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FINAL REPORT

PROJECT NO. E-142

PROPOSAL FOR ANTENNA TEST FACILITY

Prepared by


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I. ABSTRACT

An evaluation was made of the facilities that were available for making microwave antenna pattern measurements at the Engineering Experiment Station as of 1 July 1956. Plans and recommendations were made for improving the existing facilities and for expanding them to meet the anticipated requirements of future projects. A description is given of a receiving test site that was designed and fabricated as a result of recommendations under this project. The studies were limited to establishment of detailed requirements for an antenna test range; it was determined that the requirements of a target reflection pattern range were not compatible with those which would satisfy the requirements for an antenna test range.

II. INTRODUCTION

Since 1946 fifteen research projects have been conducted at the Engineering Experiment Station which involved the design, development, and testing of microwave radar antennas. These projects represented an income to the Experiment Station of over \$4,000,000 from the United States Department of Defense. In order to complete these projects it was necessary to make pattern measurements of antennas designed and developed on the projects. It was often necessary to make these measurements on temporary or improvised facilities with unreliable test equipment. It was impossible in certain cases to attain the precision which was required for measurements of a quality in keeping with the standards of the Experiment Station.

In order for EES to maintain its high national reputation in microwave antenna research, it was deemed necessary that the station's antenna test facilities and equipment be improved and expanded. The purpose of this project was to make an evaluation of facilities that were available for making antenna and target reflection pattern measurements and to make long range plans for antenna and target reflection measurements.

III. LIMITATIONS OF ANTENNA TEST FACILITIES

As of 1 July 1956 EES had a single 920 ft antenna test range. This consisted of a receiving site on the roof of the Main Research Building and a transmitting site on the top of a 40-ft modified windmill tower located in the former military parking lot near the corner of Atlantic Drive and 5th Street as shown in Figure 1. These facilities were constructed on previous research projects for the purpose of performing the testing of antennas necessary for the completion of these projects and were donated to Georgia Tech by the Government.

Some of the limitations of this test range were as follows:

1. the restricted size and frequency range over which antennas could be tested,
2. the inability to make quantitative measurements of the back radiation characteristics of antennas,
3. the difficulty of positioning heavy antennas on the turntable at the receiving site,
4. lack of an adequate instrument room for the test site,
5. lack of accessibility of both the receiving site and the transmitting site,
6. instability of the transmitting tower, and
7. inadequacy of the antenna test equipment.

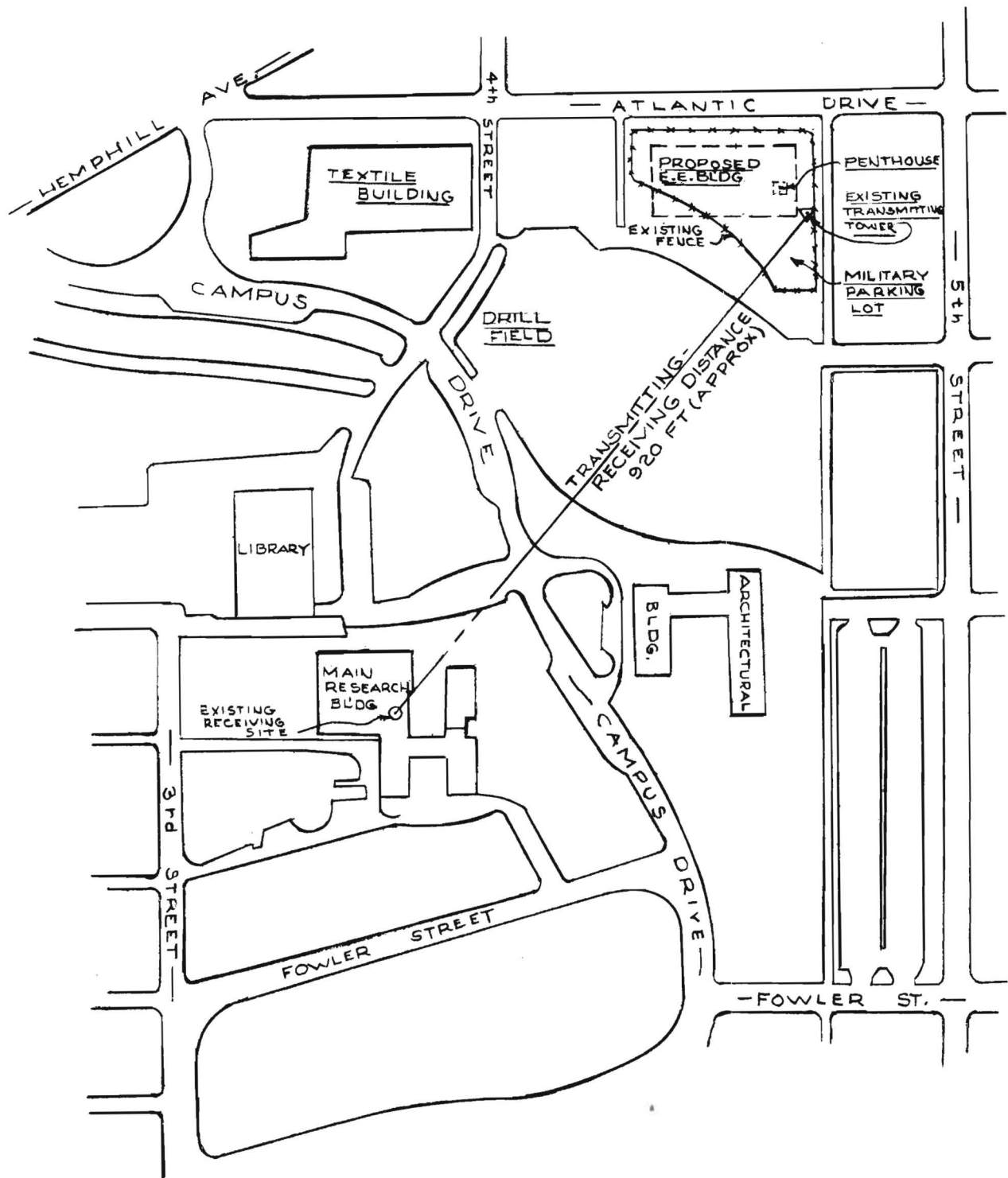


Figure 1. Antenna Test Range as of July 1959.

IV. INVESTIGATION OF POSSIBLE SITES

The possibility of relocating the antenna test facilities at another site in the vicinity of Georgia Tech was investigated. Many possible locations were considered and the more desirable ones are summarized below.

1. A 2000 foot range could be obtained by transmitting across the reservoir of the Atlanta Water Works at the intersection of Howell Mill Road and Huff Road. The water works has electrical power in the area which could probably be purchased for use at this site; the area is also enclosed with a fence which would provide security for test equipment. An undesirable feature of this range is the small clearance which would be provided between the transmitted beam and the surface of the reservoir. Additional information on this site can be obtained from Mr. Sherman Russell at the Atlanta Water Works Purification Plant.

2. A 3200 foot range could be obtained between the Main Research Building and the WAGA-TV tower near the intersection of West Peachtree Street and Tenth Street. The transmitting antenna could be located on a platform in the tower at a height of about 200 feet. The receiving test-antenna could then be positioned at the existing test site on top of the Research Building. This arrangement would provide an unobstructed line of transmission between the transmitter and receiver with ample clearance between the beam and ground obstructions. Mr. H. A. Bordy, Chief Engineer for WAGA-TV, stated that the tower was not being used for television transmission, and it might be removed in the future. Mr. Glen C. Jackson could grant permission to use the tower as a test site.

3. A 500 foot range could have been obtained between the roof of the Research Building and the roof of the penthouse on the Architectural Building; however, the use of this, even temporarily, was refused by Mr. P. M. Heffernan, Director of the School of Architecture.

4. A 3300 foot range could be obtained between the roof of the Research Building and the roof of the northwest penthouse on the Peachtree-Seventh Building at 50 Seventh Street, N. E. This building provides the best long range (approximately 3300 feet) test facility that can be found in the area of Georgia Tech. This site offers a height of ten floors above street level, an unobstructed line of transmission with ample clearance to the receiving site on the Research Building, good access by means of elevators and stairs, and readily available electric power. The building is leased by the U. S. Government. Permission to use this penthouse roof and a small amount of power was obtained from the Building Superintendent whose address is General Services Administration, Room 146C, Peachtree-Seventh Building, 50 Seventh Street, N. E., Atlanta 23, Georgia.

5. A 2575 foot range could be obtained between the roof of the Research Building and the roof of the Atlanta Biltmore Hotel. This site provides the same desirable features as described above for the Peachtree-Seventh Building. Verbal permission to locate a transmitting antenna and accessory test equipment on the second roof-level (eleven floors above the street) and to use a small amount of electric power was obtained from Mr. Donald Mount, Building Superintendent. Written permission can be obtained from Mr. D. O. Busse, Vice President and General Manager, if the existing condition of the roof is guaranteed.

6. A 920 foot range is now being maintained between the roof of the Research Building and a 40 foot tower located in the military parking lot on Atlantic Drive. To provide a permanent facility, it has been requested of Mr. C. A. Petty, Director of the Physical Plant, that a 20' x 20' x 10' penthouse with a roll-up type door be provided on the proposed Electrical Engineering Building (see Figure 2) when it is constructed in the military parking

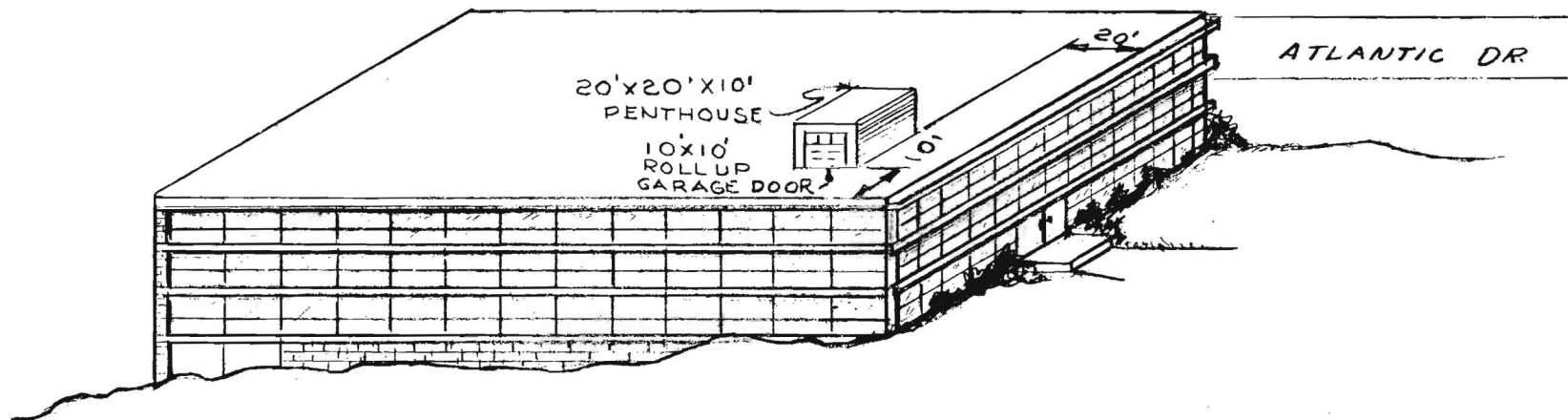


Figure 2. Requested Transmitting Site Atop the Proposed Electrical Engineering Building.

lot on or near the location of this tower. This penthouse would provide space for the transmitting antenna and associated electronic equipment.

7. A range that would provide a variable separation between transmitter and receiver of 370 to 770 feet could be obtained by constructing a 20 foot steel tower on the rear of a truck and locating the transmitting antenna on the tower and the receiving antenna at the existing site; this tower could then be temporarily located at various positions on the drill field between the Textile Building and the Architectural Building.

V. PROPOSED ANTENNA TEST FACILITY

Receiving Site

It was decided that the existing receiving site on the roof of the Main Research Building should be retained and improved as shown on the enclosed sketch (Figure 3). This site is located so as to provide an adequate range of reflection-free transmitter-receiver separations. It also offers reasonable security for test equipment, and it is conveniently located near other research facilities used by the operating personnel. In order to convert this site into a suitable test facility, the following improvements were proposed:

1. Increase the height of the antenna turntable and mounting platform to that of the shop roof; this will make "back-scatter" measurements possible by eliminating specular reflections from the shop and pent-house walls.
2. Construct a large instrument room below the mounting platform; this will provide ample space for test equipment and operating personnel and shield them from the elements.
3. Provide hoists for transporting test antennas from the ground level to the antenna turntable. No other method of locating heavy antennas on the turntable and platform is available since the construction of the Rich Computer Center makes it impossible to use a rented steel-erecting crane as was done previously.
4. Construct stairs and "cat walks" for easy access from ground level to the instrument room and the platform. Stairs and walks from the top of the platform to the shop floor will provide quick and convenient access of operating personnel to the shop and the electronic lab

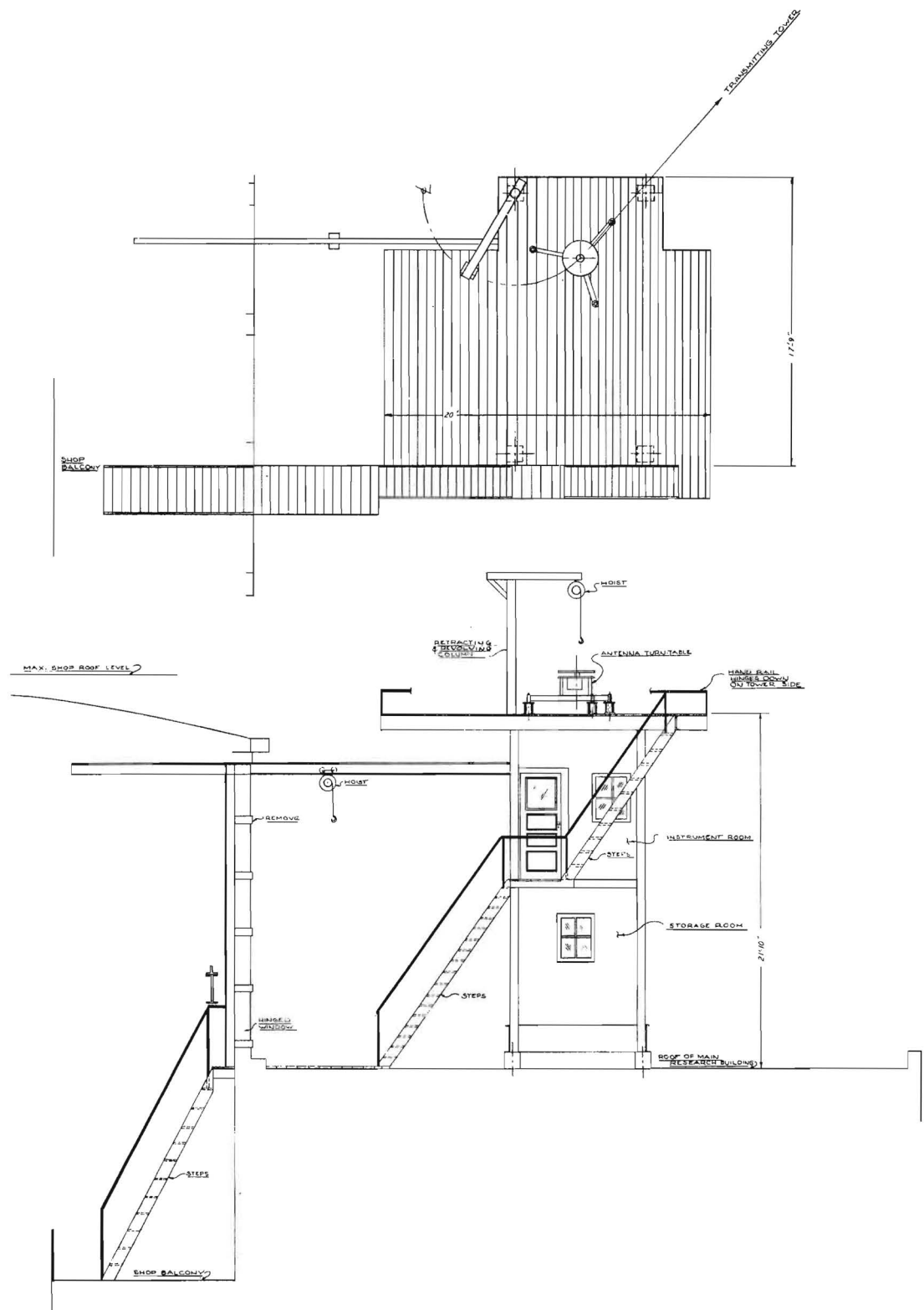


Figure 3. Sketch of Proposed Receiving Site.

facilities. It will also be possible to "hand-carry" light-weight test equipment from the ground to the test facility.

Transmitting Site

The transmitting sites indicated in paragraphs 2, 4, 5, 6, and 7 are feasible for use in conjunction with the proposed receiving test site. At present the transmitting site listed under paragraph 6, in a penthouse of the proposed Electrical Engineering Building, is being developed as a permanent transmitting site through the coordination of personnel of EES and the School of Electrical Engineering. This site should be satisfactory for testing most of the antennas that will be developed at EES.

New Microwave Antenna Receiving Test Site

On the basis of recommendations made under Project E-142, funds were made available in the amount of \$10,000 from the Georgia Tech Research Institute and \$2,650 from the Board of Regents to design and construct a new microwave antenna receiving test site. A photograph of this site is shown in Figure 4.

Test Equipment

The present antenna test facility includes a precision, heavy duty azimuth positioner. Additional equipment that should be provided by Georgia Tech to complete the permanent instrumentation of the facility are a precision rectangular antenna pattern recorder and an antenna measurements type superheterodyne receiver.

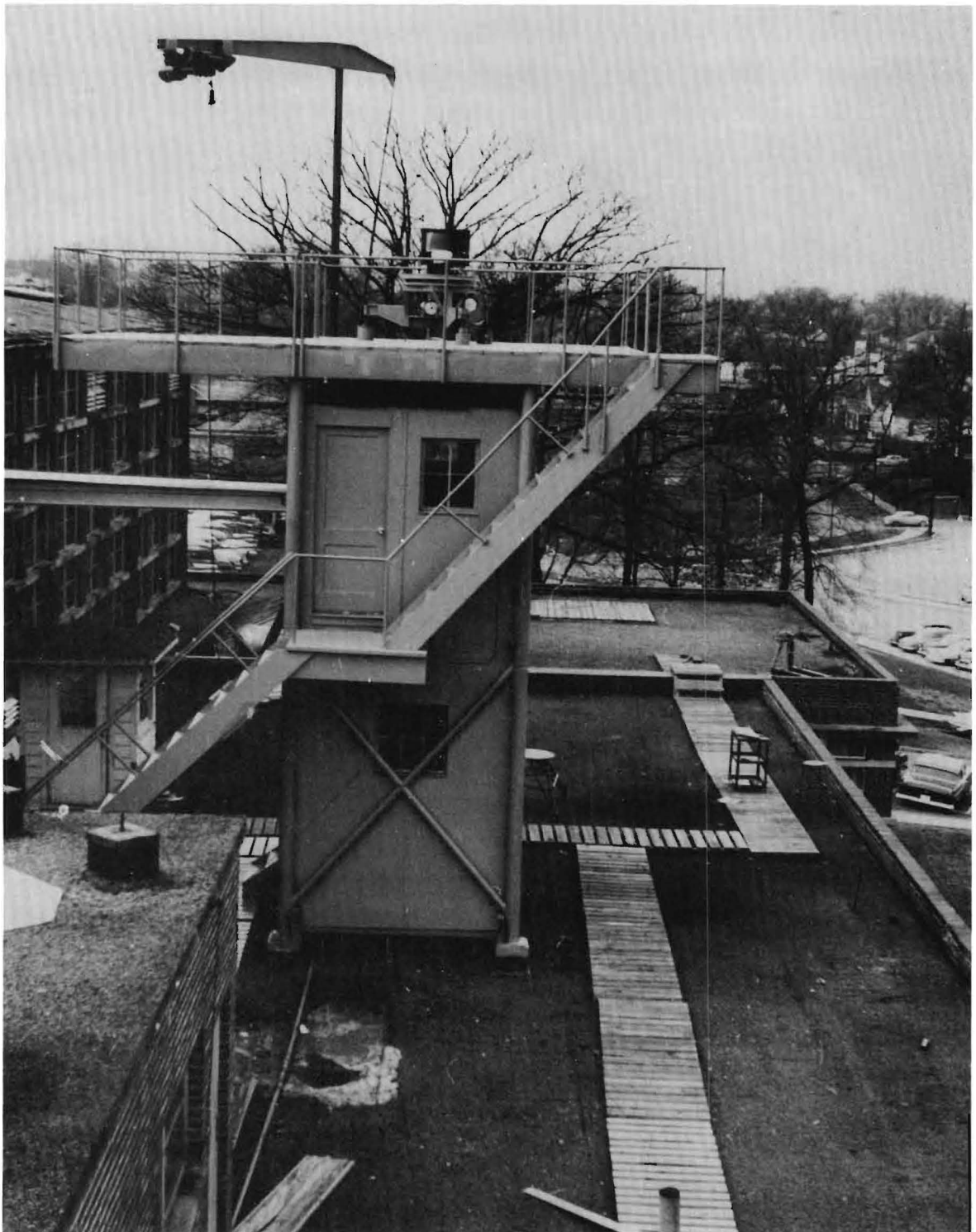


Figure 4. Constructed Receiving - Site for Microwave Antenna Test Facility.