



P E R S P E C T I V E S

VOORHEES WALKER SMITH SMITH & HAINES
ARCHITECTS

NUMBER 3 · 1959



HENRY AND EDSSEL FORD
RESEARCH AND ENGINEERING CENTER
DEARBORN, MICHIGAN

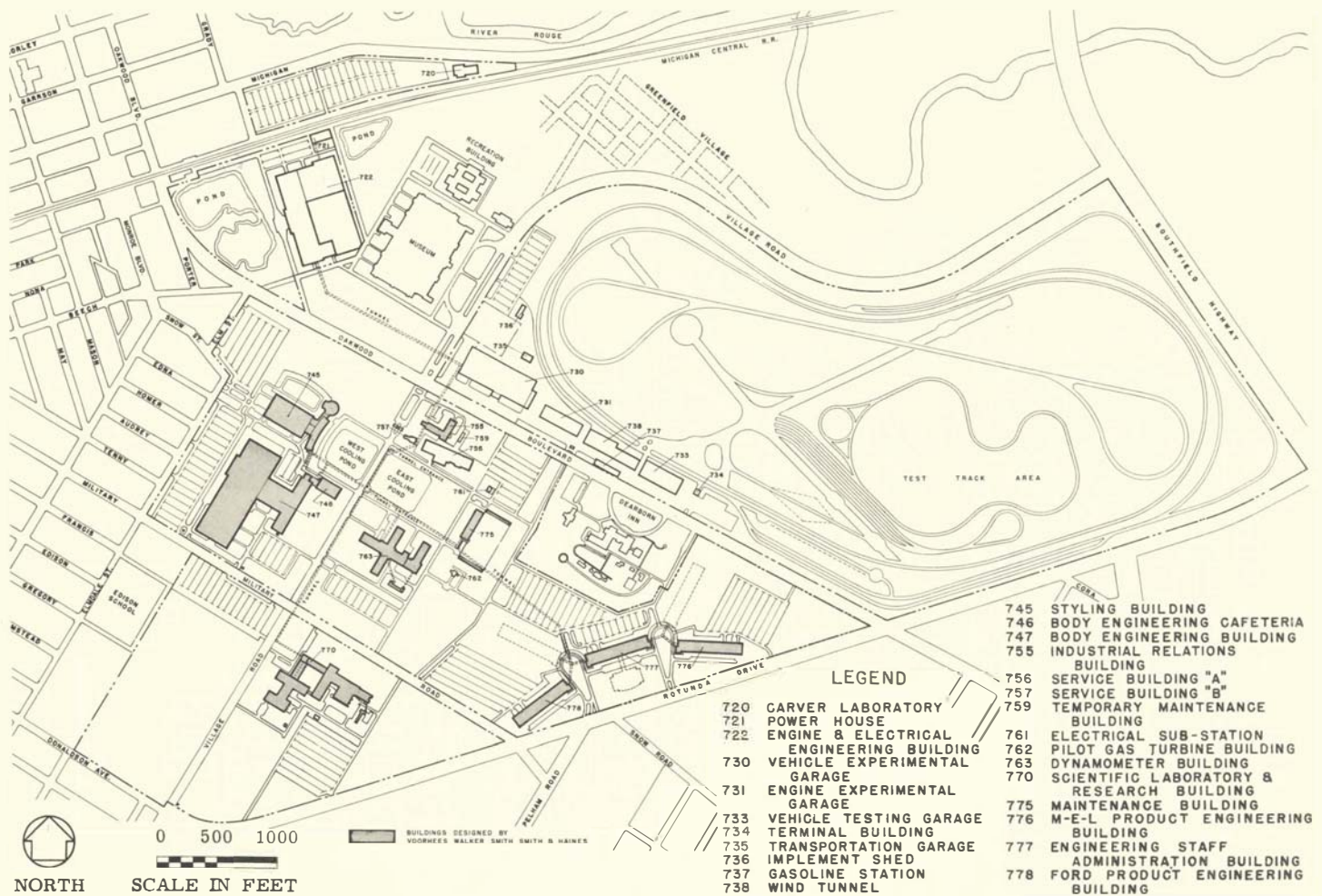
Introduction

The quality of a product can be only as good as the engineering behind it. This is the philosophy, expressed by an official of the Ford Motor Company, that inspired the construction of the Henry and Edsel Ford Research and Engineering Center, the largest integrated facility of its kind in the automotive industry. The Center was completed at a cost of \$150,000,000 in May, 1958. Its staff of 11,000 includes scientists, engineers, stylists, technicians and supporting personnel.

The seeds of the project were sown in 1945, when Ford commissioned Voorhees Walker Smith Smith and Haines* to assist in assessing future needs and to design a new research center. A thorough study of requirements was made. It was found that designing and engineering cars of the future called for the coordinated efforts of many specialized teams. Each team is responsible for a particular component development or testing phase of the finished automobile. After the engine, chassis or body components have undergone study and improvement they are combined into a prototype vehicle for testing as a complete preproduction model. Sustaining the teams are basic and applied research projects.

At the time of the study Ford engineering and research units were scattered throughout a number of buildings. These units, often isolated from each other, were neither large enough nor suitable for the diversified functions of a long-range scientific and engineering program. Out of the study emerged a plan for the construction of thirteen new buildings and the modernization of six older ones. These buildings, each designed to serve a special purpose, were arranged to form an inte-

*Voorhees Walker Foley and Smith in 1945



General Site Plan

grated Center devoted to research and the development, engineering and styling of Ford products.

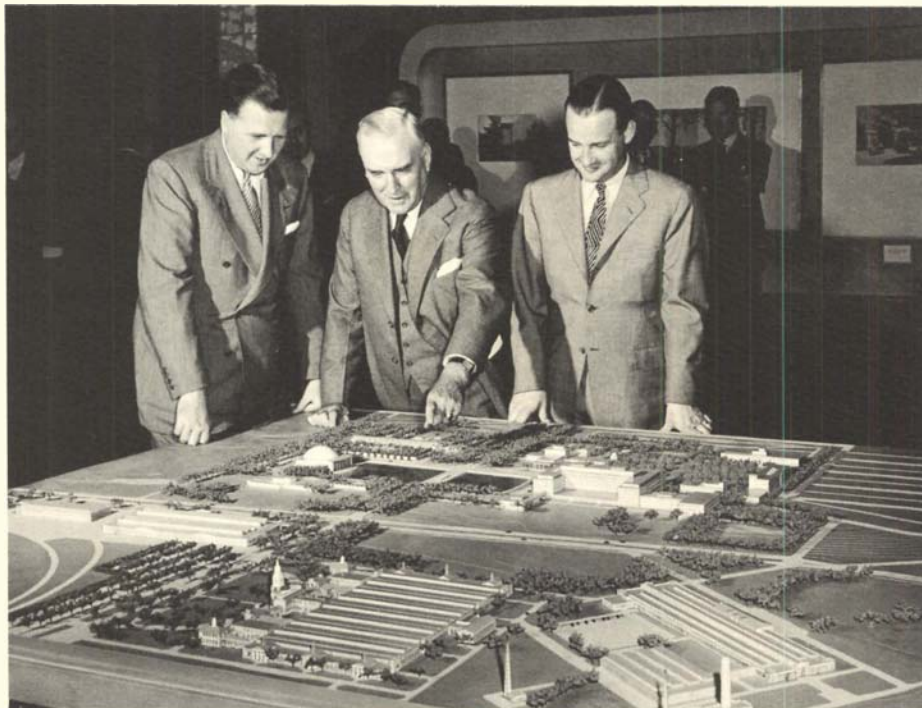
The site chosen for the center was a thickly wooded area in the pleasant suburban community of Dearborn, Michigan. The 722-acre tract, bisected by a major thoroughfare and serviced at its perimeter by paved streets, already was the site of facilities for engine and electrical engineering, engine experimentation and vehicle testing. It adjoins a test track for cars, formerly the Ford Airfield. The site also is adjacent to the Edison Institute, the Henry Ford Museum, Dearborn Inn and historic Greenfield Village. The Central Office Building of the company and the

Ford Division Office Building are only a mile away, while the Rouge plant, the Mercury-Edsel-Lincoln headquarters and the Rotunda exhibition building are within a five-mile radius.

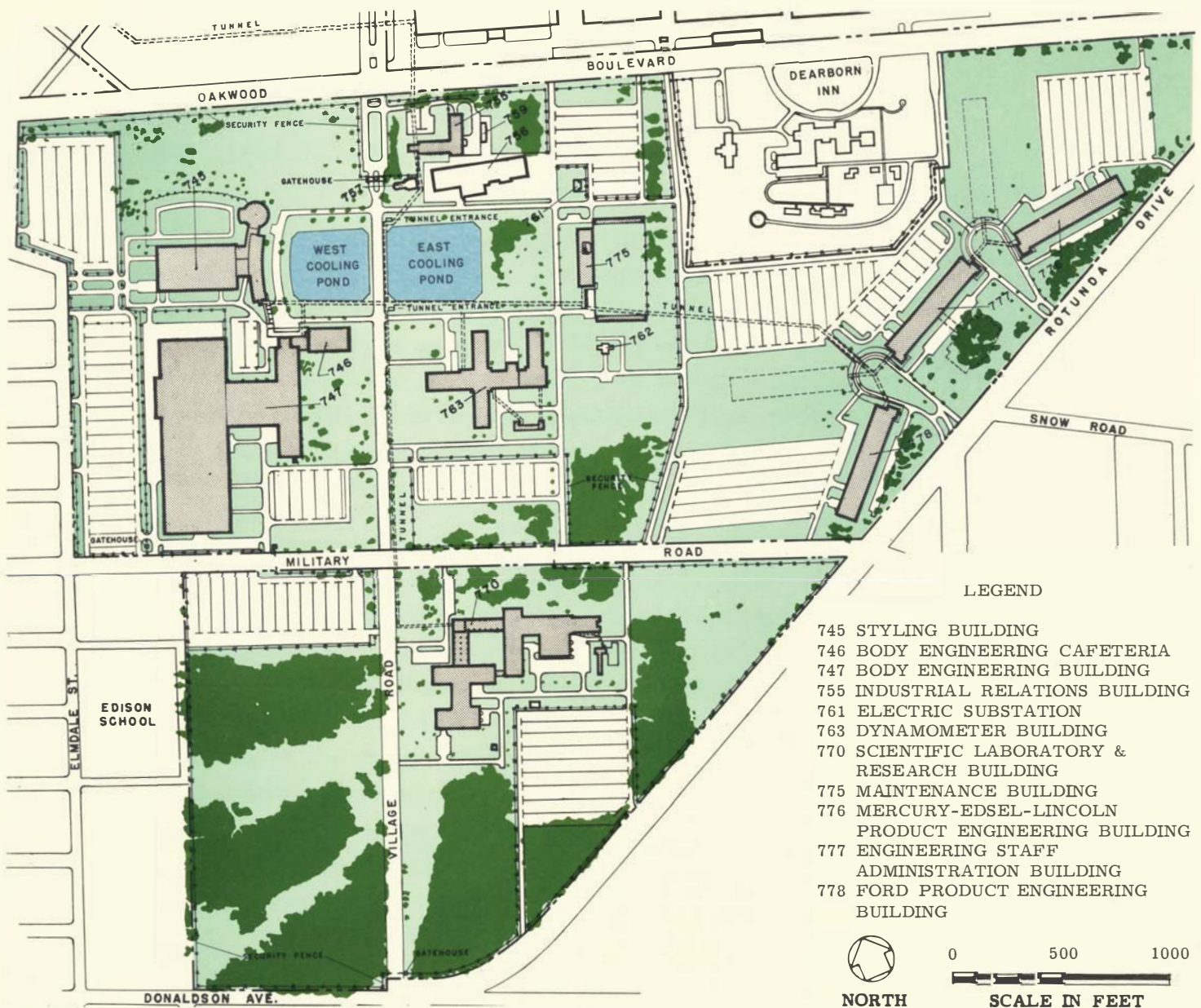
Nine new buildings, representing 70 per cent of a total construction area of 3,700,000 square feet, were designed by Voorhees Walker Smith Smith and Haines. These buildings and their identifying site plan numbers are:

Staff and Product Engineering (3 units)	776,777,778
Styling	745
Body Engineering and Cafeteria	746,747
Scientific Laboratory and Research	770
Dynamometer	763
Industrial Relations	755
Maintenance	775

The residential character of the community was a significant factor in determining the scale of the buildings and in the planning of the site. Informal orientation of the buildings and completely landscaped grounds relate the campus-like environ-



*Henry Ford II
Stephen F. Voorhees
Benson Ford*



Detail Site Plan

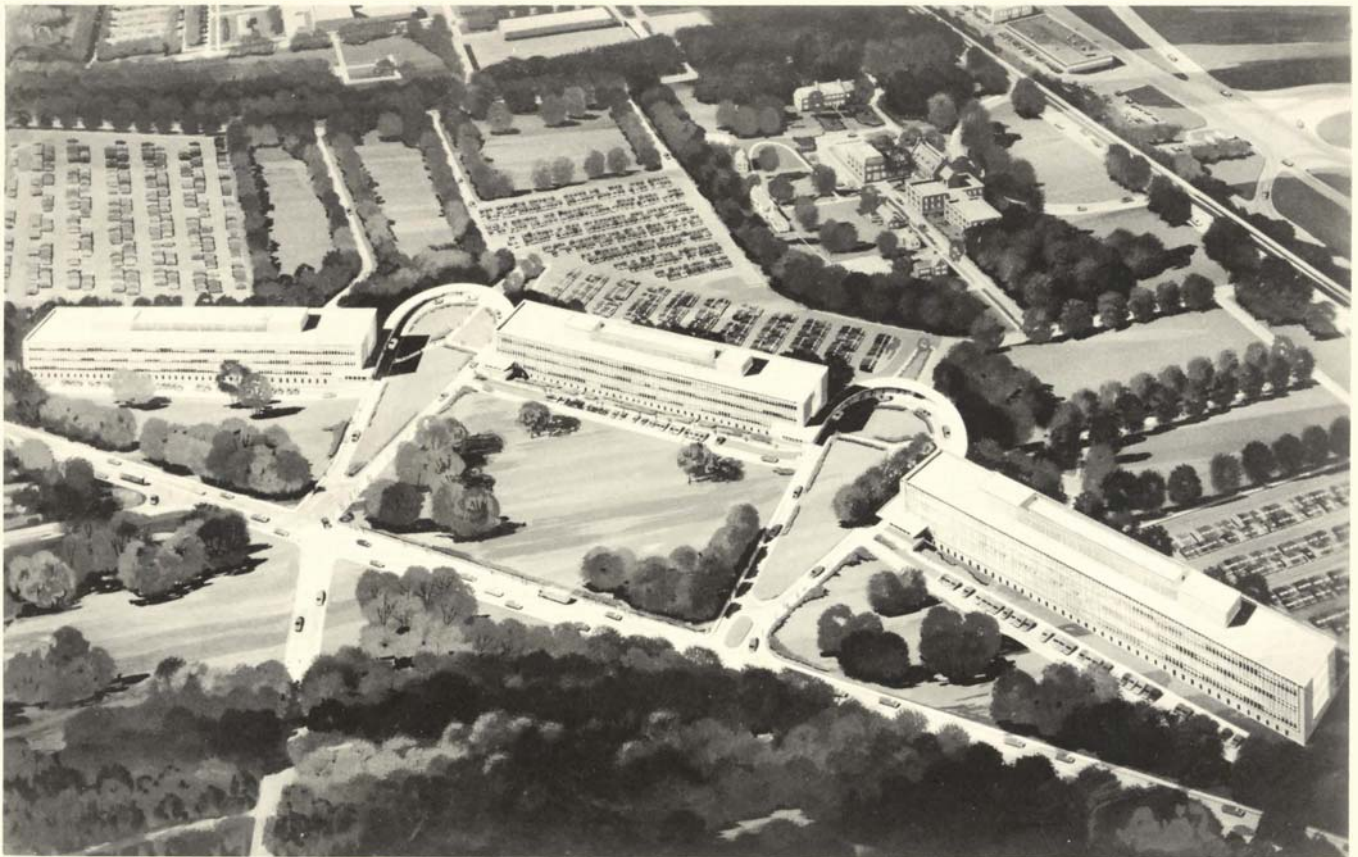
ment to the neighborhood. The Staff and Product Engineering Buildings contain most of the offices in which business with outside agencies is conducted and are therefore on the perimeter of the Center, near the street. So is the Industrial Relations Building, where applicants for employment are interviewed. Because

secrecy concerning new models is vital in the automotive industry, the interior of the Center is fenced and restricted. But convenience and utility still influenced the placement of buildings. Thus the Styling and Body Engineering Buildings adjoin each other because they house intimately related programs. The Scientific Laboratory and Research Building, the scene of highly confidential research and product study, is separated from the other buildings.

The Dynamometer, Industrial Relations, Maintenance, Styling and Body Engineering Buildings form a large open quadrangle. Two reflecting pools in this quadrangle have function as well as beauty. They provide cooled water for air conditioning the five buildings. Chilled water for air conditioning the Scientific Laboratory and Research Building and the Staff and Product Engineering Buildings comes from near-by cooling towers. Steam for heating all buildings is generated in the Power House (721) and distributed through a network of tunnels, some of which also are used for pedestrian traffic between buildings.

As suggested by their names, there is a great variation in the occupancy requirements of the buildings. Almost every type of industrial and commercial occupancy may be found at the Center: offices, laboratories, shops, styling studios, display area, medical facilities, modeling studios, garages, pilot plant operations, a library and many other special services. The first step toward the solution of the design problem thus created was the careful study of work routines of Ford operating groups. The patterns that emerged from this investigation formed the basis for the design of space units, or modules. Each module has sufficient space and building services, such as illumination, heat and air conditioning, to meet the needs of a work routine. The Architects, by putting modules together, designed rooms that automatically had the proper amount of work space and building services for their occupants. Flexibility in arrangement was possible because modules are repetitive in one direction in some instances and in both directions in others. Additional flexibility was achieved by the installation of movable metal partitions on modular lines. These can be re-arranged to form a variety of spaces without altering the basic building services. Various modules were used to satisfy the particular requirements of the occupants.

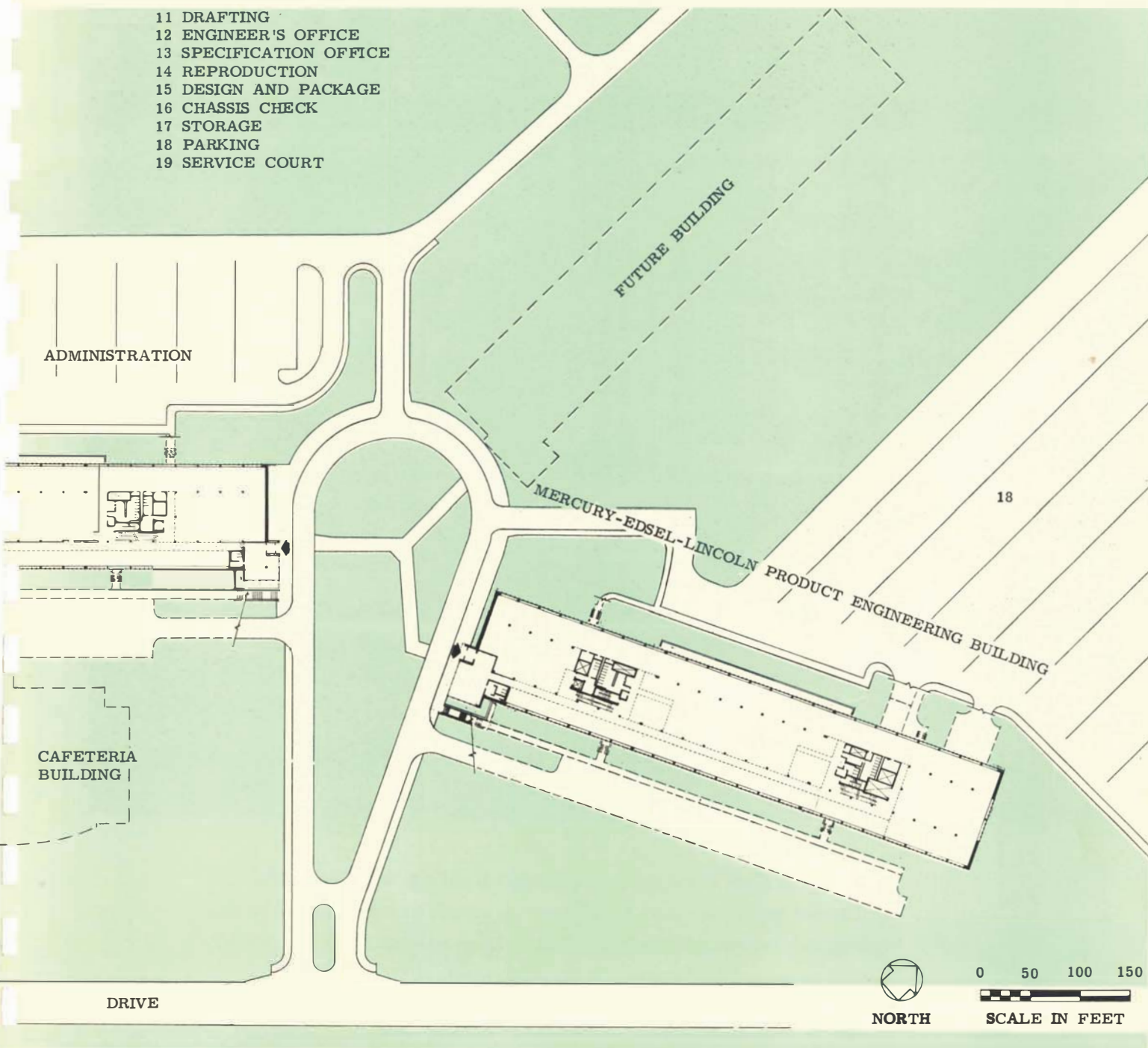
About 85 per cent of the buildings' floor space is designed on a modular basis. Exceptions are cafeterias, lobbies and other areas having special functions.



Staff and Product Engineering Buildings

The Engineering Staff Building is the administrative headquarters of the Center. This building is flanked by two similar structures, the Mercury-Edsel-Lincoln Product Engineering Building and the Ford Product Engineering Building. The Product Engineering Buildings house the design and evaluation groups responsible for the complete engineering development of new models, from original inception and design all the way through the entire two to three-year program that results in actual production line automobiles.

- 11 DRAFTING
- 12 ENGINEER'S OFFICE
- 13 SPECIFICATION OFFICE
- 14 REPRODUCTION
- 15 DESIGN AND PACKAGE
- 16 CHASSIS CHECK
- 17 STORAGE
- 18 PARKING
- 19 SERVICE COURT



First Floor and Site Plan



The design of these structures, primarily office buildings, was largely influenced by the need for large areas of flexible space to provide for regrouping of various sections and divisions during a contemplated re-organization as well as to provide suitable permanent headquarters for the final set-up.

The plan provides for five buildings and a cafeteria connected at the first floor by covered loop-shaped walks and driveways, each leading to three lobbies. Three buildings and the connecting loops are completed. Employee parking, adjacent to

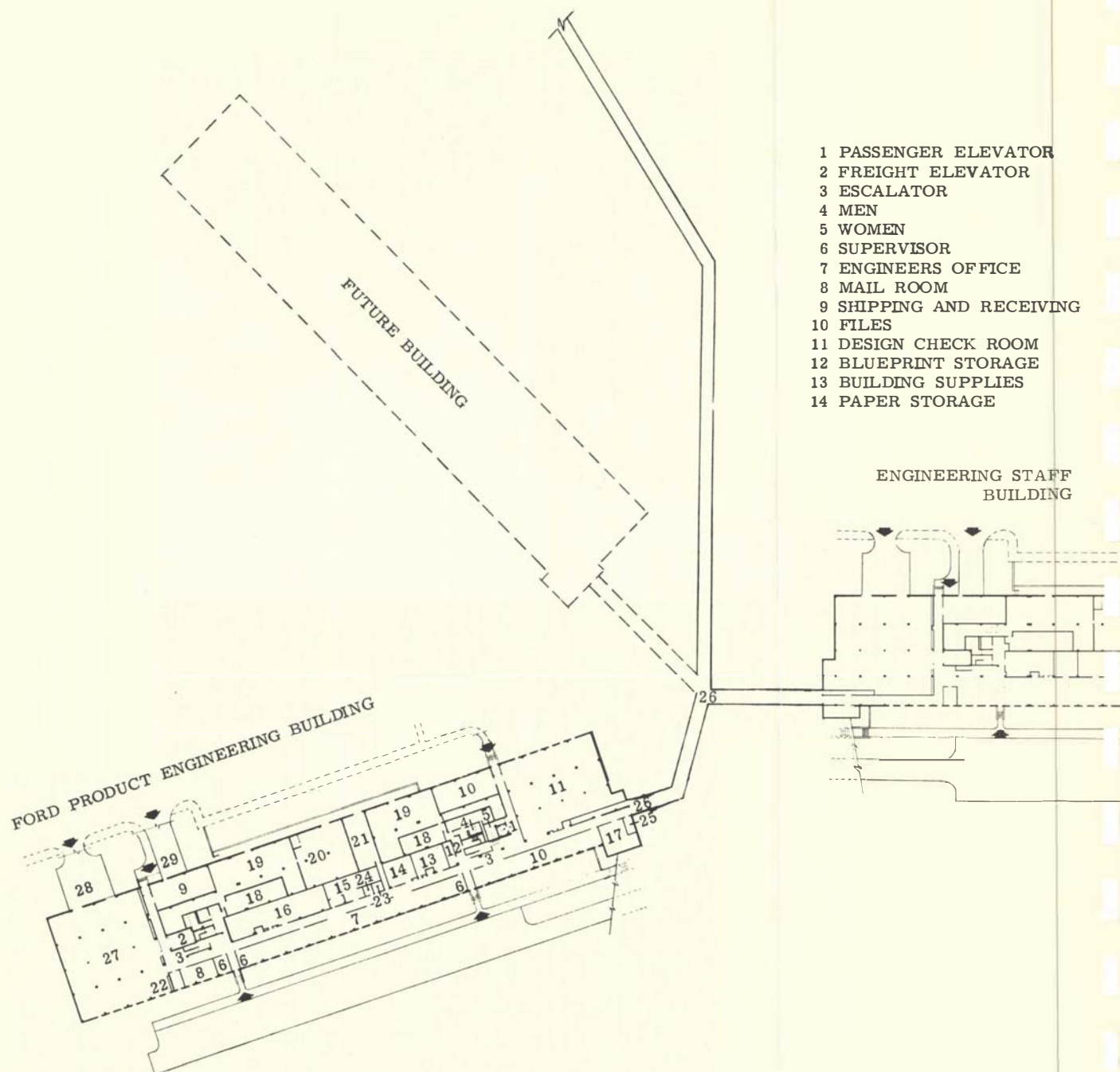


Entrance

each building, is convenient to entrances at ground floor level. Pedestrian and service passages at this level connect all buildings, including the area for the future cafeteria. These passages also lead to the two cores in each building where escalators, stairs and a passenger elevator are situated. Each building also has one freight elevator for passenger cars, accessible from the ground floor executive garage, for transporting prototype cars to each floor level. The ground floors house building services, receiving, storage, files and some special office space. The upper floors are designed for office and drafting space.

To provide maximum flexibility the perimeter spaces of each building are designed on a modular grid 4 feet 6 inches wide by 16 feet deep. Various combinations of this module were used to design rooms for various classifications of employees. The central area, with a clear span of approximately fifty feet, easily accommodates large drafting boards up to twenty feet in length used by some of the engineering groups.

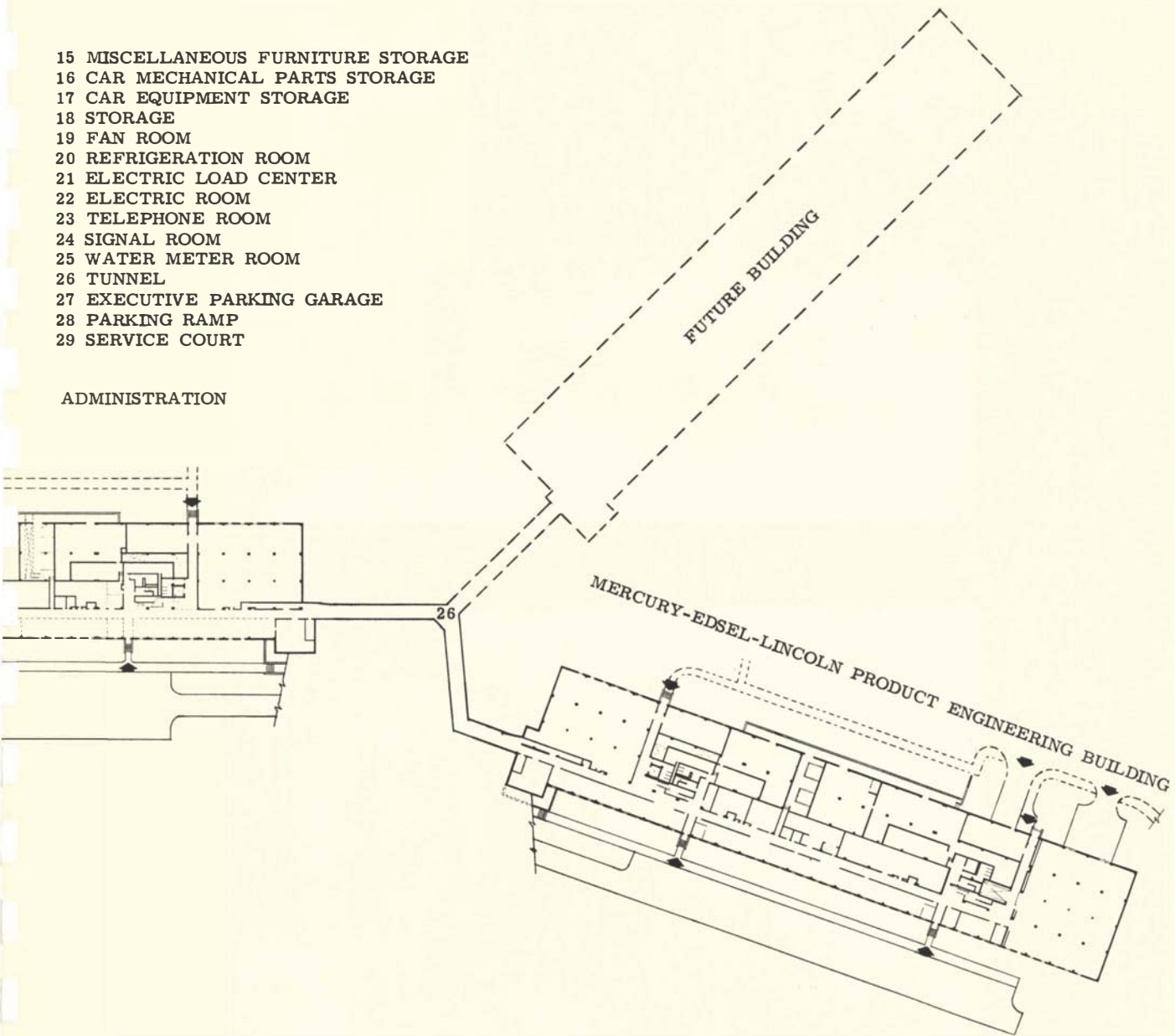
The ceilings provide high-intensity lighting. Metal "egg-crate" type screen conceals acoustic treatment and air conditioning services. Air conditioning of the office



Staff and Product Engineering Buildings

- 15 MISCELLANEOUS FURNITURE STORAGE
- 16 CAR MECHANICAL PARTS STORAGE
- 17 CAR EQUIPMENT STORAGE
- 18 STORAGE
- 19 FAN ROOM
- 20 REFRIGERATION ROOM
- 21 ELECTRIC LOAD CENTER
- 22 ELECTRIC ROOM
- 23 TELEPHONE ROOM
- 24 SIGNAL ROOM
- 25 WATER METER ROOM
- 26 TUNNEL
- 27 EXECUTIVE PARKING GARAGE
- 28 PARKING RAMP
- 29 SERVICE COURT

ADMINISTRATION



NORTH

0 50 100 150



SCALE IN FEET

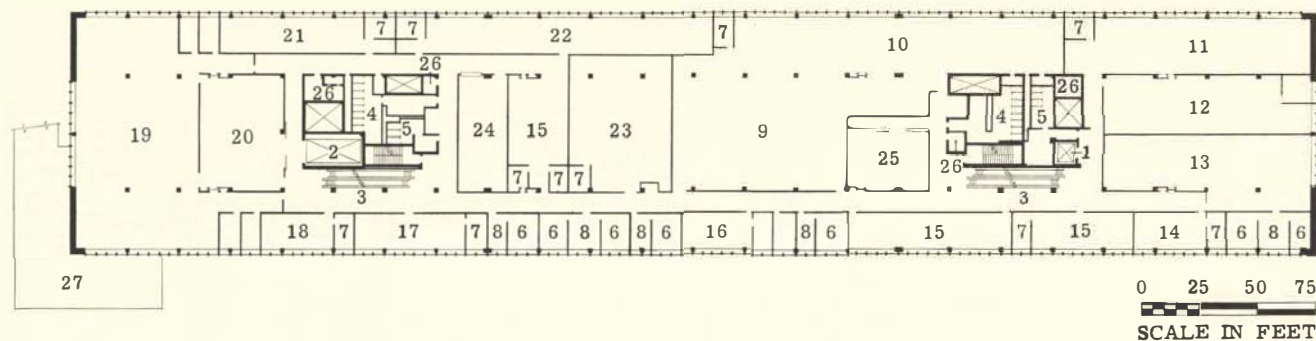
Ground Floor Plan



Lobby



*Vice President's
Office*



LEGEND

- | | | |
|---------------------------------|-----------------------------------|-------------------------------------------|
| 1 PASSENGER ELEVATOR | 11 DESIGN SECTION OFFICE | 21 EXPERIMENTAL RELEASE AND BUDGET OFFICE |
| 2 FREIGHT ELEVATOR | 12 CHANGE CONTROL OFFICE | |
| 3 ESCALATOR | 13 BUDGET OFFICE | 22 CAR PROGRAMMING AND SCHEDULING |
| 4 MEN | 14 FINANCE OFFICE | |
| 5 WOMEN | 15 ADMINISTRATION OFFICE | 23 PRODUCT SCHEDULING |
| 6 MANAGER | 16 ORGANIZATION OFFICE | 24 FILE ROOM |
| 7 SUPERVISOR | 17 CHASSIS SECTION ADMINISTRATION | 25 REPRODUCTION |
| 8 SECRETARY | 18 RIDE AND HANDLING ENGINEERS | 26 STORAGE |
| 9 PRODUCT ENGINEERING DRAFTING | 19 CHASSIS DESIGN ENGINEERS | 27 ROOF |
| 10 SERVICE ENGINEERING DRAFTING | 20 ENGINEERING TEST ROOM | |

Typical Floor Plan

modules is provided by individually controlled units beneath windows; interior bays are serviced by central systems divided into four zones. Power, telephone and other communication services are distributed through ducts under the floors.

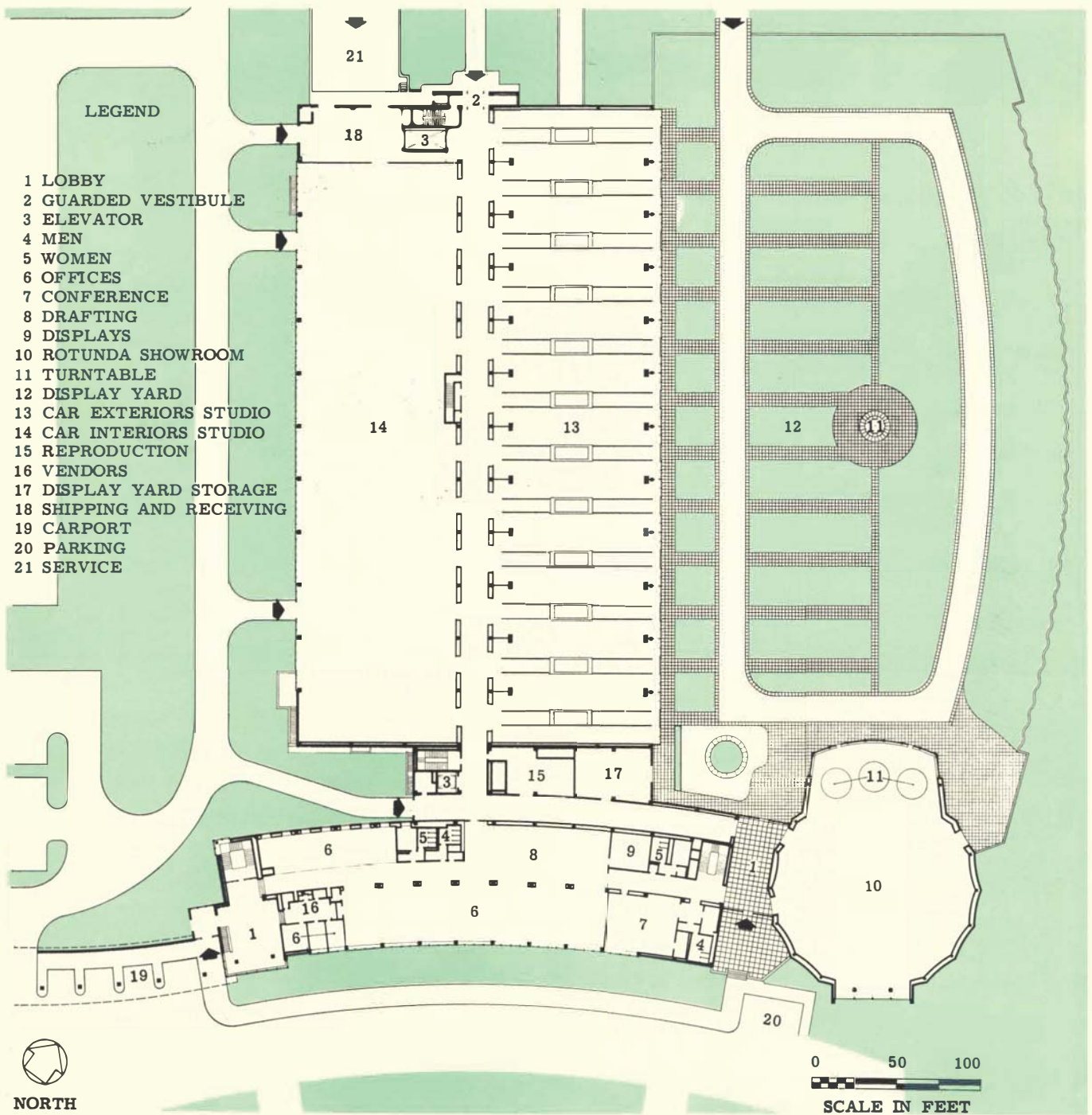
The central Administration Building has a lobby at each end, one used primarily by sales representatives of companies doing business with Ford. A cafeteria seating 750 persons and a private dining area for ninety persons are incorporated on the first floor of this building to serve until the two additional office buildings and separate cafeteria building are required. Then the space occupied by the temporary cafeteria will be used for offices.

The buildings completed in 1958 have a combined area of 646,775 square feet.



Styling Building

The Styling Building consists of a design and office wing, a studio wing and a display rotunda with screened outdoor display garden. Here stylists work with clay, wood, plaster and plastic modelers, translating styling concepts into both three-eighths and full size models that are complete in every detail. Once approvals have been given, the styling models are mated with engineering designs and start the long move toward production, a process requiring two to three years.



First Floor and Site Plan



Lobby and Corridor Office Wing

Although modular design usually is associated with rectangular structures, it is readily adaptable to other forms as indicated by the curved plan of the design wing shown on page 17. This area contains the administrative offices of the styling group as well as drafting and display rooms.

In converting styling sketches and drawings to models, many of the materials and techniques found in the sculptor's studio are used. Moreover, as models progress they must be constantly studied under natural light so that details and color can be accurately assessed. To obtain this condition, studios with exceptionally high ceilings and completely glazed north walls were provided. Each studio bay is 102 by 32 feet, providing ample working and viewing space around full-scale automobile and truck models. Each studio has a modeling bridge which accurately transfers measurements from the three-eighths-scale study models to full-size models.



Conference Room Office Wing

The bridge can be rolled out of the way to allow models to be viewed. Larger working areas may be created by opening folding partitions that separate the bays.

The studios are furnished with complete fabricating services by the shops located on the ground floor of the studio wing. The wood and metal shops make the precision armatures, or frames, on which the clay models are shaped. The plaster shop casts molds of the models used to make reproductions for further styling studies. Bright-metal parts, tail-light lenses, windshields and windows, bumpers and grilles — all are simulated in the shops in metal, plaster, plastics or wood. Mock-ups of car interiors, complete with fabrics and colors, and dimensional seating mock-ups are also built here.

The display rotunda connected to the design wing serves as a showroom where models may be evaluated. This polygonal structure, 120 feet in diameter, offers an



unobstructed view throughout its entire expanse. Three display turntables allow easy inspection and comparison of models. A large window, partly enclosing the turntable alcove, provides a view of the display garden, which is also equipped with a turntable. The garden is screened from view by a serpentine brick wall.

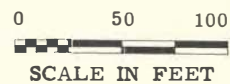
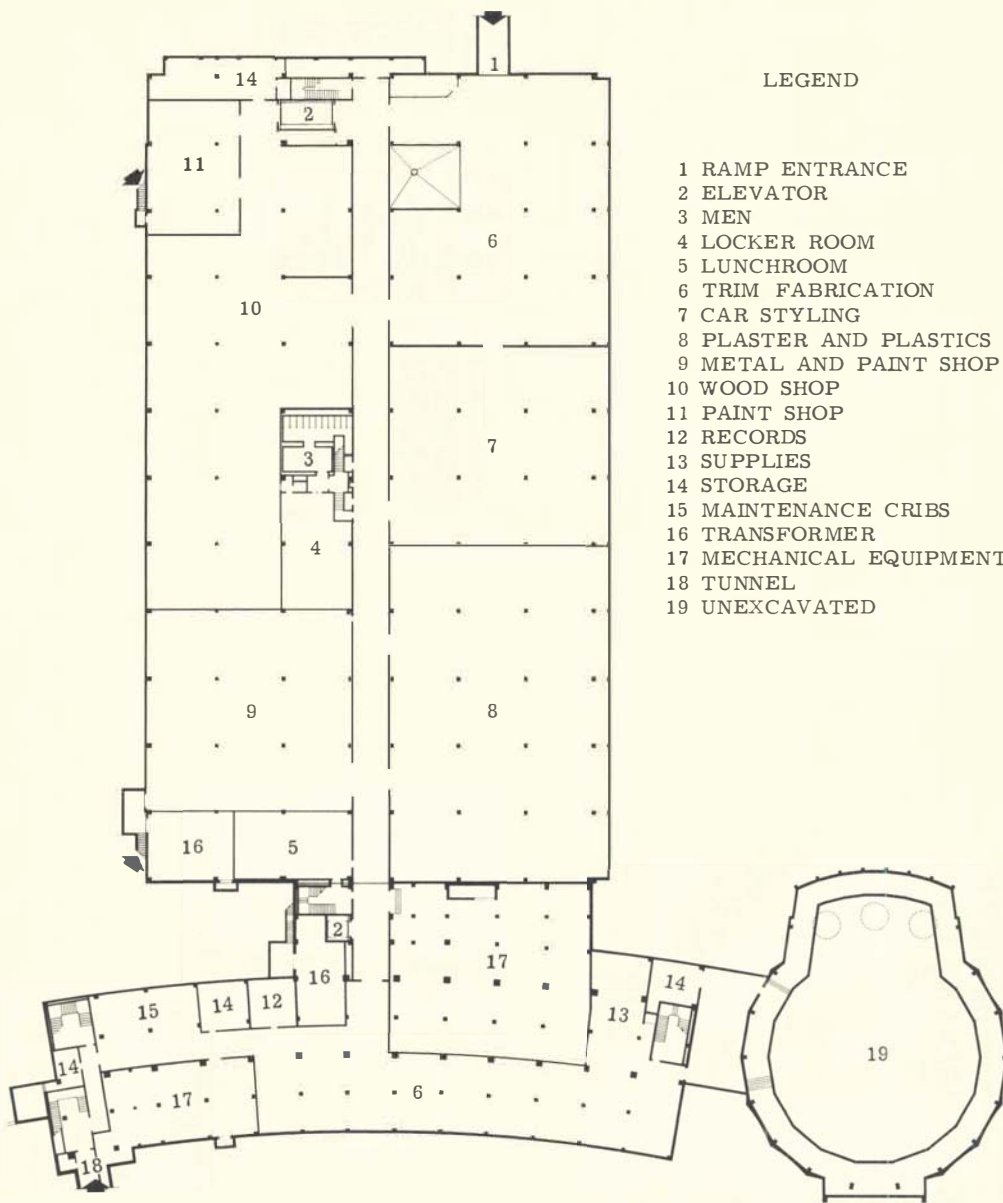
The building, completed in 1953, has an area of 295,782 square feet.



*Display
Rotunda*

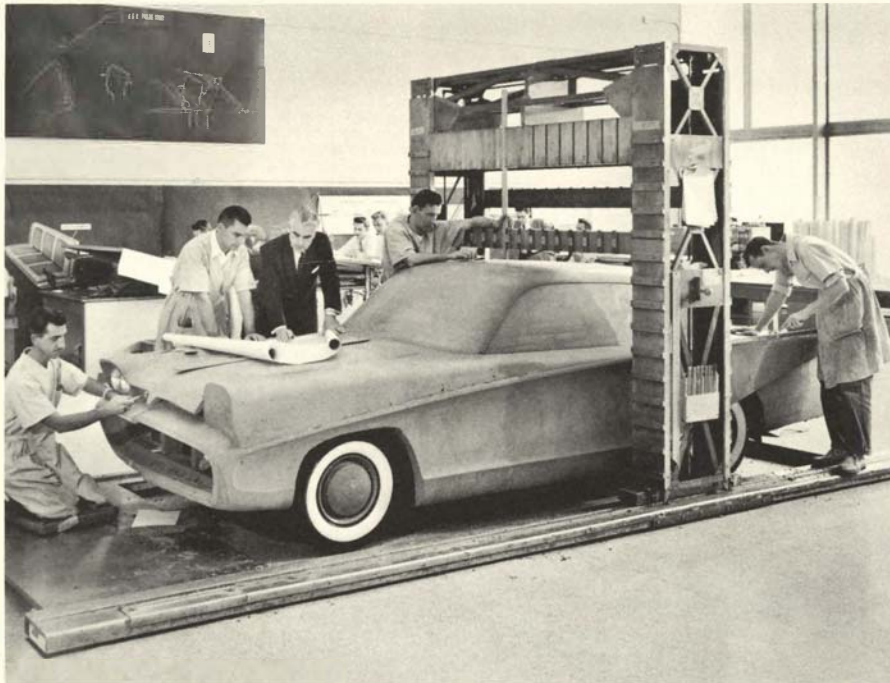


*Display
Garden*



Styling Building

Ground Floor Plan



*Studio
First Floor*

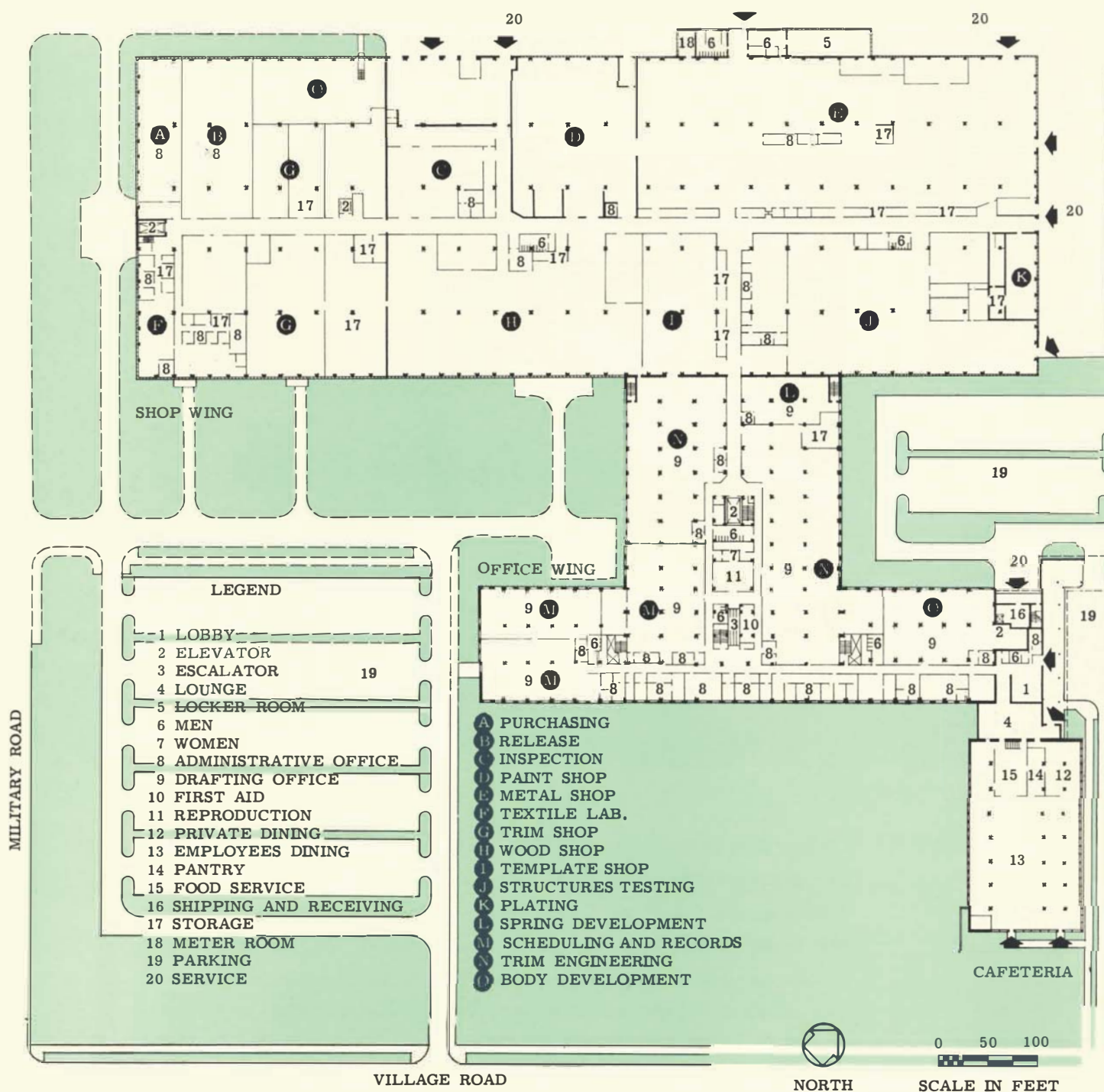


*Shop
Ground Floor*



Body Engineering Building and Cafeteria

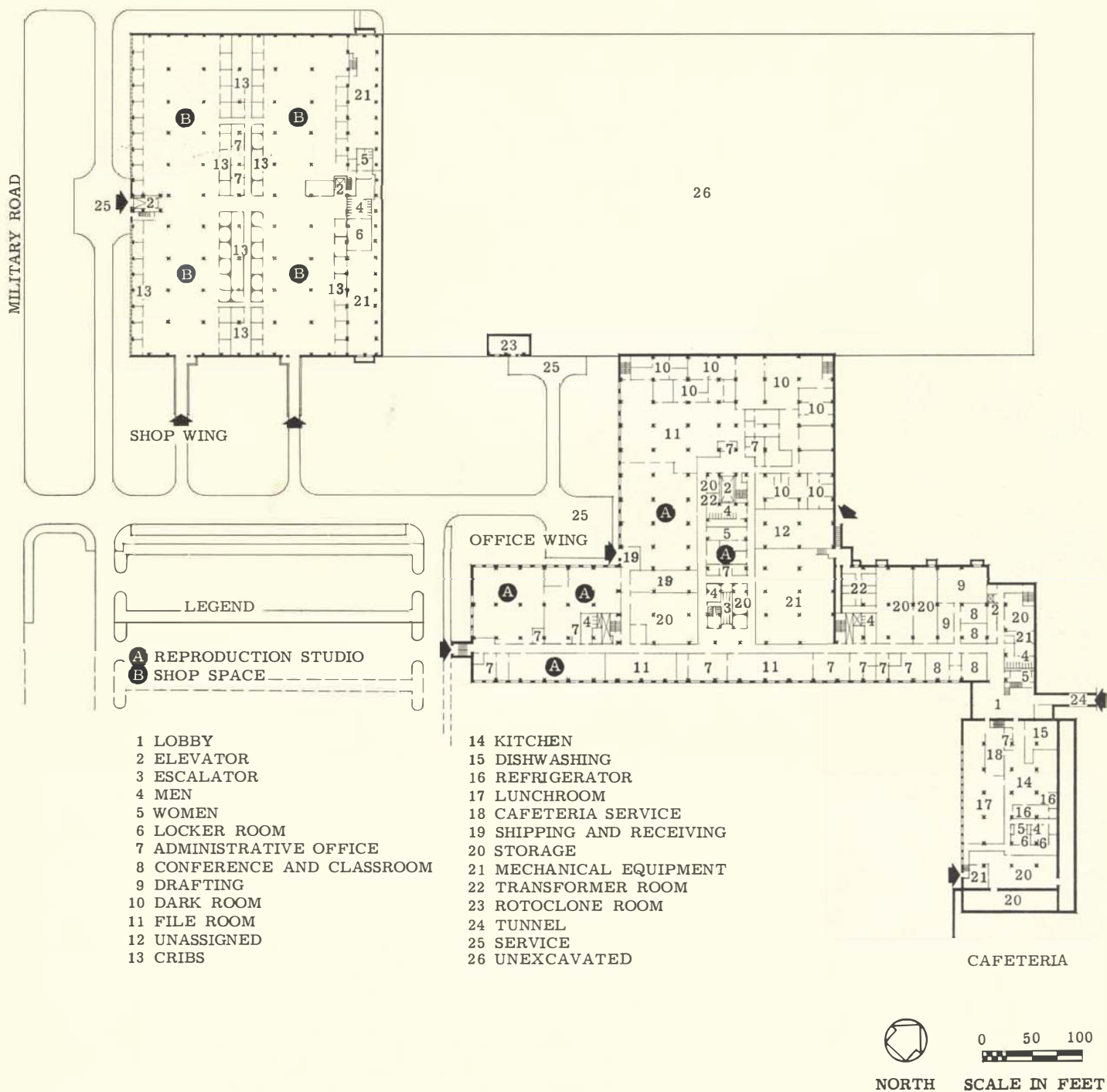
The Body Engineering Building, consisting of engineering offices, drafting and reproduction areas and shops, contains all the necessary facilities for translating the stylists' three-dimensional clay renderings into sound engineering designs and the fabricating of prototype body structures. The T-shaped building devoted to offices is adjacent to the Styling Building and has a covered walk connecting the two lobbies and the cafeteria wing, as shown on the site plan.



First Floor Plan



Drafting areas arranged on twelve-foot modules are approximately fifty to seventy feet deep, extending from exterior walls to supervisory offices, which control the drafting groups. Offices and conference rooms in the central core area are accessible from a corridor around its perimeter. The core also contains stairs, toilets, reproduction units and facilities for transporting tracings and prints between each floor and the main reproduction area and files at ground floor level. At the rear of the core an elevator for prototype cars connects to the shops at the first-floor level. Escalators are located at the intersection of wing corridors. Executive offices are grouped at the center of the front wing. Salesmen and other visitors have direct access to offices and conference rooms without entering the engineering drafting



Body Engineering Building and Cafeteria

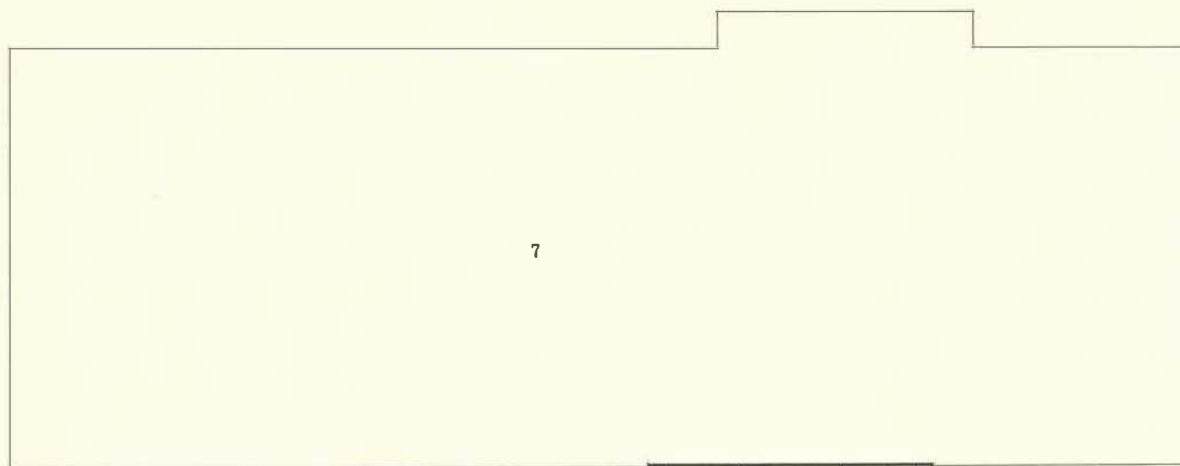
Ground Floor Plan

*Typical
Drafting Area*



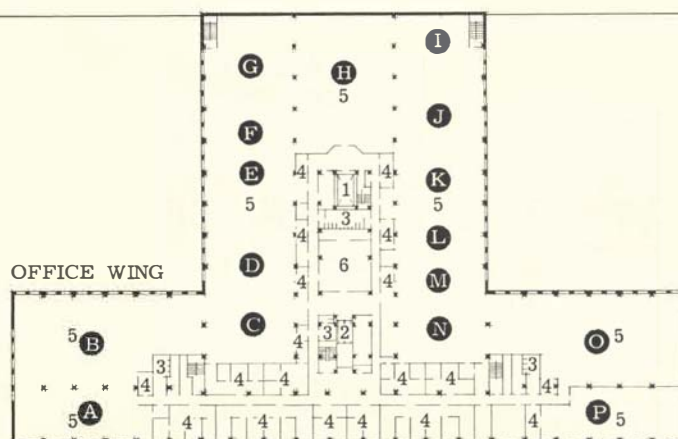
Shops





LEGEND

- 1 ELEVATOR
- 2 ESCALATOR
- 3 MEN
- 4 ADMINISTRATIVE OFFICE
- 5 DRAFTING OFFICE
- 6 PRINT DISTRIBUTION
- 7 ROOF



- A MECHANICAL HARDWARE GROUP
- B ORNAMENTATION GROUP
- C CONVENTIONAL DOOR GROUP
- D SPECIAL DOOR GROUP
- E CONVENTIONAL QUARTER PANEL GROUP
- F SPECIAL QUARTER PANEL GROUP
- G CHECKERS GROUP
- H ILLUSTRATORS GROUP

- I DETAILERS GROUP
- J CONVERTIBLE GROUP
- K INSTRUMENT PANEL GROUP
- L ROOF AND FRONT END STRUCTURE GROUP
- M STATION WAGON AND TRUCK CAB GROUP
- N UNDER BODY GROUP
- O FRONT END GROUP
- P ADVANCE BODY GROUP



NORTH



SCALE IN FEET

Body Engineering Building and Cafeteria

Second Floor Plan



Cafeteria

areas. The ground floor contains one of the world's largest reproduction and photographic studios, serving the entire Center. Lighting is generally provided by over-all luminous ceilings, while electrical, telephone and intercommunication circuits are distributed through ducts under the floors.

In the high-bay shop wing, body structures are fabricated in the metal and wood shops. Body shapes are formed of sheet steel, welded into sections and finally assembled into finished bodies. Mounted on chassis, the assemblies are sent to a structural-testing laboratory and the test track for evaluation before being released for mass production. These tests check the riding and handling characteristics of the car and the ability of the prototype to withstand vibration, fatigue and stress. Master patterns for steel dies used in the company's manufacturing plants are also made in the wood shops. Plating areas, paint shops, special welding cranes and stress analysis areas are provided.



Private Dining Room

A textile laboratory investigates the wearing quality, soil resistance and color fastness of upholstery fabrics.

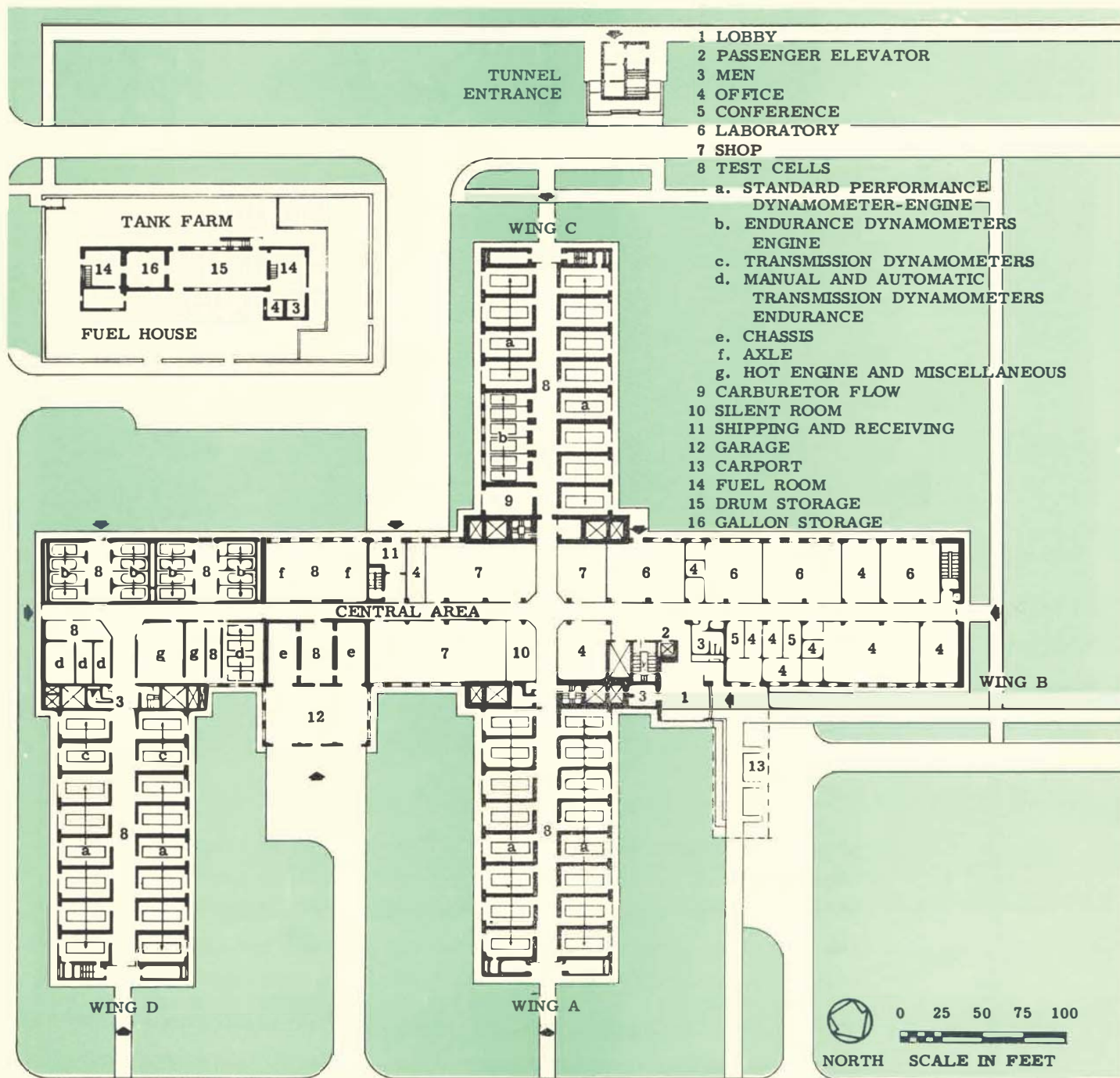
The main cafeteria, connected to the office wing of the Body Engineering Building, provides dining facilities for all personnel in buildings south of Oakwood Boulevard, except those in the Staff and Product Engineering Buildings. It will accommodate 700 diners at one serving and has two private dining rooms seating ninety persons. Generous use of glass on three walls of the cafeteria affords a sweeping view of the ponds and landscaped grounds. A smaller cafeteria at ground floor level serves personnel from the shop area.

The Body Engineering Building and Cafeteria were completed in 1956. The shop wing was enlarged in 1957. The combined area is 778,185 square feet.

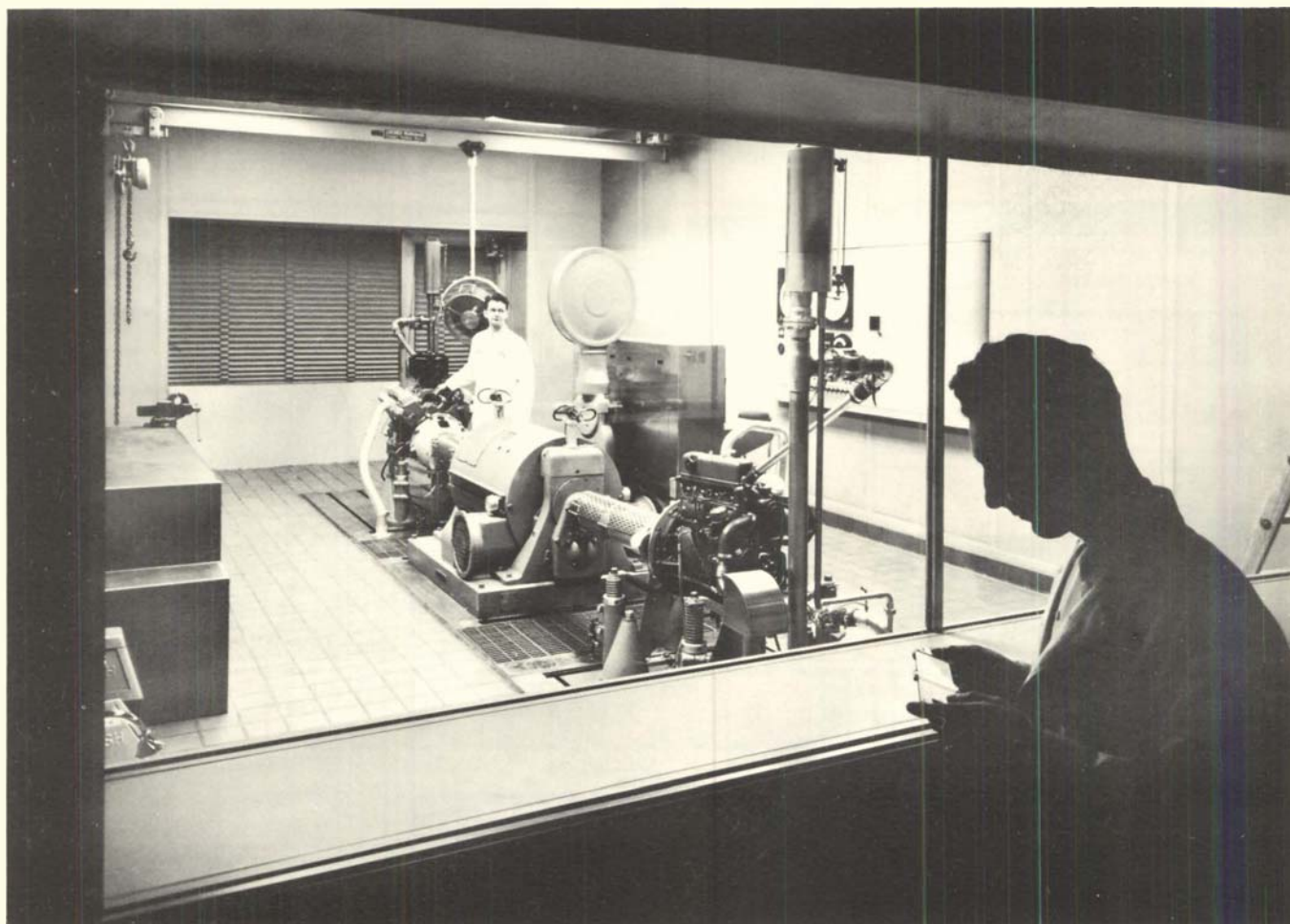


Dynamometer Building

Top product performance is a primary objective of the research and engineering programs at the Ford Center. Investigations that reveal the characteristics of engines under varying operating conditions are meticulously conducted on production as well as experimental models. The same rigid tests are applied to transmissions, carburetors, axles, chassis and various engine components. Electro-mechanical machines, called dynamometers, are used to simulate work loads for



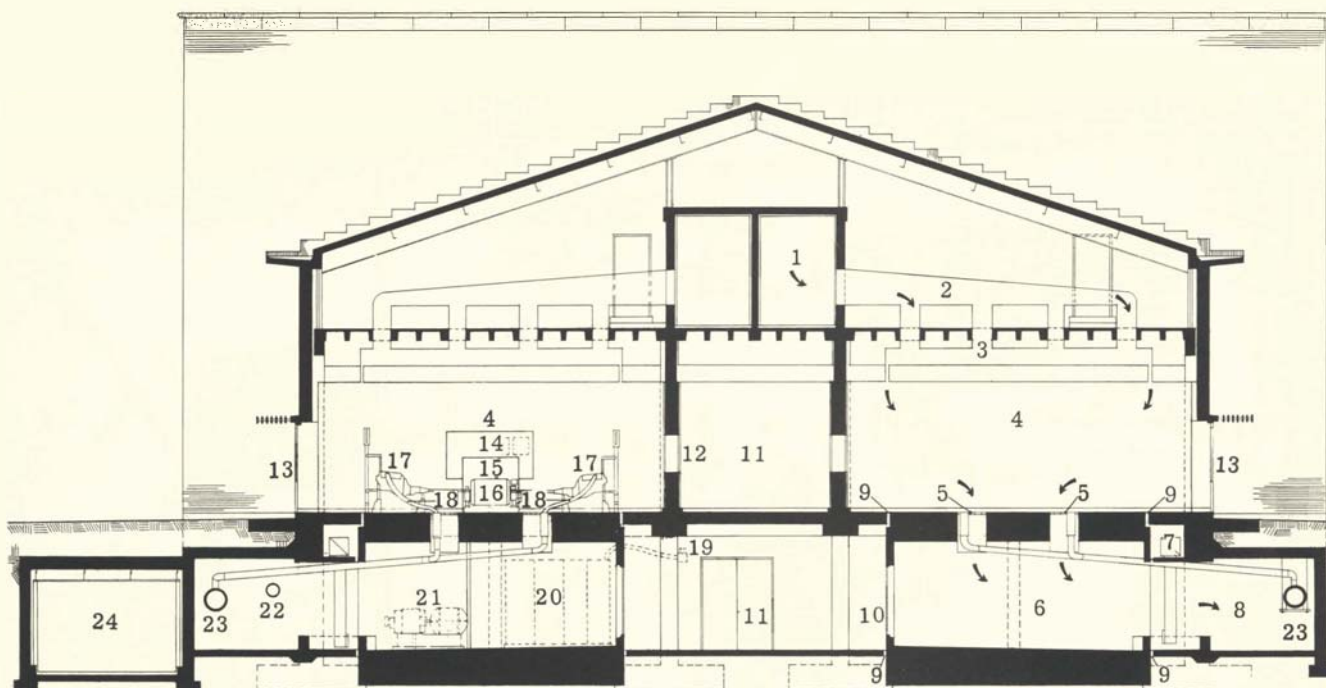
First Floor Plan



Standard Performance Cell

obtaining performance and endurance data. These machines are designed to measure accurately the friction of engines undergoing tests, or conversely, may absorb and measure the power produced. The Dynamometer Building, housing this phase of engineering and research, contains ninety test cells with associated offices and laboratories. Two chassis cells provide tests for the entire vehicle.

The office areas and laboratories are located in Wing B and the first floor of the central area, with the dynamometer test cells occupying Wings A, C and D. This arrangement isolates the test cells for maximum noise control and safety, yet affords a compact relationship between administrative and testing areas. Direction of the

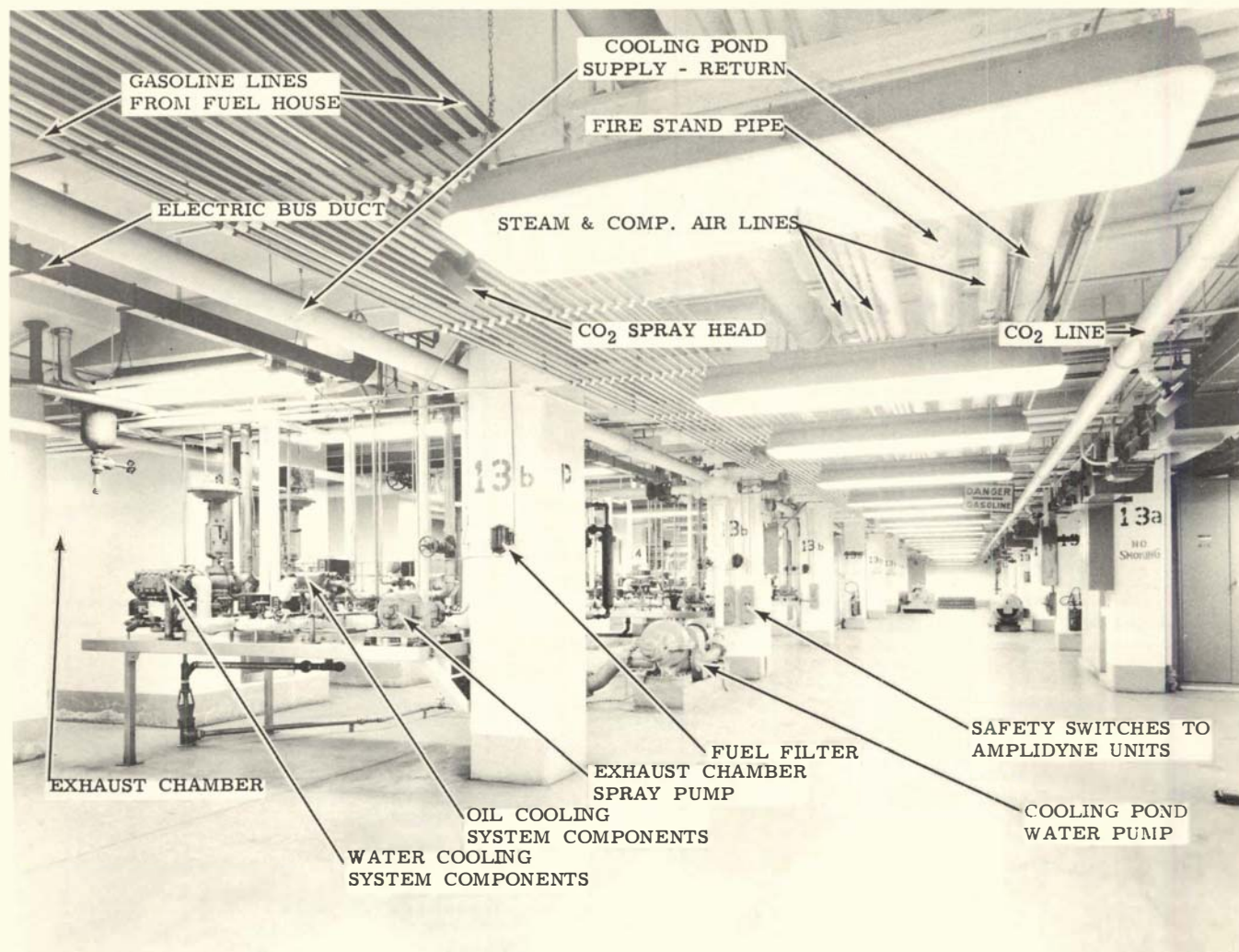


LEGEND

- | | |
|------------------------|---------------------------------------------|
| 1 MASONRY DUCT | 14 INSTRUMENT BOARD |
| 2 DUCT | 15 CONTROL CONSOLE |
| 3 PLENUM CHAMBER | 16 DYNAMOMETER |
| 4 TEST CELL | 17 TEST ENGINE |
| 5 GRILLES | 18 EXHAUST HOSE |
| 6 SPRAY CHAMBER | 19 BUS DUCT |
| 7 EXHAUST HEADER | 20 DYNAMOMETER ELECTRIC SWITCHGEAR CUBICLES |
| 8 EXHAUST TUNNEL | 21 MOTOR-GENERATOR SET |
| 9 VIBRATION JOINT | 22 POND WATER RETURN |
| 10 CHAMBER ACCESS DOOR | 23 ENGINE EXHAUST |
| 11 CORRIDOR | 24 PEDESTRIAN TUNNEL |
| 12 VIEWING PORT | |
| 13 EMERGENCY EXIT DOOR | |

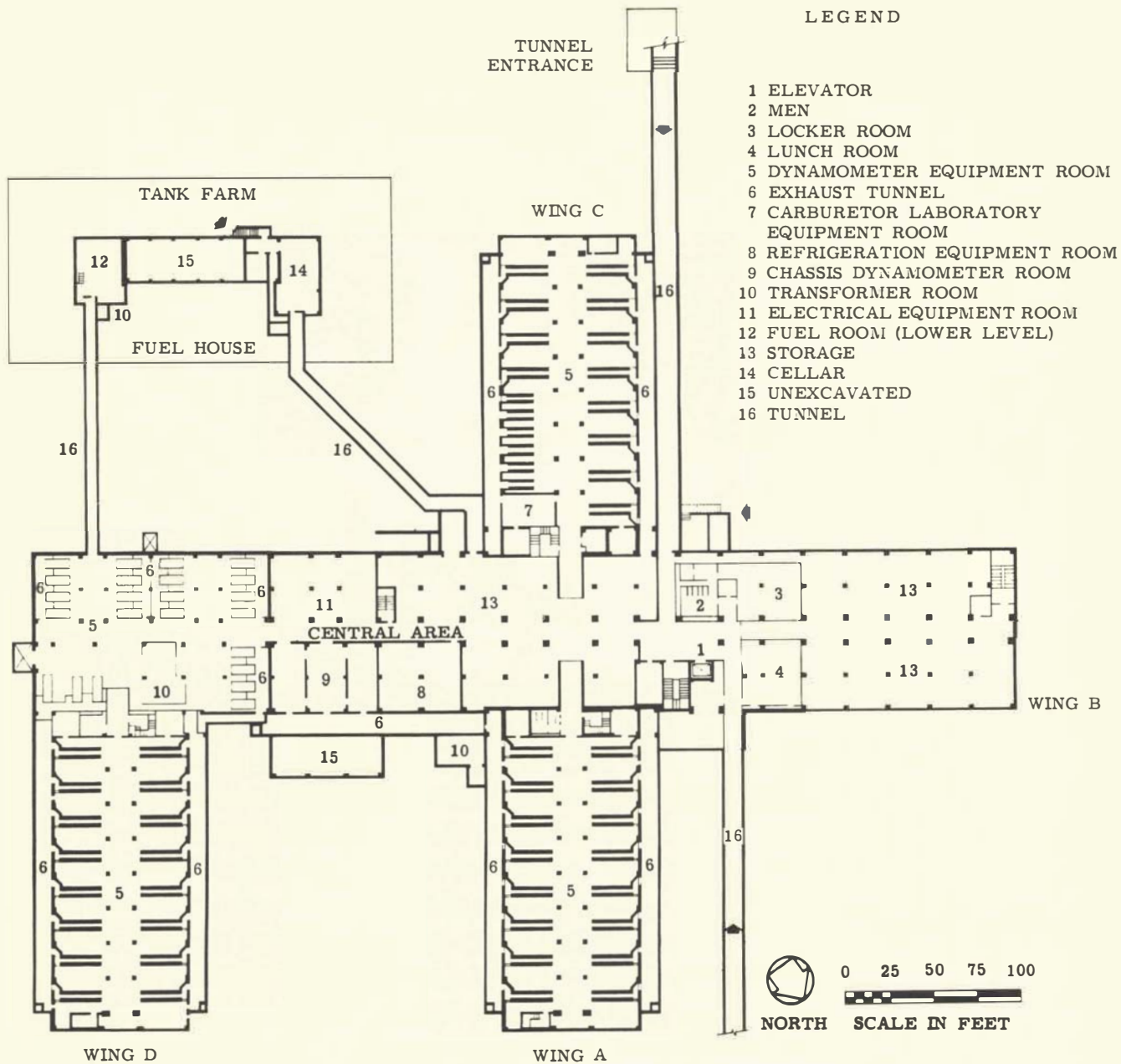
Section of Wing C

testing program is supervised by personnel whose offices and laboratories are in the central area of the building and in the office wing B. Flexibility in the arrangement of these areas is provided by the use of twelve-foot by twelve-foot modules in twenty-four-foot by thirty-six-foot bays. Movable metal partitions located on modular lines can be re-arranged easily to accommodate changing requirements. Laboratory services are located at twelve-foot intervals along the exterior walls.



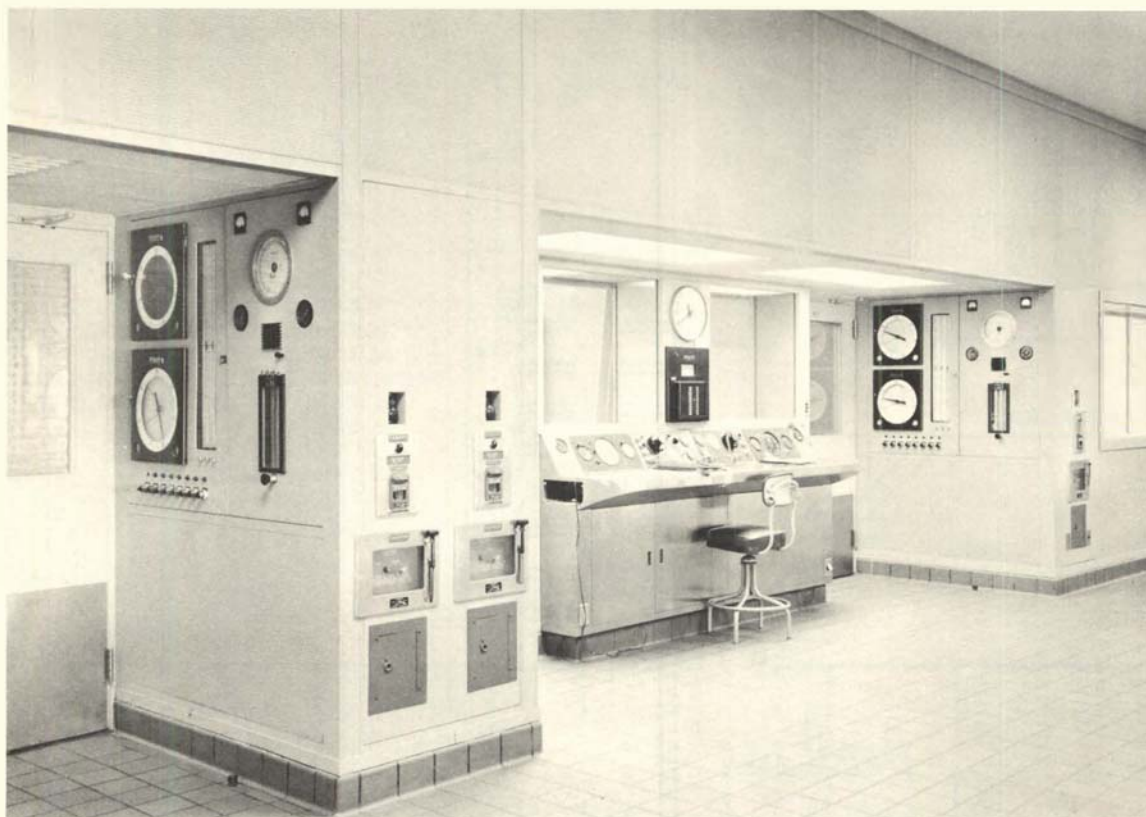
Ground Floor Wing C

Two types of cells were developed for engine component testing. Standard performance engine and transmission testing is done in rooms eighteen feet wide by thirty feet eight inches deep in which all services and controls are provided. For the endurance test cells, where requirements differ and where there are greater noise and hazard factors, the control areas are separated from the testing areas by walls with viewing windows. This arrangement allows operators to service one or several cells, depending on the nature of the tests. Wide corridors permit the movement of heavy engines and vehicles.



Dynamometer Building

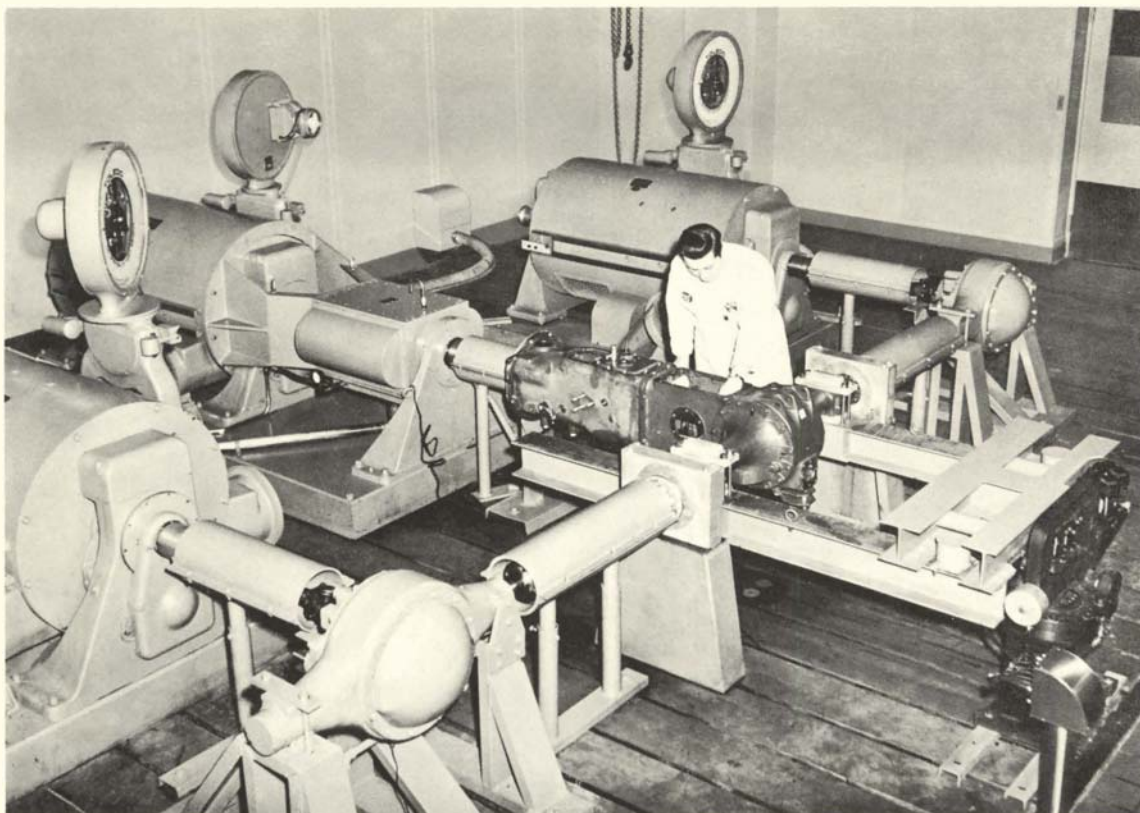
Ground Floor Plan



Endurance Cell Control Area

Services provided for each dynamometer cell are engine coolant, oil coolant, engine exhaust and a fuel-supply system. Fuel is pumped into the engine by an aqua-type fuel system, which uses water pressure to propel and control the gasoline. Water-cooling of the engine jacket is accomplished by a heat exchanger utilizing water from the cooling ponds. Similarly, oil-cooling is performed by circulating the lubricant through a filter and a water-cooled heat exchanger back into the engine's oil pan. The various components of these electronically controlled systems are located in the basement underneath the test cells. Ventilation and control equipment are located above the cells.

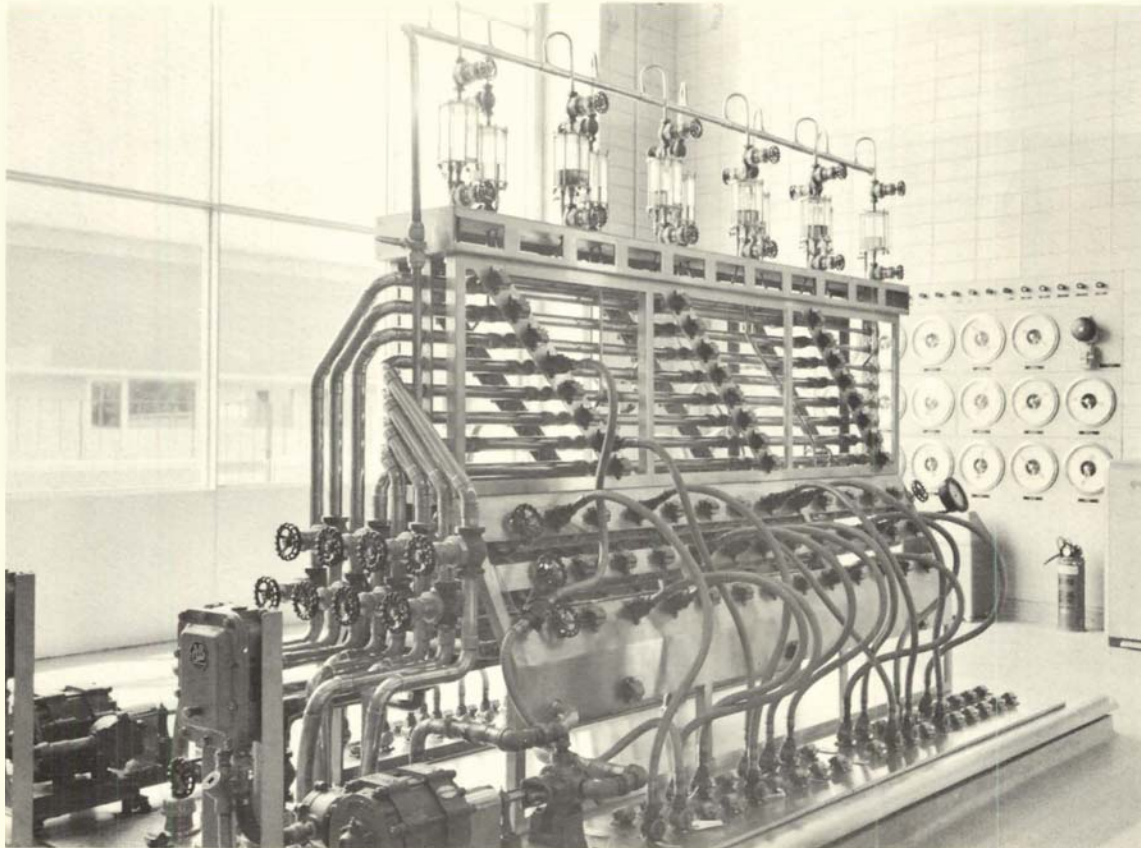
Each test cell has an isolated foundation to prevent transmission of vibration to other areas of the building. The foundation also forms an airtight enclosure in the basement that serves as an exhaust chamber. Water sprays in the exhaust chamber wash down the walls to reduce possible fire hazards.



Axle Test Cell

Each dynamometer is mounted on the center of three foundation bedplates so that it may be coupled with an engine at either end. This set-up makes it possible to obtain maximum use of the dynamometer; simple disconnecting devices permit rapid change-over from one engine to the other whenever engine adjustment or removal is required.

Studies conducted during the early design stage of the building indicated that considerable heat would be generated during tests. Inasmuch as operators would be in the cells for periods of up to two hours, temperatures had to be controlled to achieve comfortable working conditions. Some method of dissipating the heat was required without subjecting the operators to blasts of cold air. This was solved by introducing temperature-controlled air through ceiling slots located directly over the sides of the bedplates and removing it through floor openings between the bedplates, creating a moving air-curtain to shield the operators. This air-curtain



Fuel Mixing Rack Fuel House

also provides protection from fumes produced during engine testing. A water-injector system connected directly to the engine exhaust reduces exhaust temperatures.

Exhaust air from the test cells is carried above the roof by a central exhaust system. Further safety factors include emergency exits from each test cell to the outdoors, the use of fire resistant construction materials, a central carbon-dioxide fire-protection system and emergency control circuits that shut off all operating equipment in case of fire. Air-sampling devices recording on a central panel constantly check all lower levels for hazardous fumes.

Excessively high noise levels during engine tests were to be expected, especially with units rated up to 500 horsepower and speeds exceeding 4,000 revolutions a minute. Covering the ceilings and walls of cells and corridors with perforated metal

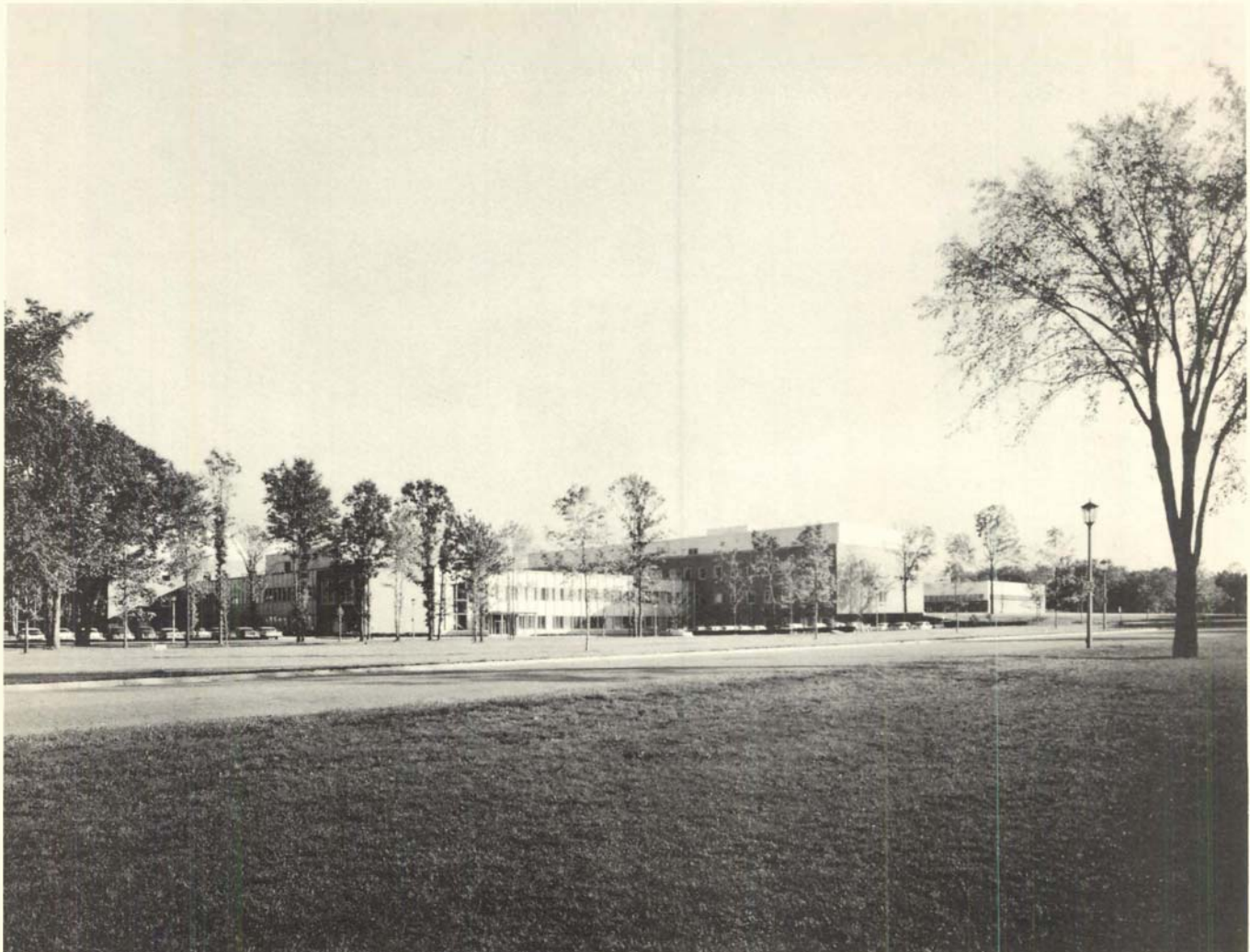


Corridor of a Test Wing

panels backed with rock-wool blankets reduced the noise level to the average found in a large busy office.

The fuel house, located about 100 feet from the main building, contains the main elements of the water-flotation distributing system that supplies fuel to the test cells. The heart of this system is a fuel transfer rack that permits selection and distribution of fuels from underground tanks, or barrels. The fuel-supply system is capable of furnishing twenty basic types of fuels as well as an almost unlimited number of blends.

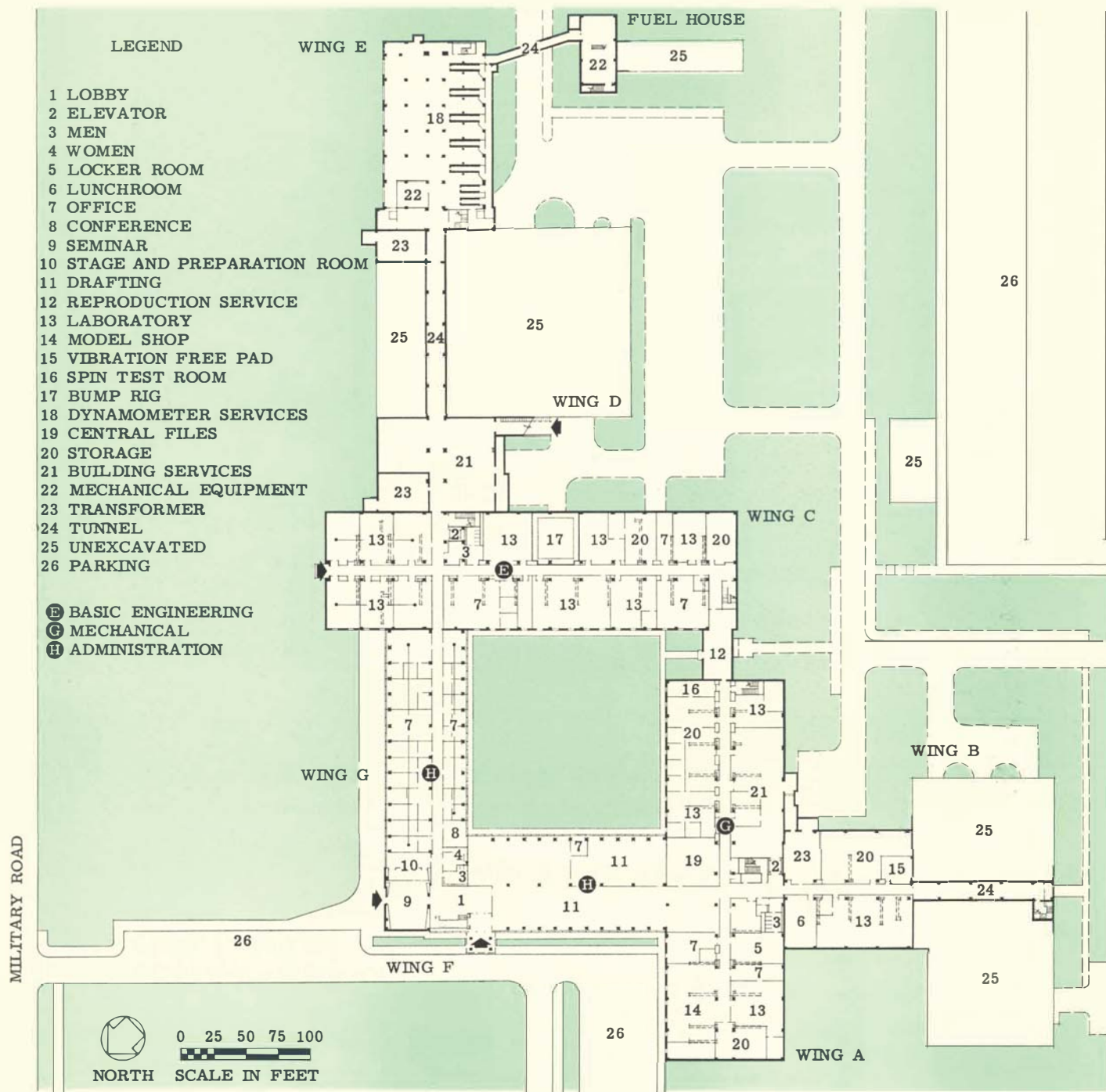
The building with its fuel house, having an area of 304,354 square feet, was constructed in three stages: Wing A was completed in 1949; Wings B and C, the central area and fuel house in 1952 and Wing D, extension of the central area and an addition to the fuel house in 1954.



Scientific Laboratory and Research Building

Two independently oriented research programs are housed in the Scientific Laboratory and Research Building.

The programs of the Scientific Laboratory involve basic and applied research in the physical sciences — physics, chemistry, metallurgy, and electronics — studies dedicated to the advancement of knowledge in those fields that will contribute to the technological growth of the company.



Ground Floor Plan



Seminar Room

The Engineering Research and Advanced Product Study programs, on the other hand, are concerned with the improvement of automotive products and the development of new concepts in vehicles and their components — a shorter range research program.

The Architects' concept included two separate facilities for these groups within the single building. Each group required office-type space and typical laboratory modular space.

The problem was solved by placing two T-shaped units at right angles to each other as shown on page 43. Two office wings form a court at the front connected by a common entrance lobby, seminar room and library. An employee entrance provides access between laboratory wings near the parking area at the rear of the building.



Library

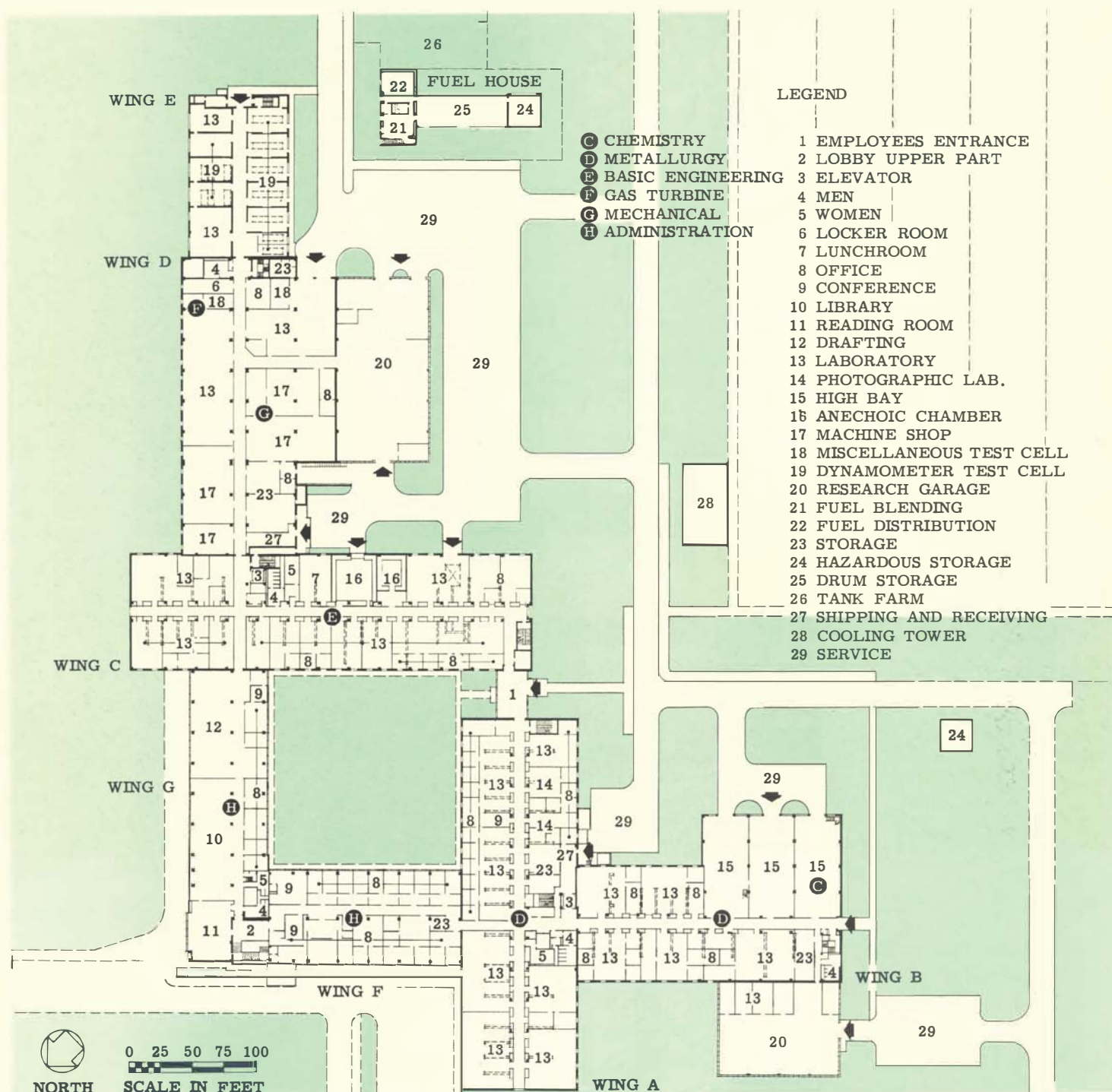
Existing grades allow for access from the rear at the first-floor level, the floor above the main entrance level. Room for expansion for each function has been provided.

Twelve-foot-wide modules for the office areas are seventeen feet deep on one side of an eight-foot corridor and thirty-two feet wide on the other side, to provide greater flexibility. Laboratory areas can be divided into twelve-foot by twelve-foot units without modification of essential building services. Laboratory services may be extended to all modules, providing maximum flexibility for the varying requirements of the research program.

In addition to standard modular space, special areas were required. The Scientific Laboratory has a two-story high-bay area for the development and evaluation of new materials and processing methods identified with the Chemistry and Metal-



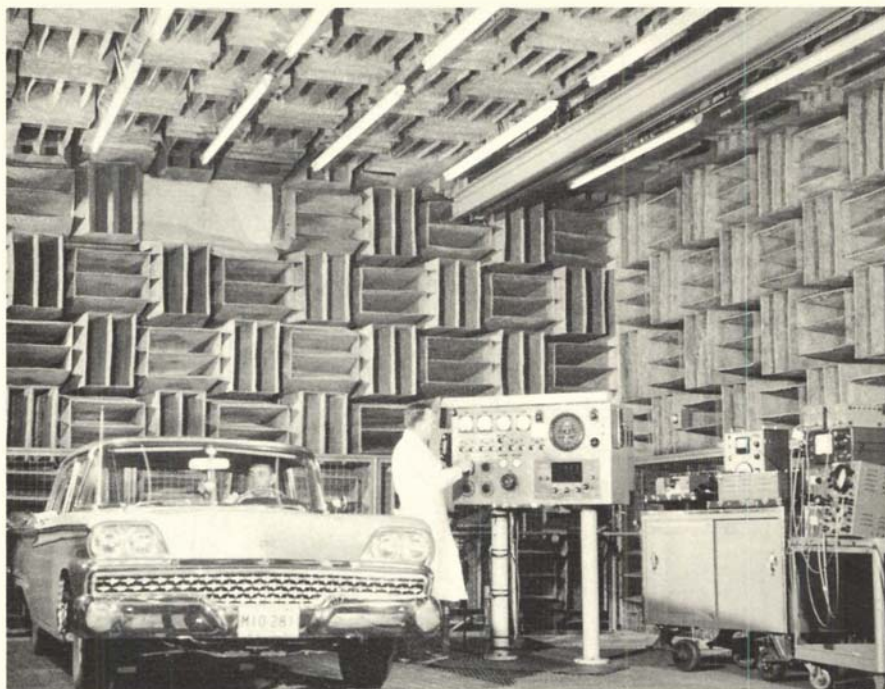
lurgy Departments. Shop type space is provided for the Laboratory's pilot-plant operations. Engineering Research has machine shops, test rig installations, a garage for test vehicles and a wing for experimental engine test-cells with a separate fuel supply house. It also has an anechoic sound cell equipped for testing complete cars. This room is acoustically treated on all sides, top and bottom so that there are no echoes. An isolated steel grating floor provides a working surface for sound tests and for detecting noise transmission in cars operating on rollers at simulated speeds up to 125 miles an hour.



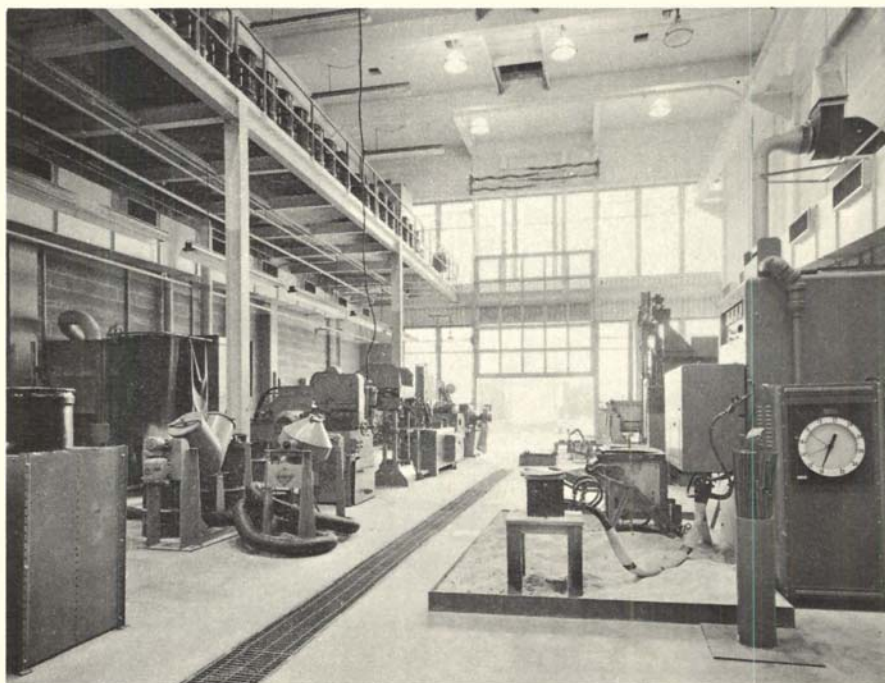
Scientific Laboratory and Research Building

First Floor Plan

Anechoic Chamber



High-Bay Area





Industrial Relations Building

The Industrial Relations Building, consisting of an office wing and a garage wing, houses the employment offices, medical department, personnel services, security operations, the central telephone switchboard, the fire department and a small bank for cashing employee checks.

The first floor is devoted to offices for employee applications and interviews, wage and salary processing, retirement program, training, publications and similar per-

*Application
Area*



*Medical
Department*

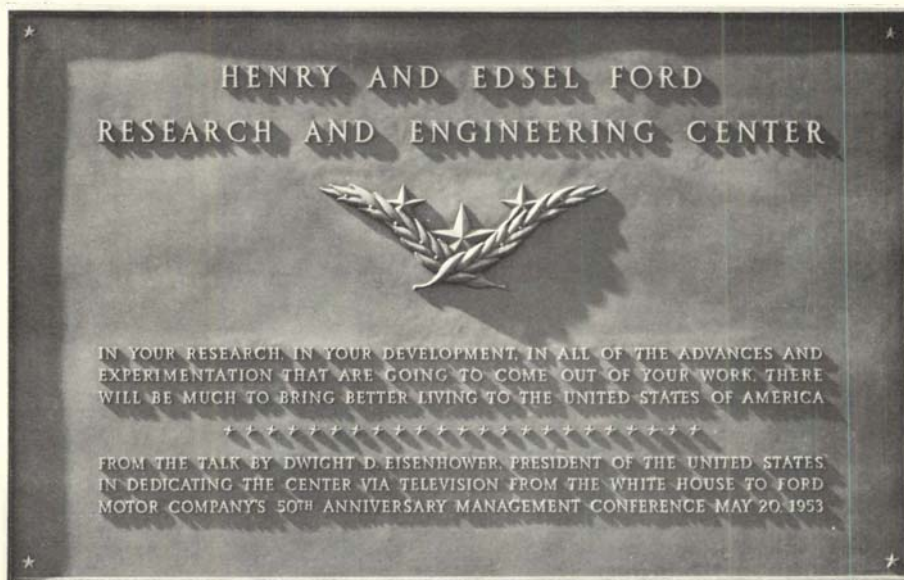


sonnel functions. The second floor houses complete medical facilities for applicant examinations and emergency treatment and the communications center. The garage wing houses company vehicles, an ambulance, fire fighting equipment and the security center.

The building, erected in 1954, has an area of 47,119 square feet.



*Industrial Relations Building
Second Floor Plan*



Acknowledgments

Ira W. Martin and Ira W. Martin, Jr. Photos on pages 1, 14, 18, 19, 20, 21, 23 lower, 26, 28, 30, 31, 34, 36, 38, 39, 40, 41, 44, 45, 46, 48 lower, 50 and 52.

Ford Motor Company Photos on pages 4, 16, 23 upper, 24, 32, 42, 48 upper, 54, 56.

E. Glushak Rendering on page 7.



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