

**Building 45, Project Engineering Building**  
**NASA Lyndon B. Johnson Space Center**  
**Houston, Texas**

The Project Engineering Building is a rectangular, seven-story office building connected via a small foyer on the north side to a single-story library wing. The facility is located at the intersection of Second Street and Delta Link directly east of the Christopher C. Kraft, Jr. Mission Control Center (Building 30). The main building has approximate dimensions of 198 feet in length and 72 feet in width with an overall capacity of 135,898 square feet. An approximately 3,000-square foot penthouse is located above the seventh floor of the tower wing. The north wing measures 141 feet in length and 108 feet in width with an overall capacity of 14,599 square feet, while the foyer measures 29 feet in length and 16 feet in width with a capacity of 456 square feet. Original construction features included a reinforced concrete foundation, concrete and vinyl tile floors, PEA and aluminum window walls, and a roof built-up over one inch and finished with rigid insulation and light weight fill on a metal deck. Floor layout is relatively uniform across the main tower and consists of a rectangular central core composed of two elevator shafts and adjoining restrooms, conference rooms, and additional features, such as janitorial closets and vaults. The core is surrounded by a main hallway edged with offices. The original library layout differed considerably. A shallow C-shaped patio ran the length of the wing's north face with egress to the large collections space (Room 102), which occupied the northern portion of the library. A sizeable vault (Room 100BB) with adjoining support space was located in the southeast portion of the library, and divided office and support space comprised the southwest portion of the wing. Room 100 opened to the foyer, providing egress to the tower wing.

The facility was constructed by Warrior Construction, Inc. of Houston, Texas between March 1, 1965 and April 22, 1966. The main building was originally designed to support the Gemini Program Office, Apollo Spacecraft Program Office, Central Data Branch offices, and Propulsion and Energy Systems Division, while the north wing housed the Technical Information Division and Library (Roundup January 20, 1965:1). Program Offices, such as those located in Building 45, lead the design, construction, and operation of spaceflight programs and coordinate program activities with other NASA Centers and contractors. The location of these offices represented the programmatic hub of human spaceflight. During the Apollo Program (1961-1972), the Project Engineering Building also housed the Mission Evaluation Room (MER), which provided real-time engineering support for the Mission Control Center in Building 30. At this time (ca. 1967), the only mainframe computers at the Center were in two locations. The first was operated by the Central Data Branch on the first floor of the Project Engineering Building to support engineering data analysis, and the second was located in Building 12 where analysis was conducted offline (Reeves 2009:4). MER operations were conducted in Building 45 from 1968 to 1988, at which time the MER upgraded and relocated to Building 30 to support changing requirements for the Space Shuttle

Program. The Technical Library, which provided state-of-the-art technical information support for the human spaceflight program, has been located in the north wing of Building 45 from the date of building completion in 1966.

### Mission Evaluation Room

Following the Apollo 1 fire of January 27, 1967, George M. Low became manager of the Apollo Spacecraft Program Office (ASPO) and implemented a series of program changes, including the use of FMEA (Failure Mode and Effects Analysis) to define risks associated with human spaceflight. At this time, Low set up the Mission Evaluation Room to coordinate the efforts of the ASPO's lead engineer, contract engineers, and the E&D (Engineering and Development Directorate) with their 36 subsystem managers and contractor counterparts (Lee 2008:36). The MER comprised most of the third floor of Building 45 during its operation from 1968 to 1988. According to engineer Emery E. Smith (2006), the Apollo MER was a busy and vibrant place that brought a diverse team of engineers, mainly from Structures, Propulsion, and Guidance and Control Divisions, together. Full-scale technical drawings were "taped to the walls, all up and down the building and all around the room" so that engineers could easily work from them (Reeves 2009:4). Building 45 engineers hand-drafted these drawings into operational diagrams used for mission handbooks and real-time console support. During the manned Apollo missions (Apollo 7-17), the MER worked closely with the Mission Control Center in Building 30. The front rooms of the MER were staffed by experienced people from Project Gemini who communicated directly with the crew. Engineering issues were largely worked out in the Staff Support Room. "Front Room" operations were conducted at large, gray tables rather than individual consoles (Sanzone 2011:30-31). Staff wore headsets, hand-plotted data on graph paper using data displays from CRTs (cathode ray tubes), and monitored astronaut life support systems from stopwatch display boards. Former MER engineer William D. Reeves (2009) points out that this method of trend plotting might seem "antique" now, but it kept Apollo-era engineers "right in the middle of the system at all times" (5). "You knew exactly what was going on," Reeves argues, "and today we rely so much on computers that we've gotten away from some of that." During missions, MER engineers had to solve problems in real-time. When the Apollo 13 accident occurred, Staff Support Room engineers wrote the innovative emergency procedure to power up the Lunar Module from the Command Module and passed it up to the large front room where engineers successfully talked the crew through the procedure (Reeves 2009:10). As the Apollo 17 spacecraft splashed down into the Pacific Ocean on December 19, 1972, former MER engineer Thomas V. Sanzone (2011) recalls that "everyone put their headsets down, and Elvis [had] left the auditorium" (55). "But we knew Skylab was coming," Sanzone continues, "There was always something coming." Skylab, an applied Apollo program that flew manned missions between 1973 and 1974, continued to utilize the MER. When Skylab 1 sustained heat damage during ascent, MER engineers developed a thermal shield to protect the damaged area, walked the Skylab 2 crew through docking issues using a small, 6-foot long contingency cable, and supported the deployment of the

thermal shield that allowed the crew to successfully recover the space station (Johnson 2010:31). After the cessation of Skylab, Building 45 MER supported test and orbital flights during subsequent programs until April 1988, at which time the MER was upgraded and relocated to the Lobby Wing of Building 30. The move followed in the wake of major changes to the U.S. Space Shuttle Program during the thirty-two month stand-down after the Challenger accident (ACI 2011f:17). Relocation to the Mission Control Center building met new security requirements for supporting Department of Defense Shuttle missions, facilitated the growth of a new flight control system, and dovetailed with significant modifications to Building 30 (Roundup April 8, 1988:2).

### Technical Library

Prior to the construction of the Manned Spacecraft Center, all technical information support for the manned spaceflight program was provided by the Langley Research Center (Grant 1968:1). As the MSC developed, the need for an in-house technical information organization quickly surfaced. In June 1962, Charles M. Grant began to plan a centralized technical library at the MSC to support Project Gemini (1962-1966) and all future programs (Grant 1968:3). The Langley Research Library furnished the initial reference collection, which was copied on film in its entirety (Grant 1968:4). However, the MSC's technical library broadened the scope of the Langley collection, adding journals and books to a technical report base. From June 1962 until December 1963, the MSC's Technical Information Division was located in downtown Houston pending the completion of on-site construction (Grant 1968:8). Original office space, which included the growing library, was leased in the Farnsworth Chambers Building, two downtown apartment complexes, and the Veteran Affairs Building. Technical Information was one of the first organizations to move on-site, occupying Building 12 with the Computation and Analysis Division in December 1963. Due to increasing needs for library space, the organization moved into Building 45 in April 1966 (Roundup March 4, 1966:7). At this time, microfilming operations were conducted at Ellington Air Force Base in Building 122 (Grant 1968:8). After Project Gemini, all mission-related material kept by the acting Program Office was centralized in the Technical Library to avoid data loss and increase ease of access (Grant 1968:13). From its inception, the Technical Library was designed to support automated circulation systems and new developments in library science. In June 1969, the library converted from the manual punch-card data system to computerized circulation conducted on a Univac 418 computer (Roundup June 13, 1969:4). By the mid-1970s, the facility operated the RECON information retrieval system and SCAN (Selected Current Aerospace Notices), which allowed library patrons to search and receive automatic updates from collections at the NASA Scientific and Technical Information Facility in College Park, Maryland (Roundup June 21, 1974:3; Roundup February 28, 1975:4). In March 1988, the JSC integrated into the NASA-wide Aerospace Research Information Network (ARIN), slowly adding its collection of over 65,000 books, 17,000 journals, 840,000 microfilmed technical reports, 230,000 hardcopy technical reports, 3,400 classified documents, and 403 subscriptions to an on-line database that connects users to over three million documents from NASA

Center libraries and university archives (Green 1988:3). The Technical Library launched its new NASA GALAXIE Online Catalog and UnCover document delivery service following a major facility upgrade in 2000 (Roundup May 19, 2000:6).

Originally located in Building 16, the Technical Information Library and staff were one of the first groups to move on site. At the time it opened in Building 45, the Technical Library contained over 6,792 books, nearly 500 periodicals and approximately 60,000 technical reports. While most of the information was in the scientific and technical fields, the library also had significant collections of books in other areas including management and administration. JSC's library collection and locations expanded in response to demand to create the Scientific and Technical Information (STI) Center whose collections were housed in the Main Library in Building 45, the Medical Sciences Library in Building 37, and the International Space Station Library in Building 4 South. Additionally, in 2000, the new STI Center Web site was launched which provided access to multiple electronic resources.

In 2004, the Main Library entered into a partnership with The University of Houston – Clear Lake (UHCL) to transfer JSC's books into the school's library. There were nearly 30,000 books sent to UHCL. The remaining JSC books were sent to other NASA libraries or the Library of Congress book exchange. At the end of 2011, the partnership ended and ownership of the books was transferred to UHCL as part of the agreement. That partnership was the first step towards an all-digital library at JSC. Today, the Main Library does not have any physical books, but over 5000 e-books. It also has no hard copy periodicals but access to over 3,000 electronic journals.

In addition to the books, the library housed literally millions of Department of Defense (DOD), NASA, JSC and contractor documents (fiche and paper) that dated back to the late 1950's. As the DOD and NASA documents became digital, the physical copies were removed from the library. Today there are only a few thousand paper / fiche copies. The Librarian and staff still work to remove the microfiche and paper copies as they are scanned at the Center for Aerospace Information (CASI). The library remains the official repository of formal JSC documents and still holds original paper, fiche, and PDF copies of JSC documents. Documents are scanned on demand for customers, but the originals are kept in the library. The STI Main Library has been moved into a new location in Building 30, Christopher C. Kraft, Jr. Mission Control Center while the libraries in 4S and 37 remain. The libraries are open to all JSC employees.

### New Clinic

As part of the Johnson Space Center's Central Campus Revitalization, JSC reconfigured the technical library portion of Building 45 to create a state of the art clinic for employees at JSC. This project combined the Space Flight Clinic and Occupational Clinic which was housed in Building 8, Photographic Technology Laboratory, to generate optimal efficiencies.

The Building 45 Library Redesign Refurbishment Project involved selective strategic demolition, reuse and refurbishment of the existing north library pavilion of approximately 13,500 existing square feet into a new facility to house the combined Space Flight Medicine, Occupational Medicine and Behavioral Health Groups from several other facility locations. The goals of the newly refurbished facility are to enhance the productivity, efficiency and standard of care for all three medicine groups from the current outdated and inefficient spaces in order to meet current group mission goals and medical industry best practices. The new location on the west side of the JSC Campus in the underutilized Library affords the convenience of being closer to the largest concentration of JSC employees while also being in closer relationship to other nearby buildings housing related NASA scientific groups who have allied missions with the clinic occupants.

After selective demolition of the existing Library, the remaining structural framing and roof deck received strategic engineering reinforcement to bring the structure up to current applicable JSC code requirements. To allow for the programmed area of the clinic, the existing open porch at the north side of the Library was structurally captured and fully enclosed as new conditioned space. All existing mechanical HVAC systems, electrical lighting and power systems, and fire protection systems were demolished and replaced to coordinate with the new concept design for the clinic interior and to meet or exceed current JSC building, life safety, energy and accessibility code requirements. The resultant enclosed new clinic area is approximately 15,500 square feet. The area includes a new enclosed rooftop mechanical penthouse designed to house the new HVAC units serving the clinic below. The entire exterior perimeter envelope and roofing system for the facility was reconstructed using new thermally efficient high-performance moisture management roofing, wall and glazing systems.

The new interiors meet healthcare best practices for institutional durability, infection control and maintainability and cleaning. Color psychology for the enhancement of health care has been specified in the interior finishes with coordinated accent walls in the exam rooms, waiting rooms and private offices. The behavioral health suite features premium finishes designed to induce a soothing domestic impression of comfort and security. The Behavioral Health suite is also designed to provide maximum privacy to patients, patients' families and staff including both visual and acoustical privacy.

## Evaluation

Building 45 consists of architectural features and construction commonly known in the area and across government installations in the 1960s, but the National Register criteria does not dismiss resources as insignificant simply because there are numerous examples of the type. National Register eligibility for any property, including Historic Period sites, depends largely on integrity and significance. Integrity for a Historic Period

site or district is based on the presence of features and whether or not they can tell us something about the location. An architectural inventory was conducted at Building 45 to determine if unique features are present. ARCADIS noted no specific features that “embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction” (Criterion C). Most of the basic construction components (eg. foundation, framework, siding, and windows) retain their original integrity, but significant changes to the interior layout and construction materials used has occurred several times since the building was first erected. Integrity alone, however, does not automatically include or exclude this site as eligible for the National Register. Interviews and in-depth historic research revealed a number of significant historical occurrences and individuals associated with the building. In many cases those significant events and programs are related to other buildings at JSC and the Space Program. The interviews and research revealed that the MER in Building 45 had significant associations with the Gemini, Apollo, and SkyLab Programs. In addition, the Technical Library had a distinct association with Langley Research Center.

While Building 45 appears to lack a unique design and any other unusual physical characteristic, the significance of the building lays with the activities that took place that were of national importance (Criterion A). The events that occurred in Building 45 and the consistent change of use of the facility illustrate the fluidity of change that is prevalent throughout the use of each building at JSC and that is a prominent theme in the Manned Space Program. Building 45 is a contributing component of the JSC Historic District.