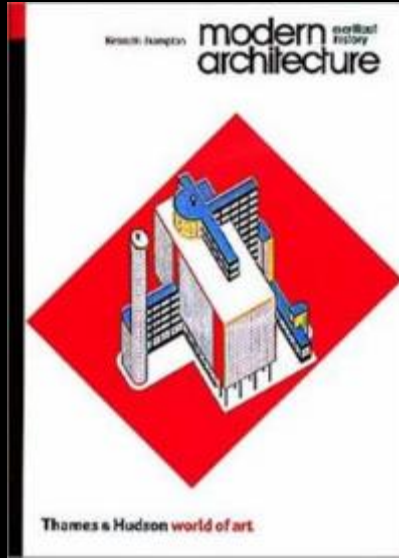


The Architecture of Assembly:  
The Advent of Industrialized  
Construction Methods and the Impact on  
the Design Process



causes of the change in the way of  
building things...

"cultural transformations"  
human ability to exercise control over  
nature

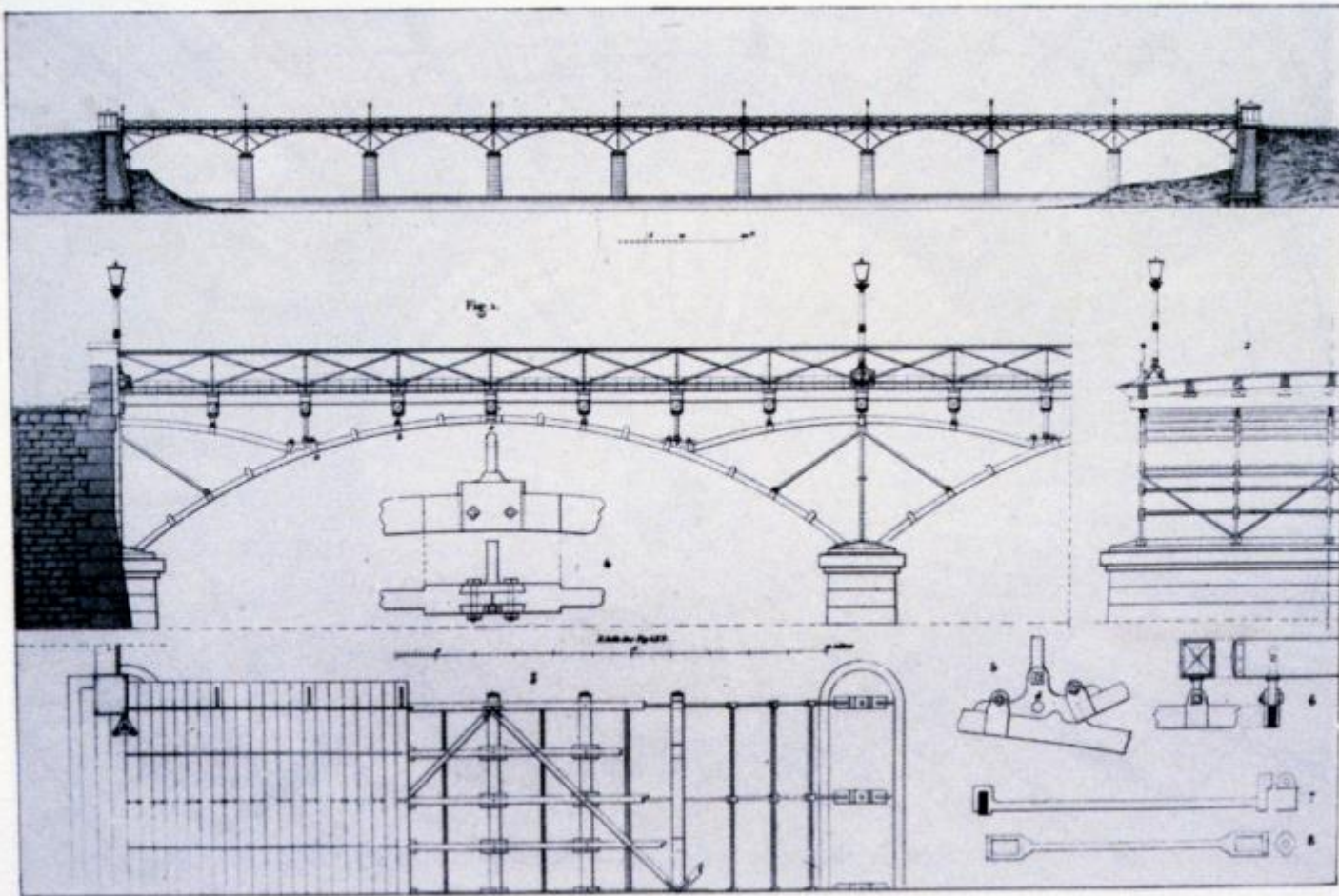




"territorial transformations"  
increase in population and general  
urbanization and demand for buildings



“technical transformations”  
advances in mathematics, physics and  
structural engineering



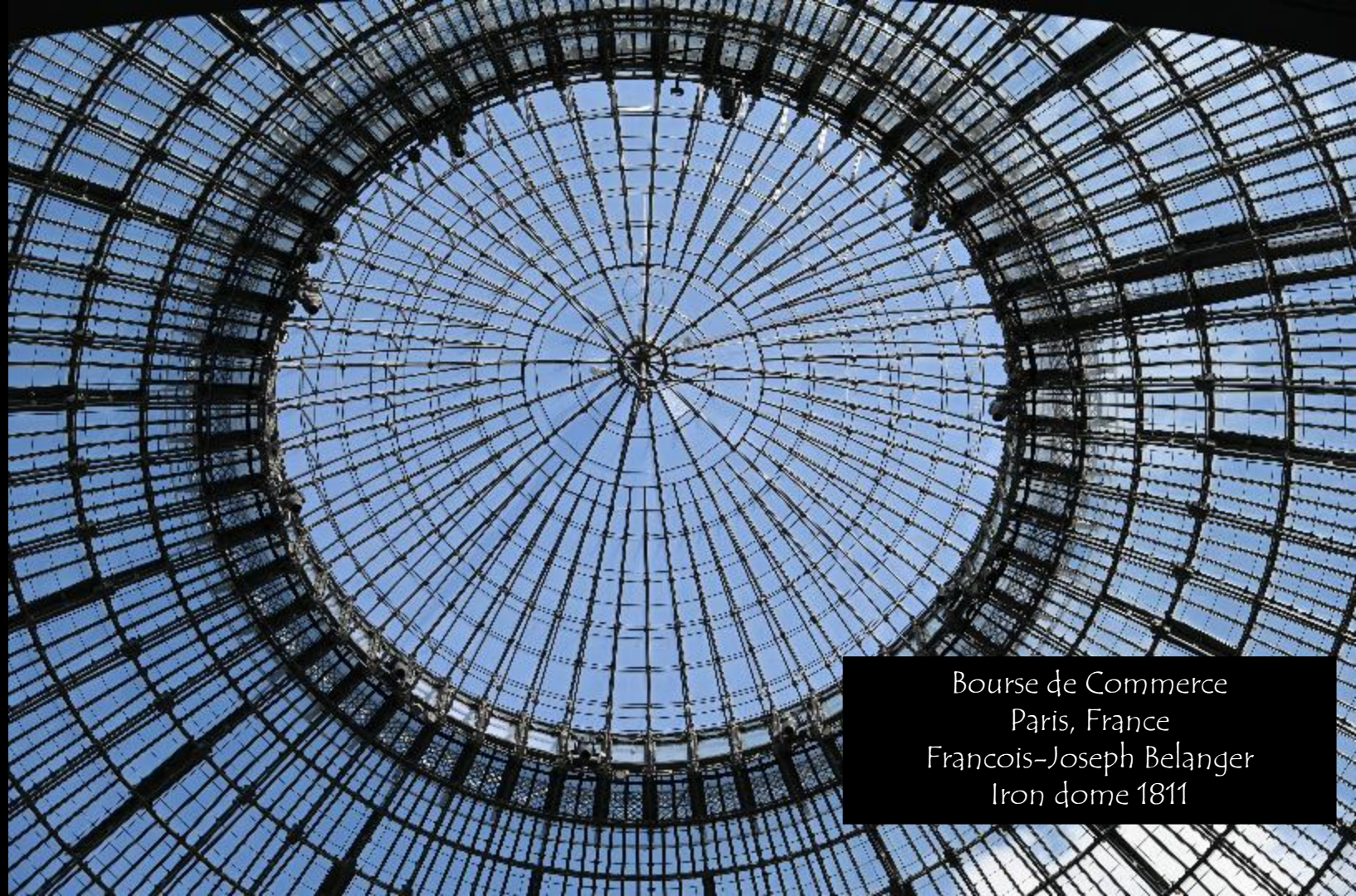
Pont des Arts  
 Louis-Alexandre de  
 Cessart and Jacques  
 Dillon  
 Paris, France  
 1804  
 original 9 arch bridge  
 rebuilt 1984 with 7  
 arches

Plate 7. Delon de Cessart and Dillon. Pont des Arts, Paris, 1803 (Rondelet, *L'Art de bâtir*, pl. 159)









Bourse de Commerce  
Paris, France  
François-Joseph Belanger  
Iron dome 1811



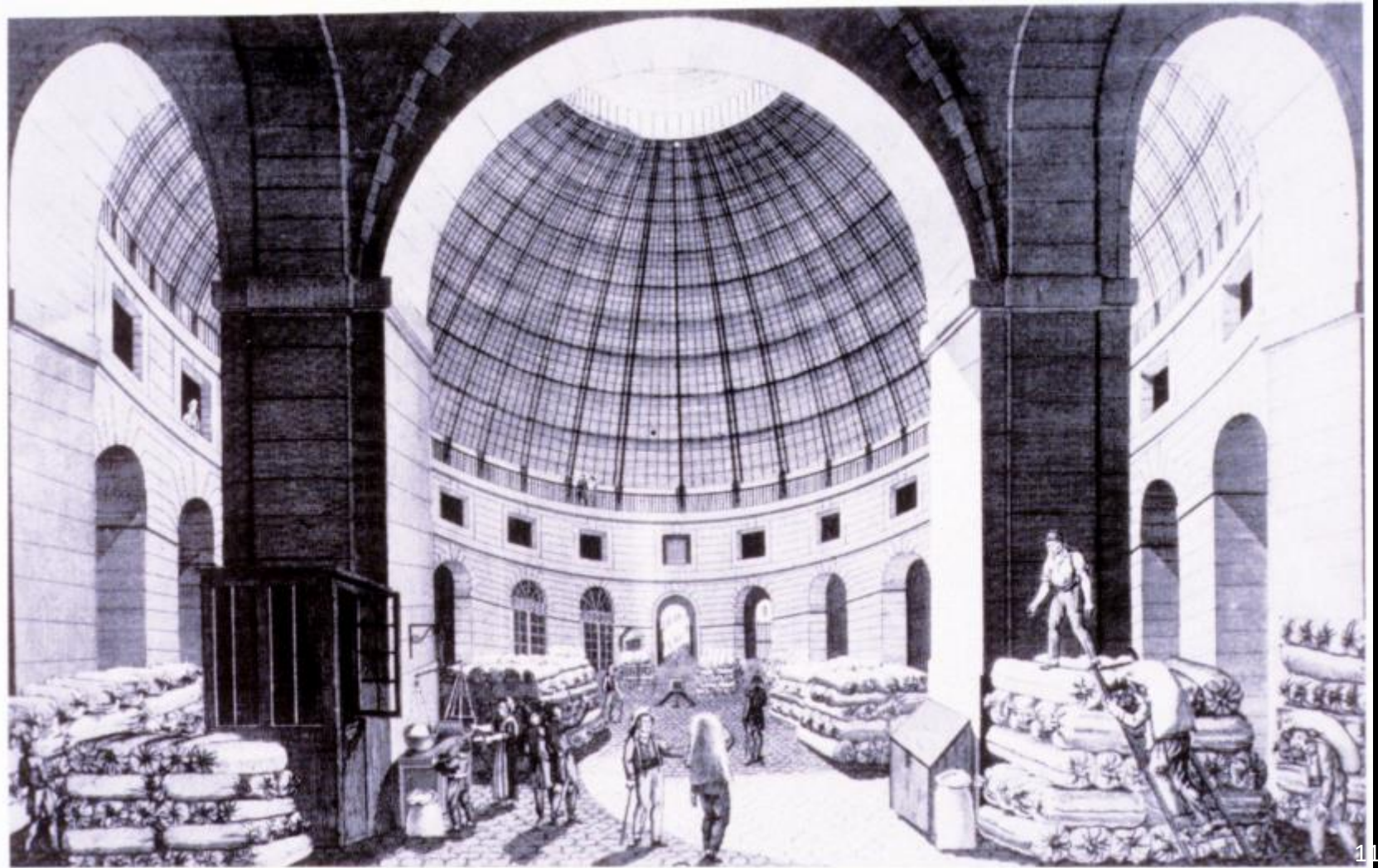




Plate 19. Passage des Princes, Paris, 1860 (Frances H. Steiner)



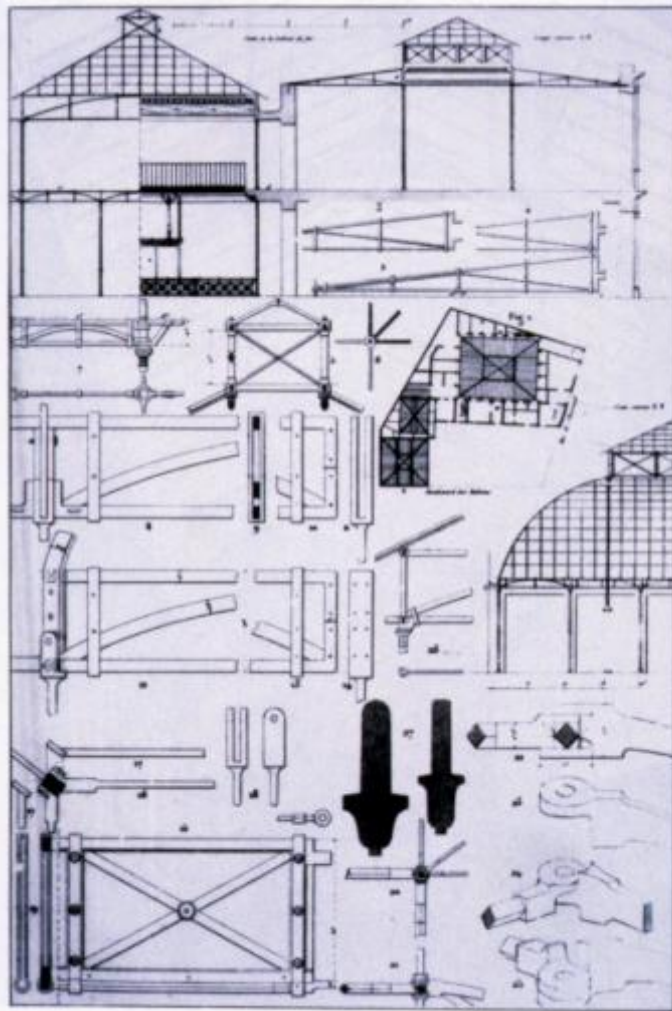


Plate 20. Tavernier. Galerie de Fer, Paris, 1829 (Thiollet, 1832, pt. 26)

P R É C I S  
D E S L E Ç O N S  
D'ARCHITECTURE

D O N N É E S :

A L'ÉCOLE POLYTECHNIQUE,

PAR I. N. L. DURAND,

ARCHITECTE ET PROFESSEUR D'ARCHITECTURE.

SECOND VOLUME

CONTENANT TRENTEDeux PLANCHES.

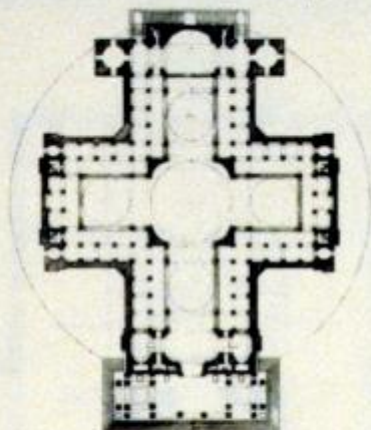
*Paris, 40 francs.*

A P A R I S,

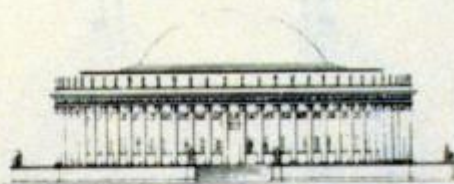
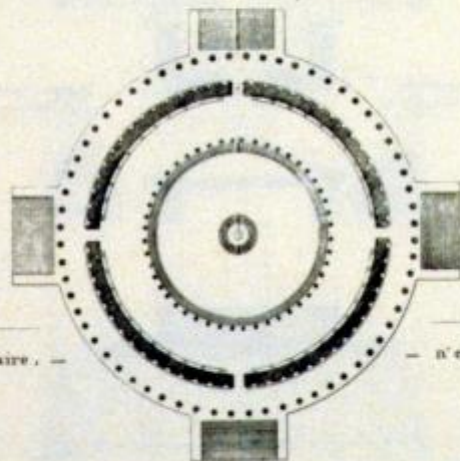
Chez { AUTEUR, à l'École polytechnique,  
et BERNARD, Libraire de l'École polytechnique,  
et de celle des Ponts et Chaussées, quai des Augustins,  
n.º 31, au premier, près la rue Gît-le-Cœur.

à X III, (1803.)

Jean-Nicolas-Louis Durand  
French Architect  
1760 - 1834



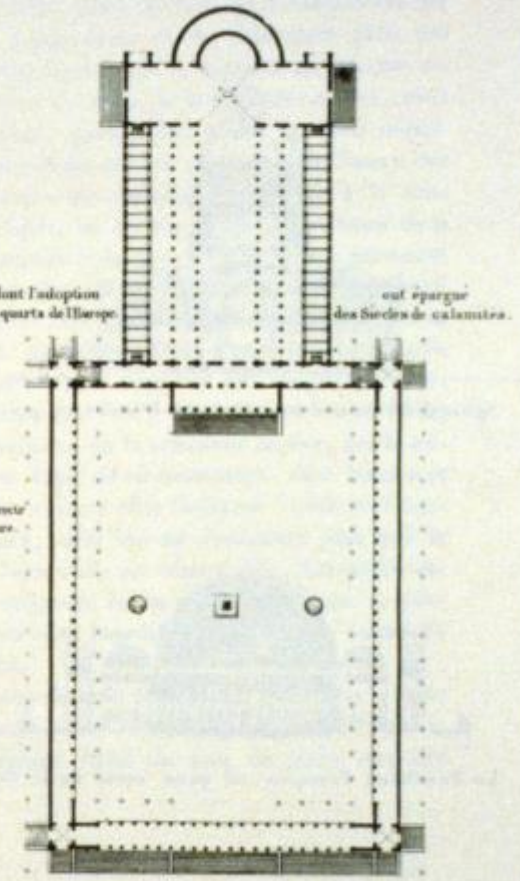
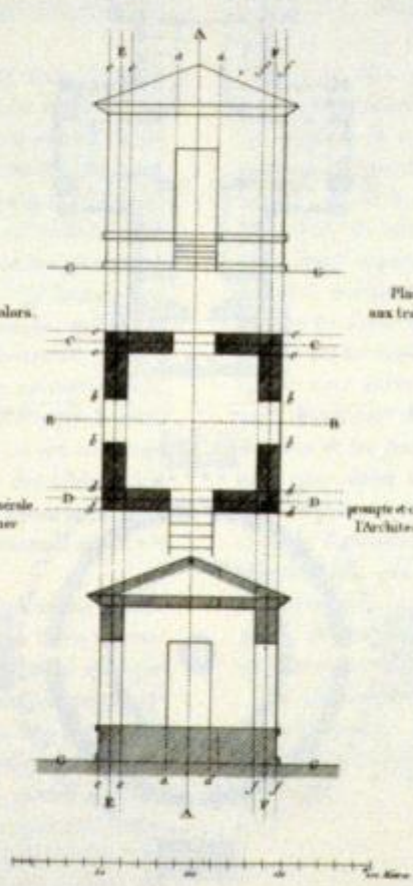
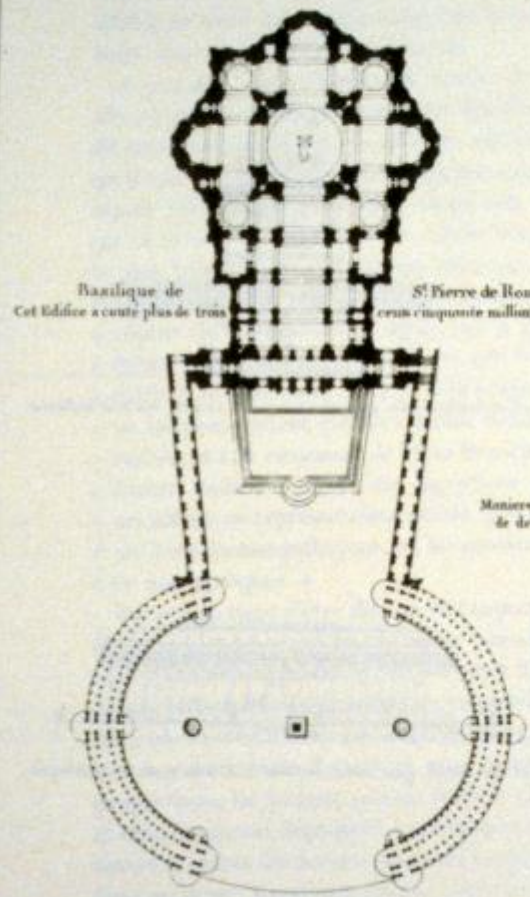
Eglise de S<sup>t</sup> Genevieve, ou Panthéon Français, tel qu'il est. — Cet Edifice quoi qu'assez resserré, a coûté dix huit millions.



Le Panthéon Français, tel qu'on auroit dû le faire. — n'en eût coûté que neuf, et eût été vaste et magnifique.

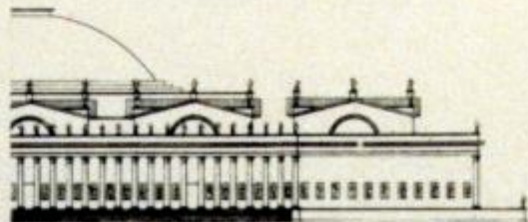
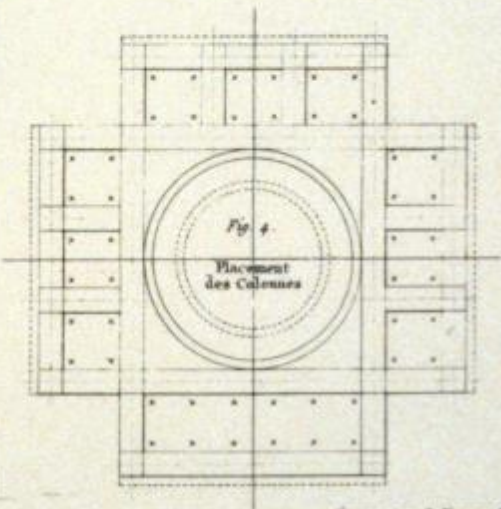
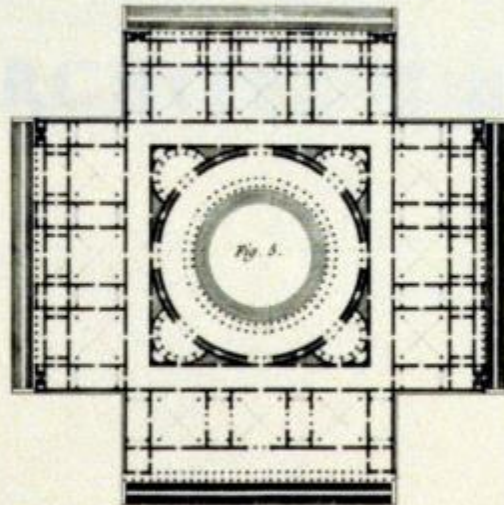
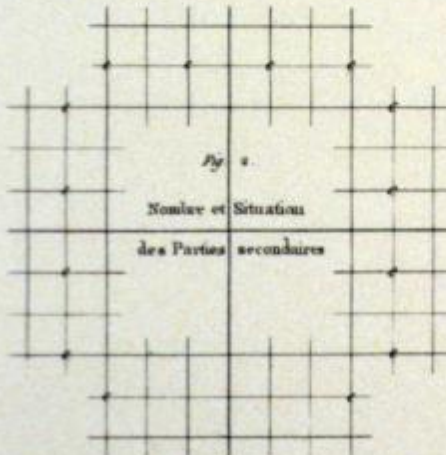
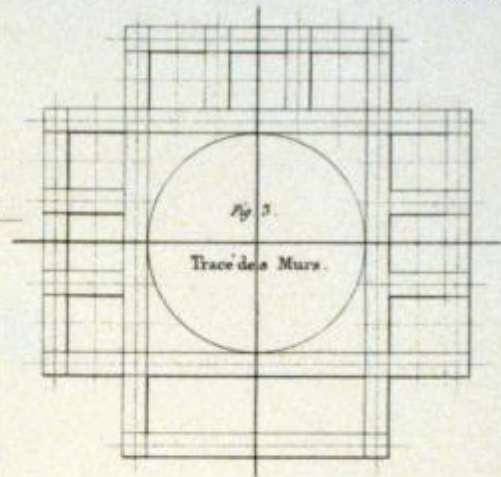
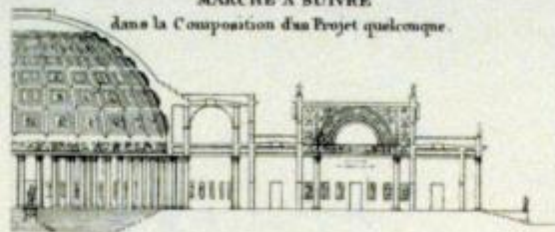
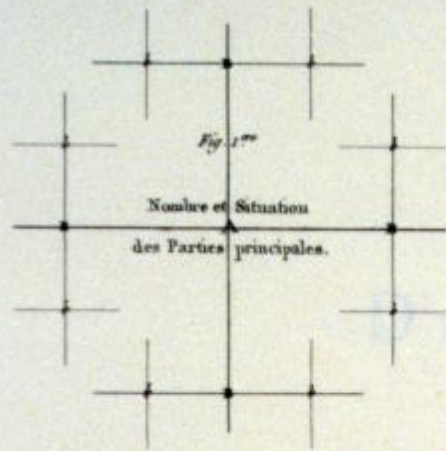


EXEMPLE DES FUNESTES EFFETS  
qui résultent de l'ignorance ou de l'inobservation des vrais Principes de l'Architecture.



MARCHE A SUIVRE

ans la Composition d'un Projet quelconque.





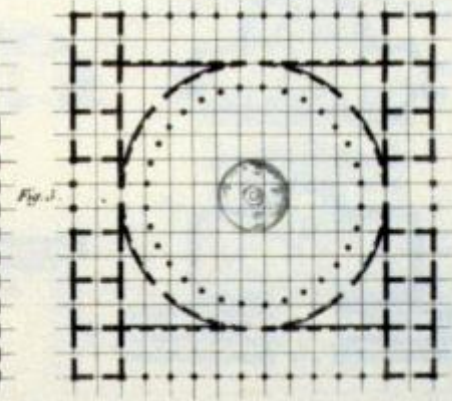
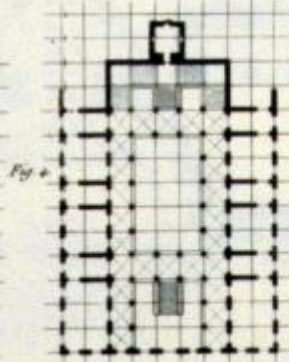
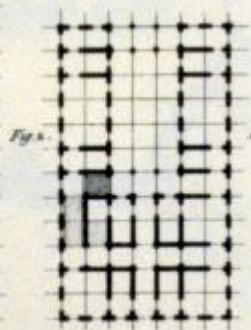
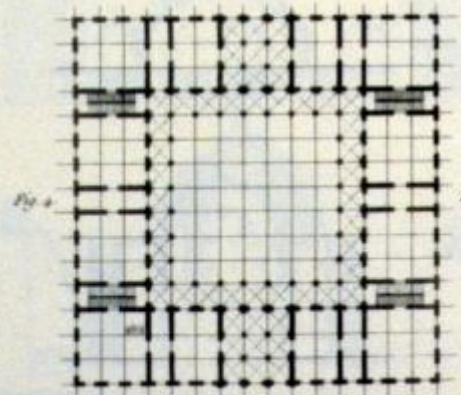
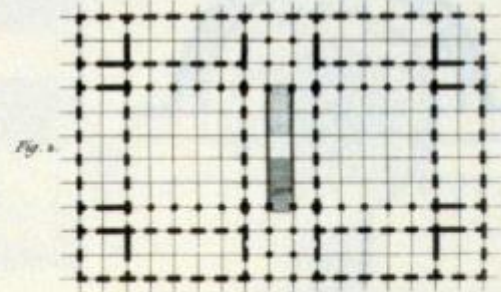
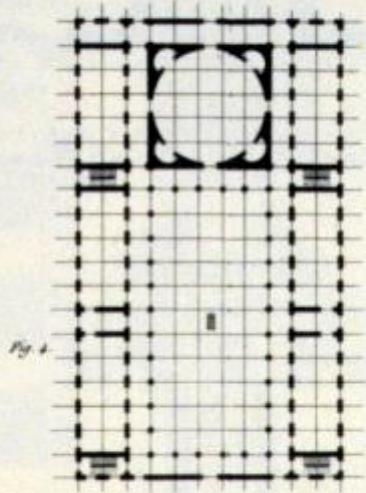
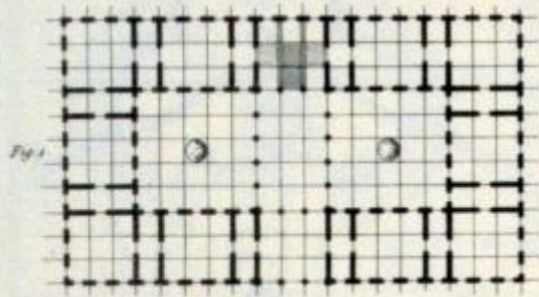
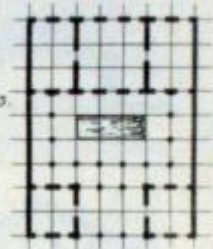
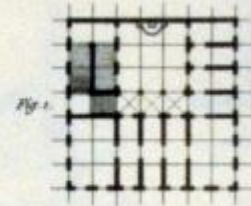
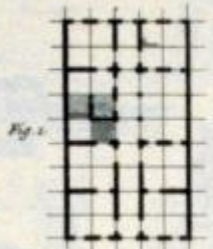
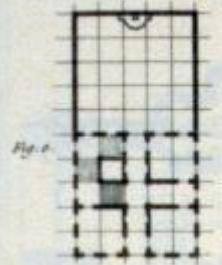


Fig. 1.

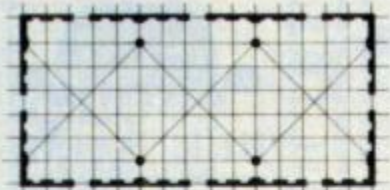


Fig. 2.

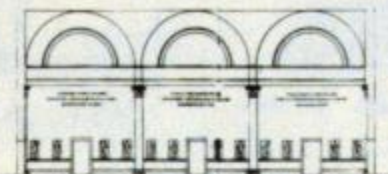


Fig. 3.

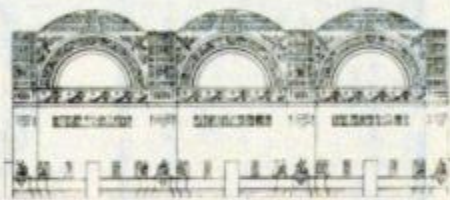
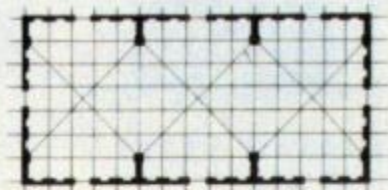


Fig. 4.

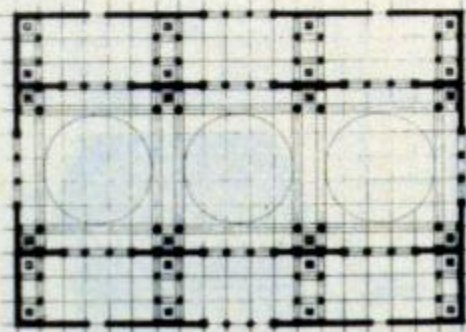


Fig. 5.

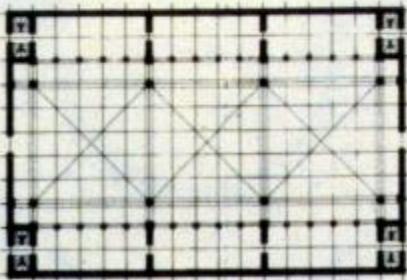
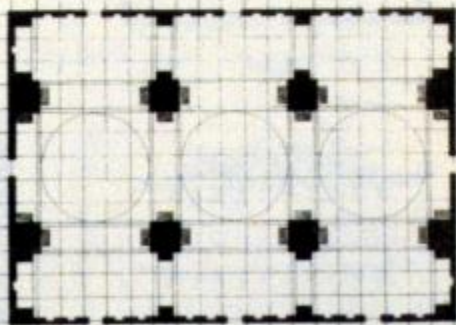
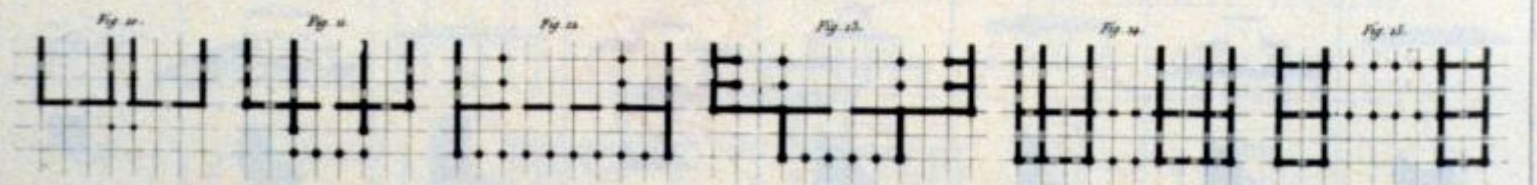
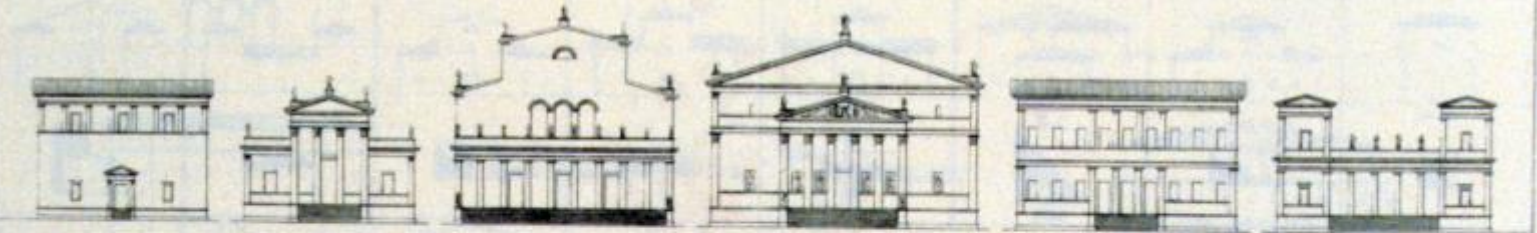
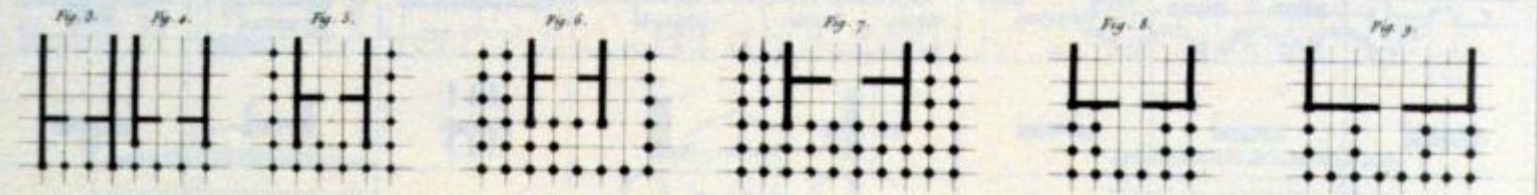


Fig. 6.





# PORCHES ouverts par des entrecroisements.





COMBINAISONS HORIZONTALES,  
de Colonnes, de Pilastres, de Murs, de Portes et de Croisées.

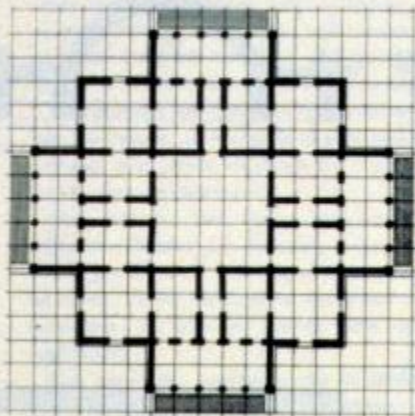


Fig. 1.

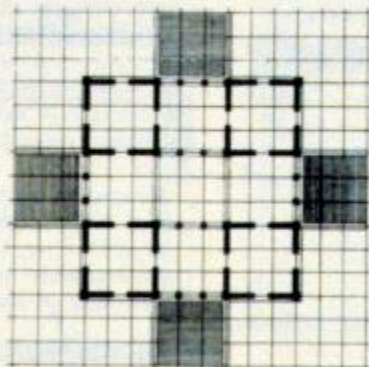


Fig. 2.

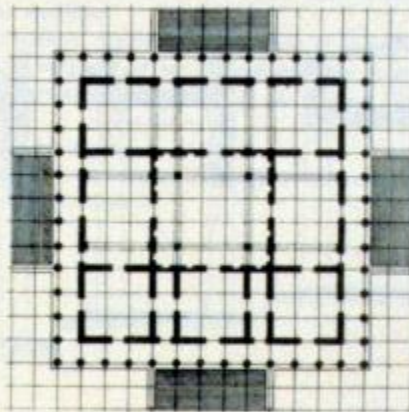
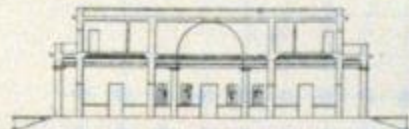
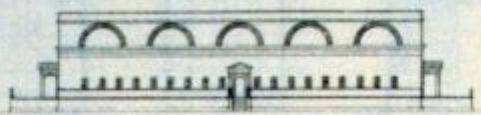


Fig. 3.

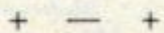


ENSEMBLES D'EDIFICES

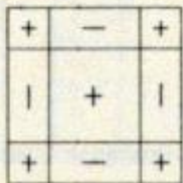
formés par la combinaison de parties de cinq entrées axes de largeur.



marche à suivre -



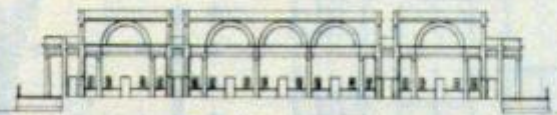
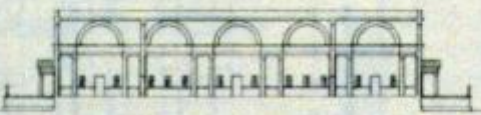
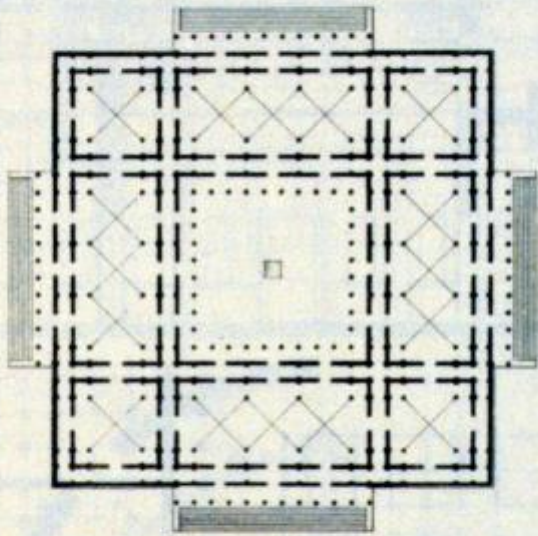
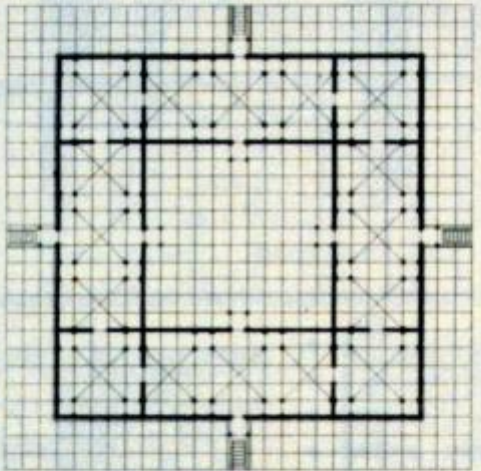
- lorsque l'on compose -



- ou même -



lorsque l'on copie.

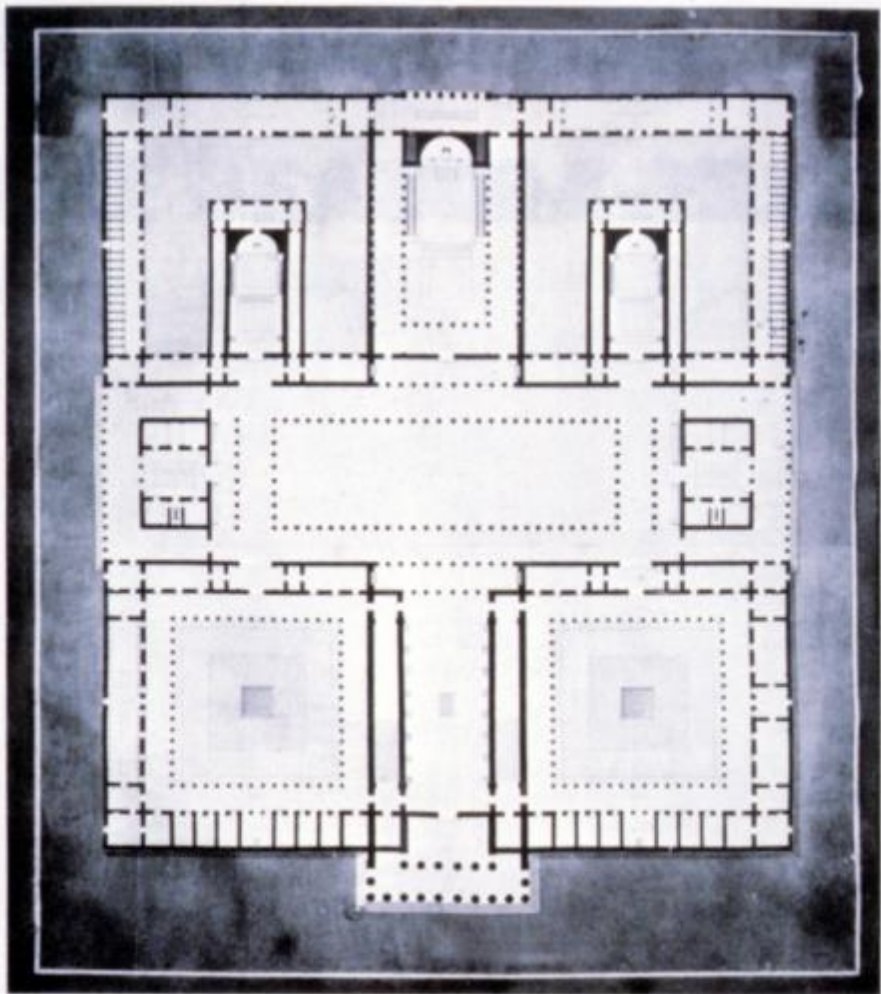


# Structural Rationalism

Henri Labrouste  
Ecole des Beaux Arts  
1801 to 1895

Structural Rationalism



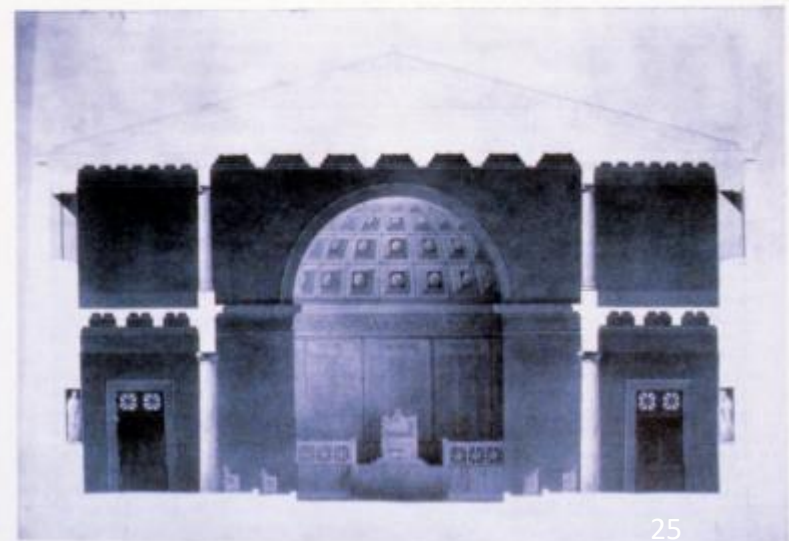


3 Henri Labrouste, plan of the Tribunal de Cassation, 1er Grand Prix, 1824

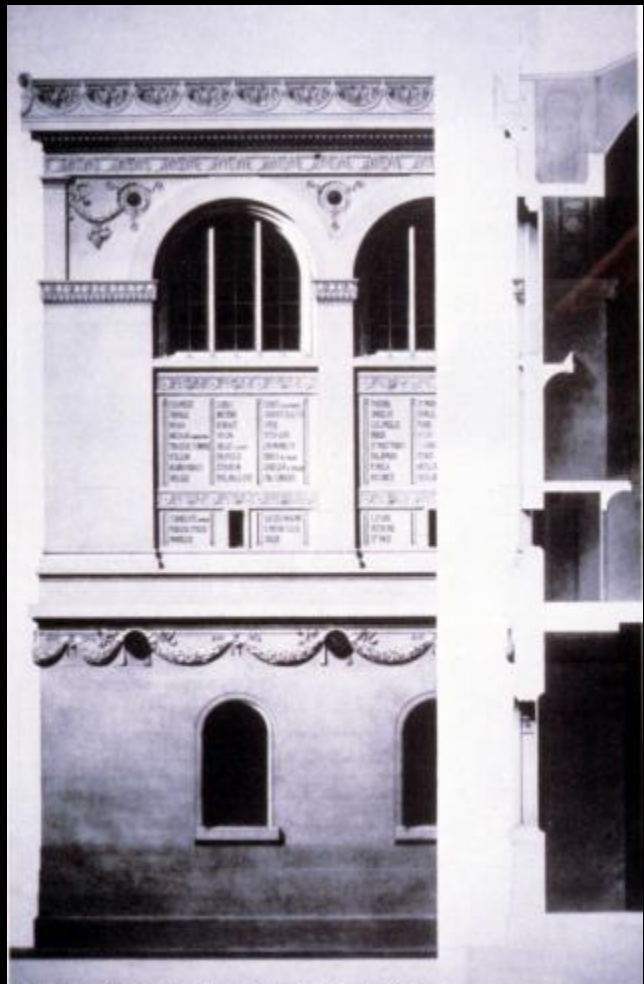
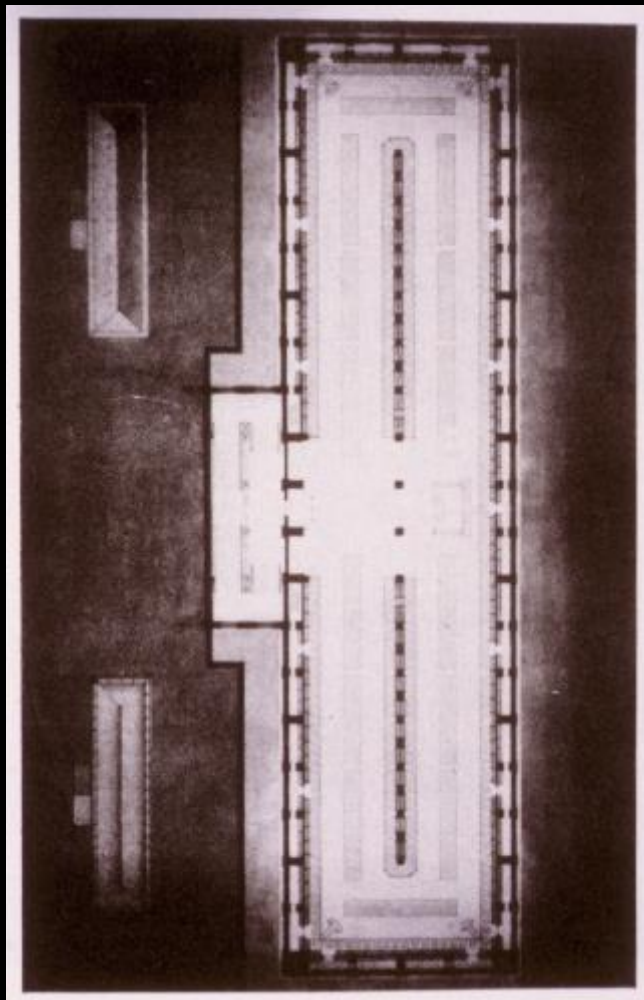
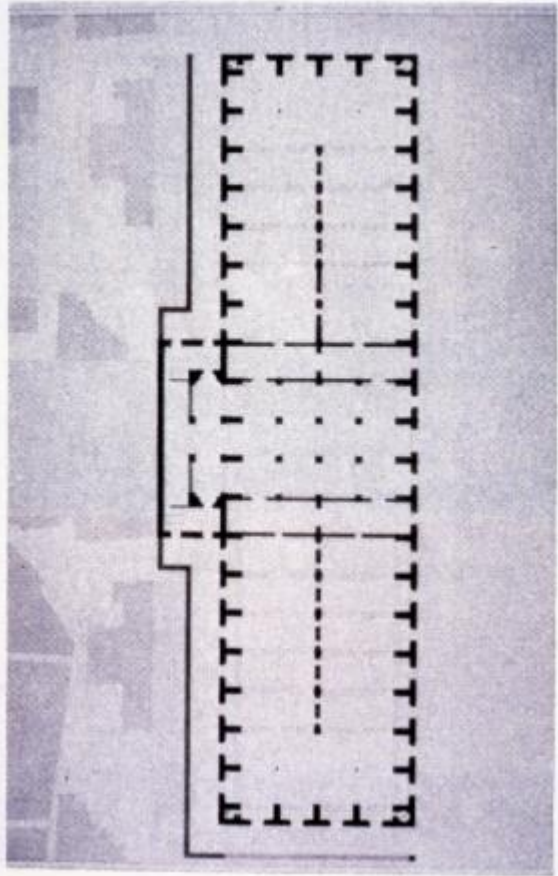
3 Henri Labrouste, plan du Tribunal de Cassation, 1er Grand Prix, 1824.



84, 85 H. Labrouste. Cour de Cassation, 1824: rendered elevation and longitudinal section (above), and rendered cross-section of main courtroom. (Beaux-Arts)



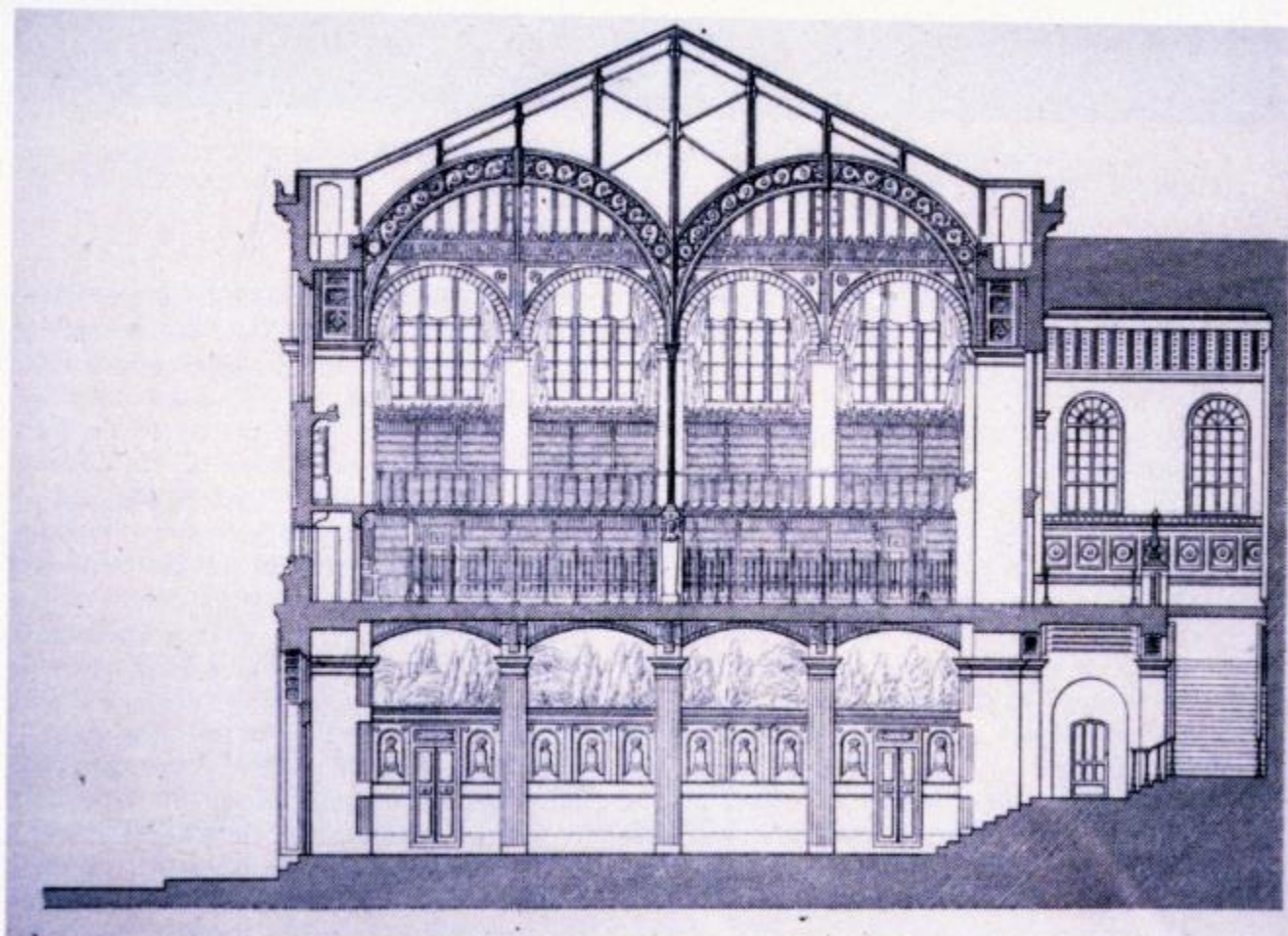
*Henri Labrouste's Bibliothèque Sainte-Geneviève, Paris, 1838-50*



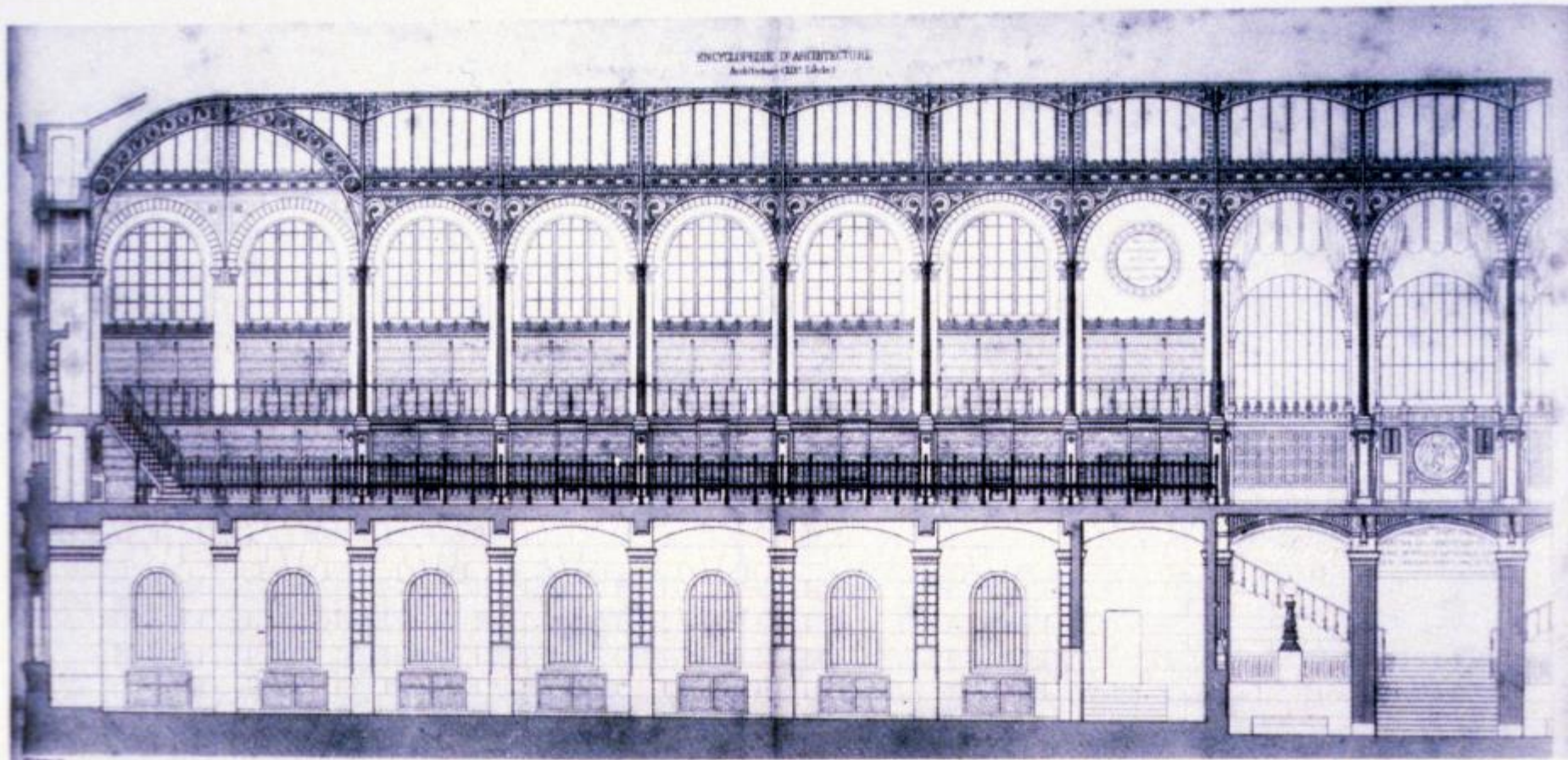
Bibliothèque Sainte-Geneviève d'Henri Labrouste à Paris (1838-50)





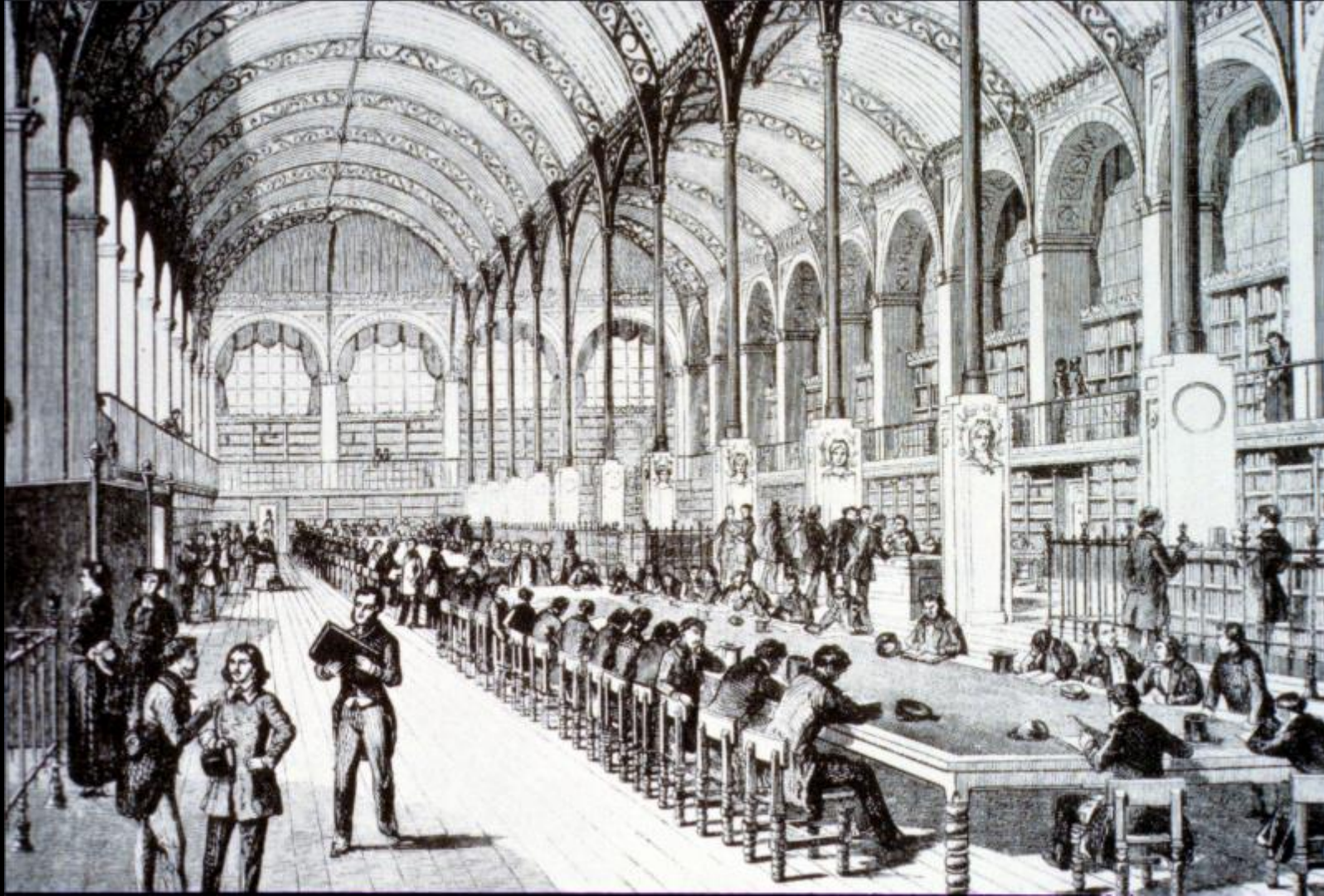






143 Bibliothèque Ste-Geneviève: longitudinal section of western half. Engraved after a drawing by Labrousse. (From the *Encyclopédie d'architecture*, V, 1855)









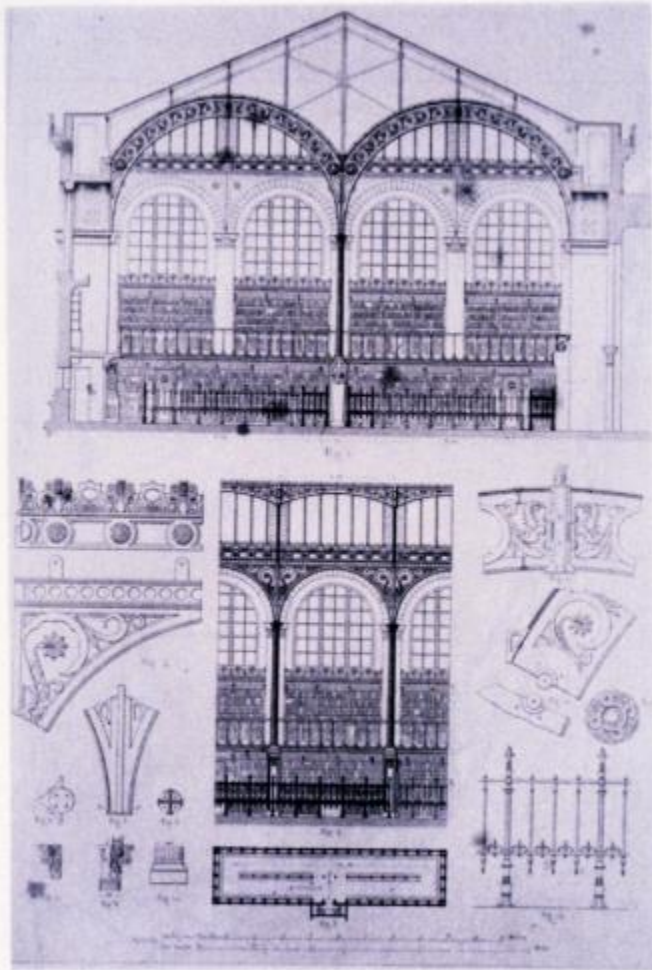
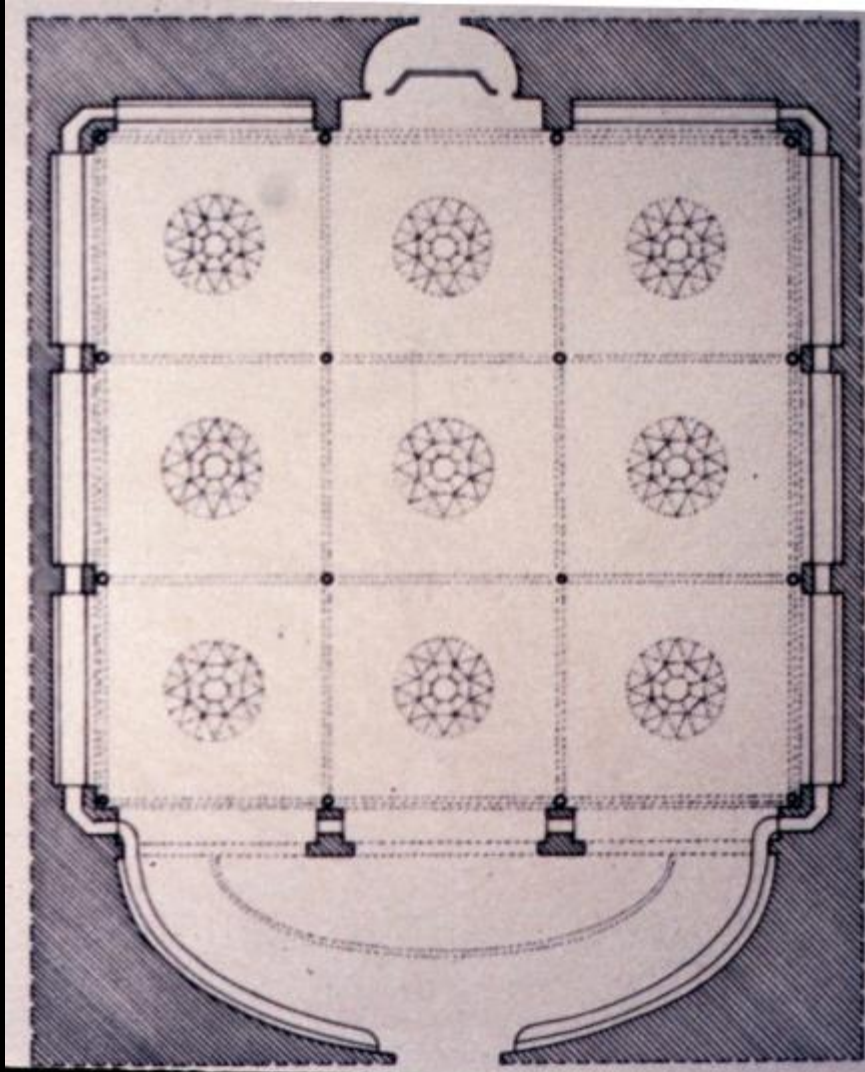


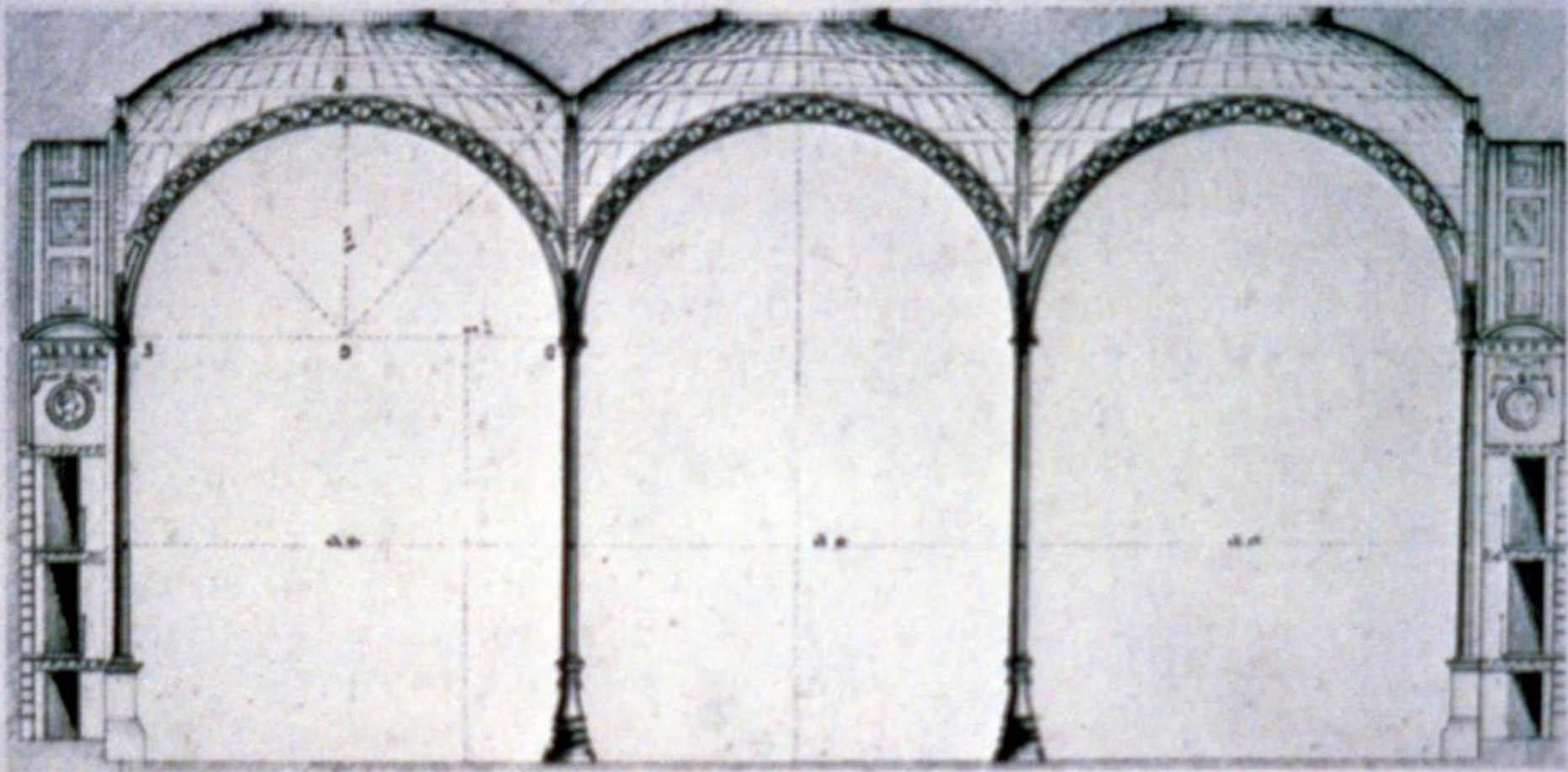
Plate 44. Henri Labrouste. Bibliothèque Saint-Geneviève, Paris, 1843-50.  
Section, plan and details (Reynaud, 1860-63, Pl. 80)



Bibliothèque Nationale de  
France  
Paris, France  
Henri Labrouste  
1862 to 1868

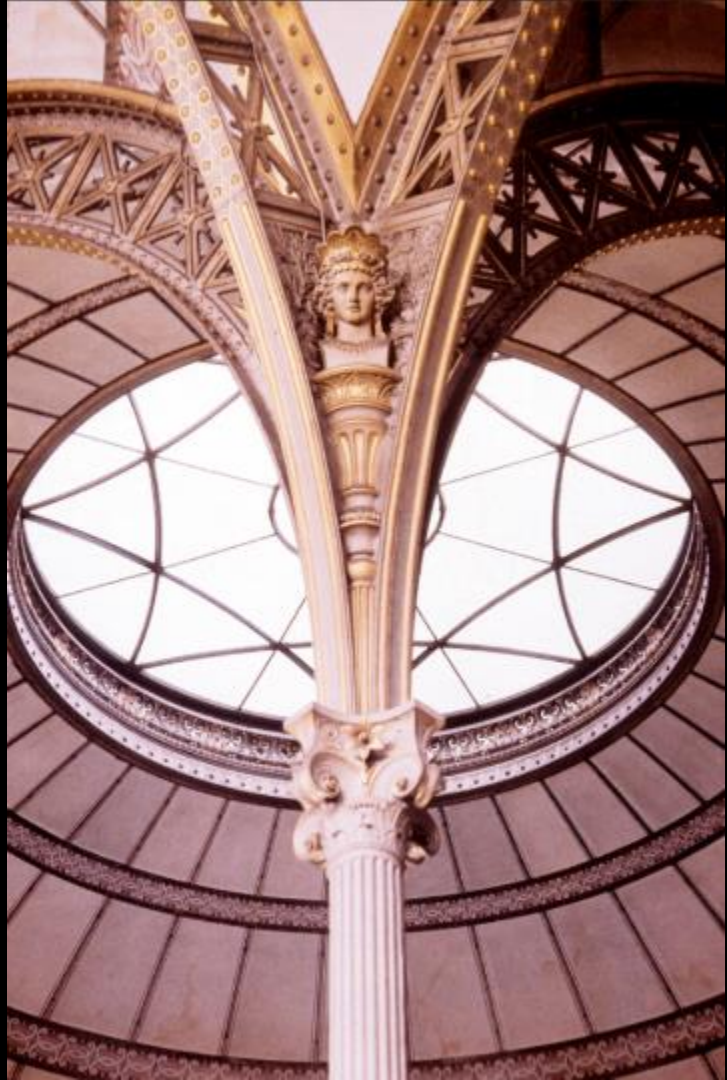












The Great Exhibition 1851  
Hyde Park, London, England

Sir Joseph Paxton

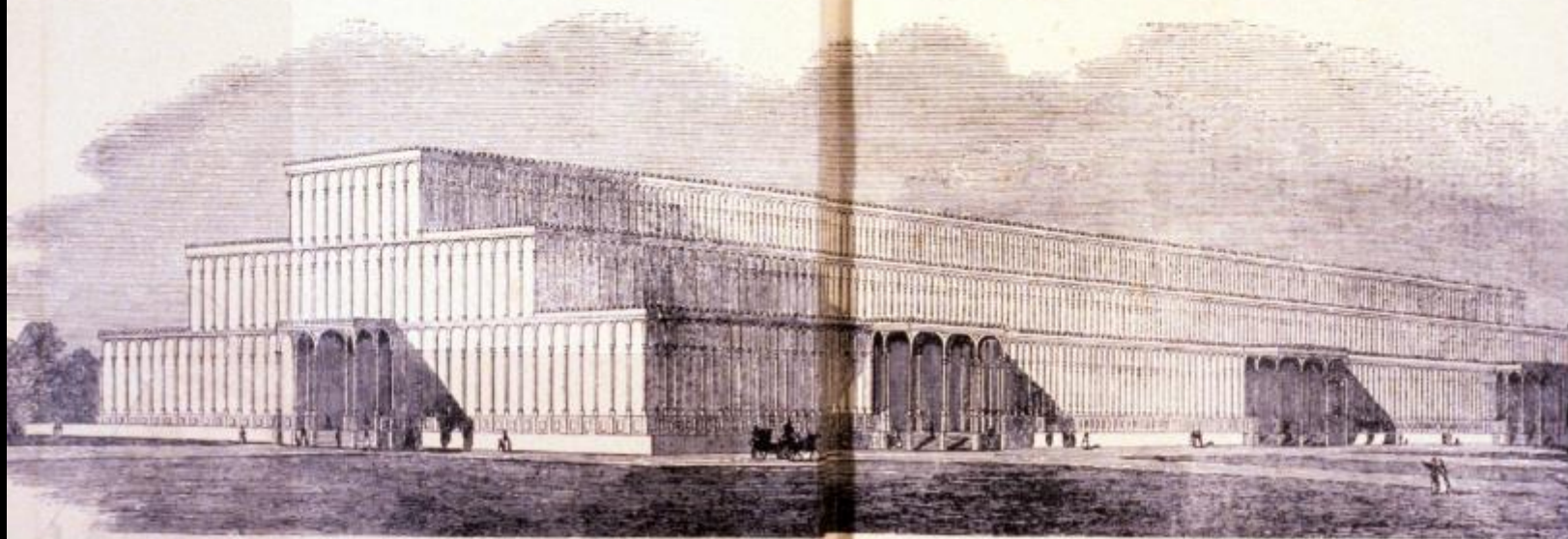


The Great Exhibition 1851  
Hyde Park, London, England  
Sir Joseph Paxton



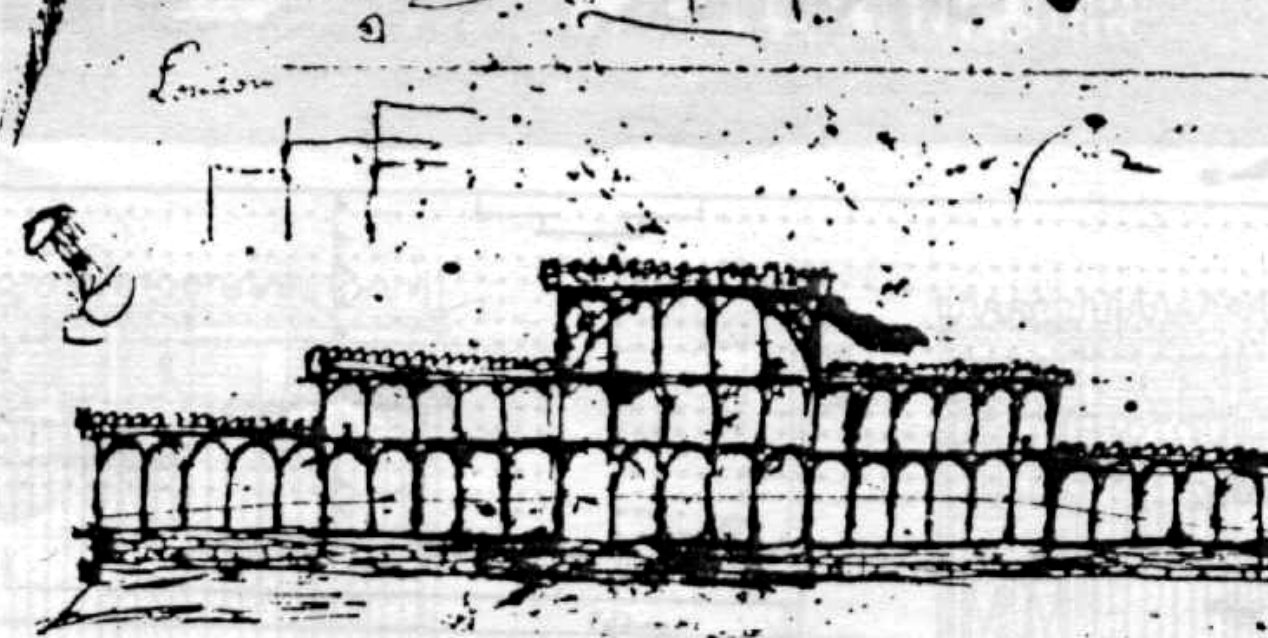
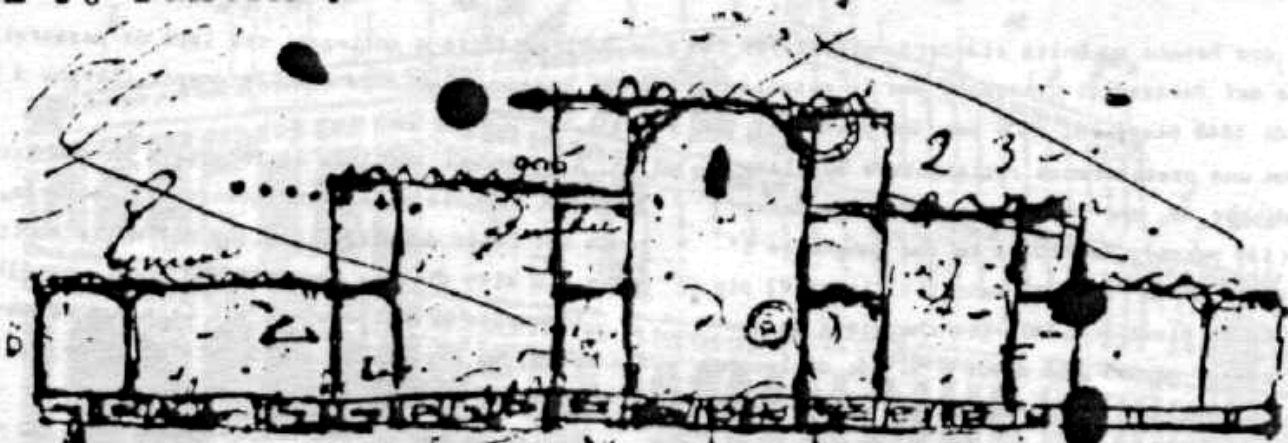


THE OFFICIAL DESIGN.

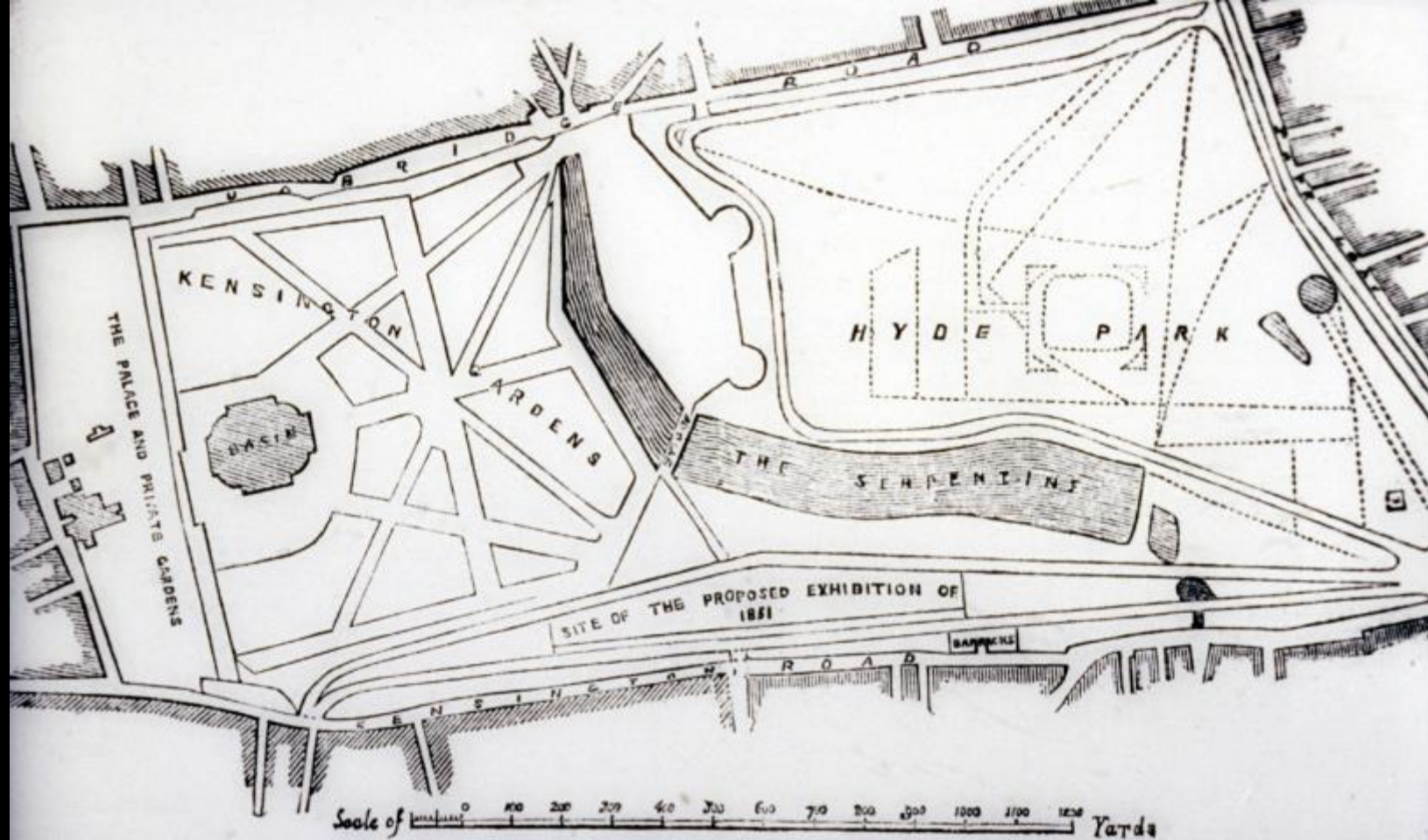


FAXTON'S DESIGN.

PROPOSALS FOR THE EXHIBITION BUILDING

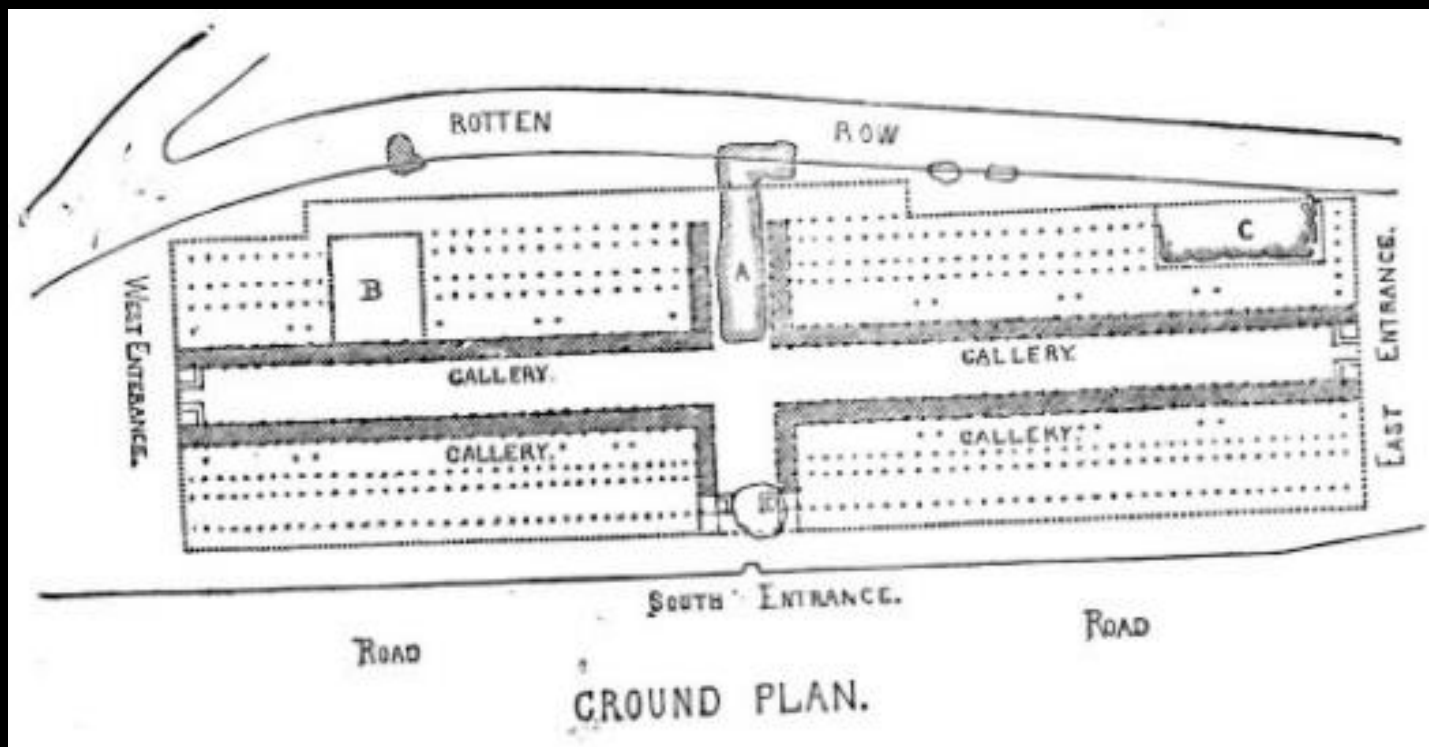


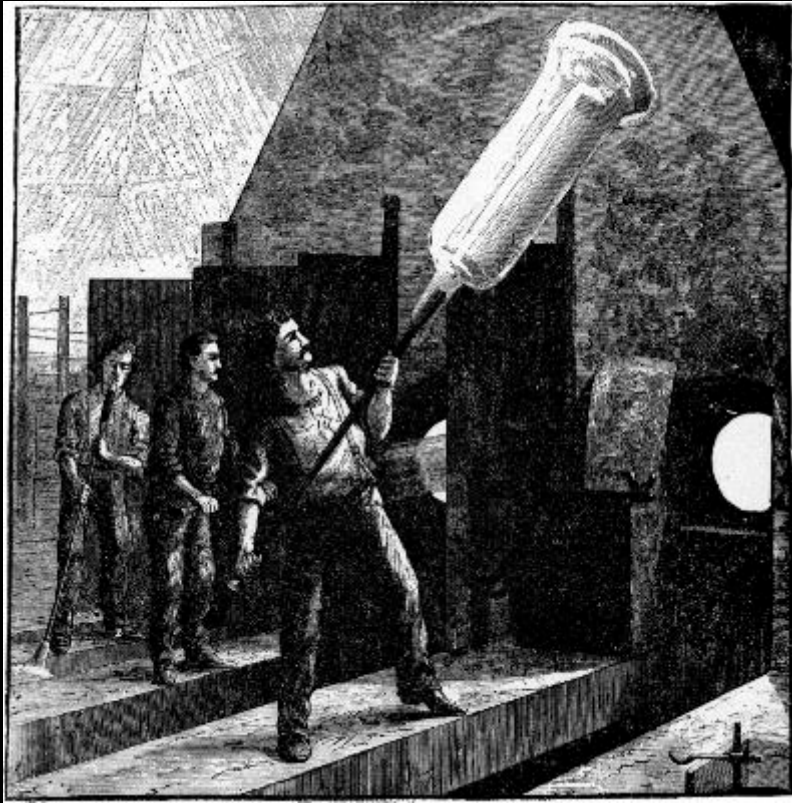




PLAN OF HYDE PARK.

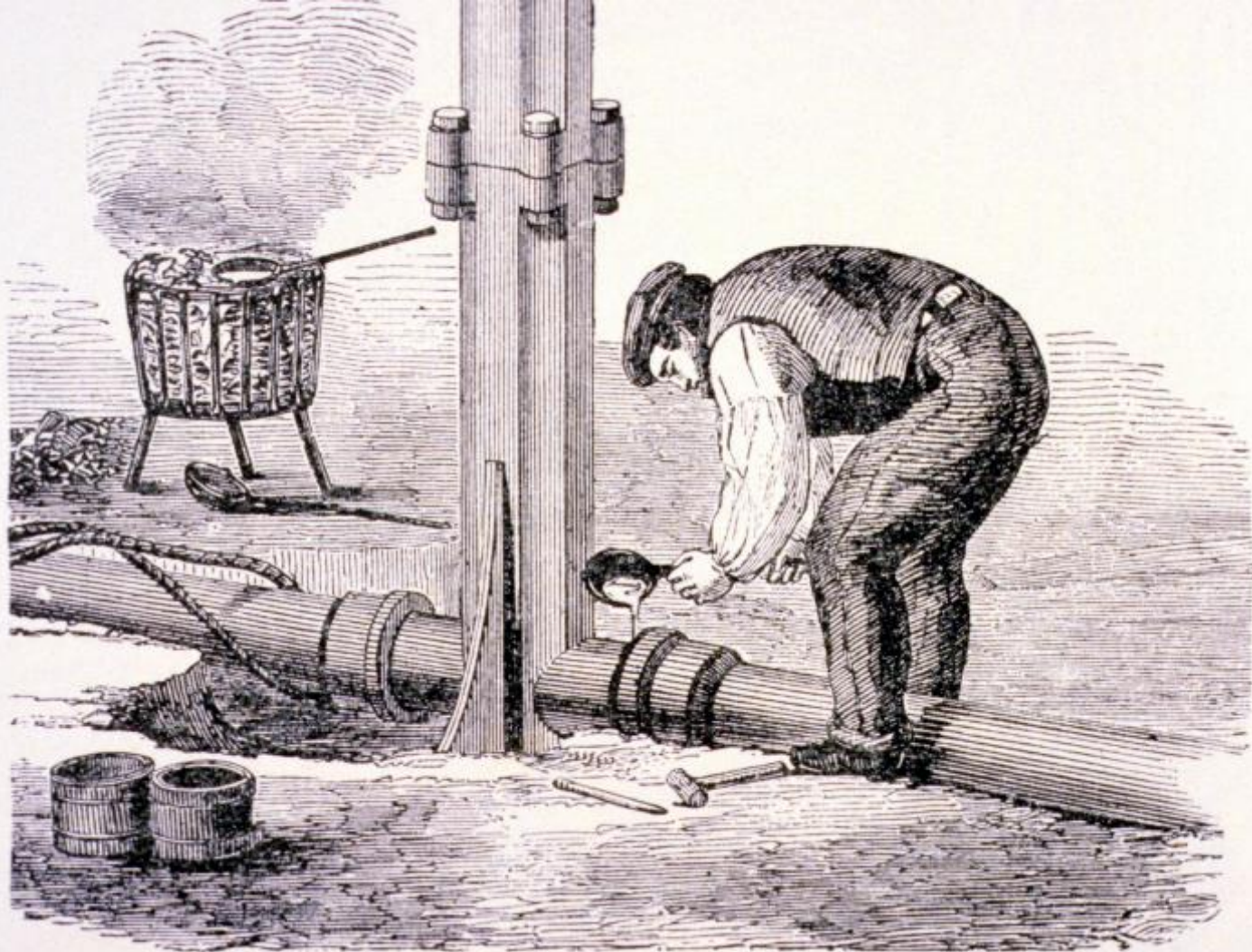




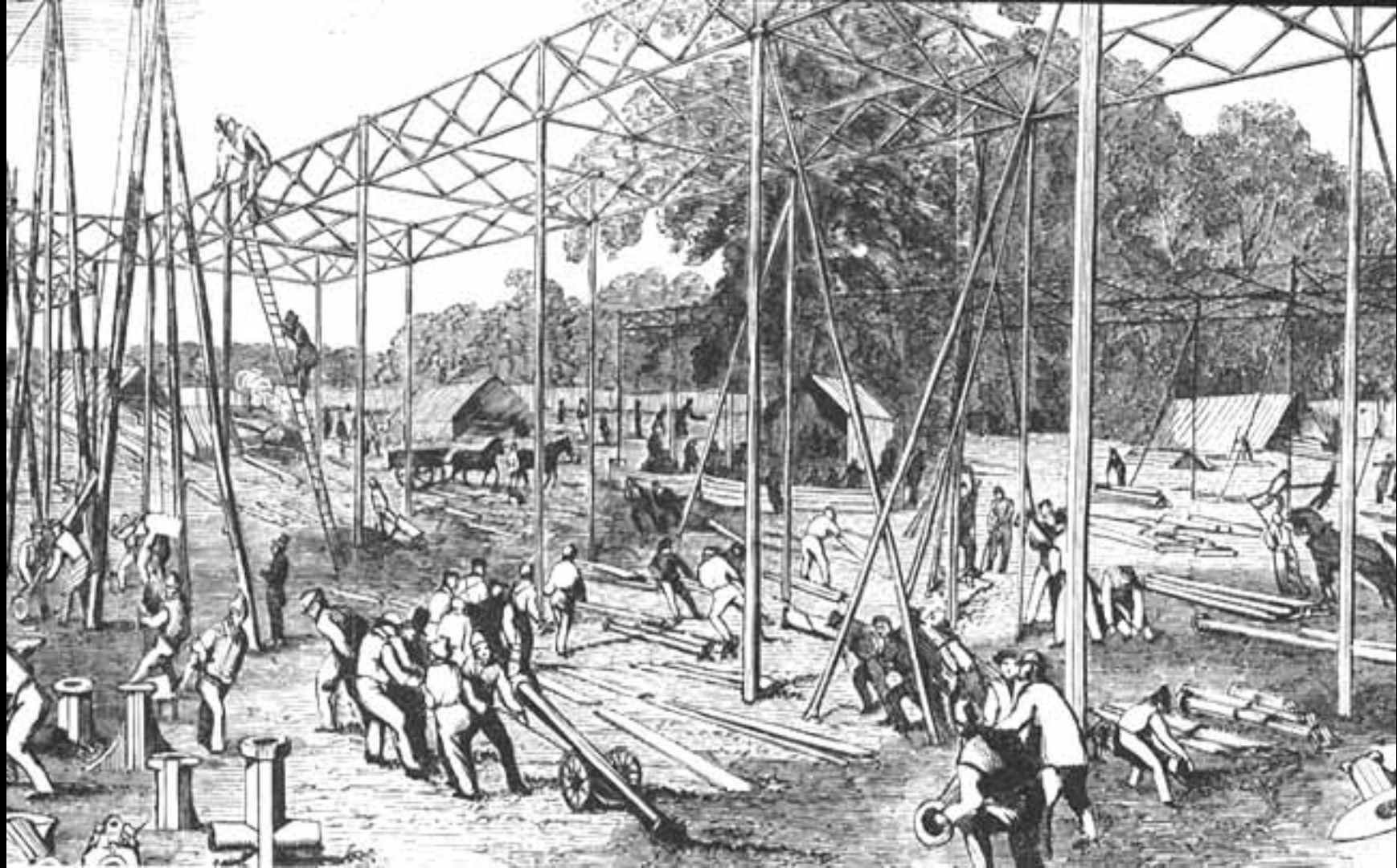


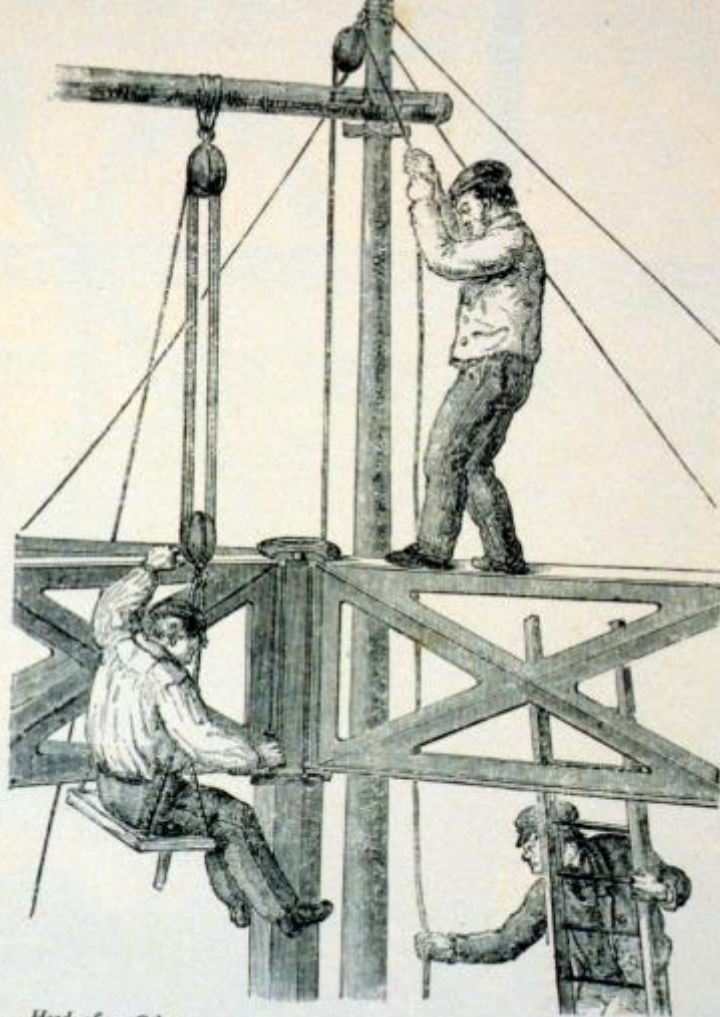
Cylinder glass is made by swinging a long hollow tube of glass in a long pit. It folds out to 30" x 49".

It was cut into 3 panes of 10" x 49" and this formed the basis of the modules for the building – combined with the slope required so that the condensation on the roof glass would not drip, but rather cling to the glass and end up in a condensation gutter at the base of the sloped glass.





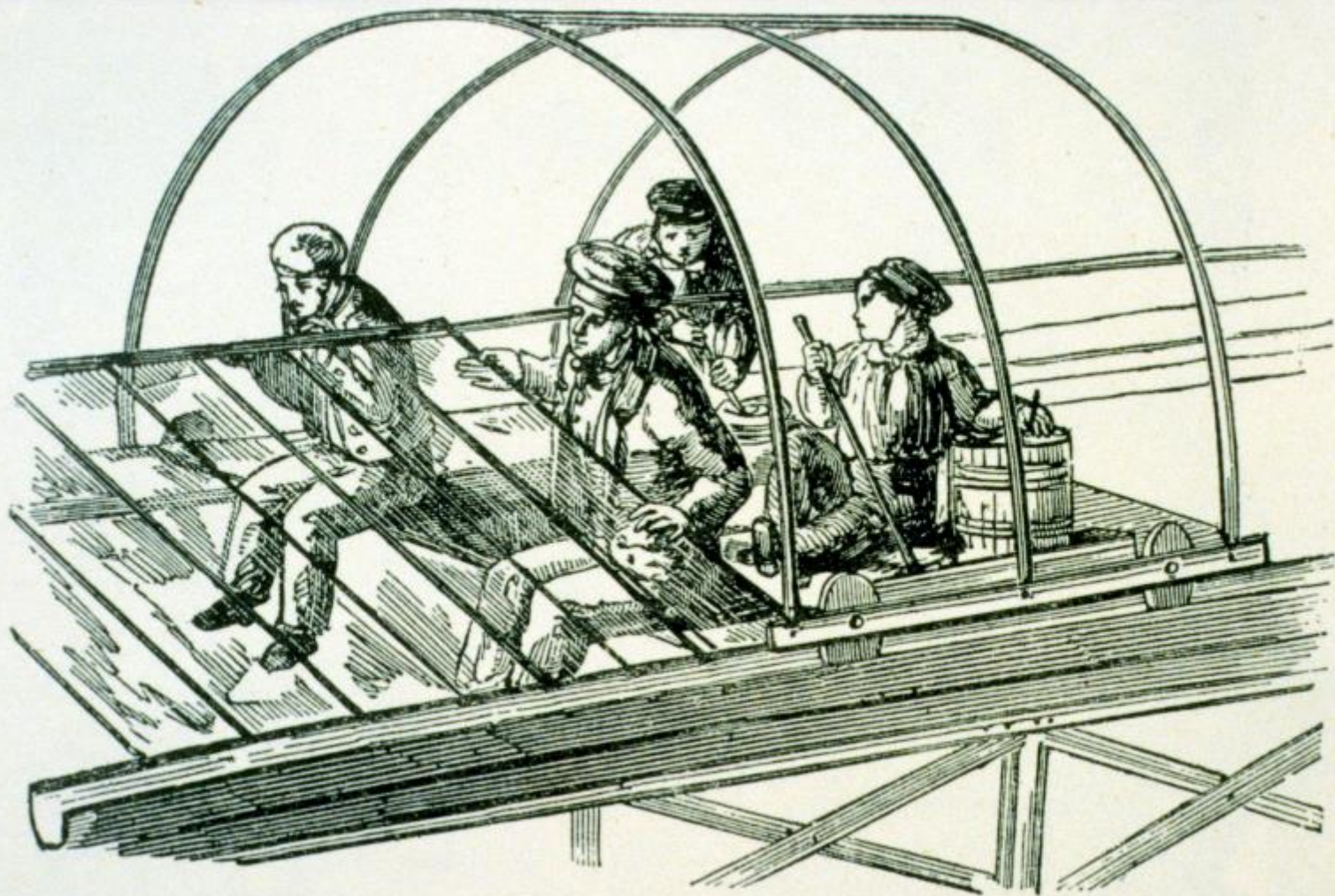




*Head of a Column.*

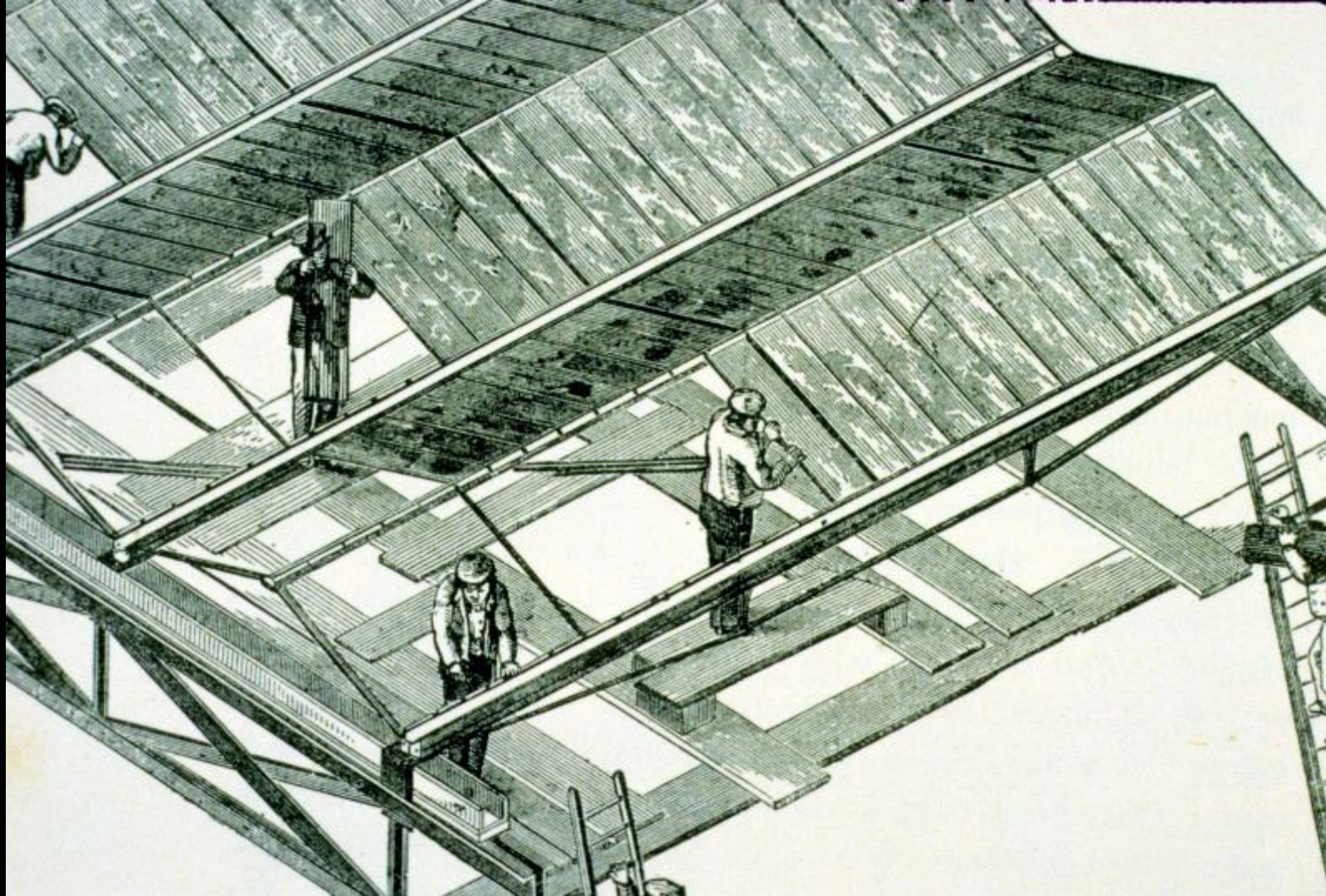




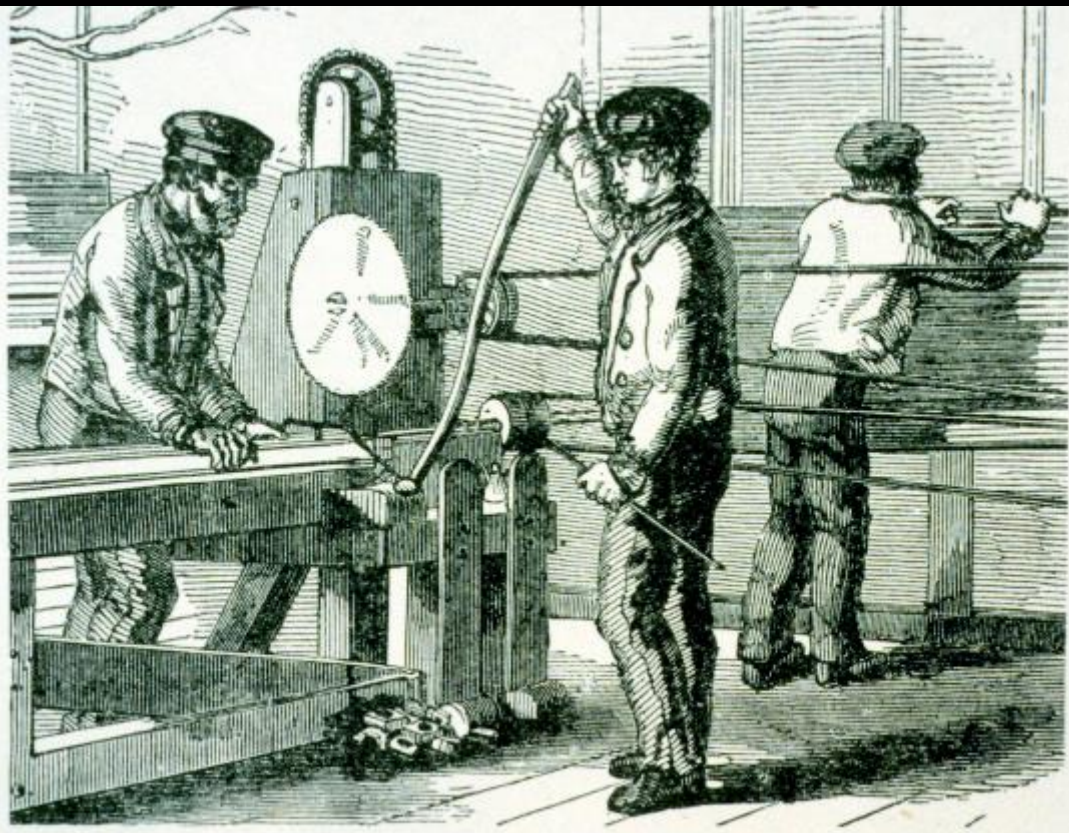


*Glazing Waggon.*









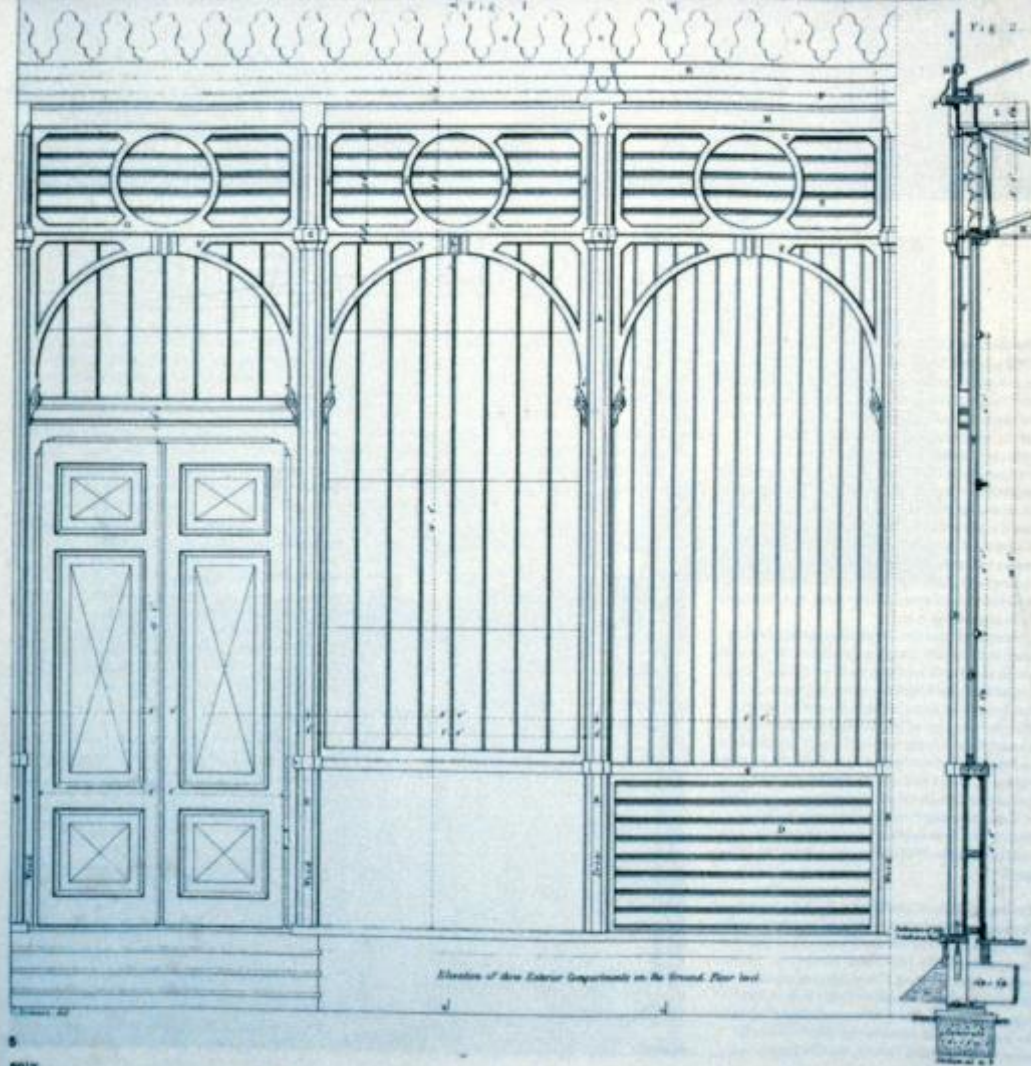
*The Sash-bar Finishing Machine.*



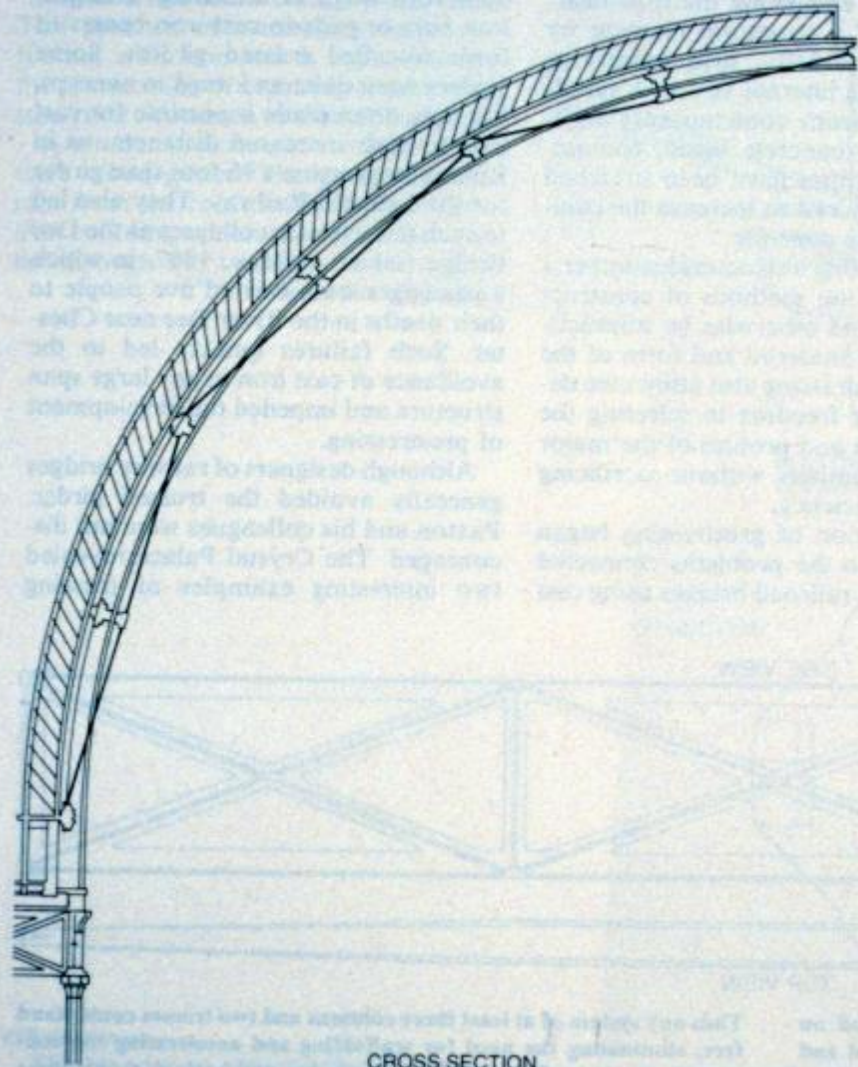
*Punching Machine.*



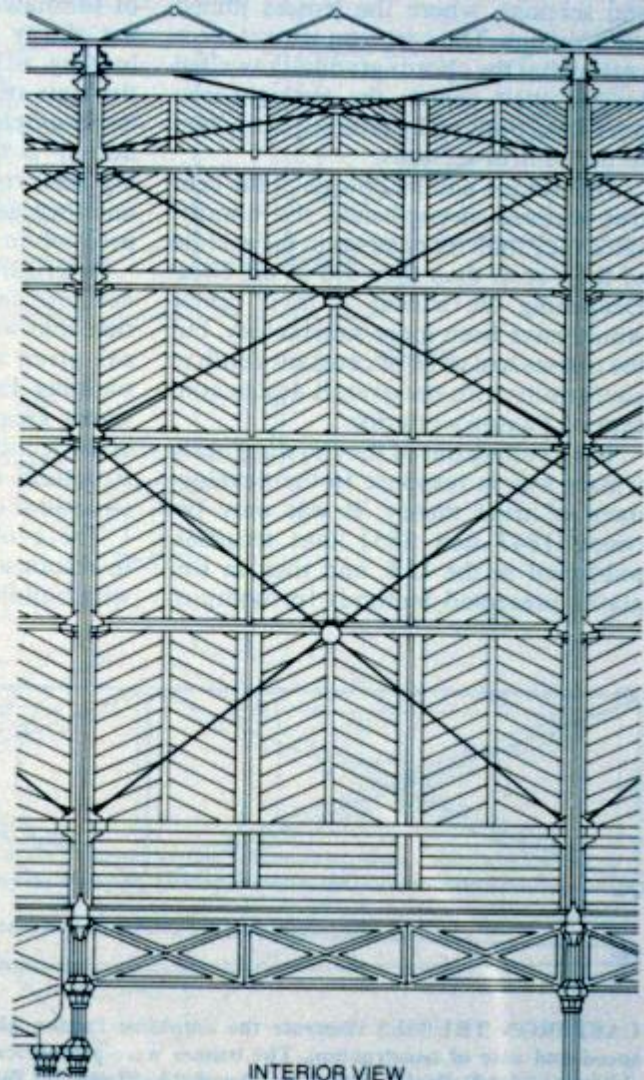






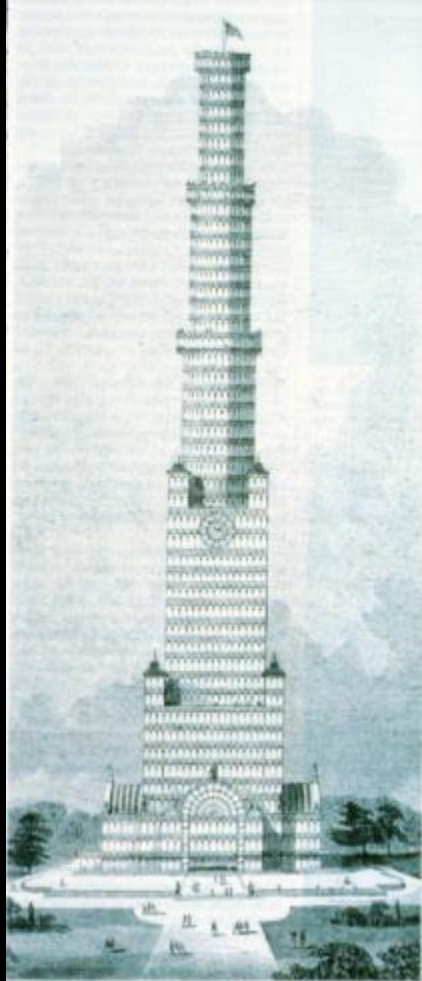


CROSS SECTION



INTERIOR VIEW

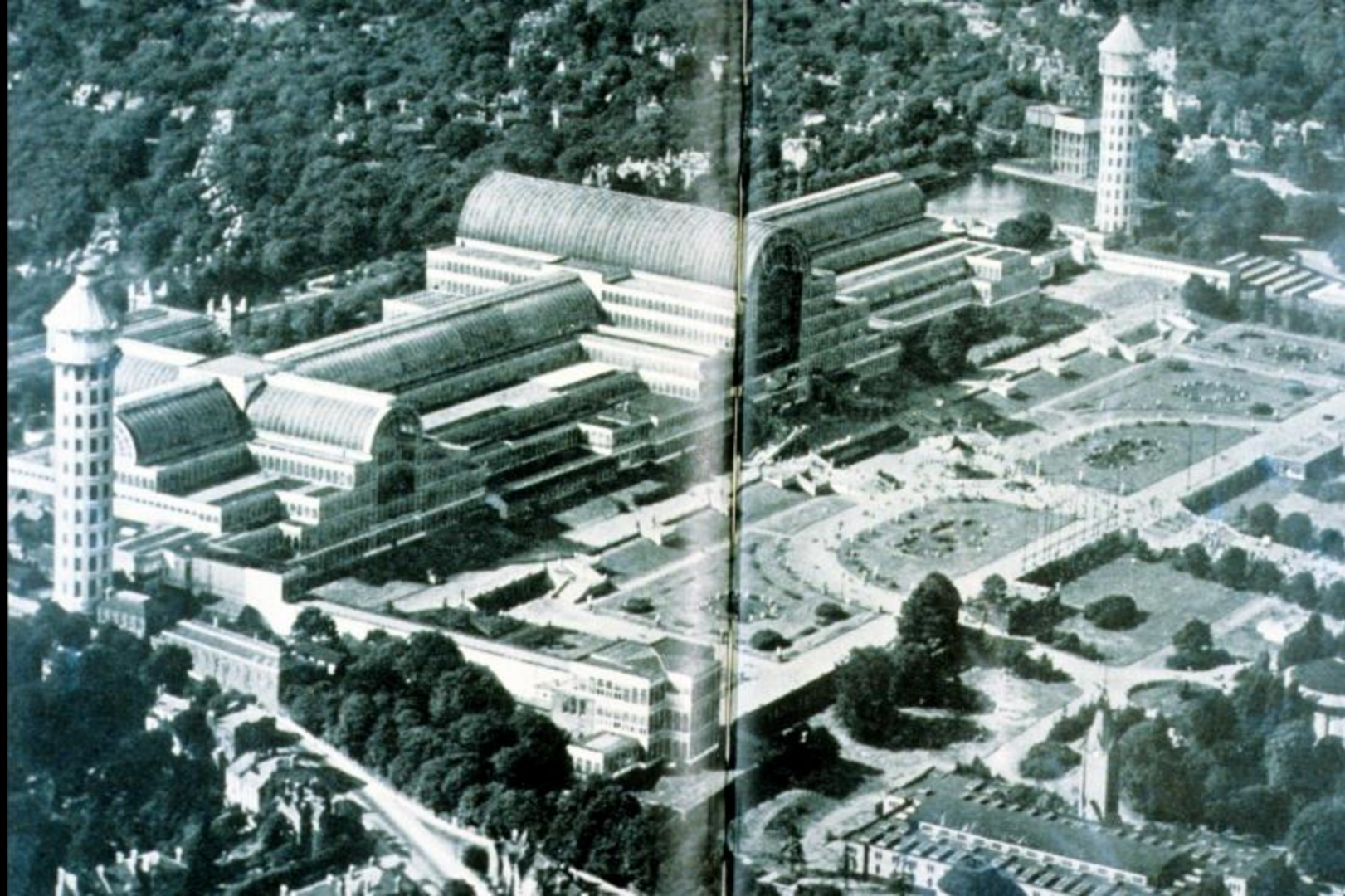




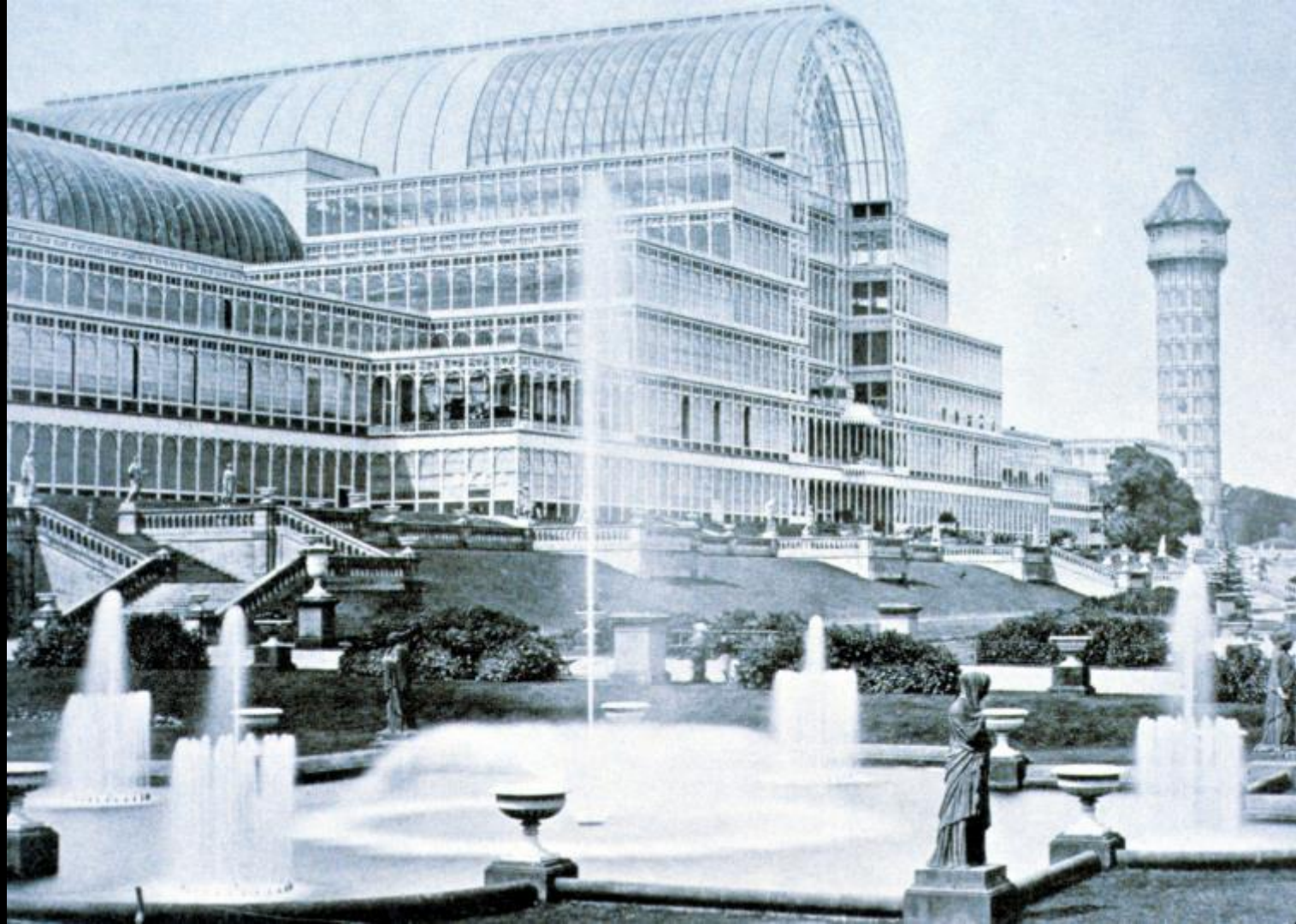
**MODULAR CONSTRUCTION** of the Crystal Palace prompted a contemporary of Paxton's to suggest that the modular units of the building be rearranged to form a 1,000-foot tower (left). A vertical



Crystal Palace would have been too heavy for its cast-iron columns; now steel beams make such buildings possible. At right is Skidmore, Owings & Merrill's Sears Tower, built out of stacked modular units.









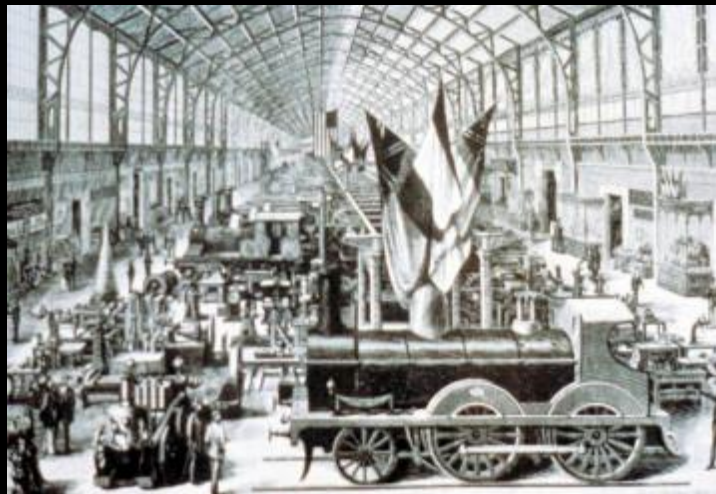




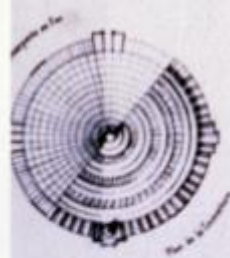








Plan Circulaire



Plan Elliptique

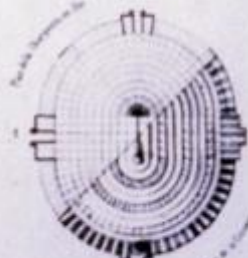


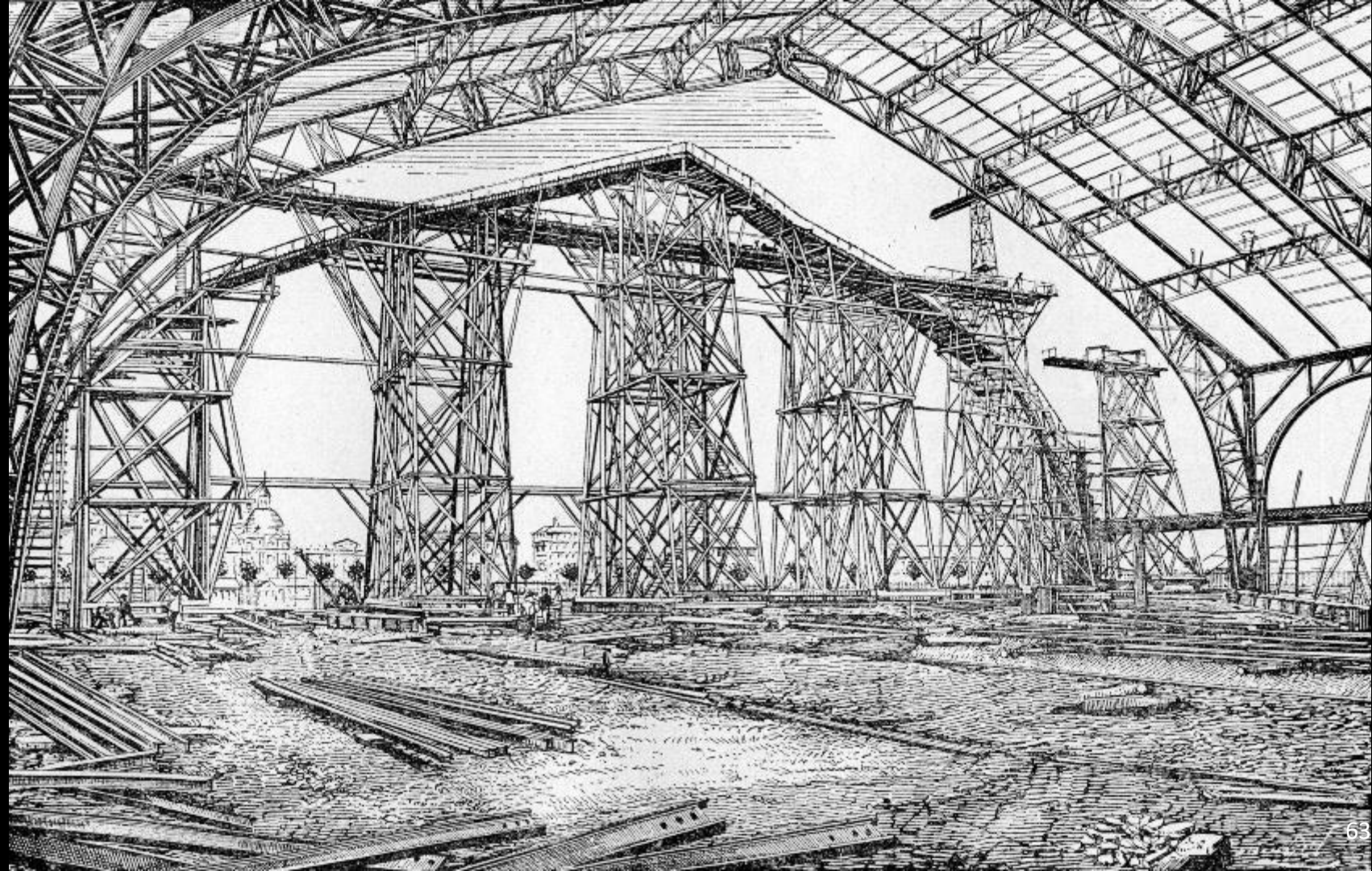
Plate 41. Paul Gricemard. Project for the International Exhibition Building of 1867, published in 1865 (Gricemard, pl. 1)

528. PARIS — Galerie des Machines C. L. C.



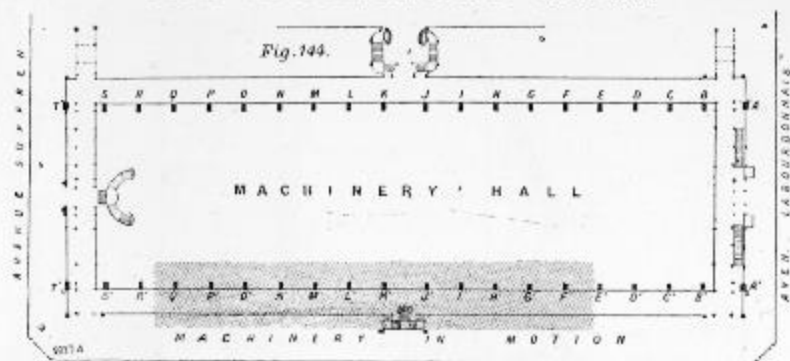
Galerie des Machines  
Exposition Universale  
Paris, France  
Victor Contamin Engineer  
1889







## THE MACHINERY HALL.



PLAN SHOWING POSITION OF PIERS AND STAIRCASES. (See page 453.)

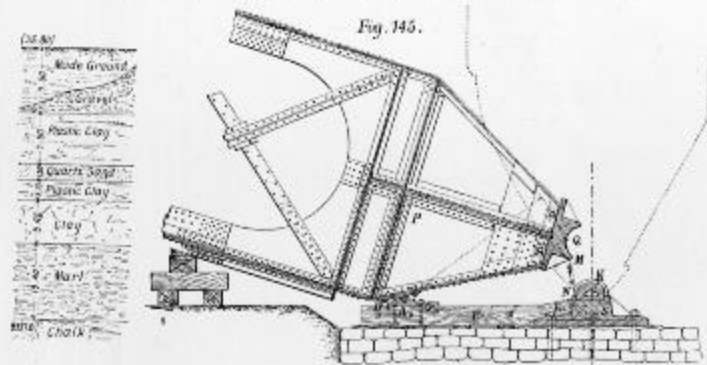
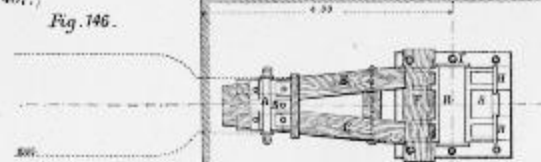
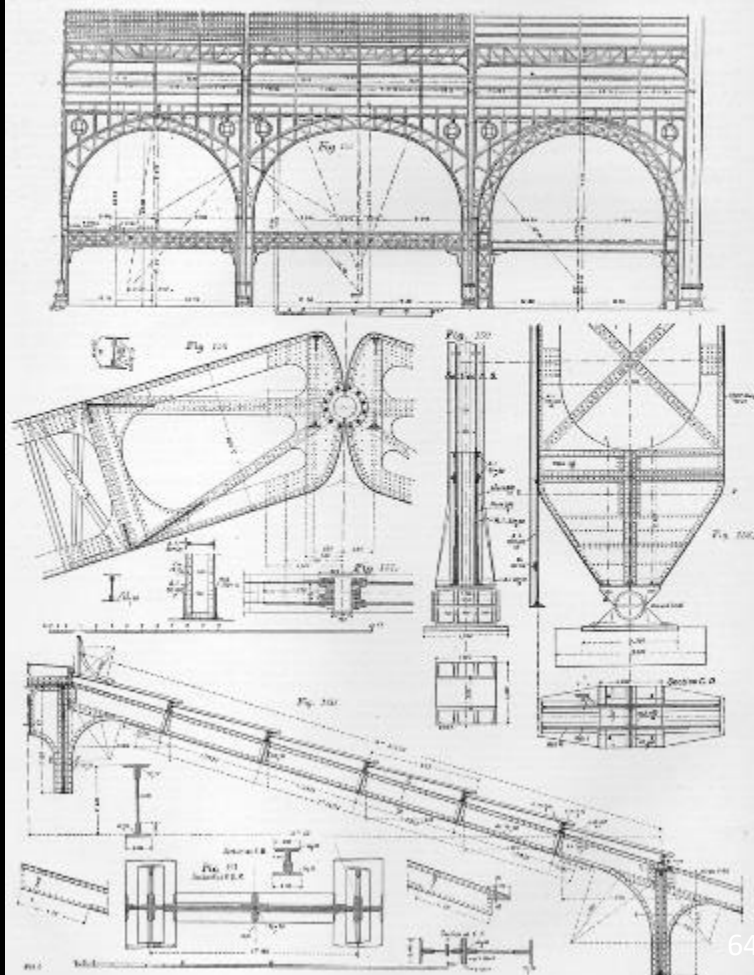


FIG. 147. (See page 457.)



MODE OF ERECTING PRINCIPALS. (See page 458.)

DETAILS OF ROOF OF MACHINERY HALL AND OF SIDE GALLERIES.  
(See Description, on page 452.)





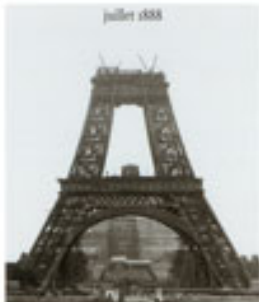
Eiffel Tower  
Great Exposition 1889  
Paris, France  
Gustav Eiffel  
324m



mai 1888



juillet 1888



septembre 1888



mai 1889



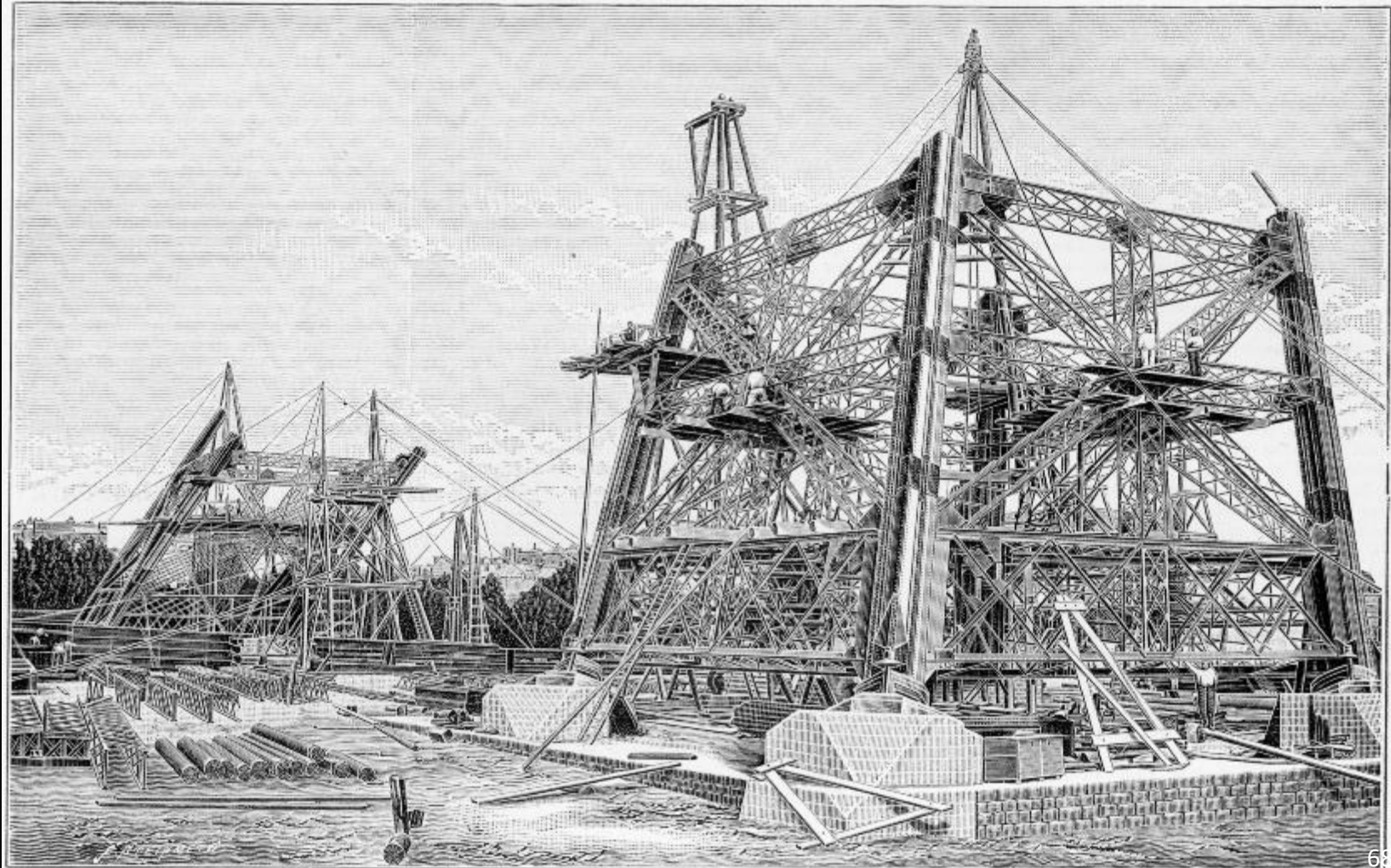
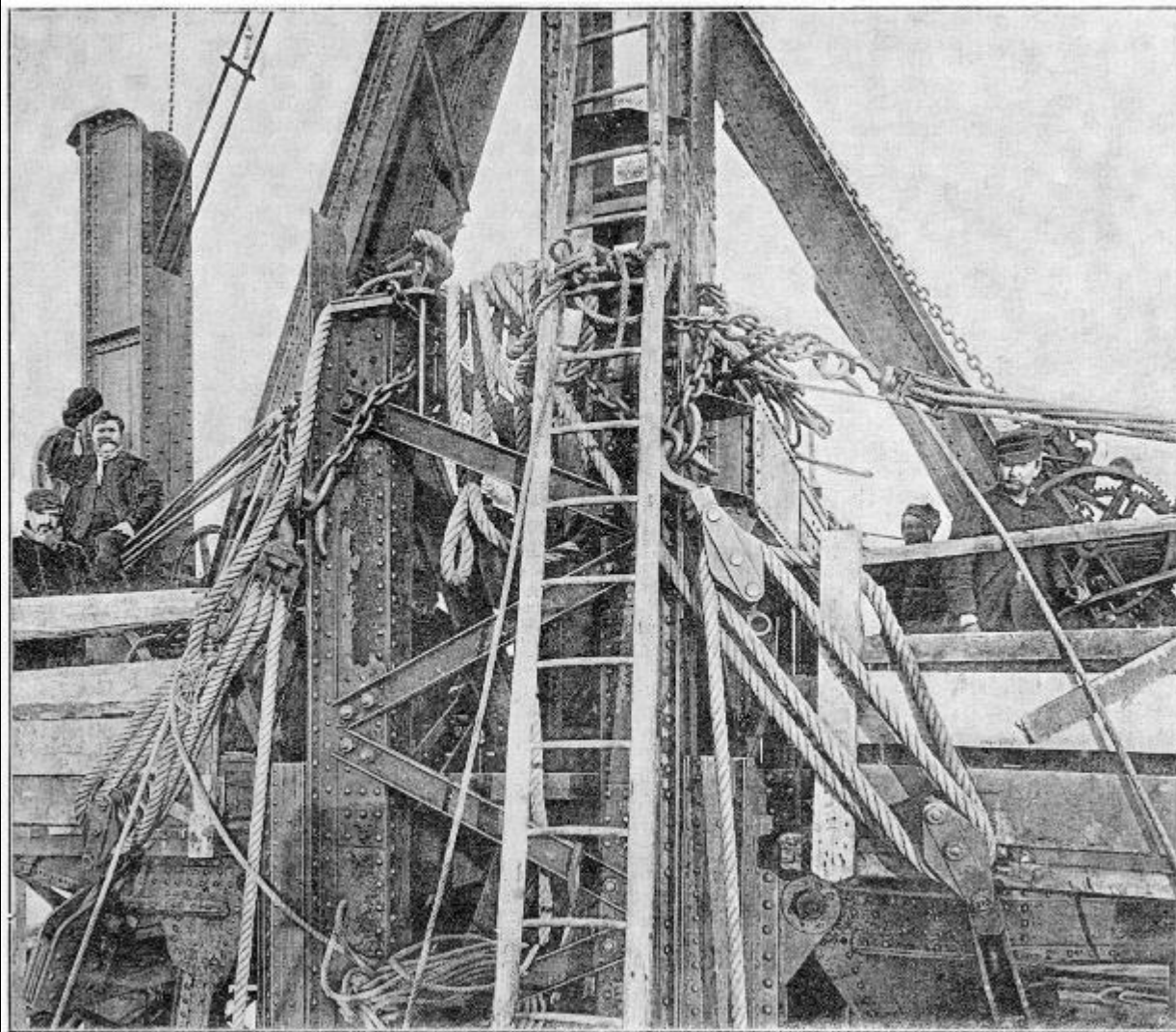


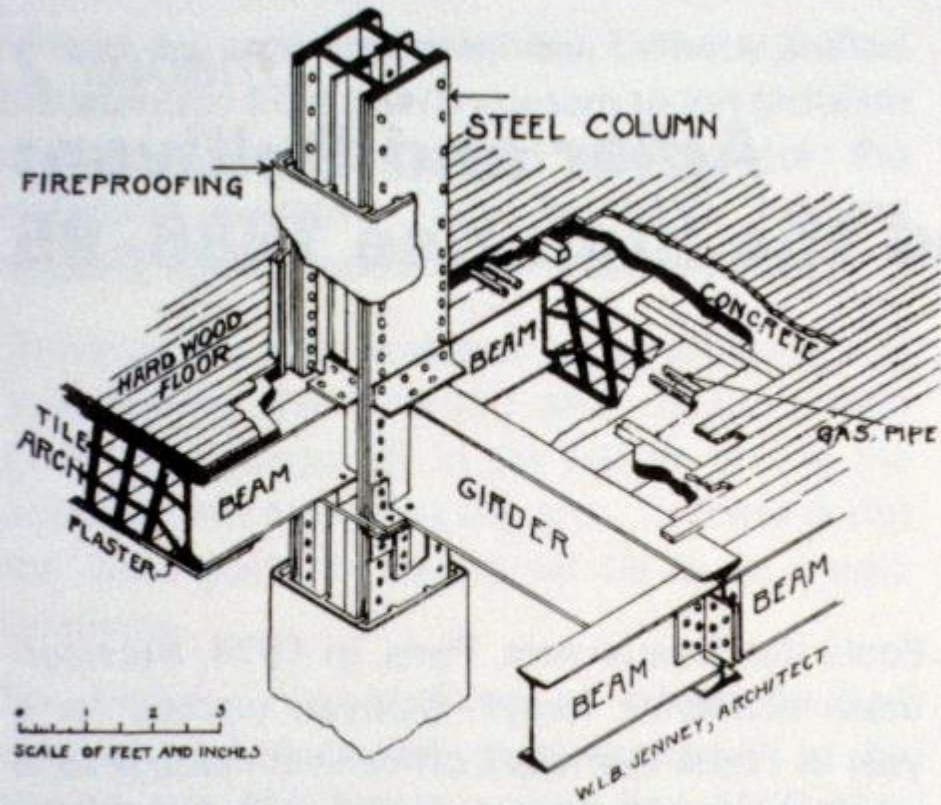
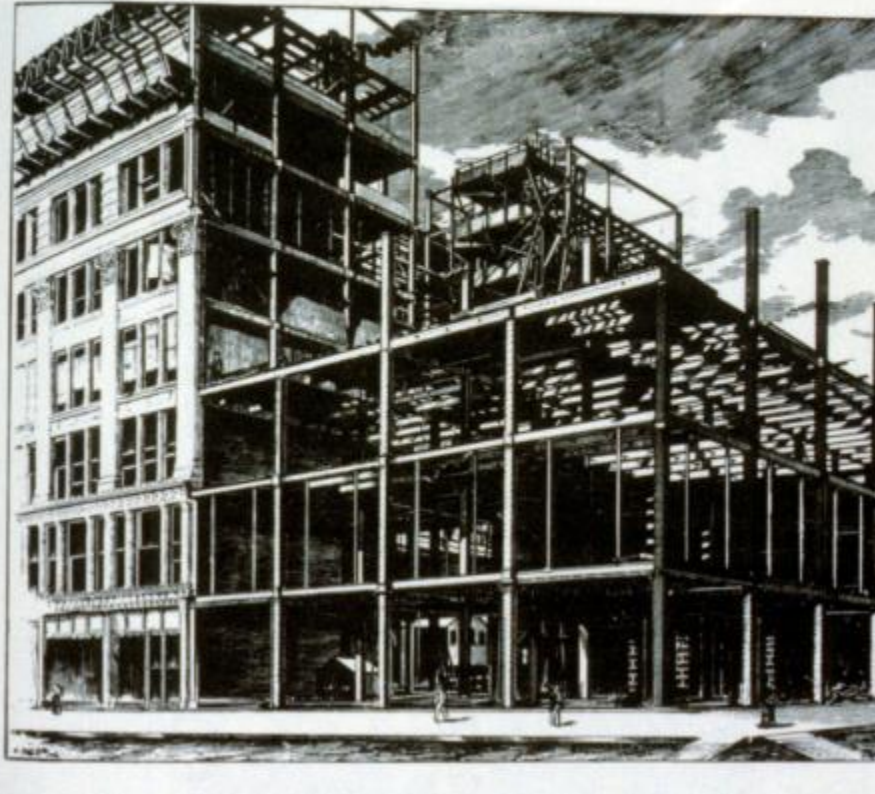
FIG. 37. THE EIFFEL TOWER, COLUMN NO. 4; SEPTEMBER, 1887.







44. Fair (Montgomery Ward) Store, Chicago, Ill., 1890-91. William Le Baron Jenney, architect. Part of the steel and wrought-iron frame during construction.



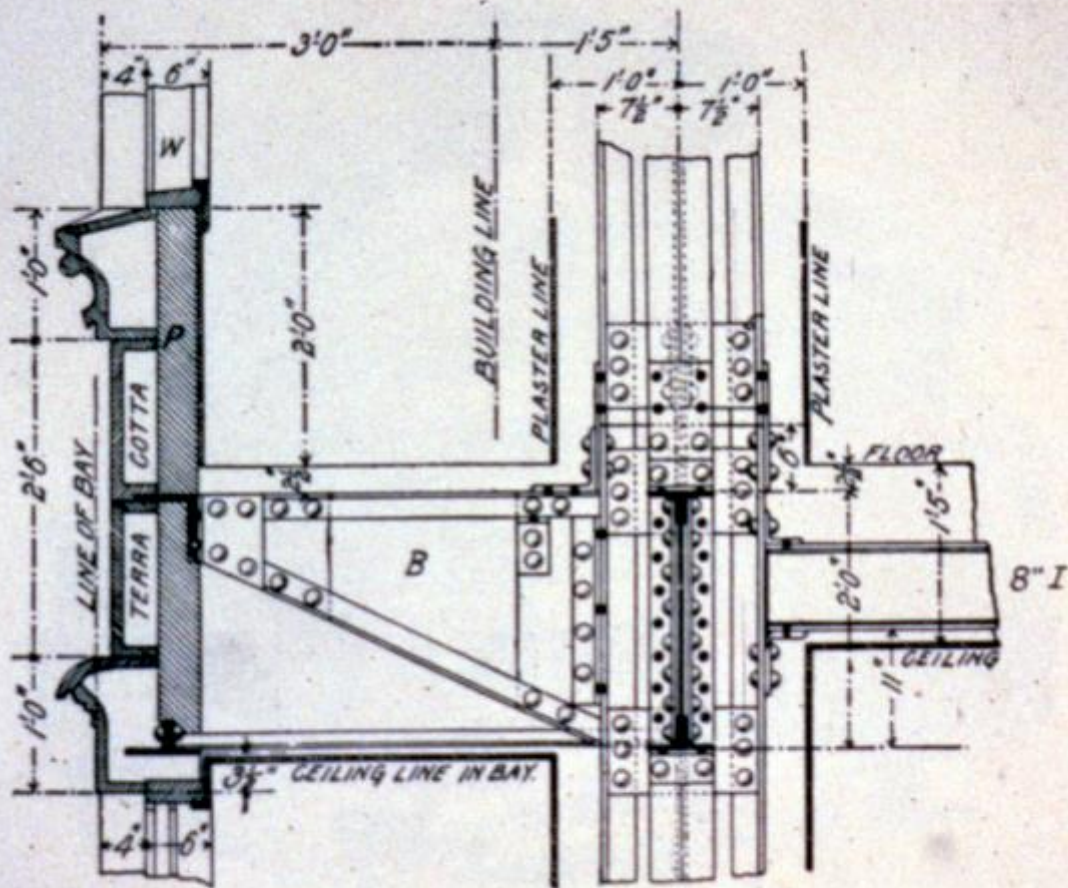
32 Jenney, Fair Store, Chicago, 1890-91. Detail of fireproof steel-frame construction.





Reliance Building  
Chicago, Illinois  
Burnham, Root & Atwood  
1895  
First real curtainwall skyscraper





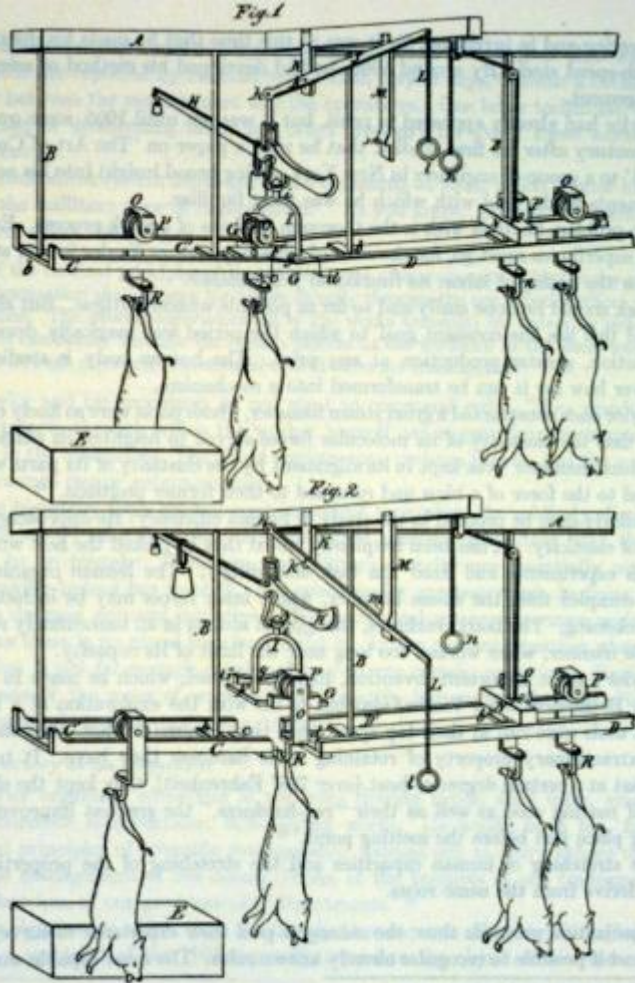
27 Atwood and Burnham, Reliance Building,  
Chicago, 1890/94-95. Cross section of window bay.

MECHANIZATION  
TAKES  
COMMAND

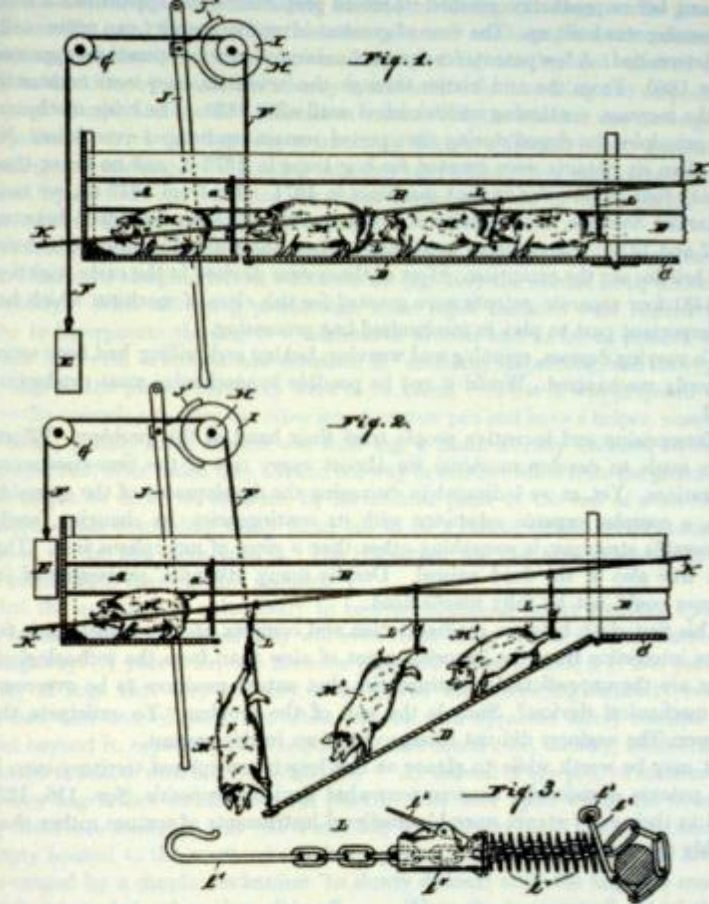
S. GIEDION



The Effects of  
Industrialization



50. Automatic Hog-Weighing Apparatus for Use in Packing Houses. Cincinnati, 1869. This device invented by a Cincinnati shows that the late 1860's had considerable practice in combining the overhead railway with sections of the assembly line. (U. S. Patent 92,083, 29 June 1869)



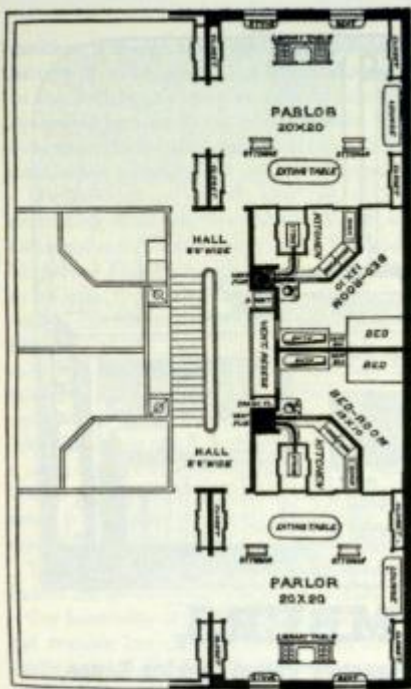
117. Apparatus for Catching and Suspending Hogs, 1882. Here the living animal must be introduced into the 'disassembly' line. From the 1870's on when stunning was found too slow, devices were proposed to hoist the hog to the overhead rail without struggle: 'The hog M acts as a decoy for the others, and much time and labor are thus saved. The brake is manipulated to allow the trap D to slowly descend until the hogs are completely suspended, when they slide off on the bar K to the place where they are to be killed.' (U. S. Patent 225,712, 10 January 1882)



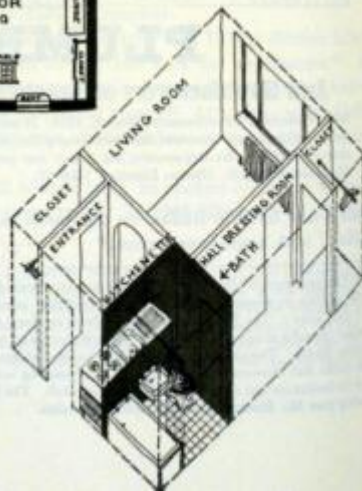
# Residential Initiatives



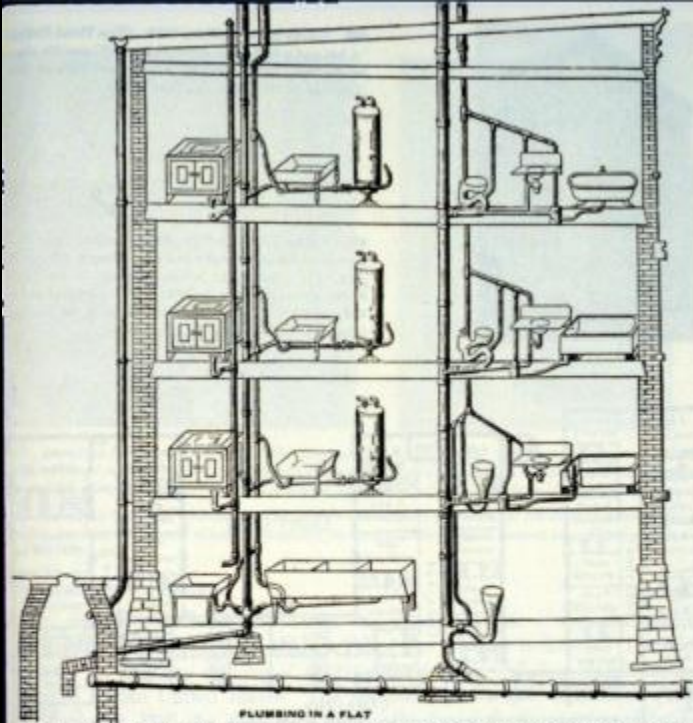
Prince Albert's Model Houses.



489. CATHERINE BEECHER. Plan of a City Flat, with Built-in Bedroom, Kitchenette, and Bath, 1869. Just as Catherine Beecher's kitchen anticipates the present-day kitchen in its arrangement (fig. 338), her layout of a city flat realizes, in primitive form, the unit of bathroom, bedroom, and enclosed kitchenette. (The American Woman's Home, 1869)



490. One-Room Apartment with Kitchenette and Bath Back to Back, 1930's. Left of the entrance, a closet; to its right, an open kitchenette, which a wall separates from the bathroom. This wall carries the fixtures for both. (850 Seventh Avenue, New York. Sketch by Florence Schust)



491. Chicago Apartment-House Plumbing, 1891. The Chicago apartment houses of the 'nineties, which incorporated the most advanced standards, already show the fixtures aligned along one wall, but not in the most compact way. The bathtub is still set against the long wall. Later it will be turned 90°, as will the toilet. (Industrial Chicago, 1891)

Like Pullman's sleeping car *The Pioneer* (1865), this marked an important step toward the democratization of comfort, when a middle-class hotel was built around a standard living unit of bedroom, bath, and closet. In Europe, even today, the combination of a room with private bath borders on luxury. Putting into practice the maxim 'a bath to every bedroom' immediately influenced the whole plan (figs. 492-4), and was as decisive for the hotel as the organization of the bath and kitchen for the plan of the private house. At once the standard American layout had appeared: The bath is a cell and an appendage to the bedroom.



# Le Corbusier's 5 points of Architecture

## 2. Free Facade

non-supporting walls that could be designed as the architect wished

## 4. Roof Terrace

compensate for the green area consumed by the building and replace it on the roof

## 3. Ribbon Window

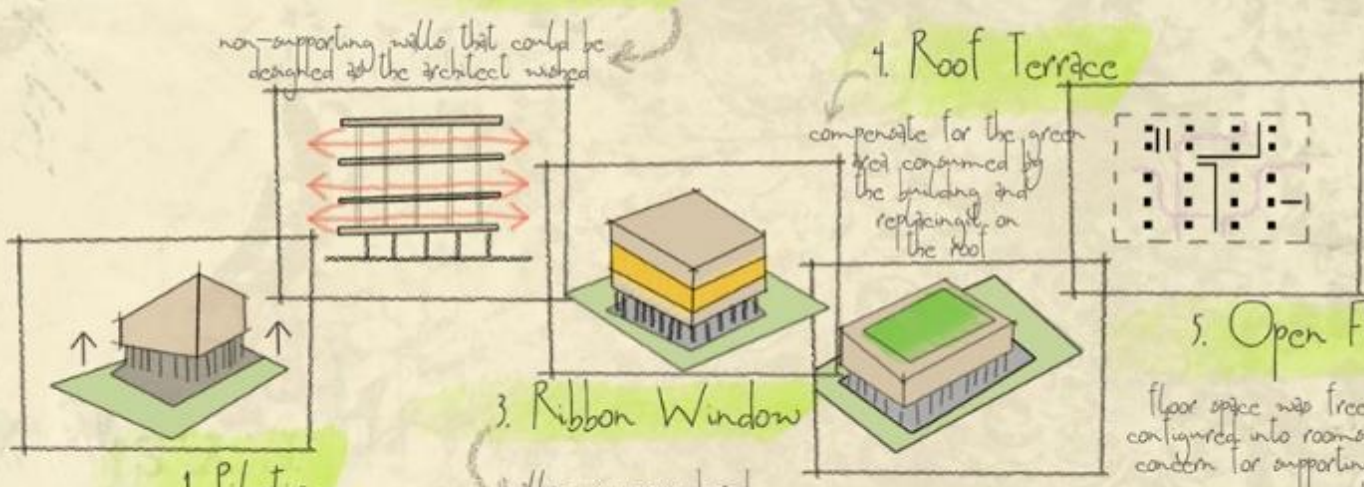
allow unobstructed views of the large surrounding

## 5. Open Floor Plan

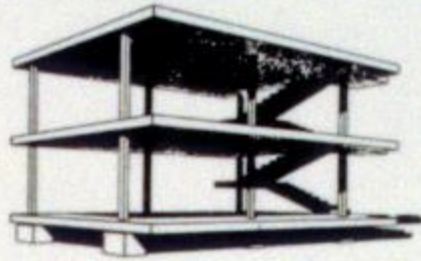
floor space was free to be configured into rooms without concern for supporting walls.

## 1. Pilotis

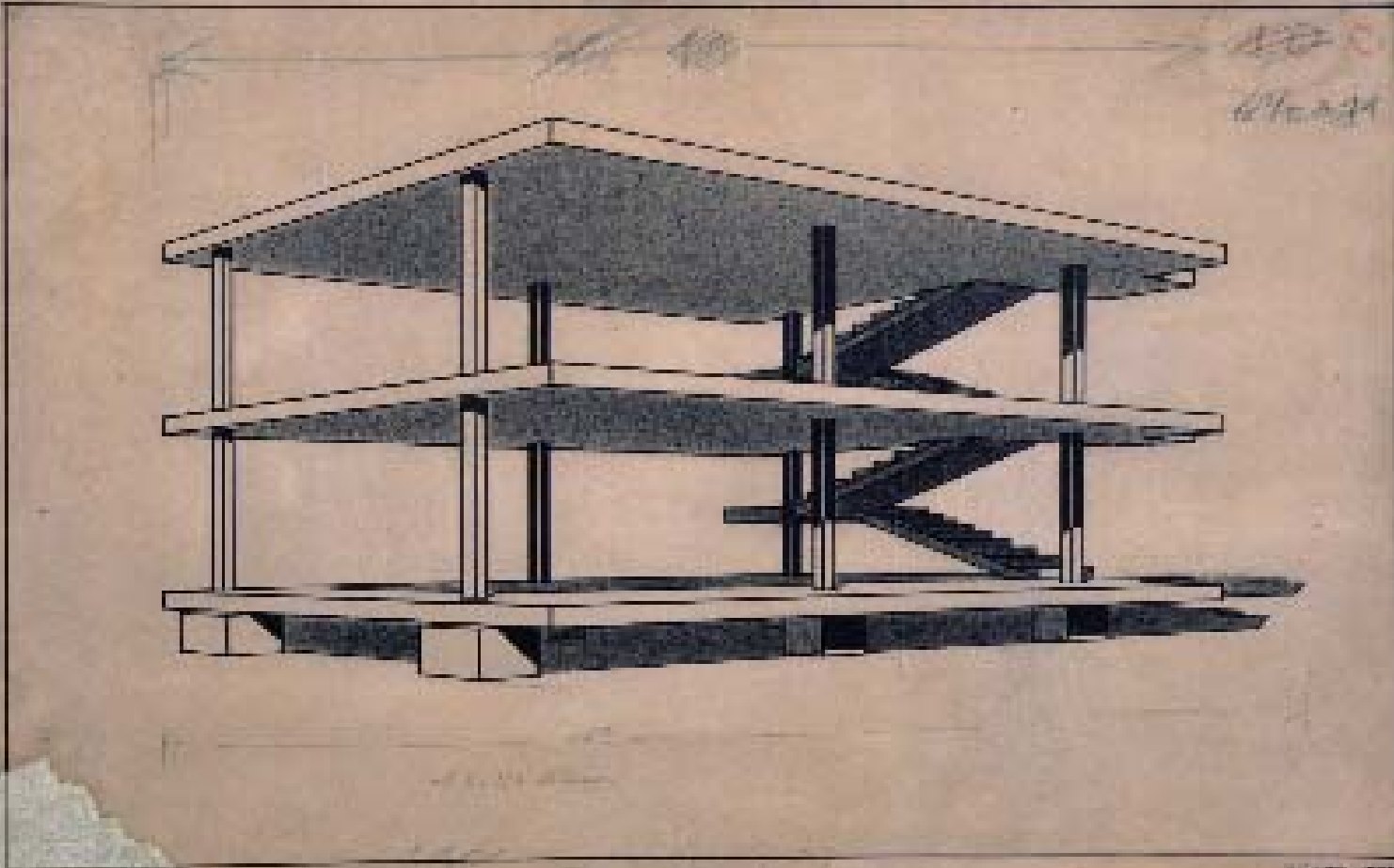
provides structural support



Le Corbusier  
Swiss/French Architect  
1887 to 1965



“In the next twenty years, big industry will have co-ordinated its standardized materials . . . technical achievements will have carried . . . methods of rational construction far beyond anything we are acquainted with.”  
—Le Corbusier, 1914

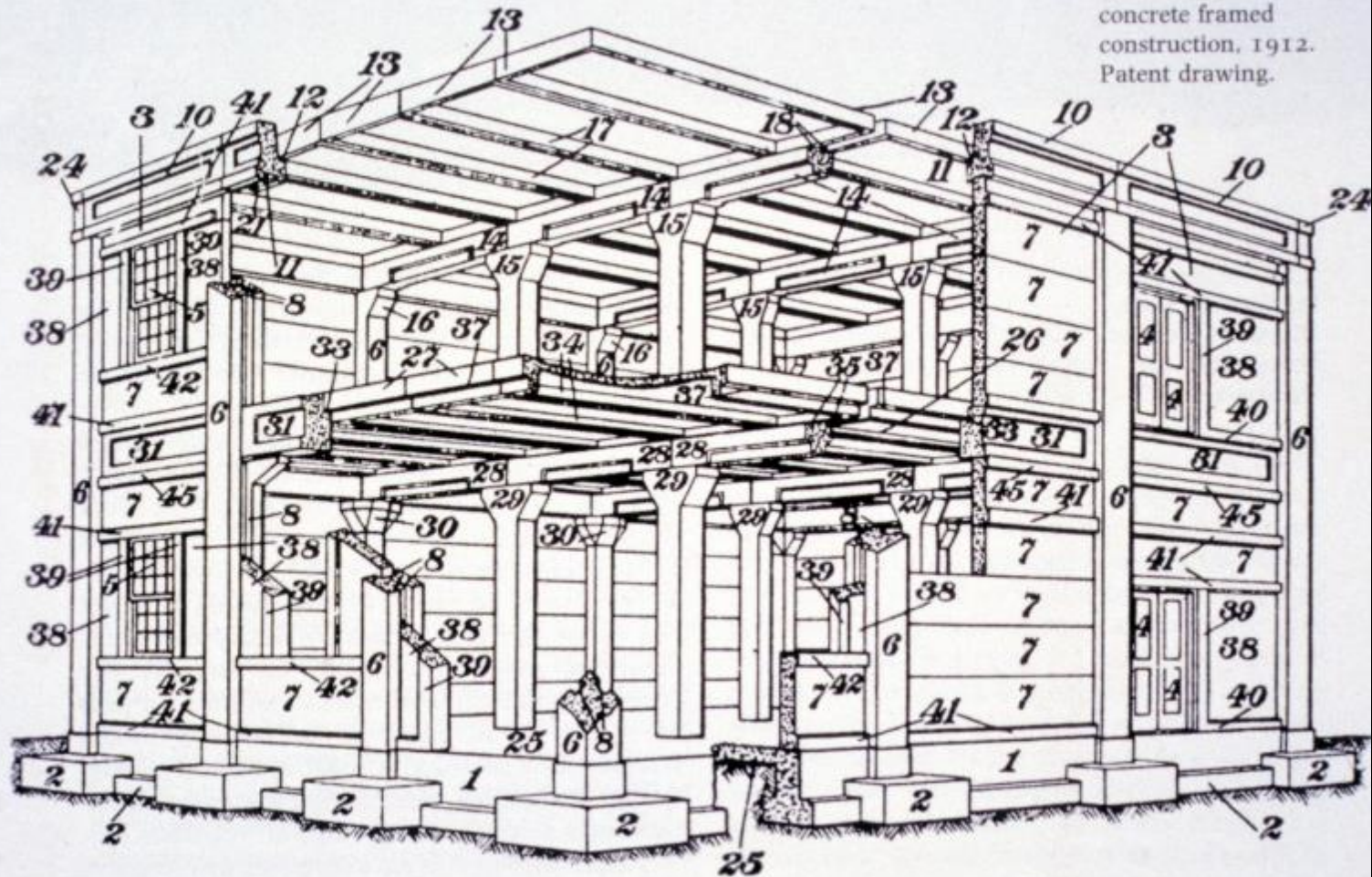


(C) FLC

10209



4.10 Conzelman  
system of precast-  
concrete framed  
construction, 1912.  
Patent drawing.

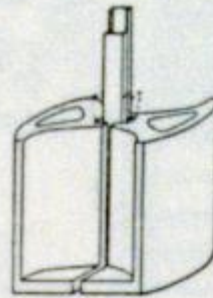
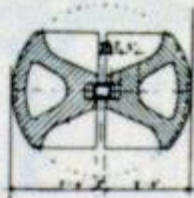
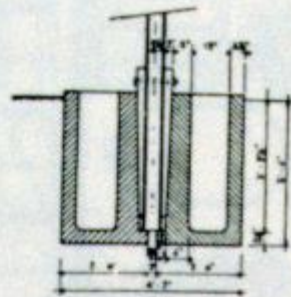
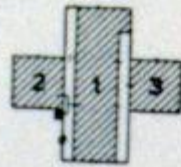
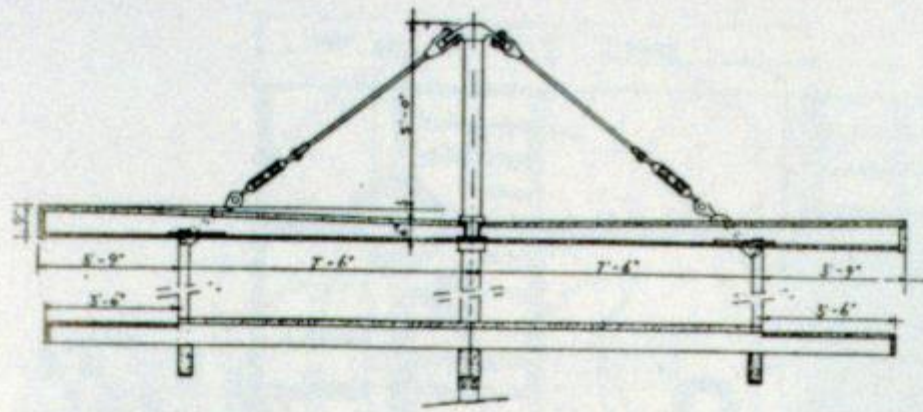


# The Birth of Modular Design

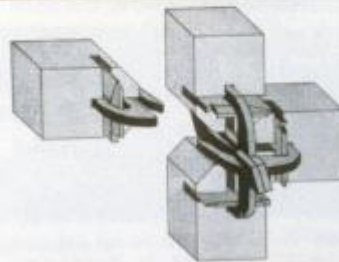
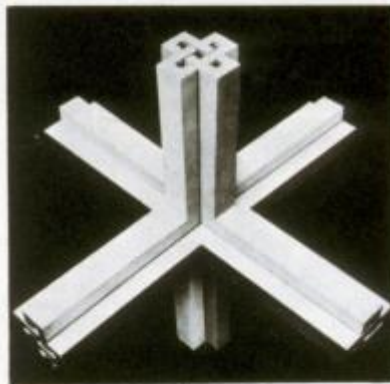
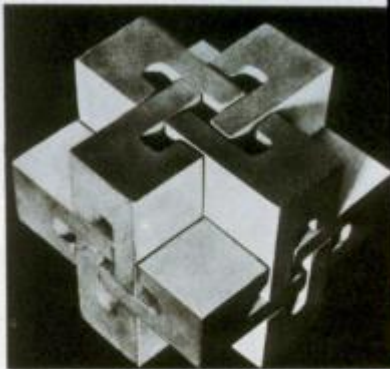


Architects were very jealous of Henry Ford who could make something as complicated as the Model T car, on an assembly line, and make a big profit. Why couldn't architecture do that?<sup>84</sup>





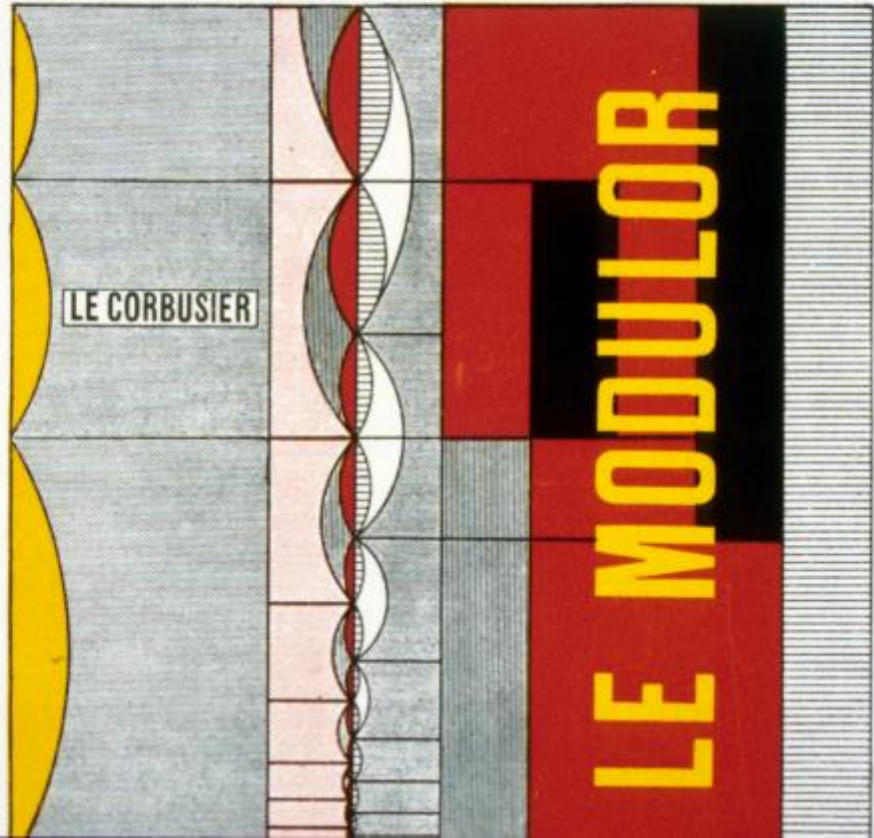
155 Neutra, One-Plus-Two prefabricated extendable family house, 1926.  
 Details of structural support and assembly pattern.



819-822 Details of the packaged house system worked on by Gropius and Wachsmann in 1942 for the General Panel Corp. (from K.W. The Turning-point of Building)

# THE MODULOR

**Le Corbusier**







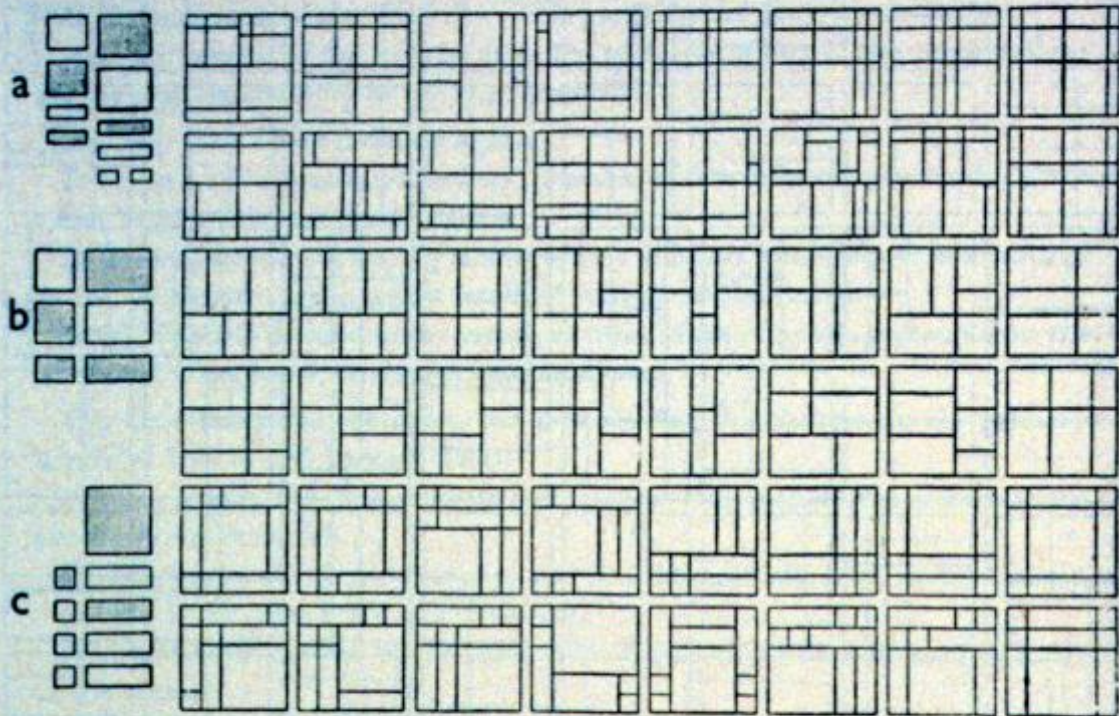
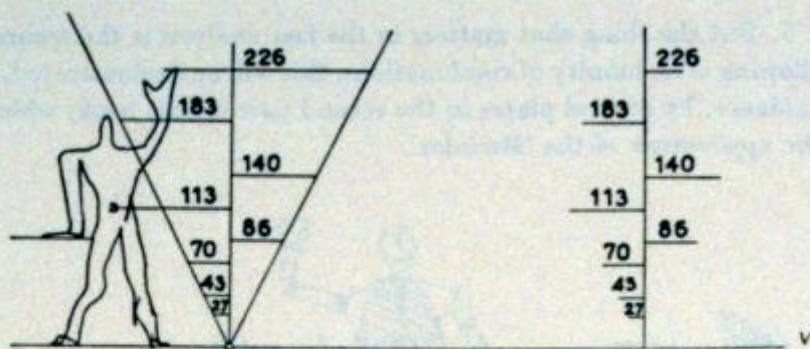


FIG. 40

FIG. 25



They may be drawn as follows:

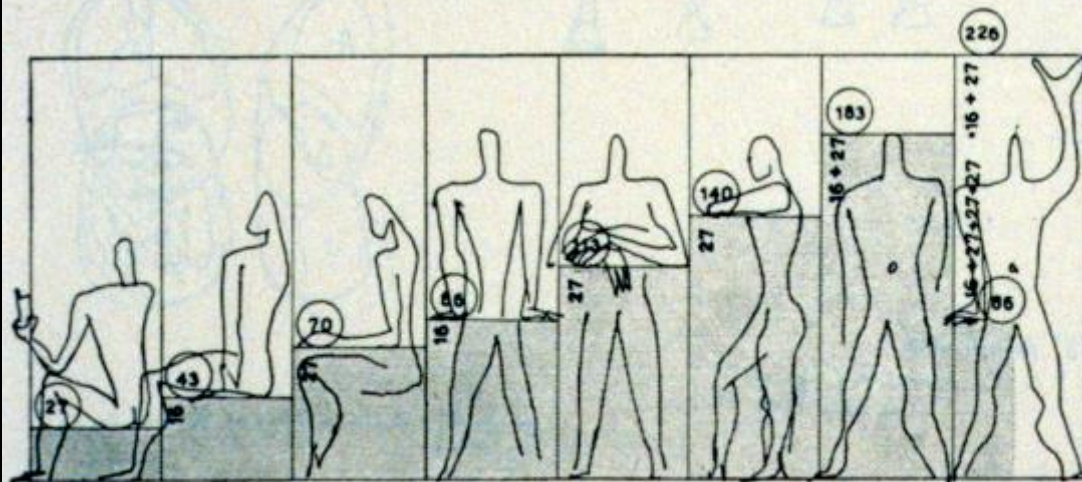
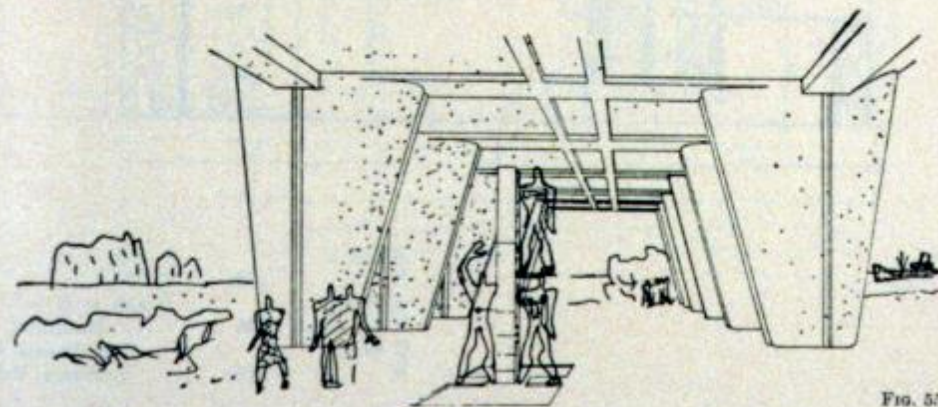
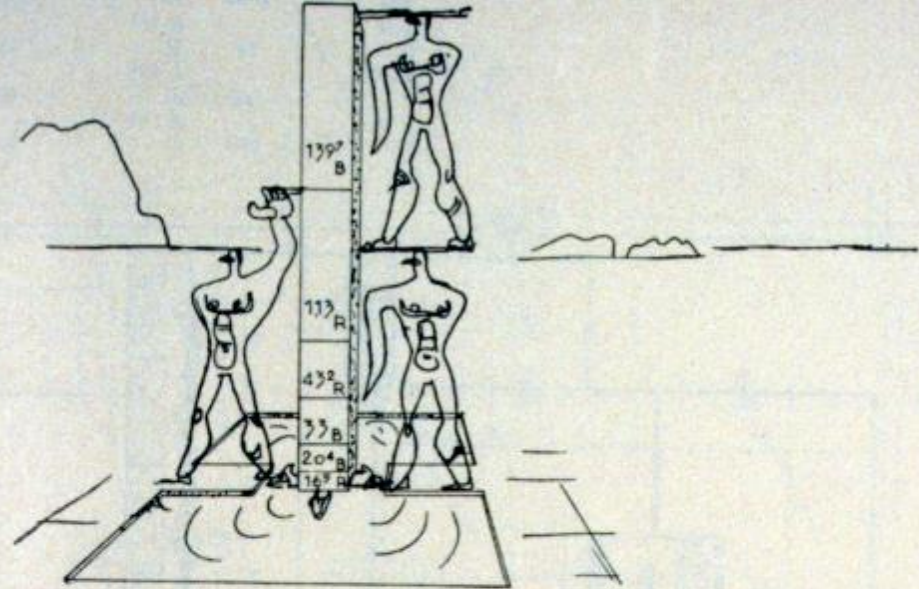



FIG. 26





143

FIG. 55

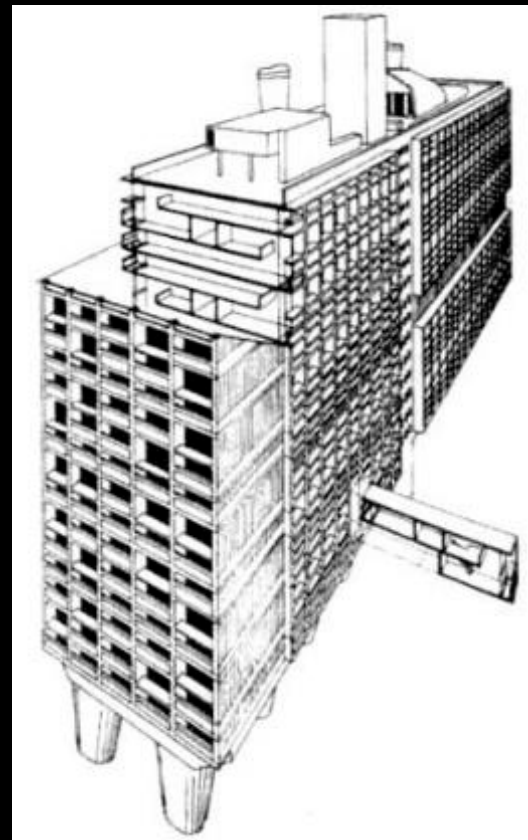
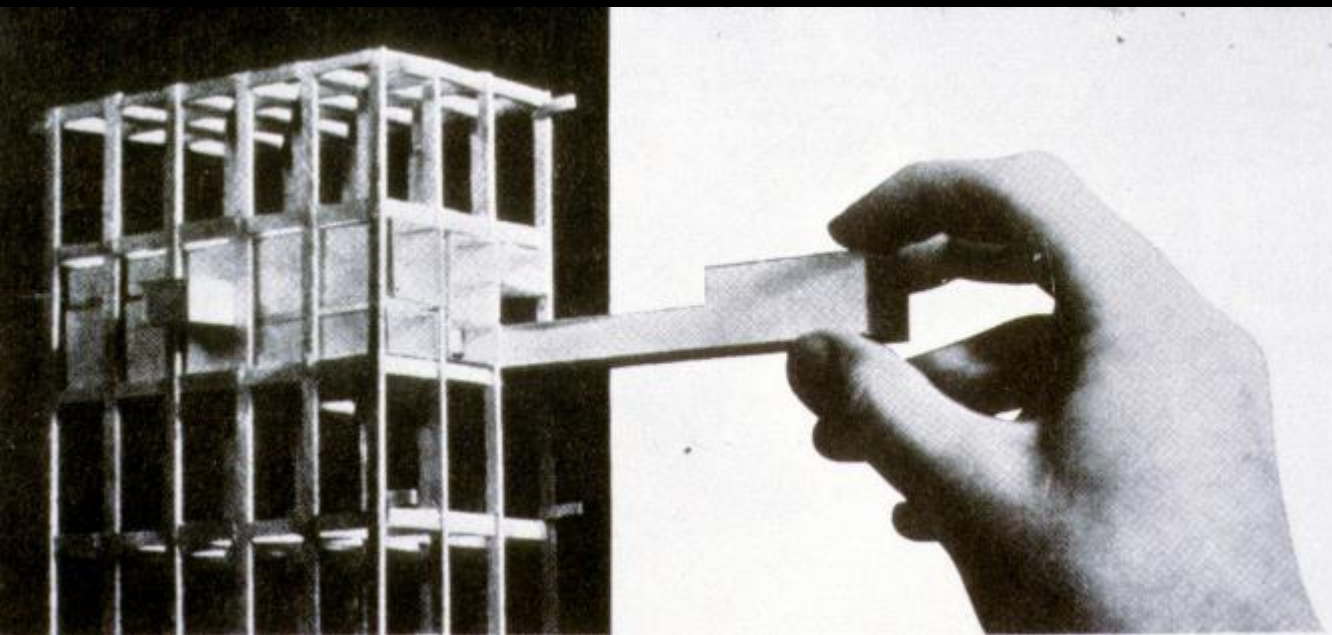


Unité d'habitation  
Marseille, France  
1947 to 1952  
Le Corbusier









Series	
Red	Blue
A	65 <sup>s</sup>
B	165 <sup>s</sup>
C	20 <sup>s</sup>
D	33
E	43
F	53
G	70
H	86
I	113
J	226
K	296
L	336
M	419 = L + F

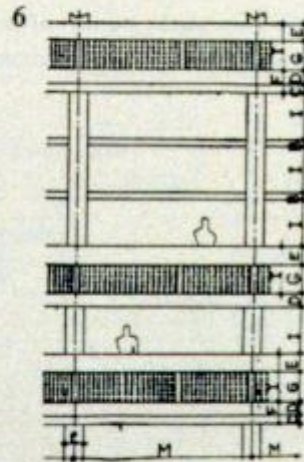
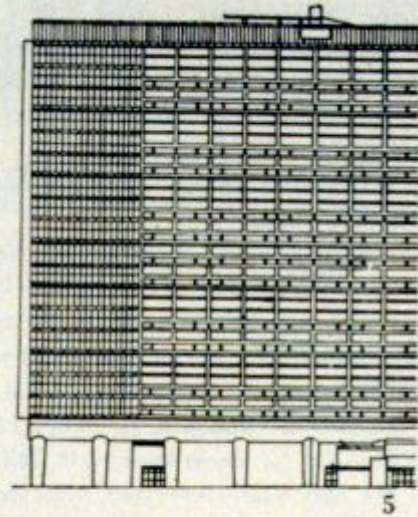
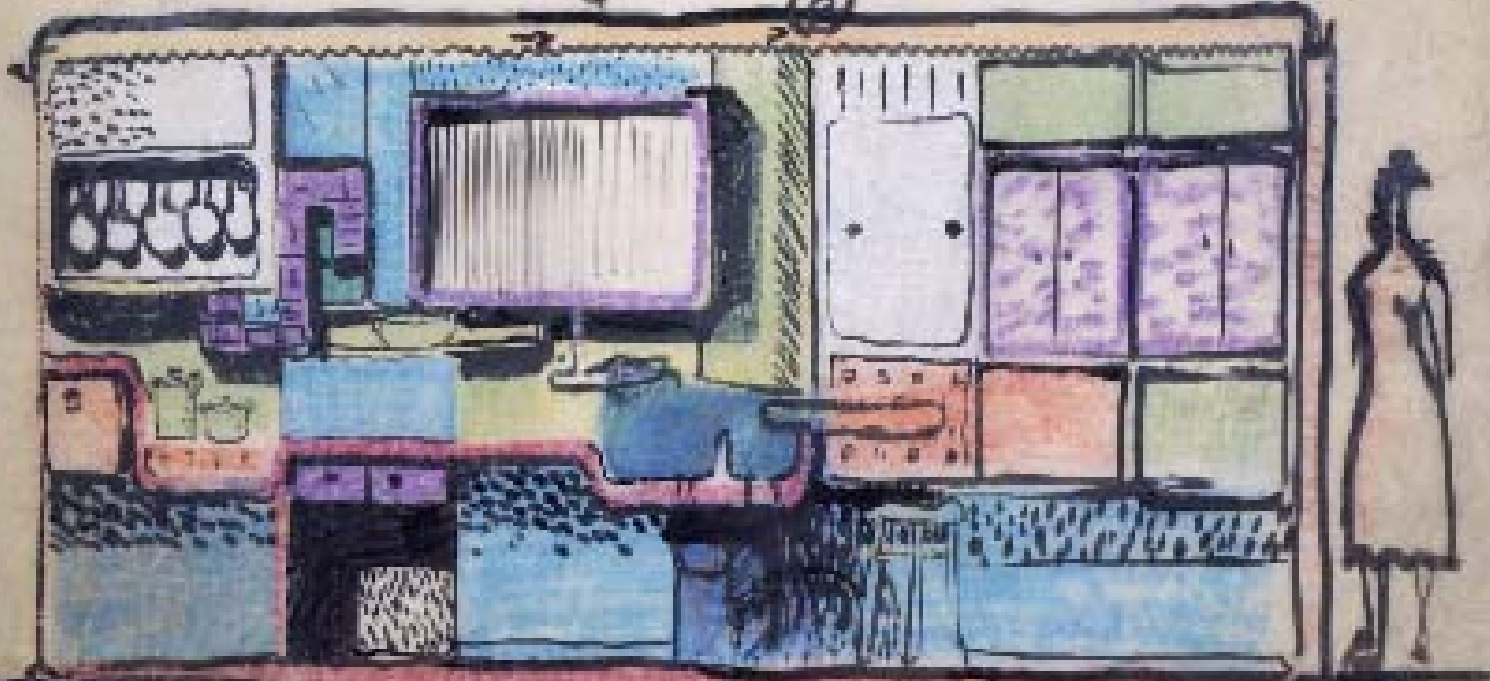


FIG. 50

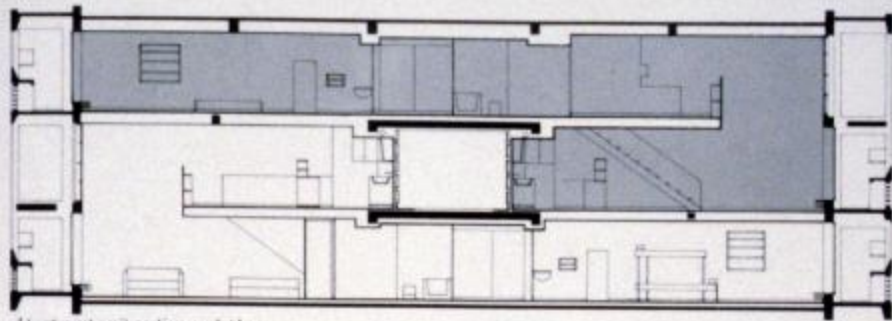
# Development. Cuisine

2      3      5      1      6

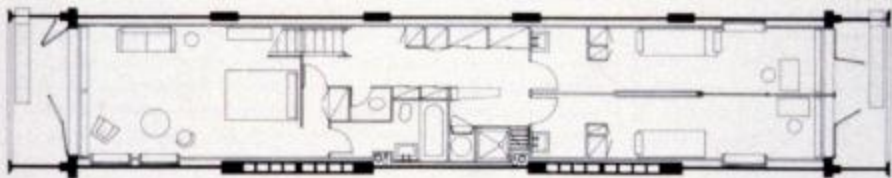
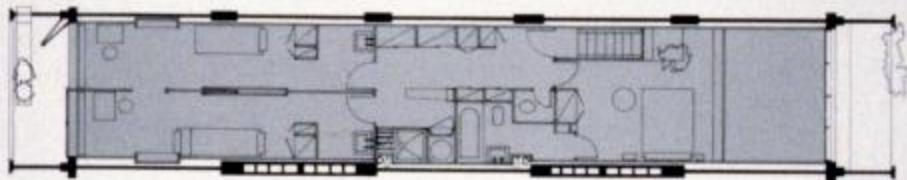


\* LA CUISINE (table casseroles - empilables) (table de cuisson) Placards et rangement (Table de préparation - Réfrigérateur - Freezer) Placards 6 porte \*

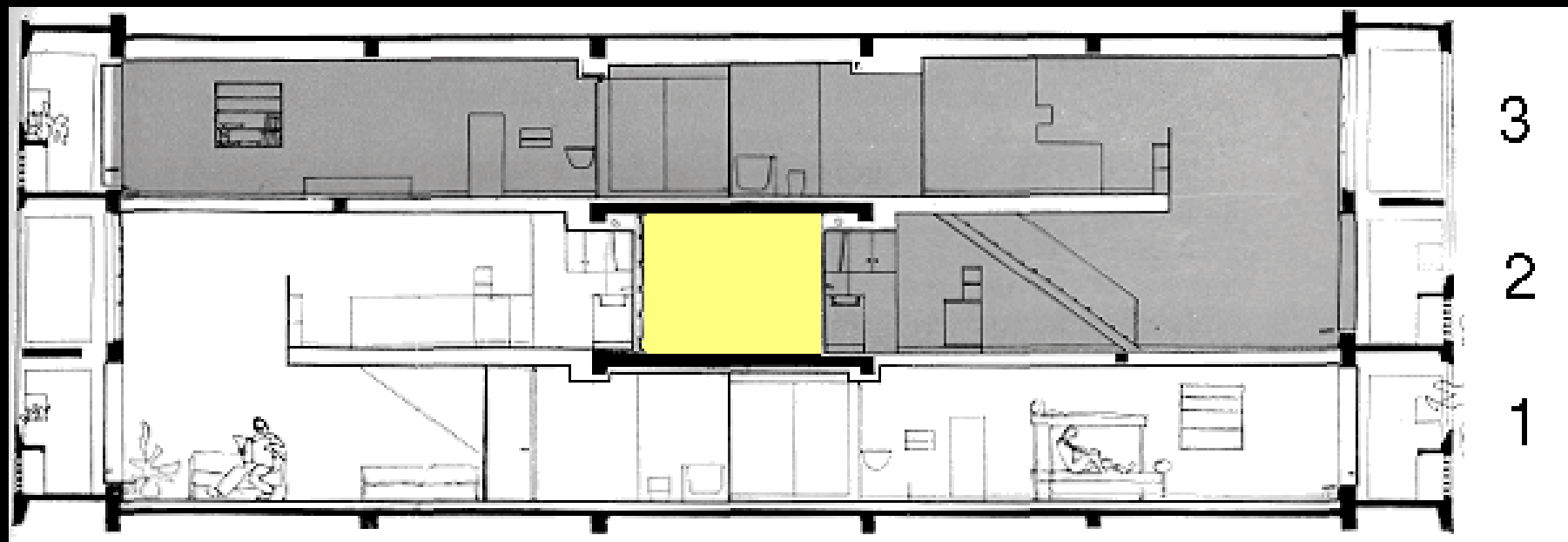


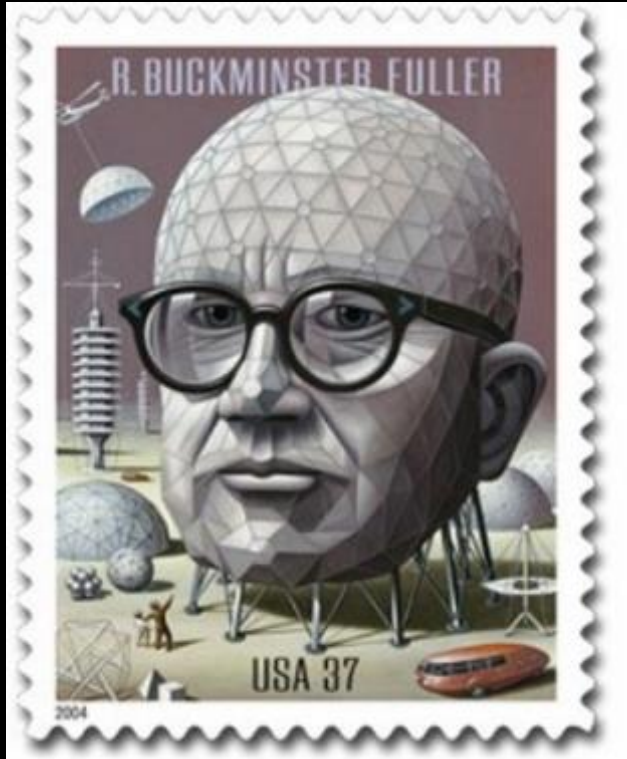


*Apartment unit section and plans.*



*L'Unité d'habitation in Berlin*

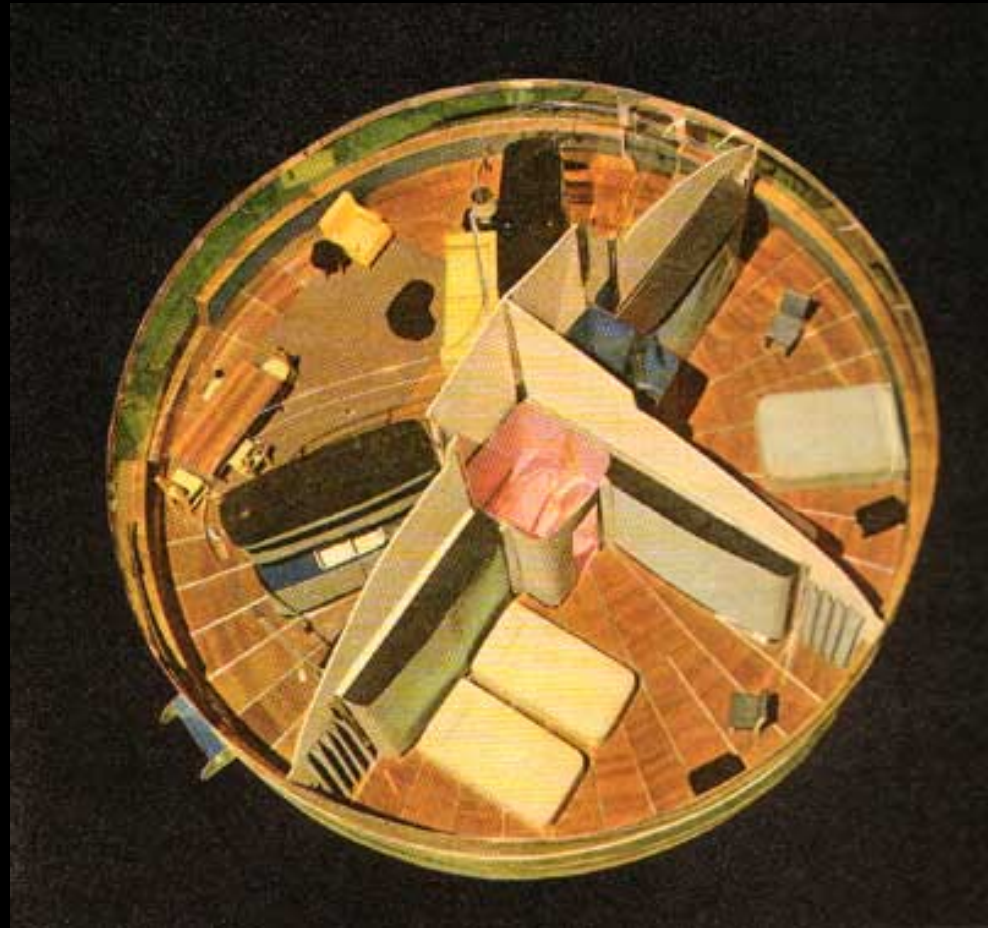
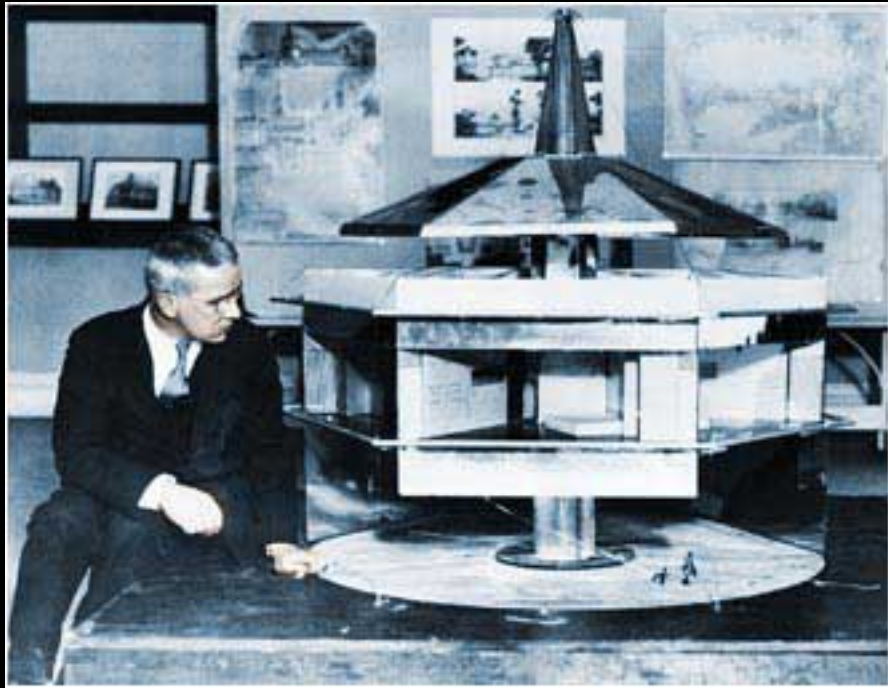




Buckminster Fuller  
American Architect  
1895 to 1983

Buckminster Fuller's dymaxion principles  
signified "dynamism plus efficiency"















236 Fuller, prefabricated bathroom, patented 1938-40.

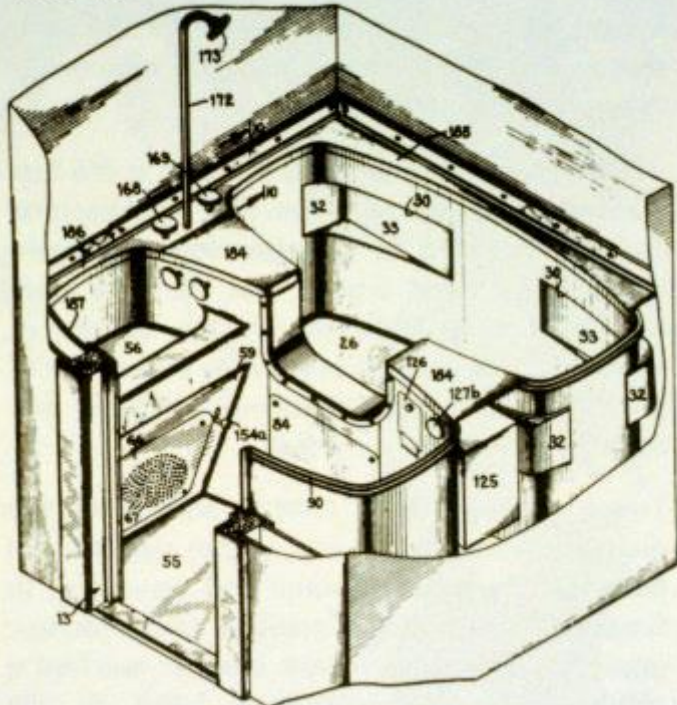
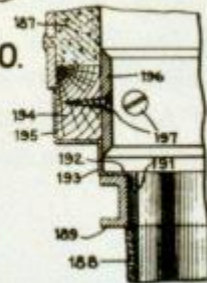


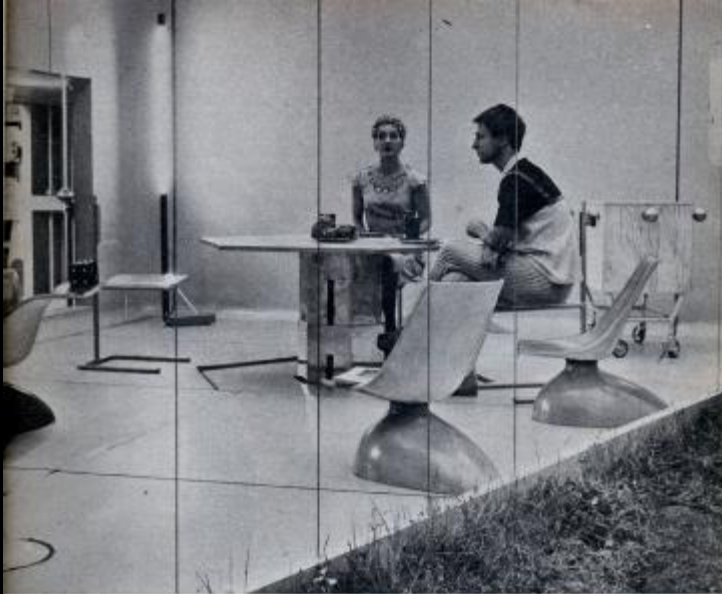
FIG. 10.



INVENTOR  
RICHARD BUCKINGHAM FULLER  
BY *F. Chas. Churchill*  
ATTORNEY







Main room of 1980 home adjoins central garden. The dining table can sink into floor.



Short-wave transmitter with push buttons controls radio-phonograph-color TV set.

## This is a House?

*British architects have designed this Home Of The Future to prove that living will be much easier in the brave new world of tomorrow.*

**S**TAR of the London Daily Mail Ideal Home Exhibition of 1956 was this eye-opening Home Of The Future designed by architects Alison and Peter Smithson. It is a one-bedroom town house that contains a garden within it. The shell is moulded of plastic-impregnated plaster and the roof is covered with aluminum foil to reflect the sun's

1956 – Peter and Alison Smithson's  
"house of the future"











The Jetsons  
1963





"custom" vs "off-the-shelf"  
repeated elements

## LIFE IN A CHINESE KITE

Standard industrial products assembled in a spacious wonderland



Designed by Eames about flexibility of frame, every area of contrasting blocks of pattern

The sparkling construction shown on these pages happens to be the place where one of America's foremost young designers and his wife are living the ease of their lives. More important, it is also one of the most advanced house structures built in this country to date.

So far as Charles Eames is concerned, there is no country where a house should not be:

- ▶ Spacious—space being the greatest luxury there is;
- ▶ A sophisticated industrial product;
- ▶ And as light and airy as a suspension bridge—as skeletal as an airplane fuselage.

Having got this straight in his own mind, Eames asked himself these questions: How cheap is space? How industrial is our building industry? How light is steel?

LOCATIONS: Santa Monica, Calif.  
 CHARLES EAMES, Designer\*  
 SYMPHONY CATHAL-SALZMAN, INC., General Contractor



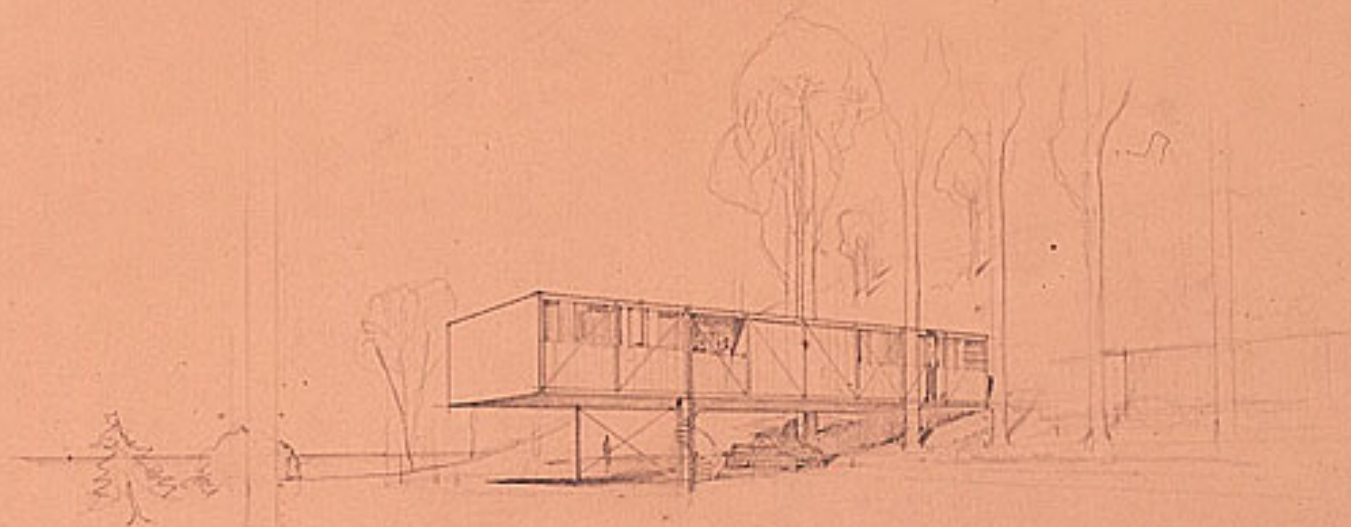
Flexibility being given suspended frame work over Eames-designed upholstery as light is sought in opening porches and, standing up, to achieve better balance.

Porch is not lower end of building (left) is made without by E. E. retaining wall. Lateral is 200 sq. ft., reserved for later construction building to house.

\*Designed and built by the Eames Study House program of the Department of Architecture, University of California, Berkeley.

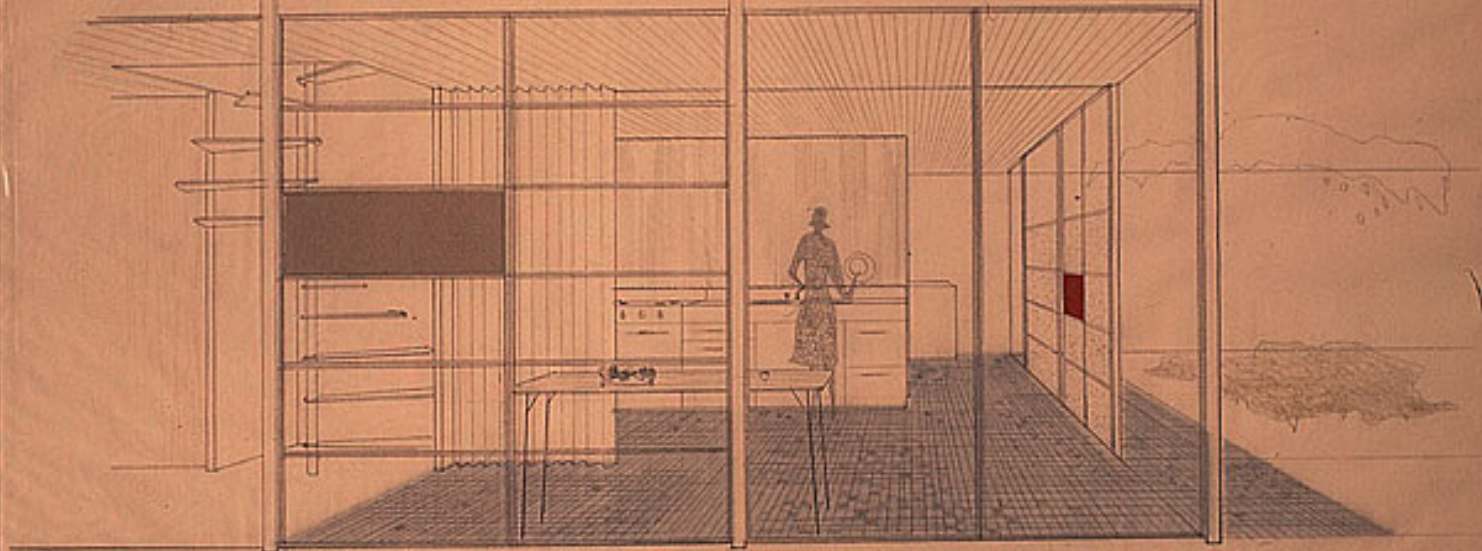
Photo by 1959 (except top) by G. Julius Anderson

Case Study House No. 8  
 Pallisades, California  
 Charles and Ray Eames  
 1949



Bottom Page 9





KITCHEN-DINING AREA OF CASE STUDY HOUSE NO. 8  
2 3/16" UNGLAZED CERAMIC TILE EXTENDS FROM  
DINING AREA INTO KITCHEN AND TO UTILITY AREA  
EXTEND.



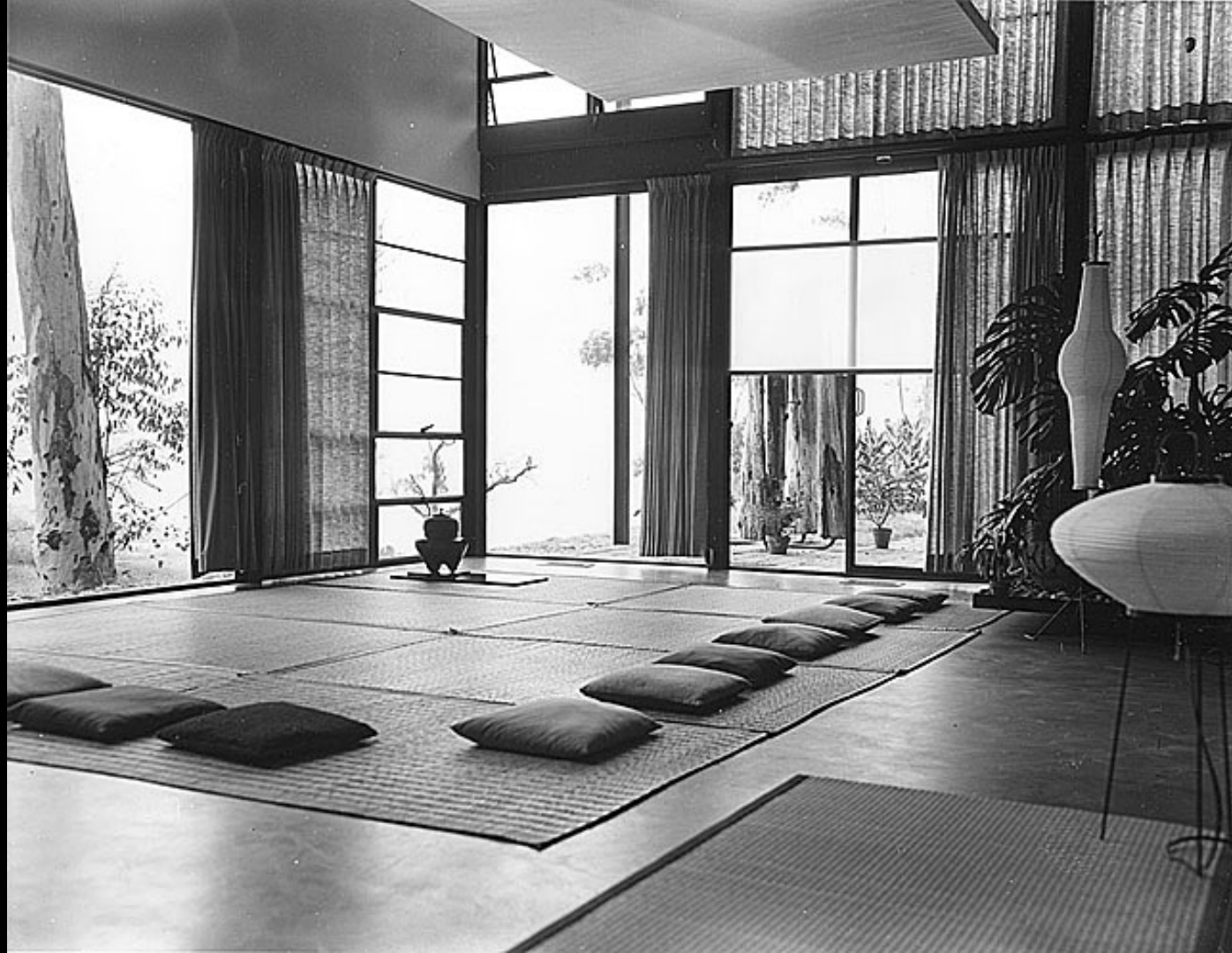












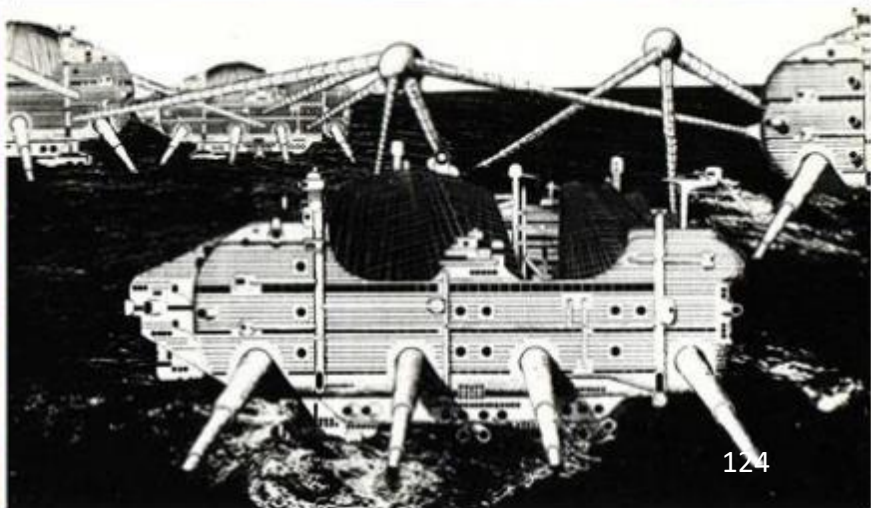
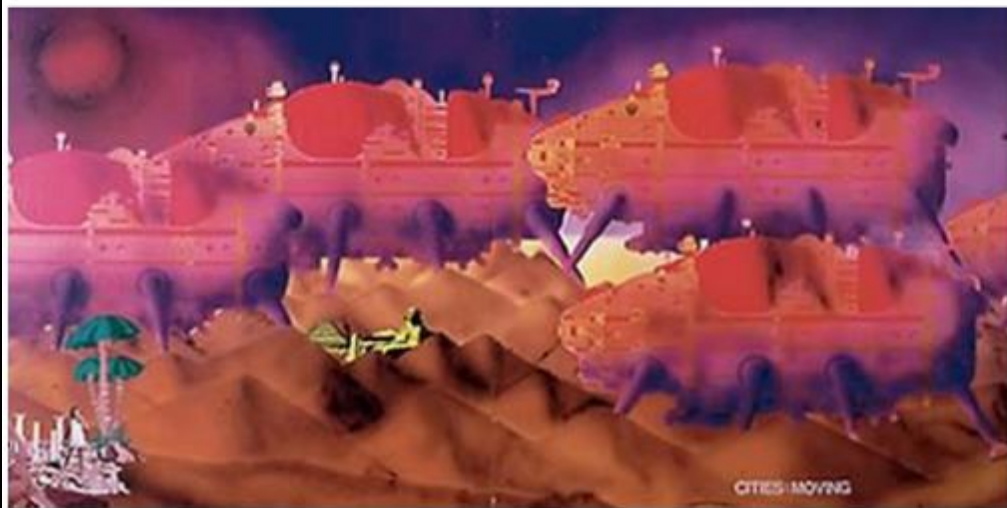
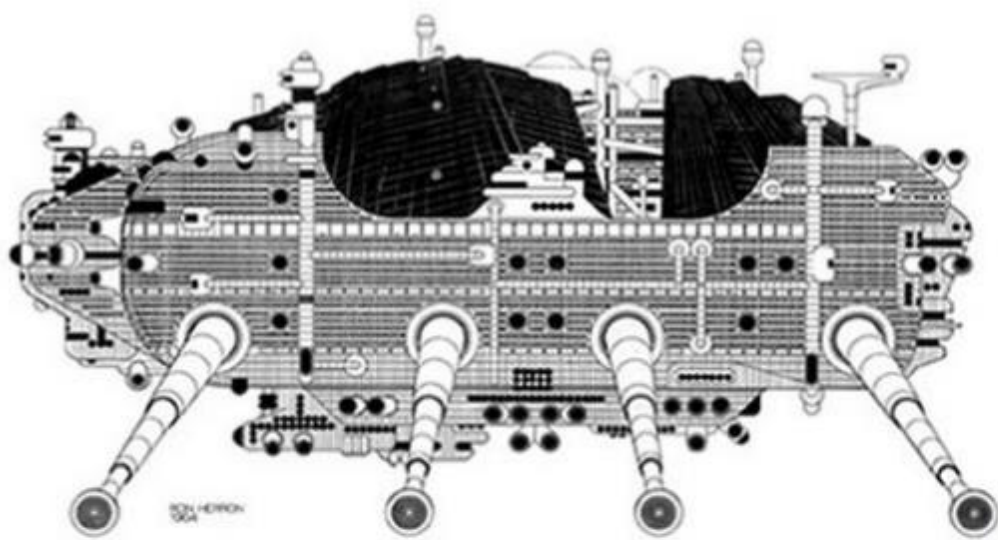






Archigram  
Avant-garde British Design Group  
1960s







EACH WALKING UNIT HOUSES NOT ONLY A KEY ELEMENT OF THE CAPITAL , BUT ALSO A LARGE POPULATION OF WORLD TRAVELLER-WORKERS.

## A WALKING CITY

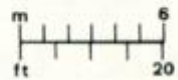
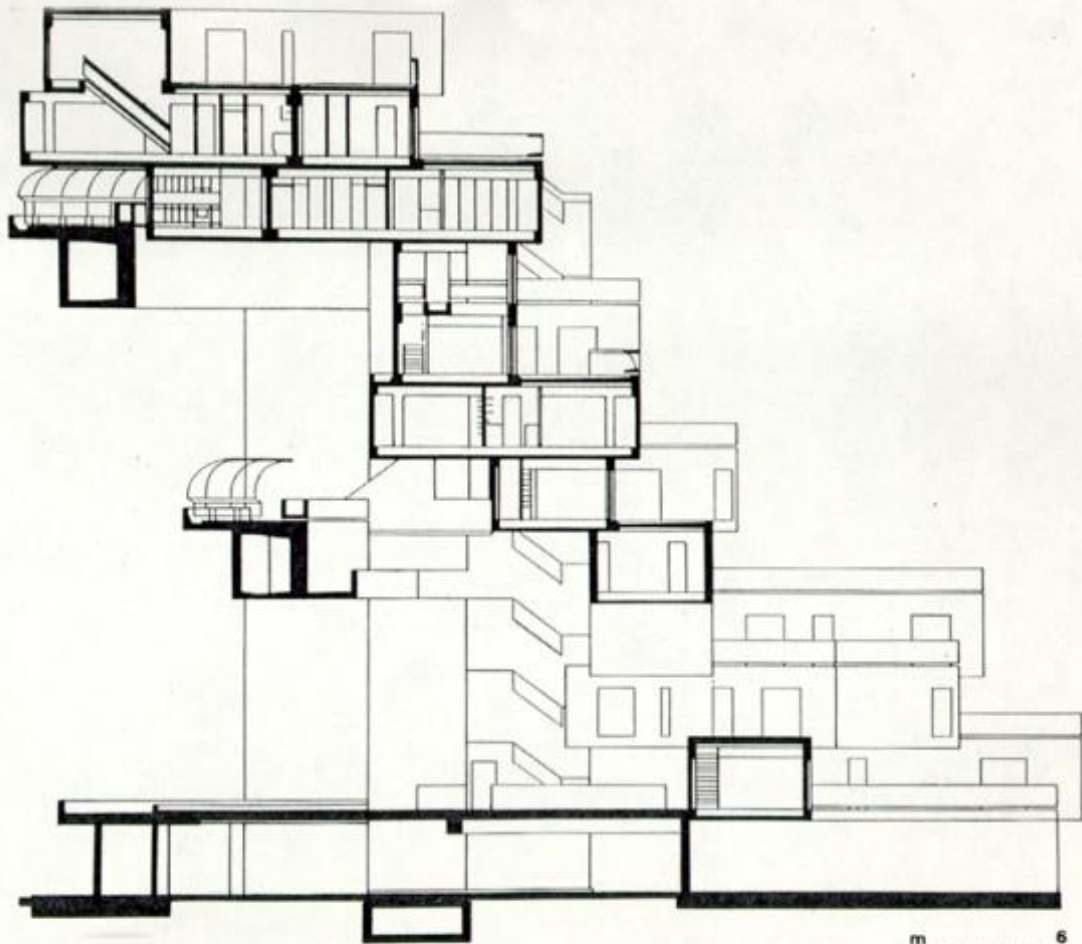


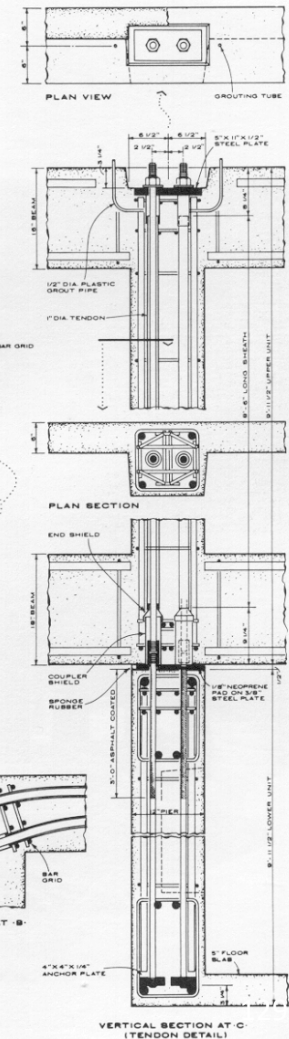
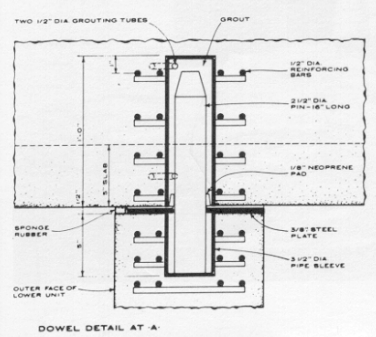
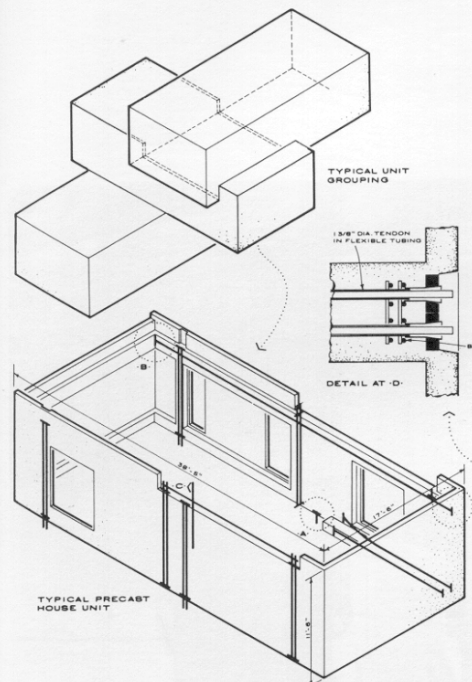
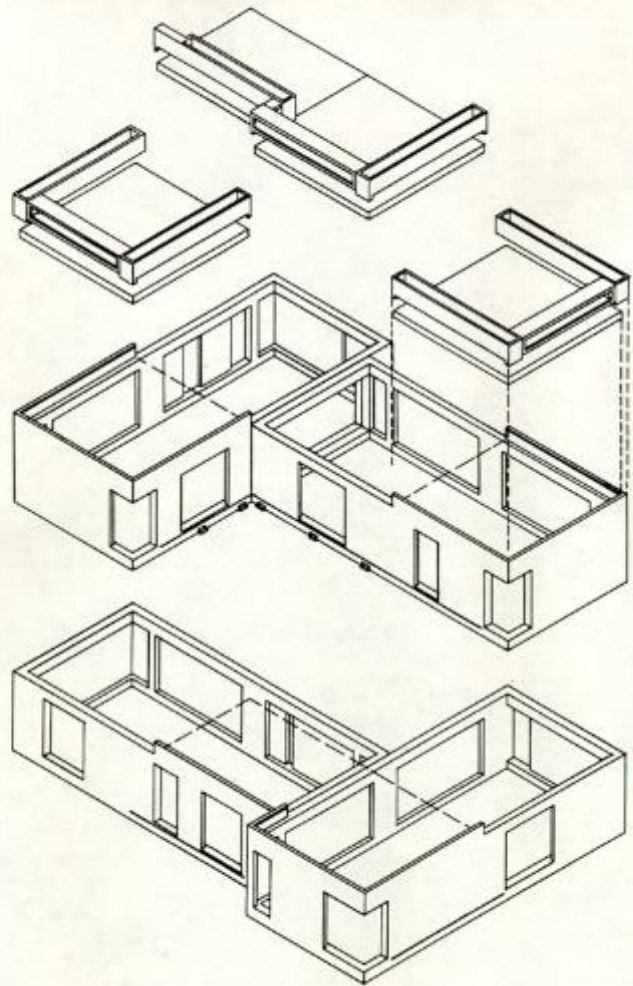




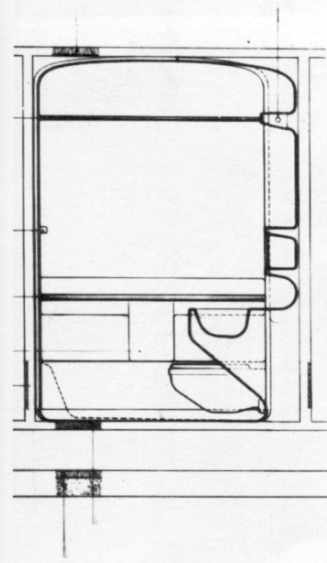
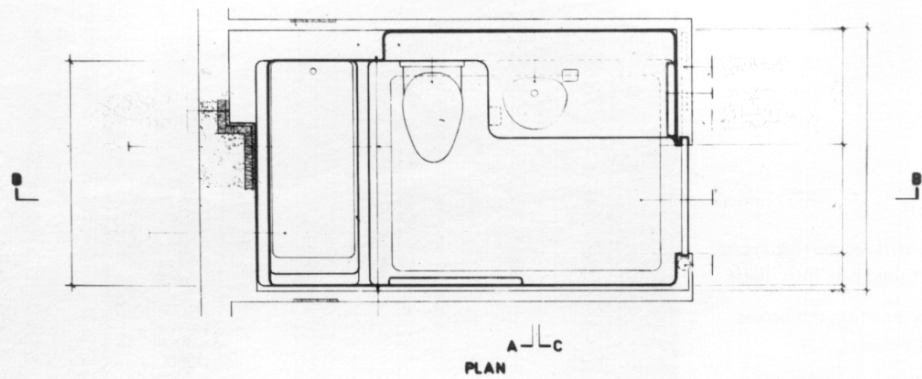
Habitat '67  
Montreal Expo Residences  
Moshe Safdie Architect  
1967



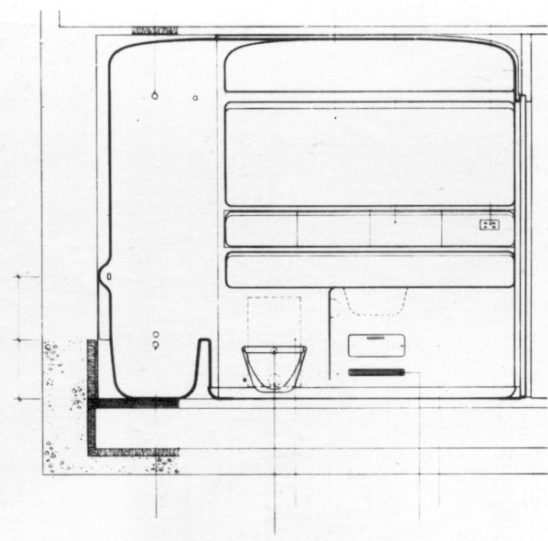




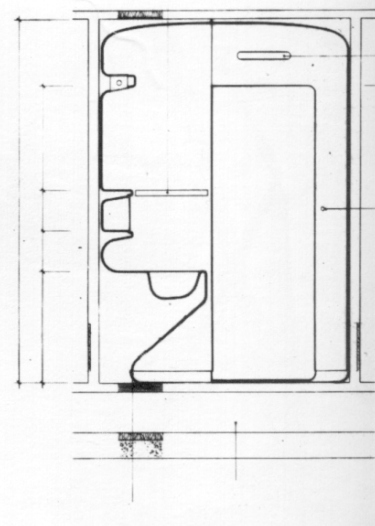




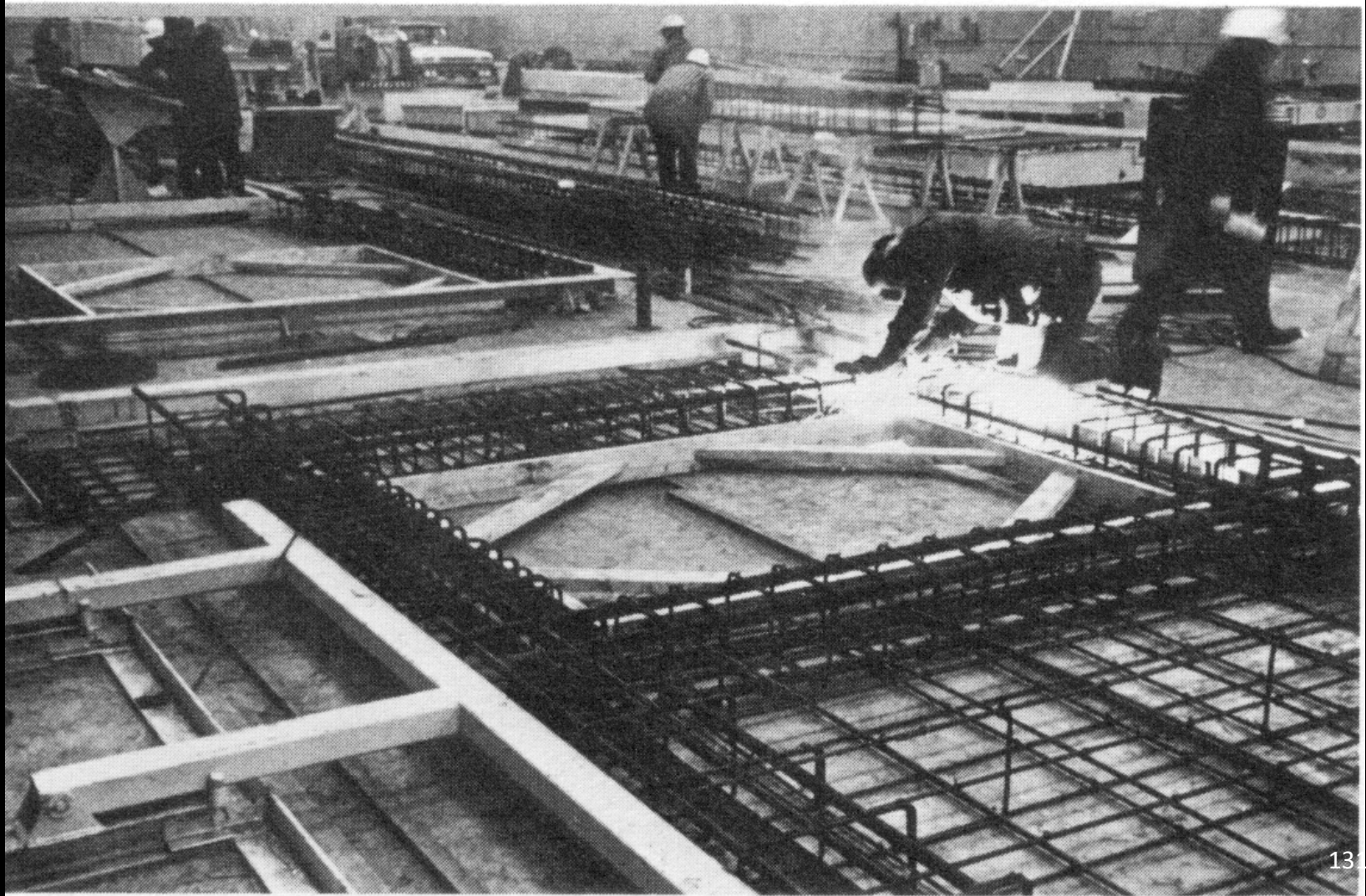
SECTION A-A  
COUPE

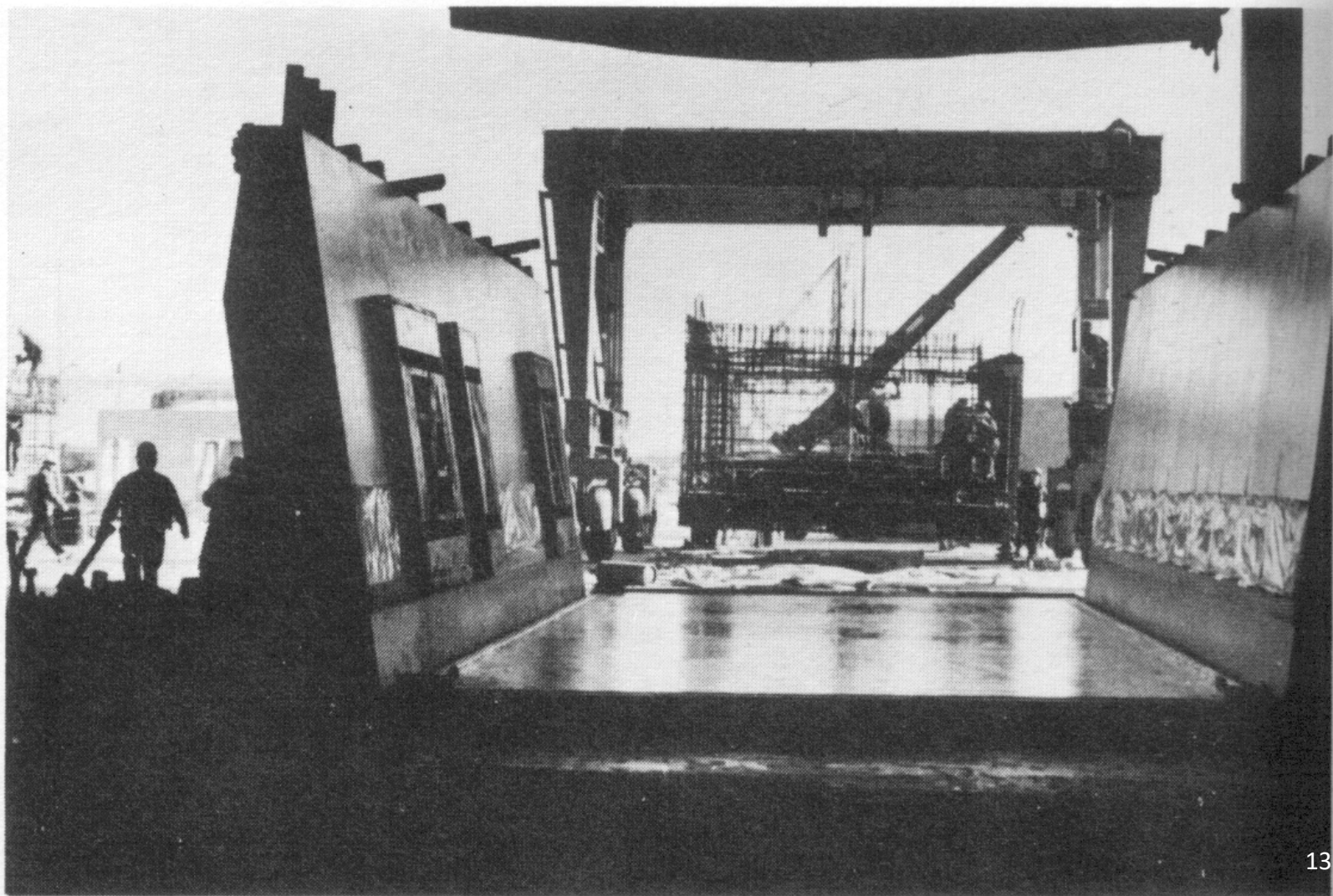


SECTION B-B  
COUPE

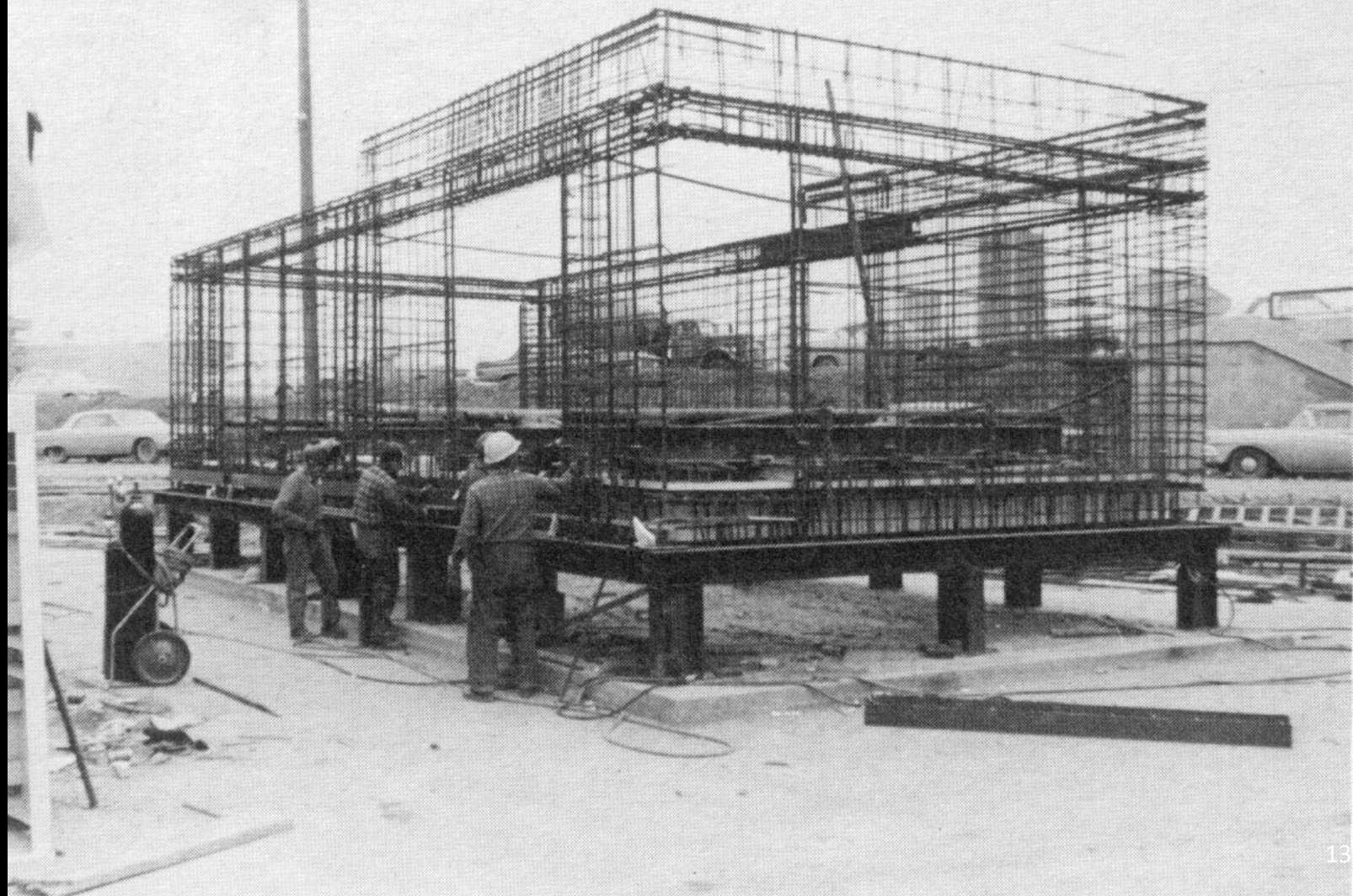


SECTION C-C  
COUPE

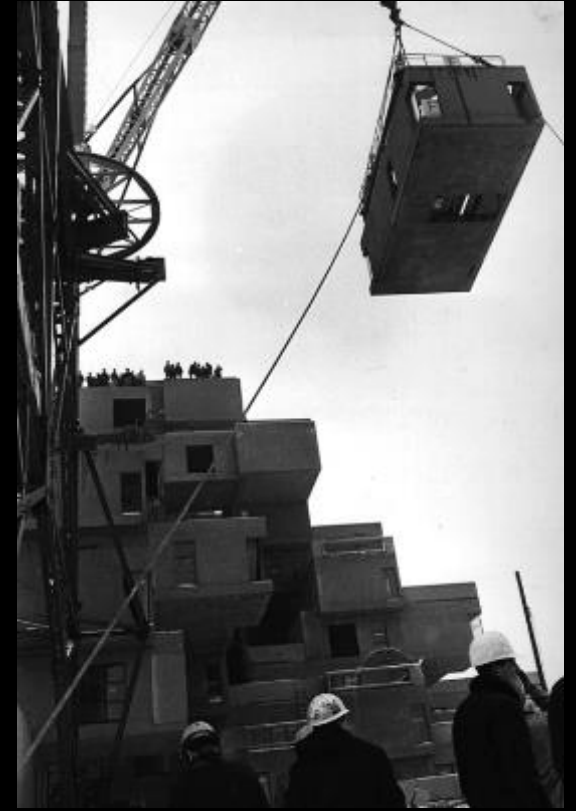
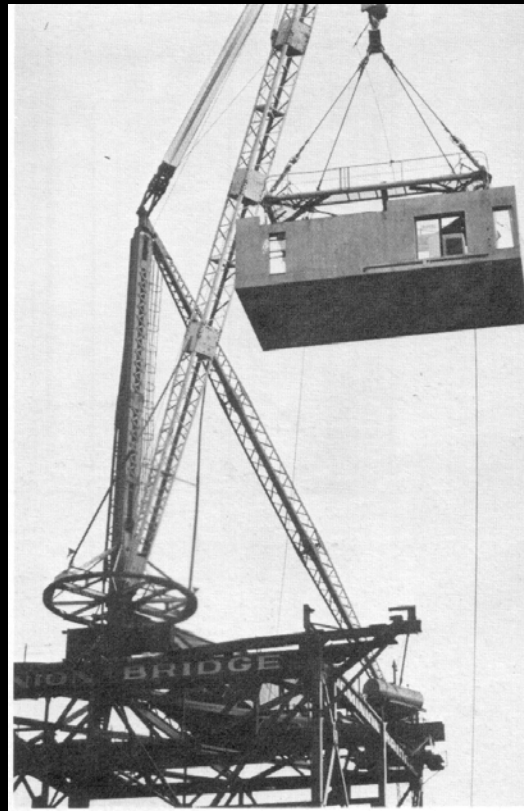




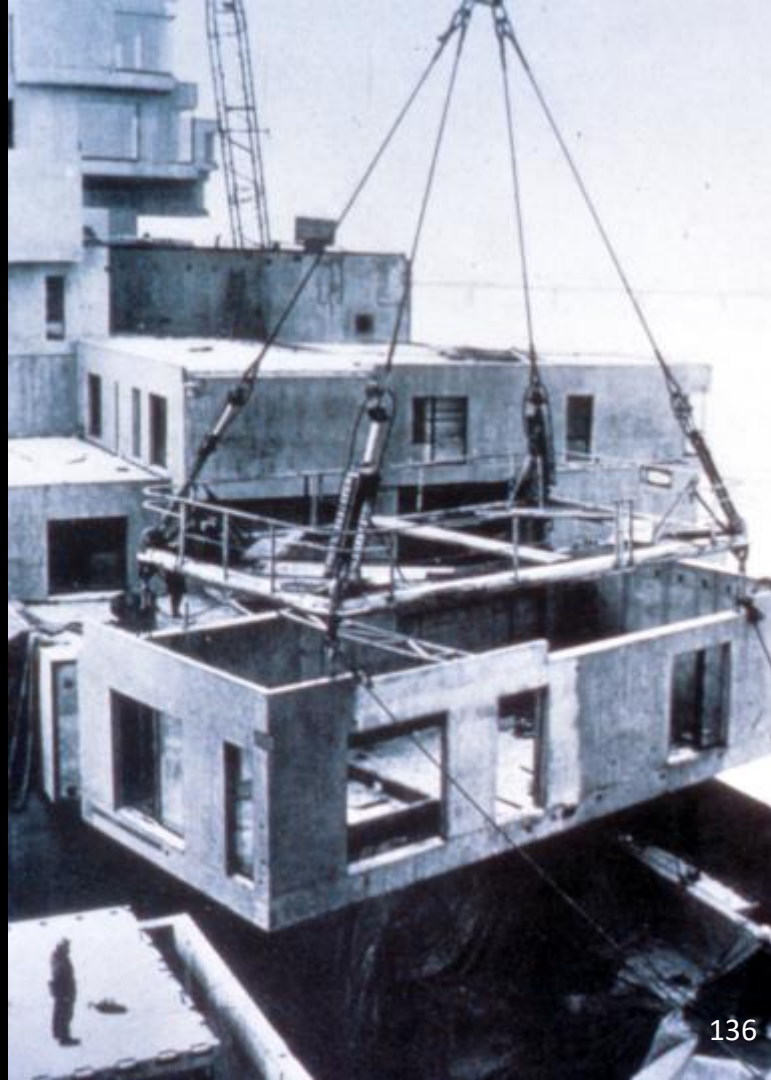














American Pavilion  
Expo 1967  
Montreal, Quebec  
Buckminster Fuller



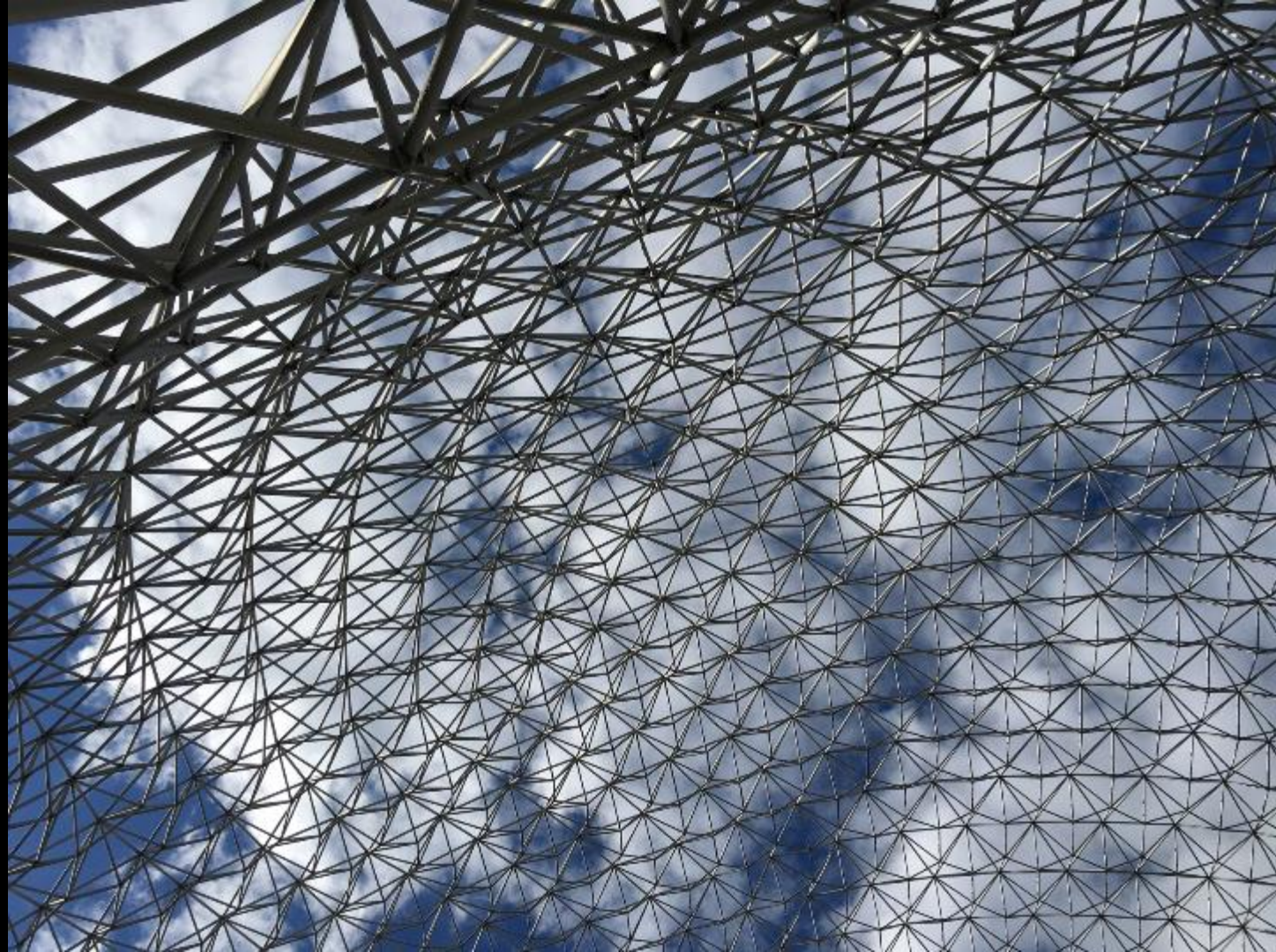


Geodesic dome



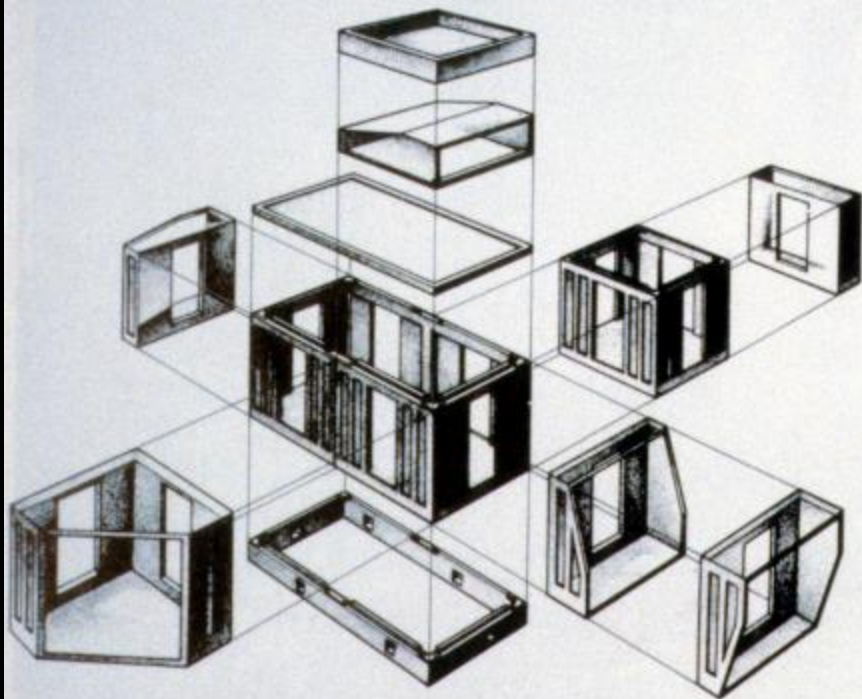






Economy is achieved through  
repetition of the elements and mass  
production

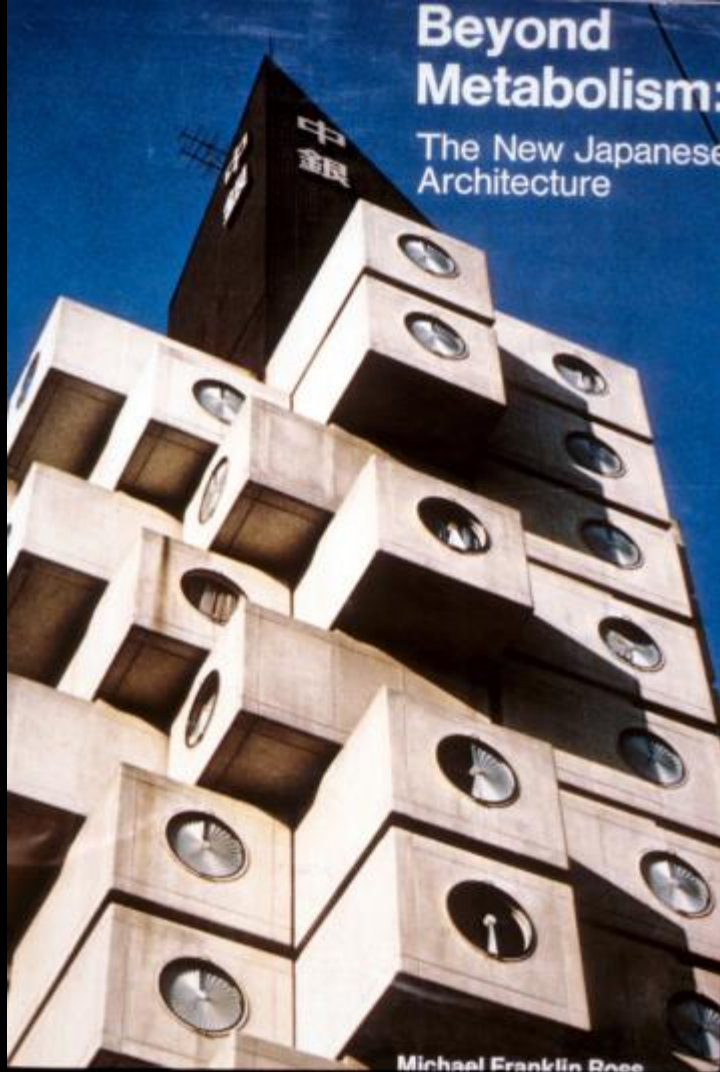




102, 103.

Taisei Overseas System, Design Prototype, Kisho Kurokawa, 1971: This closed system of prefabricated concrete elements fits together like the traditional Japanese puzzle. A variety of floor-plan clusters are available.



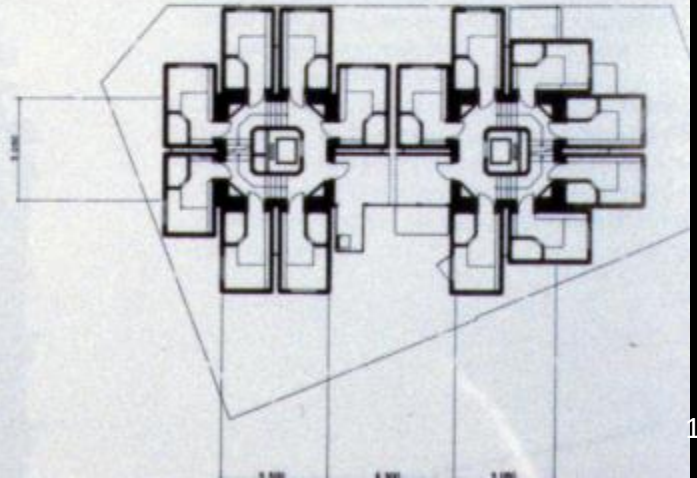
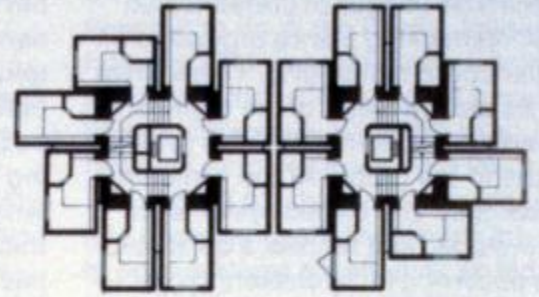
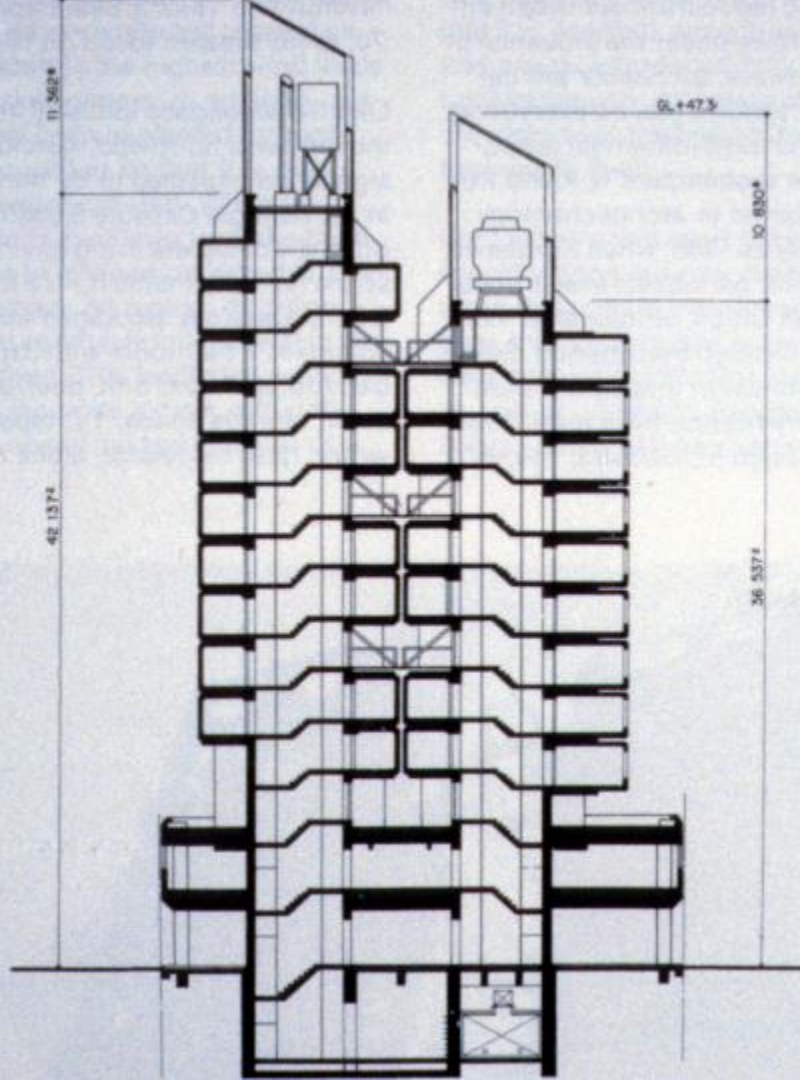


# Beyond Metabolism:

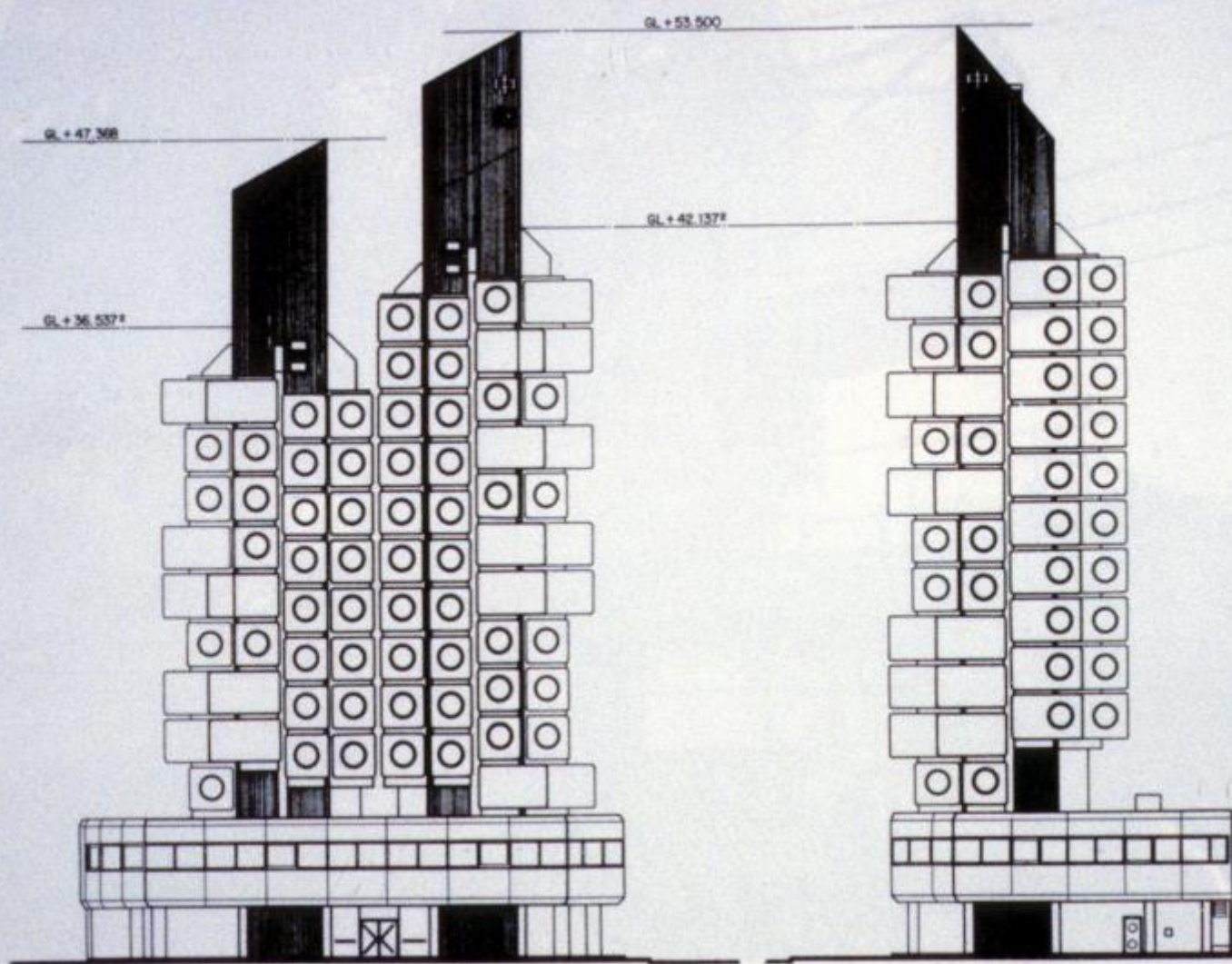
The New Japanese  
Architecture

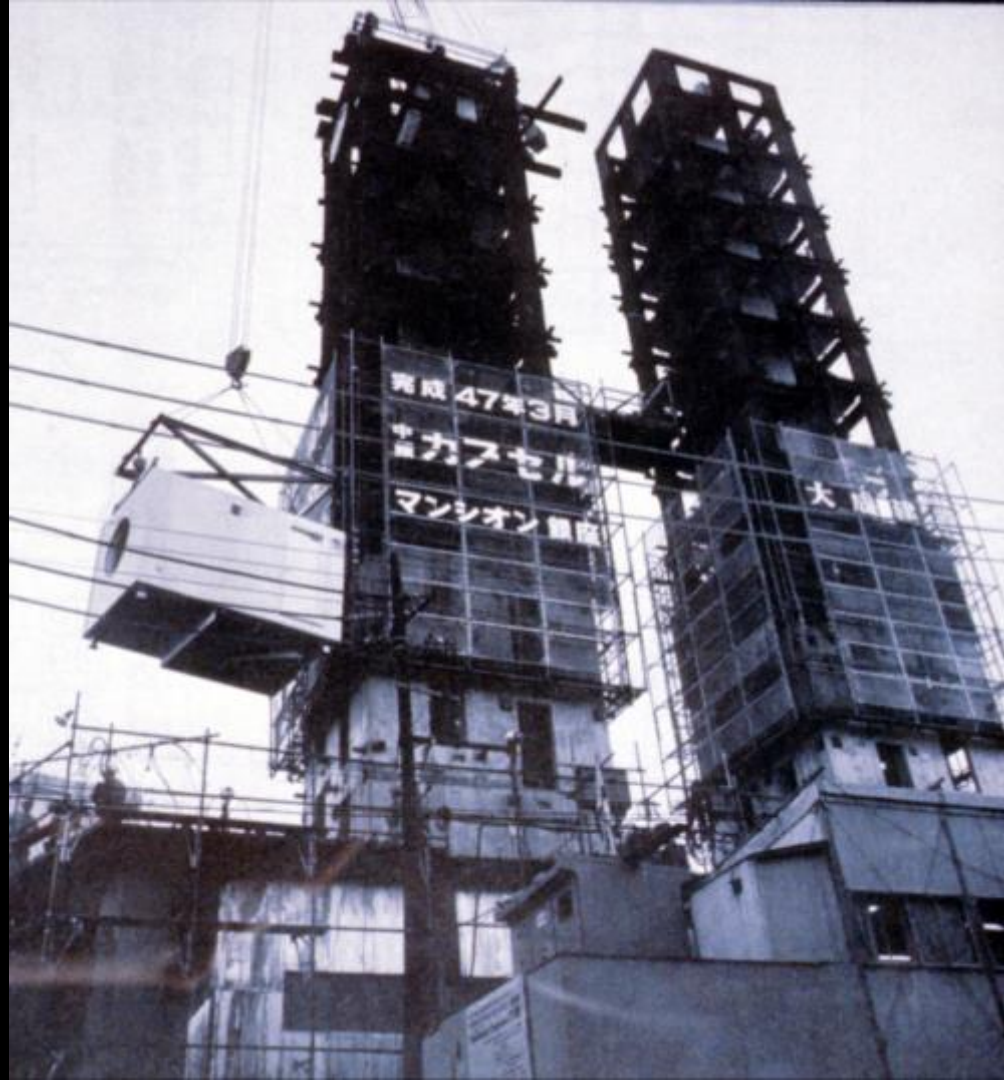
Nakagin Capsule Tower  
Tokyo, Japan  
Kisho Kurokawa  
1972

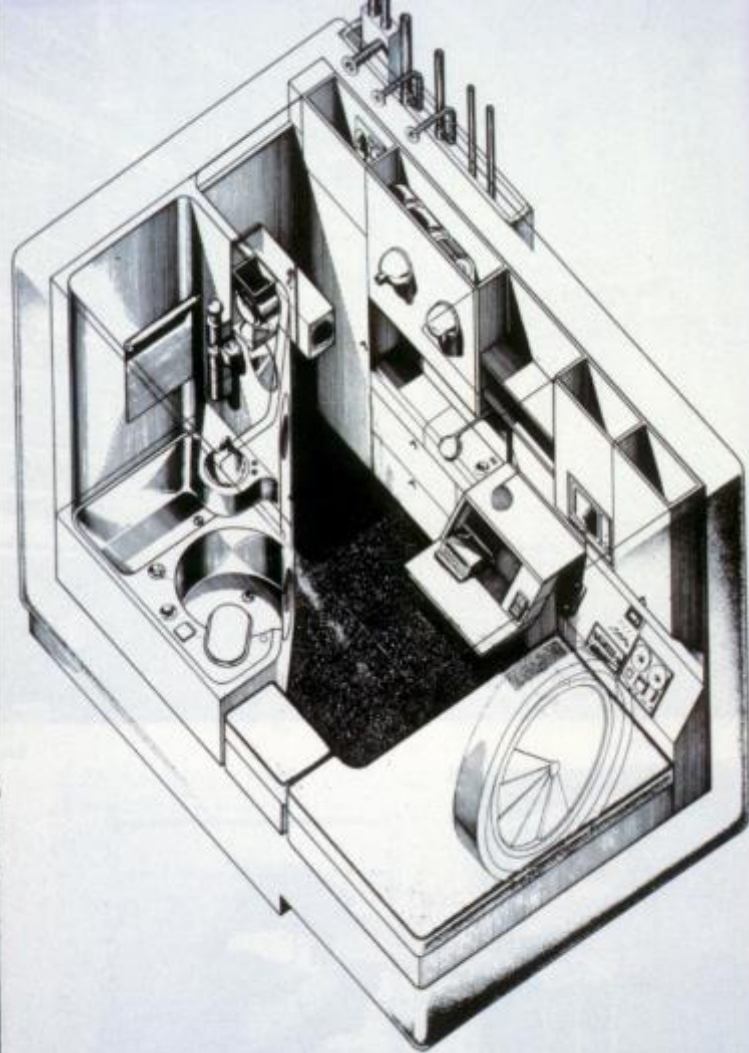
Michael Franklin Rose



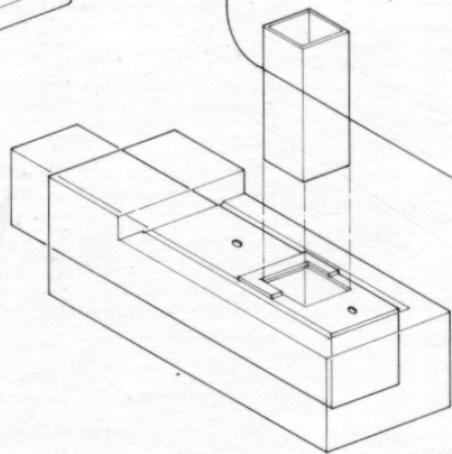
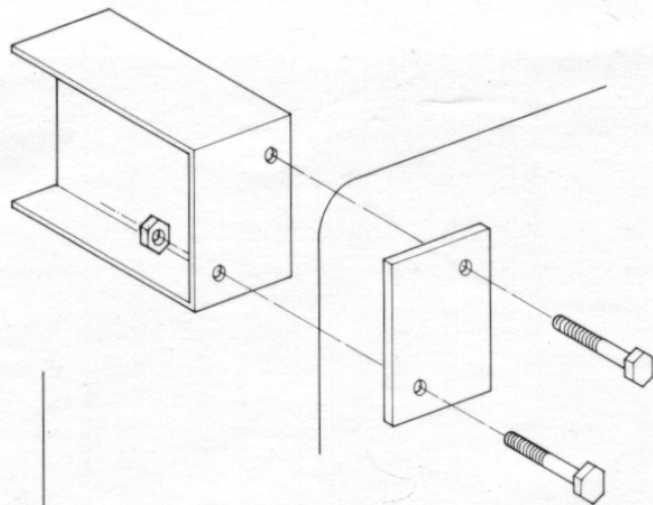
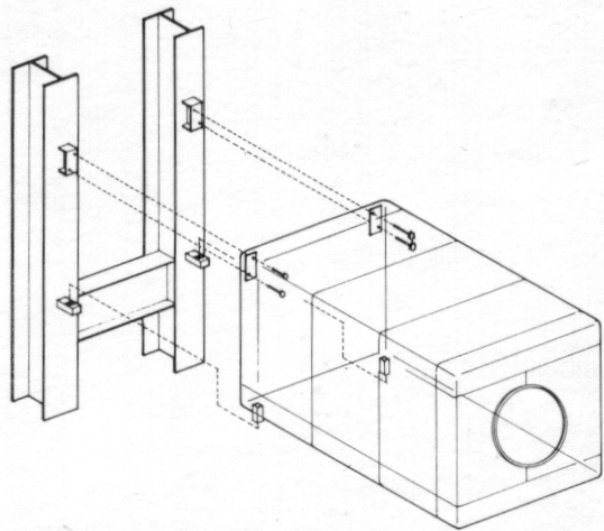




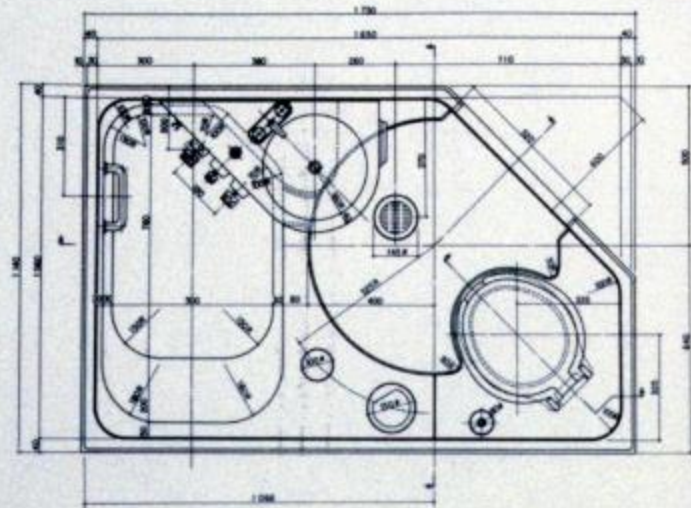
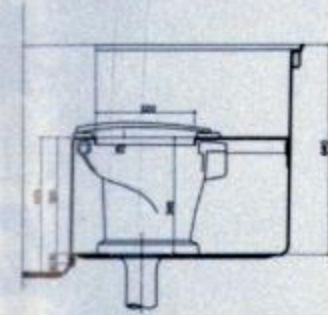
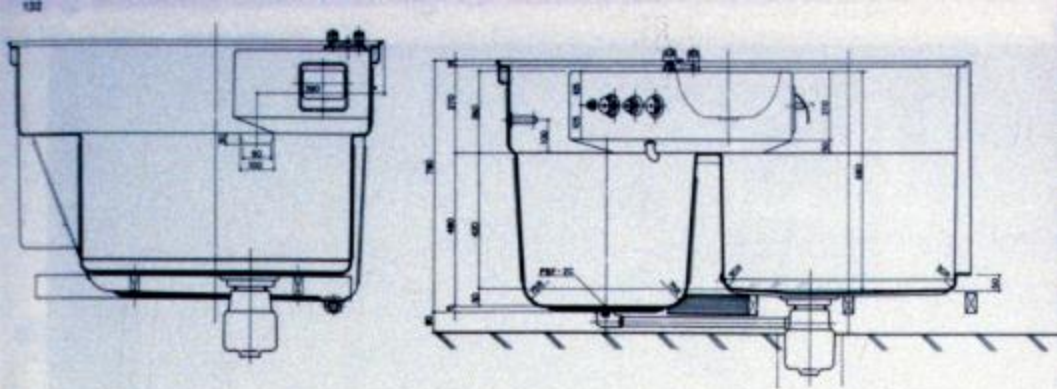






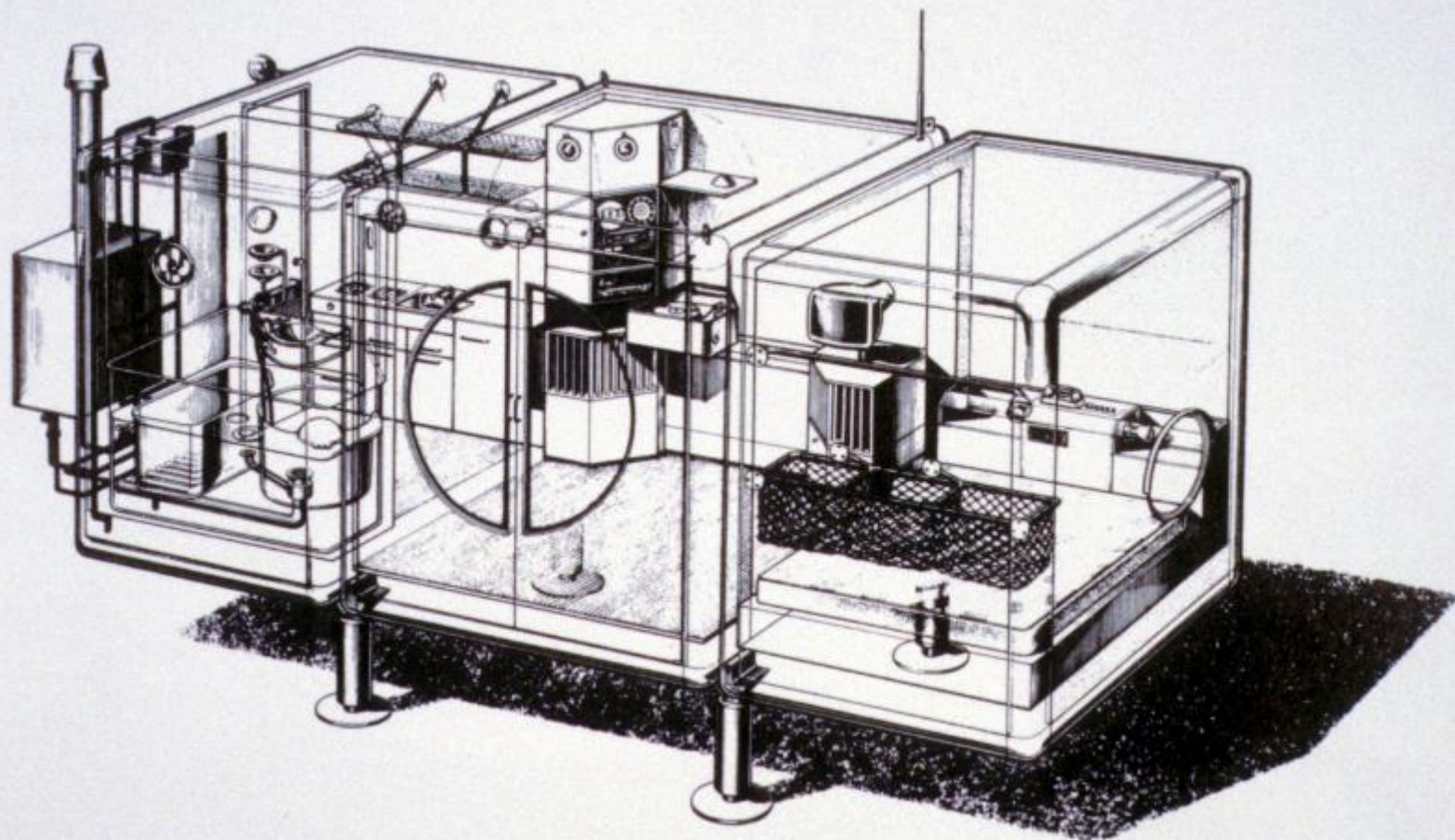


Detail of system of joining capsule to shaft

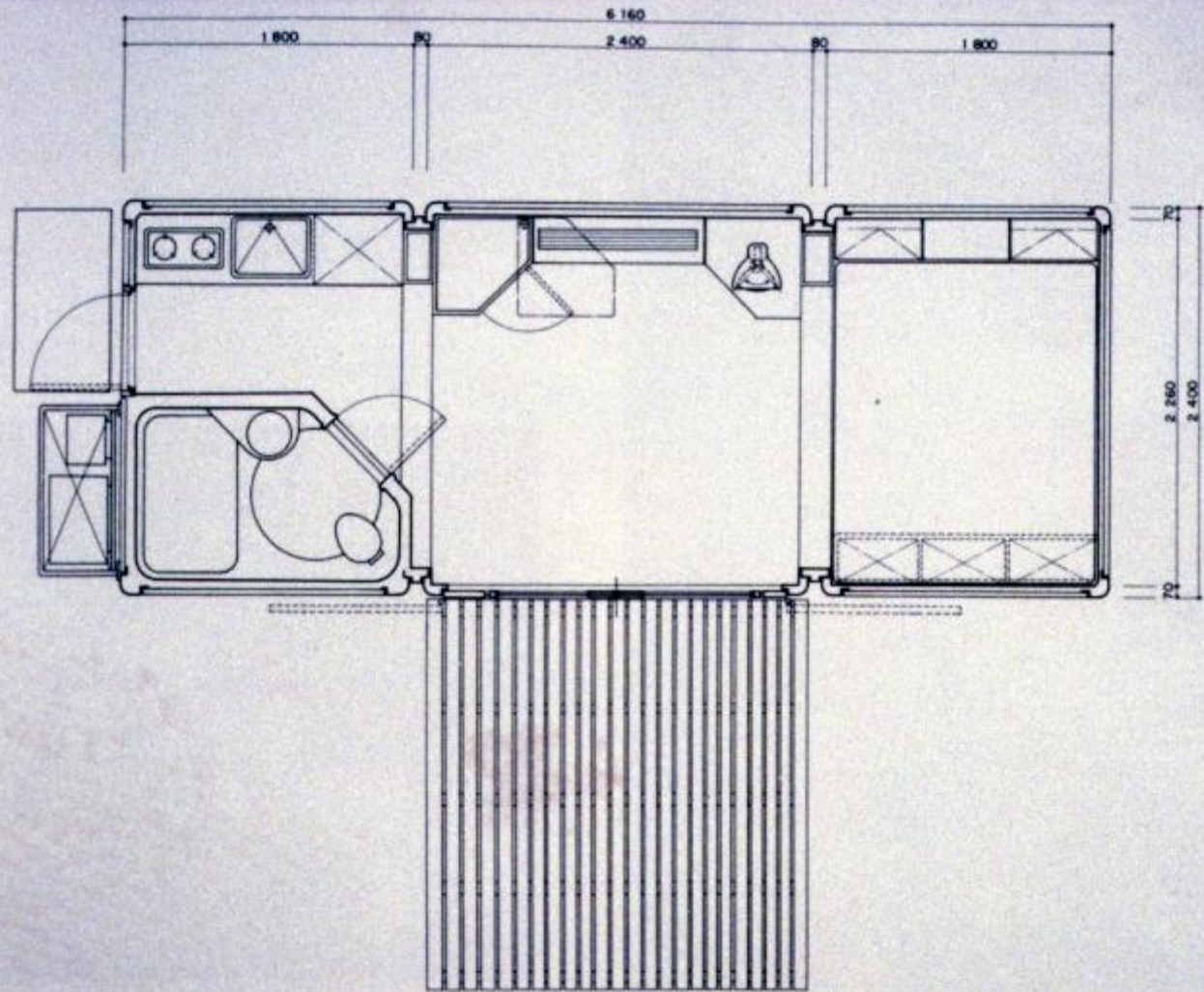


131. Plans, Section and Elevations, Nakagin Capsule Building. As the drawings illustrate, the twin service towers are connected by bridges on every third floor, reminiscent of the megastructures of the 60s. This building is considered by Kurokawa as a prototype for a larger urban community.

132. Bathroom, Nakagin Capsule: Evolved from the toilet capsules that Kurokawa created for the Celestial Theme Pavilion at Expo '70, this piece of industrial design is in itself a modern-day Japanese puzzle, integrating all sanitary functions into 21 sq ft (2m<sup>2</sup>).













タワーヒル

銀グループ 2F



VICTORY SERVICE STAND















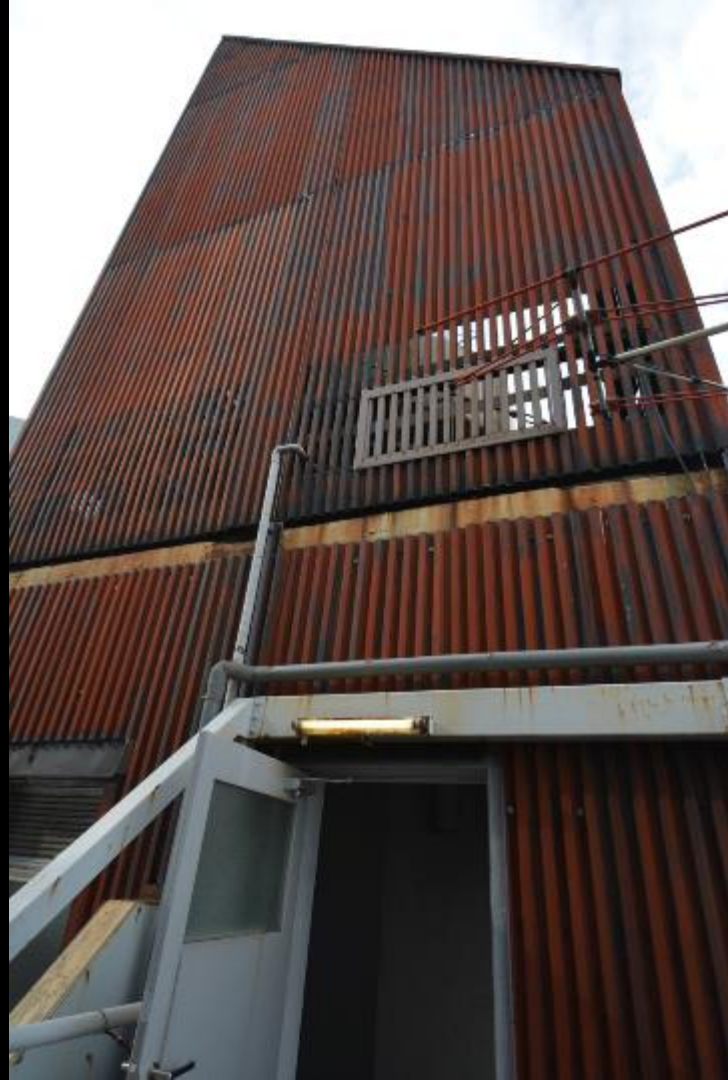




























 **nakagin**  
LEGENDA TOWER

**LEGENDA TOWER**  
A new landmark building in the heart of the city, the Legenda Tower is a prime example of Nakagin's architectural philosophy. The building's design is a blend of traditional Japanese aesthetics and modern architectural techniques, creating a unique and harmonious environment. The tower's facade is a masterpiece of craftsmanship, featuring a complex pattern of windows and balconies that create a rhythmic and dynamic visual effect. The interior spaces are designed to be functional and comfortable, with a focus on natural light and ventilation. The Legenda Tower is not just a building, it is a statement of architectural excellence and a testament to Nakagin's vision for the future of urban living.



**LEGENDA TOWER**  
A new landmark building in the heart of the city, the Legenda Tower is a prime example of Nakagin's architectural philosophy. The building's design is a blend of traditional Japanese aesthetics and modern architectural techniques, creating a unique and harmonious environment. The tower's facade is a masterpiece of craftsmanship, featuring a complex pattern of windows and balconies that create a rhythmic and dynamic visual effect. The interior spaces are designed to be functional and comfortable, with a focus on natural light and ventilation. The Legenda Tower is not just a building, it is a statement of architectural excellence and a testament to Nakagin's vision for the future of urban living.



**WELCOME!**  
PLEASE TIGHTEN THE FAUCET IF IT LEAKS.  
IF YOU NEED ANYTHING, CALL MASATAH HAF: 080 9575 5192

Gracias!!!  
LIZZY RAY  
Tips: Valencia 20th - Spain  
There's a public bath (Sento) nearby.  
IF YOU NEED ANYTHING, CALL  
MASATAH HAF: 080 9575 5192

Enjoy 東京!  
TIP: There's a public bath (Sento) nearby.  
IF YOU NEED ANYTHING, CALL  
MASATAH HAF: 080 9575 5192

PLEASE TIGHTEN THE FAUCET IF IT LEAKS.  
IF YOU NEED ANYTHING, CALL  
MASATAH HAF: 080 9575 5192

Gracias!!!  
LIZZY RAY  
Tips: Valencia 20th - Spain  
There's a public bath (Sento) nearby.  
IF YOU NEED ANYTHING, CALL  
MASATAH HAF: 080 9575 5192

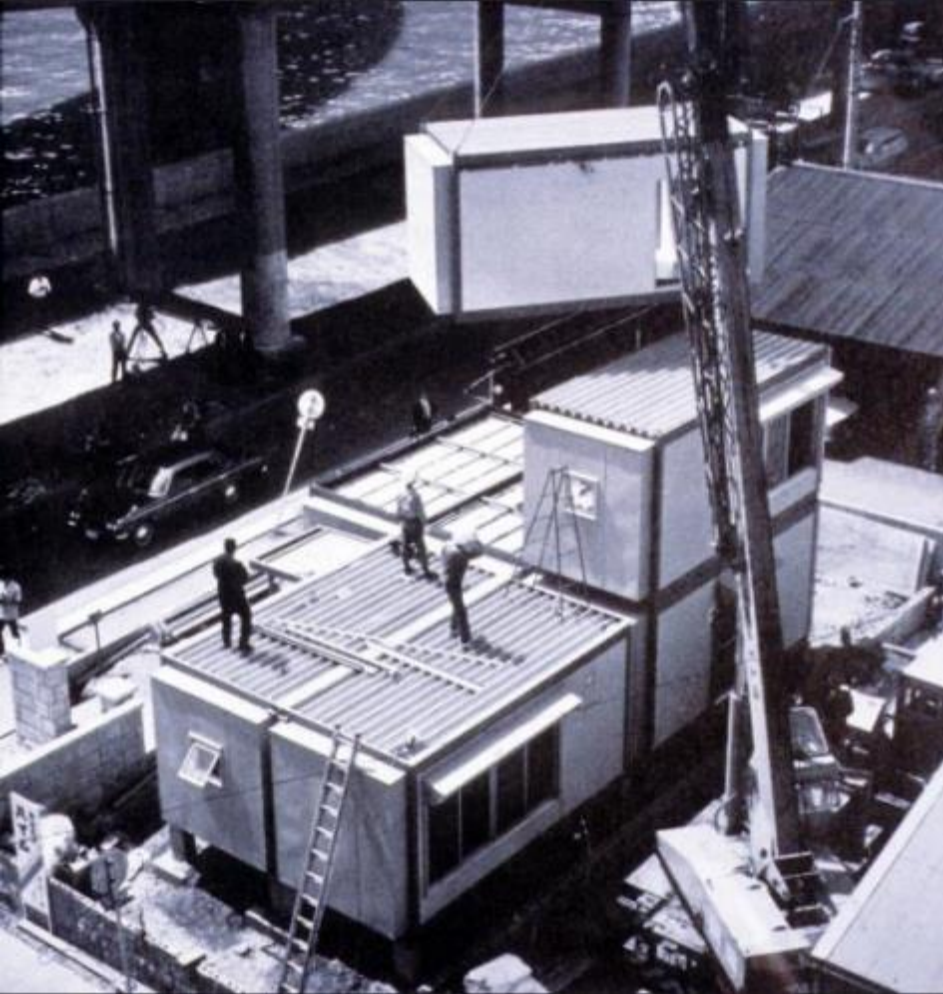




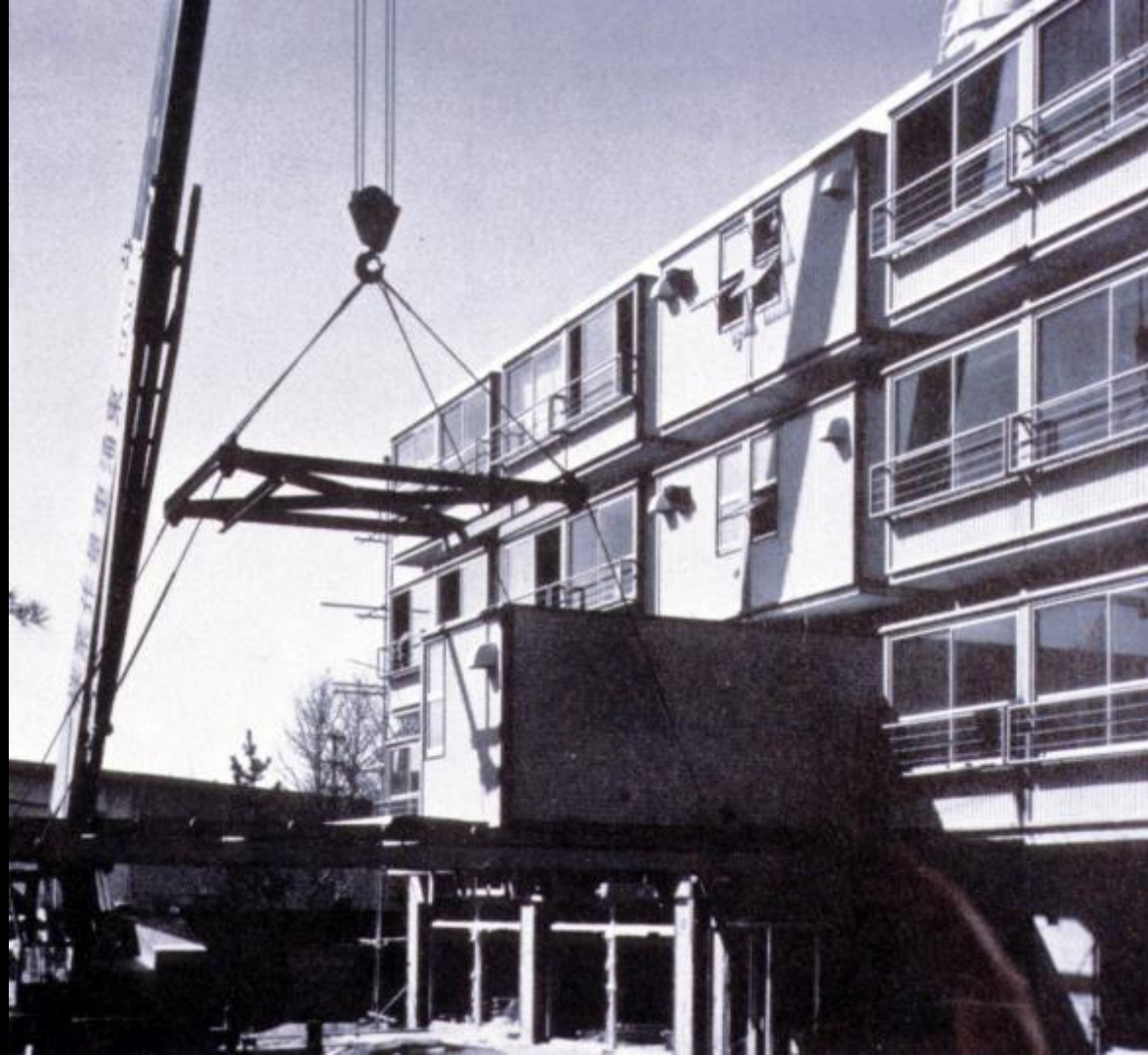














816, 817 Two types of American prefabricated houses: the "colonial cottage" produced by the American Houses Inc. at \$7,500 and the "Catalina" house produced by the U.S. Steel Houses Inc. at \$11,500



Very good—14 hours flat—but they're all upside down!



845 (above, left) New York, One of the façades of the U.N. building

846 (below, left) Cartoon from the Architectural Record, April 1955

847 (right) Pittsburgh, A.L.C.O.A. building (Harrison and Abramowitz, 1952)



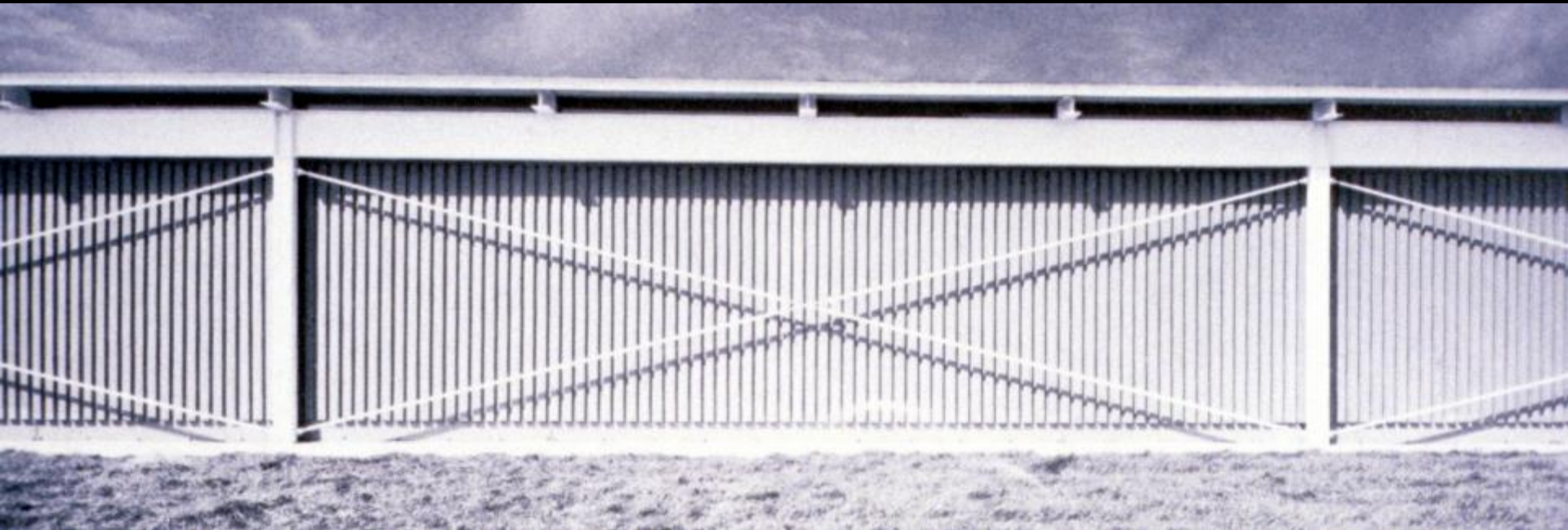




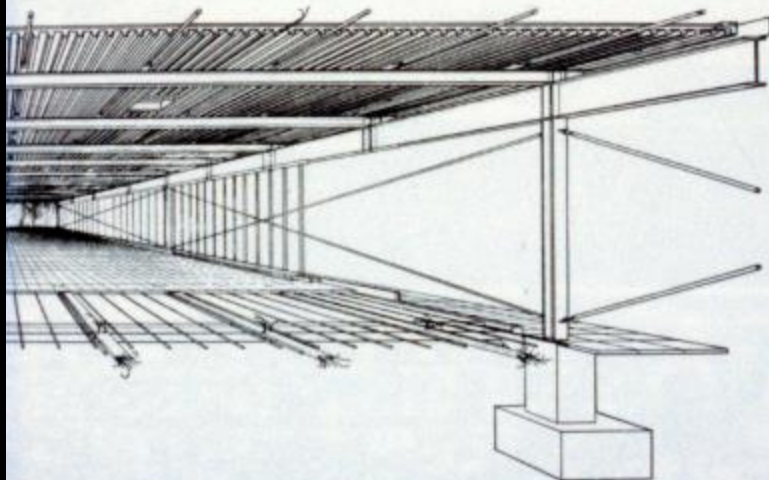
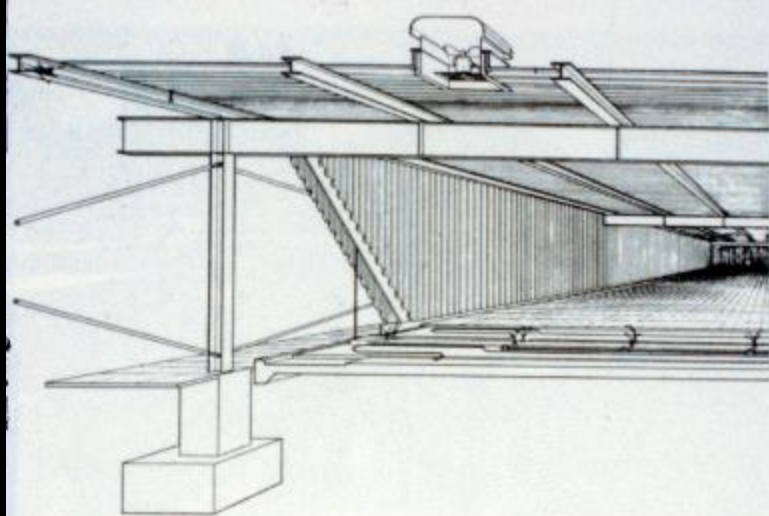
# The High Tech Movement







Reliance Controls  
Swindon, UK  
Team 4 (Wendy and Norman Foster +  
Richard and Sue Rogers)  
1967



2 Team 4, Reliance Controls Factory, Swindon, 1966



Characterized by components that  
express their forces

-

Tension vs. Compression

-

Skinny vs. Fat



Pompidou Centre  
Paris, France  
Piano and Rogers  
1977





















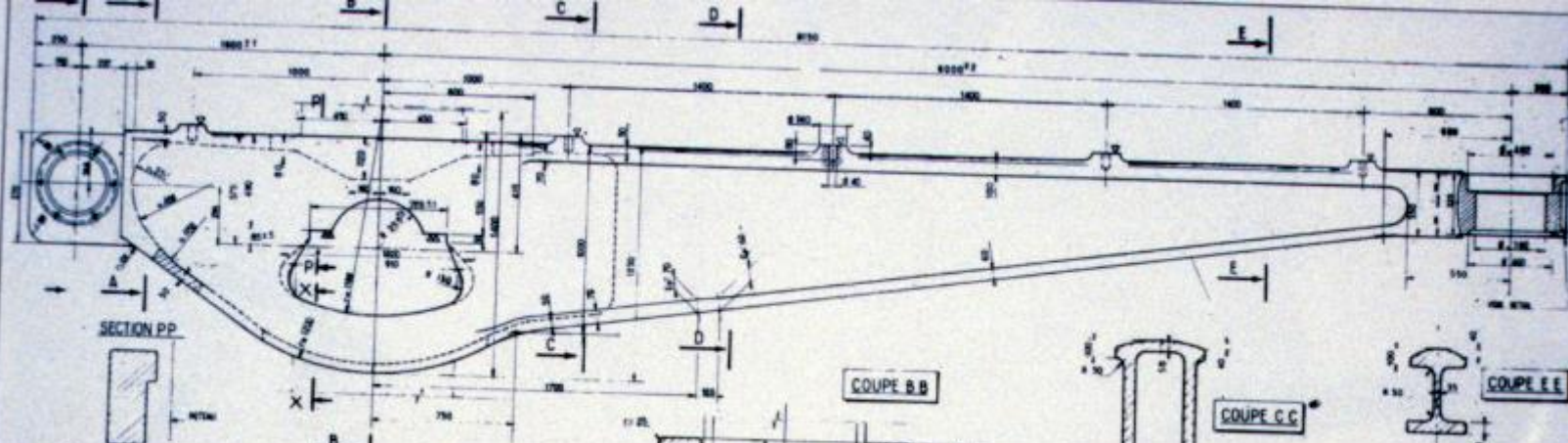












**NOTA**

**MATIERE**

APRES MISE EN PLACE DES CHARGES  
 LIMITE DE RUPTURE MIN. 32.5kg/cm<sup>2</sup>  
 LIMITE ELASTIQUE MIN. 14.5kg/cm<sup>2</sup>

**TOLERANCES**

SAUF INDICATION CONTRAIRE POUR  
 LES DIMENSIONS LES TOLERANCES  
 SERONT CONFORMES AUX NORMES  
 ET A 3000 CLASSE A

LA TOLERANCE DE RECTITUDE DE L'AXE (DISTANCE A...)  
 SERA DE 0.15mm

REFERENCES PLANS N° 14.10.22

TYPE A 22  
 TYPE B 22

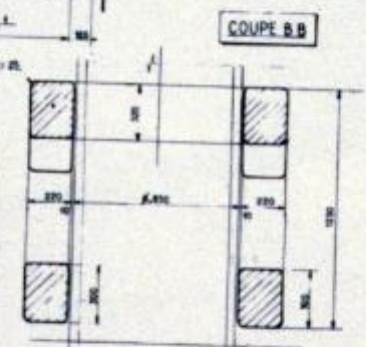
**NOTA (suite)**

INDICATIONS D'USURE CONFORMES  
 A LA NORME NF 104.01

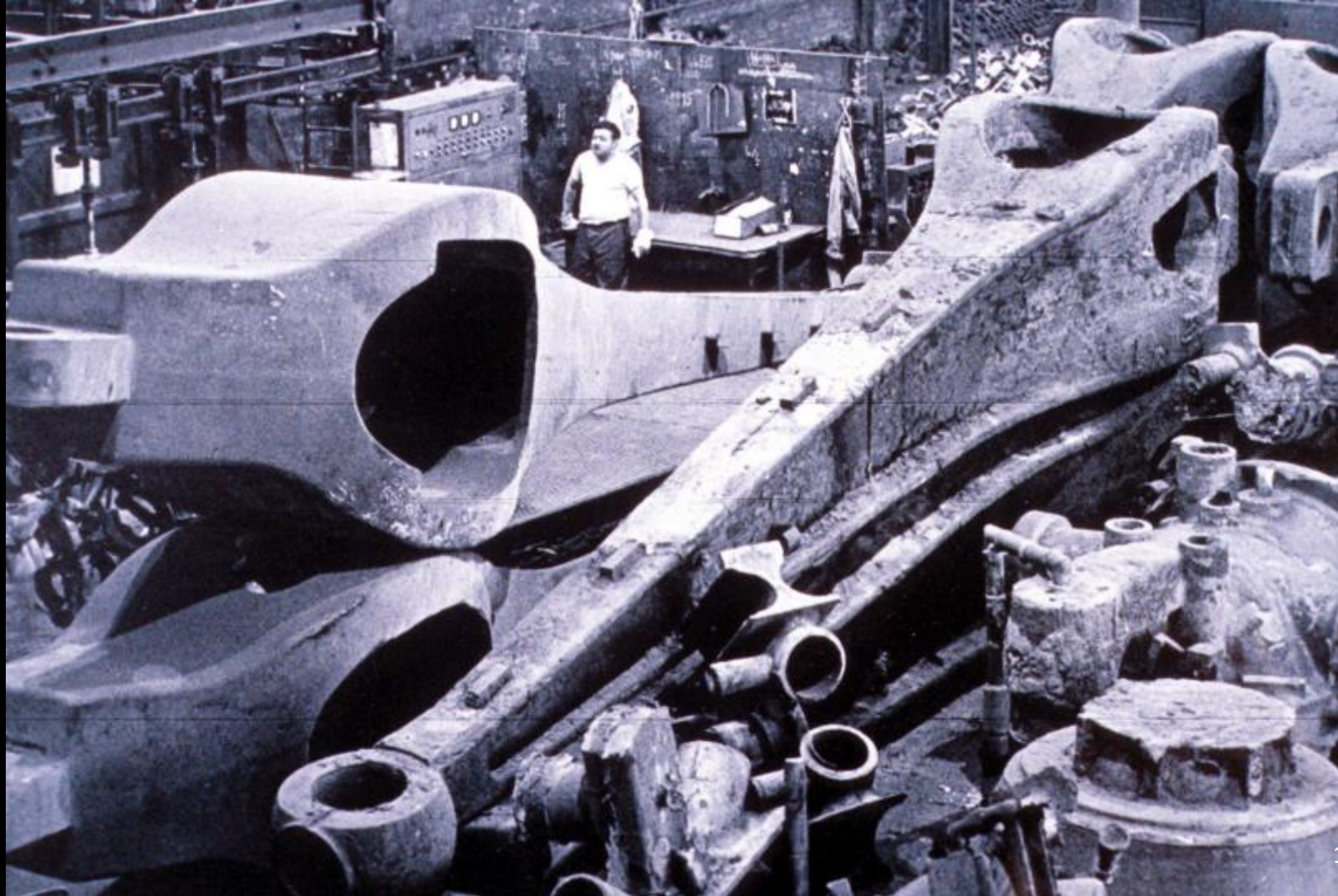
APRES MISE EN PLACE DES APPUIS  
 LES ESPACES LIBRES SERONT REMPLIS  
 DE COUPELLE SERRISSE

COULÉ APPROXIMATIVEMENT A 100°C

*Centre des Poids & des Mesures*  
*Technique Industrielle de France*

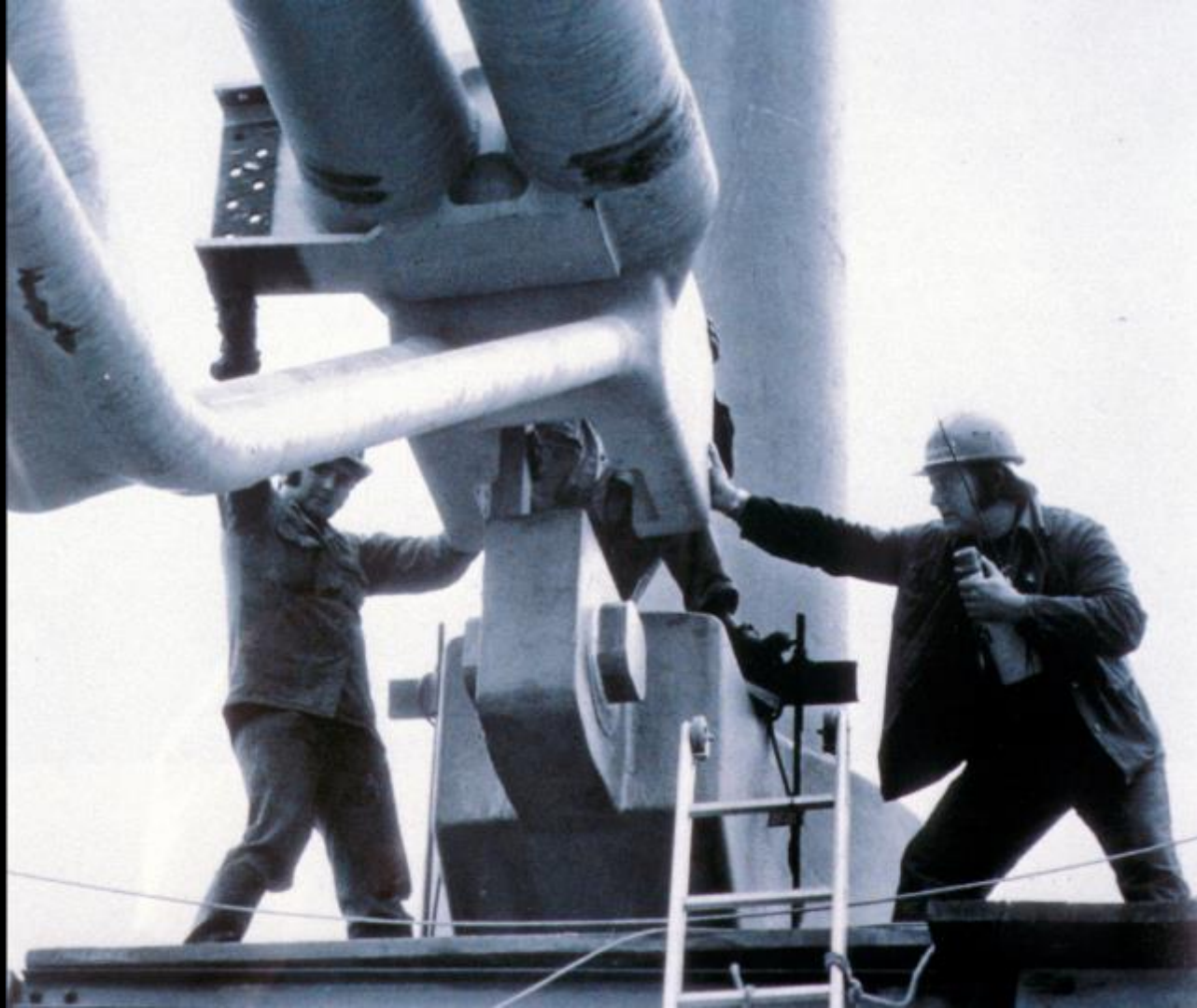




















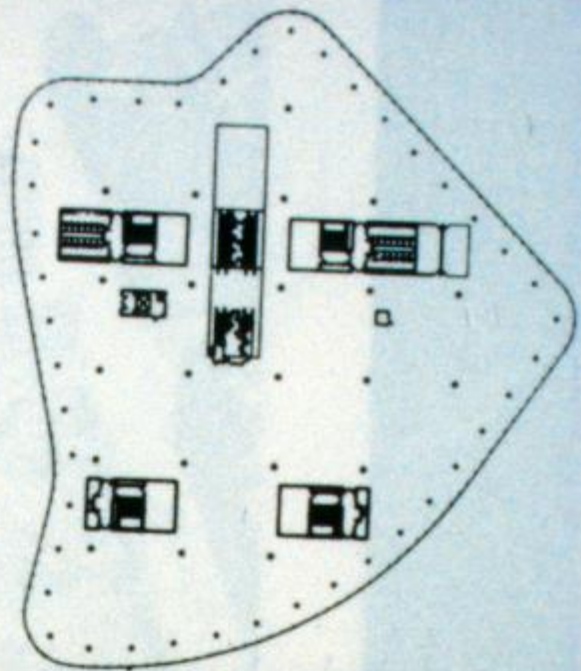
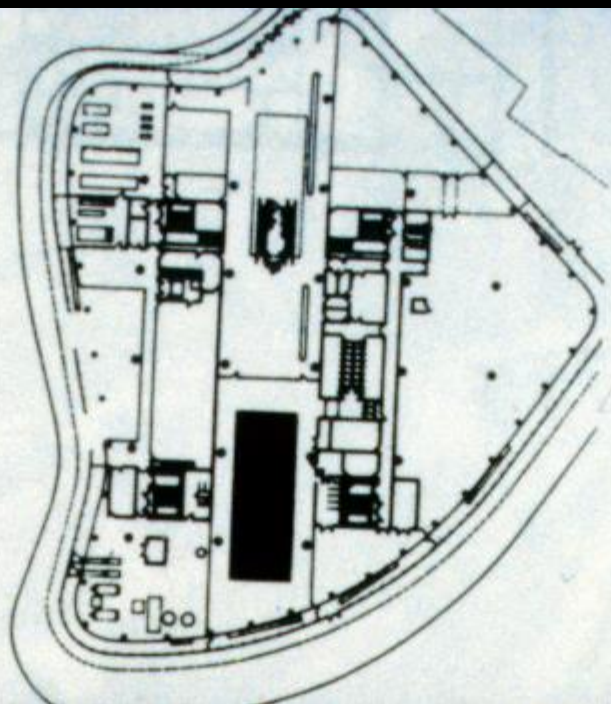
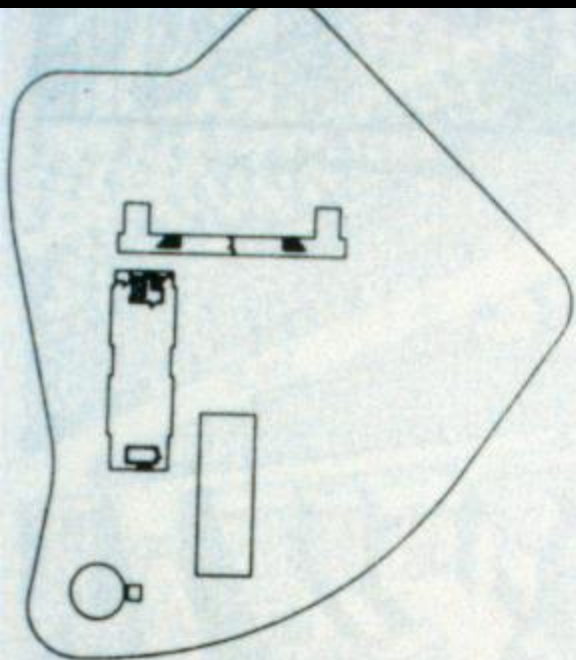


Willis Building (Willis Faber Dumas)  
Ipswich, England  
Norman Foster and Michael Hopkins  
1975



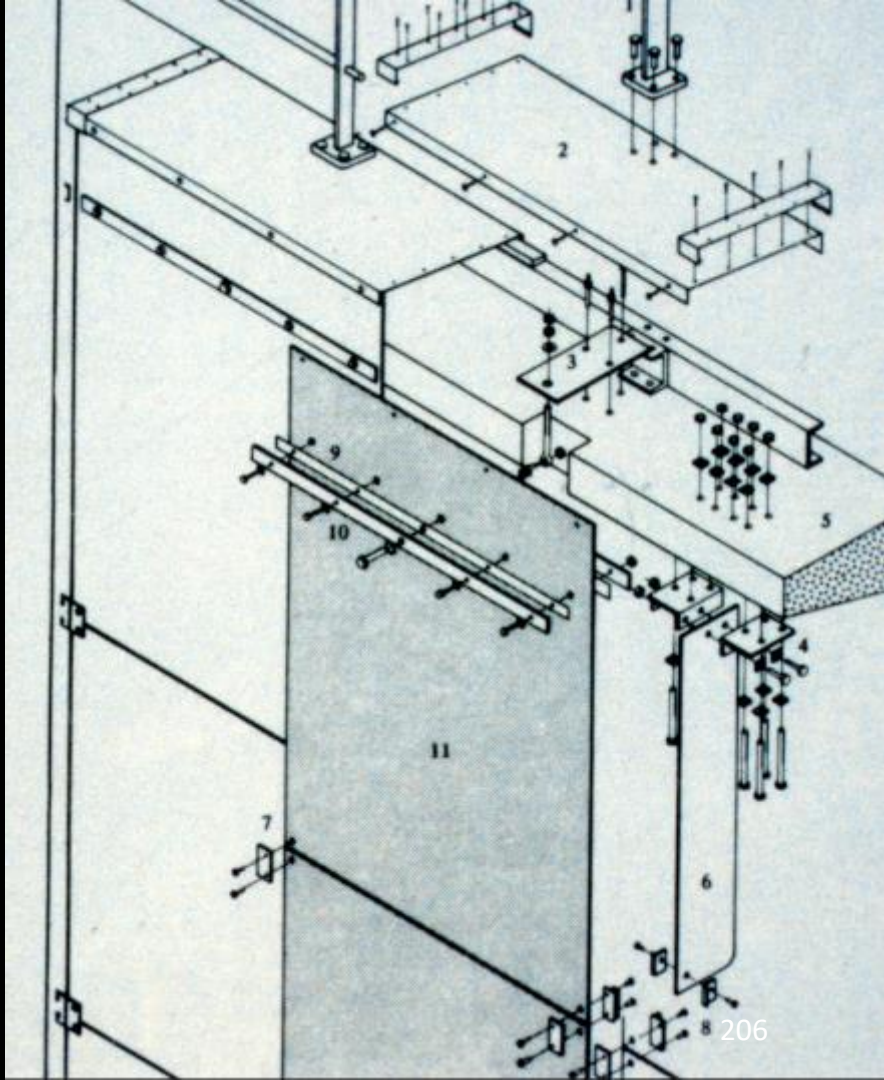
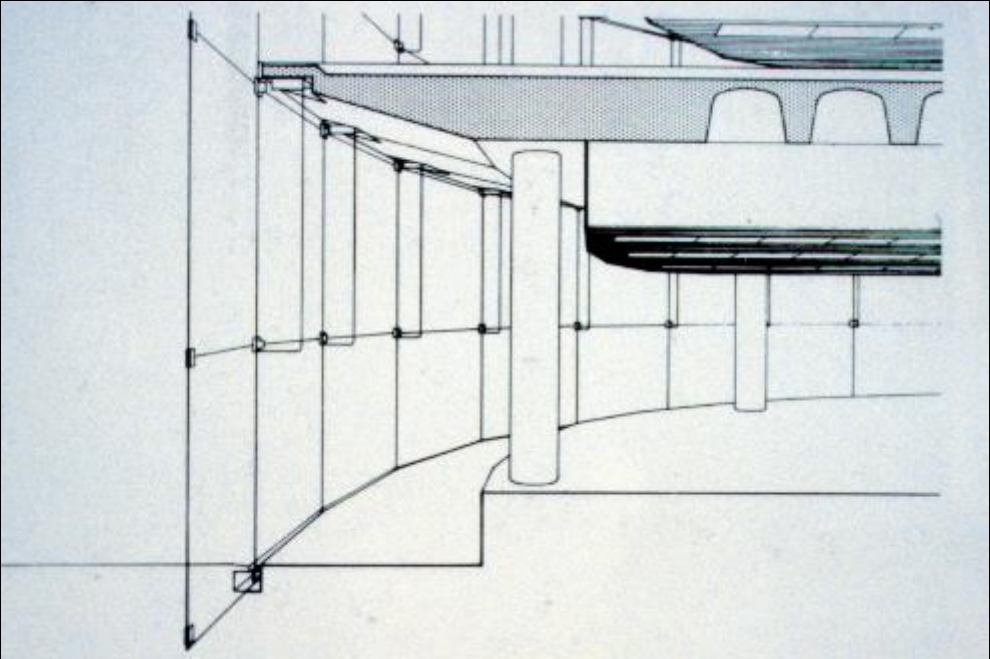
















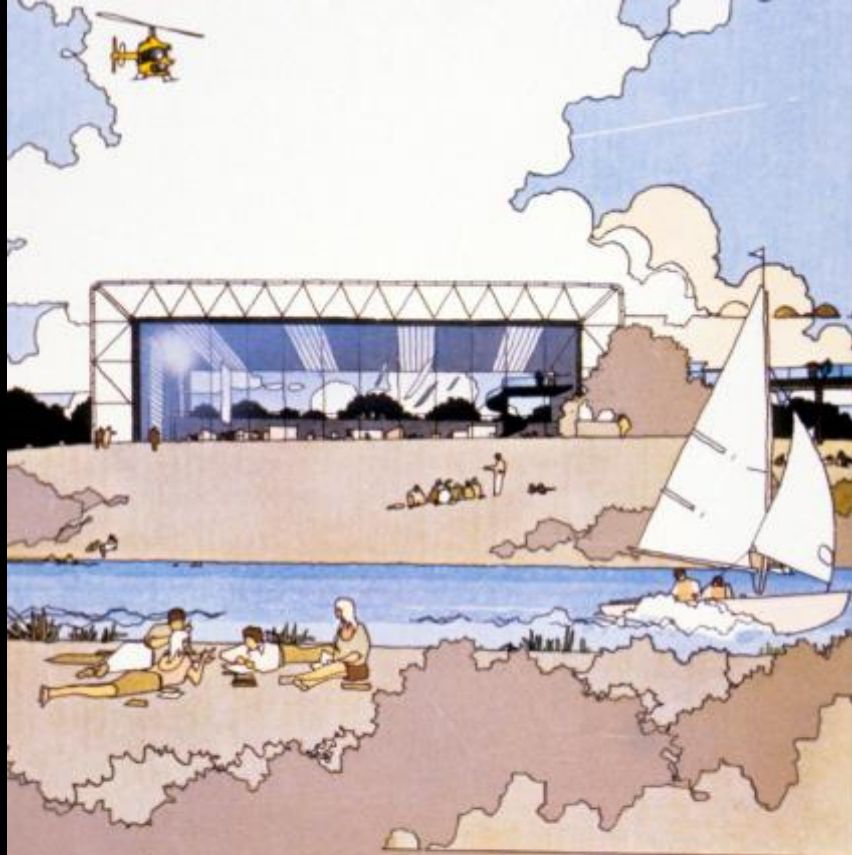






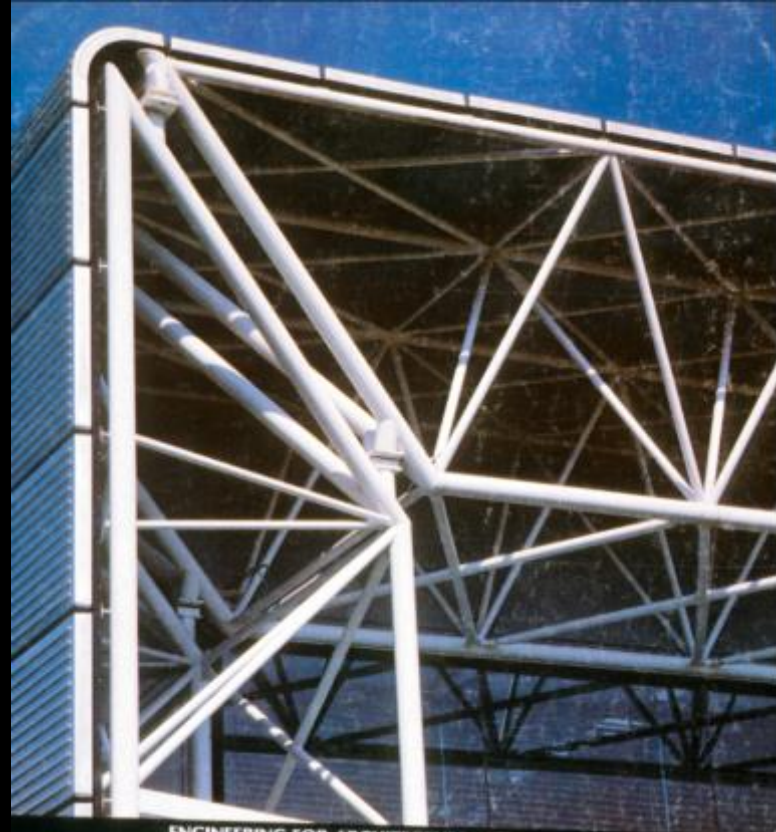
Sainsbury Centre for the Arts  
England  
Foster and Partners  
1977





FOSTER ASSOCIATES'

# SAINSBURY CENTRE



ENGINEERING FOR ARCHITECTURE 1979

# ARCHITECTURAL RECORD

MID-AUGUST 1979 A MCGRAW-HILL PUBLICATION \$5.50 PER COPY



# THE BUILDING AS SERVICING MECHANISM (TECHNOLOGY)



Given the progressive highly serviced and technological 'Sheddy' that has tended to be associated with Foster Associates' buildings in the past, the Laboratory Centre can either be seen as a special case (as a laboratory case building) or alternatively making a change in emphasis of Foster's use of advanced technology. The diagrammatic concept shows around a concrete to exploit the 2.1m deep, spectacular, free-spanning structural system eventually chosen, as a consistent service zone around the entire envelope of the building (since the original proposal to expose the structure externally was deleted).

This case - that on one side with the glazed, solid (insulating) or louvre cladding system, and on the other, internally, with adjustable perforated aluminium louvres - is able to dynamically manage the environmental conditions within the building, by filtering or generating light, introducing and extracting air, and alternatively buffering or absorbing sound. It houses service rooms at ground level and provides outside access across the roof to the lighting system and roof panels. Rather than the commonplace of decentralised servicing of Wills Faber, which is displayed as part of the building yet justified by its efficiency, the servicing of the Laboratory Centre, decentralised in a similar manner, is deliberately low key - optimised by the established network service lines in the external elevation, internally the service entrances are similarly disguised as part of the overall consistent louvre network finish. As Foster notes, the servicing is sensed rather than visible - magically responding to the changing light levels.<sup>18</sup>

The concept of the building as machine has previously featured architecturally in the 20th century. The Centre's visible response to the changing external environment brings the building close to re-asserting the Constructivist ideal of an objective architecture of technical function; bearing a striking, if pragmatic, similarity to Maki's Nagai's vision of a 'light architecture'.<sup>19</sup>

Foster's container for outdoor conditions its internal environment discreetly, as a 'sensitively controlled box' - its camera and security system revealed into perforated walls. This stress on security, it could be argued, has had a not insignificant influence both on the siting and organisation of the building (the security system extends into the university grounds). The 'living' area for the collection site atop a concrete retained, excavated basement, whose presence speaks of the immense facility of the laboratory. Foster, talking of his visit to Louisiana museum outside Copenhagen (with the Laboratory while researching the project), was impressed by the 'social ingredient' of the place: 'everybody was there, everybody was enjoying it, the kids were there, the old age pensioners were there. It was a great flat place - when you was also very exciting were the displays, which were not over-prominent, were really enjoyed...'.<sup>20</sup> While enjoying the relaxed atmosphere, he deplores the lack of attention to servicing and security:

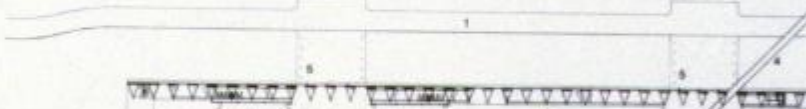
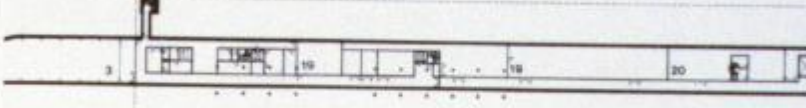
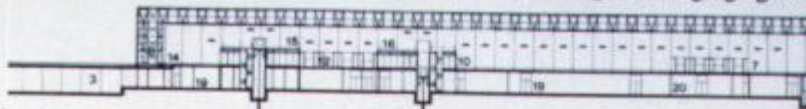
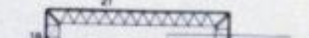
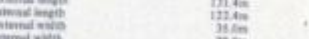
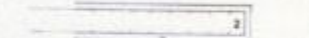
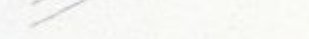
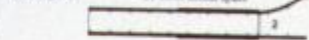
... their negative facilities - it was almost none, you really felt that with a screw driver you could have opened the whole place up and taken whatever was in storage away... if they had a Japanese exhibition which was due to come that week, and they were in a terrible state, they were going to have a container truck outside in the street and they were wondering how to get security between the street and this particular display how in such a way they can move these pieces outwards from the container into the building itself.<sup>21</sup>

The Laboratory Centre solves the dilemma by taking underground its service entrance for receiving

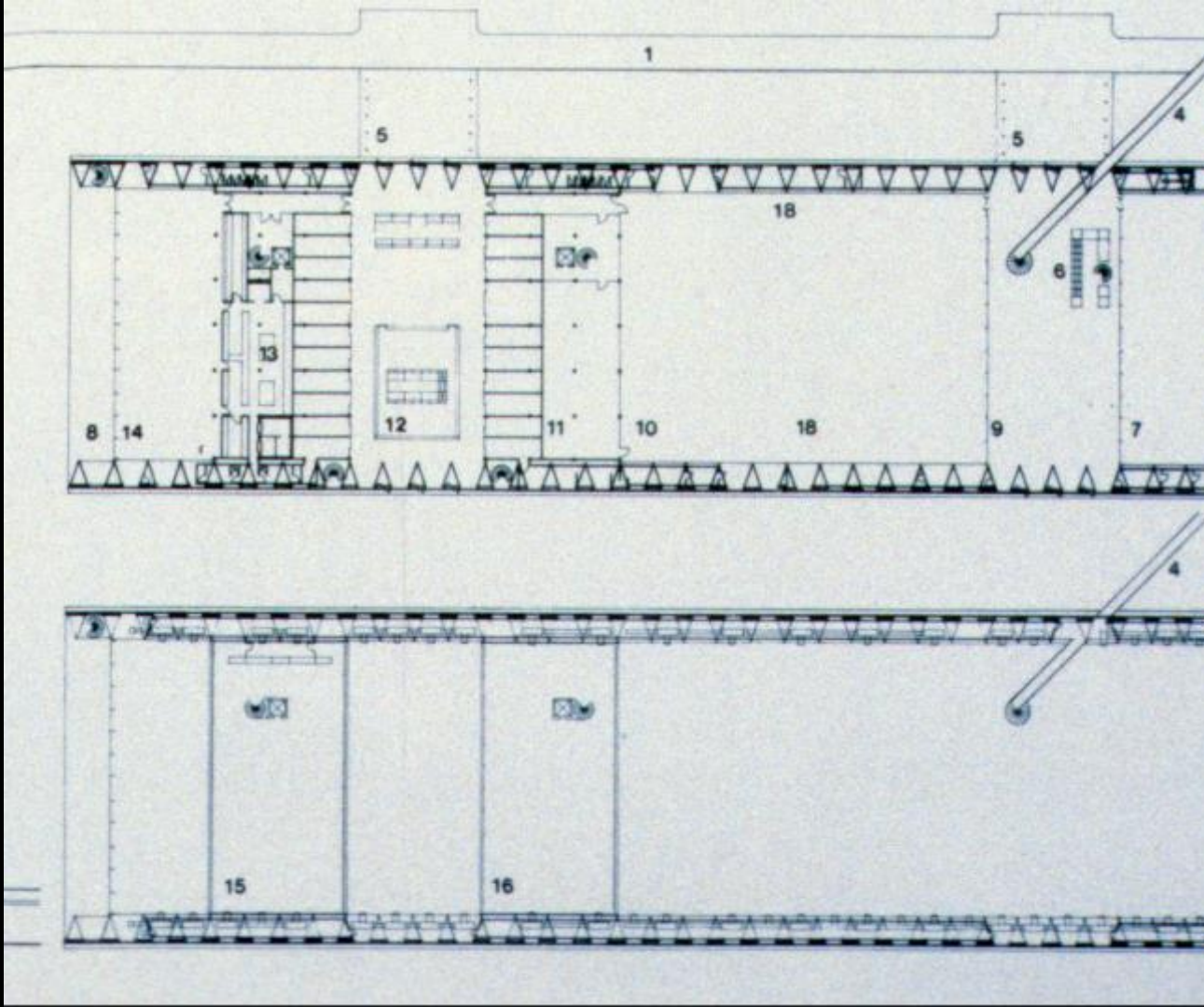
ing is sensed rather than visible - magically responding to changing light levels

Key to plans and sections

- 11 Study reserve
- 1 Access road
- 2 Ramp
- 3 Loading bay
- 4 High level walkway
- 5 Entrance
- 6 Information desk
- 7 Special exhibition area
- 8 Terrace
- 9 Coffee area
- 10 'Living area'
- 12 Study reserve
- 13 School of Fine Art
- 13 Kitchen
- 14 Restaurant
- 15 Service common study room
- 16 Study area
- 17 WC's
- 18 Plant
- 19 Storage
- 20 Workshop
- 21 Roof access space



Dimensions	
External length	121.4m
Internal length	122.4m
External width	35.6m
Internal width	29.0m
External height	10.2m
Internal height	7.2m
Ground floor area	
Maximum floor area	3550.0m <sup>2</sup>
Business floor area	830.0m <sup>2</sup>
Service core area	1064.0m <sup>2</sup>
Service core area	735.0m <sup>2</sup>
Total area	6186.0m <sup>2</sup>



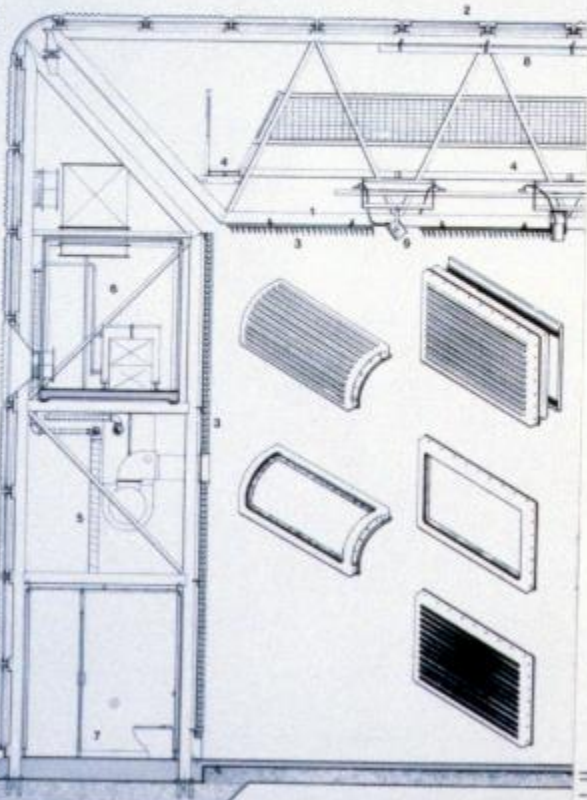
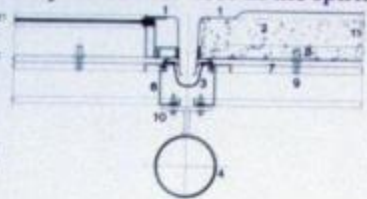


strained by an insistence on discreet hidden services in the spirit of a living room environment rather than a climate controlled vault for works of art

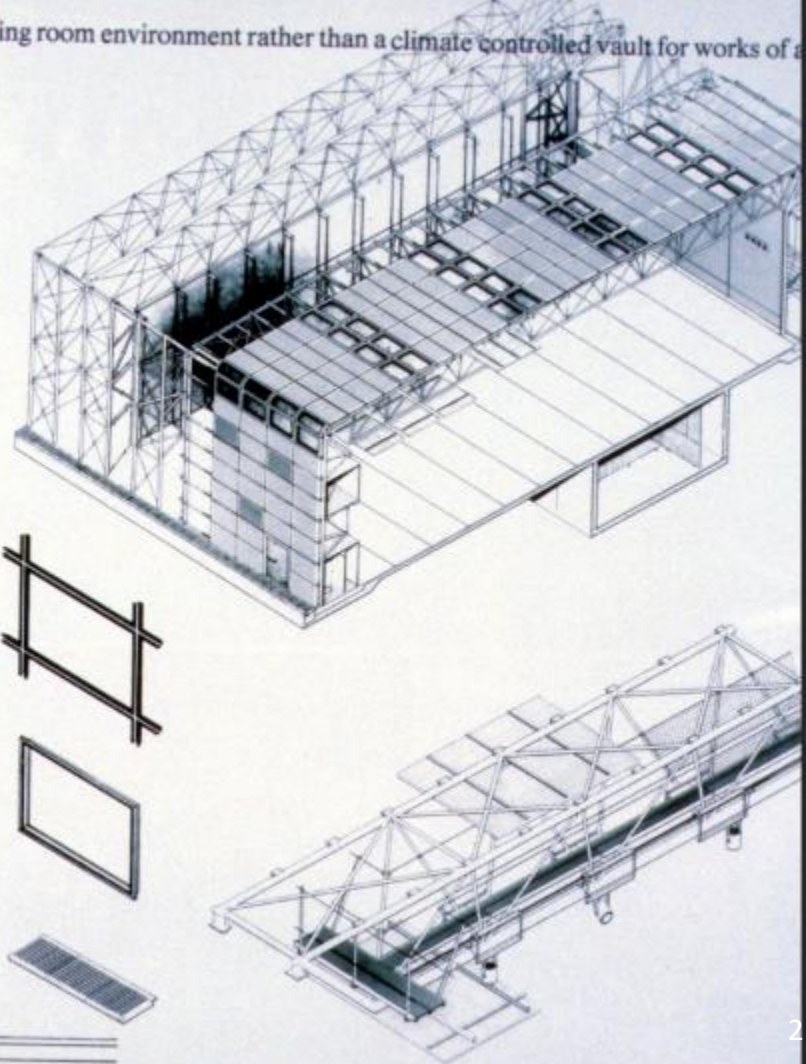
...ing exhibitions and deliveries. From the end a special extension is cut into the ground deep from the building, and ramped down to the basement. Lined with proper landing systems, doors have many of the characteristics of a modern office - indeed with 1.5 million ft<sup>2</sup> is not entirely a trivial comparison - built up against a full-level landing deck only in front of the works doors. Behind, the basement corridor, capable of being cut off in any way, provides access to the works of art, to a hydraulic lift at the end of the building (concealed as part of the temporary exhibition space). The basement is linked to the world above by transport lifts and linked to the street. However it functions quite as a security device ensuring the safe storage of valuable works of art - it is not intended for long-term storage, as the items are to be made available for study and for scientific purposes in the adjacent study. It is not only security areas, perhaps the most of the security comes in the 'living' areas that the domestic aspect of this space is highly different physical organization and security that are linked into the building. The main entrance level the main service building is the restaurant kitchen located in the SCB. It is the one major internal space and through it the service with a view to the building. Efficiently serviced in terms of its somewhat restricted and interconnected plan (compared with the apartment) is provided on the roof of Faber is apparently constrained by an extensive location serving as a whole, however the spirit of a living room environment in a climate controlled vault for works of art is substituted, and relies on the engineering of the ventilation system, the broad diameter of floor angles, and the screens, reflective and highly insulated the building envelope.

... a limitation of efficient and separate of deliveries and security, achieved by and discreetly integrating land (giving an environment), the location appears as the local environmental modification of the space viewed through the glazed end of the art installation environment of the building significantly the atmosphere for the work is based not in the open, or the (humble) security house). Notably the service mechanism is not a fixed or it is open to modification and change the building cladding system, but the flat flexibility has to take account the re-organization and use of the building

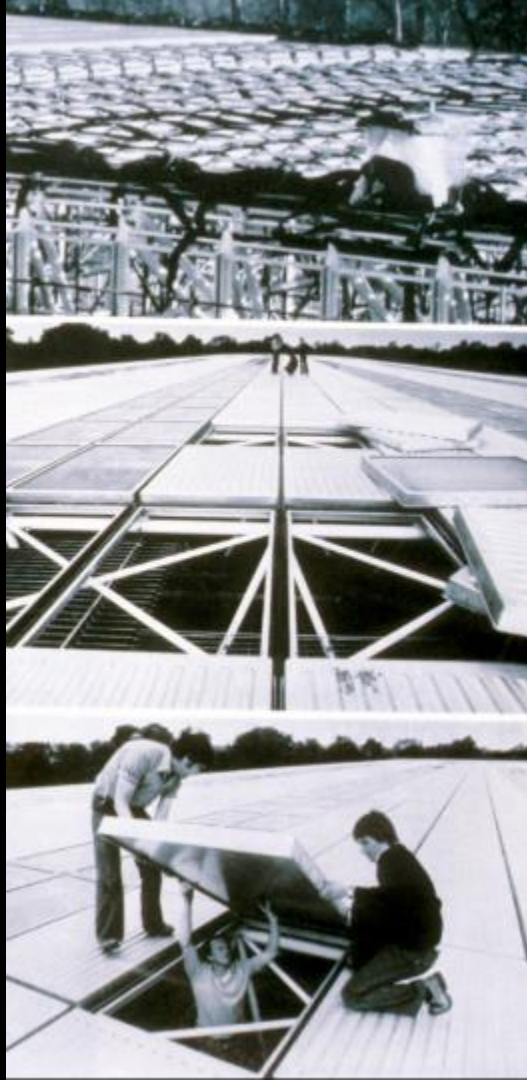
- Typical cladding panel key:
- 1 Aluminium outer skin
  - 2 Insulation core
  - 3 Suspense ladder gasket
  - 4 Tubular steel frame
  - 5 Laminated glass
  - 6 Extruded extruded aluminium substrate
  - 7 Aluminium inner skin
  - 8 Nut and bolt fixing
  - 9 Stainless steel screws
  - 10 Stainless steel nuts and bolts
  - 11 Aluminium channel stiffener



- 1 Floor
- 2 All services, plant, ductrooms, WC's, stairs
- 3 Suspense ladder gasket
- 4 Suspense ladder aluminium leaves
- 5 Combined artificial and natural top light
- 6 Cast aluminium grille
- 7 Gutter
- 8 Display screens
- 9 Display cases

































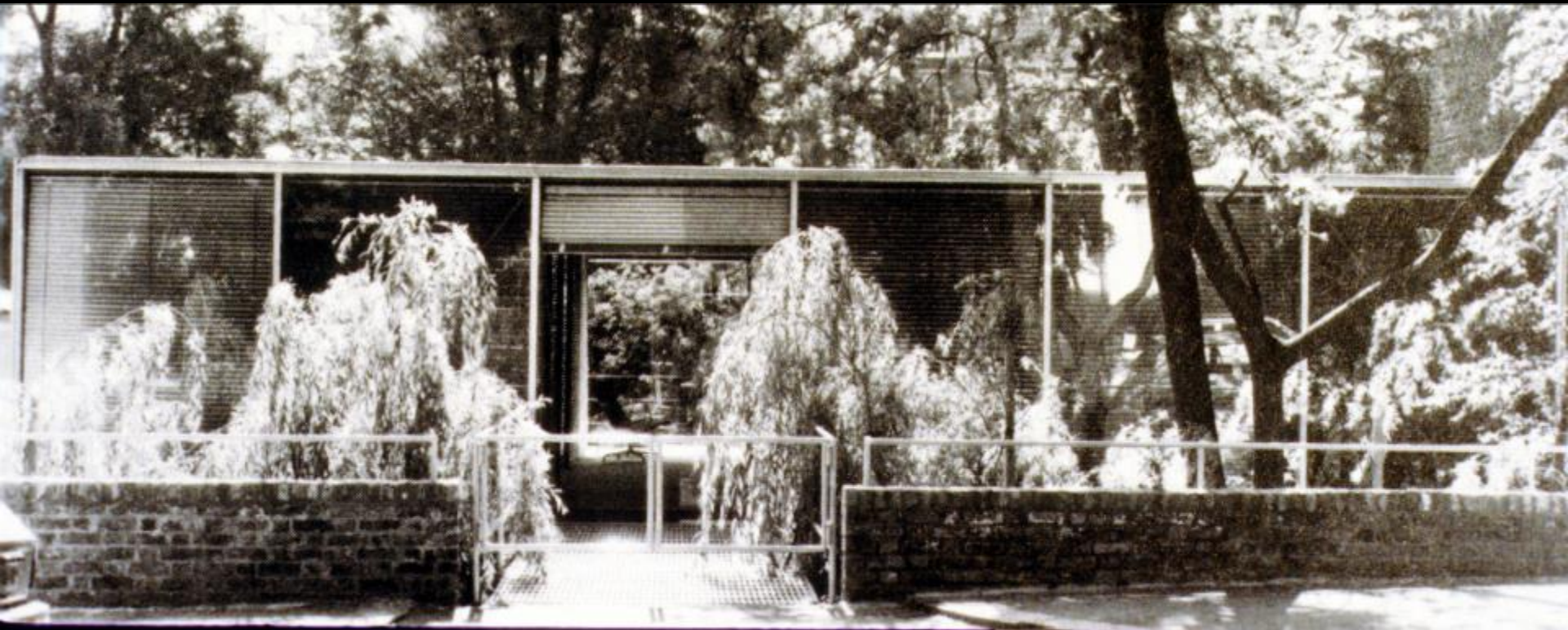






High Tech design approaches vary based on the choice to create custom components or use standard off-the-shelf materials

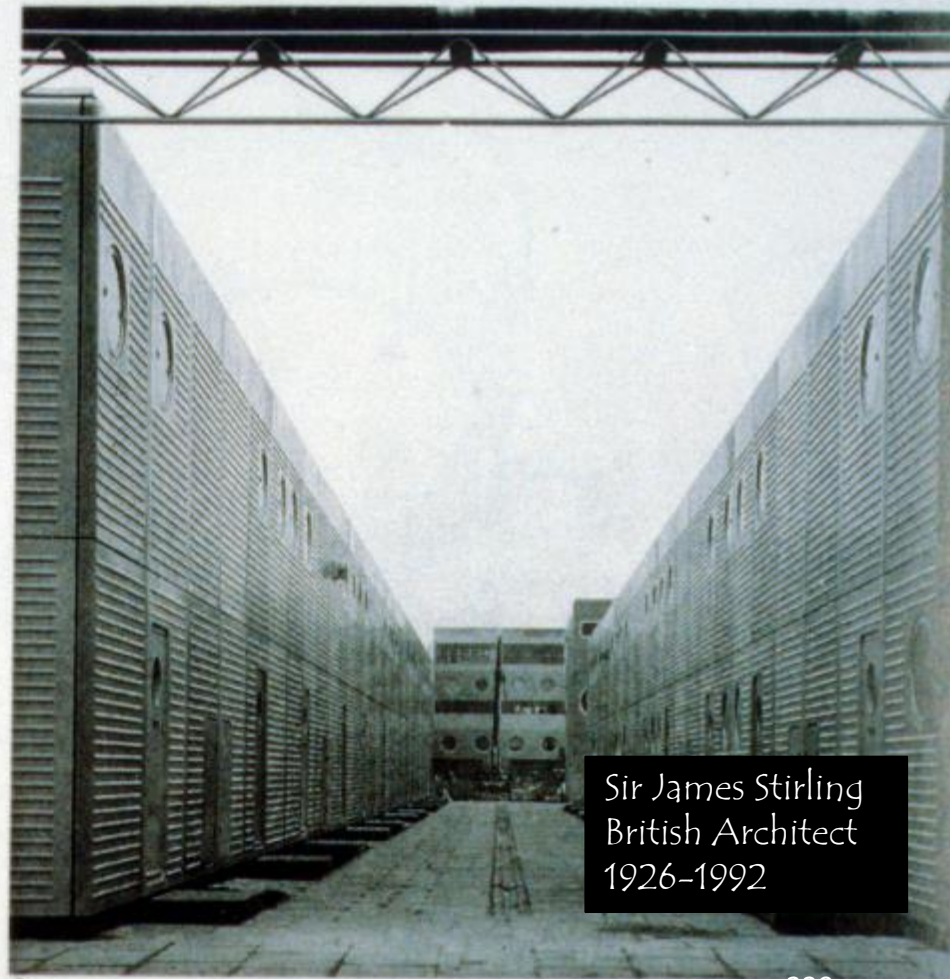
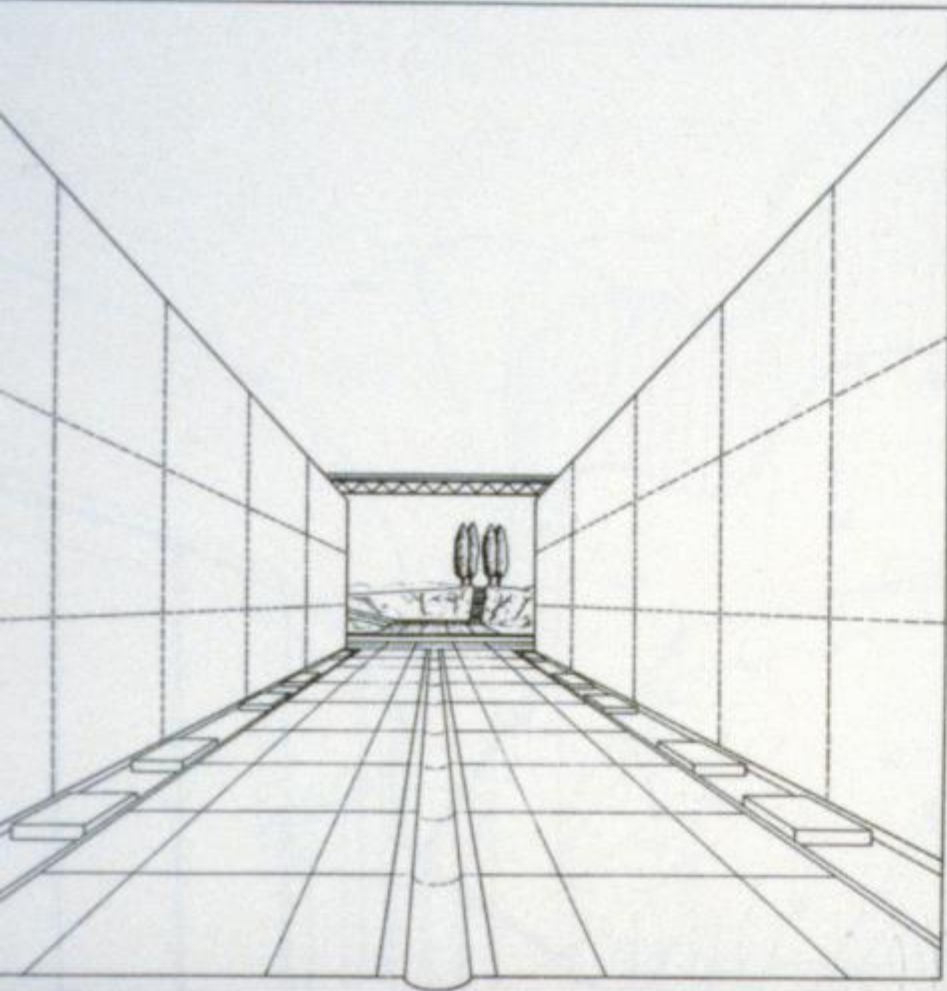
The historian Reyner Banham referred to these early buildings as "serviced sheds" as they exposed the structure and also all of the mechanical systems.



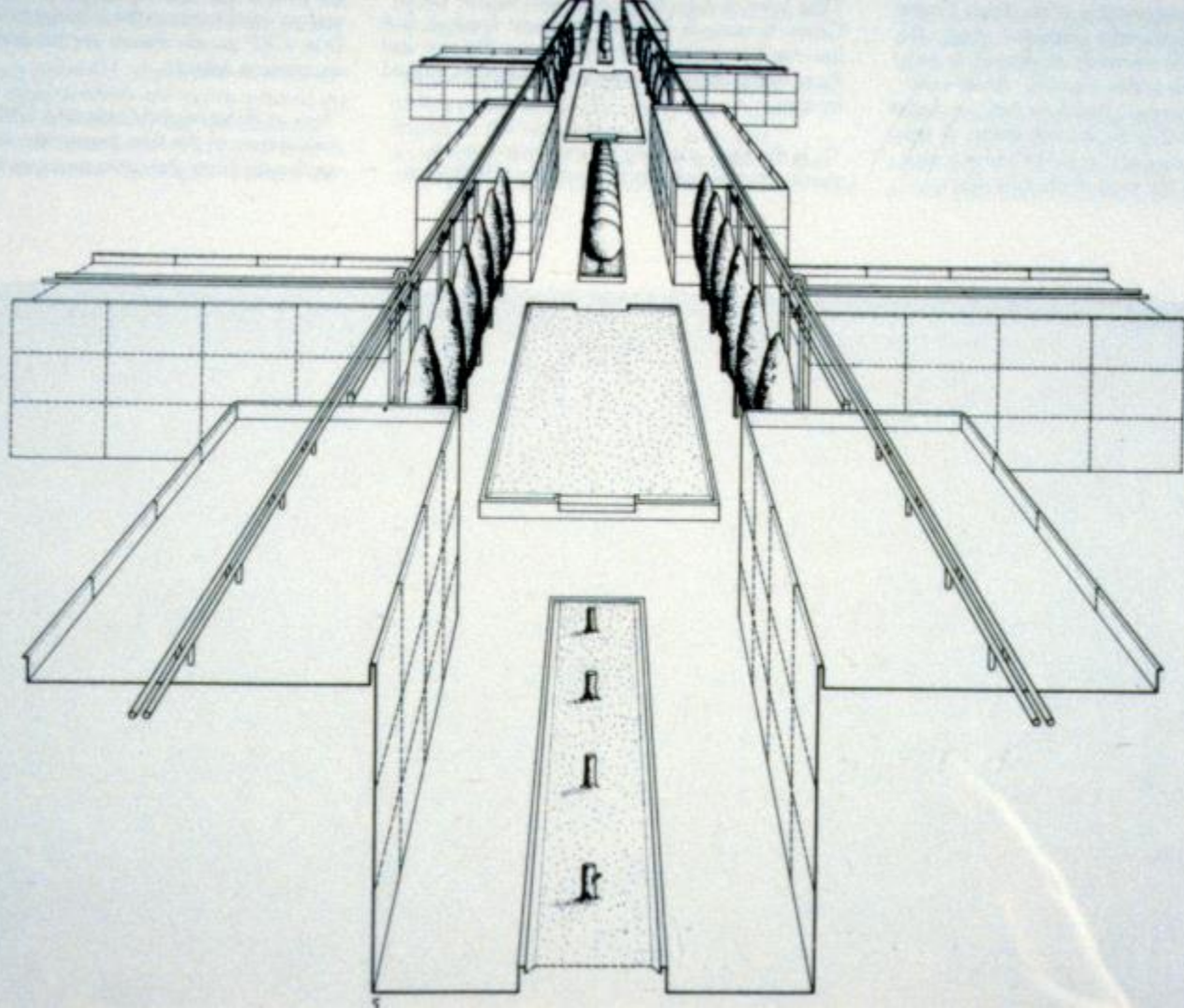
Residence  
Michael Hopkins  
1976







Sir James Stirling  
British Architect  
1926-1992







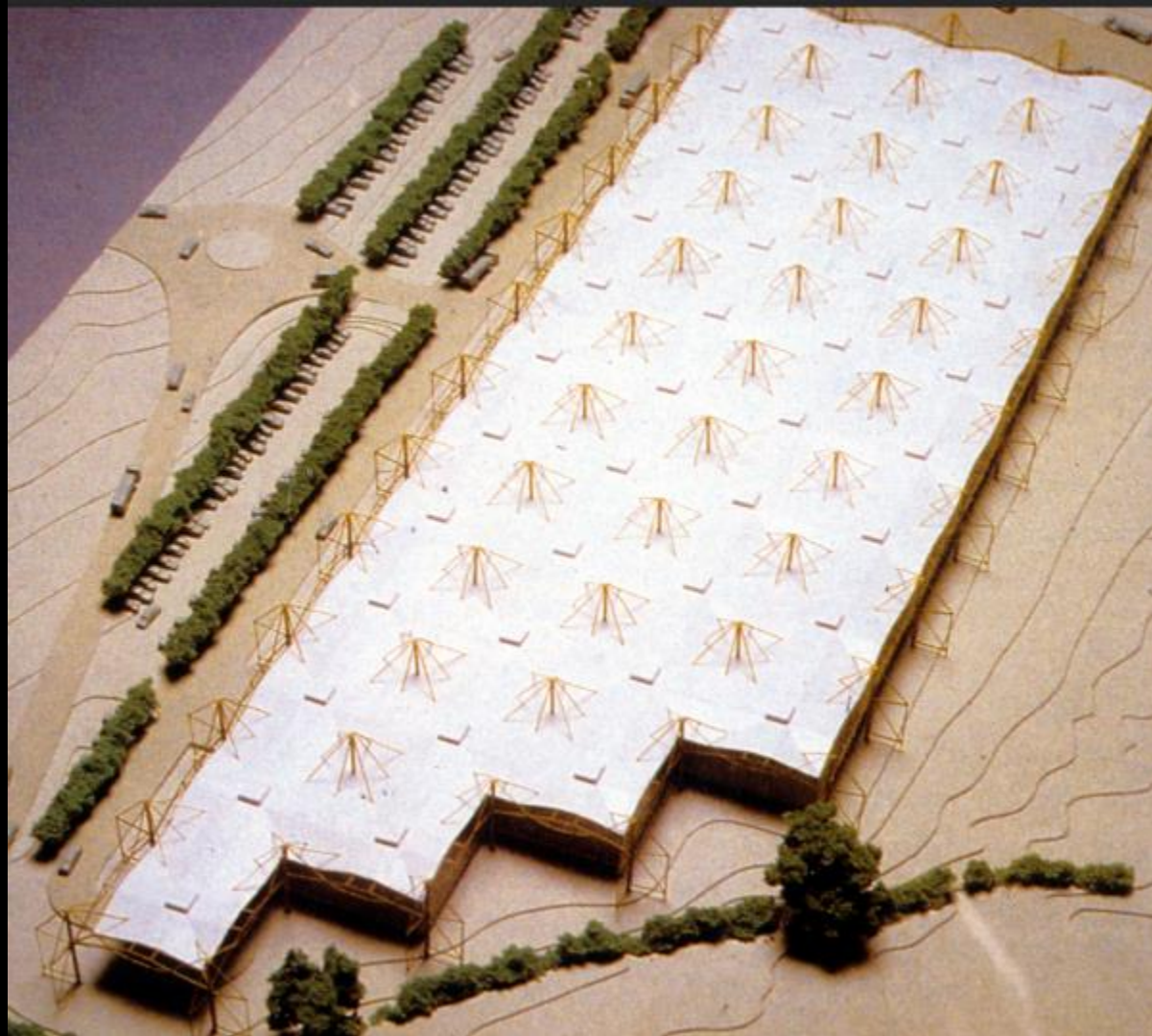




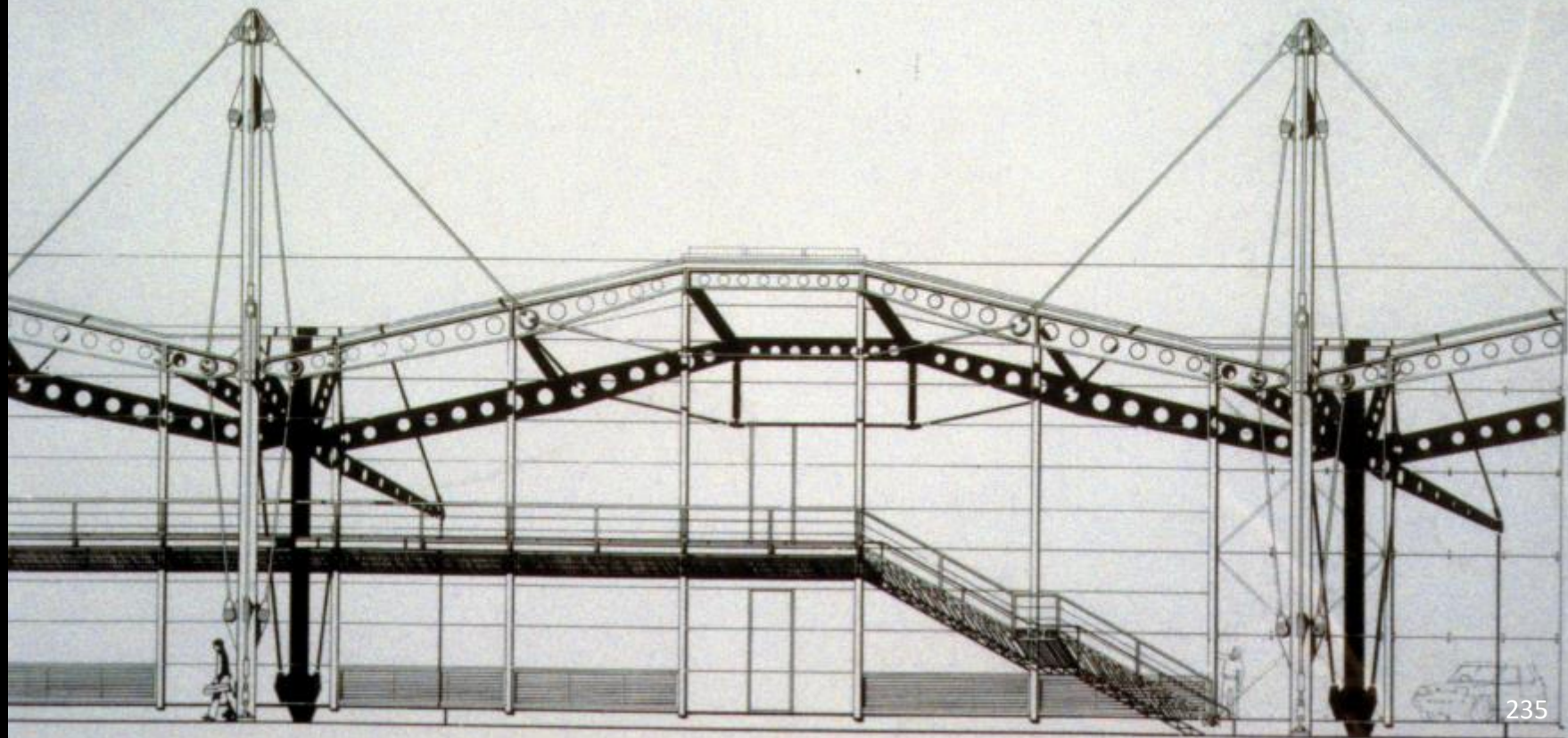


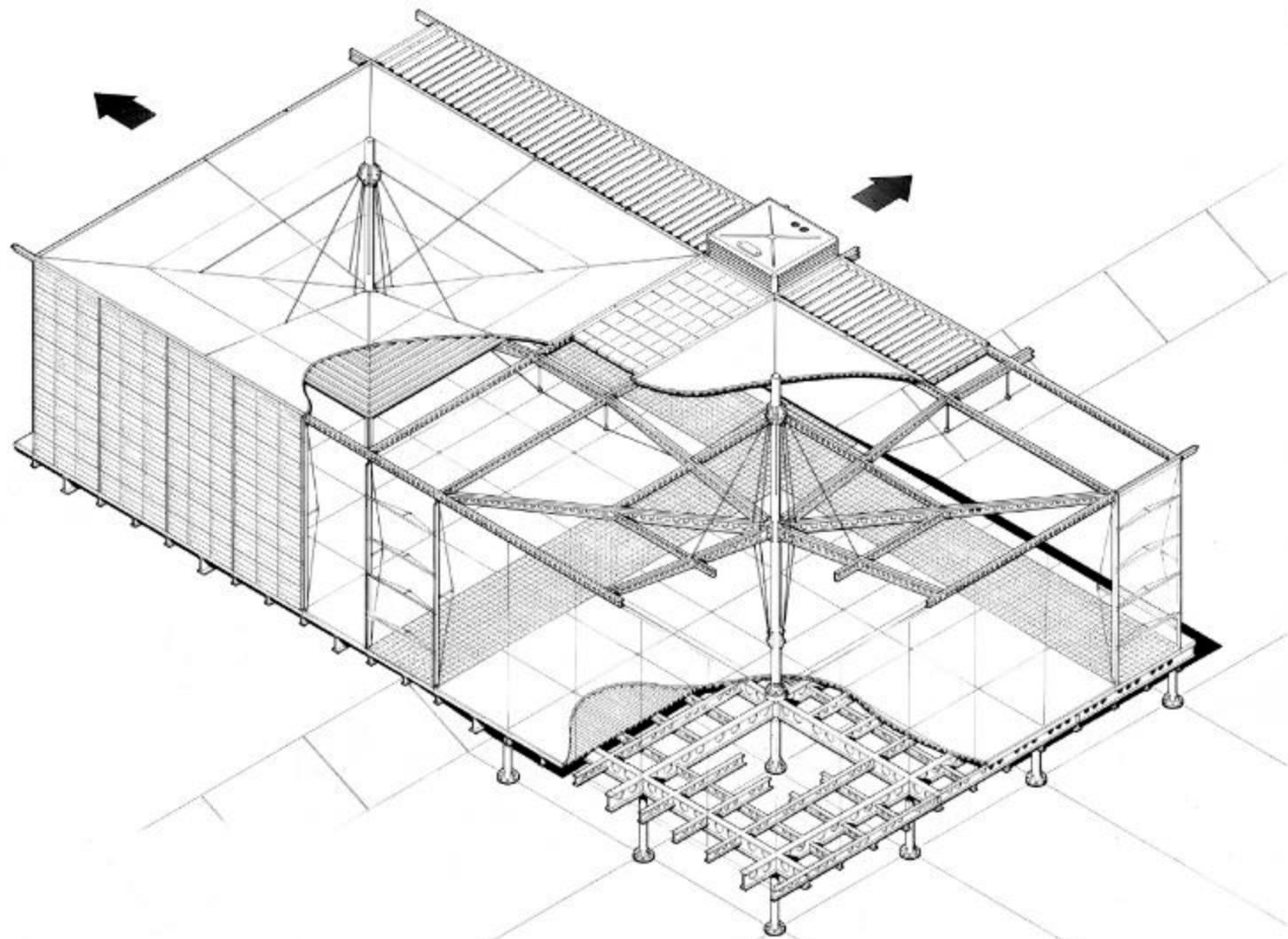
Renault Centre  
Swindon, UK  
Foster Associates  
1982

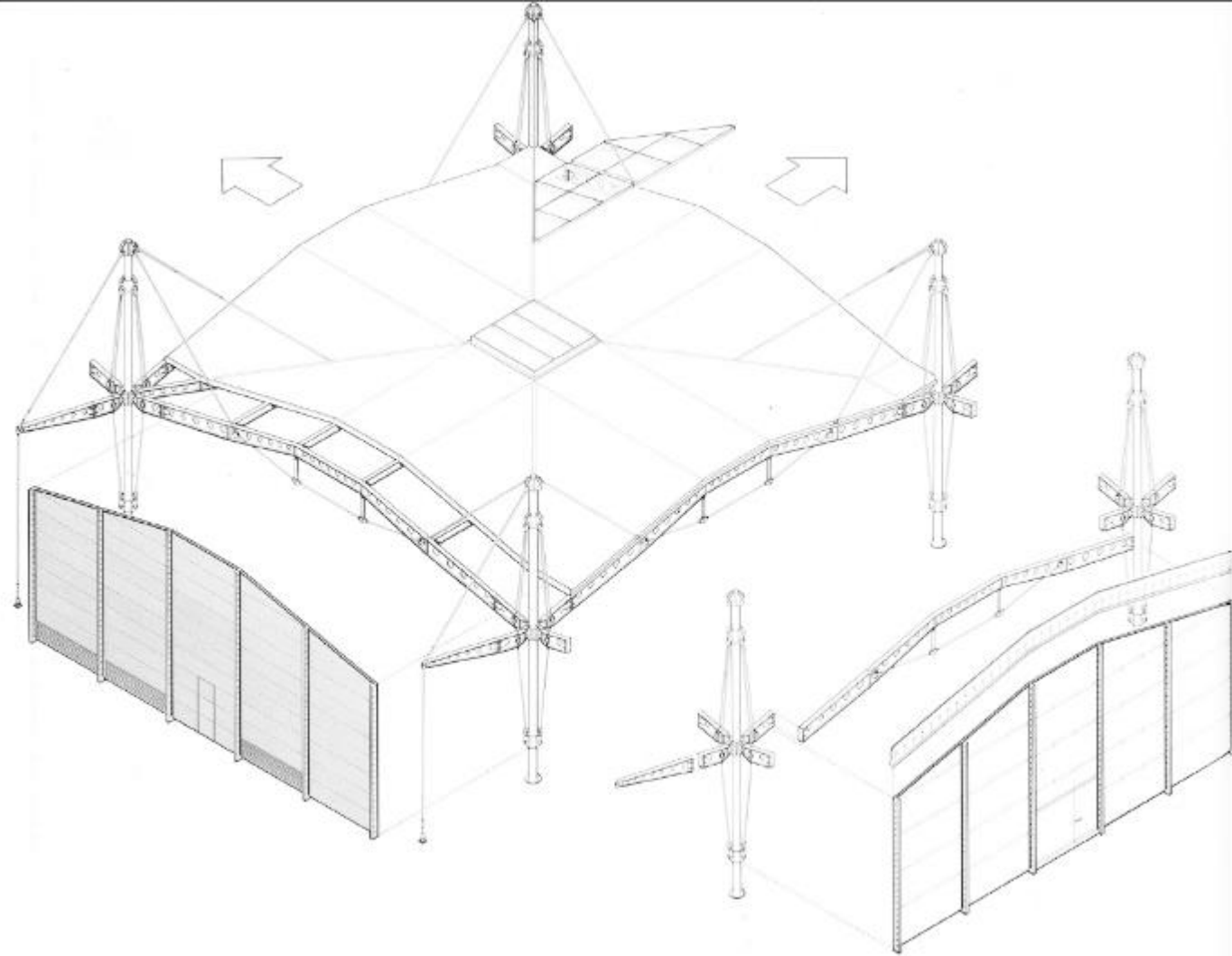














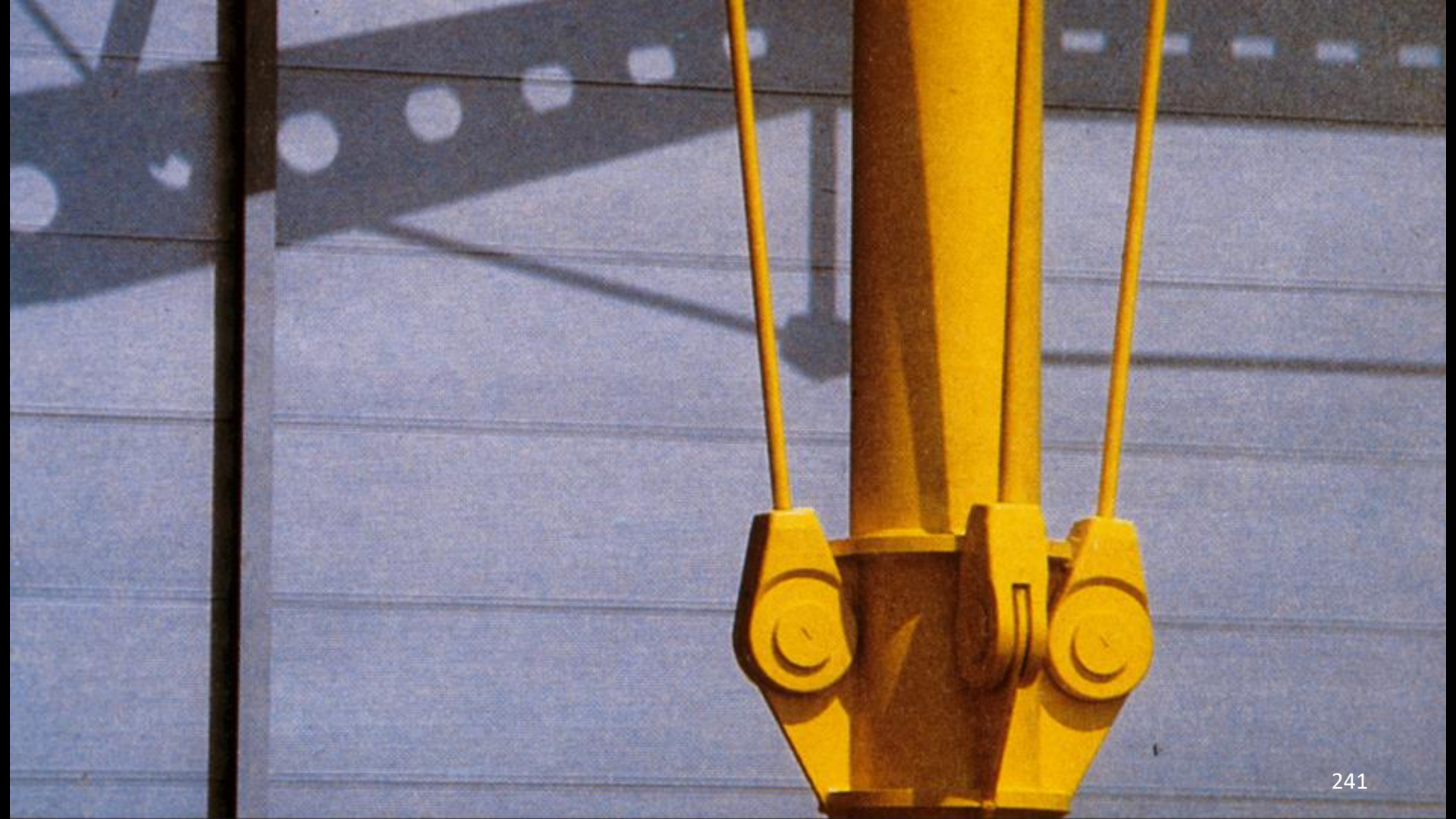












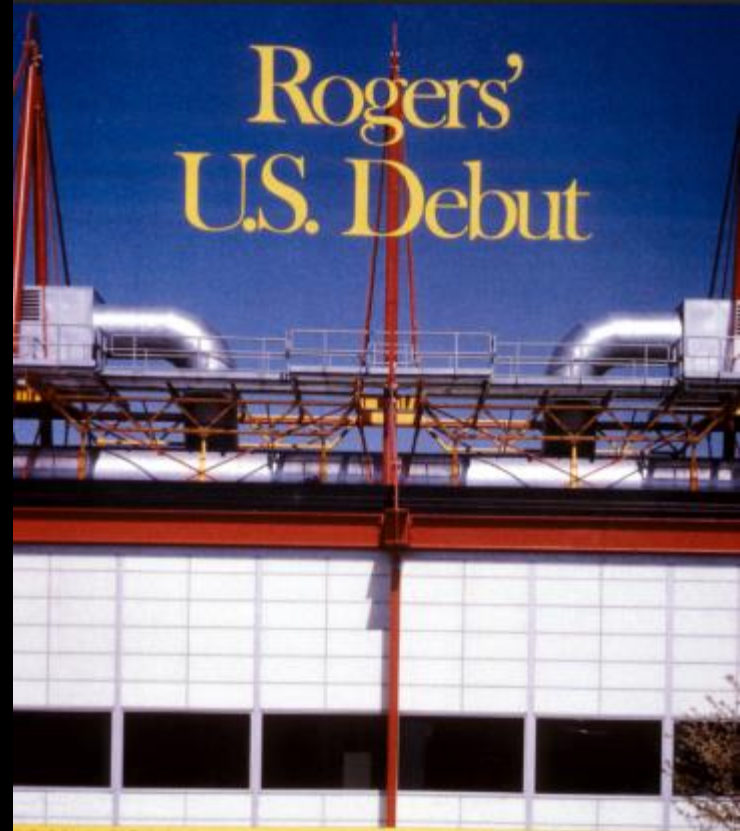
# Progressive Architecture

AUGUST 1988



PA Technology  
Hightstown, NJ  
Richard Rogers  
1985

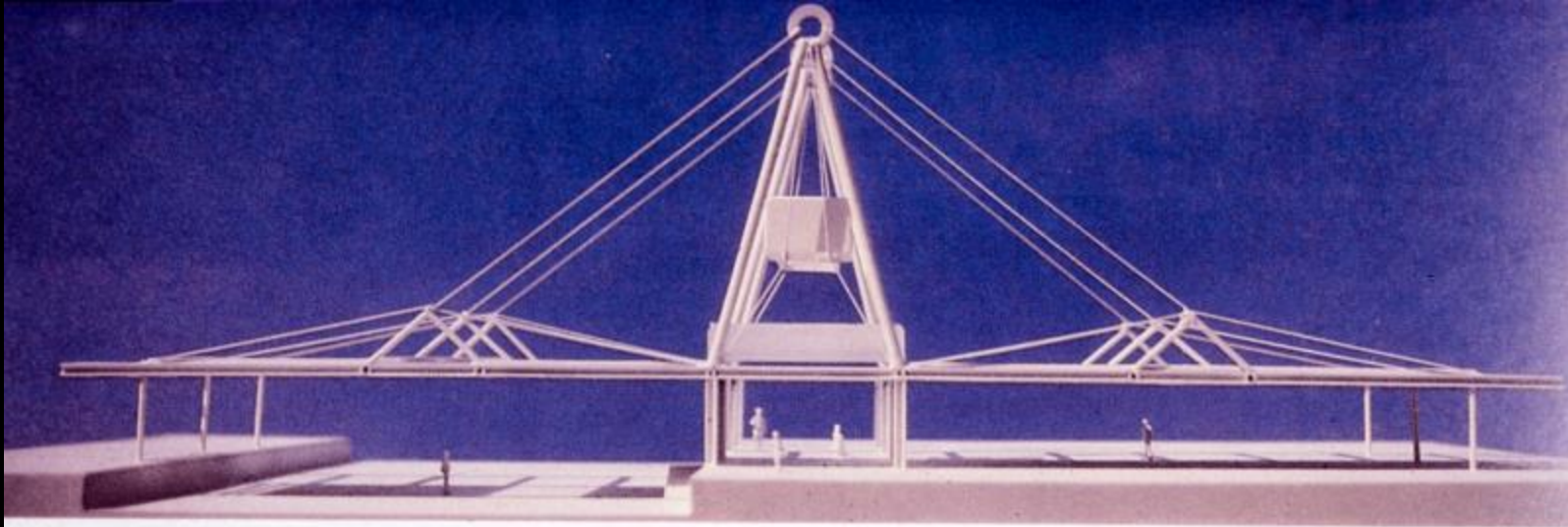
# Rogers' U.S. Debut



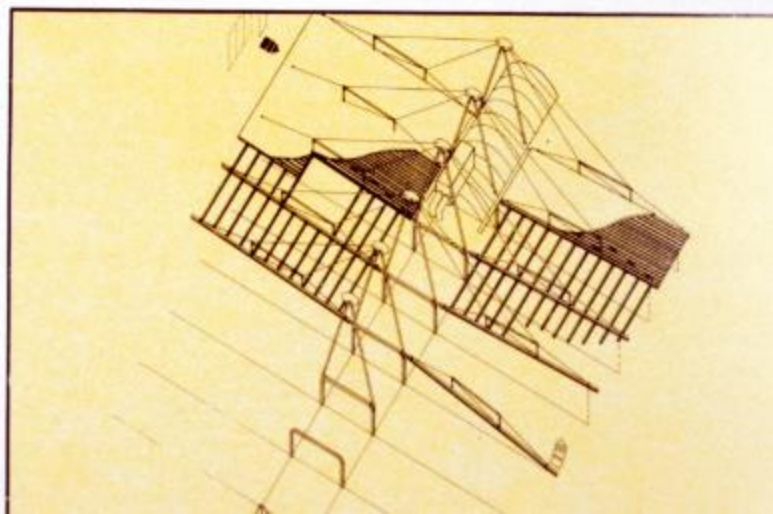
Industrial elevation, PA Technology Center.

*The PA Technology Facility in Hightstown, N.J. is the first work in the U.S. by British architect Richard Rogers, with Kelbaugh & Lee of Princeton, N.J.*



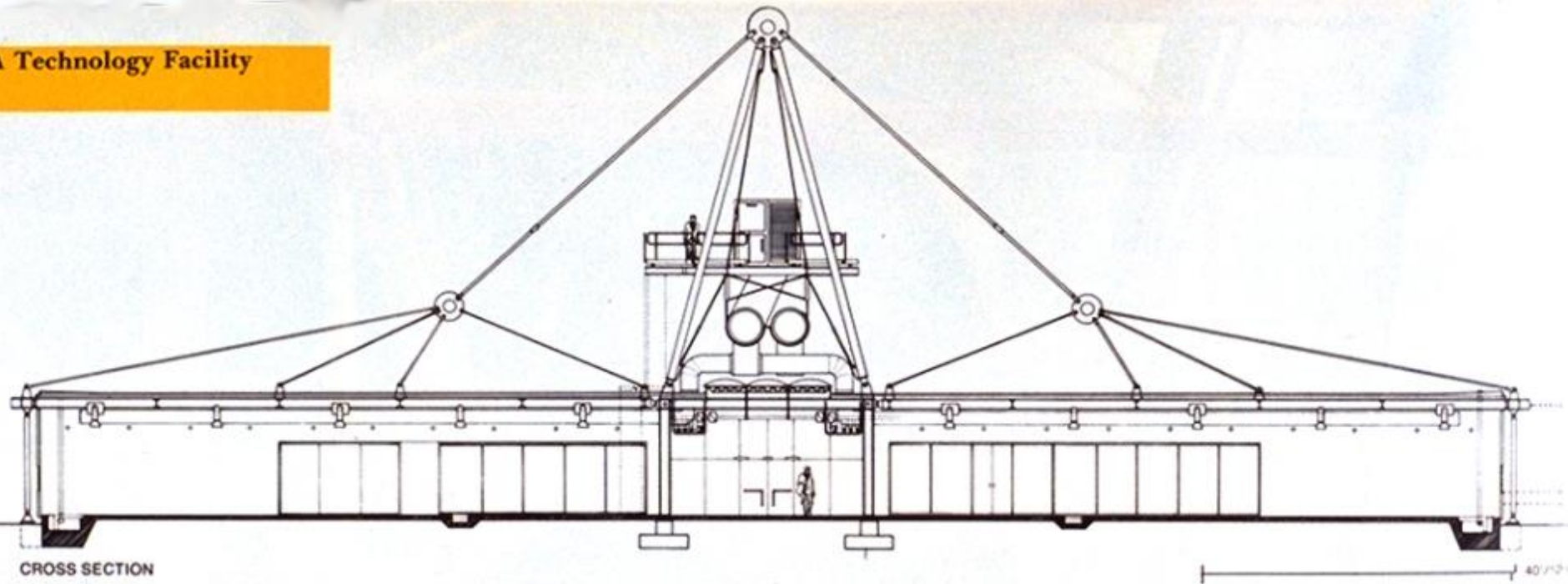


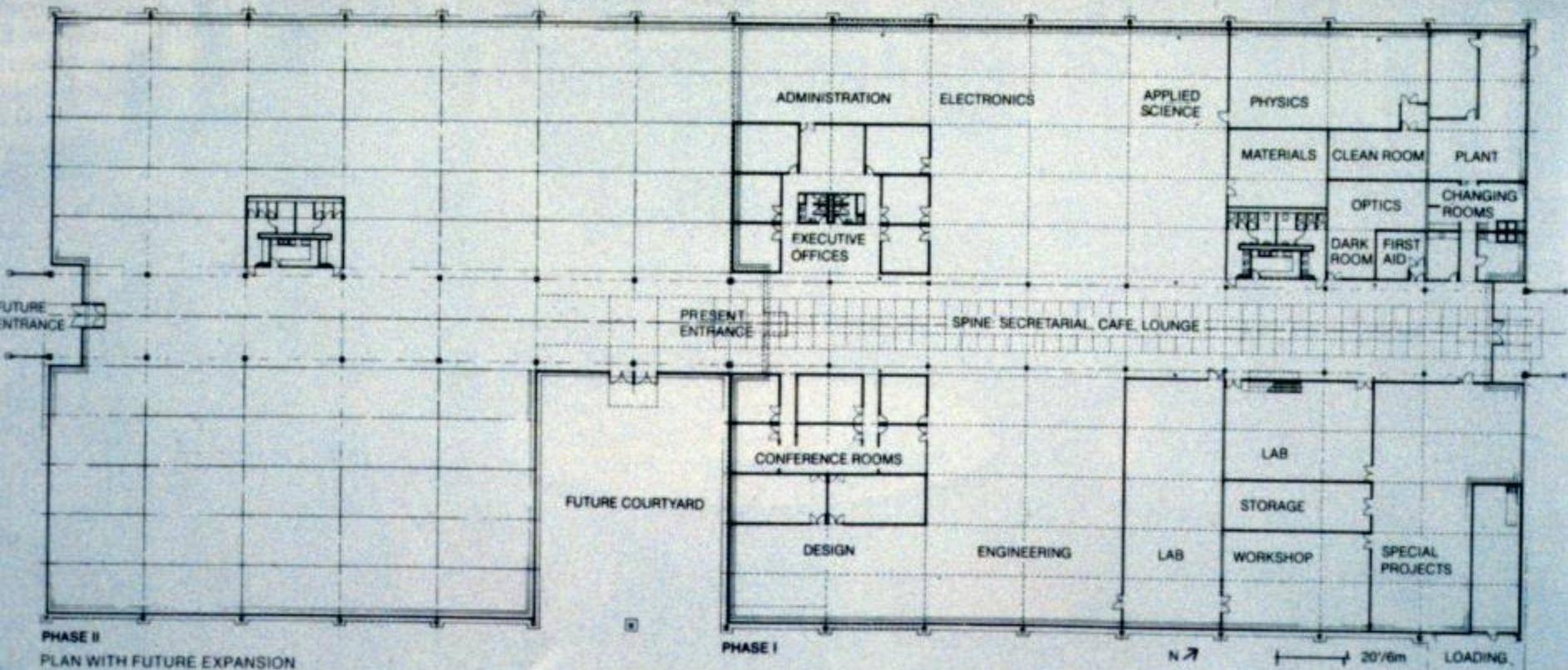
Model of structure

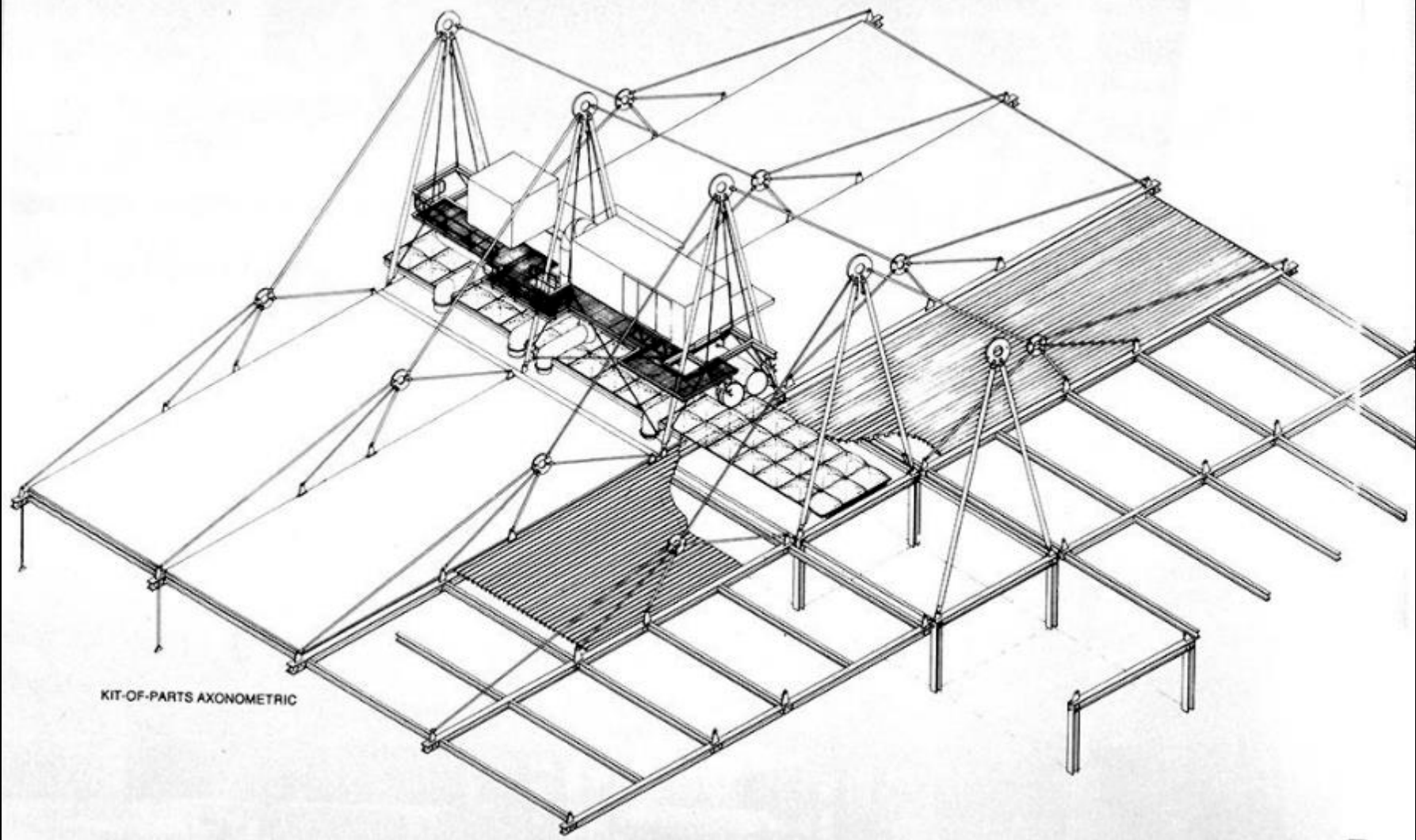




PA Technology Facility







KIT-OF-PARTS AXONOMETRIC



Building a structure that served as the headquarters of a Federal Reserve Bank offered an opportunity to create a new presence in Hightstown, New Jersey. The project was a combination of museum, archive, and exhibition space. The design and construction of the building was a challenge because of the site's location and the building's unique design.











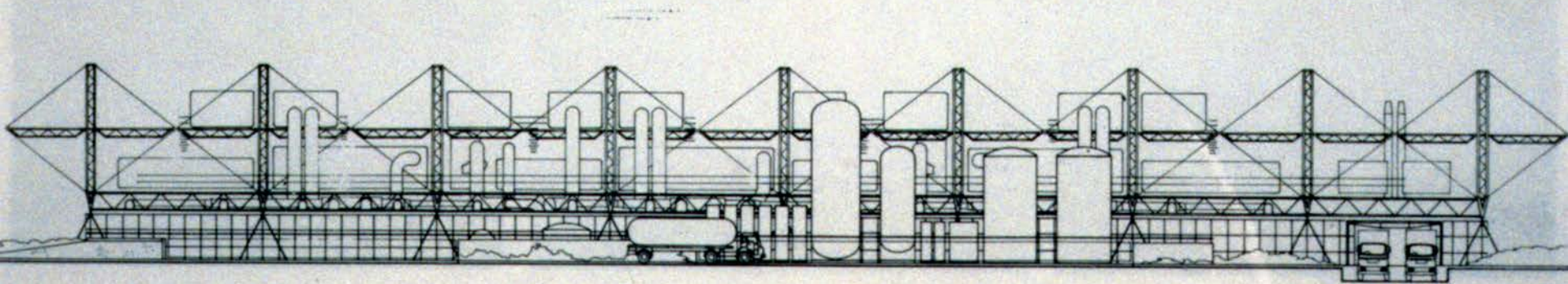
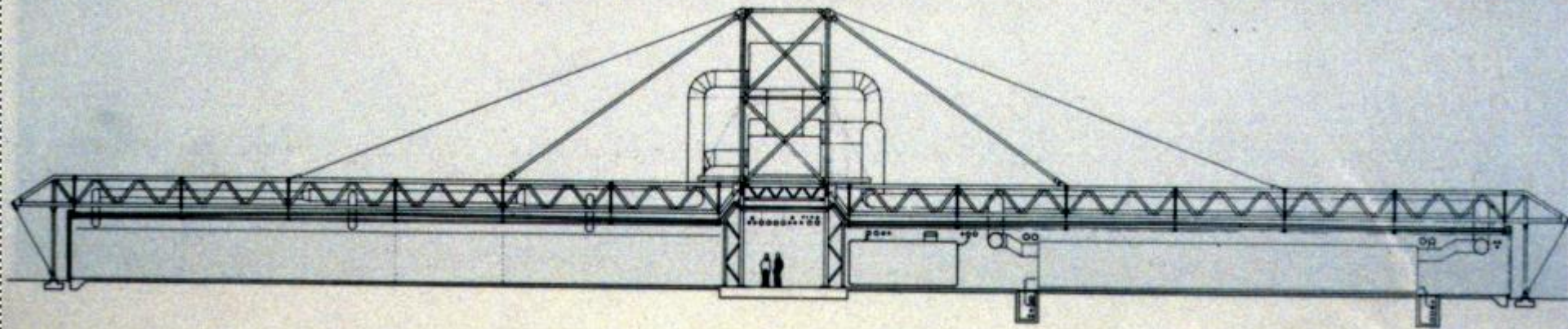




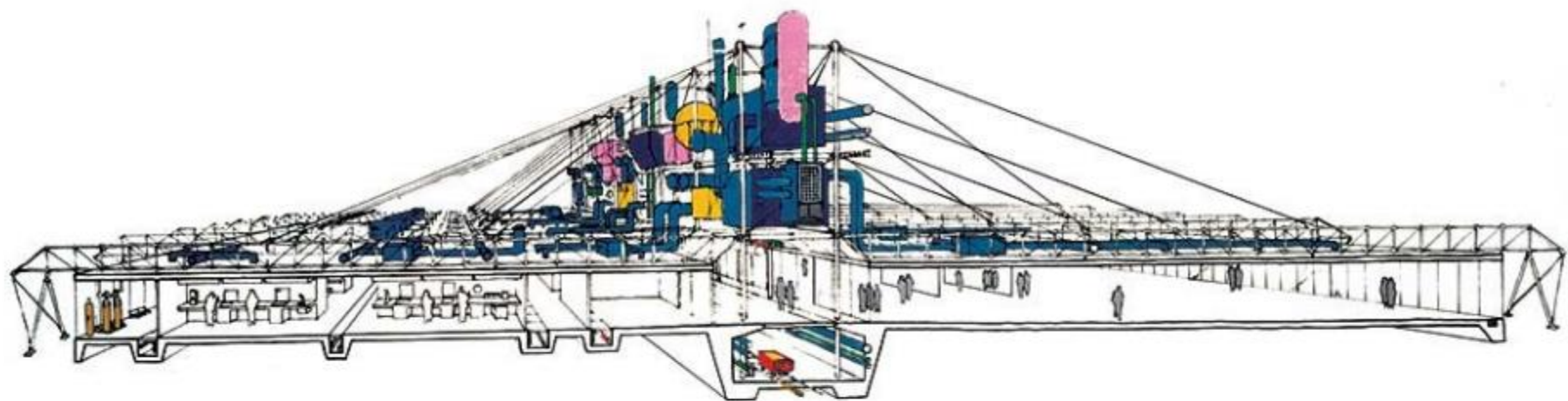


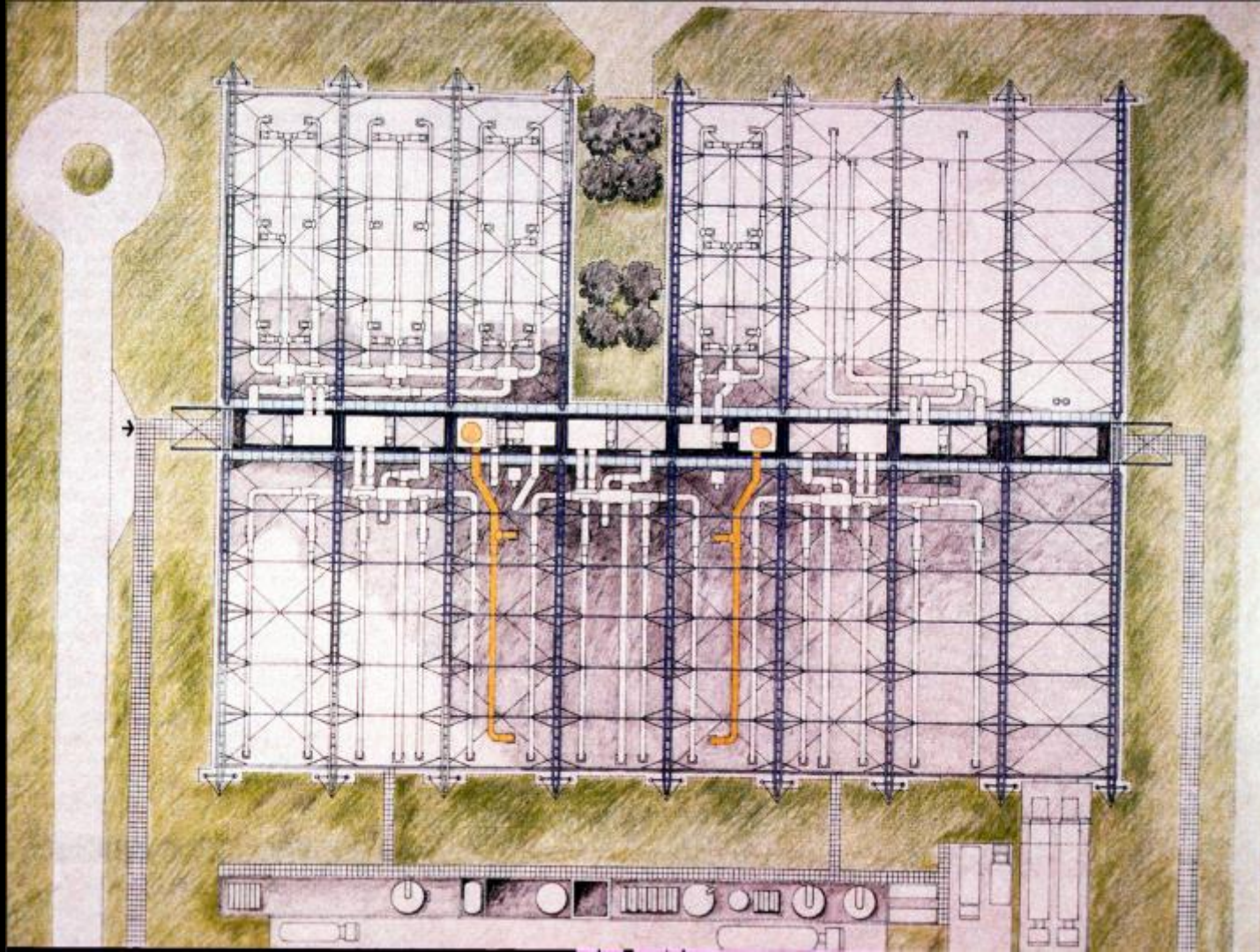
Inmos Technology  
Newport, Wales  
Richard Rogers  
1982



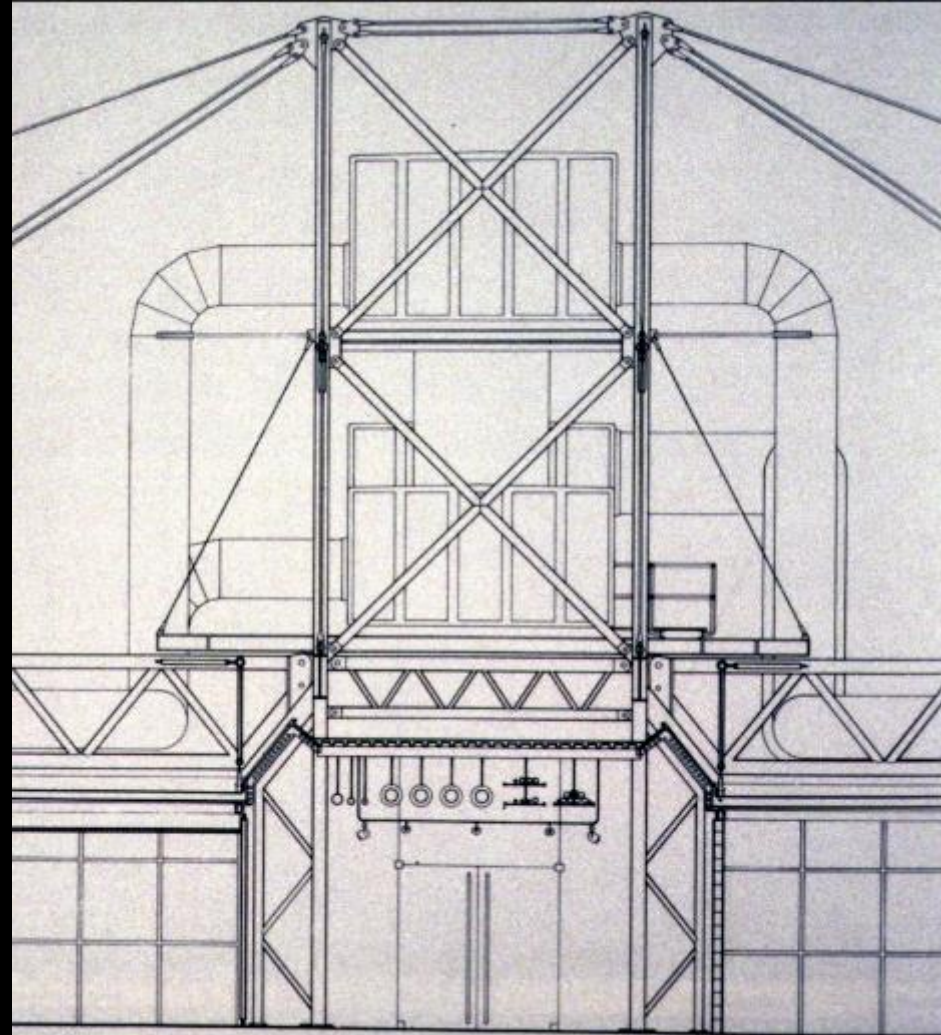






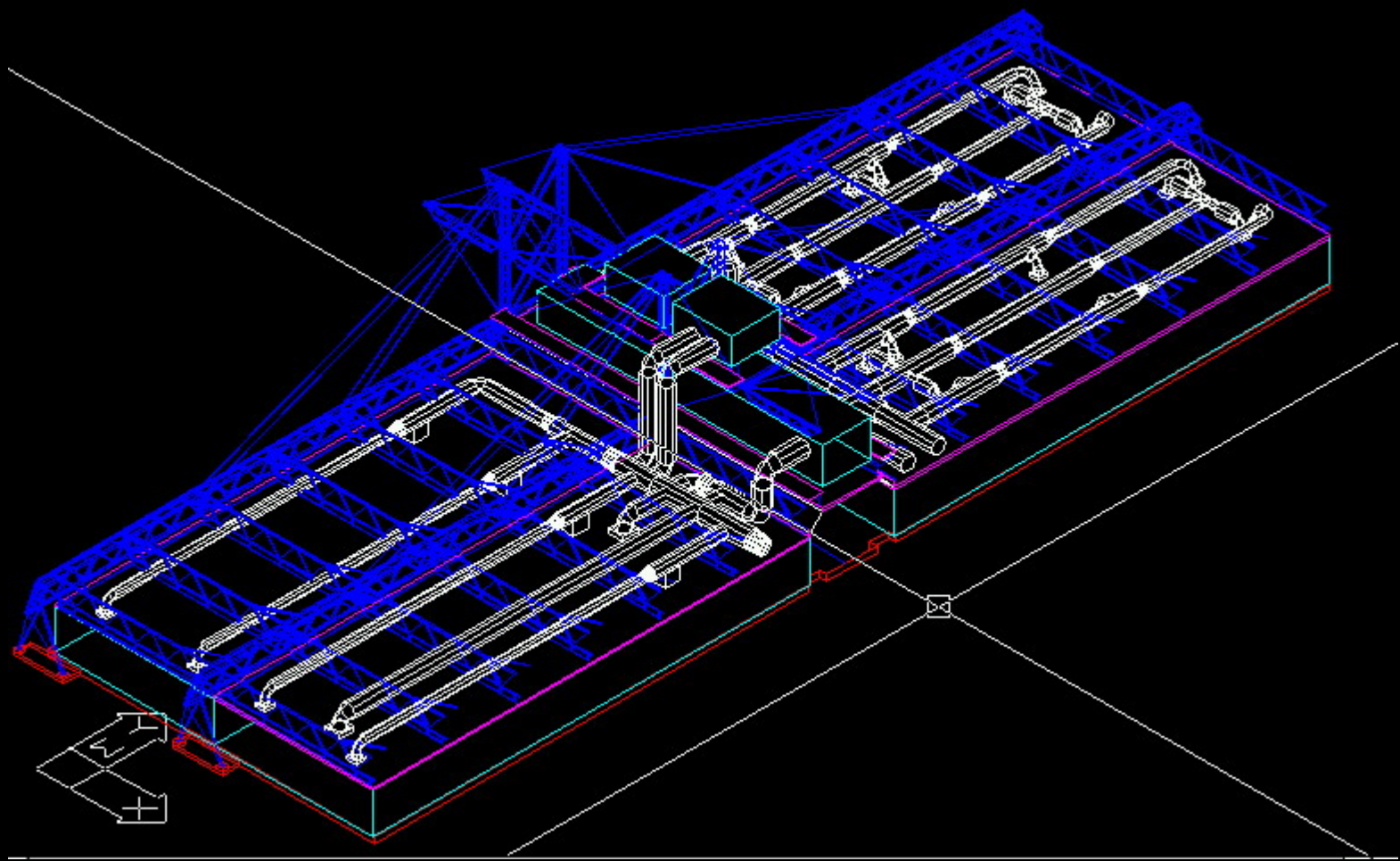


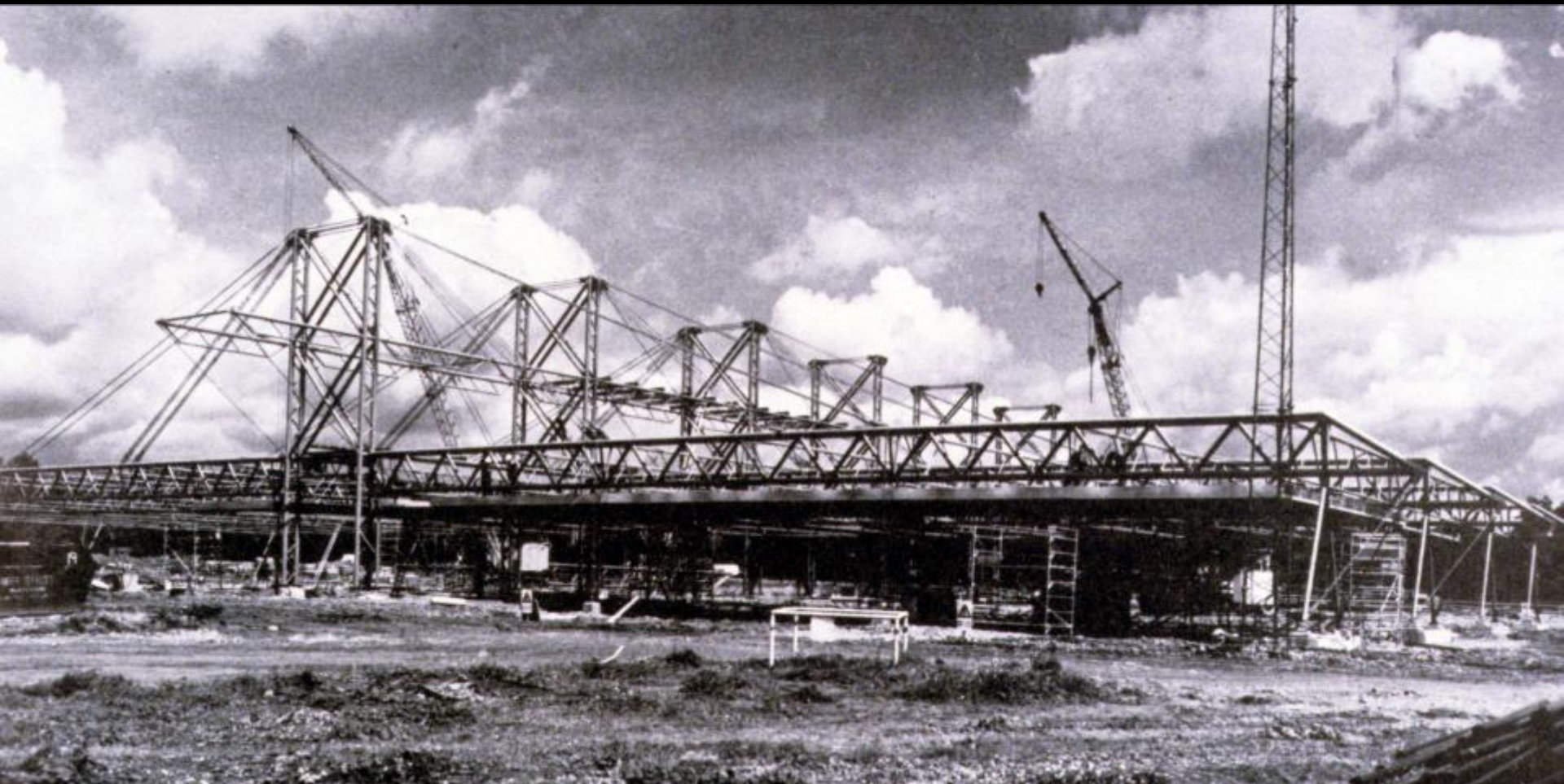




Detail of elevation









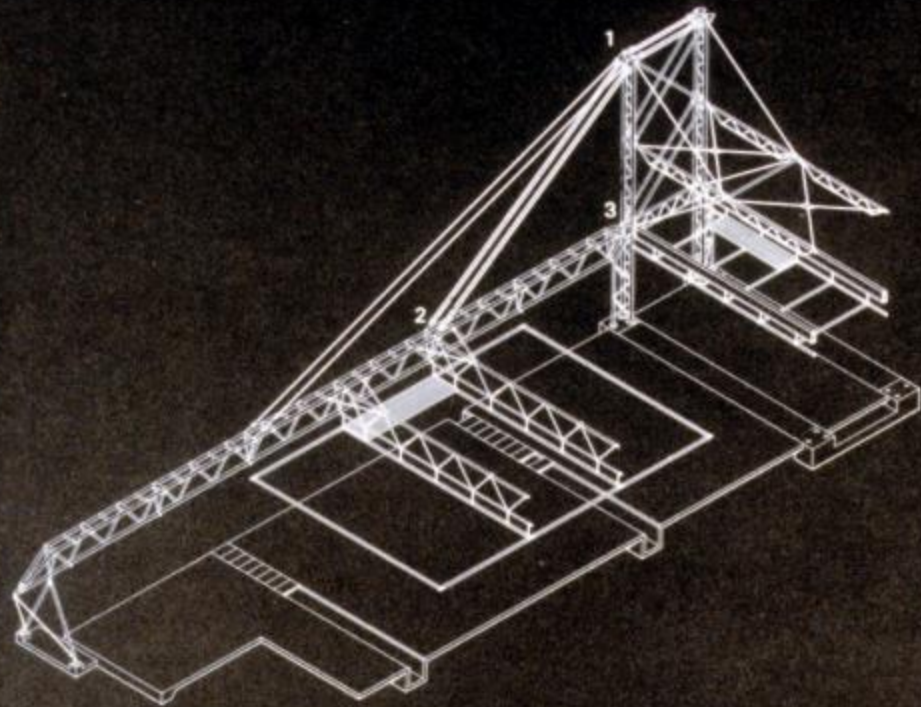


CONSTRUCTION SEQUENCE

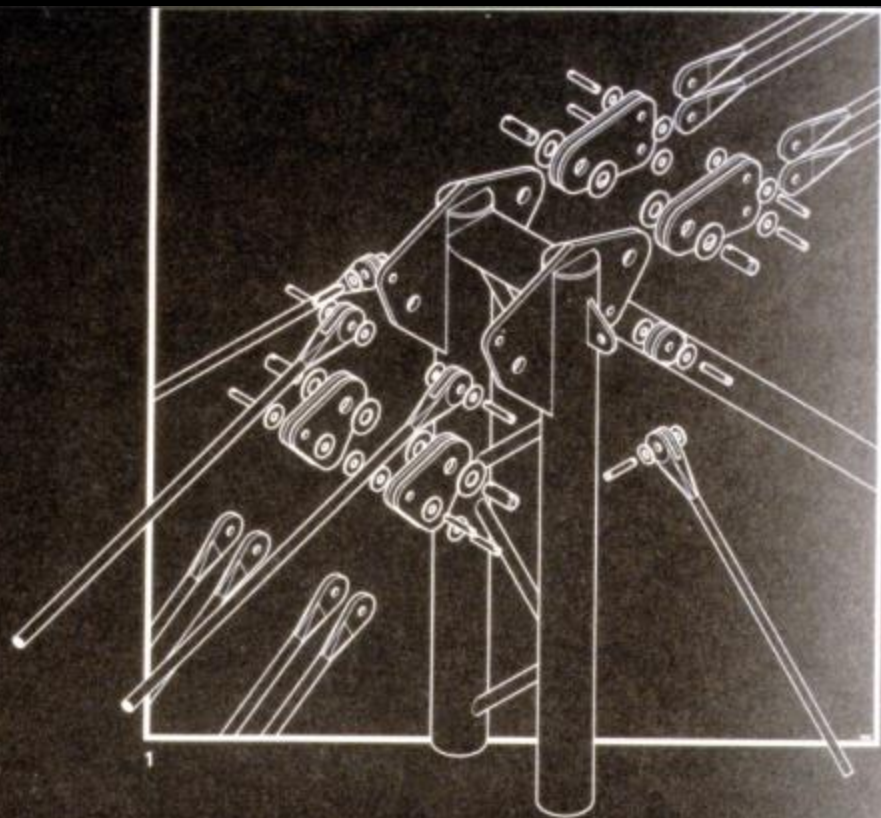




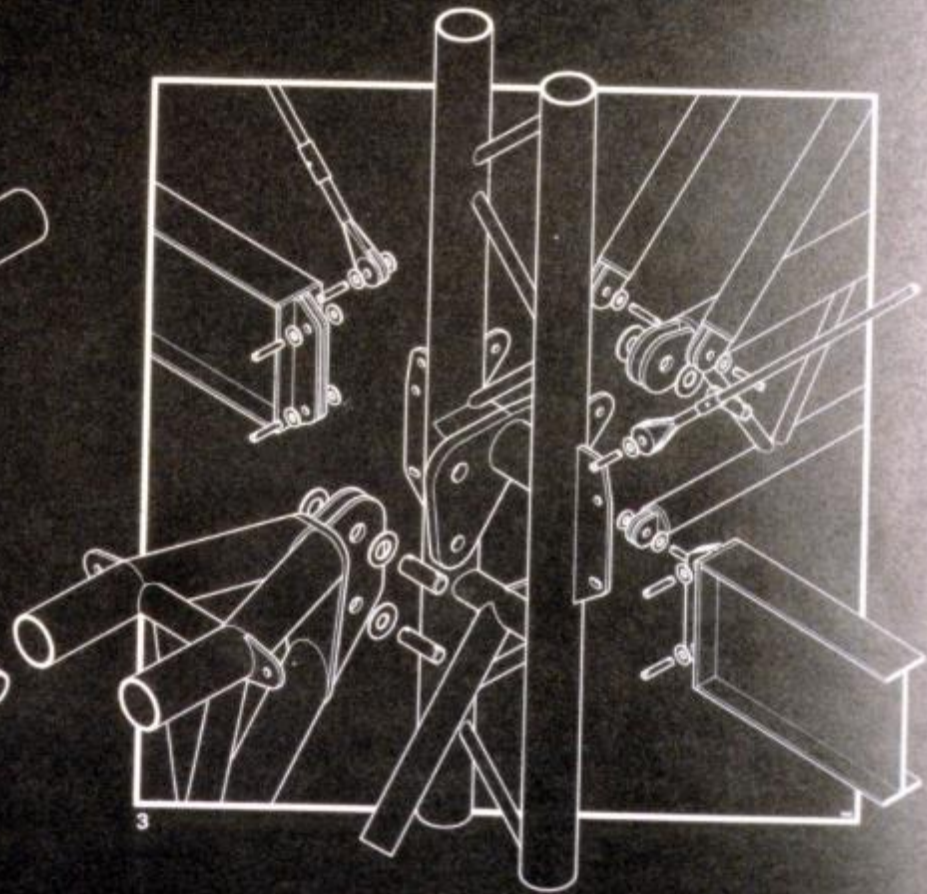
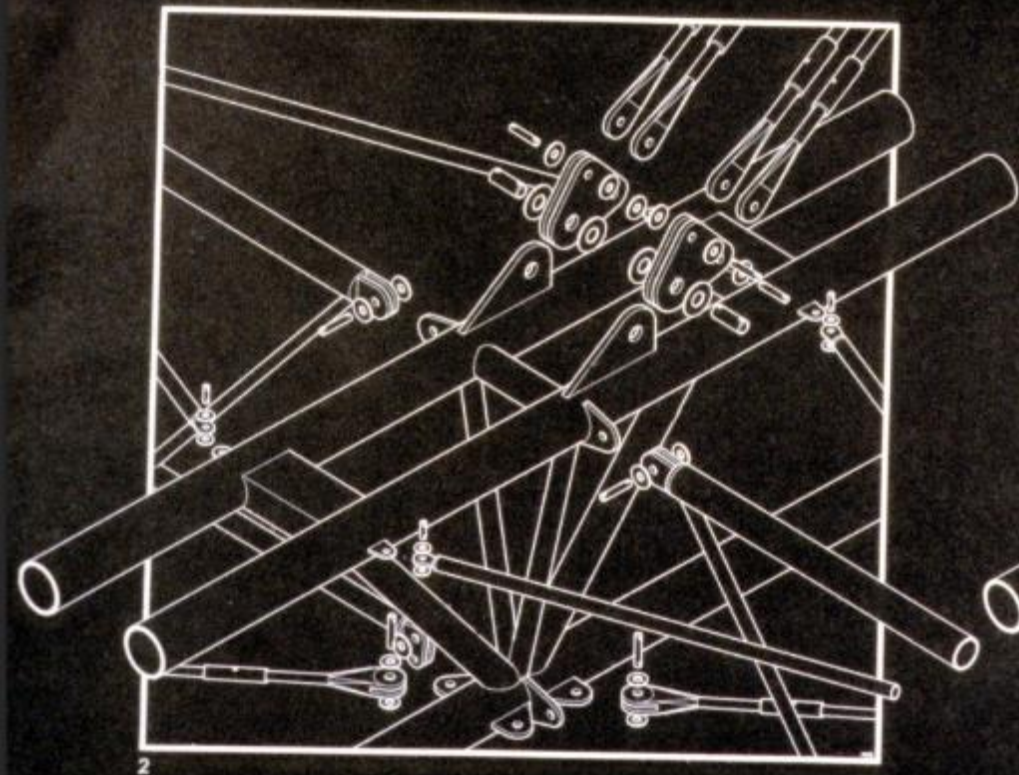




Structural axonometric with junction details



















Oxford Ice Rink  
Oxford, England  
Grimshaw Architects  
1984





























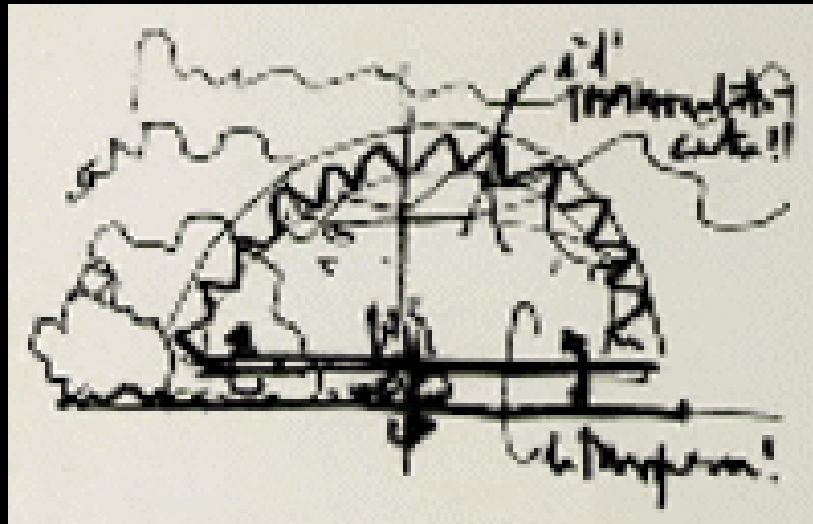




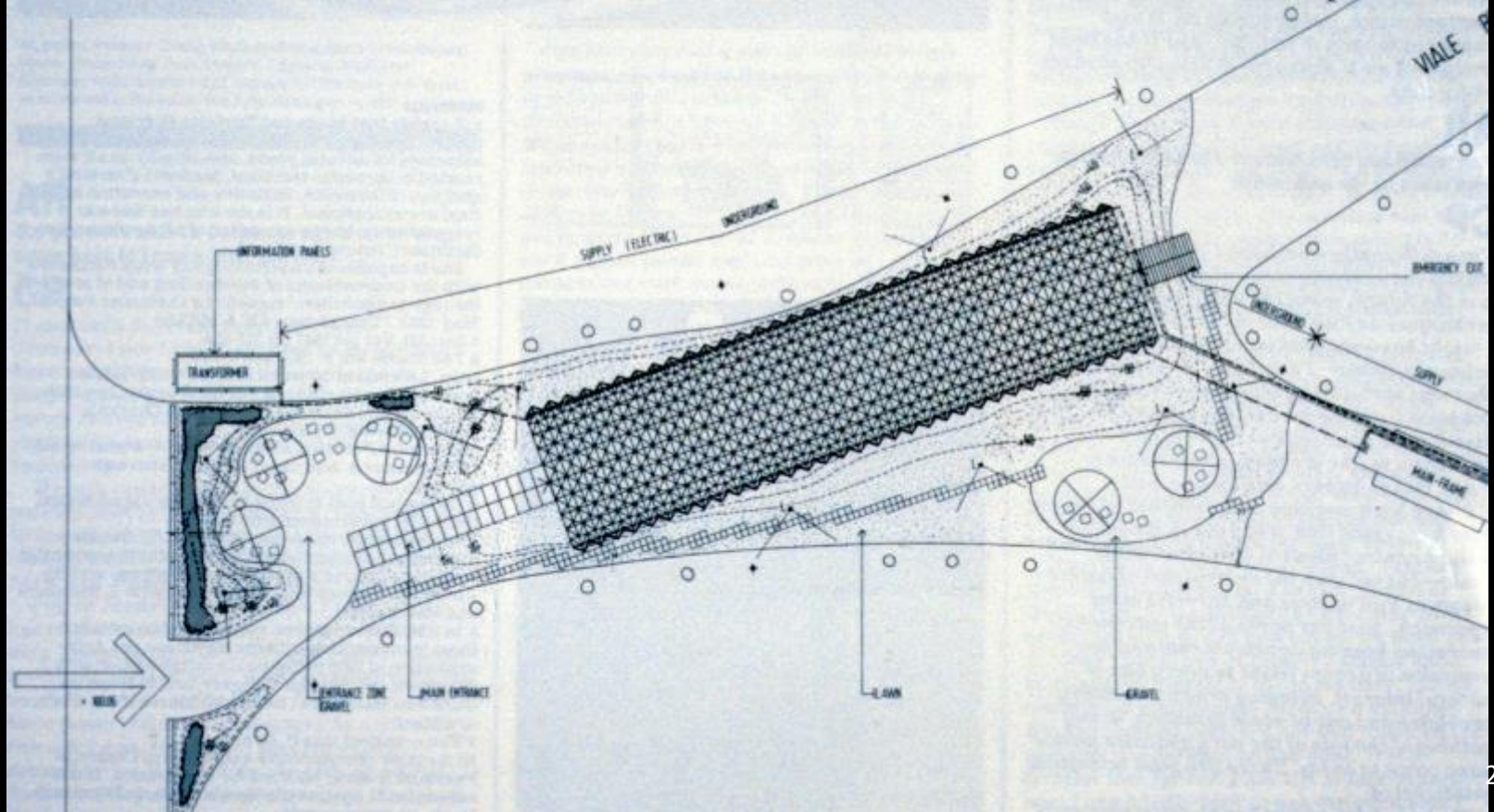




IBM Traveling Pavilion  
Europe  
Renzo Piano  
1982-1986

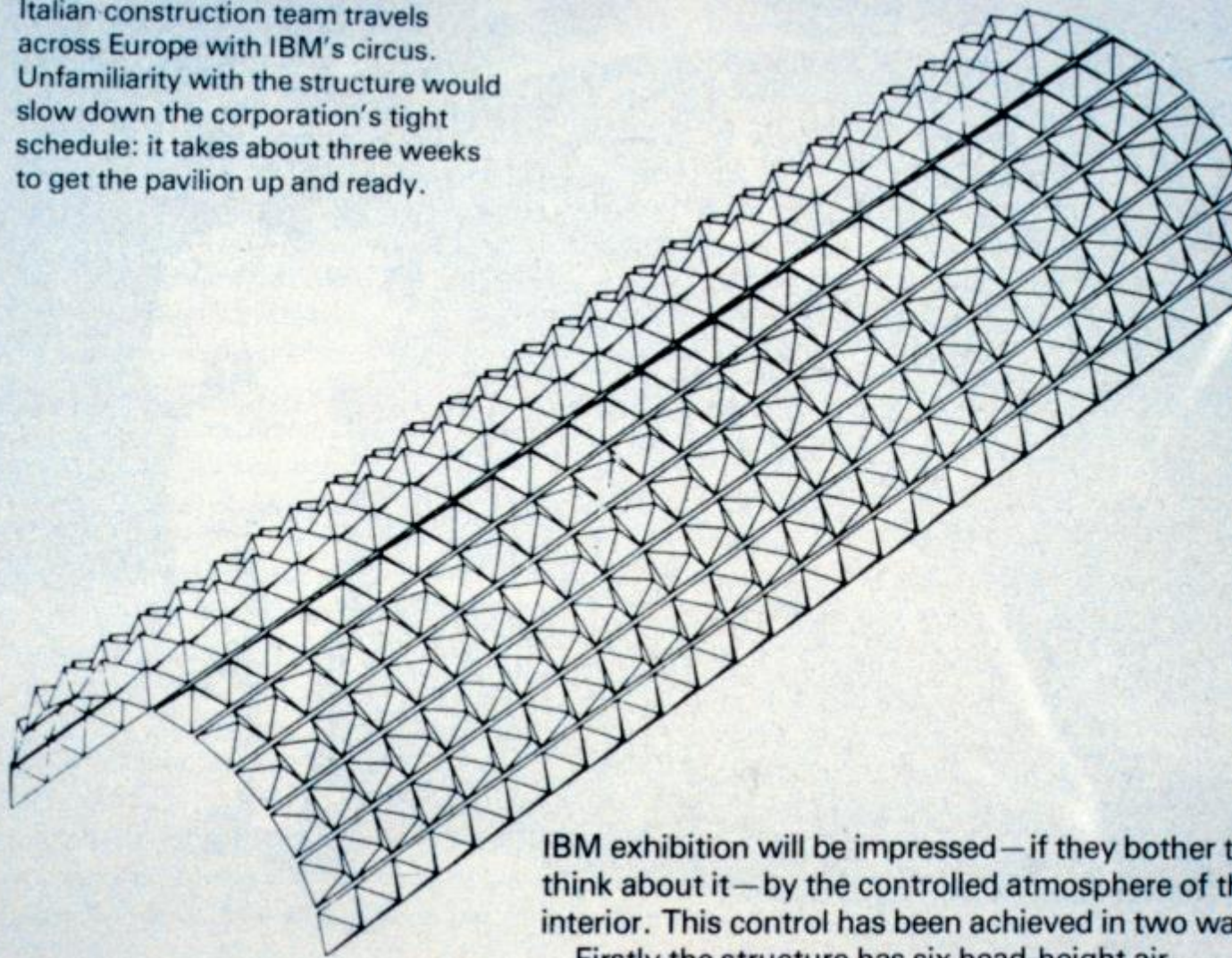


IBM's intriguing exhibition for children and students has just opened in the grounds of the Natural History Museum, London. Designed by Renzo Piano, this pre-packed portable structure has travelled across the Channel from Paris and Milan. But treating a sophisticated building as a product for the export market was not as straightforward as the architects had imagined, as Jonathan Glancey found out.





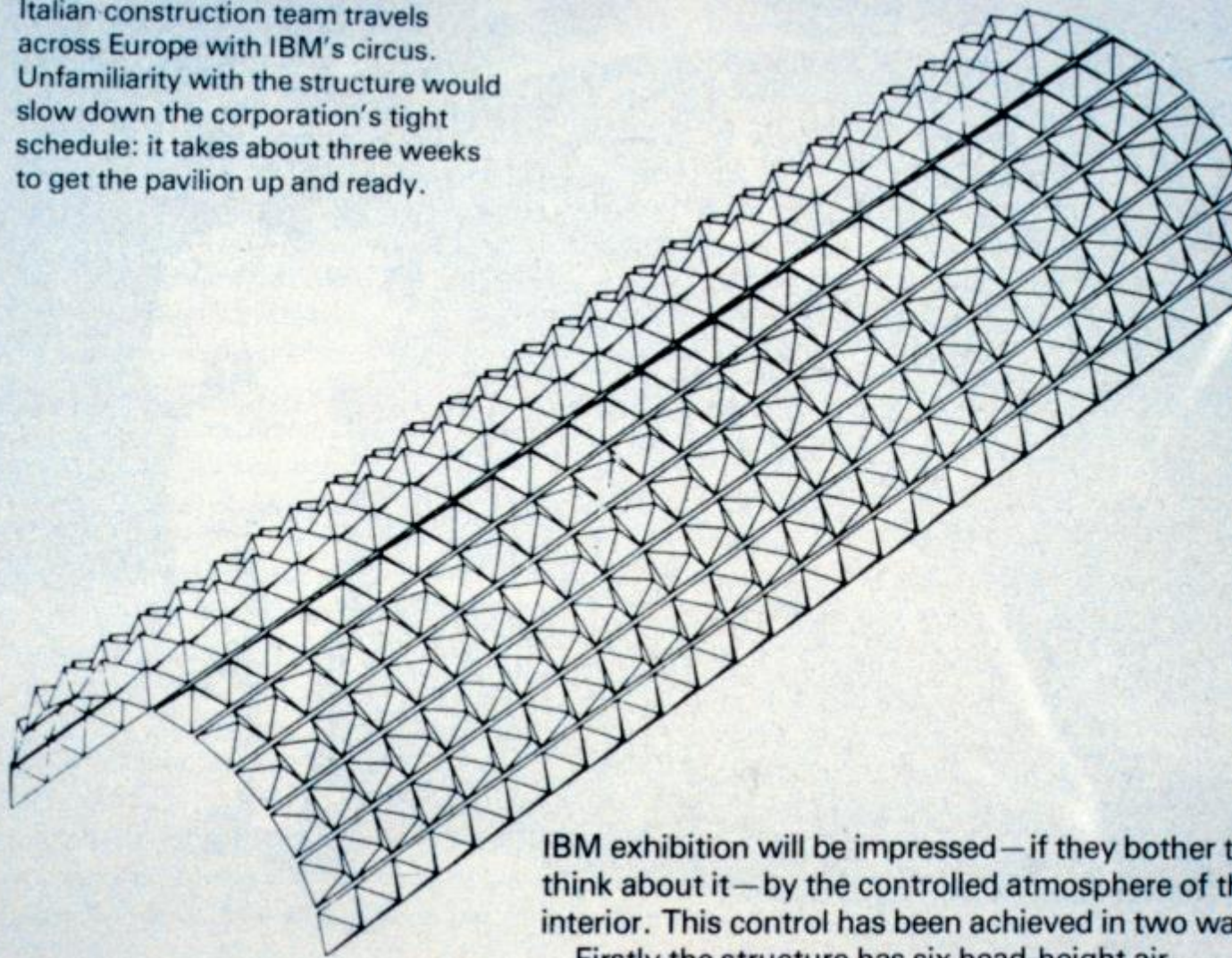
Italian construction team travels across Europe with IBM's circus. Unfamiliarity with the structure would slow down the corporation's tight schedule: it takes about three weeks to get the pavilion up and ready.



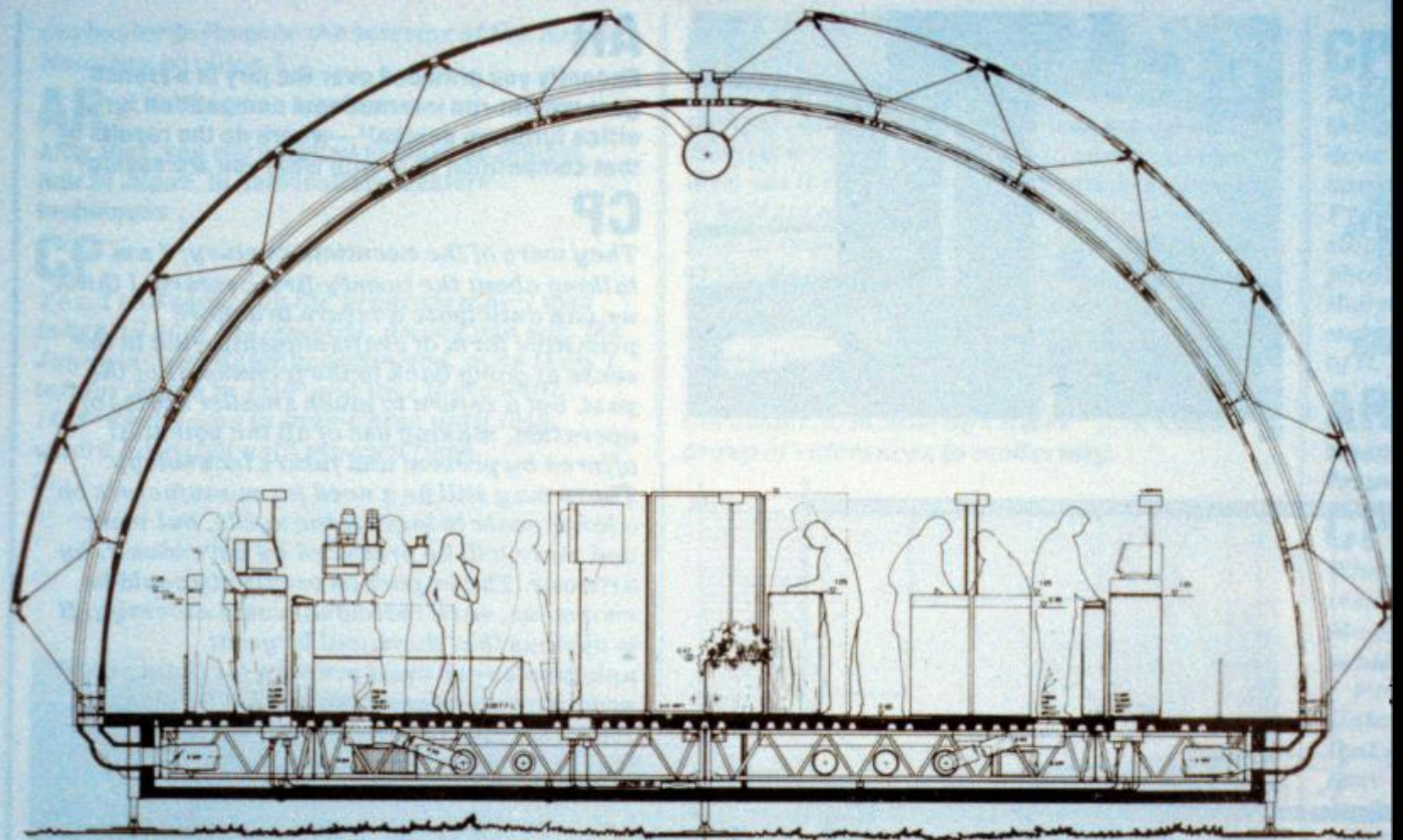
IBM exhibition will be impressed — if they bother to think about it — by the controlled atmosphere of the interior. This control has been achieved in two ways. Firstly the structure has six head-height air-



Italian construction team travels across Europe with IBM's circus. Unfamiliarity with the structure would slow down the corporation's tight schedule: it takes about three weeks to get the pavilion up and ready.

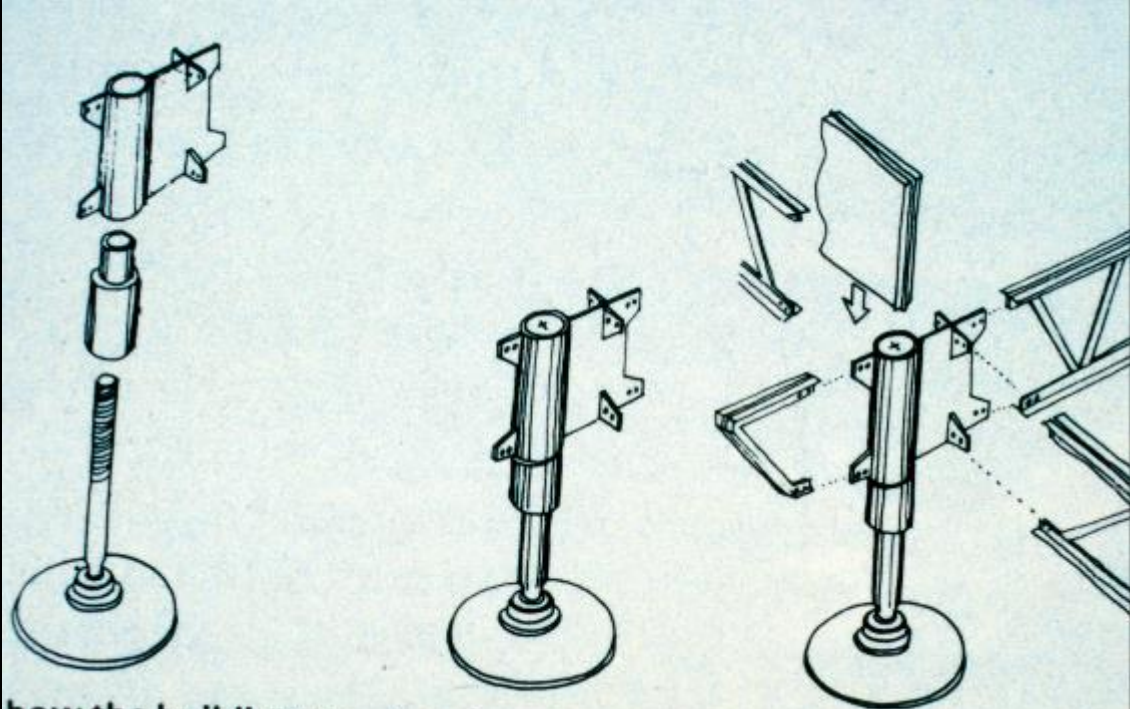
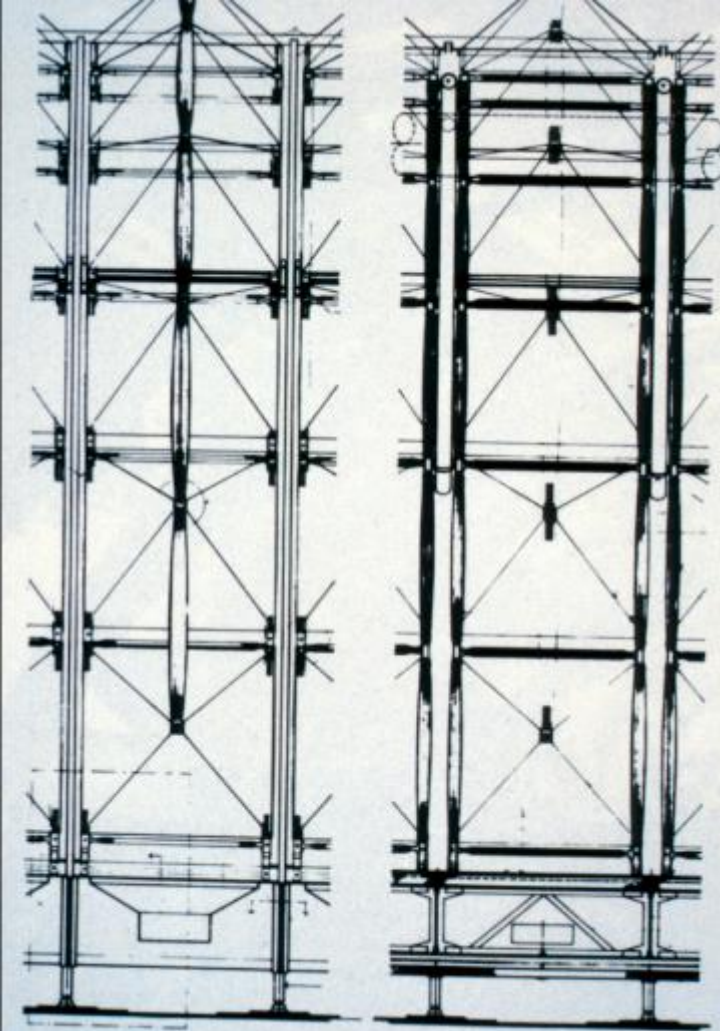


IBM exhibition will be impressed — if they bother to think about it — by the controlled atmosphere of the interior. This control has been achieved in two ways. Firstly the structure has six head-height air-



section showing structural and air-conditioning systems





how the building touches down: adjustable feet











IKOY Architects (Winnipeg, MN)  
Founded 1968

Was interested in "systems buildings"  
A combination of custom components  
and off-the-shelf

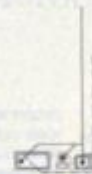
Ron Keenberg, one of the principles,  
taught at UWSA in the late 1980s



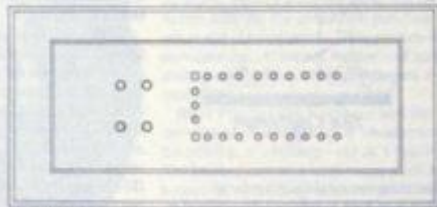
IROY'S INDUSTRIALIZED BUILDINGS



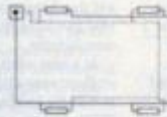
Plumbing



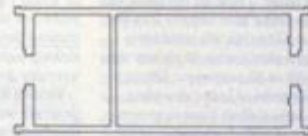
Structural



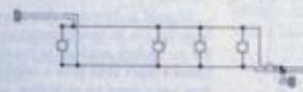
Fitments



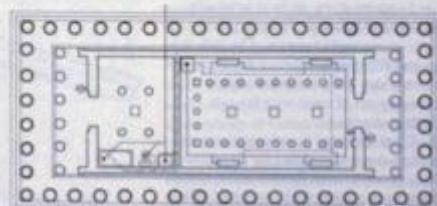
Mechanical



Enclosure

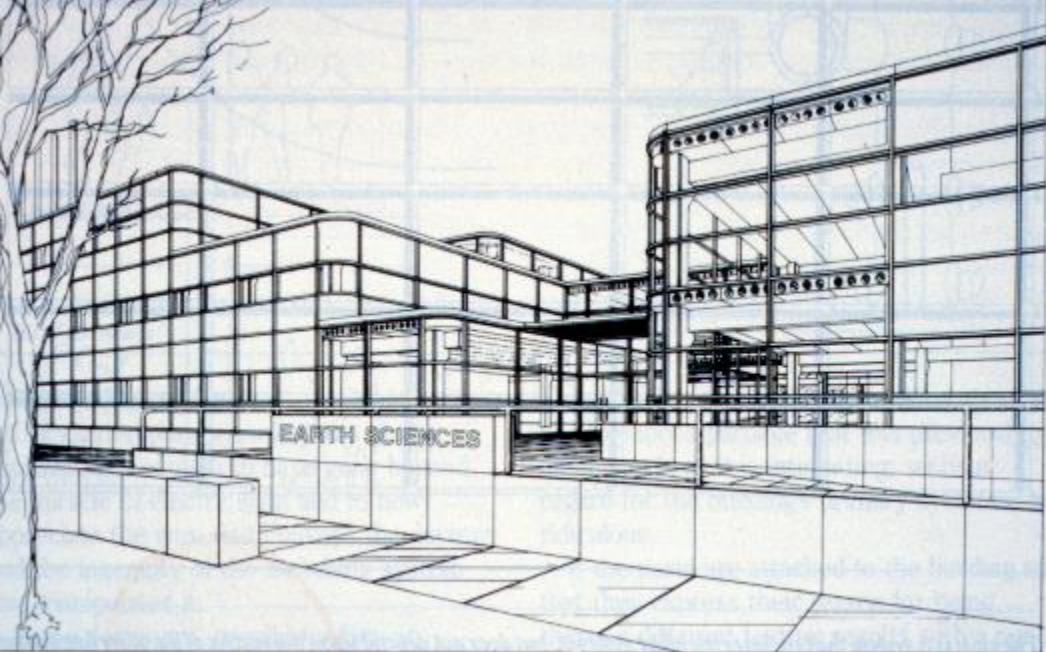


Electrical

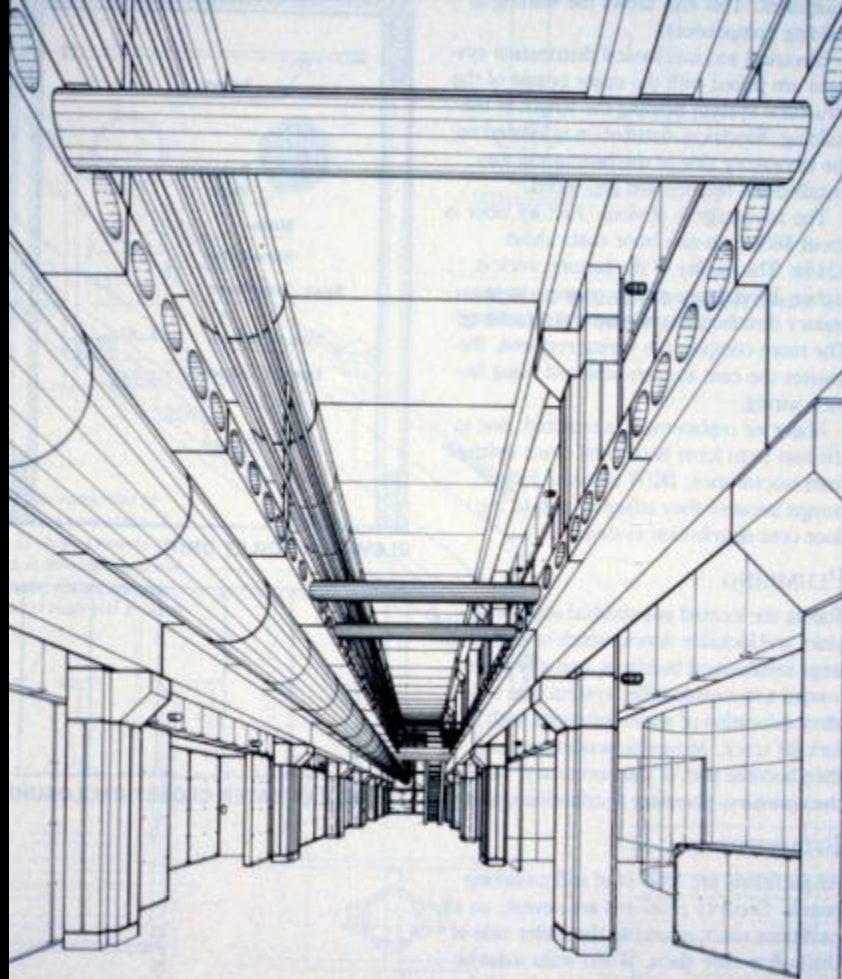


Parthenon, Acropolis, Athens 448-432 B.C. Plan





*IKOY Architects*





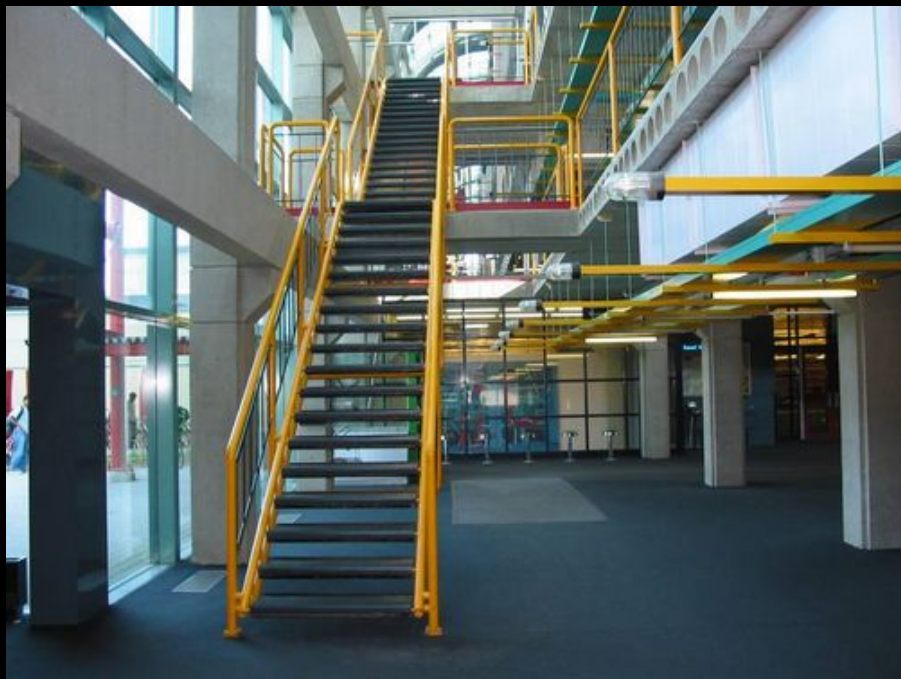
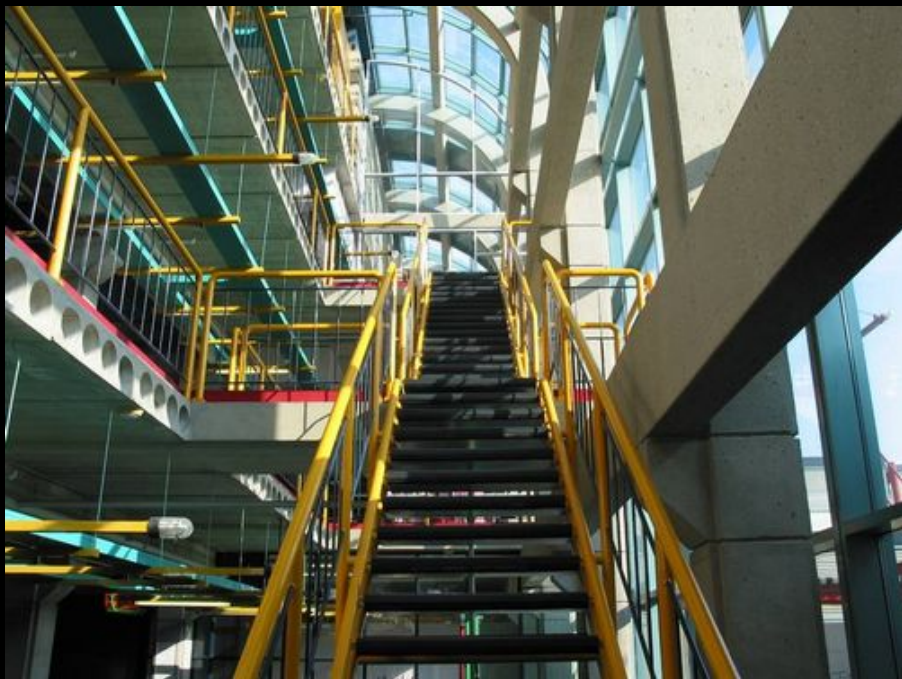




Davis Centre, UofW  
IKOY Architects  
Late 1980s

























Saskatoon Recreation Centre  
IKOY Architects





















Red River Community College  
Auto Repair Teaching Facility  
Winnipeg, MN  
IKOY Architects











Intumescent fire  
protective coating







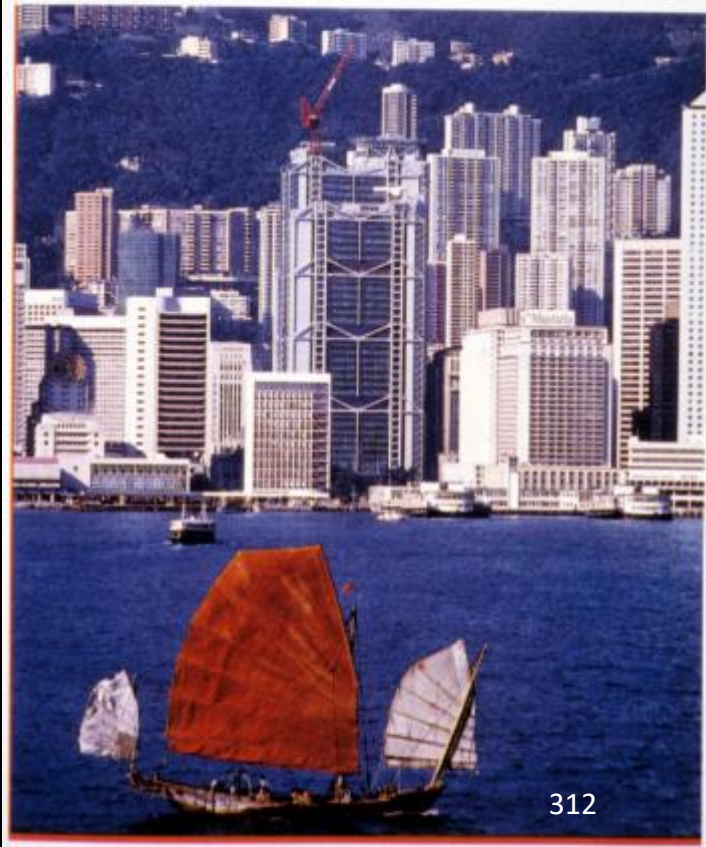






The Hong Kong  
and Shanghai Bank  
Hong Kong  
Foster + Partners  
1985

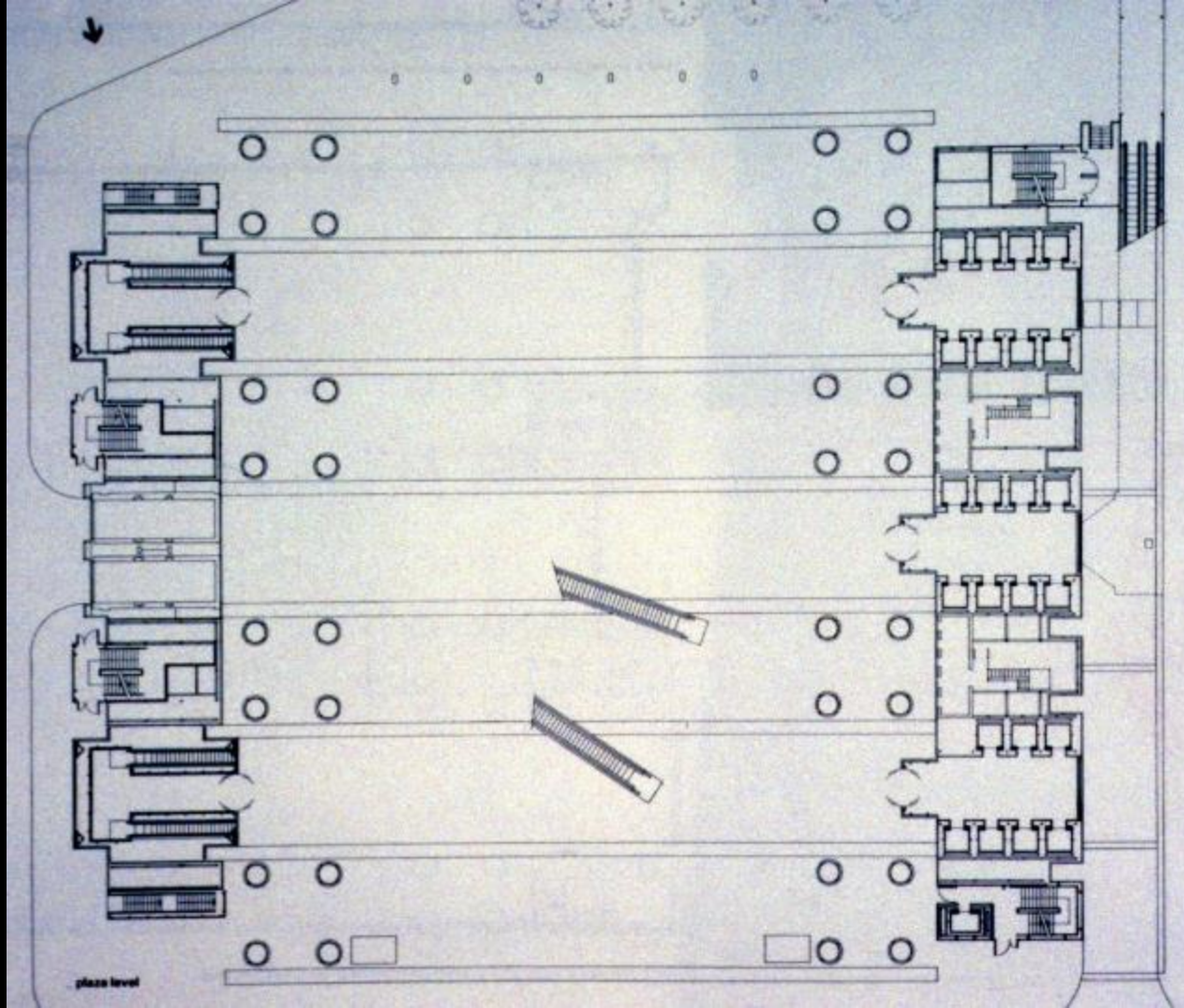
# 滙豐銀行



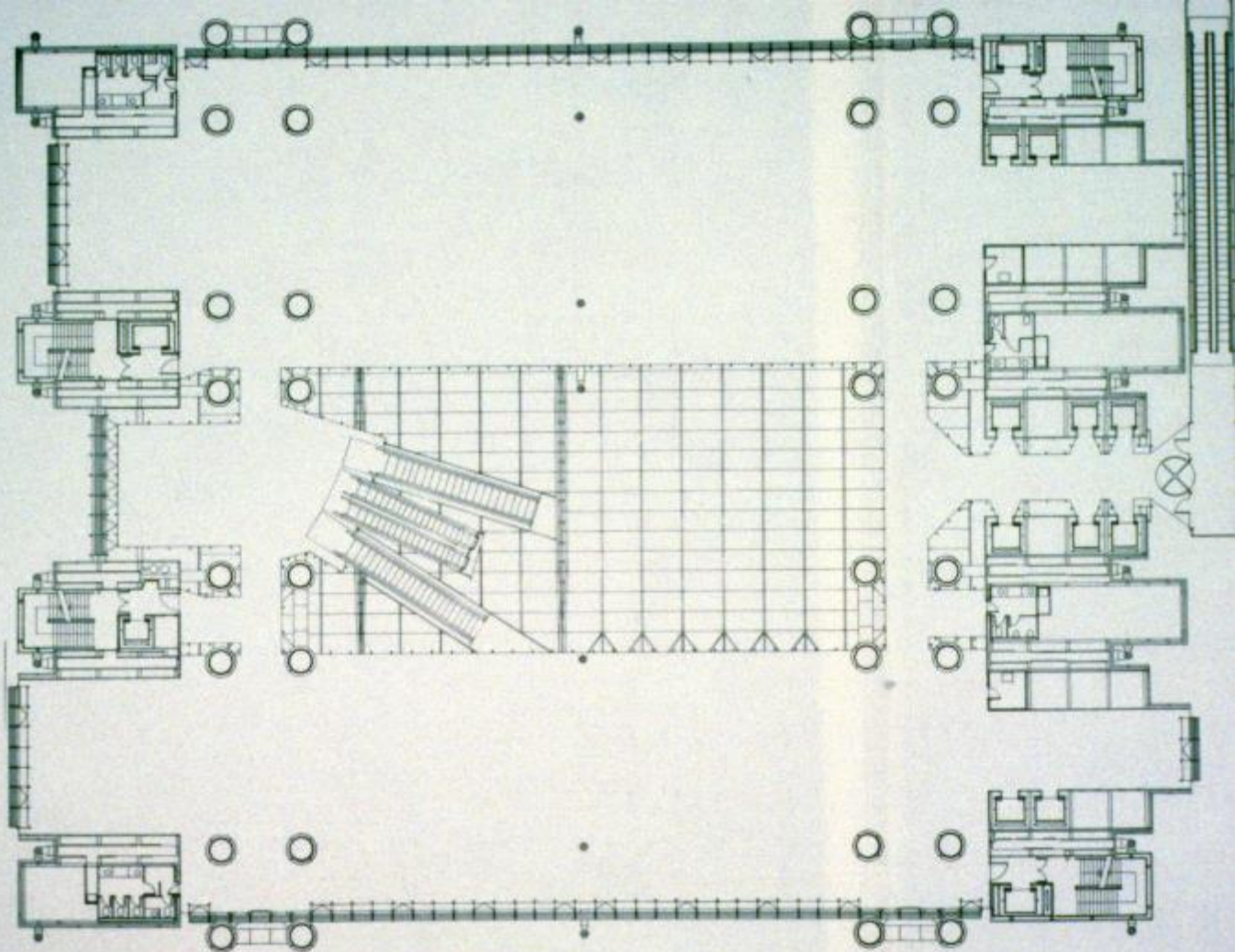




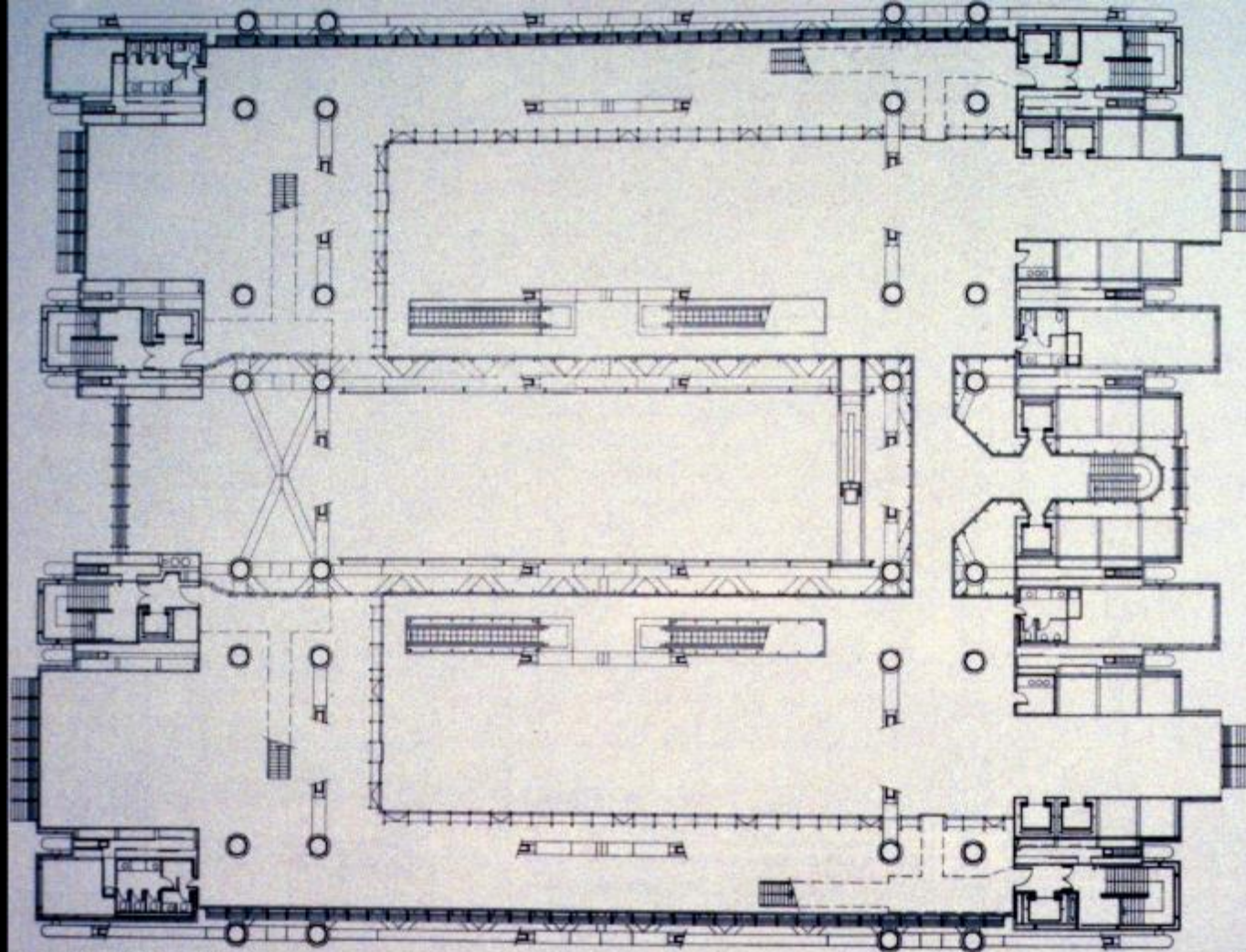






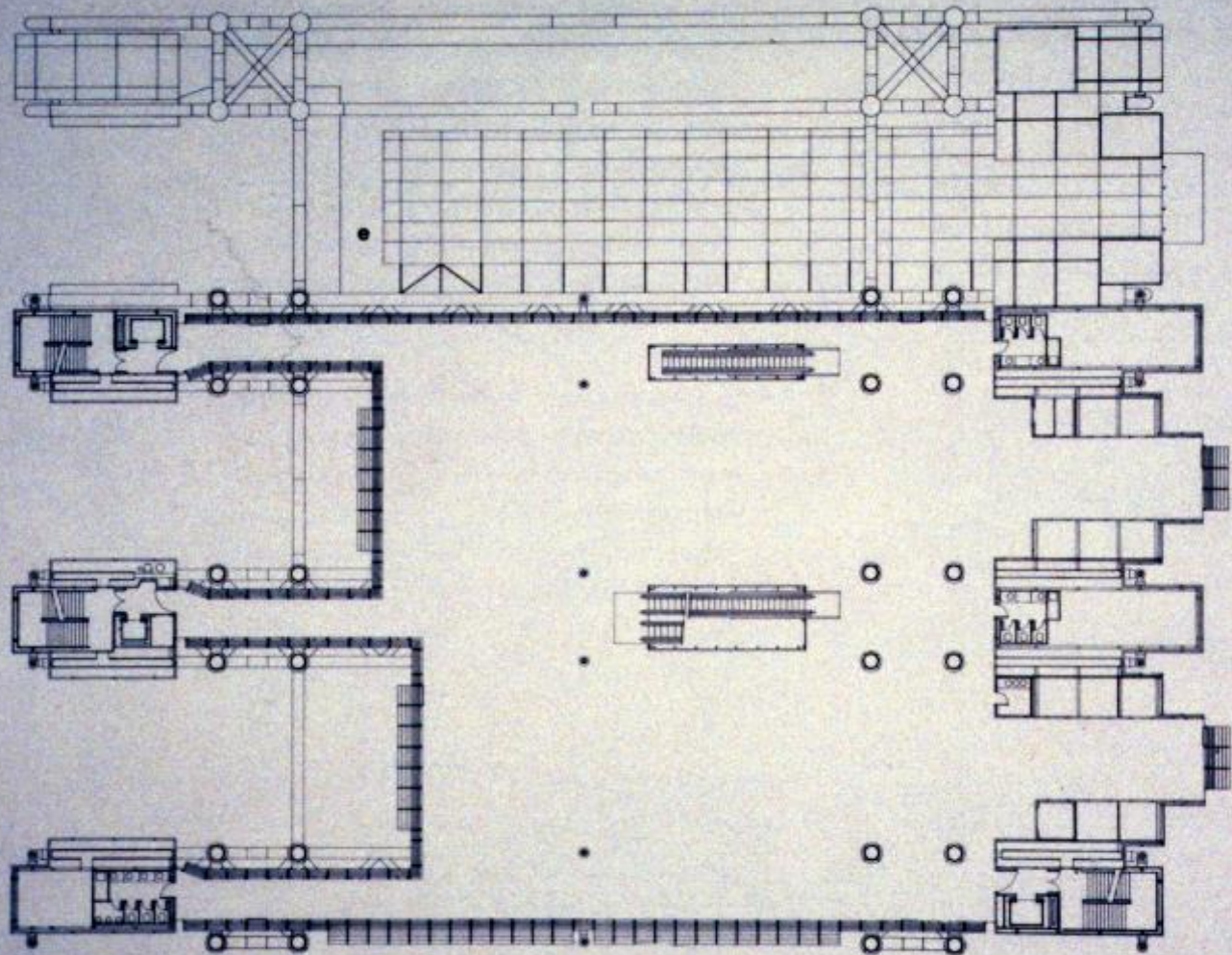


level 3: first level of banking hall at which public arrives on escalators from plaza



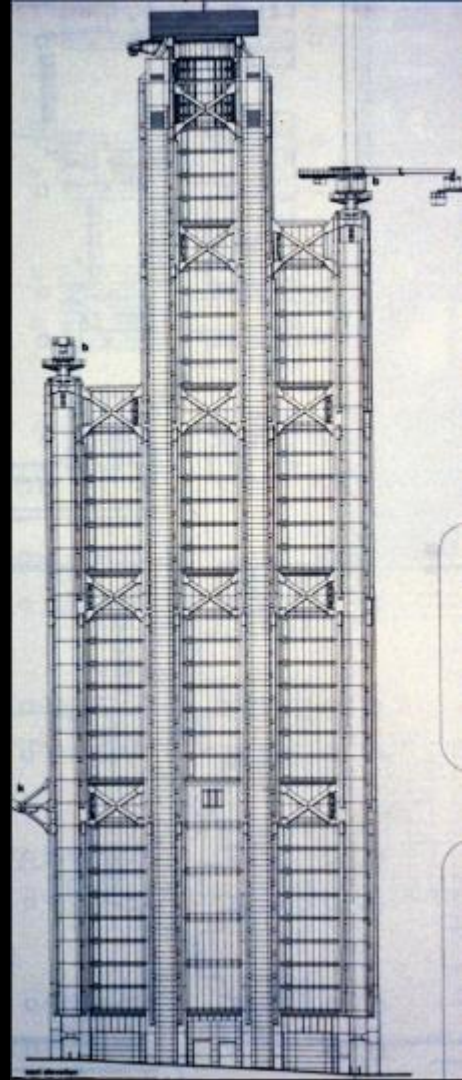
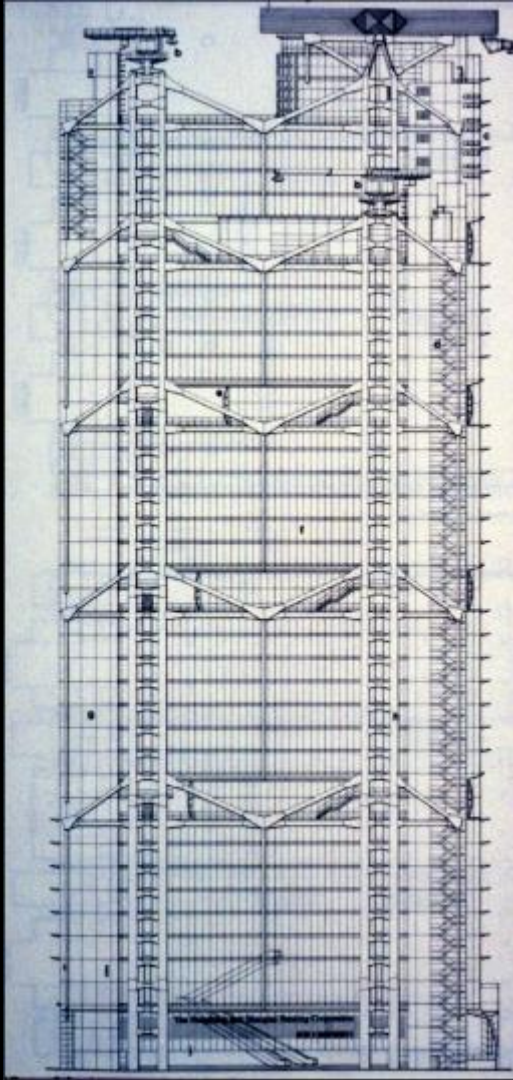
level 11: double height at top of atrium



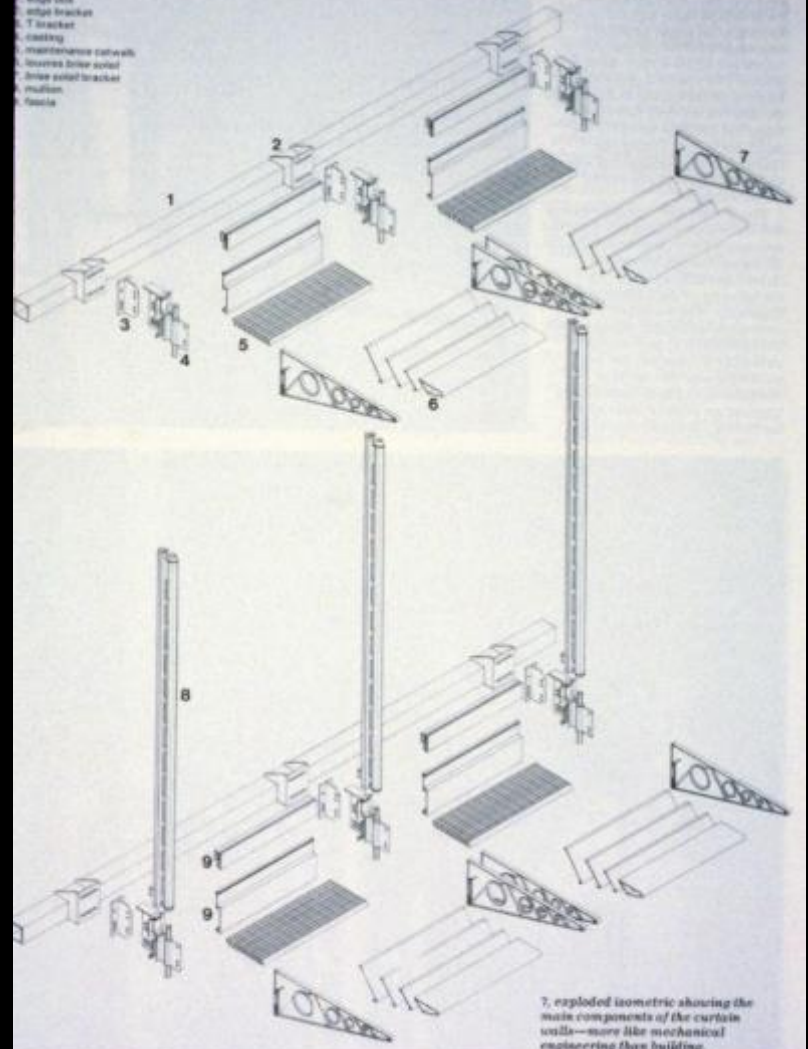


level 30: bulk of building is eroded by light angle requirements

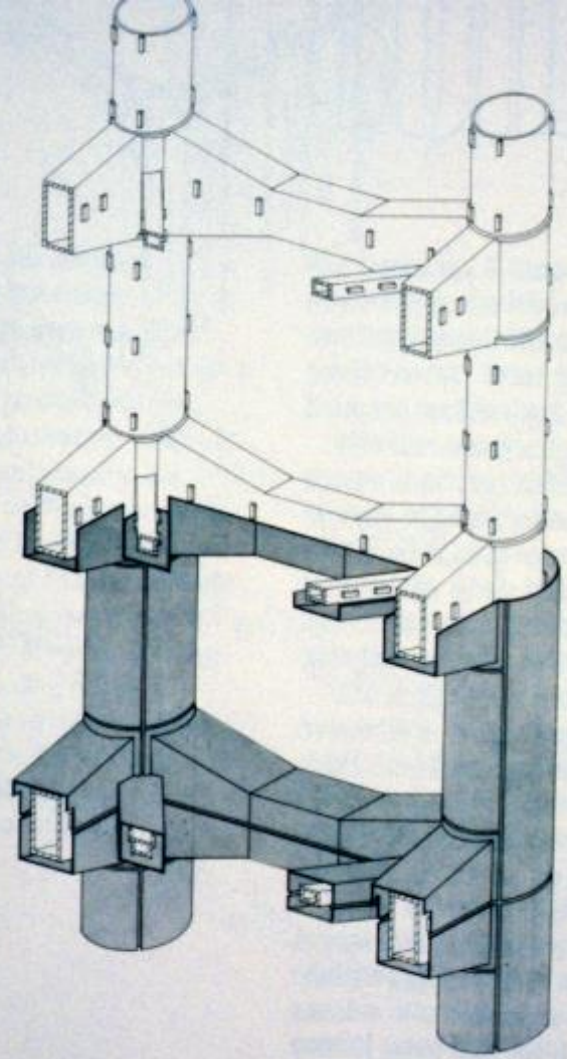




- edge box
- edge bracket
- T bracket
- cladding
- maintenance catwalk
- insulation panel
- drive pulley bracket
- mullion
- facade



7, exploded isometric showing the main components of the curtain walls—more like mechanical engineering than building





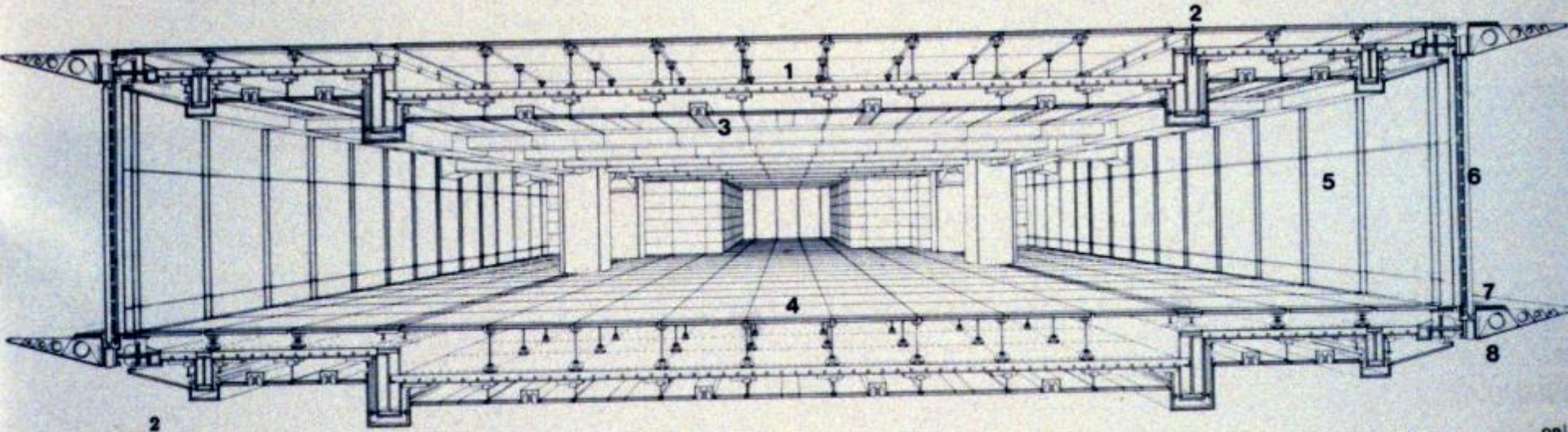
1

*1, isometric section showing the floors cut back between masts on the east side of the building.*

- |                    |                         |
|--------------------|-------------------------|
| <b>key</b>         | 5, outer hanger         |
| 1, stairs          | 6, terrace              |
| 2, risers          | 7, trussed mullion      |
| 3, glass grid wall | 8, n/s cross bracing    |
| 4, panel wall      | 9, typical curtain wall |

*2, section through a one-bay wide floor.*

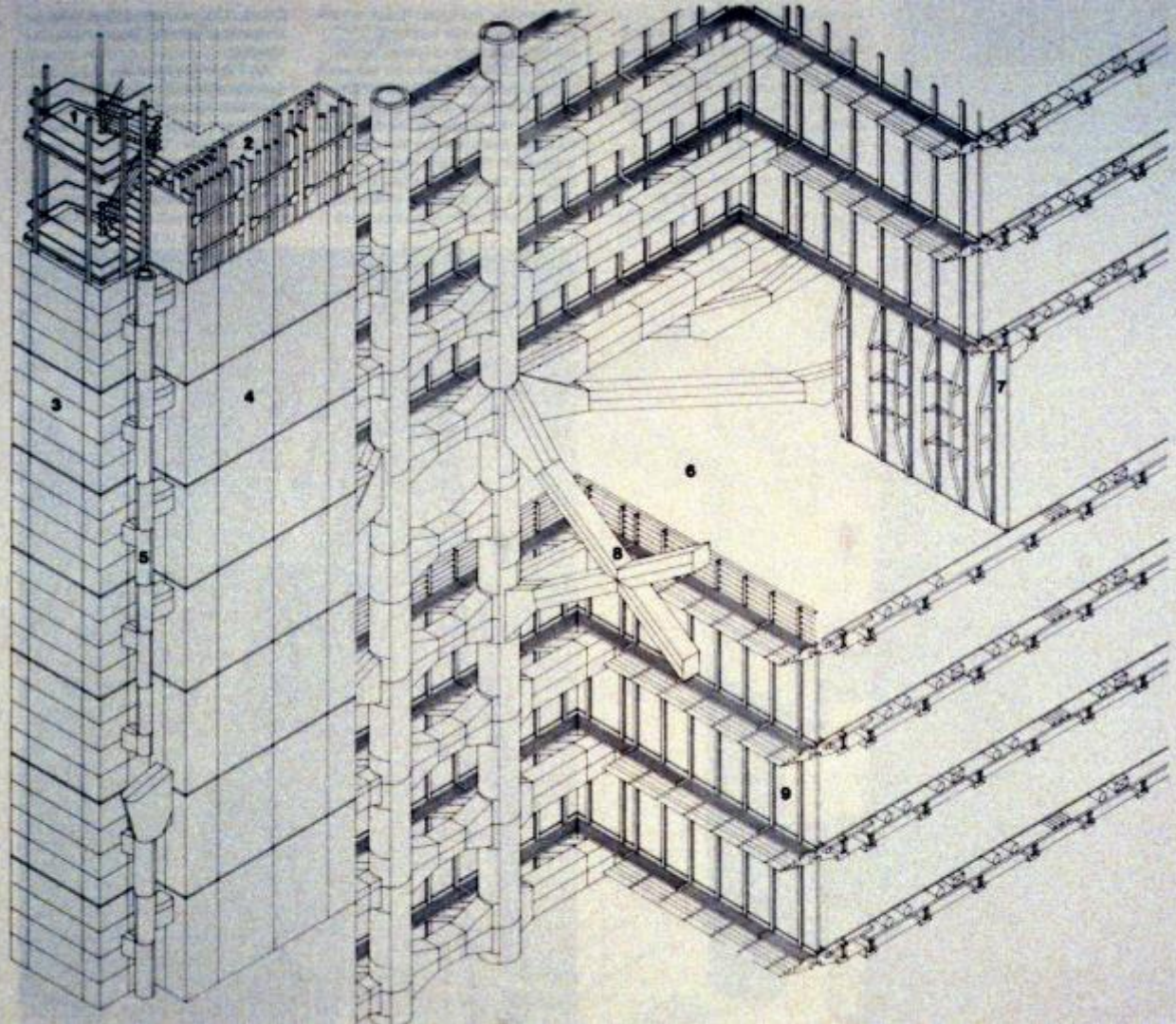
- |                         |                         |
|-------------------------|-------------------------|
| <b>key</b>              | 5, back-up wall         |
| 1, 100 mm concrete slab | 6, typical curtain wall |
| 2, primary beam         | 7, catwalk              |
| 3, lighting             | 8, brise soleil         |
| 4, raised floor         |                         |



2

83



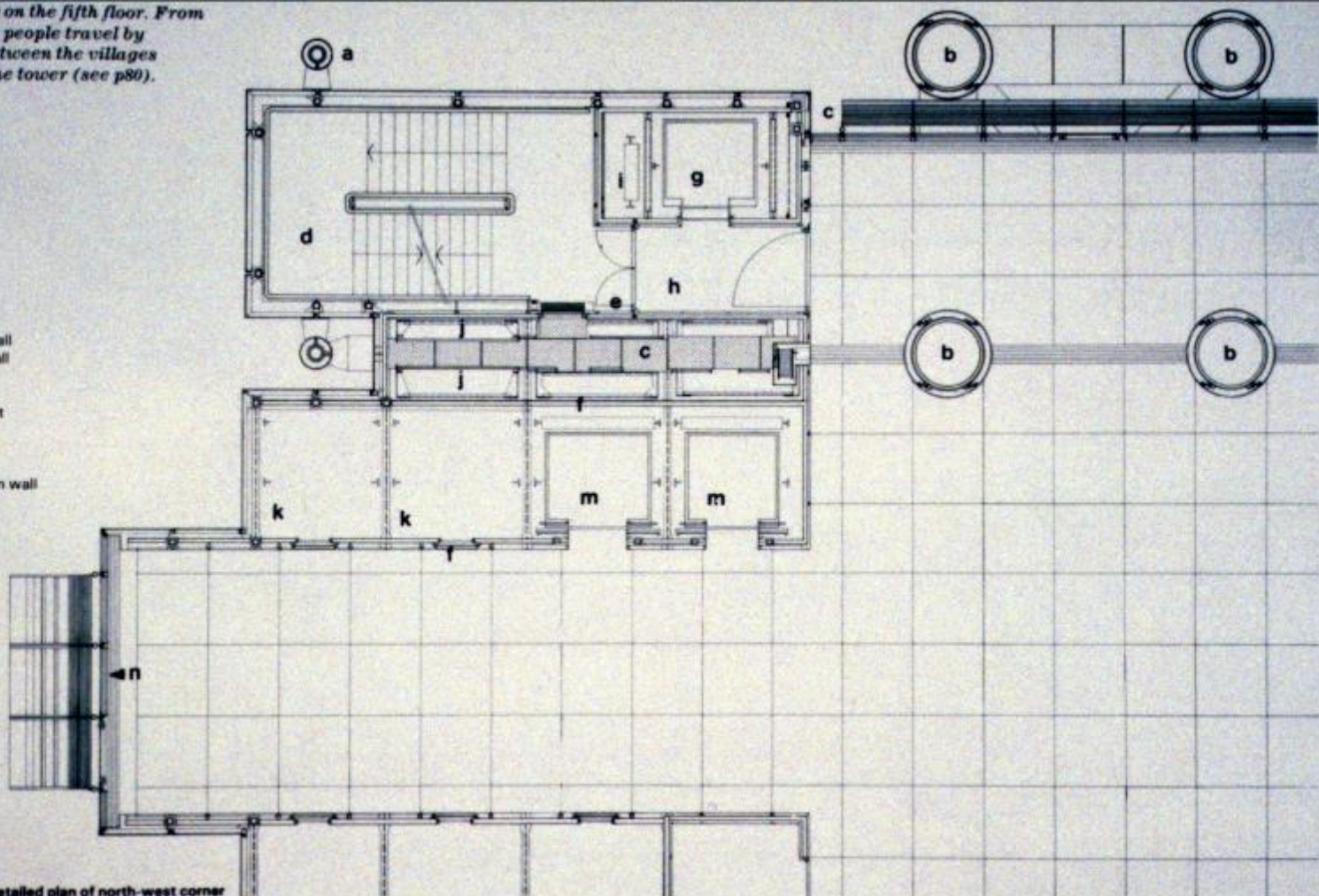




20. lift lobby on the fifth floor. From such lobbies people travel by escalator between the villages stacked in the tower (see p89).

key

- a, hanger
- b, tubular mast
- c, catwalk
- d, stairs
- e, 1-hour fire wall
- f, 2-hour fire wall
- g, goods lift
- h, escape lobby
- i, counterweight
- j, riser
- k, lift shaft
- m, lift
- n, typical curtain wall



detailed plan of north-west corner





































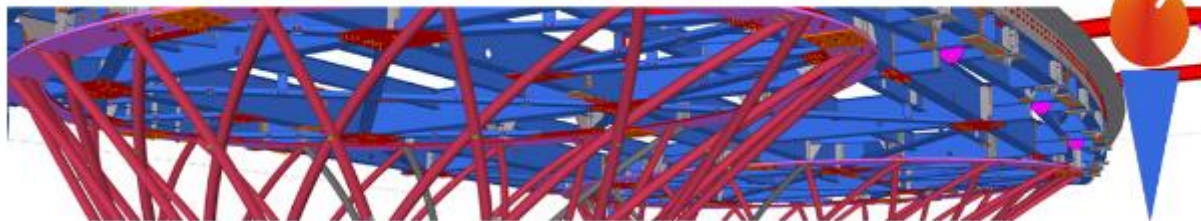


To be continued....

If you take Arch 570: Architectural Steel Design as an elective later on!

<http://tboake.com/SSEF1/index.shtml>





## Fun is in the Details: Innovation in Steel Connections

### A Curriculum Materials Project

Welcome to "Fun is in the Details: Innovation in Steel Connections"! This curriculum materials project has been funded by the **Steel Structures Education Foundation** the former educational arm of the **Canadian Institute of Steel Construction (CISC)**.

The web site is structured into *SEVEN* primary sections on *CONNECTION DESIGN* that will take you through the understanding and development of steel connections. Navigation is accessible at the top of each page, with subheadings for each section available in the left sidebar or through the pull down menu at the top.

#### HOME SUB MENU

- [Project Introduction](#)
- [Using the 3D PDFs](#)
- [About the Authors](#)
- [References and Links](#)
- [Site Index](#)
- [Legal Disclaimer](#)



This web based project is designed to increasing the understanding of connection design in steel structures to better assist students of architecture and engineering in creating more convincing and compelling structures. The project looks at how to take basic methods of creating connections and transform them into innovative connections, using similar principles. Although Standard Structural Steel connections will be included, the emphasis will be on an exploration of Architecturally Exposed Structural Steel (AESS). The project will reference the new CISC AESS documents, in particular the "Category Matrix" and "CISC Guide for Specifying Architecturally Exposed Structural Steel".

Please check out my [Facebook page for AESS](#) . Many more projects there!