

Sandy Hook Unit
Gateway National Recreation Area
New Jersey

Structural Conditions Assessment

Mortar Battery Tunnel Complex

February 8, 2006

Final Report

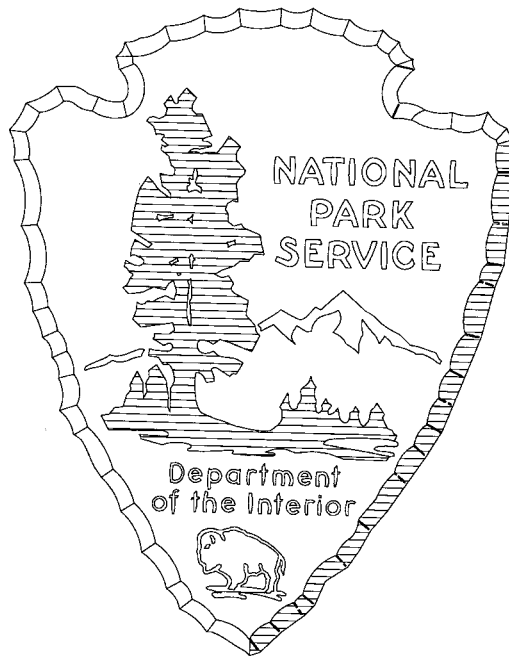


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INTRODUCTION

This report deals solely with the Mortar Battery tunnel system and is intended to be a supplement to the EYP report dated May 16th, 2005, "Structural Analysis and Historic Characterization, Battery Gunnison, Battery Potter & Mortar Battery." The earlier report provides conditions assessment and remedial recommendations for the gun pits and other components of the Mortar Battery. All services for the tunnel system report were performed in accordance with National Park Service (NPS) contract number 1443CX2000, and Gateway NRA PMIS 57952.

SUMMARY OF EXISTING CONDITIONS AND RECOMMENDATIONS

General Site Description

The Mortar Battery complex at Sandy Hook, constructed between 1890 and 1894, is the product of nineteenth century military engineering relative to defense strategy and the requirements for the operation of guns of the period. In addition, the military engineers implemented the use of mass, unreinforced concrete to create a "bombproof" system of tunnels and chambers for storing and transporting ammunition. In 1903 the entire Mortar Battery was named in honor of Major General John F. Reynolds, a Civil War hero. When it was decided in 1906 that the four pits should be operated as two pairs, another Civil War figure, Major General Alexander McCook, was chosen.

The McCook and Reynolds mortar battery complex consists of two pairs of open gun pits surrounded by massive parapet walls set in sand and flanked by a counterscarp wall (figures 1 & 2, from NPS/Gateway NRA archives, plan and section). In 1894 there were sixteen mortars emplaced there, four in each pit. The entrance galleries contain rails embedded in the concrete slab for movement of ammunition. The walls of the gun pits

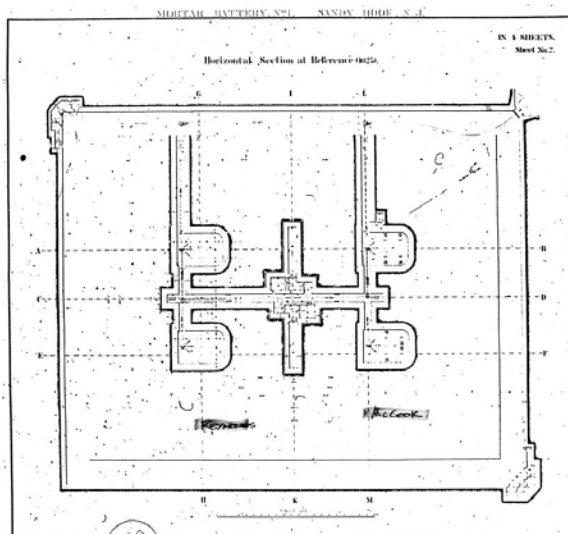


Figure 1: "Plan of Mortar Battery No. 1, Sandy Hook, NJ," Sheet 2, undated. Gateway Museum Collection, Catalog #10667.

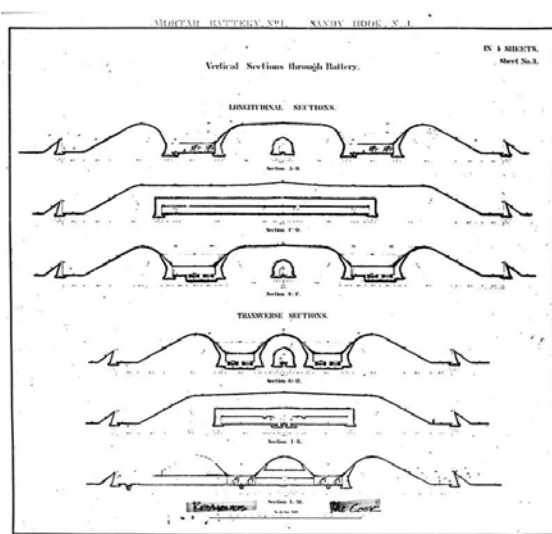


Figure 2: "Plan of Mortar Battery No. 1, Sandy Hook, Sheet 3, undated. Gateway Museum Collection, Catalog #10667.

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are vertical for about ten feet and then taper outward another ten feet or so; the outside faces of the pits are covered with soil and vegetation for camouflage. The batteries are connected to magazines, storerooms, and to each other by a tunnel system; the tunnels consist of cast-in-place concrete barrel vaults, ranging in thickness from about 5'-6" to 8'-0". In 1907 two reinforced concrete Battery Commander Stations were constructed between the Battery pits; these are not visible from below. Built at the same time are concrete Data Booths that are visible immediately above the entrance pathway leading into each of the four pits; these structures functioned in conjunction with the Battery Commander Stations.

Two transverse galleries connect the eastern and western gun pits; the transverse galleries are connected by a north-south oriented longitudinal gallery. At the center, the longitudinal gallery connects to magazine tunnels on the east and west.

The massiveness of the construction, with additional surcharge from the sand/vegetation cover, would have served to protect the battery from incoming fire, and would also contain any accidental explosion in the ammunition storage areas. There are numerous nineteenth century engineering texts, some of which were used to teach students at West Point, covering the many aspects of military architecture (figures 3 & 4).

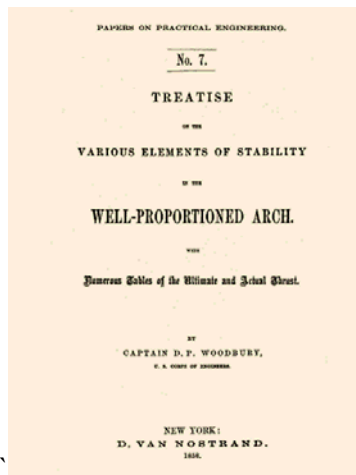


Figure 3: 1856 U.S. Army Corps Engineering Text

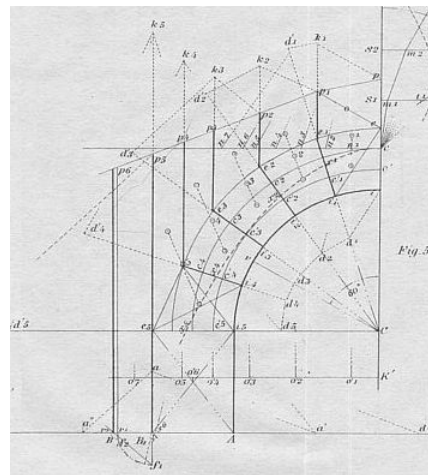


Figure 4: Engineering diagram of loading in an arch

Several alterations were made over time to “modernize” the complex: trolley and hoist system c1895 and c1907; widening/heightening of the galleries c1907; addition of Battery Commander Stations c1907; addition of four concrete data booths (unknown); addition of air ventilator shafts c1912; removal of one mortar from each pit c1917; removal of remaining mortars c1920; installation of anti-aircraft guns c1921-22; conversion to Telephone Communications and Harbor Defense Headquarters Command Center c1921-22 to 1945; Harbor Defense Command Post (HDCP) c1941 to 1950. These final alterations required the installation of heating/ventilating/dehumidification systems, electrical service, plumbing, partitions, communications equipment, soundproofing and

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gasproofing. The soundproofing drawings (c1944) indicate the application of spray-on asbestos throughout the tunnel system (refer to Clough Harbour report on hazardous materials); this would have deadened the harsh echo that must have existed in the exposed concrete tunnels and chambers. The gasproofing drawings indicated a system of doors, air locks, relief valves, blowers, shutters and vents within the transverse and longitudinal galleries and magazine tunnels presumably to prevent the infiltration of gas during an enemy attack.

Existing Conditions

- **Water Infiltration and Ventilation:** The tunnel complex is extremely damp with very limited air turnover. This condition was noted by the military early on in the life of the structure and was addressed in 1912 with the addition of air ventilator shafts. Subsequent use during WWII included a fairly elaborate ventilation and dehumidification system. It is unknown how effective the ventilation was after the 1912 modification, but the installation of gasproof doors in 1942-44 would have adversely affected any natural draft effect intended by the installation of the shafts.
- **Vegetation:** Other than potential encroachment at existing ventilation shafts, there are no signs that the vegetation and the associated root systems have affected the stability of the concrete structure.
- **Concrete:** The construction of the Mortar Battery complex consists almost exclusively of unreinforced mass concrete using Rosendale Natural Cement. The underside of the concrete vaults are covered with insulation throughout the complex and may conceal some minor concrete cracking and spalling. There is no evidence of differential settlement visible. Where surface mounted conduit, ductwork, and trolley rails are attached, there is some spalling of the concrete in the vicinity of the embedded anchors.
- **Tripping Hazards:** The existing 12”X12” floor tiles, which are partially broken and buckled, will be removed as part of the Hazardous Materials Abatement Project. The most significant tripping hazard is the presence of trenches in the floors, with many areas of the steel plate covers missing or displaced.

Recommendations

- **Water Infiltration and Ventilation - High:** It appears that rain water is entering the tunnel complex through exterior doors, ventilation penetrations in the concrete arches, and possibly ground water. The existing shafts should be cleaned and capped to increase air flow through the spaces while reducing water infiltration. Figure 5 is a sketch based on a 1911 drawing in the Gateway Museum Collection (Catalog #10674), “Ventilating Flues for Magazines Mortar Batteries Reynolds and McCook.” The doors to the pits can be retrofitted or replaced to increase air circulation and reduce water infiltration

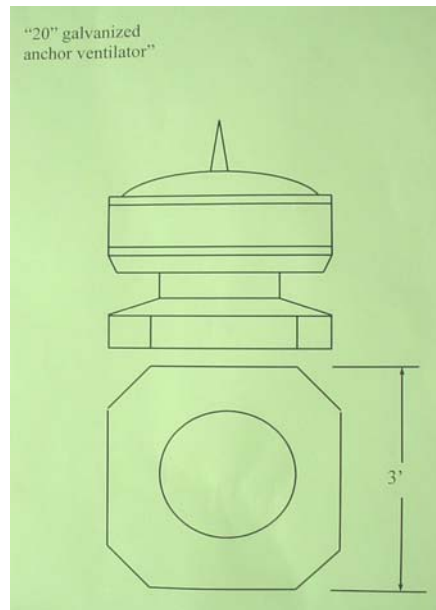


Figure 5: Ventilation shaft cap, schematic sketch drawn by Mike Thomas of the NPS

- **Tripping Hazards – High:** Removal of adhesives down to the structural slab should be part of the floor tile abatement project. Depending upon the condition of the exposed concrete surface, the treatment is likely to be minor patching; if the condition warrants, placing a new concrete top coat may be necessary. New steel “checker plate” can be replace missing cover plates for the trench systems. Due to the uncontrolled environment, replacement covers could be resistant to corrossions (figure Existing plating that has been displaced can be cleaned, painted and reinstalled.

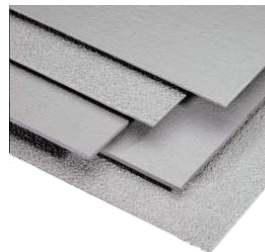


Figure 6: Safplate by McNichols, fiberglass trench cover

- **Lighting – High:** Anyone who has entered the Mortar Batter tunnel complex is aware of how important lighting will be for visitation. Surface mounted conduit can be utilized that has good resistance to moisture since even with improved ventilation there will be significant fluctuations in ambient humidity.



Figure 7: Corrosion resistant conduit,
Ocal PVC coated conduit
by Thomas & Betts



Figure 8: Lighting for harsh environments,
by Hazlux

- **Vegetation – Low:** There are no signs of structural damage from large tree root systems. Vegetation only needs to be addressed where it encroaches on existing ventilation shafts.

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**Longitudinal Gallery
(F)**



**Longitudinal Gallery
(A)**

Brick partition
wall

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**Magazine Tunnel
(J)**

Standing water



**Magazine Tunnel
(I—H)**

Condensation
on metal duct



**Magazine Tunnel
(G)**



**Magazine Tunnel
(M)**

Condensation
on metal duct

Clay tile parti-
tion with plaster
finish

Structural Conditions Assessment
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**Magazine Tunnel
(O)**



**Longitudinal Gallery
(T)**

Floor trench

Metal plate
trench cover

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**North Transverse
Gallery (Y)**



**North Transverse
Gallery (Y)**

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**Floor Trench
(T-Y)**

Steel cover plate

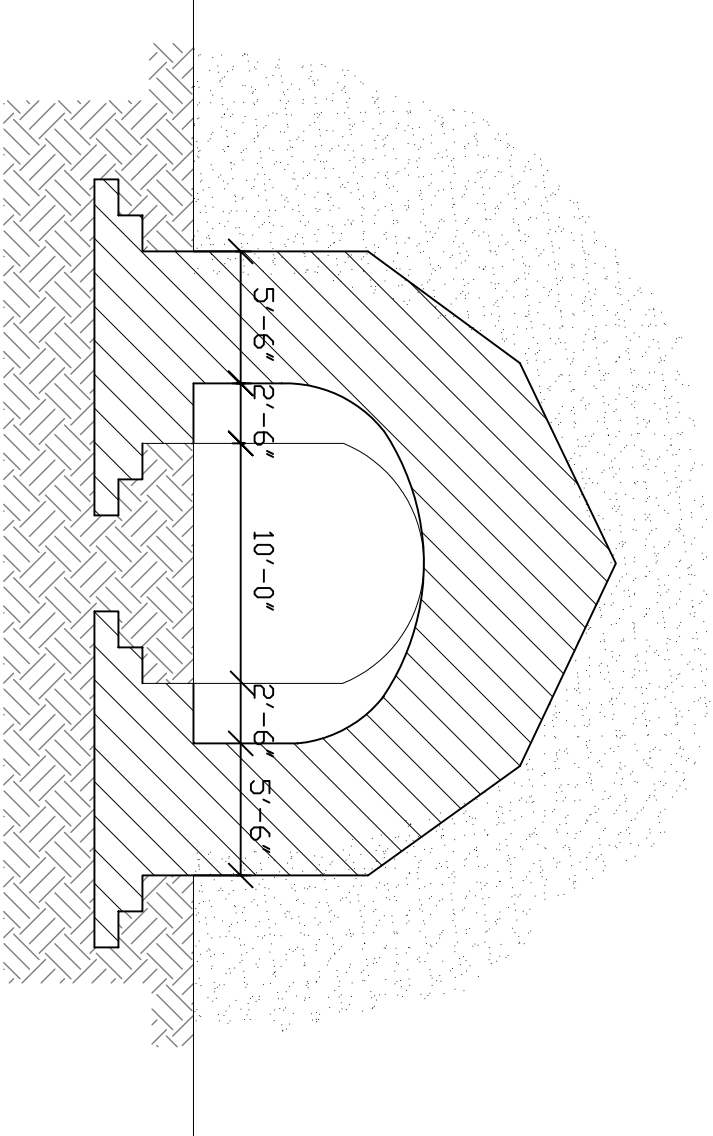
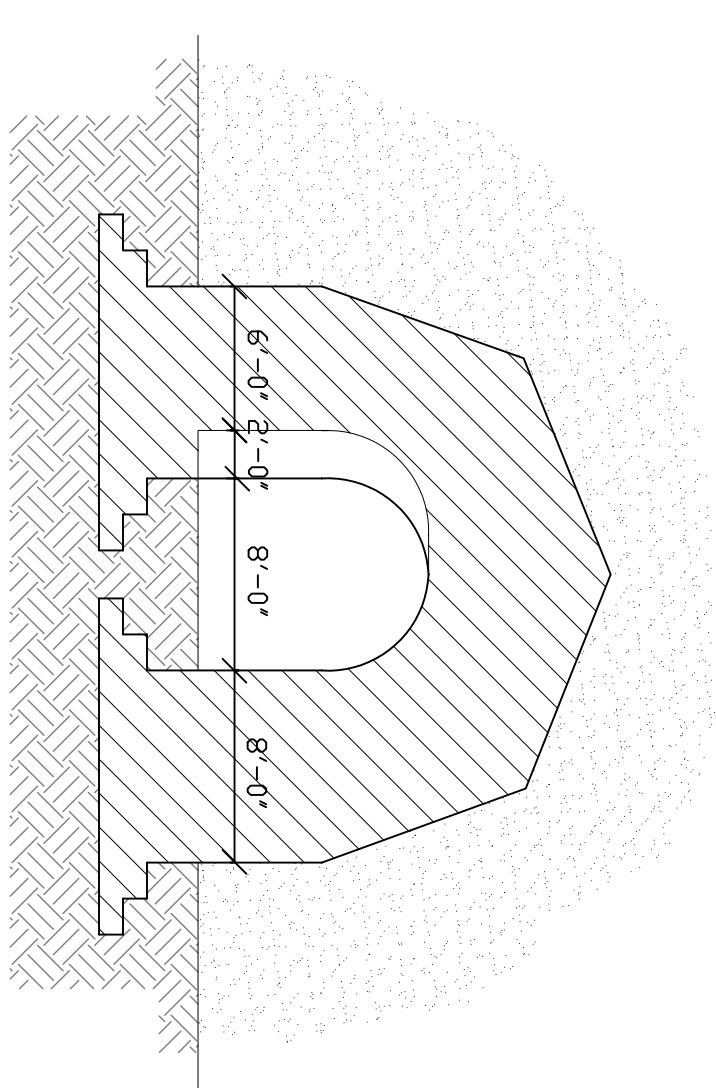
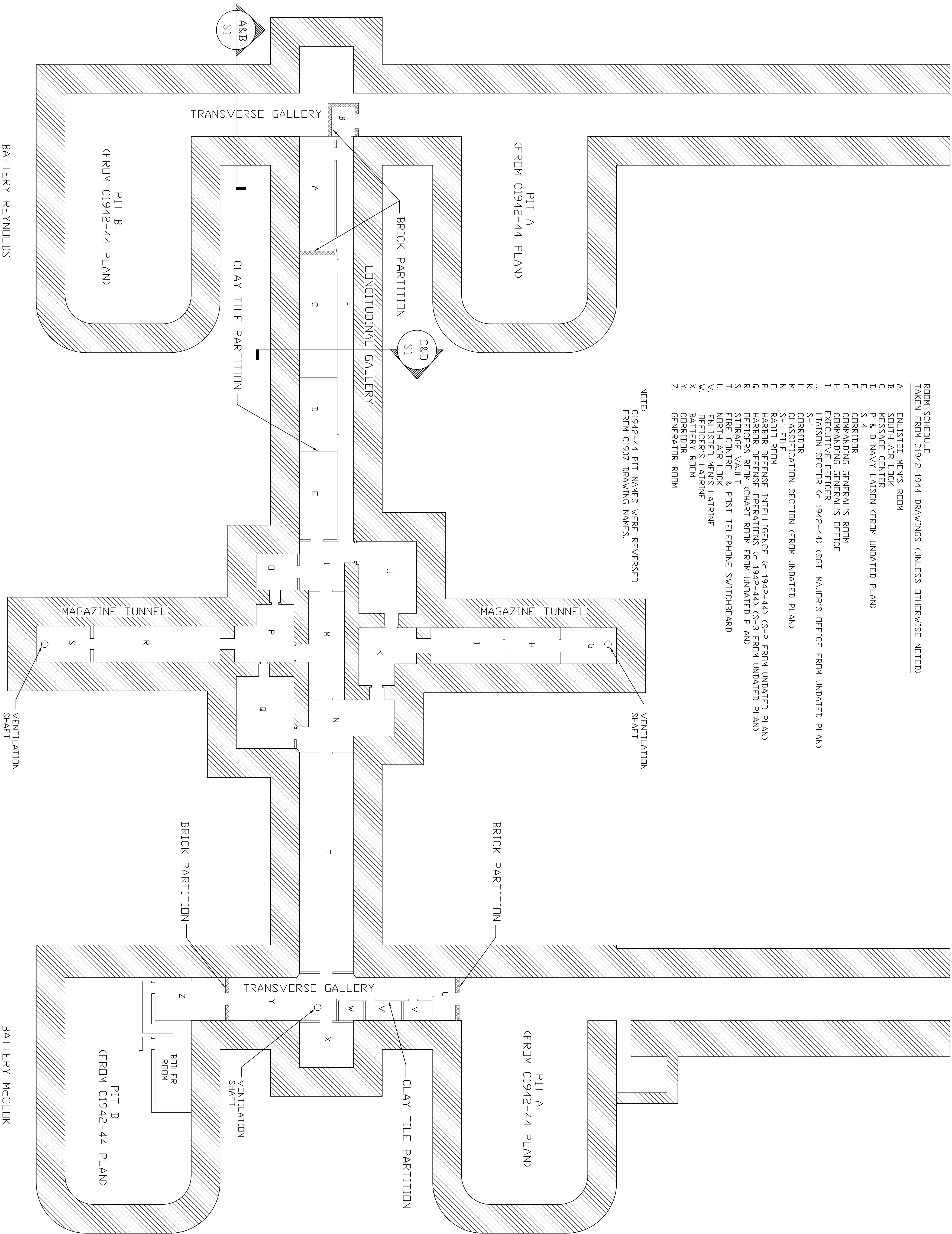


**North Transverse
Gallery (Y)**

Ventilation shaft cut
through concrete arch
(7 feet +/-)

- ROOM SCHEDULE
TAKEN FROM C1942-1944 DRAWINGS (UNLESS OTHERWISE NOTED)
- A. ENLISTED MEN'S ROOM
 - B. SOUTH AIR LOCK
 - C. MESSAGE CENTER
 - D. P & D NAVY LIAISON (FROM UNDATED PLAN)
 - E. S 4
 - F. CORRIDOR
 - G. COMMANDING GENERAL'S ROOM
 - H. COMMANDING GENERAL'S OFFICE
 - I. EXECUTIVE OFFICER
 - J. LIAISON SECTOR (C 1942-44) (SGT. MAJOR'S OFFICE FROM UNDATED PLAN)
 - K. S-1
 - L. CORRIDOR
 - M. CLASSIFICATION SECTION (FROM UNDATED PLAN)
 - N. S-1 FILE
 - O. RADIO ROOM
 - P. HARBOR DEFENSE INTELLIGENCE (C 1942-44) (S-2 FROM UNDATED PLAN)
 - Q. HARBOR DEFENSE OPERATIONS (C 1942-44) (S-3 FROM UNDATED PLAN)
 - R. OFFICERS ROOM (CHART ROOM FROM UNDATED PLAN)
 - S. STORAGE VAULT
 - T. FIRE CONTROL & POST TELEPHONE SWITCHBOARD
 - U. NORTH AIR LOCK
 - V. ENLISTED MEN'S LATRINE
 - W. OFFICER'S LATRINE
 - X. BATTERY ROOM
 - Y. CORRIDOR
 - Z. GENERATOR ROOM

NOTE:
C1942-44 PIT NAMES WERE REVERSED
FROM C1907 DRAWING NAMES.



SECTION C&D THROUGH TUNNEL
SCALE (B)
SCALE OF FEET

- LEGEND:
- INDICATES EXISTING CONCRETE WALLS
 - INDICATES CLAY TILE PARTITIONS
 - INDICATES BRICK PARTITIONS

TUNNEL SYSTEM FLOOR PLAN
SCALE (A)
SCALE OF FEET

DESIGNED: M.E. GARD VDT TECH. REVIEW: M.E. DATE: 2/08/06  NORTH	SUB SHEET NO.	S1	TITLE OF SHEET	MORTAR BATTERY TUNNEL COMPLEX	SANDY HOOK UNIT GATEWAY NATIONAL RECREATION AREA	DRAWING NO.	646
							25095
	PKG. NO.	SHEET					
	GATE	1					
	57992	OF	1				