WRIGHT-PATTERSON AIR FORCE BASE, AREA B,
BUILDING 260, ROTOR TEST STAND
DAYTON VIC.
GREENE COUNTY
OHIO

HAER No. OH-79-BD

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

WRIGHT-PATTERSON AIR FORCE BASE, AREA B, BUILDING 250, ROTOR TEST STAND

HAER No. OH-79-BD

Location: On E Street, north of the Propeller Test Complex; Wright-Patterson Air Force Base, Area B, Dayton Vicinity, Greene County, Ohio.

Date of Construction: 1950.

Present Owner: USAF.

Present Use: Unused.

Significance: The rotor test towers at Wright Field have been the Air Force's only in-house rotor test facilities and have been used to verify the integrity of helicopter rotors. When in use, the nearby gyroscopic propeller test stand simulated flight conditions better than conventional test stands.

Project History: This report is part of the overall Wright-Patterson Air Force Base, Area B documentation project conducted by HAER 1991-1993. See overview report, HAER No. OH-79, for a complete description of the project.

DESCRIPTION: At the center of the rotor test site is a 50'-tall structural steel tower, covered with sheet steel. The tower has a 30-foot-square base and measures 6' across at the top. The concrete control room is located directly under the tower structure, and from here a large variable speed drive connects with a direct-driven vertical output shaft which turns the rotor blades. An elevator carries personnel to a removable work platform at the top of the tower.

A safety enclosure with a diameter of 100' surrounds the tower and extends 25' above and below the plane of rotation. It consists of heavy wire mesh which hangs between eight structural steel vertical trusses. The removable work platform and a one-ton monorail crane extend across the top of the tower from the enclosure.

HISTORY: The Rotor Test Stand was built in 1950 to test helicopter blades of up to 100' in diameter. It has a ground clearance of 50' to eliminate the ground-turbulence which arises when the blades are too low. The equipment has a maximum power of 4,000 horsepower and can operate at speeds ranging from 150 to 600 revolutions per minute. The shaft is strong enough to resist thrusts of 50,000 pounds and side loads of 10,000 pounds, while the tower itself can sustain side loads of up to 100,000 pounds. Instruments in the control room measure speed, power, thrust, and the side load imposed on the output shaft, and also track the rotor blades individually.

To the east of the present rotor tower is a concrete pad which once supported an older rotor tower. This tower was originally installed inside Building 20A, the propeller test acoustical enclosure, near the end of World War II, but was moved outside around 1950 to make room for propeller test rig Number 4. The test equipment consisted of two 500-horsepower, variable-speed, electric motors driving through a gear box into one common vertical shaft. Test articles of up to 100' in diameter were attached to the shaft about 10' above the ground and rotated between 185 and 790 revolutions per minute. Instruments could measure the speed, power, and thrust imposed on the output shaft. The shaft could sustain thrusts up to 10,000 pounds, and the tower could support instantaneous side loads up to 25,000 pounds. A 40'-high safety enclosure of structural steel and heavy wire mesh surrounded this tower at a diameter of 100'. Staff at the Propeller Lab relate that the mesh is hand-woven using elevator cables from the Empire State Building in New York. Unlike the larger tower, the drive equipment could be removed so that tie-down tests could be conducted on complete helicopters. However, in all tests at this facility, the proximity of the rotor to the ground created turbulence patterns that hampered attempts to effectively duplicate in-flight situations.

Farther to the east is a gyroscopic propeller test stand (Building 438), which was constructed in 1956 and used for approximately fifteen years. This was designed to test propellers under a variety of vibratory stress conditions. Test propellers were mounted inside a steel drum 19½' in diameter by 3½' thick, which is evacuated to a simulated altitude of over 100,000 feet. The propeller horsepower required is reduced by this vacuum so that propellers up to 20' in diameter, capable of absorbing up to 20,000 horsepower, can be spun with a 60-horsepower electric motor. Superimposed on the normal rotation of the propeller is the rotation of the entire steel drum containing the test unit at speeds of up to 25 revolutions per minute. The gyroscopic action set up by this dual rotation produces vibratory stresses similar to those caused in flight by air flowing through the propeller at abnormal angles. Propeller stresses induced by this rig simulate even the most severe flight conditions. Despite the capabilities of this unique device, it has not been used in nearly twenty years.

For bibliography, see Wright-Patterson Air Force Base overview report (HAER No. OH-79).