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A Prototype Terminal Elevator Program & Conclusion

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PROTOYPE TERMINAL ELEVATOR - SAXTON

B.A. 1967

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A Prototype Terminal Elevator
Program & Conclusion
for a
Bachelor's Thesis
in
Architecture
by
Gary Saxton
August 5, 1968
at
The University of New Mexico

PROTOTYPE TERMINAL ELEVATOR
FOR CLOVIS, NEW MEXICO

BY
GARY SAXTON

BACHELOR'S THESIS

Presented to the faculty of the Department of Architecture, University of New Mexico, in part fullfilment of requirements to receive the degree of Bachelor of Architecture.

AUGUST 5,1968

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Dedication

To those who made this thesis possible goes my deepest appreciation.

Micheal Garrett
Ray Pritchett
Phil Crystal
Steve Self
Fred Russell
Troy Monroe
Ray Thompson
Jim Kirby
Mr. Strader
Dr. Dittmer
Otie Kilmer
Chuck Ivy

Method & Direction

Available material concerning grain production, existing facilities, and technical studies of grain handling problems has been obtained, classified, and will be analyzed with the intention of producing a superior grain handling plant. The direction taken has been one of the integration of visual elements and physical design in parallel with the practical applications of the mechanics of grain handling, processing, and storage, for the efficient operation of an entire complex.

Concept

In parts of the Southwest, as in other regions of the United States where grain production is the basis of the economy, the huge form of the grain elevator becomes a powerful visual element of the landscape. Truly, in most cases, it is the only outstanding element. Imagine, if you will, in an area where it is not uncommon to be able to see 20 or 30 miles, a giant white tower, 150 feet or more tall, that is the only vertical breaking the horizon line, and you begin to see the natural magnificence of these structures. The drawback, it seems, lies in the fact that, with few exceptions, these plants have been designed by structural engineers who have been unaware of or completely ignored the possibility of exploiting their inherent visual strength.

In this thesis it is my purpose to make careful re-examination of all pertinent information concerning the efficiency and physical systems of the grain handling plant, as a total process, and to incorporate my conclusions into a final statement that takes advantage of the possibilities for a stronger visual expression of the physical plant, that expression not being, necessarily, vertical. Though the final form of thesis be oriented toward the end visual result, at no time will pure design be allowed to hinder or otherwise circumvent the purpose or efficient function of the facility.

General Design Assumptions

The following paragraphs set forth the assumptions and design criteria necessary to the developement of the design, and recommendation suggested in this thesis.

Type of Operations

The administrative role shall be one of buying, selling, and, in general, controlling the movement of grain.

Upon receiving grain from field or on-farm storage, the grain must be weighed, testedfor moisture content and quality, and unloaded. From here the grain is moved to storage until it is processed or shipped.

Previous research has shown that it is economically feasible to incorporate sister operations into the complex. This will be in the form of a food-grain processing plant (flour) and a rolling mill for the production of livestock feed. Other integrated units will include grain dryer and cleaner.

Storage Capacity

A total storage capacity of 10,000,000 bushels of grain has been selected for the proposed plant. This capacity will be devided into bins and tanks of various sizes.

Handling Capacity

A volumn handling capacity of 20,000 bushels per hour (to facilitate expansion) has been selected to fulfill the following criteria:

(a) to speed up unloading and reduce the waiting lines of trucks during peak seasons.

(b) to fulfill the anticipated need for faster receipts with the use of larger grain trucks and larger harvesting equipment.

(c)because high capacity equipment may be installed at low unit cost.

(d)because research data shows that farm trucks of up to 500 bushel capacity can be unloaded in 5 minutes or less.

Structural Design Criteria

Since structure compromises, almost entirely, the form of the grain plant, the choice of materials and methods of building construction should be carefully considered as it becomes economically important to such a plant. Furthermore, materials control the effect of the final visual product and this is a major consideration of this thesis.

Loading conditions will include the following:

(a)normal dead load

(b)grain load and pressure

(c)wind load

(d)live load

(e)seismic load

(f)equipment load

(g)erection load

(h)thermal expansion

(i)internal pressure

(j)soil bearing capacity

Site Considerations

The location of the site has been chosen only after careful consideration of the following factors:

(a)accessibility of transportation facilities.
(b)accessibility of utilities
(c)topography

The site should be readily accessible to main roads that allows traffic of large tractor-trailer rigs, and to railway facilities, usually in the form of a spur track.

Off-site power must be available for lighting as well as to run handling units and other necessary equipment.

Site investigation should include the determination of a water source for drinking, fire prevention, power, and sewage disposal.

The site should be reasonably flat for ease of traffic and ease of construction, but should also allow for sufficient drainage.

Plant Planning

The layout of the plant will be planned with the intention of integrating men, materials, and equipment so as to move material over the shortest distance, in the least amount of time, while providing a natural sequence of operations, in a safe manner and under good working conditions.

A major consideration will be the centralization and automation of control, that will, in turn, increase the efficiency of the proposed plant over that of the old system, and reduce the amount of labor required to operate existing plants.

The various units will be arranged to provide ease of flow of grain trucks into and out of

the buildings and site, and to provide for adequate on-site parking for administrators, employees, and customers.

The site should be planned for ease of administrative control.

Buildings and Storage

A well designed and well built plant will maintain the market quality and provide sanitary conditions for the grain. The walls, roof, and floors should be sealed to protect the grain from rodents and birds, to prevent spoilage from weather conditions, and to allow for efficient aeration and fumigation, if and when these needs arise. Crevices and ledges, where grain can collect and provide breeding places for insects should be avoided. Tank and bin bottoms should be self cleaning.

The storage tanks will be designed to achieve maximum efficiency of storage and reduce the amount of material used in their construction.

Handling Equipment

Capacities of the various handling units should be carefully co-ordinated to avoid waiting time. The handling equipment should be flexible enough to perform all the necessary operations, such as receiving, shipping, drying, turning, cleaning, and processing, and do several of them simultaneously. Crackage and other damage to the grain should be avoided through the use of good equipment and careful handling.

Access for easy maintenence and inspection of all machinery and equipment should be provided. Dangerous moving equipment should be provided with guards and away from, as much as possible, main walkways and aisles.

Accessories for Maintaining Grain Condition

In addition to a grain drying unit for early wet grain, an aeration system will be installed to reduce the necessity, caused by extreme hot spots in the grain, of turning.

Since hotspots cause spoilage and insect activity, temperature indicators will be installed throughout the storage area to pinpoint their exact location.

Dust Control and Explosion Prevention

Dust control is the first line of defense against dust explosion. A complete system for dust control, including fans, duct systems, venting, and a central dust collector, will be studied and integrated into the design.

Achievement of the following will provide further insurance against dangers:

(a)a mandatory daily program of cleaning.
(b)use of construction with a minimum of ledges and pockets where dust can collect.
(c)provide ample ventilation

The following systems will be vented or connected with the dust control system:

(a)bucket elevator
(b)bins and hoppers
(c)distributors
(d)automatic scales
(e)loading and discharge sections of conveyors

Design Requirements

Administrative Unit

Duties of the administrative unit are as follows:

(a)recording of weights of grain trucks and loads.

(b)testing and grading of grain samples.

(c)keeping records of the interprise.

(d)computing and analyzing sales, costs, and other figures.

(e)filing and storing of records.

(f)administration of elevator employees.

(g)meeting and communicating with customers.

(h)provide lounge area for customers.

Area requirements are:

-general reception area.....200 sq. ft.
-general office area & scale....200 sq. ft.
-manager's office.....150 sq. ft.
-bookkeeping.....150 sq. ft.
-lounge.....200 sq. ft.
-records storage..... 50 sq. ft.
-general storage & utility.....100 sq. ft.
-men's toilet..... 50 sq. ft.
-women's toilet..... 30 sq. ft.

Grain Working Area

Since the areas of these various units cannot be determined immediately in square footages, the following requirements will be determined by extensive study and incorporated into the final design.

Considerations, for the design of each unit, are:

Receiving Unit

(a)monitor control of the receiving unit.

(b)circulation

(c)scale, office, & unloading relationship.

(d)mechanical unloading device.
(e)boot(unloading hopper) cap. 20,000 bu./hr.
(f)location.
(g)type of grain movement
    (1)bucket
    (2)screw
    (3)pneumatic
    (4)conveyor

Grain Cleaner
(a)monitor control of unit.
(b)size (cap. req. 1,000 bu./hr.)
(c)trash disposal.

Automatic Scales
(a)control monitor
(b)cap. equal to boot & leg
(c)location

Aeration Equipment
(a)control monitor
(b)type
    (1)portable
    (2)integral
(c)size of power & blower units
(d)location

Grain Temperature Indicators
(a)control monitor
(b)distribution
(c)required number

Magnetic Separators
(a)type
(b)location

Insect Control Devices

(a)type

(b)location

Static Arrestors

(a)type

(b)location

Manlift

(a)number req. (2 @ max.)

(b)cap. 1,000 lbs. min.

(c)location

Shutes

All loading shutes should be constructed of a material that is little affected by continous use.

(a)truck

(1)location

(b)railway

(1)location

The previous program was written as a guideline to follow while working on preliminary design studies. The following pages are my final studies, including the presentation, comparison study, and photographs.

Comparitive Statistics

	Existing 10,000,000 bushel capacity elevator	Prototype Terminal Elevator 10,000,000 bu. cap.
Cost:	$10,000,000.00	$6,000,000.00
Lateral Conveyor:	no less than 2,000 ft.	no more than 500 ft.
Grain Movement:	majority by Lateral Conveyor	almost exclusively Gravity
Turning:	majority by Lateral Conveyor	Integral Aeration System
Control:	manual and decentralized	Automated and Visual Monitor
Employees:	15	8
Support Structure:	walls of individual tanks and bins	Comp./Tens. Rings & The Earth
Loading & Unloading	departmentalized operation (3 stops)	Single Stop (Continous Flow)
Cover Structure:	concrete	Plastic w/ Steel Support

PROTOTYPE TERMINAL ELEVATOR

SYSTEMS

STORAGE

BASIC UNIT

- boot
- leg
- main storage
- man lift
- distribution
- loading-unloading
- aeration
- temperature metering
- conveyor
- structure

CONTROL

BASIC UNIT

- visual
- scanner
- monitor
- thermo-ganglia
- inter-communication
- central console
- clean room
- digital programmer
- physical link

FOOD PRODUCTION

BASIC UNIT

- cleaning
- tempering
- blending
- conditioner
- grinding
- storage
- package
- bulk storage
- loading
- fluid-lift

FEED PRODUCTION

BASIC UNIT

- cleaning
- mixing
- admixing
- rolling
- press
- cooking
- cooling
- package-bulk
- loading
- fluid-lift

ADMINISTRATION

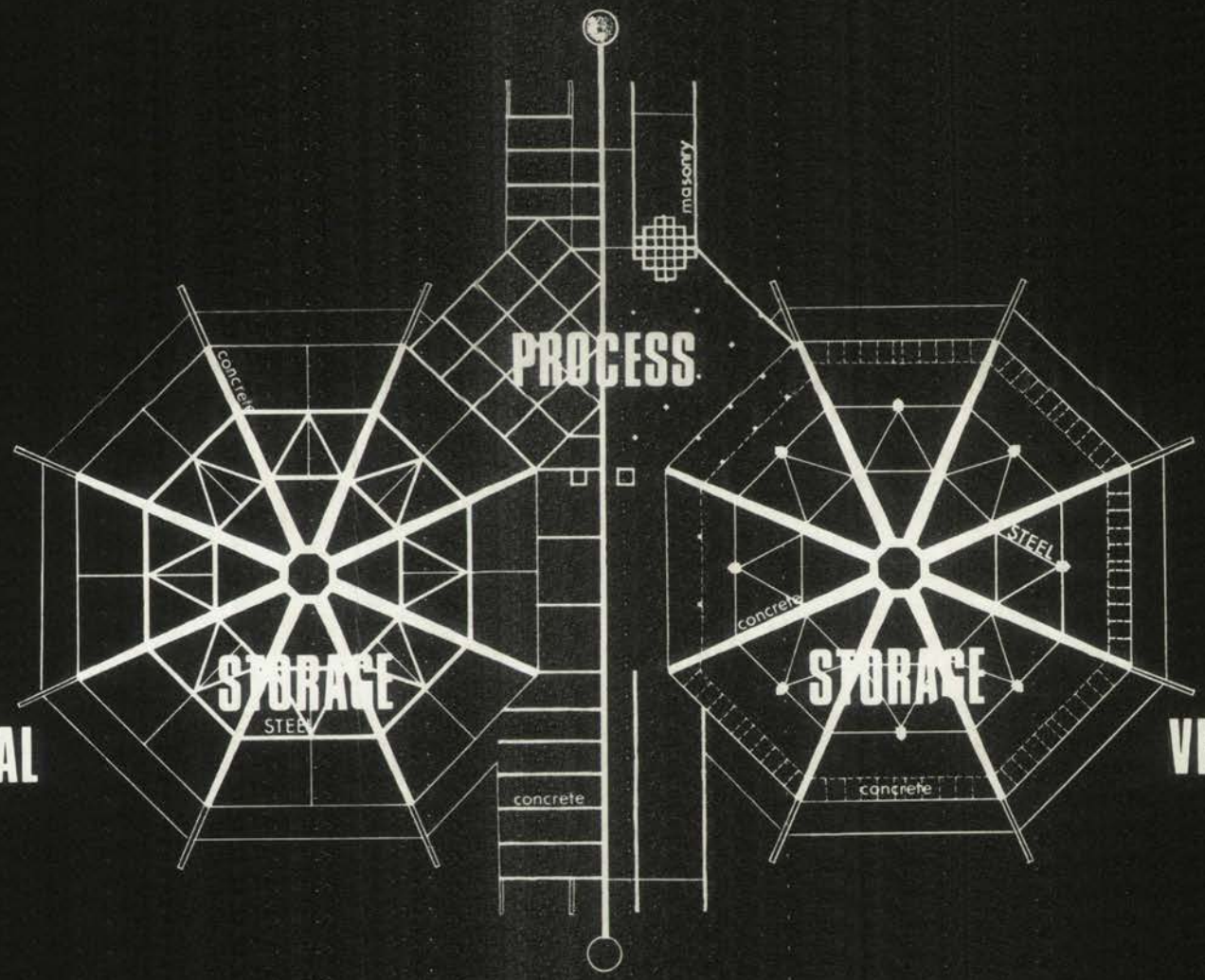
BASIC UNIT

- scales
- testing
- reception
- bookeeping
- management
- lounge
- utilities
- storage
- toilets

MAINTENANCE

BASIC UNIT

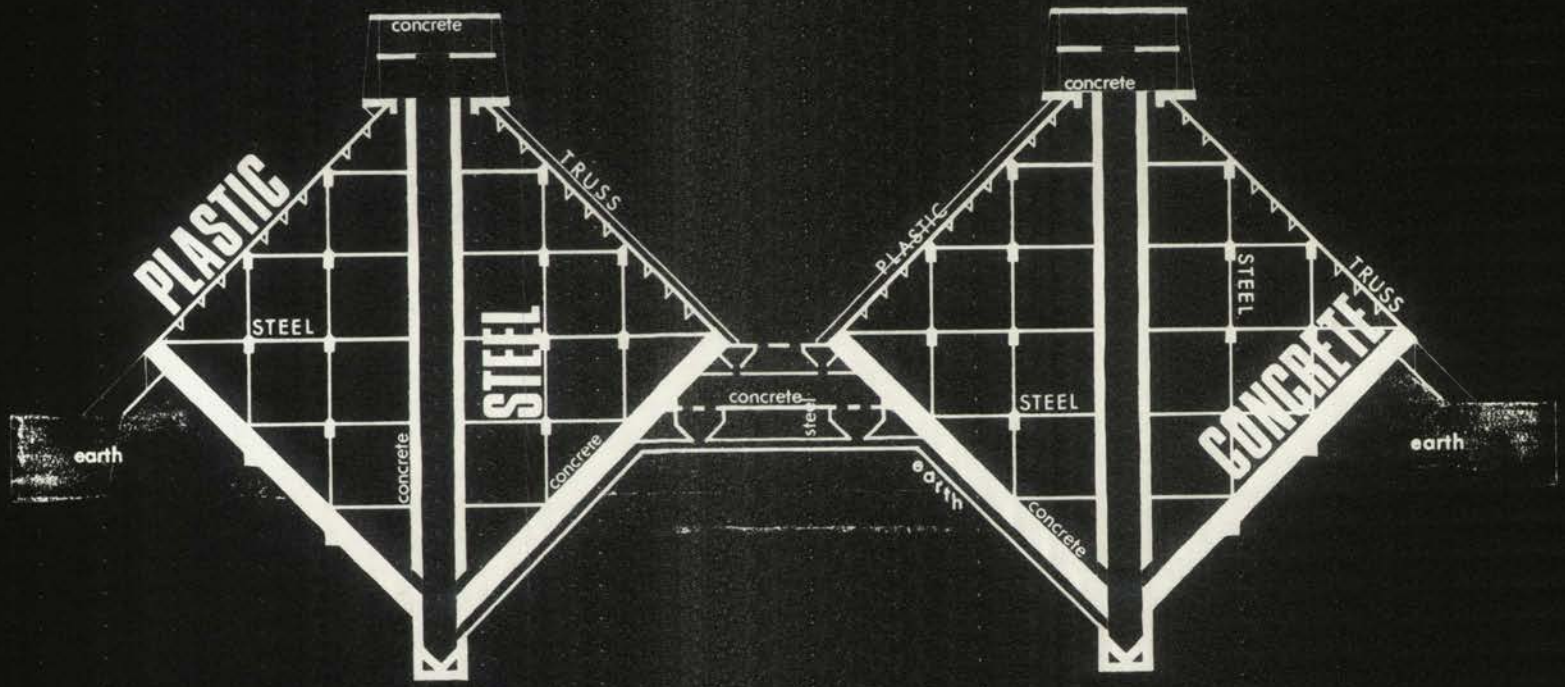
- welding
- mechanical
- vehicular
- plant
- office
- toilet
- storage



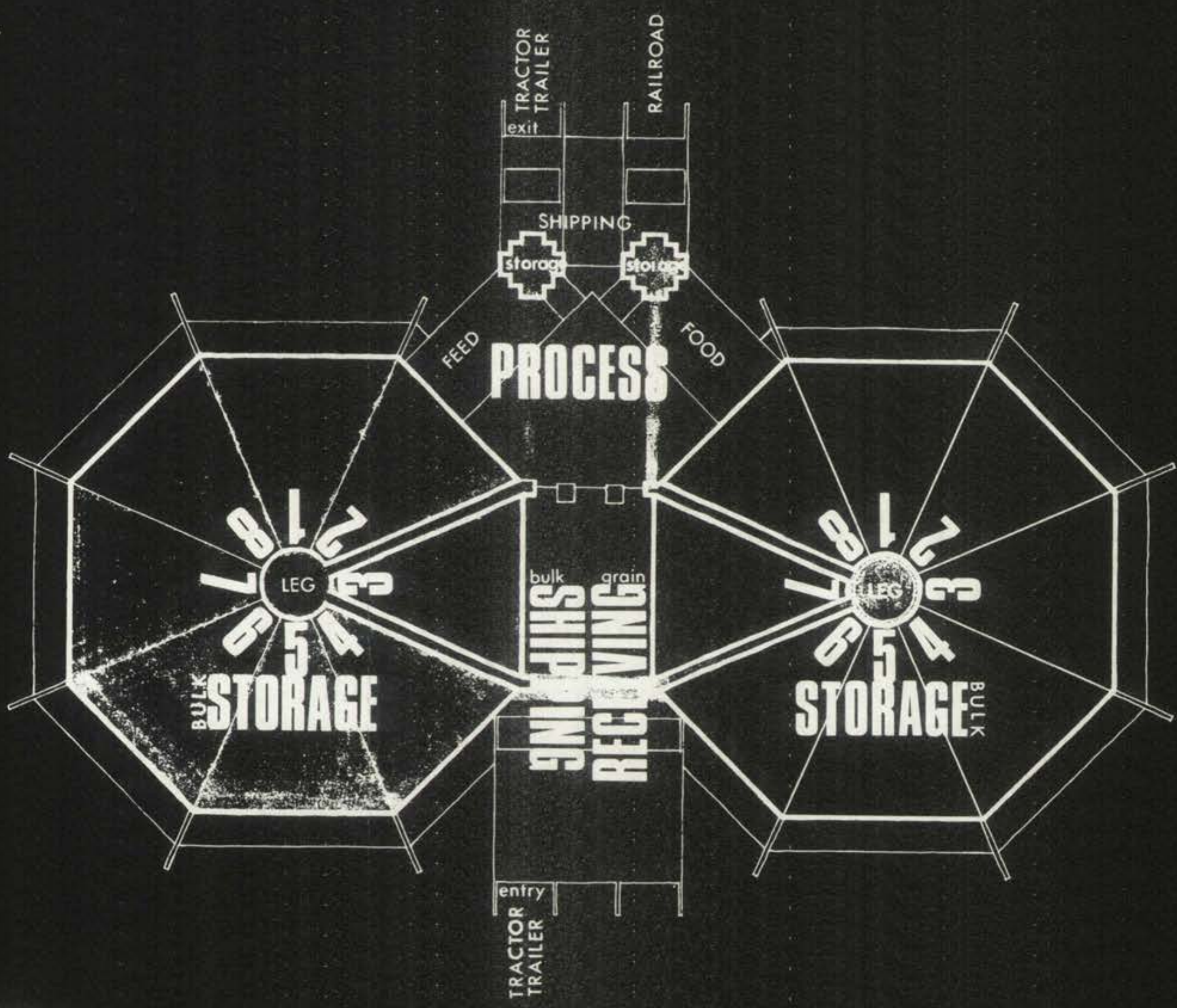
HORIZONTAL

VERTICAL

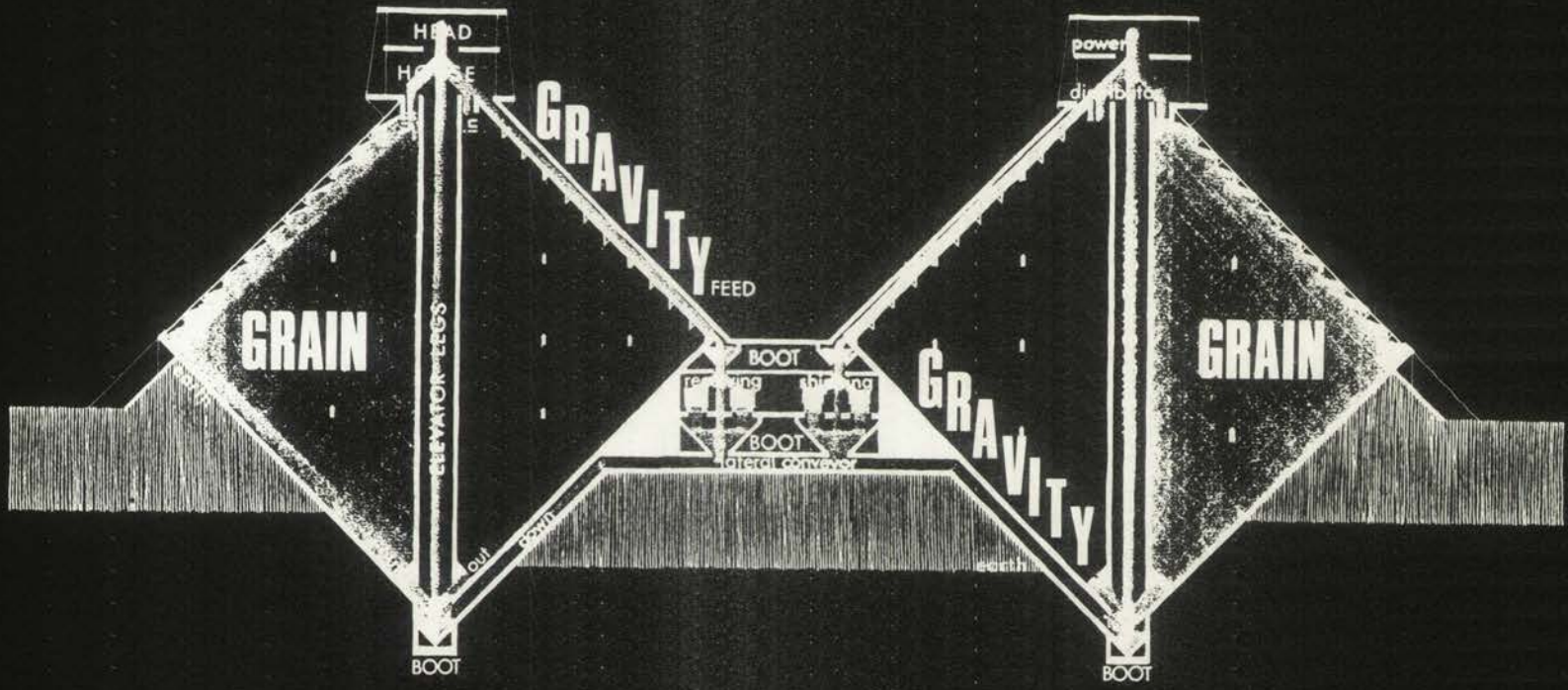
STRUCTURE PLAN



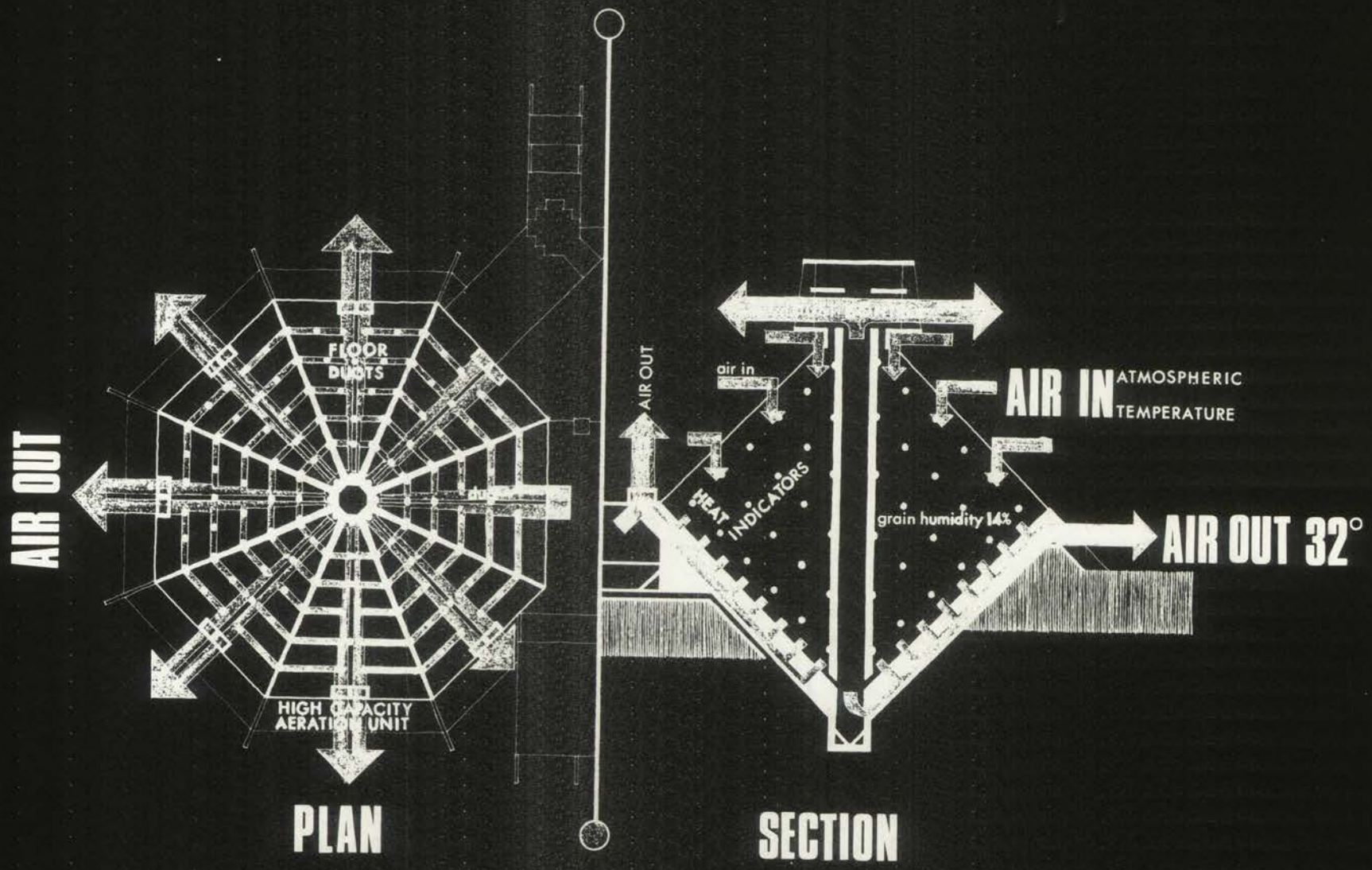
STRUCTURE SECTION



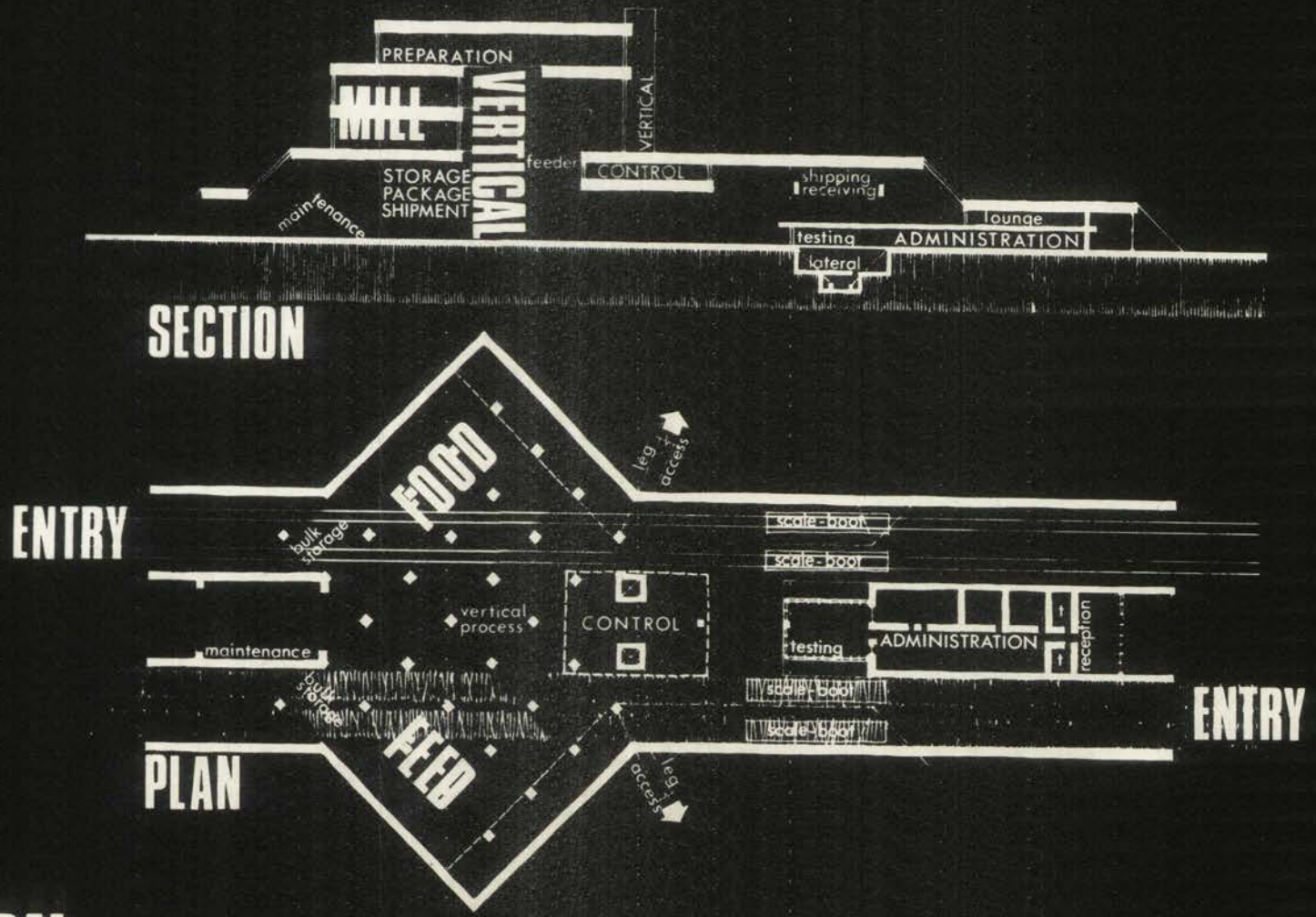
GRAIN FLOW PLAN



GRAIN FLOW SECTION


AIR OUT
FLOOR DUCTS
HIGH CAPACITY AERATION UNIT
PLAN
AIR OUT
air in
HEAT INDICATORS
grain humidity 14%
AIR IN ATMOSPHERIC TEMPERATURE
AIR OUT 32°
SECTION

AERATION


PREPARATION
MILL
VERTICAL
VERTICAL
feeder
CONTROL
STORAGE
PACKAGE
SHIPMENT
main-tenance
shipping
receiving
lounge
testing
ADMINISTRATION
lateral
SECTION
ENTRY
FOOD
leg
access
bulk
storage
scale-hoist
scale-hoist
vertical
process
CONTROL
maintenance
testing
ADMINISTRATION
reception
scale-hoist
scale-hoist
ENTRY
FEED
leg
access
PLAN

OPERATION