

**Primary Battery File**

**National Archives, Washington D.C.**

**Record Group 77**

**Correspondence of the Chief of Engineers**

**Entry 103**

**File, Fort, Battery:**

**61757**

**Ft. Story**

**16-inch Project**

**1914-17**

*Copy*

From: The District Engineer Officer, Norfolk, Va.

To: The Chief of Engineers, U. S. Army.

Subject: Plans and estimates for direct fire batteries at Cape Henry, Va.

1. In compliance with the Department's instructions of the 31st ultimo (M. D. 61757), I submit a report upon the relative cost of emplacements for 14-inch and for 16-inch guns at Cape Henry, Va.

2. Accompanying this report are a set of 10 tracings, four showing the general plans of batteries A, B, C and D for 16-inch emplacements, and a fifth sheet showing the location of these batteries relative to one another and to other batteries, and a similar set of sheets of batteries consisting of emplacements for 14-inch guns.

3. The drawings of batteries submitted are based upon the designs of batteries now under construction at Panama and are general only, such details as drainage slopes, wiring, speaking tubes, etc., which are more or less standard, are not shown.

4. In order to determine the character of foundation for the batteries test holes were sunk at each of the different sites and the results were so nearly uniform that it would appear that we can rely upon a sub-soil of sand many feet in thickness and sufficient to carry, without undue settlement, the weights of the batteries, if these weights be properly distributed. In the same connection the Lighthouse Board was communicated with and the records obtained, which related to the foundation and construction of the Cape Henry Lighthouse. This structure was built on a spread concrete foundation, the weights per cubic foot being not very much less than those required under the batteries and the settlement was quite uniform and almost negligible.

5. I therefore recommend that the portions of the Cape Henry emplacements consisting of the rooms and magazines be founded upon concrete slabs so reinforced as to distribute the weight, this slab to have its lower level at about the elevation of ground water, and the lower portion of the walls, where possible, to be made cellular. The parapet walls should be built on a slightly spread foundation somewhat cellular below the level of the landing platforms and numerous planes of weakness should be made where possible, in order that any irregularity in settlement may cause no trouble.

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6. In order to keep the level of the batteries down as much as possible and thus reduce the cost, it has been found necessary to place the bottom of the gun wells, and consequently the gun blocks, quite a distance below low water. In order to render the excavation for these gun blocks possible below the water level where the sand flows easily, it is believed that sheet piling will be necessary, and consequently estimates of cost for this sheet piling are included.

7. The four batteries whether of the 14-inch or of the 16-inch type, resemble each other closely and the estimated quantities differ so little, that the cost of any may be taken as typical of all; and in the enumeration below the average has been taken.

8. The average estimate of cost for the 16-inch batteries of one gun each is as follows, the usual allowances for contingencies being included in the figures given:

Excavation 11,000 cubic yards, at 30 cents per cubic yard,-----	\$ 3,300
Sheet piling, excavation of gun well, and foundation for same,-----	5,000
Foundation concrete of battery, 2,000 cubic yards, at \$12,-----	24,000
Concrete of battery, 16,000 cubic yards, at \$8.00,-----	128,000
Tile lining, 12,000 square feet, at 25 cents pr. sq. ft.--	3,000
Granolithic paving, 1200 square yards, at \$2.00,-----	2,400
Sand fill, 40,000 cubic yards, at 50 cents per Cu. Yard,-	20,000
Sodding, 10,000 square yards, at 40 cents per sq. yd.----	4,000
Doors and windows,-----	2,000
Trolley system,-----	3,000
Speaking tubes,-----	600
Mechanical indicator,-----	1,800
Sewer and plumbing fixtures, and installation of same,---	2,000
Electric wiring and fixtures, and installation of same,--	5,000
Reserve electric plant and installation of same,-----	<u>4,000</u>
Total,-----	208,000

or about \$208,000 per emplacement.

9. The average estimate of cost for the 14-inch batteries of one gun each is as follows; the usual allowance for contingencies being included in the figures given:

Excavation 9,000 cubic yards, at 30 cents per cubic yard,-----	\$ 2,700
Sheet piling, excavation of gun well, and foundation for same,-----	4,000
Foundation concrete of battery, 1,800 square yards, at \$12,-----	21,600
Concrete of battery, 12,500 cubic yards, at \$8.00,-----	100,000
Tile lining, 10,000 square feet, at 25 cents per sq. ft.--	2,500
Granolithic paving, 1,000 square yards, at \$2.00,-----	2,000
Sand fill, 36,000 cubic yards, at 50 cents per Cu. yard,-	18,000
Sodding 9,000 square yards, at 40 cents per square yard,-----	3,600
Doors and windows,-----	2,000
Trolley system,-----	3,000
Speaking tubes,-----	600
Mechanical indicator,-----	1,800
Sewer and plumbing fixtures, and installation of same,---	2,000
Electric wiring and fixtures,-----	4,800
Reserve electric plant, and installation of same,-----	<u>4,000</u>
Total,-----	172,600

or about \$172,500 per emplacement.

E. EVELATH WINSLOW,  
Lt. Col., Corps of Engineers,  
U. S. Army.

10 tracings under sep. cover.

(#1 to 10)

61,757/123

(Copy)

5809/S-S, C.A.D.  
61757/149, O.C.E.

WAR DEPARTMENT,  
United States Engineer Office,  
Room 2, Custom House,  
Norfolk, Va.

September 16, 1914.

From: The District Engineer Office, Norfolk, Va.

To: The Chief of Engineers, U. S. Army.

Subject: Estimates for work at Cape Henry, Va.

I have either in other letters of this date or in those previously submitted, forwarded preliminary designs and estimates of cost of all the larger items of engineer work at Cape Henry, Va.. These items of cost can now be summarized, and adding other items, there results as the approximate cost of the Engineer work at Cape Henry:

4 batteries of 14" guns, at \$200,000.	\$ 800,000.00
If 14" guns be used instead, these items will be reduced \$35,400 per battery, or a total of \$141,600.00.	
Four batteries.	440,000.00
Four 12" batteries, at \$155,000.	620,000.00
One central installation.	170,000.00
One defense installation, not including wharf.	200,000.00
Wharf.	45,000.00
Refrigerator (if built).	150,000.00
Central power plant and battery reserve plants.	170,000.00
Searchlight installation and reserve plants for same.	95,000.00
Construction plant.	50,000.00
Construction railroad, and rolling stock for same, from wharf to battery sites.	60,000.00
Living life saving station.	5,000.00
Changing location of Norfolk Southern Railroad tracks.	40,000.00
Total.	\$2,584,000.00

The above figures include about all the Engineer work connected with Cape Henry Fortifications, for which it is possible at the present time to make estimates, but there are other items which will not improbably come up in the future.

A large part of the surface of all five of the parcels consists at present of sand. In places this sand is held to some extent by vegetation, but over the larger part of the area there are sand dunes that drift here and there as the winds may change. Experience at Virginia Beach, about 5 miles to the South, has shown that if the sand surface be properly graded and if some clay soil be mixed in and arrangements be made for irrigation during the dry spells, a good growth of grass and other vegetation can be induced that will hold the sand from drifting as long as vegetation is maintained.

4. In connection with lay out of the post proper, roads must be constructed, the ground must be graded, and the grass must be held and vegetation encouraged. On the post proper this undoubtedly pertains to the Quartermaster's Department, but in the immediate vicinity of the batteries it may be that the Engineer Department will be called upon to do some work of this character, for it is extremely essential that the drifting of sand be stopped so that it may not be blown into the gun carriages and other machinery.

5. Another item of possible Engineer Department work, which may come up in the future, is the question of sea walls. As far as can be learned, the shore line at Cape Henry is unusually stable for a sea beach, but this stability is due to the present equilibrium of forces. At times the sand is forced up by the waves and when dry is blown in shore, and at other times the breezes from the land drive the sand toward the sea and deposit it along the fore shore. If the drifting of the sand on shore be stopped, this equilibrium will to some extent be destroyed, and this may be followed, as has happened at other places, by the slow eating away of the shore.

6. It is considered not impossible, therefore, that in the future some means of protecting the shore may be necessary, such as sea walls or groins, or other structures intended for the same purpose, and, in consequence, I think it should be noted that the estimate of two and a half million dollars, given in paragraph 1 above as the approximate cost of the Engineer features of the fortifications, may have to be exceeded, even without an increase in the character and extent of the proposed defenses.

E. EVELYN WINSLOW,

Lt. Col., Corps of Engineers, U.S. Army.

1st Ind.

Office C. of E., September 21, 1914.- To THE CHIEF OF STAFF.

For the information of the Cape Henry Fortification Board; in compliance with instructions from The Adjutant General's Office dated March 26, 1914.

DAN C. KINGMAN,

Chief of Engineers, U. S. Army.

MEMORANDUM FOR THE JEFFERSON COUNTY FORTIFICATION BOARD.  
Dated: 11-1-1913

The Board met, pursuant to call of its president, at 2:30 p.m., in the office of the Assistant Chief of Staff.

Major General W. W. Hetherington, General Staff Corps.  
Colonel E. Burr, Corps of Engineers.  
Lieutenant Colonel E. E. Winslow, Corps of Engineers.  
Major E. P. O'Hara, Ordnance Department.  
Major George Hahely, Coast Artillery Corps.  
Major William Chamberlaine, Coast Artillery Corps.

Major E. P. O'Hara was detailed as a member by paragraph 3, Special Order, No. 233, War Department, 1913.

The Board, after consideration of the studies submitted by Lieut. Col. Winslow, recommends as follows:

1. That the armament consist of -

- a. 14-inch B.L. Rifles (See par. 5).
- b. 12-inch B.L. Rifles.
- c. 10-inch B.L. Rifles.

That the 14-inch armament be employed in two batteries of two pieces each, one in each pit; the batteries to be located as shown on the accompanying charts.

That pending the construction and proof of the 14-inch carriage, the 12-inch and 10-inch armaments be employed in the interim. That the 12-inch armament be employed in the interim in the position of the 14-inch armament.

That the 10-inch armament be employed in the interim in the position of the 12-inch armament. That the 10-inch armament be employed in the interim in the position of the 12-inch armament.

That the Board be authorized to prepare the location of the armaments, and to prepare the location of the armaments. That the Board be authorized to prepare the location of the armaments, and to prepare the location of the armaments.

That the Board be authorized to prepare the location of the armaments, and to prepare the location of the armaments. That the Board be authorized to prepare the location of the armaments, and to prepare the location of the armaments.



4 - 12-inch rifles, on disappearing carriages.  
 4 - 12-inch  
 4 - 12-inch  
 4 - 12-inch mortars.

7. That a copy of the accompanying chart be furnished the Chief of Engineers, with the request that estimates be prepared for the following -

Emplacing in one-gun emplacements  
 4 - 12-inch guns on disappearing carriages.  
 4 - 12-inch guns on disappearing carriages.

Emplacing in two-gun batteries  
 4 - 6-inch guns on disappearing carriages.

Emplacing in batteries of two pits of two mortars each  
 4 - 12-inch mortars.

Purchase and installation of six 60-inch searchlights.  
 Construction and installation of central power plant.

Wiring casemate.

Building storeroom.

Fort Commander's station. 90' hill.

Two commanders' stations.

Two commanders' stations.

Two primary stations (14").

Two primary stations (mortar).

Two primary stations (14").

Two primary stations (mortar).

Two secondary stations (mortar).

Two secondary stations (mortar).

One secondary station (mortar).

Four secondary stations (14").

Two secondary stations (mortar).

And such other structures as are furnished by the Engineer Department.

WILLIAM SHAMBERLAIN,  
 Major, Coast Artillery Corps.

Approved: \_\_\_\_\_  
 Major General

U. V. WITHERSPOON,  
 Major General, General Staff, U.S.A.,  
 President

Secretary of War.

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COMPLEMENTARY PROCEEDINGS OF THE CAPE HENRY FORTIFICATION BOARD  
WAR DEPARTMENT, WASHINGTON, D. C., OCTOBER 10, 1916.

The board met, pursuant to the call of its President, at 10 a.m.

October 10, 1916.

PRESENT:

Major General W. W. Wetherpoon, General Staff Corps,  
Colonel John W. Rushman, Coast Artillery Corps,  
Colonel Richmond P. Davis, Coast Artillery Corps,  
Lieutenant Colonel E. E. Winslow, Corps of Engineers,  
Major Edward P. O'Hara, Ordnance Department.

ABSENT:

Colonel Edward Barr, Corps of Engineers.

1. Colonel Davis was detailed as a member by paragraph 13, Special Order, No. 200, War Department, 1914.

2. The board then considered the estimates called for in its proceedings of March 11, 1914, submitted by the Chief of Engineers, the Chief of Ordnance, and the Chief of Artillery, and the Chief of Staff, and finds that the cost of the Cape Henry Fortification Project, according to these estimates, will be approximately as follows: (Exhibit A)

Item	
1. Purchase of land	\$ 151,000.00
2. Buildings and accessories, C.E. Corps	702,000.00
3. Submarine Mines	222,750.00
4. Fire Control Equipment	124,000.00
5. Engines installed	1,000,000.00
6. 14-inch guns	250,000.00
7. 6 12-inch guns	250,000.00
8. 4 6-inch guns	100,000.00
Total	\$ 4,200,000.00

If 14-inch guns be installed in lieu of 12-inch guns, it will be necessary to add \$124,000.00, an increase of 10.0%, approximately.

making the total cost of the defenses with the 14-inch armament \$4,324,000.00 (Exhibits A and B).

The estimate of the cost of the establishment of a fresh water supply for the Cape Henry defenses has been included in the amount above stated. The board understands that certain projects for bringing water to Cape Henry are in contemplation.

planned by a civil organization. If these projects are realized, the water supply question can be satisfactorily met by purchase; if not, then a special estimate covering the cost of a water supply<sup>system</sup> will have to be made.

6. No provision is made in the foregoing estimates, nor is it possible at this time to make any provision for the items referred to in a report from Lieut. Colonel Winslow (page 940, Exhibit A), in the following terms:

"3. A large part of the surface of all five of the parcels consists at present of sand. In places this sand is held to some extent by vegetation, but over the larger part of the area there are sand dunes that drift here and there as the winds may change. Experience at Virginia Beach, about 8 miles to the south, has shown that if the sand surface be properly graded, and if some clay soil be mixed in and arrangements be made for irrigation during the dry spells, a good growth of grass and other vegetation can be induced that will hold the sand from drifting as long as vegetation is maintained.

"4. In connection with layout of the post proper, roads must be constructed, the ground must be graded and the grade must be held, and vegetation encouraged. On the post proper, this undoubtedly pertains to the Quartermaster's Department, but in the immediate vicinity of the batteries it may be that the Engineer Department will be called upon to do some work of this character, for it is extremely essential that the drifting of sand be stopped so that it may not be blown into the gun carriages and other machinery.

"5. Another item of possible Engineer Department work, which may come up in the future, is the question of sea walls. As far as can be learned, the shore line at Cape Henry is unusually stable for a sea beach, but this stability is due to the present equilibrium of forces. At times the sand is forced up by the waves and when dry is blown in shore, and at other times the breezes from the land drive the sand towards the sea and deposit it along the fore shore. If the drifting of the sand on shore be stopped, this equilibrium will to some extent be destroyed, and this may be followed, as has happened at other places, by the clay eating away of the shore."

6. The Board approved the preliminary searchlight, power, and fire control project, prepared by Lieut. Colonel Winslow, and submitted by the Chief of Engineers.

7. The general layout of the Quartermaster Corps buildings is not approved by the Board, and it will be necessary, in the opinion of the Board, for a representative of the Quartermaster Corps, the Engineer Corps, and the Coast Artillery Corps to submit at a later date a project made on the ground. This, in the opinion of the Board, will not add

to the east of these features of the project.

8. In general, the storerooms, shops, and buildings of that character should, in the opinion of the Board, be near the railroad station at the northwest corner of the reservation; the officers, and uncommissioned officers' quarters at the eastern end, and the barracks approximately where they are indicated on the accompanying sketch.

9. The Board believes that, on account of the proximity of the buildings to the batteries, some method of interior lining for these buildings should be adopted which will minimize damage from the shock of explosions.

10. Miscellaneous information concerning the Cape Henry project is contained in appendix "C".

11. The Board then adjourned sine die.

Major General, General Staff Corps, U.S.A.,  
President.

Colonel, Coast Artillery Corps,  
Recorder.

Approval recommended:

Major General, Chief of Staff.

APPROVED:

Secretary of War.

FILE NO. 3/54 F. C. H.

WAR DEPARTMENT  
UNITED STATES ENGINEER OFFICE  
ROOM 2, CUSTOM HOUSE,

JPJ/JFK

NORFOLK, VA. February 3, 1915.

From: The District Engineer Officer, Norfolk, Va.

To: The Chief of Engineers, U. S. Army, Washington, D. C.

Subject: Turrets for emplacements at Cape Henry, Va.

1. In accordance with instructions contained in letter, Office of the Chief of Engineers, dated November 25, 1914 (E. D. 61757), I am submitting estimates for the Engineer work necessary for the mounting of 14-inch and 16-inch guns, in turrets, at Cape Henry, Va., as compared with the estimates for the same guns mounted on disappearing carriages. Six (6) tracings, giving preliminary studies showing the locations of the proposed turrets, two types of emplacements for each class of gun, and a sketch illustrating a possible modification of the turret and emplacement, in order to secure a lower crest elevation, are forwarded under a separate cover.
2. A copy of a letter from the Chief of Ordnance, dated October 26, 1914, accompanying your letter of November 25, 1914, refers to turrets for 6-inch guns. The memorandum of the Chief of Staff, dated October 23, 1914, accompanying the same letter, however, calls only for estimates for emplacing 14-inch and 16-inch guns. Hence, no plans or estimates for 6-inch guns are submitted at this time by this office.
3. In the location sheet, the proposed locations for the turrets are marked A & B, and B & C. The limiting lines of the arcs of fire for the two turrets are indicated by lines marked A & B 1915, and C & D 1915. For the disappearing guns, the corresponding limits are marked A 1914, B 1914, C 1914, and D 1914.
4. A wider field of fire, assumed from the Ordnance drawings at 220°, is, of course, obtained for the turrets, and the extreme right and left limits of this field are covered in the location, as shown, by a minimum of two guns instead of one, as is the case with the disappearing carriages.
5. The locations given are more or less diagrammatic, and cannot be definitely fixed until type plans are adopted and approved. It will probably be found advisable to rotate the battery containing guns A and B to the left until its field of fire coincides with that of guns C and D, thus rendering the fire of all four heavy guns available for the entire field of attack. Such rotation would, however, somewhat increase the exposure of the rear of emplacement A & B.

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6. The mortar battery "H", in the position shown, interferes with the close range fire of guns "C and D" over the area west of Cape Henry. To meet this objection, an alternative position for battery "H" alongside of guns "C and D" is shown in dotted lines. This alternative position would result in additional expense for mine cable. Another apparently satisfactory arrangement would be simply to interchange the positions of the guns "C and D" and battery "H".

7. The preliminary plans, four (4) in number, are as follows: Two 14-inch guns, "A and B", turret mounts, with single observing station and plotting room; two 16-inch guns, "A and B", turret mount, with single observing station and plotting room; two 14-inch guns, "C and D", turret mount, with double observing station and plotting room; two 16-inch guns, "C and D", turret mount, with double observing station and plotting room. As it may be found desirable to observe and control the fire of each gun separately, the plans and estimates provide for either one or two observing stations and plotting rooms.

8. The magazine floor level is assumed at plus (12.5) above mean low water, the average elevation of the locality being plus (10), and the elevation of the railroad track about plus (14). This assumption makes the height of the crest of the Battery Commanders Station plus (54). Lowering the floor level 3 or 4 feet will reduce the cost a few thousand dollars, but beyond this limit, while still reducing the quantity of fill, will rapidly increase the cost of excavation, and will eventually produce negative results from the standpoint of economy. The floor level assumed is, therefore, satisfactory, providing the resulting great height of the batteries is not an objectionable military feature.

9. A reduction in the elevation of the crest of the batteries may be still more desirable from a military standpoint than from one of economy. This consideration leads to the inquiry, how far it would be possible to reduce the height of the turrets. In the accompanying sketch, attempts have been made to indicate possible schemes for the reduction in the height of the turrets from 48' 5" to 30' 6" and 27' 6". Such a reduction, in its main features, changes the location of the electrical platform and makes the ammunition supply more direct, as only one hoist, instead of two, would be necessary. How far, however, such a scheme is practicable will greatly depend on details which are not at present available in this office.

10. The detailed estimates are shown in the table which follows, and are based on the same cost units as were the estimates of August 20, 1914. It is assumed that it will be necessary to found the turrets on piling, and a lump sum of \$10,000 for the 14-inch guns, and \$12,000 for the 16-inch guns, are included in each estimate.

(Two 14-inch Guns.)

Material and Labor.	Price.	One B.C. Station.		Two B.C. Stations.	
		Quantity:	Cost.	Quantity:	Cost.
Excavation,-----	.30 c.y.	7,000:	2,100:	8,000:	2,400
Fill,-----	.50 c.y.	39,000:	19,500:	44,000:	22,000
Sodding,-----	.40 c.y.	8,000:	3,200:	9,000:	3,600
Granolithic Paving,----	2.00 s.y.	1,400:	2,800:	1,600:	3,200
Concrete,-----	8.00 c.y.	16,500:	132,000:	18,600:	148,800
Foundation, Concrete and Steel,-----	12.00 c.y.	2,340:	28,080:	3,040:	36,480
Foundation, Piling,----			10,000:		10,000
Tile Lining,-----			5,000:		5,000
Doors and Windows,----			3,800:		4,000
Trolley System,-----			5,000:		5,020
Speaking Tubes,-----			1,000:		1,100
Indicators,-----			3,000:		3,000
Sewer and Plumbing					
Fixtures,-----			3,500:		3,500
Electric Wiring and					
Fixtures,-----			8,020:		8,900
Reserve Power Plant,----			26,000:		26,000
			\$253,000:		\$283,000

(Two 16-inch Guns.)

Material and Labor.	Price.	One B.C. Station.		Two B.C. Stations.	
		Quantity:	Cost.	Quantity:	Cost.
Excavation,-----	.30 c.y.	8,400:	2,520:	9,800:	2,940
Fill,-----	.50 c.y.	42,000:	21,000:	49,000:	24,500
Sodding,-----	.40 c.y.	9,200:	3,680:	11,000:	4,400
Granolithic Paving,----	2.00 s.y.	1,700:	3,400:	2,000:	4,000
Concrete,-----	8.00 c.y.	20,500:	164,000:	23,500:	188,000
Foundation, Concrete and Steel,-----	12.00 c.y.	2,800:	33,600:	3,500:	42,000
Foundation, Piling,----			12,000:		12,000
Tile Lining,-----			6,000:		6,000
Doors and Windows,----			3,800:		4,000
Trolley System,-----			5,500:		5,500
Speaking Tubes,-----			1,000:		1,160
Indicators,-----			3,000:		3,000
Sewer and Plumbing					
Fixtures,-----			3,500:		3,500
Electric Wiring and					
Fixtures,-----			9,000:		10,000

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Reserve Power Plant, ---:	:	:	30,000:	:	30,000
:	:	:	:	:	:
:	:	:	\$302,000:	:	\$341,000

Difference in favor of Turret Mounts:

Two 14-inch Guns:

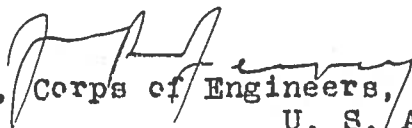
One B. C. Station, -----\$92,000  
Two B. C. Stations, ----- 62,000

Two 16-inch Guns:

One B. C. Station, -----\$114,000  
Two B. C. Stations, ----- 75,000

11. The cost of reserve power plants and the central power plant will be largely increased. This will be partially offset by a reduction in the number of fire-control stations needed.

12. It thus appears from the estimates, as prepared in this office, that a substantial saving, so far as Engineer features are concerned, will result in the use of turret mounts, as compared with emplacements for single guns mounted on disappearing carriages.

  
 Major, Corps of Engineers,  
 U. S. Army.

6 tracings (#75-80) under sep. cover.

61757/178

1st Ind.

EEW-FF

Office C. of E., February 17, 1915 - To the District Engineer Officer,  
NORFOLK, VA.

It is requested that additional sketches be prepared of sections sufficient to bring out somewhat more clearly the design contemplated, with especial reference to construction in the immediate vicinity of the gun turrets and to the matter of ammunition service, etc. Only the 14-inch plans need be considered at present in this connection.

By command of the Chief of Engineers:

  
 Lieut. Col., Corps of Engineers.

Inclos. 179-184 in sep. roll.

61,757/178



U. S. Engineer Office, Norfolk, Va., Mar. 6, 1915.- To the Chief of Engineers, U. S. Army.

1. An additional tracing, and the six tracings previously transmitted with my letter of February 3, 1915, are sent under a separate cover. This additional tracing shows, in more details, the design contemplated, with special reference as to ammunition service, from the railroad to the magazines, and from the magazines to the guns.

2. The method of entering the turret, with the guns pointing in any azimuth, is also indicated.

3. The ammunition service, as far as the storage is concerned, remains the same as in previous designs for these batteries. The projectiles and powder are brought to the battery by railroad, and are transferred from the railroad to the shell rooms and powder magazines by means of an overhead trolley line. In serving the guns, the projectiles are first brought from their storage place to the shell table, and are transferred from the shell table, by trucks, passing through the shell passage to the ammunition table in the lower handling room. The powder charges are carried from the powder magazines through the powder passages to the same room. The ammunition is then hoisted by the lower hoist to the upper handling room, and thence by the upper hoist to the breech of the gun. These arrangements are shown in the two "half horizontal sections", and in the "cross section M-N".

4. For communication with the turret, a gallery leading to the electrical platform has been shown in "horizontal section O-P". By having this gallery open into a corridor, as shown, it becomes possible to enter the turret with the guns pointing in any azimuth, as there will always be at least one of the doors of the turret within the limits of the corridor.

5. It has not been possible to indicate the sizes of the power rooms with precision, as full information is not yet available in regard to the number and capacity of motors which will be needed.

Major, Corps of Engineers,  
U. S. Army.

7 tracings (#75-80 & 84) under sep. cover.

RECD. OFFICE CHIEF OF ENGRS

MAR 8 1915

61,757/178

FILE NO. 16 F.C.H.

WAR DEPARTMENT.  
UNITED STATES ENGINEER OFFICE,  
ROOM 15, CUSTOM HOUSE,  
NORFOLK, VA.

JPJ/RB

June 29, 1917.

From: The District Engineer Officer, Norfolk, Va.

To: The Chief of Engineers, U.S. Army, Washington, D.C.

Subject: Studies for 16" Battery all round fire.

1. I am forwarding under separate cover seven studies for a 16" battery for all round fire.

2. It has been the object in preparing these studies to place the interior crest in front of the gun at the same elevation as the top of the traverse, so as to give complete horizontal all round fire without any dead sectors, except where caused by adjacent batteries.

3. The studies show different general methods, without details, for delivery of ammunition from shell rooms and magazines to gun platform, and involve a complete abandonment of the horizontal system of ammunition service. It is thought, however, that no arrangement can be designed that will be in all respects as satisfactory for handling the ammunition as is furnished by the horizontal system.

4. At Fort Story particularly where the batteries are so located that to a large extent they mutually cover the ground in rear of each, the raising of the gun platforms to give all round fire gun, it is thought, should be avoided and the horizontal system of ammunition service adhered to. Moreover, the irregular line formed by making the traverse higher than the crest in front of gun will make the battery less conspicuous from the sea. It should also be noted that direct fire to the rear at short ranges at Fort Story will be impossible on account of the great sand dune, which lies in rear of each of the batteries. In addition, the need of all round fire involves the assumption that the objects which the batteries are supposed to protect have been lost.

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5. It is believed that some protection from rear attack should be provided for both gun and personnel. This protection can be furnished by carrying the slope around in rear of the loading platform or by placing magazines and shell rooms in rear of the gun.

6. The plan marked Type "A" contemplates the use of hydraulic elevators for raising the standard shot and powder trucks from the magazines level to the platform level. These elevators are used extensively in commercial practice, are very reliable, simple in operation, have sufficient speed for the short lift involved, and, it is believed, would be the most satisfactory of any of the strictly elevating devices which can be used.

7. The design permits the use of four elevators, operated by independent, motor driven pumps, two on each side of the gun, which will give an ample reserve in case of damage or breakdown, and allows the gun to be fired in any direction without interference with the ammunition service.

8. The arrangement of rooms and magazines permitted by this design is very convenient. Ample space for the storage of powder in shipping cases is provided, with a large blending room conveniently located with respect to the powder magazines. The distance between the plotting room and Battery Commanders station is reduced as much as possible. The quarters and other rooms can be shut off from the magazines by means of two doors.

9. The gun and loading platform are protected from fire from any direction. While no cover for the rear of the battery is shown on this plan, it can be provided by building a tunnel for the railroad track, as shown on plan Type "B", by building a detached parapet in rear of the track, or omitted until the outbreak of hostilities, when a temporary parapet, with a sand bag revetment could be constructed. The magazines are protected by the parapet in front of the gun in addition to the cover in rear of the loading platform. If more cover than is shown is considered necessary, it can be secured by moving the magazines further to the rear, which will involve merely the lengthening of the corridors between the magazines and the elevators. As these corridors are below the platform level, they do not require very heavy construction, and little additional concrete will be required.

10. The plan shown on the drawing marked Type "B" is similar in the general layout of the rooms and other features to Type "A", and has many of that plan's advantages. The arrangement of rooms is necessarily different in order to secure

the easiest grade possible for the ramp between the magazine level and the platform level. In this plan, it is contemplated that the projectiles and powder charges would be placed on the Ordnance trucks at the magazines and the trucks pushed by hand to the foot of the ramp, where they would be engaged by lugs on an endless motor driven chain, running under the floor of the ramp, and carried to the upper end of the ramp, where they would be disengaged and pushed by hand to the gun. If feasible, these chains would be kept running continuously, but it is possible that on account of the strain which would come on the chain in picking up the heavy projectiles truck while running, it would be necessary to stop it whenever a truck was to be attached. It is recognized that this would be objectionable. Possibly a lug with some form of shock absorber might be used. Each incline is provided with a double track, consisting of guide rails for the wheels of the truck. One incline can be used to take up loaded trucks and the other to return the empty trucks. These inclines have been made with a very slight grade to make the handling of trucks as easy as possible. Two B.C. Stations have also been provided for this Type.

11. The plan shown on drawing marked Type "C" contemplates the use of the same method of elevating the ammunition as in Type "B". It has a slightly easier ramp than that plan, and the same advantages as to all round fire and protection from hostile fire. There is less space, however, for ammunition storage and the arrangement of the rooms is not as convenient, while the amount of concrete and the cost will be about the same. A corridor is provided for the personnel with steps leading to the loading platform. One B.C. Station is provided on the left flank. If desired, the service rooms may be placed on the right flank of the battery, thus giving more protection to magazines and shell rooms.

12. Type "D" shows a battery arranged with an endless track carried around magazines and shell rooms to loading platform. This Type would require a specially designed car operated by third rail, trolley, or if sparking from third rail or trolley is objectionable, by storage battery and arranged, if desired, to stop automatically at any designated point. The design of a car of this character to be used in place of the standard ordnance truck, so that the gun could be loaded directly from the car seems a simple problem. Such a car could probably be designed to carry both projectile and powder charge. The truck while on the platform would, with a properly arranged track, be always at the proper distance for loading from the breech of the gun. The arrangement of rooms in this plan is about the same as shown on plan received from the Chief of Engineers. A ramp is also provided in rear of the loading platform for use with standard ordnance trucks, in case of breakdown in the power system. This battery as shown has no protection from rear attack, though this can be readily provided by troop labor, after the outbreak of war.

13. The plan shown on the drawing marked Type "E" is similar in its general layout to the above, and allows a combination of the hydraulic elevators described in connection with Type "A" and the endless chain and ramp described in connection with Type "B". The grade of this ramp is such that in an emergency it would be possible to push the trucks up by hand. The arrangement of rooms allowed by this design is very convenient and the principal objection which may be found in it lies in the lack of all round protection afforded the gun and personnel.

14. The plan shown of the drawing marked Type "F" is similar to the above except that the ammunition service is by means of a single ramp with motor driven endless chain or cable as described in connection with Type "B", leading to the rear of the loading platform. It is not believed that this plan would be as satisfactory as either "B" or "C", which have the same system of ammunition service.

15. The plan shown on the drawing marked Type "G" involves the use of motor driven trolley hoists running on overhead I beam trolleys. These trolleys would pick up the shot and powder charges at the magazines, hoist them a certain distance and convey them to the openings in the parapet wall at the platform level, where they would deliver them to the ordnance trucks. This is merely a suggestion as it is not known whether it would be possible to run such trolleys on the grades which would be necessary or whether it would be possible to prevent dangerous sparking at the trolley contacts.

16. In addition to the methods of ammunition service outlined in the preceding paragraphs, in all but the first plan this service could be carried on by means of motor driven, storage battery trucks. Either the standard Ordnance trucks could be fitted with batteries and motor driven, or separate trucks provided for hauling the Ordnance trucks as trailers. The storage batteries should be arranged in readily removable units, so that the spare batteries rather than the spare trucks would be needed. Such trucks are extensively and satisfactorily used commercially, are reliable and can be operated with unskilled labor. By providing an ample number, with a number of spare batteries, the likelihood of any interruption of the ammunition service would be small. The first cost of such equipment would probably be less than that of any of the elevating devices. It is believed that the use of this equipment with the design of battery shown on the drawing marked Type "B", in place of the endless chain, would be very satisfactory.

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7 incls. (BP. # 16-22) accomp.

Lt. COL., Corps of Engineers,  
U.S. Army.

FILE NO. 16/30 F. C. H.

WAR DEPARTMENT.  
UNITED STATES ENGINEER OFFICE,  
ROOM 15, CUSTOM HOUSE,  
NORFOLK, VA.

December 20, 1917.

From: The District Engineer, U. S. Engineer Office, Norfolk, Va.

To: The Chief of Engineers, U. S. Army, Washington, D. C.

Subject: Design of 16" batteries, Fort Story, Cape Henry, Va.

OFF. CH. OF ENGRS., WAR DEPT

REC'D JAN 9 1918

61757

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1. In compliance with instructions contained in letter, Office of the Chief of Engineers, dated June 29, 1917 (E. D. 61757), I am forwarding, under a separate cover, five (5) tracings, showing designs for 16-inch gun batteries, types A, B, and C, two tracings showing alternative designs for the left flank of type A, three tracings showing designs for ammunition tables, and one tracing showing approximate location of batteries at Fort Story, Cape Henry, Virginia.

2. The designs for the batteries have been prepared, following, in general, the arrangements shown on the plans received with letter from the office of the Chief of Engineers, dated June 29, 1917 (E. D. 61757).

3. Type "A" (two sheets), prepared in this office by Lieut.-Colonel J. P. Jervey, Corps of Engineers, shows a design with the floor of all the rooms and corridors on the same level; two pairs of hydraulic elevators, one pair on each side of gun, have been provided for handling the ammunition from the lower rooms to the loading platform. One of each pair of elevators can be used for the loaded trucks, and the other to return the empty trucks. Ramps have also been provided in rear of loading platform, with about 6% grade, and trucks can be returned by these ramps, if necessary.

4. This battery shows a design of shell room and magazine with a series of tables for storing the shells and powder cases, - 96 cases of powder and 126 shells, or about 100 rounds. The shells can be brought in by trolley from the outside, and, by means of two trestles and two skids set in corridor, of the same height as tables, they can be delivered on the skids and rolled in on the table. After one table is full, the skids can be moved to the next, and so continue until all the tables are filled. It also allows for the solid shot and shells to be kept separate, by using one table for each skid. The bars forming the outside end of tables projecting into the corridor are to have 3/16-inch steel plates riveted on under side, and to be arranged so that when tables are not in use they will automatically close upward and form a door for each opening. Locking bars are provided on outside for securing doors in place. Escapements are provided on the ends of bars for shell tables, and, when the table is in use, a shell cannot be rolled off until truck is ready to receive it

5. Two designs are submitted for the powder service, type "A-A" and type "B-B". The former has a movable table operated on a railroad track in floor of corridor. It receives the single section cartridge-storage-case. When the door is let down the case is rolled out on this table, the truck is pushed up to the end of table and the powder charge is drawn out on the truck. This movable table is made wide enough to allow room for two cases, and a truck can be brought to each end of the movable table, if necessary. After the powder charge is drawn out, the empty container is rolled back on the door where it can be picked up by the trolley and carried to the blending room and stored, to avoid blocking the corridor. Or, one of the tables in magazine can be left unfilled and the empty containers placed on this table, so that as fast as one table becomes empty it can be used to hold the empty containers from the next full table.
6. Type "B-B" shows a design of table with the outer bars forming door projecting out into the corridor, so the truck can be pushed against the door, with the powder charge in position shown; the empty containers to be removed in same manner as shown for type "A-A".
7. A passage 2' 6" wide between tables and wall, and 2' 0" between adjacent tables, has been provided, so men can be stationed on each side of tables to guide the projectiles and powder charges and roll them to the trucks. Guide-rails made of suitable angles are to be placed on the floor of corridors in front of tables, so the trucks can be placed in proper position for receiving the ammunition.
8. It is thought that the above arrangement will reduce the handling to the minimum, as once the ammunition is placed on the tables it is ready to be rolled on the trucks.
9. The methods of handling the powder and shells above outlined are to be regarded as provisional, and subject to further modification after further study.
10. Trolley track is shown running through the main corridor from each outside portal, with switches and sidings, so trolleys can pass each other. It is also carried through magazine, blending rooms, and rooms holding powder in shipping cases. Small rooms for motors operating the elevators, and room for electric pump to remove water from the gun-well, have been provided under the loading platform.
11. Air spaces are carried around all rooms, excepting the rooms under the loading platform proper.
12. The plotting room has been made 22' 0" x 24' 0", inside, as suggested by the Chief of Coast Artillery.
13. The B. C. stations on top of battery have walls on all sides, and stairs, with door, at top, leads down into lower corridor. A short Battery Commander's walk is provided, and steps to crest of the station.

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14. The elevator shafts in this type are made high enough to allow men to go up with the loaded trucks, and render turning in lower corridor unnecessary.
- ✓ 15. The two alternative designs submitted for the type "A" battery show the wing walls at entrance reversed, to prevent any possible danger of hostile fire from the rear entering the main corridor.
16. In sheet 1, the latrines are omitted. Such latrines placed in the interior of batteries will be a nuisance. They can be built in separate buildings outside. If retained, their arrangement as shown on sheet 2 is suggested.
17. Hydraulic elevators are suggested, in place of the inclined hoists. By moving them in 5' 0" from the face of the breast wall, and inclosing them on three sides by a concrete wall, by having the elevators made with a heavy solid steel top that will fit the sides of shaft fairly close, and with heavy steel doors at top openings of elevator shafts, there will be little, if any, danger from blast, or sucking up of air from the corridor, when the gun is fired with the muzzle over and near the elevator openings. This same arrangement for the elevators can be made to suit type "B" and type "C".
18. Type "B" shows a design similar to type "A", except that the magazines and shell rooms are placed opposite each other, and the front corridor has been widened to 12' 0" to allow easy passing of trucks.
19. One elevator is provided on each side of gun, and it is intended in this type to send up the loaded trucks and have the men on the loading platform take them off and return them, as sufficient room is provided in lower corridor for turning the trucks. Ramps are also shown in rear of loading platform for returning the empty trucks, and this will prevent any danger of confusion in the lower corridor, as the trucks on each flank will all be moving one way.
20. In this type a mound is shown between the ramps, and carried up to reference 26' 0". The slopes of this mound prevent the returning trucks from being pushed off the ramps and rolling down the slope, as might occur in type "A".
21. The B. C. stations are shown with the Battery Commander's walk connected by a ramp 4' 0" wide, leading to the loading platform.
22. The horizontal sand cover on front and right flank of type "A" and type "B" have been made 10' wider than shown on plans received from the office of the Chief of Engineers, with letter dated June 29, 1917, referred to above, owing to the magazines having been placed on this front.
23. Type "C" shows a design similar to the design received from the office of the Chief of Engineers, except that hydraulic elevators have been provided instead of inclined hoists, and stairs leading from lower corridor to loading platform, arranged as shown on type "A" and type "B".

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24. The plotting room has been enlarged, blending rooms omitted, and pump room provided under the loading platform proper.

25. The counter-weight well has been made to suit the cast-iron counter-weight; this has also been done in types "A" and "B".

26. A tracing has been prepared, showing the new arrangement of batteries, railroad track, etc. The arrangement shows the eight (8) 16-inch mortars placed in the southern end of the reservation. In this new location, there is a natural sand dune about reference 40' above mean low water. This can be excavated, and the battery set down to the proper reference, and the existing sand dune will furnish the necessary sand for parapet, etc.

27. The 6-inch batteries are shown about 900 feet from the 16-inch batteries, and the 16-inch batteries are placed about 1,000 feet between gun centers.

28. The railroad track is shown in rear of each battery, with sidings, so cars can be unloaded in rear of each 16-inch emplacement without obstructing the main line track.

29. In preparing the above-mentioned plans, no attempt has been made to go into much detail, and only the general outlines of the batteries are shown, and such details as are necessary to explain the designs.

30. Arrangement of speaking tubes, electric lights, drainage, etc., will be prepared, if general design is satisfactory.

31. Estimates for the three types of 16-inch batteries are as follows:

Estimate for 16-inch Battery, - Type "A":

Clearing site,-----	\$	400.00
110 wood sheet-piles, 30 feet long, @ 80¢ per ft.,---		2,640.00
Excavating about 1,200 cubic yards of sand for gun block, @ 70¢,-----		840.00
Excavating 11,600 cubic yards of sand for foundation, @ 30¢,-----		3,480.00
386,000 feet, B. M., of Y. P. lumber for forms, bracing, etc., @ \$40 per M.,-----		15,440.00
Carpenters' Labor, erecting forms, etc.,-----		7,300.00
About 31,500 cubic yards of concrete, @ \$10,-----		315,000.00
Reinforcement,-----		15,300.00
Labor handling and placing reinforcement,-----		2,500.00
Taking down sheathing and washing walls,-----		1,000.00
Waterproofing,-----		2,500.00
Iron work, hold-down bolts, etc.,-----		15,600.00
11,000 square feet of roofing for interior rooms,-----		3,300.00
Carried forward,-----	\$385,300.00	

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Brought forward,-----	\$385,300.00
Plumbing, fixtures, sewer pipe, etc.,-----	1,500.00
Elevators,-----	20,000.00
Mechanical indicator,-----	2,500.00
Electric pump for counter-weight well,-----	3,000.00
Two (2) 25-K.W. generating sets, complete,-----	10,000.00
Two (2) gasoline tanks,-----	500.00
Switchboards, complete,-----	600.00
Installing generating sets,-----	500.00
Electric lights, wires, etc.,-----	3,500.00
Trolley track,-----	4,500.00
Differential blocks,-----	600.00
Sand slopes, clay, soil, sod, etc.,-----	39,200.00
Painting,-----	1,000.00
Hardware,-----	1,200.00
	<u>\$473,900.00</u>
Contingencies,-----	20,100.00
Total,-----	\$494,000.00

Estimate for 16-inch Battery, - Type "B":

Clearing site,-----	\$ 400.00
110 wood sheet-piles, 30 feet long, @ 80 per ft.,-----	2,640.00
Excavating about 1,200 cubic yards of sand for gun block, @ 70¢,-----	840.00
Excavating about 11,000 cubic yards of sand for foundation, @ 30¢,-----	3,300.00
380,000 feet, B. M., of Y. P. lumber, for forms, bracing, etc., @ \$40 per M.,-----	15,200.00
Carpenters' labor, erecting forms, etc.,-----	7,000.00
About 31,200 cubic yards of concrete, @ \$10,-----	312,000.00
Reinforcement, and placing reinforcement,-----	15,200.00
Taking down sheathing and washing walls,-----	2,500.00
Waterproofing,-----	2,500.00
Iron work, hold-down bolts, etc.,-----	15,600.00
About 11,000 square feet of roofing for interior rooms,-----	3,300.00
Plumbing, fixtures, sewer pipe, etc.,-----	1,500.00
Elevators,-----	10,000.00
Mechanical indicator,-----	2,500.00
Electric pump for counter-weight well,-----	3,000.00
Two (2) 25-K.W. generating sets, complete,-----	10,000.00
Two (2) gasoline tanks,-----	500.00
Switchboards, complete,-----	600.00
Installing generating sets,-----	500.00
Electric lights, wires, etc.,-----	3,500.00
Trolley track,-----	4,500.00
Differential blocks,-----	600.00
Sand slopes, clay, soil, sod, etc.,-----	38,551.00
Painting,-----	1,000.00
Hardware, nails, locks, etc.,-----	1,200.00
	<u>\$459,431.00</u>
Contingencies,-----	20,069.00
Total,-----	\$479,500.00

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Estimate for 16-inch Battery, - Type "C":

Clearing site,-----	\$ 400.00
110 wood sheet-piles, 30 feet long, @ 80¢ per ft.,---	2,640.00
Excavating about 1,200 cubic yards of sand for gun block, @ 70¢,-----	840.00
Excavating about 8,400 cubic yards of sand for foundation, @ 30¢,-----	2,520.00
295,000 feet, B. M., of Y. P. lumber for forms, bracing, etc., @ \$40 per M.,-----	11,800.00
Carpenters' labor, erecting forms, etc.,-----	5,500.00
About 23,500 cubic yards of concrete, @ \$10,-----	235,000.00
Reinforcement,-----	11,280.00
Labor handling and placing reinforcement,-----	2,200.00
Taking down sheathing and washing walls,-----	900.00
Waterproofing,-----	2,100.00
Iron work, hold-down bolts, etc.,-----	6,000.00
Plumbing, fixtures, sewer pipe, etc.,-----	1,500.00
About 5,000 square feet of roofing for interior rooms,-----	1,500.00
Elevators,-----	10,000.00
Mechanical indicator,-----	2,500.00
Electric pump for counter-weight well,-----	3,000.00
Two (2) 25-K. W. generating sets, complete,-----	10,000.00
Two (2) gasoline tanks,-----	500.00
Switchboards, complete,-----	600.00
Installing generating sets,-----	500.00
Electric lights, wires, etc.,-----	3,000.00
Trolley track,-----	4,000.00
Differential blocks,-----	600.00
Sand slopes, clay, soil, sod, etc.,-----	32,000.00
Painting,-----	1,000.00
Hardware, nails, locks, etc.,-----	1,000.00
	<u>\$352,880.00</u>
Contingencies,-----	16,120.00
	<u>\$369,000.00</u>

32. In submitting these three designs for Departmental action, I desire to state that my preference is for type "A", though the ~~extra~~ cost of that type is considerably more than that of the others. In works of such great importance, a few thousand dollars, however, is a small consideration, if the type itself is superior. Moreover, while type "B" has my signature as the submitting officer, it is not my design in any sense of the word, but was, in all essential respects, the work of my predecessors.

33. In making the foregoing report, I have assumed that the disappearing mount for 16-inch guns is settled, at least for the four mounts to go to Cape Henry. I have, therefore, refrained from offering any suggestions of my own as to any other type, and will

lend my best efforts towards perfecting the mount that has been adopted.

*Victor A. Haines*

Major General, U. S. Army, Retired,  
District Engineer.

22 inclosures under sep. cover.:  
(11 tracings, #31-41, and 1 B.P. of each).  
By regd. mail.

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