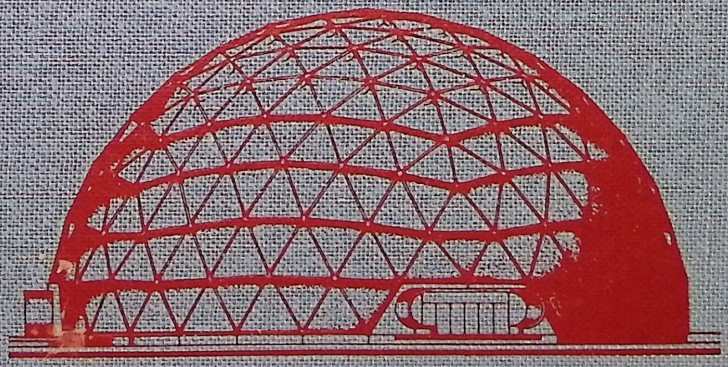
THE ARTIFACTS OF R. BUCKMINSTER FULLER

A Comprehensive Collection of His Designs and Drawings



Volume Four

Artifacts of R Buckminster Fuller

Volume Four: The Geodesic Revolution, Part 2, 1960-1983

James Ward (Editor)

Garland Publishing, Inc. | New York and London

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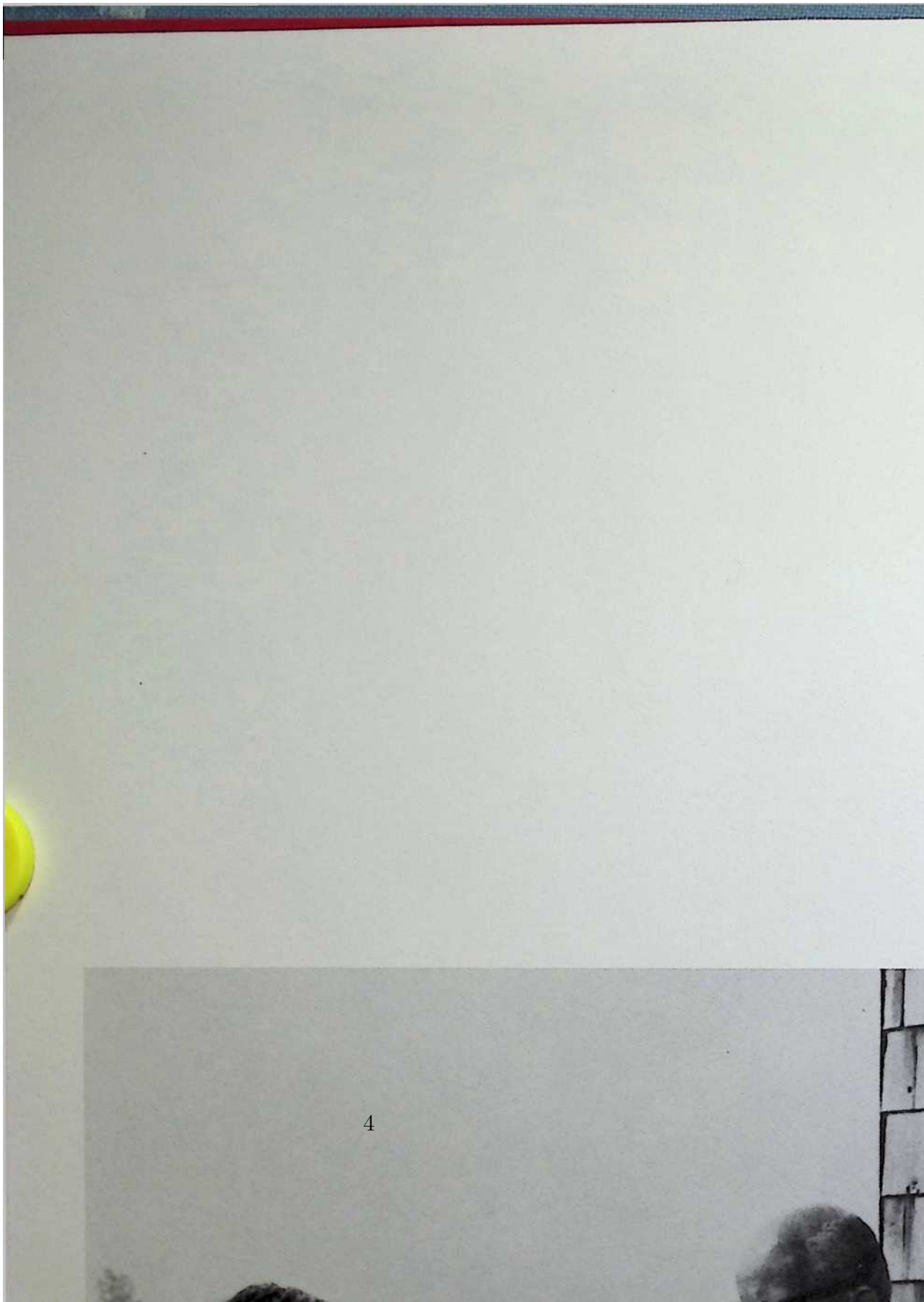

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R. BUCKMINSTER FULLER

A Comprehensive Collection of His Designs and Drawings in Four Volumes

Edited with descriptions by James Ward

A Garland Series

Contents of the Set

Volume One. The Dymaxion Experiment, 1926–1943

Volume Two. Dymaxion Deployment, 1927–1946

Volume Three. The Geodesic Revolution, Part 1, 1947–1959

Volume Four. The Geodesic Revolution, Part 2, 1960–1983

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R. BUCKMINSTER FULLER

Volume Four: The Geodesic Revolution Part 2, 1960–1983

Edited with descriptions by James Ward with an Appendix by D. L. Richter

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Janies Ward is presently a visiting professor at Trinity College. Hartford, Connecticut. He studied engineering as an undergraduate and received his Ph.D. in the history of art from the Institute of Fine Arts of New York University. His dissertation was on Le Corbusiers villa. Les Terrasses. He has published articles on early modern architecture in Europe and has compiled a directory of New York architects before World War II.

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1 Proposed Geodesic Dome for a Shopping Center in Montreal, Canada 1960

The plan of this dome is its most interesting feature. Two concentric rings of forty-eight shops were to be reached via two concentric arcades and two cruciform arcades. The dome's center is occupied by a department store that spreads out to cover the inner ring of shops. Merchandise enters and leaves the complex through the basement storage area.

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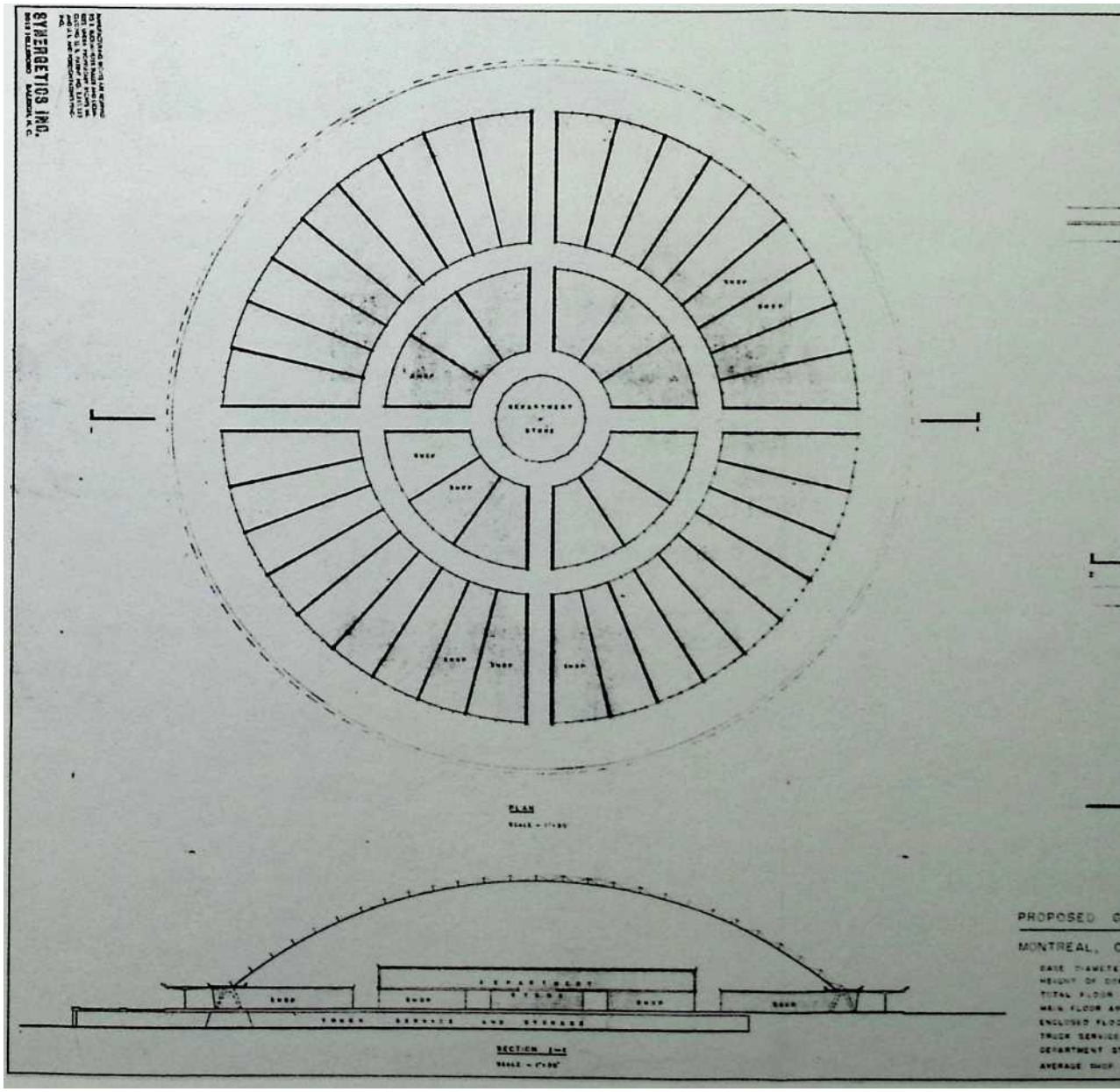
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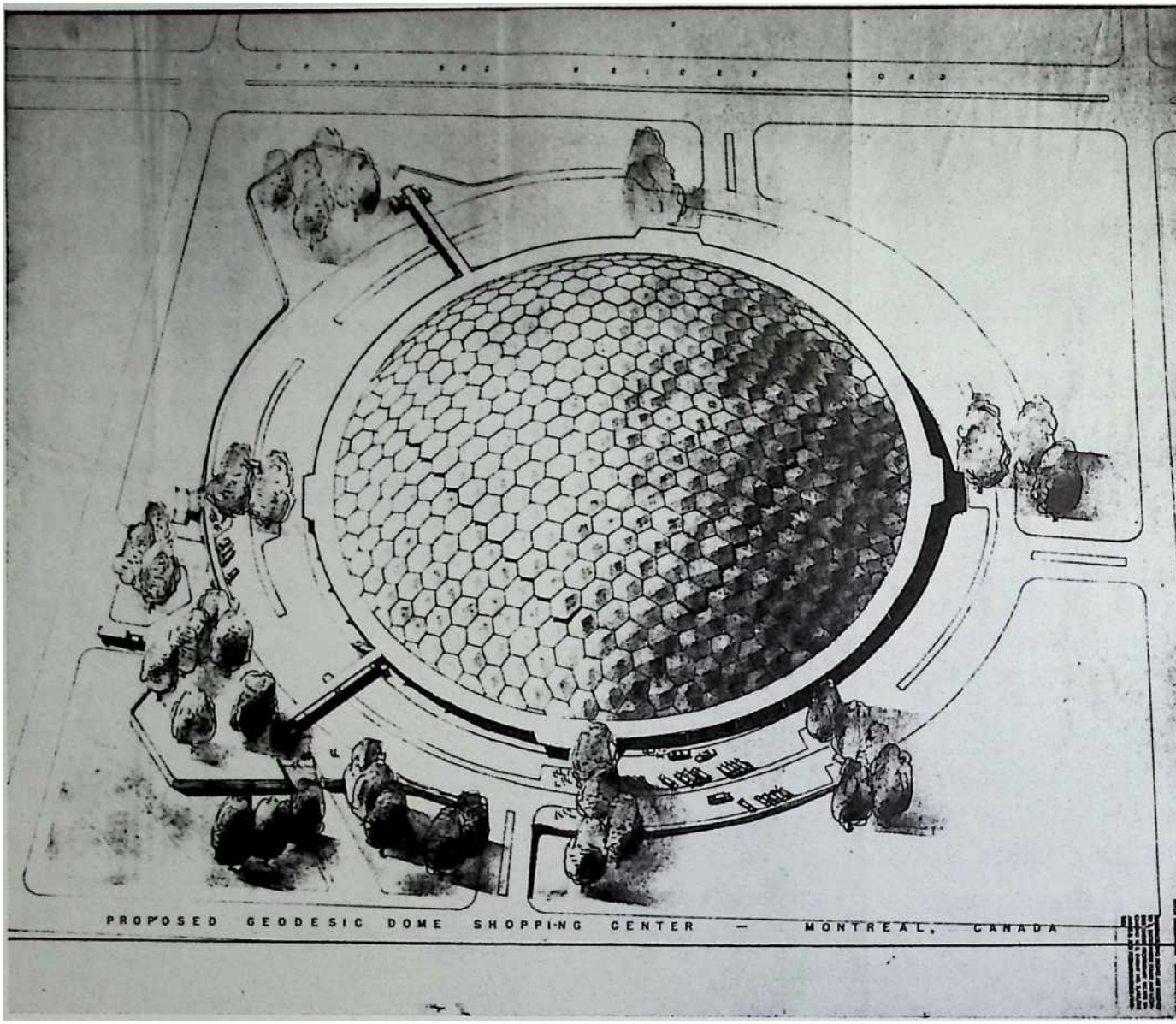
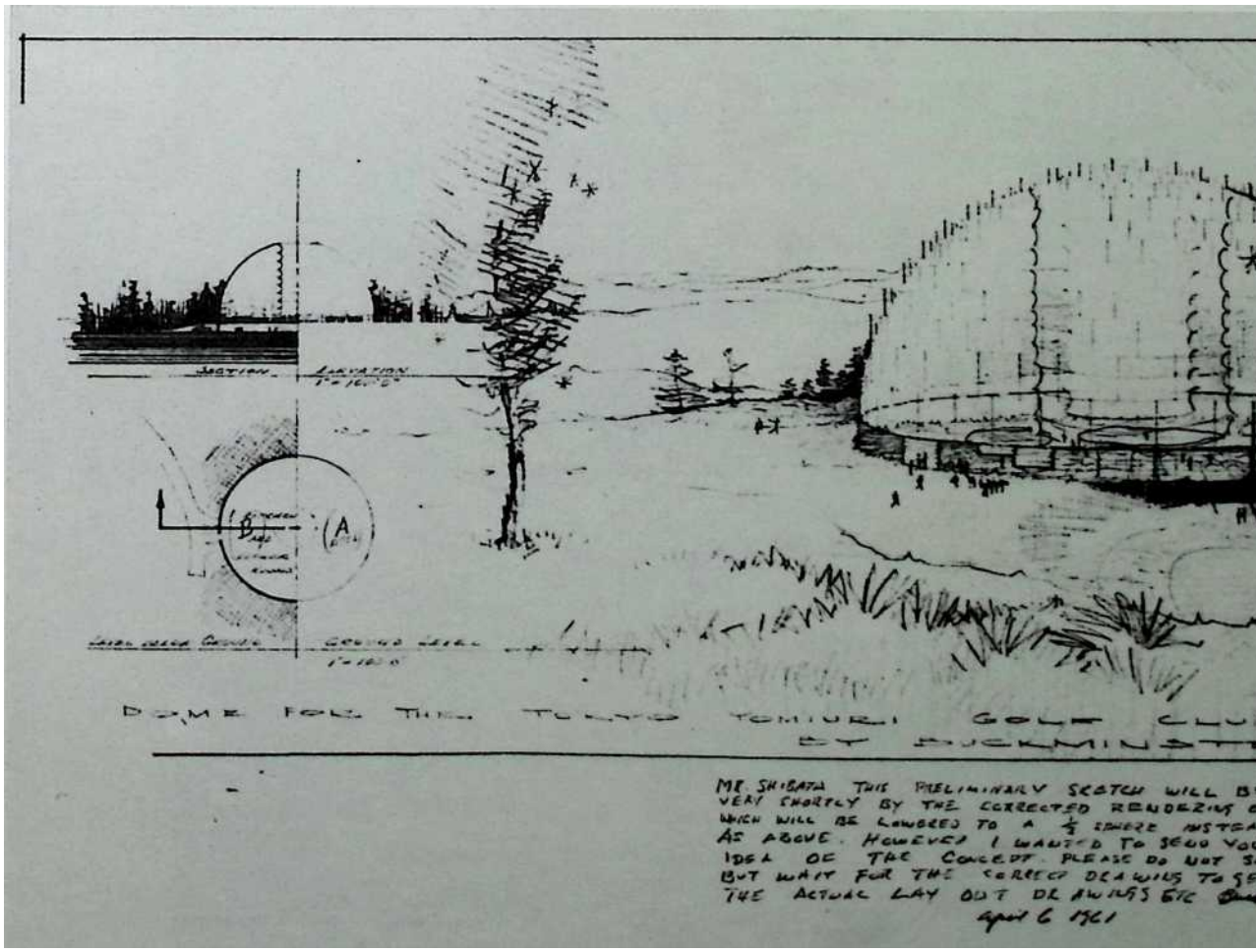

PROPOSED GEODESIC DOME SHOPPING CENTER — MONTREAL, CANADA

2 Yomiuri Golf Club Geodesic Dome, Tokyo 1961–1963

The Yomiuri Golf Club project began in a sketch of 1961 that may be Fuller's earliest attempt to design an aspension structure. An aspension dome is a set of vertical tube supports arranged concentrically and stacked from the ground to the apex in progressively shorter sizes. They are supported and held in place by metal cables held in tension. This project evolved from a half to a third of a sphere. The intermediate phase of the design called for a radomelike structure with portholes, later called the monohex. But this was abandoned eventually for the aspension system. The base was also set above the ground, like the national headquarters of the American Society for Metals, although the supports in the 170-foot Japanese building were triangular volumes clad in metal panels.



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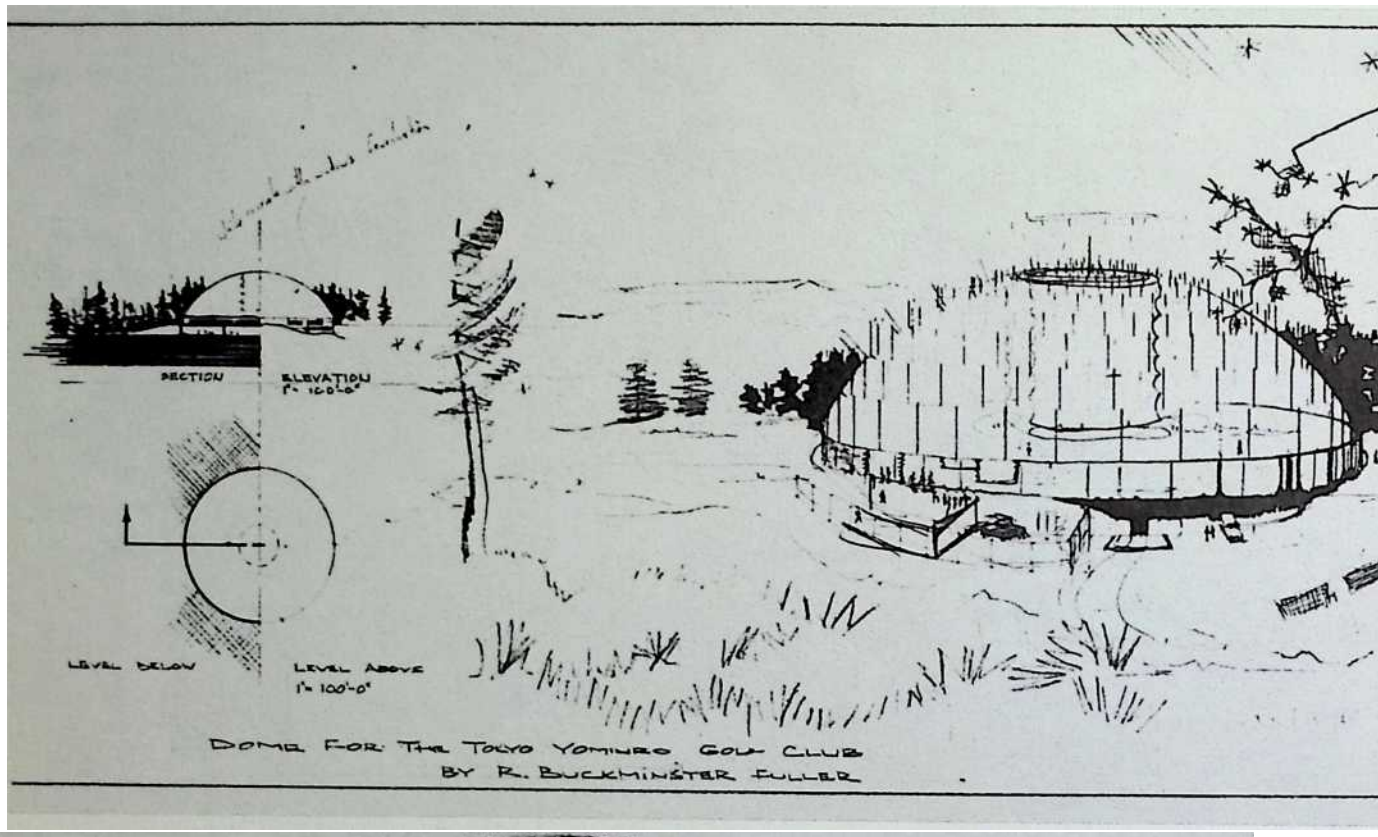
SECTION
ELEVATION
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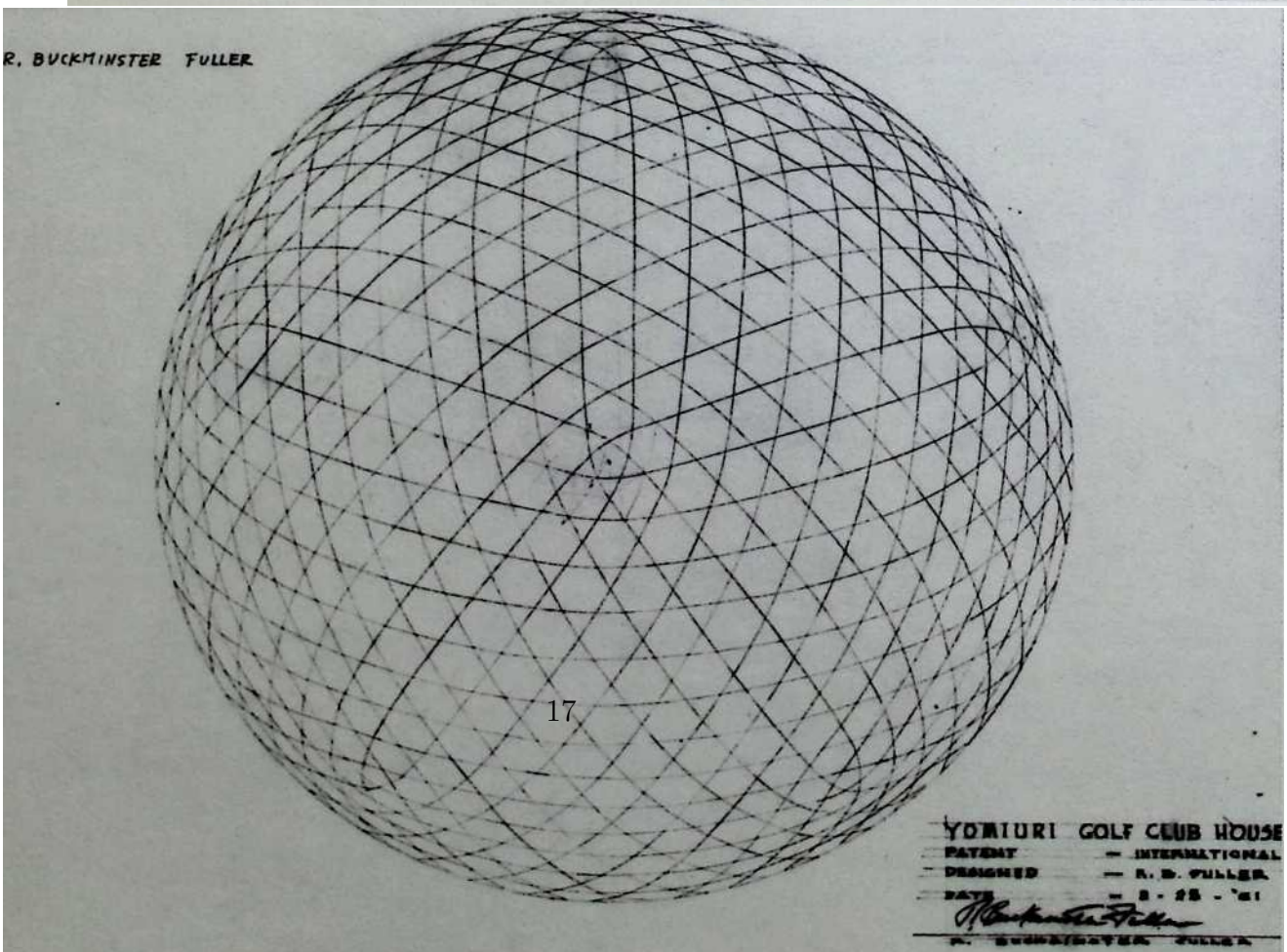
LEVEL BELOW
LEVEL ABOVE
1" = 100'-0"
DOME FOR THE TOKYO YOMIURI GOLF CLUB
BY R. BUCKMINSTER FULLER


R. BUCKMINSTER FULLER
YOMIURI GOLF CLUB HOUSE
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DESIGNED — R. B. FULLER
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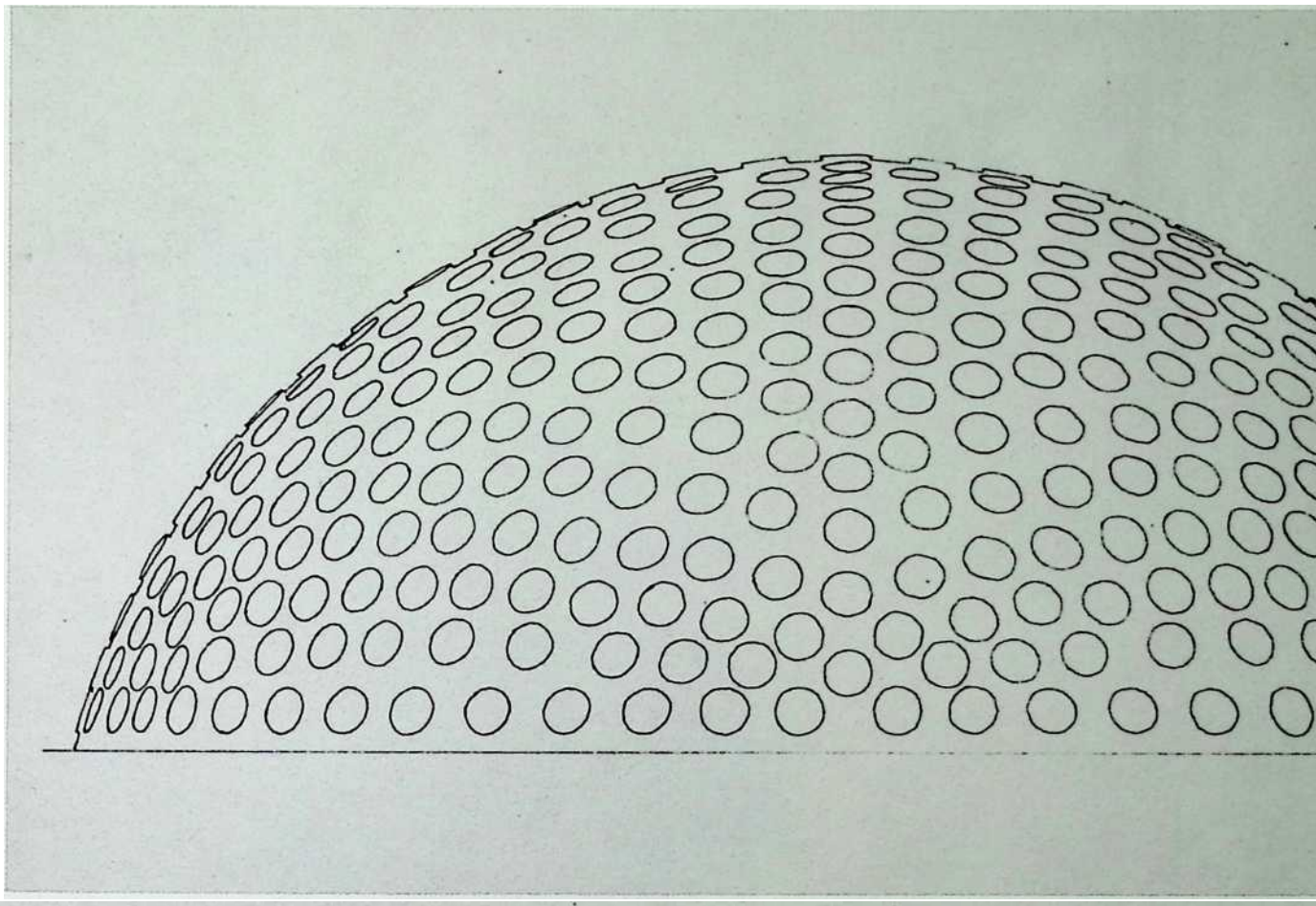
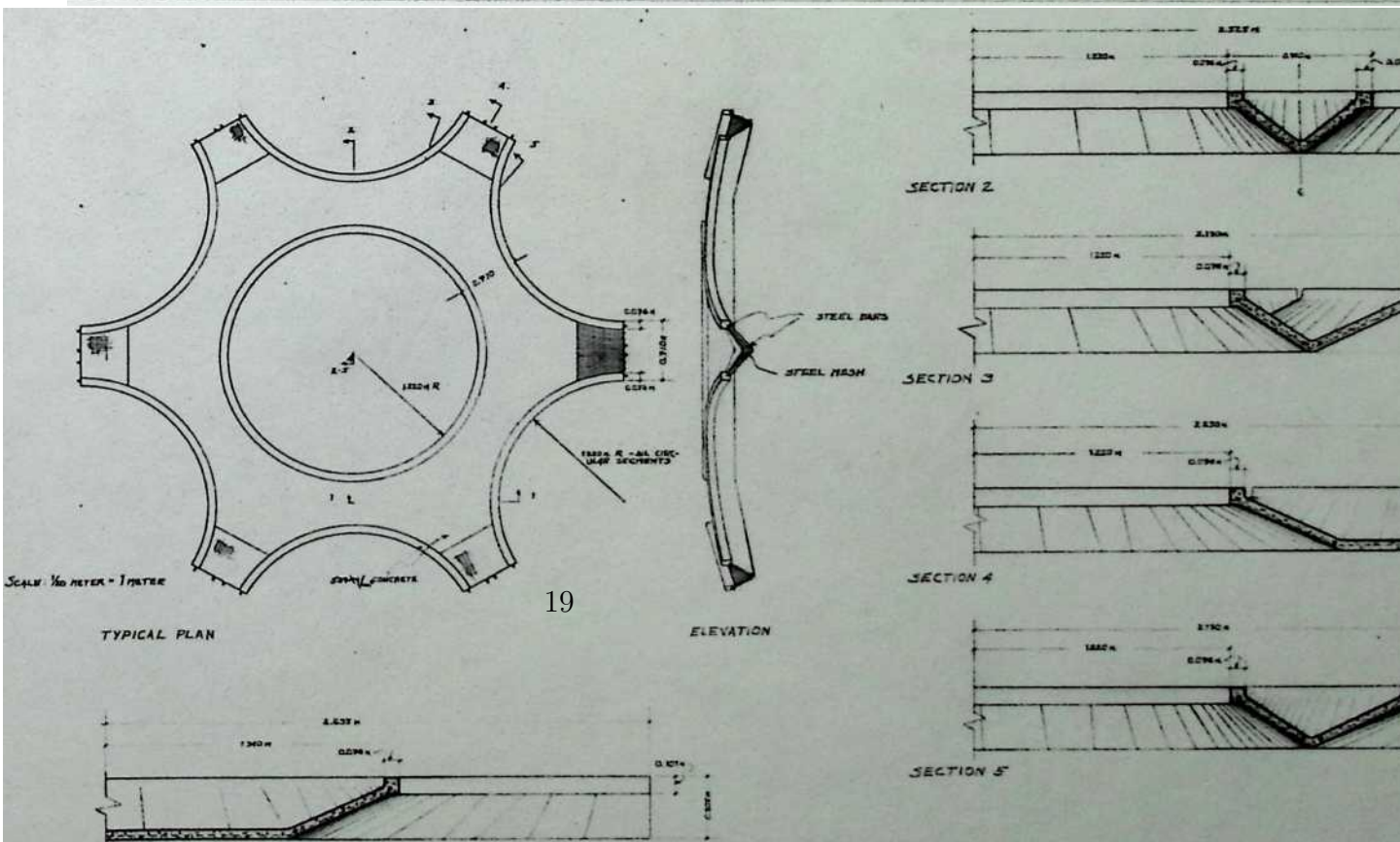
THE GEODESIC REVOLUTION, P/XRT 2–5




STEEL BARS
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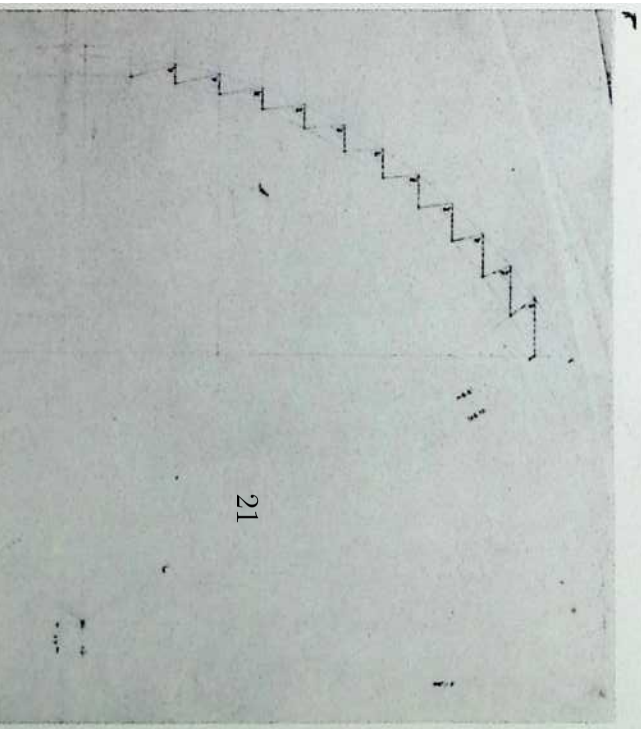
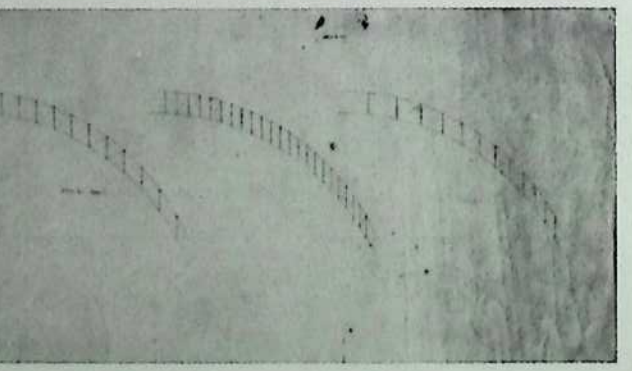
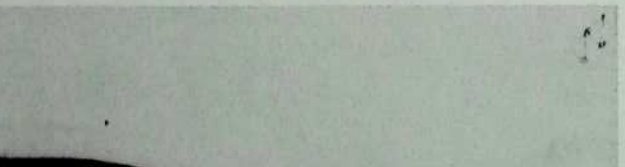
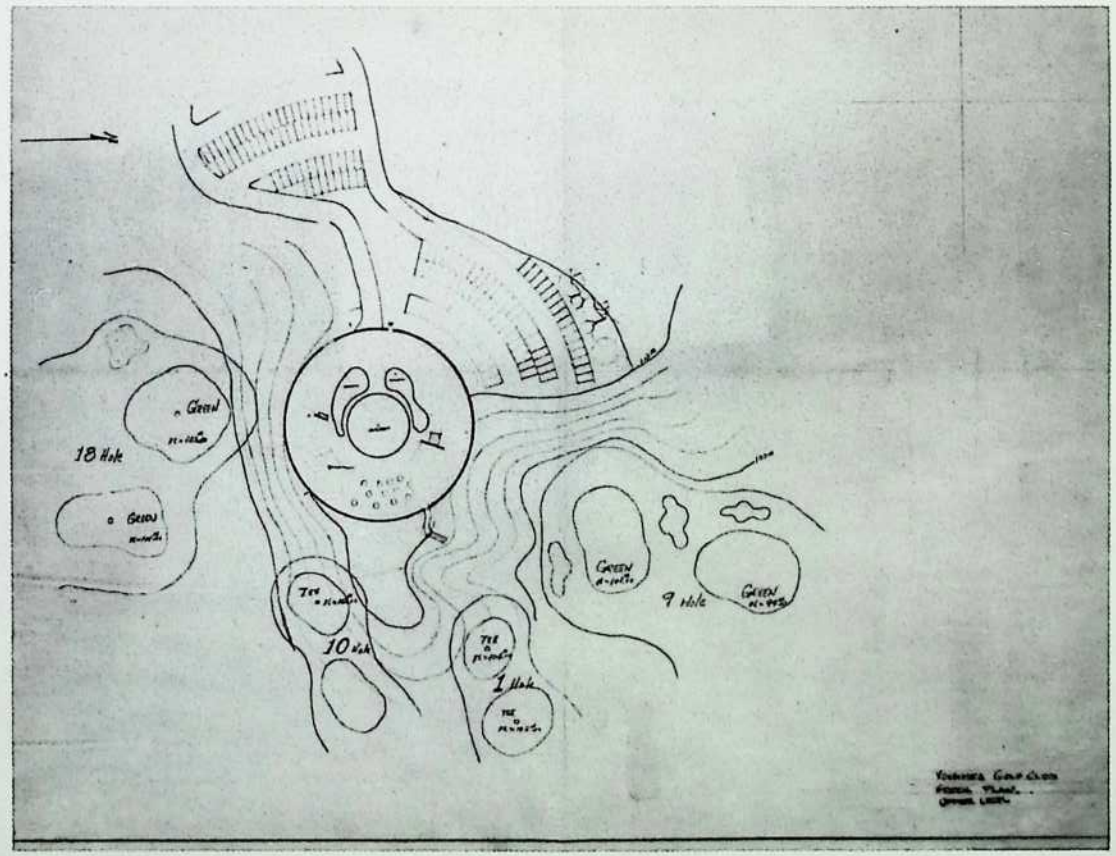
DOME FOR THE TOKYO YOMIURI GOLF CLUB
BY R. BUCKMINSTER FULLER





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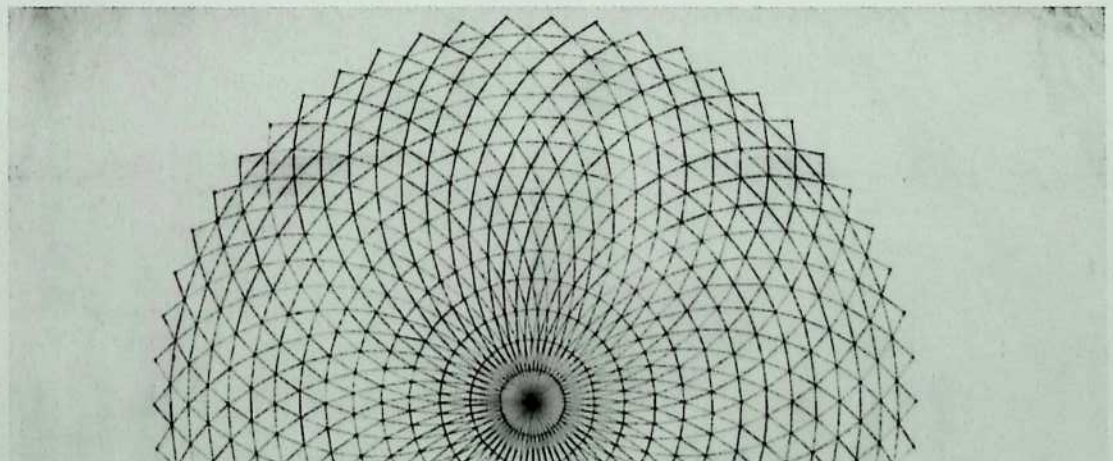

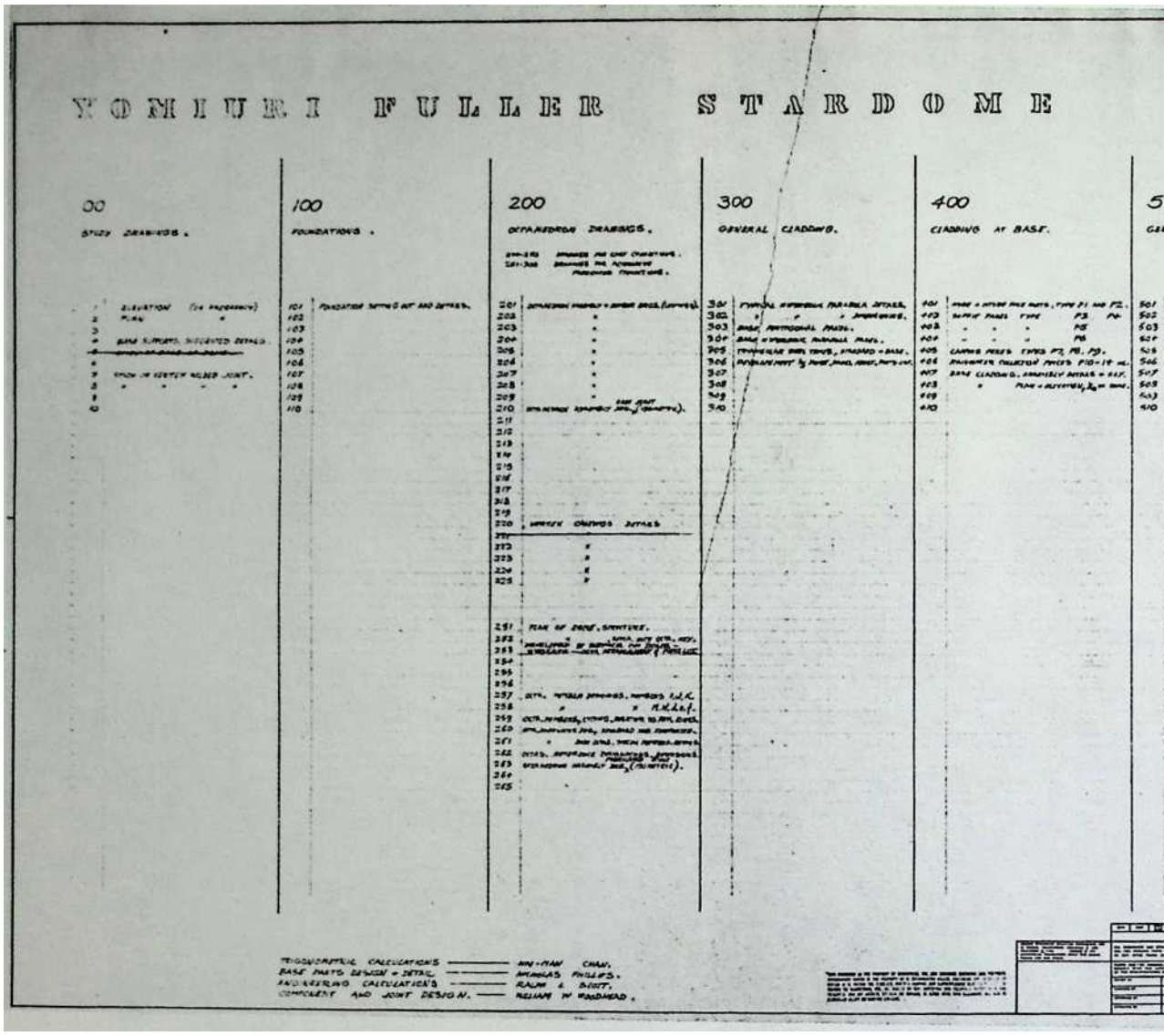
YOMIURI FULLER STARDOME
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FOUNDATIONS.
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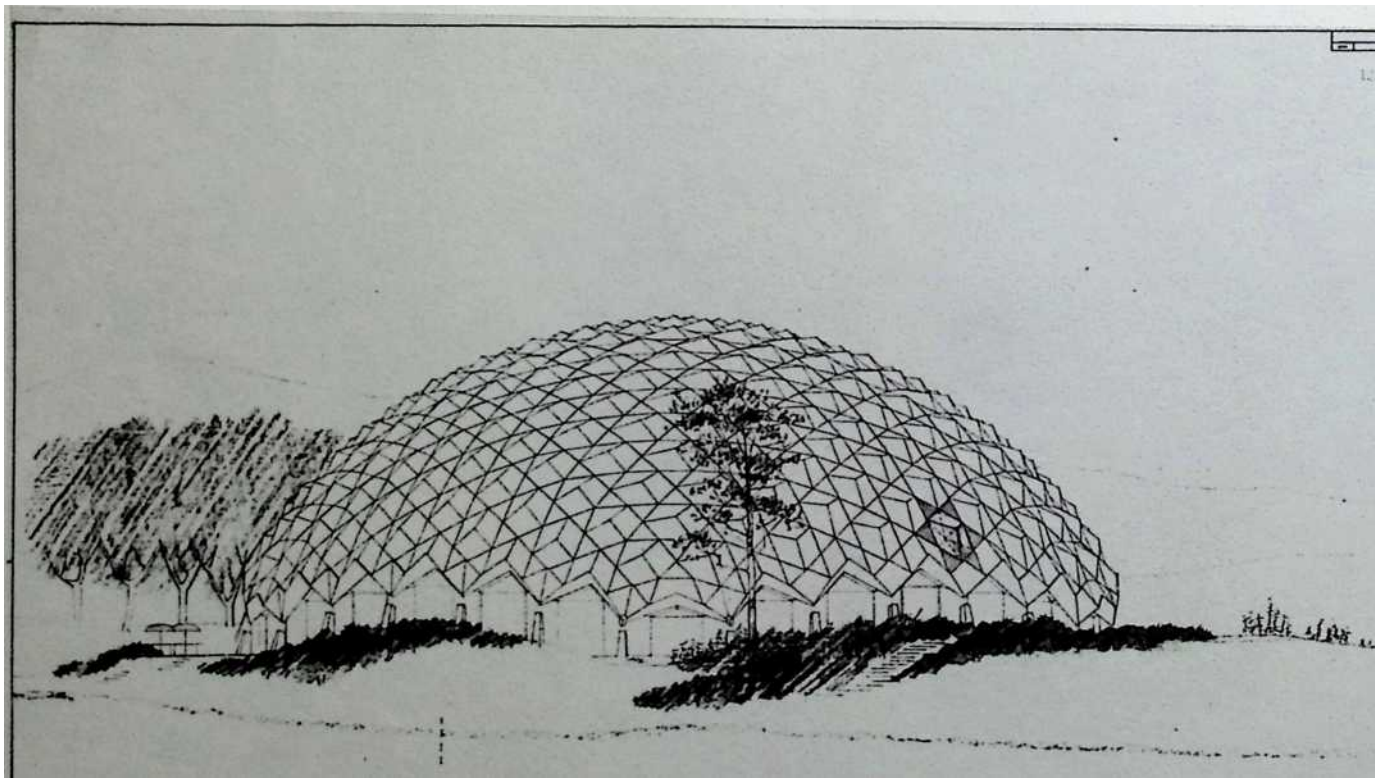
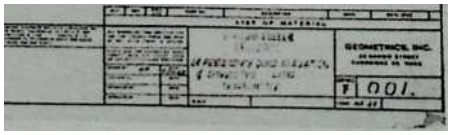
OCTAHEDRON DRAWINGS.
300
GENERAL CLADDING.
400
CLADDING AT BASE.
TRIGONOMETRIC CALCULATIONS — WU-HAN CHAN.
BASE PARTS DESIGN + DETAIL — NICHOLAS PHILLIPS.
ENGINEERING CALCULATIONS — RALPH L. DUFF.
COMPONENT AND JOINT DESIGN. — WILLIAM W. WOODHEAD.





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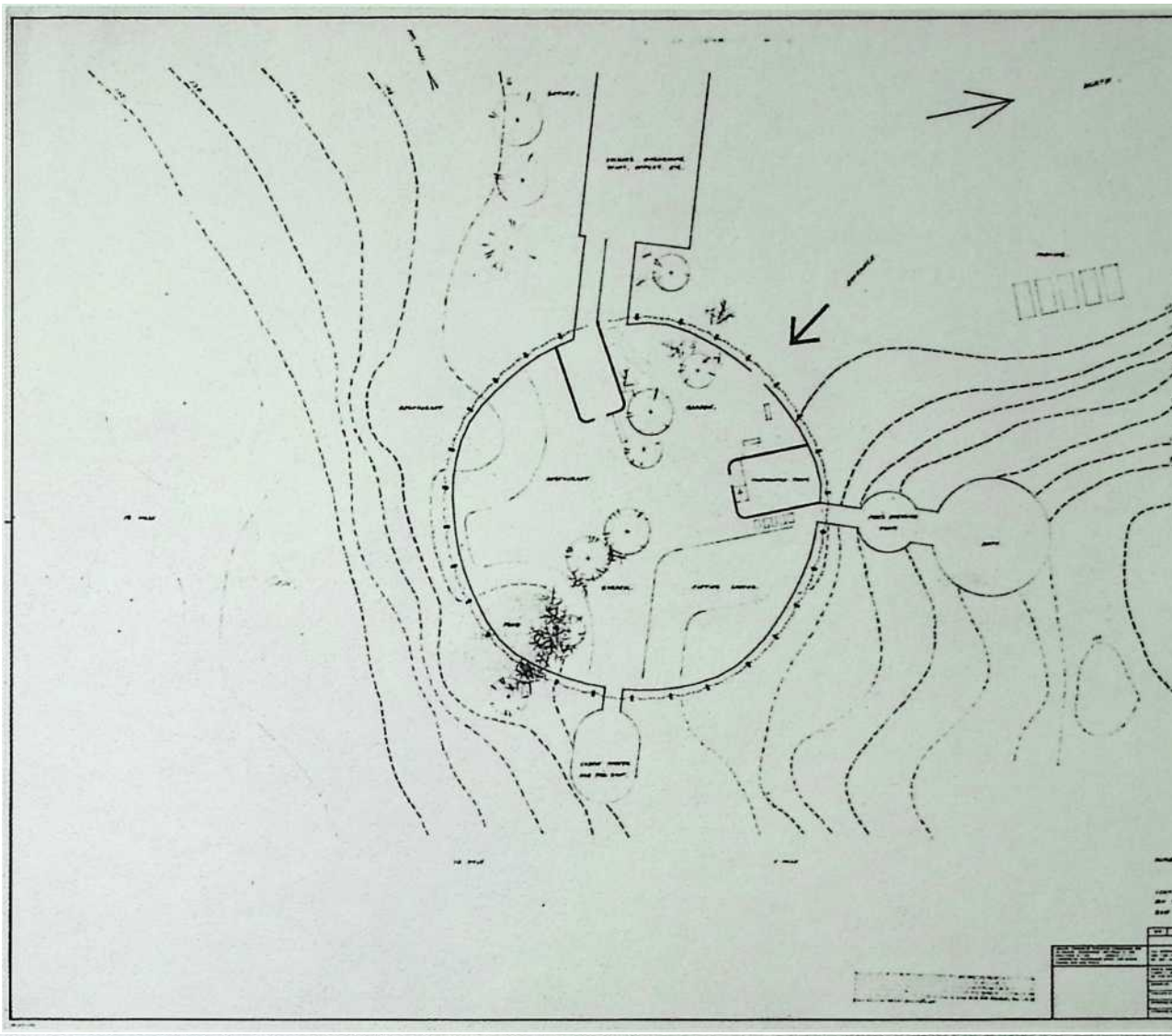

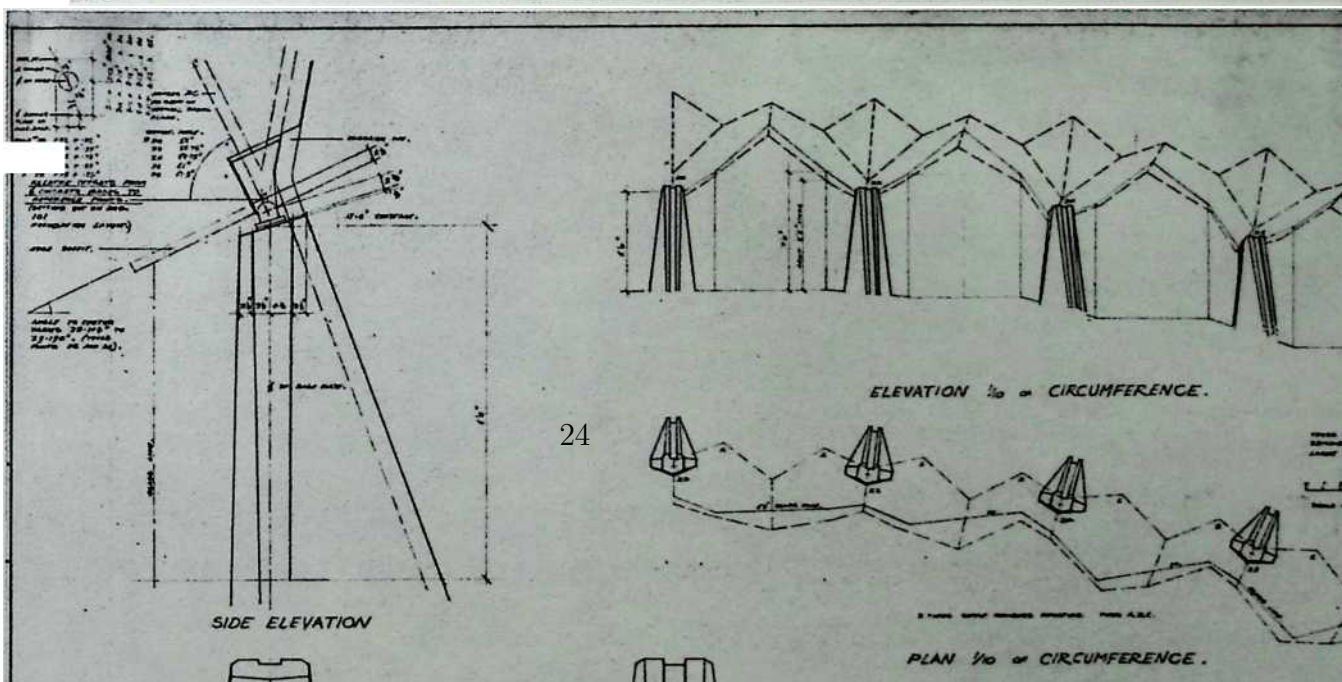
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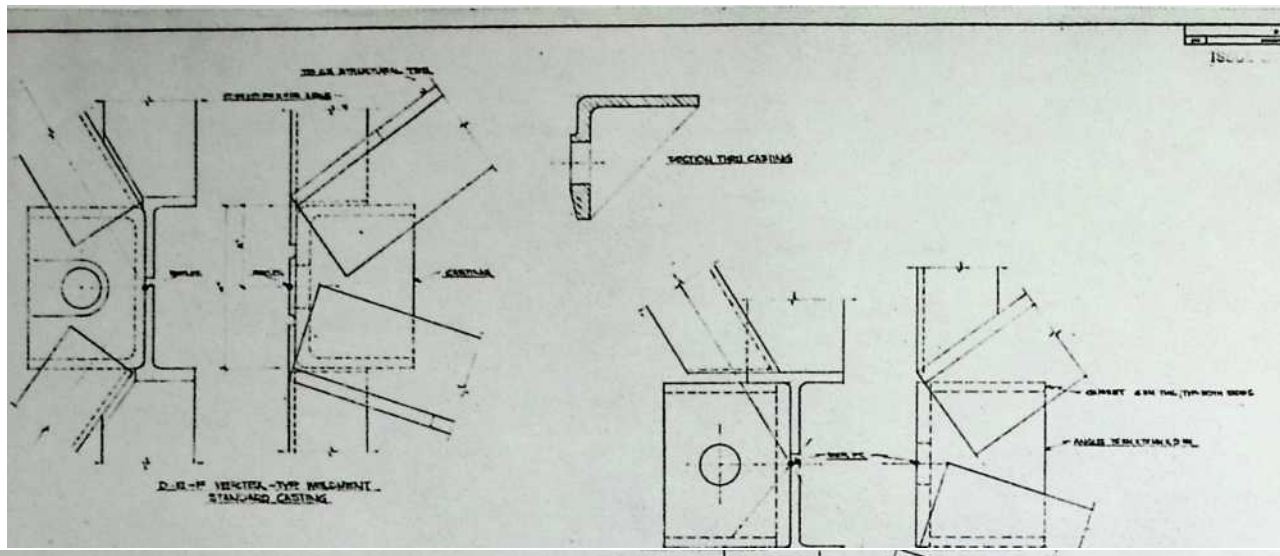
10 THE GEODESIC REVOLUTION. PART 2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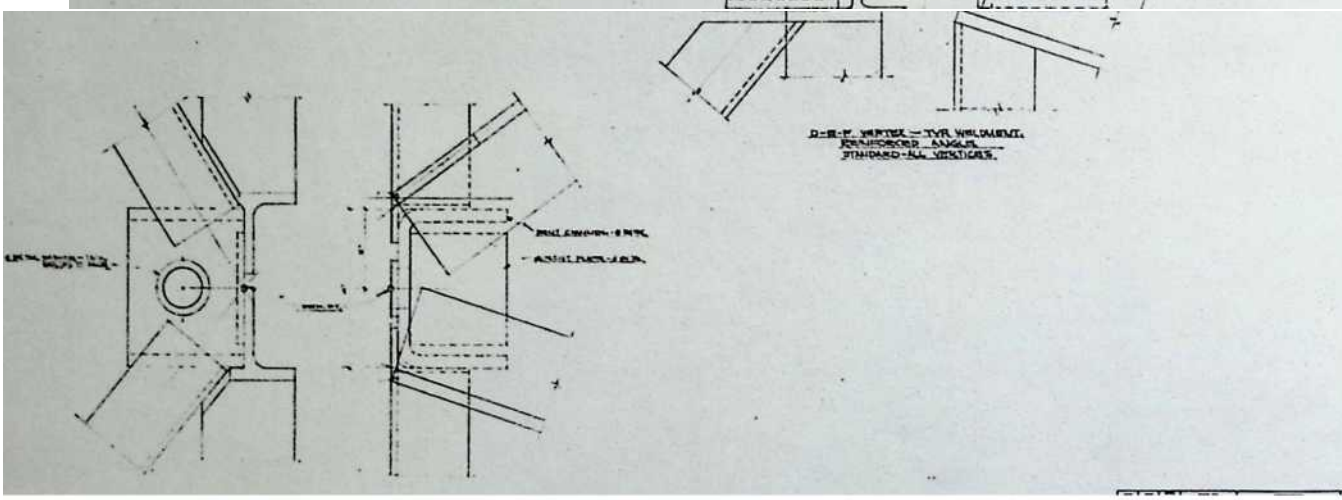
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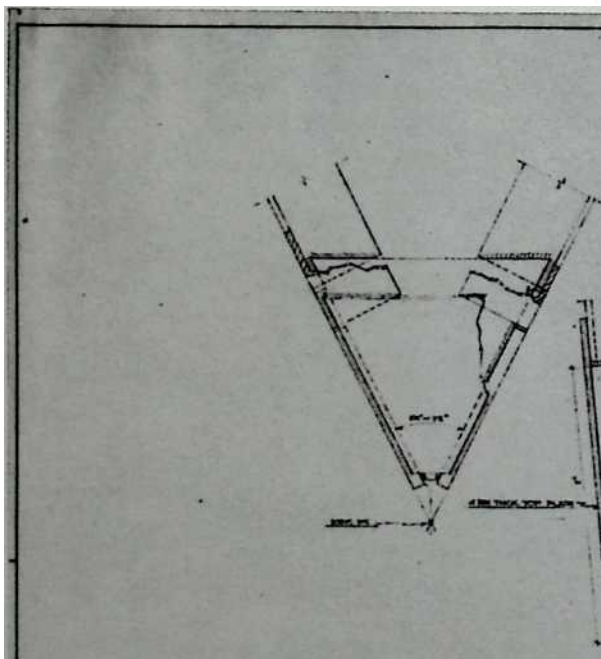

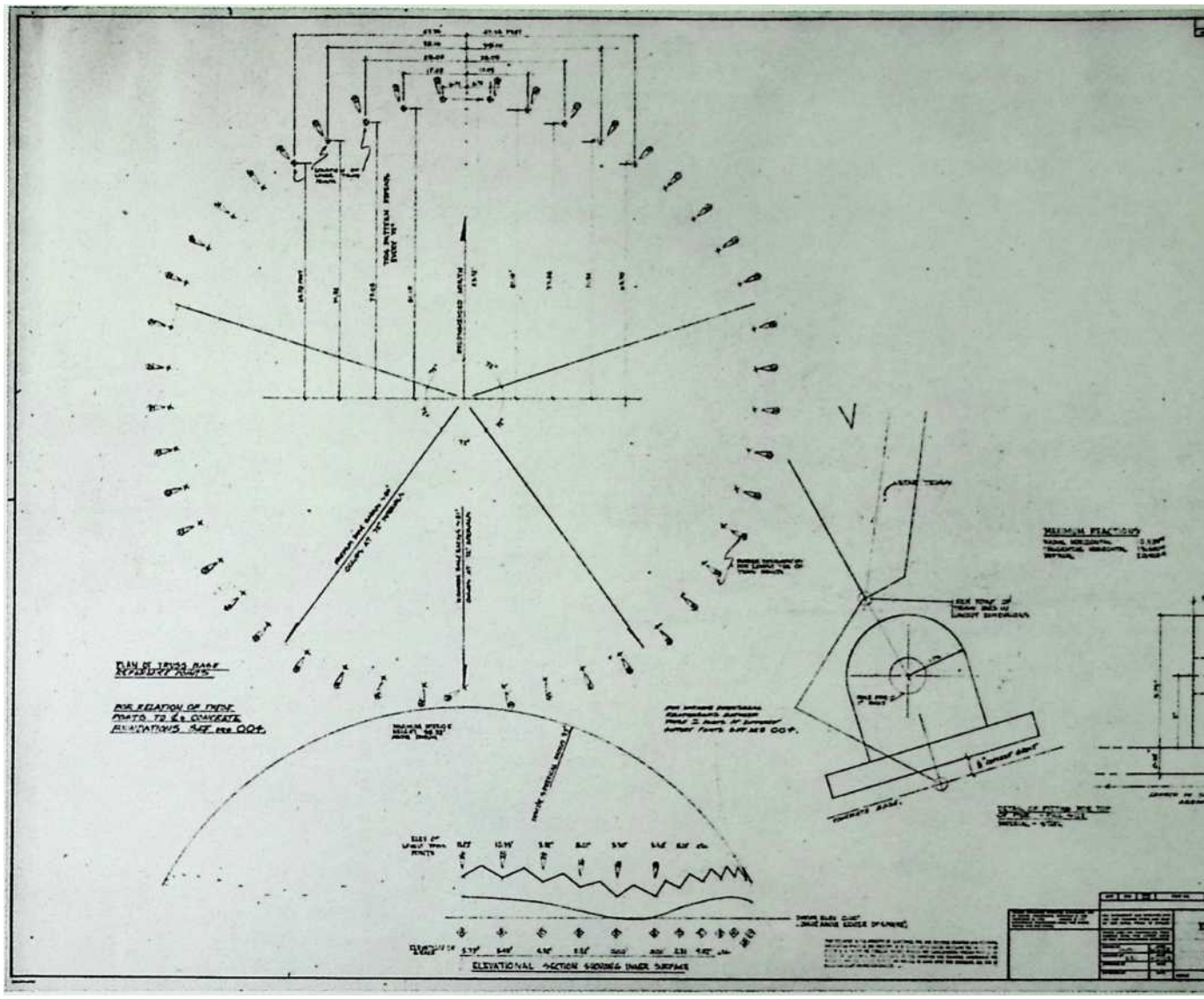
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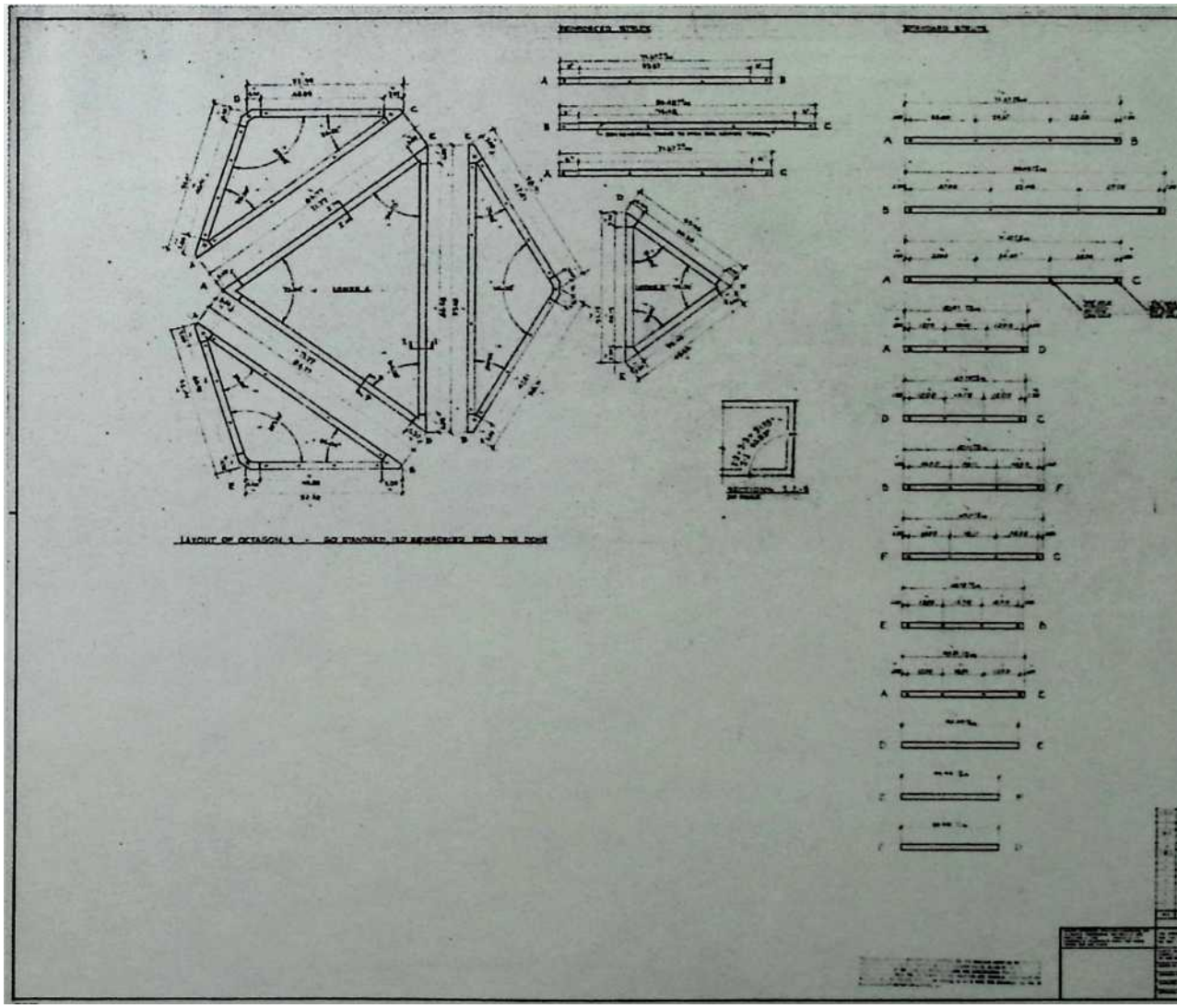

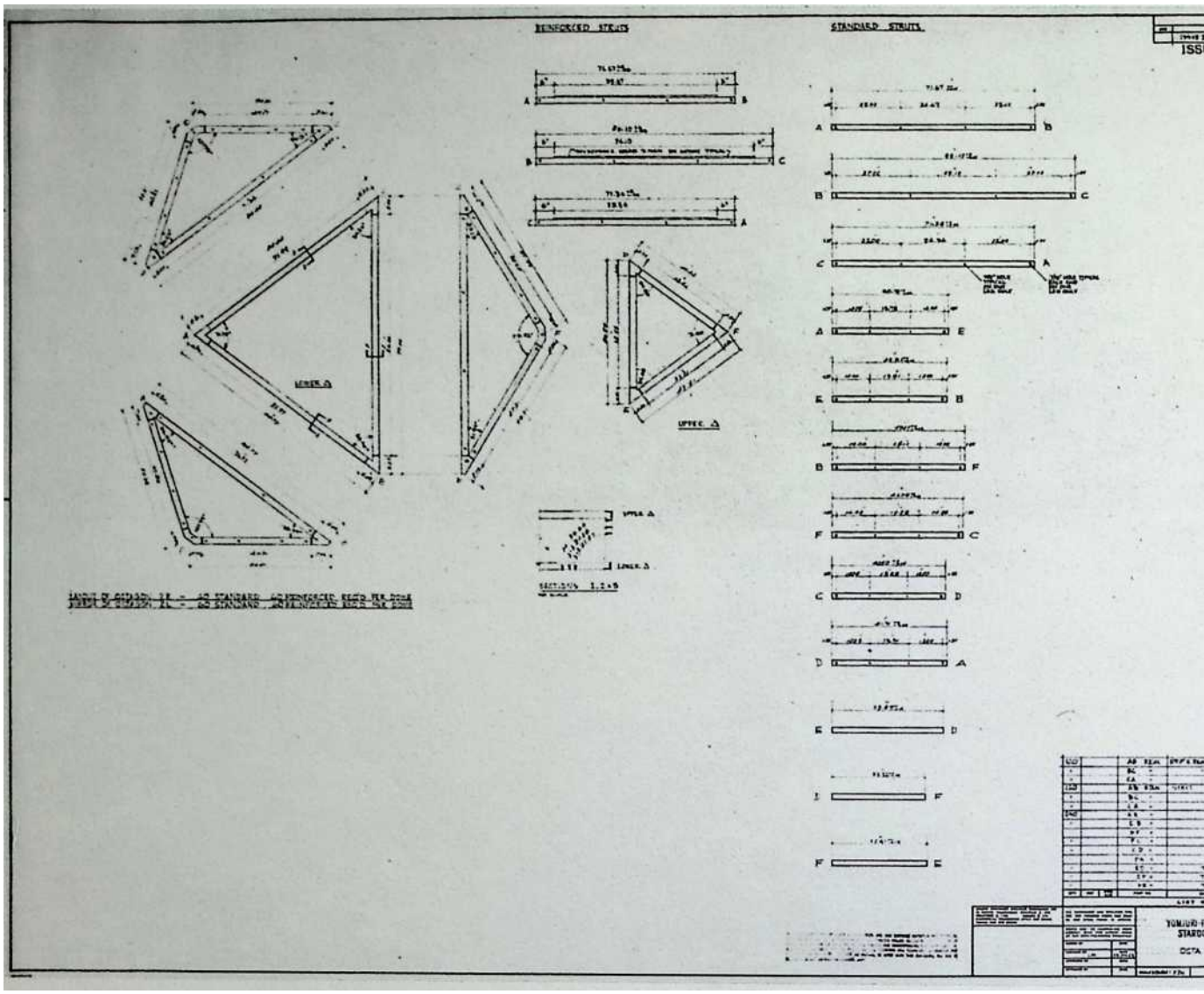
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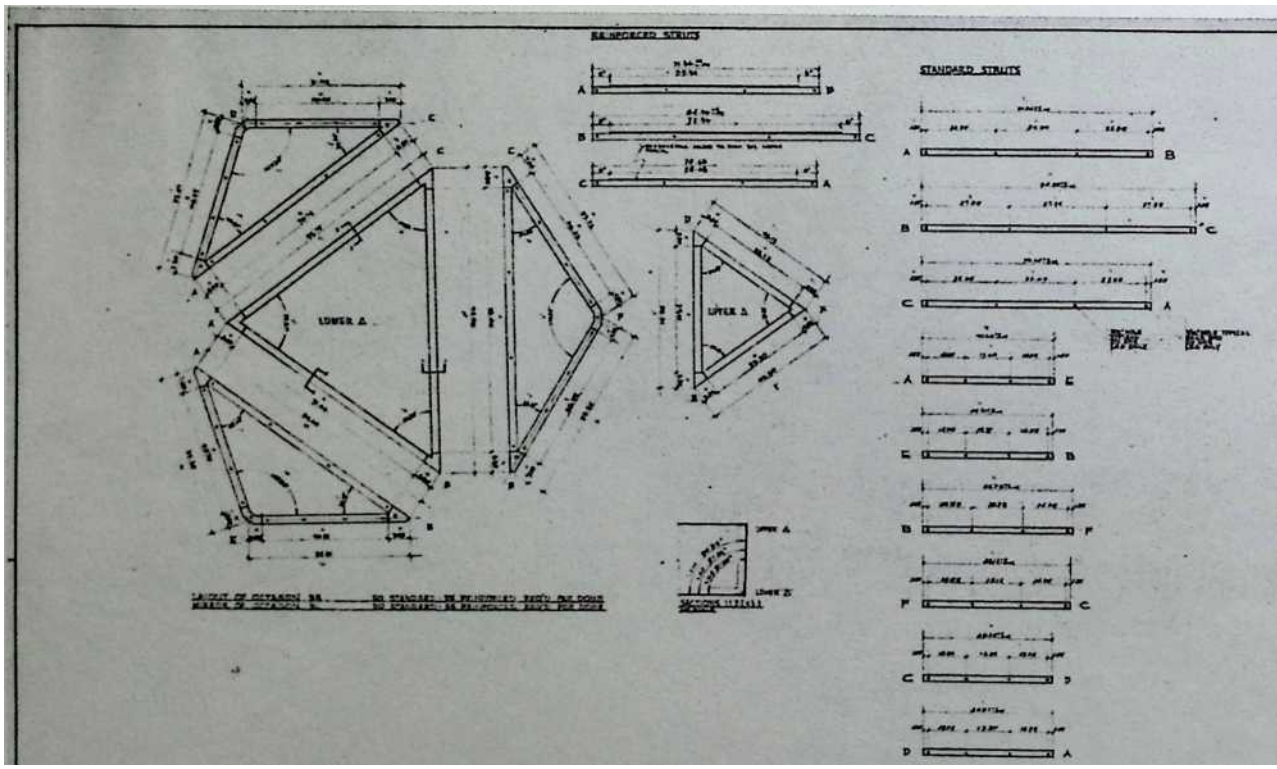
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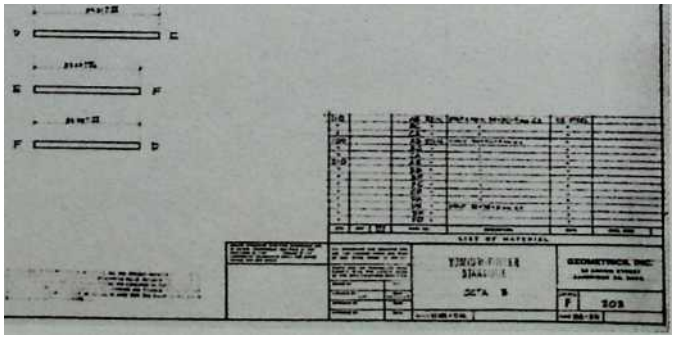
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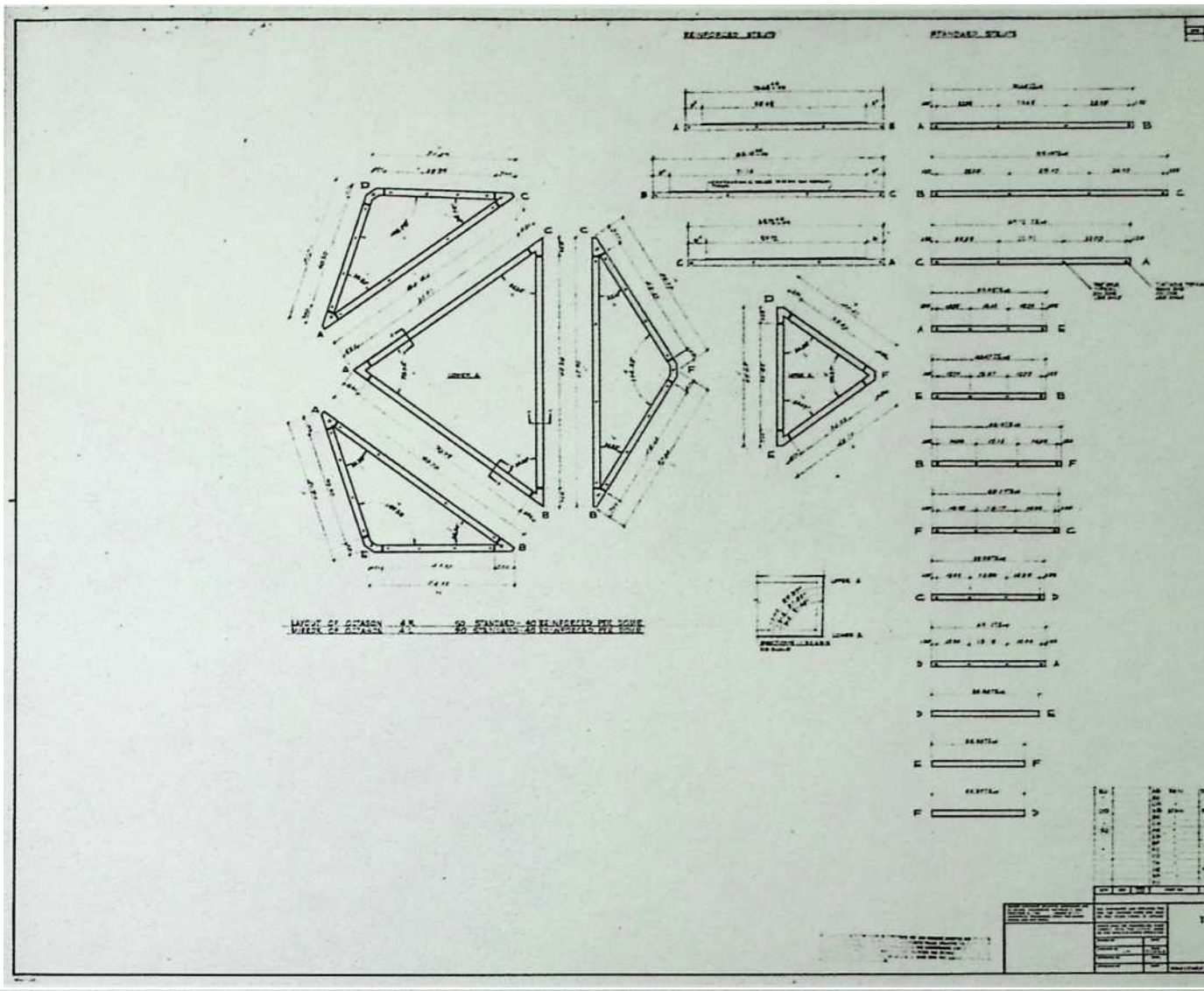

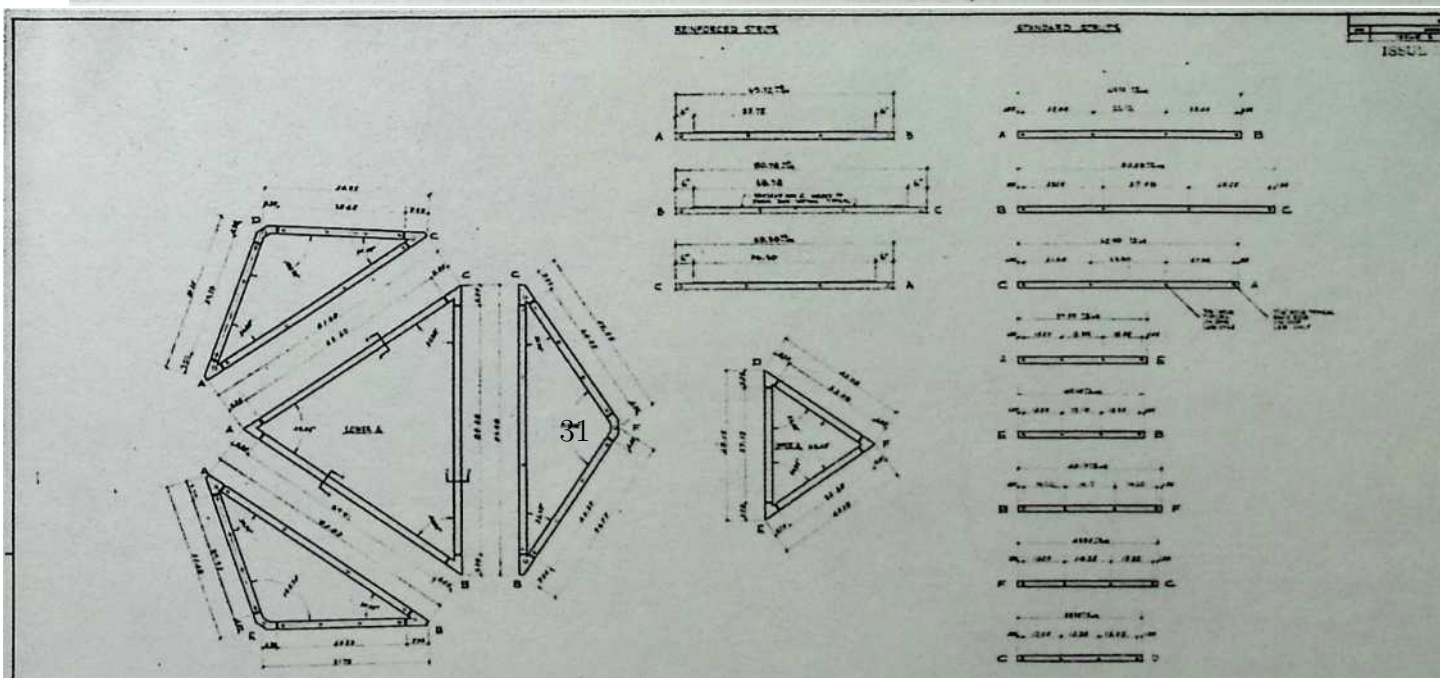

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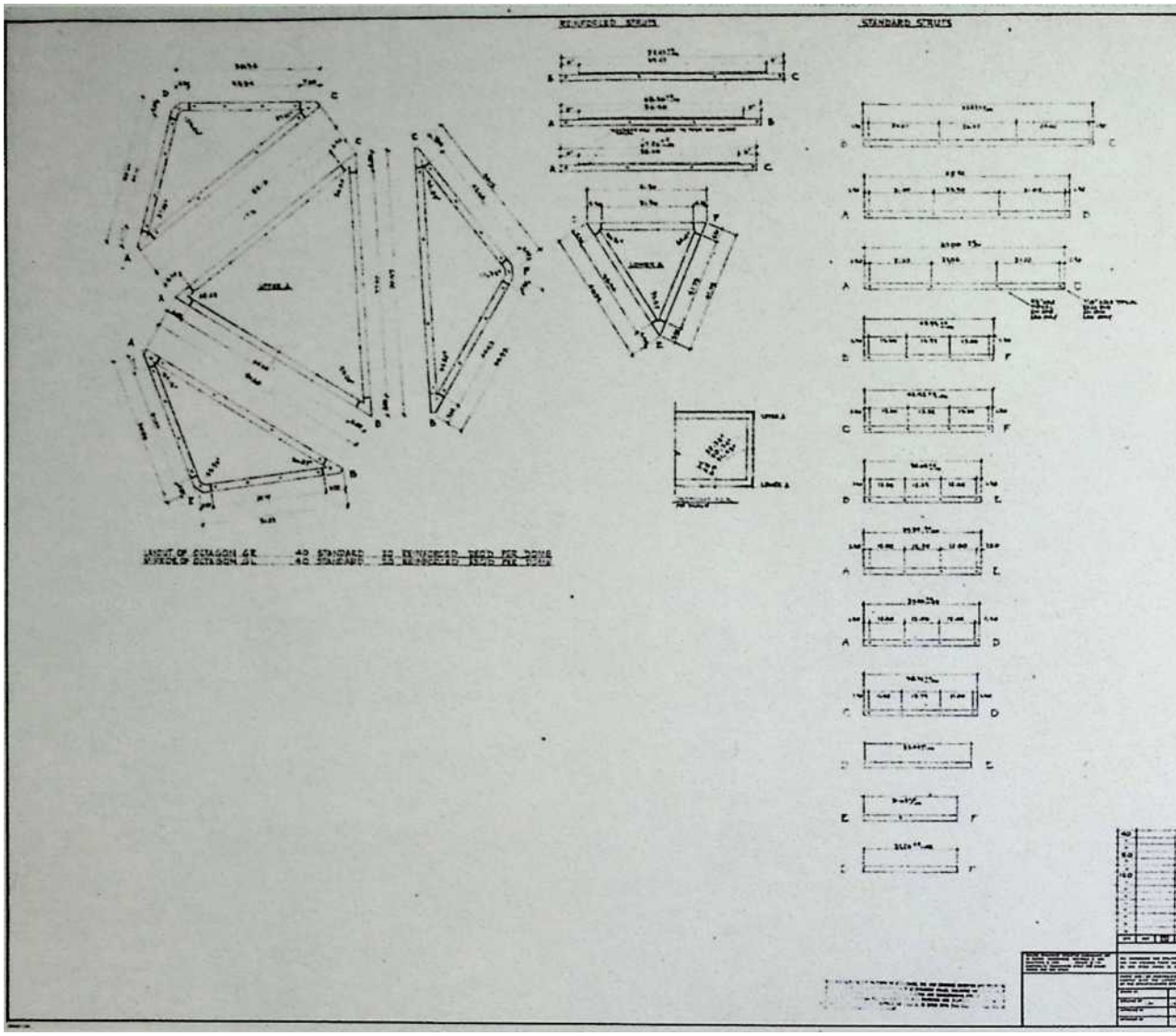
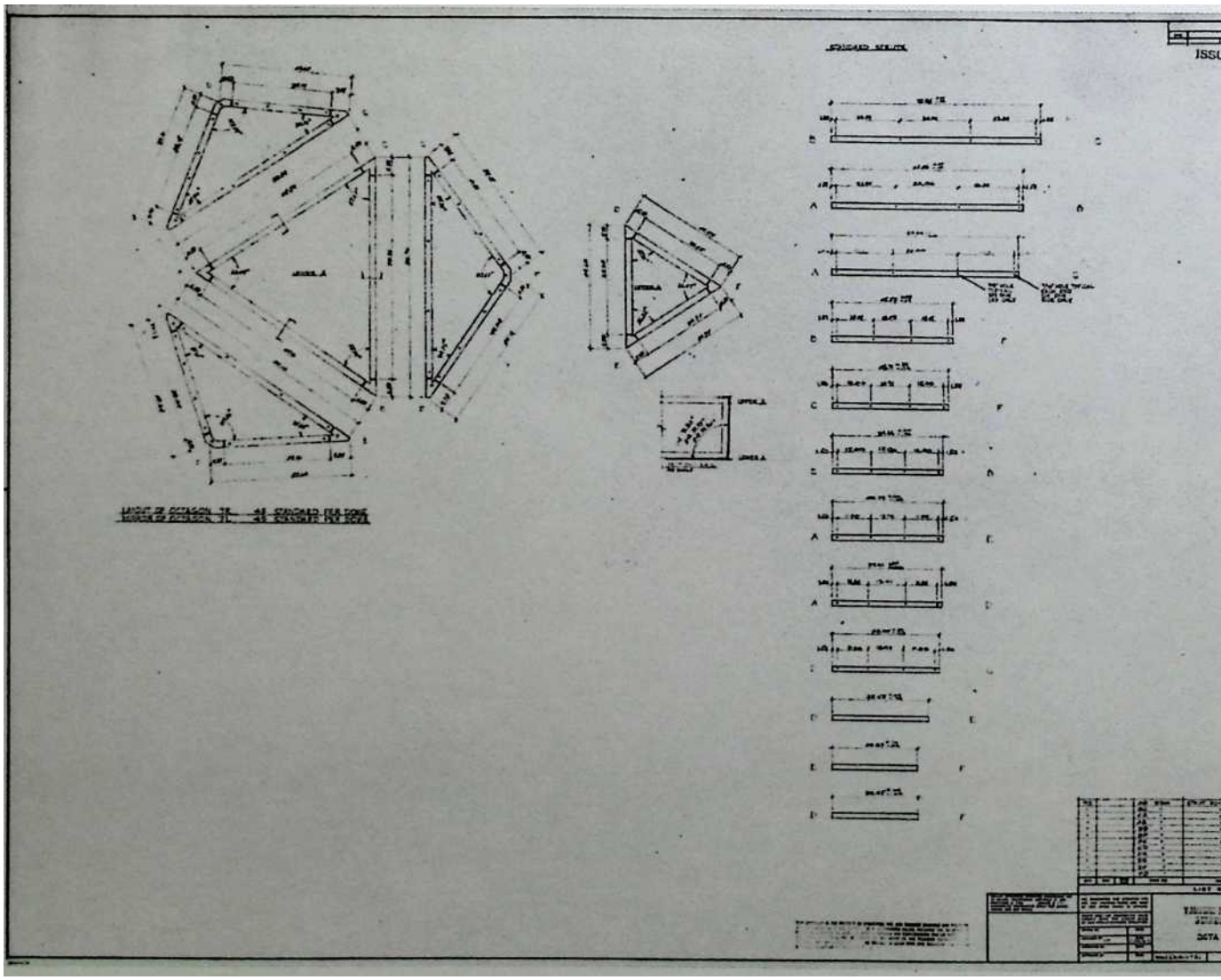
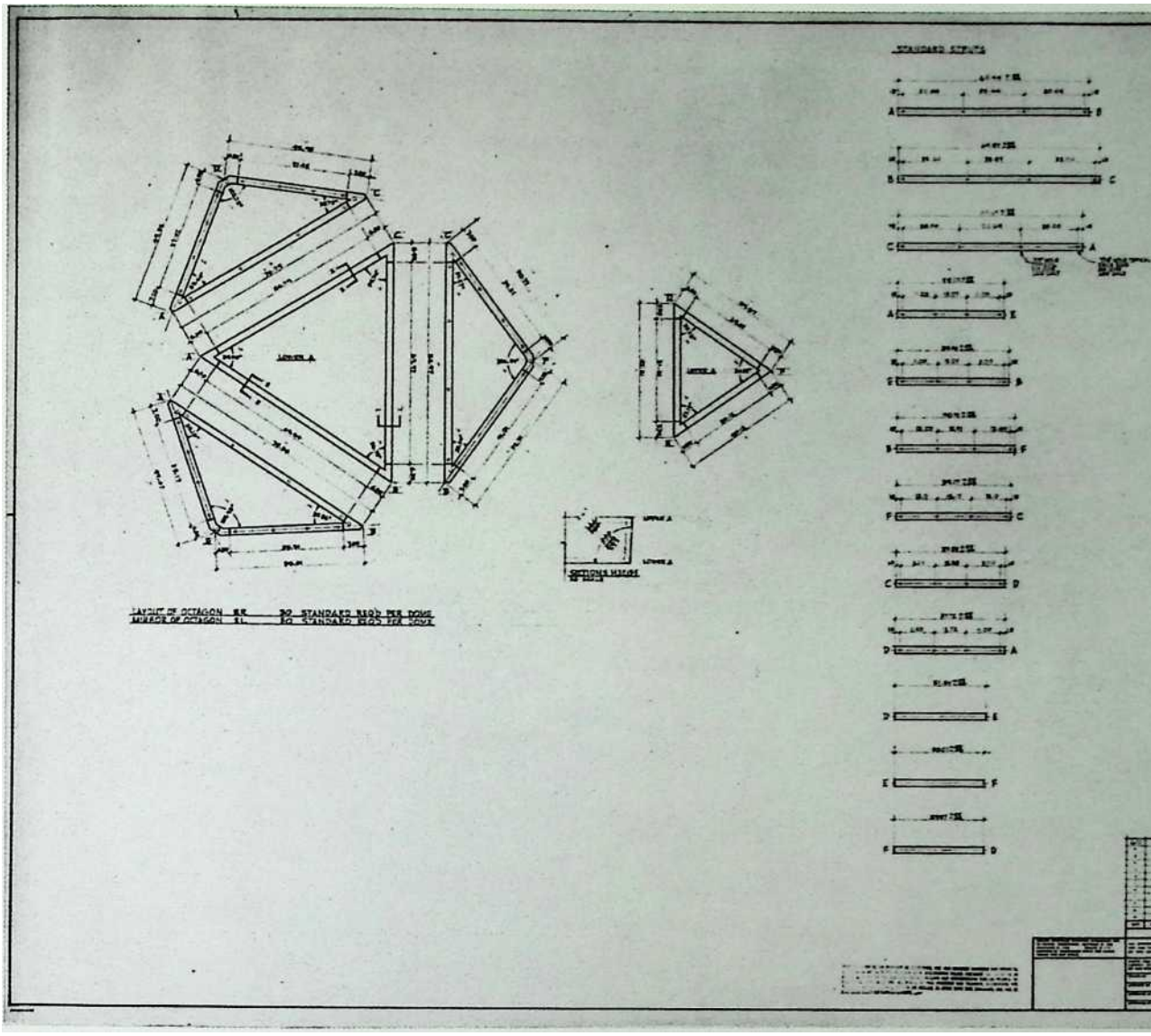
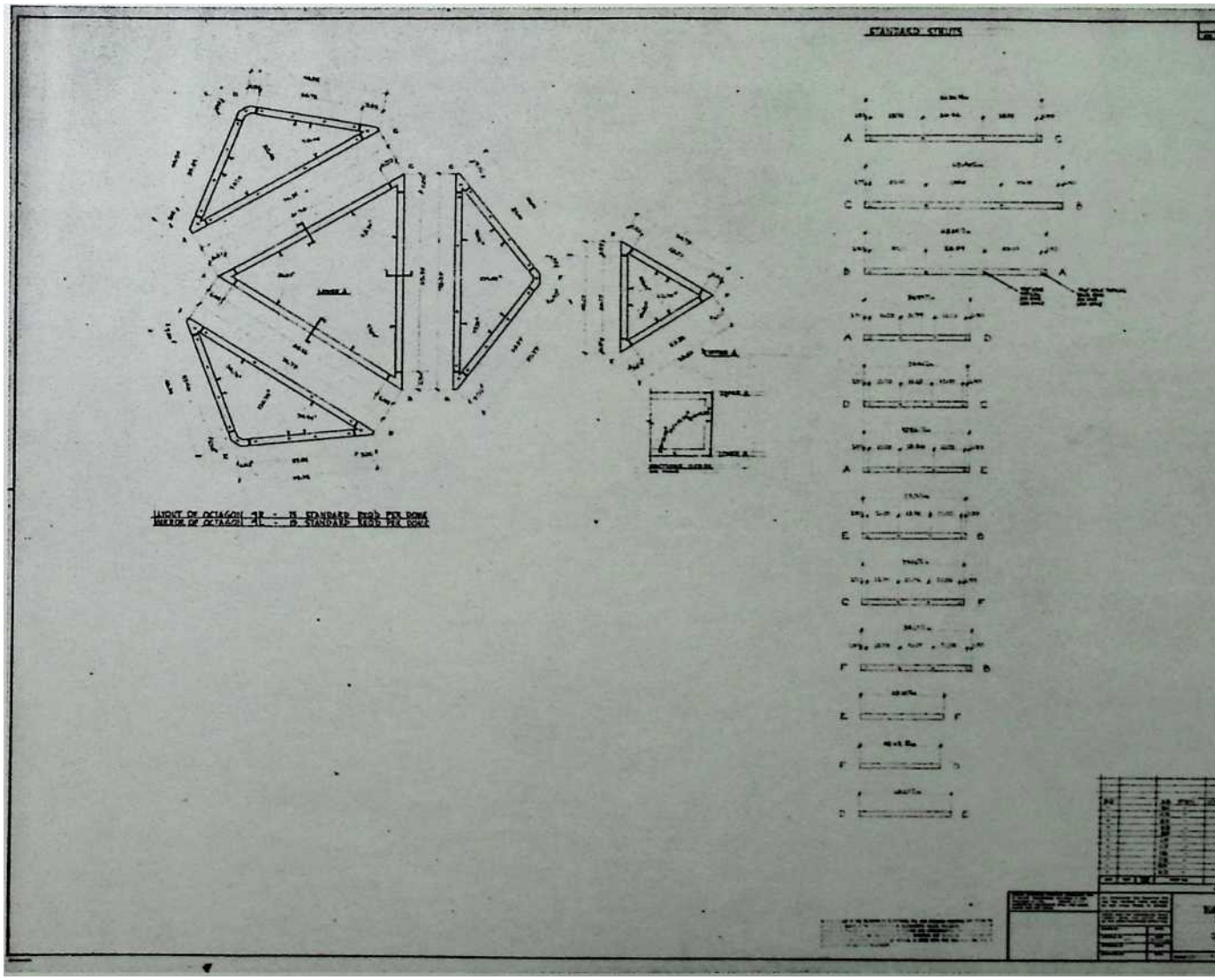





STANDARD STRUTS
LAYOUT OF OCTAGON
NUMBER OF OCTAGON
30 STANDARD RODS PER DOME
30 STANDARD RODS PER DOME


STANDARD STRUTS
LAYOUT OF OCTAGON
MIRROR OF OCTAGON

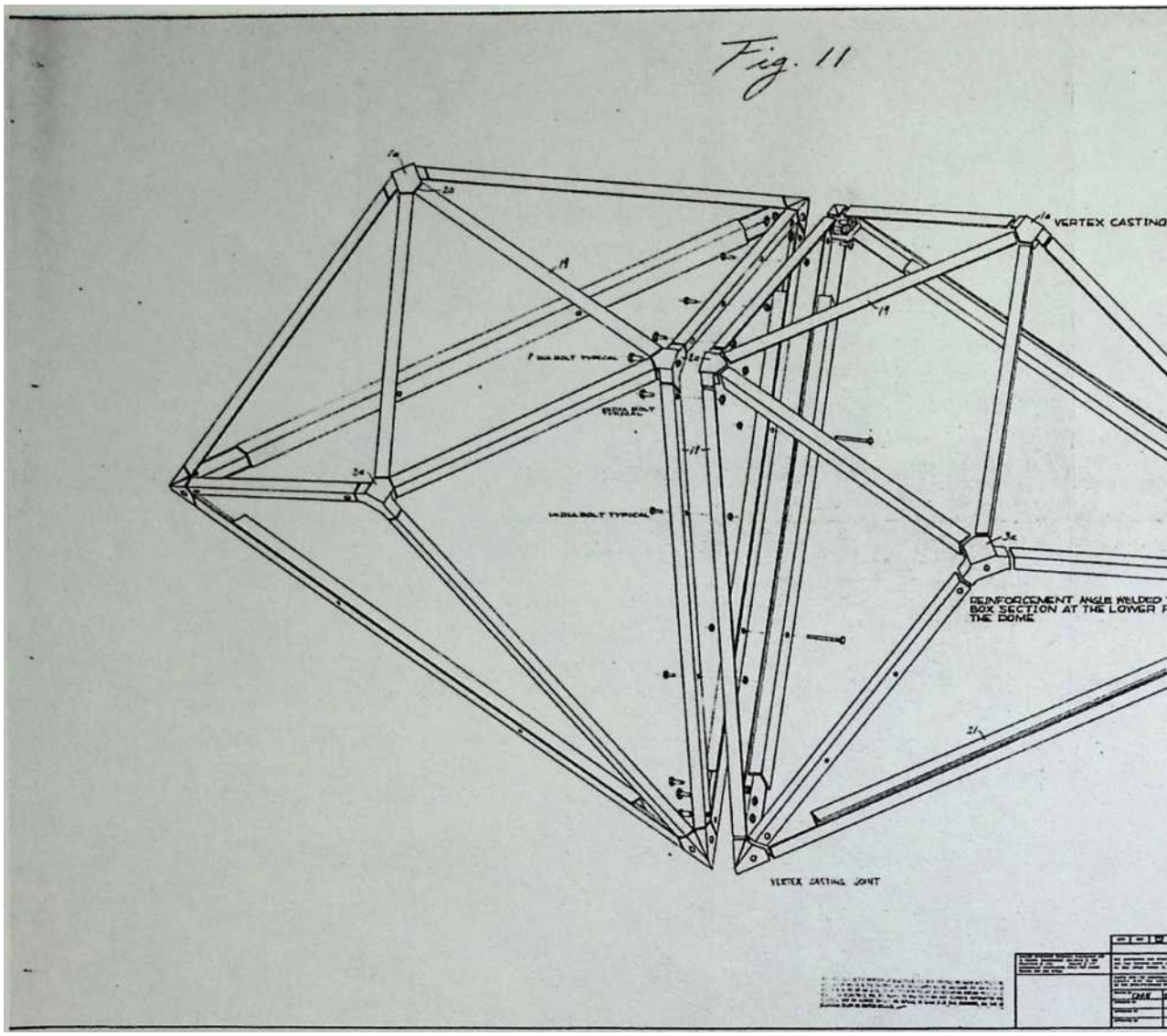
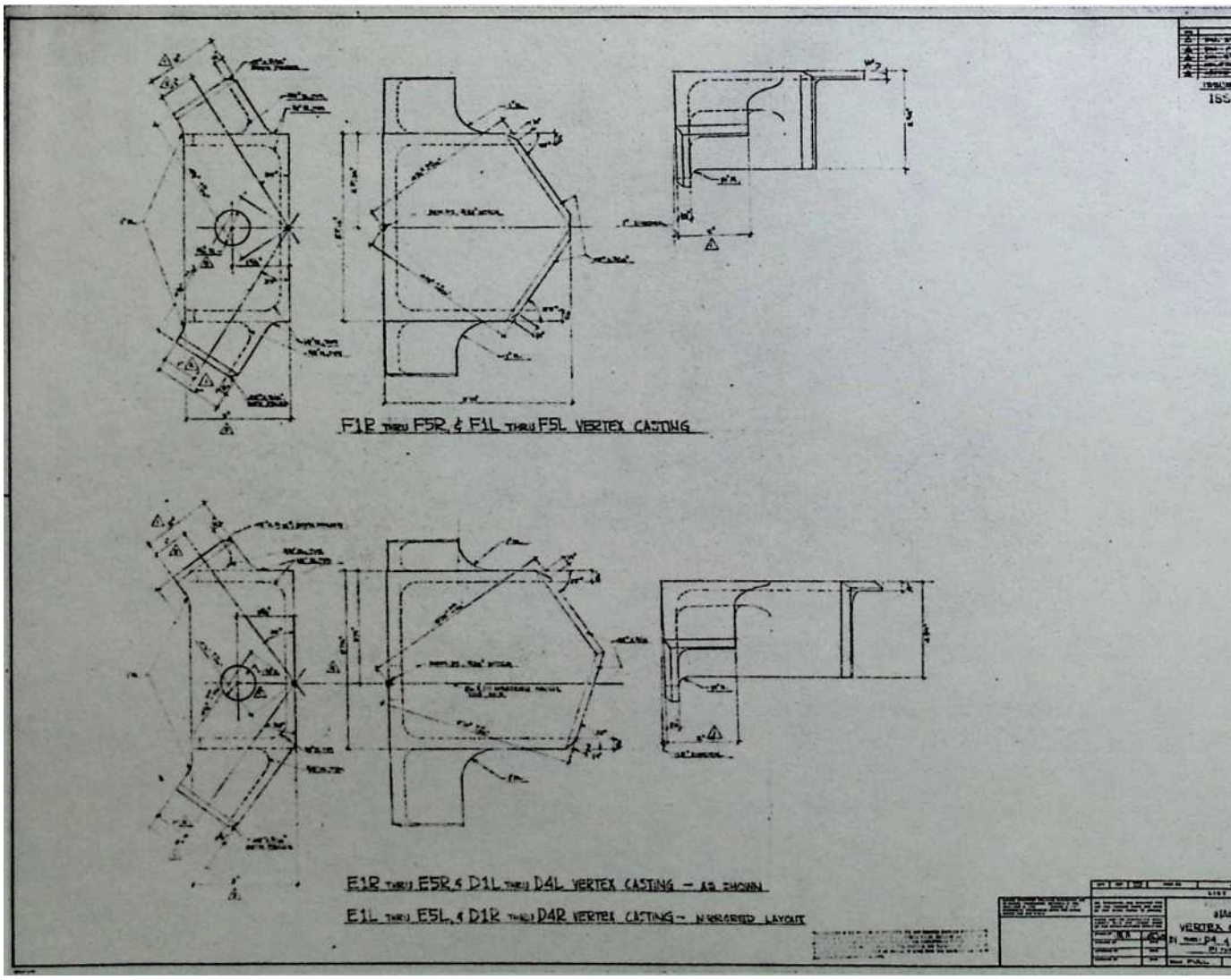
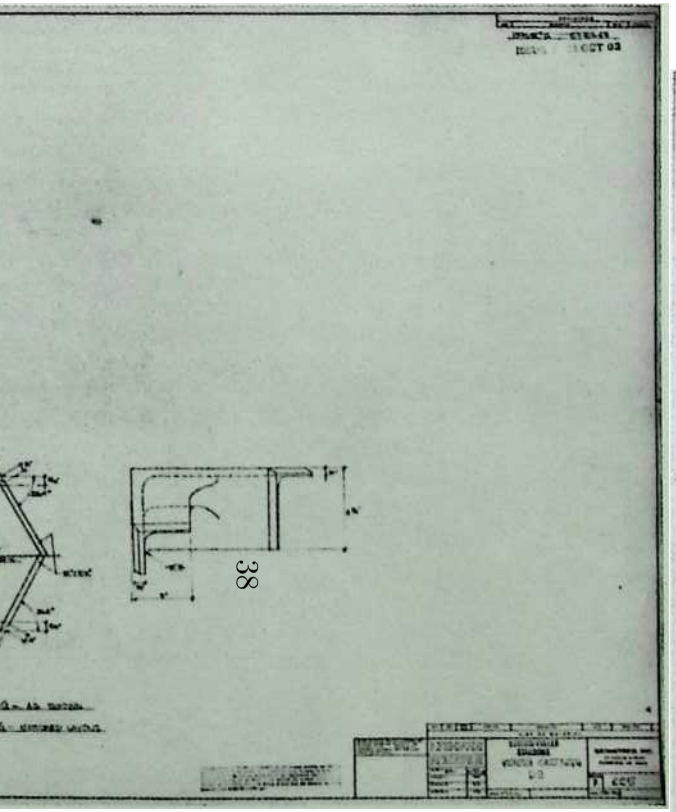
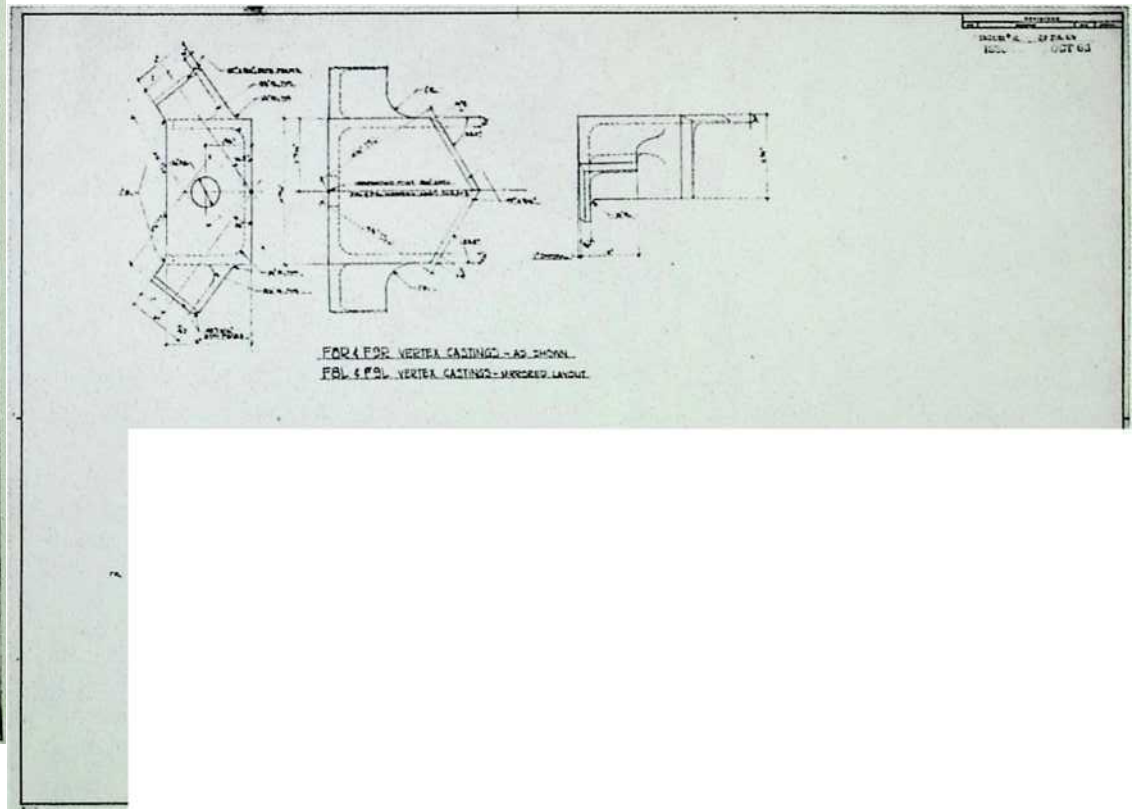
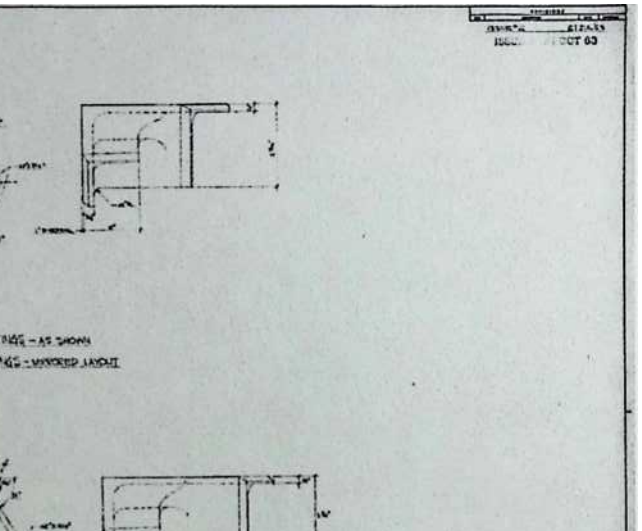


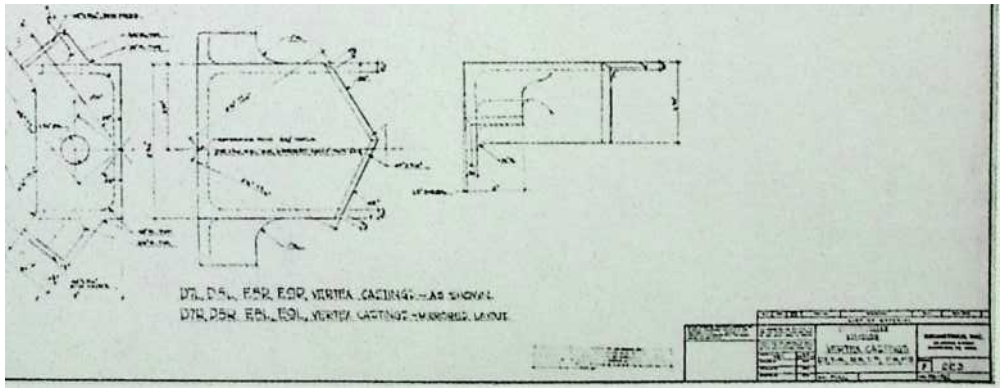
Fig. 11
VERTEX CASTING
REINFORCEMENT ANGLE WELDED
BOX SECTION AT THE LOWER
THE DOME
VERTEX CASTING JOINT

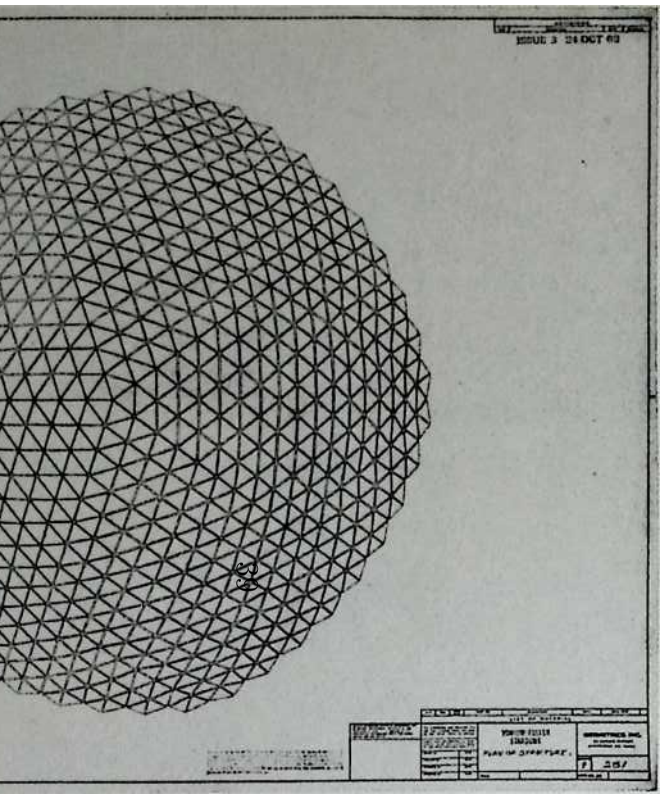

F1R THRU F5R, & F1L THRU F5L VERTEX CASTING
E1R THRU E5R, & D1L THRU D4L VERTEX CASTING – AS SHOWN
E1L THRU E5L, & D1R THRU D4R VERTEX CASTING – MIRRORED LAYOUT

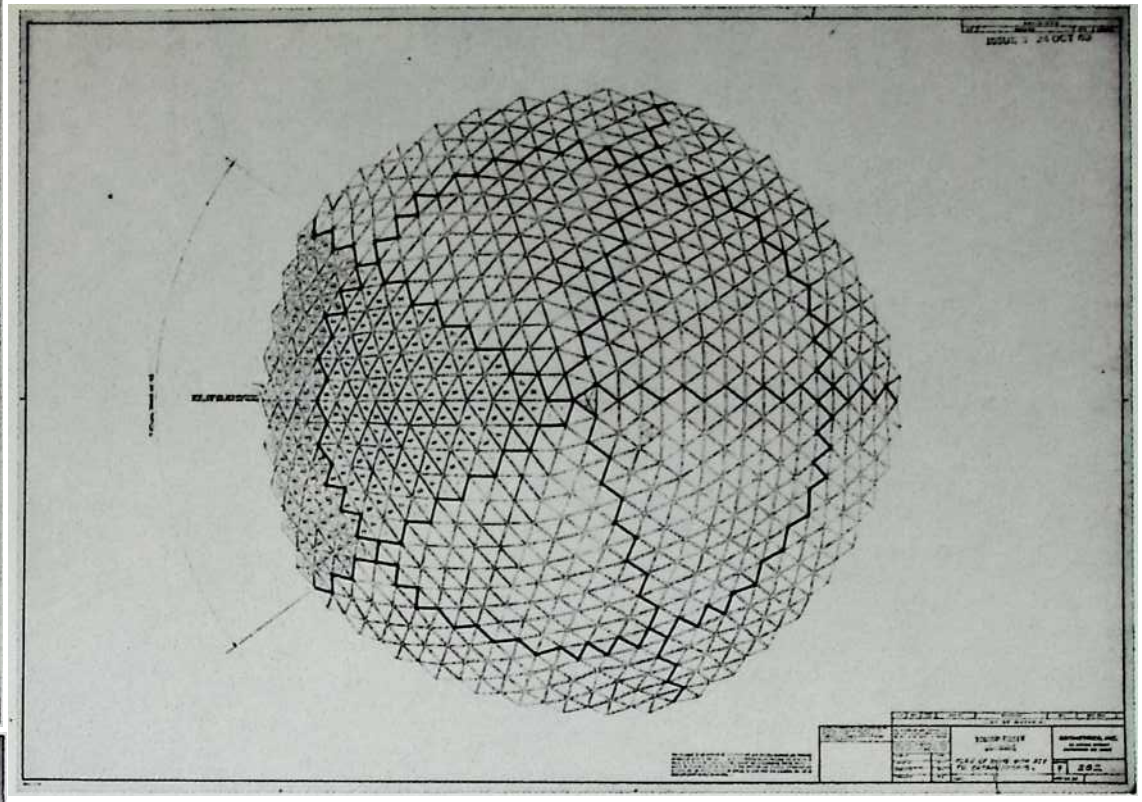


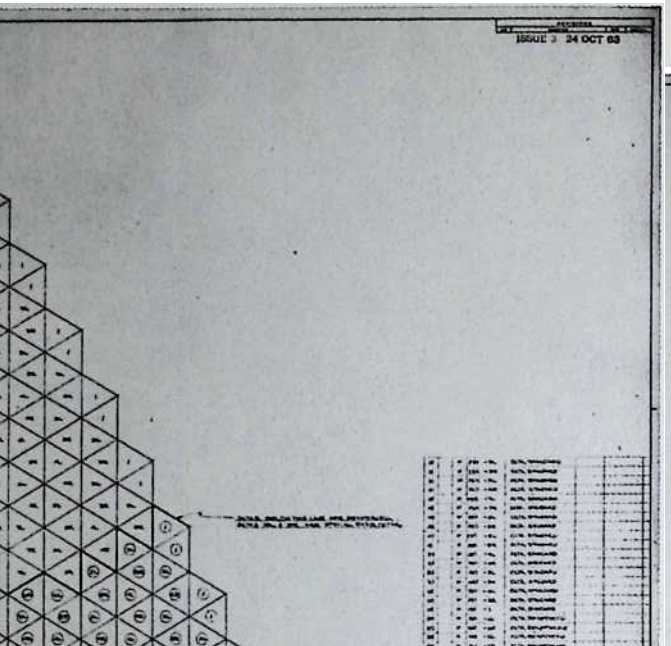

FOR & FOR VERTEX CASTINGS - AS SHOWN
FBL & FBL VERTEX CASTINGS - MIRRORED LAYOUT

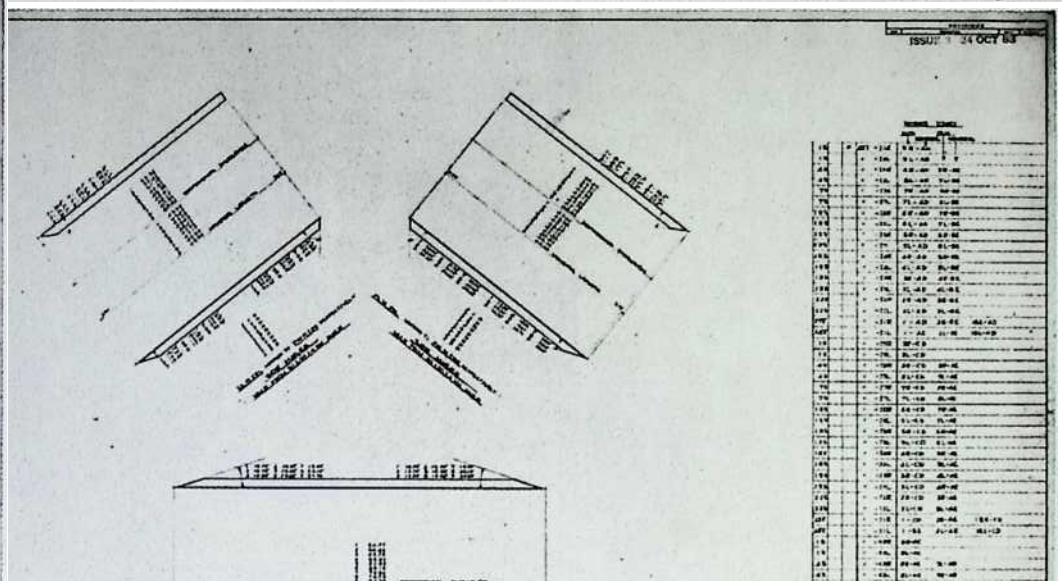


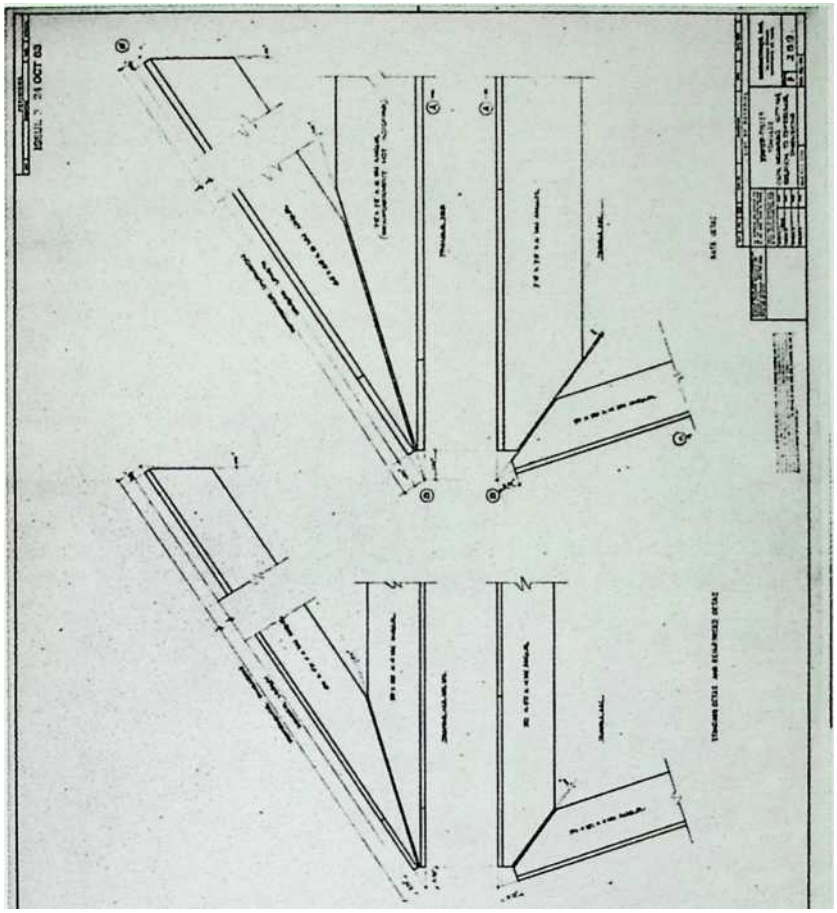

D7L, D5L, F5R, E0R, VERTEX CASTINGS - AS SHOWN
D7R, D5R, F5L, E0L, VERTEX CASTINGS - MIRRORED LAYOUT

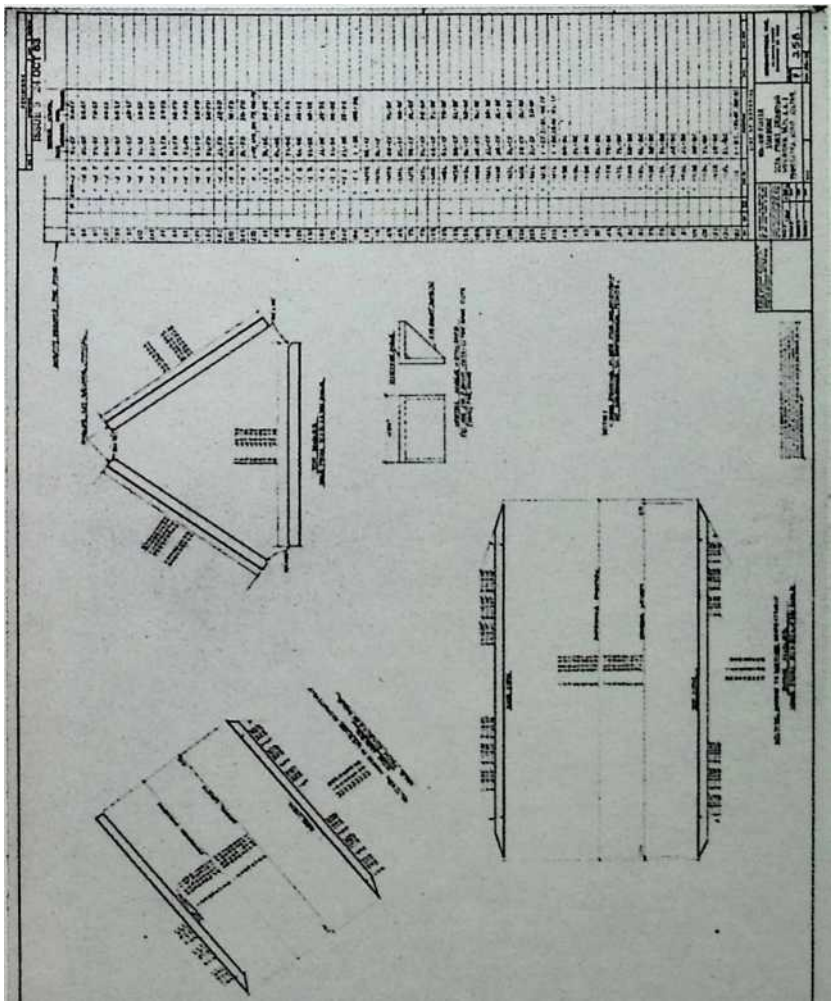

ISSUE 3 24 OCT 63

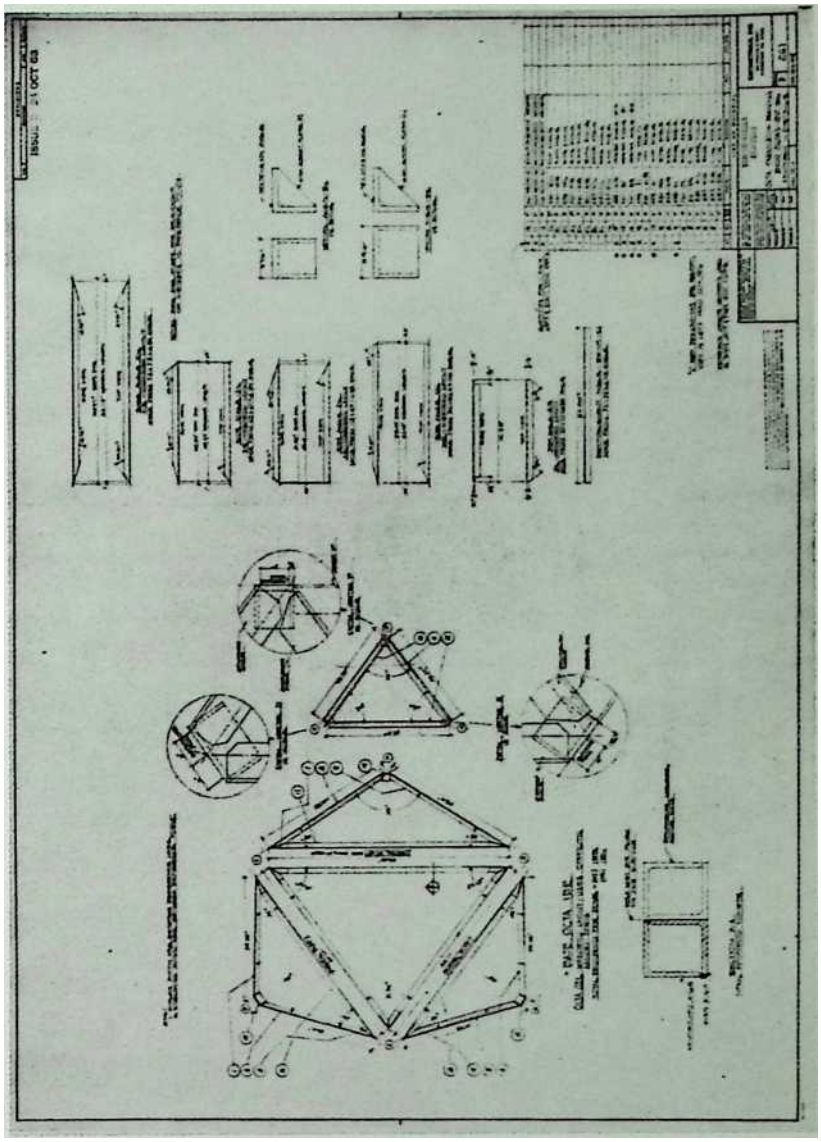


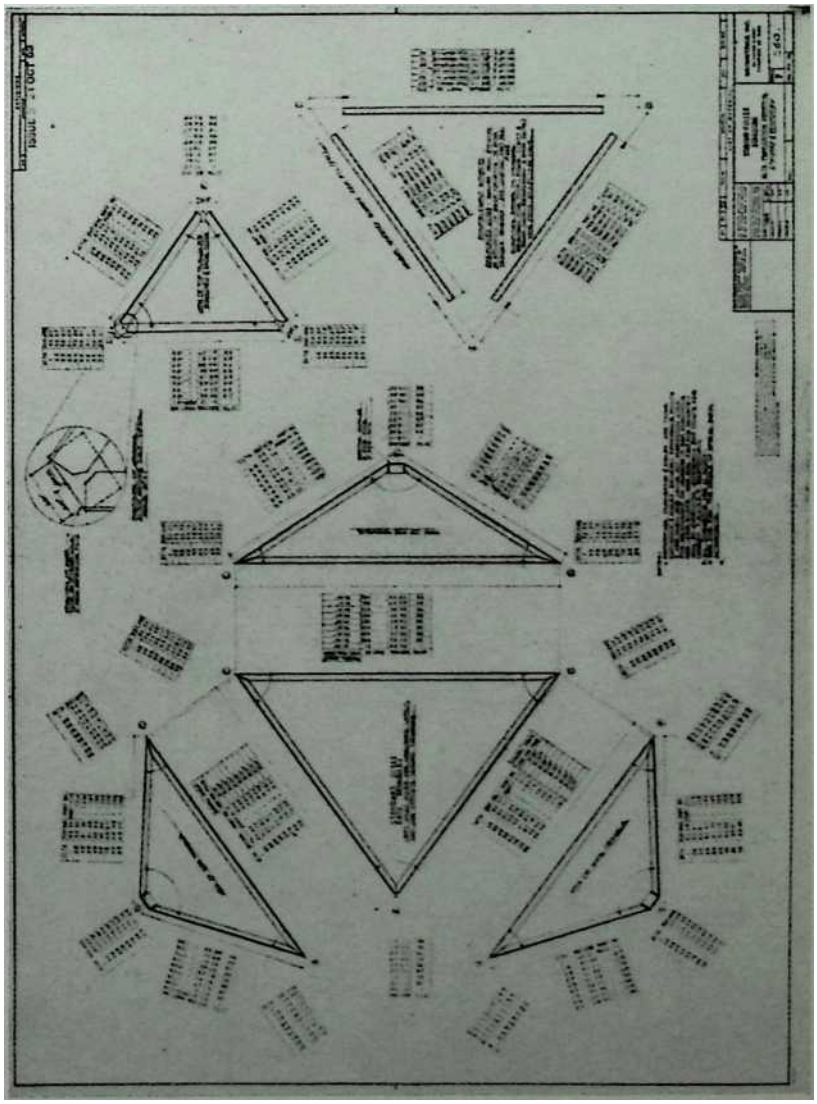

ISSUE 3 24 OCT 63

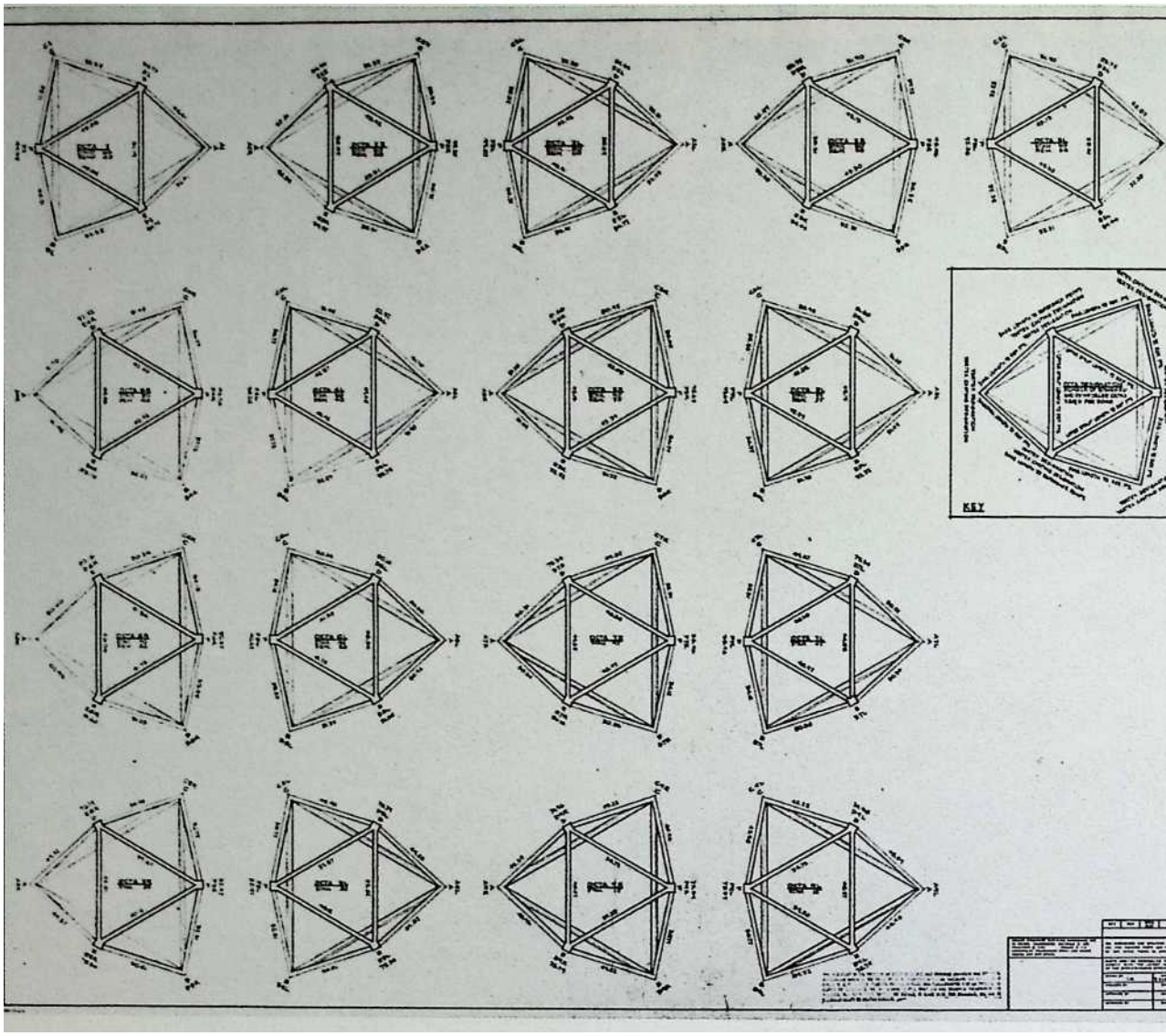


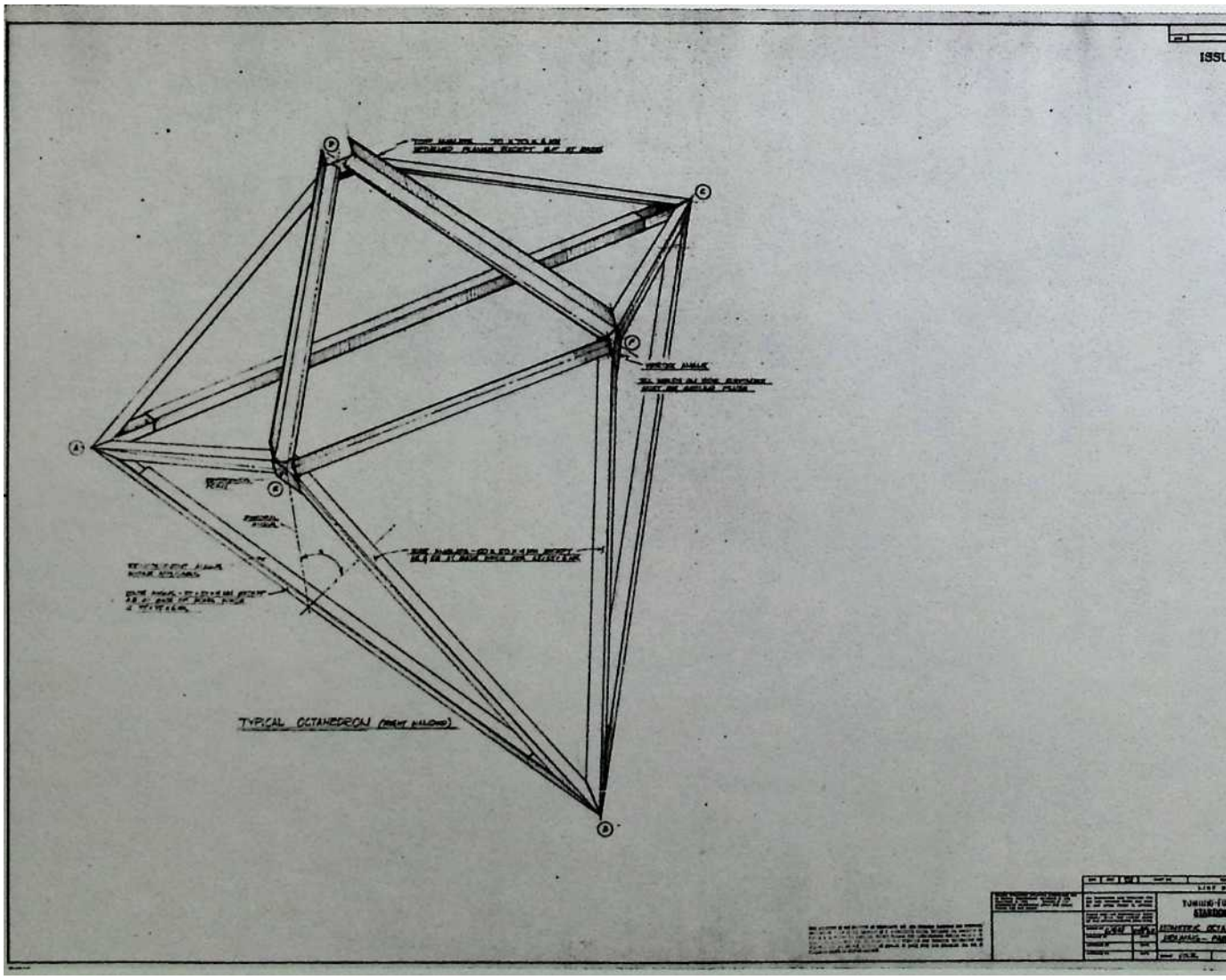


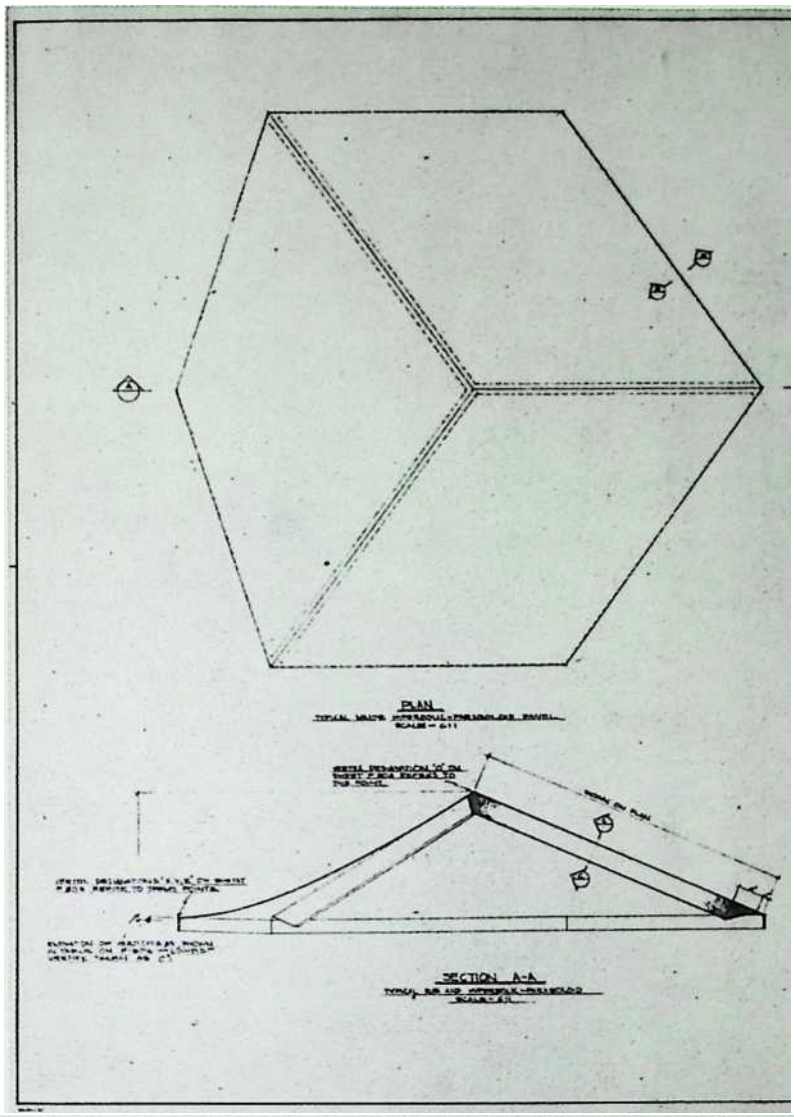


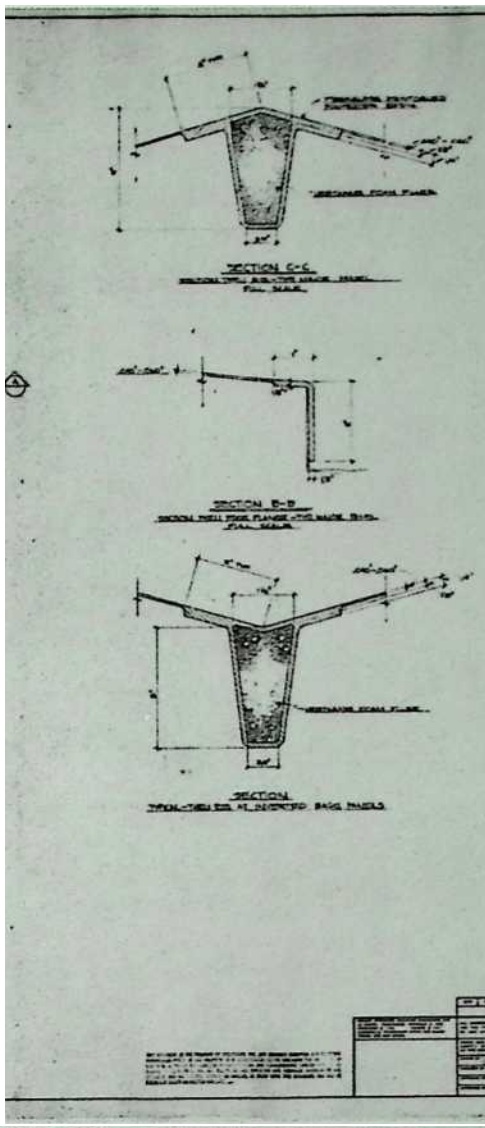


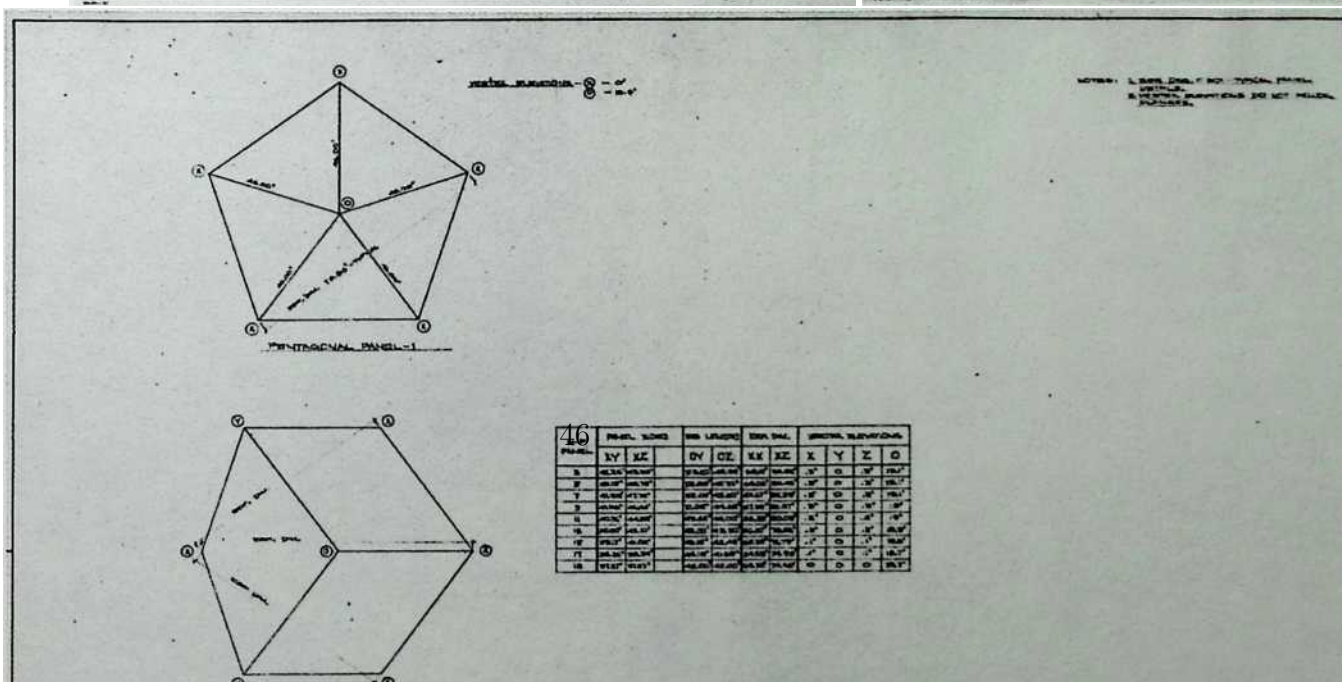




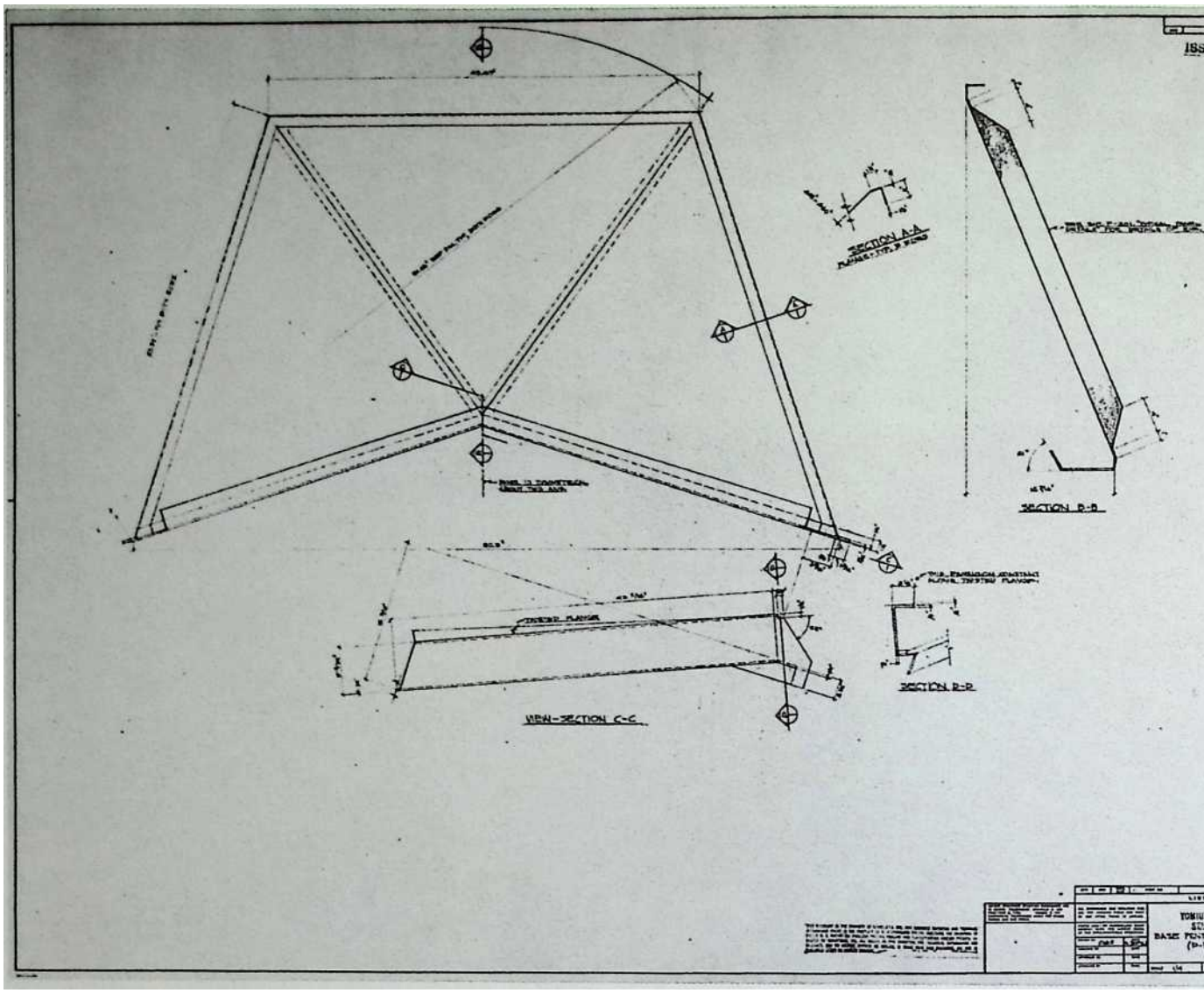

TYPICAL OCTAHEDRON

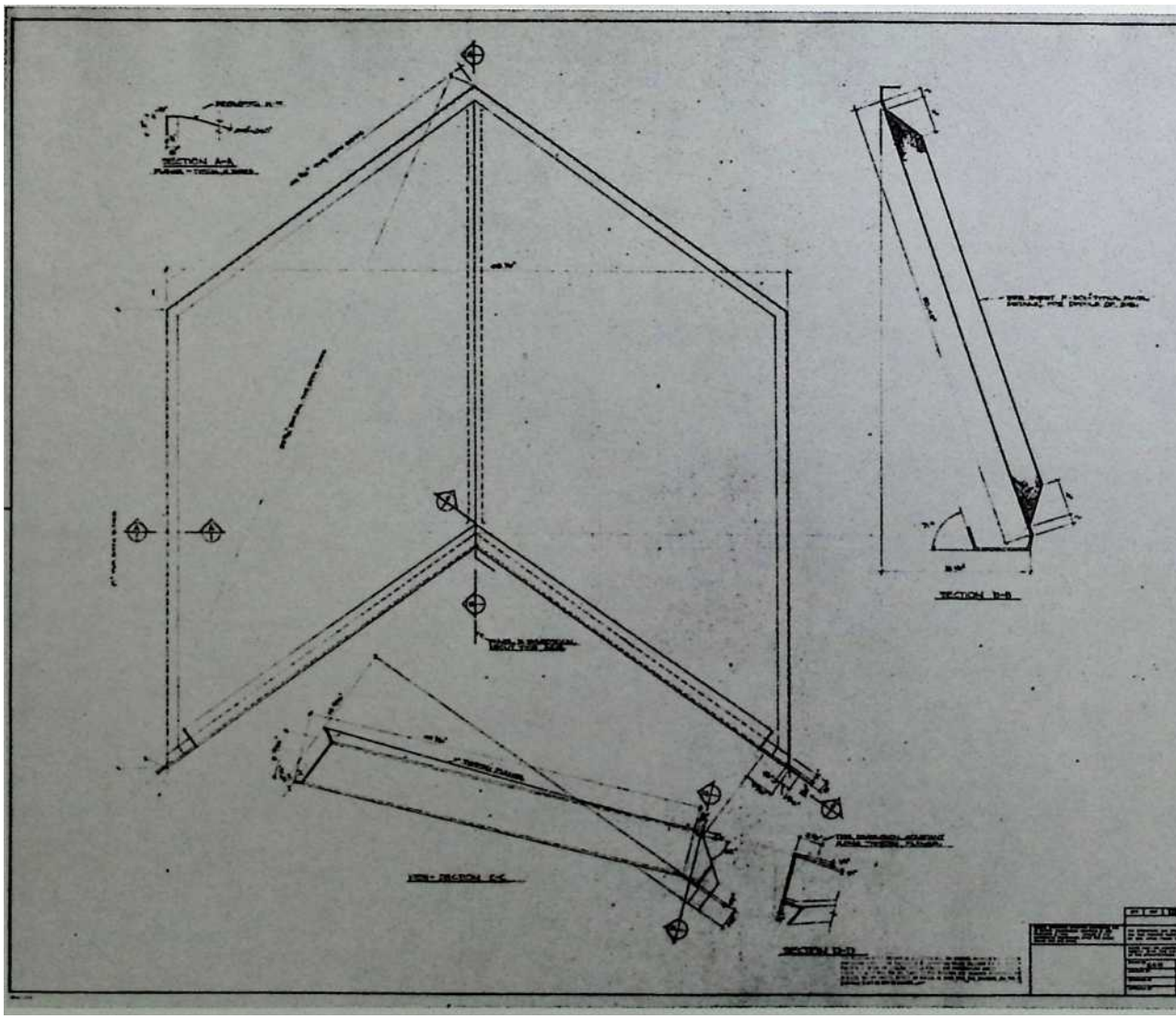


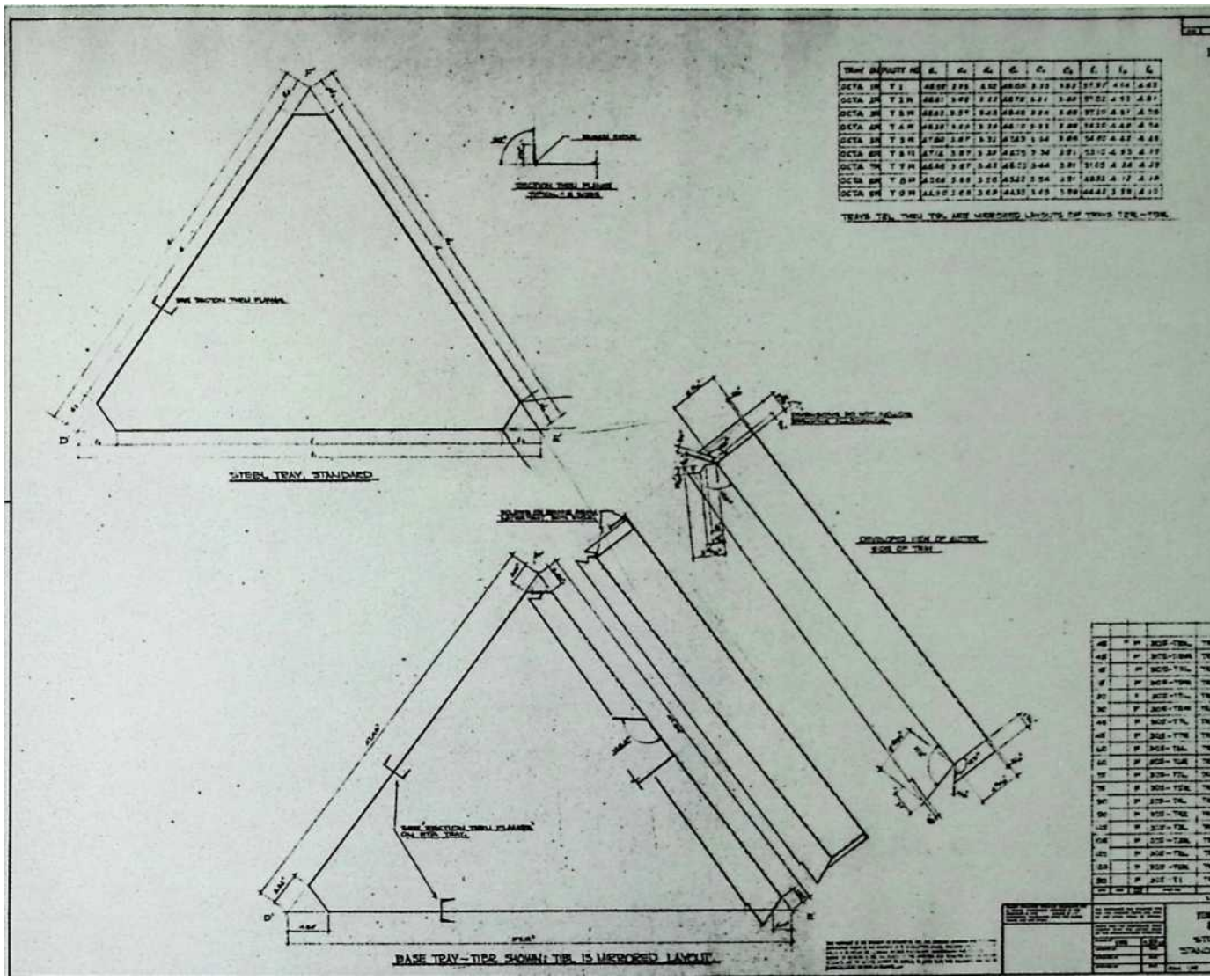


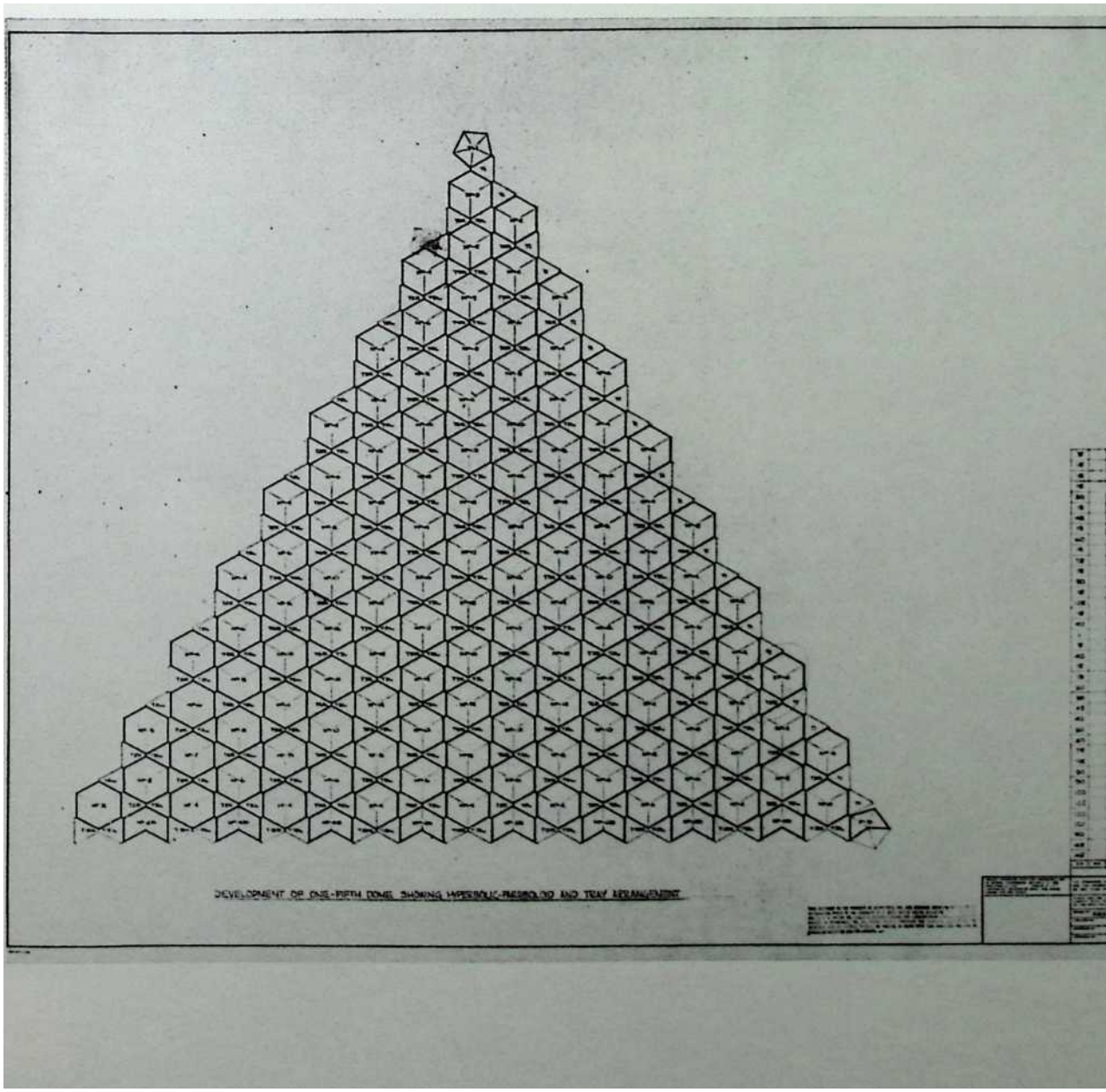


PANEL	PANEL SIDES			RIB LENGTHS			DIAG. DIAL.		VERTICAL ELEVATIONS			
	XY	XZ		OY	OZ		XX	XZ	X	Y	Z	O
5	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
6	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
7	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
8	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
9	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
10	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
11	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
12	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
13	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
14	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	0	0	0	[illegible]

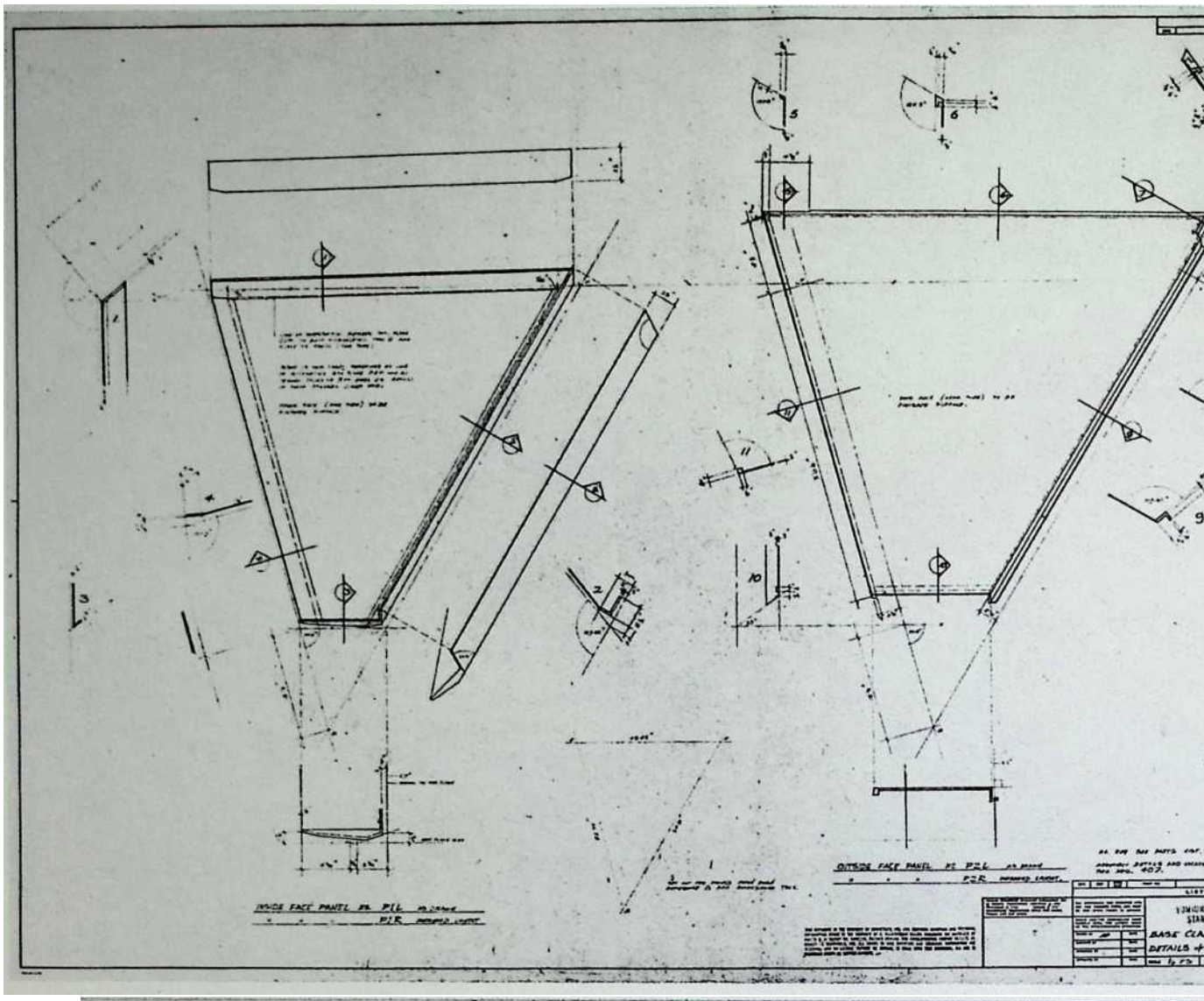

SECTION A-A
SECTION B-B
SECTION D-D
VIEW-SECTION C-C

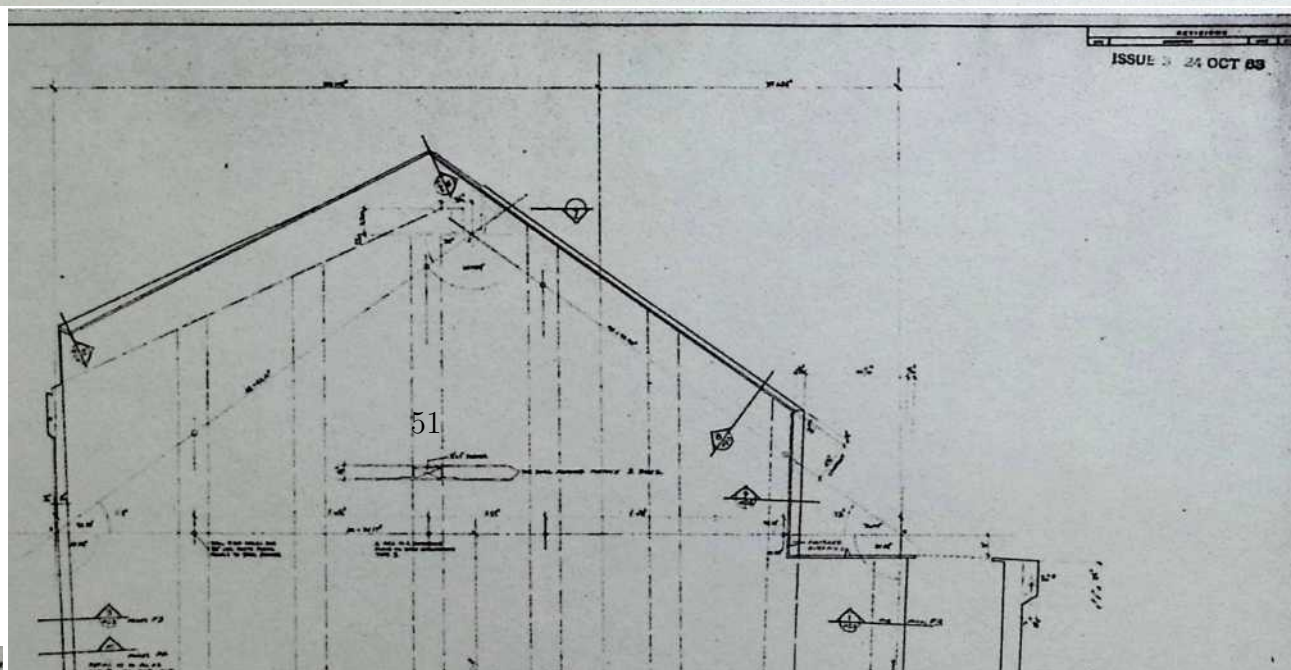


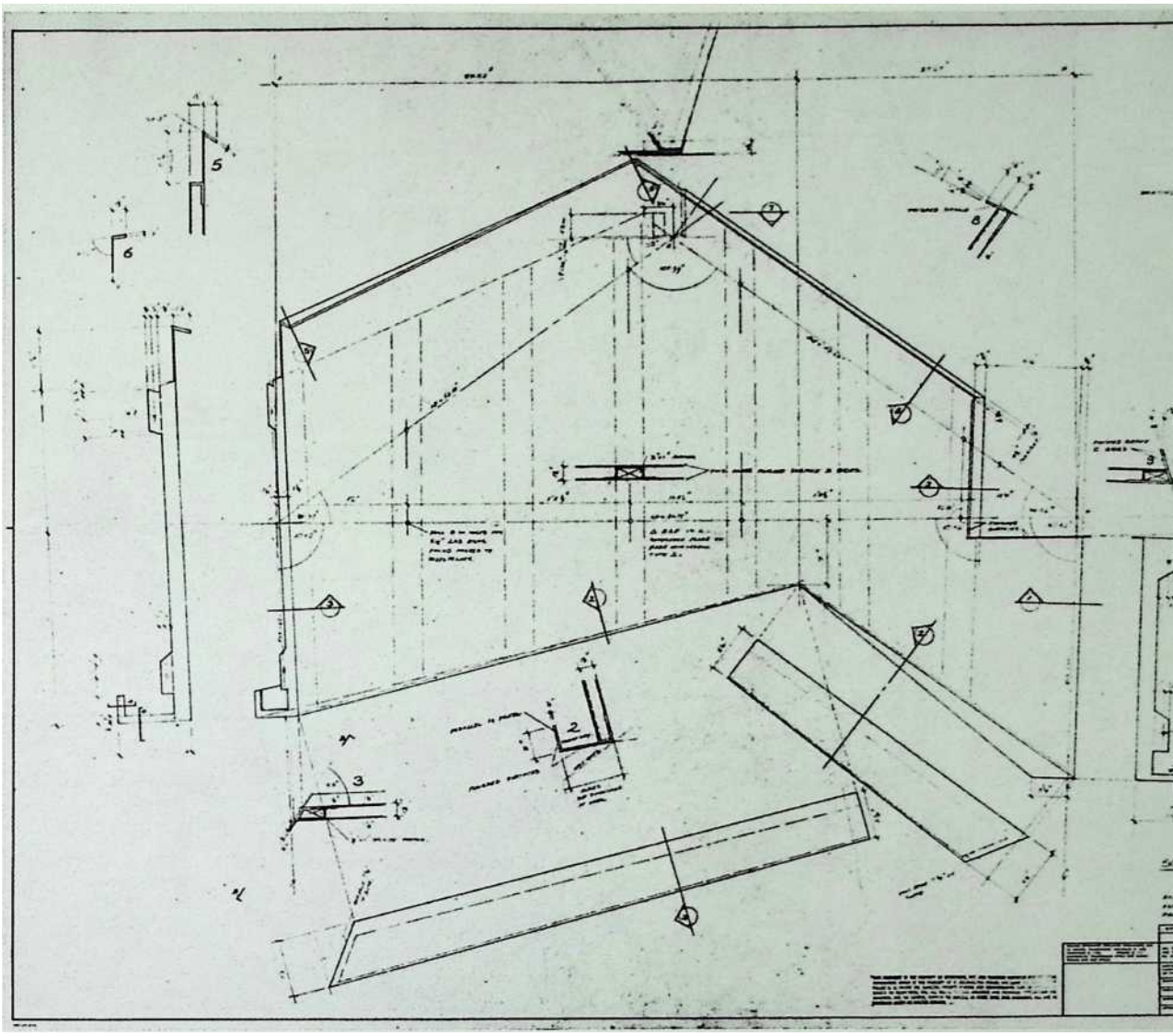

STEEL TRAY, STANDARD
BASE TRAY – TIPR SHOWN; TIBL IS MIRRORED LAYOUT

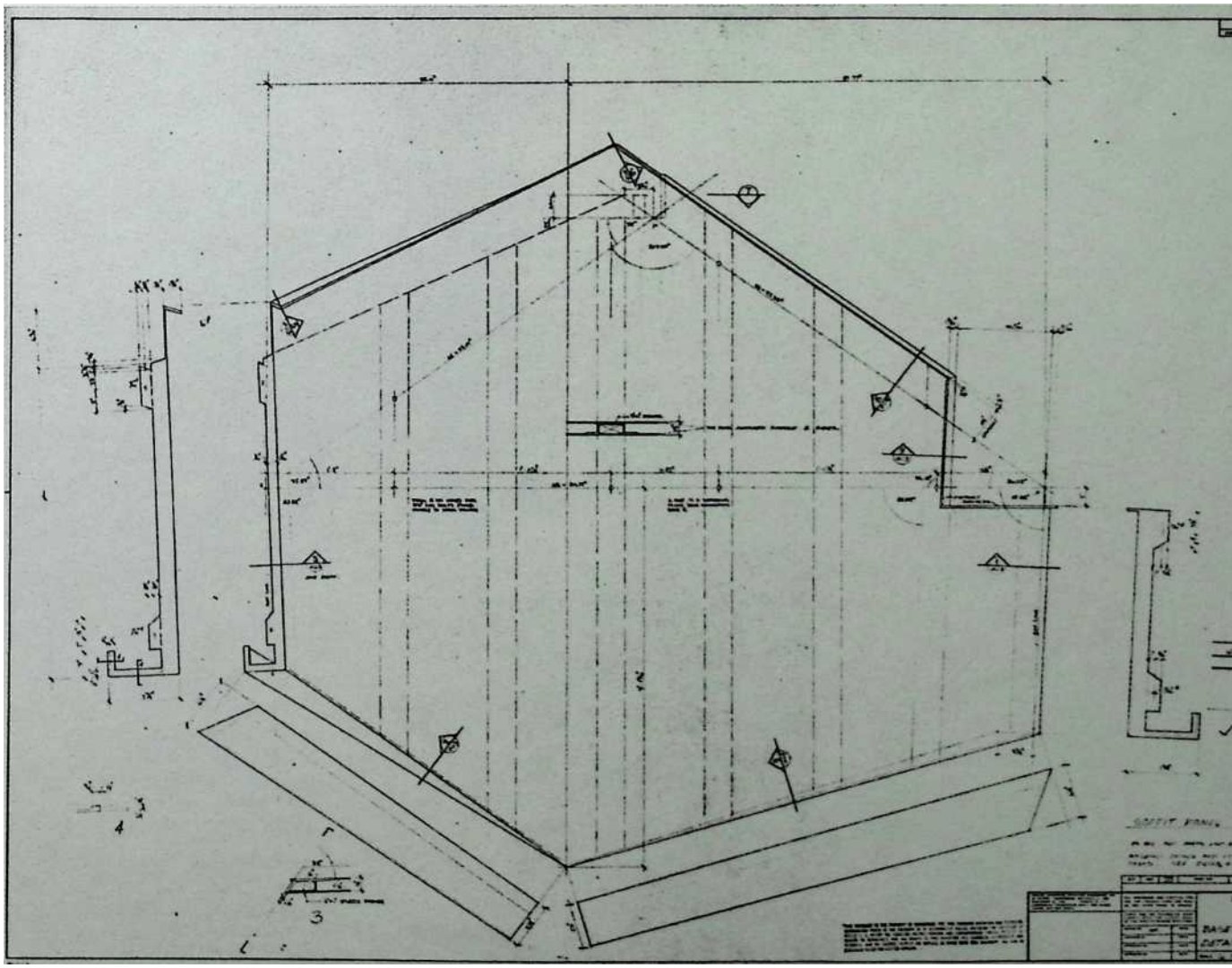


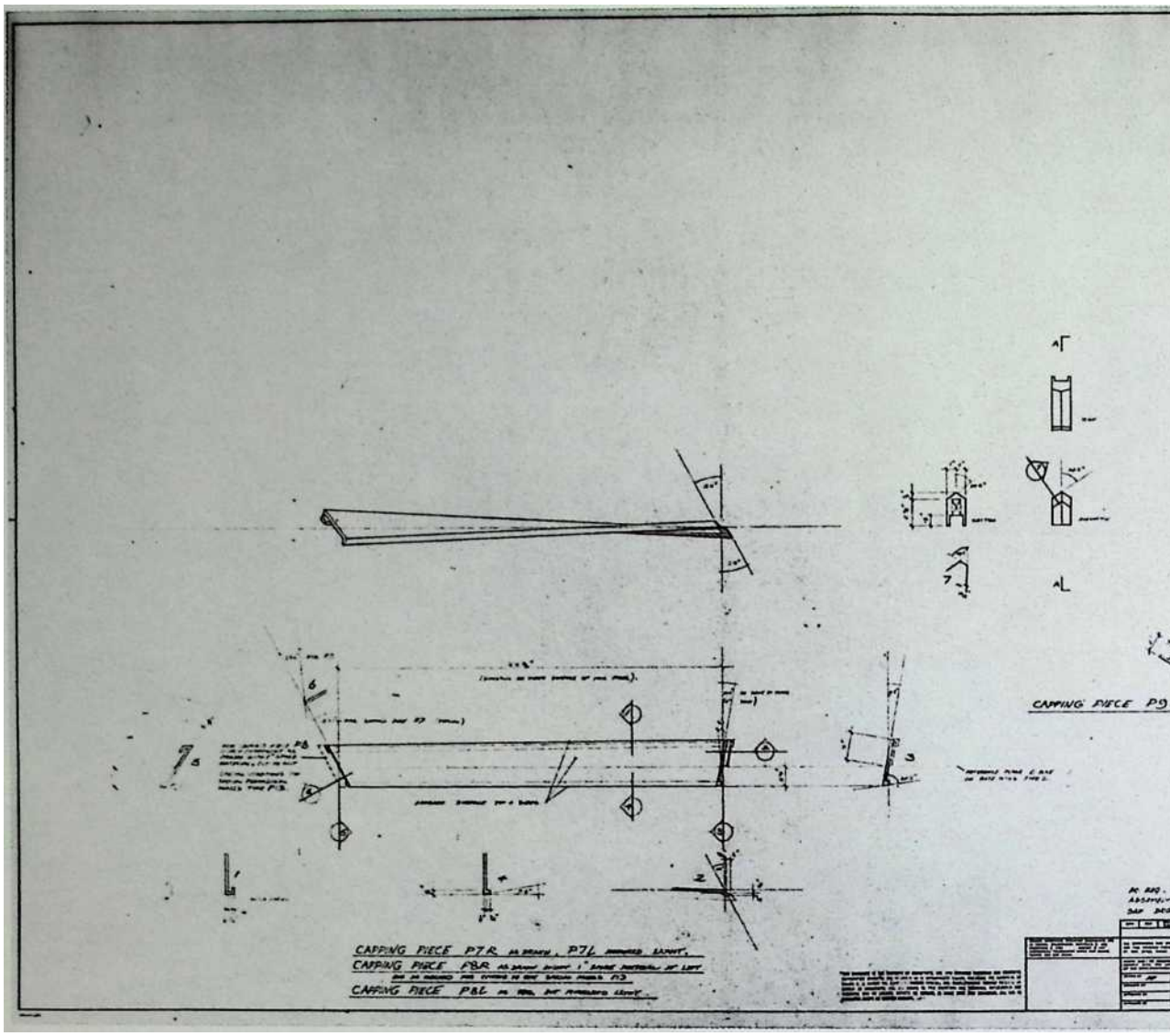
24 THE GEODESIC REVOLUTION, PART 2

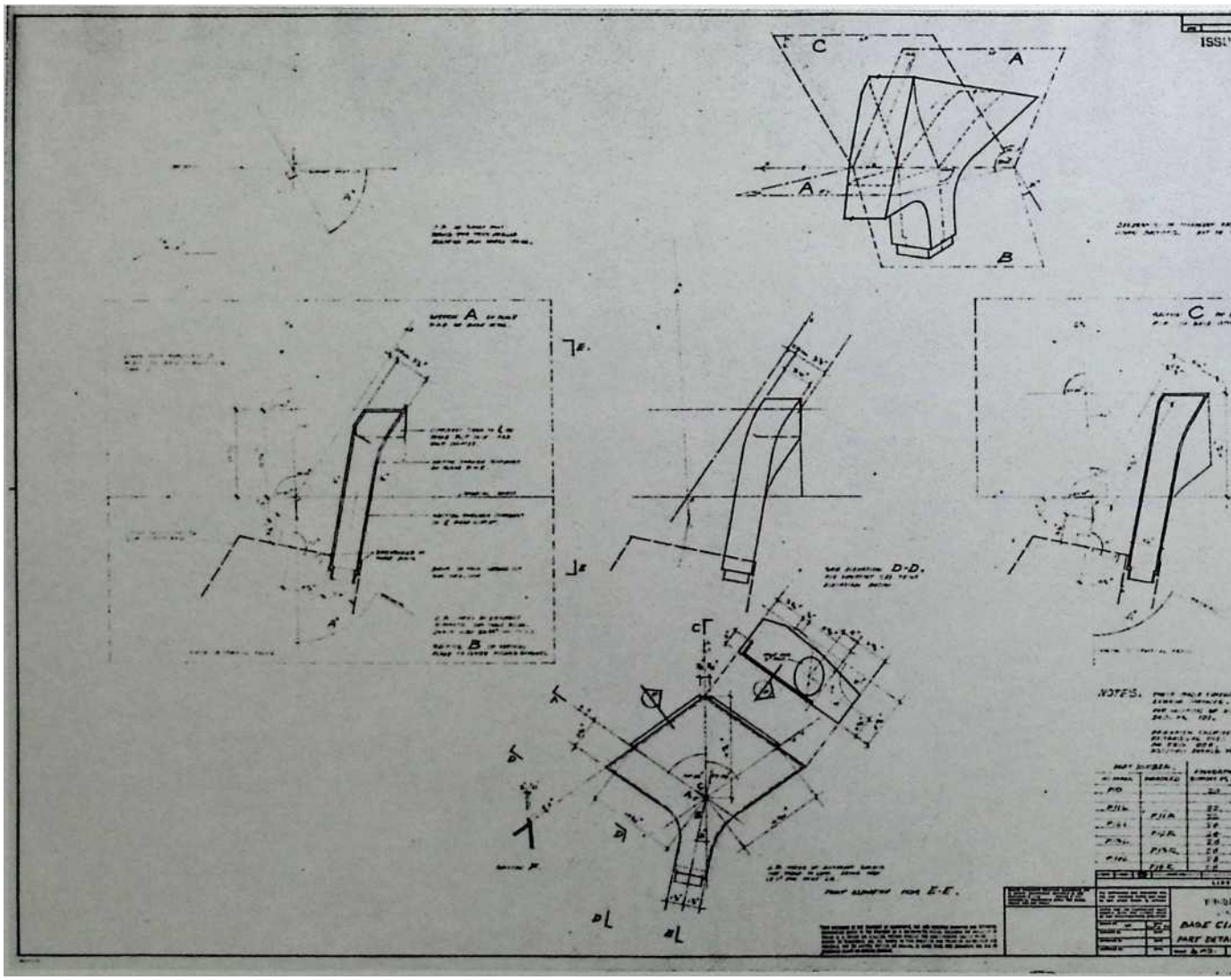

INSIDE FACE PANEL
OUTSIDE FACE PANEL

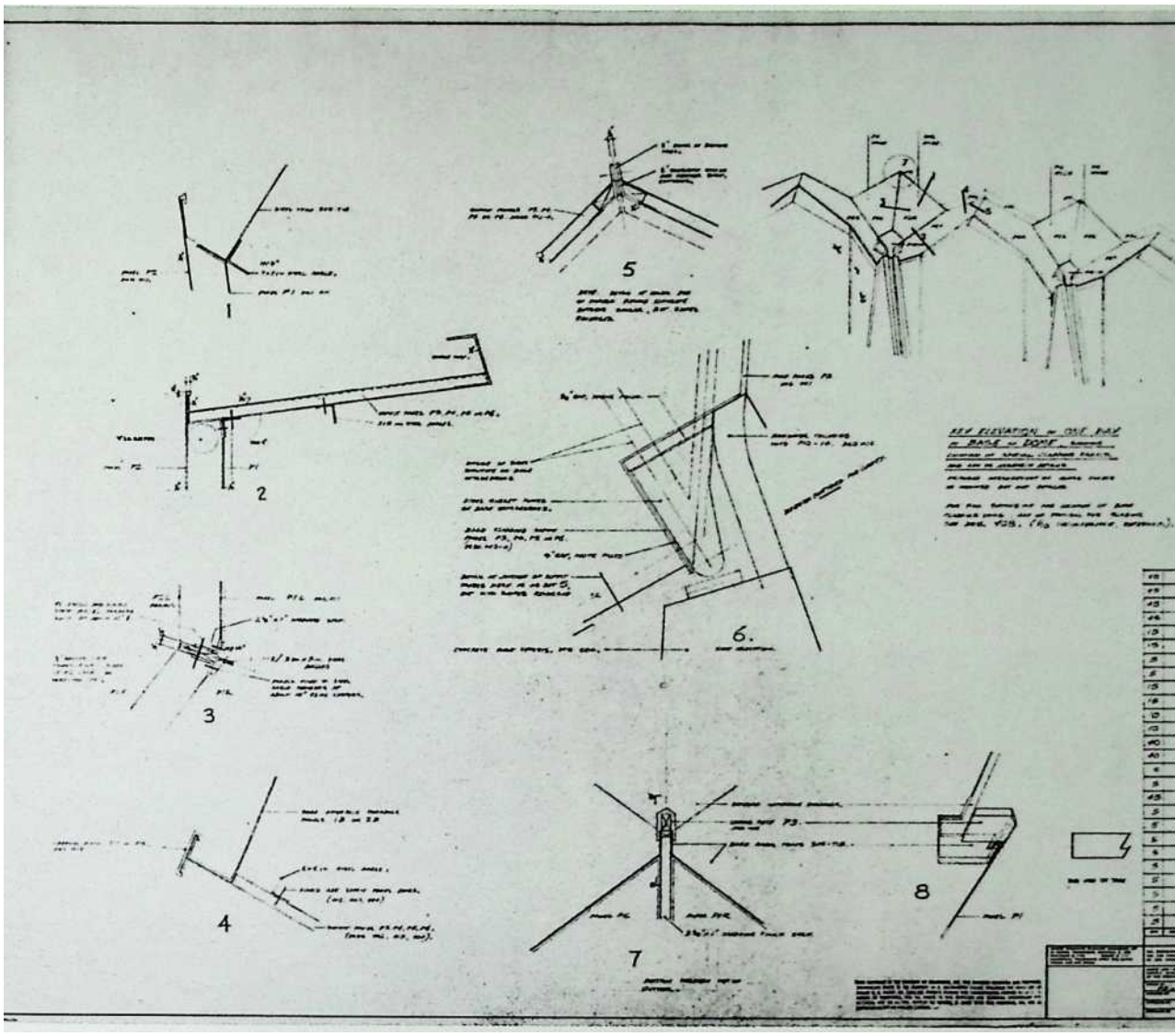

ISSUE 24 OCT 83






CAPPING PIECE P7R
CAPPING PIECE P8R
CAPPING PIECE P8L
CAPPING PIECE P9


C
A
A
B
D-D.
NOTES.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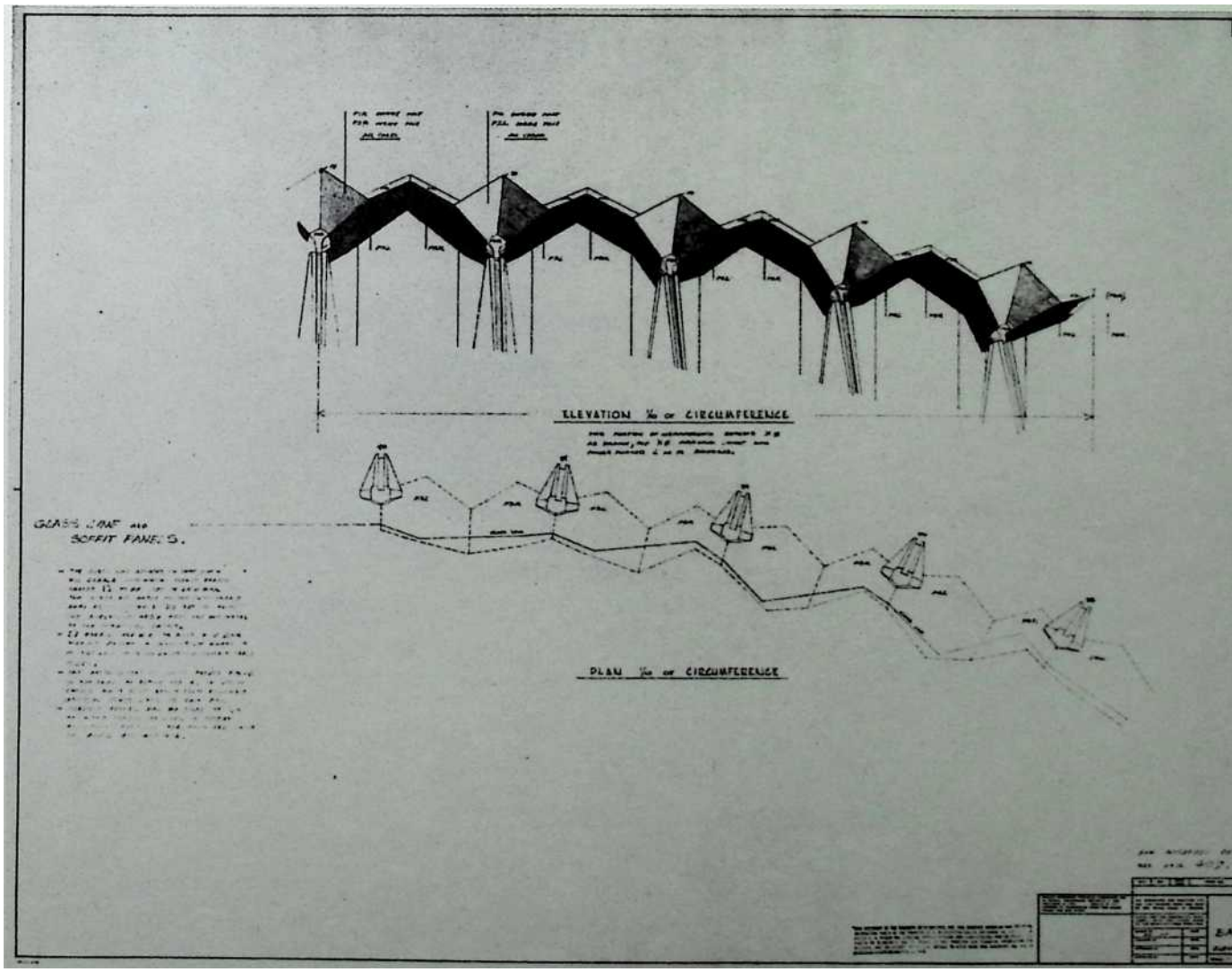
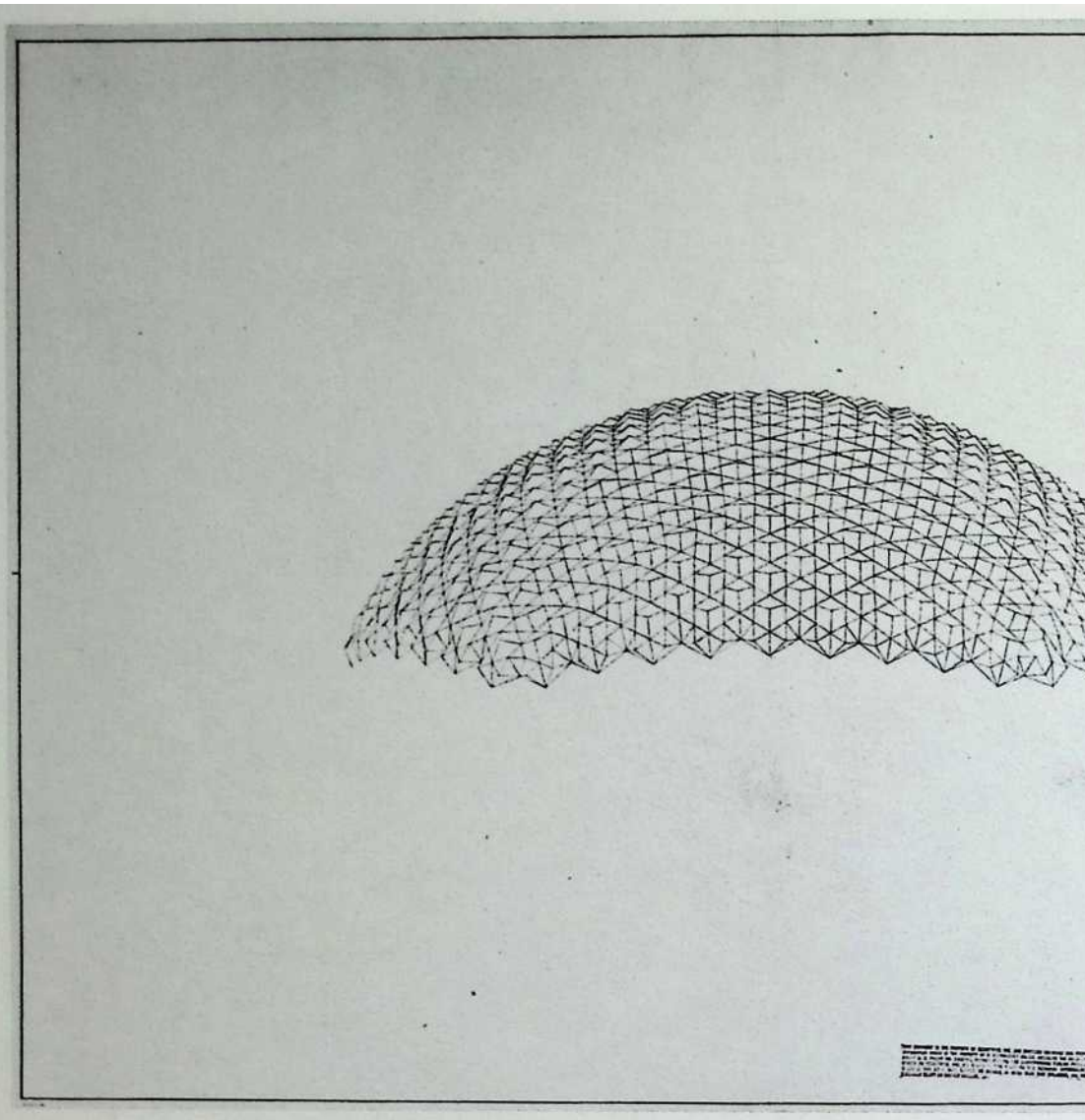
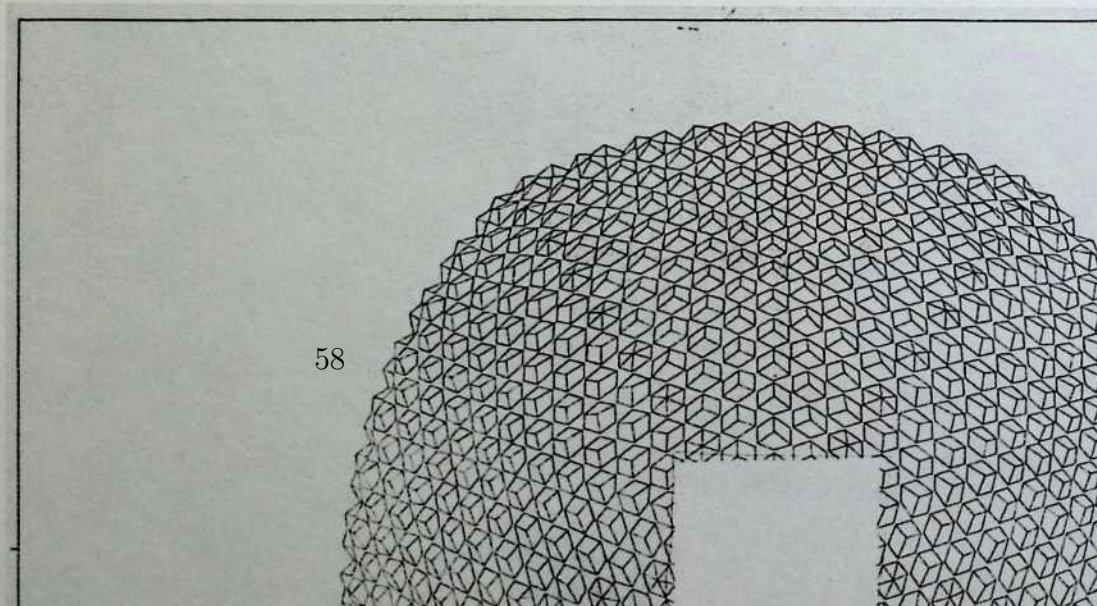
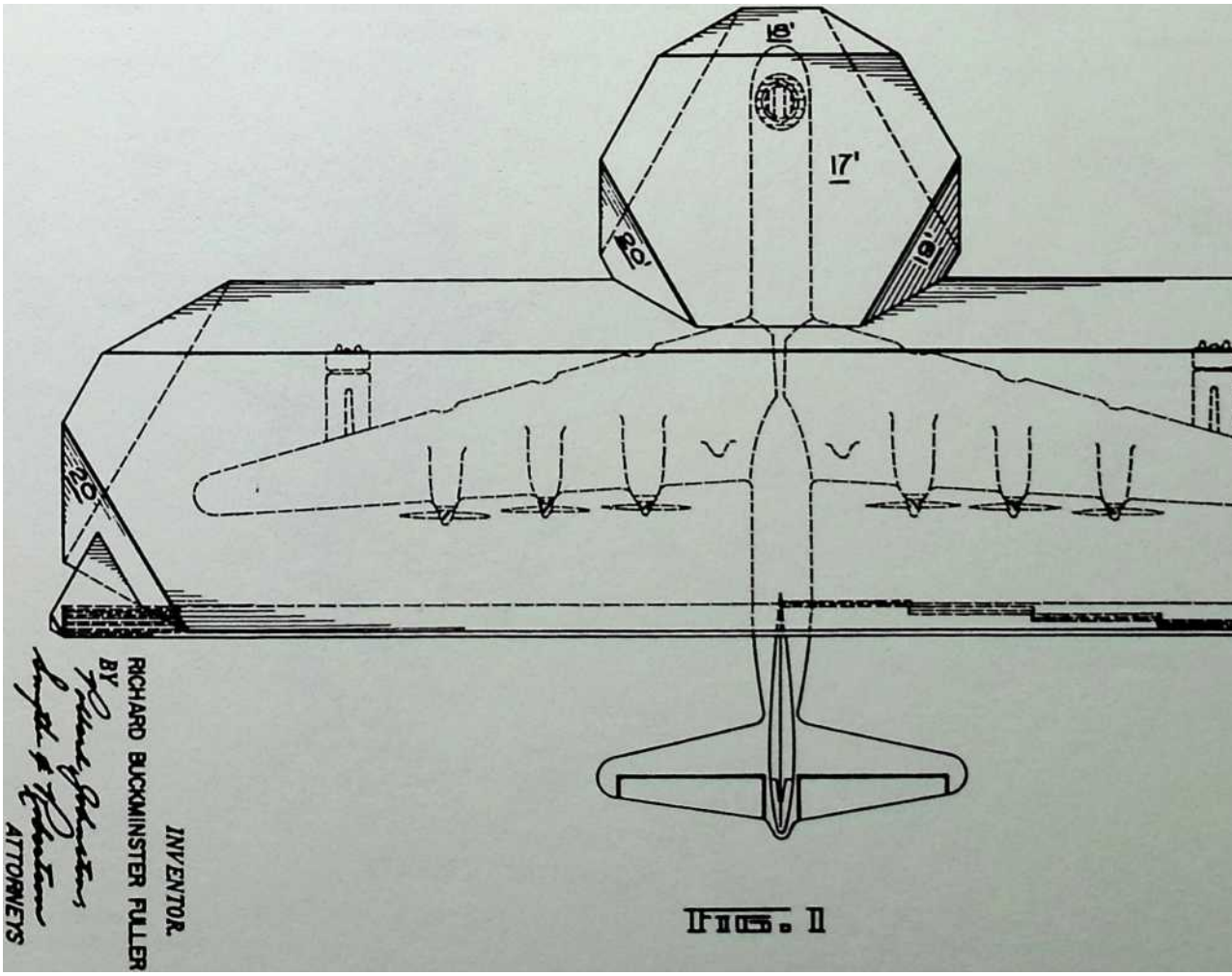

ELEVATION 1/16 OF CIRCUMFERENCE
GLASS LINE AND
SOFFIT PANELS.
PLAN 1/16 OF CIRCUMFERENCE





3 Octet Truss Patent 5/30/61

The octahedron truss is the most adaptable construction unit because it can fill any kind of space. It combines the octahedron and the tetrahedron and can be flat or curved in any direction.



M*y 30, 1961 r. b, fuller 2,986,241

SYNERGETIC BUILDING CONSTRUCTION Filed Fib. 7, 1956 7 Sheeti-Sbeet 2

May 30, 1961

Filed Feb. 7, 1956

R. B. FULLER 2,986,241

SYNERGETIC BUILDING CONSTRUCTION

7 Sheeti-Sbeet 3

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May 30, 1961

Filed Fib. 7, 1956

R. B. FULLER

SYNERGETIC BUILDINC CONSTRUCTION

2,986,241

May 30, 1961 r. $_{B-}$ fuller 2,986,241

SYNERGETIC BUILDING CONSTRUCTION
Filed Feb. 7, 1956 7 gbeetl-Sbeet *B*

7 Sbeeti-Sbeet 4

ItnOSo SO

INVENTOR.

RICHARD BUCKMINSTER FULLER

BY

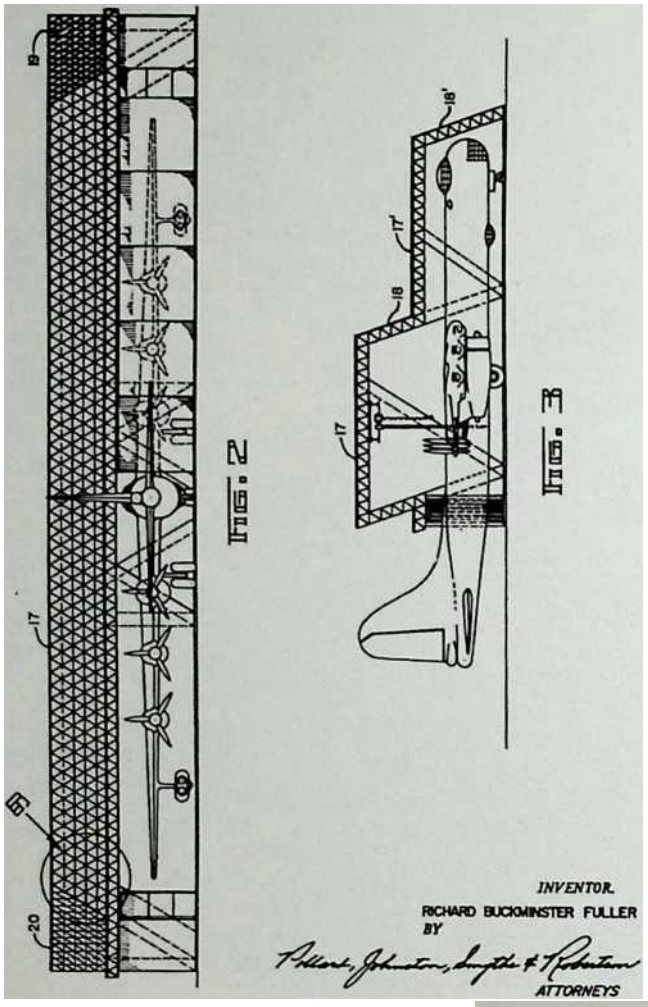


FIG. 2
FIG. 3
INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS

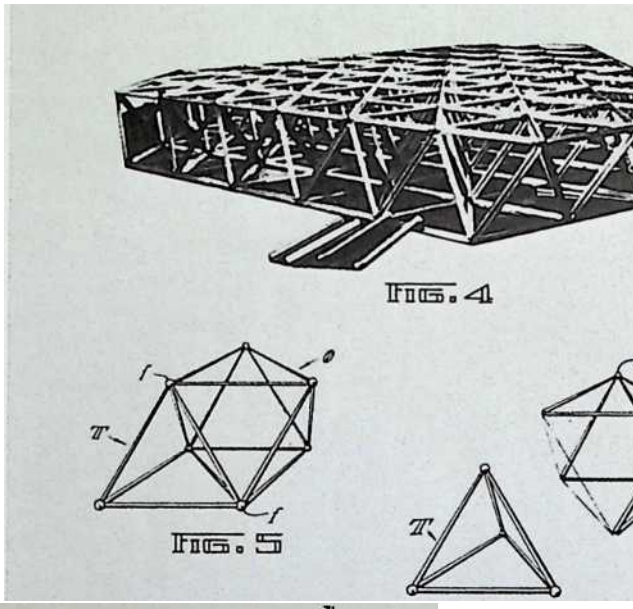


FIG. 4
FIG. 5

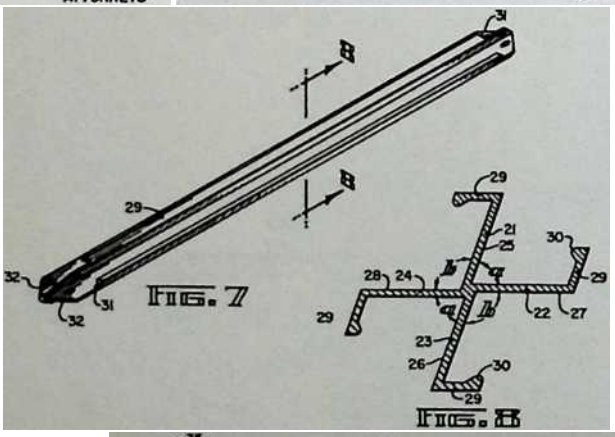
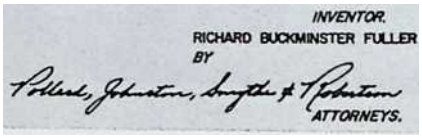


FIG. 7
FIG. 8


INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS.

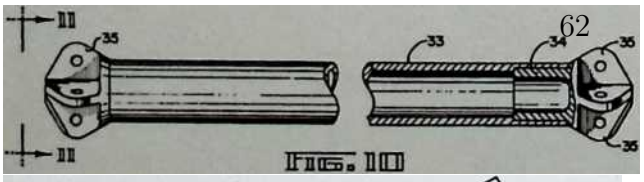


FIG. 10

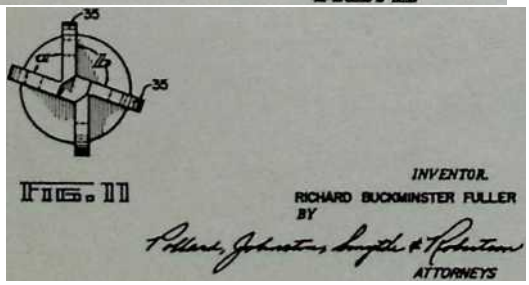


FIG. 11
INVENTOR.
RICHARD BUCKMINSTER FULLER
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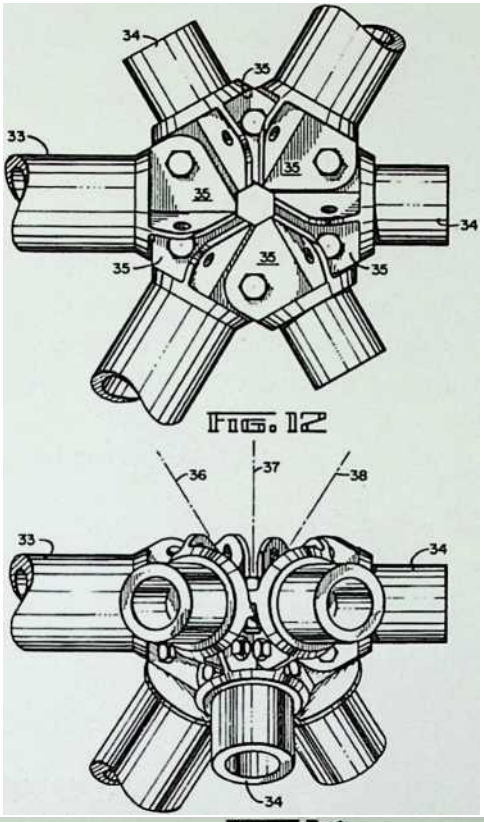
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FIG. 12
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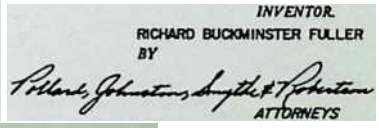
FIG. 14


INVENTOR.
RICHARD BUCKMINSTER FULLER
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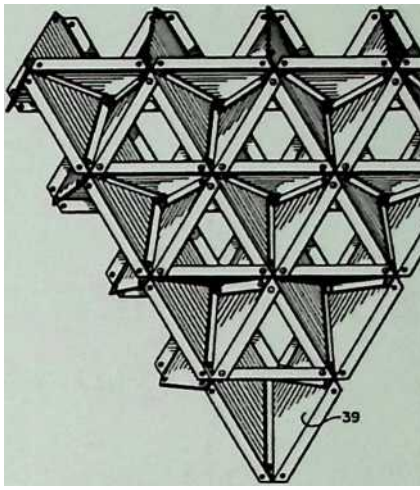
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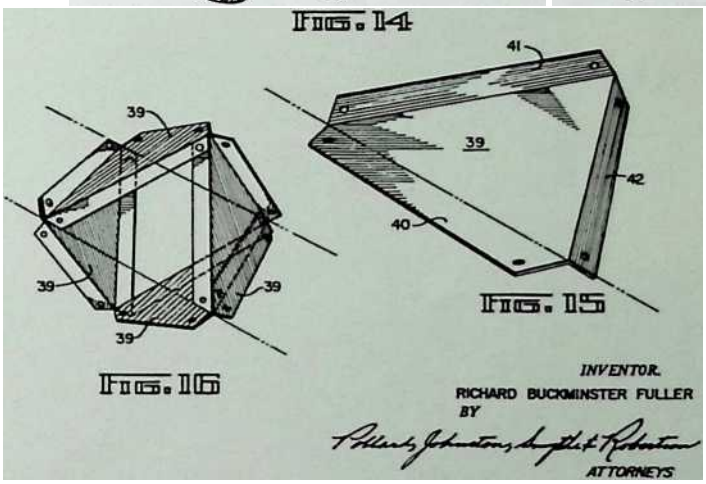
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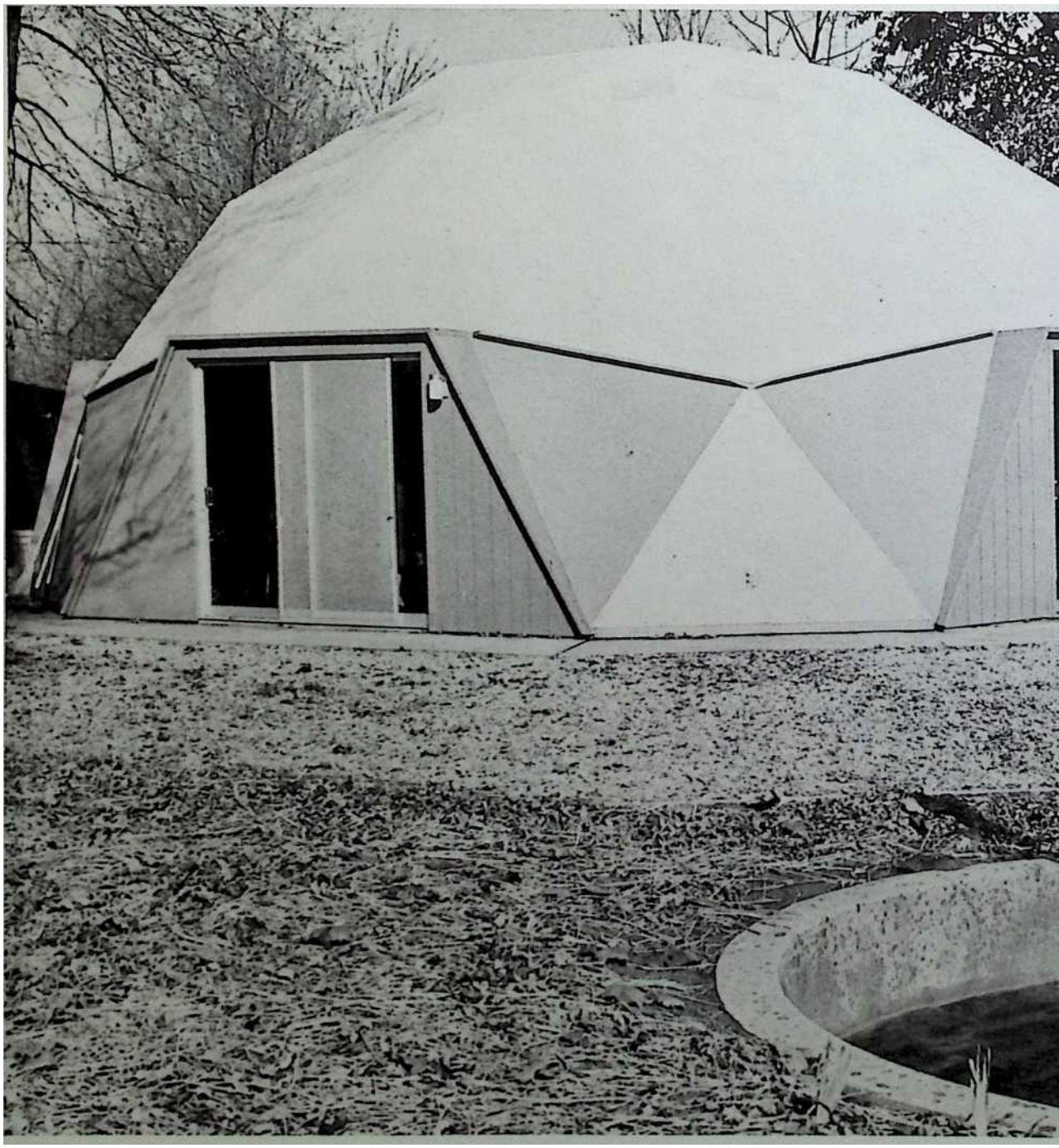
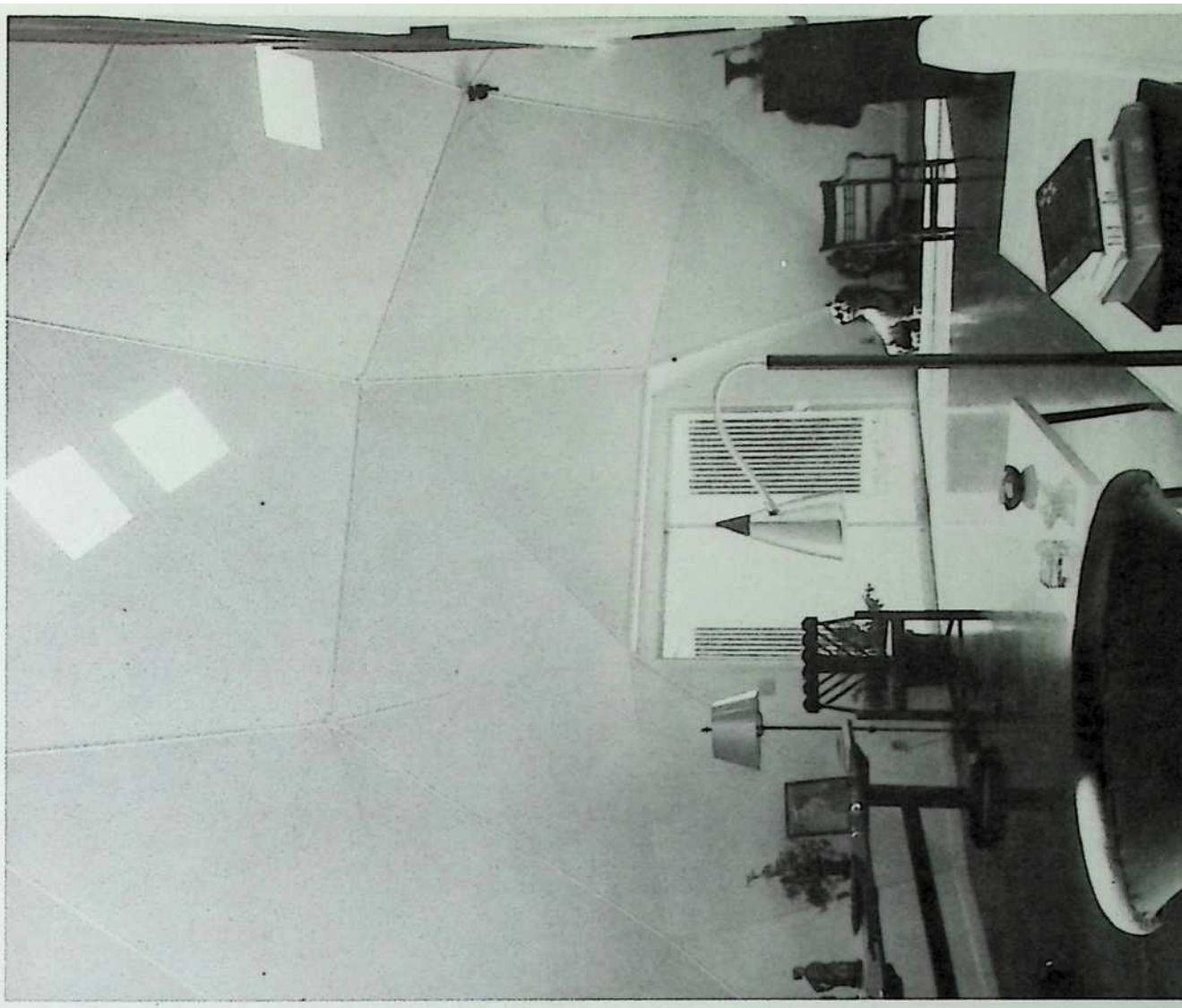
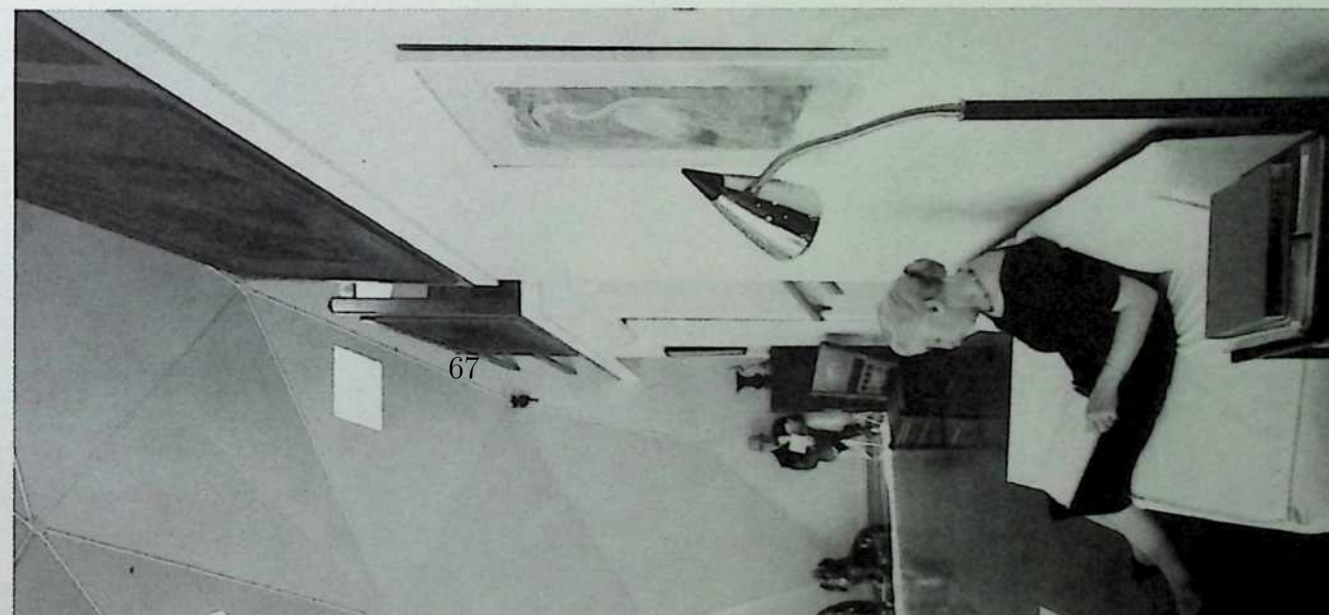
FIG. 15
FIG. 16
INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS

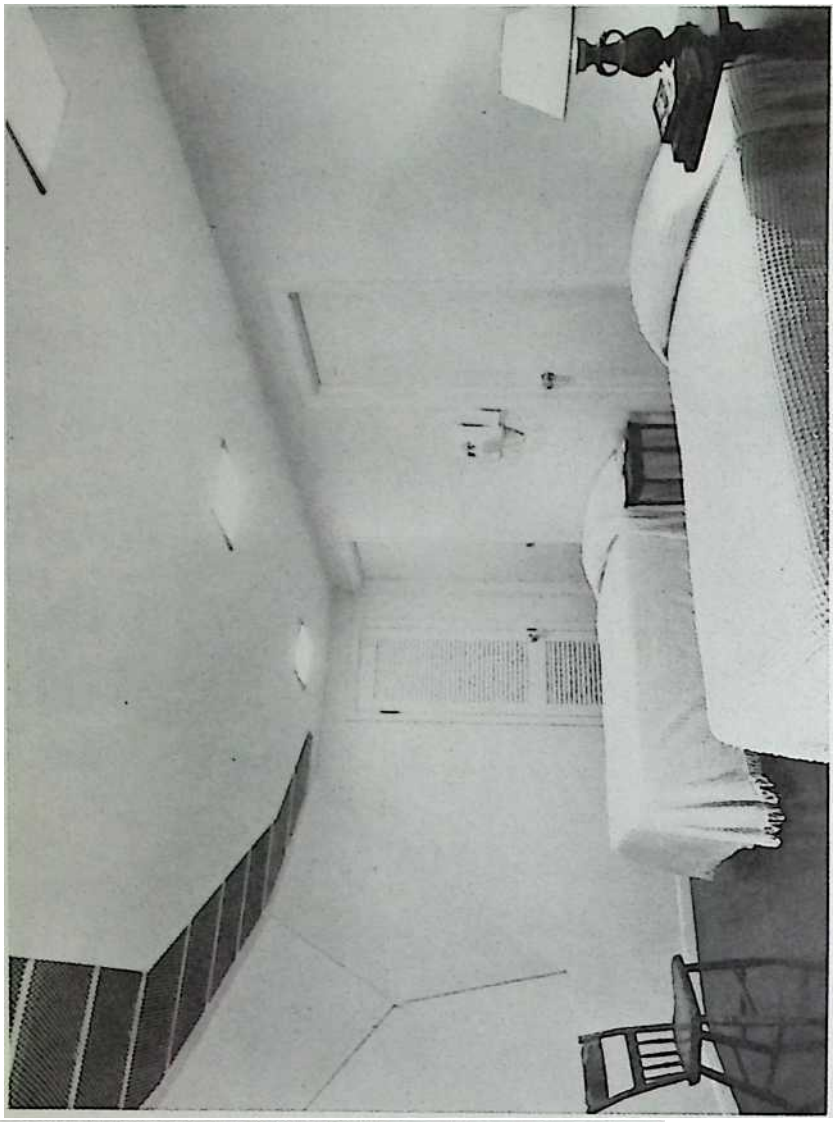
4 Residence of R. Buckminster Fuller and Anne Hewlett Fuller, Carbondale, Illinois 1960

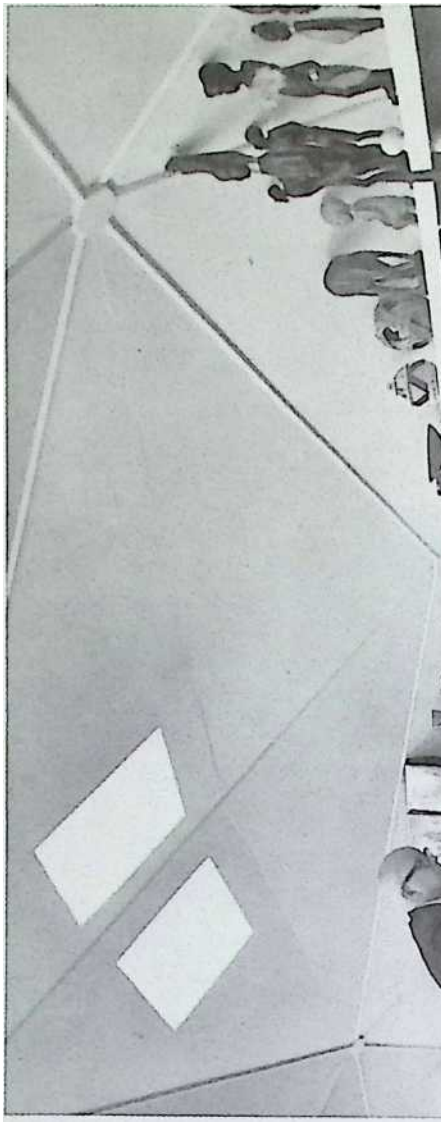
Fuller's own home may be the only geodesic residence that he lived in during his lifetime. Located in Carbondale, Illinois, the two-story dome has a study on a loft platform and a relatively large living room. Notwithstanding his enthusiastic experimentation with the skybreaks, Fuller's own house is fenestrated conservatively. It was designed with Al Miller of the Pease Company of Ohio.

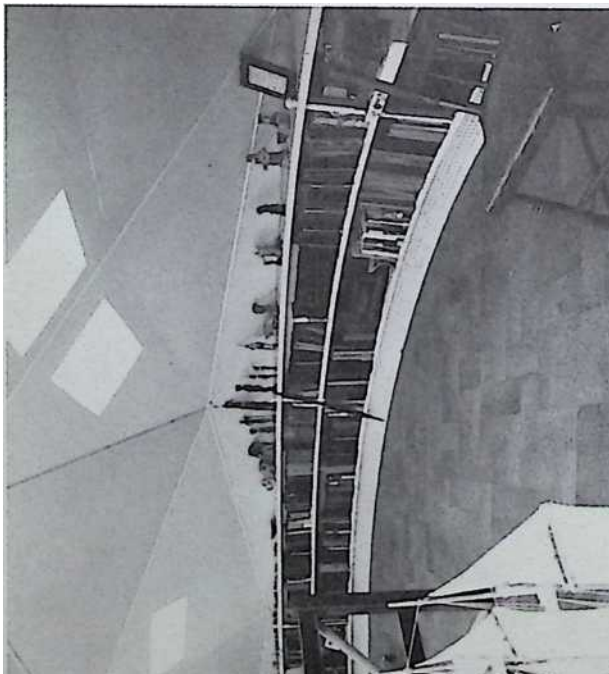


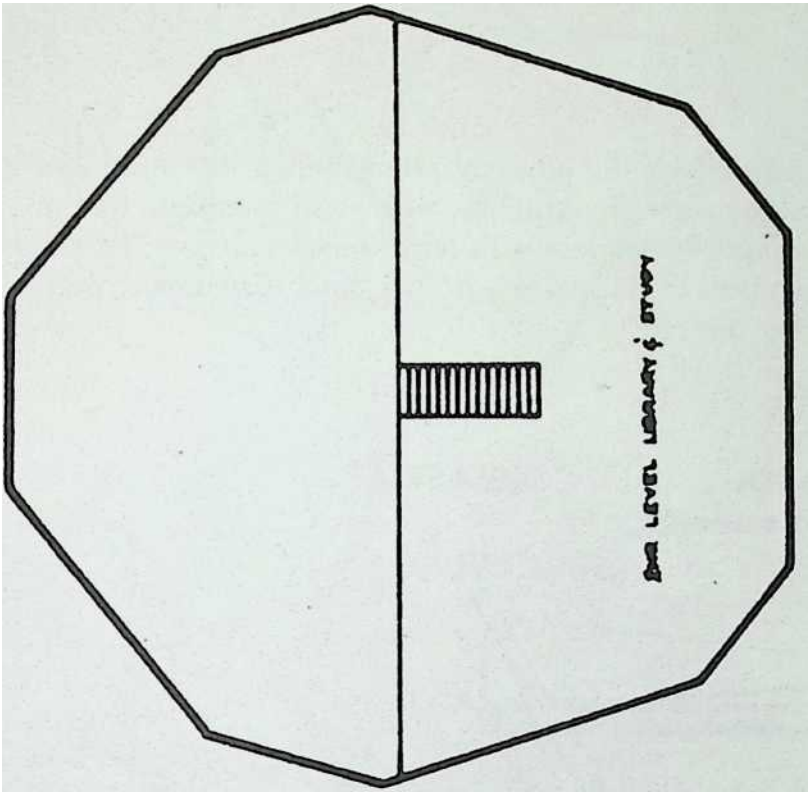








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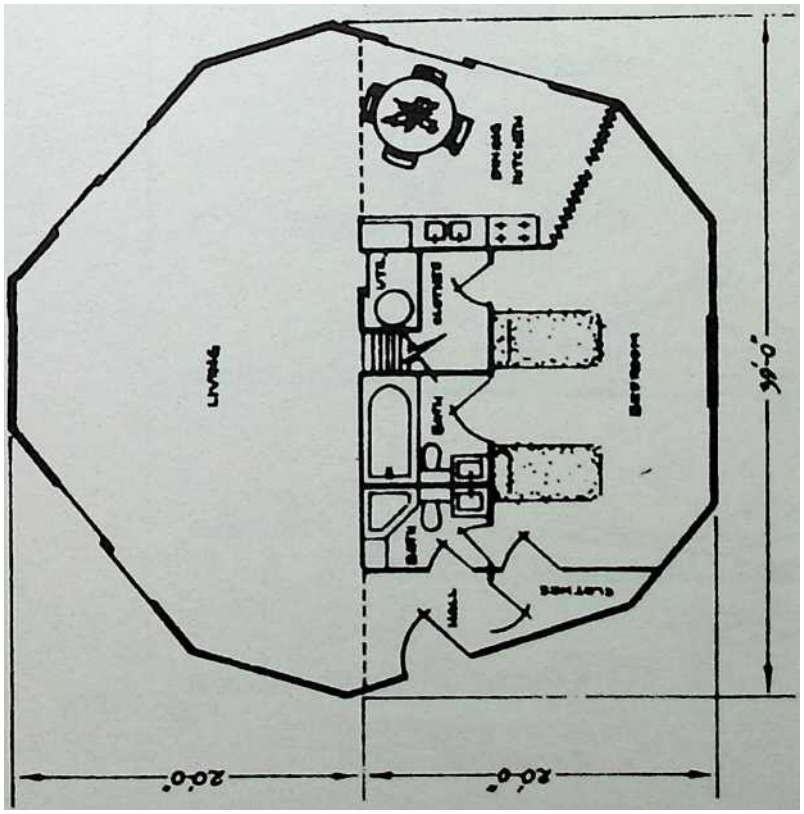
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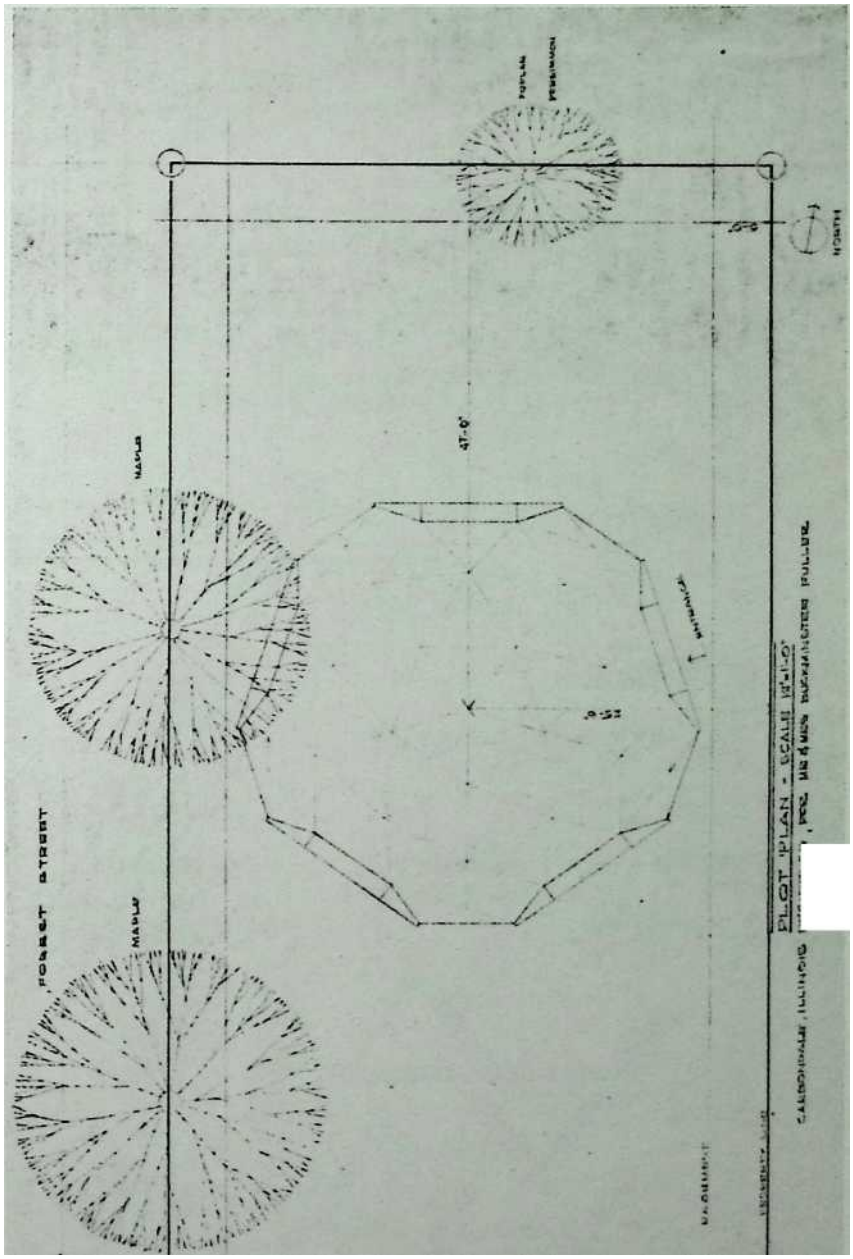
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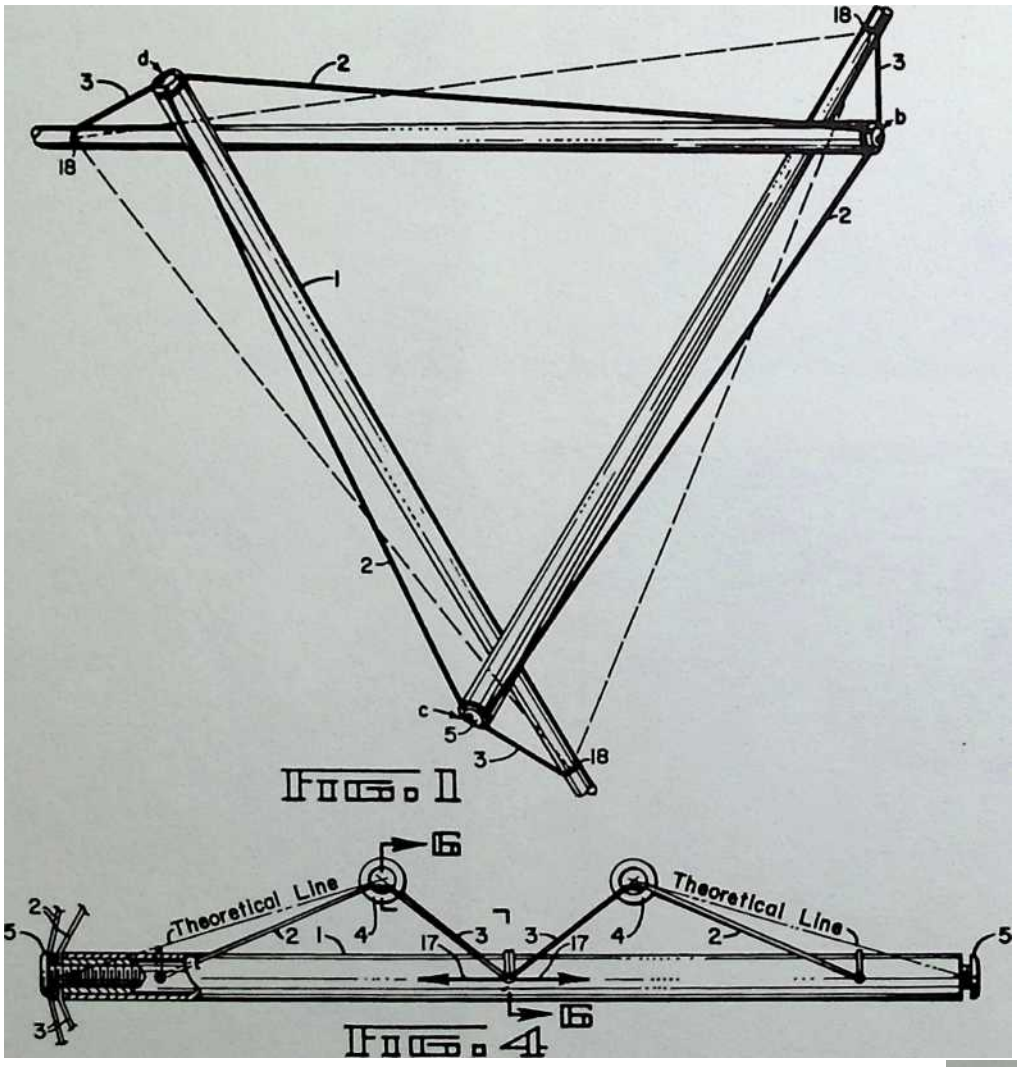
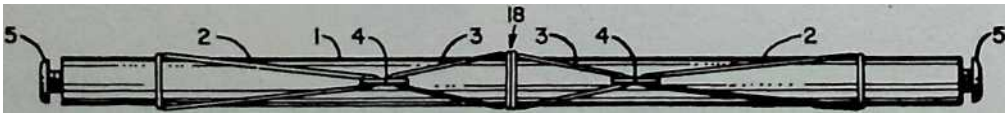
5 Tensegrity Patent 11/13/62

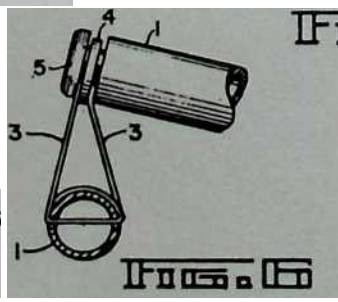
Tensegrity is the physical phenomenon that produces a stable geometric structure with solid members that are arranged in tandem with tense metal cables. The solid members of this system do not touch or support each other directly.

Nov. 13, 1962 R. B. FULLER 3,063,521

TENSILE-INTEGRITY STRUCTURES Filed Aug. 31, 1959 13 Sheets-Sheet 1







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R. a FULLER 3,063,521
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- SILVER
- BLACK
- ORANGE
- PURPLE
- YELLOW

INVENTOR.
R. BUCKMINSTER FULLER
Nov. 13, 1962
Filed Aug. 31. 1959
R. B. FULLER
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R. BUCKMINSTER FULLER

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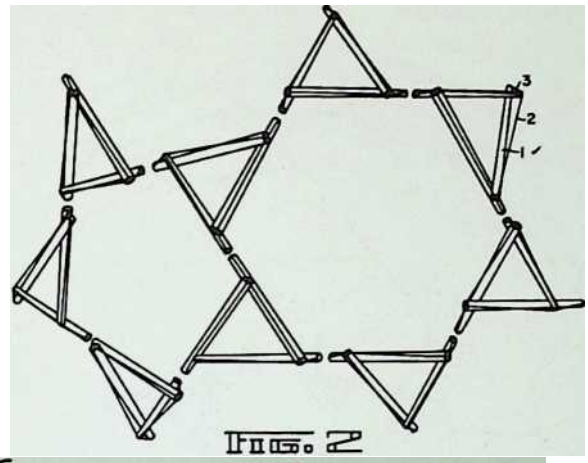


FIG. 2

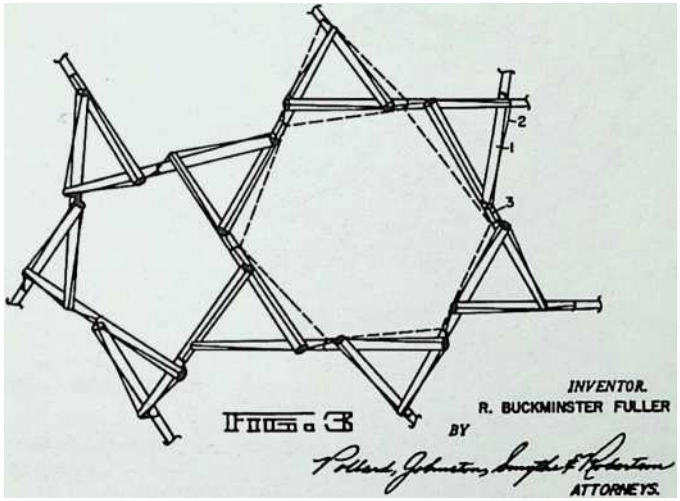
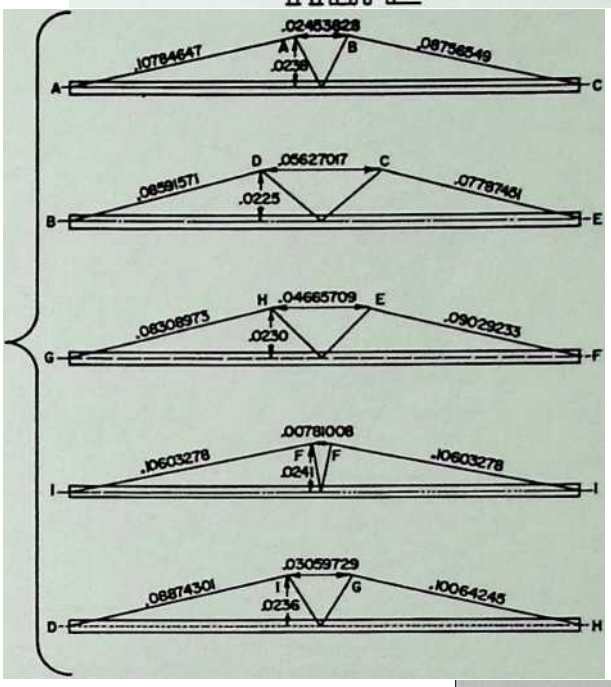
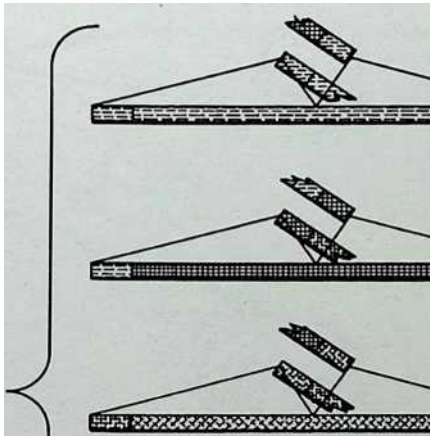


FIG. 3





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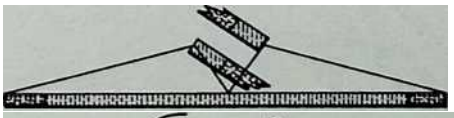

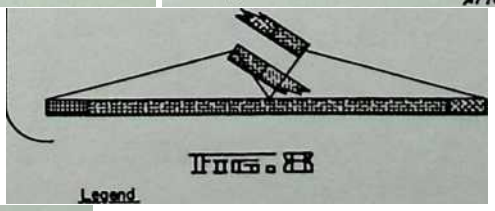

FIG. 8

Legend

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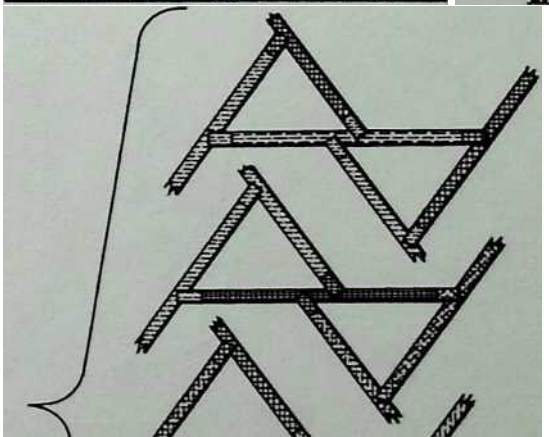

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R. B. FULLER 3,063,521

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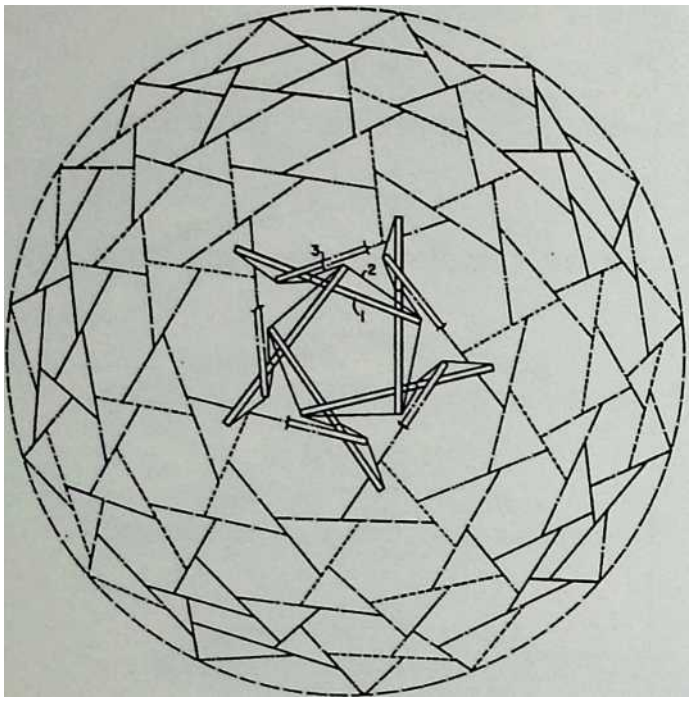

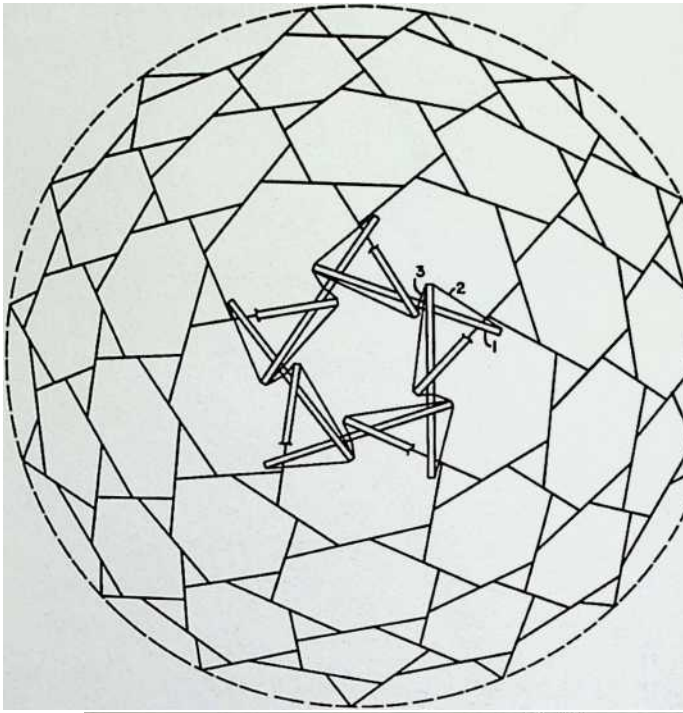

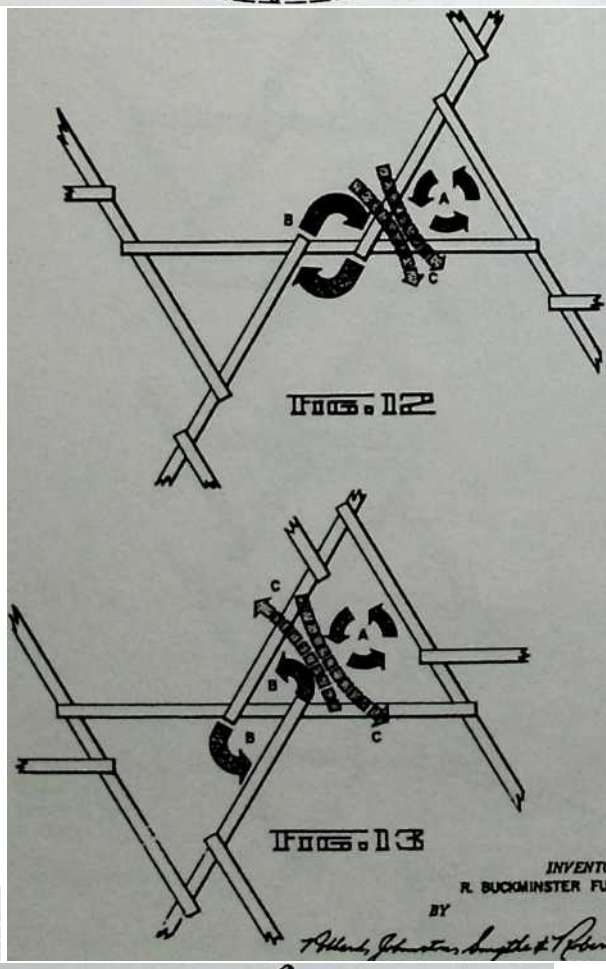

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Pollard, Johnston, Smythe & Robertson
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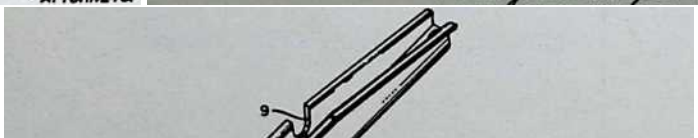

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R. BUCKMINSTER FULLER

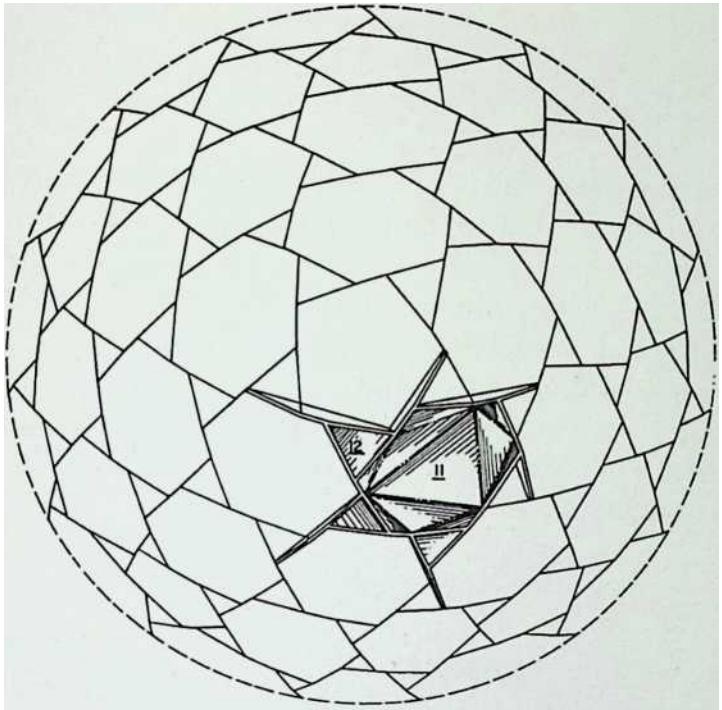

FIG. 17

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Pollard, Johnston, Smyth & Robertson
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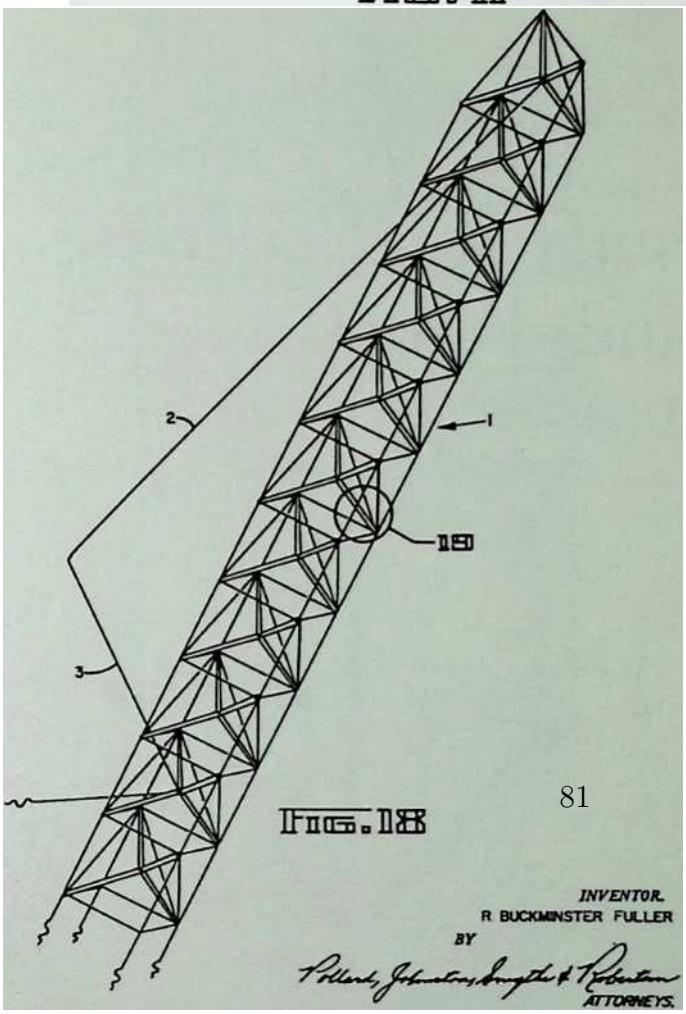

FIG. 18

INVENTOR.
R. BUCKMINSTER FULLER
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R. BUCKMINSTER FULLER

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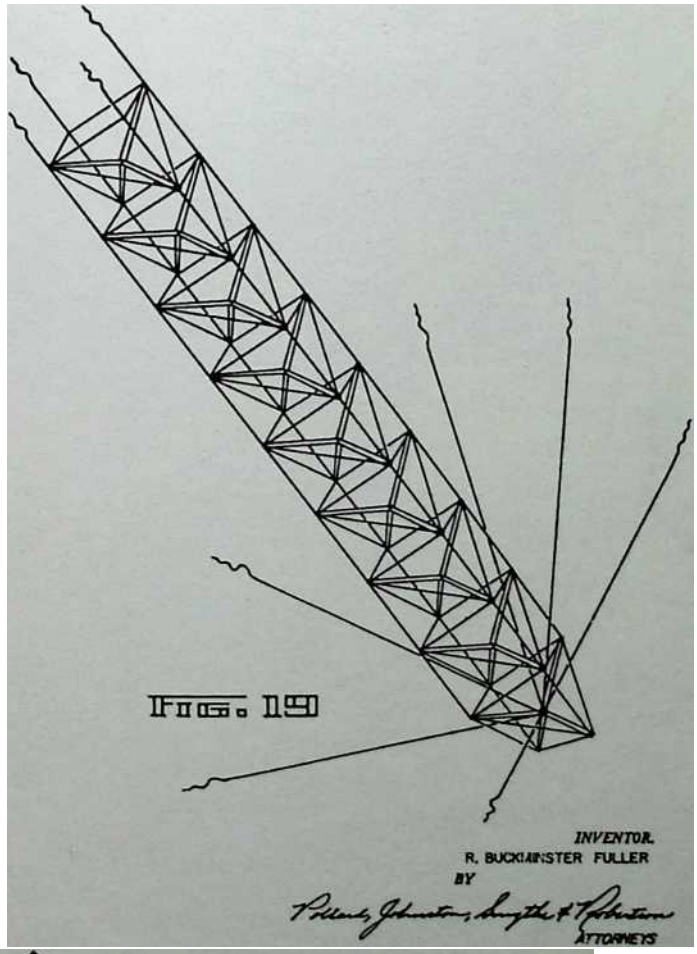
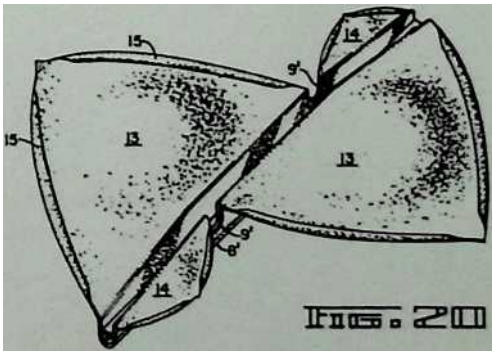


FIG. 19
INVENTOR.
R. BUCKMINSTER FULLER
BY
ATTORNEYS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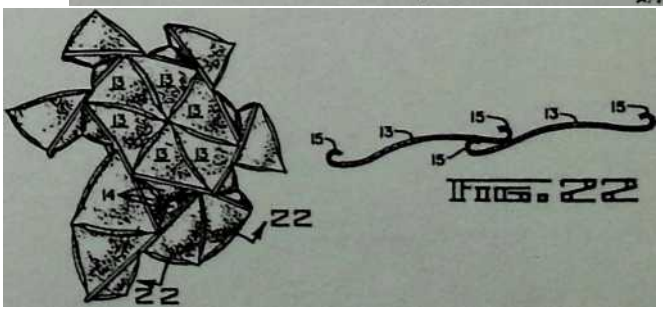
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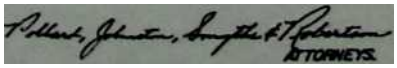

ATTORNEYS

6 Submarisle (Undersea Island) Patent 3/12/63

The submarisle represents Fuller's return to the idea of floating islands that he had explored during the twenties. The technological advances realized by the sixties would have made submarisle feasible. It is essentially a submerged depot for the loading and unloading of goods from submarines, eliminating the need for a harbor and ensuring the safe delivery of goods during bad weather. The semisubmerged vessel is anchored below surface turbulance.

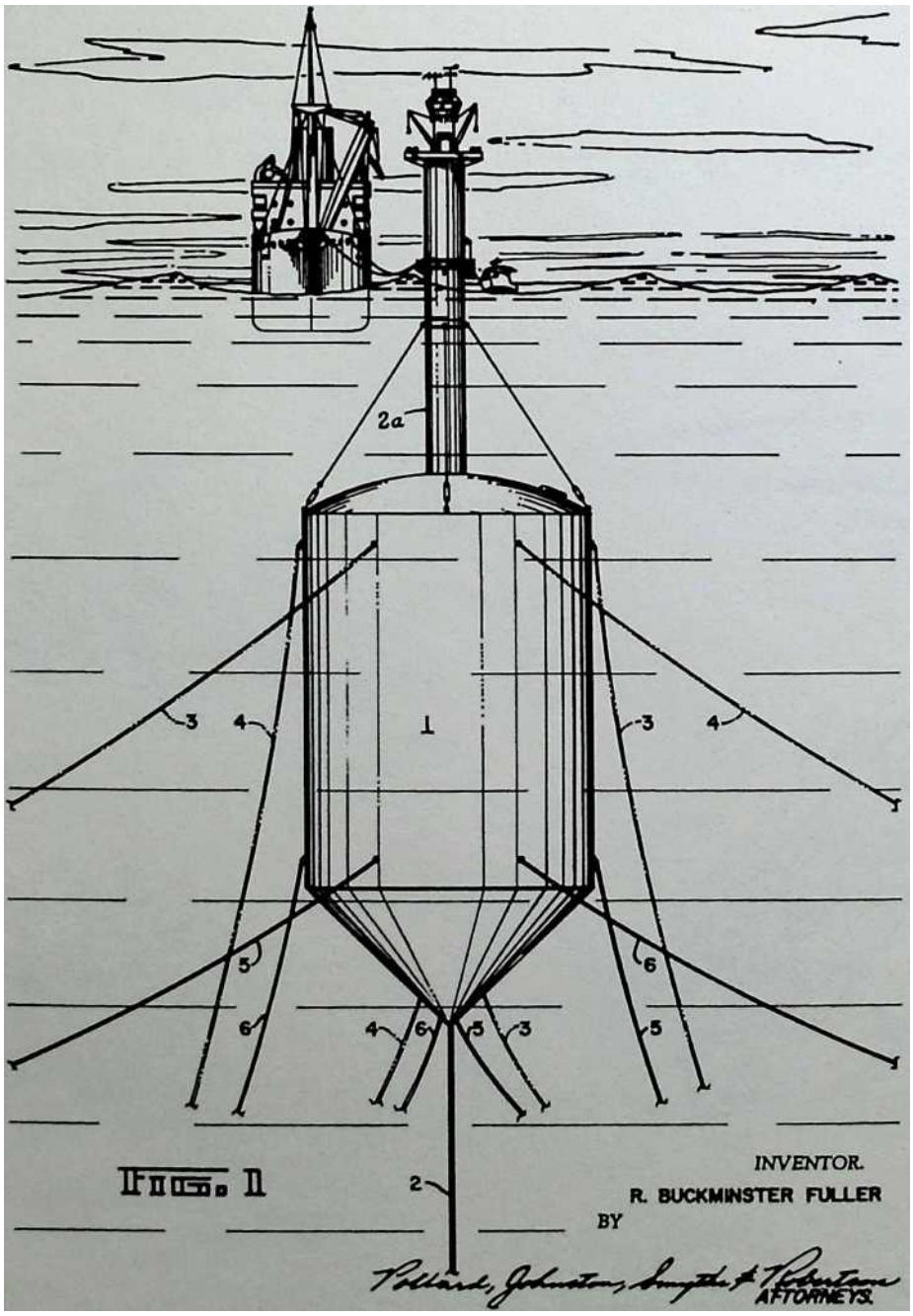
March 12, 1963

3,080,583

Filed June 8, 1959

R. B. FULLER UNDERSEA ISLAND

8 Sheets-Sheet 1



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UNDERSEA ISLAND

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March 12, 1963

Filed June 8, 1959

R. B. FULLER

UNDERSEA ISLAND

3,080383

8 Sheets-Sheet 3

March 12, 1963

Filed June 8. 1959

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UNDERSEA ISLAND

3,080383

8 Sheets-Sheet S

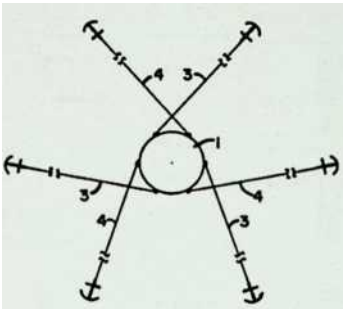


FIG. 2

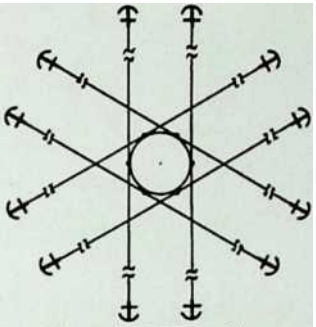


FIG. 4

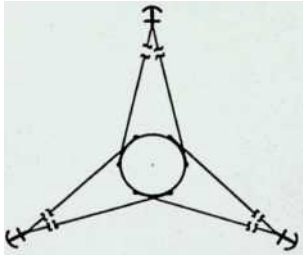
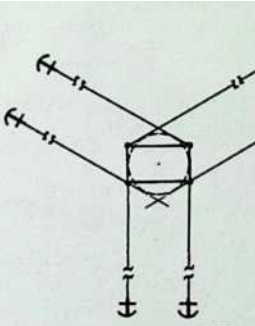


FIG. 3



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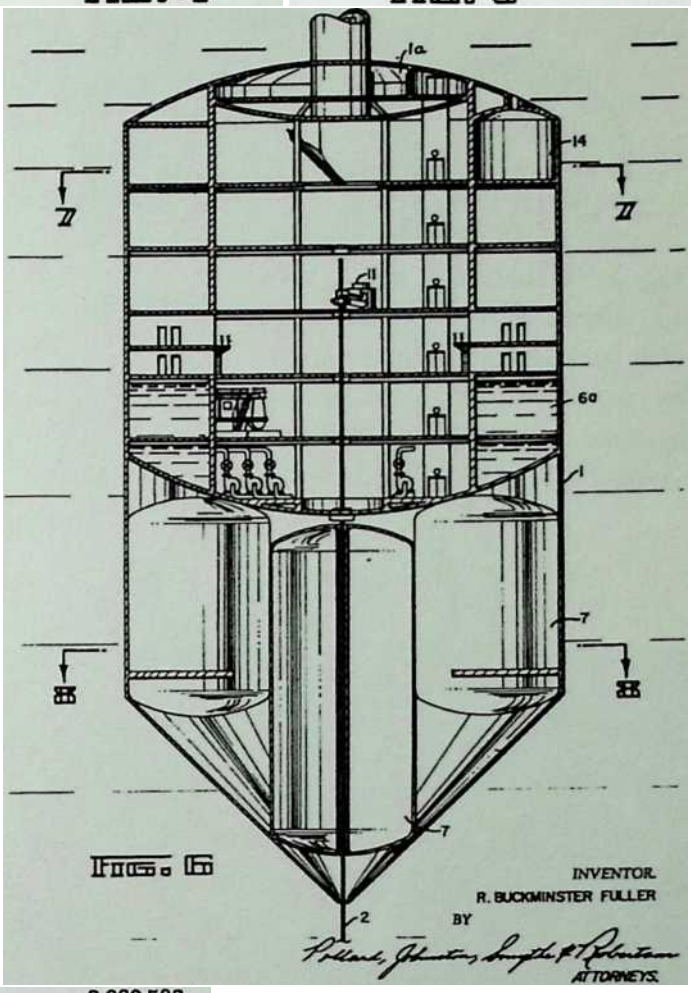


FIG. 6

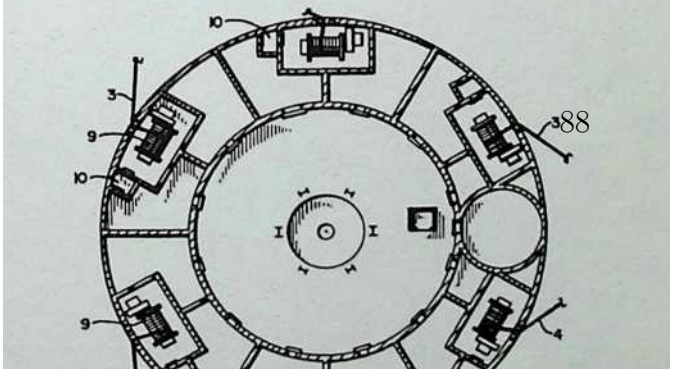
INVENTOR.
R. BUCKMINSTER FULLER
BY
Pollard, Johnston, Smythe & Robertson
ATTORNEYS.

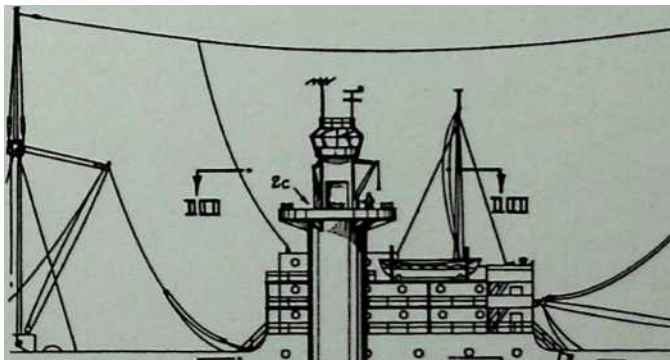
INVENTOR.
R. BUCKMINSTER FULLER
BY
Pollard, Johnston, Smythe & Robertson
ATTORNEYS.

March 12, 1963 R. B. FULLER 3,080,583

UNDERSEA ISLAND

Filed June 8, 1959 8 Sheets-Sheet 4





March 12, 1963

Filed June 8, 1959

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March 12, 1963

Filed June 8, 1959

R. B. FULLER

UNDERSEA ISLAND

3,080,583

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INVENTOR.

R. BUCKMINSTER FULLER

BY

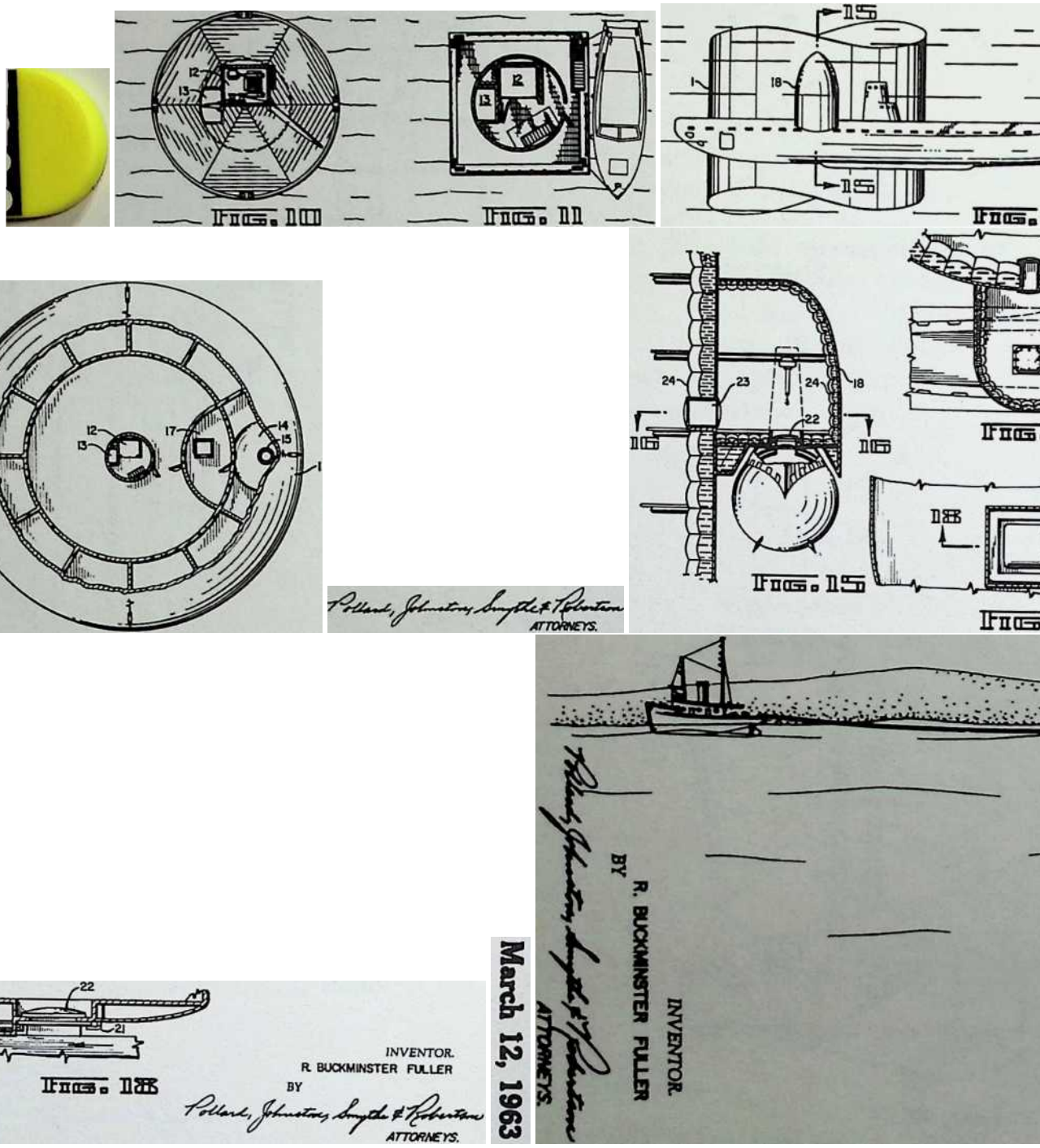


FIG. 10
FIG. 11
FIG. 15
FIG. 16
FIG. 18
INVENTOR.
R. BUCKMINSTER FULLER
BY
Pollard, Johnston, Smythe & Robertson
ATTORNEYS.
March 12, 1963

7 Tensegrity Chandelier for Princess Margaret 1964

One of Fuller's most conspicuous public gestures during the sixties was the presentation of this geodesic sphere of crystal struts and silver wires to Princess Margaret, thus realizing in sumptuous materials and bringing to royal attention the innovational and universal principles he had developed during the early fifties. This glittering monument to the concepts of tensegrity and the thirty-one great circles was built by James and Gill Meller.

The thirty-two year association of the architect Shoji Sadao with the inventor R. Buckminster Fuller helped establish the latter as a serious shaper of the human environment. The designs produced by the architectural firm of Fuller & Sadao from 1964 until 1983 are distinguished both by the originality of Fuller's imagination and the practicality of Sadao's architectural details. When Sadao joined Fuller, both men resolved to concentrate on the potential of architecture to influence the evolution of modern society. The most famous product of this inventor—architect liaison is the towering geodesic dome built for Expo '67, the world's fair held in Montreal. In this building, structural invention is the most obvious aspect of Fuller's design, but Sadao and scores of engineers were responsible for the details of its realization.

8 Fuller & Sadao 1964–1983

Shoji Sadao, was born and raised in Los Angeles. He earned his bachelor's degree in architecture at Cornell University in 1954. It was there in Ithaca in 1952 that he first met Fuller, who had been engaged as a guest lecturer. Sadao became his most avid pupil and assisted him with the erection of a twenty-foot lath globe comprising the thirty-one great circles that formed the basis of Fuller's geodesic theories. This venture united the two in creative endeavor for over three decades.

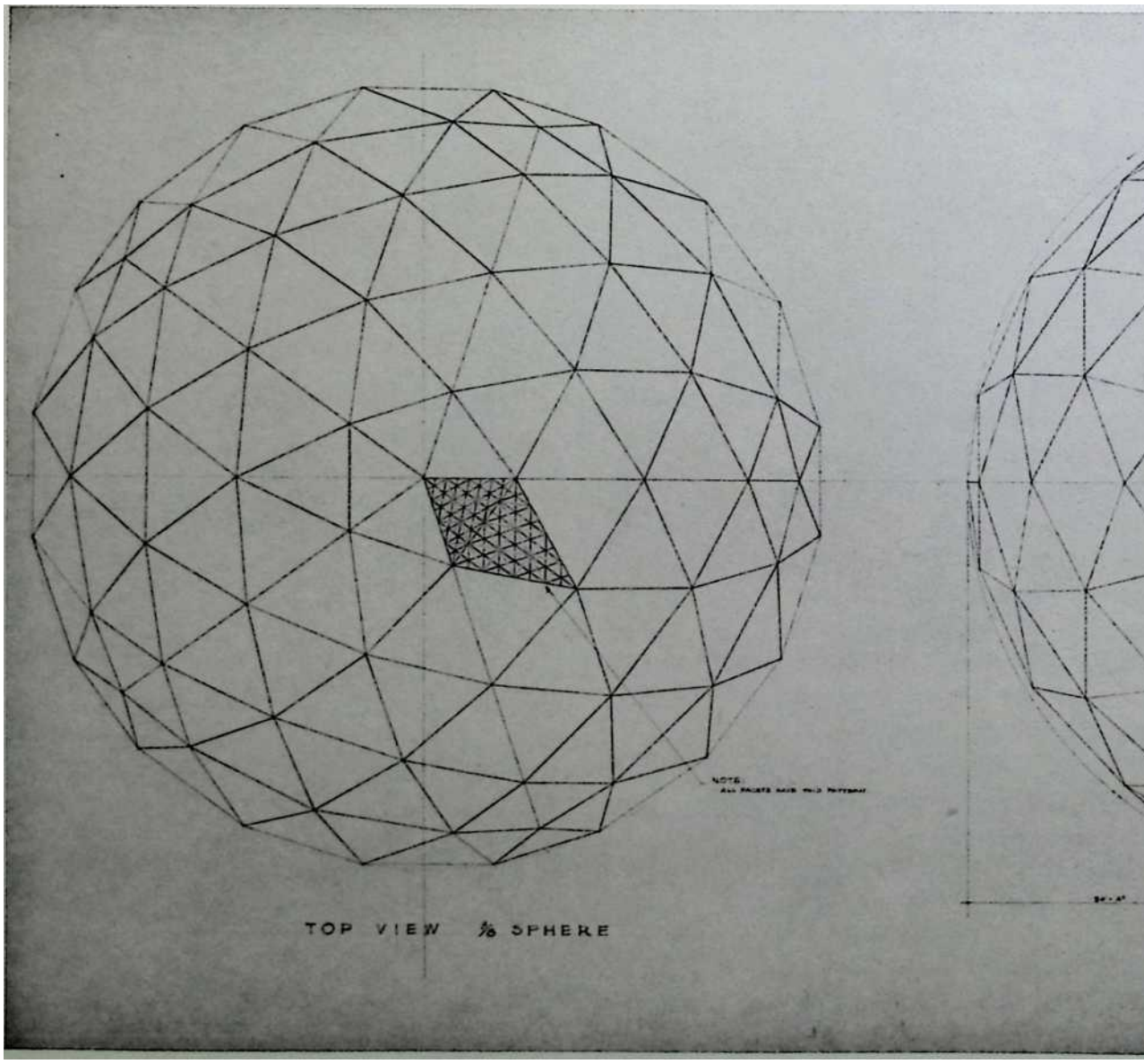
Soon after the successful erection of the geodesic globe at Cornell, Fuller employed Sadao again to help realize a new edition of the Dymaxion Airocean World Map (1954). Notwithstanding the cartographic nature of these debut commissions, Sadao's contribution to Fuller's design team during the fifties was chiefly architectural. Fuller's projects of this period were basically of two types, the most important of which involved the materialization of abstract structural notions. The more practical, if less interesting, projects were the lightweight, demountable geodesic structures Sadao helped design for the U.S. Marine Corps and the Army Quartermaster Corps. Interesting examples of the abstract designs are the two thirty-six-foot, perforated paperboard domes Sadao designed for the Biennale in Milan in 1954, which functioned mainly to demonstrate geodesic principles. But the most significant effort of these years was the tensegrity mast, designed by Sadao with Edison Price for the Fuller exhibition at the Museum of Modern Art in New York in 1959.

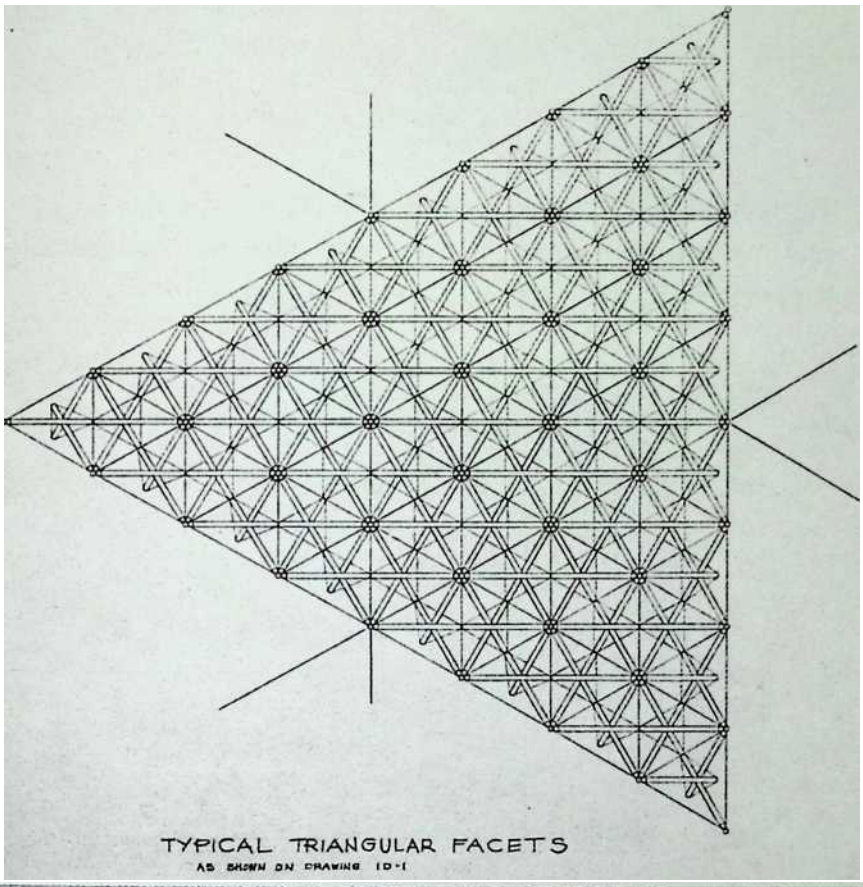
Sadao was affiliated with Edison Price, Inc., a lighting manufacturer of some distinction, from 1959 until he joined Fuller in 1964. He was job captain for several of their most important commissions including:

the Four Seasons Restaurant and the Seagram Building lobby in New York City, the Munson-Williams-Proctor Institute in upstate New York, and the Amon Carter Museum in Fort Worth, Texas.

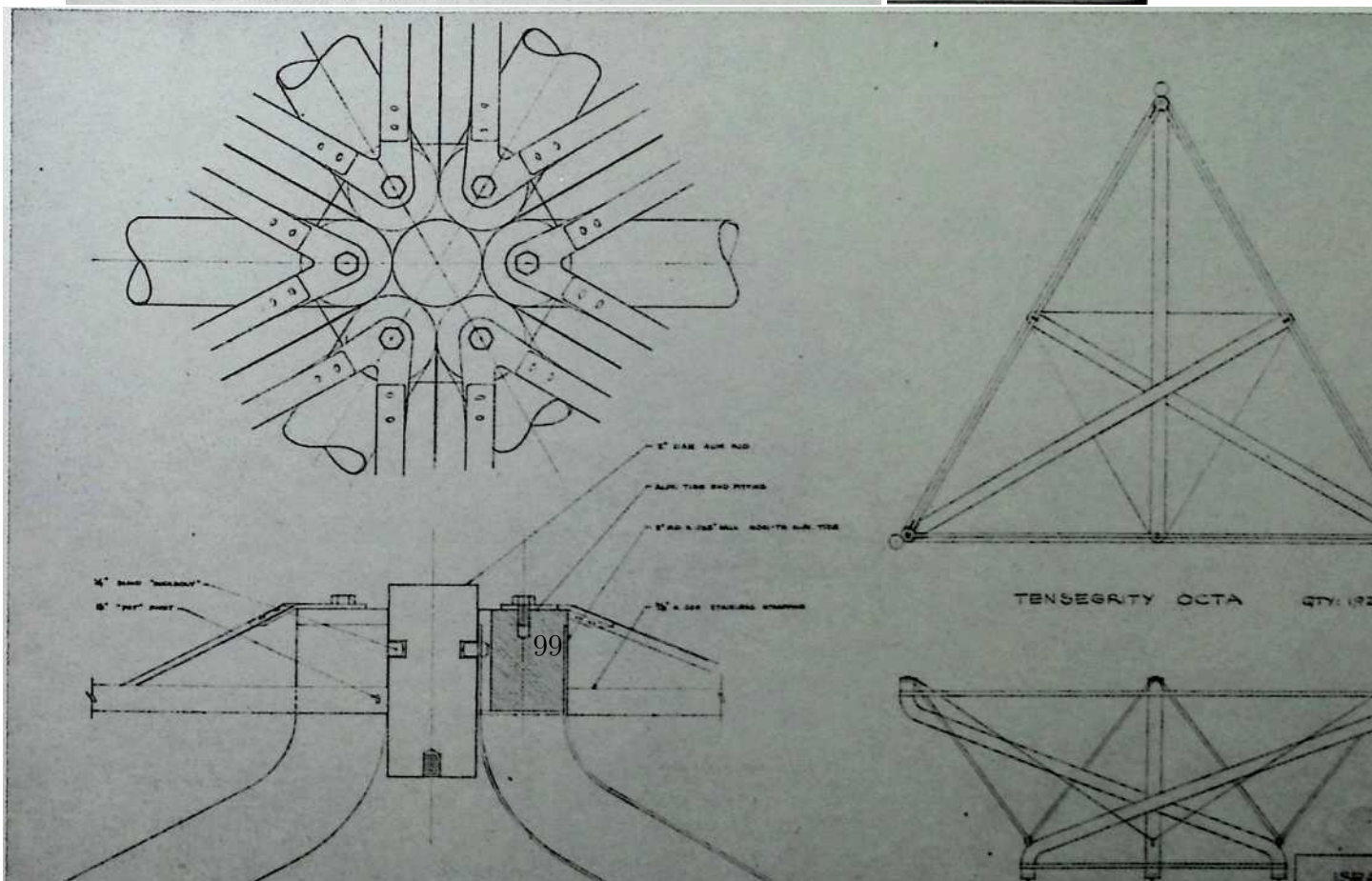
9 Tensegrity Dome for Israel Fuller & Sadao, 1964

This tensegrity dome designed for an unspecified function in Israel is three-eighths of a sphere and 150 feet in diameter. Each unit of this aluminum tube and steel cable structure would have been covered by a transparent acrylic pane. Although completely dependent on the structural principles of tensegrity, it would have been one of the most complex of Fuller's creations, with its interplay of bent tubes and winding metal cables.


TOP VIEW 5/8 SPHERE

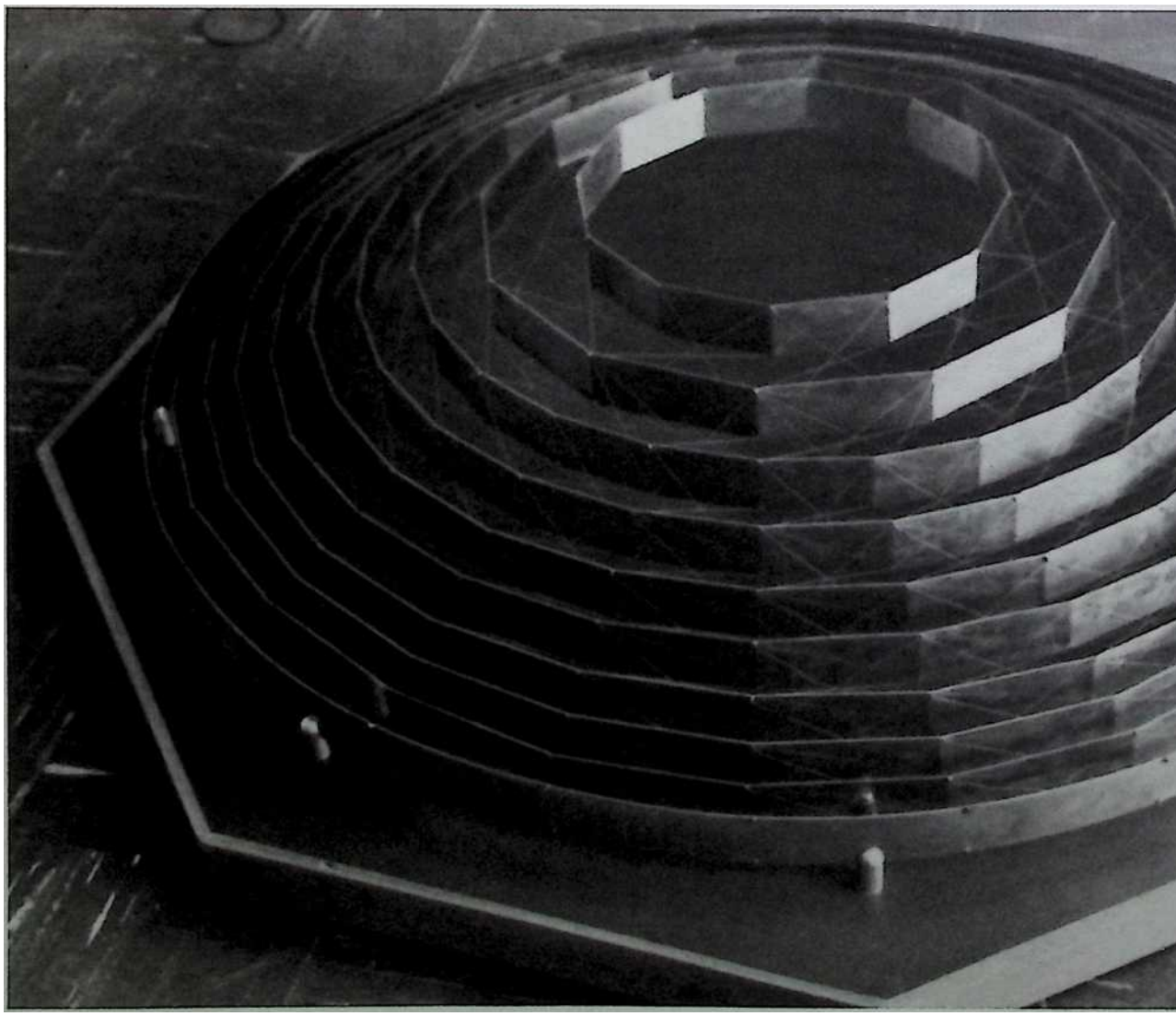

TYPICAL TRIANGULAR FACETS
AS SHOWN ON DRAWING ID-1

ISRAEL DOME
DETAILS
FULLER & SADAO
ID-2


TENSEGRITY OCTA

10 Aspension Geodesic Structures Patent 7/7/64

The principle of the suspension bridge is utilized in this invention, creating a domical space of vertical tube supports held in shape with tense metal cables.



July 7, 1964
R. B. FULLER
SUSPENSION BUILDING
3,139,957
July 7, 1964
Filed Jan. 24, 1961
R. B. FULLER
SUSPENSION BUILDING

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INVENTOR.

RICHARD BUCKMINSTER FULLER

July 7, 1964

Filed Jan. 24. 1961

R. B. FULLER

SUSPENSION BUILDING

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R. B. FULLER

SUSPENSION BUILDING

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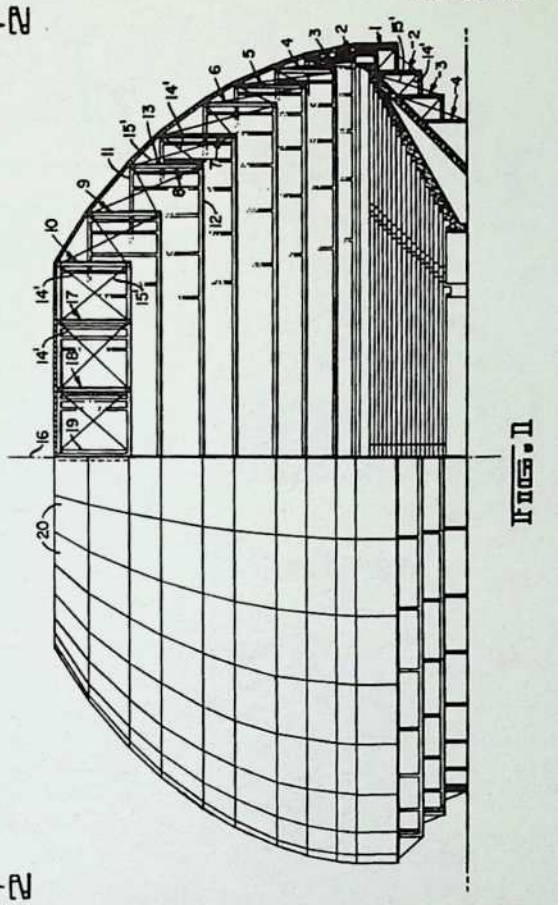
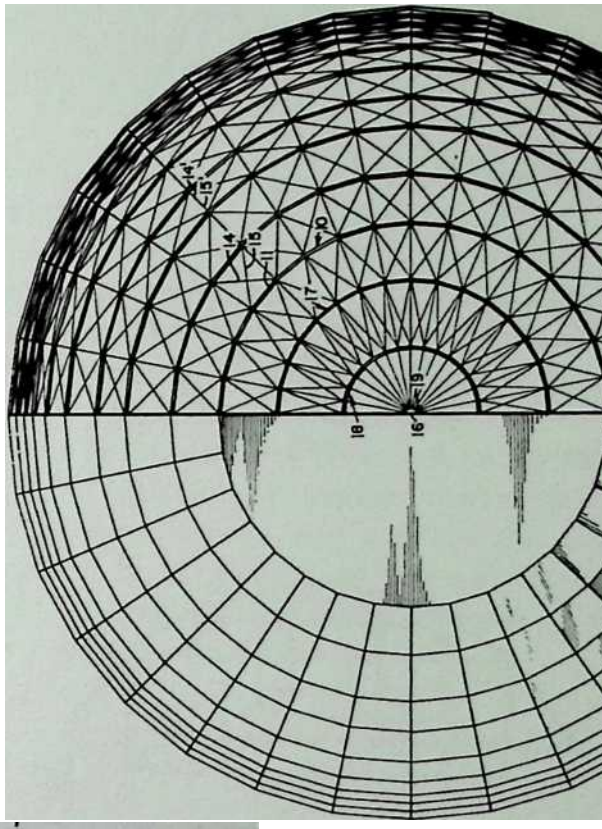


FIG. 11

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
Robertson & Smythe
ATTORNEYS.



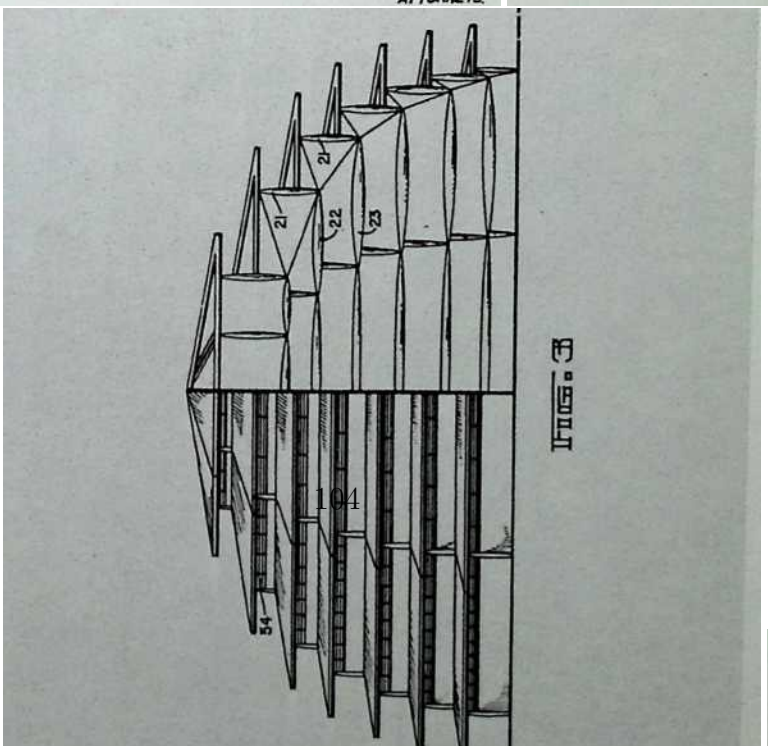


FIG. 13

July 7, 1964 R. $_{B}$. FULLER 3,139,957

SUSPENSION BUILDING Filed Jen. 24. 1961 $_{B}$ Sheets-Sheet 5

July 7, 1964

Filed Jan. 24. 1961

R. B. FULLER

SUSPENSION BUILDING

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INVENTOR.

RICHARD BUCKMINSTER FULLER

July 7, 1964

Filed Jan. 24. 1961

R. B. FULLER

SUSPENSION BUILDING

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July 7, 1964 $_{R}$. $_{B}$. FULLER 3,139,957

SUSPENSION BUILDING

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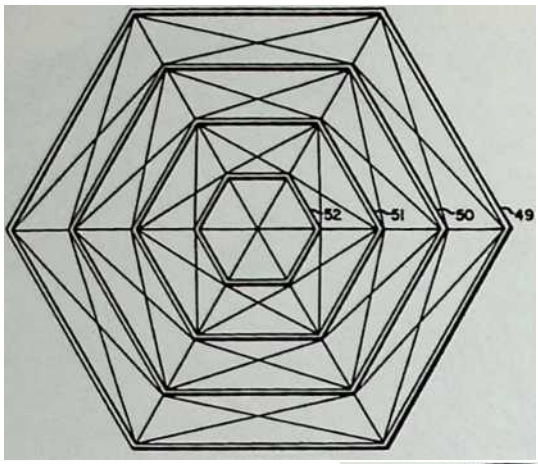
INVENTOR.

RICHARD BUCKMINSTER FULLER



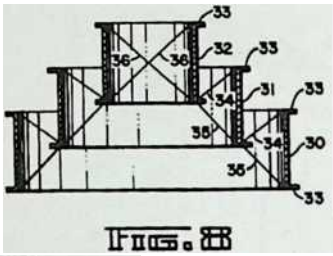
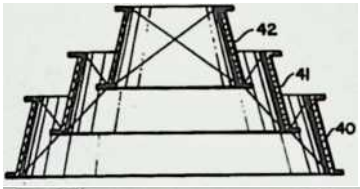
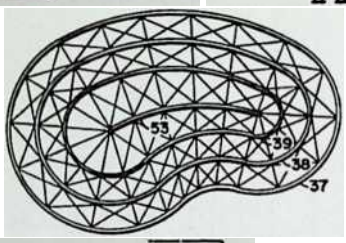
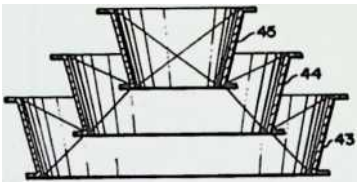


FIG. 8 FIG. 9







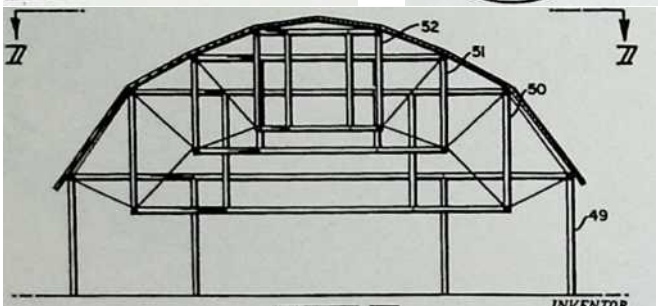
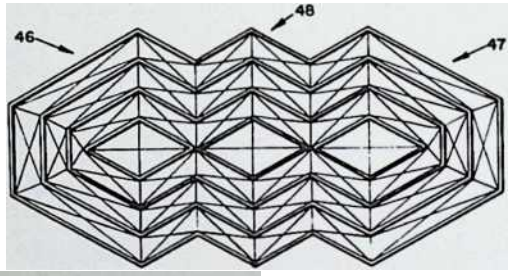


FIG. 6

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS.



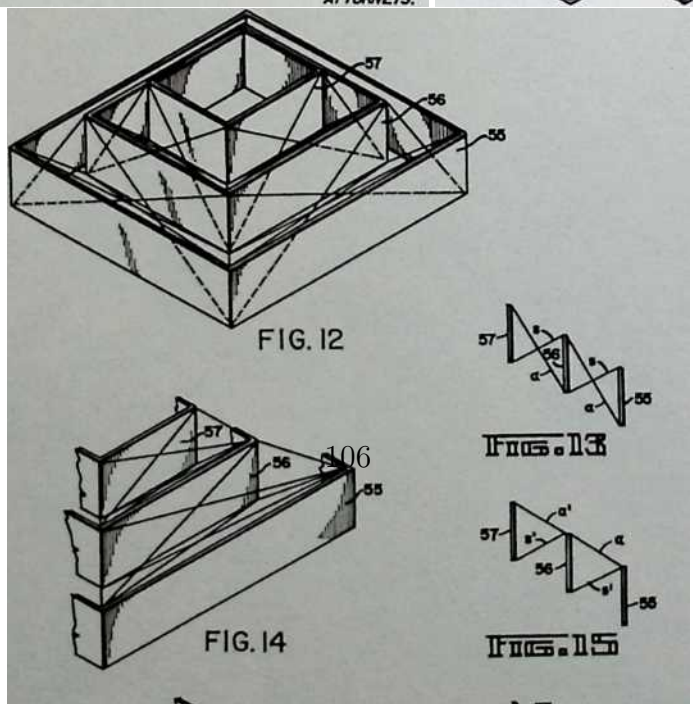
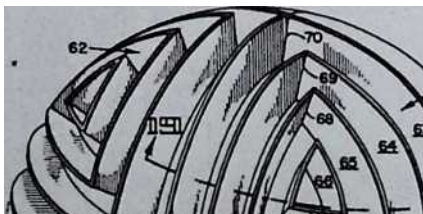


FIG. 12

FIG. 13

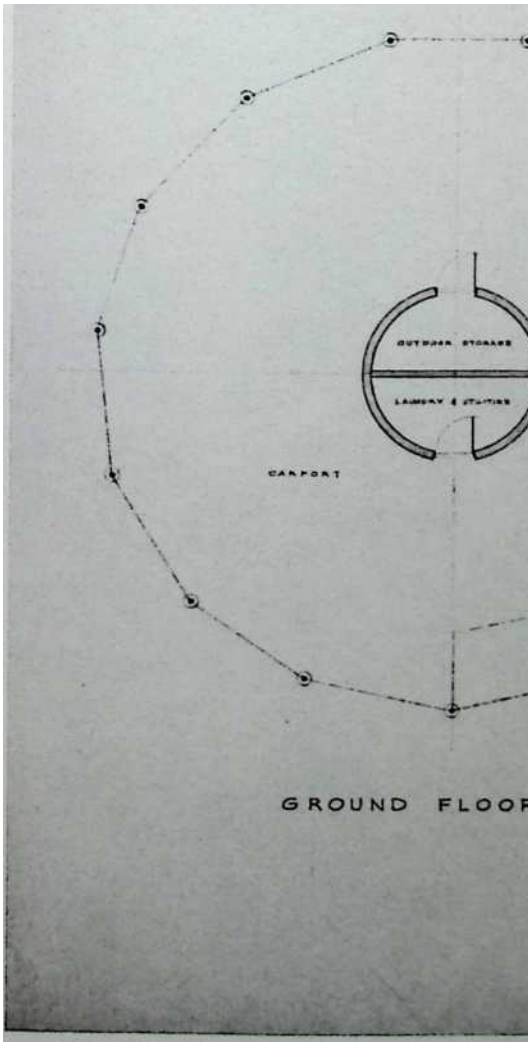
FIG. 14

FIG. 15

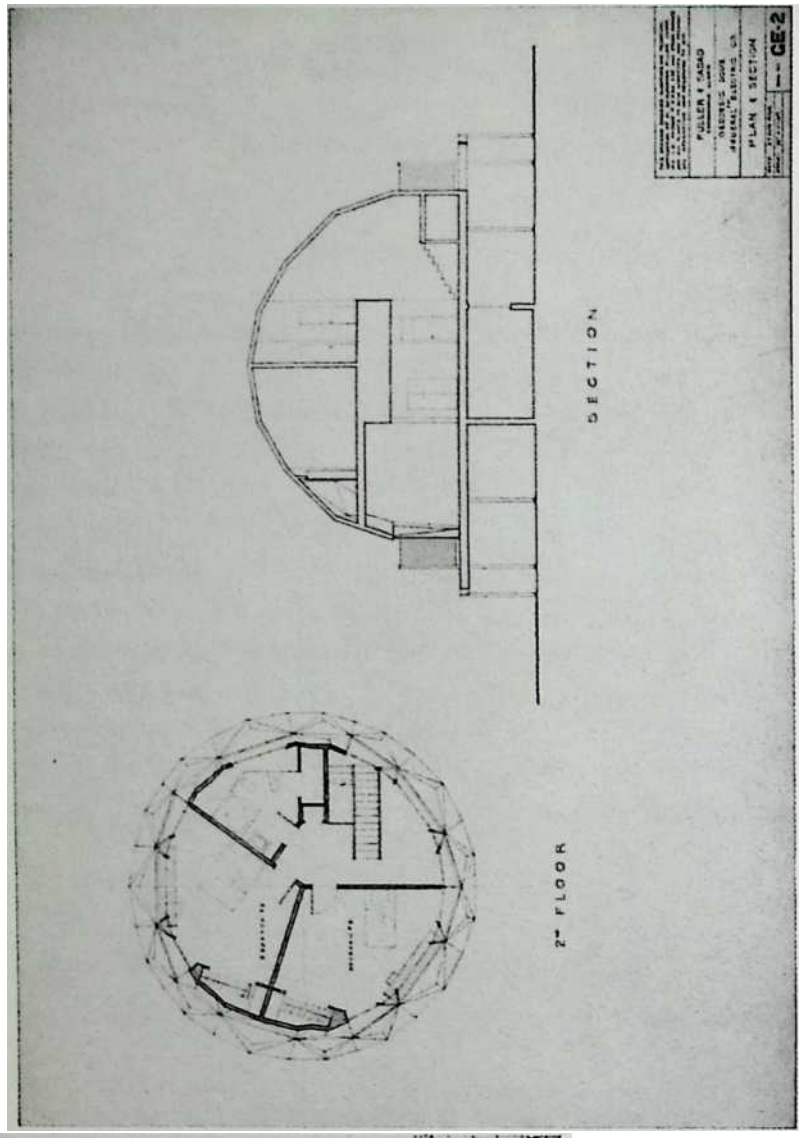


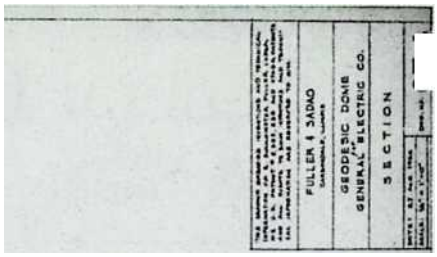
11 Geodesic Dwellings for General Electric Fuller & Sadao, 1964

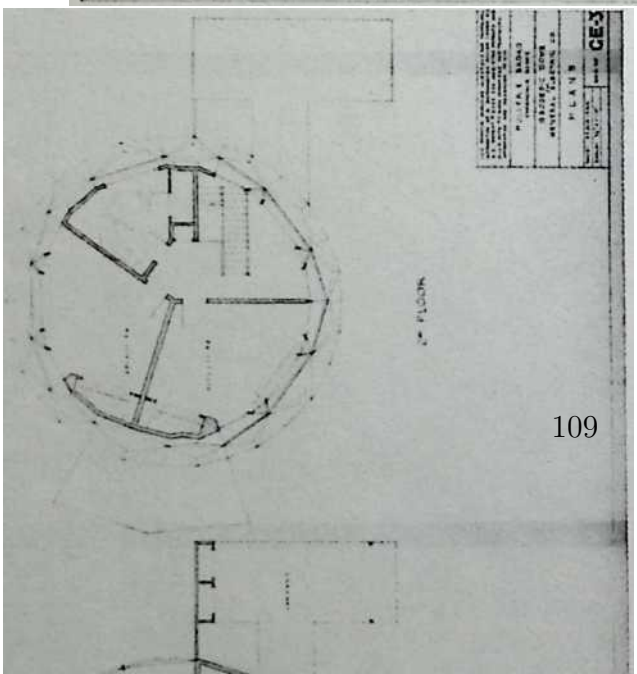
The General Electric (G.E.) Company, which sponsored the radomes of the 1950s, had Fuller design these geodesic dwellings for mass production in 1964. There are two types: the first has a base housing a carport and laundry, four bedrooms, two baths, a living room, and a kitchen—all of which were arranged to fit the curvature of the dome; the second type corresponds with the skybreaks of the late 1940s, in that the rooms are stacked, rectangular volumes and are discrete from the sheltering dome. One sees at a glance that the new domes for G.E. are feasible in terms of contemporary construction, unlike the earlier skybreaks that were decades ahead of their time.

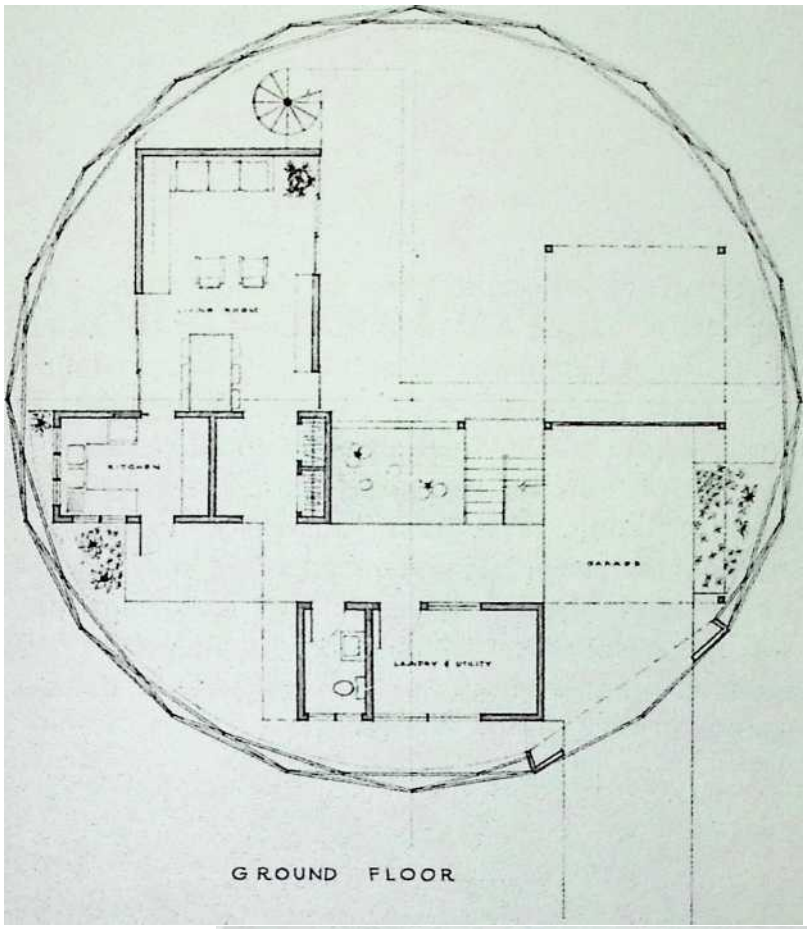


GE-4


2ND FLOOR
SECTION
FULLER & SADAO
GEODESIC DOME
GENERAL ELECTRIC CO.
PLAN & SECTION
CE-2


FULLER & SADAO
GEODESIC DOME
GENERAL ELECTRIC CO.
SECTION


2ND FLOOR
PLANS
CE-3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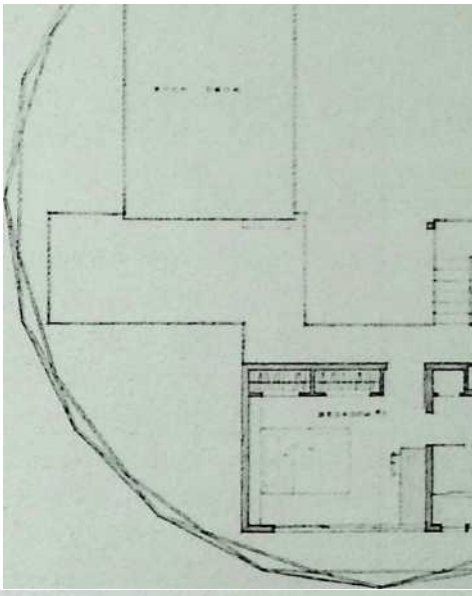
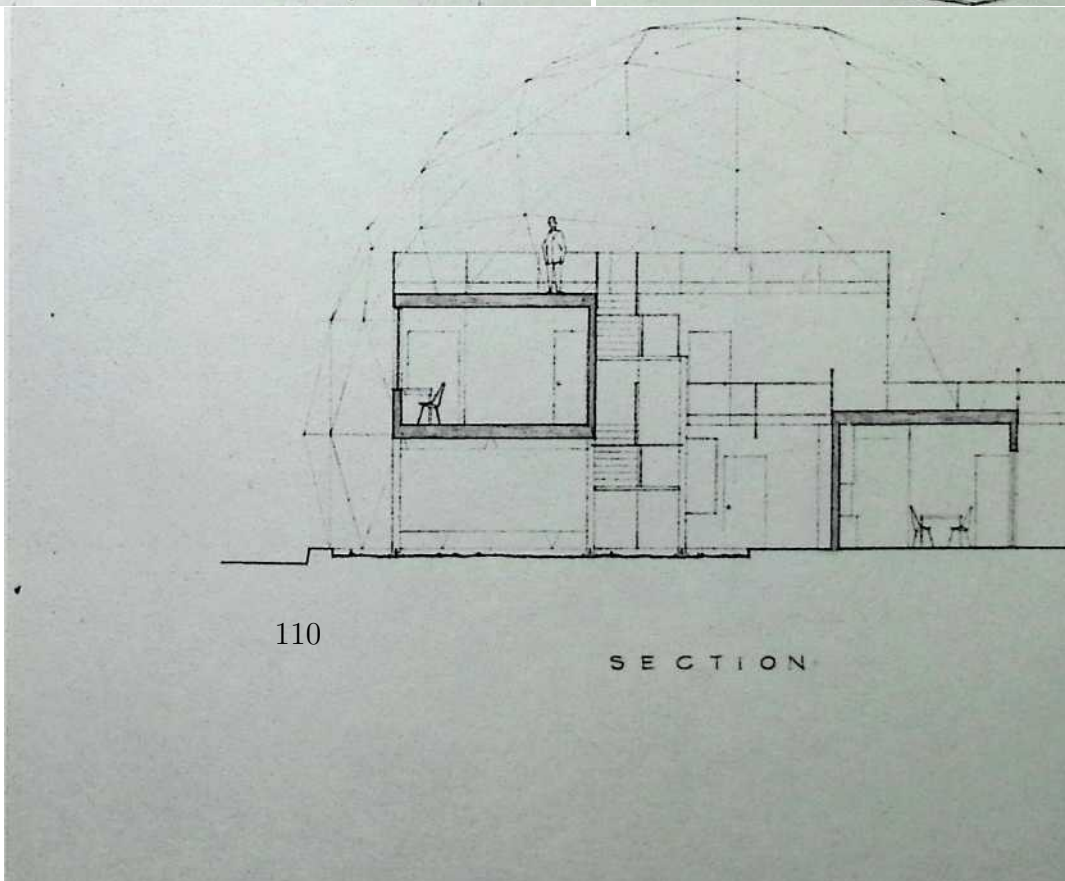
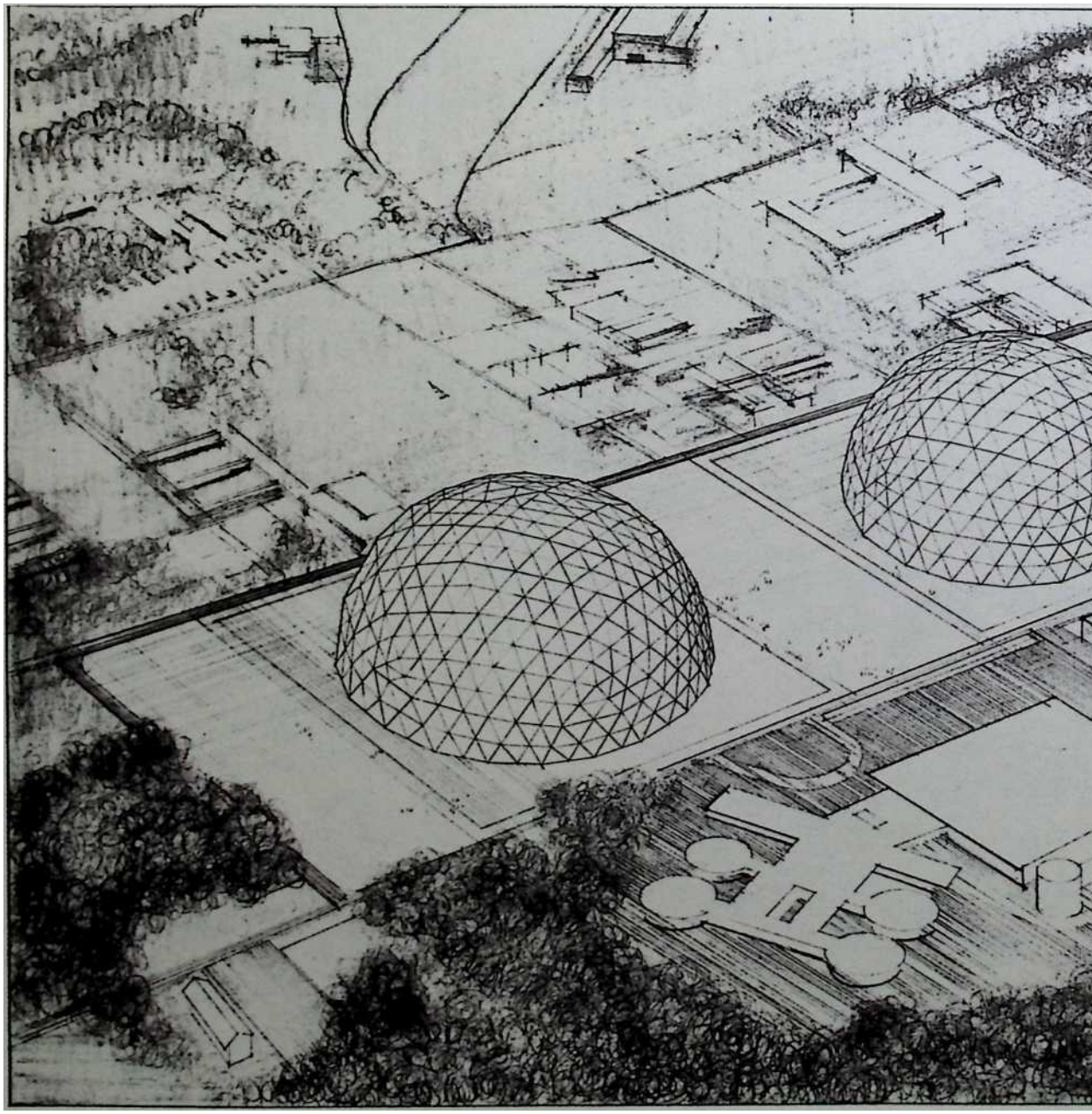



SECTION

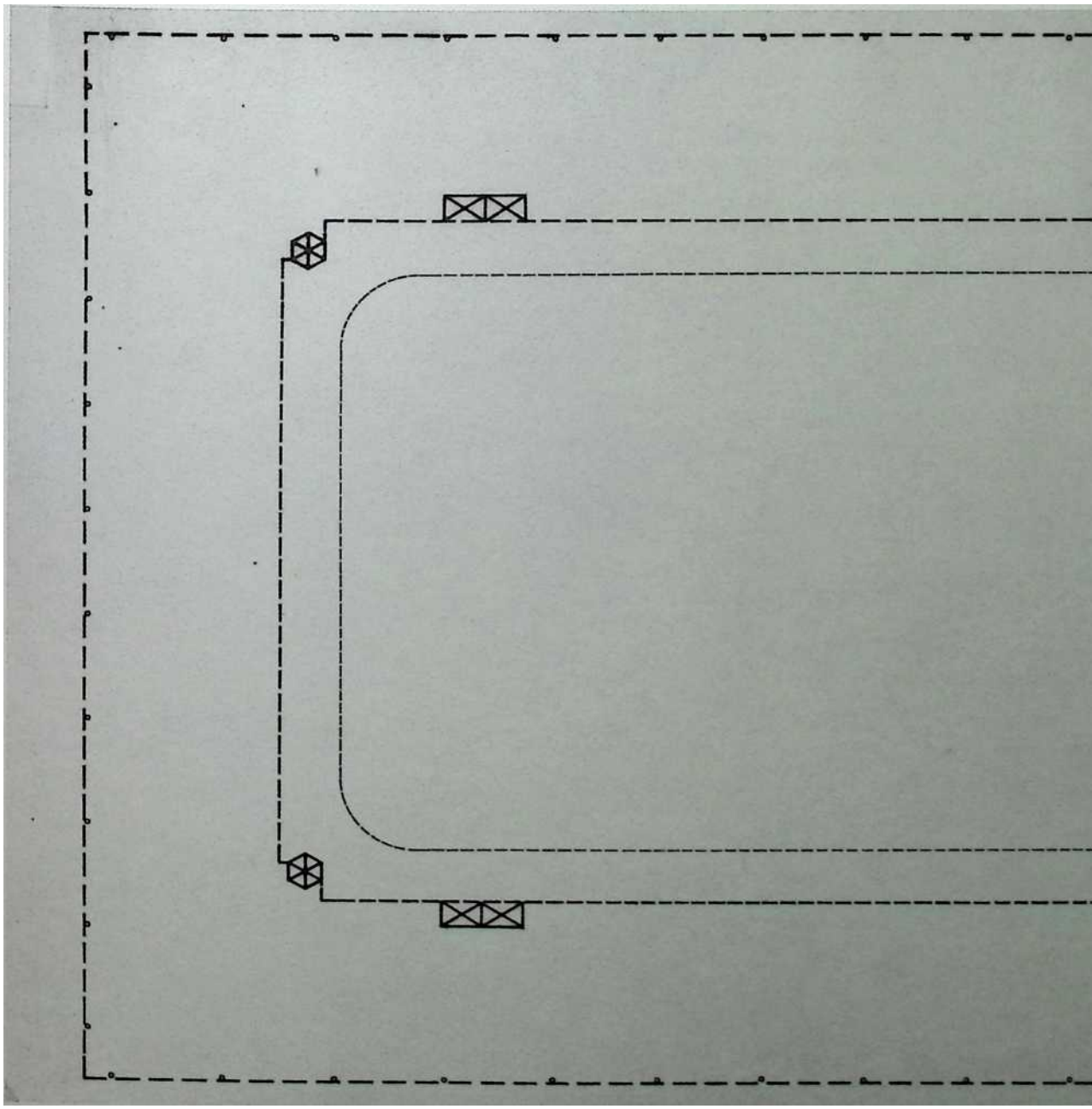
12 Geodesic Domes for the Brookhaven National Laboratory Fuller & Sadao, 1964

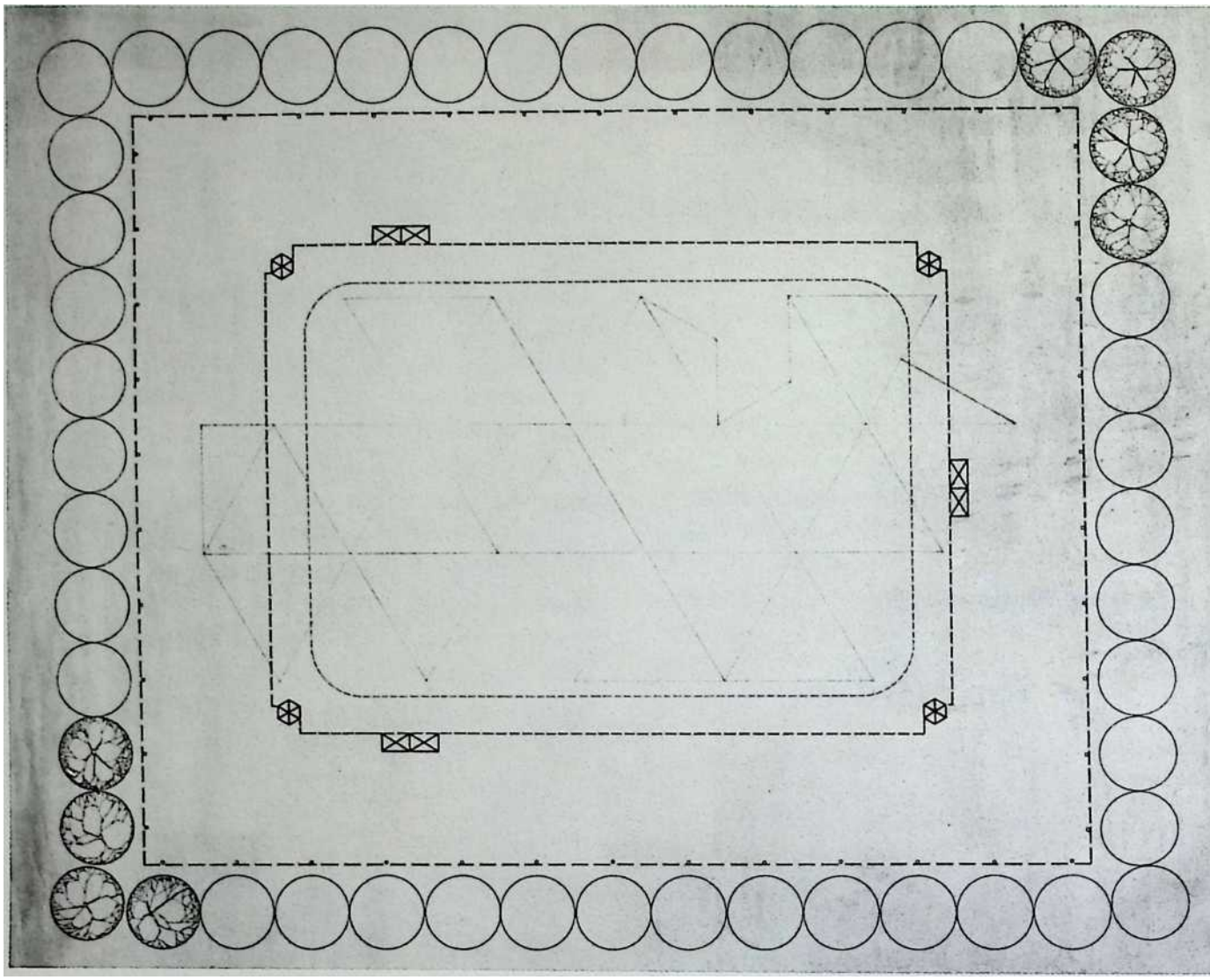
This single sketch depicts two geodesic domes, each over 100 feet high, designed by Fuller for the Brookhaven National Laboratory in 1964. This Long Island (New York) facility houses a particle accelerator, a nuclear reactor, and medical and biological research centers. Fuller, who was operating out of his office in Carbondale, Illinois, at the time, was not invited to complete the project. Neither Sadao, Fuller's partner, nor the administration at Brookhaven recall how the domes were intended to function; although a cafeteria building was erected on the site shortly after the designing of the geodesic domes.

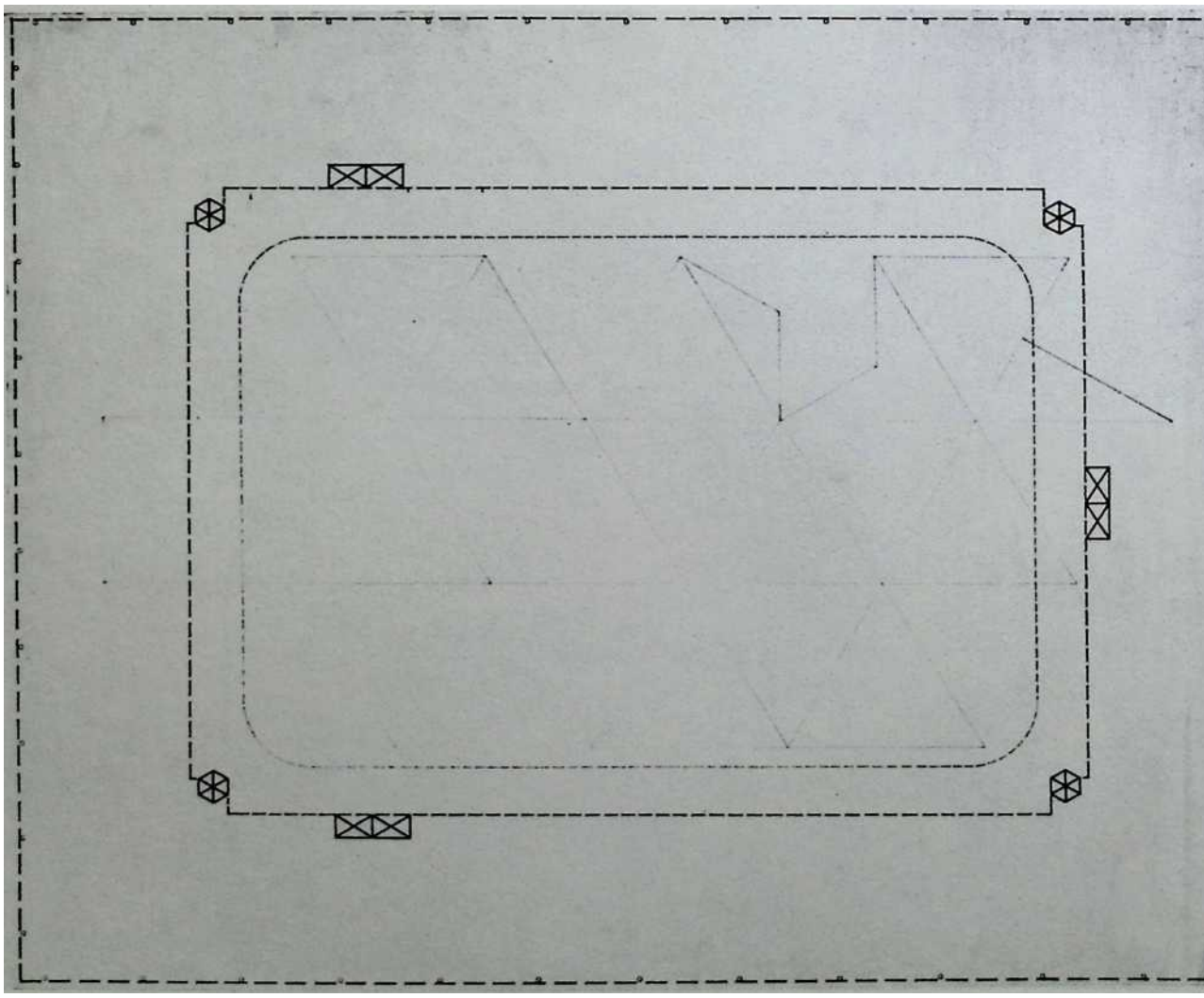


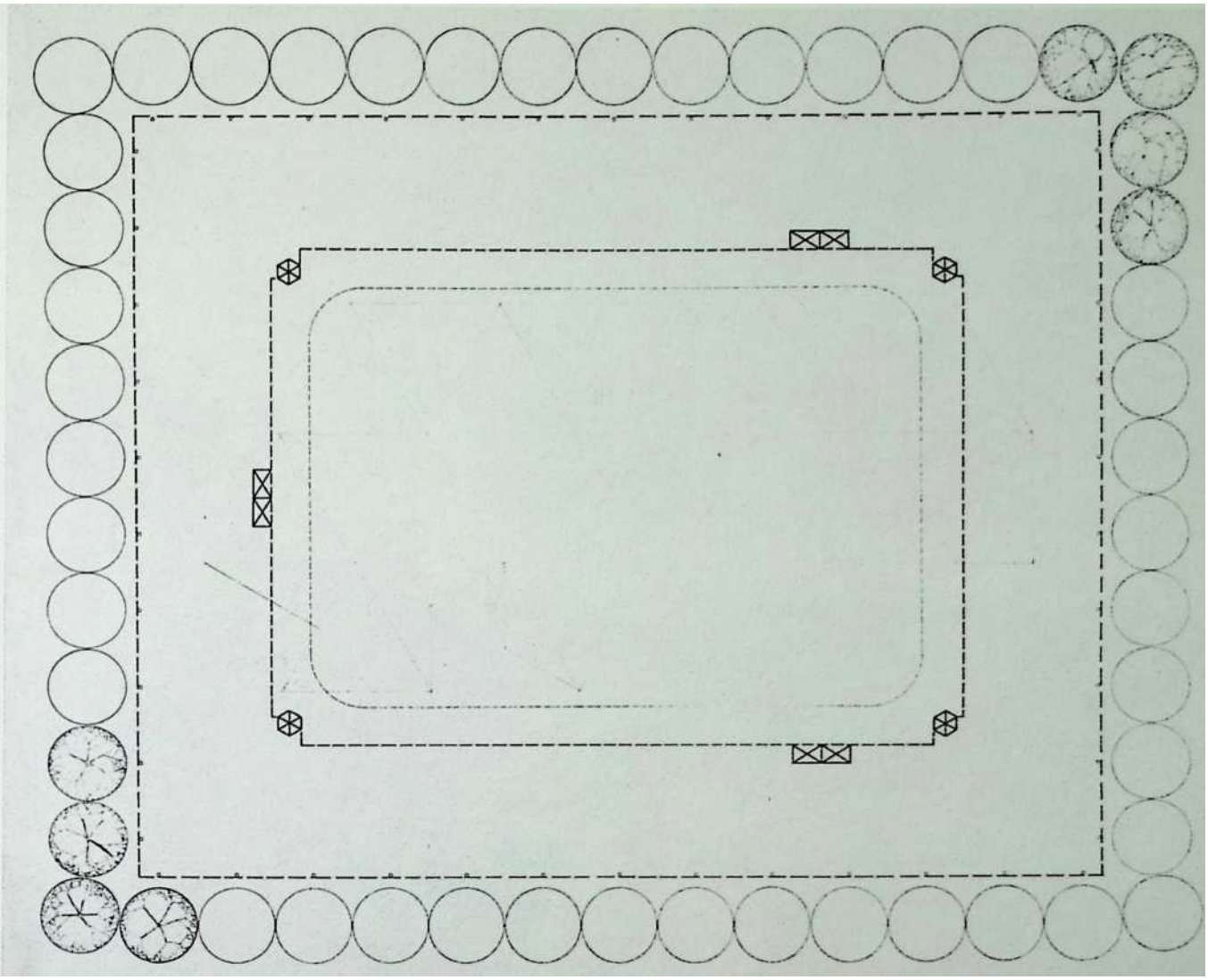
13 United States Pavilion Designed for Expo '67 (Trabeated Truss) Fuller & Sadao, 1964

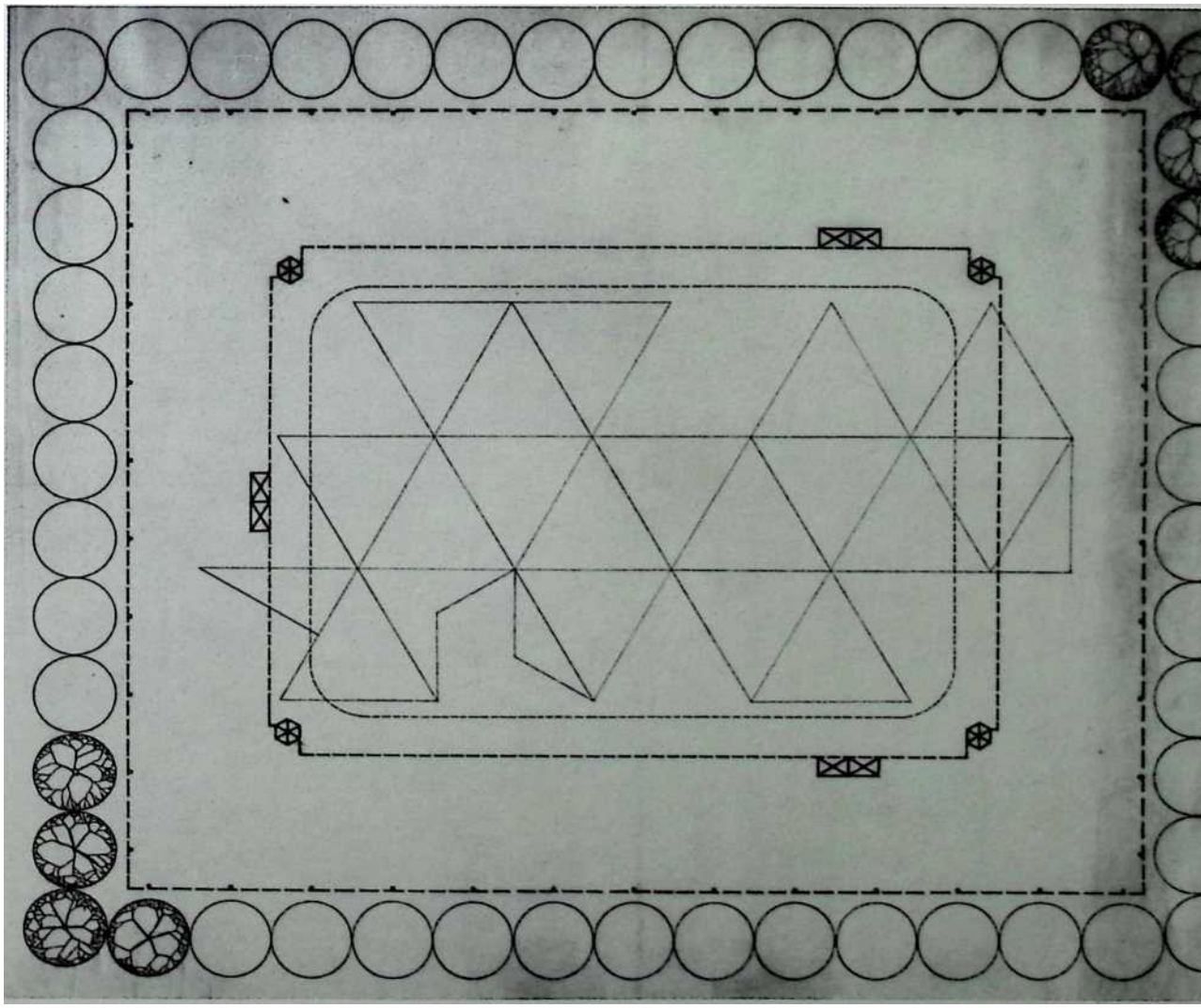
This important design commission came to Fuller from Jack Masey, a former student of his at Yale, and the director of the exhibition. There was no competition for the United States Pavilion. This initial project is a vast truss on four pylons, perhaps inspired by Fuller's study of the octet truss. The exhibition space was suspended from the uppermost truss and was to be reached by a single tower of elevators. In the end the plan was rejected because the Dymaxion World Map, Fuller's intended exhibit, was preempted by a broader group of themes, among which were Hollywood and the lunar landing (then three years in the future). AH of the designers involved were agreed that these themes would be accommodated better in a geodesic dome.

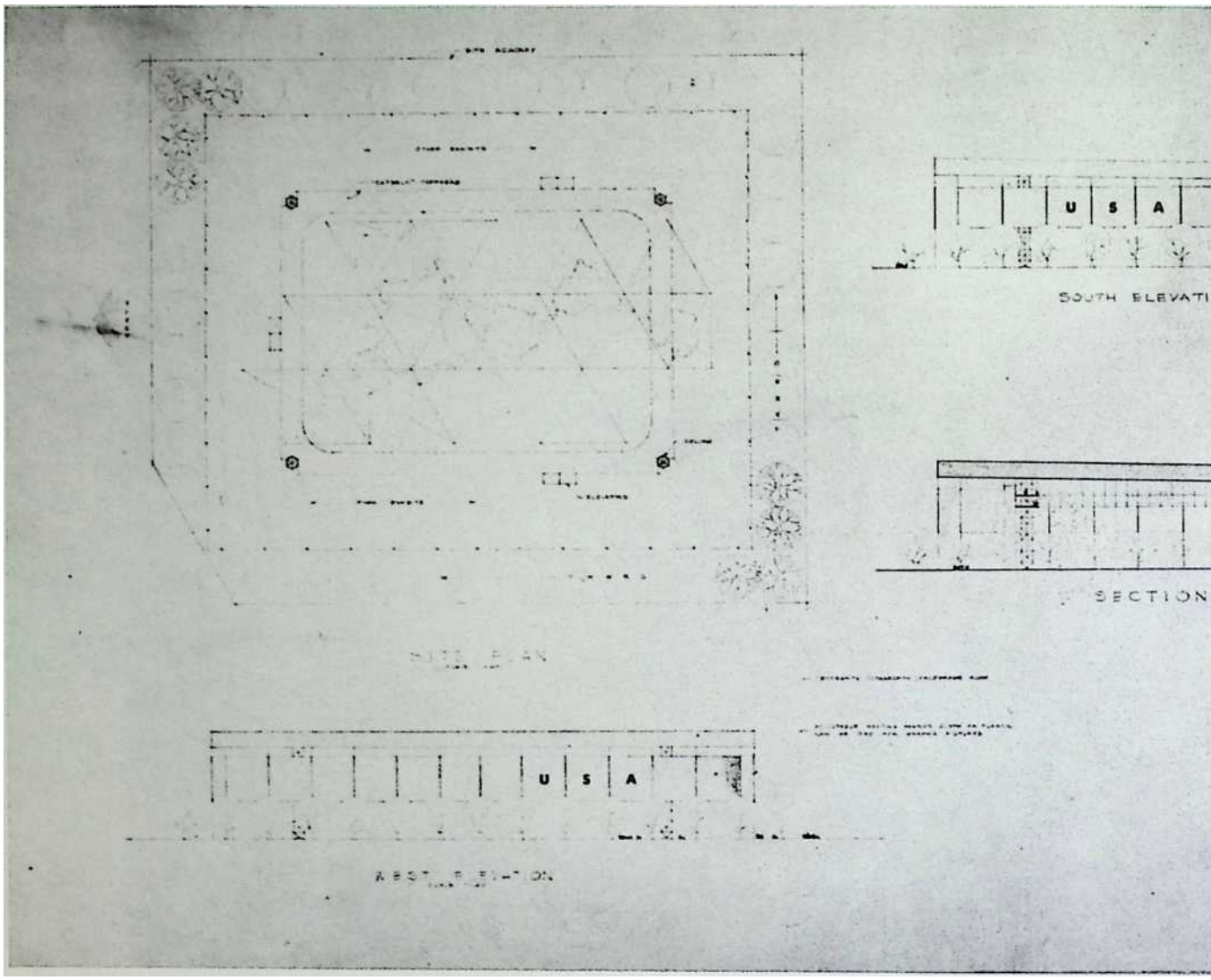











U S A
SOUTH ELEVATI
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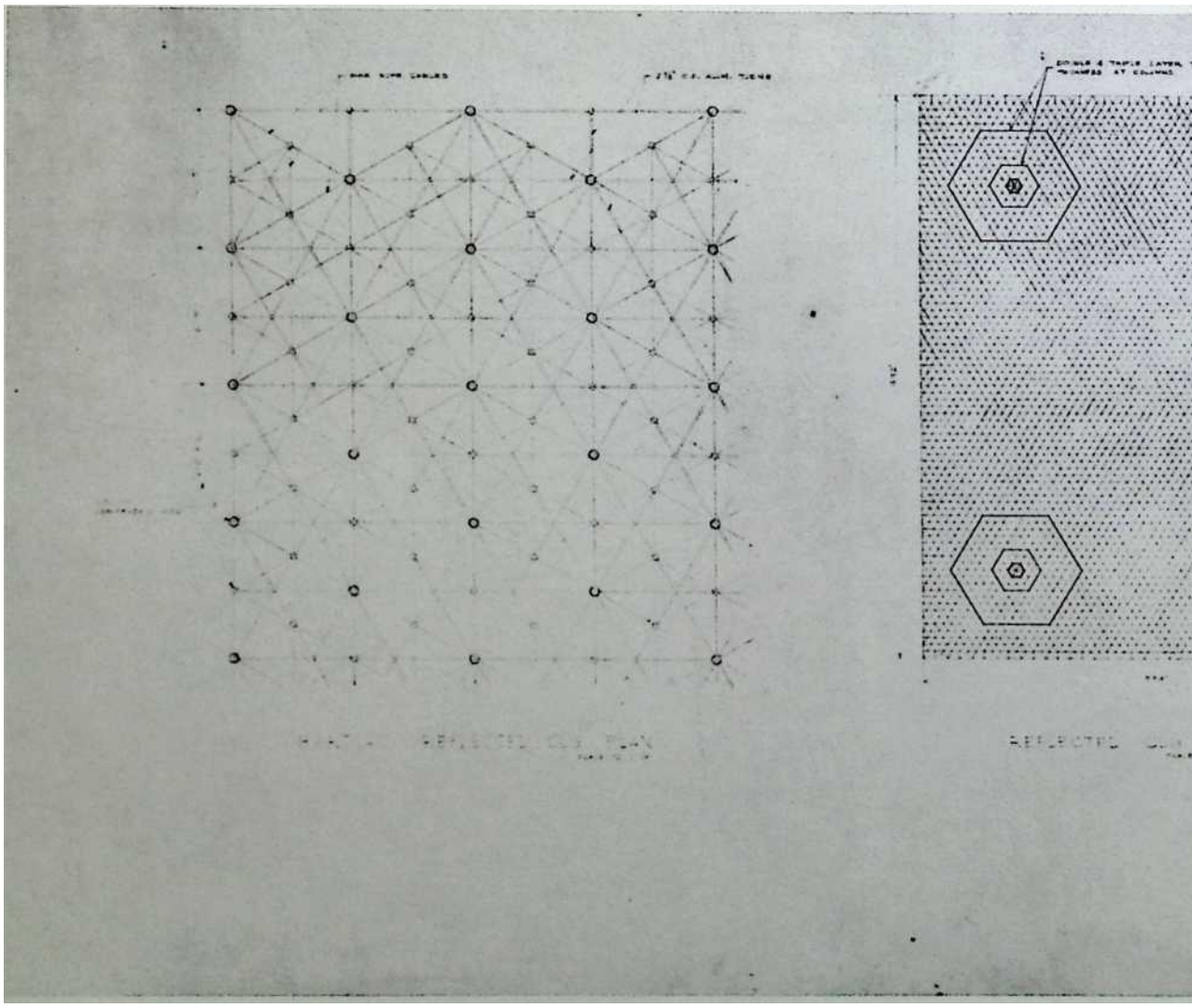
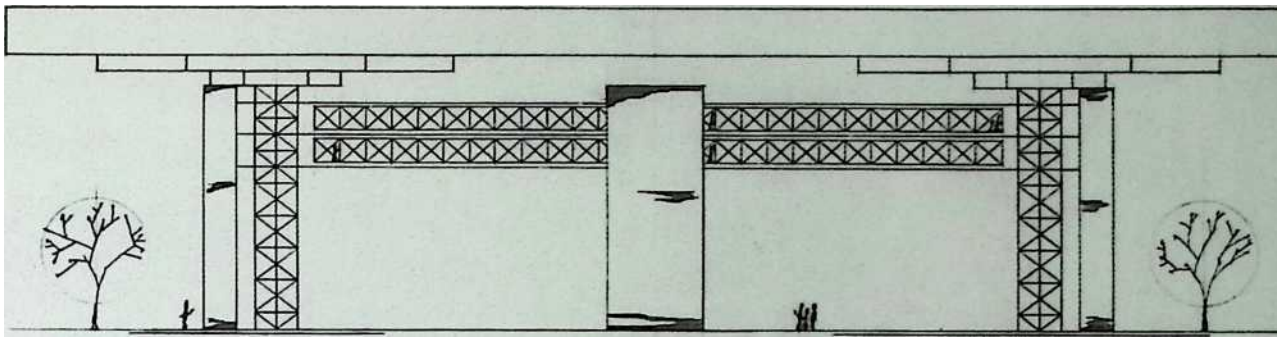
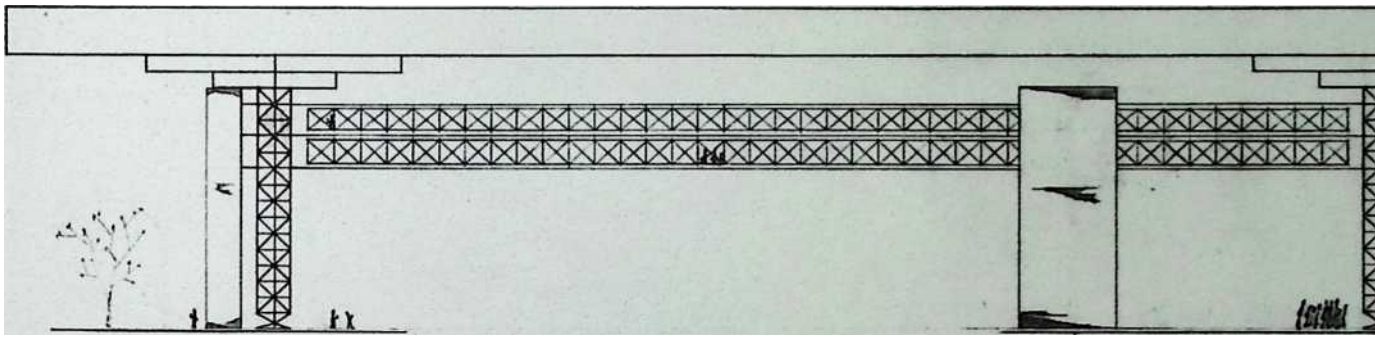
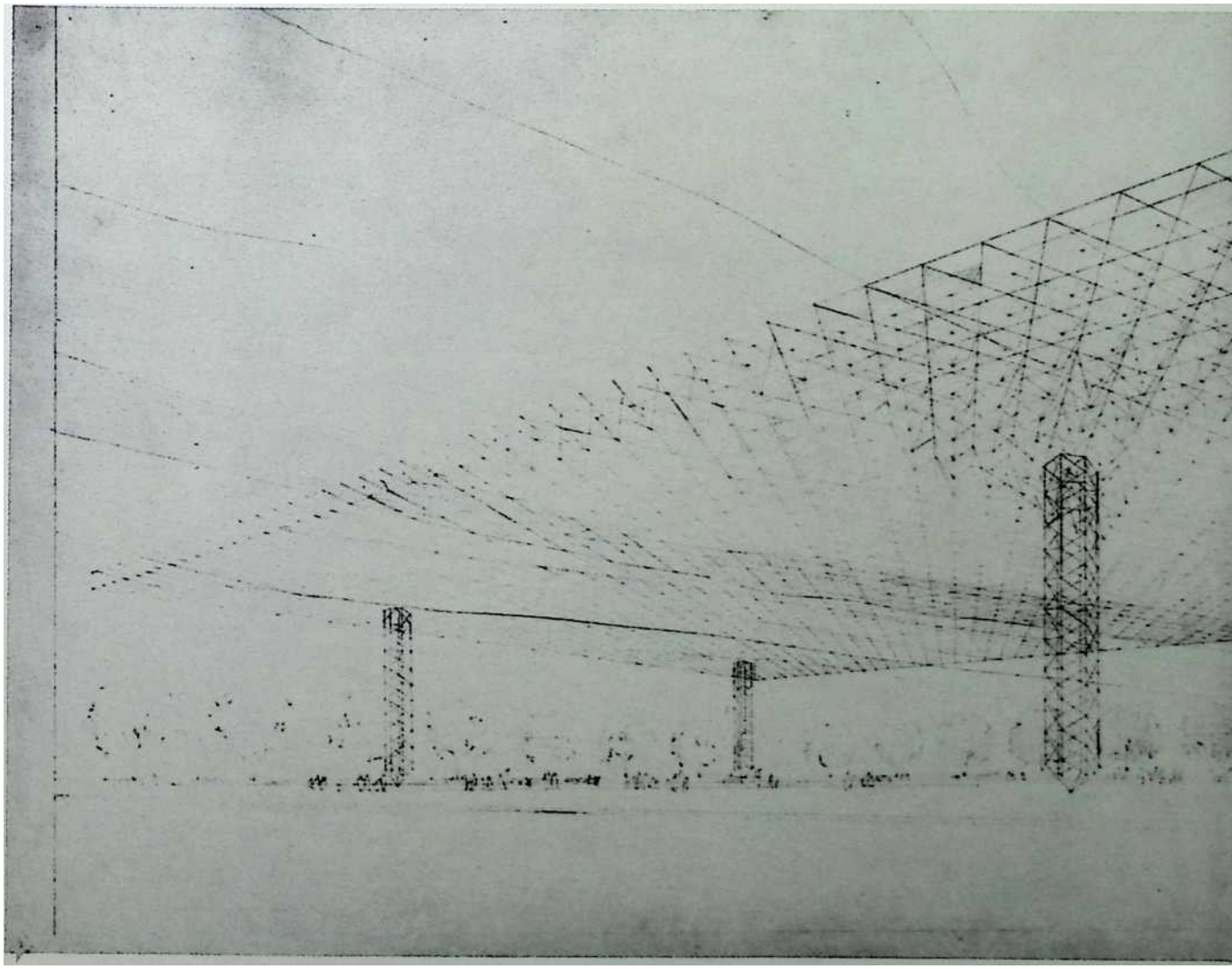
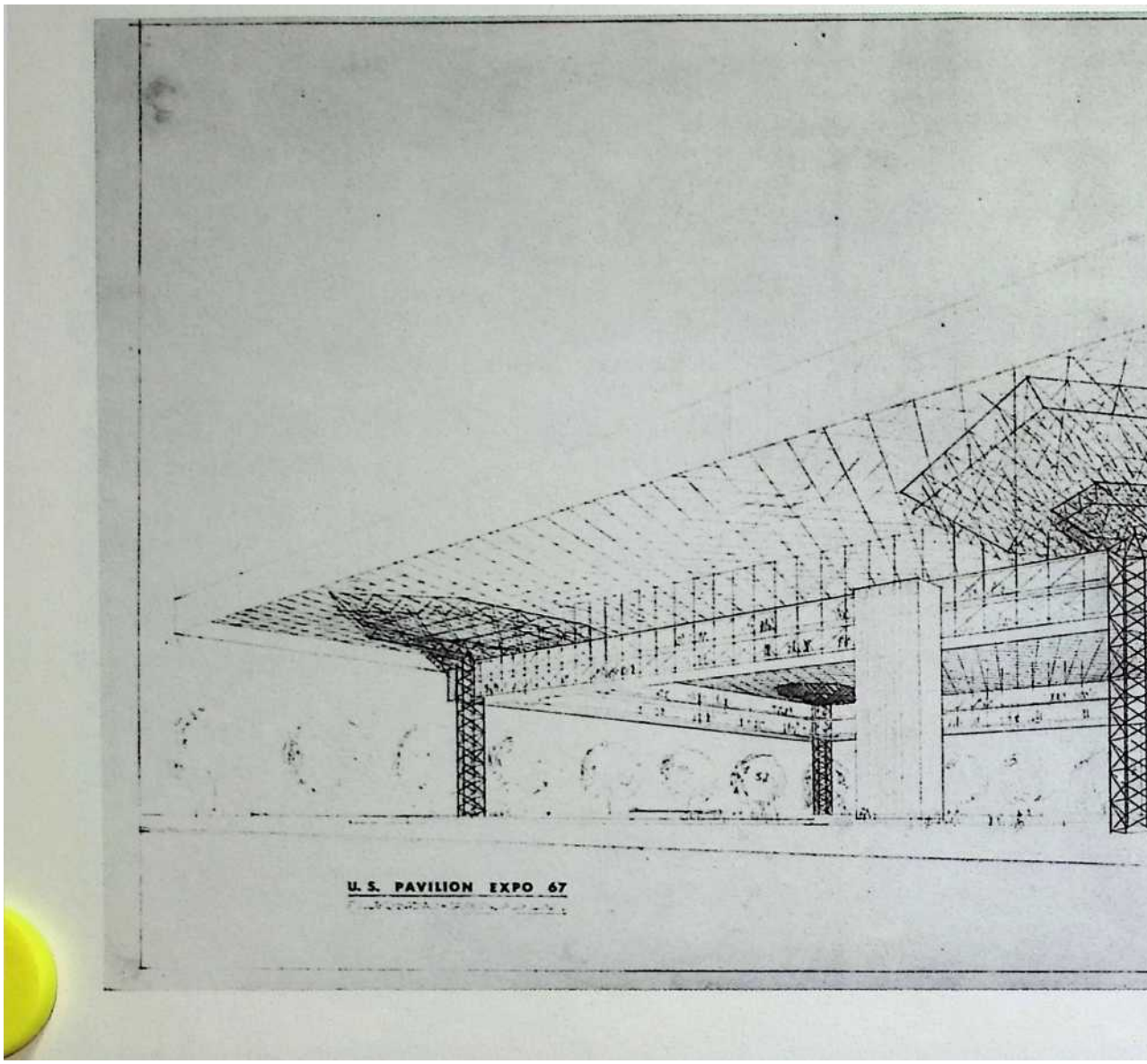
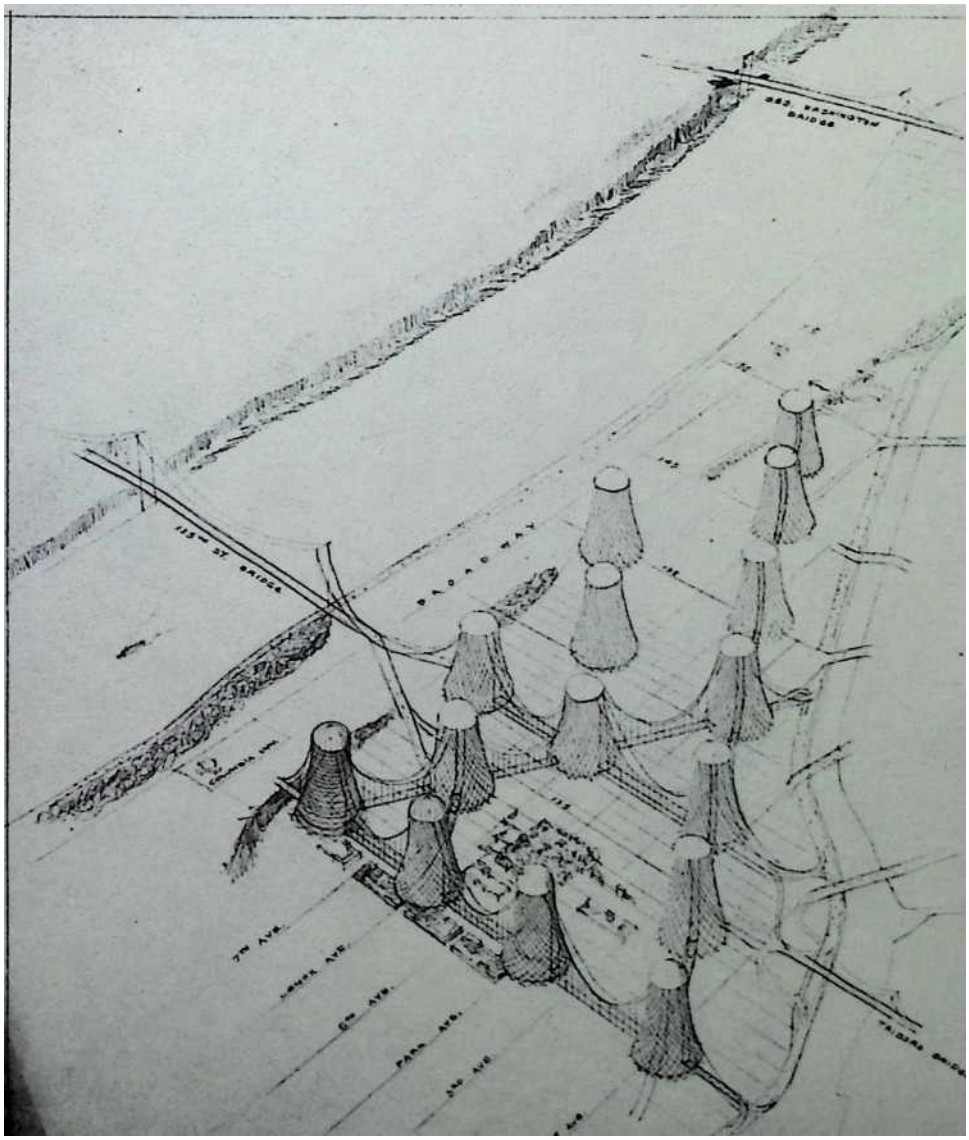









U. S. PAVILION EXPO 67

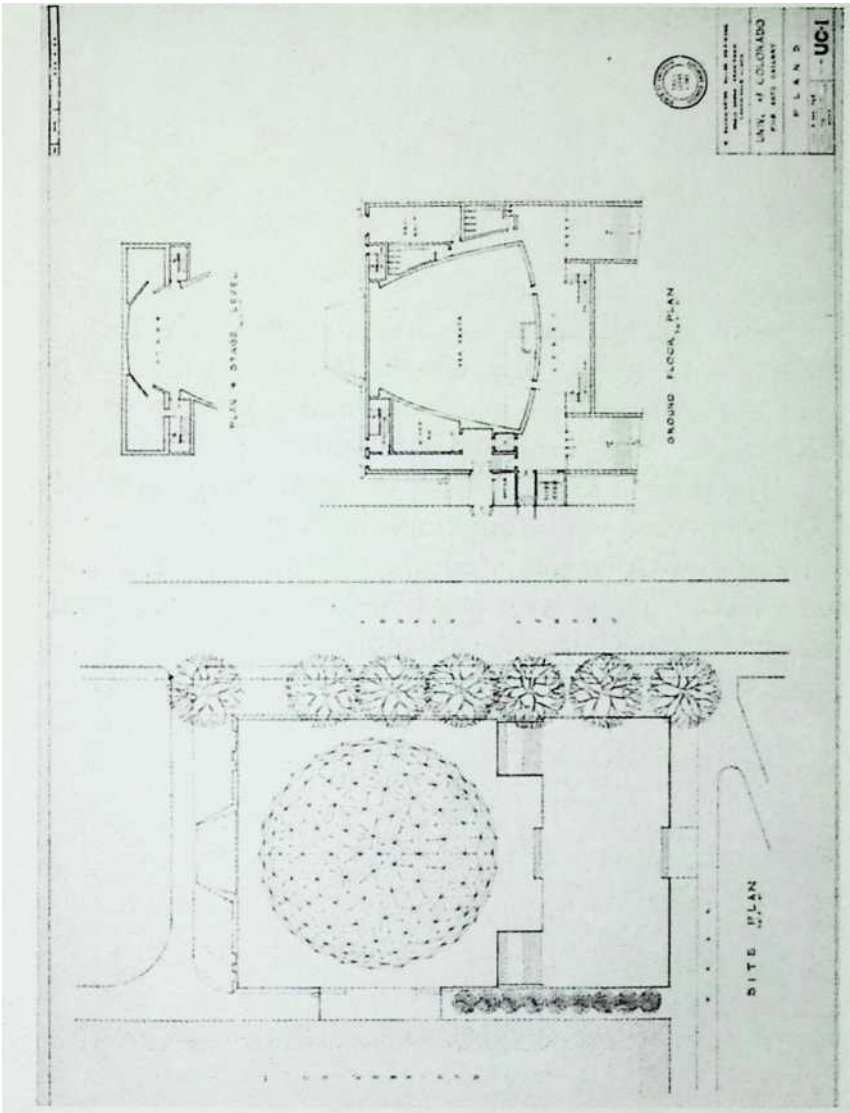

GEO. WASHINGTON BRIDGE
113TH ST. BRIDGE
PALISADES PARKWAY
I-95
7TH AVE.
LENOX AVE.
6TH AVE.
PARK AVE.
2ND AVE.
TRIBORO BRIDGE

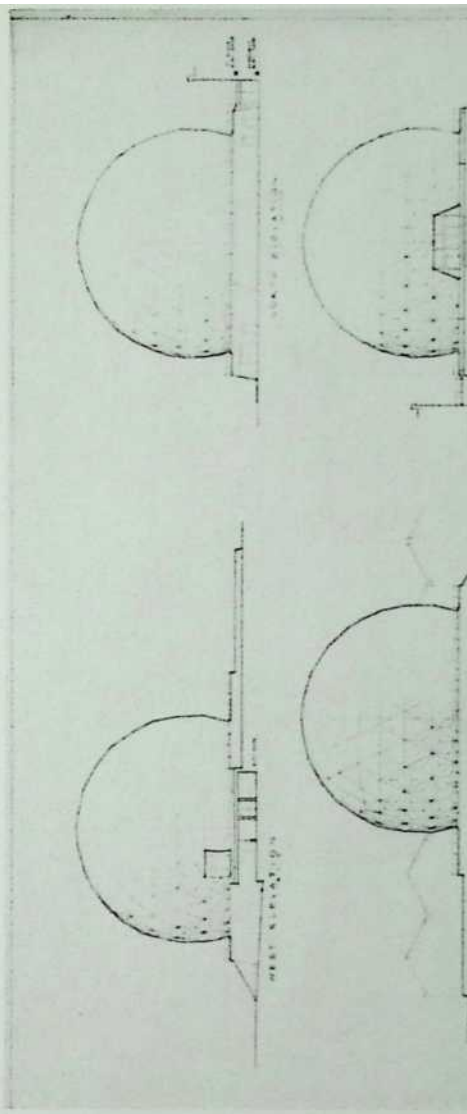
14 Harlem Redesign, New York City Fuller & Sadao, 1964

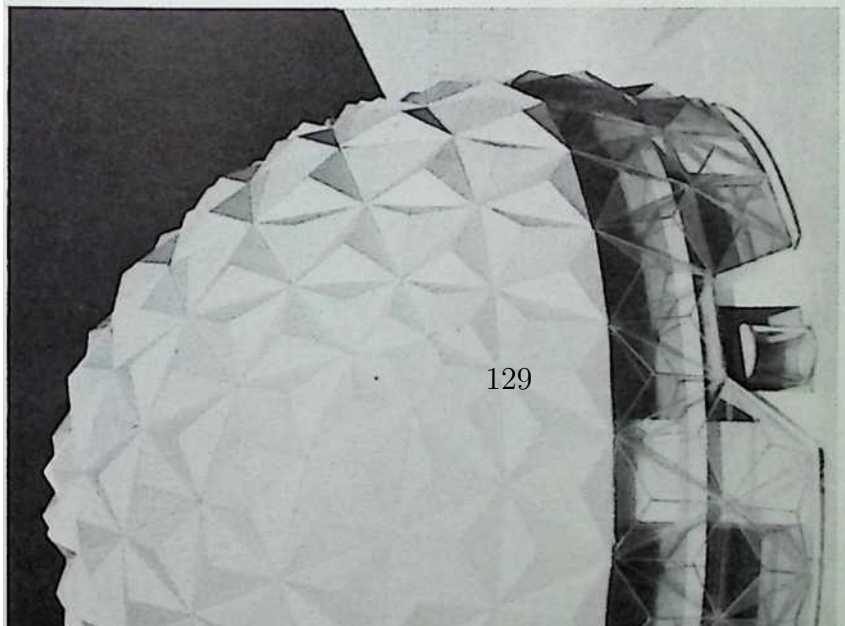
This dramatic redesign of Harlem during the 1960s could not have come too soon, although it actually did not call for the complete demolition of the neighborhood. These fifteen towers, if constructed, would have looked like the cooling towers of typical nuclear power plants. But, unlike the parabolic towers on which they were based, Fuller's dwellings would have been one hundred stories each and housed an average of seventy- five families per floor. Each would have connected to the other via a suspension bridge, like a reprise of Fuller's Utopian schemes of the late twenties. The new towers would have been spread out over an area bordered by 110th Street to the south and by 150th Street to the north.

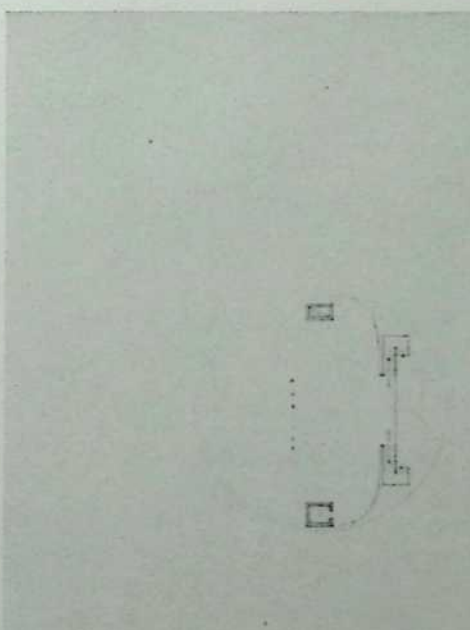
15 Fine Arts Gallery of the University of Colorado Fuller & Sadao, 1965

The Fine Arts Gallery of the University of Colorado combines a 650-seat auditorium, a two-story gallery, and a geodesic dome. One would have entered via a ceremonial masonry plinth and four graceful staircases to three rhombic main entrances. Through revolving doors, one encounters the stairway to the second level of the gallery. The stage entrances along the back side of the complex also accommodate the loading and unloading of works of art. Architecturally, the gallery would have been one of this design team's finest works, with the interesting juxtaposition of the opaque roof over the gallery and the transparent glazing of the first two stories.


UC-1
PLANS
UNIV. of COLORADO
GROUND FLOOR PLAN
PLAN @ STAGE LEVEL
SITE PLAN

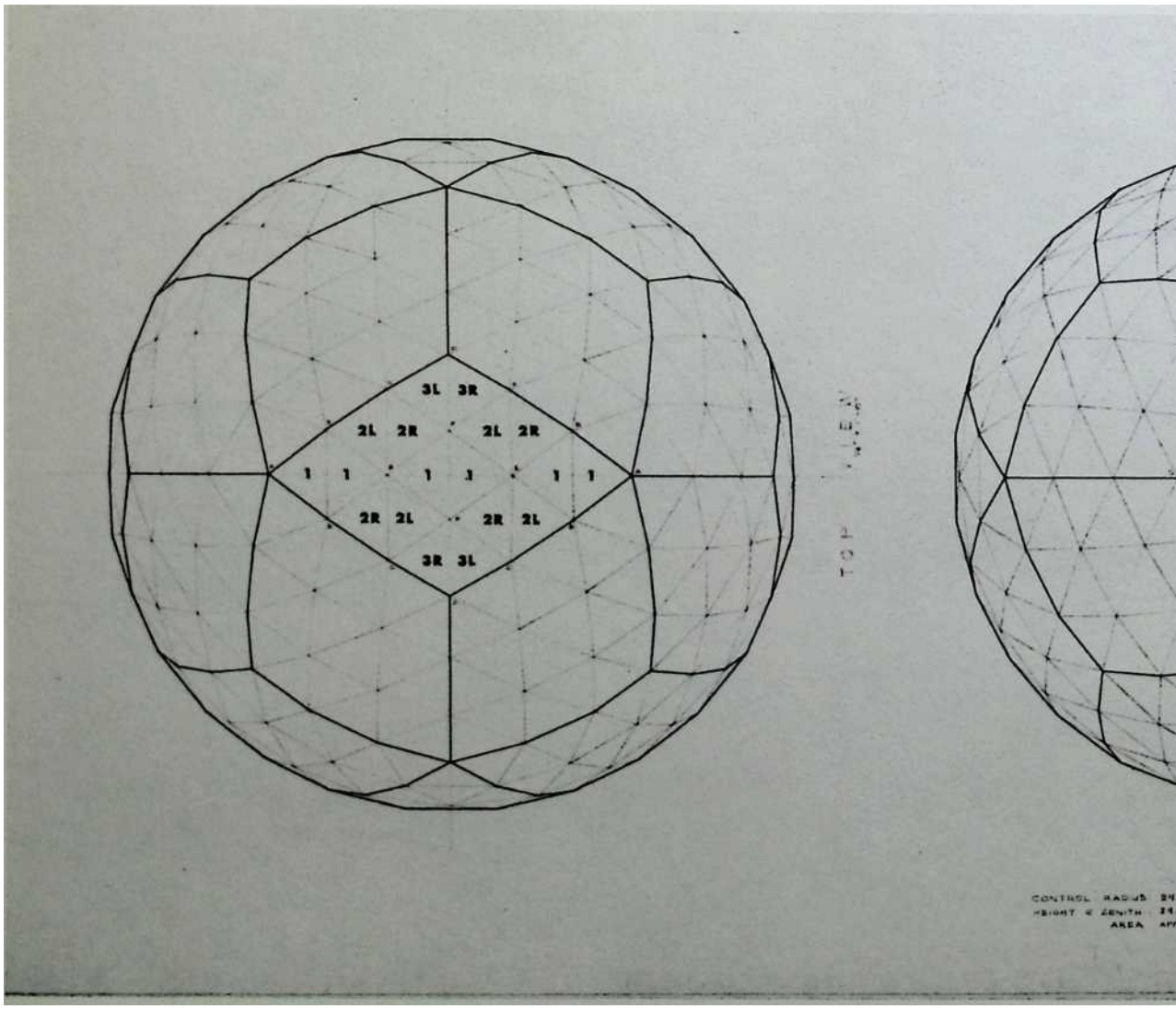


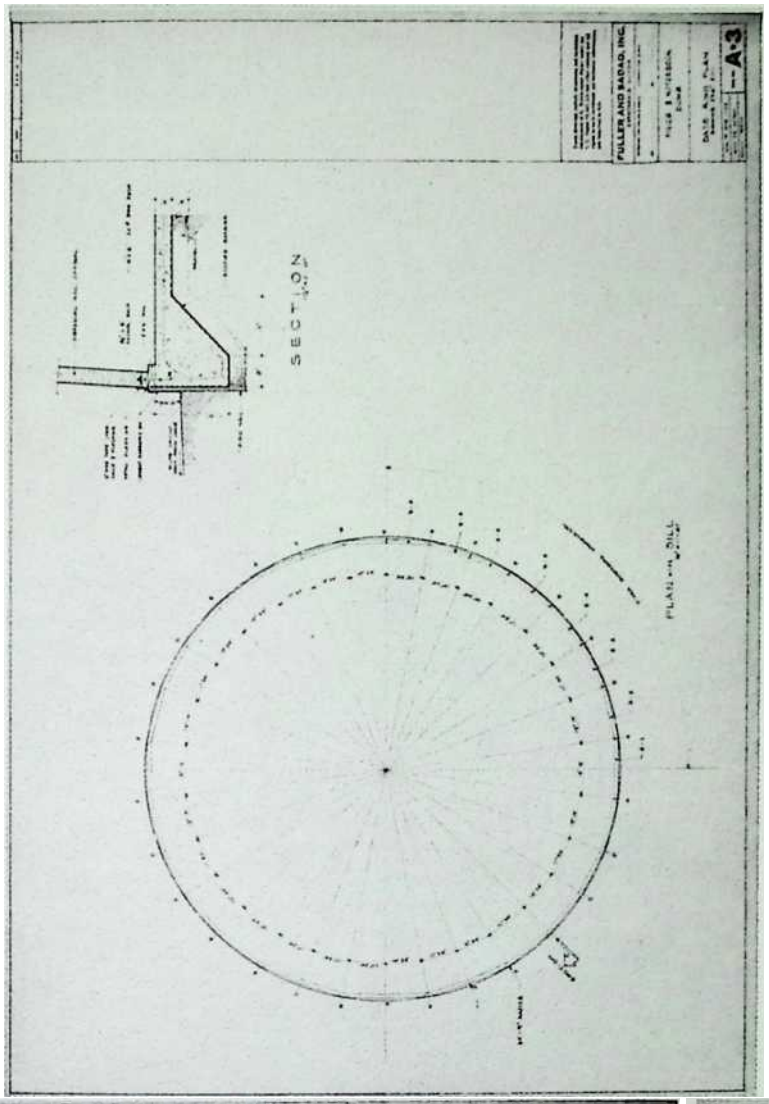




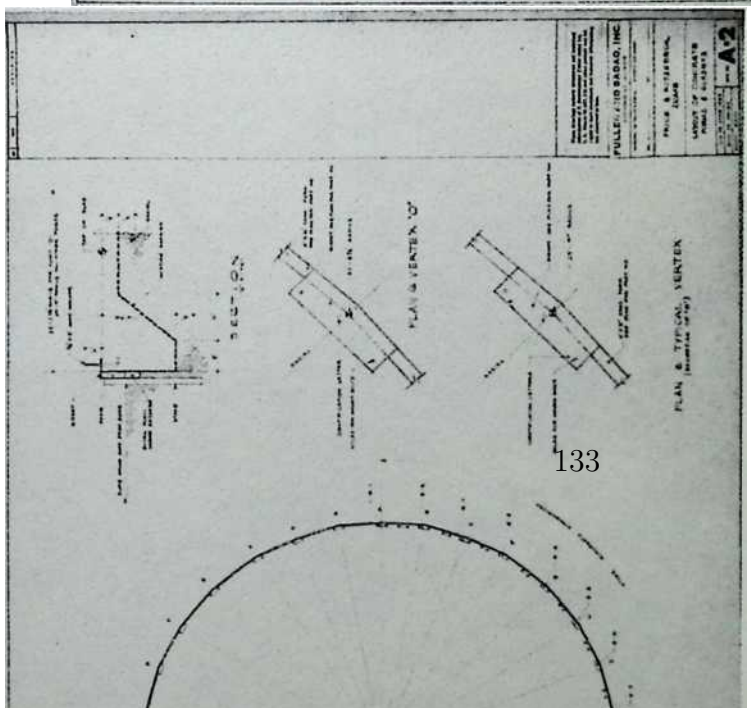
16 Price and Rutzebeck Dome Fuller & Sadao, 1965

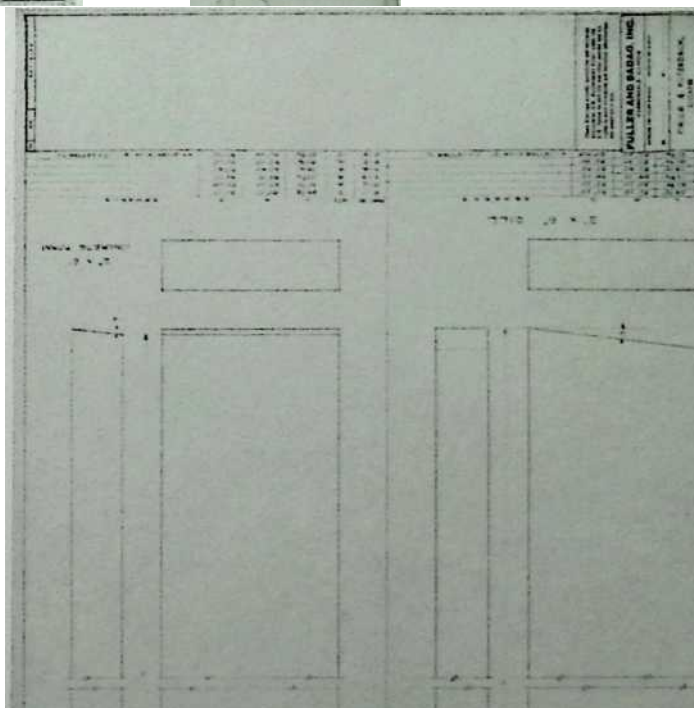
The radius of this dome was specified as 29.75 feet, and it was to be 29.75 feet high. It would have had two shells with a fiberglass insulation and two types of triangular frames, the smaller of which fit the ground line. The double layer of exterior grade Douglas fir plywood is covered with a medium-density plastic, making it waterproof. Also intended for mass production, this dome was designed with two types of doors: one small and square; one large and rhombic.

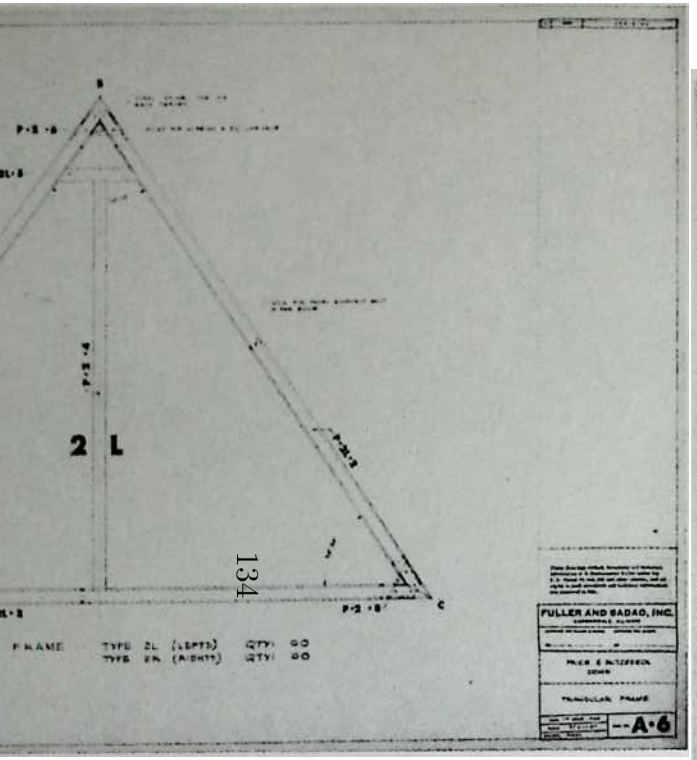

3L 3R
2L 2R
2L 2R
1 1 1 1 1 1
2R 2L
2R 2L
3R 3L
TOP VIEW

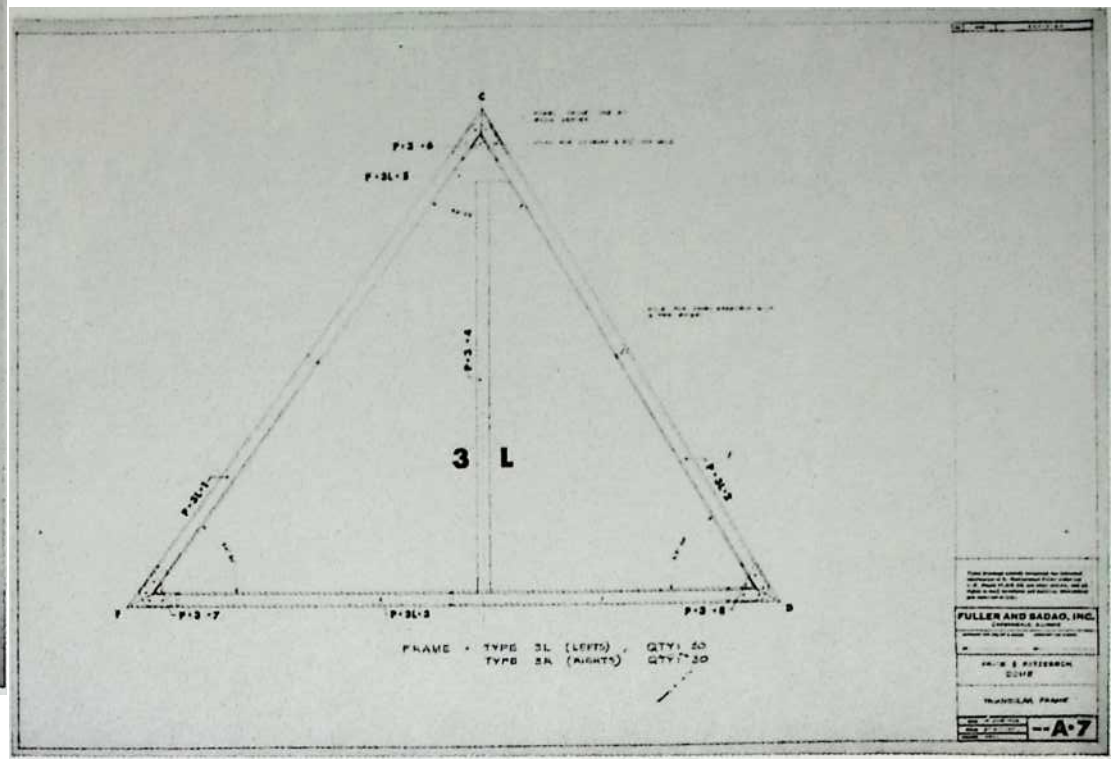

SECTION
FULLER AND SADAO, INC.
A-3

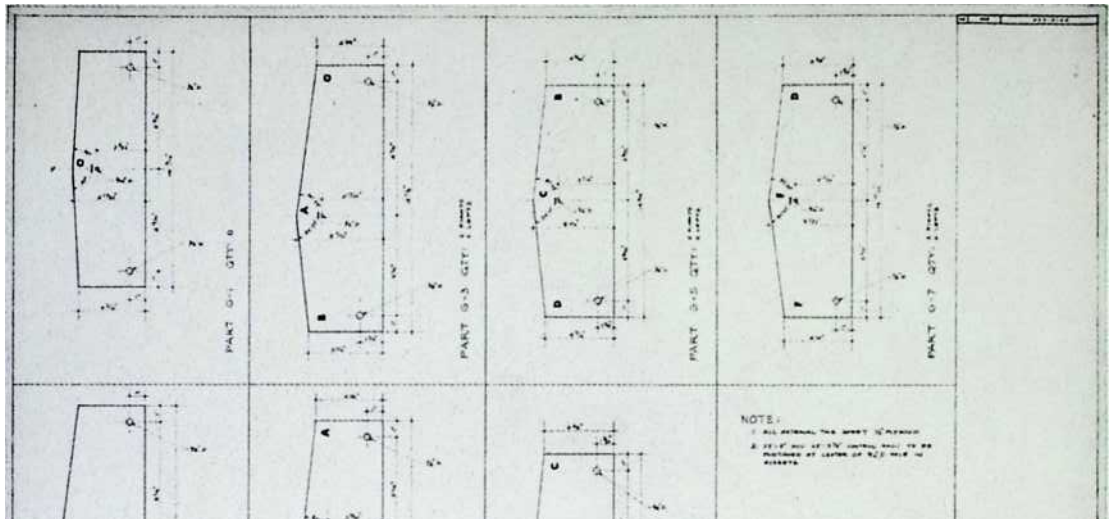
FULLER AND SADAO, INC.
A-5

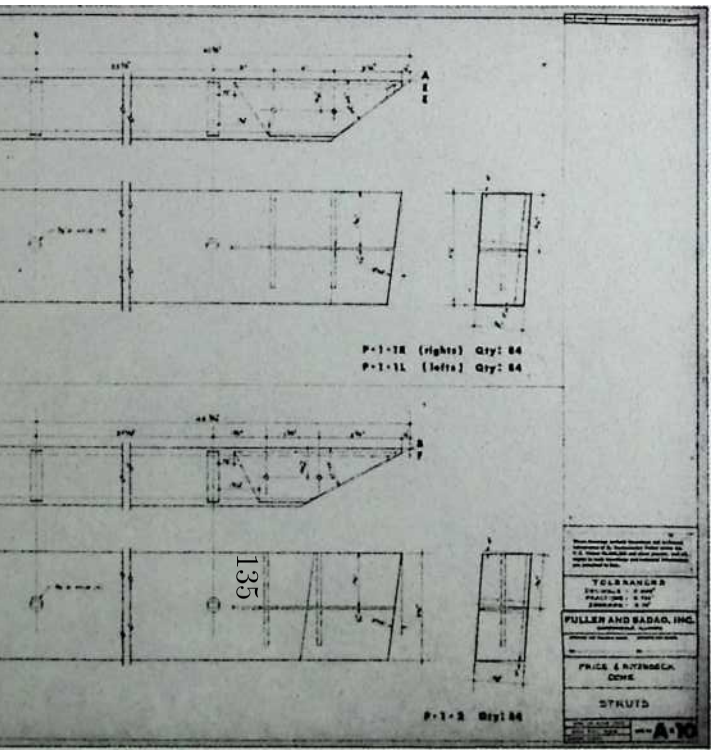

SECTION
FULLER AND SADAO, INC.
A-2

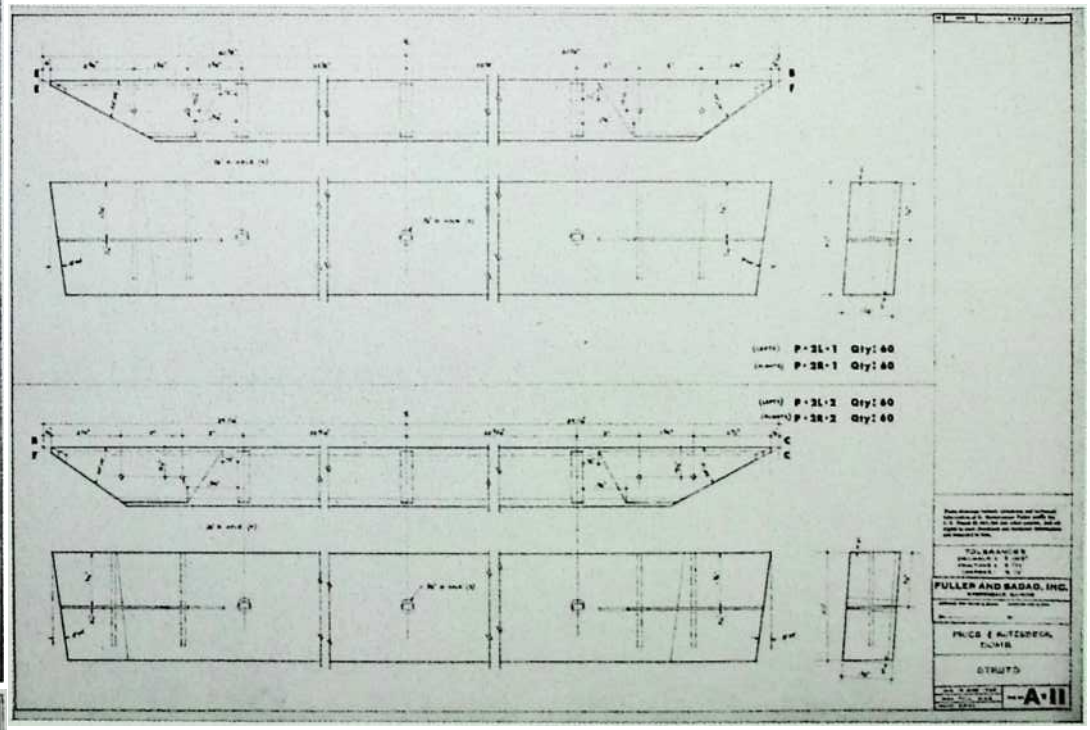

FULLER AND SADAO, INC.

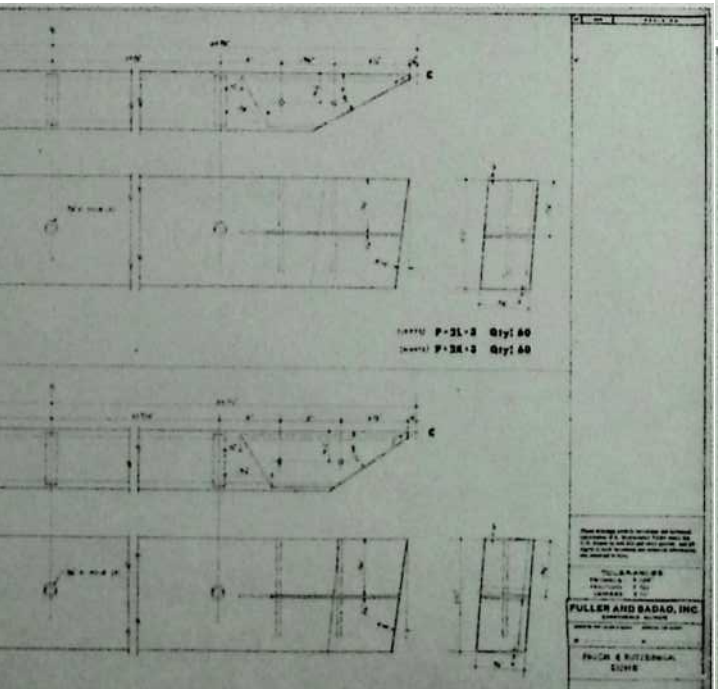

2 L
FRAME TYPE 2L (LEFTS) QTY: 00
TYPE 2R (RIGHTS) QTY: 00
FULLER AND BADAO, INC.
A-6


3 L
FRAME - TYPE 3L (LEFTS) QTY: 50
TYPE 3R (RIGHTS) QTY: 50
FULLER AND BADAO, INC.
A-7


PART G-1 QTY: 8
PART G-3
PART G-5
PART G-7
NOTE:


P-1-1R (rights) Qty: 84
P-1-1L (lefts) Qty: 84
P-1-2 Qty: 84
TOLERANCES
FULLER AND SADAO, INC.
PRICE & RITZENDECK
DOME
STRUTS
A-10


P-2L-1 Qty: 60
P-2R-1 Qty: 60
P-2L-2 Qty: 60
P-2R-2 Qty: 60
TOLERANCES
FULLER AND SADAO, INC.
PRICE & RITZENDECK
DOME
STRUTS
A-11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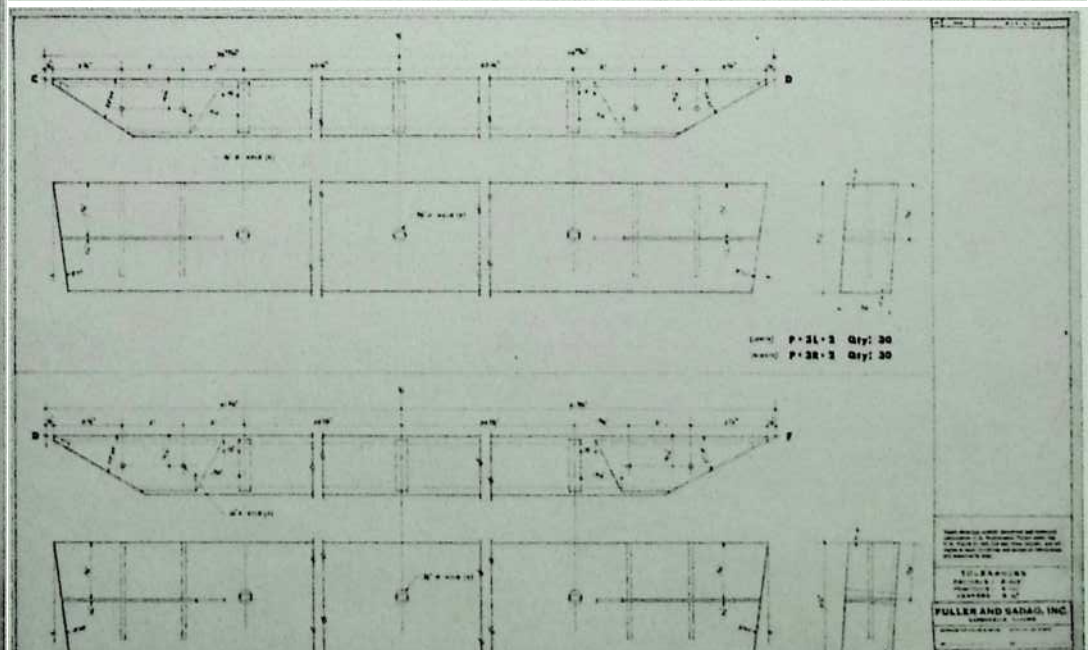
FULLER AND SADAO, INC.
PRICE & RITZENDECK
DOME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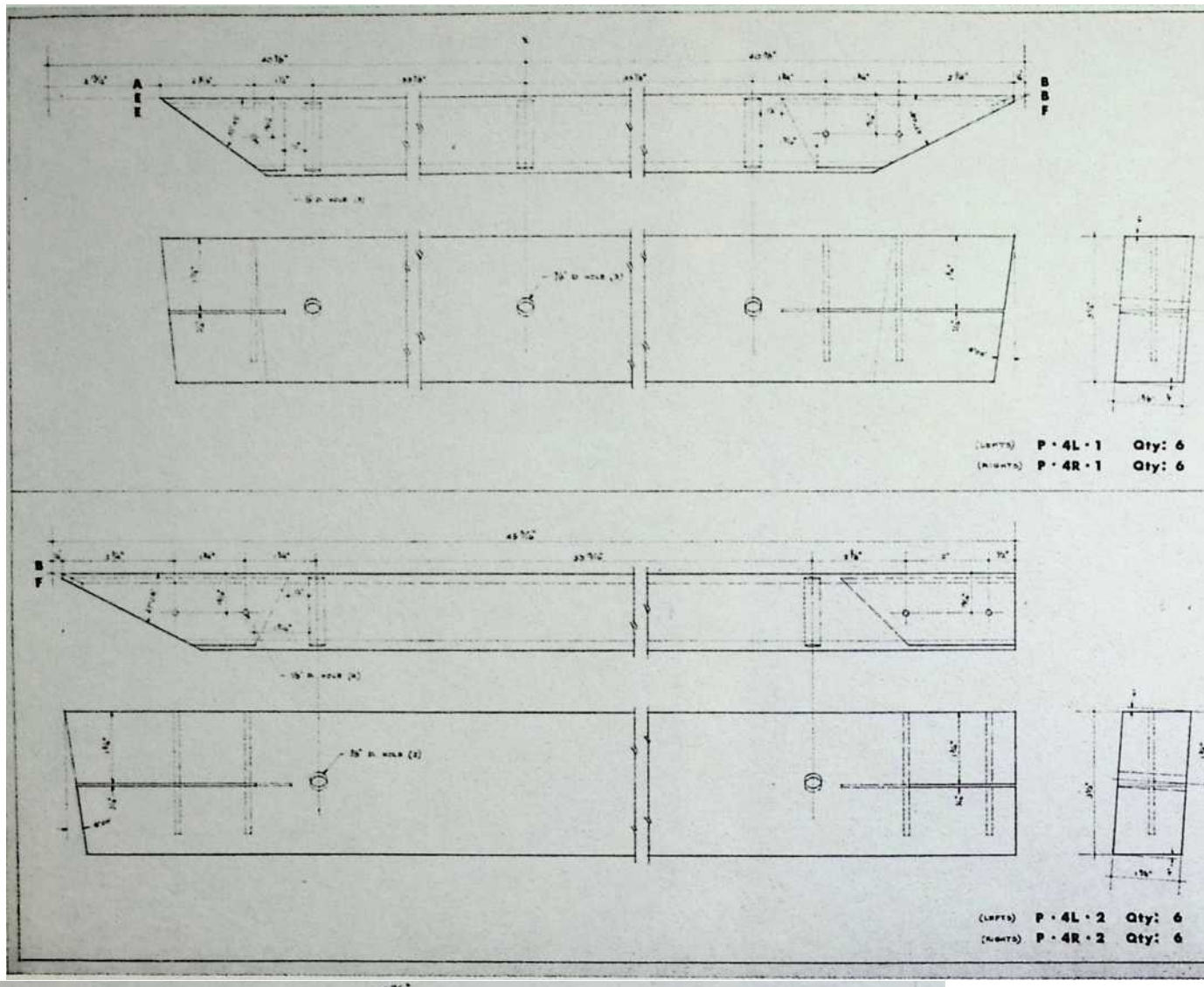
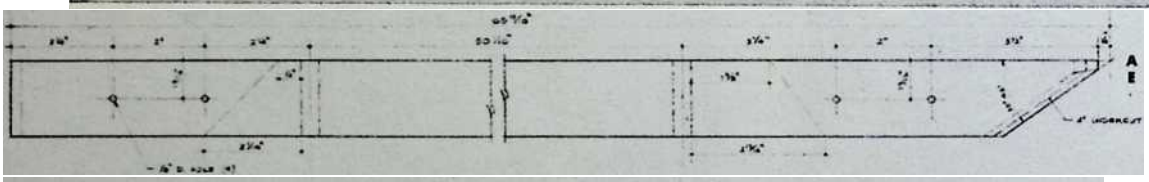
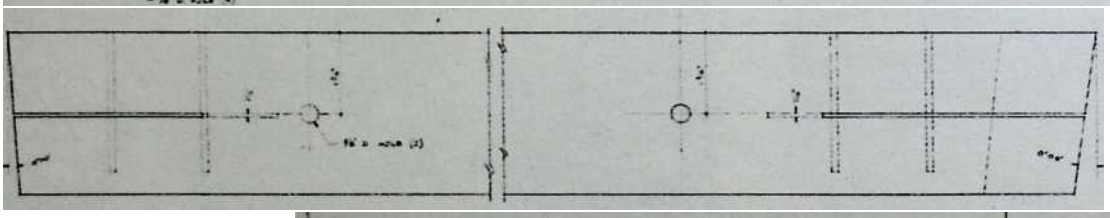
P-2R-3 Qty: 30
TOLERANCES
FULLER AND SADAO, INC.

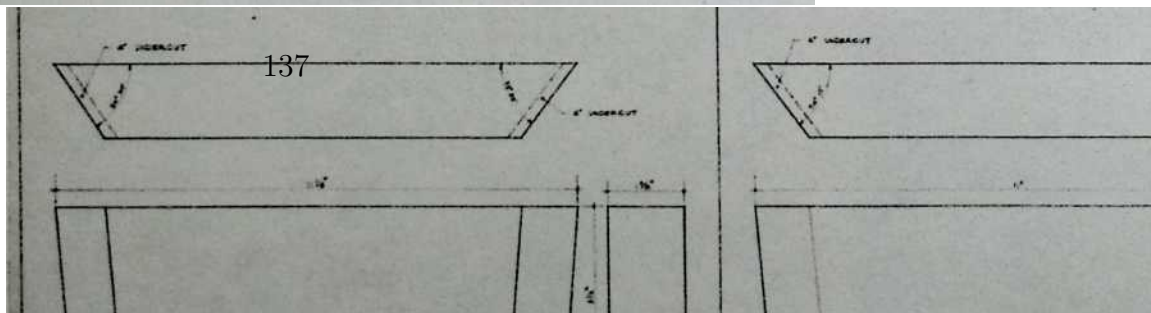
Qty: 6

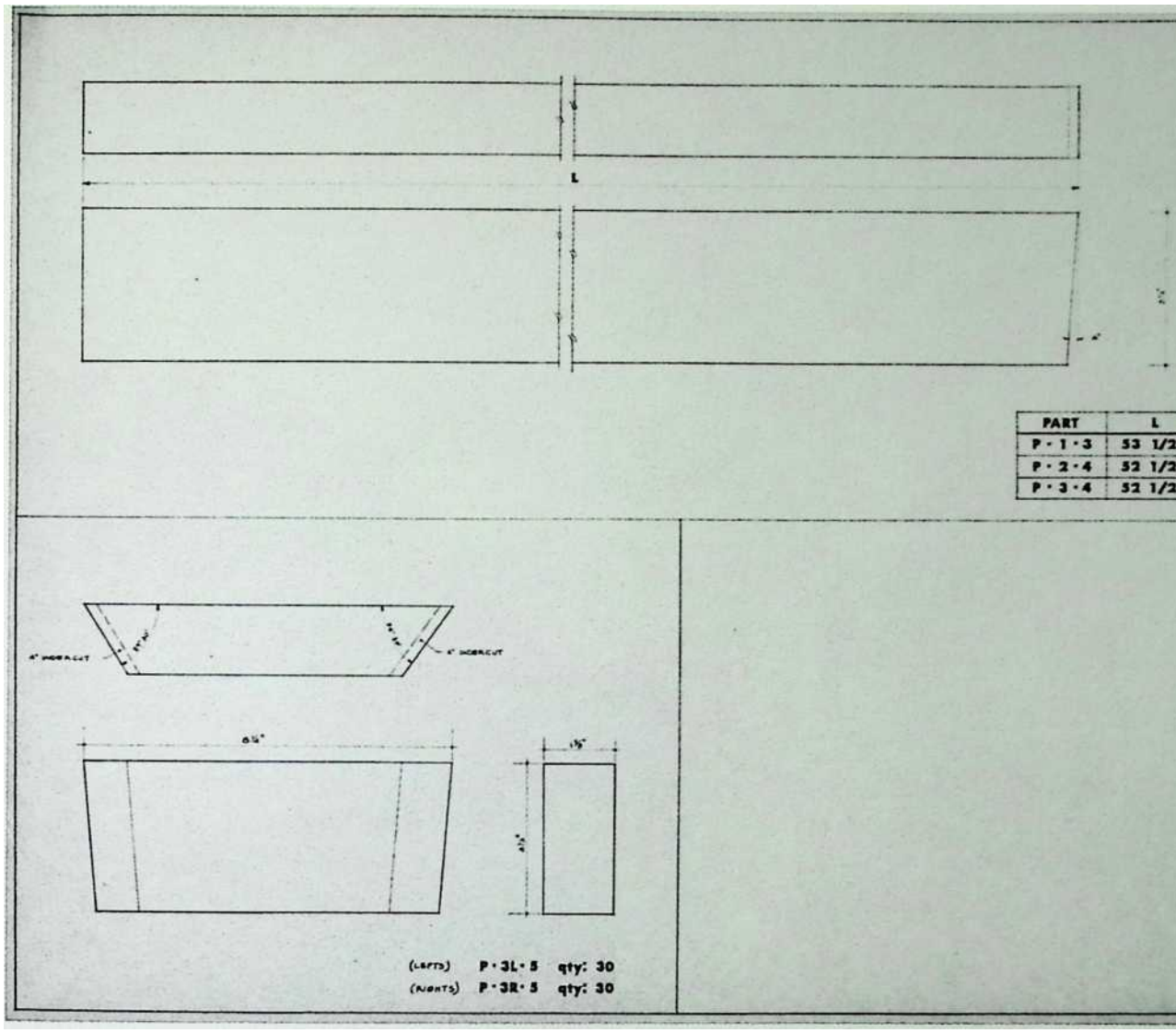
Qty: 6

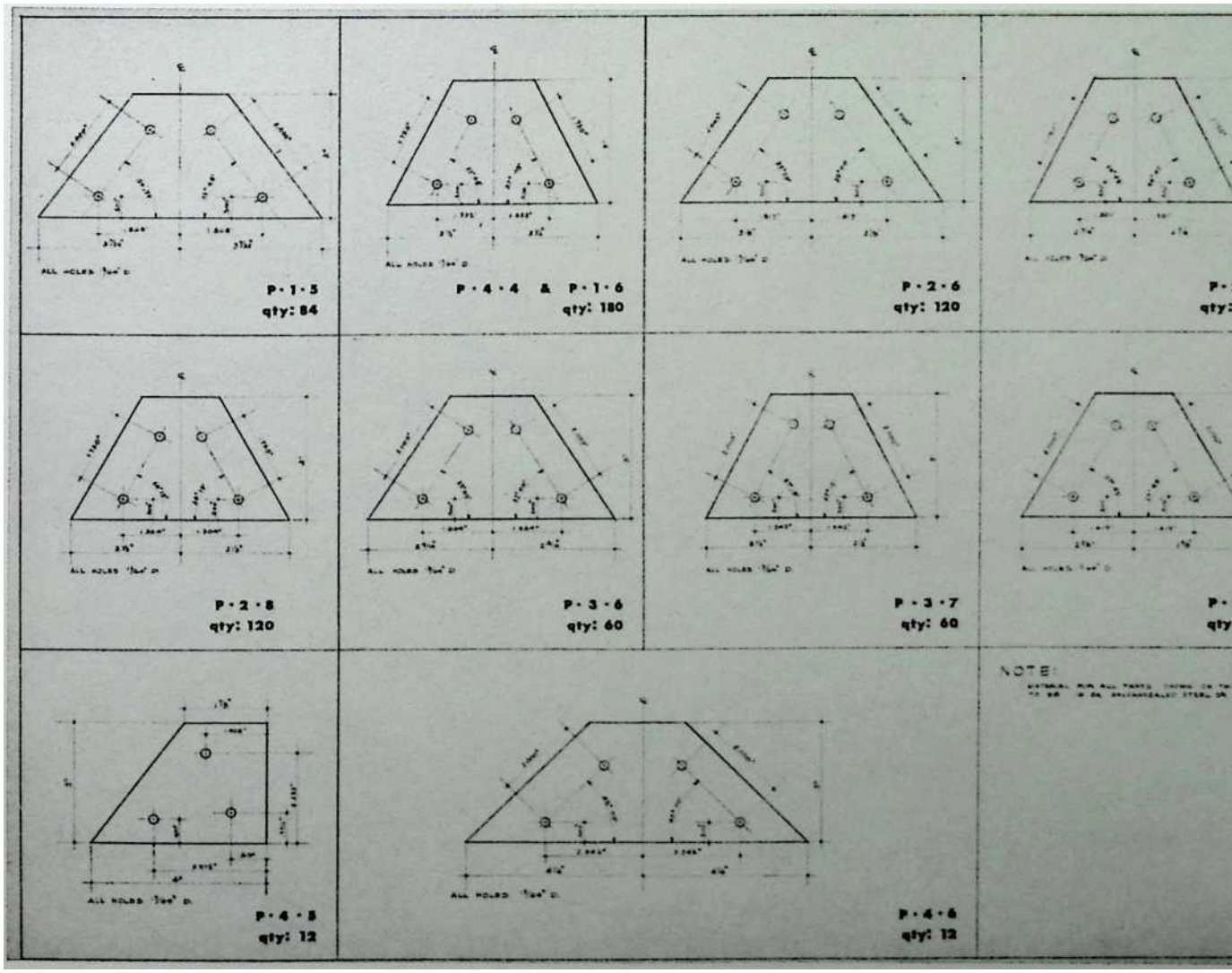

A
E
E
B
B
F
(LEFTS) P · 4L · 1 Qty: 6
(RIGHTS) P · 4R · 1 Qty: 6
B
F
(LEFTS) P · 4L · 2 Qty: 6
(RIGHTS) P · 4R · 2 Qty: 6


A
E






L
PART
L
P · 1 · 3
53 1/2
P · 2 · 4
52 1/2
P · 3 · 4
52 1/2
(LEFTS) P · 3L · 5 qty: 30
(RIGHTS) P · 3R · 5 qty: 30


P·1·5
qty: 84
P·4·4 & P·1·6
qty: 180
P·2·6
qty: 120
P·2·8
qty: 120
P·3·6
qty: 60
P·3·7
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P·4·5
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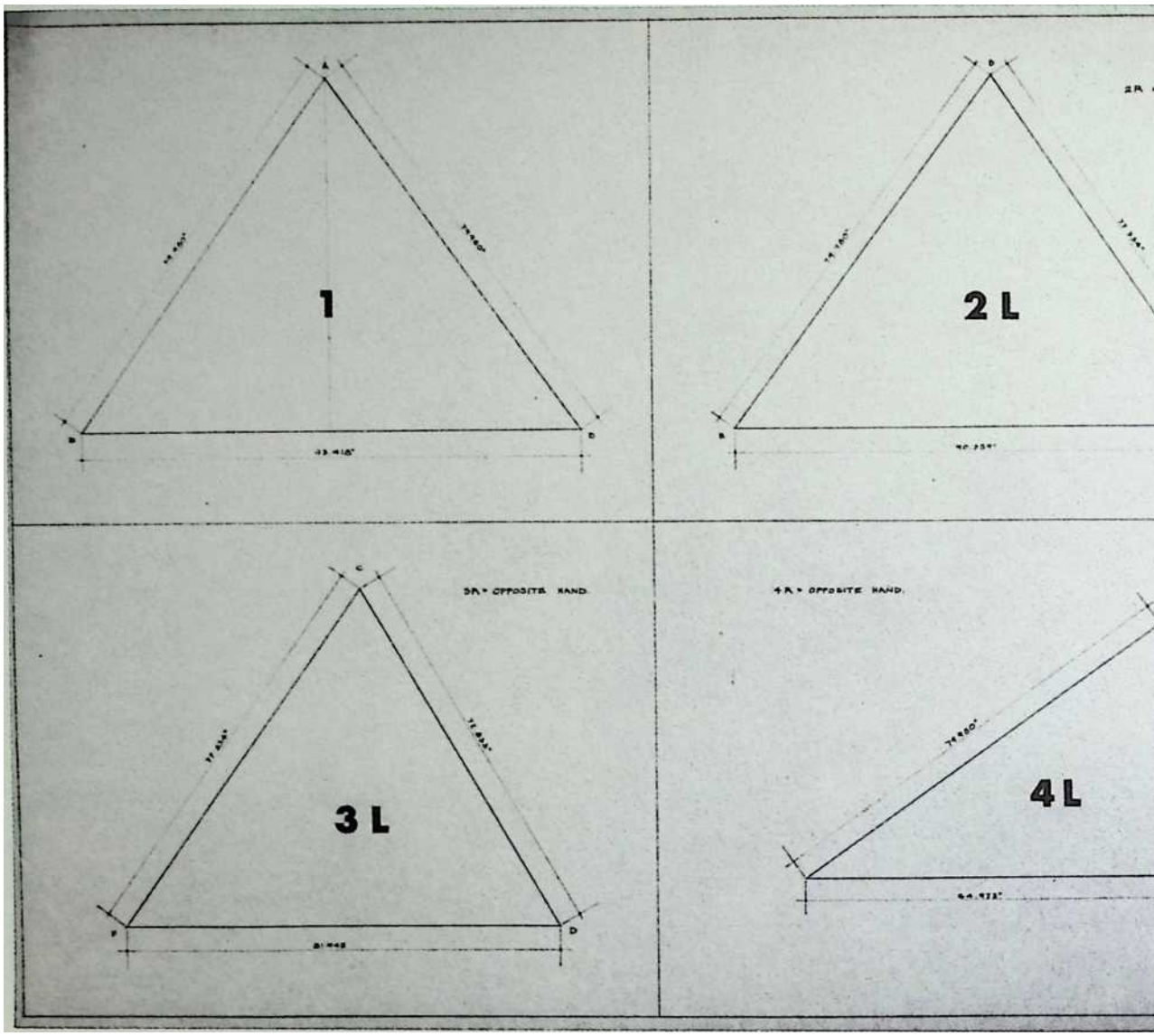
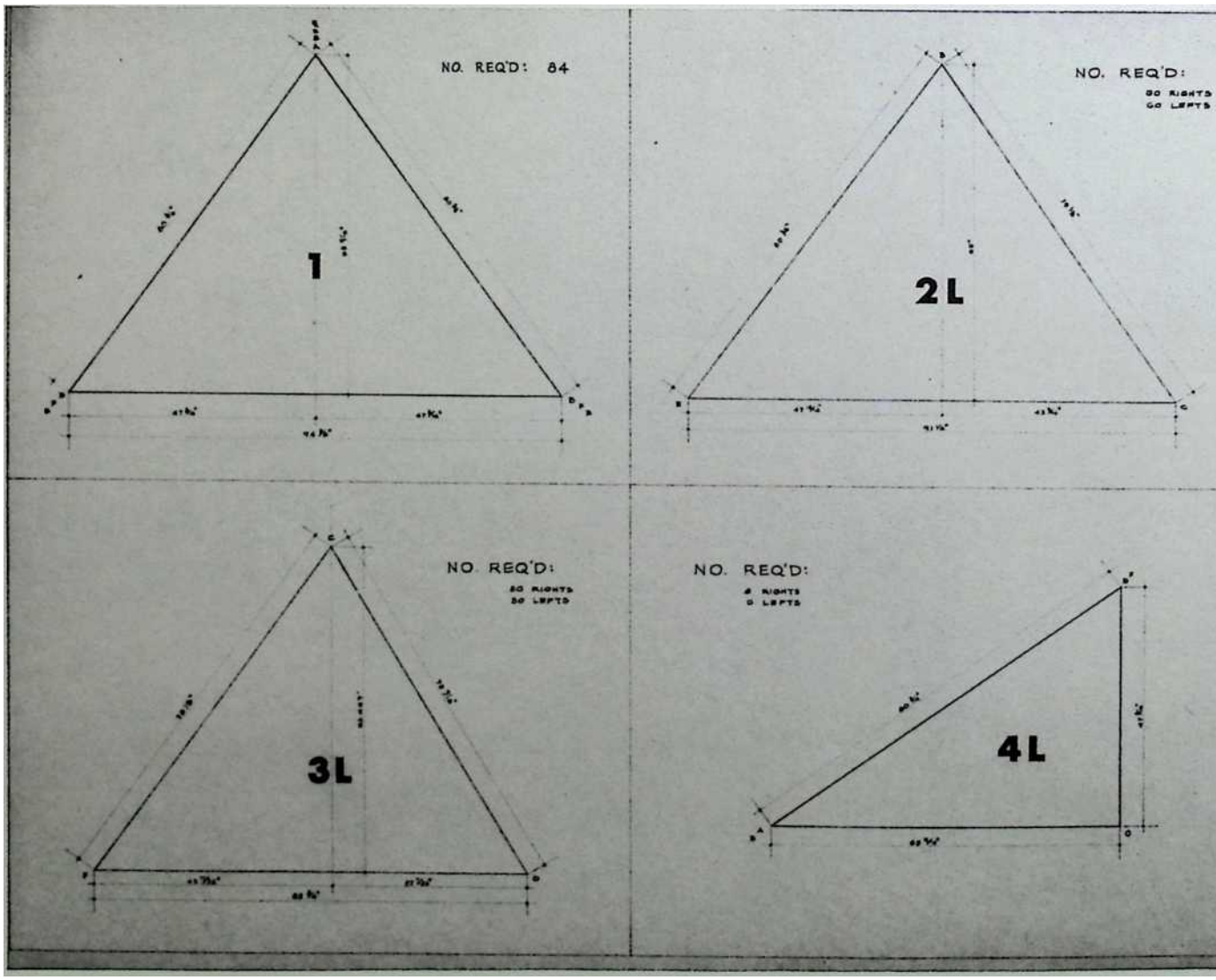
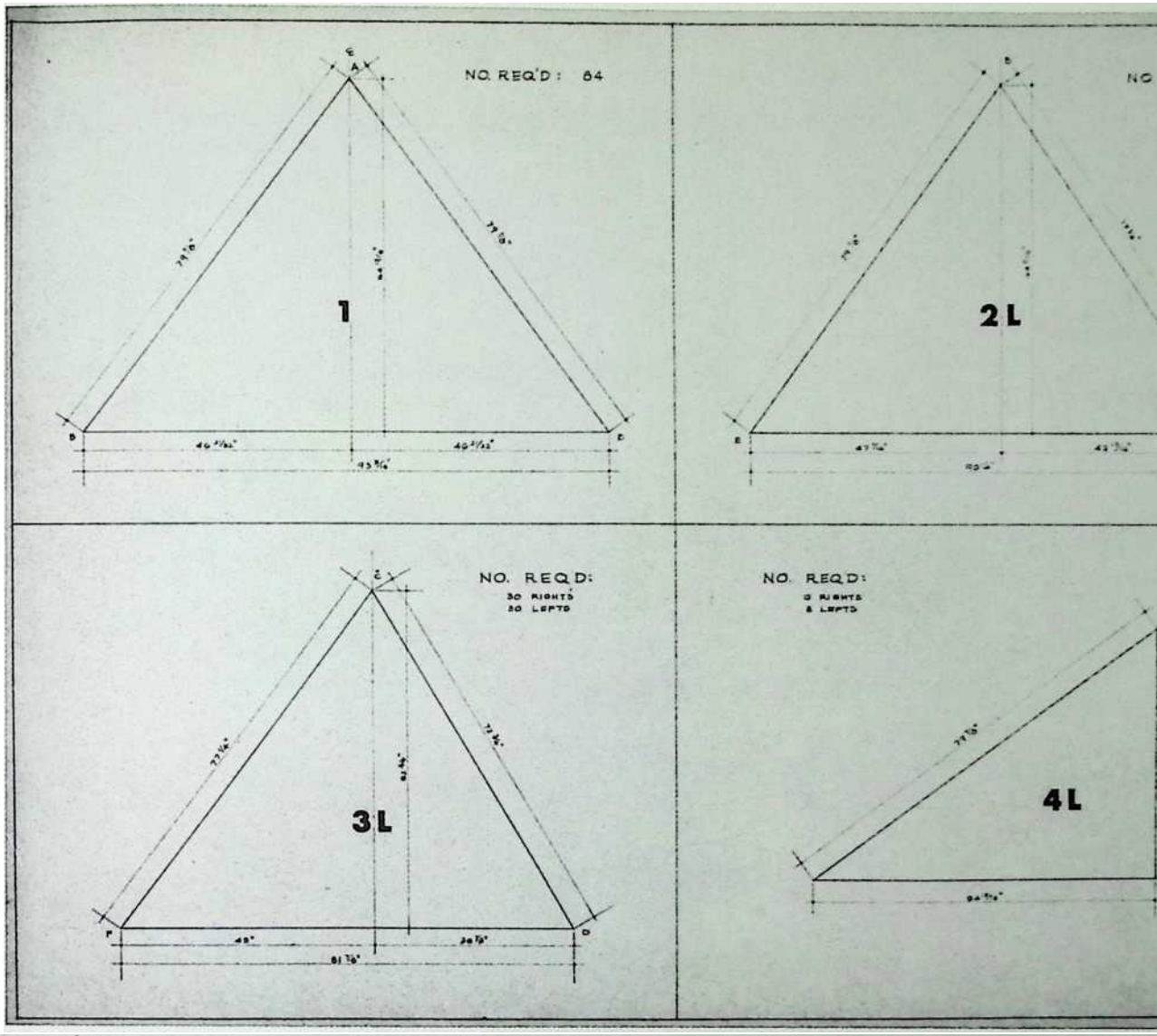
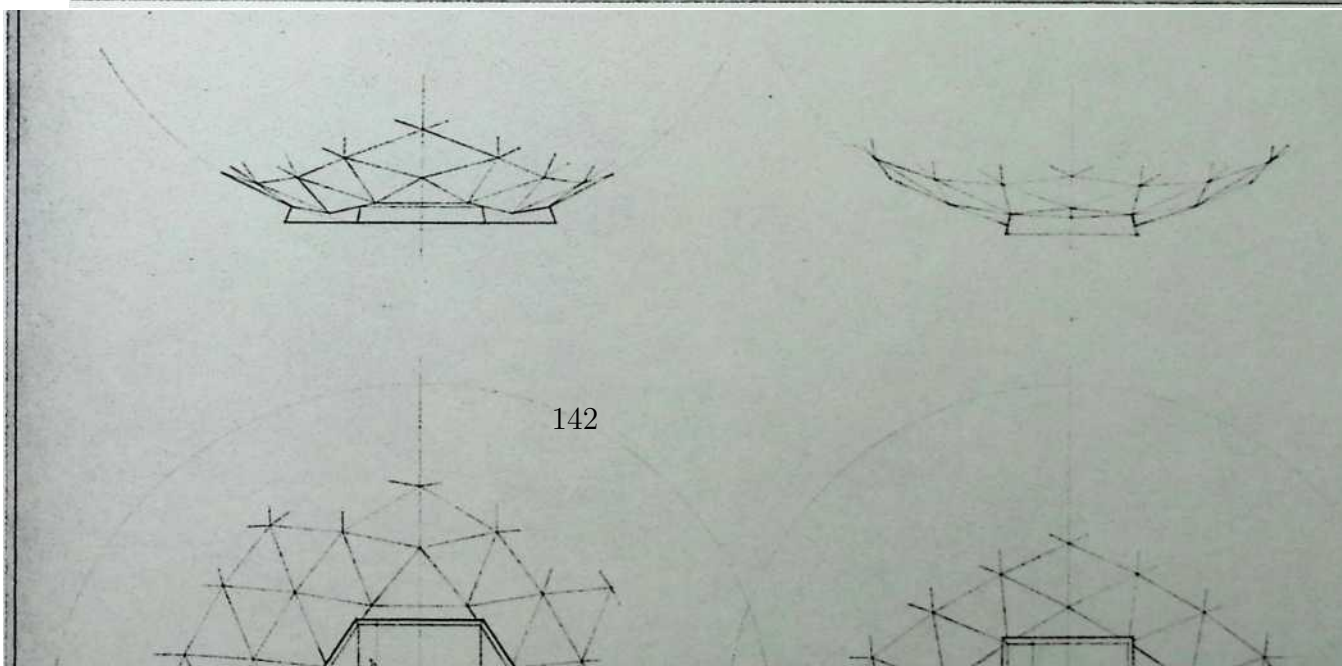

1
2L
3L
3R = OPPOSITE HAND
4R = OPPOSITE HAND
4L



ALTERNATE DOOR DETAiLS

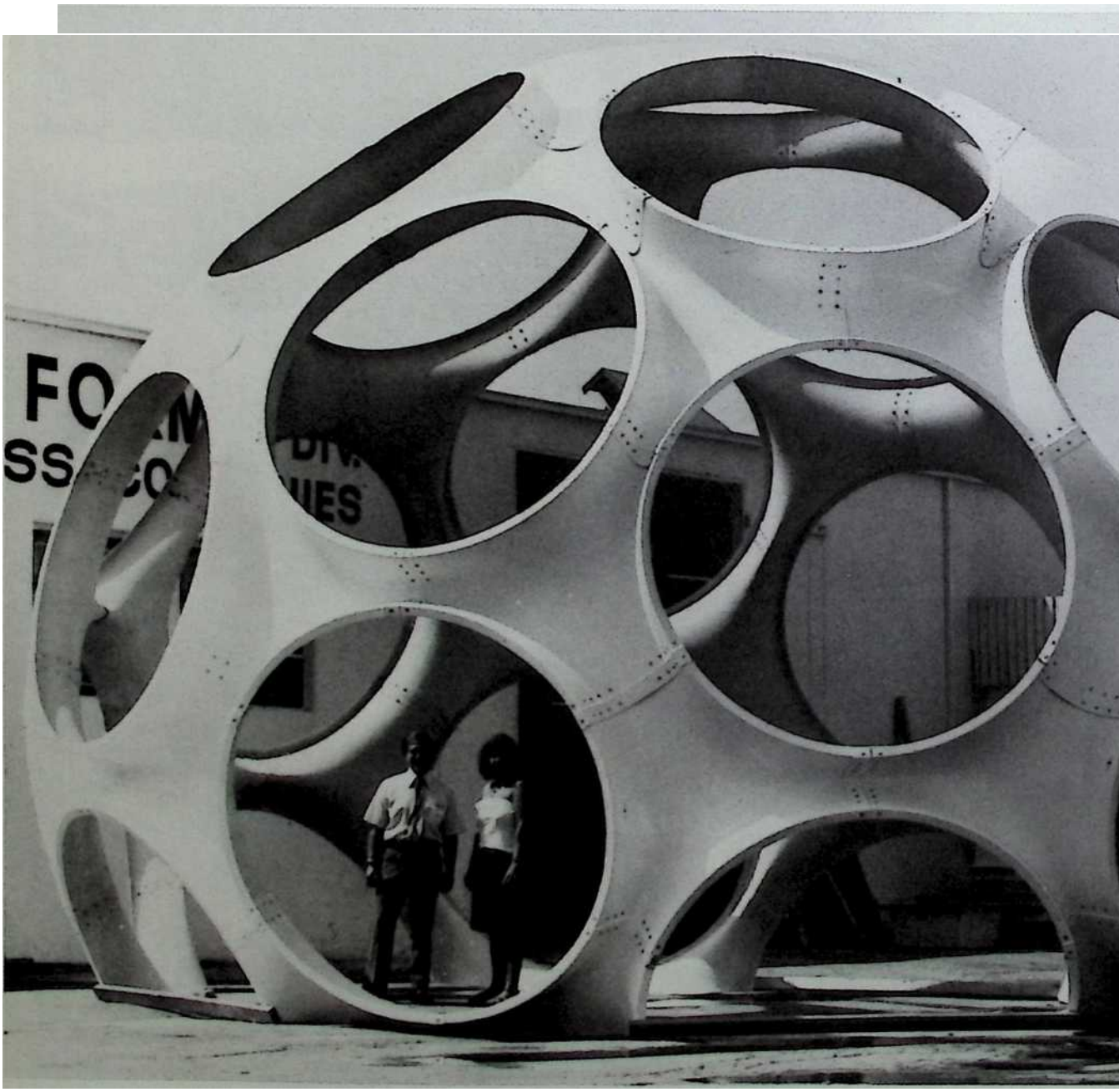
FULLER A??D SASAO. INC.


NO. REQ'D: 64
1
2L
NO. REQ'D:
30 RIGHTS
30 LEFTS
3L
NO. REQ'D:
0 RIGHTS
& LEFTS
4L



17 Monohex Geodesic Structures Patent 8/31/65

The monohex was conceived earlier as one manifestation of the radome. It is composed of molded polygonal sections, the corners of which can be cut to form circular windows when assembled to adjacent panels.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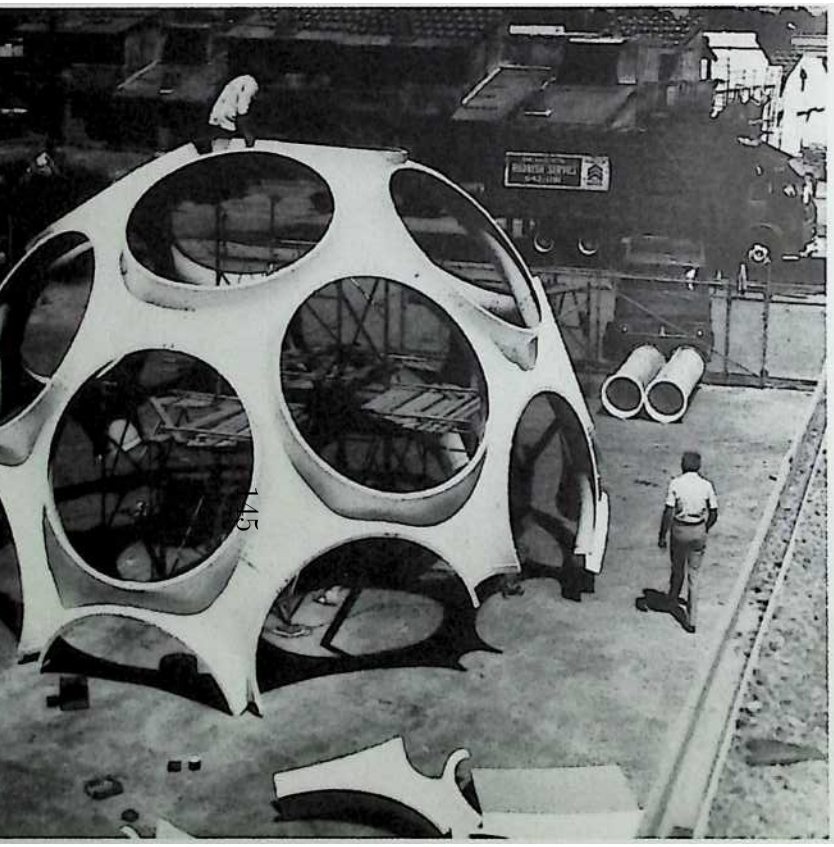
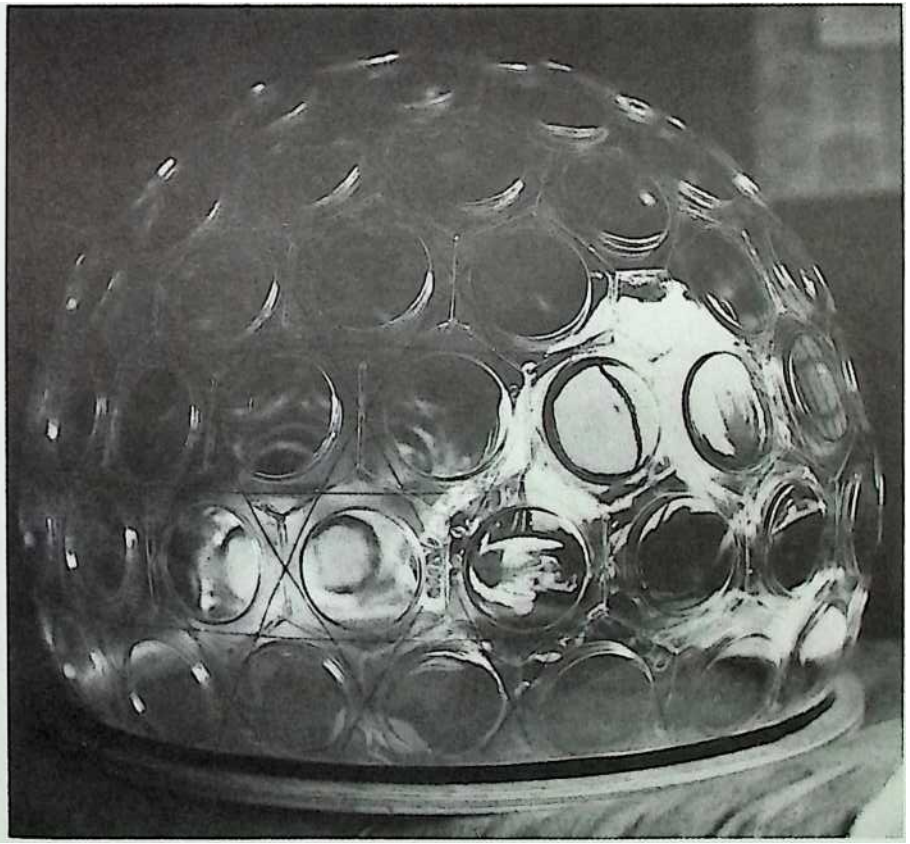
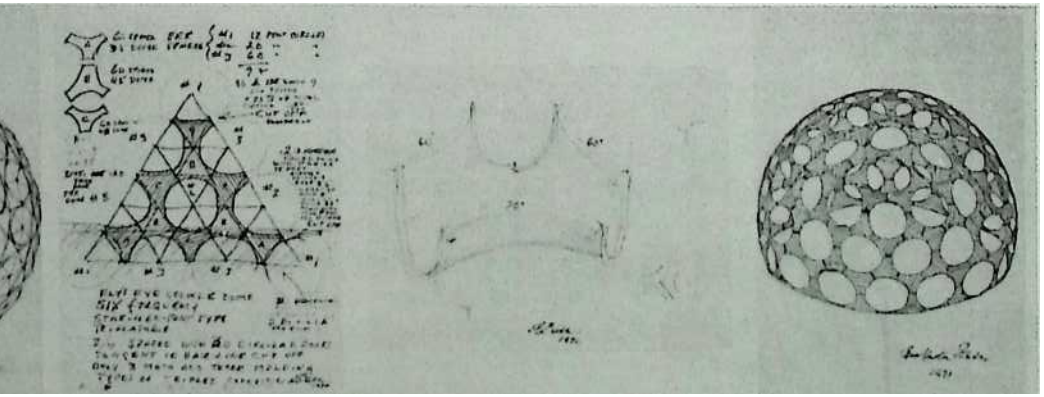






Aug. 3, 1965

Filed Dec. 19. 1961

R. B. FULLER

GEODESIC STRUCTURES

3,197,927

6 Sheets-Sheet 1

Aug. 3, 1965

R. B. FULLER

GEODESIC STRUCTURES

3,197,927

Filed Dec. 19. 1961

6 Sheets-Sheet 2

ItII**(Edo** 3

INVENTOR.

RICHARD BUCKMINSTER FULLER

Aug. 3, 1965

Filed Dec. 19, 1961

R. B. FULLER

GEODESIC STRUCTURES

3,197,927

6 Sheets-Sheet 3

Aug. 3, 1965

Filed Dec. 19. 1961

R. B. FULLER

GEODESIC STRUCTURES

3,197,927

6 Sheets-Sheet 4

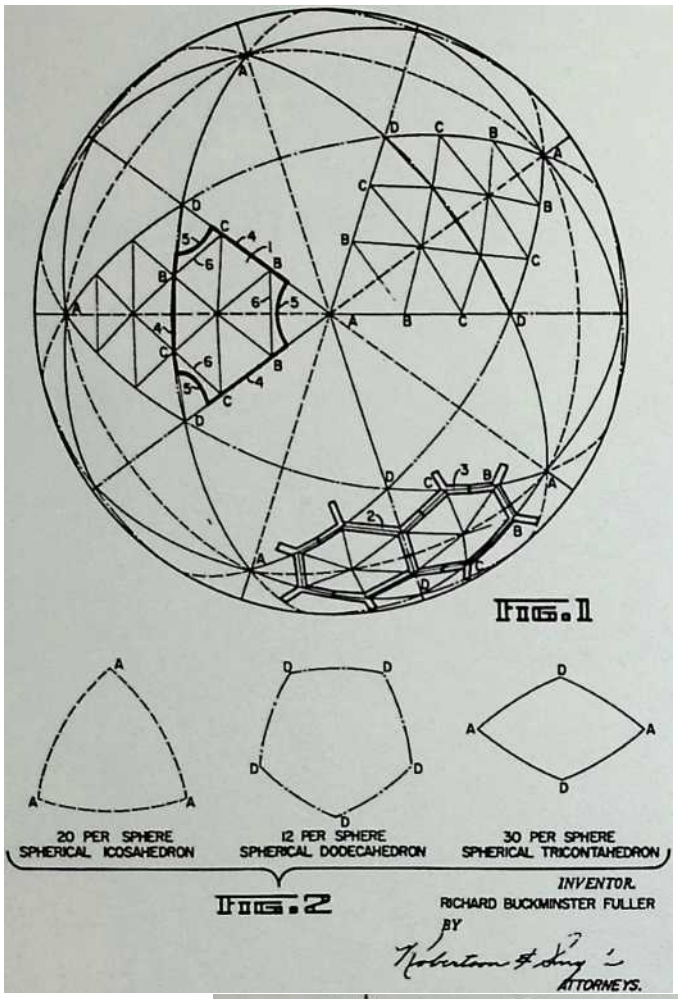
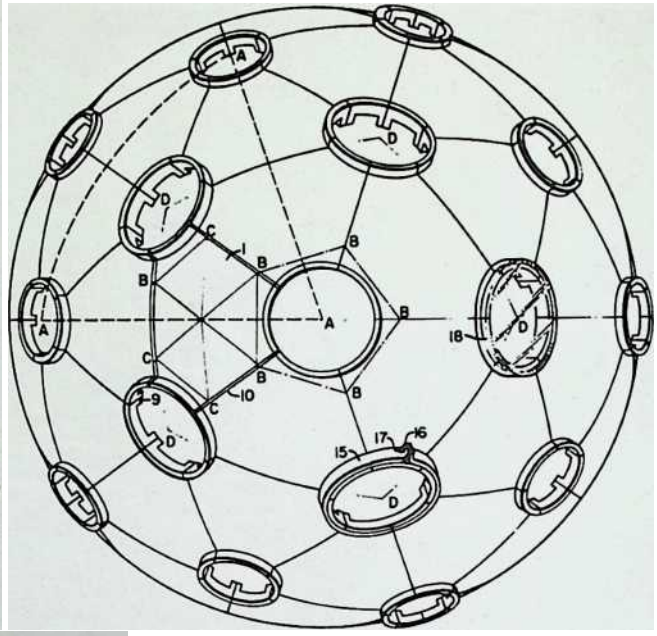


FIG. 1
20 PER SPHERE
SPHERICAL ICOSAHEDRON
12 PER SPHERE
SPHERICAL DODECAHEDRON
30 PER SPHERE
SPHERICAL TRICONTAHEDRON
FIG. 2
INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS.



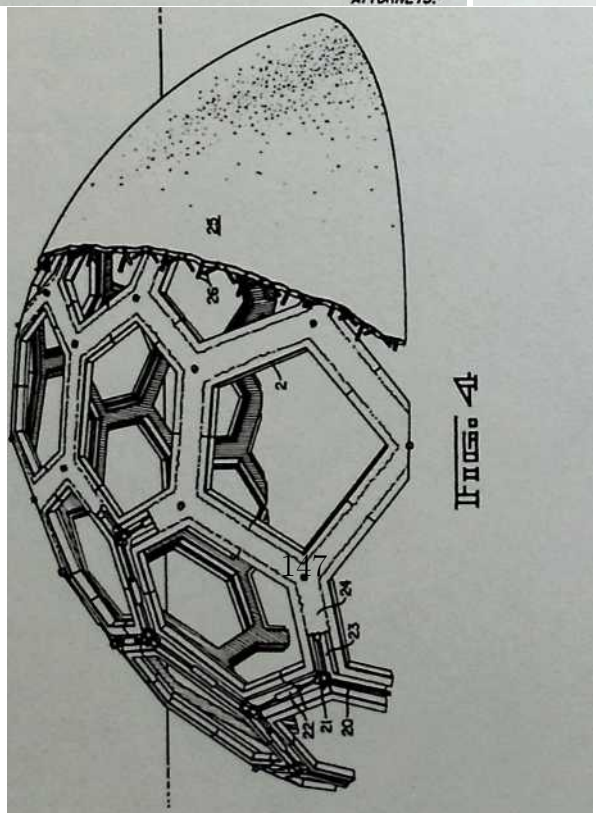
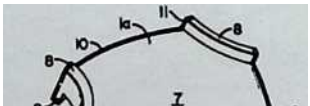


FIG. 4



Aug. 3, 1965

Filed Doc. 19. 19S1

R. B. FULLER

GEODESIC STRUCTURES

3,197,927

6 Sheets-Sheet 5

Aug. 3, 1965

Filed Dec. 19. 1961

R. B. FULLER

GEODESIC STEVCTUEES

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6 Sh««tB-Shwt 6

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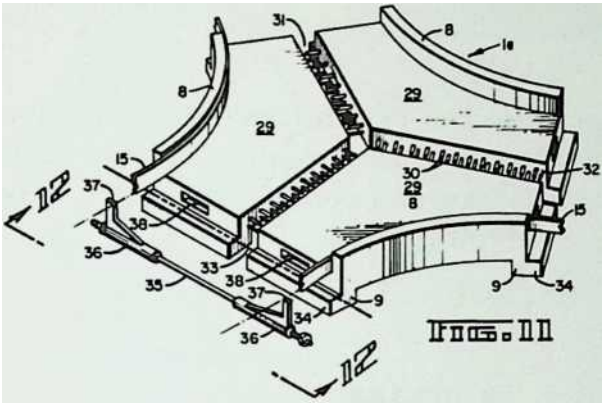

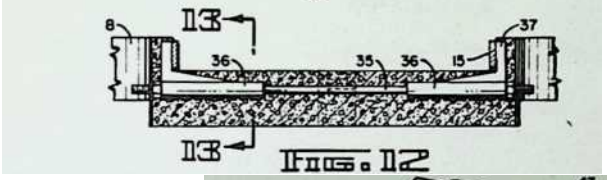

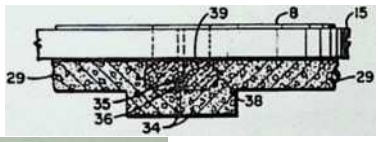

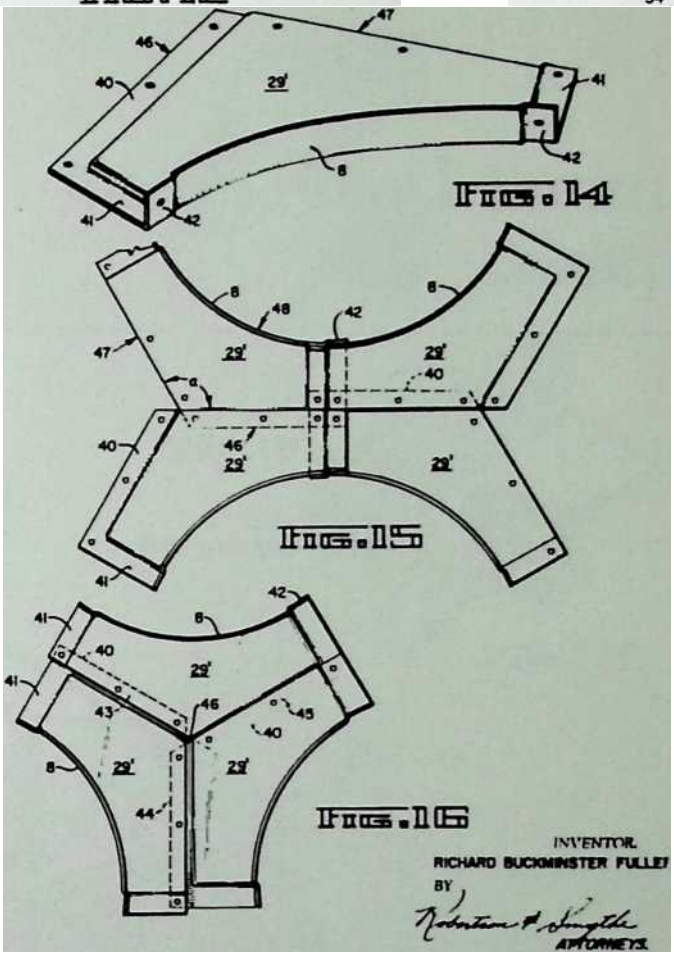

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
Robertson & Smythe
ATTORNEYS.

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
Robertson & Smythe
ATTORNEYS.

I HIH

Laminar Dome Patent 8/31/65

The laminar dome can be fabricated of aluminum, plastic, paperboard, or steel diamonds. These are bent along the shorter axis and connected to other diamonds along their eccentric flanges.

Aug. 31, 1965

3,203,144

Filed May 27. 1960

R. B. FULLER

LAMINAR GEODESIC DOME

14 Sheets-Sheet 1

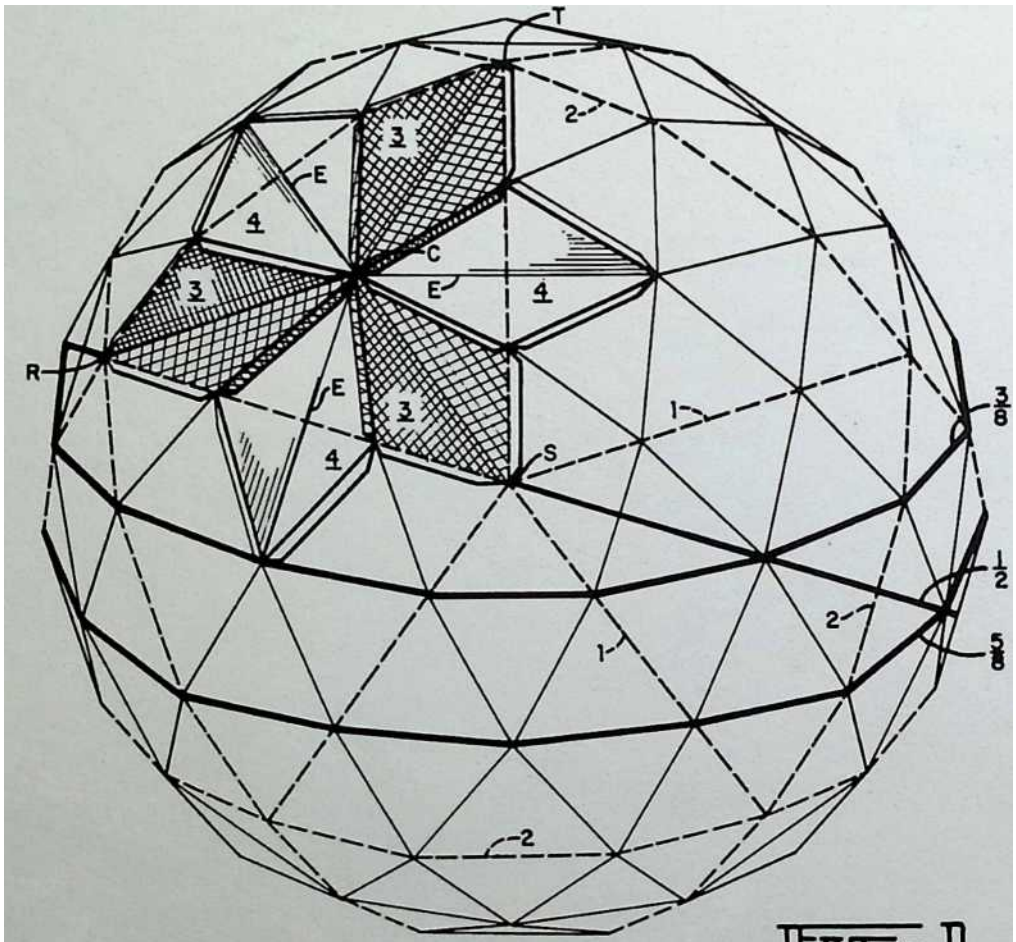

FIG. 1

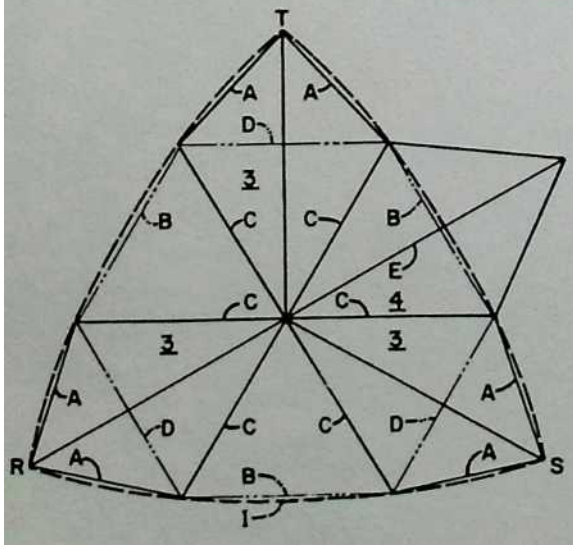

FIG. 2

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
Robertson & Smythe
ATTORNEYS.

Aug. 31, 1965

Filed way 27. 1960

R. B. FULLER

LAMIHAR OEODESIC DOME

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R. a FULLER 3,203,144

LAMIHAR GEODESIC DOME

14 SbeeU-She.t 3

Aug. 31, 1965 R. B. FULLER 3,203,144

LAMIHAR OEODESIC DOME

Filed May 27. 1960 14 ShMt»£ll„t 4

Aug. 31, 1965

Filed May 27. 1960

R. a FULLER

LAMINAR OEODESIC DOME

3,203,144

14 Sheota-Sheet 5

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irnas» H-4

INVENTOR.

RICHARD BUCKMINSTER FULLER

INVENTOR.

RCHARD BUCKMINSTER FULLER

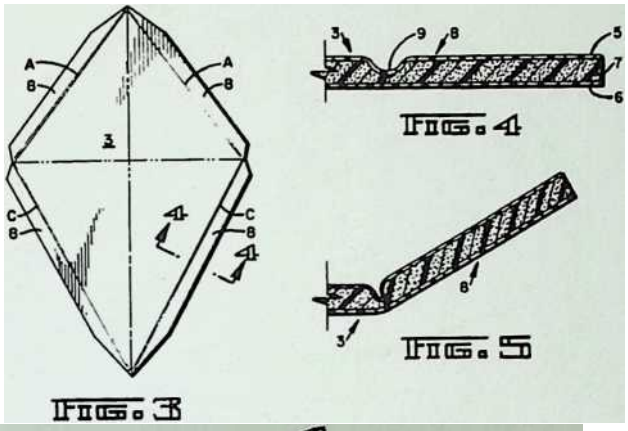


FIG. 3
FIG. 4
FIG. 5

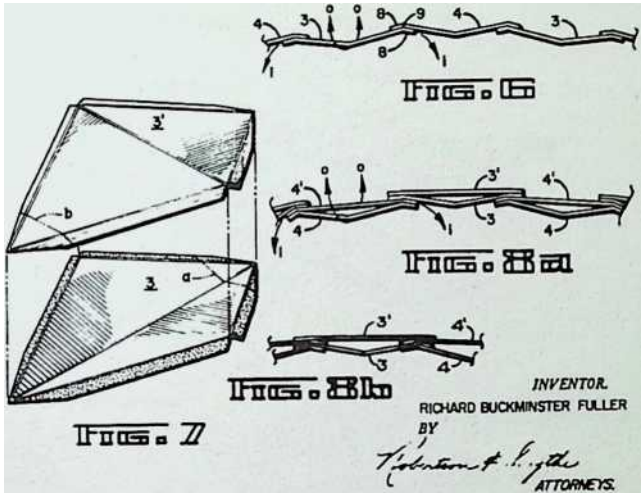


FIG. 6
FIG. 8a
FIG. 8b
FIG. 7
INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS.

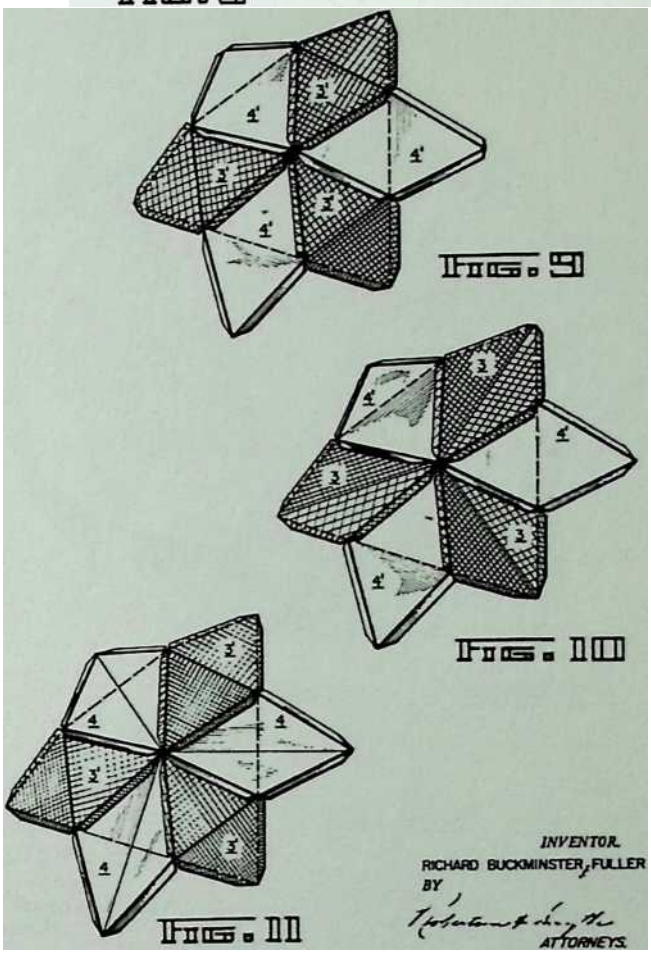
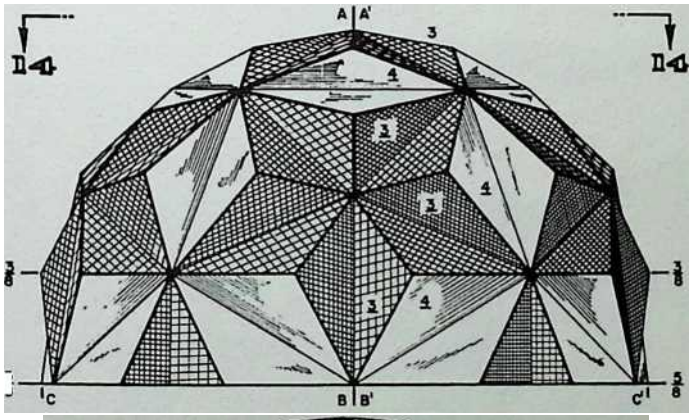


FIG. 9
FIG. 10
FIG. 11
INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS.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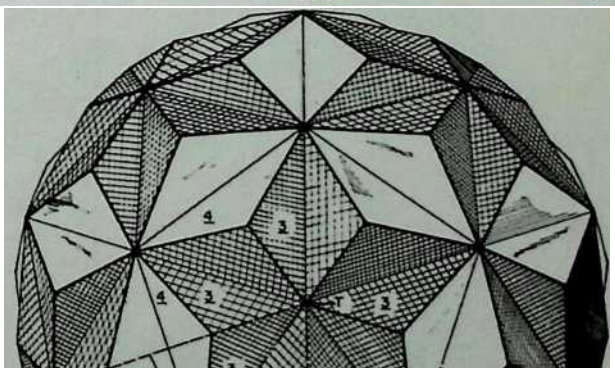
C C'



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LAMINAR GEODESIC DOME

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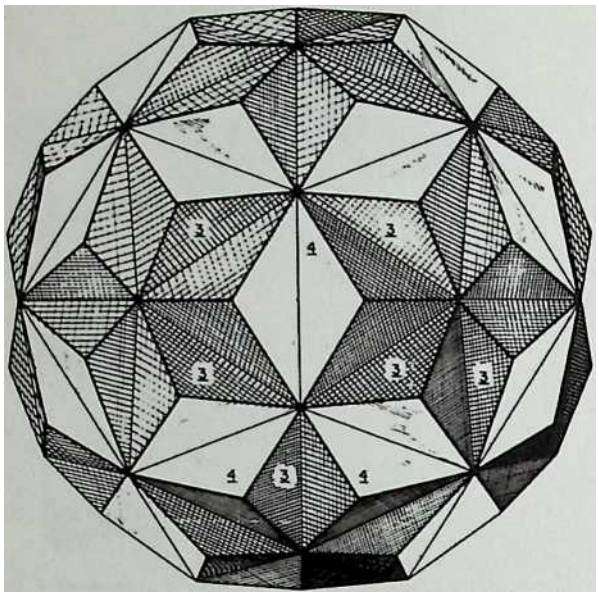
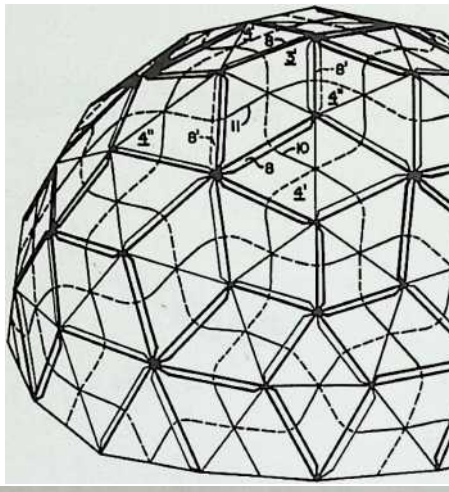
INVENTOR.

RICHARD BUCKMINSTER FULLER *BY*

RICHARD BUCKMINSTER FULLER





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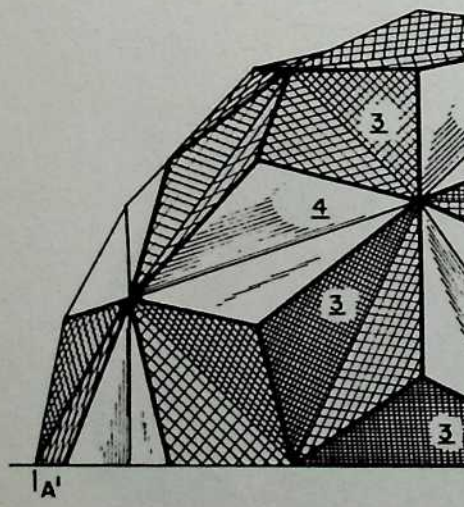

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
ATTORNEYS.

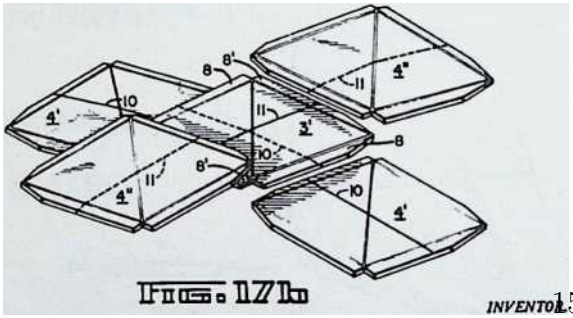

FIG. 17b

INVENTOR.
BY
ATTORNEYS.

Aug. 31, 1965 R. B. FULLER 3,203,144

LAMINAR GEODESIC DOME

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LAMINAR GEODESIC DOME

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Aug. 31, 1965

Filed May 27. 1960

a B. FULLER

LAMINAR GEODESIC DOME

3,203,144

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INVENTOR.

RICHARD BUCKMINSTER FULLER

BY

INVENTOR.

RICHARD BUCKMINSTER FULLER

BY

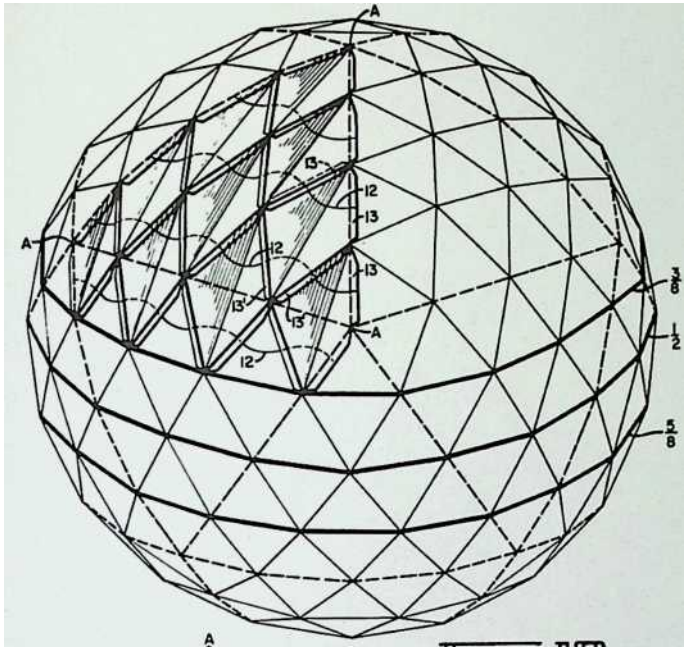


FIG. 18

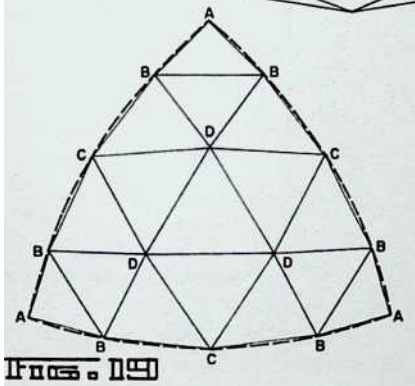


FIG. 19

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
Tibbetts & Smythe
ATTORNEYS.

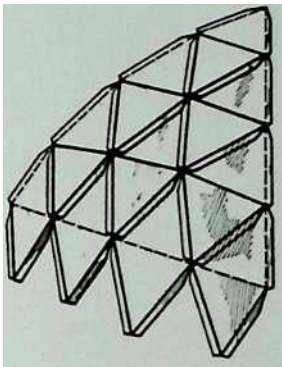


FIG. 20

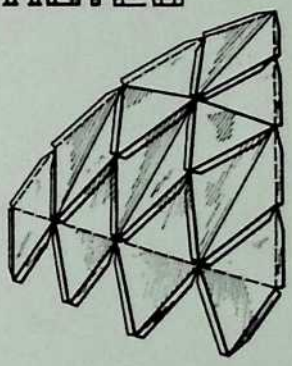


FIG. 21

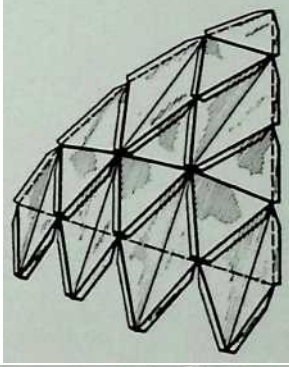


FIG. 22

INVENTOR.
RICHARD BUCKMINSTER FULLER
BY
Tibbetts & Smythe
ATTORNEYS.

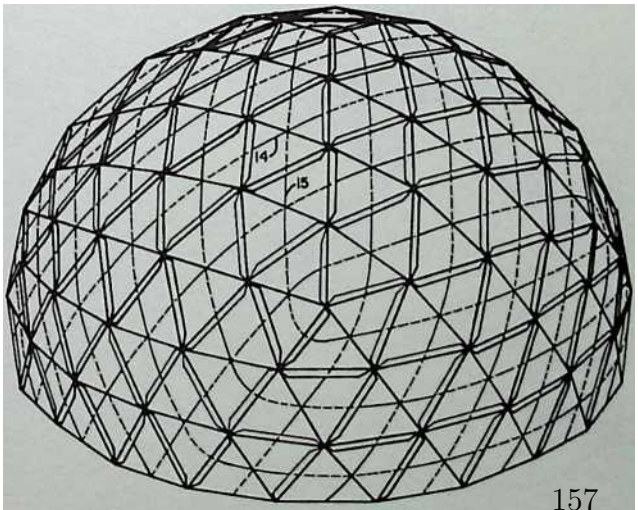
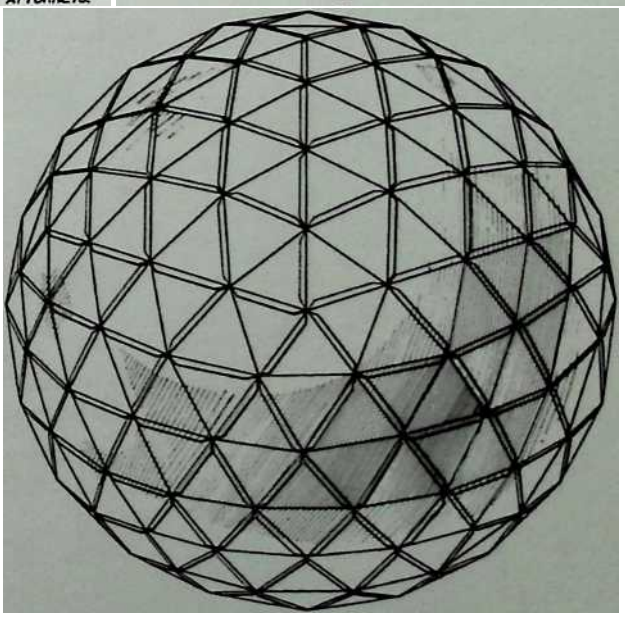
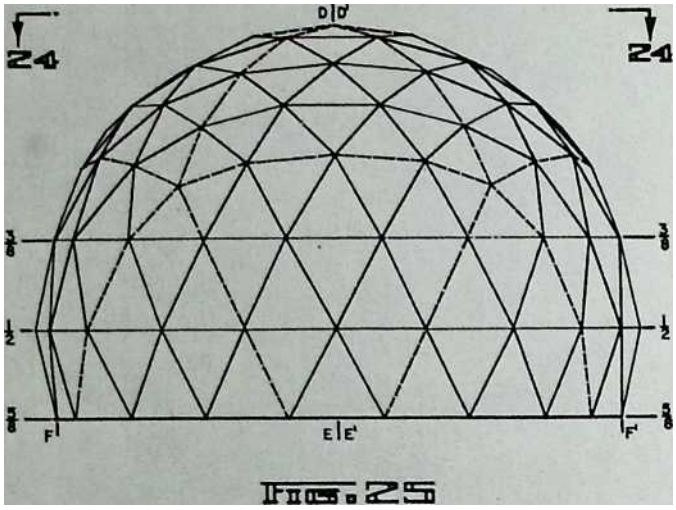
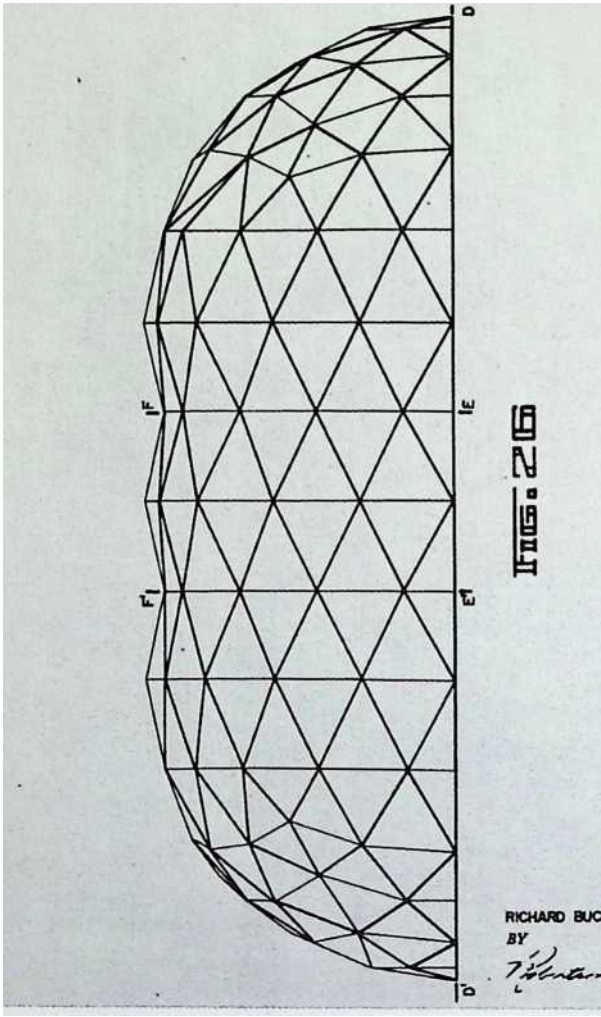


FIG. 23







Aug. 31, 1965

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INVENTQR.

RICHARD BUCXMWSTER FULLER BY

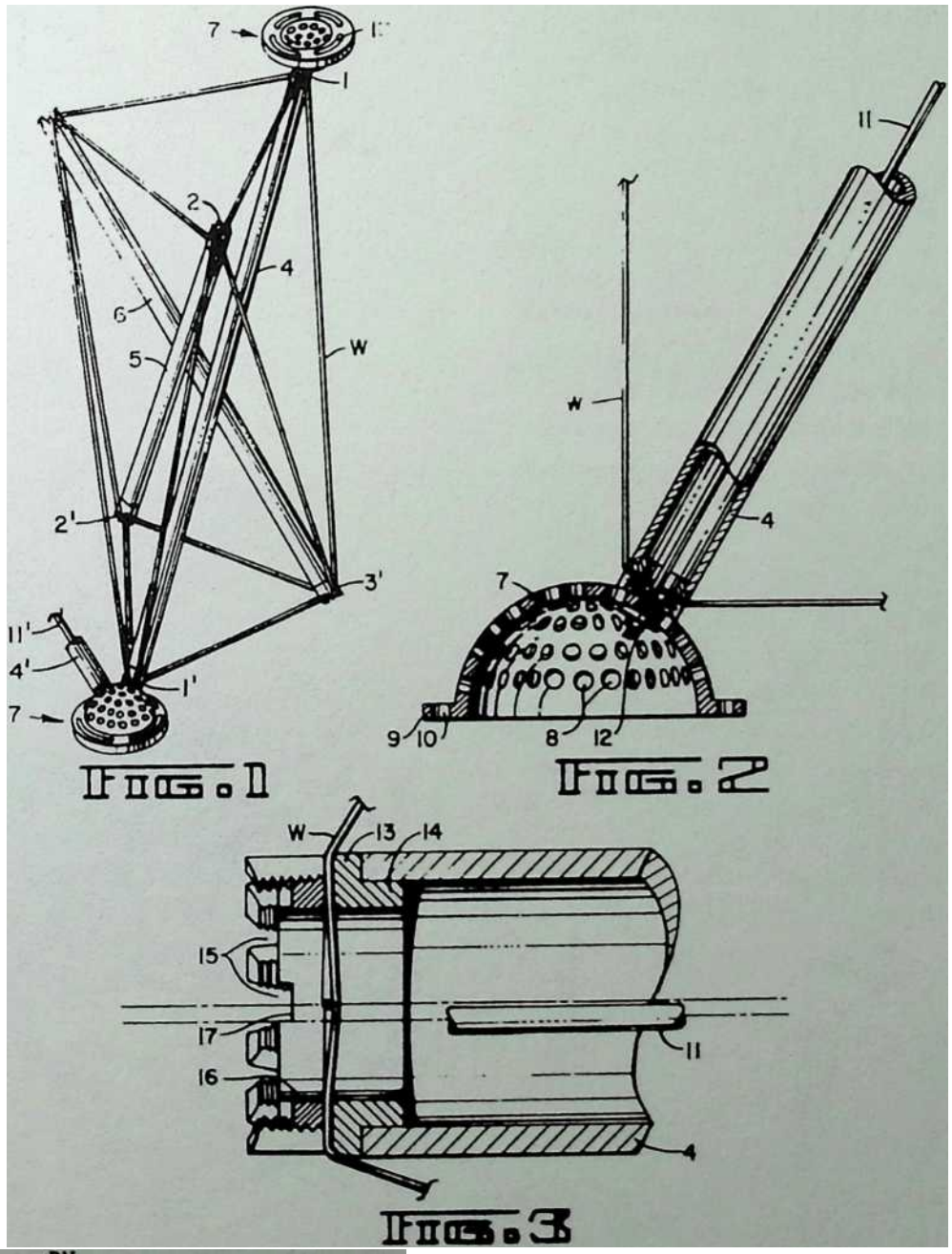
ᵛ ATTORNEYS.

18 Octa Spinner Patent Application 1965

The Octa Spinner is a machine that bends sheet metal into stiff octahedrons that can be fashioned into an octet truss. Because of the expense and time involved, Fuller never pursued his application and never secured a patent for the Octa Spinner.

INVENTOR.

RICHARD 8UOMNSTER FULLER



BY

Robertson, Smythe & Bryan

ATTORNEYS.

INVENTOR.

INVENTOR.

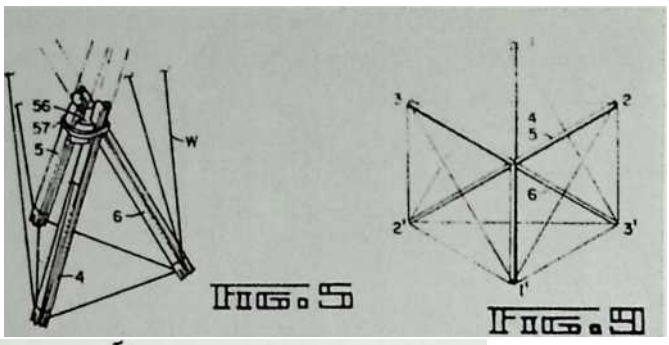


FIG. 5 FIG. 9

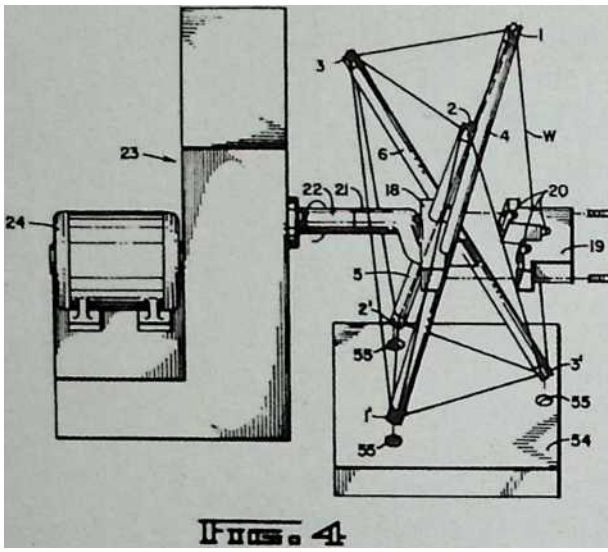


FIG. 4

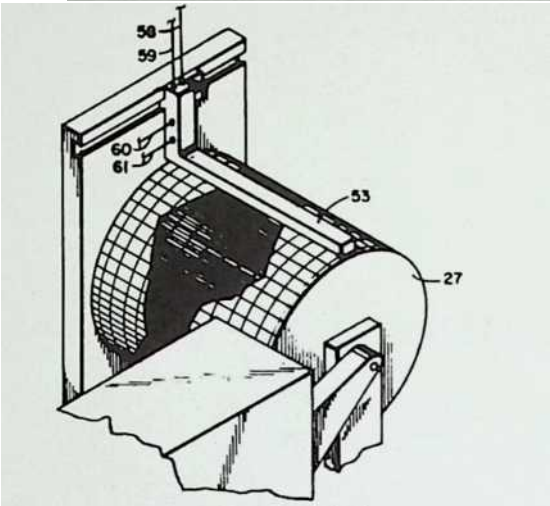


FIG. 7

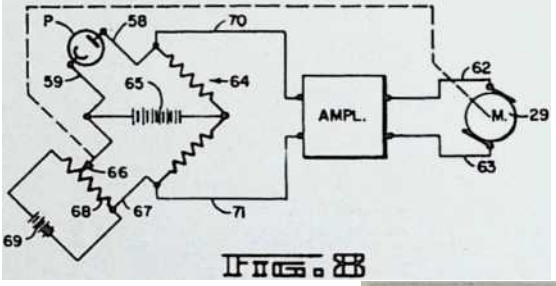
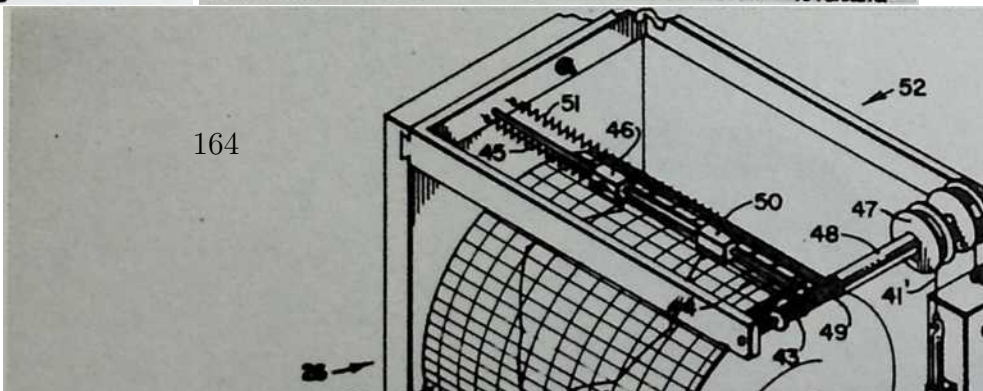


FIG. 8

RICHARD BUCKMINSTER FULLER
BY
Robertson, Sanders & Bryan
ATTORNEYS

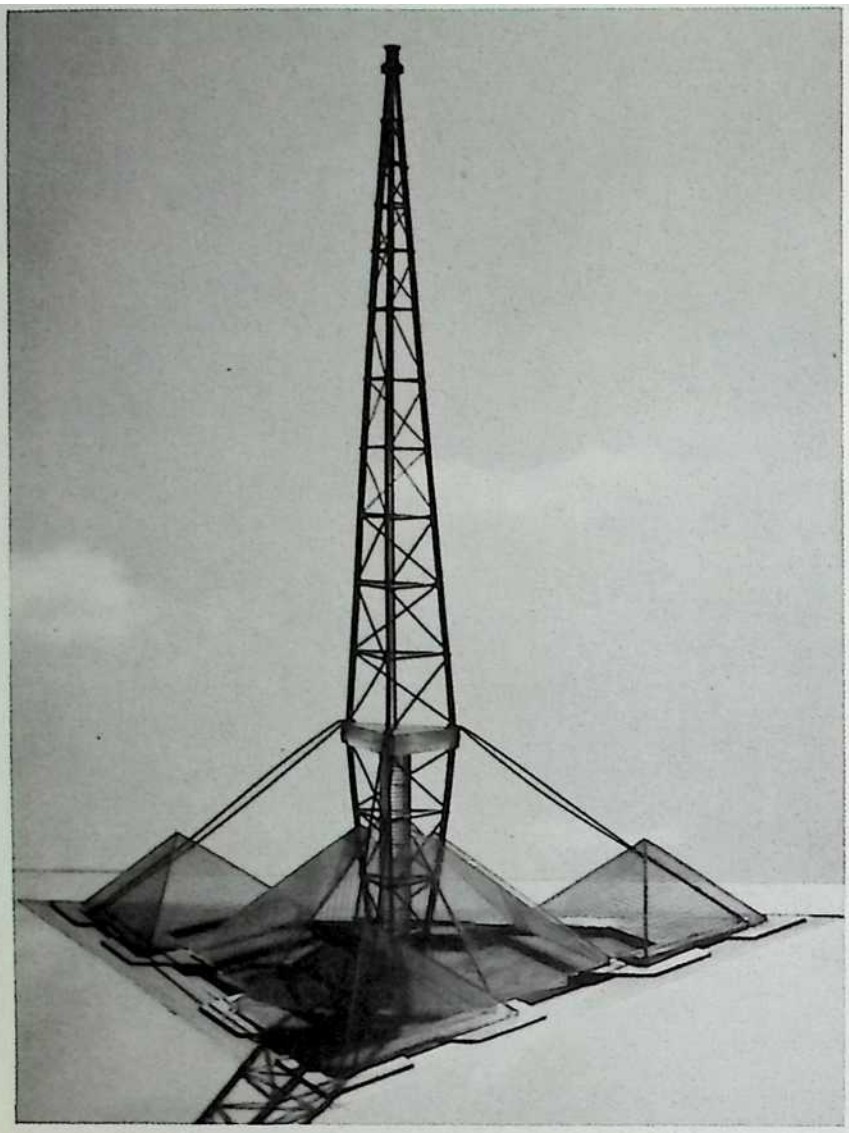


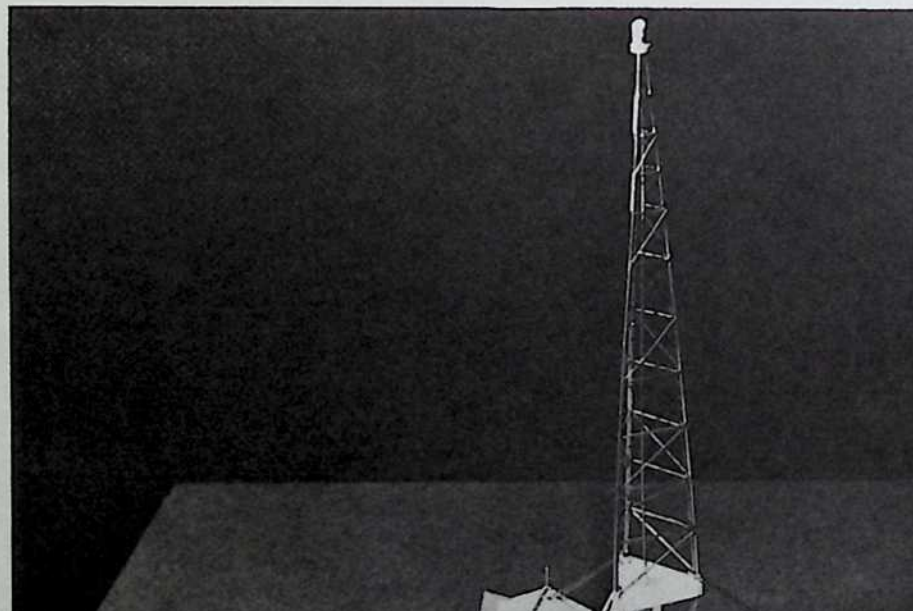
19 Yomiuri Tower, Japan Fuller & Sadao, 1966

The impetus for the Yomiuri Tower was to erect a structure higher than the summit of Mount Fuji. It would have been 12,300 feet high if it had been feasible to construct. Originally planned as a large tenseg- rity mast on three legs, the Yomiuri Tower would have had an observation pod of over thirty stories at the top with plexiglass windows providing a 360° view of Japan and the Pacific. Subsequent studies proved that such a tall structure could not withstand the force of the winds at high altitudes, and six guy wires were added to the tower's lower third. These guy lines were to be anchored by three vast tetrahedral feet (containing housing), each of which would have been much larger than the Eiffel Tower. Offices built into the base of the tower mast would have been twice as high as the World Trade Towers in New York City. In order to maximize the use of the real estate, a stadium and covered park were also planned to be fit into the hexagonal lot at the base.

The problems that defeated this project were many, but chief among them was cost. As a tower two miles high, the Yomiuri project would have cost over SI.5 billion, which was six times the original estimate. When the project was redesigned to be roughly half as tall, the expense was reduced drastically, but the diminished height of the tower would have countermanded its original function. Another problem would have been the acquisition of the real estate necessary to contain the elaborate structures of the tower's base. Moreover, the dangers of ice sherds falling from thousands of feet called for intermediate shelters above the buildings on the ground.

If the tower were erected, it would immediately become the world's tallest building, offering impressive views from pressurized lounges, rest rooms, restaurants, and shops.





Tower studies proved construction technically possible (scale model photo shows Eiffel Tower in background) but economically unfeasible.

An entrepreneur from Japan presented a trio of design firms with a proposal for an observation tower to tall that. If it were built, would certainly discourage any other* with the ambition to own the world'* tallest anything. If. Indeed, it would not extinguish their hope* altogether. The objective of the structure envisioned was to provide an observation point that would overtop Mount Fuji, which, at 12489 It above tea level, it the highest point on the island of Hon«hu. For the tile selected. thia would have required a structure that iltclf would be 12450 ft high, just over two mile*.

The scale of the tower contemplated exceeded the boundaries of known structural parameter* *0 far a* to require the eonvuliant* to prepare a 100-page report jutl to decide whether it wa* practicable to prepare a feasibility study. The answer was no. but. In arriving at that answer. they uncovered some relationship* between height, co* I, and life al the top that are interesting In themwlret. and. Incidentally, may shed some light on any schemes planner* may have for buildings substantially taller than the 100-story structures now under construction.

Among the problems faced by the designer* that arc not normally encountered in the design of building* or even, for that matter, tall tower* of the «ire that have been built to date were: king, high wind*, high ratio of structural weight to load* supported, and the need for pressurisation of the occupied space at the topi

From the best available data, the designers were forced to assume that all structural member* might accumulate a* much a* 12 In. oi ice; moreover, in any latticelike arrangement of structural members, apace* between member* lesa than 5 ft apart would have to be considered'M completely plugged with ice. Not only would the ma** of iee add substantially to the gravity load Imposed on the tower and it* foundation; the encrusted ice would also increase the effective area exposed to wind, and because of It* rough surface, the drag coefficient would be in* *rr*rased, too.

Exact data on wind velocity at the cleva- tioo tonirmplated wa* not available, but the designer* suspected it might possibly be at high a* 300 mph. The effect of high wind velocity at high altitude* is offset somewhat by the lower density of the air at thowi elevations. Nevertheless, the la- feral force* imposed by wind loading became "the tingle most Important determinant of (the tower**] safety and economy," according to the engineer*.

FOR NOW, FORGET IT!

For the comfort of mc«t airline passenger*. and for the very health and wellbeing of some, the cabin* of mo*r aircraft miL*uig at altitudes alwe 10.000 fl are pre-»urired to roeretpr.nd to an altitude of between 5000 and 8000 ft — about 10 psi. Similarly, the pod atop a 12450-ft tower would require pressurization. a* would the elevators serving the pod.

Quite aside from the problem of providing air locks for the elevator doors at both lop and bottom terminals pre-sur- izalion of the capsule at the top of the tower add* considerably to the structural requirement* of the shell of the capsule. The negative air pressure induced on the leeward side of the ca|»ule at de-ign wind velocity, when added to the positive internal pressure, would create unit pre— sum of TOO to 800 psf. much higher than the unit pressure* encountered by conventional building wall systems.

Indeed, the design of the occupied observation and recreation foiiluy planned for the top of the tower would net be unlike the design fur an aircraft fuselage intended for cruising al 300 mph al an altitude of 12450 ft. Unlike an aircraft body, however, the tiny, porthole-like window* that serve well enough in airplane* would be wholly untuitable fur an observation tower, since a wide, unobstructed view of the *urrvundiag country side would have to be one of the lower'* mo*l irnjwriant feature*.

Structure

Two types of configuration* were considered: a free standing tower and a guyed structure. Also, two constructional material* were considered: type T-l steel (minimum yield point 90.000 psi), and type 7075-T6 aluminum (minimum yield point 60.000 psi I.

- Free-standing tower cucfiguralian with three hollow leg* with tubular heriicn-tai and diagonal was selected as having the best potential for further study by structural optimization.

- A computer program was developed to assist optimization of dimension* and weight for abuse free-standing tower 1 onfiguration.

- Computer pregram permitted cpt iniza- turn of weight and dimension* and substantial study of parameter* such as magnitude of wind load, weight supported at top. and height of tower.

- A similar approach was used for guyed tower. Basic configuration with three set* of guys one al each of three comer* uf triangular central tower. A computer program wav drvel.'ped to determine the optimum guy slope, the optimum number of guy level*, and weight of structure.

Frw-SUnding Canliltvor

The must evvnomkal free-standing tower 12450 ft high turned out to be a three-legged structure with hallow. circular leg* spaced about KXN ft apart al the base. It would weigh about 3200 culLcn lb, which, at an estimated coat oi 1500

JUT 1000 lb nf erected Merk would I* >1600 millixi (excluding foundation*). vrry mu< b m»re than the 1500 million the sponsor of I lie project had originally rnvi*iwwd. (A similar tower of aluminum would weigh about 30 per rent les*, licit tlx erected ris-t nf aluminum i* nrarly . twice- Hut of steel.) Curve* l-hetrd from the nunpuler |<rintcct* show Imw extremely sensitively the Ictal weight, and hence the 1 o>t. of the structure read* Io relatively -mall changes in the design parameter*. Uy cutting the height fnm 12450 ft to 10.000 ft. the weight of the structure dru;v by 46 per vent. Changing the arbitrarily assigned wind velocity frern 300 tn;i!i to 200 mph < nt* lice weight by 61 jier reel.

Stayed Mast

An analyse* of a guyed tower 12450 fl high di-*lu-ed that this configuration luuld dranuti ally reduce lite weight of the required structure. The optimum de- .!g3 would weigh ju»t 700 million Ih. just under 22 per cent of the comparable free-landing tower. Of the 700 million lb. the shaft accounted for 570 million Ih. at an estimated $500 per 1000 lb erected. acai the guy cable* fur 170 millinn lb at >750 per 1000 lb erected, a total of $100 million (excluding foundation*). which uf course i* much cfo-er to the »pcnsee'* original expectation.

However, the longest of each of the three *et* of guy wires (spaced 120 ft apart! would have reached out ever 10.000 ft fruzn the bate of the matt. The vast amount uf land beneath the three »et* of guy wire* poed a severe problem; tn acquire the land outright would be costly, and it is doubtful if acquiring air right* ak-ne would be practical in view uf the hazardous condition* that would o.cur under the cable* whrn they shed accumulated ice during a thaw.

Since the guyed tower with it* attendant real estate problem* exceeded the <ci»l fur which the vpca*ur wo* prepared. the designer* proposed an al- tentative. They recommended an 8000-ft. semi-guyed structure, a mudel of which i« illustrated. Linulmg the height to ft eliminated the need for pre»surixati=a; by adding three massive structure* around the l>a«e of the mast, the designers nut only provided solid anchorages fur the short guy* that stay the lower section of the lower, they al*o generated space that could l< turned to revenue- |ctudu> eng activities that would help to amurtire the io*l of the tower.

Because the (rebminary study ruled out the cvom-mic fca>:bcLty cl extending the tower above the height of Mount Fuji, the *|*«sur felt tbit the project would base sacrificed it* greatest (vienlial for attraiting visiter*; the project i» now indefinite Is deferred.

Partis ipaUng in the study were; Fuller-Sadao Gcumctrw*. arc helot* and engineer*; and Sunpsvo. Cuabrrtz A Heger, la., consulting engineer*.

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MVDCIU IM r/a

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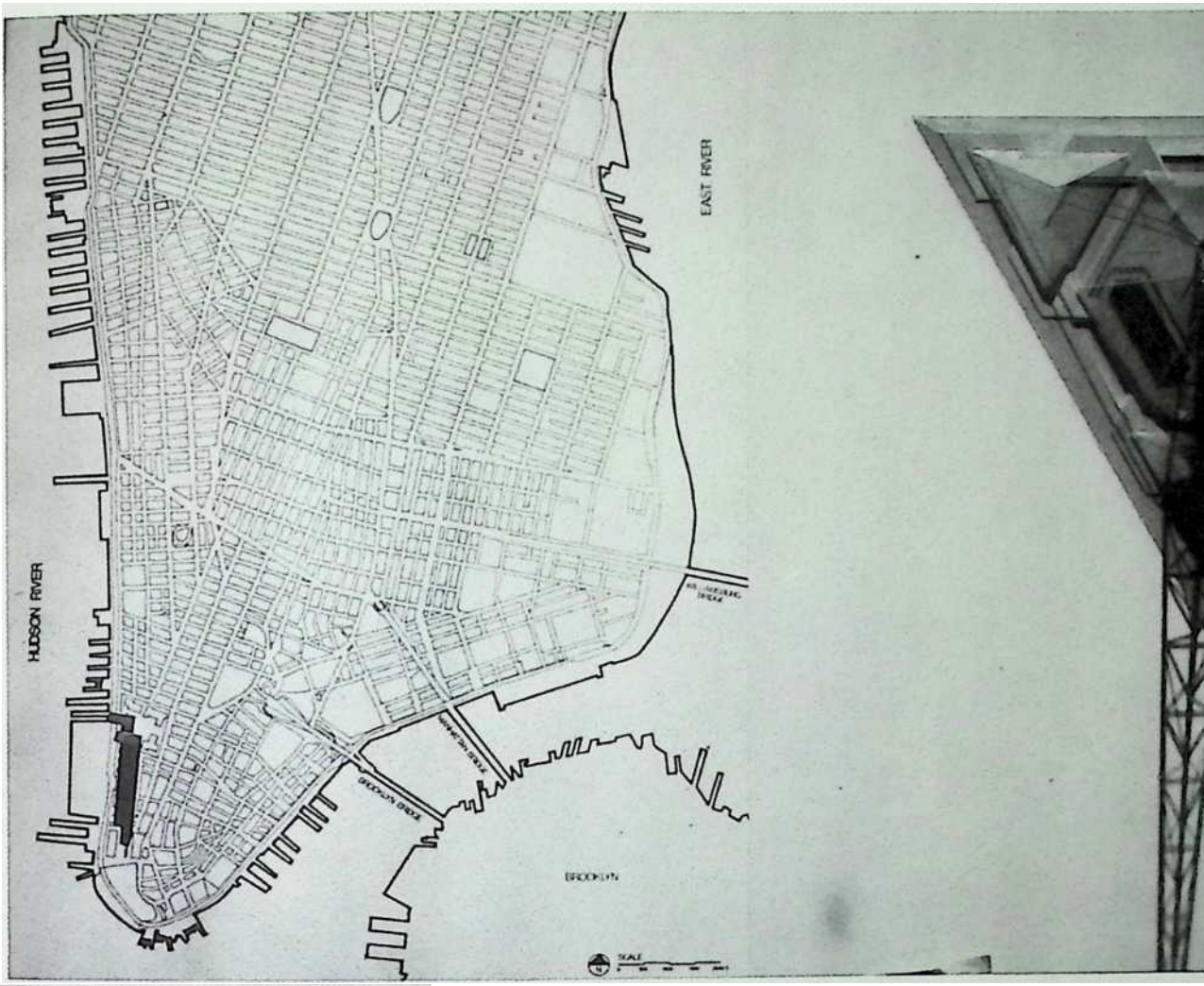
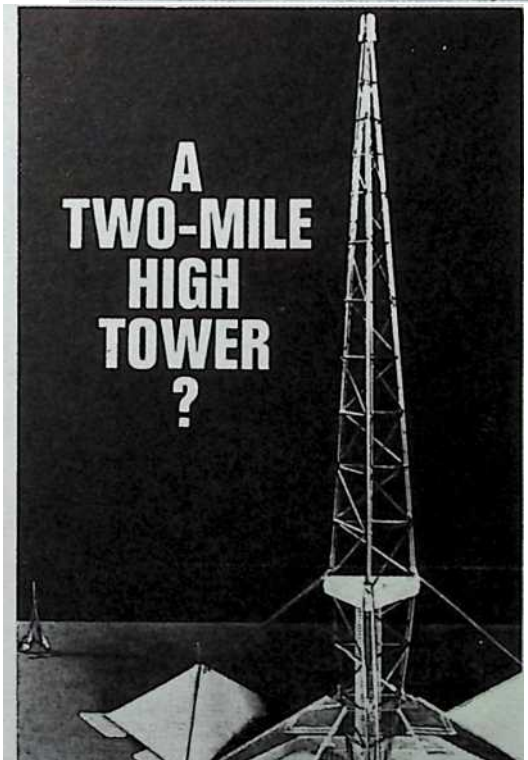
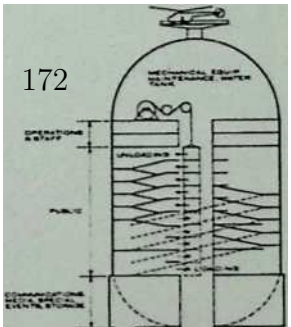
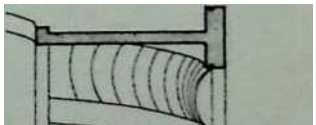
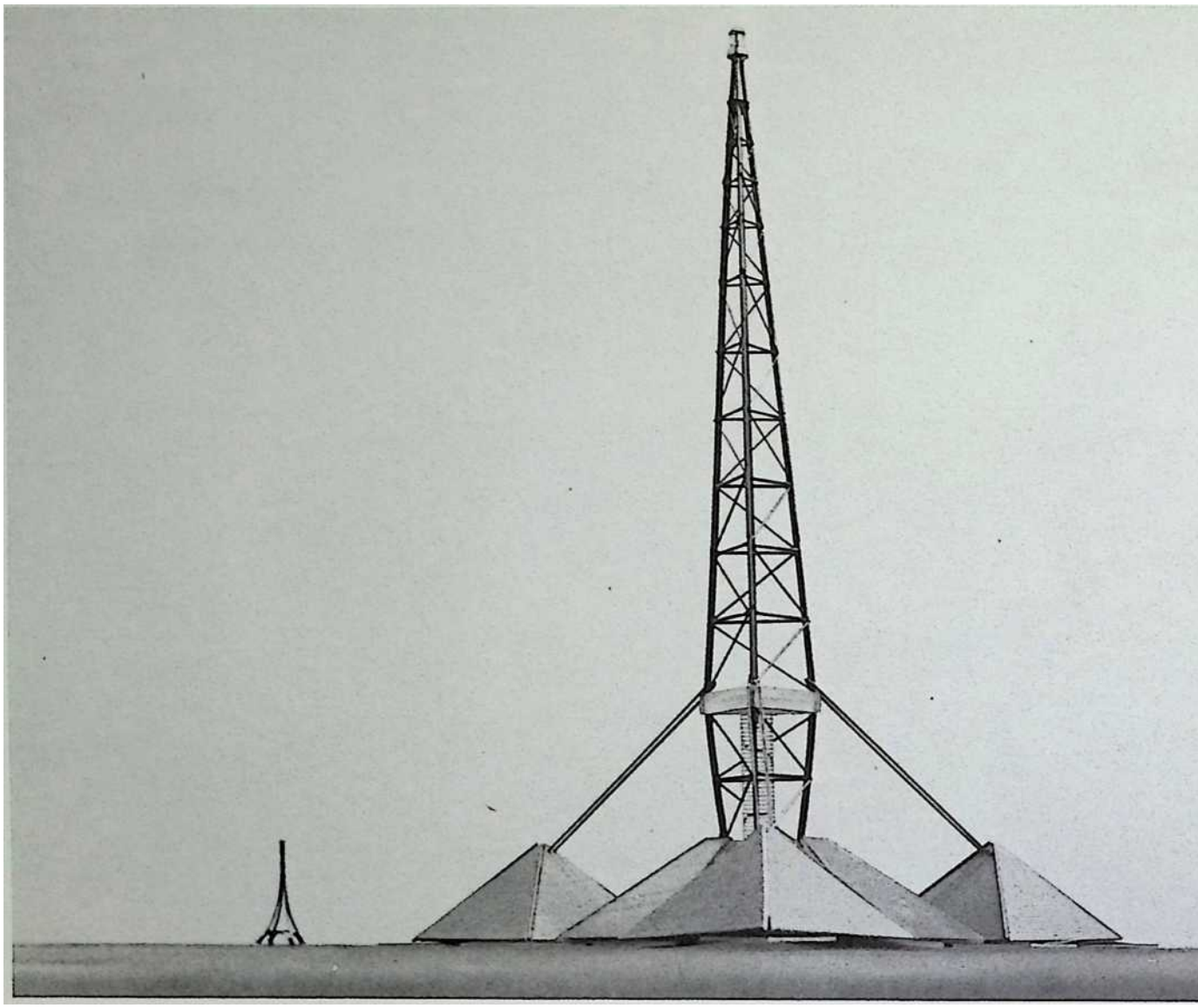
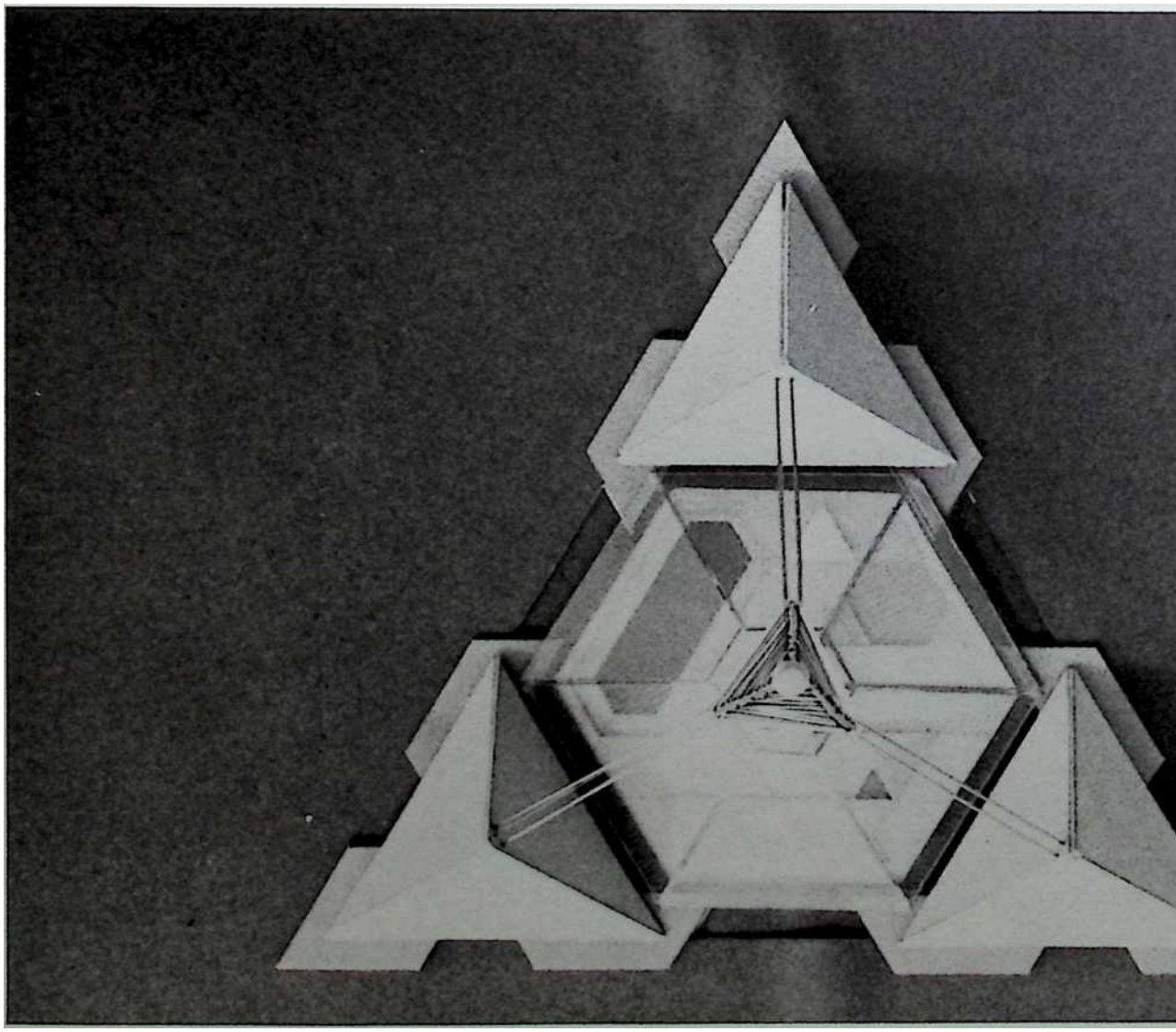

HUDSON RIVER
EAST RIVER
BROOKLYN
BROOKLYN BRIDGE
MANHATTAN BRIDGE
WILLIAMSBURG BRIDGE
SCALE

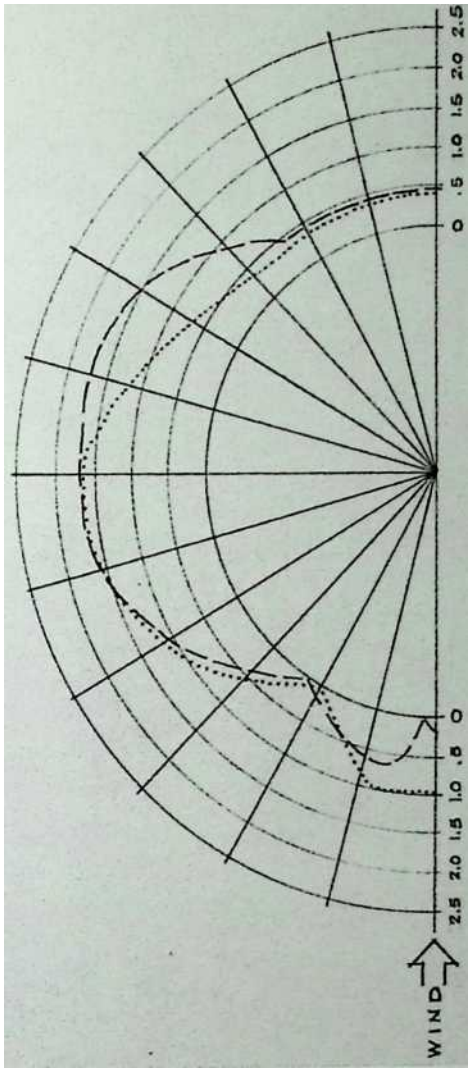

A
TWO-MILE
HIGH
TOWER
?

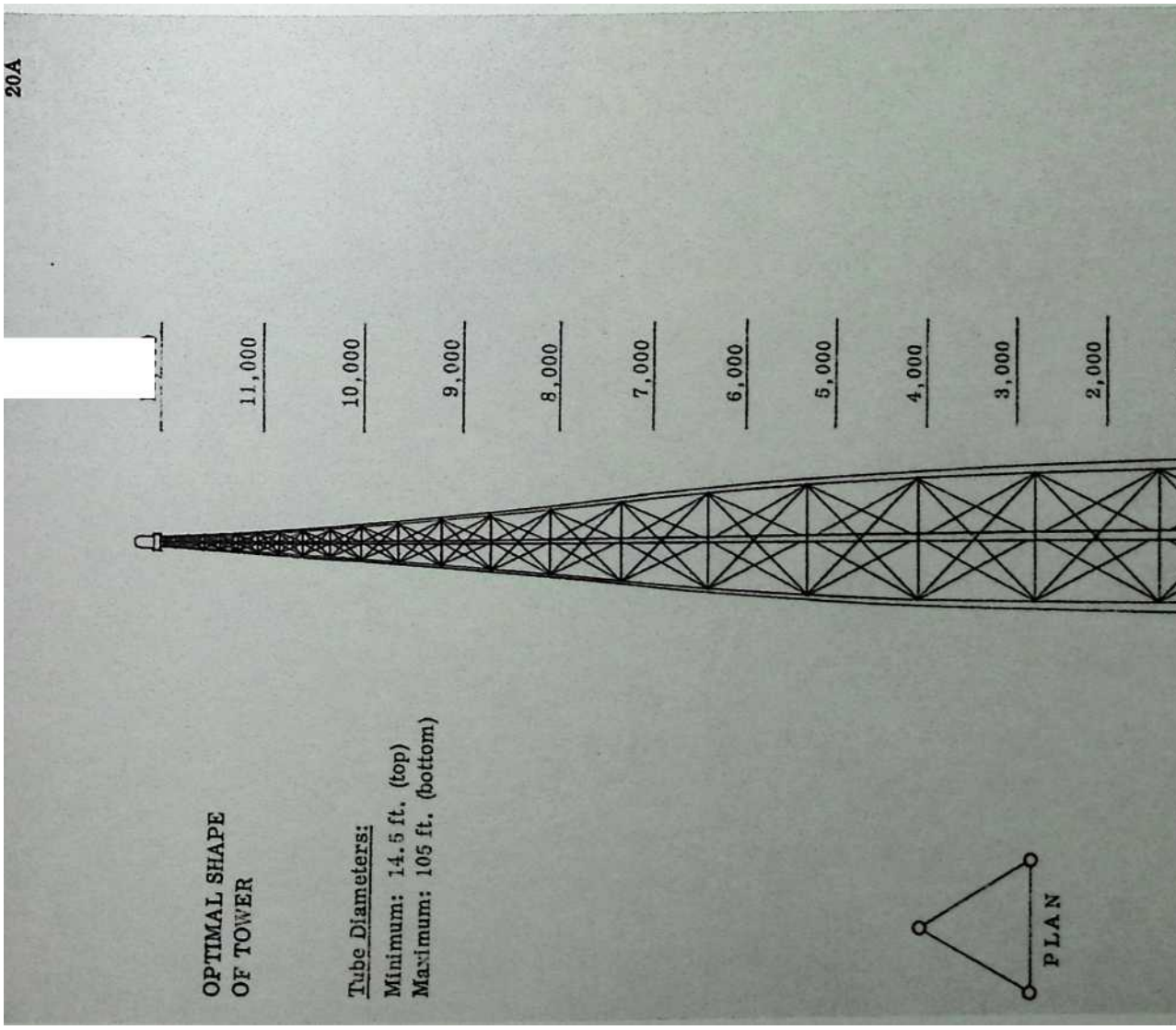









WIND
2.5 2.0 1.5 1.0 .5 0
0 .5 1.0 1.5 2.0 2.5



12,000

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SCHEMATIC

A N

SCHEMATIC SECTION

BASE OF ELEVATOR SHAFT

FIGURE 15

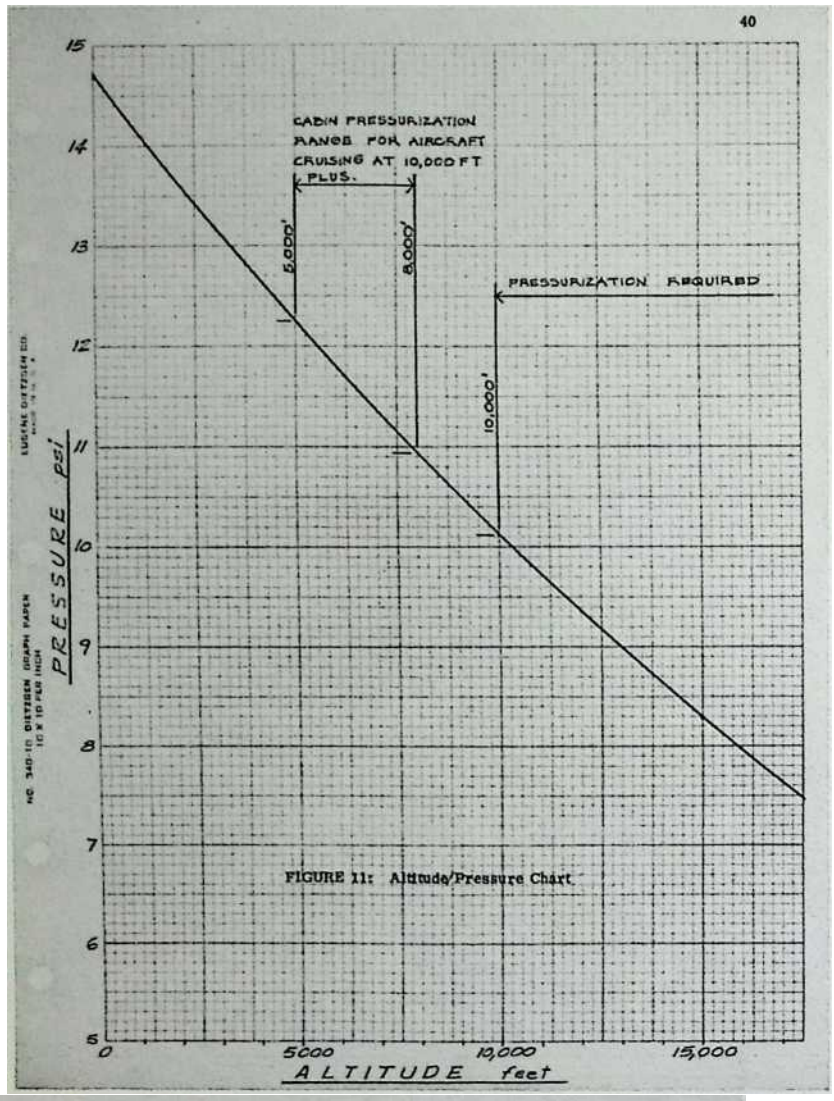


FIGURE 11: Altitude/Pressure Chart

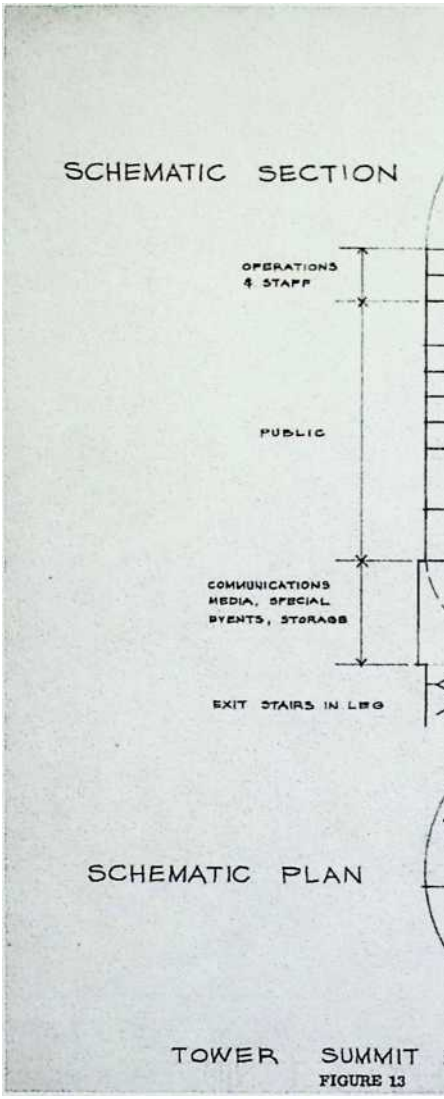
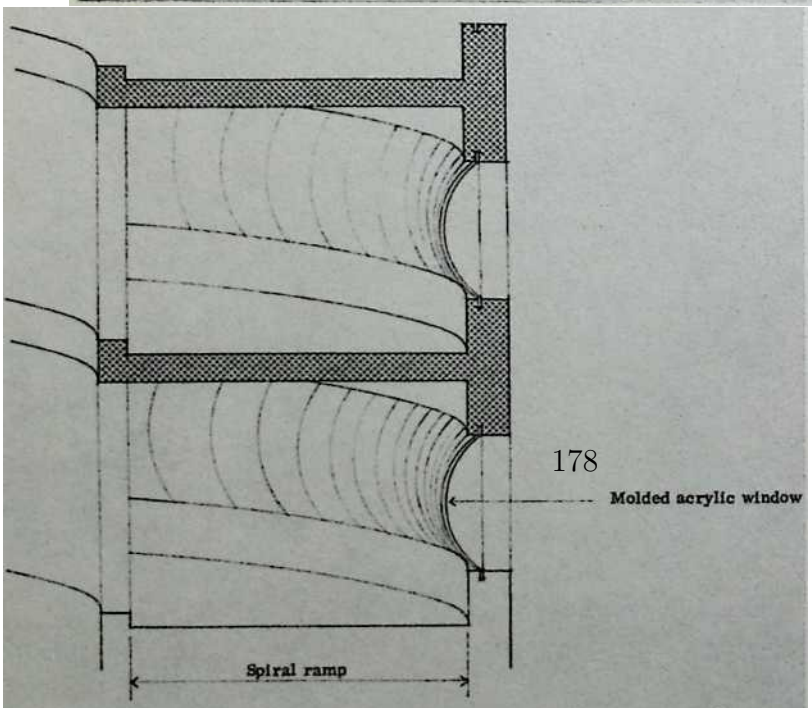
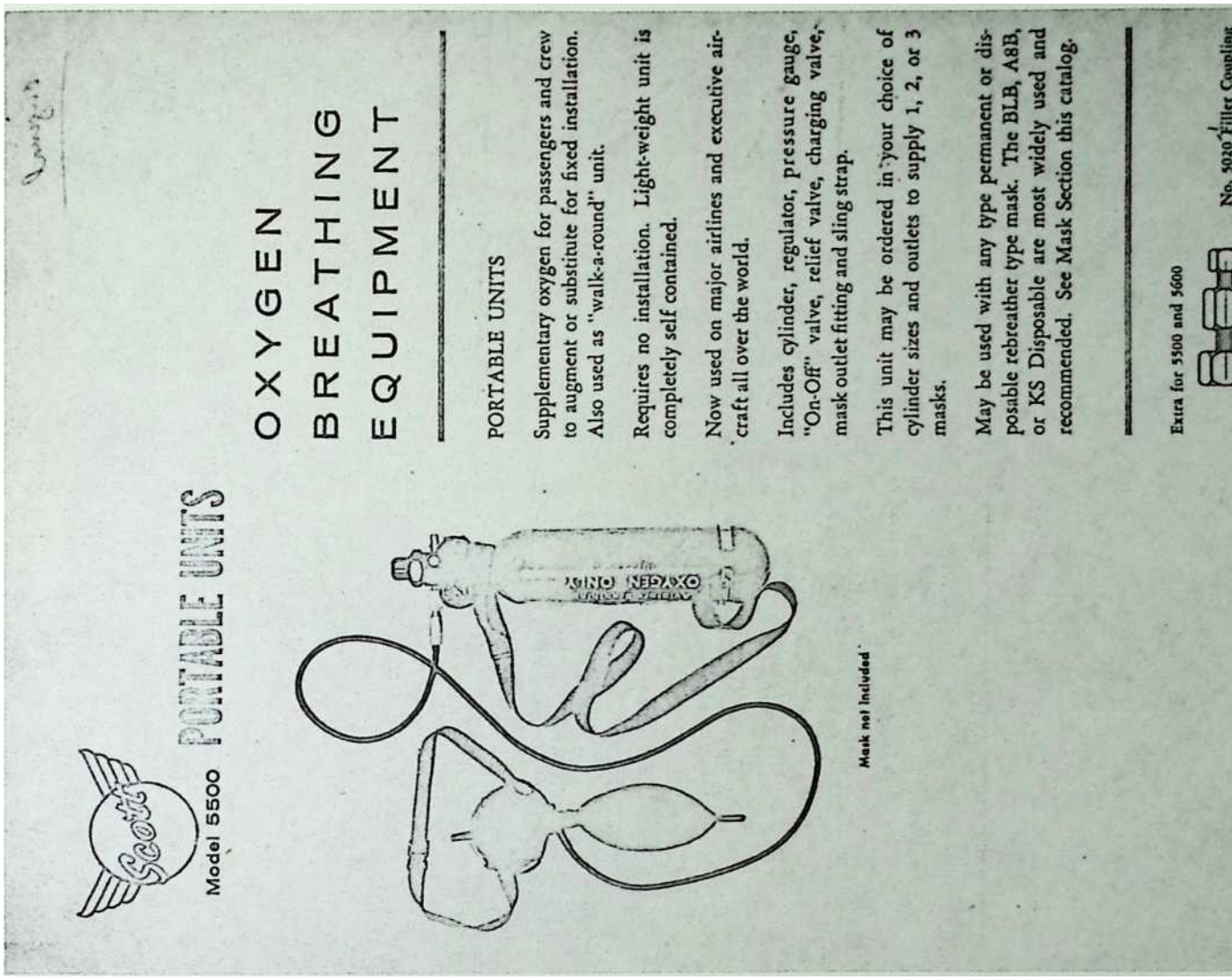


FIGURE 13





Model 5500 PORTABLE UNITS

OXYGEN BREATHING EQUIPMENT

Mask not included

PORTABLE UNITS

Supplementary oxygen for passengers and crew to augment or substitute for fixed installation. Also used as "walk-a-round" unit.

Requires no installation. Light-weight unit is completely self contained.

Now used on major airlines and executive aircraft all over the world.

Includes cylinder, regulator, pressure gauge, "On-Off" valve, relief valve, charging valve, mask outlet fitting and sling strap.

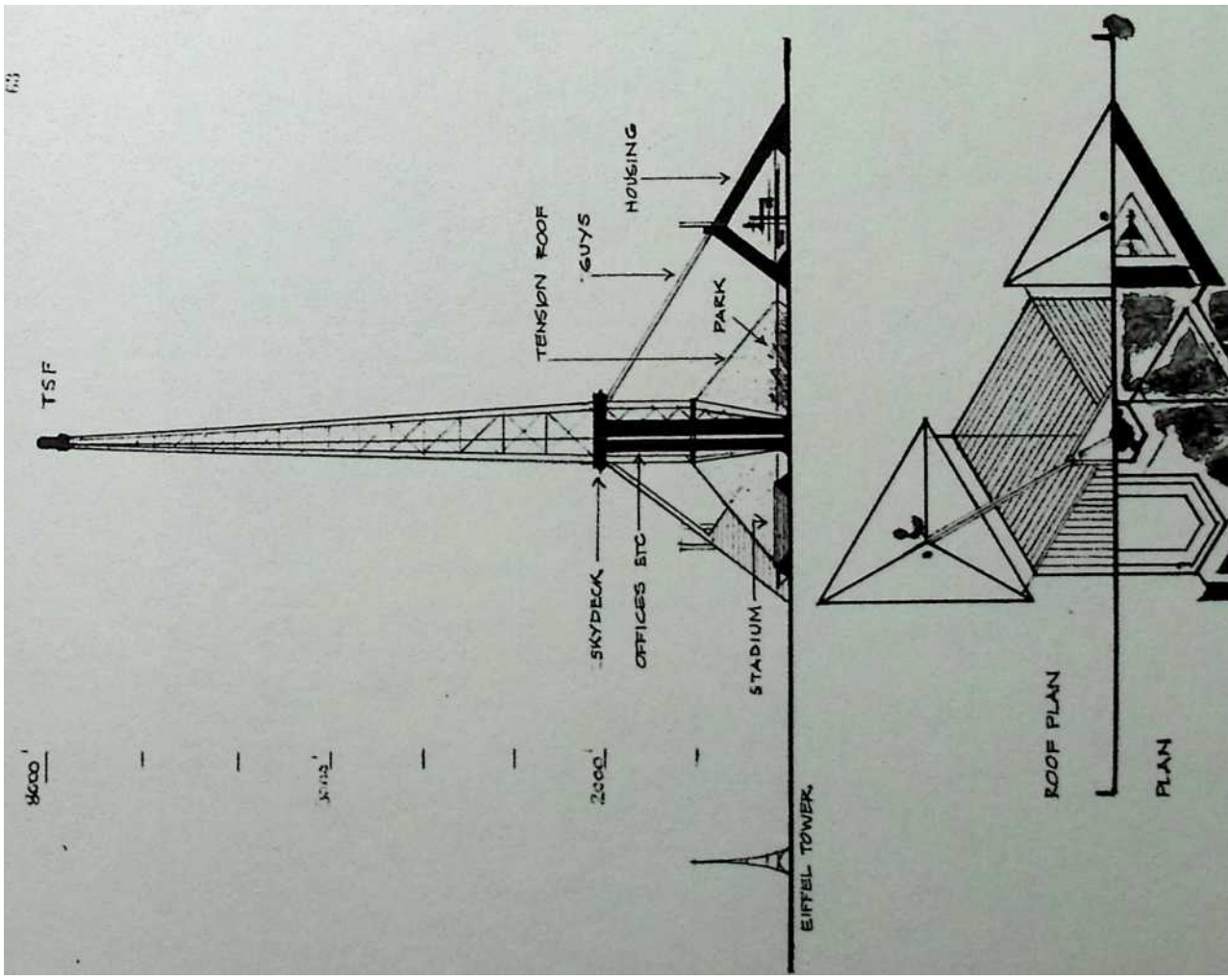
This unit may be ordered in your choice of cylinder sizes and outlets to supply 1, 2, or 3 masks.

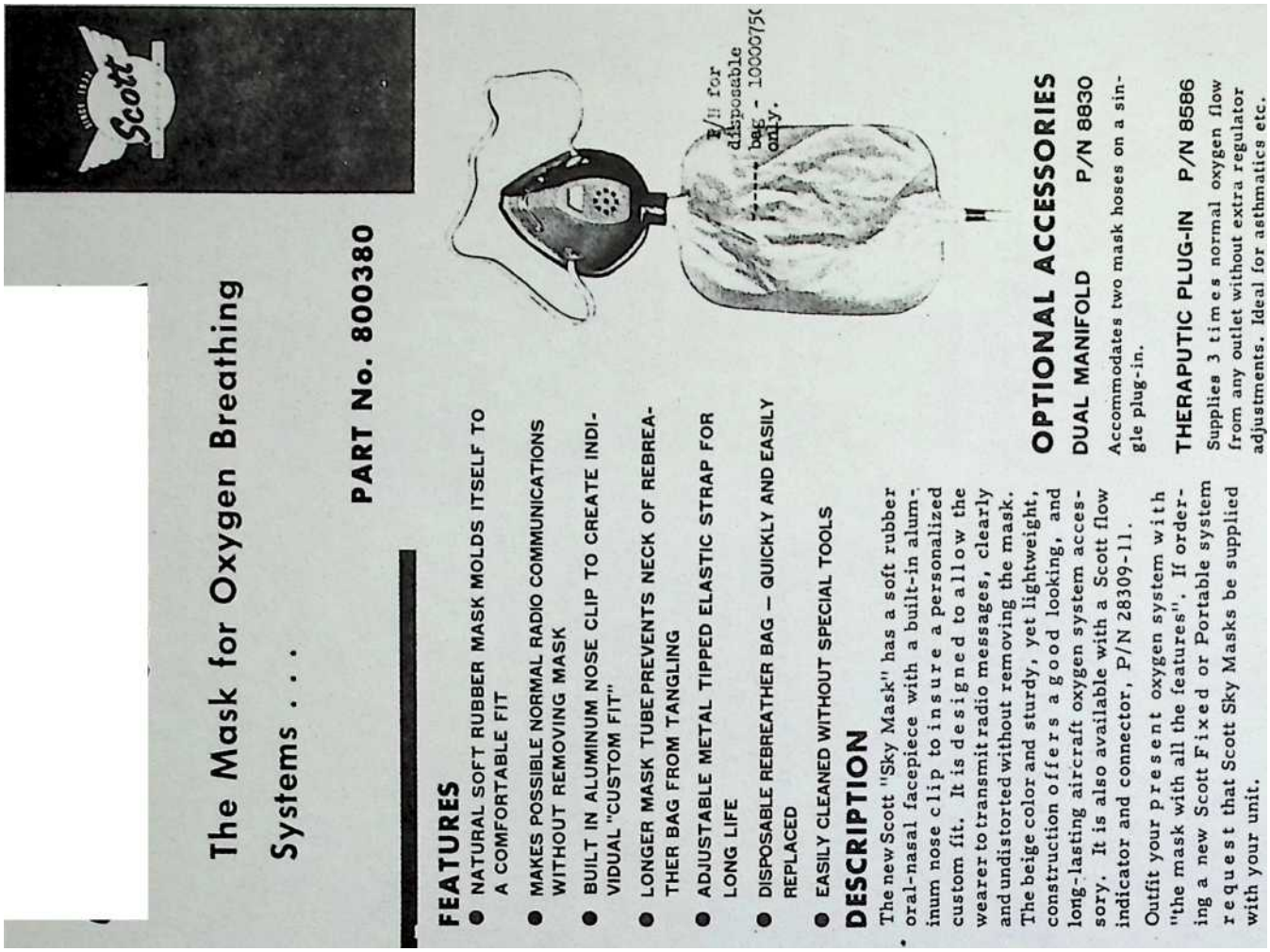
May be used with any type permanent or disposable rebreather type mask. The BLB, A8B, or KS Disposable are most widely used and recommended. See Mask Section this catalog.

Extra for 5500 and 5600

No. 3020 Filler Coupling

Connects portable to recharging source.


TSF
TENSION ROOF
GUYS
HOUSING
PARK
SKYDECK
OFFICES ETC
STADIUM
EIFFEL TOWER
ROOF PLAN
PLAN



The Mask for Oxygen Breathing Systems . . .

PART No. 800380

FEATURES

- NATURAL SOFT RUBBER MASK MOLDS ITSELF TO A COMFORTABLE FIT
- MAKES POSSIBLE NORMAL RADIO COMMUNICATIONS WITHOUT REMOVING MASK
- BUILT IN ALUMINUM NOSE CLIP TO CREATE INDIVIDUAL "CUSTOM FIT"
- LONGER MASK TUBE PREVENTS NECK OF REBREATHER BAG FROM TANGLING
- ADJUSTABLE METAL TIPPED ELASTIC STRAP FOR LONG LIFE
- DISPOSABLE REBREATHER BAG — QUICKLY AND EASILY REPLACED
- EASILY CLEANED WITHOUT SPECIAL TOOLS

DESCRIPTION

The new Scott "Sky Mask" has a soft rubber oral-nasal facepiece with a built-in aluminum nose clip to insure a personalized custom fit. It is designed to allow the wearer to transmit radio messages, clearly and undistorted without removing the mask. The beige color and sturdy, yet lightweight, construction offers a good looking, and long-lasting aircraft oxygen system accessory. It is also available with a Scott flow indicator and connector, P/N 28309-11.

Outfit your present oxygen system with "the mask with all the features". If ordering a new Scott Fixed or Portable system request that Scott Sky Masks be supplied with your unit.

OPTIONAL ACCESSORIES

DUAL MANIFOLD P/N 8830

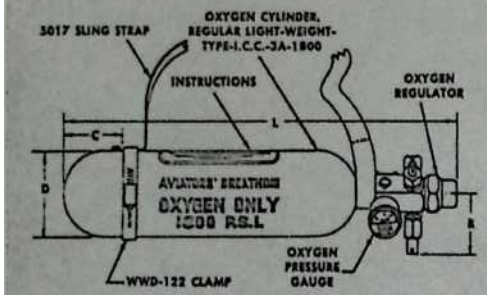
Accommodates two mask hoses on a single plug-in.

THERAPUTIC PLUG-IN P/N 8586

Supplies 3 times normal oxygen flow from any outlet without extra regulator adjustments. Ideal for asthmatics etc.

SKY MASK

SCOTT AVIATION CORPORATION O LANCASTER, NEW YORK form No. 1442 9-65SAC 5m Printed in U S A.



DURATION TIME

To determine total "on oxygen" time in minutes, divide cylinder liter capacity by flow rate of outlets. For example: 11 cu. ft. cylinder (310 liters) provides 155 minutes duration using "B" outlet (2 liters) per minute.

TO ORDER BASIC NUMBER: **5500-A1A-A20A**

A					1		A		A		20		A	
CYLINDER ASSEMBLY					CYLINDER FINISH		HARNESS		CONSTANT FLOW OUTLET SETTING AT 14.7 p.s.i. AT 0°C		DESIRED OPERATING ALTITUDE		OUTLET STYLE	
LTR	CU. FT.	EST. WT. (lbs.)	DIM. D	DIM. L	NO.	COLOR	LTR	DRAWING NO.	LTR	FLOW (LPM)	NO.	ALTITUDE (Ft.)	LTR	PART NO.
A	4.25	4.88	3.56	12.98	1	GRAY-GREEN — w/LETTERING	A	5017 Sling	A	.5	10	10,000	A	5009 (AN)
B	7.15	6.31	3.56	17.10					B	2	11	11,000	B	5041 (ARO)
C	11.0	8.62	3.56	22.60					C	2.5	12	12,000	C	5052 (Heidbrk.)
D	22.0	14.44	5.25	22.60					D	2.7	13	13,000	D	5507 (Puritan)
E	28.8	17.53	6.75	19.48					E	3	14	14,000	K	Plug—no outlet)
F	38.4	21.04	6.75	23.35					F	4	15	15,000		
G	48.3	28.84	6.75	27.60					G	7	16	16,000		
									H	8	17	17,000		
											18	18,000		
											19	19,000		
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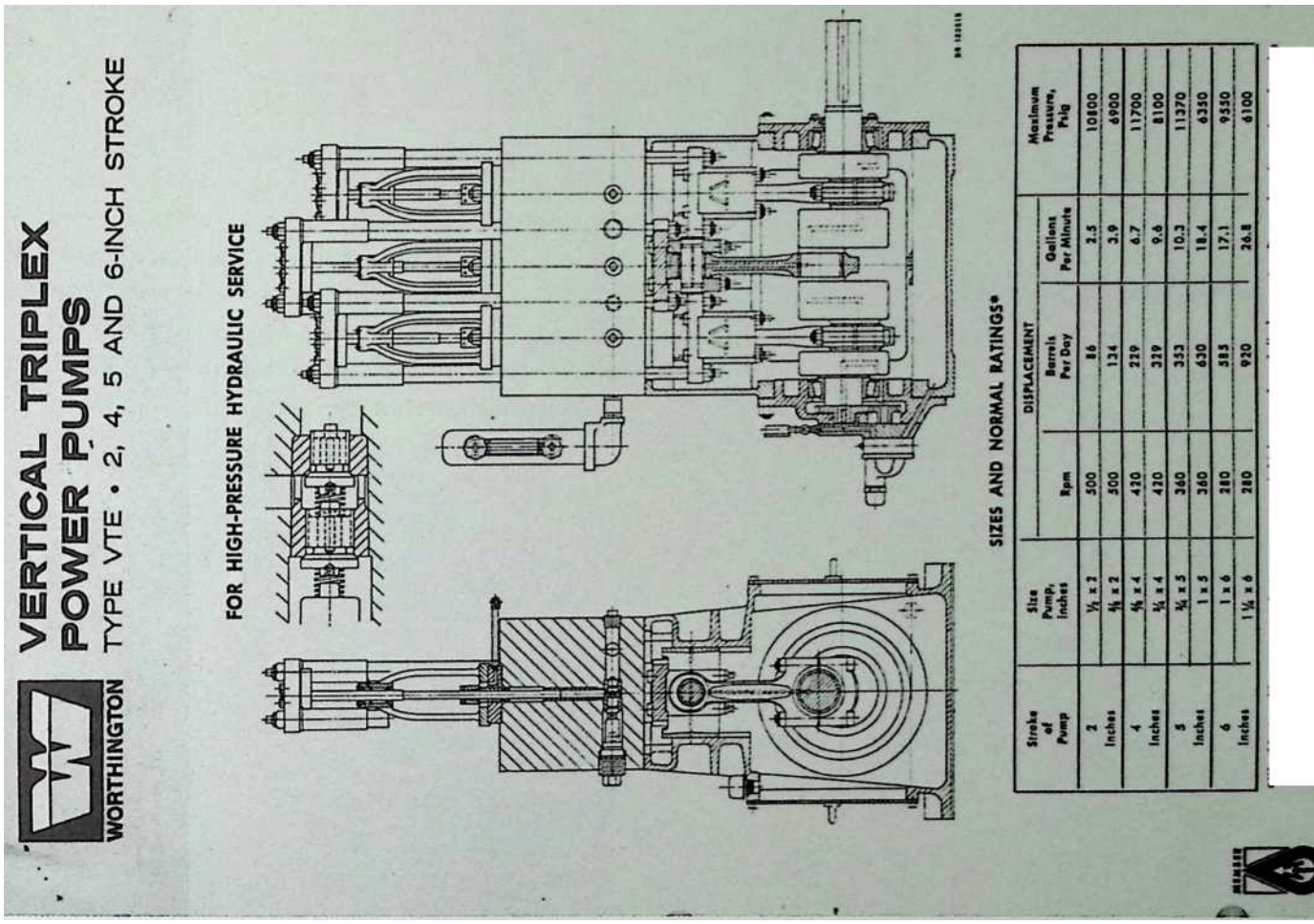


WORTHINGTON

VERTICAL TRIPLEX POWER PUMPS

TYPE VTE • 2, 4, 5 AND 6-INCH STROKE

FOR HIGH-PRESSURE HYDRAULIC SERVICE

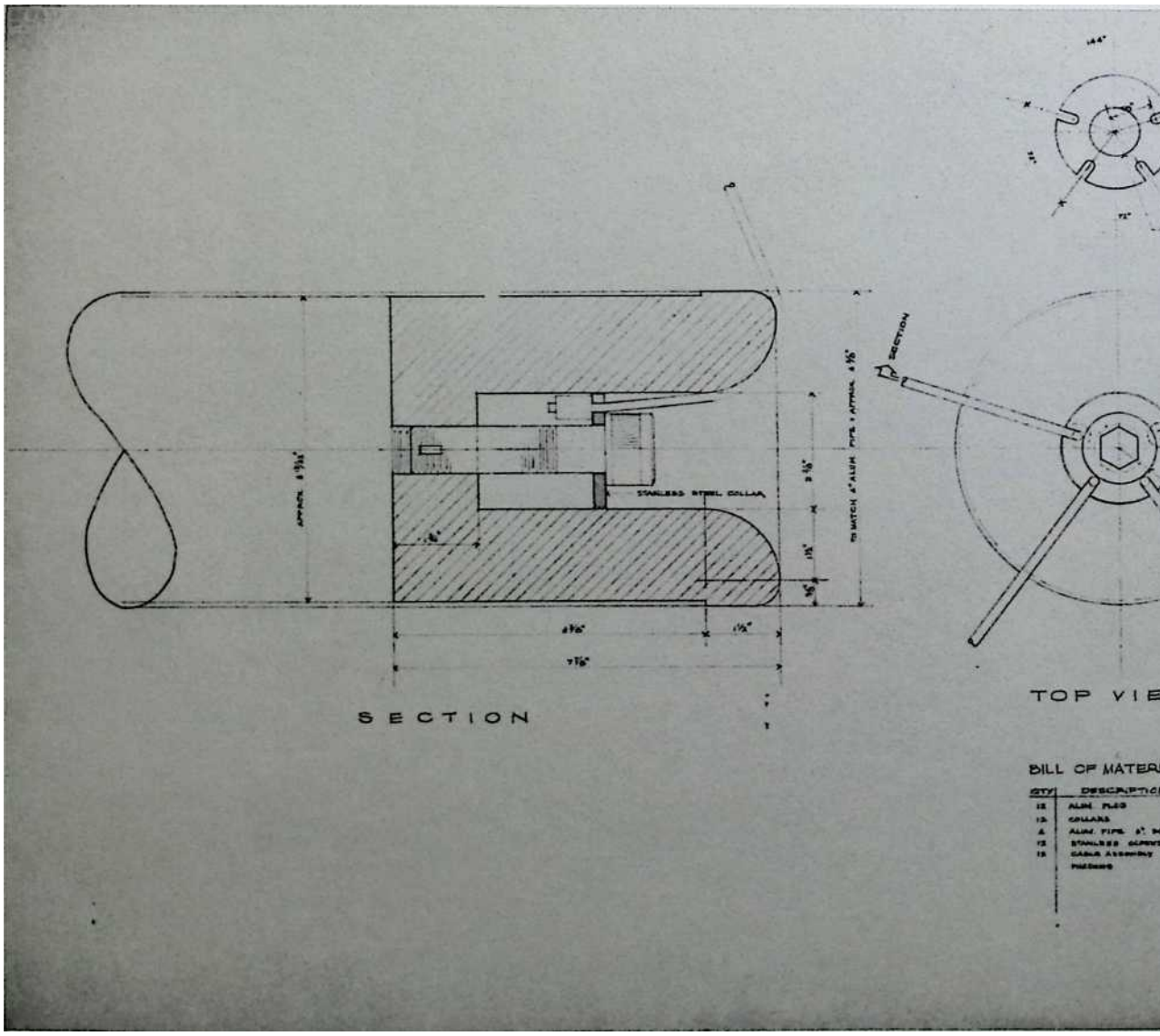
SIZES AND NORMAL RATINGS*

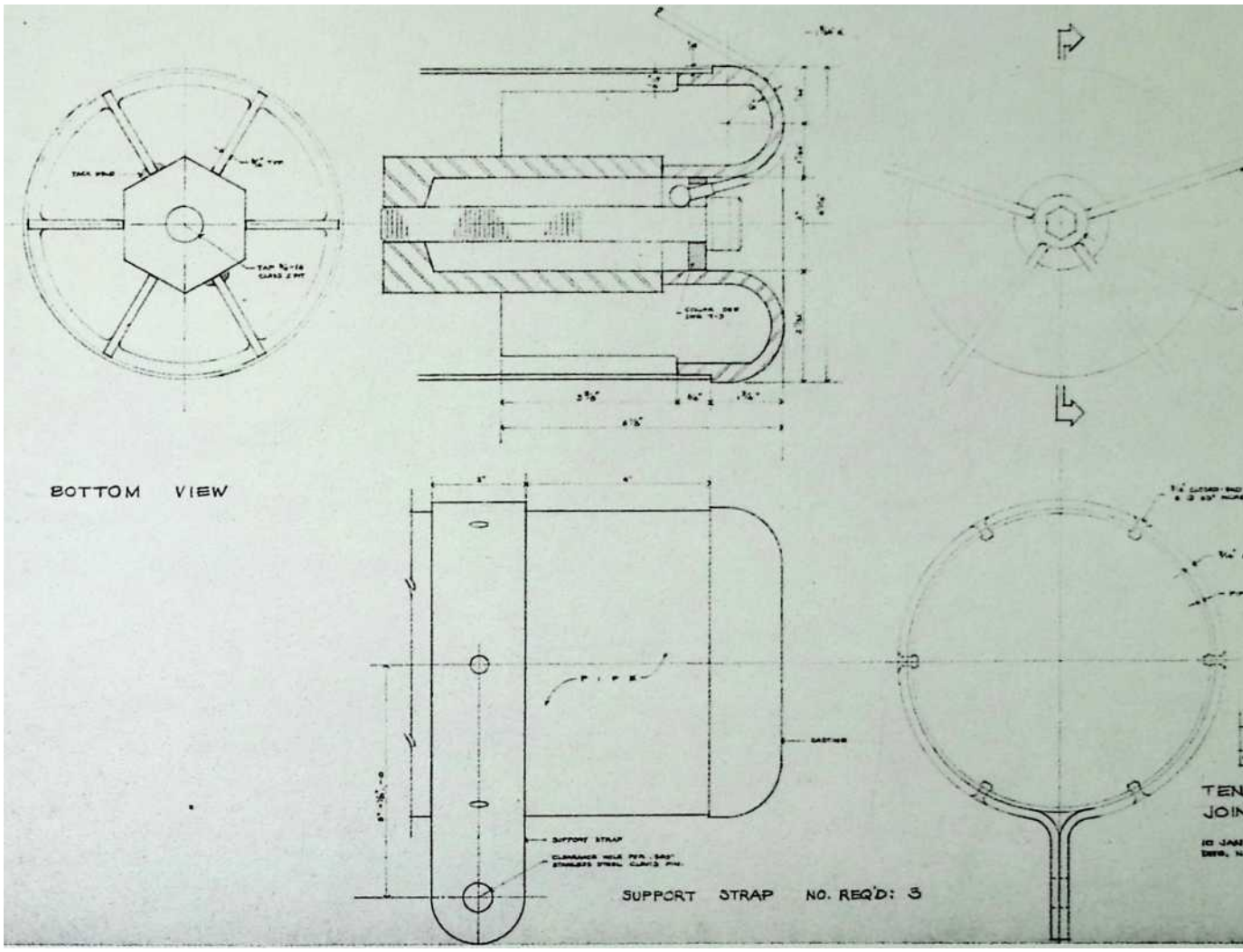
Stroke of Pump	Size Pump, Inches	DISPLACEMENT			Maximum Pressure, Psig
		Rpm	Barrels Per Day	Gallons Per Minute	
2 Inches	½ x 2	500	86	2.5	10800
	¾ x 2	500	134	3.9	6900
4 Inches	¾ x 4	420	229	6.7	11700
	¾ x 4	420	329	9.6	8100
5 Inches	¾ x 5	360	353	10.3	11370
	1 x 5	360	630	18.4	6350
6 Inches	1 x 6	280	585	17.1	9550
	1¼ x 6	280	920	26.8	6100

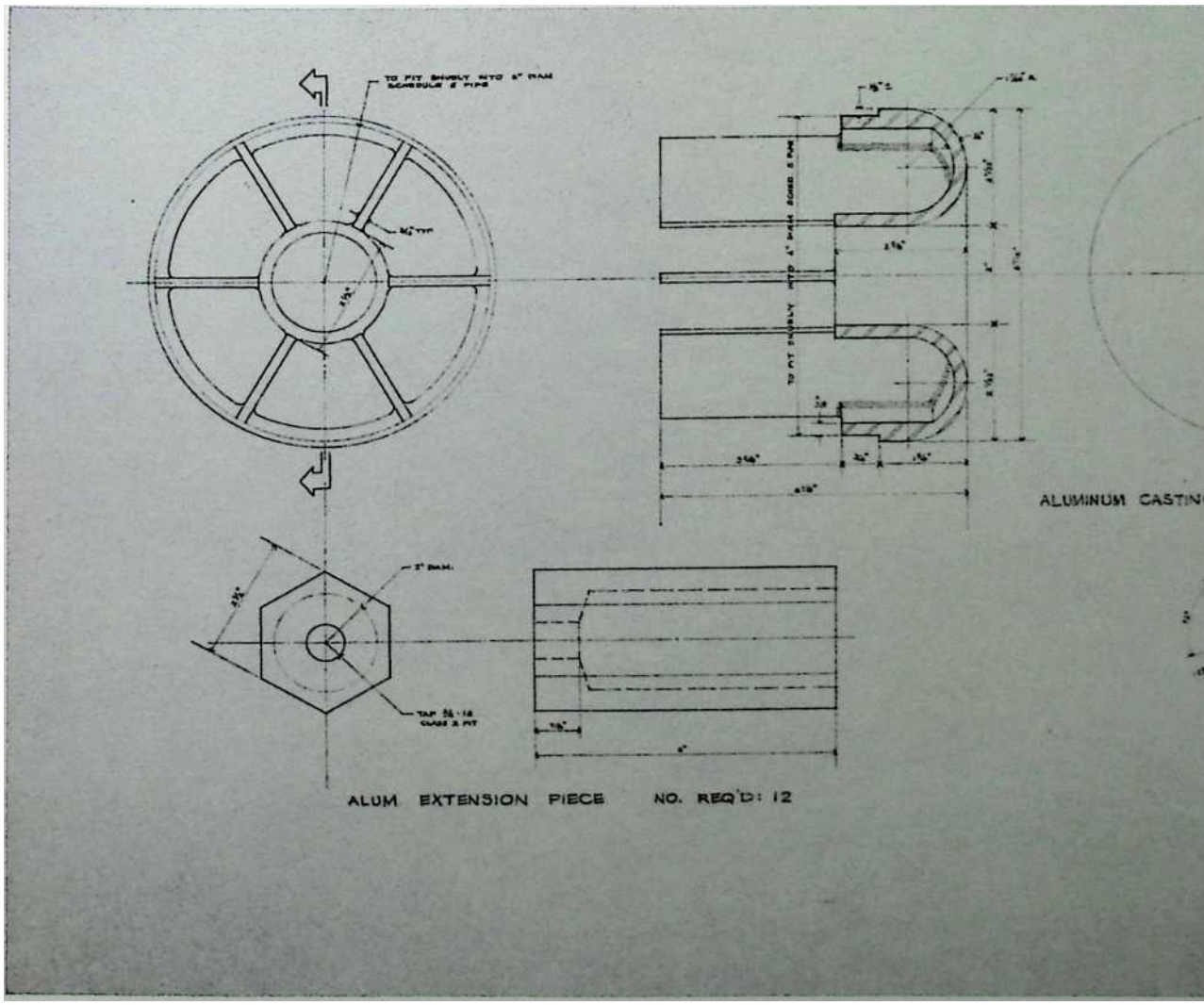
"Worthington, Ilk* lome manufacture r», may permit higher ipeedi and dliplacemenli, after engineering review of ionic* condition!.

20 Tensegrity Joint Fuller & Sadao, 1966

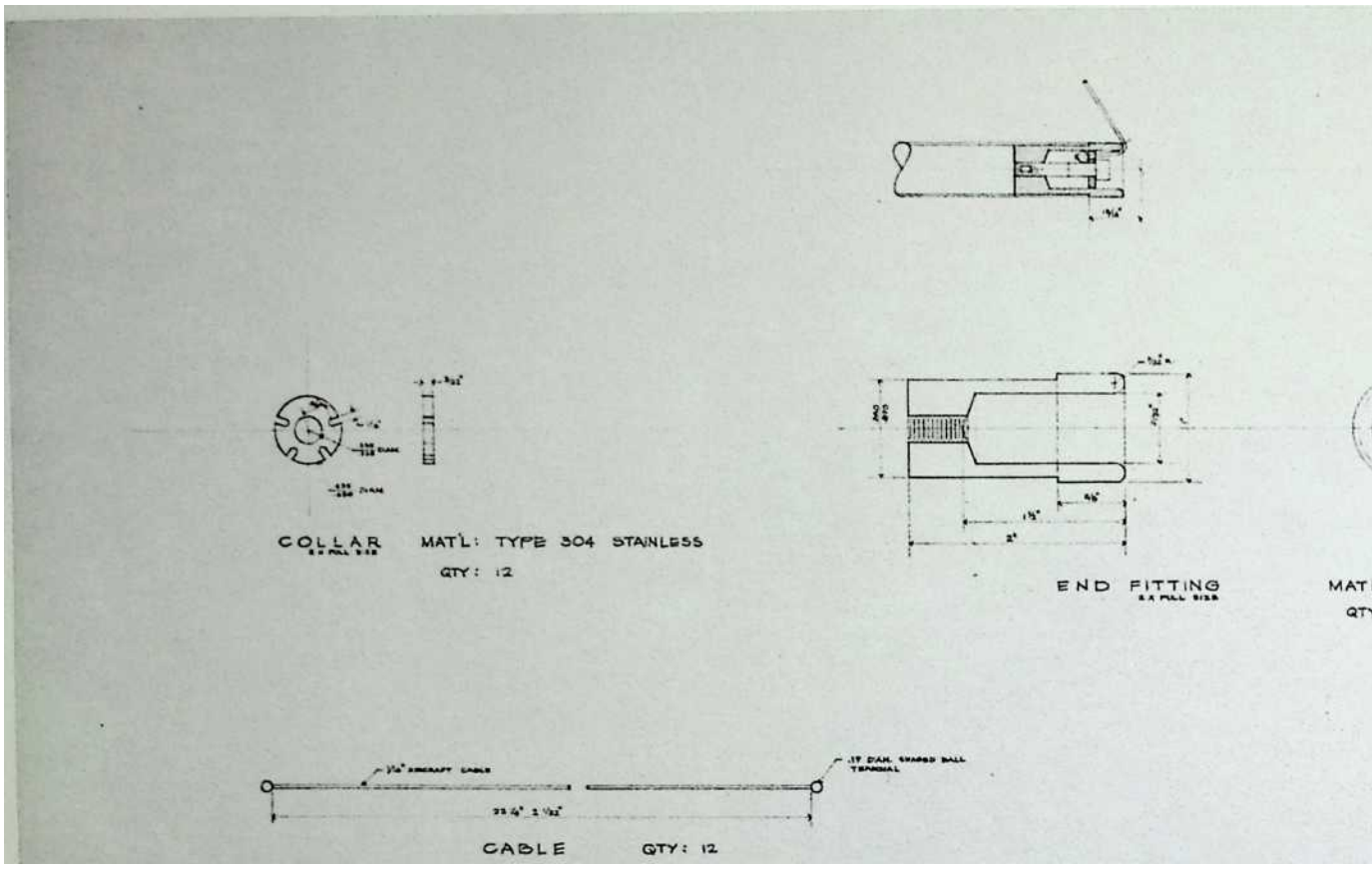
Attending the patents of aspension structures, Fuller designed this tensegrity joint with the architect Shoji Sadao. This design fulfilled the need for a device that would make the pipe ends and cable anchors both precise and more durable. The tensegrity joint is indispensable for a structure that is required to last longer than an exhibition.


STAINLESS STEEL COLLAR
SECTION
TOP VIE
BILL OF MATER


BOTTOM VIEW
SUPPORT STRAP NO. REQ'D: 3

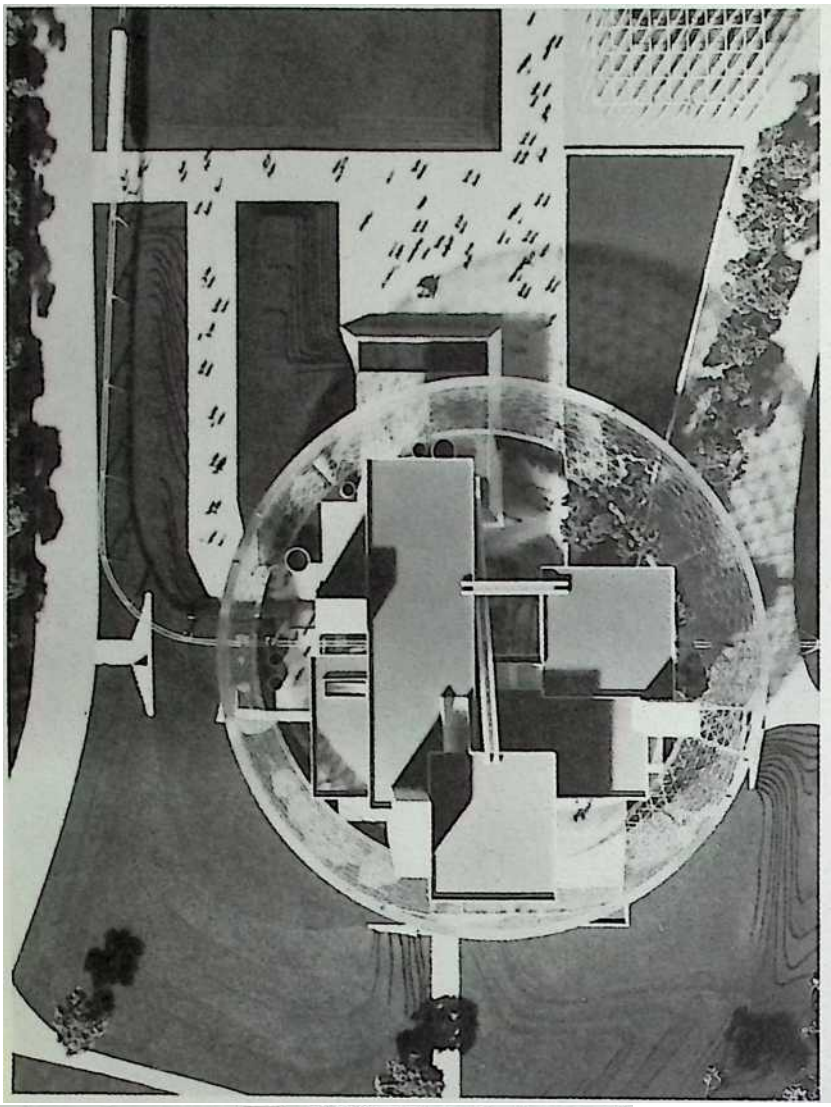


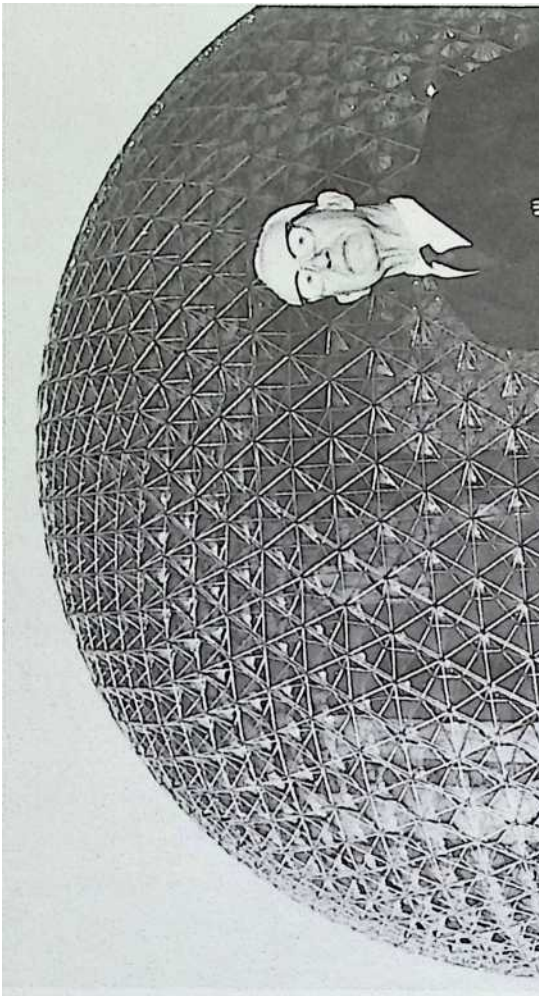
£ STRUT

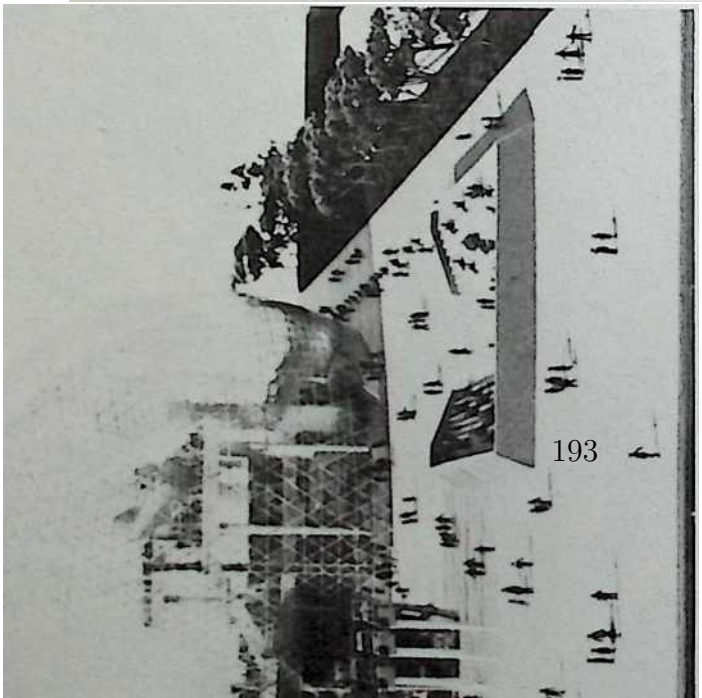

COLLAR
MAT'L: TYPE 304 STAINLESS
QTY: 12
END FITTING
CABLE
QTY: 12

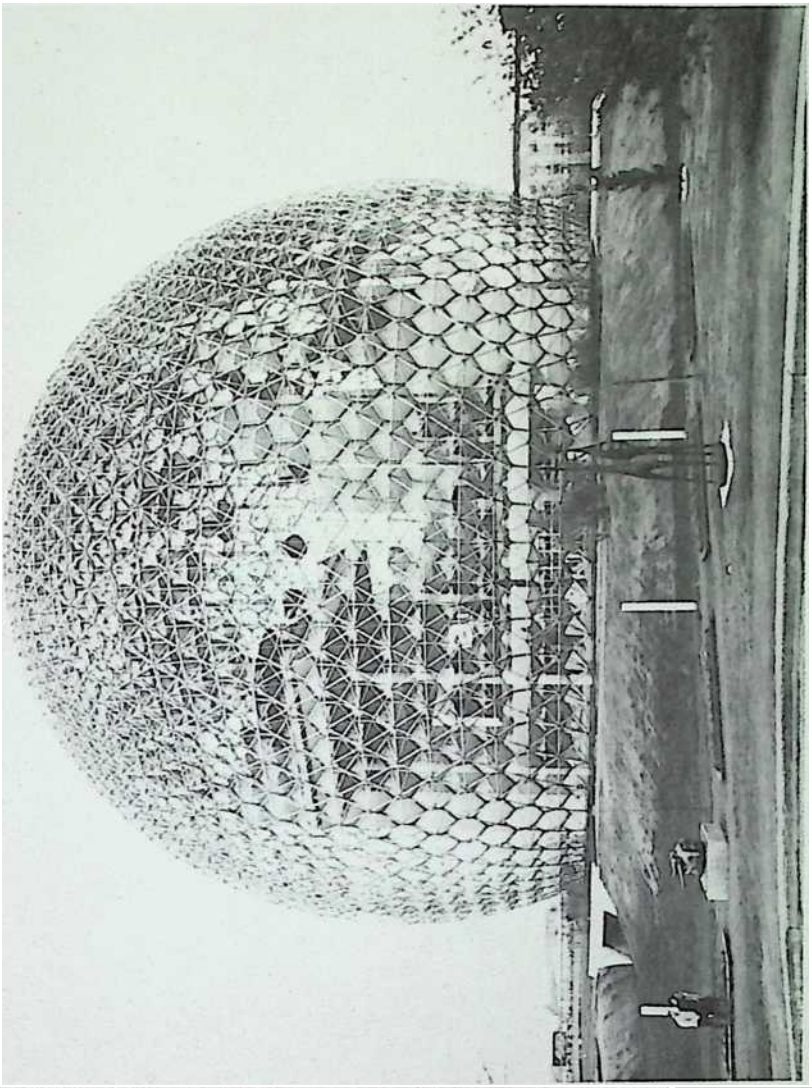
21 United States Pavilion Designed for Expo 1967, Montreal, Canada Fuller & Sadao with Geometries, Inc., 1966–1967

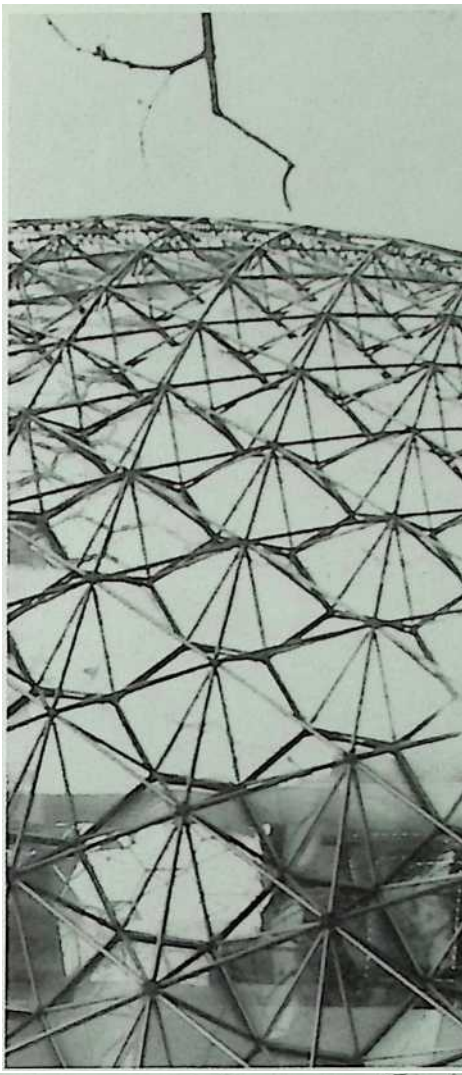
The United States Pavilion at Expo '67 in Montreal was the crowning commission of Fuller's architectural career. Immediately recognized as the symbol of this international fair, the geodesic dome assumed a position on the vanguard of modern design that it had not known since its invention in the late forties. It was conceived as a totally dynamic structure, through which a throng of people were guided on escalators to the various levels of the exhibition. On the outside, one could observe the monorail as it penetrated the glistening acrylic skin of the dome, which was outfitted with triangular shades that were to close automatically in accordance with a computerized scheme reflecting the path of the sun. The structure is the star tensegrity truss that had been perfected during the mid-1960s.

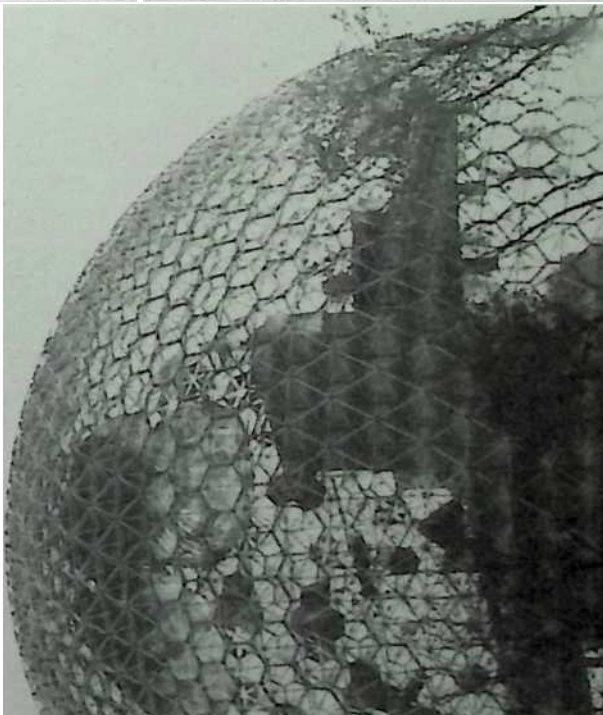


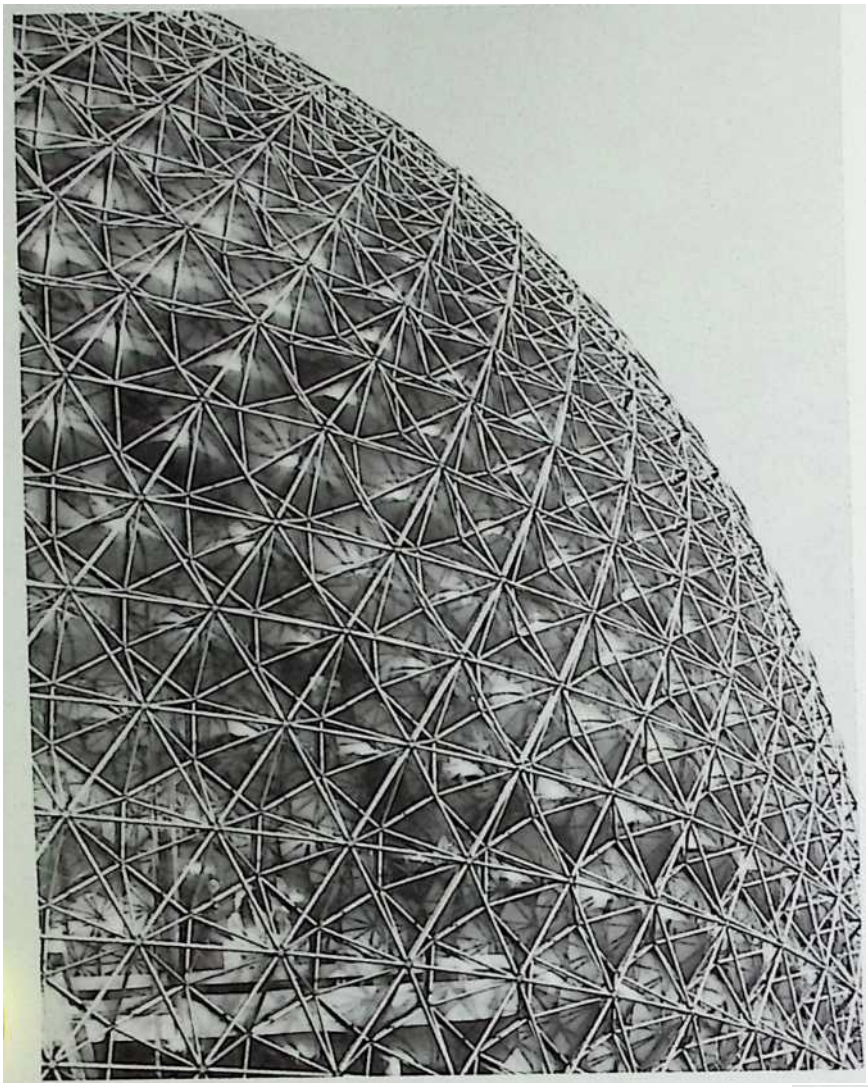


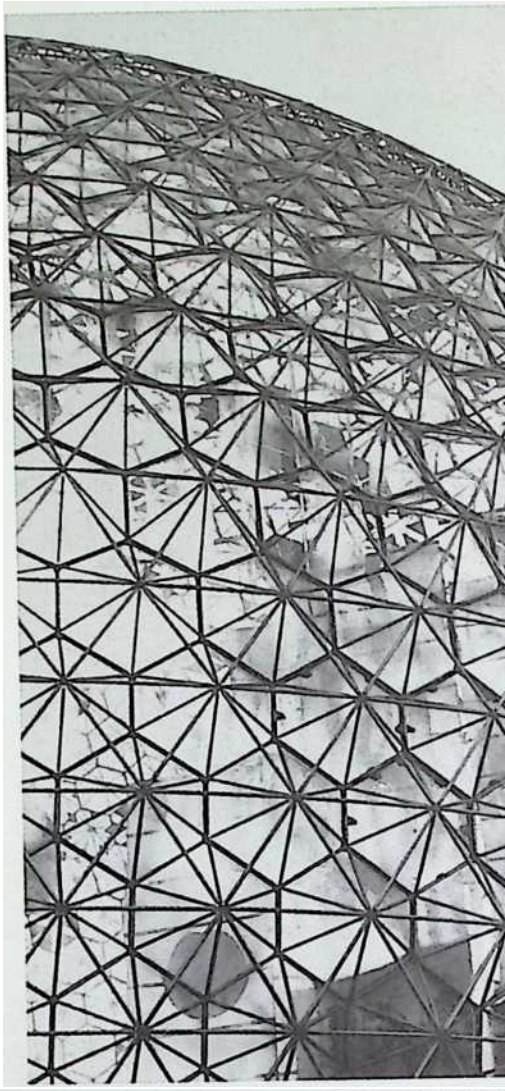


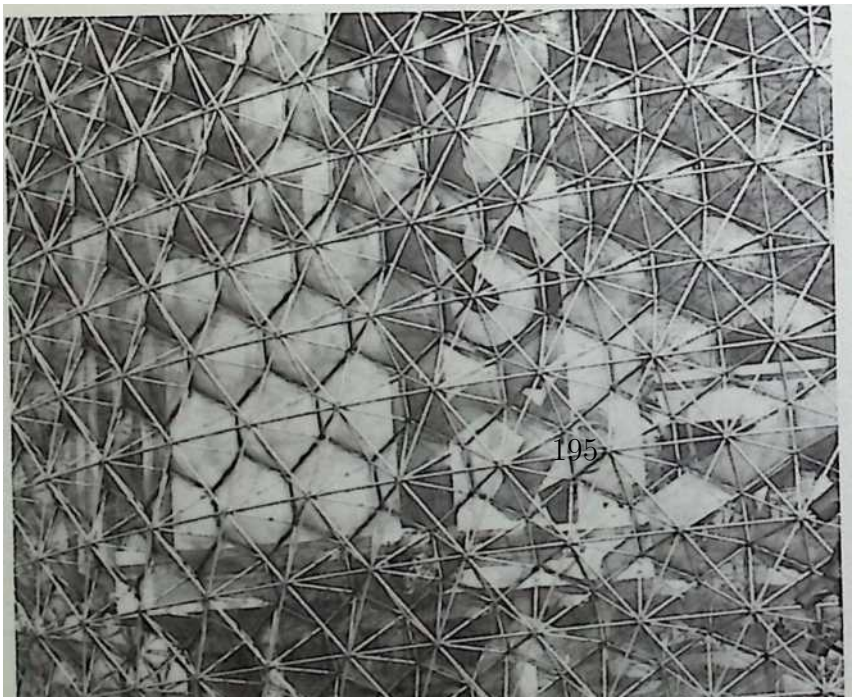


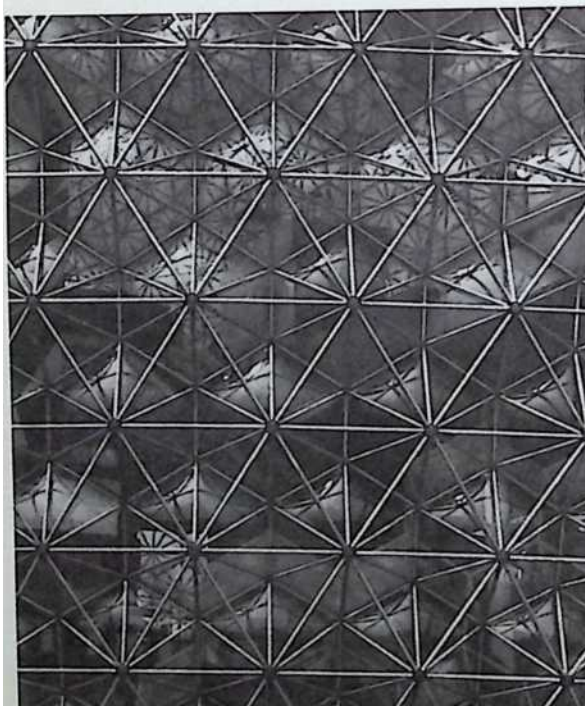


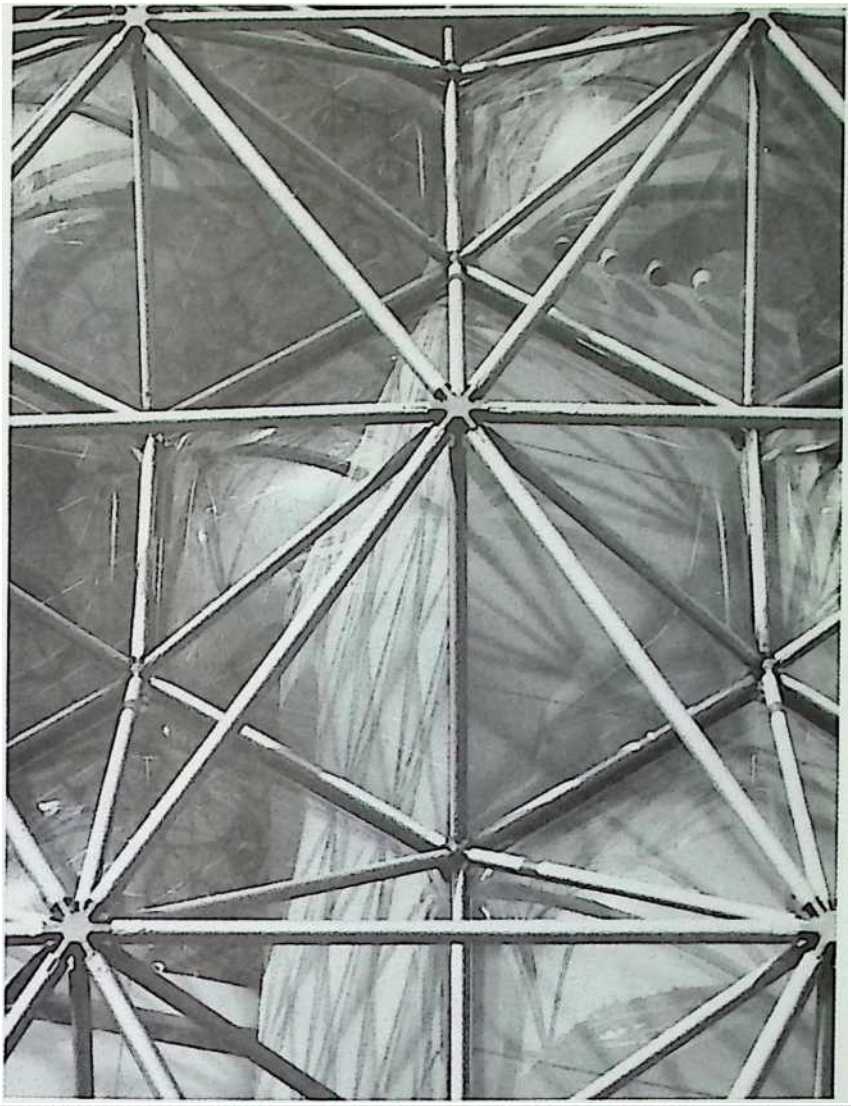


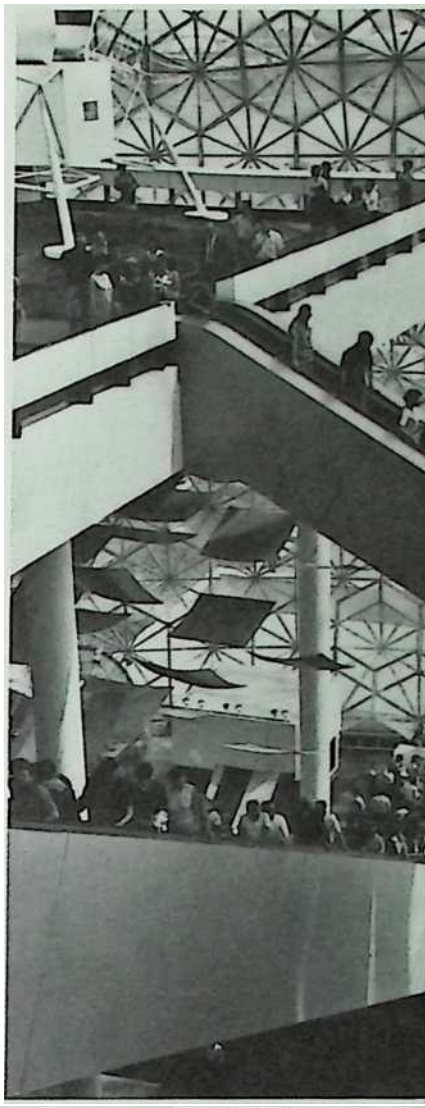


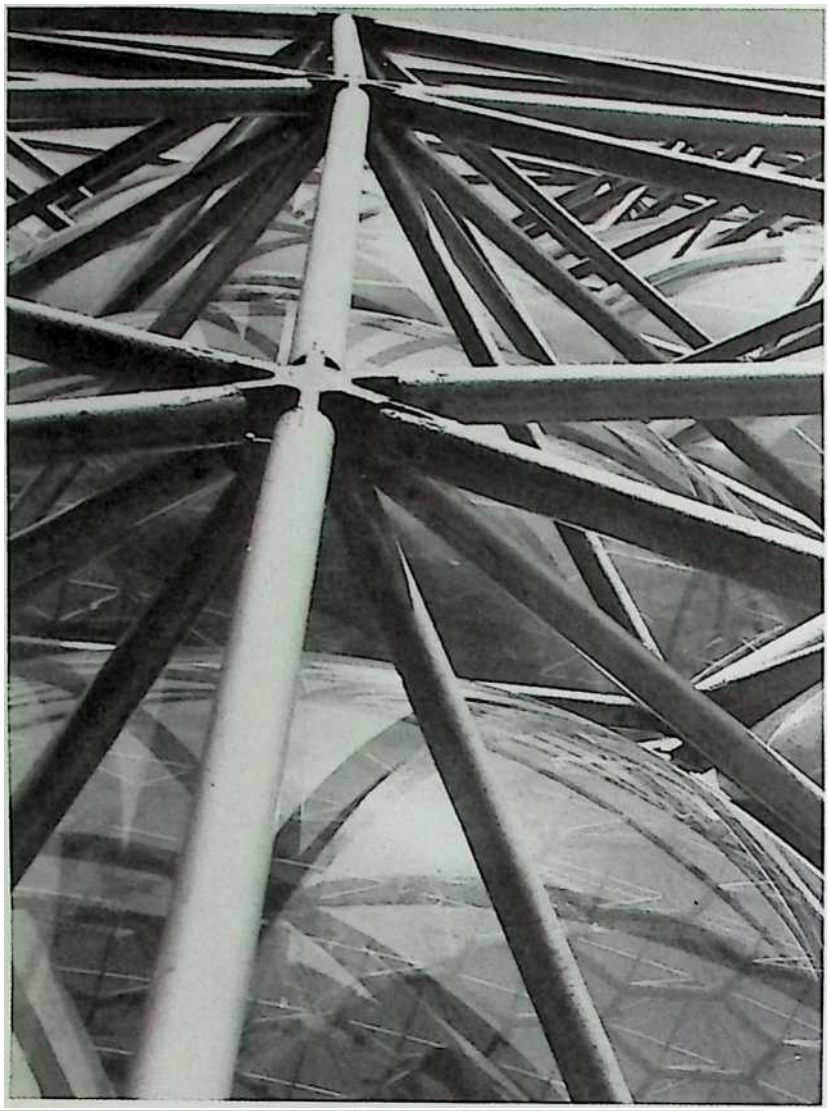


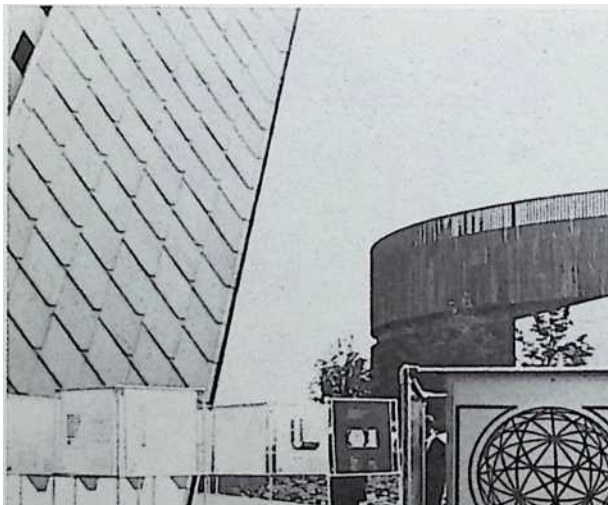


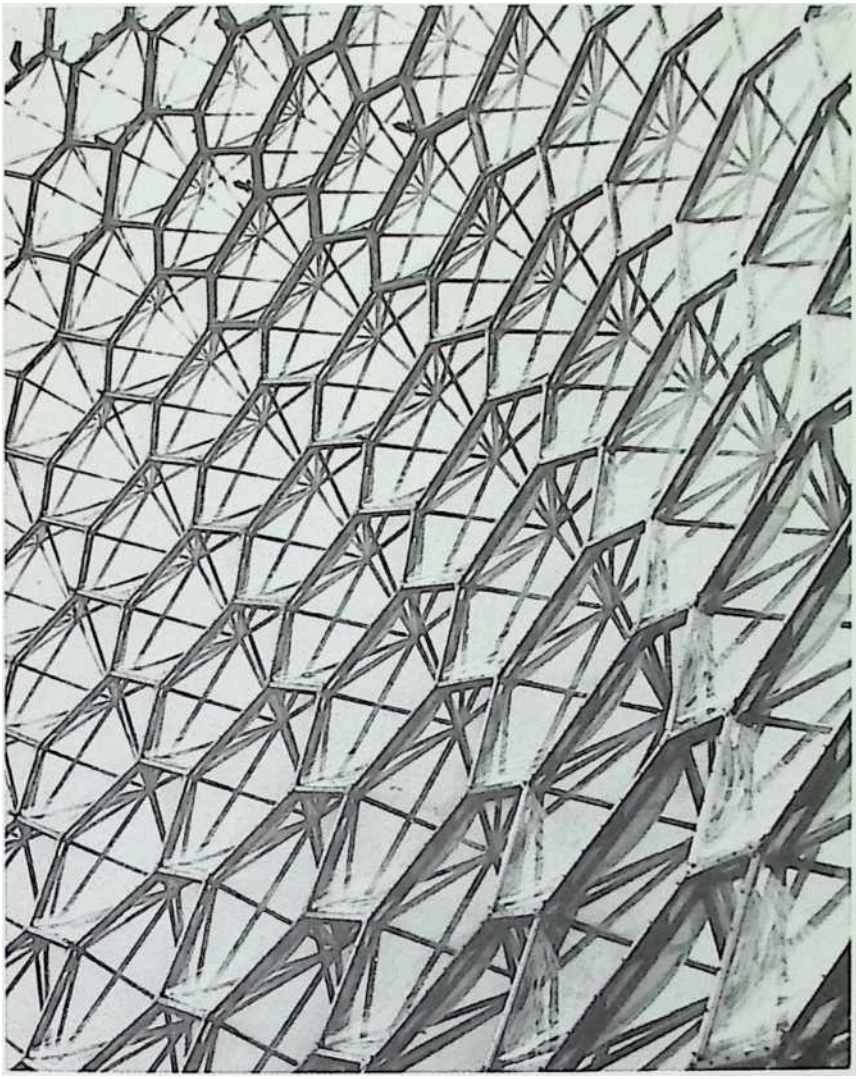


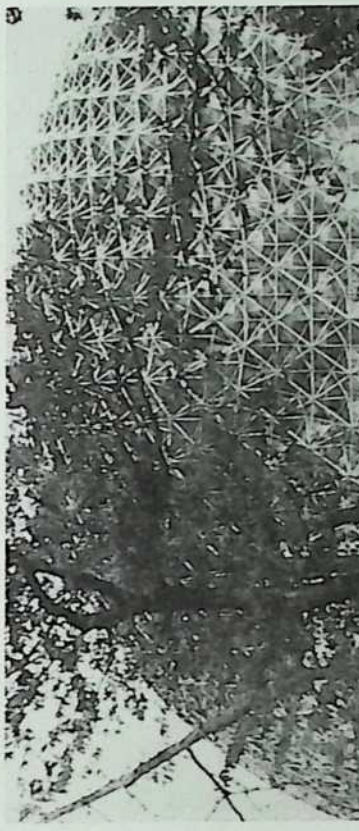


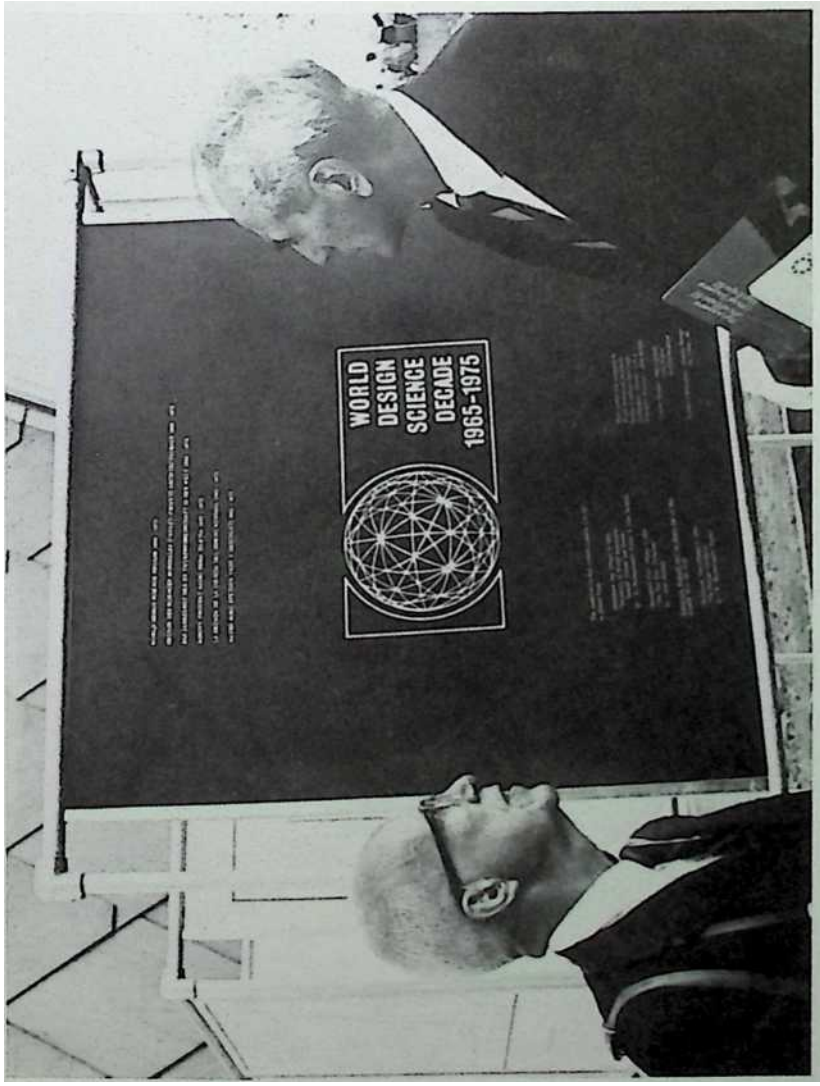


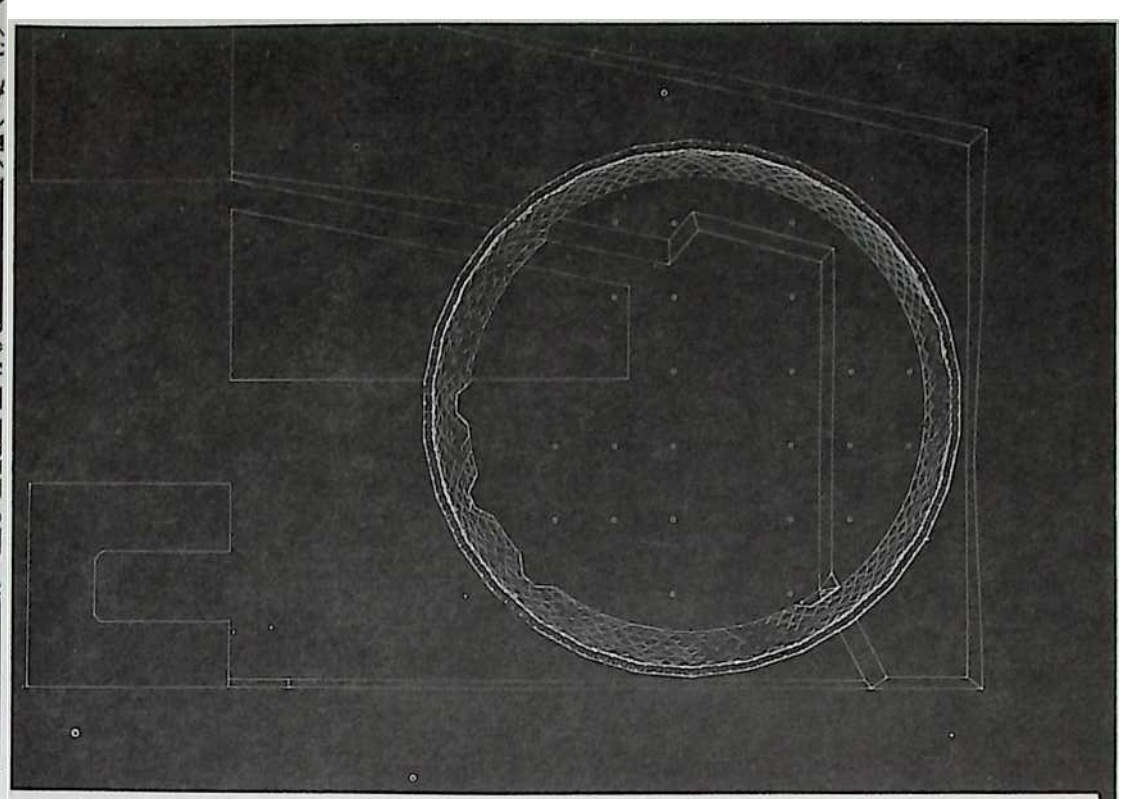




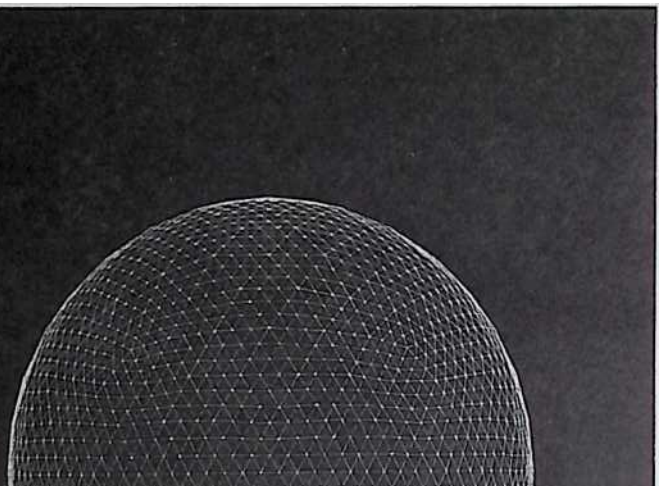


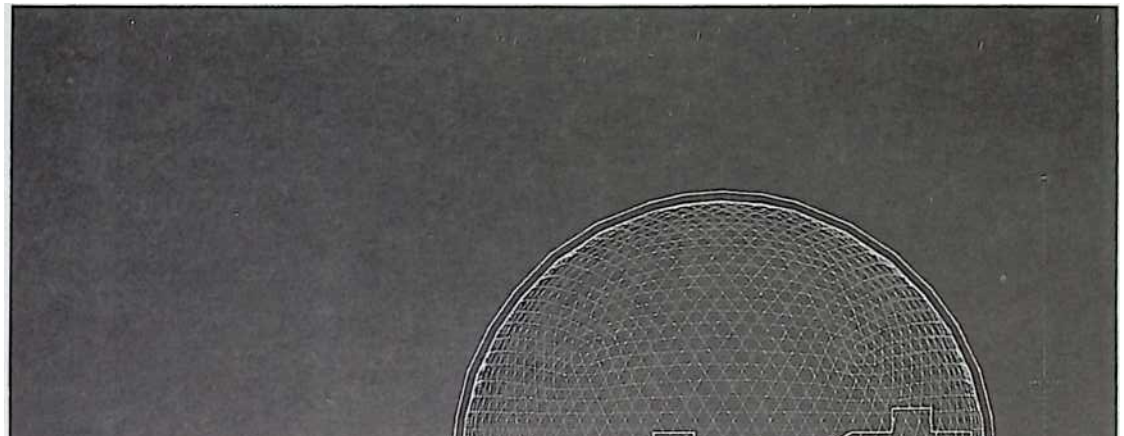



WORLD
DESIGN
SCIENCE
DECADE
1965-1975



UNITED STATES PAVILION, MONTREAL 1967 R. Buckminster Fuller. Fuller and Sadao, Inc. Geometrics Inc. Plan 1





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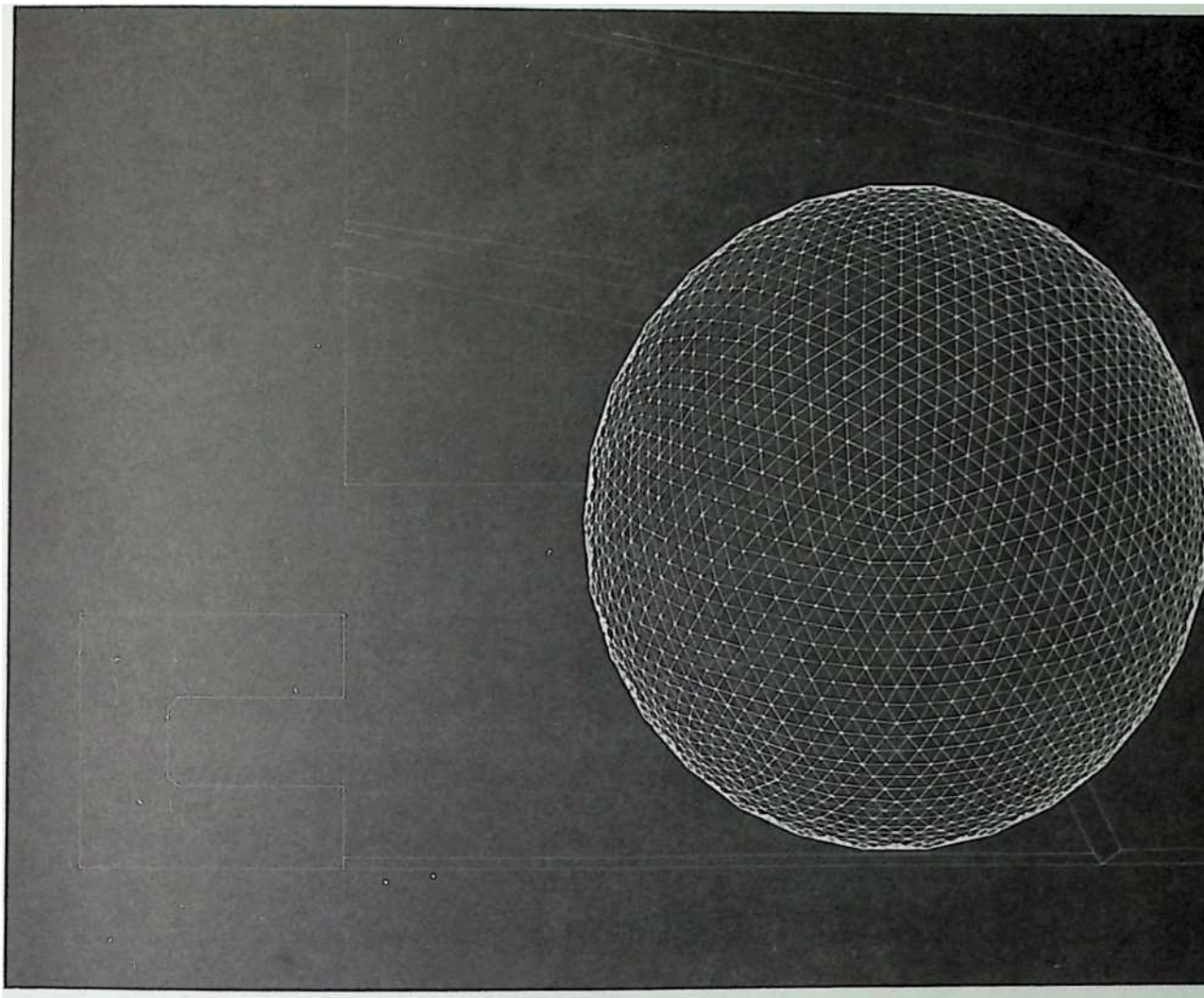
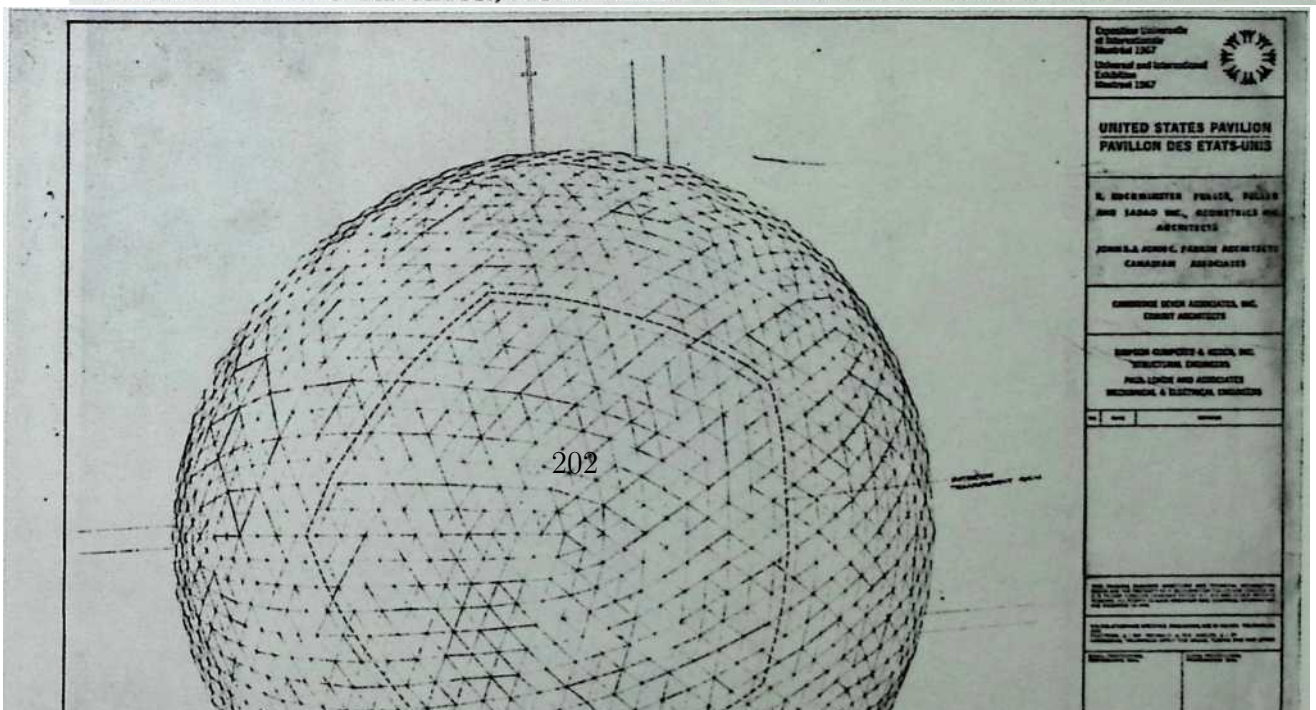
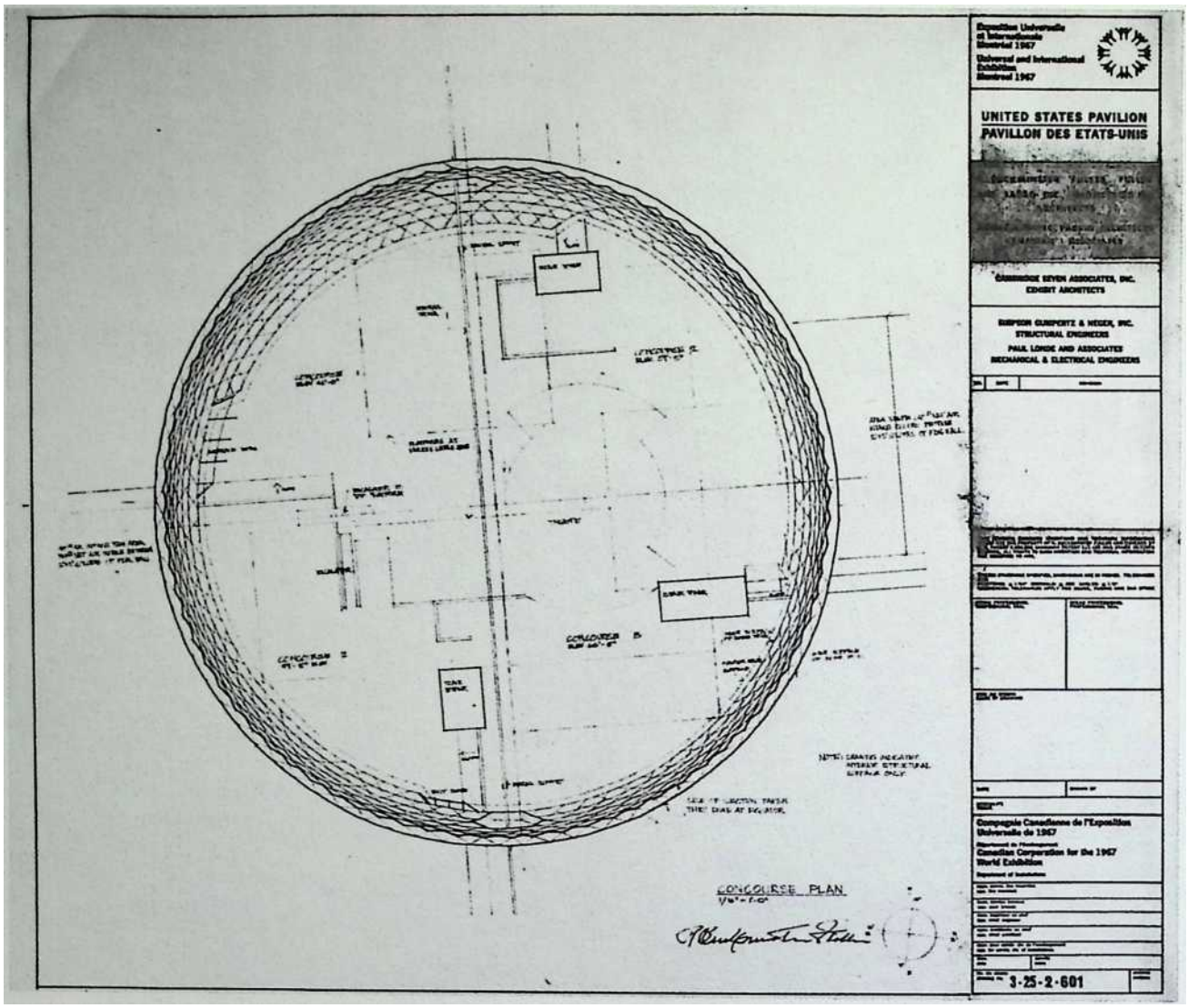
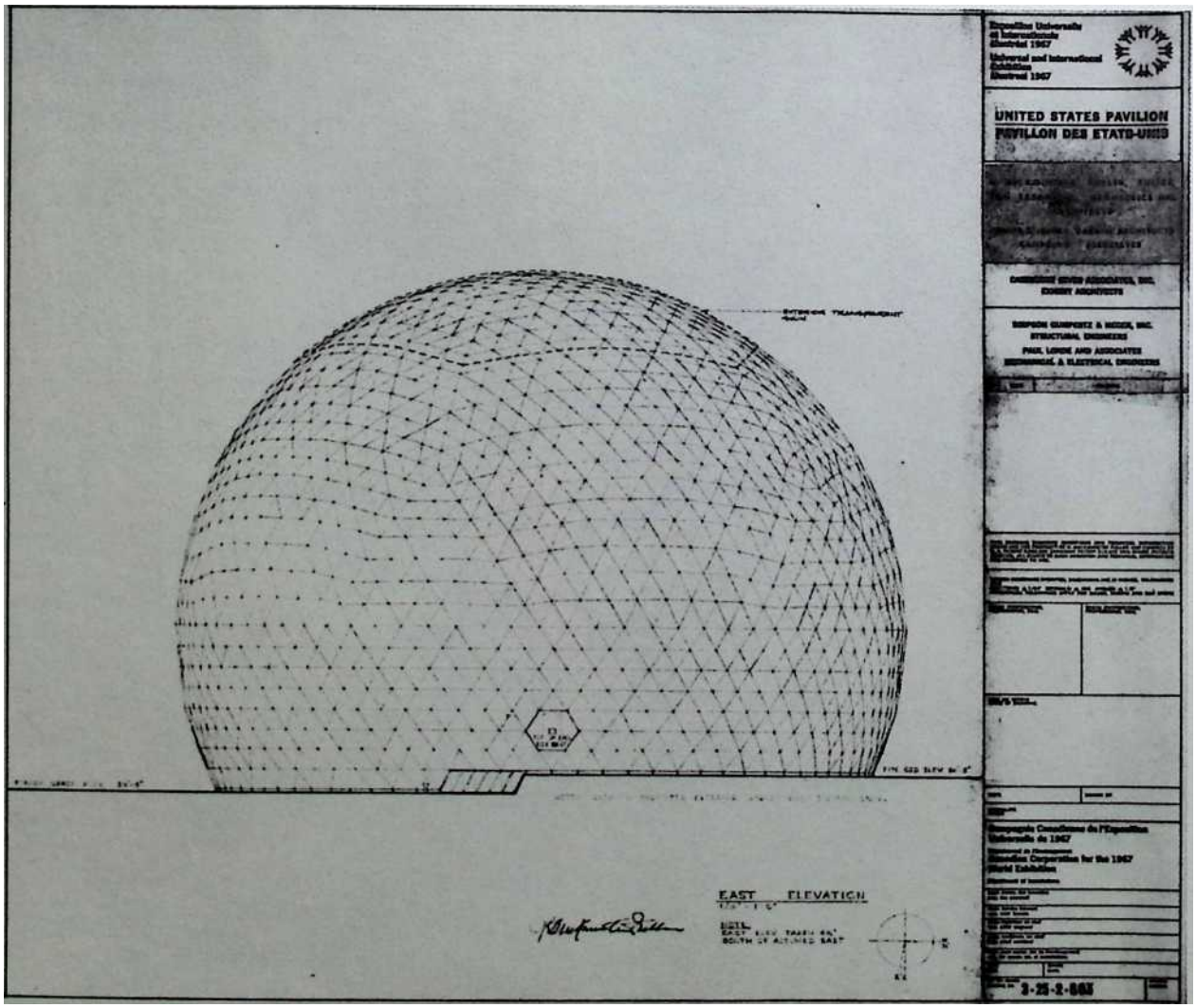


UNITED STATES PAVILION, MONTREAL 1967 R. Buckminster Fuller. Fuller and Sadao, Inc. Geometrics Inc. Top




Exposition Universelle et Internationale Montréal 1967
Universal and International Exhibition Montreal 1967
UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
CAMBRIDGE SEVEN ASSOCIATES, INC.
CONSULT ARCHITECTS
SIMPSON GUMPERTZ & HEGER, INC.
STRUCTURAL ENGINEERS
PAUL LONDE AND ASSOCIATES
MECHANICAL & ELECTRICAL ENGINEERS
Compagnie Canadienne de l'Exposition Universelle de 1967
Canadian Corporation for the 1967 World Exhibition
CONCOURSE PLAN
3-25-2-601



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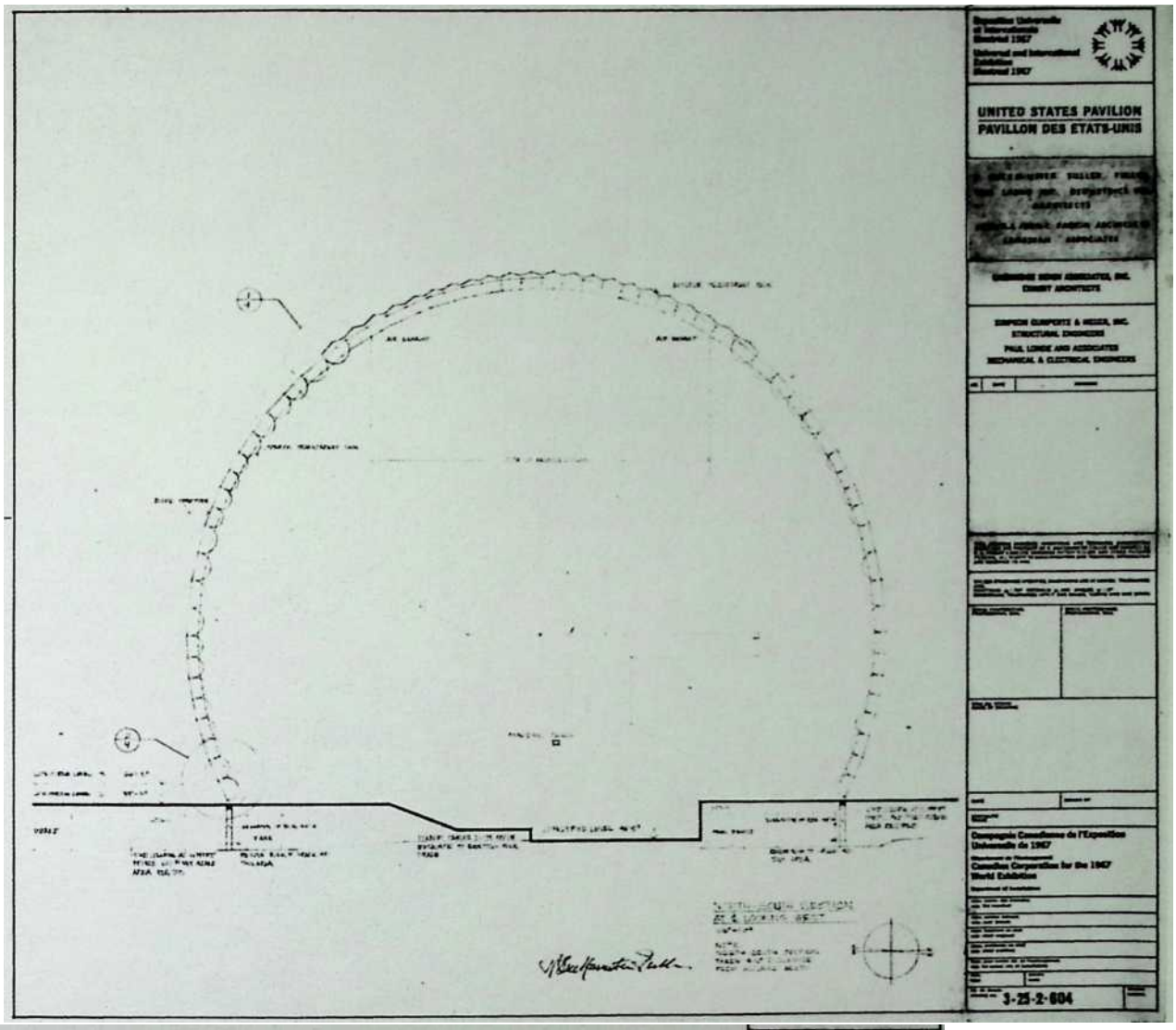
UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
CAMBRIDGE SEVEN ASSOCIATES, INC.
EXHIBIT ARCHITECTS
SIMPSON GUMPERTZ & HEGER, INC.
STRUCTURAL ENGINEERS
PAUL LONDE AND ASSOCIATES
MECHANICAL & ELECTRICAL ENGINEERS
Compagnie Canadienne de l'Exposition Universelle de 1967
Canadian Corporation for the 1967 World Exhibition
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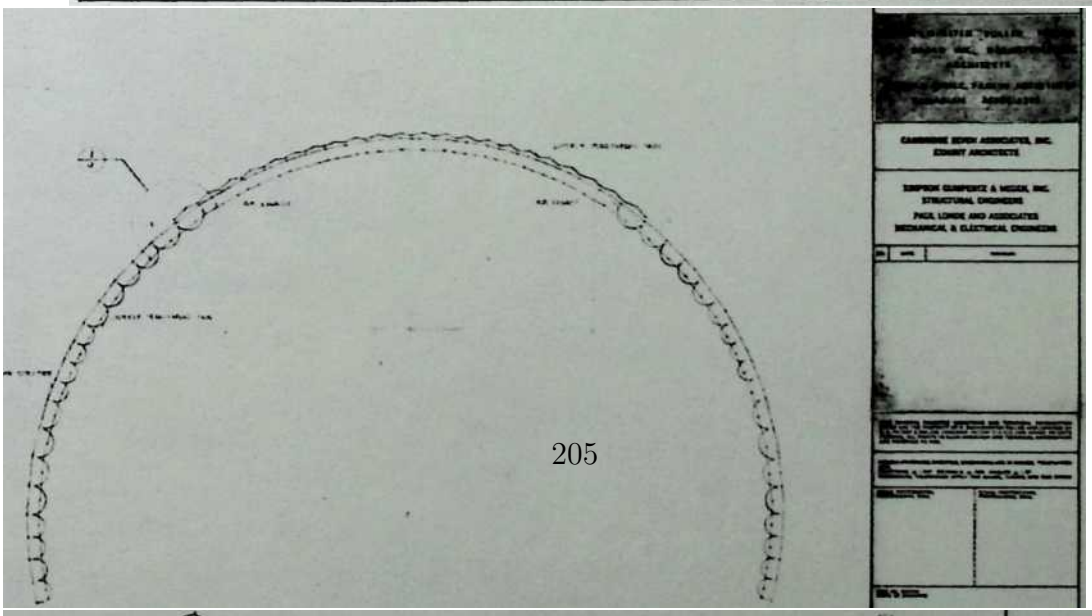
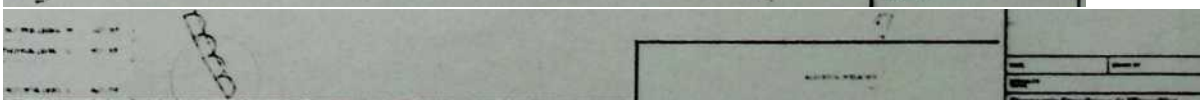
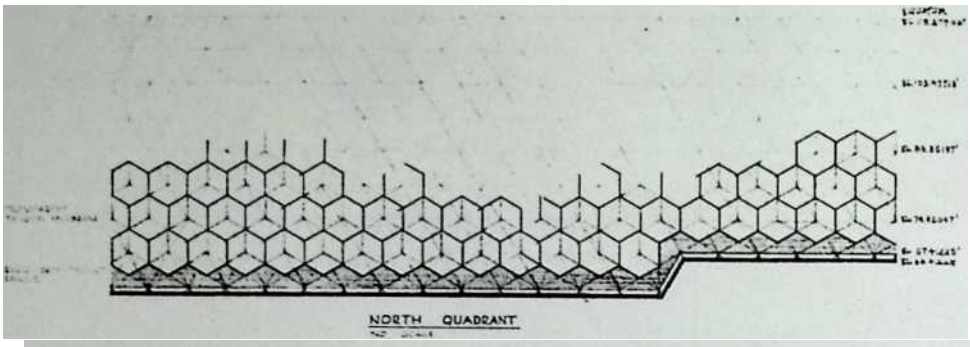
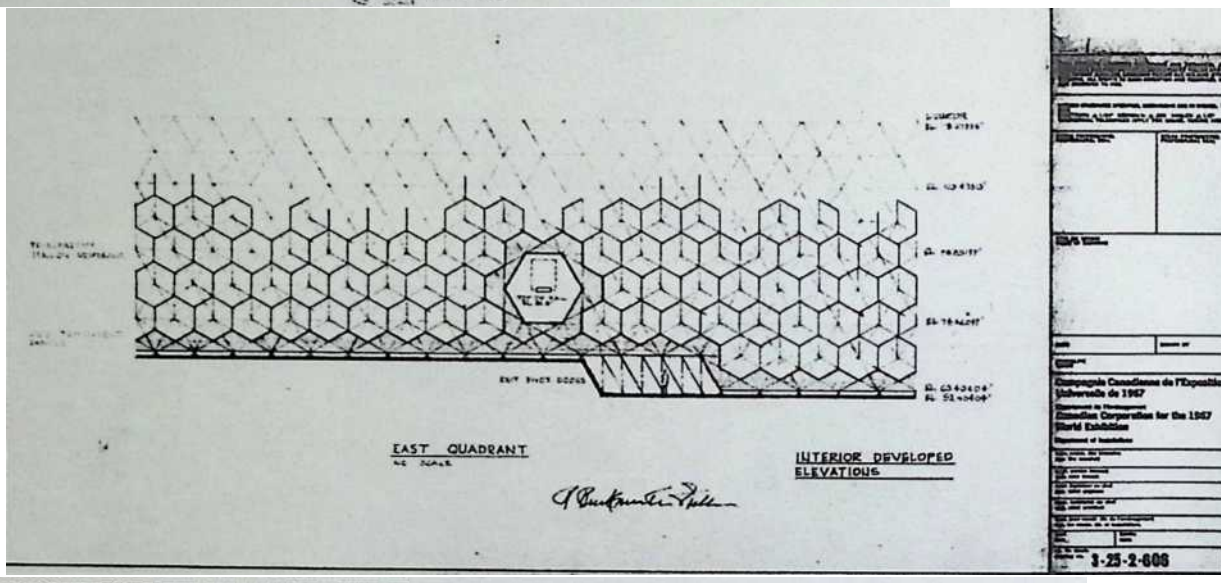
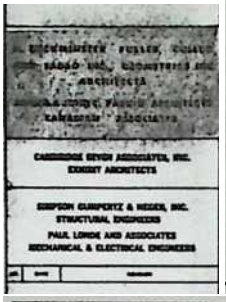

CAMBRIDGE SEVEN ASSOCIATES, INC.
EXHIBIT ARCHITECTS
SIMPSON GUMPERTZ & HEGER, INC.
STRUCTURAL ENGINEERS
PAUL LONDE AND ASSOCIATES
MECHANICAL & ELECTRICAL ENGINEERS

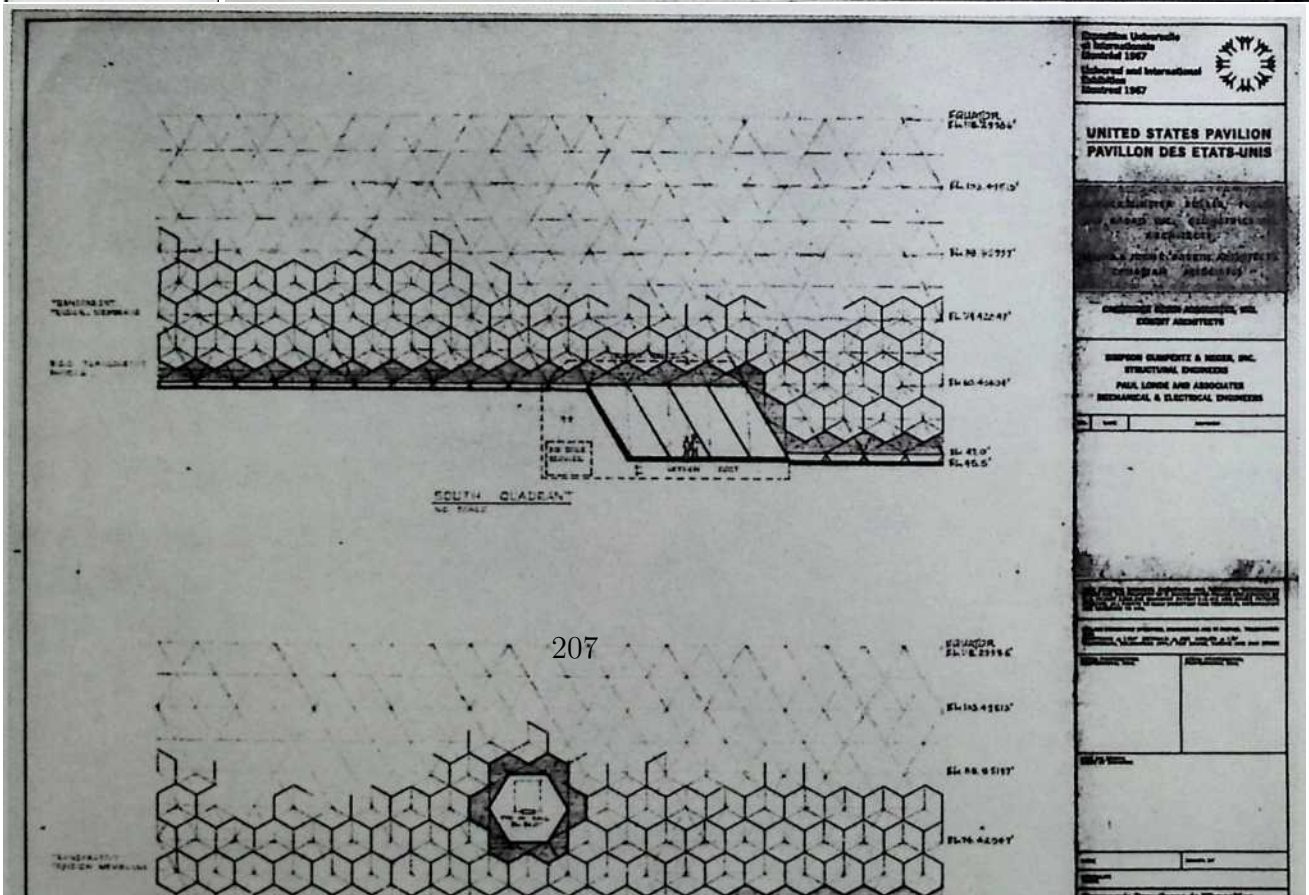


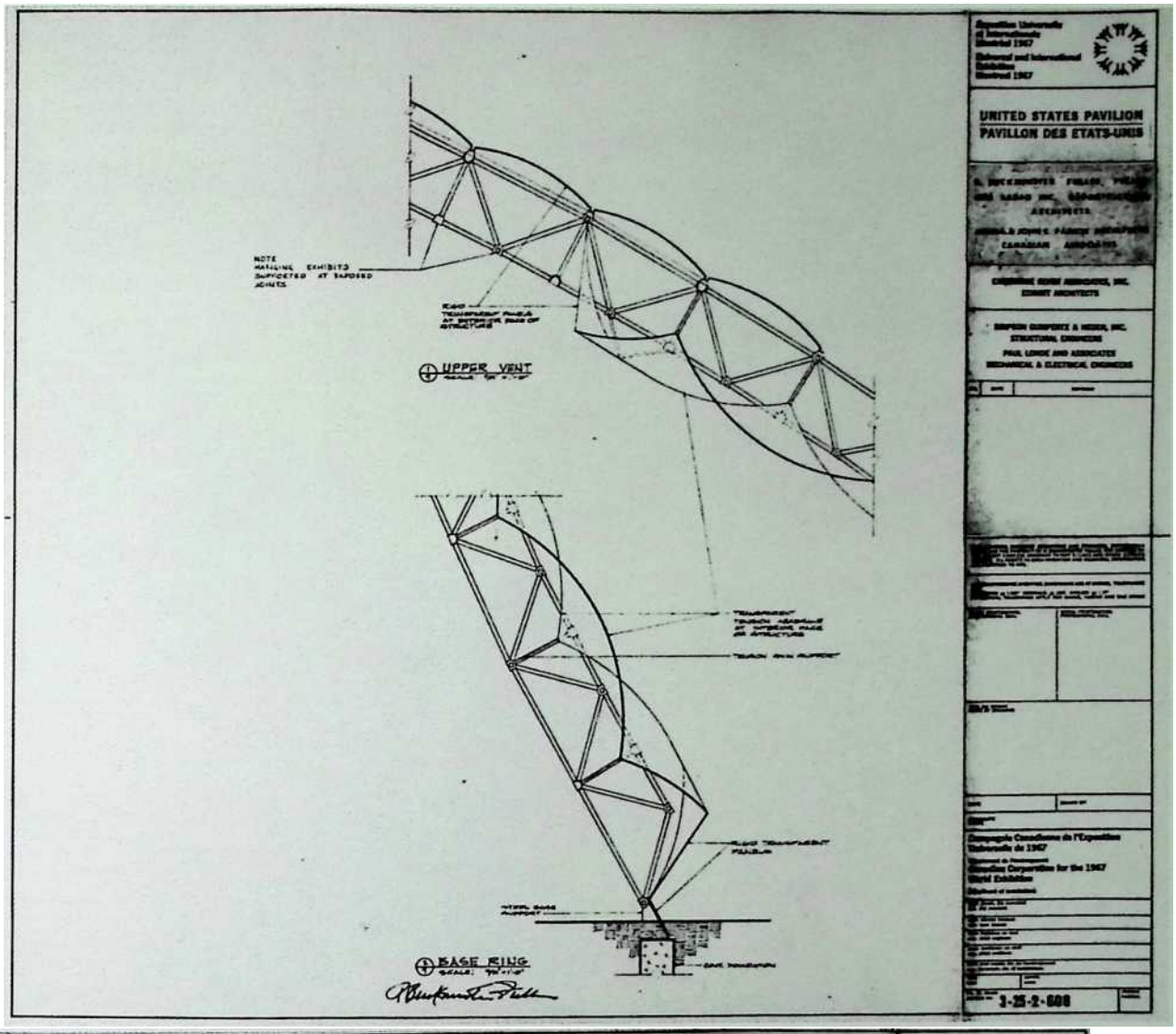
UNITED STATES PAVIUON PAVILLON DES ETATS-UNIS


NORTH QUADRANT


EAST QUADRANT
INTERIOR DEVELOPED ELEVATIONS
3-25-2-608


CAMBRIDGE SEVEN ASSOCIATES, INC.
EXHIBIT ARCHITECTS
SIMPSON GUMPERTZ & HEGER, INC.
STRUCTURAL ENGINEERS
PAUL LONDE AND ASSOCIATES
MECHANICAL & ELECTRICAL ENGINEERS


UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
SOUTH QUADRANT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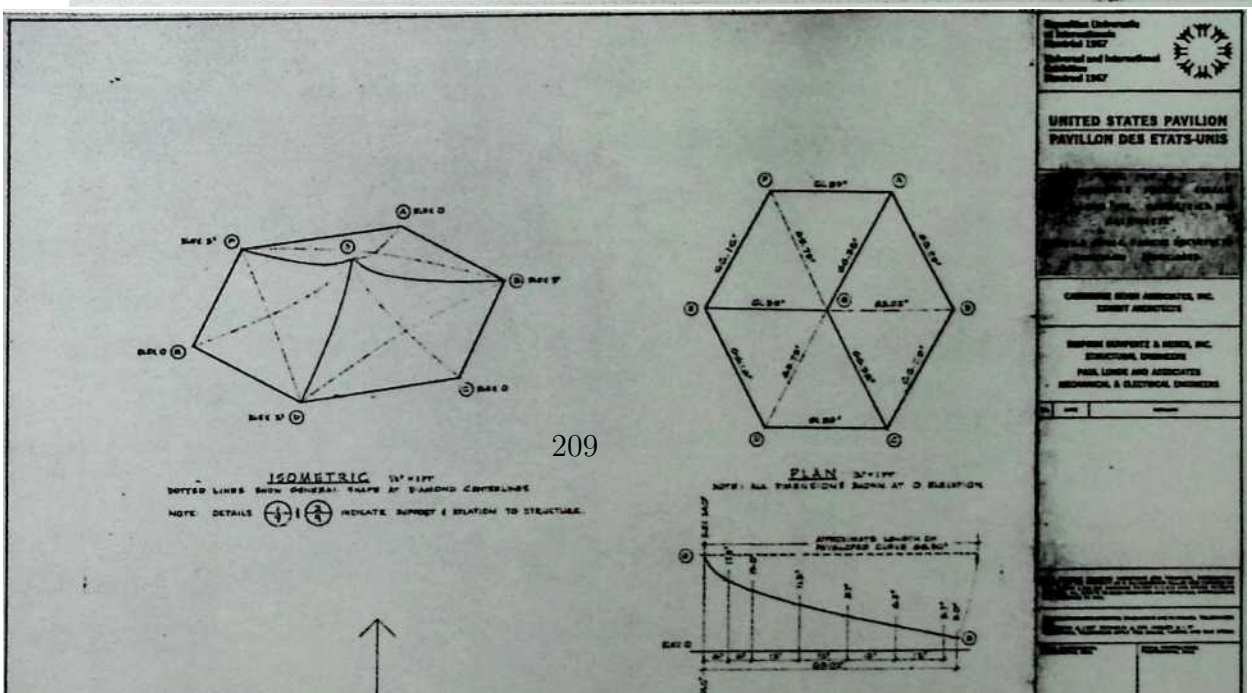
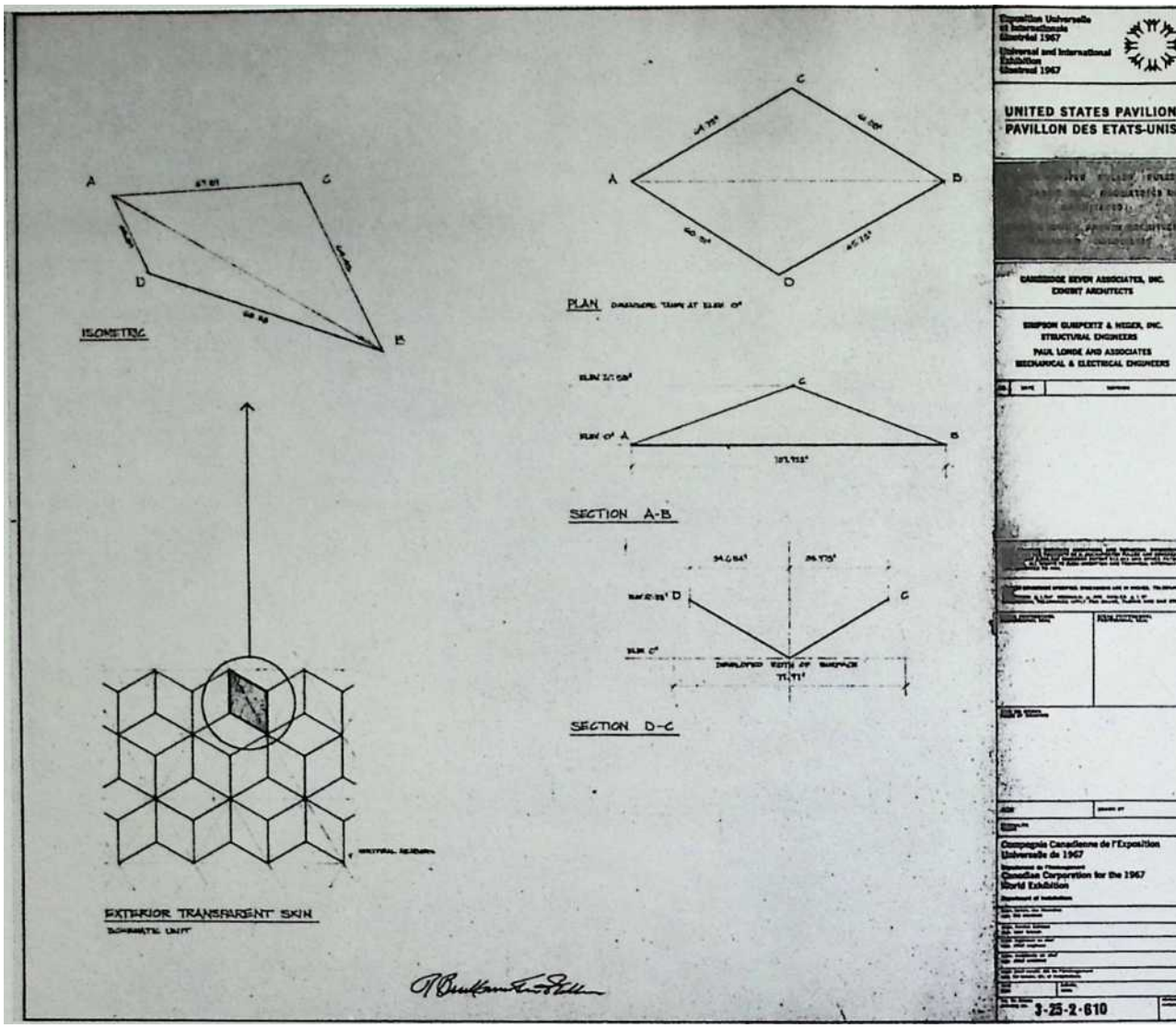
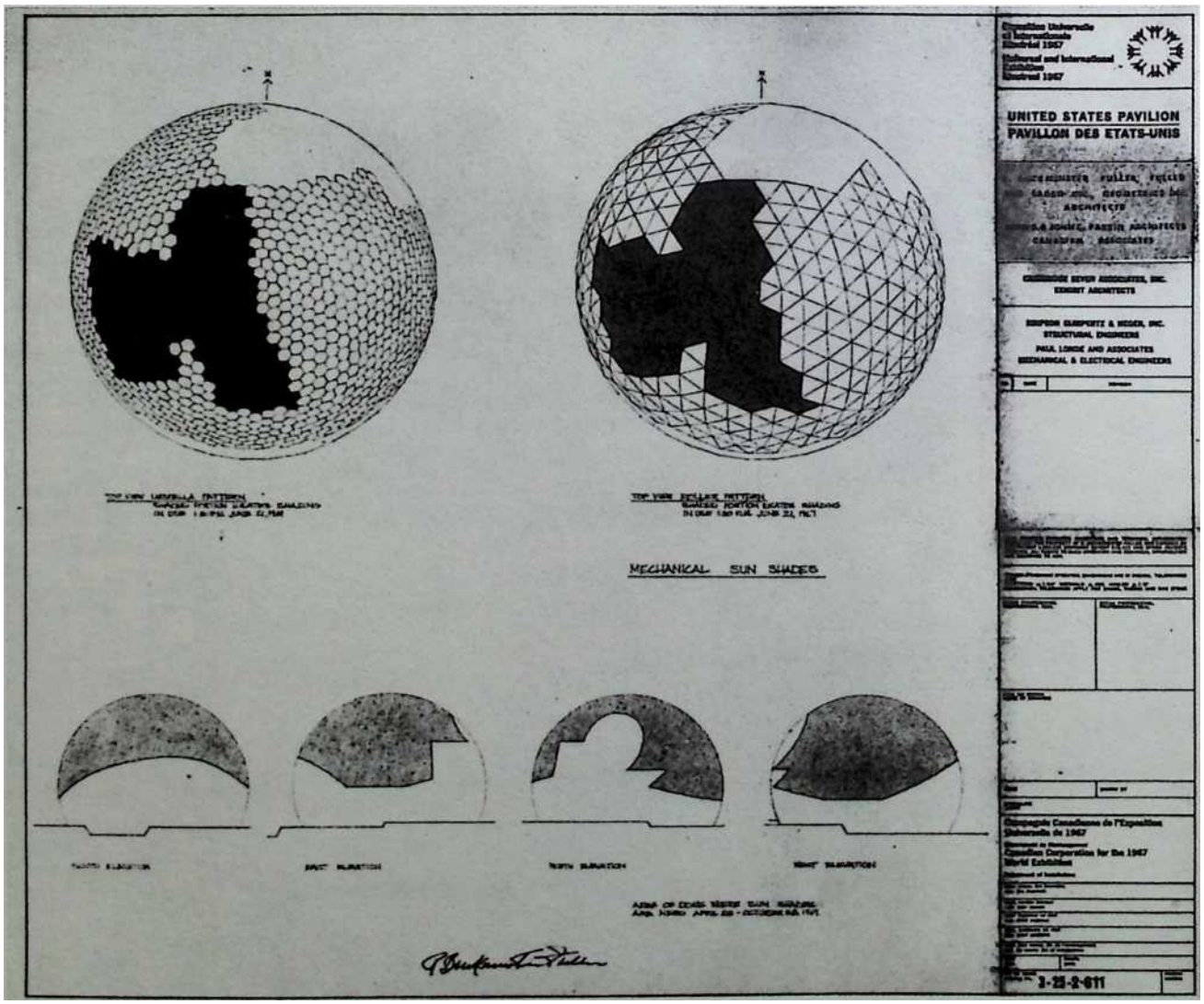
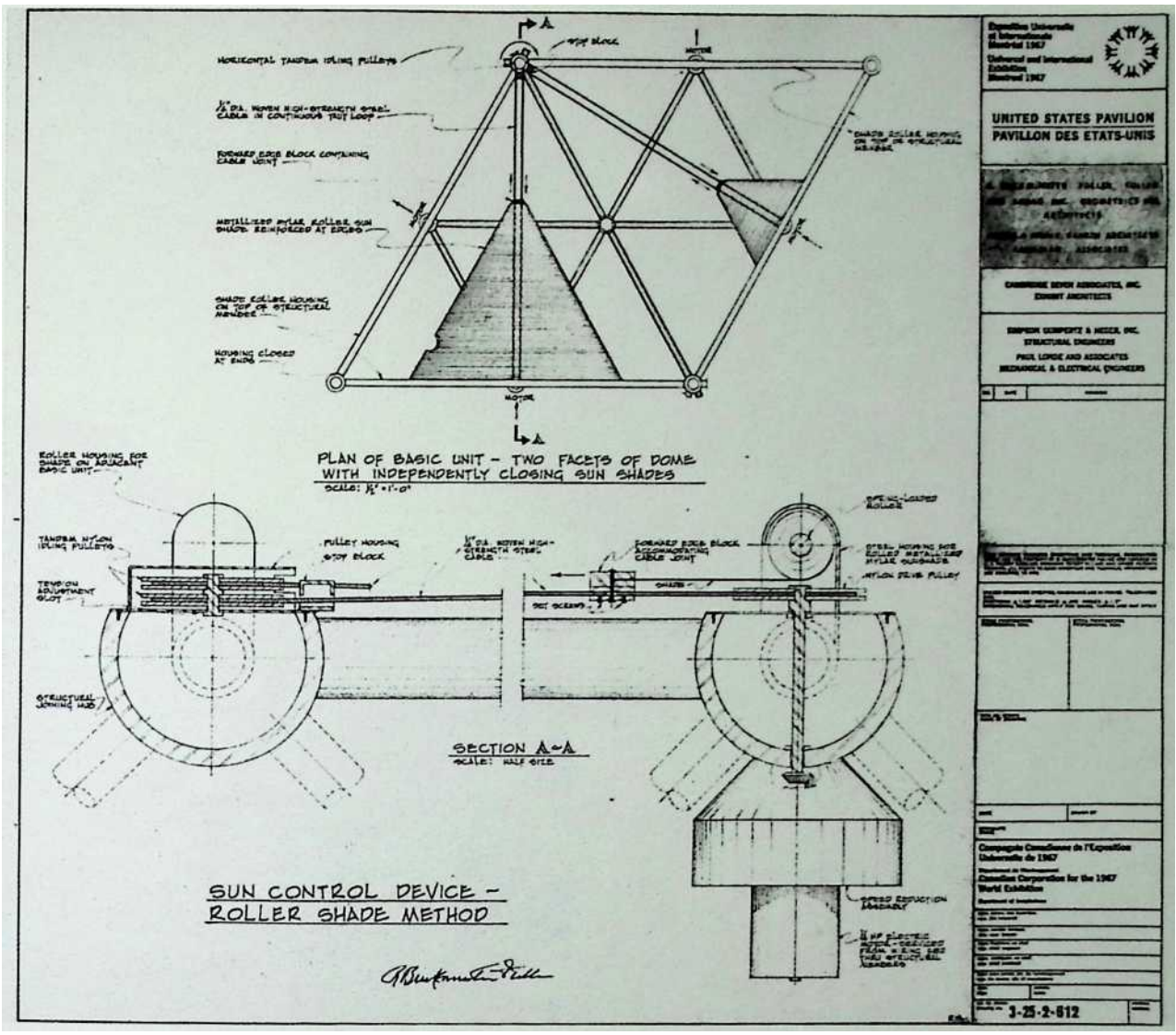
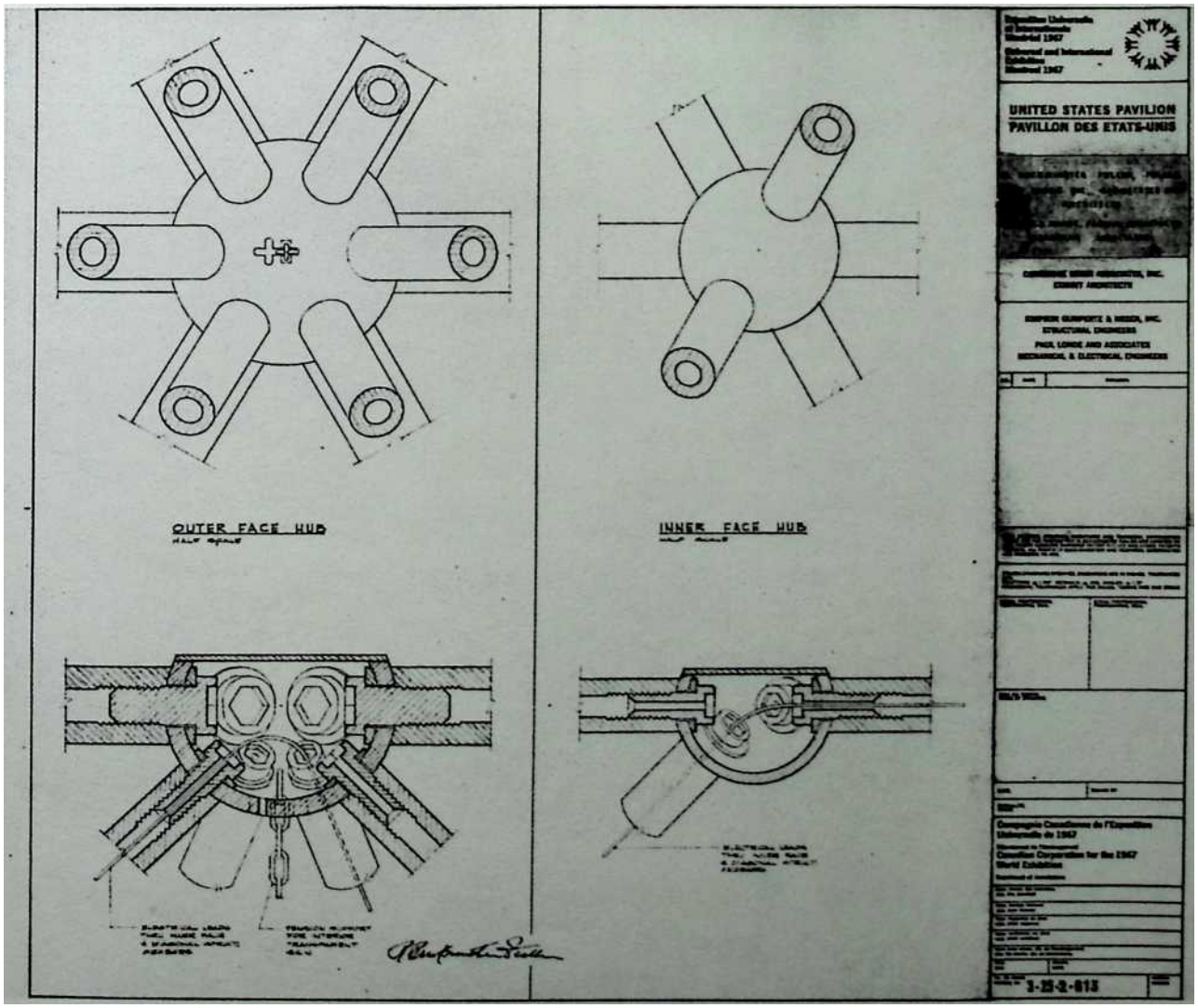
PAVILLON DES ETATS-UNIS
UPPER VENT
BASE RING
3-25-2-608

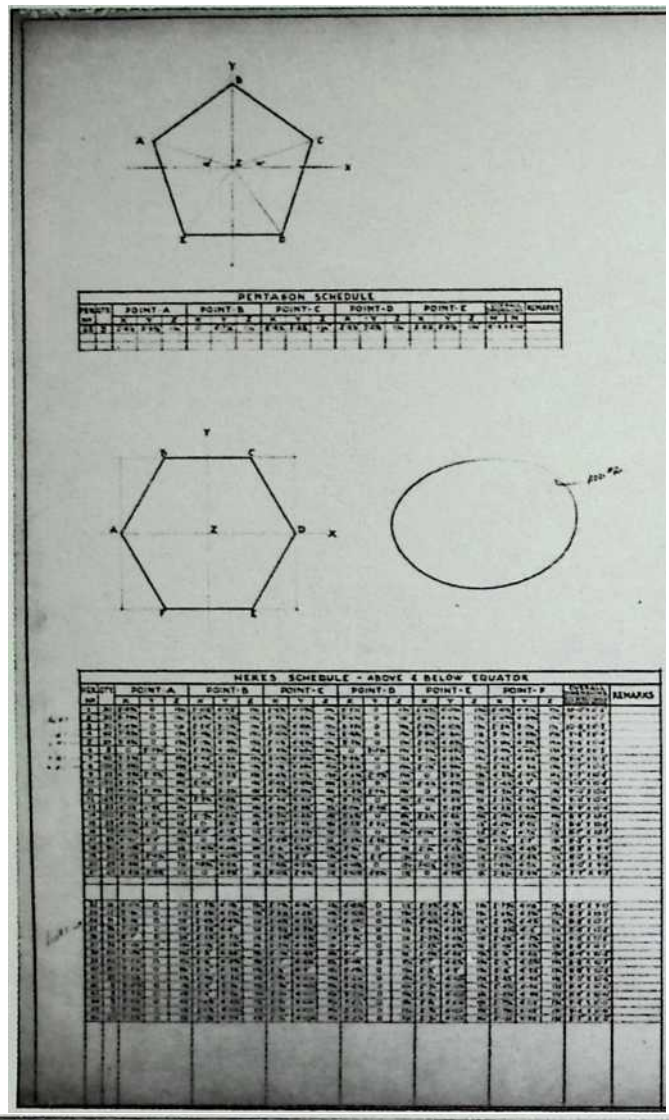

UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
ISOMETRIC
PLAN

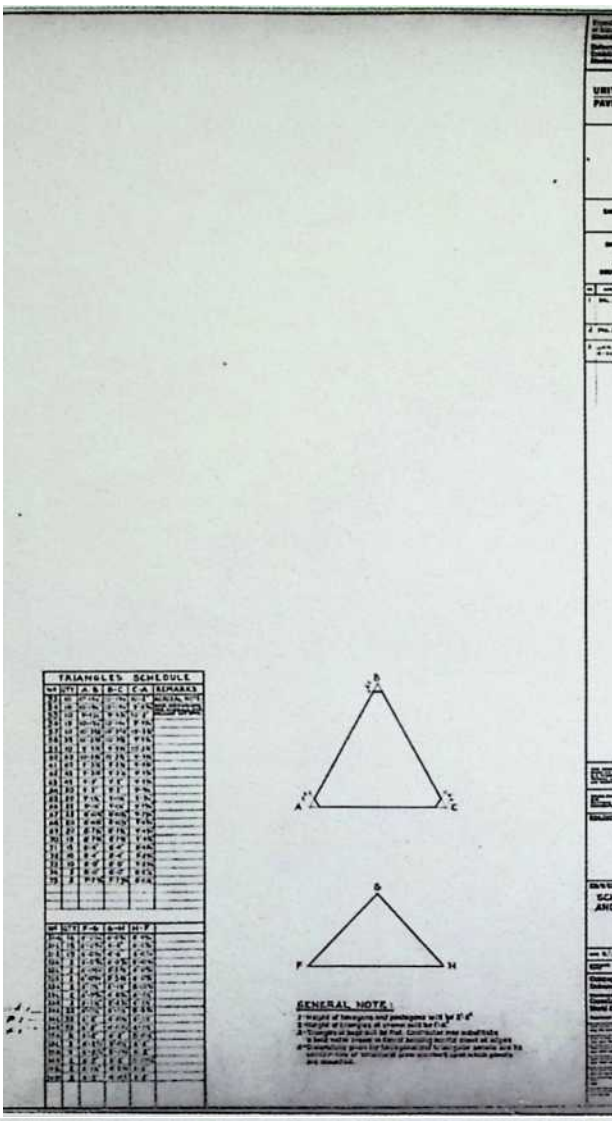

ISOMETRIC
PLAN
SECTION A-B
SECTION D-C
EXTERIOR TRANSPARENT SKIN
UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
3-25-2-610

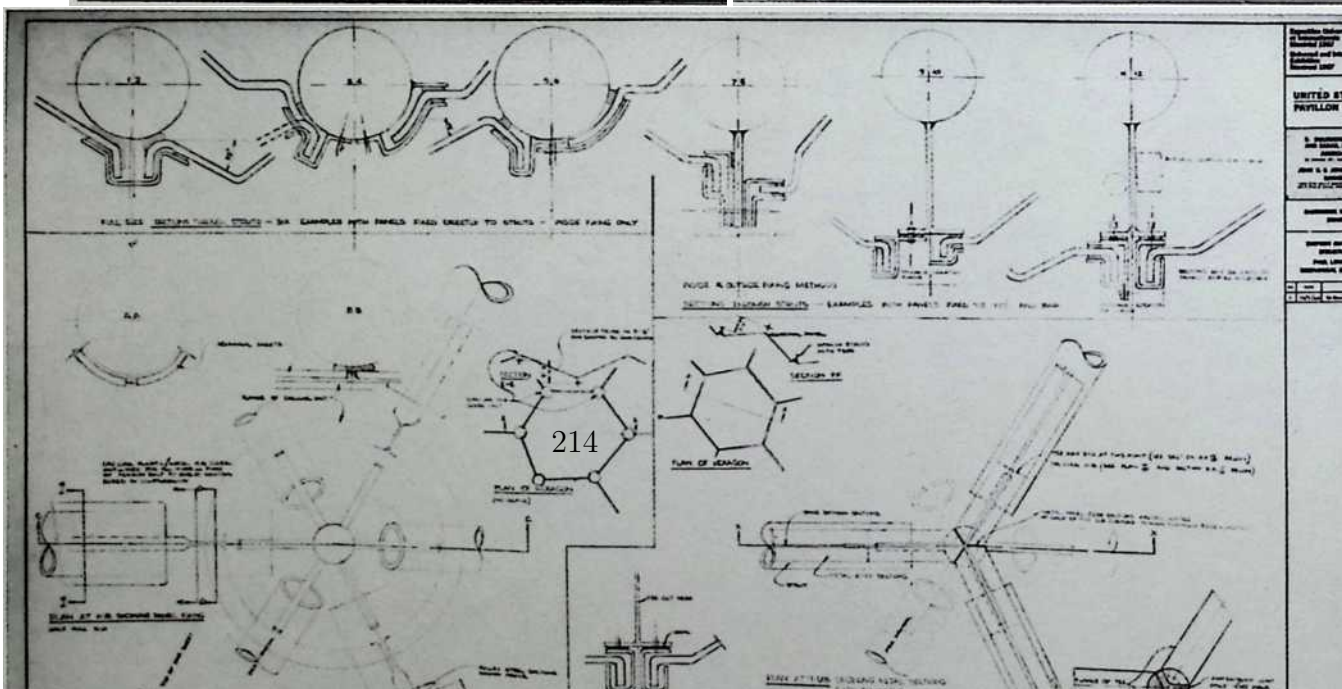

UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
MECHANICAL SUN SHADES

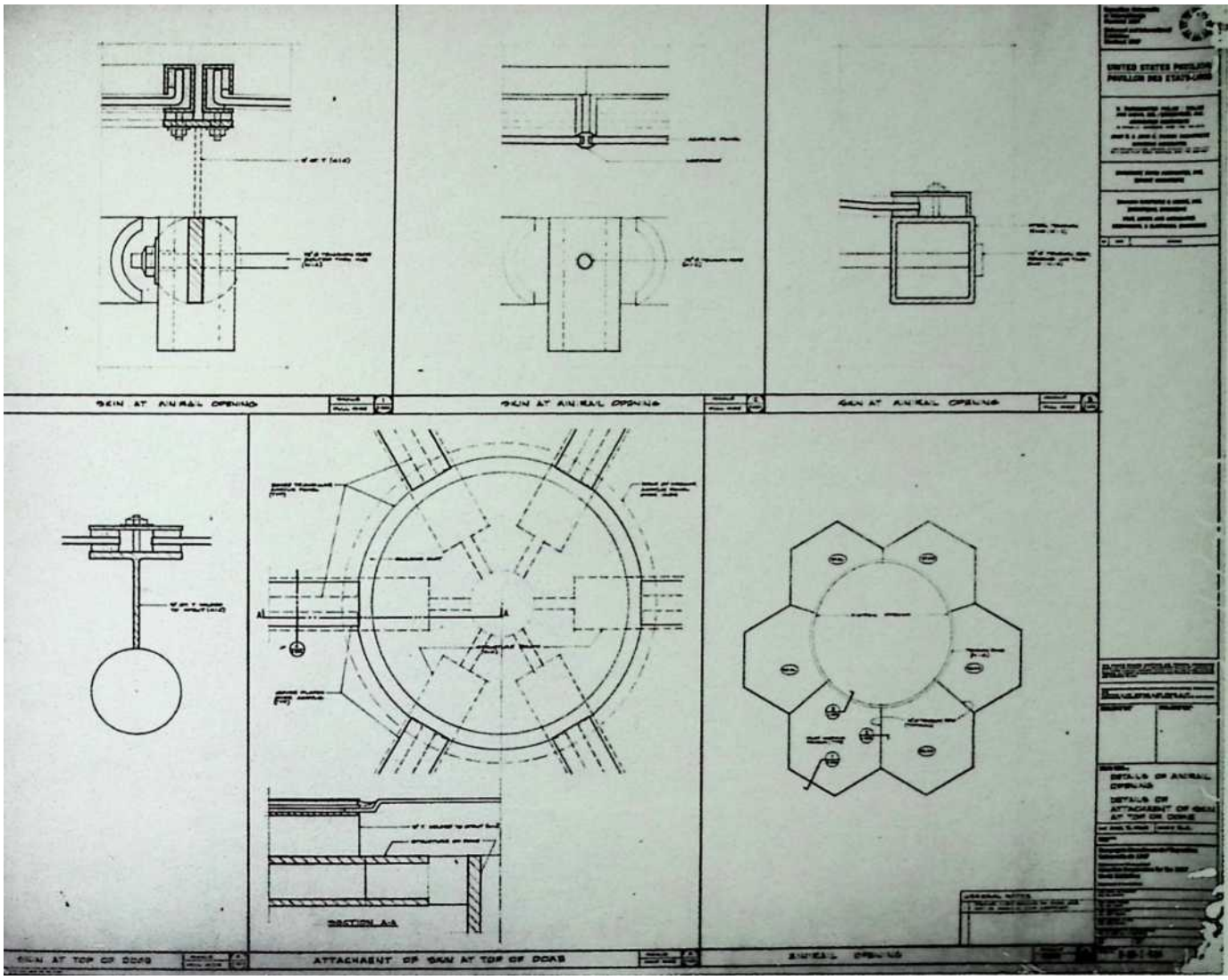

UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
PLAN OF BASIC UNIT - TWO FACETS OF DOME WITH INDEPENDENTLY CLOSING SUN SHADES
SECTION A-A
SUN CONTROL DEVICE - ROLLER SHADE METHOD
3-25-2-612

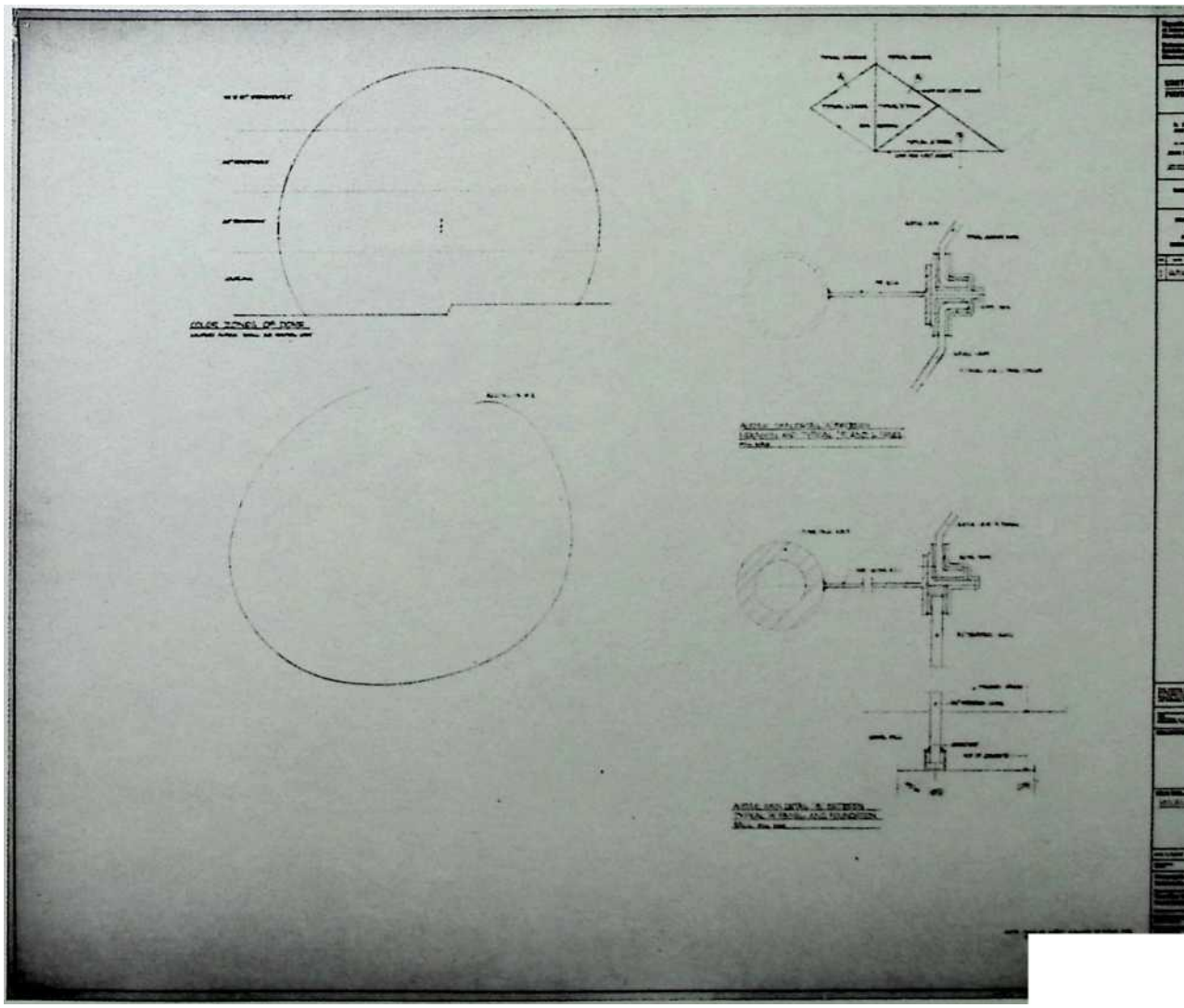

UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
OUTER FACE HUB
INNER FACE HUB


PENTAGON SCHEDULE
POINT-A
POINT-B
POINT-C
POINT-D
POINT-E
REMARKS
HEXES SCHEDULE - ABOVE & BELOW EQUATOR
POINT-A
POINT-B
POINT-C
POINT-D
POINT-E
POINT-F
REMARKS

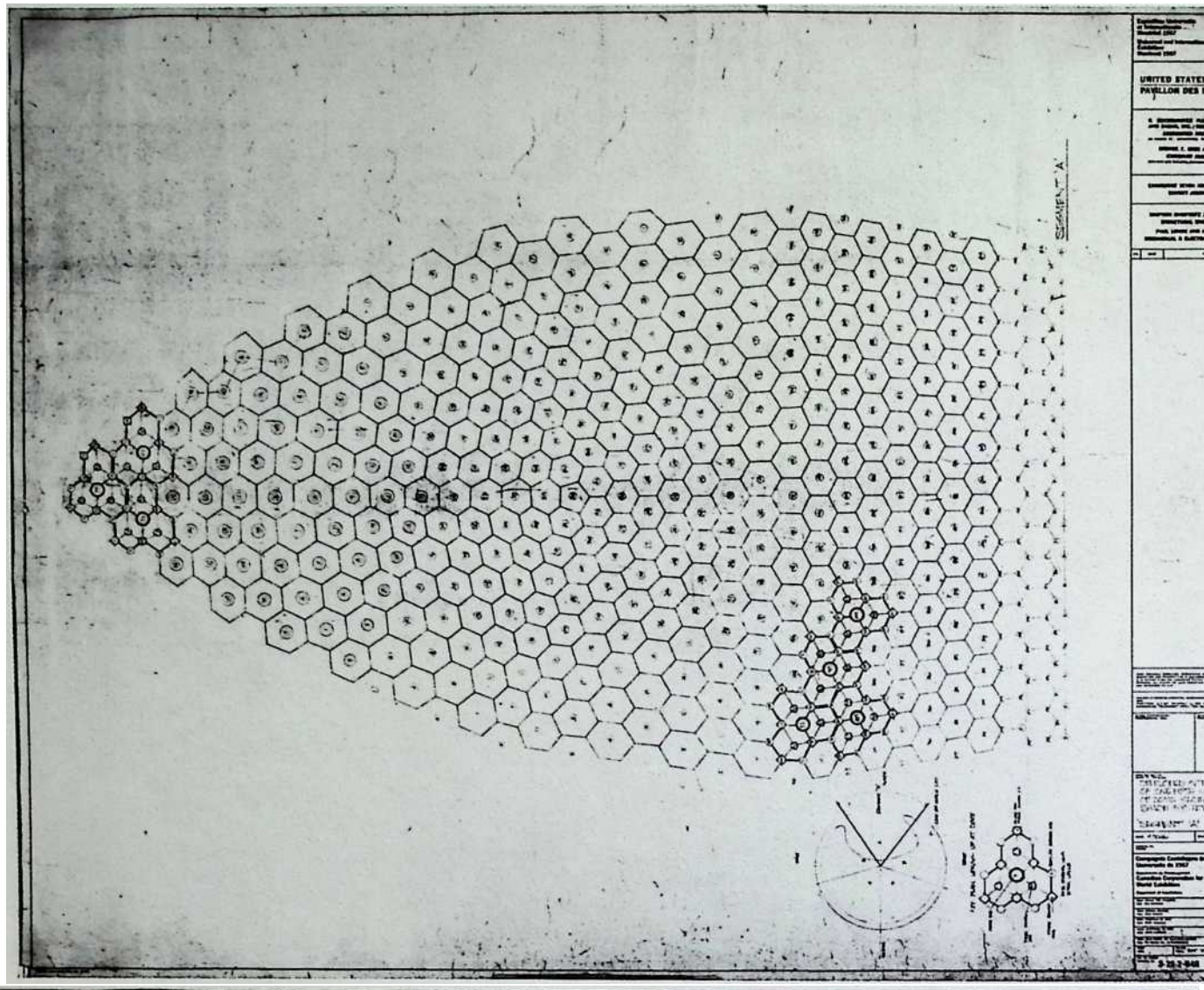

TRIANGLES SCHEDULE
A & B
B-C
C-A
REMARKS
GENERAL NOTE:

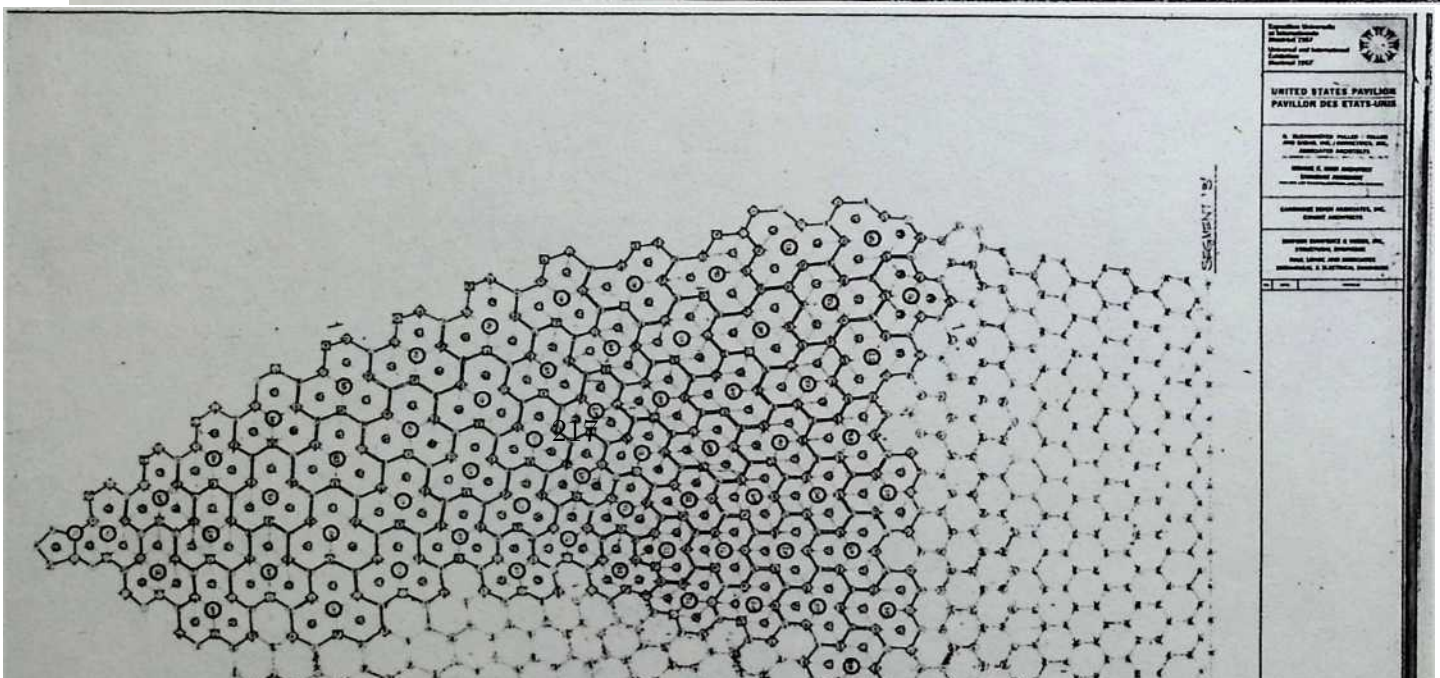

UNITED ST
PAVILLON

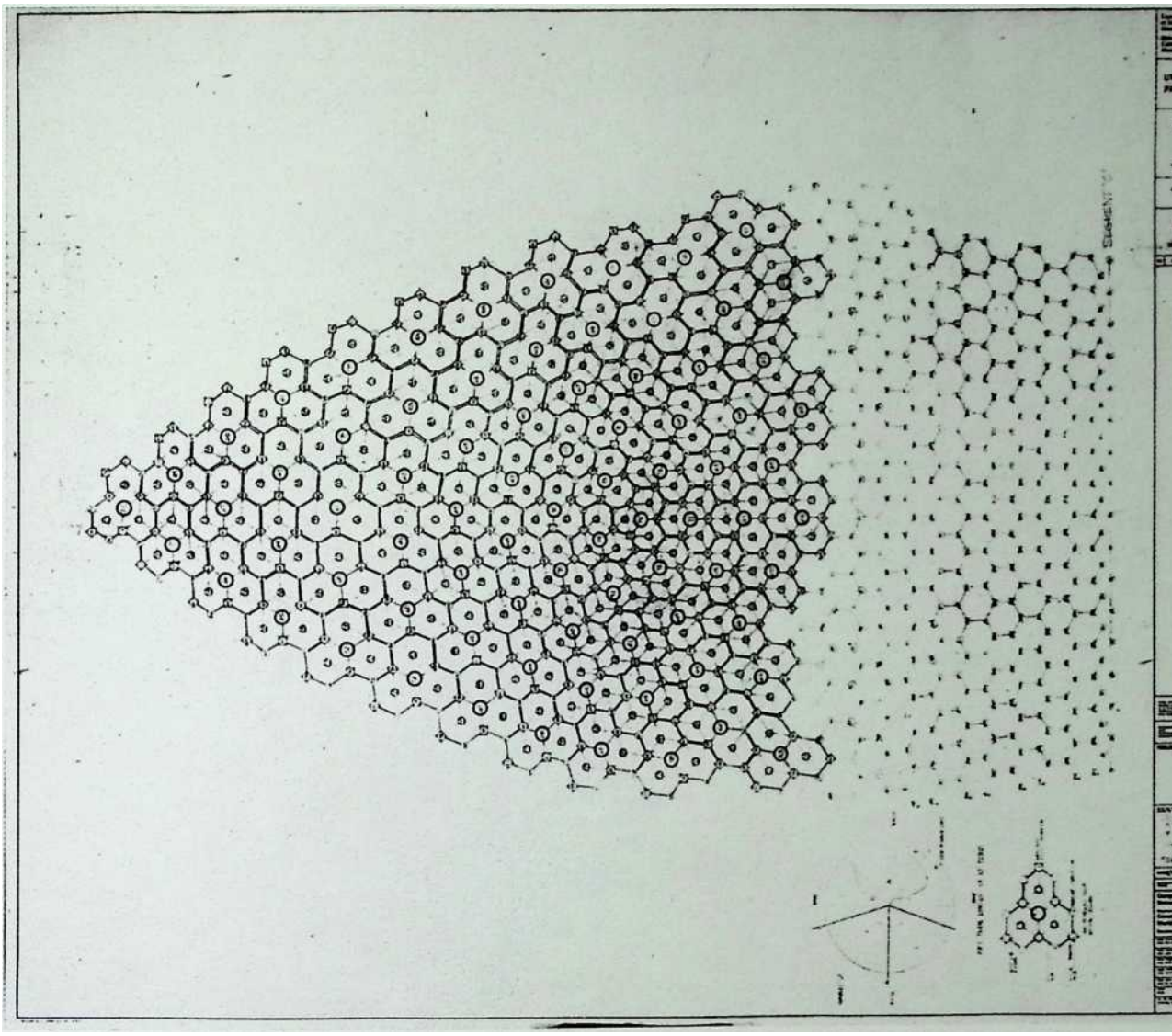

SKIN AT AIRRAIL OPENING
SKIN AT AIRRAIL OPENING
SKIN AT AIRRAIL OPENING
SKIN AT TOP OF DOAS
ATTACHMENT OF SKIN AT TOP OF DOAS
SECTION A-A
DETAILS OF AIRRAIL OPENING
DETAILS OF ATTACHMENT OF SKIN AT TOP OF DOAS

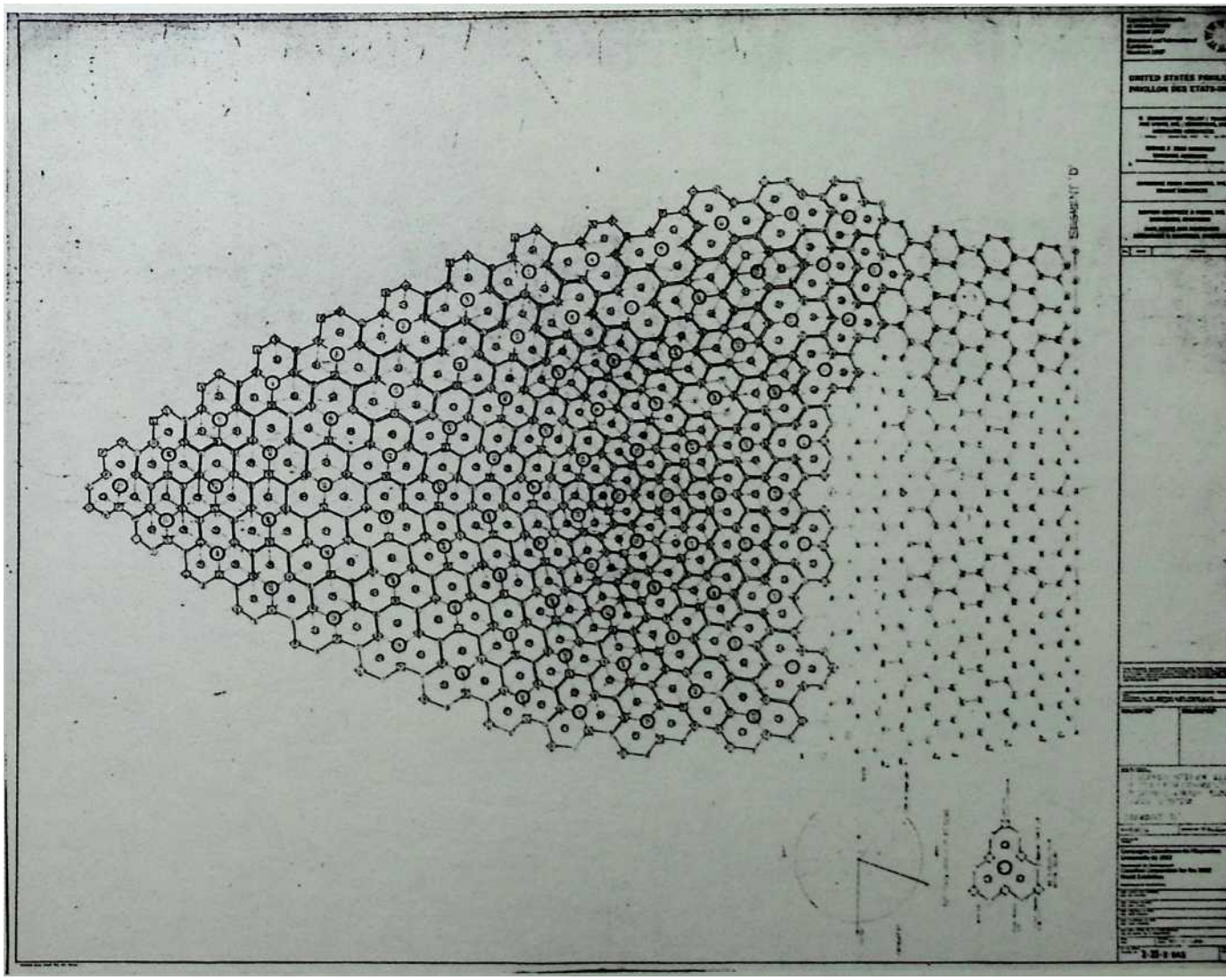


112 THE GEODESIC REVOLUTION, P/VRT 2


SEGMENT 'A'
UNITED STATES
PAVILLON DES


SEGMENT 'B'
UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS





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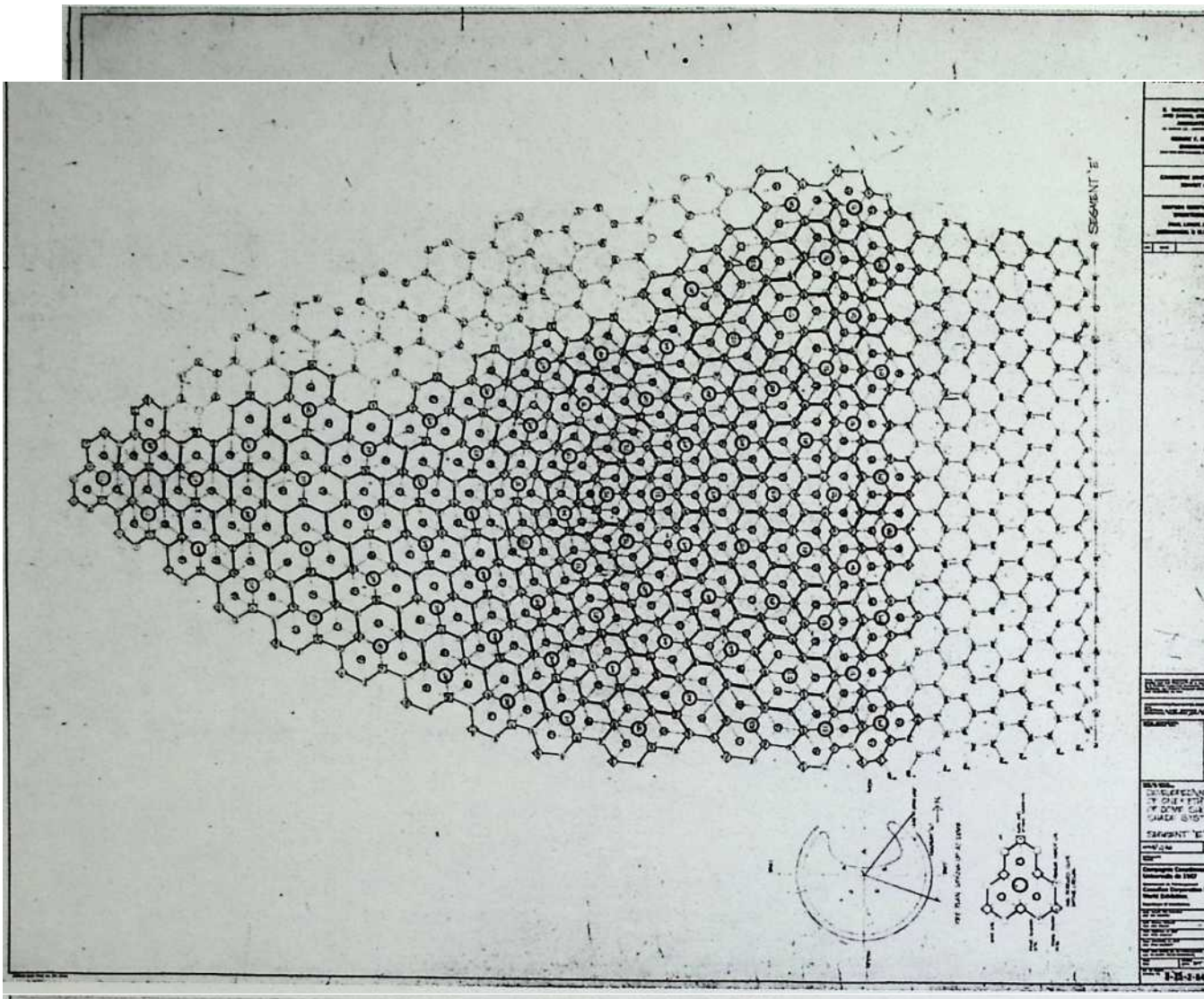
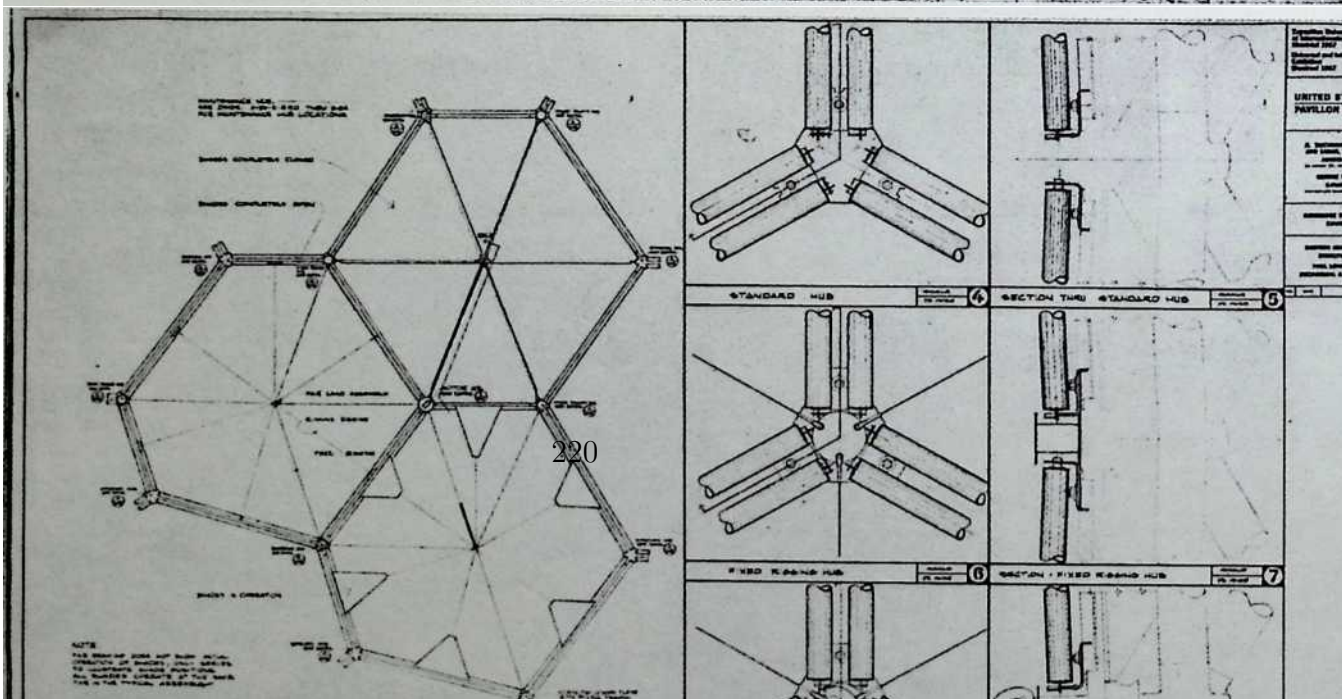
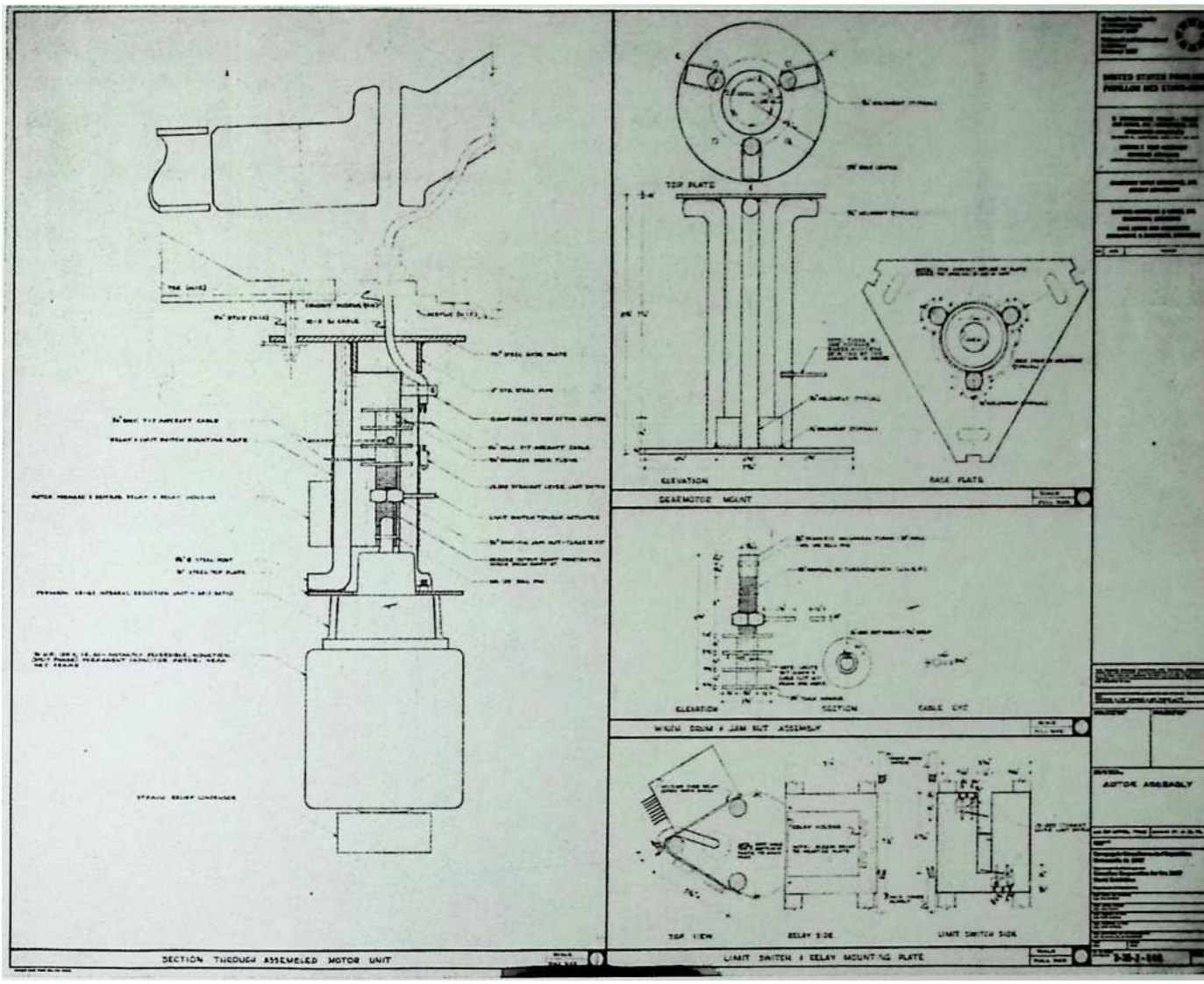
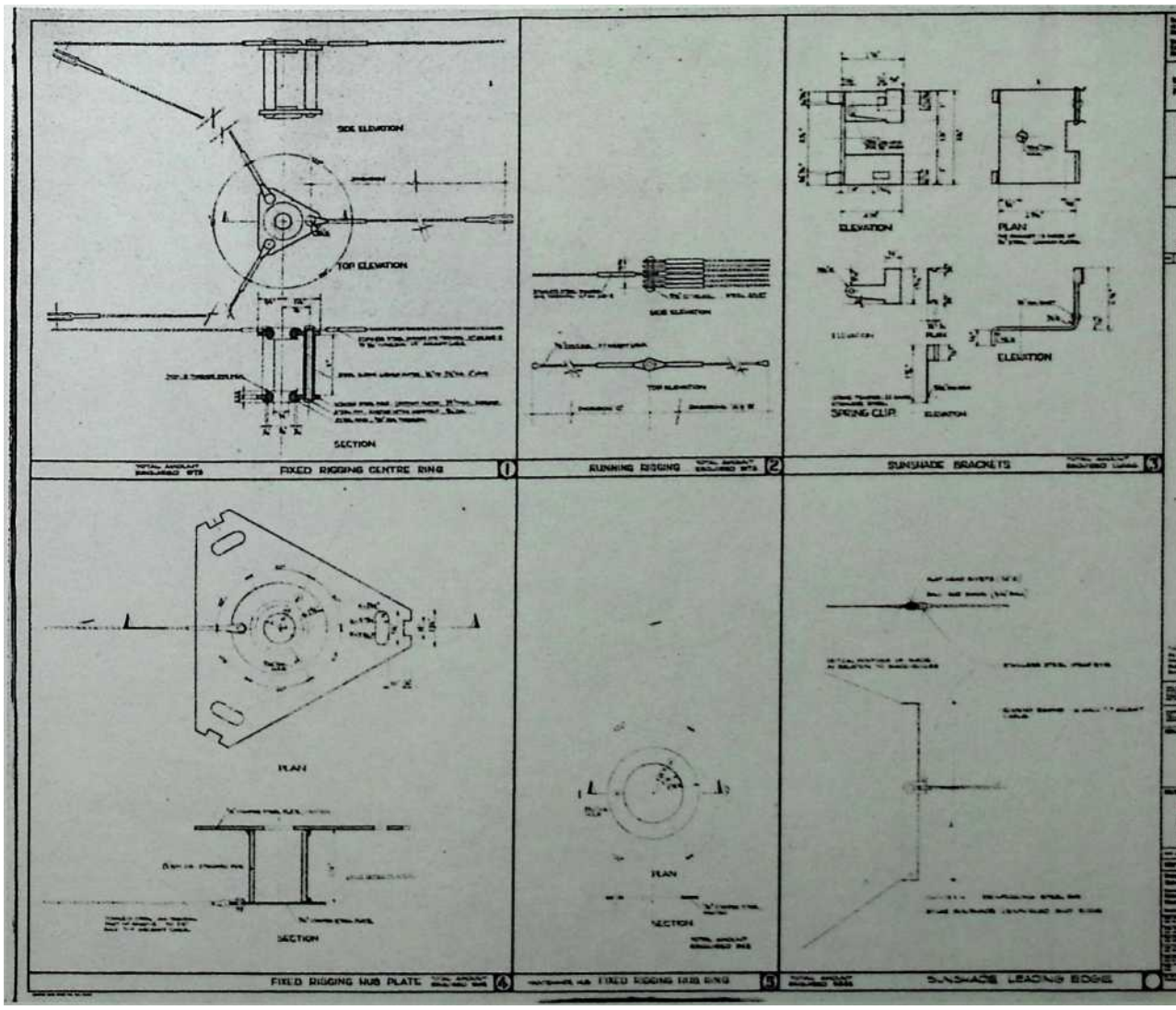
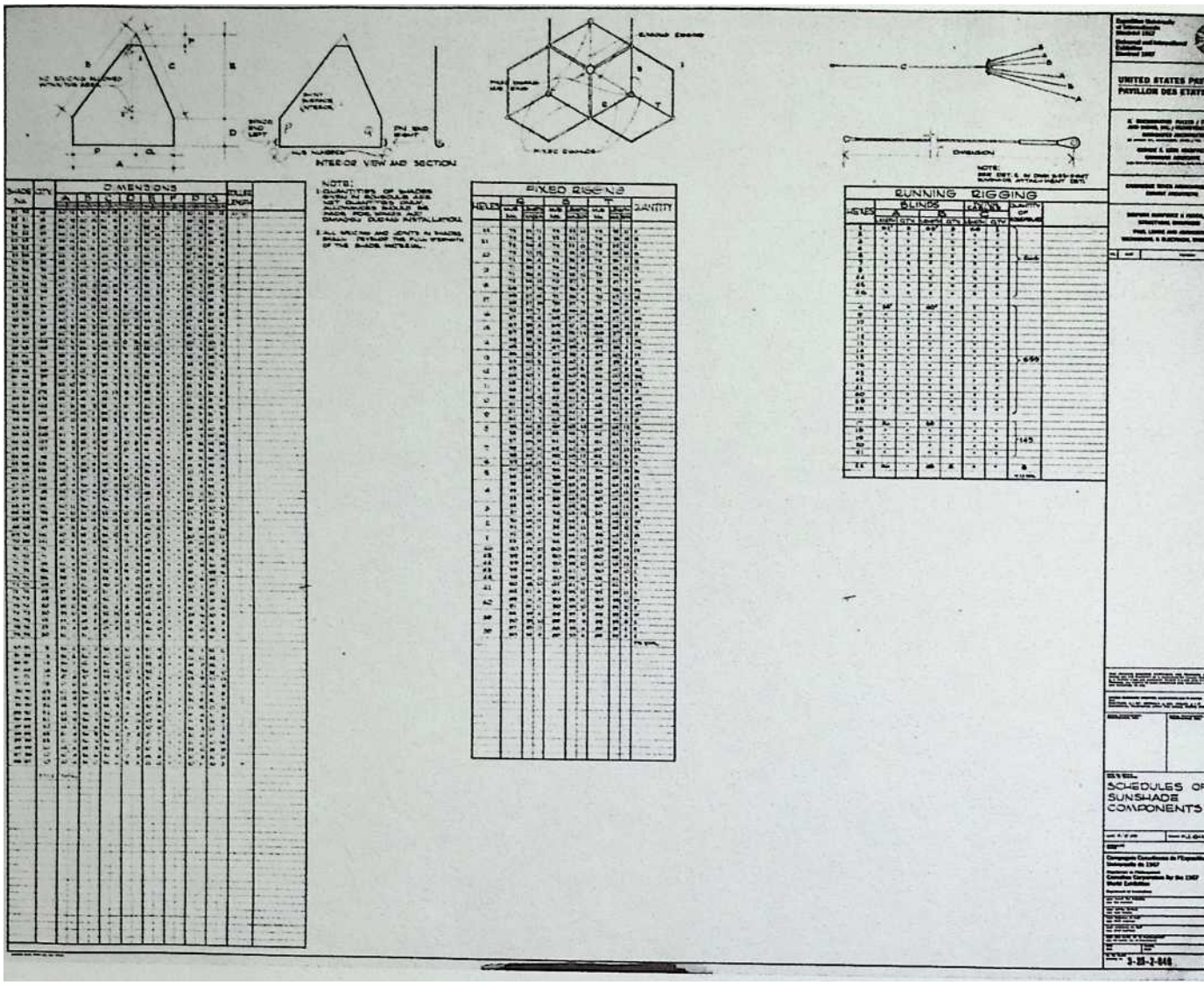
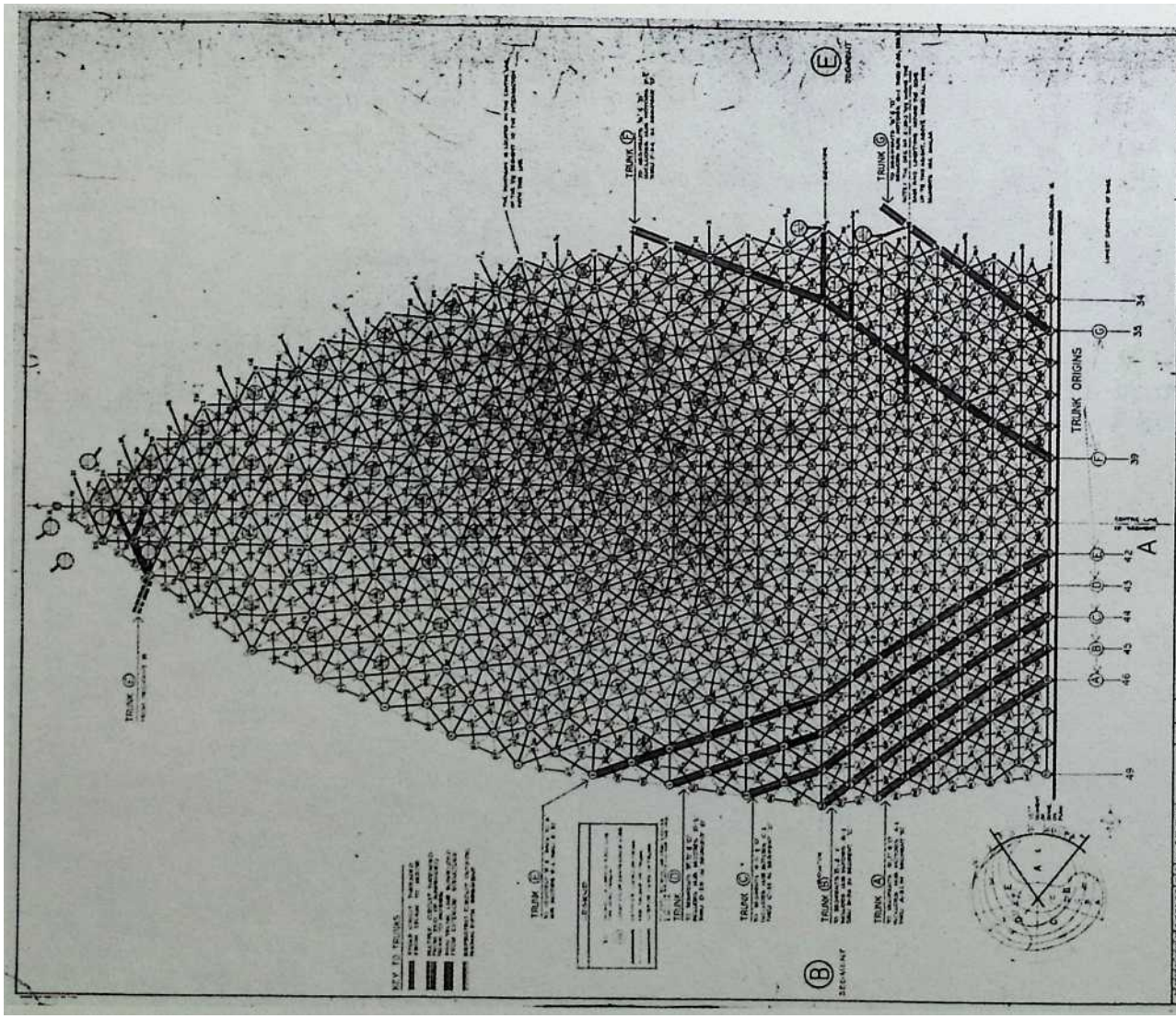

SEGMENT "E"

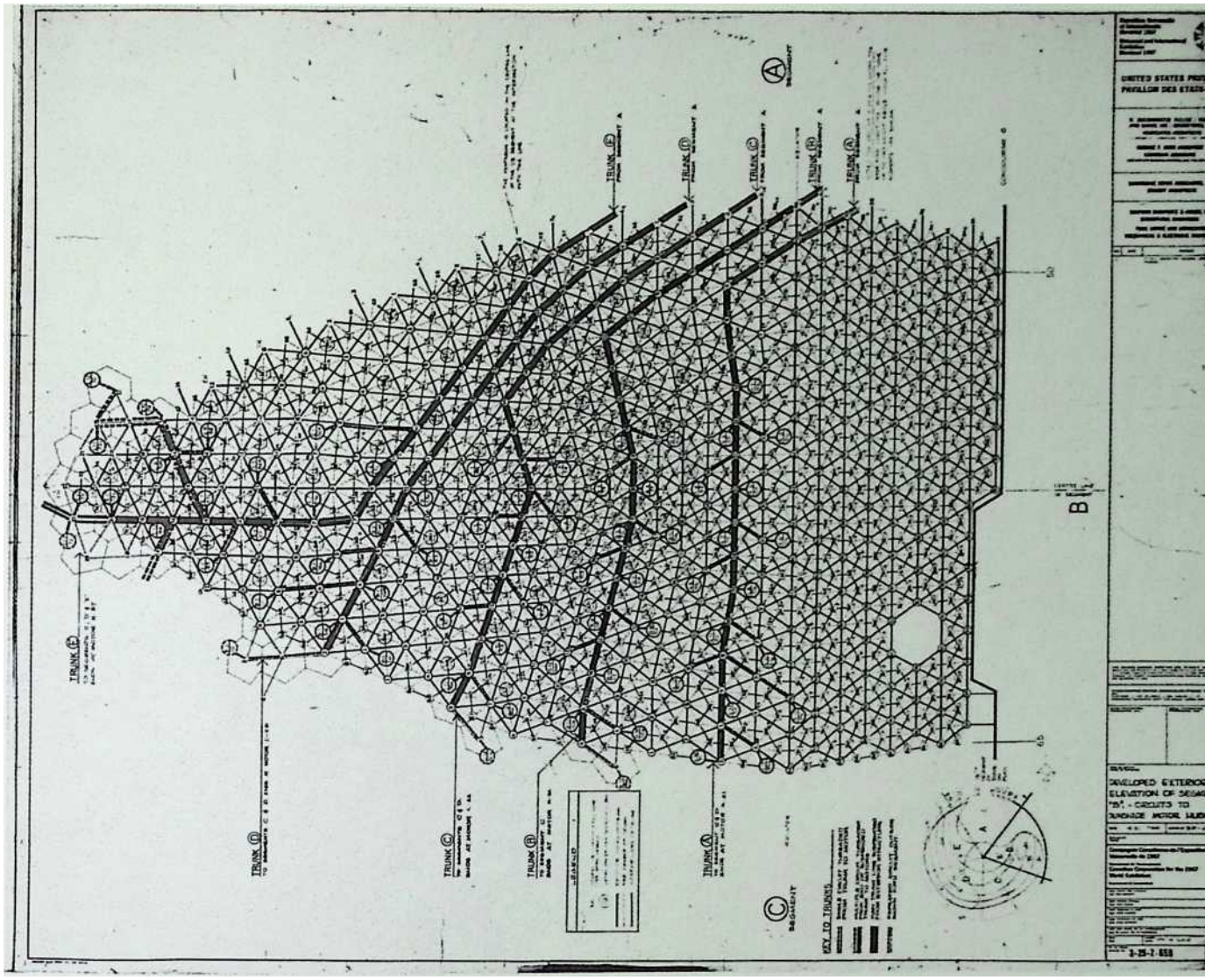

STANDARD HUB
4
SECTION THRU STANDARD HUB
5
FIXED KEYING HUB
6
SECTION - FIXED KEYING HUB
7

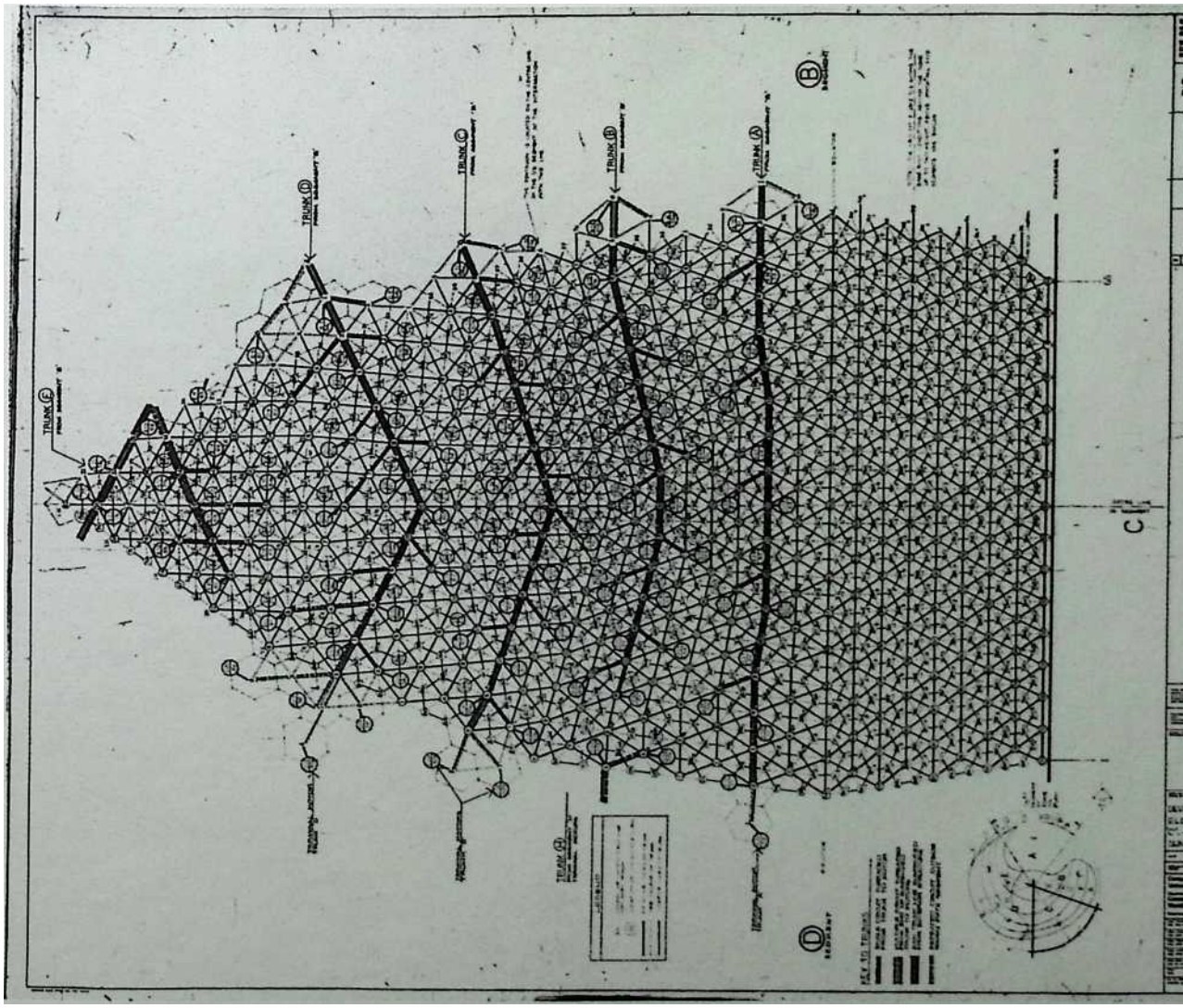

SECTION THROUGH ASSEMBLED MOTOR UNIT
TOP PLATE
ELEVATION
BASE PLATE
GEARMOTOR MOUNT
ELEVATION
SECTION
CABLE EYE
WINCH DRUM & JAM NUT ASSEMBLY
TOP VIEW
RELAY SIDE
LIMIT SWITCH SIDE
LIMIT SWITCH & RELAY MOUNTING PLATE
MOTOR ASSEMBLY

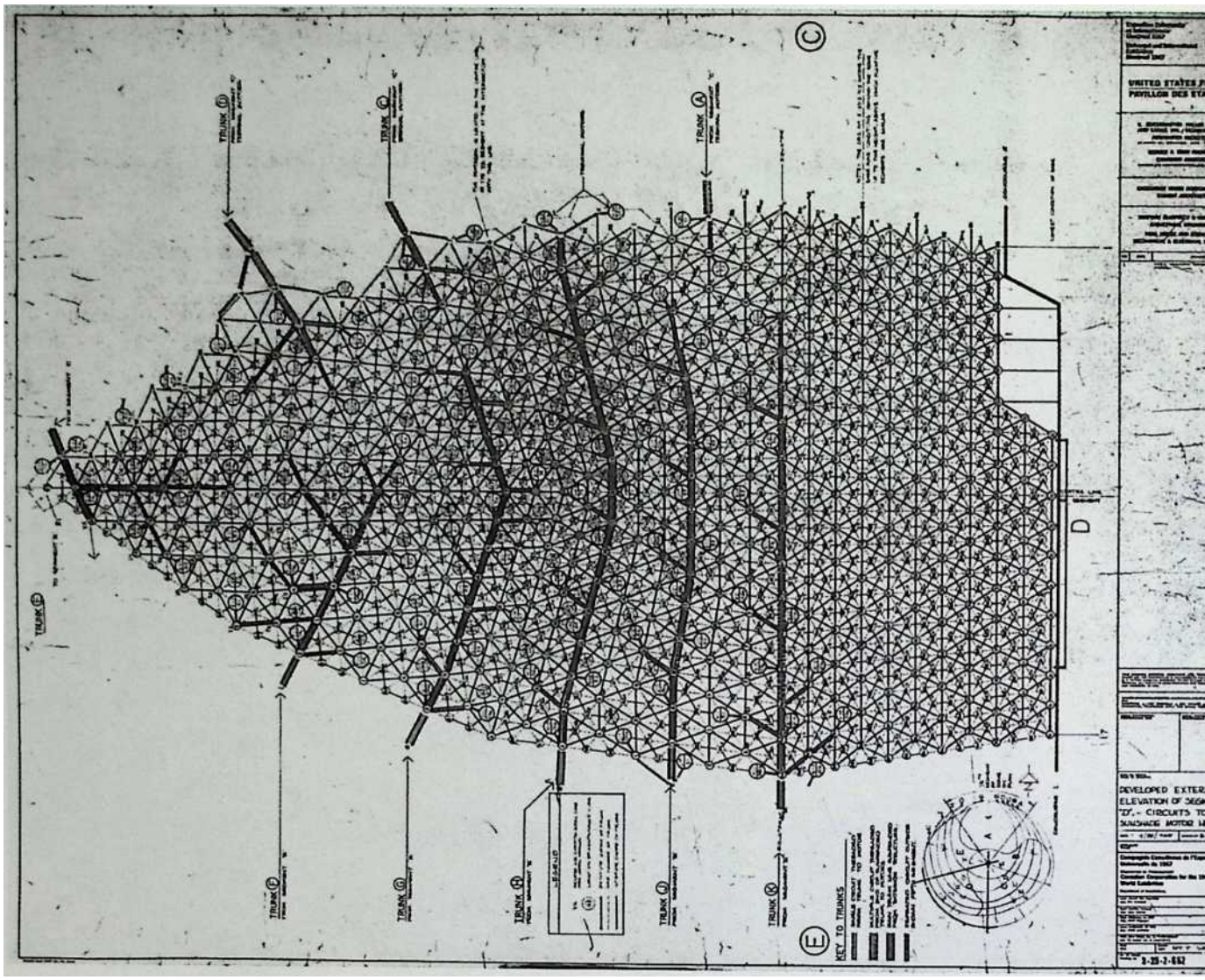

SIDE ELEVATION
TOP ELEVATION
SECTION
FIXED RIGGING CENTRE RING
1
RUNNING RIGGING
2
ELEVATION
PLAN
SPRING CLIP
ELEVATION
SUNSHADE BRACKETS
3
PLAN
SECTION
FIXED RIGGING HUB PLATE
4
PLAN
SECTION
5
SUNSHADE LEADING EDGE

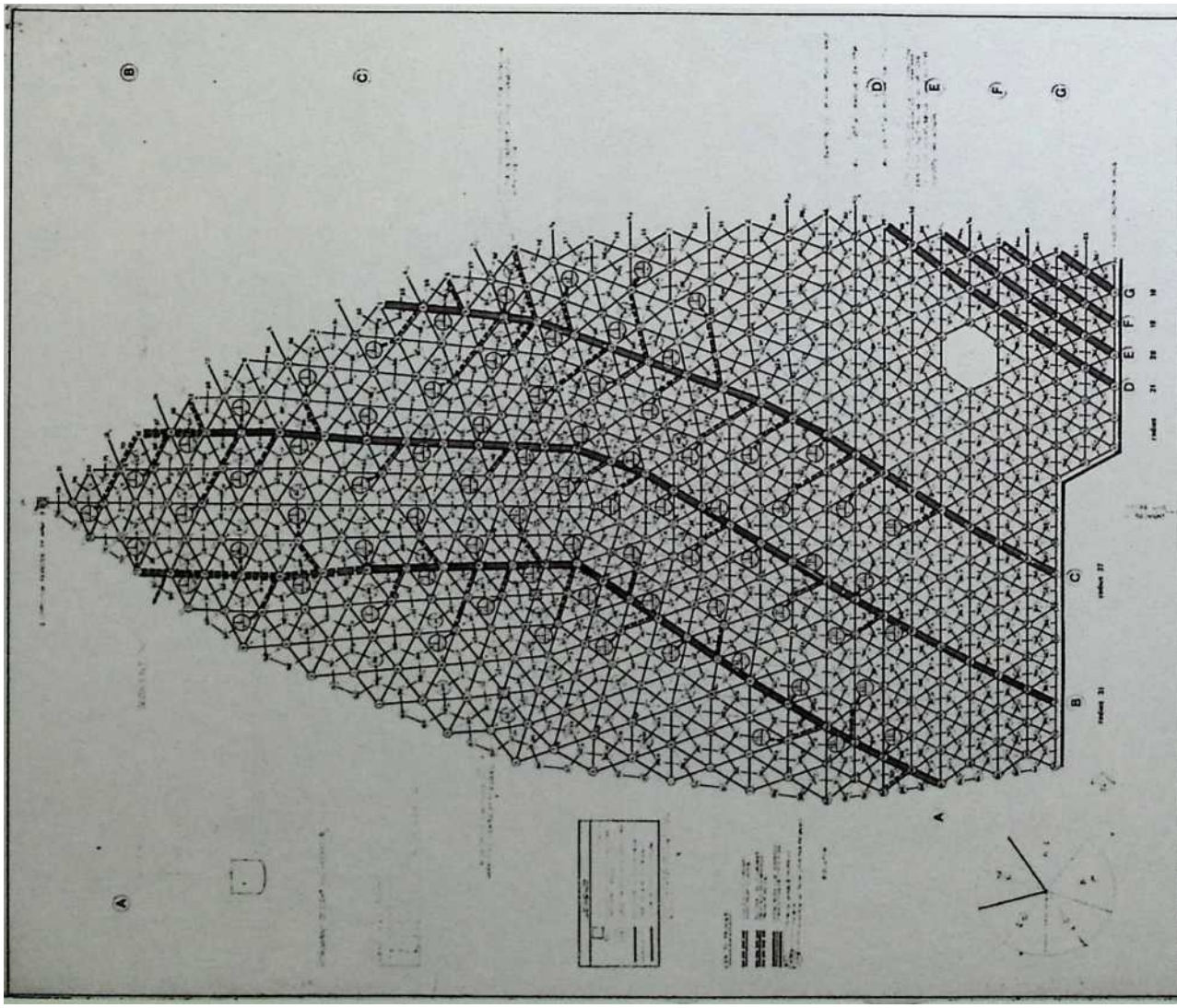

DIMENSIONS
FIXED RIGGING
RUNNING RIGGING
BLINDS
QUANTITY
SCHEDULES OF
SUNSHADE
COMPONENTS

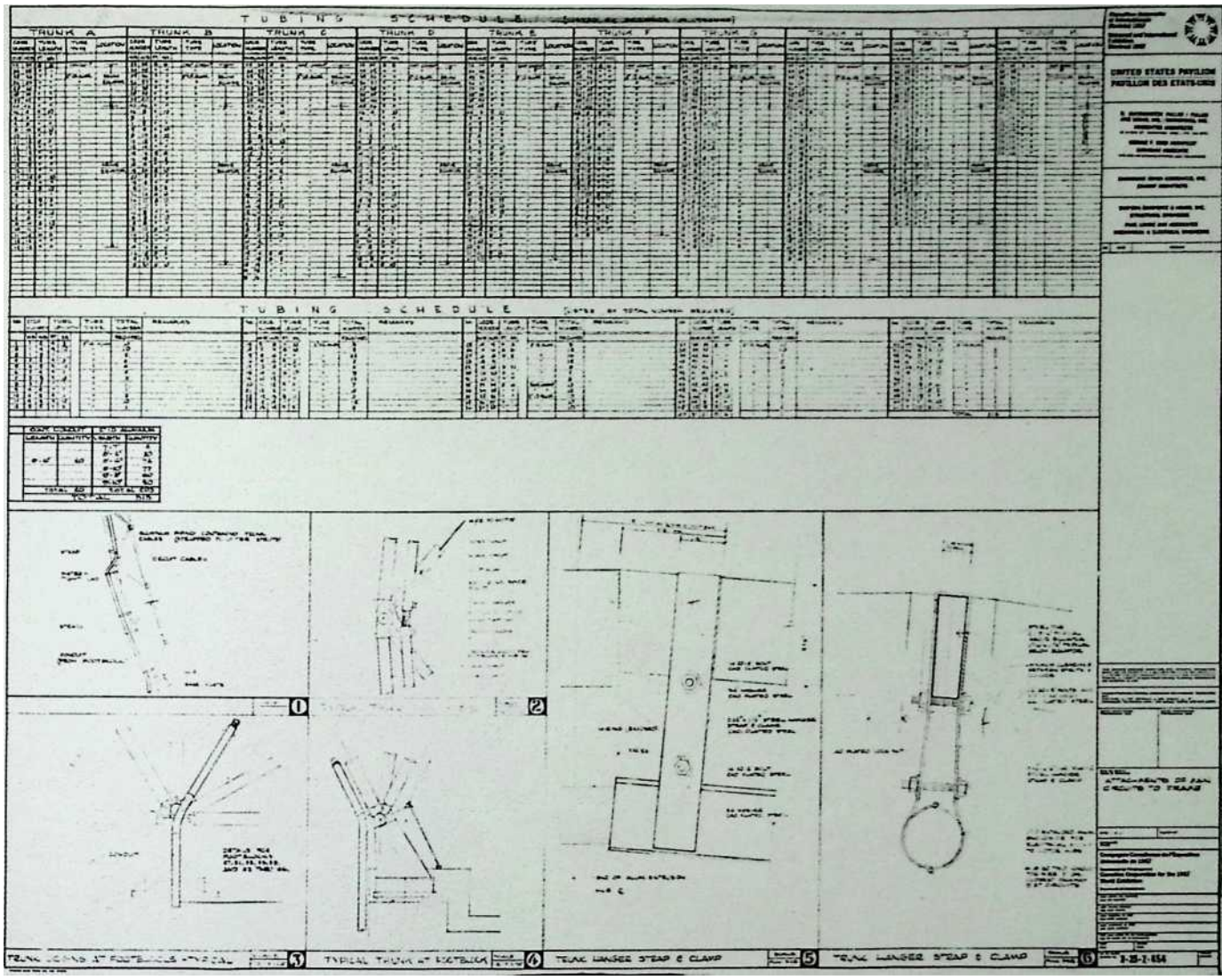

TRUNK ORIGINS
TRUNK A
TRUNK B
TRUNK C
TRUNK D
TRUNK E
TRUNK F
TRUNK G
KEY TO TRUNKS

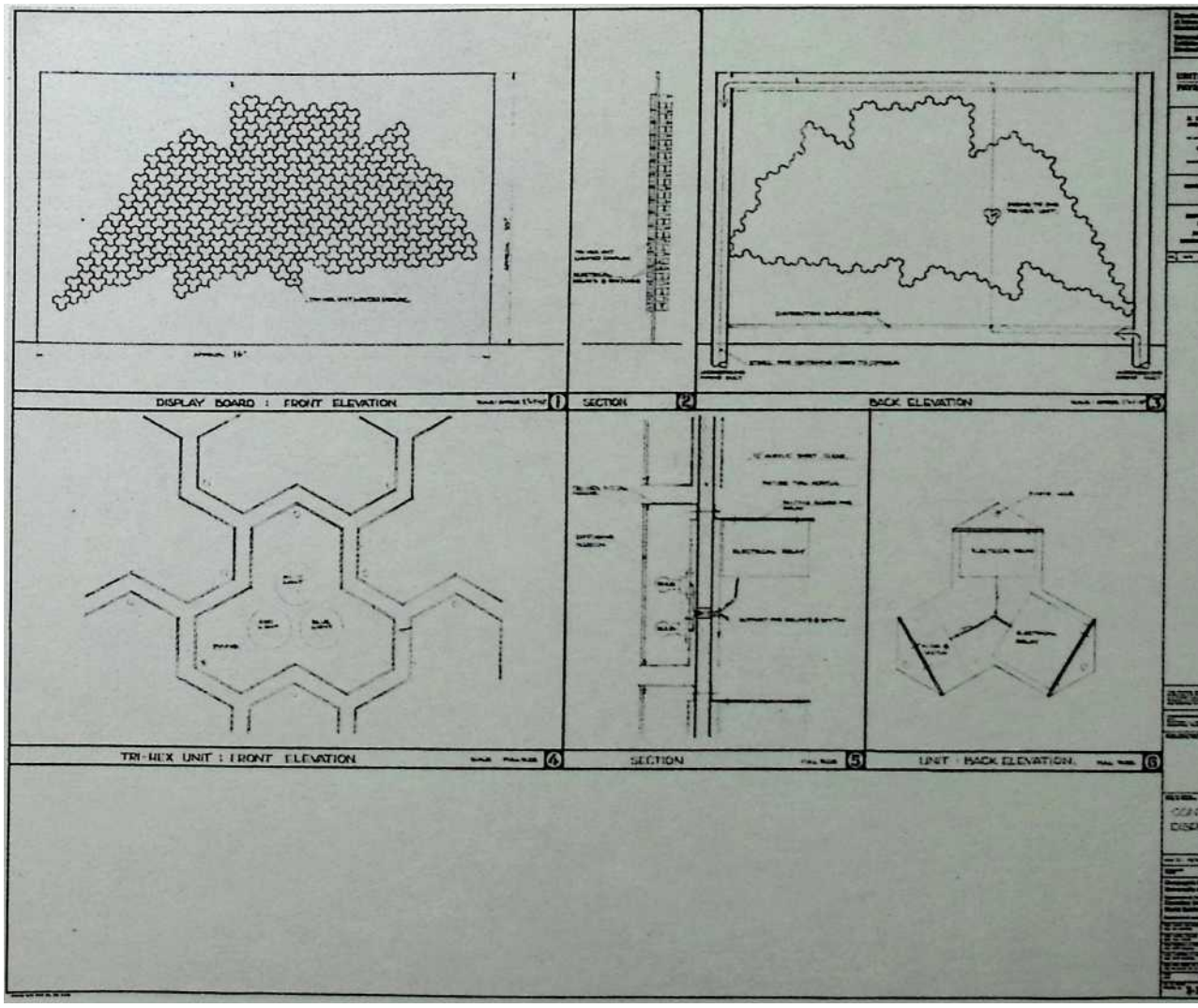

TRUNK (E)
TRUNK (D)
TRUNK (C)
TRUNK (B)
TRUNK (A)
TRUNK (E)
TRUNK (D)
TRUNK (C)
TRUNK (B)
TRUNK (A)
SEGMENT A
SEGMENT C
KEY TO TRUNKS
B
DEVELOPED EXTERIOR
ELEVATION OF SEGM
"B1" - CIRCUITS TO
INDOOR MOTOR, SUD

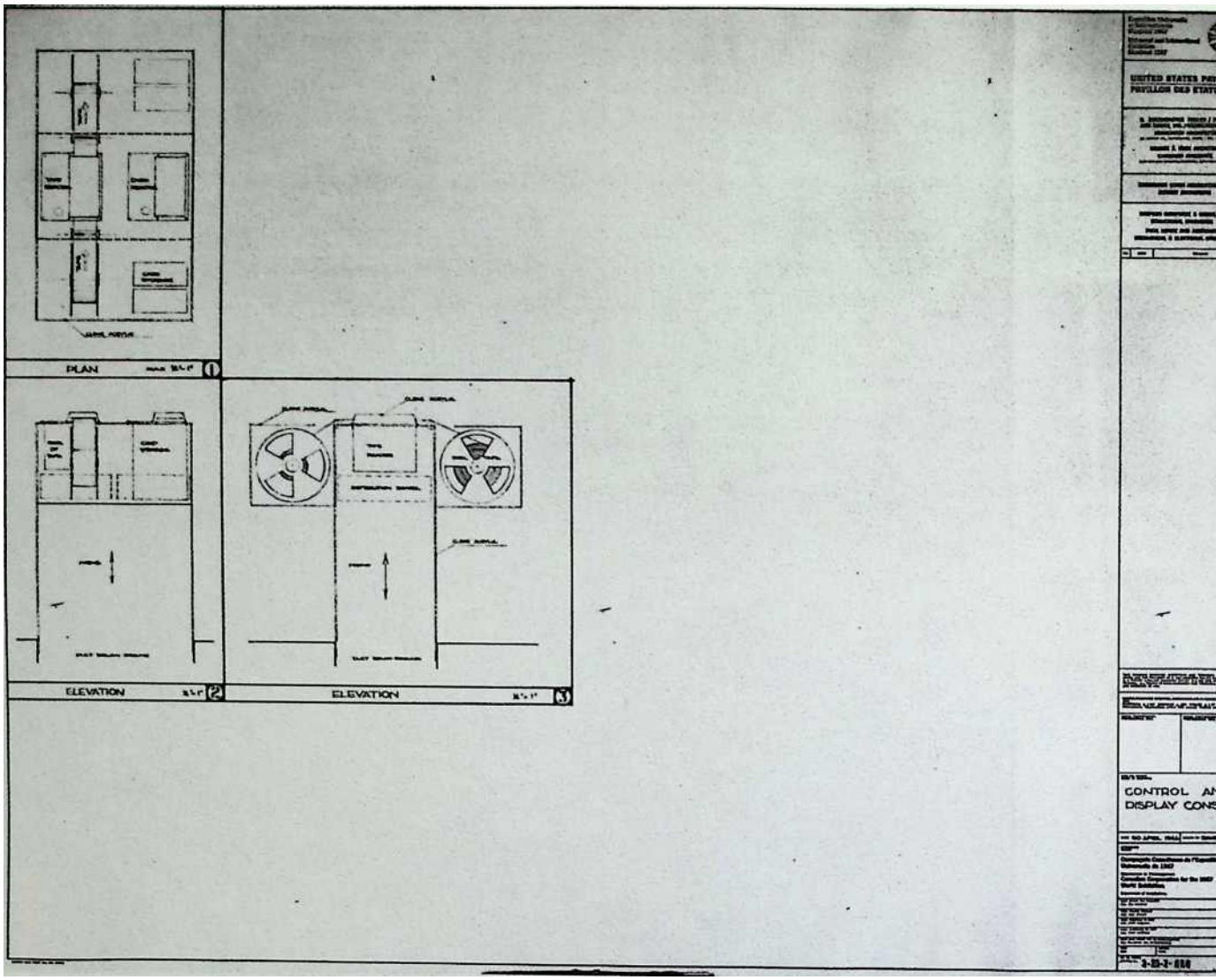


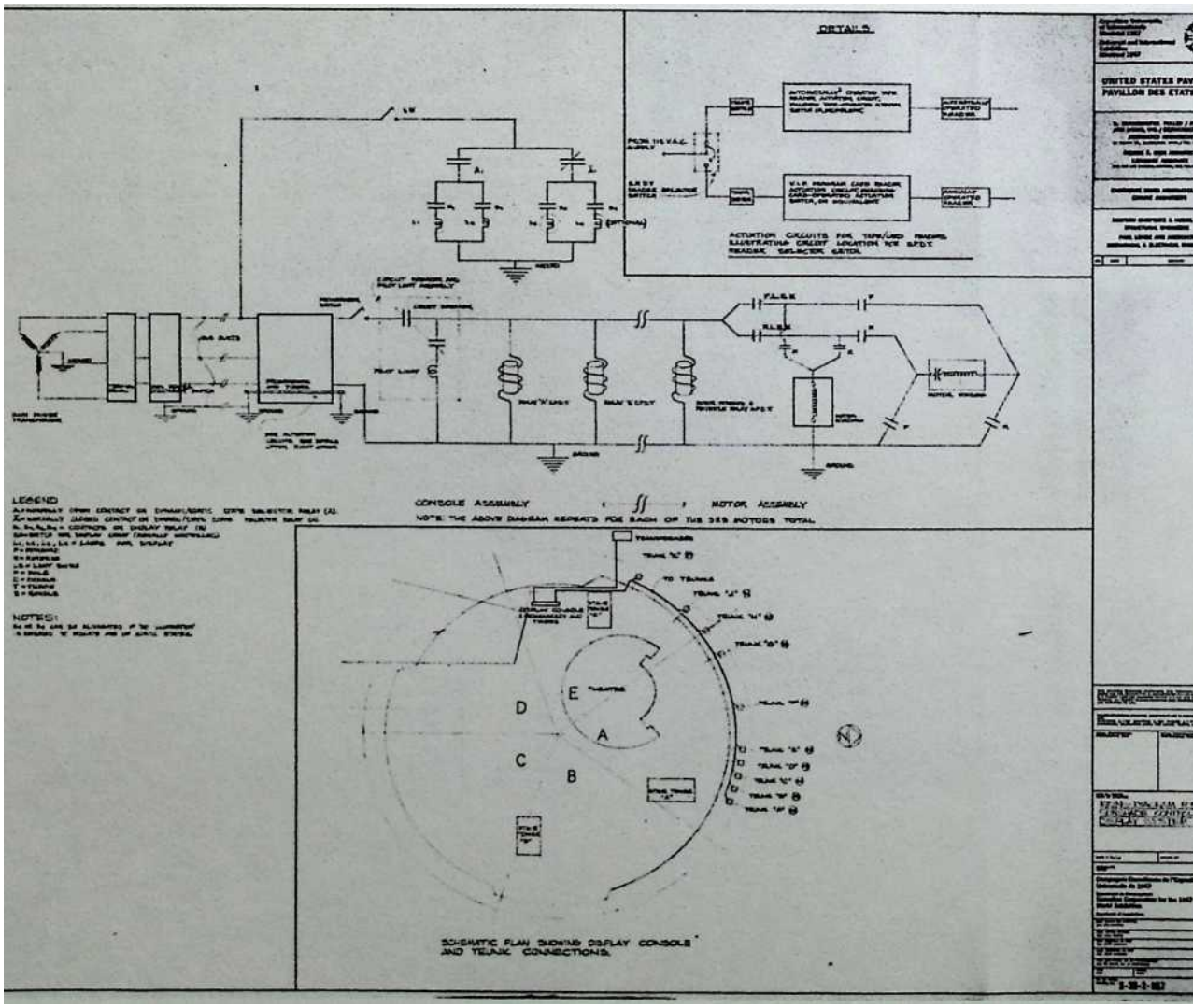

TRUNK
KEY TO TRUNKS
DEVELOPED EXTER
ELEVATION OF SEGM
"D". - CIRCUITS TO
SUNSHADE MOTOR

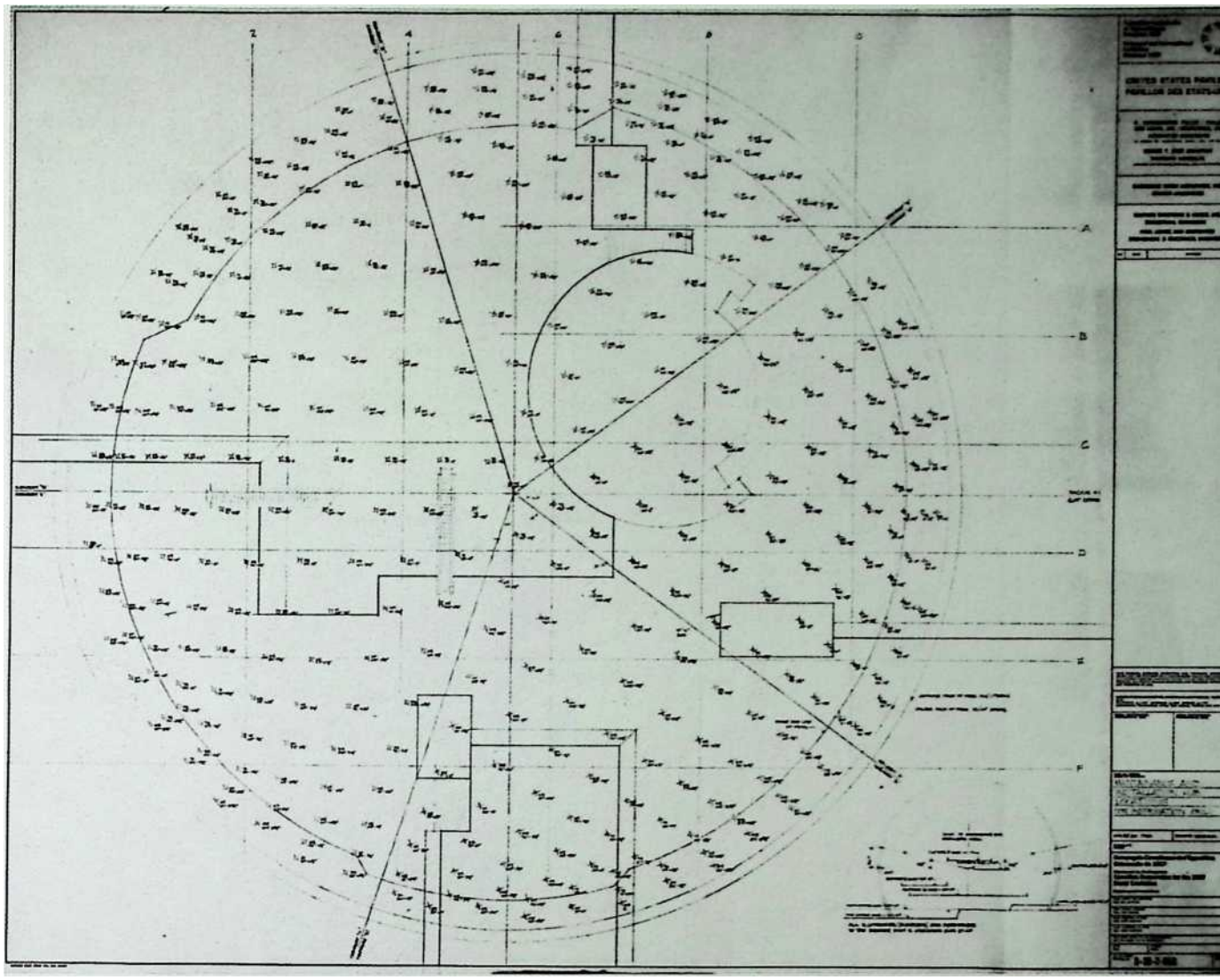


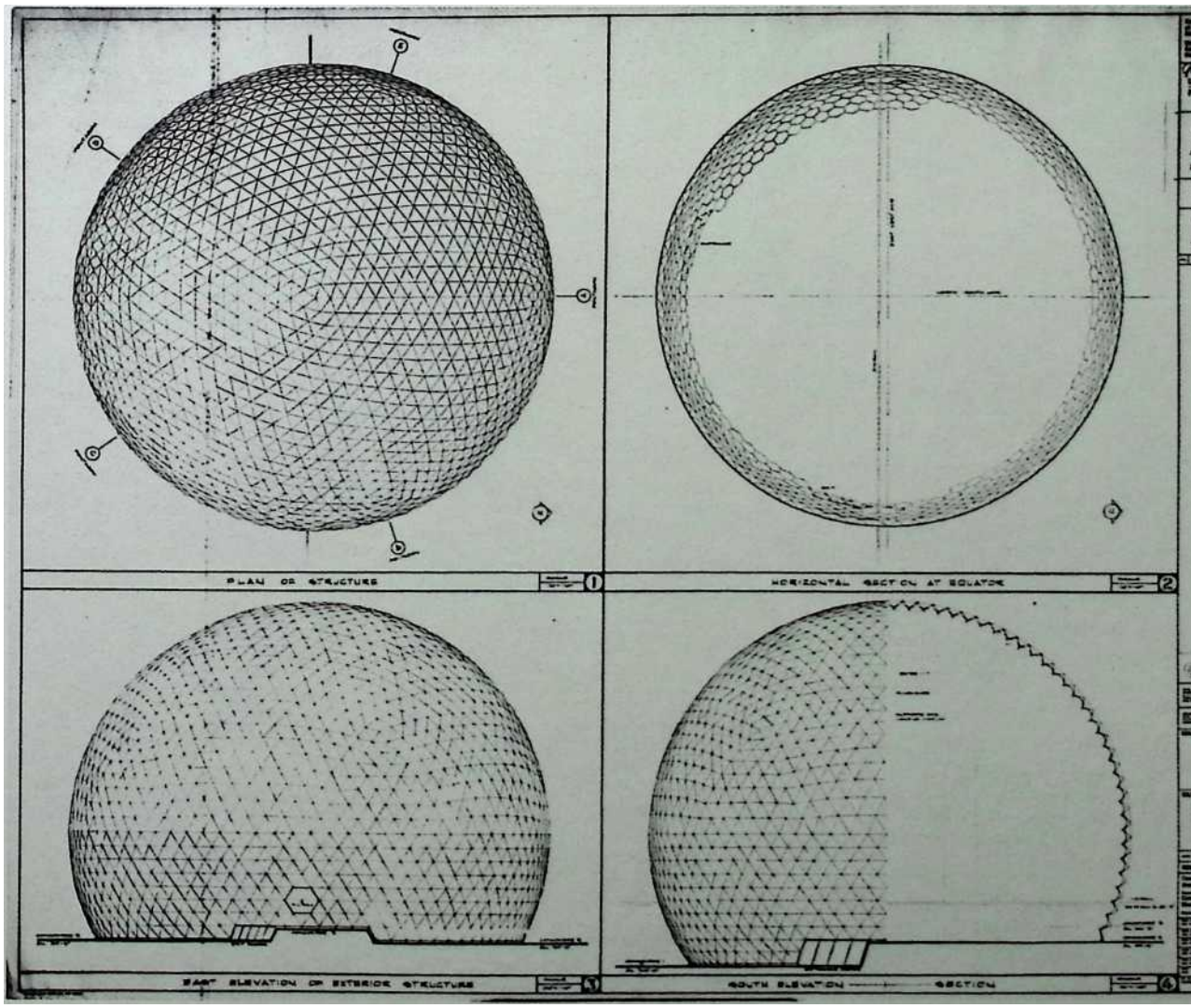

TUBING SCHEDULE
TRUNK A
TRUNK B
TRUNK C
TRUNK D
TRUNK E
TRUNK F
TUBING SCHEDULE
UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS
TYPICAL TRUNK AT EXTERIOR
TEAK HANGER STRAP & CLAMP
TEAK HANGER STRAP & CLAMP

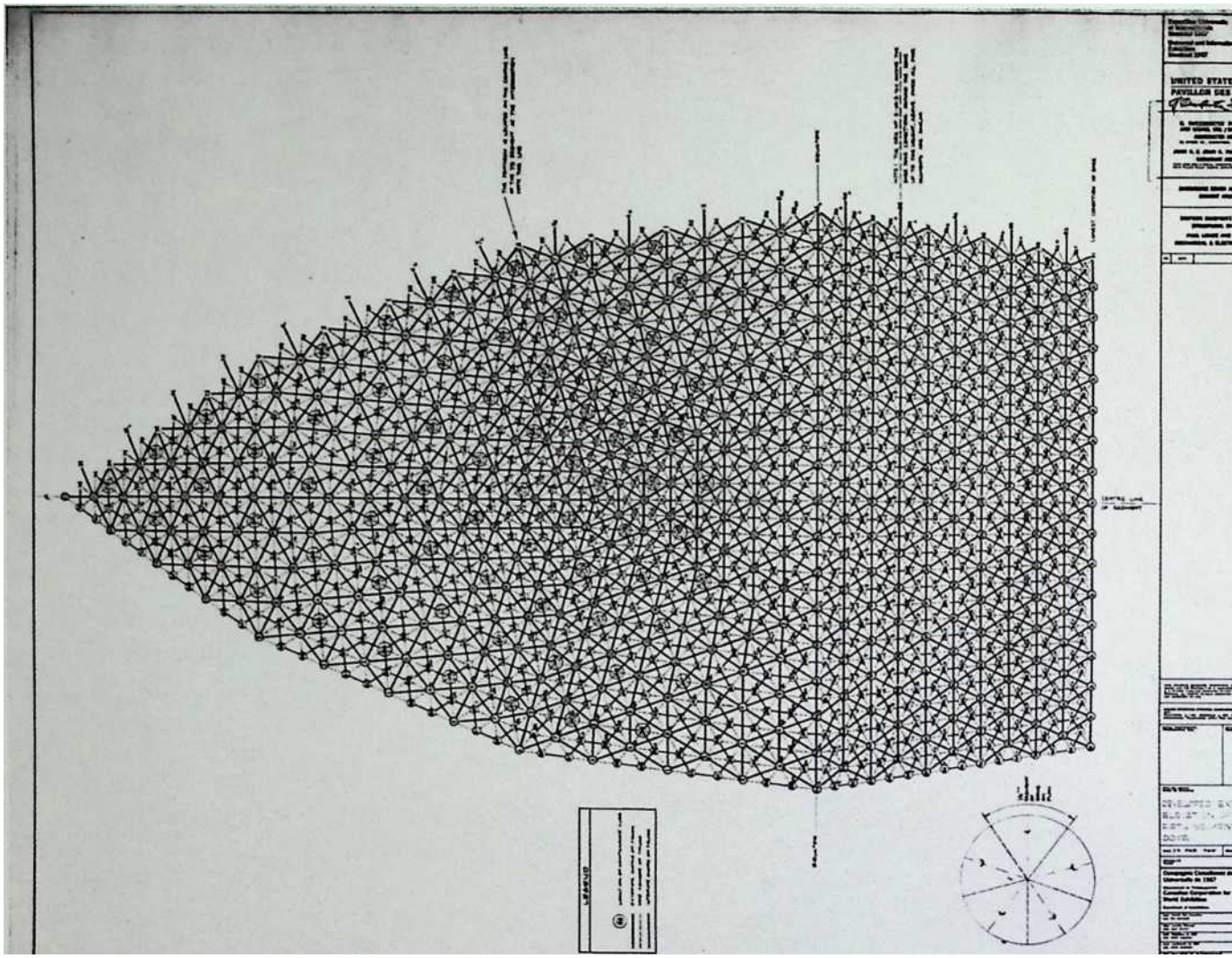

DISPLAY BOARD : FRONT ELEVATION
1
SECTION
2
BACK ELEVATION
3
TRI-HEX UNIT : FRONT ELEVATION
4
SECTION
5
UNIT : BACK ELEVATION.
6

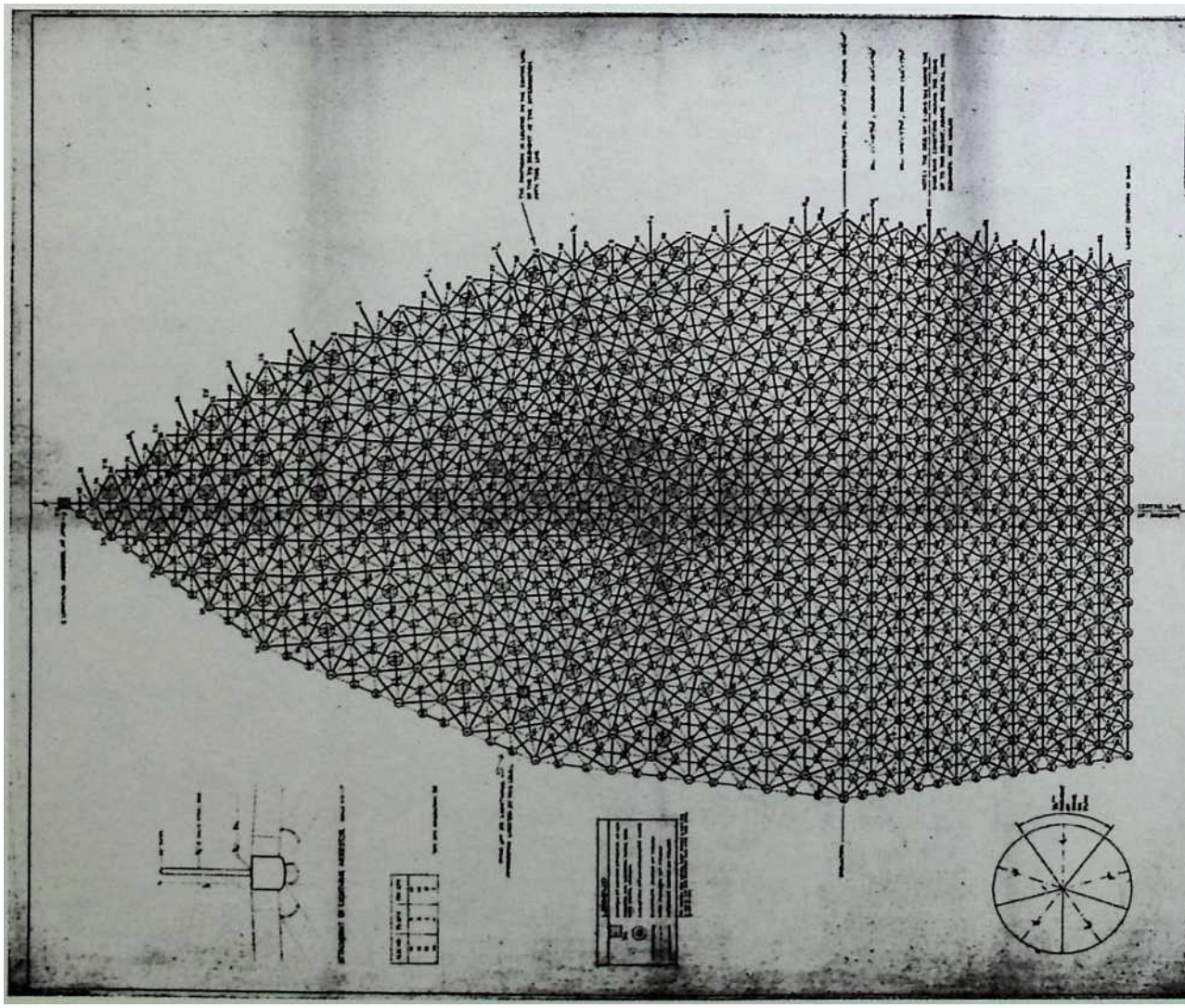

PLAN
ELEVATION
ELEVATION
CONTROL AN
DISPLAY CONS

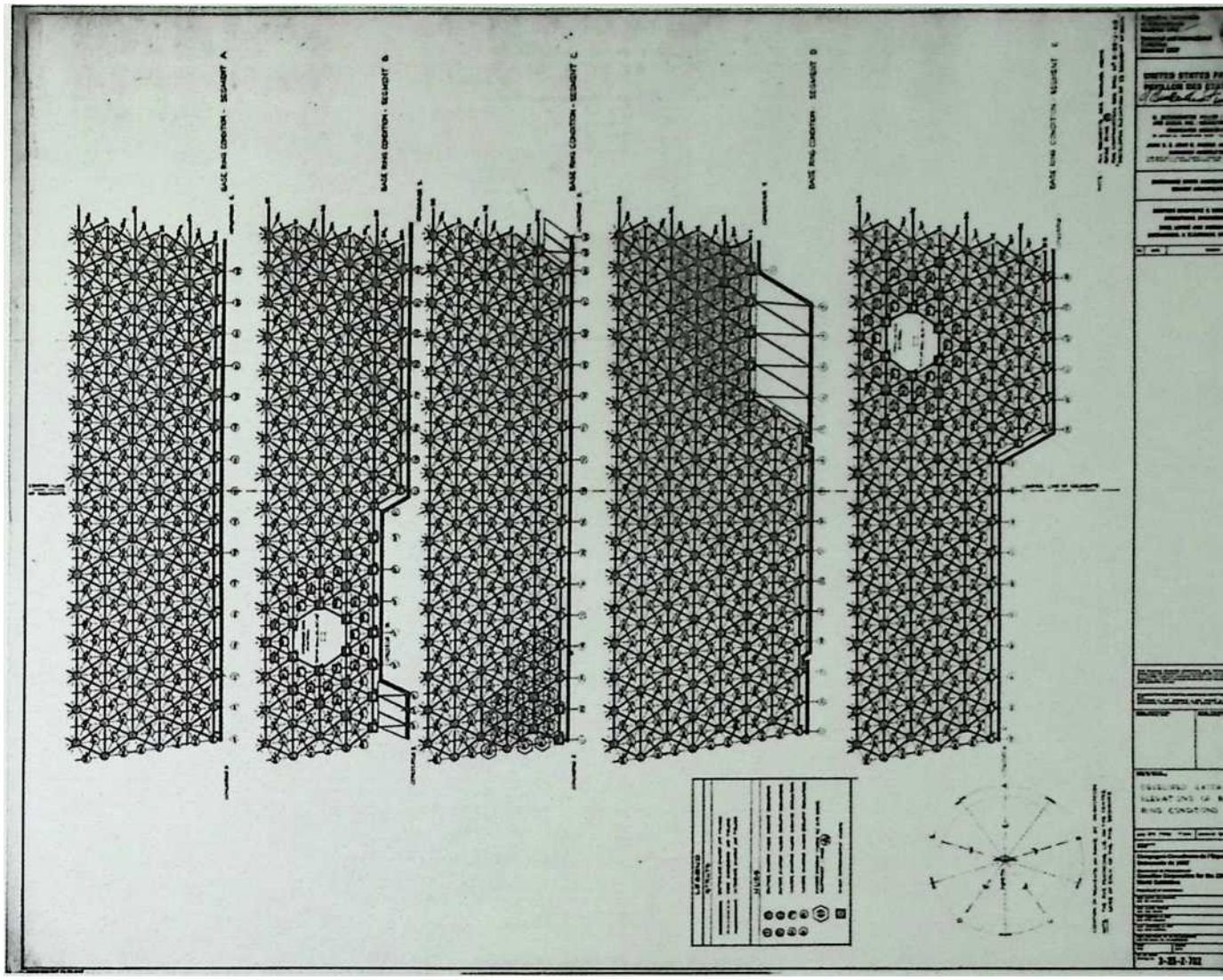

DETAILS
LEGEND
CONSOLE ASSEMBLY
MOTOR ASSEMBLY
NOTES:
D
E
A
C
B

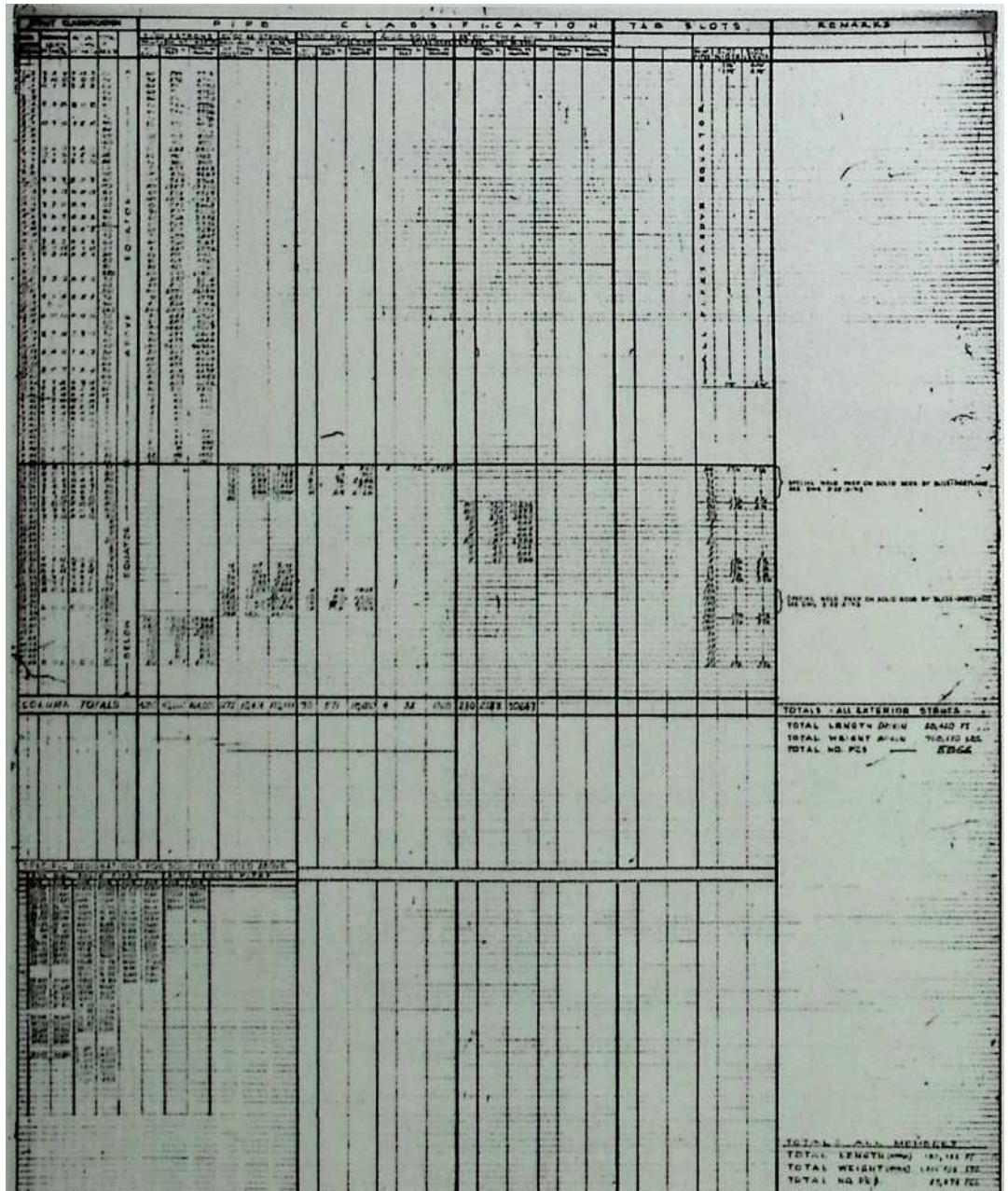


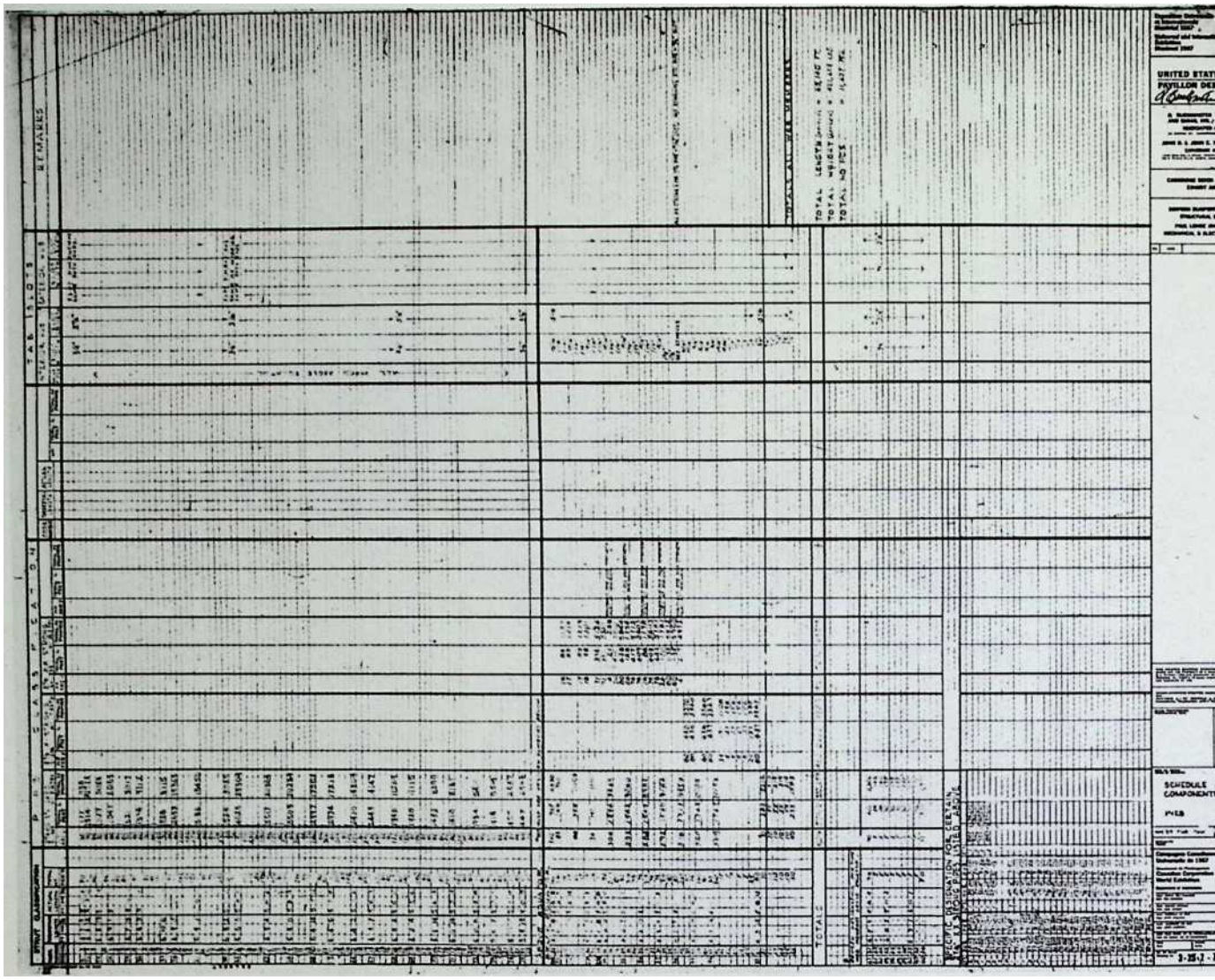

PLAN OF STRUCTURE
1
HORIZONTAL SECTION AT EQUATOR
2
EAST ELEVATION OF EXTERIOR STRUCTURE
3
SOUTH ELEVATION ——— SECTION
4

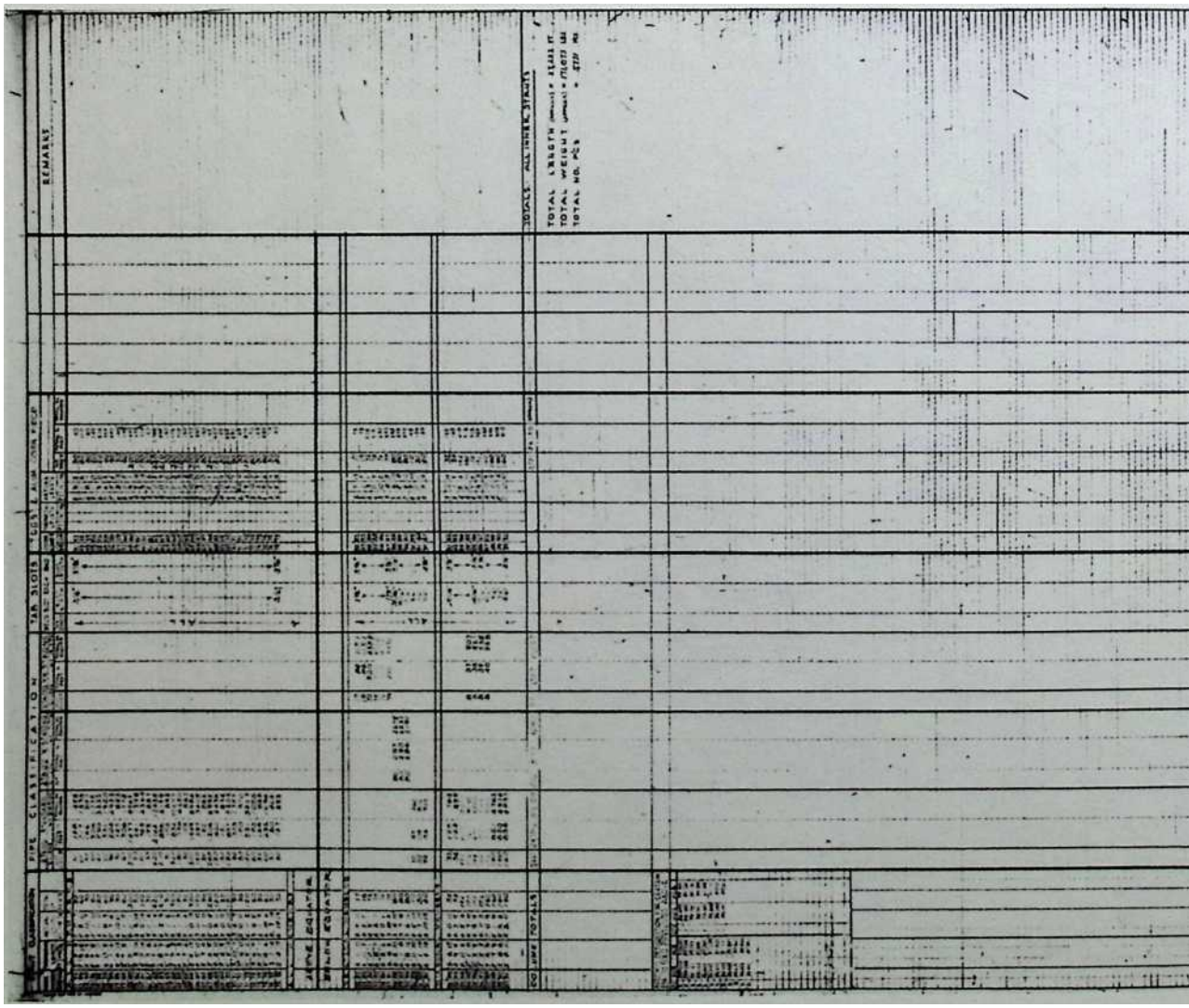


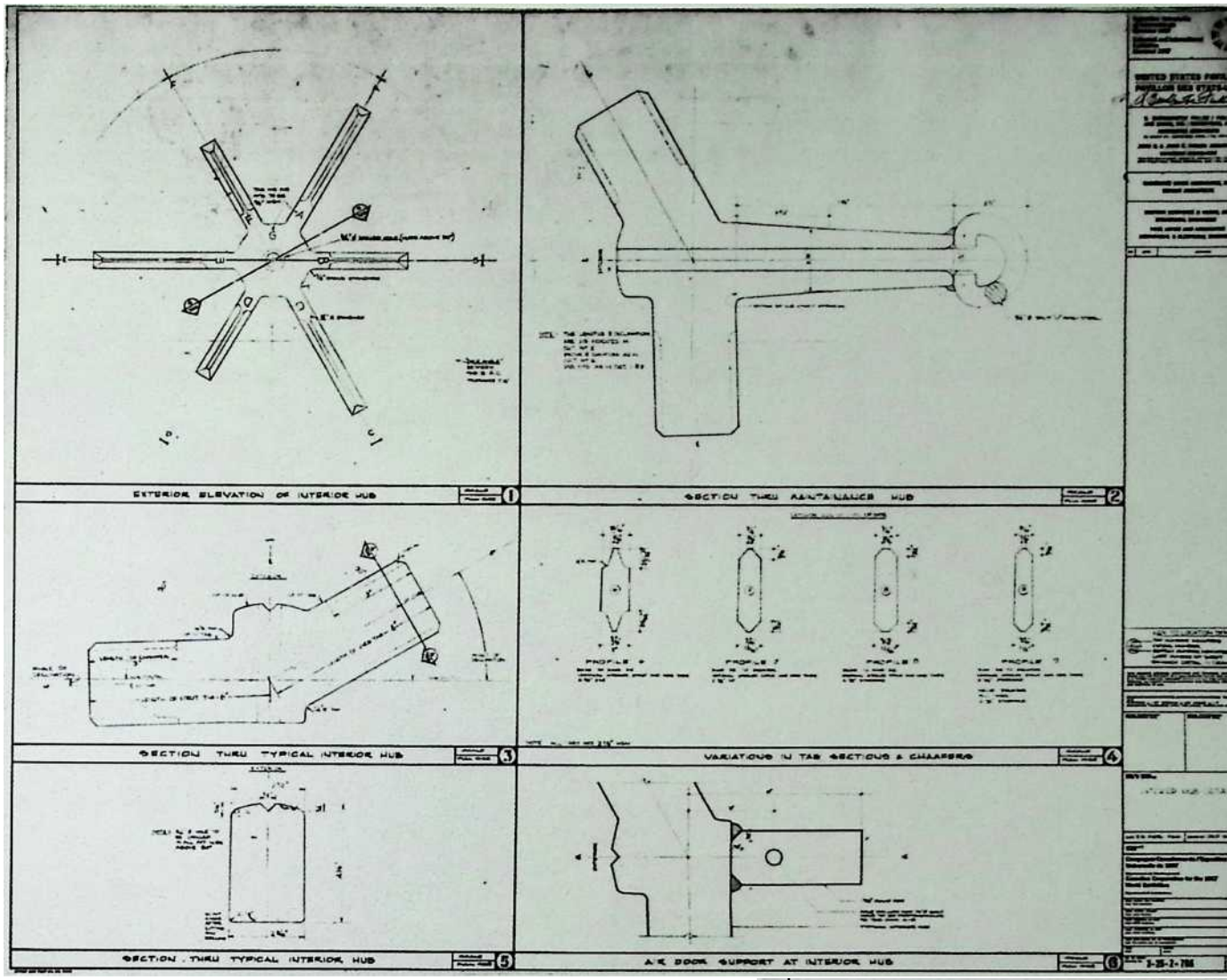


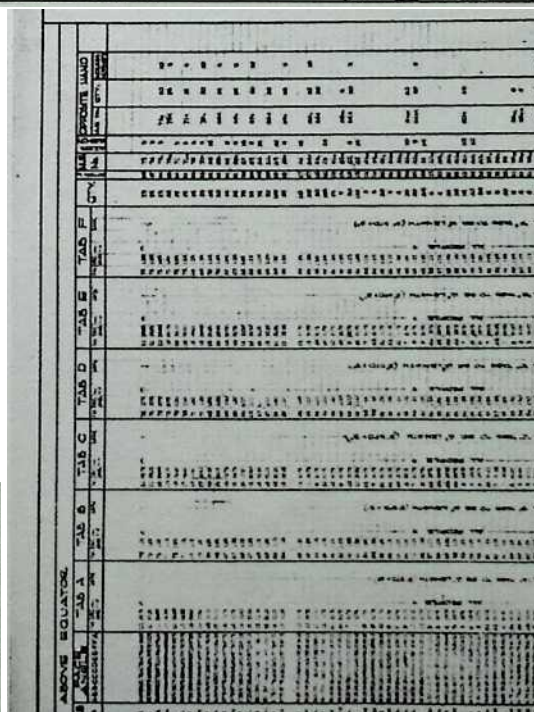

BASE RING CONDITION - SEGMENT A
BASE RING CONDITION - SEGMENT B
BASE RING CONDITION - SEGMENT C
BASE RING CONDITION - SEGMENT D
BASE RING CONDITION - SEGMENT E

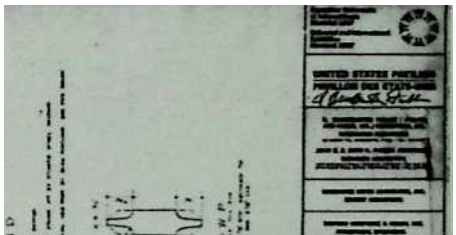

PIPE CLASSIFICATION
TAB SLOTS
REMARKS
COLUMN TOTALS
TOTALS - ALL EXTERIOR STRUTS
TOTAL LENGTH
TOTAL WEIGHT
TOTAL NO. PCS

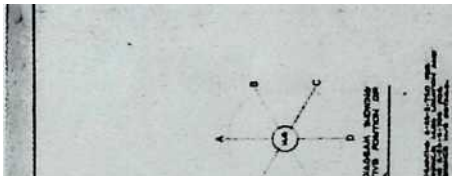


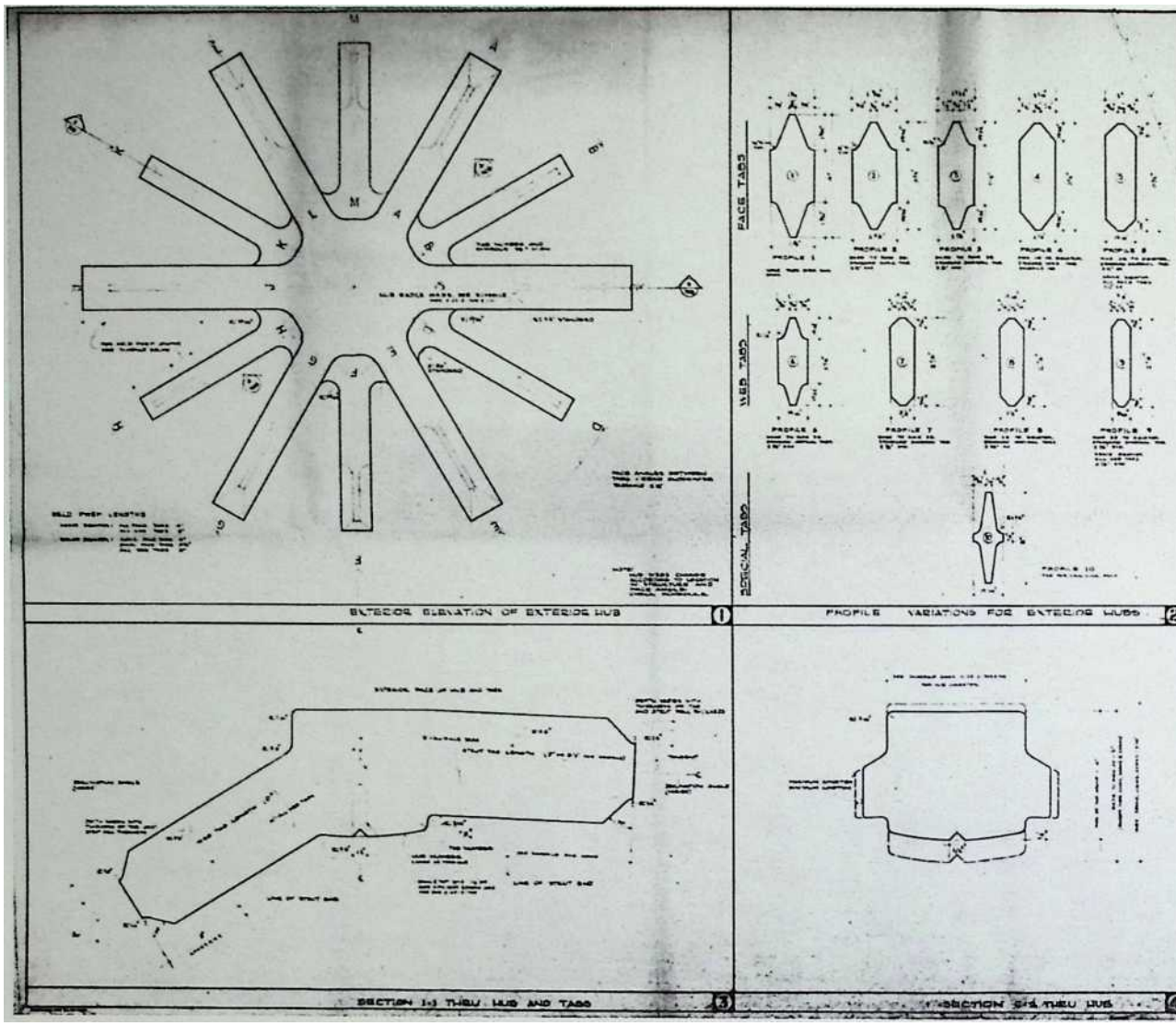


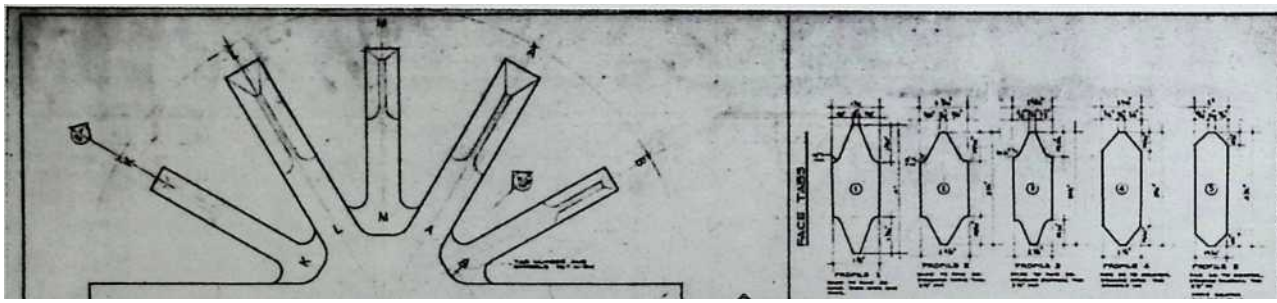

EXTERIOR ELEVATION OF INTERIOR HUB
SECTION THRU TYPICAL INTERIOR HUB
VARIATIONS IN TAB SECTIONS & CHAMFERS
SECTION THRU TYPICAL INTERIOR HUB
AIR DOOR SUPPORT AT INTERIOR HUB

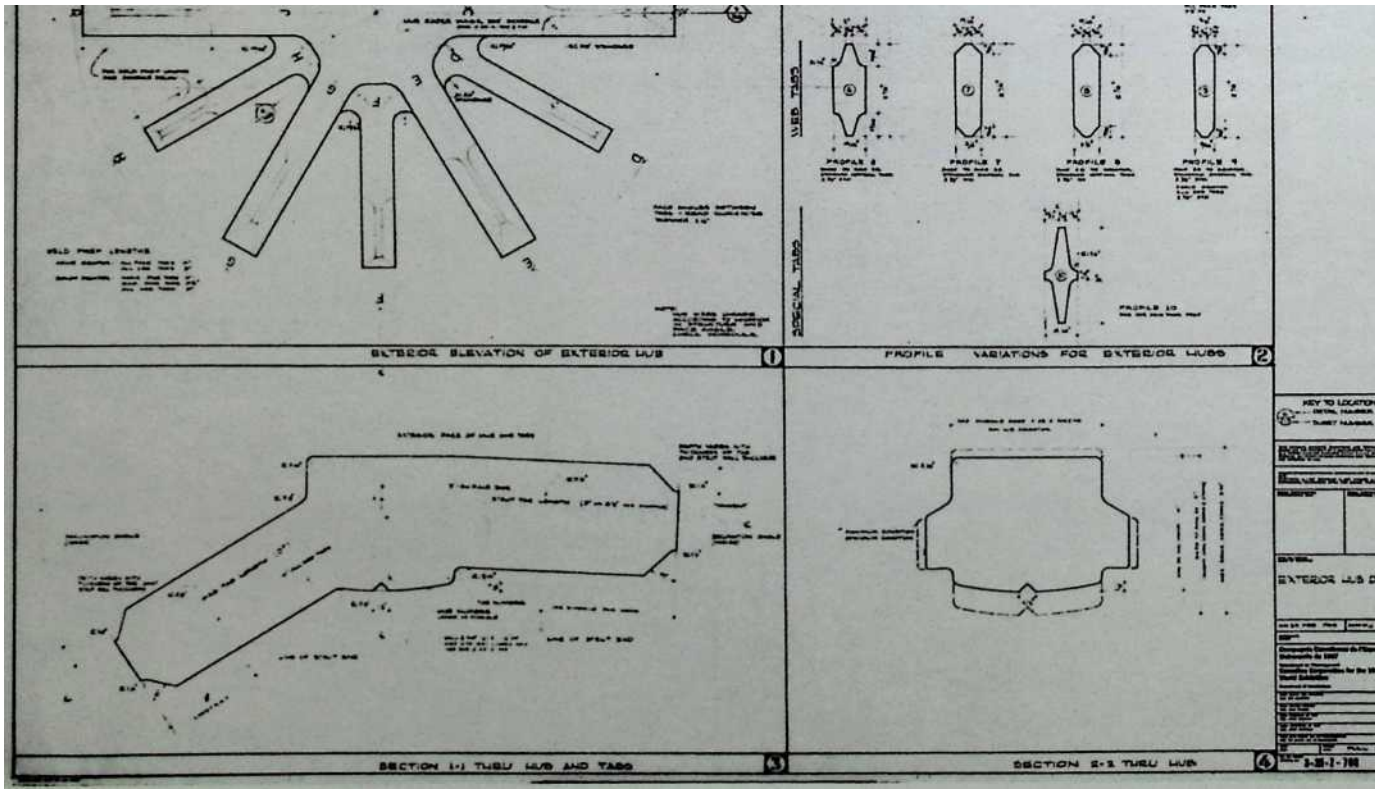

ABOVE EQUATOR
TAB A
TAB B
TAB C
TAB D
TAB E
TAB F

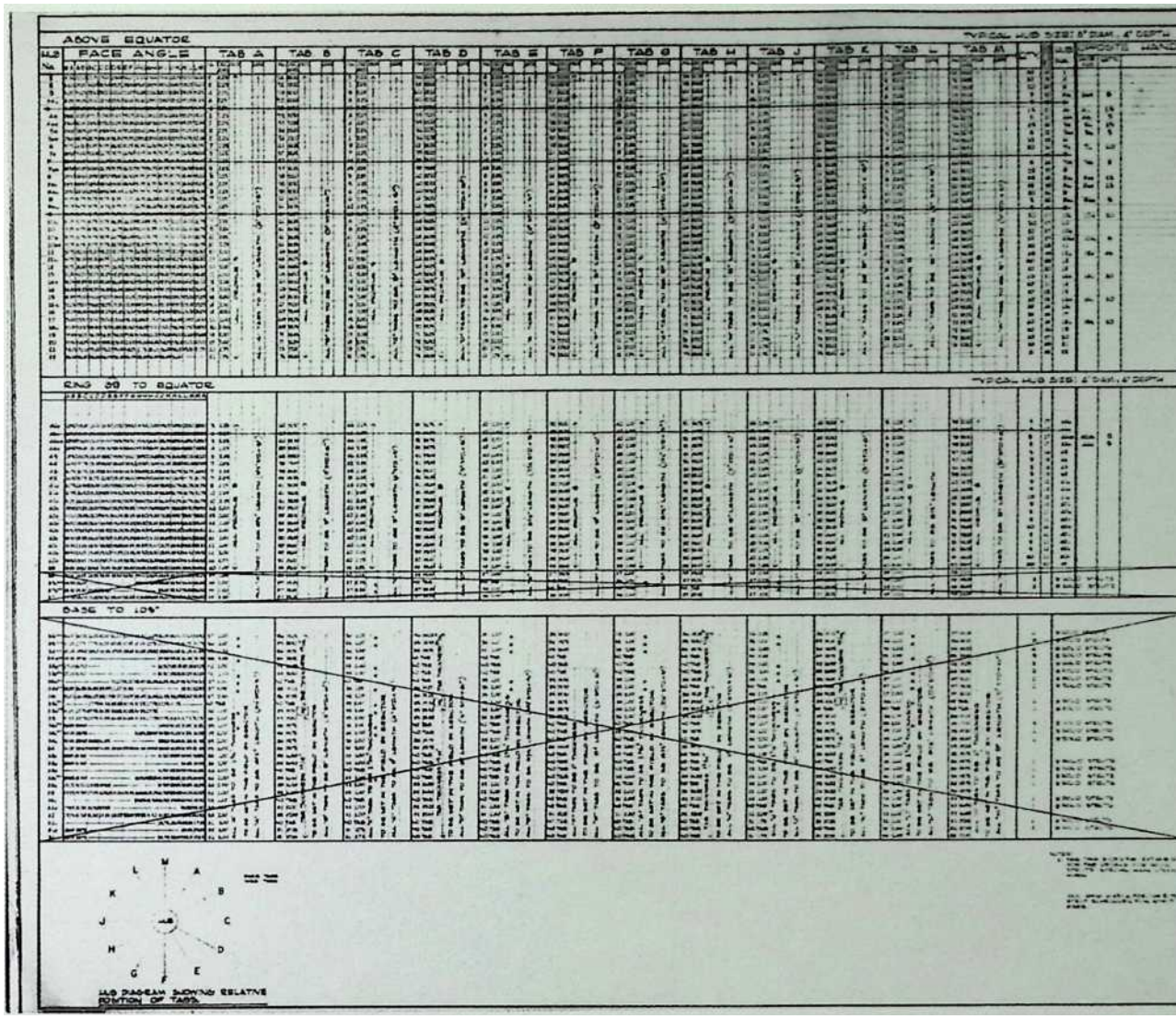


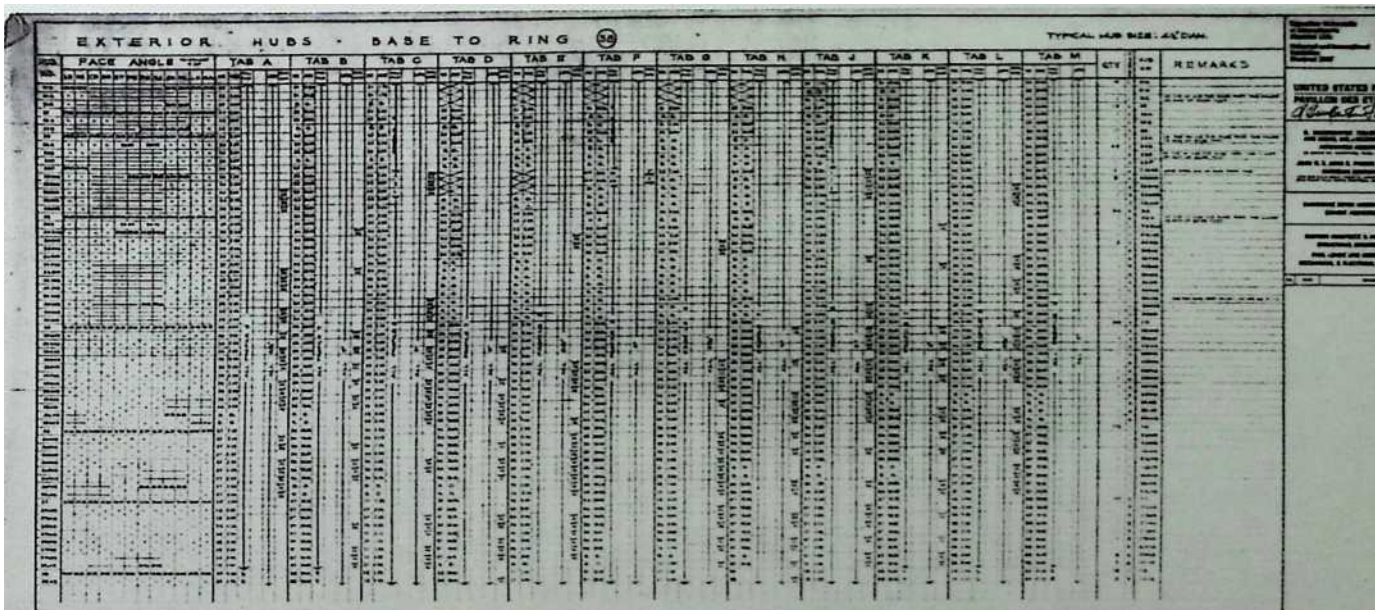


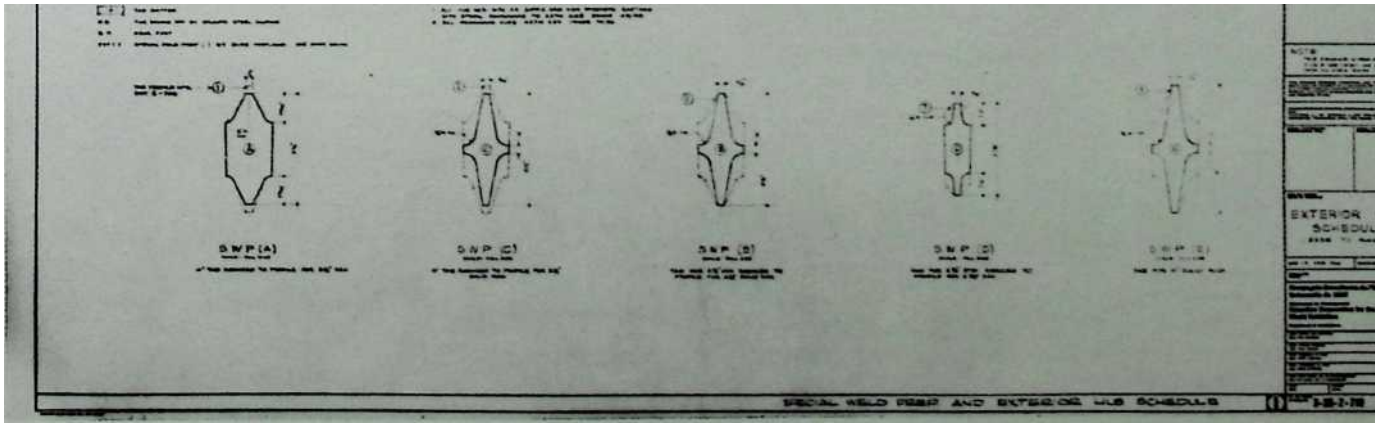

FACE TABS
WEB TABS
ELEVATION OF EXTERIOR HUB
PROFILE VARIATIONS FOR EXTERIOR HUBS
SECTION 1-1 THRU HUB AND TABS


FACE TABS

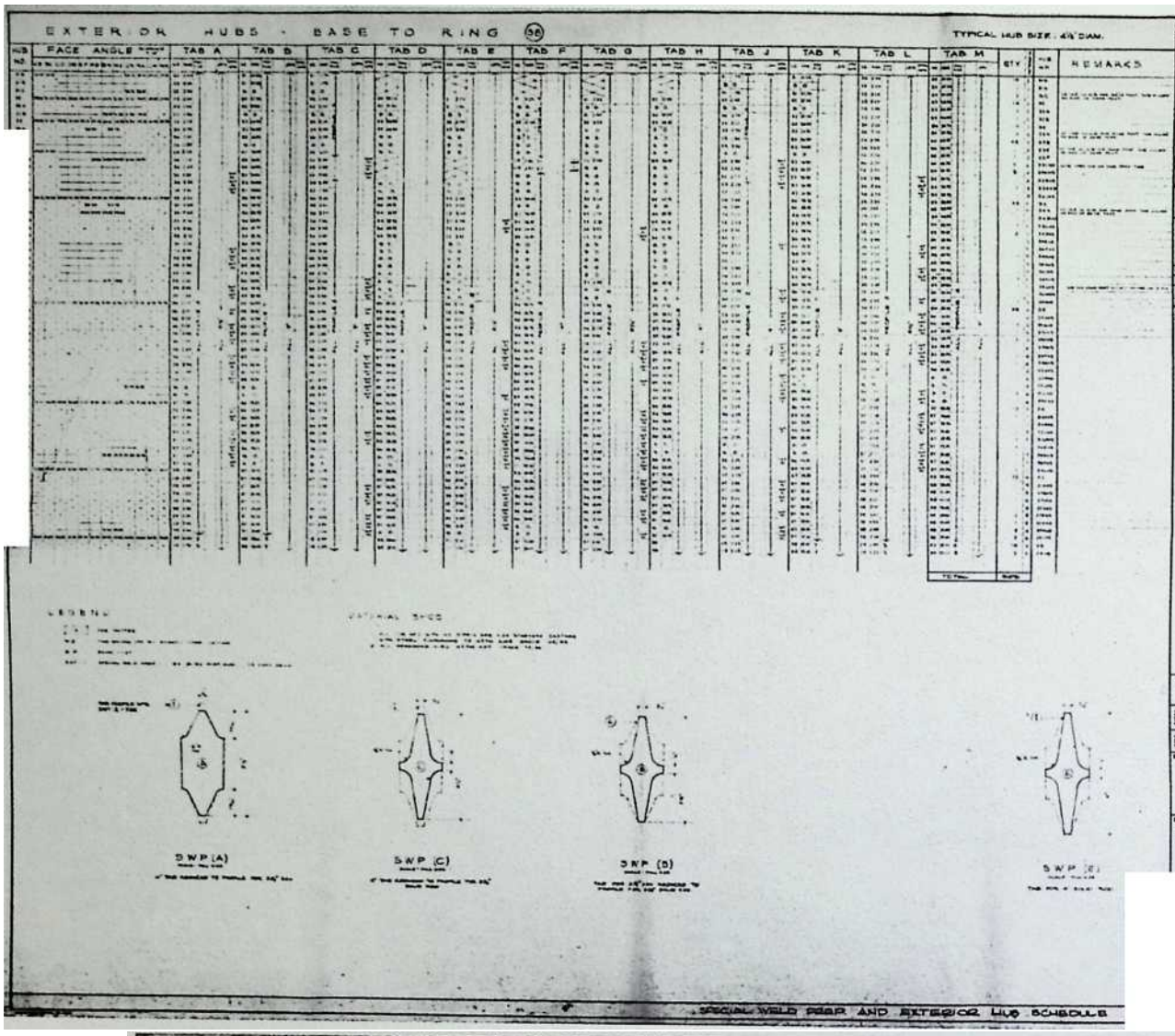

EXTERIOR ELEVATION OF EXTERIOR HUB
PROFILE VARIATIONS FOR EXTERIOR HUBS
SECTION 1-1 THRU HUB AND TABS
SECTION 2-2 THRU HUB

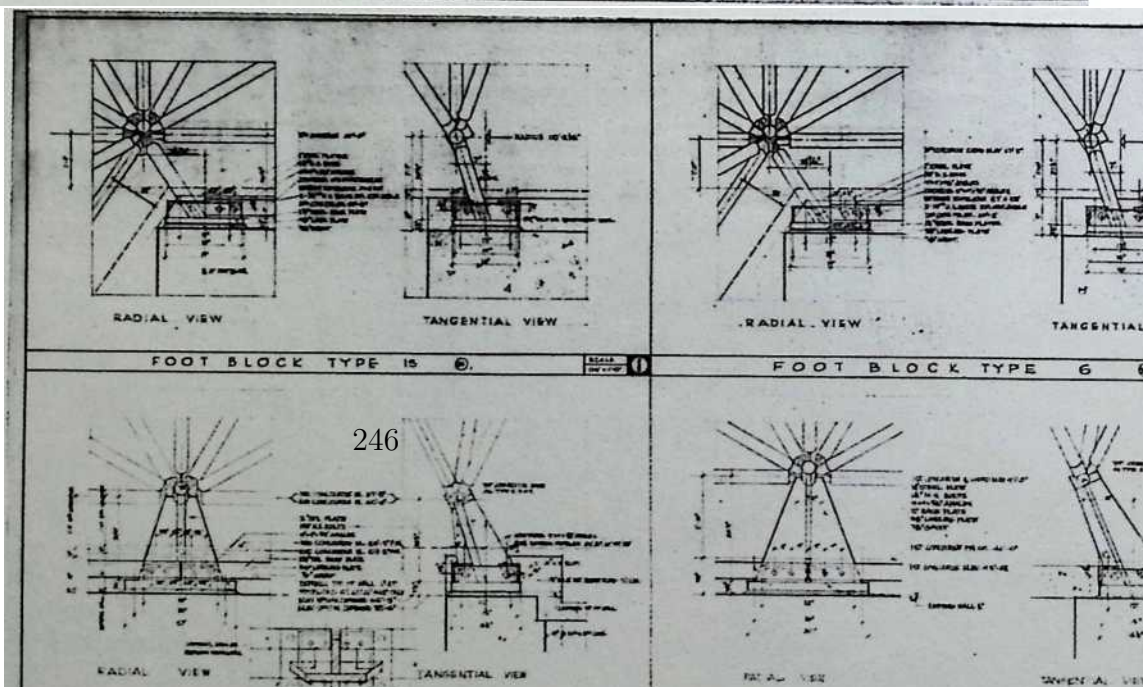

ABOVE EQUATOR
FACE ANGLE
TAB A
TAB B
TAB C
TAB D
TAB E
TAB F
TAB G
TAB H
TAB J
TAB K
TAB L
TAB M
RING 30 TO EQUATOR
BASE TO 10°
L
M
A
K
B
J
C
H
D
G
E
HUB DIAGRAM SHOWING RELATIVE POSITION OF TABS.


EXTERIOR HUBS - BASE TO RING
FACE ANGLE
TAB A
TAB B
TAB C
TAB D
TAB E
TAB F
TAB G
TAB H
TAB J
TAB K
TAB L
TAB M
QTY
REMARKS

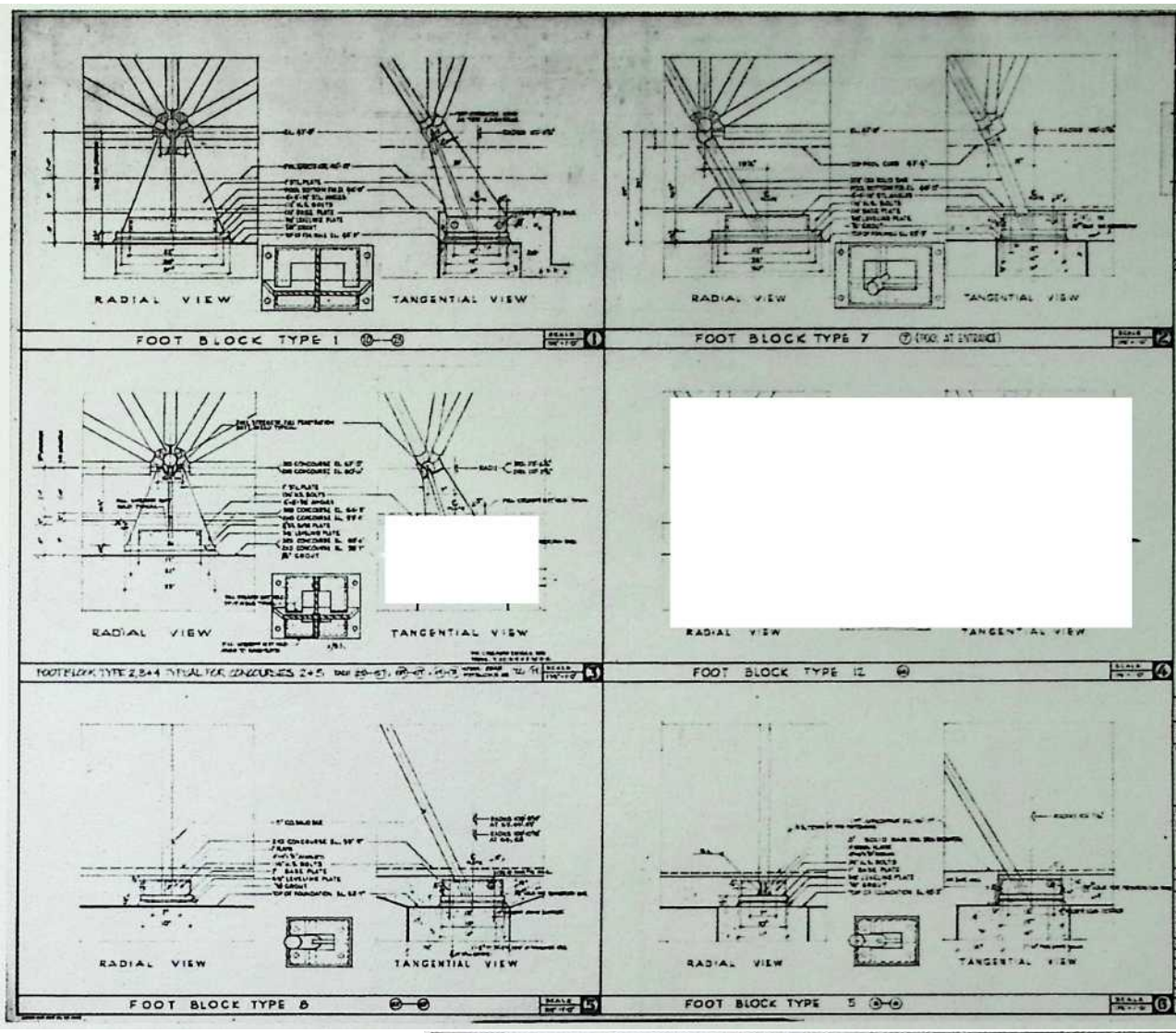

SPECIAL WELD PREP AND EXTERIOR HUB SCHEDULE

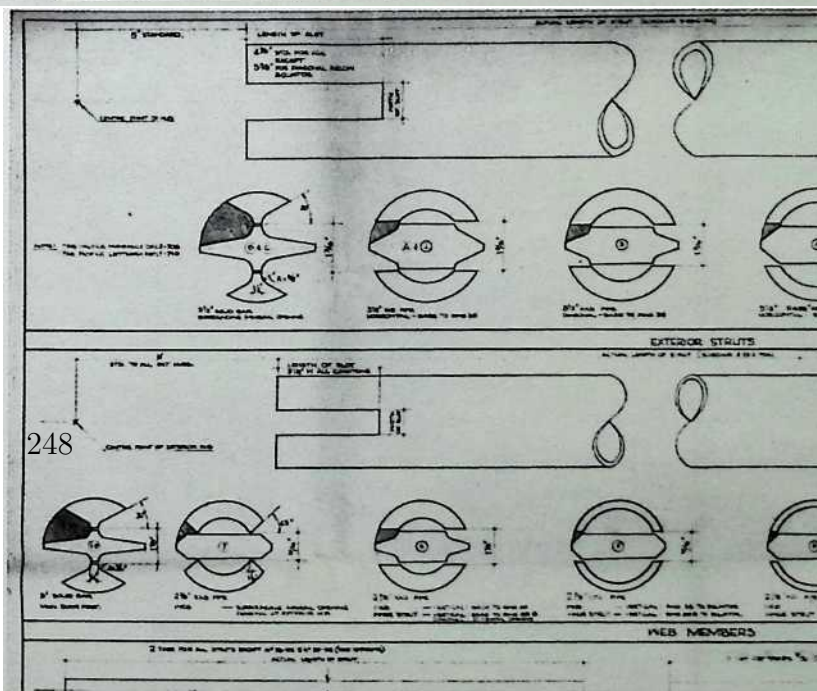
1tin

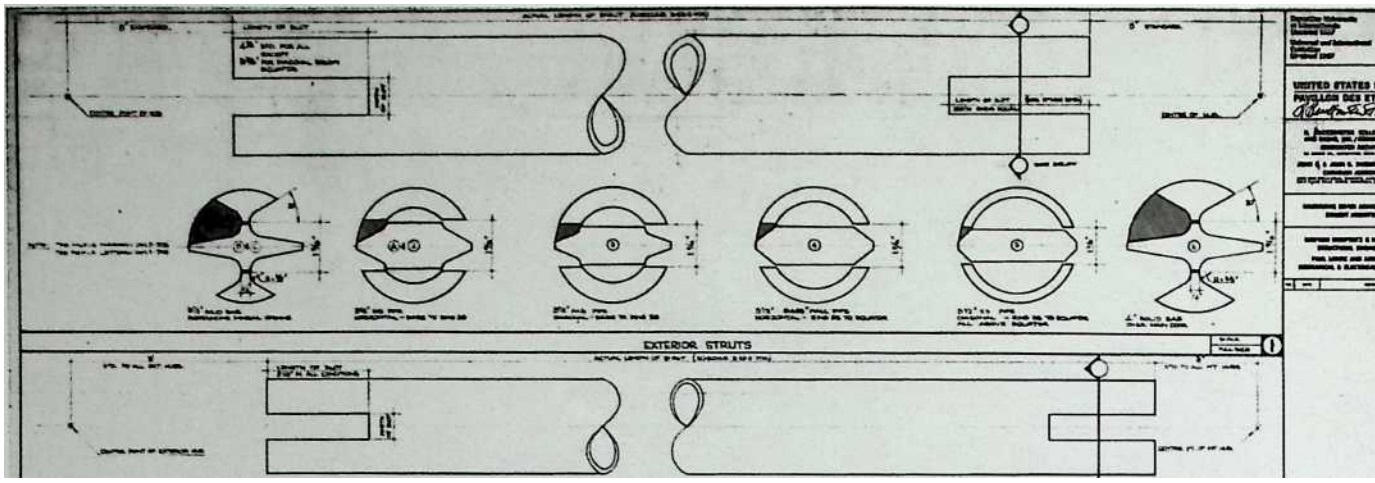

EXTERIOR HUBS - BASE TO RING
TYPICAL HUB SIZE - 4½" DIAM.
FACE ANGLE
TAB A
TAB B
TAB C
TAB D
TAB E
TAB F
TAB G
TAB H
TAB J
TAB K
TAB L
TAB M
QTY
REMARKS
S.W.P. (A)
S.W.P. (C)
S.W.P. (D)
SPECIAL WELD PEER AND EXTERIOR LUG SCHEDULE

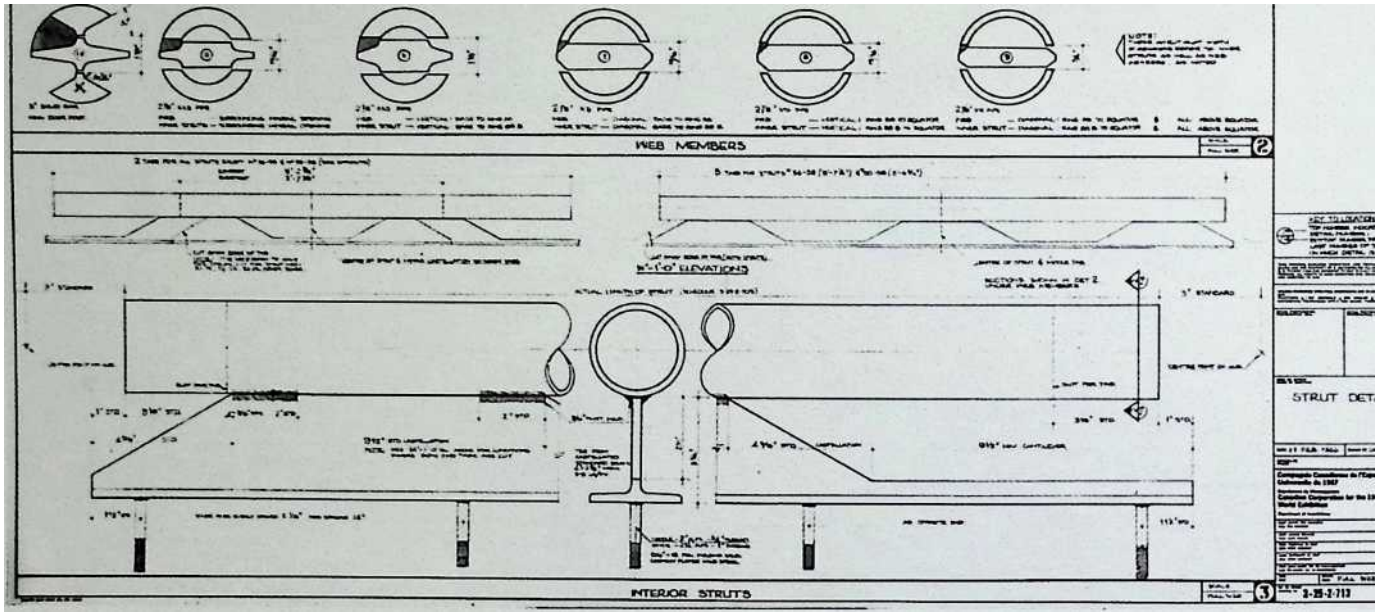

RADIAL VIEW
TANGENTIAL VIEW
FOOT BLOCK TYPE 15
RADIAL VIEW
FOOT BLOCK TYPE 6
RADIAL VIEW
TANGENTIAL VIEW

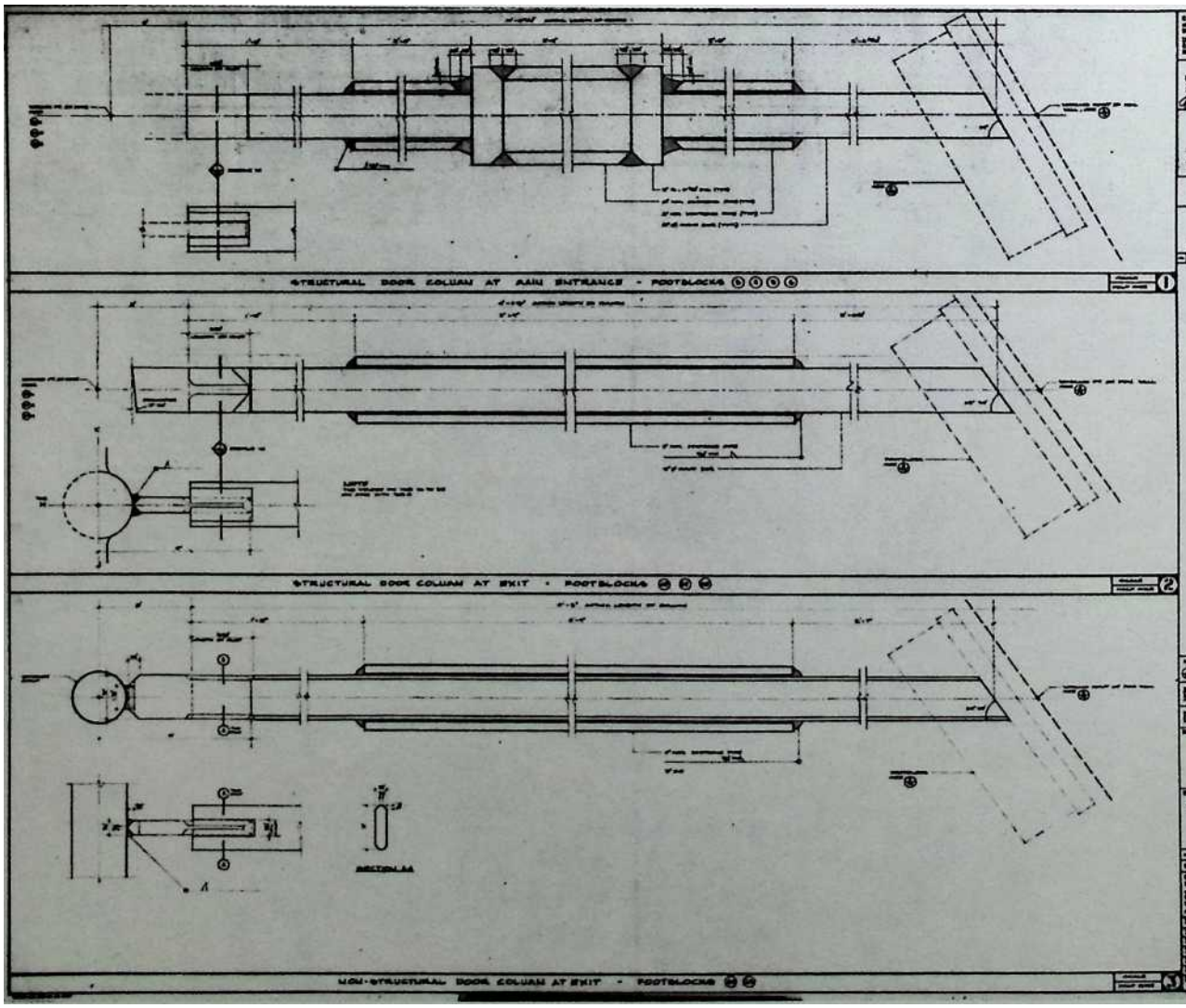
	WK-
Th— -	

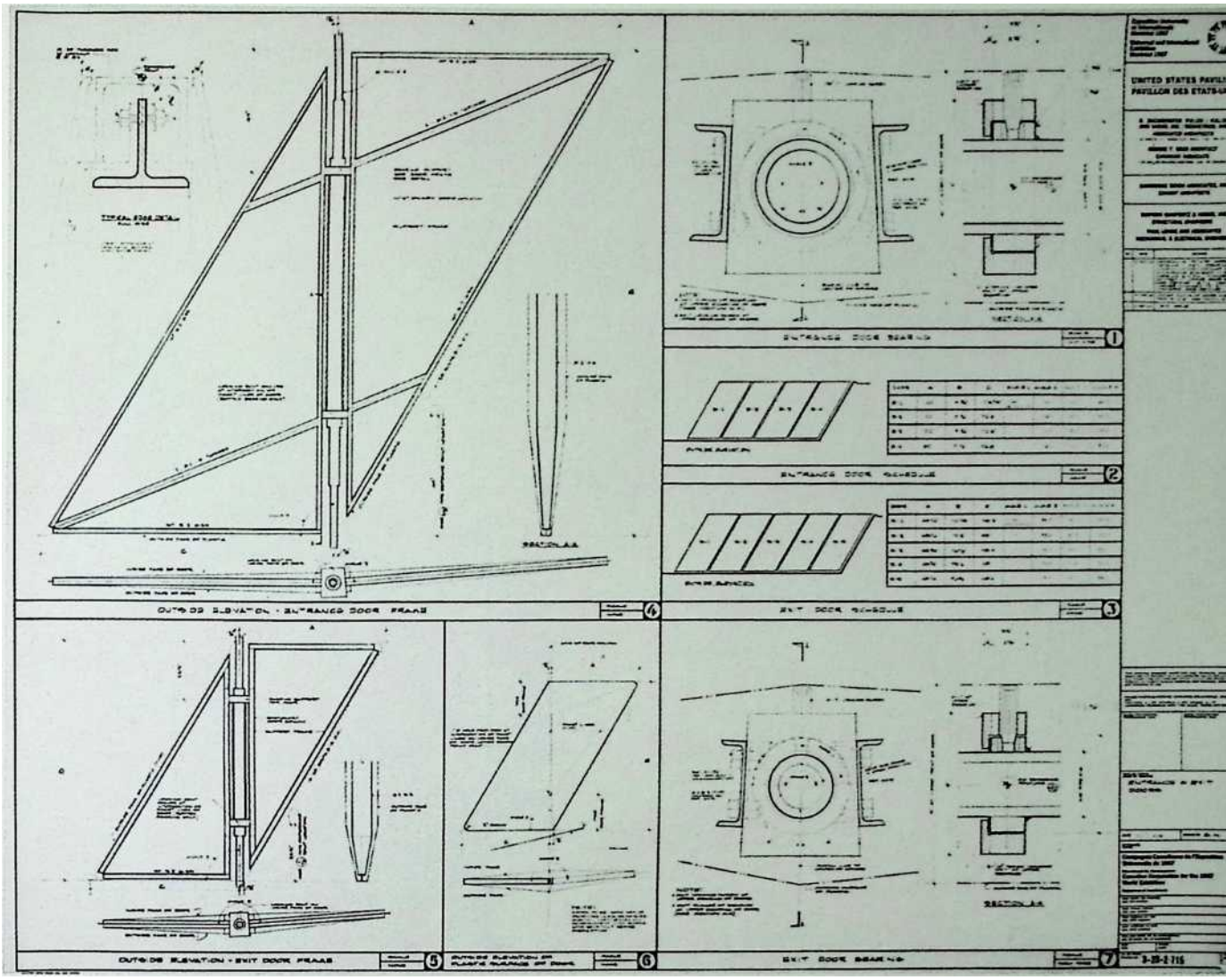

RADIAL VIEW
TANGENTIAL VIEW
FOOT BLOCK TYPE 1
FOOT BLOCK TYPE 7
FOOT BLOCK TYPE 12
FOOT BLOCK TYPE 8
FOOT BLOCK TYPE 5

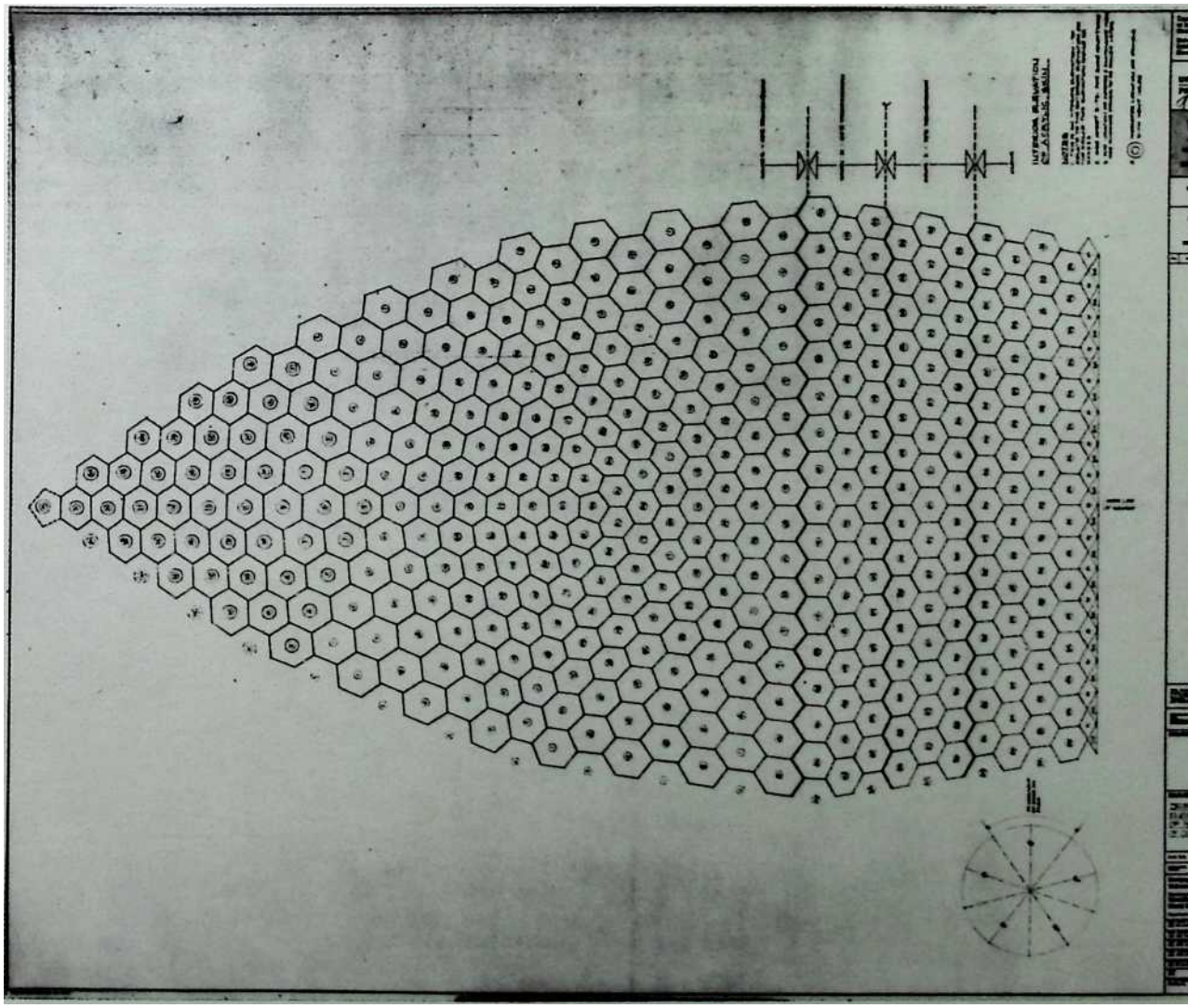

EXTERIOR STRUTS
WEB MEMBERS


EXTERIOR STRUTS


WEB MEMBERS
INTERIOR STRUTS


STRUCTURAL DOOR COLUMN AT MAIN ENTRANCE - FOOTBLOCKS
STRUCTURAL DOOR COLUMN AT EXIT - FOOTBLOCKS
NON-STRUCTURAL DOOR COLUMN AT EXIT - FOOTBLOCKS





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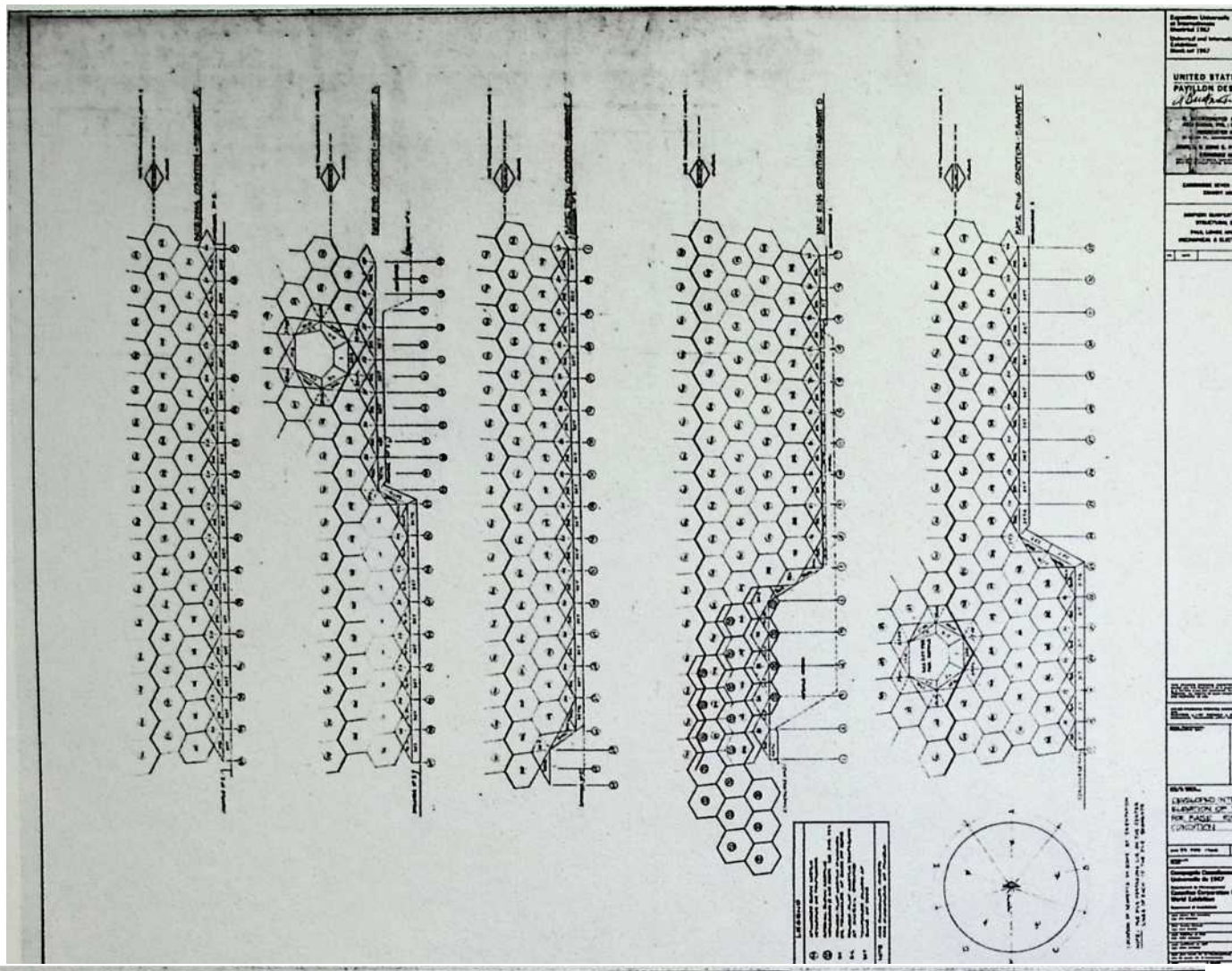
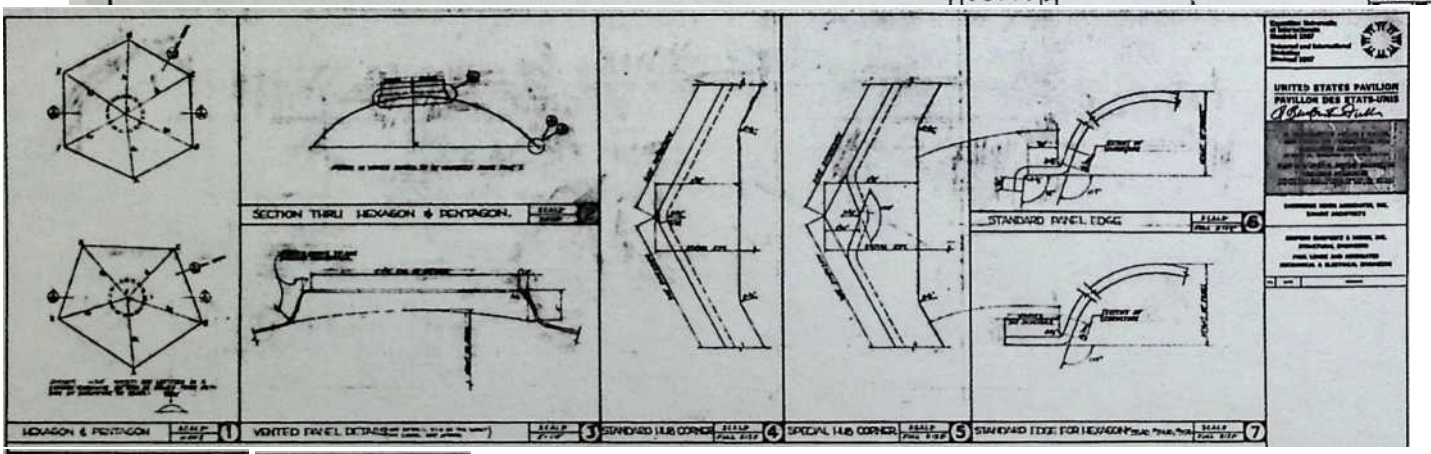
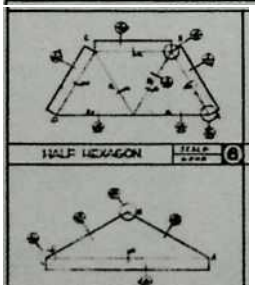
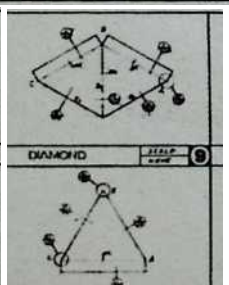
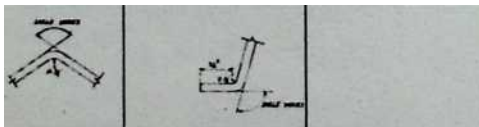
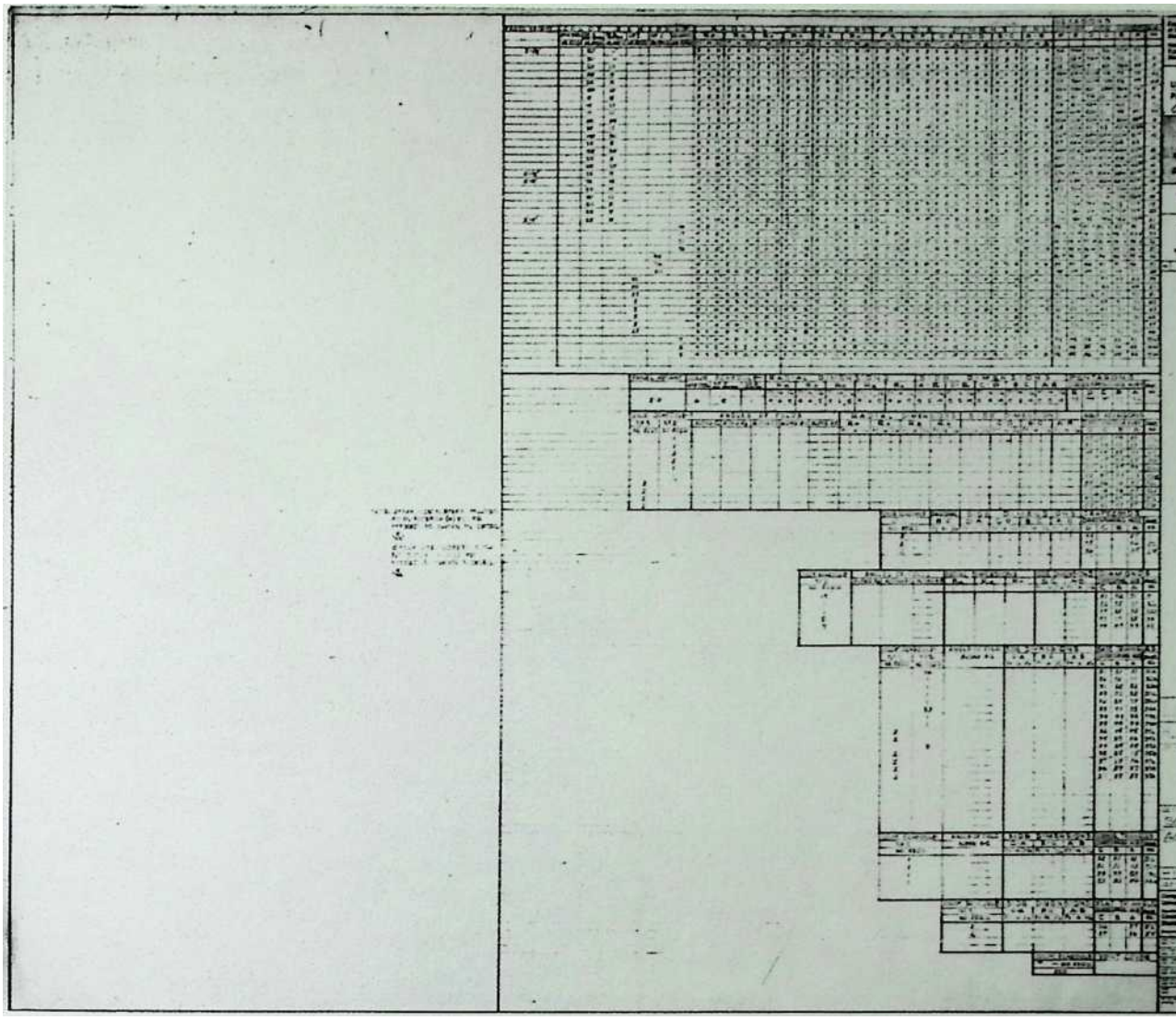


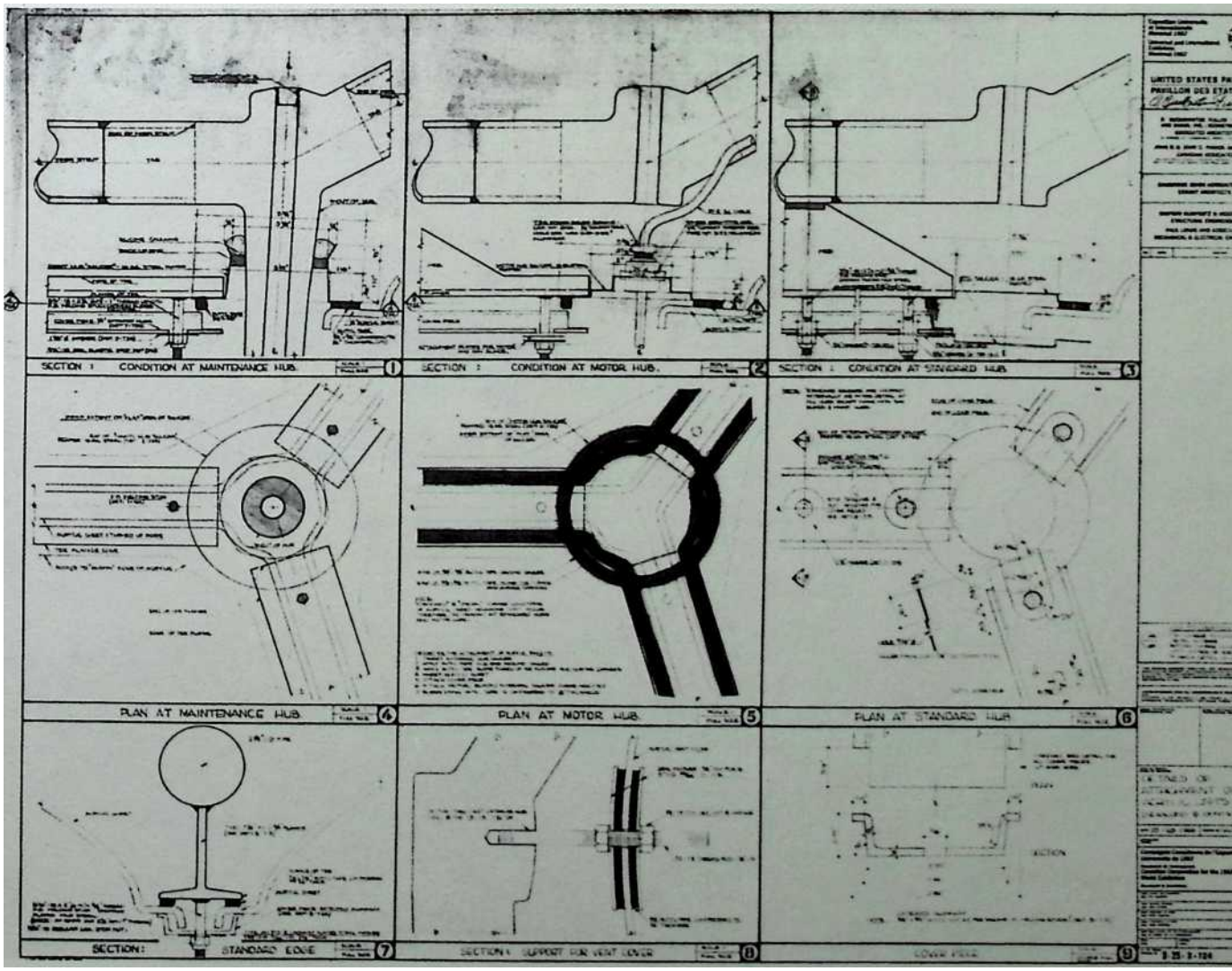

HEXAGON & PENTAGON
1
SECTION THRU HEXAGON & PENTAGON.
3
STANDARD HUB CORNER
4
SPECIAL HUB CORNER
5
STANDARD PANEL EDGE
6
STANDARD EDGE FOR HEXAGON
7
UNITED STATES PAVILION
PAVILLON DES ETATS-UNIS

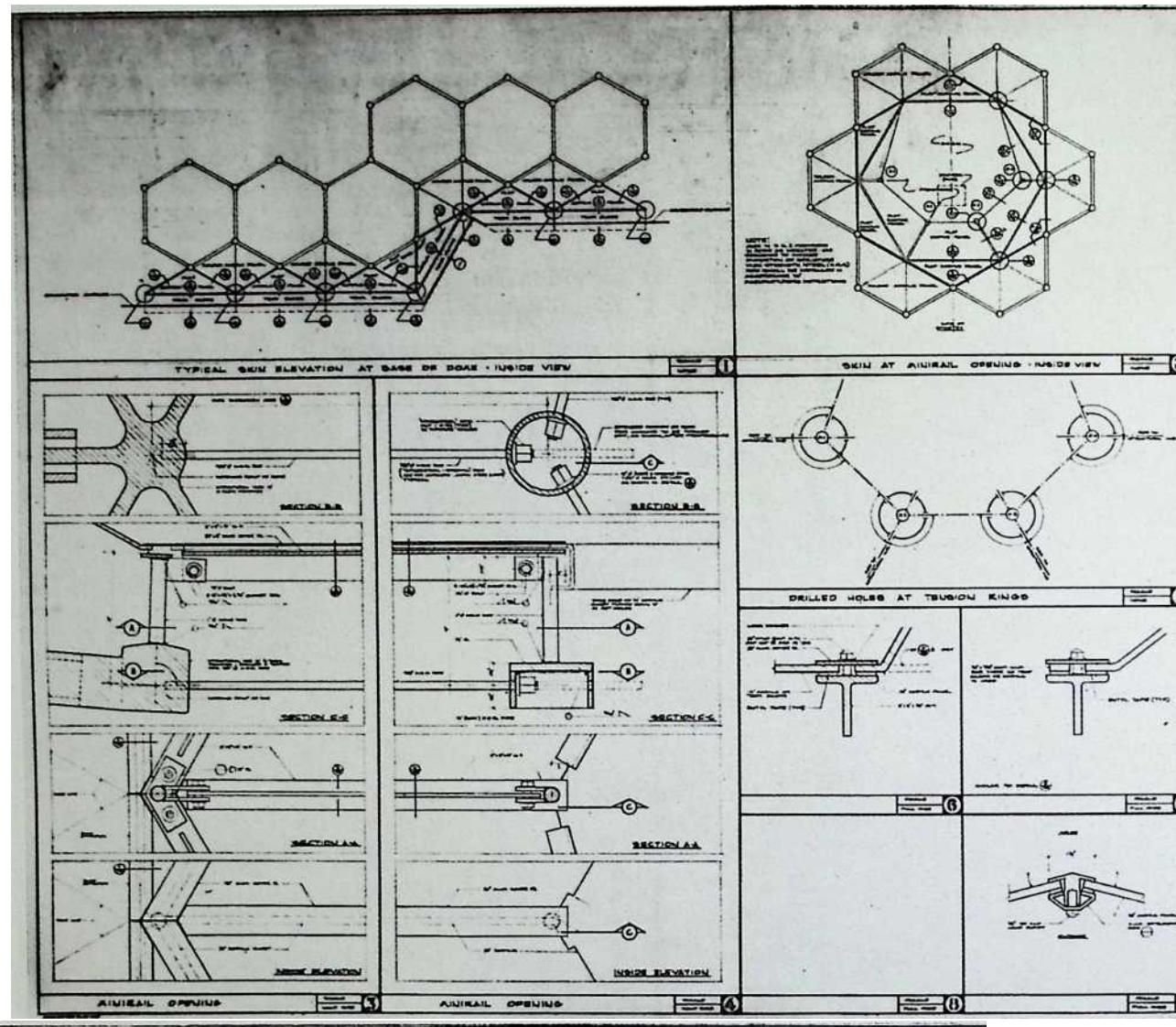

HALF HEXAGON
8

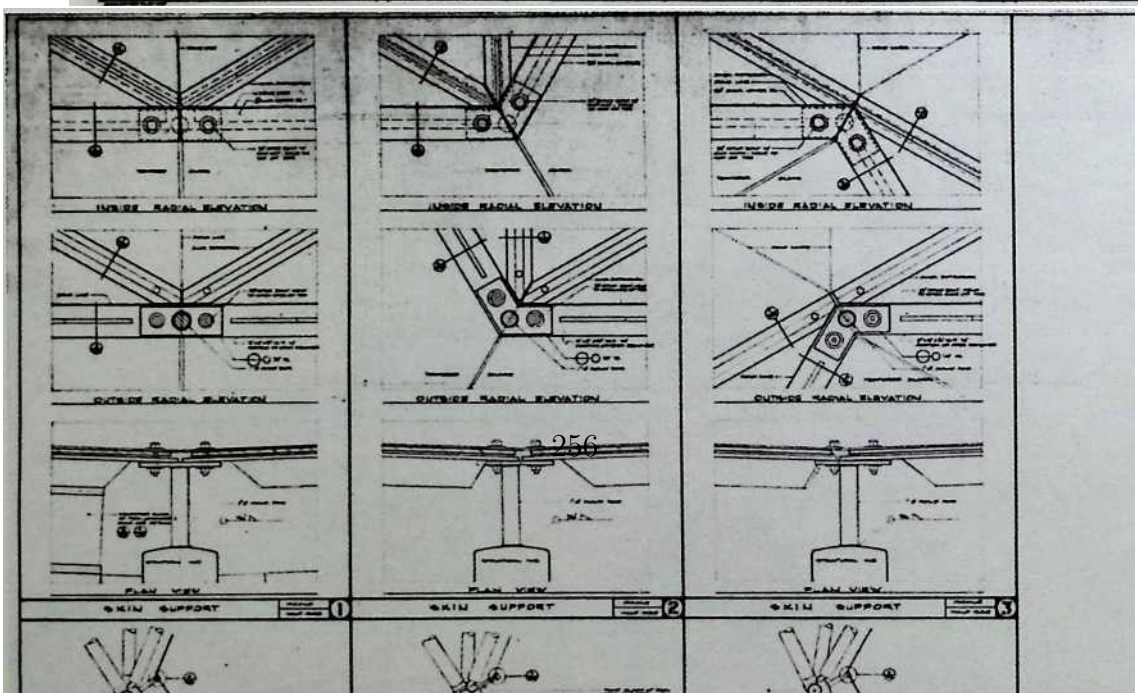

DIAMOND
9



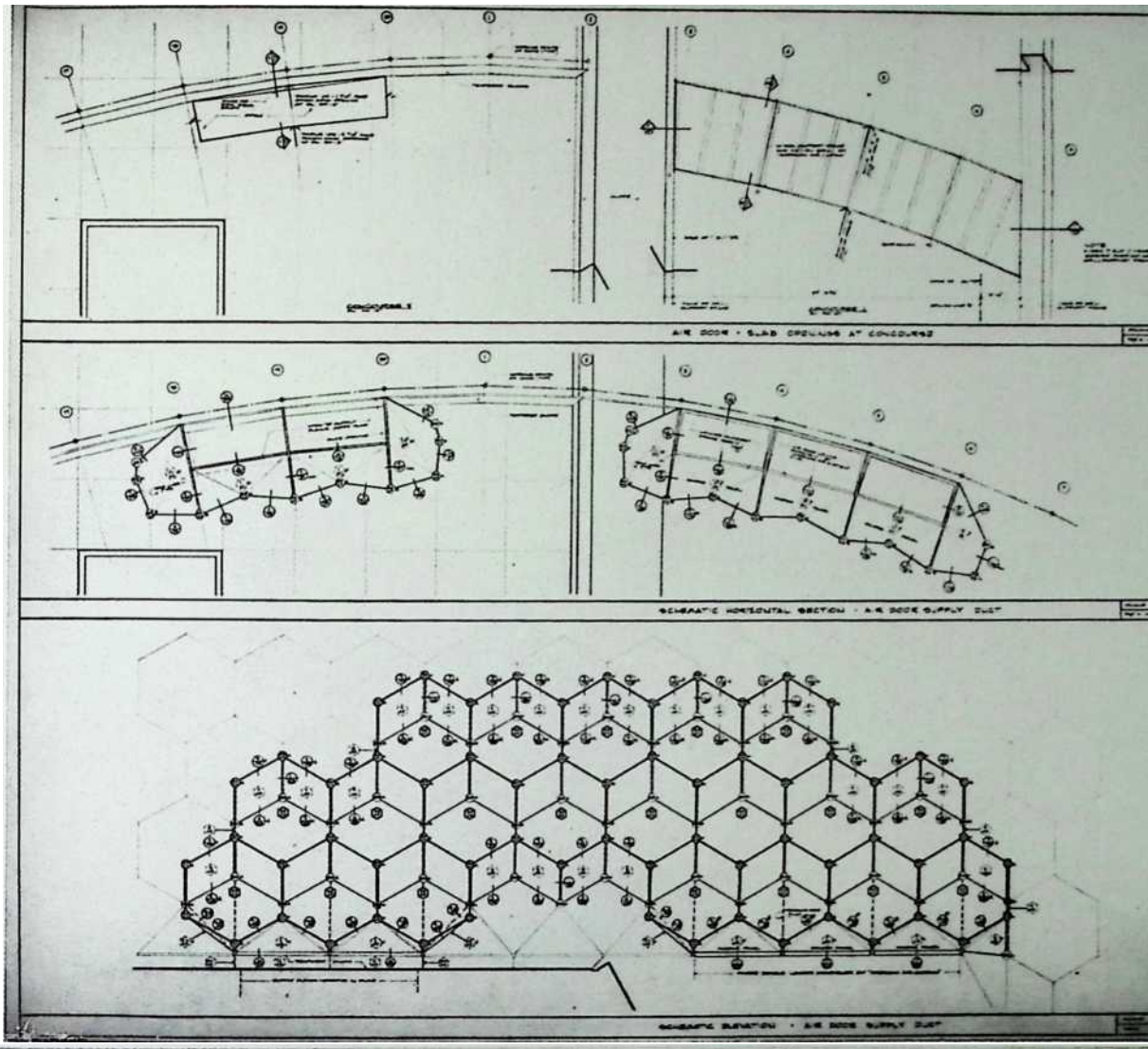


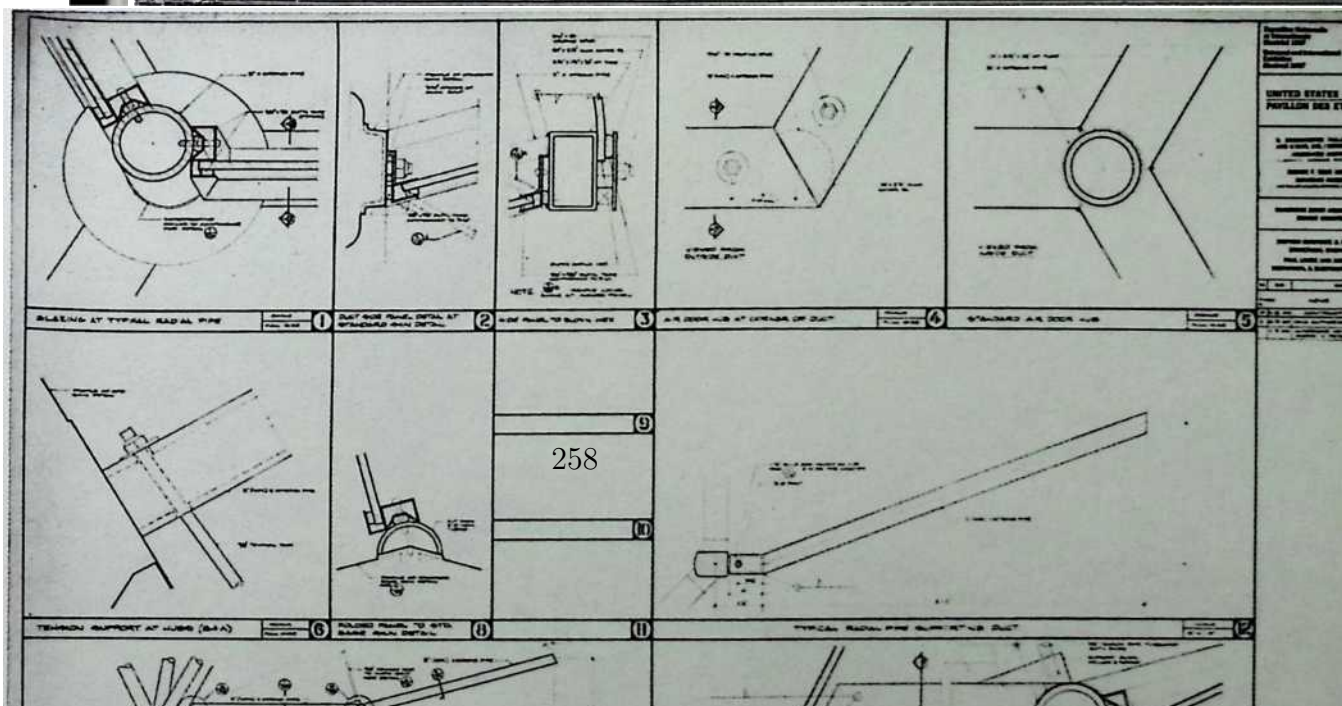

SECTION : CONDITION AT MAINTENANCE HUB.
SECTION : CONDITION AT MOTOR HUB.
SECTION : CONDITION AT STANDARD HUB.
PLAN AT MAINTENANCE HUB.
PLAN AT MOTOR HUB.
PLAN AT STANDARD HUB.
SECTION : STANDARD EDGE
SECTION : SUPPORT FOR VENT COVER

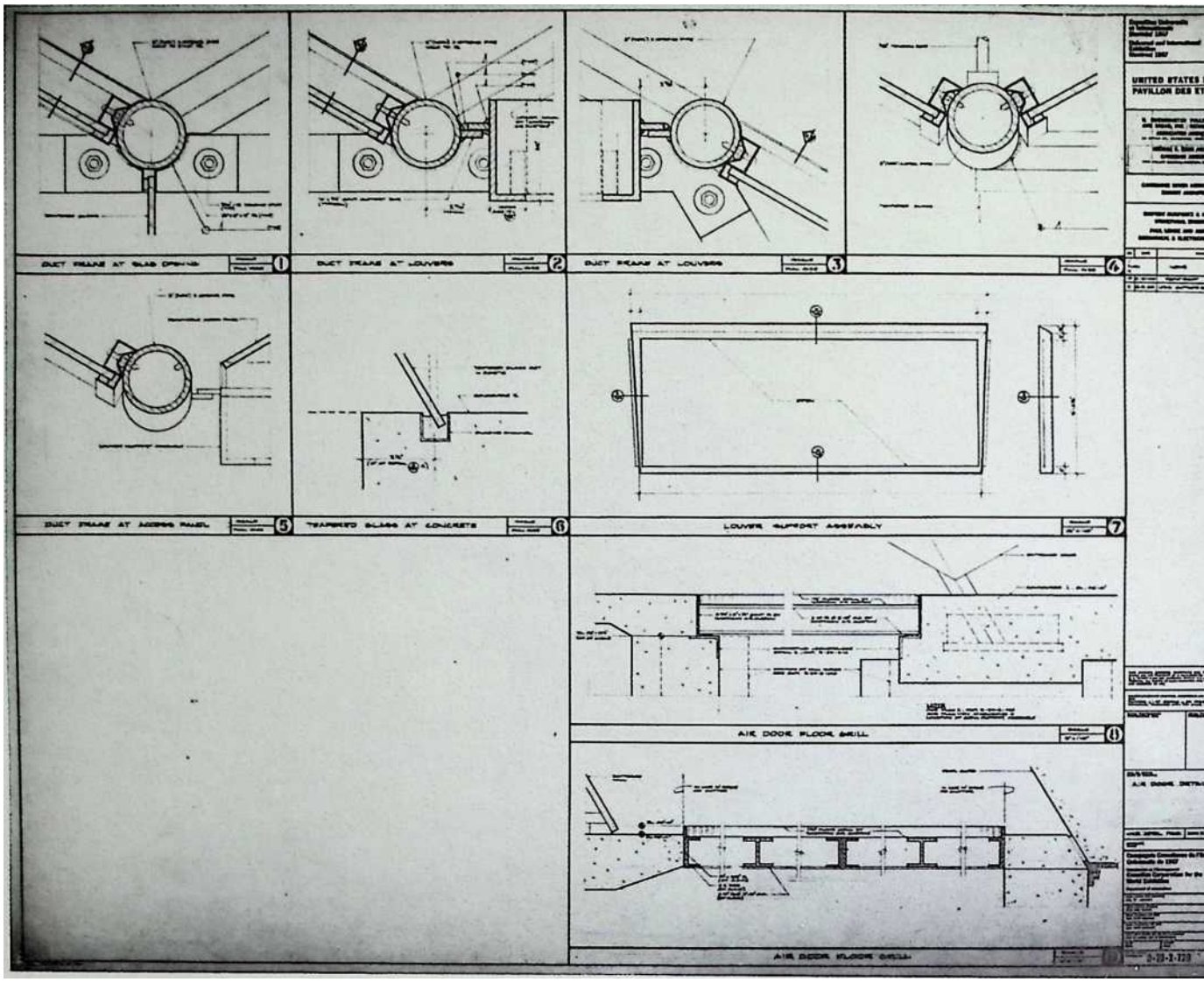

TYPICAL SKIN ELEVATION AT BASE OF DOME - INSIDE VIEW
SKIN AT AIRRAIL OPENING - INSIDE VIEW
DRILLED HOLES AT TENSION RINGS
SECTION B-B
SECTION C-C
SECTION A-A
INSIDE ELEVATION
AIRRAIL OPENING
AIRRAIL OPENING

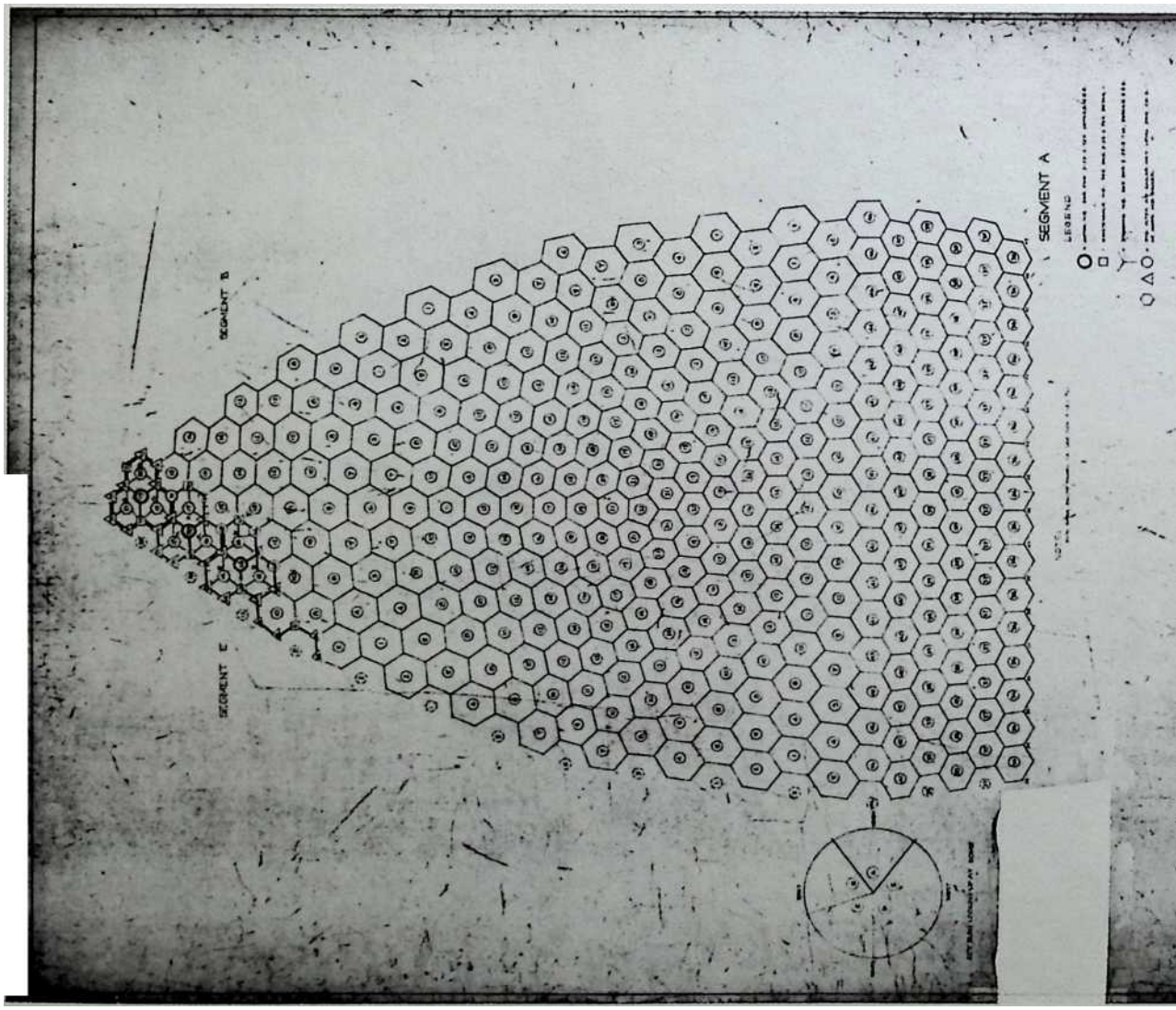

INSIDE RADIAL ELEVATION
INSIDE RADIAL ELEVATION
INSIDE RADIAL ELEVATION
OUTSIDE RADIAL ELEVATION
OUTSIDE RADIAL ELEVATION
OUTSIDE RADIAL ELEVATION
PLAN VIEW
PLAN VIEW
PLAN VIEW
SKIN SUPPORT
SKIN SUPPORT
SKIN SUPPORT

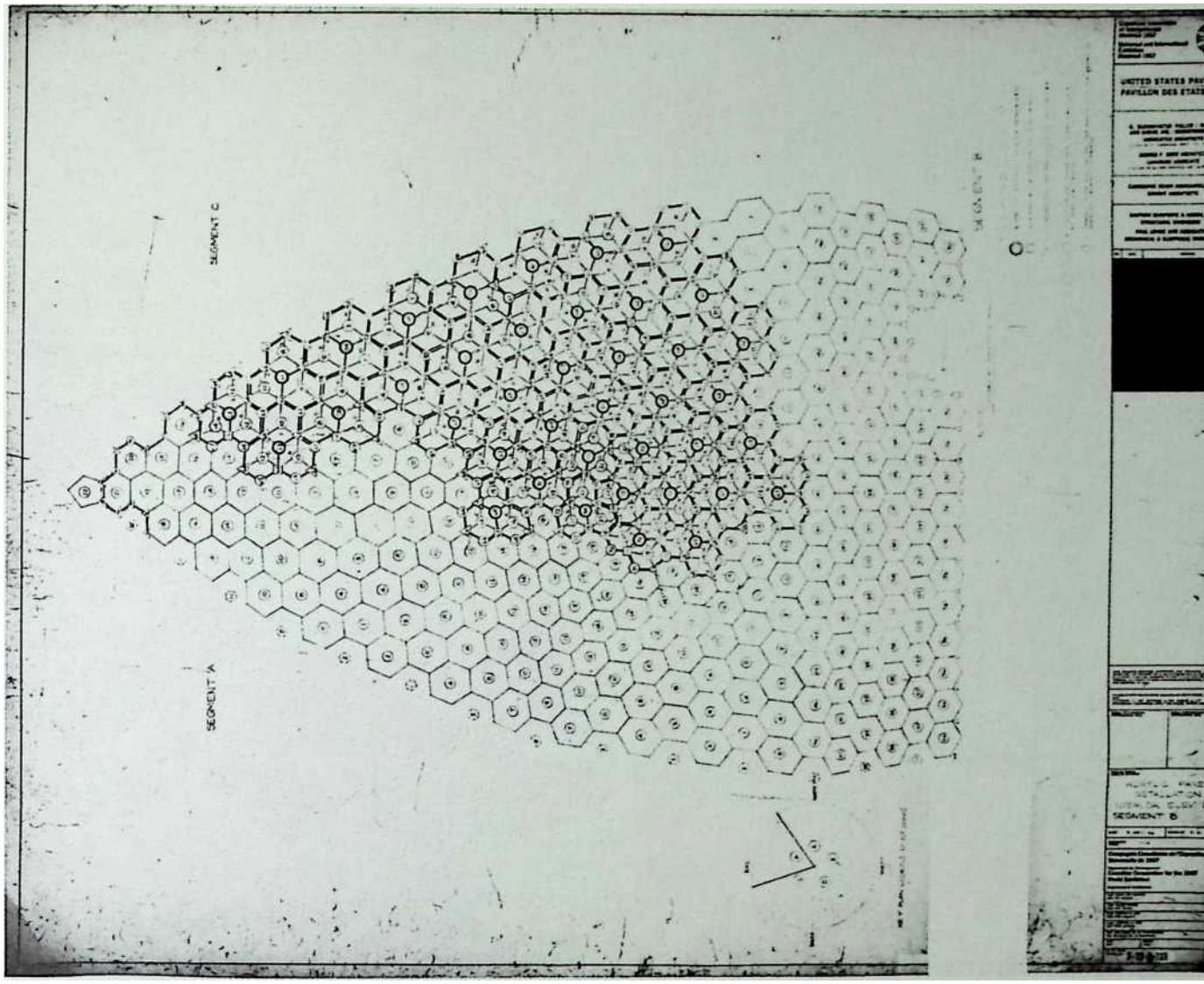
ii

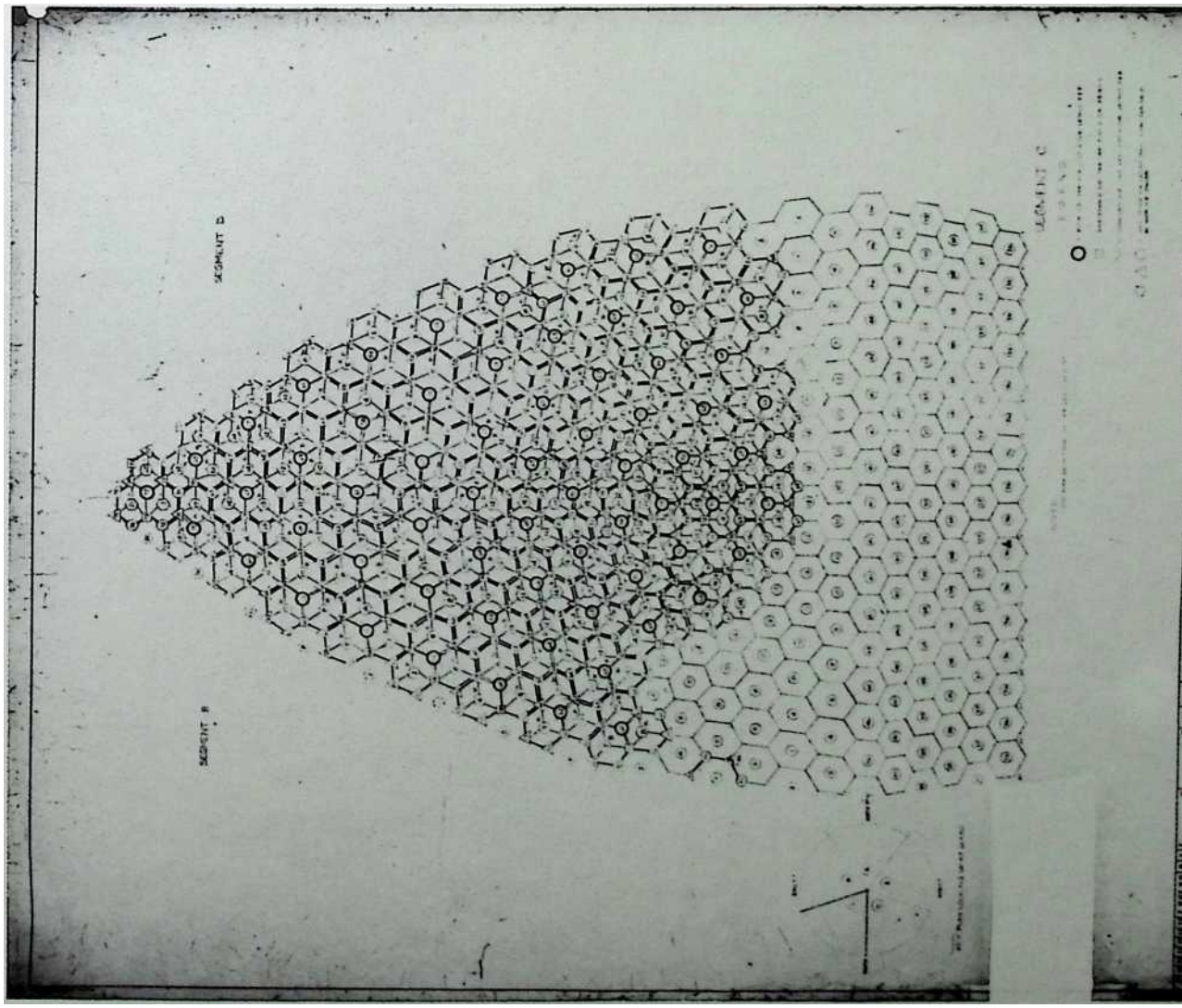


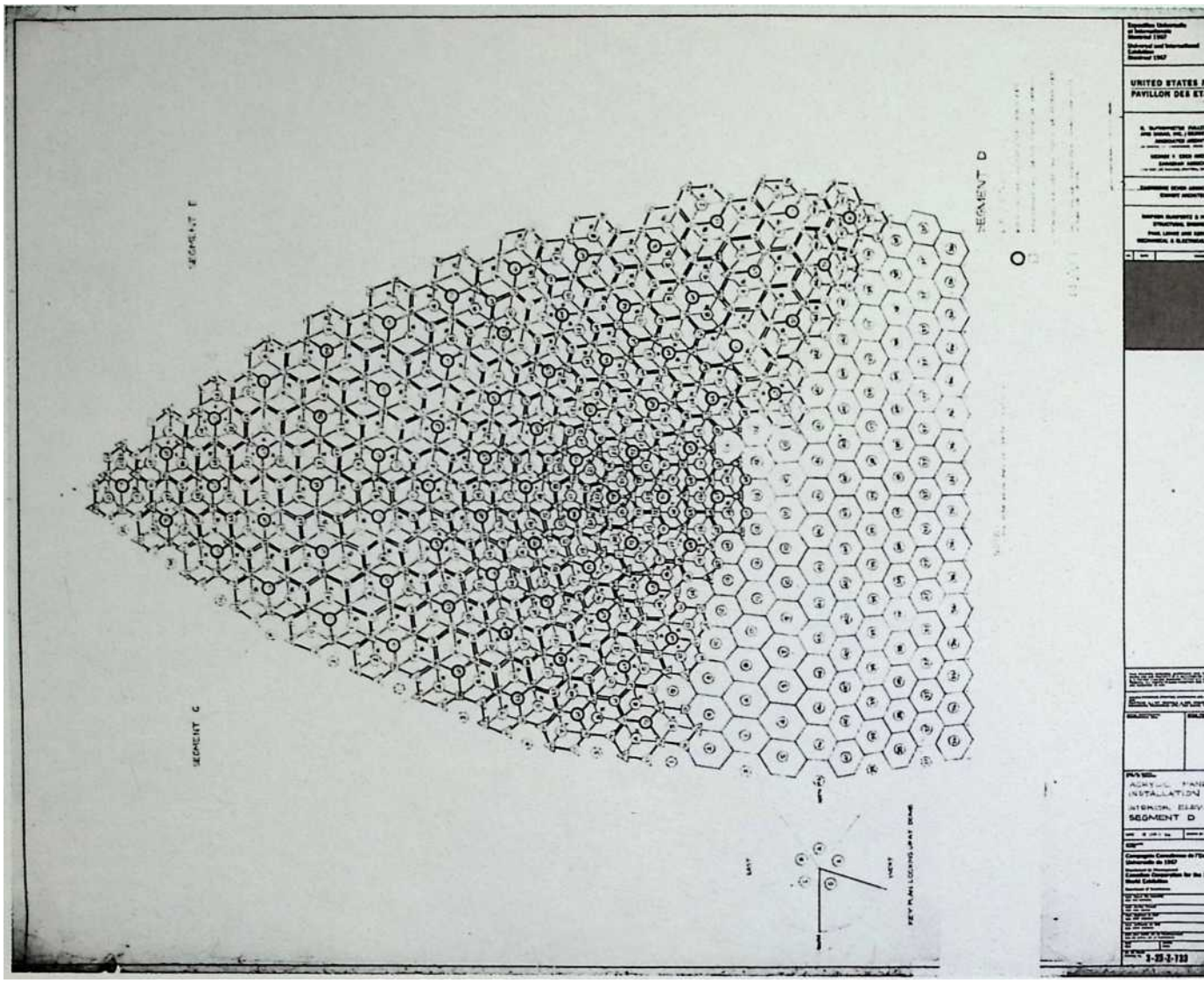


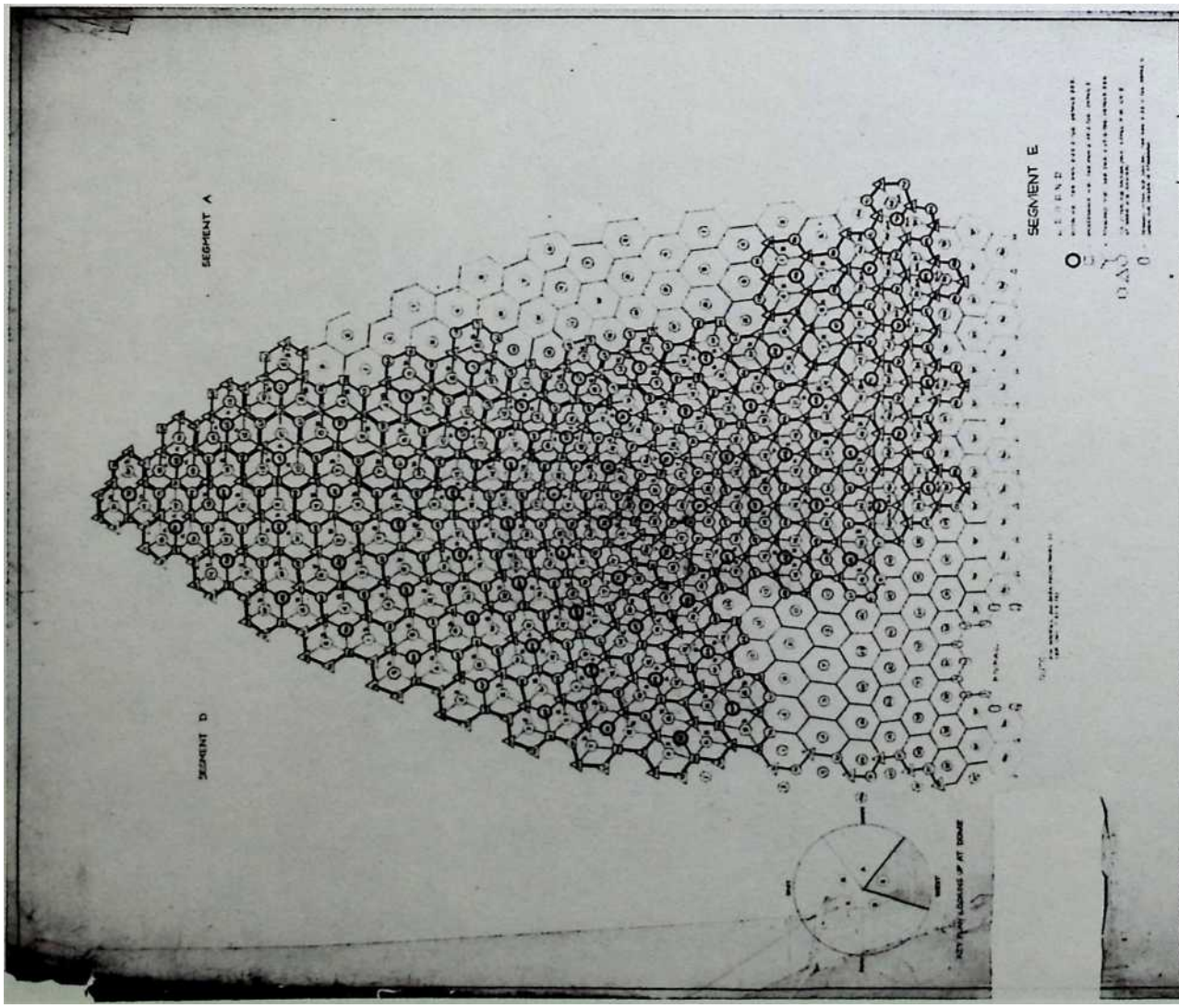

DUCT FRAME AT SLAB OPENING
1
DUCT FRAME AT LOUVERS
2
DUCT FRAME AT LOUVERS
3
4
DUCT FRAME AT ACCESS PANEL
5
TEMPERED GLASS AT CONCRETE
6
LOUVER SUPPORT ASSEMBLY
7
AIR DOOR FLOOR SILL
8
AIR DOOR FLOOR SILL


SEGMENT A
LEGEND
SEGMENT B
SEGMENT C


SEGMENT A
SEGMENT C
SEGMENT B


SEGMENT B
SEGMENT B


SEGMENT F
SEGMENT C
SEGMENT D
EAST
WEST
KEY PLAN LOCATING GRAY ZONE
UNITED STATES
PAVILLON DES ET
SEGMENT D



Star Tensegrity Octahedral

Truss Patent

11/28/67

The advantage of the star tensegrity octahedral truss is that the outer edges of the octahedron are tensegrity cables held in place by three crossbars on the interior. By adjusting these bars, the outer configuration of the octahedron presumably could be an infinite variety of shapes using the same crossbars.

2 o

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3

R. B. FULLER 3,354,591

OCTAHEDRAL BUILDING TRUSS

6 Sheets-Sheet 1

Filed Dec. 7, 1964

Nov. 28, 1967 R. B. FULLER 3,354,591

OCTAHEDRAL BUILDING TRUSS

Filed Dec. 7, 1964 6 Sheets-Sheet 3

FIG. 4

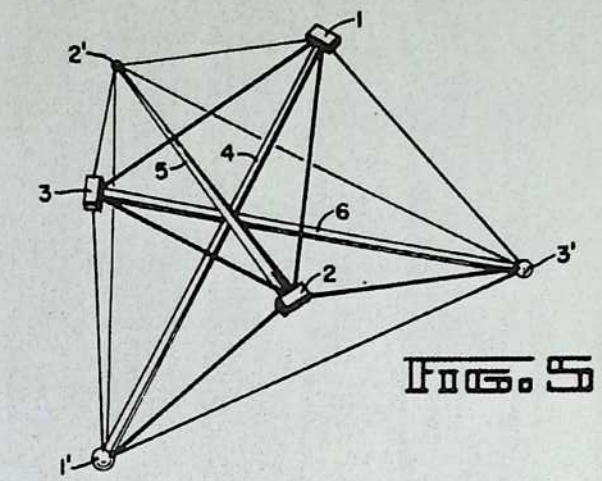
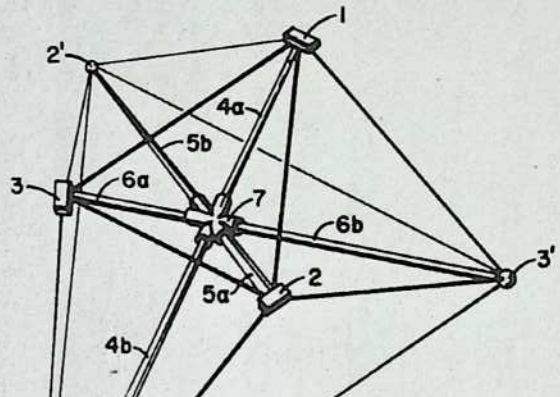


FIG. 5



Nov. 28, 1967 R. B. FULLER 3,354,591

OCTAHEDRAL BUILDING TRUSS

Filed Dec. 7, 1964 6 Sheets-Sheet 2

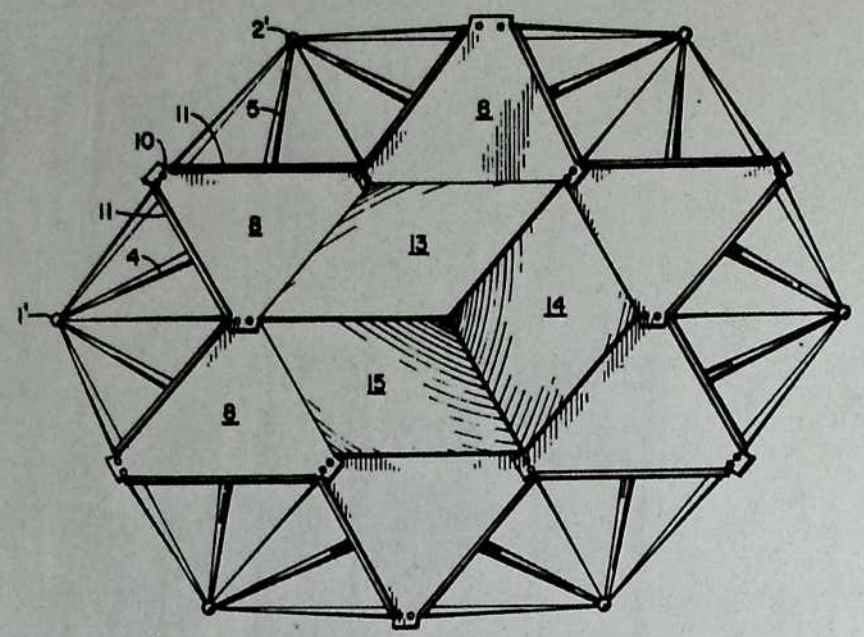
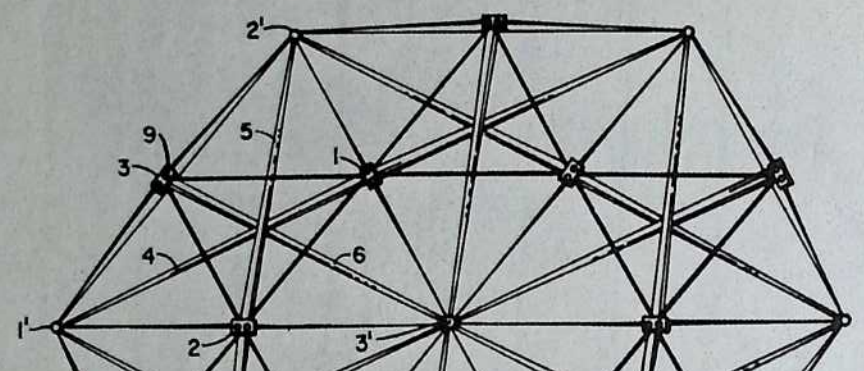
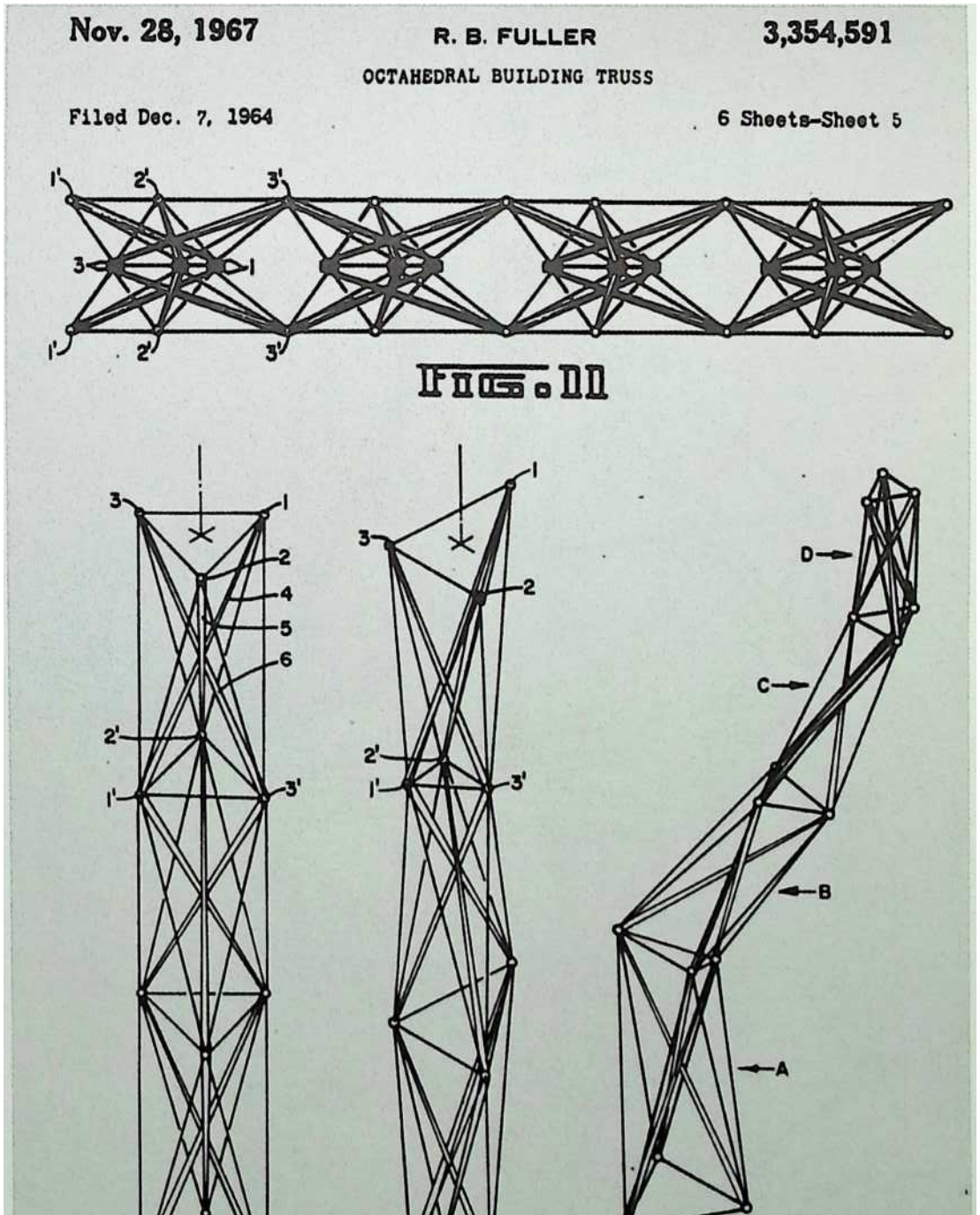
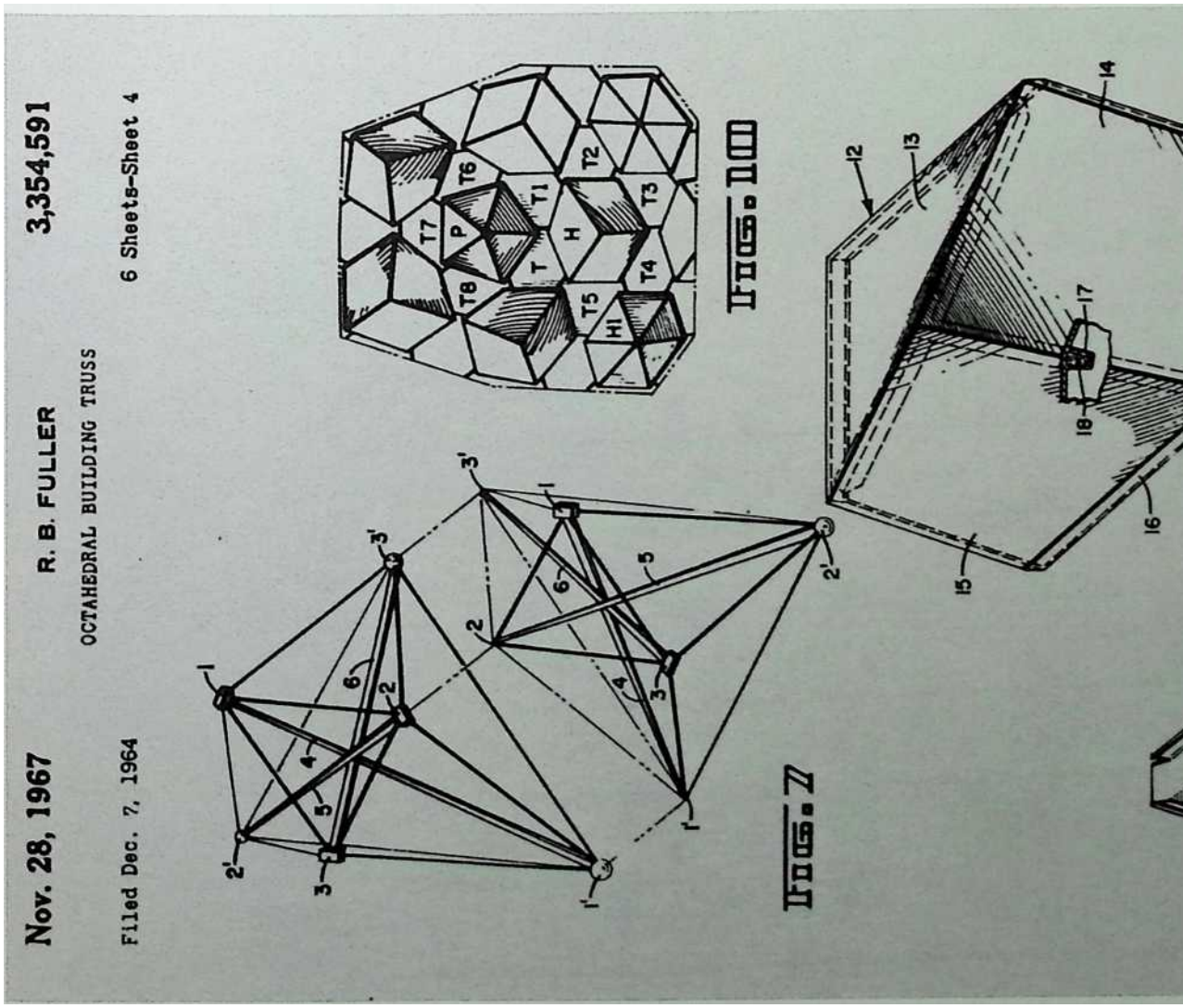


FIG. 2




Nov. 28, 1967
R. B. FULLER
3,354,591
OCTAHEDRAL BUILDING TRUSS
Filed Dec. 7, 1964
6 Sheets-Sheet 5
FIG. 11
A
B
C
D



INVENTOR.

RICHARD BUCKMINSTER FULLER

bO QO

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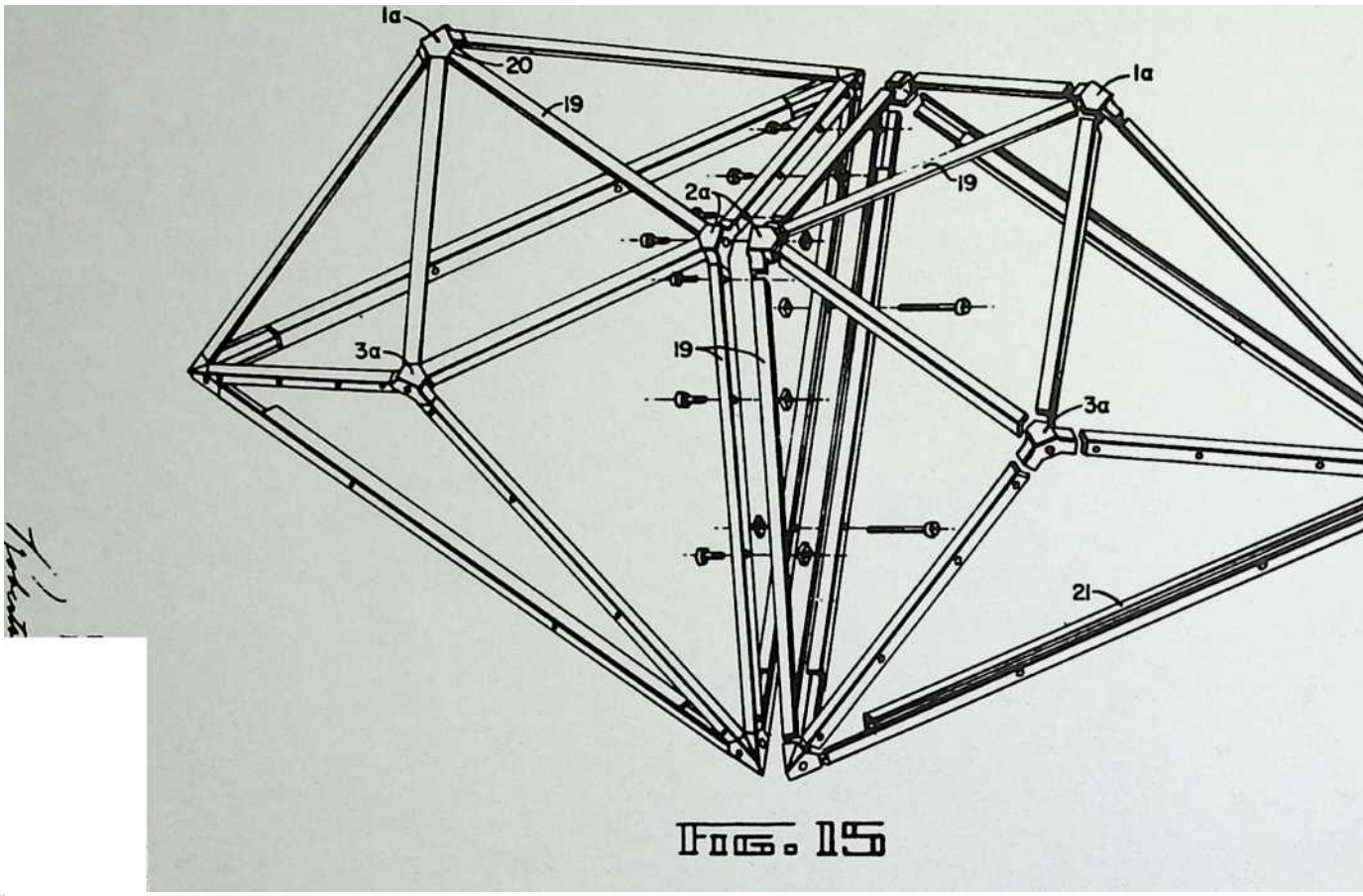


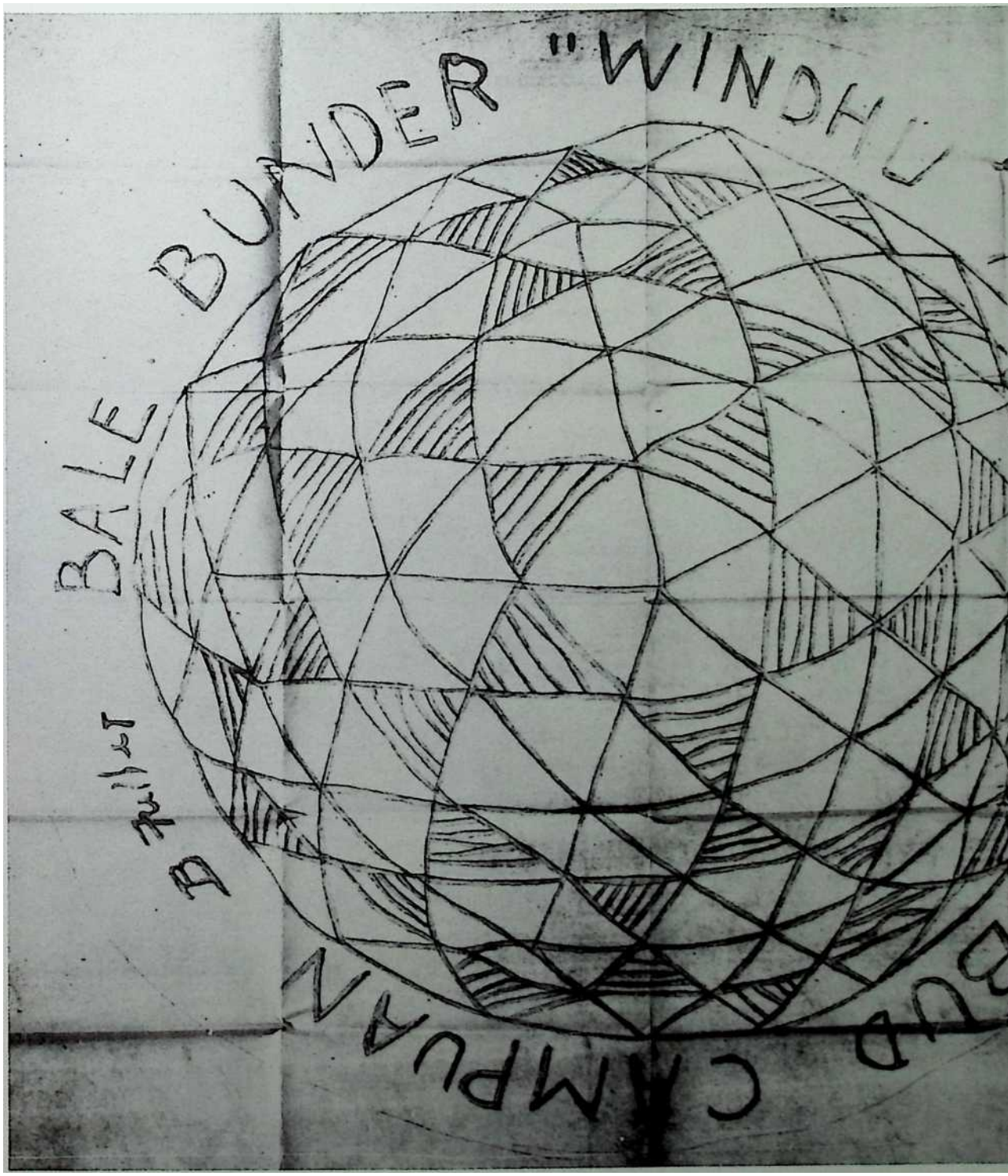
1967
Nov.
OCTAHEDRAL BUILDING TRUSS
Filed Dec. 7, 1964

"Bale Bunder Windhu

The function of this dome is not known.

Anne Bali Ubud

Campuan" Dome 1967


BALE BUNDER "WINDHU
CAMPUAN

World Man Center

Conference Building,

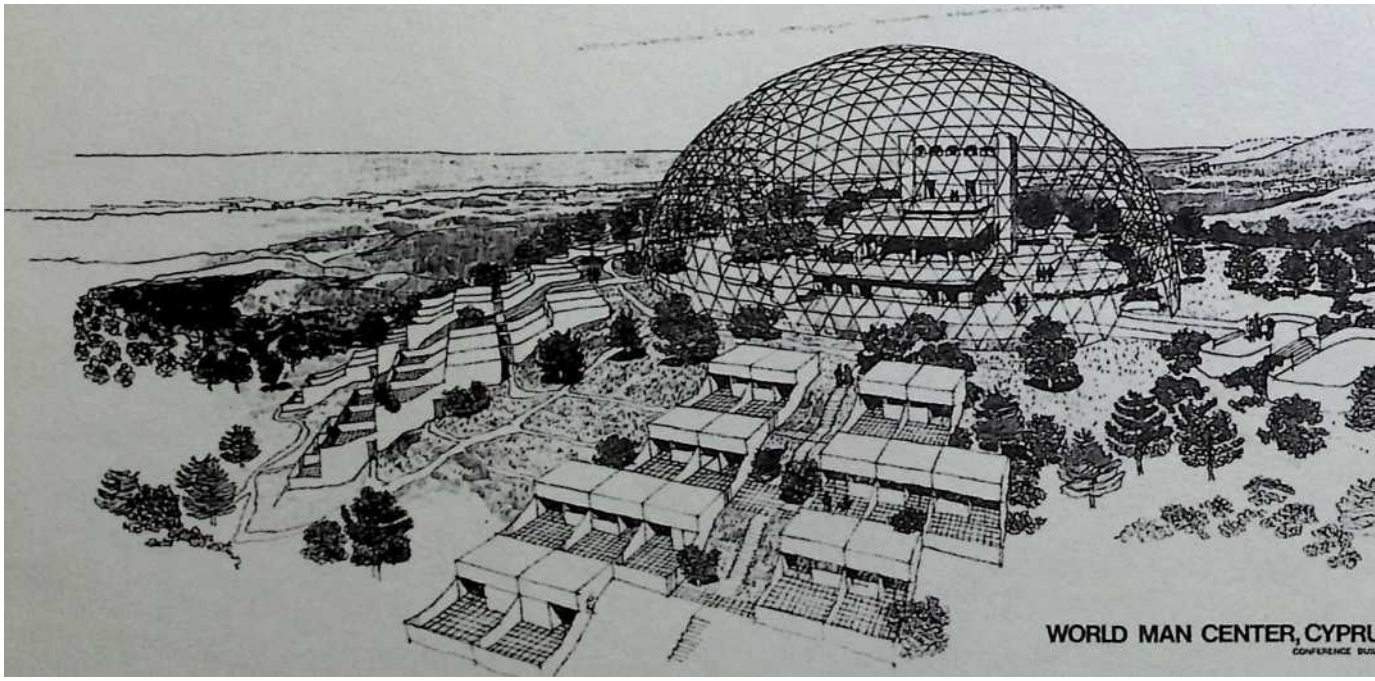
Cyprus

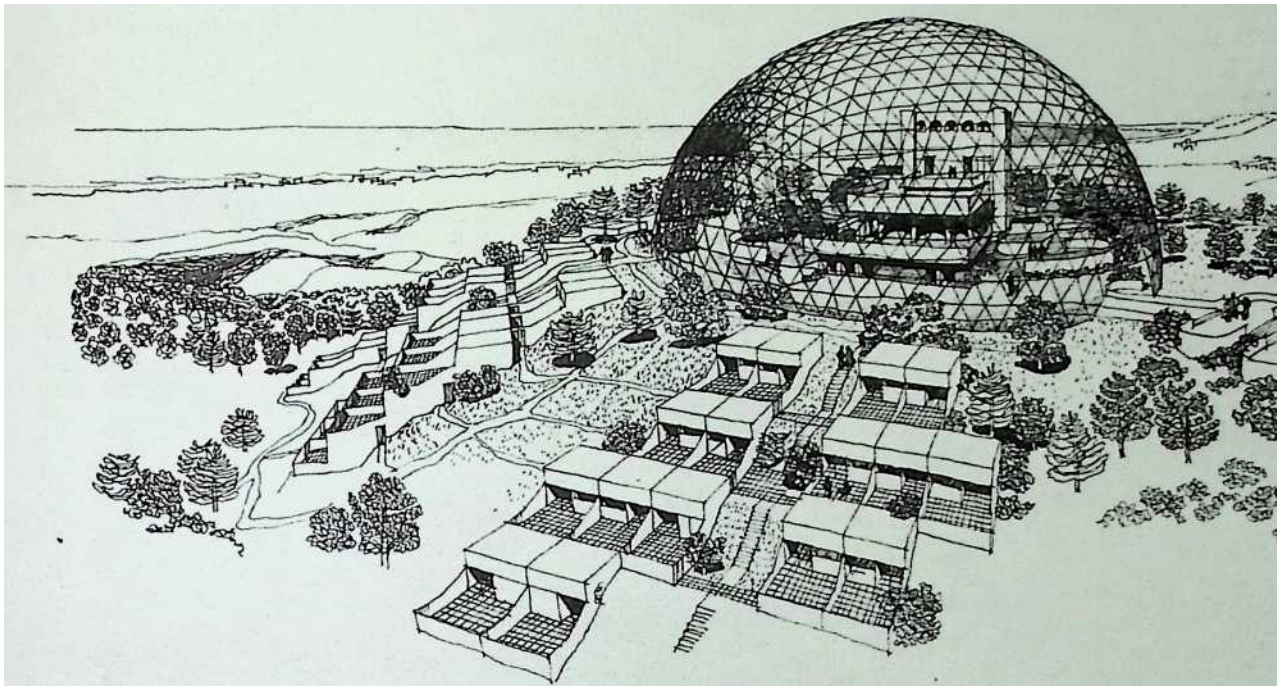
Fuller & Sadao, 1967

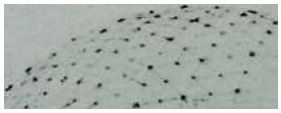
The World Man Center was designed to be the central landmark of the World Center, a parcel of land that was to have no national identity. Thus, the geodesic globe was a relevant symbol for the center of a unified planet. It encloses a cultural center building. Bungalows designed for the Mediterranean climate cascade down a hill at the base of the dome. These architectural elements are the work of Sadao and Karlis Grinbergs.

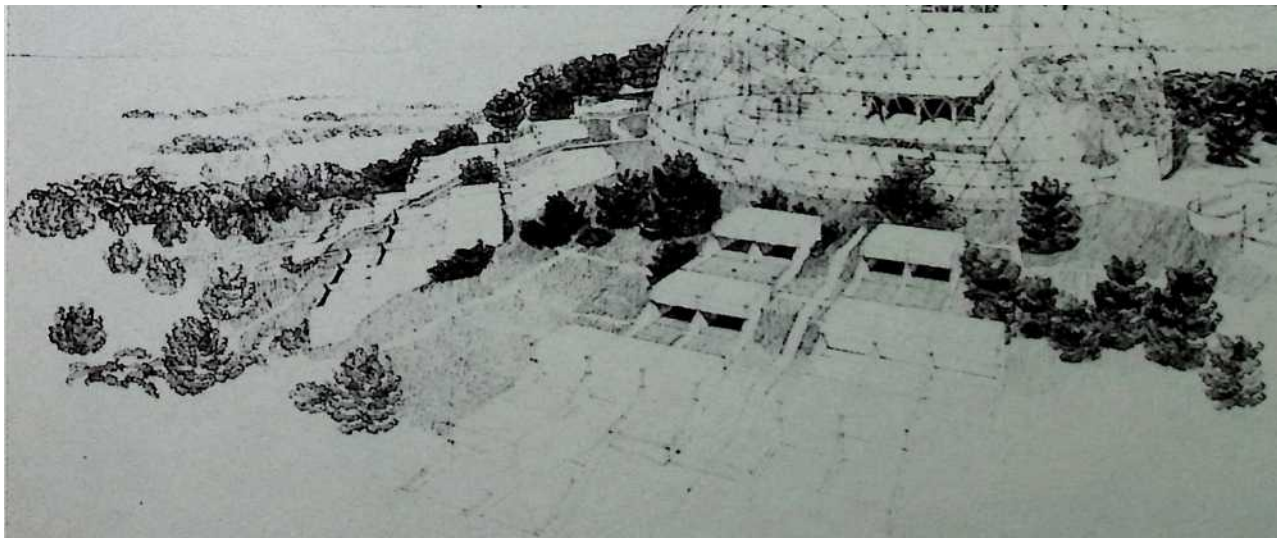
Fuller and Sadao, inc.

Architects









H'

22 The Coburn Classical Institute, Waterville, Maine 1968

The Coburn Classical Institute was designed by Fuller with Krumbauer and Holt for the inclement weather of a northern college town. The seamless gypsum dome was designed to divert winter blasts, and the insulated interiors of this concert hall-planetarium were the most complex in Fuller's oeuvre. It would have been one of the first of his domes to be constructed of poured gypsum and steel I beams.

COBURN CLASSICAL INSTITUTE

WATERVILLE, MAINE

SYNERGETICS, INC.

KRUMS HA AR A HOLT

GROUP ENGINEERS

MOMMCAL C3—LtTAMTl

«tari*09«. BAM

DRAW

ARCHITECTURAL

1. • SITE PLAN
2. • MAIN FLOOR PLAN
3. • BALCORY a GROUND FLOOR PLAN
4. • BUILDING ELEVATIONS

5. BUILDING SECTIONS

S • 1/2 MAIN FLOOR PLAN (NORTH)
7 • 1/2 MAIN FLOOR PLAN (SOUTH)
• • BALCONY PLAN
S • GROUND FLOOR PLAN

10. • WALL SECTIONS A DETAILS

11. • DETAILS

ING I
STRUCTURAL

12. • FOUNDATION PLAN B DETAILS I2A* CONCRETE REINFORCING DETAILS IS • GROUND FLOOR B BALCONY STRUCTURAL PLANS B DETAILS

14. * DOME PLAN & DECKING DETAILS

15. • DOME ERECTION DETAILS

IB • DOME FRAME MEMBERS
IT * DOME FRAME VERTEX PLATES

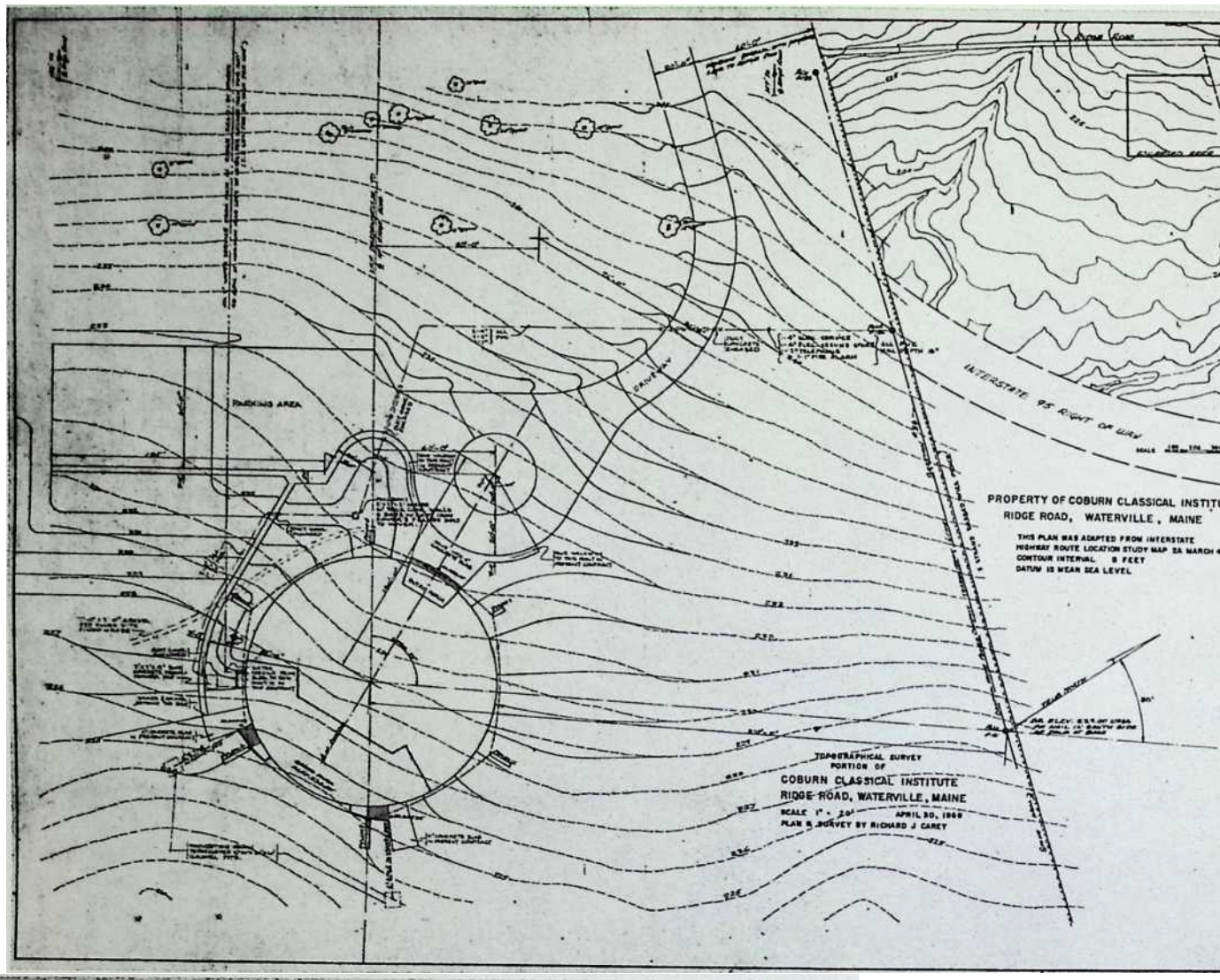
IS * DOME FRAME FITTINGS IB • SPECIAL EQUIPMENT

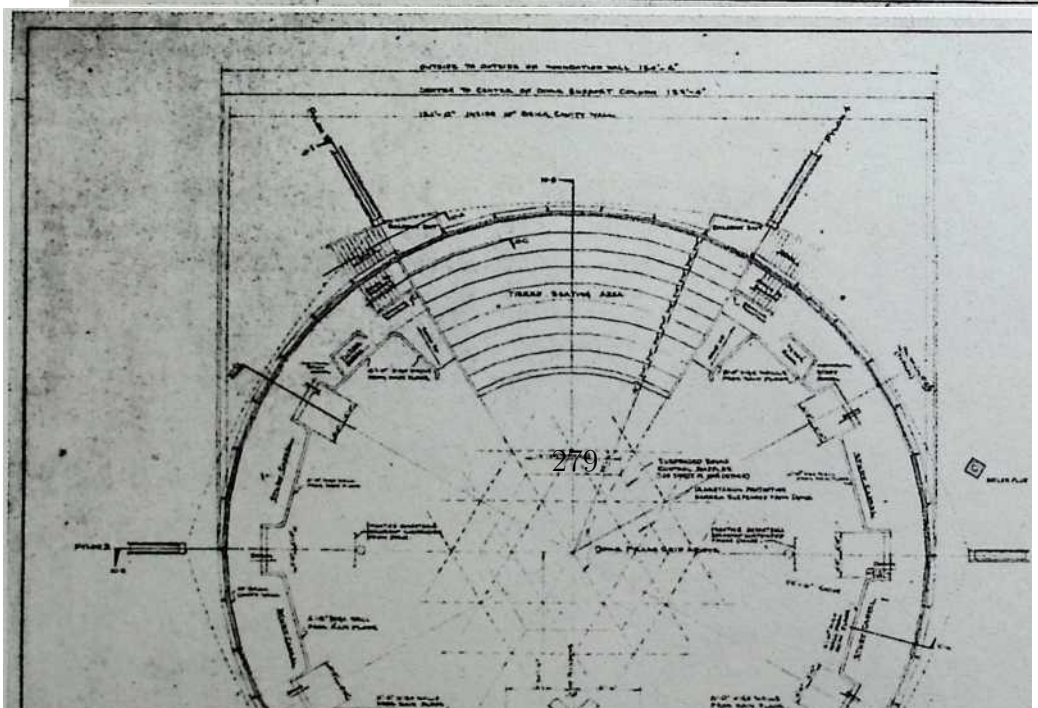
N D E X $_{t}$

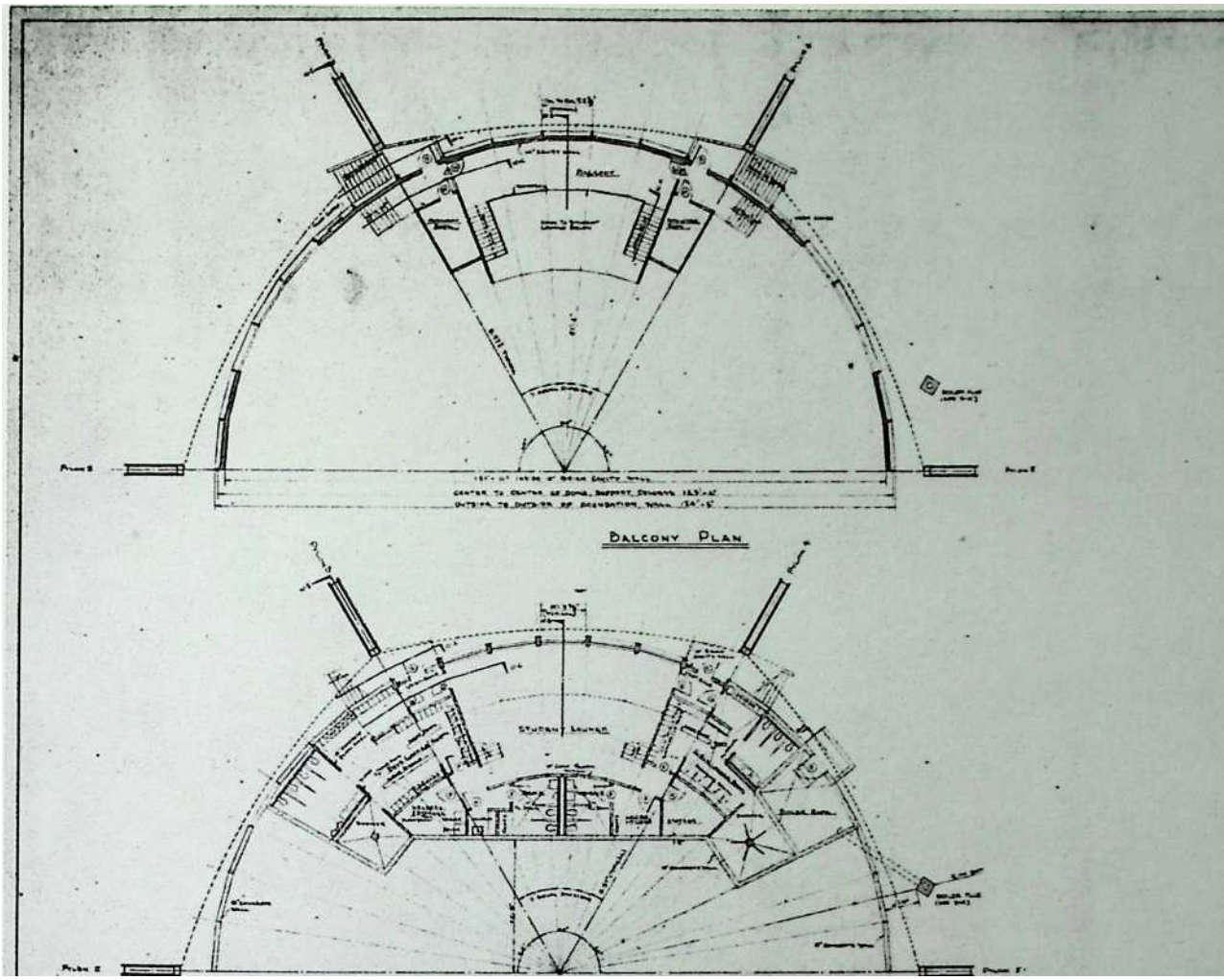
MECHANICAL

Ml - KEATING a VENTILATING M-2 * HEATING A VENTILATING ` ` PI* PLUMBING

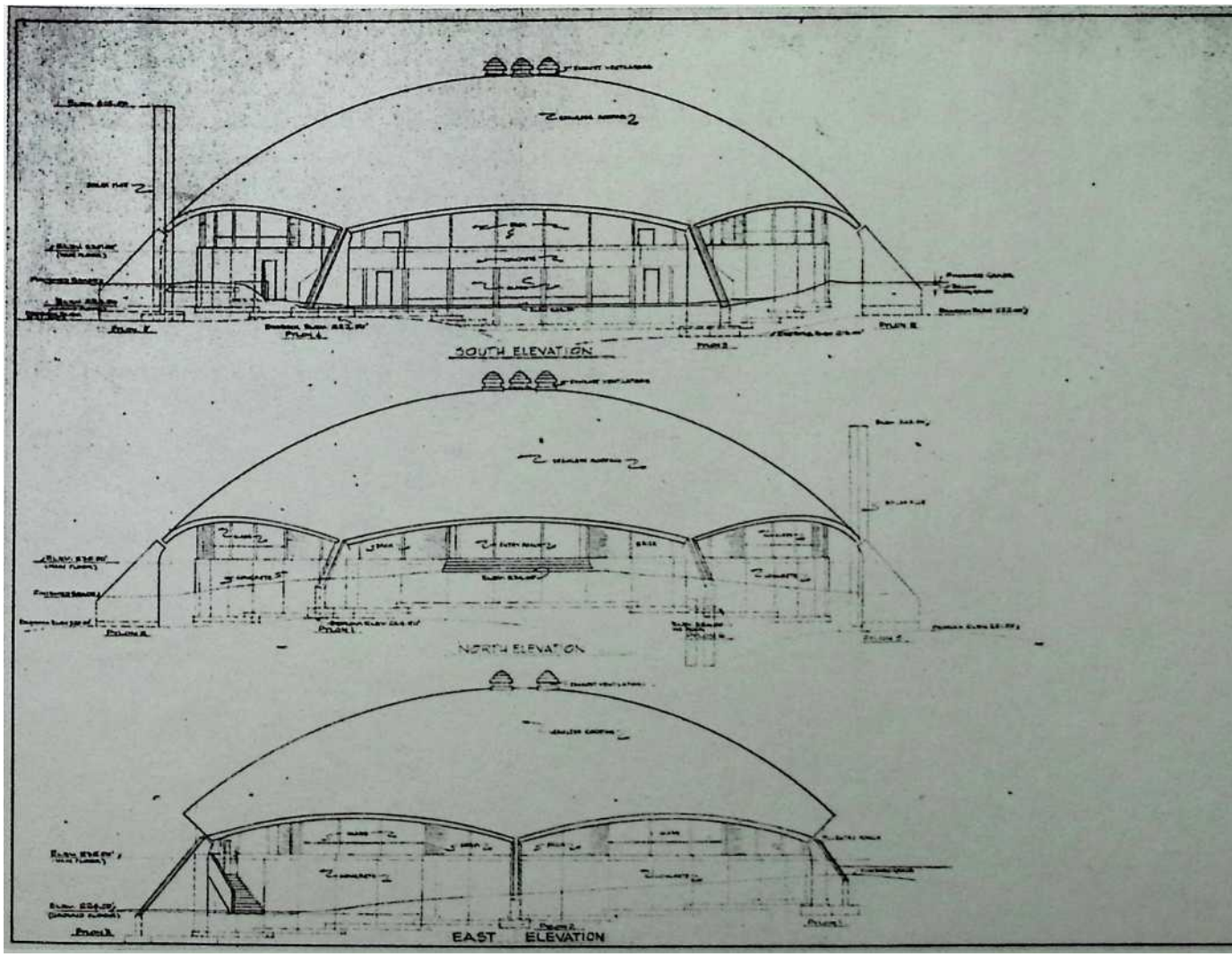
P-2 - PLUMBING E-l • ELECTRICAL E-2 - ELECTRICAL E» - ELECTRICAL

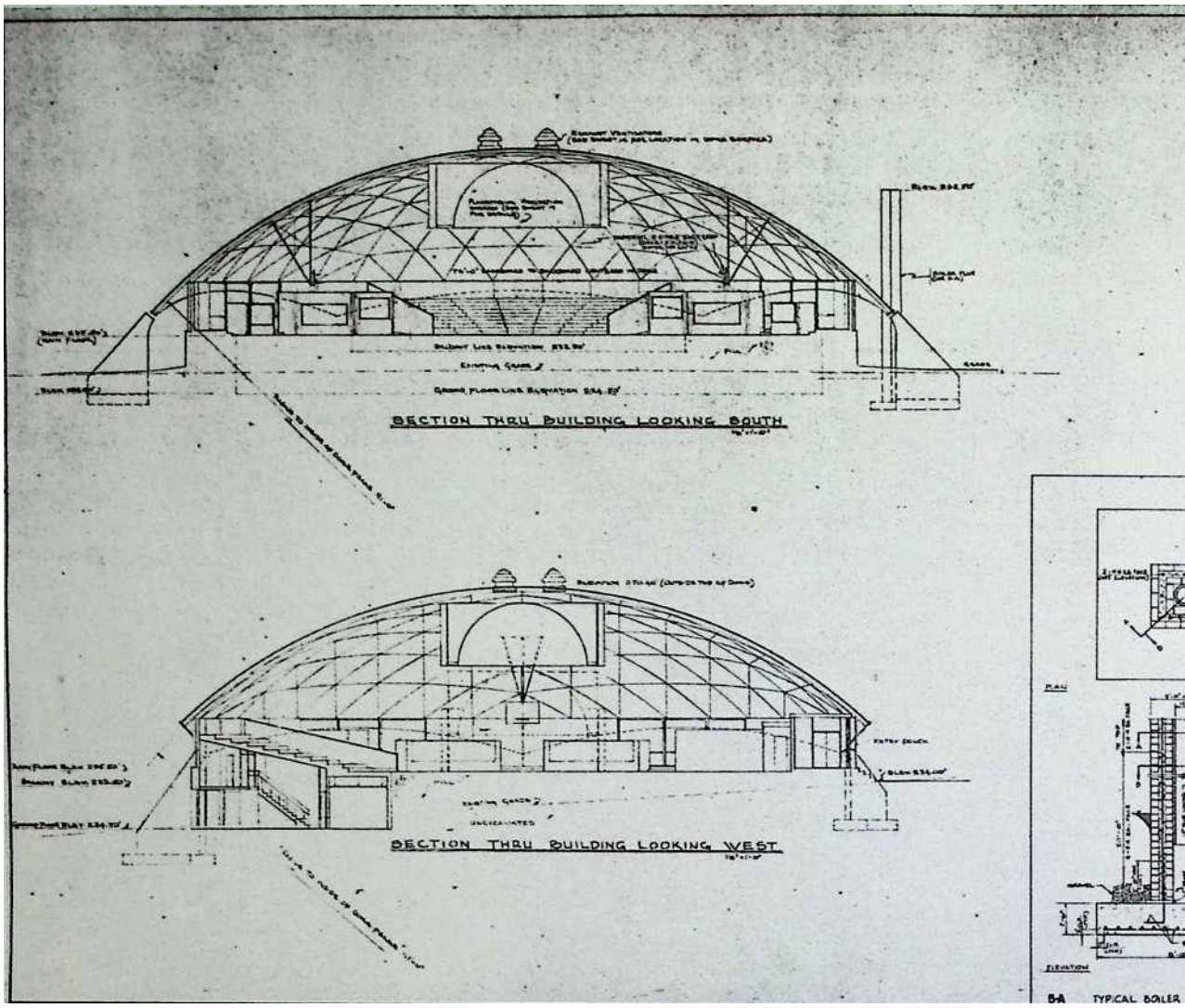

PARKING AREA
DRIVEWAY
INTERSTATE 95 RIGHT OF WAY
PROPERTY OF COBURN CLASSICAL INSTITU
RIDGE ROAD, WATERVILLE, MAINE
THIS PLAN WAS ADAPTED FROM INTERSTATE
HIGHWAY ROUTE LOCATION STUDY MAP 2A MARCH
CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL
TOPOGRAPHICAL SURVEY
PORTION OF
COBURN CLASSICAL INSTITUTE
RIDGE ROAD, WATERVILLE, MAINE
SCALE 1" = 20'
APRIL 20, 1969
PLAN & SURVEY BY RICHARD J CAREY

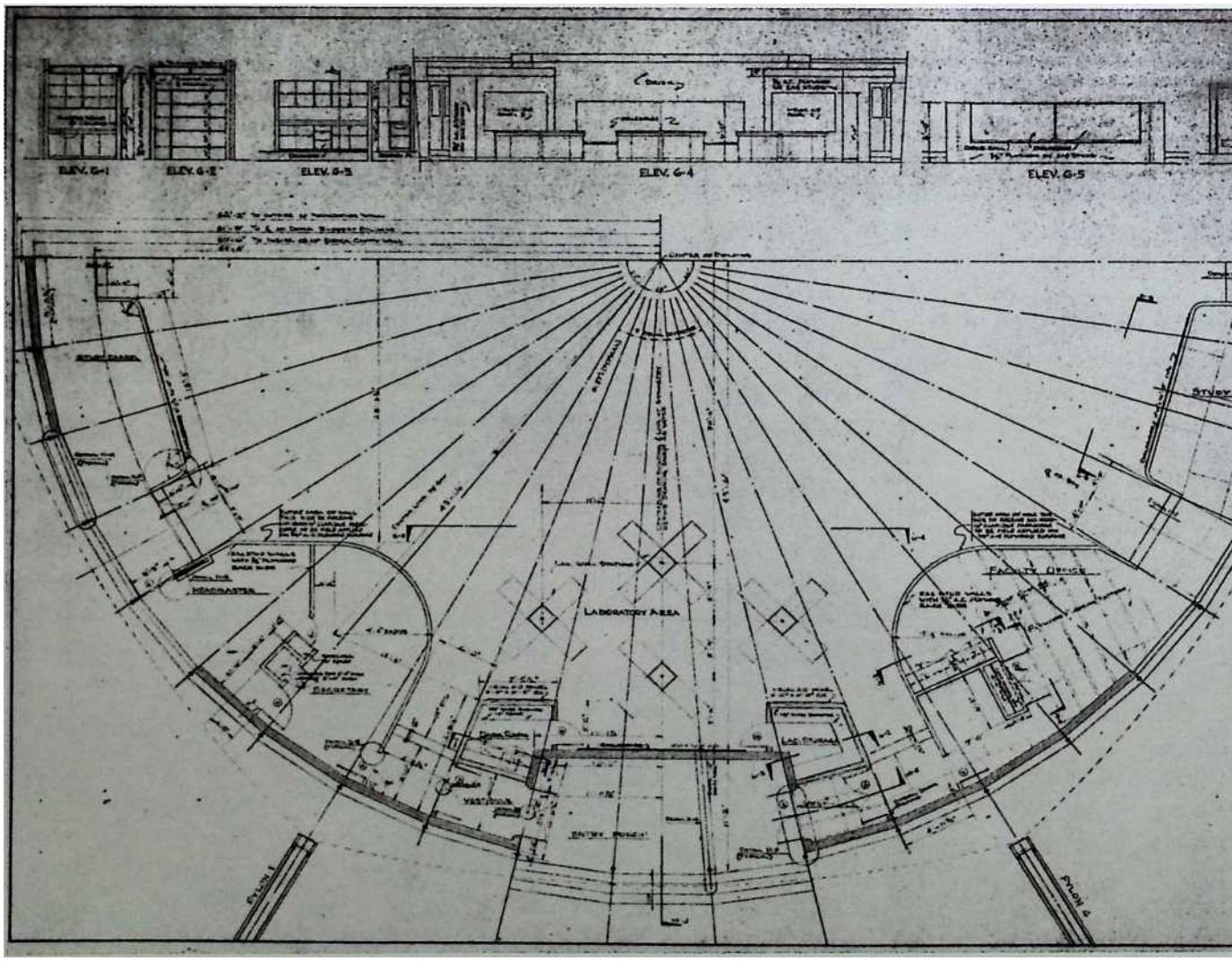


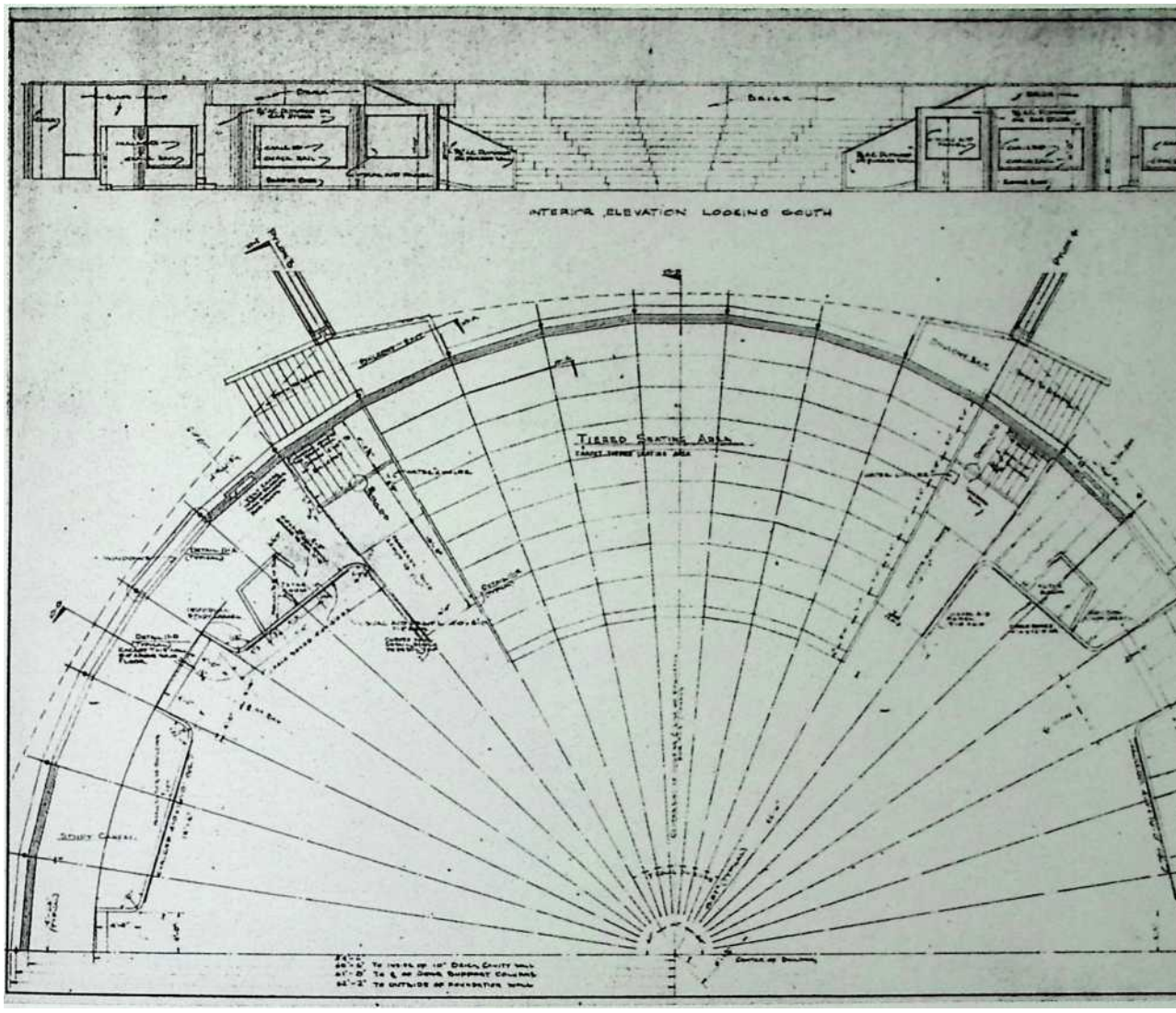


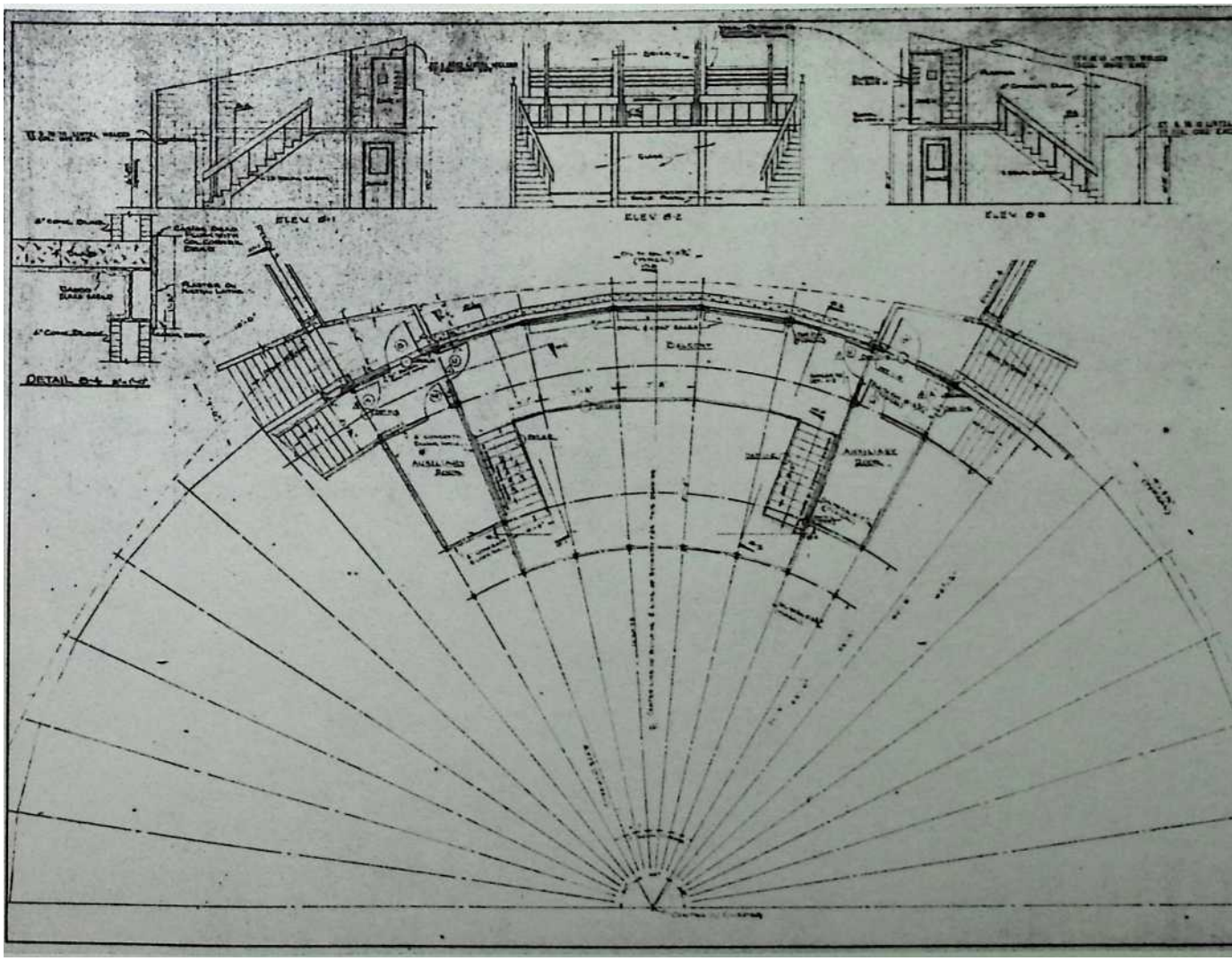
GROUND FLOOR PLAN

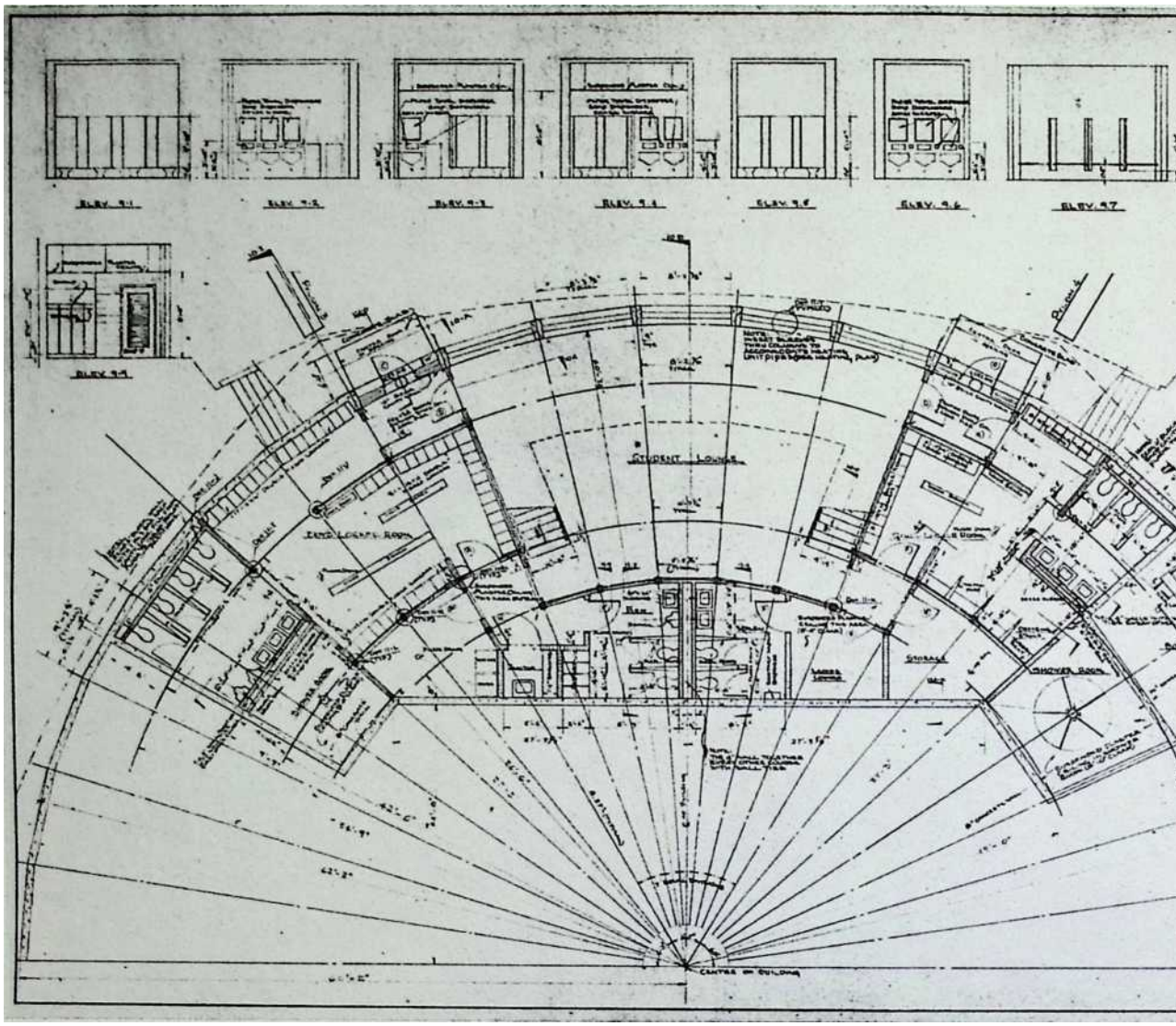

SOUTH ELEVATION
NORTH ELEVATION
EAST ELEVATION

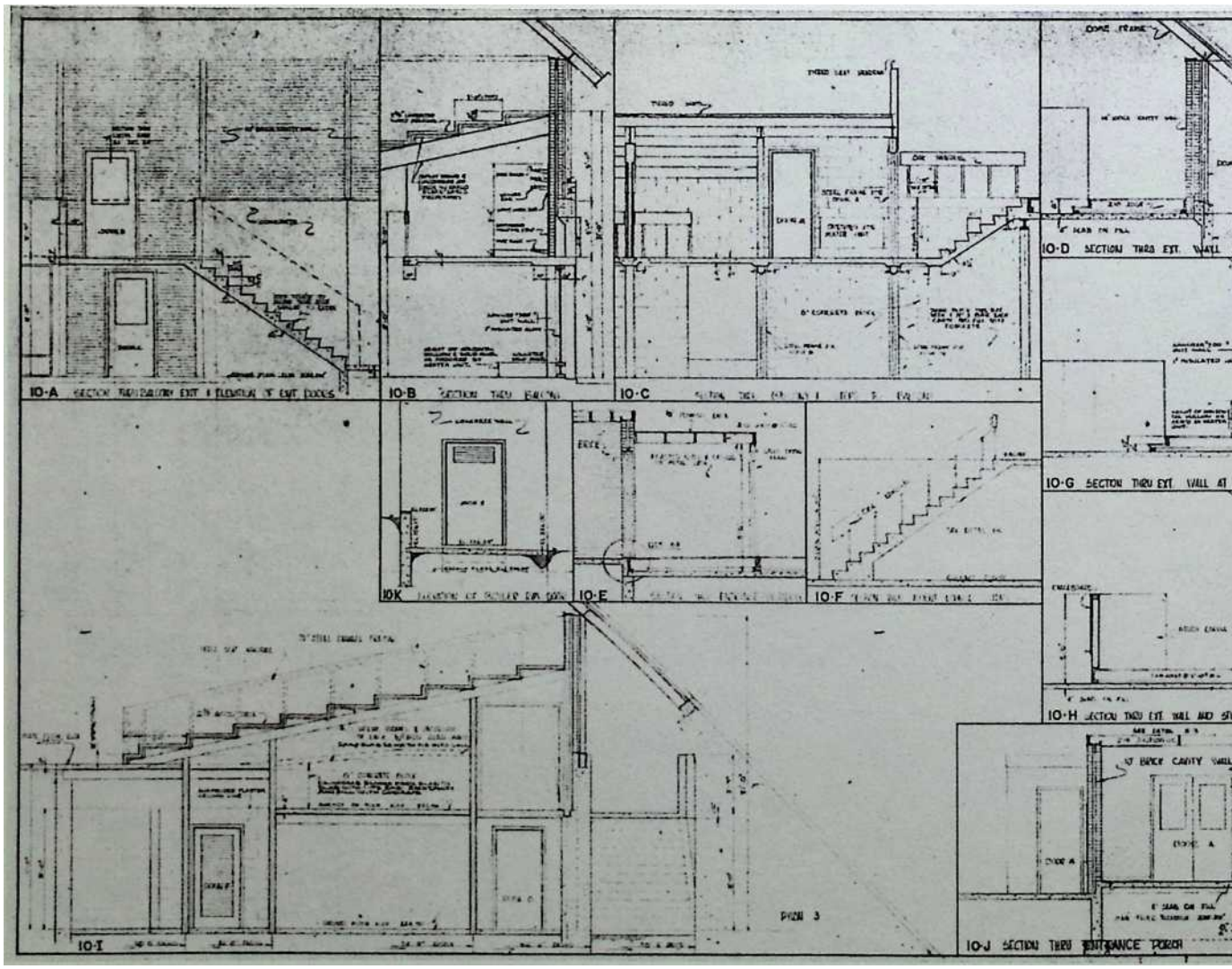

SECTION THRU BUILDING LOOKING SOUTH
SECTION THRU BUILDING LOOKING WEST
PLAN
ELEVATION
TYPICAL BOILER

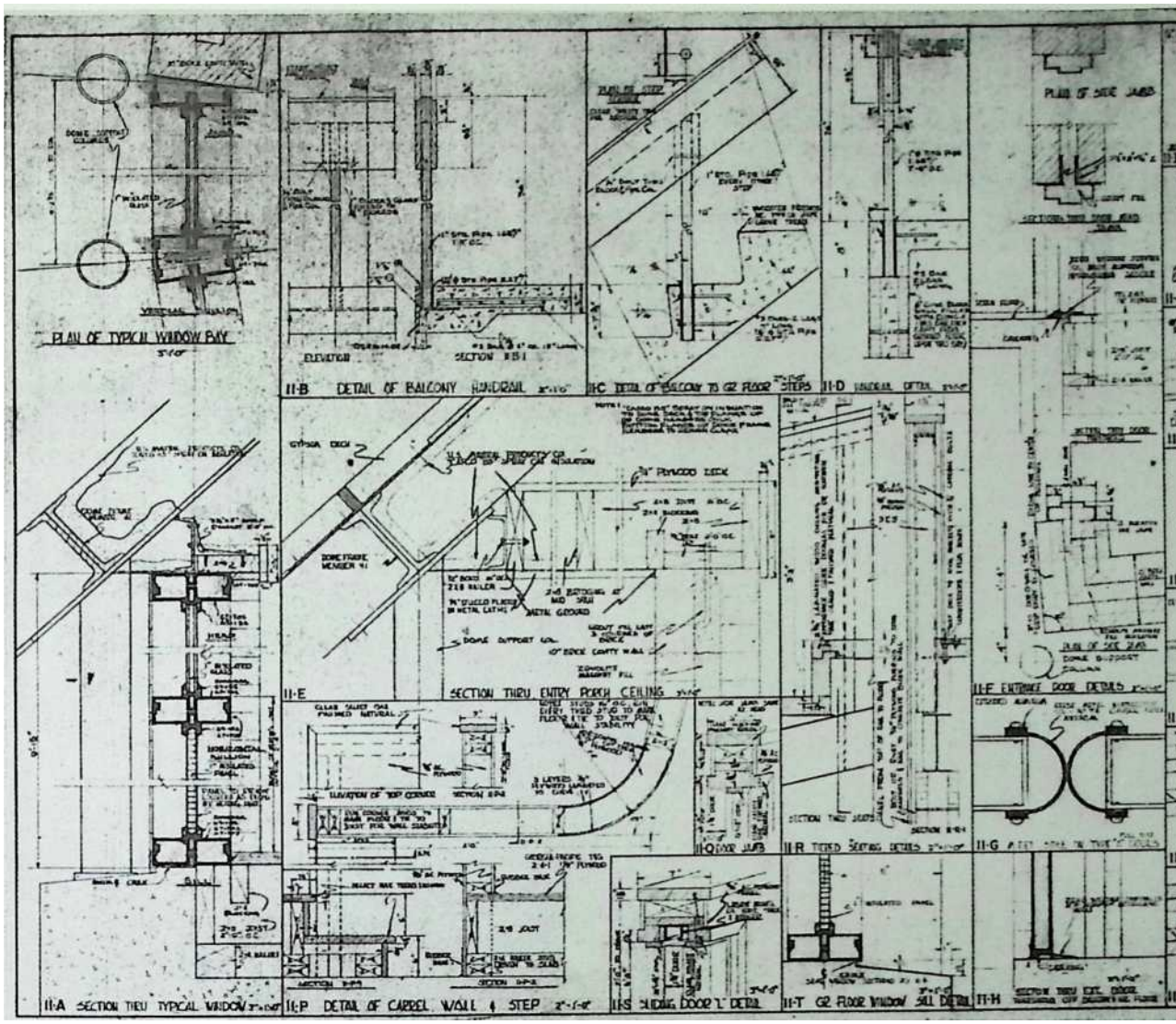

ELEV. G-1
ELEV. G-2
ELEV. G-3
ELEV. G-4
ELEV. G-5
LABORATORY AREA
FACULTY OFFICE
STUDY
PYLON 1
PYLON 4

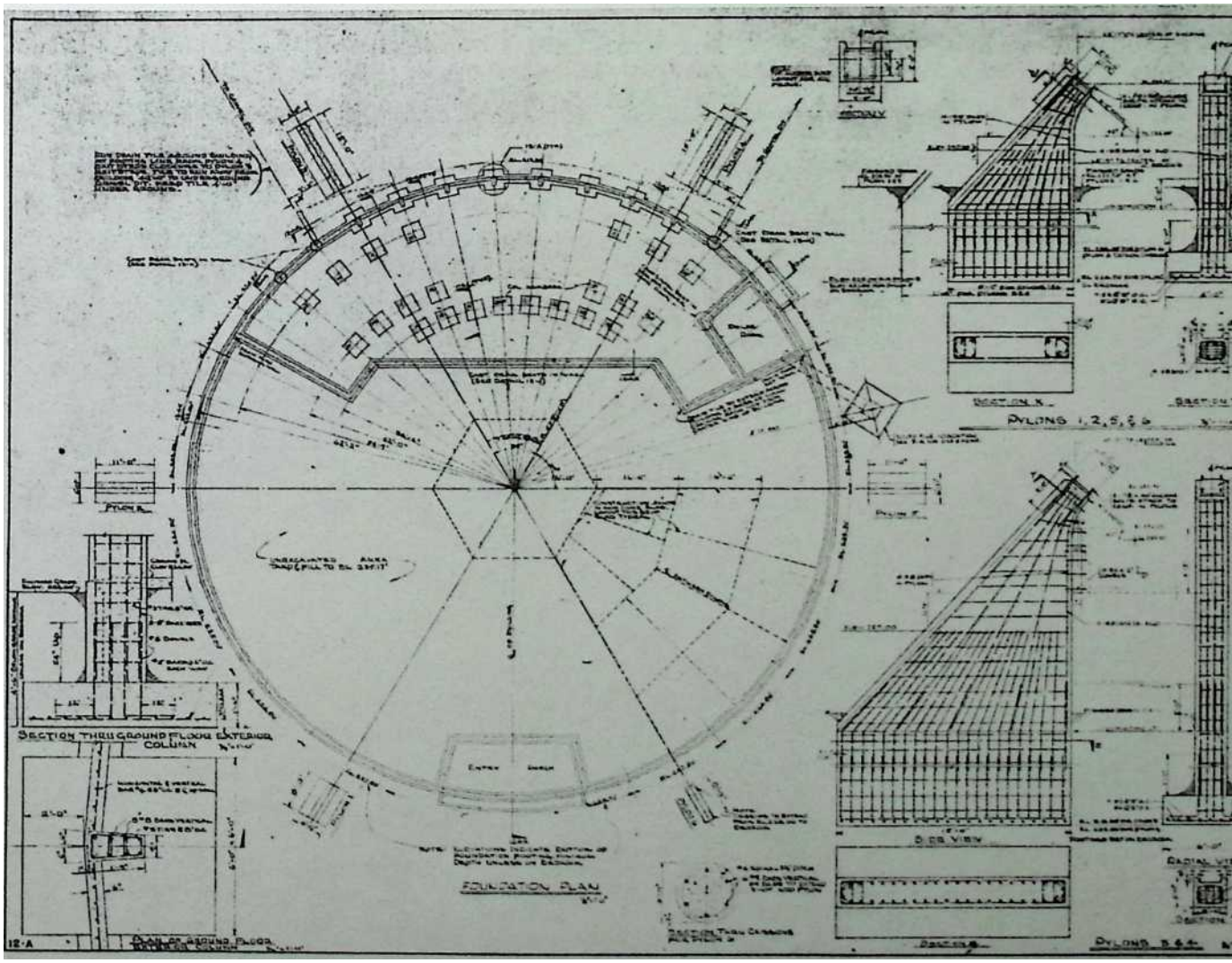

INTERIOR ELEVATION LOOKING SOUTH
TIERED SEATING AREA

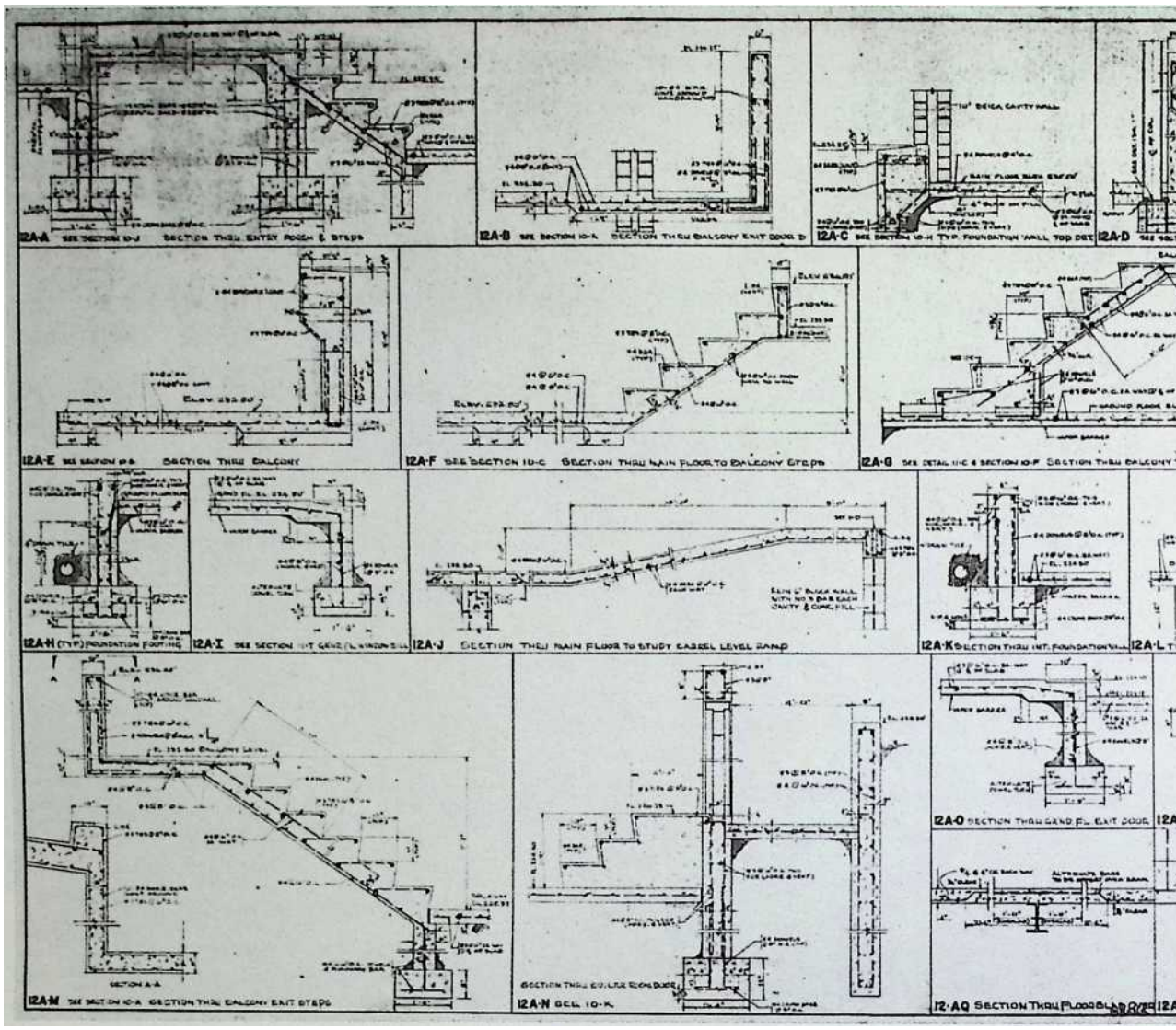


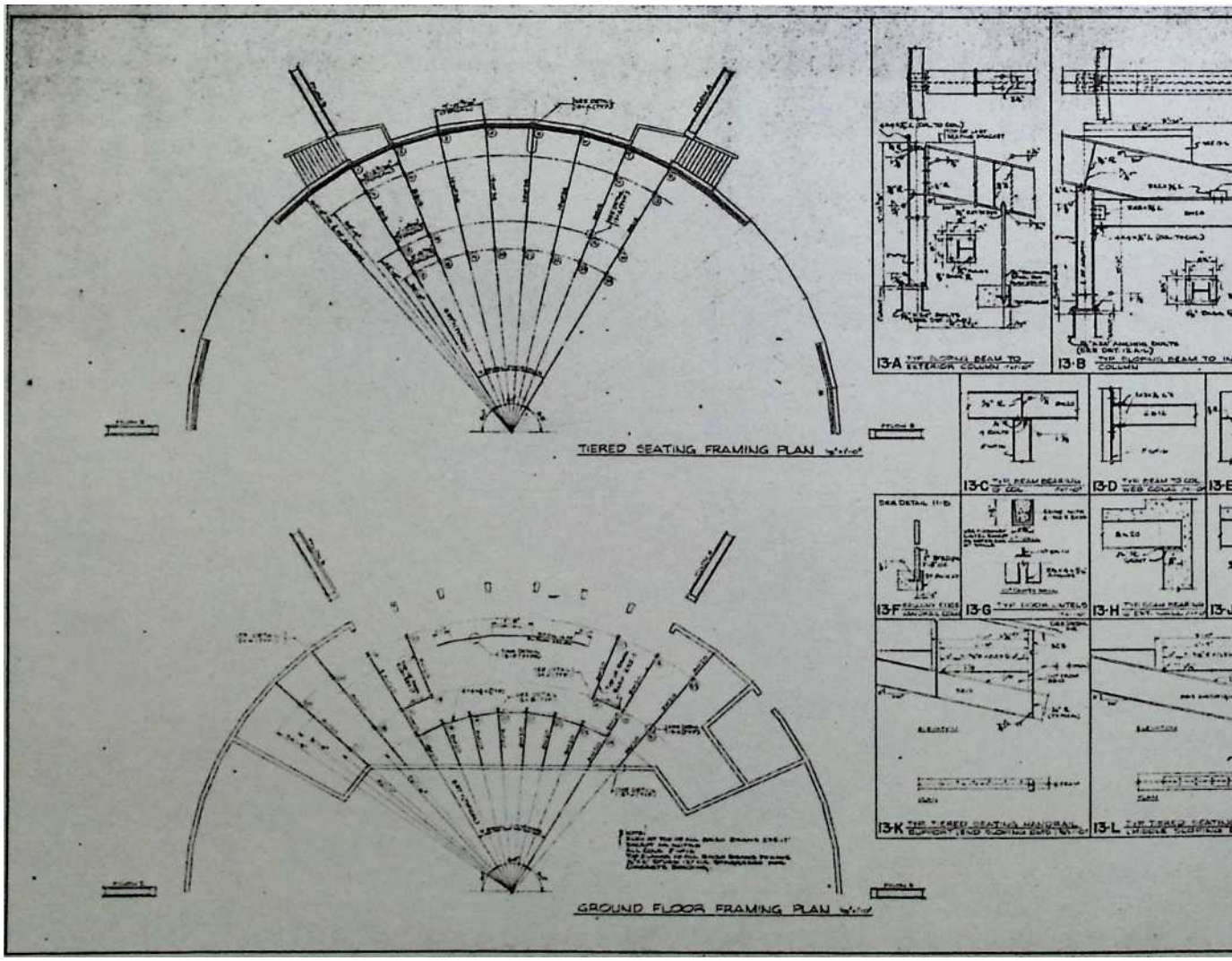

STUDENT LOUNGE
STORAGE
CENTER OF BUILDING

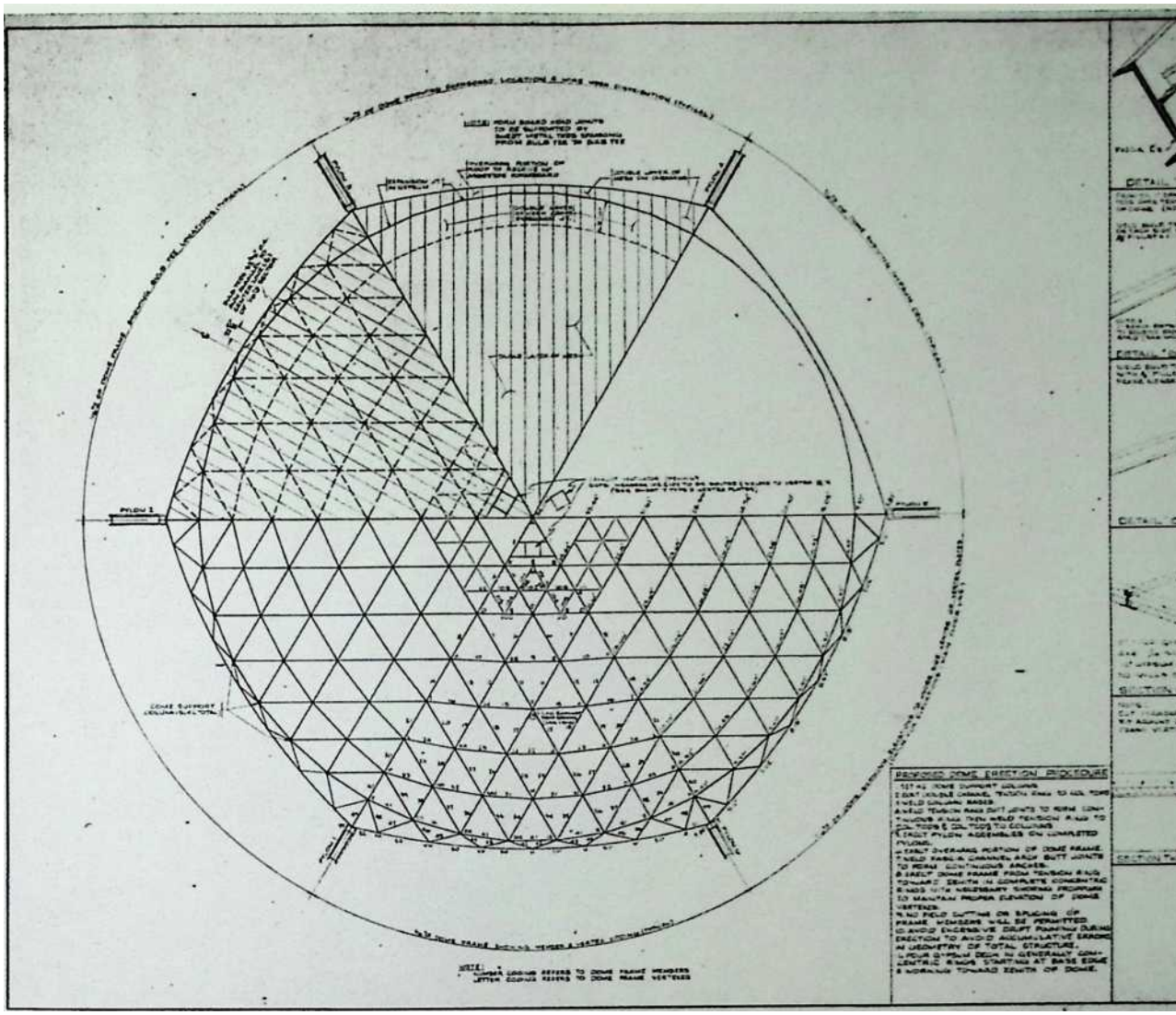

10-A
10-B
10-C
10-D SECTION THRU EXT. WALL
10-G SECTION THRU EXT. WALL AT
10-H SECTION THRU EXT. WALL AND
10-I
10-J SECTION THRU ENTRANCE PORCH

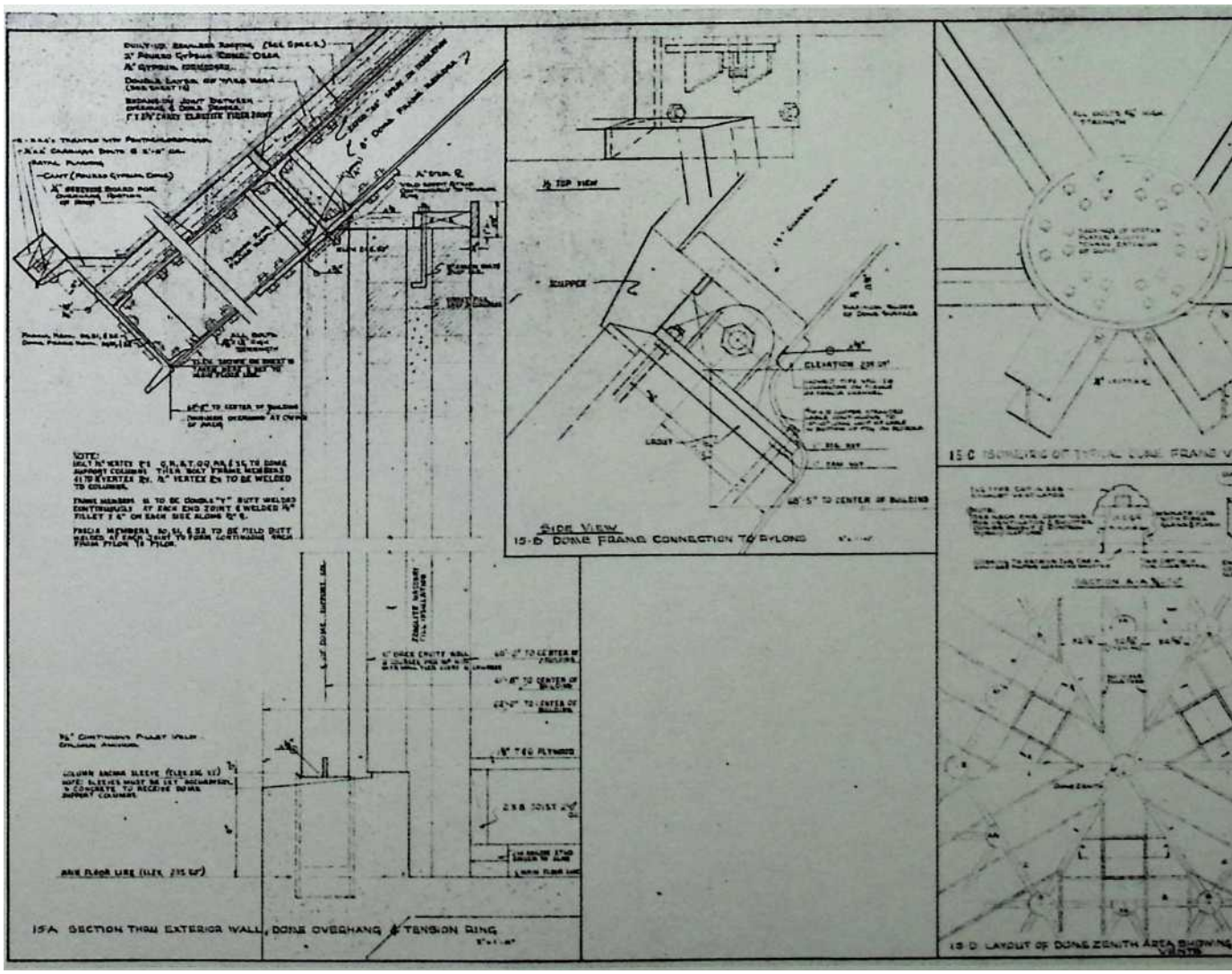

PLAN OF TYPICAL WINDOW BAY
11-B DETAIL OF BALCONY HANDRAIL
11-C DETAIL OF BALCONY TO G2 FLOOR STEPS
11-D HANDRAIL DETAIL
11-E
SECTION THRU ENTRY PORCH CEILING
11-F ENTRANCE DOOR DETAILS
11-G
11-Q DOOR JAMB
11-R TIERED SEATING DETAILS
11-A SECTION THRU TYPICAL WINDOW
11-P DETAIL OF CARREL WALL & STEP
11-S SLIDING DOOR "L" DETAIL
11-T G2 FLOOR WINDOW SILL DETAIL
11-H

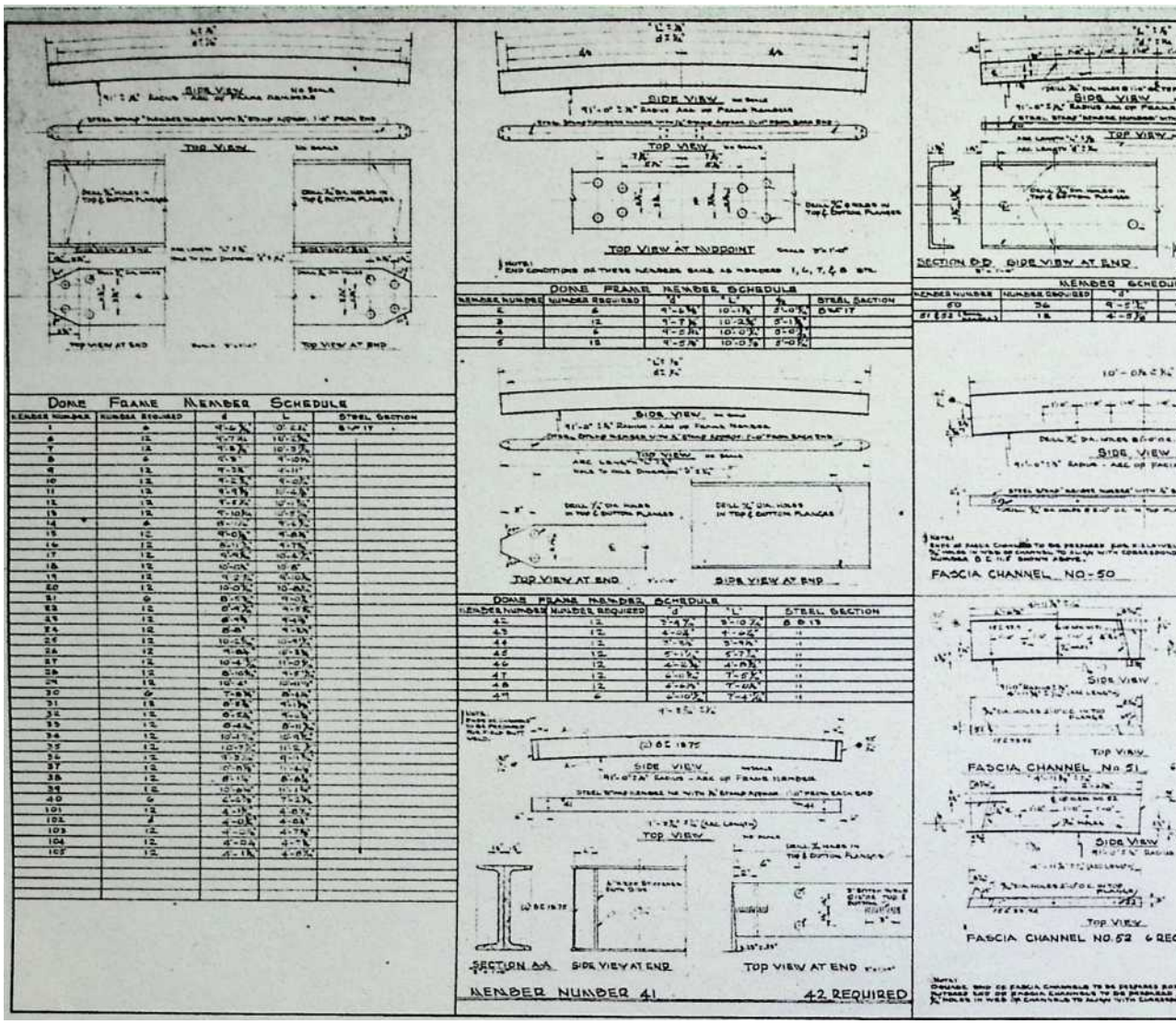

SECTION THRU GROUND FLOOR EXTERIOR COLUMN
FOUNDATION PLAN
PYLONS 1, 2, 5, & 6
12-A

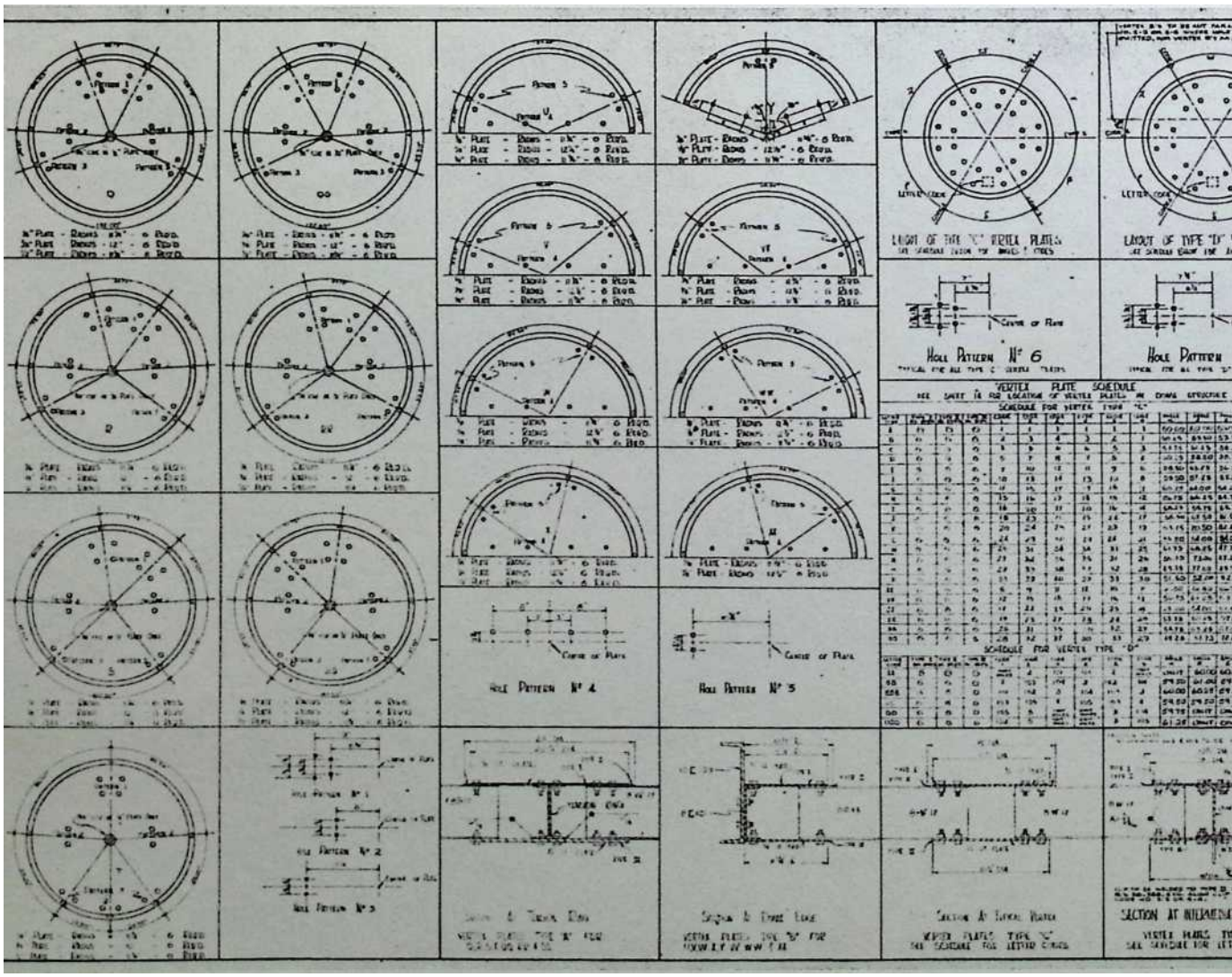

12A-A
12A-B
12A-C
12A-D
12A-E
12A-F
12A-G
12A-H
12A-I
12A-J
12A-K
12A-L
12A-M
12A-N
12A-O
12-AQ

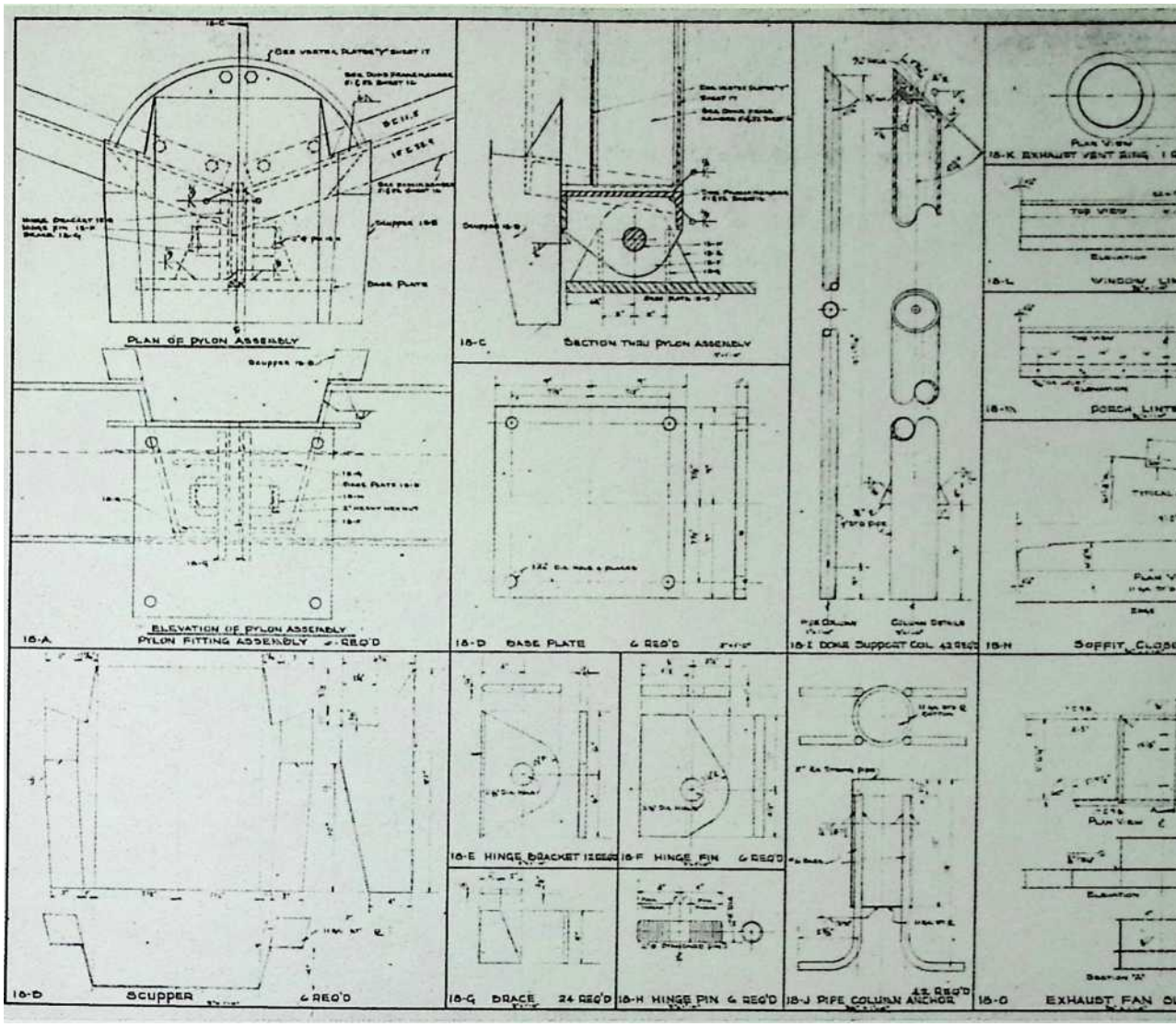

TIERED SEATING FRAMING PLAN
GROUND FLOOR FRAMING PLAN
13-A
13-B
13-C
13-D
13-F
13-G
13-H
13-K
13-L

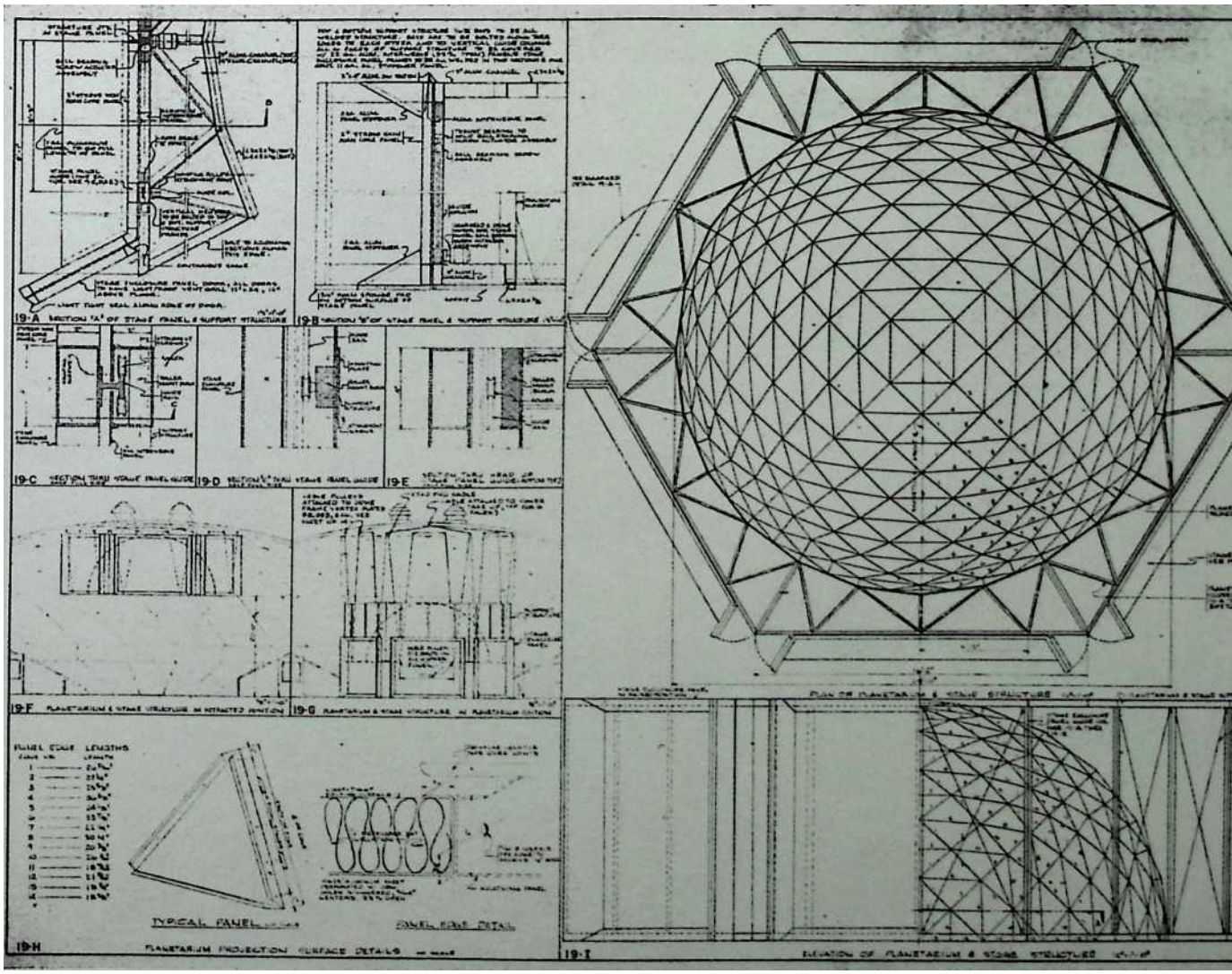



SIDE VIEW
15-B DOME FRAME CONNECTION TO PYLONS
15A SECTION THRU EXTERIOR WALL, DOME OVERHANG & TENSION RING

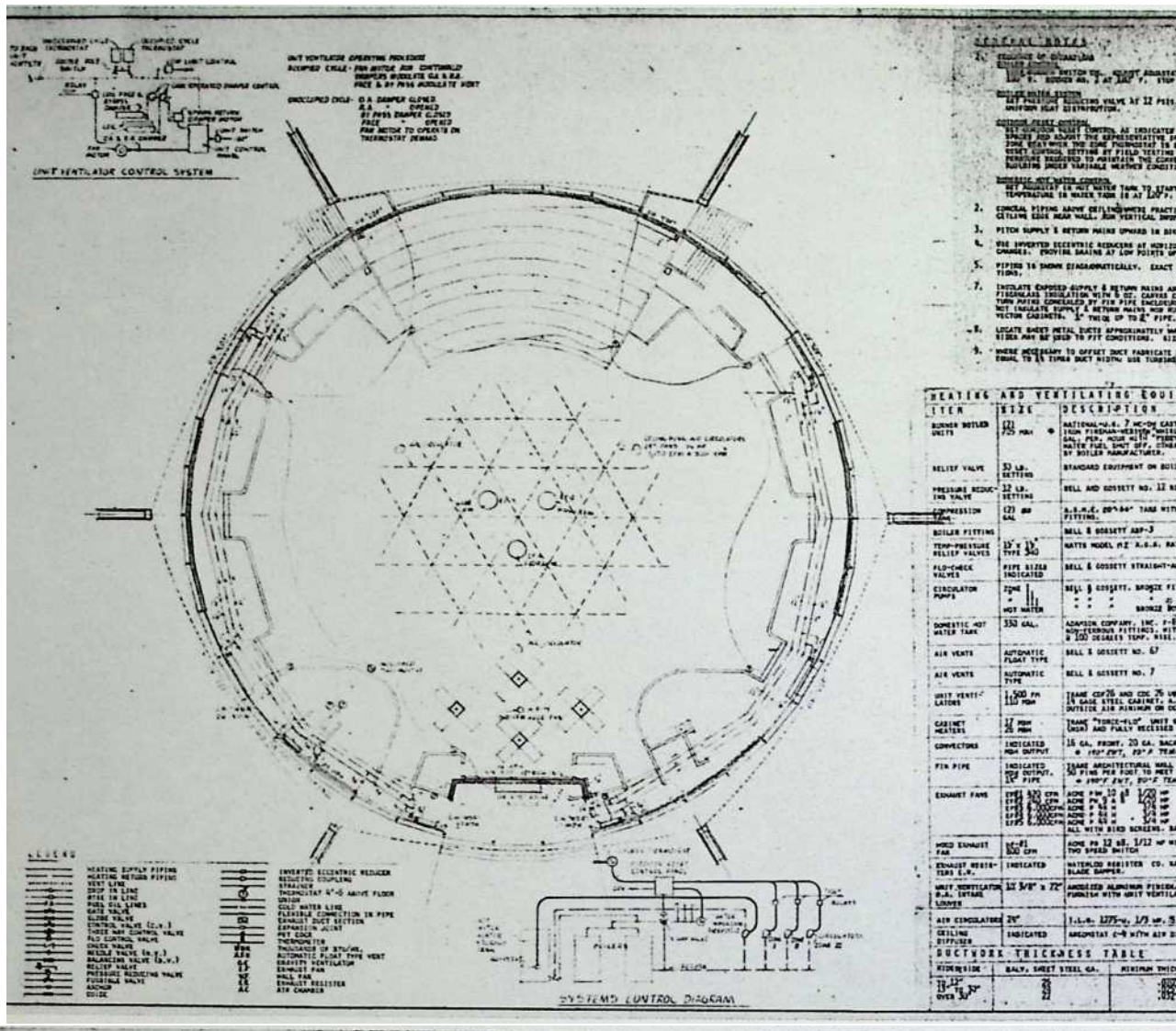

SIDE VIEW
TOP VIEW
TOP VIEW AT END
TOP VIEW AT MIDPOINT
DOME FRAME MEMBER SCHEDULE
STEEL SECTION
SECTION A-A
SIDE VIEW AT END
TOP VIEW AT END
MEMBER NUMBER 41
42 REQUIRED
SECTION D-D
SIDE VIEW AT END
FASCIA CHANNEL NO-50
FASCIA CHANNEL No 51
FASCIA CHANNEL NO 52

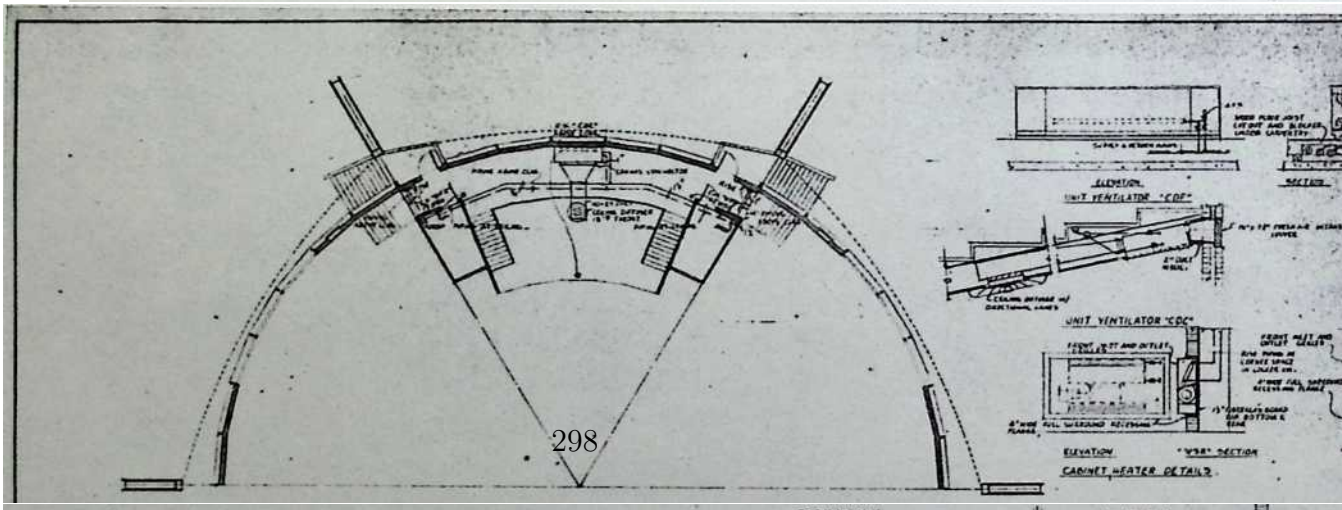

Hole Pattern Nº 6
Hole Pattern Nº 4
Hole Pattern Nº 5
Hole Pattern Nº 2
Hole Pattern Nº 3
Center of Plate
Vertex Plate Schedule
Schedule for Vertex Type "C"
Schedule for Vertex Type "D"

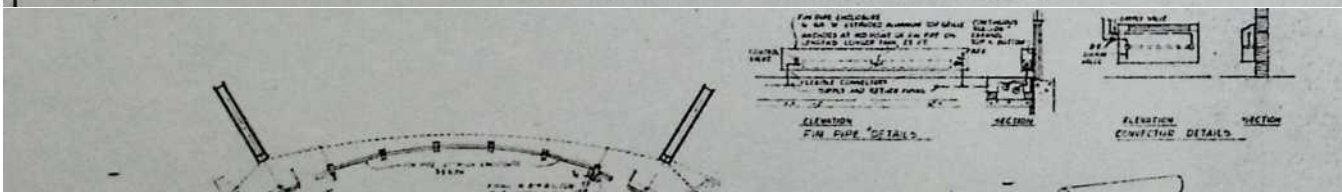

PLAN OF PYLON ASSEMBLY
ELEVATION OF PYLON ASSEMBLY
PYLON FITTING ASSEMBLY
18-A.
18-C.
SECTION THRU PYLON ASSEMBLY
18-D BASE PLATE 6 REQ'D
18-I DOME SUPPORT COL. 42 REQ'D
18-K EXHAUST VENT RING
18-L
18-N
SOFFIT CLOSE
18-E HINGE BRACKET
18-F HINGE PIN 6 REQ'D
18-D SCUPPER 6 REQ'D
18-G BRACE 24 REQ'D
18-H HINGE PIN 6 REQ'D
18-J PIPE COLUMN ANCHOR
18-O EXHAUST FAN

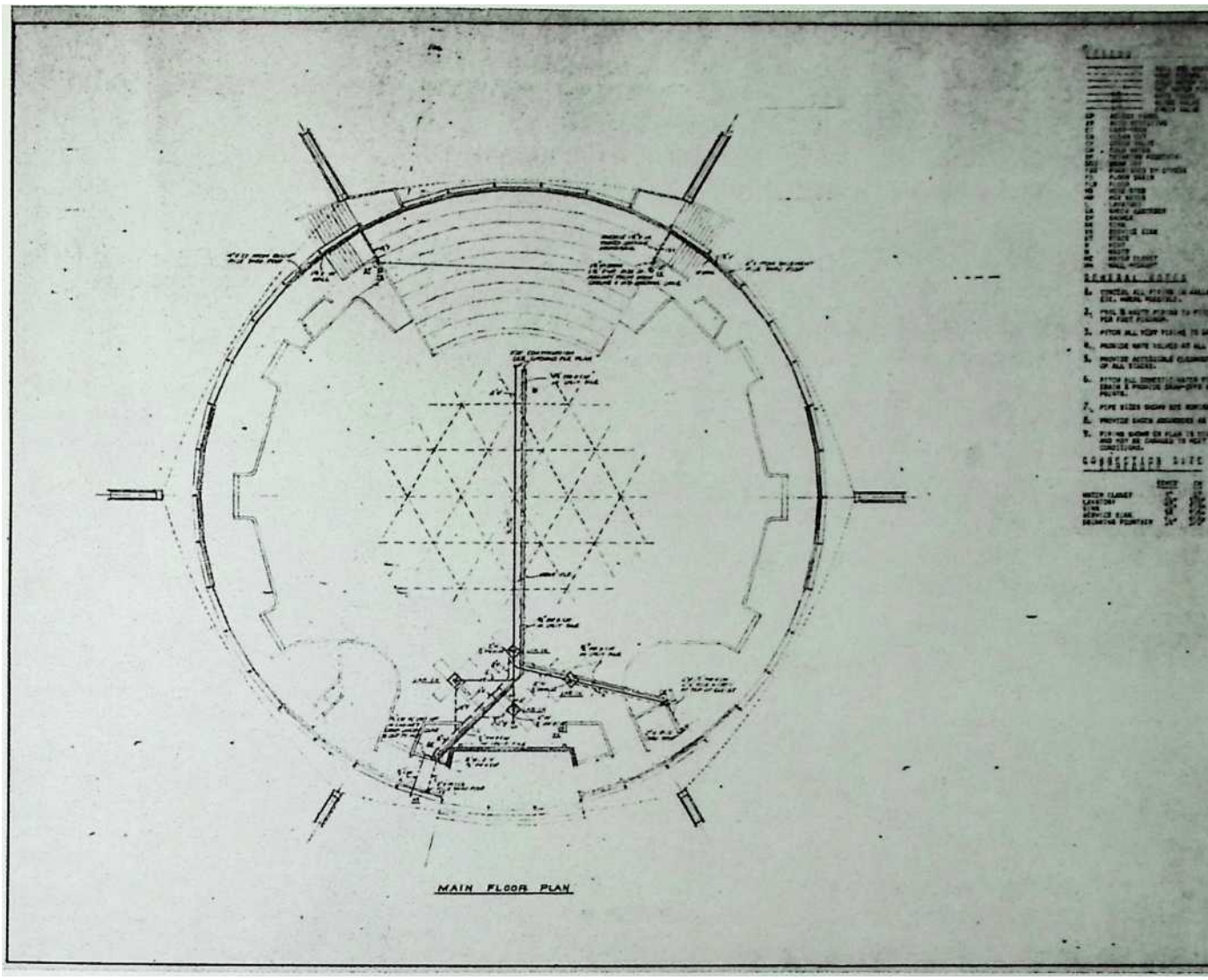

19·A
19·B
19·C
19·D
19·E
19·F
19·G
19·H
19·I
TYPICAL PANEL
PANEL EDGE DETAIL
PLANETARIUM PROJECTION SURFACE DETAILS

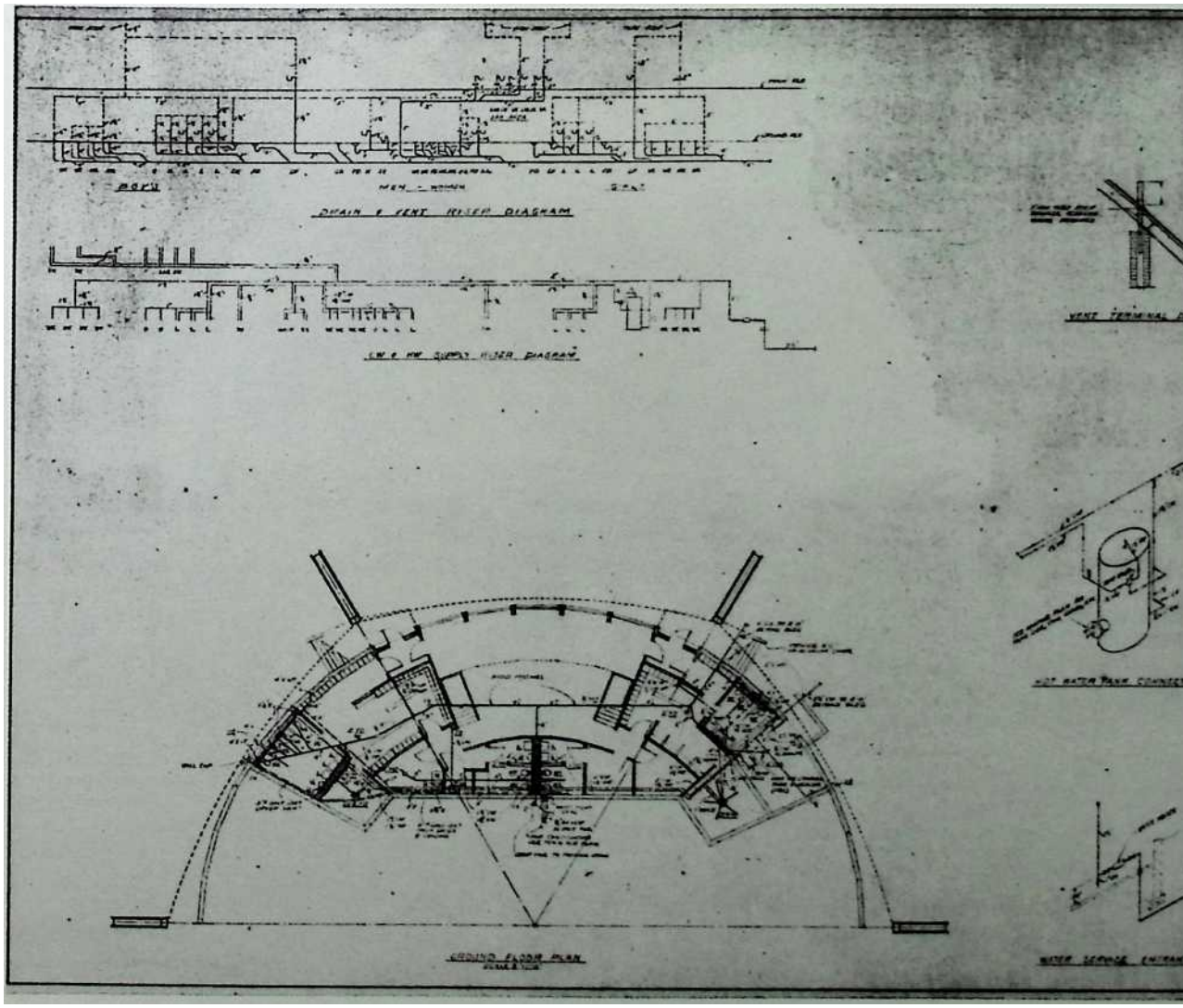
I No I1 IUI t.

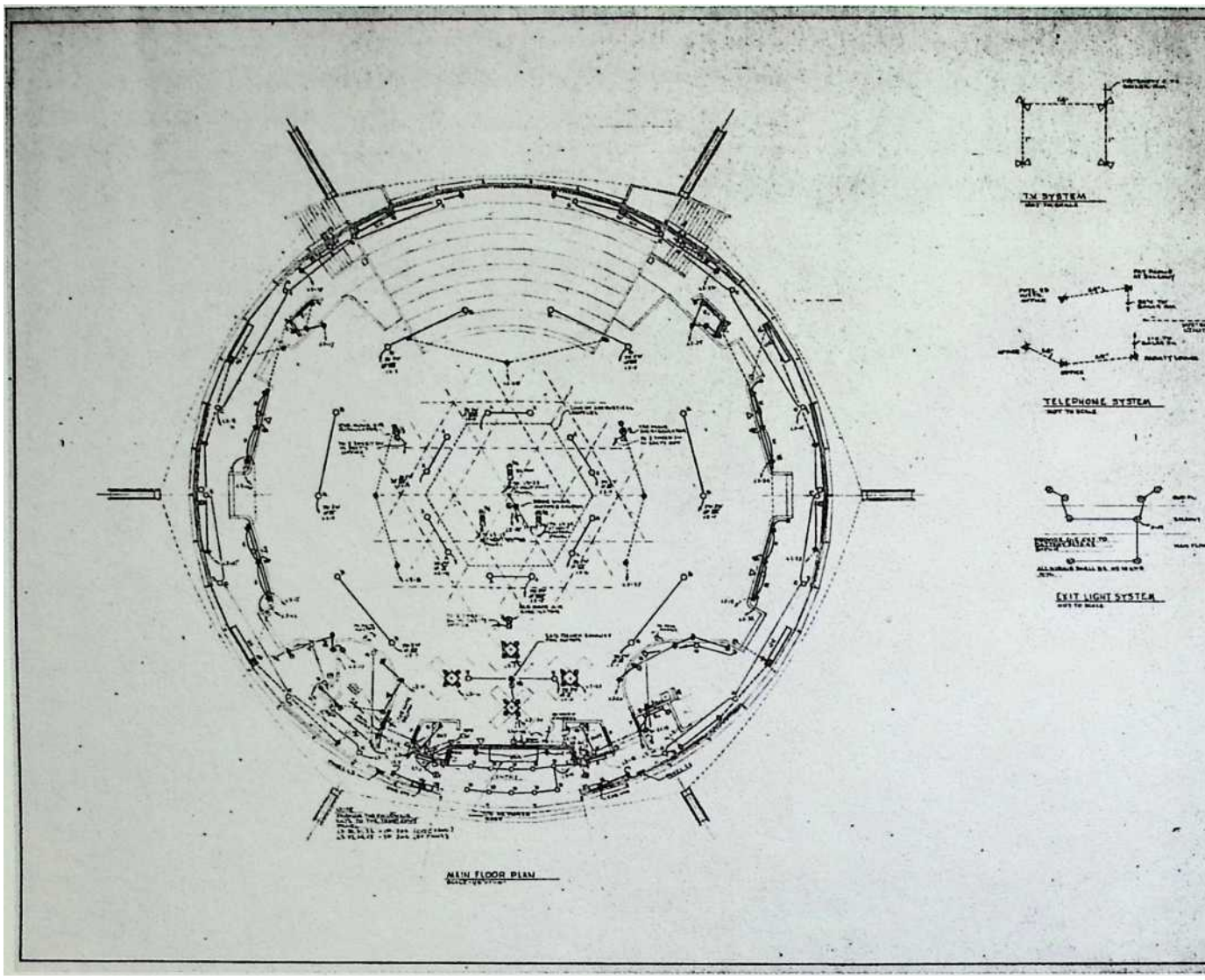

UNIT VENTILATOR CONTROL SYSTEM
SYSTEMS CONTROL DIAGRAM
HEATING AND VENTILATING EQUI
ITEM
SIZE
DESCRIPTION
RELIEF VALVE
BOILER FITTING
CIRCULATOR PUMPS
AIR VENTS
CONVECTORS
EXHAUST FANS
DUCTWORK THICKNESS TABLE

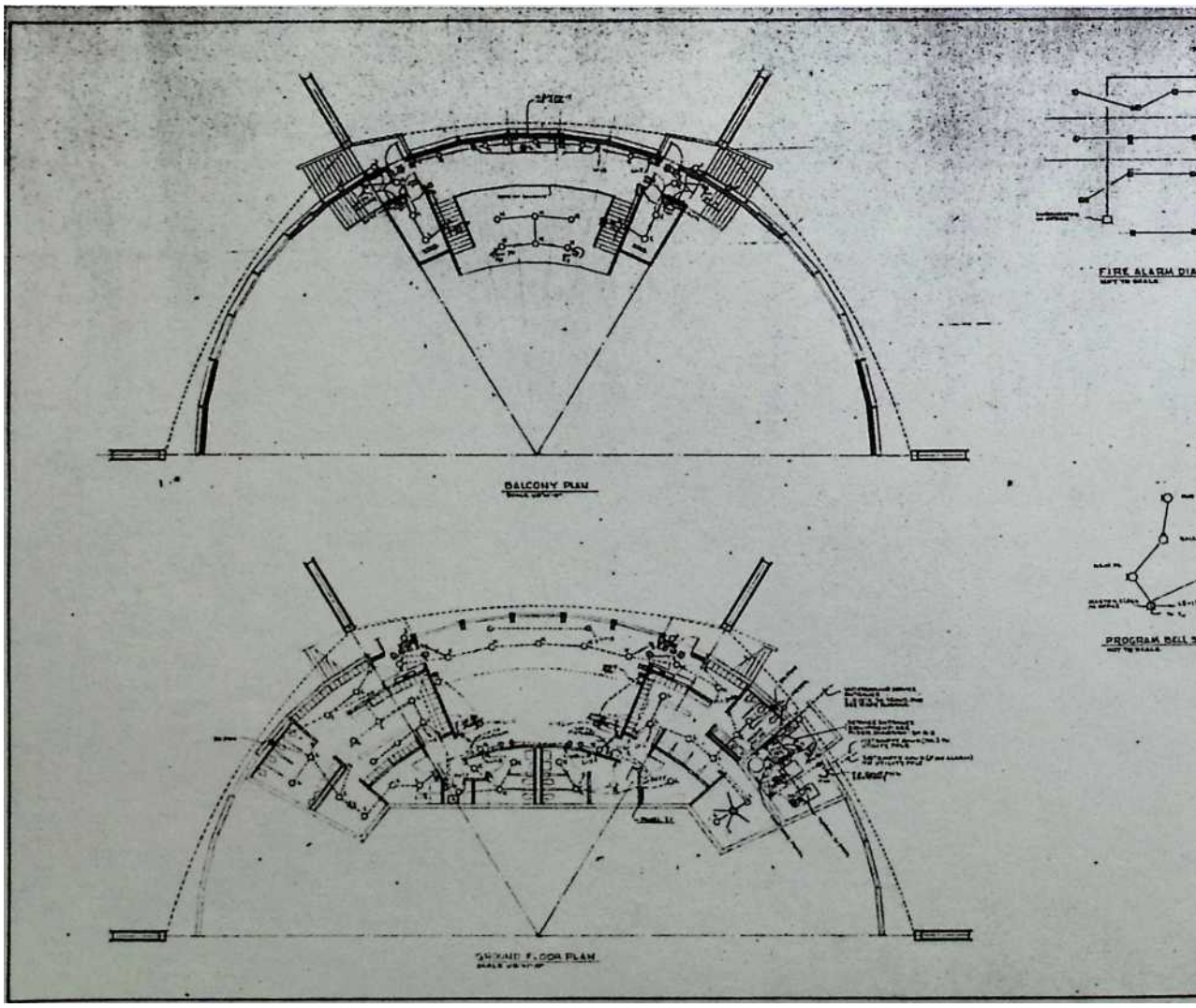

ELEVATION
UNIT VENTILATOR "CDC"
ELEVATION
"WSW" SECTION
CABINET HEATER DETAILS


ELEVATION
FIN PIPE DETAILS
SECTION
ELEVATION
CONVECTOR DETAILS
SECTION


MAIN FLOOR PLAN


DRAIN & VENT RISER DIAGRAM
VENT TERMINAL
GROUND FLOOR PLAN


TV SYSTEM
TELEPHONE SYSTEM
EXIT LIGHT SYSTEM
MAIN FLOOR PLAN

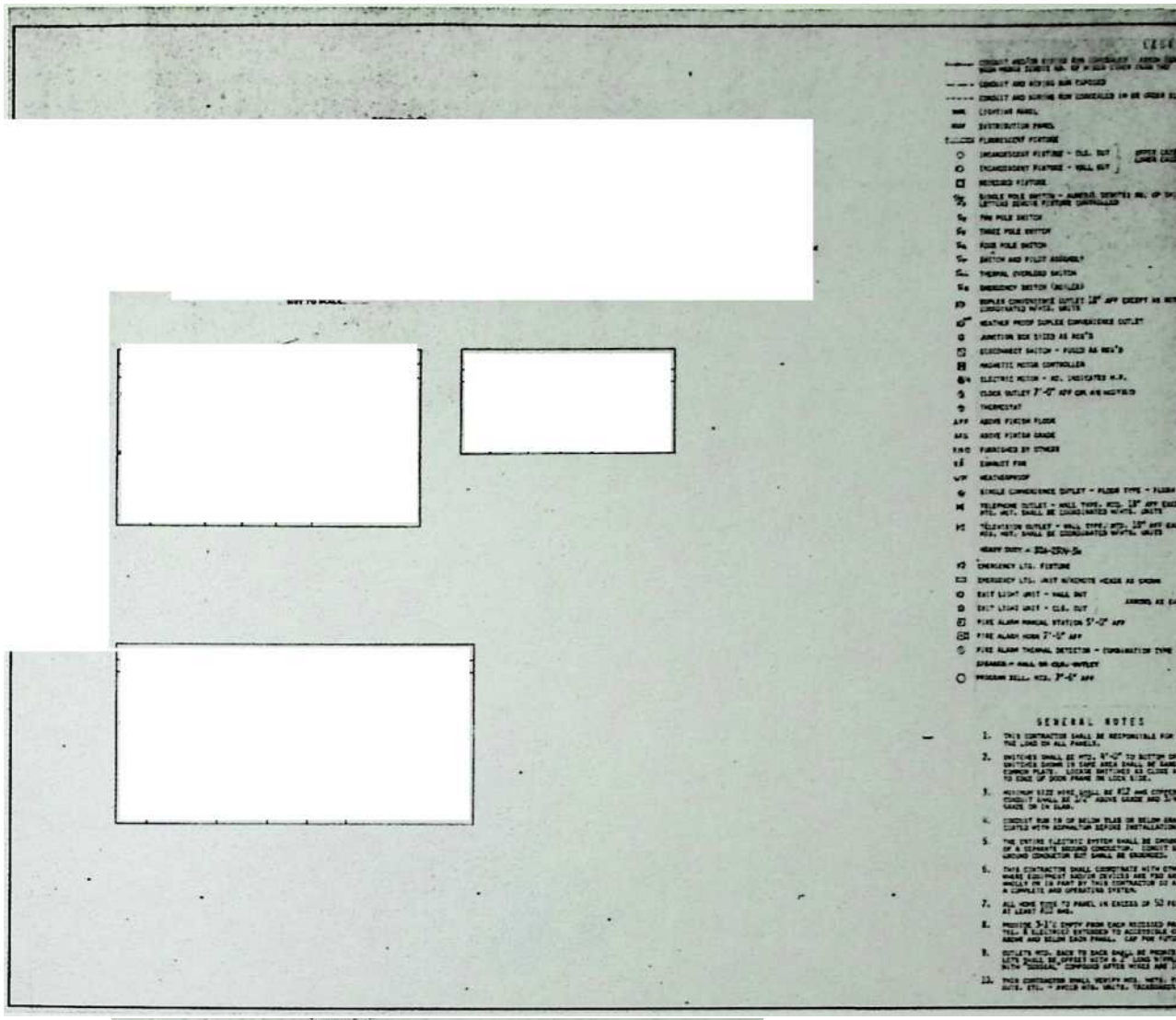


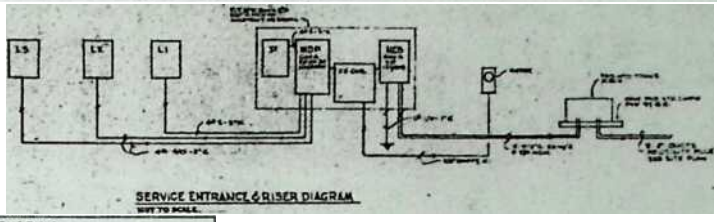
ELECTRICAL

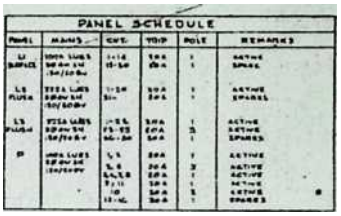
M»iH DiSraiUTICM PANEL C«TT»t *4«W«M A auwa M-O				
err	***104**	**a >**	**• C41**	
4	**11 • "L Lt**			IHH
	»-»a«		**1 * »**	

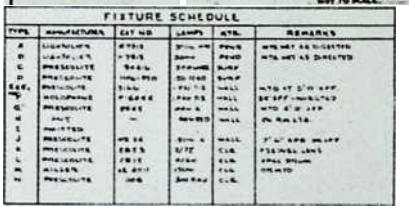
COBURN
CLASSICAL
INSTITUTE

[**SYNERGETICS, INC**


GENERAL NOTES


SERVICE ENTRANCE & RISER DIAGRAM


PANEL SCHEDULE

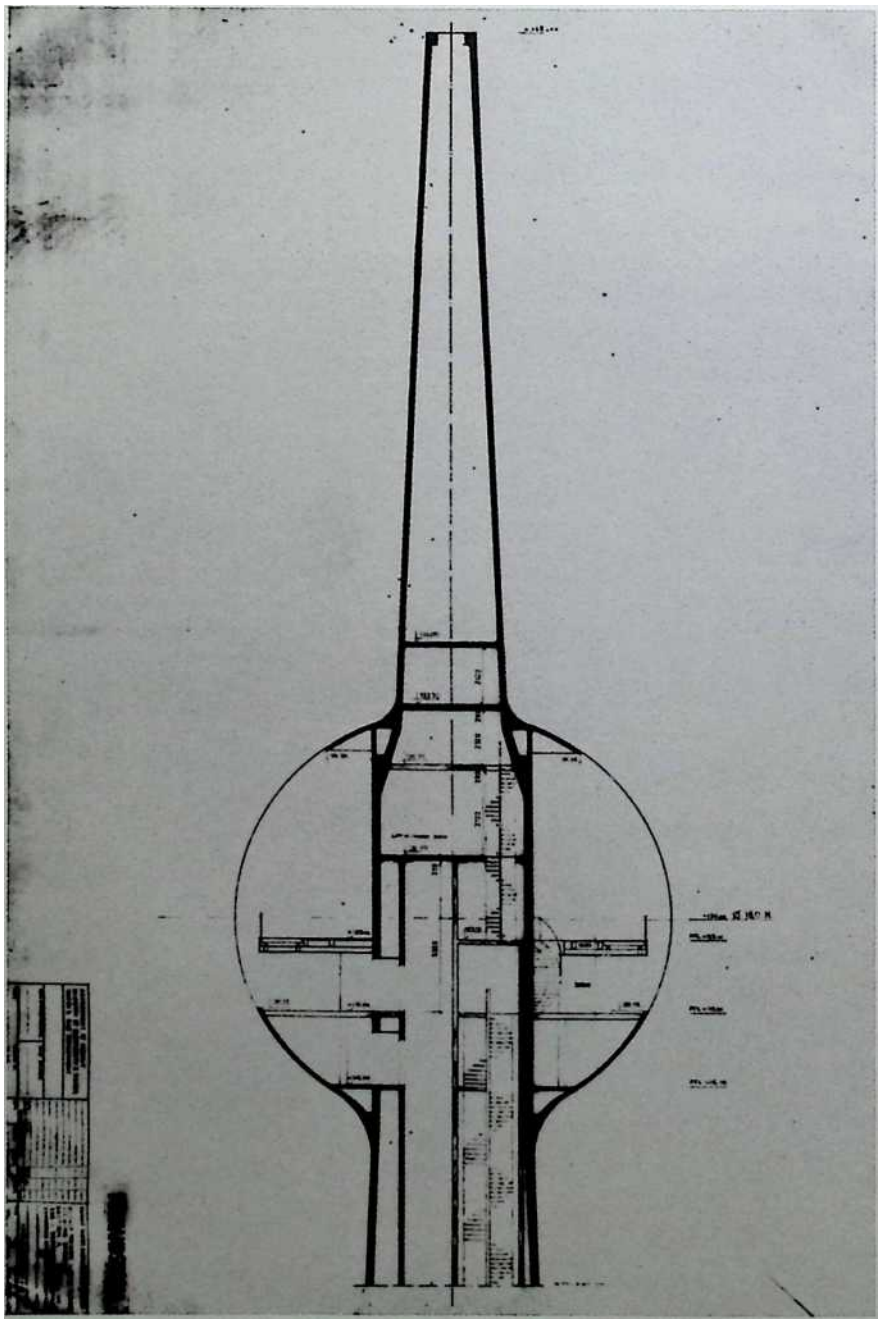

FIXTURE SCHEDULE

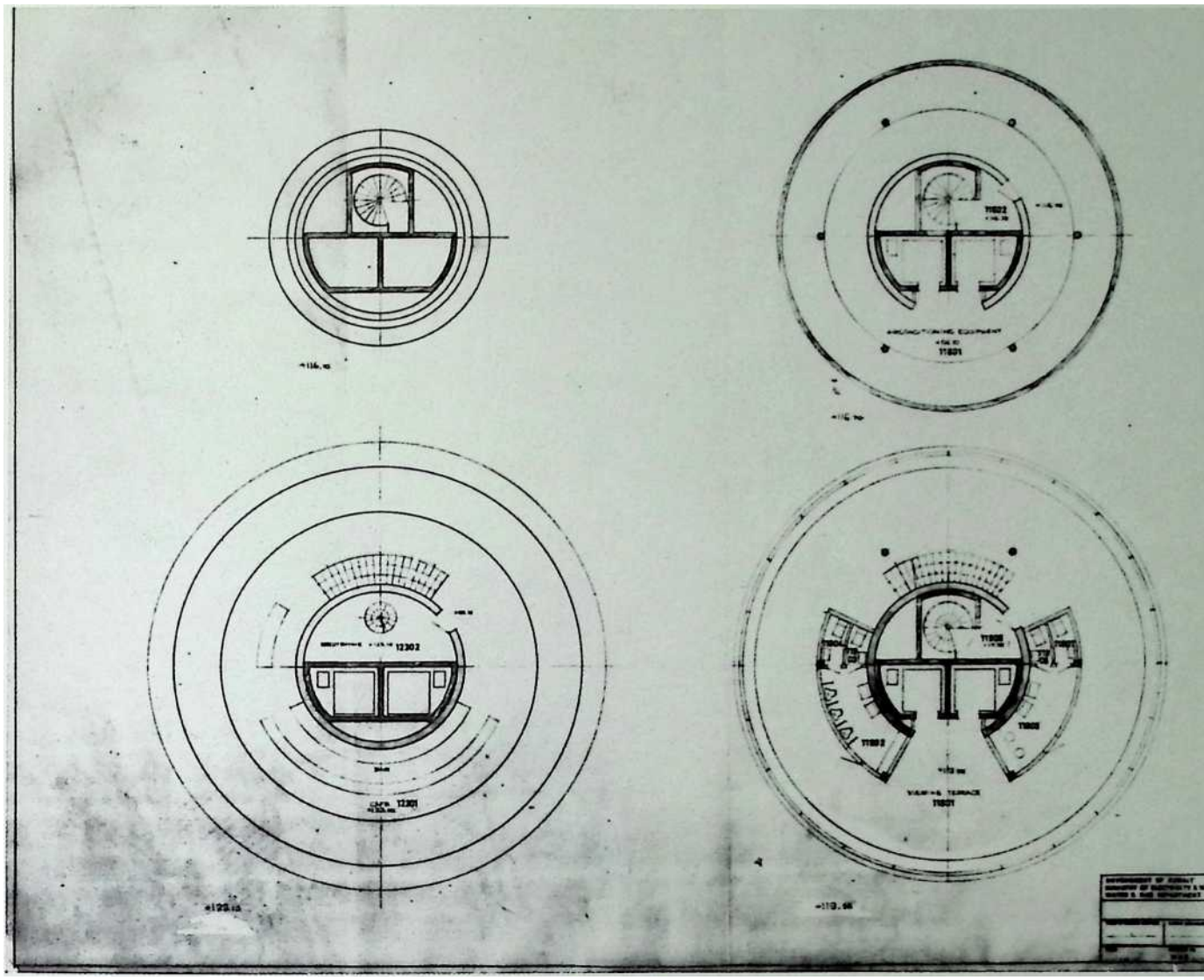
Main Observation Tower, Government of Kuwait, Ministry of Electricity and Water

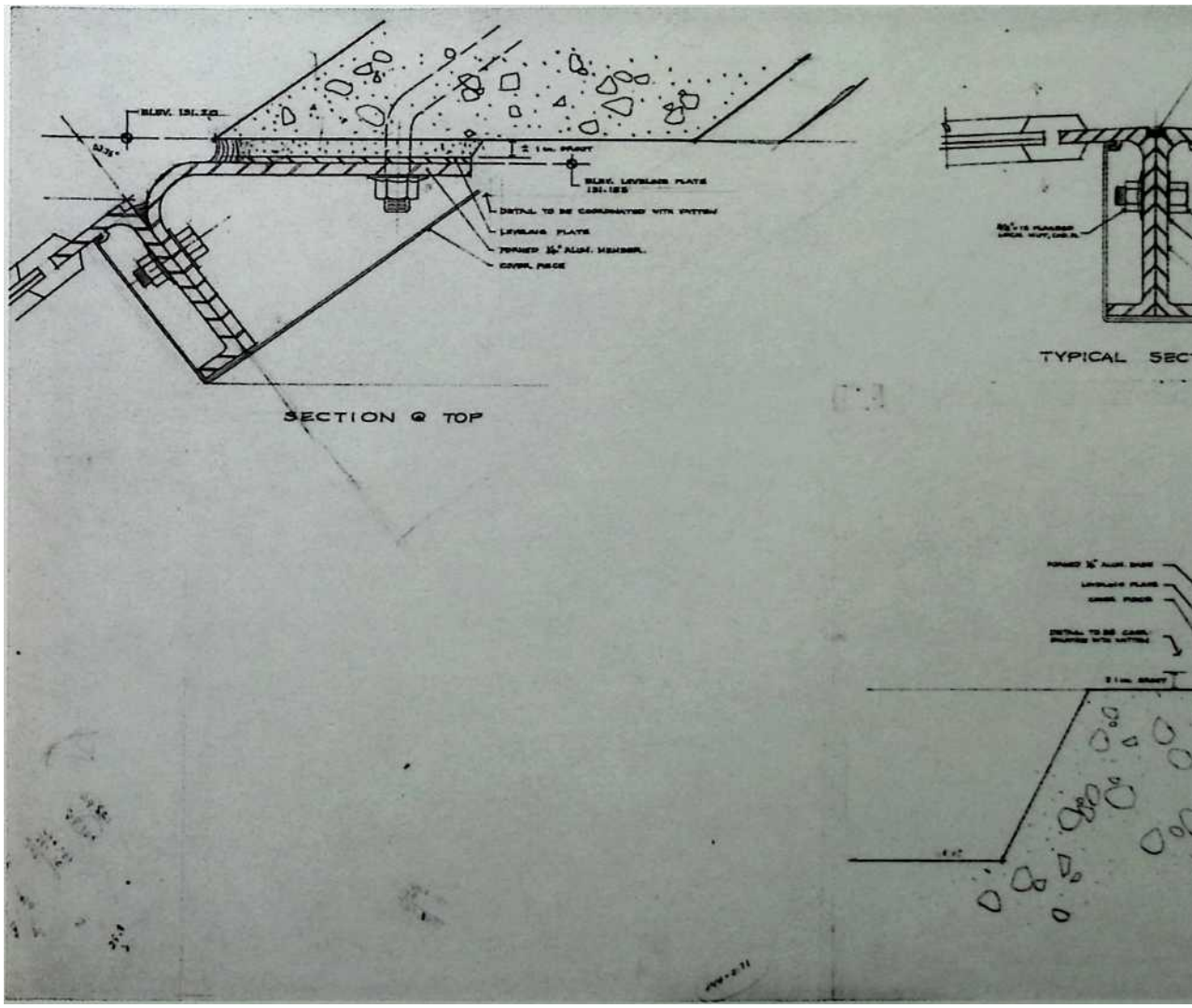
Fuller & Sadao with

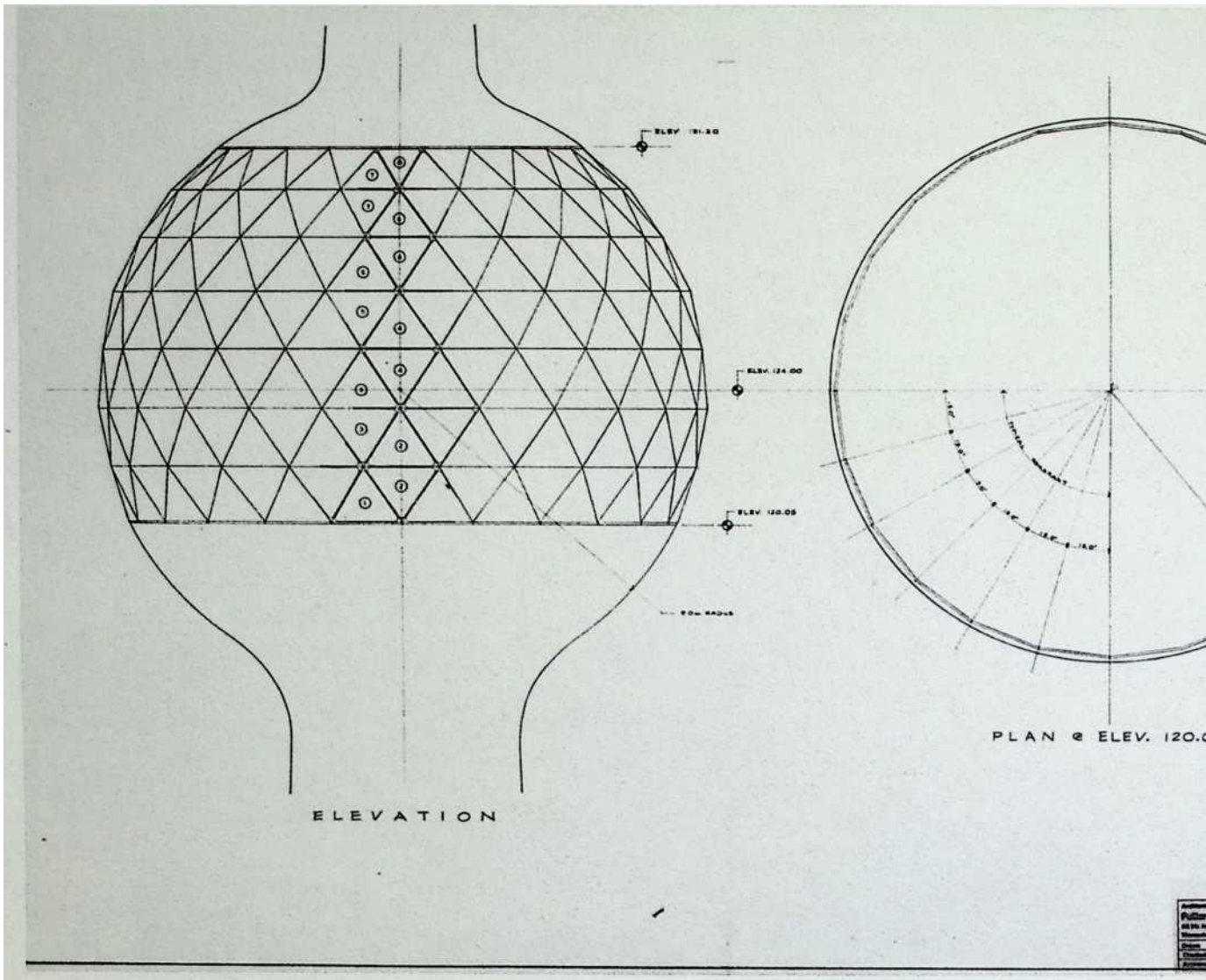
Geometries, Inc., 1968

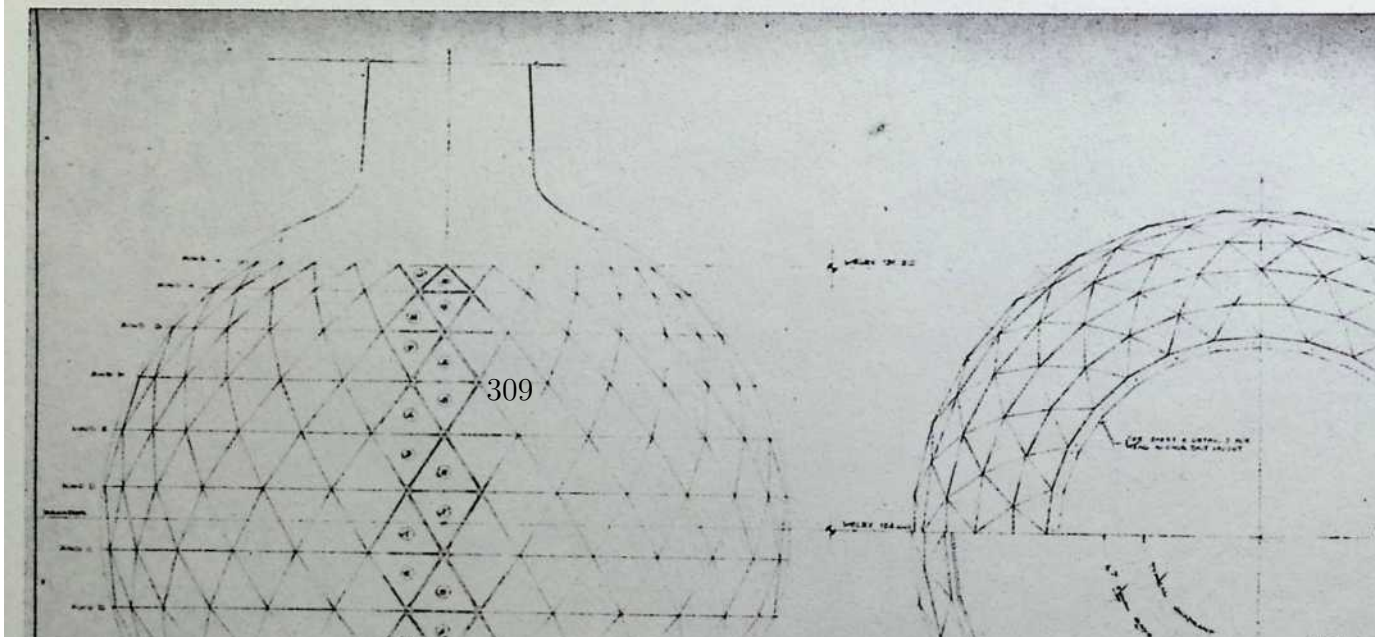
This observation tower combines the volumes of the cone and sphere. Designed by Fuller for the government of Kuwait, this irrigation observation tower was constructed by a Swedish firm. The center of the dome is a glazed geodesic structure that provides a 360° view of the site.

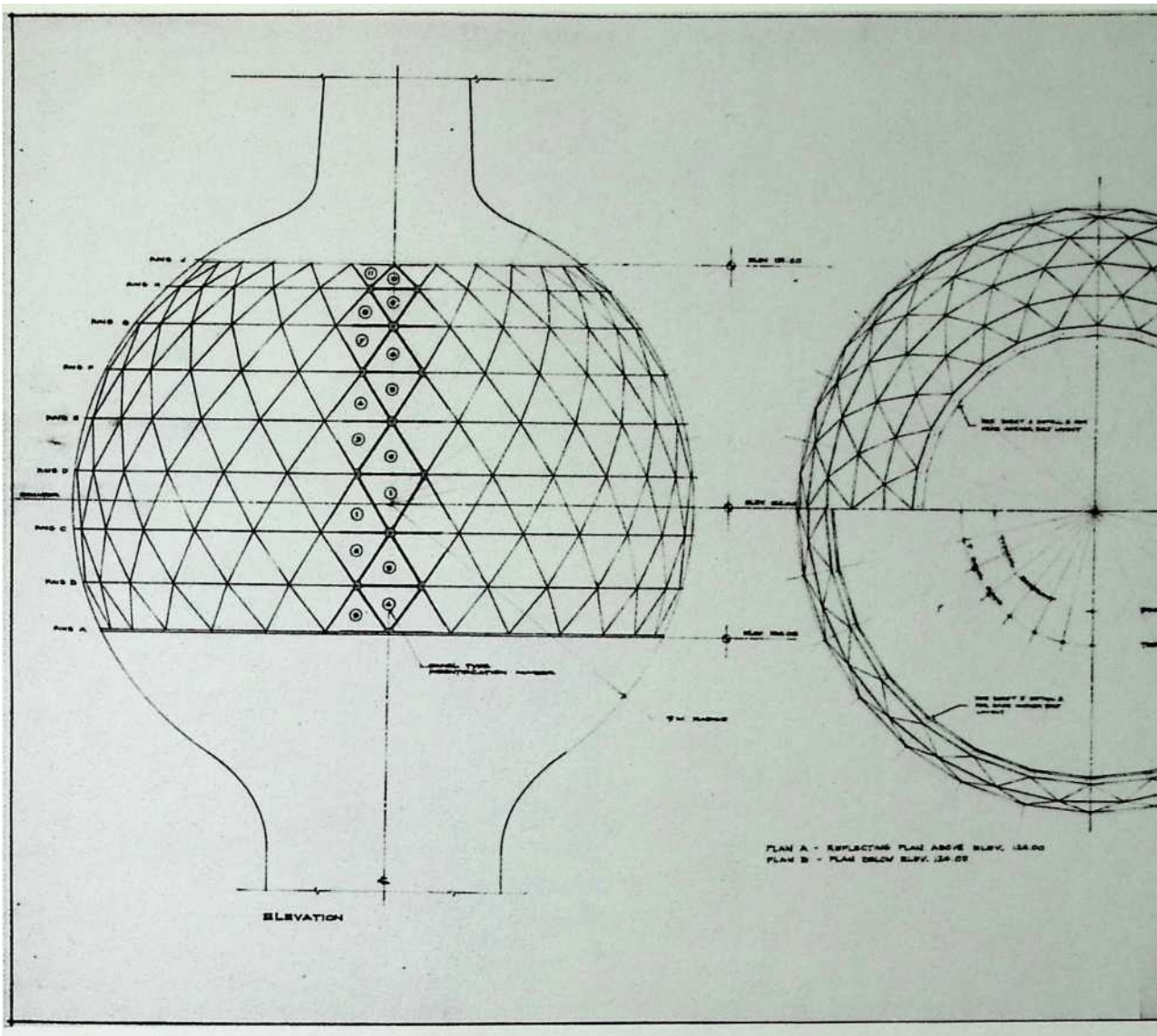


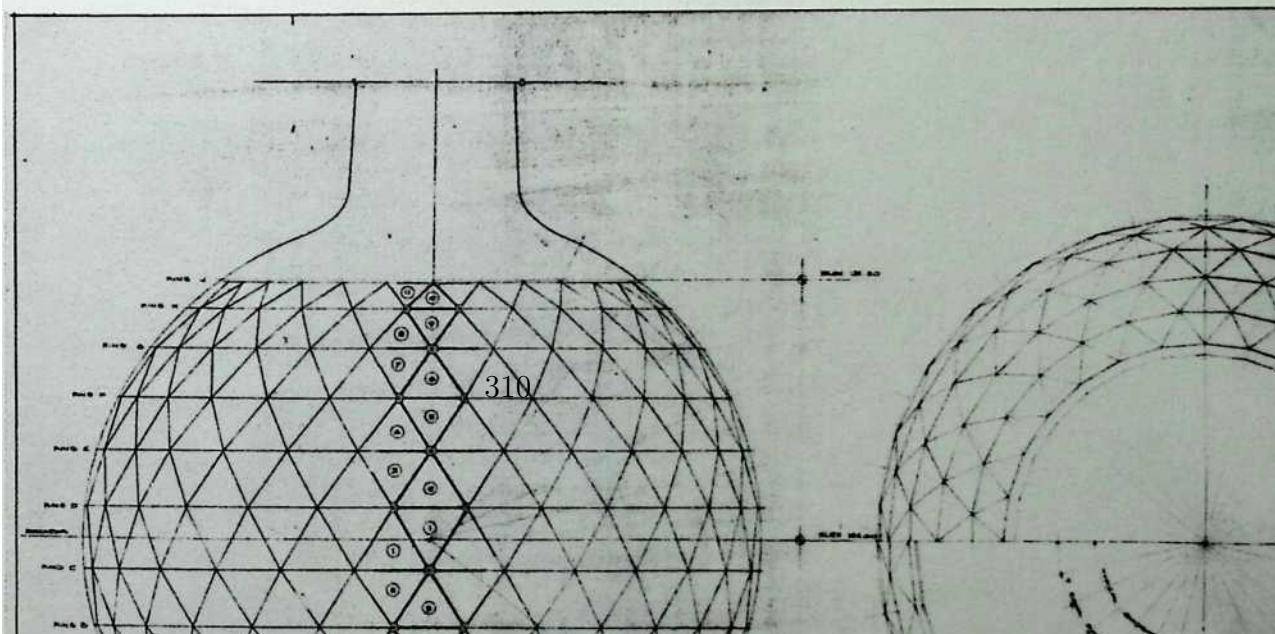


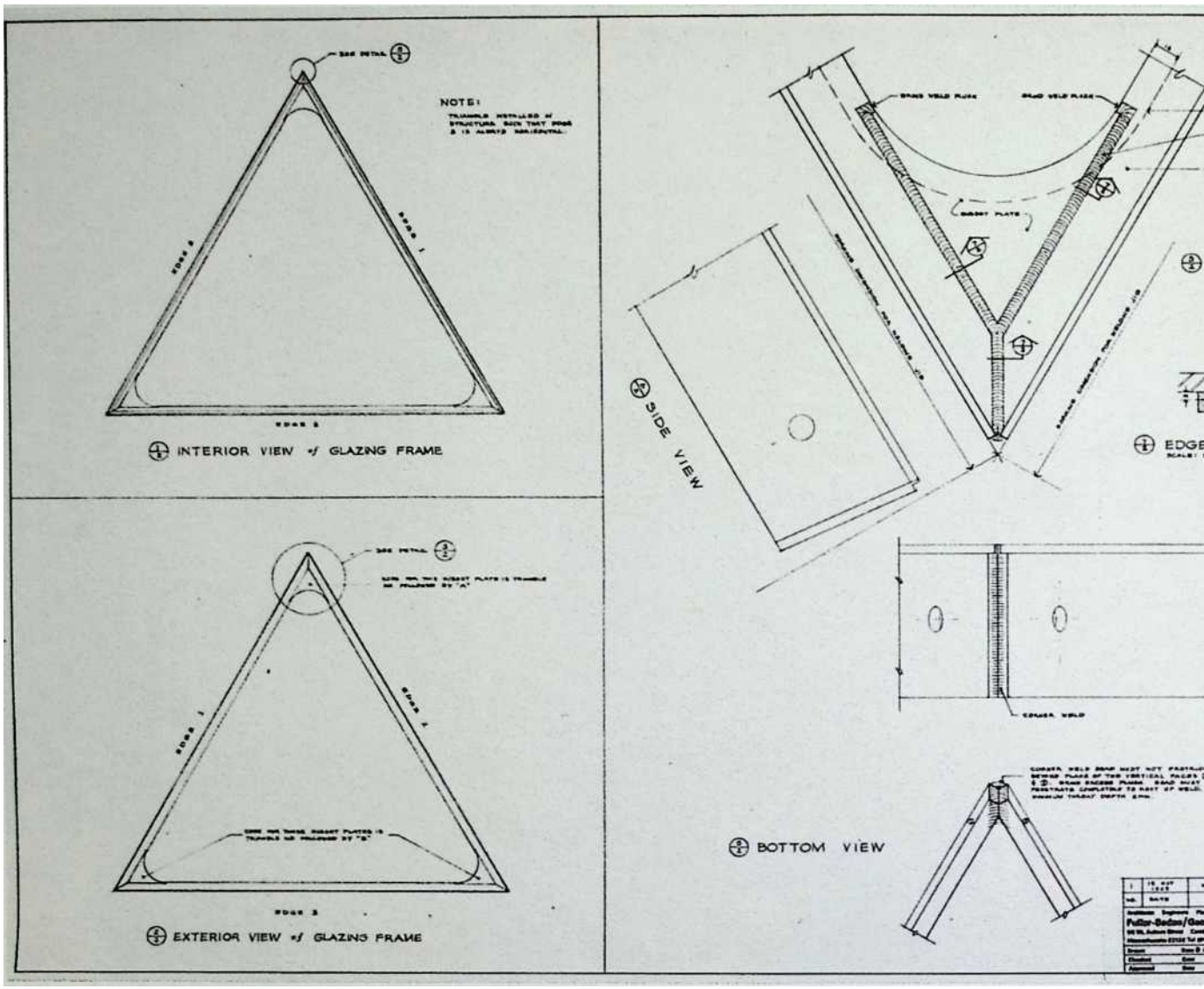

SECTION @ TOP
TYPICAL SEC

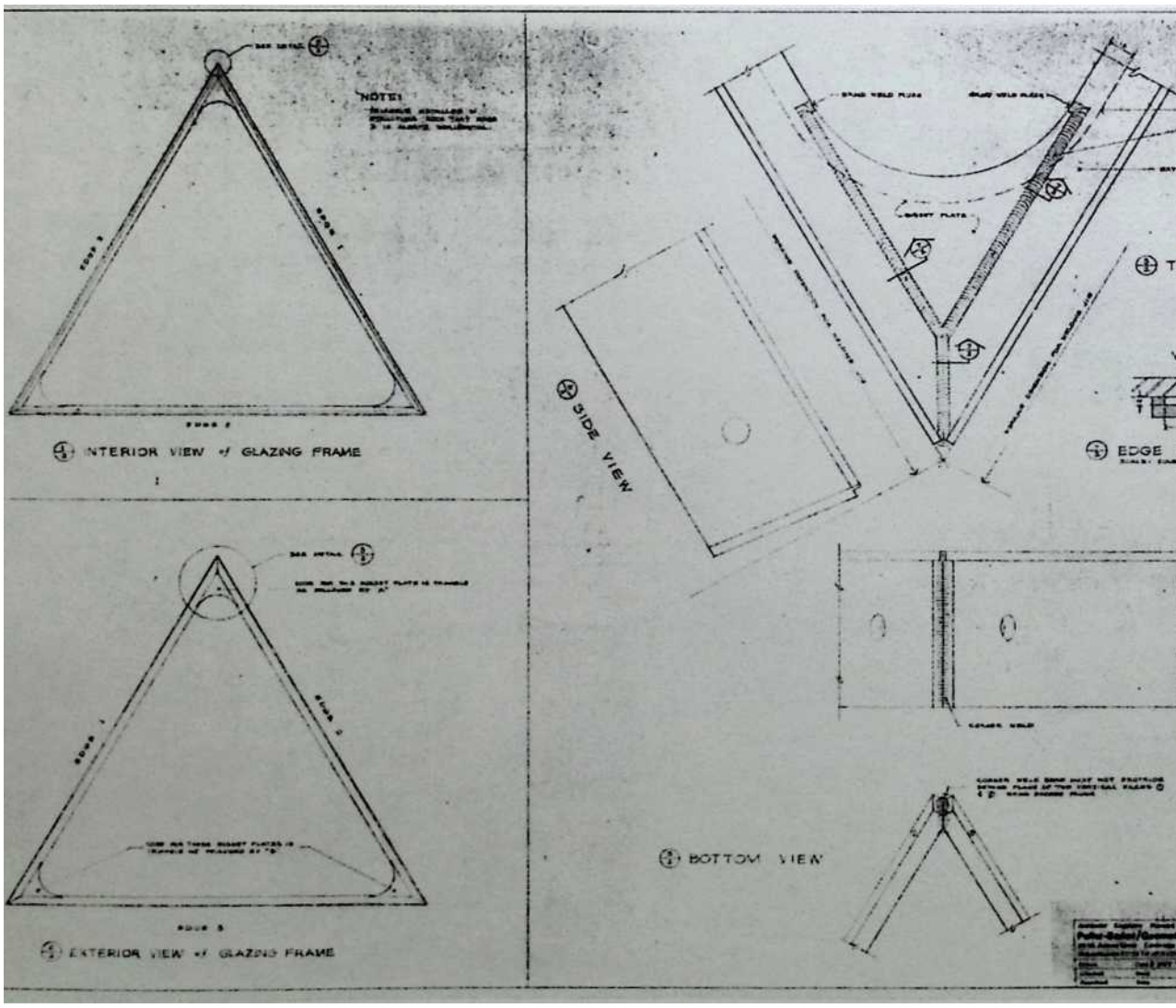

ELEVATION
PLAN @ ELEV. 120.0




ELEVATION



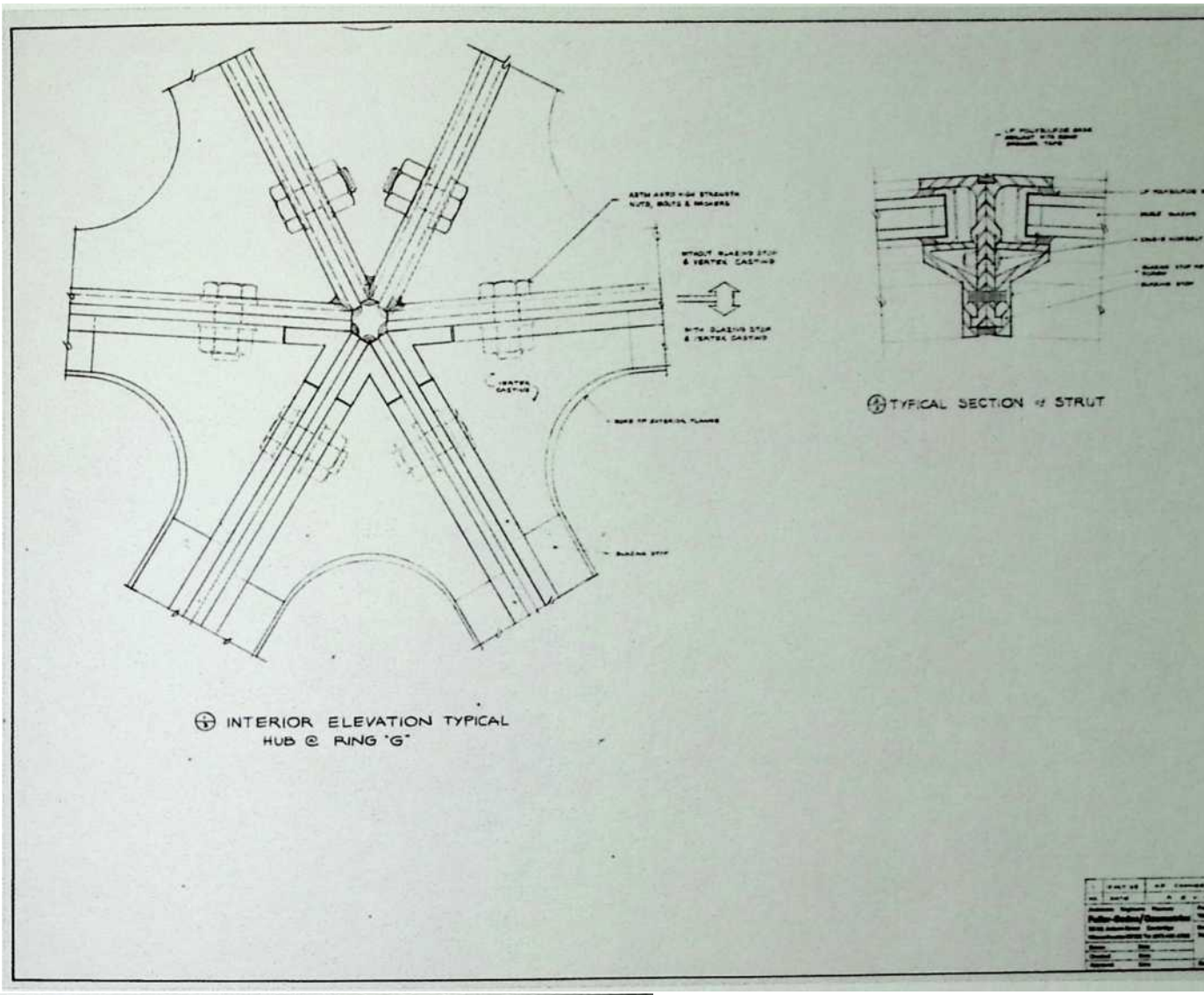

NOTE:
INTERIOR VIEW of GLAZING FRAME
EXTERIOR VIEW of GLAZING FRAME
SIDE VIEW
BOTTOM VIEW

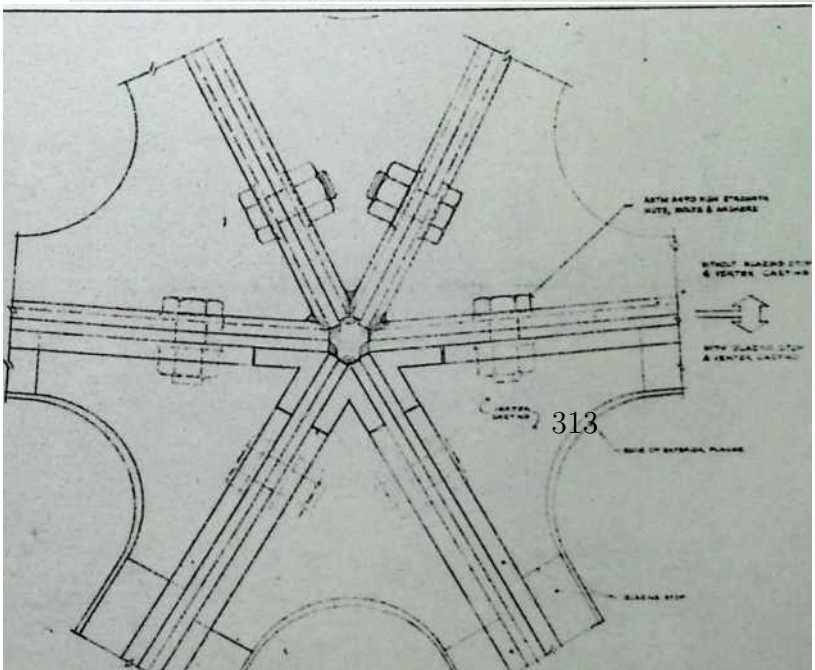


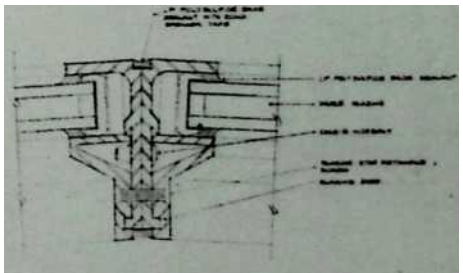
© INTERIOR ELE/VTiOM TyP»CA»L
HUt> £. RING *G*

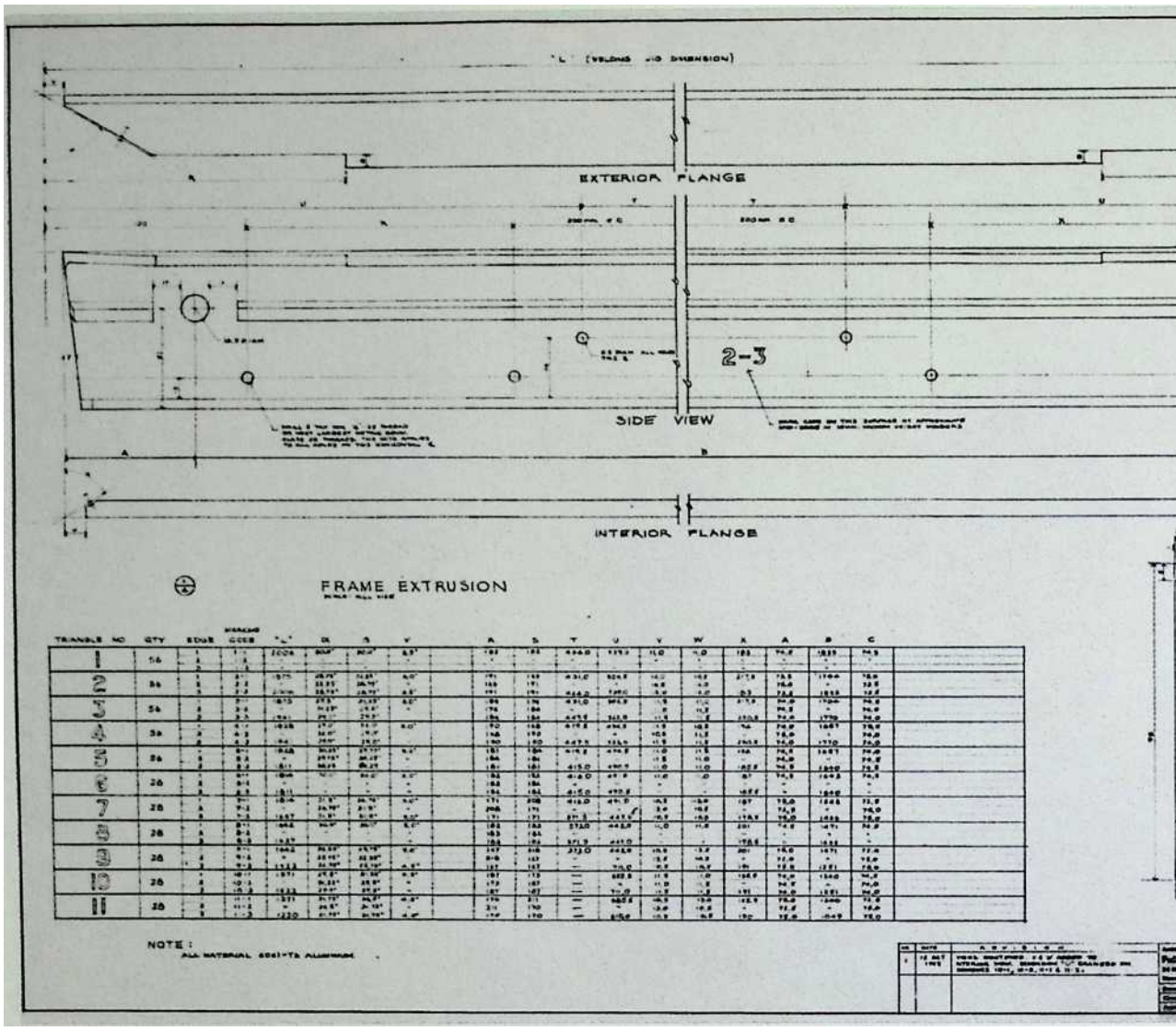
FOR

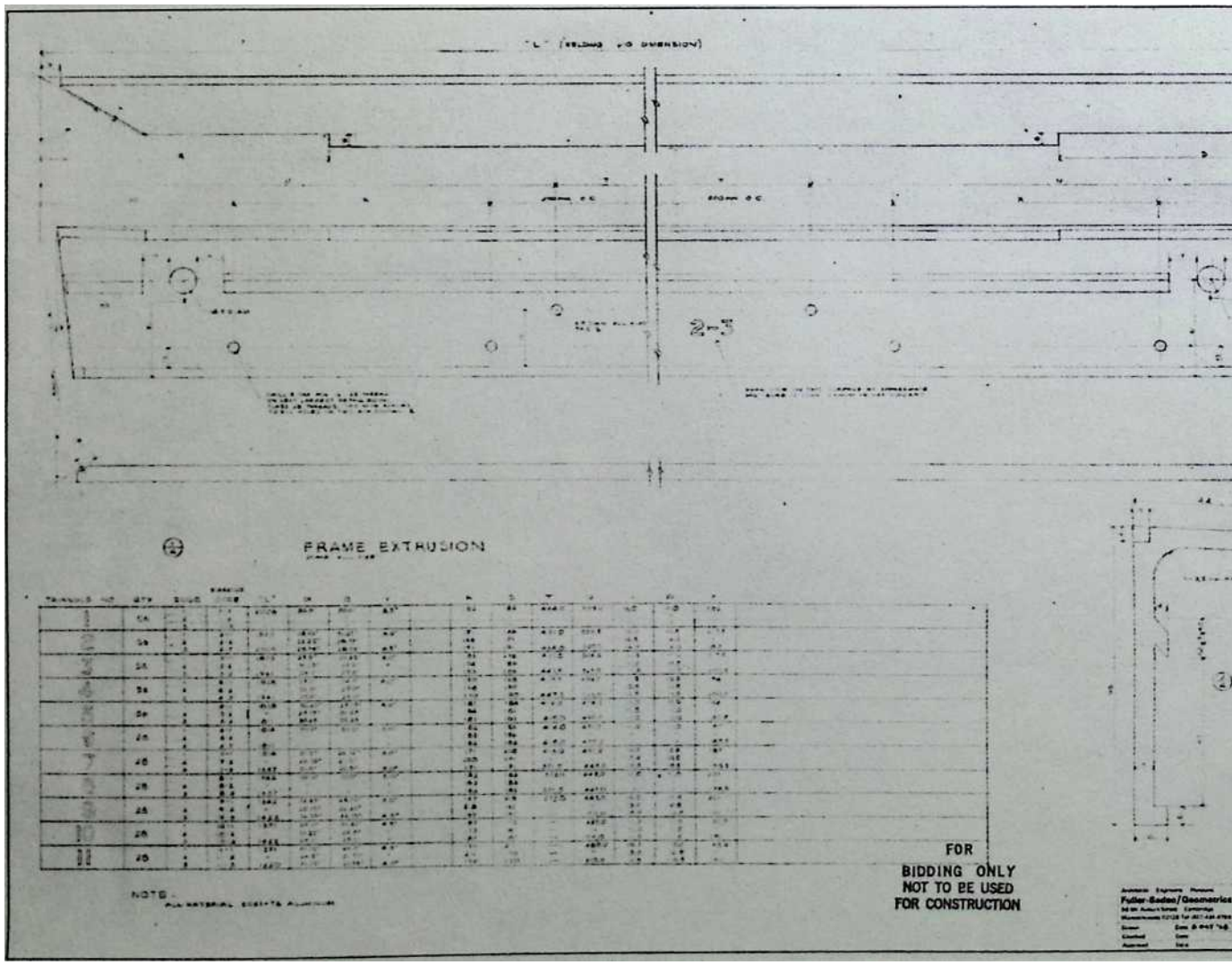
BIDDING ONLY
NOT TO FE UScJ
FOR CONSTRUCTOR

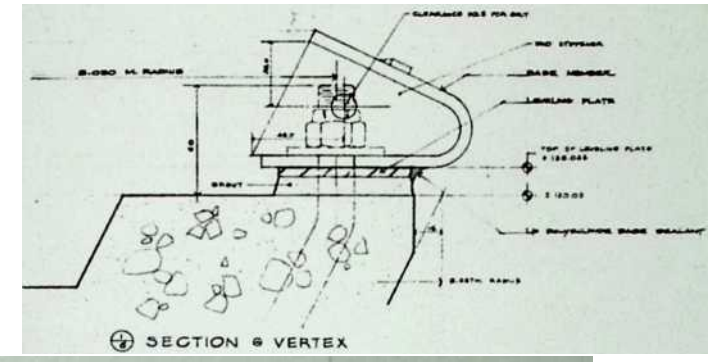

INTERIOR ELEVATION TYPICAL
HUB @ RING "G"
TYPICAL SECTION of STRUT

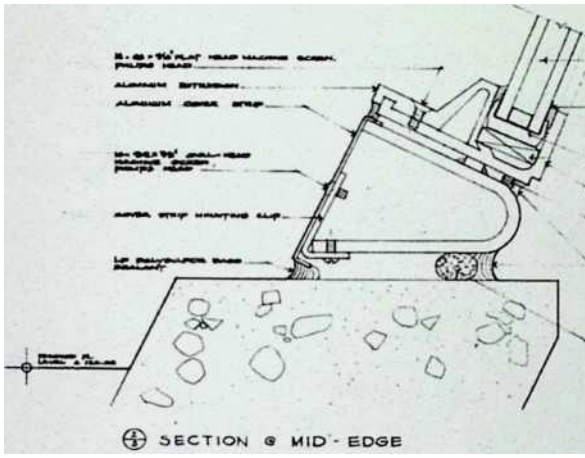


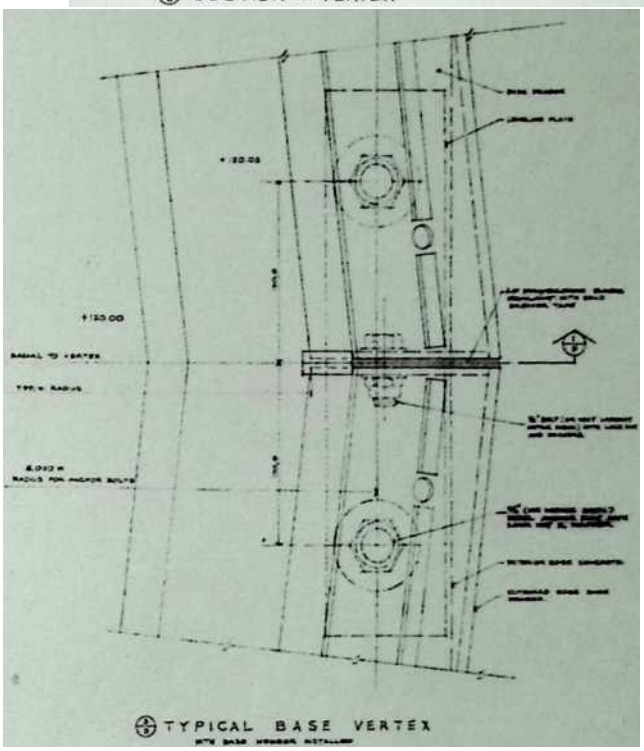



EXTERIOR FLANGE
2-3
SIDE VIEW
INTERIOR FLANGE
FRAME EXTRUSION
NOTE:

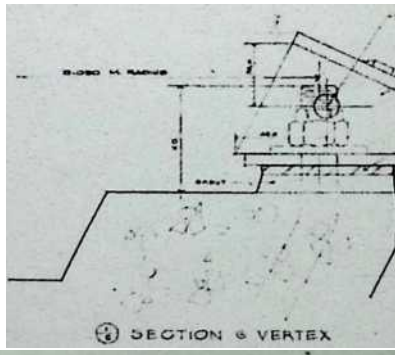

FRAME EXTRUSION
FOR
BIDDING ONLY
NOT TO BE USED
FOR CONSTRUCTION

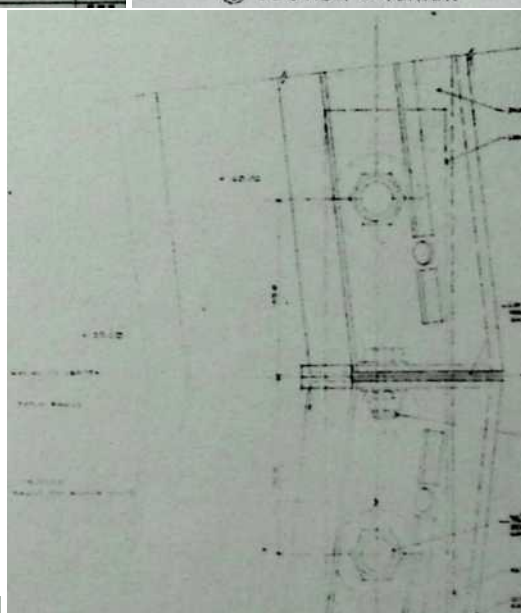

SECTION @ VERTEX

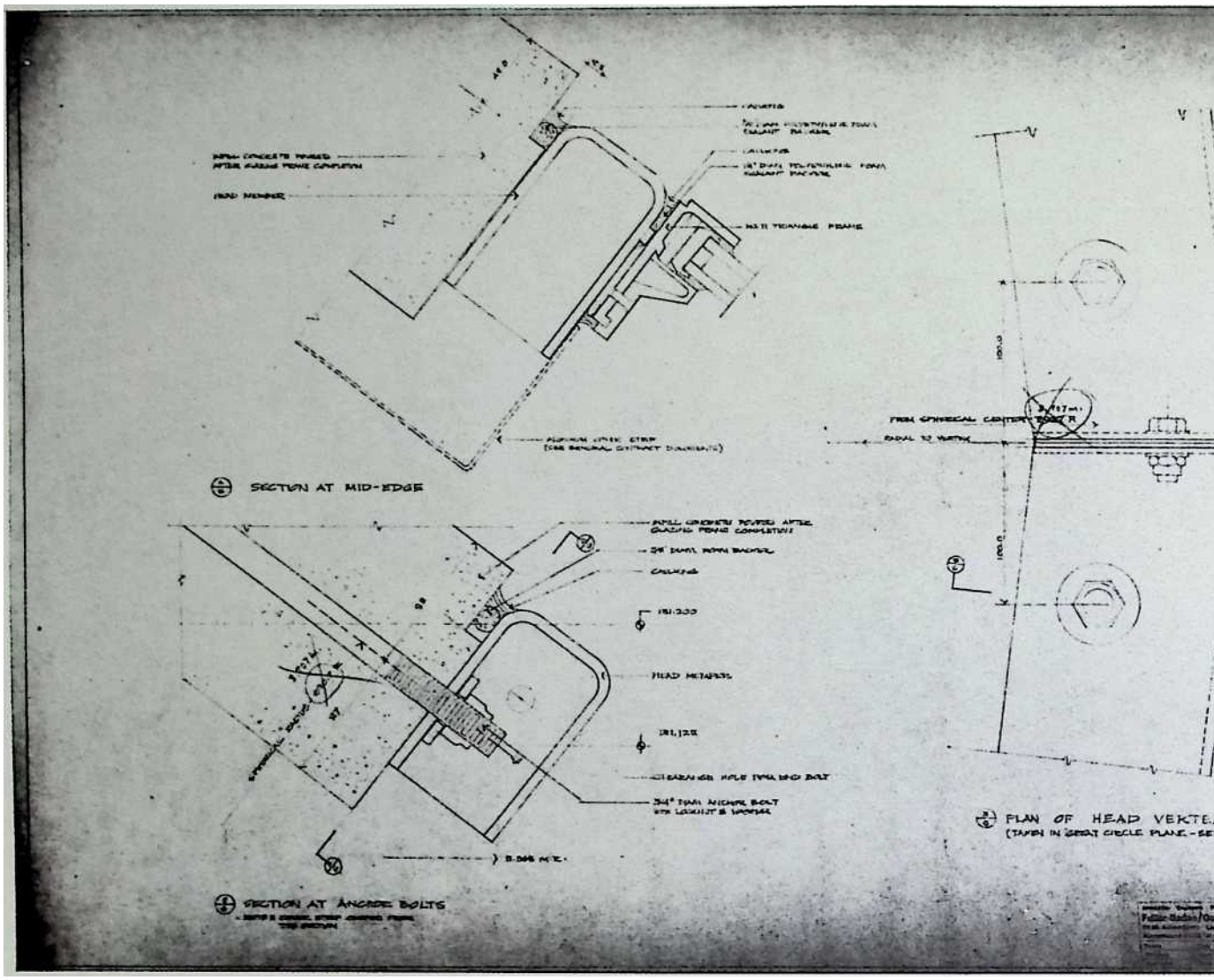

SECTION @ MID - EDGE

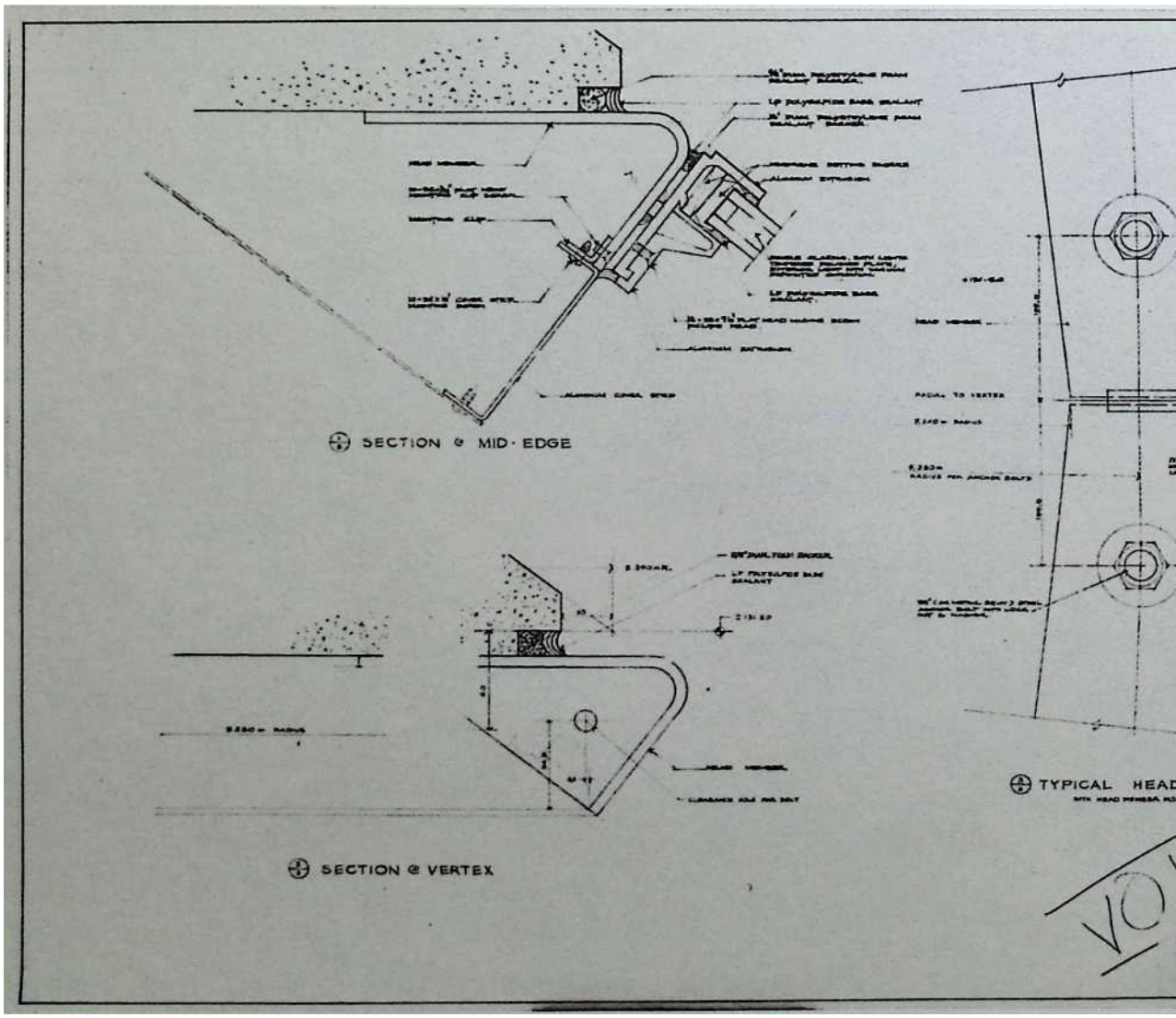

TYPICAL BASE VERTEX

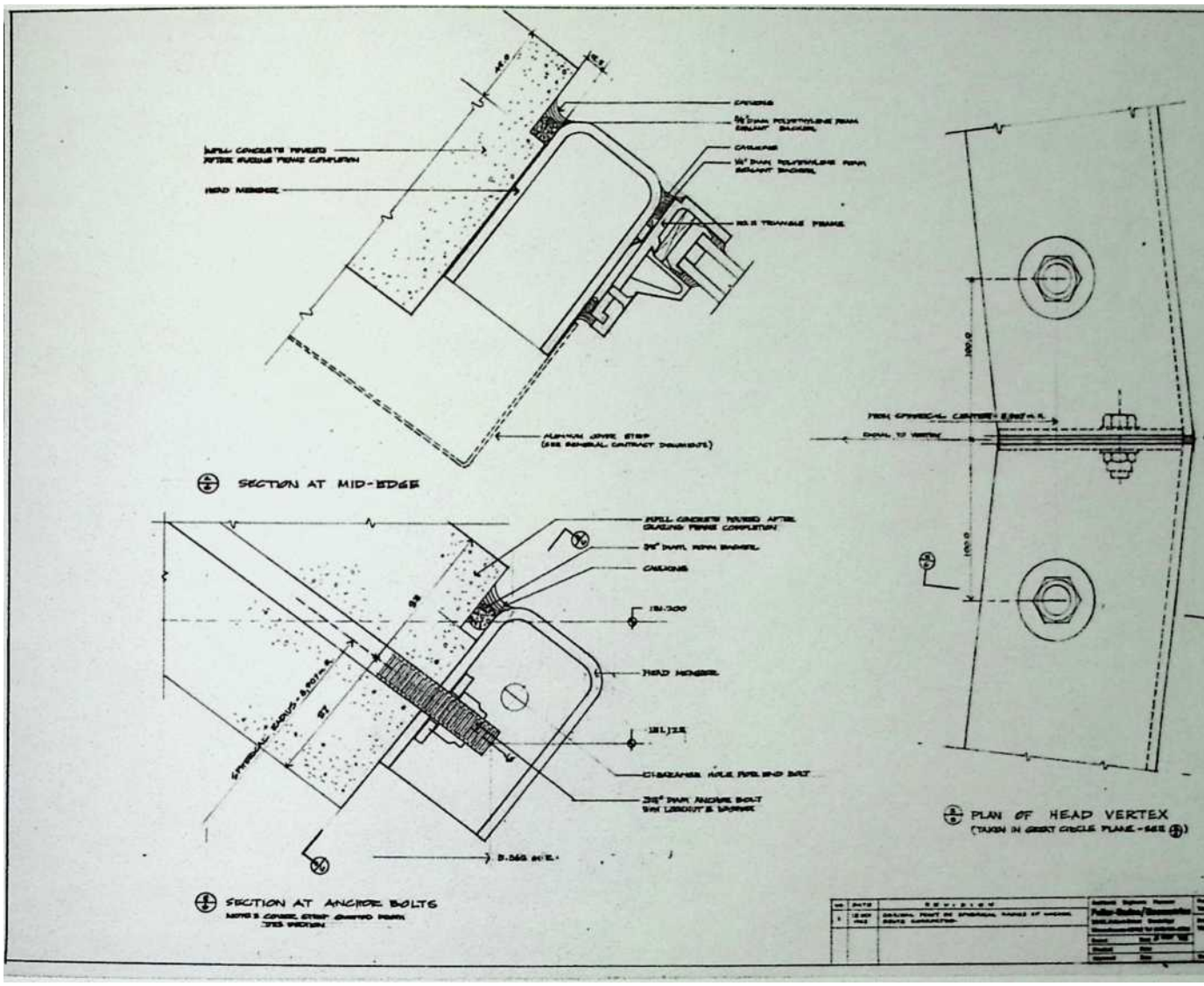
5

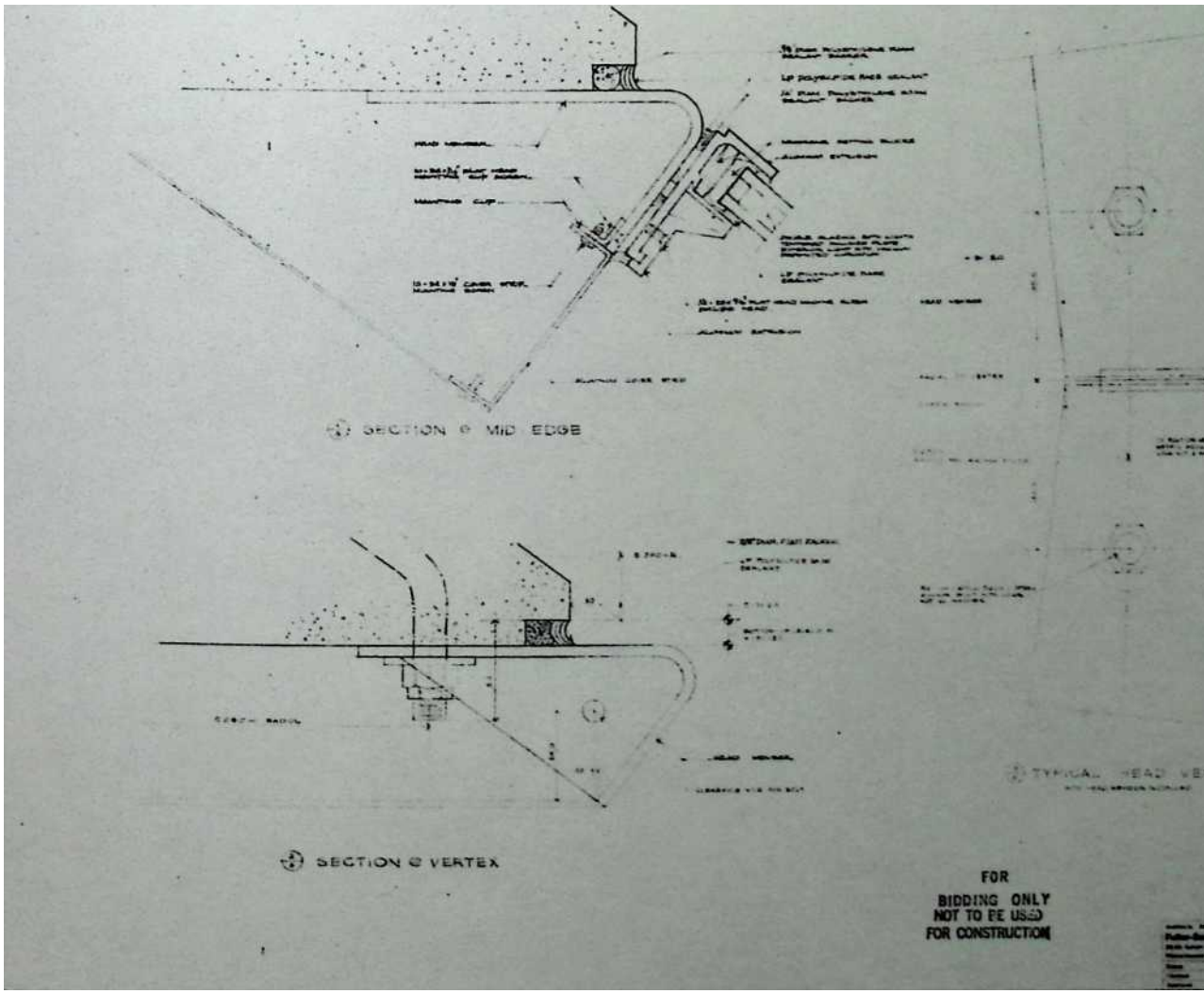

SECTION @ VERTEX

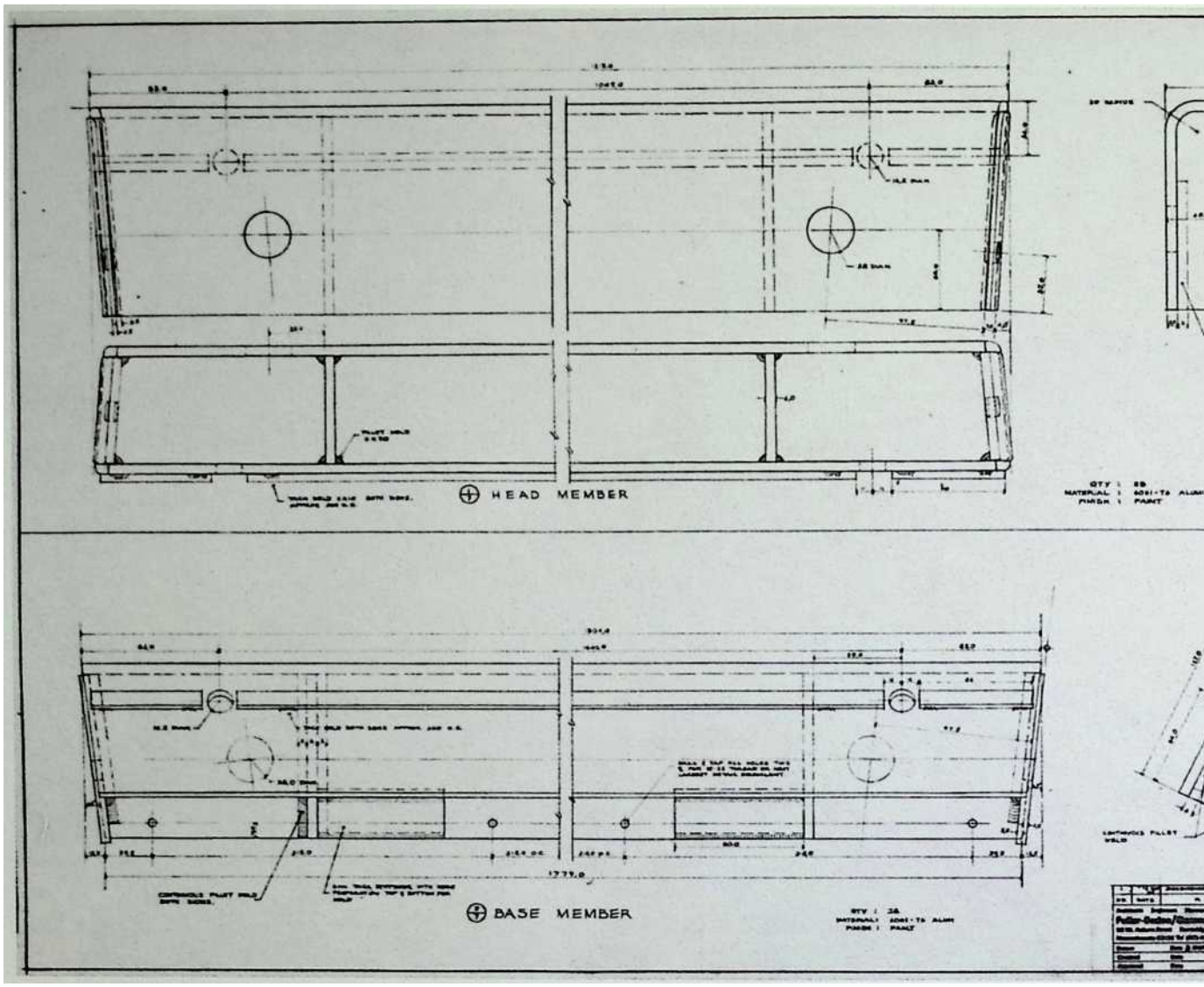


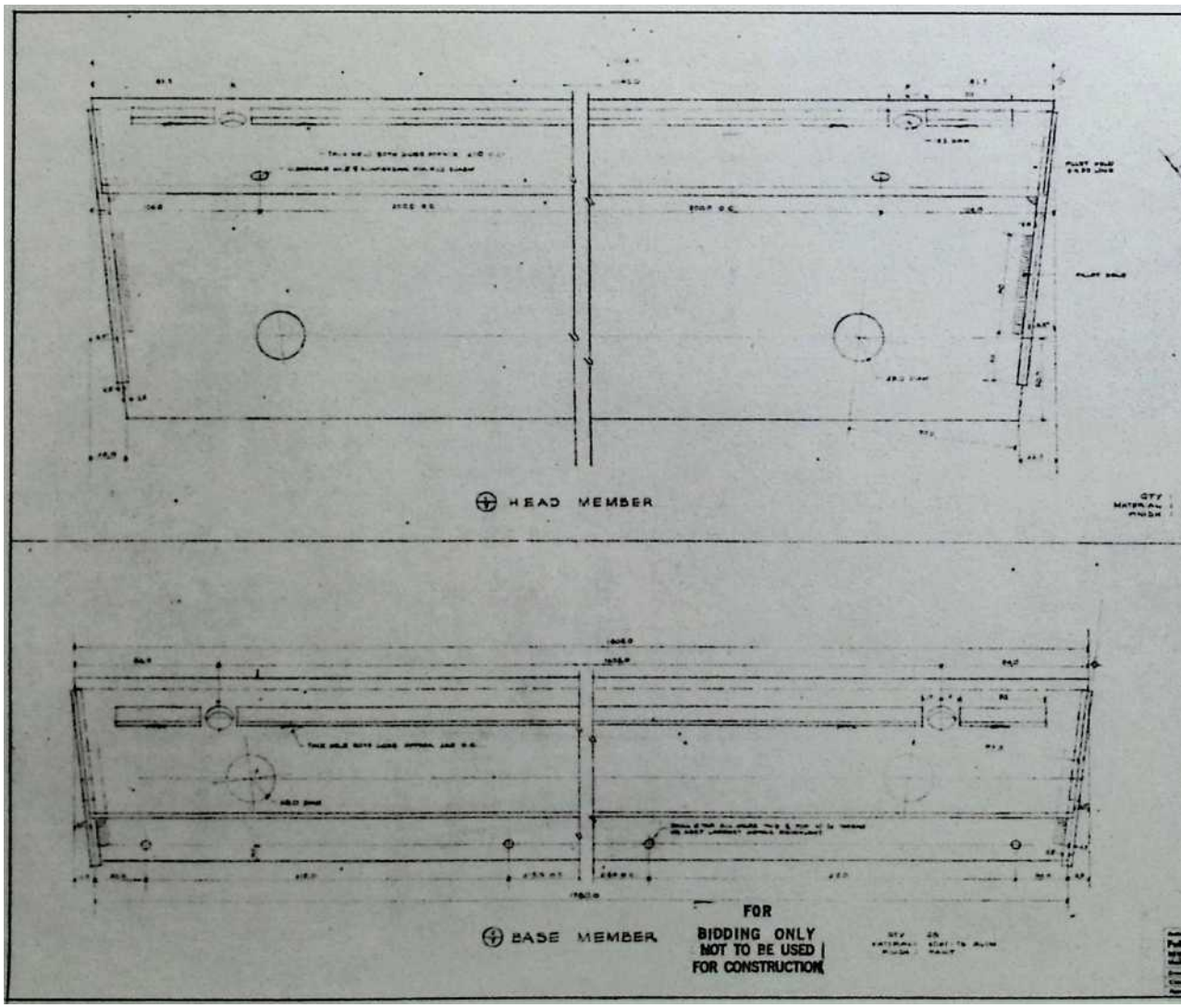

SECTION AT MID-EDGE
SECTION AT ANCHOR BOLTS
PLAN OF HEAD VEKTE


SECTION @ MID-EDGE
SECTION @ VERTEX
TYPICAL HEAD

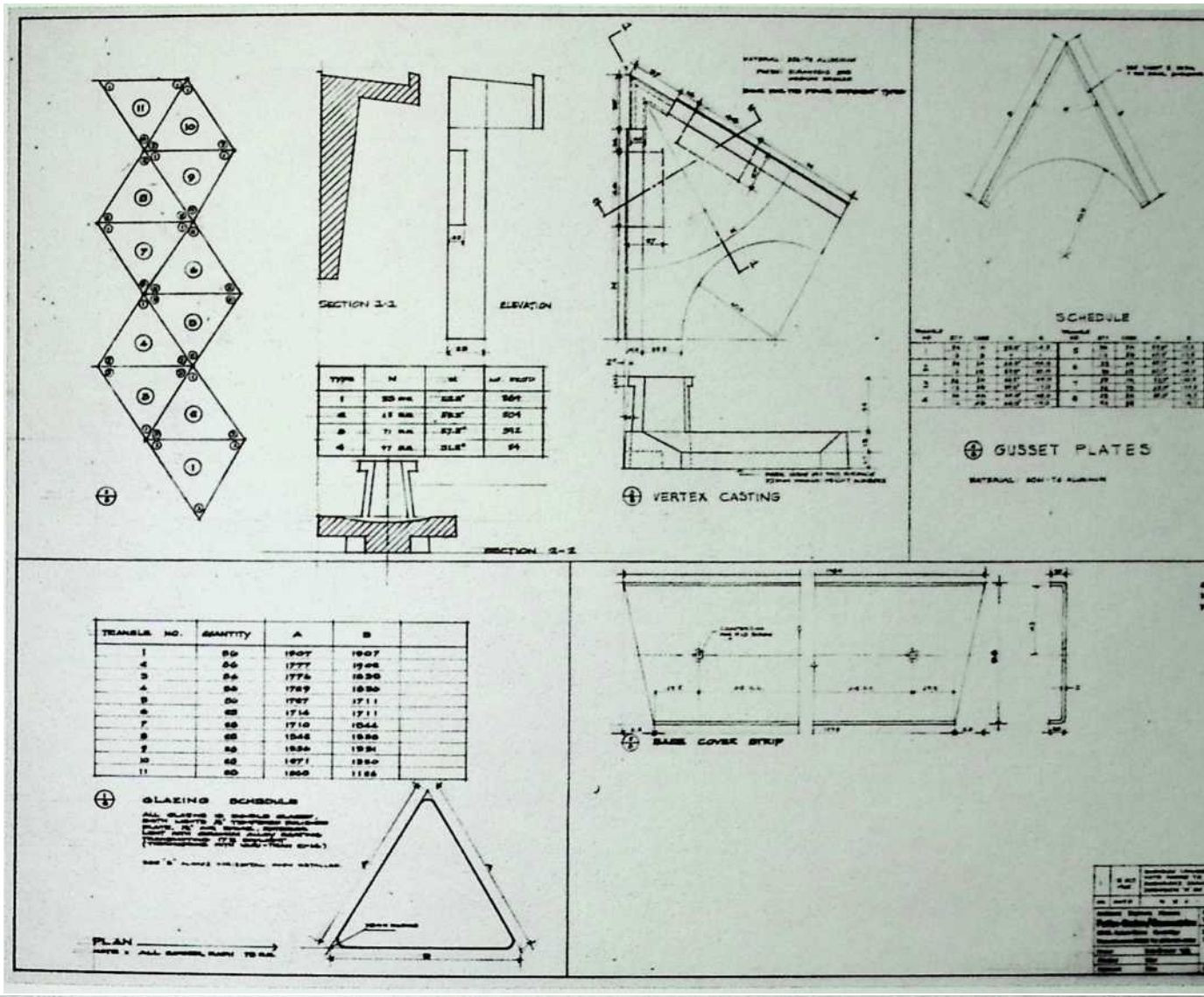

SECTION AT MID-EDGE
SECTION AT ANCHOR BOLTS
PLAN OF HEAD VERTEX

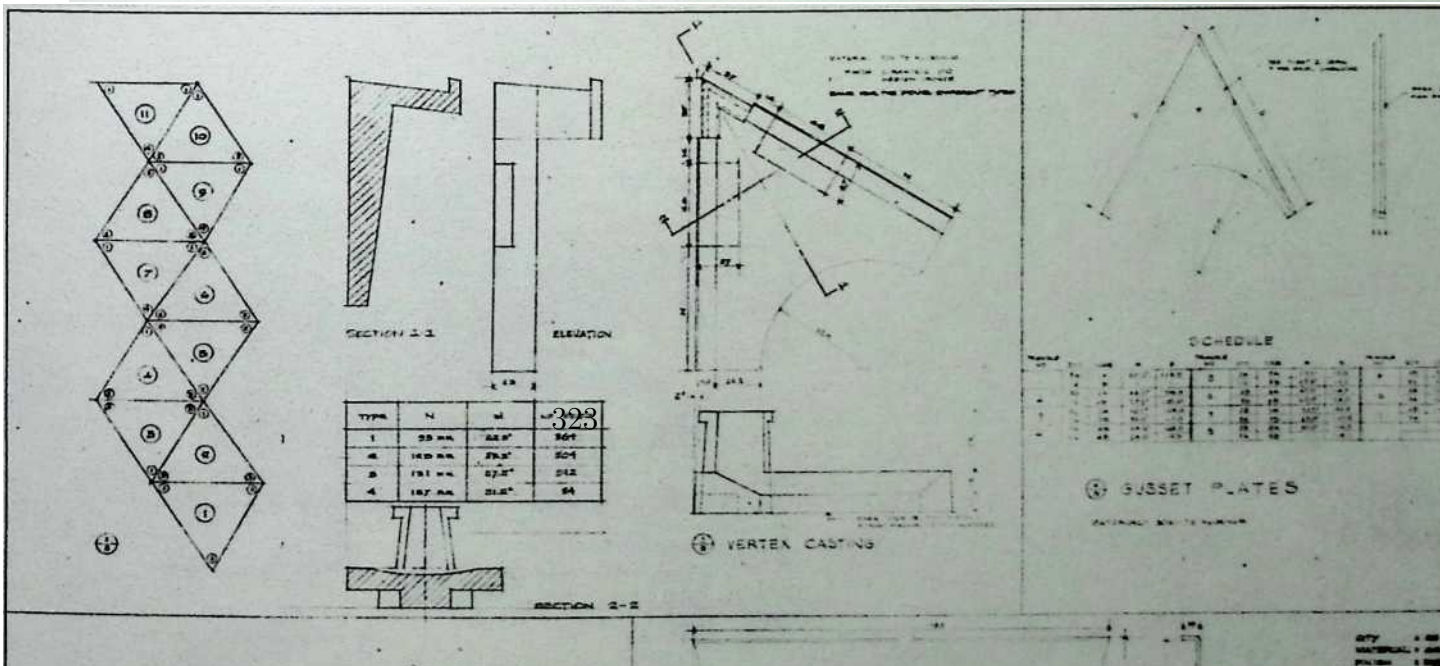

SECTION @ MID EDGE
SECTION @ VERTEX
FOR
BIDDING ONLY
NOT TO BE USED
FOR CONSTRUCTION

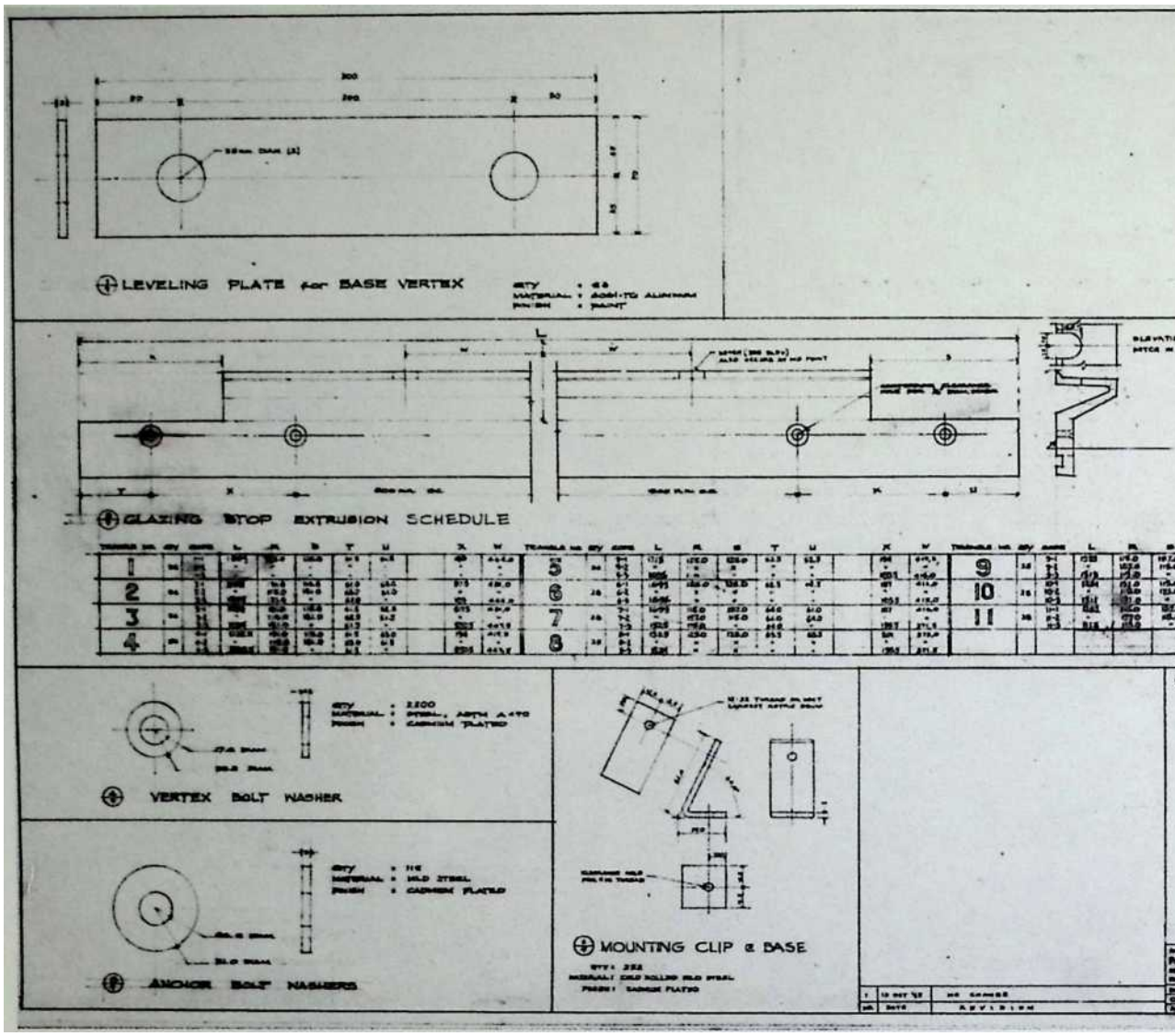

HEAD MEMBER
BASE MEMBER

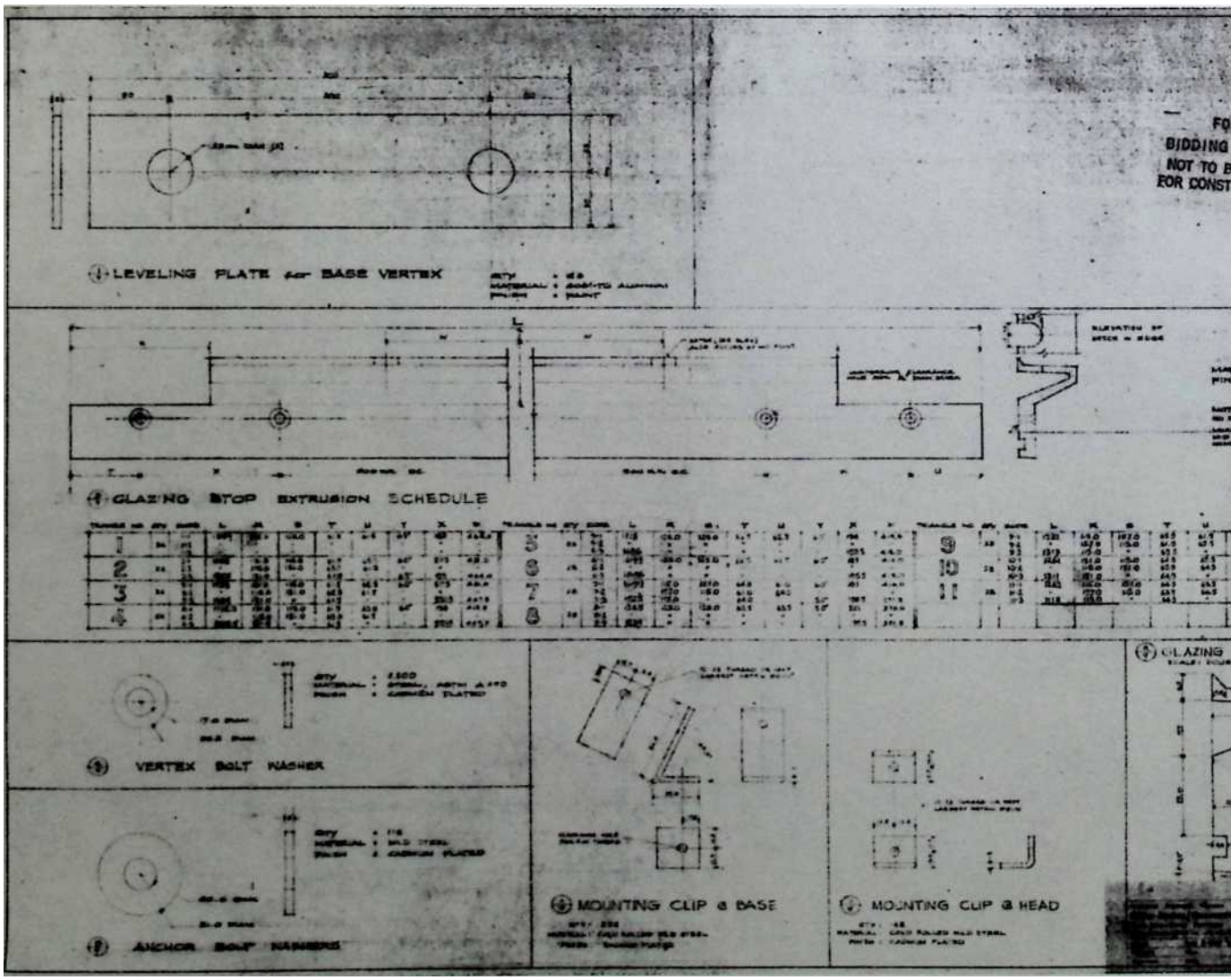

HEAD MEMBER
BASE MEMBER
FOR
BIDDING ONLY
NOT TO BE USED
FOR CONSTRUCTION

HL.


SECTION 1-1
ELEVATION
SECTION 2-2
VERTEX CASTING
SCHEDULE
GUSSET PLATES
GLAZING SCHEDULE
PLAN
BASE COVER STRIP


SECTION 1-1
ELEVATION
SECTION 2-2
VERTEX CASTING
SCHEDULE
GUSSET PLATES

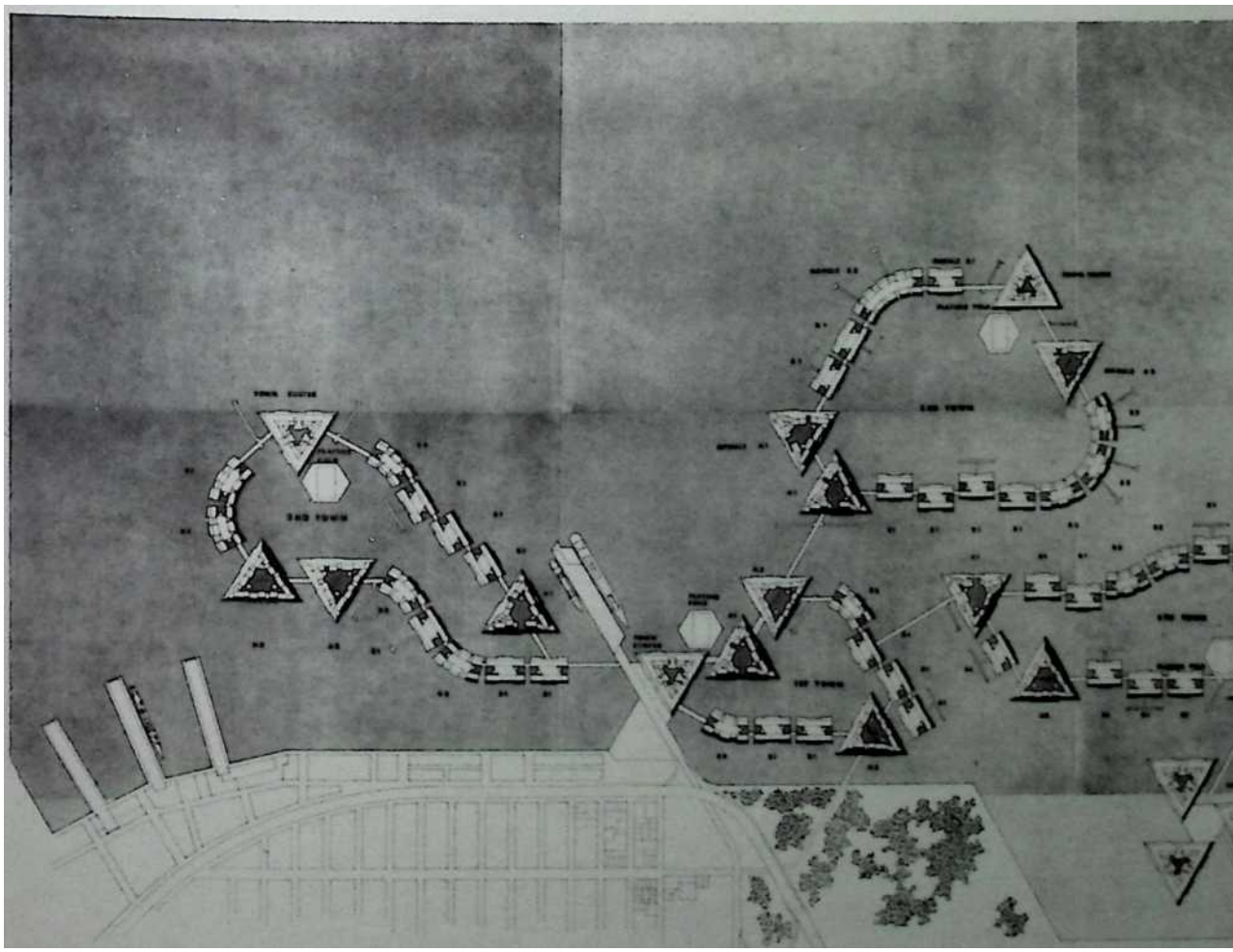

LEVELING PLATE for BASE VERTEX
GLAZING STOP EXTRUSION SCHEDULE
VERTEX BOLT WASHER
ANCHOR BOLT WASHERS
MOUNTING CLIP @ BASE



Triton City, Triton Foundation

Fuller & Sadao, 1968

Fuller & Sadao founded the Triton Foundation during the late sixties. They designed this self-sufficient concrete structure for the U.S. Department of Housing and Urban Development with other members of the foundation in 1968. The tetrahedral housing cluster was intended to be floated offshore. The "megastructure" of this city would be fully equipped to house 5,000 people, who would have made use of stores, schools, and other public spaces designed for the uppermost levels.



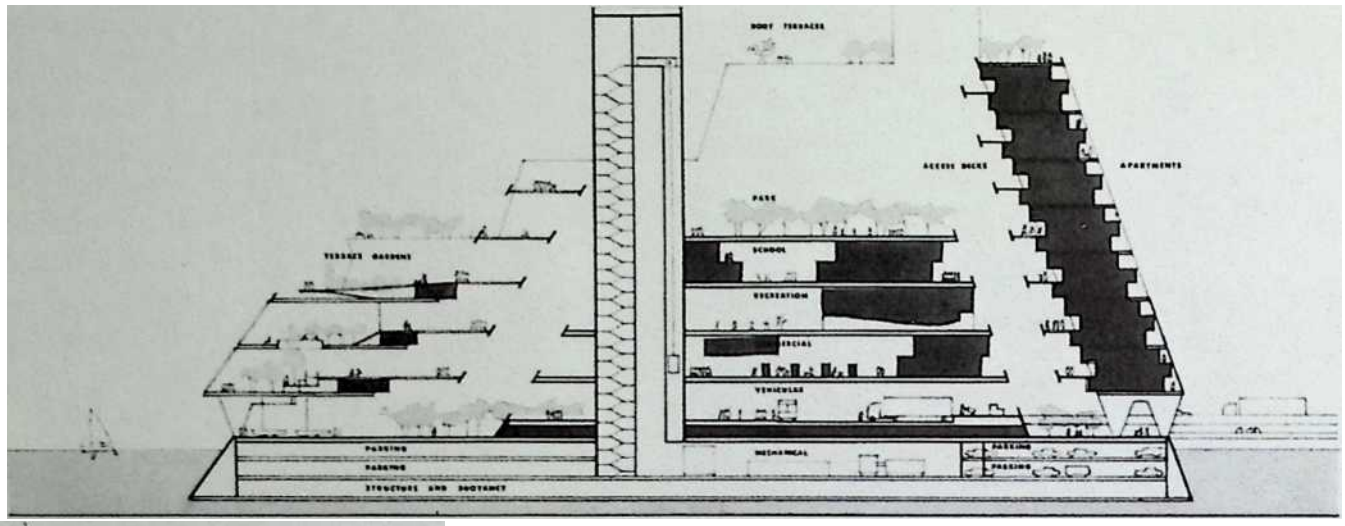
TRITON CITY

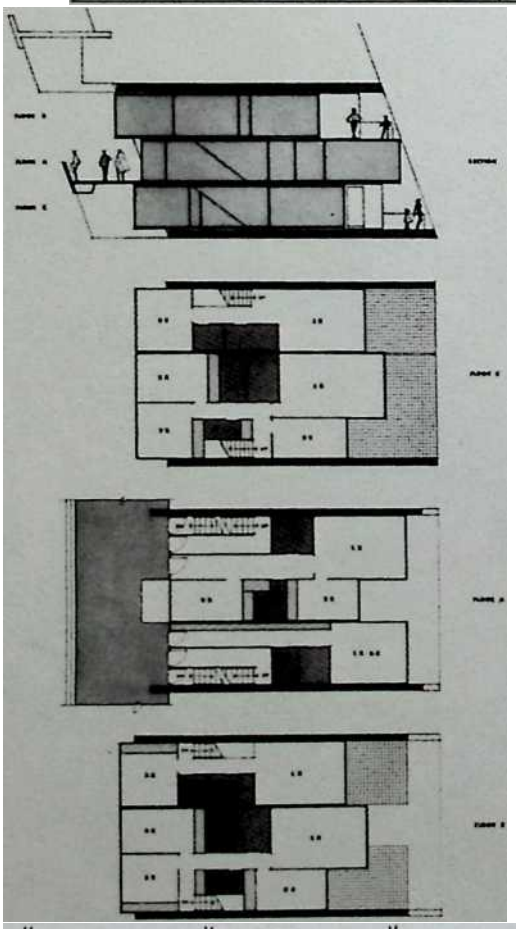
A PROTOTYPE FLOATING COMMUNITY Mali « r •

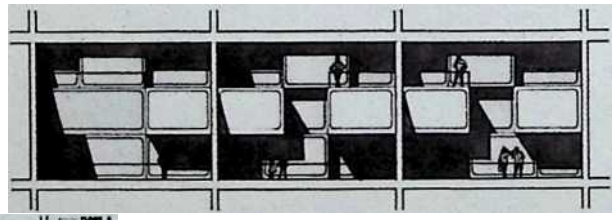
MODULE 'A' SECTION

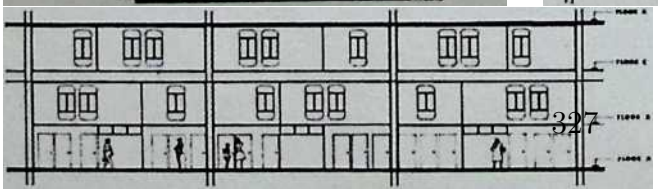
EXTERIOR ELEVATION

INTERIOR ELEVATION


ROOF TERRACES
ACCESS DECKS
APARTMENTS
PARK
SCHOOL
RECREATION
SOCIAL
VEHICULAR
MECHANICAL
PARKING
PARKING
PARKING
PARKING
STRUCTURE AND BOUYANCY

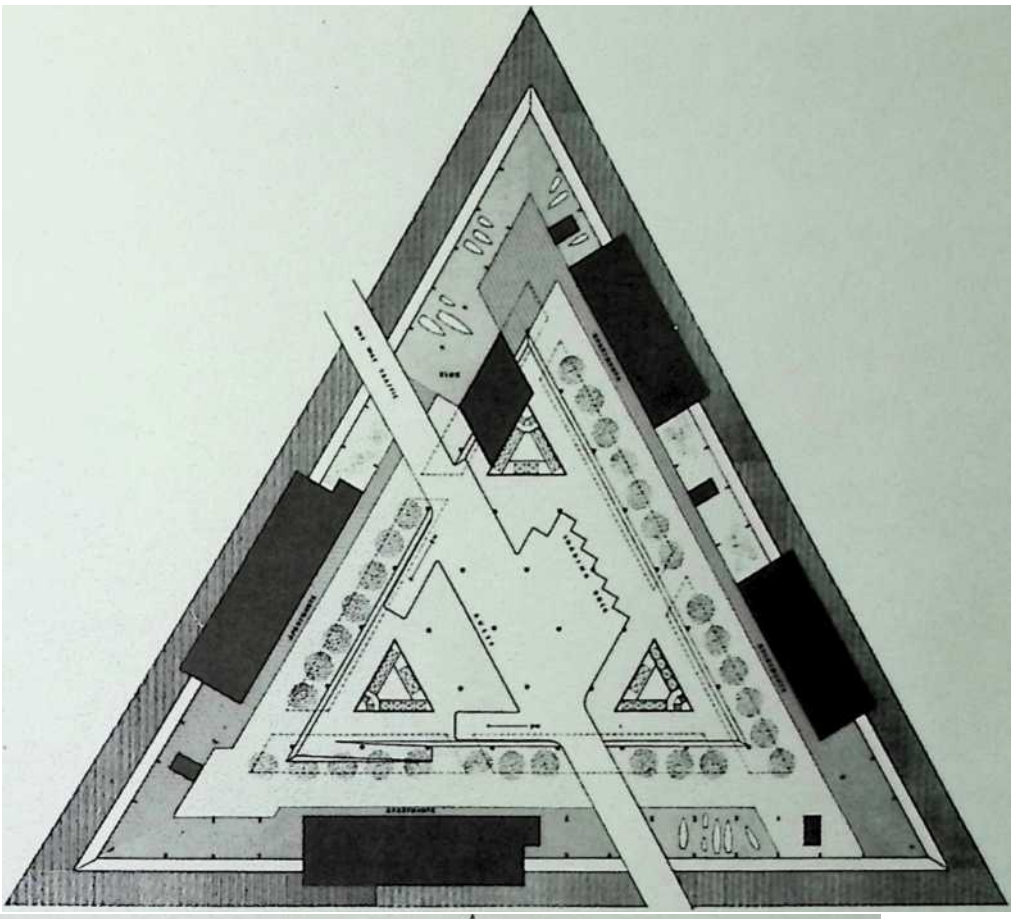


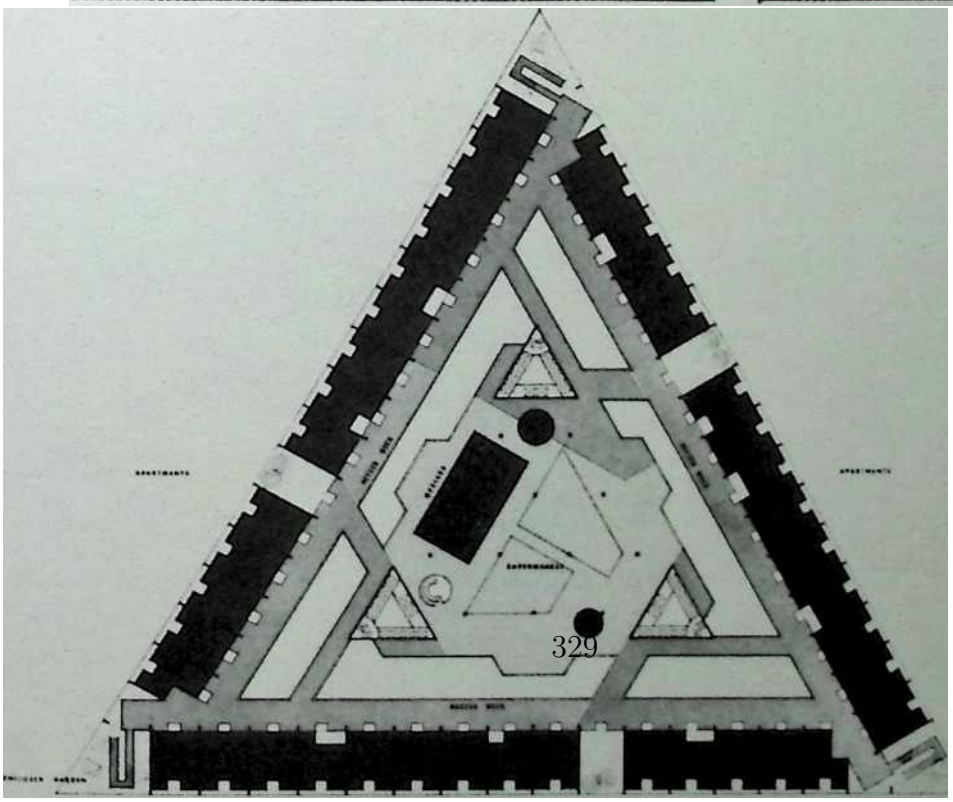


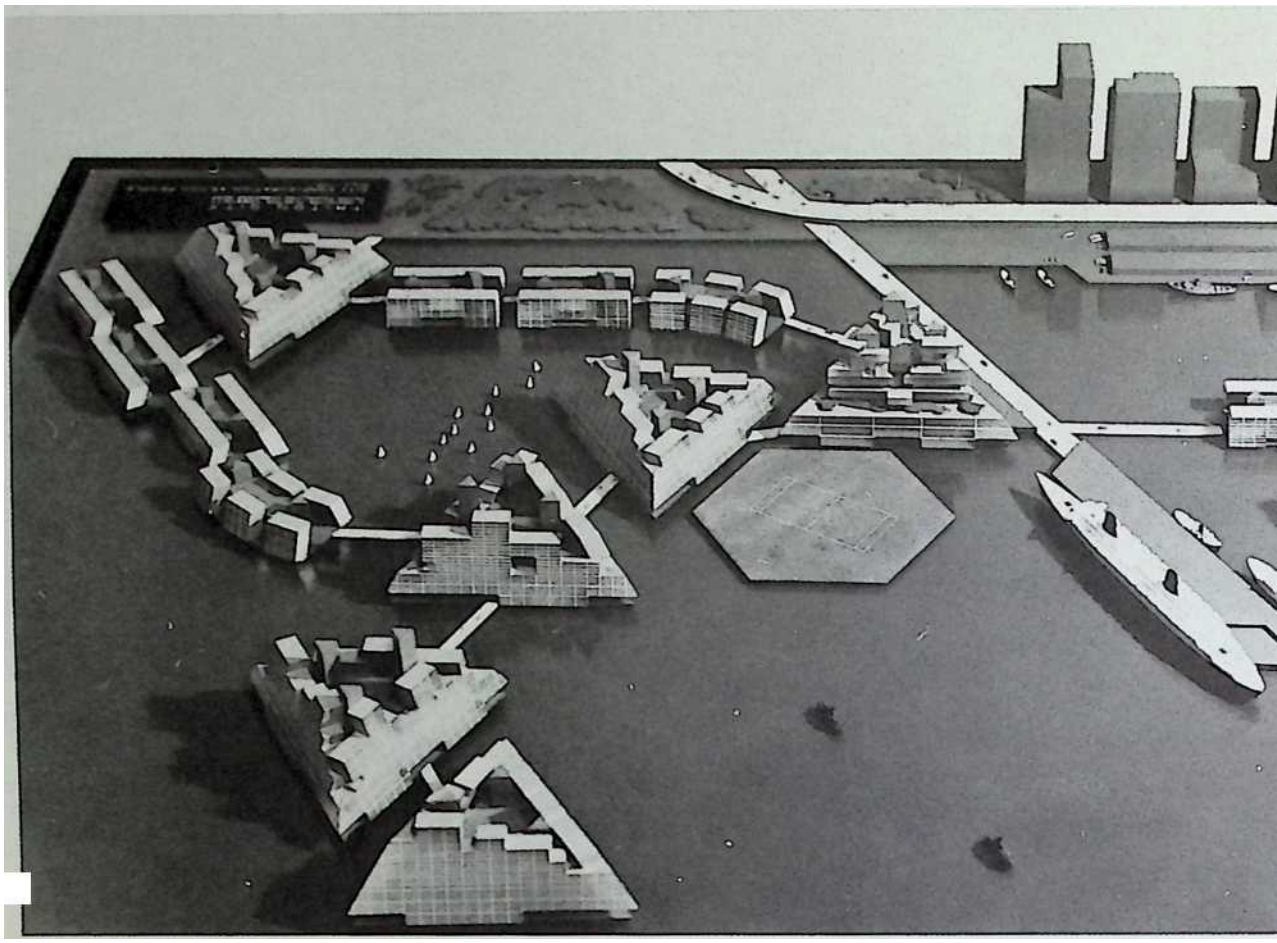


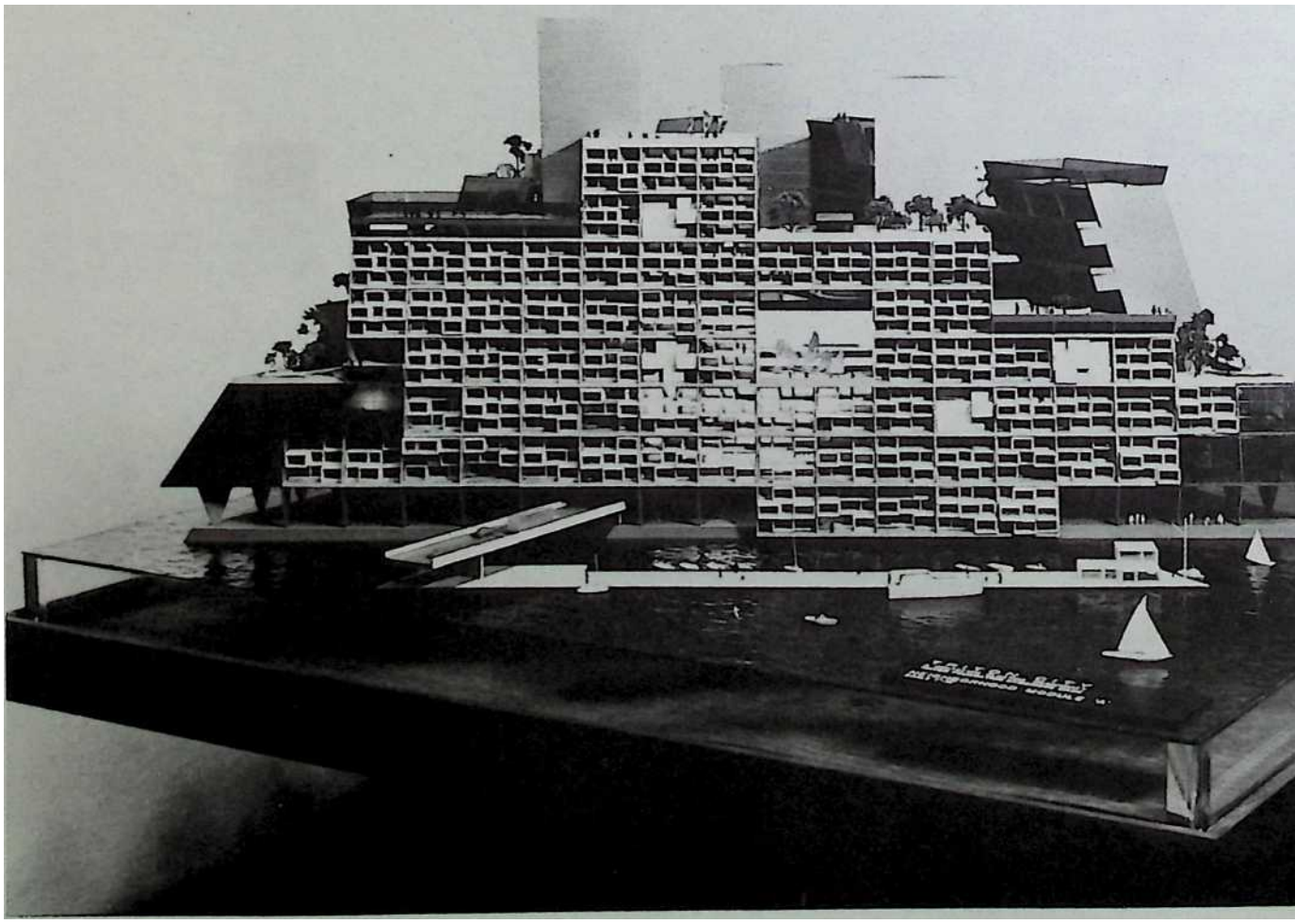
TRITON CITY MODULE ‘A’

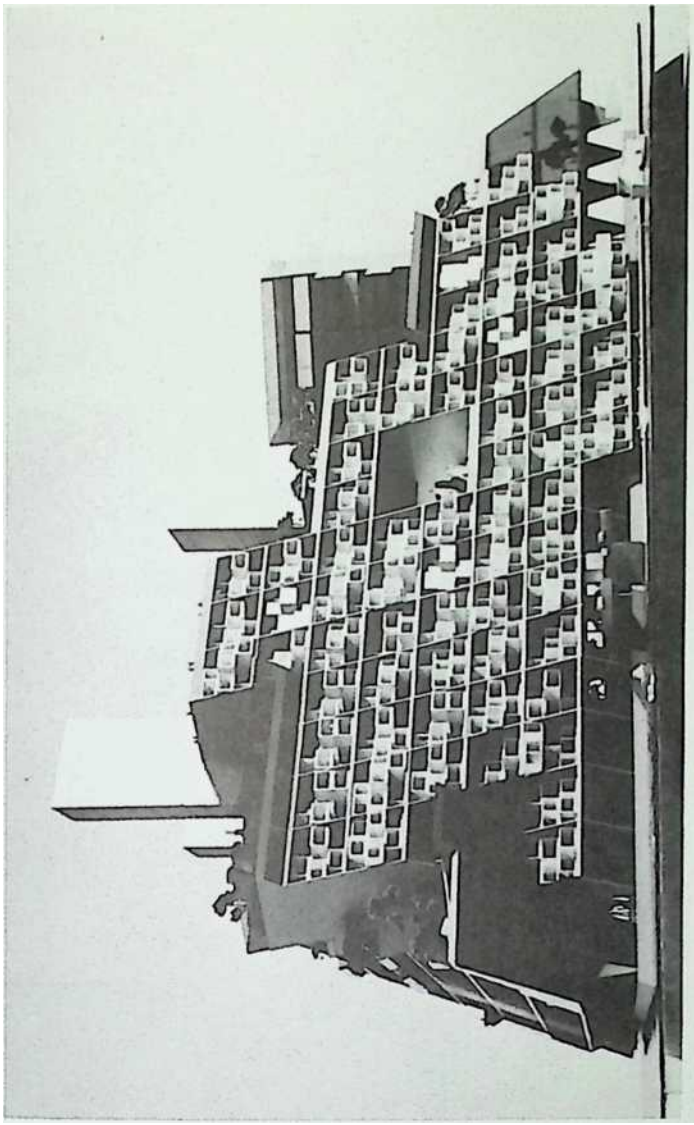
A PROTOTYPE FLOATING COMMUNITY VEHICLE LEVEL

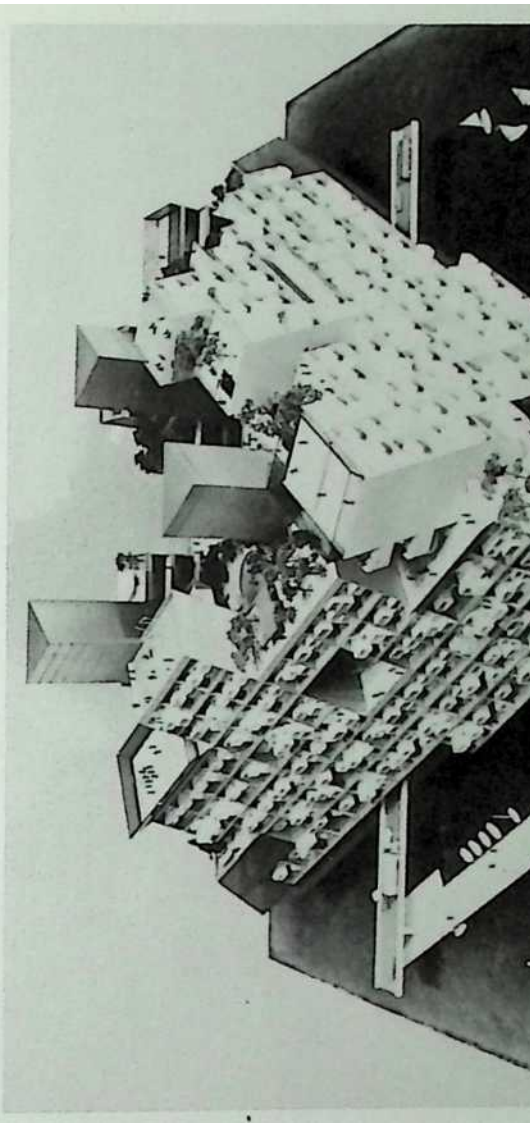


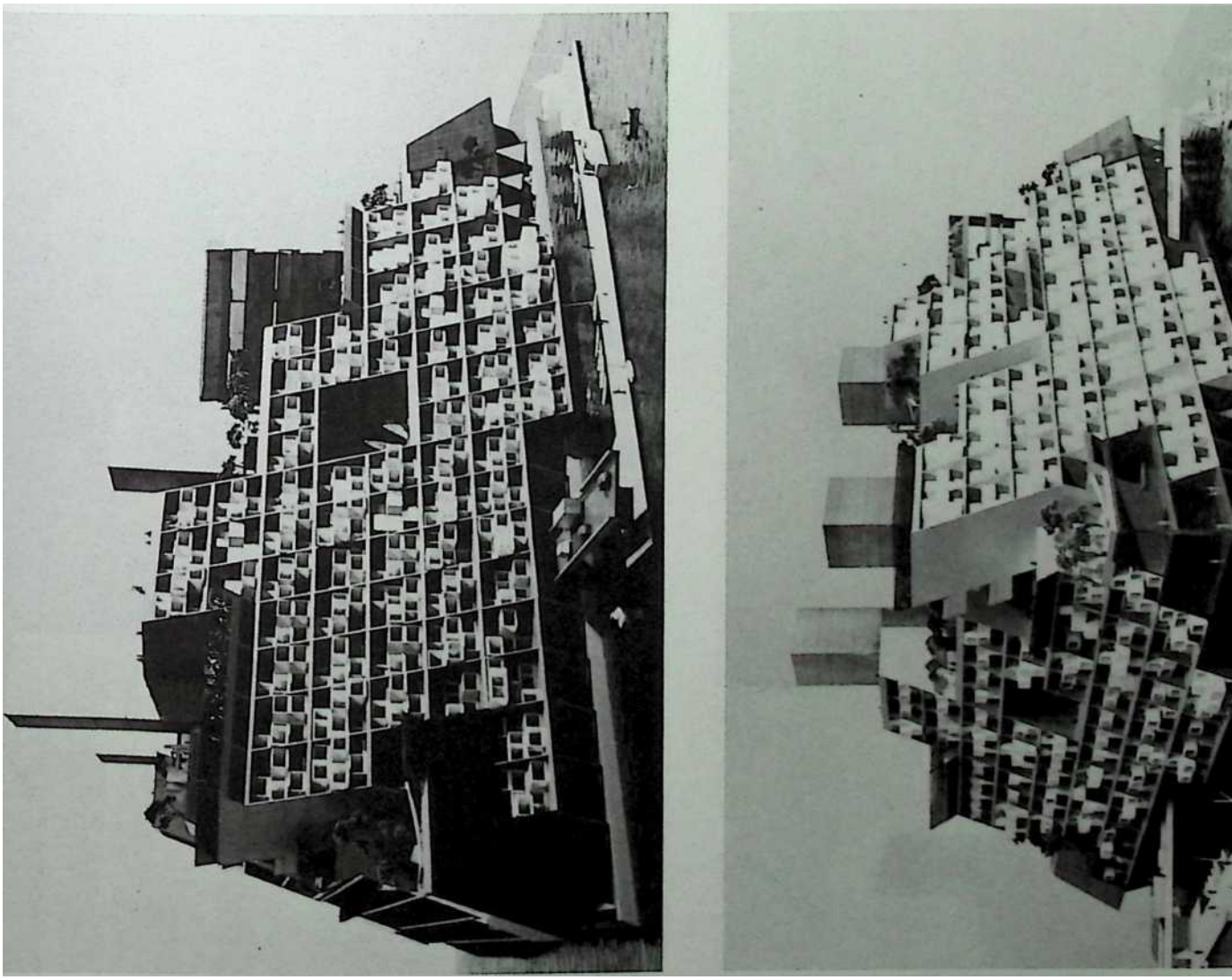












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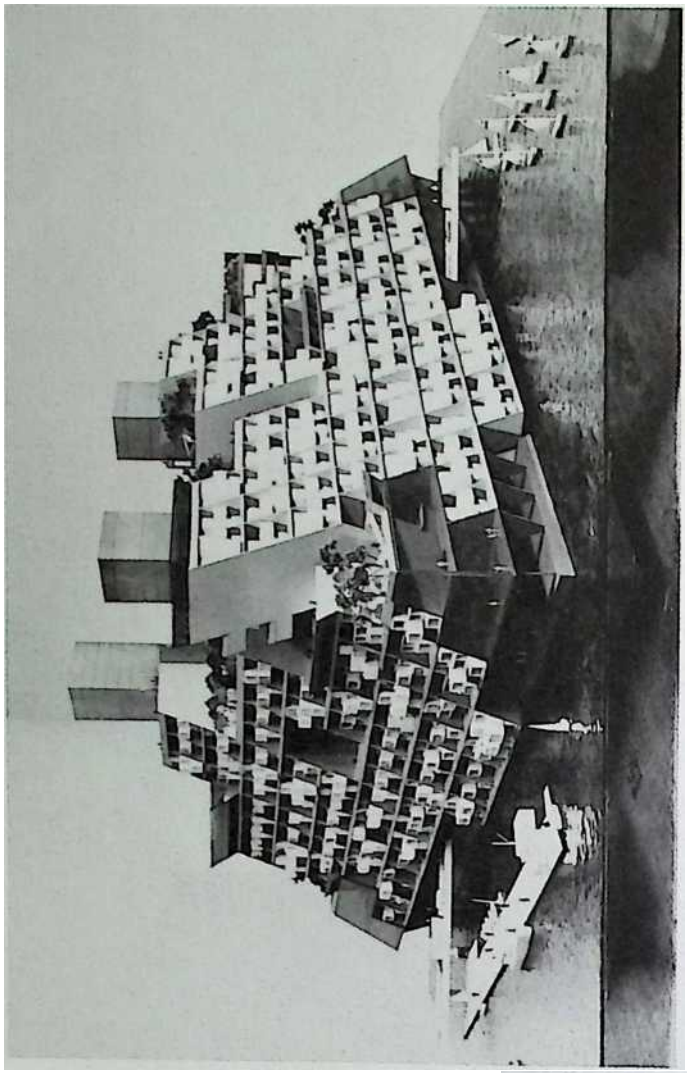
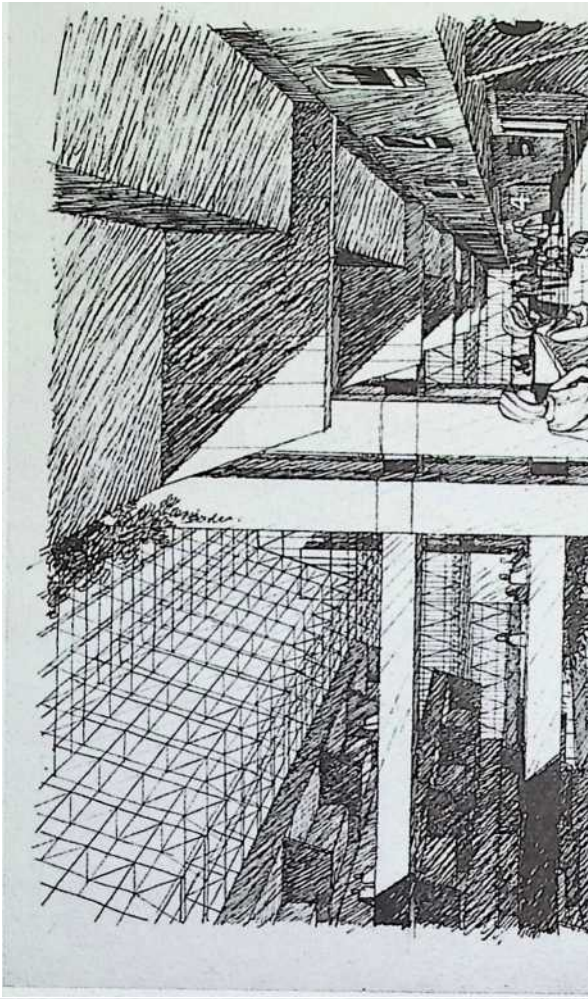
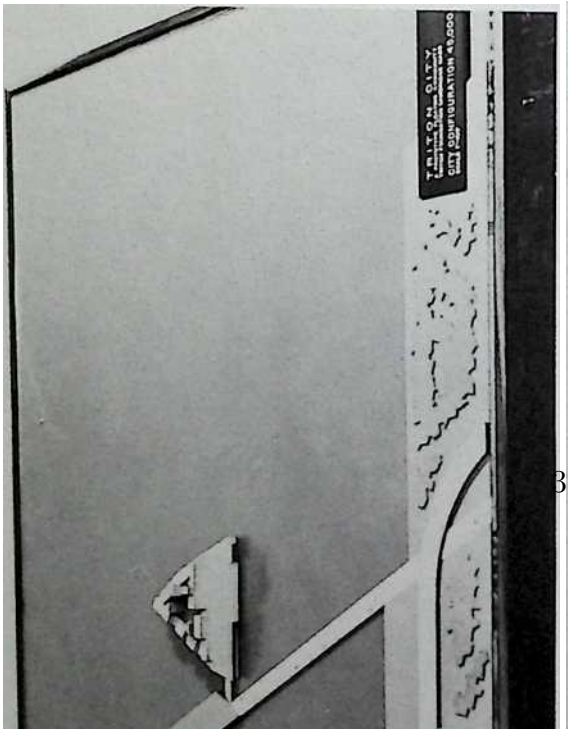
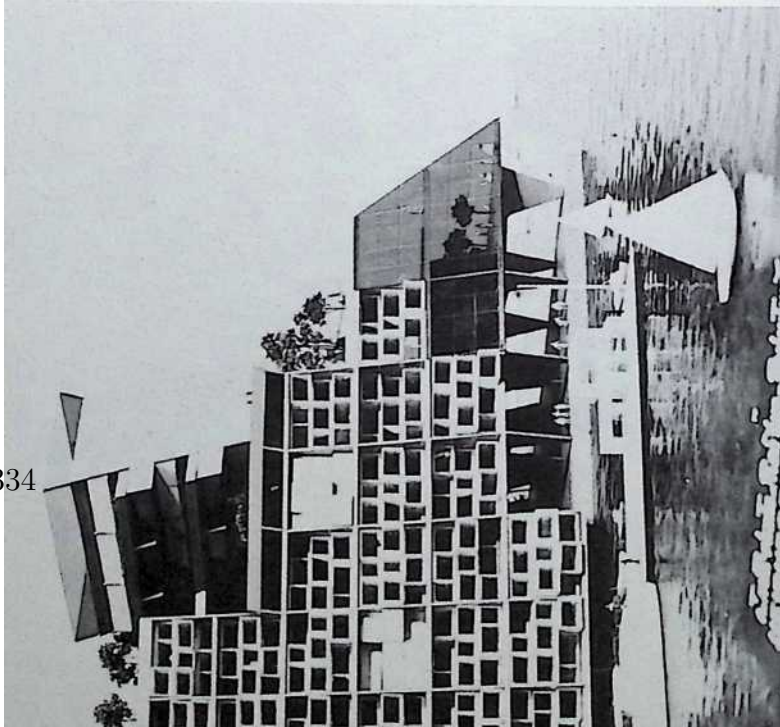




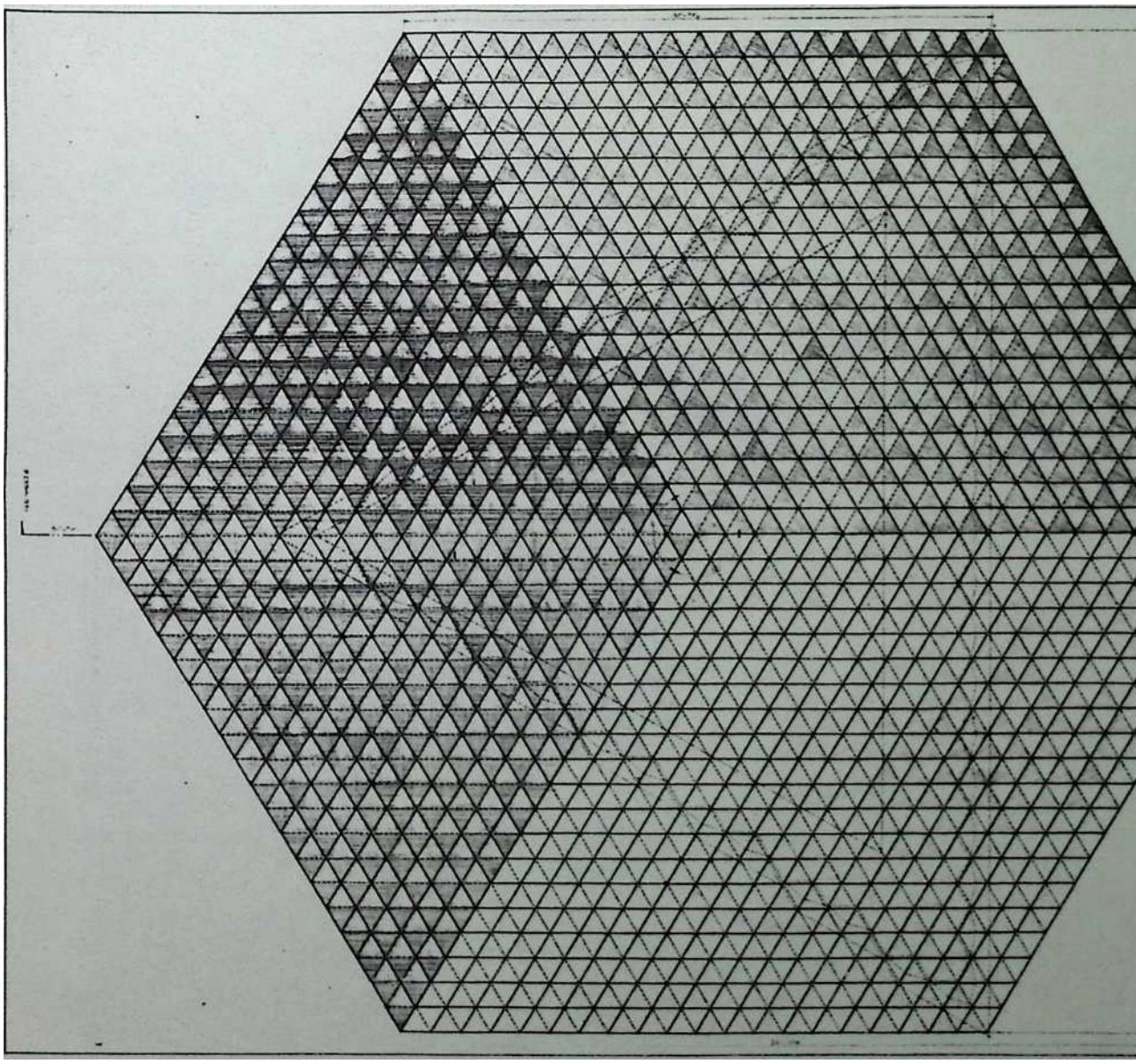

TRITON CITY
CONFIGURATION 40,000



23 Piedmont Panorama Center for the South Carolina Tricentennial 1969–1970

The Piedmont Panorama Center was to be a twelvesided volume composed of octet trusses and sited on a hill.

II



BWORAMA CENTER

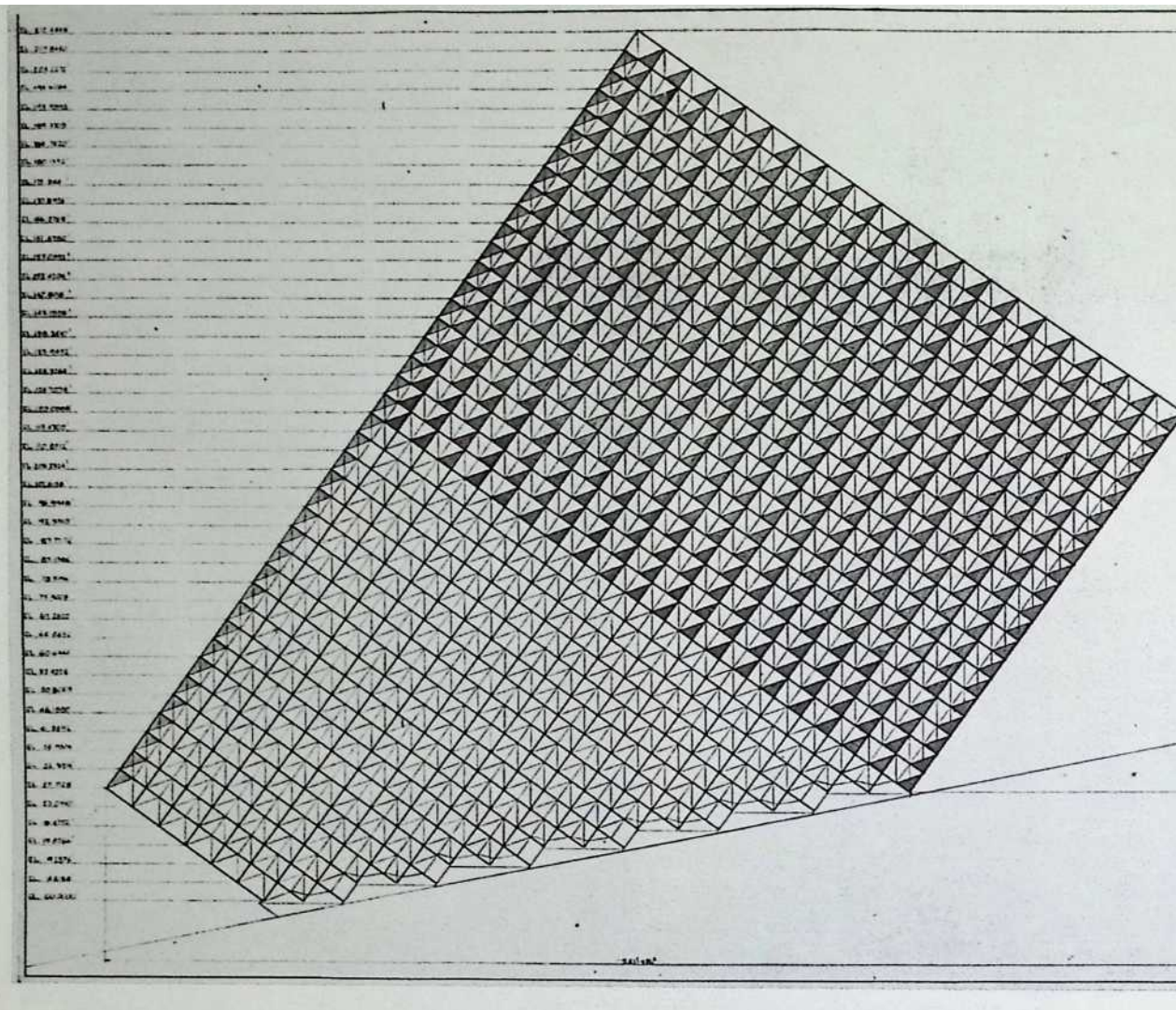
RBUCXMMSTER FULLER

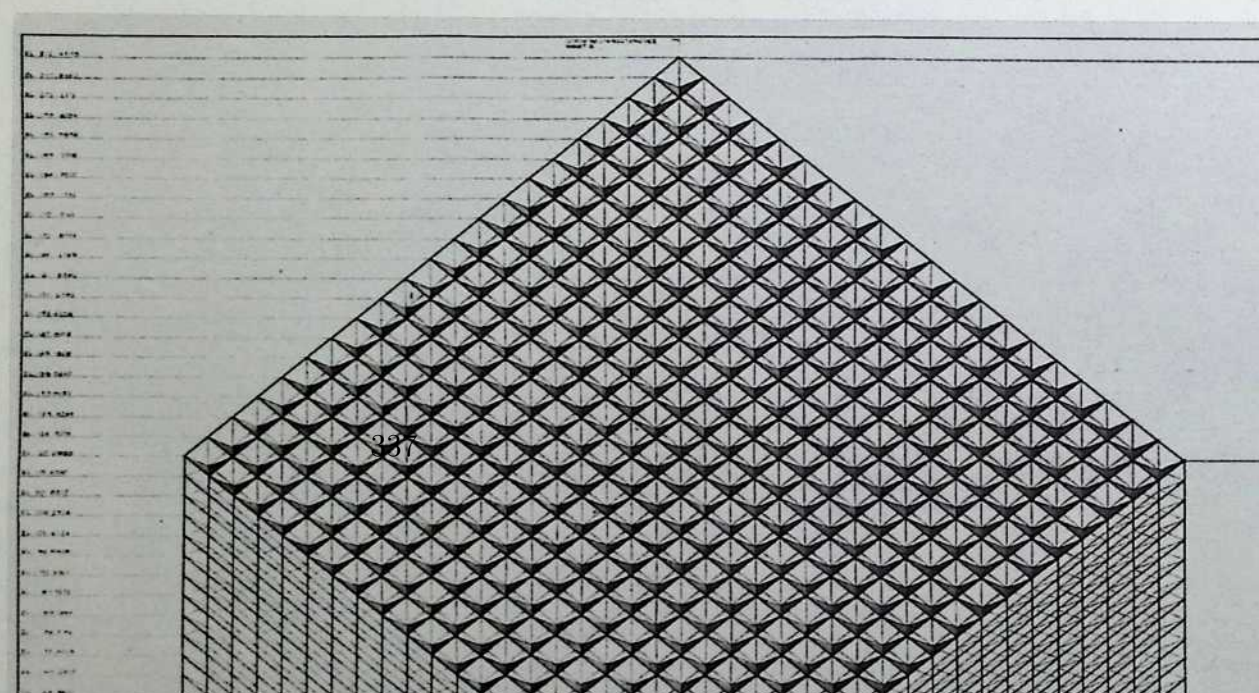
EAST ELEYATrOJl

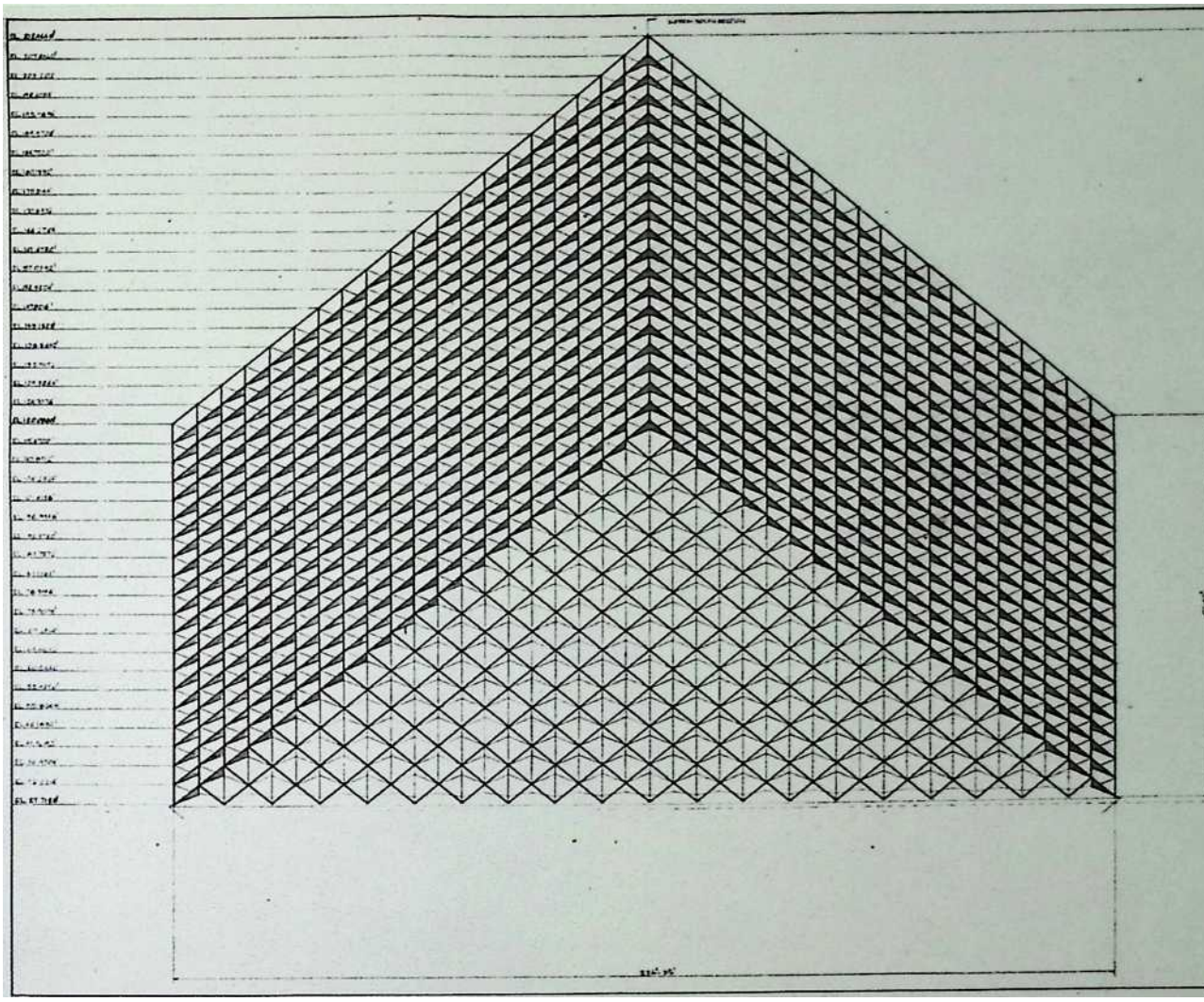
PIEDMONT

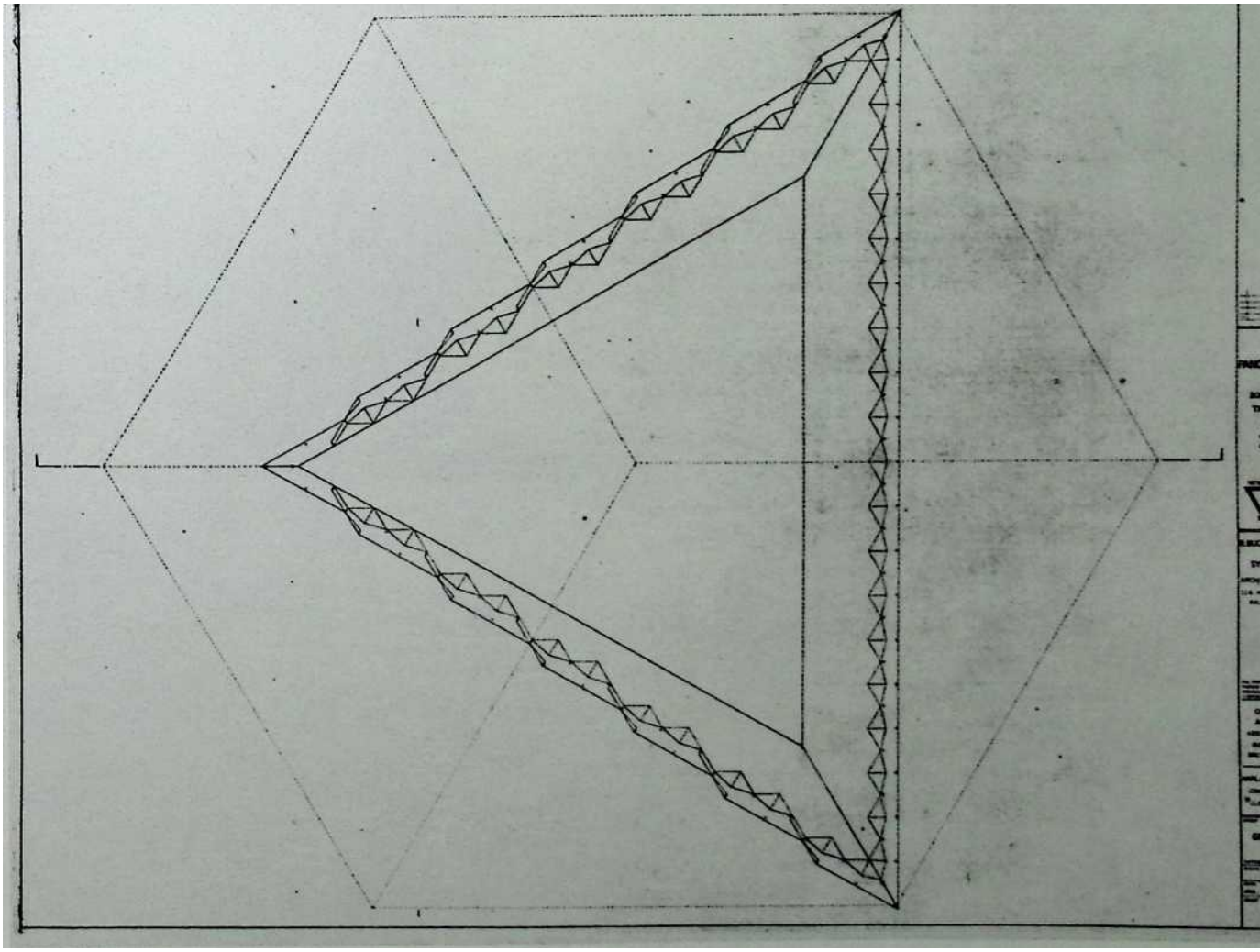
SOUTH CAROL! MA

TR1CENTEXNIAL









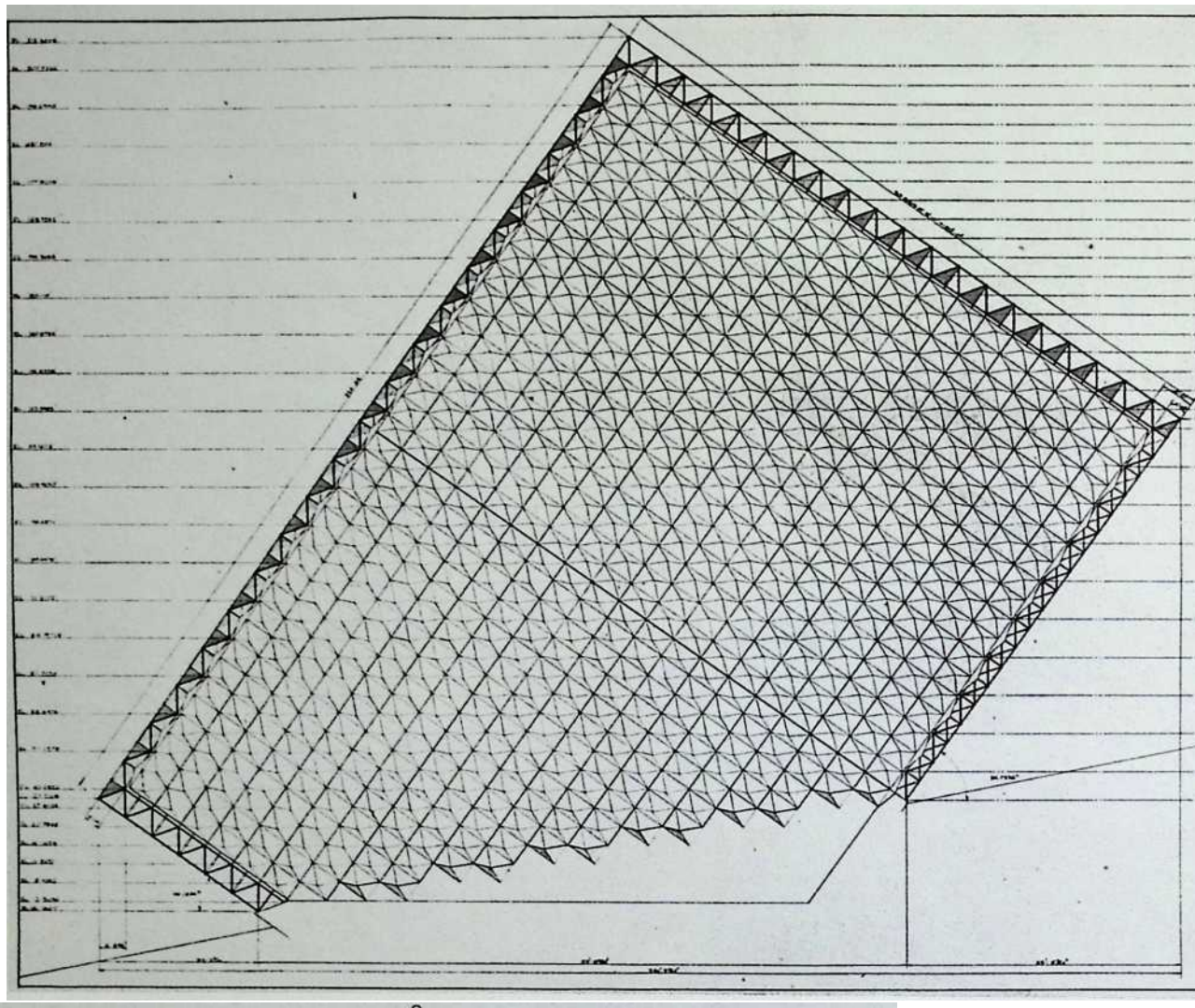
PIEDMONT

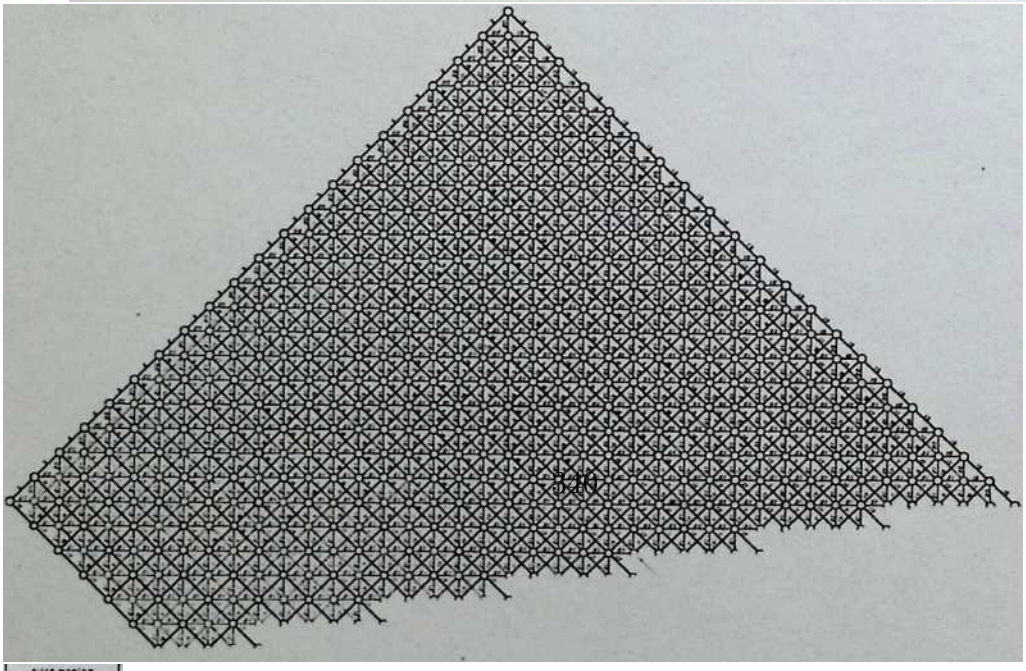
31NORAMA CENTER

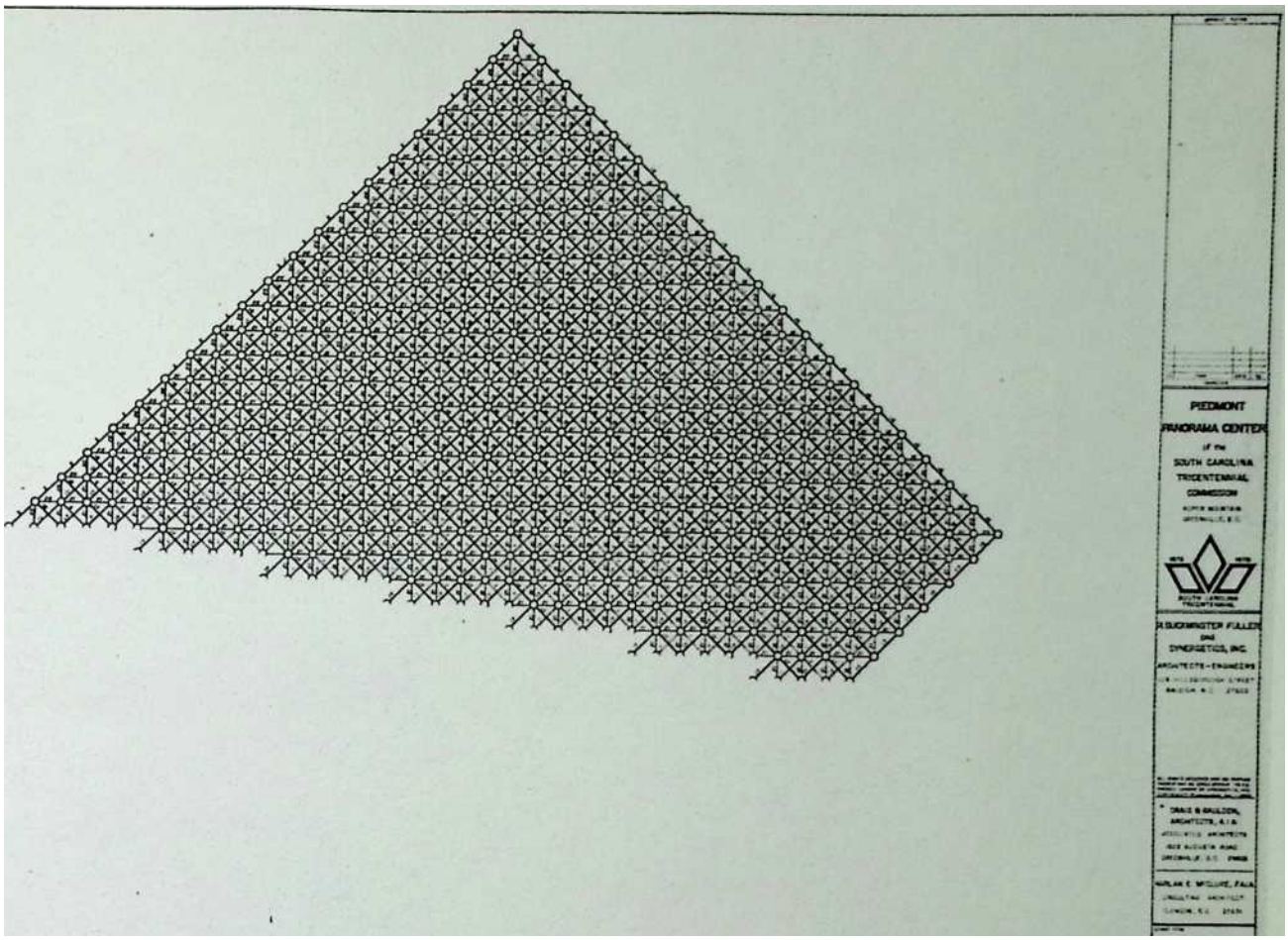
SOUTH CAROLINA TRICtNTtNNt AL CCAAC13.0H

SOUTH-EAST

WALL







iSUTH-WUT MLL

10

PEMXT ,*N0RM4A CTXTTM

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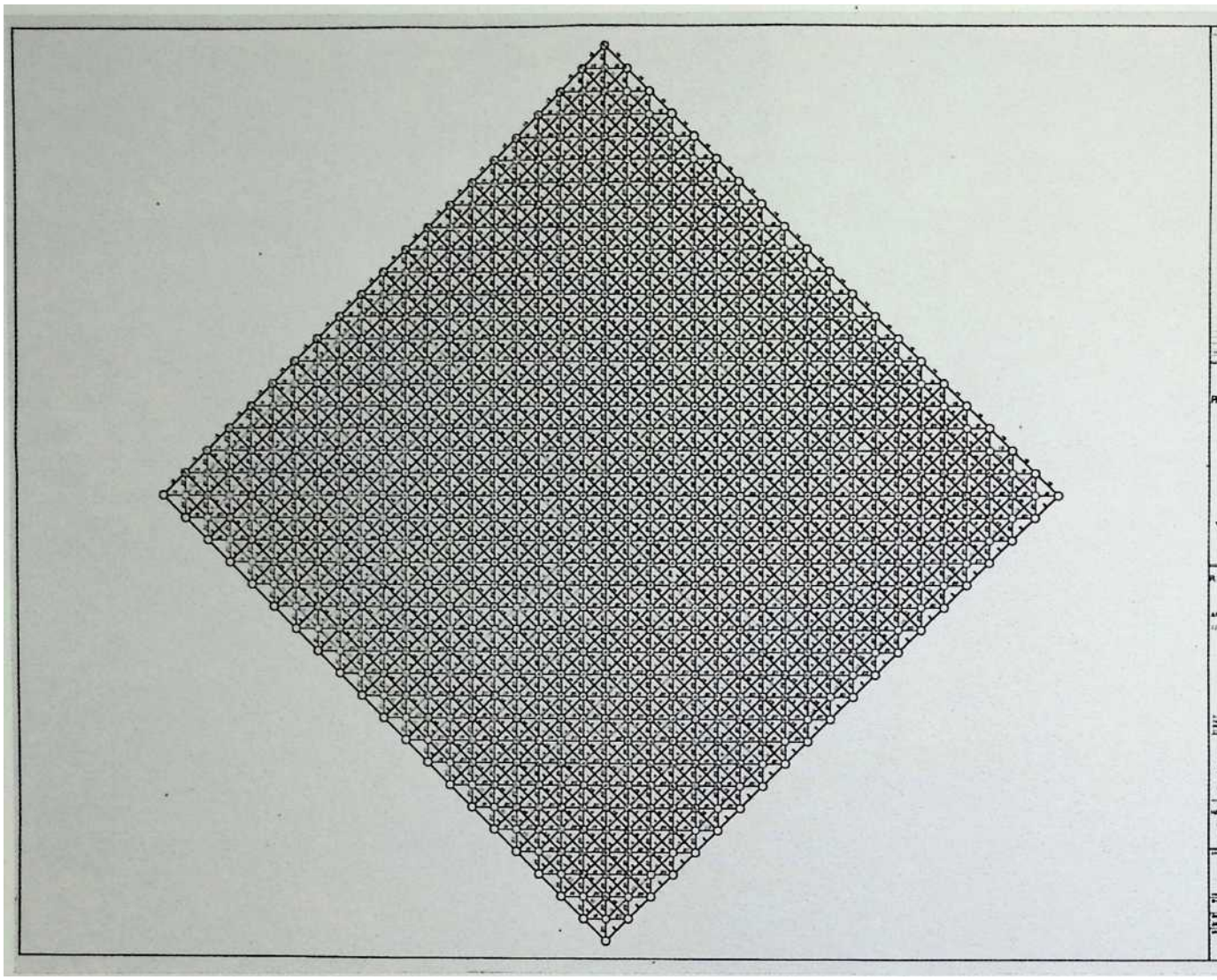

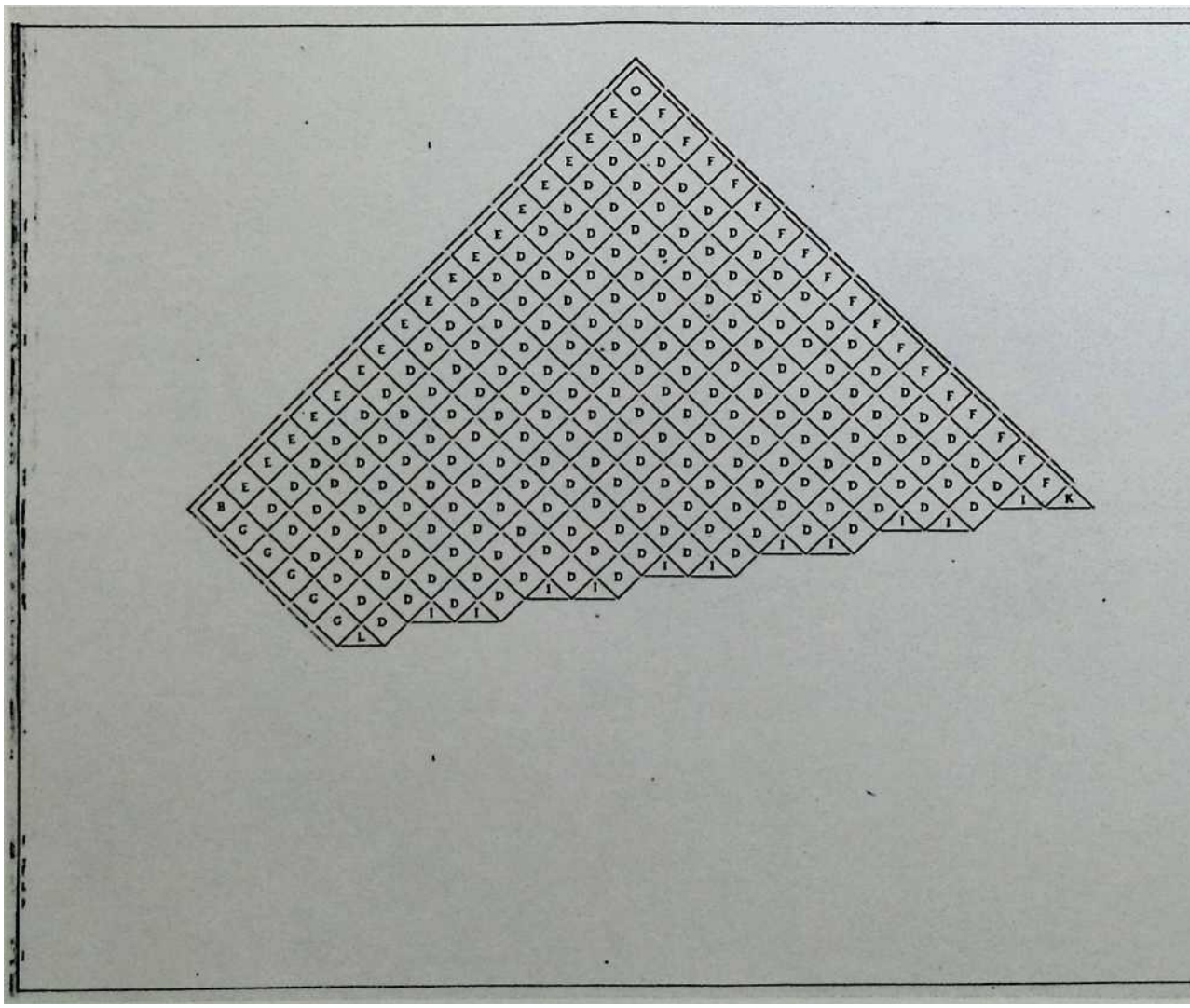

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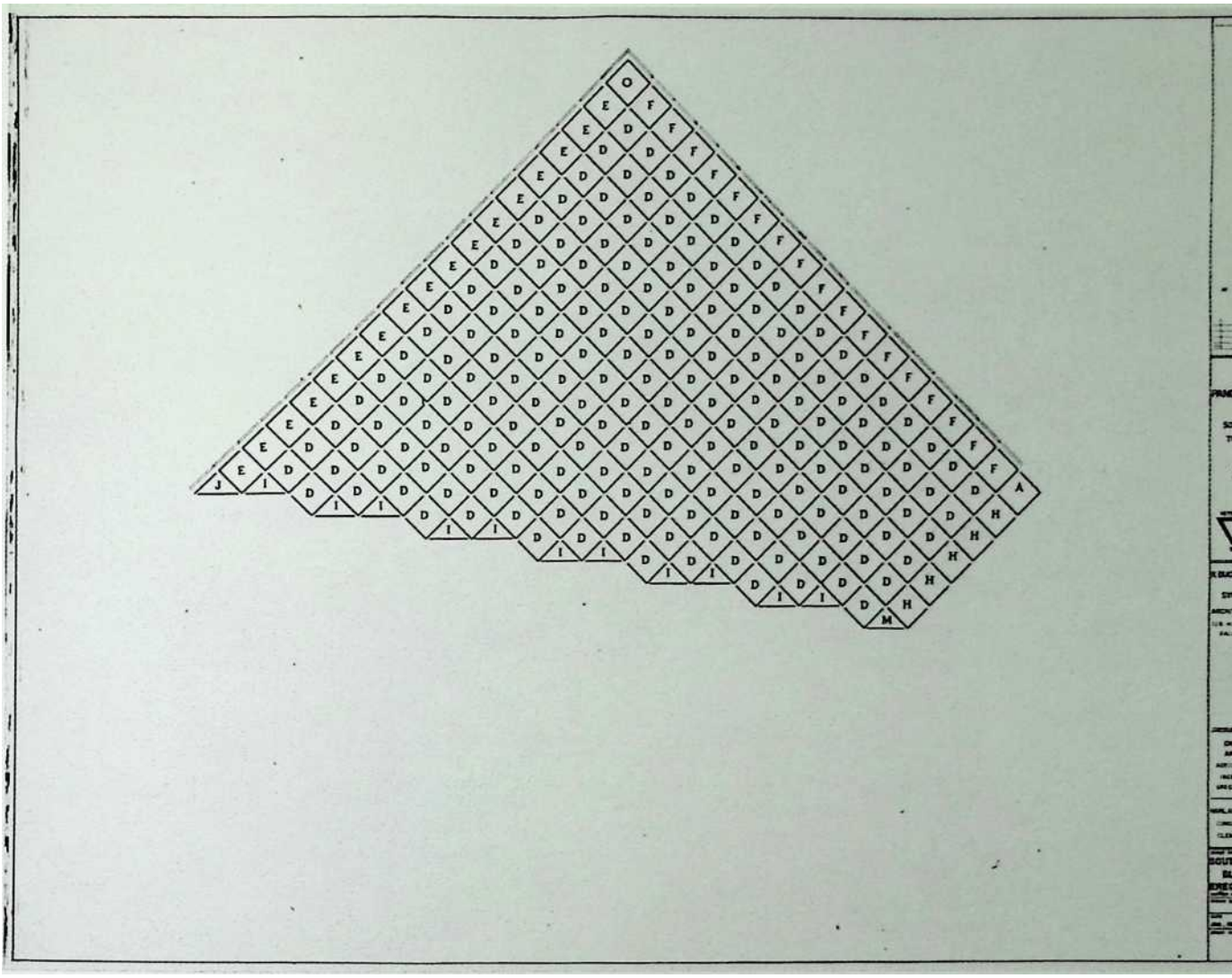

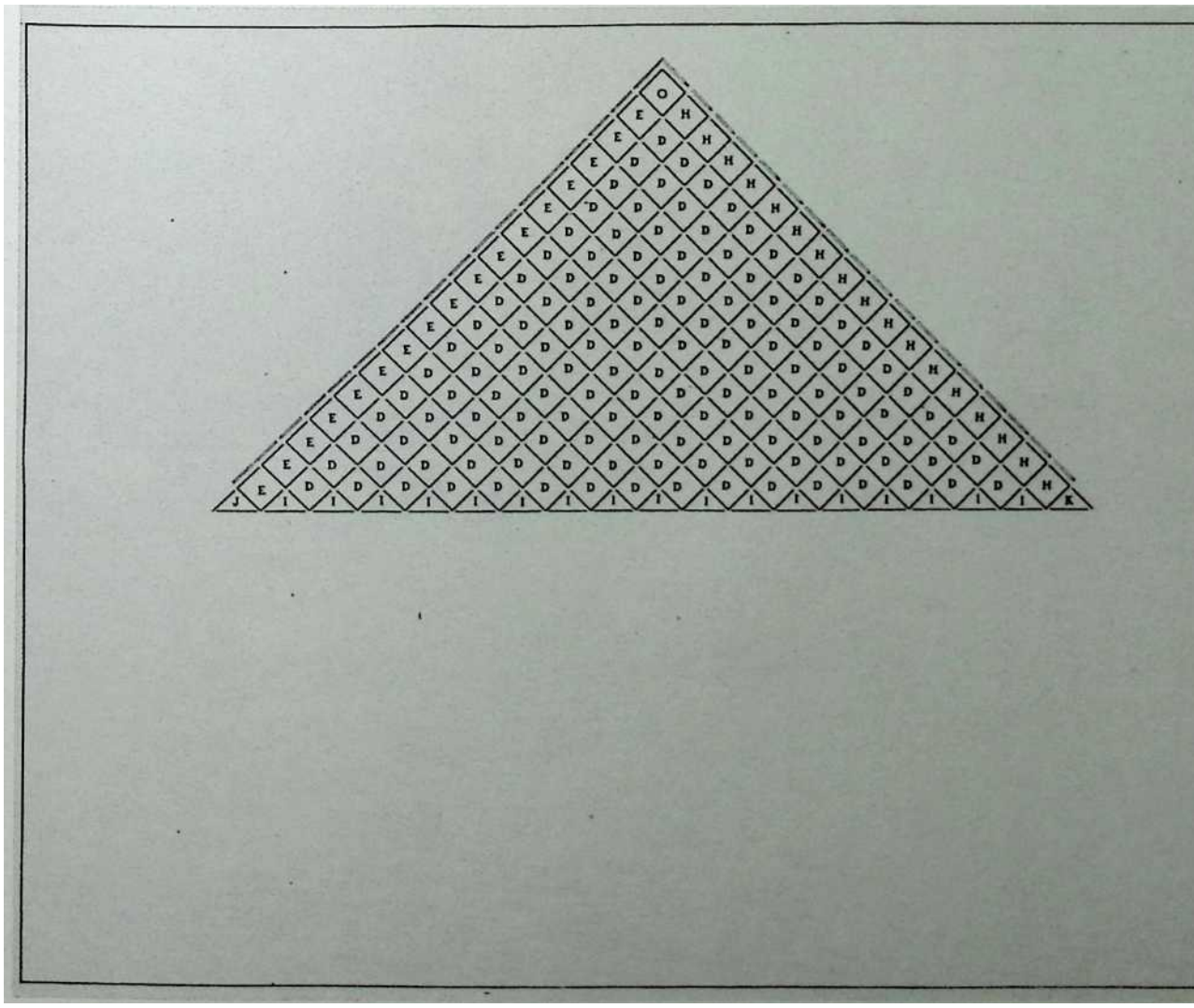
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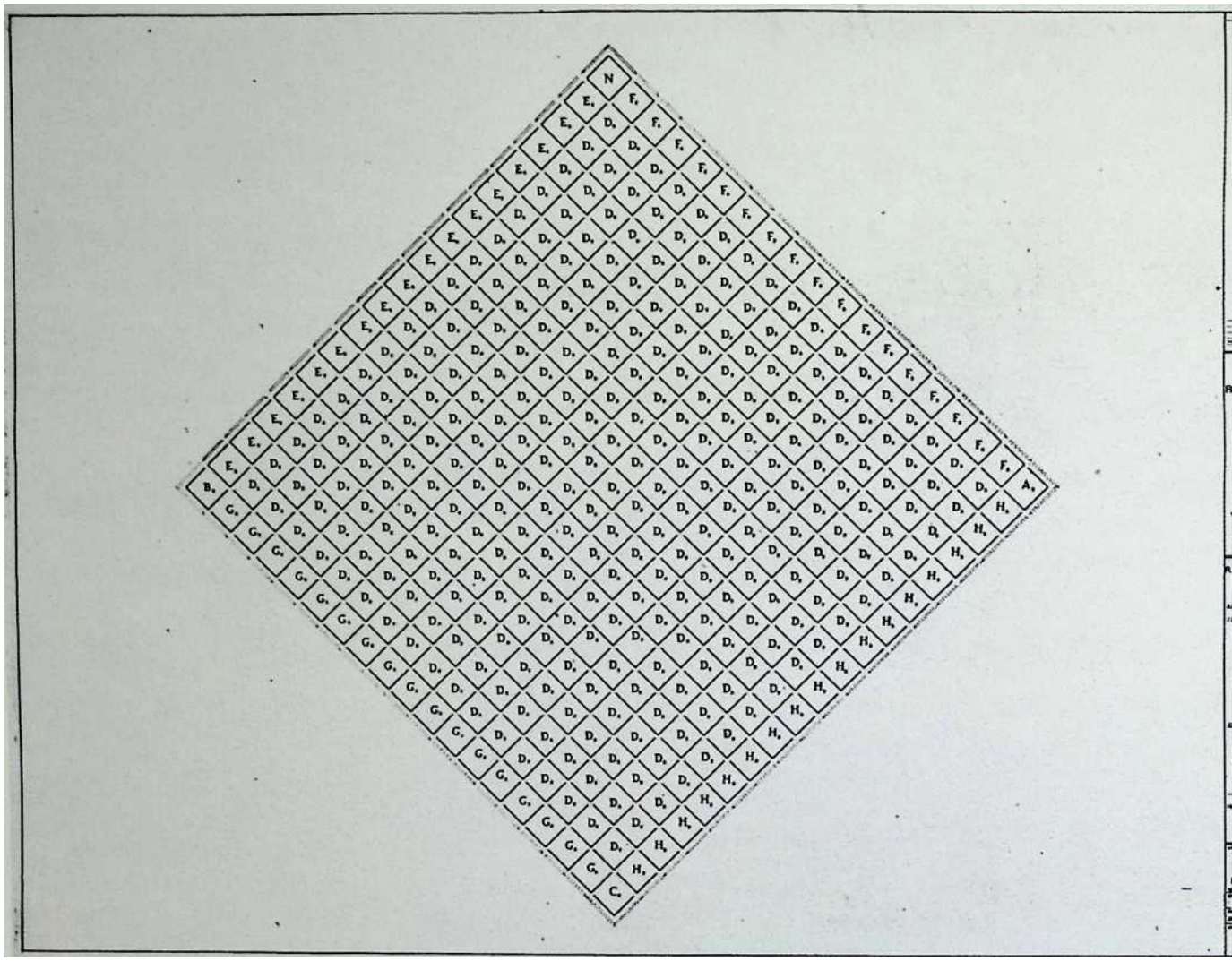

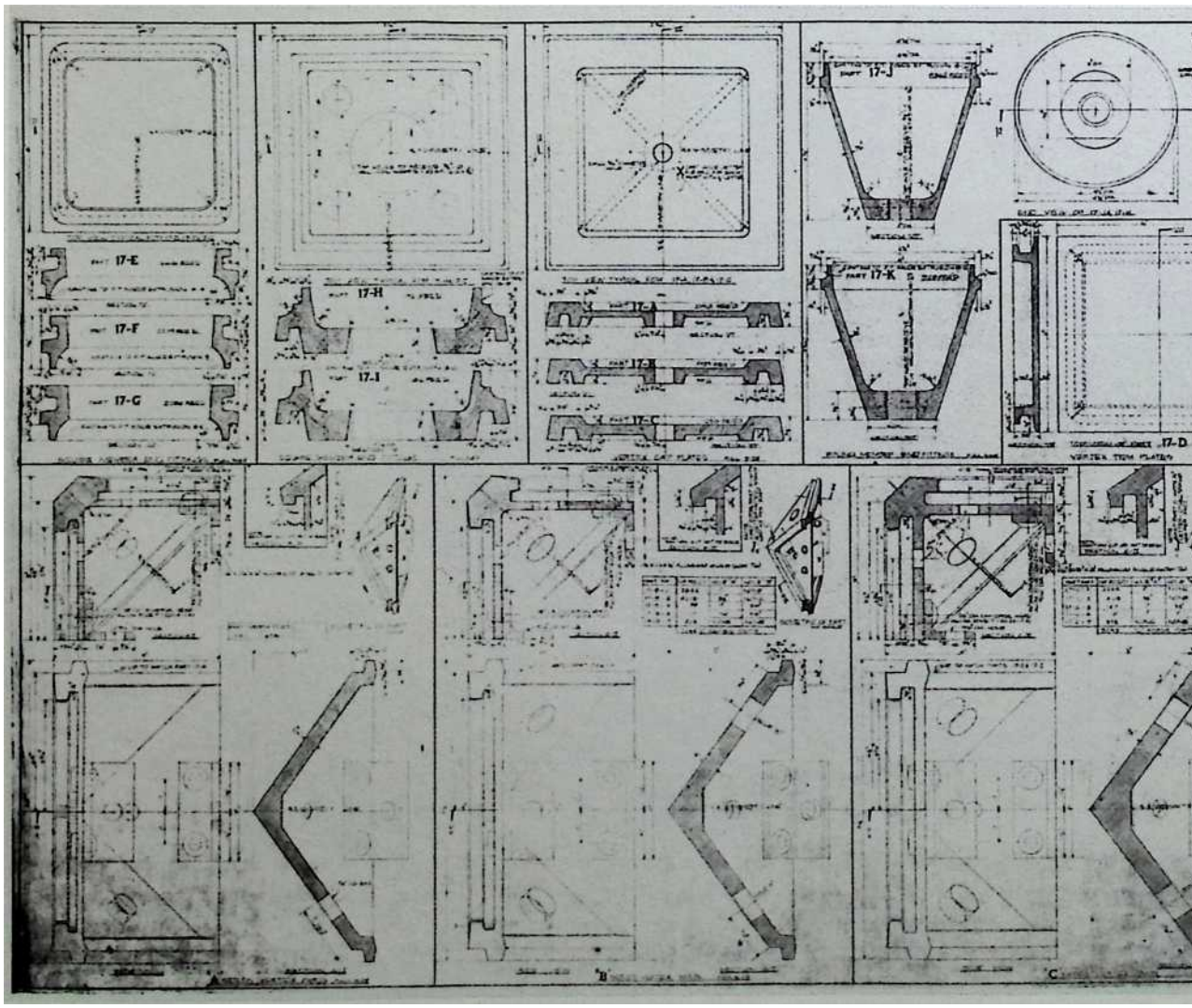
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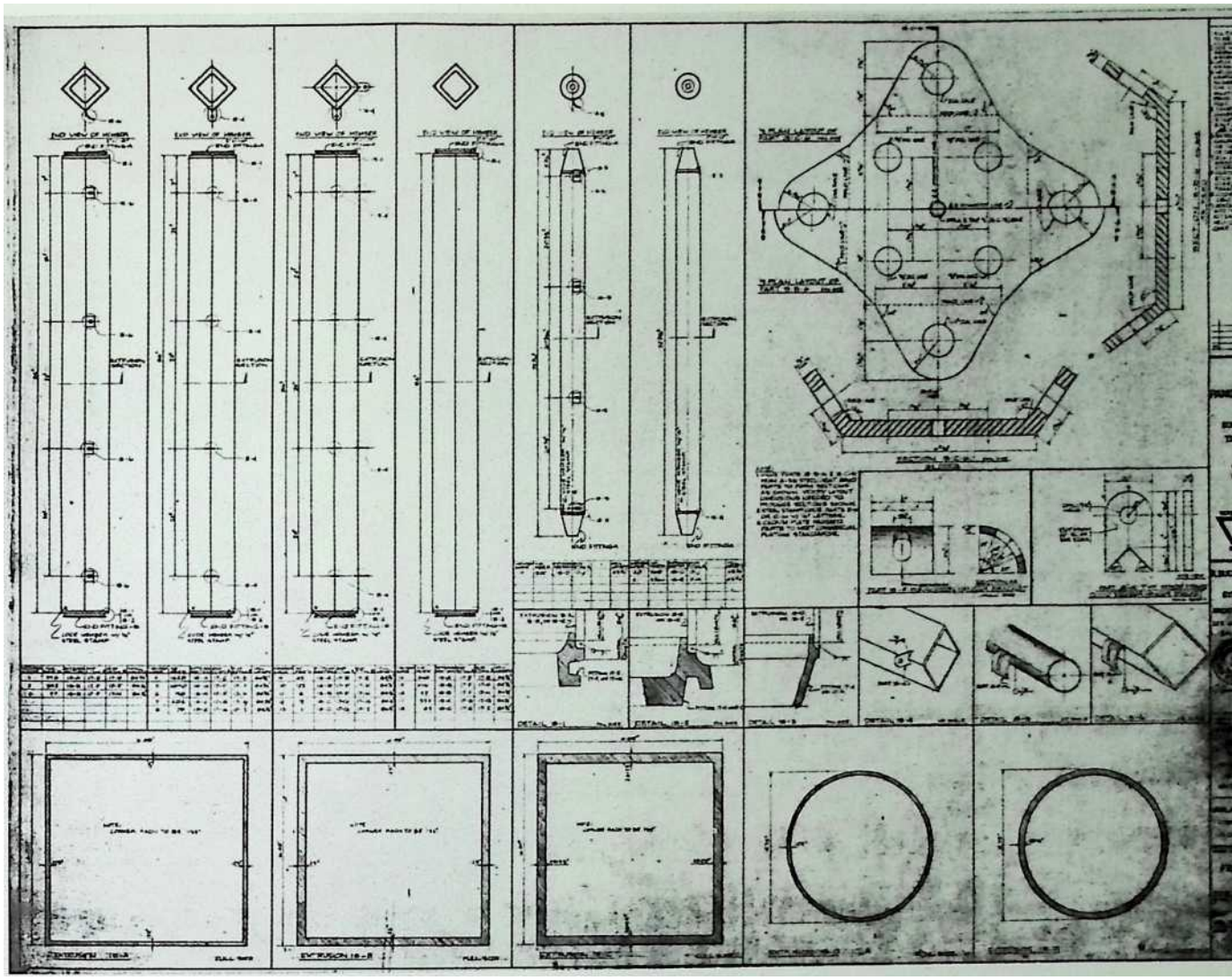

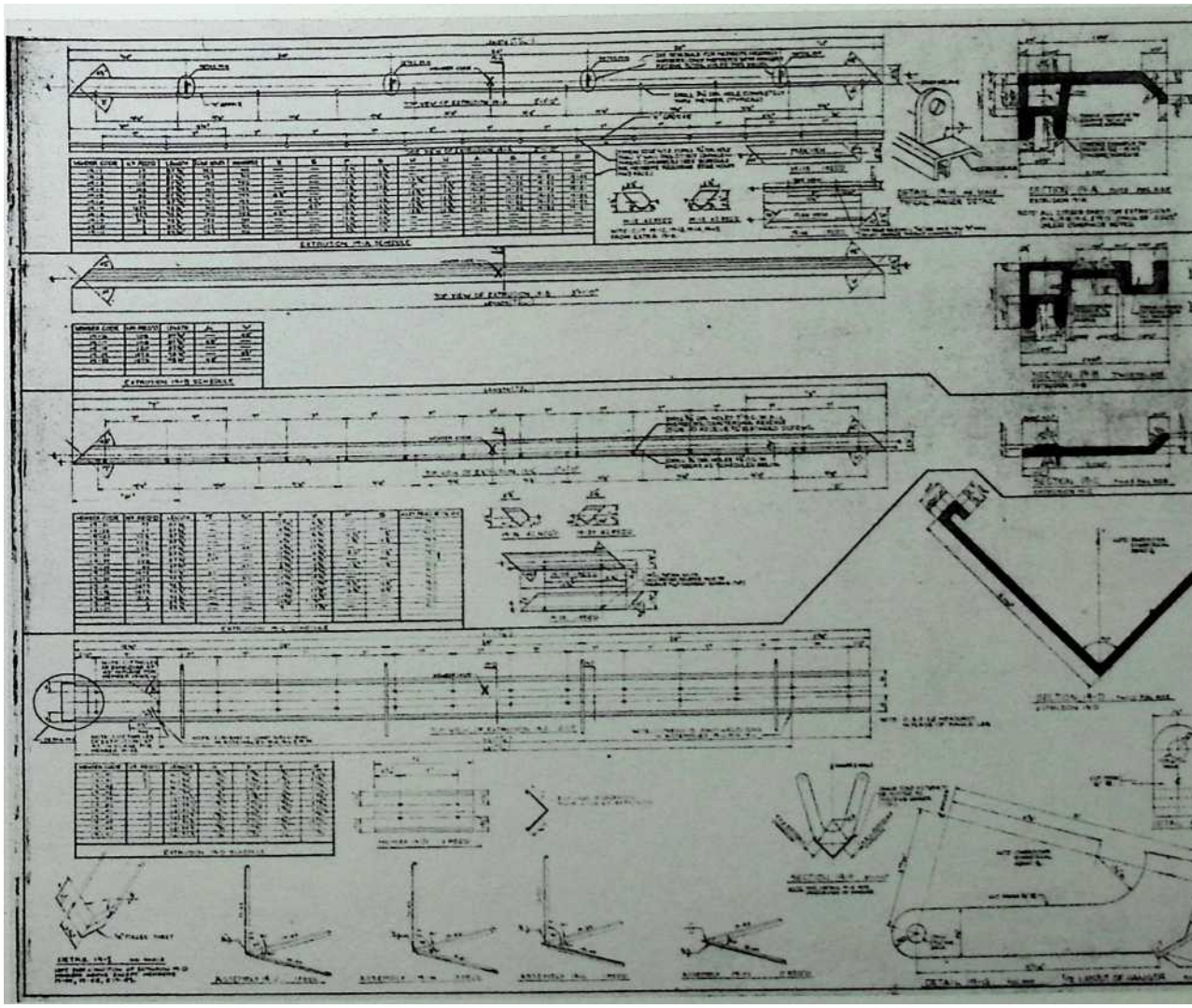

190 THE GEODESIC REVOLUTION. PART 2

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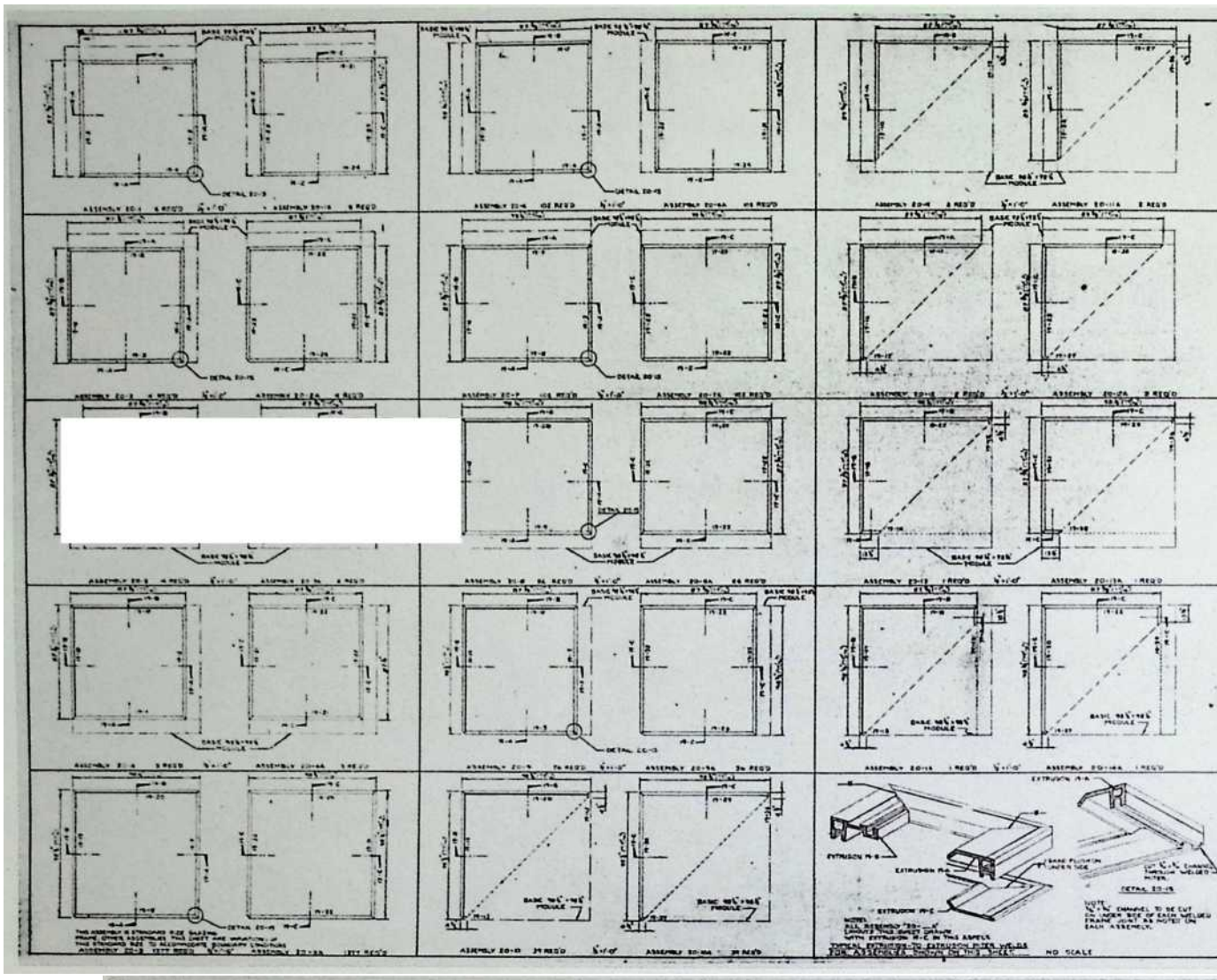
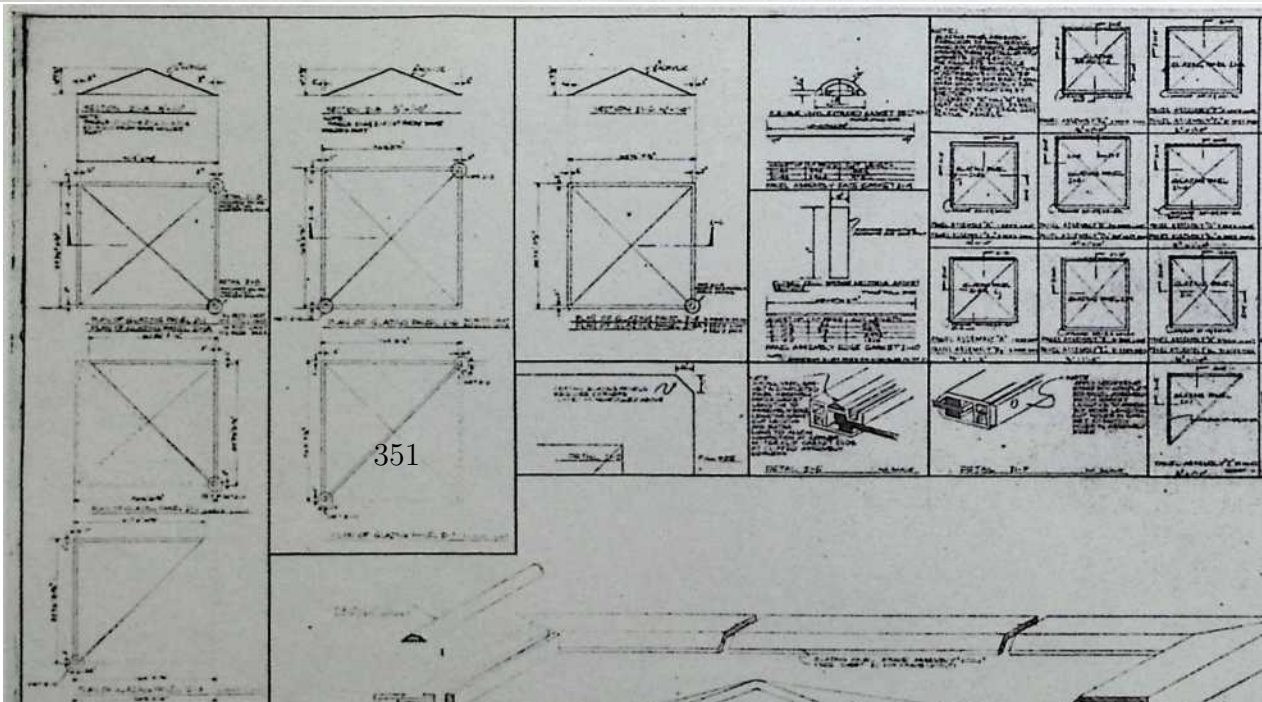
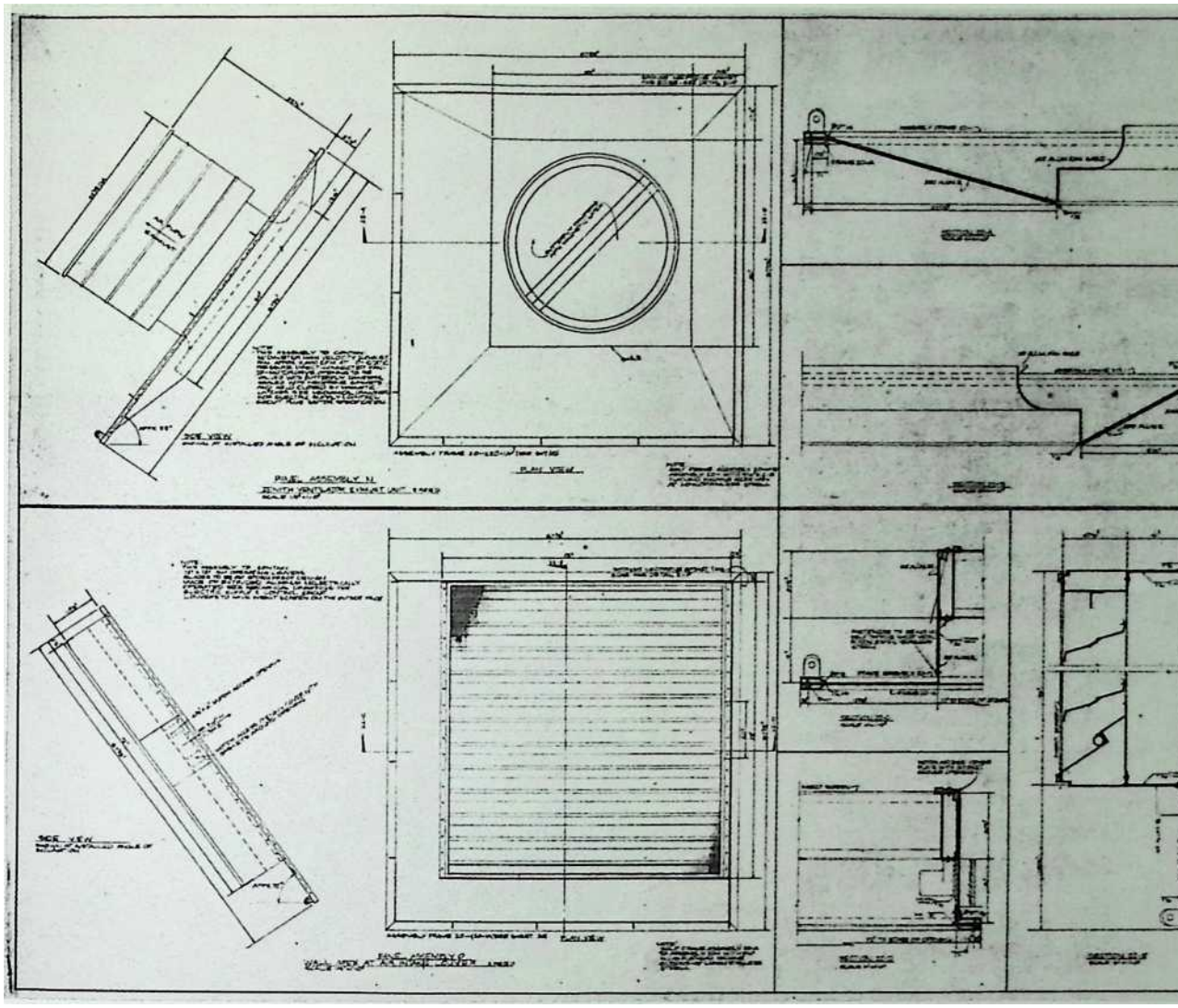
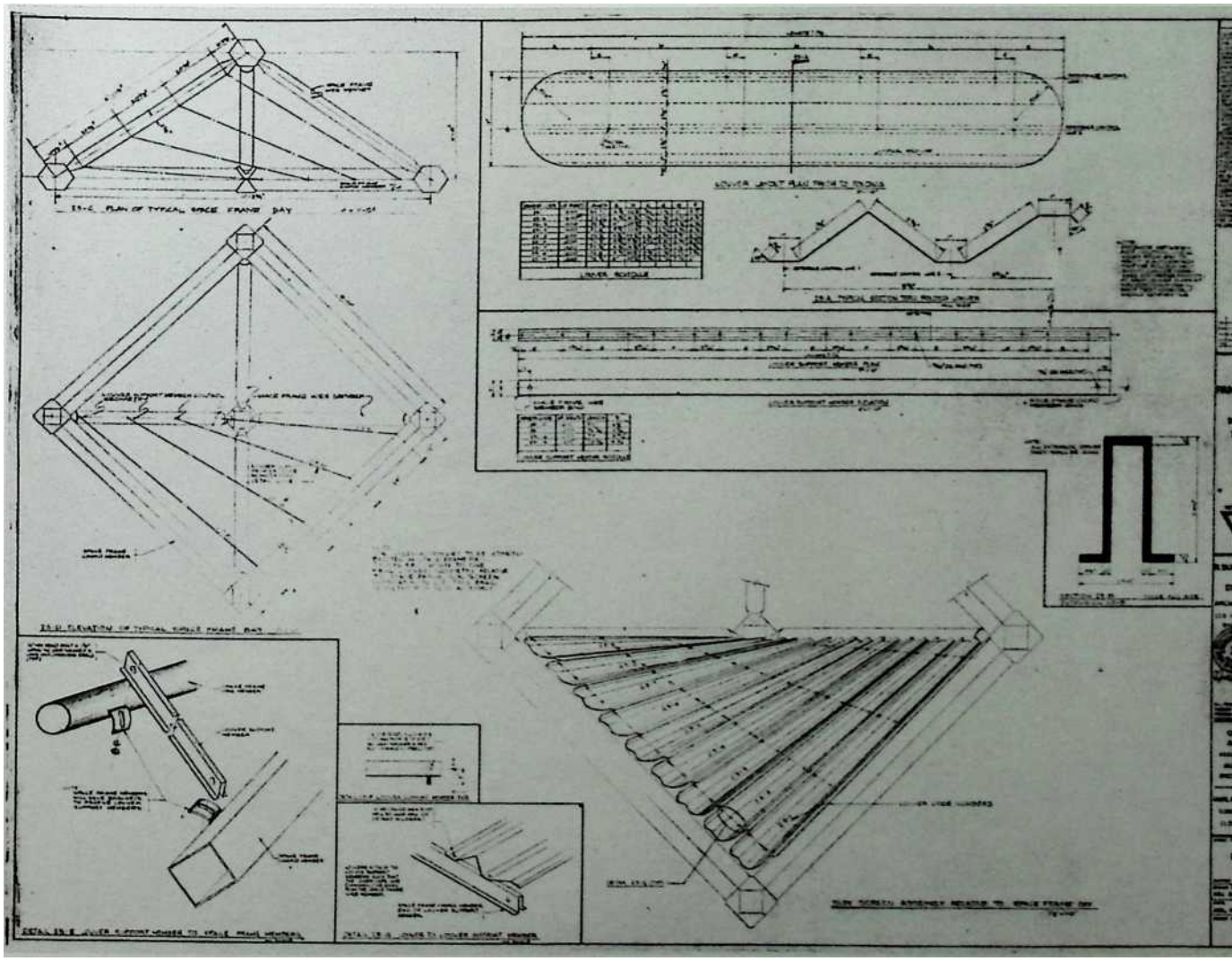






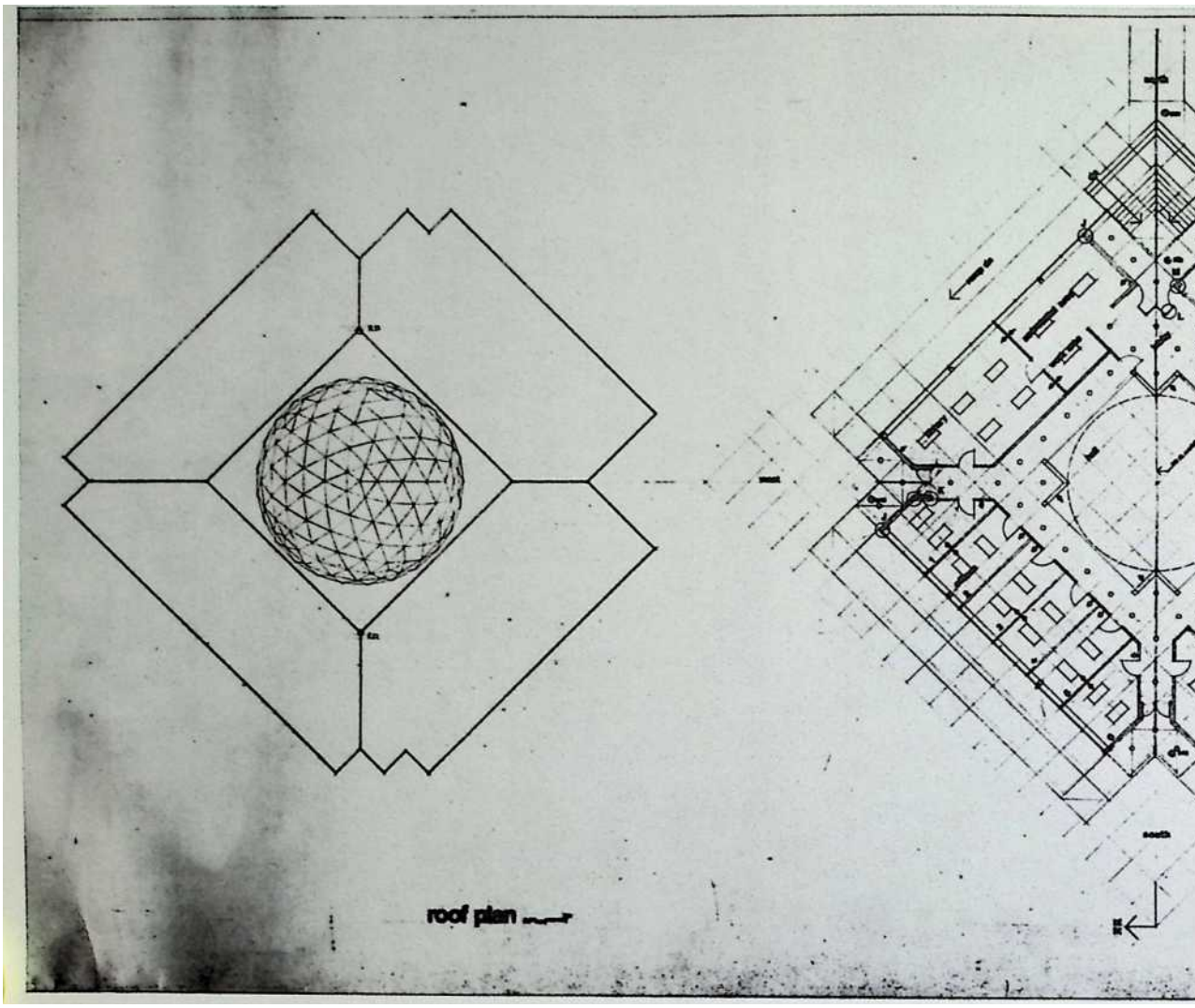


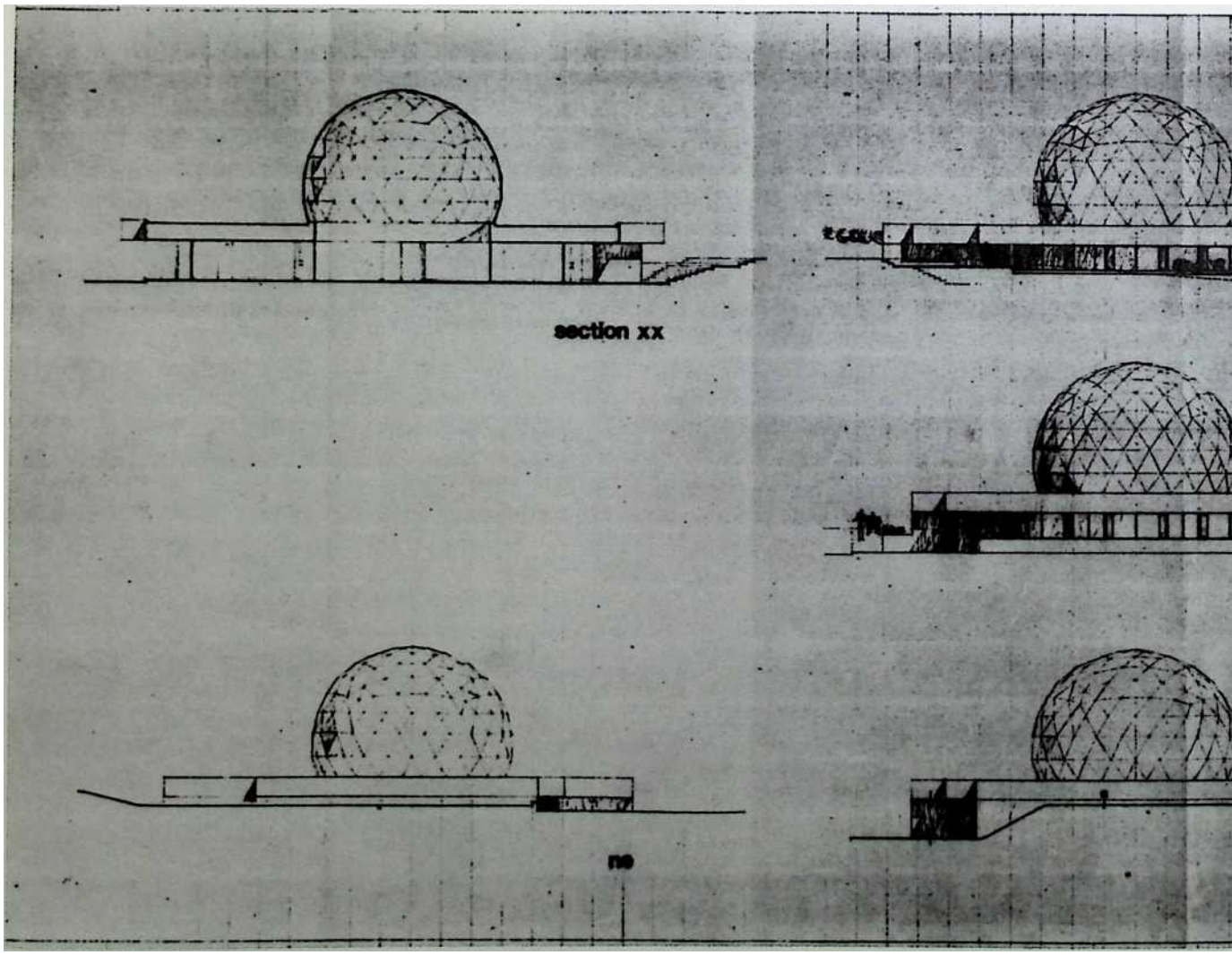
Campus Religious Center, Southern Illinois University, Edwardsville Fuller & Sadao (Designed by Shoji Sadao and Karlis Grinbergs), 1969

This center was designed to accommodate any denomination. Sadao's treatment of the masonry base and sunken entrance and Fuller's dome of black glass and silver mullions combine to produce one of the most elegant geodesic structures extant.

CAMPUS RELIGIOUS CENTER
section xx

RELIGIOUS CENTER


roof plan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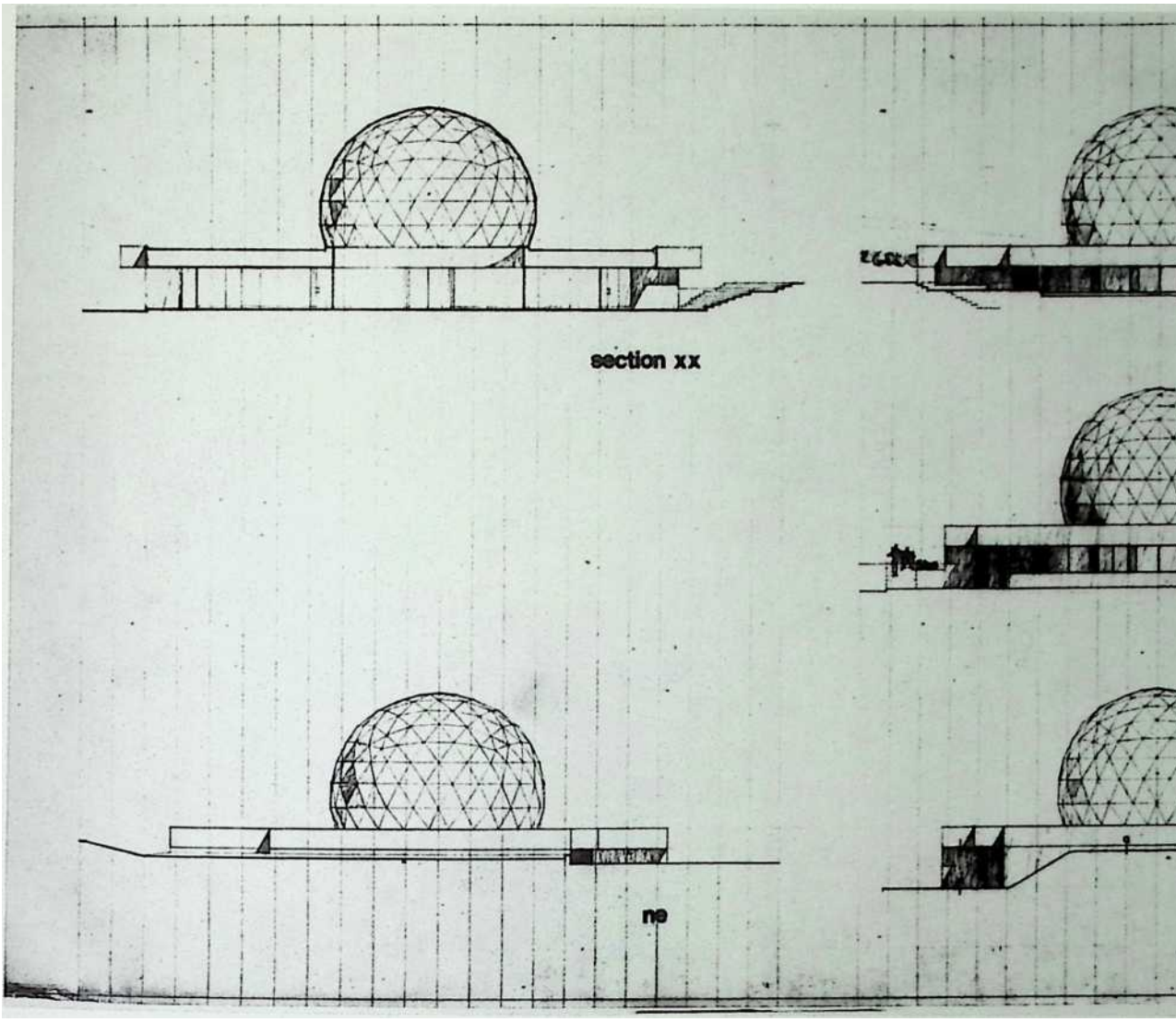
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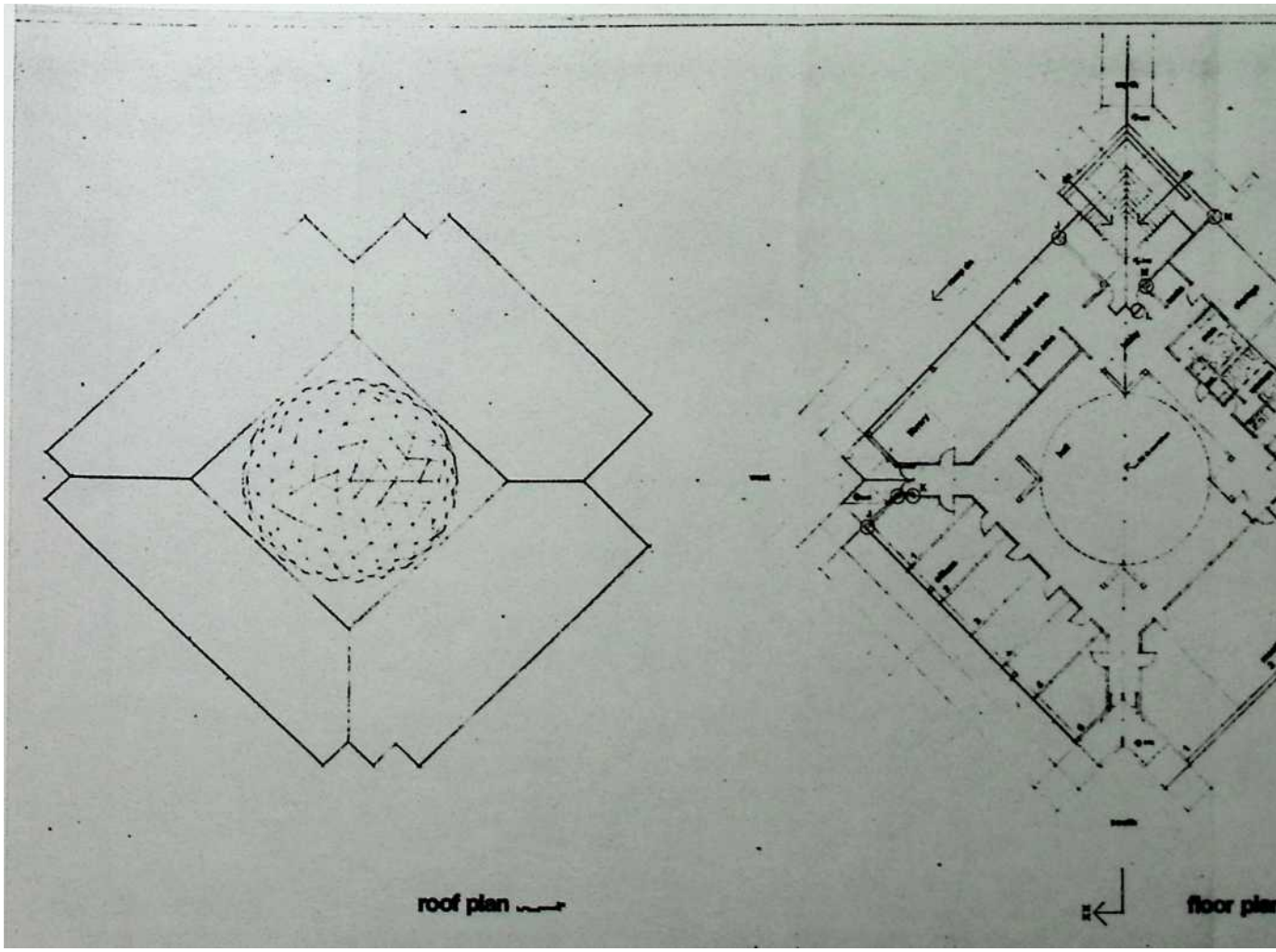

CAMPUS RELIGIOUS CENTER Fuller and Sadao, inc. Architects

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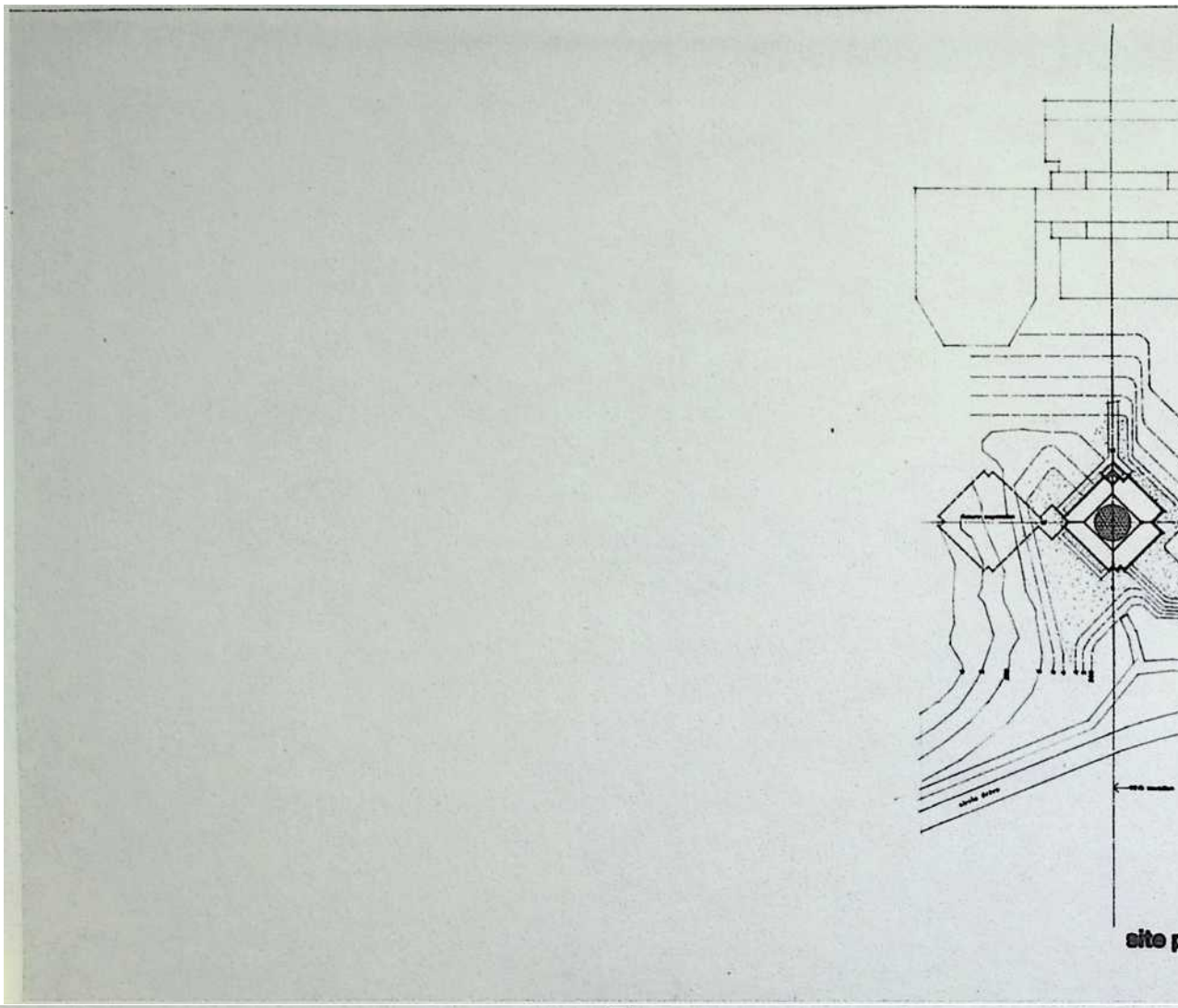
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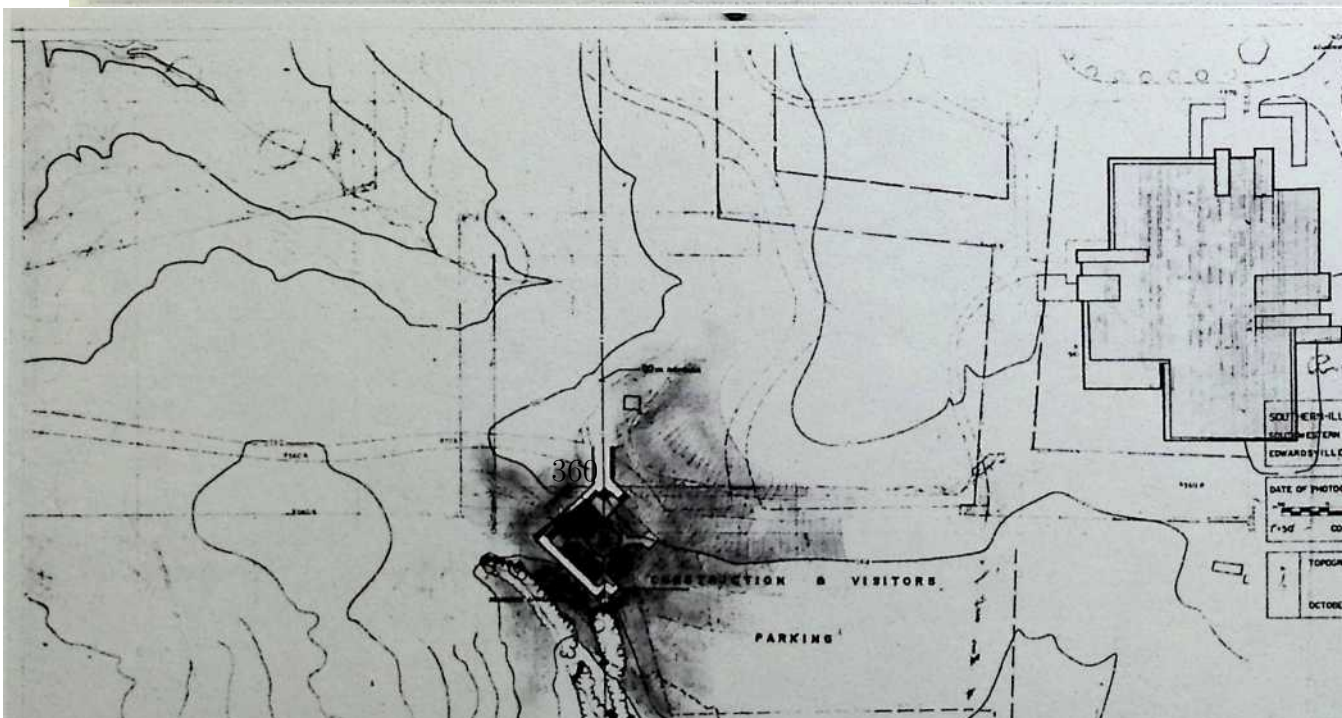
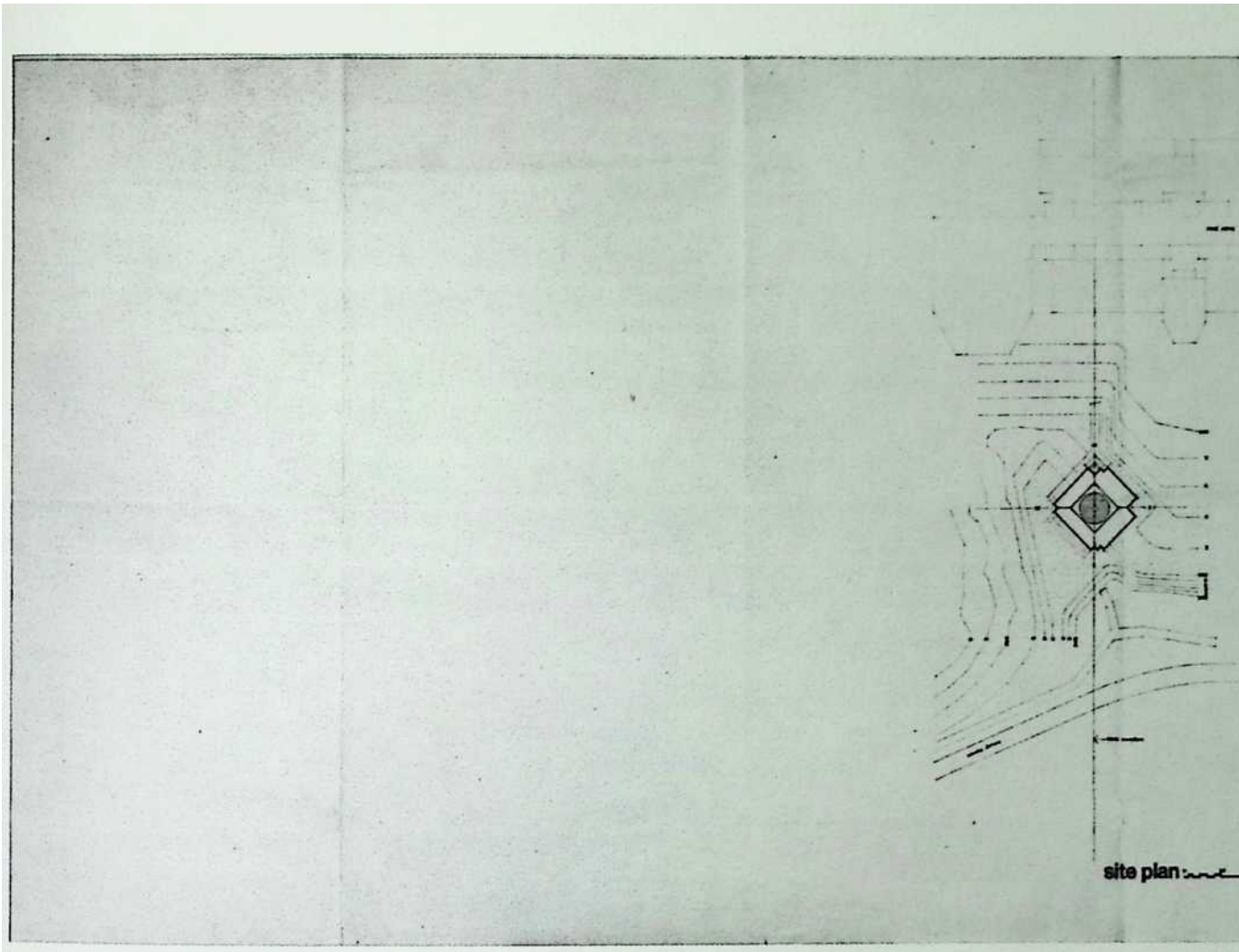

VISITORS
PARKING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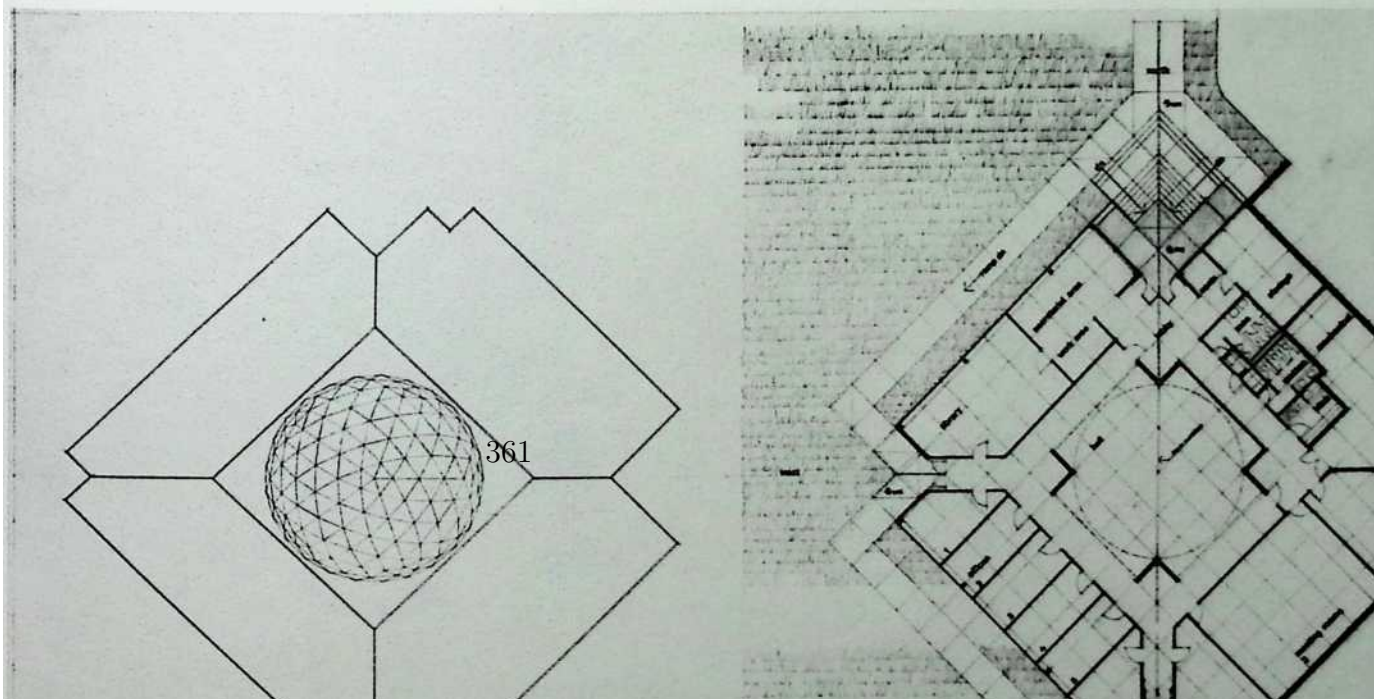

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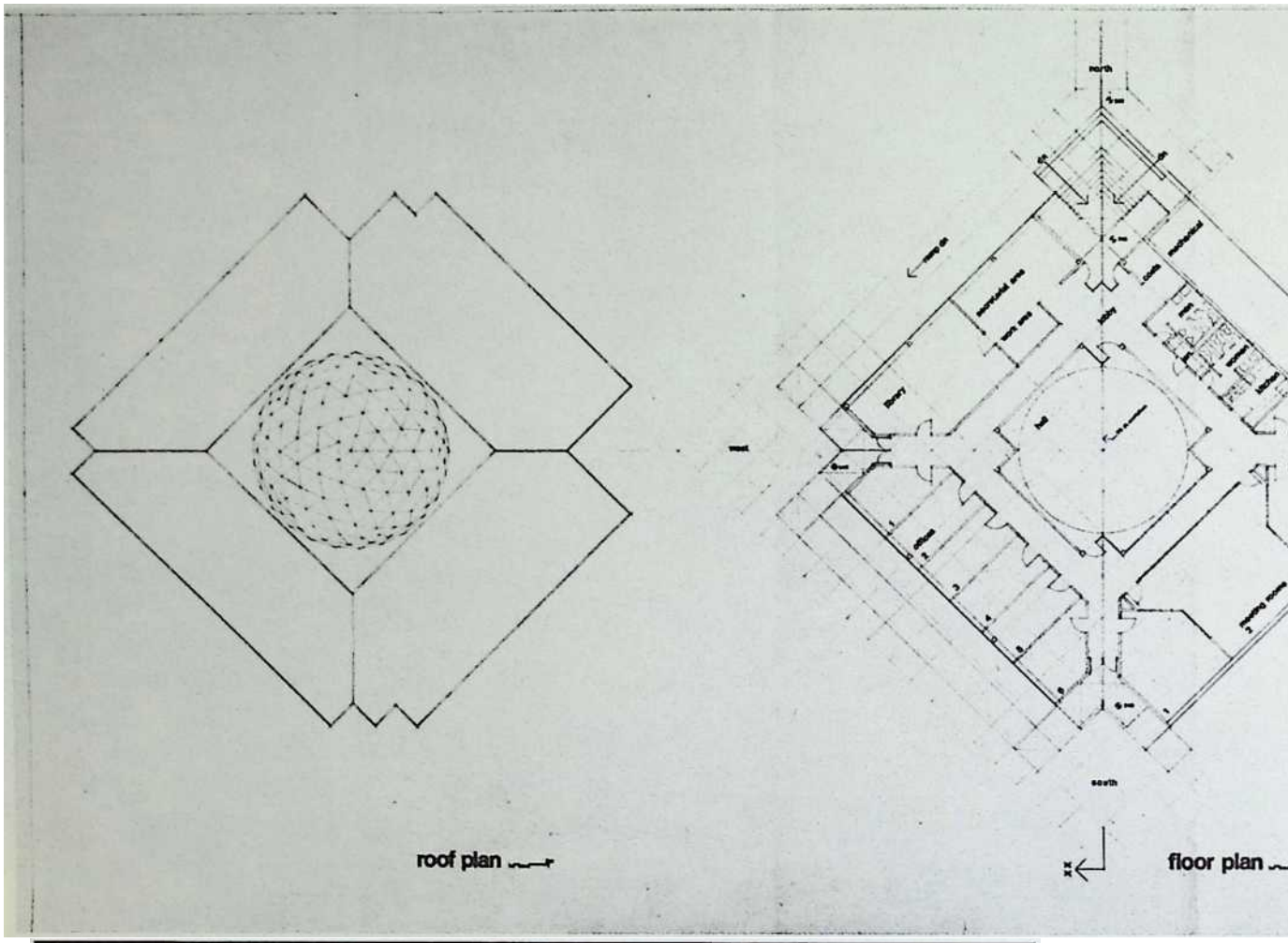
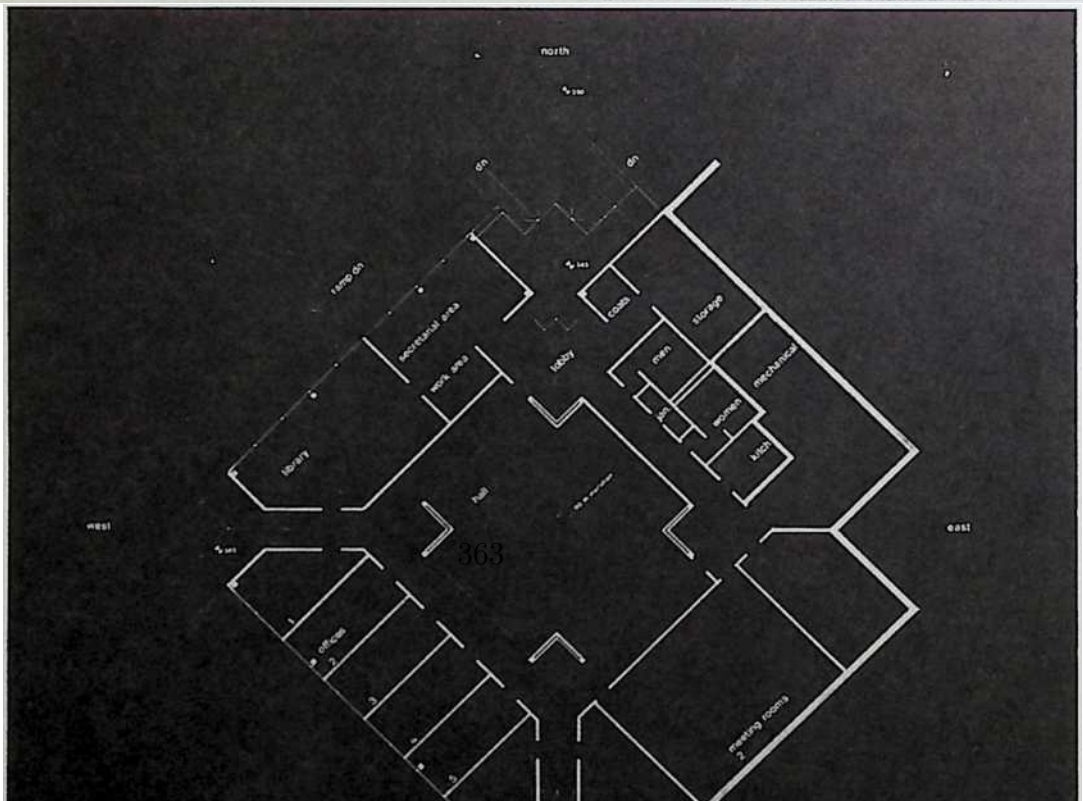
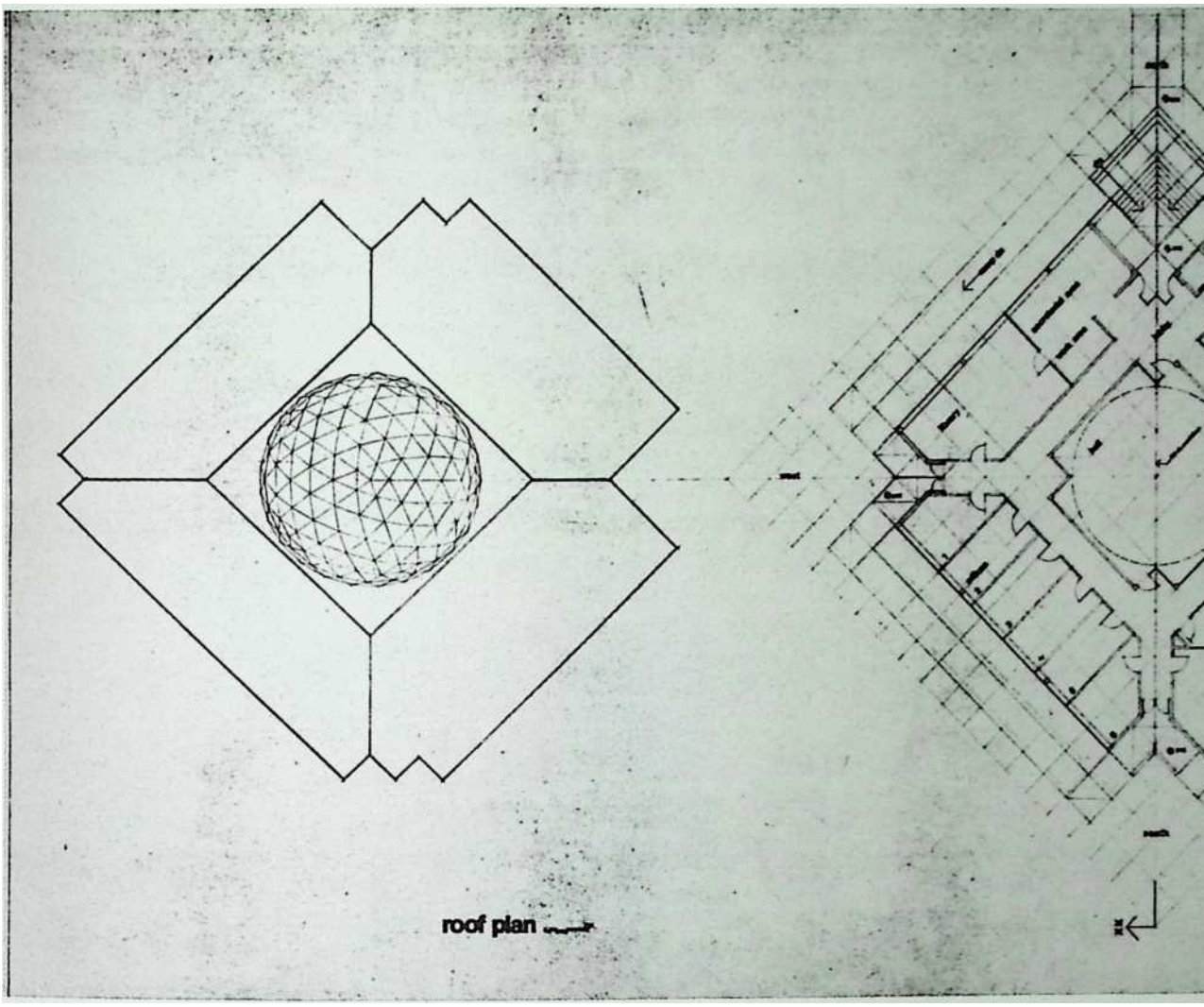




Fuller and Sadao, Inc. Architects
GIOUS CENTER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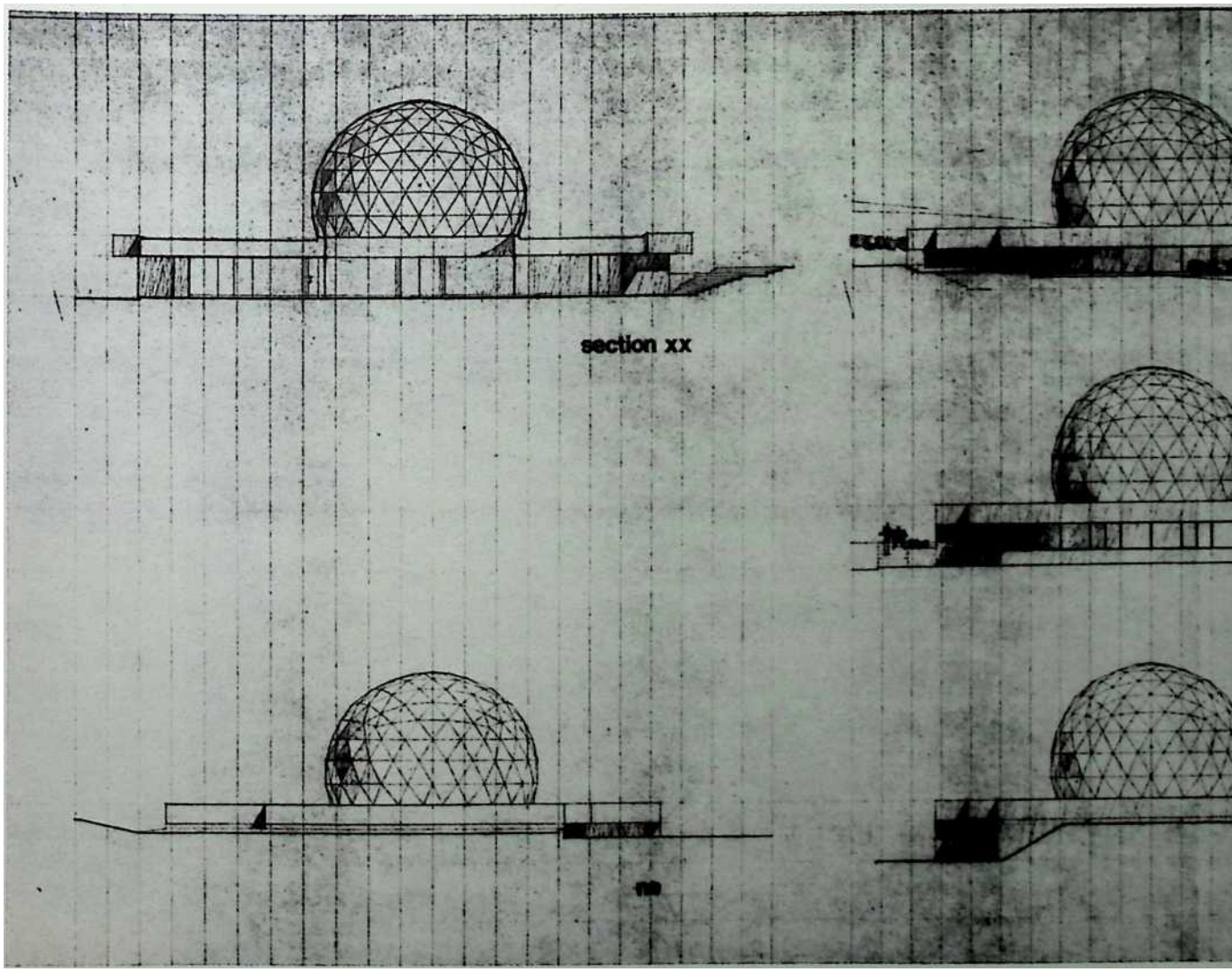
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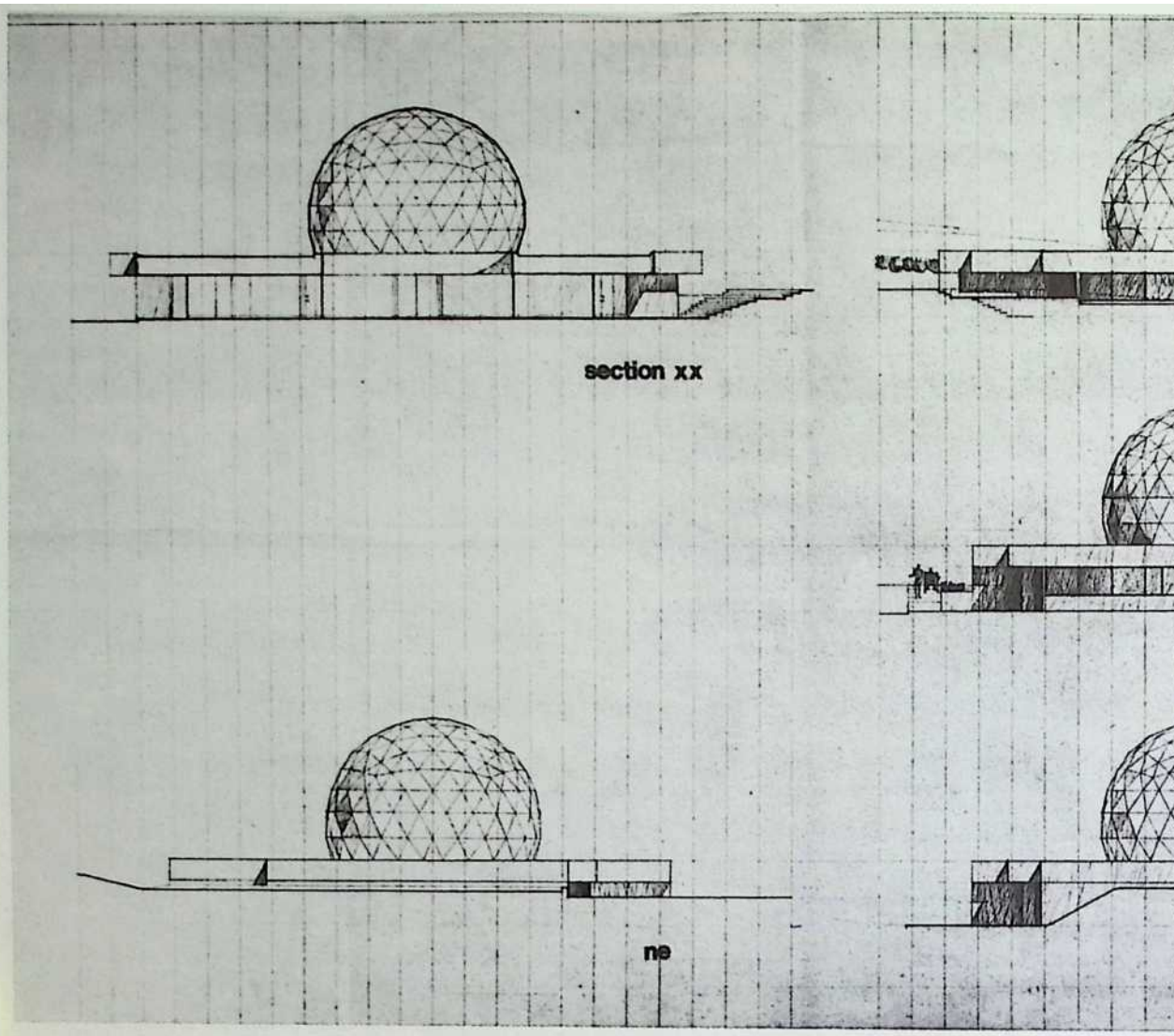
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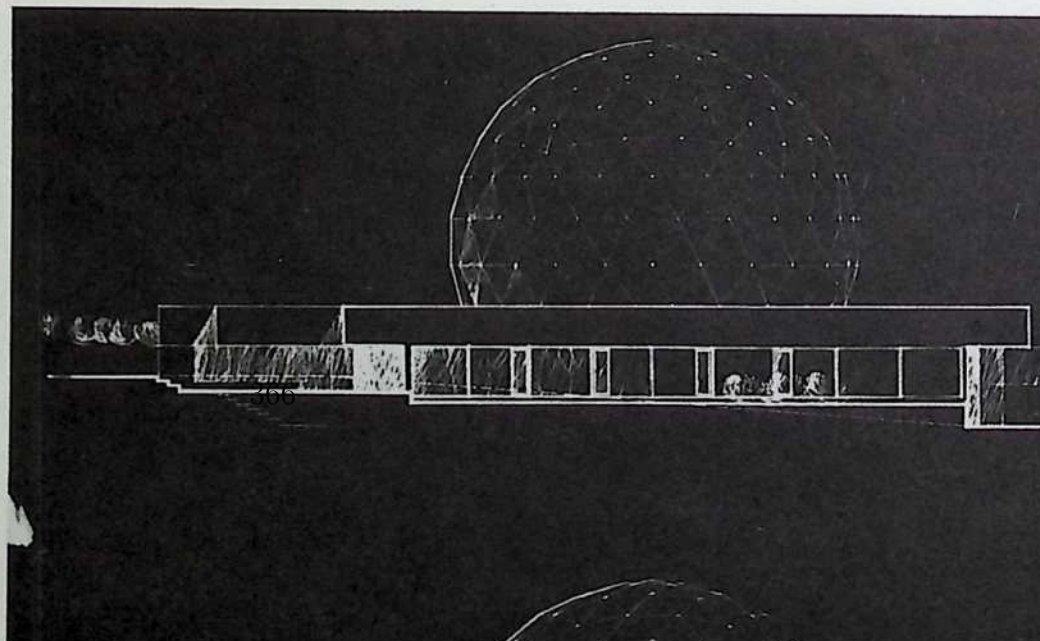
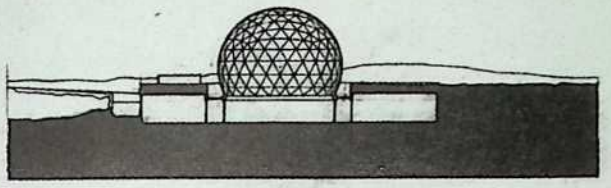
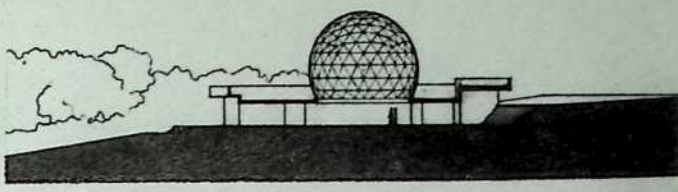
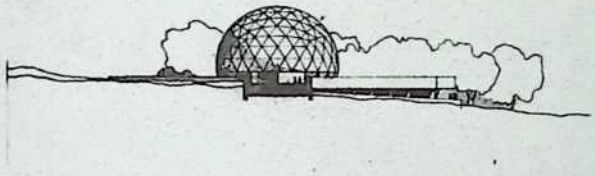




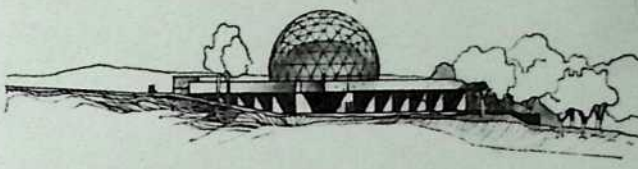
Section A·A



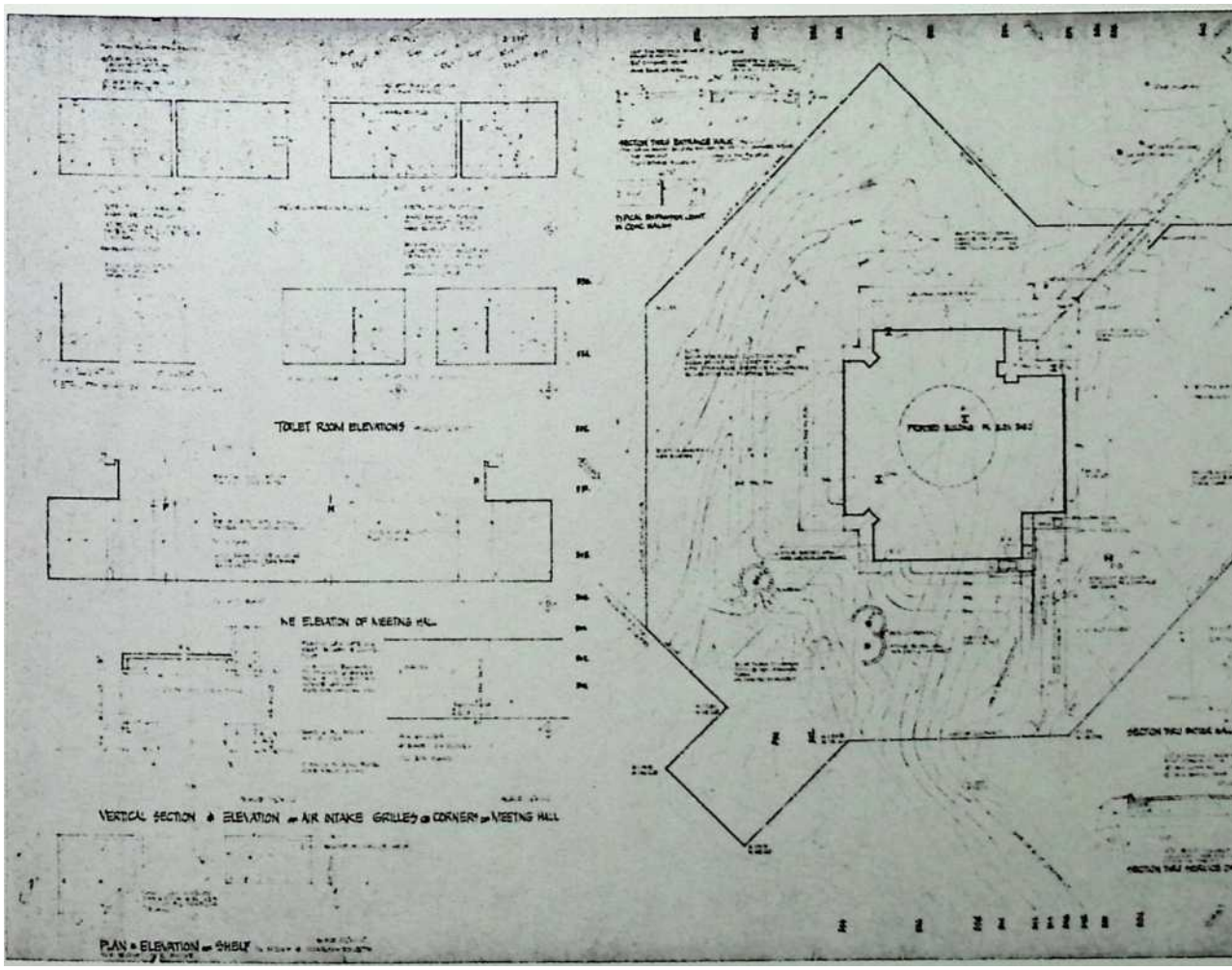
Section B·B

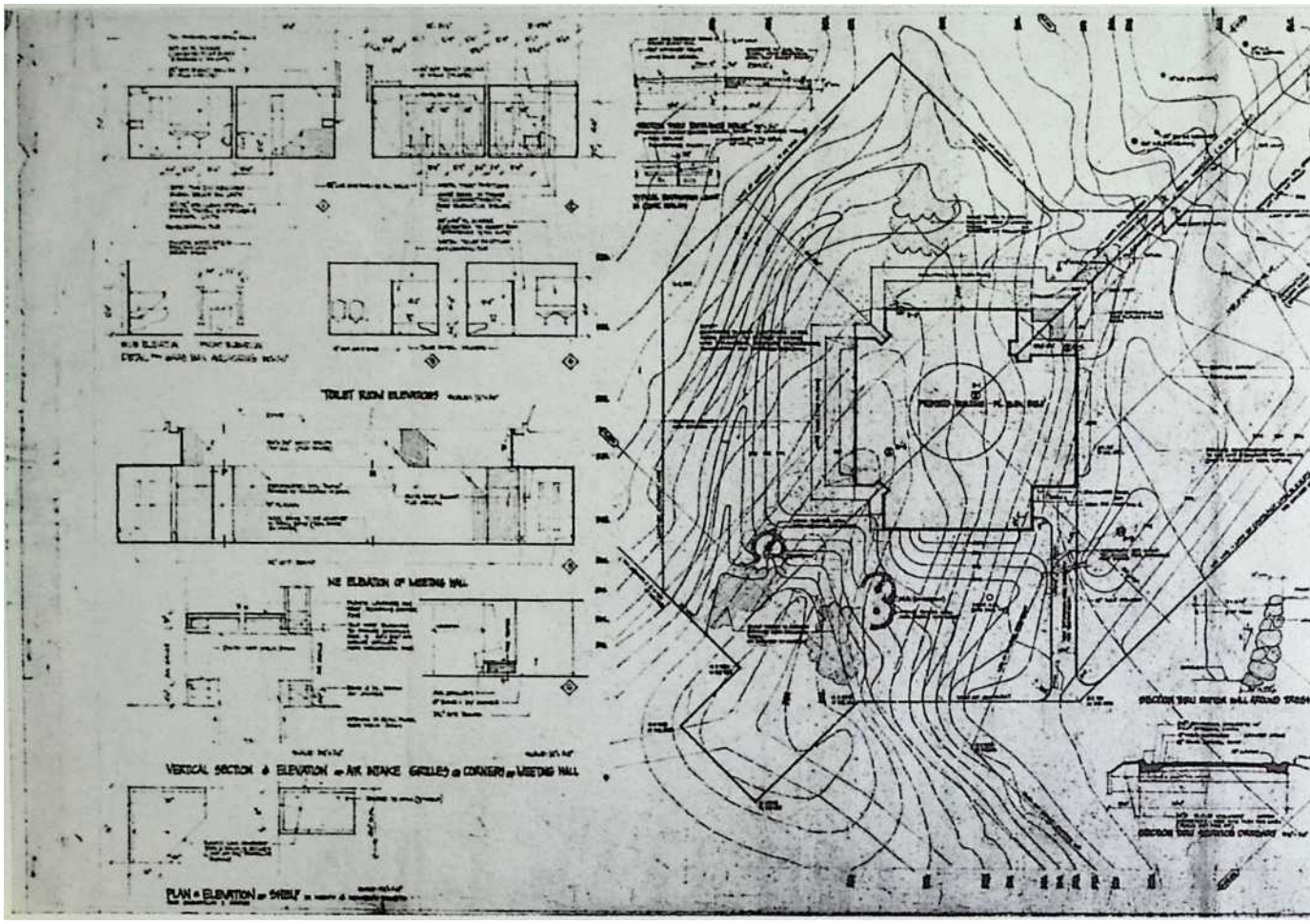


North Elevovation



West Elevation


TOILET ROOM ELEVATIONS
NE ELEVATION OF MEETING HALL
VERTICAL SECTION & ELEVATION AIR INTAKE GRILLES CORNERS MEETING HALL
PLAN & ELEVATION SHELF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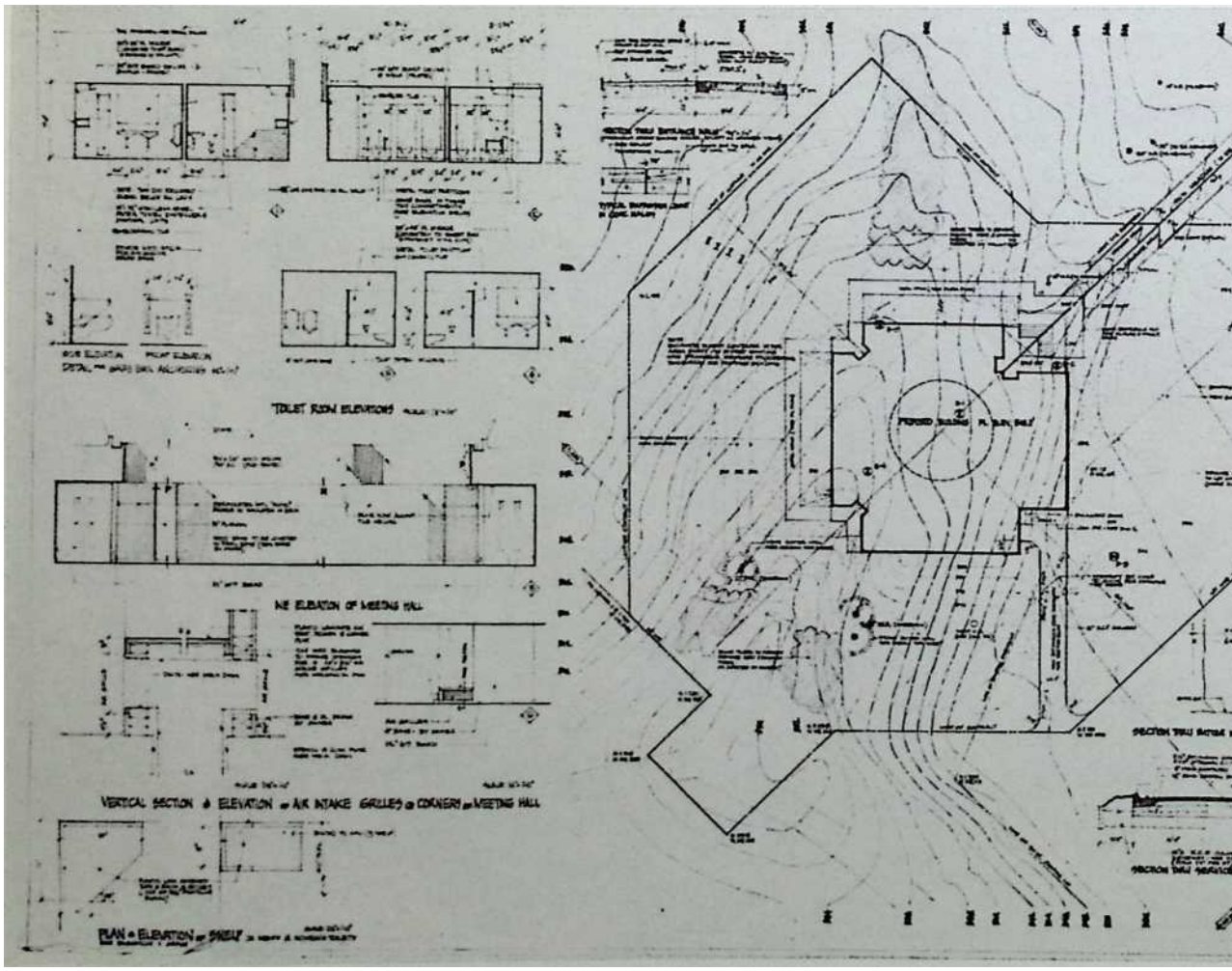
NE ELEVATION OF MEETING HALL
VERTICAL SECTION & ELEVATION OF AIR INTAKE GRILLES IN CORNERS OF MEETING HALL
PLAN & ELEVATION OF SHELF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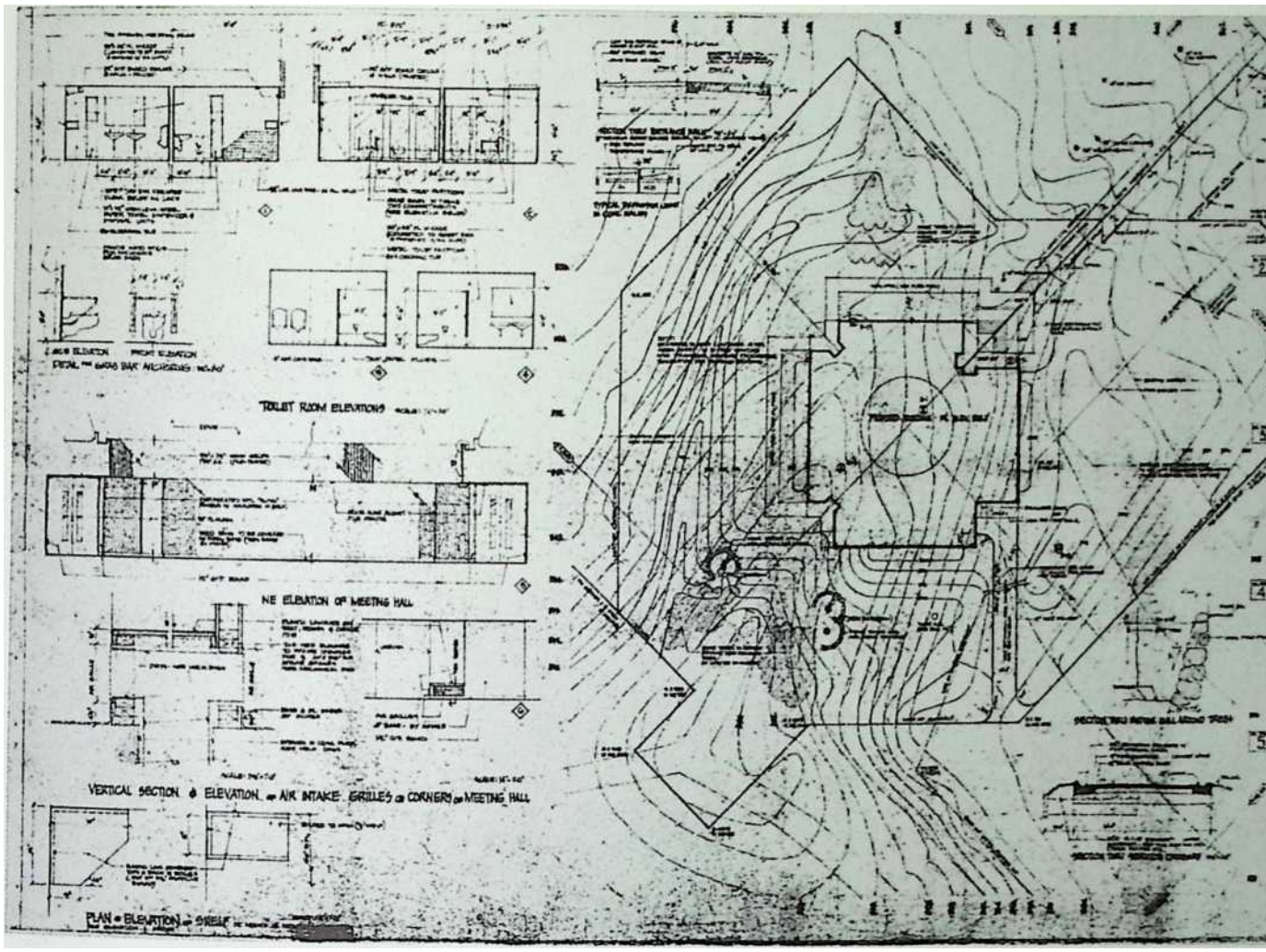
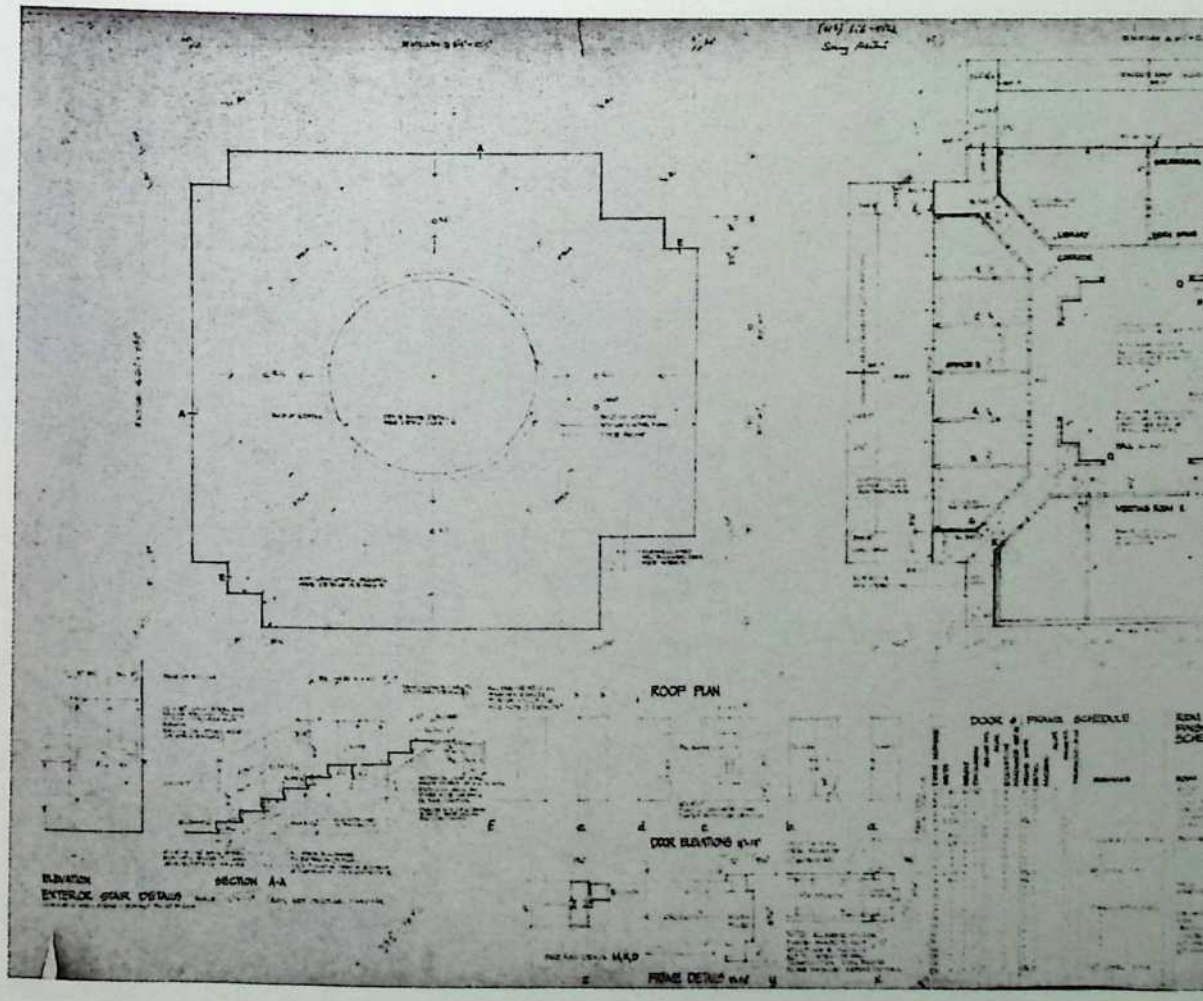
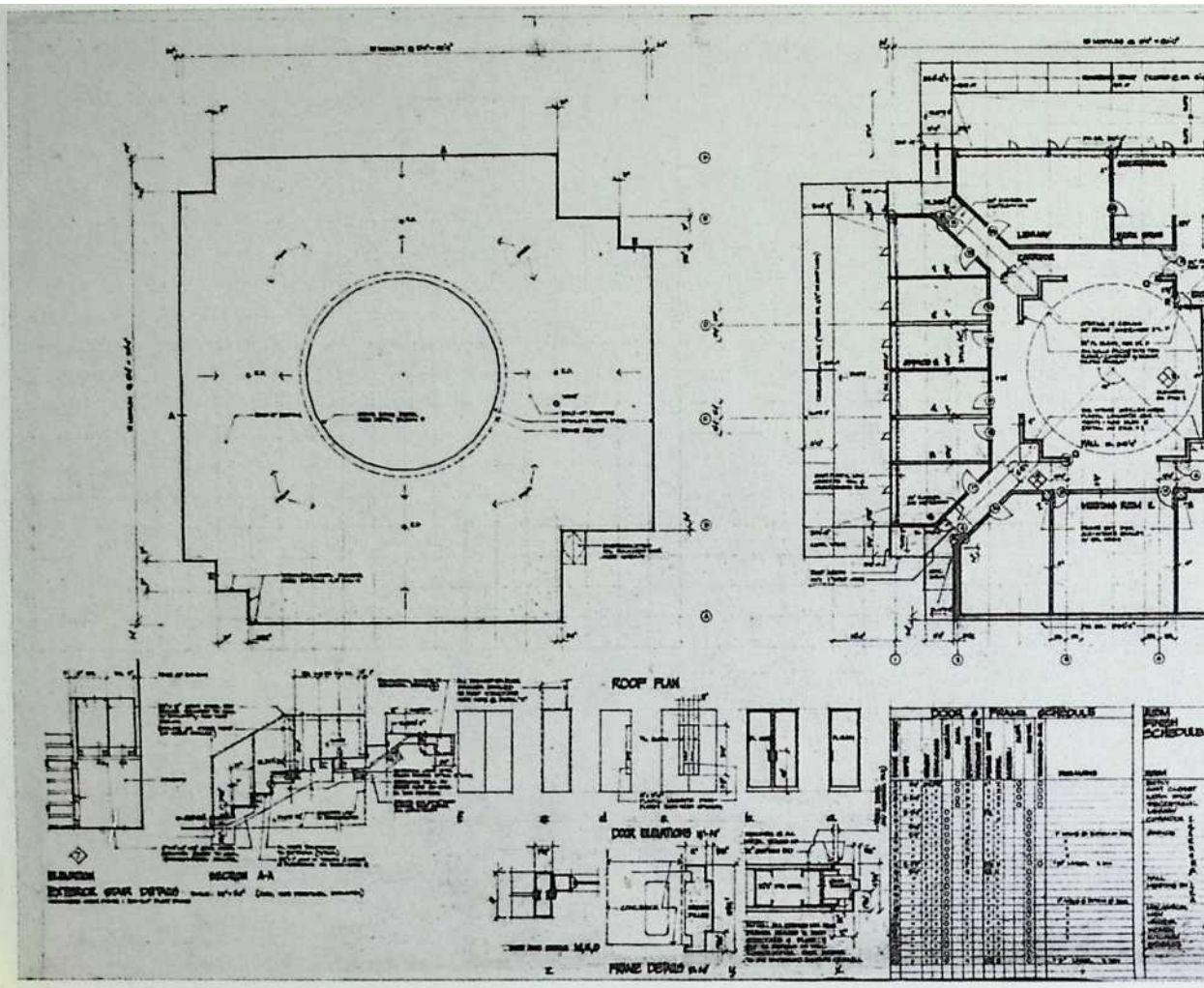
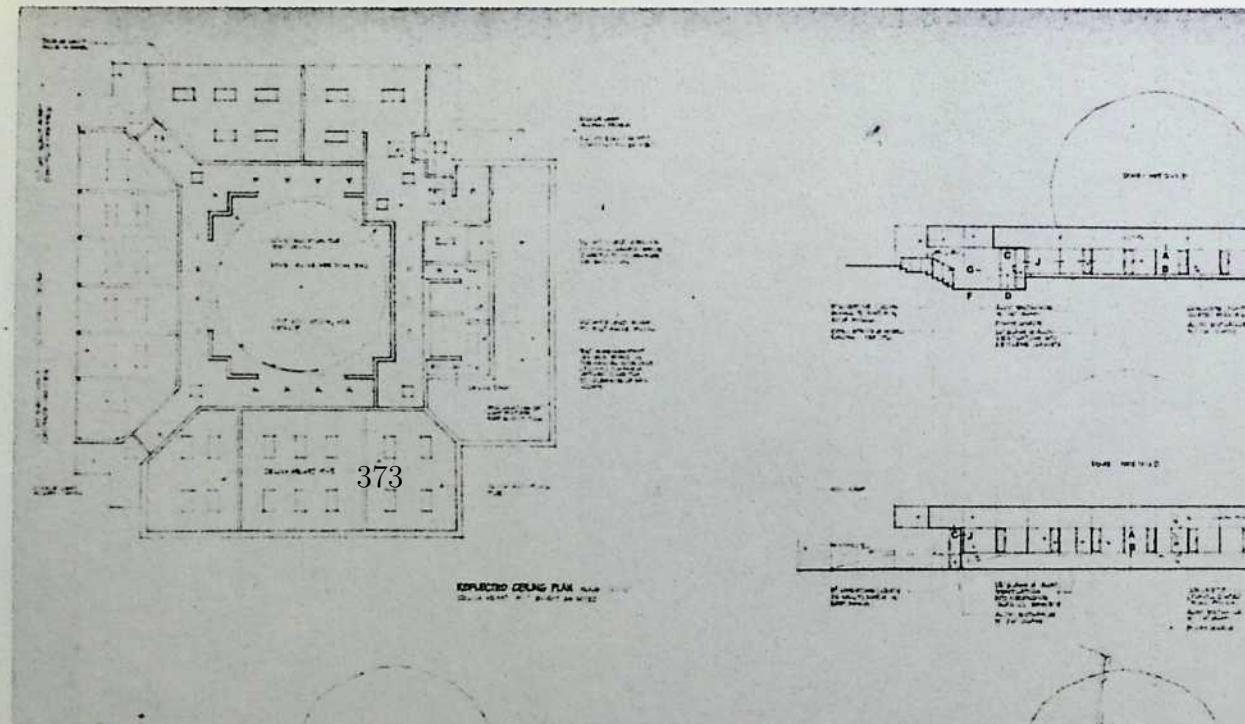
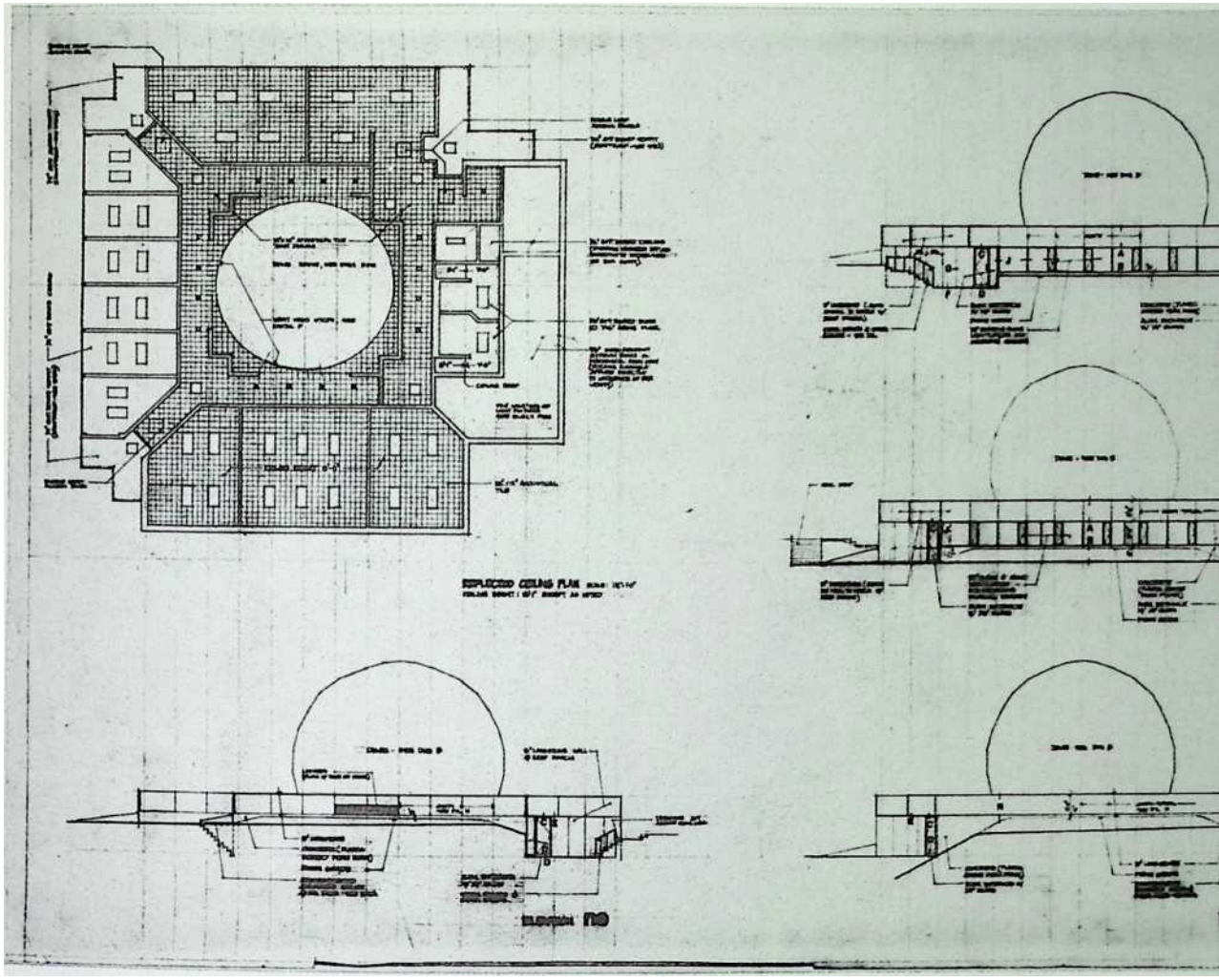
VERTICAL SECTION & ELEVATION OF AIR INTAKE GRILLES @ CORNERS OF MEETING HALL
PLAN & ELEVATION OF SHELF


TOILET ROOM ELEVATIONS
NE ELEVATION OF MEETING HALL
VERTICAL SECTION & ELEVATION OF AIR INTAKE GRILLES ON CORNERS OF MEETING HALL
PLAN & ELEVATION OF SINGLE


ROOF PLAN
DOOR & FRAME SCHEDULE
DOOR ELEVATIONS
ELEVATION
SECTION A-A
EXTERIOR STAIR DETAILS
FRAME DETAILS


ROOF PLAN
DOOR ELEVATIONS
FRAME DETAILS
SECTION A-A
EXTERIOR WINDOW DETAILS
DOOR & FRAME SCHEDULE


REFLECTED CEILING PLAN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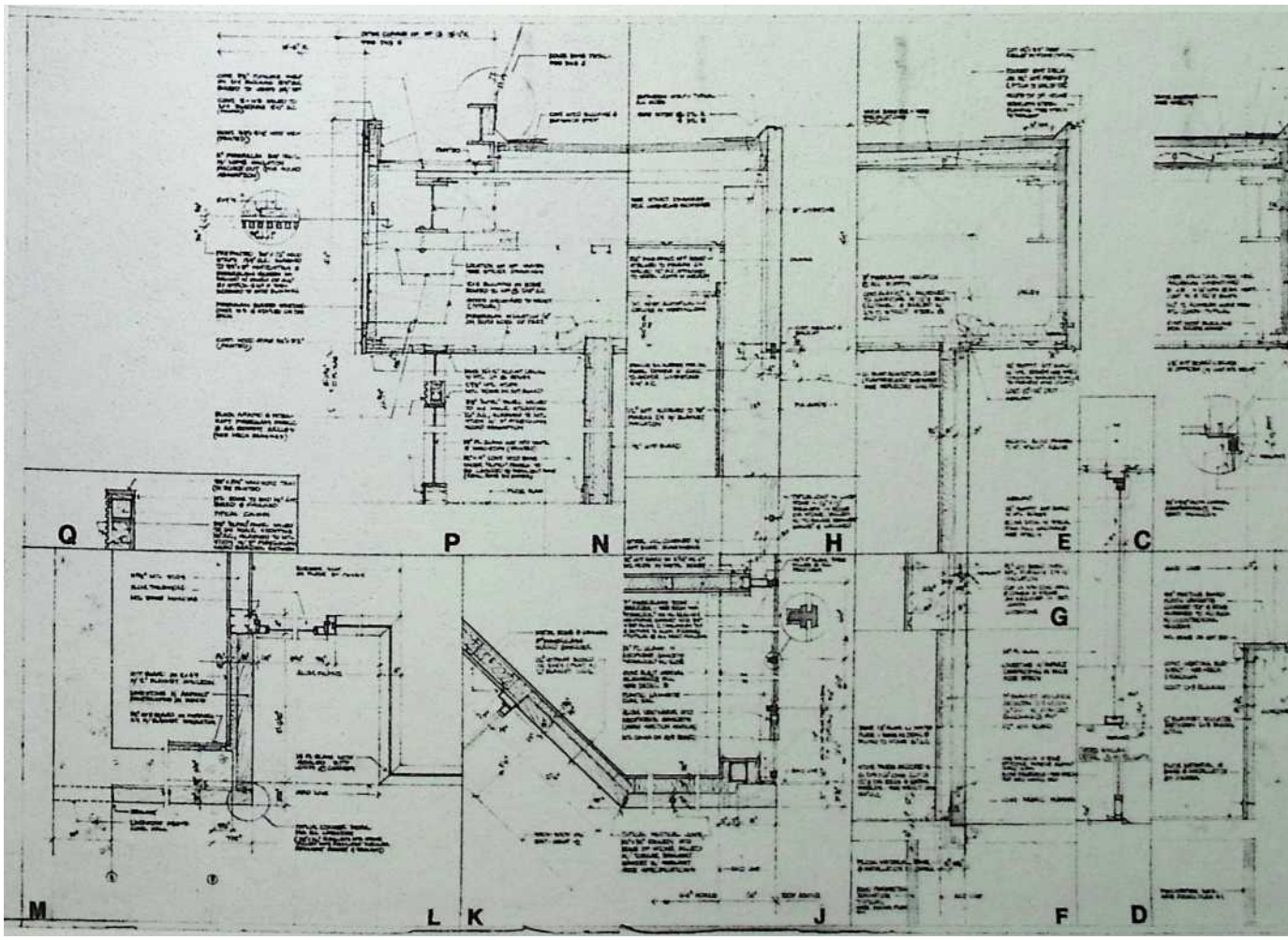
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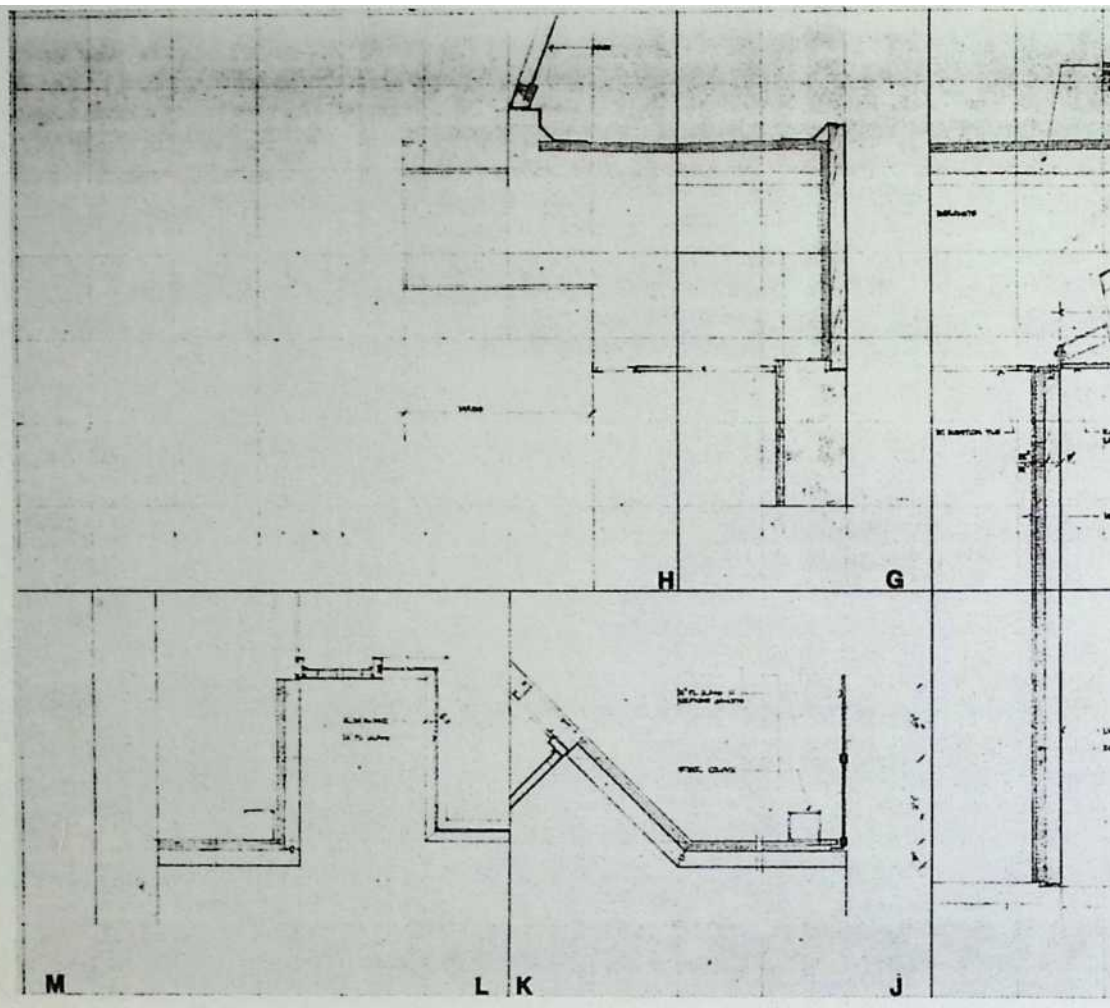
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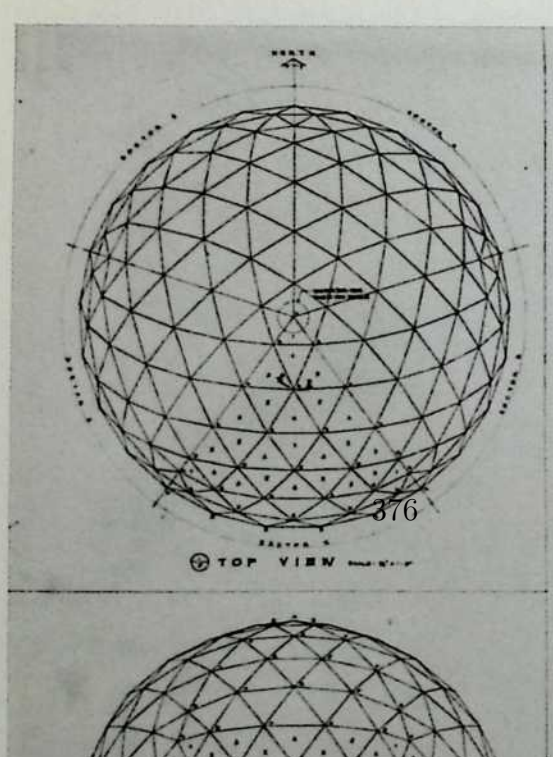
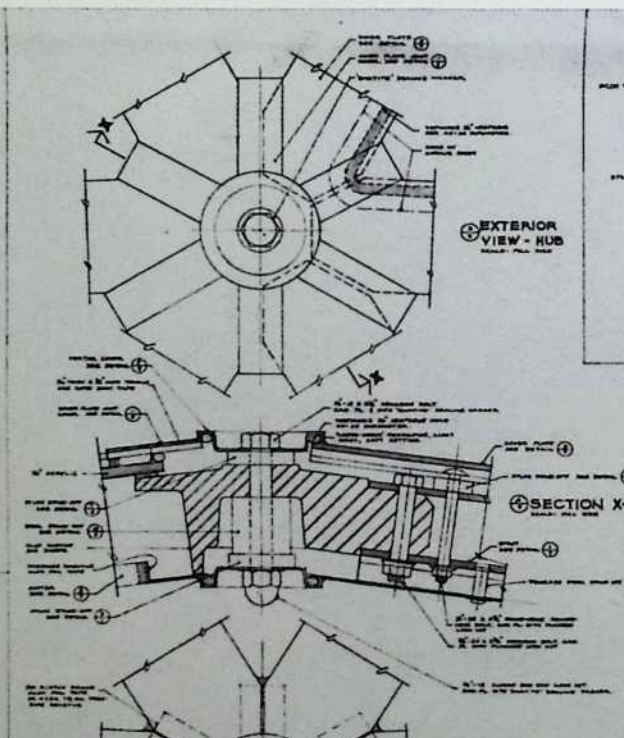
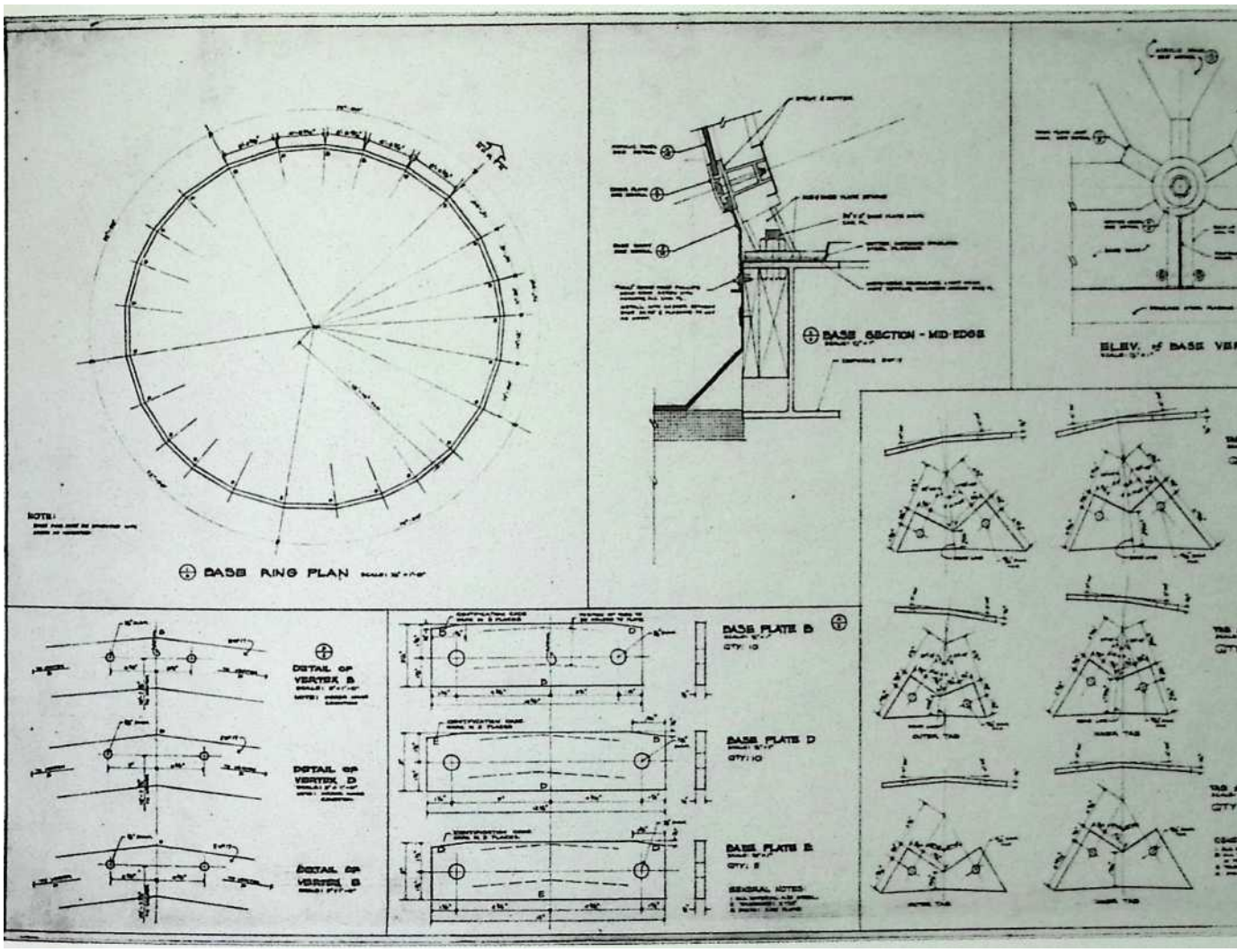
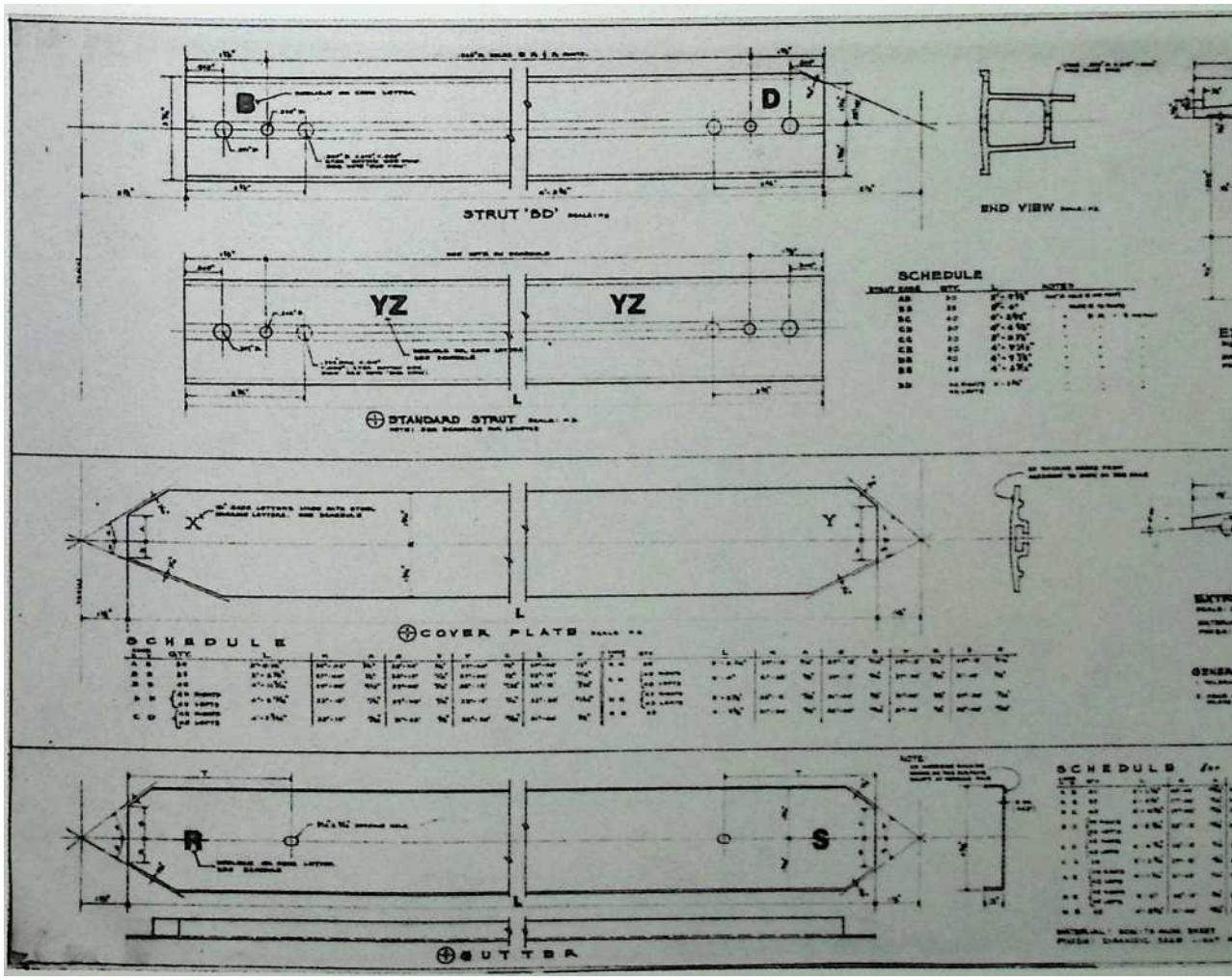
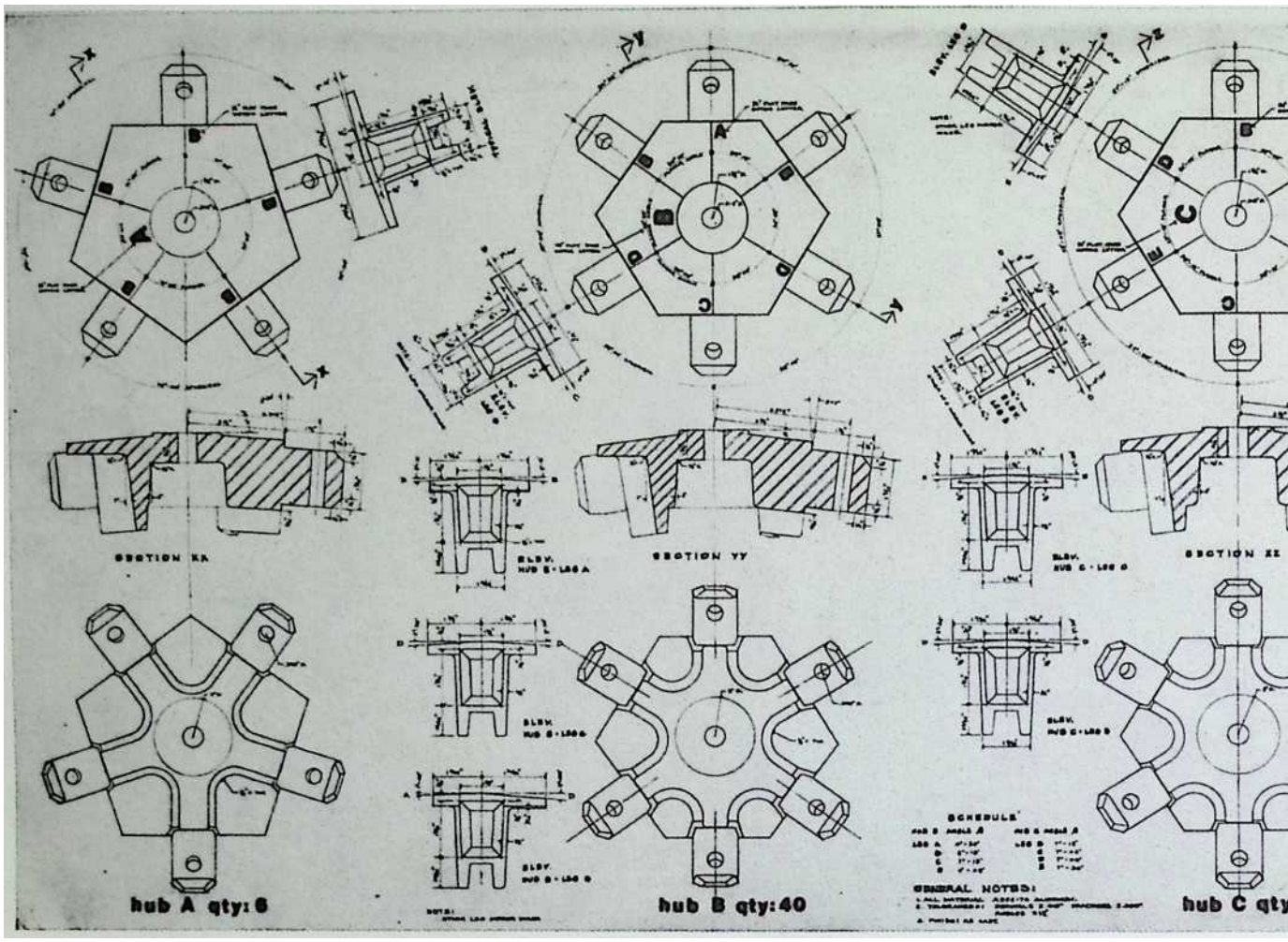
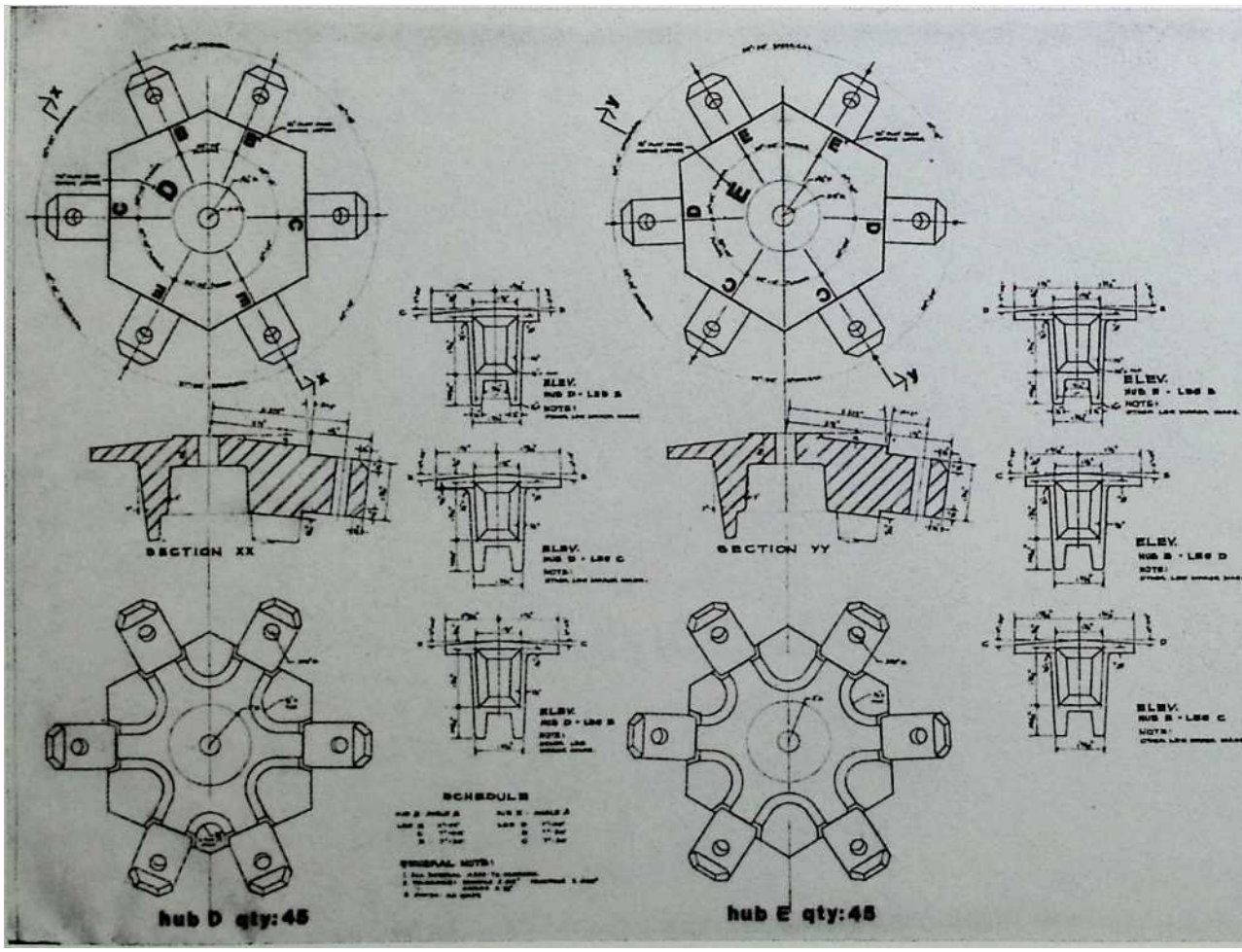

TOP VIEW

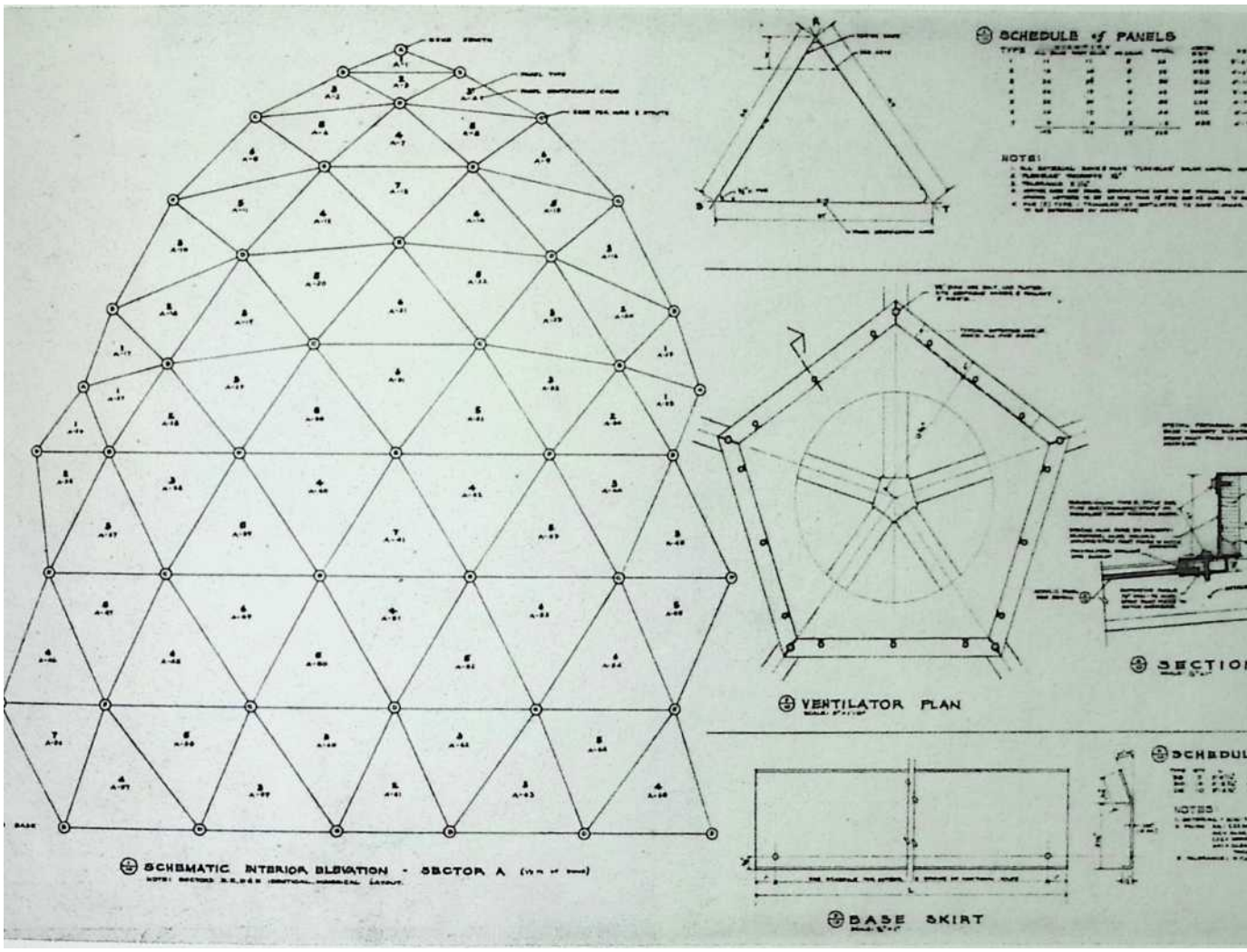

EXTERIOR VIEW - HUB

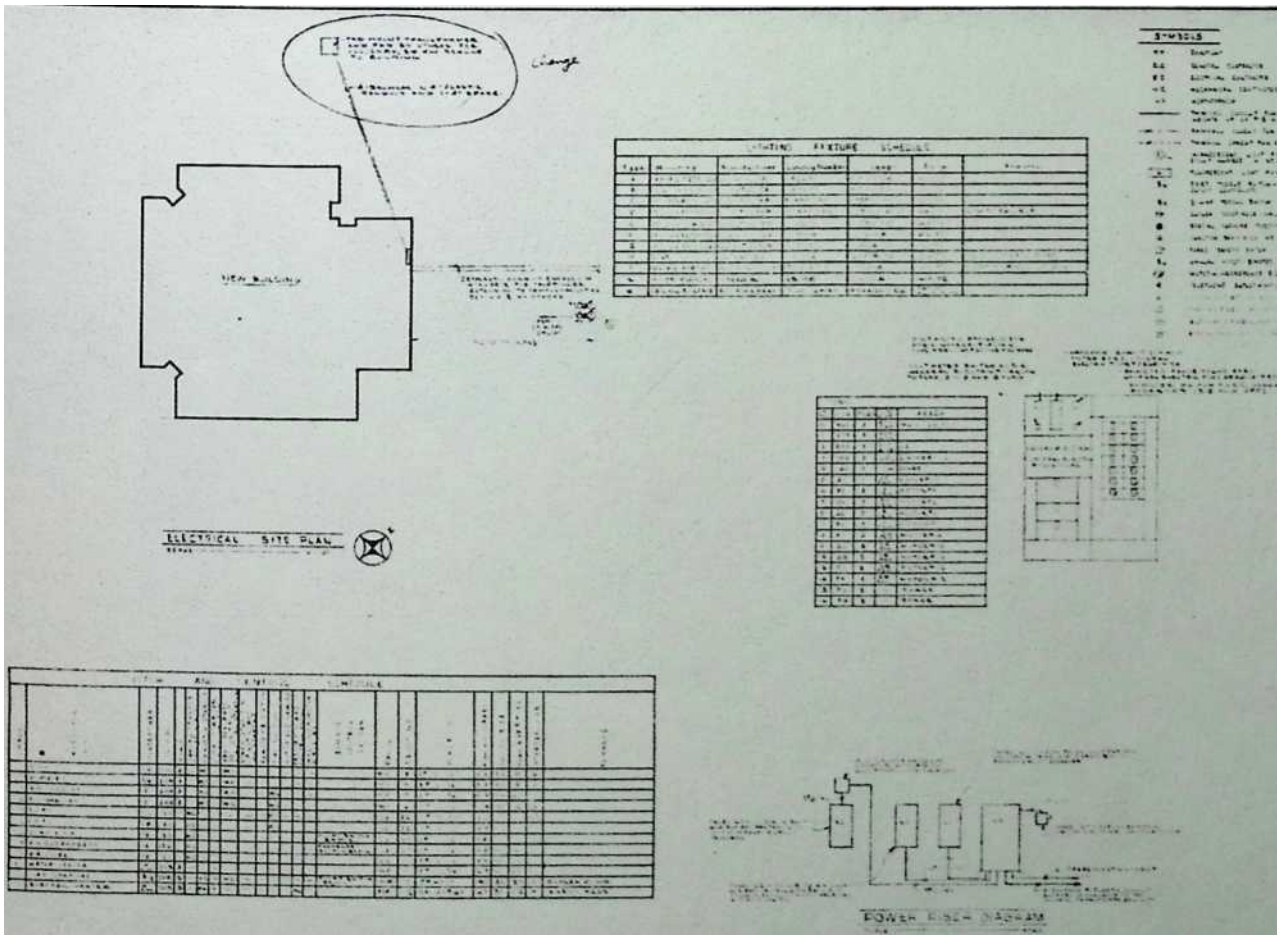

BASE RING PLAN
BASE SECTION - MID EDGE
DETAIL OF VERTEX B
DETAIL OF VERTEX D
DETAIL OF VERTEX B
BASE PLATE B
BASE PLATE D
BASE PLATE B

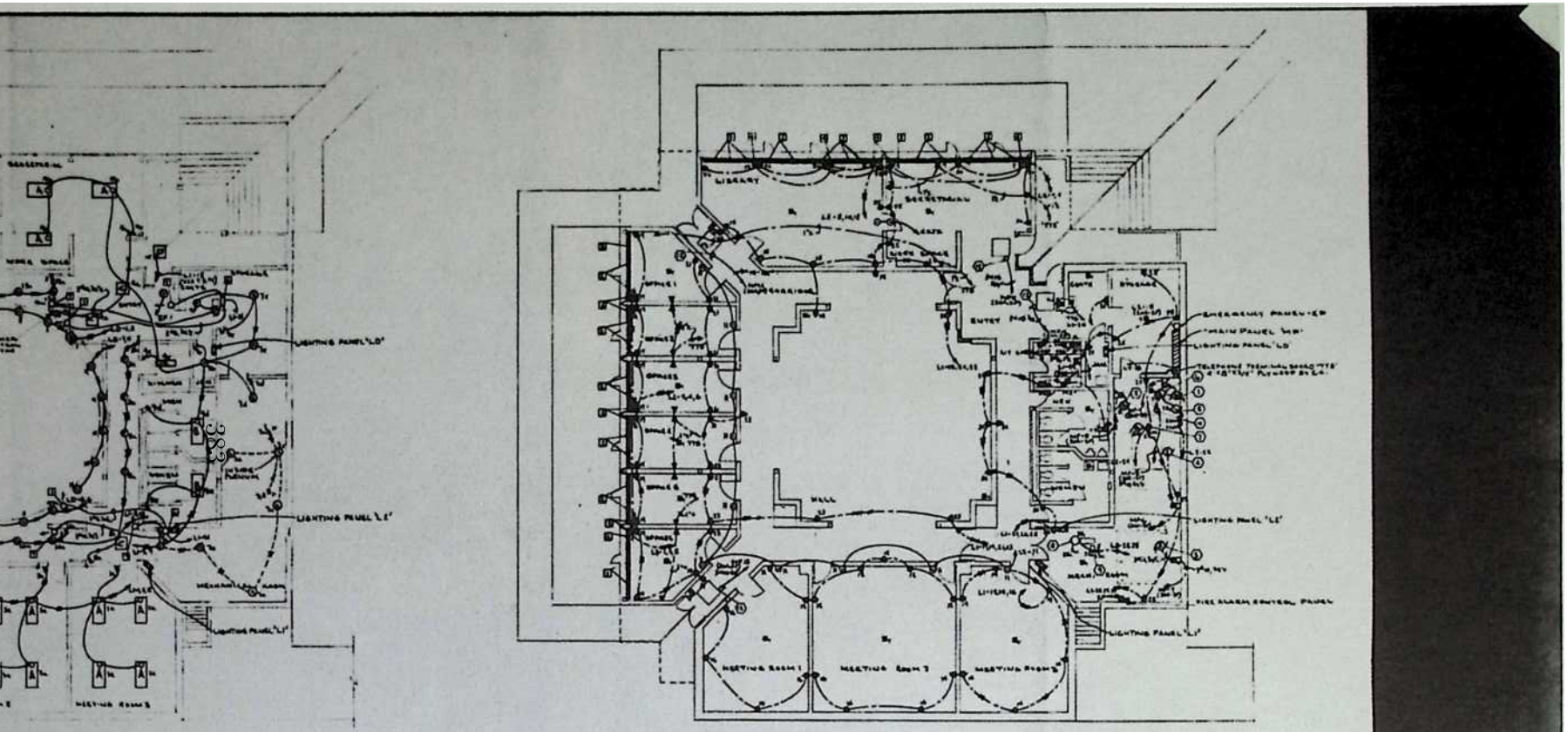

B
D
STRUT 'BD'
END VIEW
SCHEDULE
YZ
YZ
STANDARD STRUT
X
Y
COVER PLATE
SCHEDULE
R
S
SCHEDULE


SECTION XX
SECTION YY
SECTION ZZ
SCHEDULE
GENERAL NOTES:
hub A qty: 6
hub B qty: 40
hub C qty


SECTION XX
SECTION YY
ELEV.
SCHEDULE
hub D qty:45
hub E qty:45


SCHEDULE of PANELS
NOTES:
VENTILATOR PLAN
SCHEMATIC INTERIOR ELEVATION - SECTOR A
BASE SKIRT


ELECTRICAL SITE PLAN
POWER RISER DIAGRAM



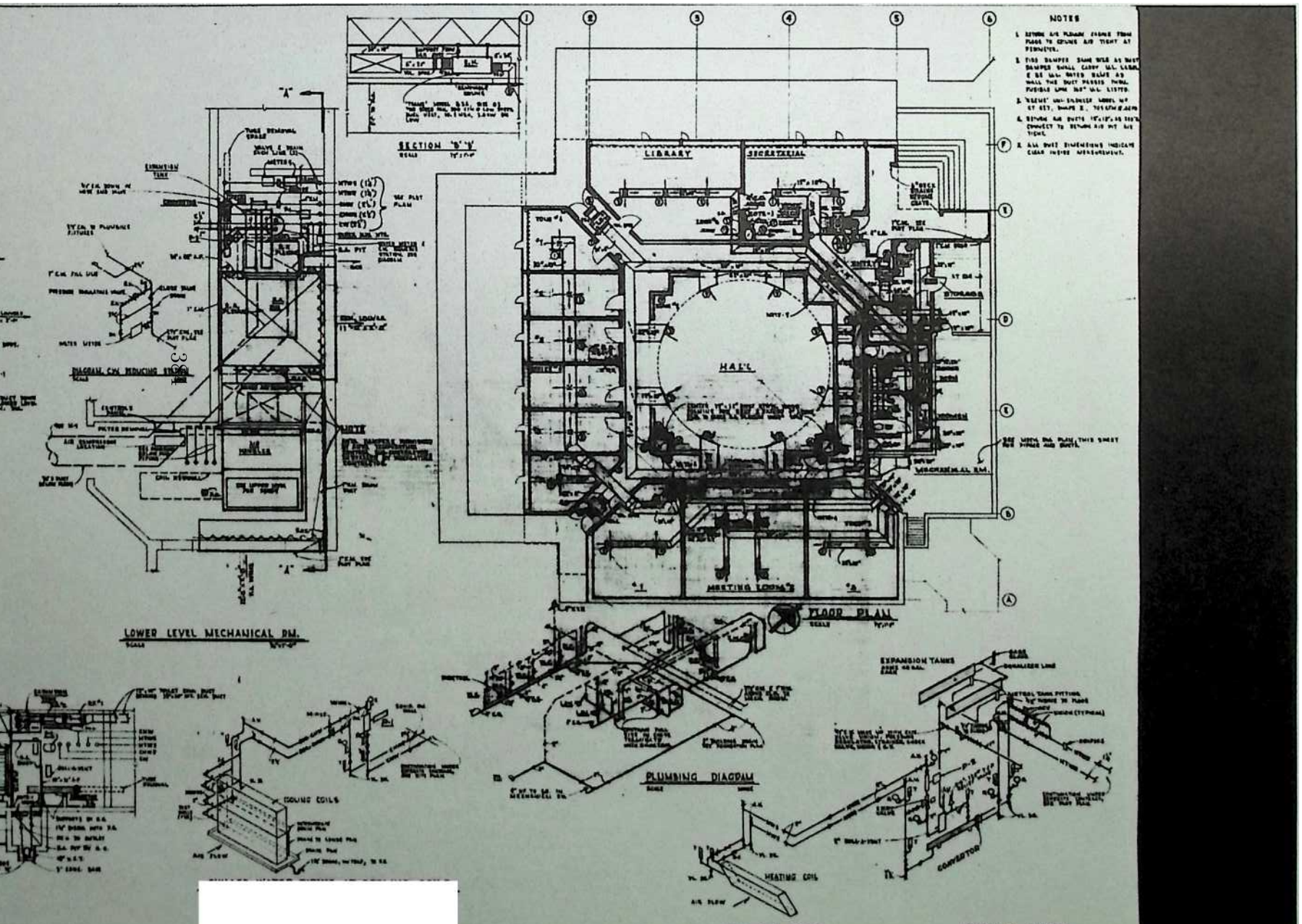
LOOR PLAN

POWER FLOOR PLAN

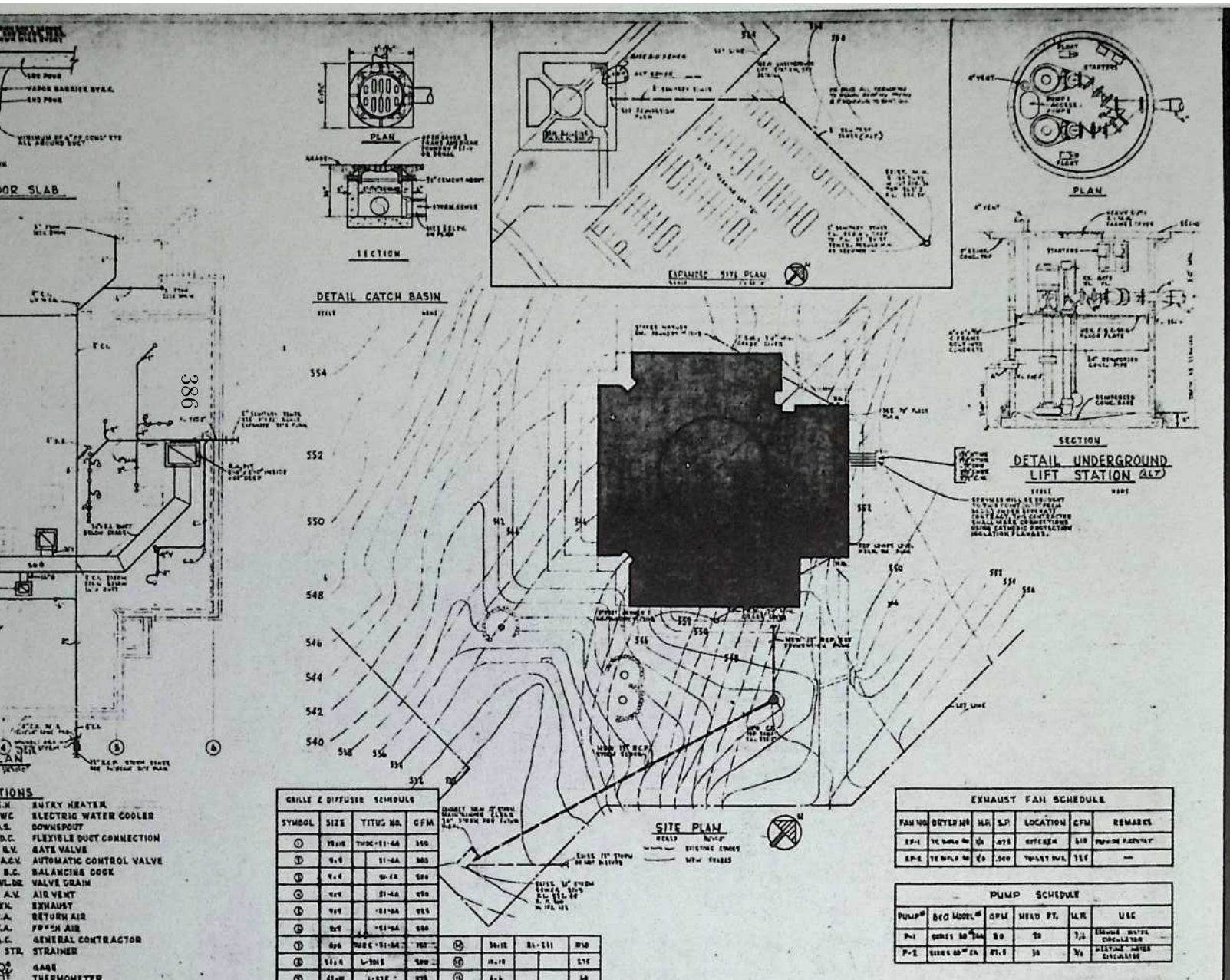
SCALE

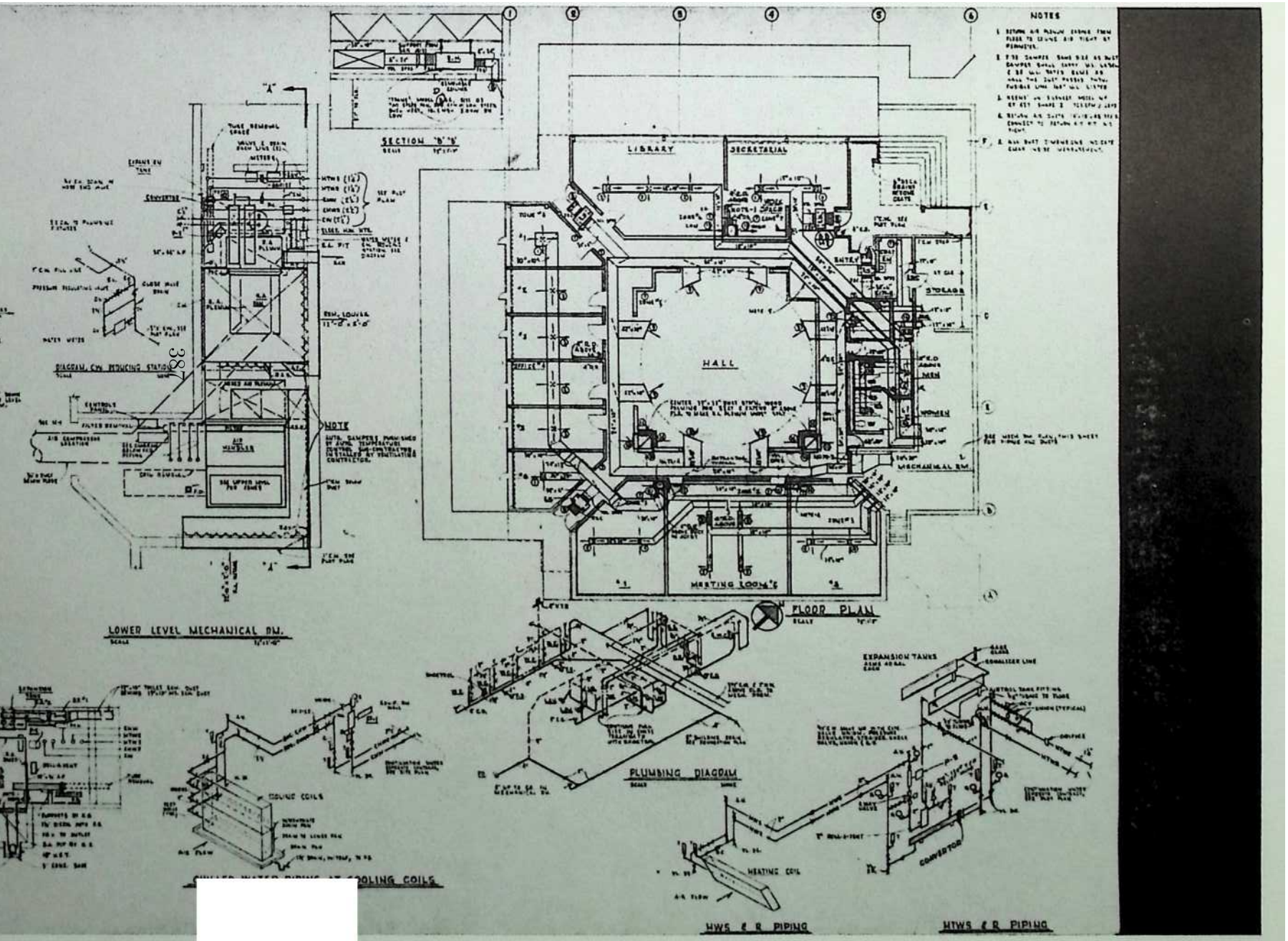
NOTES

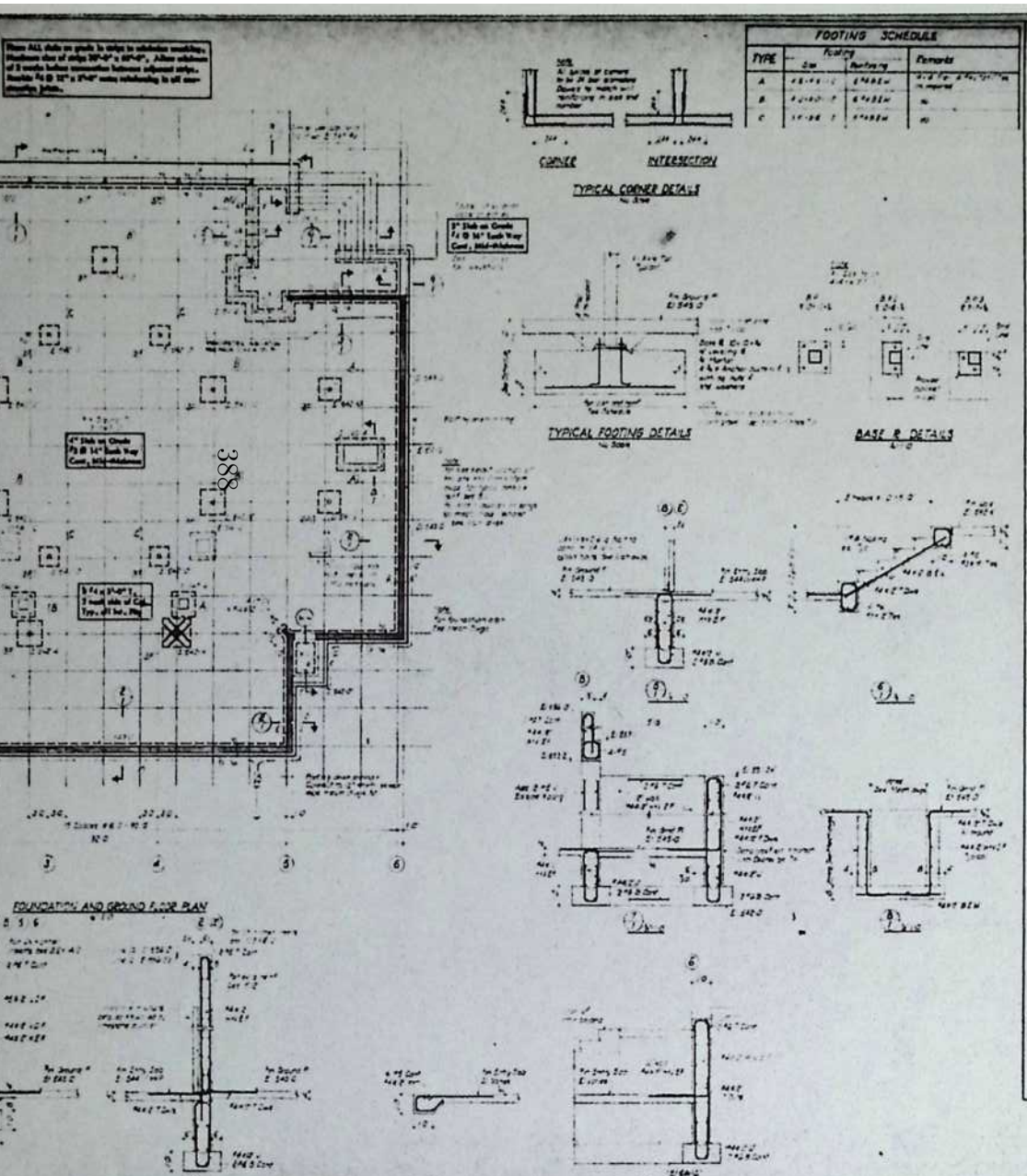
1. EMERGENCY LIGHT (1 HEAD) / DUAL-LIGHT # [illegible] WITH # [illegible] LIGHT, MOUNTED ON # [illegible] MOUNTING PLATE. MOUNT ON SAME AXIS AS TO FLUORESCENT LIGHT. SEE NOTE 5.
2. ELECTRIC DRAFT BARRIER, 'ELECTROMASTER' # T3-6AL OR APPROVED EQUAL. MOUNT AS SHOWN ON DRAWING # [illegible], [illegible] WATTS, [illegible], SEE NOTE 5.
3. ELECTRIC DRAFT BARRIER, 'ELECTROMASTER' # T3-6SL OR APPROVED EQUAL. MOUNT AS SHOWN ON DRAWING # [illegible], [illegible] WATTS, [illegible], SEE NOTE 5.
4. ELECTRIC DRAFT BARRIER AND THERMOSTAT BUILT-IN-TO UNIT, SEE NOTE 5.
5. ITEMS TO BE FURNISHED AND INSTALLED COMPLETE AND READY FOR OPERATION BY E.C.
6. EMERGENCY BATTERY UNIT - 'DUAL-LIGHT' # AD-[illegible] OR APPROVED EQUAL COMPLETE WITH # [illegible] SHELF, SEE NOTE 5.
7. EMERGENCY LIGHT - 'DUAL-LIGHT' # EXT-[illegible] WITH # [illegible] LAMP, SEE NOTE 5.


NOTES
SECTION "B"-"B"
LIBRARY
SECRETARIAL
HALL
MEETING ROOMS
STORAGE
LOWER LEVEL MECHANICAL RM.
FLOOR PLAN
PLUMBING DIAGRAM
EXPANSION TANKS
COOLING COILS
HEATING COIL
CONVECTOR

WWUm biLVM ww


PLAN
SECTION
DETAIL CATCH BASIN
EXPANDED SITE PLAN
PLAN
SECTION
DETAIL UNDERGROUND LIFT STATION (ALT)
SITE PLAN
554
552
550
548
546
544
542
540
EXHAUST FAN SCHEDULE
PUMP SCHEDULE
GRILLE & DIFFUSER SCHEDULE
ENTRY HEATER
ELECTRIC WATER COOLER
DOWNSPOUT
FLEXIBLE DUCT CONNECTION
GATE VALVE
AUTOMATIC CONTROL VALVE
BALANCING COCK
VALVE DRAIN
AIR VENT
EXHAUST
RETURN AIR
FRESH AIR
GENERAL CONTRACTOR
STRAINER
GAGE
THERMOMETER


NOTES
SECTION "B"-"B"
LIBRARY
SECRETARIAL
HALL
STORAGE
MEN
WOMEN
MECHANICAL RM.
MEETING ROOM'S
FLOOR PLAN
LOWER LEVEL MECHANICAL RM.
PLUMBING DIAGRAM
EXPANSION TANKS
COOLING COILS
HEATING COIL
CONVECTOR
HWS & R PIPING
HTWS & R PIPING



FOOTING SCHEDULE

TYPE	Footing Size	Footing Reinforcing	Remarks
A	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]	[illegible]

GENERAL NOTES

SPECIFICATIONS
Refer to the project specifications for detailed requirements for material and workmanship.

DESIGN LIVE LOADS
1) Roof — 25 psf, except design load increases from 25 psf at 25 ft beyond eave to 90 psf at front of dome.
2) Wind — 100 mph.

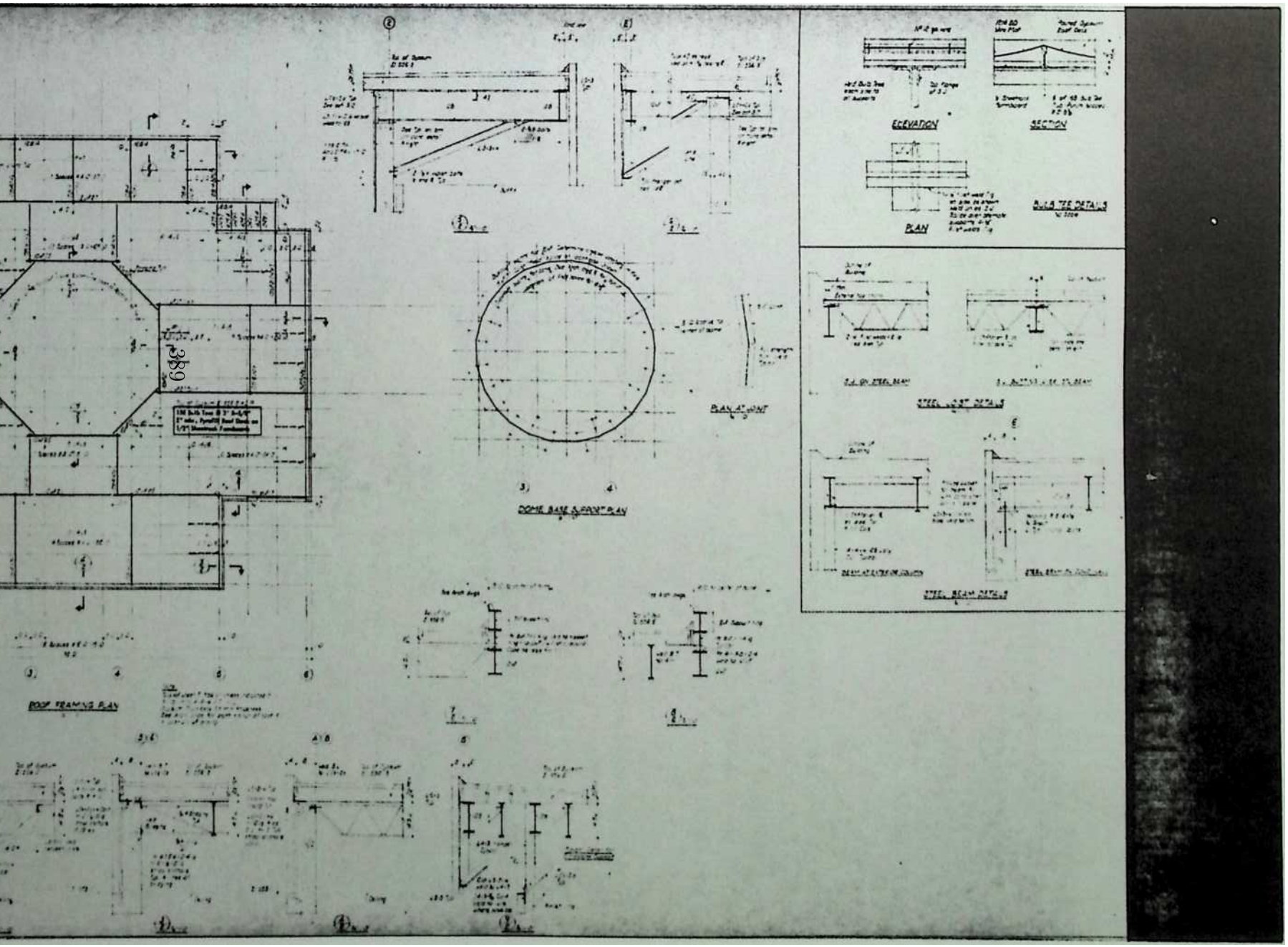
SOIL BEARING CAPACITY
1) Natural Undisturbed Soil and Compacted Backfill — 2000 psf even for interior footings
2) — 1500 psf even for wall footings

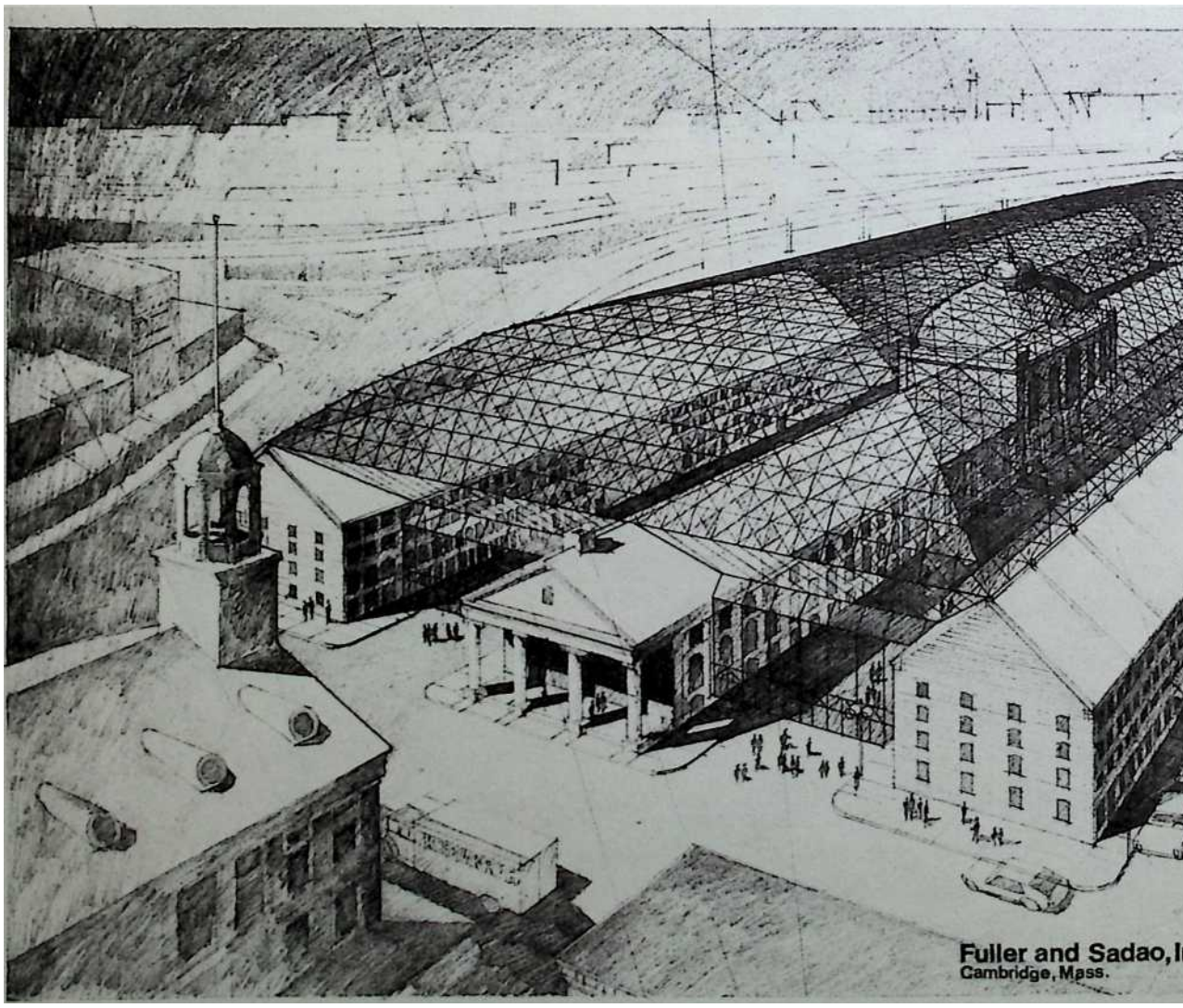
FOUNDATIONS
1) Excavation — Excavate to lines and grades required to properly benefit the foundations on undisturbed soil or on compacted fill approved by the Architect. Remove all soft clay or loamy material from under slab on grade.
2) Soil Preparation — Prepare approved bearing material under foundations and slabs on grade as required by removing loose material from the surface or compacting as directed.
3) Footings — Exterior wall footings are to be placed on natural soil or approved compacted fill at a minimum depth of 2 ft below the lowest adjacent ground surface unless required to bearing, and interior footings are to be placed on natural soil or approved compacted fill at elevations shown on plans. Any adjustment of elevations of footings due to field conditions must have written approval of the Architect. Backfill the excavation with approved backfill material placed in 6 in. layers and compacted to 95% density of optimum moisture content as indicated in the project specifications after bottom of excavation has been approved by the Architect. Provide 6 in. layer of compacted crushed stone or pea gravel immediately below slab on grade.
4) Backfill Under Slab on Grade
5) Backfill Against Foundation Walls — Backfill against foundations only after gypsum slab at roof level has been in place a minimum of 7 days and foundation walls have attained their full design strength. Provide free draining granular material against walls and footing perimeter drains as shown on the drawings.

CONCRETE WORK
1) Design Strength of Concrete — All concrete - 3000psi
2) Portland Cement — ASTM C150 Type I or II - Cement factor as required for design but not less than 6 sacks/cu yd for 3000 psi.
3) Aggregate — ASTM C33 - 3/4 in., maximum size for structural concrete.
4) Admixtures — Use air entraining agent ASTM C260 as required to provide 4-6% total air for concrete walks, steps, foundation walls, and footings.
Use water reducing agent ASTM C494 in all concrete. Calcium Chloride may not be used to accelerate the setting time.
5) Water — Potable with maximum water cement ratio of 6 gals per sack.
6) Slump — Pavement, walks and slabs on grade 1 in., to 3 in. All other concrete 2-4 in.
7) Minimum Concrete Cover over Reinforcing Steel — Concrete placed against earth, 3 in., except slabs on grade. Formed concrete exposed to earth,weather or water, 2 in. Slabs on grade, 1-1/2 in. Formed slab top and bottom, 3/4 in.
8) Reinforcing Steel — ASTM 615 Grade 40, A305 deformations for bars, ASTM A185 or A497 for welded wire fabric. Provide PS chair bars, bolsters, ties, clips, and chairs as required. Galvanize accessories in concrete exposed to weather.
9) Splicing Reinforcing — 36 diameters in slabs, walls, and at corners. Lap wall steel for full continuity.
10) Curing — Maintain curing compound conforming to ASTM C309, or 6 days of continuous water curing.
11) Testing and Control — Concrete mixes to be designed and controlled at the batch plant, and to be field by an approved independent testing laboratory. Submit for approval proposed mix mixes based on results of test cylinders. Submit for approval the methods to be used to protect concrete when air temperature is below 32°F.
12) Codes and Standard Practice — Comply with the latest recommendations and specifications of the American Concrete Institute:
ACI 318 for general design of items not otherwise specified
ACI 347 for formwork
ACI 306 for cold weather concreting
ACI 613, 614 for design of mix, batching, and placing of concrete
ACI 315 for detailing of reinforcing steel
13) Shop Drawings — Submit for Architect's approval complete bending and placing details for all reinforcing steel.
14) Grouting — Grout under all column leveling plates with Portland cement-sand-mortar (1:2).

STRUCTURAL STEEL
1) Structural Shapes — ASTM A36
2) Bolts — ASTM A325, 3/4" ϕ; Anchor bolts A307
3) Square Columns — ASTM A500 Grade B, Seamless tubing, concrete filled
4) Concrete for Square Col. — 3500 psi at 28 days installed in shop
5) Welding Electrodes — AWS Specifications for type and grade of steel.
6) Fabrication — Shop fabricate to greatest extent possible by welding including beam stiffeners, column caps and bases, holes and connections. Shop prime all steel not encased in concrete.
7) Erection — Provide anchor bolts, 1/4 in., leveling plates under all columns. Provide all necessary connecting hardware. Plumb and square all steel and provide temporary bracing until walls are in place.
8) Steel Joists — Steel Joist Institute J. Series, fabricated by a currently active member of the S.J.I. Fabricate joists in strict conformance with the standard specifications for open web steel joists, J series as adopted by the AISC. Provide complete detailed shop drawings and calculations for Architect's approval prior to fabrication. Provide certified mill certificates on all steel used in joist fabrication. Provide extended bottom and top chords where indicated and horizontal and bridging as detailed.
9) Lintels — For openings in masonry walls not otherwise provided for, see Architect's drawings, or provide for each 4 in. thickness of wall:
1L 3 x 3 x 3/16 for openings not over 3'-0" long
1L 3-1/2 x 3-1/2 x 3/16 for wider openings up to 7'-0" long
10) Standard Specifications — Comply with AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings, the AISC Code of Standard Practice, and the applicable specifications of the American Welding Society.
11) Shop Drawings — Submit complete shop drawings of all structural steel from field dimensions for the Architect's approval prior to fabrication.

GYPSUM DECK
1) Gypsum Formboard — ASTM C318 1/2 in. thick treated sheathing by U.S.Gypsum Co.
2) Poured Gypsum — ASTM C317 U.S. Gypsum Pyrofill
3) Welded Wire Fabric — ASTM A185 Galvanized 4 x 8 - 12/14
4) Bulb Tees — PTSX welded to all supporting members or as shown on drawings. Run tees continuous over 2 spans and stagger end joints.
5) Tests — Test cylinders shall be taken at the roof level by a representative of an independent testing laboratory approved by the Architect.


ROOF FRAMING PLAN
DOME BASE & FRAMING PLAN
ELEVATION
SECTION
PLAN
STEEL BEAM DETAILS


Fuller and Sadao,
Cambridge, Mass.

24 Vault for Quincy Market, Boston Fuller & Sadao, 1969

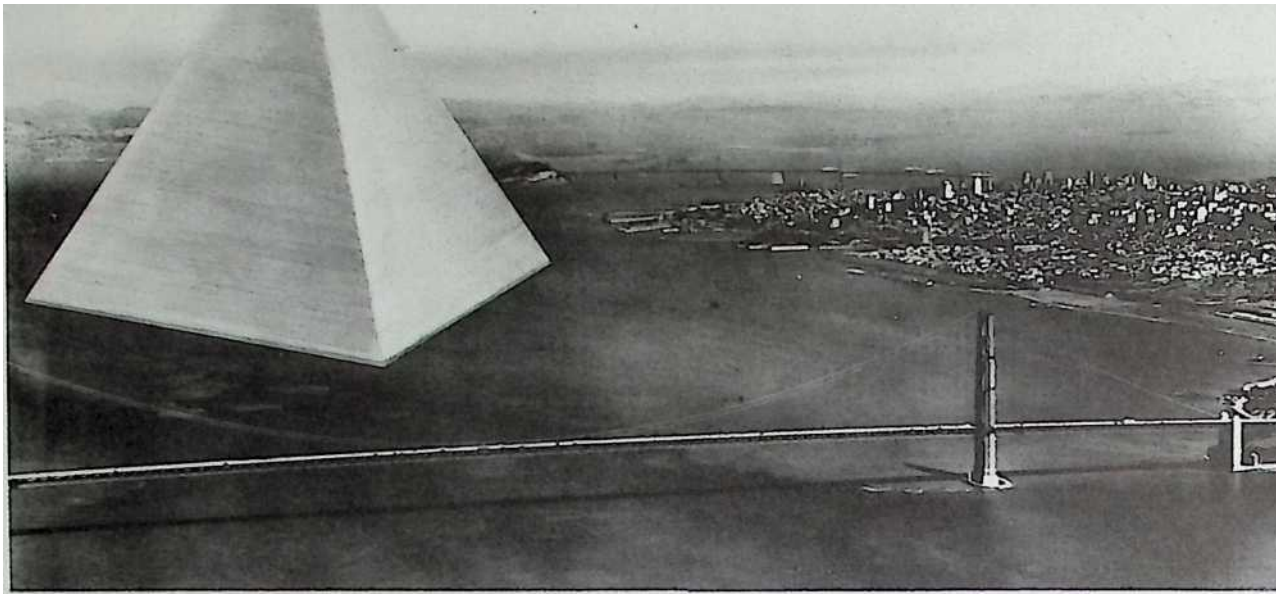
This proposal for Quincy Market comprises a series of octet trusses that, in tandem with the masonry construction of the colonial market, emphasizes the lightness of Fuller's technique. Ultimately, a more conservative restoration of the market was adopted.

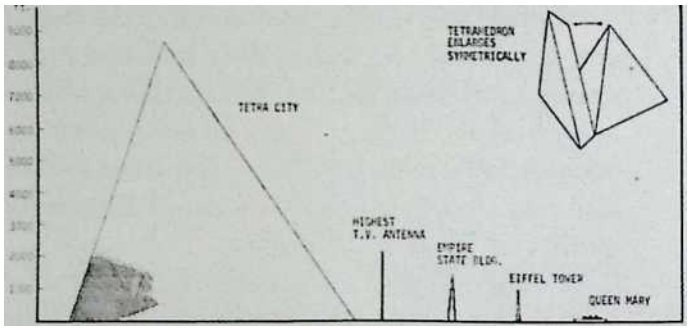
These three projects characterize three phases of Fuller's plan to make his metaphor Spaceship Earth' a reality. The first and best known of these is the hypothetical geodesic dome for New York City, the diameter of which would have covered fifty blocks of Manhattan Island (1960). From Fourteenth to Sixty-fourth streets and from the East River to the Hudson River the city becomes a single room. But this dome mainly was meant as a daring graphic metaphor to suggest the possibility of controlling the effects of sunlight and the quality of air.

25 Three Utopian Projects 1960–1970

Developed during the late sixties, the tetrahedron city was to be two miles wide and two miles high. It would have housed 300,000 families and would have been hollow. In fact, it would have been buoyant enough to float at sea. Thus the time and money usually required to obtain land could be redirected to the quality of the structure itself.

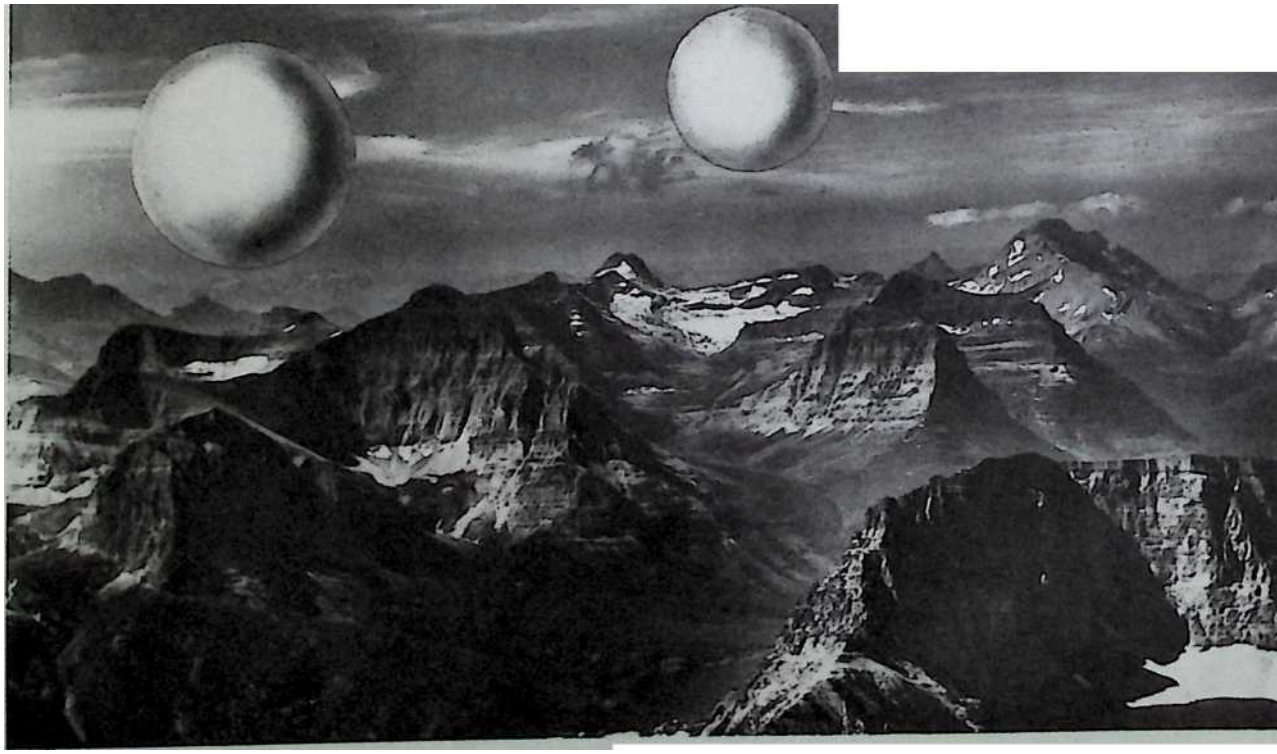
Finally in the late sixties, Fuller produced a scheme for floating cities housed by geodesic spheres up to a mile wide. Like the floating city, the airborne globes would have required no land. Their independence from earth would have made the flying spheres Fuller's first domestic satellites.





We find that 1 tetrahedronal city, to house a nil- Hcn people, it both technologically and economic- ally feasible. Such a vertical-tetrahcdronal-city can be constructed with all of itstbrec hundred thousand families each having balconied "outside* acartrents of t»o thousand square feet floor space. All of the machinery necessary to its operation will be housed Inside the tetrahedron, it is found that such a one nil lien passenger tetrahed- ronal city is so structurally efficient, and therefore so relatively lioht, that together with its hollow bov sectioned reinforced concrete foundations it can float. Such tetrahedror.al floating cities would rasure Uo riles to an cdie, and can be floated in a triangularly patterned canal. This ill make the whole structure earth-.uaic-croof. The whole city can be floated cut into the ocean to any point and anchored. The depth of its foundations will go tclow the turbulence level of the seas so that the floatin') tetrahedrons! island will be, in effect, a floatin') triangular atoll. Its t»o nile long toat' foundations will constitute landing strips for jet airplanes. Its interior ti.o nile harbor will provide refuse for the largest and smallest ocean vessels. The total structural and rcchanical materials involved in production of a nu-ber of such cities are within feasibility rannitude of the already operating retals manufacturing capabilities of any one company of the several major industrial nations around the earth. The tetrahedron city >*ay start with a thousand occupants and grew symmetrically to hold nil lions without changing overall shape though always providing each fanily with 2C0 $J. ft. of floor space. Withdrawal of materials fror obsolete buildings on the land will ;emlt the production of enough of these floatin-: cities to support frequently spaced floatini cities cf various sites around the oceans of the earth. This will permit etd-ocean cargo transferring and therewith an extraordinary increase of efficiency Of the Inter-distributicn of the

world's raw enJ finished products as well as of the passenger traffic. Three quarters of the cart- is covered ty water, fan is clearly intent on penetrating those >.-orld-around ocean waters in every way to work both their ocean totters and their marine life and chemistry resources. Sue*' ocean passage shortening habRais of ever trar - lent humanity will remit his individual fl.r i sailing, economic steoning stone travel arcund the whole Earth in nan/ directions.

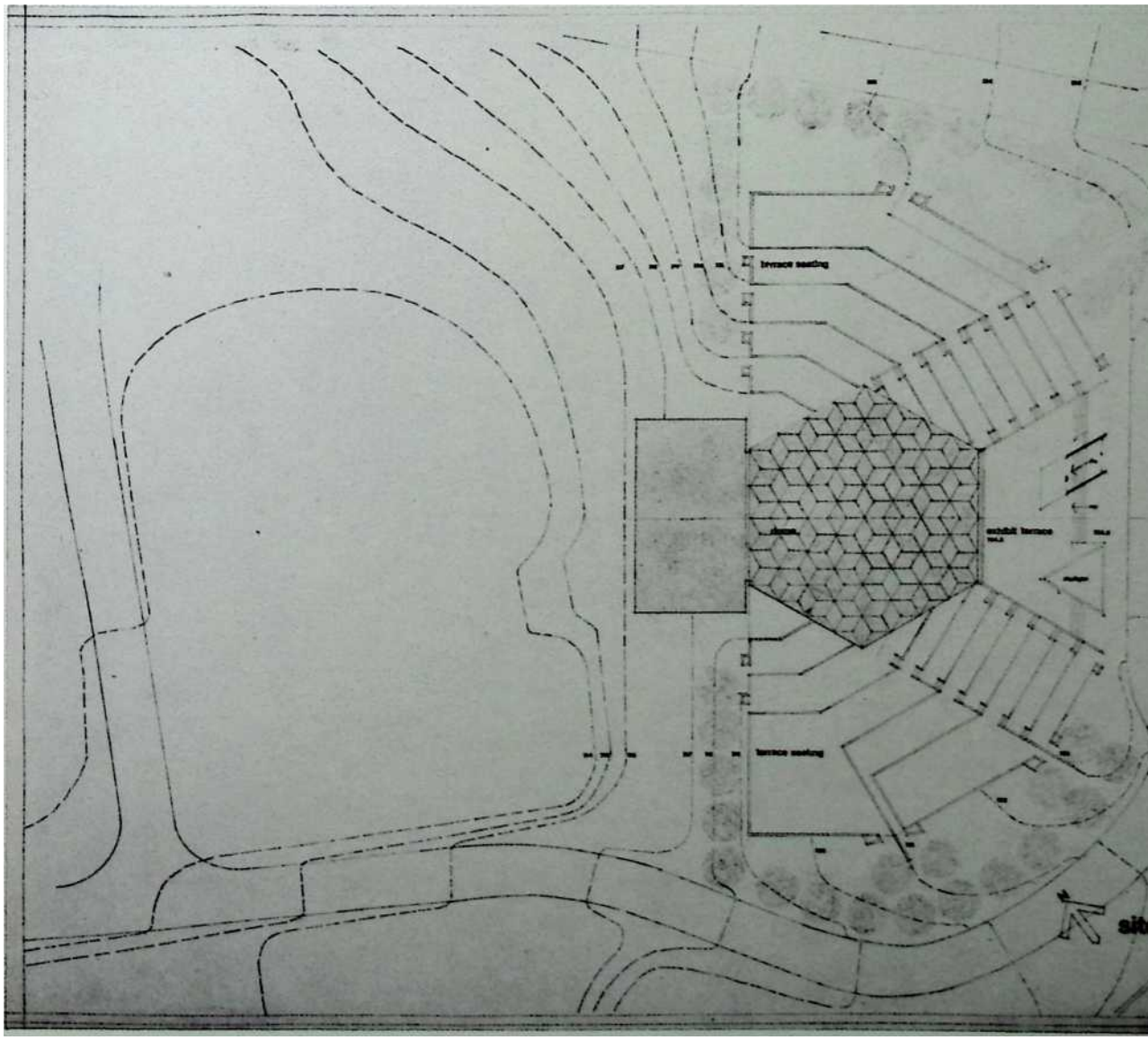


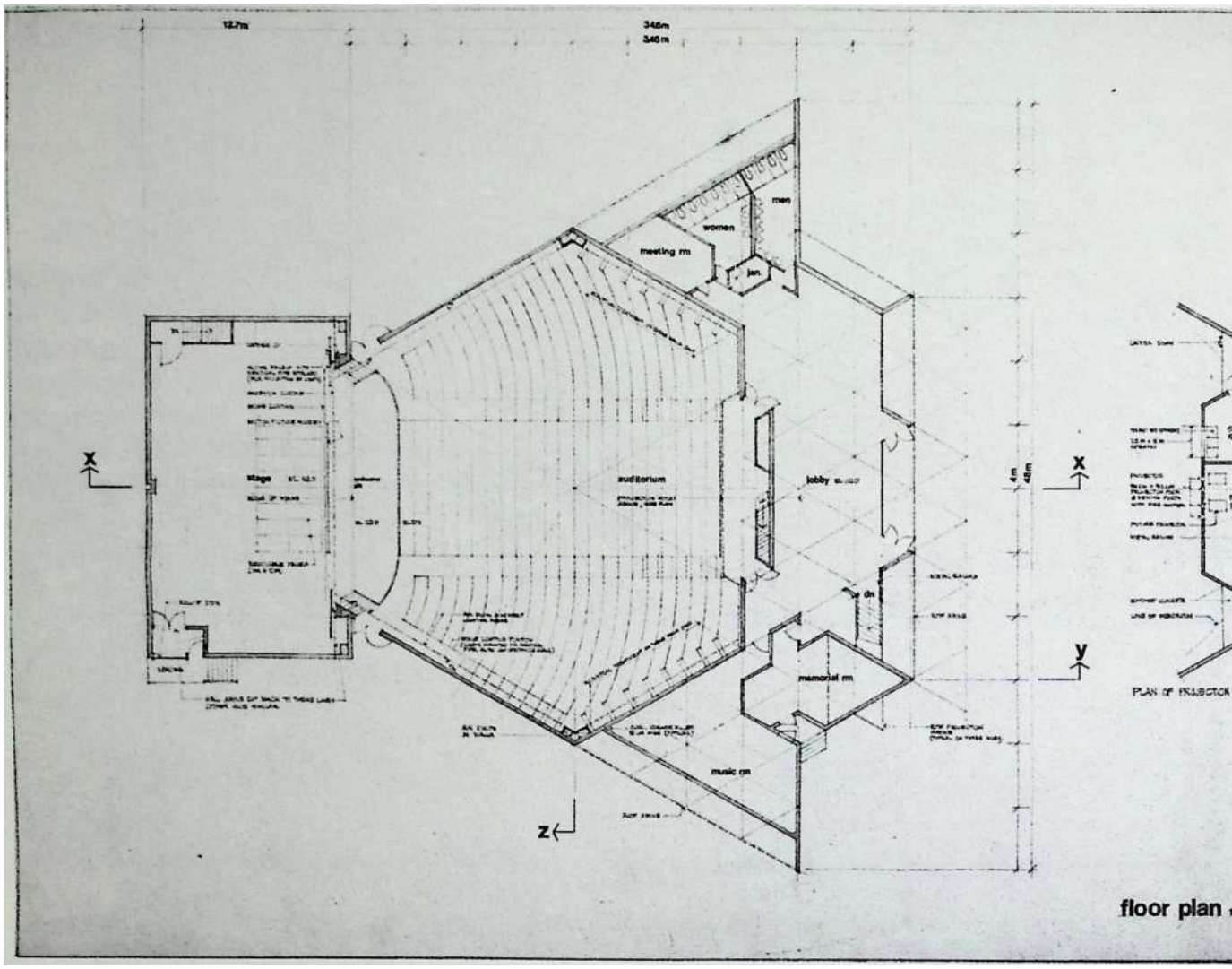
A ere hundred fact di are ter erodes II Sphere we'<;htrg three terns encloses seven tors cf air. Th* air to structural weight ratio is *TH.* Mhrc we double the site so that geodesic severe H i'W feet in deleter the weight of tr« structure goes up to *1* tors while the •eight of the air gees up to 56 tors — the air to structure ratio charges to 8/1. en «• dcuble t'-e sire ejain to a *KO* *«l geodesic sphere -- ire size c* several geodesic dxxs row operating -• the weight cf the air irside *czei* to alout 585 tons wMle the wei'/l cf Ve structure goes up to 15 tons. Air weight to structure weight ratio <s row 2J»1. -e get to a geodesic sphere c-ne- alf rile tn dicrxUr, Ve weight cf the air c-cU-.ed <5 so groat t'at the weight o' the structure itself becoces c<

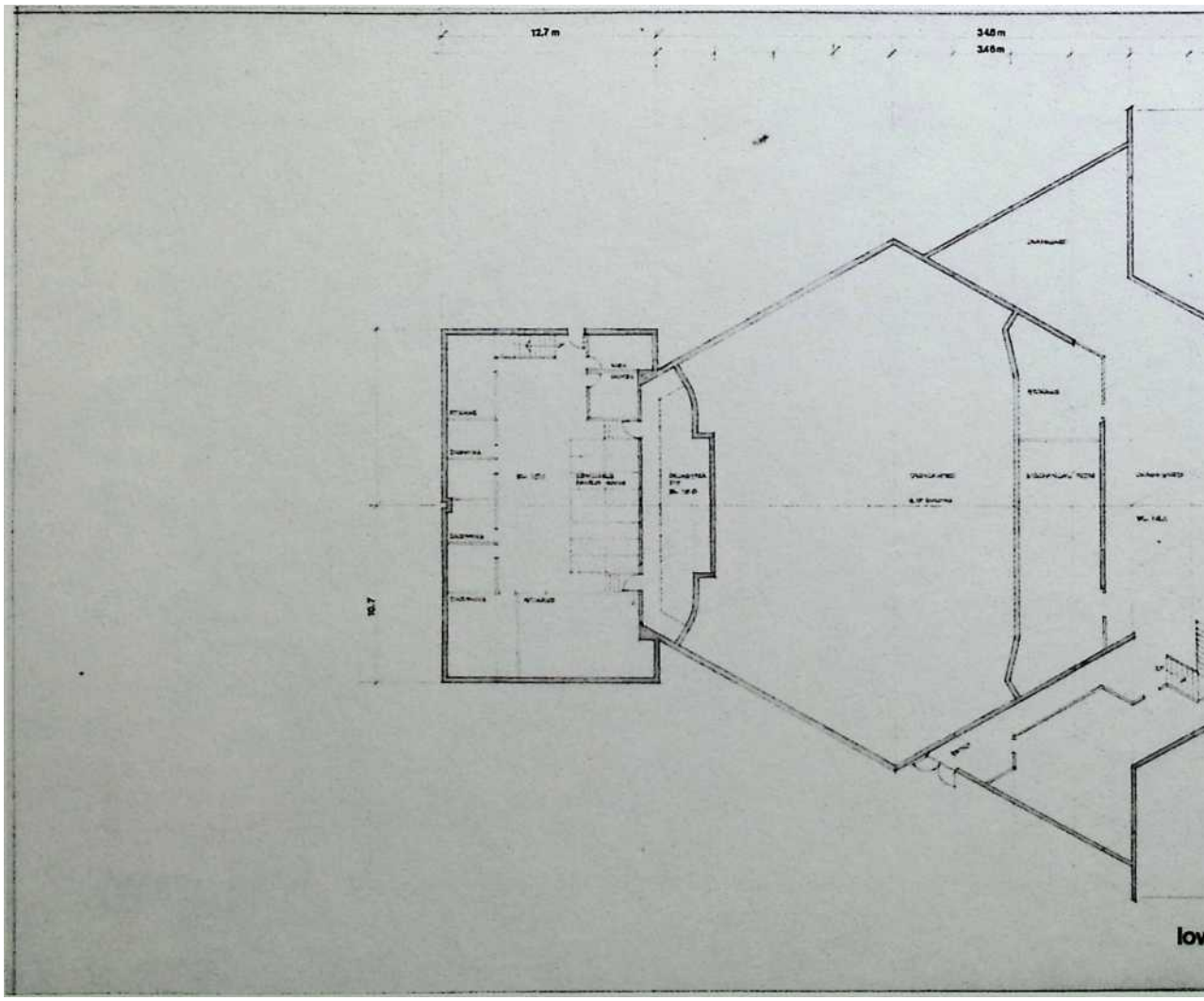
relatively negligible magnitude for the ratio is 1,800/1. When the sun shines on an open *frar** aliral- n_n geodesic sphere of one-half nile diameter the sun penetrating through the frame and reflected fren the ccncave far side, bounces back into the sphere and gradually heats the interior a tr-c sphere to a did degree. When the interior temperature of the sphere rises only ere degree Fahrenheit, the weight of air pushed cut of the sphere is greater than the weight of the spherical frame geodesic structure. This roans that t*-e total weight cf the interior air, plus the weight cf the structure, is «uch less than the surrounding atmosphere. This nears that the total asse-btage, of the geodesic -i-nrrc and ns contained air, will rave to fkat outwardly, into the sky. being displaced by the heavy atmosphere around it. When a great bank of nist lies in a valley in the coming and the sun shines upon 1t, the sun heats the air Inside the bank of nist. The heated air expands and therefore pushes soce of itself outside the nist bank. The total assembly of the mist bank weighs less than the atmosphere surrounding It and the nist bank floats aloft into the sky. Thus are clouds manufactured. As geodesic spheres get larger than one-half allo in diemeter they Lccane floatable cloud structures. If their surfaces were draped with outwardly hung polyethelene curtains to retard the rate at which air would coca* back in at night, the sphere and Its internal atu>- sphere wculd continue to be so light as to remain aloft. Such sky- floating geodesic spheres ray be designed to float at preferred altitudes of thousands of feet. The weight of hiasan beings added to such prefabricated "cloud nines"* would be relatively negligible. f»any thousands of passengers cculd be boused aboard one nile diameter and larger cloud structures. The passengcri cculd core and go frtn cicud to cicud, or cl0.3 to ground, as the clouds float around the earth or are anchored to rvyjntaln tws. KM It the building of such floating cicuds is several decades hence, «e cay fersee that along with the floating tetrahedrcnal cities, air-deli«-crable skyscrapers, submarine tsla-ds. sub-dry surface dwellings, dor-ed-cver cities, flyable dwelling cachir.es, rentable. autcncccus-ii»lr»g, plack toes, that ran «say be able to converge and deploy arcurj earth witrcut its depletion.

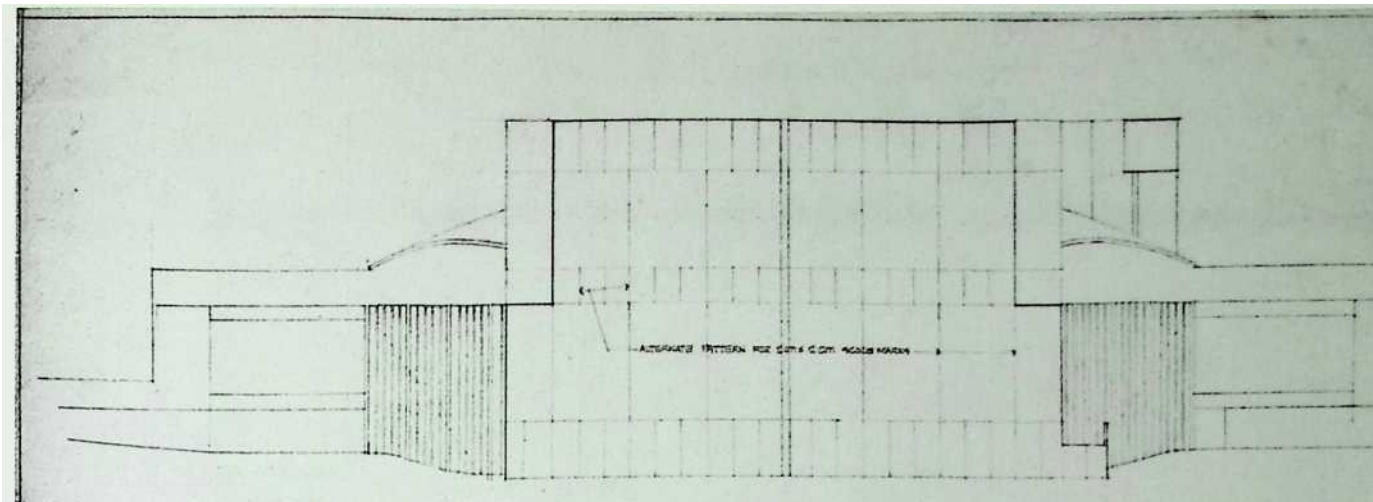
26 Cultural Community Center, Kfar Menachem, Kibbutz Kashomer, Hatzair, Israel Fuller & Sadao, 1970

The composition of the Kfar Menachem Cultural Center is a hexagonal auditorium set into a triangular building. Flanges of terrace seating radiate from its exterior sides and the stage is an appended rectangular pavilion. It was constructed primarily of reinforced concrete and panels of prestressed concrete. The pattern of the coffered ceiling is complemented by Fuller's hexagonal pan vault, which covers the auditorium. This structure is topped by an aluminum dome on the exterior.

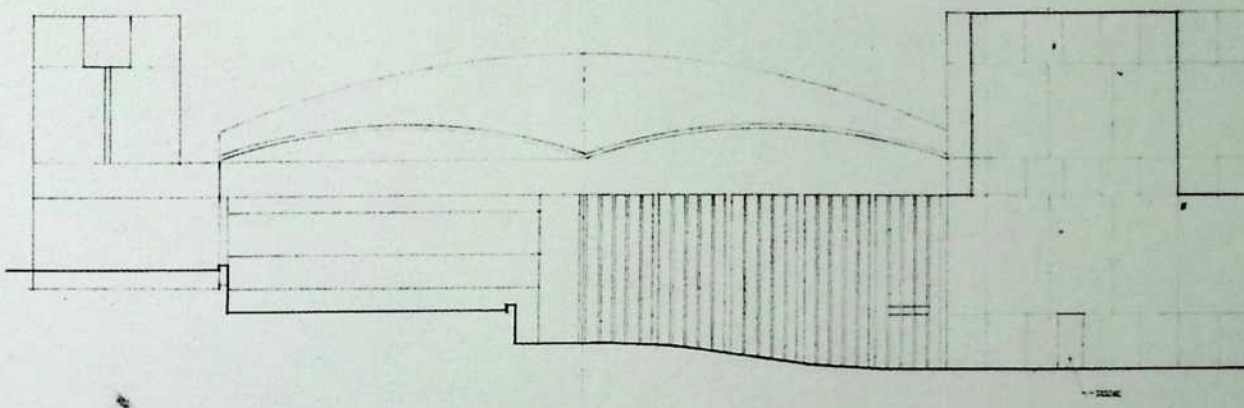

terrace seating
exhibit terrace
terrace seating


12.7m
34.6m
34.6m
men
women
meeting rm
jan
Stage
auditorium
lobby
memorial rm
music rm
x
x
y
z
PLAN OF EXHIBITION
floor plan

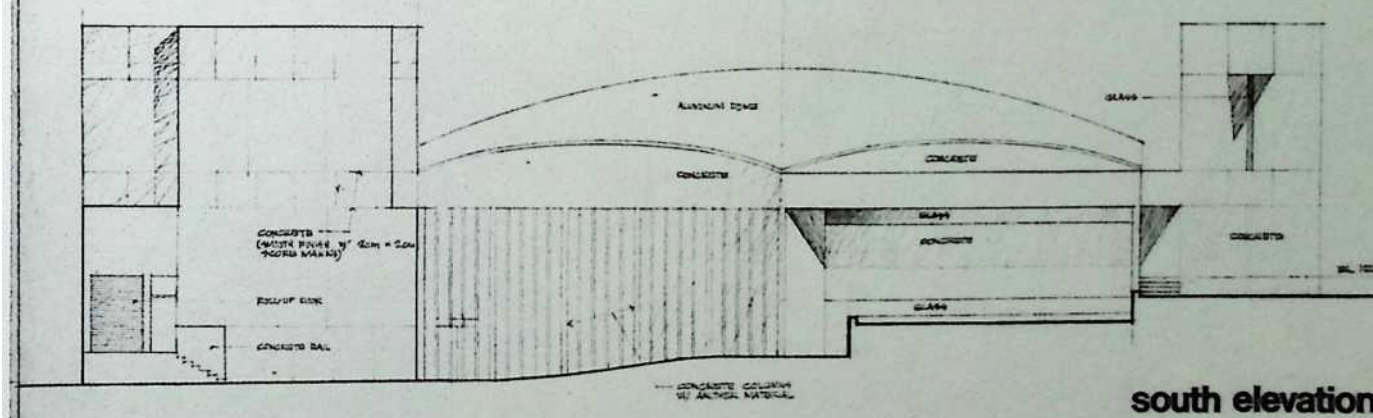

12,7 m
3,48 m
3,48 m
10,7
lov



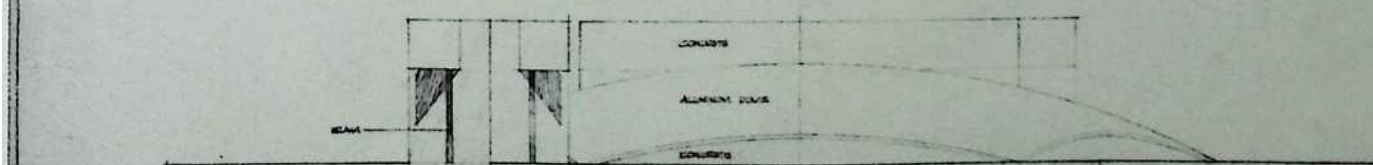
east elevation

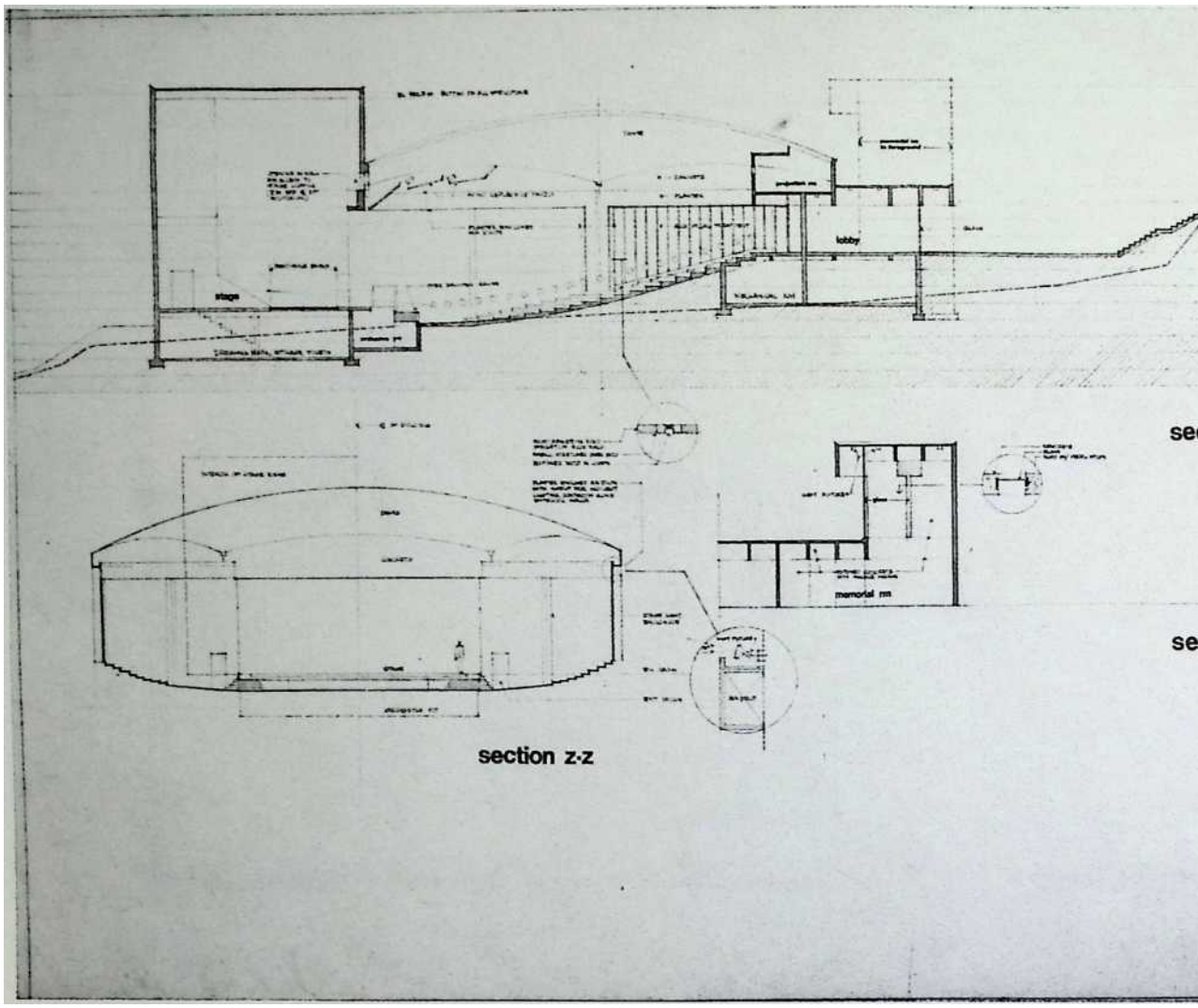


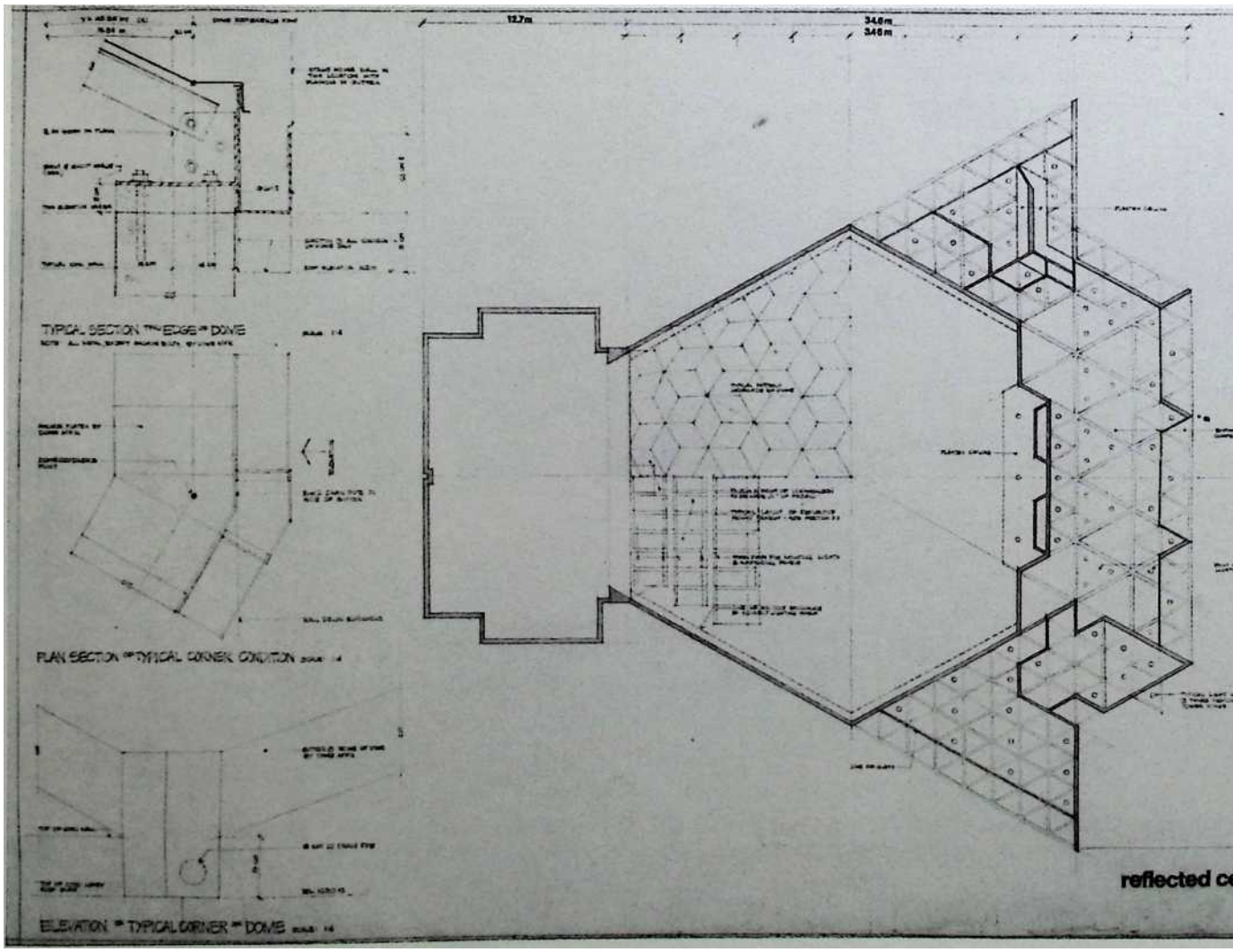
north elevation



south elevation

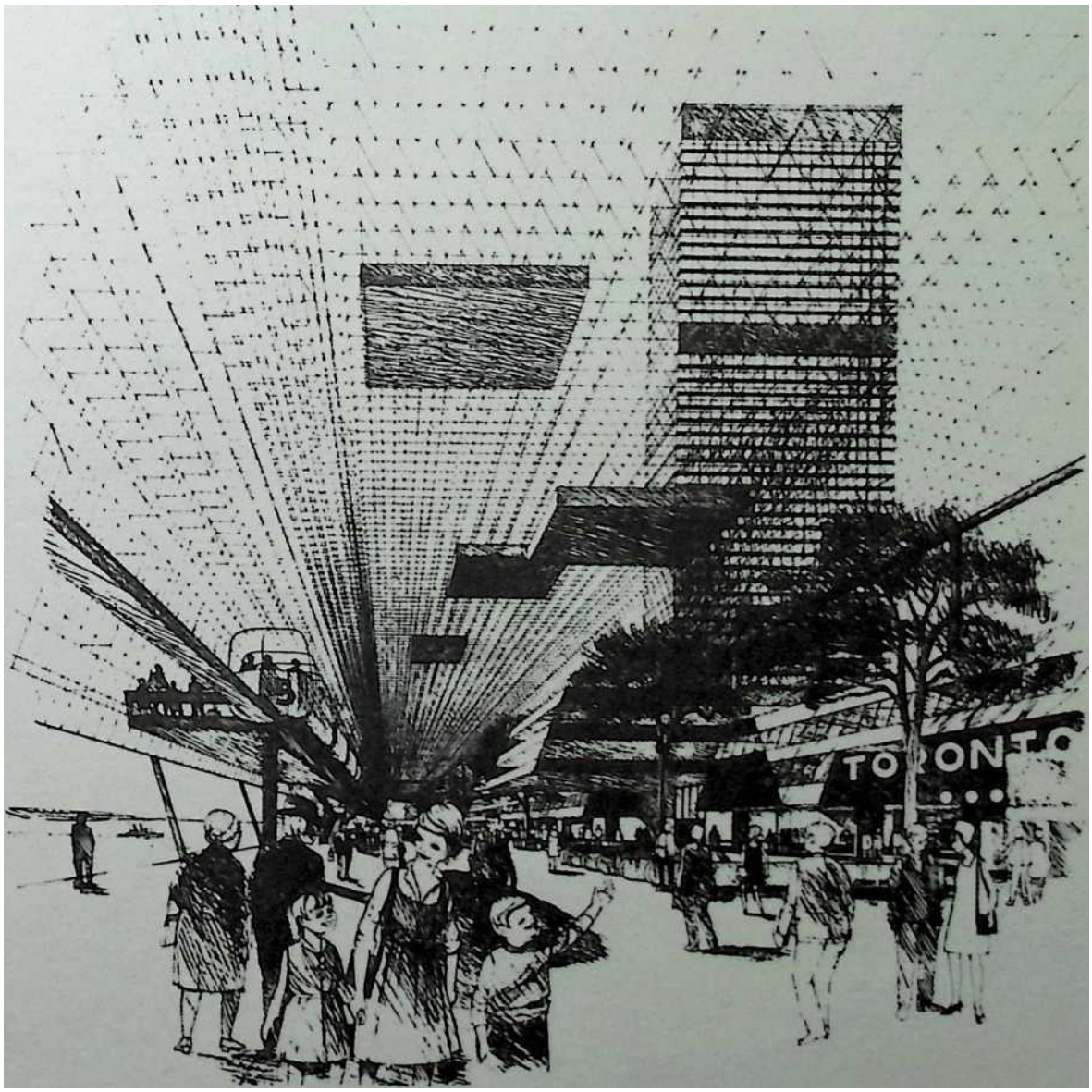


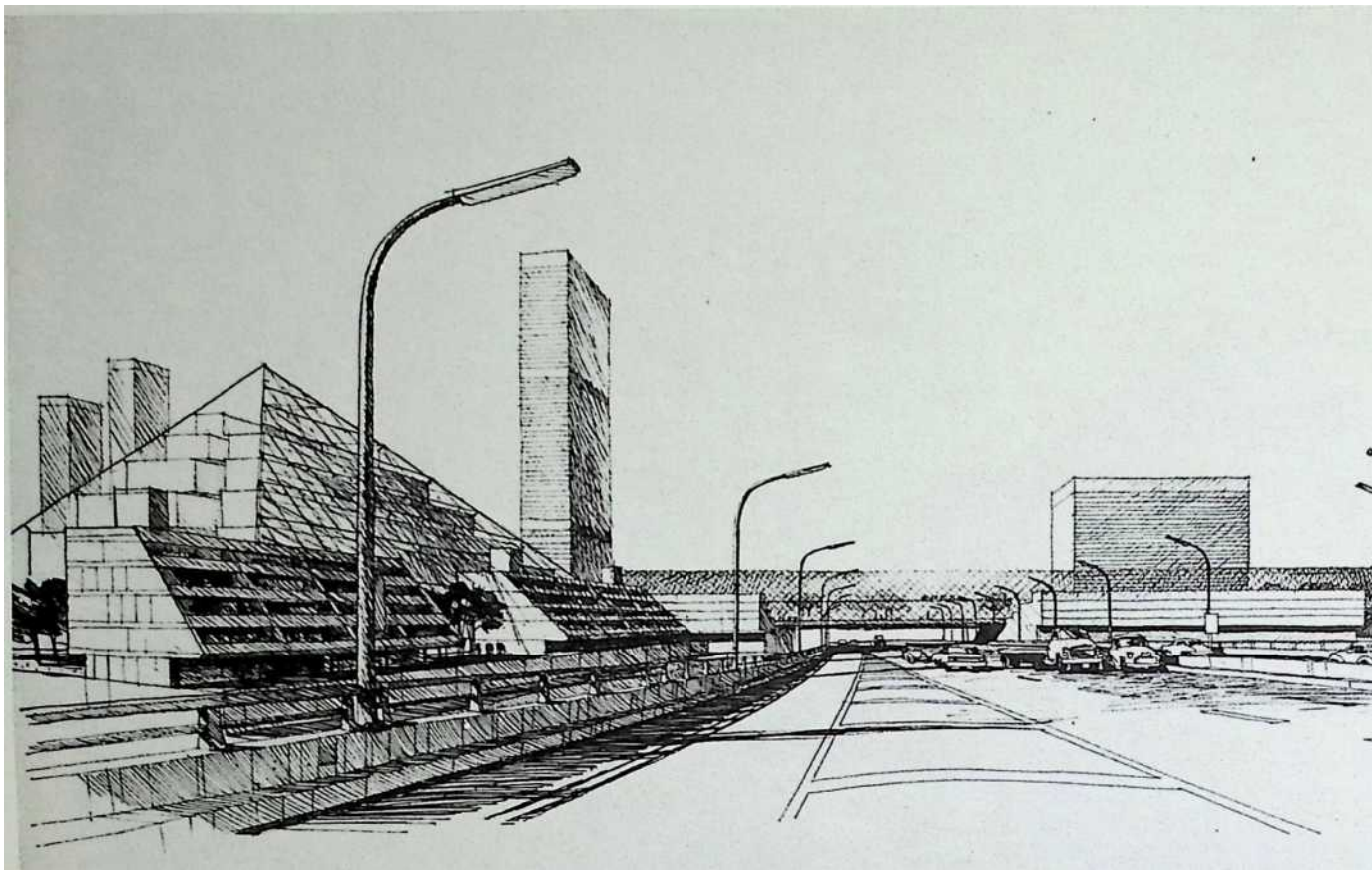

stage
lobby
memorial rm
section z-z


12.7m
34.6m
34.6m
TYPICAL SECTION "EDGE" DOME
PLAN SECTION "TYPICAL CORNER CONDITION
ELEVATION "TYPICAL CORNER" DOME
reflected c

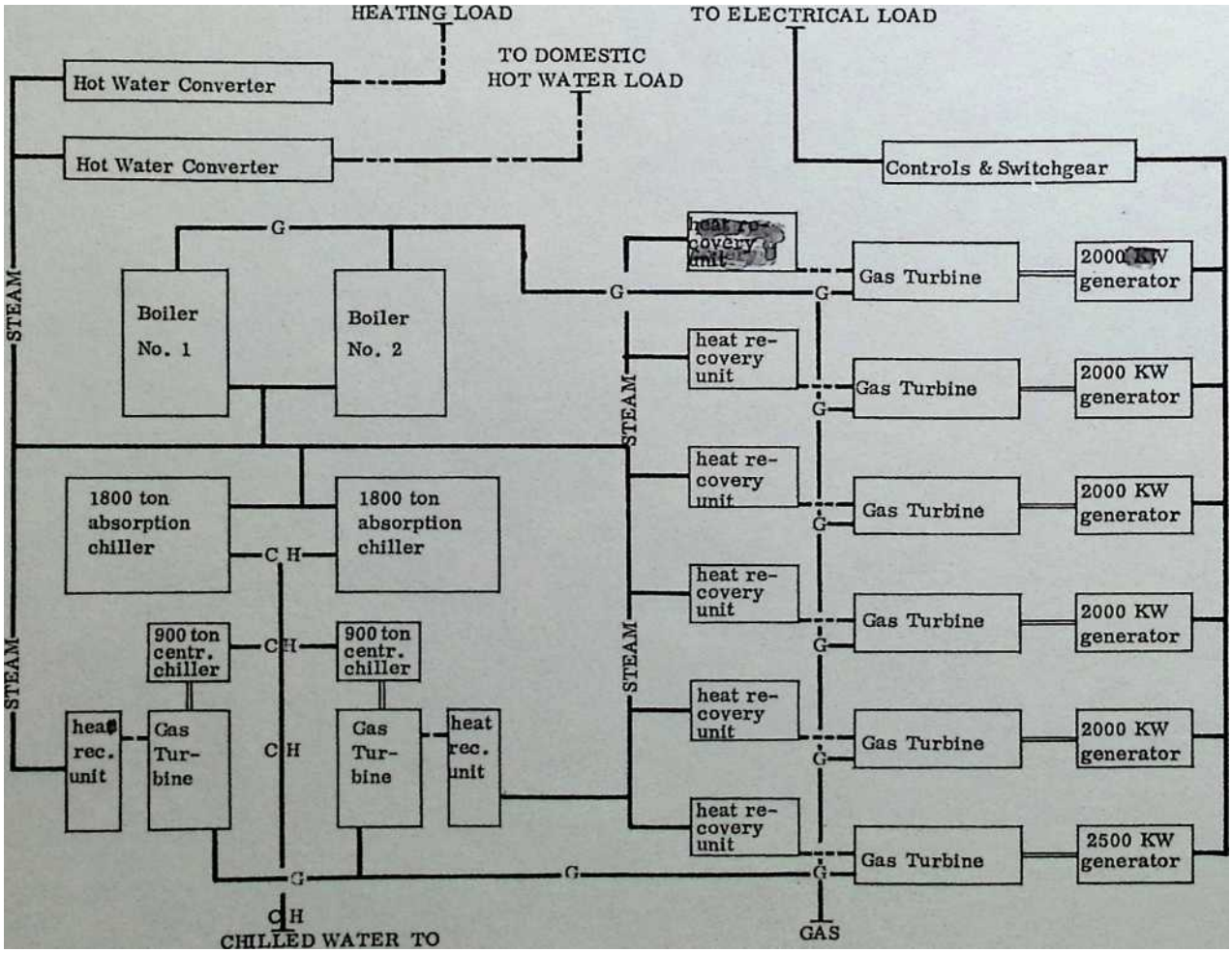
27 Project Spadina, Toronto, Canada Fuller & Sadao, 1970

The idea behind this example of advanced urban renewal is the consolidation of several functions in one megastructure running along one traffic artery . From the air this complex would have resembled crystalline growth with its central concourse enclosed dramatically by a glazed octet truss system. The truss, in addition to the concrete pilings, would have been the main building supports. Apartments, stores, business offices, and a monorail would have made this city within a city nearly self sufficient, and the complex geometries of the constituent buildings would have made it architecturally ahead of its time.


TORONTO



HOT WATER TO

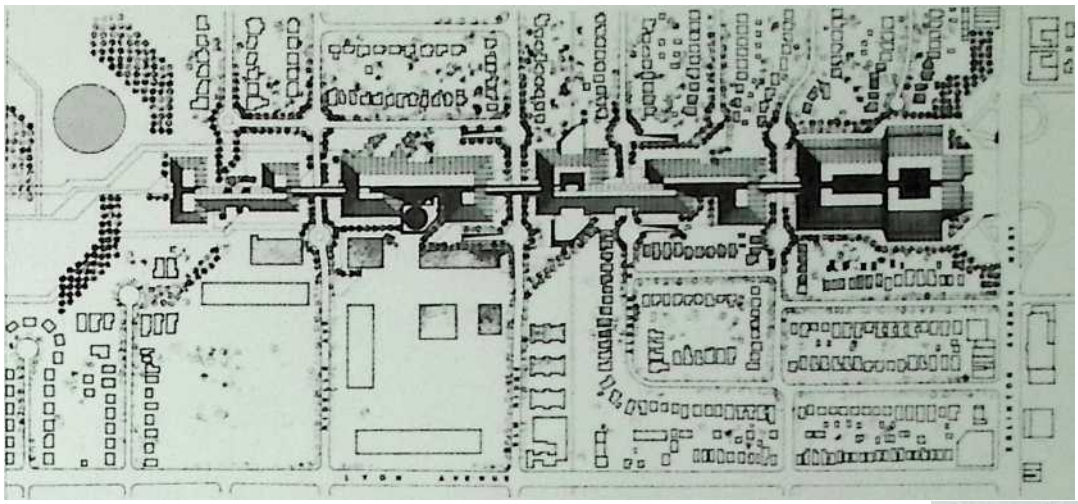


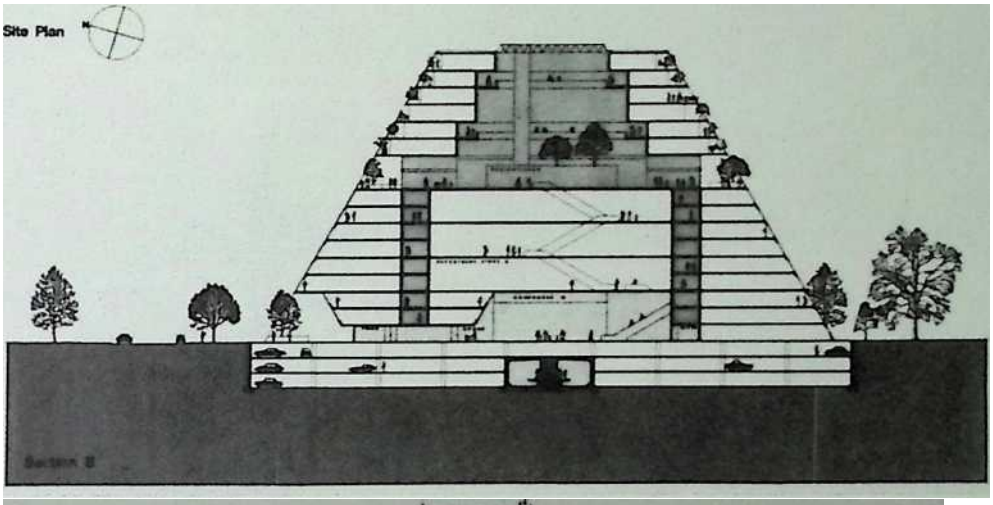
SUPPLY

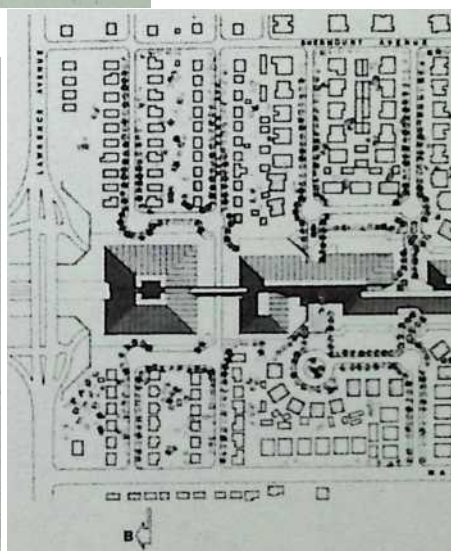
AIR CONDITIONING LOAD

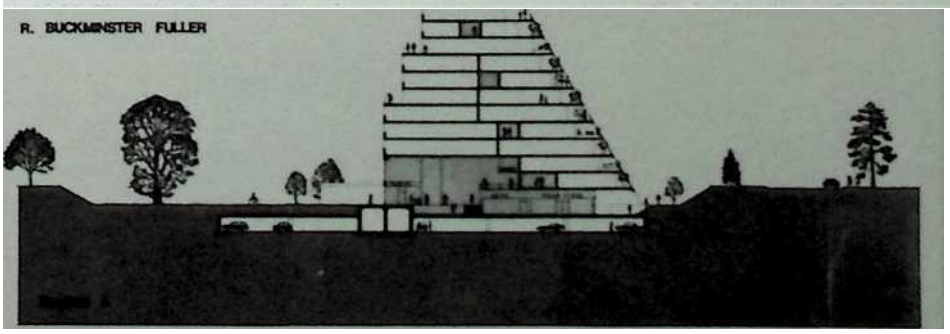
PROJECT SFADINA

CONCEPTUAL PLAN









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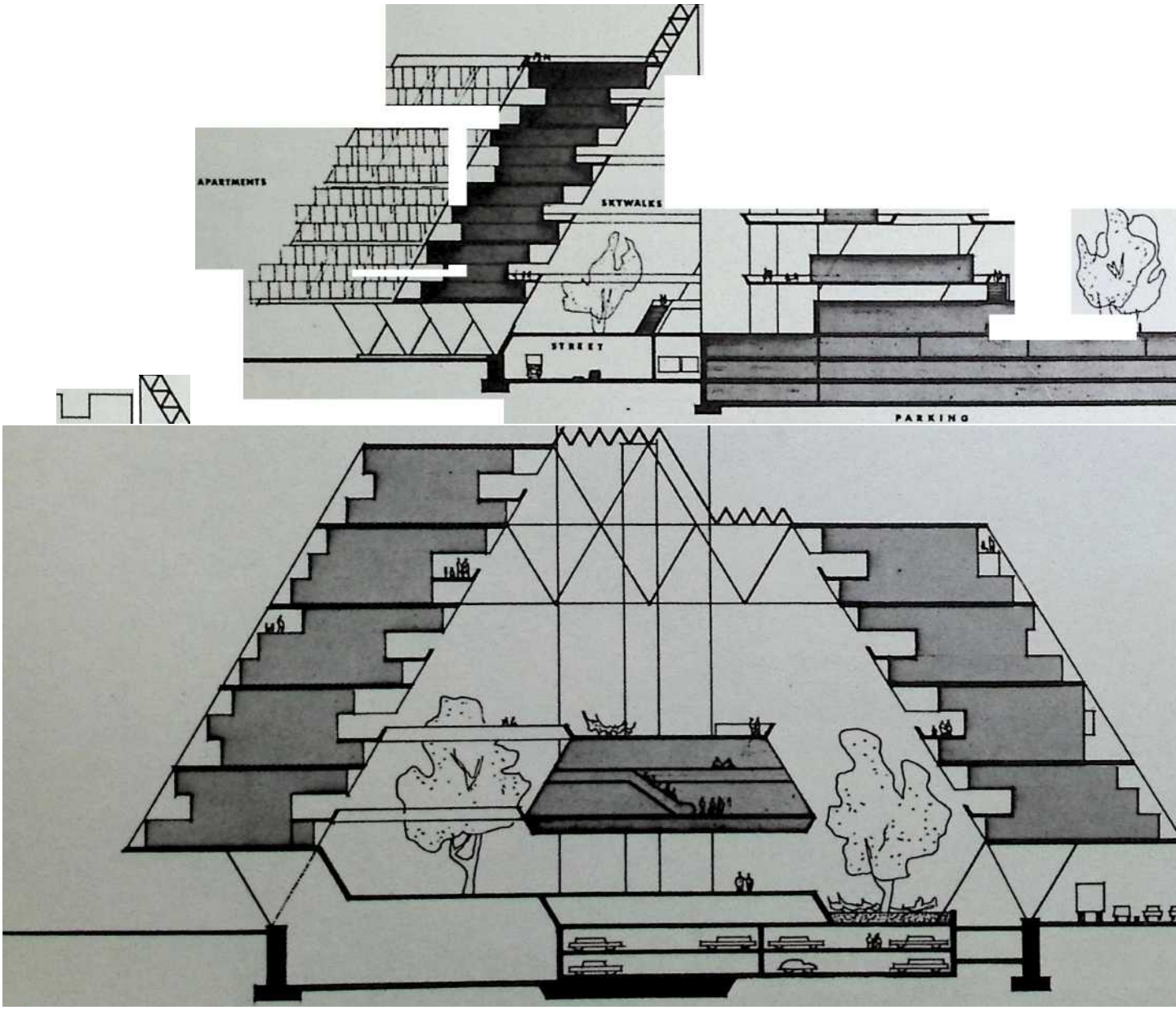
APARTMENTS
SKYWALKS
STREET
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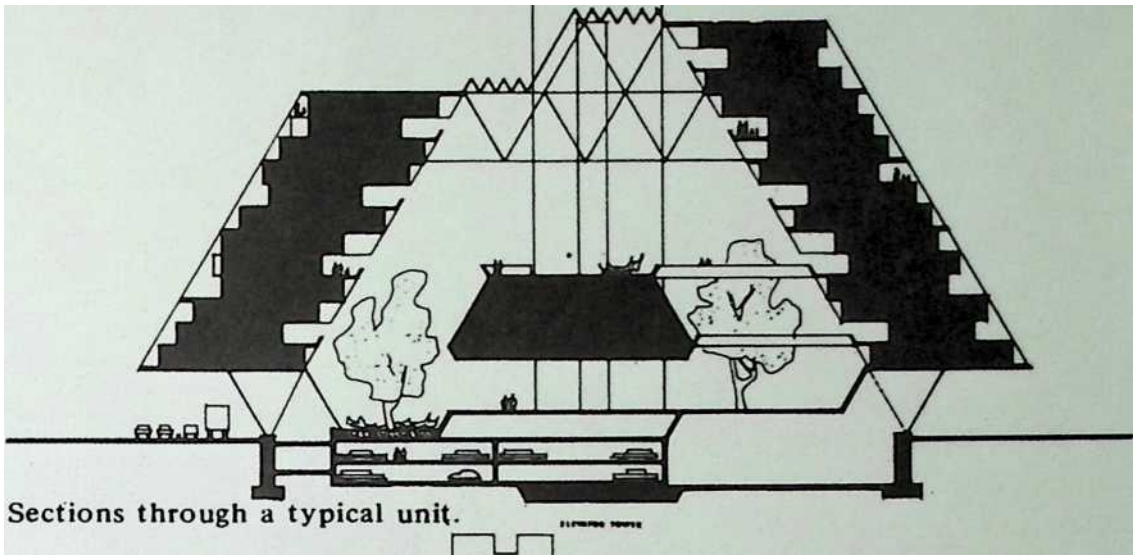
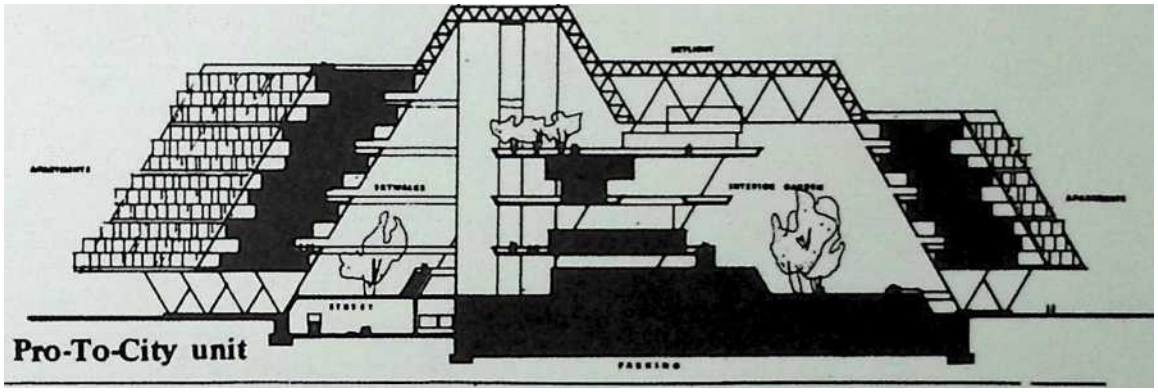
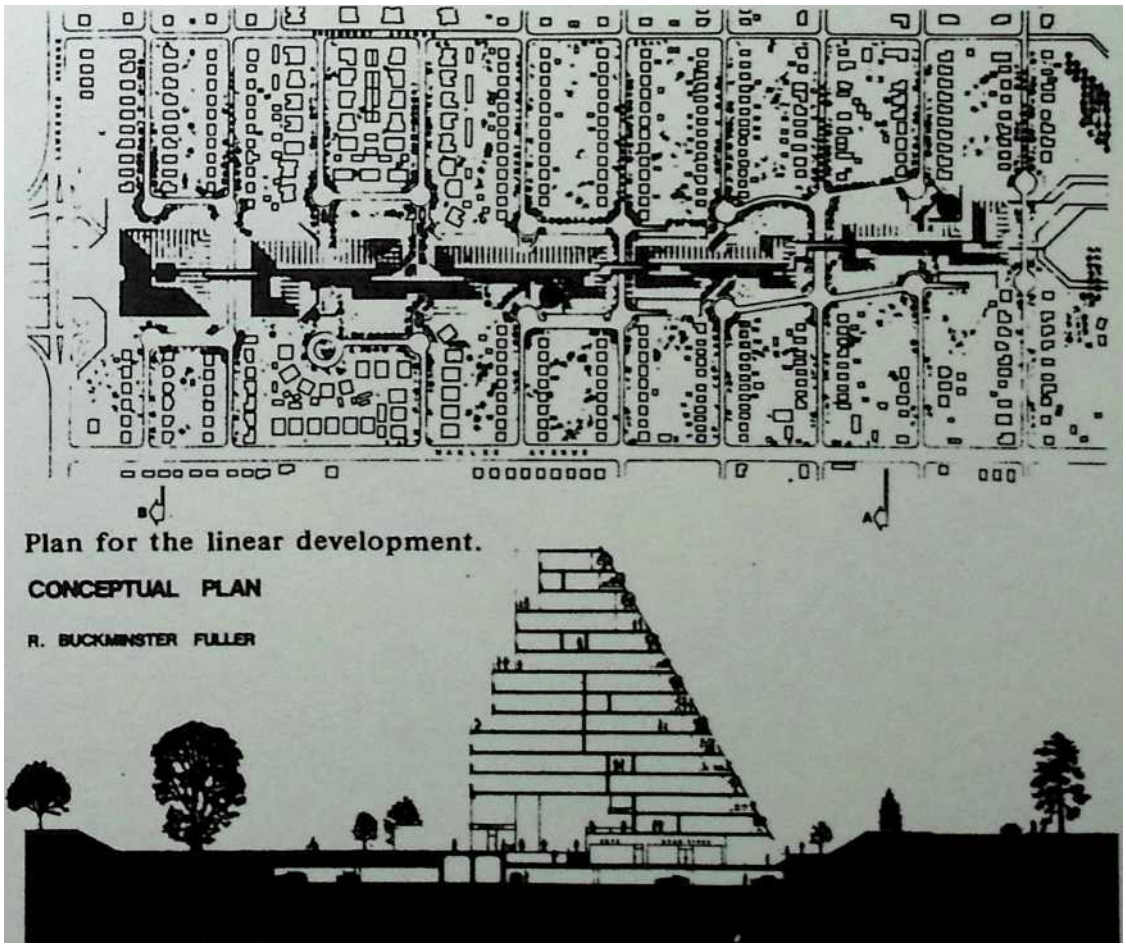


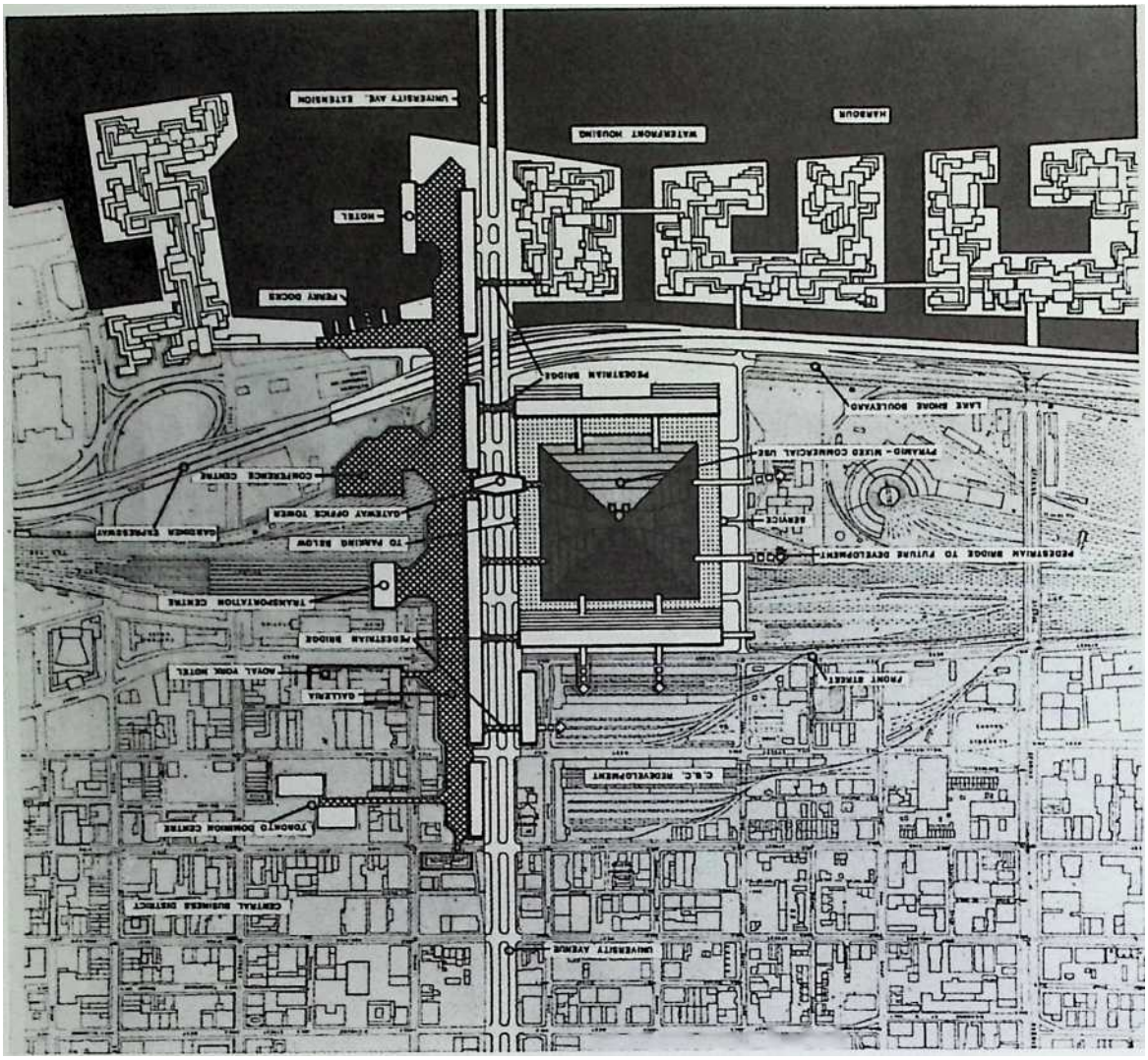
Sections through a typical unit.



Pro-To-City unit



Spadina expressway Sections through the megastructure.



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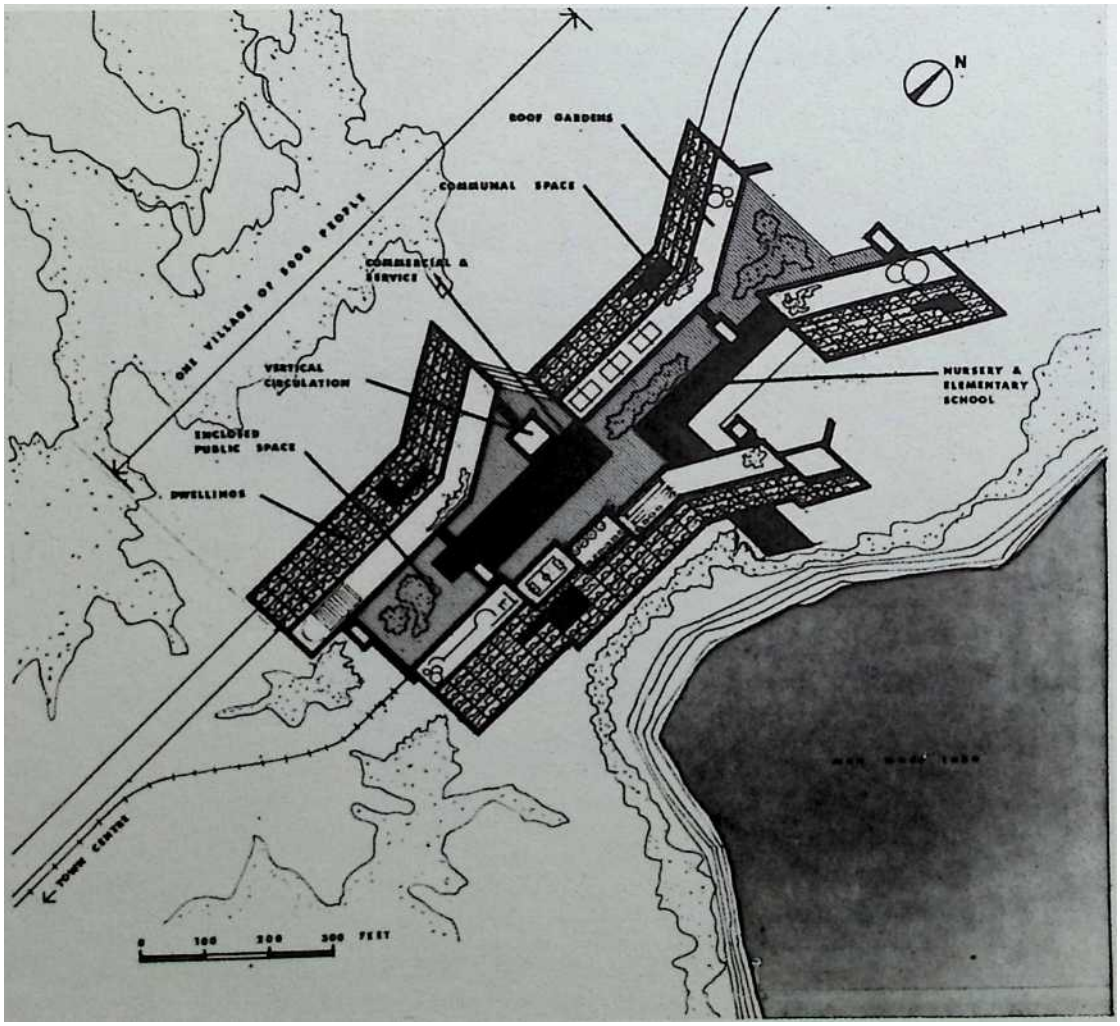
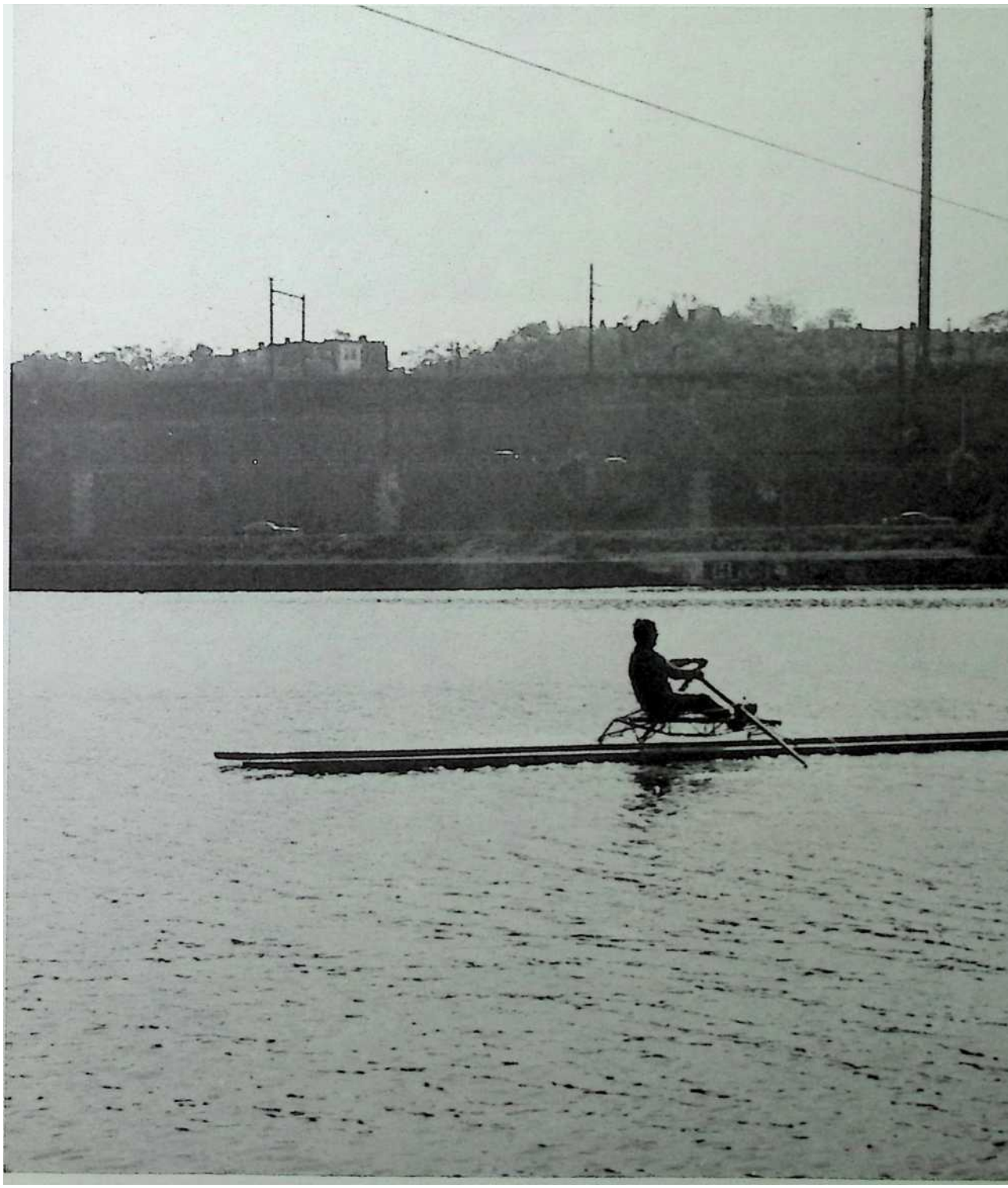
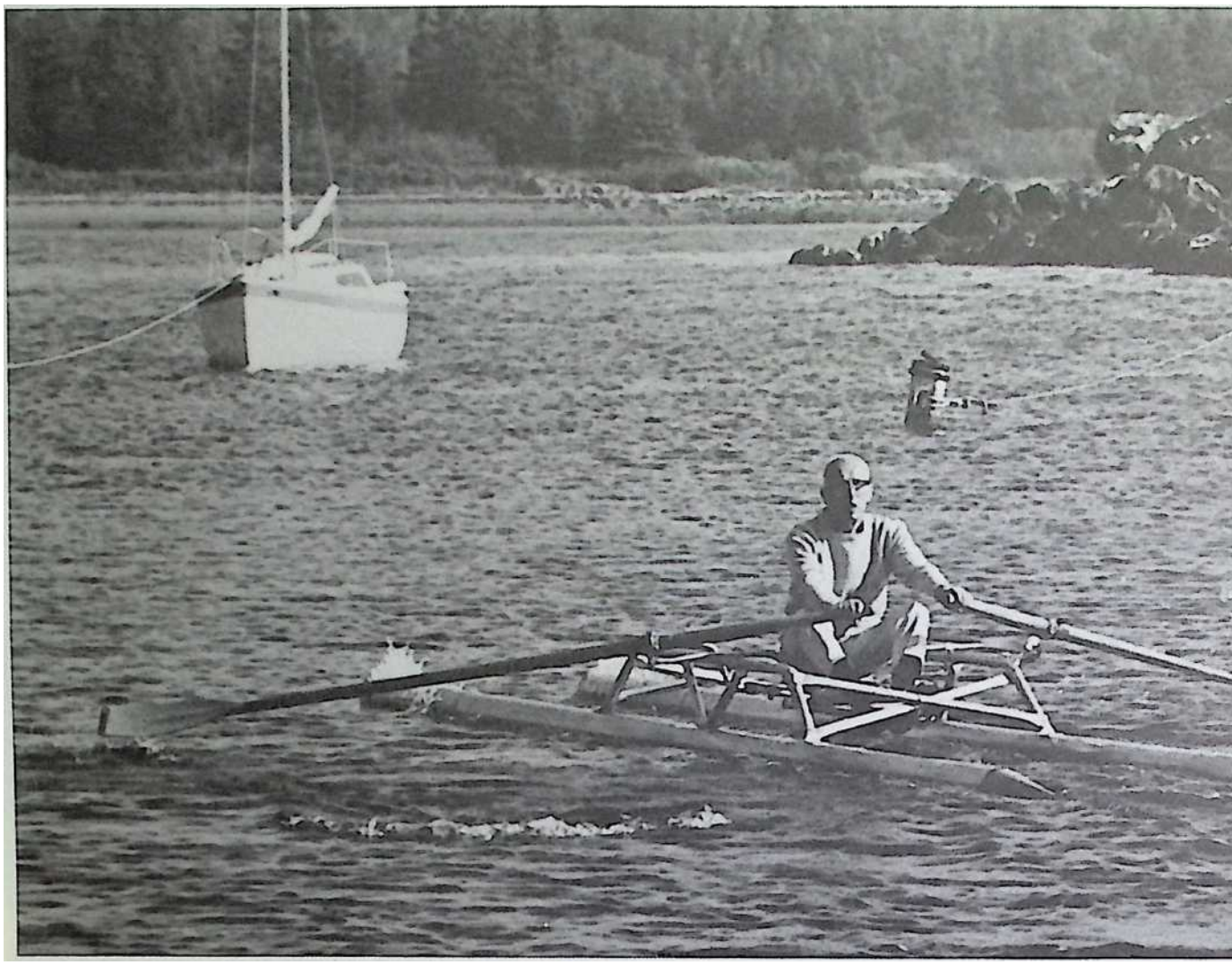
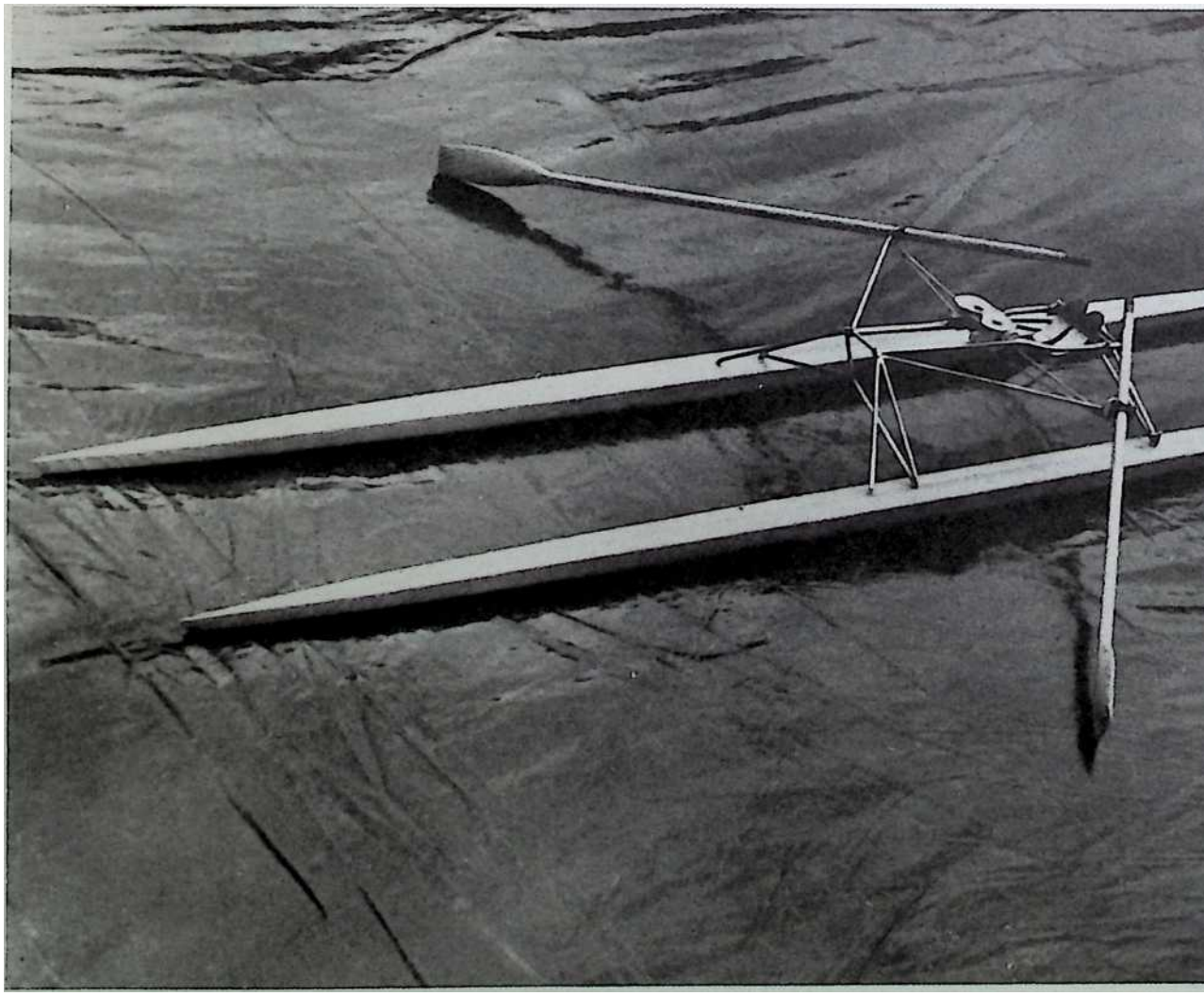


Rowing Needles (Watercraft) Patent 8/18/70

This invention is actually a catamaran that one can either row or sail. Its two pontoons are watertight so that the vessel cannot founder even if overturned.







nil **3,524,422**

United States Patent

Oil

Inventor

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Appl. No.

Filed Patented

Richard Buckminster Fuller

P. O. Box 909, Carbondale. Illinois 62901 716,957

March 28,1968

Aug. 18,1970

2.685.270 8/1954 Pierac 9/2X

3.179.960 4/1965 Nimmo 9/2

3,236.202 2/1966 Quadyelal 1I4/6IX

3.273.528 9/1966 Kiefer „…114/61

Primary Examiner— Andrew H. Farrell *Attorney*—Smythe and Moore

(54) WATERCRAFT

10 Claims, 8 Drawing Figs.

(521 ll-S.CL 114/61

[51] lat.CL B63b 1/14

[50] Field of Search 114/61,

22.26,27;9/2S

(56] References Cited

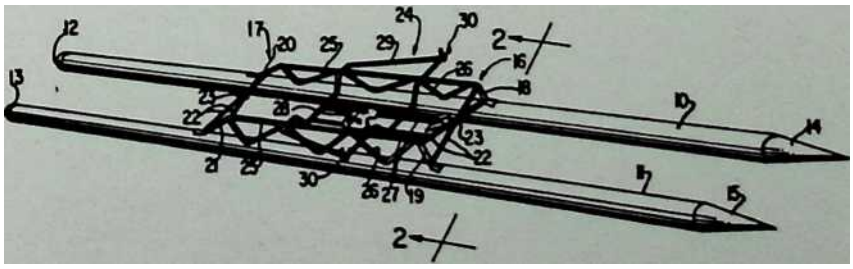
UNITED STATES PATENTS

612,920 10/1898 Winquistetal 115/26

1,190,569 7/1916 Maxwell 9/2

2,341,166 2/1944 Todd 114/61

ABSTRACT: A watercraft useful for rowing, sailing, and the like, wherein there are two spaced substantially parallel float members, the float members being joined by longitudinally spaced transversely extending structural means, each structural means including a vertically extending post, means, or column on its float, the tops of said posts being joined by al least one structural cross member extending therebetween so as to keep the floats parallel or al the desired angle relative to each other and so as to inhibit rolling thereof relative to each other.



Patented Aug. 18, 1970

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INVESTOR RICHARD BUCKMINSTER FULLER

Sheet 3 of 3

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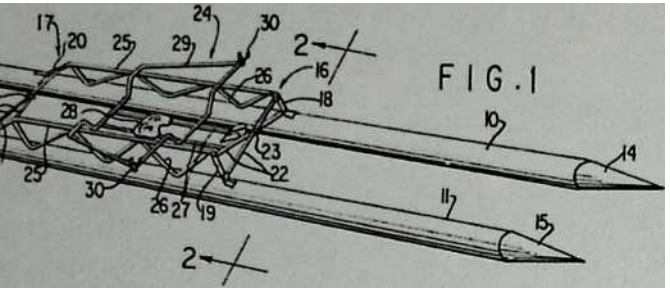


FIG. 1

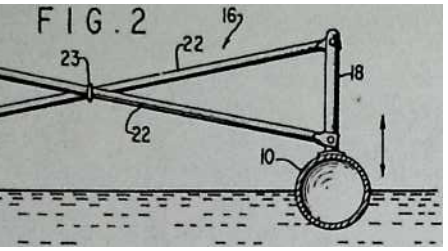


FIG. 2

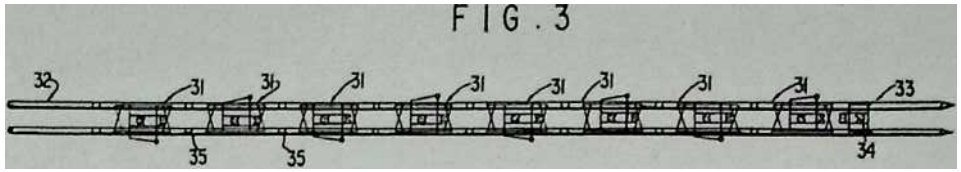


FIG. 3

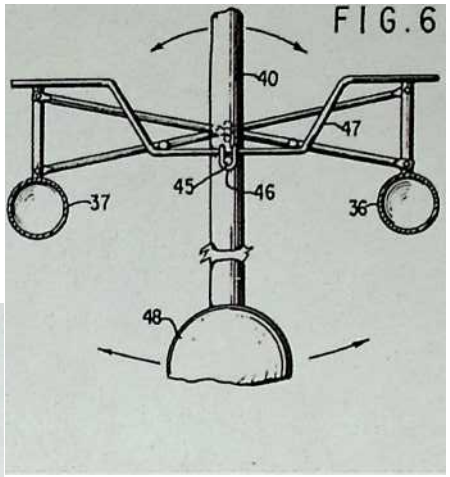


FIG. 6

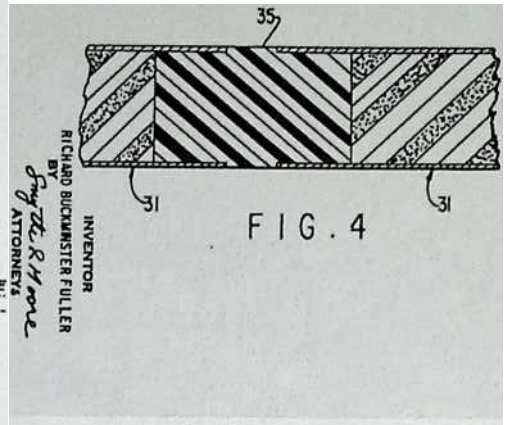


FIG. 4

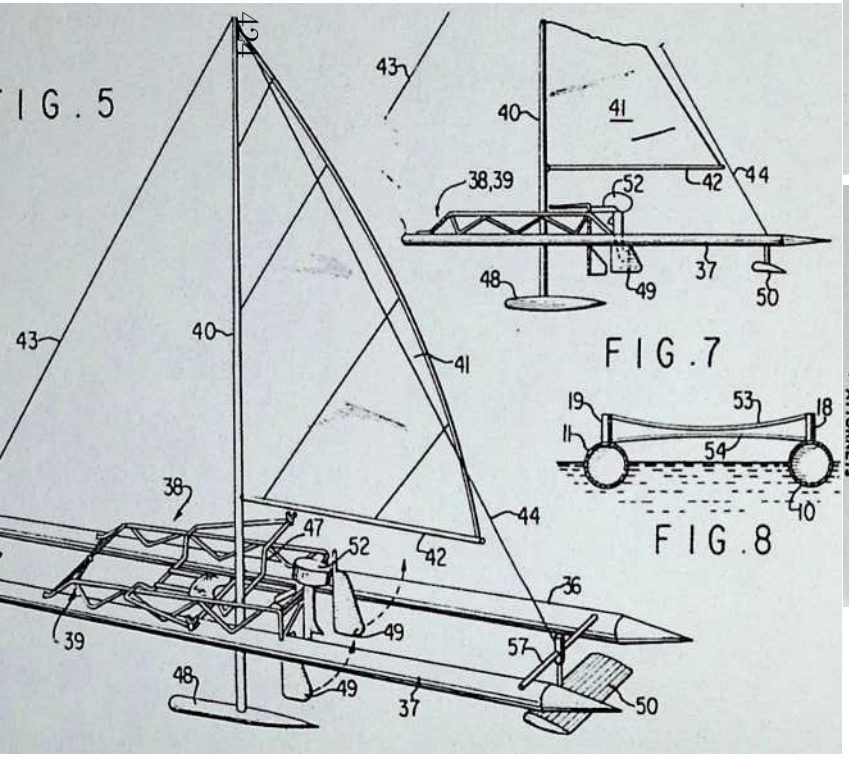


FIG. 5

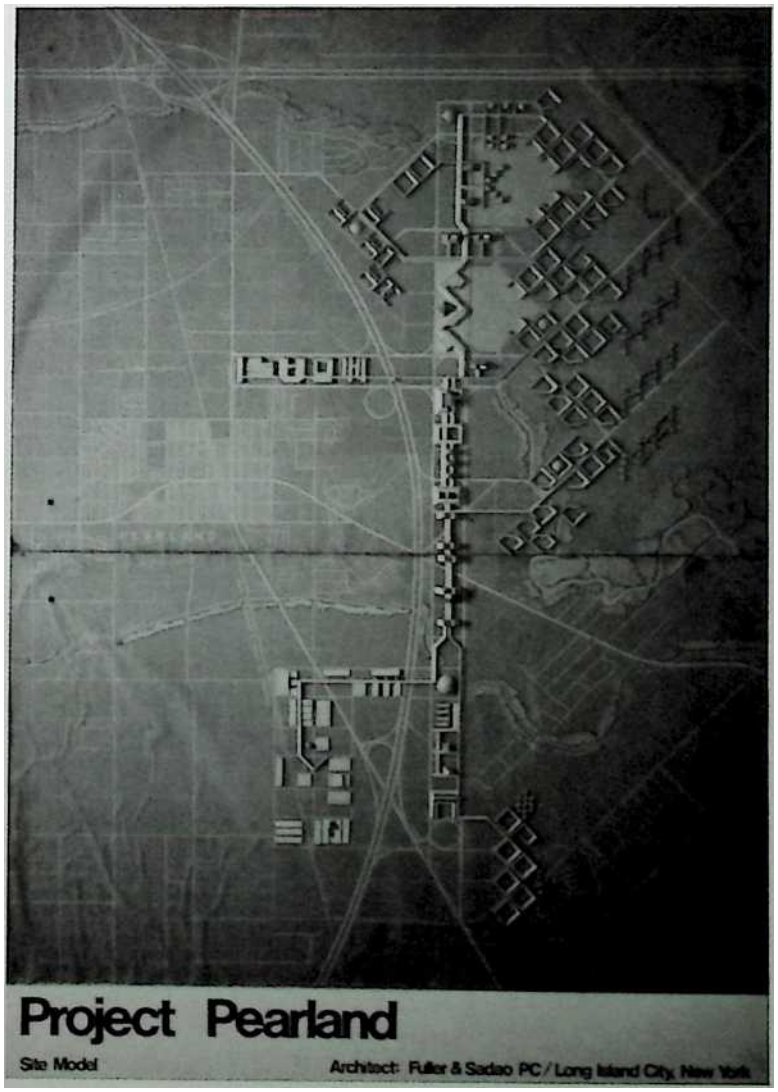
FIG. 7

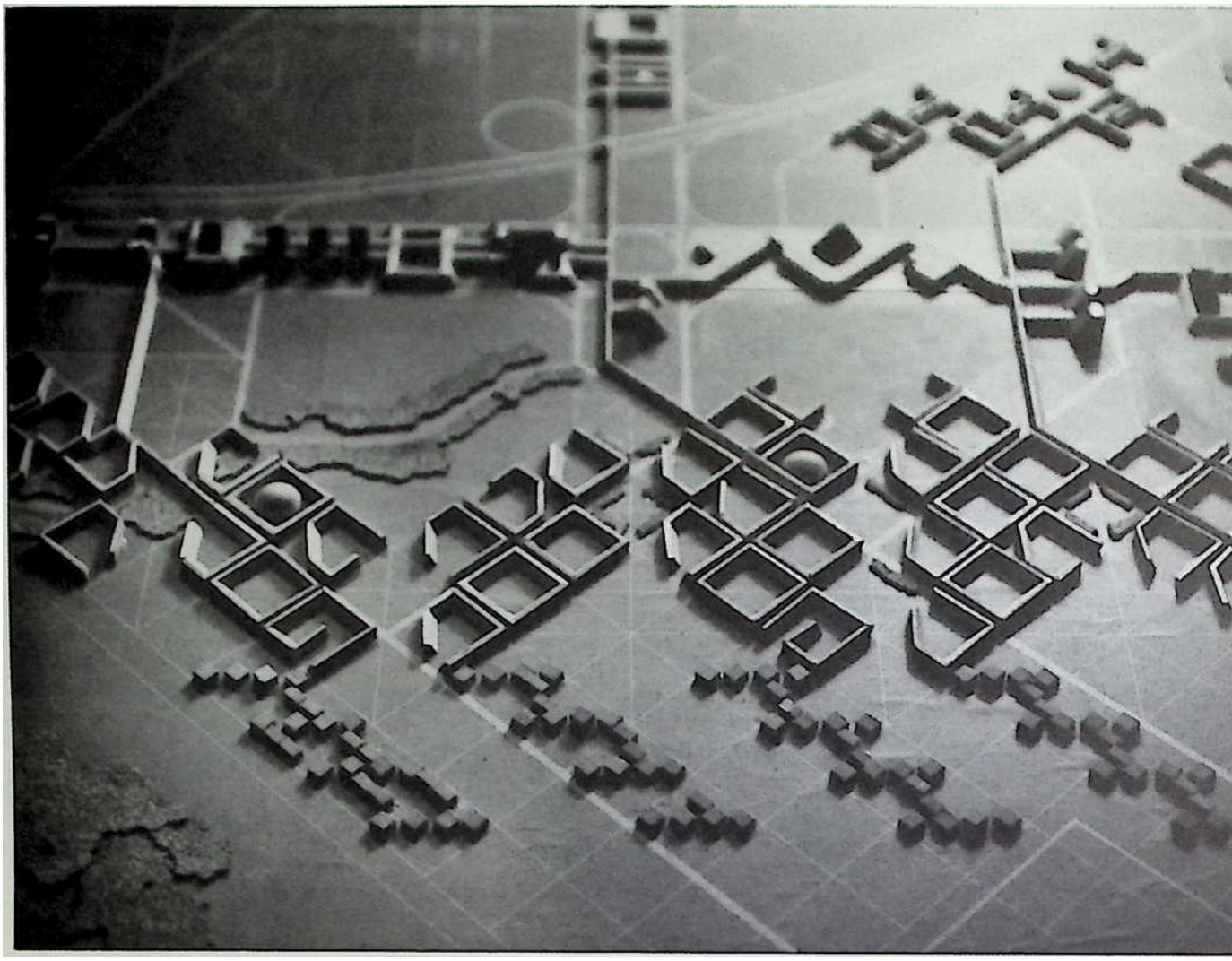
FIG. 8

INVENTOR
RICHARD BUCKMINSTER FULLER
BY
Guy E. R. Hope
ATTORNEYS

28 Project Pearland, Pearland, Texas Fuller & Sadao, 1971

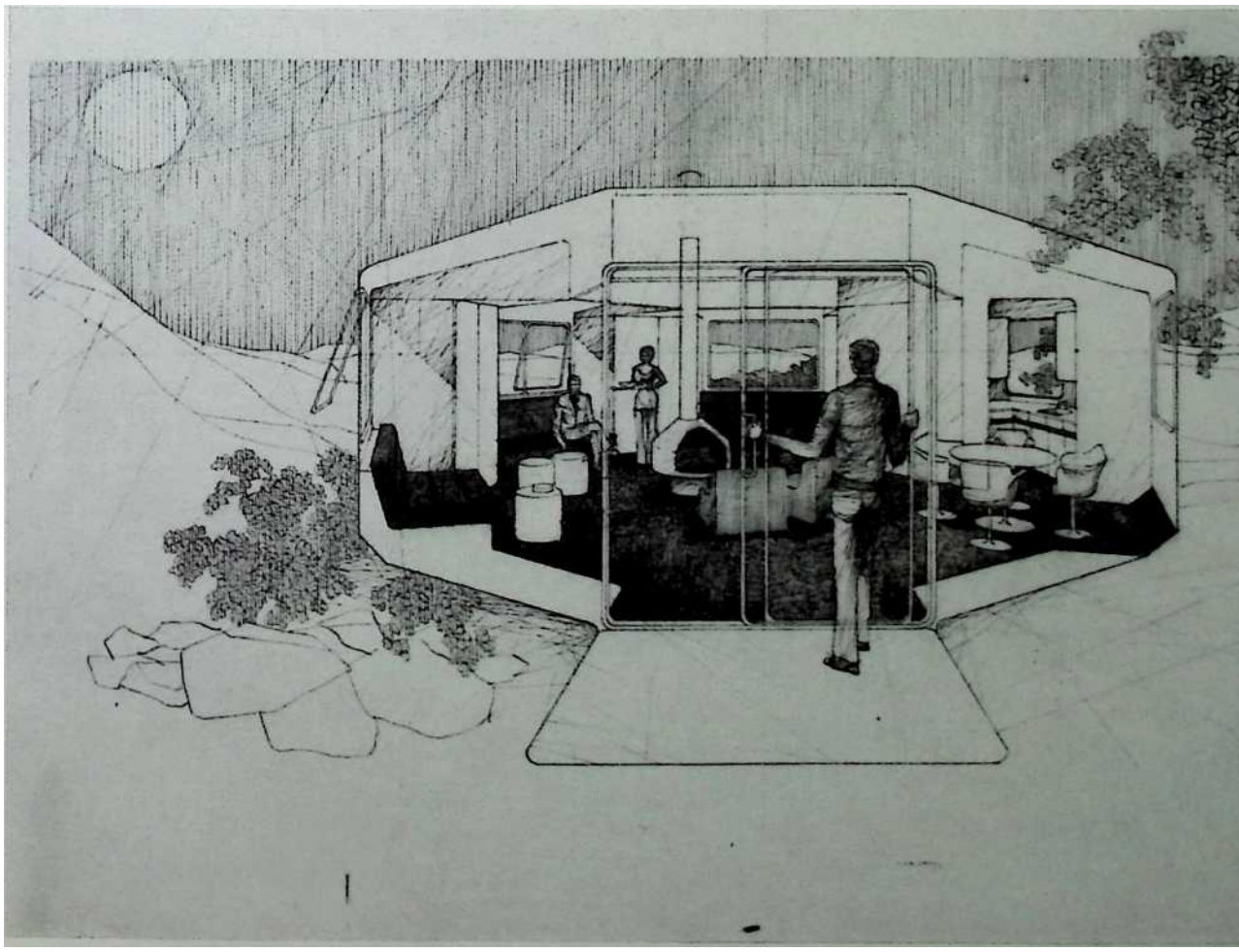
Project Pearland is an example of Fuller's urban planning that takes into consideration a specific site. Designed as a multifaceted megastructure for a burgeoning town on the outskirts of Houston, Pearland seems to have been produced in the creative wake of Fuller's slightly earlier project Spadina for a much smaller area of downtown Toronto, Canada. At the time Pearland contained a 4,000-acre rice field gone fallow. As a planned city, the community would not have been too far beyond the technical capabilities of the day. The centralized megastructure runs along the main traffic artery and encloses two pentagonal reservoirs. Radiating from this epicenter is a latticework of buildings that would have also served as offices and factories. Lower, and less rigidly geometric, residential structures extend to the city's perimeter. Pearland, like Spadina, will remain a maquette until a time more amenable to such large-scale urbanism.

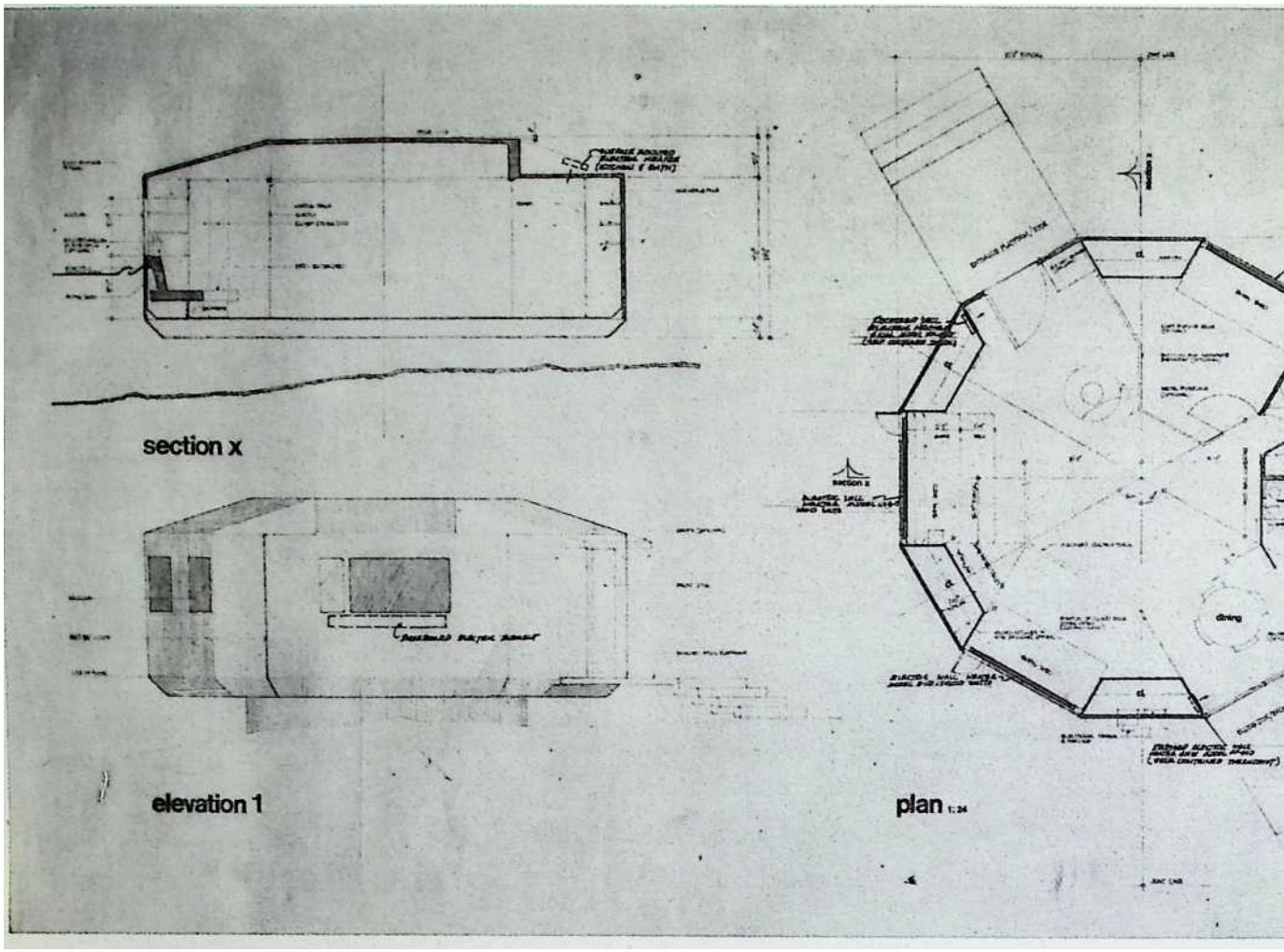

Project Pearland
Site Model
Architect: Fuller & Sadao PC / Long Island City, New York



29 Bangor-Punta Production Domes Fuller & Sadao, 1971

This mass-producible dwelling was designed in an elegant style comparable to that of such pleasure vehicles as yachts and sport cars. Unlike the Wichita House or the Dymaxion Bathroom, the Bangor-Punta Domes are of extremely refined proportions. They look less like low-cost housing than luxurious beach houses, are set above ground on piers, and are topped by an ornamental roof in a star pattern. Each would have had four closets, two patios, three sofa beds, a kitchen, and a bathroom—all arranged on one floor.

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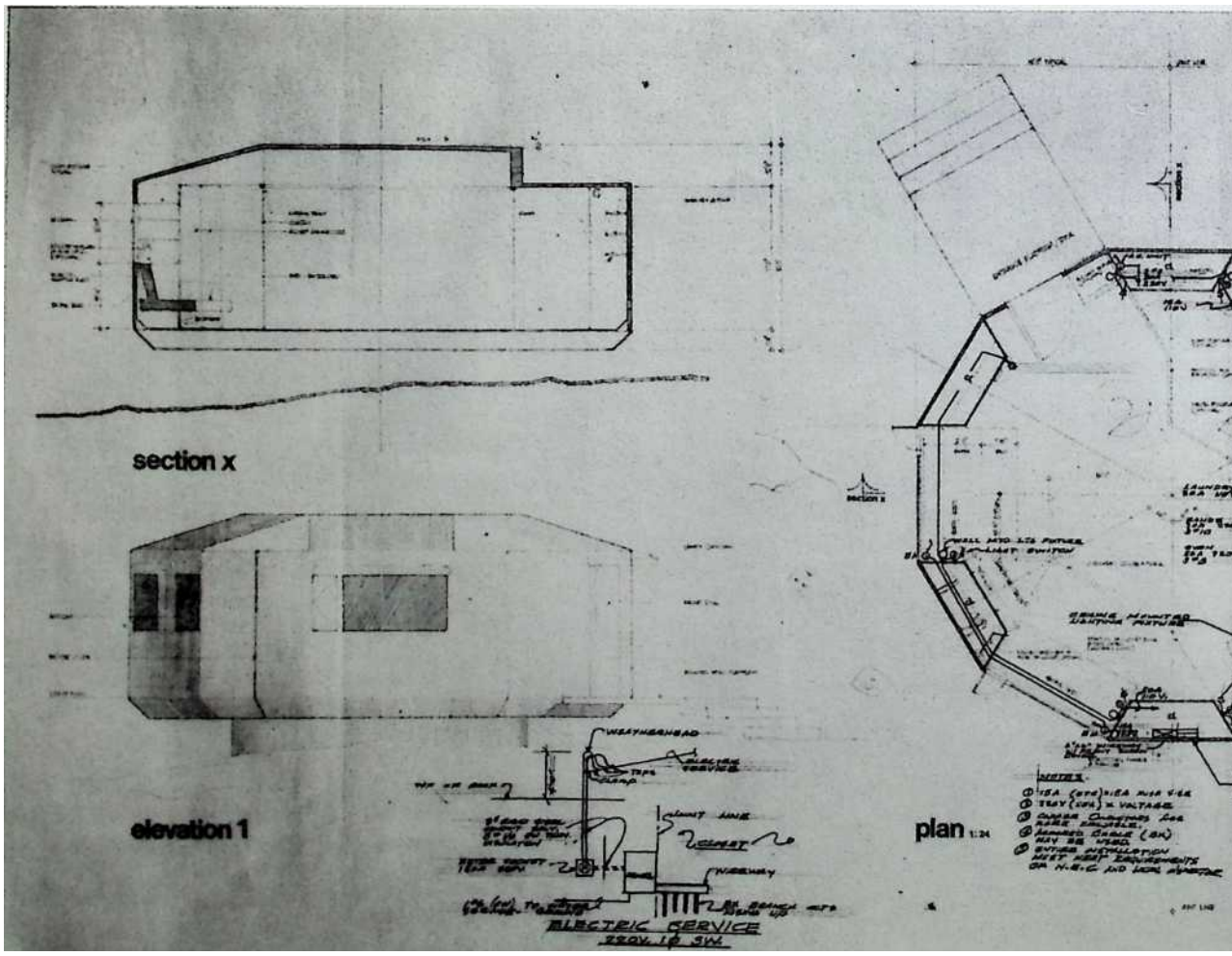
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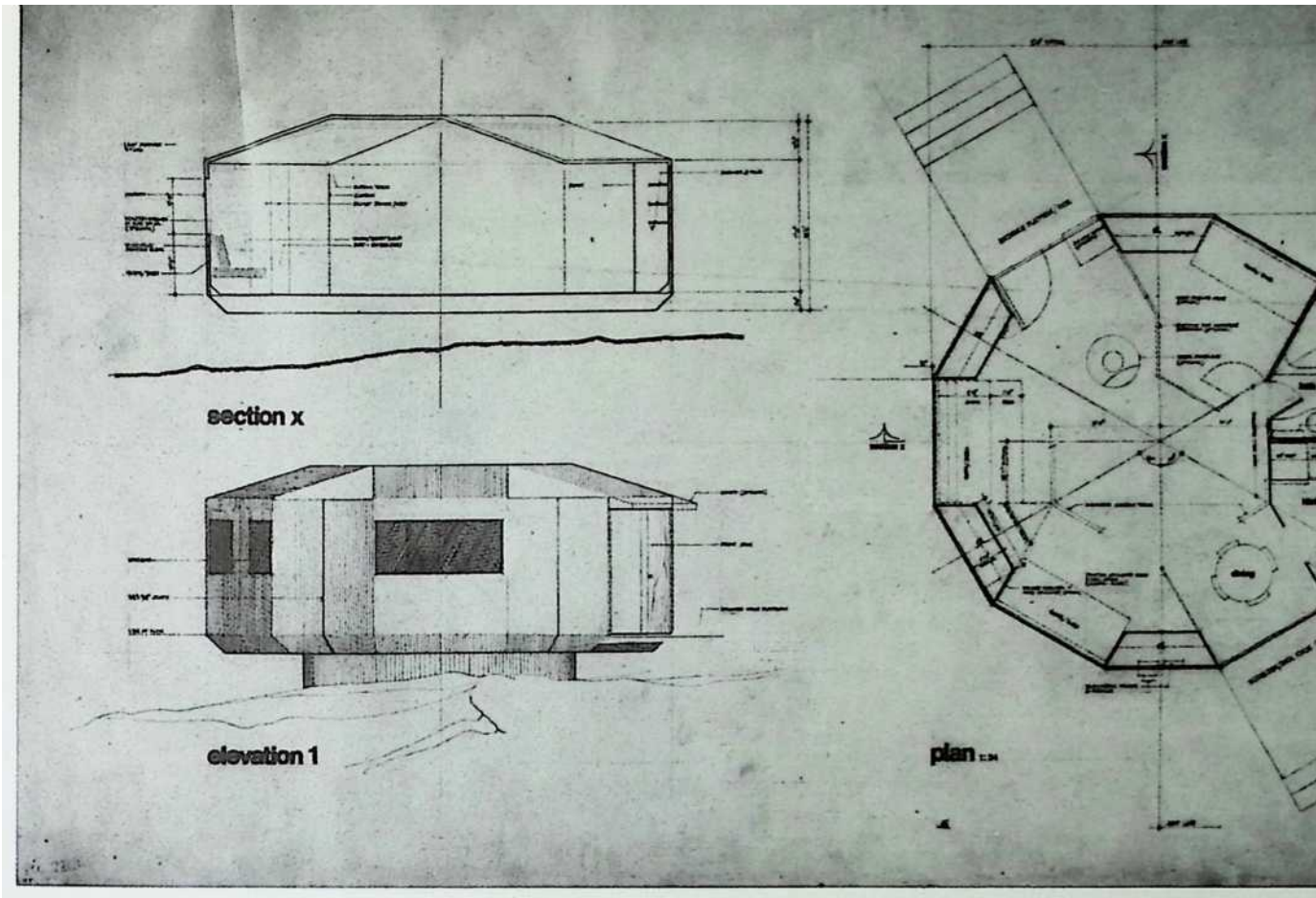
ELECTRIC SERVICE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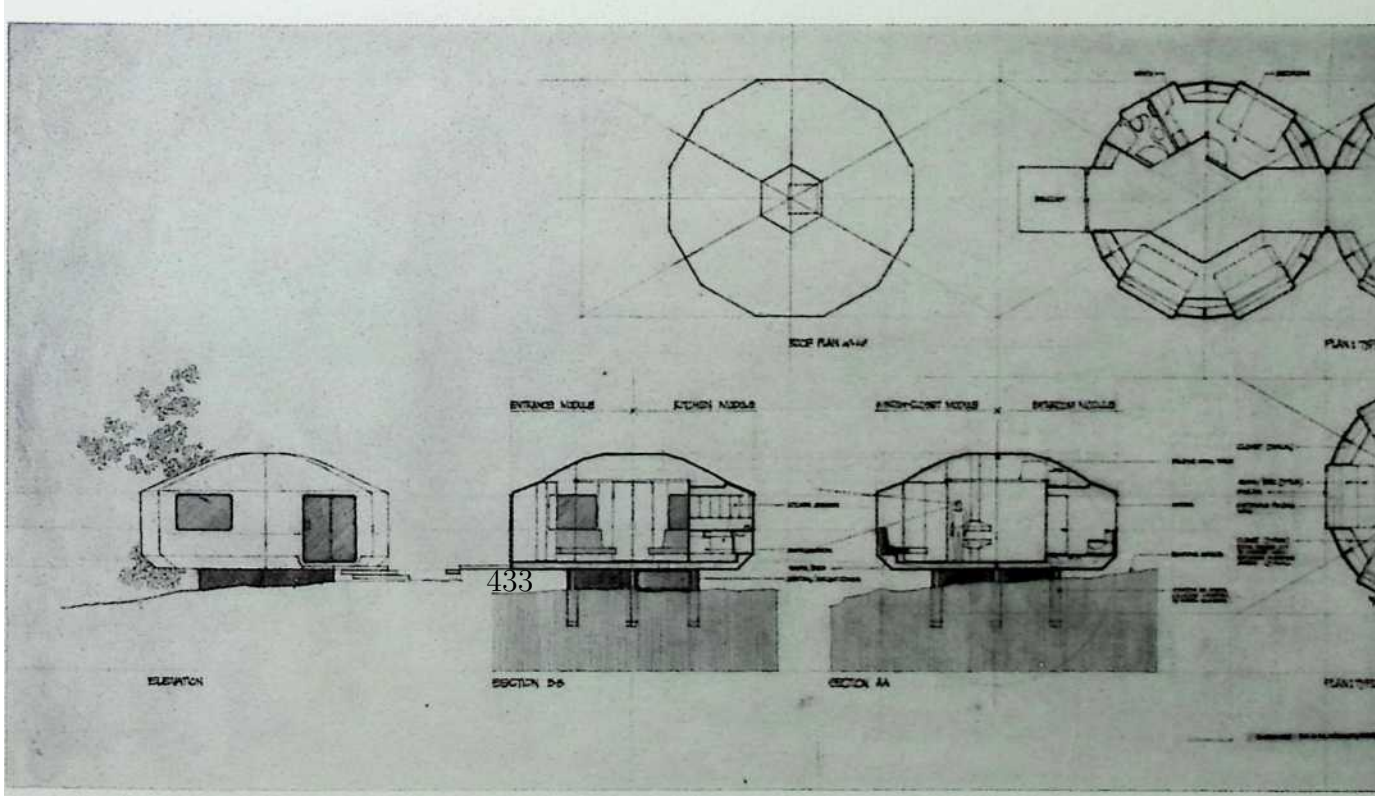
ELEVATION
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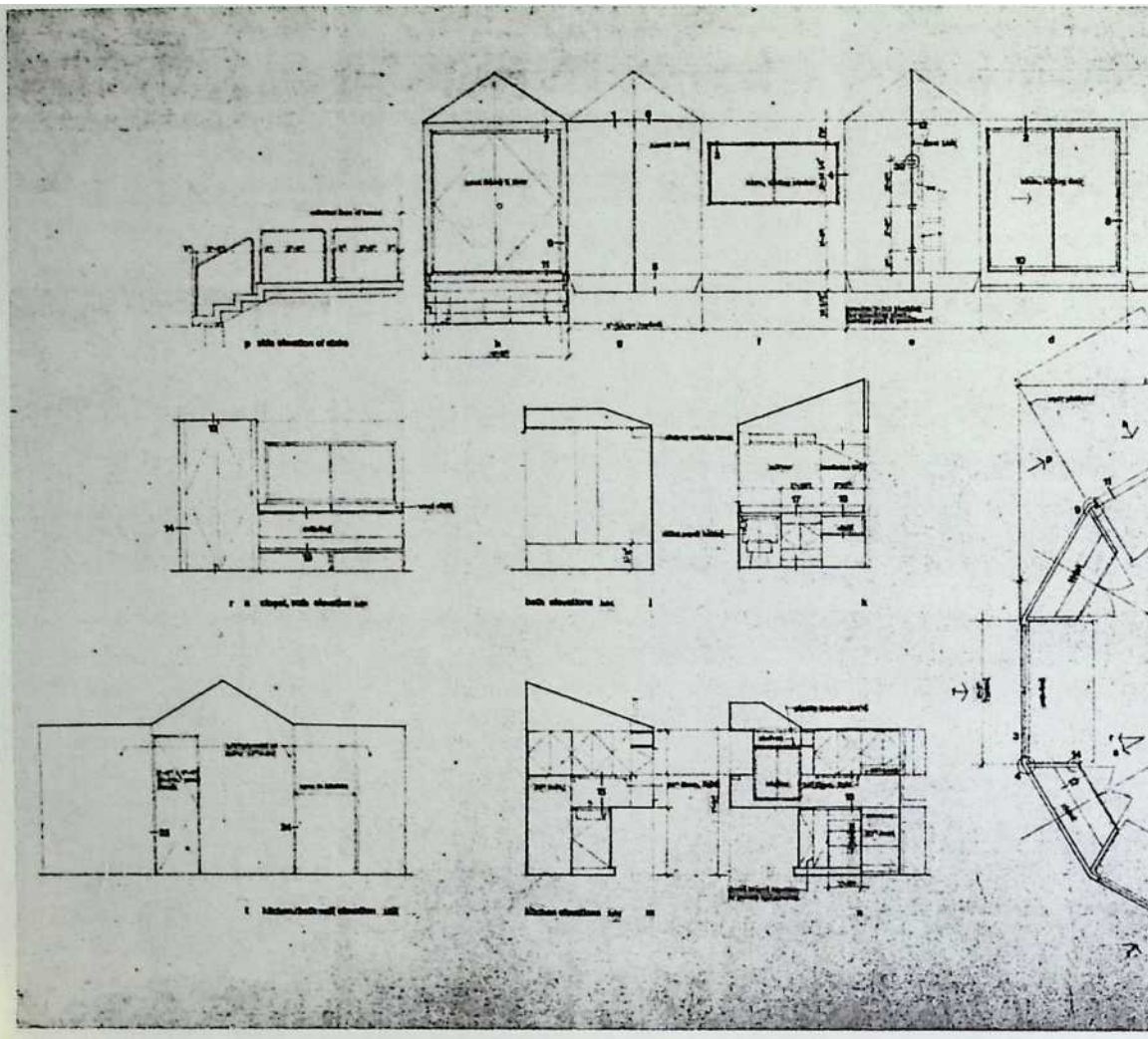
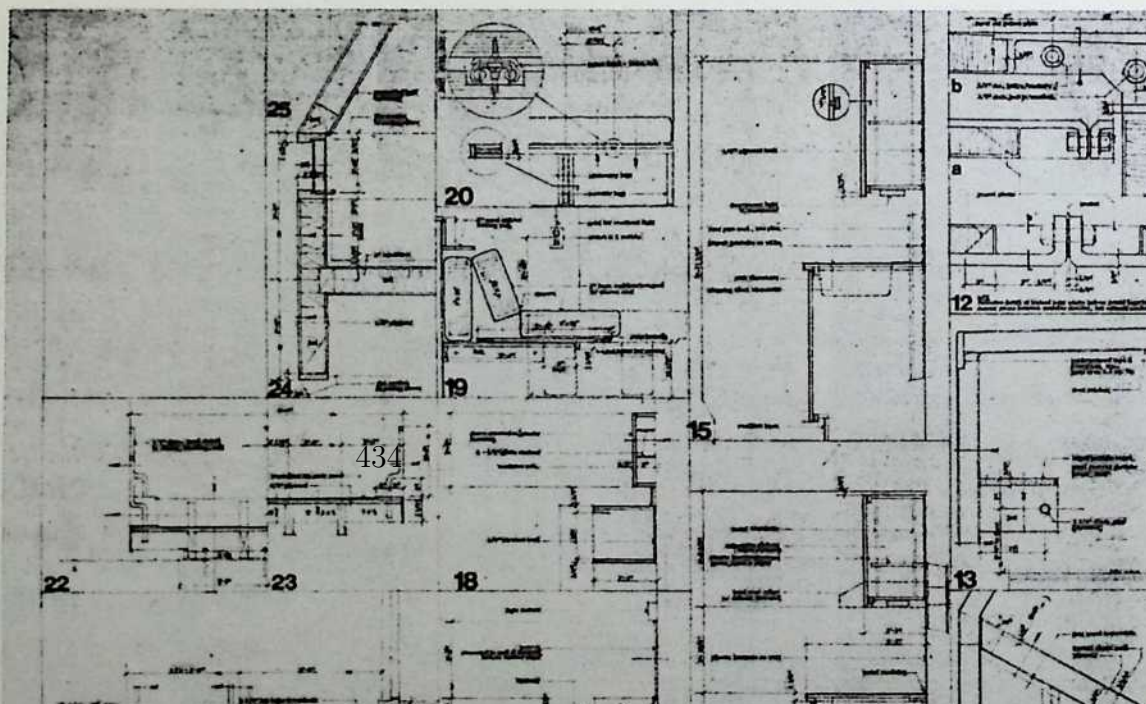
SECTION AA

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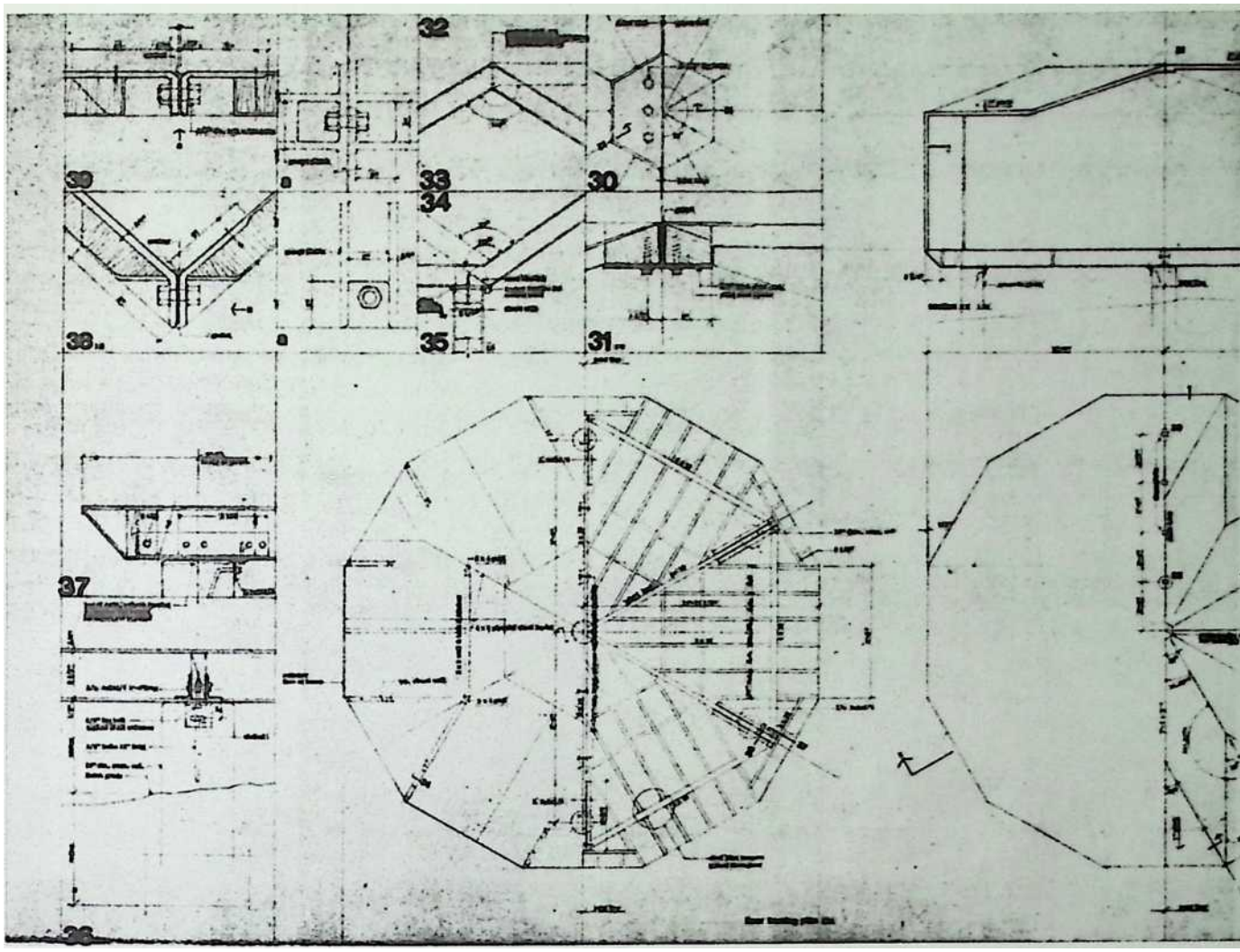
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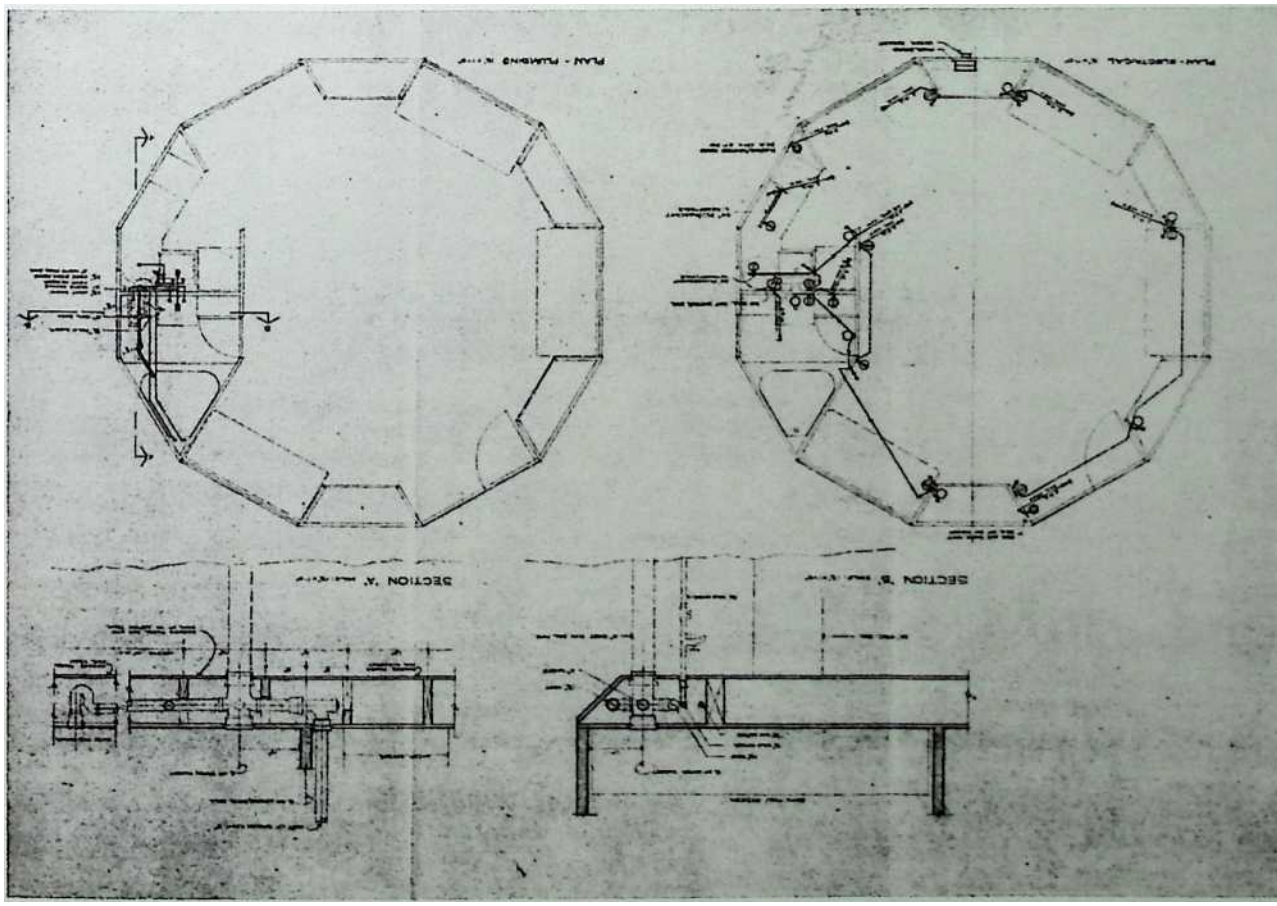
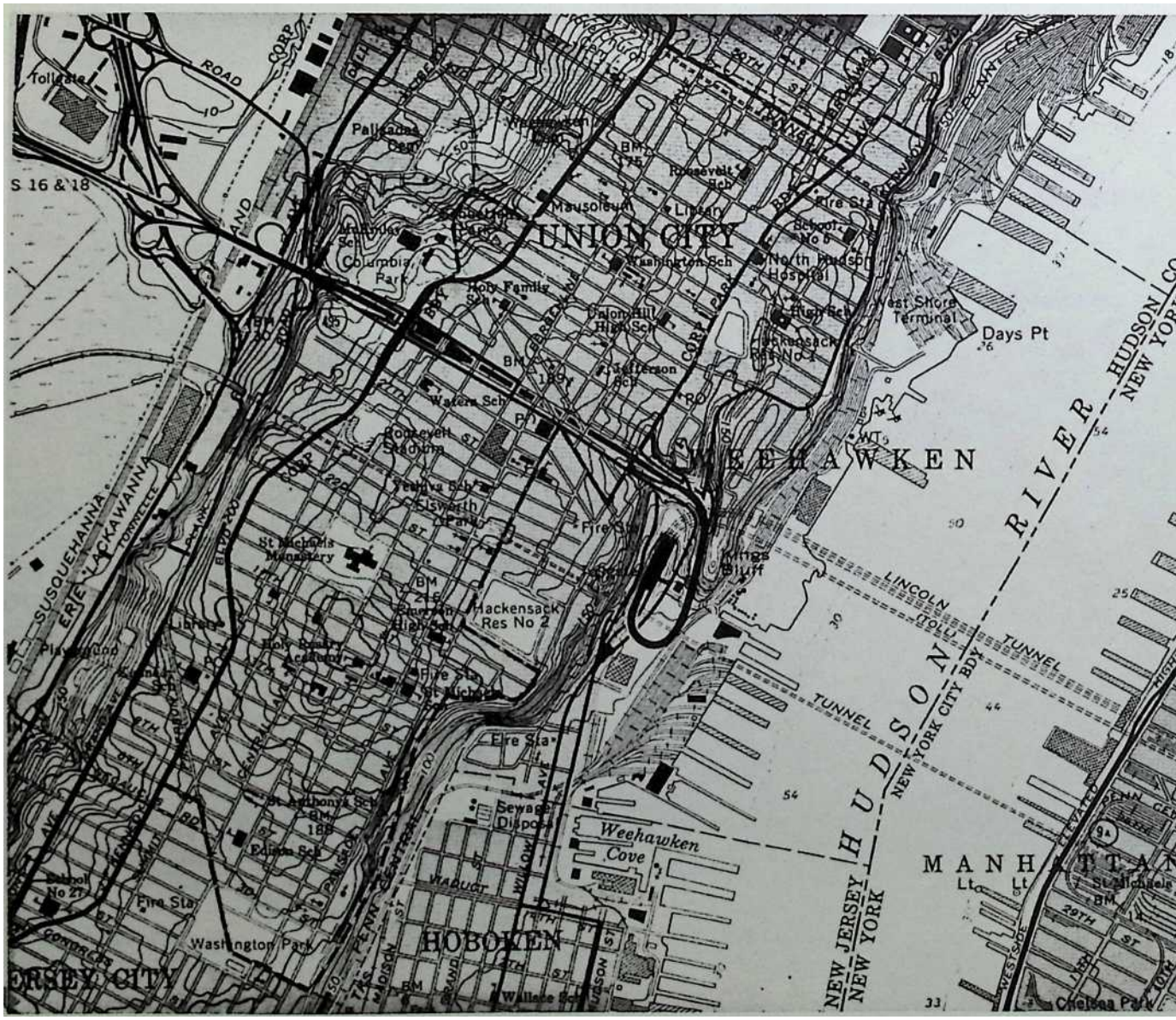


Union City High School, Union City, New Jersey Fuller & Sadao, 1971
The proposal for a new high school in Union City, New Jersey, although not constructed, provided a precedent for several firms that have exploited the glazed truss subsequently. The high school would have had two lower stories of classrooms and offices, and its gymnasium would have occupied the tapered uppermost stories.


UNION CITY
WEEHAWKEN
HUDSON RIVER
NEW JERSEY
NEW YORK
MANHATTAN
HOBOKEN
JERSEY CITY
Weehawken Cove
Days Pt
West Shore Terminal
North Hudson Hospital
Columbia Park
Palisades Park
Mausoleum
Library
Washington Sch
Roosevelt Sch
Fire Sta
Holy Family Sch
Calvary Hill High Sch
Jefferson Sch
Hackensack Res No 1
Hackensack Res No 2
Water Sch
Roosevelt Stadium
Yeshiva Sch
Elsworth Park
St Michaels Monastery
Sherman High Sch
Holy Rosary Academy
St Anthony's Sch
Edison Sch
Sewage Disposal
Kings Bluff
LINCOLN TOLL TUNNEL
NEW YORK CITY BDY
Washington Park
Wallace Sch
Chelsea Park
Tollgate
S 16 & 18
SUSQUEHANNA
ERIE-LACKAWANNA
TURNPIKE
ROAD
CORP
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CENTRAL
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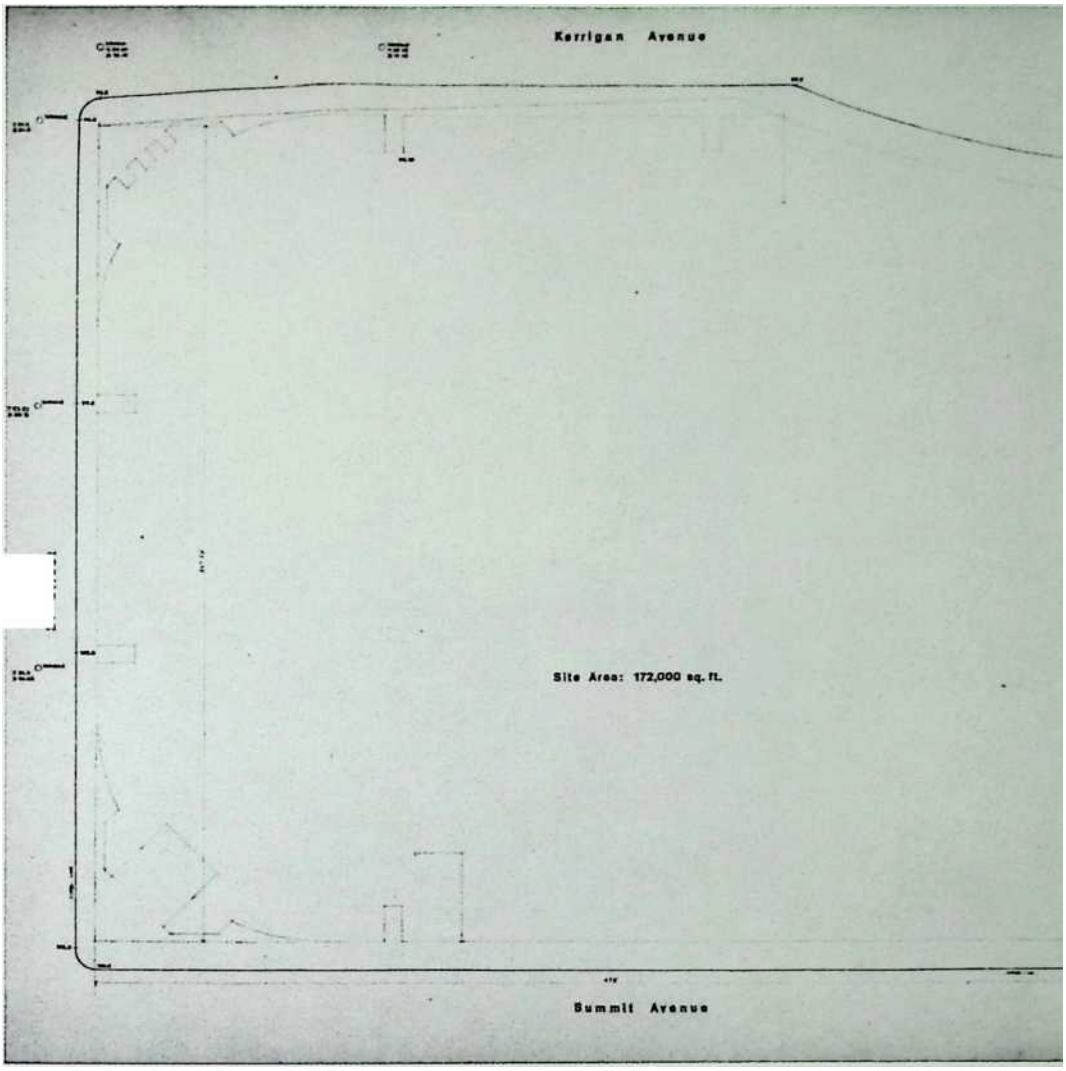
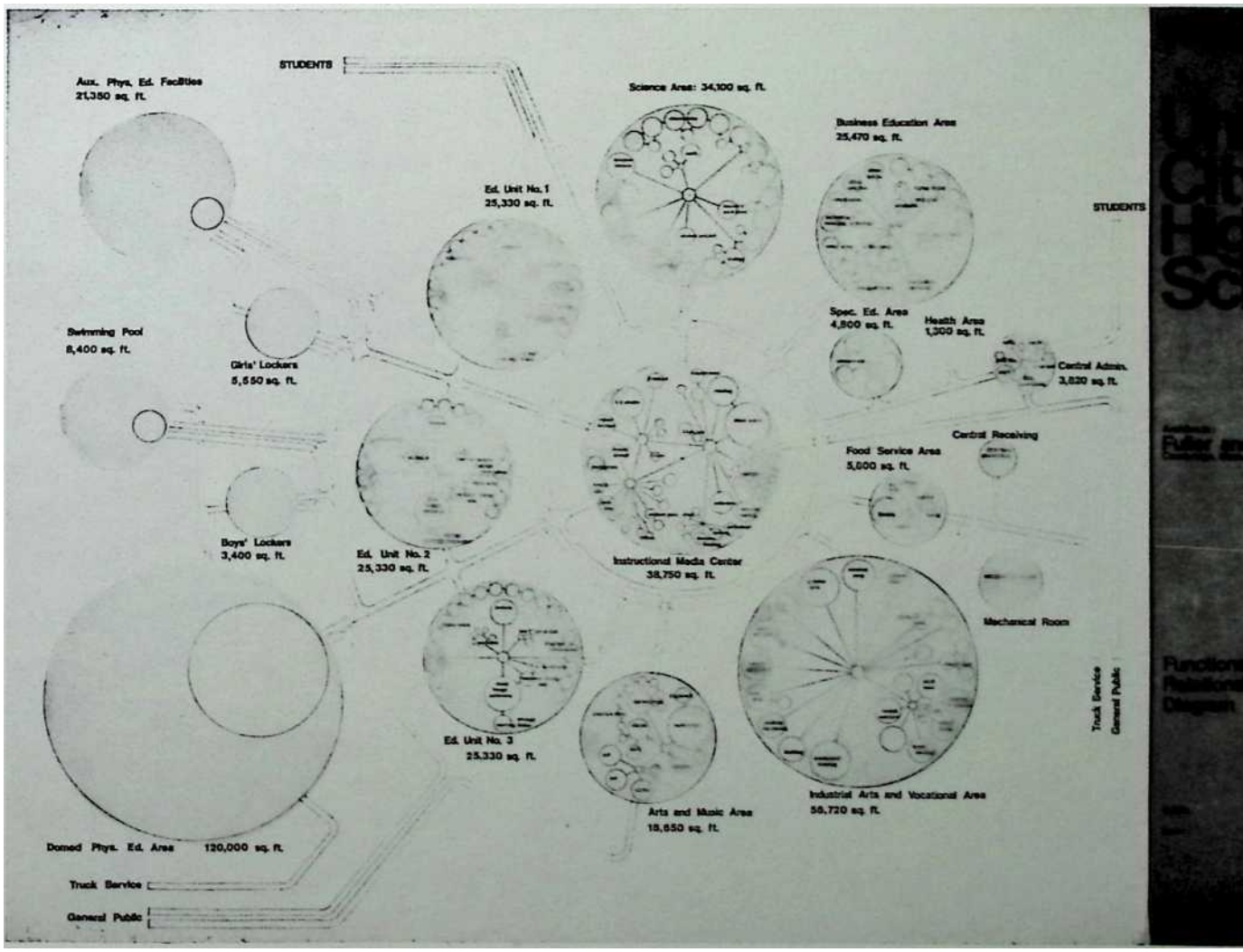


24" Street



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Second level plan

Architects:

Fuller andSadao.inc.

CcmbrkJgo, Moss.

Erst level plan

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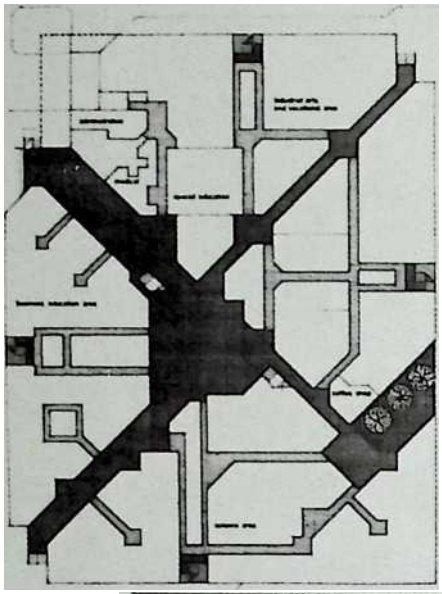
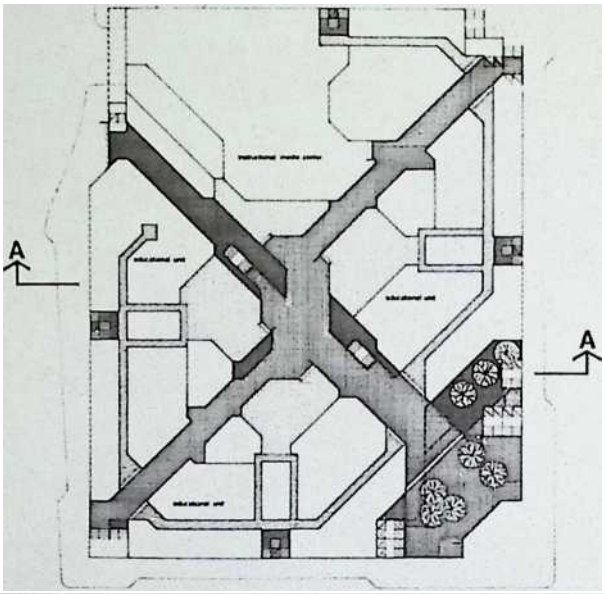
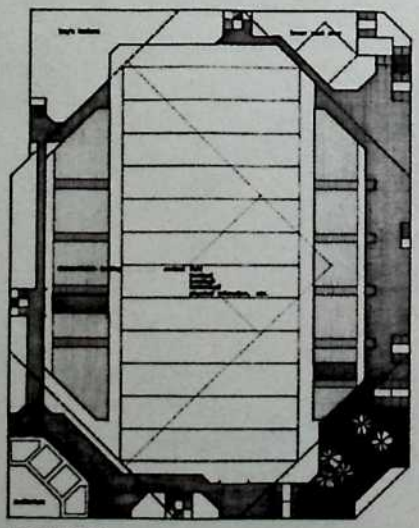
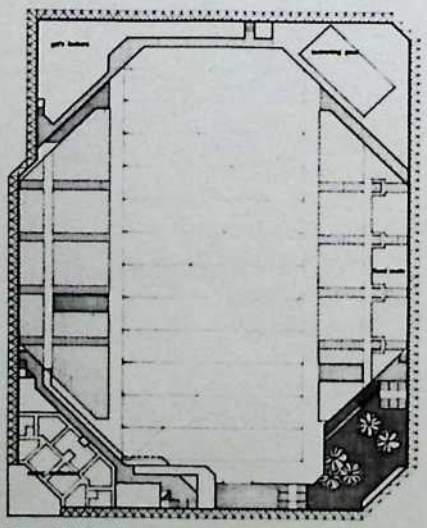


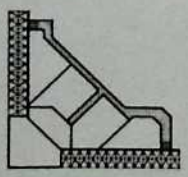




Third level plan



Upper third level



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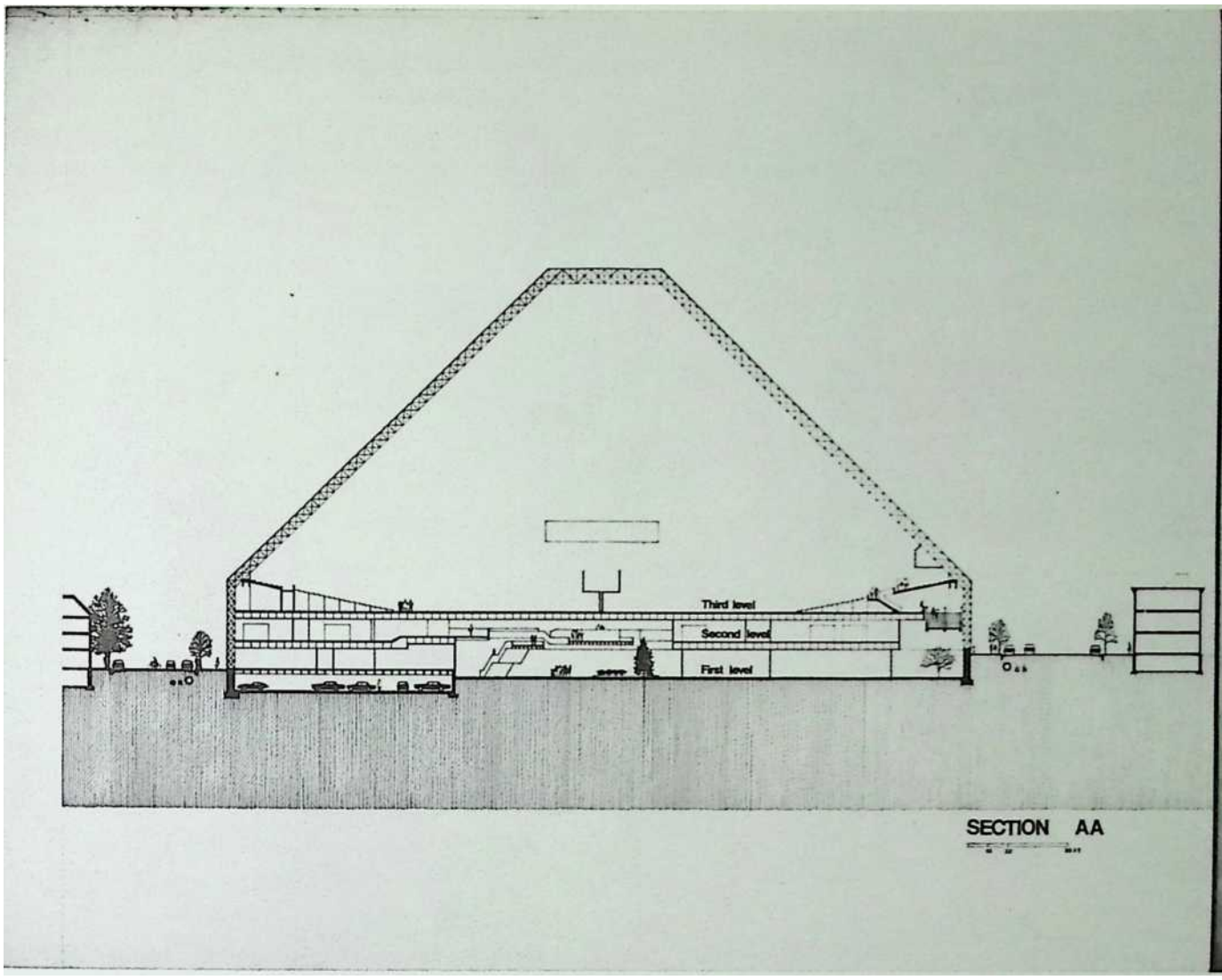
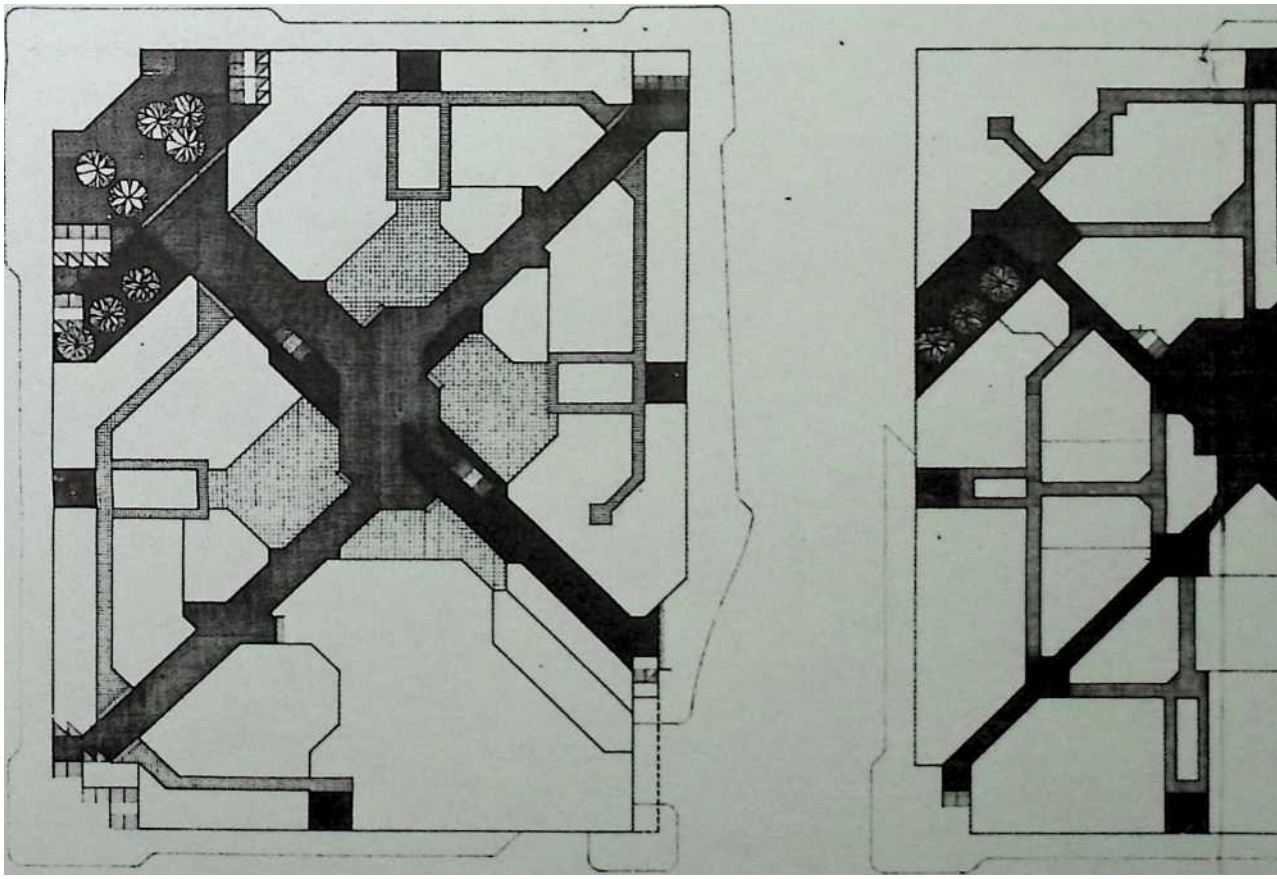

Third level
Second level
First level
SECTION AA



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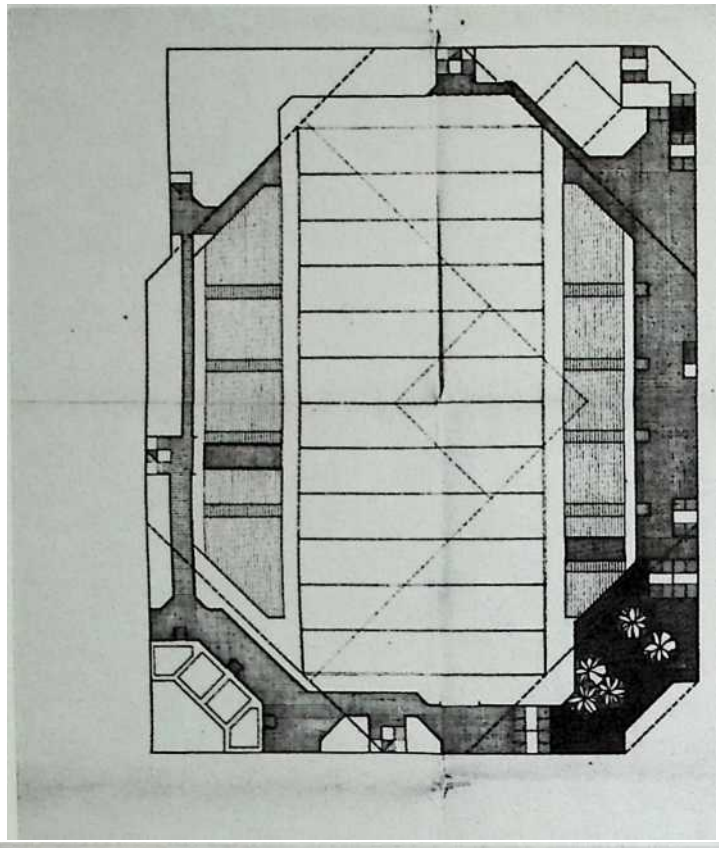
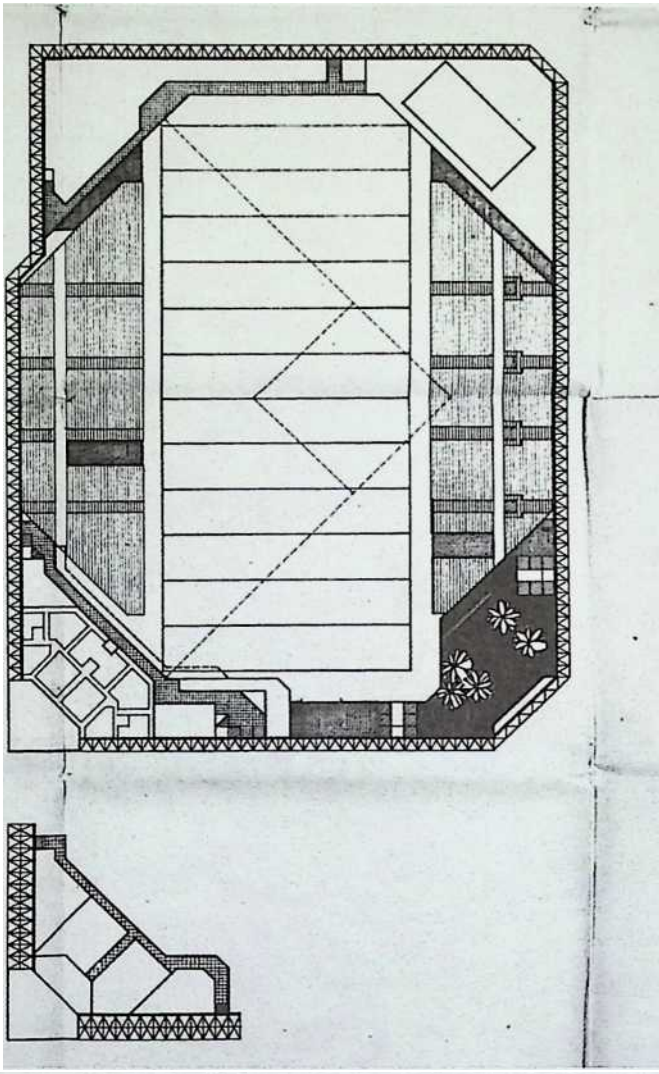
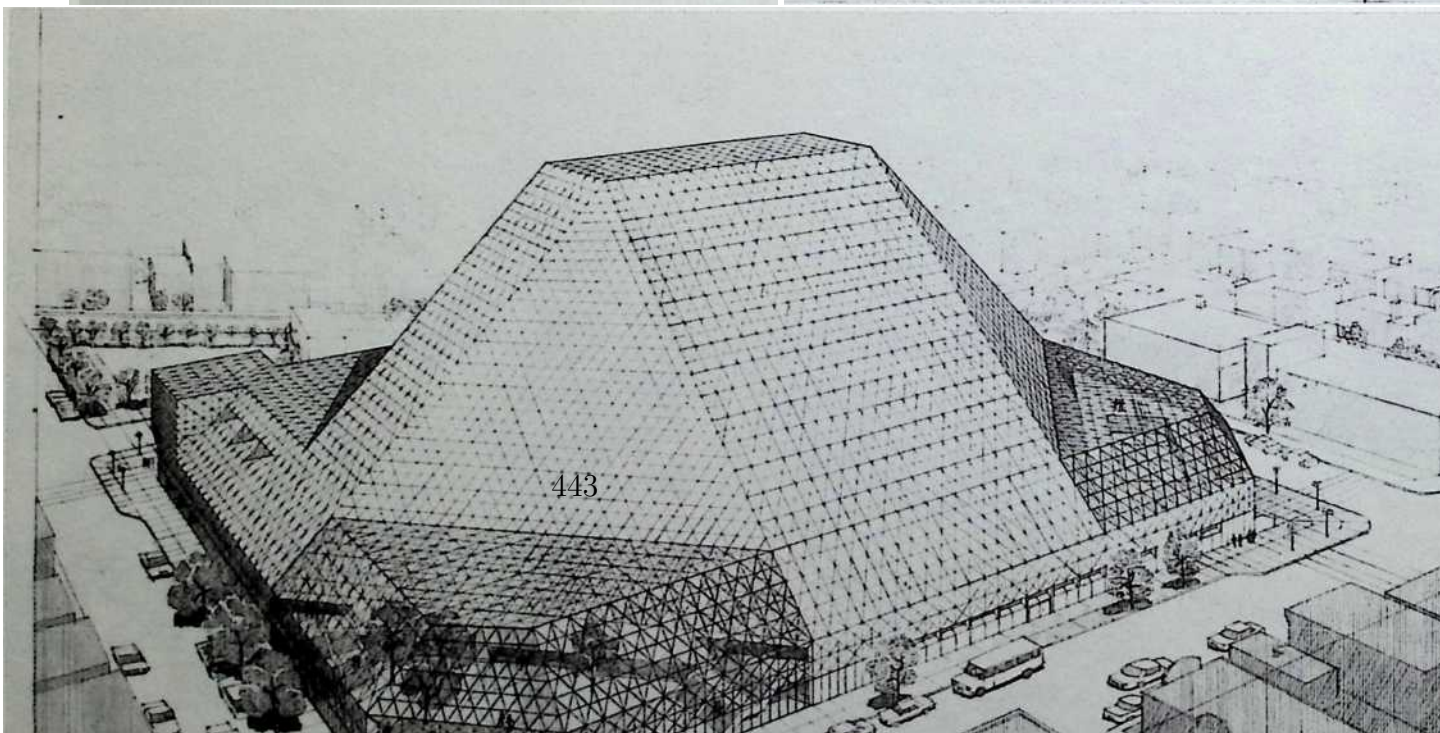
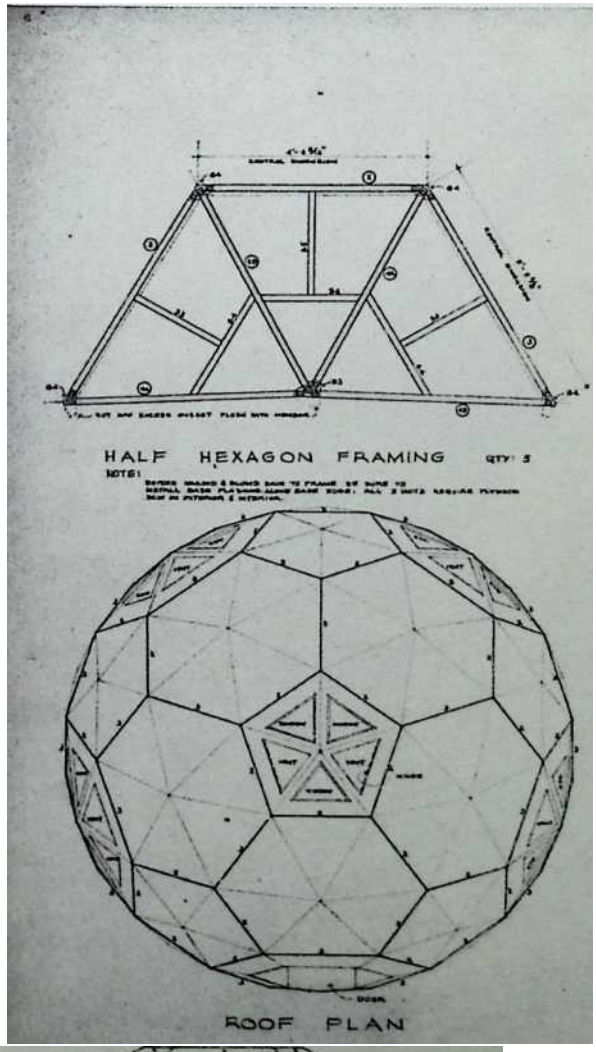


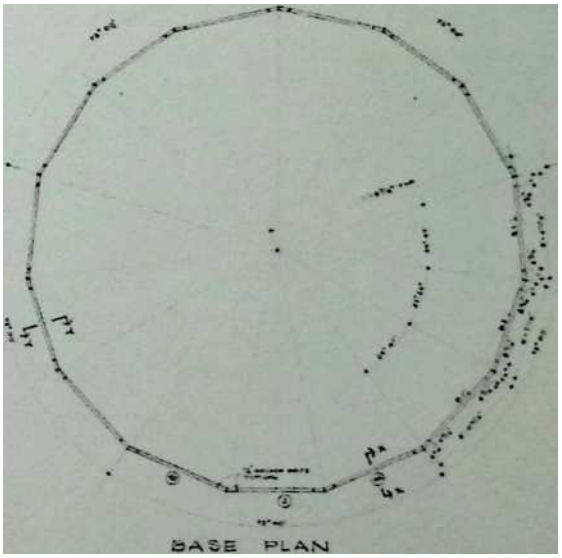


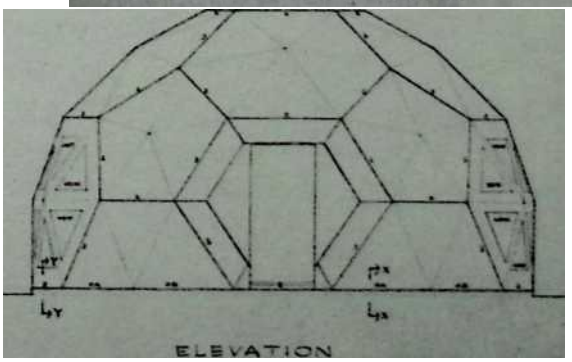


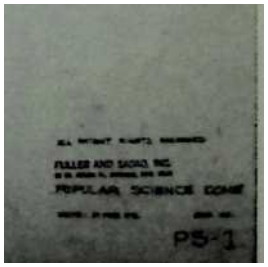
Popular Science Dome Fuller & Sadao, 1972

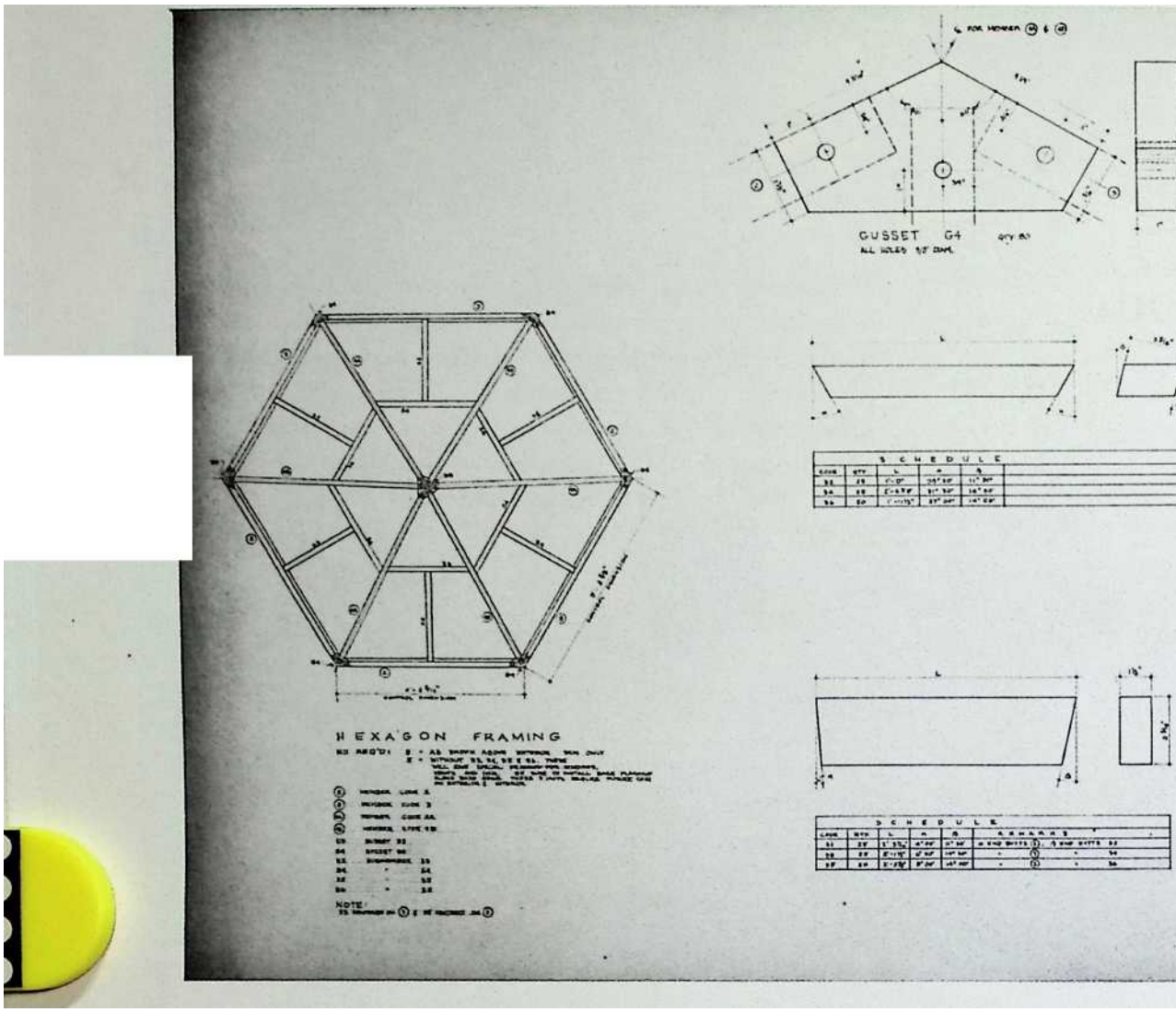
This dome was designed for mass production and, was simplified in order to promote the idea of the geodesic dome. The framing of two-by-fours and the sheathing of plywood made these structures both inexpensive and relatively easy to construct. Perhaps because of its cost and the interesting arrangement of fenestration and vents, the *Popular Science* Dome was a great success.

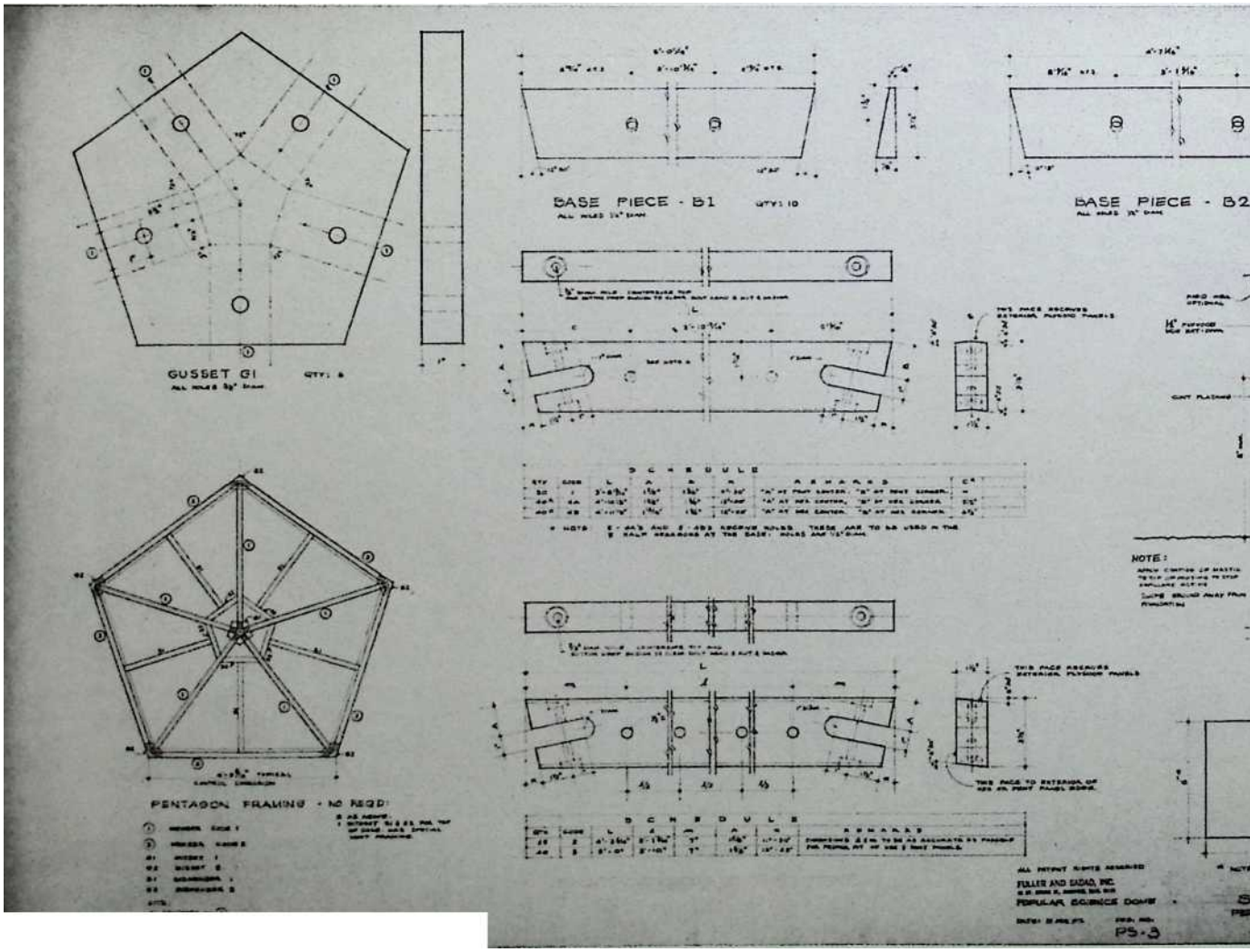

HALF HEXAGON FRAMING
ROOF PLAN

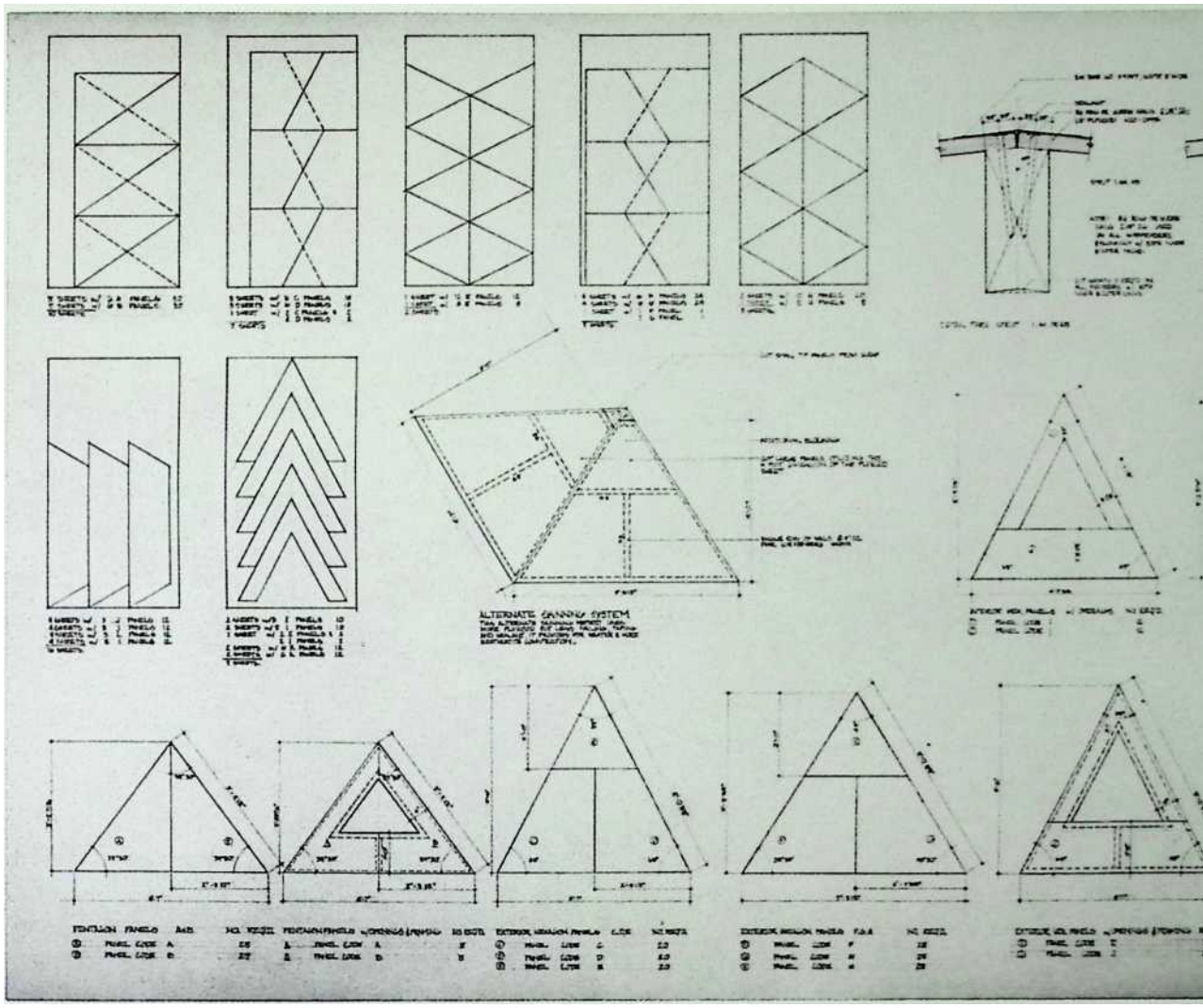

BASE PLAN

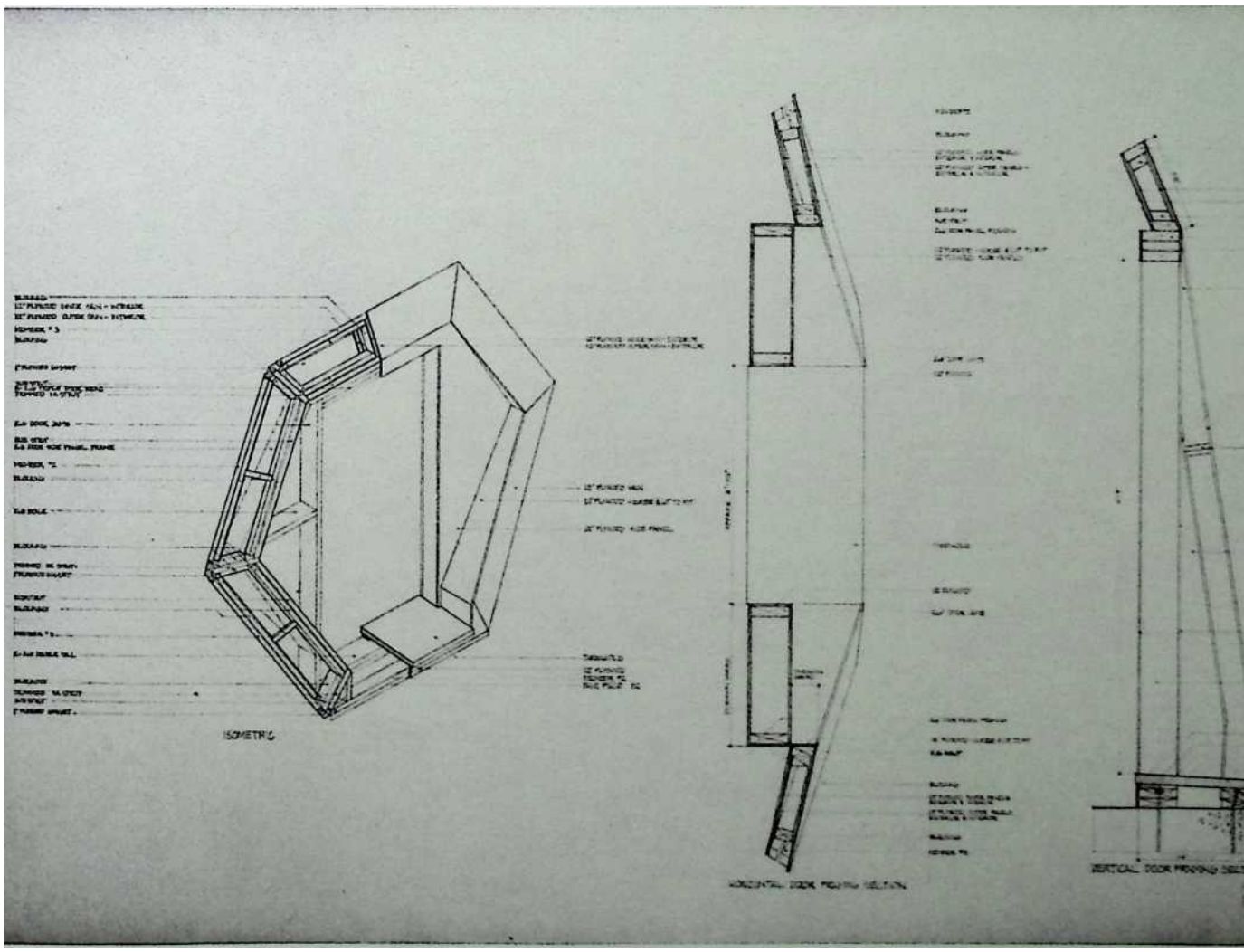

ELEVATION

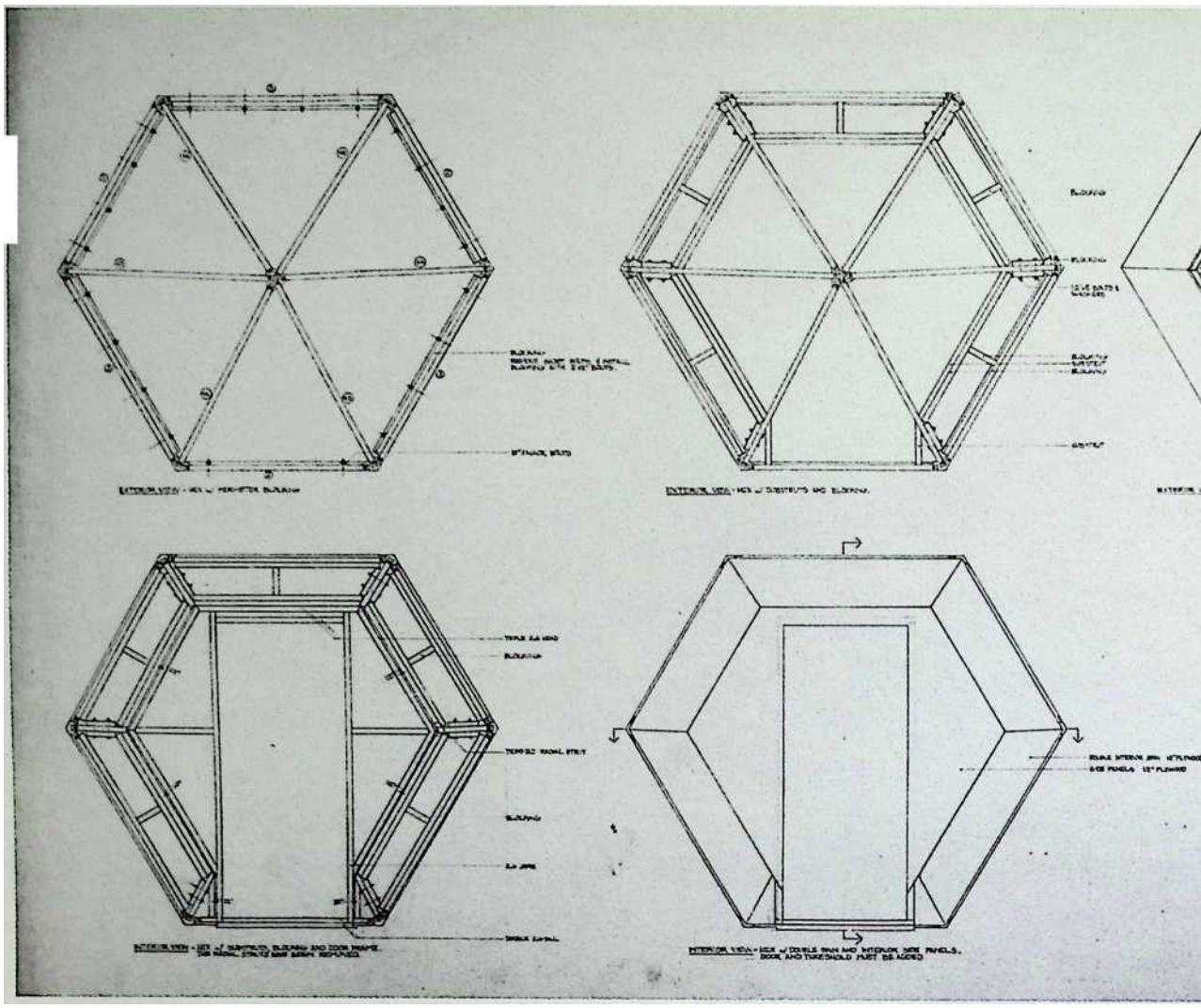

POPULAR SCIENCE DOME
PS-1

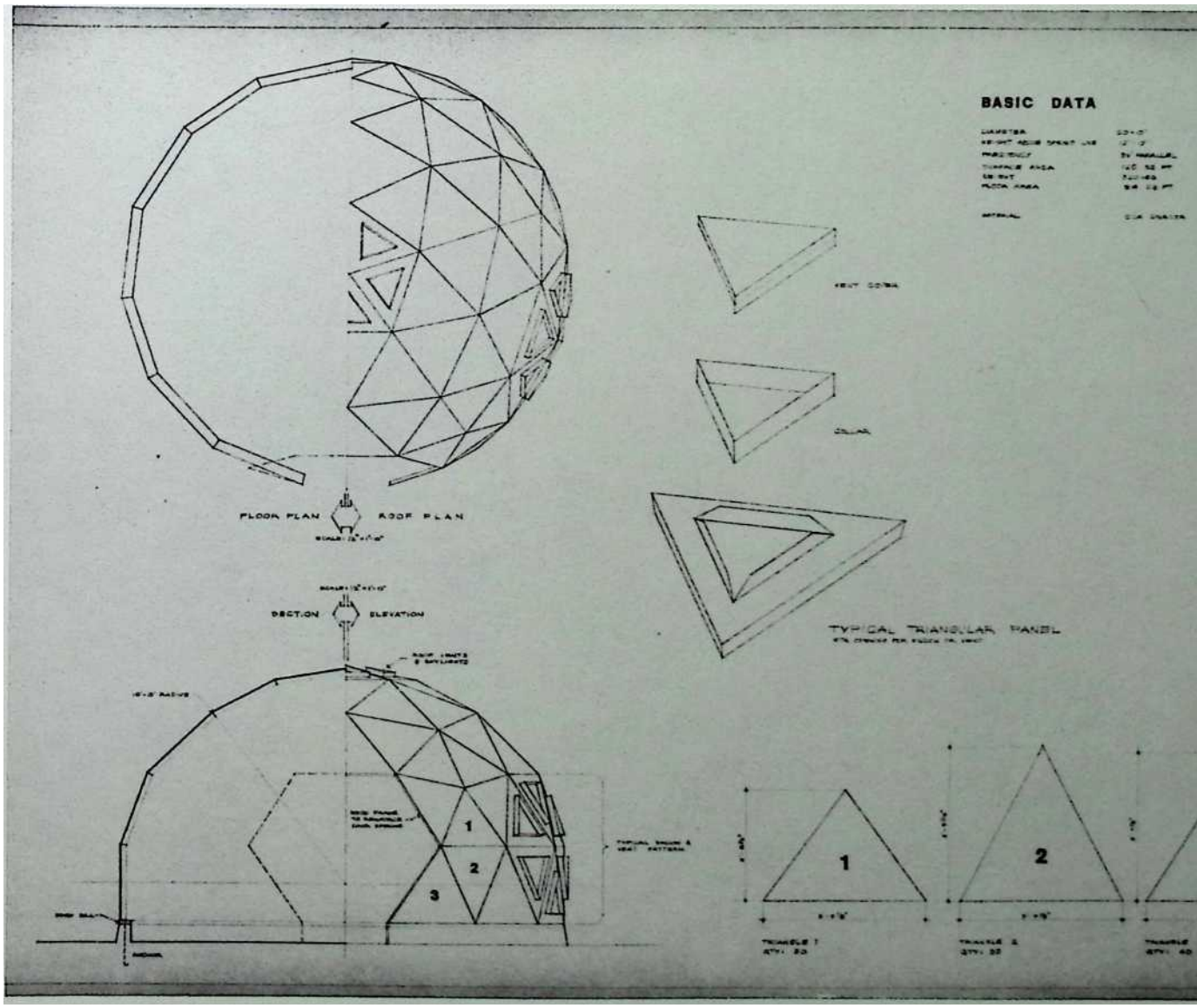

GUSSET G4
HEXAGON FRAMING
SCHEDULE
SCHEDULE
NOTE:


GUSSET G1
BASE PIECE - B1
BASE PIECE - B2
PENTAGON FRAMING - NO REQD
NOTE:
FULLER AND SADAO, INC.
POPULAR SCIENCE DOME
PS-3


ALTERNATE GANNAY SYSTEM


ISOMETRIC




BASIC DATA
FLOOR PLAN
ROOF PLAN
SECTION
ELEVATION
TYPICAL TRIANGULAR PANEL
1
2
3

30 Paperboard Dome, India Fuller & Sadao, 1972

This paperboard dome was designed during 1972, a time when Fuller was particularly keen on solving the housing problems of the Third World. It is twenty feet in diameter and twelve feet high, weighs 320 pounds, and was fabricated in CCA Dinacor. It is composed of triangular panels, into which the occupant can cut air vents. The dome is raised on a wood sill, and its hexagonal door has a wood frame. Although Dinacor is waterproof, the dome is suited ideally to arid climates.

31 International Airports for India: Palam in New Delhi Fuller & Sadao, 1972

The Palam Airport for New Delhi is a very large, open decagon, each building of which is composed of glazed trusses. A traffic rotary runs around the center of the decagon, at the center of which is a control tower with a geodesic dome. The planes are serviced on the terminal's polygonal perimeter.

INTERNATIONAL AIRPORTS AUTHORITY OF INDIA NEW AIR TERMINALS PROJECT PALAM INTERNATIONAL AIRPORT, NEW DELHI

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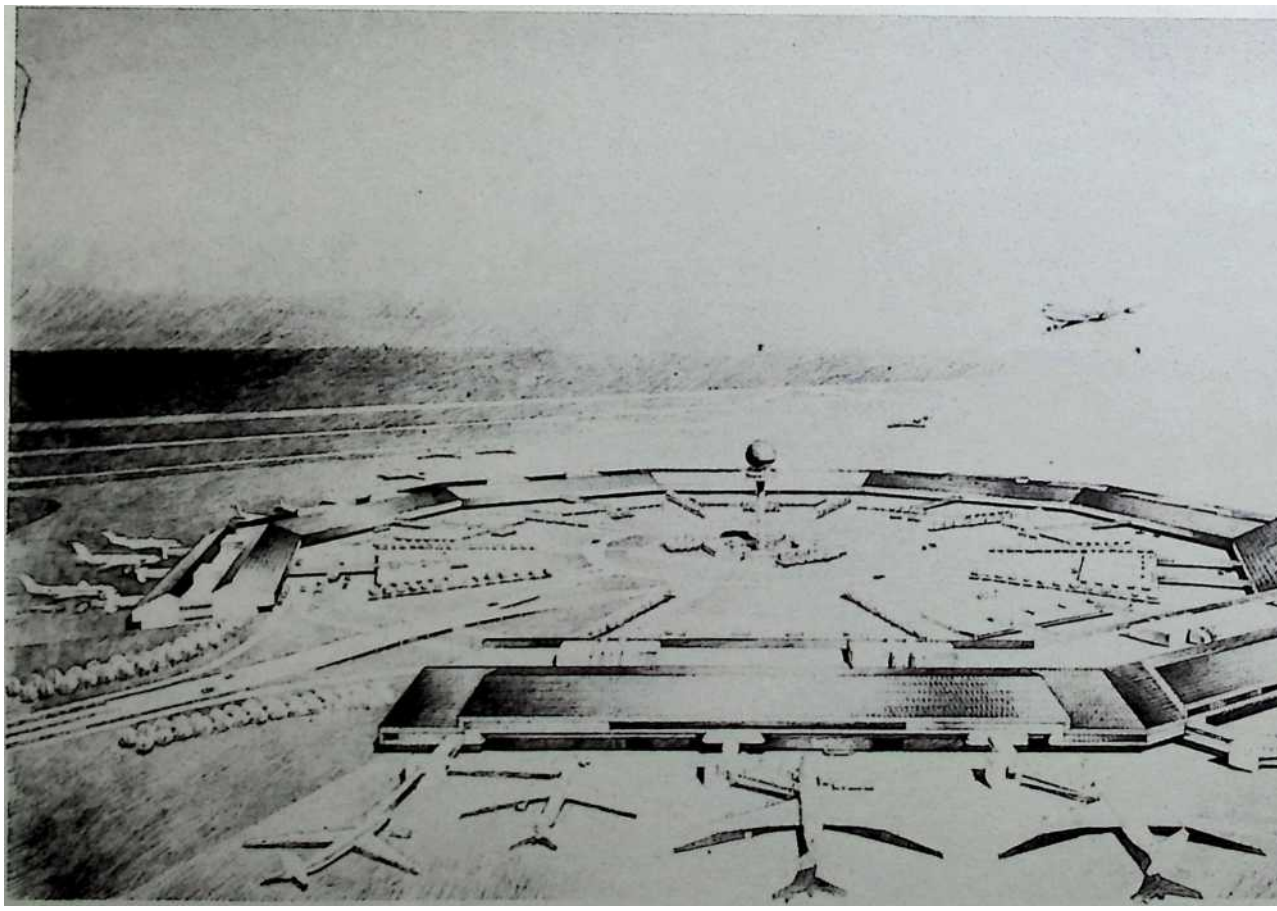
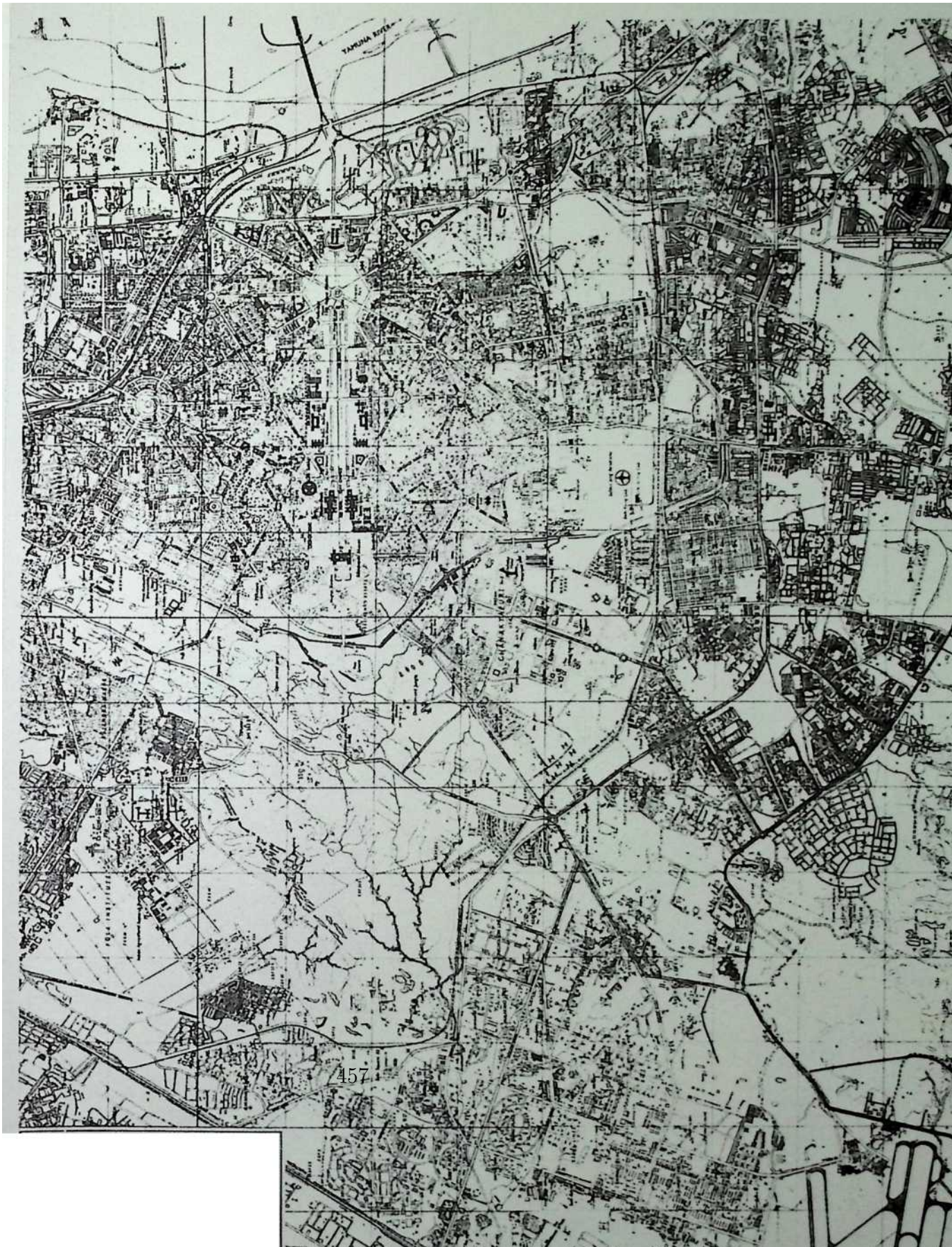
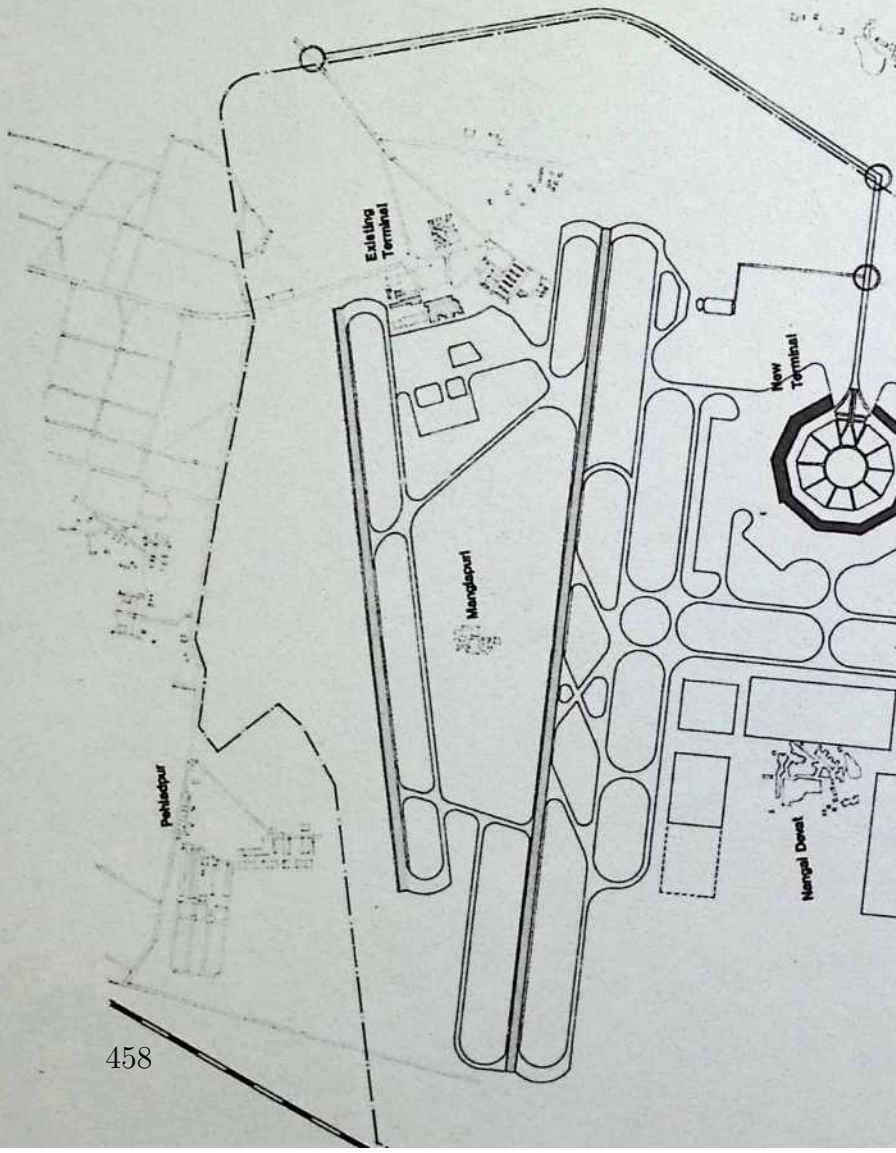



YAMUNA RIVER


Existing Terminal
New Terminal
Mangalpuri
Pahladpur
Nangal Dewat

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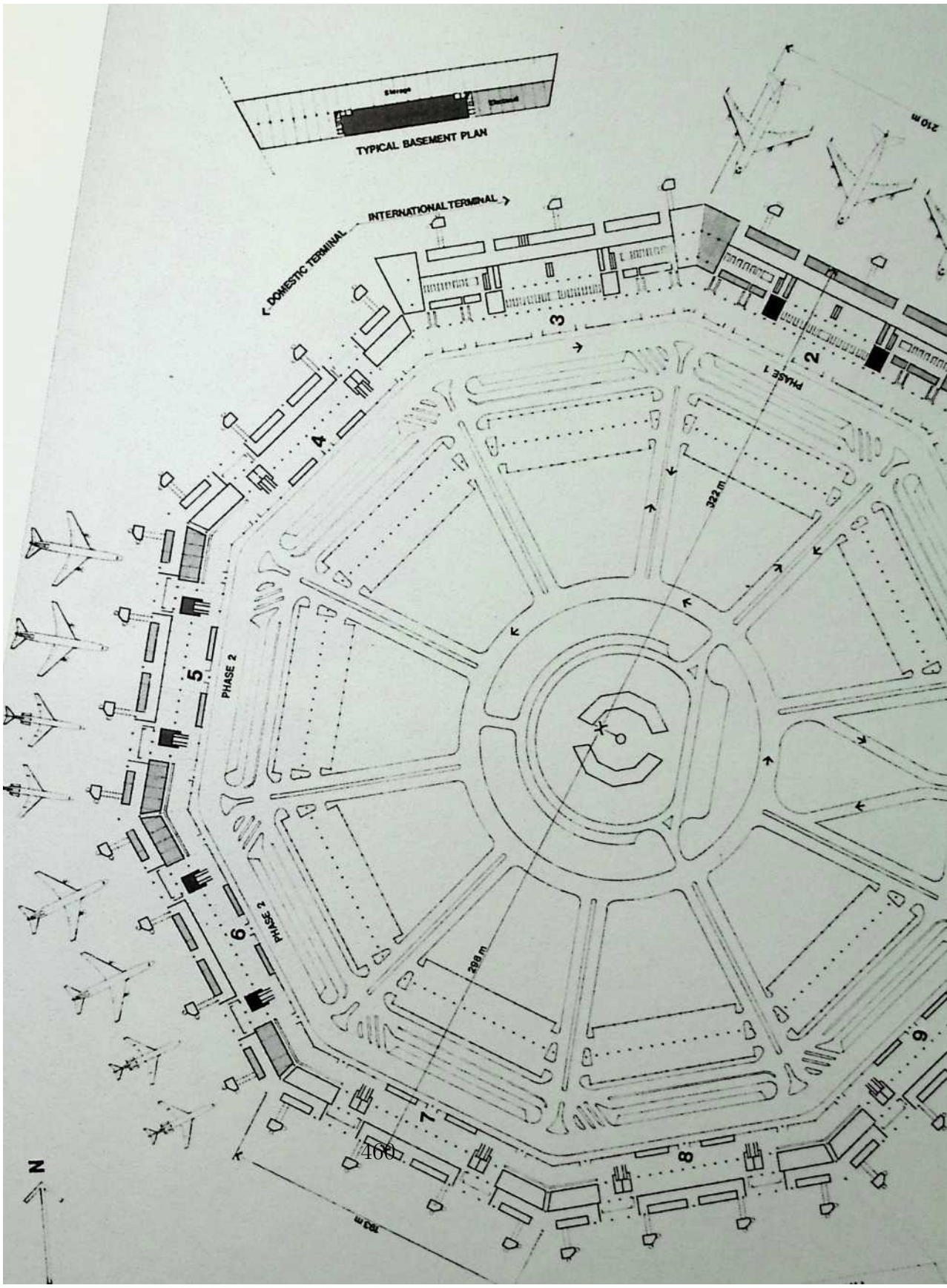
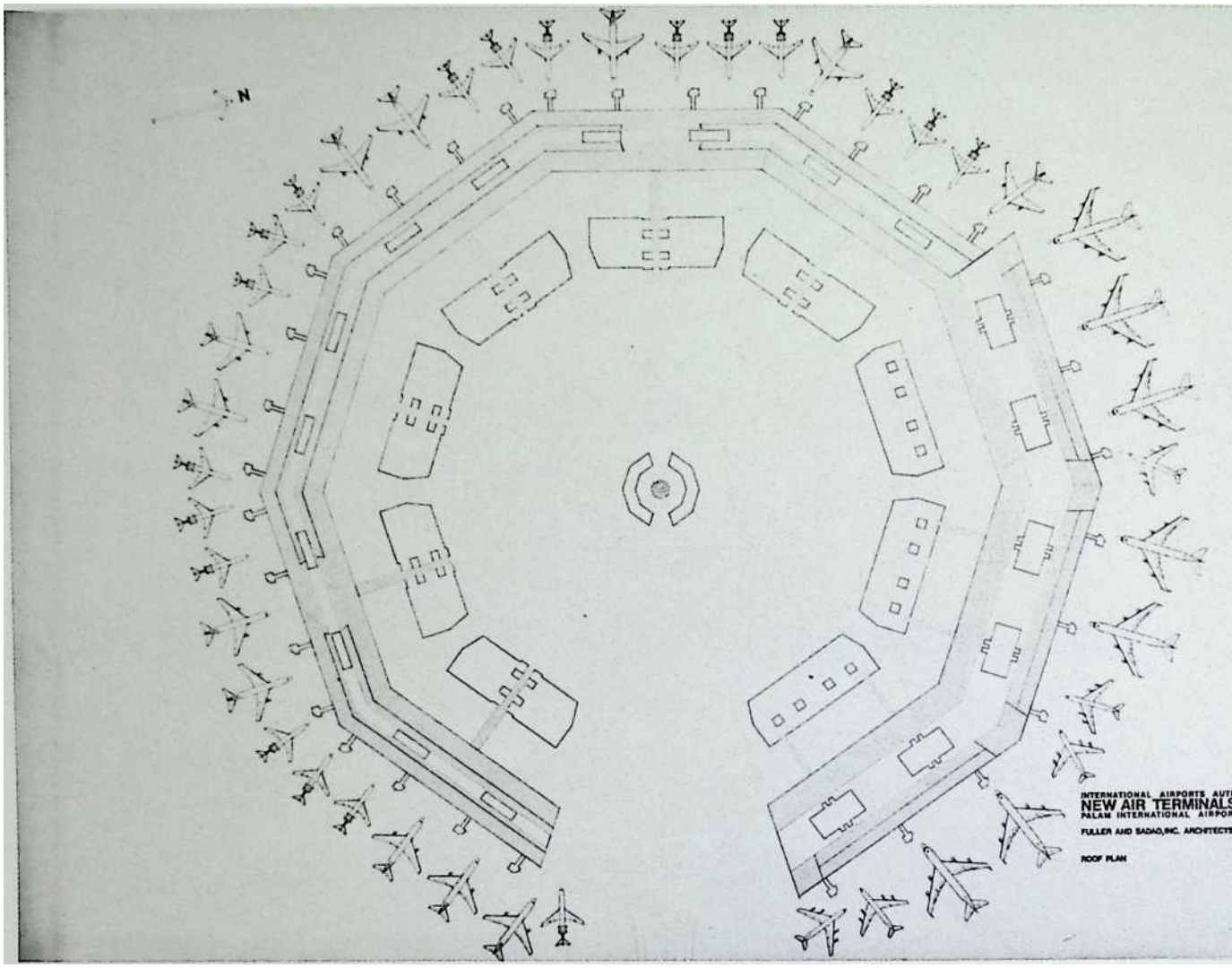

TYPICAL BASEMENT PLAN
INTERNATIONAL TERMINAL
DOMESTIC TERMINAL
PHASE 1
PHASE 2
PHASE 3
322 m
298 m
210 m
N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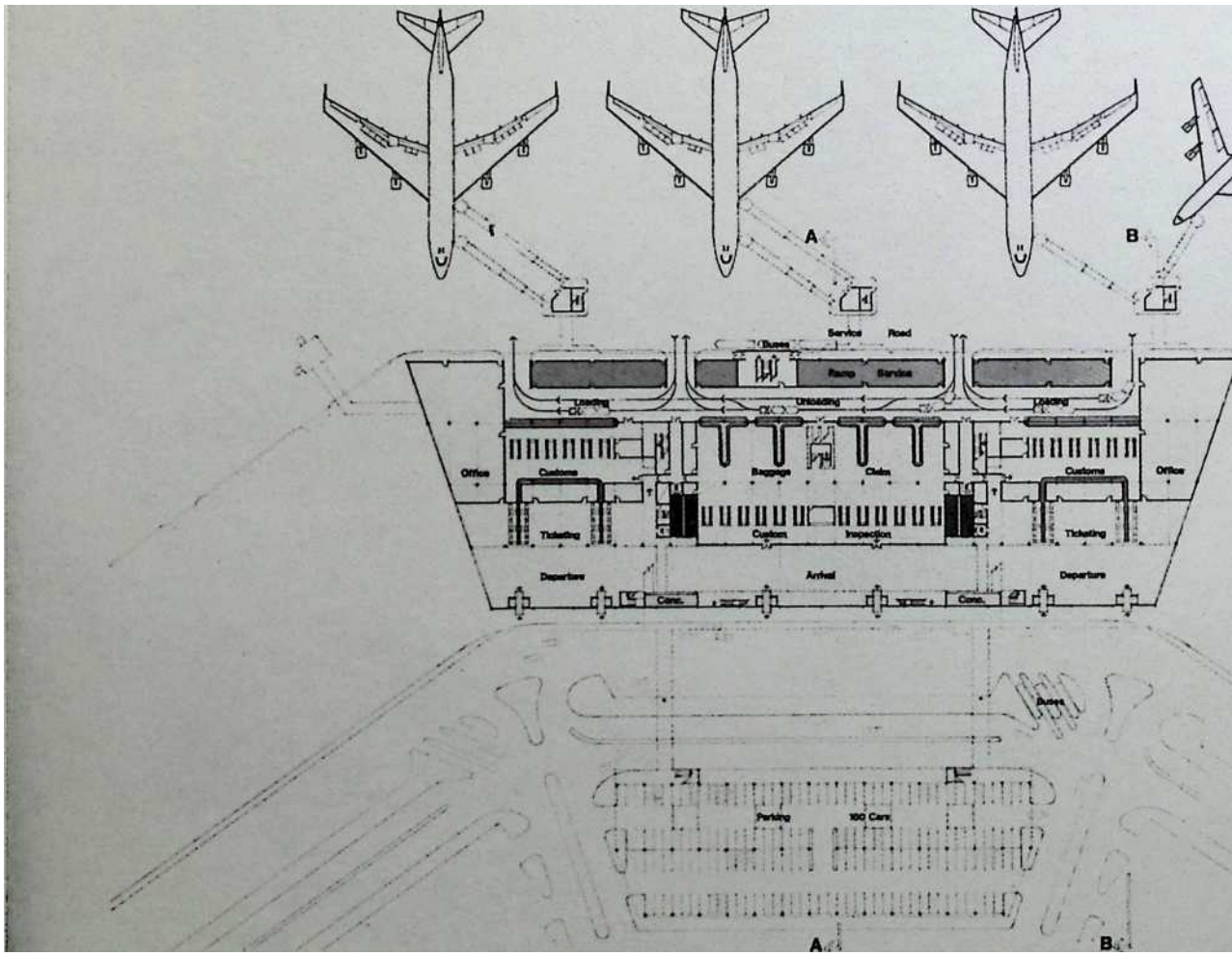
INTERNATIONAL AIRPORTS AUT
NEW AIR TERMINALS
PALAM INTERNATIONAL AIRPOR
FULLER AND SADAO, INC. ARCHITECTS
ROOF PLAN


A
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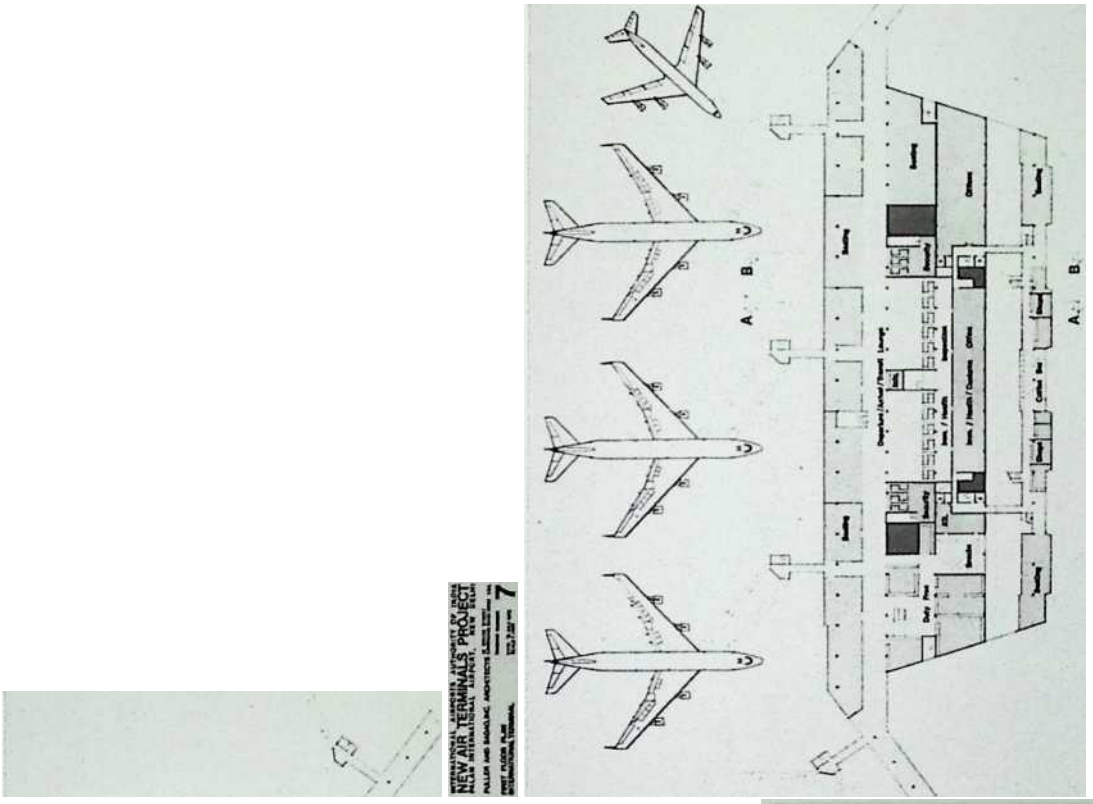
Service Road
Buses
Ramp Service
Loading
Unloading
Loading
Office
Customs
Baggage
Claim
Customs
Office
Ticketing
Customs
Inspection
Ticketing
Departure
Arrival
Departure
Cons.
Cons.
Buses
Parking
100 Cars
A
B


INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
ALLAN INTERNATIONAL AIRPORT, NEW DELHI
PALLER AND BANDALINI ARCHITECTS
FIRST FLOOR PLAN
INTERNATIONAL TERMINAL
7
A
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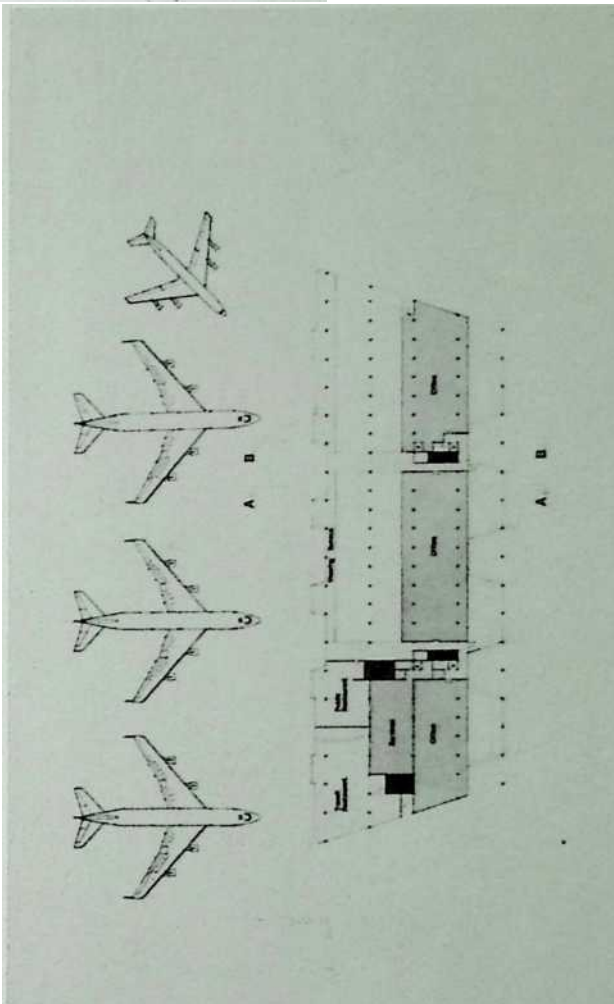
A
B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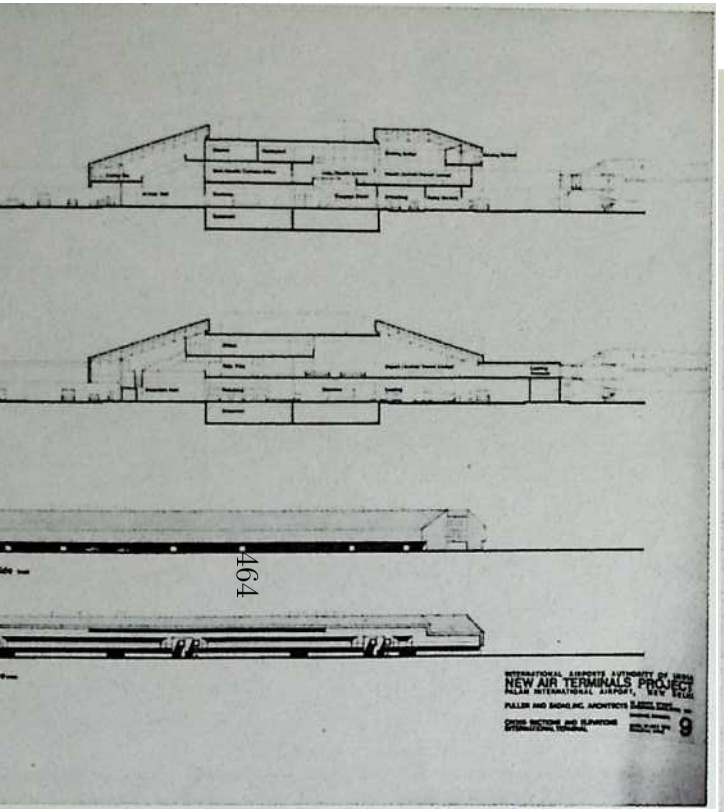
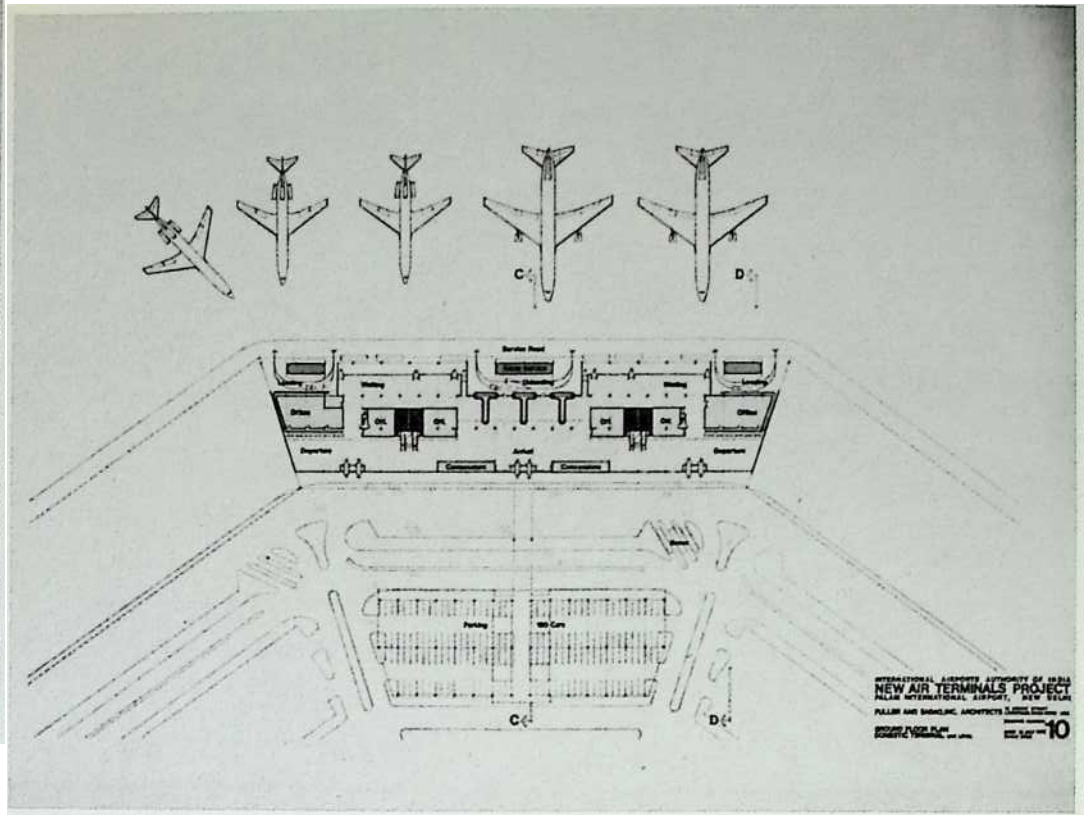

NEW AIR TERMINALS PROJECT
9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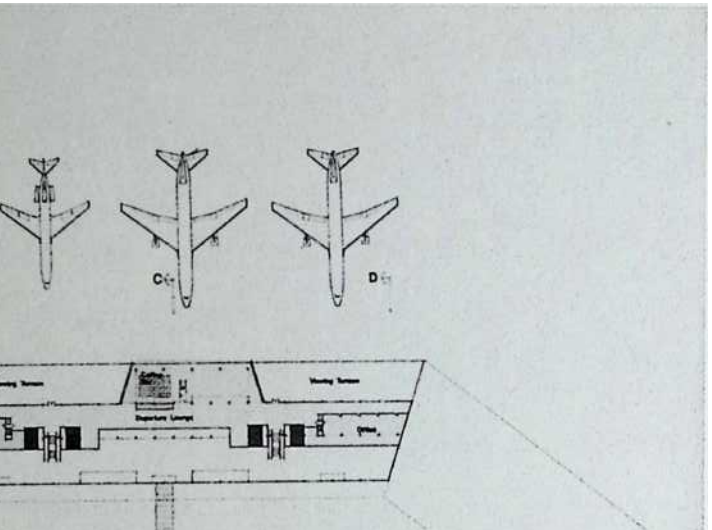
NEW AIR TERMINALS PROJECT
10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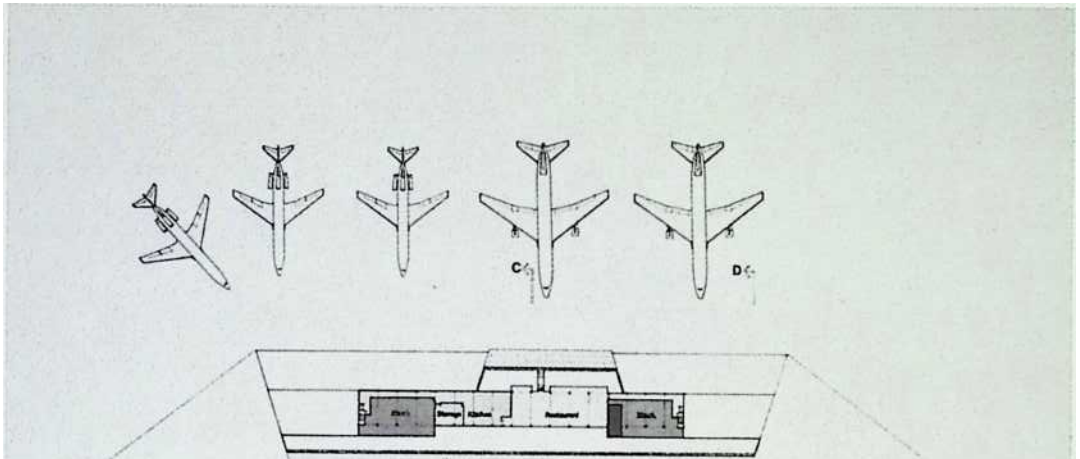
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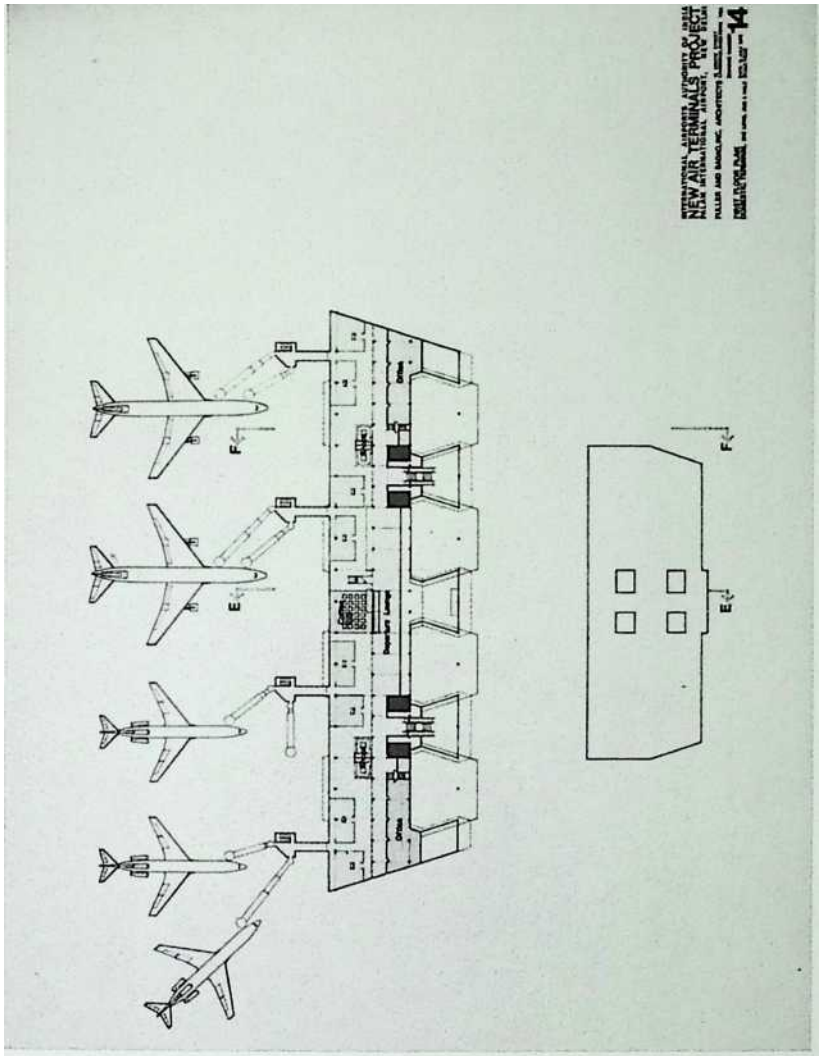
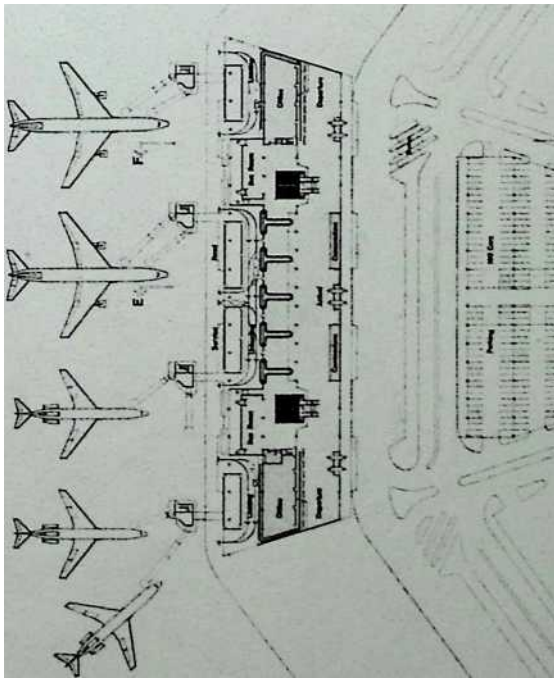

NEW AIR TERMINALS PROJECT
NEW INTERNATIONAL AIRPORT, WASH. D.C.
PULLER AND BANGLIN, ARCHITECTS
ROOF PLAN
14
E
F
Departure Lounge
Offices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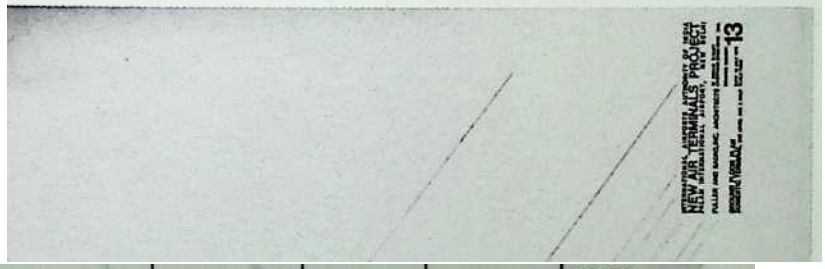
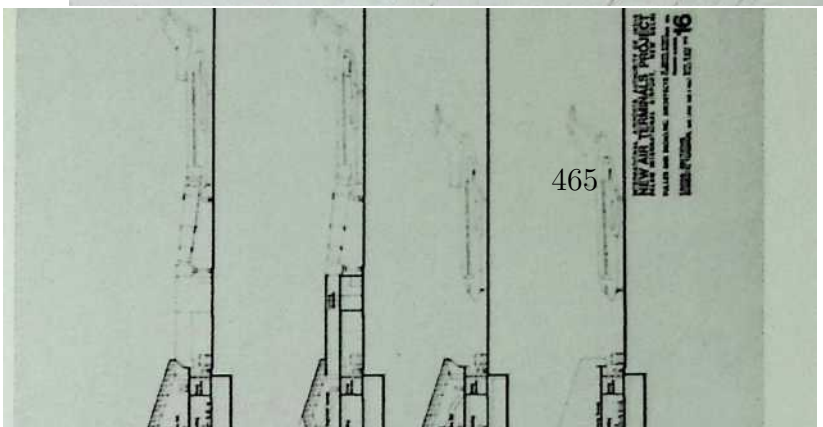
Departure
Arrival
Offices


NEW AIR TERMINALS PROJECT
NEW INTERNATIONAL AIRPORT, WASH. D.C.
13


NEW AIR TERMINALS PROJECT
NEW INTERNATIONAL AIRPORT, WASH. D.C.
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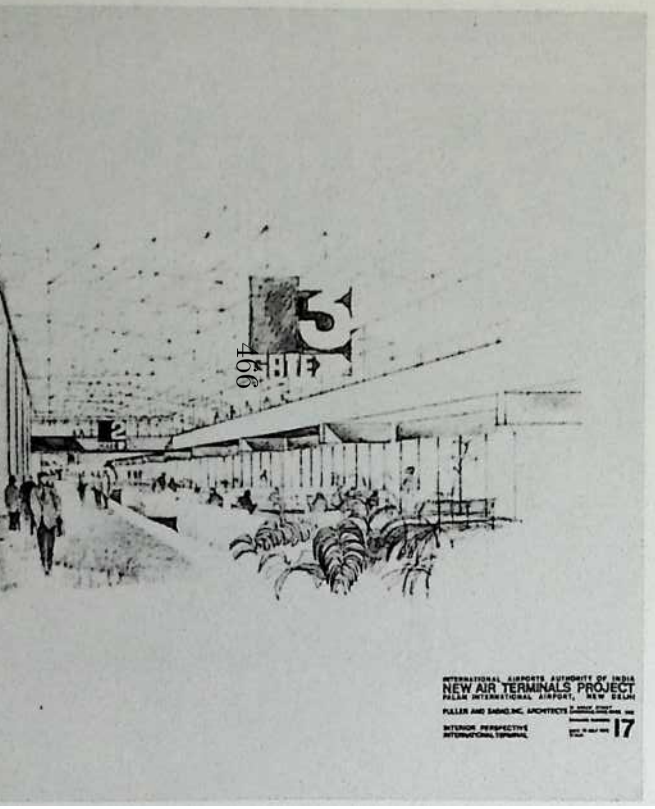
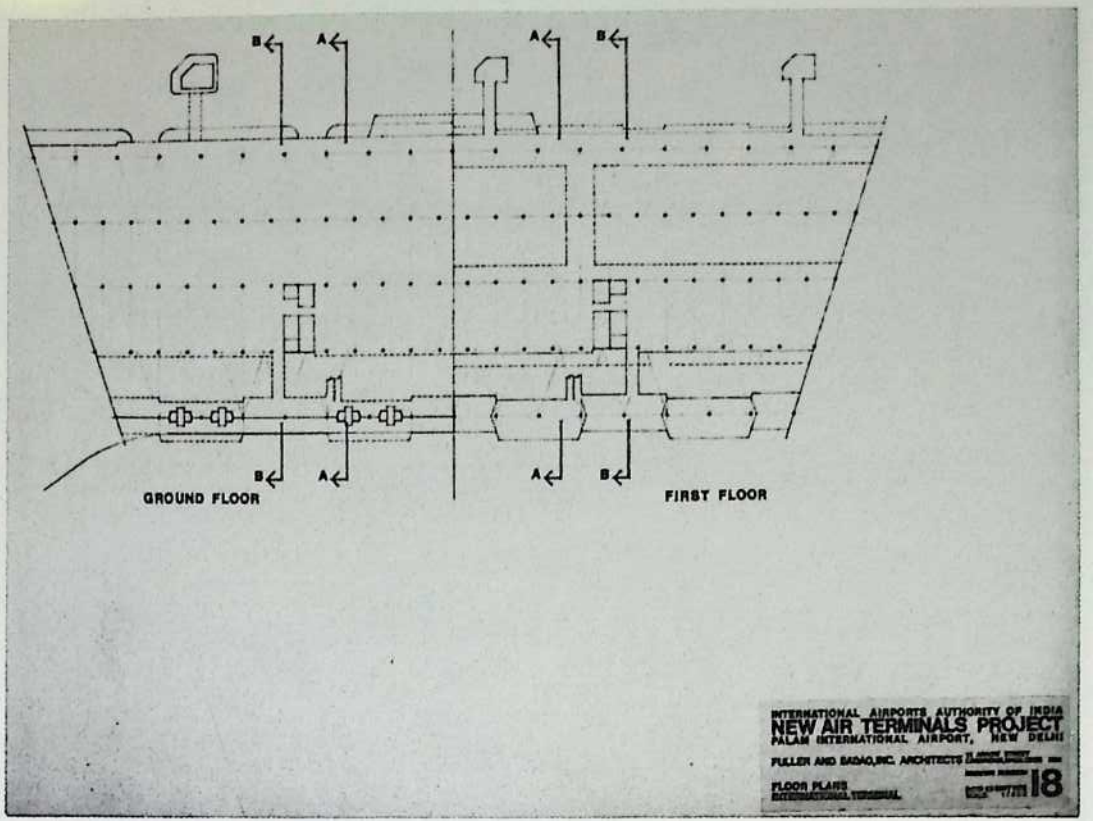

INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
PALAM INTERNATIONAL AIRPORT, NEW DELHI
FULLER AND SADAO, INC. ARCHITECTS
INTERIOR PERSPECTIVE
INTERNATIONAL TERMINAL
17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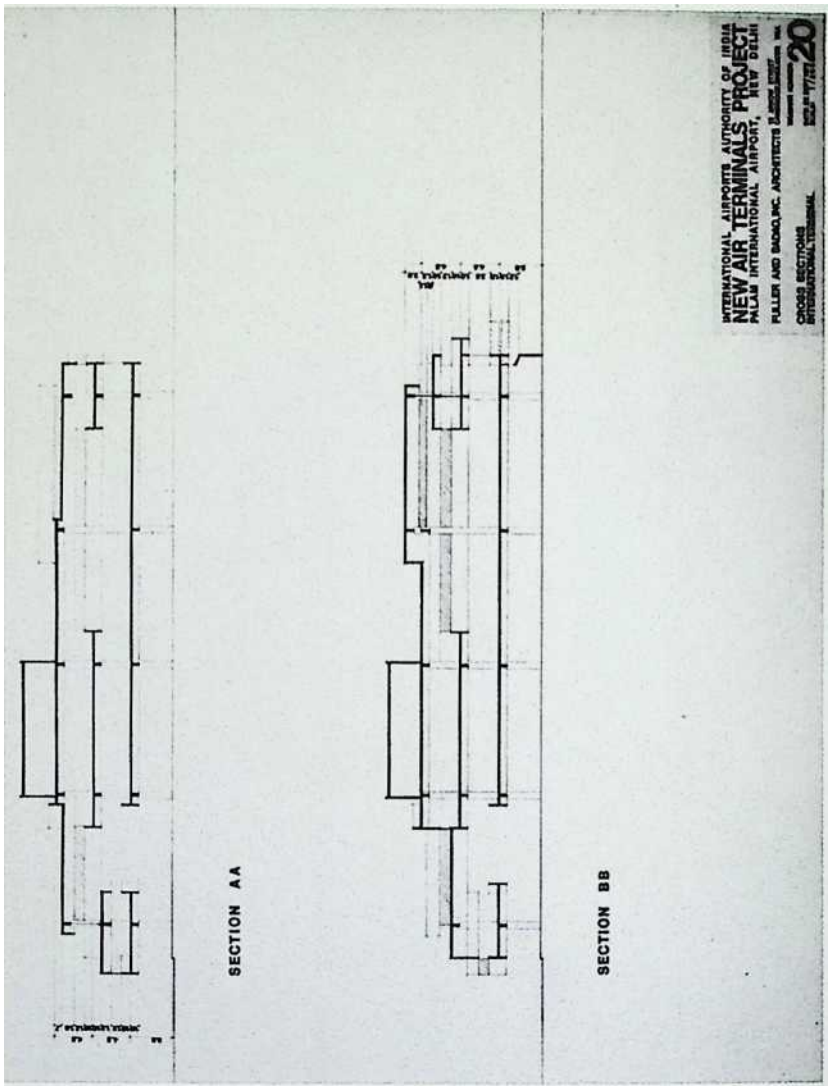
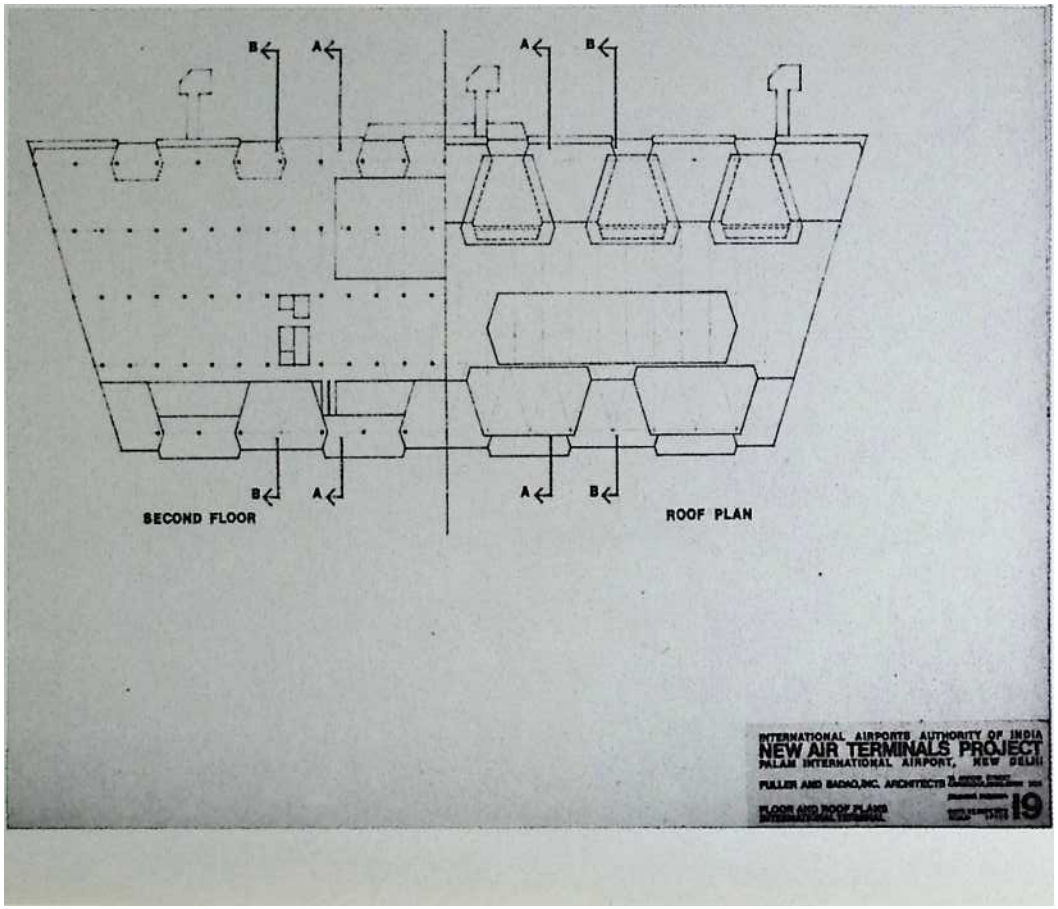
GROUND FLOOR
FIRST FLOOR
INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
PALAM INTERNATIONAL AIRPORT, NEW DELHI
FULLER AND SADAO, INC. ARCHITECTS
FLOOR PLANS
INTERNATIONAL TERMINAL
18


SECTION AA
SECTION BB
INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
PALAM INTERNATIONAL AIRPORT, NEW DELHI
FULLER AND SADAO, INC. ARCHITECTS
CROSS SECTIONS
INTERNATIONAL TERMINAL
20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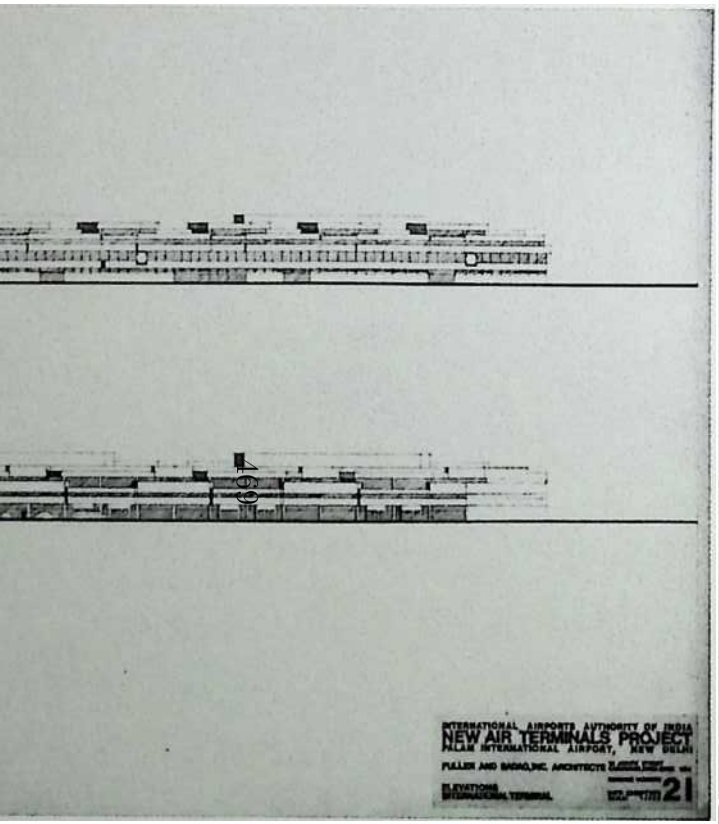
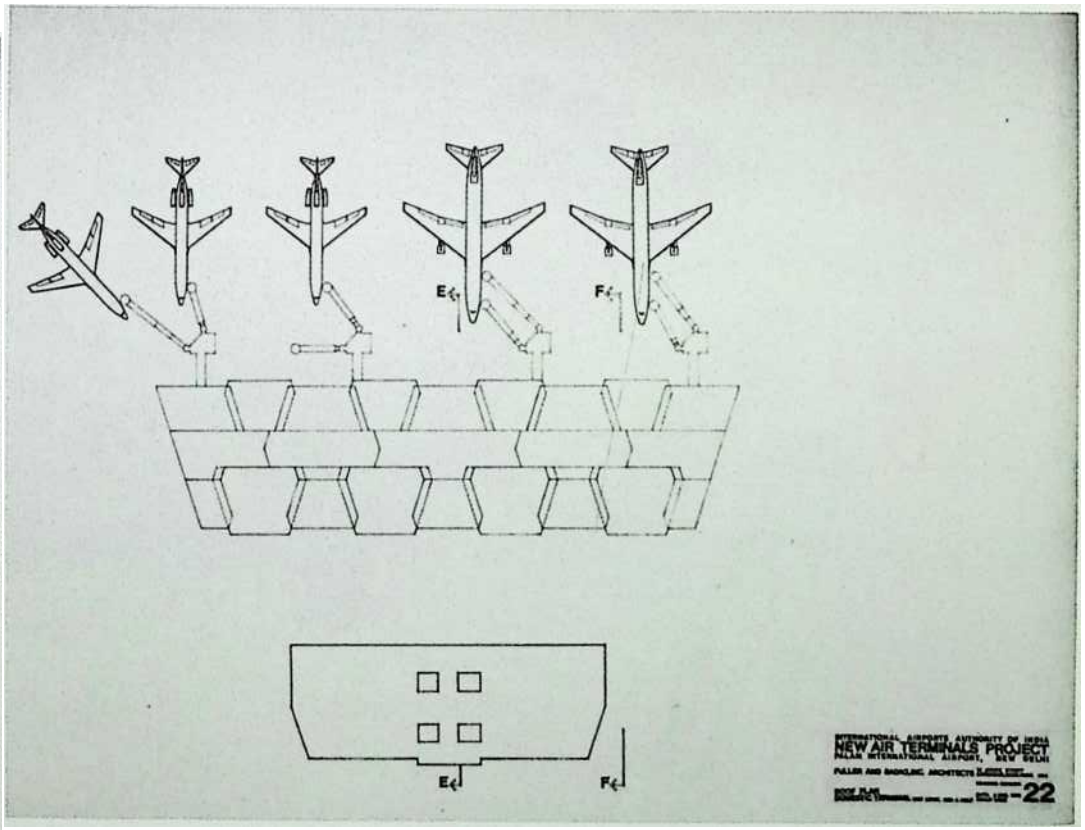
SECOND FLOOR
ROOF PLAN
INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
PALAM INTERNATIONAL AIRPORT, NEW DELHI
FULLER AND SADAO, INC. ARCHITECTS
FLOOR AND ROOF PLANS
19


INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
PALAM INTERNATIONAL AIRPORT, NEW DELHI
FULLER AND SADAO, INC. ARCHITECTS
ELEVATIONS
INTERNATIONAL TERMINAL
21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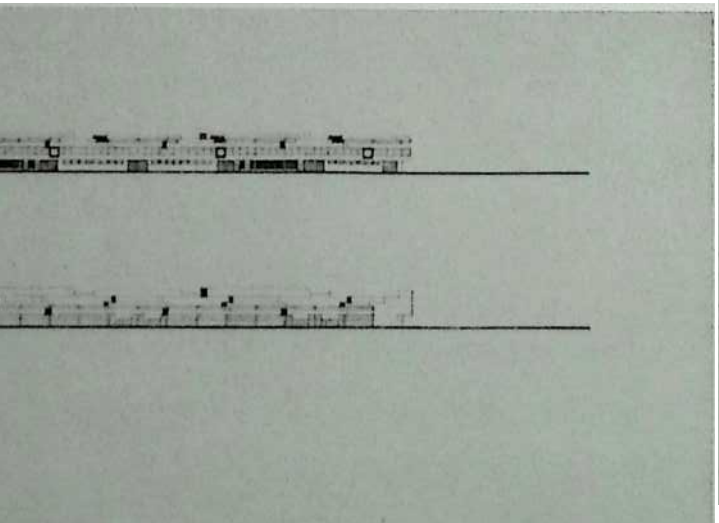
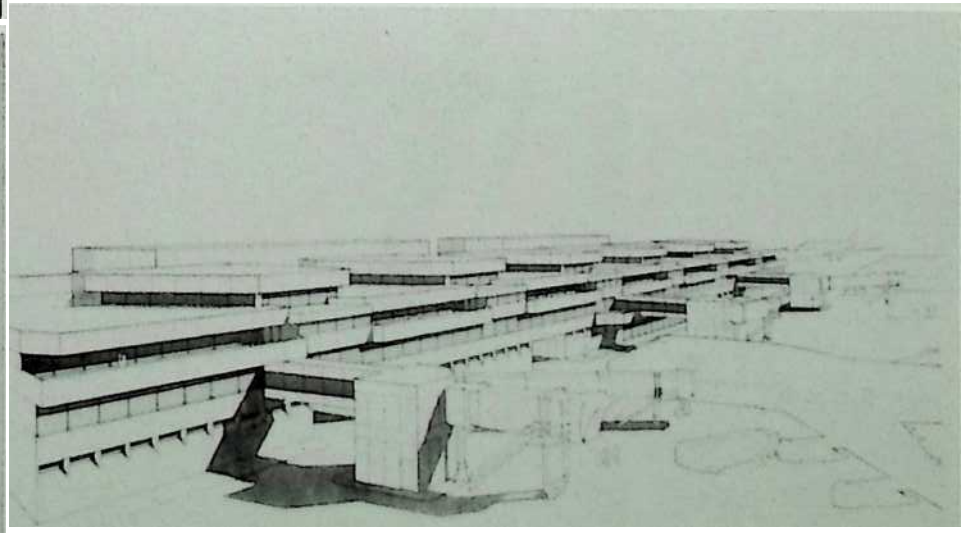
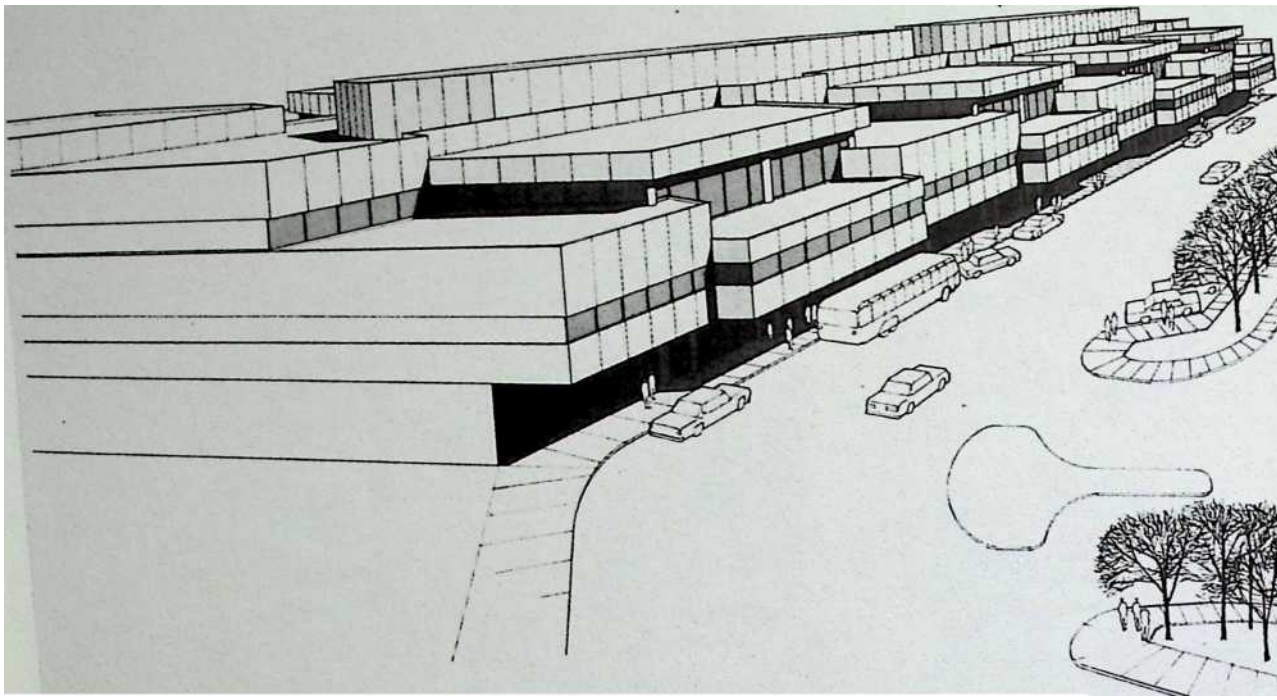
INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
PALAM INTERNATIONAL AIRPORT, NEW DELHI
FULLER AND SADAO, INC. ARCHITECTS
22







PALAM INTERNA! I
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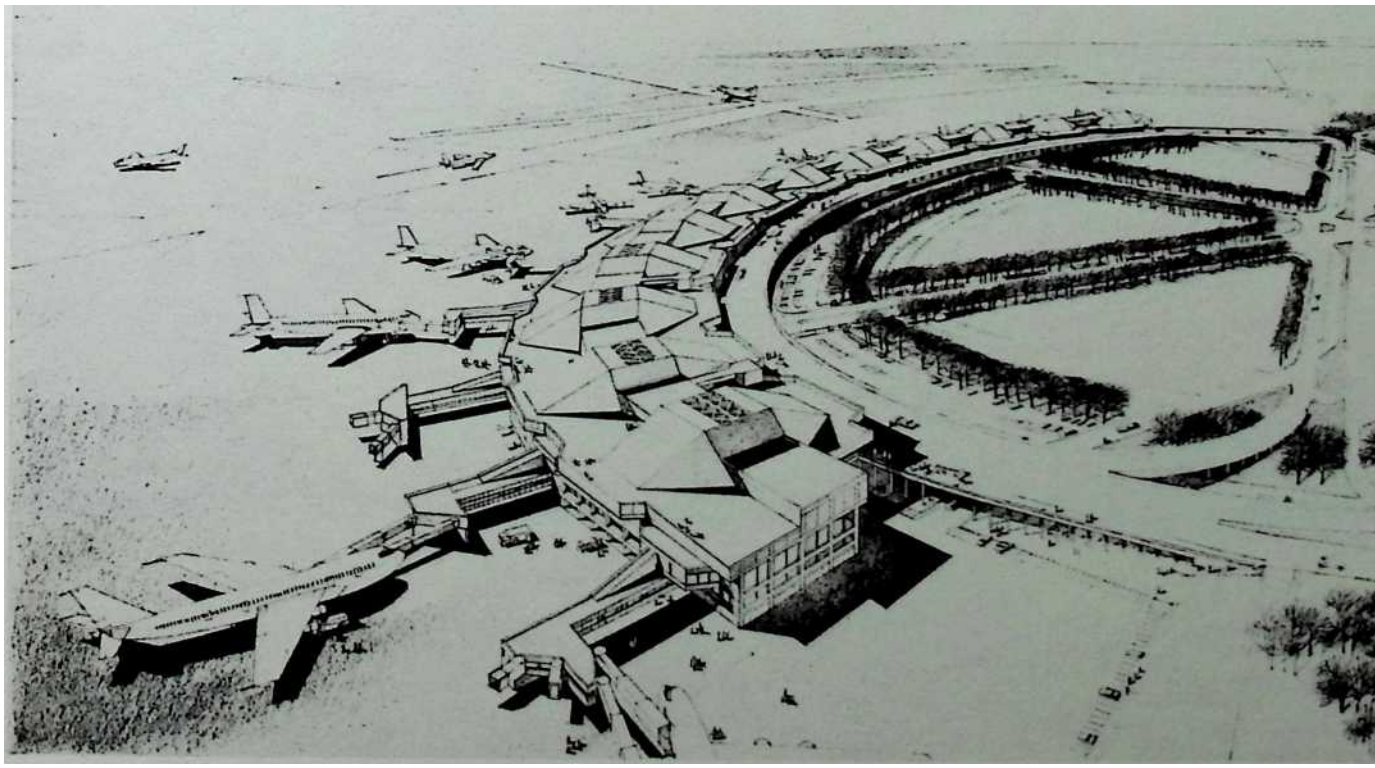
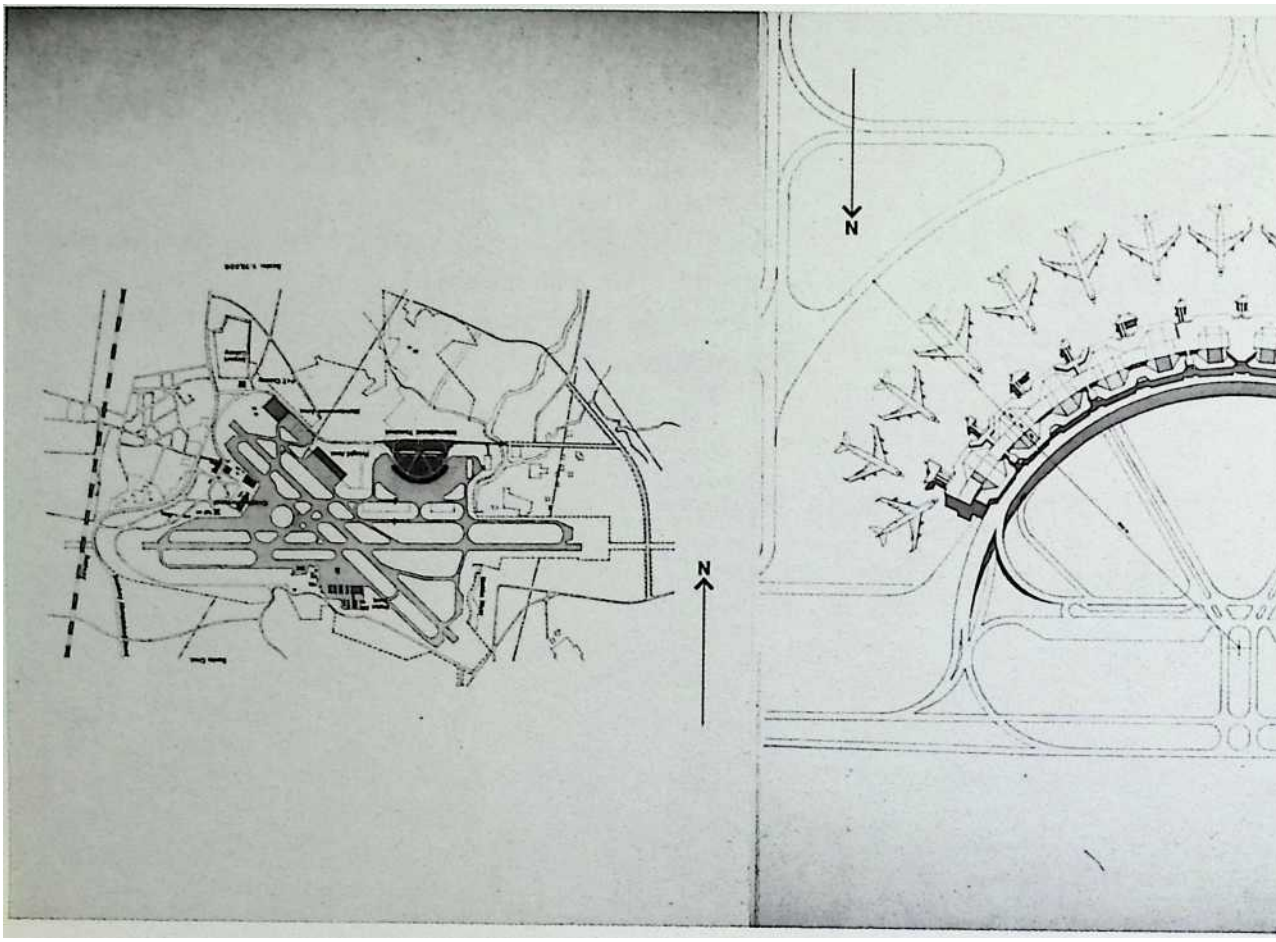
32 International Airports for India: Santa Cruz in Bombay Fuller & Sadao, 1972

The design of the Santa Cruz Airport in Bombay is architecturally the most impressive of the Fuller & Sadao designs for airports in India. Its concave plan of twelve octagonal, geodesic concourse vaults combines with the shapes of the attending jet liners to produce an aviatory diadem when viewed from the sky.

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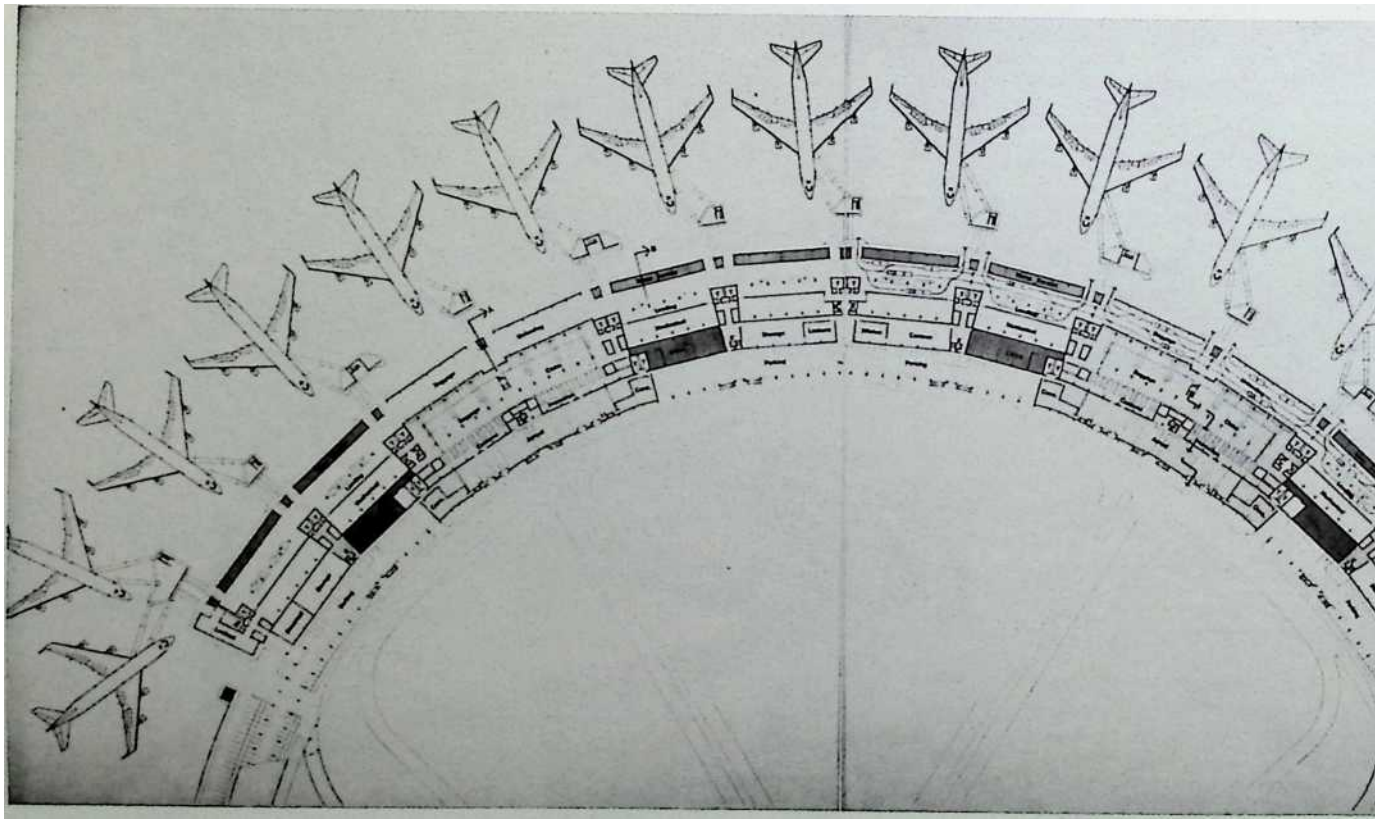

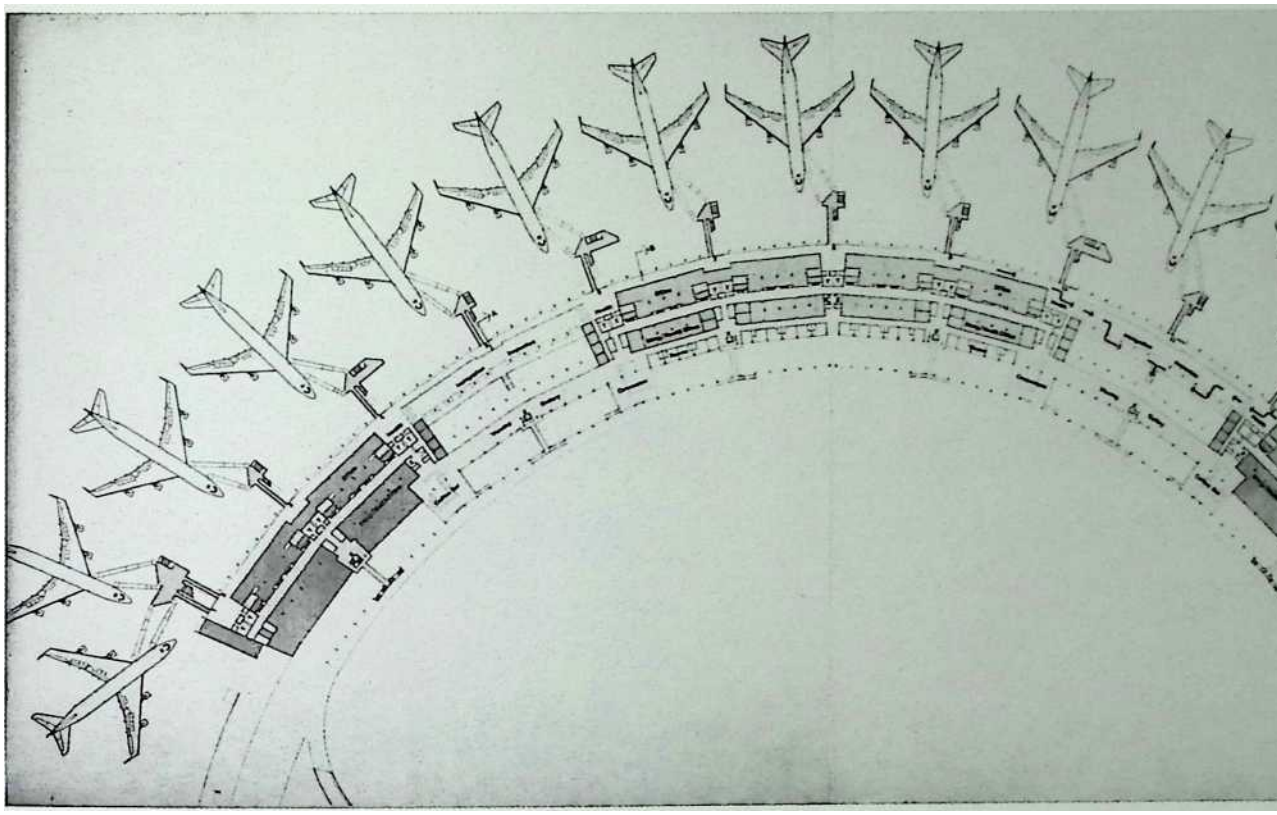

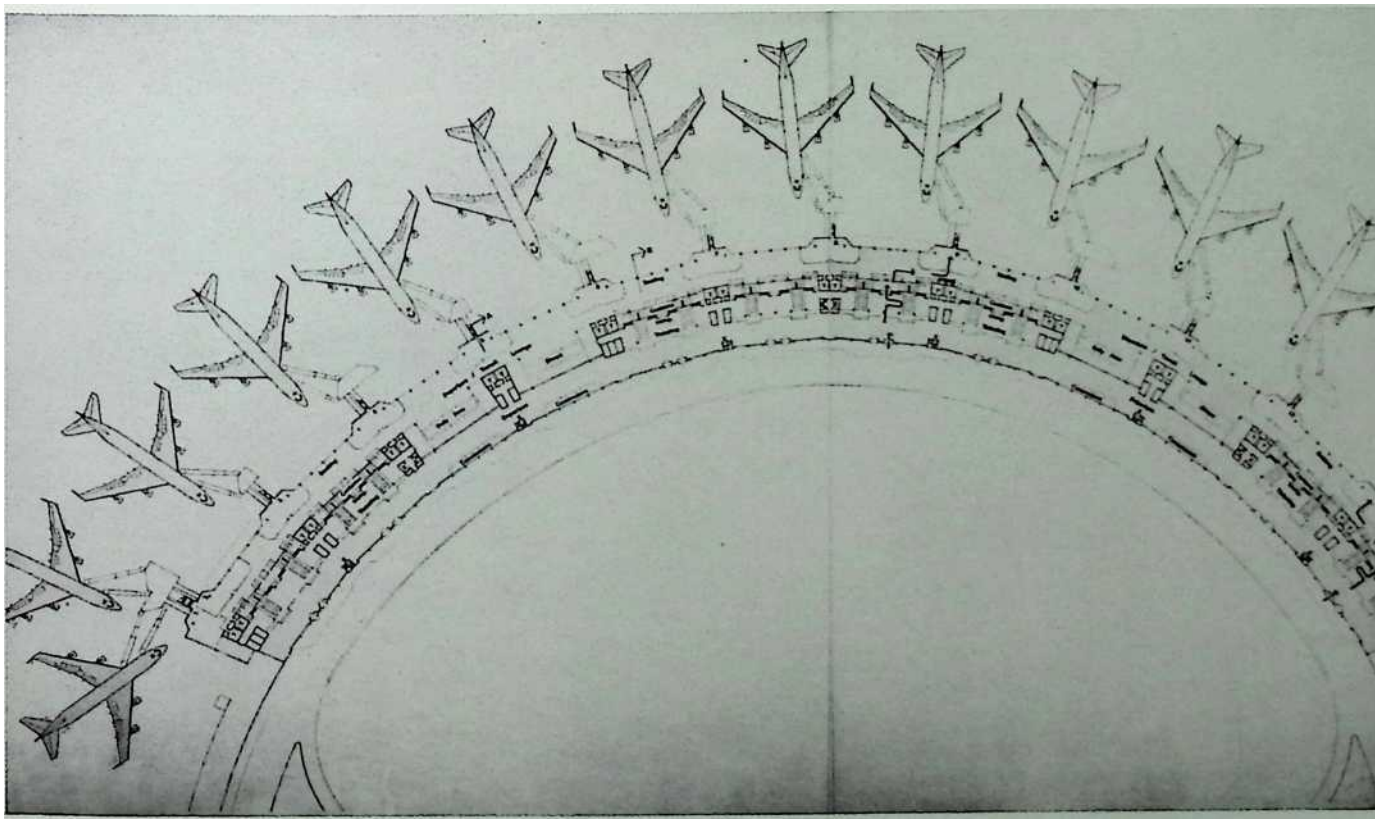

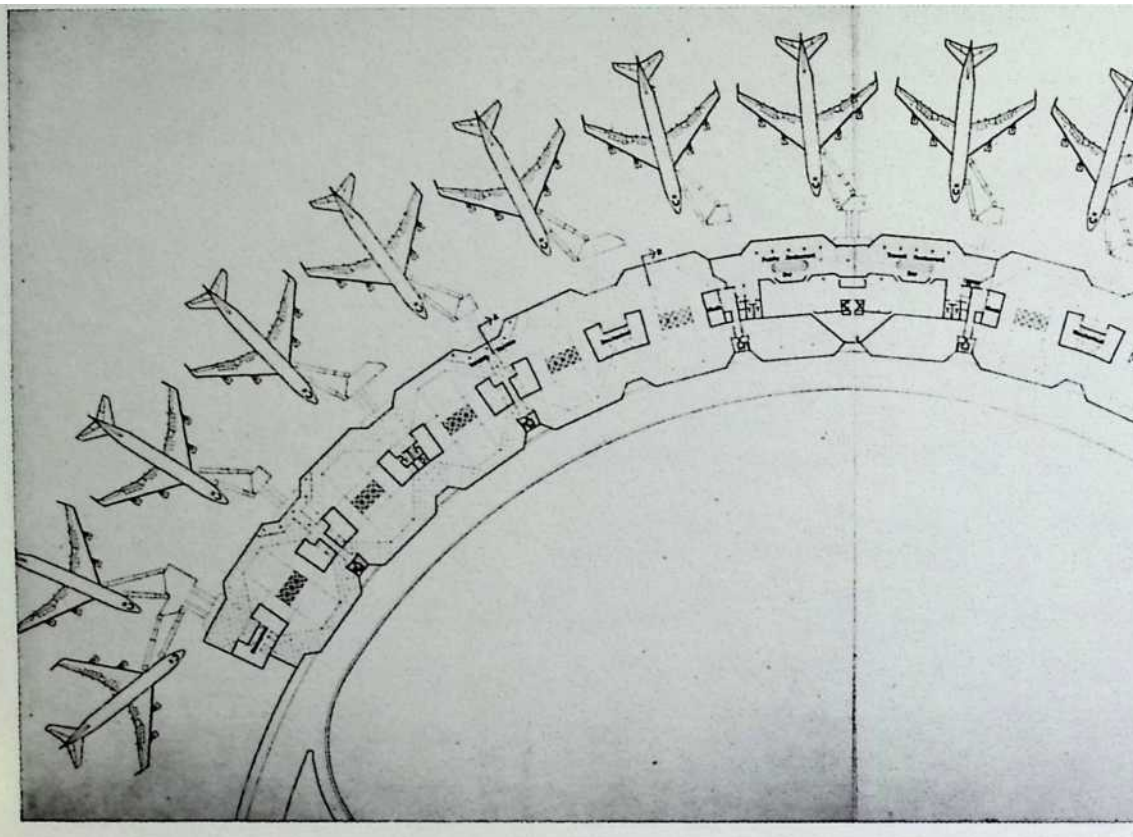

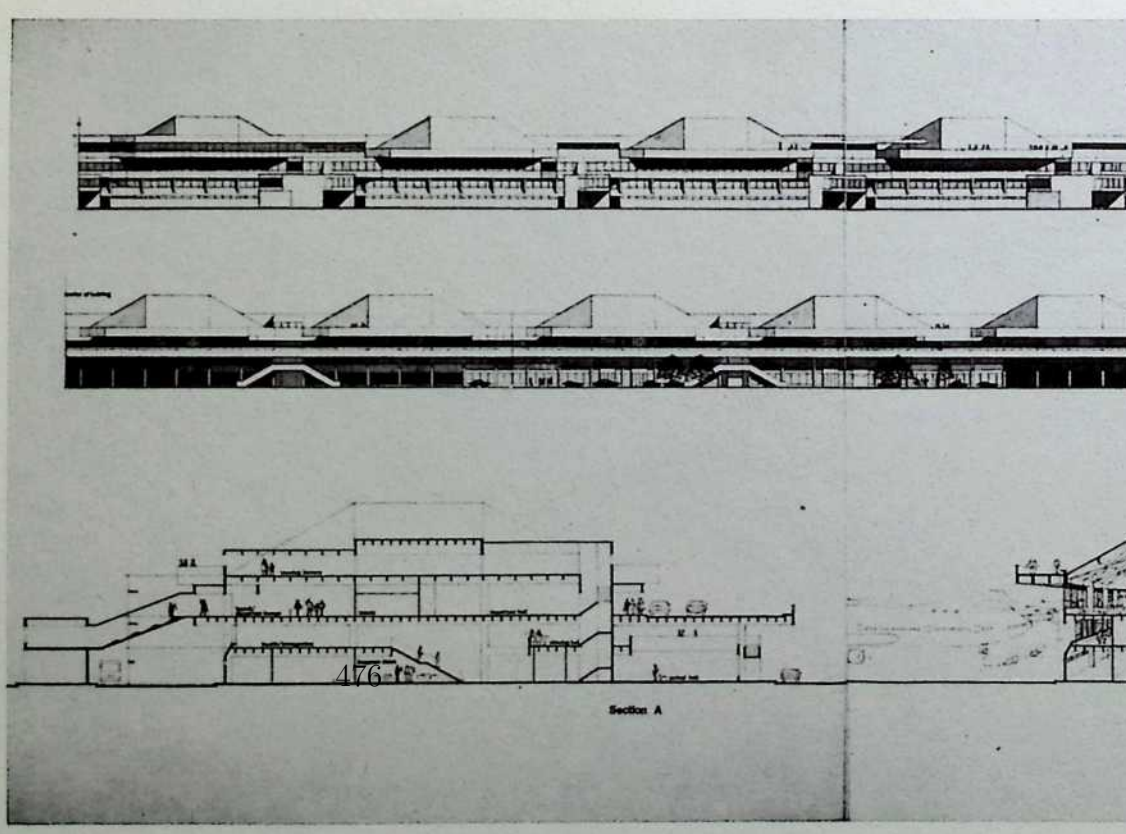
Section A

International Airports for India: Meenambakkam in Madras

Fuller & Sadao, 1972

The Meenambakkam Airport in Madras has two small pavilions (three stories each) and was designed to allow visitors to view passengers at every stage of their arrival and departure.

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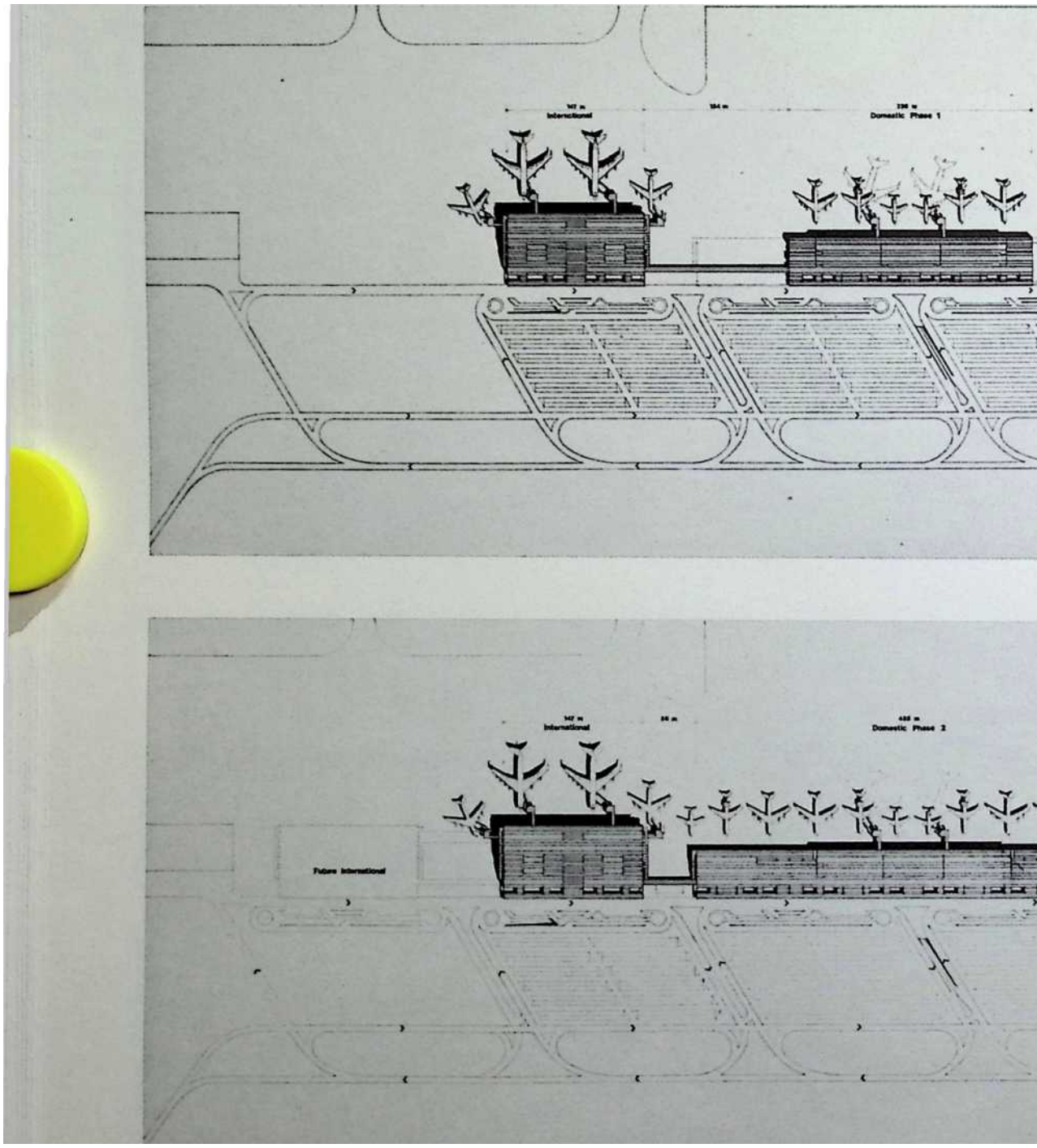
International
Domestic Phase 1
International
Domestic Phase 2
Future International

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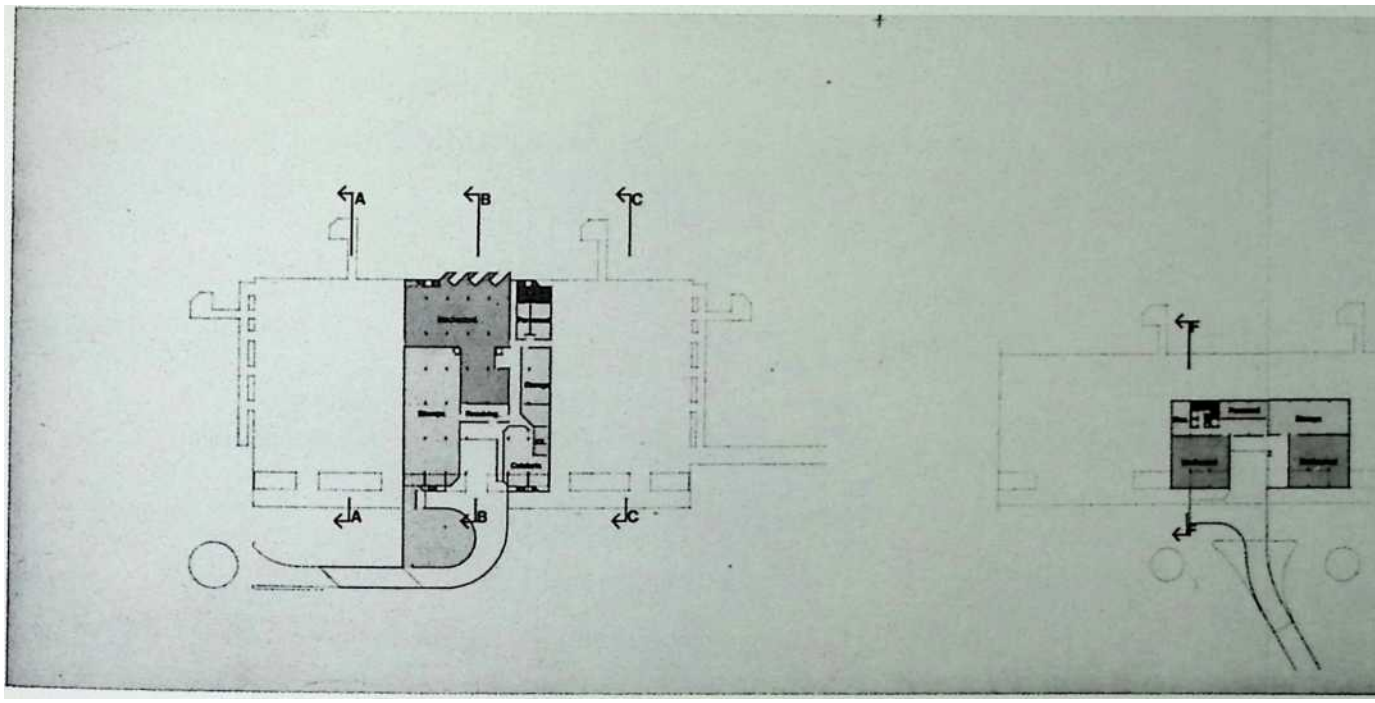
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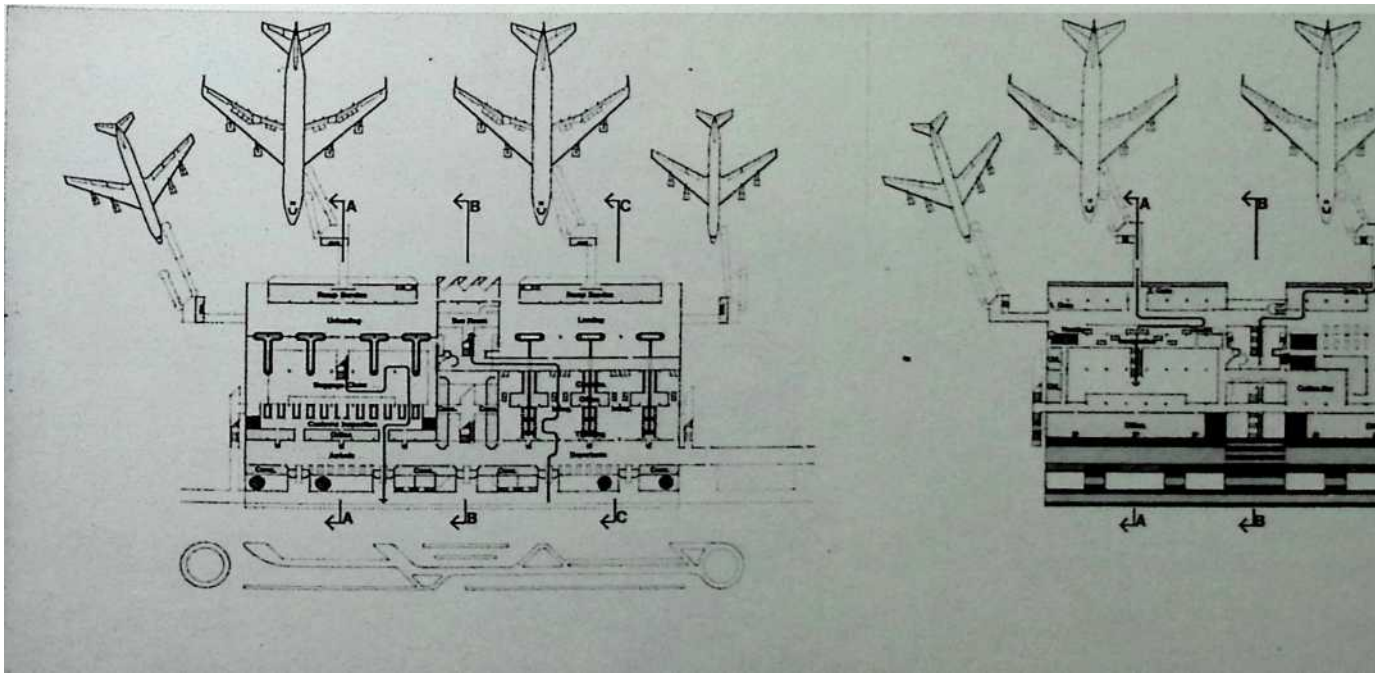
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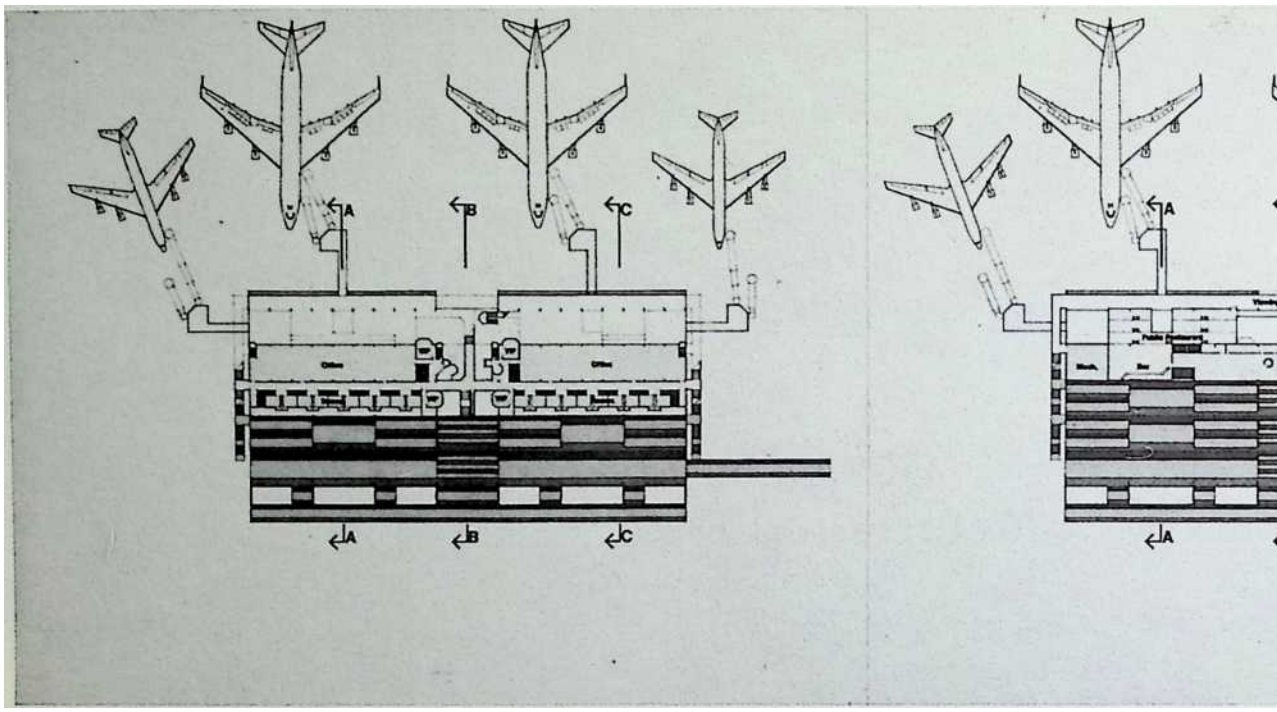

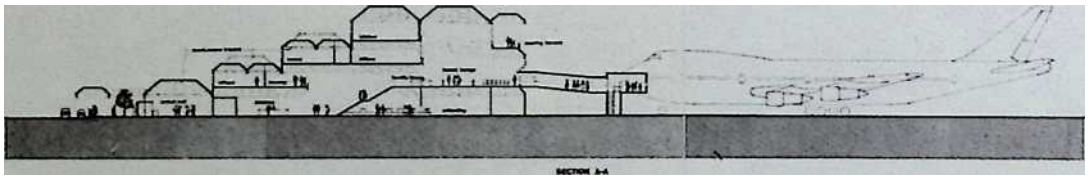

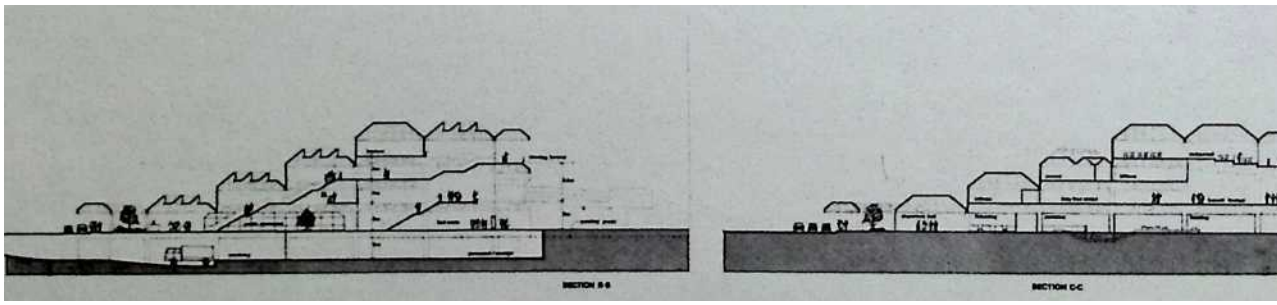

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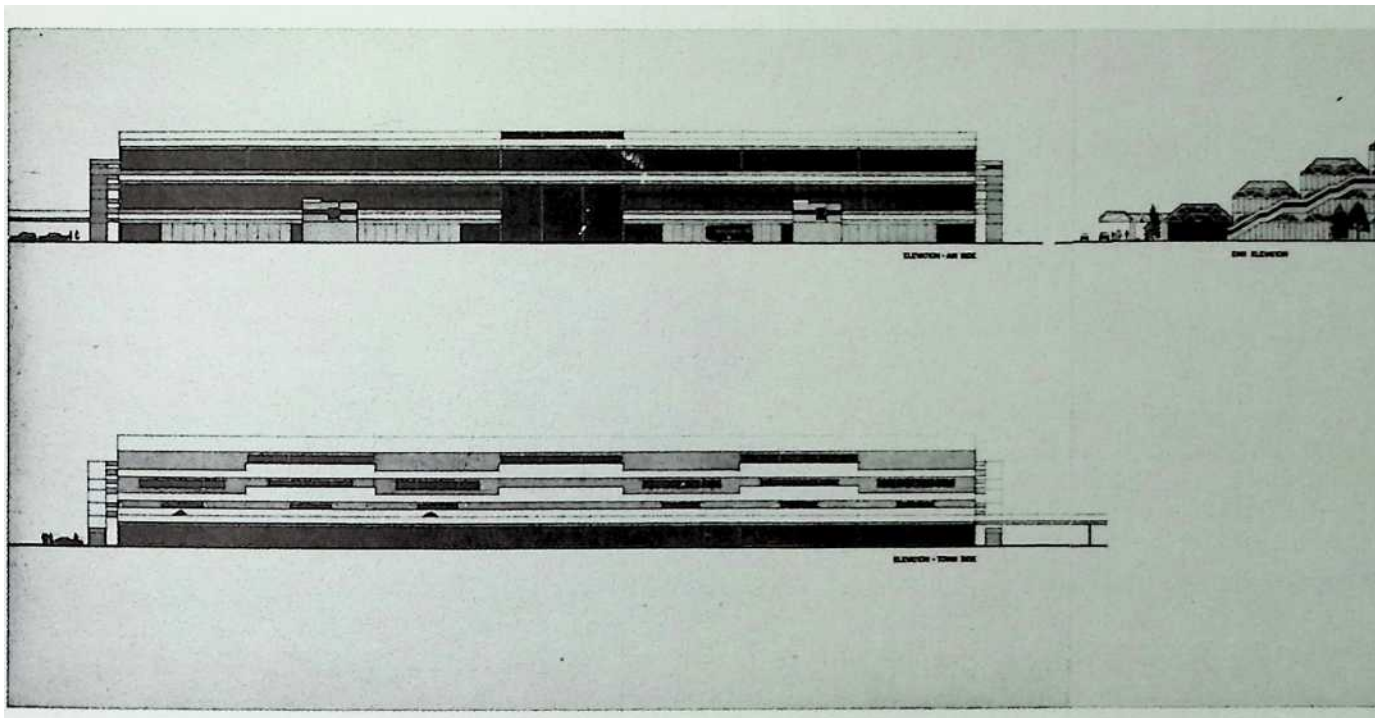

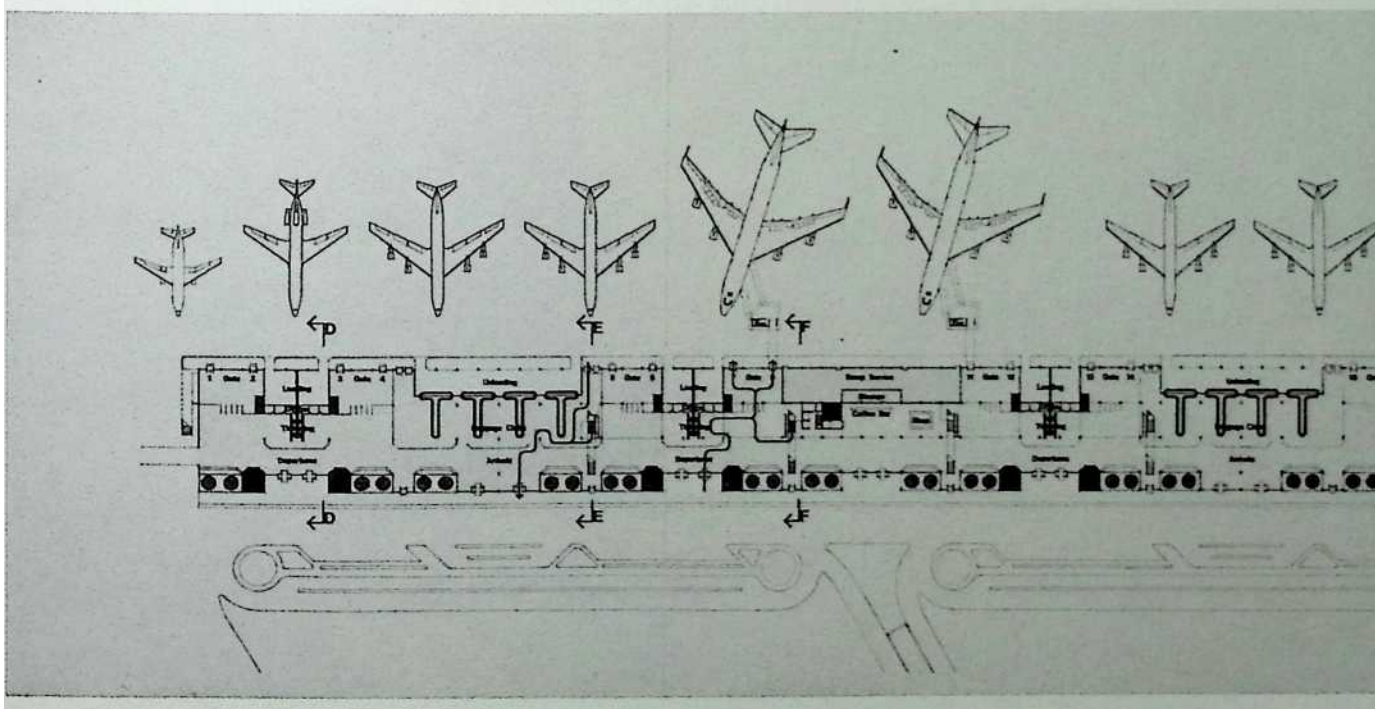

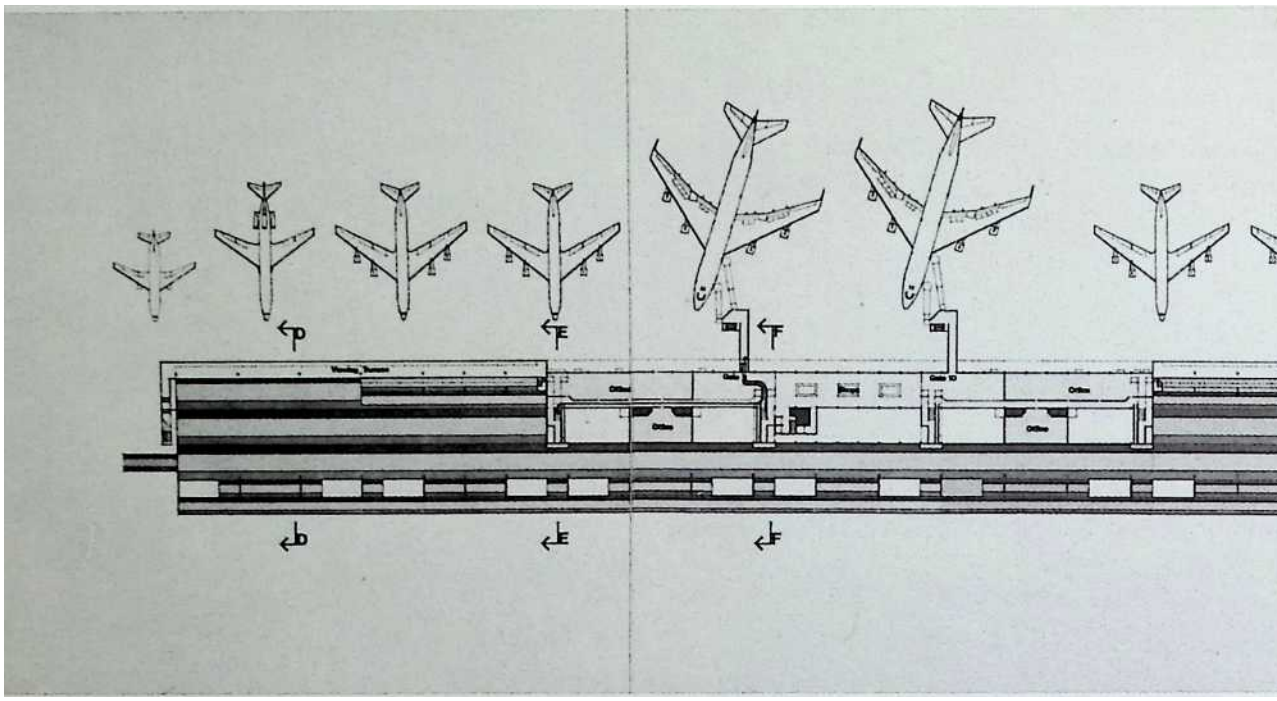
p
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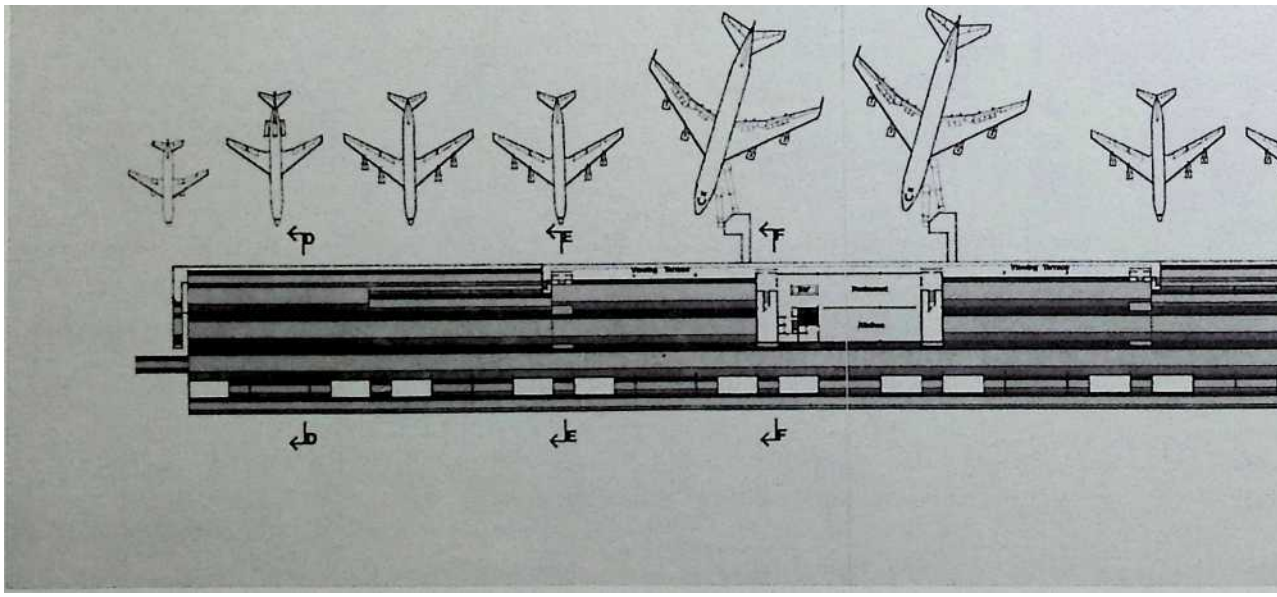
p
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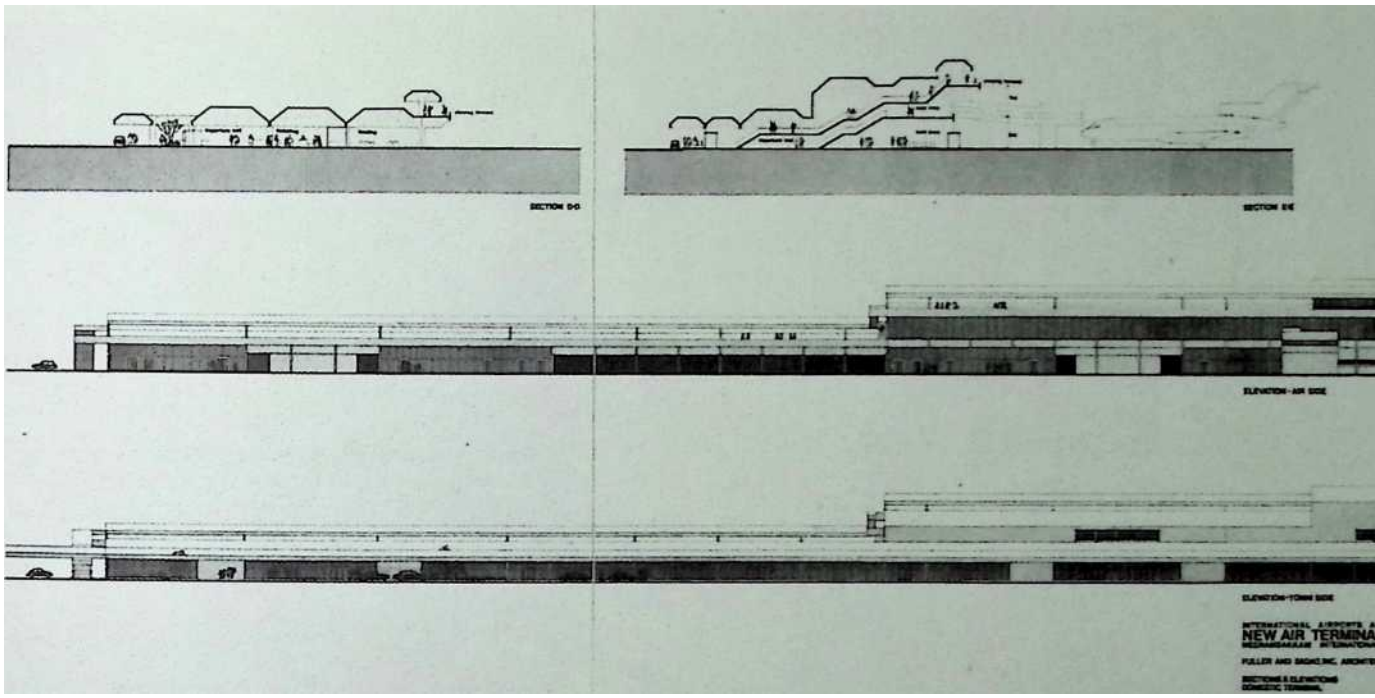
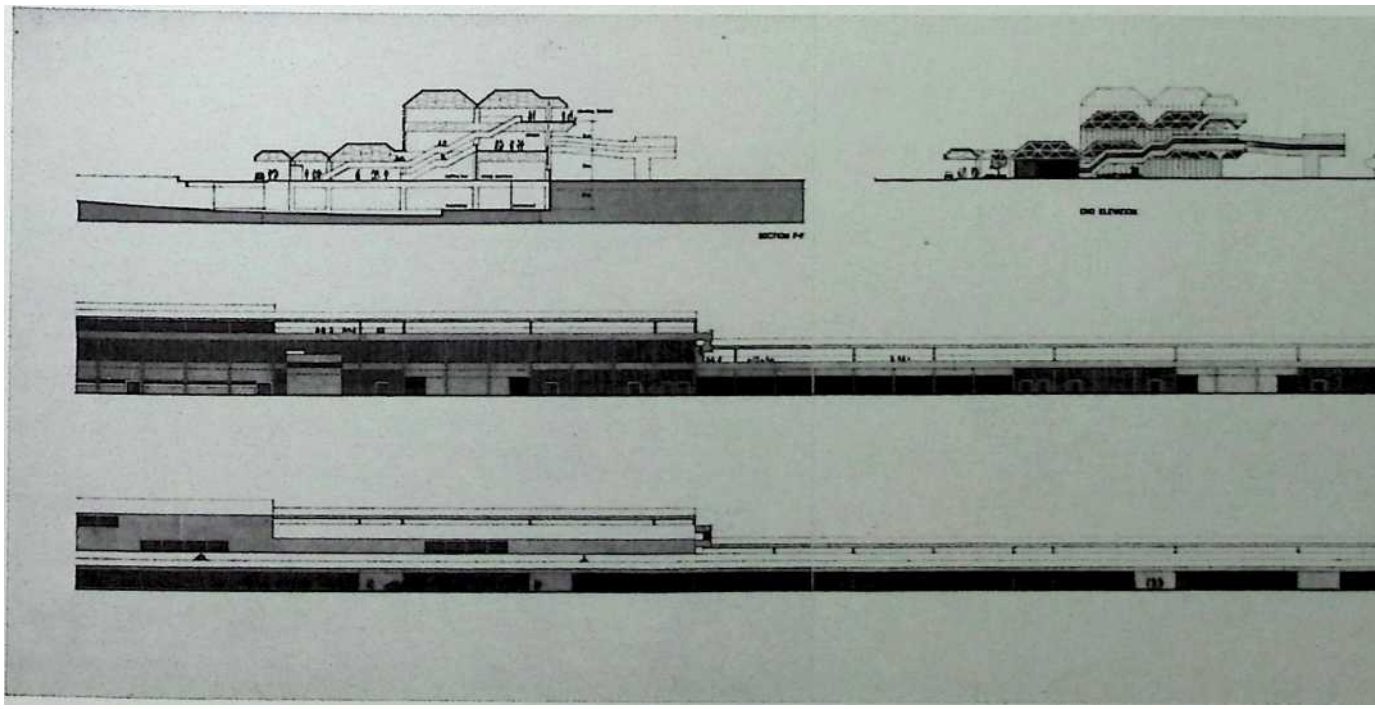
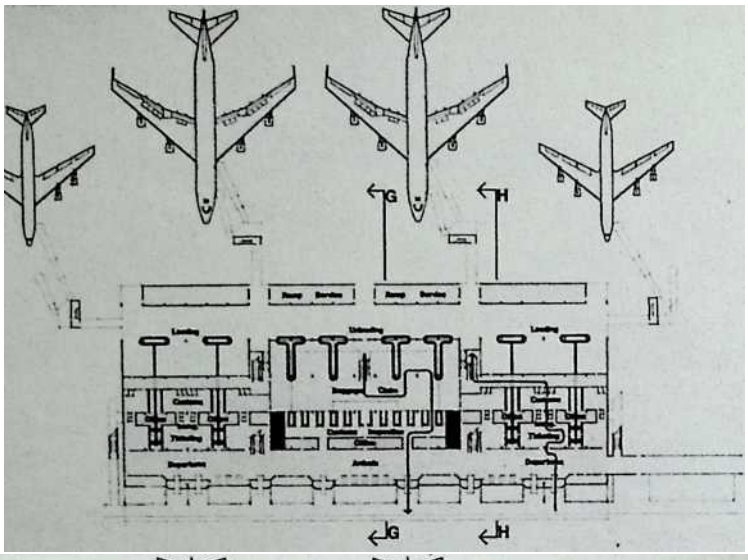
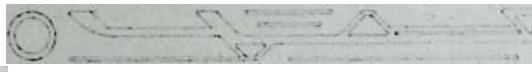
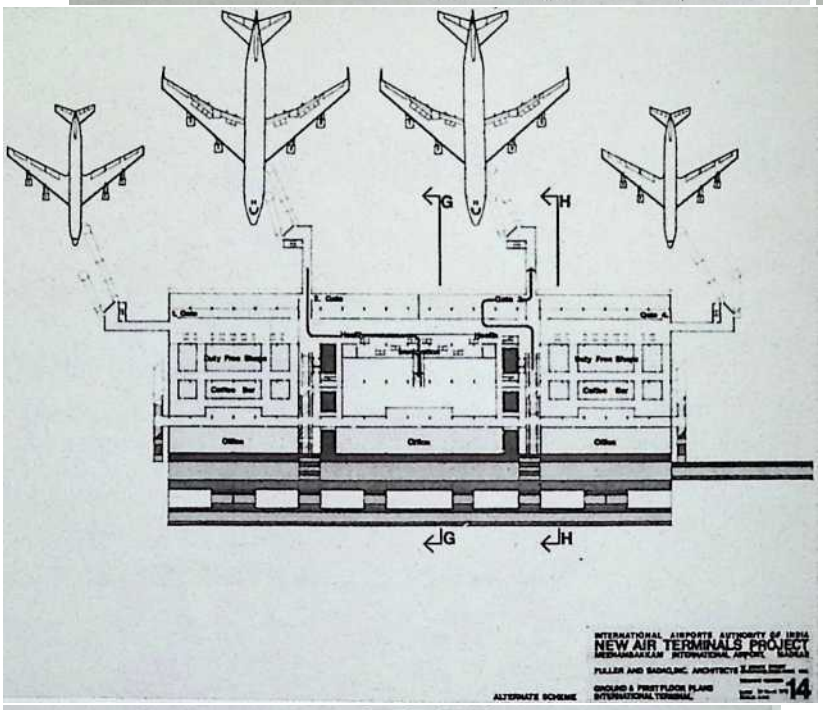
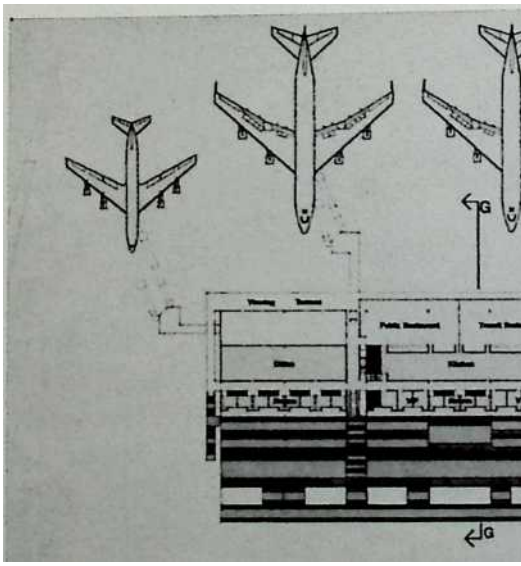

SECTION D-D
SECTION E-E
ELEVATION-AIR SIDE
ELEVATION-TOWN SIDE
NEW AIR TERMINA


SECTION F-F
END ELEVATION


G
H
Ramp Service
Ramp Service
Loading
Unloading
Loading
Departure
Arrival
Departure
G
H




G
H
Duty Free Shops
Coffee Bar
Duty Free Shops
Coffee Bar
Offices
Offices
Offices
G
H
INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
MEENAMBAKKAM INTERNATIONAL AIRPORT, MADRAS
FULLER AND BADALONI, ARCHITECTS
GROUND & FIRST FLOOR PLANS
INTERNATIONAL TERMINAL
14
ALTERNATE SCHEME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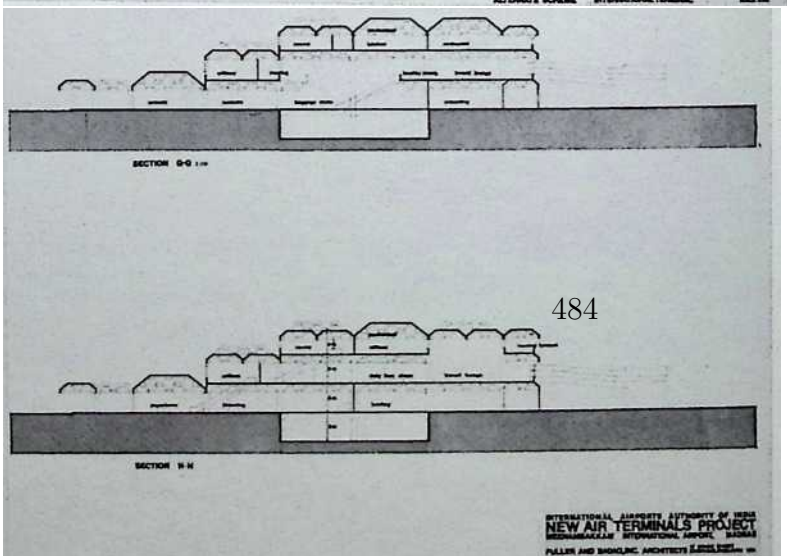
SECTION G-G
SECTION H-H
INTERNATIONAL AIRPORTS AUTHORITY OF INDIA
NEW AIR TERMINALS PROJECT
MEENAMBAKKAM INTERNATIONAL AIRPORT, MADRAS
FULLER AND BADALONI, ARCHITECTS

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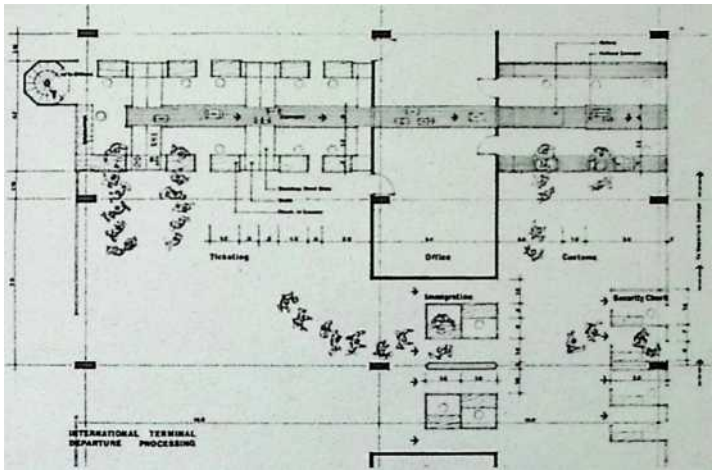
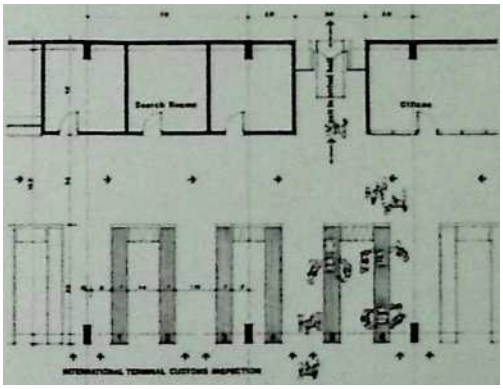
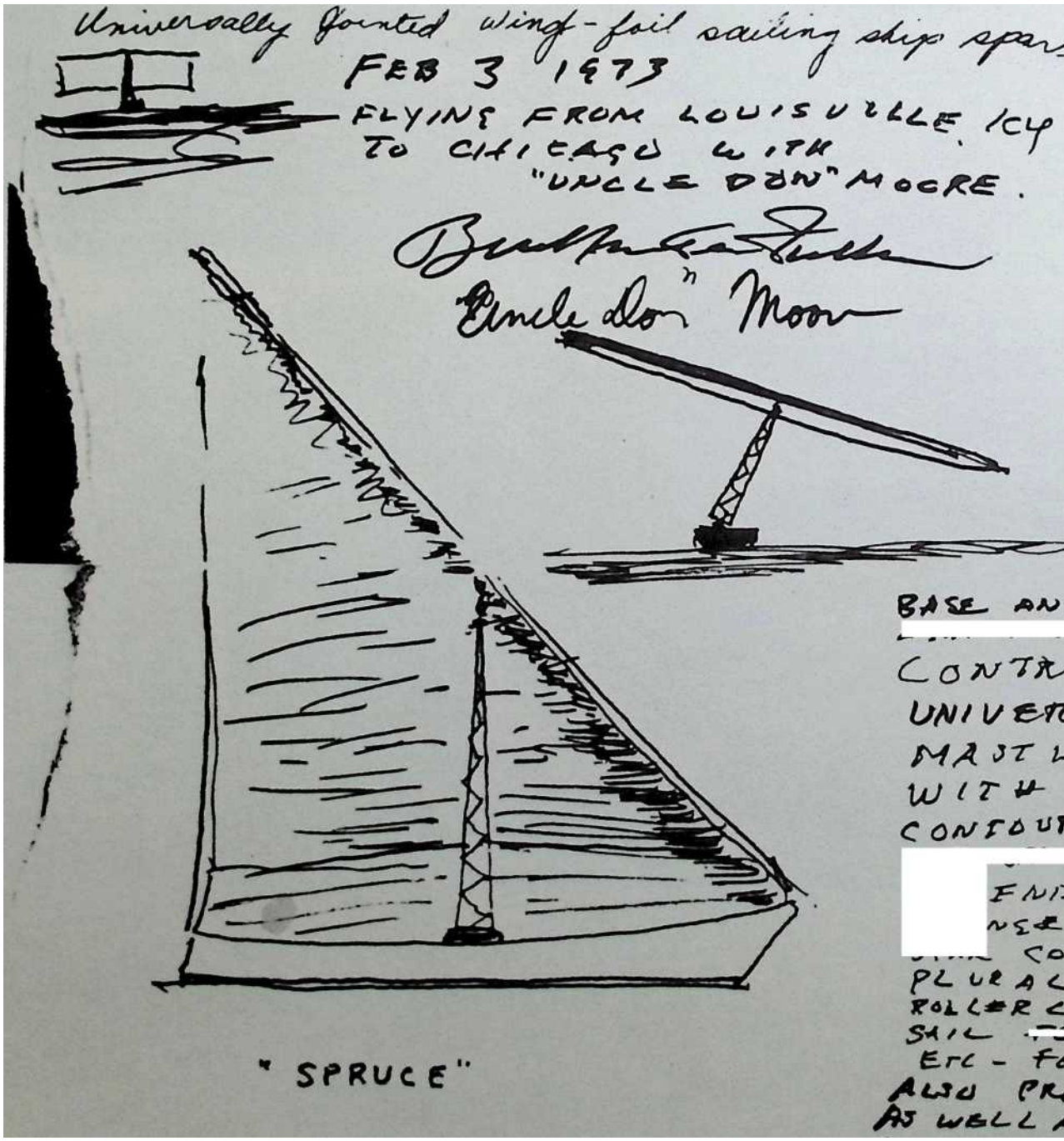




The *Spruce* (Sailboat) 1973

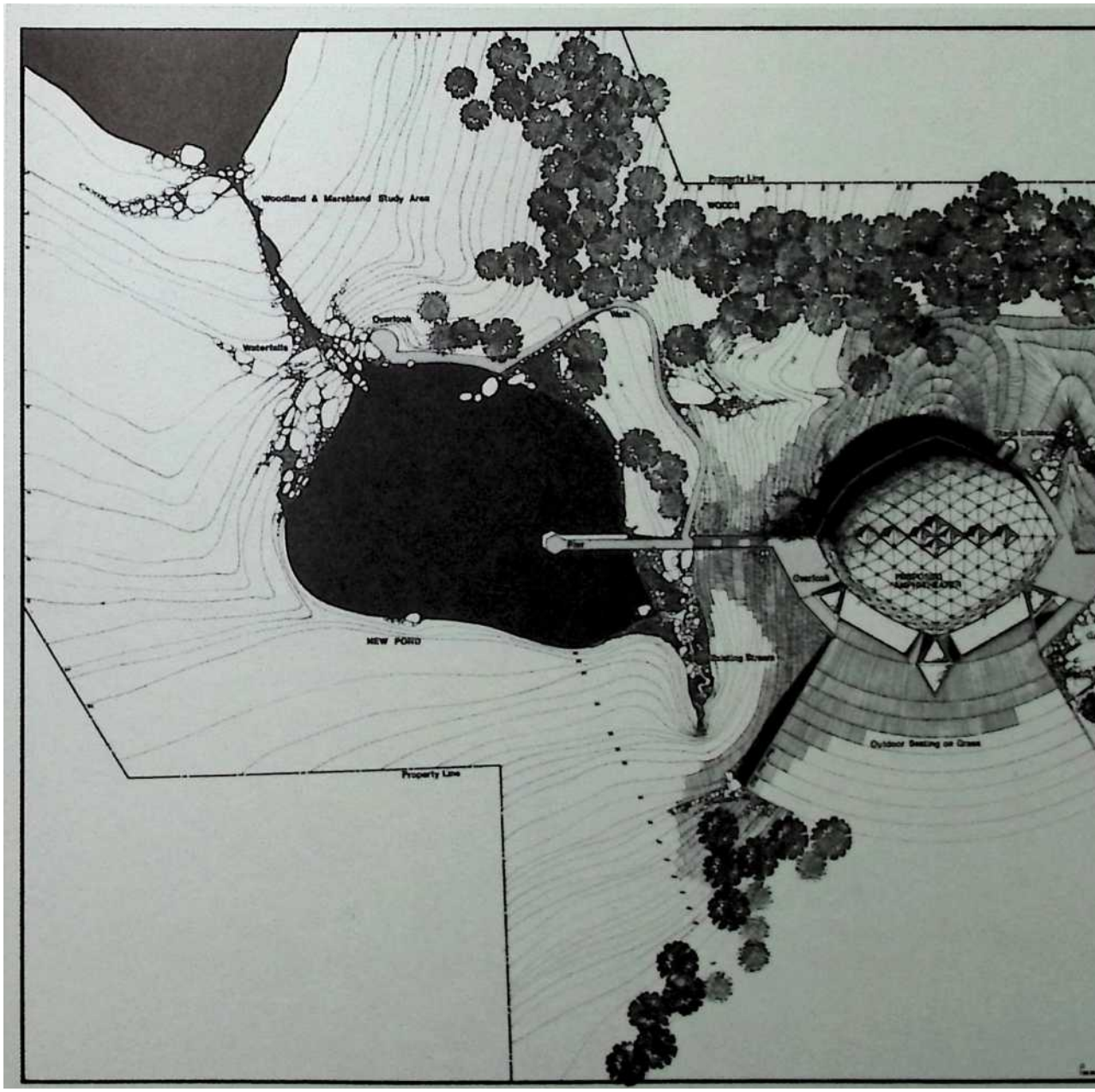
The *Spruce* is a sailboat with a spar attached to a geodesic mast with a universal joint.

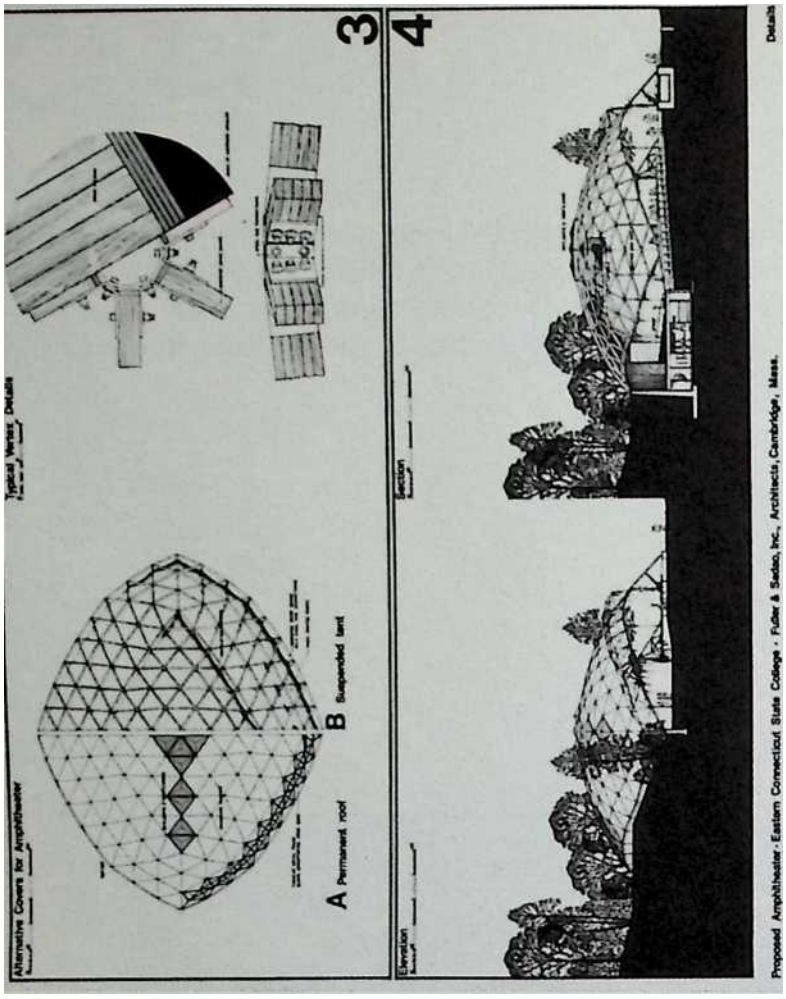

Universally jointed wing-foil sailing ship spar
FEB 3 1973
FLYING FROM LOUISVILLE KY
TO CHICAGO WITH
"UNCLE DON" MOORE.
"Uncle Don" Moore
BASE AN
CONTR
UNIVER
MAST
WITH
CONTOUR
PLURAL
ROLLER
SAIL
ETC - F
ALSO PR
AS WELL
"SPRUCE"

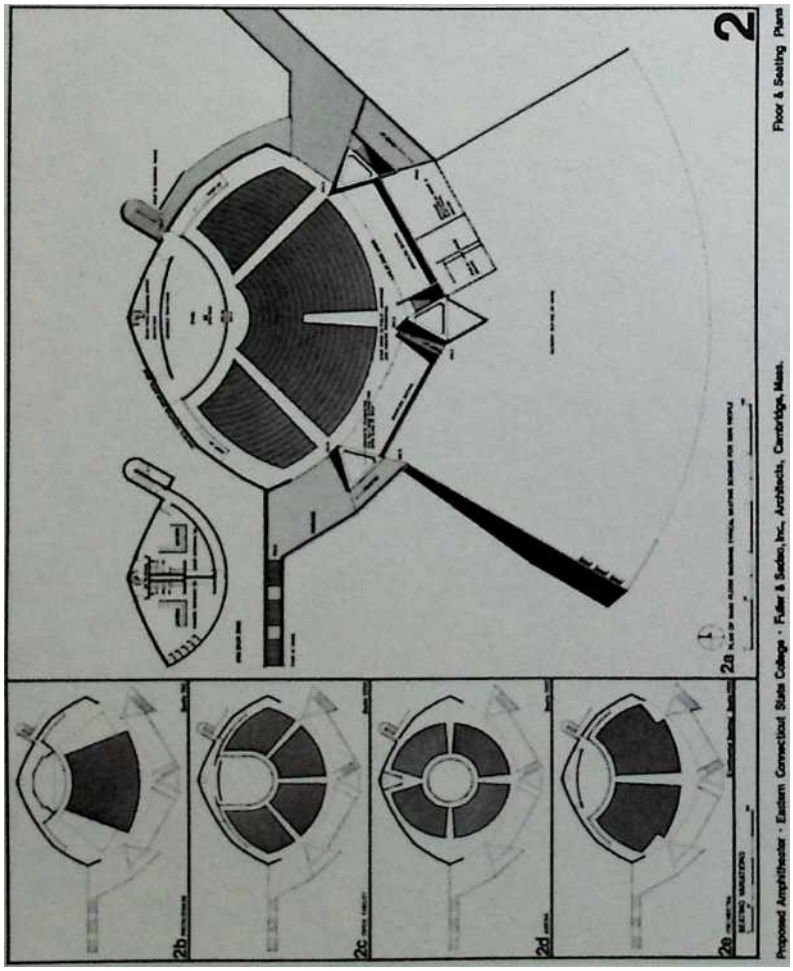
33 Eastern Connecticut State College Amphitheater Fuller & Sadao, 1973

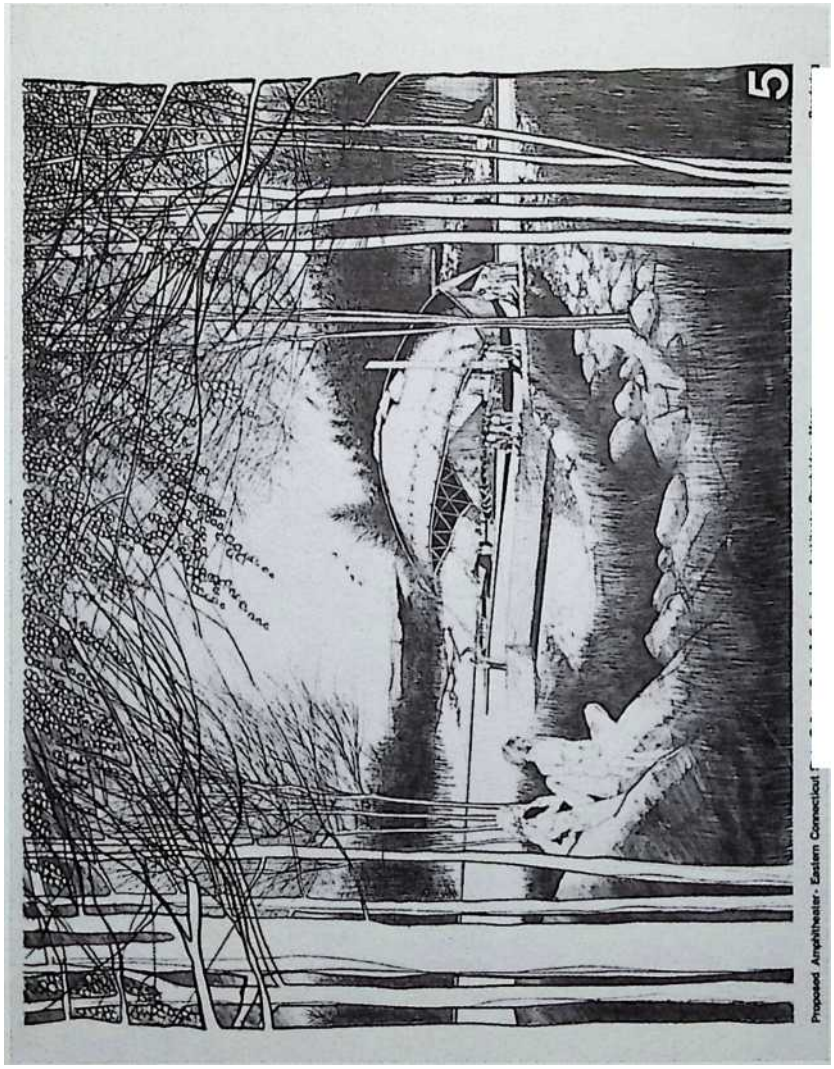
Fuller pushed the design of the geodesic dome to its architectural limit in this assembly hall that resembles superficially such striking prototypes as the Ingalls Hockey Rink at Yale University by Eero Saarinan (1959).

Proposed Amphitheater • Eastern Connecticut State College • Fuller & Sadao, Inc., Architects. Cambridge. Mass. Site Plan


Woodland & Marshland Study Area
Property Line
WOODS
Overlook
Waterfalls
Walk
Pier
Overlook
NEW POND
Outdoor Seating on Grass
Property Line

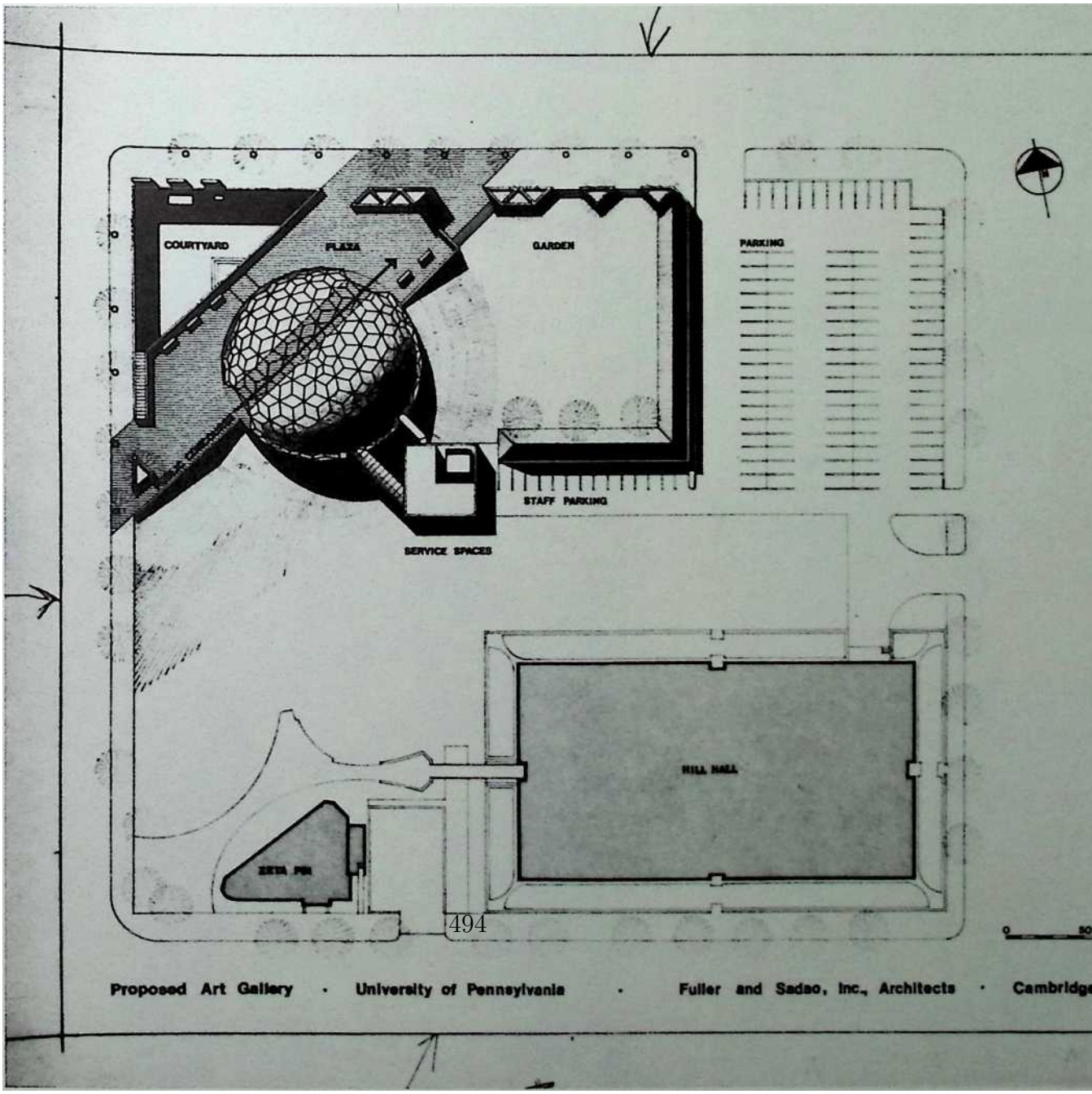

Alternative Covers for Amphitheater
Typical Vertex Details
A Permanent roof
B Suspended tent
3
Elevation
Section
4
Proposed Amphitheater - Eastern Connecticut State College - Fuller & Sadao, Inc., Architects, Cambridge, Mass.
Details

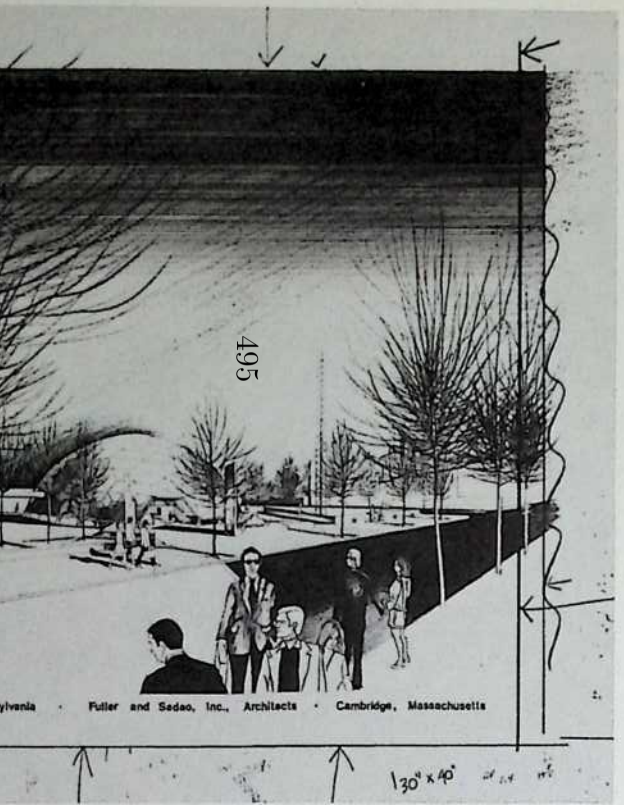

2
Proposed Amphitheater · Eastern Connecticut State College · Fuller & Sadao, Inc., Architects, Cambridge, Mass.
Floor & Seating Plans

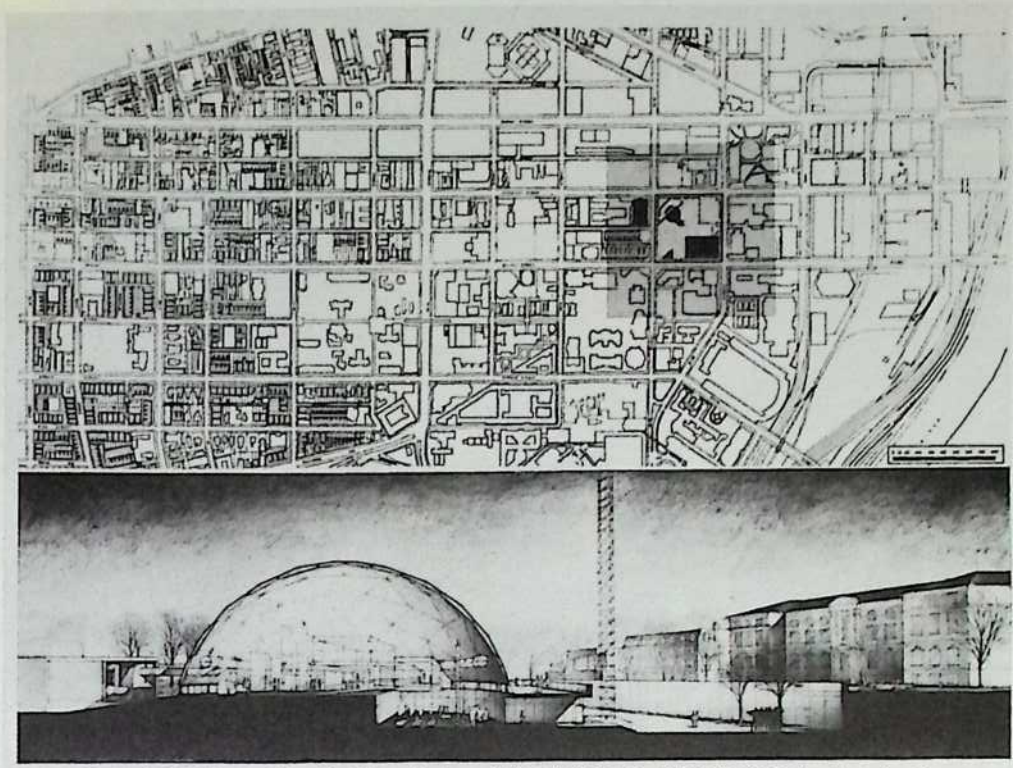


State CoOego • Fuller & Sadao, Inc., Azchilecta, Cambridge, Ma*a. Rendering University of g$^{eo<eSC}$ ome unfortunately, was never realized.

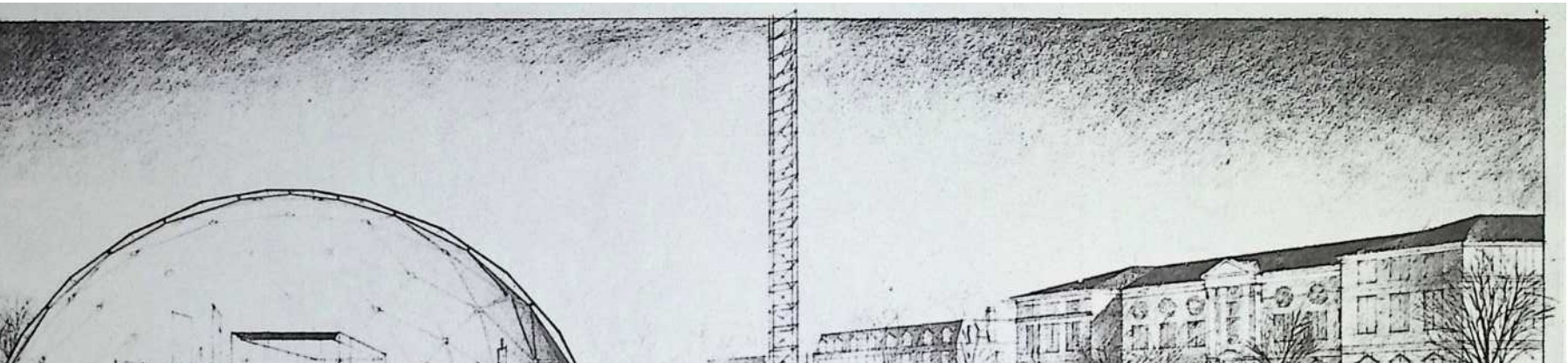
34 Pennsylvania Art Gallery Fuller & Sadao, 1973







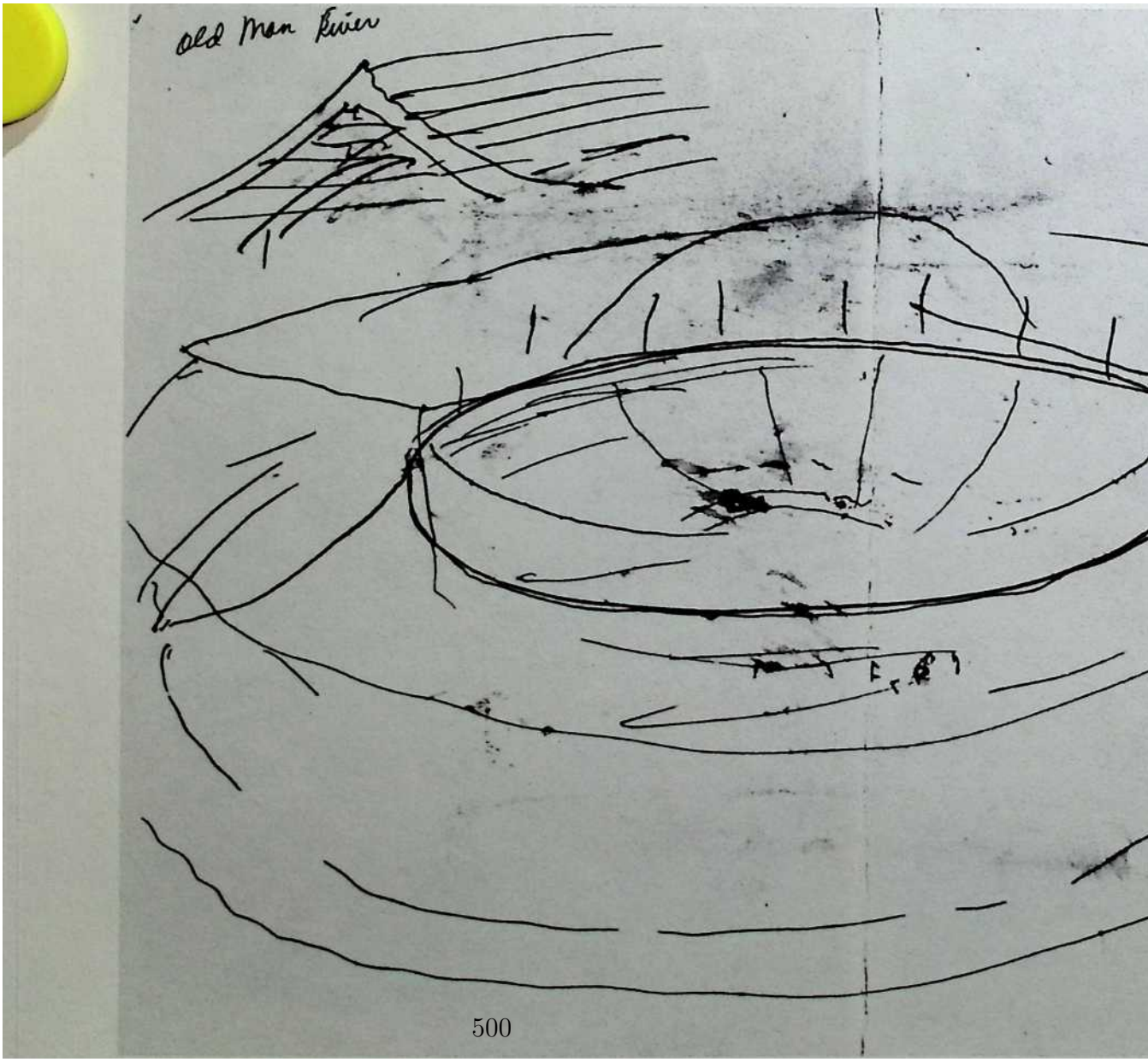
Proposed Art Gallery · University of Pennsylvania · Fuller and Sadao, Inc., Architects; Cambridge, Massachusetts

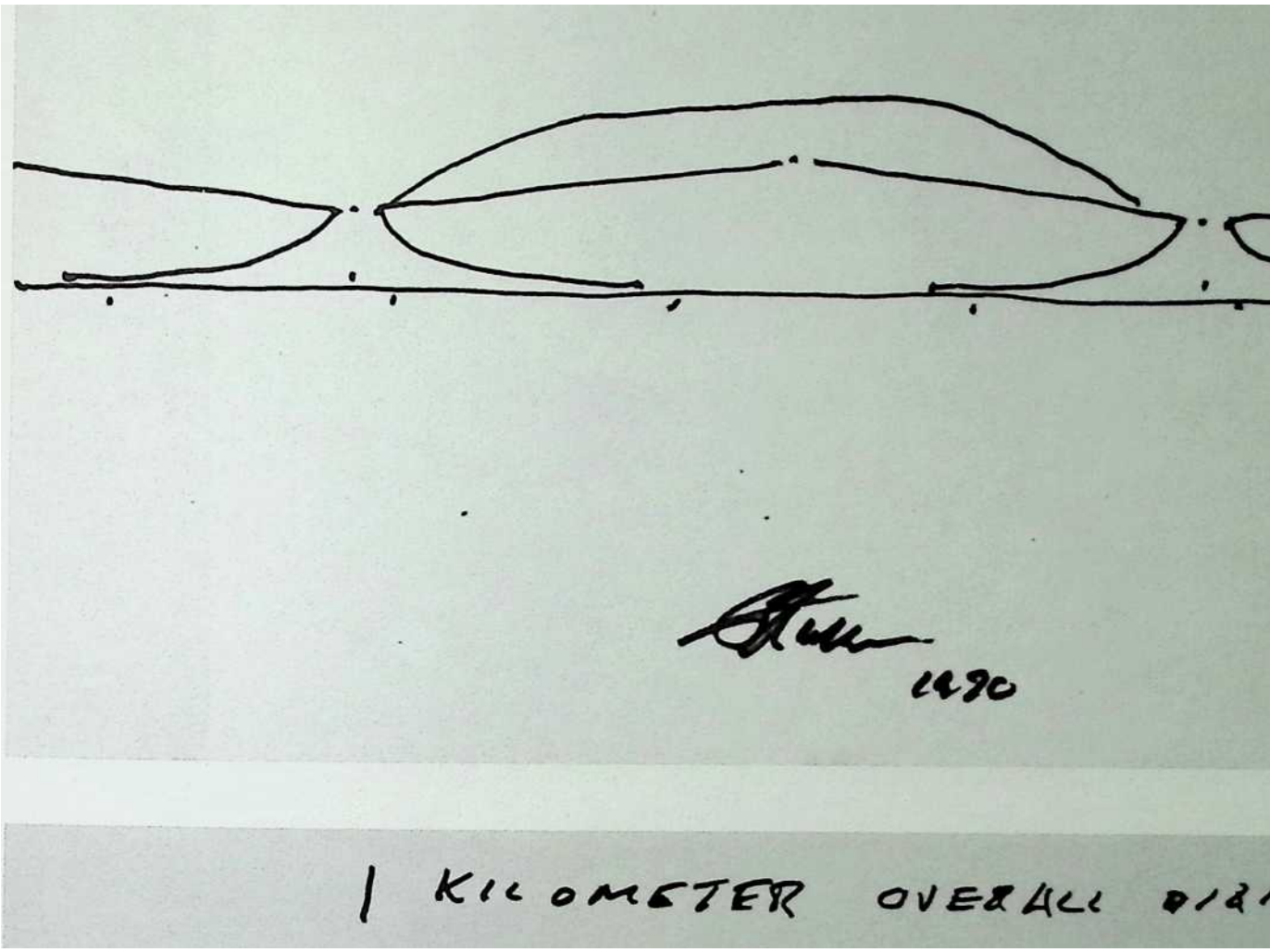


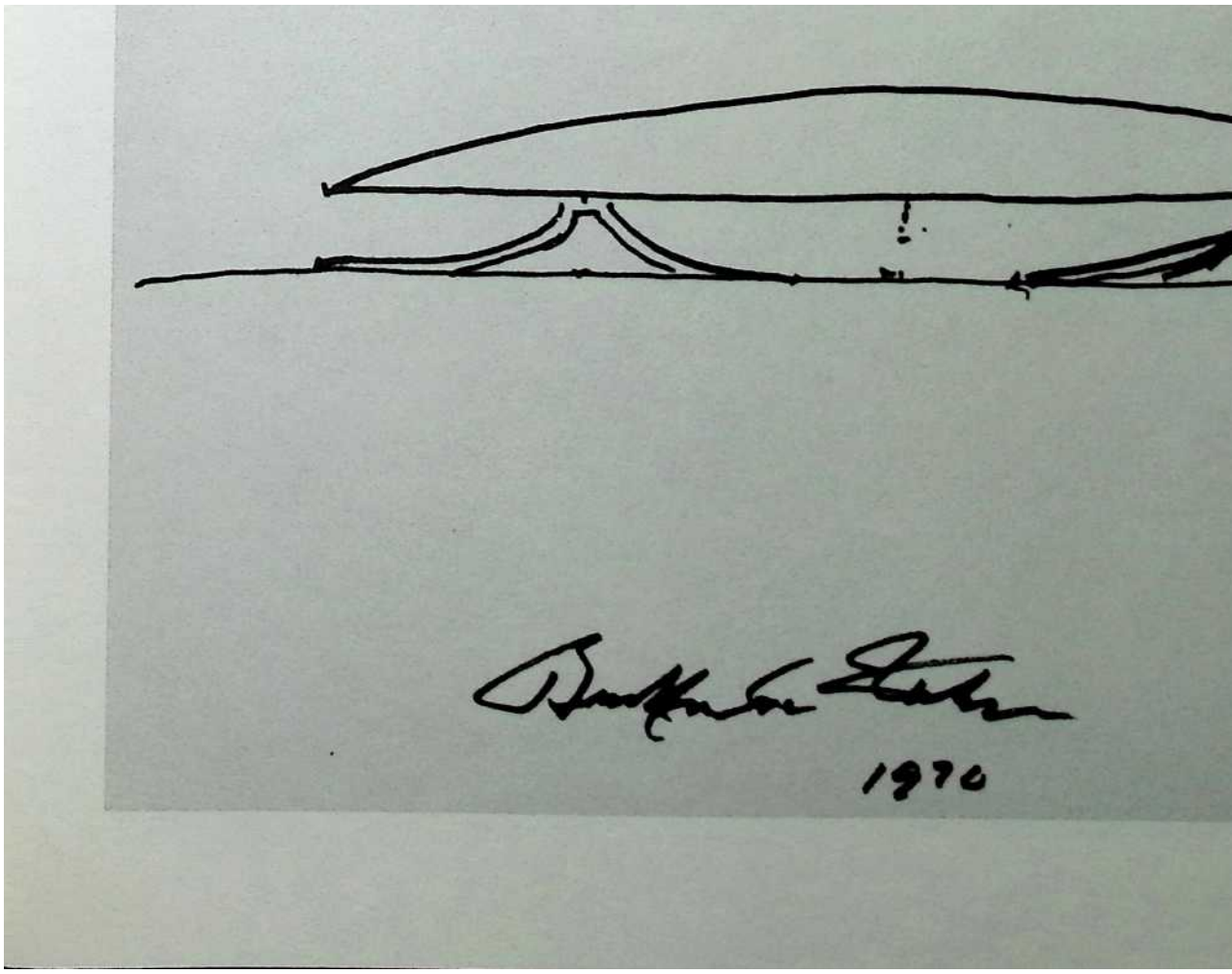
35 Old Man River: An Umbrellaed Town Concept for East Saint Louis, Illinois 1970–1974

Old Man River is Fuller's most ambitious planned city organized under a single roof. It is a circular town with a protective, domical umbrella 2,200 feet in diameter and 500 feet above the ground at its edge. This structure, which is like a vast and stiffened velarium, is supported on beams driven into the rim of a reinforced crater, on either side of which are arranged the buildings of the town.

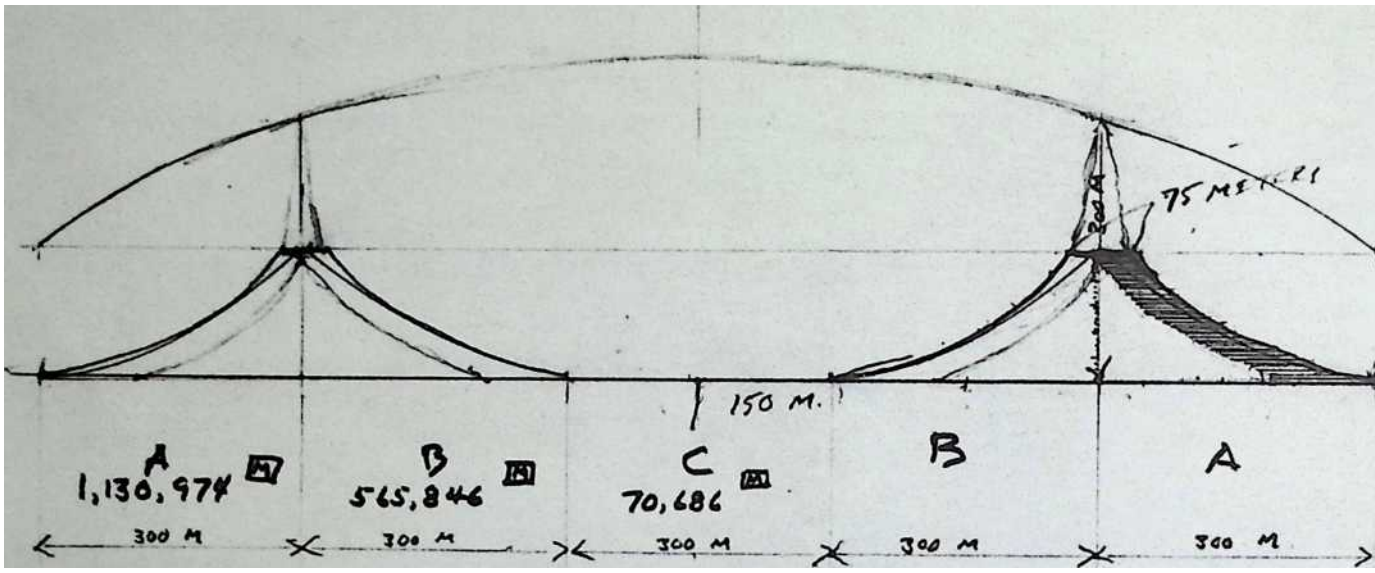
36 Old Man River, Sketches 1970–1971

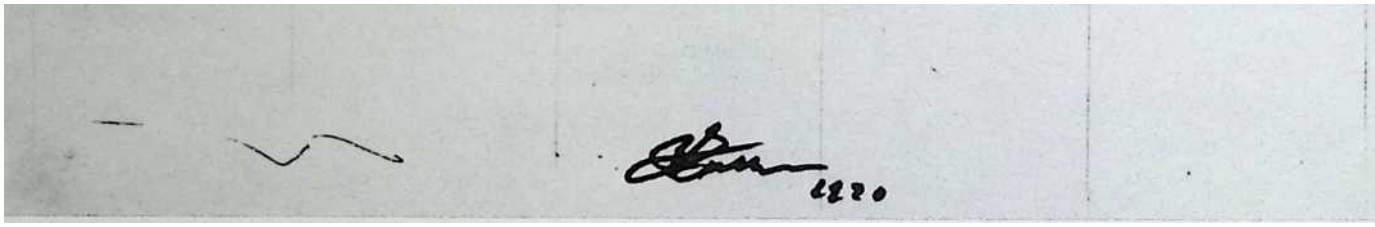


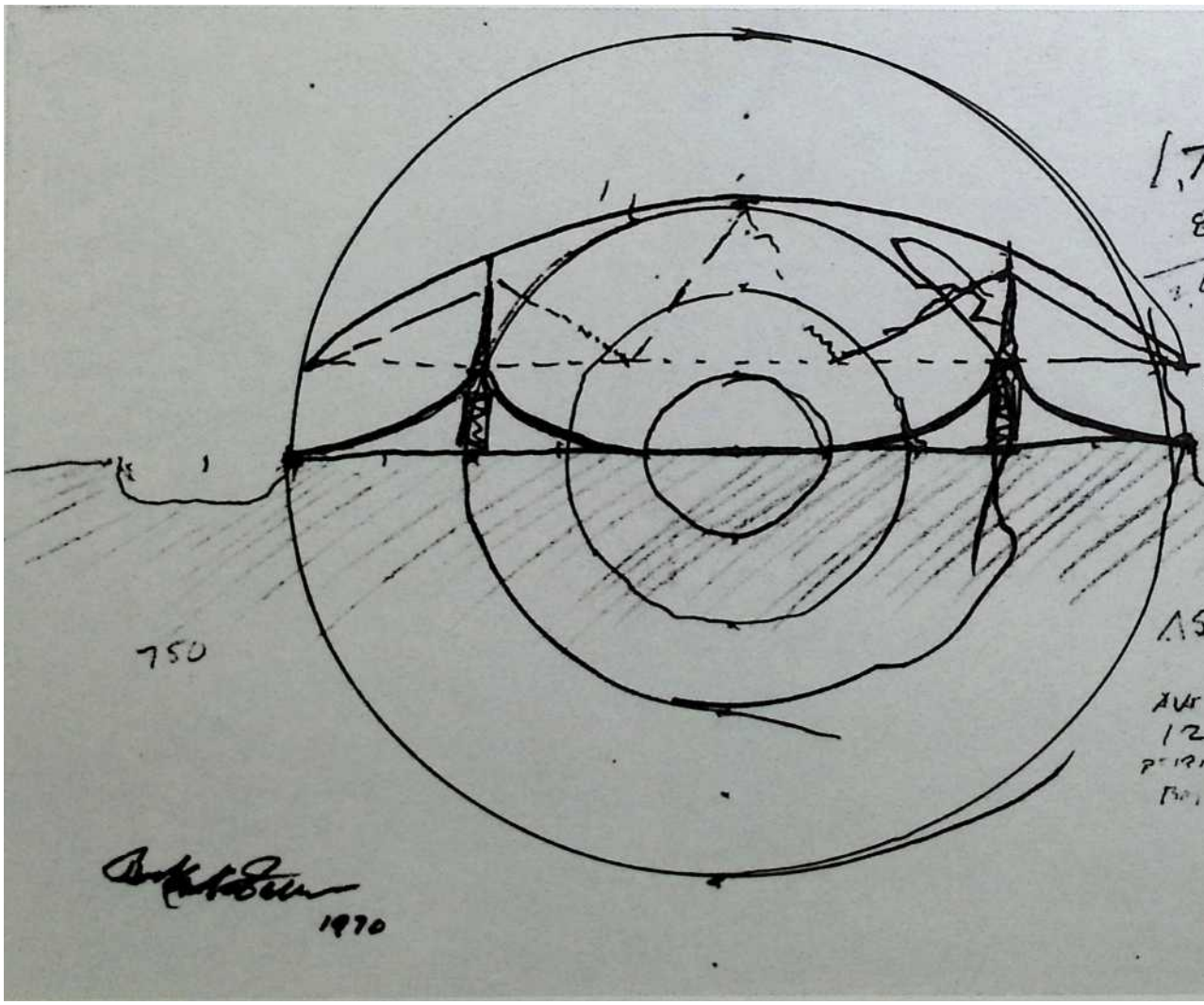

1490
1 KILOMETER OVERALL

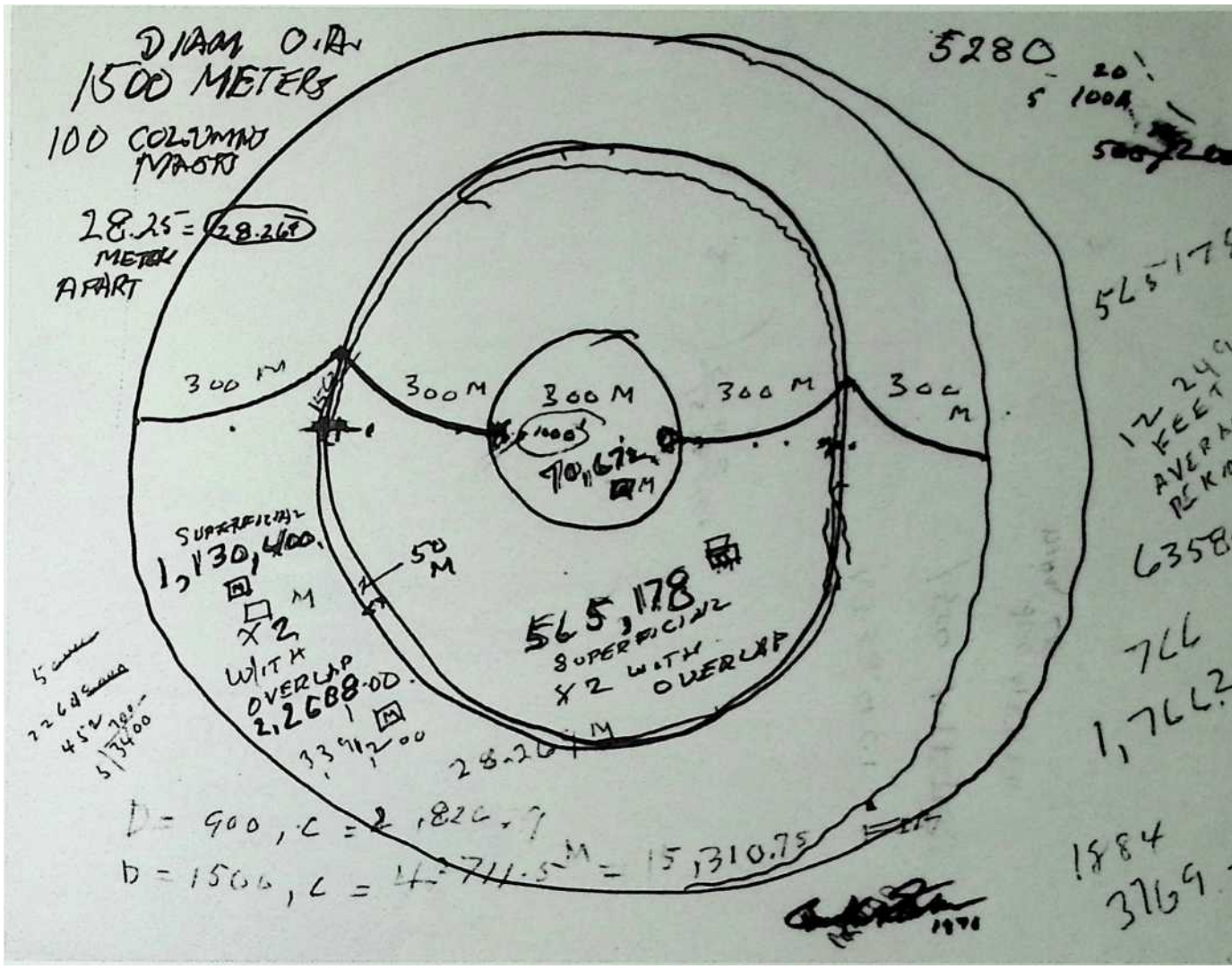

1970

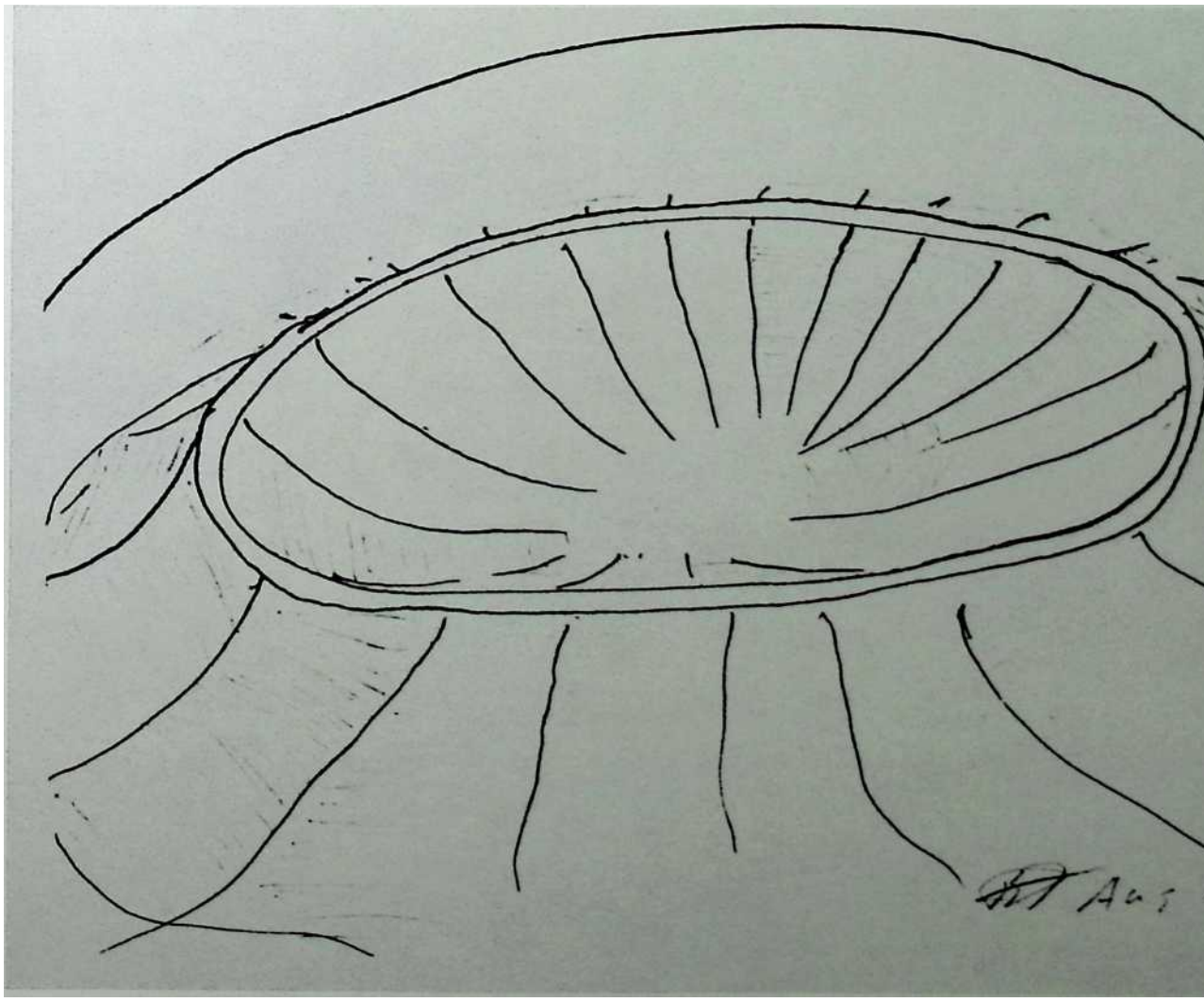
14 000
5770.5
300
37.5 M.
5022 62.5
5.

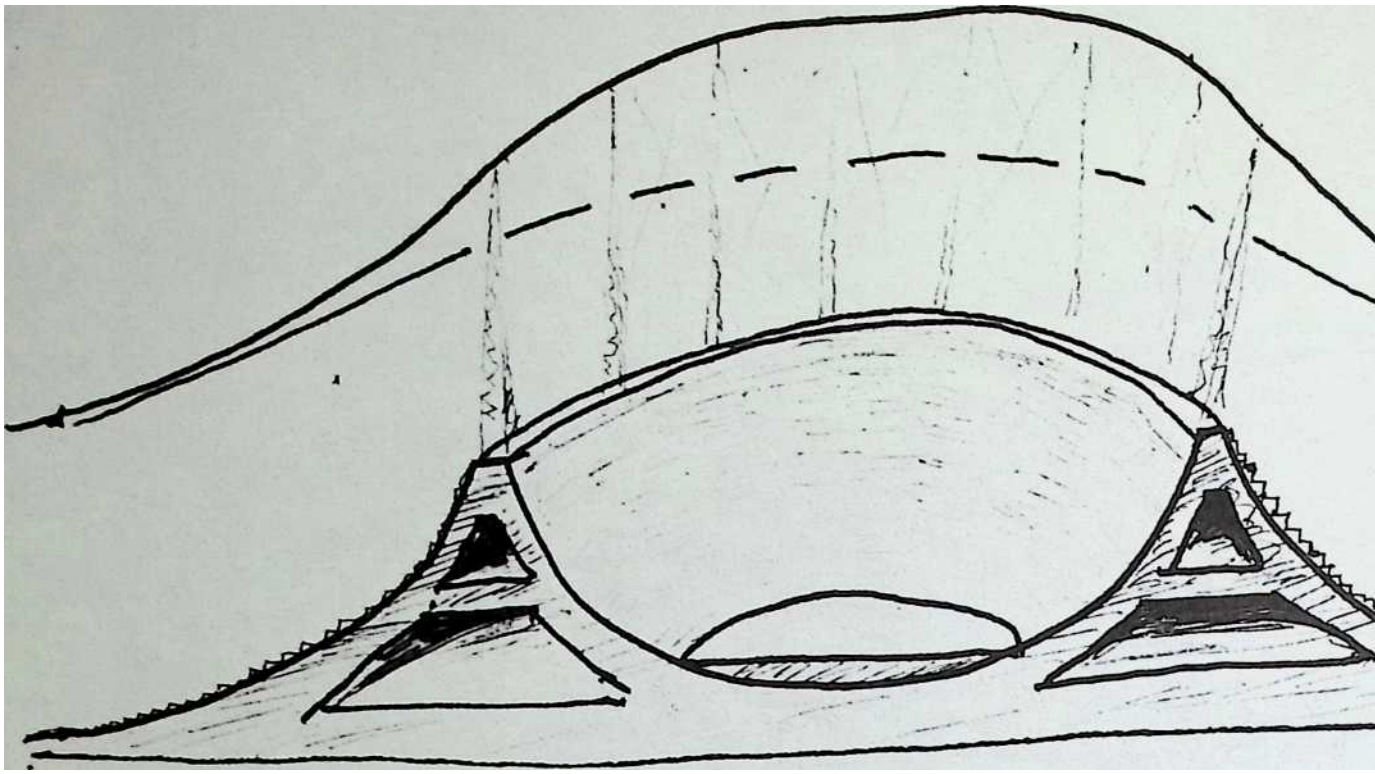

75 METERS
150 M.
A
1,130,974
B
565,846
C
70,686
B
A
300 M
300 M
300 M
300 M
300 M

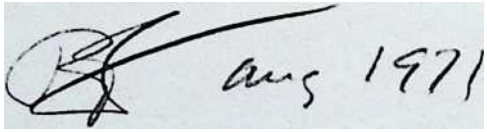



750
1970


DIAM O.A.
1500 METERS
100 COLUMNS
MADE
28.25 = 28.268
METERS
APART
300 M
300 M
300 M
300 M
300 M
1,130,400
X2 M
WITH
OVERLAP
2,2688.00
565,178
SUPERFICIAL
X2 WITH
OVERLAP
50 M
28.268 M
D = 900, C = 2,826.9
D = 1500, C = 4,711.5 M = 15,310.75
5280
565178
6358
766
1,766
1884
3769







Old Man River, Finished Project 1974

AN UMBRELLAED TOWN CONCEPT FOR EAST ST. LOUIS. ILLINOIS

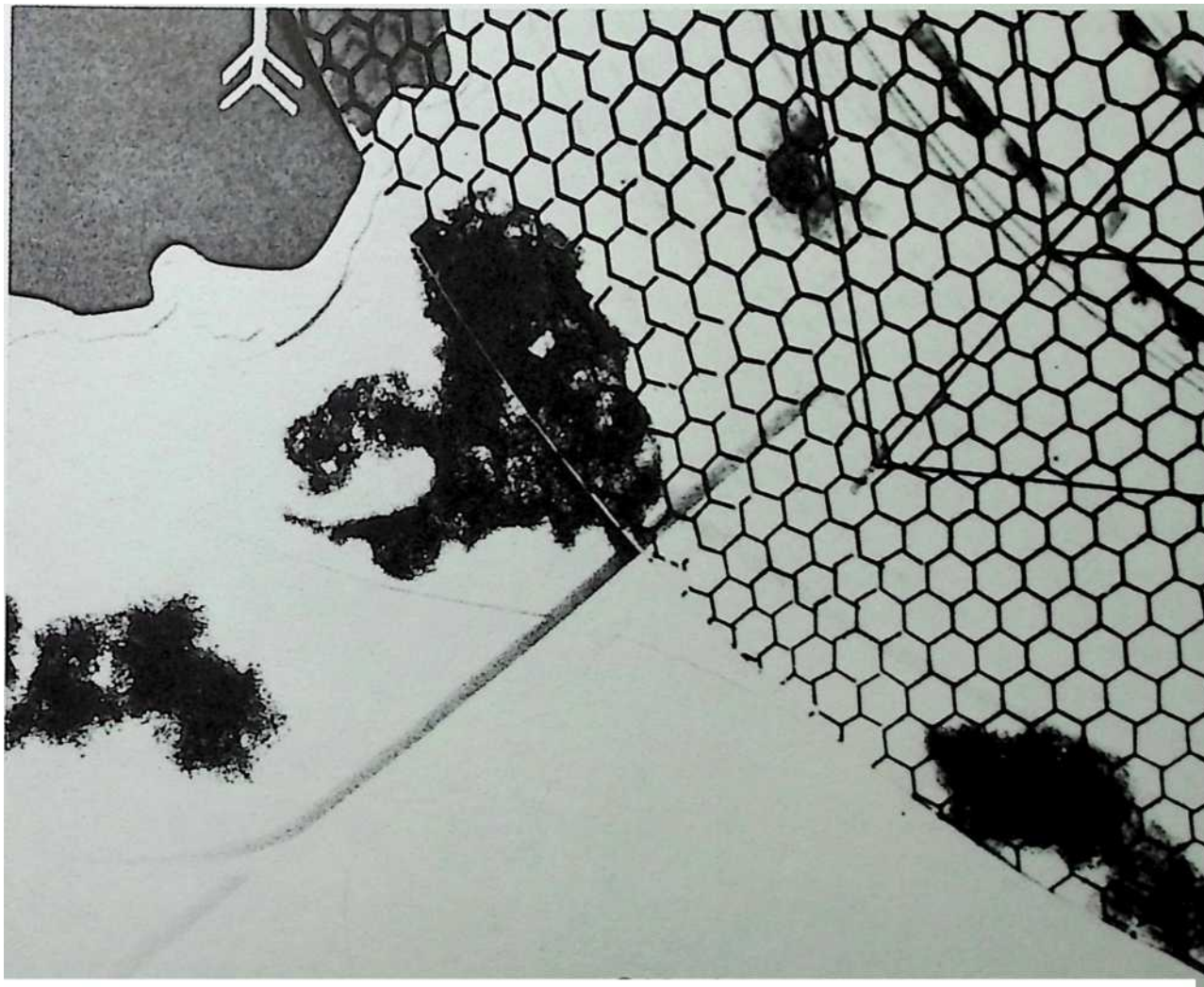
OLD MAN RIVER)Sro

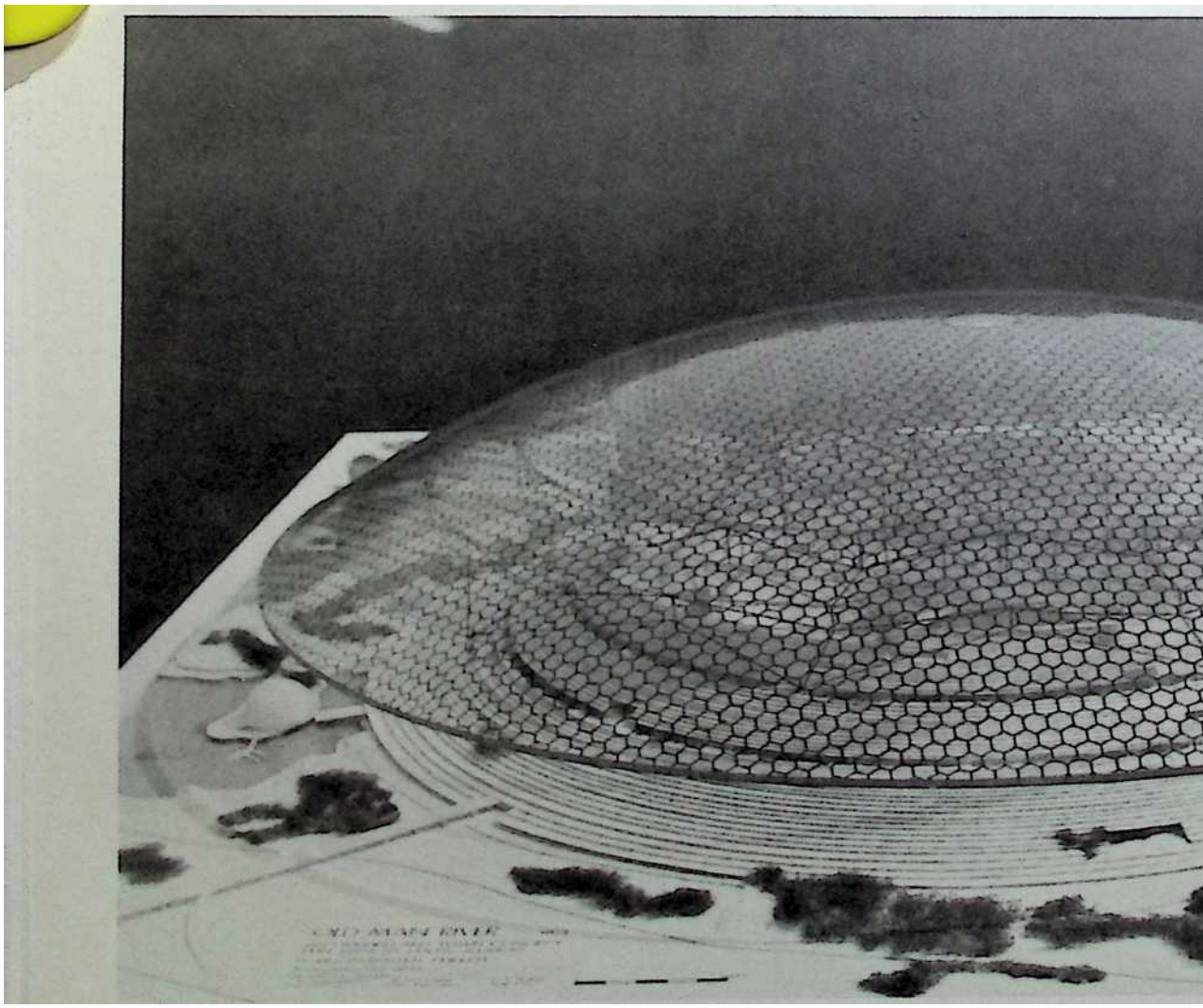
R. BUCKMINSTER FULLER

DESIGN DEVEIOPMENT GROUP WASHINGTON UNIVERSITY

J W fITZGIBBON LEl-HOO MAK C P WANG

CHAI-HSU IU PING-PING HSU ISA' CHi





ONE MILE

1000 ft.

BRARY, MUSEUM

A

STADIUM

'.ENTRANCE

ROCK

KING-T

450 'eat

Jf^MiLE

-RADIUS

100 'eet

ELEVATORS

SHOPS.-, [rti

BUS TRANSIT CENTER

HOUSING

HOUS'NG

RING ROAD THRU ROAD HOUSING PARKS

COMMUNITY, F|R£\

MAJOR SHOPPING A STATlOf

COMMERCIAL AR~$_{A}$—

UNDERGROUND

ROADWAY

PARK NG

ACCESS

ELEVATOR,

TRANSIT

CONCOURSE

ST LOU IS

MISSOURI

© OLD MAN RIVER

SITE

CLUBS

NIGHT CLUBS

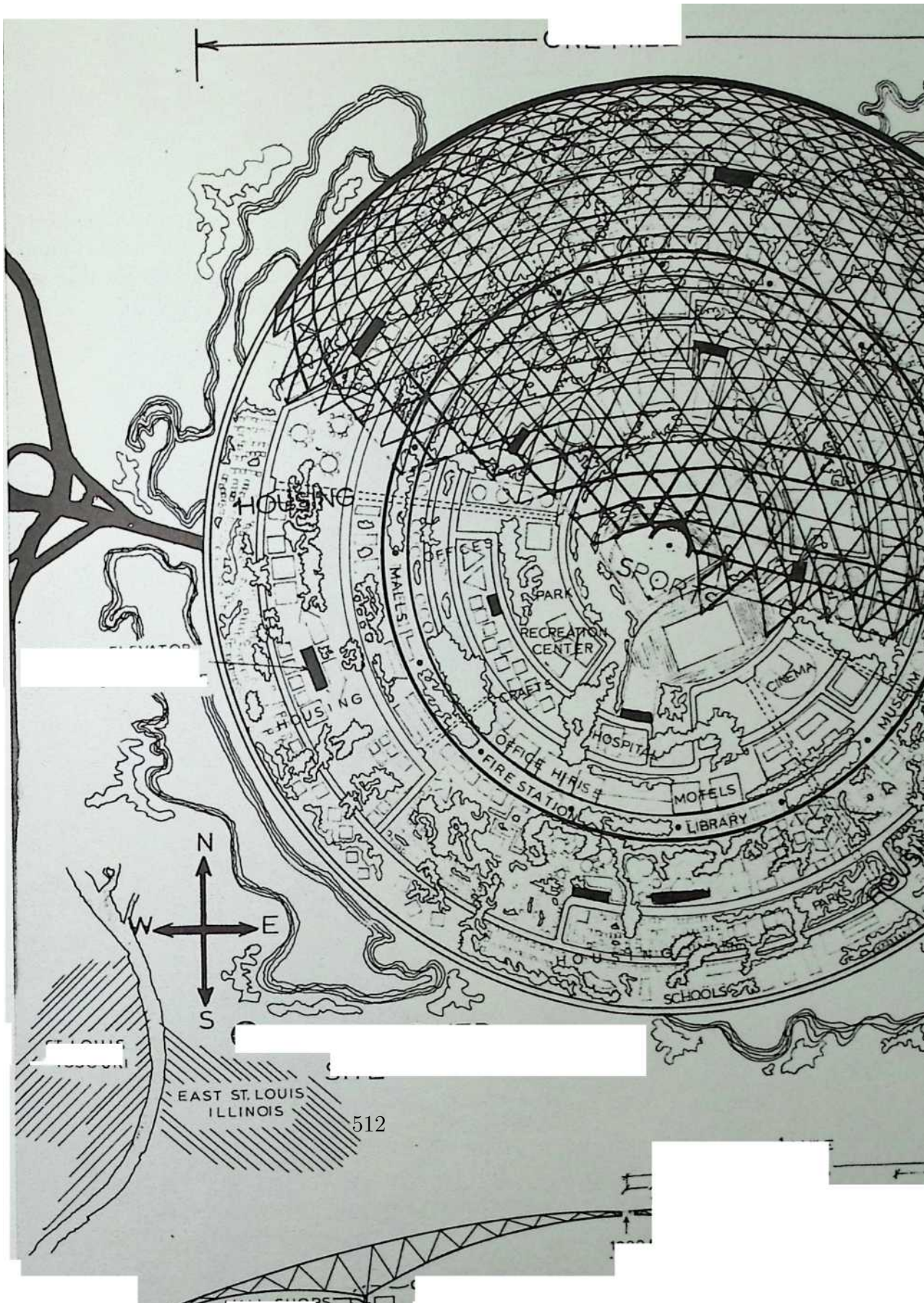
CINEMA

MOTEL

TURIN!

R £S

PARKING[1].


HOUSING
MALLS
PARK
RECREATION CENTER
CRAFTS
HOSPITAL
OFFICE HIRIS
FIRE STATION
MOTELS
LIBRARY
CINEMA
MUSEUM
PARKS
SCHOOLS
HOUSING
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S
EAST ST. LOUIS
ILLINOIS

OLD MAN RIVER-AN UMBRELLAED TOWN CONCEPT FOR EAST ST. LOUIS, ILLINOIS

IsC

R> BUCKMINSTER FULLER

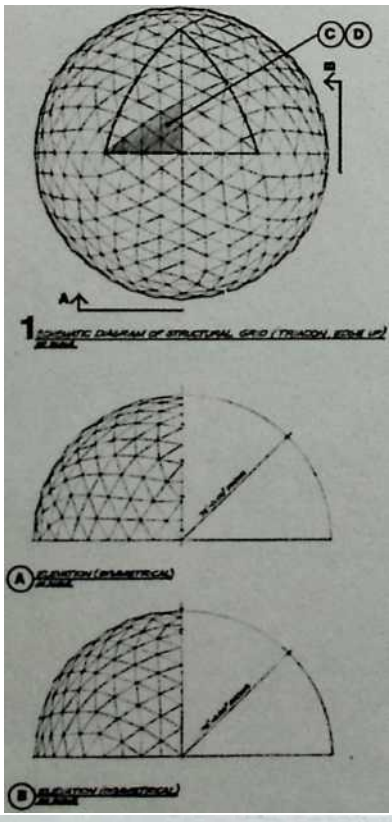
WASHINGTONCJNIV'ERSTTY SCHOOL OF

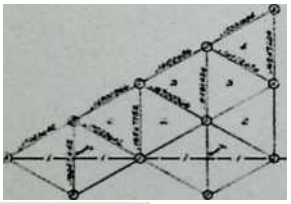
ARCHITECTURE - FEB 1974

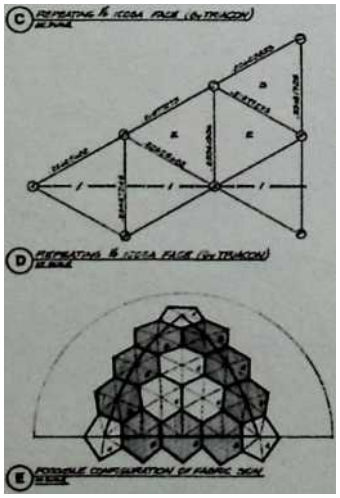
Penang Urban Center, Penang, Malaysia Fuller & Sadao, 1974

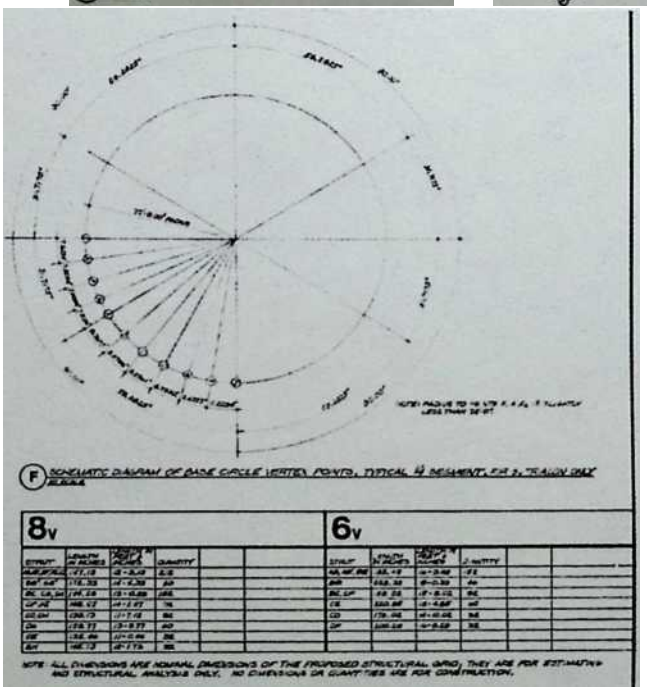
Fuller and Sadao developed the concept of the sphere above a rectangular volume (see the Campus Religious Center, Southern Illinois University, 1969) for this island state.

fuu^{f} /: T ^{C} NC

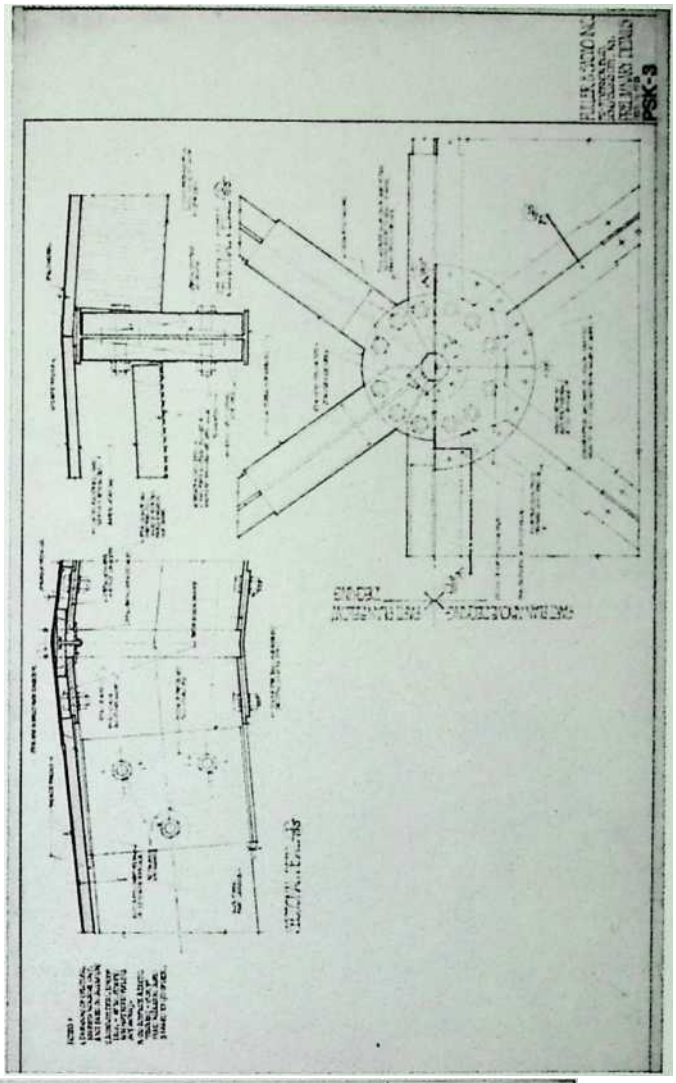


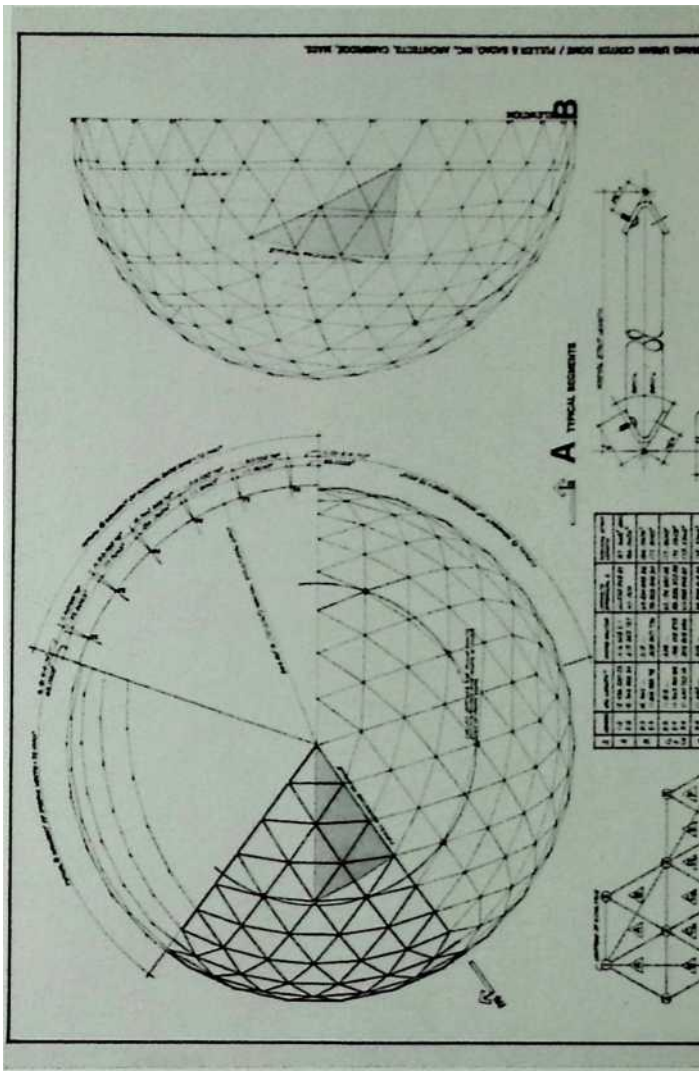


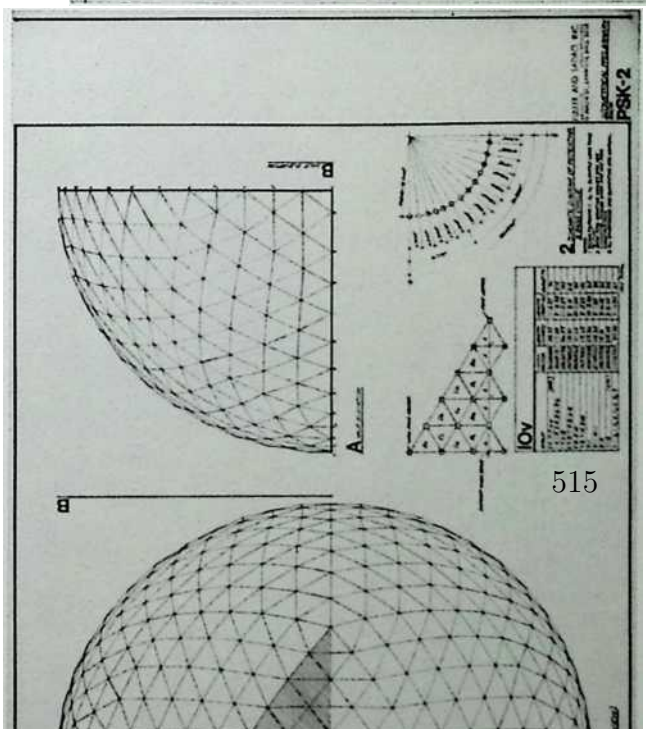


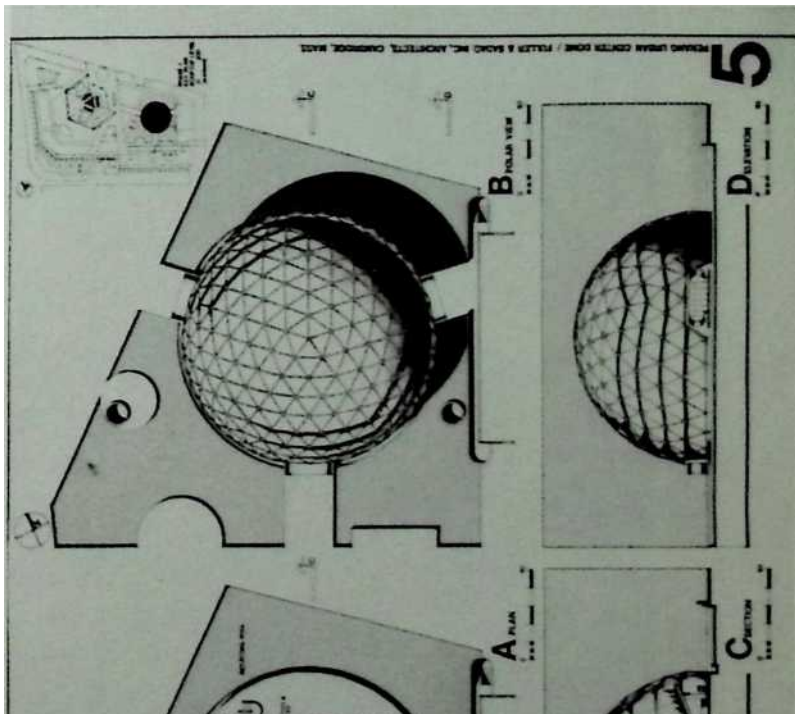


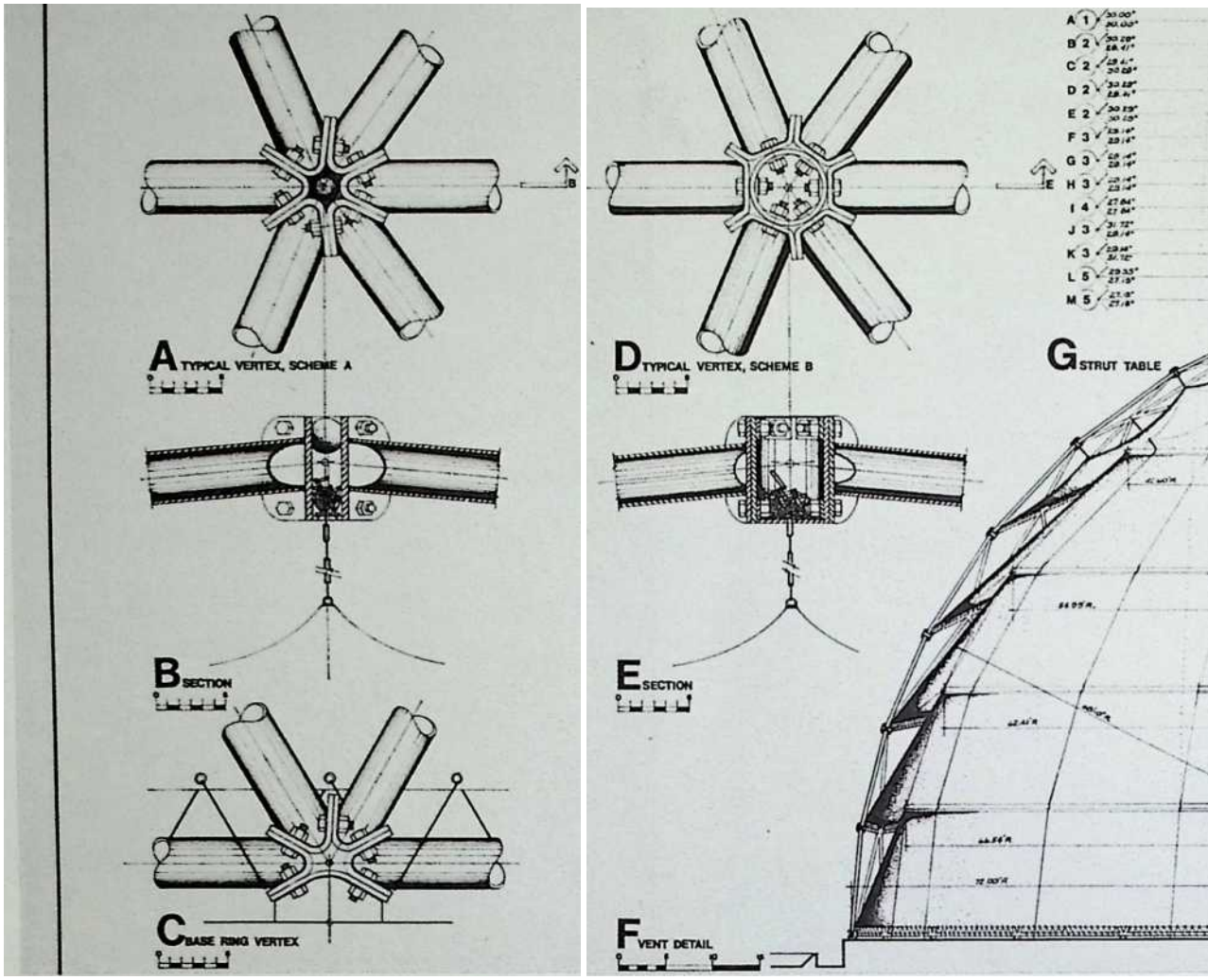
GEOMETRICAL PRELIMINARY
PSK-1


PSK-3



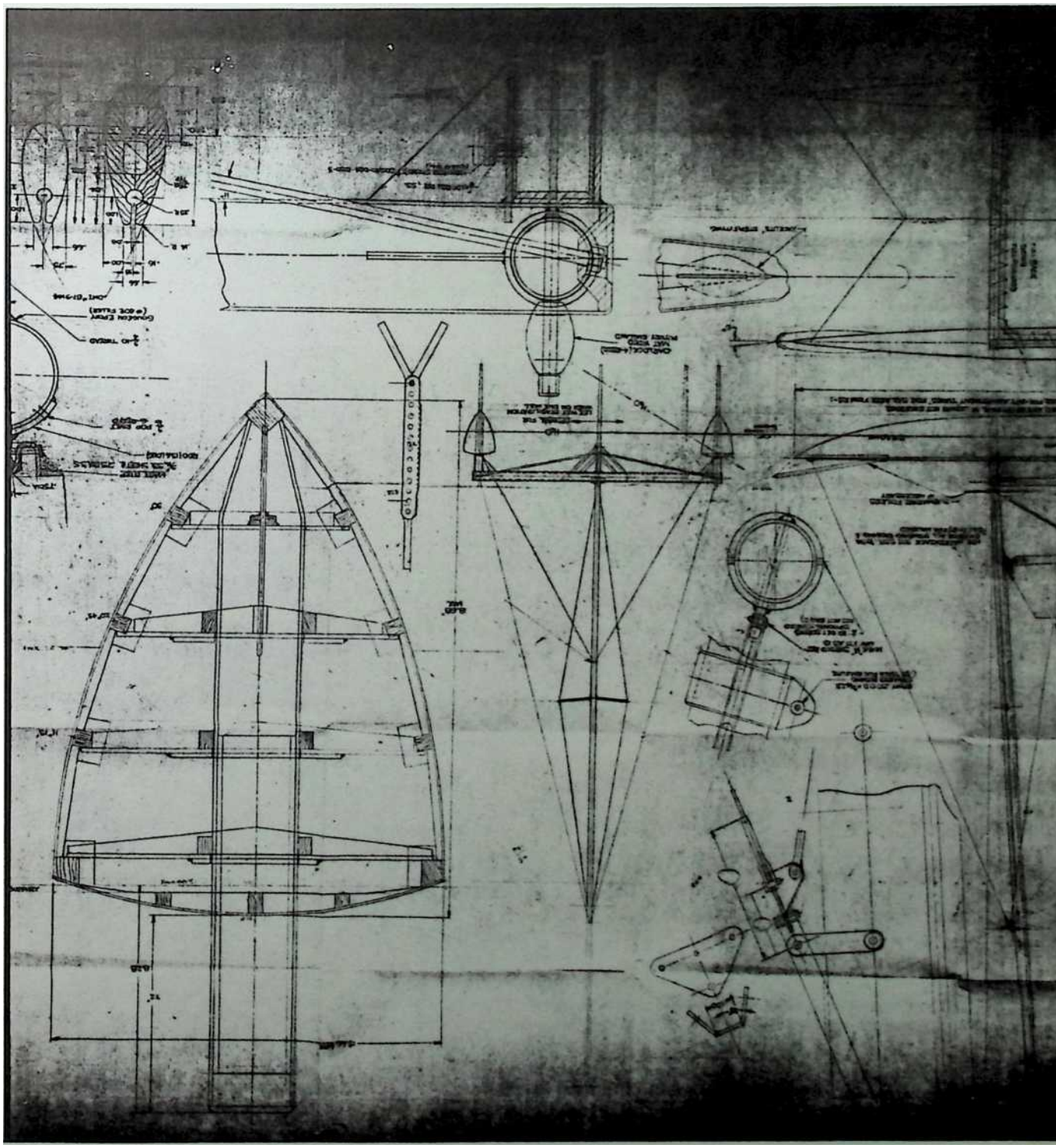

PSK-2

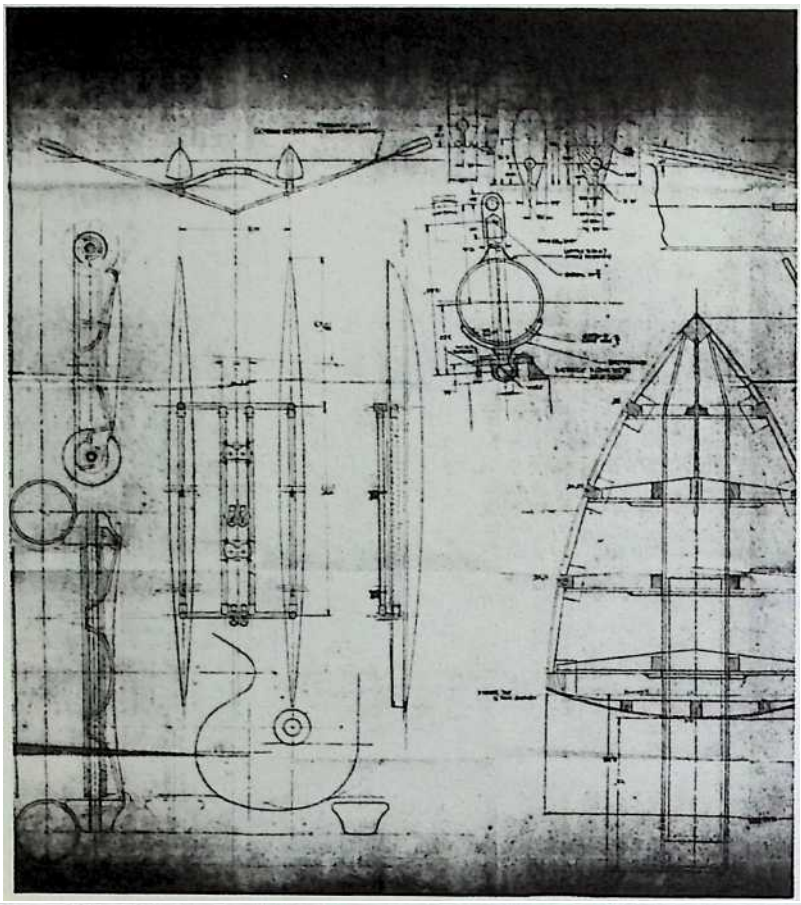


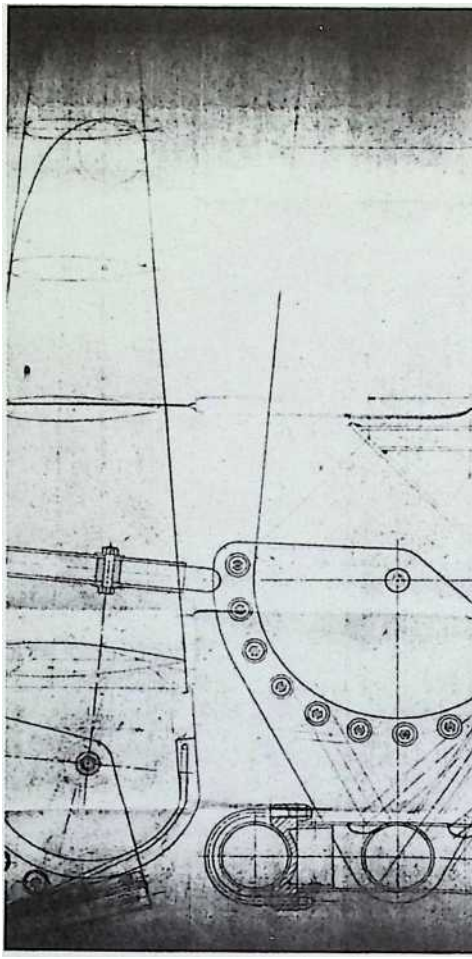


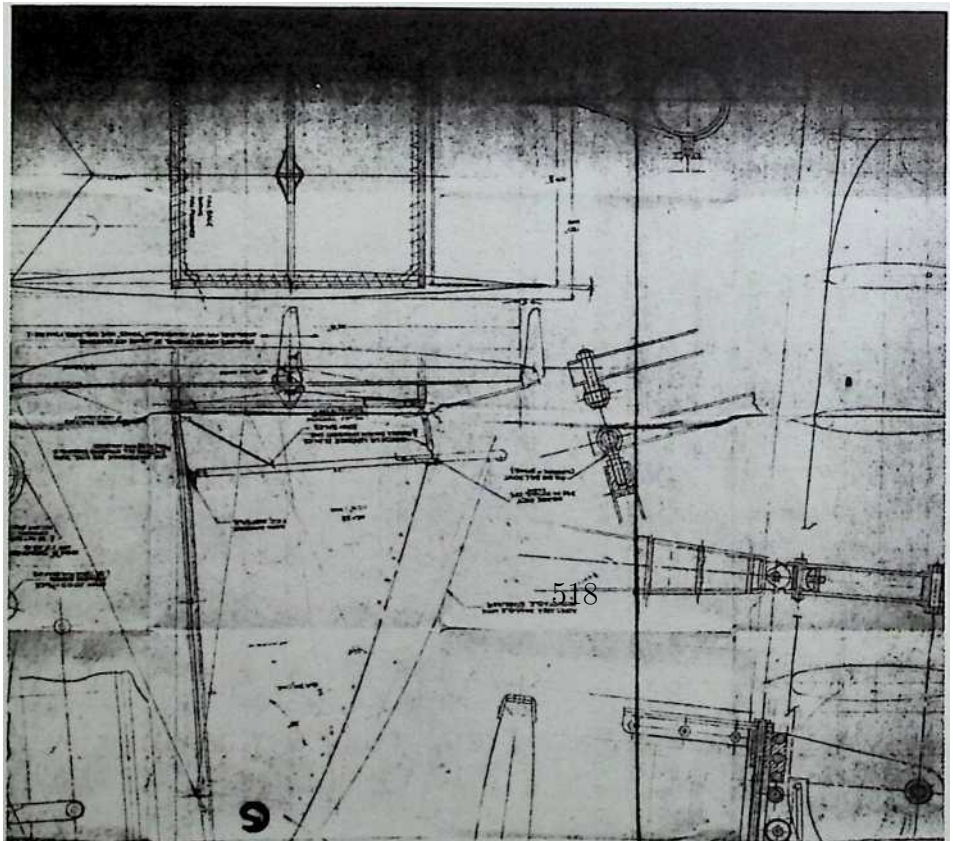
The *Sailor Cat* (Catamaran) 1974

The *Sailor Cat* combines the stability of the earlier rowing needles patent, with the power and maneuverability of a sailboat.









Hexa-Pent Patent
5/14/74

Uunited States Patent i«9j

Sadao

Shoji Sadao designed this small geodesic dome for mass production as low-cost housing. It utilizes hexagonal and pentagonal panels, some of which have transparent panes of plexiglass.

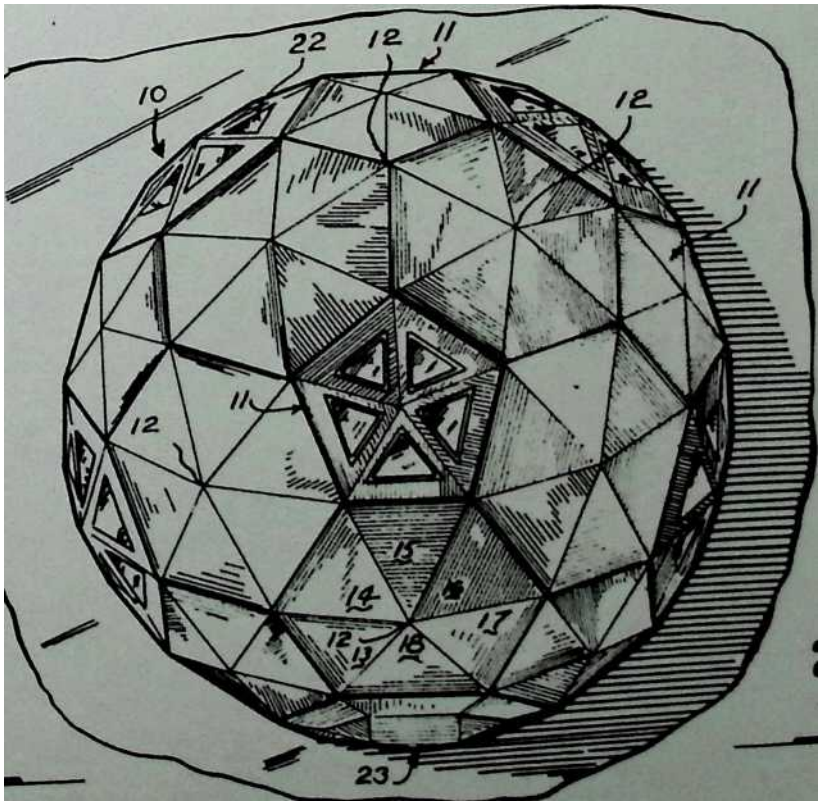
mi 3,810,336

145) May 14, 1974

[54] **GEODESIC PENTAGON AND HEXAGON STRUCTURE**
[75] **Inventor: Shoji Sadao, Boston, Mass.**
[73] **Assignee: Fuller & Sadao, Incorporated, Cambridge, Mass.**
D217.76O 6/1970 Critchlow 52/81 UX
3,114,176 12/1963 Miller 52/81
3.530,621 9/1970 Rutzebeck 52/81
OTHER PUBLICATIONS
Domebook 2, May 1971, pages 14, 25. 31.
22] Filed: May 9, 1972
21] Appl. No.: 251,803
52] U.S. Ci 52/81
51] Int. Cl E04b 1/32
58] Field of Search 52/80, 81, DIG. 10
56] References Cited
UNITED STATES PATENTS
1.918.992 12/1959 Gelsavage 52/81
***Primary Examiner*—Henry C. Sutherland *Assistant Examiner*— Henry Raduazo *Attorney, Agent, or* Firm—Smythe & Moore**
[57] **ABSTRACT**

A geodesic-type dome structure having the structural elements connected in a pattern of great circle arcs and lesser circle arcs in a three-way grid defining isosceles triangles and including hexagon and pentagon modules.

5 Claims, 7 Drawing Figures



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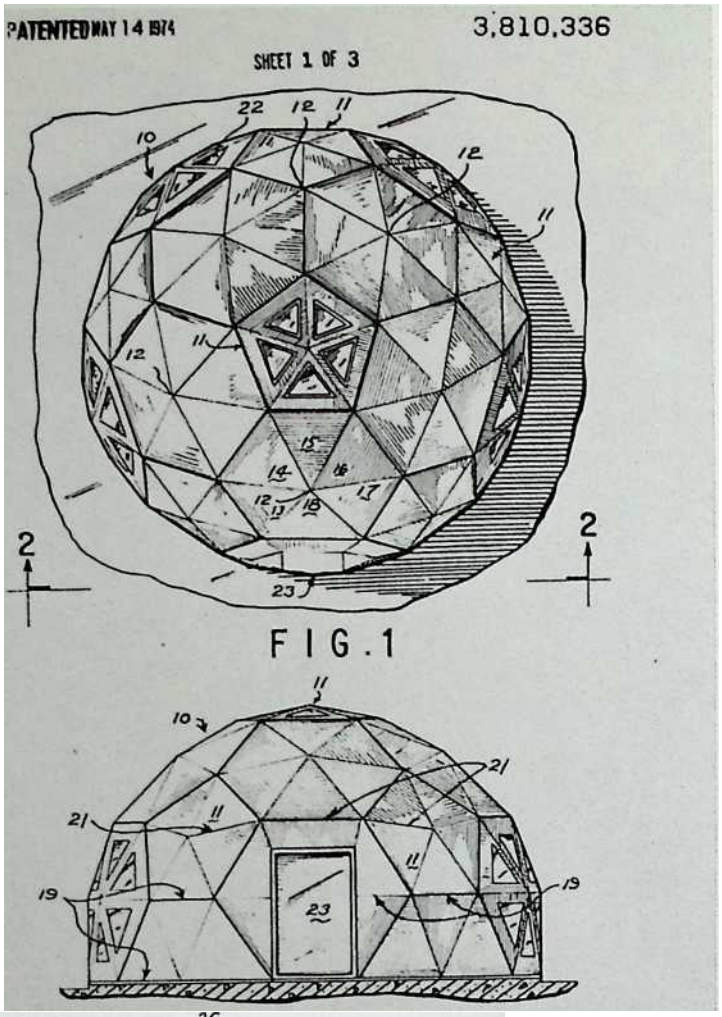
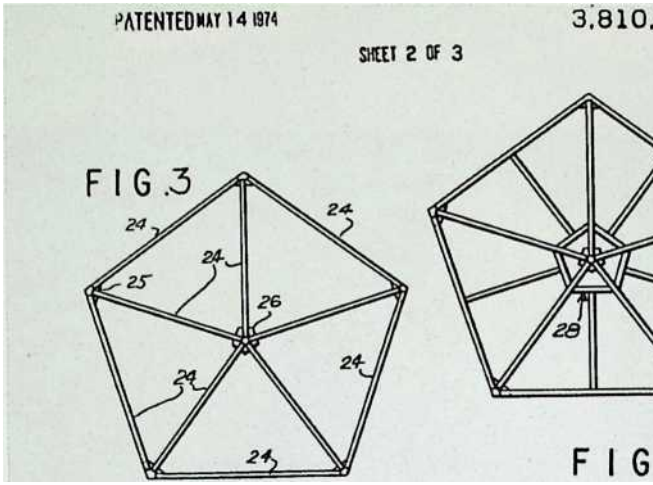
3.810,336

SHUT 3 OF 3


PATENTED MAY 14 1974
3,810,336
SHEET 1 OF 3
FIG.1


PATENTED MAY 14 1974
SHEET 2 OF 3
FIG.3

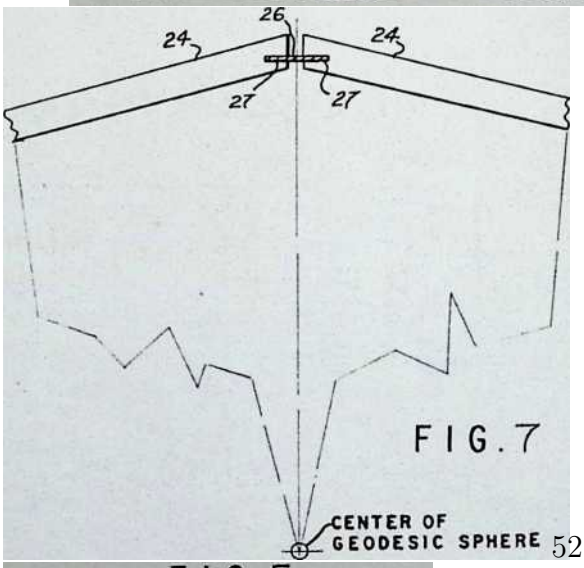


FIG.7
CENTER OF
GEODESIC SPHERE

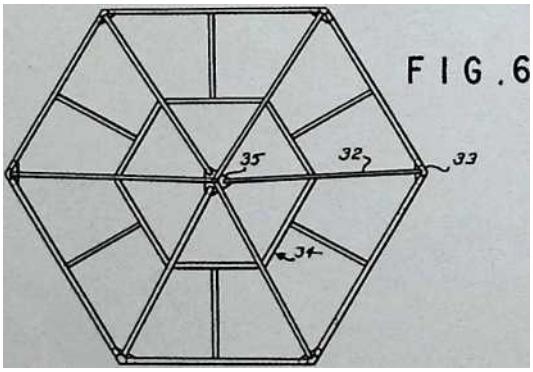


FIG.6

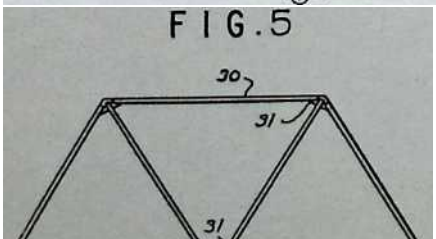


FIG.5

Floatable Breakwater

Patent

2/4/75

The floatable breakwater is a cylinder floated by tubes twenty feet in diameter and anchored at both ends. It serves to diffuse the energy of approaching waves so that the shore can be developed into a harbor.

(ill 3,863,455

[45] **Feb. 4, 1975**

United States Patent

Fuller

[54] **FLOATABLE BREAKWATER**

[76] **Inventor: Richard Buckminster Fuller, 200**

Locust St., Philadelphia, Pa. 19106

[22] **Filed: Dec. 10, 1973**

[21] **Appl. No : 423,006**

[52] **U.S. Cl 61/5**

[51] **Int. Cl E02b 3/04**

|5X| **Field of Search 61/1 F, 5; 114/.5; 9/8 R**

| **561 References Cited**

UNITED STATES PATENTS

3,237,414 3/1966 Straub et al 61/5

3,357,192 12/1967 Hibarger 61/5

3,576,108 4/1971 Rowland 61/1 F

3,755,829 9/1973 Walklet 1I4/.5FUX

3,788,254 1/1974 Sheil I14/.5F

***Primary Examiner—Paul* R. Gilliam *Assistant Examiner—David* H. Corbin *Attorney, Agent, or* Firm—Smythe & Moore**

[57] **ABSTRACT**

A floatable breakwater comprises a flexible tubular element supported upon a number of water buoyant rings at the surface of the water so that the envelope can be filled with water. Both ends of the envelope are open and have drawstrings attached thereto which in turn are anchored to secure the breakwater in position. The envelope has sufficient flexibility to enable the rings therein to move with respect to each other in an accordian-like movement.

8 Claims, 11 Drawing Figures

PATENTEDFEB 41975 3.863,455

SHEET 1 OF 2

PATENTED FEO 41975 3,863.455

SHEET 2 Of 2

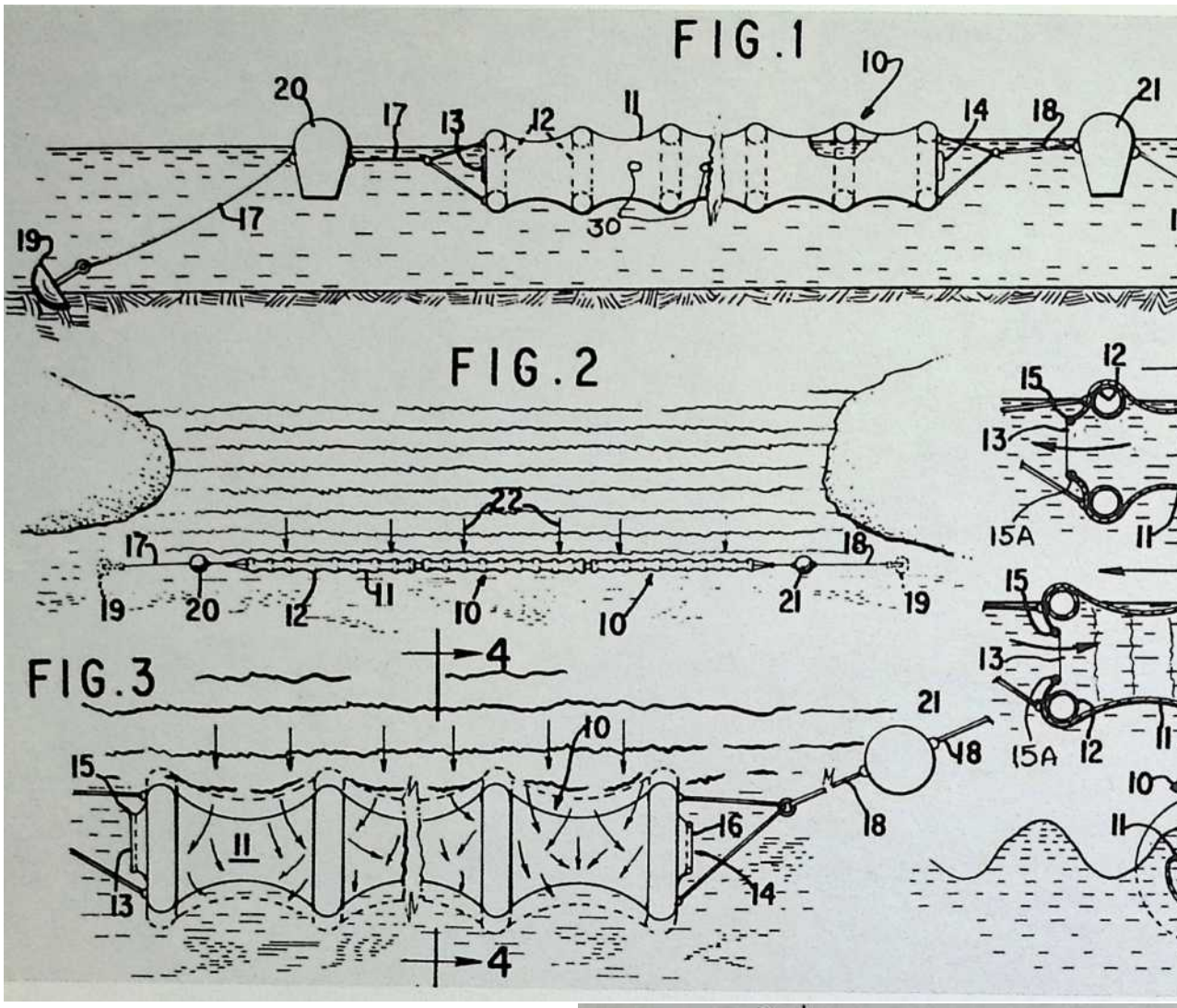


FIG.1
FIG.2
FIG.3

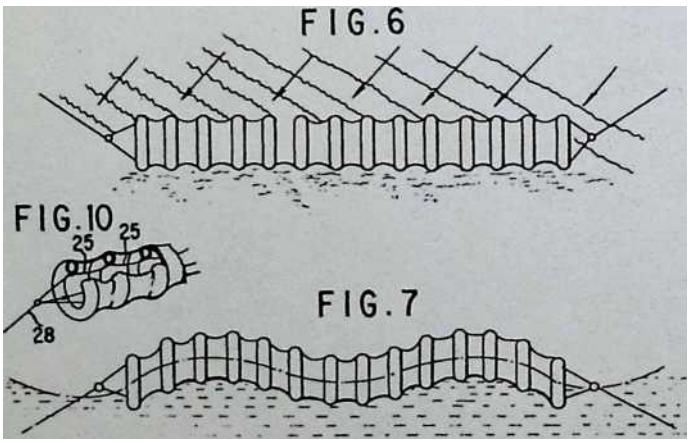


FIG.6
FIG.10
FIG.7

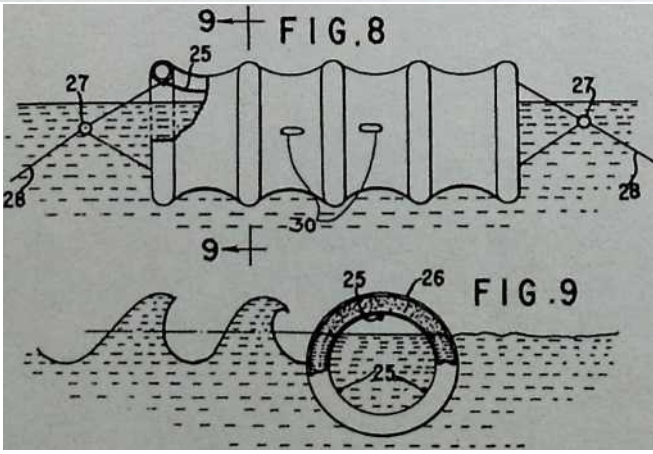


FIG.8
FIG.9

Nonsymmetrical Tensegrity Patent 2/18/75

Nonsymmetrical tensegrity dates from the early fifties, although Fuller did not patent this system until 1975. One notable example of its potential use is the portable theater he designed for St. Peter's College, Oxford, in 1969.

United States Patent [19) Fuller

mi 3,866,366

[45] Feb. 18, 1975

[54] NON-SYMMETRICAL

TENSION-INTEGRITY STRUCTURES

[761 Inventor: Richard Buckminster Fuller, 200

Locust St.. Philadelphia, Pa. 19106

(22) Filed: Aug. 7, 1973

(2I[Appl. No.: 386302 (52[U.S. Cl 52/81, 52/648

[51] Int. Cl E04b 1/32

(58) Field ot Search 52/81. 648

[56] References Cited

OTHER PUBLICATIONS

The Dymaxion World of Buckminster Fuller, Robert Marks. 1960, Reinhold Pub. Corp., pp. 160-161, FIG. klf.

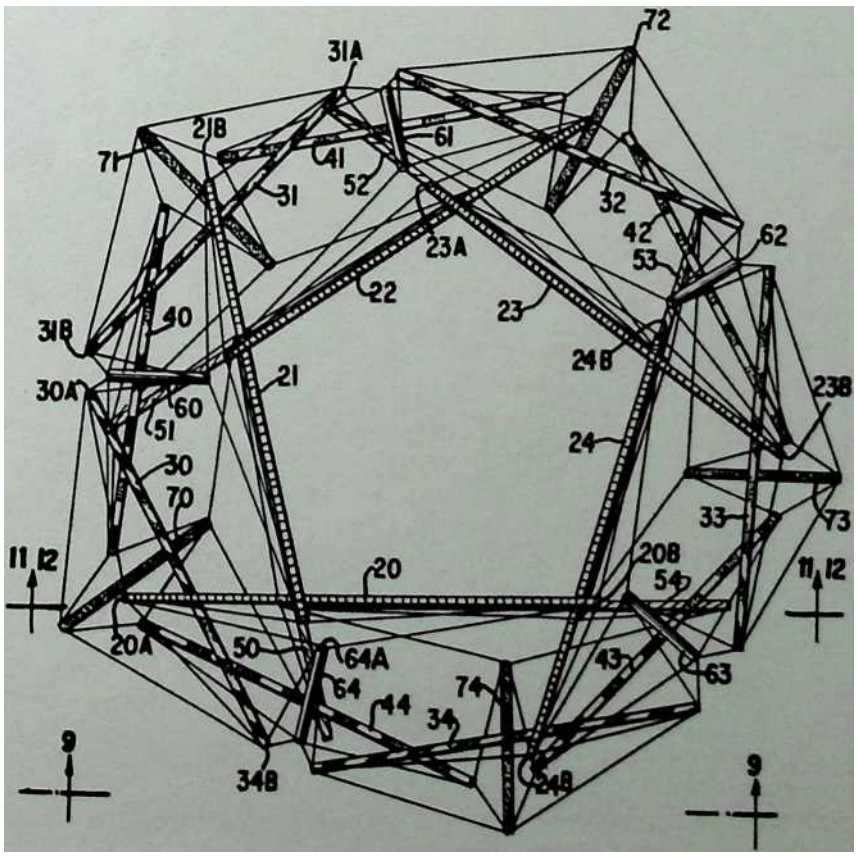
Primary Examiner— Ernest R. Purser *Assistant Examiner*—Carl D. Friedman *Attorney, Agent, or* Firm—Smythe & Moore

(571 ABSTRACT

A building structure composed of column-like discontinuous compression members held by a plurality of tension elements, the column-like compression members being held in spaced relation by tension elements attached adjacent the ends of the column-like compression members. In the form shown, there are what can be termed two substructures, one at the top and one at the bottom, each substructure having pentagonal configurations of parallel lesser circles formed by column-like members and tension elements at its base, said pentagonal configurations being twisted relative to

each other so as to provide rectangular openings therebetween. There are column-like compression members between the substructures held in spaced relation to each other and to the substructures by tension elements. The entire combination produces a generally spherical-like building structure.

7 Claims, 12 rawing Figures



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SHEET 3 OF 5

FIG.1

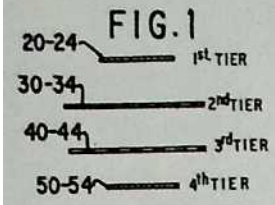


FIG.2

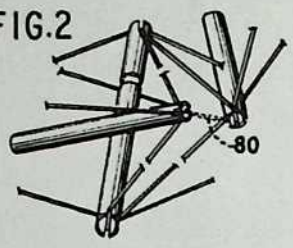


FIG.3

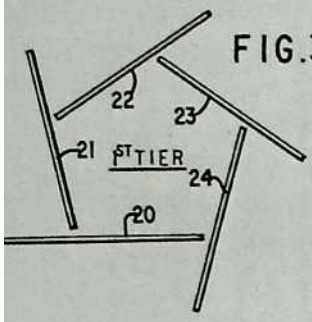
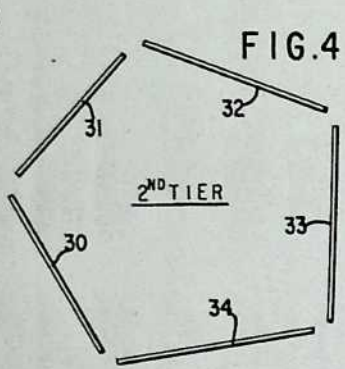


FIG.4



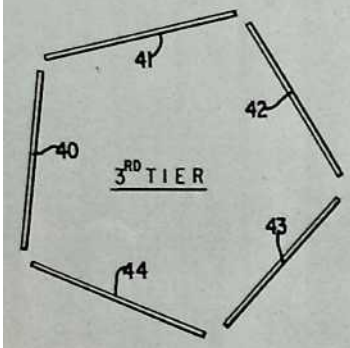


FIG.5

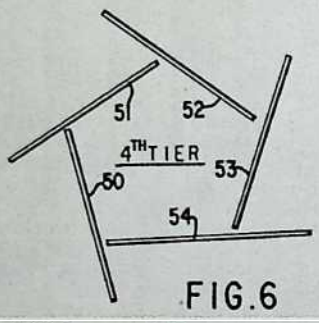


FIG.6

FIG.7

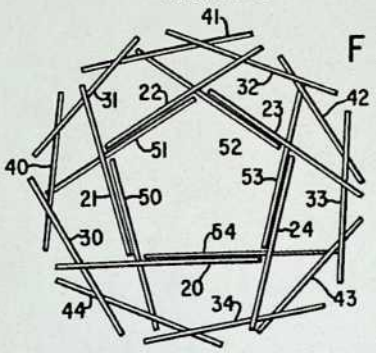


FIG.8

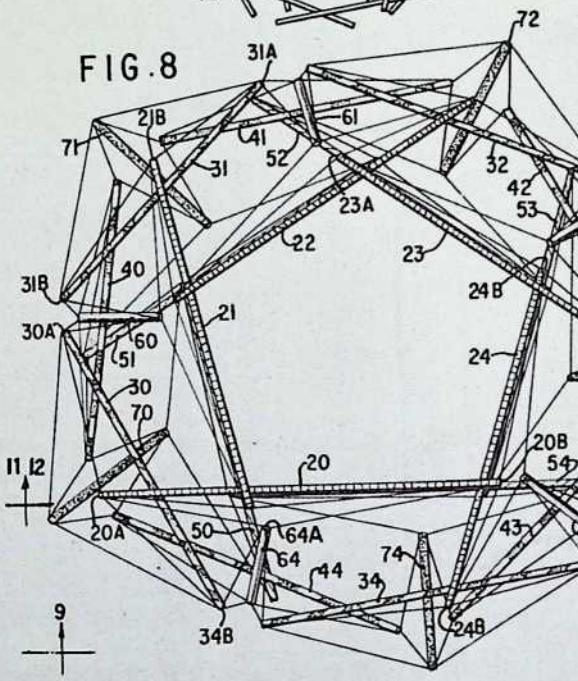
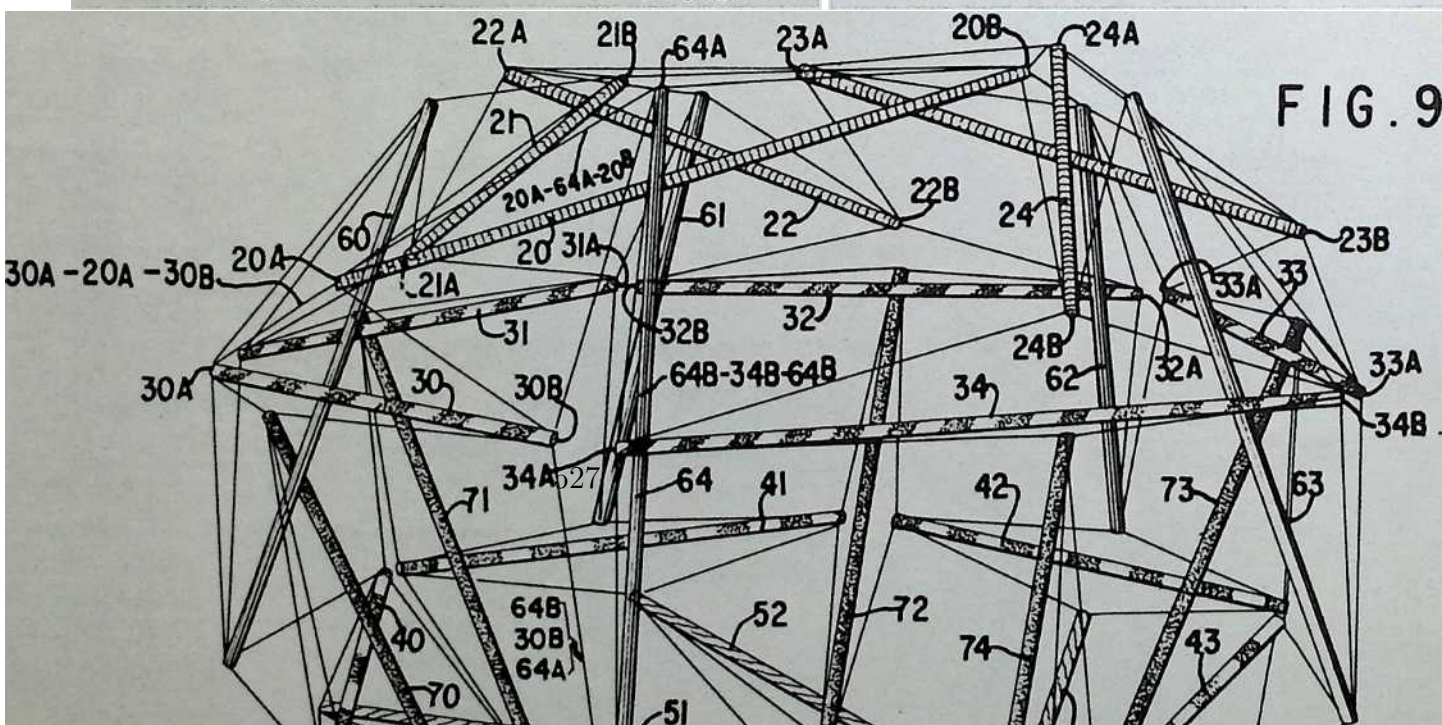
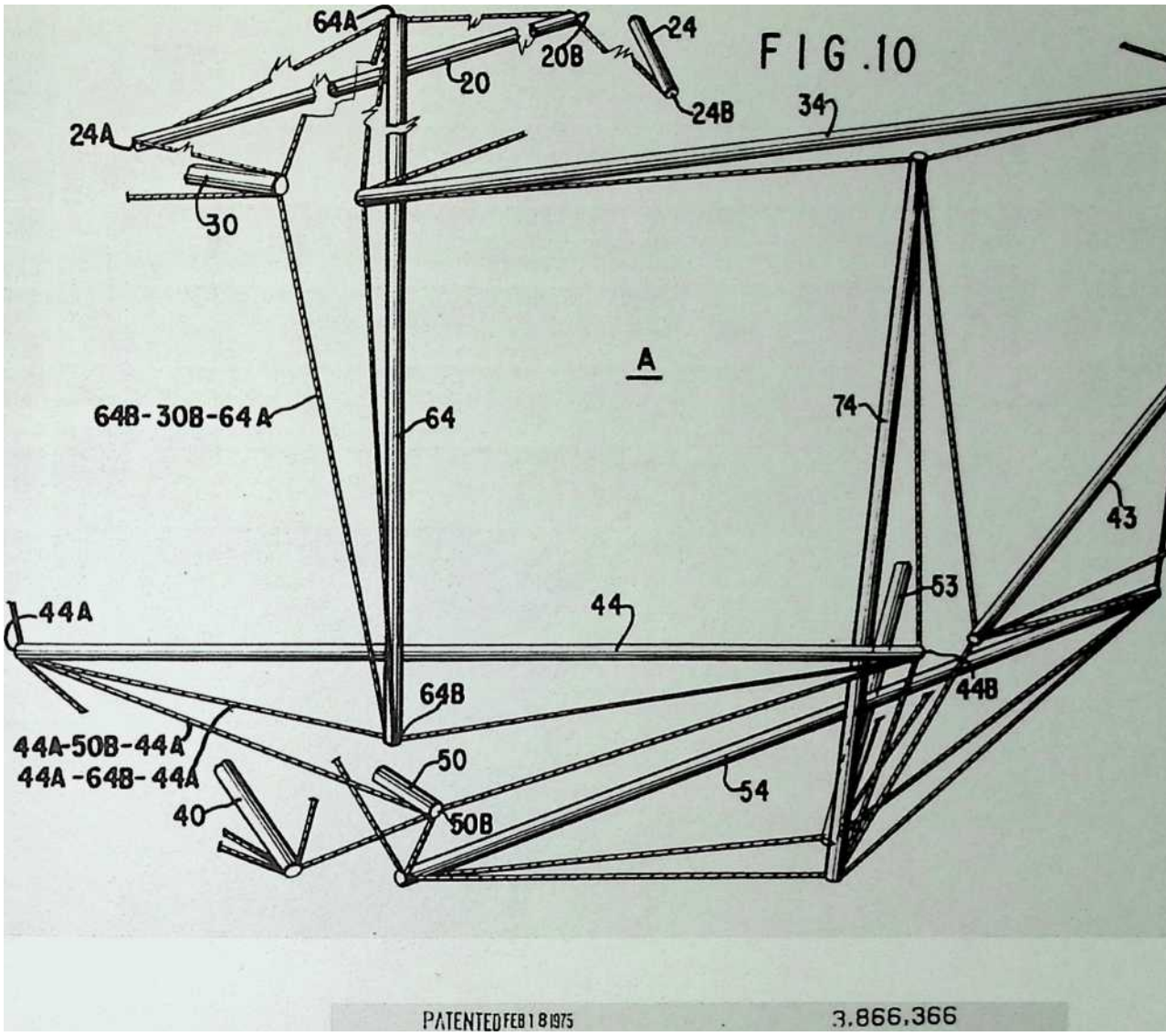


FIG.9





PATENTED FEB 181975 3.866,366

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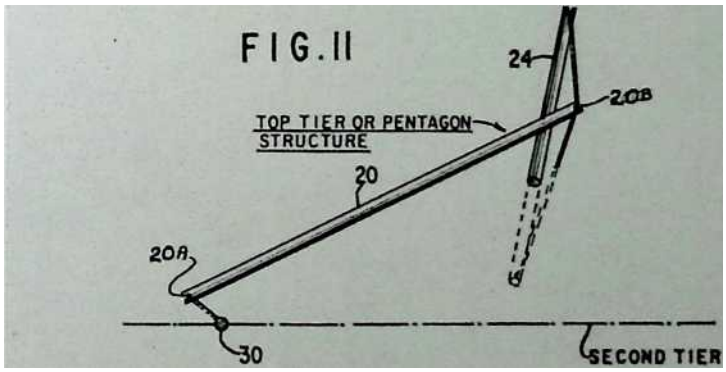
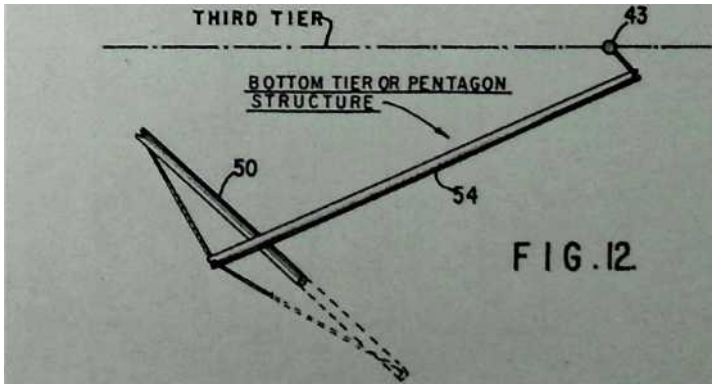
SHEET 5 OF 5





Allegra Dome

1975

This dome might have been intended as a greeting or might be an early stage of a project for Fuller's daughter.

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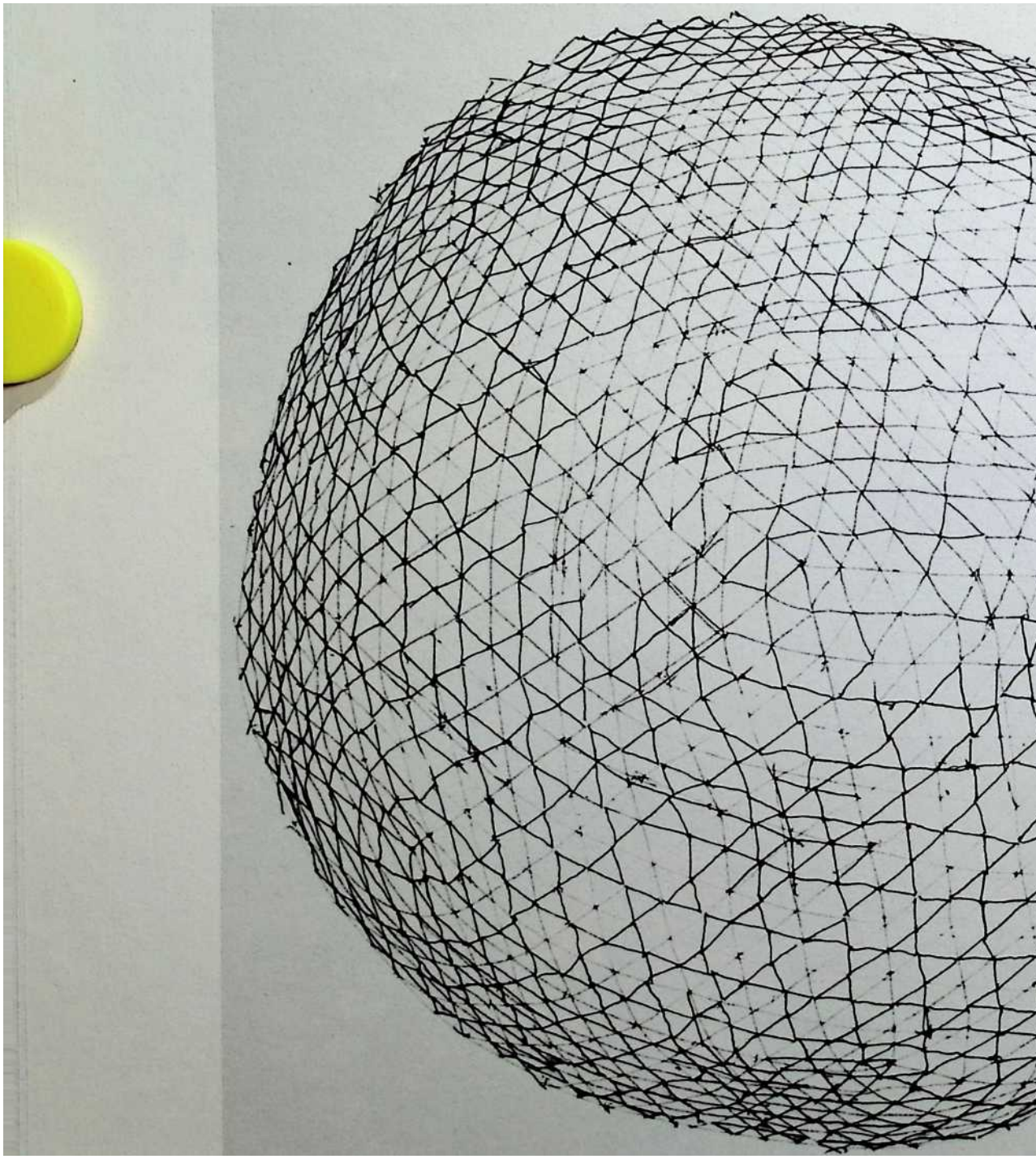

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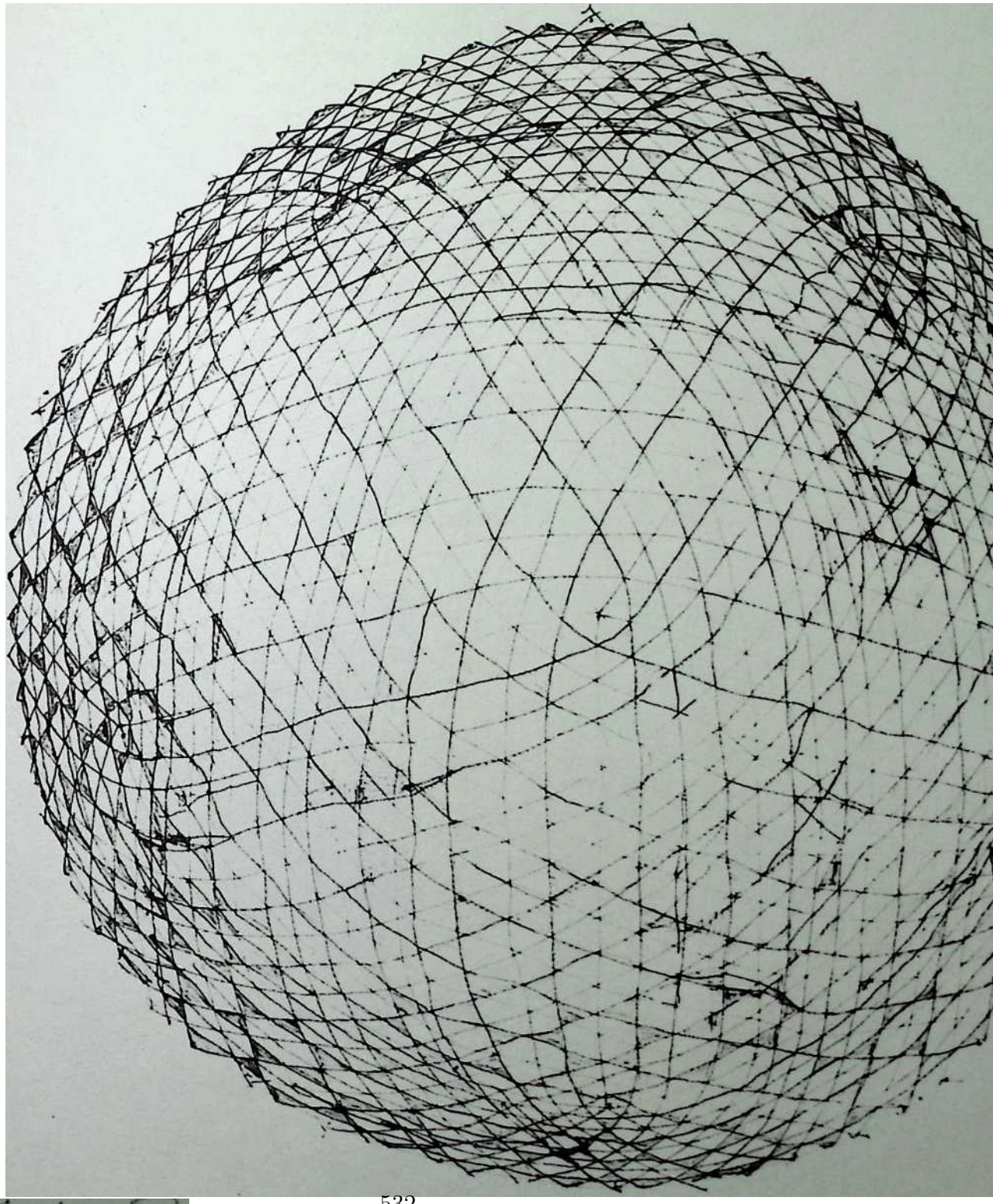
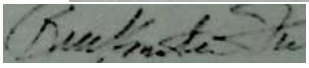


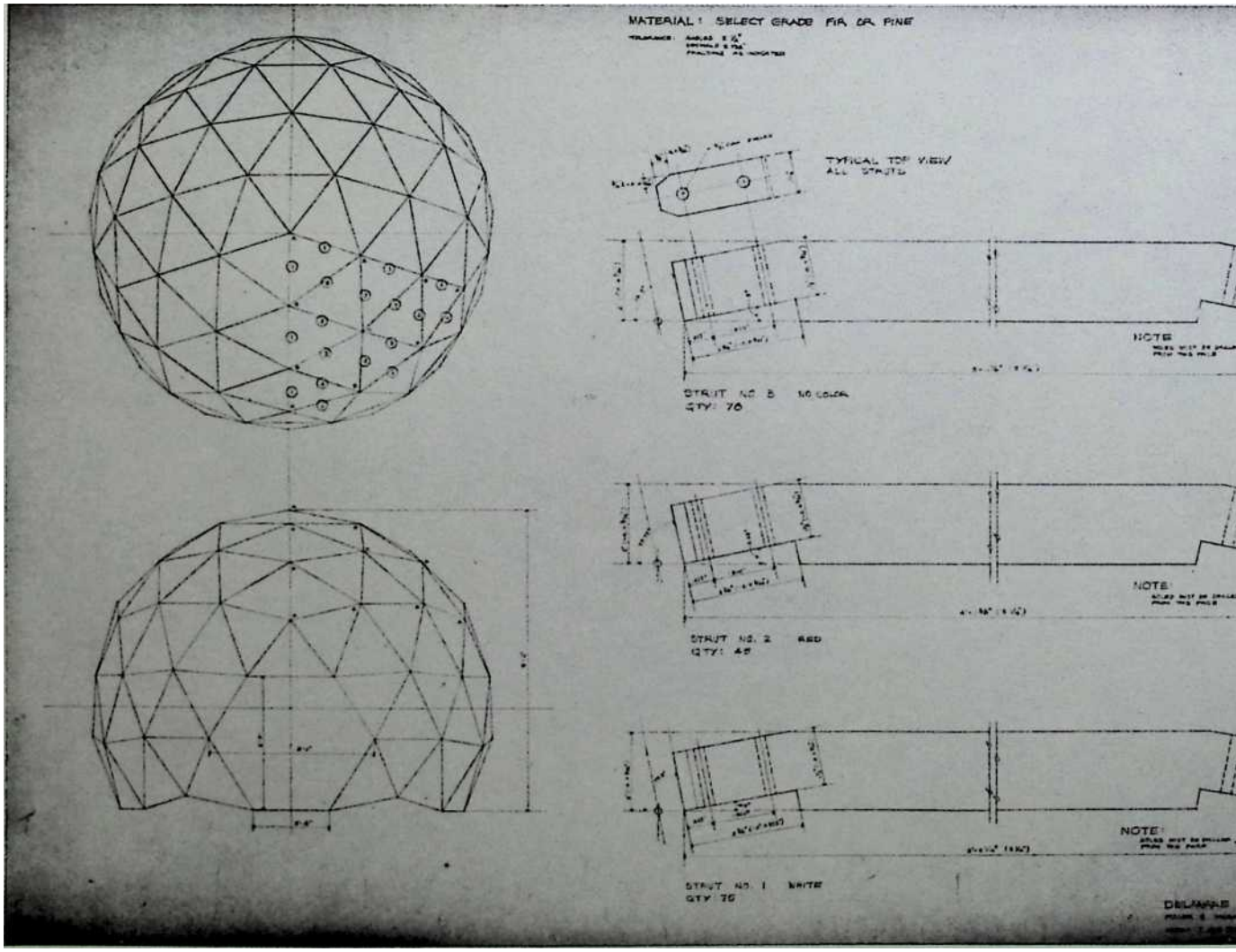


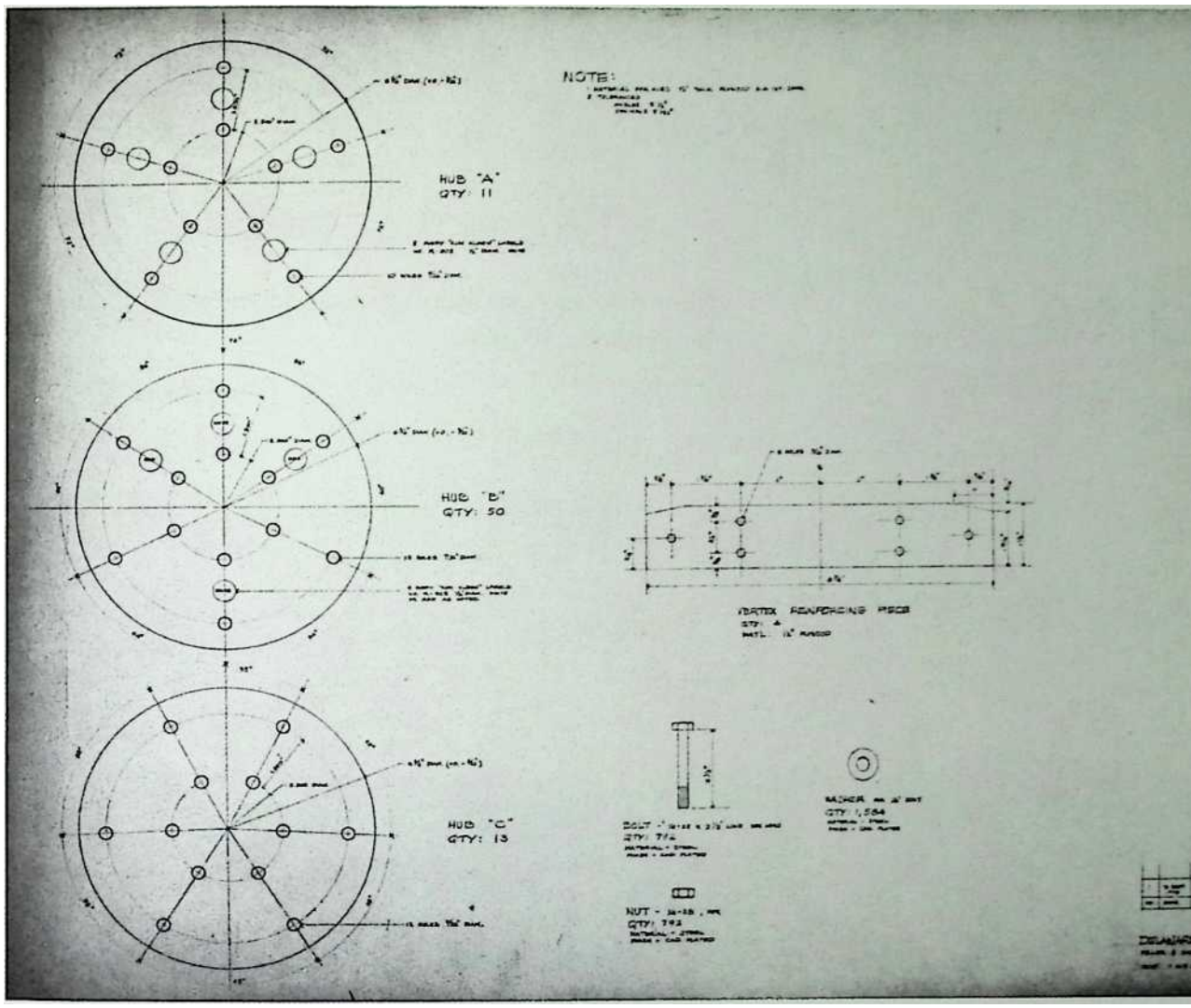
Delaware Flower

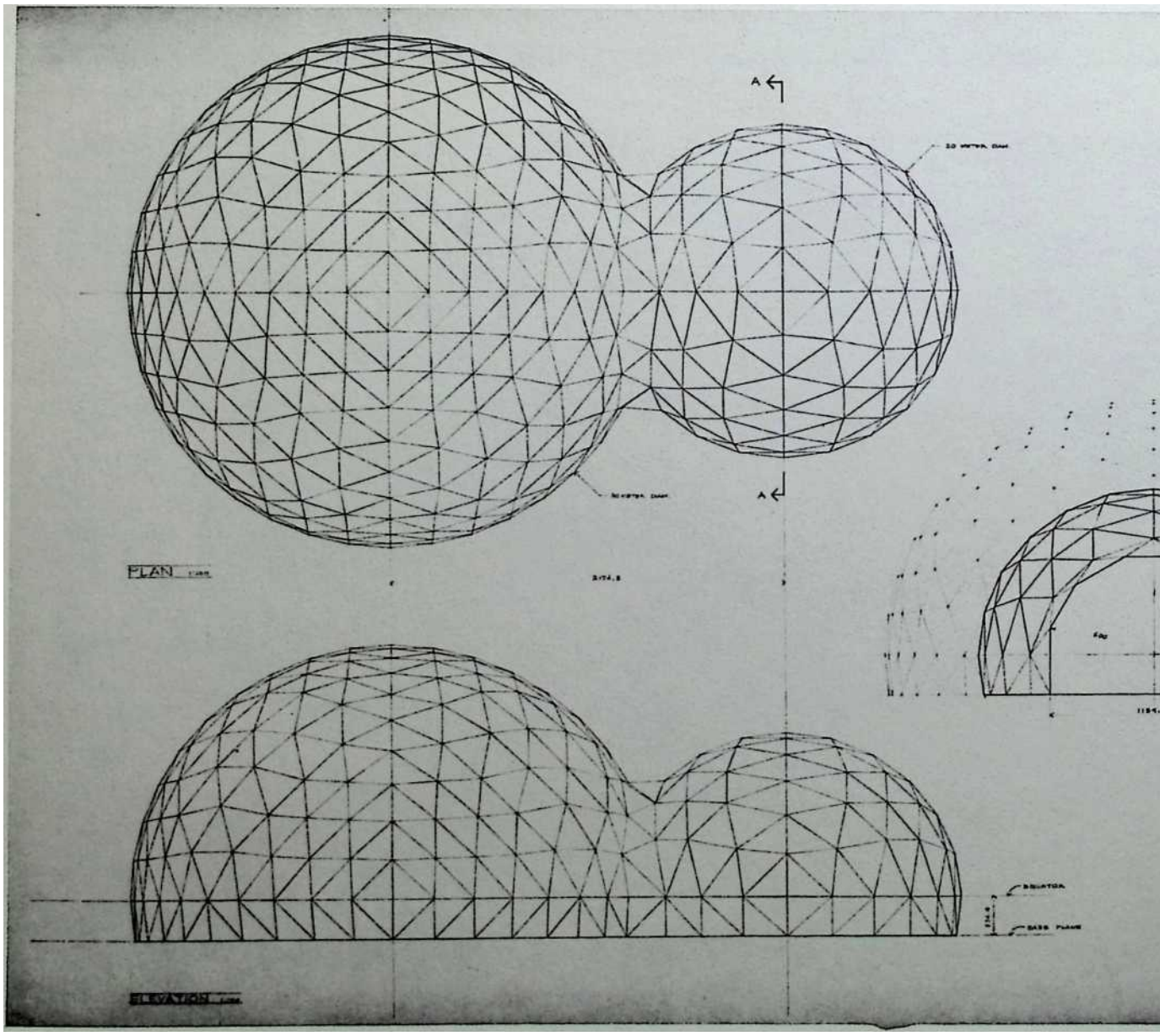
Show Dome

Fuller & Sadao, 1975

This white enameled dome was constructed of pine struts with plywood hubs for the Delaware Flower Show of 1976. Perhaps intended to promote the idea of the geodesic greenhouse, this relatively small structure (nineteen feet wide and fifteen feet high) was not glazed nor was a solid hexagonal door planned for its entrance. Particularly noteworthy is the fact that the frequency of this dome results in an irregular base.




NOTE:
HUB "A"
QTY: 11
HUB "B"
QTY: 50
HUB "C"
QTY: 13



Twindome 20/30

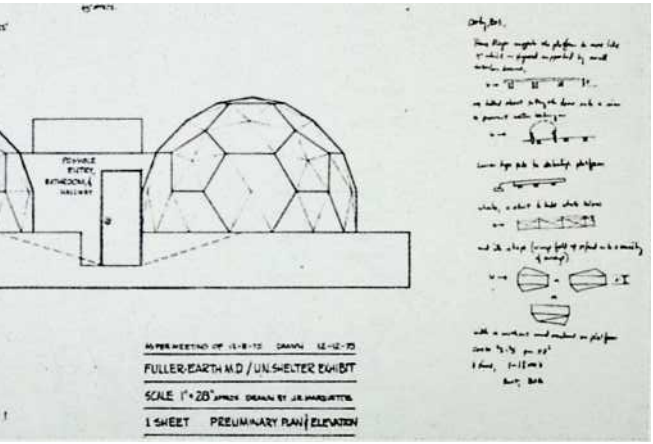
Fuller & Sadao, 1975

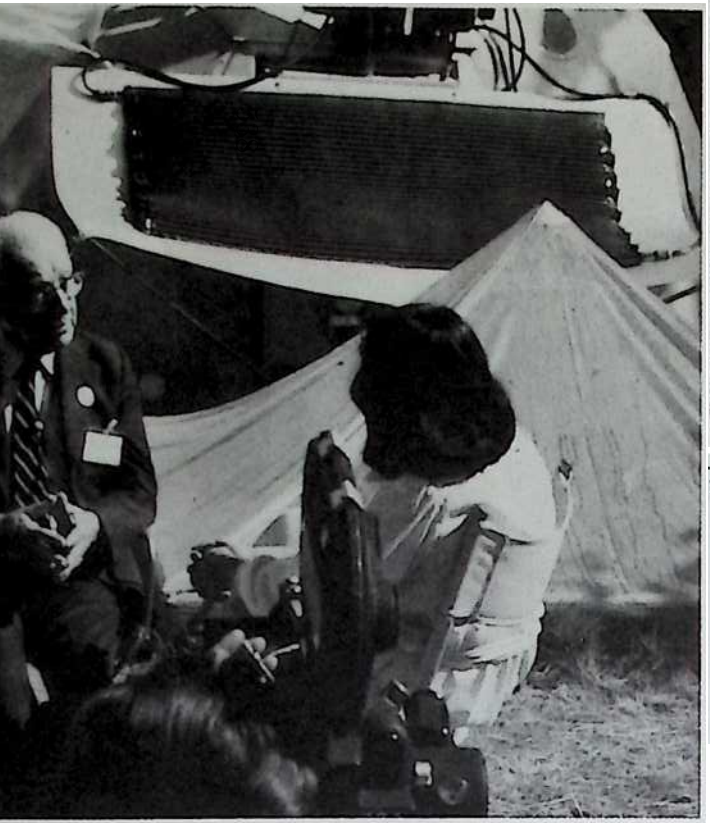
The twindome expanded the planning possibilities of the geodesic volume.

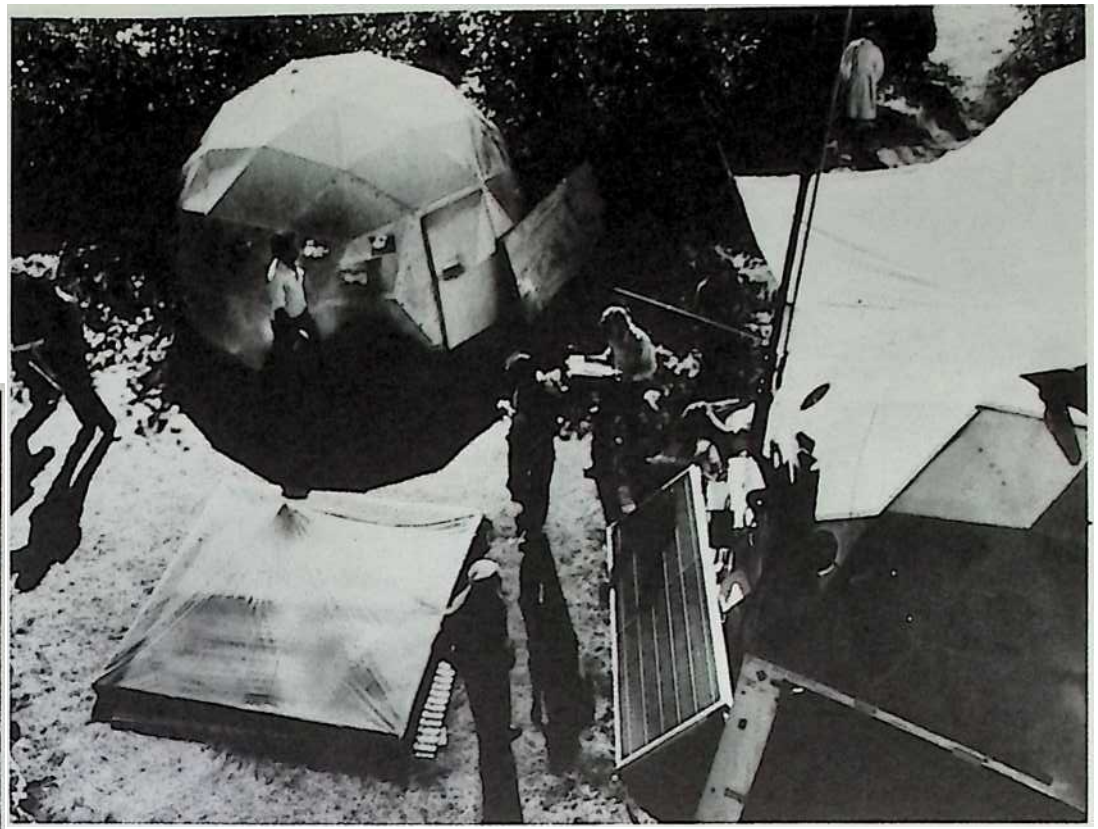
The Now House

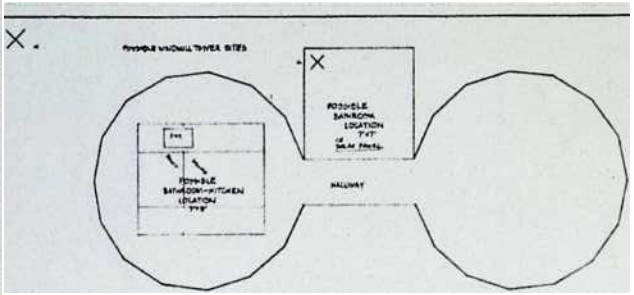
1975-1976

The Now House broadened the horizons of geodesic structures in being a minimal dwelling of two domical rooms connected by a rectangular vestibule. It was designed by Fuller for the United Nations Habitat Exhibition in 1976.

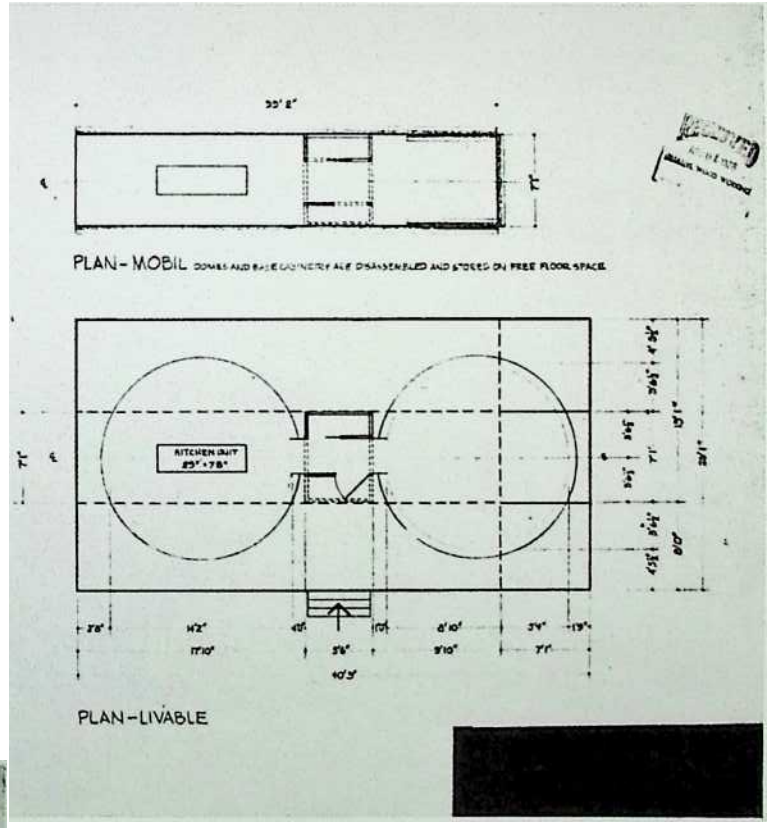

FULLER-EARTH M.D / UN.SHELTER EXHIBIT
SCALE 1"=28'
1 SHEET PRELIMINARY PLAN / ELEVATION

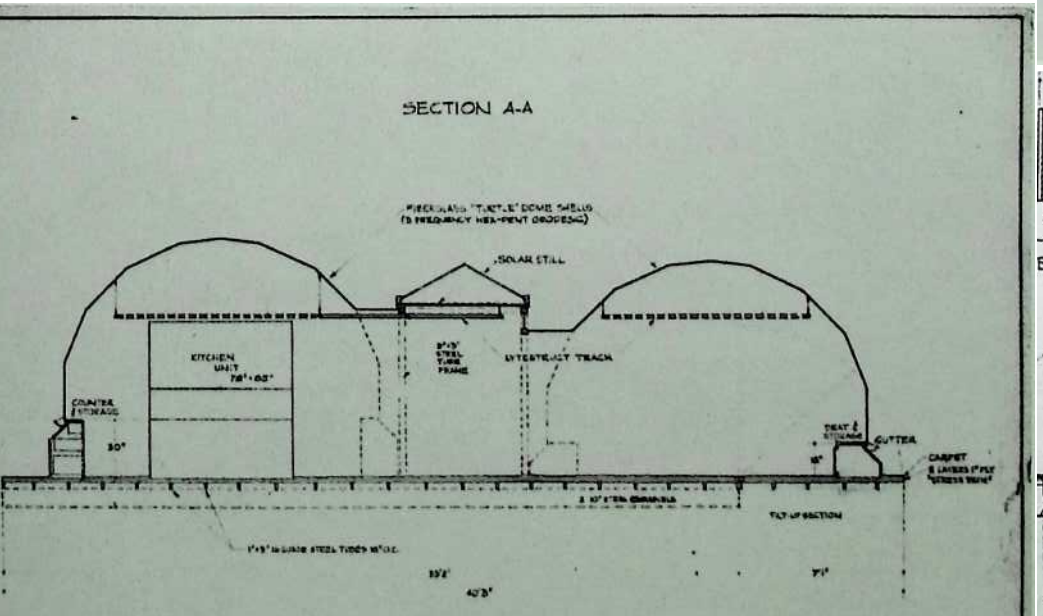


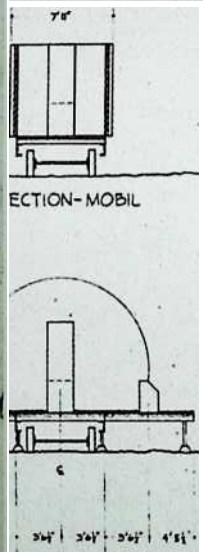


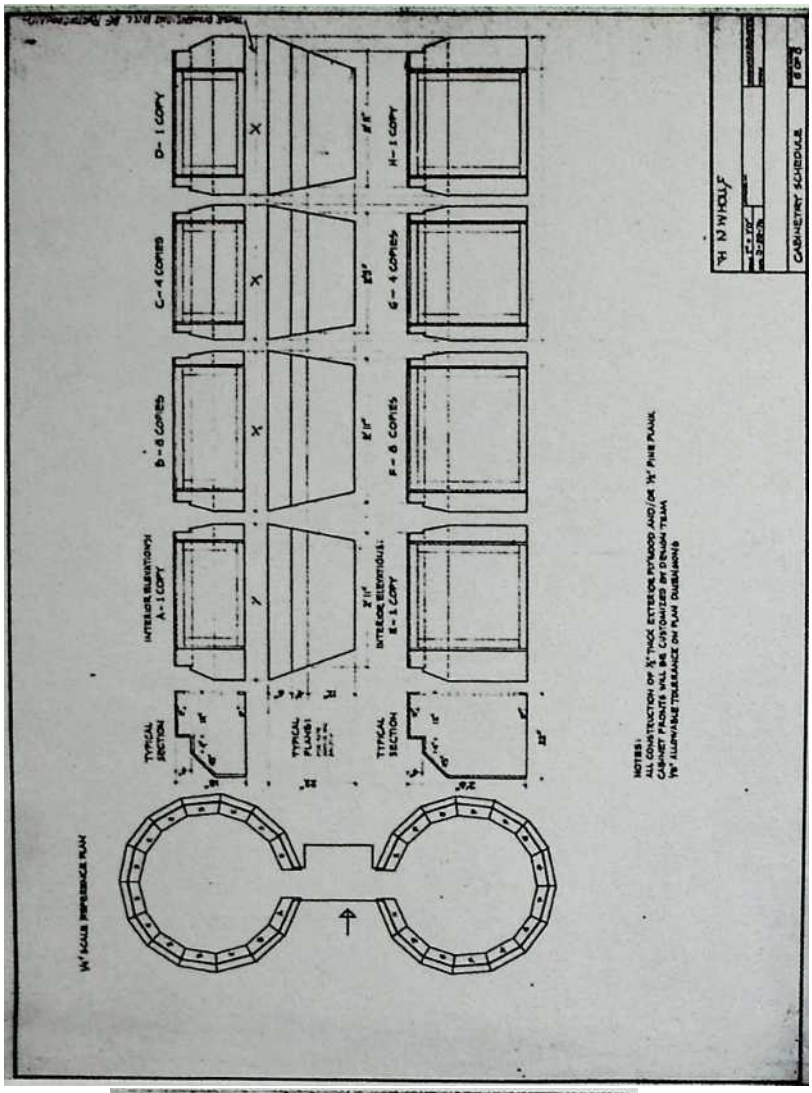

POSSIBLE WINDMILL TOWER SITES
POSSIBLE BANDONG LOCATION
POSSIBLE BATHROOM-KITCHEN LOCATION
HALLWAY

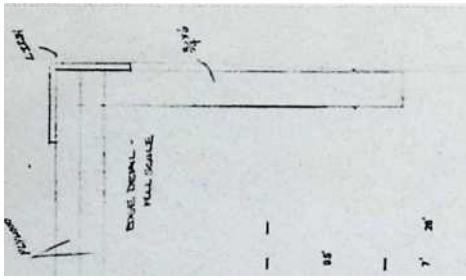
YPICAL S
YPICAL S

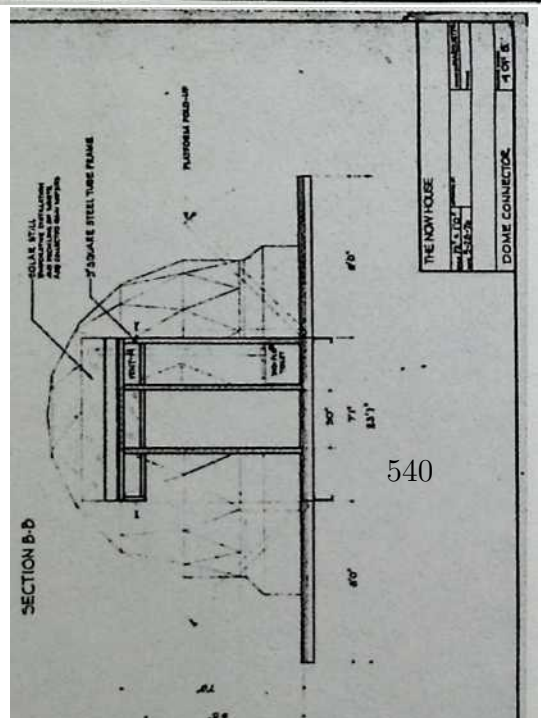

PLAN- MOBIL
KITCHEN UNIT
PLAN-LIVABLE

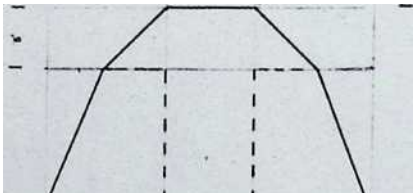

SECTION A-A
SOLAR STILL
KITCHEN UNIT
INTERSTATE TRACK
GUTTER
CARPET

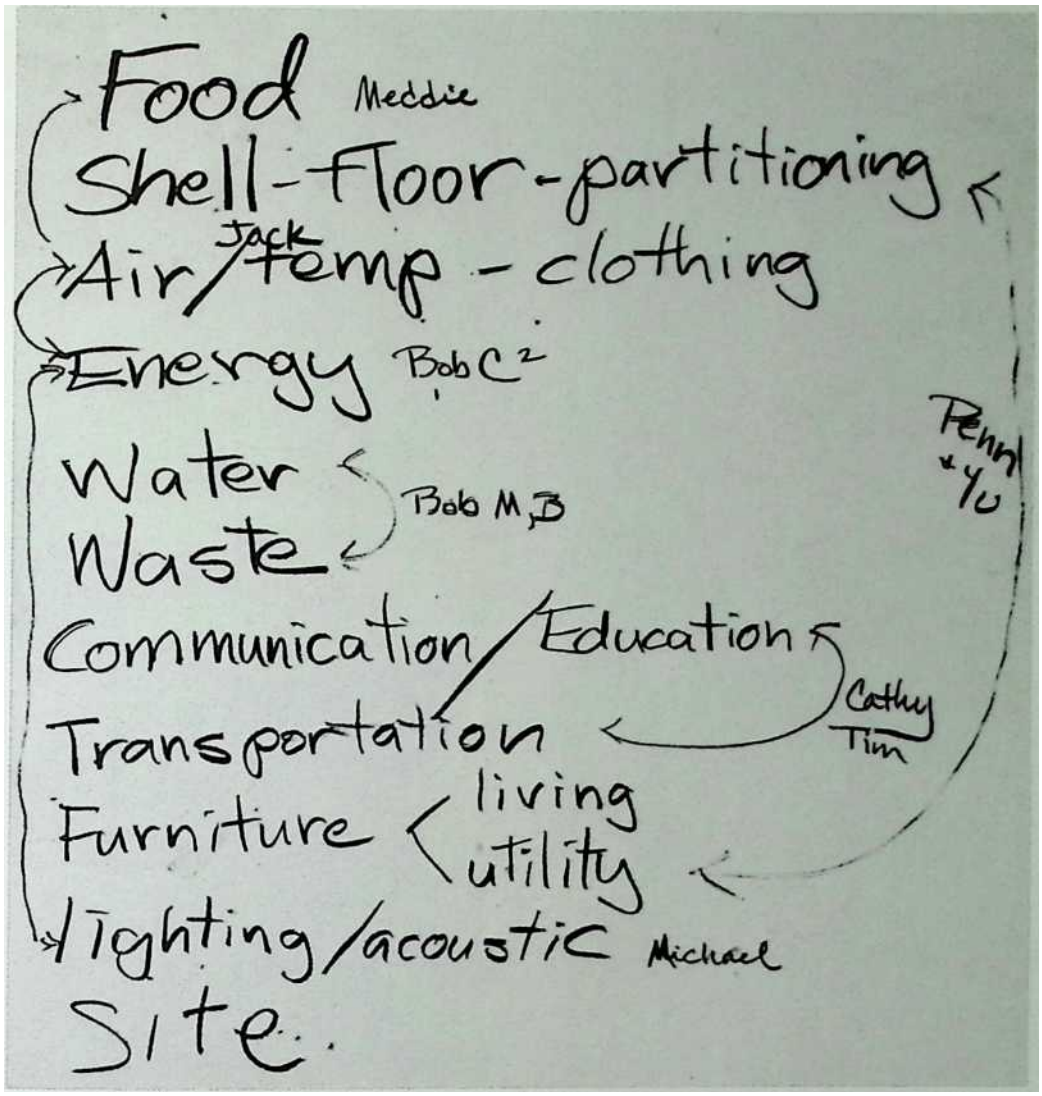

ECTION- MOBIL

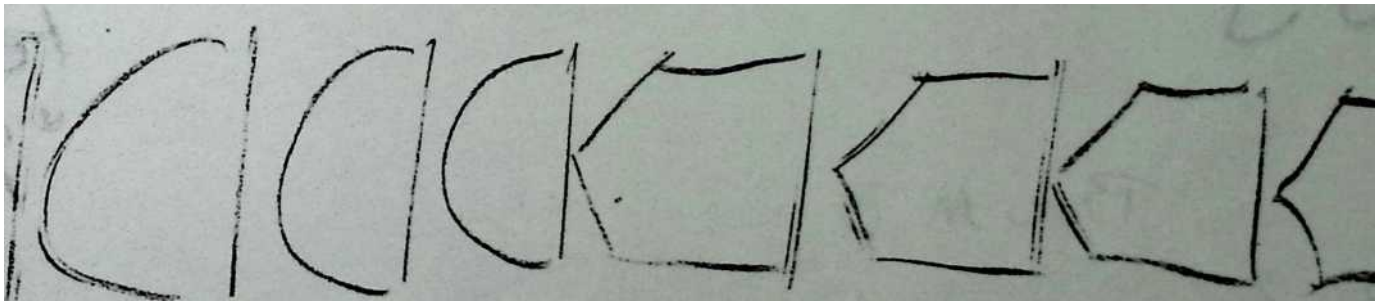

1/4" SCALE PRESENCE PLAN
TYPICAL SECTION
INTERIOR ELEVATION A - 1 COPY
B - 8 COPIES
C - 4 COPIES
D - 1 COPY
TYPICAL PLANS
INTERIOR ELEVATIONS E - 1 COPY
F - 8 COPIES
G - 4 COPIES
H - 1 COPY
NOTES:
ALL CONSTRUCTION OF 3/4" THICK EXTERIOR PLYWOOD AND/OR 3/4" PINE PLANK.
CABINET PROFILES WILL BE CUSTOMIZED BY DENIAH TRIAN.
1/8" ALLOWABLE TOLERANCE ON PLAN DIMENSIONS.
CABINETRY SCHEDULE

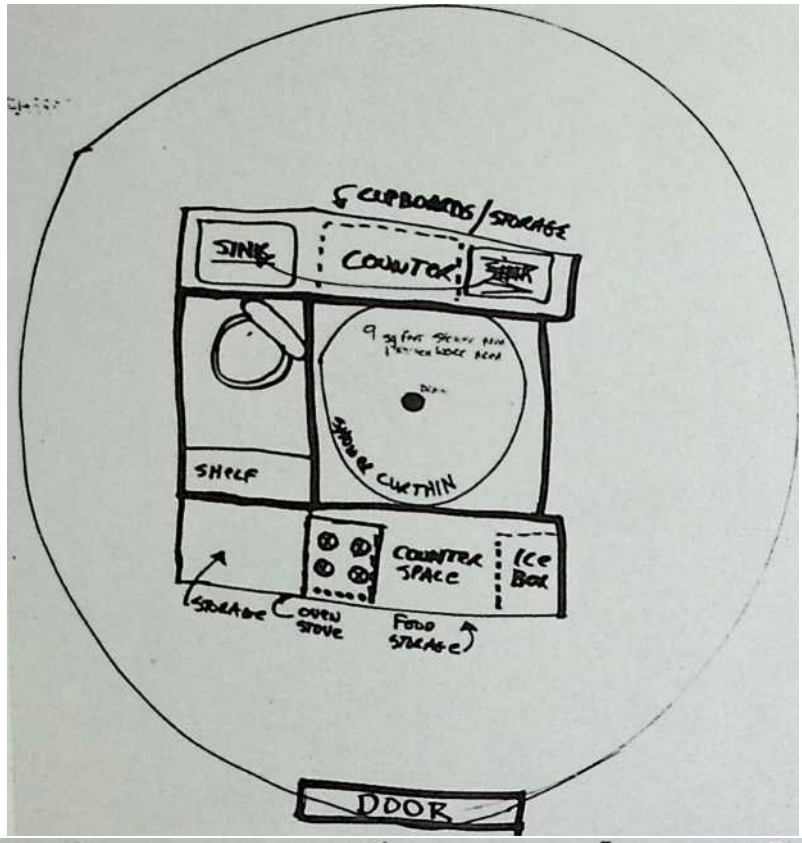

DOME DETAIL - FULL SCALE

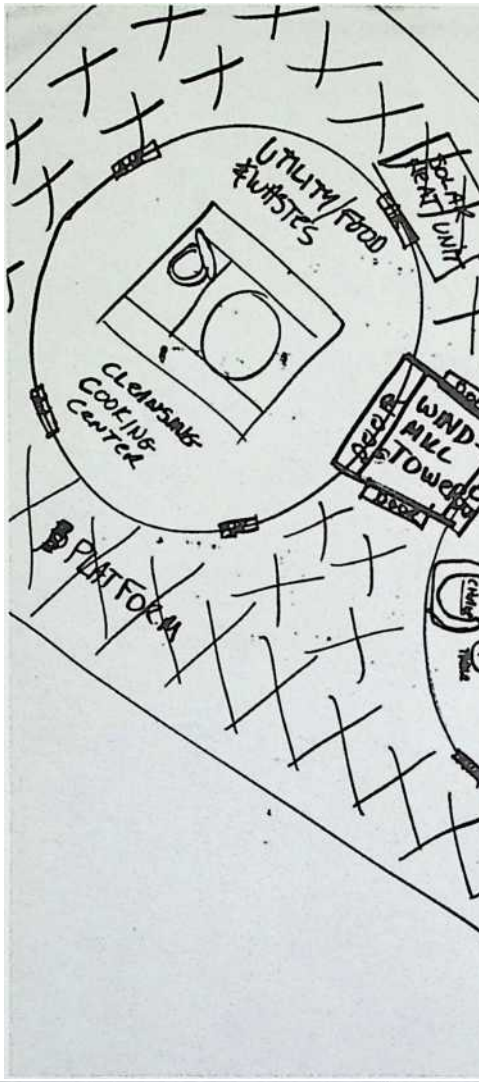

SECTION B-B
SQUARE STEEL TUBE FRAME
PLATFORM FRAME-UP
THE NOW HOUSE
DOME CONNECTOR

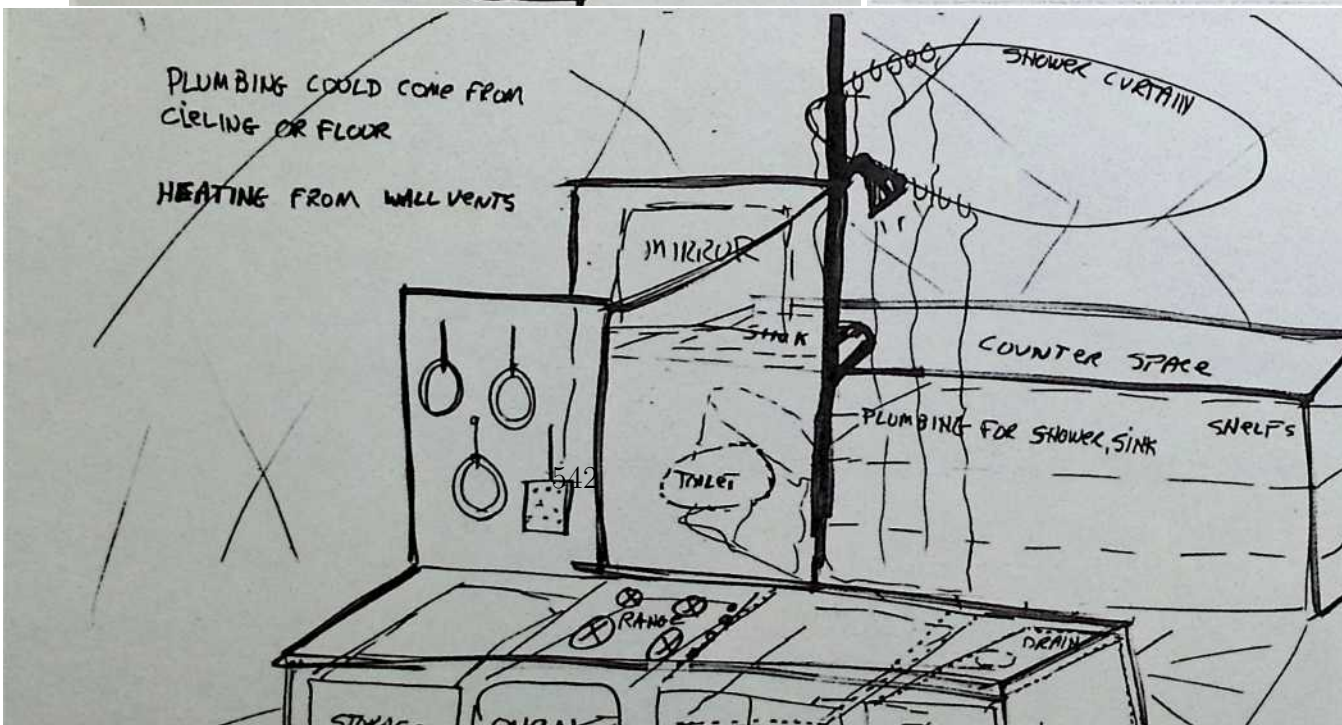


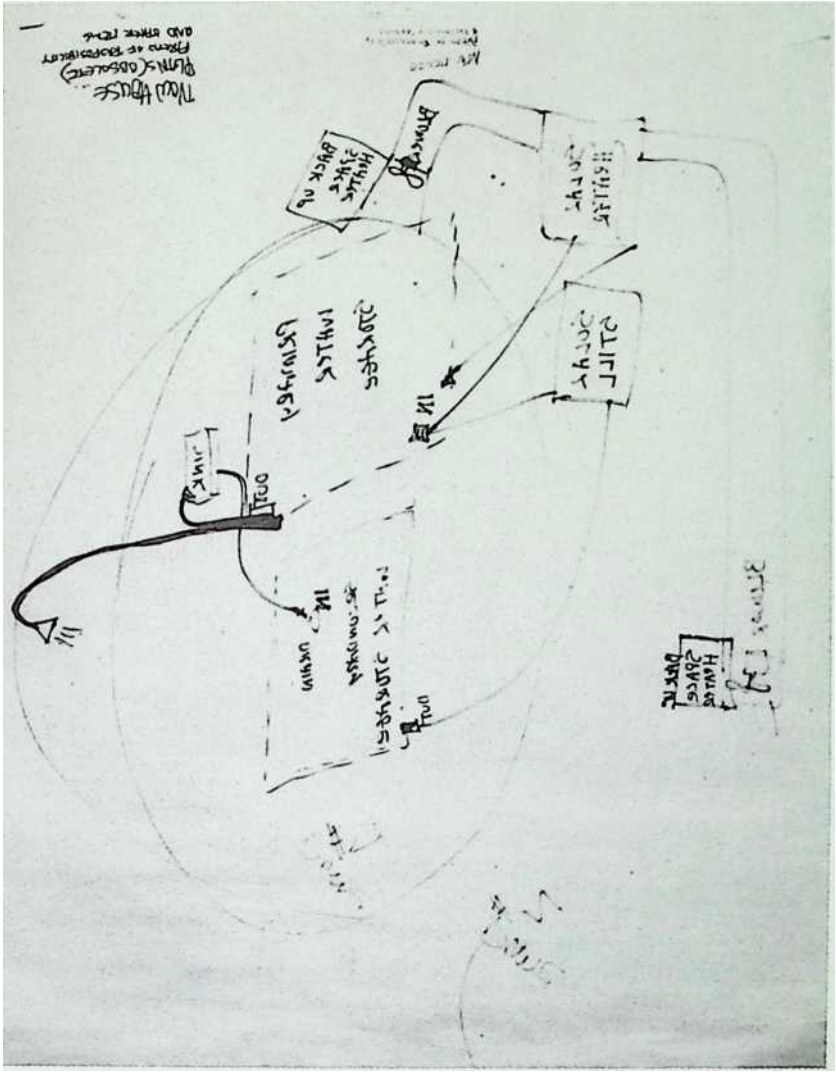

Food Meddie
Shell-Floor-partitioning
Air/Jack temp - clothing
Energy Bob C²
Water
Waste
Bob M,B
Penn + Yu
Communication/Education
Transportation
Cathy Tim
Furniture
living
utility
lighting/acoustic Michael
Site.

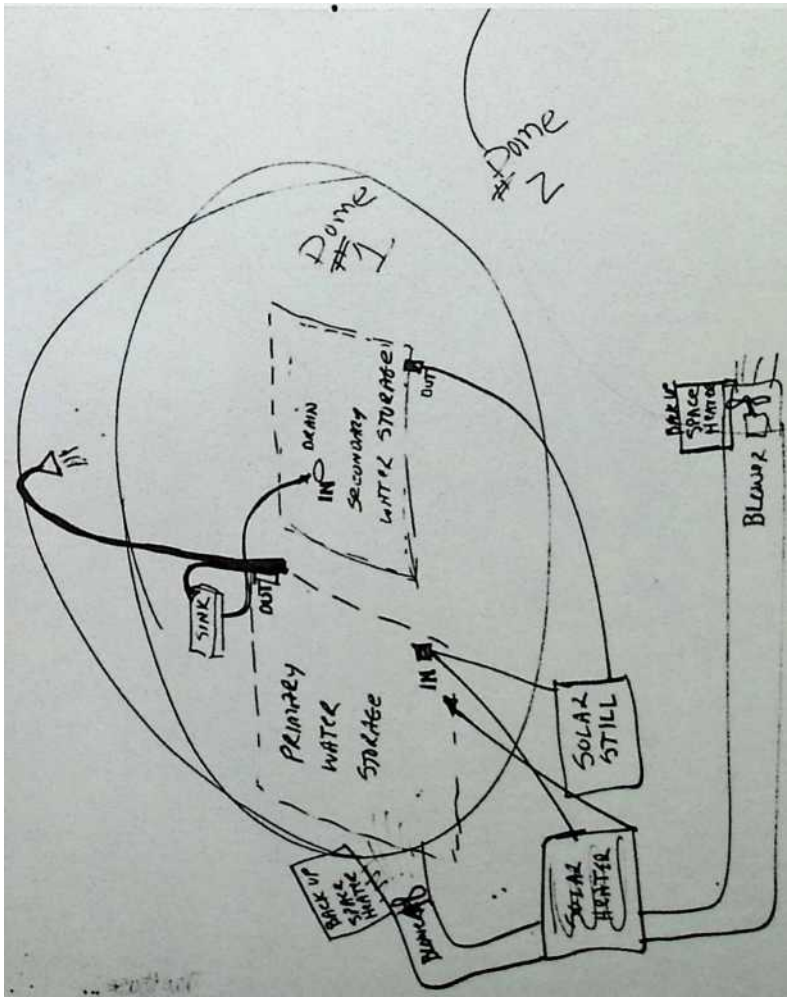


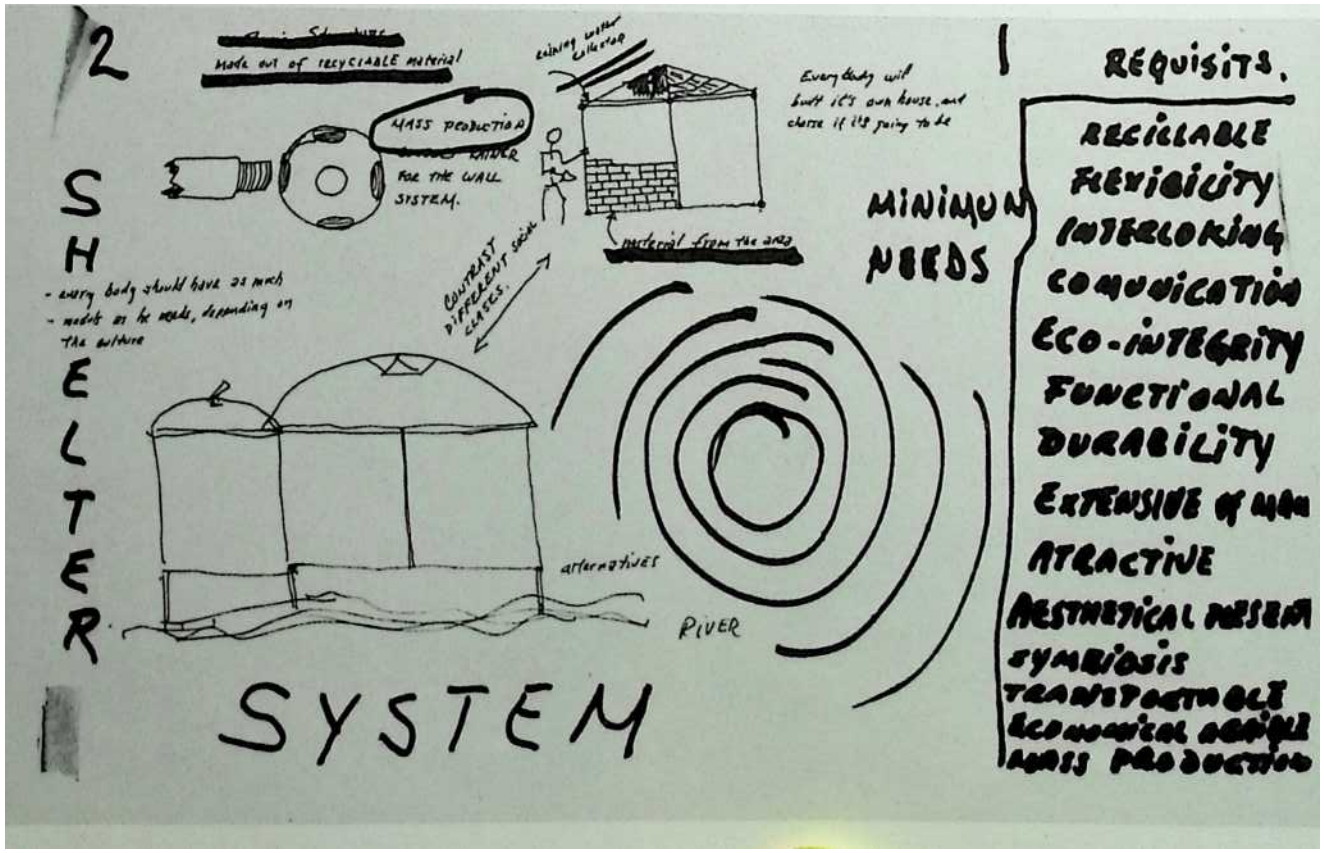

CUPBOARDS/STORAGE
SINK
COUNTER
SINK
SHELF
SHOWER CURTAIN
COUNTER SPACE
ICE BOX
STORAGE
OVEN STOVE
FOOD STORAGE
DOOR

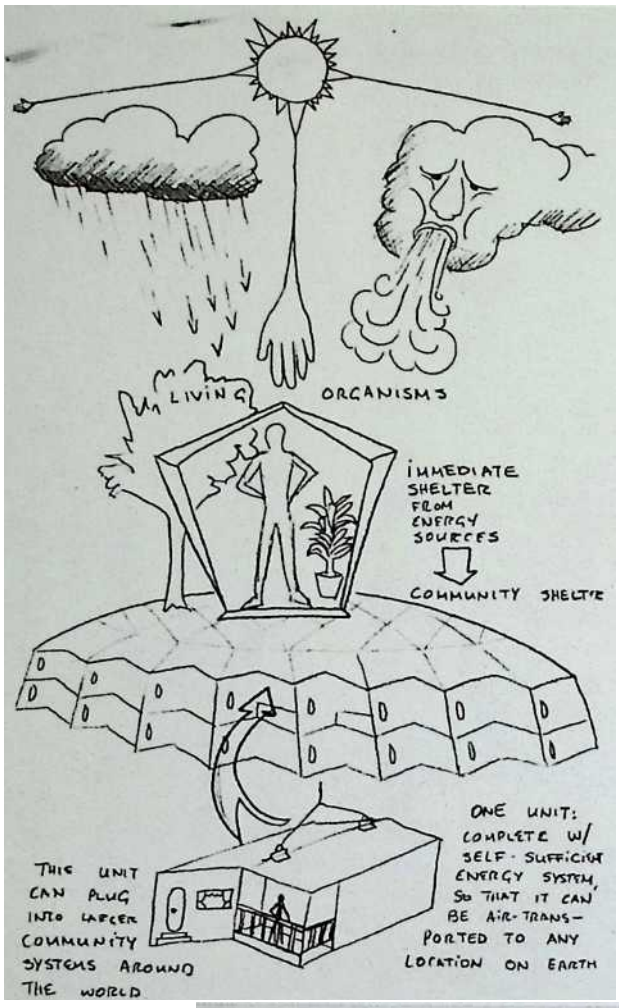

UTILITY/FOOD WASTES
CLEANSING COOKING CENTER
WIND MILL TOWER
PLATFORM

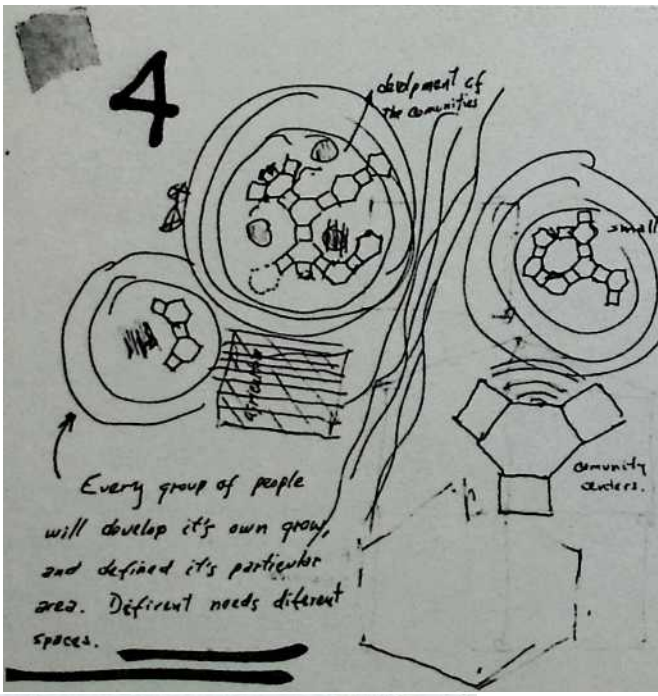

PLUMBING COULD COME FROM CIELING OR FLOOR
HEATING FROM WALL VENTS
SHOWER CURTAIN
MIRROR
SINK
COUNTER SPACE
PLUMBING FOR SHOWER, SINK
SHELFS
TOILET
RANGE
DRAIN

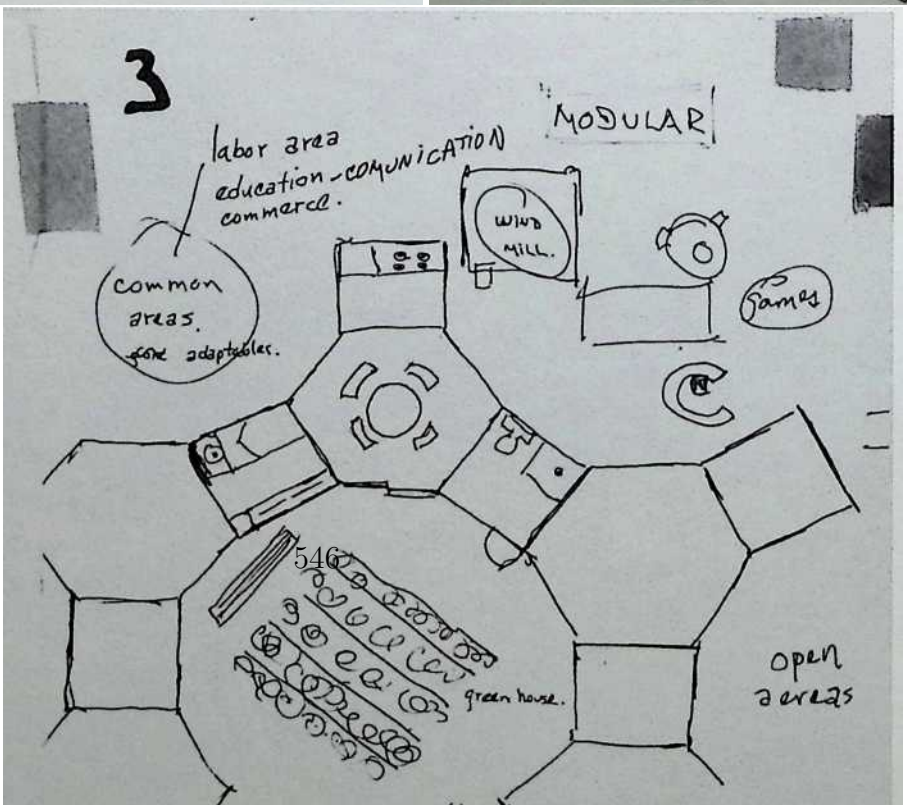


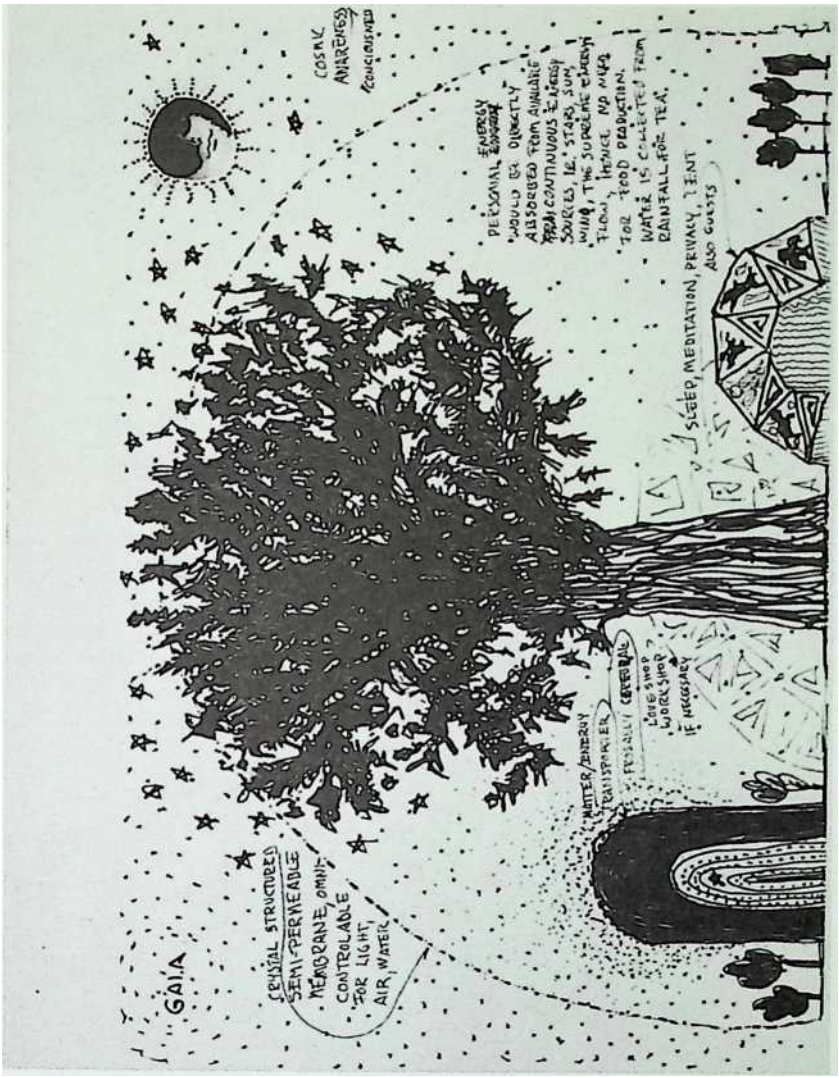

Dome #1
Dome #2
SINK
OUT
IN
DRAIN
SECONDARY WATER STORAGE
OUT
PRIMARY WATER STORAGE
IN
SOLAR STILL
SOLAR HEATER
BLOWER

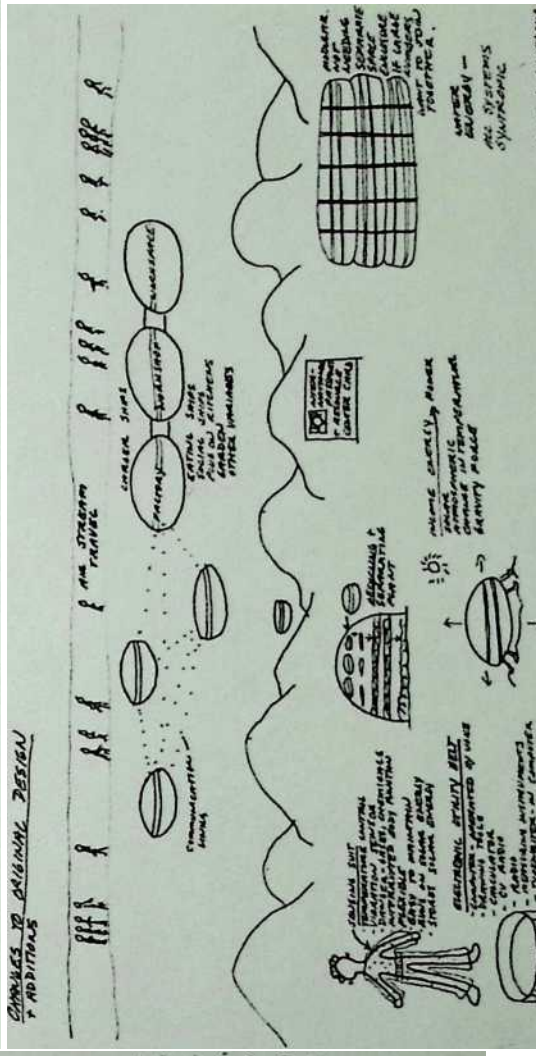

2
Made out of RECYCLABLE material
MASS PRODUCTION
FOR THE WALL SYSTEM.
Every body will built it's own house, and choose if it's going to be
material from the area
- every body should have as much
- modify as he needs, depending on the culture
CONTRAST DIFFERENT SOCIAL CLASSES.
alternatives
RIVER
SHELTER
SYSTEM
MINIMUN NEEDS
1
REQUISITS.
RECICLABLE
FLEXIBILITY
INTERLOKING
COMUNICATION
ECO-INTEGRITY
FUNCTIONAL
DURABILITY
EXTENSIVE OF MAN
ATRACTIVE
AESTHETICAL PRESEN
SYMBIOSIS
TRANSPORTABLE
ECONOMICAL
MASS PRODUCTION

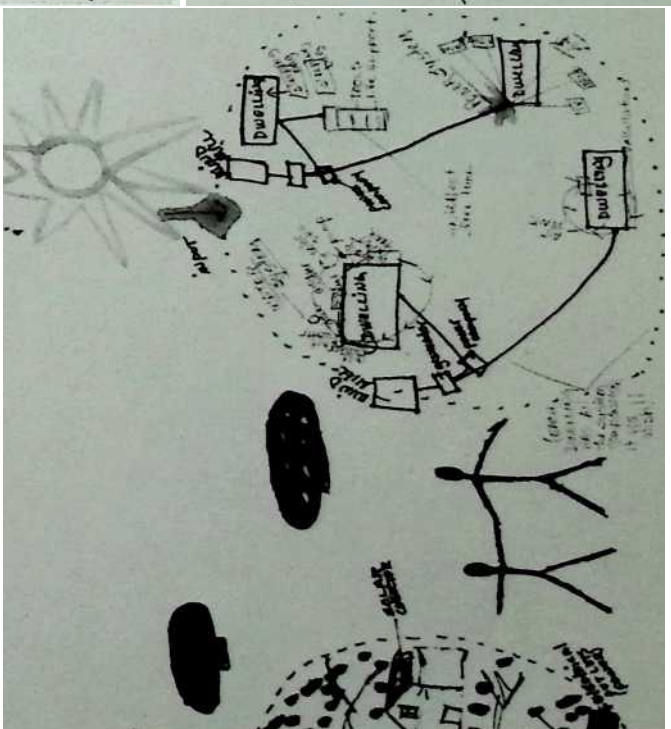

LIVING
ORGANISMS
IMMEDIATE SHELTER FROM ENERGY SOURCES
COMMUNITY SHELTER
ONE UNIT: COMPLETE W/ SELF-SUFFICIENT ENERGY SYSTEM, SO THAT IT CAN BE AIR-TRANSPORTED TO ANY LOCATION ON EARTH
THIS UNIT CAN PLUG INTO LARGER COMMUNITY SYSTEMS AROUND THE WORLD

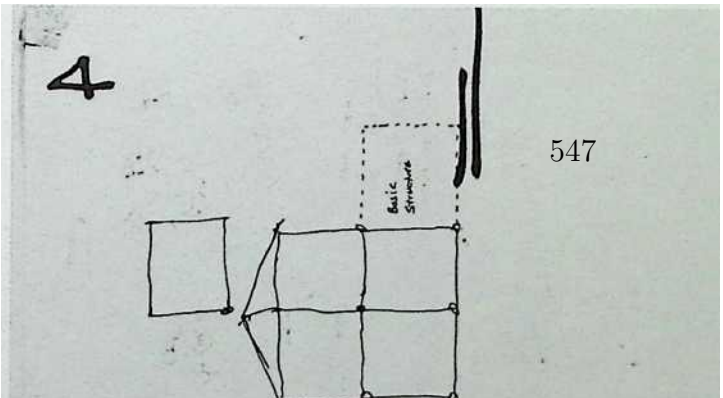

4
development of the communities
small
community centers.
Every group of people will develop it's own group, and defined it's particular area. Different needs different spaces.

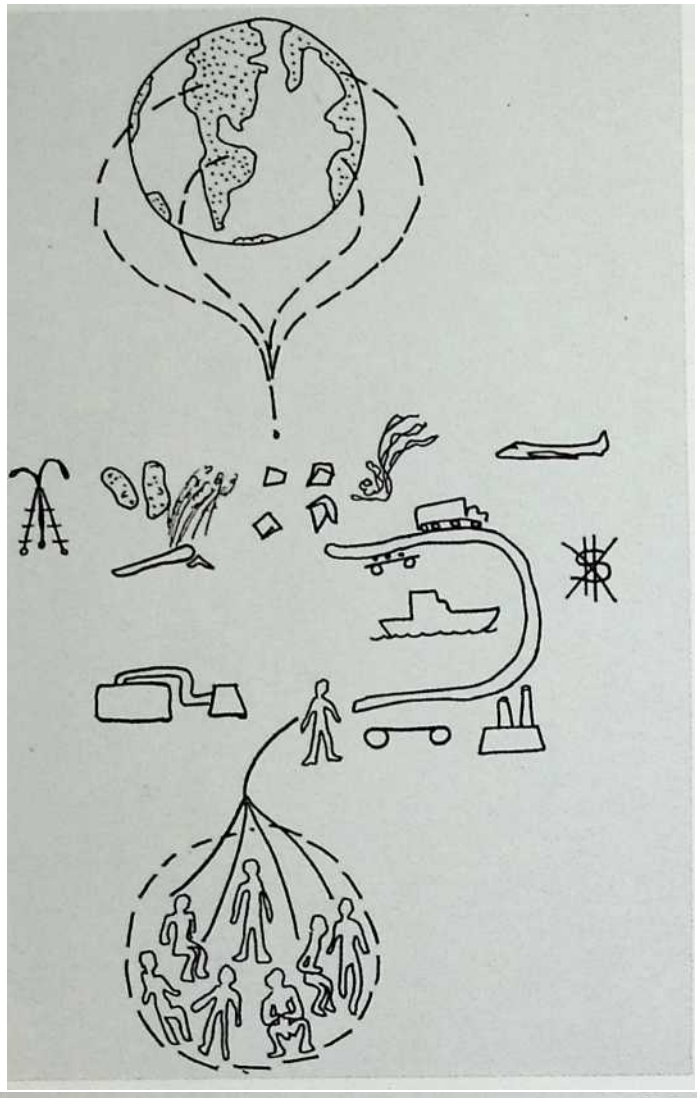

3
MODULAR
labor area
education-COMUNICATION
commerce.
WIND MILL.
common areas.
some adaptables.
games
green house.
open areas

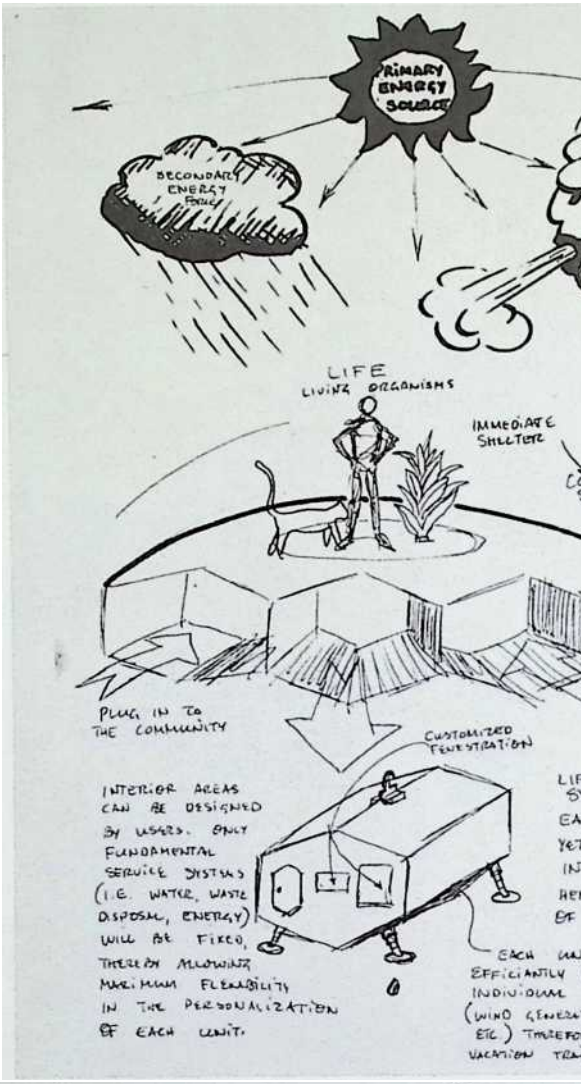

GAIA
SEMI-PERMEABLE
MEMBRANE, OMNI-
CONTROLABLE
FOR LIGHT
AIR, WATER
COSMIC
AWARENESS
SLEEP, MEDITATION, PRIVACY, TENT
ALSO GUESTS

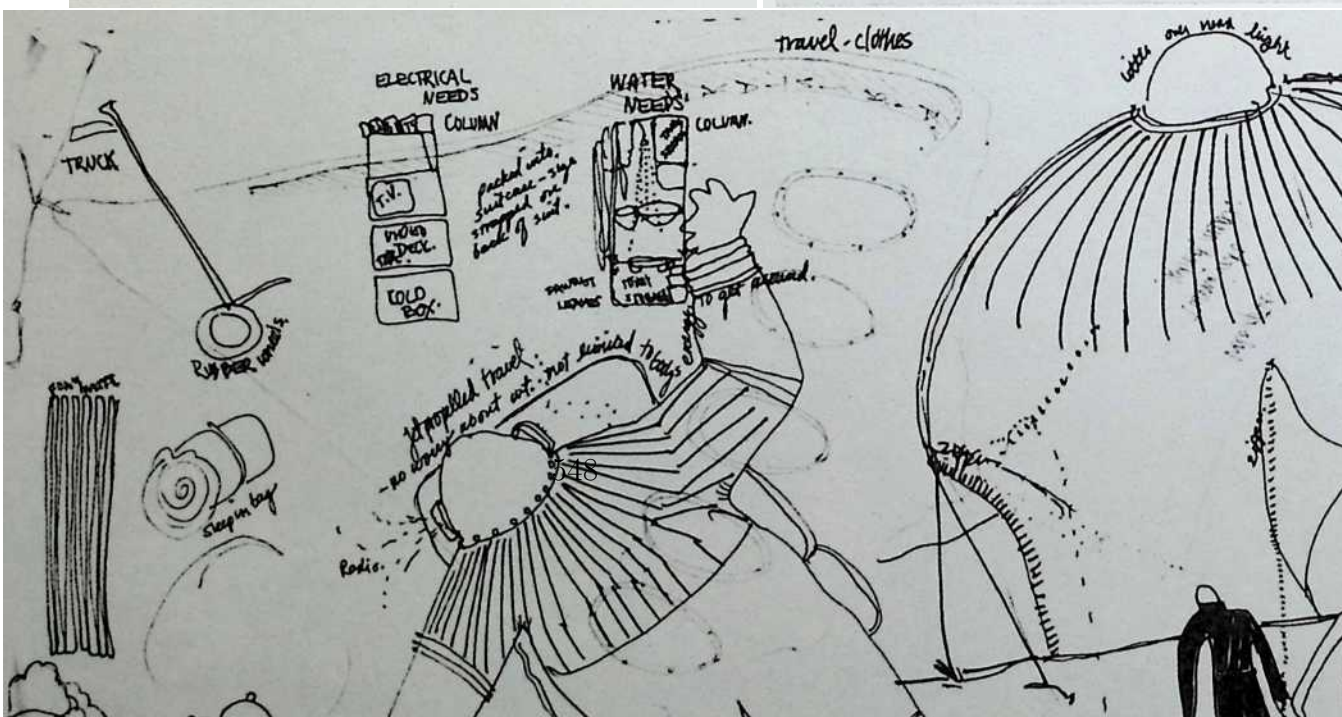


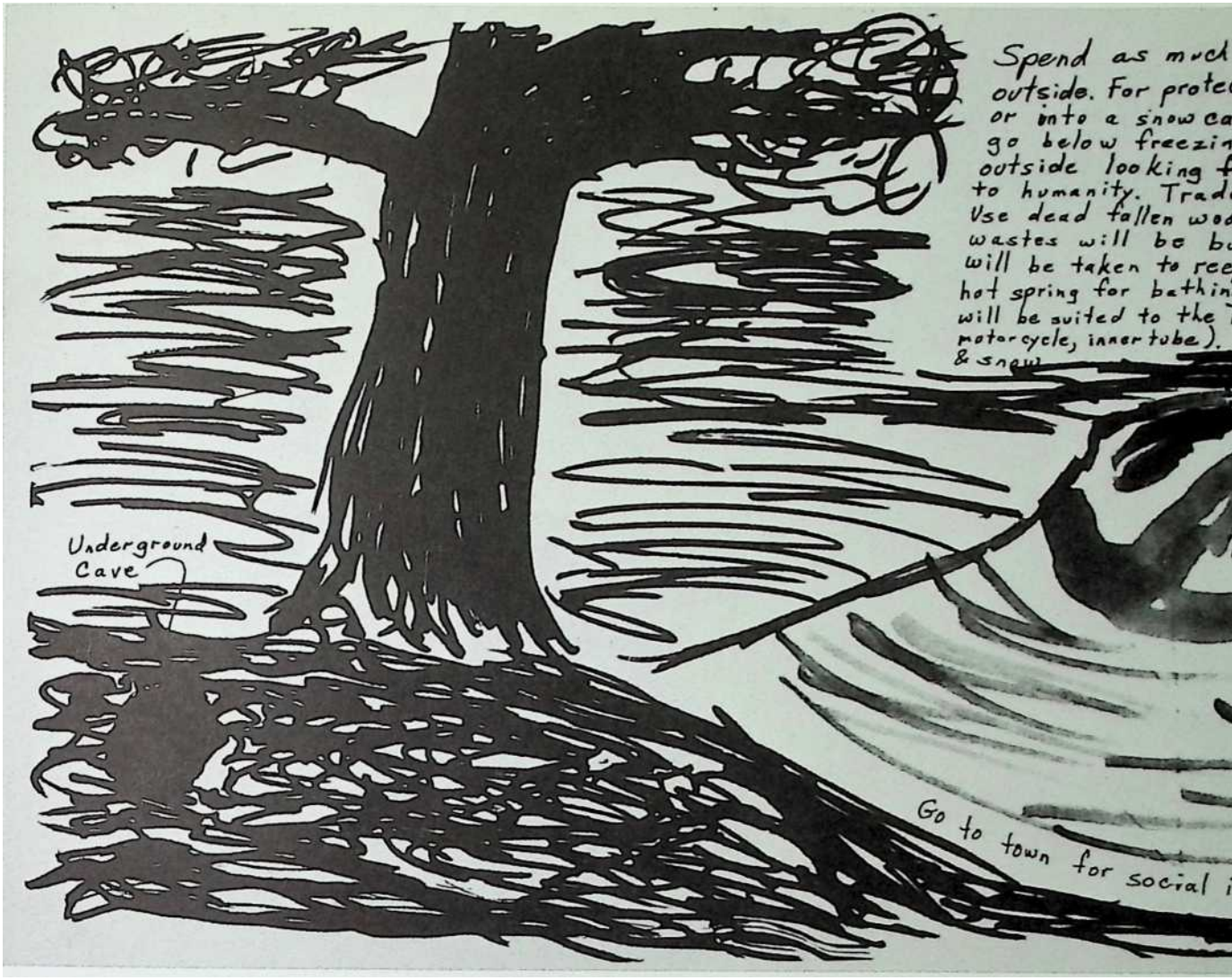

DWELLING
DWELLING
DWELLING
DWELLING


4
Basic
Structure




PRIMARY ENERGY SOURCE
SECONDARY ENERGY FORMS
LIFE
LIVING ORGANISMS
IMMEDIATE SHELTER
PLUG IN TO THE COMMUNITY
CUSTOMIZED FENESTRATION
INTERIOR AREAS CAN BE DESIGNED BY USERS. ONLY FUNDAMENTAL SERVICE SYSTEMS (I.E. WATER, WASTE DISPOSAL, ENERGY) WILL BE FIXED, THEREBY ALLOWING MAXIMUM FLEXIBILITY IN THE PERSONALIZATION OF EACH UNIT.


travel - clothes
ELECTRICAL NEEDS
COLUMN
WATER NEEDS
COLUMN
TRUCK
T.V.
COLD BOX.
RUBBER WHEELS
SONG WRITE
Stay in bag
Radio.
to get around.
Zipper


Spend as much
outside. For protec
or into a snow ca
go below freezin
outside looking f
to humanity. Trad
Use dead fallen wo
wastes will be b
will be taken to ree
hot spring for bathin
will be suited to the
motorcycle, inner tube).
& snow
Underground
Cave
Go to town for social

Preferred State Prototype 1 Small Community Dwelling Units

individual dwelling hardware inventory:

communication unit:
radio TV (2way) phone
environment control computer

climate valving: hardware/interfs.
ventilation - insulation
solar impounding - efficiency
water use technologies

food preparation & storage units / energetically integrated w/ other energy consuming components

modular design -
capability to link units
light weight / nomadic capabilities

community level efficiencies
for hardware:
solar photovoltaics → AC power
small hydro development → "
methane production (?)
medium level - coop food production
tooling

work spaces?
meeting "

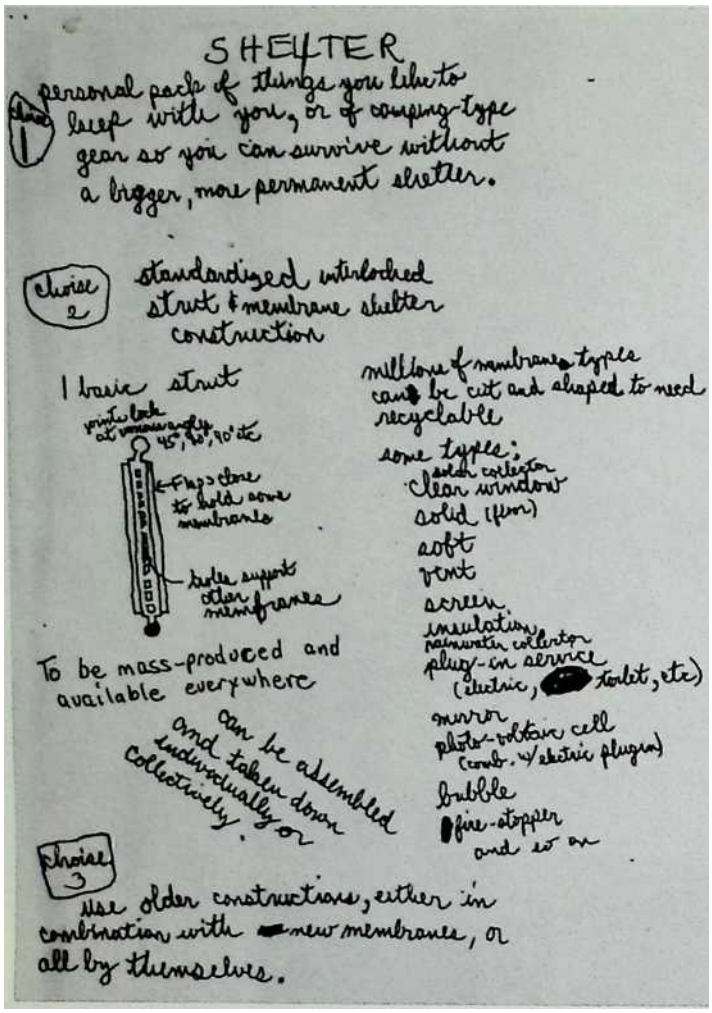
animal husbandry [cultural assumption?]

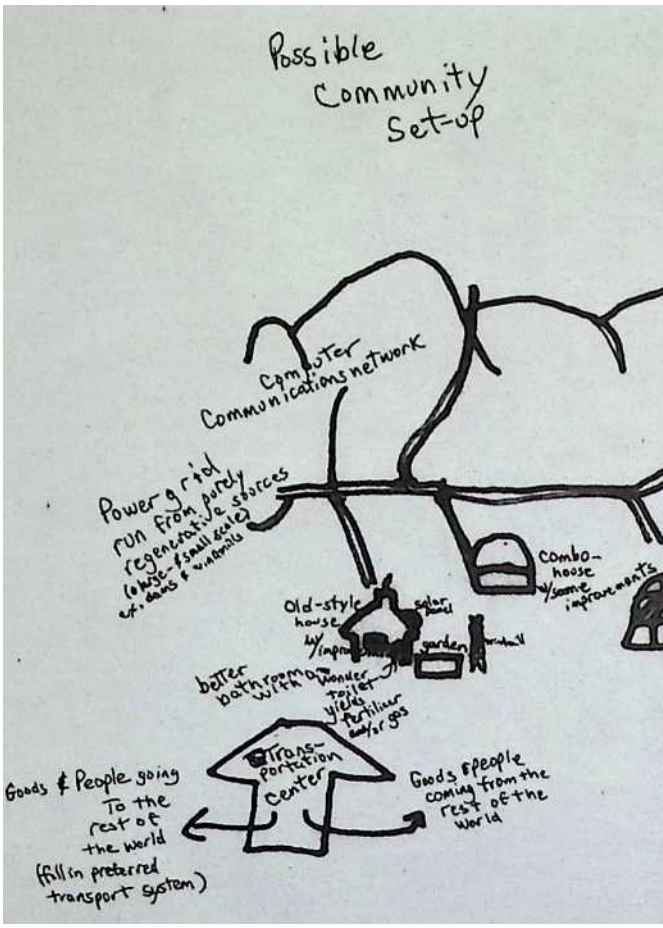
linkage w/ distribution system!

distinct from semi autonomous dwelling:

1. waste efficiency
2. energy (AC) efficiency
3. possible water system efficiencies
4. food production

definition of present state of centralized control!?



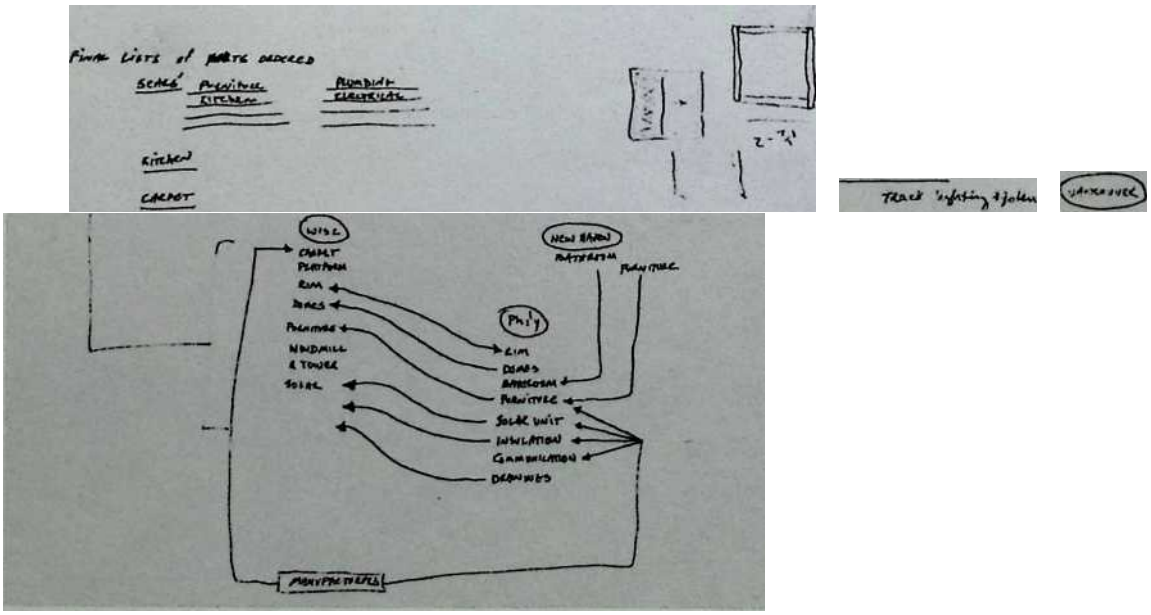


Ft MW 70 fa. cPtnvc.rro/O

TutrF»y 6fa4tn, to* ---

Wer» *uotrthG*

*CA&*TO*

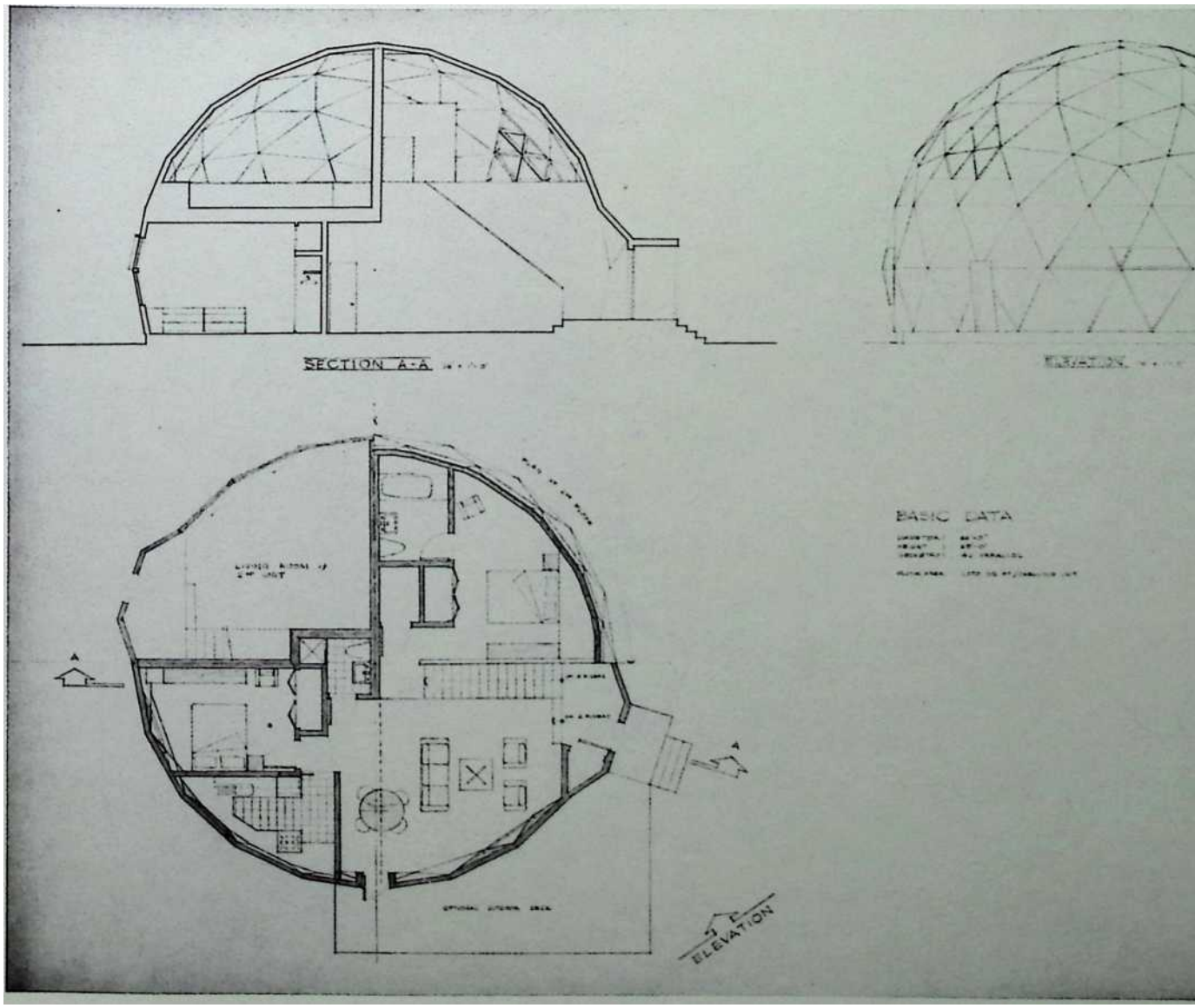


F orty-four-Foot-Diameter

Duplex Dome

Fuller & Sadao, 1976

The novelty of this design relies on the combination of the duplex type (a phenomenon that developed as a result of the housing shortage after World War I) and the geodesic dome. The two entrances are set on a diagonal line off axis with respect to the floor plans. Each of the two housing units has two bedrooms, two bathrooms, a dramatic, two-story living room, and a shared sun deck (optional).

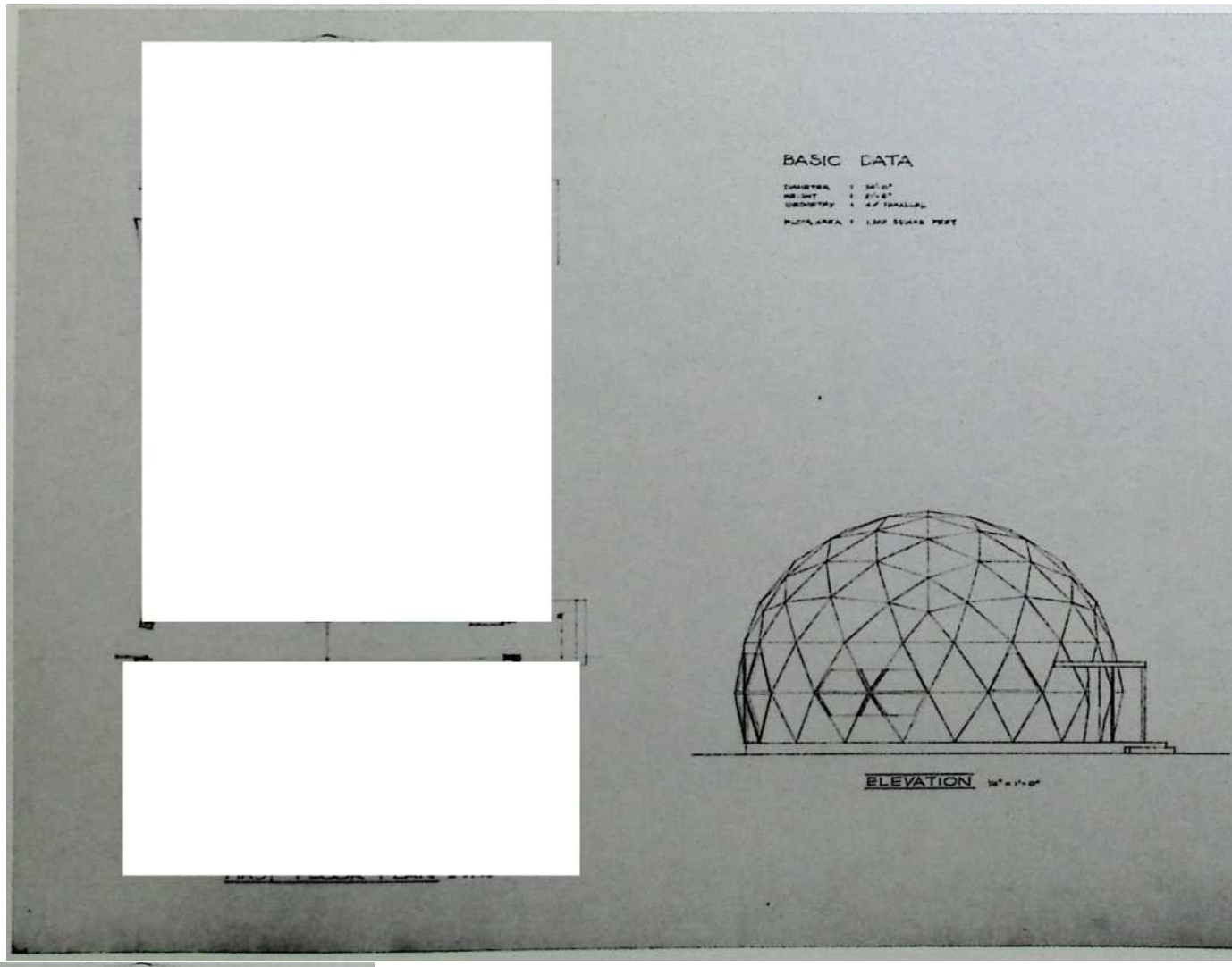


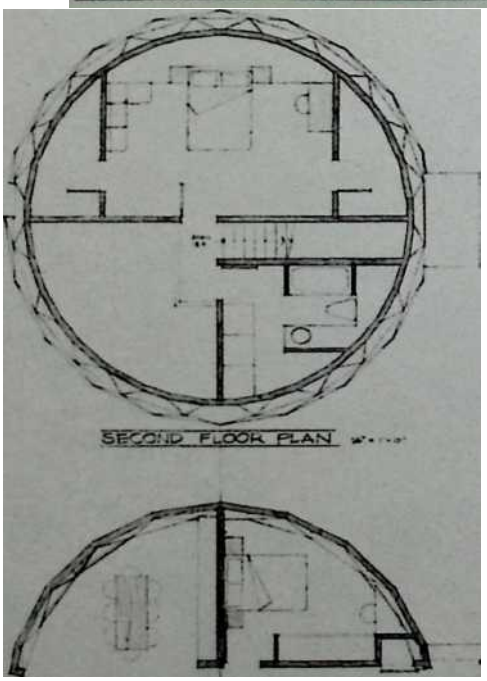
Thirty-four-F oot-Diameter

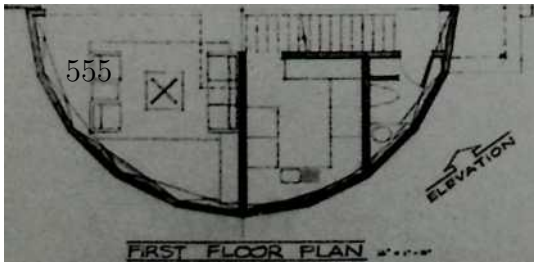
Single-Family Dome

Fuller & Sadao, 1976

With its one large bathroom and a large master bedroom, this two-story geodesic dome provides an interesting alternative to the typical row house. A corridor runs through the center of the dome to the front and rear entrances. The corridor upstairs that connects the master bath and bedroom is cantilevered dramatically above the two-story living room. Fuller explored the possibilities of geodesic fenestration, with the large hexagonal window of the living room, and the modified ribbon window of the kitchen.


BASIC DATA
ELEVATION

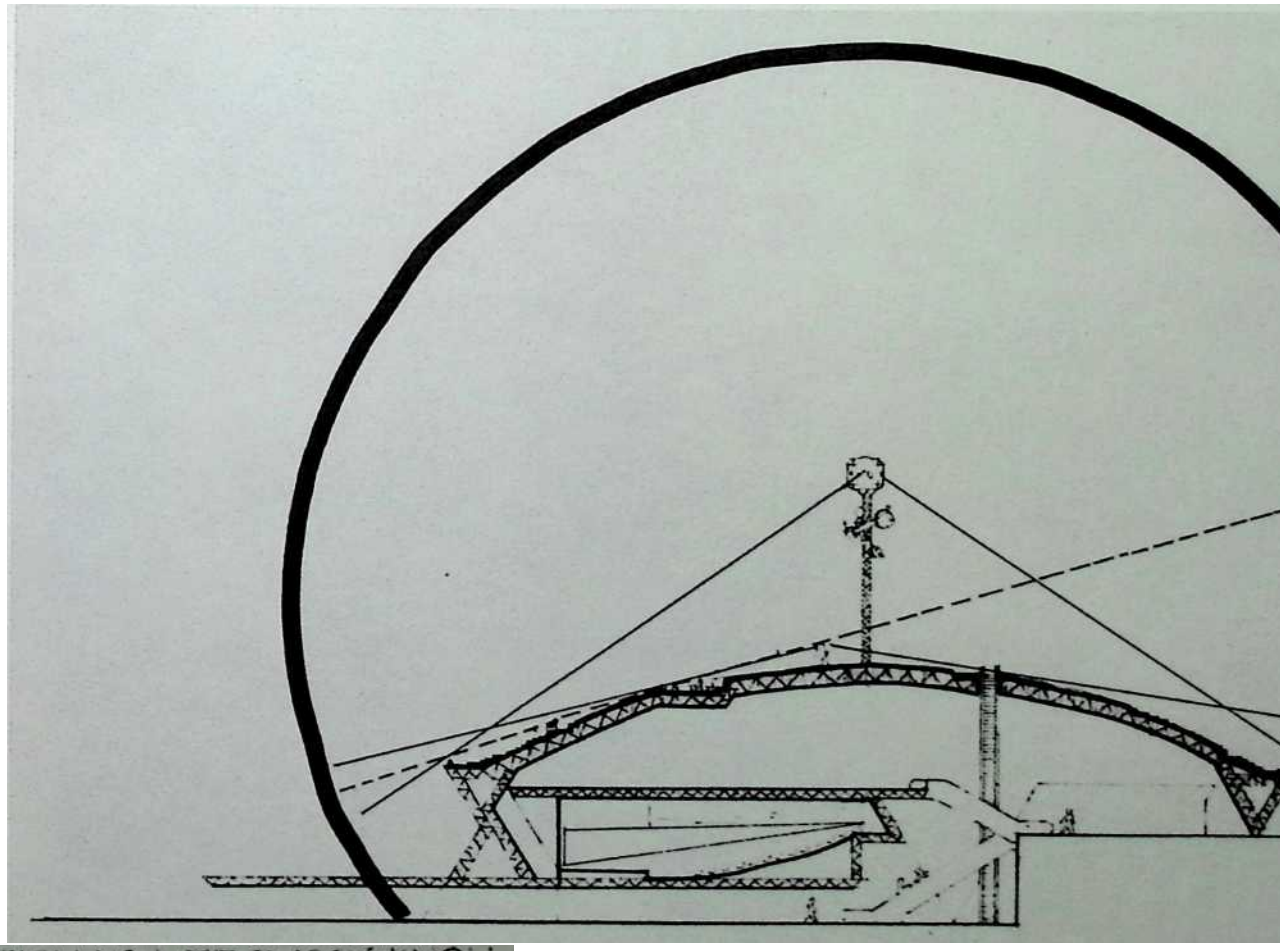

SECOND FLOOR PLAN

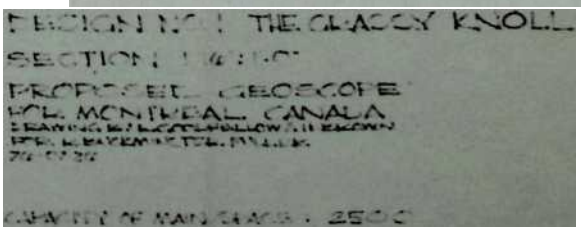

ELEVATION
FIRST FLOOR PLAN

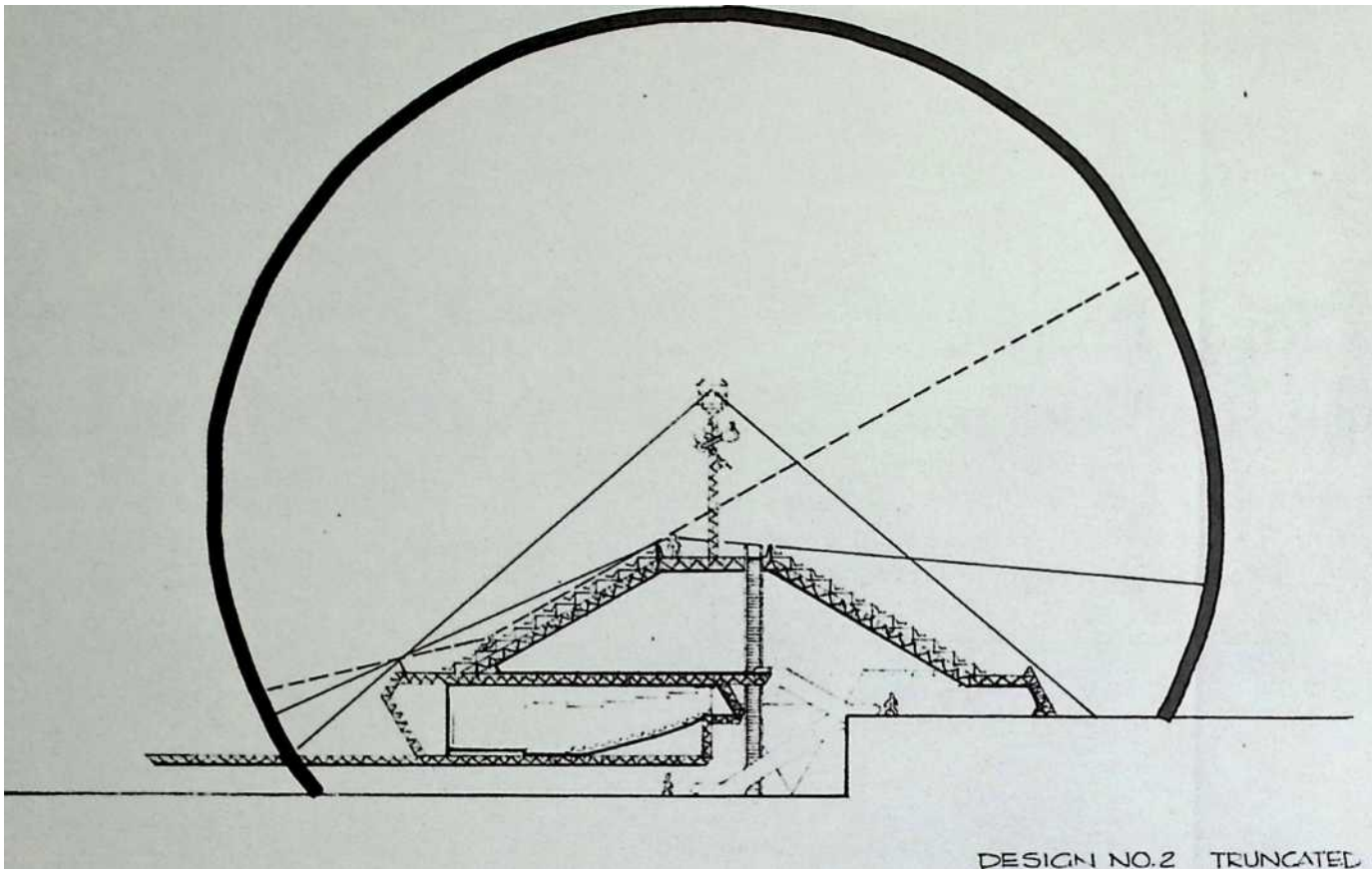
Designs for a Proposed Geoscope for Montreal, Canada

The geoscope, if executed, would be a planetarium with a lecture hall and a capacity for 2,500 spectators.

1976







isr-.CTiObj i_z i&- •. f-o-

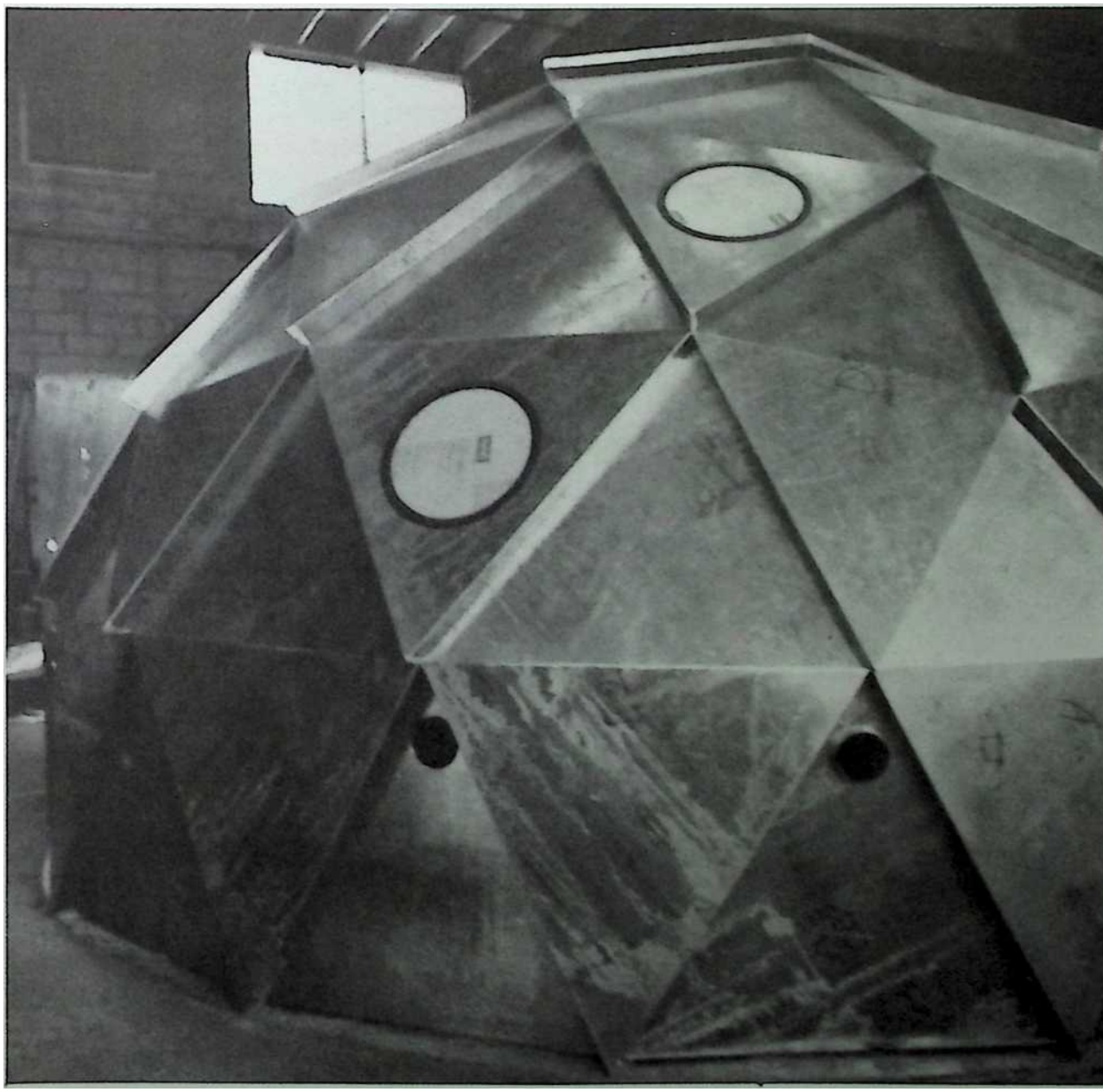
T K.CTO5E.L GEOKCPE MB MONTEEAL CA.NAUA, □cwa-a' tsie; «=»y
r.. fxoruxtO'-v A u bmowm fog*. v?. eocKAAikxrniw. fugles?.

7(tr CfJ 2.0-

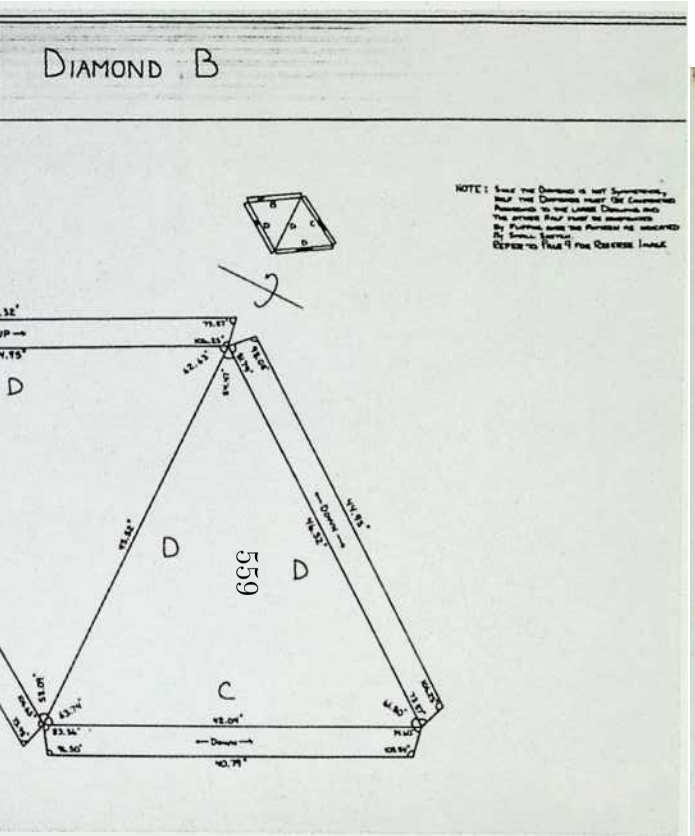
CAPAT.ITY CF MAIN S+AOE. ' 100

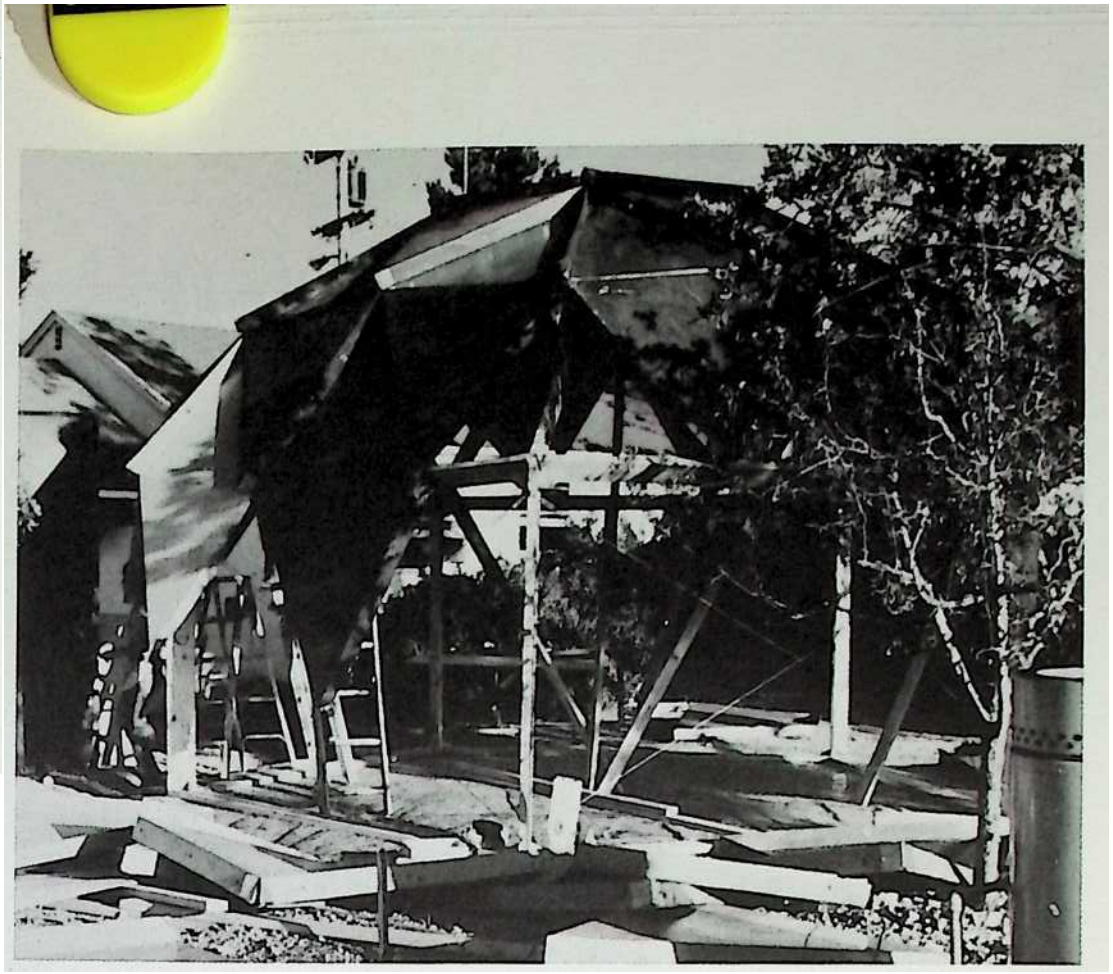
Pine Cone Dome 1977

This dome is essentially a revision of the laminar dome patent of 1965.



W.95


DIAMOND B
D
D
D
C

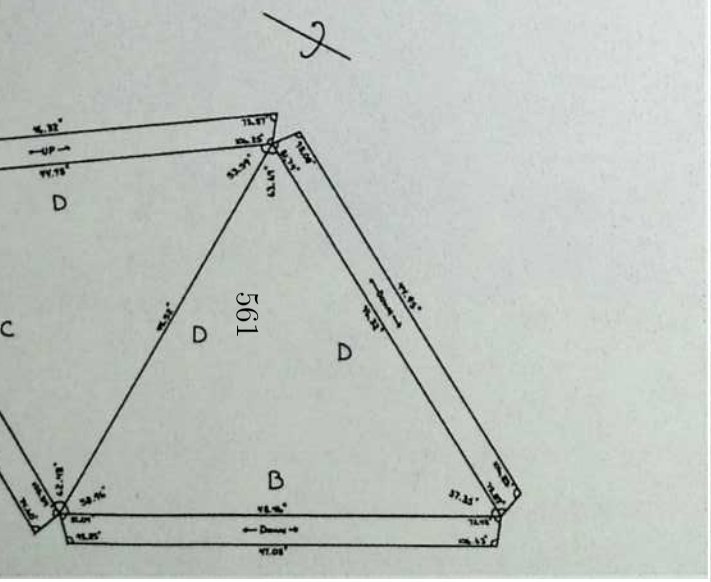


I

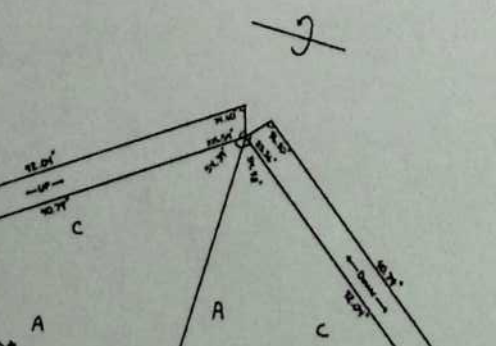
1 **I 1!**

I

DIAMOND E



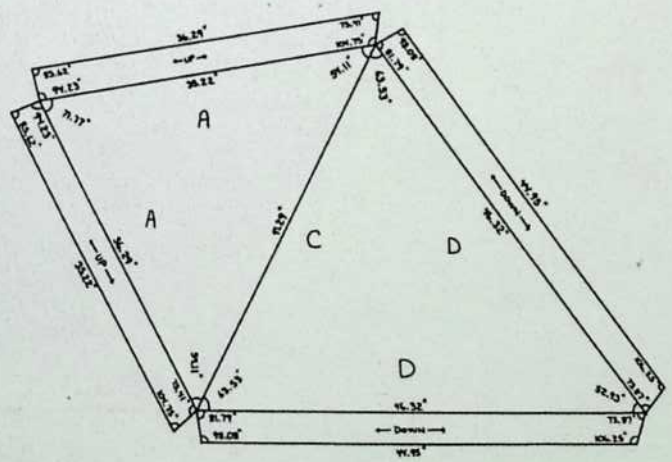
DIAMOND D



PINE CONE DOME — R. BUCKMINSTER FULLER
May 19, 1977
Drawn by: C.J.K.

PAGE 4
SCALE
3/16" = 1'

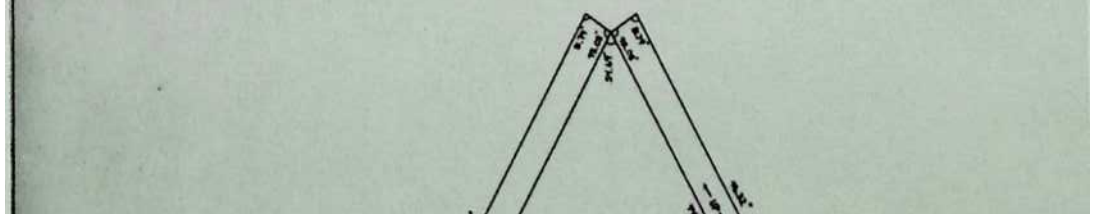
DIAMOND A



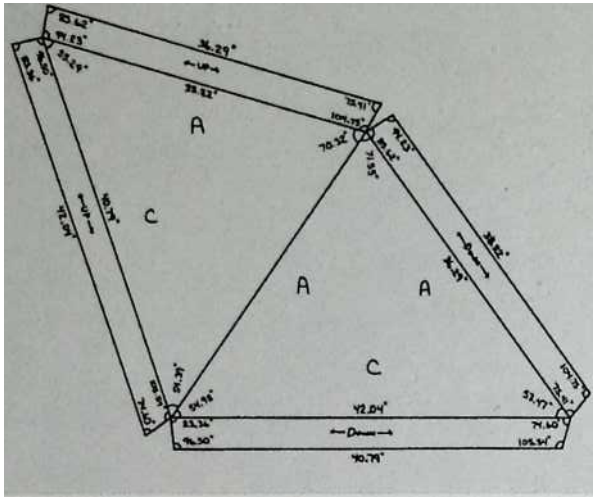
PINE CONE DOME — R. BUCKMINSTER FULLER
May 19, 1977
Drawn by: C.J.K.

PAGE 6
SCALE
3/16" = 1'

DIAMOND F

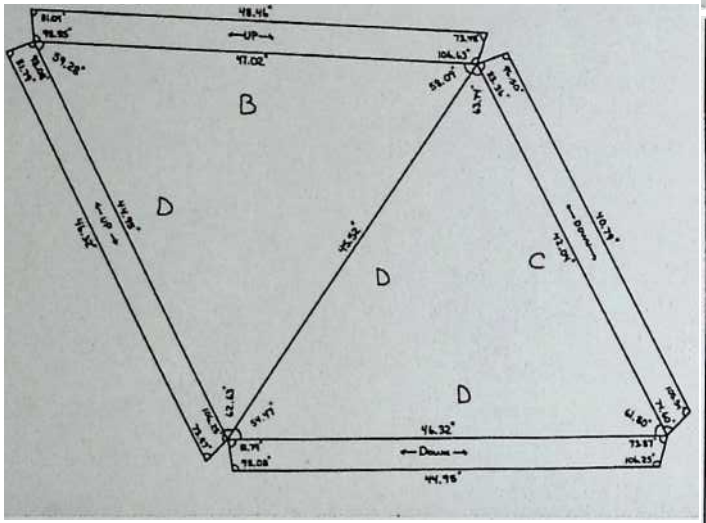


~ J 7



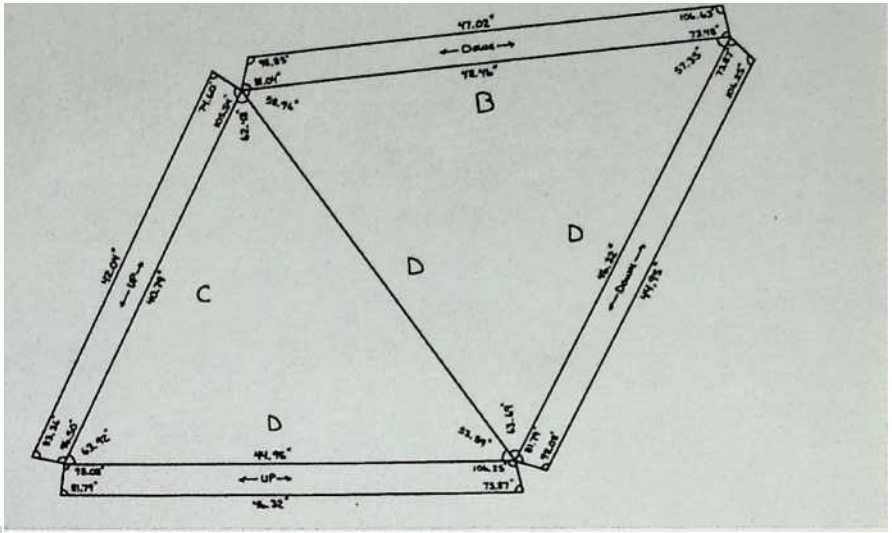
DIAMOND B_2

PINE CONE DOME — R. BUCKMINSTER FULLER
May 19, 1977
Drawn by: C.J.K.



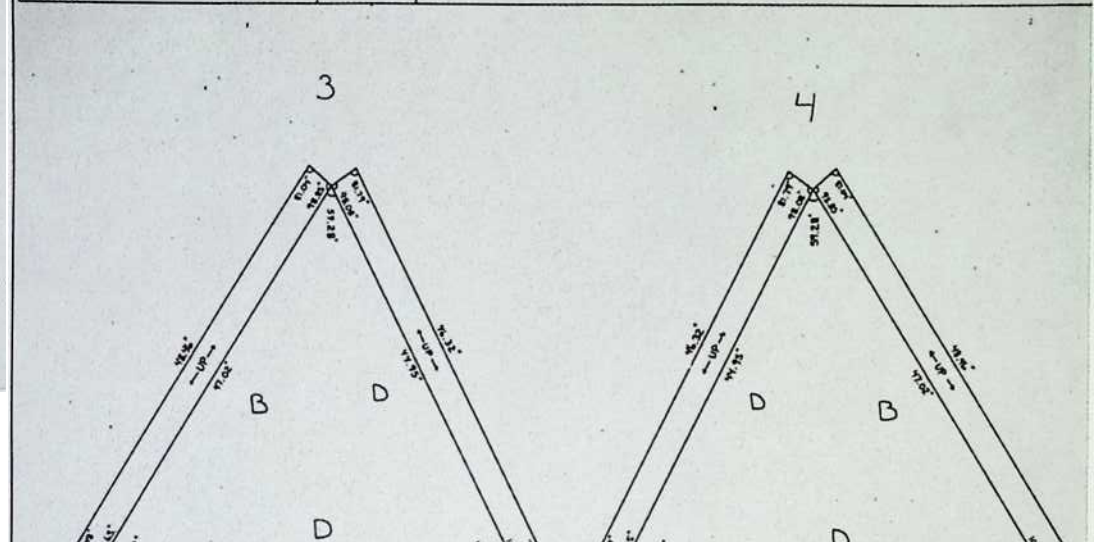
PINE CONE DOME — R. BUCKMINSTER FULLER
May 19, 1977
Drawn by: C.J.K.
PAGE 8
SCALE
3/16" = 1'

DIAMOND E_2



PINE CONE DOME — R. BUCKMINSTER FULLER
May 19, 1977
Drawn by: C.J.K.
PAGE 10
SCALE
3/16" = 1'

DIAMOND B_{3-4}



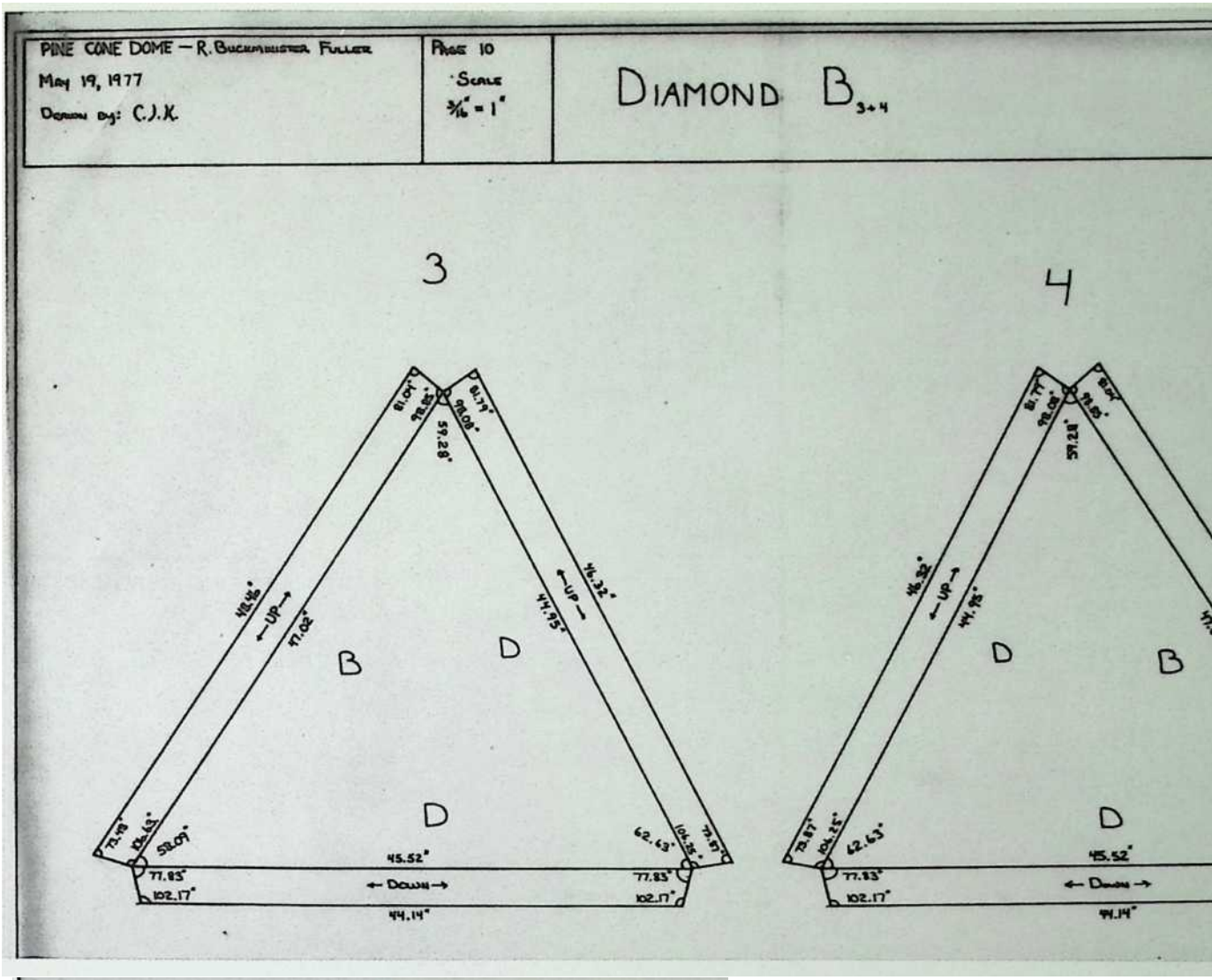
M*, H, I'm

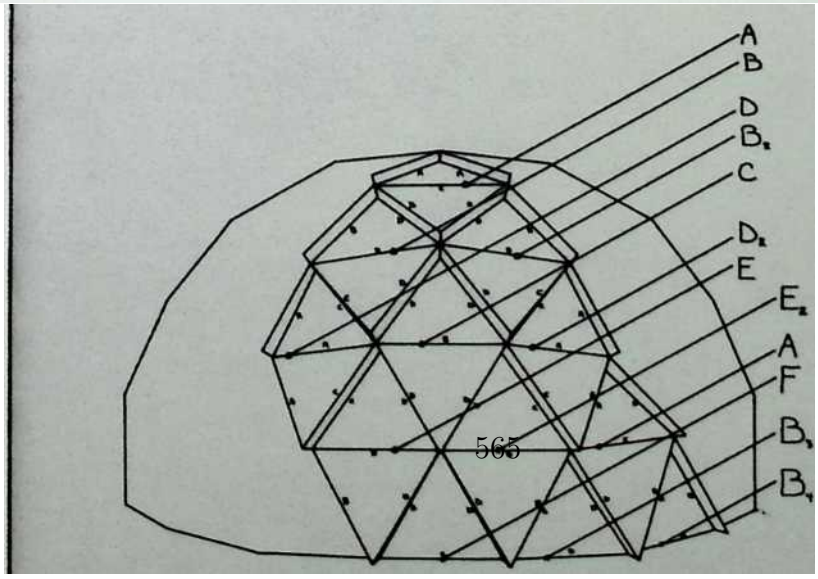
CJ-K-

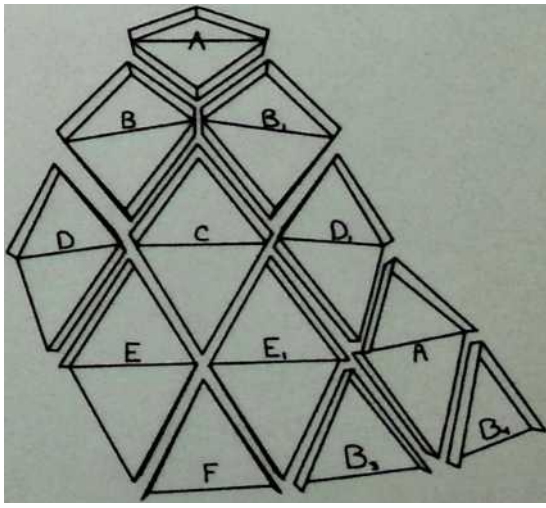
PINE CONE DOME — R. BUCKMINSTER FULLER
MAY 19, 1977
DRAWN BY: C.J.K.

PAGE 10
SCALE
3/16" = 1"

DIAMOND B_{3+4}



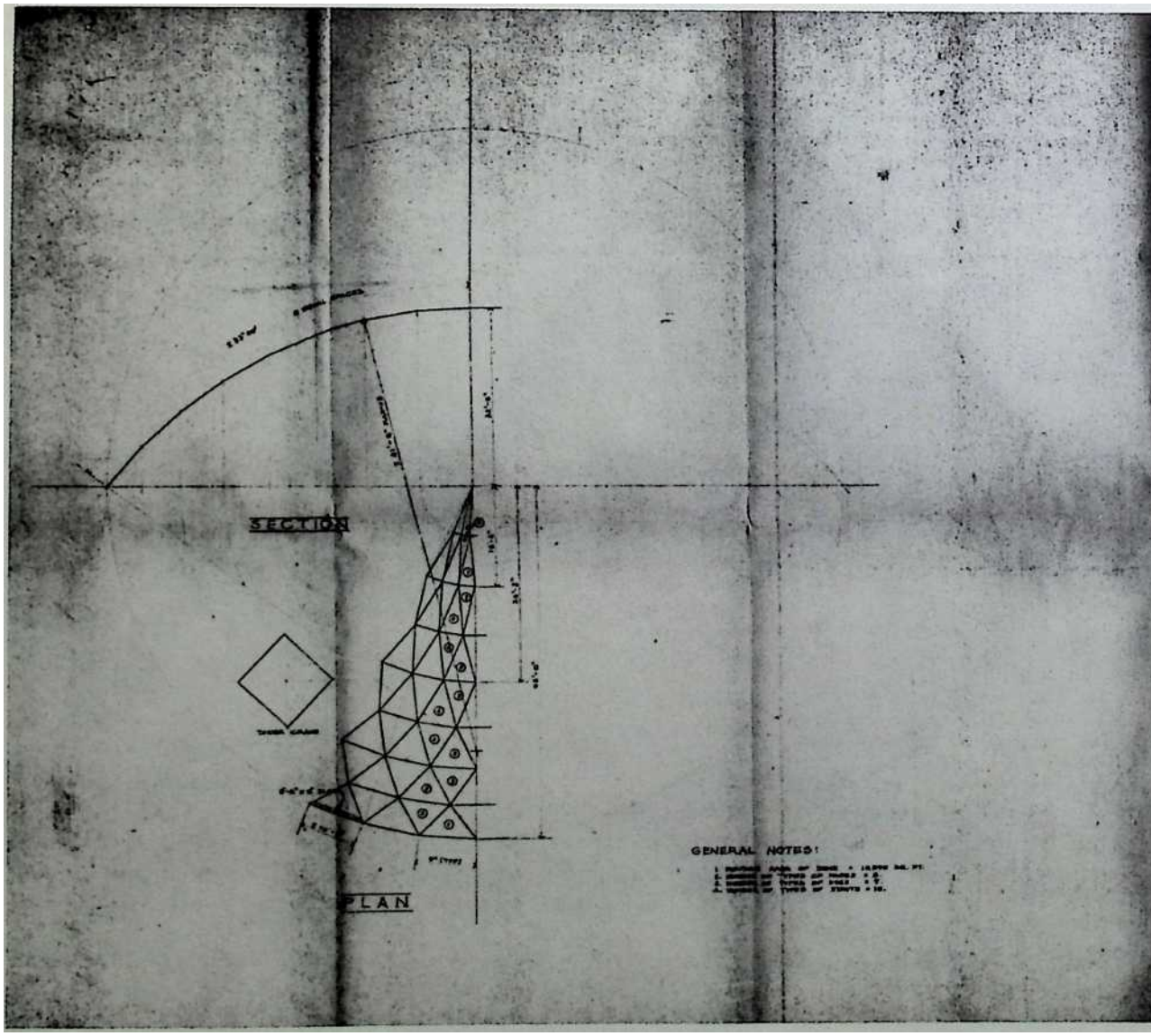


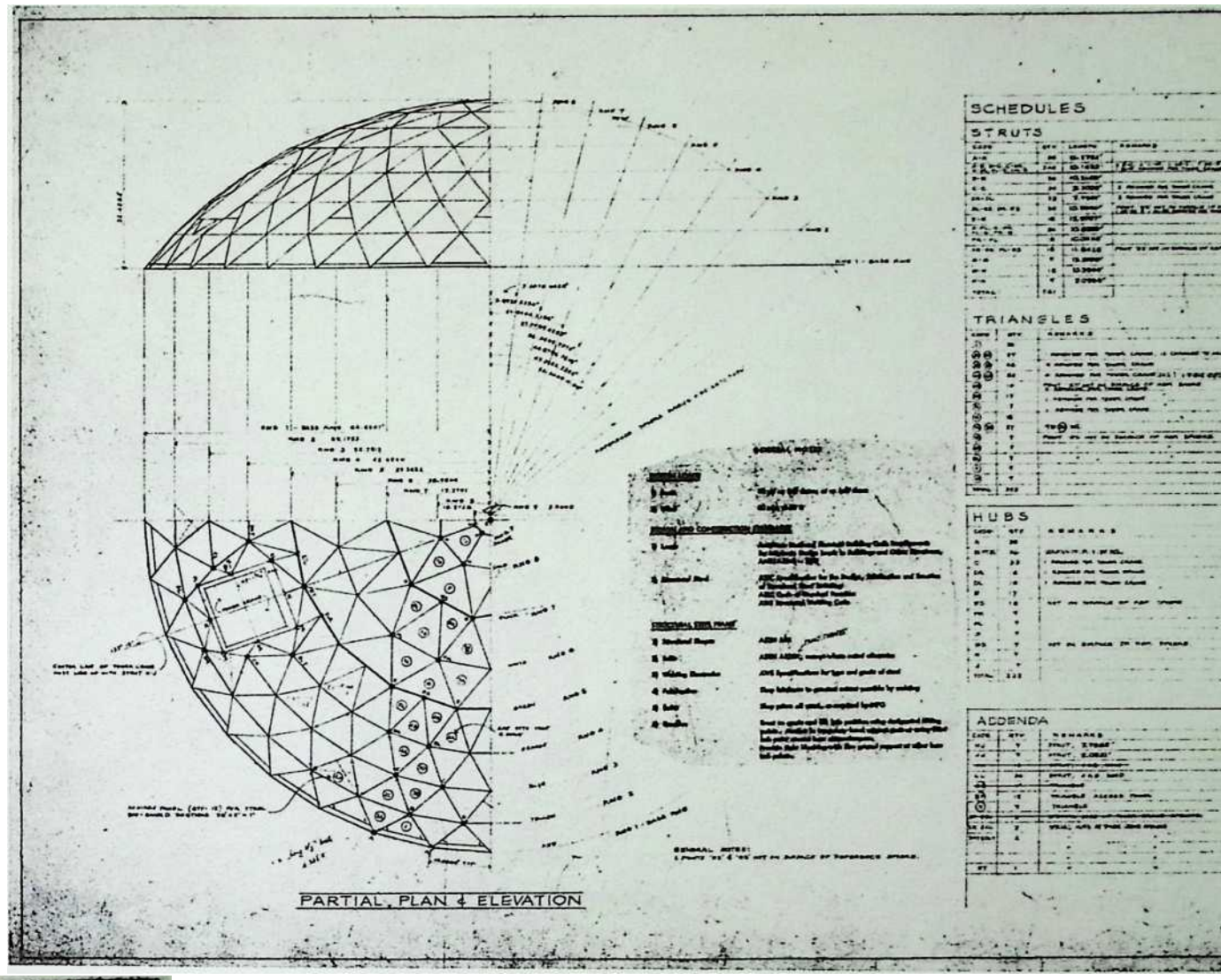


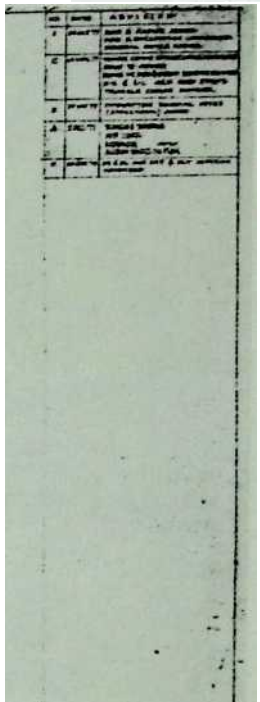
SCALE
3/16" = 1"

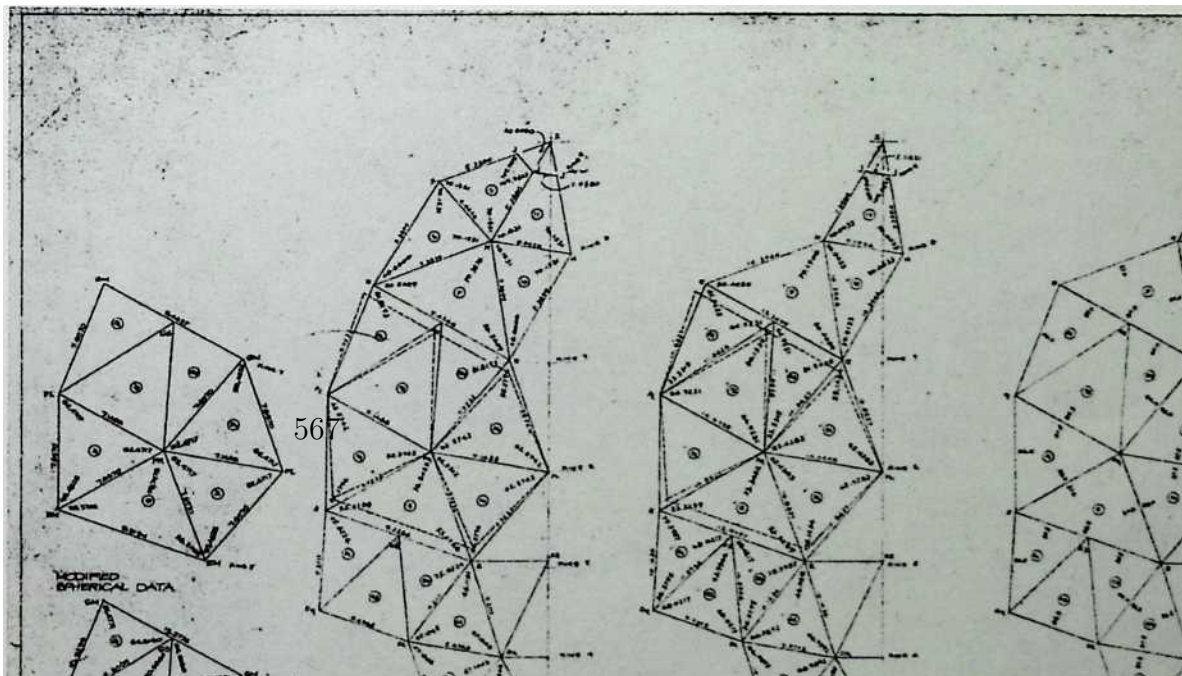
Temporary Dome for the Perry Nuclear Power Plant, Perry, Ohio 1977

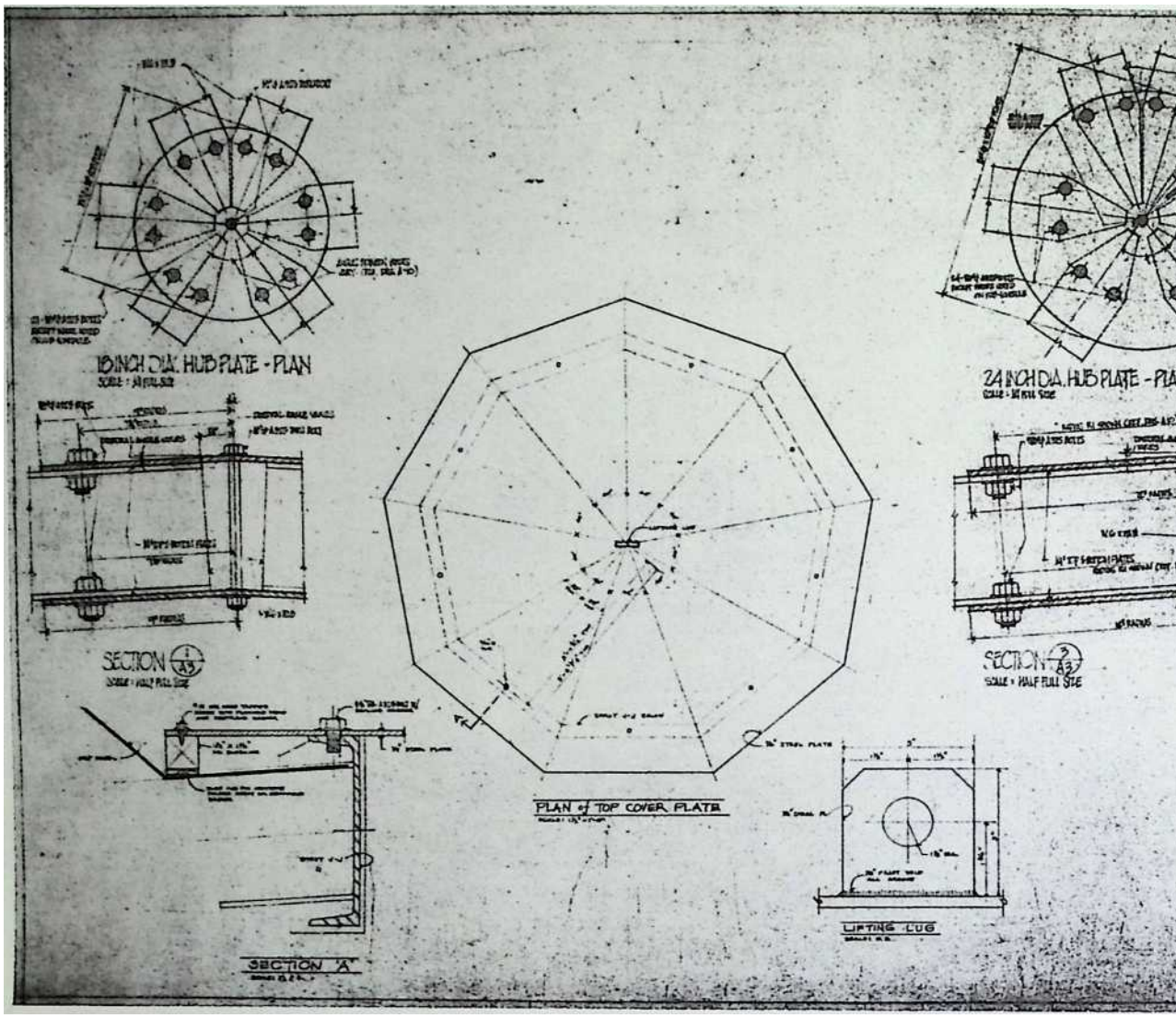
During the construction of the reinforced concrete dome of the nuclear powei' plant in Perry, Ohio, the interior was protected by a geodesic dome of Fuller's design.

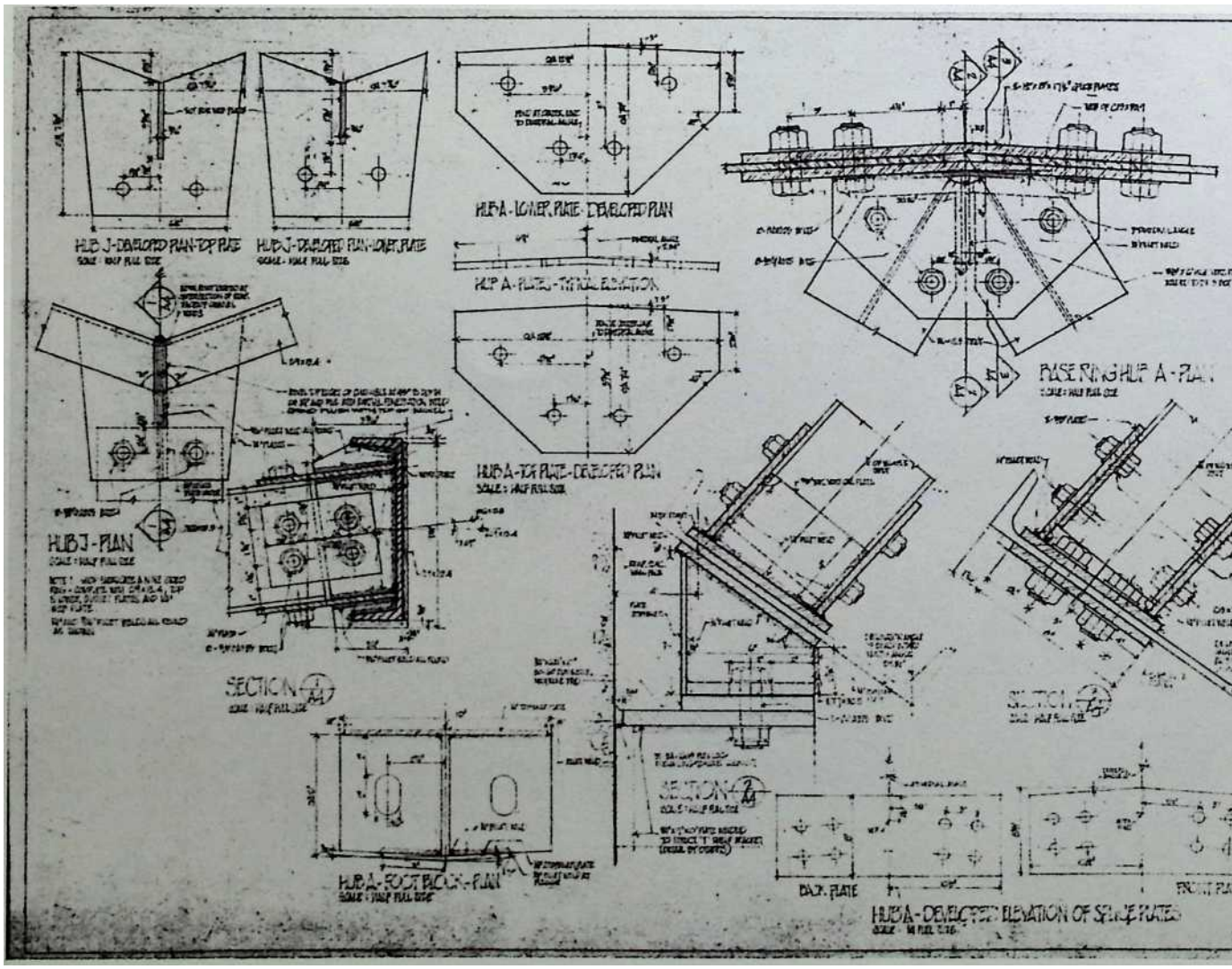


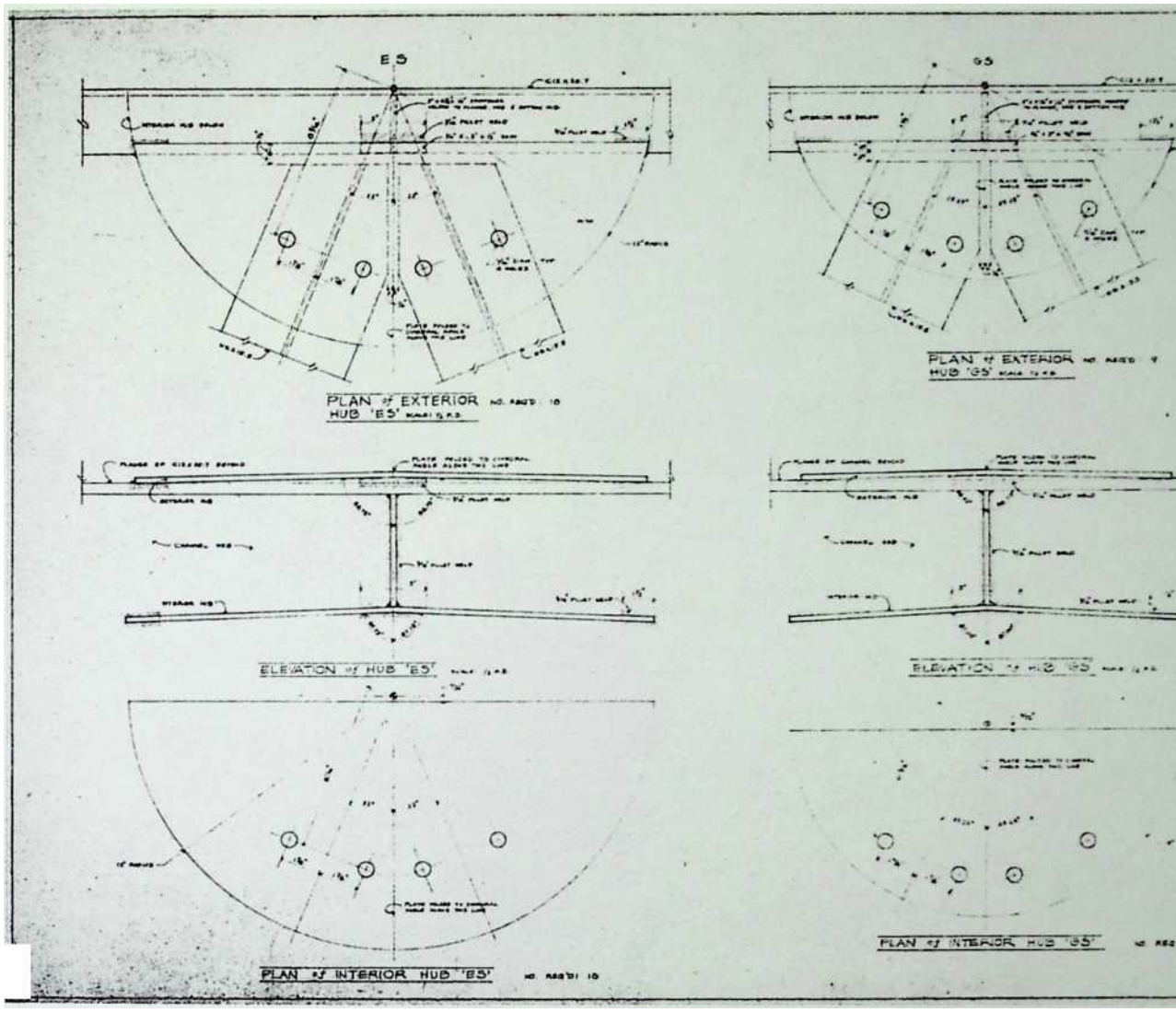

SCHEDULES
STRUTS
TRIANGLES
HUBS
ADDENDA
PARTIAL, PLAN & ELEVATION

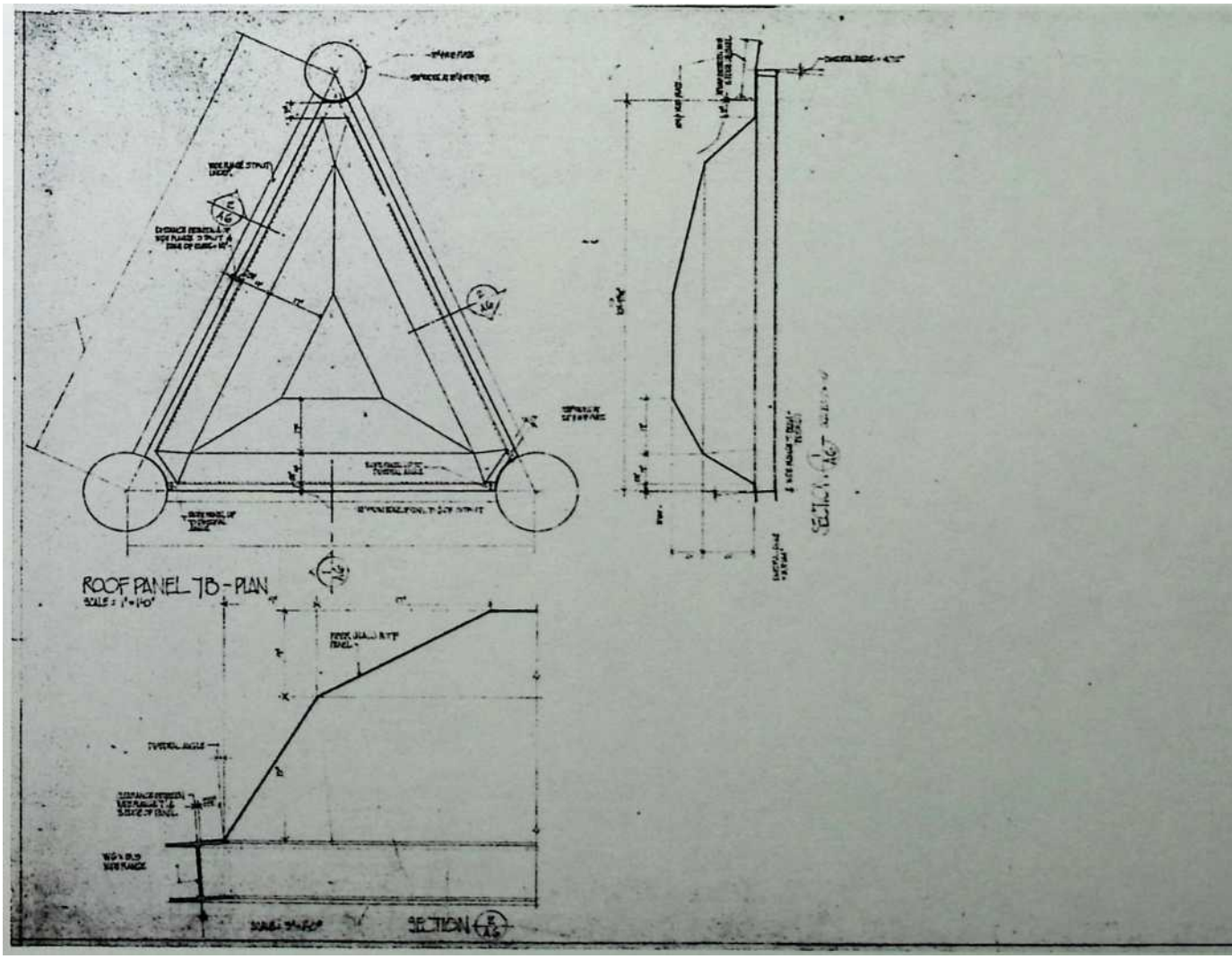


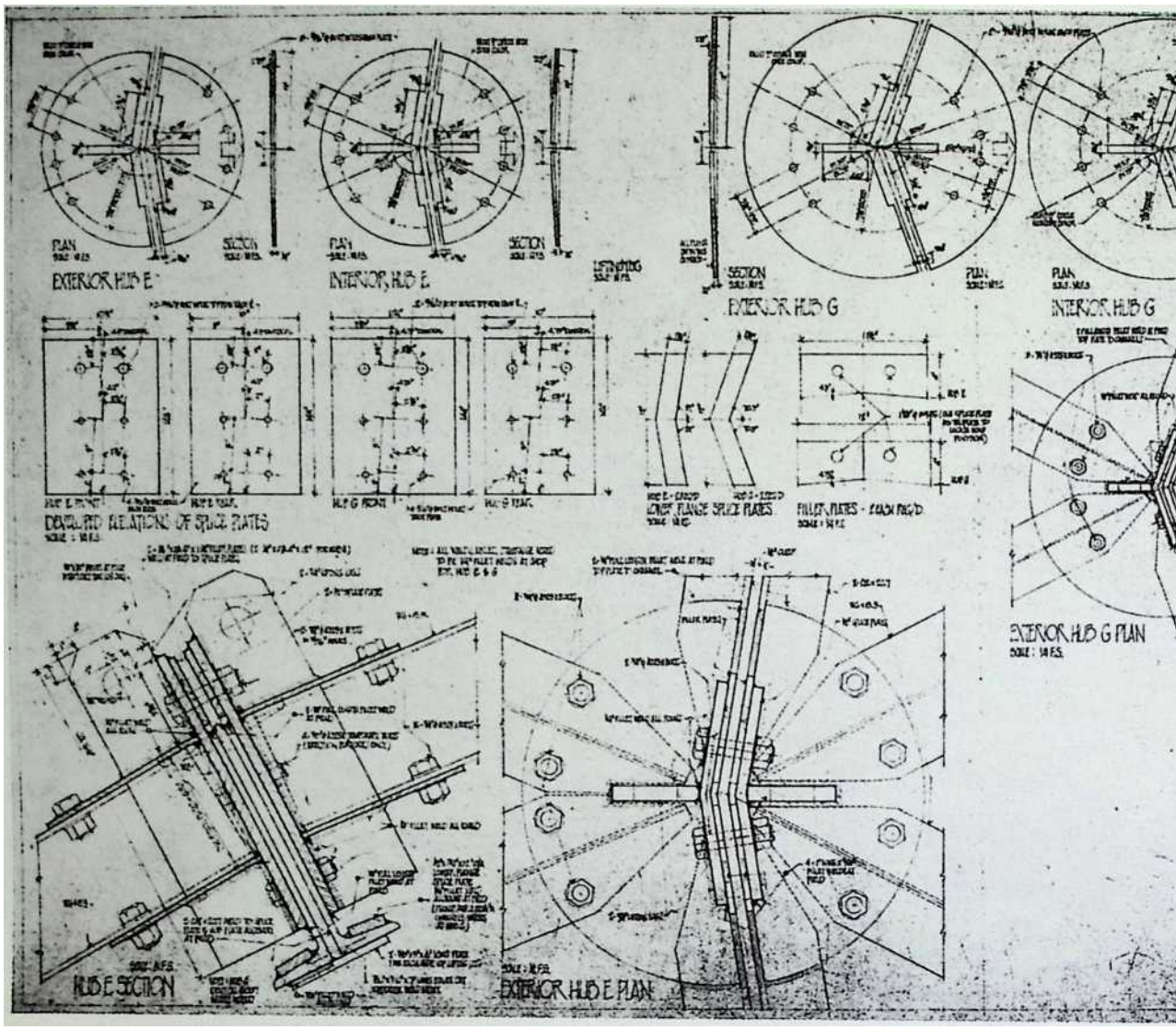

MODIFIED
SPHERICAL DATA

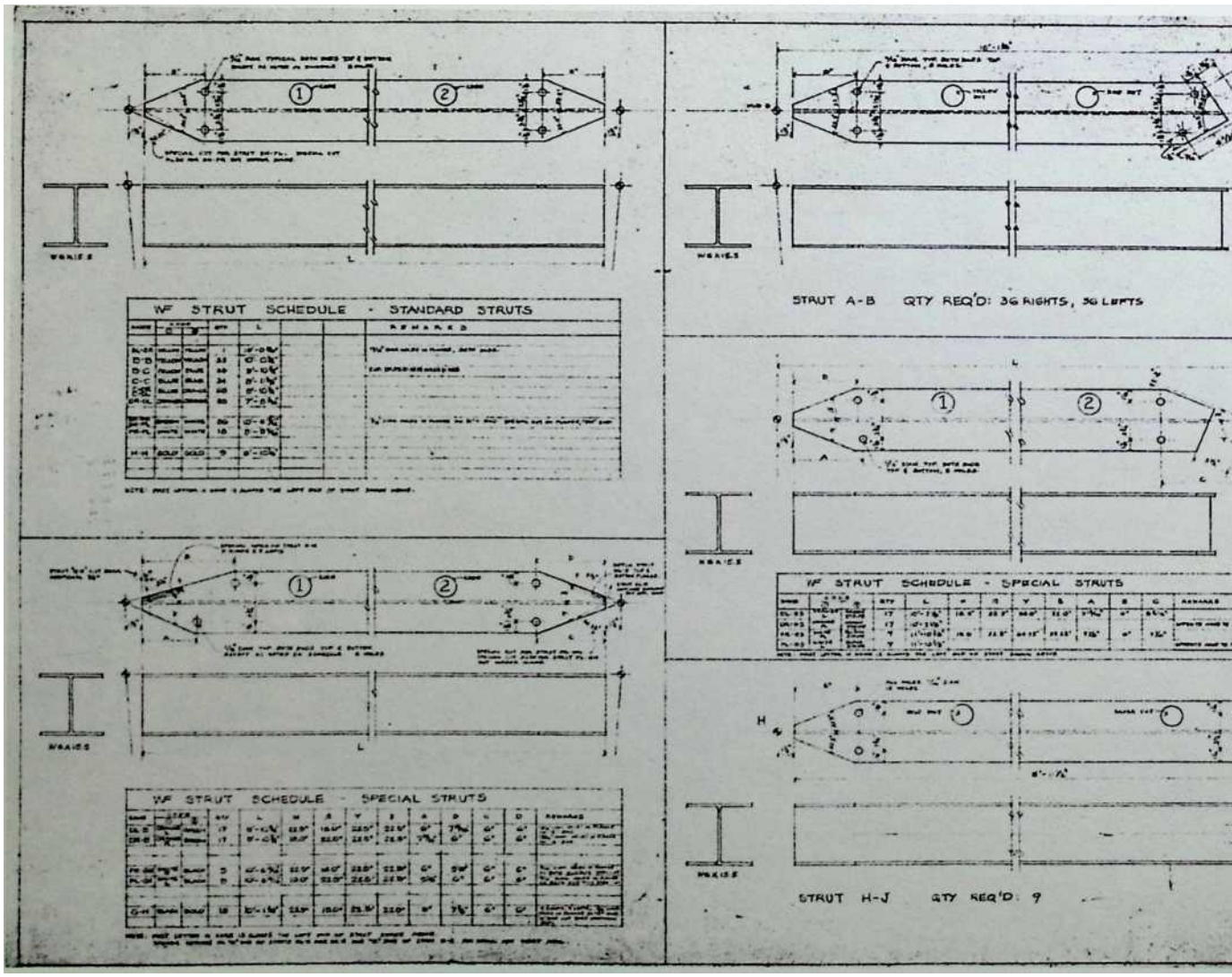

18 INCH DIA. HUB PLATE - PLAN
24 INCH DIA. HUB PLATE - PLA
SECTION 1/A3
SECTION 2/A3
PLAN of TOP COVER PLATE
SECTION "A"
LIFTING LUG

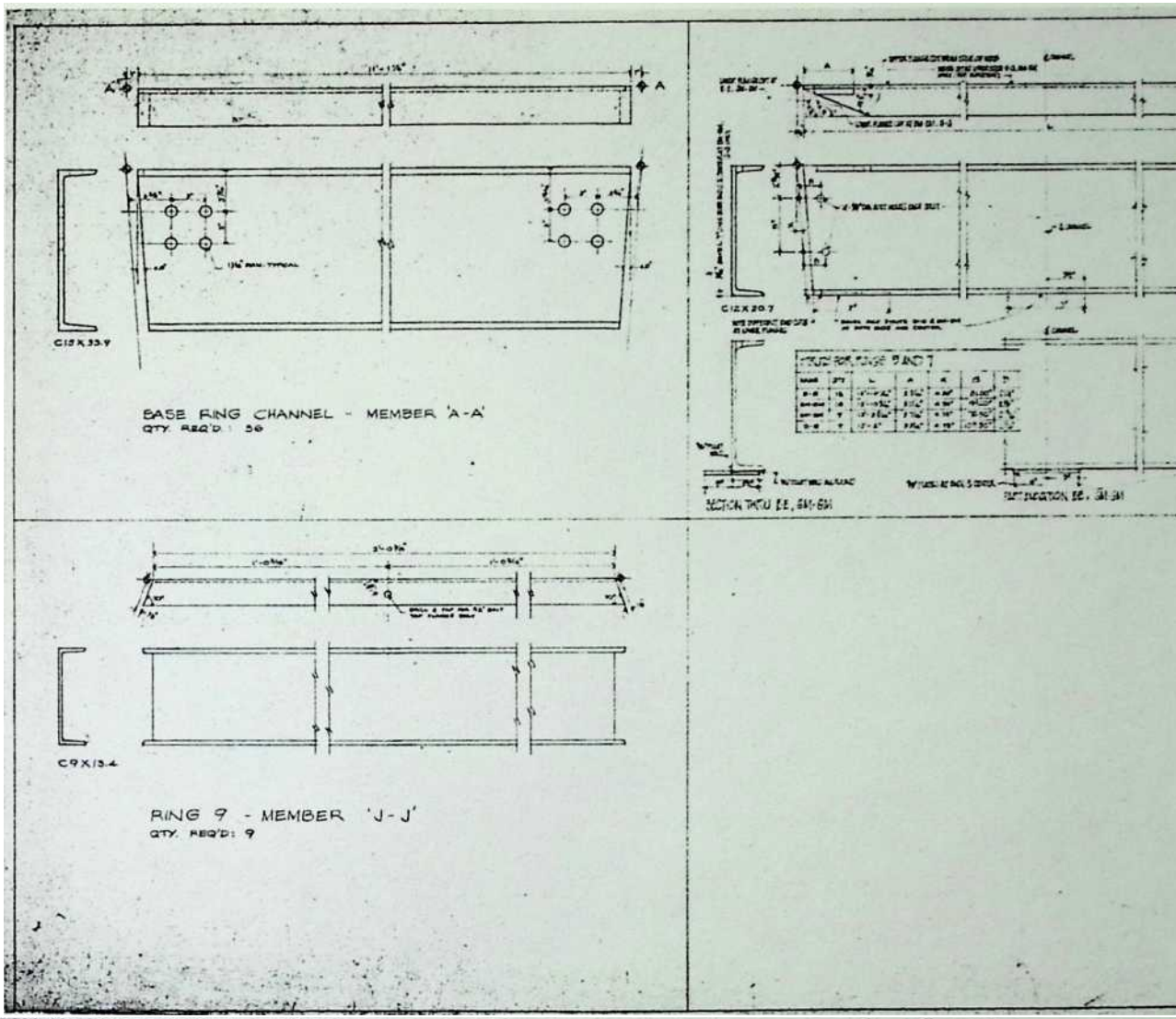

HUB J-DEVELOPED PLAN-TOP PLATE
HUB J-DEVELOPED PLAN-LOWER PLATE
HUB A-LOWER PLATE-DEVELOPED PLAN
HUB A-PLATES-TYPICAL ELEVATION
HUB A-TOP PLATE-DEVELOPED PLAN
HUB J-PLAN
SECTION
HUB A-FOOT BLOCK-PLAN
BACK PLATE
HUB A-DEVELOPED ELEVATION OF SIDE PLATES

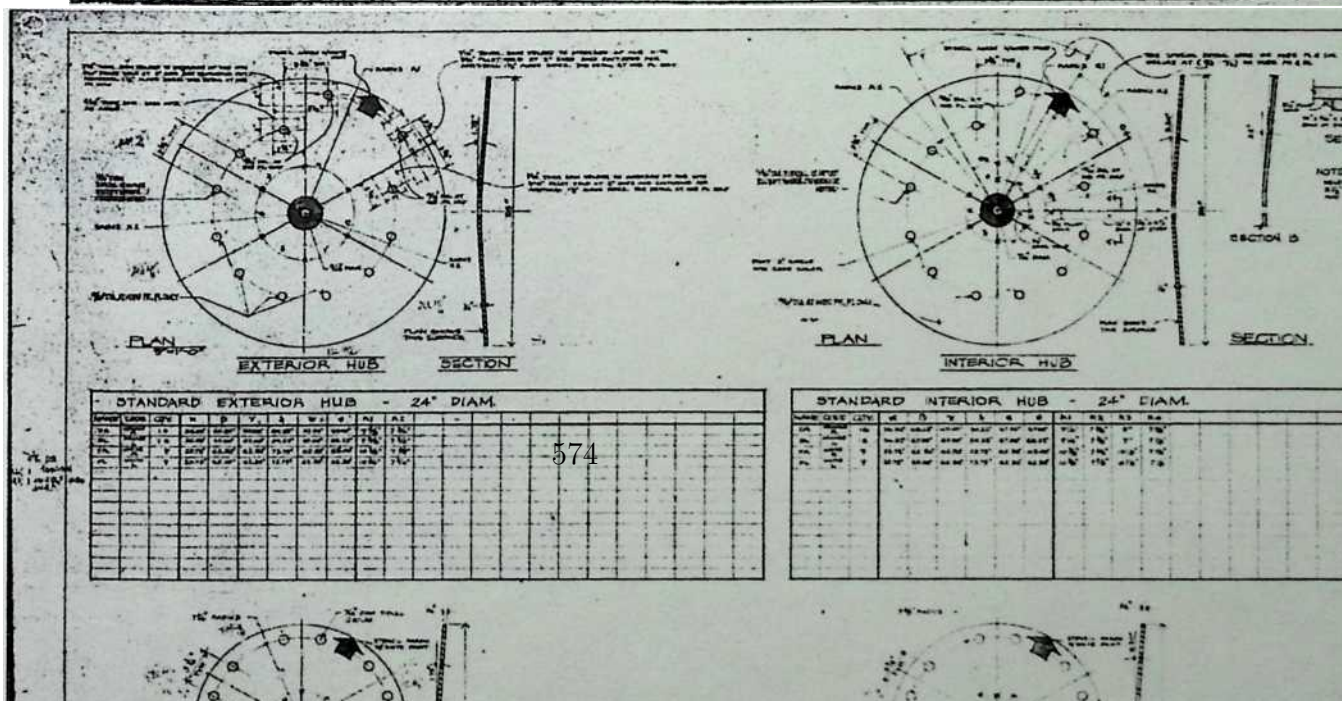

E5
PLAN of EXTERIOR
HUB 'E5'
PLAN of EXTERIOR
HUB 'G5'
ELEVATION of HUB 'E5'
ELEVATION of HUB 'G5'
PLAN of INTERIOR HUB 'E5'
PLAN of INTERIOR HUB 'G5'


ROOF PANEL 7B - PLAN
SECTION


PLAN
SECTION
EXTERIOR HUB E
INTERIOR HUB E
EXTERIOR HUB G
INTERIOR HUB G
DEVELOPED RELATIONS OF SPLICE PLATES
LONGIT. FLANGE SPLICE PLATES
FILLET PLATES - EACH END
EXTERIOR HUB G PLAN
HUB E SECTION
EXTERIOR HUB E PLAN


WF STRUT SCHEDULE - STANDARD STRUTS
STRUT A-B QTY REQ'D: 36 RIGHTS, 36 LEFTS
WF STRUT SCHEDULE - SPECIAL STRUTS
WF STRUT SCHEDULE - SPECIAL STRUTS
STRUT H-J QTY REQ'D: 9


C15X33.9
BASE RING CHANNEL - MEMBER 'A-A'
QTY. REQ'D: 56
C12X20.7
C9X13.4
RING 9 - MEMBER 'J-J'
QTY. REQ'D: 9


PLAN
EXTERIOR HUB
SECTION
PLAN
INTERIOR HUB
SECTION
STANDARD EXTERIOR HUB - 24" DIAM.
STANDARD INTERIOR HUB - 24" DIAM.

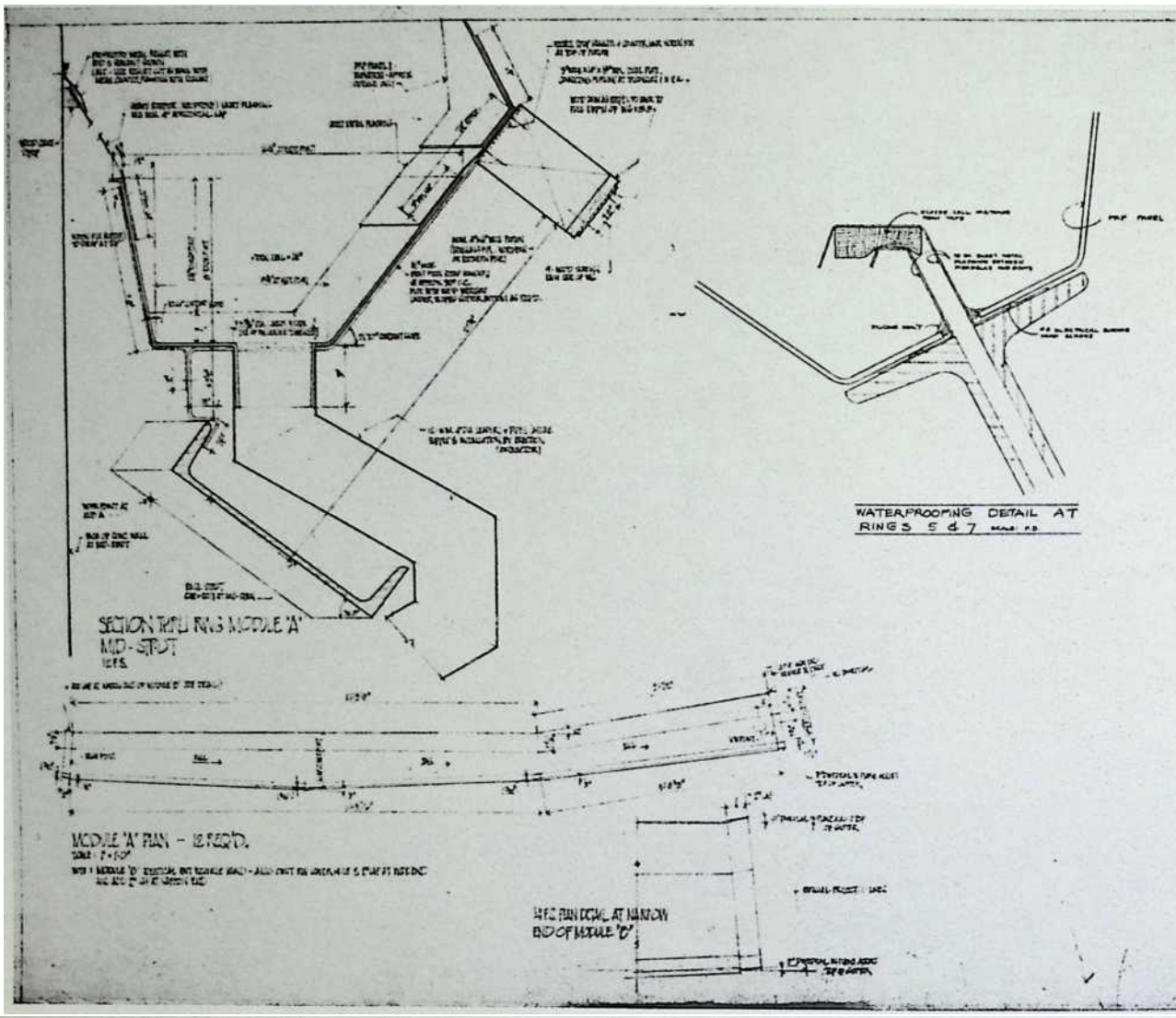
I

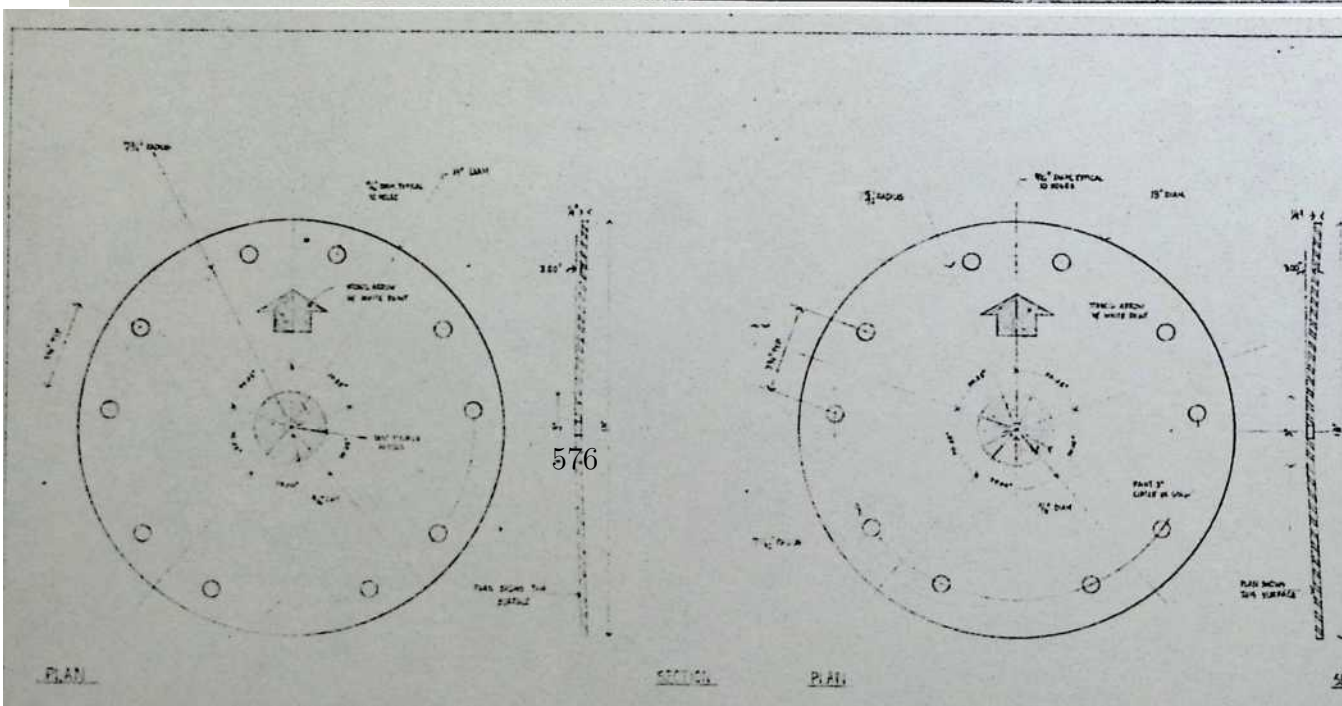
F

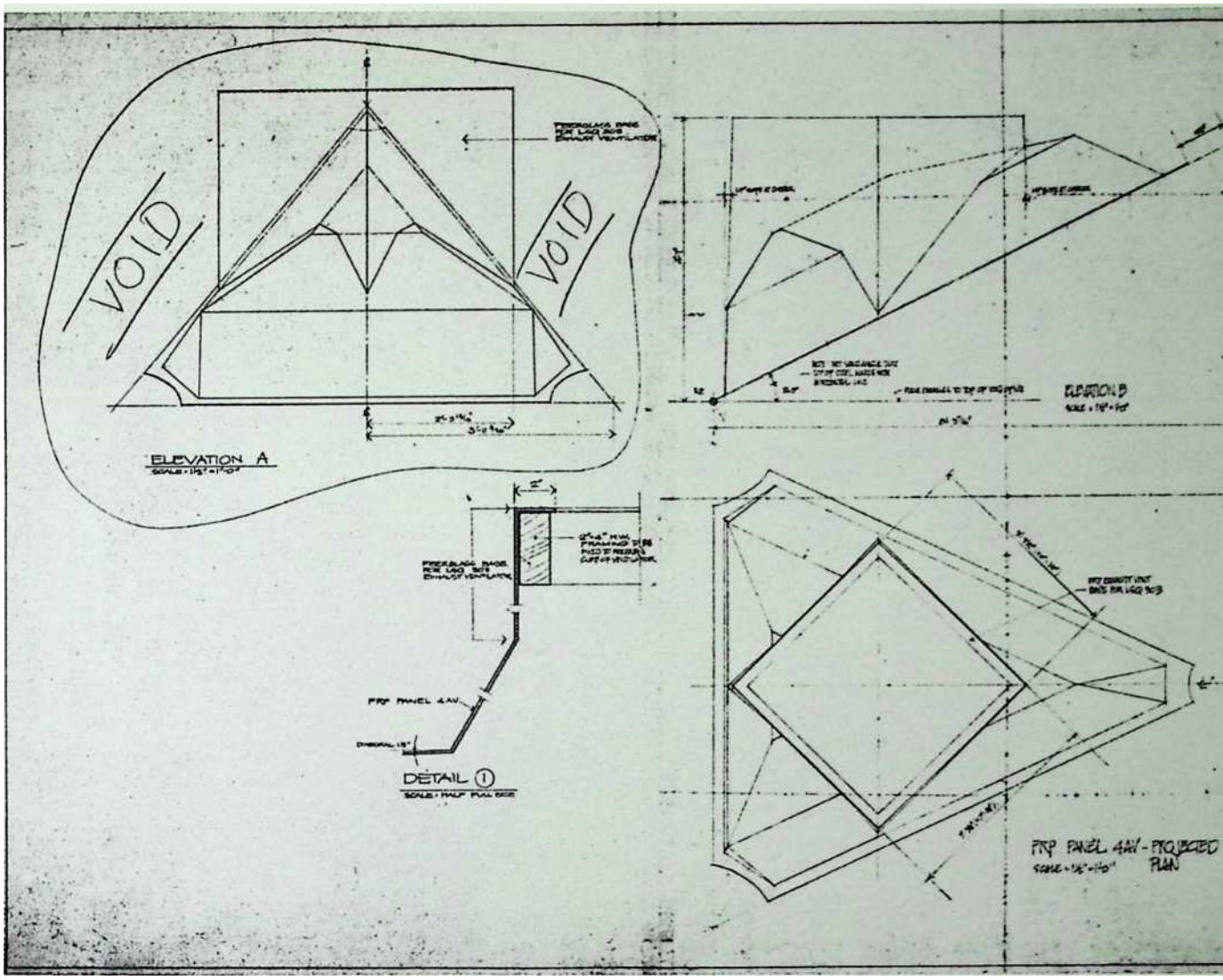
I

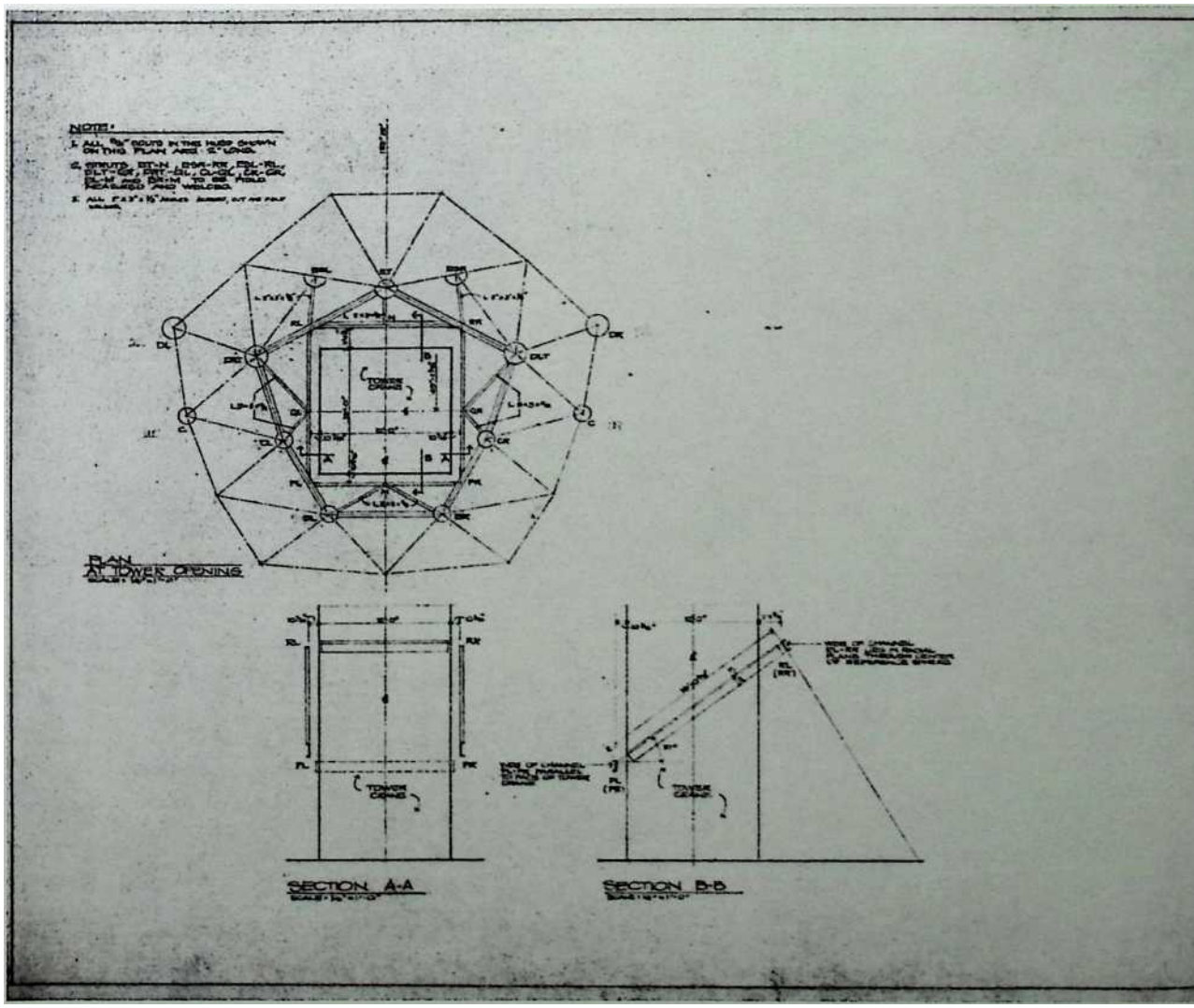
I

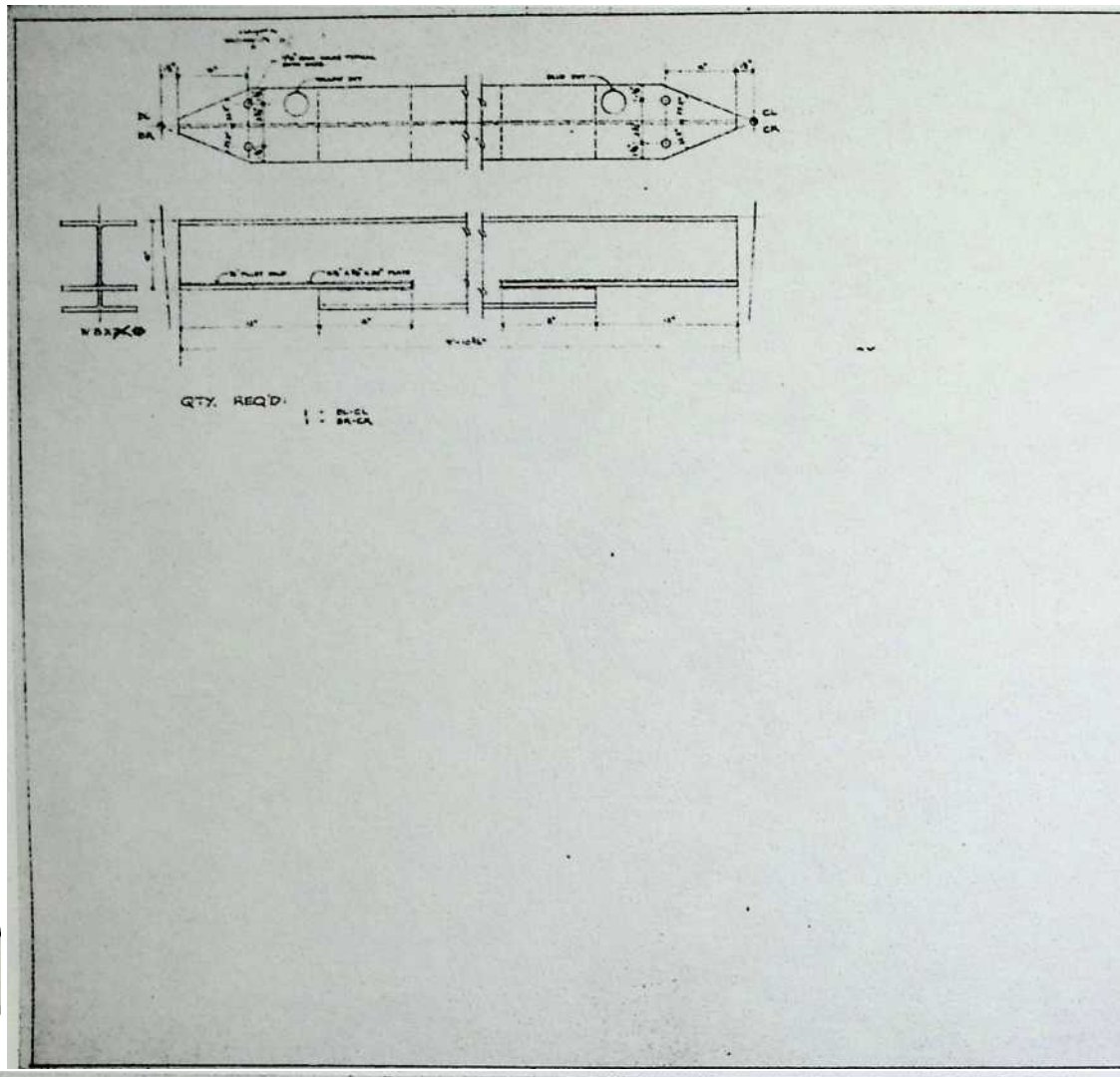
HIW WVKWIMG HUB M

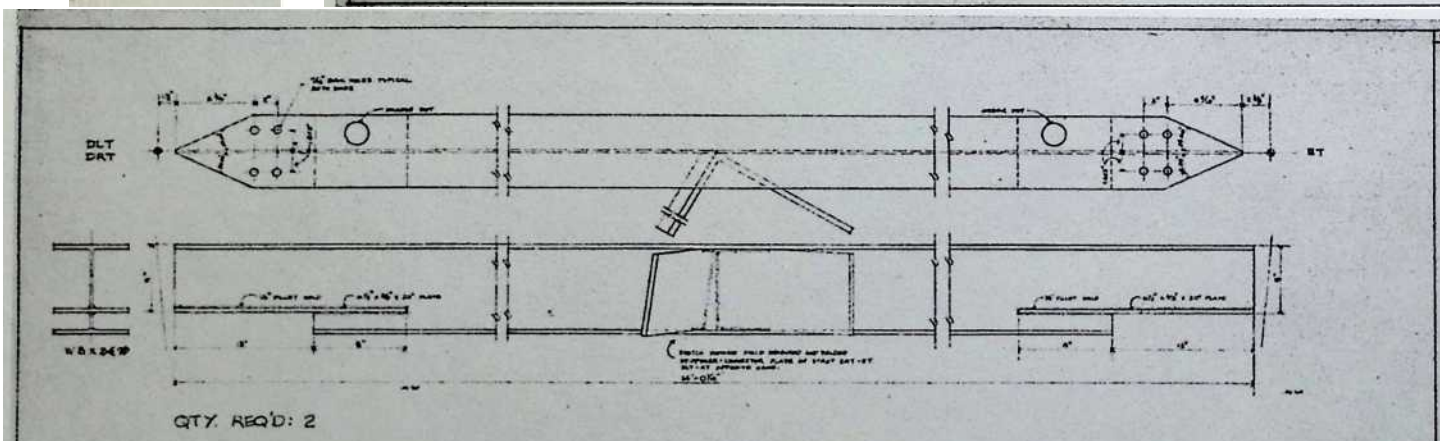

WATERPROOFING DETAIL AT
RINGS 5 & 7
SECTION THRU RING MODULE 'A'
MID-STRUT
MODULE 'A' PLAN - 18 REQ'D.

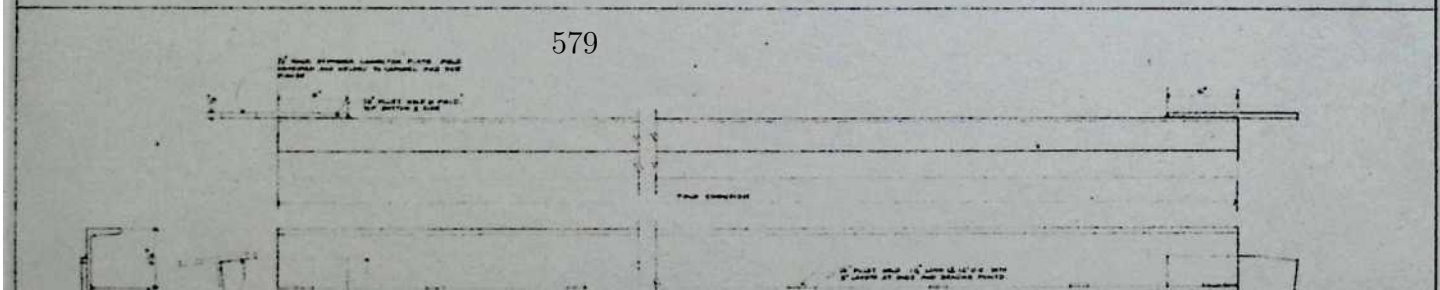

PLAN
SECTION
PLAN


VOID
VOID
ELEVATION A
ELEVATION B
DETAIL 1
FRP PANEL 4AV - PROJECTED PLAN


NOTE:
PLAN
AT TOWER OPENING
SECTION A-A
SECTION B-B


QTY. REQ'D:


DLT
DRT
QTY. REQ'D: 2



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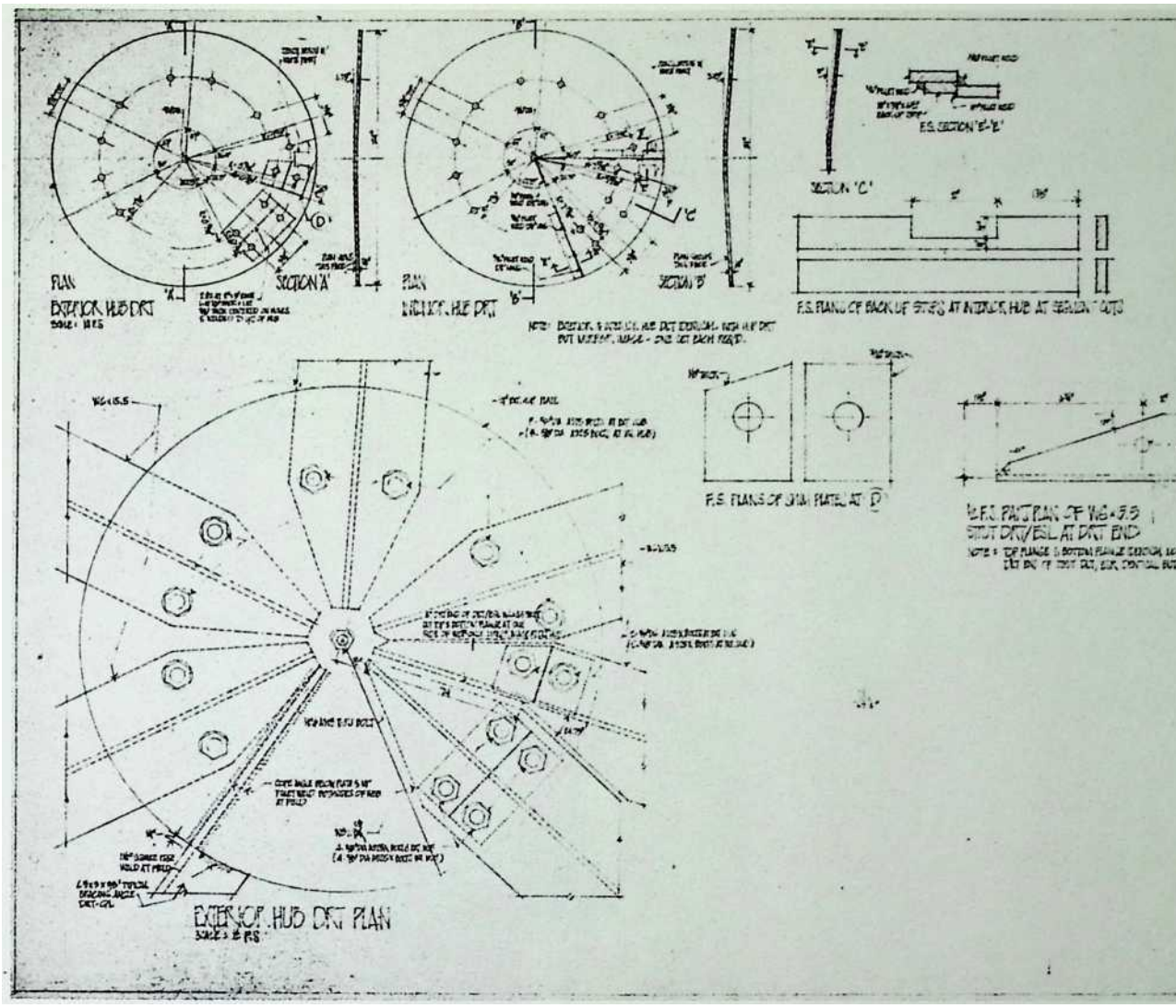
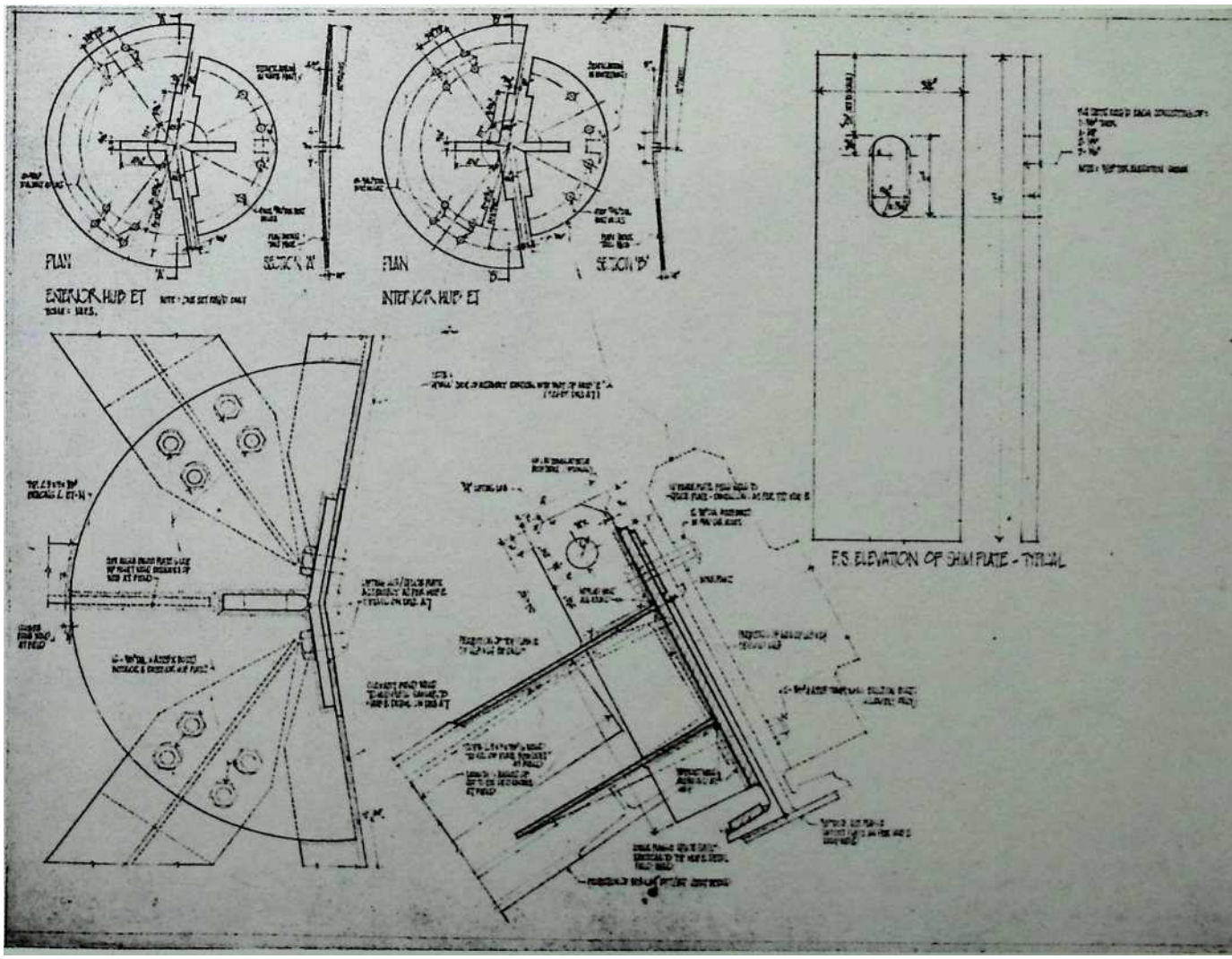

PLAN
SECTION 'A'
PLAN
SECTION 'B'
SECTION 'C'
F.S. PLANS OF SHIM PLATES AT 'D'
EXTERIOR HUB DRT PLAN



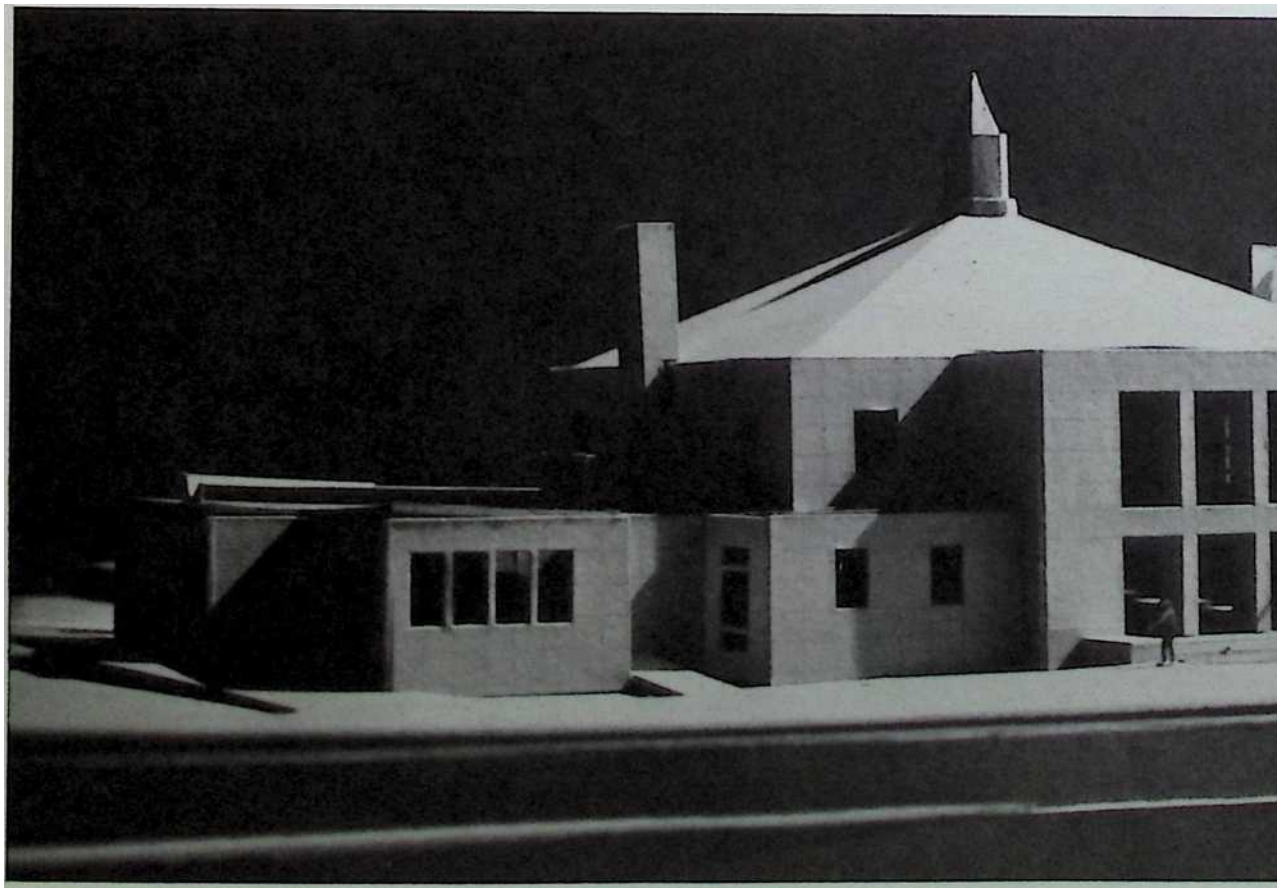
East River Park

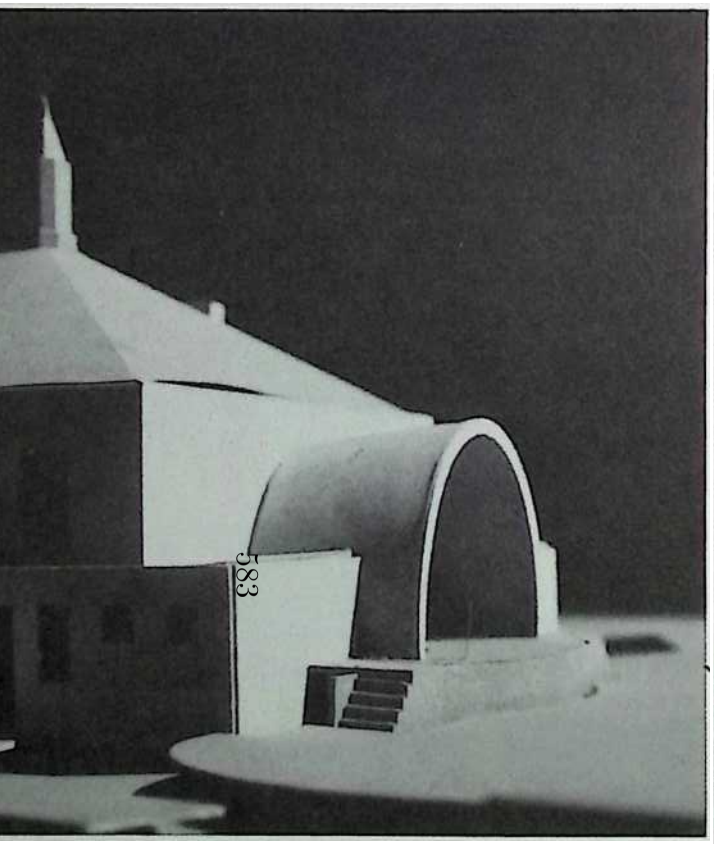
Amphitheater,

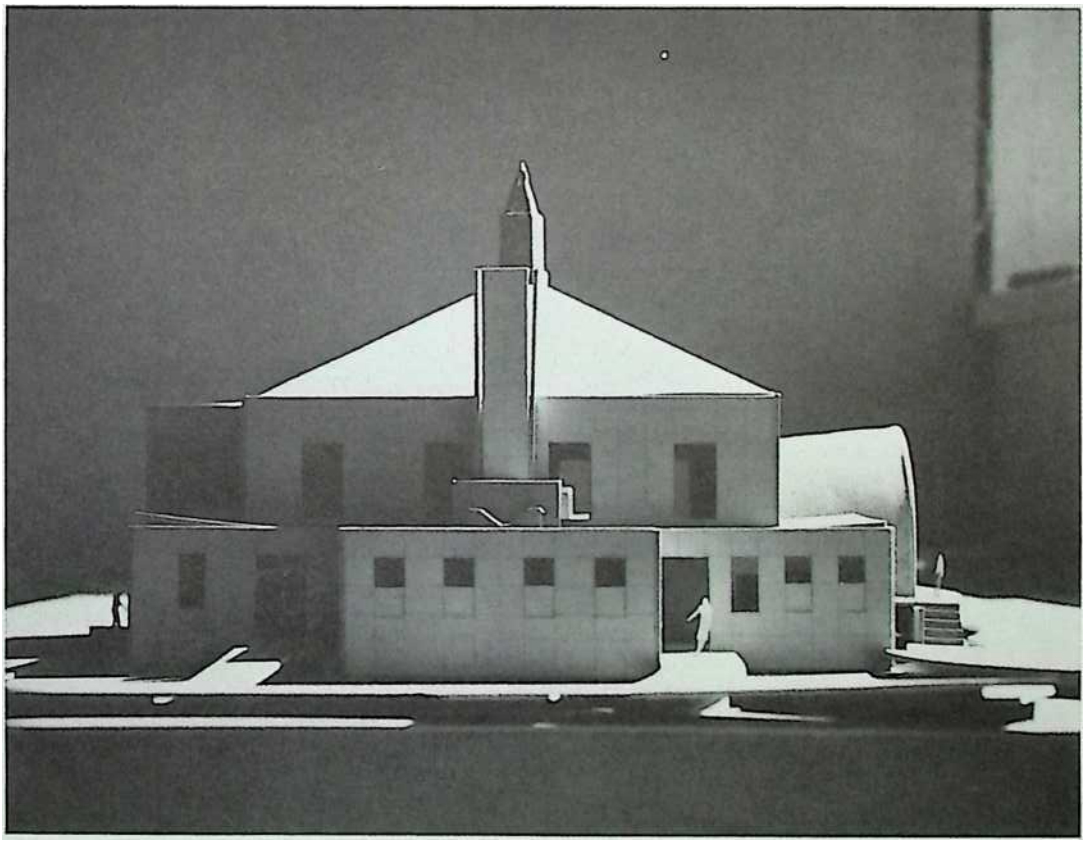
New York City

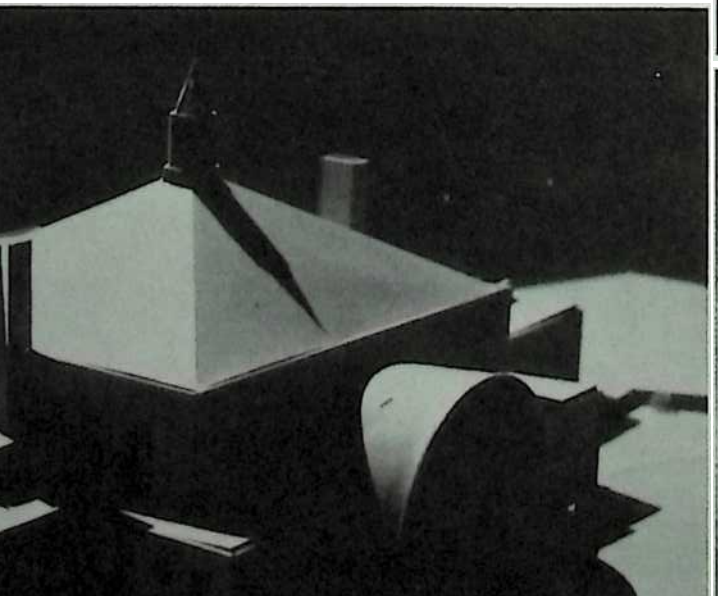
Fuller & Sadao, 1977-1979

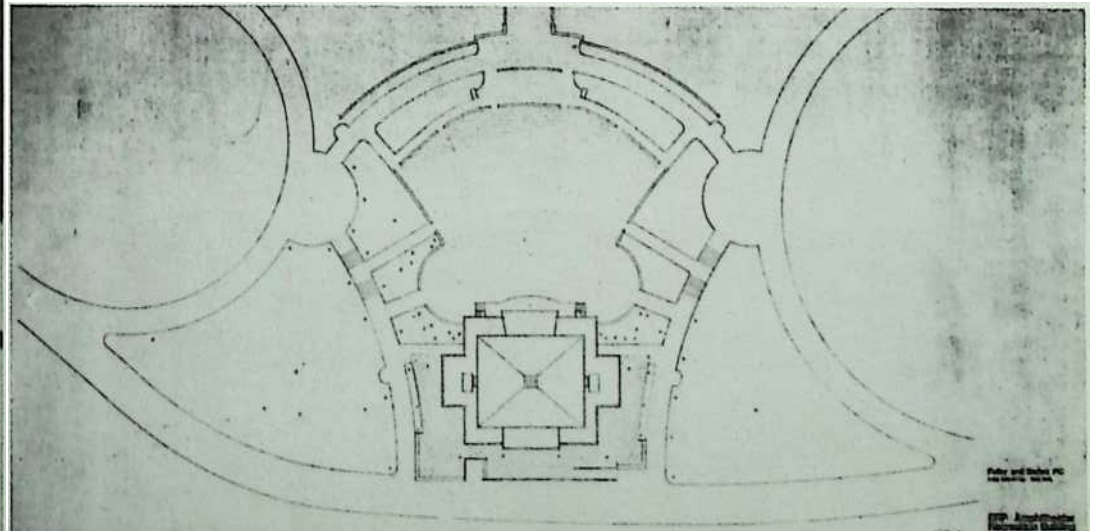
This is Fuller & Sadao's solution to the renovationremodeling of an obsolete structure on the Manhattan side of the East River. Community groups and the theater's future managers had considerable impact on the design adopted eventually.

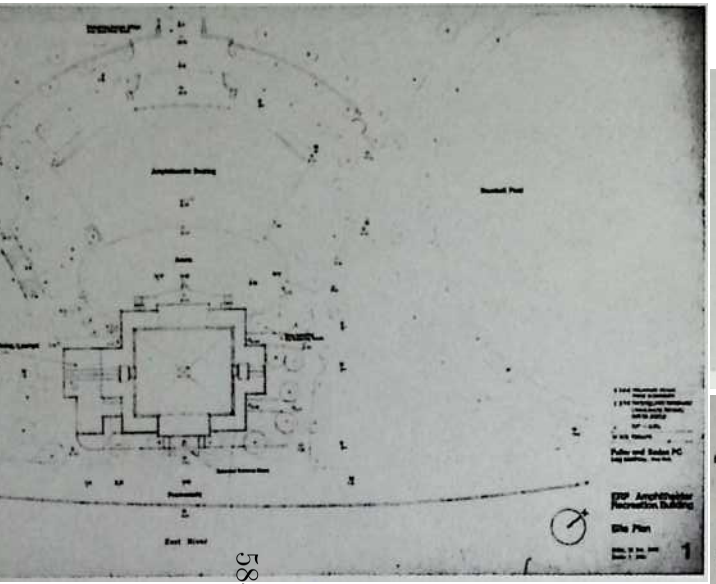


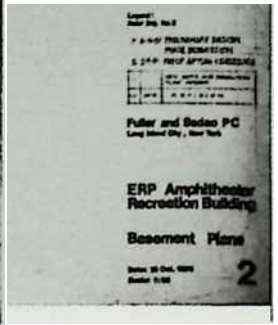


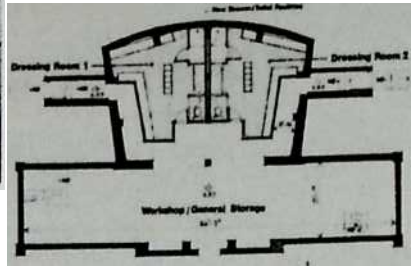


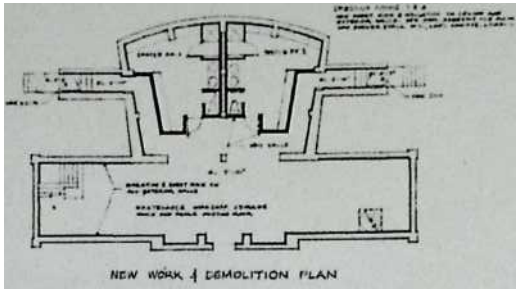


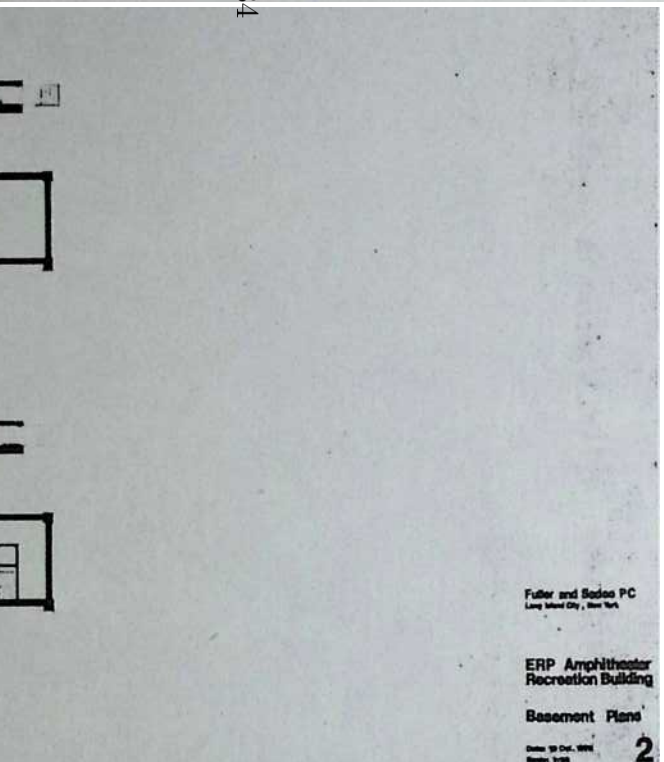


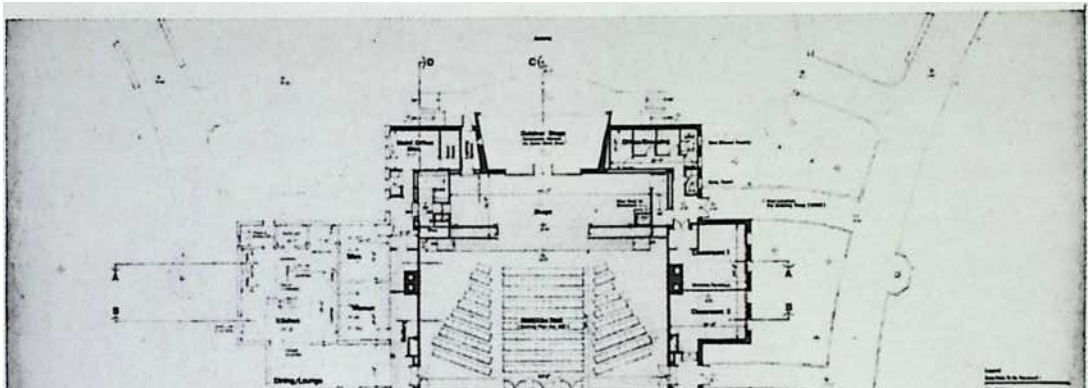

Fuller and Sadao PC
ERP Amphitheater
Recreation Building
Site Plan
1

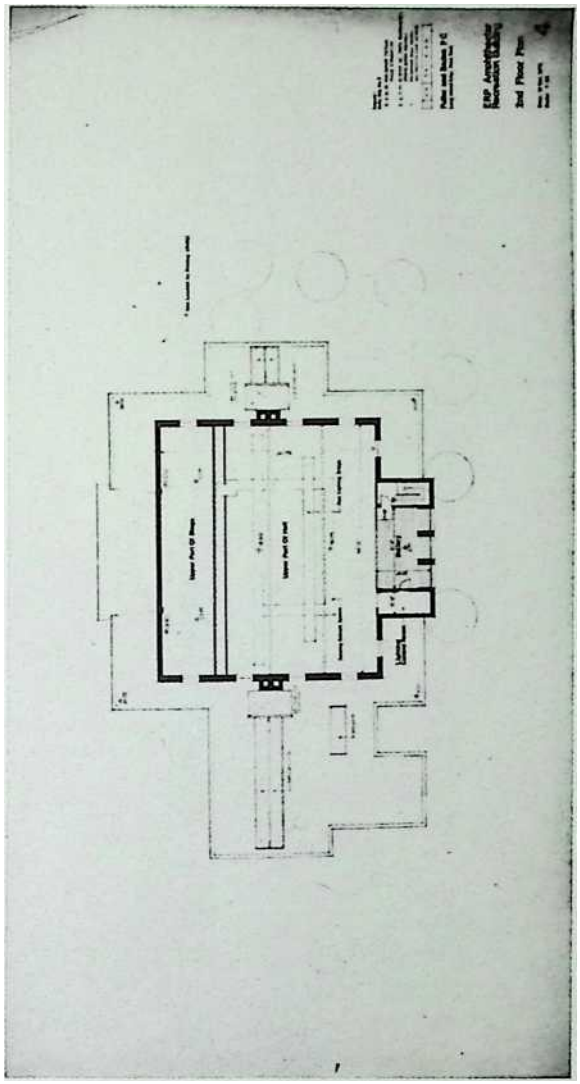

Fuller and Sadao PC
ERP Amphitheater
Recreation Building
Basement Plans
2

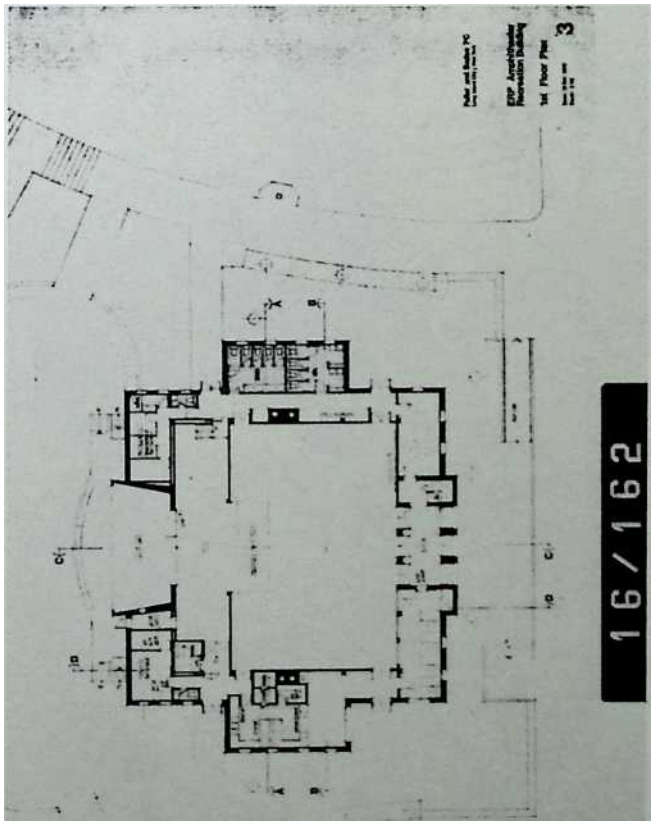

Dressing Room 1
Dressing Room 2
Workshop / General Storage

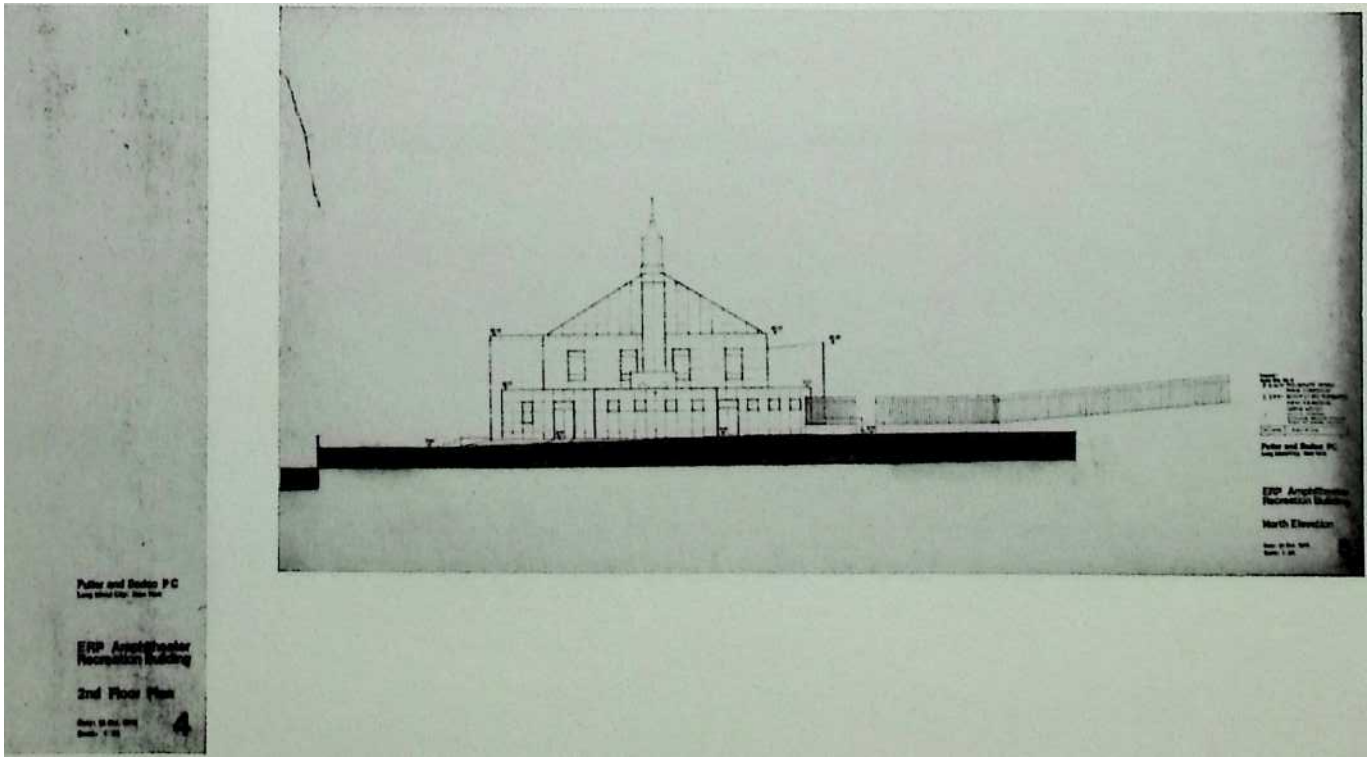

NEW WORK & DEMOLITION PLAN

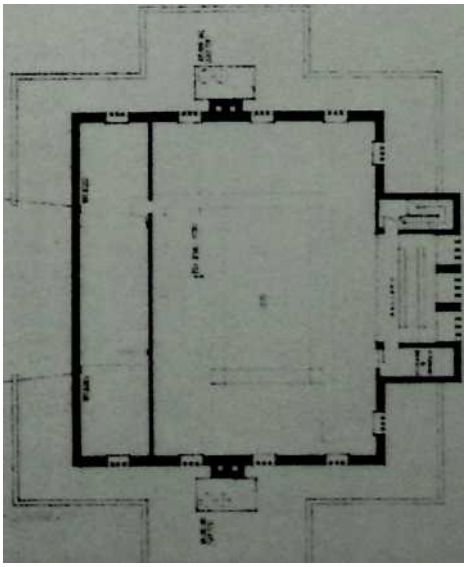

Fuller and Sadao PC
ERP Amphitheater
Recreation Building
Basement Plans
2

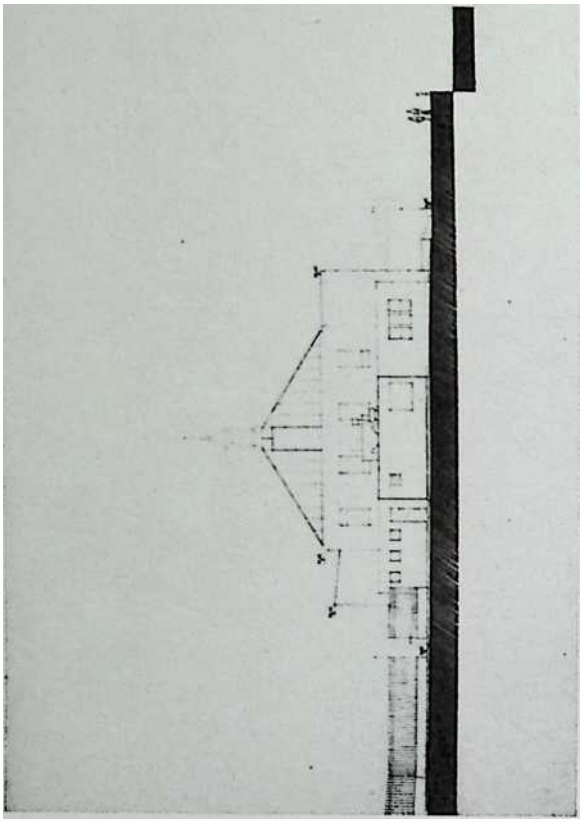


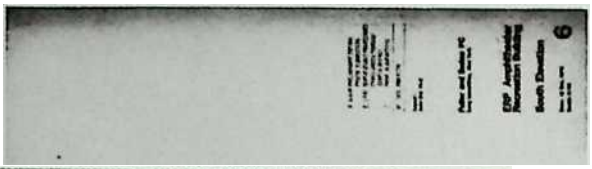


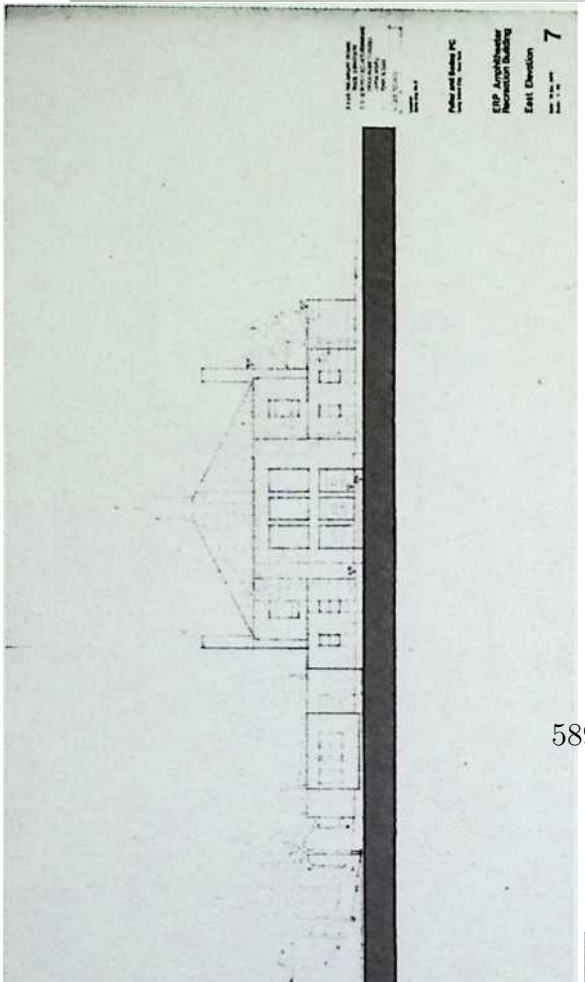

16/162

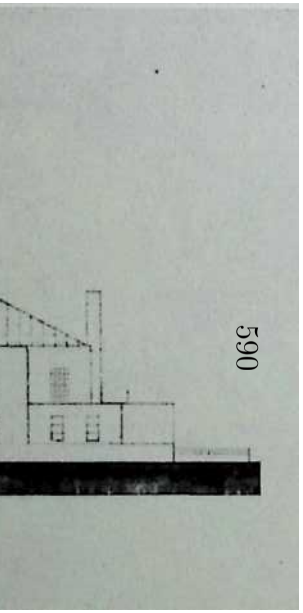

Potter and Boden P.C
ERP Amphitheater
Recreation Building
2nd Floor Plan
4
North Elevation

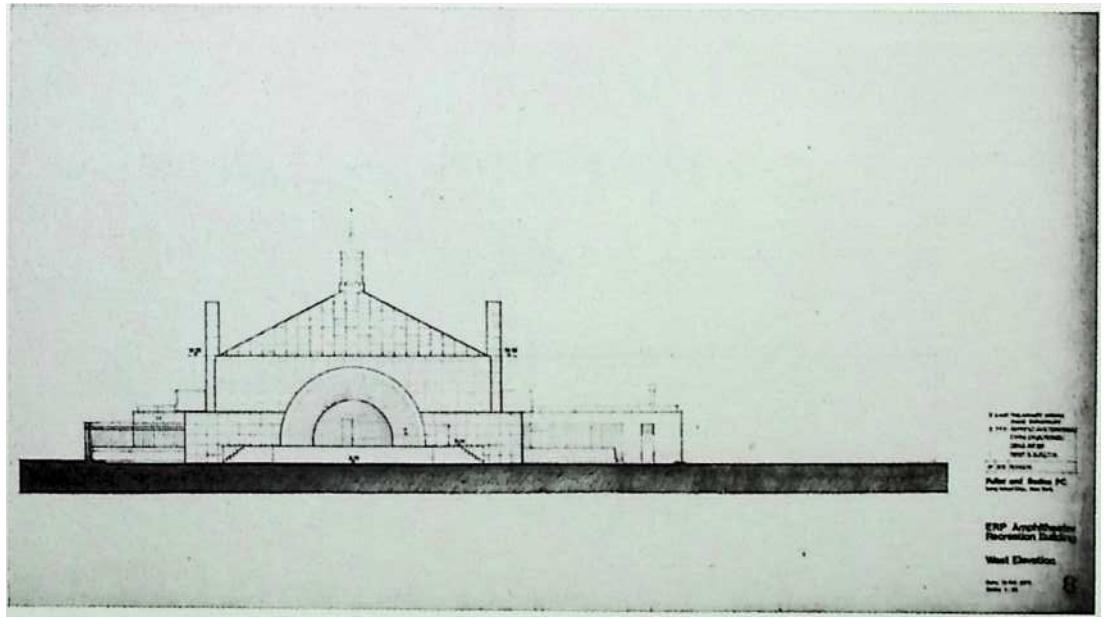


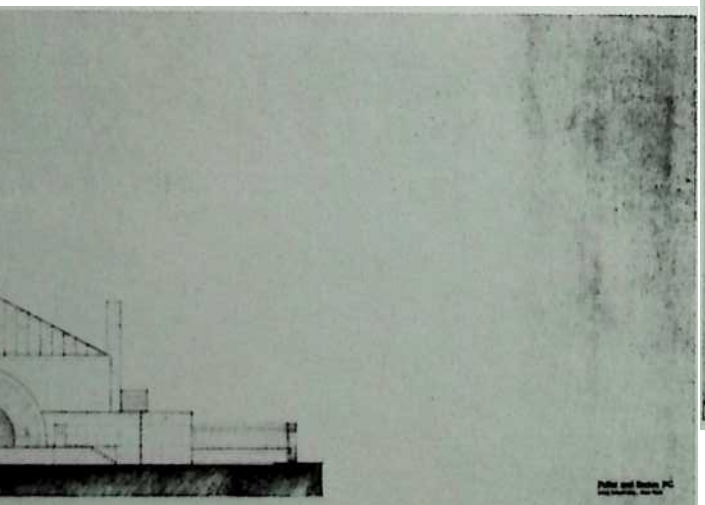


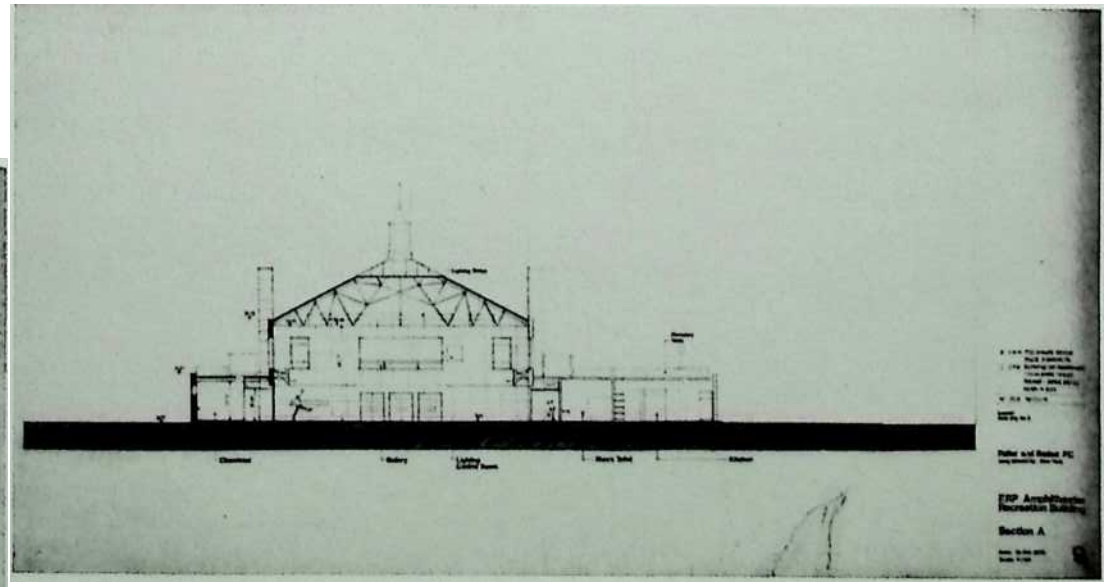


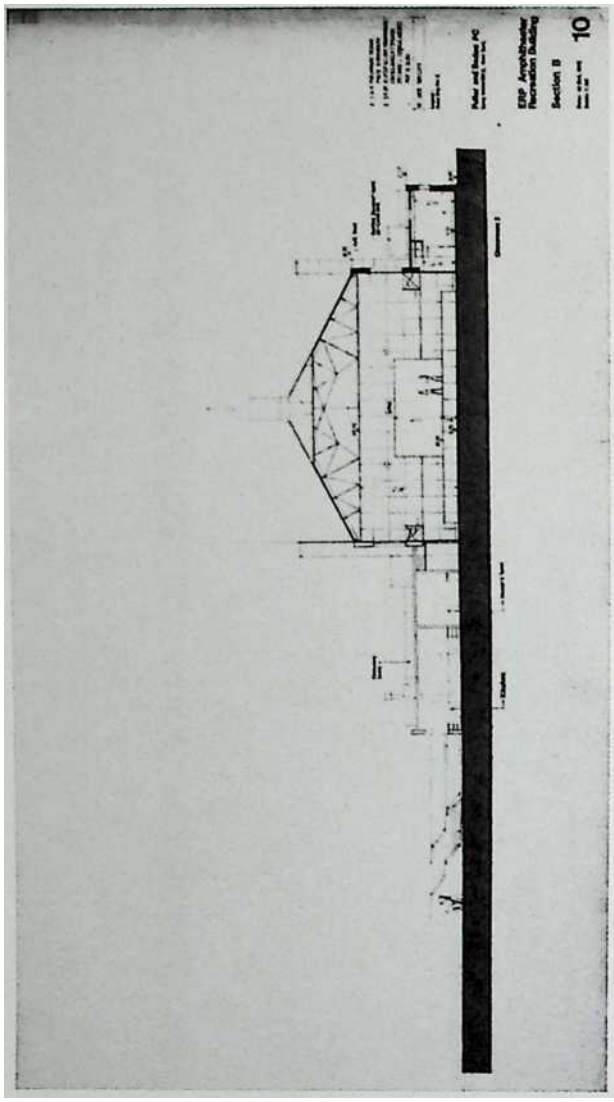


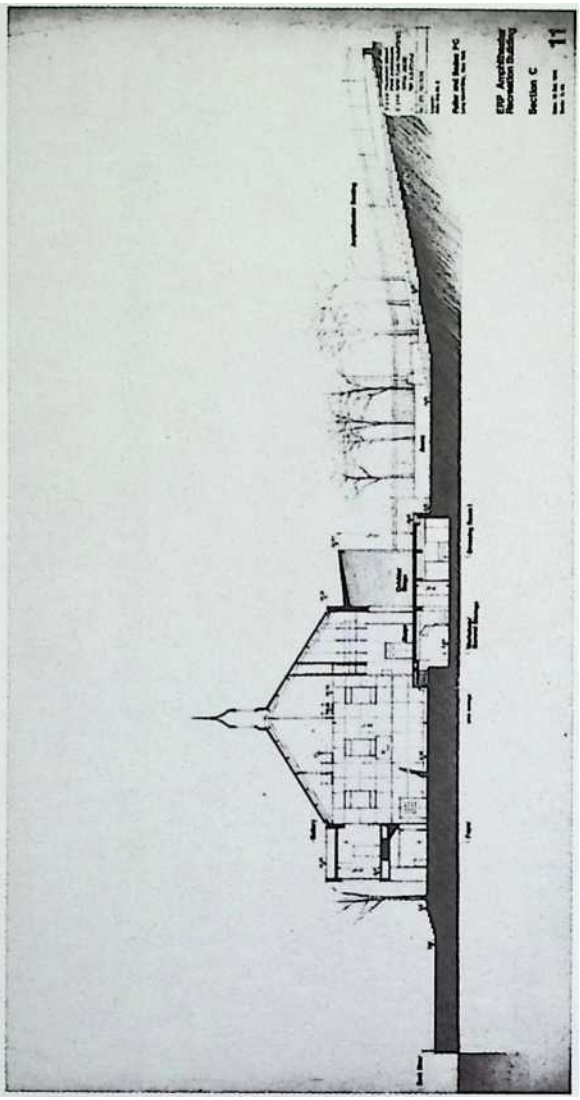


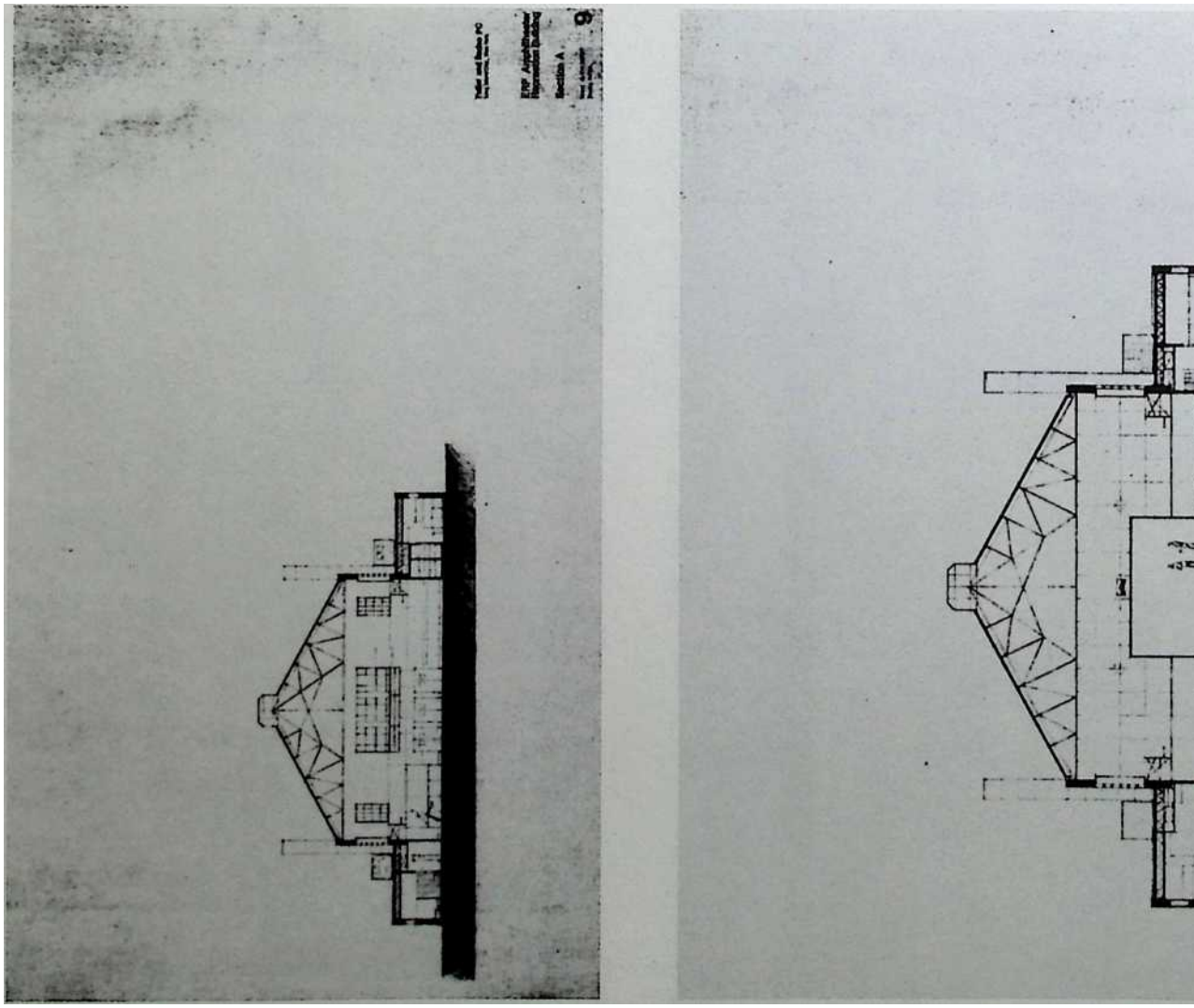

Pelter and Bailey PC
ERP Architecture
Recreation Building
West Elevation


Pelter and Bailey PC

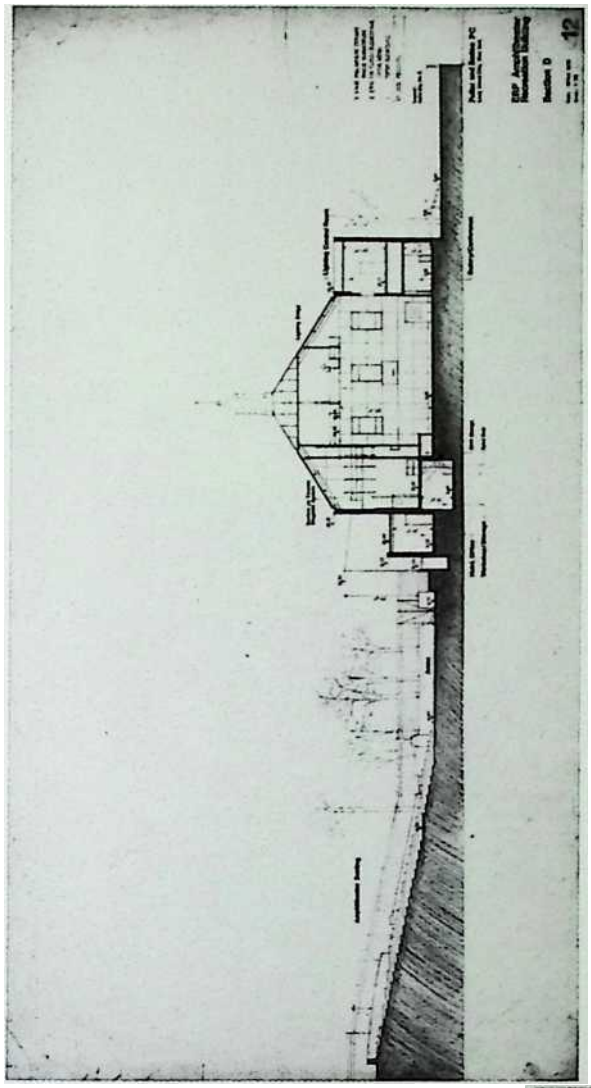

Pelter and Bailey PC
ERP Architecture
Recreation Building
Section A

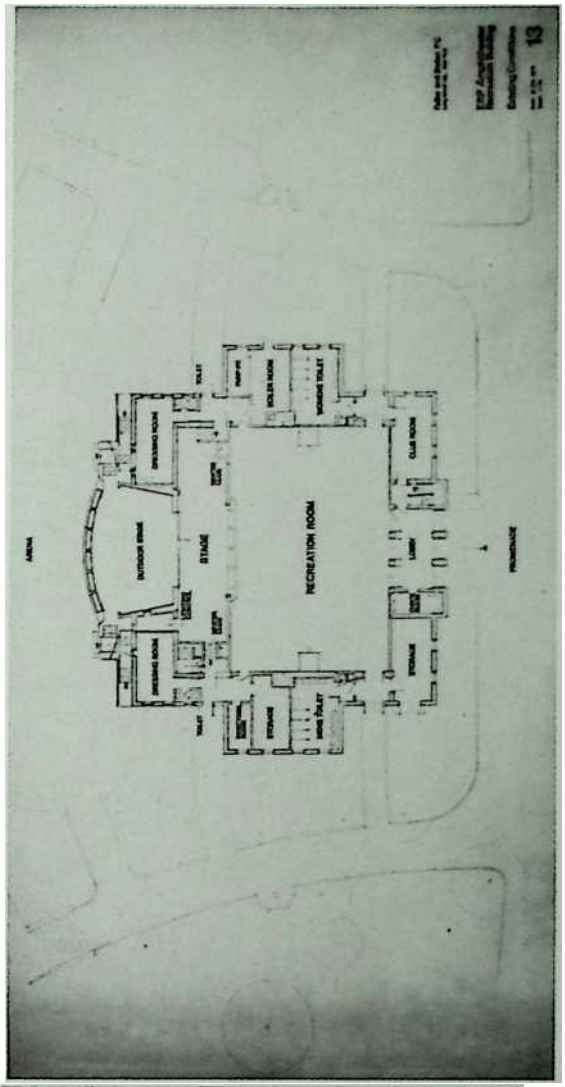

Peter and Rabbe P.C.
EFP Amphitheater
Recreation Building
Section B
10

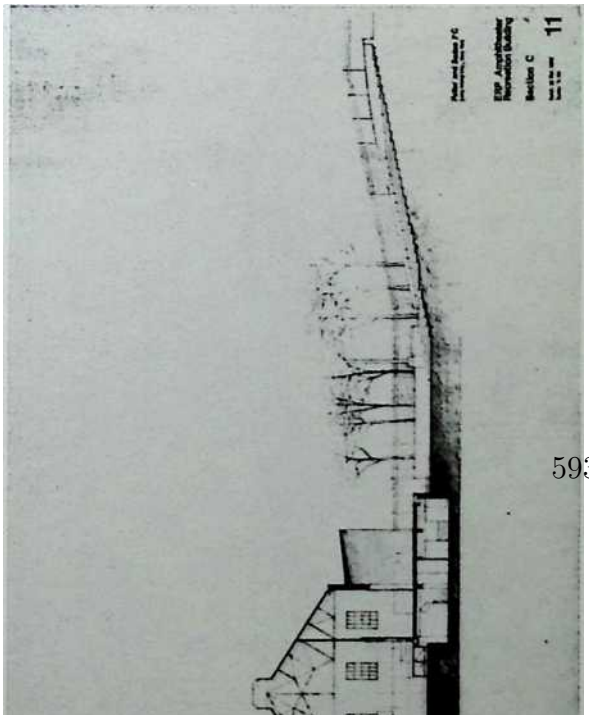

Peter and Rabbe P.C.
EFP Amphitheater
Recreation Building
Section C
11

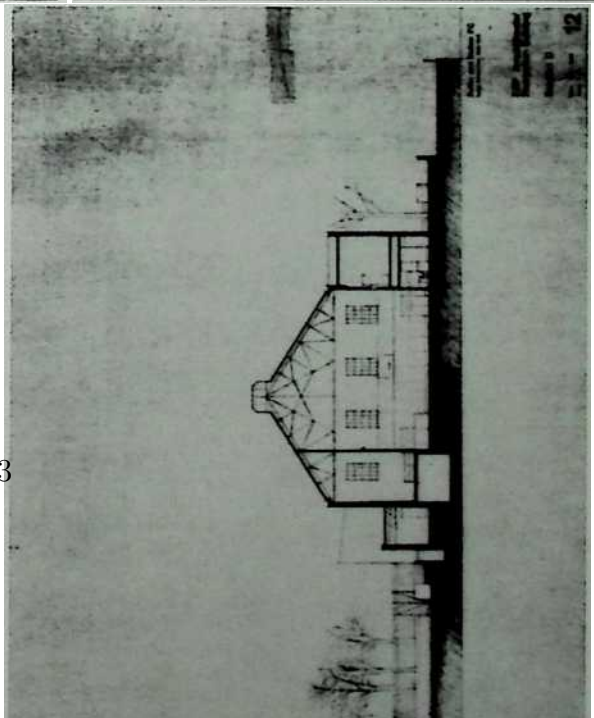


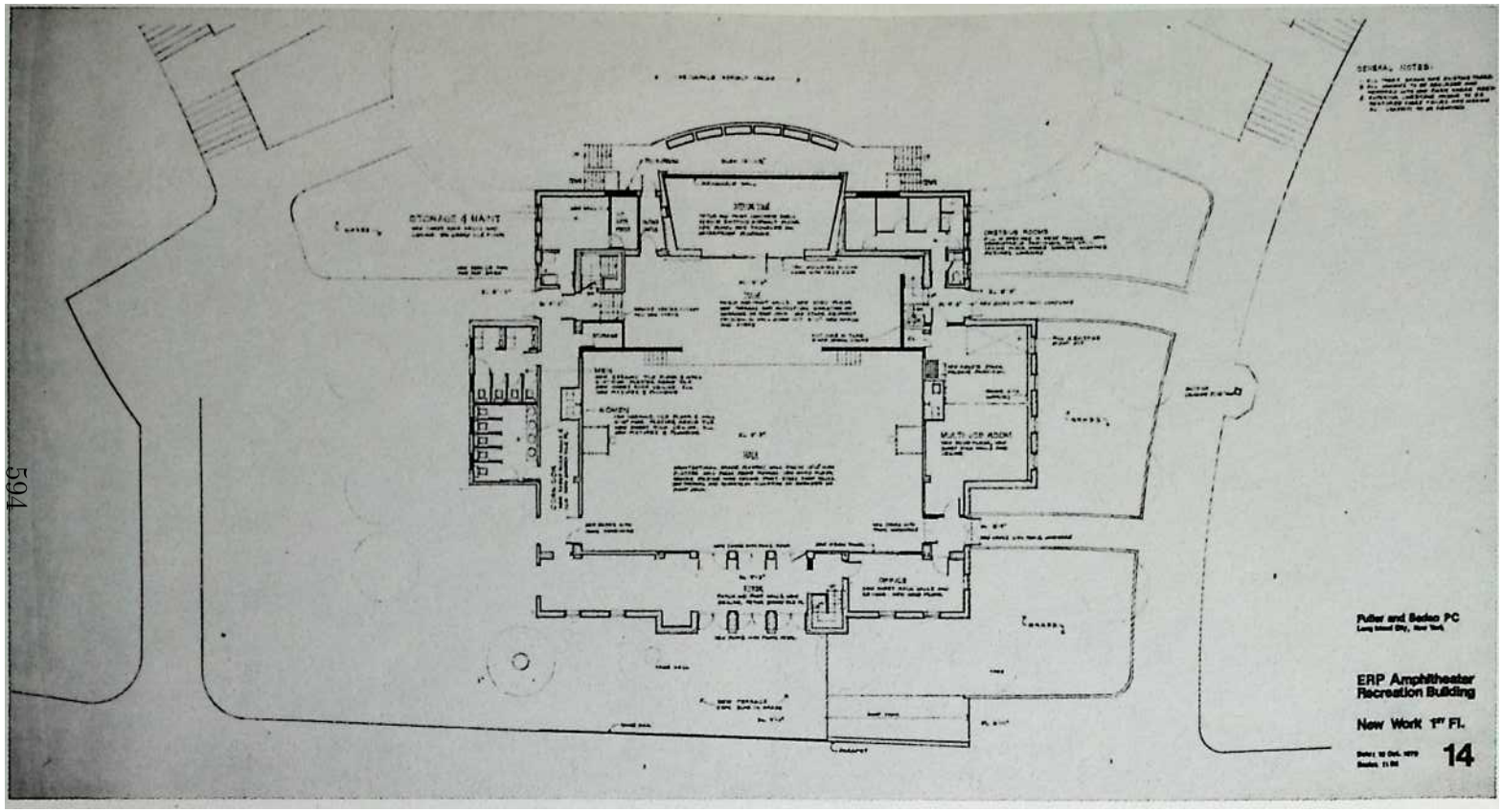
THE GEODESIC REVOLUTION. P/\RT 2 343

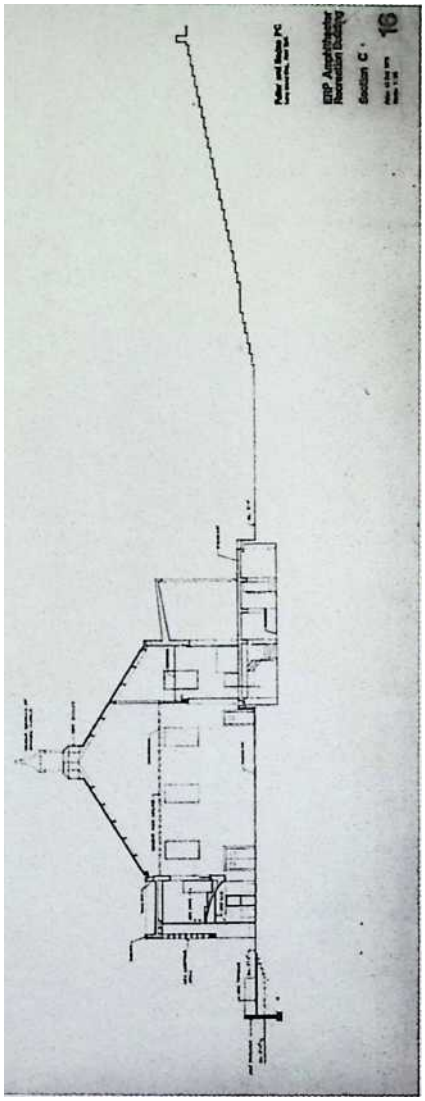


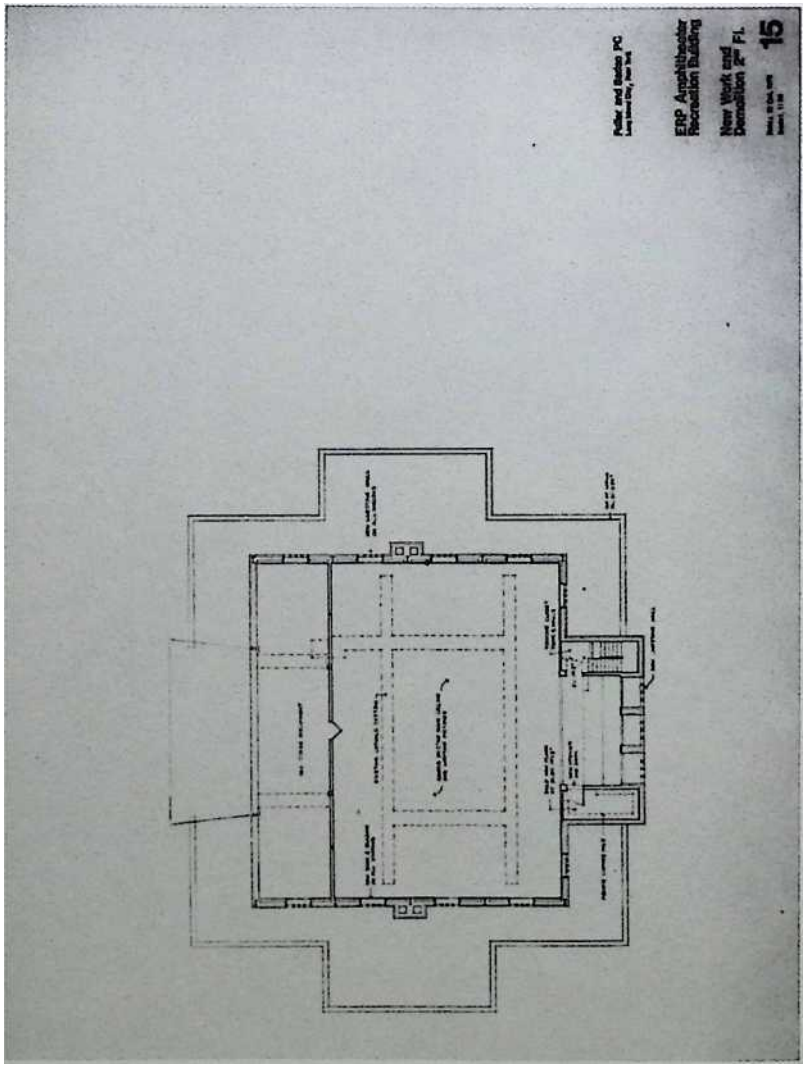

ARENA
OUTDOOR STAGE
DRESSING ROOM
STAGE
RECREATION ROOM
BOILER ROOM
WOMENS TOILET
CLUB ROOM
STORAGE
MENS TOILET
PROMENADE





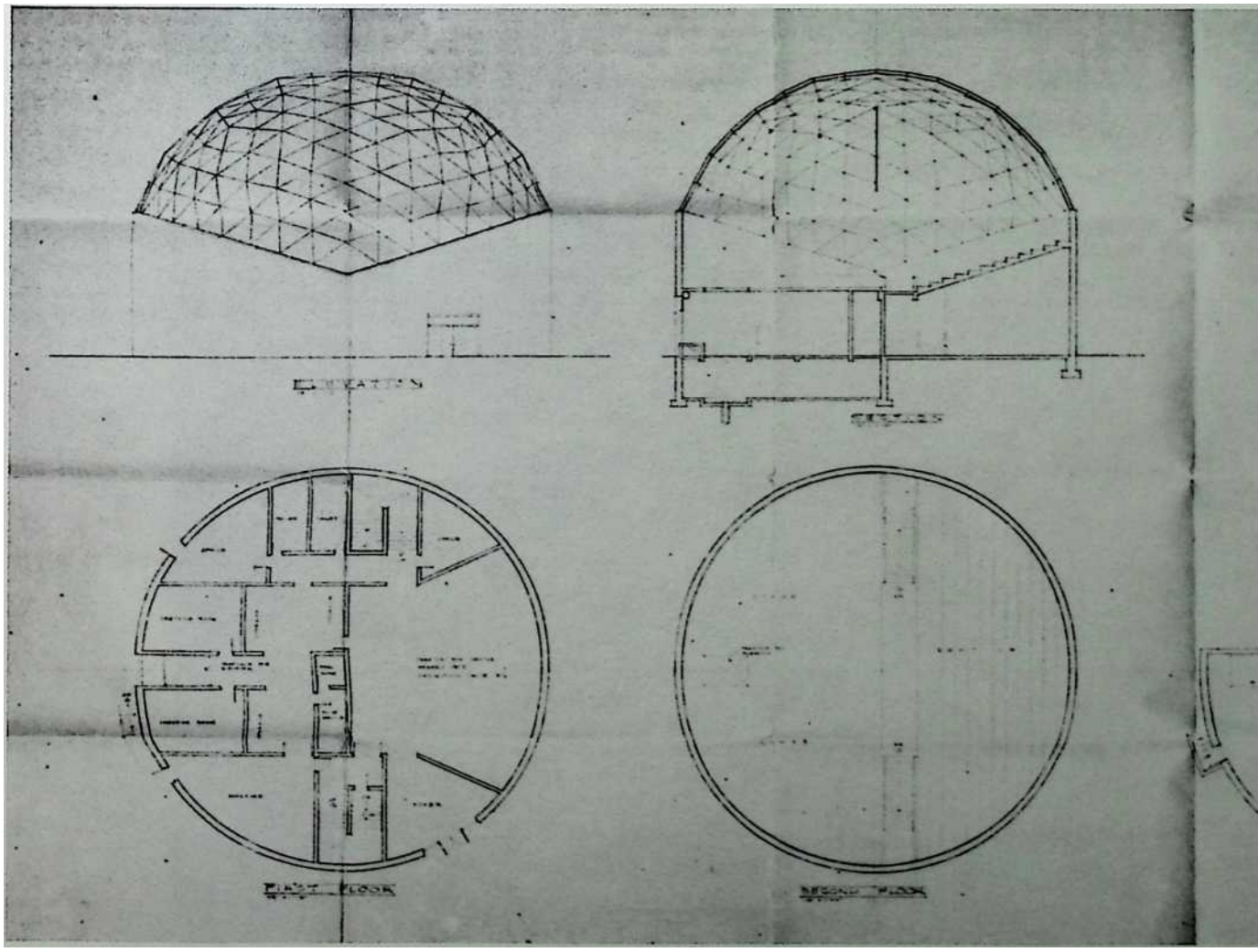

Fuller and Sedeo PC
ERP Amphitheater
Recreation Building
New Work 1st Fl.
14


Section C
16



Space Theater for Dance and Noguchi Sets Designed by Isamu Noguchi 1978

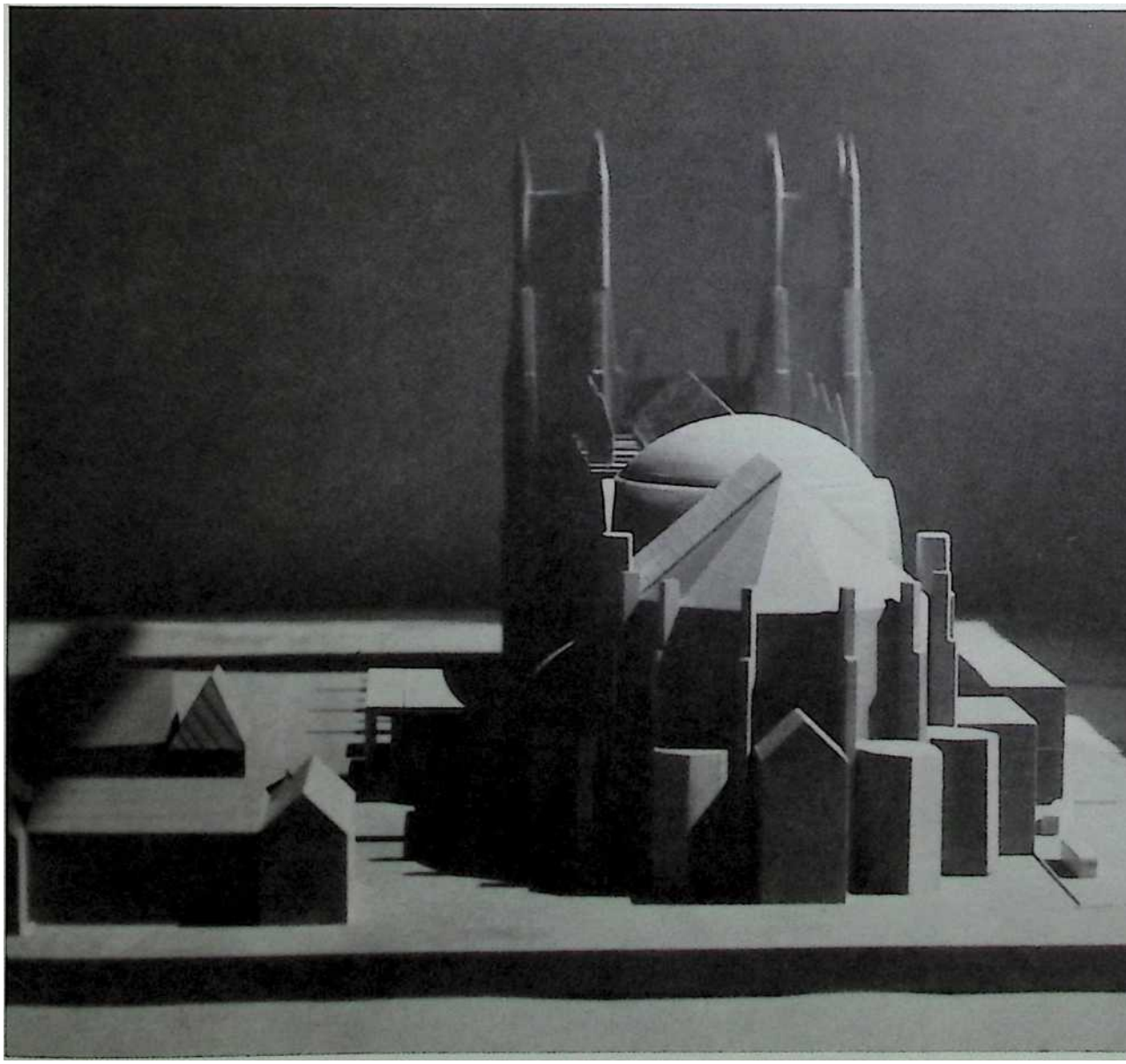
This would have been an elegant, circular, two-story theater with a masonry base and a geodesic roof. The tiers of seats are reached by way of a bifurcating staircase, and their diagonal arrangement is reflected by the lines where the masonry of the walls meets the glazing of the dome. The performers enter from a trap-door elevator located at center stage.

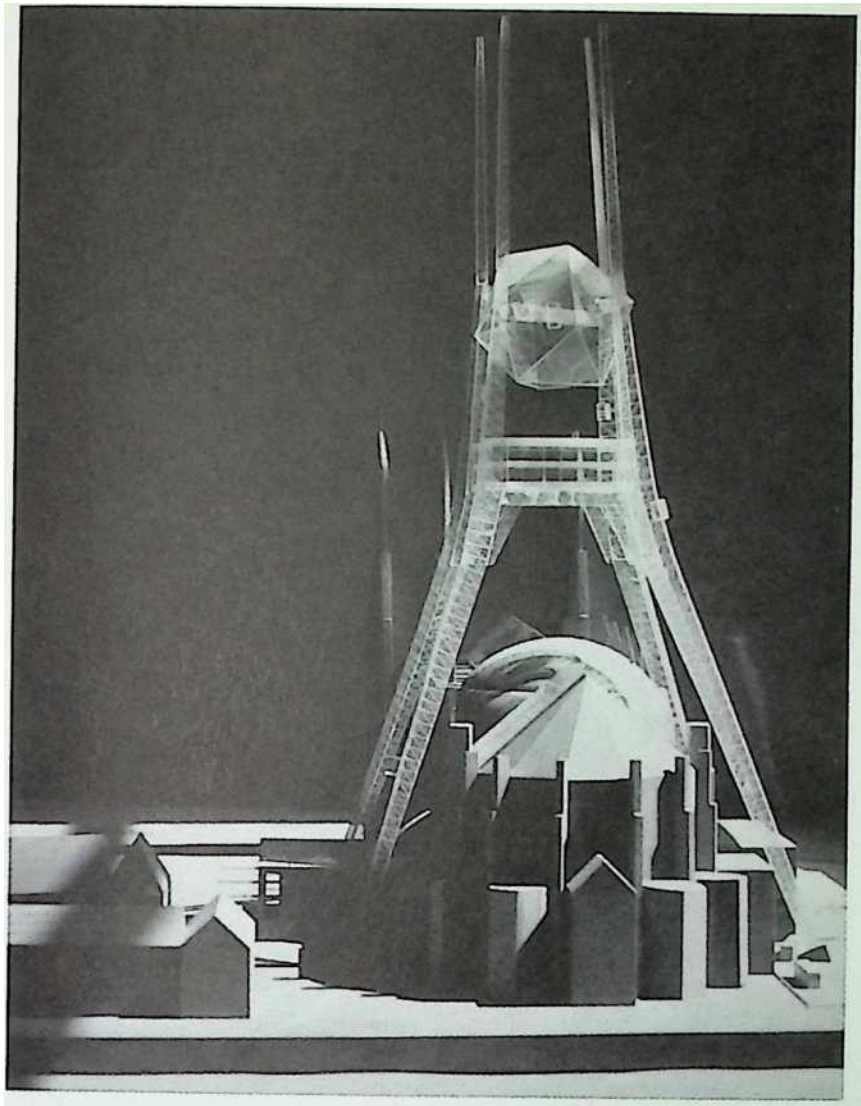


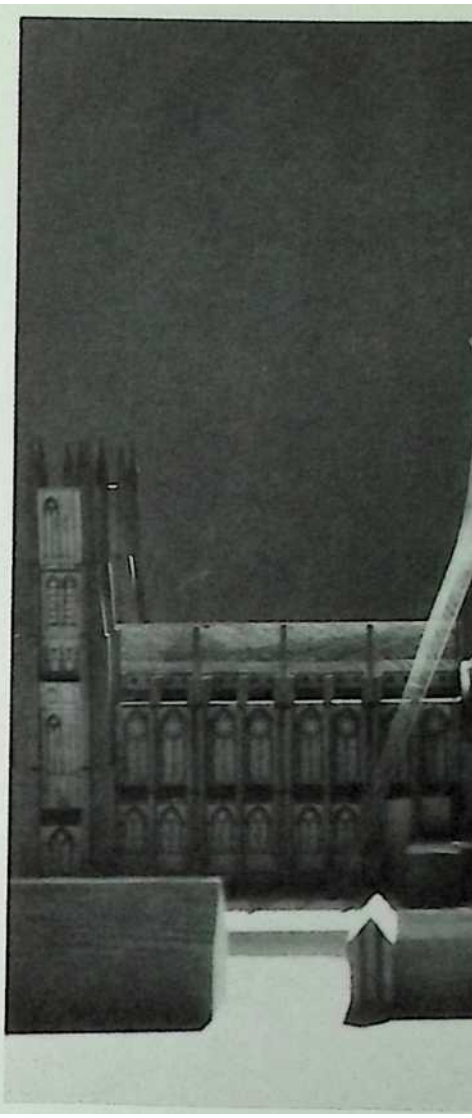
Icosahedron Tower for the Crossing of the Cathedral Church of St. John the Divine (Unexecuted), New York City Fuller & Sadao, 1978

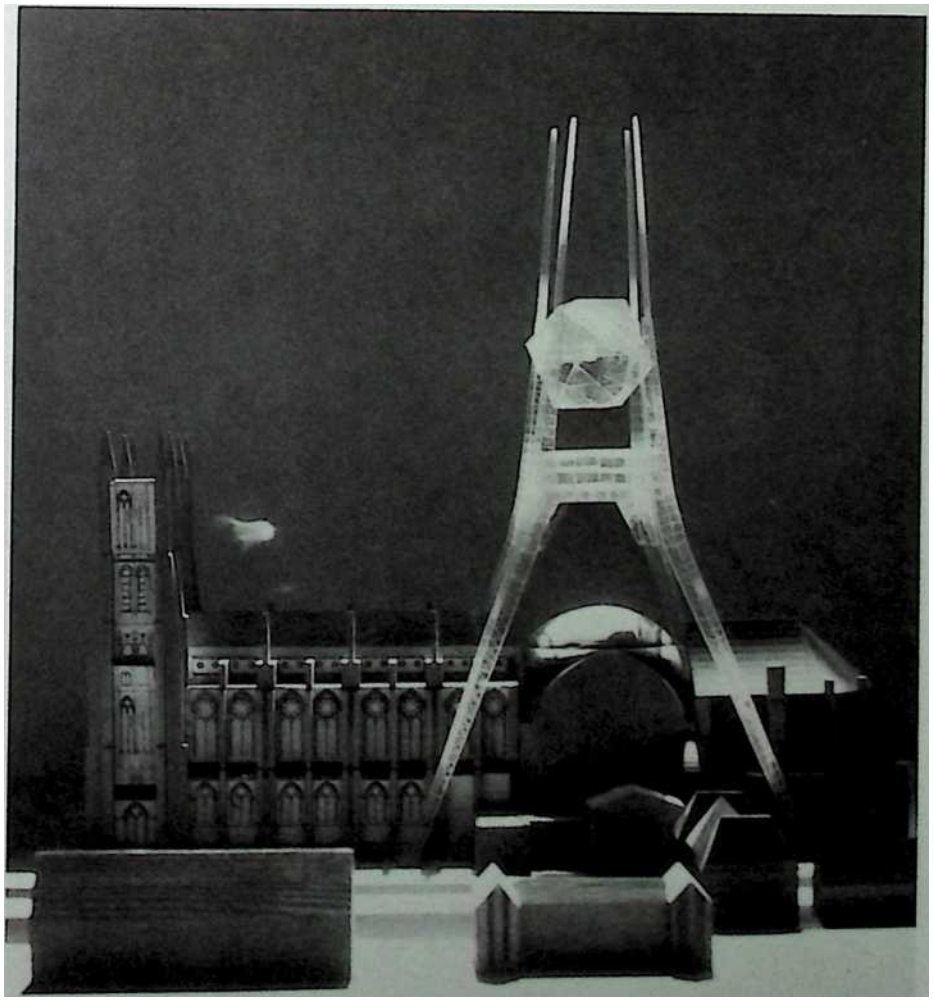
This icosahedron truss tower designed by Fuller & Sadao for the crossing of the Cathedral Church of St. John the Divine might seem to upstage the massive neo-Gothic structure as designed by Ralph Adams Cram. Fuller's revision of the design for the crossing would have incorporated four tall tetrahedron trusses in hyperbolic curves, forming a high-tech tower harmonious with existing stone finials.

These supports were to be united by a large, open icosahedron and by an observation platform. The church trustees apparently decided to adhere to the master plan of 1911; and thus the piquant combination of Fuller's futuristic structural style and its medieval antecedent remains unrealized.



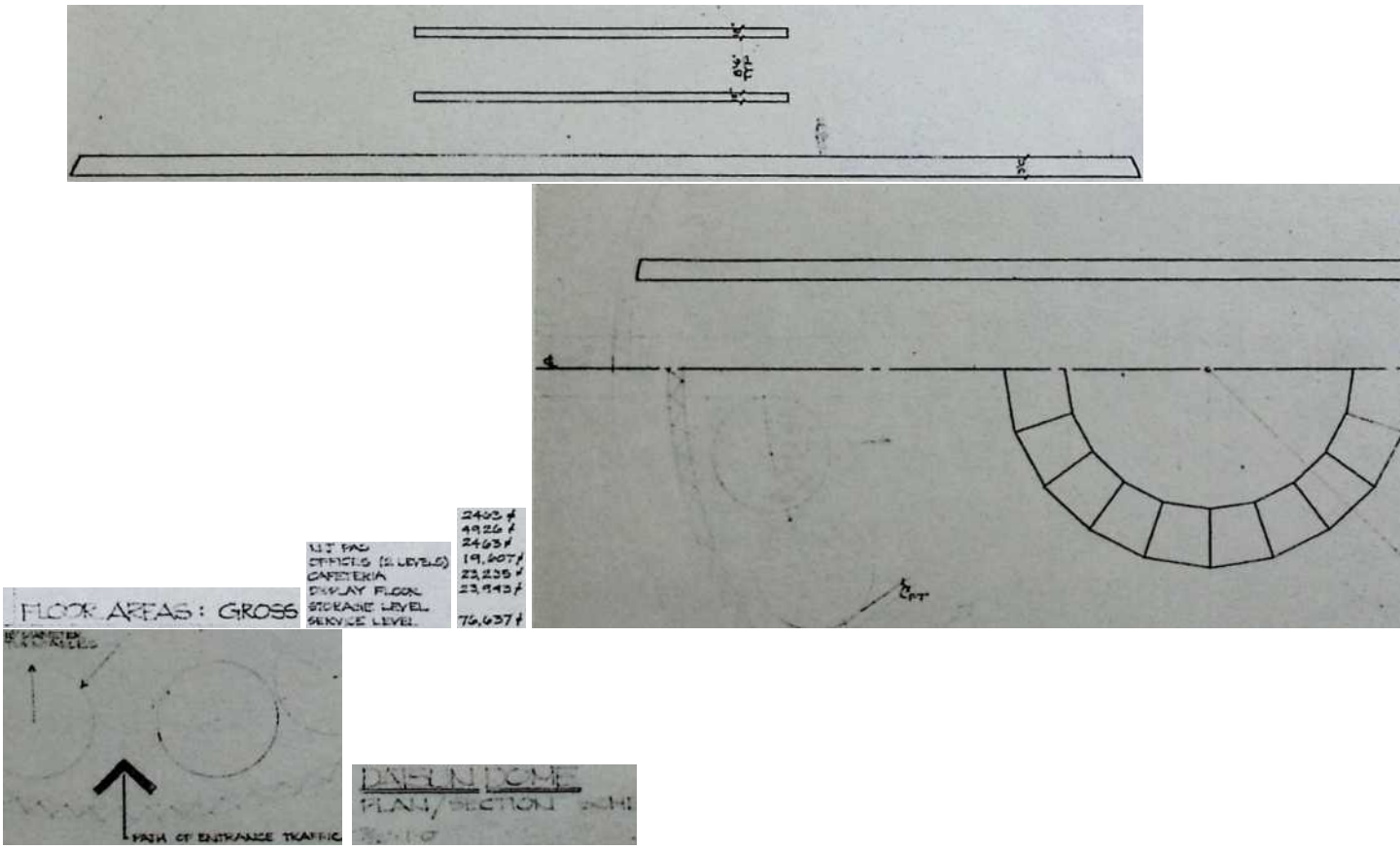






NJ's Datsun Dome for Wichita, Kansas Fuller & Sadao, 1978

This would have been the first geodesic dome with useful floor space up to the level of the interior apex. The office pavilion within this dome is eight stories high, flanks a service area and showroom, a restaurant, and is accessible via elevator or the vertiginous catwalks of the exterior staircase.



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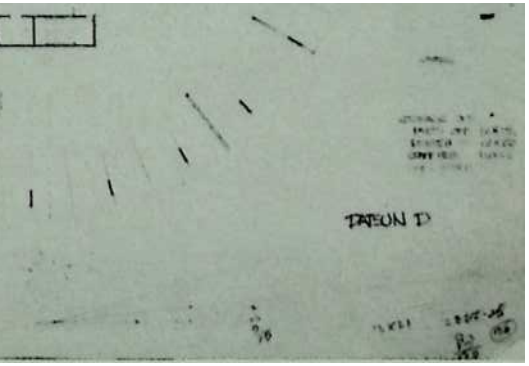
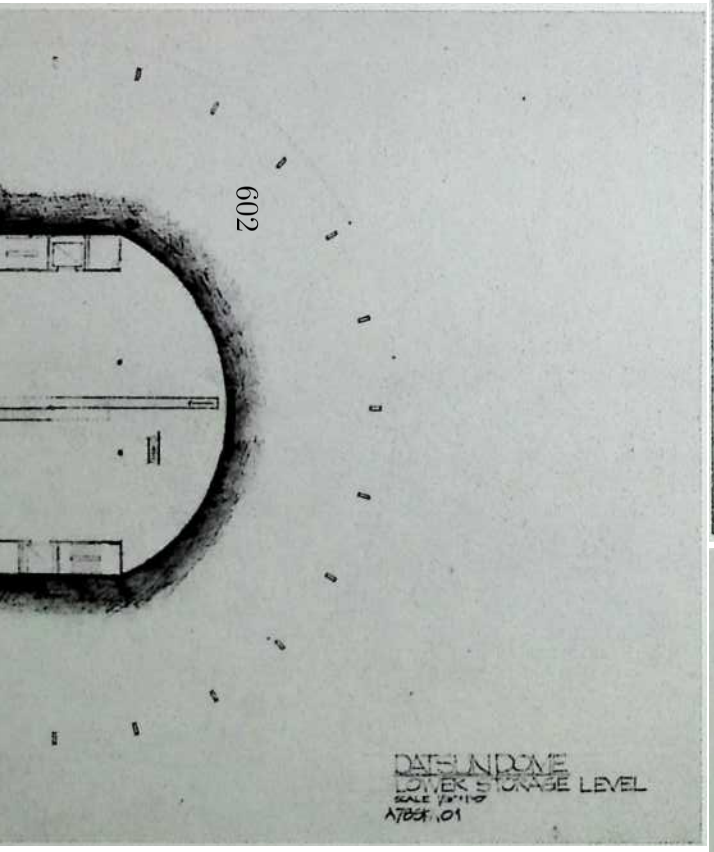
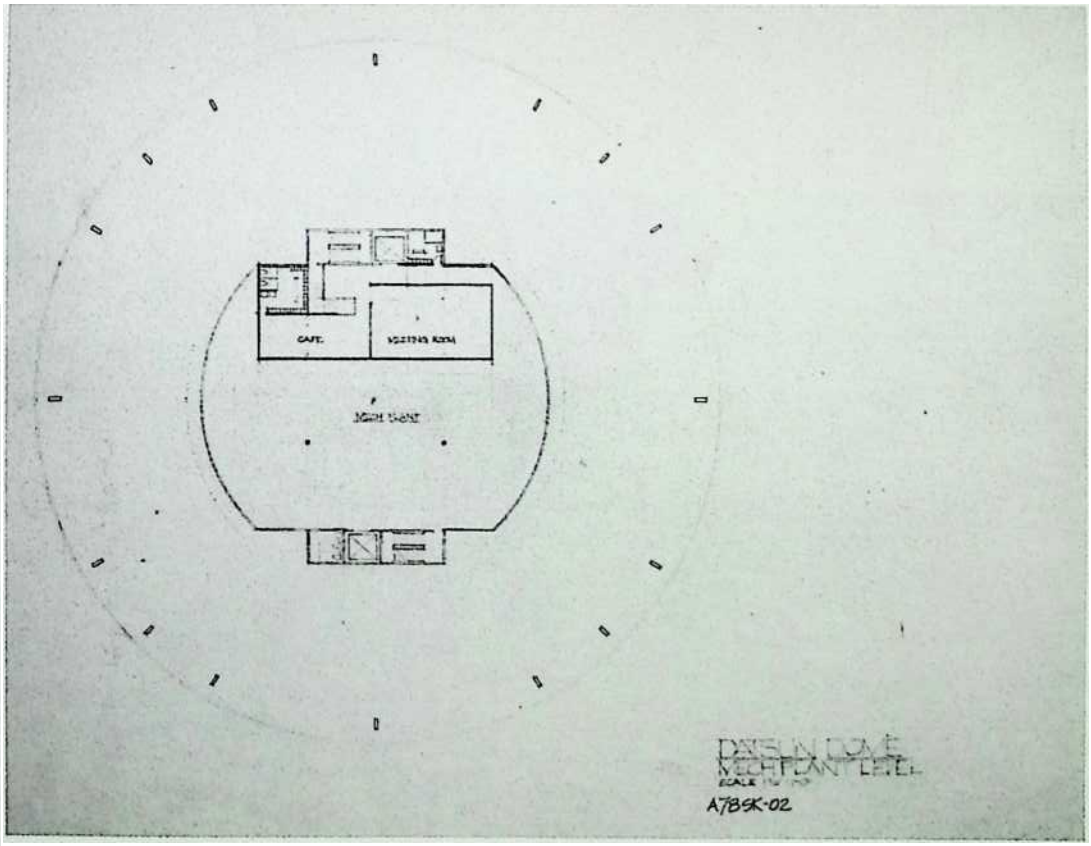
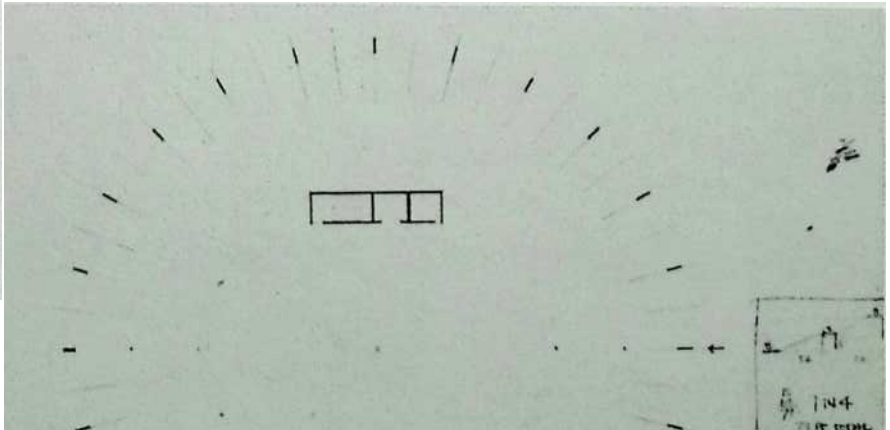
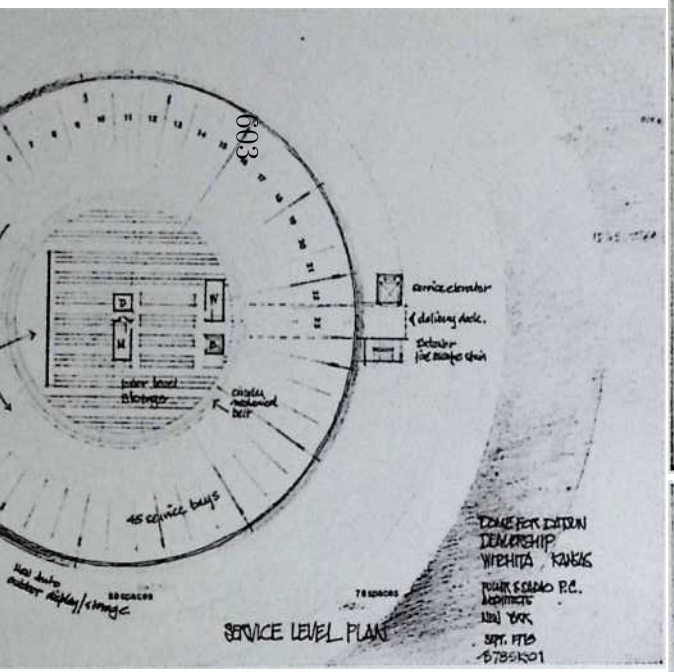
- -5

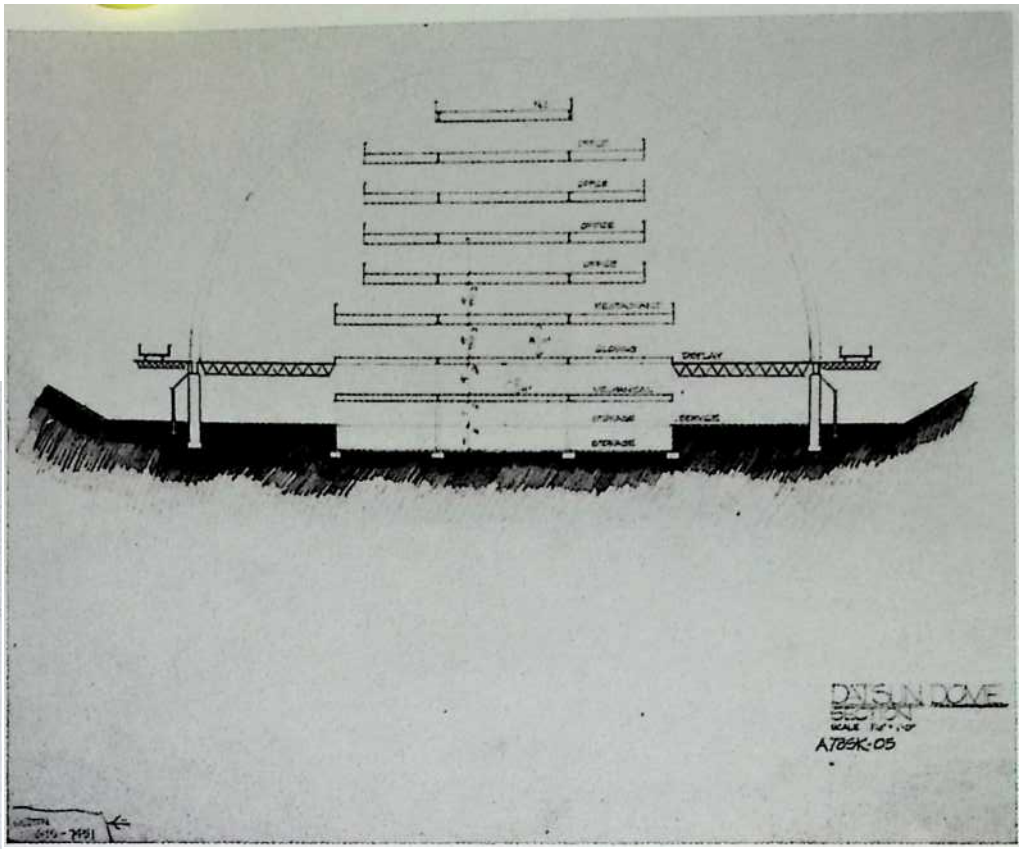

TATSUN D

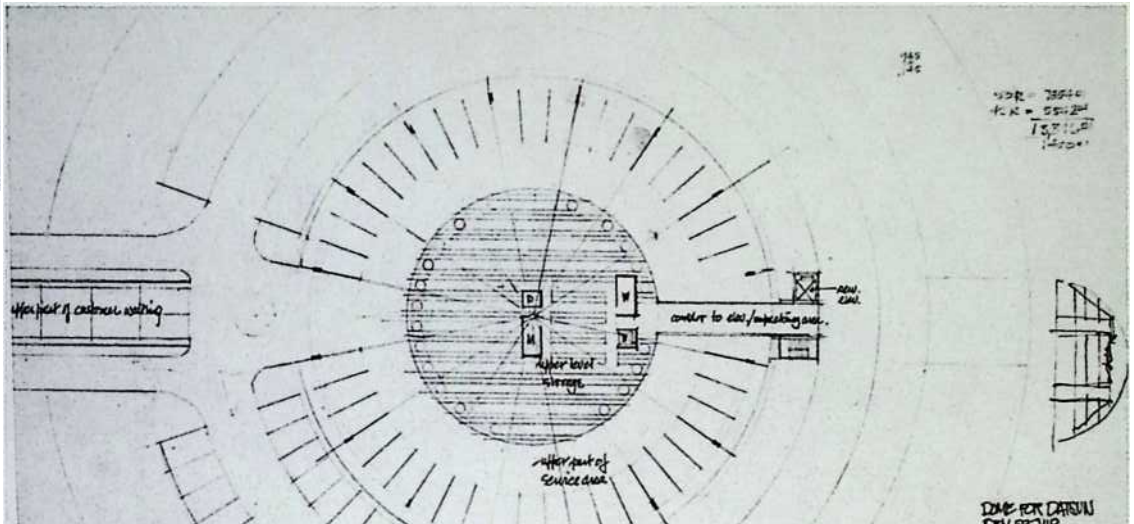

DATSUN DOME
LOWER STORAGE LEVEL
A7B5K.01

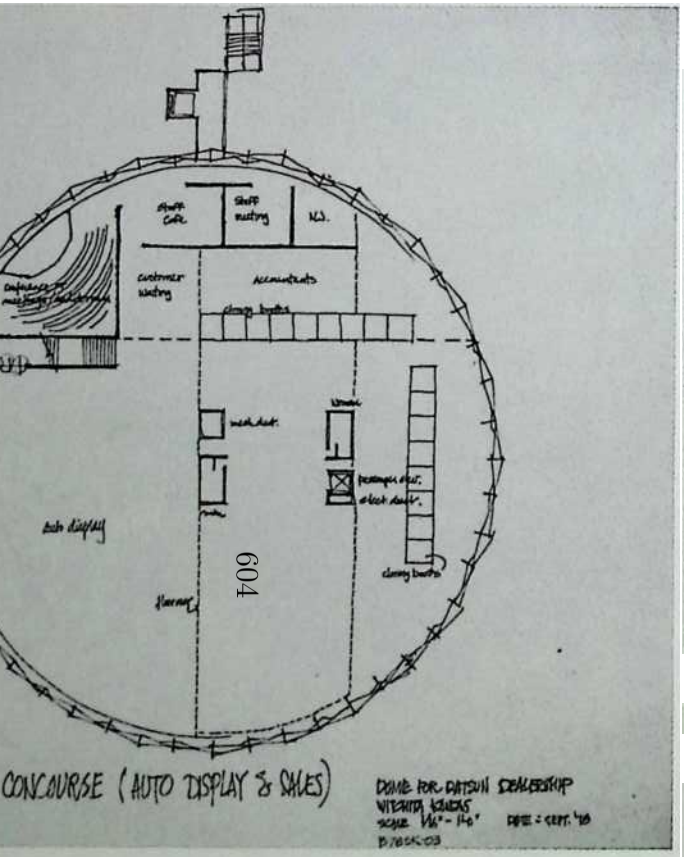

CAFE
DATSUN DOME
MEZZANINE LEVEL
A7B5K-02

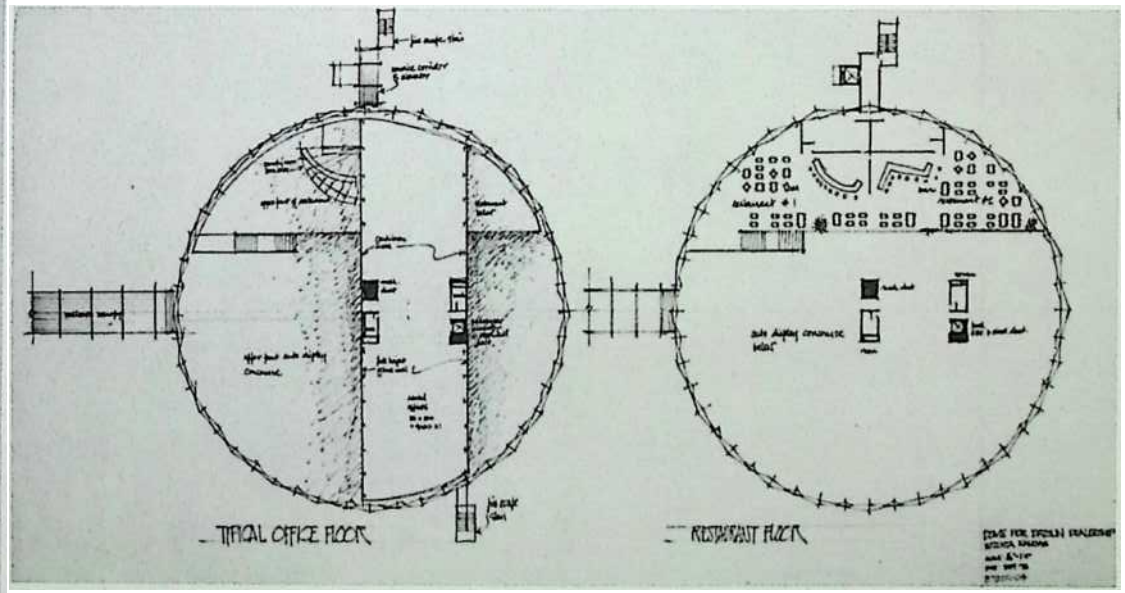


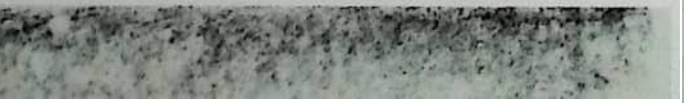

service elevator
delivery dock.
45 service bays
DOME FOR DATSUN
DEALERSHIP
WICHITA, KANSAS
SERVICE LEVEL PLAN

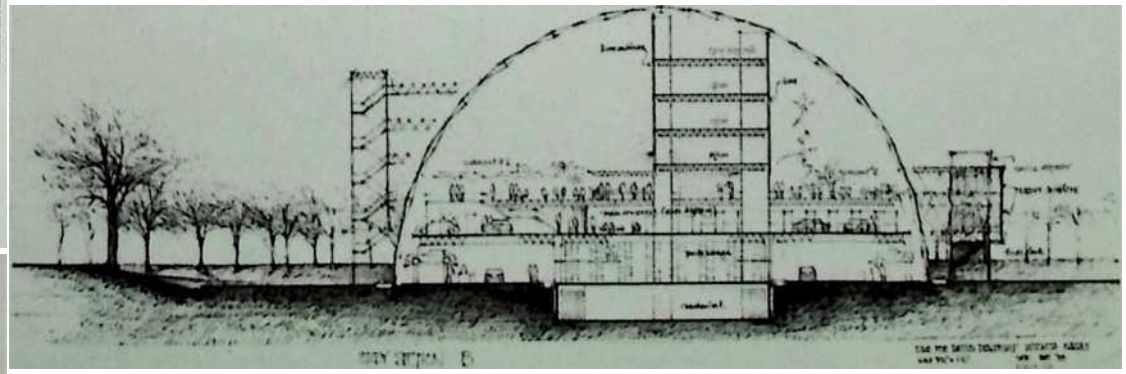

DISPLAY
SERVICE
STORAGE
DESIGN DOME
SECTION
A785K-05

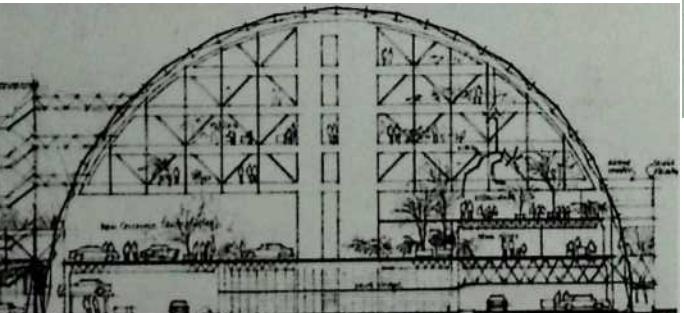

upper level storage
upper part of service area
DOME FOR DATSUN

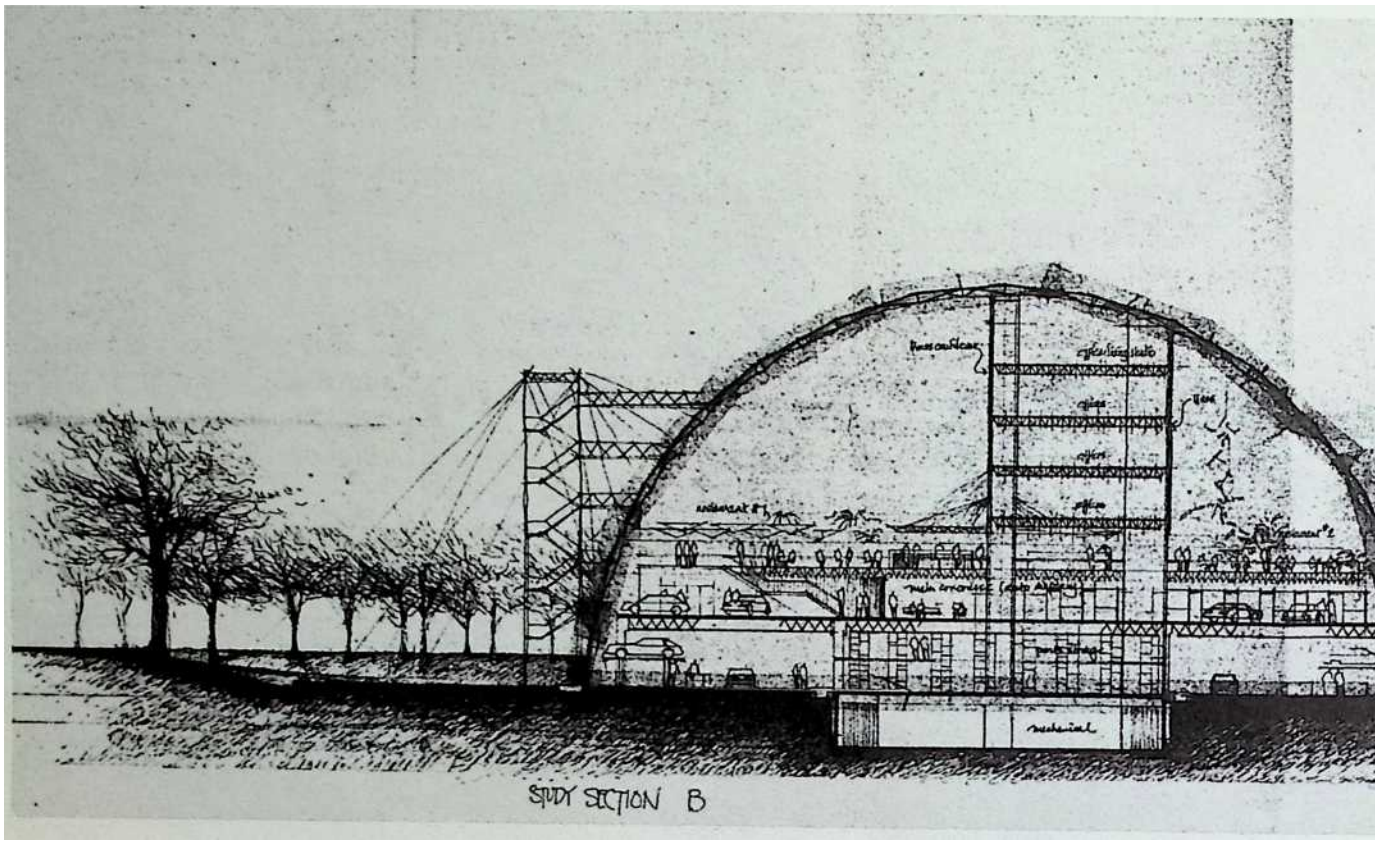

customer waiting
accountants
auto display
CONCOURSE (AUTO DISPLAY & SALES)
DOME FOR DATSUN DEALERSHIP
WICHITA KANSAS


TYPICAL OFFICE FLOOR
RESTAURANT FLOOR





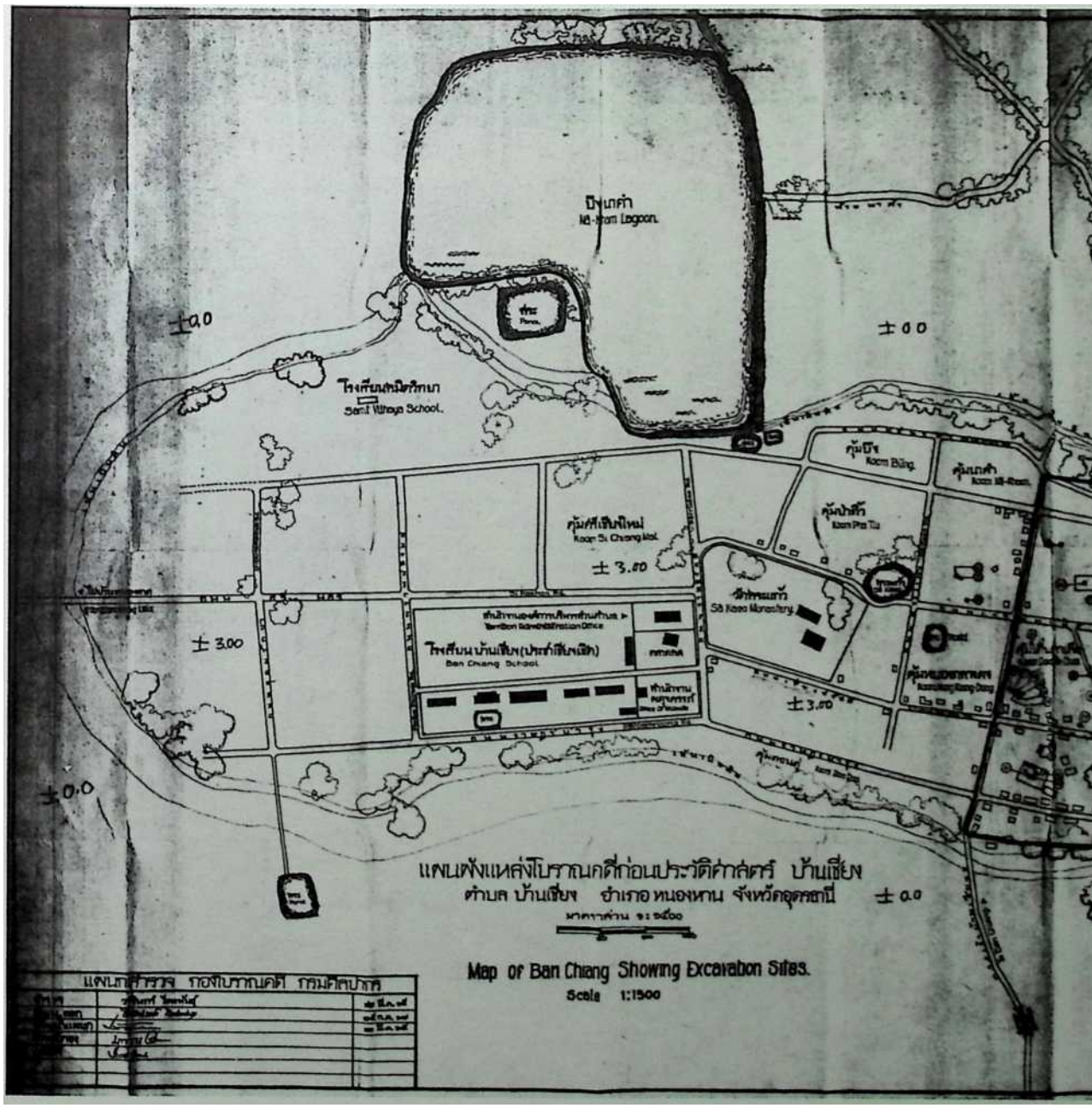




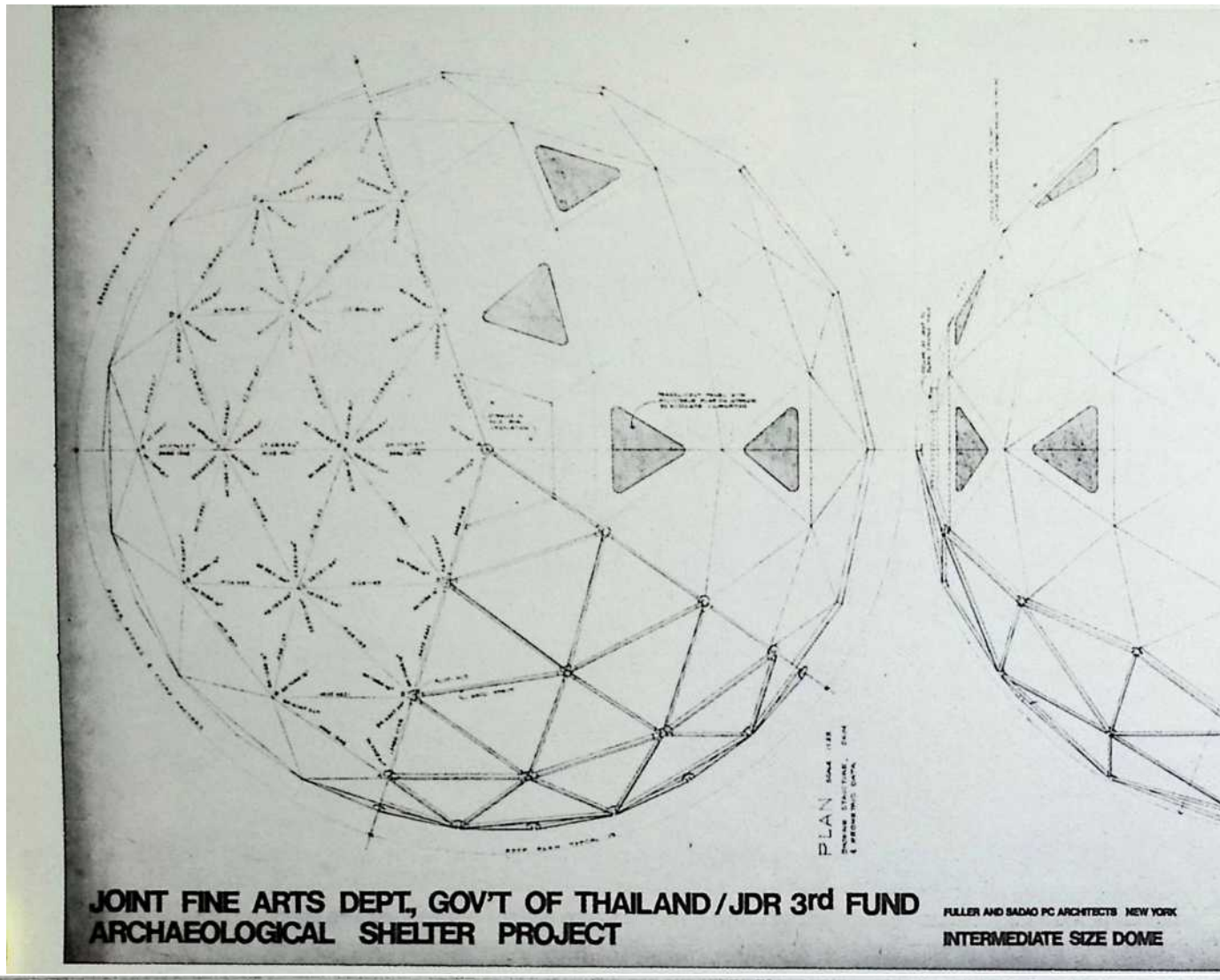
Archaeological Shelter Project at the Excavation Site of Ban Chiang, Thailand

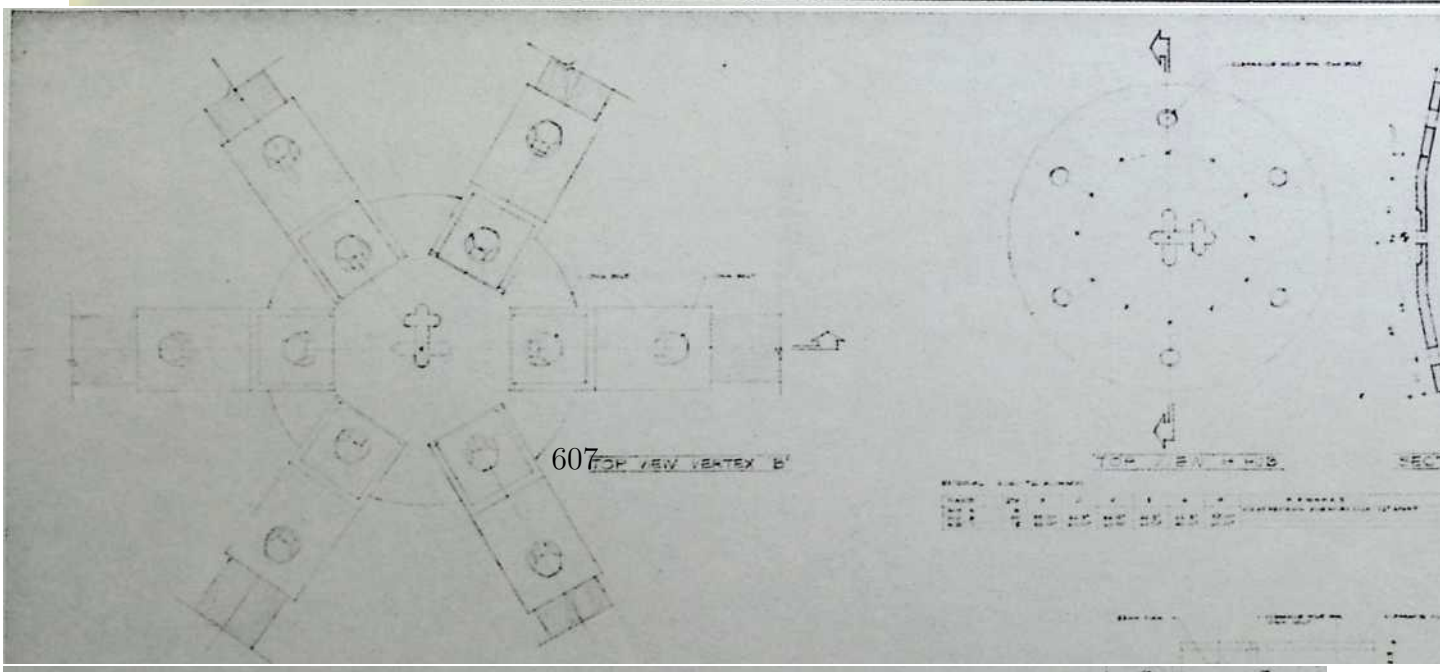
Fuller & Sadao, 1978–1979

The chief function of these small aluminum domes was to keep the sun's rays from disturbing the archaeologists at Ban Chiang and to protect the excavation site. The open spaces of the aluminum armature were sheathed by individual panels of tent material, some of which had plastic transparent panes to admit some natural daylight.



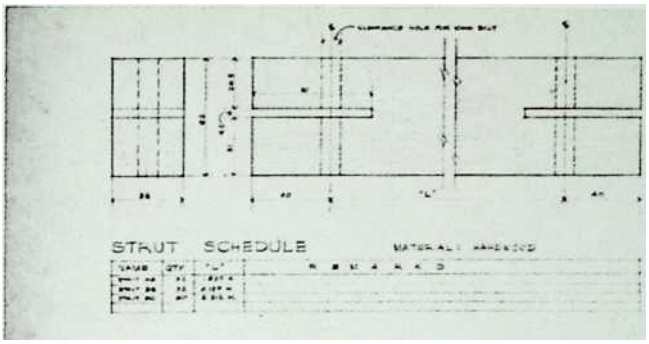
JOHT HNE ARTS DEPT, GOVT OF THALAND/JDR 3rd FIN) rvusiAN-DaMMOFCMOtnacra kwwrk dcdwchb dwq ^{W0}*/\SP^{mb} ARCHAEOLOGICAL SHELTER PROJECT ^{wTMwre}J^{nED0*e}. ;

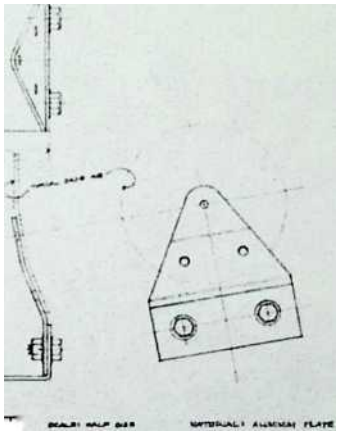

PLAN
JOINT FINE ARTS DEPT, GOV'T OF THAILAND / JDR 3rd FUND
ARCHAEOLOGICAL SHELTER PROJECT
FULLER AND SADAO PC ARCHITECTS NEW YORK
INTERMEDIATE SIZE DOME


FOR VIEW VERTEX 'B'

EASE PLATE

HOTBi





J03W FKE ARTS DEPT, GOVT OF THALAMT/JDR 3 FUND ARCHAEO-LOGICAL SHELTER PROJECT

”“ “ASP-3

ARCHAEOLOGICAL SHELTER

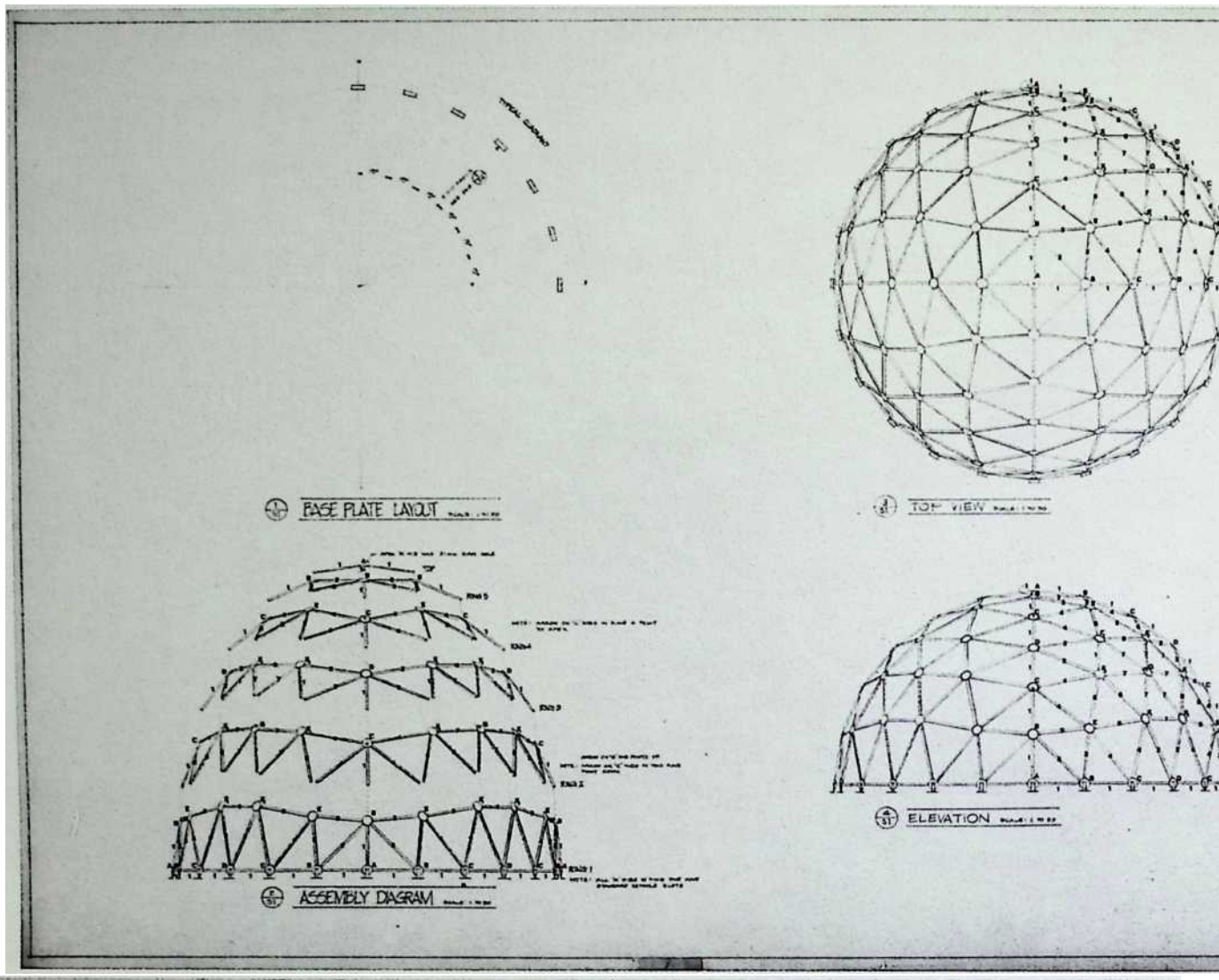
JOINT PROJECT:

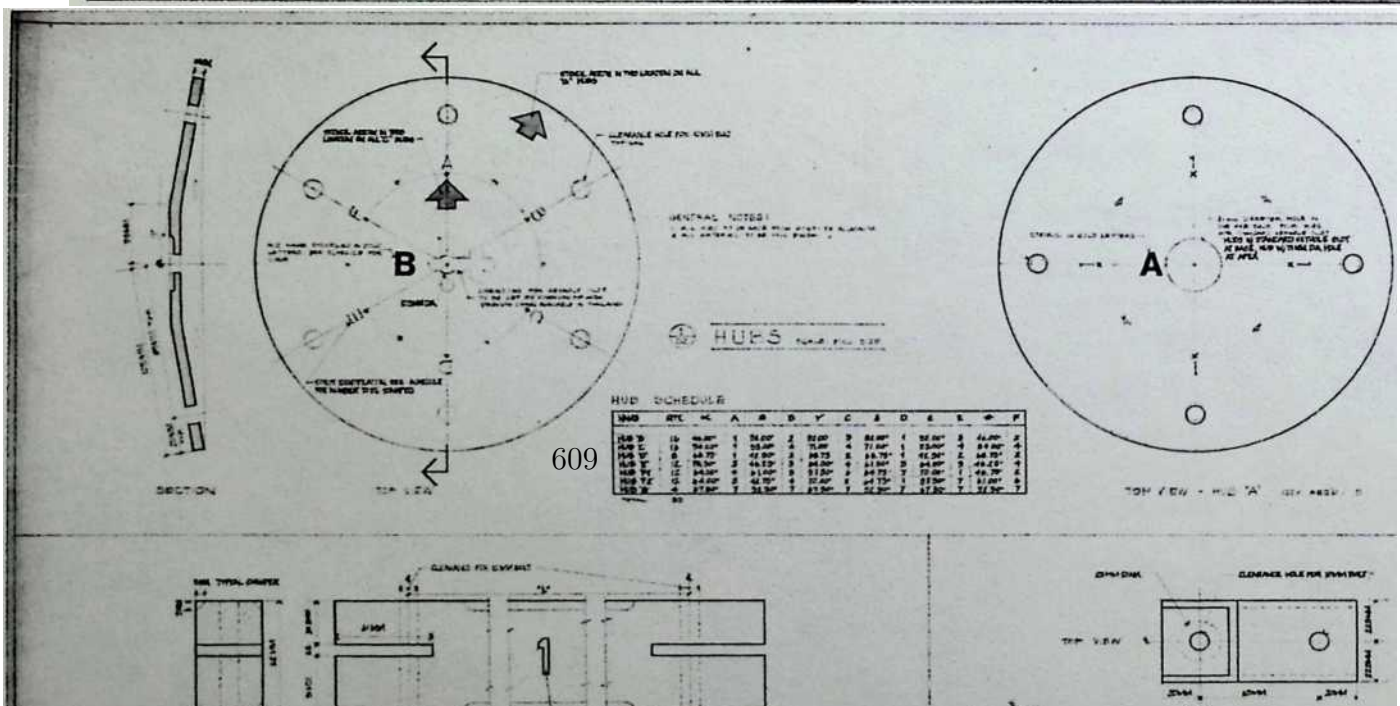
FINE ARTS DEPARTMENT - GOVERNMENT OF THAILAND

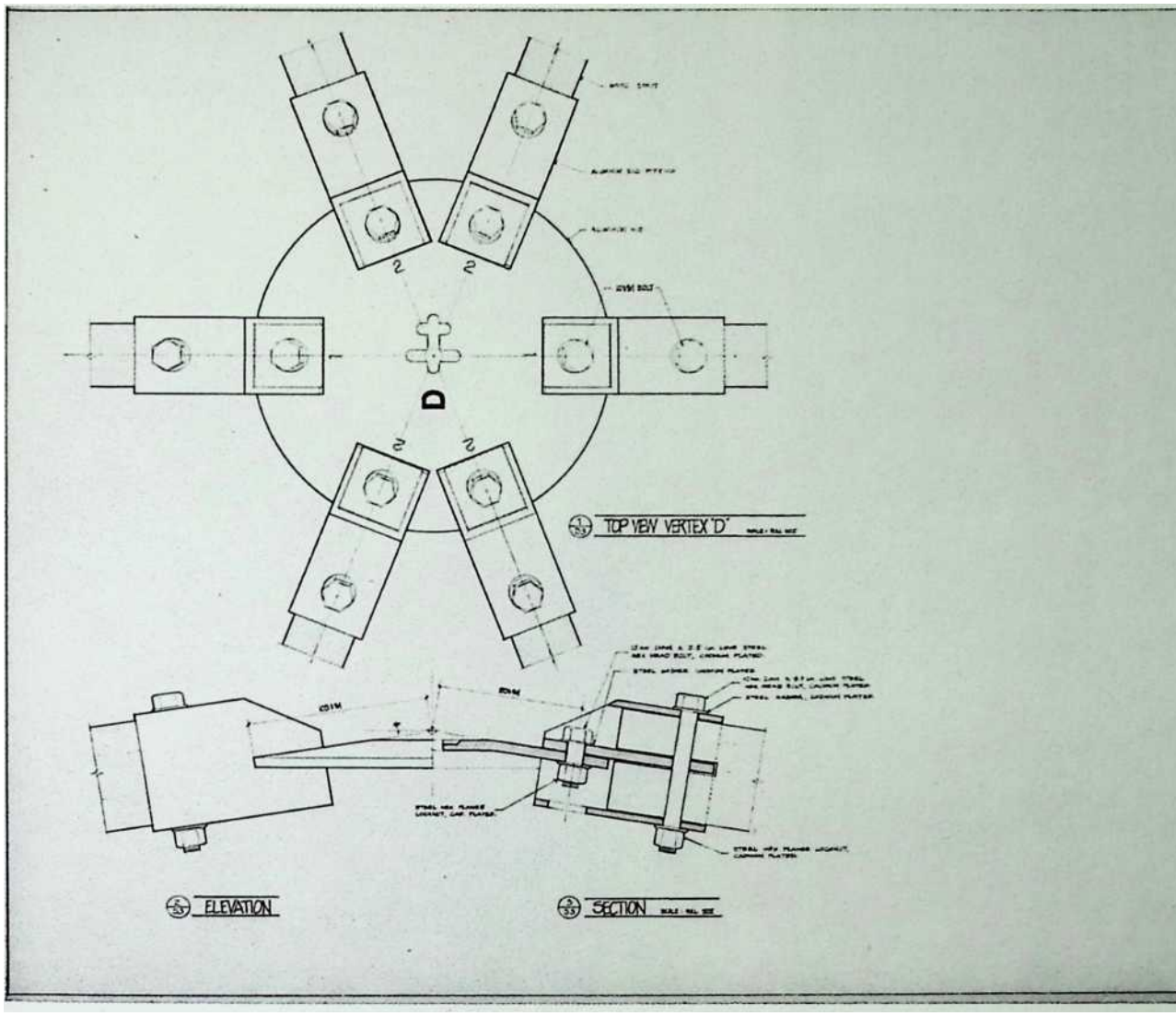
JDR 3RD FUND

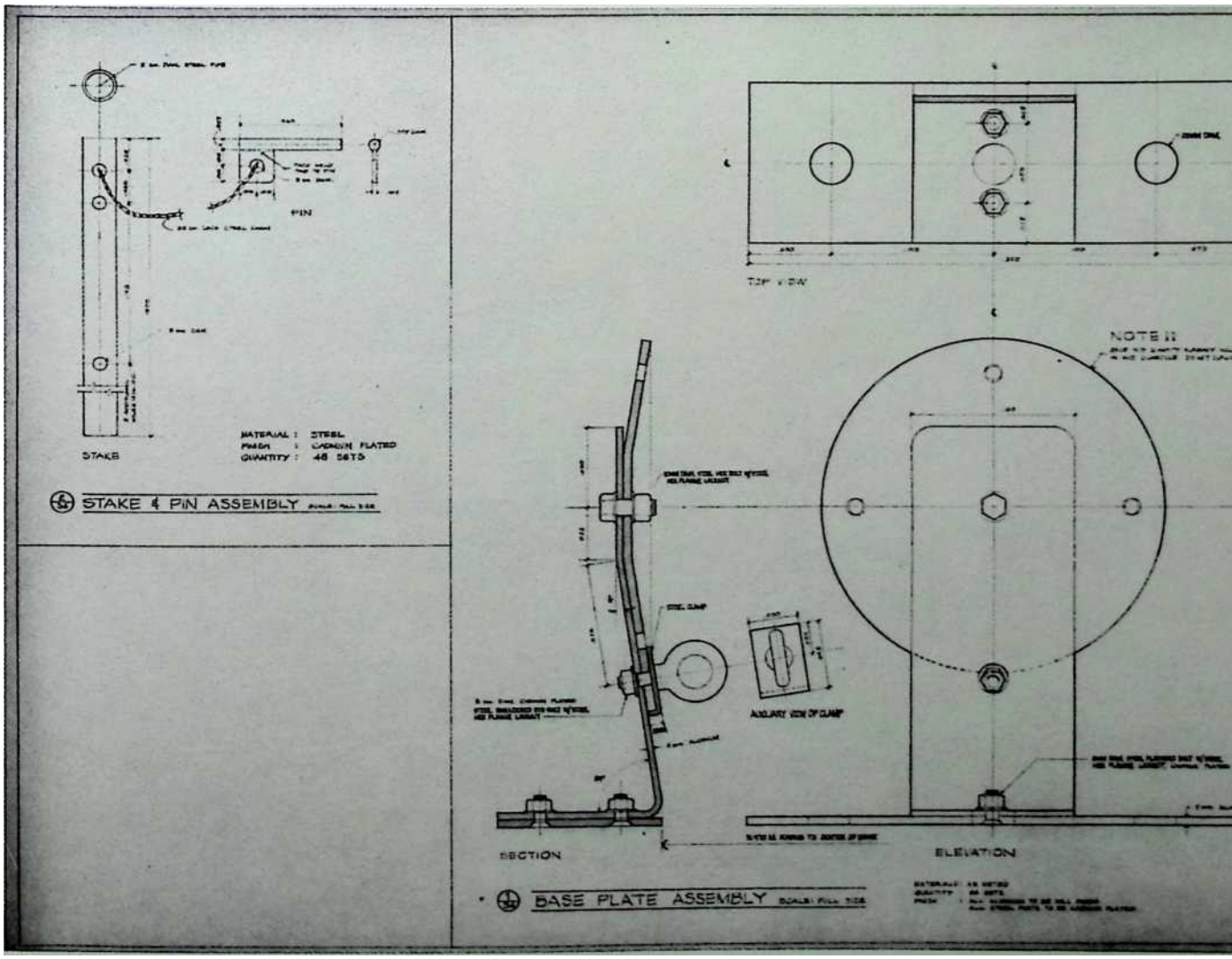
BILL OF MATERIALS

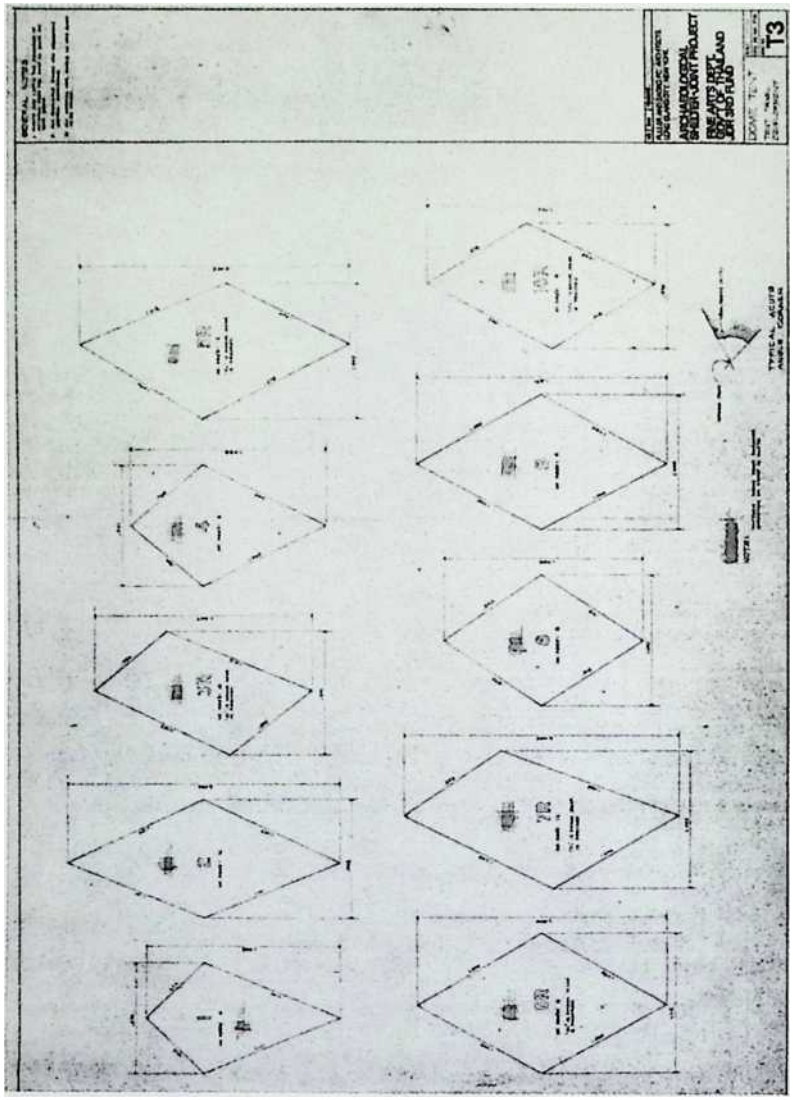
FULLER AND SADAO PC - ARCHITECTS LONG ISLAND CITY, NEW YORK

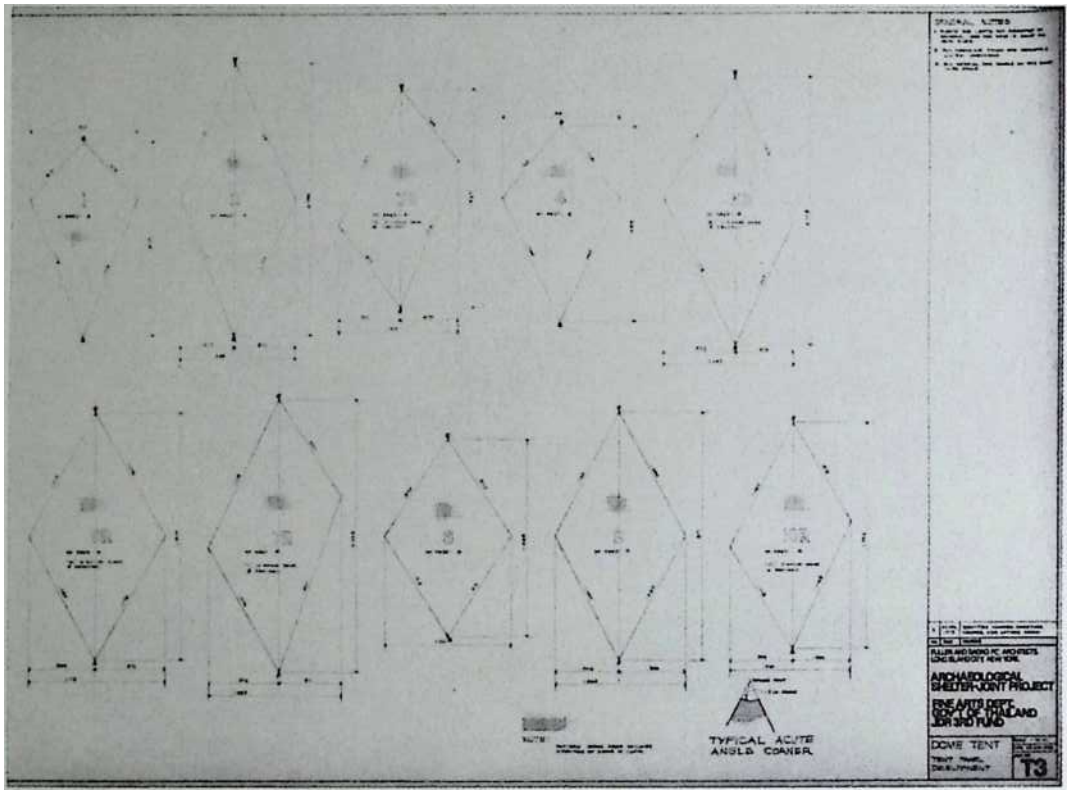

BASE PLATE LAYOUT
TOP VIEW
ASSEMBLY DIAGRAM
ELEVATION

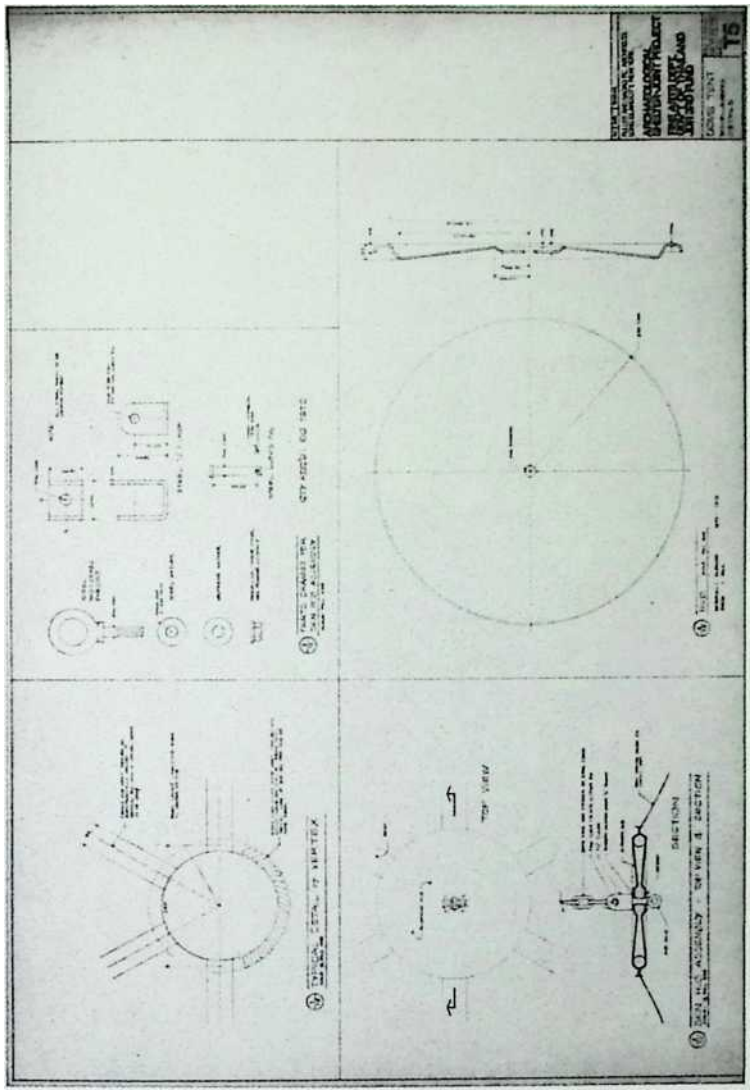

HUBS
HUB SCHEDULE
B
A
SECTION
TOP VIEW

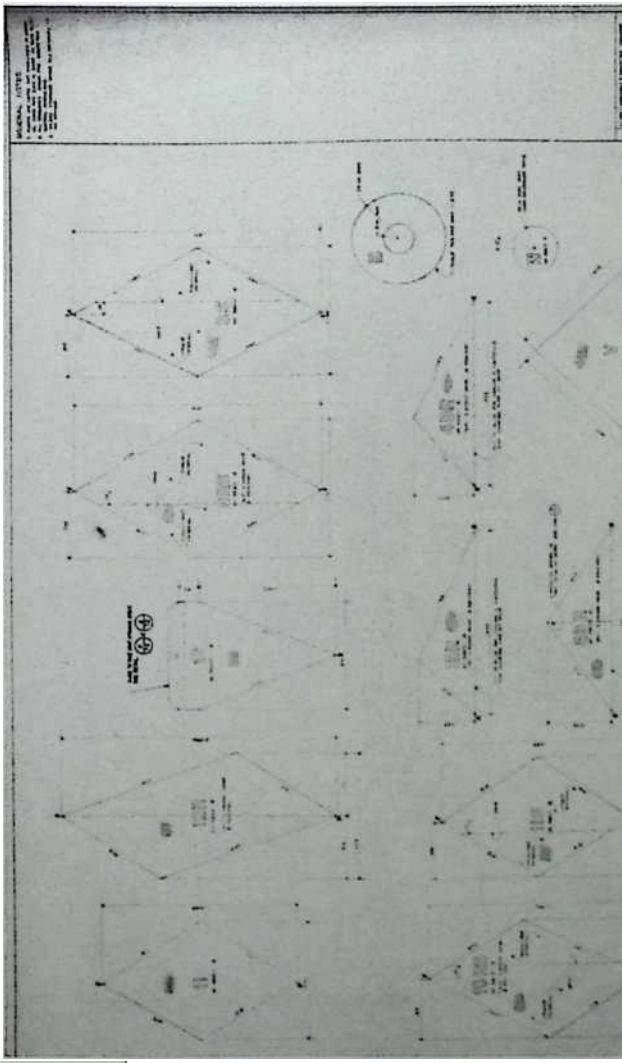

D
TOP VIEW VERTEX 'D'
ELEVATION
SECTION

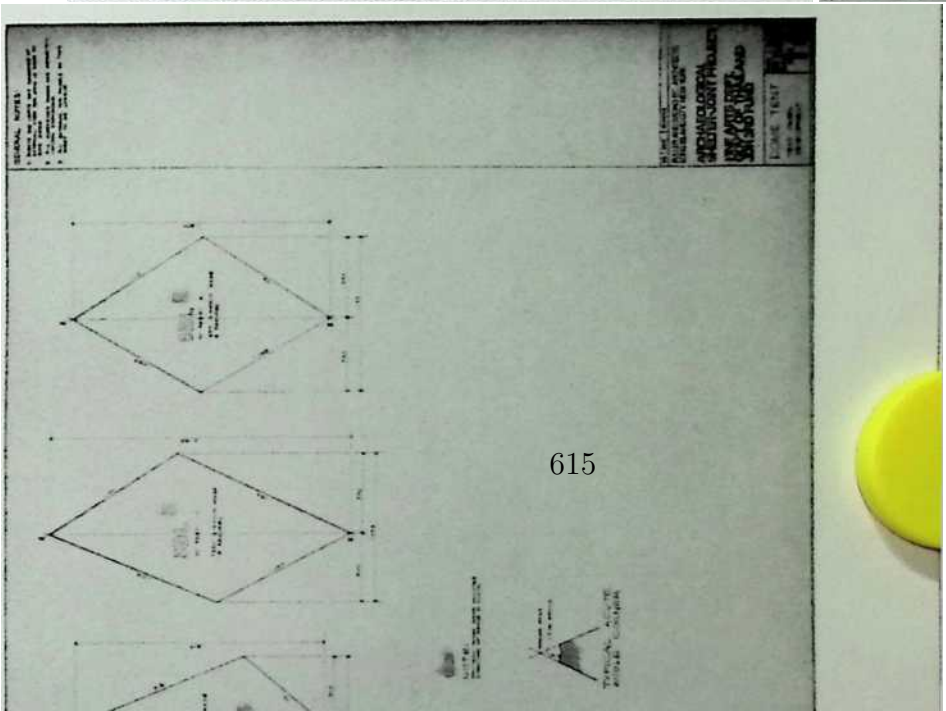

PIN
STAKE
MATERIAL : STEEL
FINISH : CADMIUN PLATED
QUANTITY : 48 SETS
STAKE & PIN ASSEMBLY
NOTE II
AUXILIARY VIEW OF CLAMP
SECTION
ELEVATION
BASE PLATE ASSEMBLY


GENERAL NOTES
ARCHAEOLOGICAL
SALVAGE PROJECT
BREAKPOINT
BREAKPOINT PROJECT
BREAKPOINT
BREAKPOINT
TYPICAL ACUTE
ANGLE TOMBS
T3


TYPICAL ACUTE
ANGLE CORNER
ARCHAEOLOGICAL
SHELTER JOINT PROJECT
DOME TENT
T3







Earth Resources

Observatory, the

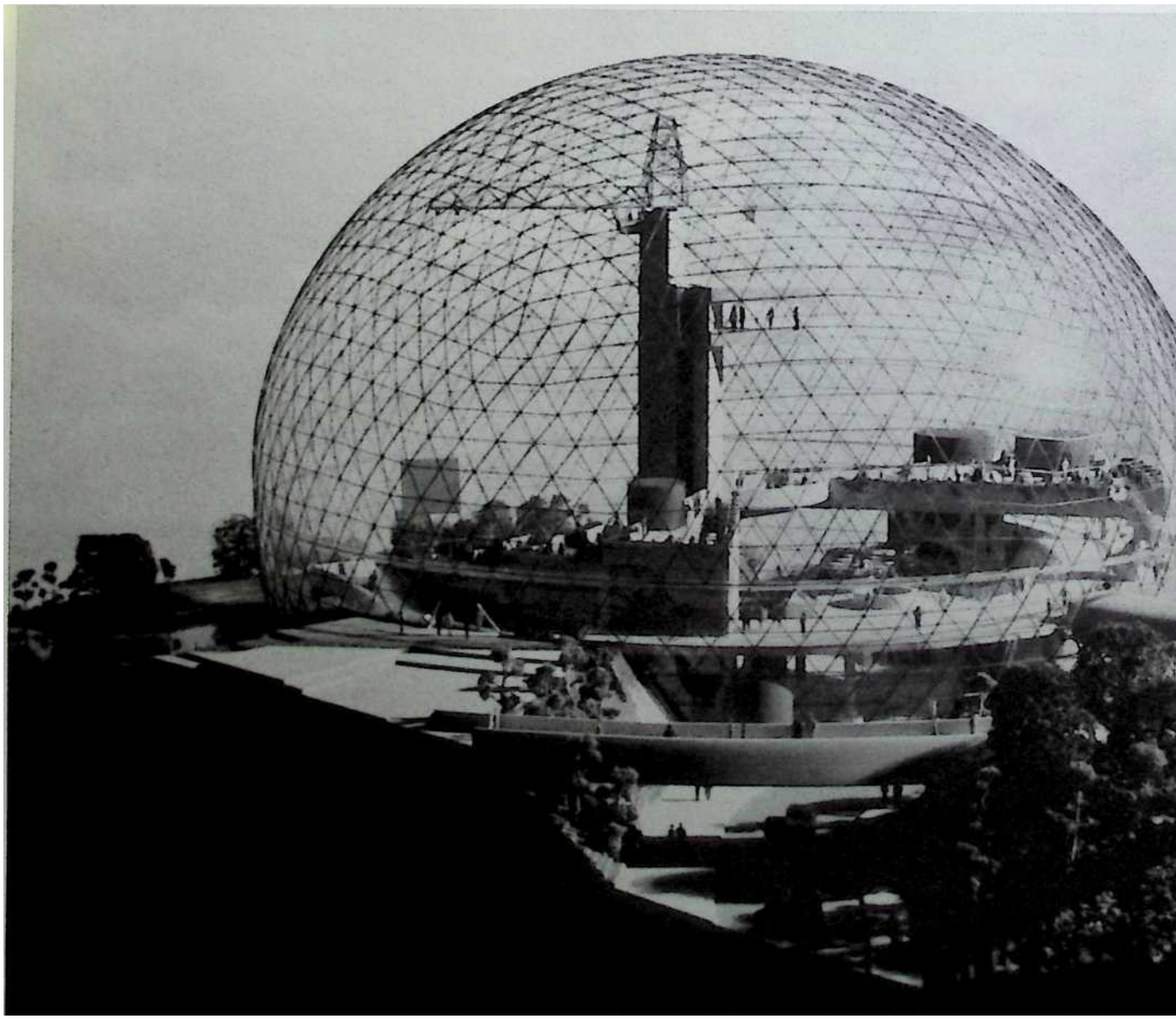
Unisphere, Sioux Falls,

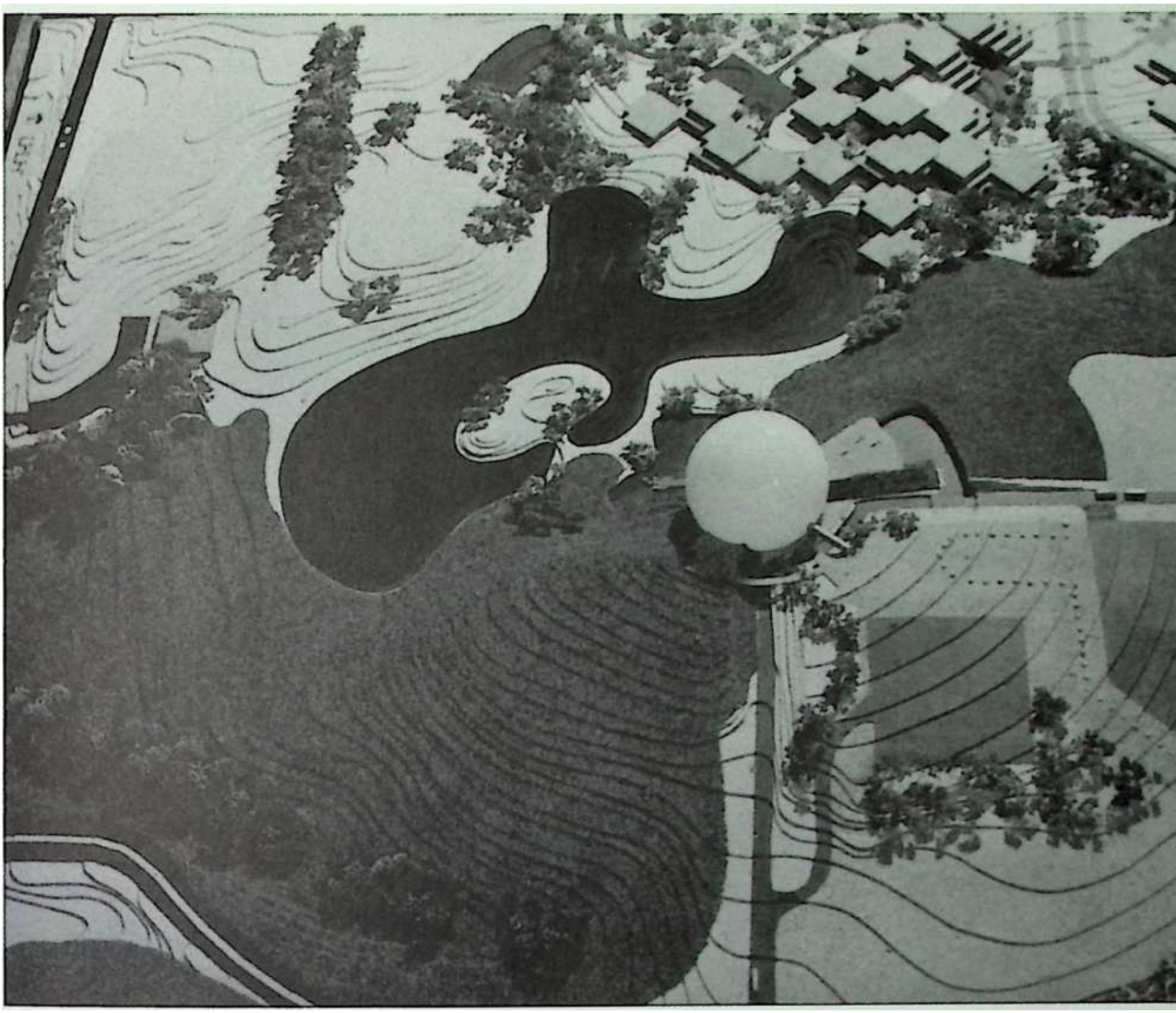
South Dakota

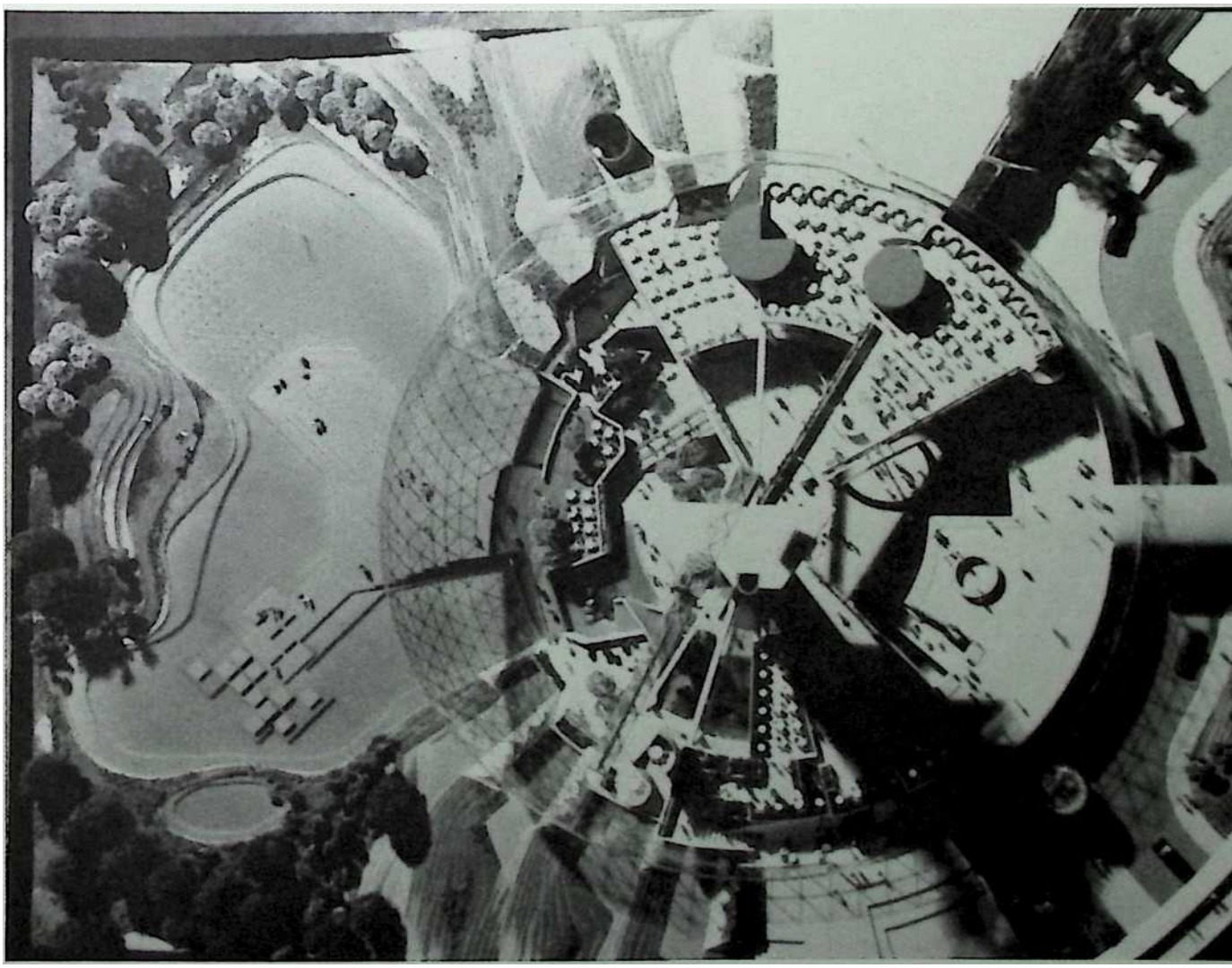
Fuller & Sadao (Consultants) and The Spitznagel Partners, Inc.

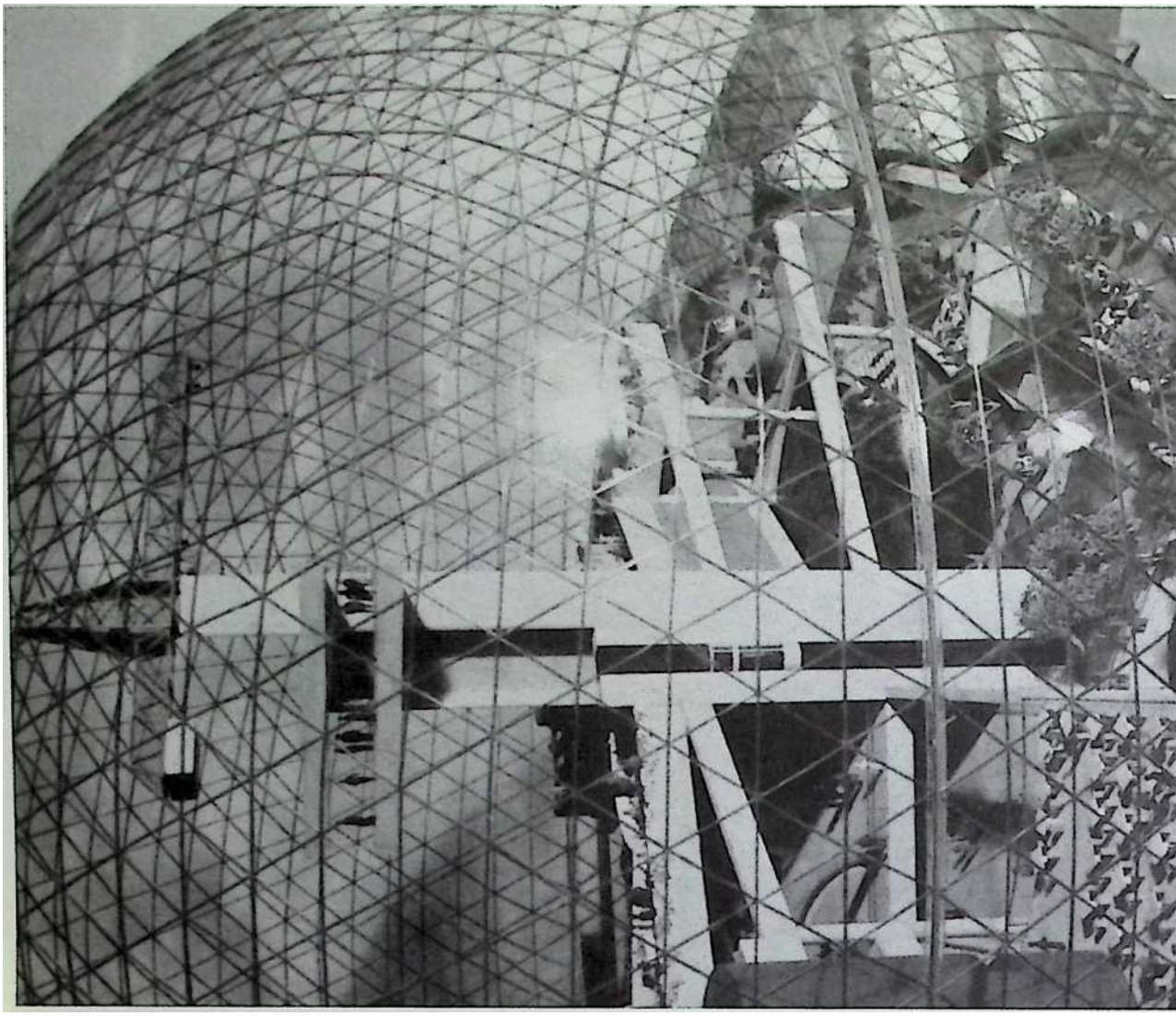
(Architects and Engineers), 1979

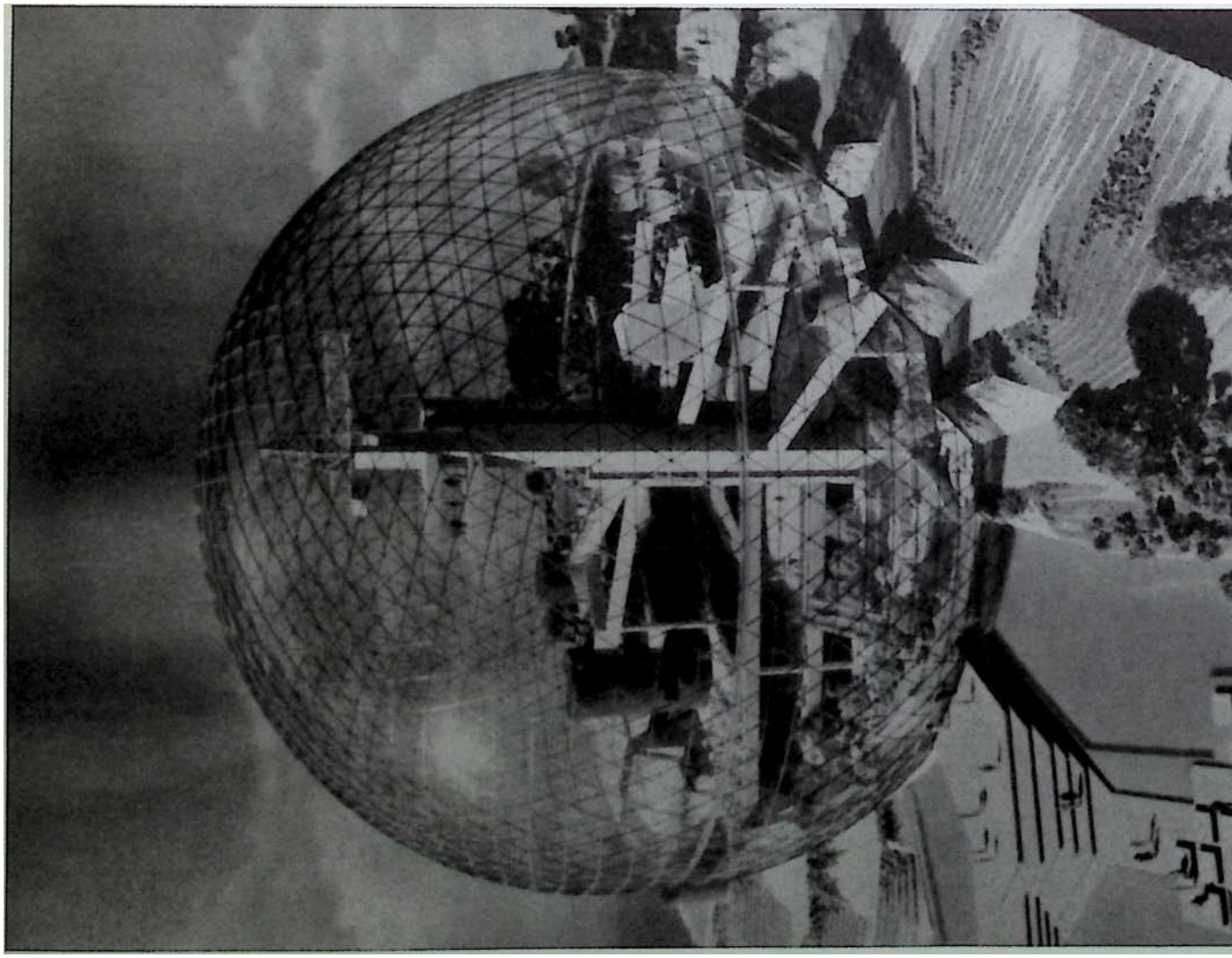
These preliminary studies were done by Fuller & Sadao as consultants for the architects, The Spitznagel Partners, Inc. The interior of the Unisphere would house exhibitions on the theme of ecological building technology. Seventy-seven percent of the air conditioning requires no fuel or electricity.











This floating breakwater can be distinguished from the one Fuller patented earlier by its ability to absorb the energy of the ocean's waves and convert it to electricity.

[ii] 4,136,994

[45] Jan. 30,1979

Floating Breakwater Patent

1/30/79

United States Patent [i9j

Fidler

[54] **FLOATING BREAKWATER**

[76] **Inventor: Richard B. Fuller, 200 Locust St, Apt. 31B, Philadelphia, Pa. 19106**

21. **Appl. No.: 834449**

22. **Filed: Sep. 19,1977**

51. **1st CL^2 E02B3/06**

52. **U.S. CL 405/27; 405/63**

[58] **Field of Search 61/1 F, 1 R, 4, 5, 20**

[56] **References Cited**

U.S. PATENT DOCUMENTS

461. 9/1924 Chase 61/20

462. 6/1971 Oadd 61/1 F

3,590,584 7/1971 Fitzgerald et al 61/1 F

3,863,455 2/1975 Fuller — 61/5

3,969,901 7/1976 Matsudaira et al 61/5

4,023,370 5/1977 Watson — 61/5

***Primary Examiner*—Mervin Stein**

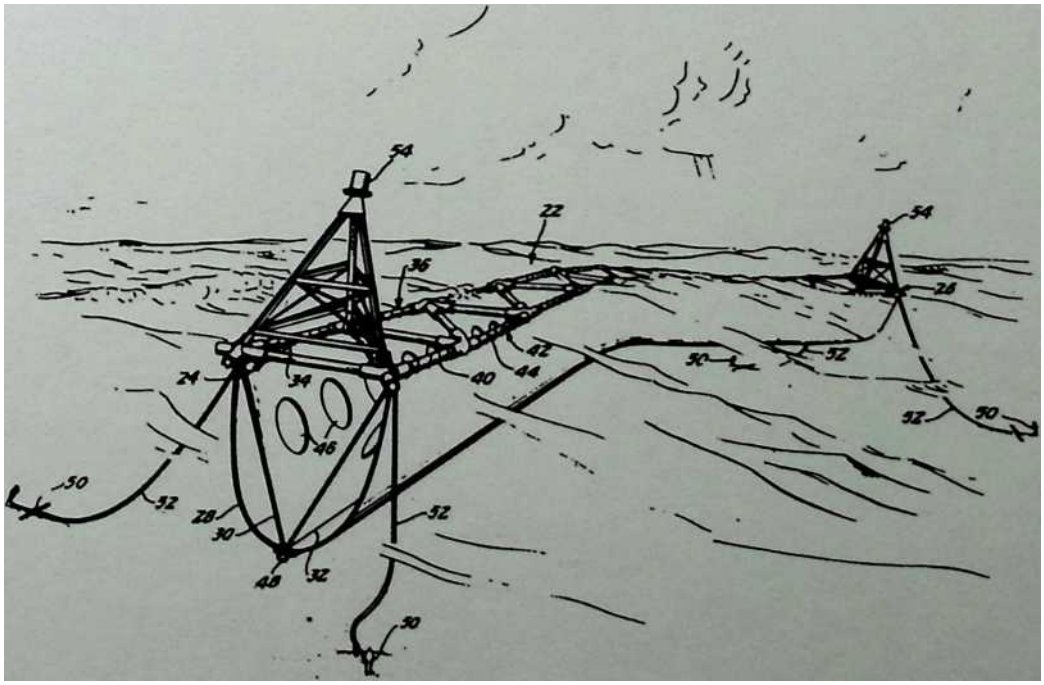
***Assistant Examiner*—David H. Corbin**

***Attorney. Agent,* or Firm—Parmelee, Johnson, Bollinger & Bramblett**

[57] **ABSTRACT**

In a floatable breakwater, one or more flexible membranes are suspended below a floatable, open grid. An outer membrane is formed into a trough. Inner membrane components serve to define multiple ports and reduce the energy of the wave as water is moved and churned through the various ports. The inner membrane components may have a truncated tetrahedral configuration. A turbine may be positioned at one end of the breakwater to utilize the wave energy.

19 Claims, 9 Drawing Figures



U.S. Patent Jan. 30, 1979 Sheet 2 of 4 4,136,994

U.S. Patent Jan. 30, 1979 Sheet 1 of4 4,136,994

4,136,994

U.S. Patent Jan. 30. 1979

Sheet 3 of 4

FIG. 1.

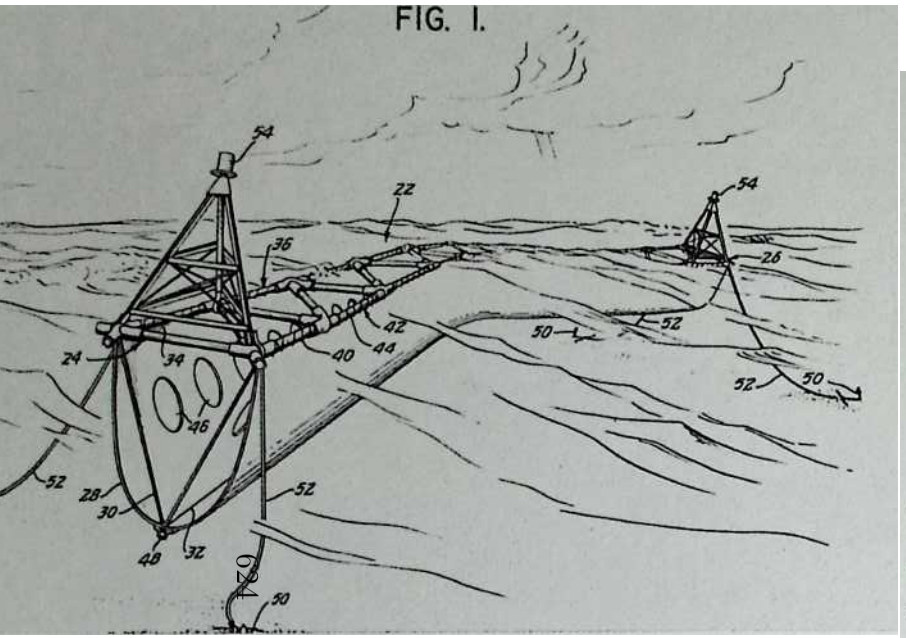


FIG. 2.

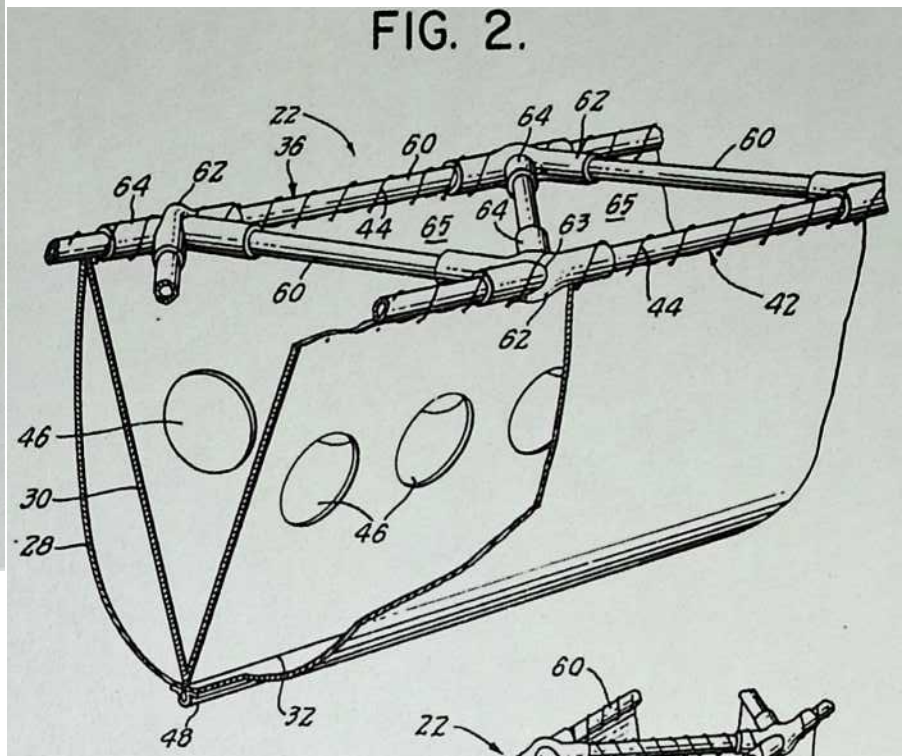


FIG. 3.

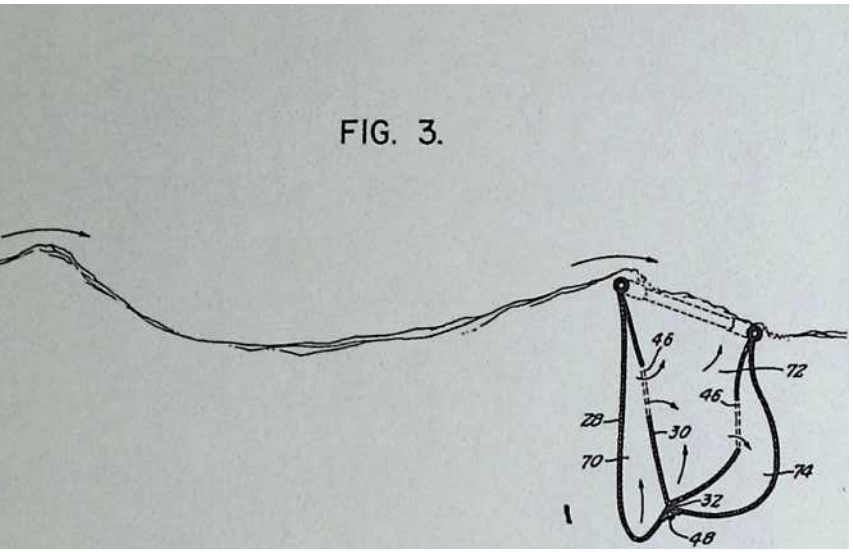


FIG. 5.

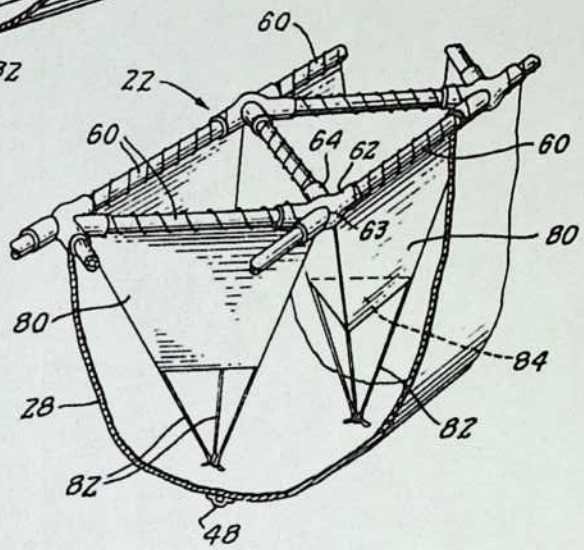


FIG. 4.

FIG. 6.

FIG. 9.

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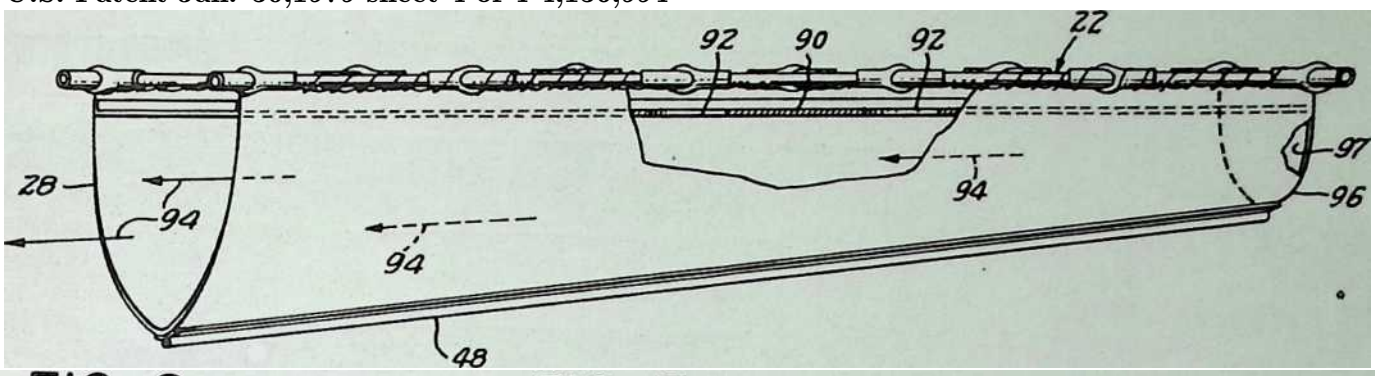


FIG. 8.

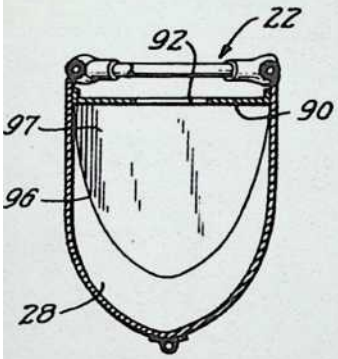
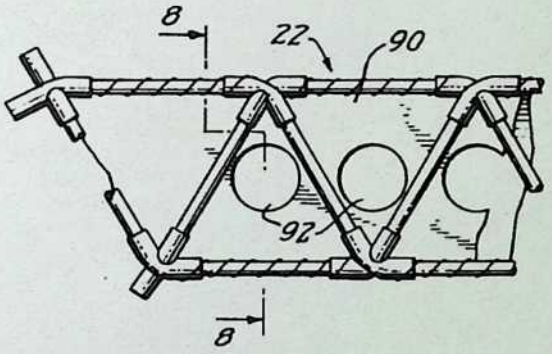
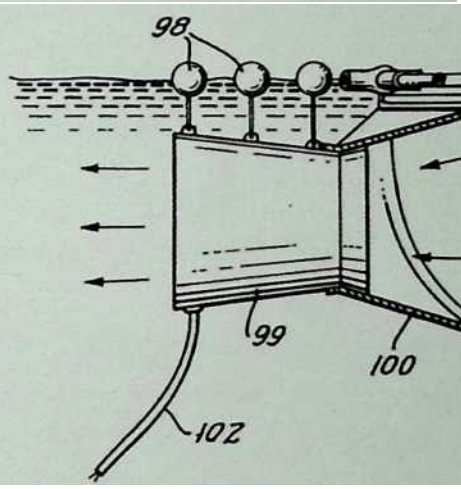


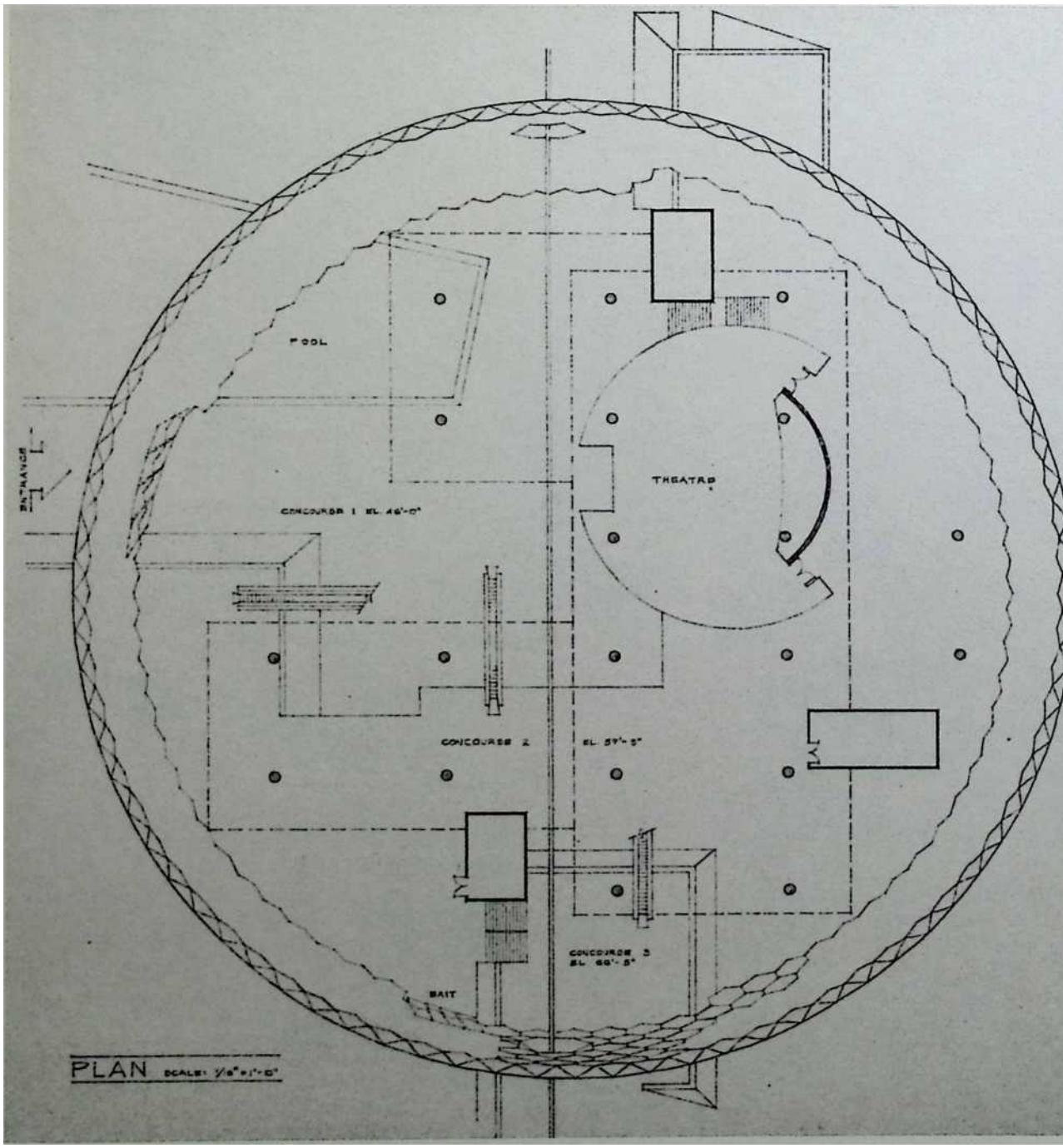
FIG. 7.

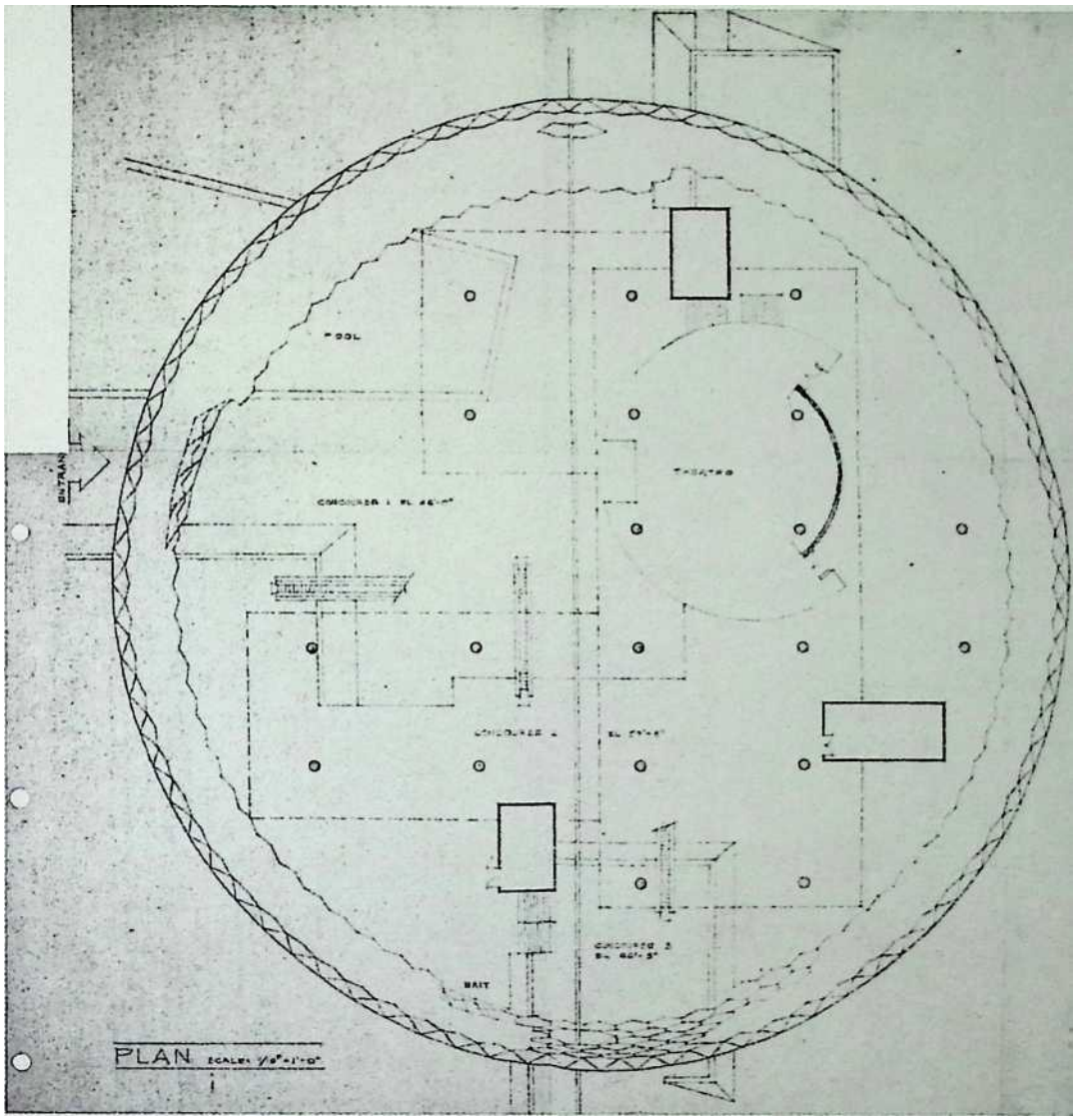


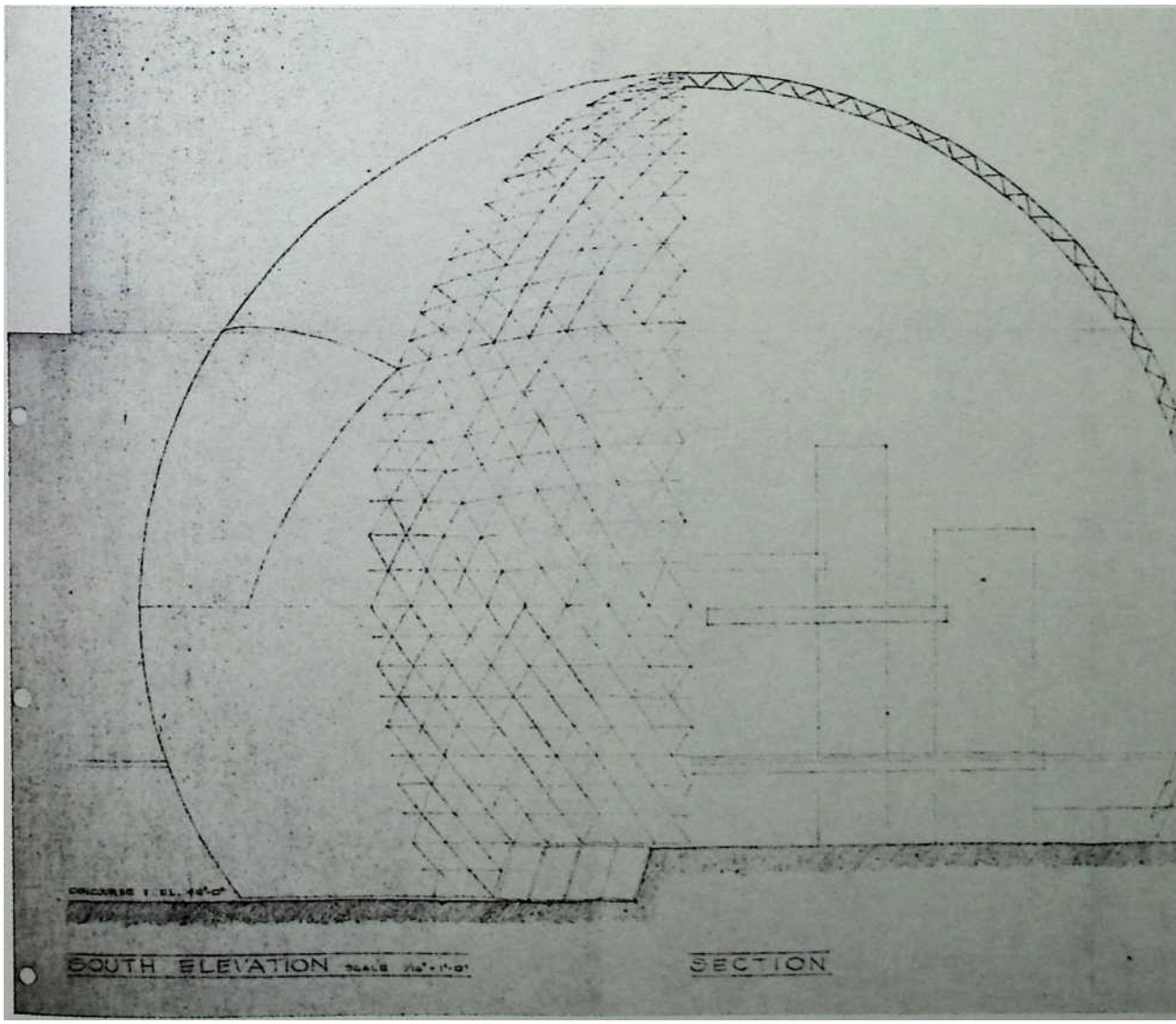


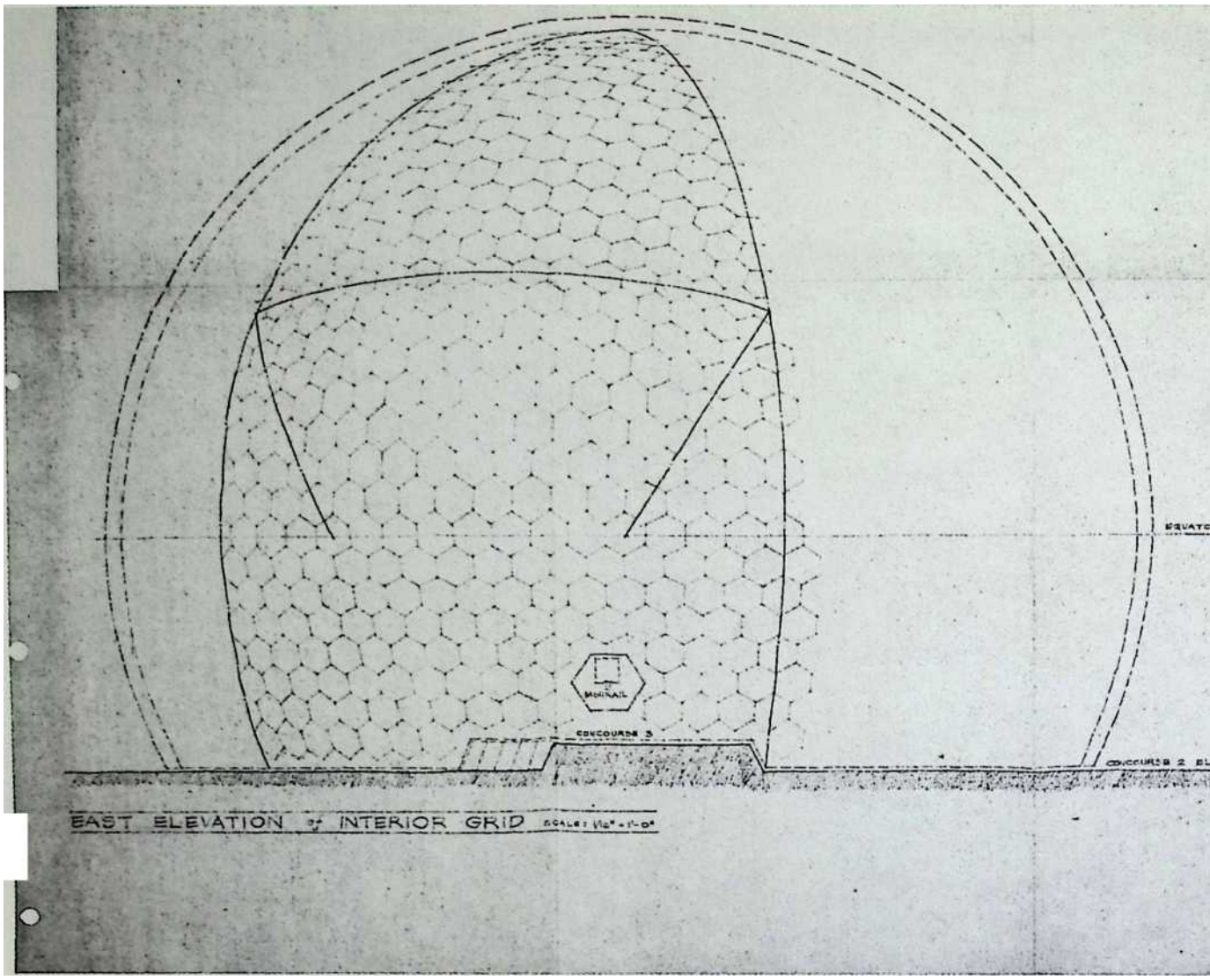
37 Restoration of the United States Pavilion, Expo 1967 Fuller & Sadao, 1979

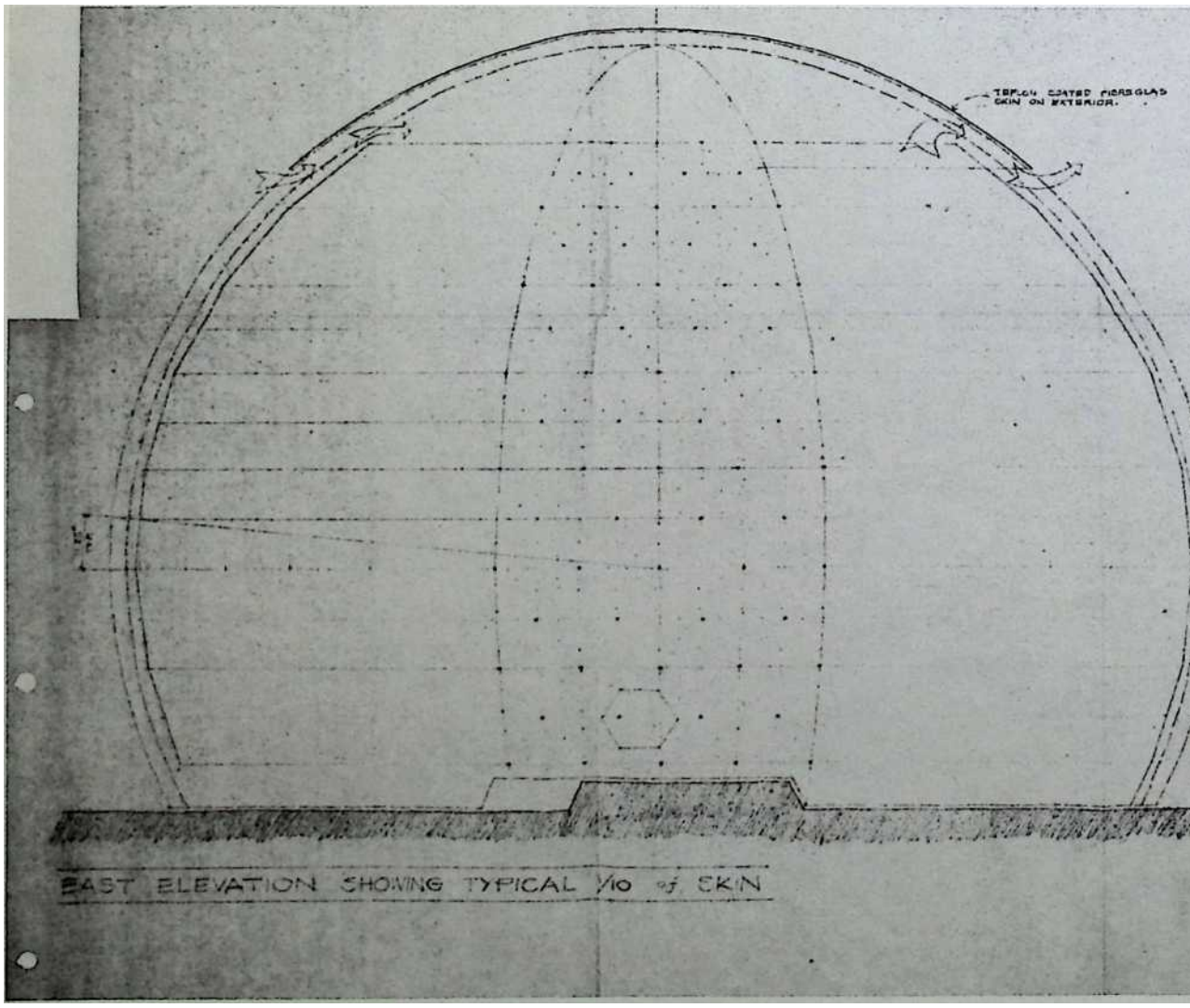
Fuller & Sadao planned to restore the burned pavilion by replacing the acrylic panels with fireproof ones of teflon-coated fiberglass.


POOL
THEATRE
CONCOURSE 1 EL 46'-0"
CONCOURSE 2
EL 57'-5"
CONCOURSE 3
EL 68'-5"
BAIT
PLAN SCALE: 1/8"=1'-0"


POOL
THEATRE
WAIT
PLAN


SOUTH ELEVATION
SECTION


MONORAIL
CONCOURSE 3
EAST ELEVATION of INTERIOR GRID



Tensegrity Module Patent 6/17/80

This truss has octahedra, the edges of which are tense cables and the interiors of which are three adjustable crossbeams.

_ - „ip3- ~ >*

United States Patenter¯ . jin ? 4,207,715/

Ki trick [45] Jun. 17, 1980

[54] TENSEGRITY MODULE STRUCTURE AND METHOD OF INTER-CONNECTING THE MODULES

[76] Inventor: Christopher J. Kitrick, 3500 Market St., Philadelphia, Pa. 19104

[21] Appl. No.: 942301

Primary Examiner—Price C. Faw, Jr.

Asirrant Examiner—Carl D. Friedmaif

Attorney. Agent, or Firm—Parmelee, Johnson. Bollinger

& Bramblett

[57]

ABSTRACT

[22] Filed: Sep. 14,1978

51. lot. CL^2 EO4B 1/32

52. US. CX „ 52/81; 52/747;

52/D1G. 10

[58] Field of Search 52/81, DIG. 10. 747

[56] **References Cited**

U.S. PATENT DOCUMENTS

3.063,521 11/1962 Fuller — 52/81 X

3.354,391 11/1967 Fuller — 52/581 X

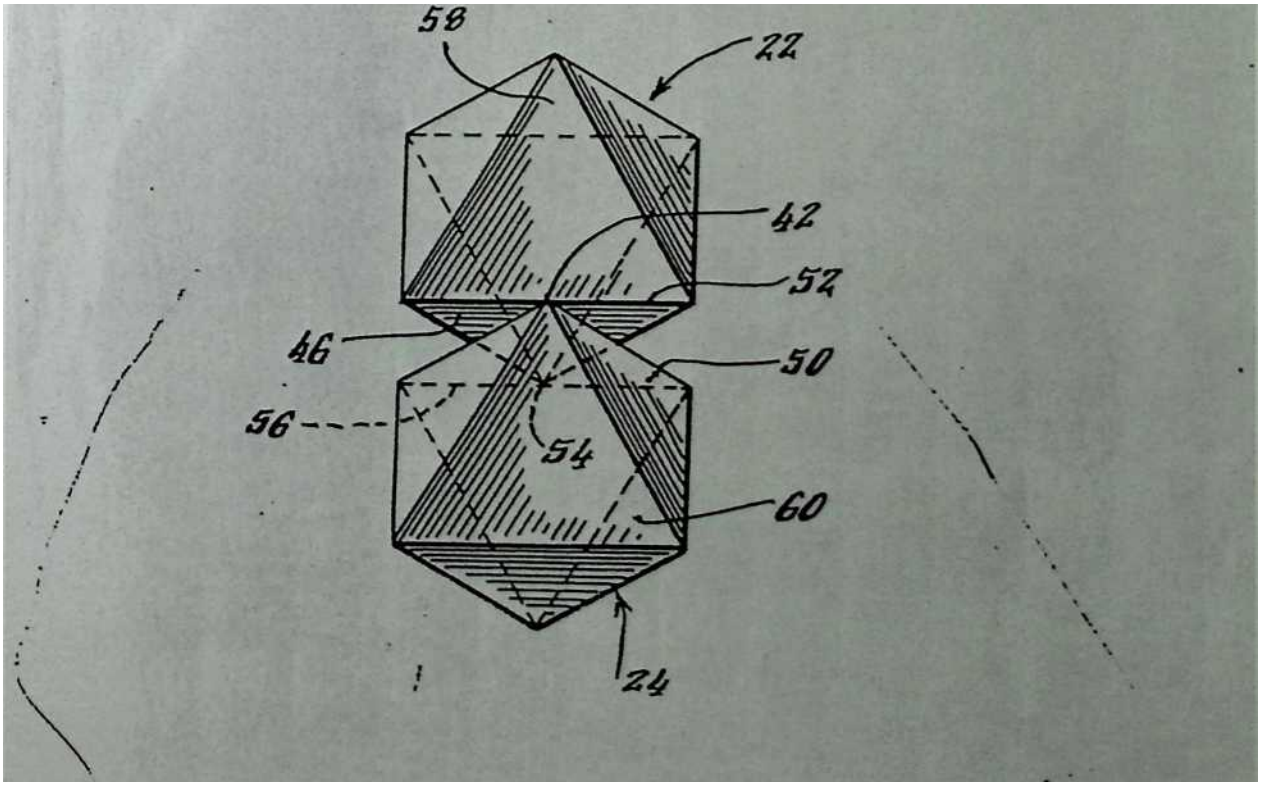
A tensegrity structure is- formed from a plurality of interconnected tensegrity modules. Each module includes several column-like compression members and tension elements run between ends of the compression members to define a polyhedron. The tension elements form the edges of the polyhedron and intersect at the vertices of the polyhedron. The interconnected modules are joined to each other with triangular faces abutting but with the edges and faces of the abutting triangular surfaces of the respective modules rotated 180* away from superposition and with the vertices joined to tension element edges, being joined at a point located one- half or one-third of the way along the length of such

FOREIGN PATENT DOCUMENTS

edge.

7 Claims, 17 Drawing Figures

659780 I/I964 Italy 52/608



UrS.-Patent—Tun. 17. 1980 “ ' Sheet 2 of 6 4,207,715

mjL-Patent Jun.-F7.-198O Sheet 4 of 6 **4,-207,715**

Fig. 1A.
PRIOR ART

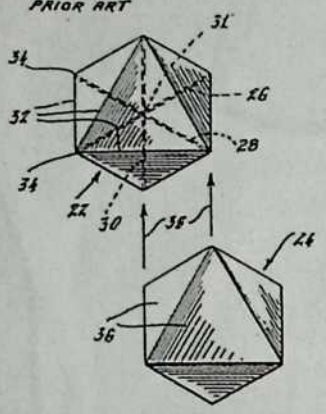


Fig. 1B.
PRIOR ART

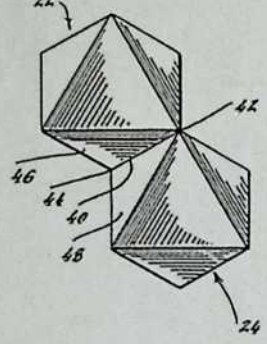


Fig. 2A.

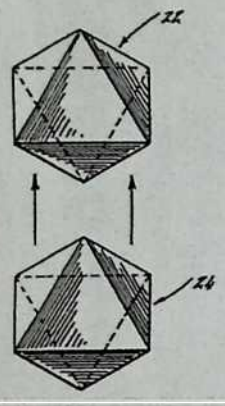


Fig. 2B.

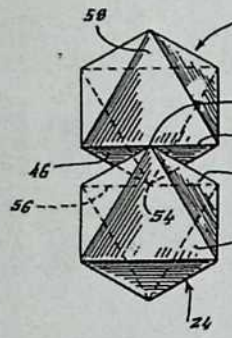
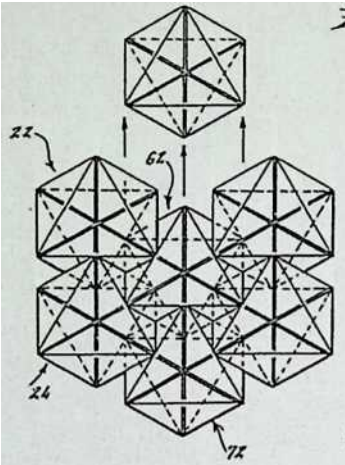


Fig. 3.



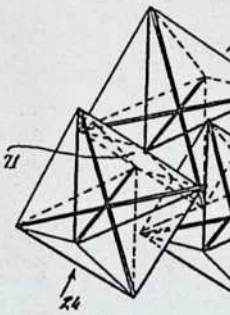


Fig. 5.

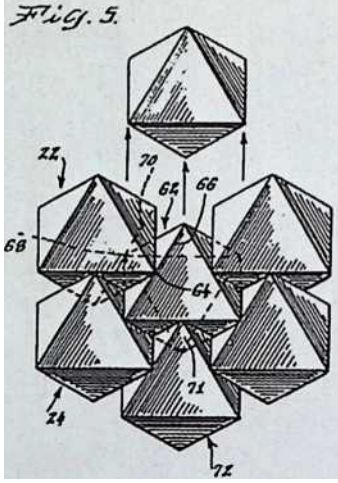
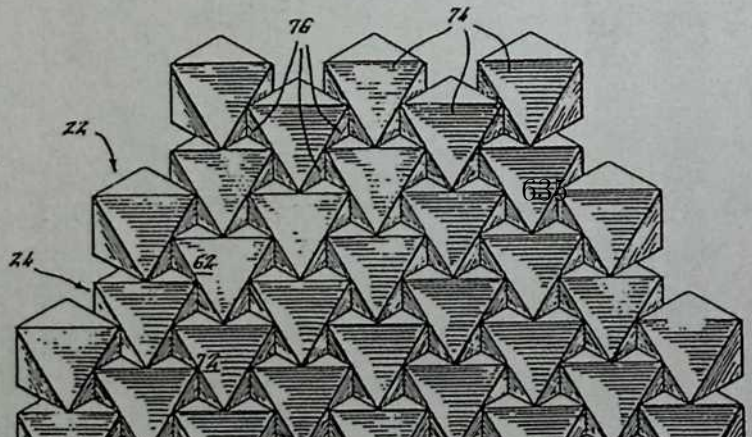


Fig. 6.



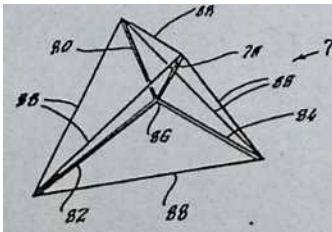
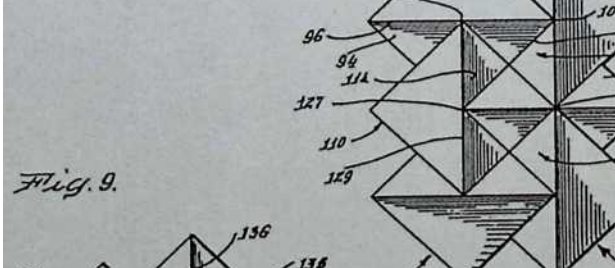
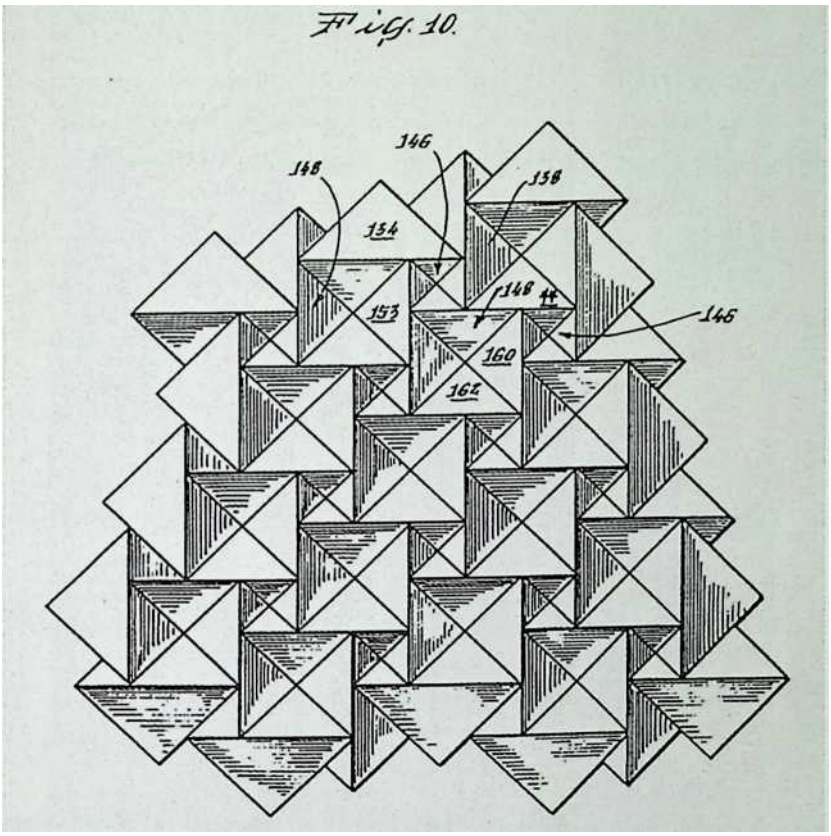
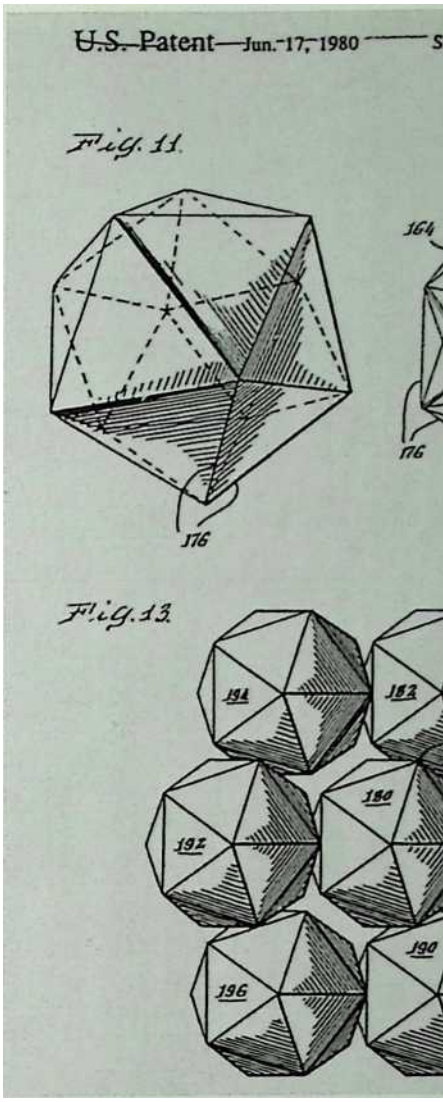


Fig. 9.



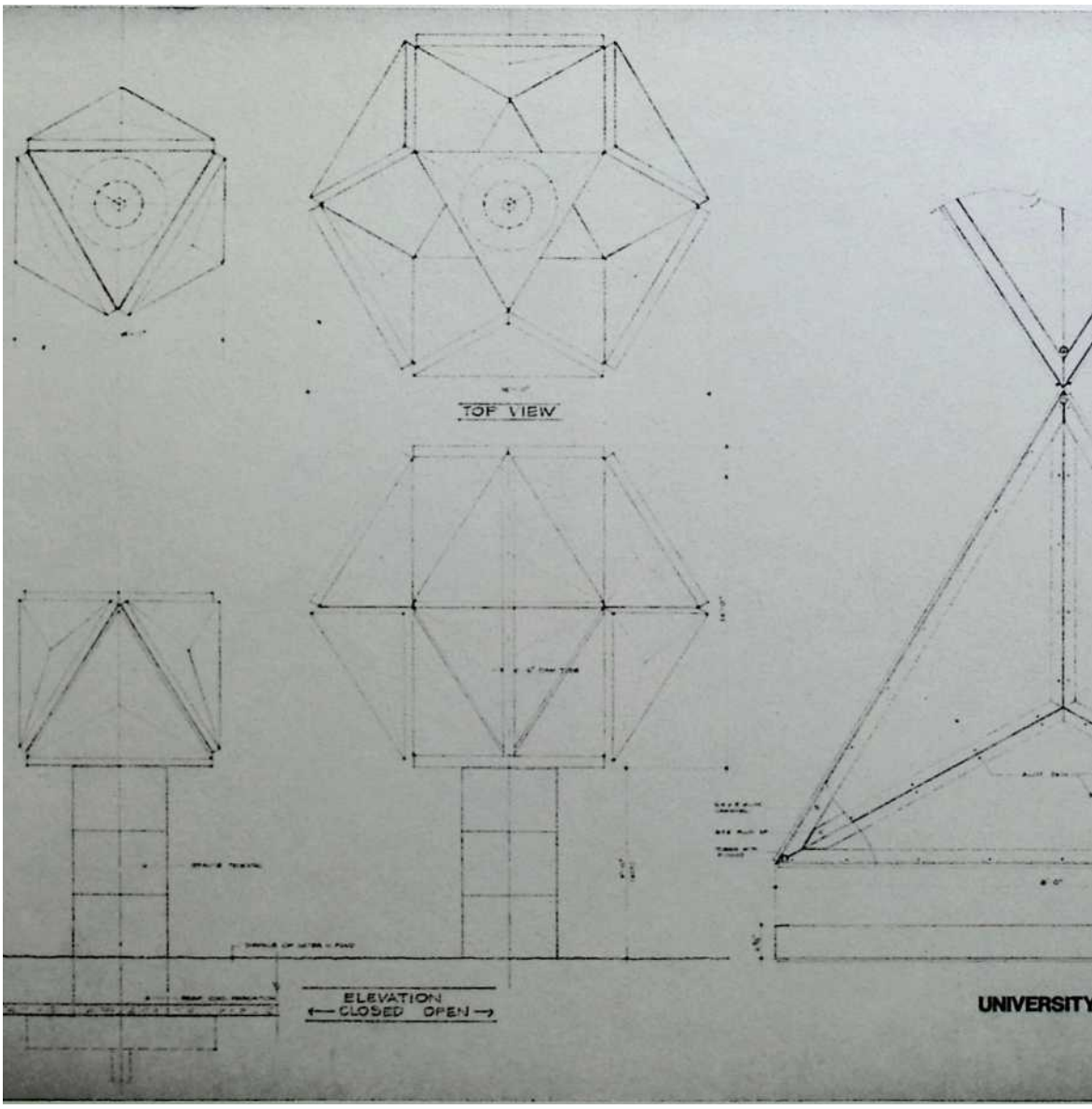


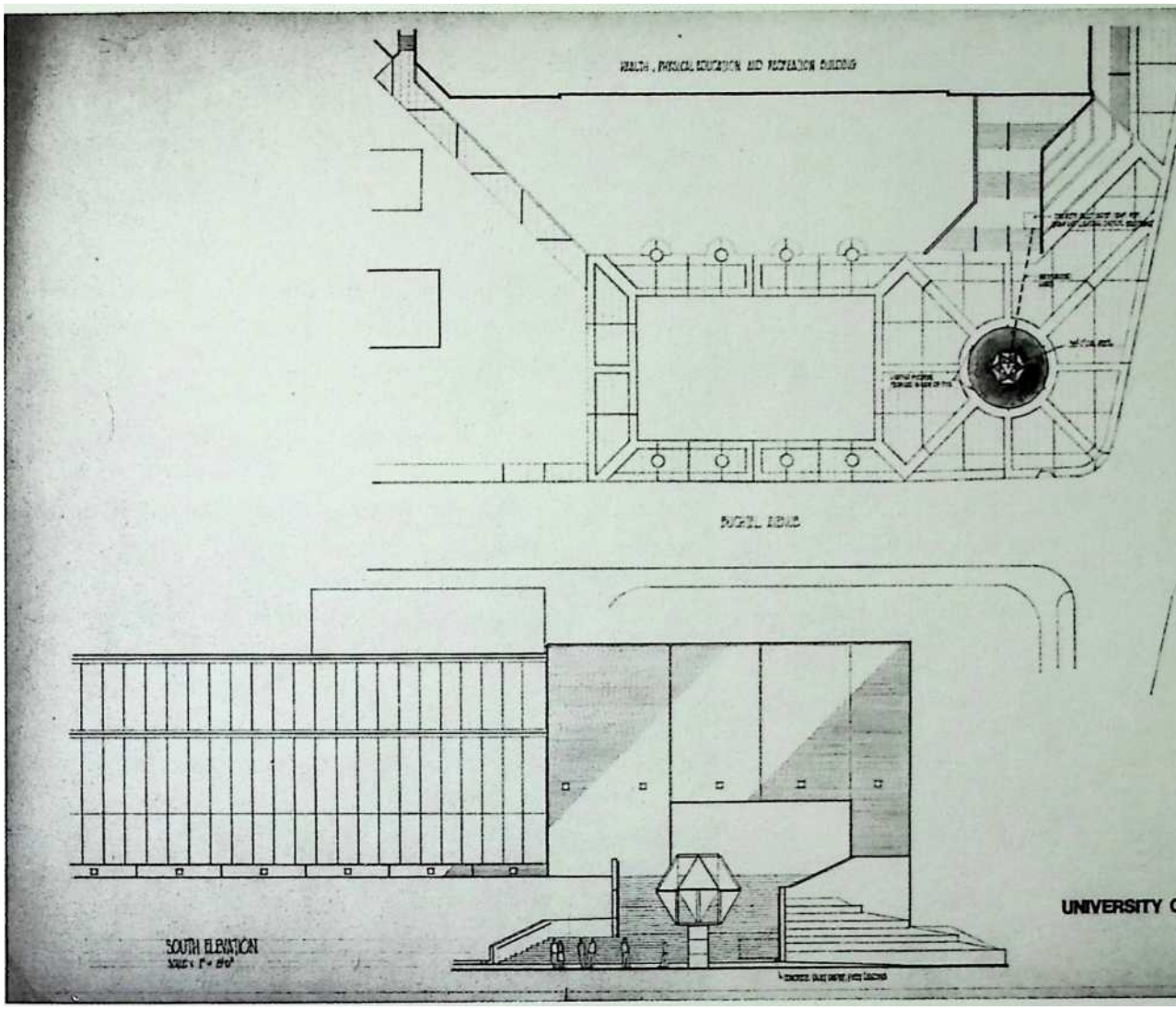


Jitterbug Sculpture, University of Akron

Fuller & Sadao, 1979–1980

The Jitterbug is a sculpture based on the vector equilibrium principle developed decades earlier. It has three phases: icosahedral, octahedral, and tetrahedral.

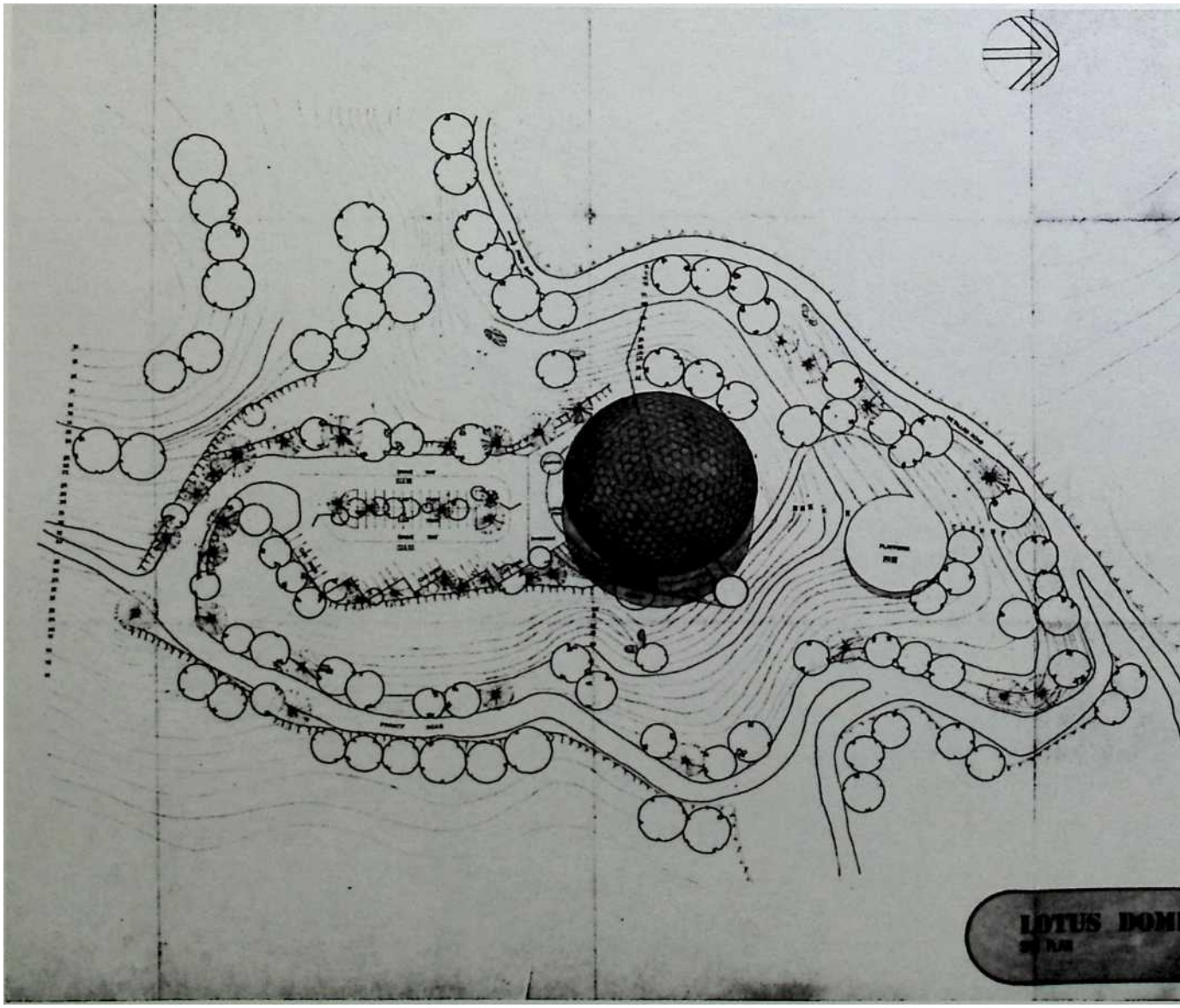

TOP VIEW
ELEVATION
← CLOSED OPEN →
UNIVERSITY

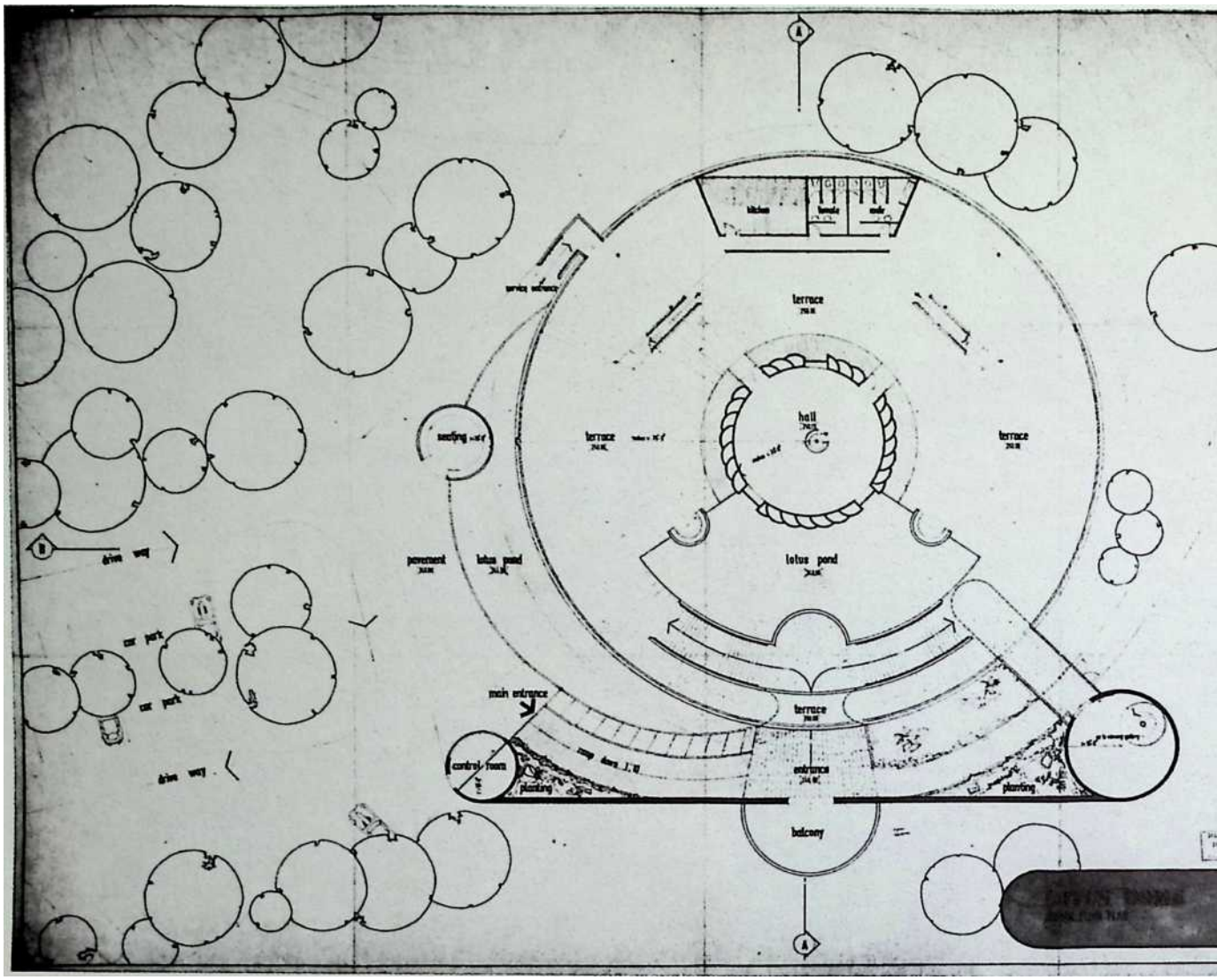


Lotus Dome, Penang, Malaysia Fuller & Sadao, 1980

Fuller & Sadao, in collaboration with Architects Team Three, designed a fly's eye geodesic dome to house the monumental cult statue of Kuan Yin. One hundred sixty-seven feet in diameter, this transparent structure houses terraces, a lotus pond, a kitchen, restrooms, in addition to a hall in the base of the statue. Kuan Yin faces east over a lotus pond, which stretches beyond the base of the dome to the outside. Pilgrims would have been able to park their cars in a specially designed lot and would have reached the pergola-covered east entrance via a ramp. Beyond the vestibule,

they would have ascended first to a bifurcating staircase to the level of the statue's lotus base and then to two viewing galleries. This unexecuted idea is important because it explores the possibility of inexpensive and aesthetically harmonious shelter for artifacts on a monumental scale.

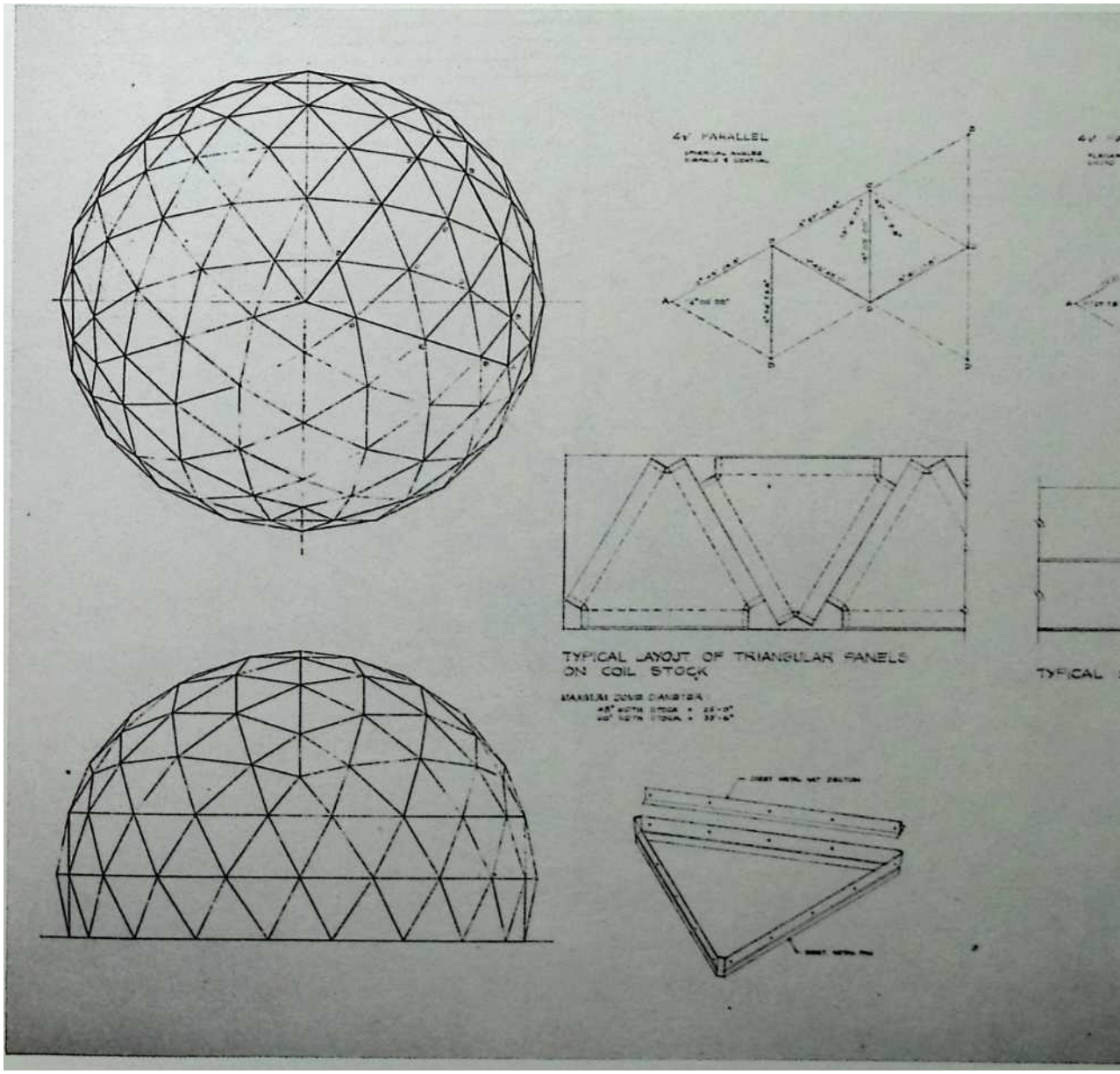




4V Parallel Sheet-Metal Dome Fuller & Sadao, 1980

The lower half of this sheet-metal dome is of parallel "truncatable" sections, although the upper half conforms to a "triacon" grid. The "triacon" grid was developed by Duncan Stuart during the early fifties; and structures based on this grid are theoretically more stable, as the constituent panels conform to the thirty-one great circles. With the use of this grid, one has the smallest discrepancy in the sizes of individual panels. By contrast, the "truncatable" grid is necessary to ensure

that a dome touches the ground on the points of evenly spaced triangular sections of equal size. Although this sheet-metal structure provides a clear illustration of the triacon-truncatable combination, the most famous example of this structure is the United States Pavilion for Expo '67, the lower third of which is composed of truncatable sections.



Hanging Storage Shelf Unit Patent 3/22/83

The equal pull of a vertical, rectangular shelf on three ceiling bolts attached to six overlapping support cables produces a hovering piece of furniture accessible on all of its four sides. It actually becomes more stable as the weight of its load is increased. (See Dymaxion Victrola Agents Record Library, Volume One.)

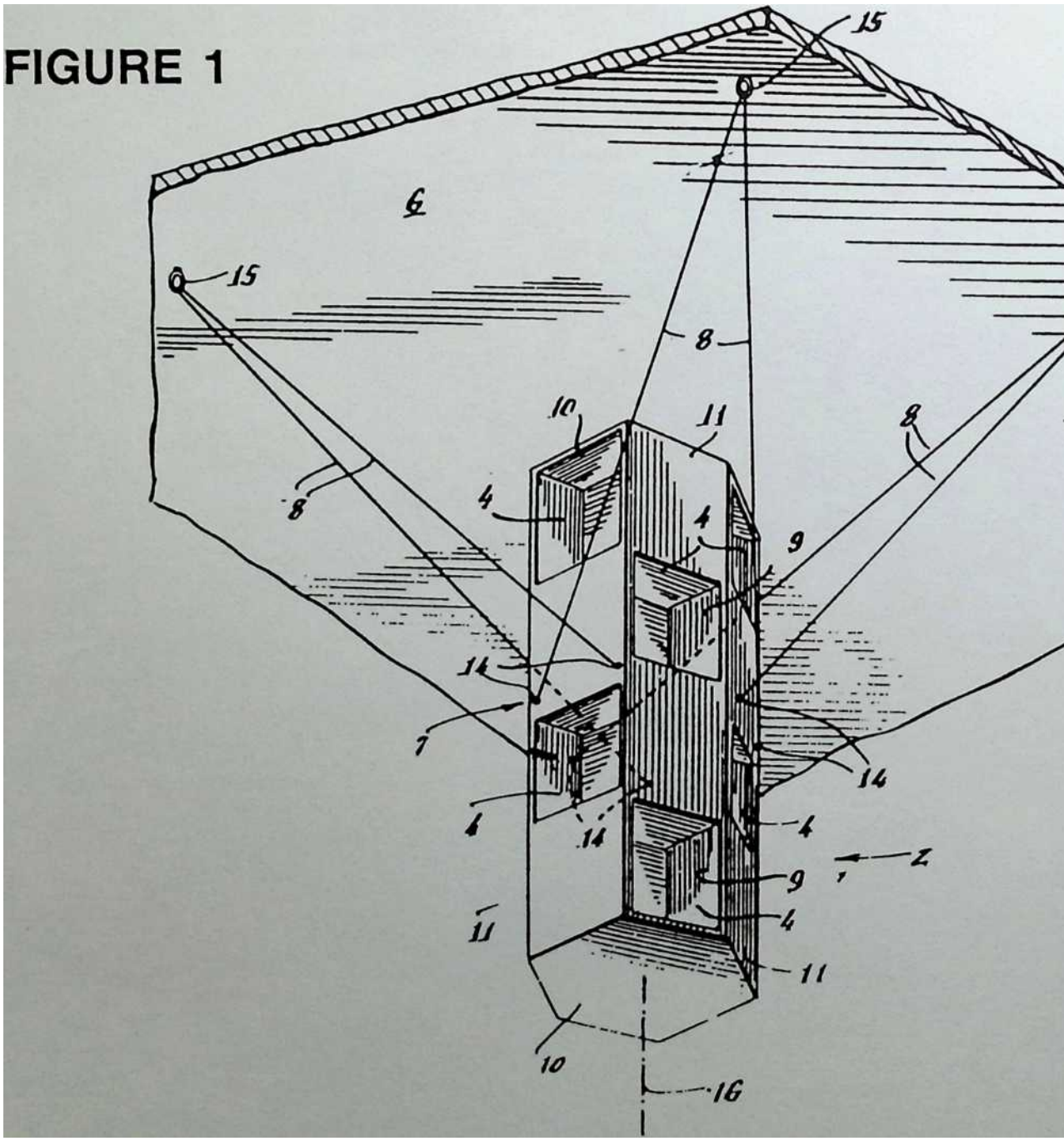


FIGURE 1
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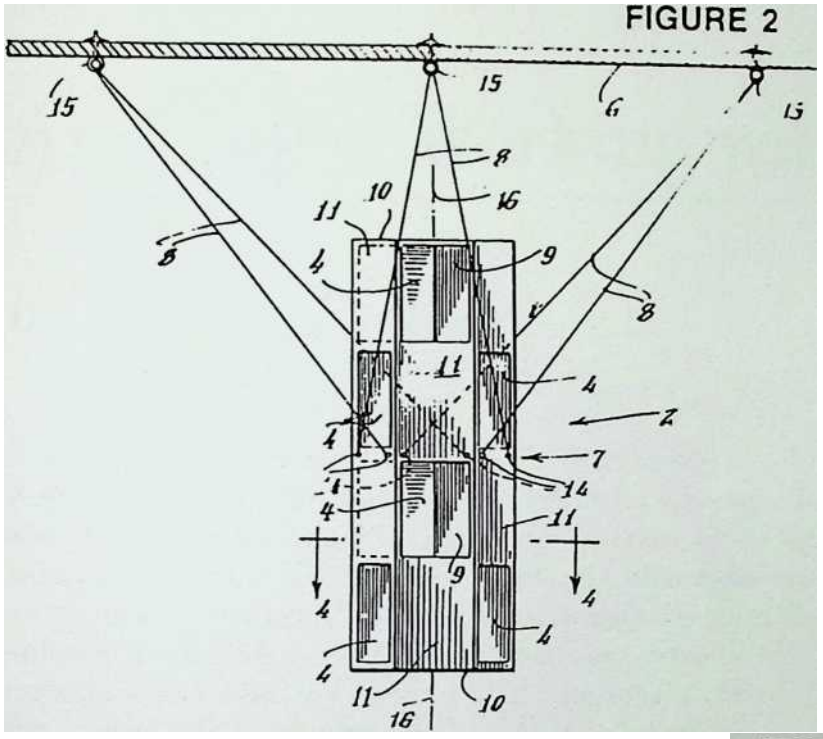
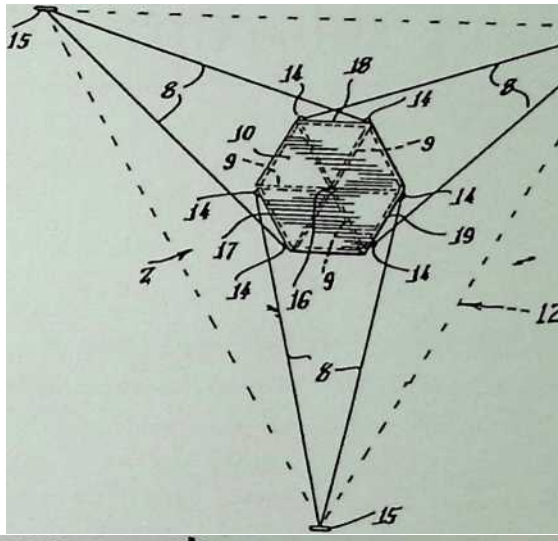


FIGURE 2



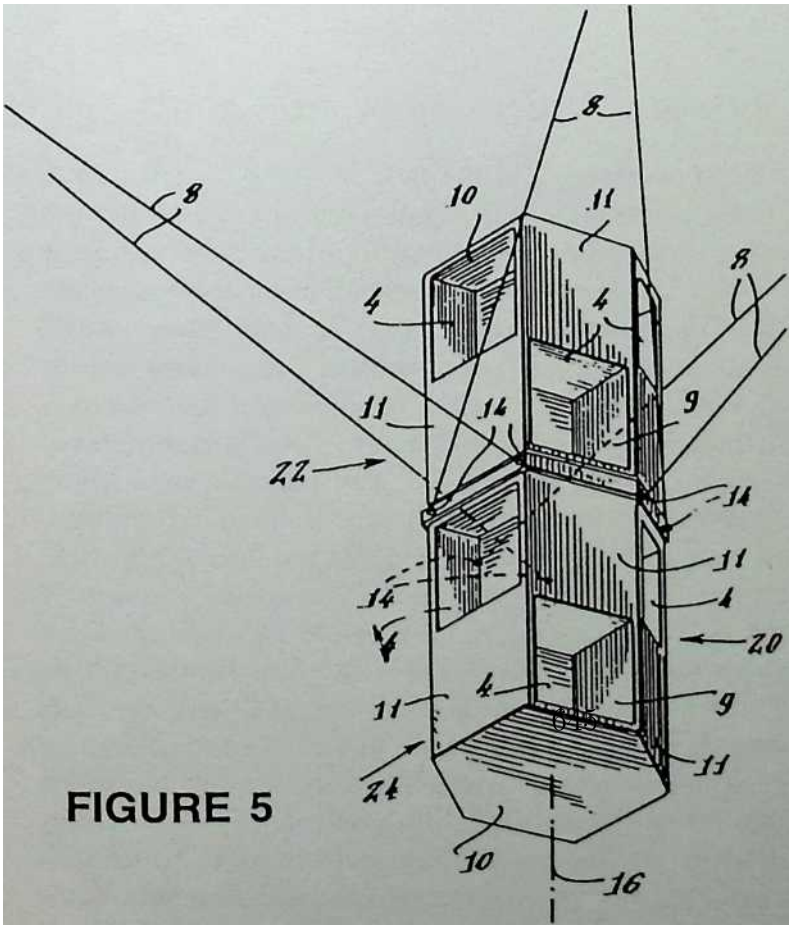


FIGURE 5

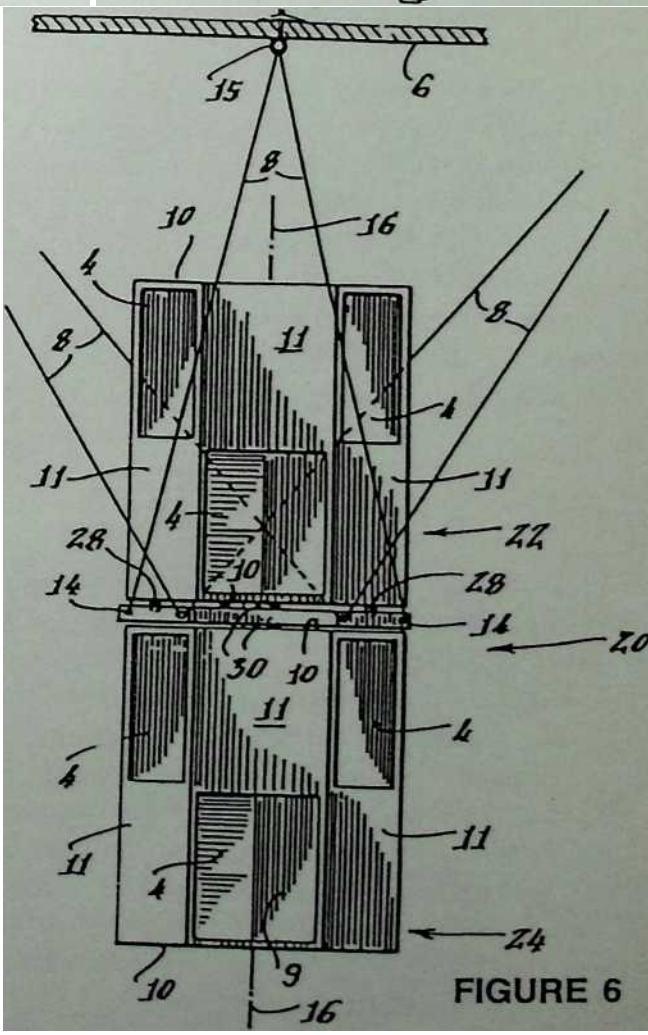


FIGURE 6

Appendix: Working with Buckminster Fuller

by Don L. Richter

It was my privilege to study with R. Buckminster Fuller in 1949 at the Institute of Design in Chicago. It was "Bucky" who first stimulated my interest in the development of new structural systems. He also made me aware that to continue to build structures with slow, inefficient technology with a huge waste of precious raw materials was a luxury society could no longer afford: the impact of man on his environment is becoming more important than the impact of the environment on man. Fuller faced such issues during his early studies of great circle and geodesic dome geometry. These developments were concerned primarily with dome framing techniques, and, more particularly, with the geometry of such frames (Figure 1).

THE EARLY WORK OF D. L. RICHTER

It was my conviction, that while a geodesic framing system had many advantages from the standpoints of structure and production, it represented only part of the enclosure solution. Given a good structural dome frame, some form of cover is still required to make it a shelter enclosure. Furthermore, if this cover, or skin, is made tough enough to act as a secure barrier between interior contents and exterior environment, it might also be used to carry a share of the structural burden. I reasoned that if it were shaped properly, the skin might replace the frame totally and become the complete structure.

This concept led to a series of independent studies on the effects and factors involved in compound curved shell shapes. The research studies expanded to include many different forms of shaped surfaces, such as non- spherical domes, involute and hyperbolic paraboloid shells, as well as many other shapes without names (Figure 2). These dome models are indicative of the early research into compound-curved shapes developed in 1949.

It was recognized that while such research discoveries are vital, it is equally important to develop them into real products for a real world. This pioneering design work has resulted, over the past twenty-five years, in many dome structures that are being used throughout the world, from Alaska to the Antarctic. The first opportunity

to employ these new stressed-skin principles combined with a space truss system and geodesic dome geometry came in 1956, when I was with the research and development division of Kaiser Aluminum. The problem posed was to design and fabricate a 150-foot dome of all aluminum construction for erection in Hawaii.

The structural system of space truss and stress-skin development for the Hawaii Dome Project (Figure 3) was patented and erected by Kaiser Aluminum. The first of many such domes was designed for the Hawaiian Village Convention Center built in 1957. Several years were required to develop the Hawaiian geodesic dome structures for use in more severe climates. To facilitate their realization, we designed permanent tooling and trained personnel in the new construction techniques.

TEMCOR DOMES

Following the success of the Hawaiian projects, I formed Temcor with two others in Torrance, California. Temcor was fortunate to have R. Buckminster Fuller as a member of our board of directors until his death in 1983. In Torrance, we designed a full line of pentagonal and hexagonal geodesic domes in sizes up to 232 feet in diameter. Our success in the myriad problems related to design fabrication and erection is perhaps best exemplified by the construction of a triple geodesic dome sports complex in 1973 in upstate New York. It comprises an interconnected cluster of three hexagonalshaped domes, each having a clear span of 232 feet and a height of 62 feet at the apex.

The more than 33,000 gold-anodized aluminum panel and strut components for the three domes were engineered and fabricated to precise tolerances at Tem- cor's manufacturing plant in Torrance and shipped to Elmira, New York, for assembly. They were erected at ground level around the base of a lifting tower and raised into place (Figure 4). After a dome was totally assembled around the tower, it was hoisted and secured to previously prepared supports, and the lifting tower was then removed (Figures 5 and 6).

It is rather significant that aluminum geodesic domes designed and manufactured by Temcor have been selected in competition with non-geodesic domes of steel, concrete, wood, and fiberglass plastic---an excellent proof of the coordinated design, fabrication, and erection indicated by Bucky Fuller many years earlier.

Temcor also manufactures two other types of patented dome structure that employ geodesic great circle geometry: the Crystogon structures and PolyFrame domes, each of which has its own unique applications.

TEMCOR CRYSTOGON

/ Crystogon domes employ triangular panels of acrylic secured to a framework of extruded aluminum. The transparent or translucent plastics are nonstructural; they do not carry loads from the aluminum dome frame. The inherent stiffness of the geodesic frame has been proven to be particularly important for this product.

Unlike the Expo 1967 dome in Montreal, Temcor Crystogon domes have a single layer geodesic framing plan, yet they can be built in spans up to 250 feet.

Temcor Crystogon domes are now employed in a variety of applications including arboretums and aviaries, skylights in restaurants, all-weather swimming pool covers, and other public buildings. Perhaps the most dramatic Crystogon installation to date is the 150- foot diameter Tropical Botanical Center Exhibition Building in Des Moines, Iowa.

TEMCOR POLYFRAME

In contrast to the Crystogon, the Temcor PolyFrame dome employs wide-flange beams of extruded aluminum that are covered with flat, triangular aluminum panels. As with the Crystogon, the nonstructural panels are designed primarily to provide protective covering and contribute only secondarily to the strength of the dome frame.

The PolyFrame domes are widely used for bulk storage covers, wastewater treatment plants, sports facilities, and special structures such as the famous South Pole PolyFrame and Long Beach Spruce Goose domes. Its advantage as a tank cover is obvious when one considers that a concrete dome for a typical 150- foot diameter tank weighs about 360 tons. A steel cover for the same tank weighs about 175 tons. But an aluminum PolyFrame dome weighs only 18 tons---just five percent of the concrete and ten percent of the steel ones. Part of this efficiency is the direct result of using geodesic geometry.

DOME GEOMETRY COMPARISON

To illustrate the merits of geodesic structures, one could compare them with the computer analyses of three other dome framing systems. In this assessment, all four domes were made as nearly equal as their individual geometries would permit. All four domes analyzed had the same base diameter, the same spherical radius, and the same number of gusset, or nodal, points interconnected by struts following their four different geometries: geodesic, lattice, Lamella, and Schwedler (Figure 7).

A true geodesic geometry does not employ concentric lesser circles. This is the key feature to look for when determining whether the dome geometry is fully geodesic. The great circle arcs in the geodesic dome example of the accompanying figure extend from the base ring on one side of the dome to a corresponding point on the other side. The space truss formed by the three sets of intersecting great circles yields surprisingly uniform, almost equilateral triangles.

The plan view of the lattice geometry dome has framing struts that follow intersecting, spiral-like patterns that connect the base ring to the concentric inner rings and the apex of the dome. None of the framing lines in the lattice dome follows a great circle arc.

A typical Lamella geometry also has horizontal lesser circles concentric with the base ring. The Lamella dome has an advantage over the previous two systems, because the clutter of members intersecting at the apex has been reduced. The triangles formed between rings and struts are also more nearly equal in size.

In the plan view geometry of the Schwedler, or radial rib, dome, you will notice that a group of frame members extend from the base tension ring to the apex in great circle arcs. The base ring and the three concentric inner rings are lesser circles. Virtually all the commonly used nongeodesic dome frame systems have a number of such lesser circles in concentric rings. In the Schwedler dome, the diagonal framing members required to stabilize the dome have been shown as dashed lines. These diagonals are required to make the dome a completely triangulated three-dimensional space truss.

Although other geometric configurations and variations have been studied, these four basic types are the most representative. For our computer analysis of the four types, the following equalizing criteria were used:

1. All domes are the same overall size—that is, 100 feet in diameter and 14 feet high.

TABLE 1

	Schwedler Radial Rib		*Lattice*	*Lamella*	*Geodesic*
	Without Diagonals	*With Diagonals*			
Weight in pounds	10,000	10,000	10,000	10,000	10,000
Number of nodal points	61	61	61 .	61	61
Max. uniform load p.s.f. evenly distributed	45	29	25	32	45

Max. unbalanced load p.s.f. right side	12	28	20	28	40
p.s.f. left side	6	14	10	14	20
Relative strength with unbalanced load	30%	70%	50%	70%	100%
Inches deflection with unbalanced load of 12 p.s.f. and 6 p.s.f.	171/2	l!/2	1%	%	%

2. All domes have sixty-one nodes (strut connections).

3. All domes used tubular struts of the same diameter to make up the frame.

The results of our computer analysis are shown in Table 1. Although the Schwedler dome without diagonals looks rather good under uniform symmetrical load, the unbalanced loading caused by simulated snow and wind is far more important. Under such loading, the Schwedler dome without diagonals would only support 12 p.s.f. on one-half the dome, with six pounds distributed over the other half. By adding the diagonals to the Schwedler dome, its strength was more than doubled. This increase in strength was accomplished by reducing the tubular frame wall thickness and without increasing the total weight of the dome.

The lattice dome will support 20 p.s.f. under the unbalanced condition, the Lamella, 28 p.s.f. By contrast, the geodesic configuration will support a full 45 p.s.f. as a symmetrical load over the total surface, or a nonsymmetrical loading of 40 p.s.f. on one side and 20 p.s.f. on the other.

SOUTH POLE POLYFRAME

A special application of the PolyFrame dome, and one that has received worldwide attention, is the U.S. Navy's South Pole Station. This huge, all-aluminum dome is 50 feet high and 164 feet in diameter, and serves as a giant weather break to protect the Navy's science headquarters, communications center, and crew's quarters (Figure 8).

The lightweight Temcor dome was selected for this difficult task because it could be broken down readily into coded components for air shipment and assembly under frigid working conditions. Moreover, the PolyFrame dome is inherently capable of withstanding heavy winds and drifting snow. The South Pole Dome was designed to withstand winds of 125 miles per hour, uniform loads from ten feet of snow on top and, even more importantly, unbalanced loadings of thirty feet of snow on one side (Figures 9 and 10).

POLYFRAME COVERS THE GOOSE

Probably the most significant verification of geodesic efficiency in dome structures is the Temcor PolyFrame dome erected to house and exhibit Howard Hughes' *Spruce Goose* aircraft in Long Beach, California. Housing without damaging the world's largest wooden airplane of World War II vintage presented some very' difficult structural and logistics problems. The *Spruce Goose* has a wing span of 320 feet and a tail section that stands 100 feet above the ground. The Temcor dome was selected to be the permanent home of the flying boat instead of steel, wood, concrete, or fabric structures. The PolyFrame dome, including its foundations, saved the builder well over a million dollars—a great verification of the fact that quality need not be sacrificed to reduce costs when good design and geodesic principles are employed.

The 415-foot-diameter aluminum dome required to house the flying boat rests directly on the foundation at ground level and rises 130 feet at the center to clear the aircraft (see Figures 11—14). Unique erection procedures were required to realize this dome. Notice the large temporary' opening left in the side of the dome to allow passage of the flying boat. One view clearly shows the special geodesic geometry as modified for the construction requirements (Figure 15).

Bucky Fuller expressed to me complete satisfaction with the design during a visit to the site of the Temcor *Spruce Goose* dome (Figure 16). The dome represents the state of the art in efficient structures, as it requires only 0.75 ounces of material per cubic foot of enclosed volume.

These and other construction concepts brought forth by Bucky Fuller will become more feasible with each passing day. My work and success with Temcor is only a beginning.

Figure 1. The forty-nine-fool-diaineler structure best illustrates some of the early geodesic geometry frame domes. Il was designed and erected by Jeff Lindsay in Canada in 1949. This prototype shows the "sprit-truss" method of stabilizing gusset points to prevent individual gussets from snapping through.

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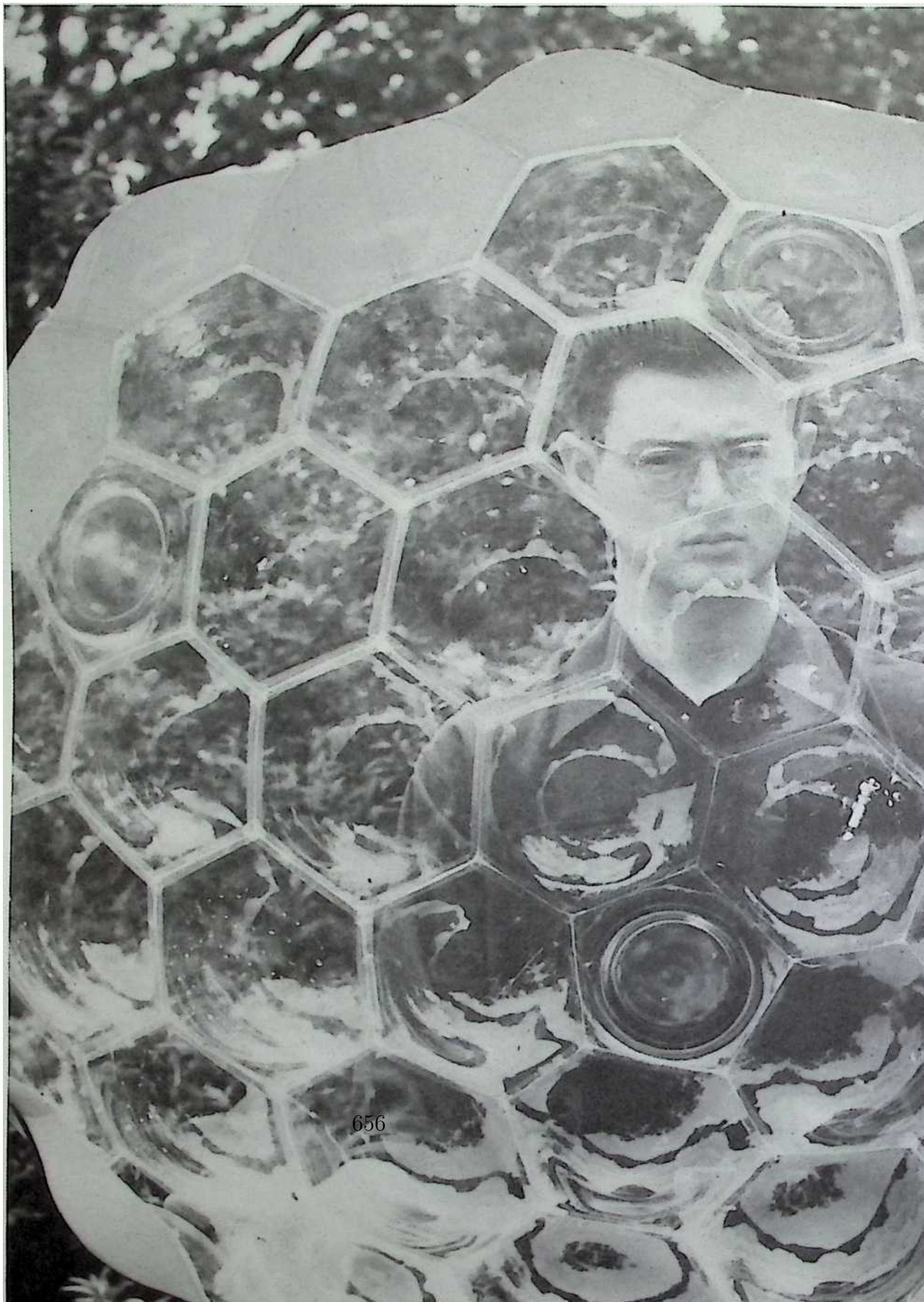


Figure 2. The model shown here is the first involute dome system. It is one of several types developed in 1949.

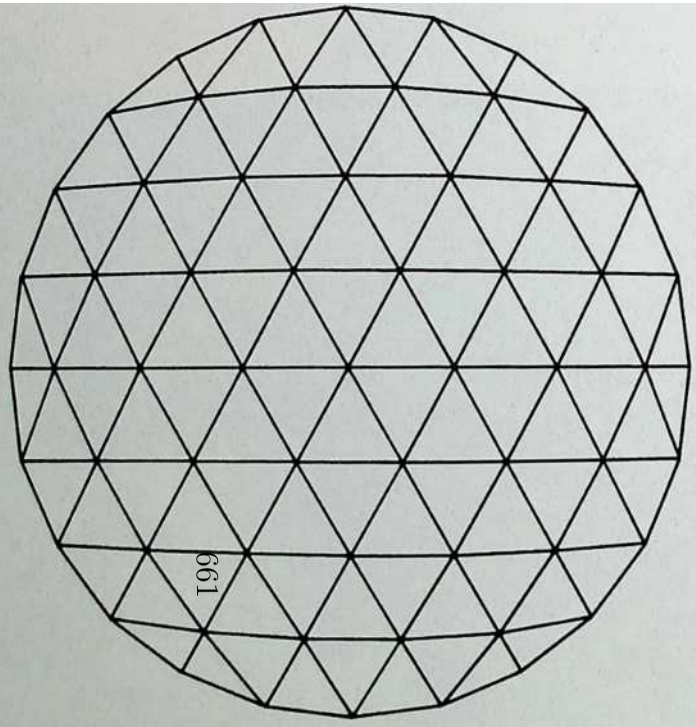
Figure 3. This 1957 photo shows the completion of the first true aluminum panel geodesic dome al Kaiser's Hawaiian Village on Honolulu's Waikiki Beach. The dome is still in use as a nightclub.

Figure 4. View of a 232-foot-span Temcor geodesic dome erection, working around a central lifting lower. Diamond-shaped structural panels on the ground have been braced with tubular aluminum struts anil are ready to he added to the next "ring" of dome construction. All assembly takes place safely al ground level.

Figure 5. In this aerial view, the world's first triple geodesic dome complex blends harmoniously into the snowy winter landscape al Elmira College in upstate New York. Flanking the gymnasium dome at center are the fieldhouse dome (left) and the hockey dome.

Figure 6. The dedication of the Elmira College triple geodesic dome complex took place on January 28, 1973. This photo taken during the community luncheon preceding the ceremonies shows details of the interior of the hockey dome, including the indirect lighting system that bounces light off the dome interior.

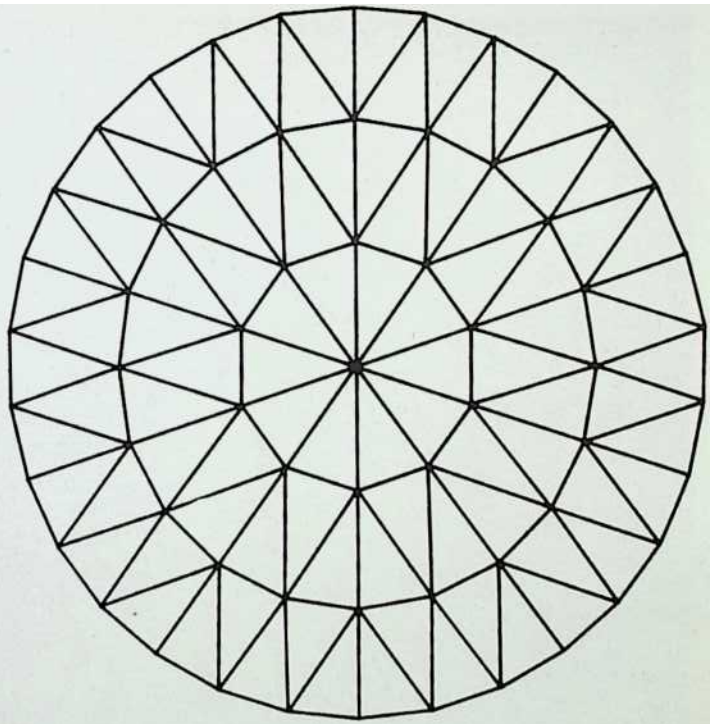
Figure 7. These basic dome geometries were studied by computer to determine their relative structure efficiency.

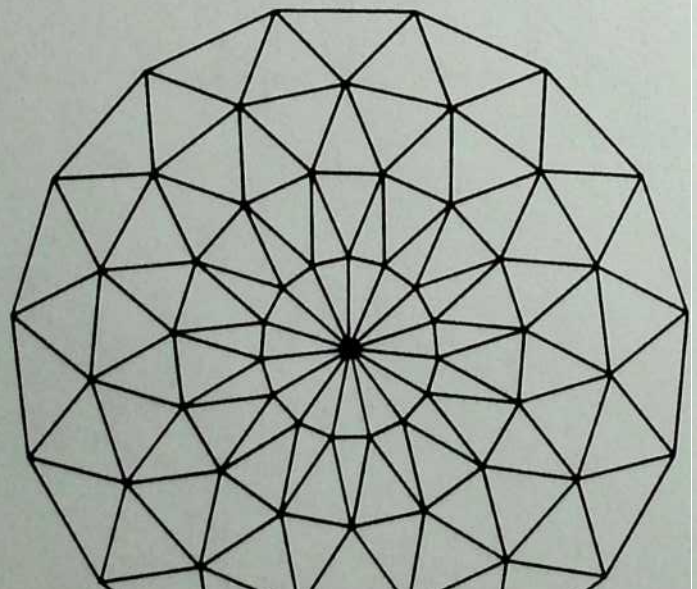


LAMELLA DOME

strength 70

stiffness 100

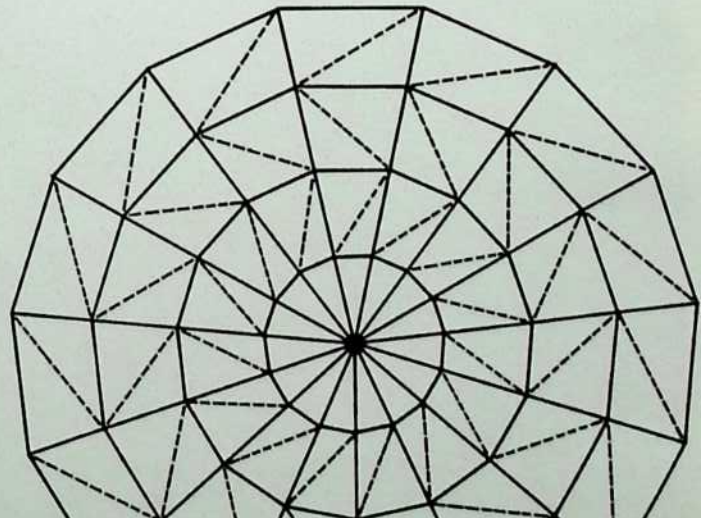




SCHWEDLER DOME

strength 30

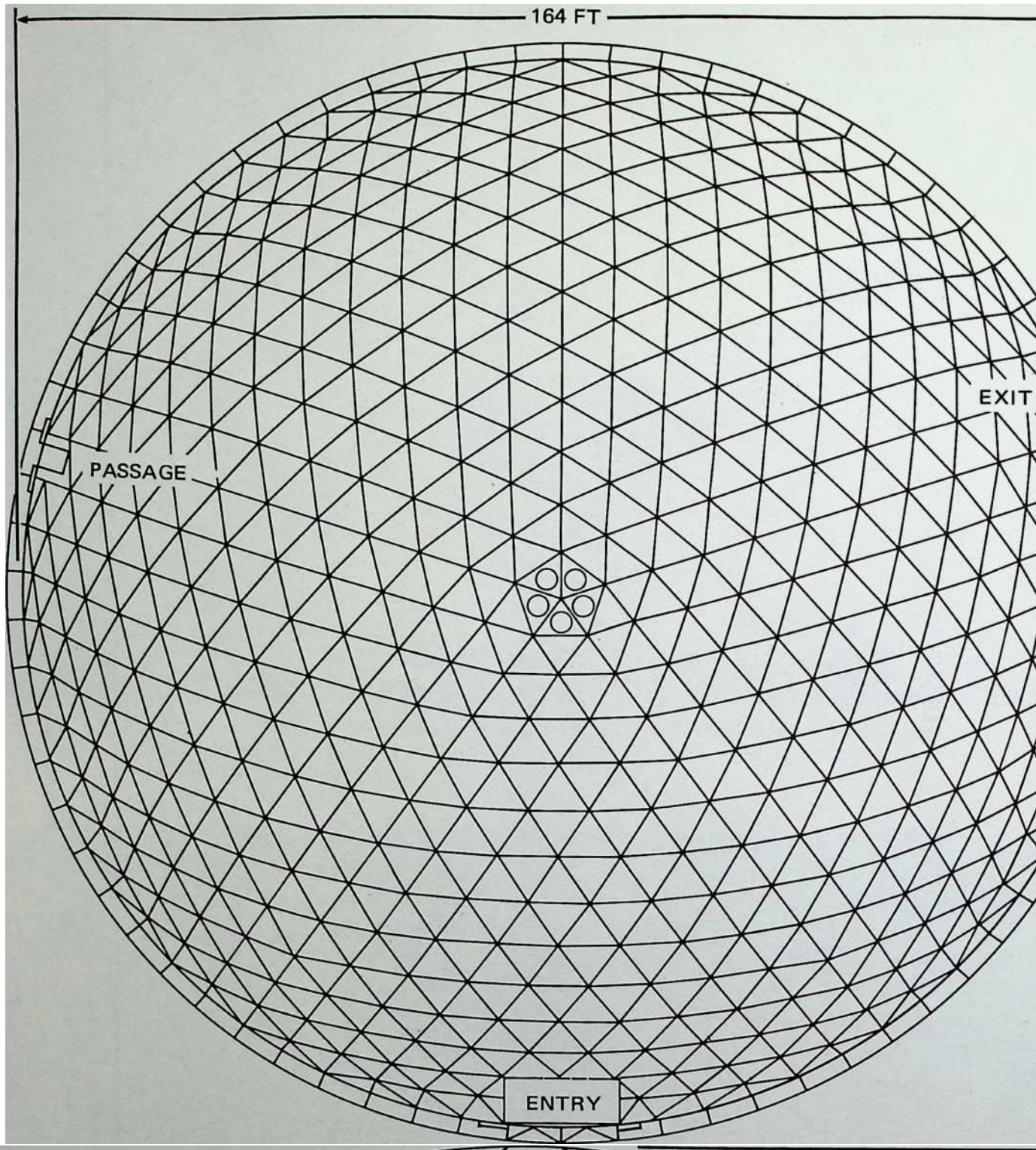
stiffness 5

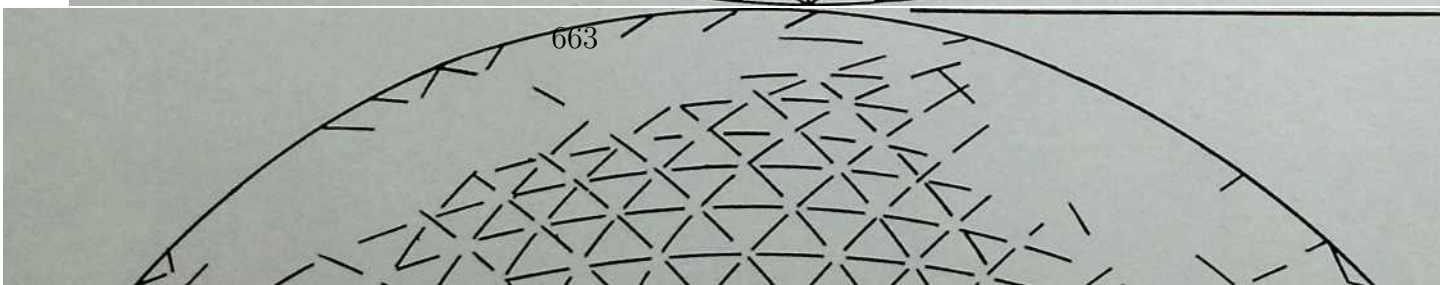


TEMCOR POLYFRAME

Figure 8. Temcor South Pole PolyFrame dome plan and elevation.

ELEVATION


164 FT
EXIT
PASSAGE
ENTRY



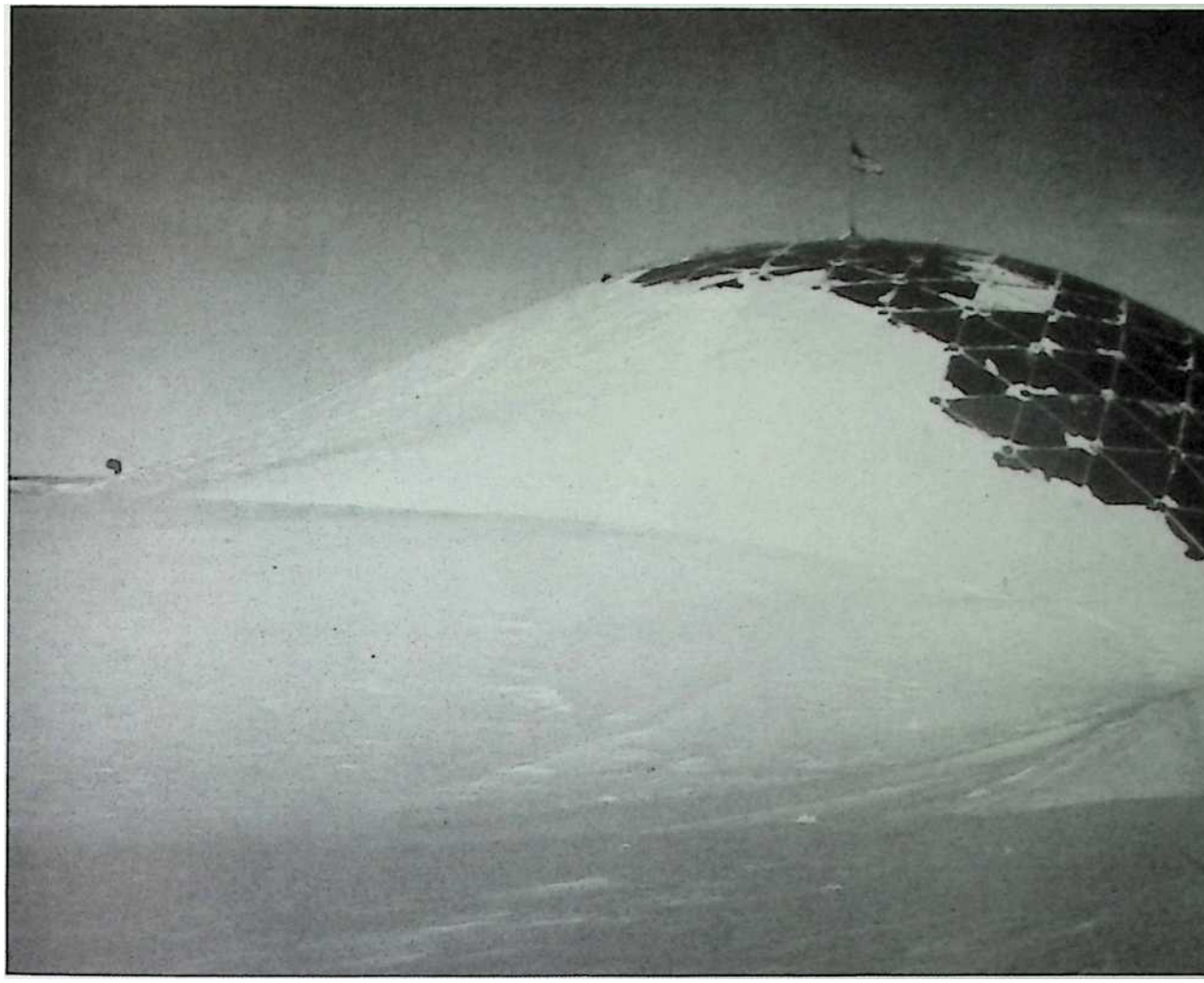


Figure 9. The all-aluminum PolyFrame dome had withstood ten years of sendee half buried in snow drifts when this photo was taken.

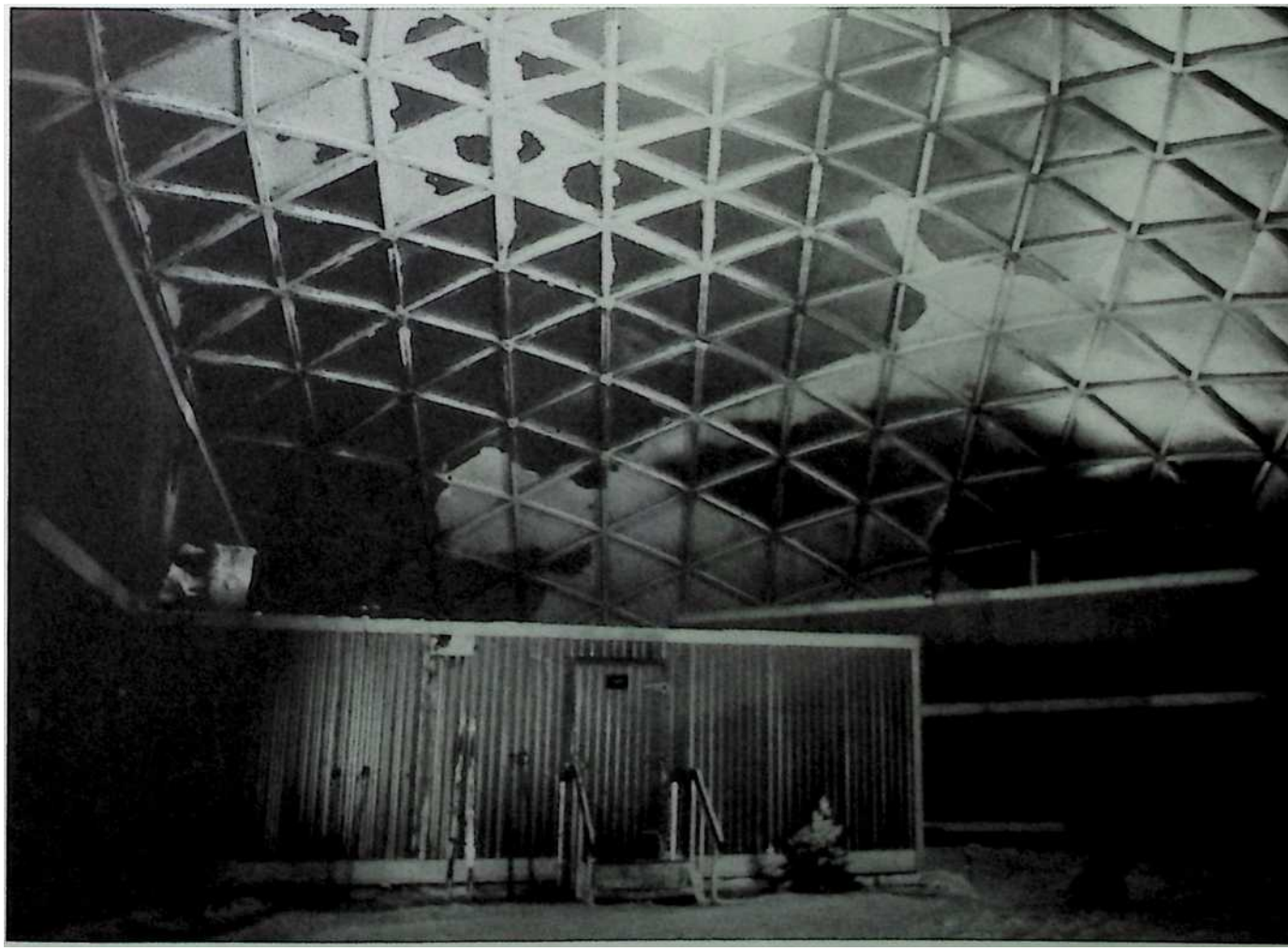


Figure 10. The 164-fool ``weather-break'' dome protecting the enclosed scientific station makes life at the South Pole livable.

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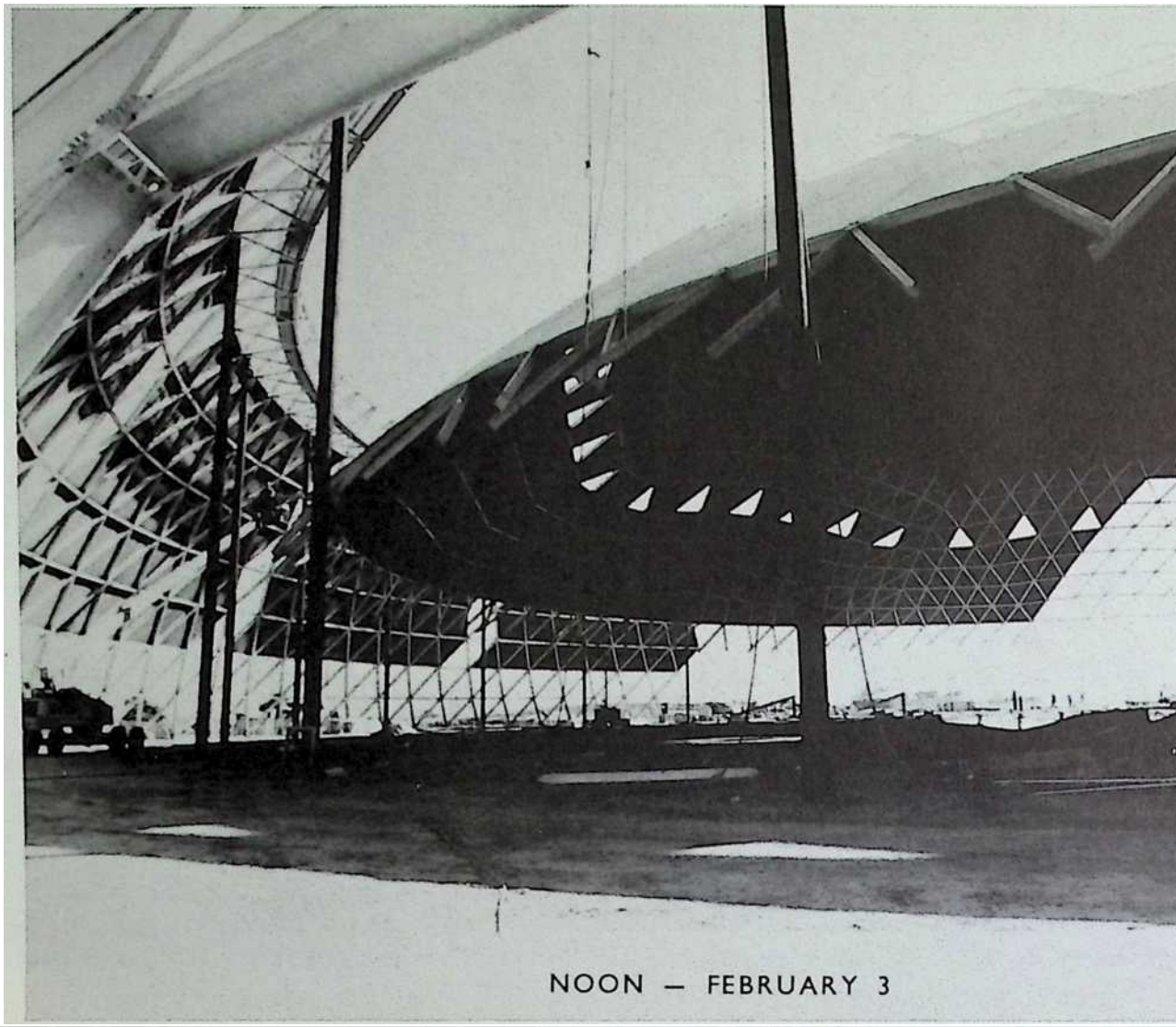
Figures 11 and 12. Photographs documenting the erection procedures of the *Spruce Goose* dome in Long Beach, California.



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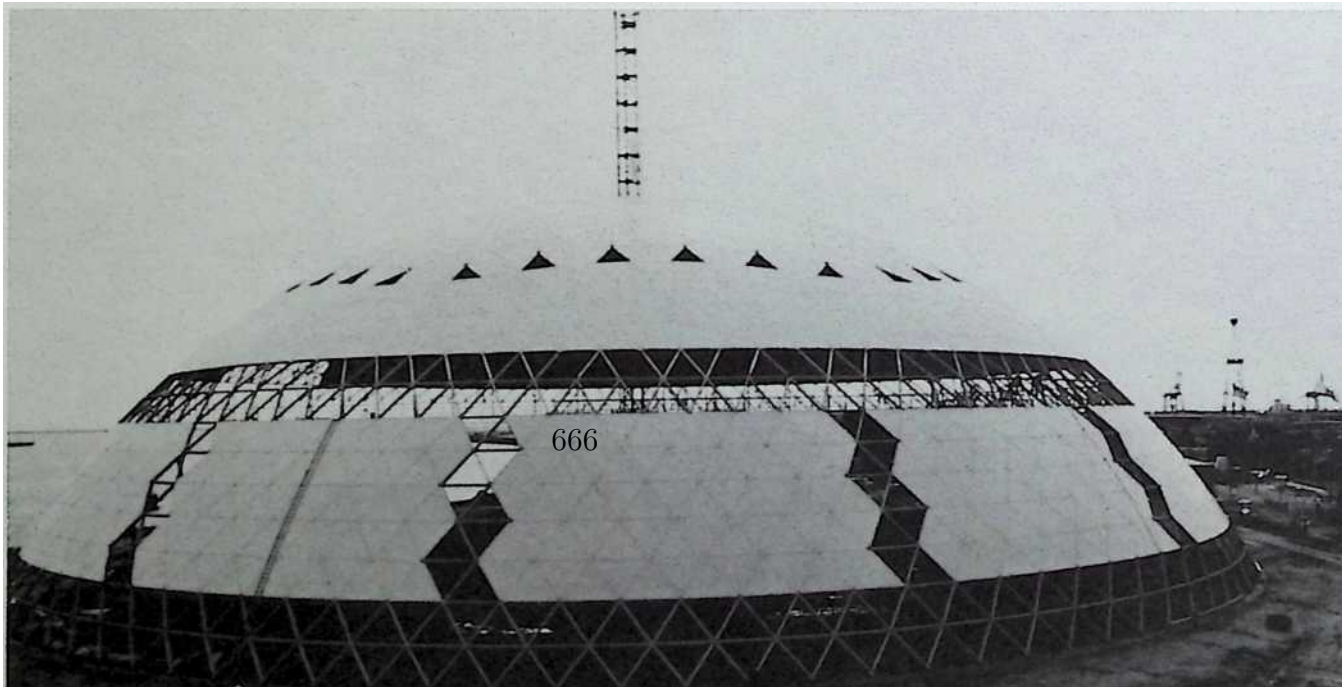

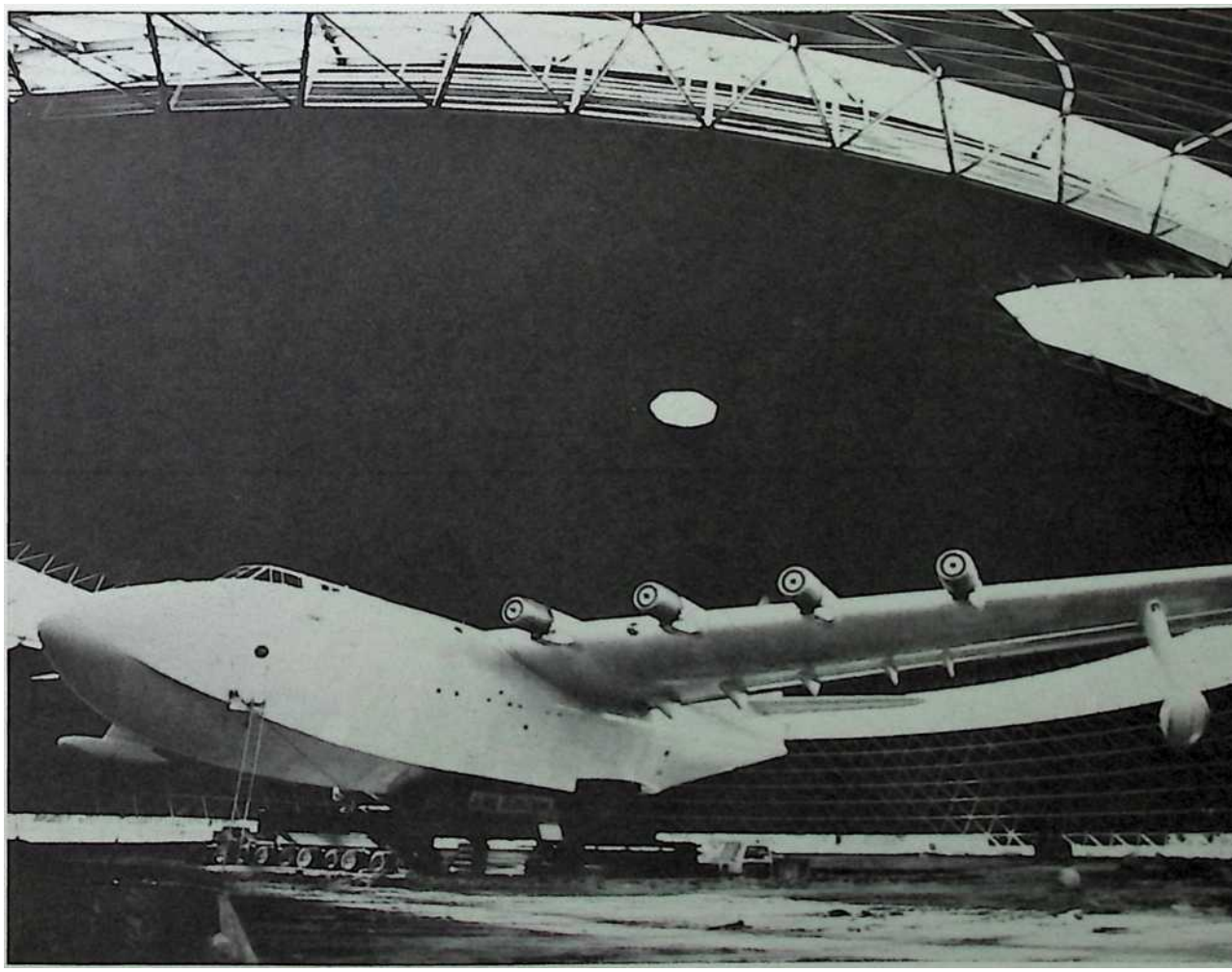

Figures 13 and 14. Photographs documenting the erection procedures of the Spruce Goose dome in Long Beach, California.

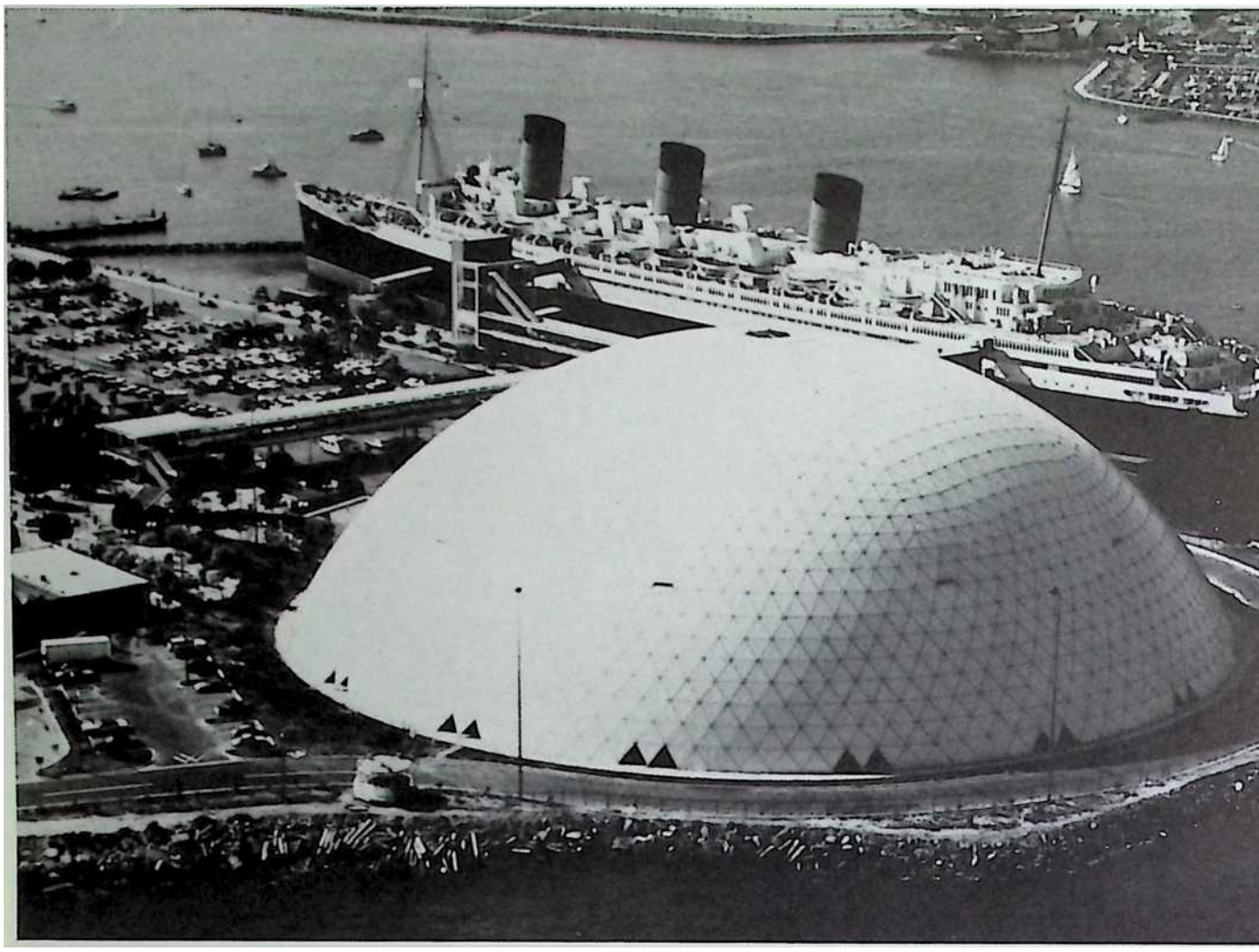

Figure 15. Completed in 1983, the 415-foot-diameter by 130-foot-high, all-aluminum, Temcor PolyFrame dome now provides a permanent home for the *Spruce Goose* aircraft in Long Beach, California.

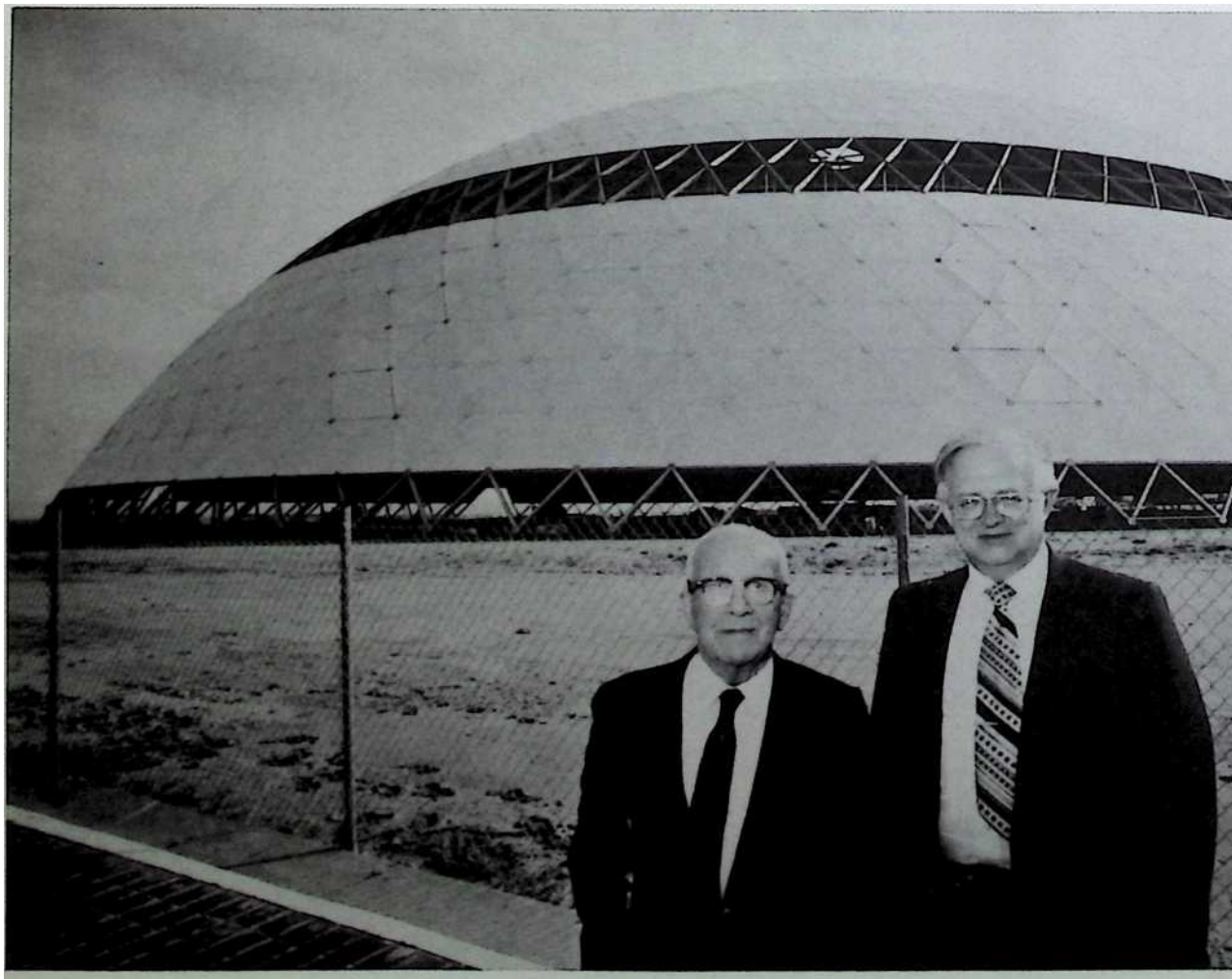

Figure 16. R. Buckminster Fuller and Don L. Richter survey the New World's larg

dome—the Temcor PolyFrame dome that houses the *Spruce Goose.*

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