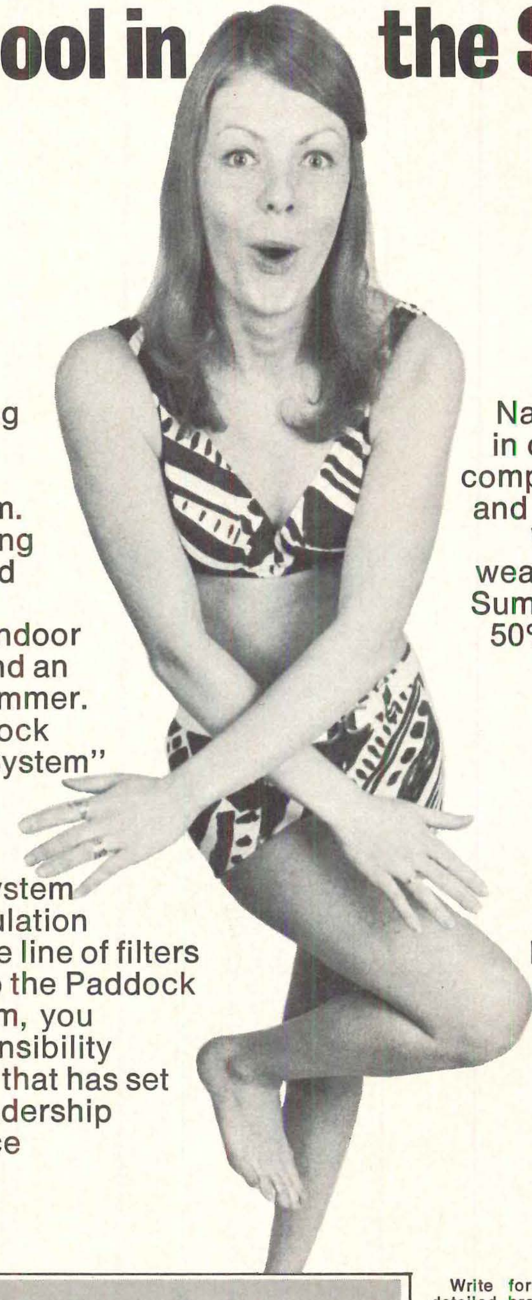

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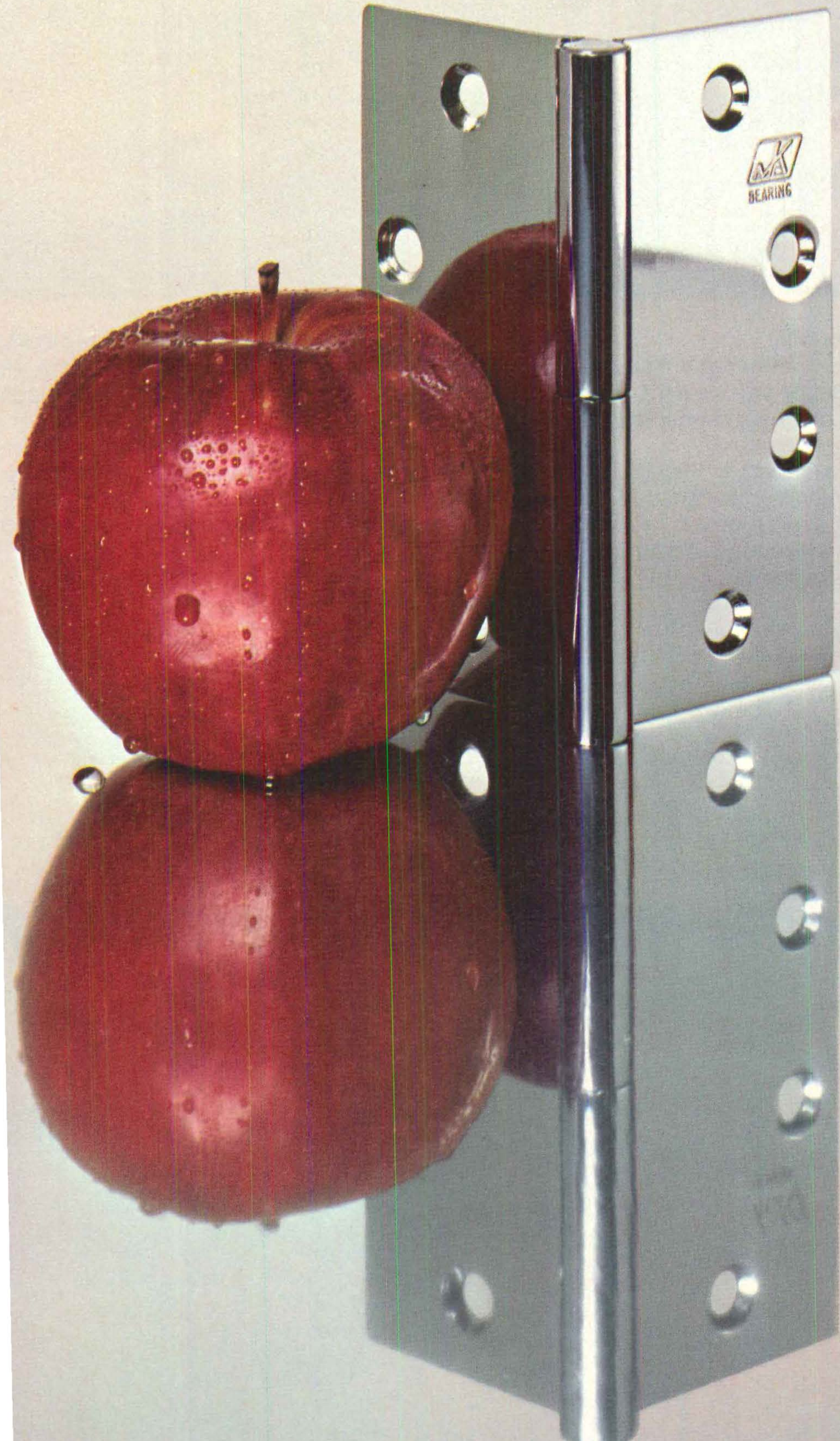
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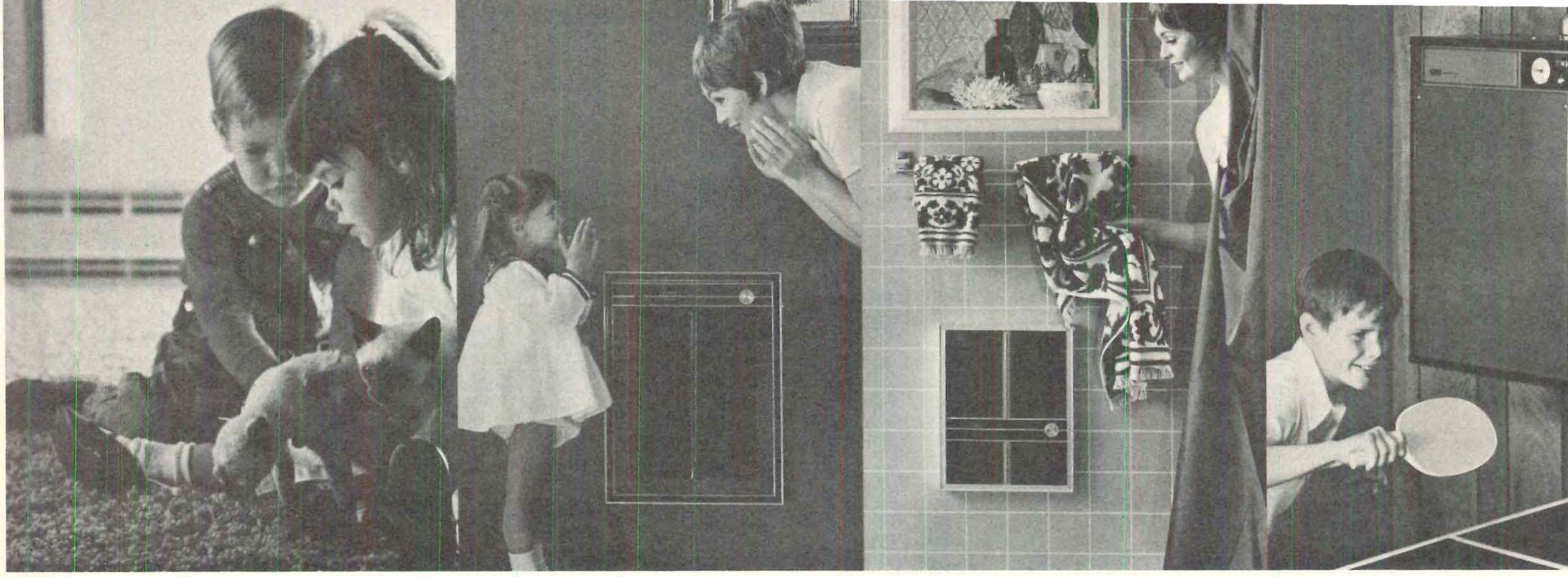

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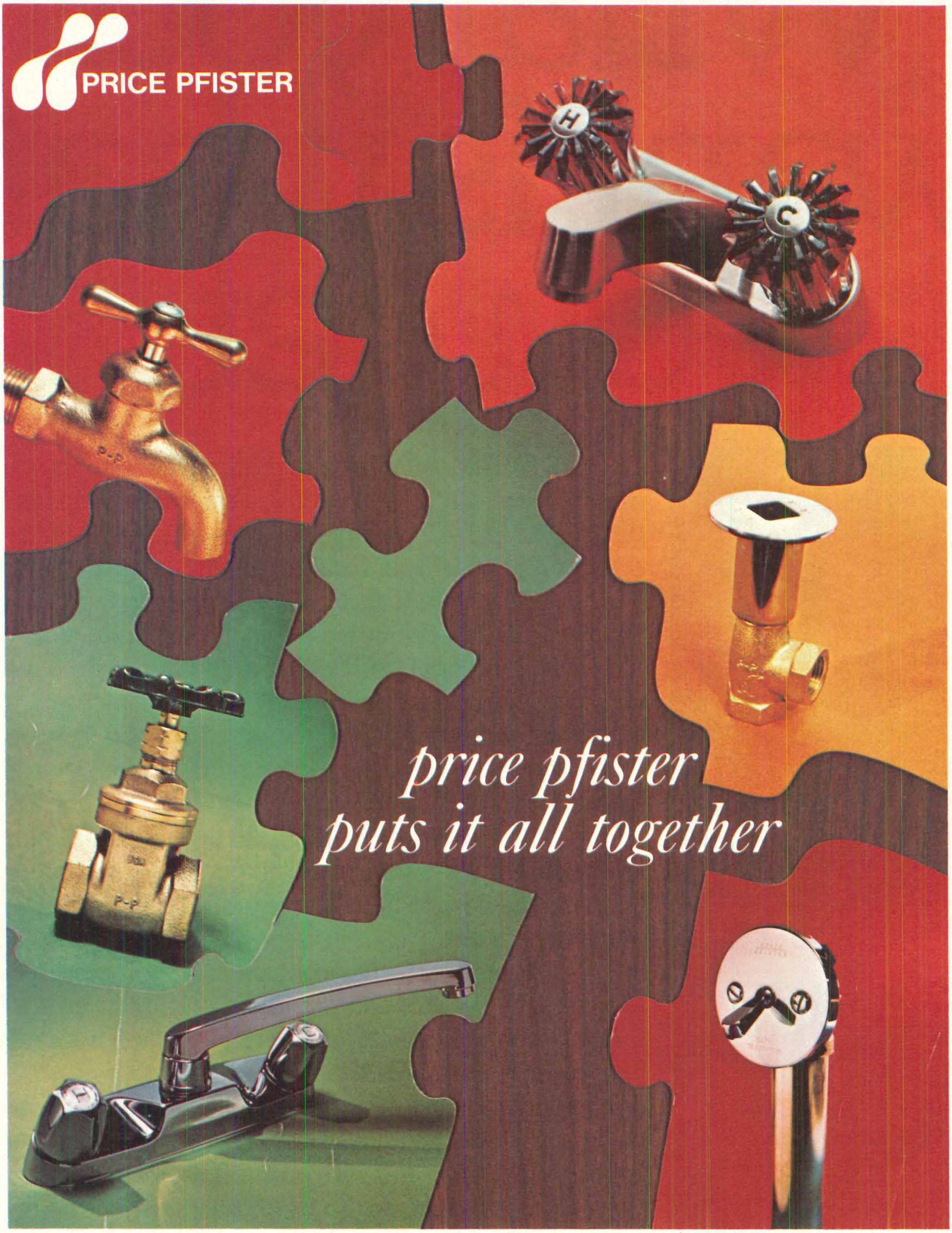
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essive Architecture: Editorial

ghting design

mber 1973

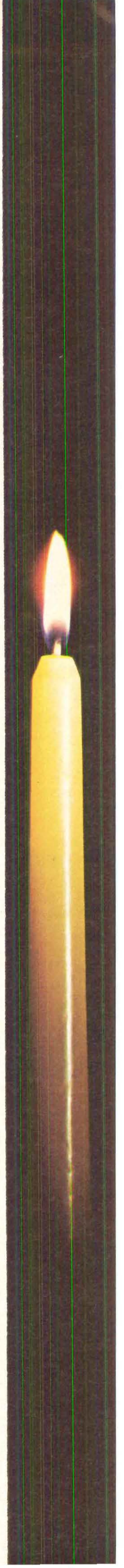
ay the lights went off. It happened again this summer: a om the utility company to please turn off the office lights djust the air conditioning. For two days the women wear their summer dresses without sweaters and the happily discarded coats and ties. The halls, receiving spill light, became quite pleasant. While the lights had to n on in the inside offices, people on the perimeter ed the curtains, adjusted the blinds and carried on by ght. The atmosphere was strangely more friendly and eful, and we had a small satisfaction in doing something leviate the energy crisis." On the third day it rained; went the temperature, on went the lights.

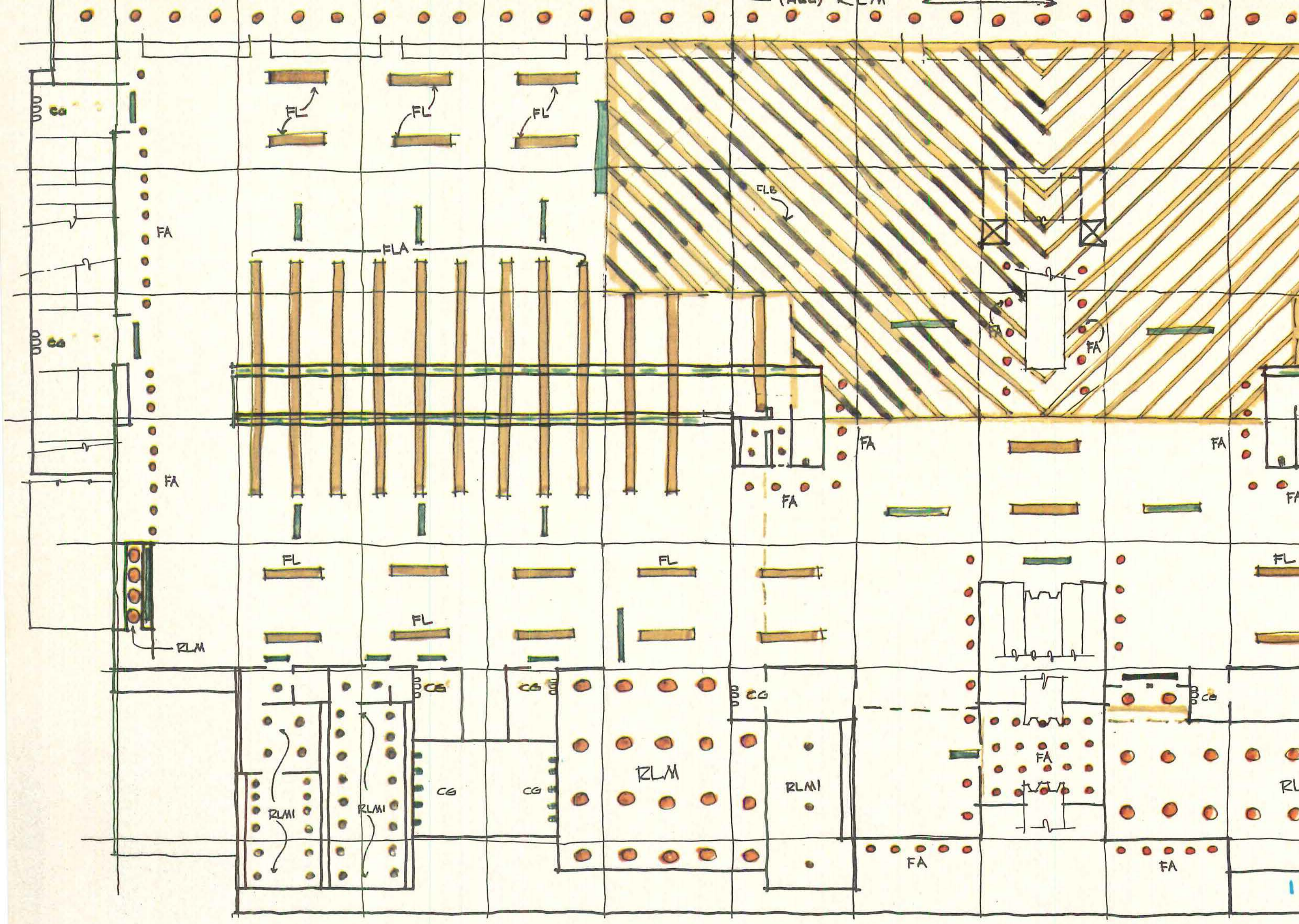
those of us engaged in putting out this special issue on ng design, it was a timely experience; theory became y. Questions arose. Do we really need frigid summer eratures? Is our building too bright? The answers are yes o. Yes, because we managed for two days and no one verheated or developed eyestrain. No, because no one ted to the return to "normal." Mainly what it proved was umans are quite adaptable, enjoying a change of atmo- e and a very minor, not-uncomfortable "crisis." People shop, live and play under conditions not of their own ng. They express acceptance or rejection of a place gh performance and use of a place.

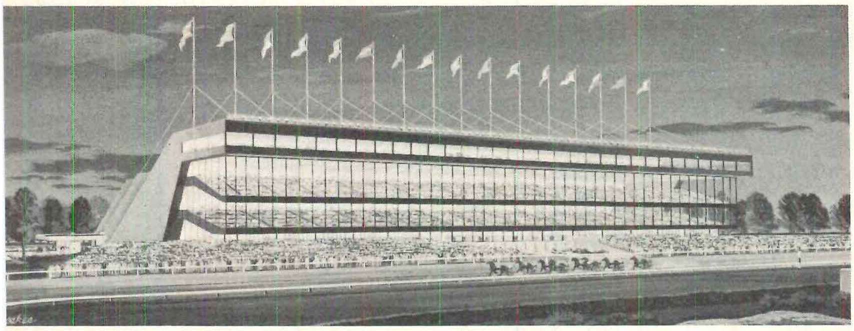
hting, of course, plays only one part in creating produc- nd/or pleasant spaces. But it has direct bearing on all factors—temperature, perception of the architecture e of place, sense of direction) and personal safety. In re- years, the quest for higher lighting levels has become as d as apple pie and motherhood. But, just as motherhood to overpopulation and there is cholesterol in apple pie, is something questionable about higher lighting levels— ly, money and the need to differentiate between actual heoretical requirements. P/A, despite the recently ex- ed fears of several persons and institutions, is not st high lighting levels, is not "for" any method or device. cognize that much of the research done over the years fectly valid, that certain recommendations for certain nstances are necessary to preserve vision and promote acy and comfort. We believe that good lighting en- es not only architecture, but the elusive "quality of life." what is "good" lighting? The criteria vary from place to , from situation to situation. It cannot be measured in watts or lumens. It can only be measured by its effectiveness, appropriateness and allowances for adjustment by the individual user, who is apt to have needs or preferences different from the average. The research must go on, the body of knowledge must grow. Facts must be separated from opinion, scientific criteria from subjectivity. Probably the most important input will come from the lighting designers—those who earn their livings by mixing scientific principles, technical know-how and educated tastes into what becomes a technical art form, applying it to real, not theoretical, situations.

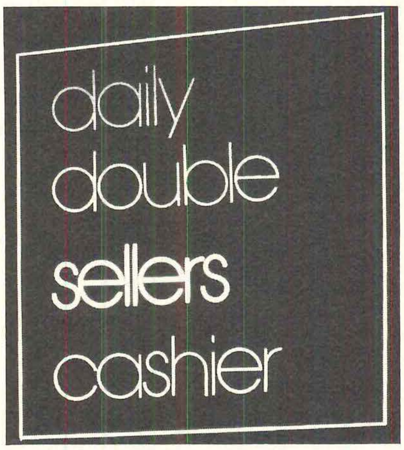
The problems of the lighting designers are like those of any other consultants: they do best when brought in at the earliest stage; they never seem to have enough money allocated to them; everybody, including the client's wife, is an "expert." The growth of the lighting design profession, which is still relatively new, will depend on how the practitioners handle themselves, their problems and their commissions. Their trend seems to be towards nonbright (if not nonvisible) sources, variable lighting for variable situations, and more effective light per watt. One client, an architect, offered the supreme compliment to the lighting designer he met accidentally in an almost-complete project: "I hadn't realized the place was lit yet, until I saw you here."

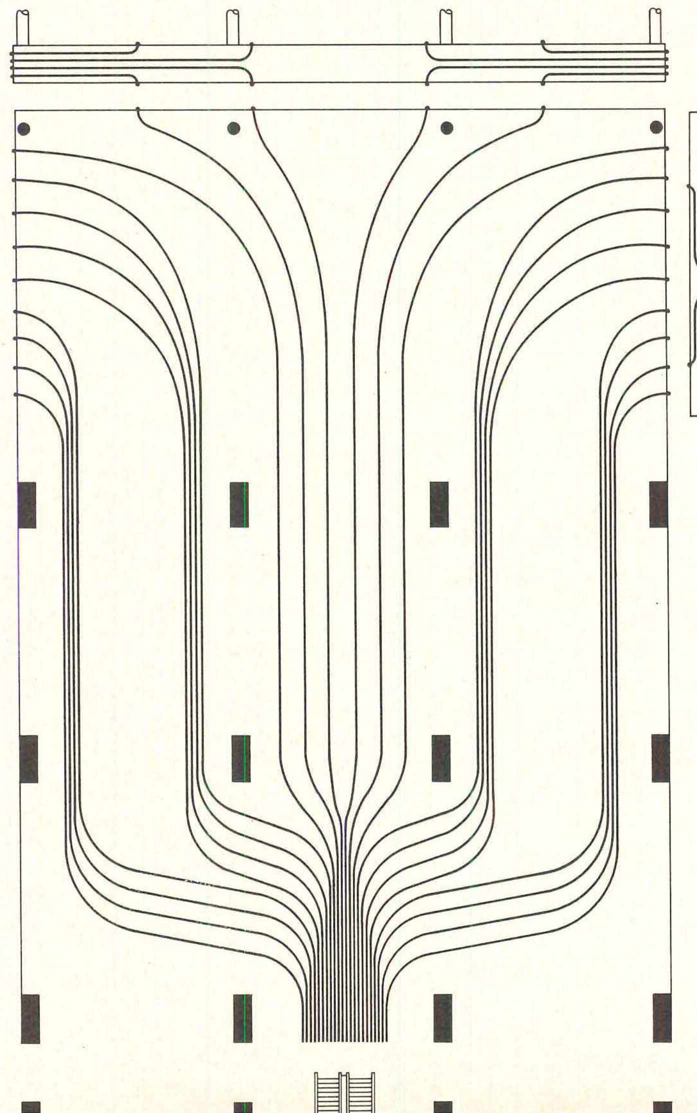
Every group of specialists has its passionate participants, those who fervently argue the finer professional points, insisting that their knowledge, method, viewpoint and expertise is *the only* way. The lighting profession has more than its share of them, and because most have a vested interest—whether it be method, means, scientific principle or product—the independent lighting designer is in a good position to cut through the dogma, often-conflicting facts and opinions. The lighting designers, whether independent (as most of the ones represented in this issue are) or working within an architectural, engineering or commercial firm, have taken on a formidable task. Theirs is the job of enhancing architecture and space; delineation, direction, utility and safety, all within the ultimate goal: aesthetics. As a group, they're fascinating. Like other consultants they have clients to satisfy, budgets to meet, egos as well as families to support. But they're human. Like all of us, they cope. One has a conference room—in a building designed especially for him—that can't be darkened for showing slides. Another shouts after visitors using his rest room: "If the light doesn't go on, jiggle the string." [RR]



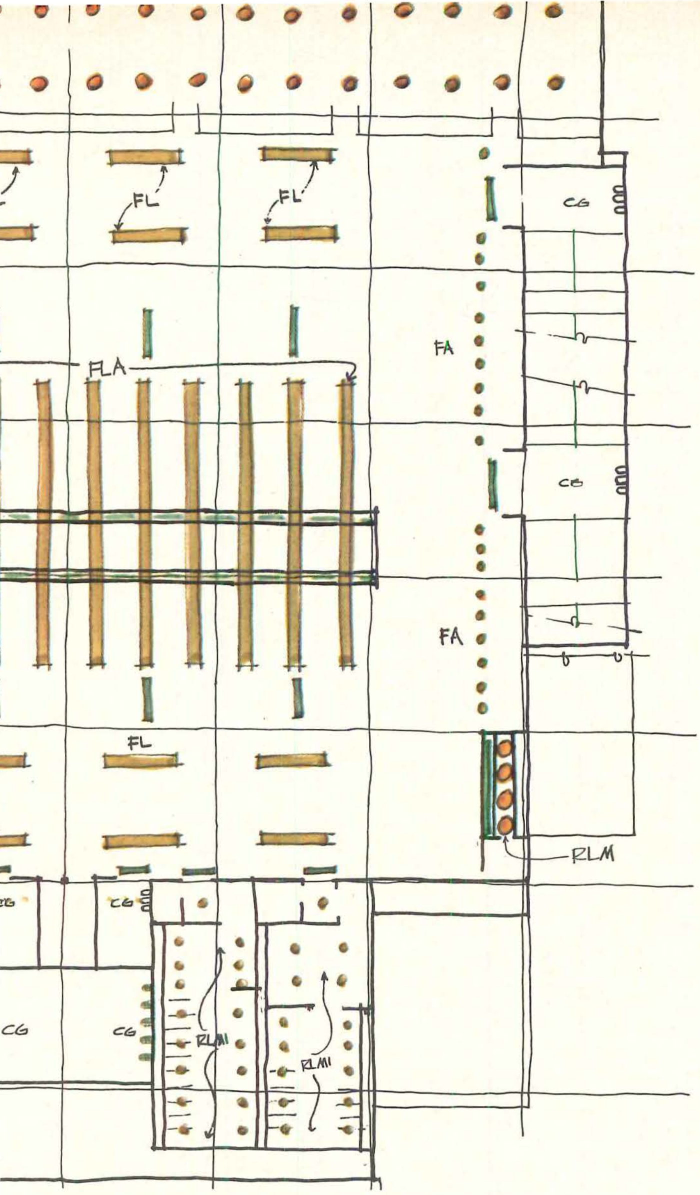








Grandstand building will have neon on the ceiling (reflected ceiling plan, right with canopy elevations) to lead people through the main entrance. Neon signs at windows can be changed according to need. At top is lighting plan of one level; diagonal fixtures are in the restaurant.



Lighting design

A profession grows up

Howard Brandston

Emergence of lighting design as a separate consulting profession is largely due to recognition that architecture and lighting are entirely dependent upon each other

Light does not exist in a void. Wave lengths of radiant energy must strike an object—a mote of dust, a building. Because architecture is both visual and functional, it requires light to be seen and to be used. And both light and architecture require the eye of a beholder.

If light reveals the space the architect has created and renders it usable, the converse is equally true: The architect's space, interrupting the beam, creates the light. Architect and lighting designer thus have a basic mutual interest.

In the hands of a skilled designer, lighting creates a planned sequence of visual revelations, clearly expressing the architect's aesthetic intent, and provides visual understanding of the functional elements of the architect's space. Lighting can, if its inherent dramatic and psychological qualities are exploited with sensitivity and imagination, add fresh visual and emotional dimensions to an architectural solution. This is not to say that the medium is the message—only that the medium can significantly reinforce the message.

Clearly, if light is so vital to the fulfillment of the architect's scheme, then light is not an added component, as it is sometimes treated, but a basic material in the architectural solution. It is at once the material that renders all other materials visible and the one material common to all spaces.

What is a lighting designer? He is not a mechanical, electri-

New Jersey Sports Complex. Brandston, who had never been to a racetrack before getting a commission to light one, spent considerable time at various tracks studying the behavior patterns of the patrons—constant motion, highly varied, with the majority following their own personal superstitions and routines. The lighting emphasis, therefore, would be on the people in a stage setting. The racing facility at the New Jersey Sports Complex, now under construction in the meadows near Hackensack, was conceived as a machine for betting. It is frankly industrial, with exposed purlins and mechanical equipment. The lighting designers followed through, using standard industrial fixtures throughout. "Industrial" was extended to include neon, in ceiling strips which sweep from the main entrance canopy through the ticketing gates, directing persons to the escalators. Neon signs, with multiple messages so that a window can be switched from "seller" to "cashier" when necessary, tell where the action is. "Event areas" are highlighted with low hanging fixtures, such as those over the queues and the chevron-patterned air-lighting system in restaurants.

Architects are Ewing Cole Erdman & Eubank/Claus & Nolen; Lawrence Kerner is associate in charge for Howard Brandston Lighting Design, Inc.

Author: Howard Brandston started out as a Brooklyn College graduate intent on a career in theatrical lighting, but soon found himself designing for a manufacturing company and then heading its research and development department. His design firm has been deliberately kept small, with Lawrence Kirnon, Maurisio Rossi and Ron Steinhilber as associates. This, he says, allows him some time to keep pen in hand, drawing preliminary concepts. Brandston is a member of the Illuminating Engineering Society, the United States Institute for Theatre Technology, the Architectural League of New York, and is a charter member of the International Association of Lighting Designers.

cal or illuminating engineer—though he is thoroughly conversant with all of these specialties. He is not a footcandle calculator—though illumination adequate for specific functions is certainly one of his concerns. He is not a fixture broker—though selection or design of fixtures appropriate to a given space is one of the services he provides. A lighting designer is what the term says he is—a *designer* whose field of specialization is light, an independent professional who earns his living solely by providing a design consultation service. The good lighting designer does not think in terms of equipment, wattage or illumination level. He thinks in terms of space.

The lighting designer's approach to his commission is—or should be—much like the architect's. He analyzes the project thoroughly. How will people first see the building and what is the first impression to be? How will the building be entered and what should people experience at this critical point? Where will people proceed to and how can their passage be made efficient, comfortable, stimulating or, perhaps, tranquil? How will the various spaces be used and what mood should each convey? Always: Does the lighting help the architecture fulfill its function? Such analysis applies to a high-rise office building or a single-story dwelling, to a roadway or a comfort station along the route.

The lighting practitioner has not always been a lighting *designer.* As a separate and distinct professional service, lighting design has evolved over the past four decades from a minor speciality most commonly offered by sales representatives (but not infrequently practiced by unqualified "consultants") to its present status as an independent discipline similar to landscape architecture, acoustical engineering, graphic design and other professional services.

If the experience of my own firm is typical, the lighting designer receives half of his commissions from the owner and half from the architect. The ideal arrangement is selection by the architect (who will feel more secure with a lighting designer of his own choice) and payment by the owner, with whom the lighting designer negotiates his own contract.

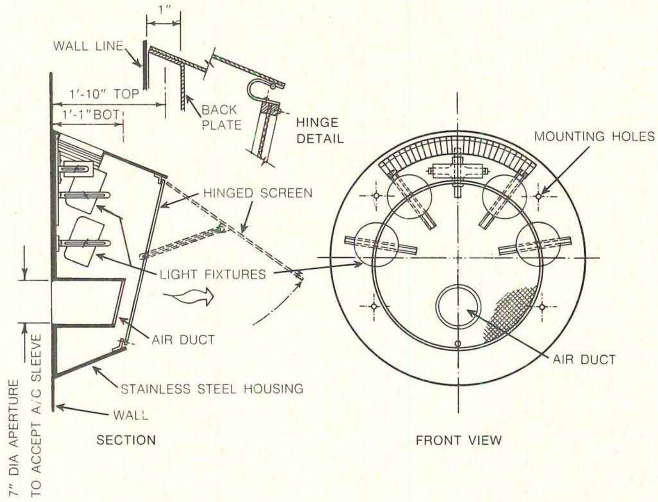
Fee arrangements vary, the most common being (again using the experience of my own office) 1) upset fee and hourly rate, 2) flat fee with schedule of payments contingent on job progress, 3) flat fee with monthly payments. Each contract is based on a proposal specifying all services.

The lighting designer should be equipped to create a lighting system for all areas outlined in the contracted scope of work, following consultation with the architect, landscape architect, interior designer and graphic designer. He will also consult with the electrical, structural and mechanical engineers on all phases of electrical design affecting the lighting plan. He should perform the following services:

1 Provide complete lighting plans for all spaces outlined in the scope of work, showing location and type of all fixtures necessary to complete the lighting system.
2 Prepare a dimmer or control diagram as required by the lighting design.
3 Prepare a lamp schedule using currently available lamps.
4 Prepare scale drawings or specifications suitable for competitive bidding of all fixtures shown on the lighting plan.
5 Prepare dimmer specifications suitable for competitive bidding on all dimmers shown on the lighting plan.

Insurance Company of North America. The design problem at the INA annex building in Philadelphia was to illuminate its spatially complex lobby as a "big room" yet provide variety and some directional clues for persons entering it. The designers chose to place "big objects" on the walls as the source for both lighting and air conditioning. The "objects" are duct outlets with multiple lamps and a screen to hide them visually but permit free distribution of both light and air. Light patterns cross and reinforce each other, giving an uneven pattern. At the mezzanine level, cold cathode provides an extra interplay of light, shadow and form. There are no ceiling sources—the designers felt that any version of the chandelier was inappropriate to the "room" concept. Within the fixtures, PAR lamps are used for downlight, tungsten halogen for uplight, all aimed for bounce, not direct, illumination.

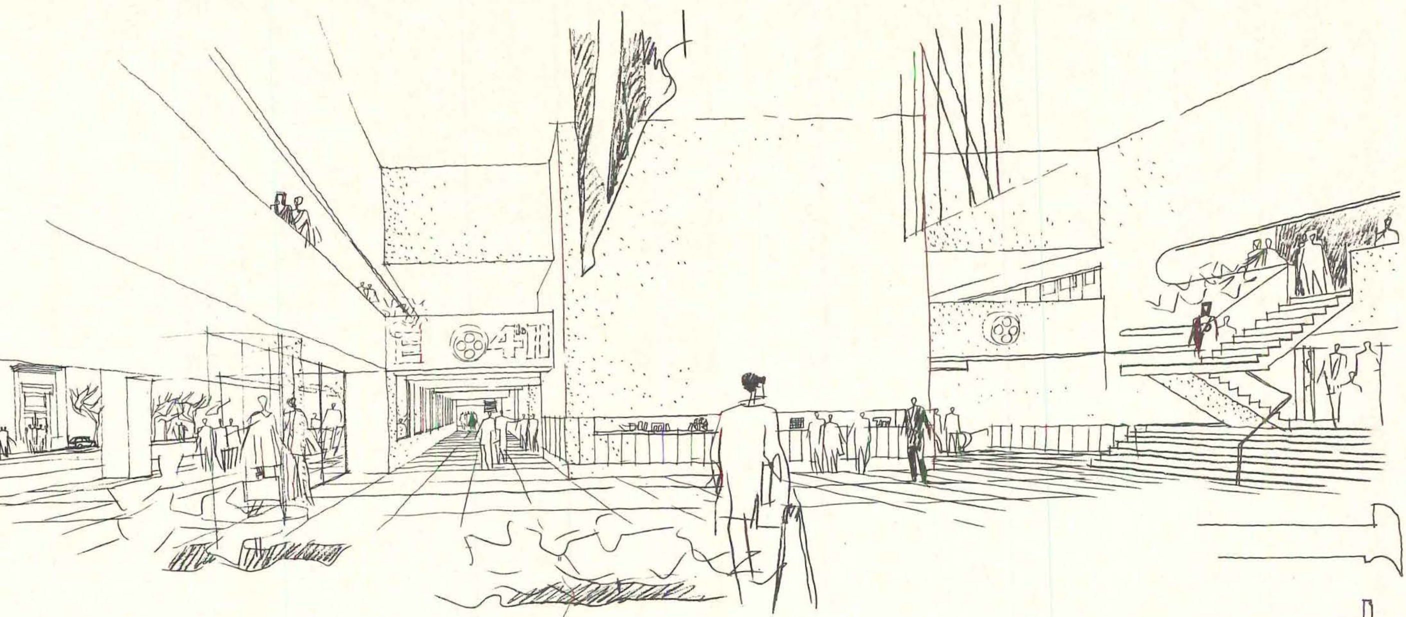
Architects are Mitchell-Giurgola; Lawrence Kerner is associate in charge for Howard Brandston Lighting Design, Inc.

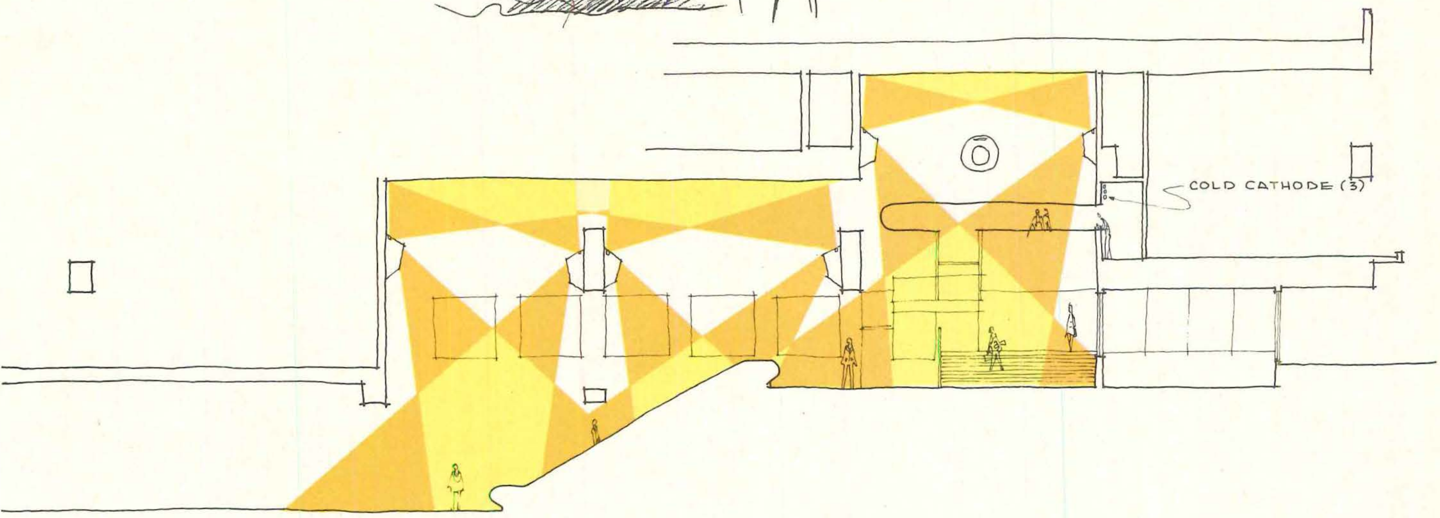


Special air/lighting fixture designed for INA.

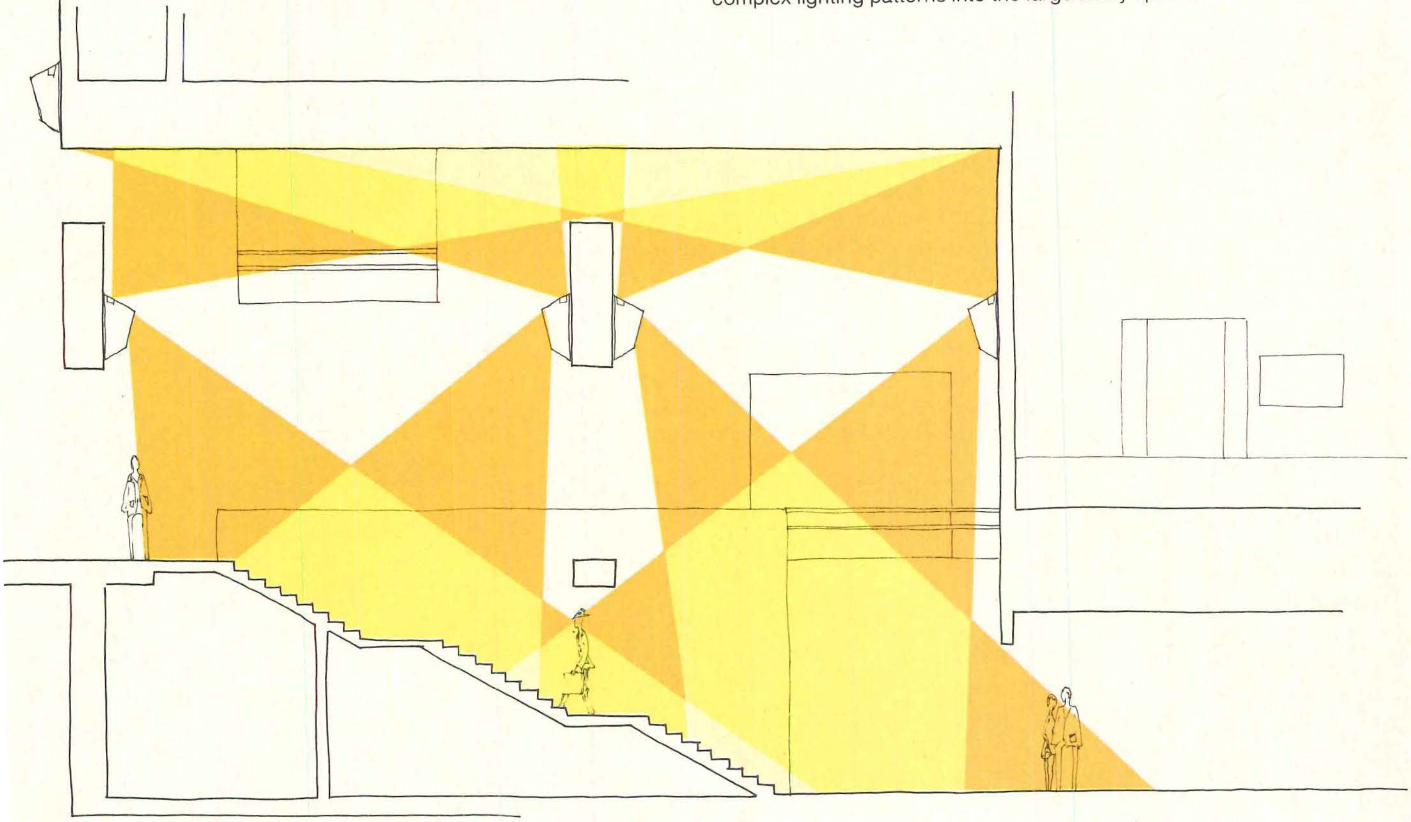
6 Prepare a budget estimate on specified fixtures and dimmers.
7 Check shop drawings of specified fixtures and dimmers.
8 Supervise and inspect all work as requested. (Supervision by the lighting designer should be distinguished from the continuous personal superintendence by the contractor.)
9 Furnish all information available about the lighting system, including calculations, mock-ups, renderings, etc.

Because lighting is so important to the architectural solution, the lighting designer should be a full working member of





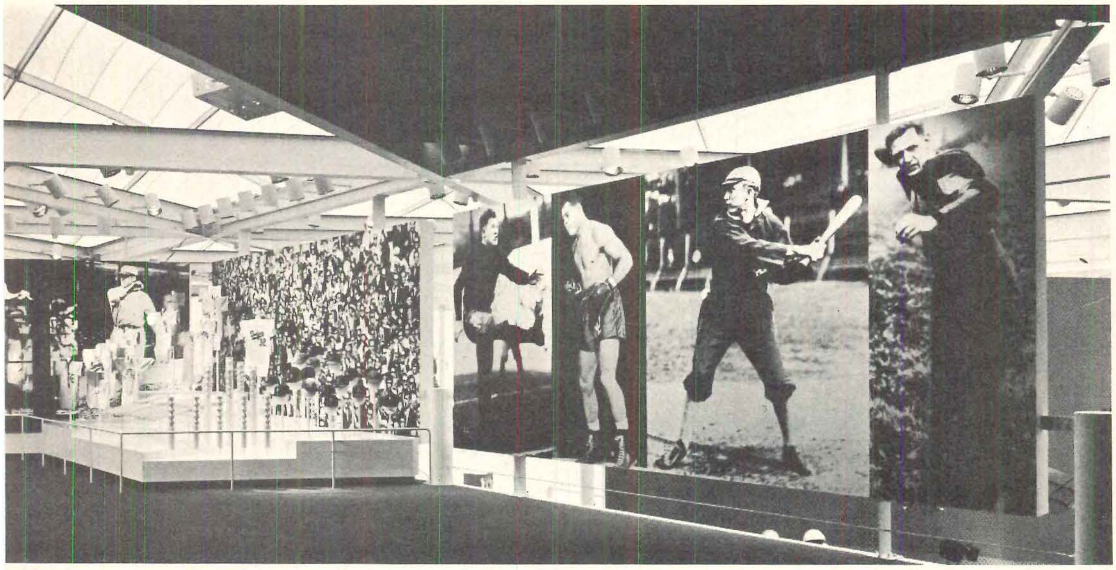
Special air/lighting units mounted on the walls are used instead of ceiling fixtures; they throw complex lighting patterns into the large lobby space.

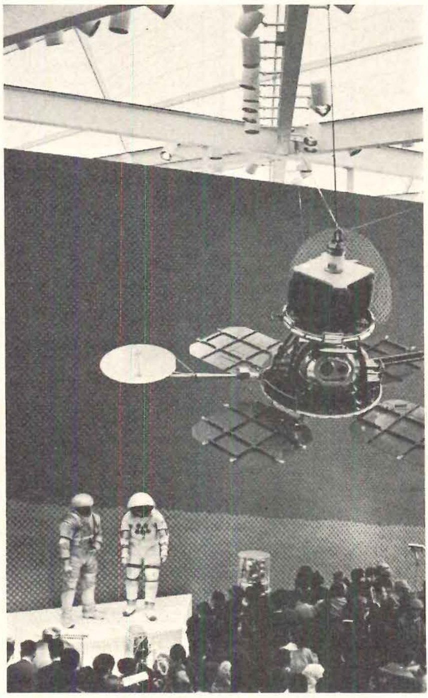


the design team from the outset of a commission. To limit his range of solutions through controls set by feasibility or preliminary design studies in which he has not participated is to risk incorporating dubious expediencies or courting expensive changes to achieve the optimum solution.

In practical terms, lighting affects heating and air conditioning requirements and, in certain situations, structural requirements. Light sources and air conditioning ducts frequently vie for the same space. Failure to establish at the outset various lighting system criteria—watts per square foot, ceiling heights, restrictions on crossovers, requirements for mechanical and electrical closets, etc.—invites problems later on. Where the architect, lighting designer, structural engineer and mechanical-electrical engineer are working together throughout, and where the role and responsibilities of the lighting designers are clearly understood by all members of the team, there are fewer conflicts and cross-purposes; design-engineering decisions may be coordinated at every stage to generate a smooth-flowing operation, a logical progression of drawings and, ultimately, a successfully and economically executed project.

Worthy of special mention is the lighting designer's role vis-a-vis the general contractor and the electrical subcontractor, who sometimes look upon lighting specifications as the key to sound family financial planning. Lighting fixtures are particularly vulnerable to price-shaving and to the substitution of equivalents which are not precisely equivalent. The reason for this stems from the nature of the lighting industry itself. It is replete with small operators competing fiercely for contracts. This affords advantages, of course, but it can also lead to abuses. To assure that the integrity of the design will not be compromised, the lighting designer must approve all shop drawings and sample submittals pertaining to the system, and it must be clearly understood that he has the right of refusal.



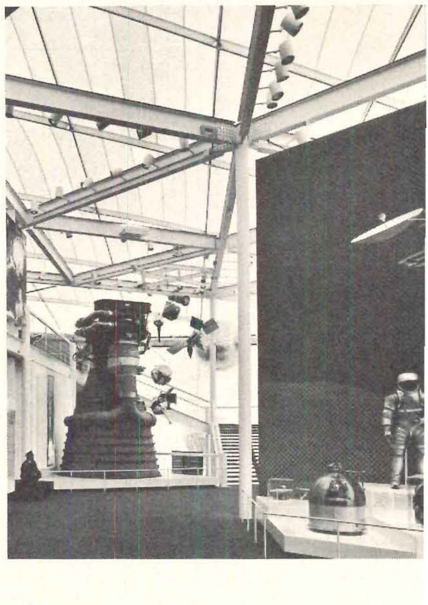


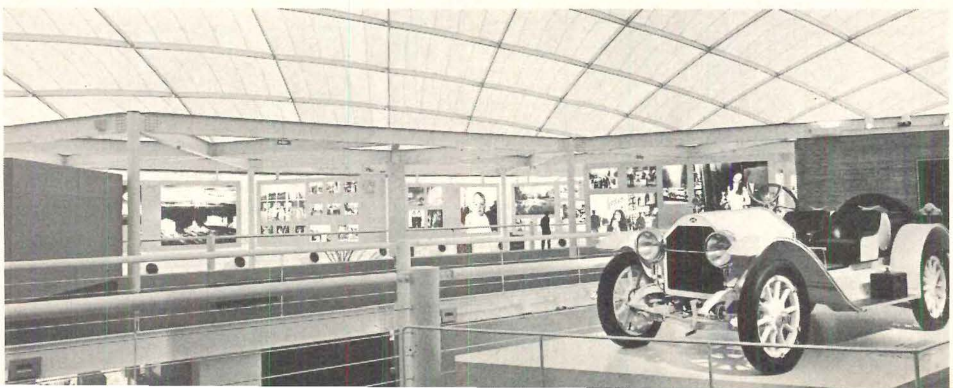
U.S. Pavilion, Expo 70. Lighting the U.S. Pavilion in Osaka differed from lighting any exhibit only in scope: illuminate each object but not the crowds. Each item—and there were thousands—had to be considered separately, each plane and the angle of the source determined.

The major design problem, however, was the translucent roof, which transmitted 400 footcandles by day and nothing at night. The system had to work steadily under both conditions, as, due to severe budget restrictions, there could be no dimming or multiple switching, no imports from the U.S. Uplights maintained the luminosity of the roof at night, and to prevent the monotony of this overpowering luminuous ceiling, these lamps were varied from warm to cool—clear, white and deluxe white mercury, depending on the area.

Use of plain PAR lamps provide excellent control for lighting the objects without spill. The system was designed for competitive bidding of existing equipment by Japanese manufacturers, and a final economy measure was to specify lamps with long enough lives to last through the entire exhibit, eliminating relamping costs.

The pavilion was designed by Davis, Brody Chermayeff Geismer deHarak; associate in charge for Howard Brandston Lighting Design, Inc. was Ron Steinhilber. Photos: Shunk-Kender except top right, Tom Geismar.

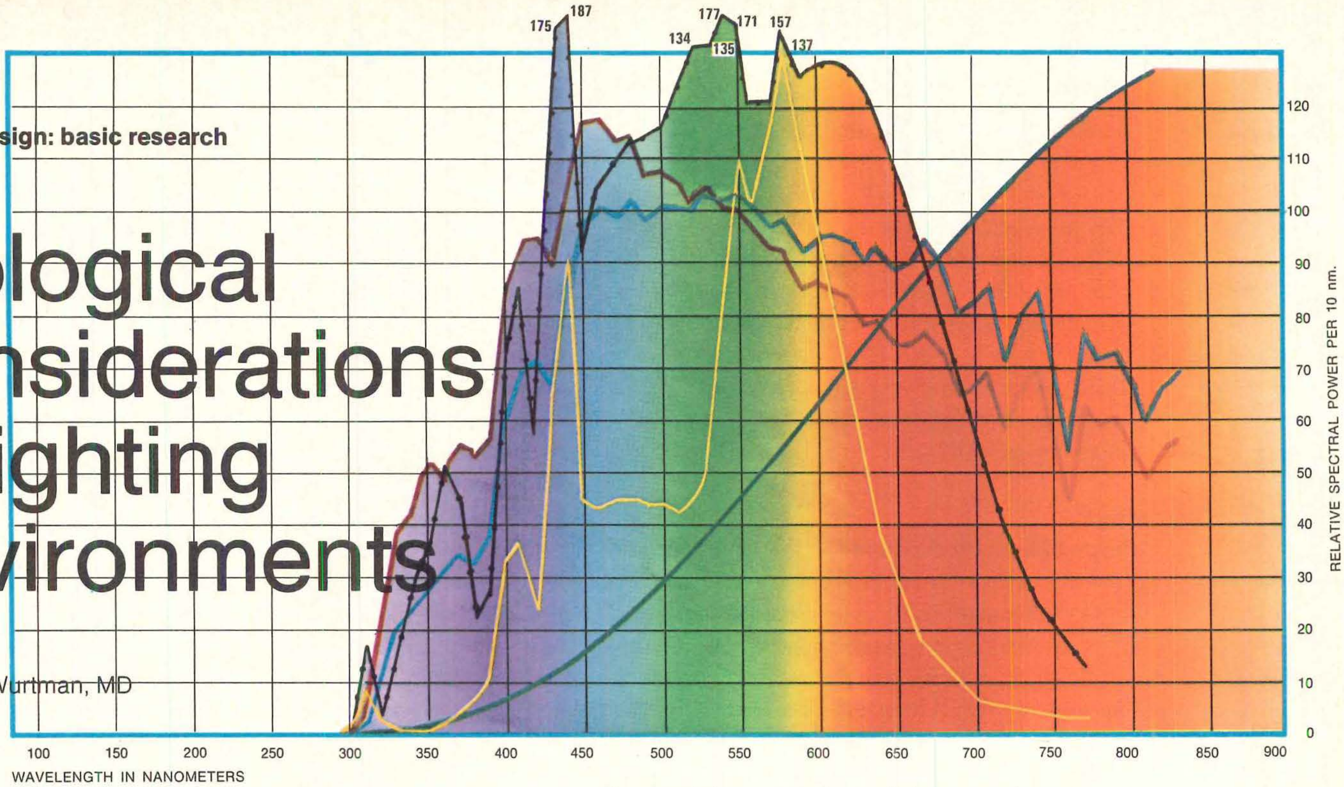




.ighting design: basic research

Biological considerations in lighting environments

Richard J. Wurtman, MD



Characteristic spectra of some light sources by color temperature
Sunlight varies between 5500 K (blue line) and 6800 K (red line); incandescent is shown as green line, cool-white fluorescent as yellow, ultraviolet-enriched fluorescent as black line with dots.

Biomedical researchers are uncovering facts proving that fresh air and sunshine are good for you—sometimes. A few hows and whys, important to lighting design, have been discovered, and much more is yet to be learned

The traditional concern of architects and lighting engineers who design artificially lit interiors has been visual and aesthetic. Environments in which people work or study are pronounced successful if they provide adequate illumination without glare or veiling reflections. Since the brightness response of the photoreceptor cells in the human retina is most stimulated by yellow-green light, light sources are commonly used that emit the major portion of their energies in this region of the spectrum (500–630 nm). The desired lighting intensity for most ordinary occupations based on visual acuity tests, has been set at about one-hundredth of that normally present out-of-doors at midday (that is, 40–100 footcandles). Environments for recreation or relaxation have lower light intensities and lower color temperatures, i.e., more energy in the orange-red portion of the spectrum, to simulate candlelight, or perhaps a bonfire in a cave.

There is now abundant evidence that environmental lighting exerts important effects upon human health and productivity, far beyond its requirements for vision. (Even the visual effects of light depend upon more than brightness: the poor color rendition of most artificially lit interiors provides a major source of errors to physicians attempting to make diagnoses based upon small changes in skin color, and an annoyance to the woman who steps outside after having put on her make-up indoors.) Environmental lighting has been shown to affect humans and experimental animals *directly* or *indirectly;* directly from interactions between photons and molecules in cells or blood near the surface of the body; indirect effects, like vision, result from nervous impulses generated by light impinging on retinal photoreceptors. Light has perhaps several hundred important effects on bodily functions, but only a few dozen are currently known and an even smaller number really understood. Since these particular biological effects presumably evolved in relation to a *particular* lighting environment, i.e., sunlight, filtered and reflected by atmospheric constituents, architects, lighting designers and engineers might be well-advised to be conservative about introducing great deviations from "natural" lighting in designing the lighting environments in which people spend their working hours.

The direct effects of light on cells on or near the surface of the body include erythema (sunburn), tanning and (very rarely) an increase in the incidence of skin cancer. Over-exposure to sunlight causes an increase in the blood flow to the skin and other signs of sunburn. The damage is caused by wave lengths in the mid-ultraviolet range (about 290–320 nanometers). Wave lengths shorter than 290 nanometers could also produce erythema, but are kept from the earth's surface by the atmosphere and the ozone shield. Sunlight also stimulates pigment or melanin production within the melanocytes of the skin—tanning—apparently by activating an enzyme, tyrosinese, within the pigment cells. The wave lengths that cause tanning appear to be the same as those that cause erythema; hence, window glass shields against both reddening and tanning, and it has not yet been possible to devise a light source which will cause people to become tan without first becoming at least a little bit red.

Very large amounts of sunlight, acting over many years, increase the incidence of skin cancer within certain highly susceptible populations, i.e., the Celts of Ireland. The mechanisms responsible for this genetic hypersensitivity, however, have not yet been identified. The observation that a lifetime of exposure to the ultraviolet rays of the sun increases the likelihood of a generally curable skin cancer cannot, of course, be construed as meaning that all exposure to ultraviolet should be avoided. A certain amount of ultraviolet exposure is necessary to induce the synthesis of vitamin D within the body and, perhaps, for other medically important photochemical reactions. (The Russian government has established mandatory irradiation standards for ultraviolet exposure for people working in certain industries. For example, coal miners are required by law to receive daily doses of ultraviolet [but not enough to sunburn], presented along with white light. This is believed to decrease the incidence of "black lung," and of respiratory disease in general.)

Other direct effects

The direct effects of light on chemicals in the skin and in the circulation are currently of great interest to physicians. Three such effects will be discussed here: effects of light on vitamin D, on bilirubin, and on drugs which act as photosensitizers. It should be obvious that if environmental light affects three or four known compounds, it is just as likely to affect a much larger number of still-unknown compounds. Most researchers seem to feel that, during the next decade, the concentrations of many more circulating compounds will be shown to depend upon environmental lighting.

Vitamin D is an extremely important hormone in the body; it acts on the intestines to facilitate absorption of dietary calcium. If one drinks a glass of milk, it does not necessarily follow that the calcium in the milk will be able to pass from the gut into the blood stream, and become available to the bones and the other tissues of the body. Left to their own devices, the intestines are rather inefficient absorbers of dietary calcium, but vitamin D helps markedly. It is now known that the body can synthesize vitamin D up to a critical step. The vitamin D precursor, at this step, is transported by the blood vessels to the skin, where it is activated by light. After this photoactivation, the vitamin D precursor is carried by the blood back to the liver and kidneys, where additional enzymatic changes render it fully active. The precise wave lengths which activate vitamin D await definition. Most likely, they are confined to the near- and long-wave portions of the ultraviolet.

It is well-known that children deficient in vitamin D (e.g., children who grew up in the tenements of New York City at the turn of the century and were not exposed to adequate sunlight) develop rickets. In this disease, so little calcium is absorbed that the bones fail to calcify properly, and become bowed. Adults who fail to consume adequate calcium, or to absorb enough of this compound because they lack vitamin D, develop a similar disease known as osteomalacia. Recent studies show that if *normal, healthy* adults remain indoors for several months, i.e., during the long Boston winter, and are exposed to their customary incandescent or fluorescent light sources, which provide very little, if any, ultraviolet light, so little vitamin D is synthesized within their skin that calcium absorption is impaired. Exposing such people to other light sources designed to provide some ultraviolet can correct this.

Bilirubin. The direct effect of environmental light that has generated the greatest interest during the past decade is its capacity to destroy circulating bilirubin in premature infants. Bilirubin is a breakdown product of the hemoglobin released when red blood cells die after their 120-day lives.

In normal adults, the circulating bilirubin is destroyed within the liver. However, in adults with liver disease such as hepatitis, or in newborn infants whose livers are not yet mature, bilirubin is not destroyed, and its accumulation within the blood and tissues causes the skin to become yellow, or jaundiced. Newborn premature infants with other diseases that cause accelerated breakdown of red blood cells (e.g., an Rh blood incompatibility between the mother and the child) can develop very high blood bilirubin levels. Since bilirubin is very fat-soluble, it tends in these infants to collect within certain portions of the brain, where it acts as a toxin on developing brain cells. The resulting neuronal destruction can lead to death, or to such neurological diseases as cerebral palsy.

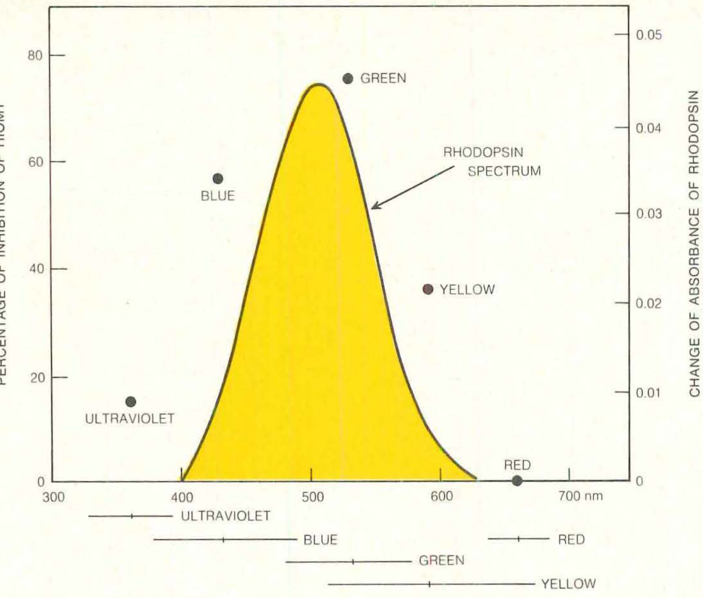
One way of treating such jaundiced premature infants is to remove all of their blood and to replace it in an "exchange transfusion." This procedure, developed about three decades ago, is highly effective; however, it has its own risks, and even some mortality. About a decade ago, according to anecdote, an English nurse observed that newborn infants whose cribs were near open windows developed jaundice less often than infants whose cribs were at a distance from the windows. This led to the discovery that light exposure could accelerate the rate at which infants could excrete or destroy circulating bilirubin. It had been known for some time that if light were shone on a pure solution of bilirubin in a test tube, the bilirubin was photolytically decomposed. Studies in England, Russia, Brazil and, eventually, the U.S., have amply confirmed that exposing newborn jaundiced babies to light for three or four days (until their livers mature) is a highly efficient treatment for hyperbilirubinemia. Indeed, many jaundiced infants are now treated in this fashion (at least 25,000 in 1972).

It still remains to be established whether or not the *mechanism* by which light destroys bilirubin in the jaundiced infant is the same as the mechanism by which light waves destroy bilirubin in solution. It is not yet known whether the action spectrum of bilirubin decomposition *in vivo* is the same as the action spectrum *in vitro,* and a great debate now rages between those physicians who would expose jaundiced babies to monochromatic blue light sources (which are most effective in destroying bilirubin in solution) and those who argue that, since the *in vivo* action spectrum has not yet been defined, babies should be treated using white light. In any case, both light sources seem to be highly effective in intensities considerably lower (100–500 footcandles) than those present out-of-doors on a cloudy day. The observation that light can be used to modify the blood levels of one chemical (in this case, a toxic chemical) is of very great theoretical importance; it suggests that multiple additional uses will be found for light as a "drug."

Photosensitizers. A certain number of widely used medicines are activated by light, yielding intermediates which can damage tissues. It is not at all uncommon for a person being treated with a particular antibiotic, for example, to develop a rash on the hands, face or other parts of the body exposed to sunlight. The rash disappears when the antibiotic is stopped.

Indirect effects

The indirect effects of light include, of course, its capacity to generate the raw material for vision; they also include the effects of light on sexual maturation, on the pineal gland and on biological rhythms. It had been known for some time that the annual rhythm in changing day length is the major factor



Effect of light on melatonin synthesis in the rat pineal gland compared to the absorption spectrum for the retinal photopigment rhodopsin. Melatonin synthesis rate is expressed in terms of the activity of a pineal enzyme, HIOMT. (Reprinted from Cardinali, D.P., Larin, F. and Wurtman, R.J.: *Proc. Nat. Acad. Sci.* 69: 2003-2005, 1972.)

in determining the time of the year that various species of birds and domestic animals ovulate and bear young. About 40 years ago, it was shown that environmental lighting also had a profound effect on sexual functions in animals that ovulate periodically during the year. If rats were exposed to continuous illumination from birth, they matured considerably earlier than animals exposed to a normal light cycle of 12 hours of light per day. Exposure to constant darkness delayed sexual maturation.

About 10 years ago, on the other hand, it was shown that the capacity to perceive light also influences sexual maturation in humans: girls blind from birth had a significant *acceleration* of sexual maturation, having their first menstrual period about a year earlier than non-blind control girls born at the same hospital at the same time. In general, totally blind girls underwent menarche earlier than legally blind girls who had retained some light perception. But no information is available on just how light perception influences these effects, except that it is probably *not* a result of the psychological stresses associated with blindness (such stresses invariably *delay* sexual maturation).

The pineal gland might possibly play a part in these effects of environmental lighting. The pineal of the mammal is a *neuroendocrine transducer.* It responds to nervous signals by releasing more or less of its hormone, melatonin, into the blood stream. Melatonin apparently acts on the brain to inhibit sexual maturation and ovulation, at least in experimental animals. The rate at which melatonin is synthesized seems to depend upon environmental lighting. In the rat, light acts on the eyes to generate nervous impulses which eventually reach the pineal. The effect of light is to *decrease* the number of nerve impulses, inhibiting the synthesis and release of melatonin. Animals exposed to continuous light for three or four days have less than a fifth as much melatonin-forming enzyme in their pineals as animals kept under normal lighting conditions. The action spectrum for this effect of light on neuroendocrine function appears to be the same as the action spectrum for vision, i.e., yellow-green light is most effective in inhibiting melatonin biosynthesis.

It should be noted that the effect of light on the pineal is *not* direct; the pineal responds to light because light, acting through the eyes, modifies the number of nerve impulses that reach this organ. The pineal is *not* a photoreceptive structure, like the retina. In lower vertebrates, such as the frog, the pineal *is* photoreceptive; it constitutes a genuine "third eye" on the back of the head. However, with evolution, the pineal has lost this function: instead of responding directly to light and *sending* nerve impulses to the brain, it *receives* nerve impulses from the brain that tell it about the lighting environment. These impulses cause it to release more or less of its gonad-inhibiting hormone. (The nerves that carry light-dependent instruction from the brain to the pineal also run to the parotid gland, a salivary gland. Recent studies have shown that the rate of saliva formation in humans also depends upon the availability of light: salivary flow is minimal in darkness, but attains near-maximal rates when people are exposed to as little as 0.1 footcandle of light.)

Biological rhythms are also indirectly affected by light. In normal adults, there is a definite rhythm in body temperature, usually from about 97.6 F on awakening at 7a.m., to 98.6 F by midafternoon. This rhythm seems to depend on environmental lighting; if subjects are forced to live under light at night and kept in the dark in the daytime, the temperature rhythm will shift 12 hours. The action spectrum for this effect of light also seems to be the same as that for vision, at least in the laboratory rat. A vast number of other physiological functions in humans have a 24-hour rhythm which is largely dependent upon the daily cycle of light and darkness.

Designing without enough knowledge

Most of the above information about the biological effects of light has been accumulated only during the last decade. It seems likely that much more information will become available during the next decade. Meanwhile, knowing only that we do not know enough, architects, lighting designers and engineers will have to continue to decide on the lighting spectra under which most people will live.

It seems reasonable that the light sources to which we expose people should not deviate markedly from the lighting environment under which people evolved in nature. The fragmentary data now available suggests that working under such "natural" conditions significantly decreases visual fatigue, and may also increase productivity. I, for one, would worry somewhat about keeping my children under, let us say, pure green light, or, of more immediate concern, yellow sodium light, even if it can be shown that the brightness indices of such lights are greater than that of existing broad-spectrum light sources. I suspect that all one can do is hope that new information about biological effects of light accumulates as quickly as possible, and that such information is applied on a continuing basis in the design of light sources.

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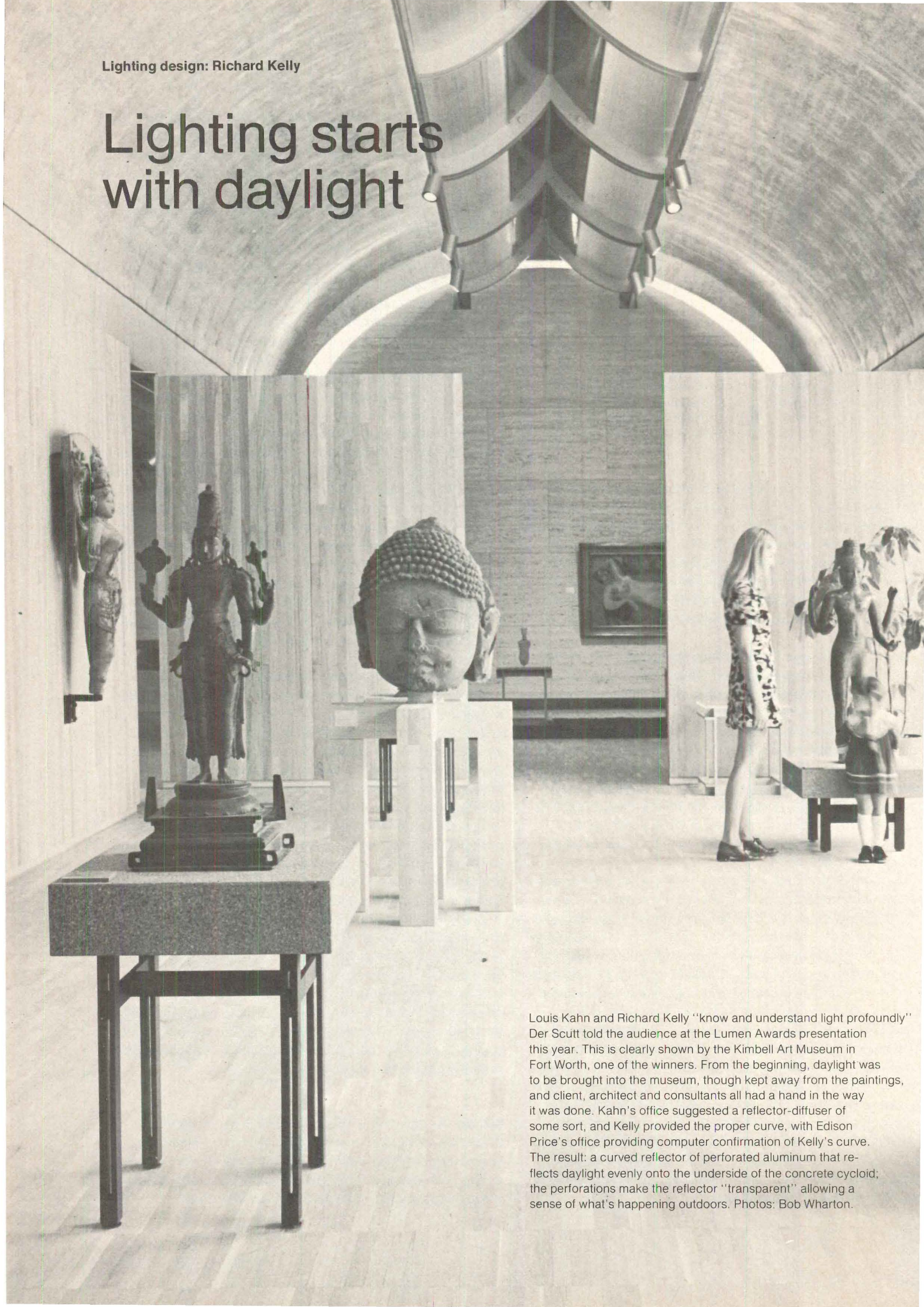
Lighting design: Richard Kelly

Lighting starts with daylight

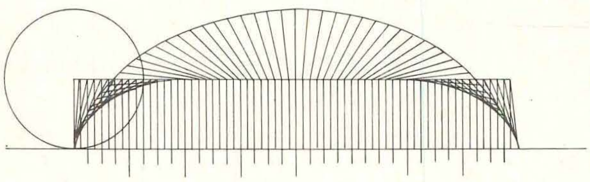


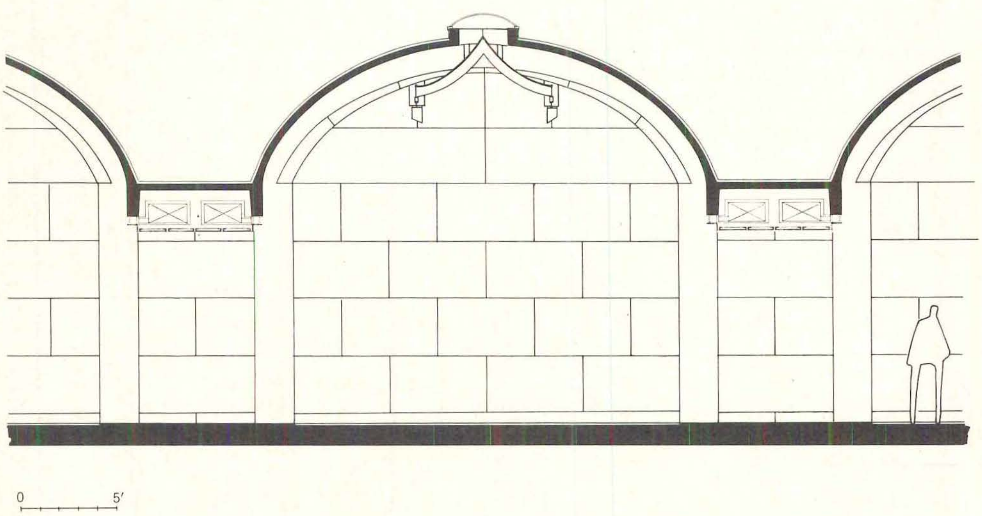
Louis Kahn and Richard Kelly "know and understand light profoundly" Der Scutt told the audience at the Lumen Awards presentation this year. This is clearly shown by the Kimbell Art Museum in Fort Worth, one of the winners. From the beginning, daylight was to be brought into the museum, though kept away from the paintings, and client, architect and consultants all had a hand in the way it was done. Kahn's office suggested a reflector-diffuser of some sort, and Kelly provided the proper curve, with Edison Price's office providing computer confirmation of Kelly's curve. The result: a curved reflector of perforated aluminum that reflects daylight evenly onto the underside of the concrete cycloid; the perforations make the reflector "transparent" allowing a sense of what's happening outdoors. Photos: Bob Wharton.

To Richard Kelly, who has designed lighting for many of the architectural landmarks of recent years, lighting is the central part of architecture, and it starts with daylight

If there is anyone who might be ungrudgingly acknowledged as the dean of American lighting designers, it would probably be Richard Kelly. His credentials are certainly in order: he has been designing lighting since the 30s when nobody made a living designing lighting; his credits include many of the most important buildings of the recent past; and the architects he has worked with make up a Who's Who in Architecture.

There are almost as many theories and approaches as there are lighting designers, and Kelly is probably most closely identified with daylighting. "I've been involved with it for an awfully long time," he says. "I first became interested because night lighting really affects a small part of our lives. Daylight is part of our way of seeing: we see things because of the way our ancestors saw; our sense of color is based on





daylight. And architectural form always seems to be related to daylight."

Once you get inside a building, Kelly says, it is daylight that focuses the room. Office buildings, where only executive offices have windows, are an exception, as are motels—they are essentially night-time spaces. "But traditionally a room is organized by the importances created by daylight; electric light is supplementary. So we have to study brightness patterns from daylight, even to light electrically. The handling of forms, the meaning of a room have to relate to daylight."

Consider two museums for which Kelly was the lighting designer—the Kimbell Museum in Fort Worth and the Paul M. Mellon Center for British Studies at Yale University. The Kimbell Museum, says Kelly, is "a great big museum built from scratch, with a collection started from scratch. Lou [Kahn] very excitedly thought of a structure of long barrel vaults, which opens up space and allows for change; there are no columns or walls to limit space. The vaults span 100 ft, and because 20 ft has been established as a good dimension for a room in which to view paintings, they are 20 ft wide, with 10 ft between them. Since everybody wanted the feel of daylight in the museum (the Museum of Modern Art, for instance, is almost hermetically sealed against daylight in the exhibition areas), the vaults are slotted to let in daylight. Right away there's a problem—contrast—as the slots would always be in the line of sight in barrel vault construction."

The other problem with daylight is that it is anathema to museum directors. Light of any kind is destructive to paintings, and daylight is the most damaging of all. "We wanted daylight, but we couldn't let any daylight reach the paintings." Kelly solved the problem by devising a reflector under the slot that throws the daylight onto the underside of the concrete vault. The reflector was designed, with a computer, to a special curve (a cycloid—generated by rolling a circle) to give completely even light on the vault, and fabricated from perforated metal—"transparent metal"—so the sky can be discerned, if not seen, from inside the museum. The daylight comes through at about 1/20 to 1/40 of natural brightness, but isn't important to seeing. Electric light is for seeing: it creates the focus, and the reflected and diffused daylight creates a low ambience overhead that doesn't distract. And no daylight damages the paintings.

For the Mellon Center at Yale, the program was different. "The paintings are English and again everybody wanted daylight. This time we decided to light them with daylight."

It seemed to Kelly that perhaps the elevation of the sun might be used to some advantage, with inverse shielding. After eight or nine months of computer calculation, he developed a "kind of unit louver to create a sun shadow pattern on a diffusive material that then becomes the source of daylighting for the paintings." Mocked up and tested during the past year, the louver seems to do the job. "As it stands now," Kelly says, "daylighting will be the prime light source for viewing paintings. Electric light will be used only at times when there's not enough daylight, primarily a few periods during the winter. The damage factor has been brought below that for incandescent lighting; in fact, the damage factor is lower than in any gallery ever built." When the museum is not open, the sunlight can be "turned off" with movable blinds.

Lighting as artifice

As both museums suggest, daylight is an integral part of Kelly's approach to lighting. In fact, it is such an integral part that he will seldom be heard to say "artificial lighting" when he means "electric lighting." Once daylight has been manipulated—reflected, for instance, or diffused—it becomes "artificially used daylight, daylight used with artifice."

Using light with artifice calls for the manipulation of three basic kinds of "light energy impacts" identified by Kelly more than 20 years ago. Each has its own characteristics and can be organized for almost any desired reaction.

"Focal light is directive, creates a bright center; it tells us what to look at, organizes, marks the most important element. It creates a sense of space; you can organize depth through a sequence of focal centers." Background light, or luminous ambience, is somewhat the opposite. "The best example is a foggy day on a mountain top. There is an even glow without incidence all around; there are no shadows, nothing to tell you what to look at. In that sense it's confusing, but it is also relaxing and restful, as there is no excitement, no interest. It minimizes man—think about a figure moving through that fog—and destroys form." Scintillation is Kelly's substitute for a term he originally borrowed from the jewelry business—the play of brilliants. "It is a tiny microscopic bombardment of points of light—the most exciting kind of light there is. It stimulates and arouses appetites of all kinds: chandeliers in dining rooms, sequins on dresses, lights on theater marquees all take advantage of the fact."

Lighting, says Kelly, is really just planning what we see; what we see and how we respond to it can be organized by mixing the various light energy impacts. "Going back to the focal glow for a moment," he says, "if interest is all drawn upwards, the result is formal, as in a cathedral, or even a corporate office, for a less extreme example. The most extreme result would be the feeling of frustration that might come from being at the bottom of a well. Reverse things, put the interest beneath you, and the result is very informal, like a clear bright day at the beach."

Lighting consultant as consulting architect

Kelly, who says he was always excited by architecture, sees himself as a consulting architect. "The very idea of lighting being just the plotting of electric outlets is so very depressing that I often tell people I'm a specialized architect rather than a lighting designer." He came into the business at an early age—between high school and college. He had skipped his high school commencement to come to New York to see a Eugene O'Neill play and stayed on. To support himself, he took a job designing lighting fixtures—his first job—and entered Columbia College the next fall. There he did a double major, physics and math, and English literature. Two years after graduation he opened his own office and was in business designing lighting. "There weren't lighting consultants then. Nobody would pay for my ideas, but they would buy fixtures, so I designed lighting and I designed lighting fixtures which I made and sold."

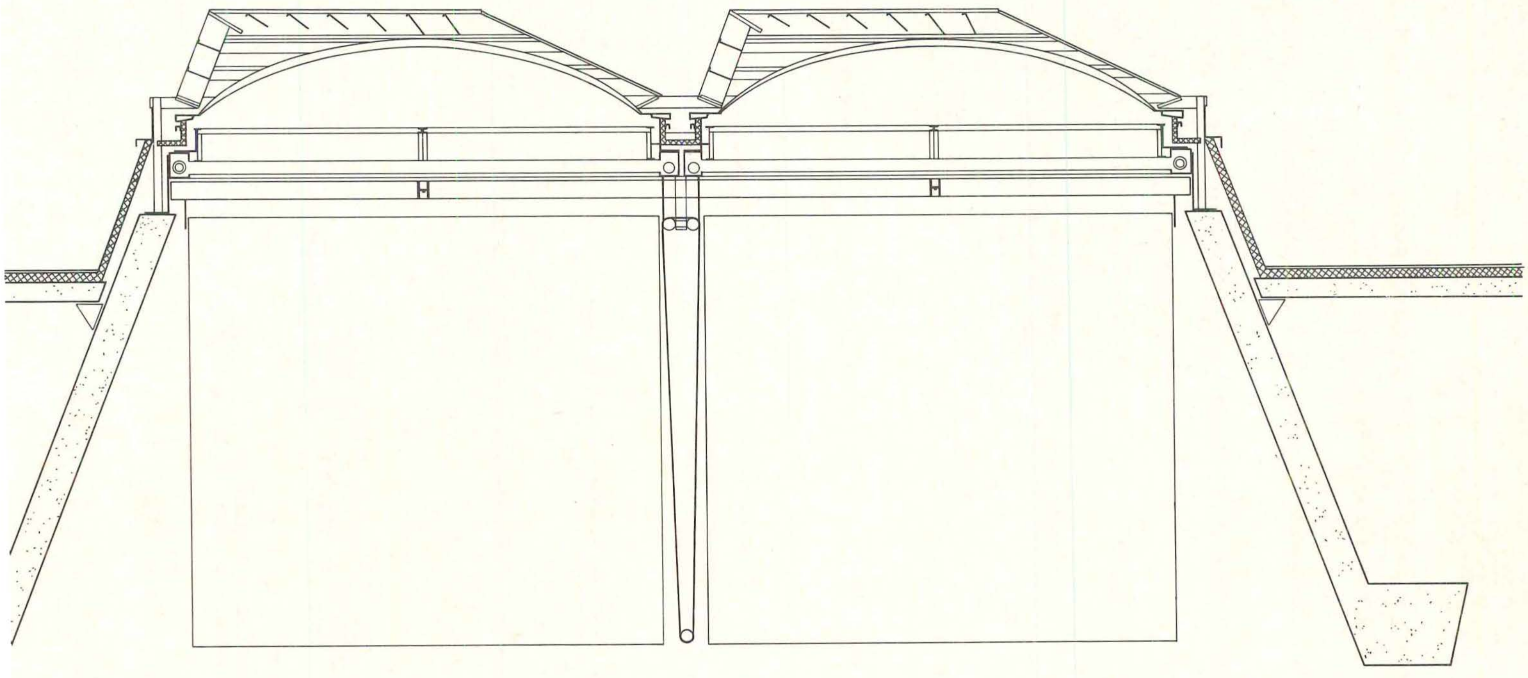
When World War II forced Kelly to close his office, and a medical problem kept him out of the military, he went back to school, this time to Yale, where he studied architecture

"Then I could talk back to architects"). Shortly after he fin-
shed at Yale he reopened his office, no longer selling fix-
ures, but working for fees as a consultant, which is how it has
been ever since.

Even a partial list of projects is impressive: Seagram Build-
ng, Lincoln Center (theaters and outdoors, except for the in-
erior of the Metropolitan Opera), Dulles International Airport
site, runways, terminal), General Motors Technical Center
"the equivalent of a Rennaissance Palace in today's econ-
omy); the Museum of Modern Art ("when they had their fire, I
had already done a great deal of the lighting design; then I re-
did the whole thing"), Philadelphia Academy of Music (it was
being redone for its centennial in 1956, and the aim was to
make it look like it did in the beginning; the trick was to put in
modern lighting without making it obtrusive), the St. Louis
Arch, Philip Johnson's glass house, Place Ville Marie in Mon-
treal, Toronto City Hall, the Capitol of Hawaii in Honolulu, the
Readers Digest Building in Tokyo. And his biggest single
job—lighting for the harbor of Rio de Janiero. "The basic in-
novation was precast concrete poles with the lights shielded
so you can't see the source at night. The effect is an intense
moonlight, man-made, of course, that is unevenly distributed.
There are football fields that have no other lights, and there are areas that are less bright; there are no streetlights." Kelly also did a lighting plan for Sugar Loaf Mountain, but it hasn't been executed yet.

These days, Kelly works out of his apartment—he used to have an office and a staff, but now he works with an engineer who is called in on jobs, and few other regular helpers. "Lighting is the central part of architecture, not separate from it," he says, "and it has to be done in the architects' office." Like most consultants, Kelly feels the lighting consultant should be on the job early, "before design is started—it's in the writing of the program that the lighting consultant is needed."

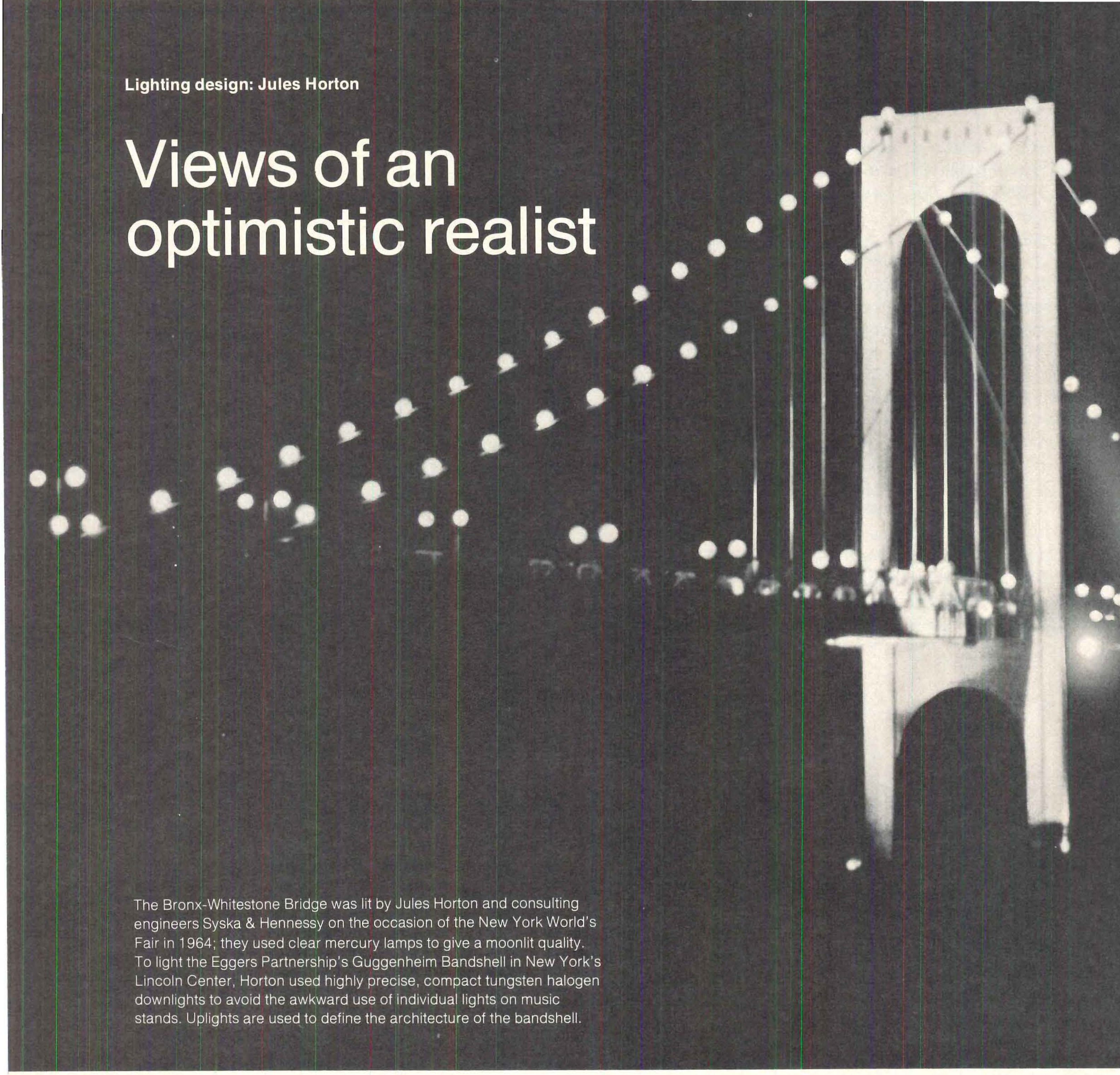
Writing the program has changed greatly in the past 30 to 35 years, Kelly says. "The amount of research that has gone on in the more mundane elements of lighting is enormous. The architect hasn't the time to know enough to really design light, or to know what new things can be done. Programs are often written on the basis of what used to be needed, with no awareness of today's unknown possibilities." To Kelly, the ideal solution is to "identify what great things could happen and then make the program encompass them." [CP]



nother Kahn/Kelly collaboration is the Mellon Center for British Studies
eing built at Yale University. This time, however, the emphasis on
aylight is different: it is to be the primary light in the museum, even
r viewing the paintings. The key: a unit louver mounted over the
kylights that cover the entire roof. The louver casts a shadow pattern
n a layer of diffusing material, and the diffused daylight is further
eflected into the museum space by light-colored vertical baffles beneath.

Lighting design: Jules Horton

Views of an optimistic realist



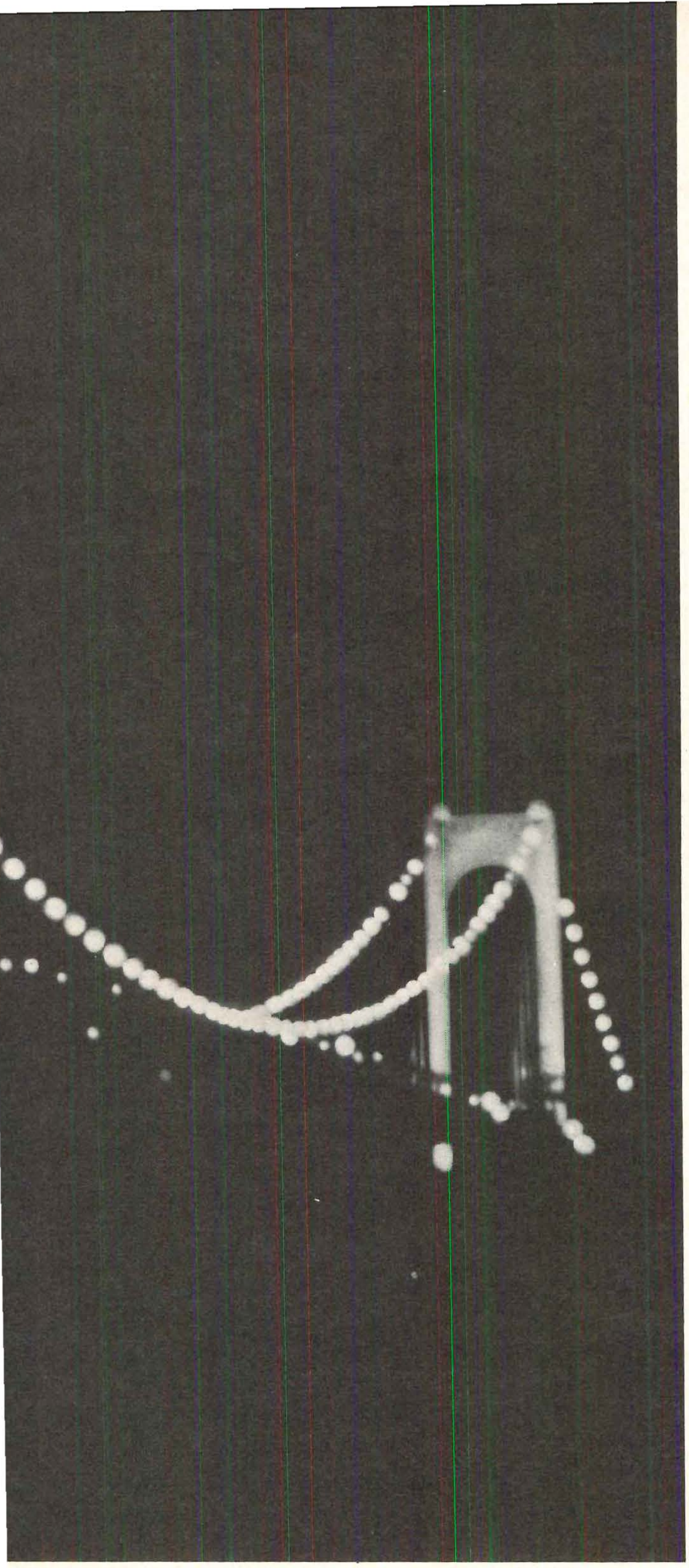
The Bronx-Whitestone Bridge was lit by Jules Horton and consulting engineers Syska & Hennessy on the occasion of the New York World's Fair in 1964; they used clear mercury lamps to give a moonlit quality. To light the Eggers Partnership's Guggenheim Bandshell in New York's Lincoln Center, Horton used highly precise, compact tungsten halogen downlights to avoid the awkward use of individual lights on music stands. Uplights are used to define the architecture of the bandshell.

A conversation with Jules Horton yielded his opinions on light levels, quality vs quantity, the need to design "idiot proof" installations, energy conservation and what he sees as some optimistic future trends

Too many projects—in fact most of the projects I know—are witness to a very curious divorce proceeding between the ceiling and everything else in the space. The ceiling seems to be the Siberia where you send everybody for bad behavior. You send the sprinklers, the fixtures, the air-handling system and the acoustical system. In other words, all the mechanical systems go into the ceiling and you're not supposed to see them—they don't exist. Well, that's changing now. There is a trend toward bringing the ceiling back into the family. It can still fulfill all of the functions, but in an organized way. This is especially important where lighting is concerned.

I don't think a utilitarian ceiling should be very obvious; in fact, I believe brightness in the ceiling is a negative factor. The brightness attracts the eye, you keep raising your head without even knowing it, your efficiency drops, and eye fatigue enters. When you add up all of this—the loss of time throughout eight hours—the loss of efficiency is quite apparent, and so is the loss of money over a year.

We recently worked on a job with Associated Space Design, Inc. of Atlanta who was designing the interior spaces fo the Iowa Electric Light and Power Company. The power com pany was moving into a new building in Cedar Rapids where rather bright, inexpensive 2' x 4' fluorescent fixtures had been provided. If the client accepted them, he would save quite a bit of money. But they were too bright; they blinded you and made you feel very uncomfortable.



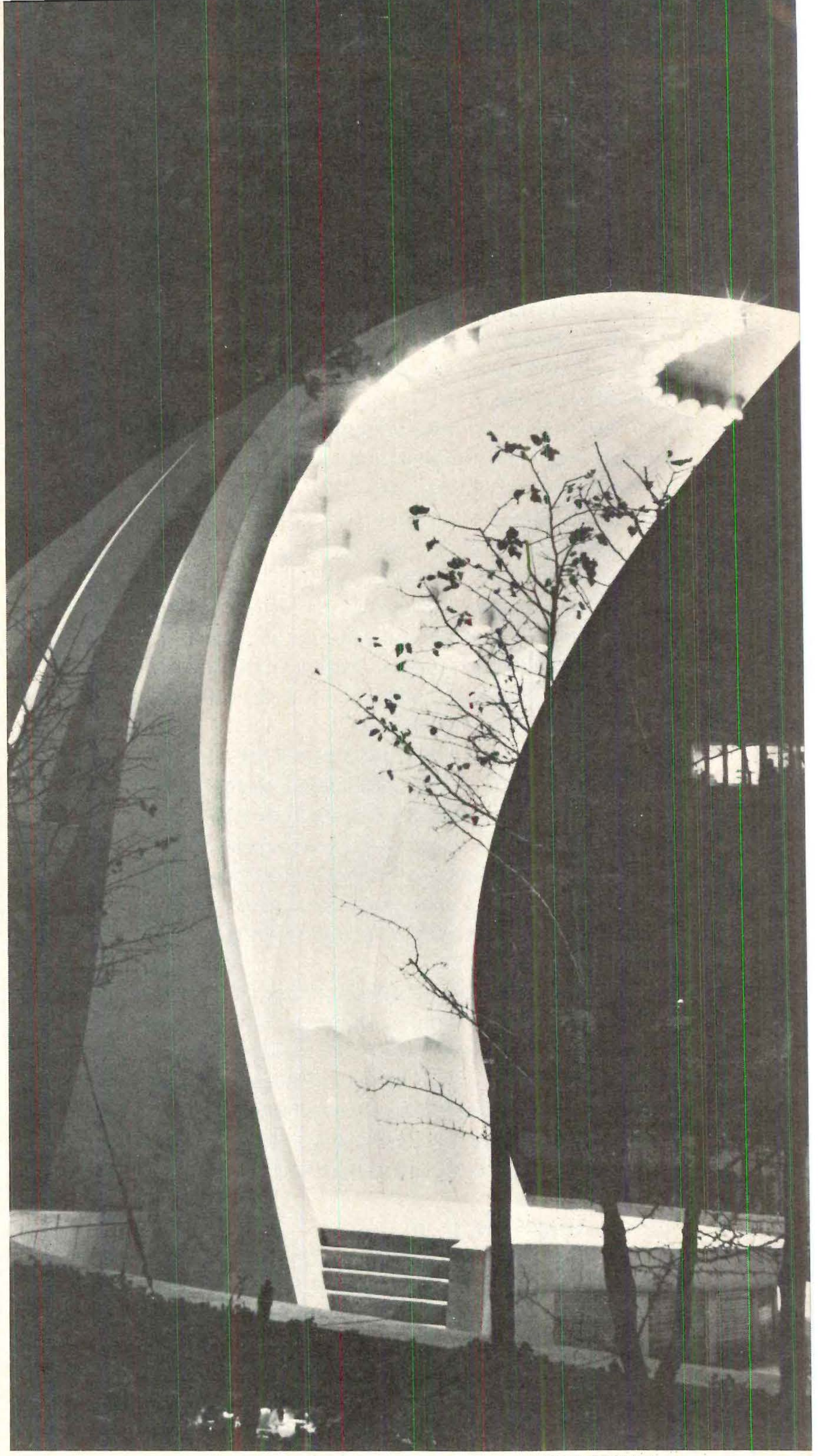


Photo: Gil Amiaga

Our recommendation to Iowa Electric was that they not ake the fixtures supplied. We told them if they really wanted ;ood lighting, if they wanted to show others how to create an ɜnvironment conducive to difficult visual tasks, they would ıeed a consistent level of nonglaring, high quality illumina-ion. We took them to Houston Light and Power Company to ;how them an installation where low-brightness parabolic ɔuver fluorescent fixtures were used. They took one look and ınderstood what we were after. The brightness of these fix-ures, within the normal viewing angle, is about the same as he brightness of the surrounding ceiling. One is aware only ·f a glowing plane on the ceiling, rather than those punched, ·right holes all over the place. People keep their heads down ·ecause nothing pulls them up to the glare. If they do raise ıeir heads, the ceiling doesn't assault them, and they return ɔ their work without temporary loss of vision.

In every job, the real question is how to determine the client's true needs, and the consideration of maintenance is always part of the client's needs. We don't try to design lighting that is foolproof. We design jobs that are "idiot proof," which means that even if you try you can't mess it up. We don't want to do something that looks good only in magazines, or looks good only for the opening day. So if the management really doesn't pay much attention to maintenance, that is important to us. It affects our thinking about maintenance problems and about possible sacrifices in the first design that could make maintenance simpler and easier. In such cases, I would avoid certain trimmings or even more effective, more desirable solutions that require more conscientious upkeep. That's what we have to weigh and try to get from the client in the beginning. We make maintenance simpler by minimizing the number of lamp types so the under-paid, under-educated and under-respected maintenance man will not have to figure out too much, will not have the opportunity of mixing and shifting things. We avoid some extra effects and "specials" which could only be maintained by well-trained, well-paid and well-educated maintenance men under good supervision.

The second thing we try to do is to use light sources that have longer life. For instance, incandescent lamps can be manipulated. Dimming them, dropping the voltage, extends their life. We can use a dimmer that will never allow the lamps to burn at full voltage. Consequently, the life of the lamp will increase several times because the life of the incandescent lamp is in reverse relationship to the voltage under which it operates. It's an exponential curve, so it increases very rapidly. If you step down the voltage by 5 percent, you double the rated life of the lamp. And what is most important, the eye cannot see the difference.

Another thing we do is try to use simpler fixtures, ones that are easier to get to, like certain incandescent and mercury fixtures that can be relamped easily from the floor without a ladder. Sometimes we would like to use color filters but we don't, because I have seen too many places where the first time they have to relamp they just never replace the filters. Often, if a filter is broken, it's replaced with the wrong color or the wrong lamp is put behind it.

We try to evaluate all of these factors to determine our intent so far as providing the optimum maintenance condition. But neglect will always show; it's the degree to which we think it may show that concerns us. In the last analysis, the main way to reduce maintenance is to simplify it and to educate the maintenance staff. It's like having a very low budget; we simplify the design and try to make the best of the minimum.

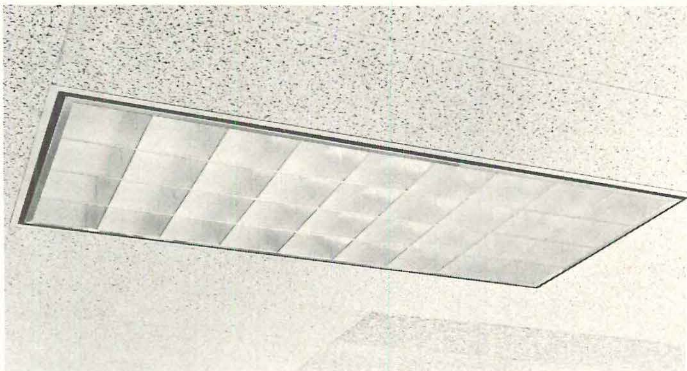
Ways to waste not

There are wasteful forms of using lighting, too; I have no doubt about this. People compete by increasing and increasing light levels, particularly in some commercial areas. In some supermarkets, for instance, you're blinded by the lighting. It's extremely inefficiently used. If the local codes were more specific about requirements of permissible brightness in public spaces, we could all see much better, because with bright lights the eye pupils narrow and we actually see less. I really believe a law should be passed as soon as possible that would license the use of footcandle meters. Many people seem to think that "more light is better light," but footcandles, per se, mean nothing unless the quality of light is defined at the same time.

A good example of this misconception about illumination is seen in municipalities that use 10 or even 15 footcandles for street lighting, thinking it will reduce the crime. But whether you have 5 or 15 footcandles of good illumination doesn't make any difference. Someone who is going to commit a crime at 5 footcandles will not be deterred by 15. In fact, he will be just as visible at 5 footcandles of good, uniform light. It is really the spotty illumination and marginal illumination that is a problem, not the light level. Incidentally, many of these highly publicized installations are so glarey that the visual perception of motorists is actually reduced.

Another area of waste is in office buildings. I've seen so many where they just put in a fixture for every 25 sq ft. It makes a totally inhuman environment because everything is the same. There is no accent, no direction, no focusing and no motivation added by the proper lighting gradient. It's totally wasteful. Why not use desk lamps along with a general low ceiling illumination? They are much better so far as reflected glare is concerned. Then you can save by not putting fixtures where you don't need them, and just provide an electrical system for future change. This way you can cut the energy demand; in fact, I believe you can easily cut the connected load in many office buildings by at least 50 percent. Corridors are another place to cut down. Many of them are lit at exactly the same level as the office spaces, and that's sheer idiocy.

There are other areas of waste, but they are a little more difficult to define precisely. People know, for instance, that keeping fluorescent installation on for 12 hours a day, rather than frequently turning it off and on, extends the life of the lamp. But if you try to save electricity by turning the lamps off when not in use, you may ultimately use more lamps. This means you use more energy and raw materials in manufacturing them, so the saving on the actual energy is only one



For Iowa Electric Light and Power Company, Horton used the type of low brightness parabolic louver fluorescent fixture shown above. It gives a consistent level of nonglaring, high quality illumination, and its overall brightness is about the same as the brightness of the surrounding ceiling.

At the Fieldcrest Shop in Harrods of London (right), Horton worked with architect Mary T. Hood to light merchandise rather than the room. Using adjustable, incandescent lights of low brightness and high degree of control, he disproves the belief that "more light is better light."

part of the story. There is also energy spent in transporting and distributing the lamps.

It's very hard to say how it all adds up; you would need computers to get all the answers. There are many problems still to be answered, but overall I am optimistic about the direction lighting seems to be taking. I think there is a real trend toward more efficient sources, toward more concentrated sources which give better optical control. Color rendition is getting better. In fluorescent lamps we have more and more deluxe colors that are closer to incandescent lamps and natural daylight in color and rendition. Unfortuntely, though, with one lamp—currently the most efficient one, the high-pressure sodium lamp now lighting our streets—the color rendition makes you look like you're in an advanced stage of jaundice. You can't tell the color of your car or of the clothes you're wearing. But there are really two varieties of high-pressure sodium vapor. There is the "official" variety you can buy—the only one you can buy—which is highly efficient at the expense of color rendition. There is also a prototype that is not on the market. It gives about 30 percent less illumination with the same amount of power, but it has a vastly superior color rendition. With the intensity of these lights, nobody would be able to notice the 30 percent difference, and so far as I'm concerned I would rather have a little less illumination in any space if it gave a better color. We don't need high levels of bad light. We need to think about our total visual environment.

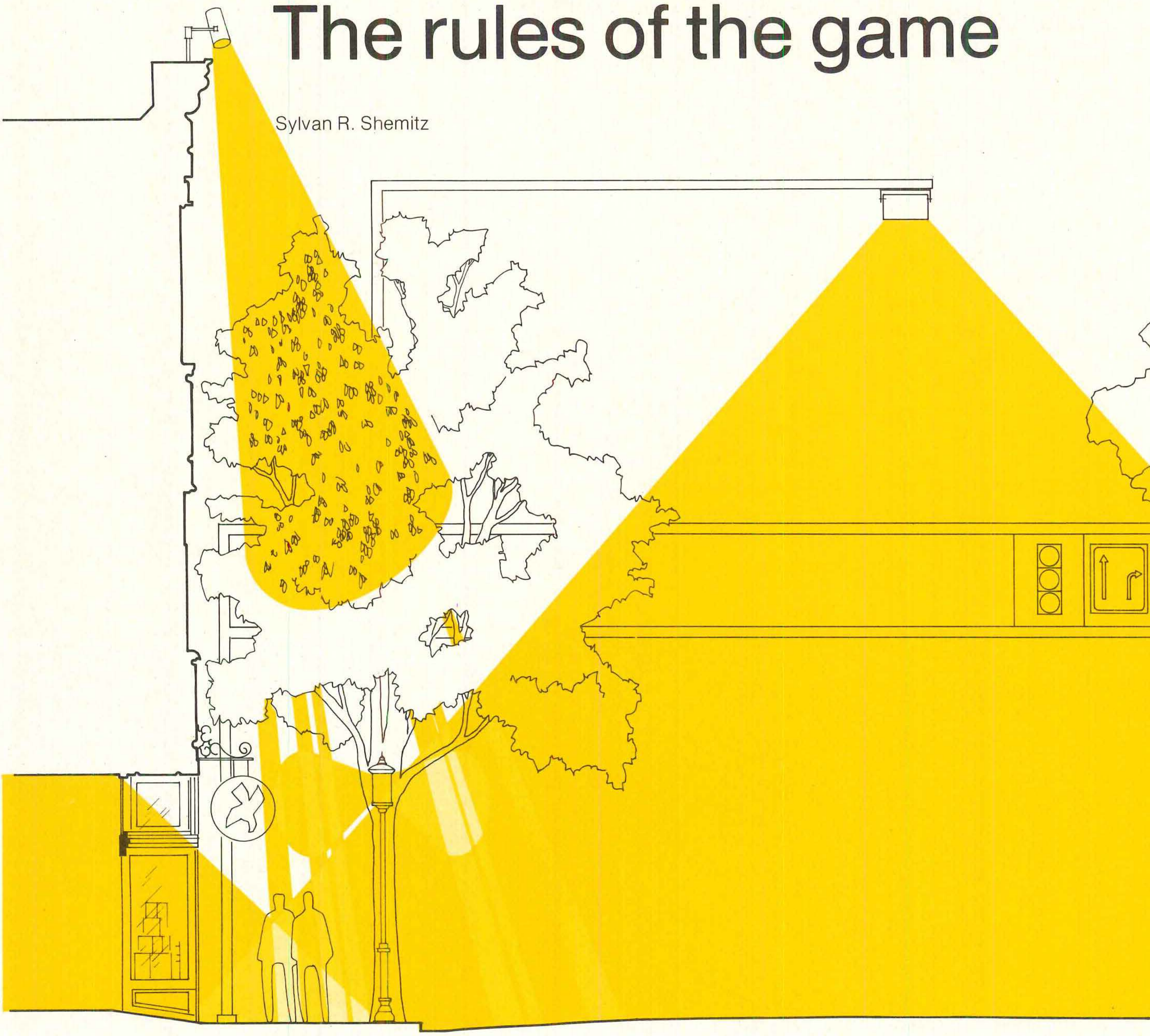
Fortunately, the public is getting more educated. People are becoming more and more aware of the importance of lighting and, as they become more aware of good lighting design, they will begin to demand it. Eventually, I hope they will begin to affect the merchandising of lighting as they have affected so many other commodities. [DM]

Lighting designer Jules Horton's main office is in New York City, but his work is spread across five continents. In New York, he has been responsible for the lighting of three of the city's major bridges, the Triboro, the Bronx-Whitestone and the Throgs Neck. He has designed the lighting for many of Fifth Avenue's leading shops, and won the New York Section of the Illuminating Engineering Society's Lumen Award in 1970 for his work in Bergdorf Goodman's recent extension. In a completely different vein, he has designed the lighting for Madison Square Garden's main sports-entertainment complex, and for the new Guggenheim Bandshell in Lincoln Center.

Lighting design: Sylvan R. Shemitz & Associates, Inc.

The rules of the game

Sylvan R. Shemitz



Asked for a statement of his design philosophy, the author produced two sets of rules: one for architects who use lighting designers, one for his own office

Good lighting makes the finished building look and function as the architect intended, at all hours of the day and night, in bright sunlight or under overcast skies. Good lighting contributes to the mood, to the desired attitude toward form and space, and to the effective functioning of the space.

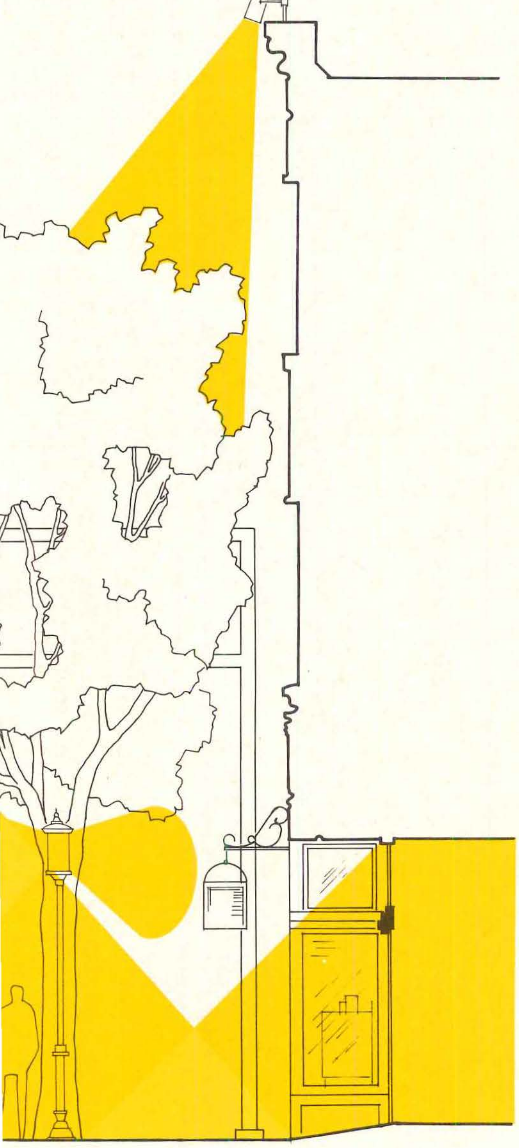
If the architect, however, designs the building and then asks the lighting consultant to lay the lighting on it—if he says "Here's my building, light it"—he gets what he deserves. He ends up with lighting fixtures that are appendages to the building rather than an integral lighting system which expresses its space and form. The rules below, one set for architects to follow and the other set which we use in our own office, should give a better understanding of the close cooperation required to obtain good, effective lighting design.

How to get the most from the lighting designer

Work with your lighting consultant as you would have your client work with you. We work best with a team spirit based on a mutual understanding of the philosophy and method that apply to the project at hand. Lighting should be an integral part of the architecture, not something superimposed on it like a cosmetic.

Because lighting is the key to the visual experience and inseparable from it, lighting considerations should be raised at the earliest conceptual stage.

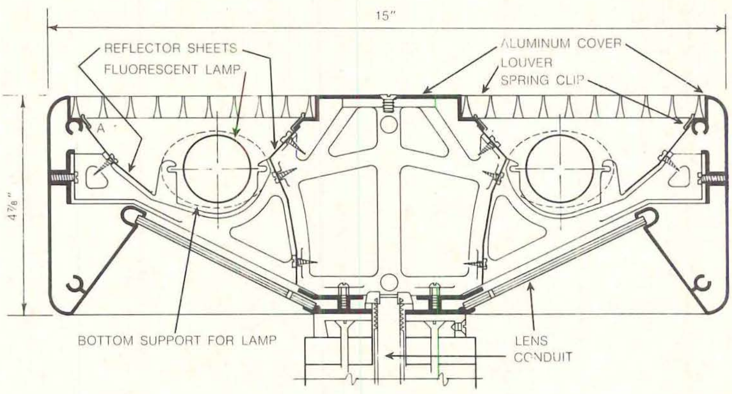
The lighting consultant's role belongs to the design function and his primary relationship should be with the architectural designer. Interaction is vital during the design stage, when it can influence choices of materials and integration of daylighting techniques. The lighting consultant must be able to offer options at a time when they can be acted upon. He must help to establish a reasonable budget, help to sell the budget to the client and then bring the job in on target.



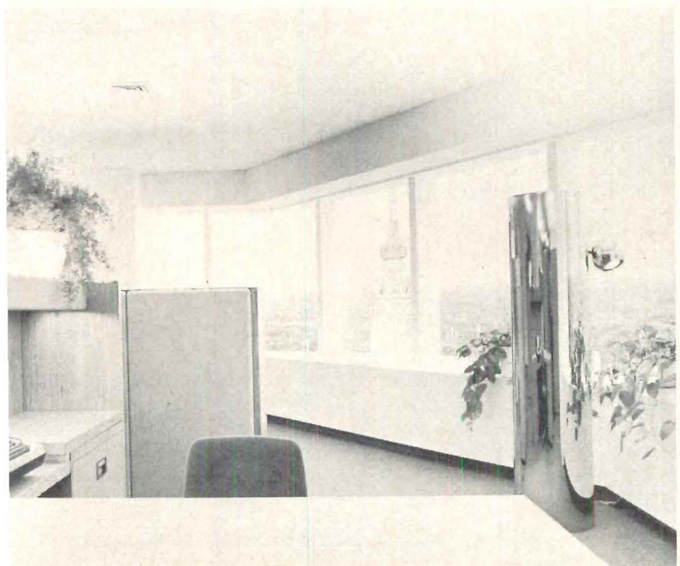
e street lighting plan for Corning, N.Y. includes accents from
cornices, uniform illumination of the street and "gaslights"
n glow. Geddes Brecher Qualls Cunningham, architects and planners.

Robert Perron photo

Columbia Mall in Maryland has no general illumination to distract from storefronts. Trees and other objects are downlighted. "Absence of light is important," says Shemitz. Cope, Lindler & Walmsley are architects.



System that integrates lighting with office furniture (left and above) was devised for the Atlantic Richfield offices in Philadelphia. Downlight lens eliminates veiling reflections, while uplighting through a wedge-shaped louver gives indirect general illumination. Kiosk fixture provides accent and sparkle. There are no ceiling fixtures, and concentrating the light on the task saves half the watts. Interior designer is Interspace, Inc.



Lighting design: Shemitz

The lighting consultant can serve the architect properly only if he works through from schematics to final inspection.

Even if you call in the lighting designer early enough, you should not simply get his ideas and try to execute them yourself (this is equivalent to a builder designing his own building on the basis of consultation with you). Similarly, don't delegate or let your lighting consultant delegate any design responsibility to a manufacturer. That might save some work, but it can be at the price of lost professionalism and the increased cost of giving the manufacturer an exclusive.

Don't force standards that confuse quantity of light with quality. A lot of light is not necessarily good lighting. Too many lighting systems are designed simply to avoid criticism for not supplying adequate levels. This leads to wasted energy and the destruction of form, space, texture and mood.

Avoid fads in lighting. The building is going to be around a long time and no quick benefit from gimmickry is worth the price of being out of style for the rest of its life.

Rules for practicing lighting design

The first rule in our office is *get all disciplines to interact* and work on the client's needs, using our staff architects, electrical engineers and industrial designers.

Define the problem, which is frequently the hardest part of design. To get the right answer, ask the right question. (Example: we developed a valuable new reflector contour for uniform wall lighting by asking not "What can we use here?," but "How can we distribute light evenly on a plane surface from a source at one edge?")

Go back to basics to bring fresh thinking to each assignment. Within reason, look at every job as though it is a new problem. (Example: our *Lite-A-Part* (tm) lighting system, which eliminates fixtures in the ceiling, derived from the relationship between light on the task and light throughout the space and restudying the qualities of superior task lighting.)

Present alternatives. In working with an architect, present the reasonable alternatives with their pros and cons rather than a single solution . . . and then offer an opinion.

Don't be afraid of custom design. It's a common misconception that custom-designed fixtures must be more expensive than stock items. On the contrary, if enough units of a given type are needed, if they are intelligently and carefully detailed, and if put out for competitive bids, we can frequently get exactly what we want at no increase in cost over a standard fixture which may compromise the result.

Budget for now and later. Never lose sight of the importance to all parties of establishing a reasonable budget that is concerned with more than initial cost. It must take into account the cost of energy and must use sources of reasonable life and efficiency that can be economically maintained. The lighting system must not waste light.

Pay attention to documents, as the ultimate result depends heavily on their professionalism. We devote tremendous energy to our drawings and specifications and measure how good they are by the phone calls we don't get.

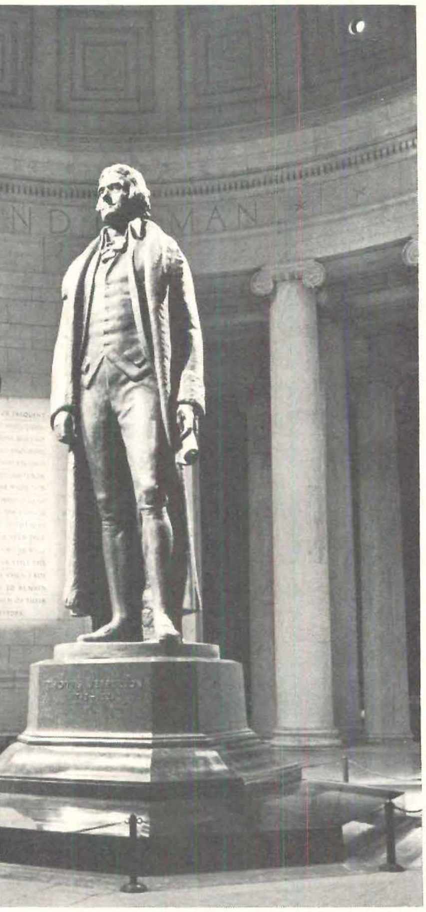
Get totally involved. We do our best work when we are totally involved in the project, providing design input, counsel, execution and inspection.

Teach. As part of our professional responsibility, we carry a heavy teaching load at architectural schools. We believe in teaching how to define problems as well as how to solve them. We find that in teaching we get as well as give and that our interaction with students stimulates our own personal and professional growth.

Have fun. We believe that our work should be fun.

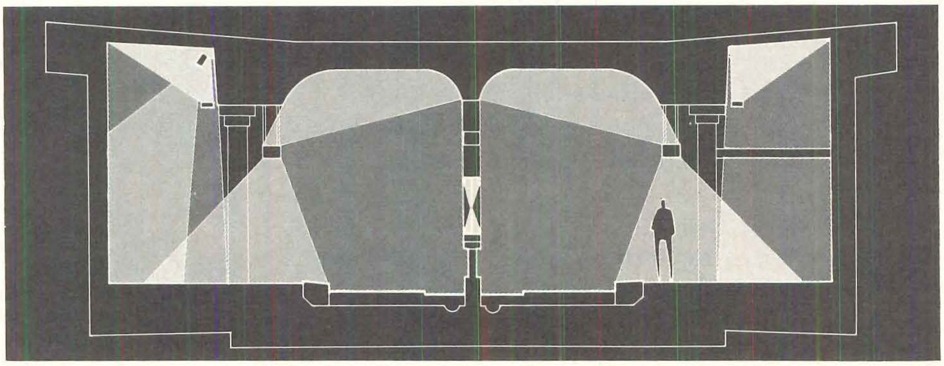
Author: Sylvan R. Shemitz practices out of West Haven, Conn., where he began his design firm in 1963 after having operated an electric supply corporation for a number of years. An active member of IES, he is a graduate of the University of Pennsylvania. Believing firmly in the value of teaching, he is a visiting professor at the University of Pennsylvania, Princeton and Rhode Island School of Design. Associates in the firm are Benjamin L. Stahlheber, PE and Donald W. Isenberg. The staff includes architects, engineers and industrial designers.

Light in the Orlando, Fla. Public Library is limited to desk, reading areas and stacks, where fixtures are integral part of the stack design. Books are illuminated evenly at 30 fc. John M. Johansen is architect.

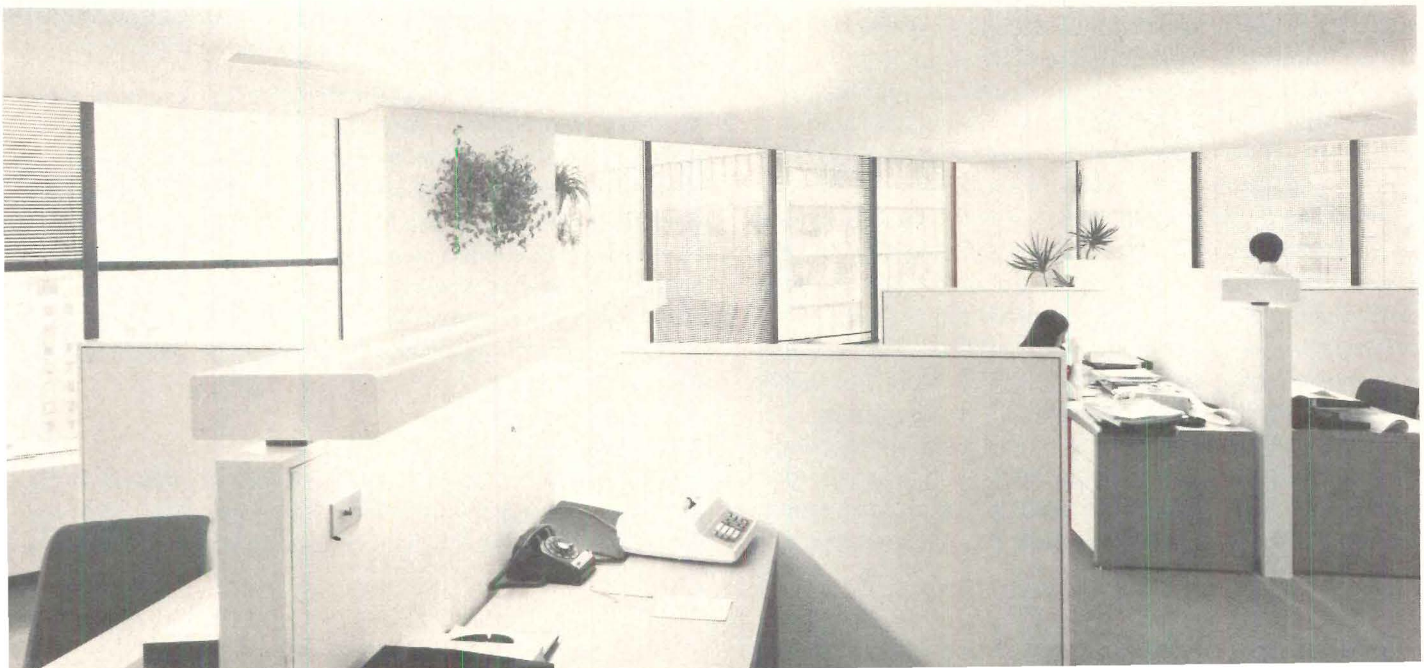


Quotations in the Thomas Jefferson Memorial, Washington, D.C. are framed in light from theatrical projectors mounted in the dome. Light levels are high by day to reduce brightness contrast, lower at night. Amber beam highlights bronze statue and metal halide fills shadows. National Park Service, client.

Boston subway has low brightness luminaire running full length of platforms. Custom designed fixture, which also carries AC, DC, emergency and audio systems, costs 20 percent less than conventional equipment. Light patterns are shown in drawing below. Cambridge Seven Associates, architects.



Further development of lighting fixtures mounted directly on office partitions was done for Joseph E. Seagram & Sons, Inc. in New York City. Giovanni Pasanella is architect.

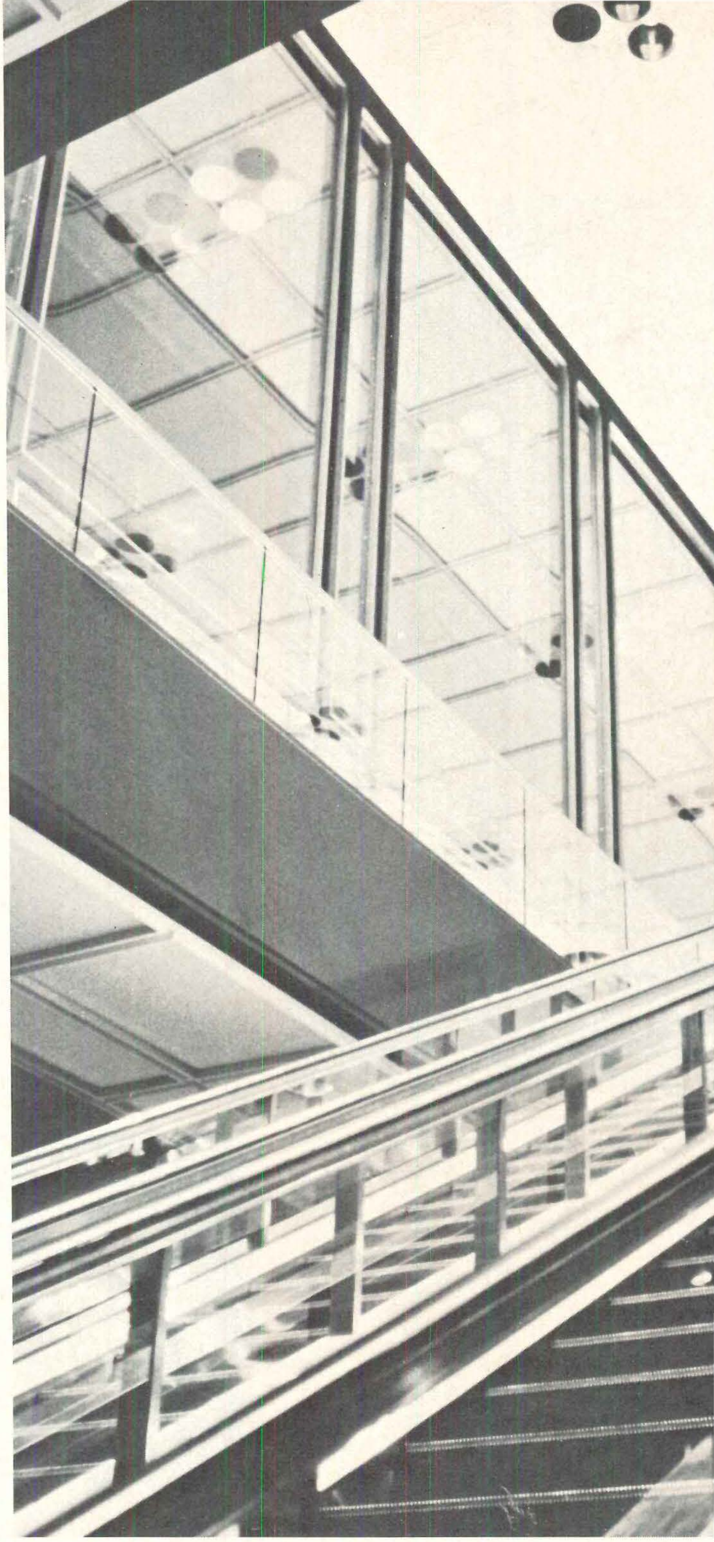


Lighting design: Evans & Hillmann

In celebration of large spaces

Seymour Evans and Carl Hillmann

Programming lighting to meet varying conditions, the authors feel, is the antidote for boredom in large spaces as well as the solution to budget and energy problems



Lighting varies with time at U.S. Steel building (above and below, left).

We operate under three principles: budget is a major influence on design; energy conservation is an economic and moral imperative which will soon have the force of law; and the lighting designer must grow in his craft to remain a responsible professional and creative influence. The projects shown here trace such an evolution—away from the high energy cost of the incandescent, low brightness, concealed source idiom to an exploration of the high-intensity discharge light source for major spaces. This exploration has also led to design of lighting equipment expressed as form for the celebration of large spaces, and to relocating this equipment both in relation to architecture and involvement with people.

The projects, shown in chronological order, illustrate these evolving ideas and the improvements in lamp technology.

U.S. Steel Headquarters

The lighting system for the main lobby of the U.S. Steel Building in Pittsburgh is programmed to change its color, amount and emphasis according to the conditions of natural light, weather, time of day and patterns of activity. Selective switching and dimming allow five lighting modes, programmed to repeat each working day, plus a weekend mode that conserves energy. During the winter, photocells sense the variable daylight and command a gradual increase of electric light when daylight falls below a pre-set threshold.

Pods of four semi-recessed, low brightness downlights each contain a 400 w high-pressure sodium lamp, a 1000 w Quartz R-lamp, and two 400 w deluxe white mercury vapor R-lamps. Certain pods above entrances and escalators contain one mercury vapor, one high pressure sodium and two directional quartz PAR56 or PAR64 lamps for lighting focus. A building core wall-washing system and downlights in core elevators and cross corridors complete the system. The ceiling and the fixtures were designed together for visual unity.

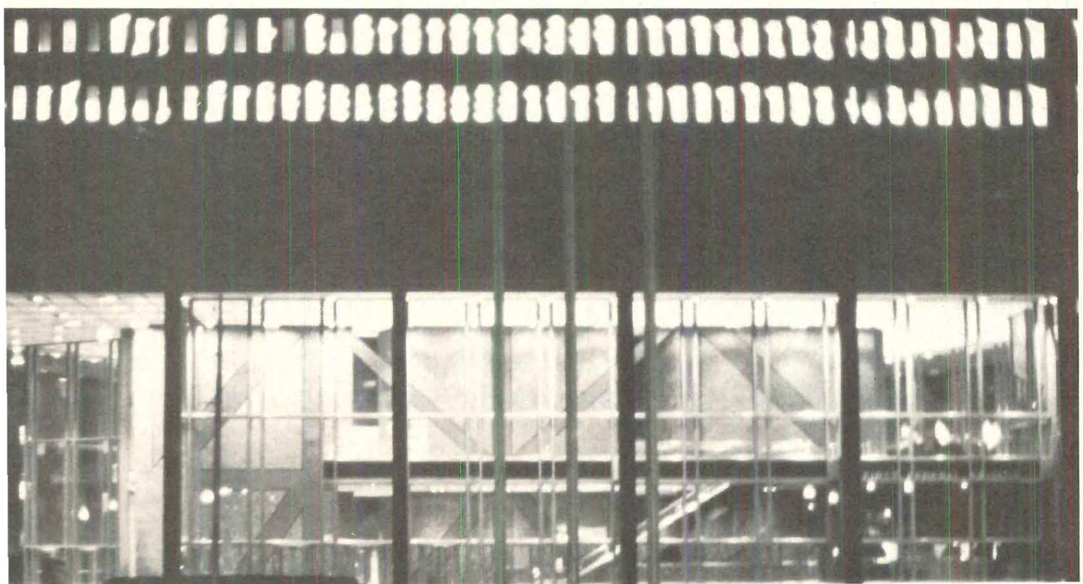
Various combinations of the downlights and wall lighting cause subtle or dramatic changes to occur in time and from zone to zone in the lobby and immediate plaza areas, producing a dynamic luminous environment. Daytime, end of day, early evening, late evening and after closing periods, all have an appropriate lighting configuration. Except on dark winter days, daytime lighting makes the least demand on energy, while end of day and early evening periods make the highest demand due to activity and the need for a strong luminous light contribution onto adjacent sidewalk, street and plaza areas. After closing, lighting is mercury vapor only since light color quality is least important and burning hours are longest.

Watts per sq ft (maximum) are 4.0. Harrison, Abramovitz & Abby are architects.

Southridge Mall

Architects Wah Yee Associates provided skylights in all major spaces of the Southridge Mall, Greendale, Wis. to admit a slowly shifting play of sunlight and shadow. Winter in Wiscon-

At Southridge Mall (above and below, right) variable lighting reinforces that from skylights; bare lamps add glitter.



sin does not always provide sunny days, however, and the lighting system, like that for the U.S. Steel Building, was designed to compensate for the vagaries of natural light.

Because of ceiling and skylight complexity and because of budget, a recessed, low-brightness system was designed for general and focus illumination at the floor level; all fixtures are located in the high ceiling and in bridge and ramp soffits. Supplemental lighting consists of glitter bulbs outlining the second level opening in the link malls, a fluorescent uplight cove in the courts, and groups of decorative floor standing fixtures on the second level of the larger central court; these emit a glow of light outward and contain concealed incandescent uplights to illuminate and model the ceiling.

This lighting system, apparently conventional in its physical aspects, is interesting for the use of both high pressure sodium and quartz lamps as general illumination sources in a day/night program of change. The high pressure sodium lamps add warmth on overcast days, especially in winter when the flatness and reduced level of natural light in the mall can be visually depressing; they also restore the natural shadow and highlight characteristics of a clear day. In contrast, the quartz fixtures provide night-time light levels from 200 footcandles, when concentrated for focus, down to 30 footcandles as a minimum for general illumination. Glitter in the link malls plus pink color filters in the bridge and ramp soffit downlights create additional zoning differences to complete the lighting composition.

Maximum watts per sq ft are 5.59.

Eastridge Mall

At Eastridge Mall, San Jose, Calif., successful blending of architecture and lighting produced a strong visual impact and economy in first cost, maintenance and energy demands. The skylit mall requires artificial lighting only at night except in certain areas around the perimeter between the shopping levels. The lighting problem was posed by 70-ft-high spaces and a dramatically configured ceiling. The skylights are simple rectangular openings based upon a consistent dimensional module, which permitted design of a single luminaire organized in groups within the skylight openings. The principal lighting criterion for these spaces requires that the luminaires emit light horizontally to light the ceilings as well as downward to light the floor.

Although multiple-lamp designs were considered, the luminaire eventually became a single 250 w or 400 w mercury vapor source; a standard industrial fixture in a simple rectilinear housing which ended in panels of clear acrylic at a 45 degree angle deflects sufficient light horizontally to make the ceiling glow, while the main flux passes through to light the floor. Transparent acrylic colored disks at the bottom of each construction modify portions of the downward light to create subtle color nuances at floor level. The use of mercury vapor was advisable because of its long life and because it had progressed in available phosphor types to where its color was acceptable. Although the luminaire is totally functional, grouping them creates a planar chandelier with a consistent relationship to the ceiling geometry and a proper scale relationship to the total space. To provide glitter at floor level, a standing chandelier of exposed clear lamps within clusters of polished chrome tubes was designed at a smaller scale.

Watts per sq ft average 1.97. Architect is Avner Naggar.

Northridge Mall

Northridge Mall in Milwaukee is a two-level mall with a high, articulated ceiling containing skylight groupings for all major spaces. The lighting design combines suspended luminaires and a floor-standing system of decorative fixtures at people scale. In lieu of the major pieces of sculpture that were purchased for Southridge and Eastridge, the floor system was designed to combine light and form in a thematic idea to link all spaces. It provides glitter, uplight and sound, interacting with people and each other in a program of light and sound effects. Boredom is a dependable reaction to sameness and change is the antidote. In these fixtures, change speeds up to become kinetics. The fixtures are polished chrome cylinders with a vertical row of clear bulbs circuited to permit "chase" type flashing sequences.

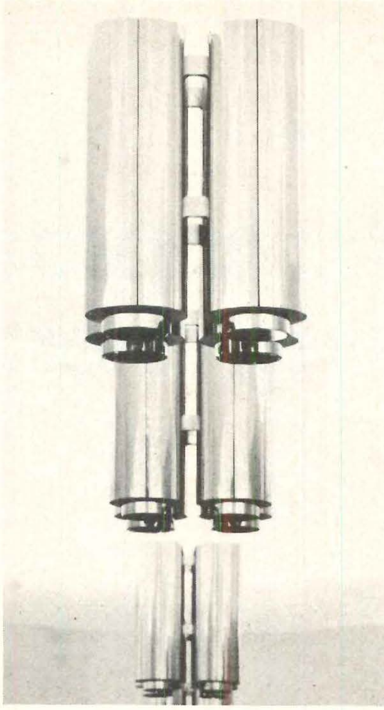
Those in the link malls are clustered in close groups of four and contain an incandescent uplight to provide emphasis on the larger skylight openings directly above. Those in the two end courts are clustered in one closely spaced group of nine in each location. These groups contain either loudspeakers directed downward or strobe lights directed upward. The sound program was especially composed with whimsical content. Loudness and direction of sound are designed to affect the area immediately surrounding the fixture group only. The sequencing of steady burning, "chase," sound and strobe flashing is pre-programmed and controlled from a central location with the program changeable at will. The transfer of budget dollars from sculpture to lighting made the system affordable, with a probable net reduction in overall costs.

The general lighting luminaires in the courts are suspended below the skylight openings in clusters of two or four depending on skylight openings and adjacent ceiling surfaces, downlighting from wide distribution mercury vapor and focus lighting from aimable quartz lamps. Luminaire housings are polished chrome cylinders with low brightness conoid shielding. Watts per sq ft average 2.21. Wah Yee Associates is the architect.

Authors: The New York firm of Evans & Hillmann, Inc. (formerly Seymour Evans Associates) has been designing environmental lighting since this particular art was first recognized. The staff includes an architect, a lighting engineer and a graphic designer. Facilities include means for testing and mock-up of fixtures and installations, most recently a new system for retail lighting.

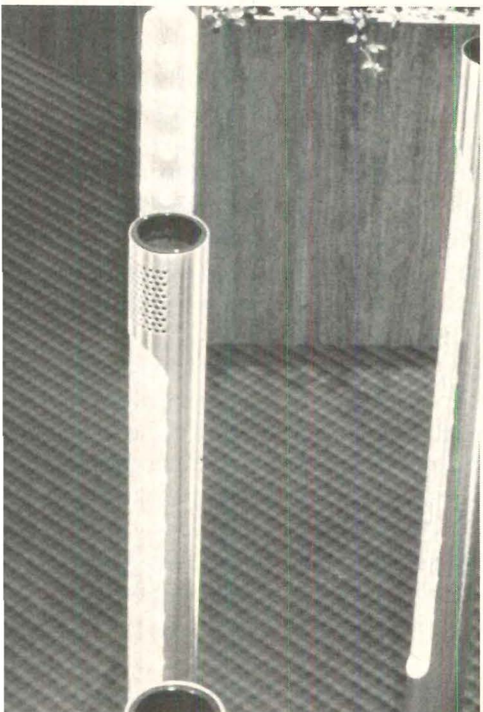
Seymour Evans, partner, is a visiting lecturer on architectural lighting design at Princeton; member of the United States National Committee for Esthetics in Lighting of the Commission Internationale de l'Eclairage. Evans has been actively practicing the art of lighting design for over 20 years. Carl Hillmann, partner, is a graduate of Pratt Institute (Bachelor of Industrial Design), author and lecturer on lighting design. He has been actively practicing architectural lighting design for over six years.

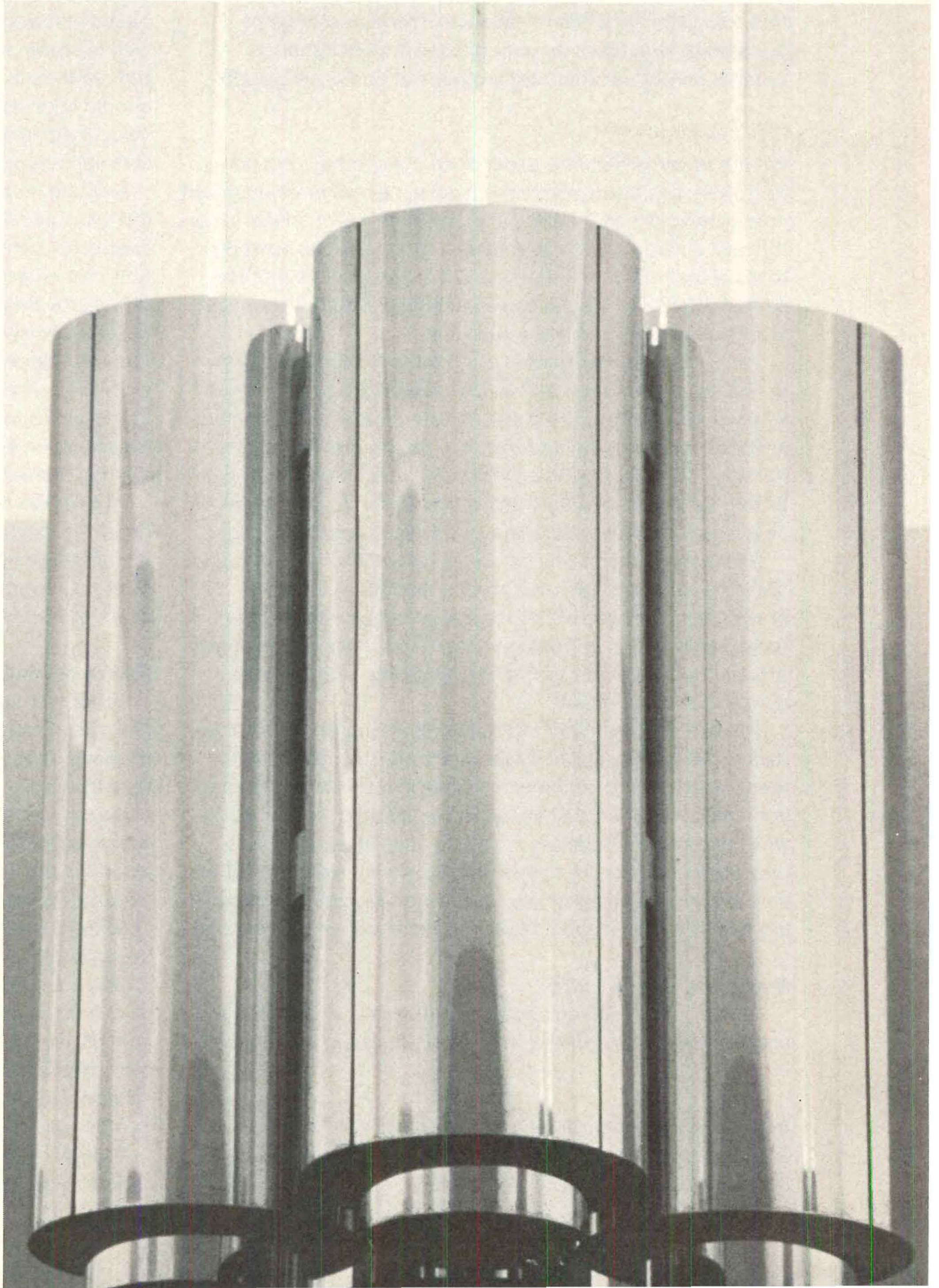
Skylit Eastridge Mall (above) requires lighting only at night.



At Northridge Mall, luminaires are chrome cylinders (above and below).

Light/sound floor fixtures at Northridge.





A realistic approach to conserving energy

John Fuchs

In any crisis, those who over-react in their zeal to find a solution threaten to cause a second crisis, warns the author, who takes an unperturbed look at lighting criteria, energy sources and methods of conserving them

We are today undeniably experiencing a shortage of energy, and professionals involved in the design of systems which use energy have a responsibility to study methods of conservation through design. It is dangerous and irresponsible, however, to insist that recommended practices, based on years of research, be abandoned to serve immediate needs without considering the long-term repercussions.

Current quality and quantity standards for lighting design are based on thorough and valid research programs. Those who would arbitrarily discard these standards for the immediate goal of conserving energy fail to realize that in the long run this could damage the eyesight of our school children, affect visual acuity in factory and office workers, and years from now result in widespread diminished vision among our aged.

On the other hand, we cannot just as arbitrarily continue increasing lighting levels or apply our present levels indiscriminately. They should be re-evaluated and possibly refined, as part of an ongoing process. This has become more urgent because of our present fuel shortages and energy conservation movement.

Critics of high lighting levels claim that English recommendations based on similar research are considerably lower than the lighting levels recommended in the U.S. The reason is simply that our criteria are based on 99 percent accuracy, while British standards are based on only 90 percent accuracy of visual tasks. To compromise our high standards at this time would be a mistake. We are the world leaders in designing quality systems and equipment and should keep that lead.

Current lighting practice

Current office lighting concepts and some recommendations for factory and industrial plant lighting call for "blanketing" an area with relatively even levels of illumination. This is based on designers' demands for space flexibility in keeping with modular architectural design. Flexibility is a fine concept but requires an imaginative approach. Lighting designers should take their lead from architectural designers and develop lighting systems with the type of flexibility that modular architecture provides.

Lighting recommendations for factory and office workers are very specific. Areas assigned to specific visual tasks should be identified early enough so that the lighting for each area can be properly designed and specified. At present, architectural and engineering design progresses simultaneously to promote early completion of plans and specifications. A little rescheduling and increased attention to this problem during the design phase can pay off later in the ownership and operation of a building, especially if lower lighting levels can be used in some areas. This will not only conserve energy, but will lower operating and owning costs.

What about flexibility? What happens when changes in a firm's operation warrant architectural and lighting revisions? We have been approaching this type of flexibility for a number of years. Lighting equipment is now available with easily interchangeable electrical assemblies.

Energy consumption and supply

According to an article in *Fortune* magazine, our sources of fuel and power have shifted several times since 1850, when firewood supplied nine-tenths of U.S. energy needs. Coal supplanted wood, and then petroleum and natural gas became dominant. By the end of this century nuclear power—which, surprisingly, still accounts for less energy than firewood—may meet nearly a fourth of our needs. Our needs have increased from approximately three quadrillion Btus in 1850 to 85 quadrillion today. The projected requirement for the year 2000 is over 190 quadrillion Btus.

This is a staggering statistic, not only in terms of need but also in terms of supply. Many researchers predict that 90 percent of our present supply of oil, gas and coal will be used up by the beginning of the next century. Before that happens, most experts believe, we will have alternate power sources—geothermal, solar, etc. The real problem is when.

Another point to consider is that current projections on fuel depletion are based on present methods of collection and

Author: John Fuchs is an Associate with Syska & Hennessy, engineers of New York and Washington, D.C., and is Director of the firm's Lighting Design Workshop.

processing. Better methods of coal mining, gasification, and oil and gas drilling will increase these fuel supplies. Experts feel that the theoretical supply of coal in the U.S. alone will last 650 years at the present rate of consumption. With these long-range factors in mind we can consider more rational methods of conserving energy while at the same time maintaining our high standards.

Lighting energy recommendations

In February 1972, the Illuminating Engineering Society prepared 12 recommendations for better use of lighting energy. These were later incorporated in a report prepared for the Ad Hoc Committee on Energy Efficiency in Large Buildings under Governor Rockefeller's New York State Interdepartmental Fuel and Energy Committee. The recommendations, which would not reduce the quality of lighting design, follow:

1 Design lighting for expected activity. It is necessary to determine what types of activities are expected, their duration and where they occur. Lighting should be provided for the seeing tasks with less light on surrounding nonworking areas such as corridors, storage and circulation areas. There should be the capability to relocate or alter lighting equipment where changes in the use of the space are anticipated.

2 Design with more effective luminaires and fenestration. Select lighting equipment and windows capable of providing proper visibility for performing tasks. This includes selecting lighting equipment designed to avoid veiling reflections and glare, and windows with controls for sun and sky light.

3 Use efficient light sources. The various lamps available today have different properties including light output per watt input. This ranges from less than 10 lumens per watt to over 100. The choice should be the most efficient source that is appropriate to the application (light source color, life, physical size are characteristics also to be considered).

4 Use more efficient luminaires. More efficient luminaires produce a greater amount of light for the wattage consumed; however, consideration should also be given to veiling reflections and glare and the ease of cleaning and relamping.

5 Use thermal controlled luminaires. Recognize lighting heat. Design the heating and cooling system to use lighting heat to reduce heating energy and to control lighting heat for minimal effect on cooling.

6 Use lighter finish on ceilings, walls, floors and furnishings. Dark finishes absorb light, while very light finishes can cause glare. Follow IES reflectance recommendations.

7 Use efficient incandescent lamps. Higher wattage incandescent lamps are more efficient. Thus, using fewer higher wattage lamps can save power. The less efficient long-life lamps consume more energy than general service lamps for the same light output.

8 Provide flexibility in the control of lighting. Use separate and convenient switching or dimming devices for areas that have different use patterns. Photoelectric control of the electric lighting should be considered where adequate daylighting is possible. Turn off lights when not needed. Institute a program that will remind occupants to turn off lights as they leave an empty room or when daylighting is adequate.

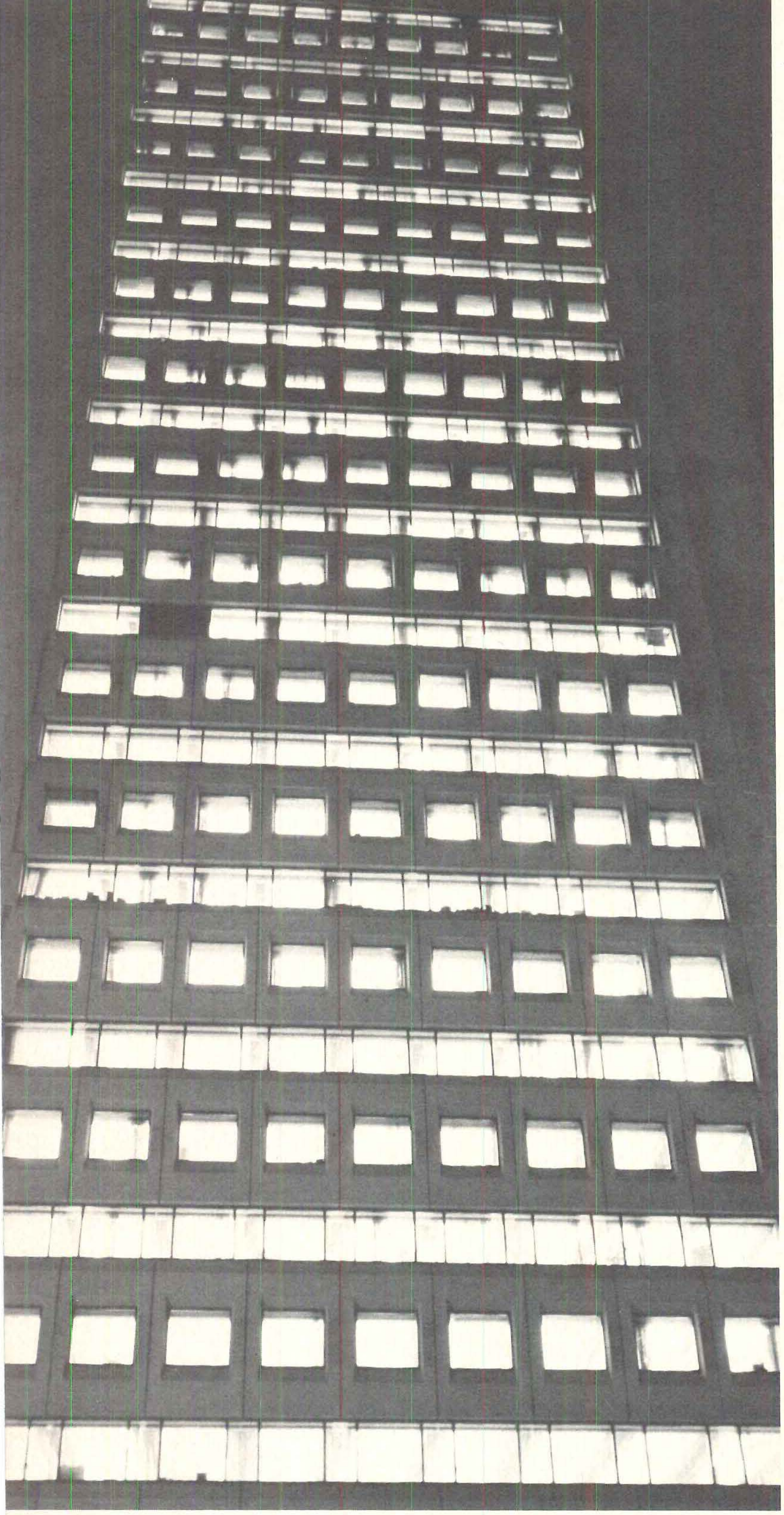
9 Design fenestration to control heat-producing radiation entering a space to reduce the cooling load while still making use of the available daylight.

10 Design fenestration to use daylighting as practicable to produce the required illumination either alone or with an electric lighting system.

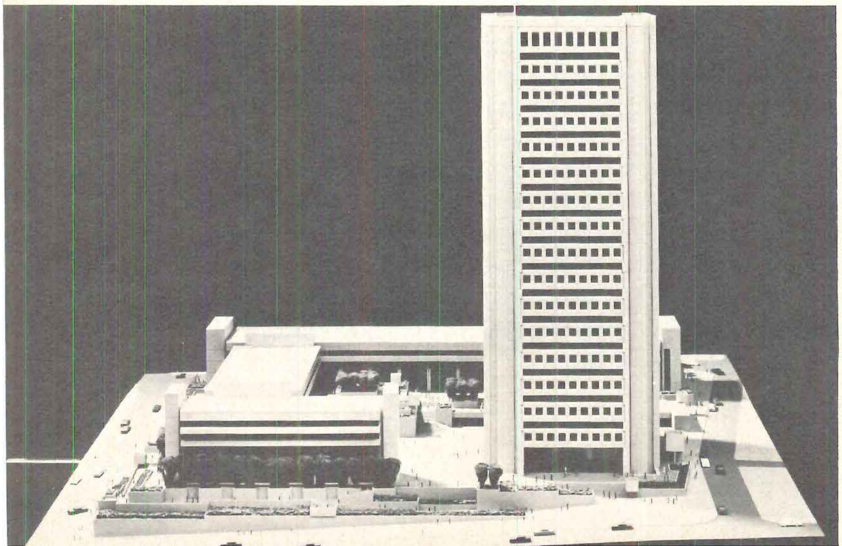
11 Select luminaires with good cleaning capability and lamps with good lumen maintenance. Select lighting servicing plan to minimize light loss during operation and thus reduce the number of luminaires required. Keep lighting equipment clean and in good working condition through a well-planned program of regular cleaning, relamping and servicing.

12 Post instructions covering operation and maintenance. These initially should be based on the design criteria but may by modified later as more efficient, newer replacement equipment is installed. As activity locations change, modify the lighting system and instructions accordingly.

As a guide, the list is a most rational approach, considering that buildings are designed to last well into the 21st Century and that the so-called energy crisis is a somewhat temporary energy shortage which should be resolved well within this century. Each of the 12 recommendations offers an opportunity for savings in energy for lighting and air conditioning without sacrificing visual performance and visual comfort requirements established through research. Not all of the recommendations will save dollars spent on materials or services, however. An overall system analysis of cost over the expected life of the system would reveal the relative dollar costs and energy savings.



Complex G, Cité Parlementaire, Québec, occupies an entire block. Plans opposite show integration of structure, lighting and mechanical systems.



Lighting design: a case history

Integrating lighting and structure

William M.C. Lam

Integrating lighting with structure is so important, says the author, that one project, a government complex in Quebec, was redesigned to conform to this concept

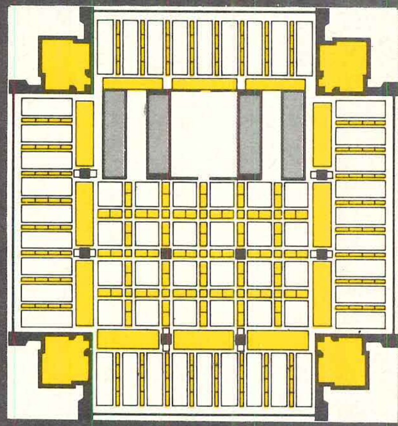
A good environment results less from consideration of light levels and brightness ratios than from careful design and perception of where the light is coming from. An environment is most comfortable and pleasant when illuminated from surfaces which are themselves pleasant to look at, such as walls and ceilings, rather than from obtrusive fixtures; this requires careful integration of structure and services.

These principles are easy to apply to high-ceiling spaces with simple subdivision and mechanical systems, such as churches and schools. More complex spaces, such as offices with their low ceilings and requirements for flexible subdivision, are a greater challenge.

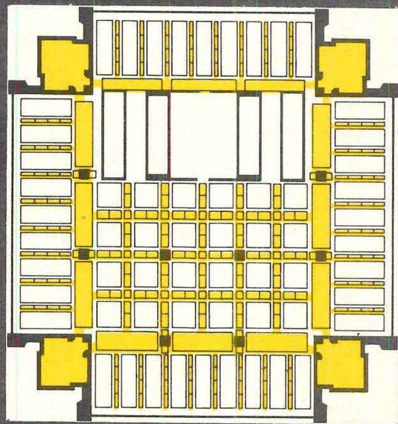
Early attempts to integrate structure with mechanical and lighting systems produced buildings such as Weese's IBM-Milwaukee and SOM's American Republic Building in Des Moines. Important as pioneers, these projects suffered from two defects. First, lighted coffers were based on a one-way module too small to be easily integrated into a perception of the created spaces as unified volumes, while the one-way orientation made subdivision of spaces difficult. Second, the integrated systems developed for lighting and air distribution made no provision for flexible distribution of other mechanical services such as plumbing and sprinklers.

A successful solution to both problems is incorporated in Complex G of the Cité Parlimentaire, Québec City. Despite

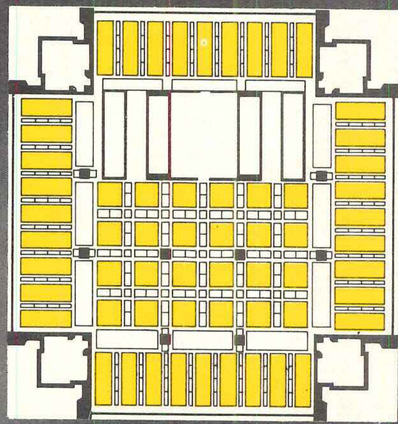
Author: William Lam graduated from MIT with a B.Arch. in 1949, but soon founded a manufacturing firm that produced lighting equipment and furniture from his designs. He started his lighting design practice in 1961 in Cambridge, Mass. and has just completed a move to larger quarters. He is an associate member of the AIA, a member of the Commission Internationale de l'Eclairage and the Illuminating Engineering Society of London. Associates in the firm are Jon S. Birdsey, a registered architect, and Marietta S. Millet and Bill Bruneau, both of whom hold M.Arch. degrees.



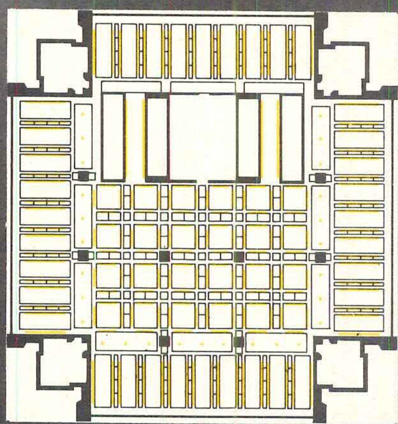
STRUCTURE



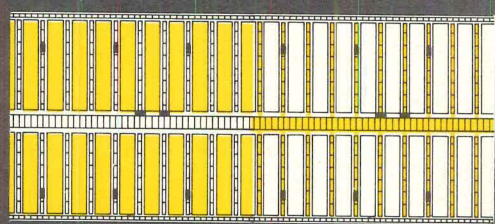
MECHANICAL DISTRIBUTION CHANNELS



LIGHTED CEILING COFFERS



FIXTURE LOCATIONS



MECHANICAL
DISTRIBUTION CHANNELS

LIGHTED CEILING COFFERS

the fact that lighting design for Complex G began late (the garage level went out to bid simultaneously), the design concept prompted a structural redesign. The neutral suspended ceiling arrangement became a well-articulated system integrating architectural, structural, mechanical and lighting elements. The revised design was built for less than the estimated cost of the original design, without delaying construction.

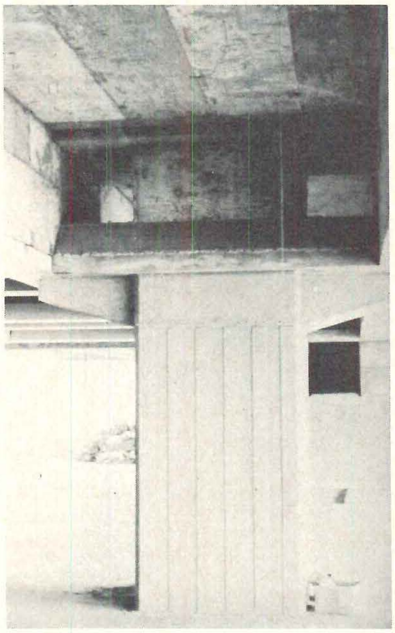
While the unified design approach suggested use of a single vocabulary of architectural materials throughout the project, the different volumes of the tower and the low buildings seemed to preclude a single structural-mechanical solution. The perimeter system worked out for the tower, however, proved equally suited to the low buildings with their longer spans and cantilevers. Functionally, extending the same system throughout the project was entirely justified, as almost all spaces are office landscape.

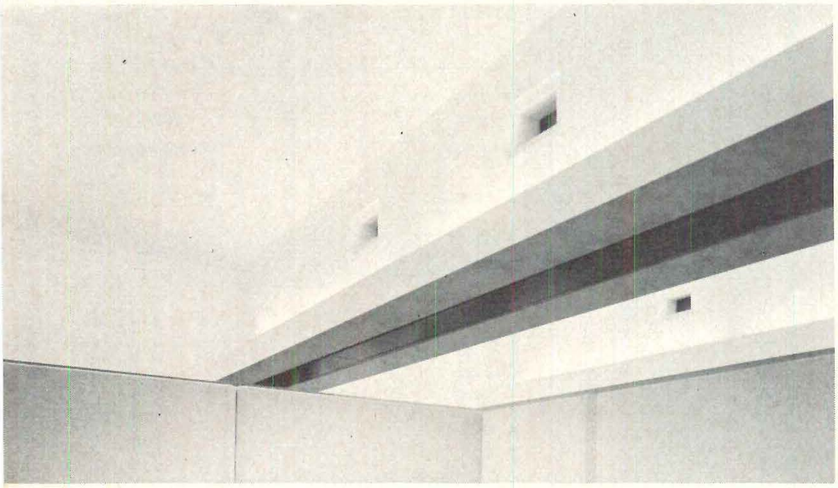
Because the service cores are located at the corners of the tower, the most logical distribution of mechanical services would be inward and outward from service bands connecting them. The problem then became how to enclose and finish the necessary channels. The design team developed a deep structure which incorporated the necessary service channels while maintaining maximum visible height between them. A key to the solution was dual-duct high-velocity air distribution for the tower (but not the low buildings) that required only small holes to penetrate the column branches which support the channel beams. In the service channels, "shadows" created by the wide columns offered a natural place to locate the mixing boxes. The lowered service channels could thus be in the most logical position and still be quite narrow.

If perimeter spaces, supplied from the main channel, are subdivided, smaller channels spanning to the exterior wall are used for air supply. The uniform pattern of holes for air supply and return, located in the sides of the beams, does not interfere with partitions which adds to the economy and flexibility of the system. Initial skepticism about the air distribution was dispelled by testing full-scale mock-up.

This perimeter service system was adapted to the low buildings, where the deep channel form was even more advantageous structurally for the long spans and cantilevers. To keep the integral lighting coves as small as possible, superhigh-output lamps are placed in minimum-size strip fixtures in each cove. The bulky ballasts are mounted in the adjacent channel beams and connected to the fixtures through the holes.

Integrated systems allow full use of office landscape (above). Tree column has holes for high velocity ducts, while those in the beams distribute air. Light sources are not visible.

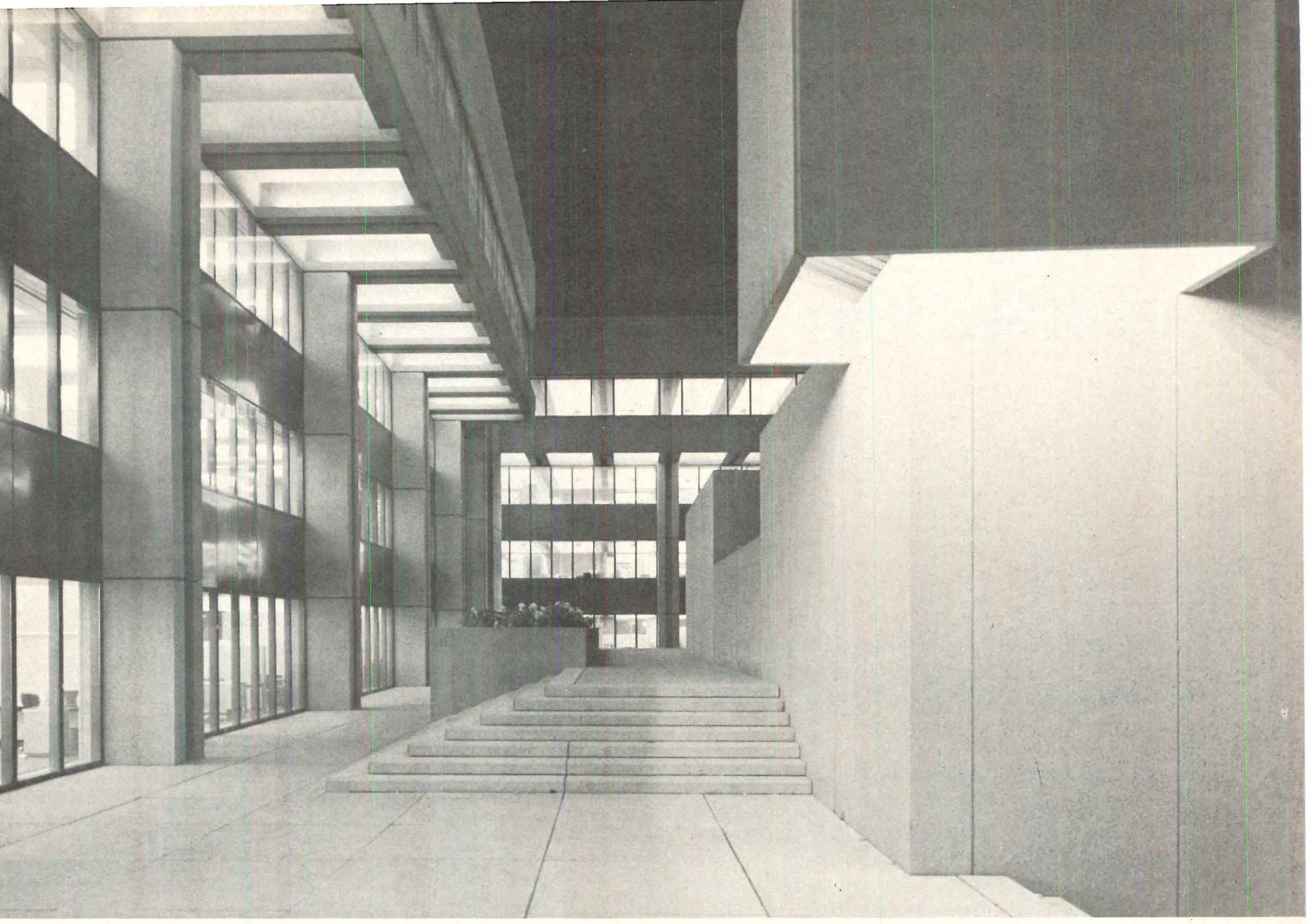




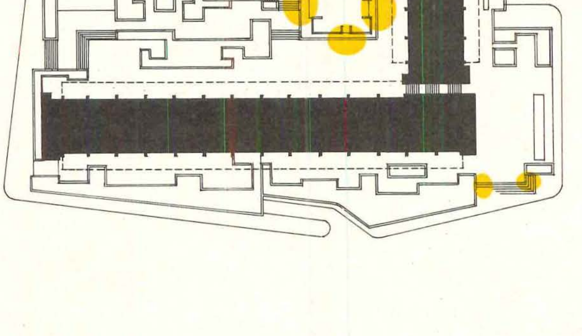
Highlighting the exterior

In the plazas, all lighting required for safety is spill from the building overhangs and interiors, where fixtures in the perimeter bays are left on at night. The major functions of exterior fixtures, therefore, are to illuminate the buildings as focal points in the city, provide interest and define circulation. Since the daytime image is one of horizontal bands between vertical corner shafts, these shafts are highlighted by very narrow incandescent fixtures mounted in air wells at the corners. The horizontal bands are defined in silhouette against the illuminated perimeter ceilings.

Lighting the terrace horizontals posed several problems. Recessing lights into the public sidewalk would have meant jurisdictional and maintenance difficulties, while uniform



Concrete projections serve as shelters for people and as chandeliers. Exterior lighting was designed to define circulation in the plazas, with spill from offices serving as general security lighting.



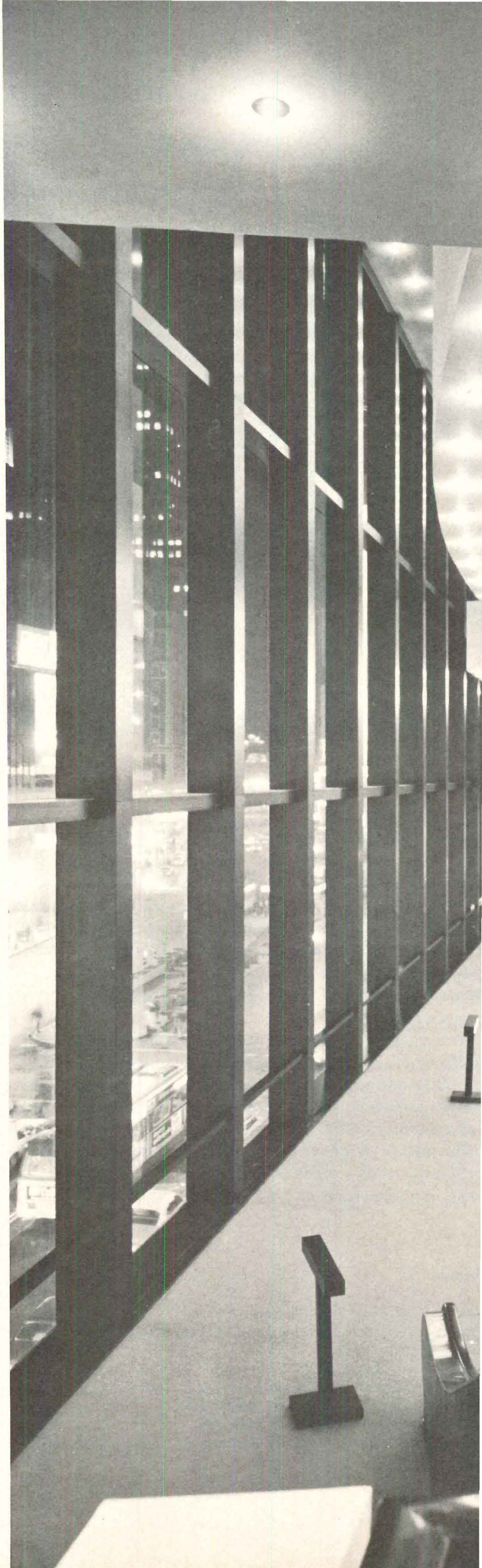
ighting of the great expanses of the other walls would have ɔeen extravagant. Instead, the terracing was emphasized by lluminating only portions of each wall as a guide to circulation. Some sources are placed under the terraces where they overhang truck entrances. Others are in large cubic precast concrete shelters which were provided for pedestrians waiting for rides. Strings of protected clear lamps within each cube highight wall and ground surfaces around the entrances, and provide sparkle.

The uplight from these shelters lends a subtle wash of light o the otherwise unlit building surfaces and trees. To those on he street and plaza or on upper floors, the illuminated cubes dentify entry points to the terraces. Seen together or sequenially, they constitute "environmental sculpture" at the edges of the podium, define its boundaries and form the view, adding intimacy and a sense of scale frequently lacking in conemporary urban plazas.

Credits

Project: Complex G, Cité Parlementaire, Québec (government offices).
Architects: Fiset & Deschamps-Gauthier, Guité & Jean-Marie Roy; Gilles Guité, partner in charge.
Structural engineers: Dufresne, Beaulieu, Trudeau & Associates.
Mechanical and electrical engineers: Gilbert, Bourassa, Gagné, Morin; ssociate engineers; Leblanc, Montpetit, Lagacé.
Lighting design: William Lam Associates, Inc.
Photography: Photo International, except model photo: Christian Herdeg.

Merging the disciplines



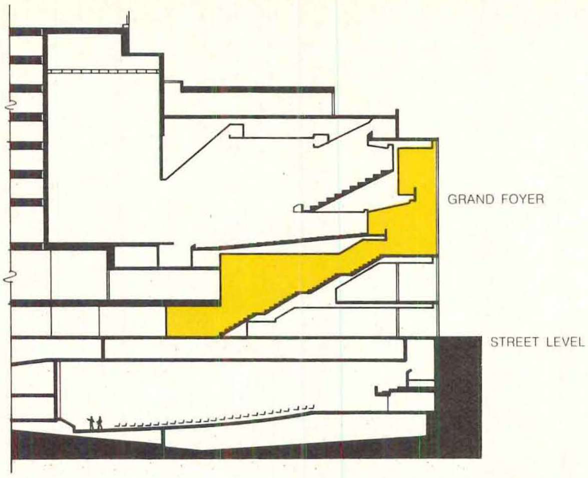
Committed to combining lighting and architecture, a New York architect chides illuminating engineers and the design professions to dispel outmoded standards

If it is difficult to decide, after a discussion with Der Scutt, whether he's an architect or a lighting expert, that's because he's both. As an architect and an associate at Kahn & Jacobs/HOK Architects and Planners, Scutt is very active in both the IES and the AIA. It is not unusual for him to take pokes at both disciplines interchangeably for failing to get together to make architecture more responsive through lighting. Recently, at a combined AIA/IES meeting in Cleveland, Scutt said, "As an architect, I am generally not pleased with my profession's frequent inability to grasp and comprehend the research that IES and IERI have compiled. Still, I am not convinced that the illuminating engineer is always sensitive to the design approach embodying the aesthetics of lighting."

Some of Scutt's design principles include such convictions as: a) the luminous environment cannot be designed solely with footcandle measurements; b) a light value, or total desired effect, must be set, then designed for; c) nonstatic lighting systems should be considered; d) lighting sources should be integrated with architectural form; e) lighting energy should never be wasted. "Too frequently we throw light on the task in staggering proportions," he warns, "instead of providing task lighting. When, in our continual refinement of standard equipment, we reach the extreme point of competitive venality and forget the human being, it is time to pause."

A prime example of overused standardization, he feels, is "the 2x4 fluorescent troffer, with ubiquitous acrylic." He sees the multiplication of these units—an industry standard—as dehumanizing, representing an all-too-easy panacea. With some notable exceptions, he would avoid the typical clichéd uses. "The clean-looking, efficient ceiling plane is really quite banal aesthetically; I'm not convinced that it is ever a positive sensory stimulant. I am tired of the myth of universal applicability, and bored with dependable regularity." He further questions the almost automatic decision to design for 100 footcandles in office buildings, noting that a ceiling full of troffers usually reduces acoustical treatment while increasing air conditioning loads and lighting costs.

Scutt points out that banality is not limited to troffer installa-



Grand Foyer of the Minskoff Theater, which is in the One Astor Plaza office building, New York City, is lit by small, clear, exposed-filament G-lamps placed to emphasize the sculptural quality of its design. Their glitter and sparkle add to the excitement of theater-going, as does the view of Times Square through the window wall at left. Patrons reach the Foyer via a dramatic escalator ride that carries them 35 ft up from the street-level arcade. Der Scutt is project designer for architects Kahn & Jacobs. Photo: Norman McGrath.

tions, however. "The now familiar luminous ceiling, which was conceived to simulate sky cloud cover, is really a corny bit of symbolism. This environment represents visual boredom at its highest." Like the wall-to-wall troffer, the glowing ceiling applies light throughout an area with no regard for the amount needed for tasks below it. It is not that the troffer and the luminous ceiling have to be scrapped, only that their rampant misuses should be curbed. A bank officer interviewing a loan applicant needs light quite different from that needed by the bookkeeper in the same bank.

Still another set of failures has to be attributed to the manufacturer, Scutt feels. "I still abhor many of the standard lighting fixtures and systems available today, and feel that manufacturers have a long way to go in improving the appearance of their equipment. The present catalog of lighting horrors is overwhelming. We are still not consistently design oriented, and when we are, we frequently over-reach. Other impediments to expanding our quest for creative and meaningful environments are the designs for table lamps which are both free-form sculpture and lights; they become neither, somehow. This restless flapping about suppresses rational thought. At best these idiocies might lift the neurotic spirits temporarily."

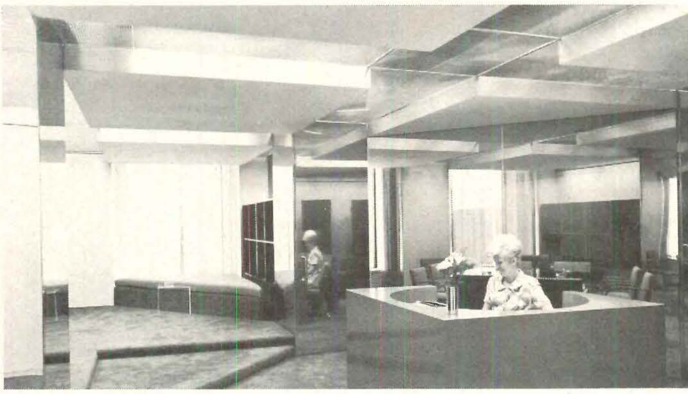
In addition to the examples of Kahn & Jacobs' work shown here, Scutt singles out other buildings that successfully combine lighting and architecture. He admits that troffers, as used in the GM Styling Administration Building Lobby (1956) helped to create "one of the more beautiful ceilings in existence." Similarly, he praises the Knights of Columbus Building by Roche & Dinkeloo (P/A, Sept. 1970, p. 84) for integrating required lighting levels and architectural/mechanical elements into "an exciting three-dimensional ceiling architecture—one of interest, relief and intimacy—and it works."

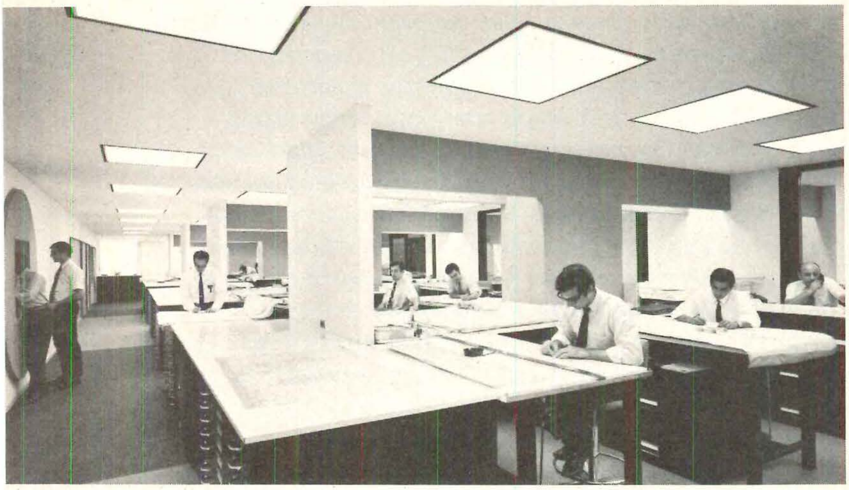
Two more extreme solutions elicit praise, and caution, from Scutt. Both, he notes, are laudable because they dare to be extreme, even though they are not for every client. In the Fabergé headquarters (P/A, June 1971, p. 78) cold cathode colored tubing is used to light, and decorate, a lobby and corridors which would otherwise probably be dominated by troffers. At Mel Kaufmann's office building at 127 John Street, New York City (P/A, Apr. 1972), the designers successfully used cathode tubes in entry tunnels, and G-lamps to indicate elevator locations. The lesson from both: think beyond standard applications to heighten an environment.

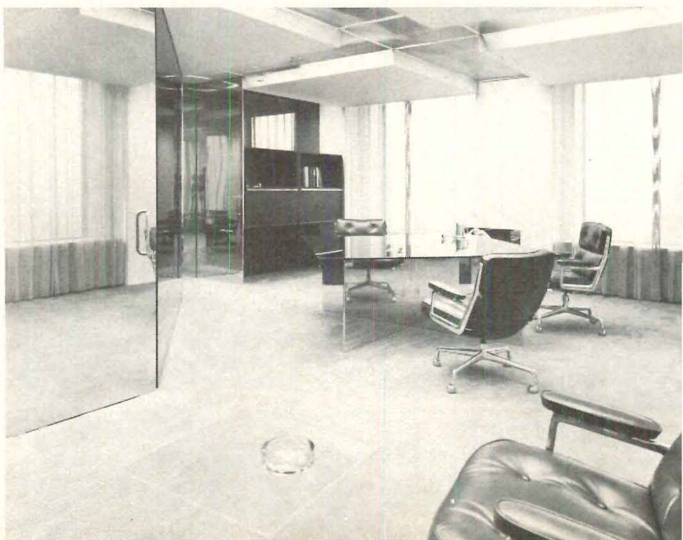
Lighting design: Scutt

Probably his highest praise is for Louis Kahn and Richard Kelly's combined natural and artificial lighting in the Kimbell Museum (p. 82). "Here the natural and artificial lighting are married with sophistication," Scutt says. "A total integration of lighting and architecture exists. The light washes the plain concrete surface of the cycloids evenly and poetically. This gentle blending of warmer reflection with the white oak floor establishes a light value—an aspect rarely dealt with today."

It is Scutt's hope that more such marriages can be arranged. Two of the roadblocks that he hopes to see removed are the use of the footcandle as a standard, and the wasteful lack of restraint on the part of architects and lighting engineers. With care, we could develop a more design-oriented methodology for creating the luminous environment. [JM]

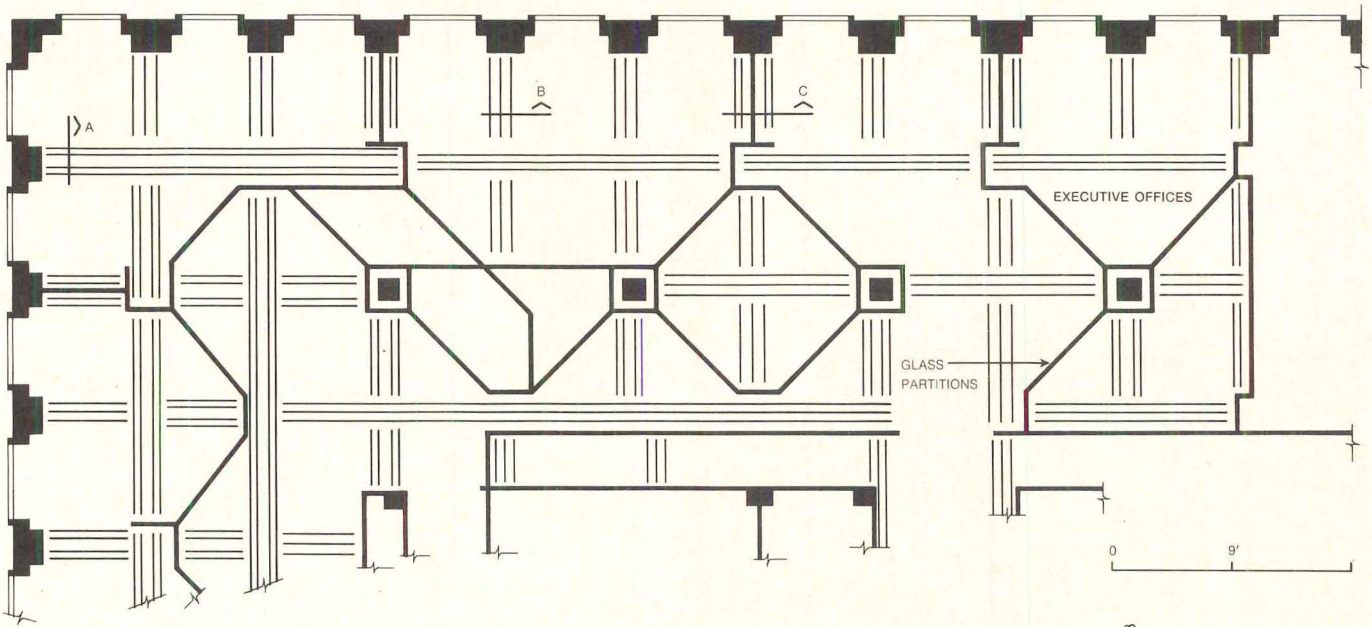


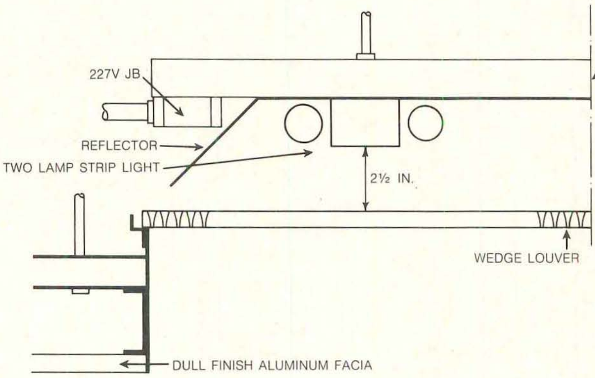




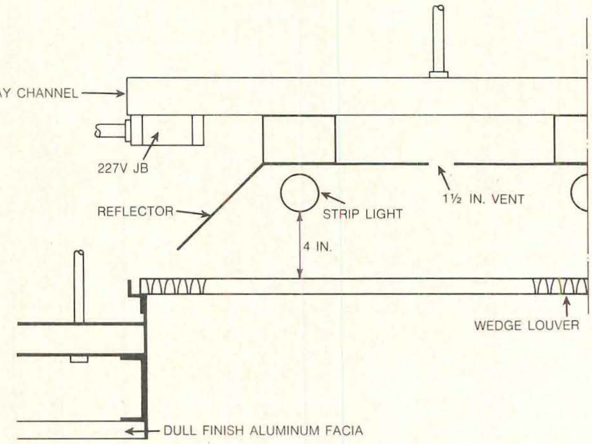
Executive area of W.A. Di Giacomo Associates, consulting electrical and mechanical engineers, is divided by gray glass partitions which cause some confusing reflections in these photos. Continuous panels of silver-surfaced, acrylic parabolic-wedge louvers originate 9 ft o.c. at each perimeter column; above are fluorescent lamps in continuous strips with integral reflectors, plus air handling and audio equipment. The diffusers provide a 45 degree cutoff, but light is also reflected from the brushed aluminum facings of the recesses. Although images do reflect on the glass-topped tables and desks, they are not normally seen by the worker. Level of illumination is 150 fc.

In the drafting area (above) auxiliary lighting is built into space dividers that organize the area into clusters of six drafting stations. Air-handling troffers are placed above each board; each contains six 30 w cool-white lamps shielded by an acrylic low-brightness lens. Project designer for Kahn & Jacobs is Der Scutt, who also designed most of the furniture. Photos: John T. Hill.

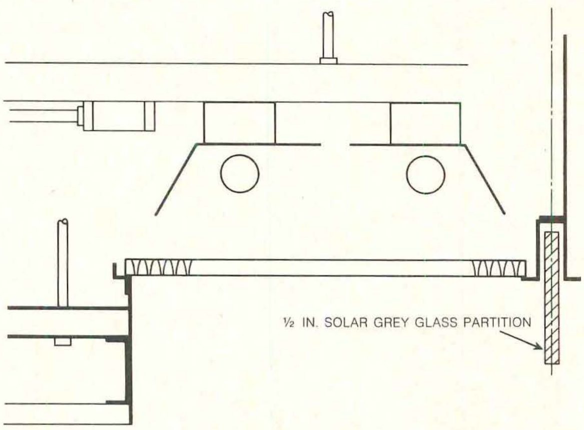




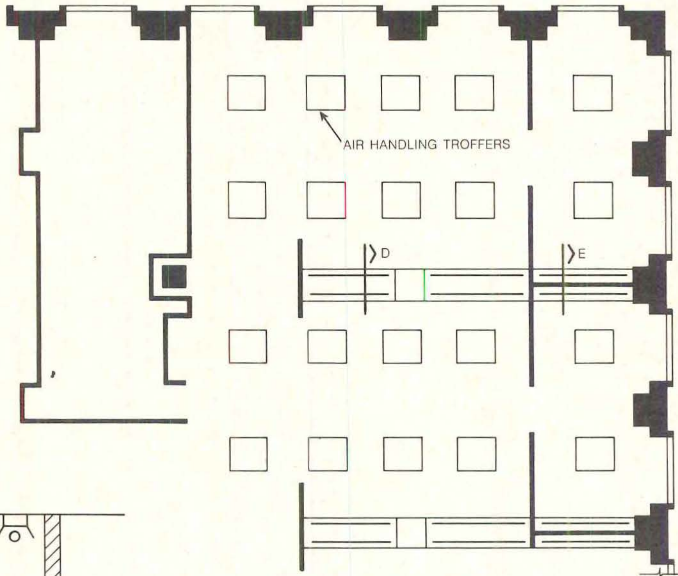
SECTION A-A



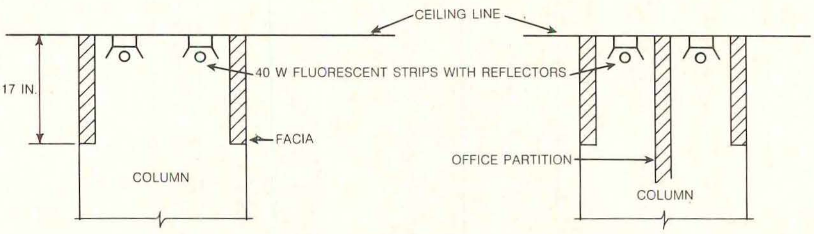
SECTION B-B



SECTION C-C



DRAFTING AND DESIGN AREA



SECTION D-D

SECTION E-E

Typical lighting plans for the DeGiacomo offices show how lighting strips connect in the executive area, where many of the partitions are diagonal. In the drafting area, ceiling troffers are supplemented by fixtures in the partitions.

All about sources

Terry K. McGowan

The lamp is the prime component of any lighting design, and its selection depends on far more than wattage requirements. The author reviews the various sources, their color characteristics, economics and applications

Light sources have become increasingly difficult to evaluate and specify. Not only are there more varieties, but there are now major new groups whose electrical and radiation characteristics differ from the familiar incandescent and fluorescent lamps.

In addition, the traditional performance indicators (life, light output, cost, size, etc.) often do not accurately reflect the importance of the lamp in the total lighting system. Calculation and analysis procedures which provide VCP (Visual Comfort Probability), ESI (Equivalent Sphere Illumination), luminance values and information on visibility, plus contrast, thermal and cost considerations, help to put the lamp into perspective by weighing the importance of each characteristic and then blending the items together into a meaningful answer.

There is little question that the lamp is a powerful design element because its effects go far beyond supplying light for the performance of visual tasks. It may influence the building module because of its dimensions, the electrical design because of its power requirements, the HVAC system because of its output radiation, surface finishes and ceiling appearance because of its optical characteristics, colors and textures because of the character of the emitted light and, of course, the economics because the lamp, along with the luminaire, wiring and controls, is part of the initial investment.

Selection of a light source strongly influences the operational costs of the space and its use of energy. The two most important factors involved are lamp luminous efficacy and the coefficient of utilization of the luminaire. Together these source-dependent qualities determine how much light per watt of input power reaches the desired surfaces within a space. This has a strong impact on operational costs, since electrical energy is typically a third to over half of the total cost of providing light (initial, operating and owning costs included). Also important are high lumen per watt sources that use energy efficiently.

Because of the subtle differences between many types of lamps, the question "Which light source?" often ends up being "Which light source will be the most economical in this situation?" or "How do I design this lighting system for minimum cost and energy consumption over so many years?"

About the only way to obtain meaningful answers is to put the lamp and its associated components through a comparative cost and maintenance analysis. The tables and information in this article are designed to bring together the essential characteristics of representative lamp types and their auxiliary equipment, plus some general application information. Although not intended to replace the manufacturer's catalog as the prime source of detailed information, this material should help the specifier narrow the choices and provide sufficient data for preliminary design evaluation.

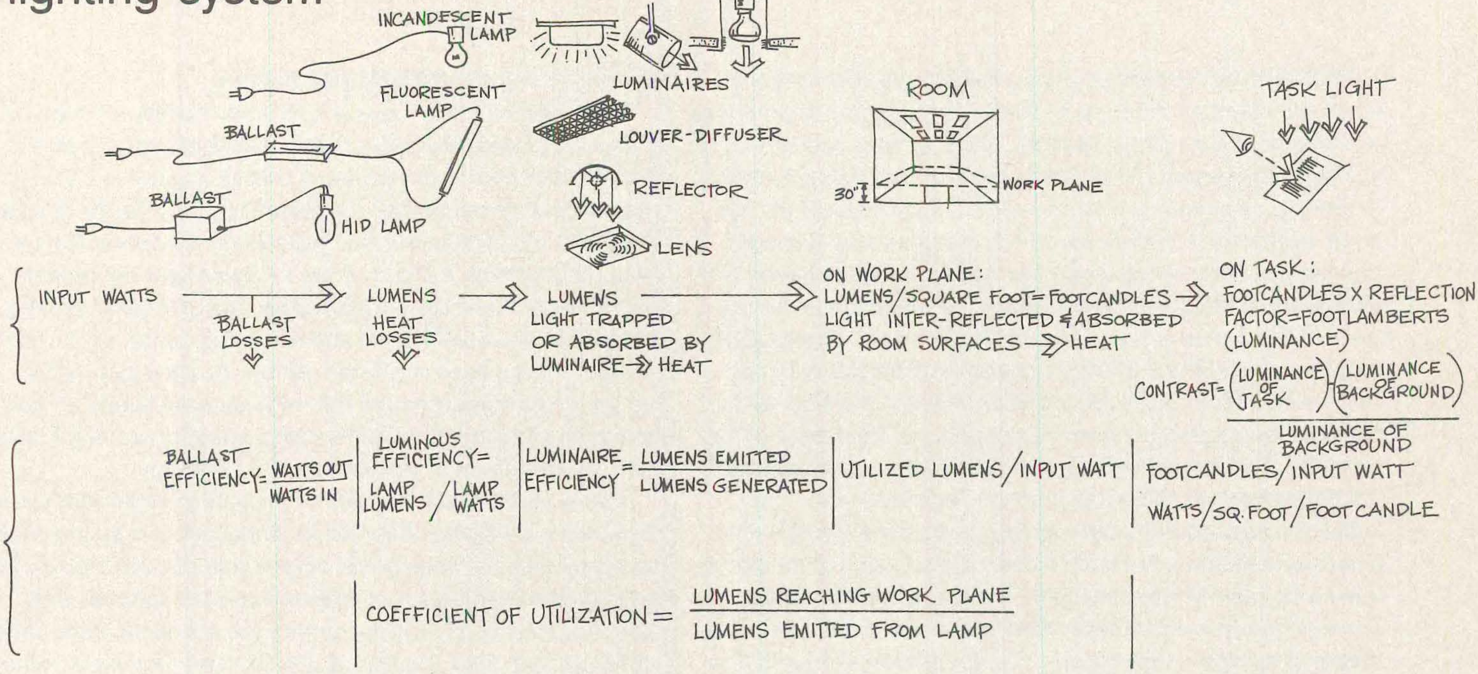
Cost and maintenance analysis

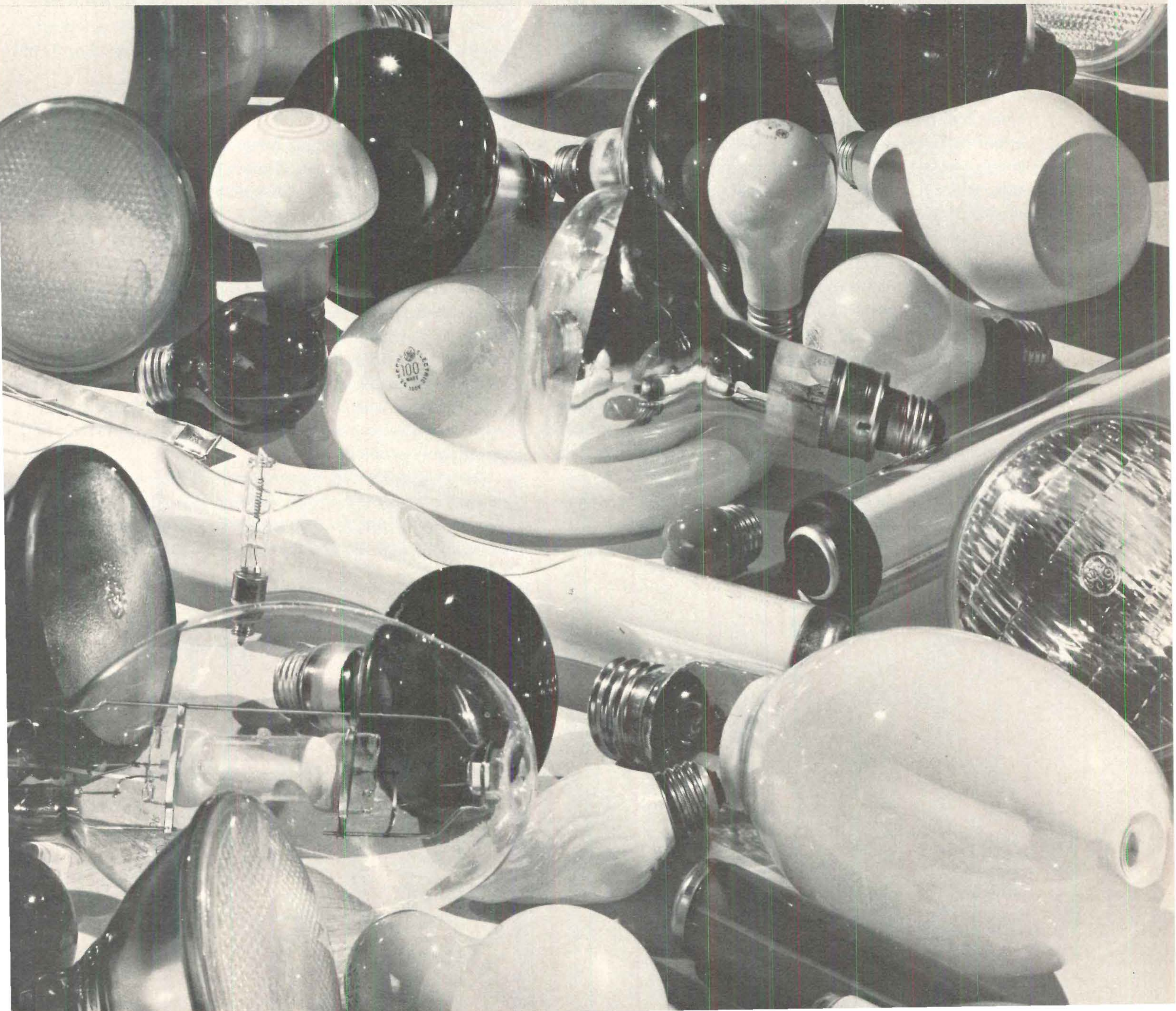
A lighting system cost analysis is an organized look at the factors which contribute to the cost-of-light. Charts are available by which designers can compare several systems for initial, operating or total cost. Costs for either spot or group replacement of lamps can be calculated. This is important since designers, reflecting the concern of their clients over increasing labor and maintenance costs, are now asking for more detailed information about cleaning procedures, replacement methods and maintenance equipment. Whole maintenance programs have been planned years into the future by predicting cost structures for electric energy, labor and replacement parts. This is possible because lamp performance is predictable; we know when a lamp can be expected to fail and what the light output of that lamp will be throughout life.

One measure of a lamp's quality is the shape of the mortality curve (Chart 1). Curve B represents the same lamp life rating as Curve A; however, a lighting system containing "B" lamps would have far more premature failures than would a system lamped with "A." Published life ratings, therefore, tell only part of the story.

Author: Terry K. McGowan is a lighting specialist in the Lamp Business Division, General Electric Company. He is a member of the Illuminating Engineering Society, the U.S. National Technical Committee on the Fundamentals of Lighting Calculations for the CIE (International Commission on Lighting), and the Institute of Electrical and Electronics Engineers.

e lighting system





The same can be said of a lamp's light output characteristics. Usually mean lumens or lamp lumen depreciation (LLD) are described as a single number. Mean lumens represent the average light output of the lamp over life. This rating is useful in lighting calculations if there is little concern about the minimum level of illumination which will result as a system ages and lamps are replaced. For many applications, however, it is necessary to know the lowest level to be expected in service to meet the provisions of codes, ordinances and some OSHA requirements. If the system is to be spot relamped as lamps fail, the LLD factor provides a good estimate. The LLD factor is the lumen output (in percent) of a lamp at 70 percent of its rated life. This is the average value to which a lighting system will depreciate (considering lamp depreciation only) if the lamps are replaced on a one-by-one basis. If the system is to be group relamped, the lamp's depreciated value at the group relamping point should be used. The lumen maintenance curve (Chart 2) is essential if these points are to be accurately found, since light output drop-off is not usually a straight line characteristic and can differ widely between lamps of the same general type, even the same wattage, depending upon phosphor color, ballast type or hours per start.

HID lamps

While incandescent and fluorescent lamps have gradually found their niche in the various kinds of general and supplementary lighting systems, the same is not yet true of the HID lamps. Mercury lamps have been used for outdoor roadway, area, flood and industrial lighting particularly in high bay areas where, thanks to superior optical control characteristics, they make better use of light than do typical fluorescent systems. Now, with improvements in mercury lamp color rendering and the development of self-ballasted, low-wattage, and reflector-bulb designs, mercury lamps have broadened applications in virtually every major indoor and outdoor area.

Mercury lamps have two of the most favorable characteristics of incandescent and fluorescent lamps—compactness and long life combined with superior ruggedness and reliability. Economics favor mercury where burning hours are long, replacement labor high or the lamps are difficult to service, and power costs are relatively low. Overall, however, if mercury and fluorescent lamps are both suitable in a given instance, a fluorescent system will still tend to be less costly because of its higher efficacy (see Chart 3).

The newer HID sources such as metal halide and high pressure sodium are now being used instead of mercury where careful attention must be paid to overall economics. While they are still at somewhat of a disadvantage in terms of sizes available, initial cost and life, they are most economical for general industrial, outdoor area, roadway lighting systems and many commercial lighting applications in gymnasiums, pools, lobbies, exhibit halls and shopping center malls. Lamp characteristics have improved rapidly. Some metal halide lamps are now interchangeable with mercury lamps on certain types of ballasts, and life ratings are approaching those associated with mercury and fluorescent lamps.

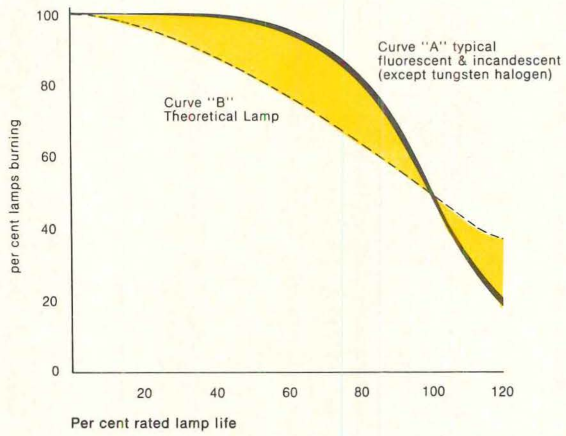
1500 w metal halide designs have replaced standard incandescent and tungsten halogen incandescent for such special applications as athletic fields, large stadiums and arenas. Besides higher efficacy (over three times more light per watt than incandescent) these sources have excellent color characteristics for color TV pickup. All HID lamps normally require an initial warm-up period and some time to restrike in the event of a power interruption. The time interval can range from a minute or so for high pressure sodium to 15 or 20 minutes for metal halide.

Fluorescent lamps

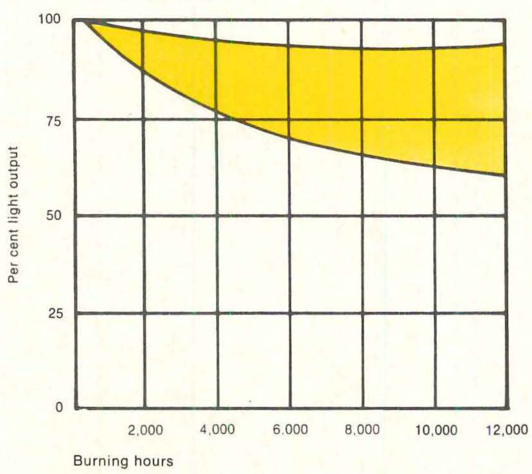
Recent fluorescent lamp developments have concentrated on improvements in color rendering and refinements in light output and depreciation characteristics. New U-shaped 40 w designs, while not generally as economical as straight 40 w lamps for conventional installations, are the best choice where luminaire dimensions are limited to 2′x2′ square sections. The only other alternative is a 20 w, 2-ft lamp which has lower efficacy and requires more ballasts, lampholders and wiring for the same luminaire light output. Where dimming is required, a 40 w rapid start system is also the best choice. Most commercially available dimming equipment is designed around the 40 w lamp, and new solid state control devices have expanded the dimming range and reduced wiring and operational problems.

More highly loaded, high-output and 1500mA lamps are good choices where the overall number of luminaires must be kept to a minimum for a given lighting level and in large areas of relatively high illumination levels. Fluorescent lamps be-

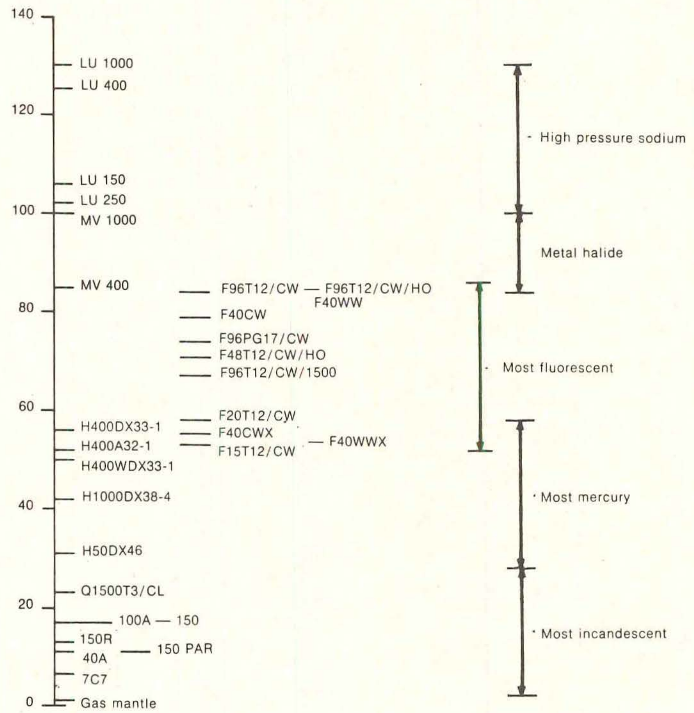
1 Lamp mortality



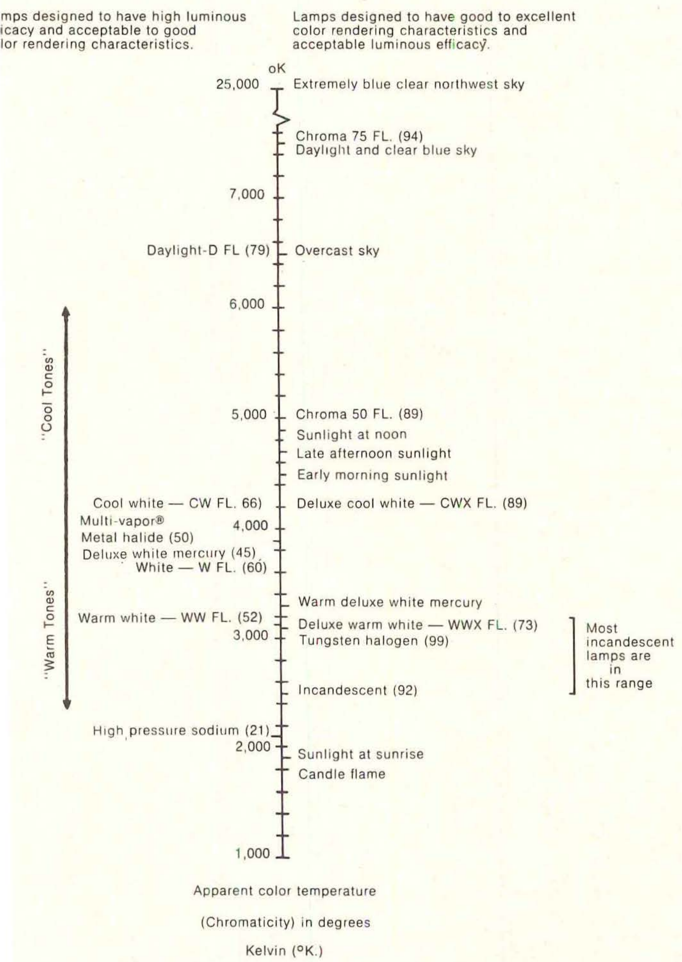
2 Typical fluorescent output depreciation



3 Luminous efficacies of common light sources (lumens/watt)



Color characteristics of light sources



Note: numbers in parenthesis denote the lamps color rendering index — Ra

come more efficient as lamp length and current loading increases, and often high-output (800mA) lamps will provide lower cost-of-light than 40 w lamps in office, store, school and other commercial installations.

Fluctuating ambient temperatures reduce light output of fluorescent lamps unless provision is made to keep the bulb wall temperature near 100 F (37.8 C) corresponding to an ambient temperature of about 77 F (25 C). Above these values, lamp watts and light output drop gradually (roughly 25 percent per 40 F). Too-cold operation is more critical. Light output drops about 75 percent per 40 F while lamp watts drop only about 25 percent and the lamp consumes almost full power while emitting very little light.

Indoor luminaires typically operate the lamp too warm unless some provision has been made for returning air through the luminaire or otherwise controlling the temperature of the air surrounding the lamp. Outdoors, using high-output or 1500mA lamps in tightly enclosed luminaires or jacketed lamps if lamps are exposed, solves the low temperature problem, although lamps may operate too warm during warm weather.

The life of fluorescent lamps as well as some of the newer HID sources is affected by the number of times the lamp is turned on and off. As fluorescent lamp life ratings have increased, this effect has become less important, so as a general rule the break-even point, where it would be more economical to leave the lamps on in an unoccupied space, is down to a few minutes. Considering costs for lamps, labor and power, the most economical approach in most systems is probably to treat a fluorescent system exactly like an incandescent system, turning it off when light is not required.

Incandescent lamps

While emphasis on efficacy and costs has eliminated incandescent lamps in most general lighting systems, their use for supplementary and special lighting tasks continues to grow. Low unit cost, familiar color characteristics, small size, variations in shape, wattage, input voltage, simplicity of wiring and control are all responsible. New incandescent lamp offerings exploit these characteristics. Low voltage lamps, for example, offer the maximum optical control using just the lamp itself. Narrow beam distribution as tight as 4.5 x 5.5 degrees are useful for spotlighting in show windows or for dramatic accent lighting on art objects. Outdoor applications include building floodlighting, fountain and spotlighting on flag standards and sculpture.

Coatings have been developed for incandescent lamps which provide improved strength, thermal protection, richer colors and decorative effects. Low wattage lamps used exposed in chandeliers are available in handsome shapes and finishes which look good lighted or unlighted. No other light source can yet match the glitter and sparkle provided by the bright filament of an incandescent lamp.

Tungsten halogen incandescent lamps have been developed to replace many standard designs in sports lighting, stage and studio, flood, accent, display and downlighting applications. Their primary advantages are higher light output per unit, superior depreciation characteristics and longer life—generally about twice as long as a standard lamp. The

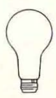
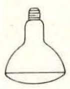
Light source characteristics: lamps for general use

Lamp ordering code	Volts	Watts	Description	Approx. hrs. life	Initial lumens	Mean lumens %	LLD %	Application notes
Incandescent								
25R14N	120	25	Reflector lamp 120° beam spread	1500	190	—	—	Efficient in multiplying cone downlights, low level lighting, decoration, display supplementary and sign lighting.
30R20	120 130	30	Reflector lamp 80° beam spread	2000	210	—	—	Efficient in multiplying cone downlights, low level floodlighting, wall washing, accent and display.
50R20	120 130	50	Reflector lamp 90° beam spread	2000	440	—	—	As above.
75PAR/SP or FL	120 130	75	Projector lamp spot: 30°x30° beam flood: 60°x60°	2000	765	—	—	Efficient in baffled or dark cone downlights, louvered units, spot and floodlighting, weatherproof for exposed outdoor applications. Cool beam versions reduce radiant heat in beam.
75R30/SP or FL	120 130	75	Reflector lamp spot: 50°x50° beam flood: 130°x130°	2000	900	—	—	Efficient in multiplying cone downlights, display, accent, wall washing colored versions available.
100A or 100A/W or 100A/C1	120 125 130	100	Inside frost white clear	750 " "	1750 1710 1750	93 " "	90 " "	General service lamp. Use in fixtures with built-in optical control: lenses, reflectors, diffusers, etc. also portable and supplementary lighting units. Extended life versions rated for 2500 hours and 1490 lumens.
150A or 150A/W or 150A/C1	120 130	150	Inside frost white clear	750 " "	2880 2790 2880	93 " "	90 " "	General service lamp as above. Extended life versions rated for 2500 hours and 2310 lumens.
150PAR/SP or FL	120	150	Projector lamp spot: 30°x30° beam flood: 60°x60°	2000	1740	84	78	Efficient in baffled or dark cone downlights. Spot flood, decorative, display, and accent lighting. Weatherproof for exposed outdoor applications. Cool beam versions reduce radiant heat in beam. Dichroic color versions have spot or flood distributions.
150R/SP or FL	120 130	150	Reflector lamp spot: 40°x40° beam flood: 110°x110°	2000	1870	89	85	Efficient in multiplying cone downlights. General flood, spot, accent, and display lighting. Colored versions available.
300/IF 300	120 130	300	Inside frost clear	1000	5820	91	87	See above. Extended life versions rated for 2500 hours life and 5190 lumens.
300PAR56/NSP or /MFL or /WFL	120 130	300	Projector lamp spot: 15°x20° beam med flood: 20°x35°	2000	3840	—	—	High level spot and floodlighting where accurate beam control required. May require enclosed fixture outdoors. Cool beam versions reduce radiant heat in beam.
300R/SP or FL	120 130	300	Reflector lamp spot: 35°x35° beam flood: 115°x115°	2000	3650	94	92	Efficient in multiplying cone downlights.
Tungsten halogen incandescent								
Q250PAR38SP or FL	120	250	Projector lamp spot: 24°x24° beam flood: 60°x60°	4000	3220	94	93	Most powerful PAR-28 lamp. Efficient in baffled downlights, accent display, spot and flood applications. Can be burned in any position.
Q250CL/DC Q250DC Q250CL/MC Q250MC	120 130	250	Single ended lamp. Bayonet base or mini-can base, clear or frosted	2000	4850	97	96	For external reflector luminaires. Spot, flood, accent and display, 130 volt lamps emit 4700 initial lumens.
Q500T3/CL or Q500T3	120 130	500	Double ended lamp clear, frosted	2000	10950	97	96	Widely used in outdoor flood lighting equipment. Frosted lamp eliminates streaks in beam pattern and broadens luminaire distribution. Lamp must be burned horizontally. 130 volt lamps emit 10550 initial lumens.
Q500PAR56 NSP or MFL or WFL	120	500	Projector lamp spot: 15°x32° beam Med. flood: 20°x42° Wide flood: 34°x66°	4000	8000	94	91	Most powerful PAR-56 lamp. Outdoo[r] floodlighting fountains, high level interior display and spotlighting. Cool beam versions reduce radiant heat in beam.
Q1000PAR64 NSP or MFL or WFL	120	1000	Projector lamp spot: 14°x31° beam Med. flood: 22°x45° Wide flood: 45°x72°	4000	19400	94	91	Most powerful PAR-64 lamp. Floodlighting fountains, high level accent and display.
Q1500T3/CL	208 220 240 277	1500	Double ended lamp	2000	35800	97	96	Widely used in outdoor floodlightin[g] equipment. Lamp must be burned horizontally. 277 volt version emits 34400 initial lumens.

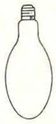
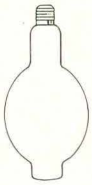
ight source characteristics: lamps for general lighting

amp ordering code	Nominal watts	Nominal length (ins.)	Description	Approx. hrs. life[2]	Approx. initial lumens	Mean lumen[3]	LLD[4] %	Application notes
luorescent								
20T12/CW	20	24	Cool white	9000*	1300	1155		Supplementary and general lighting. Dwindling use in 2'x2' Luminaires because of greater efficacy of 40 w U-shaped lamp. Trigger or preheat start.
20T12/CWX	"	"	Deluxe cool white	"	850	740		
20T12/WW	"	"	Warm white	"	1300	1155		
20T12/WWX	"	"	Deluxe warm white	"	820	715		
				25000	3150	2805		Most widely used fluorescent lamp types. Preheat or rapid start. (Rapid start ratings shown). All colors available in F40 design.
40CW or F40CW/S[1]	40	48	Cool white	(20000)	(3250)	(2960)	83 (86)	
40CWX	"	"	Deluxe cool white	"	"	"	73	
40WW or F40WW/S[1]	"	"	Warm white	"	3200 (3300)	2850 (3005)	83 (86)	
40WWX	"	"	Deluxe warm white	"	2150	1795	73	
40/C50	40	48	5000 °K	25000	2150	1805	73	Use where optimum color rendering at 5000°K or 7500° Chromaticity desired.
40/C75	"	"	7500 °K	"	1990	1603	73	
40/CW/U/3 or 6	40	24	Cool white	18000	2900	2610	83	U-shaped, 3⅝ or 6-in leg spacing. Designed for 2'x2' luminaires. Operate on standard 40 w rapid start ballasts.
40/WW/U/3 or 6	"	"	Warm white	"	2850	2560	83	
96T12/CW	75	96	Cool white	18000	6300	5800	86	Slimline instant start. Widely used commercial lighting lamps. Luminous ceilings, suspended and surface mounted luminaires.
96T12/CWX	"	"	Deluxe cool white	"	4450	3870	78	
96T12/WW	"	"	Warm white	"	6300	5800	86	
96T12/WWX	"	"	Deluxe warm white	"	4300	3740	78	
48T12/CW/HO	60	48	Cool white	(1800)	4300	3740	77	High output rapid start. Commercial and industrial general lighting. HO lamps most widely used in transilluminated plastic signs. Available lamp lengths range from 18"to 96".
48T12/CWX/HO	"	"	Deluxe cool white	"	3050	2560	72	
48T12/WW/HO	"	"	Warm white	"	4300	3740	77	
96T12/CW/HO	110	96	Cool white	"	9200	8005	77	
96T12/CWX/HO	"	"	Deluxe cool white	"	6600	5475	72	
96T12/WW/HO	"	"	Warm white	"	9200	8005	77	
48PG17/CW	110	48	Cool white	12500	7000	5600	67	1500mA rapid start. Industrial and commercial general lighting. Outdoor area and floodlighting (use enclosed luminaire for low temperature applications). Economic life typically 5000-7500 hours.
48PG17/CWX	"	"	Deluxe cool white	"	4800	3600	58	
48PG17/WW	"	"	Warm white	"	7000	5600	67	
96PG17/CW	215	96	Cool white	"	16000	12800	67	
96PG17/CWX	"	"	Deluxe cool white	"	11000	8250	58	
96PG17/WW	"	"	Warm white	"	15000	12000	67	
48T12/CW/1500	110	48	Cool white	12500	6250	4875	67	Same as above.
48T12/CWX/1500	"	"	Deluxe cool white	"	4300	2880	58	
48T12/WW/1500	"	"	Warm white	"	5800	4525	67	
96T12/CW/1500	215	96	Cool white	"	14500	11600	71	
96T12/CWX/1500	"	"	Deluxe cool white	"	10000	7200	66	
96T12/WW/1500	"	"	Warm white	"	13600	10880	74	

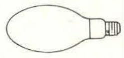
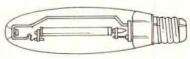
Premium design. Data shown in parentheses.
Rated life at 12 hours/start * = 3 hrs/start.
[3]For "PG" types mean lumens given at 3000 hours.
[4]For "PG" and "/1500" types LLD given for life rating of 7500 hours.

NSI designation		Watts	Description	Rated av. life hours	Initial[1] lumens	Mean[2] lumens	LLD[2] %	Application notes
igh intensity discharge—mercury								
46DL-50DX		50	Deluxe white (medium screw base)	16000	1575	65	—	Light output similar to 100 w incandescent.
43/AV-75DX		75	Deluxe white (medium screw base)	16000	2800	75	—	Light output similar to 150 w incandescent.
38MP-100DX		100	Deluxe white (medium screw base)	18000	4000	83	—	Light output similar to 200 w incandescent.
38BP-100DX		100	Deluxe white reflector flood (medium screw base)	24000+	2850	80	70	Multiplying cone downlights floodlighting (enclosed fixture).
39KC-175DX		175	Deluxe white	24000+	8150	86	81	Lay-in external reflector luminaires —commercial and industrial lighting. Reflector and refractor luminaires outdoor area and floodlighting, widely used for "dusk-to-dawn" area lights.
39KC-175/WDX	"	175	Warm deluxe white	24000+	6500	89	77	Designed for general interior commercial lighting, especially stores. Warmer color tone than deluxe white lamps.
39KB-175	"	175	Clear	24000+	7450	92	88	Poor color rendering. Suitable only for outdoor lighting where color is not important. Will accent most foliage colors.
39BB-175/DX		175	Deluxe white (medium or mogul screw base)	24000+	5700	80	71	Multiplying cone downlights. Floodlighting (enclosed fixture).
33GL-400/DX		400	Deluxe white	24000+	22500	85	78	Most widely used size for interior commercial, flood, area and industrial lighting.
33GL-400/WDX		400	Warm deluxe white	24000+	20000	82	74	Most widely used size for general lighting in stores.
36GW-1000/DX		1000	Deluxe white	24000+	63000	75	63	
36GW-1000/WDX		1000	Warm deluxe white	24000+	58000	68	—	

Light source characteristics: lamps for general lighting

Lamp ordering code	Description	Rated[1] av. life hours	Initial[2] lumens	Mean lumens	LLD %	Application notes
High intensity discharge—metal halide						
MV400/BU/I MV400/BD/I 	Clear-vertical burning ± 15°.	15000	34000	78		Interchangable with 400 w mercury lamps on some types of ballasts. Interior and exterior general lighting where ambient temperatures are 50 F (10 C) or more.
MV400/BUH MV400/BD	Clear or Phosphor coated. Vertical to horizontal burning.	10500	32000	—		General interior and exterior lighting.
MV1000/BU/I	Clear. Base-up ± 15°.	10000	88000	80		Interchangable with 1000 w mercury lamps on some types of ballasts. For ambient temperatures of −20 F (−28.9 C) and above.
MV1000/BUH MV1000/BD 	Clear. Vertical to horizontal burning.	10000	100000	80		General interior and exterior lighting.
MV1500/HBU/E	Clear. Vertical to horizontal burning.	1500*	153000	93		Sports lighting applications. General lighting for stadia and arenas where short burning hours are involved. Color rendering for color telecasting.

[1]10 or more hrs/start except * 5 or more hrs/start.
[2]Vertical operation. Lumen output is reduced if burned horziontally.

Lamp ordering code	Description	Rated[1] av. life hours	Initial lumens	Mean lumens	LLD %	Application notes
High intensity discharge—high pressure sodium						
LU150/BU or /BD 	Vertical to horizontal burning.	12000	16000	90	84	Designed to replace 175 w mercury lamps in roadway, area and interior applications. Approx. 2 x lumens with lower ballast input watts.
LU250/BU or /BD 	Vertical to horizontal burning.	15000	25500	91	88	Industrial, roadway, area and floodlighting.
LU400/BU or /BD	Vertical to horizontal burning.	20000	50000	90	88	Same as above.
LU1000/BU or /BD 	Vertical to horizontal burning.	10000	130000	92	90	Same as above. Highest luminous efficacy of any general lighting source. Especially applicable to high mast (70-150+ feet) area and roadway lighting.

[1]10 or more hrs/start.

All about sources

filament tubes of tungsten halogen lamps are quartz loaded to approximately 100 watts per square inch. PAR and R-lamp versions allow higher wattages in a given bulb size than previously possible. 250 rather than 150 watts are available in a PAR38 size, 500 instead of 300 in the PAR56 and 1000 instead of 500 in the PAR64.

Light sources and color

Color is one of the most difficult light source characteristics to evaluate. The reason is that the colored appearance which a source gives an object or a space is subjective, strongly influenced by the viewer, his experience, bias, color adaption, color vision, psychological characteristics and the setting of the object. Move an object into another setting, even under the same light source, and the opinions change.

Because the technical terms used to describe the color characteristics of light sources have rather limited use outside scientific circles, and are often highly mathematical, the specifier may find it difficult to describe what he wants in precise terms, much less specify it, and so color is often disregarded or evaluated on the basis of experience. In the case of new or unfamiliar light sources, selecting them for color characteristics, color then becomes a matter of confusion.

There are two terms, however, which can provide the specifier with useful color information: *chromaticity* or apparent color temperature (sometimes called correlated color temperature) and *color rendering index* (written as R_a in color literature). It is important to realize that each of these factors gives specific but separate information about the color characteristics of the light source. Chromaticity is the measure of a light source's "warmth" or "coolness" expressed in the Kelvin temperature scale (°K.). It describes the appearance ar object would have if it were heated to incandescence—the point of emitting light—then to higher temperatures where the appearance changes from ruddy red through a range of warn colors to white, then finally to blue white (Chart 4). While the chromaticities of these sources vary throughout the day, it is a familiar and beautiful characteristic of natural light.

People tend to associate various chromaticities with their electric counterparts which is perhaps why incandescent lighting (low color temperature) tends to be compared to flame sources or sunlight at dawn or dusk, and why incandes cent lighting seems to be preferred at low illumination levels. Fluorescent light (cool white) is preferred at higher illumina-

Outdoor lighting (area and floodlighting) lamp selection guide

Lamp	Incandescent		Fluorescent	High intensity discharge		
Type	Standard	Tungsten halogen	Cool white	Deluxe white mercury	Metal halide	High pressure sodium
Application	Small area flood & accent	General flood and accent	Immediate area flood	General flood and area	General flood and area	General flood and area
Lamp optical controllability potential	Excellent	Excellent	Fair	Good	Excellent	Excellent
Glare control with typical luminaire	Fair	Fair	Good	Fair	Good	Good
Typical mounting height (ft), area lighting	12-30	15-35	12-20	18-45+	25-100+	25-100+
Color effects: accents	Warm colors	Warm colors	Yellow, blue, green	Red, yellow, blue, green	Yellow, blue, green	Yellow, orange
Color effects: grays	Blues	Blues	Reds	Deep reds	Reds	Deep red, green, blues
Lamp wattages for typical applications	150 (PAR38) 300 (PAR56) 500 (PAR64) 1000 (PS-52) 1500 (PS-52)	250 (PAR38) 400 (T-4) 500 (T-3) 1000 (PAR64) 1500 (T-3)	60 (4′ high output) 85 (6′ high output) 110 (8′ high output) 110 (4′ 1500 mA) 215 (8′ 1500 mA)	175 250 400 700 1000	400 1000 1500	150 250 400 1000
Initial lamp lumens (correspond to wattage above)	1740 3840 6500 23740 34400	3025 7950 10600 18200 34730	4300 6650 9200 6250 or 7000 (PG) 14500 or 16000 (PG)	8150 12100 22500 42000 63000	32000 100000 153000	16000 25500 50000 130000
Initial lamp lumens/watt	11-24	11-24	60-85	45-65	80-100	100-130
Typical rated lamp life (hrs)	1000-2000	2000-4000	12500-18000 (at 12 hrs/start)	24000+	1500-10000	12000-20000
Light output depreciation characteristics	Fair	Excellent	Good	Fair	Fair	Excellent

Note: Generic or ANSI lamp designations have been used in these charts wherever possible. Some, however, are General Electric code numbers, but the reader will find equivalents in catalogs published by other manufacturers.

tion levels, perhaps for its work-a-day atmosphere.

Chromaticity, however, provides no information about how well a source will render various object colors. Natural sources in general have excellent color rendering; light is present throughout the visible spectrums, although some colors may be slightly distorted by weather conditions, time of day, season, latitude, etc. All electric sources, however, distort colors in some way since their emission of the different colors is out of balance. An incandescent lamp, for example, emits little blue and green light relative to red and so tends to mute or gray down the "cool" colors such as blue.

A measure of this distortion characteristic or how well a light source renders colors is the color rendering index (R_a). Essentially this a number which compares a given source against a "perfect" or reference source on a 0–100 scale. The system is limited, however, because the comparison is meaningful only if the two sources being compared have the same chromaticity. Thus, it would not be meaningful to compare the color rendering index of an incandescent lamp against a cool white fluorescent lamp because the chromaticity of incandescent is 2900 K vs cool white fluorescent at 4200 K. A comparison could be made between cool white, R_a = 66, and deluxe cool white fluorescent, R_a = 89, however, because both have the same chromaticity. This can also be qualitively determined by examining the spectral power distribution curve of these sources. Lamps with emission throughout the spectrum, especially in the red regions, tend to render all colors well.

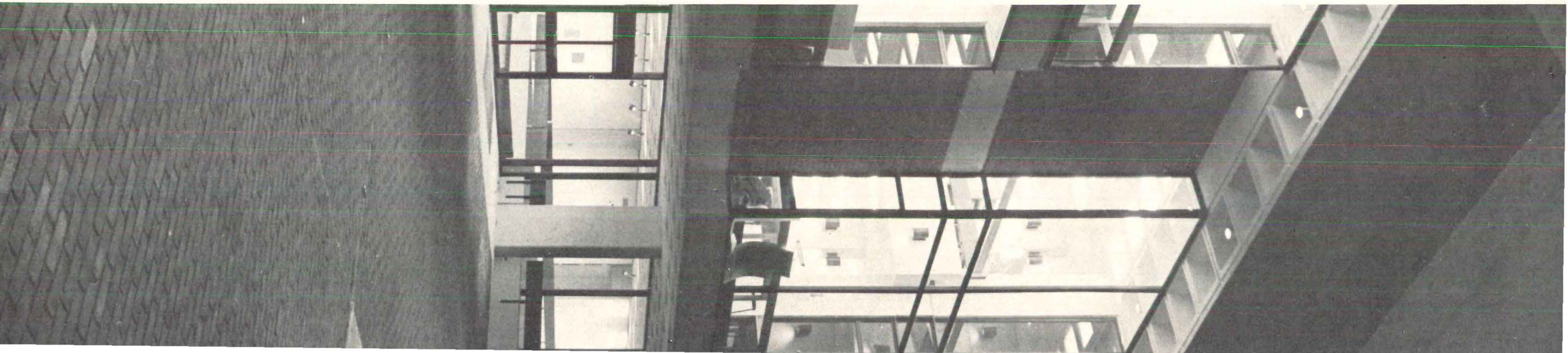
From a design point of view, if color rendering is important, one approach might be to select a chromaticity range for its warmth or coolness, then find a source with the highest color rendering index in that range, being aware that high color rendering lamps have lower luminous efficacies, so there may have to be a trade-off against illumination level.

Light sources—what to expect

Major light source developments are now concentrated in the high intensity discharge area. Metal halide and high-pressure sodium lamps are still relatively new and much is yet to be explored about enclosing high temperature vapors inside different kinds of ceramic envelopes. Present lamps use power efficiently, are compact, offer fair to good color rendering and favorable optical characteristics. HID sources have significantly lowered the cost-of-light. The next step is expan-

Interior general lighting (commercial and industrial) lamp selection guide

Lamp	Incandescent		Fluorescent				High intensity discharge			
Type	Standard	Tungsten halogen	Cool white	Warm white	Deluxe cool white	Deluxe warm white	Deluxe white mercury	Warm deluxe white mercury	Metal halide	High pressure sodium
Application	Local lighting accent, display. Low initial cost general lighting	Accent, display general lighting in lobbies, theaters, etc.	Most commercial and industrial general lighting systems	Many commercial and industrial general lighting systems	General and display lighting where good color daylight-like atmosphere important	General and display lighting where good color incandescent-like atmosphere important	Store and other commercial and industrial—general lighting	Store and other commercial—general lighting	Industrial, commercial general lighting, pools, arenas	Industrial general lighting. Some commercial applications
Lamp optical controllability potential	Excellent	Excellent	Fair	Fair	Fair	Fair	Good	Good	Excellent	Excellent
Glare control with typical luminaire	Good	Excellent	Good	Good	Good	Good	Excellent	Excellent	Good	Good
Color effects: accents	Warm colors	Warm colors	Yellow, blue, green	Yellow, green	None-excellent color balance	Yellow, orange, red-like incandescent	Red, yellow, blue, green	Red, orange, yellow, green	Yellow, green, blue	Yellow, orange
Color effects: grays	Blues	Blues	Reds	Red, blues	None	Blues	Deep reds	Deep reds, blues	Reds	Deep reds, greens, blues
Range of lamp wattages for typical applications	30-1000	200-1500	20-215	20-215	20-215	20-110	50-1000	175-1000	400-1000	150-1000
Range of initial lamp lumens for typical applications	210-23740	3460-34730	1300-16000	1300-15000	850-11000	820-6550	1575-63000	6500-58000	34000-100000	16000-130000
Initial lamp lumens/watt	7-24	17-24	65-85	65-85	40-60	40-60	30-65	35-60	85-100	100-130
Average rated lamp life (hrs)	750-2000	1500-4000	9000 (3 hours/start)—30000 (continuous burning for F40 types)				16000-24000+	24000+	8000-15000 (10 or more hours/start)	12000-20000 (10 or more hours/start)
Light output depreciation characteristics	Good	Excellent	Good	Good	Fair	Fair	Fair	Fair	Fair	Excellent



Typical fluorescent lamp ballast input watts*

Lamp type	Lamp current (amps)	Nominal lamp watts	Input watts, single lamp ballast	Lamp watts/ input watts %	Input watts, two lamp ballast	Lamp watts/ input watts %	Circuit type
F20T12	.380	20	34	59	55	73	Trigger start
F30T12	.430	30	46	65	70	86	Rapid start
F40T12	.430	40	53	75	92	87	Rapid start
F40T12	.430	40	51	78	98	82	Preheat
F48T12	.425	40	60	67	100	80	Slimline instant start
F96T12	.425	75	102	73	175	86	Slimline instant start
F48T12/HO	.800	60	85	71	150	80	High output rapid start
F72T12/HO	.800	85	130	65	200	85	High output rapid start
F96T12/HO	.800	110	140	79	245	90	High output rapid start
F48T12/1500	1.5	110	140	79	240	92	1500mA rapid start
F72T12/1500	1.5	165	185	89	345	96	1500mA rapid start
F96T12/1500	1.5	215	230	93	450	96	1500mA rapid start

*For 120 volt input power factor ballasts designed to start lamps in ambient temperatures of 50 F (10 C) and above.

Typical HID lamp ballast input watt*

Lamp type	Desig-nation	Watts	Ballast type				
			Reactor	(Lag) Autotransformer	Regulator	Auto regulator	Peaked lead
Mercury	H46	50	—	65	—	—	—
	H43	75	—	85-90	—	90	—
	H38	100	115	115-130	115-135	120-125	—
	H39	175	190	190-205	200-215	195-210	—
	H37	250	270	270-285	285-300	285-290	—
	H33	400	435	430-455	450-460	445-455	—
	H36	1000	1070	1050-1080	1085-1110	1060-1080	—
Metal-halide		400	—	—	—	460	455-460
		1000	1045	—	—	1080	1080-1090
High-pressure sodium		150	170	—	200	—	—
		250	300	—	310-320	—	—
		400	450	450-460	470-490	—	—
		1000	1075	—	—	1130	—

*For 120 volt input high power factor ballasts.

All about sources

sion of present lamp offerings in terms of shape, size, wattage and color variations similar to what has occurred with older fluorescent and incandescent sources. The result will be increased design flexibility that allows the designer to use a "family" of sources throughout an installation. Introduction of self-ballasted and externally ballasted lamps with solid state circuitry will tend to reduce luminaire size, weight and eventually the relative cost of fixture components. Increasing energy costs are expected to multiply the number of applications where high efficacy is essential.

Fluorescent lamps will continue to be the most efficient way of generally lighting building interiors. Improvements in luminous efficacy, lumen maintenance, and the application of solid state circuitry to the ballast and lamp system are expected to keep this source in step with HID sources. Shorter, fatter lamps operating at high frequencies, with new cathode designs, which emit greater amounts of light per foot are in the experimental stage. Increased use of fluorescent lamps for residential lighting can help reduce the relative amount of power required to light homes and apartments.

Historically, no new light source has ever replaced an older one. This certainly applies to incandescent lamps, since there are still plenty of lighting applications that require this source. While dramatic improvements in lamp characteristics may not be on the horizon, new developments—especially in the tungsten halogen area—will improve lamp life and maintenance of light output. No better substitutes have yet been found for glass and tungsten, the main components of incandescent lamps, which suggests that basic operating characteristics will remain the same.

Architecture building, University of Virginia, Charlottesville.
Rawlings & Wilson, architects; Hawkins & Anderson, engineers.

Predicting visibility and comfort

Henry G. Williams

Lighting design becomes a more exact science with two measurements that can be made in advance: Equivalent Sphere Illumination and Visual Comfort Probability

Two tools are available to the lighting designer to help determine the real effectiveness of light for people. Visual Comfort Probability (VCP) tells if a lighting system will be too glaring. Equivalent Sphere Illumination (ESI) tells how well a lighting system renders the visibility of a seeing task. Establishing proper criteria for comfort and visibility with these evaluation procedures enables the designer to specify effective lighting more clearly than ever before. The result is the best lighting for visual needs with the least dollars and energy.

At present, Visual Comfort Probability applies principally to fluorescent fixtures in schools and offices. The criterion established for the visual comfort of a lighting system by the Illuminating Engineering Society is a VCP of 70 or more. If this and certain other criteria of maximum and average fixture brightness are met, direct glare will not be a problem.

The entire luminous environment of a room is taken into account in the calculation of VCP. Extensive laboratory work on the complexities of people's response to glare has resulted in mathematical relationships that factor in fixture brightness and size, the number of fixtures and their locations, general room brightness and the differences in individual glare sensitivity. Computer programs now permit VCP values for a given fixture to be easily run for a large number of room sizes.

Most lighting fixture manufacturers now publish VCP tables for their equipment, and several states now specify visual comfort for school lighting in VCP. It is an easily used tool.

Equivalent Sphere Illumination is the illumination measured with a task lighted by a uniformly luminous sphere. This particular arrangement was chosen because the visibility of a task depends on the contrast of the printed or written material with its background. This in turn is affected by the specular (mirrorlike) reflections of lighting fixtures or other room surfaces in the task. These reflections are called veiling reflections. The sphere source used in the laboratory is thus a reference condition, so any combination of illumination level and veiling reflection components from an actual lighting system can be represented by a quantity of sphere illumination that produces the same visibility.

Ordinarily, when a lighting fixture is reflected specularly in a task, the result is an ESI value that is less than the actual illumination (footcandles) on the task. This means it takes fewer footcandles of sphere illumination to make the task as visible as it would be with the fixture reflecting in it.

Veiling reflections occur in almost all tasks—that is, very few objects are completely diffuse. The effect is often subtle in some, such as printing on matte paper, but usually there is some specular effect. Pencil writing has been thoroughly investigated and the predicting methods now in use for designing to a given ESI level are based on a certain reference pencil task. All the recommendations of the Illuminating Engineering Society for flat paper seeing tasks are now in footcandles of ESI.

In designing for optimum ESI, there are different approaches that can be used to minimize veiling reflections. Locating lighting equipment so it does not reflect in the task at the mirror angle is the most effective; but, if lighting and work locations cannot be coordinated, some improvement in ESI is possible by the use of so-called batwing distribution fixtures that direct light out to the sides rather than down. Most commercially available batwing luminaires are most effective when oriented parallel to the predominant viewing direction. Polarizing panels can also produce a sharper contrast rendition in the task. Spreading the light source over a large area, such as with a luminous ceiling or indirect lighting, is another effective technique.

Luminaire manufacturers and consulting engineers will soon have methods available for predicting ESI in a room with a given lighting system. A computer program has been completed which makes the calculations manageable, and more readily usable programs are being developed. Soon it will be possible for designers to provide the visibility that has been sought—that was assumed to be provided by actual footcandles—with proper equivalent sphere footcandles.

These two new evaluation systems require a different approach to lighting design than has traditionally been used. Ordinarily a regular array of light fixtures designed for efficiency is used to produce the desired task lighting level uniformly

Author: Henry G. Williams is a lighting specialist in the Lamp Business Division, General Electric Company.

throughout the room. Now, it is apparent that this is not necessarily the correct approach. The most efficient fixtures are those that do not control light very well for visual comfort.

Uniform illumination does not necessarily mean uniform equivalent sphere illumination; in fact, a variation in maximum to minimum ESI of 5 to 1 is typical for most fluorescent lighting installations. Usually the maximum is slightly over while the minimum illumination is about one-fifth the average value.

A non-uniform lighting approach may be more effective visually, and also cost less money and use less energy than a uniform lighting system. When lighting equipment illuminates only the task and is positioned to minimize veiling reflections, the ESI will usually be greater than the actual footcandles delivered. Equipment requirements are flexible. Luminaires may be on the ceiling, the walls, built into the furniture, or a combination of these. With the tasks lighted, the only other need for light in the room is to prevent dark room surfaces from creating an excessive brightness imbalance that causes visual discomfort. A moderate level of general lighting or the use of wall lighting systems can usually satisfy this requirement.

Where non-uniform approaches are deemed impractical, the batwing-type distributions and polarizing panels should be considered. Since their use may alter the light characteristics, lighting designers will need to know how one quality of lighting affects other qualities. Now, along with the effect of lighting on the aesthetic appeal of the space, the interrelation of visibility and comfort can be considered—must be considered—for optimum results.

ossary of common lamp specification terms

e. The glass or ceramic enclosure which contains discharge. Fluorescent lamps use glass; mercury tal halide lamps, quartz; high pressure sodium se a translucent alumina ceramic.

. The electrical device which supplies the proper and current to start and operate a discharge lamp. st common is the electro-magnetic type, typically a box" mounted inside the luminaire. Solid state bal- e also available for certain lamp types. Resistance -ballasted" mercury lamps have the ballast built lamp in the form of an incandescent filament. This s lamp luminous efficacy by about one-half com- o externally ballasted lamps.

he outer envelope of a light source; usually quartz s.

aticity. One of the two characteristics of light to produce color (the other is luminance). It is an ion by the human eye of the relative spectral distri- of the light source. The strongest or dominant ngths emitted by the source determine the color he degree of "warmth" or "coolness."

endering index. A mathematical procedure for ing light sources to a standard reference source by ing color shifts on test samples. A color rendering f 100 (R_a = 100) means that the test source s the reference source exactly. To be meaningful, urces should have the same chromaticity. This sys- till being developed and applies primarily to incan- t and fluorescent lamps.

eam. Refers to lamps with a dichroic coating that s radiant heat in the output beam by reflecting heat the back of the lamp.

iation curve. A graphic representation of a lamp's tput characteristics over a period of time. Some- alled lumen maintenance curve. Associated terms: mens, LLD.

nt tube. The enclosure, usually of quartz, used in n halogen lamps to contain the halogen gas and nent.

scent lamp. A discharge lamp with a fluorescent or coating on the inside of the bulb that transforms let energy, generated by passing current through ssure mercury vapor, into visible light. The internal e in an operating fluorescent lamp is less than at- eric.

np. Abbreviation for High Intensity Discharge lamp. l term for mercury, metal halide and high pressure lamps.

tput fluorescent lamp. A rapid start fluorescent lamp normally operating with a lamp current of 800 milliamperes. Associated terms: fluorescent lamp, rapid start fluorescent lamp.

High pressure sodium lamp. A high intensity discharge light source in which the light is primarily produced by the radiation from sodium vapor. "High pressure" is a relative term since the internal operating pressure in the arc tube is less than atmospheric.

Incandescent lamp. A lamp in which light is produced by heating a filament to incandescence by means of an electric current. Associated term: tungsten halogen lamp.

LCL. Light center length; the average distance from the center of the light source to the bottom of the base contact. Applies primarily to incandescent and high intensity discharge lamps.

LLD. Lamp lumen depreciation. Refers to the gradual decrease in output of a lamp during its life. Associated terms: depreciation curve, mean lumens.

Lamp. The completed light source unit. A lamp usually consists of a light generating element (arc tube or filament), support hardware, enclosing envelope and base. Associated terms: bulb, arc tube, filament tube.

Lumen. The international unit of luminous flux or the time rate of flow of light. Used to specify light output of sources.

Lumen-hour. The unit of light quantity (luminous energy). Often used in calculating "cost-of-light" where result is given in "dollars per lumen-hour," or more often "dollars per million lumen-hours." The lumen-hour is analogous to the electrical unit of watt-hour or, more usually, kilowatt hours.

Luminous efficacy. Luminous flux output divided by electrical power input expressed in lumens per watt. Usually applied only to light sources, but can refer to the lamp-ballast or lamp-ballast-luminaire assembly. Luminous efficacy has replaced the older term, luminous efficiency.

MOL. Maximum overall length of a lamp. This is the longest length which the manufacturer states will not be exceeded for the standard.

Mean lumens. Average lumen output from a lamp over a certain period of time, usually the rated life of the lamp. Because the lamp light output may not decrease uniformly, mean lumens may not occur at half life. Associated terms: LLD, depreciation curve, rated lamp life, mortality curve.

Mercury lamp. A high intensity discharge light source in which radiation from the mercury vapor produces visible light. Adding a fluorescent phosphor coating to the inside surface of the outer bulb of a mercury lamp improves the lamp's color rendering characteristics by transforming some of the ultraviolet energy generated by the arc tube into visible light. Associated terms: arc tube, fluorescent lamp, HID lamp.

Metal halide lamp. A high intensity discharge light source in which the light is produced by the radiation from mercury together with halides of metals such as sodium, thallium and indium.

Mortality curve. A graphic representation of lamp burnouts as a function of time. It indicates rate and quantity of lamps expected to fail before rated life and provides basic information for calculating optimum relamping interval. Associated term: rated lamp life.

Nominal length. The length of a fluorescent lamp *including* standard lampholders. The lamp itself, therefore, is slightly shorter.

PAR lamp. Acronym for Parabolic Aluminized Reflector lamp. A hard glass incandescent lamp with a built-in reflecting surface. Since the lamp is pressed from two pieces of glass, then assembled, the parabolic reflecting surface can be accurately formed, and the filament precisely placed for excellent beam control. Flutes or prisms on the face of the lamp determine the spread of the light beam. Another term sometimes used is pressed glass reflector lamp. Associated terms: R lamp, incandescent lamp.

R lamp. Abbreviation for reflector lamp. An incandescent lamp with a built-in reflecting surface. The glass bulb is blow-molded in one piece, and may be of soft or hard glass. Frosting on the face of the lamp determines beam spread. Associated terms: PAR lamp, incandescent lamp.

Rapid start fluorescent lamp. A fluorescent lamp designed to operate on a ballast circuit which provides a low voltage winding for preheating the cathodes. This eliminates a starting switch or the application of relatively high voltage to the lamp. All high-output and 1500 milliampere lamps are rapid start. A rapid start lamp and circuit must be used if fluorescent lamps are to be dimmed or flashed without reducing lamp life.

Rated lamp life. The point in time when 50 percent of a statistical sample of lamps has failed. Associated term: mortality curve.

Slimline fluorescent lamp. An instant start fluorescent lamp with a ballast circuit that supplies relatively high voltage (400–1000 volts) to start the lamp. Most slimline lamps have a single pin base, requiring only one connection to each end of the lamp.

Tungsten halogen lamp. An incandescent lamp containing a halogen gas which recycles tungsten (which would ordinarily be deposited on the bulb wall) back onto the filament surface. This type of lamp is sometimes called quartz-iodine or tungsten-iodine.

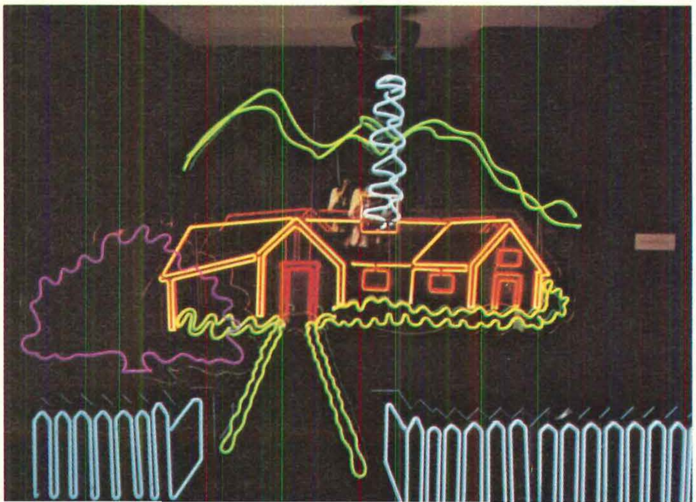
Lighting as art

A very noble gas

Cherub-faced pillow, wrapped in a band of neon, is by artist Annika Bernhard.

Neon dog (above) and signs (below, right) are part of the SoHo gallery Let There Be Neon.

"The American Dream," a neon landscape, is a collaborative effort between artist Larry Rivers and Rudi Stern.

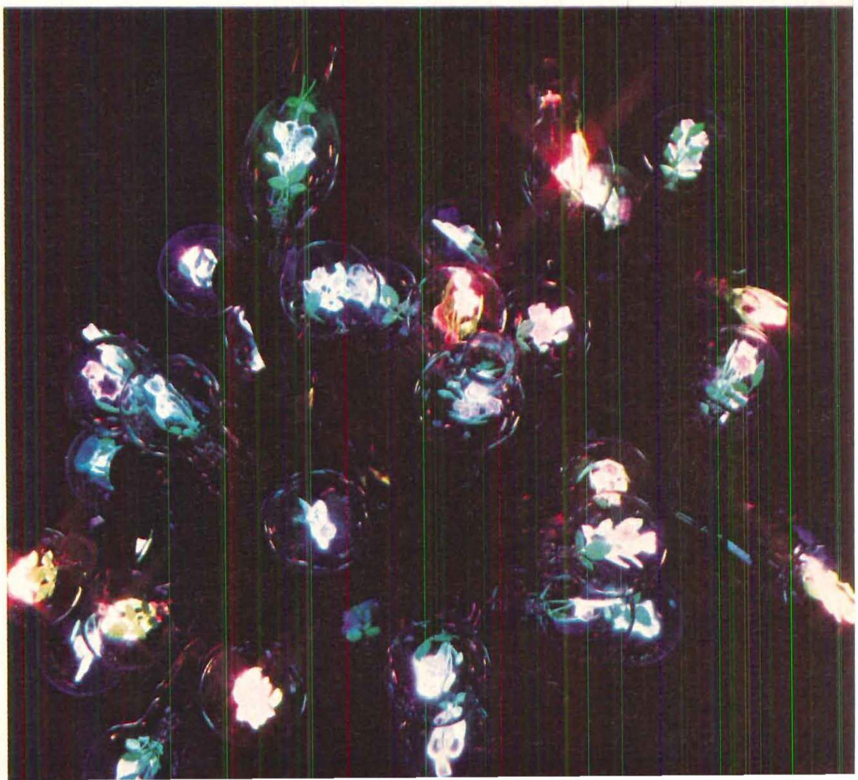


Neon signs are nothing new; neither is neon art, but the range of the artform now extends from the resale of old signs, through pop art commentary, to large environmental works

The most recent event to recognize neon as art was an exhibition at New York's Hallmark Gallery that included the graveyard plot by Paul Mohr; the "American Dream" scene, a collaboration by Rudi Stern, owner of a gallery devoted totally to neon signs and sculpture, and artist Larry Rivers; and the Cherub Pillow by Annika Bernhard. All of these pieces use the traditional form, a bent glass tube filled with neon or argon gas and a transformer to produce the ionization.

One of the most unusual pieces is a light sculpture by John Harris, who used lamps invented and produced by Phillip Kayett, president of the Aerolux Light Co. These lamps contain a nickel-coated iron filament in the shape of hearts, flowers, zodiac signs or almost anything else that can be stamped out of the metal. The gas is activated by passing the current through the metal. For people who want neon lights without the need of a buzzing transformer, these light bulbs will plug into any standard socket and say "I love you" when turned on. [SLR]

Sequenced graveyard setting in neon is by artist Paul Mohr.



Ordinary lamps, filled with nickel-plated iron filament and neon gas, were invented by Phillip Kayatt and work in a normal light socket. The bulbs, in many different sizes and shapes, have cut outs ranging from "I Love You" to a bust of Thomas Edison.

Specifications clinic

Performance concept in building—Part II

Harold J. Rosen, PE, FSCI

This month the author continues his discussion of the relationship of the performance concept to systems building and some of the problems to be overcome

The design professional in private practice is limited in his approach to performance specifying by 1) the absence of qualified individuals who have the talent and capability of performing the required research and 2) design fees that preclude the expense of making the necessary investigations. As a result, the basic research has been performed by government and universities both here and abroad.

While work in the area of systems building and performance specifications began in the early 1960s here, the most productive work has been achieved through the efforts of three Federal governmental agencies. Two documents have emerged based on work developed by the National Bureau of Standards. One is for the Department of Housing and Urban Development for use in Operation Breakthrough; the second for the Public Buildings Service for office buildings.

Both documents as developed by NBS establish performance specifications on the basis of three essential parts—requirements, criteria and test. The requirement is a qualitative statement, such as "control air movement" which is converted to a quantified statement called the criterion (how much and where). The test portion of the performance statement indicates the method of assessing the criterion.

To cite an example, if a ceiling subsystem is to be specified on the basis of performance, many attributes would have to be established such as sound attenuation, light reflectance, durability, fire safety, etc. A performance statement on fire safety would be written as follows:
Requirement—Provide fire safety
Criteria—Maximum flamespread 25
Test—ASTM E84

The example cited is relatively simple. However, the larger question is whether we have taken into account all the variables that might play a role on the built element, the ceiling system. Several statements by some of the participants of the symposium highlight this insufficiency.

"A main reason for imprecision is that, for a number of performance attributes, it is not yet practicable to state quantitative performance requirements coupled with a method of testing. If the statement is left at the qualitative functional requirement level, then differences in interpretation can arise; worse still, if no defined requirement is specified, then no standards are invoked, and the customer can hardly complain if, in the event of trouble, he is not legally protected."

"The problem relates to defining the performance standards themselves. This is still a fairly new concept, and information is incomplete. More work is necessary in relating performance standards to users' needs, and more knowledge is necessary in the definition of standards, and in particular, of test procedures."

"The question is whether it is possible to define quantitatively all the necessary properties of a material, and whether there exist reliable methods of test which can measure the properties. It is contended that neither of these conditions exists to any useful extent, that in many cases they are never likely to exist, and that the instances in which they appear to exist are deceptive."

"Even if it were admitted, in the abstract, that these difficulties (establishing performance requirements) could be overcome by continued research, it would seem almost certain that the resulting sequence of tests would be too complex for practical use. To say the least, a wholesale abandonment of material type specifications is premature."

In terms of the building product manufacturer, what do performance specifications hold in store for him? Does he stop making shelf items such as vinyl tile, acoustical tile, lighting fixtures, gypsum wallboard? Does he wait for a performance specification to bid on, which has been developed on the basis of users' needs, that has no relationship to the product he usually manufactures or which imposes severe limitations on his current capability? A first generation building system or product is the first response to a performance specification. It involves research and development of a substantial nature by the manufacturer involved. He can then market it as a shelf item provided other specifiers find it meets their performance requirements. But if individuality must be pursued, the same specifier can take the first performance specification and with slight modification produce a second generation performance specification, which results in a second generation building system or building product. The burden imposed on manufacturers and their ability to respond to this demand is yet to be determined.

In terms of the designer, how does he control the aesthetic qualities with performance specifications? With known materials he has a sense of the visual, the tactile, the nuances of the interplay of contiguous materials and assemblies. With performance specifications the designer must await the development of a prototype which the manufacturer will produce before he can assess the aesthetic qualities.

Performance specifications will ultimately play a large role in the scheme of things. However, it will require a concerted effort by the government and standards-making bodies to develop test procedures; an educational effort by the universities to prepare individuals to cope with this new concept; and a response by AIA and CSI to provide their membership with an ongoing awareness of the subject so that they do not become technologically obsolescent.

Author: Harold J. Rosen is an independent construction specifications consultant in Merrick, New York.

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Circle No. 366, on Reader Servic

Architect's liability for third party claims

Bernard Tomson and Norman Coplan

Does an architect's failure to act absolve him from liability for injury to contractor's employee? Recent court decisions have reversed traditional rule of law

Claims for personal injury by contractors' employees are often asserted against the architect premised on the theory that he, in exercising his function of supervision during construction, should have prevented the creation of a hazardous condition which caused the injury. In defense of such action, the architect usually relies upon the principle that he is not subject to liability to third persons for nonfeasance (failure to act) as contrasted to misfeasance. The architect generally also asserts a right to indemnification for any such liability against the contractor who caused the harmful condition.

These defenses, however, have been subject to attrition in decisions in various states, led by Illinois' highest court (*Miller* v. *DeWitt*), which held that an architect could be held liable for failing to take action where he knew or should have known that a dangerous condition had been created by the contractor and further held that an architect could be denied indemnification as against the contractor causing the dangerous condition if a jury concluded they were both actively responsible for the injury.

The traditional rule of law in respect to indemnification has been that a passive or secondary wrong-doer may recover indemnification from the active or primary wrongdoer. Consequently, if the failure of an architect to stop the work when a dangerous condition is created by the contractor constitutes an active wrong, he could not recover indemnification from the contractor. A new doctrine of legal liability, however, is developing, which repudiates the traditional rules covering indemnification and which measures the liability of two or more persons who contribute to injury to a third party on a comparative basis. The issue of active or inactive wrongdoing thereby becomes moot.

This change in the law was led by the New York Court of Appeals in a decision in 1972 (*Dole* v. *Dow Chemical Co.*, 30 N.Y. 2d 143) which overruled all prior case law relevant to the subject and promulgated a new doctrine of apportionment between tort feasors. That Court rejected the doctrine that full indemnity should be granted by one passively negligent from one actively negligent and enunciated a rule that the relative responsibilities of the parties who are involved in a wrong must be apportioned, based upon their contribution to that wrong. The Court said:

"As long as our present tort system is retained, an effective contribution and indemnity scheme is necessary to handle the growing problems created by multiple tort liability. . . . The present system runs counter to tort policy goals of deterrence, equitable loss-sharing by all the wrong-doers, effective loss distribution over a large segment of society, and rapid compensation of the plaintiff—as well as the judicial economy interest in settling all matters arising out of the same transaction in one proceeding. . . . Right to apportionment of liability or to full indemnity, then, as among parties involved together in causing damage by negligence, should rest on relative responsibility and to be determined on the facts."

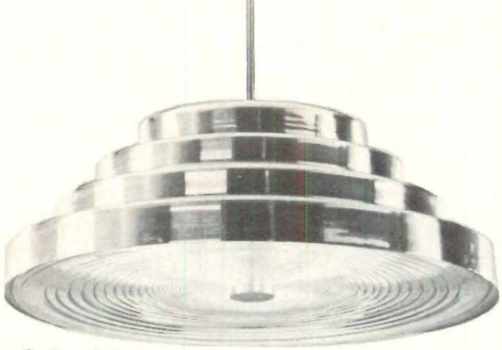
The impact of this decision in New York and in other jurisdictions which had followed the active-passive negligence concept, is vividly illustrated by the decisions which followed. For example, in the construction area in the case of *Kelly* v. *Long Island Lighting Co.*, the plaintiff, Kelly, was employed as a laborer by a subcontractor at the construction site. Kelly had been directed by his employer to assist in the storage of a bucket attached to a crane located at the site. When he touched the bucket, he received an electric shock resulting from the fact that the boom of the crane had contacted overhead high tension wires maintained by the Long Island Lighting Co. The jury rendered a verdict against the subcontractor and the lighting company. Each of the defendants had claimed indemnification against the other and the trial judge had dismissed such cross claims upon the ground that each of them had been actively negligent and that, therefore, neither could recover against the other. Upon appeal, this determination was reversed. The Appellate Court stated:

"The rule as stated in Dole now permits apportionment of damages among joint or concurrent tort feasors regardless of the degree or nature of the concurring fault. We believe a new rule of apportionment to be pragmatically sound, as well as realistically fair. To require a joint tort feasor who is, for instance, 10 per cent causally negligent to pay the same amount as a co-tort feasor who is 90 percent causally negligent seems inequitable and unjust. The fairer rule, we believe, is to distribute the loss in proportion to the allocable concurring fault."

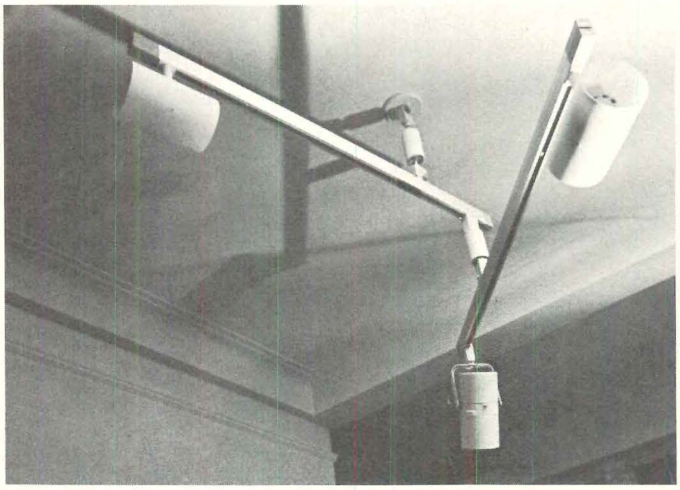
It would appear that in those jurisdictions where proof of contributory negligence on the part of the plaintiff has been a complete defense to an action for negligence against the defendant, such rule of law will be eroded or eliminated if the Dole decision rationale is followed. In any event, in those jurisdictions which follow the Dole rule, an architect who has been found liable for injury to a third person arising from a dangerous condition at the site caused by a contractor, will not be able to secure indemnification from the contractor based on the theory that he was only passively responsible and the contractor was the active wrong-doer. Rather, the amount of the architect's indemnification will be measured by the fault of the contractor as compared to that of the architect.

Authors: Bernard Tomson is a County Court Judge, Nassau County, N.Y. Hon. AIA. Norman Coplan, Attorney, is Counsel to the New York State Association of Architects, Inc. AIA.

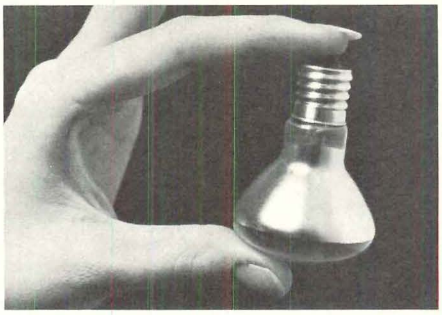
Products and literature



Ceiling fixture



Rotational lighting



Cone-shaped

Ceiling fixture. Designed by Paul Mayen, the multi-tier unit has a stepped down spun aluminum housing with the look of polished chrome. It measures 26 in. dia. and 9½ in. high; is suspended from a polished chrome stem ½ in. o.d. Plastic polycarbonate lens is designed to provide maximum downlight distribution, using up to 300 w. Lens is removable at center point for easy maintenance and relamping. Habitat Inc.
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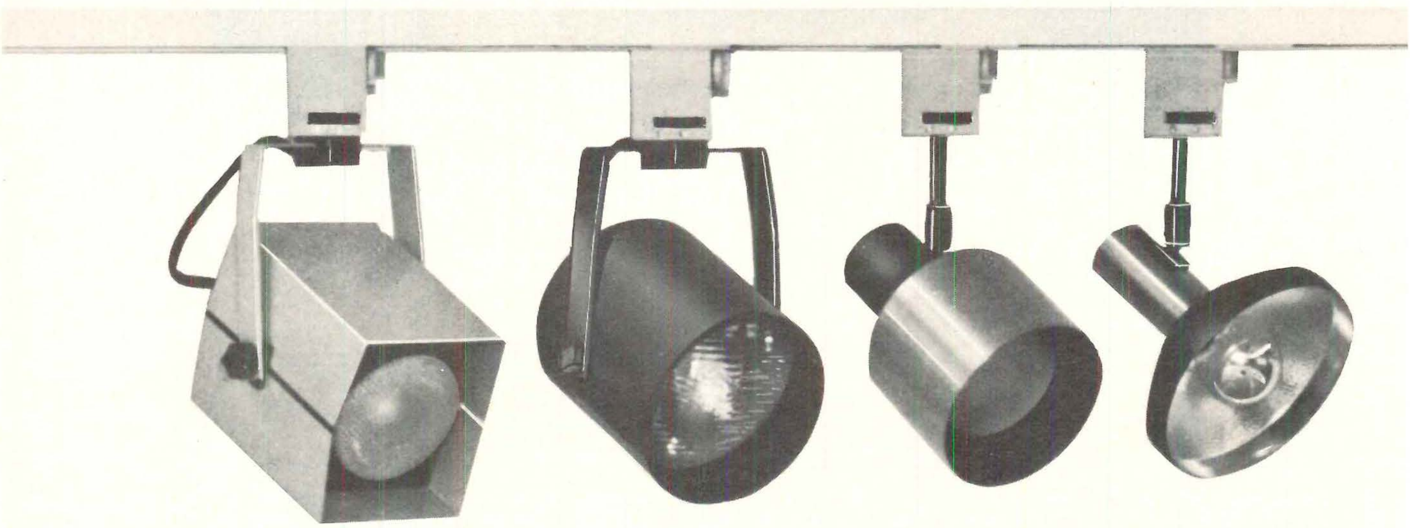
Rotational lighting. Said to be extremely flexible and easily assembled into many configurations in minutes from basic components: horizontal beams, rotary connectors, lighting fixtures and ancillary thrusters or fin plates. The system generates one or more slowly moving paths of light. In limited production. R. L. Systems Co.
Circle 102 on reader service card

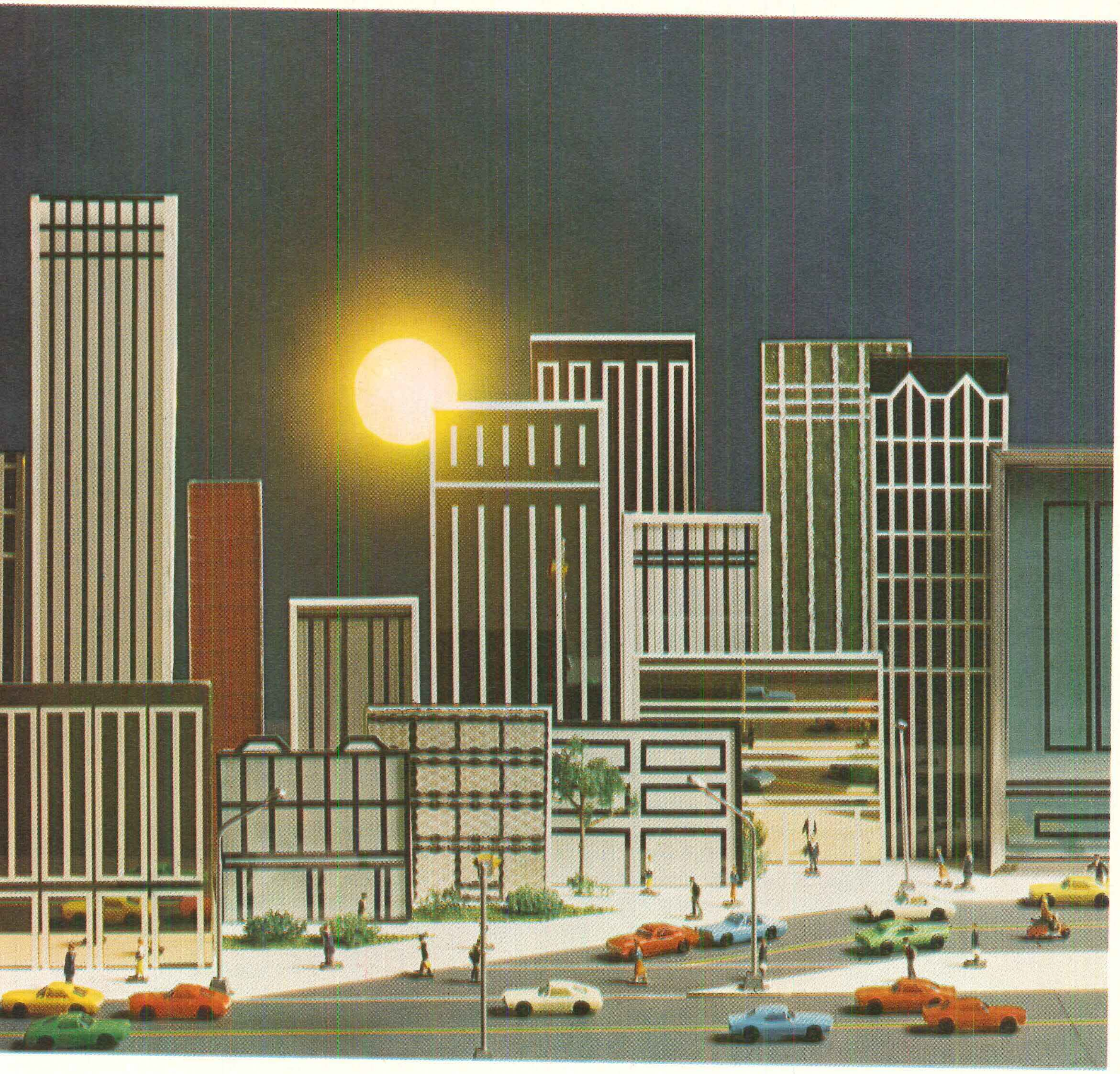
Cone-shaped. Tiny light bulb, 1¾ in. dia and 2½ in. long is designed for use in high intensity portable lamps and in accent and display lighting. Said to be brighter, cooler and longer lasting than present bulbs similarly used, the 25 w. bulb can be used in lieu of 12 v. reflector lamps and transformers and will permit similar floodlighting effects with lower-cost equipment. General Electric Co.
Circle 103 on reader service card

Sculptural. Contemporary in design, this chandelier nests 10 lights in curved stainless steel leaves and squared polished brass uprights with clear acrylic ends. Dia. 37 in., body height 16½ in. Progress Lighting.
Circle 104 on reader service card

StarSpot. 41 adjustable lighting fixtures for use in StarTrack three-circuit lighting system. Designs featured are square spotlight, cylinder units for PAR lamps; baffled cylinder units; micro-mini cylinder, micro step cylinder and micro crown which permits beam spread to be controlled, varied and focused from flood to spot by adjustment of the sliding cylinder. There are also spherical units, wall washers, torpedo shade units, pendants and a 100 w tungsten halogen framing projector. These units attach directly to the track with a twist of the circuit selector dial adapter which links the fixture to the track and automatically positions it for polarization and grounds it to the track. According to manufacturer, units adjust to any position. Choice of finishes. Swivelier Company.
Circle 105 on reader service card
[continued on page 138]

StarSpot





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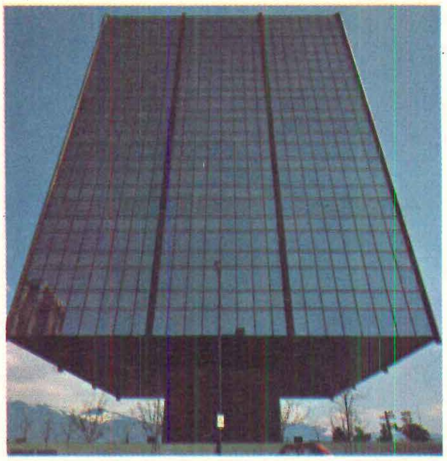
lo. 326, on Reader Service Card

Standard yet flexible

1600 Curtain Wa

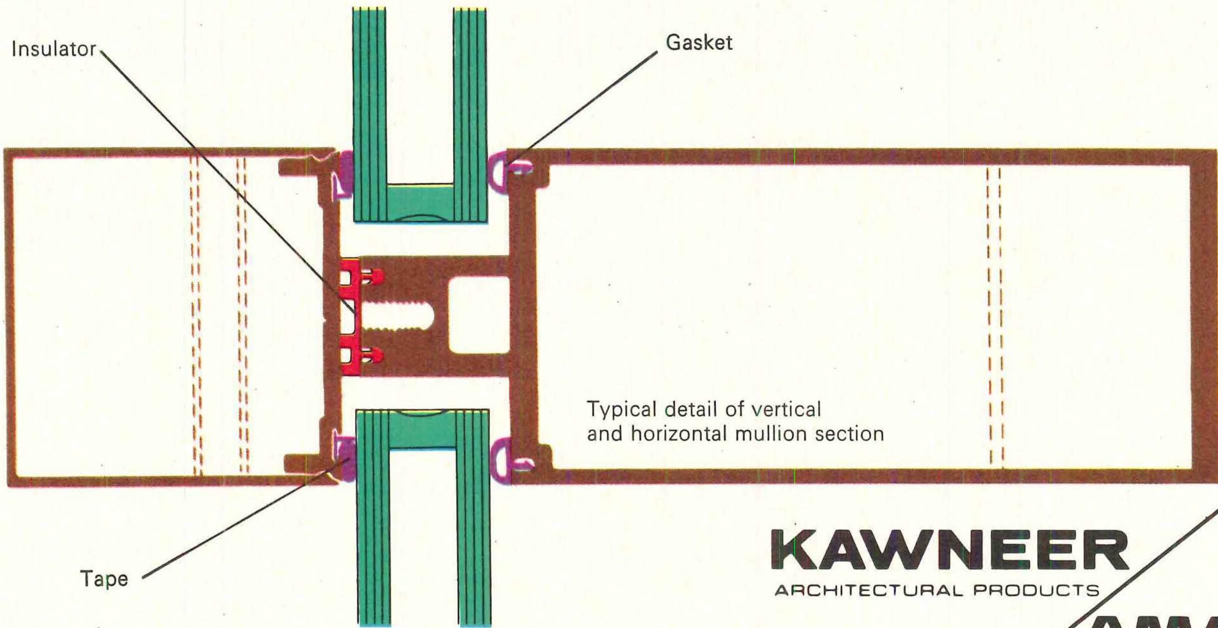
for thermal control in the energy decac

Today, and in the years to come, thermal considerations will greatly affect architectural design. Building materials have become an integral part of interior climate systems. Our present energy resources are at stake. □ For complete thermal integrity the designer must look beyond the conventional solutions of thermal and reflective glazing. The aluminum glass holding members themselves can make a vital contribution to thermal efficiency. □ Kawneer pioneered the positive thermal break concept in wall systems. This engineering innovation eliminates contact between inside and outside metal surfaces, completing the thermal barrier of the curtain wall. Heat transfer to the outside in the cold months and into the building in hot months is minimized. Result: expenditures for heating and air conditioning are reduced and energy conserved.



From the design standpo 1600 offers the architec standard thermal system v custom flexibility. A sim modification by Kawneer's sign engineering departm easily adapted the stanc 1600 Curtain Wall System an application where floors anchored in place from the down . . . with the bott storey 30 feet off the grou Result for Vancouver's r Westcoast Transmission Bu ing: a "custom" applica within standard budget requirements. □ S on covers in a variety of durable Permanoc finishes allow the architect to create str verticals . . . shadow box effects . . . or fl facings. □ In 1600 Curtain Wall . . . as in complete line . . . you can depend on Kawn engineering. □ Designing for thermal efficie with attention to detail is Kawneer's pledge the energy decade.

Architects: Rhone & Iredale, Vancouver, British Co



Typical detail of vertical and horizontal mullion section

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Circle No. 363, on Reader Service

Products continued from page 134

Downlighting. The Mark IV, ⅓ the size and 1/9 the volume of its incandescent predecessors, is capable of producing high light intensity. It can be fitted with either 150, 250 or 500 w tungsten halogen lamps; reflectors allow for 45 and 60 degree beam spreads and it is field adjustable from 0 to 30 degrees to accommodate various ceiling angles. Has spring latches that swing back into ceiling for easy maintenance and cleaning from above. The Rambusch Company.
Circle 106 on reader service card

Light poles. Designed for use in any rustic, outdoor setting, the poles are available in numerous sizes and configurations and blend with natural scenes in parks, campuses, shopping malls, office courtyards, industrial areas. Each has internal wireways and external borings to provide simple low-cost installation and long performance. Poles will weather to a natural rustic appearance or may be stained or painted. Harvey Hubbell, Inc.
Circle 107 on reader service card

Classic lighting. A hand-leaded solid brass wall lantern that measures 33¼ in. high, 10 in. wide and extends 14 in. accommodates three candelabra-base bulbs up to 60 w each. Clear acrylic or continental-brass- or old-bronze-finished panels. A smaller (24½″ x 7″ x 10¼″) matching wall lantern is available. Georgian Art Lighting Designs, Inc.
Circle 108 on reader service card

Luminaire. Dark bronze tinted polycarbonate luminaire is designed to maintain continuous lamp operation under extreme physical abuse. It accommodates G-lamps, flicker, chimney and other decorative lamps of any wattage, as well as 100 w incandescents. Made of premium material, it has a polished aluminum reflector and socket. All metal parts are concealed, is UL listed. Also available in opal and clear prismatic versions. Art Metal Lighting.
Circle 109 on reader service card

Underwater light. For swimming pools, decorative pools and fountains, maker claims there is no danger of electric shock to humans, animals or fish. Hooked to a regular 120 v house current, sensors and switches reduce this to 12 v and store it in an automatically rechargeable power source. Although peak power is never more than that of ordinary flashlight battery, it spreads a wide beam reaching as far as 40 ft. Cascade Industries, Inc.
Circle 110 on reader service card

Ventilume. A series of air handling fluorescent luminaires that are designed for high efficiency and maximum control of glare by using a shielding system which maker states will completely eliminate glare. Louver is one piece, injection molded acrylic, vacuum metalized. It has been molded with a self-flange, has full modular cells to give the visual character of a downlight, and is available in a wide range of modular sizes up to and including 3′x3′. Lightolier.
Circle 111 on reader service card.
[continued on page 140]

Products continued from page 138

Low-brightness surface-mounted fixtures have semi-specular aluminum reflectors that provide batwing type of light distribution. Luminaires direct most of their light output into the 30 to 60 degree zone and minimize light output into vertical and horizontal zones. Available in 1′x4′ and 2′x2′ sizes, 6⅛-in.-depth fixtures can be surface or pendant mounted. Baffles are open on top and available with either 30 or 40 degree cut-off angles, are hingeable from either side of fixture. Keene Corporation, Smithcraft Lighting Division.
Circle 112 on reader service card

Dimmer. A multi-location DC low-voltage remote control system provides on/off switching, preset light level intensity control and variable light travel selection. A pilot light designates which control is in command and the rate control determines how long it takes the light intensity change to occur—from 1½ min. to instantaneous. Fluorescent variations are available. Hunt Electronics Company.
Circle 113 on reader service card

Low-voltage. A series of 12 v outdoor lights is designed in solid California redwood, kiln-dried and sealed against deterioration and discoloration. Offered in four sizes, they incorporate two light levels for longer bulb life and come with ground-mounting stakes and wall-mounting brackets. Easy to install. An automatic timer is also available. Sylvan Designs, Inc.
Circle 114 on reader service card

See-through illuminated ceiling. Polished-metal reflections of ornamental G-lamps are seen through acrylic shielding elements. Twenty design variations with 100 custom-made alternatives are possible. Choices include: pans of polished chrome, polished bronze or polished aluminum; clear or tinted G-lamps; and ½-in.-thick horizontal or vertical shielding elements in clear or tinted acrylic. Neo-Ray Lighting Systems.
Circle 115 on reader service card

Literature

Troffers. Bulletin describes grid-type lay-in troffer designed to deliver uniform lighting from any viewing angle, provide precision spacing of lamps and configuration of the housing-reflector. Housing is die-formed of prime steel with reinforcing ribs for long life. Troffer features optional snap-lock wiring plate, available for shipment to jobsite for attachment before fixtures themselves are shipped, a boon to maintaining a tight time schedule. Available in four models: two-lite and four-lite, each with or without socket plate. All are U.L. listed. Lite-craft/Luminous Ceilings.
Circle 116 on reader service card

Lighting systems. A brochure, prepared for architects, engineers and other design professionals, evaluates lighting systems in terms of energy usage, seeing and effect; also includes quick reference design data. It is distributed by the National Electrical Contractors Association, Inc.
Circle 117 on reader service card
[continued on page 146]

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CAUTION: Shattering fragments are dangerous.

PLASTIC.

Also known as acrylic, styrene or butyrate. Not as fragile as glass. But even impact grades break, crack, chip, shatter. Still keeps people in the dark, maintenance men on the move. Ma become an even weaker target with exposure to the elements. Cold can cause hazing. Lacks UL self-extinguishing ratings. Frequently seen distorted by heat.
CAUTION: Since it breaks, it can hurt.

Concrete makes th

There's lots of excitement in Miami, not the least being One Biscayne Tower at 40 stories and 456 feet, the tallest building in southeast Florida.

The soaring reinforced-concrete structure shows architectural concrete at its best. From the massive elements of the 10-story garage to the slender columns in the upper floors, the concrete displays superior appearance.

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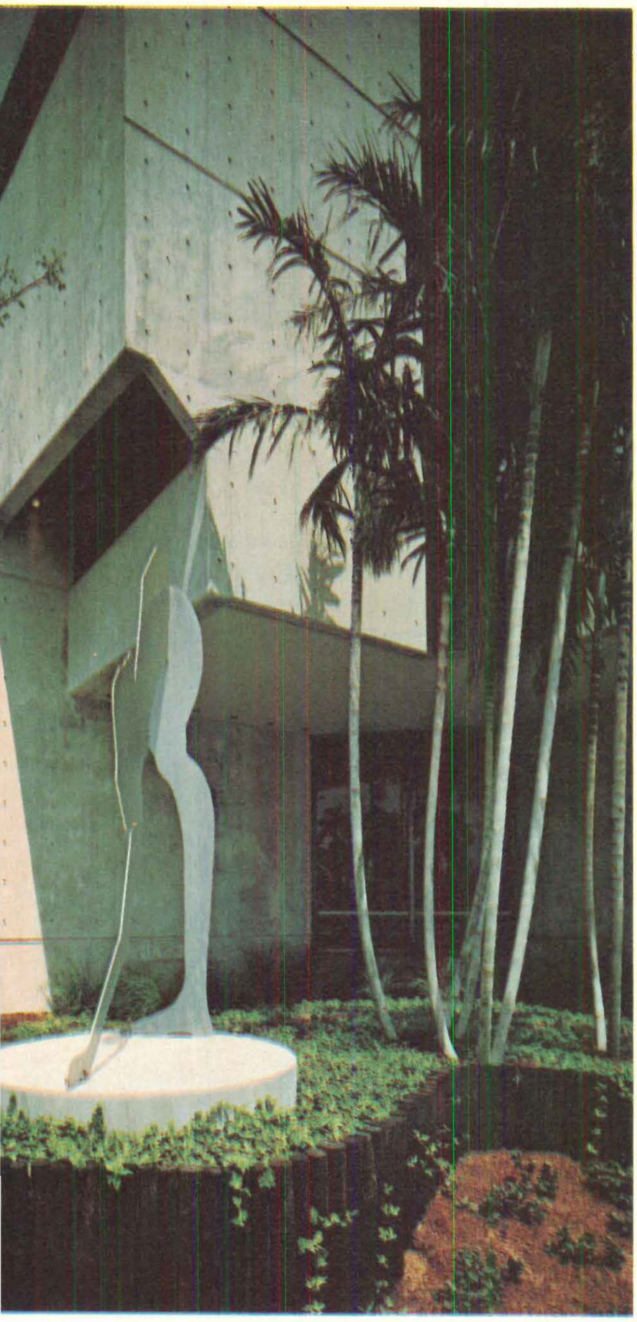
The key to quality and performanc the 50,000 cubic yards of concrete was use of *POZZOLITH* polymer-type adm ture. It made the concrete more wo able, placeable, finishable. It impro strength and reduced shrinkage crack



:ene in Miami.

:OLITH performed equally as well in 500-psi lightweight concrete for floors the 5000-psi concrete for mat, col-;, and core.
'ZZOLITH polymer-type admixture ed One Biscayne Tower make the e in Miami. And it can help make the e for you. For more information, call local Master Builders field man. Or Master Builders, Cleveland, Ohio 3.

Owner: One Biscayne Corp,, a wholly owned subsidiary of EHG Enterprises, Inc., San Juan, Puerto Rico. Architect: Fraga Associates, Miami. Structural Engineer: DeSimone & Chaplin, New York. General Contractor: Pavarlni Construction Co., New York; and Edward J. Gerrits, Inc., Miami. Concrete Producer: Maule Industries, Miami.

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Products continued from page 140

Emergency lighting systems and components. Catalog includes AC and DC power packs, remote emergency fluorescent power packs, luminaires and lighting consoles, and unit packs for retro-fitting existing fluorescent light fixtures. Complete specifications, dimensional data and drawings, plus application and technical bulletins of special interest are included. Siltron Illumination, Inc.
Circle 118 on reader service card

Indoor and outdoor lighting luminaires and accessories are fully described in color catalog complete with detail drawings, specifications, ordering guide and price list. Widelite Corp.
Circle 119 on reader service card

Luminaires. Brochures that cover a variety of outdoor luminaires for such widespread uses as lighting building entrances, approaches, walks, malls, planted areas, shopping center plazas, office building surrounds, campuses, industrial parks, plant grounds or wherever architectural lighting is required. May be wall or pole mounted. Holophane Company.
Circle 120 on reader service card

Ceilings. Color brochure illustrates use of Tab-Lock acoustical grid suspension systems and ceiling designs as well as load data and specifications. Eastern Products Corporation.
Circle 121 on reader service card

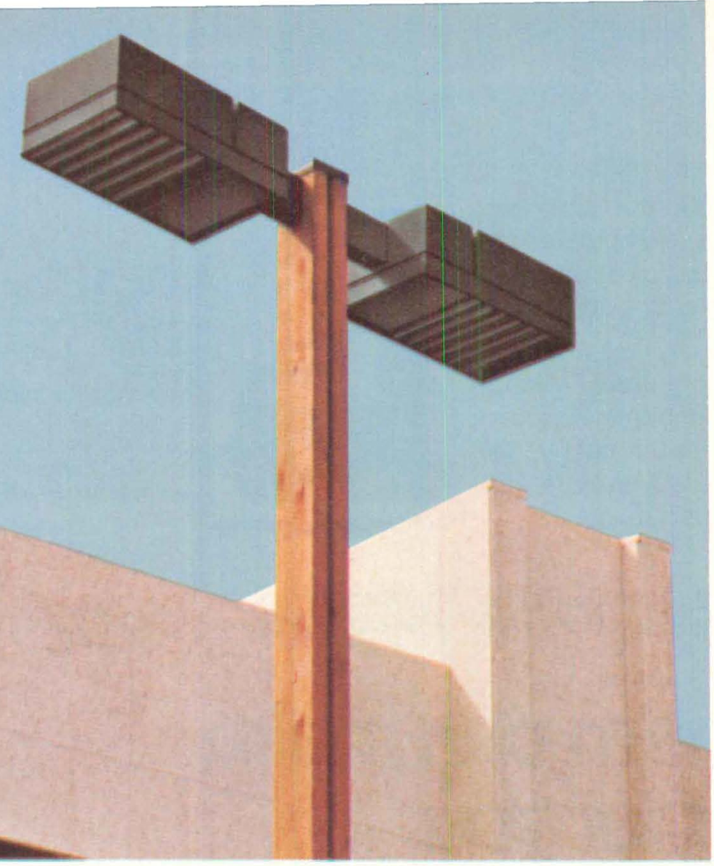
Lenses and louvers. A series of eight, four-page brochures plus illustrated price list describe more than 30 products from the company's lens and louver line. Over 100 charts, graphs, photos and illustrations accompany the descriptive data. Includes eight-page illustrated price list. Additional brochures can be added to the looseleaf series in the future. American Louver Company.
Circle 122 on reader service card

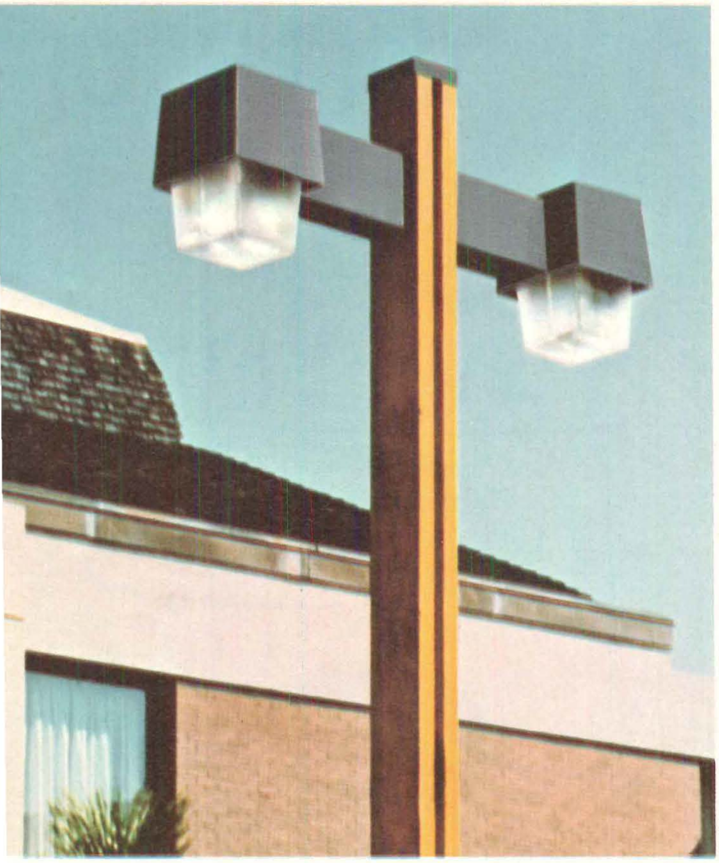
Residential lanterns. 56-page catalog shows colonial and period outdoor lanterns cast in long-life aluminum designed for apartments, condominiums, restaurants. Over 180 lanterns are shown along with full dimensional and mounting data. Sternberg Lanterns, Inc.
Circle 123 on reader service card

Dimmers. A complete line of solid state dimmers is illustrated in brochure, together with typical wiring diagrams, charts and data. Includes incandescent and fluorescent dimmers as well as custom dimming systems for special requirements. Lutron.
Circle 124 on reader service card

Glued laminated wood. Color brochure illustrates uses in recreational structures and points out its many advantages. Detail drawings and a table to aid in determining economical span ranges for various glulam roof framing systems are included. American Institute of Timber Construction.
Circle 125 on reader service card
[continued on page 150]

Circle No. 414, on Reader Service





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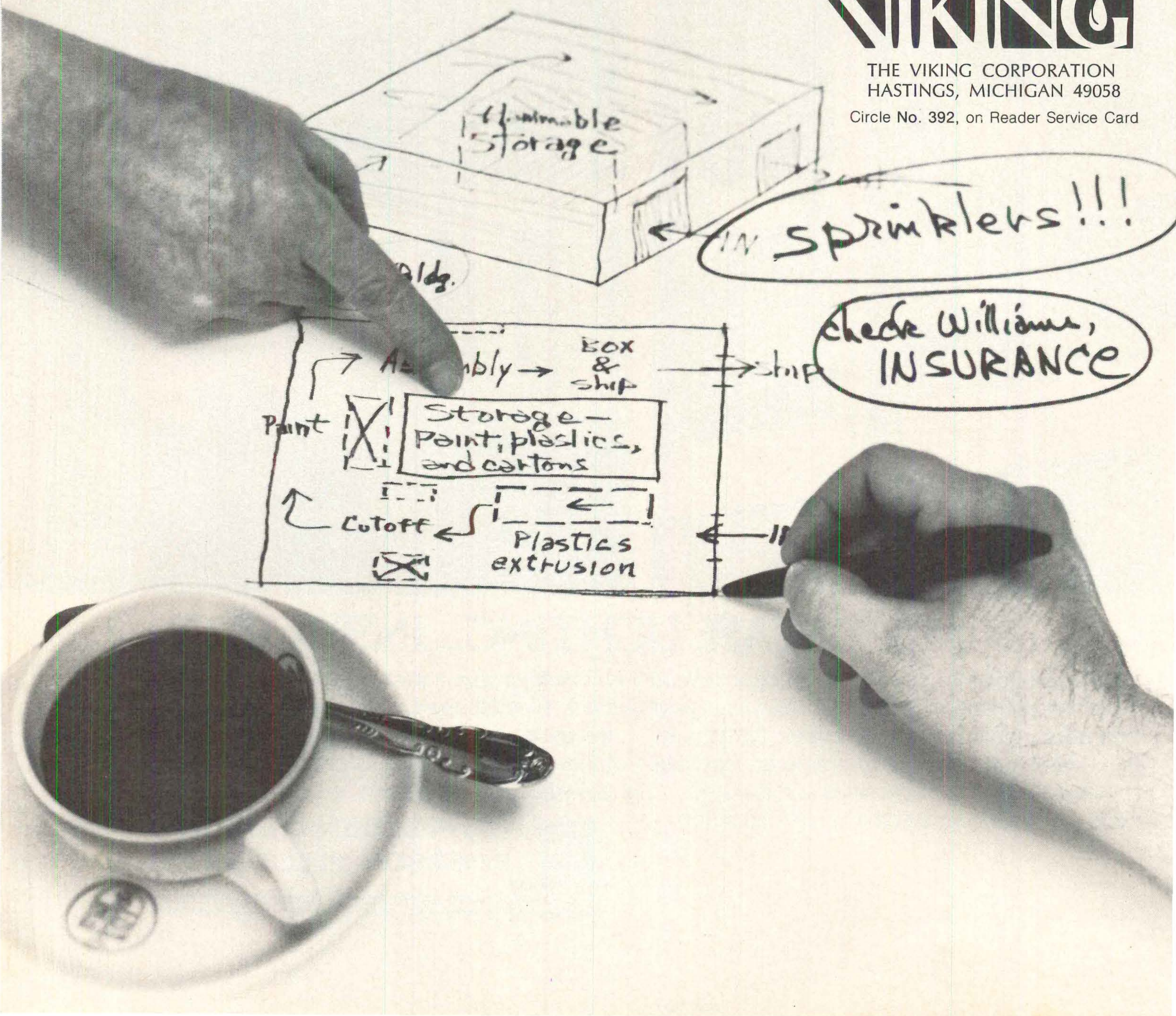
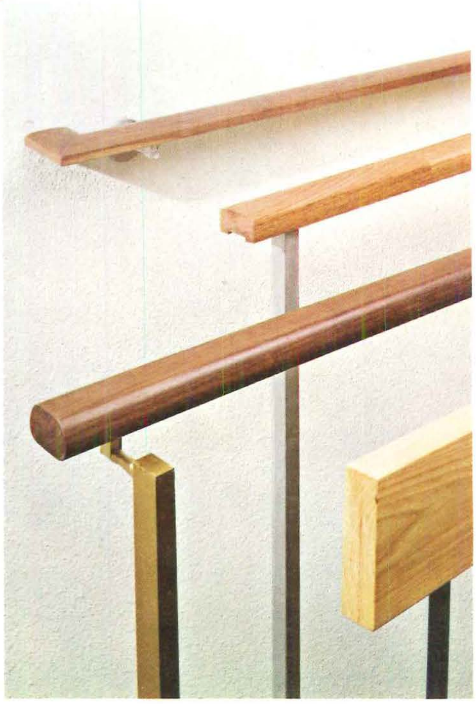


8511 Oak Moulding

PermaGrain® acrylic/wood flooring by ARCO Chemical Co.



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Products continued from page 146

Big Beam. Complete line of emergency light units for life safety illumination—ranging from power failure light and fluorescent emergency light to 12 volt central power system, remote light fixtures and accessories are illustrated, with complete specifications and ordering information, in 28-page catalog. The latest in life safety egress illumination technology is translated into plain, everyday language. Illustrates scientific light distribution patterns of 6 and 12 volt emergency systems; contains data on OSHA. Teledyne Big Beam.
Circle 126 on reader service card

Playing surfaces. Multi-purpose field house and gymnasium floor, outdoor running tracks and turf grass sport uses are described in full-color brochure. Minnesota Mining and Manufacturing Co.
Circle 127 on reader service card

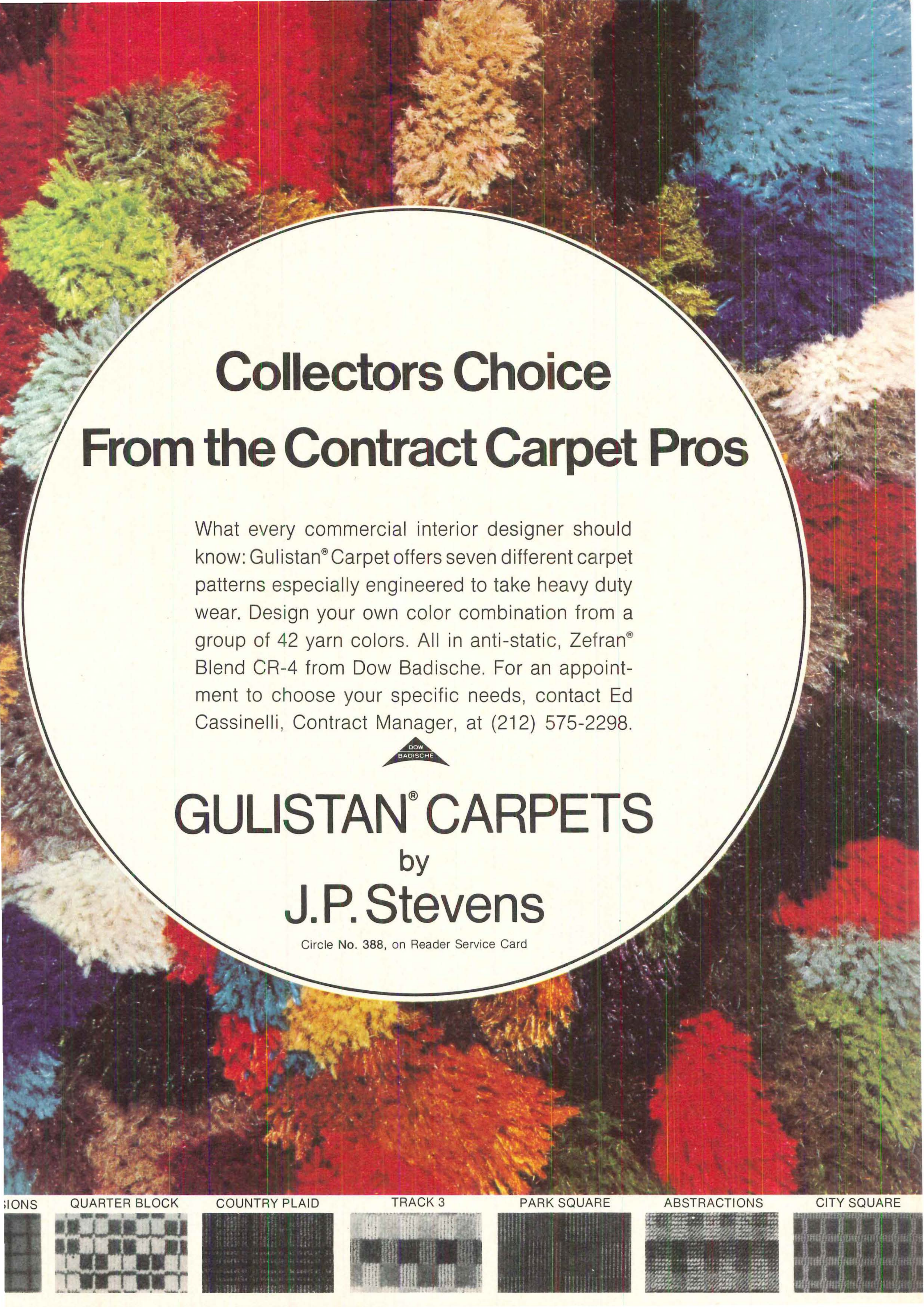
Frame construction. "A New Look at Wood Framing" is a 12-page color booklet which details new techniques along with a cost analysis of Mod 24 framing by the NAHB Research Foundation. This booklet, plus "Mod 24 Building Guide" and "Products Use Manual" is available to builders, architects and engineers. Western Wood Products Assn.
Circle 128 on reader service card

OSHA Simplified is a 64-page brochure that provides rule of thumb guidelines for specifying and ordering wiring devices that meet OSHA requirements. Pocket-sized brochure documents each wiring device, UL listing file number and index guide in company's catalog number sequence. Complete references to NAED item numbers and company catalog pages are included together with list prices. Sierra Electric.
Circle 129 on reader service card

Acoustical glass. Control of noise with laminated architectural glass for windows is described in 24-page booklet. Report examines basic theories of sound, its transmission and measurement and discusses effectiveness of laminated glass in reducing sound transmission as compared to other commonly used window glazings. Monsanto Polymers & Petrochemicals Co.
Circle 130 on reader service card

Porcelain-on-steel building panels color chart and technical guide contains samples of 47 official Porcelain Enamel Institute colors in semi-matte finish; the official 24 PEI natural tone colors in matte finish; 15 terra cal and bronze tone colors in matte finish; plus six stipple finishes. Contains information about durability, weatherability and color permanence of panels. Alliancewall Corporation.
Circle 131 on reader service card

Sealants. Brochure lists every polysulfide base building sealant that meets this company's Building Trade Performance Specification. Tested for hardness, dynamic durability for adhesion and cohesion, tensile adhesion strength, weight loss after heat aging and recovery after elongation. Thiokol Chemical Corporation.
Circle 132 on reader service card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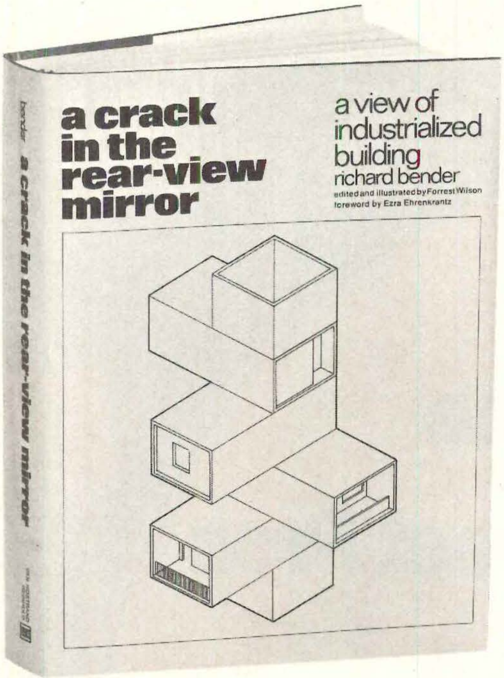
Books



A crack in the rear-view mirror: a view of industrialized buildings *by Richard Bender. New York; Van Nostrand Reinhold, 1973, 177 pp., illus., $16.95.*

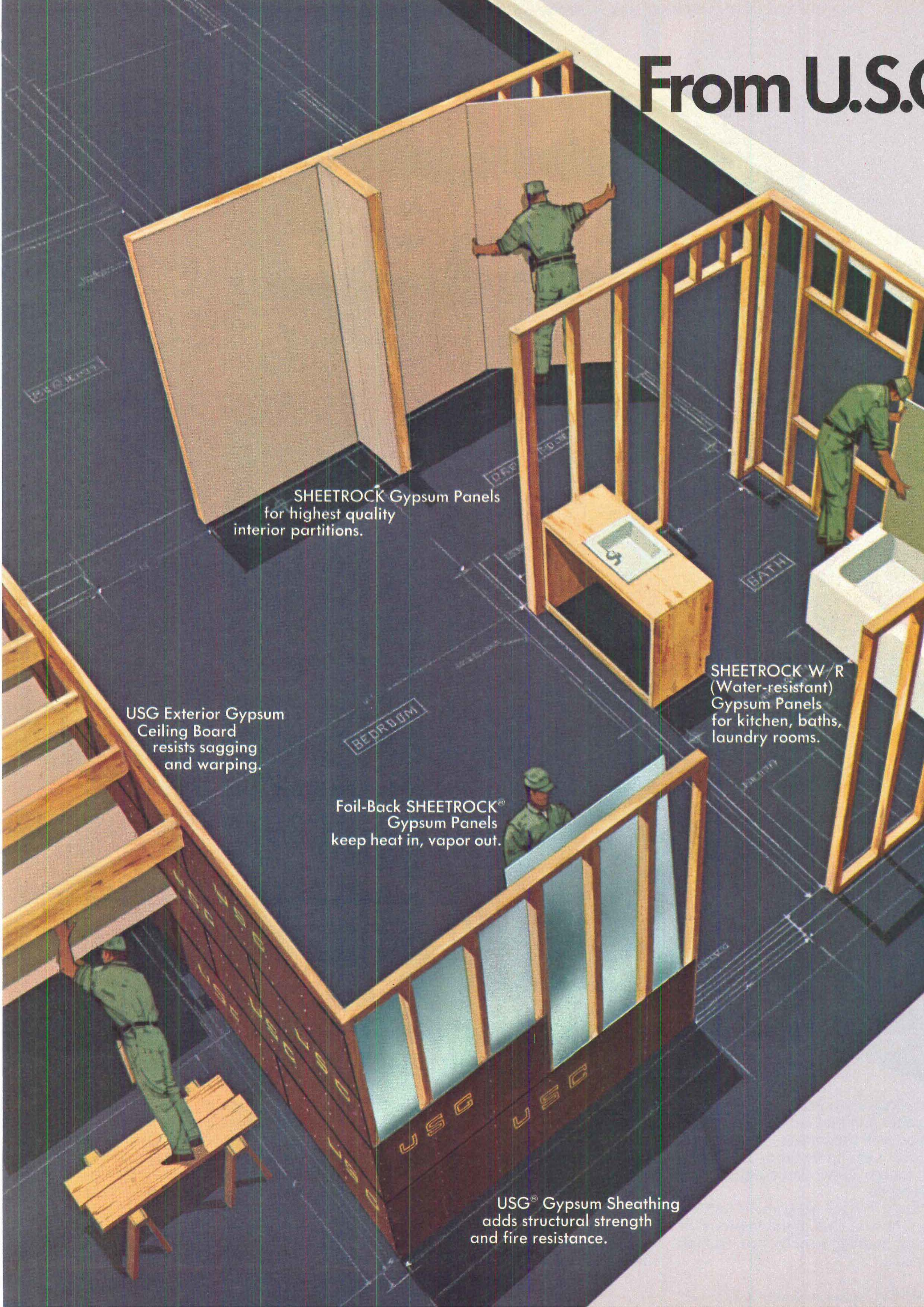
Reviewed by John P. Eberhard, president of the AIA Research Corporation.

What can you say about a fresh breath of new hope for an old and tired industry that dies on the vine before it has become fully ripe? You could say that it never had a chance because it was poorly conceived from the beginning. Or you could say that it's too bad it wasn't given better nourishment by the caretakers. Or, perhaps most intelligently of all, you could try to understand the genesis of the fresh breath and examine the industrial, economic and political climate that failed to sustain it, so that the next burst of energy would be better directed. If you moved into the future then with a new awareness, you might glimpse some notions of tomorrow's opportunities through the crack in the rear-view mirror of the past—a rear-view mirror that tends to cause us to move into the future expecting it to resemble the past.

That's what Richard Bender tried to do with this book. Give us a glimpse of possible futures for the building industry b providing a retrospective look at the h tory of industrialized building—particu housing—and some scenarios for the methods, organizations and attitudes the future. Operation Breakthrough, o has the strong impression, was the br of fresh air that failed to make it. Oper Breakthrough seems to have been, th fore, the reason for this book.

There isn't any table of contents. It' random walk through historical persp tives, philosophical viewpoints and ex ing forecasts. There's a brief forewor Ezra Ehrenkrantz—a pioneer in U.S. b ing system development—that sets th tone for the book by hoping that the b "makes us aware of the need to exerc our rights to determine future choice this need becomes more immediate a pressing." There are lots of illustratio selected and sometimes executed by rest Wilson, to make a secondary run comment on the text. For my taste, th are too many illustrations that were ju lifted from company brochures or Bre through proposals. The eight pages o lustrations of the Go-Con press devel

[continued on page 160]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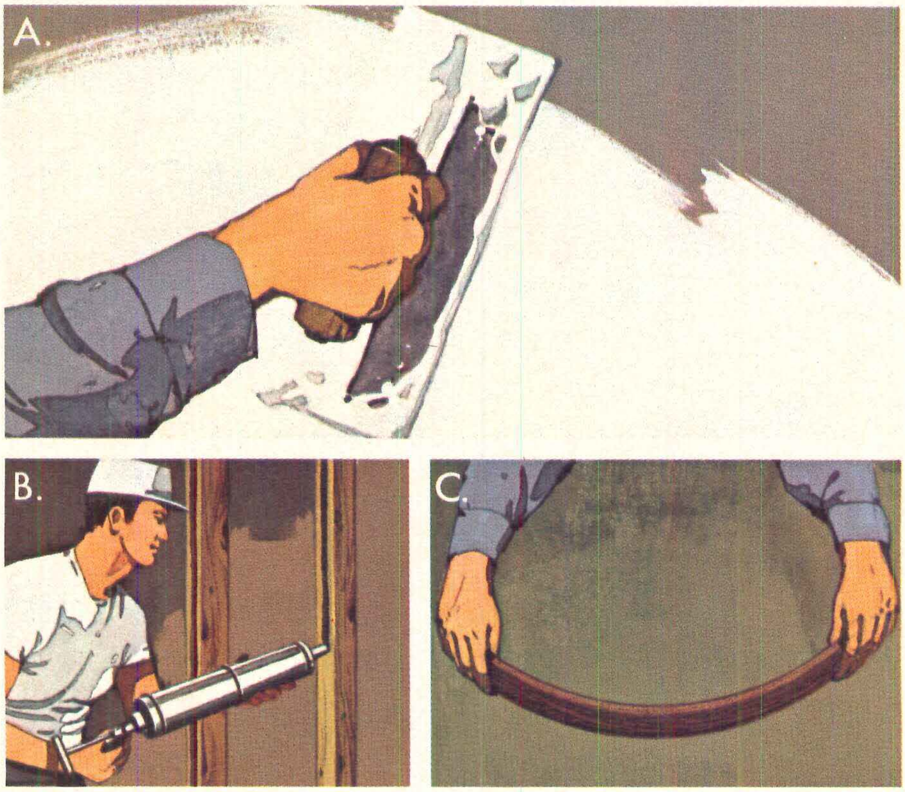

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Books continued from page 154

in England, for example, seem excessive. On the other hand, some of the illustrations are real surprises and valuable additions to the book. I was particularly impressed by the diagrammatic sketch of the Volkswagen production and assembly process used to illustrate the concept of mass production. It's the sort of book that combines an encyclopedia of housing systems with a running commentary on what's happening or likely to happen. There's no plot, so you can open it anywhere and start reading backward or forward.

A central section of the book deals with the notion of a filing cabinet as an analogy to the conceptual framework most of us in the building industry (or perhaps more appropriately the industries of building) carry around with us to help us keep track of old ideas, ideas in current use, and new ideas to which we are exposed. Bender argues that we are at the point of "information overload." We are exposed to too many new ideas and products to fit into the mental file cabinets we have created out of our training and experience, so that we tend to throw all new ideas into the miscellaneous category—to be looked at some time wh
we have more time. But of course we se
dom, if ever, have the time.

In the section entitled "The contents
the miscellaneous file" he gives us a su
vey of new forces, products, processes
and trends. It really is a kind of mis-
cellaneous collection of things that wou
have been more easily assimilated if the
had been more organization in the way
they were presented to the reader. For
ample, there is an interesting history of
Lustron House, but it's just stuck in the
middle of other material on prefabricati
and the various building systems projec
of Building Systems Development, Inc.
best organized collection in the mis-
cellaneous file section is on the subjec
volumetric housing systems—from mob
homes to Habitat.

Perhaps the most thoughtful part of t
book is that collection of subjects dealt
with in the section entitled "The conter
of the miscellaneous file III: bits and
pieces." Bender discusses the phenom
enon Buckminster Fuller has called "ep
emeralization"; Carl Popper's notion o
"clocks and clouds"; the "escalation o
technology and cycles of technology";
finally Peter Drucker's notion of "dis-
continuity." For my money, I wish this s
tion had been longer and the previous
shorter (but then I got a free copy of th
book when I agreed to review it).

The last part of the book is devoted t
the discussion of three "scenarios"; th
describe possible views of the future, g
certain assumptions about what could
happen. It's a favorite term for the milit
planning done by "think-tanks." When
Herman Kahn (or his counterpart) wan
force the military establishment to "thir
about the unthinkable" (what would we
if a foreign power destroyed six of our
jor cities in a surprise missile attack?) h
poses a possible "scenario" to them o
what the conditions might be and what
would need to be done. That's what Di
Bender is doing with his three scenario
He's suggesting that the establishment
the building industry and all the rest of
population ought to think about the po
sible future development of the housin
dustry. He calls his first scenario "The
housing factory" and discusses the co
cept of mass production developed in t
automobile industry as it might be appl
to housing. His second scenario is de-
scribed by its title "The development o
large-scale, systems-oriented life servi

[continued on page 166]

Anso® nylon's five year guarantee. It means the McCarran Airport carpet won't wear out its welcome.

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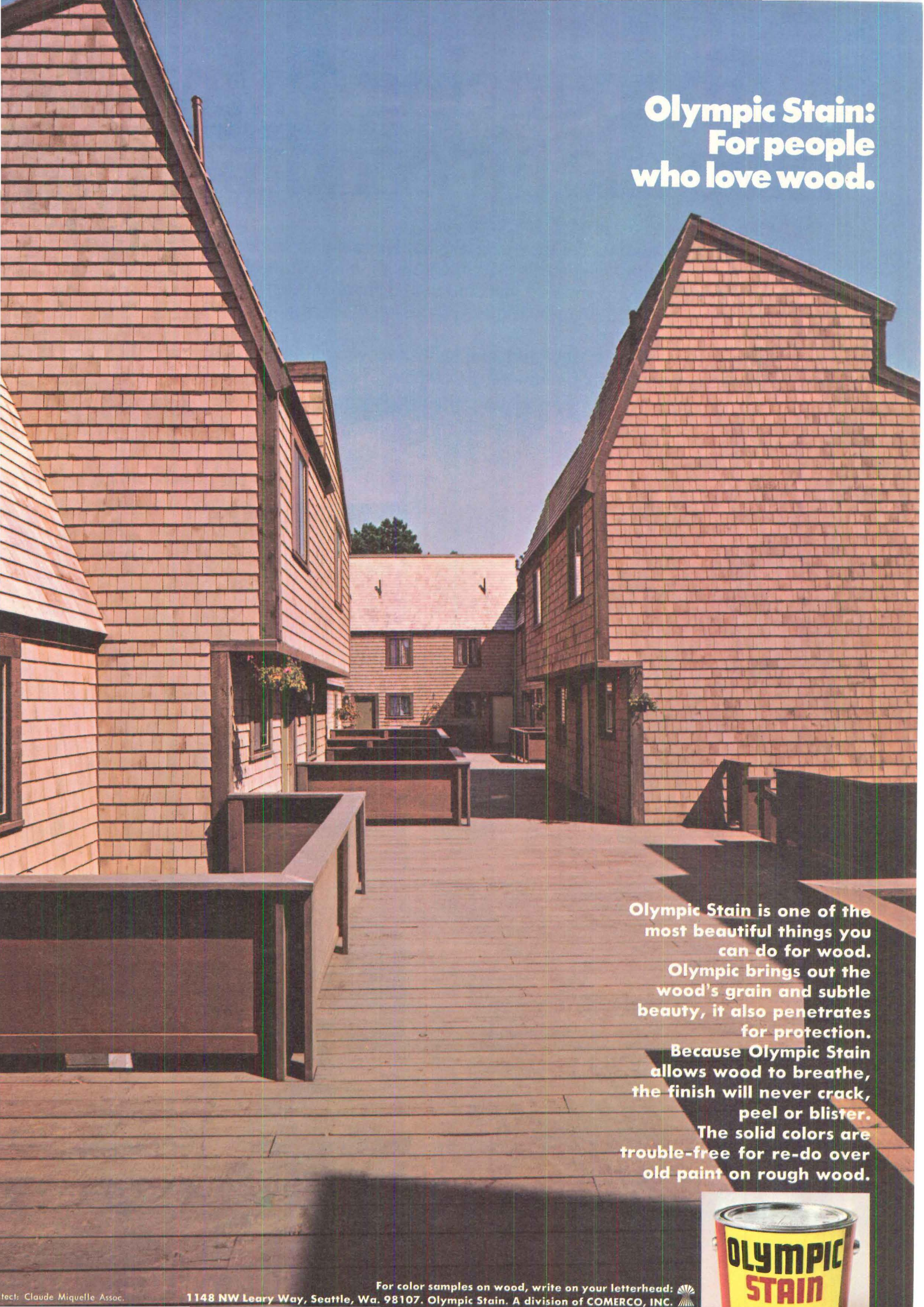
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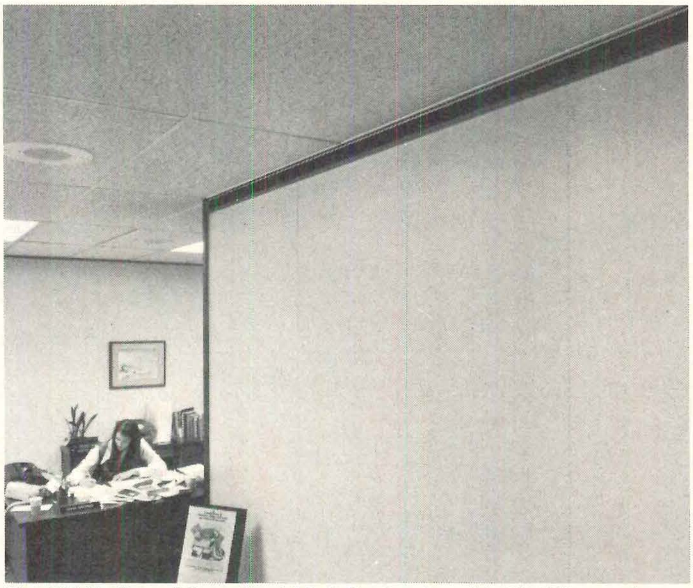
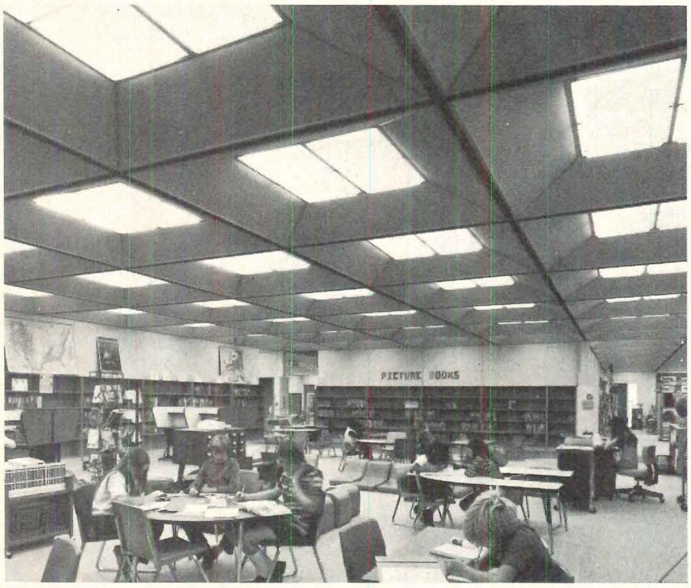
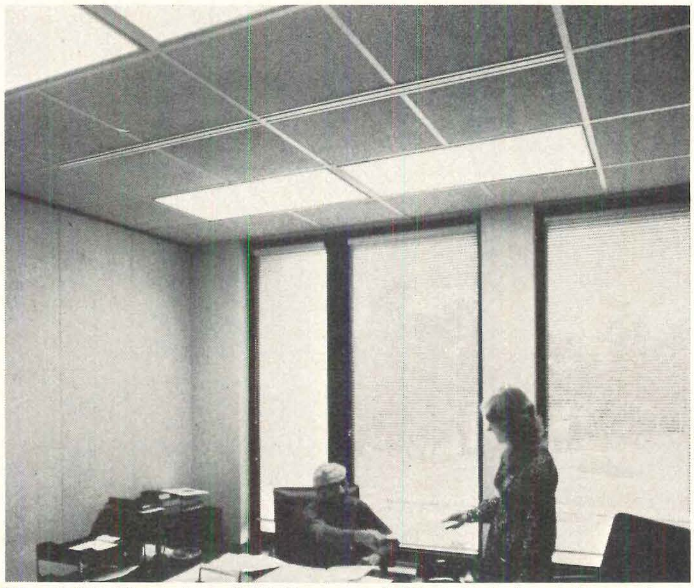
The 37P. The original Moduline System with 11½" diffusers. Works beautifully into waffle design ceilings.



The 37AE. One of three Dual Moduline® units with 3" diffusers that straddle partitions to cool two offices at once.



The 37AF (or MM5). The lightest dual-room cooler. Perfect for 2' x 4' tees, ideal for schools and clinics.



The 37AD. The unique Split-Plenum unit. Heats out of one side, cools out of the other. Lets you use all-ceiling units all over.

Books continued from page 160

industry." The third scenario, which is probably the most appealing, talks abo the emergence of a new individual-ori- ented, dispersed, "Whole Earth Cata- logue" of tools and materials. It describ a new combination of man and technol which would be organized around prov ing a Sears, Roebuck catalog of parts f which each person could create his ow dwelling instead of having a limited ch of houses.

This book will serve as a useful text f courses on industrialized building in u versities, or as background reading for next wave of HUD executives, or for an one who is seriously interested in think about the future of the industries of bu ing . . . and that ought to be everybody is professionally involved.

Rivers in the City *by Roy Mann. New Y Praeger Publishers, 1973. 256 pp., $20*

This book surveys one of the most in tensively used and abused resources o earth—the urban river. Its intensive use too often resulted in pollution, but occ sionally, intelligent efforts have been m to grapple with the myriad problems of urban river use. In this book, Roy Man who received a Fulbright grant to stud river corridors in England and in Euro spells out the crisis of mismanaged riv and wasteland riversides and publicize important aspects of progress in the c servation of the river landscape. An in duction sets forth the historical, econo sociological, aesthetic and technologi aspects of the problem and opens pat the discovery of environment-conserv solutions. Fifteen sections that follow how cities in the U. S. and Europe hav used their river landscapes in the proc of urban and regional development.

Perspecta 13/14—The Yale Architectu Journal, *edited by Robert Coombs. Ne York: Wittenborn & Co. 1972, 371 pp.,*

This large, dual-edition of *Perspecta* contains articles by 29 writers which, i publisher's press release, makes it "a tifaceted mirror reflecting man, his fan tasies, his philosophies and his civ- ilizations as given expression in architecture." Volume 13 is entitled " dise Lost," 14 is "Utopia and Anti-Uto While this edition is quite different fro previous ones, the excitement *Perspe* always manages to produce is still ver much there.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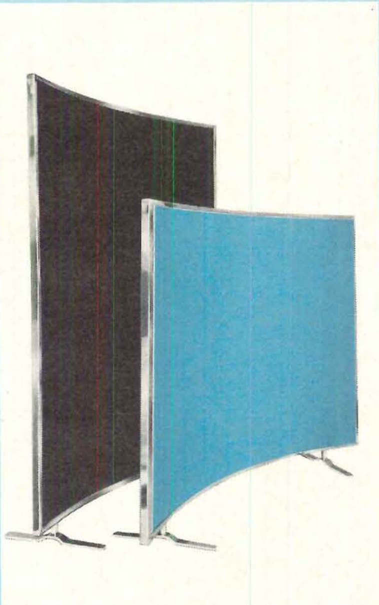

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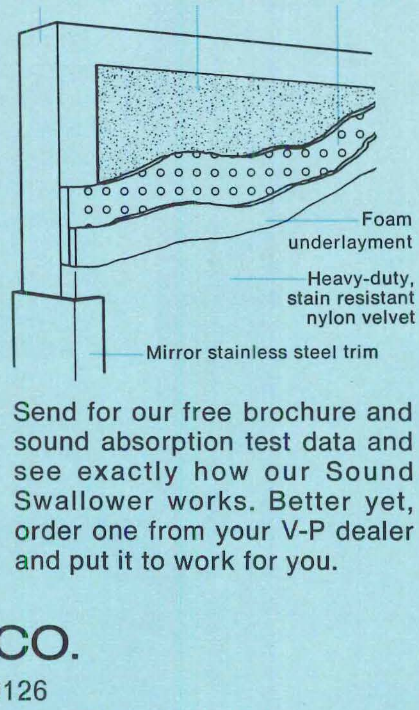

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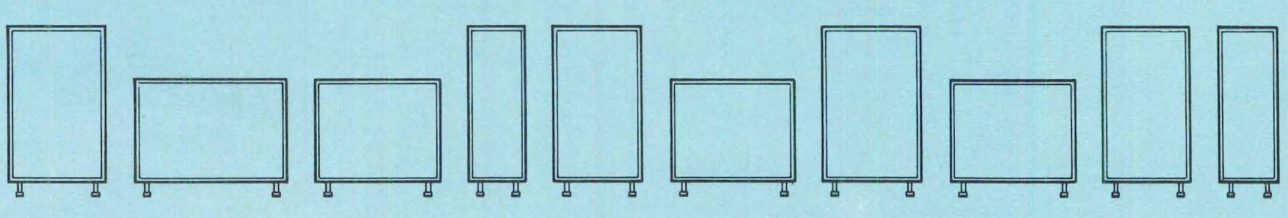

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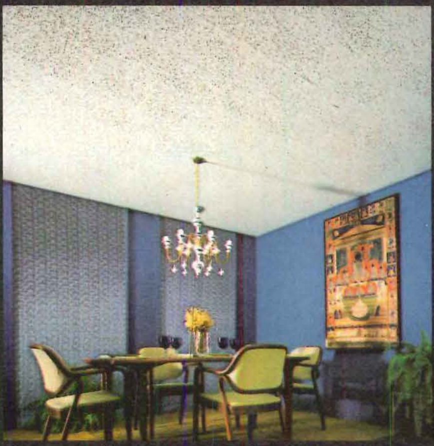
Ruf-Sawn redwood plywood combined with architectural concrete



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Inverted Batten Ruf-Sawn redwood plywood on custom residence

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"	3.82	192	336
Acco Aluminized	0.48	1,920	7,032
"	0.48	1,152	5,736
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Each of its major tenants has special communications needs. So, while planning was still in the preliminary stage, Leavell called in Clint Davis, a Building Industry Consultant with the Mountain Bell Telephone Company.

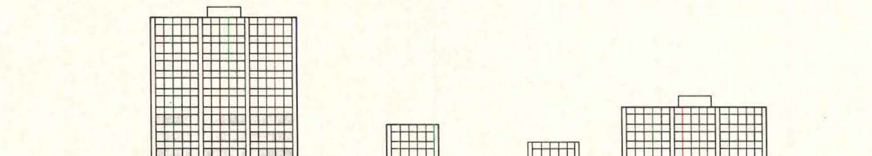
For the Central Bank and Trust Company, Clint tailored an underfloor cable distribution system.

For Leavell's own office space, he worked out a mix of movable partitions and overhead distribution.

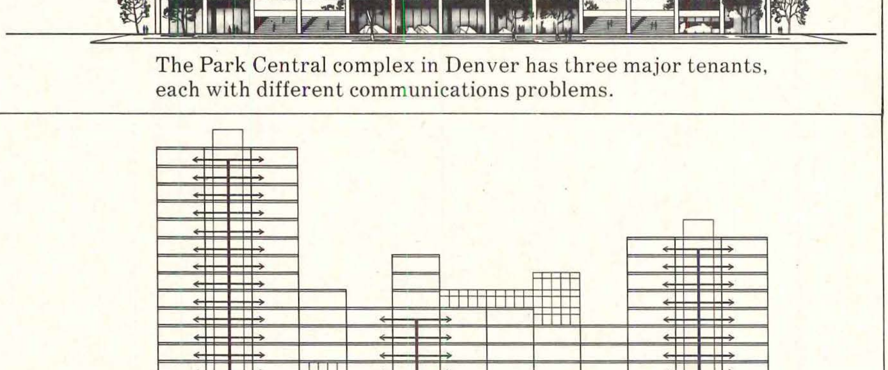
And for the headquarters of the Denver and Rio Grande Western Railroad, he developed a special tie-line system.

Because Clint worked these matters out early, the builder saved time and money.

The Bell System has a Building Industry Consultant in your territory who can help you. Whatever you are building, whatever your communications needs.



The Park Central complex in Denver has three major tenants, each with different communications problems.



But all their needs are neatly met, because the developer called the Bell System's Clint Davis early.

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Notices

Appointments

Frank S. Kelly, AIA has been named senior vice president of OMNIPLAN Architects Harrell + Hamilton, Inc., Dallas. **Stephen J. Winslow, Jesse J. Williams** and **Sam H. Fuller, CSI** have been made vice presidents.

James L. Tanner and **Stanley K. Ogden, AIA** have been appointed associates of Backen, Arrigoni & Ross, Inc., San Francisco, Calif.

Wallie E. Scott, Jr., FAIA has been named president and chief executive officer of Caudill Rowlett Scott, Houston, New York, Chicago and Los Angeles. **Paul Kennon, Jr., AIA** (a P/A Awards juror this year) and **G. Norman Hoover, AIA** have been named to the Board of Directors.

John C. Haro, FAIA has been appointed a vice president and member of the Board of Directors of Smith, Hinchman & Grylls Associates Inc., Detroit.

Sean West Sculley has been made an associate of James Stewart Polshek & Associates, New York City.

Francis C. Wickham has been named a partner of Prentice & Chan, Ohlhausen, New York City.

Allen M. Rubenstein has been made a partner of Gruen Associates, Los Angeles.

Richard B. Warfel has joined A. Epstein & Sons, Inc. as chief mechanical engineer for the Chicago region.

Richard T. Craig, AIA has been appointed to the staff of Meyers & D'Aleo, Inc., Baltimore, Md.

Richard J. Tumpes has been made a principal of Everett/Zeigel, Boulder, Colo.

Robert E. Bernard, Victor E. Cole, Jack E. Hughes and **Robert J. Wolf** have been appointed executive vice presidents of Kaiser Engineers, Oakland, Calif.

Richard B. Vanderburg has joined RYA/Architects, Dallas, Tex., as vice president and director of design.

Charles B. Turner, Tommy N. Cowan, Arthur E. Aiken and **David Yarbrough** have been named associates of Brooks, Barr, Graeber & White, Inc., Austin and Houston.

Otto Sperr has been appointed president of Tecton, Inc., planning consultants of Philadelphia, Pa.

W. Mason Smith III is now an associate of Shepley Bulfinch Richardson & Abbott, Boston, Mass.

[continued on page 180]

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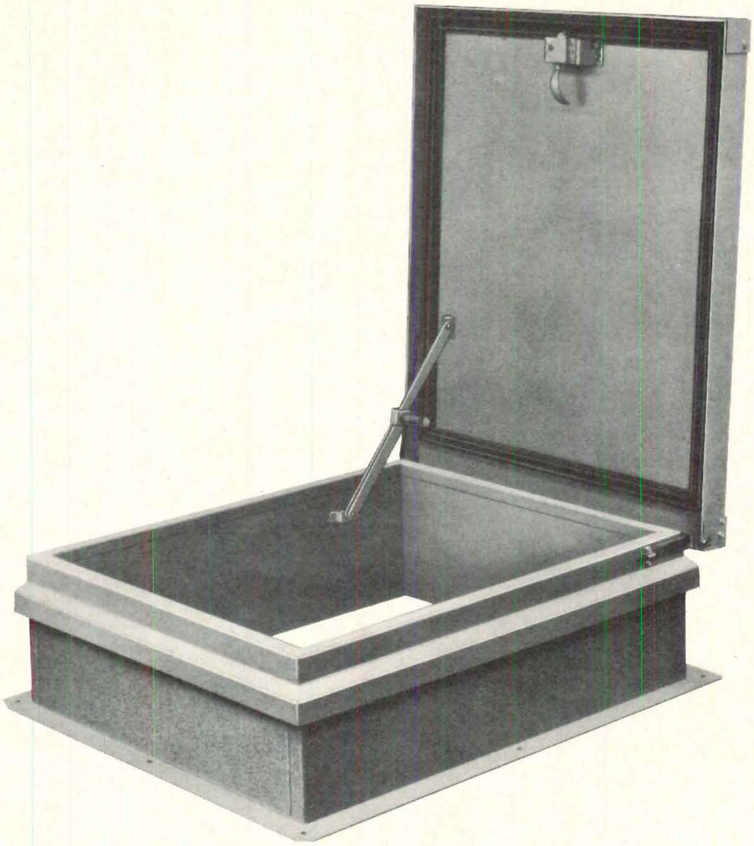

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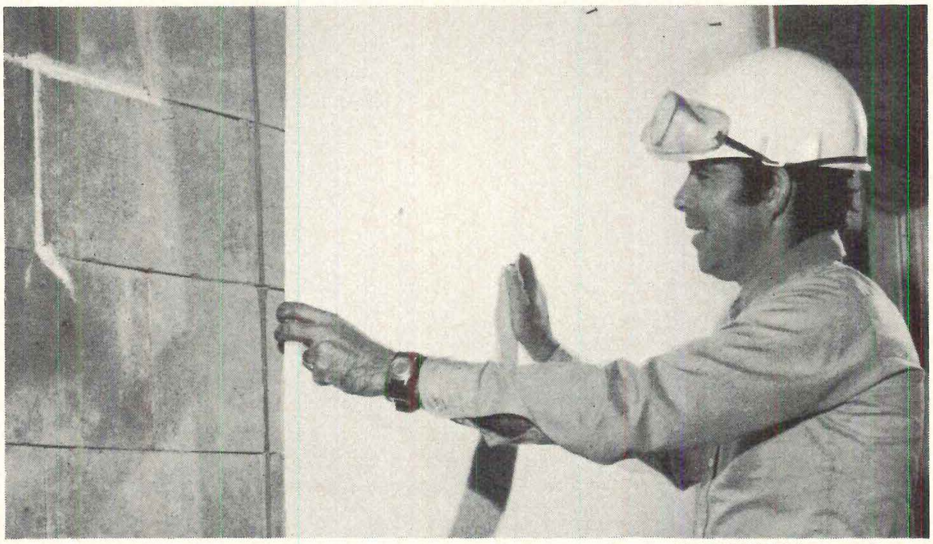

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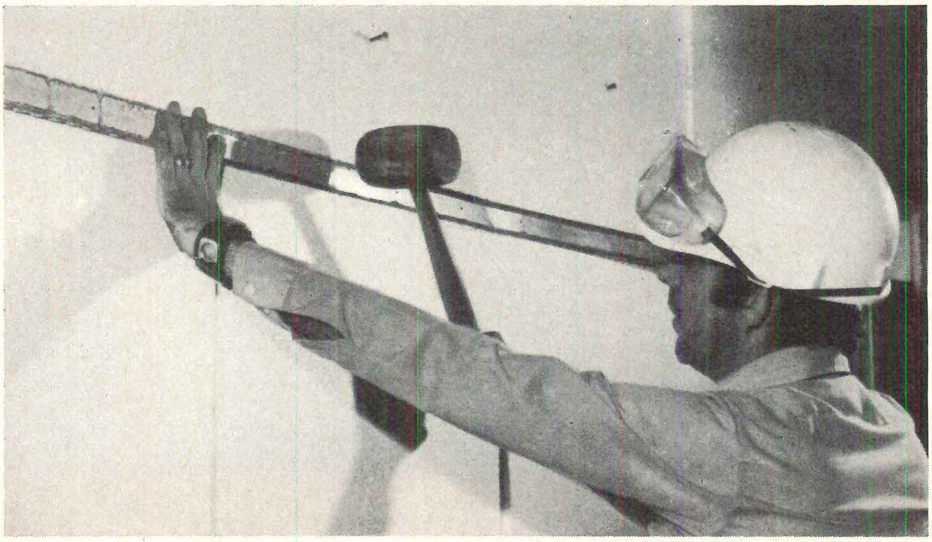

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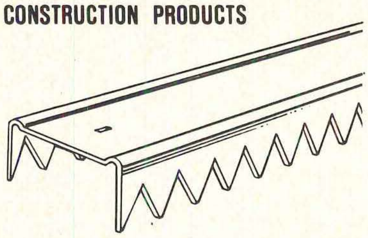
GRACE

CONSTRUCTION PRODUCTS



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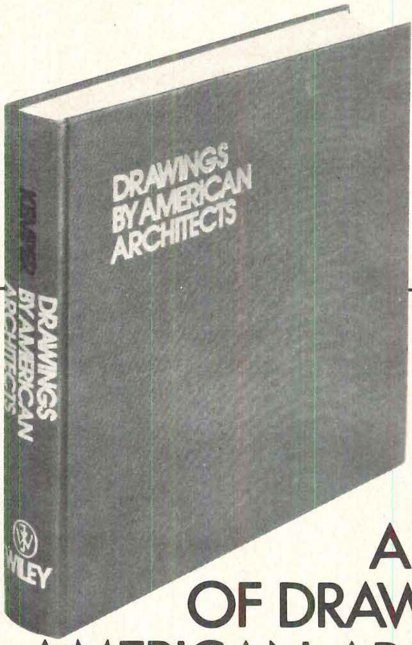
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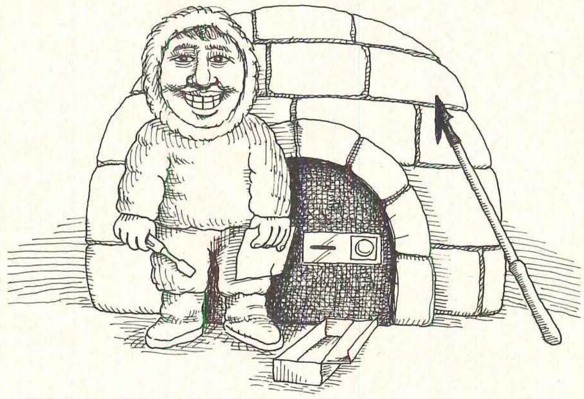
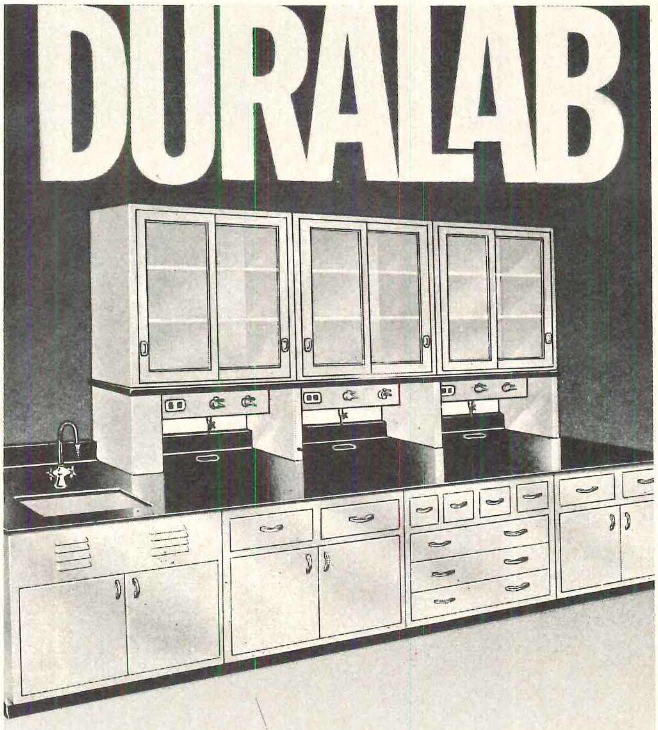



DURALAB

Notices continued from page 172

Expansions, mergers and reorganizations

Charles James Koulbanis Associates, New York City, has become Koulbanis Brandreth Associates.

Commonwealth Associates Inc., Jackson, Mich., has formed Landplan Systems Division, headed by Ralph G. Hubbard.

Philip Steel & Associates, a partnership of Philip Steel, AIA and Peter Vanderklaaw, AIA, has opened an office at 1450 Madruga Ave., Coral Gables, Fla.

David G. Ewing Architect, has opened an office at 125 S. College St., Washington, Pa.

New addresses

M. Arthur Gensler Jr. & Associates, Inc. have relocated their Houston office to 510 United Gas Bldg. and opened an office at Continental Oil Bldg., 1755 Glenarm Pl., Denver, Colo. 80202.

Ferebee, Walters & Associates, 5672 International Dr., Charlotte, N.C. 28211.

Sheldon D. Rosen Architects & Planners, 33 Hazelton Ave., Toronto, Canada.

Ferguson Sorrentino Design Inc., 5 E. 57 St., New York City 10022.

Brodsky, Hopf & Adler, Architects & Engineers, PC, 1949 N. Stemmons Freeway, Dallas, Tex.

B.A. Berkus Associates, 1450 Madruga Ave., Coral Gables, Fla. 33146.

New firms

Robert I. Abrash and Philip R. Eddy have formed **Abrash & Eddy, Architect and Designer,** 11418 Washington Plaza West, Reston, Va. 22090.

D.K. Renshaw, Ed Wimberly and Jim Daily have formed **Design 3,** architects and interior design, 140 National Old Line Bldg., Little Rock, Ark. 72201.

William P. Midgley, AIA, C. Michael Shaughnessy, Michael T. Fickel, AIA and J. William Scott have established **Midgley Shaughnessy Fickel & Scott Architects Inc.,** 20 W. Ninth St., Kansas City, Mo. 64105.

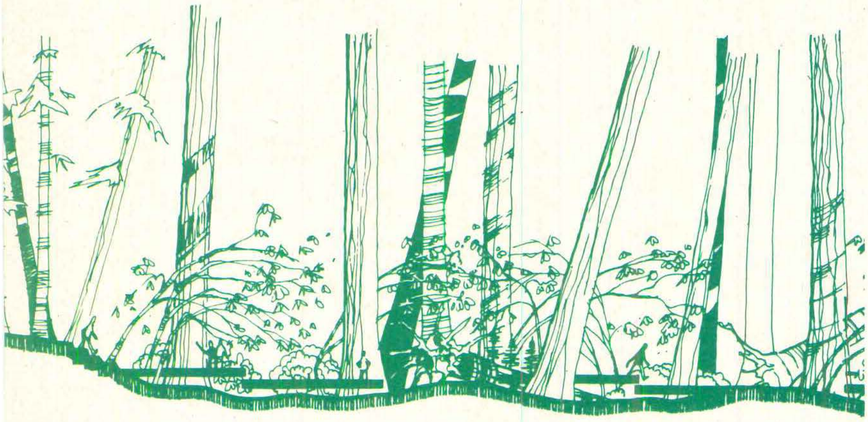
John W. Powers and Ted E. Harsham, AIA have formed **Harsham Powers Associates,** Pier 33 North, San Francisco.

Ronald L. Sable, AIA, CSI has formed a consulting practice for the preparation of construction specifications based on P.S.A.E. "Masterspec" system. The office is located at 2820 Lewis Tower Bldg., 225 S. 15 St., Philadelphia.

Vernon Carlton Bryant, Jr., architect and building systems consultant, 8250 W. Mercer Way, Mercer Island, Wash. 98040.

Next month in P/A:

"Parkitecture"



An exploration of the architect's increasing involvement with parks at all scales – in programming, locating and planning them as well as designing structures for them – demonstrating that "park" no longer has to mean rustic.

The architect in the park: where the architect fits into park programs, as seen by some who do. **National Park Service:** profile of one of the nation's biggest design and planning clients, which has produced many of its own award-winning designs – how it operates and what new tasks it is taking on. **Parks portfolio:** nationwide survey of innovative and instructive efforts both by architects and landscape architects – ranging from vast national and state parks to citizen-designed embellishments at Grant's Tomb.

Building cost information: second in the series initiated in July, this analysis will complement a full architectural coverage of the P/A-award-winning JFK Recreation Center in Cleveland, by architects Whitley-Whitley Inc.

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Architects for Peace Corps/Vista-Action: Volunteer overseas and U. S. Low income housing projects, design of schools, hospitals, community centers, etc. Most openings —singles; some couples. Information: Bruce Mazzie, Action, OCP Box 10, Washington, D.C. 20525.

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Landscape architect: Expanding multidisciplined A-E-P firm has opening for landscape architect, registered or qualifi
[continued on page 186]

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Job mart continued from page 184

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[continued on page 188]

Job mart continued from page 187

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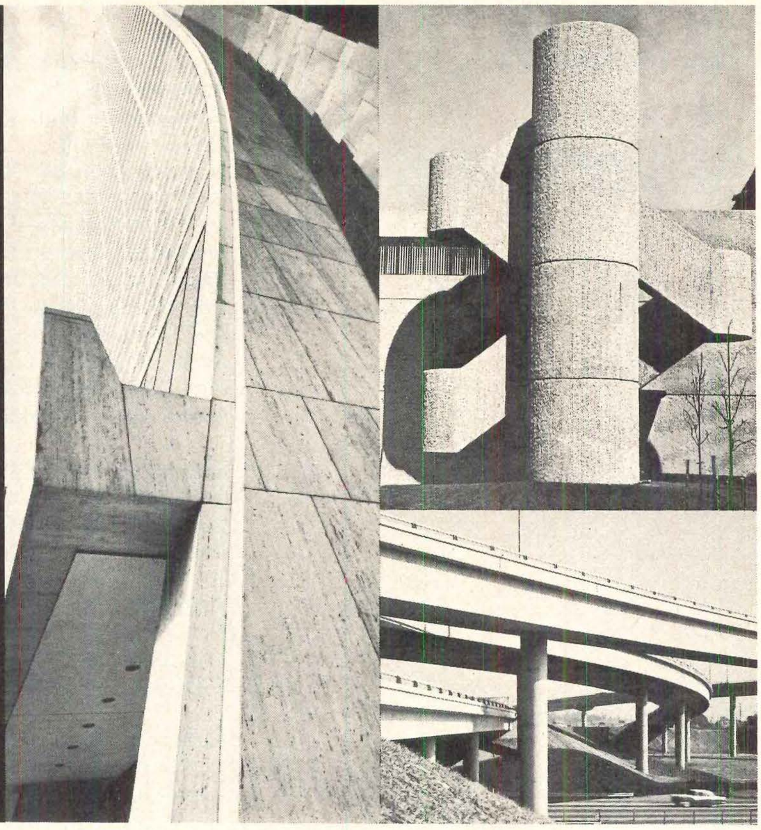

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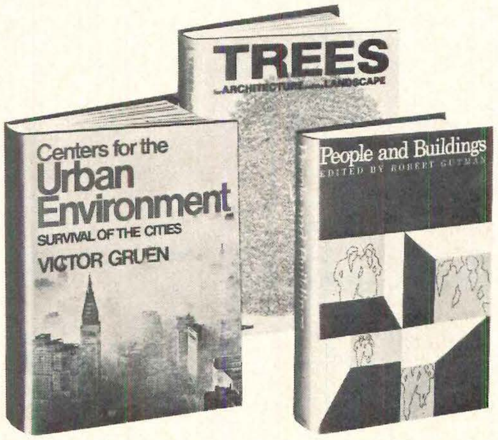

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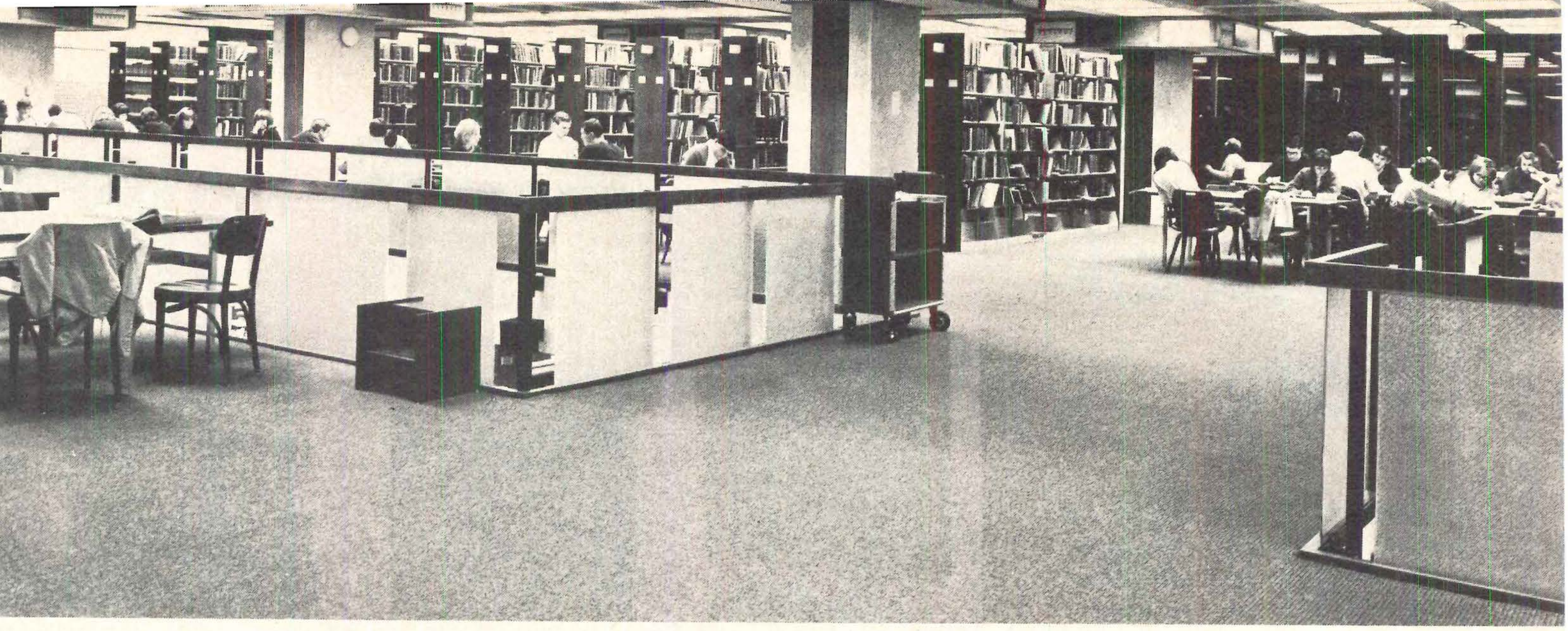

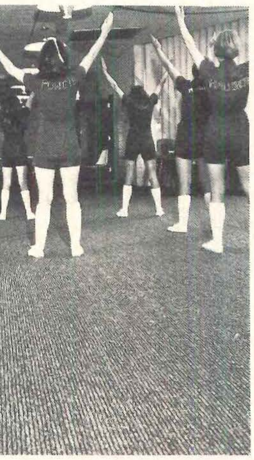

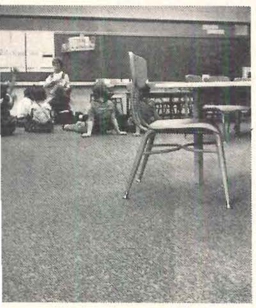

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