WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER
LOCAL PROTECTION

CONNECTICUT RIVER BASIN

HARTFORD, CONNECTICUT

DESIGN MEMORANDUM NO. 6

PUMPING STATIONS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

NOVEMBER 1974

31

DAEN-CWE-B (NEDED-E, 29 Nov 74) 1st Ind
SUBJECT: Park River Local Protection, Connecticut River Basin, Hartford, Connecticut, Design Memorandum No. 6 - Pumping Stations

DA, Office of the Chief of Engineers, Washington, D.C. 20314 10 January 1975

TO: Division Engineer, New England, NEDED-E

Approved.

FOR THE CHIEF OF ENGINEERS:

1 Incl
wd

C. E. Slayton
For HOMER B. WILLIS
Chief, Engineering Division
Director of Civil Works

RCVD 4MAR 75

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WILLES
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TAP

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED-E 29 November 1974

SUBJECT: Park River Local Protection, Connecticut River Basin, Hartford, Connecticut, Design Memorandum No. 6 - Pumping Stations

HQDA (DAEN-CWE-B)
WASH DC 20314

In accordance with ER 1110-2-1150, there is submitted herewith for review and approval Design Memorandum No. 6, Pumping Stations, for the Park River Local Protection, Connecticut River Basin, Hartford, Connecticut.

FOR THE DIVISION ENGINEER:

George T. Sarandis
for JOHN Wm. LESLIE
Chief, Engineering Division

Incl (10 cys)
as

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
CONNECTICUT RIVER BASIN
HARTFORD, CONNECTICUT

DESIGN MEMORANDA INDEX

Number	Title	Anticipated Submission Date	Date Submitted	Date Approved
1	Hydrology		16 Feb 73	12 Apr 73
2	GDM - Phase I - Plan Formulation		30 Mar 73	16 Jul 73
2	GDM - Phase II - Project Design, Site Geology & Interior Drainage			
	Part I - Box Conduit		30 Aug 74	18 Oct 74
	Part II - Auxiliary Conduit	Dec 74		
3	Hydraulic Analysis	Dec 74		
4	Concrete Materials	Jan 75		
5	Embankment & Foundations			
	Part I - Box Conduit	Jan 75		
	Part II - Auxiliary Conduit	Aug 75		
6	Pumping Stations		29 Nov 74	
7	Detailed Design of Structures			
	Part I - Box Conduit		25 Oct 74	
	Part II - Auxiliary Conduit	Dec 75		
8	Site Geology			
	Part II - Auxiliary Conduit	Apr 76		

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NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NOVEMBER 1974

WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
CONNECTICUT RIVER BASIN
HARTFORD, CONNECTICUT

DESIGN MEMORANDUM NO. 6
PUMPING STATIONS

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WATER RESOURCES DEVELOPMENT PROJECT

PARK RIVER LOCAL PROTECTION
CONNECTICUT RIVER BASIN
HARTFORD, CONNECTICUT

A. PERTINENT DATA

1. FUNCTION.	Flood Protection
2. PROJECT LOCATION.	
State	Connecticut
County	Hartford
City	Hartford
River	Park River and North and South Branch Park River
River Basin	Connecticut
3. POPE PARK PUMPING STATION. (Formerly Riverside Pumping Station)	
Location	Adjacent to east side of proposed conduit section 4 at Station 39+0
Area Controlled, acres	40
Runoff Controlled, inches per hour	1.8
Number of Pumps	3
Capacity (each)	25 cfs
Mechanically cleaned bar screens (each)	2
Engines	Diesel
Sluice Gates (each)	5
Discharge Conduit	3-20" Pipes
Gravity Conduit	3'-6" x 4'-0"
Substructure, Approx. Size	33'x63' Approx.
Superstructure, Approx. Size	23'x43' Approx.
4. ARMORY PUMPING STATION.	
Location	Between Capitol building and I-84 adjacent to existing conduit section 1
Area Controlled, acres	33 (+ 30 cfs Drain)

Runoff Controlled, inches per hour	2.4
Number of Pumps	3
Capacity (each)	40 cfs
Mechanically cleaned bar screens (each)	2
Engines	Diesel
Sluice Gates (each)	6
Flap Gates (each)	1
Discharge Conduit	7'x7'
Gravity Conduit	8'x7'
Substructure, Approx. Size	70'x80' Approx. (existing)
Superstructure, Approx. Size	29'x58' Approx.

B. INTRODUCTION

5. PURPOSE. The purpose of this memorandum is to present for review and approval the basic features of and criteria to be used in the design of the two pumping stations to be included in the Park River Local Protection Project.

6. SCOPE. This memorandum presents basic design assumptions, criteria followed and typical mechanical and structural design computations for the pumping stations. Also included are preliminary plans and other pertinent project data.

7. DESCRIPTION OF PROJECT. The construction recommended for the Park River Local Protection Project includes 4,030 feet of large twin rectangular box conduit, 8,900 feet of 22'-0" diameter reinforced concrete auxiliary conduit, 575 feet of floodwalls, inlet and junction structures, one complete pumping station (Pope Park Station) and one pumping station superstructure (Armory Station). A general plan for the project is shown on Plate 6-1.

8. PREVIOUS REPORTS. A detailed report on the design of the pumping stations has not been previously submitted. Designs of the twin box conduits, floodwalls, inlet and junction structures are presented in Design Memorandum No. 7, "Detailed Design of Structures Part I - Box Conduit" submitted 25 October 1974. Design of the Auxiliary Conduit will be presented in Design Memorandum No. 7, "Detailed Design of Structures Part II - Auxiliary Conduit" scheduled for submission during August 1975. Copies of the contract drawings for the existing Armory Station substructure prepared by the Greater Hartford Flood Commission are included in Appendix C. The substructure was constructed during 1963 by the Connecticut State Highway Department in conjunction with the building of Interstate Route 84.

C. HYDROLOGY AND INTERIOR DRAINAGE

9. GENERAL. Approved Design Memorandum No. 1 contains the hydrology for the project. This data is summarized and supplemented in Design Memorandum No. 2 Phase II - "Project Design, Site Geology and Interior Drainage Part I - Box Conduit," approved 18 October 1974.

10. INTERIOR DRAINAGE. Design Memorandum No. 1 contains the design criteria for storm drains. Hydrologic analysis for the partially completed Armory Pumping Station has reduced the required design capacity of that station from 180 cfs to 120 cfs. Indorsement No. 4 to Design Memorandum No. 1 modifies the hydrological design for the Pope Park Pumping Station. The modification reduces the acreage controlled by that station from 170 acres originally proposed to 40 acres of high damage area. The stations have been designed for a pumping capacity equaling the runoff from a 10-year storm. The gravity outlets have been designed to pass runoff from a 100-year storm. The capacities of the interior drains are adequate to handle flows which will occur.

D. HYDRAULIC ANALYSIS

11. HYDRAULIC ANALYSIS. Detailed hydraulic analysis will be presented in Design Memorandum No. 3 "Hydraulic Analysis" scheduled for submission during November 1974.

E. GEOLOGY

12. GEOLOGY. General site geology is presented in Design Memorandum No. 2 Phase II - "Project Design, Site Geology and Interior Drainage Part I - Box Conduit," approved 18 October 1974. Additional subsurface explorations will be made in the vicinity of the Pope Park Station.

F. FOUNDATIONS

13. FOUNDATION CONDITIONS. The existing substructure of the Armory Pumping Station is founded on rock. The proposed Pope Park Station will be founded on till. The characteristics of the till, foundation treatment, foundation stability and seepage control will be described in detail in Design Memorandum No. 5 "Embankment and Foundations Part I - Box Conduit," scheduled for submission during January 1975.

G. CONCRETE

14. CONCRETE MATERIALS. Concrete for the pumping stations will be supplied by local commercial sources which have been previously found acceptable for use in Civil Works Projects. Concrete will be covered in detail in Design Memorandum No. 4 "Concrete Materials," scheduled for submission during January 1975.

H. ARCHITECTURAL DESIGN

15. ARMORY PUMPING STATION.

a. General. The Armory Pumping Station is to be erected at a predetermined site on foundations and underground facilities installed in 1966 by the Greater Hartford Flood Commission. The location of the pumping station is within a complex of elevated highways which precludes ready observation of the structure except for one facade. The latter facade will be partially screened by a ramp and existing shrubbery, but is within unobstructed line of sight of the State Capitol. The Capitol is located at the crest of the hill overlooking the City of Hartford. Broad lawns and park adjoin the State Capitol.

b. Original Design. The original design for the pumping station provided an "L" shaped plan with steel frame, 4" face brick and 8" glazed block exterior walls with 1" insulation between wythes. The floor area is slightly oversized for the pumps and ancillary equipment now determined necessary. The predominant east facade facing the State Capitol had approximately 15 percent of the wall area glazed in industrial sash. In addition, the engine silencers and contiguous exhaust piping were vertically mounted external to the structure on the same wall. Existing stairs to the subterranean trash rack room were external to the structure with a concrete canopy over the stair well. The floor area over the rack room was designated as a "Utility Room" and contained toilet facilities in addition to necessary equipment openings in the floor slab. The "Utility Room" access was by an exterior door located adjacent to the principal pedestrian entrance to the "Engine Room" and above the before-referenced stairs. This arrangement required circulation between the operating room and the rack room or toilet to be by exterior travel with minimum protection from the weather.

c. Proposed Treatment. It is intended that the original column layout and building plan be utilized to the maximum extent to take advantage of existing construction. Exterior walls, except a portion of the east facade, will be designed with 4" face brick and 8" concrete masonry unit backup and reinforced to comply with current structural requirements. On the east facade, facing the State Capitol grounds, an area of precast concrete double-tee panels will extend above the roof line to screen the roof mounted equipment and piping from view. The panels will have an 8" concrete masonry unit backup to develop a thermal resistance approximating the remaining walls.

The engine exhaust silencers have been located within the building and the glazed fenestrations have been reduced substantially. By relocating the toilet and inclosing the stair well within a small appendage to the main operating (Engine) room, the essential pedestrian circulation will be internal and the security will be improved. The superstructure housing the "Utility Room" will be eliminated and the floor slab (not constructed) will become a platform with weathertight covers at areas where equipment and maintenance access is required. Plate No. 6-3 shows a plan and elevations incorporating the architectural details described above. Plate 6-2 is a grading and general site plan at the station.

16. POPE PARK PUMPING STATION.

a. General. Pope Park Pumping Station is to be located adjacent to the convergence of three city streets and the conduit alignment. The structure will be sited in a point of city park land which requires grade alteration (fill) in conjunction with the conduit construction. Well maintained apartment houses, residences and a school adjoin the park and streets on the east side of the site, and the tract on the opposite side of the conduit is a redevelopment agency area. Current planning for development of that area envisions multi-story apartment structures and landscaped grounds as a visual extension of Pope Park.

b. Proposed Treatment. Exterior walls of the pumping station will be constructed of 4" face brick with an 8" concrete masonry black backup. The concrete structural frame will be partially exposed, providing a pleasing contrast of wall treatment, facilitating facade designs harmonious with nearby structures, and improving the aesthetic relationship of the building to Pope Park. Exposed concrete will have a brush sandblast finish. Exposed flashings, louvers, and mechanical ventilators will be heavy gauge aluminum with satin finish. Plate No. 6-11 shows proposed architectural treatment for the station and Plate No. 6-10 is a grading and general site plan of the area.

c. Security Fences. Chain-link fencing with vehicle gates will be provided at the pumping station. The fabric will be green plastic coated to minimize its visible impact on the environs.

I. STRUCTURAL DESIGN

17. GENERAL. This section presents the design criteria, basic data, assumptions and procedures used in the structural design of the pumping stations. Stability analysis, typical computations, maximum loading conditions and designs for critical sections are included in Appendix A. A structural review was made of the design of the existing Armory Station substructure. This consisted of checking principal members for current loading criteria. The framing of the superstructure will be substantially as detailed on the original construction drawings with minor deviations in details necessitated by the architectural treatment and wall construction currently proposed.

18. DESIGN CRITERIA.

a. General. All working stresses conform to those specified in Engineering Manual EM 1110-1-2101, "Working Stresses for Structural Design," dated 1 November 1963. General loading conditions, design assumptions and other design and detail criteria are based on the following applicable parts of the Engineering Manual for Civil Works: Standard Practice for Concrete (EM 1110-2-2000, dated 1 November 1971), Details of Reinforcement-Hydraulic Structures (EM 1110-2-2103, dated 21 May 1971), and Structural Design of Pumping Stations (EM 1110-2-3104, dated 9 June 1958).

b. Concrete. Concrete working stresses are in general accordance with ACI Standard Building Code Requirements for Reinforced Concrete (ACI 318-63), as modified by EM 1110-2-2101, using concrete with a minimum ultimate compressive strength of 3,000 lbs. per square inch.

Flexure	(Extreme fiber in compression)	- P.S.I.
	Roof and floor framing systems of Pumping Stations	- 1350
	All other concrete	- 1050

c. Reinforcement.

(1) General. Details and placement of steel reinforcement will be in accordance with EM 1110-2-2103, dated 21 May 1971, Details of Reinforcement-Hydraulic Structures.

(2) Grade and Working Stress. All reinforcement is designed for a working stress of 20,000 psi in flexural tension. The reinforcement will be deformed bars made of new billet steel, intermediate grade (ASTM A-615, Grade 40), conforming to the requirements of Federal Specification QQ-S-632C, Type II, Class B40.

(3) The clear distance between parallel bars will not be less than 1-1/2 times the nominal diameter of the bars nor less than 1-1/2 times the maximum size of the coarse aggregate. Parallel reinforcement in two or more layers will have the bars placed directly over each other with not less than 6" clear distance between layers.

(4) Minimum Cover for Reinforcement.

Item	Min. Cover (Inches)
Interior slabs	1-1/2"
Interior griders and beams	1-1/2"
Concrete exposed to water	4"
Bottom of base slabs	6"
Exterior slabs and beams	2"

(5) Splices. All lap splices are in accordance with the ACI Building Code. Tension splices will be staggered longitudinally so that no more than half the bars are spliced at any section within the required lap length.

(6) Temperature and Shrinkage Reinforcement. Temperature and shrinkage reinforcement is provided where main reinforcement extends in only one direction. Such reinforcement will be sized for the condition of edge restraint of each member as defined by EM 1110-2-2103. The minimum reinforcement for unrestrained members provides a ratio of steel to concrete area of .001 at each face with a minimum of No. 4 bars at 12-inch centers in thin sections and a maximum of No. 6 bars at 12-inch centers in thick sections. In roof slabs and other slabs exposed to weather, a minimum ratio of steel area to concrete area of .0025 is provided with a maximum bar spacing of three times the slab thickness, not to exceed 18".

(7) Minimum Reinforcement. Principal tensile reinforcement will not be less than that required for shrinkage and temperature reinforcement.

d. Structural Steel. Structural steel is designed in accordance with the American Institute of Steel Construction, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings (Seventh Edition)" and EM 1110-1-2101. Steel conforming to the requirements of ASTM A36 will be specified. Basic working stress (tension) used is 22,000 psi.

e. Masonry. Brick masonry used for the exterior walls will conform to ASTM Specification C216, Type FBS, Grade SW. Hollow concrete masonry units will conform to ASTM Specification C90, Type 1, Grade N-I. The wall will be reinforced to resist lateral loads.

f. Increase in Working Stresses. Allowable stresses are increased 33-1/3% for those loadings including wind or earthquake forces.

g. Waterstops. A-36 steel waterstops will be used in horizontal construction joints between base slabs and walls.

19. BASIC DATA AND ASSUMPTIONS.

a. Loads.

(1) Dead Loads

Concrete	150	p.c.f.
Steel	490	p.c.f.
Soil, saturated	125	p.c.f.
Soil, submerged	60	p.c.f.
Masonry (Brick)	120	p.c.f.

(2) Live Loads

Water	62.5	p.c.f.
Wind	20	p.s.f.
Snow load	30	p.s.f.
Operating floor slabs	350	p.s.f.
Operating floor beams	100	p.s.f. plus equip. loads

b. External Water Pressure. Hydrostatic pressure is taken as the head to the natural water table uniformly distributed over the base slab area. Lateral hydrostatic pressure on exterior substructure walls is assumed to vary uniformly from zero at ground water elevation to full head at bottom of base slab. For design of the Pope Park Station, ground water was assumed at Elevation 36.2. In checking the Armory Pumping Station, ground water was assumed at Elevation 34.5.

c. Earth Pressure. Earth pressures were determined in general accordance with EM 1110-2-2502, Retaining Walls, dated 29 May 1961. An at rest lateral pressure coefficient of 0.5 was assumed for design of substructure walls.

d. Frost Protection. The bases of the structures are founded well below the 4-foot depth required for frost protection in the area.

e. Uplift Factor of Safety. A factor of safety against uplift of 1.73 is provided at the Pope Park Station assuming ground water at Elevation 36.2 with the station empty. A similar check of the Armory Station indicates a factor of safety against uplift of 1.35 assuming ground water at Elevation 34.5.

f. Location of Resultants. The resultant of all forces acting on the structures is located well within the middle-third of their base slabs.

g. Sliding. Sliding stability is not a factor in the design of these stations.

h. Earthquake Forces. An earthquake force of .017 times the gravity loads (Minor Damage - Zone 1) has been considered in design of the station superstructures (Ref. TM-5-809-10).

20. PREPARATION OF DESIGN COMPUTATIONS. The computer program "EFFRAM, *Analyis of Plane Frames on Elastic Foundation*" (*Program No. 713-DOF 7110*) was utilized in the analysis of the structural steel frames of the station superstructures. Representative calculations of typical design sections and the stability analyses have been included in Appendix A.

21. ARMORY PUMPING STATION.

a. General. The Armory Station is located in close proximity to and on the north side of existing conduit section No. 1. The operating floor and substructure are existing and were constructed of reinforced concrete. The roof will be of composite metal deck and concrete construction supported by structural steel beams and columns. The east wall of the superstructure facing the state capitol will be constructed of precast concrete panels backed with block. The panels will extend above the roof line. The panels will be 8 feet wide and will have shallow vertical ribs on the exposed face 4 feet on center. The

remaining exterior walls will be constructed of 4" brick backed with 8" concrete block. The discharge conduit measures 7 feet by 7 feet. The discharge conduit empties into the gravity conduit which becomes a pressure conduit during flood conditions and conducts the flow to existing conduit section No. 1. Plate No. 6-4 shows the structural features of the station.

b. Stability. Stability of the structure is not a problem. Gravity loads provide a more than adequate factor of safety against uplift considering the station empty at time of maximum ground water elevation. The finished grade is substantially at the same elevation around the perimeter of the building; thereby, eliminating sliding and any substantial redistribution of soil pressures due to overturning forces. The maximum soil pressure will be 2,730 lbs. per square foot assuming maximum water inside the station and no ground water uplift. The average bearing pressure under such conditions is 2,200 lbs. per square foot. These are low pressures for the rock on which the base slabs are founded.

c. Roof Slab. The roof slab is designed for one way action spanning between roof beams. It will be constructed of 3" thickness of structural concrete with welded wire fabric over 3" deep 18 gage metal decking. The metal decking and concrete are designed to act compositely. The metal decking will be continuous over at least two roof beams. Lightweight fill concrete of variable thickness will be placed over the structural slab to provide slope for roof drainage. Rigid insulation will be provided between the fill concrete and the built up roofing.

d. Superstructure Framework. The steel framing will consist of 18" deep roof beams approximately 12' on center spanning transversely connecting with 10"x10" columns. The resulting frames will be connected longitudinally at roof level by 8" deep spandrel beams, thus forming two 5-span longitudinal frames. The rails for the traveling crane will be supported on brackets attached to the columns.

e. Operating Floor. The existing operating floor is reinforced concrete slab and beam construction. Beams are located to support the equipment in its design location and to frame large openings in the slab. The slab, consisting of 8" of structural concrete overlain by 2" of finish concrete, will support a live load of 375 lbs. per square foot without overstress. This allows for the proposed

equipment, with a maximum load of 350 lbs. per square foot, to be placed at any location on the floor. Investigation shows that the operating floor beams have a capacity in excess of that required to support a live load of 100 lbs. per square foot over the entire slab plus equipment loads.

f. Superstructure Walls. The exterior walls will be supported on the foundation walls. They are considered to span vertically under the influence of lateral loads, and will be attached to the steel framing at the roof level.

g. Substructure. The existing substructure is constructed of reinforced concrete. The foundation walls are generally 2 feet thick and rest on a foundation mat 2 feet thick. The main foundation walls span vertically being fixed at the base slab and laterally supported by the operating floor. The walls and base slabs have been checked for superstructure loads, earth loads and varying conditions of water inside and outside, and have been found to be adequate. The anchor bolts for the superstructure columns are in place in the foundation walls, and the proposed superstructure will be detailed to accommodate them.

22. POPE PARK PUMPING STATION.

a. General. The Pope Park Station will be located immediately adjacent to section No. 4 of the Park River Conduit. The station will be supported independently of the conduit and will have provisions for differential movements where gate openings and pipes traverse their juncture. The east wall of the conduit and westerly substructure wall of the station will be separated by a 1/2-inch thickness of compressible fiber. The roof of the station will be reinforced construction, consisting of a concrete slab of uniform thickness supported by reinforced concrete beams and columns. The superstructure walls will be constructed of 4-inch thick face brick backed by 8-inch thick concrete masonry units. The outside dimensions of the station superstructure will measure 23'-6" x 43'-0". The substructure will consist of reinforced concrete wall and base slab 2'-0" and 2'-6" thick respectively. The gravity discharge will be by two gated openings in the walls of the station and conduit. The invert of the gravity flow will be at Elevation 17.0. The flood discharge will be through three 20" diameter pipes whose centerlines are at Elevation 24.0 where they enter the conduit. Plate No. 6-12 shows the structural features of the station.

b. Stability. The substructure will be surrounded by earth on three sides and will be stabilized by the conduit on the fourth side. Finished grade is at the same elevation around the outside of the building. The factor of safety against uplift is adequate assuming maximum ground water conditions and minimum loading within the station. A maximum soil bearing pressure of 2,890 lbs. per square foot results from maximum loading inside the station and no ground water outside. Similar loading conditions for conduit section No. 4 would result in a bearing pressure of 5,000 lbs. per square foot under the base slab of the conduit. The nature of the till foundation material is such that expected differential settlement between the conduit and the station will be small.

c. Roof Slab. The roof slab is designed to span the 12 feet between upturned roof beams. The slab will be 8" thick and will be overlain by lightweight fill concrete of variable thickness to provide slope for proper roof drainage. Rigid insulation will be provided between the fill concrete and the built up roofing.

d. Superstructure Framework. The framework will be cast-in-place reinforced concrete consisting of roof beams and columns. The framing will be exposed with upturned roof beams and tapered columns forming the major architectural feature of the station. The columns will be fixed at the operating floor level and continuous at their juncture with the roof beams to form frames in the transverse direction. Concrete spandrel beams will connect the frames and support the roof slab along the periphery of the building. The longitudinal spandrels will cantilever 3'-6" beyond the end frames to support the roof at the ends of the station. Concrete brackets cast integrally with the columns will support the crane rail beams.

e. Operating Floor. The operating floor is reinforced concrete slab and beam construction. Beams are located to support equipment and to frame two access openings in the slab. The structural slab will be 8" thick with an additional 2" concrete topping placed after equipment installation. The slab is designed for a live load of 350 lbs. per square foot which allows for the heaviest equipment to be at any location on the floor. The beams are designed for equipment loads plus a live load of 100 lbs. per square foot over the entire floor slab.

f. Superstructure Walls. The exterior walls will be supported on the foundation walls. They are considered to span vertically between the foundation wall and the roof under the influence of lateral loads.

g. Substructure. The longitudinal foundation walls are considered to span vertically being fixed at the base slab and laterally supported at the operating floor. The transverse foundation walls are assumed to span laterally being supported by the longitudinal walls in resisting lateral earth loads. The base slab is assumed to span in two directions simply supported at the foundation walls.

J. MECHANICAL DESIGN

23. GENERAL. Plate Nos. 6-5 thru 6-7, 6-13 and 6-14 show the general arrangement of pumps and other mechanical equipment and pages B-1 thru B-10 show pump computations and curves. Electric service is not considered adequately reliable for electric motor drive.

24. PUMPING EQUIPMENT.

a. General. All pumps will be driven by diesel engines through right angle gear units. The pumps will be vertical, non-clogging, mixed-flow, volute type of standard construction and proven ability. The pump casing and impeller shall be made of high grade cast iron, shafts shall be forged or high grade open hearth steel with stainless steel shaft sleeves and grease lubricated antifriction type bearings. The stations will handle both storm water and sewerage during flood conditions, a factor which contributed to the selection of the volute type pumps. In addition the existing substructure for the armory station was designed and built for the volute type pump. Also all other stations in the Hartford flood protection area use this type pump (Bushnell Park, Keeney Lane, and North Meadows Pumping Stations).

b. Armory Pumping Station. Three pumps will be provided with each pump having a capacity of 40 cfs (18,000 gpm), one-third of the required station capacity against the standard design flood with suction water elevation at 23.5 feet mean sea level. Pumps will discharge into a chamber which will discharge into the box conduit Section 1.

c. Pope Park Pumping Station. Three pumps will be provided with each pump having a capacity of 25 cfs (11,500 gpm), one-third of the station capacity against the standard design flood with suction water elevation at 30.0 feet mean sea level. Pumps will discharge directly into the box conduit Section 4.

25. SLUICE GATES.

a. Pope Park Station. Two motor operated sluice gates of the seating pressure type will be located at the entrance to the pump suction chamber. These gates will normally be kept closed to prevent water from collecting in the suction chamber. They will be opened only at such periods as is necessary to operate the pumps. Two motor operated sluice gates of the unseating pressure type will be located in the gravity discharge conduits to prevent back flow

during periods when pumping is necessary. These gates will normally be kept open to permit water to flow by gravity to the box conduit. A fifth motor operated sluice gate of the seating pressure type will be located at the inlet to the suction chamber from the 42" storm drain manhole adjacent to the station. Although the pumps in the station are sized only to pump the collected runoff from the area drained by the 72" conduit, this 42" sluice gate has been incorporated into the design of the station to provide the City of Hartford some flexibility in their operation of the storm system. All gates will be of the standard cast iron construction with bronze seals. Each electric operated floor stand will be provided with a hand wheel for manual operation.

b. Armory Station. All sluice gates shown on drawings are existing and installed as part of the existing substructure. Four of the gates are motor operated and two are hand operated.

26. TRAVELING CRANE. Each station will be provided with a hand operated, single girder, traveling crane with a low headroom, hand operated, chain hoist of capacity required to handle the heaviest piece of equipment.

27. SUMP PUMP. An electric motor-operated wet pit type duplex sump pump will be provided in each pumping station to keep the pump room dry and will also be used to dewater the suction chamber.

28. VALVES. Gate valves for the 20" and 24" pumps will be electric motor operated. Swing check valves will be provided to prevent reverse rotation of the gear units and diesel engines in the event that an engine stalls. In addition, their use will facilitate the starting of the units.

29. MECHANICALLY CLEANED BAR SCREENS. In each of the stations mechanically-operated bar screens will be installed directly behind the sluice gates at the entrance to the suction chamber.

30. HEATING. The heating systems will consist of oil-fired forced hot water boilers with unit heaters designed to maintain a temperature of 60°F with an outside temperature of 0°F. Humidistats will override the thermostats to operate the unit heaters as necessary to maintain the relative humidity at not higher than 50 percent.

31. VENTILATION. Mechanical ventilation will be provided in the engine, pump, and screen rooms.

32. WATER SYSTEM. The city water supply will be connected to the pumping stations and will be used for cooling the diesel engines.

33. WATER LEVEL INDICATORS. Indicators for both the suction conduit and box conduit water levels will be provided in each station.

K. ELECTRICAL DESIGN

34. ELECTRIC SERVICE. Electric service will be obtained from the Hartford Electric Light Company at 208 Y/120 volts, 3-phases, 60 hertz. A 23 KV underground primary in conduit will be extended to a pad mount transformer by the Utility Company in a trench to be provided by the government.

35. INTERIOR ELECTRICAL FEATURES.

a. Wiring System. All conductors will have heat and moisture resistant insulation and will be installed in rigid steel conduit.

b. Communication System. Conduit will be installed for use by The Southern New England Telephone Company to provide telephone service.

c. Emergency Lighting. A battery operated emergency lighting unit will be provided.

36. ELECTRICAL LOAD DATA.

a. Armory Pumping Station.

Item		Connected Watts Load
Sluice Gates	4@ 5 HP	20,000
Fuel Pump	1-1/2 HP	3,000
Duplex Sump Pump	1@ 1/2 HP	1,500
Lighting		7,800
Receptacle	16@ 200 W	3,200
Exhaust Fans	2@ 1/2 HP	333
Motorized Valves	6@ 100 W	600
Oil Burner	1/4 HP	250
Unit Heaters	6@ 1/40 HP and	
	2@ 1/45 HP	200
Mechanical Screen Motor	2@ 1-1/2 HP	3,000
Circulating Pump		500
	Computed Load	43,383 Watts
	Demand Load	22,800 Watts

A 25KW, 3-phase, 4 wire 120/208 volt, 60 hertz, diesel generator set is proposed to handle emergency loads.

b. Pope Park Pumping Station.

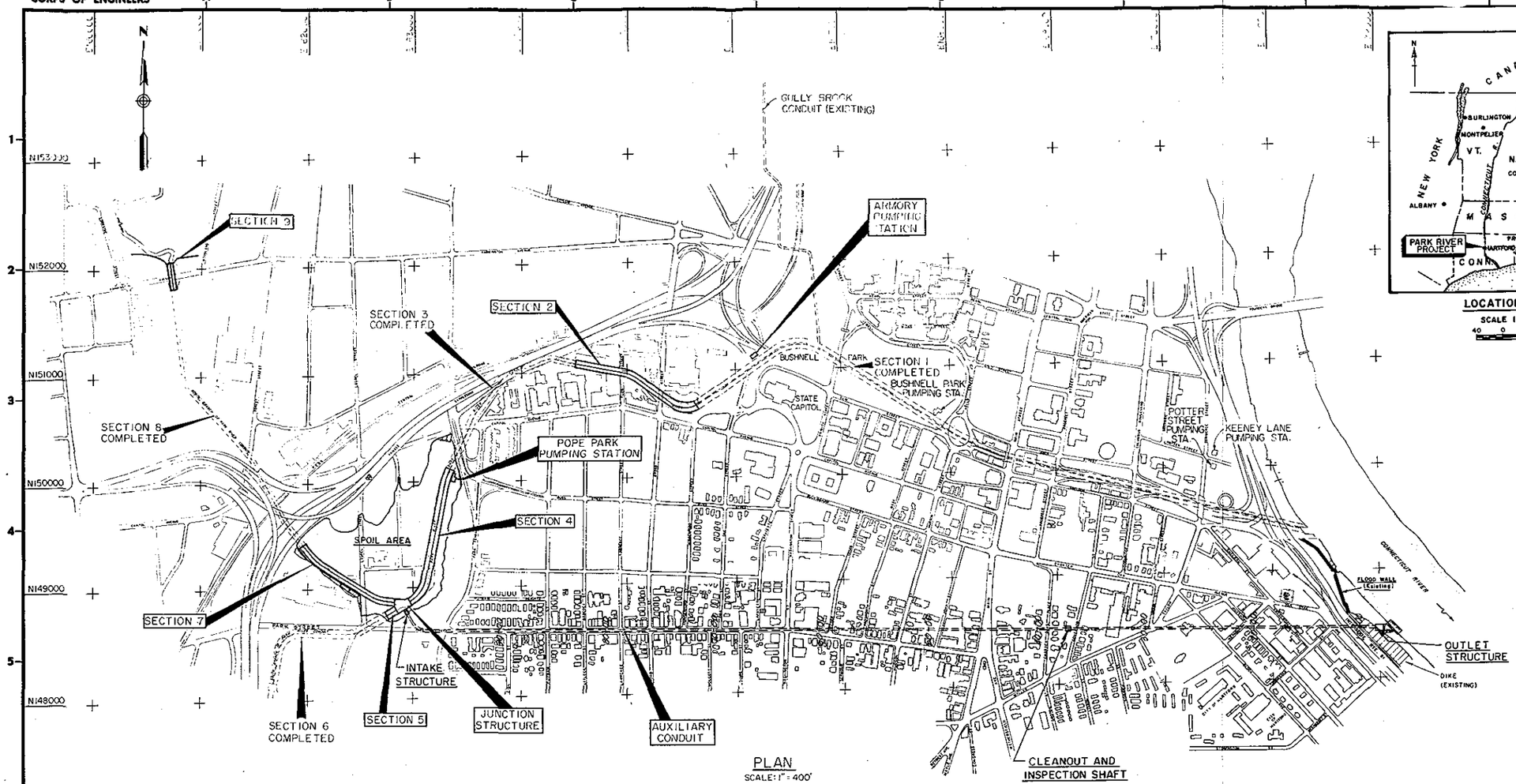
Item				Connected Watts Load
Sluice Gates	3,3,2,1,&	1	HP	10,000
Fuel Pump		1-1/2	HP	3,000
Sump Pump		1	HP	1,000
Lighting				6,000
Receptacles	14@	200	W	2,800
Exhaust Fans	3@	1/4,1@ 1/8	HP	875
Motorized Valves	6@	100	W	600
Unit Heaters				200
Oil Burner		1/4	HP	250
Circulating Pump		1/2	HP	500
Mechanical Screens	2@	1	HP	2,000
		Computed Load		27,225 Watts
		Demand Load		16,000 Watts

A 20KW, 3-phase, 4 wire, 208/120 volt, 60 hertz, diesel generator set is proposed to handle emergency loads.

L. COST ESTIMATES

37. ESTIMATE OF COSTS. The latest submitted estimate of project costs is contained in Design Memorandum No. 2, Phase II, Part I, which was submitted 30 August 1974 and approved 18 October 1974. That estimate has been revised and will be presented in Design Memorandum No. 2, Phase II, "Project Design, Site Geology and Interior Drainage, Part II - Auxiliary Conduit," which is scheduled for submittal in November 1974. A detailed cost estimate for the pumping stations has been included in Appendix D.

CORPS OF ENGINEERS — U. S. ARMY



PLAN
SCALE: 1" = 400'

LOCATION MAP
SCALE IN MILES
40 0 40 80

LEGEND

● 31 Greater Hartford Flood Commission Boring (1960-1963)

GENERAL NOTES:

1. Elevations refer to Mean Sea Level Datum.
2. All elevations are plus except as noted otherwise.
3. Plane coordinates refer to Connecticut Lambert Grid System.

GRAPHIC SCALES
1" = 400' 400' 800'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, FIELD ENG. BRANCH
REVIEWED
PROJECT ENGINEER
APPROVAL RECOMMENDED
CHIEF BRANCH

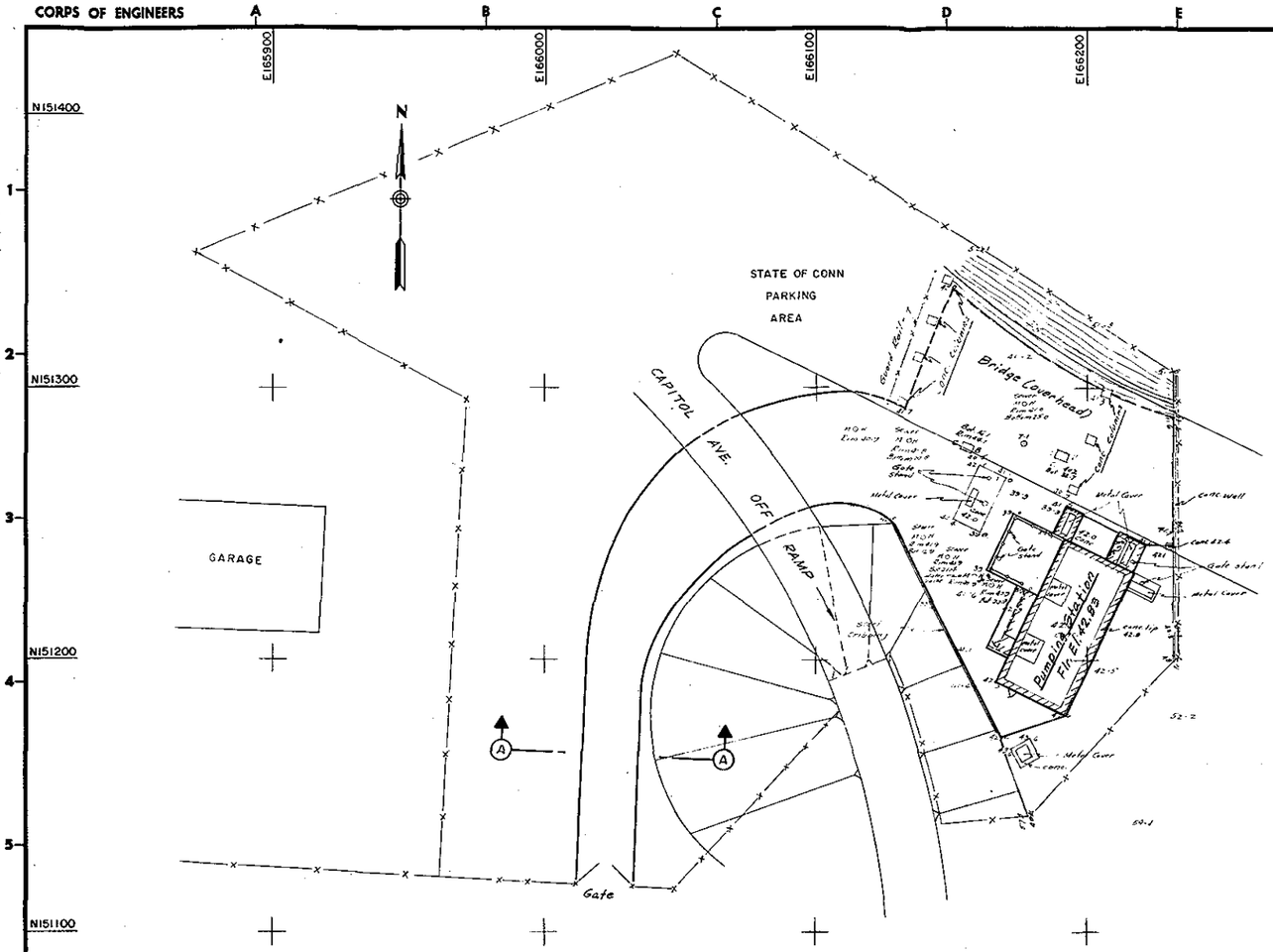
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
PUMPING STATIONS
GENERAL PLAN
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

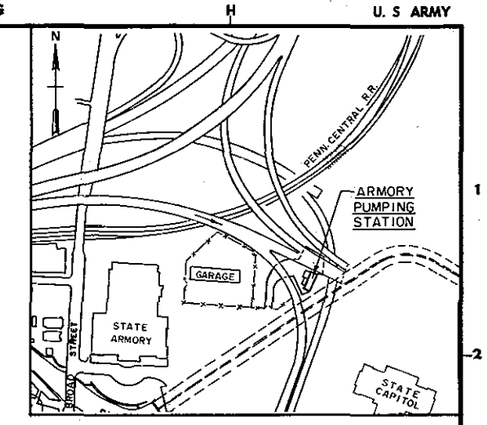
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-1

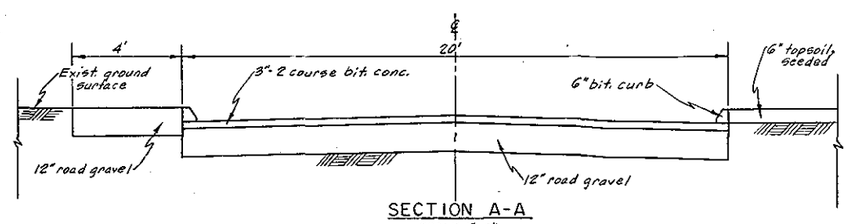
CORPS OF ENGINEERS — U. S ARMY



PLAN
SCALE: 1" = 20'



LOCATION MAP
SCALE: 1" = 200'



SECTION A-A
SCALE: 1" = 2'

GRAPHIC SCALES

1" = 200'	200'	0	200'	400'
1" = 20'	20'	0	20'	40'
1" = 2'	2'	0	2'	4'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

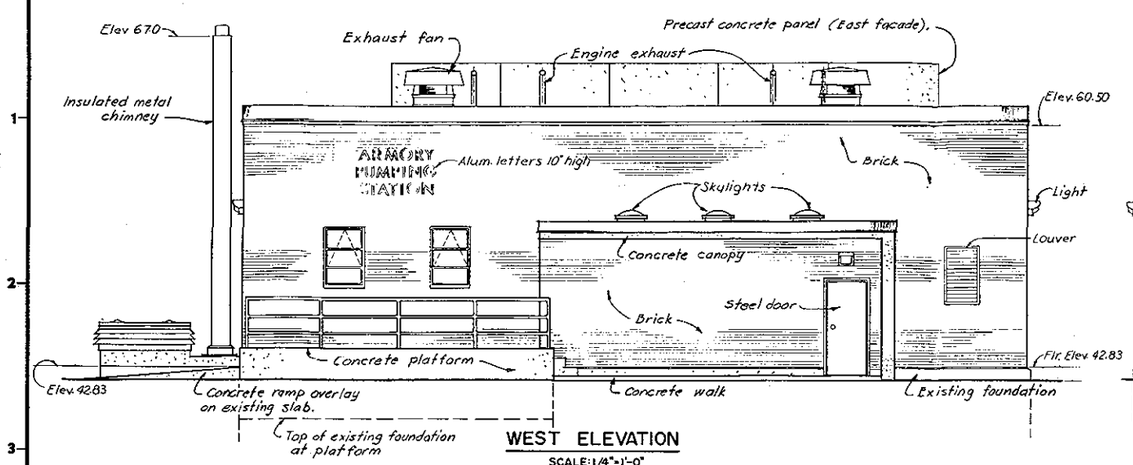
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
GRADING PLAN AND SECTION
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

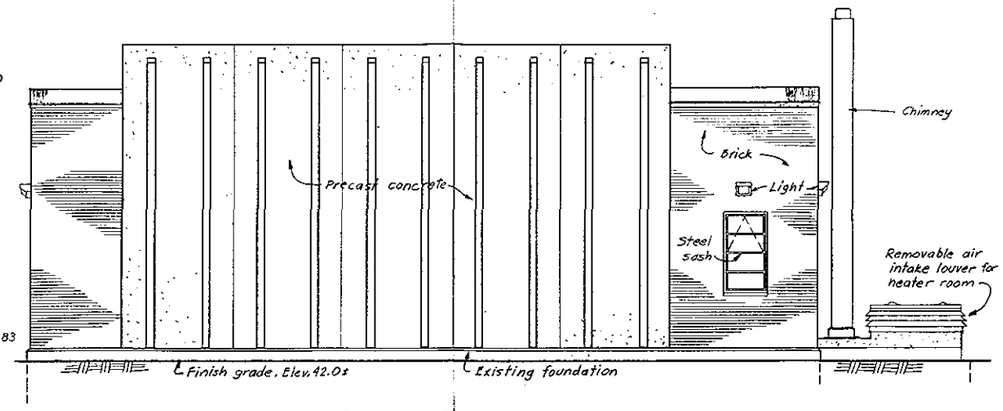
PLATE 6-2

CORPS OF ENGINEERS — U. S. ARMY



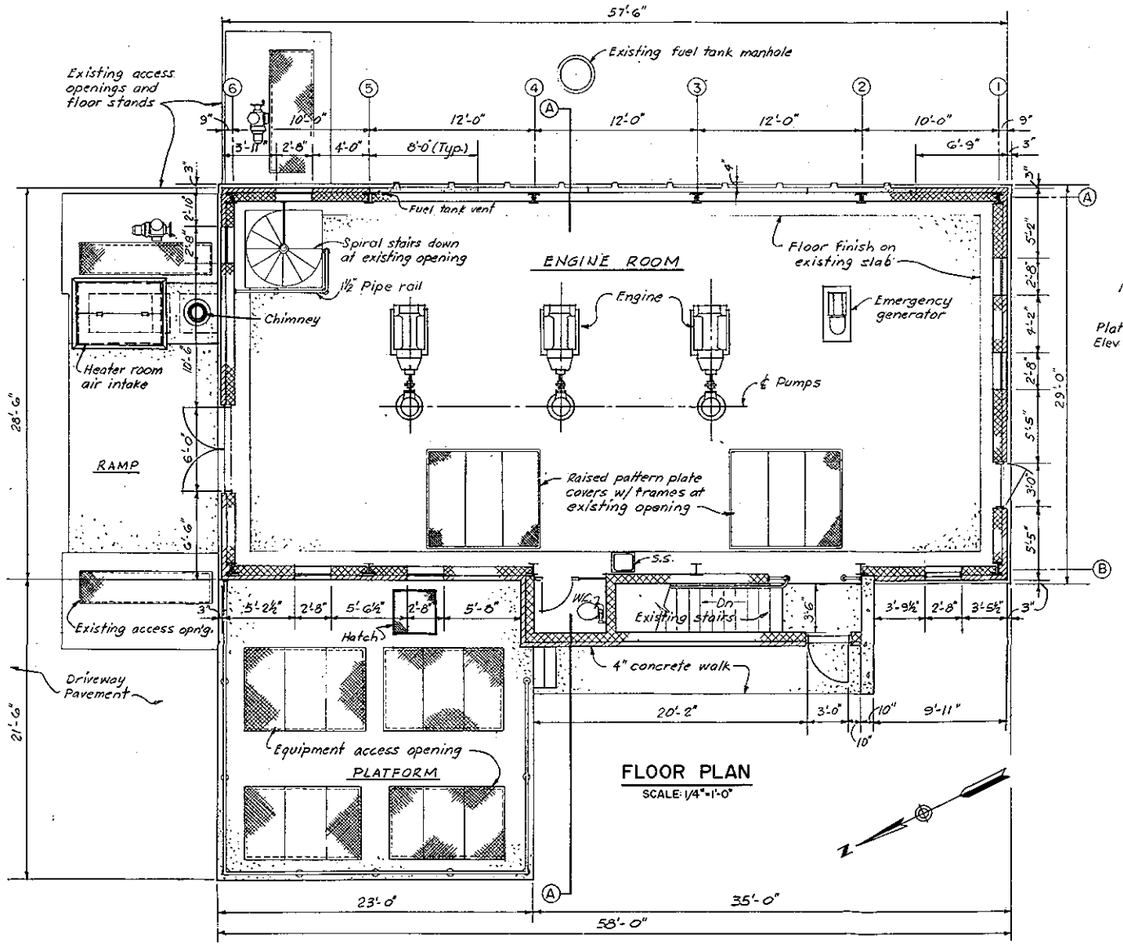
WEST ELEVATION

SCALE: 1/4" = 1'-0"



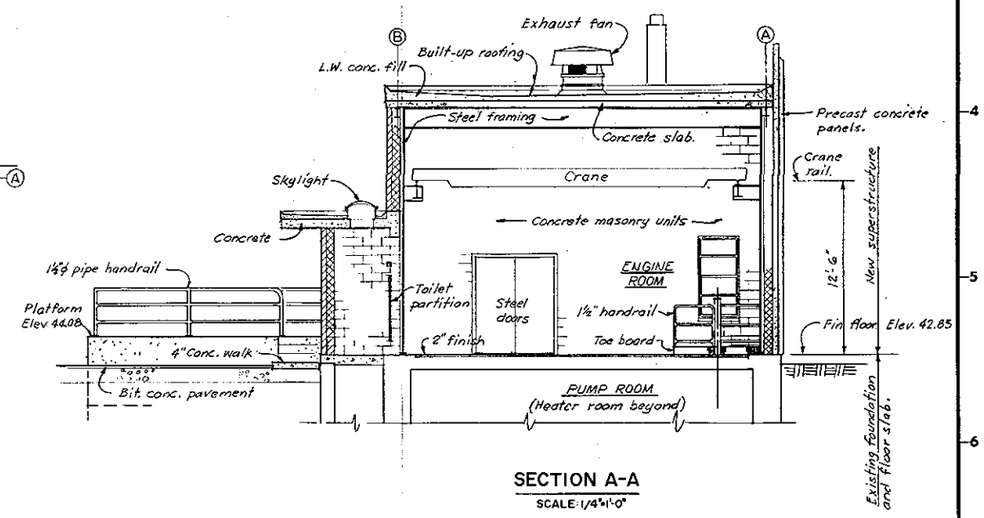
EAST ELEVATION

SCALE: 1/4" = 1'-0"



FLOOR PLAN

SCALE: 1/4" = 1'-0"



SECTION A-A

SCALE: 1/4" = 1'-0"

GRAPHIC SCALES

SCALE 1/8" = 1'-0"

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY W.O.G. | DR. BY S.D.L. | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

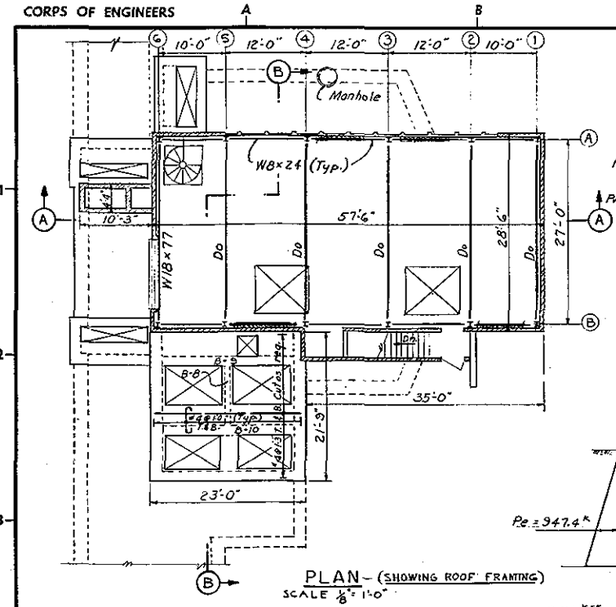
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
ARCHITECTURAL PLAN, ELEVATIONS AND SECTION
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

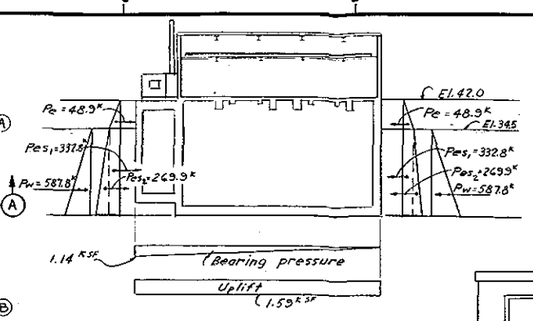
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-3

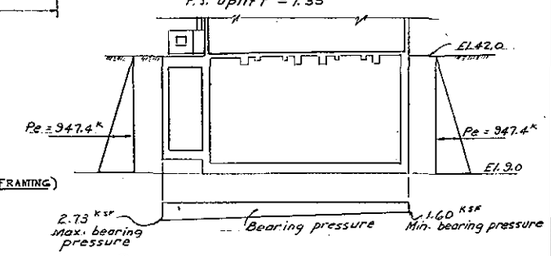
CORPS OF ENGINEERS U. S. ARMY



PLAN - (SHOWING ROOF FRAMING)
SCALE 1/8" = 1'-0"

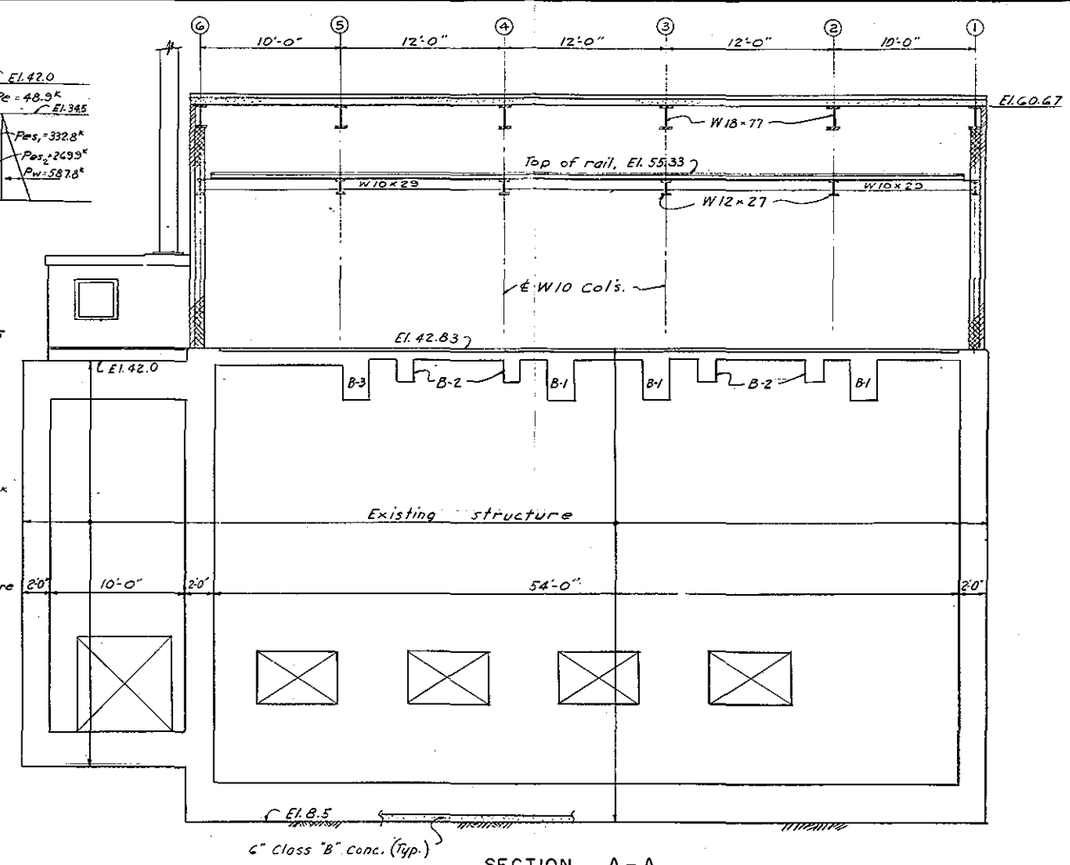


CASE II
Building weight -- Ground water at El. 34.5
No side friction considered on walls.
F.S. Uplift = 1.35

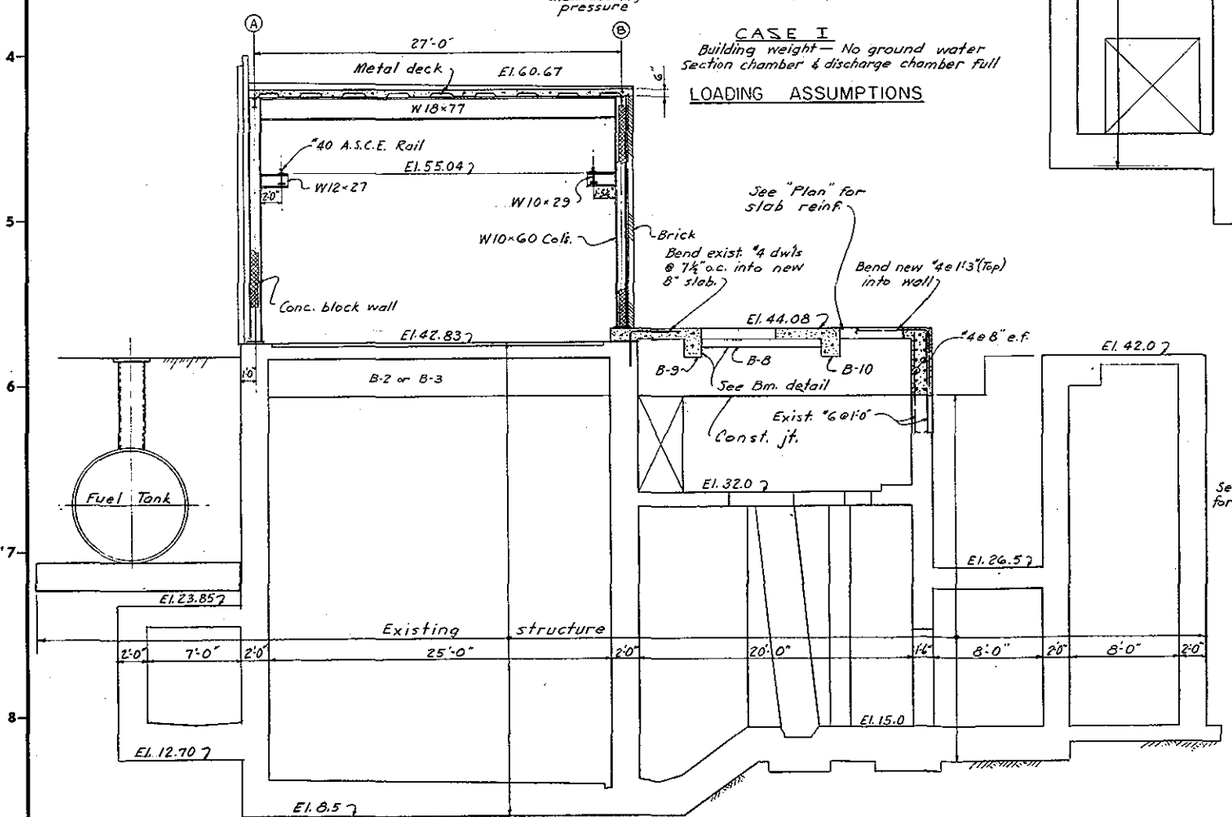


CASE I
Building weight — No ground water
Section chamber & discharge chamber full

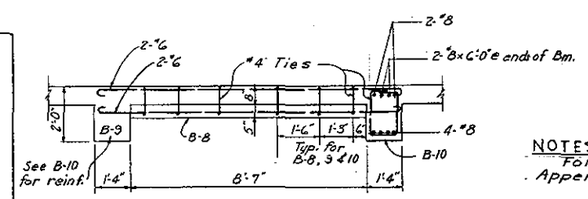
LOADING ASSUMPTIONS



SECTION A-A
SCALE 1/4" = 1'-0"



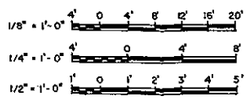
SECTION B-B
SCALE 1/4" = 1'-0"



BEAM DETAIL
SCALE 1/4" = 1'-0"

NOTES
For substructure details see Appendix C.

GRAPHIC SCALES



REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

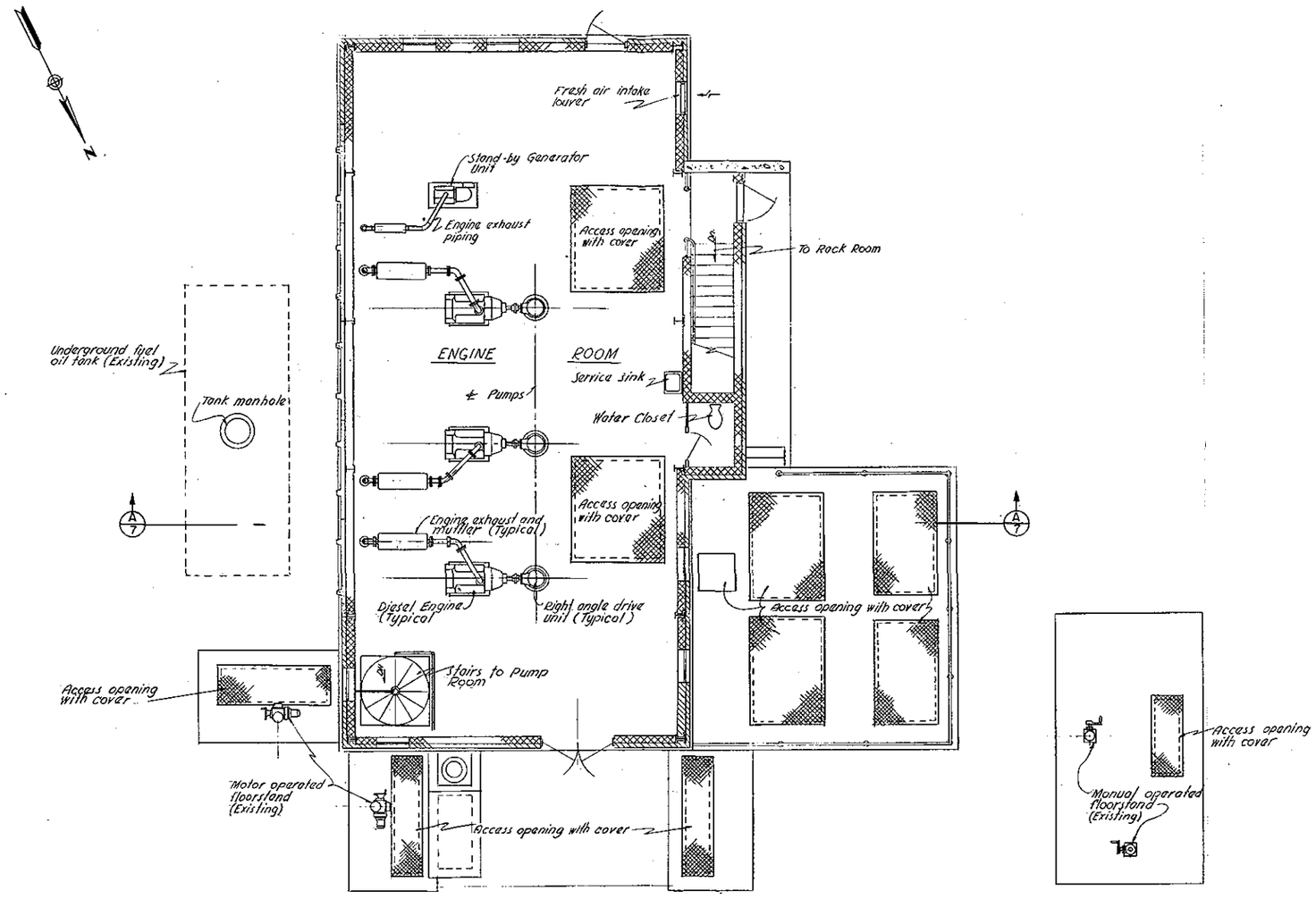
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
STRUCTURAL
PLAN, SECTIONS AND DETAIL
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-4

CORPS OF ENGINEERS U. S. ARMY



PLAN-ENGINE ROOM

SCALE 1/4" = 1'-0"

GRAPHIC SCALES

1/4" = 1'-0" 4' 2' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

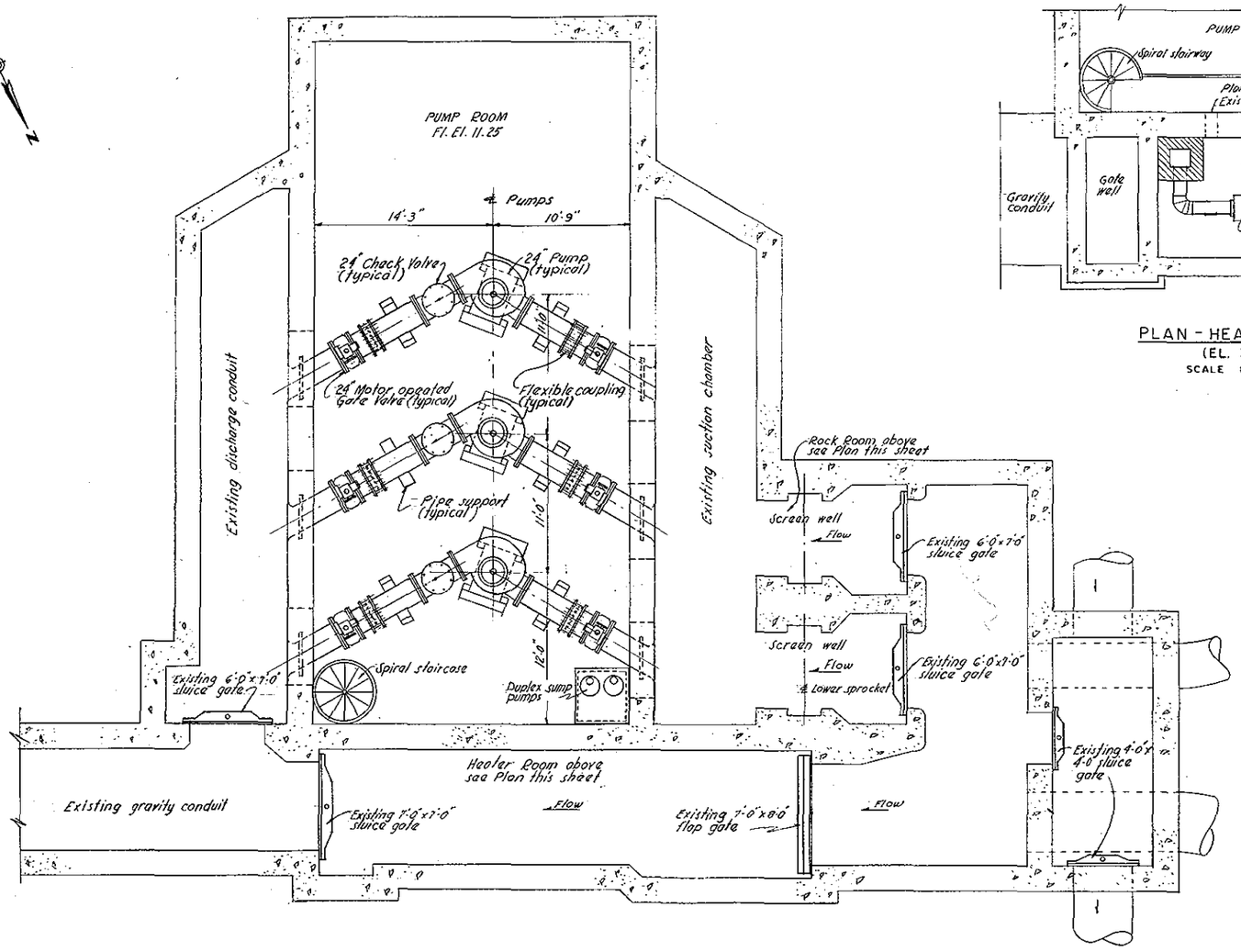
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
MECHANICAL
PLAN NO. 1
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

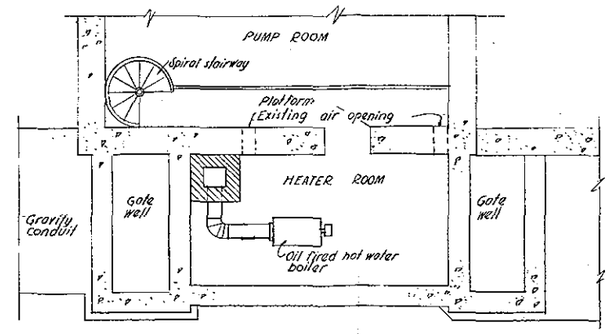
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-5

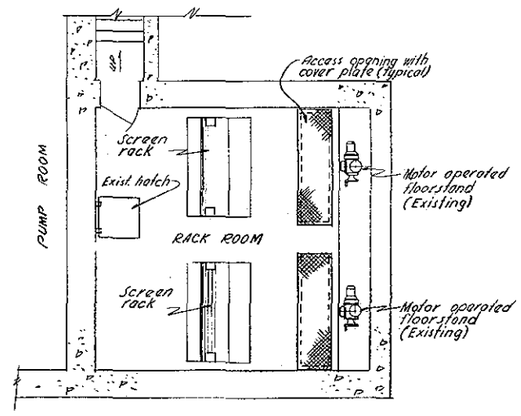
CORPS OF ENGINEERS U. S. ARMY



PLAN - PUMP ROOM
(EL. 11.25)
SCALE 1/4" = 1'-0"



PLAN - HEATER ROOM
(EL. 30.0)
SCALE 1/4" = 1'-0"



PLAN - RACK ROOM
(EL. 32.0)
SCALE 1/4" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0" 4' 2' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

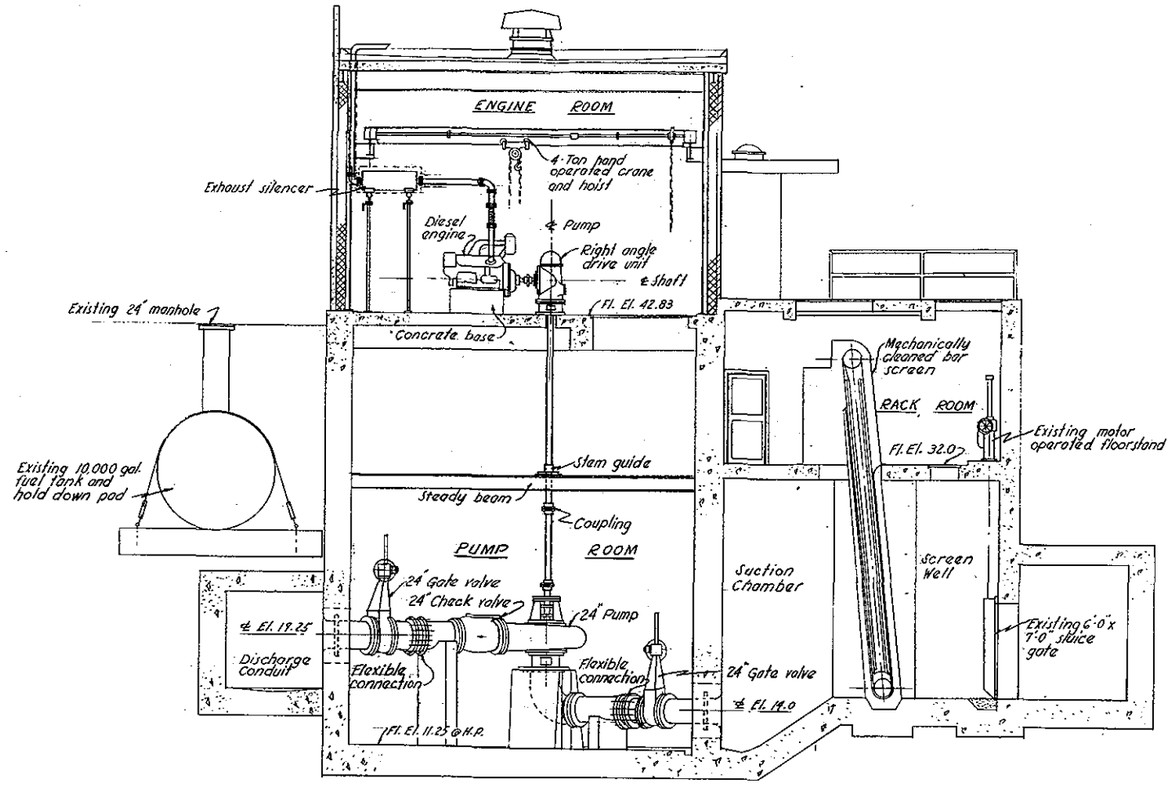
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
MECHANICAL
PLANS NO. 2
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-6

CORPS OF ENGINEERS U. S. ARMY



SECTION A/5

SCALE 1/4" = 1'-0"

GRAPHIC SCALES

1/4" = 1'-0" 4' 2' 0 4' 8'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
MECHANICAL- SECTION

HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

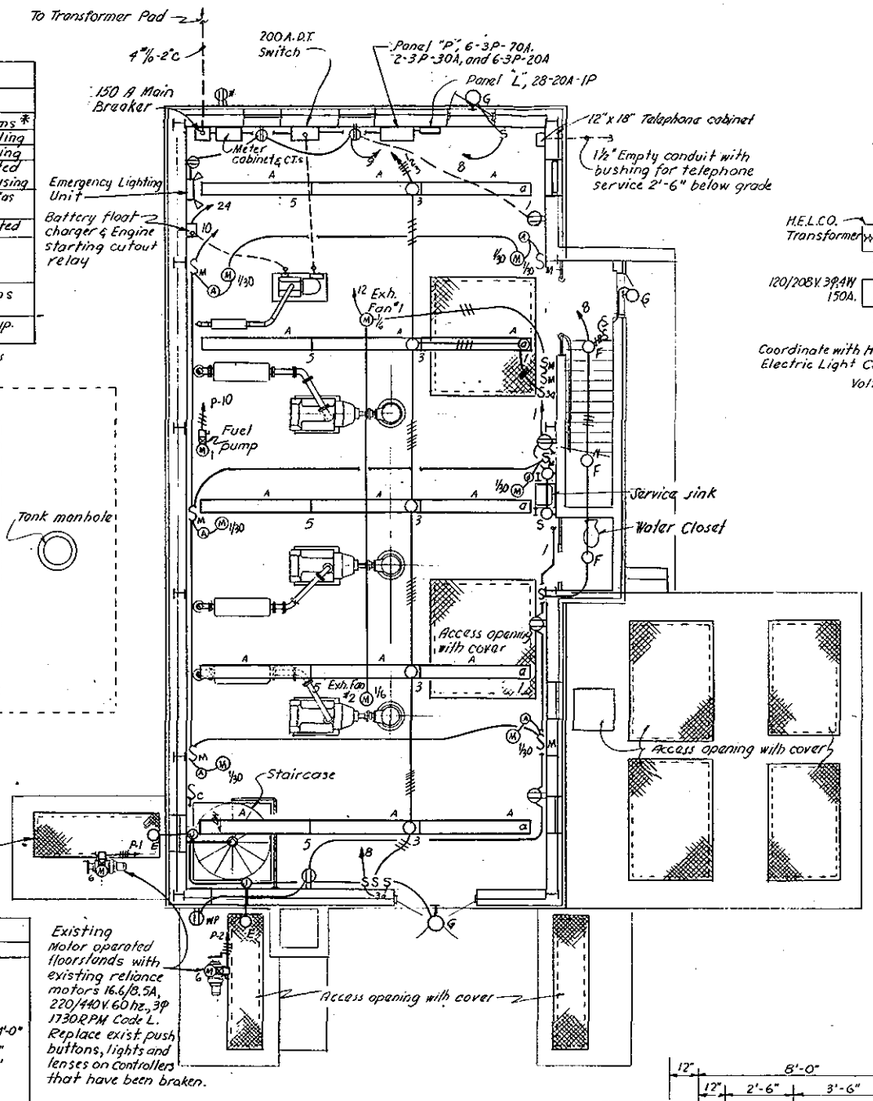
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-7

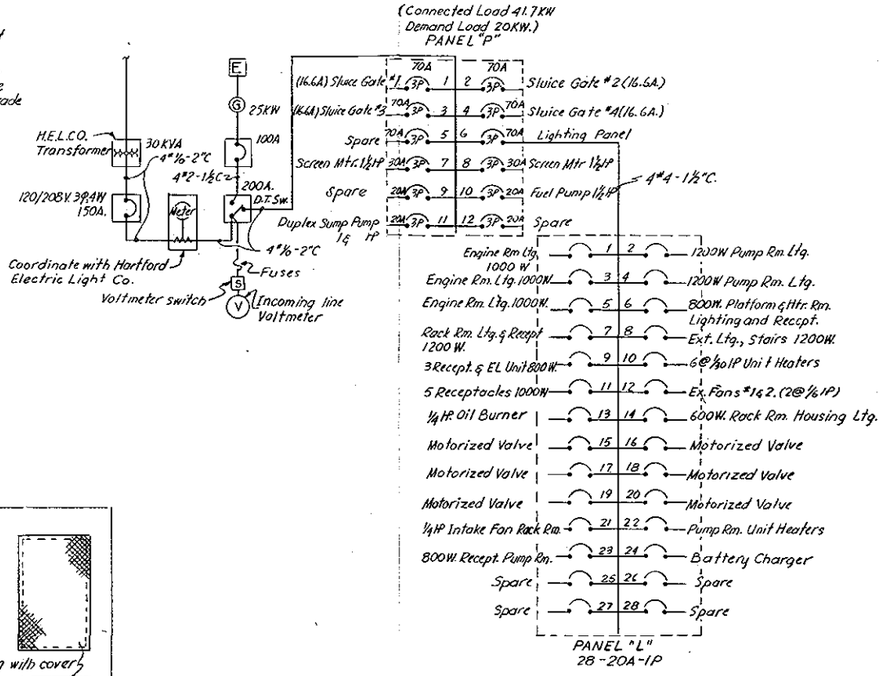
CORPS OF ENGINEERS — U. S. ARMY

FIXTURE SCHEDULE			
Type	Manufacturer and Catalog No. or equal	Lamps	Remarks
A	Lithonia B TAV 240 PO	4-F-40 CW	Mount on 12" stems *
B	Crouse Hinds EVCX 2309	1-300W. IF	Box mtd. on ceiling
C	Holophane #C-2466	1-150 W. IF	Box mtd. on ceiling
D	Crouse Hinds EVCX 210	1-150W-IF	Mounted as directed inside each housing
E	Stonco #P63701	1-100W-IF	Wall mtd. up 7'-6" as noted
F	Stonco #P6188B3	1-150W-IF	Surface mounted
G	Stonco 533-175MW, 575.	1-175W EBT 28 Mercury	Wall mounted above door
H	Crouse Hinds VDA 23GRD	1-300 W.-IF	Mnt. on 24" stems
I	Porcelain lamp holder	1-100W.-IF	Wall mnt. 6'-6" up.

*Pope Park Pumping Station to have Type A fixtures ceiling mounted.



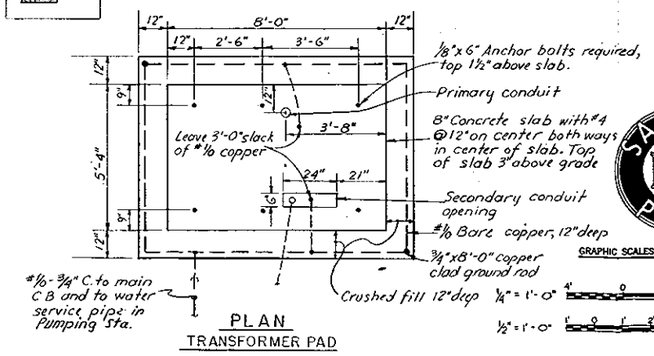
ENGINE ROOM PLAN
SCALE 1/4" = 1'-0"



ONE LINE DIAGRAM
NOT TO SCALE

LEGEND	
SYMBOL	DESCRIPTION
	Fluorescent Fixture
	Ceiling Outlet
	Wall Bracket
	Weatherproof conv. outlet H&H #5262 WP, Up 4'-0"
S	Single pole Switch H&H #2991 & #2881, up 4'-0"
S3	Three way Switch H&H #2993 & #2883, up 4'-0"
SM	Motor Switch up 5'-0"
M 1/4	Motor, HP as noted
M EX	Motor, Explosion proof, see note #1
	Disconnect, up 5'-0"
EX	Disconnect, Explosion proof, up 5'-0"
SM EX	Manual Motor starter, Expl. proof up 5'-0", see note #2
SMP	Manual Motor starter, w/pilot Lt. up 5'-0", see note #2
SMP EX	Manual Motor Starter w/pilot Lt. up 5'-0", Exposion proof, see note #2
A	Aquastat, see note #1
A EX	Aquastat, Explosion proof, see note #1
T	Thermostat, up 5'-0", see note #2
T EX	Thermostat, Explosion proof, up 5'-0", see note #2
	Magnetic Motor Starter, see note #2
EX	Magnetic Motor Starter, Explosion proof, see note #2
	Emergency Lighting Unit
J	Junction Box

NOTES:
1. Furnished and installed by others, - Wired by this Electrical Contractor.
2. Furnished by others, - Installed and wired by this Electrical Contractor.



PLAN
TRANSFORMER PAD
SCALE 1/2" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0"
1/2" = 1'-0"

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY LFF — DR. BY J.J.L. — CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
ELECTRICAL - PLANS NO. I

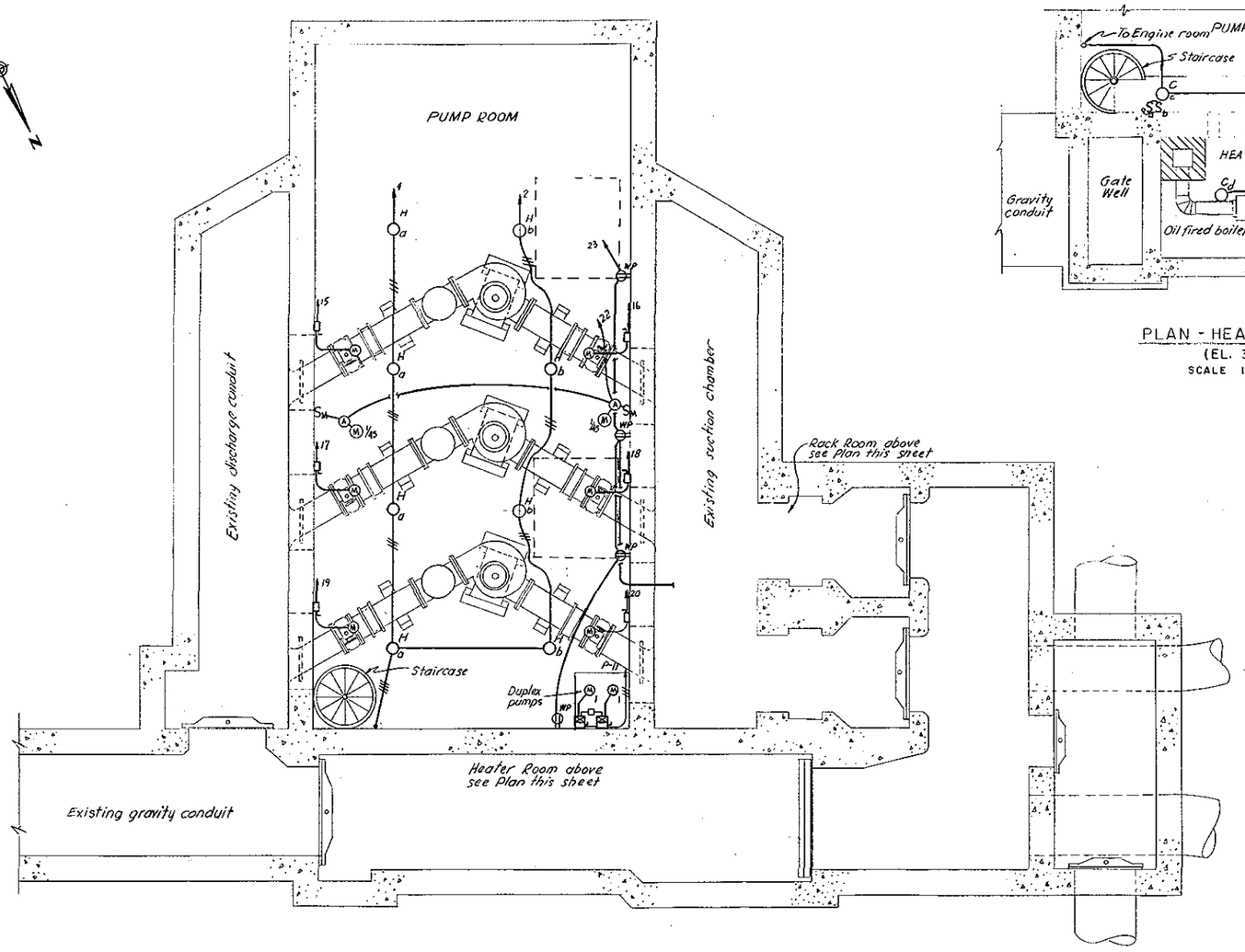
HARTFORD — CONNECTICUT

APPROVED — DATE
CHIEF, ENGINEERING DIVISION

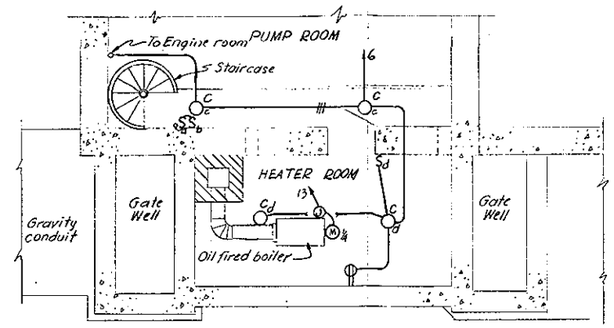
SCALE — SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-8

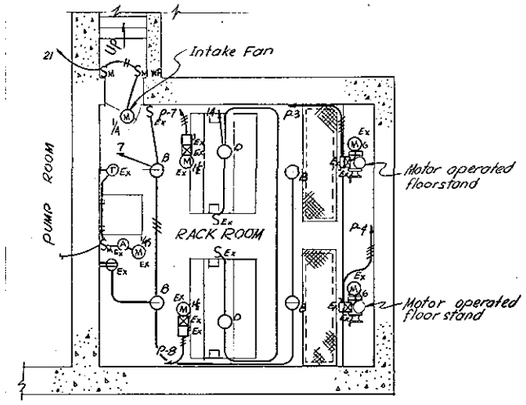
CORPS OF ENGINEERS U. S. ARMY



PLAN - PUMP ROOM
(EL. 11.25)
SCALE: 1/4" = 1'-0"



PLAN - HEATER ROOM
(EL. 30.0)
SCALE 1/4" = 1'-0"



PLAN - RACK ROOM
(EL 32.0)
SCALE 1/4" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0" 4' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY LFF DR. BY JGW CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

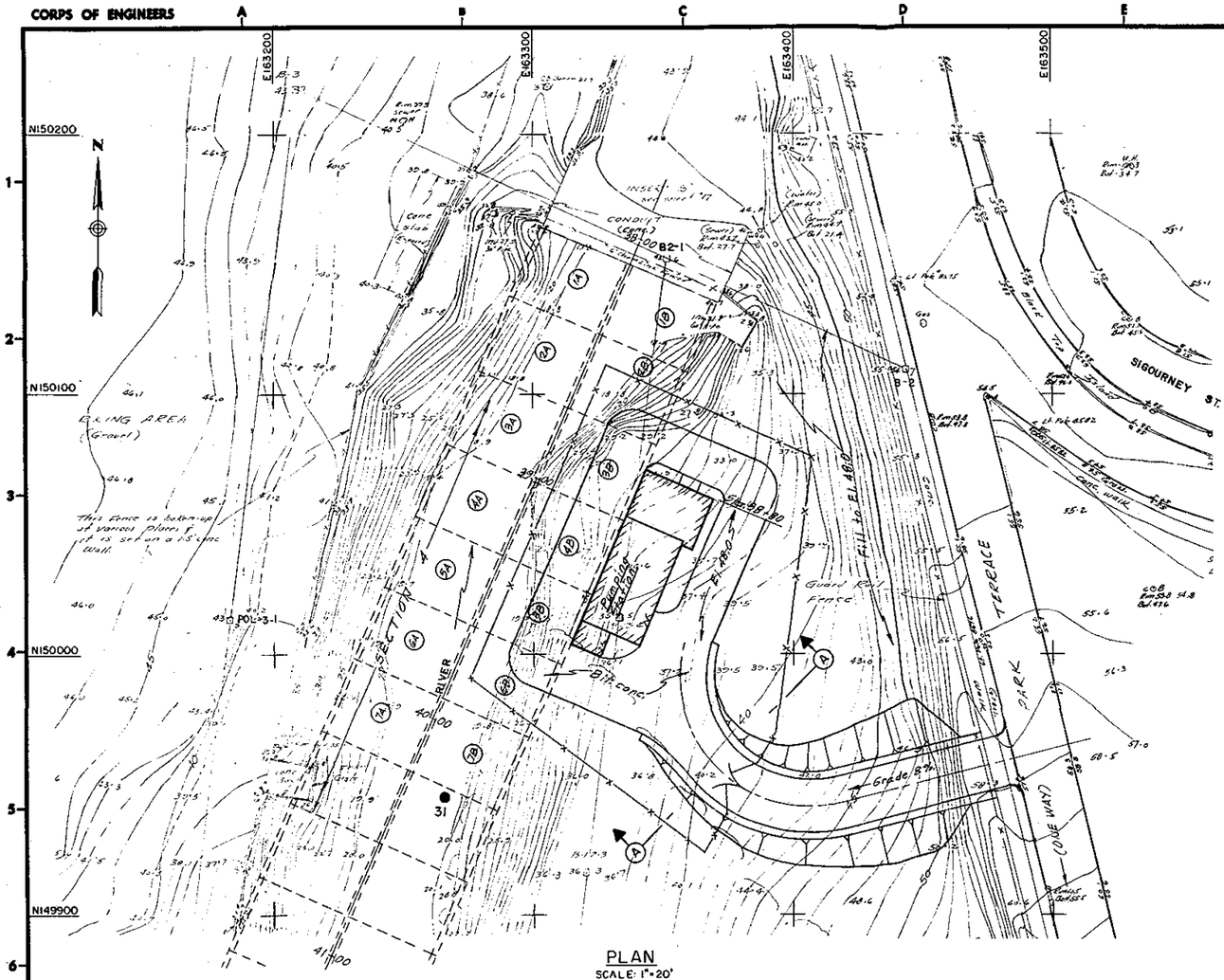
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
ELECTRICAL - PLANS NO. 2
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

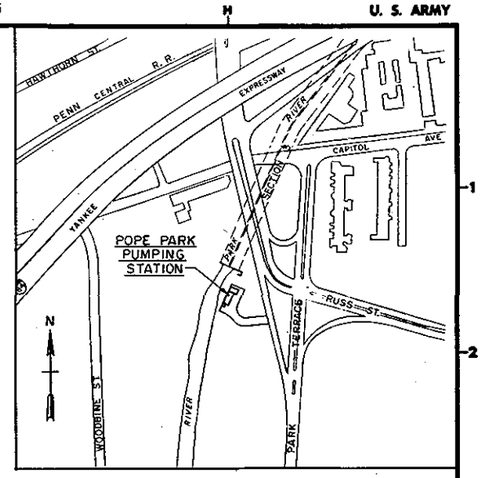
SCALE SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-9

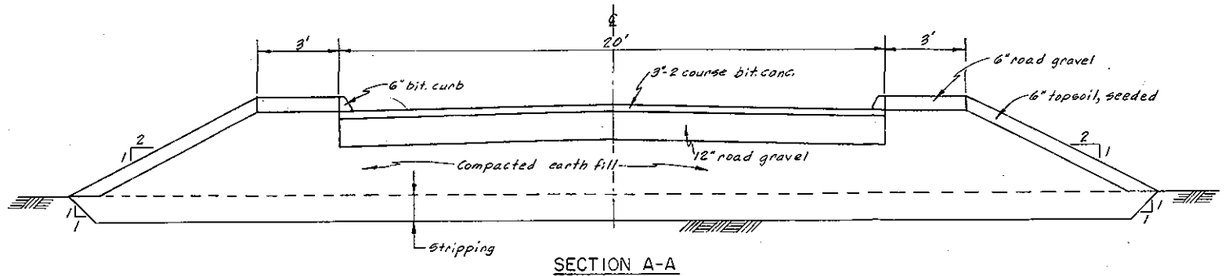
CORPS OF ENGINEERS — U. S. ARMY



PLAN
SCALE: 1"=20'



LOCATION MAP
SCALE: 1"=200'



SECTION A-A
SCALE: 1"=2'

GRAPHIC SCALES
1"=200' 200' 0 200' 400'
1"=20' 20' 0 20' 40'
1"=2' 2' 0 2' 4'

REVISION	DATE	DESCRIPTION	BY

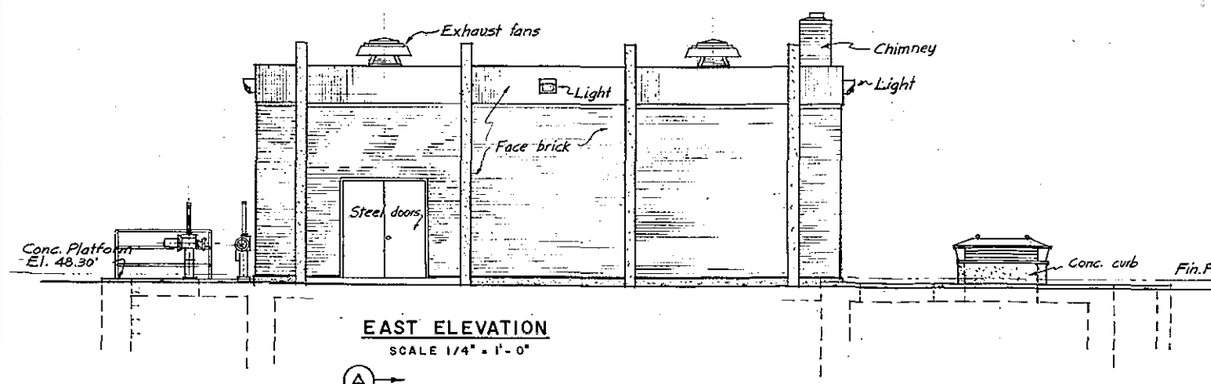
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED
CHIEF, SECTION
APPROVAL RECOMMENDED
CHIEF, HYDR. & SOIL MECHANICS BRANCH
RECOMMENDED
HEADQUARTERS ENGINEER
APPROVAL RECOMMENDED
CHIEF BRANCH

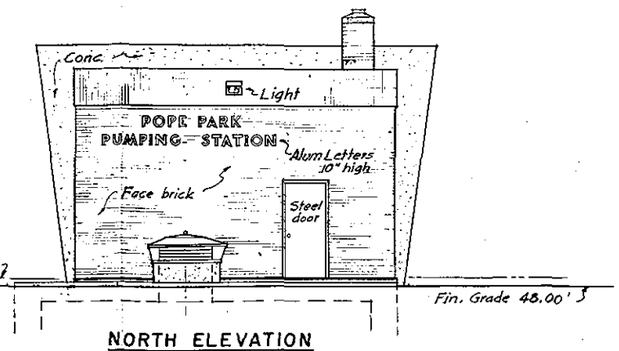
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
POPE PARK PUMPING STATION
GRADING PLAN AND SECTION
HARTFORD CONNECTICUT
APPROVED DATE
CHIEF, ENGINEERING DIVISION
SCALE SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-10

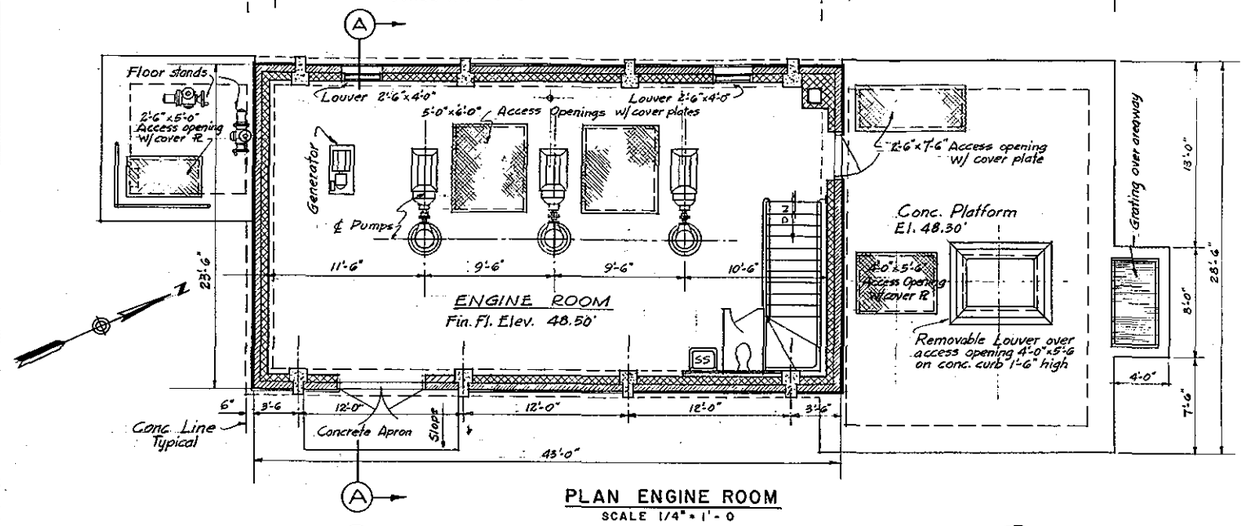
CORPS OF ENGINEERS — U. S. ARMY



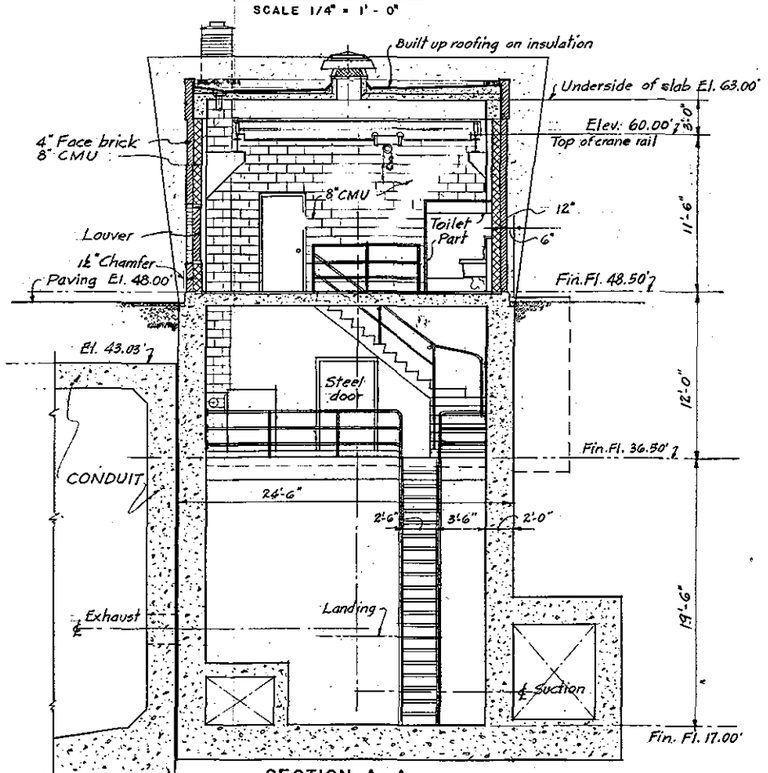
EAST ELEVATION
SCALE 1/4" = 1'-0"



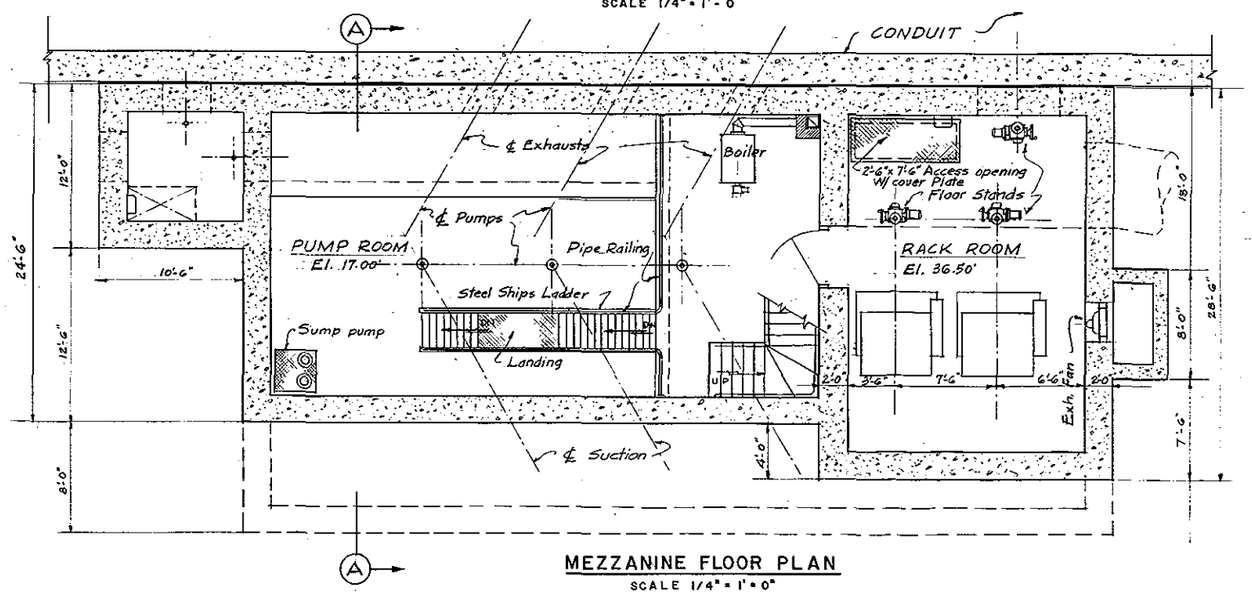
NORTH ELEVATION
SCALE 1/4" = 1'-0"



PLAN ENGINE ROOM
SCALE 1/4" = 1'-0



SECTION A-A



MEZZANINE FLOOR PLAN
SCALE 1/4" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0" 4' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

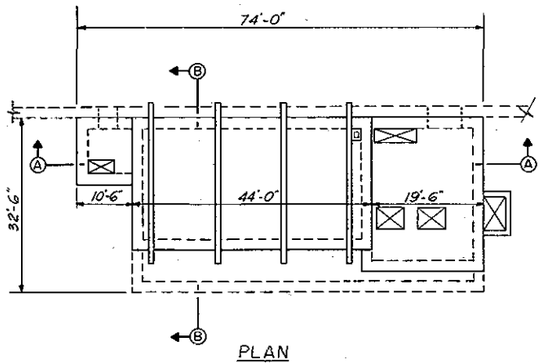
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
POPE PARK PUMPING STATION
ARCHITECTURAL
PLANS, ELEVATIONS AND SECTION

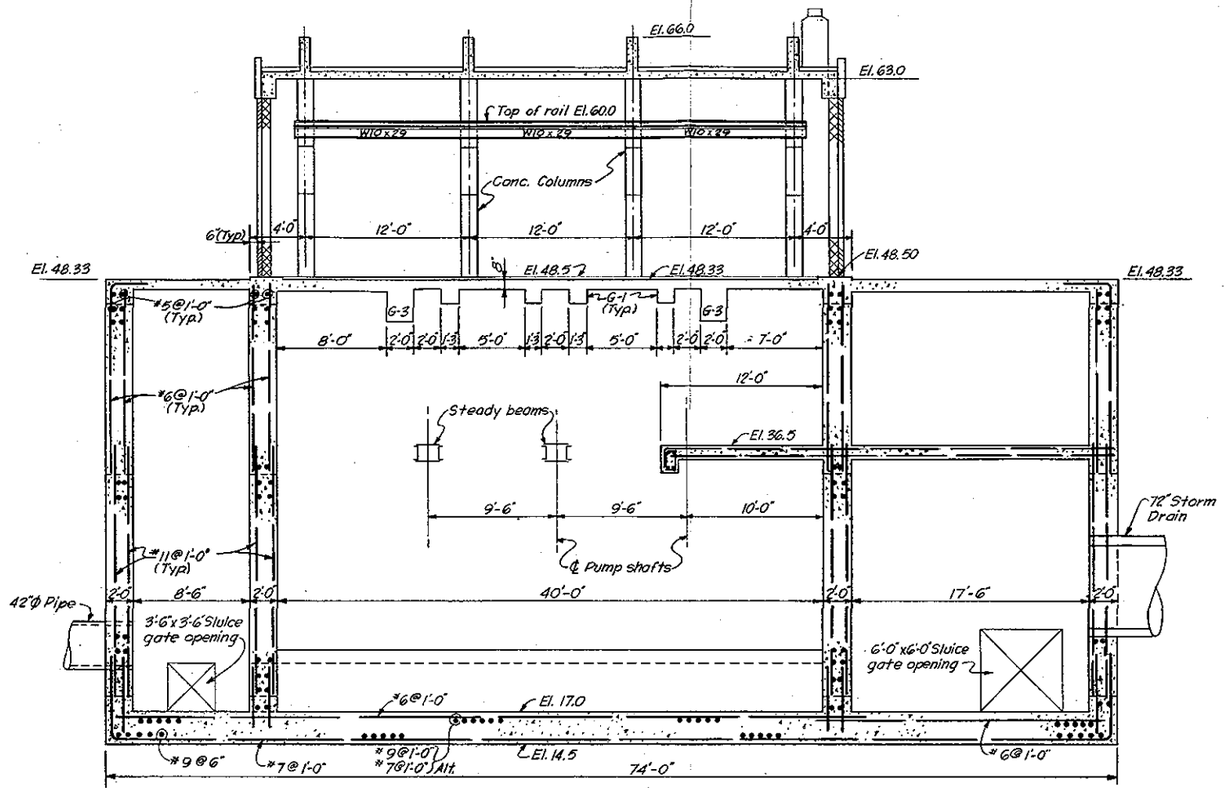
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION — DATE
SCALE | SPEC. NO. | DRAWING NUMBER
SHEET

PLATE 6-11

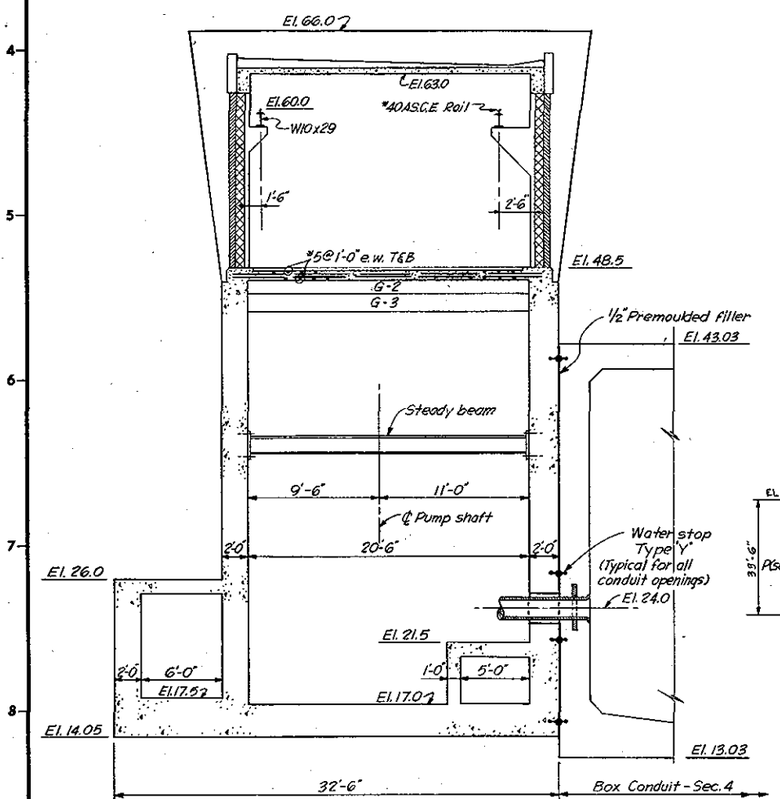
CORPS OF ENGINEERS — U. S. ARMY



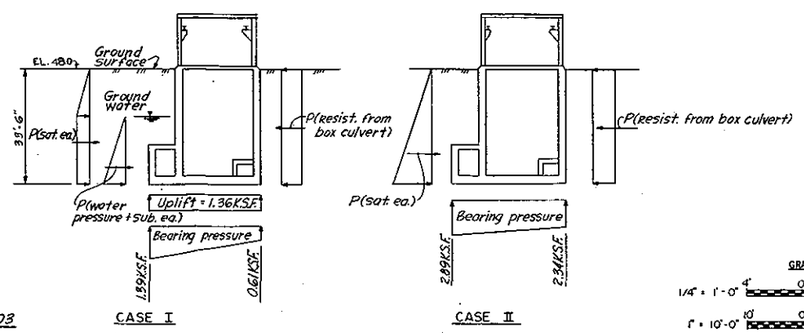
PLAN
SCALE 1" = 10'-0"



SECTION A-A
SCALE 1/4" = 1'-0"



SECTION B-B
SCALE 1/4" = 1'-0"



LOADING ASSUMPTIONS

Case I
Dead weight of structure, no water inside. Outside water to El. 36.2

Case II
Dead weight of structure and equipment. No water outside, water in suction and gravity chambers.

GRAPHIC SCALES
1/4" = 1'-0" 4' 0 4' 8'
1" = 10'-0" 10' 0 10' 20'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

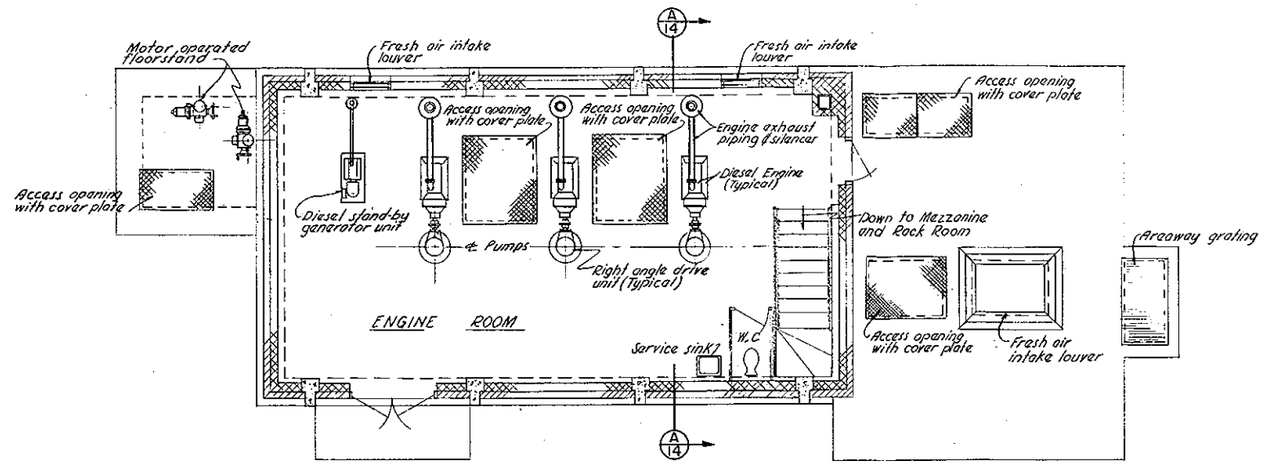
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
POPE PARK PUMPING STATION
STRUCTURAL
PLAN, SECTIONS AND DETAIL
HARTFORD CONNECTICUT

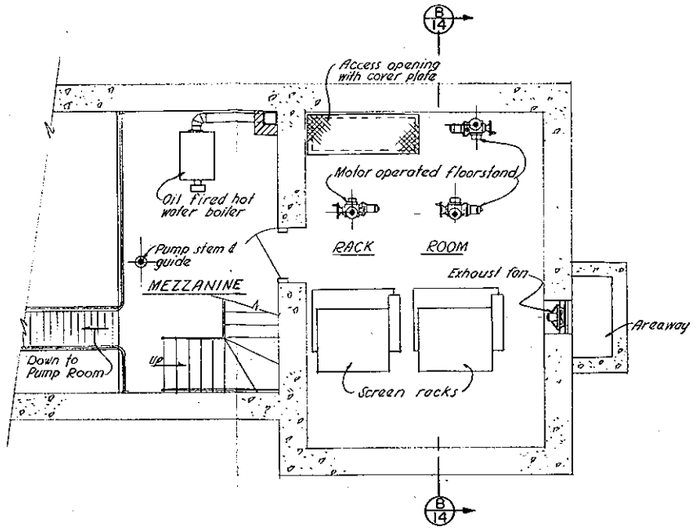
APPROVED DATE
CHIEF, ENGINEERING DIVISION
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-12

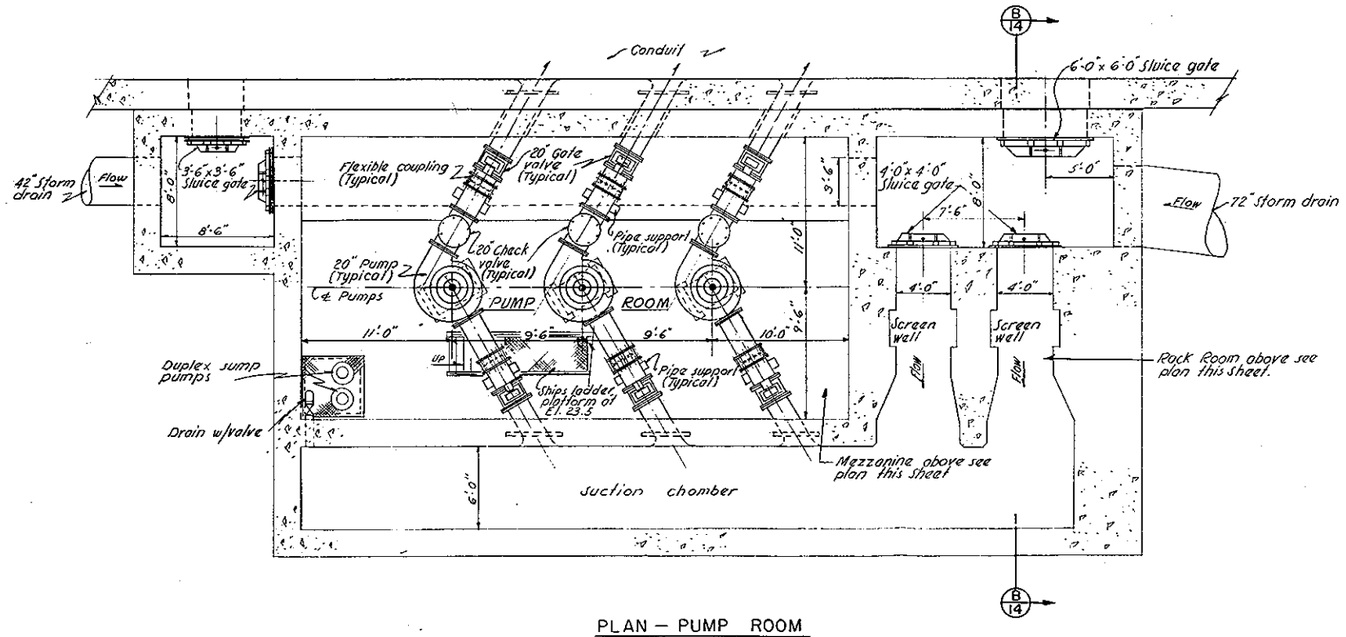
CORPS OF ENGINEERS — U. S. ARMY



PLAN - ENGINE ROOM
(EL. 48.5)
SCALE 1/4" = 1'-0"



PLAN-MEZZANINE & RACK ROOM
(EL. 36.5)
SCALE 1/4" = 1'-0"



PLAN — PUMP ROOM
(EL. 17.0)
SCALE 1/4" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0" 4' 2' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

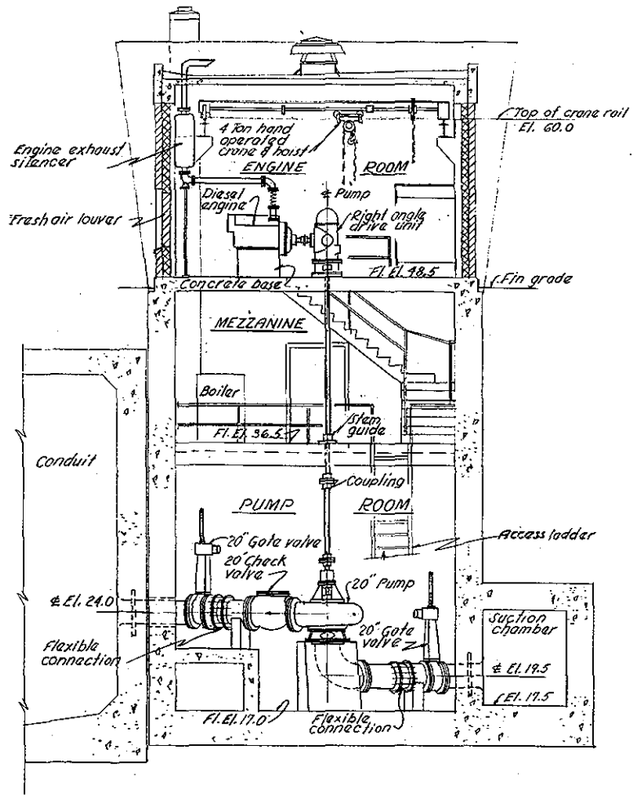
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
POPE PARK PUMPING STATION
MECHANICAL PLAN
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

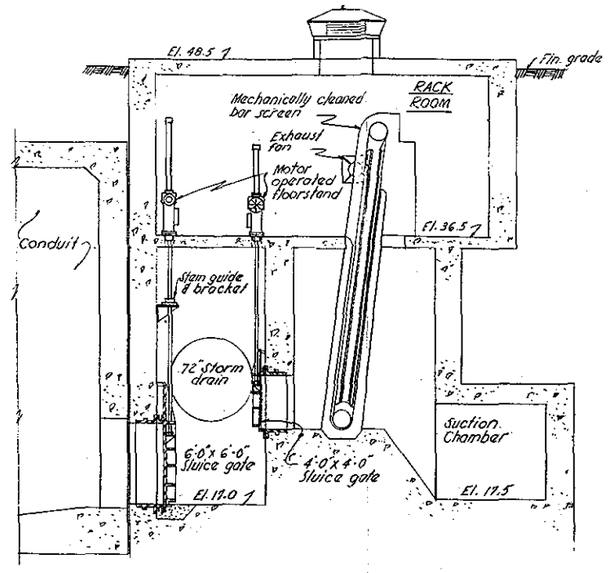
PLATE 6-13

CORPS OF ENGINEERS A B C D E F G H U. S. ARMY



SECTION A/13

SCALE 1/4" = 1'-0"



SECTION B/13

SCALE 1/4" = 1'-0"

GRAPHIC SCALES

1/4" = 1'-0" 4' 2' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF BRANCH

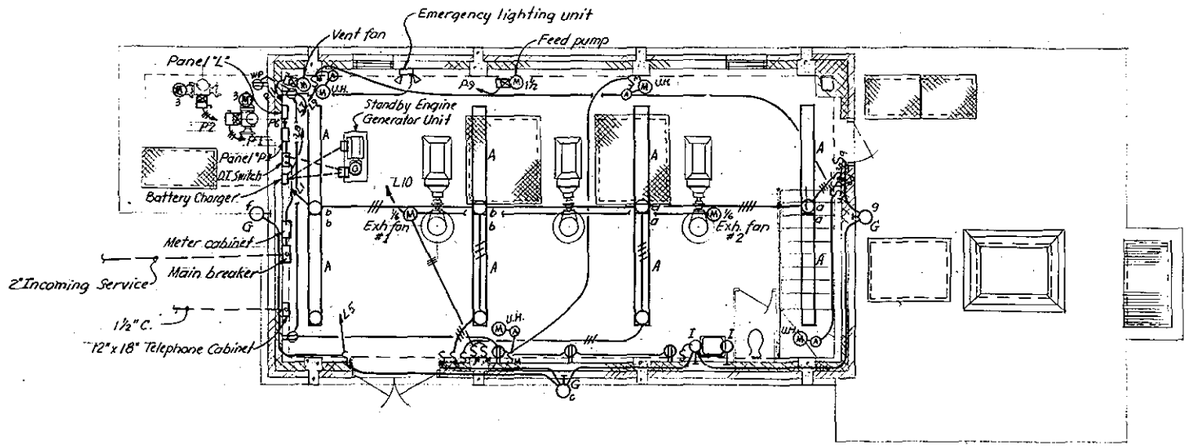
WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
POPE PARK PUMPING STATION
MECHANICAL-SECTIONS
HARTFORD CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

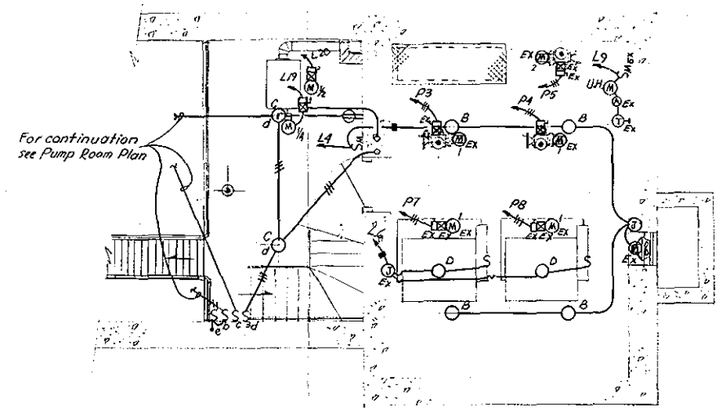
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-14

CORPS OF ENGINEERS U. S. ARMY

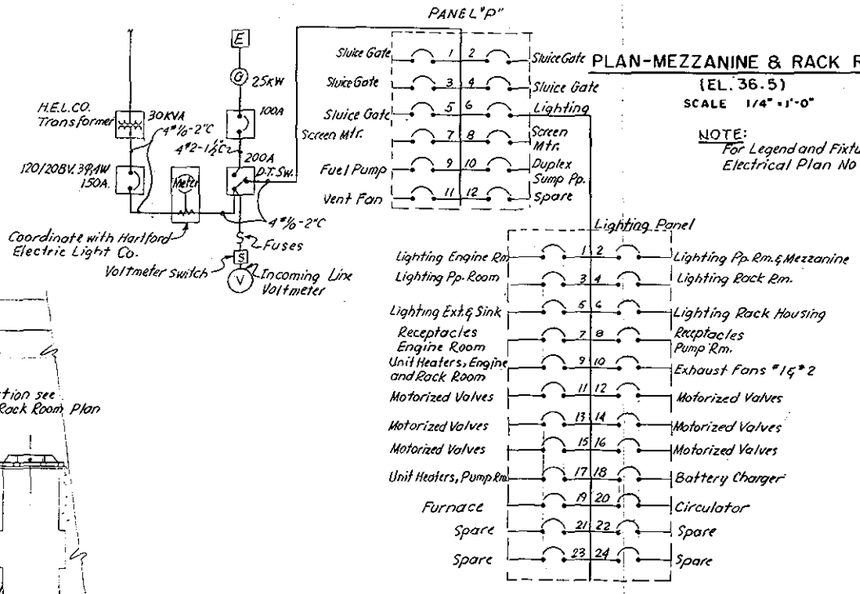


PLAN - ENGINEER ROOM
(EL. 48.5)
SCALE 1/4" = 1'-0"

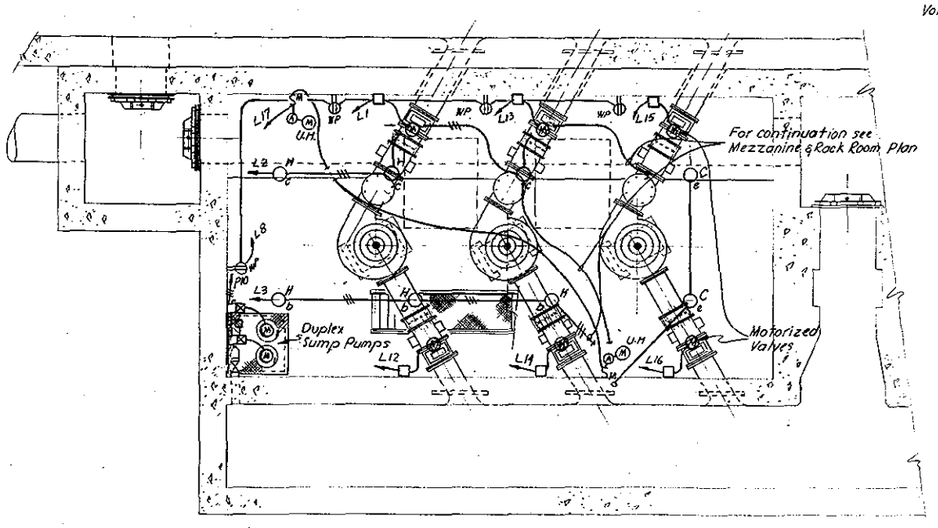


PLAN-MEZZANINE & RACK ROOM
(EL. 36.5)
SCALE 1/4" = 1'-0"

NOTE:
For Legend and Fixture Schedule, see Armory Pumping Station, Electrical Plan No 1.



ONE LINE DIAGRAM
NO SCALE



PLAN — PUMP ROOM
(EL. 17.0)
SCALE 1/4" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0"

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT
PARK RIVER LOCAL PROTECTION
POPE PARK PUMPING STATION
ELECTRICAL - PLANS

HARTFORD CONNECTICUT

APPROVED: DATE:
CHIEF, ENGINEERING DIVISION

SCALE SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 6-15

APPENDIX A

STRUCTURAL DESIGN COMPUTATIONS

APPENDIX A

Index to Sheets

Title	Page No.
ARMORY STATION	
Superstructure	A1 - A26
Engine Room Floor	A27 - A29
Superstructure Walls	A30 - A32
Stability Analysis	A33 - A47
POPE PARK STATION	
Superstructure	A48 - A60
Substructure	A61 - A78
Stability	A79 - A94
Base Slab	A95 - A100
Plans & Sections	A101- A110

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

PAGE A-1

SUBJECT: Armory Pump Station
COMPUTATION: General Design Criteria
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: Oct, 1974

General:

The Foundation For The Armory Pump Station Is Built. Only The Super Structure Is Covered Under This Contract. The Originally Planned Pump Station Has Been Partially Revised (I.E.)

1. Roof Over Utility Room Has Been Dropped.
2. Mufflers Have Been Placed Inside The Building.
3. Precast Prestressed Double Tees Have Been Added To The East Elevation.
4. Masonry Chimney Has Been Replaced By A Steel Chimney Pipe.
5. 10 TON Bridge Crane Has Been Reduced To A 5 TON Bridge Crane
6. Masonry Wall Details Have Been Added
7. Riveted Conn. Will Be Revised To Either Bolted or Welded Connections

Governing Manuals

(1) EM 1110-1-2101, 1 Nov 63, "Working Stresses For Structural Design"

(2) EM 1110-2-3104, 9 Jun 58, "Structural Design of Pumping Stations"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: GENERAL DESIGN LOADS
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: OCT, 1974

GENERAL LOADS

WIND LOADS

(A) BOCA (Conn) = 15 psf (Sect 7146.11)

(B) EM 1110-2-3104 Pg 3, = 20 psf (EITHER DIRECTION (SUCTION OR PRESSURE)

SNOW LOADS

(A) BOCA (Conn) Sec 7116.1 – 30 psf

EARTHQUAKE

(A) TM 5-809-10, APRIL 1973

From PLATE 1-4-1, Pg 1-8

AREA: HARTFORD COUN ZONE 1 SEISMIC

BASE SHEAR $V = ZKCW$

$Z = .25$ Pg 1-14
$K = .67$ (DUCTILE FRAME)
$C = .10$ (1 STORY BUILDING)
W

$\therefore V = .0167\,G$

$H_N = 17'\text{-}10'' \pm$ $D = 27' \pm$

$H/D > 3.0$ $F_T = 0$

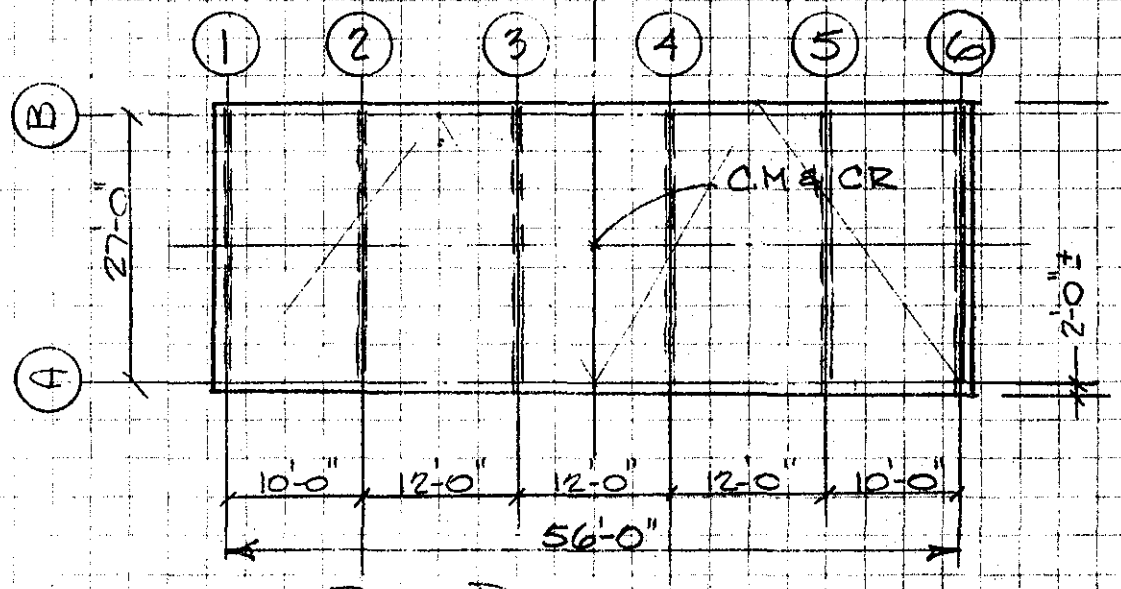
FOR PARTS & PORTION

$F_P = Z C_P W_P$

NED FORM 223
27 Sept 49

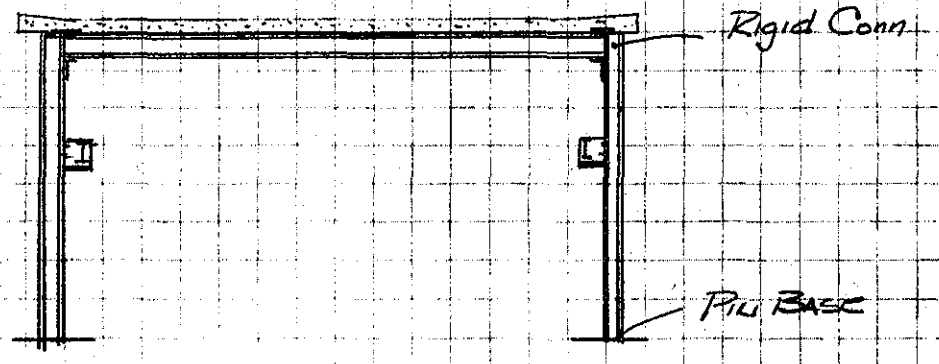
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION:
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: OCT, 1974

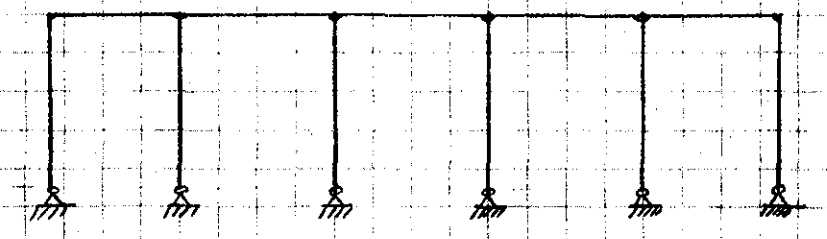


ROOF PLAN

TYPICAL INTERIOR FRAME (END FRAME SIMILAR)

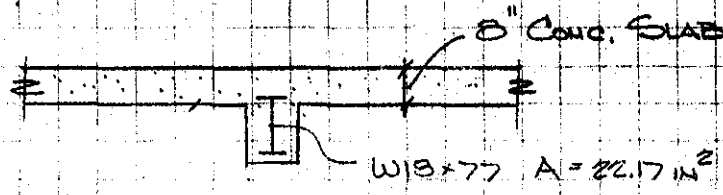


A & B LINE FRAMES



SUBJECT: Armory Pump Station
COMPUTATION: Compute W Fox Seismic
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: Oct, 1974

Consider W - (Int. Frames)



NOTE: Alt. Deck Design Used
See A-26

@ Ridge = 8" + 3" + 11"
@ Low Pt = 8"

Ave t = 8" + 2/3(3) = 10"

W Roof = Concrete = 60' × 31' (Slab, 10" Ave)
(58 cy)

= 1550 cu.ft × .150 = 233^k

Steel = 27' × 6' × .077^k/' + 20' × 6' × .06 (Gir, 1/2 Col) = 20^k ±
+ 9^k Spud Bar

75% of LL = .75(30^psf) × 60' × 31' = 42^k

Add'l DL

1½ Rigid Insul	2.25
Built-Up Roof	6.00
Add'l 2" Insul. Soffit	3.00
	11.25 psf

Say 12^psf

W = 12 × 60 × 31 = 22.32^k

W_T = 233 + 29 + 42 + 24± = 328^k

V = .0167(329) = 5.5^k

V/Frame = .917^k

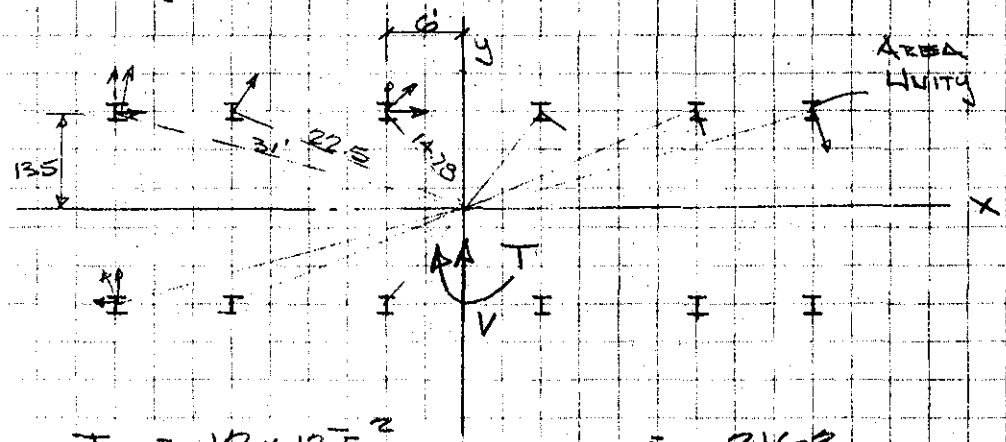
$V_{A,B}$ = 5.5/2 = 2.75^k

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Sta
COMPUTATION: Torsional Shear
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE:

$F_T = \frac{TC}{J}$ $J = I_x + I_y$ $T = 5.5^k (.05)(56)$ (MINIMUM ECCENTRICITY) $= 15.4$



$I_x = 12 \times 13.5^2 = 2163$

$I_y = A \times (6^2 + 18^2 + 28^2) = 4576$

$6739 = J$

Constant

$F_T = \frac{15.4(31)}{6739} = .07$ $F_y = .063$ $F_x = .030$

$= \frac{15.4(22.5)}{6739} = .05$ $F_y = .040$ $F_x = .030$

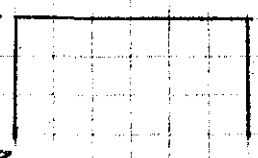
$= \frac{15.4(14.78)}{6739} = .033$ $F_y = .013$ $F_x = .030$

$F_{TOT} = A \& B = .03(6) = .18^k$

$F_{TOT, END} = .063(2) = .13^k$ MAX

(1) INT & END

$f_t + F$ →

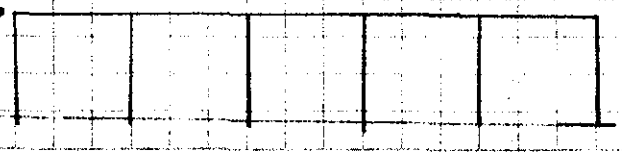


$f_t + F = .917 + .13$
$= 1.047^k$
Use 1.05^k

(2) FRAME A & B

$2.75 + .18$
$= 2.93^k$
Use 2.93^k

→



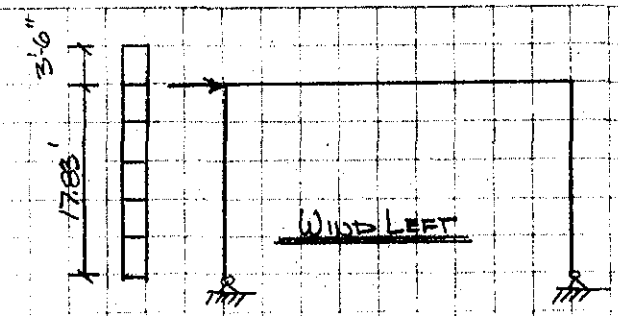
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: ARMORY PUMP STATION

COMPUTATION

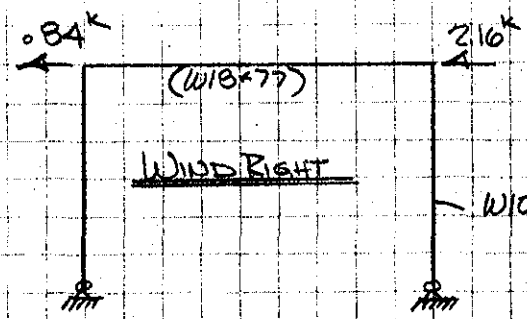
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 OCT 74



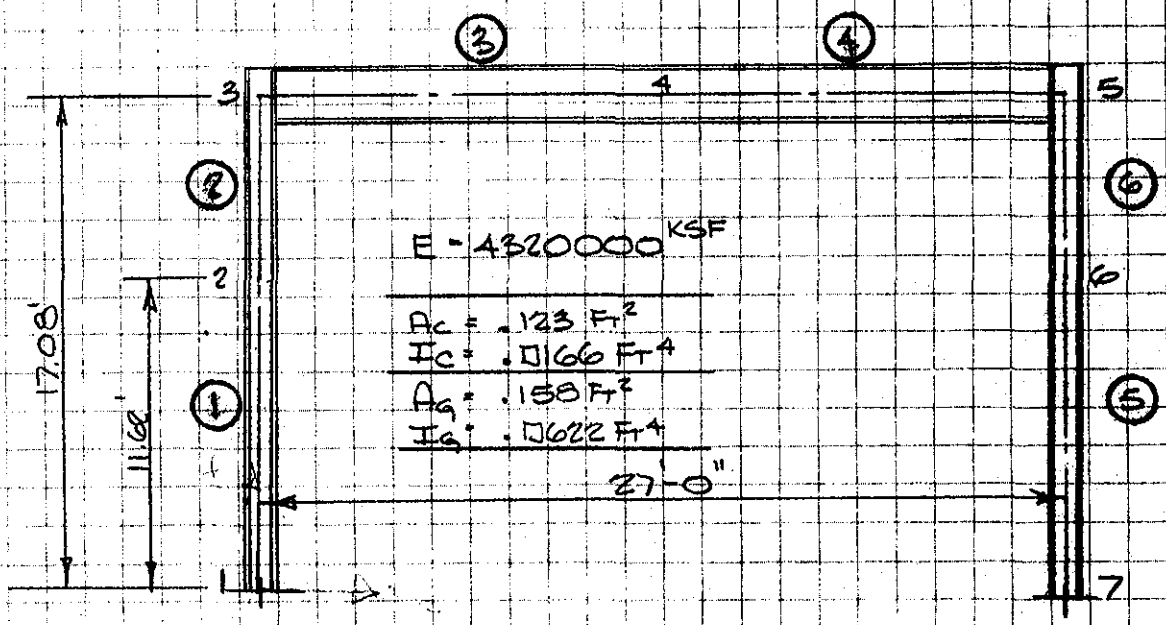
Width = 12', BASIC PRESSURE IS EQUAL TO 20 PSF (SNOW OVERHEAD)

$P = 12' \times .02^{KSF} \times \left(\frac{17.83}{2} + 3.5\right)$

$= 2.98^{K}$ OR 3^{K}



WIND GOVERNS DESIGN



$E = 4320000^{KSF}$

$A_c = .123\ Ft^2$
$I_c = .0166\ Ft^4$
$A_g = .158\ Ft^2$
$I_g = .0622\ Ft^4$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Loads
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 Oct 74

Roof

DL
10" Ave Conc Slab - 125
1½ Insulation 2.25
Built-up Roof 6.00
Add'l 2" Insulation 3.00
136.25

Concrete + Conc. Fixture

$W_{DL} = .13625(12) + .350$

$= 1.635 + .350$

$= 1.985^{k/'}$

LL = Snow = 30 psf $W_{LL} = 12(.03) = .36^{k/'}$

$W_{TOTAL} = 1.985 + .36 = 2.345^{k/'}$

Nodal Point Loads

DL only Pts. 3 & 5 Col wt = 5.5' × .06 = .33^k

Pts 2 & 6 Col wt = 11.62 × .06 = .70^k

For Crane

5 ton Crane (Hand Drawn) No Impact

Max Wheel Load = 6^k 2 Wheels / Rail

Rail
#40 Arce Rail = 14^{#/'}
W10×45 = 45^{#/'}
59^{#/'}

$P = 2 \times 6^k + 12(.059)$
$= 12.72^k$

$e_L = 2'-1'' = 2.08$ $M_L = 26.50^{'k}$

$e_R = 1'-5\frac{1}{2} = 1.46$ $M_R = 18.57^{'k}$

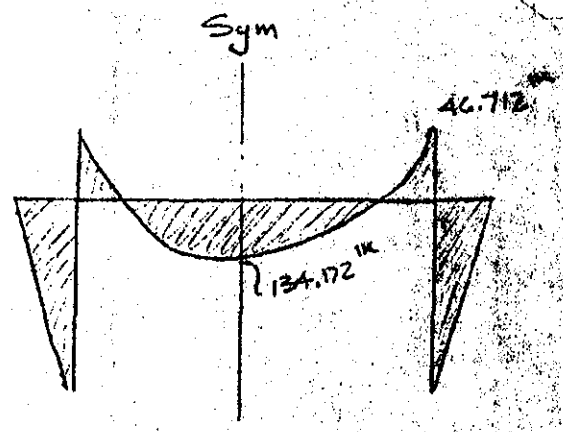
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Computer Output Main Frame
COMPUTED BY: W. Rodger CHECKED BY: DATE: 21 Nov 74

```
PARK RIVER LOCAL PROTECTION
ARMORY PUMPING STATION
TYPICAL INTERIOR FRAME
7,6,4
1,110,5*0
2,0,0,11.62,3*0
3,0,0,17.08,3*0
4,0,13.5,17.08,3*0
5,0,27.0,17.08,3*0
6,0,27.0,11.62,3*0
7,110,27.0,0,3*0
1,1,2,.123,4320000,0,.0166,3*0
2,2,3,.123,4320000,0,.0166,3*0
3,3,4,.153,4320000,0,.0622,3*0
4,4,5,.153,4320000,0,.0622,3*0
5,7,6,.123,4320000,0,.0166,3*0
6,6,5,.123,4320000,0,.0166,3*0
LC-1  DEAD LOAD ONLY
4,0
2,0,-.70,0
3,0,-.33,0
5,0,-.33,0
6,0,-.70,0
304,2,-1.935,0,1
5*0
LC-2  DEAD LOAD PLUS WIND RIGHTWARD DEFLECTION IN LOADS
4,0
2,0,-.70,0
3,3.0,-.33,0
5,0,-.33,0
6,0,-.70,0
304,2,-1.935,0,1
5*0
LC-3  FULL DEAD + LIVE LOADS
4,0
2,0,-.70,0
3,0,-.33,0
5,0,-.33,0
6,0,-.70,0
304,2,-2.345,0,1
5*0
LC-4  DEAD+CRANE LEFT
4,0
2,0,-.70,0
3,0,-.33,0
5,0,-.33,0
6,0,-.70,0
304,2,-2.345,0,1
5*0
END
```

SUBJECT: Armoku Pump Station
COMPUTATION: Computer Output - Main Frame
COMPUTED BY: W. Rodger CHECKED BY: DATE: 21 Nov 74



** DATE 10/01/74
** TIME 11:52:21
** SECTION 1
** LOADING 1

NODAL POINT DISPLACEMENTS

NODE	X-DISPL	Y-DISPL	ROT-DISPL
1	0.	0.	.13511E-02
2	-.11537E-01	-.56754E-03	-.72362E-03
3	.54095E-04	-.33729E-03	-.37117E-02
4	.35516E-07	-.22165E-01	0.
5	-.54033E-04	-.33729E-03	.37117E-02
6	.11537E-01	-.56754E-03	.72361E-03
7	0.	0.	-.13511E-02

.434"

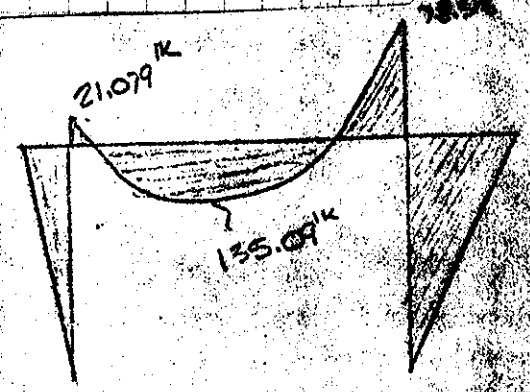
END ACTIONS WITH ELEMENT LOADS

	ELEMENT	AXIAL I / AXIAL J	SHEAR I / SHEAR J	MOMENT I / MOMENT J
L. Col	1	27.327	-2.735	-.000
		-27.327	2.735	-31.779
	2	27.127	-2.735	31.779
		-27.127	2.735	-46.712
Gir.	3	2.735	26.797	46.712
		-2.735	.000	134.172
	4	2.735	.000	-134.172
		-2.735	26.797	-46.712
R. Col	5	27.327	2.735	.000
		-27.327	-2.735	31.779
	6	27.127	2.735	-31.779
		-27.127	-2.735	46.712

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Computer Output Main Frame
COMPUTED BY: W. Rodger CHECKED BY: DATE: 21 Oct 74



** DATE 10/01/74
** TIME 11:52:31
** SECTION 1
** LOADING 2

NODAL POINT DISPLACEMENTS

NODE	X-DISPL	Y-DISPL	ROT-DISPL
1	0.	0.	-.16357E-02
2	.23507E-01	-.56704 -03	-.27975-02
3	.42229E-01	-.82629E-03	-.41458E-02
4	.49145E-01	-.36169E-01	.21301E-03
5	.49062E-01	-.24300E-03	.32733E-02
6	.45524E-01	-.55034E-03	-.13472E-02
7	0.	0.	-.53333E-02

.658" .434"

END ACTIONS WITH ELEMENT LOADS

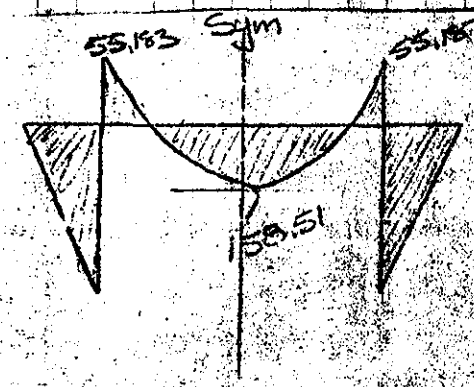
	ELEMENT	AXIAL I / AXIAL J	SHEAR I / SHEAR J	MOMENT I / MOMENT J
L.Col	1	25.930	-1.234	.000
		-25.930	1.234	-14.341
	2	25.930	-1.234	14.341
		-25.930	1.234	-21.079
Girr	3	4.234	24.930	21.079
		-4.234	1.393	134.185
	4	4.234	-1.393	-134.185
		-4.234	23.575	-72.313
R.Col	5	29.725	4.234	0.
		-29.725	-4.234	49.200
	6	29.025	4.234	-49.200
		-29.025	-4.234	72.313

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

PAGE A-11

SUBJECT: Armory Pump Station
COMPUTATION: Computer Output - Main Frame
COMPUTED BY: W. Rodger CHECKED BY: DATE: 21 Dec 74



** DATE 10/01/74
** TIME 11:52:21
** SECTION 1
** LOADING 3

NODAL POINT DISPLACEMENTS

NODE	X-DISPL	Y-DISPL	ROT-DISPL
1	0.	0.	.21368E-02
2	-.13629E-01	-.71432E-03	-.35435E-03
3	.63906E-04	-.10435E-02	-.43843E-02
4	.47439E-03	-.42719E-01	-.72750E-11
5	-.63397E-04	-.10435E-02	.43843E-02
6	.13629E-01	-.71432E-03	.35435E-03
7	0.	0.	-.21368E-02

.513" ΔT

END ACTIONS WITH ELEMENT LOADS

ELEMENT	AXIAL I AXIAL J	SHEAR I SHEAR J	MOMENT I MOMENT J
1	32.637	-3.231	-.000
	-32.637	3.231	-37.543
2	31.937	-3.231	37.543
	-31.937	3.231	-55.133
3	3.231	31.937	55.133
	-3.231	.000	153.505
4	3.231	.000	-153.505
	-3.231	31.937	-55.133
5	32.687	3.231	.000
	-32.687	-3.231	37.543

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: COMPUTER OUTPUT - MAIN FRAME
COMPUTED BY: W. Rodger CHECKED BY: DATE: 21 Nov 74

** DATE 10/31/74
** TIME 12:11:45
** SECTION 1
** LOADING 4

NODAL POINT DISPLACEMENTS

NODE	X-DISPL	Y-DISPL	ROT-DISPL
1	0.	0.	.23299E-02
2	-.11056E-01	-.93657E-03	-.13055E-02
3	.55649E-02	-.13122E-02	-.45371E-02
4	.54730E-02	-.43910E-01	.32501E-04
5	.53911E-02	-.13311E-02	.44520E-02
6	.19631E-01	-.99941E-03	.10675E-02
7	0.	0.	-.30679E-02

END ACTIONS WITH ELEMENT LOADS

ELEMENT	AXIAL I AXIAL J	SHEAR I SHEAR J	MOMENT I MOMENT J
1	45.114	-4.393	-.000
	-45.114	4.393	-51.043
2	31.394	-4.393	24.543
	-31.394	4.393	-48.527
3	4.393	31.354	43.527
	-4.393	.294	161.195
4	4.393	-.294	-161.195
	-4.393	31.951 V-Max	-55.457
5	45.701	4.393	.000
	-45.701	-4.393	51.043
6	32.231	4.393	-32.473
	-32.231	-4.393	56.457

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: GIRDER DESIGN
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: OCT 1, 1974

Consider W18×77 $A = 22.7$, $S_x = 142$, $r_y = 2.04$, $r_T = 2.36$, $d/A_f = 2.49$

Use AISC Recommended Allowable Stresses

LC-1	$M_{\oplus} = 134.17^{'k}$	$M_{\ominus} = 46.71^{'k}$
LC-2	$M_{\oplus} = 135.09^{'k}$	$M_{\ominus} = 72.32^{'k}$
LC-3	$M_{\oplus} = 158.51^{'k}$	$M_{\ominus} = 55.18^{'k}$
LC-4	$M_{\oplus} = 161.22^{'k}$	$M_{\ominus} = 56.457^{'k}$

$$v = \frac{31.951}{t_w d} = \frac{31.951}{.475 \times 18.16} = 3.7^{ksi} < 14.5^{ksi} \text{ Allowed}$$

$$C_b = 1.75 + 1.05\left(\frac{56.457}{161.22}\right) + .3\left(\frac{56.457}{161.22}\right)^2 = 2.15 \quad \text{Use } 1.0$$

$$\text{Actual Fiber Stress} = \frac{161.22^{'k}(12)}{142} = 13.62^{ksi}$$

$$\text{Say } \frac{kL}{r_y} = \frac{1(27)(12)}{2.04} = 158 \qquad F_A = 5.98^{ksi}$$

$$f_A = 4.393^{k}/22.7 = .194$$

$$f_A/F_A = .194/5.98 = .032$$

$$f_b/F_b = 13.62/22 = .619$$

$$.651 < 1.00 \text{ ok}$$

W18×77 IS MORE THAN ADEQUATE

$\Delta_{DL} = .434''$

$\Delta_{LL} = .079''$

$\Delta_{TOT} = .513''$

LUNG & MAX (Δ_{HOR}) = .56" RIGHT

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

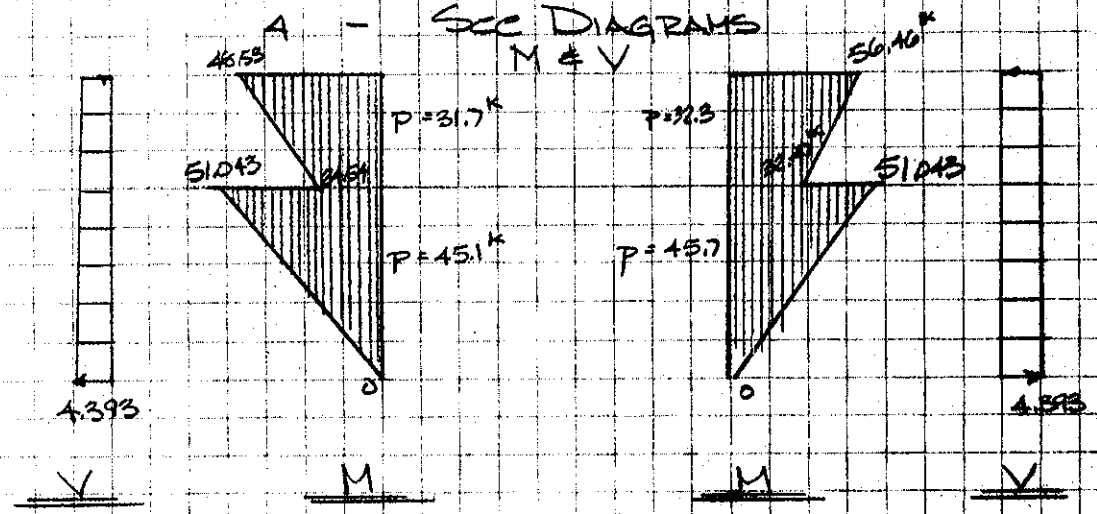
SUBJECT: Armory Pump Station
COMPUTATION: Col. Design - Prel
COMPUTED BY: W. Rodger CHECKED BY: DATE: 1 Oct 74

Load Cases 1 - M = 46.712'^k
P = 27.13^k

2 - M = 72.318'^k (Wind) 1/3 Increase in Stress Allowed
P = 27.13^k

3 - M = 55.183
P = 32^k

A - See Diagrams M & V



$G_{BASE} = 10$

$G_{TOP_x} = \frac{I_c}{L_c} \times \frac{L_g}{I_g} = \frac{341 \times 27'}{18 \times 1290} = .40$

from Pg 5-139 AISC
$K_x = 1.08$

$G_{TOP_y} = \frac{116 \times 12'}{18' \times 82.5} = .94$

$K_y = 1.9$

I_{yy} Col = 116
I_{xx} Spa = 82.5

$\frac{KL}{r_y} = \frac{1.9(17.08)(12)}{2.57} = 152$ $F_A = 6.46^{ksi}$

$\frac{KL}{r_x} = \frac{KL}{r_b} = \frac{1.8(17.08)(12)}{4.41} = 84$ $F'_{ex} = 21.16^{ksi}$

SUBJECT: Armory Pump Station
COMPUTATION: Col. Design Con
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 1 Oct 74

Consider LC-3 $P = 32^k$ $M = 55.2^{'k}$ W10×60 $A = 17.7$, $S_x = 67.1$, $r_y = 2.57$, $r_x = 4.4$, $r_T = 2.8$, $d/A_f = 1.49$

$f_A = \frac{32^k}{17.71} = 1.81^{ksi}$ $\frac{f_A}{F_A} = \frac{1.81}{6.46} = .28$

$C_m = .85$ Pg 5-23 AISC.

Use form 1.6-1A Pg 5-22 AISC

$$\frac{f_A}{F_A} + \frac{C_m f_{bx}}{\left(1 - \frac{f_A}{F'_{ex}}\right) F_{bx}} \leq 1.0$$

$f_{bx} = \frac{55.2(12)}{67.1} = 9.87^{ksi}$

$F_b = 22^{ksi}$

$$.28 + \frac{.85(9.87)}{\left(1 - \frac{1.81}{21.16}\right) 22}$$

$.914$

$.28 + .417 = .697 < 1.0$

Consider LC-4 $P = 45.7^k$ $M = 51.0^{'k}$ Below Crane Level

$f_A = \frac{45.7}{17.71} = 2.58$ $\frac{f_A}{F_A} = .40$

form 1.6-1A

$f_{bx} = 9.12$

$$\frac{f_A}{F_A} + \frac{C_m f_{bx}}{\left(1 - \frac{f_A}{F'_{ex}}\right) F_{bx}} = .40 + \frac{.85(9.12)}{\left(1 - \frac{2.58}{21.16}\right) 22}$$

$.8978$

$= .40 + .401 = .801$

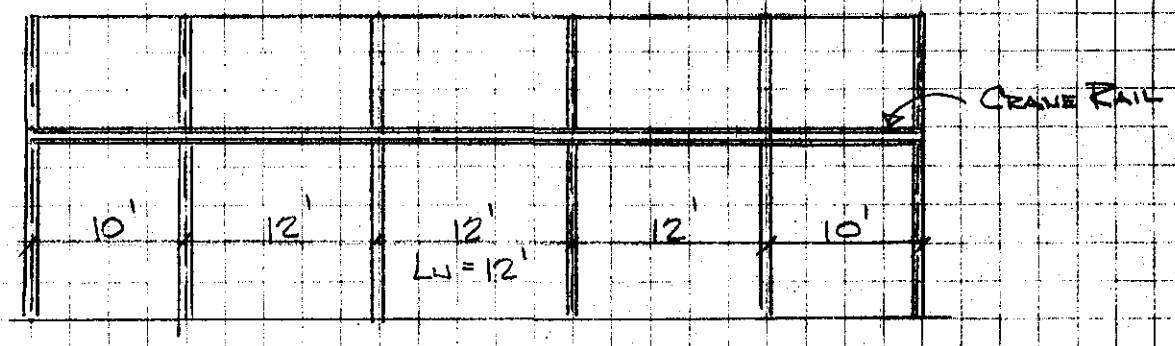
Other Load Cases 1 & 2 Not Critical

W10×60 is Adequate for Column

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: CRADE RAIL DESIGN
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 OCT 74



CONSIDER 5-TON BRIDGE CRANE (HAND DRAWN)

REF: EM 1110-2-3104 Pg 4 — 2 WHEELS/RAIL, 5'-6" SPACING

(A) MAX WHEEL LOAD = 5730# SAY 6K/WHEEL (NO IMPACT REQUIRED)

(B) LONG FORCE 10% of MAX WHEEL LOADS

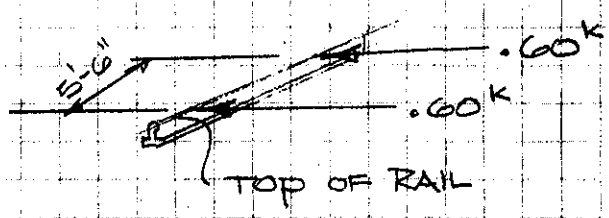
$P_L = .10(12^K) = 1.2^K$ ALONG RAIL

(C) LATERAL FORCE 10% of Trolley Weight + TARE WT

" 3/4 of this DISTRIBUTED EQUALLY AMONG CRANE WHEELS AT EITHER SIDE of RUNWAY & Applied @ TOP of RAIL"

ASSUMED TO BE VERIFIED

$P_{H_T} = .10(\underset{\text{TARE}}{10^K} + \underset{\text{DL}}{6^K}) = 1.6^K$



DIST $\frac{.75(1.6)}{2} = .60^K$

WT #40 RAIL = 14#
W10×45 = 45#
59#/'

SUBJECT: Armory Pump Station
COMPUTATION: Design of Crane Girder
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 Oct 74

$$M_U = \frac{P}{2L}\left(L - \frac{a}{2}\right)^2$$

$$a = 5.5' < .586(12) = 7.03$$

$$M_U = \frac{6^k}{2(12)}\left(12 - \frac{5.5}{2}\right)^2 = 21.39^{'k} + \frac{.06(12)^2}{8} = 22.5^{'k}$$

$$M_H = \frac{.6^k}{2(12)}(85.563) = 2.14^{'k}$$

TORSION

$$a = \sqrt{\frac{EC_w}{GJ}} = \left(\frac{29 \times 384}{11.2 \times .579}\right)^{1/2} = 41.44$$

TRY W10×29
$S_{xx} = 30.8$
$S_{yy} = 5.61$

$$l/a = \frac{12 \times 12}{41.44} = 3.47$$

$$l/2a = 1.74$$

$$M_F = \frac{P_e a}{2h}\left(.05 + .94\frac{l}{2a} - .24\left(\frac{l}{2a}\right)^2\right)$$

$$h = 10.22 - .50 = 9.72^{''}$$

$$T = P_e = .60^k(5'' + 3\tfrac{1}{2}''\text{ RAIL}) = 5.01^{''k}$$

$$M_F = \frac{(5.01)(41.44)}{2(9.72)}\left(.05 + .94(1.74) - .24(1.74)^2\right)$$

$$= 10.5^{''-k}$$

$$\therefore S_F = \frac{1}{6}(t_F)(b_F)^2 = \tfrac{1}{6}(.50)(5.79)^2 = 2.8^{''3}$$

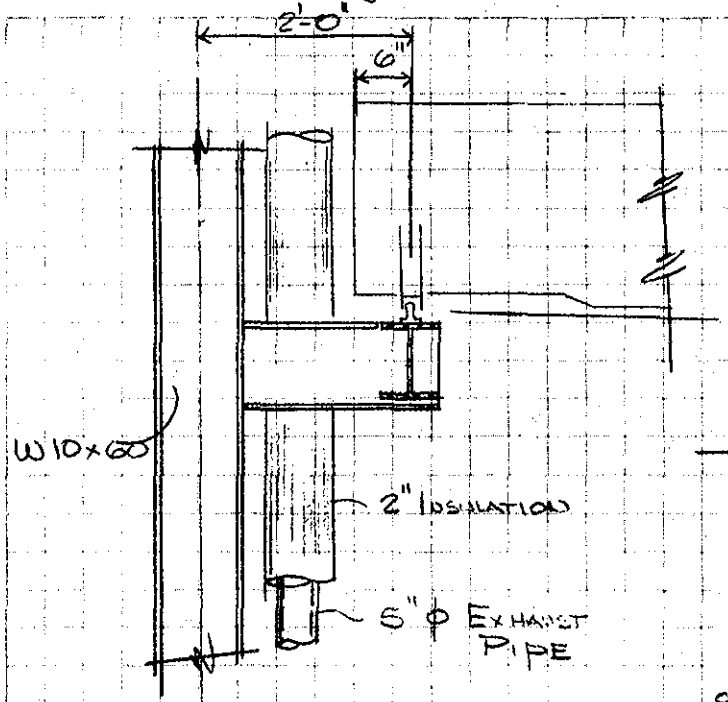
			f/F
$F_T = 27^{ksi}$	$f_t = \frac{10.5^{''-k}}{2.8} = 3.75^{ksi}$		.139
$F_{By} = 27^{ksi}$	$f_{by} = \frac{2.14(12)}{5.61} = 4.58$		.169
$F_{Bx} = 22^{ksi}$	$f_{bx} = \frac{22.5(12)}{30.8} = 8.77$		.400
			.708 < 1.0 ☐

USE — W10×29 FOR CRANE RAIL, "SEE DETAIL AT BRACKET" NEXT SHEET

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: BRACKET DETAIL
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 OCT 74



BRACKET DETAIL

$I_{W10} = 158$

DEFLECTION CHECK GRADE BEAM

$$\Delta = \frac{Pa}{24EI}(3L^2 - 4a^2)$$

$$= \frac{6(3.25)(3(12)^2 - 4(3.25)^2) \times 1728}{24(29000)(158)}$$

$$= .12 \text{ in}^2$$

or

$$\Delta = \frac{6(12)^3 \times 1728}{48(29000)(158)} = .08$$

$$.12'' = \frac{L}{1200}$$

DEFLECTION IS NO PROBLEM

BRACKET

$$P_{MAX} = 2(6)^k + .060^{kf} \times 12 = 12.72^k$$

$$M_{CANT} = 12.72^k(2) = 25.44^{'k}$$

$$S_{REQ} = \frac{25.44 \times 12}{22} = 13.88 \text{ in}^3 \quad \text{Use W12×27}$$

$$f_b = \frac{25.44(12)}{34.2} = 9^{ksi} < 22$$

$$v = \frac{12.72^k}{11.96 \times .287} = 4.5^{ksi} < 14.5^{ksi}$$

$$\Delta = \frac{PL^3}{3EI} = \frac{12.72(2)^3 \times 1728}{3(29000)(204)} = .01'' \quad \text{No Problem}$$

$$T = C = \frac{25.44^{'k} \times 12}{11.96''} = 25.53^k$$

SUBJECT: Armory Pump Station
COMPUTATION: Bracket Detail
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 2 Oct 74

W10×60 $t_w = .415$, $t_f = .683$, $K = 1\frac{1}{4}''$

W12×27 $t_w = .237$, $t_{FLG} = .400$, $b_f = 6.497$

$A_{FLG} = 2.60$

According to AISC 1.15.5

Opp Compressing Flg.

(A) $t \geq \frac{C_1 A_F}{t_b + 5K} = \frac{1.0(2.60)}{.400 + 5(1.25)} = .39$

$t_{col} = .415''$

$t_{weld} = .415''$

or

B $t \leq \frac{d_c\sqrt{F_y}}{190} = \frac{7.75(6)}{190} = .26$

No Stiffeners Required!

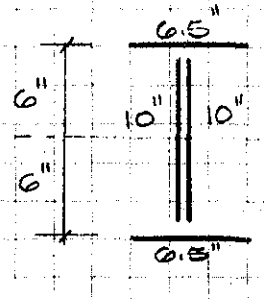
$d_c = T_{col}$

Opp. Tension Flange

$t_f < .4\sqrt{C_1 A_F} = .40\sqrt{2.60} = .645''$

$t_{actual} = .6683$

No Stiffener Req'd



Weld Pattern

N.A. Weld

$I_{xx} = 2 \times \frac{10^3}{12} + 2 \times 6.5(6)^2 = 634.6$

(166.6, 468)

$S_{TT} = S_{BB} = \frac{634.6}{6} = 105.77$

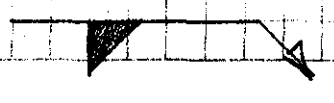
Weld Load $= \frac{12.75^k}{3''} = .390^{k/''}$

$\frac{M}{S} = \frac{25.44^{'k}(12)''}{105.77} = 2.87$

$R = [.39^2 + 2.87^2]^{1/2} = 2.90^{k/''}$

Max $t_{flg\ col} = .683''$ Min Weld $\frac{1}{4}''$ Cap $= .707(.25)(21) = 3.71^{k/''} > 2.9$

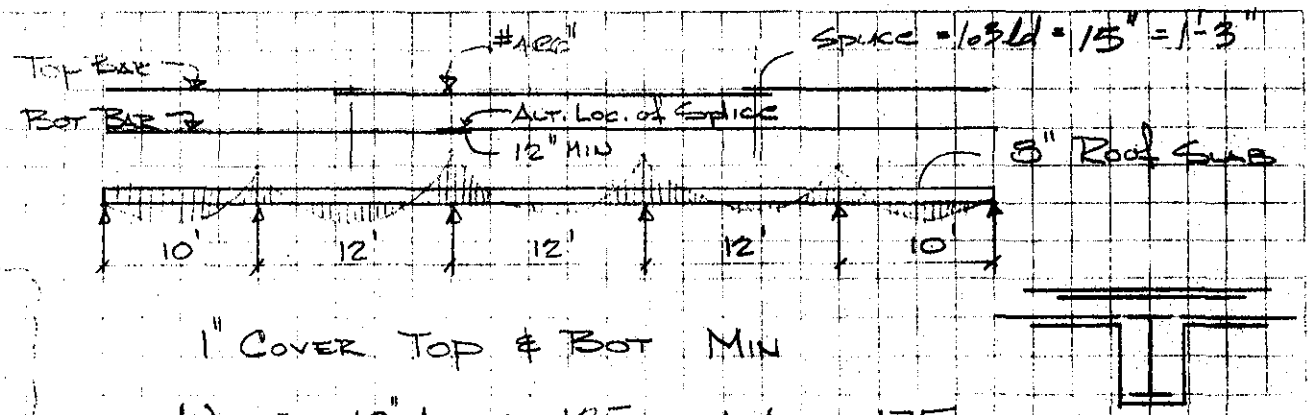
Use $\frac{1}{4}''$



NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Roof Slab Design (Concrete Slab)
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 Oct 74



Note: Alt Deck Design Used
See A-26

1" Cover Top & Bot Min

W_{DL} = 10" Ave = .125 × 1.4 = .175
Insulat + Roofing = .0113 × 1.4 = .016
LL = .030 × 1.7 = .051
.242 = W_u

Consider $f'_c = 3^{ksi}$ $f_y = 40^{ksi}$

$M_{\oplus}$ Max $= \frac{wL^2}{10} = 3.50^{'k}$ $d_{\oplus} = 8" - 2 - .25"$ ($\frac{1}{2}\phi$ of #4)
$= 5.75"$

$f = \frac{12(5.75)^2}{12000} = .033$ $K_u = \frac{3.5}{.033} = 106$

$K_{min} = 181$

(ACI 7-13)
$A_s = .002(12)(8)/2 = .10^{in^2}$ Each Face #4@12 Min Temp & Shrink.

Pg 55 - Ultimate Strength Design Handbook Vol I, SP-17 ACI

$K_u = 106$ $A_s = pdb = .003(5.75)(12)$
$= .207^{in^2}$

$M_{\oplus}$ Max First Int Col $= \frac{wL^2}{8} = \frac{.242(10)^2}{8} = 3.03^{'k}$

$\frac{wL^2}{9} = \frac{.242(12)^2}{9} = 3.87$

$d_{\oplus} = 8" - 1 - .25 = 6.75"$ $f = .046$

$K_{u\oplus} = \frac{3.87}{.046} = 84$ $K_{min} = 181$

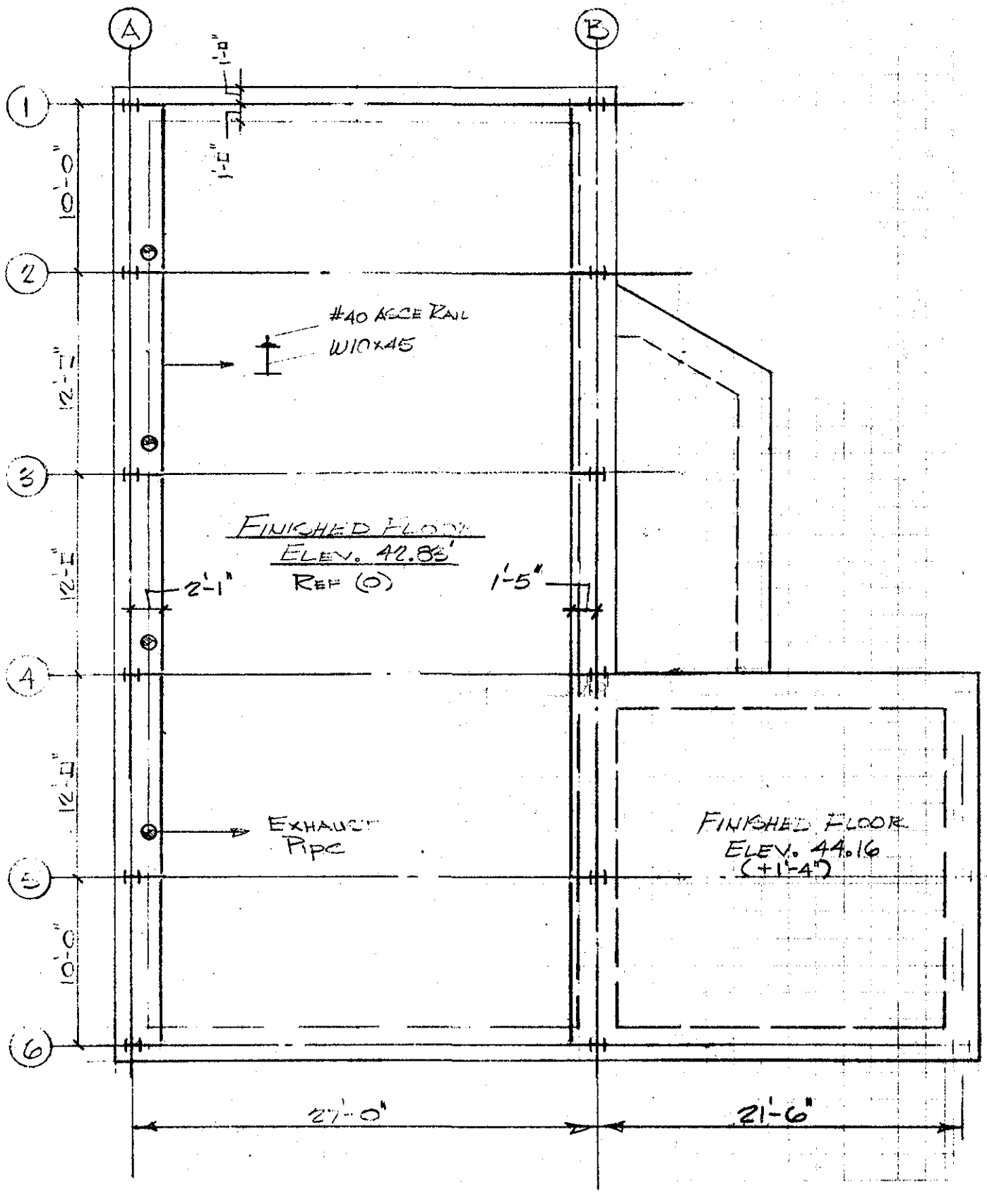
Long $= .0053(12)(6.75) = .429$ Use #4@6" T & B

Transverse = Use #4@12" Top & Bot

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARM

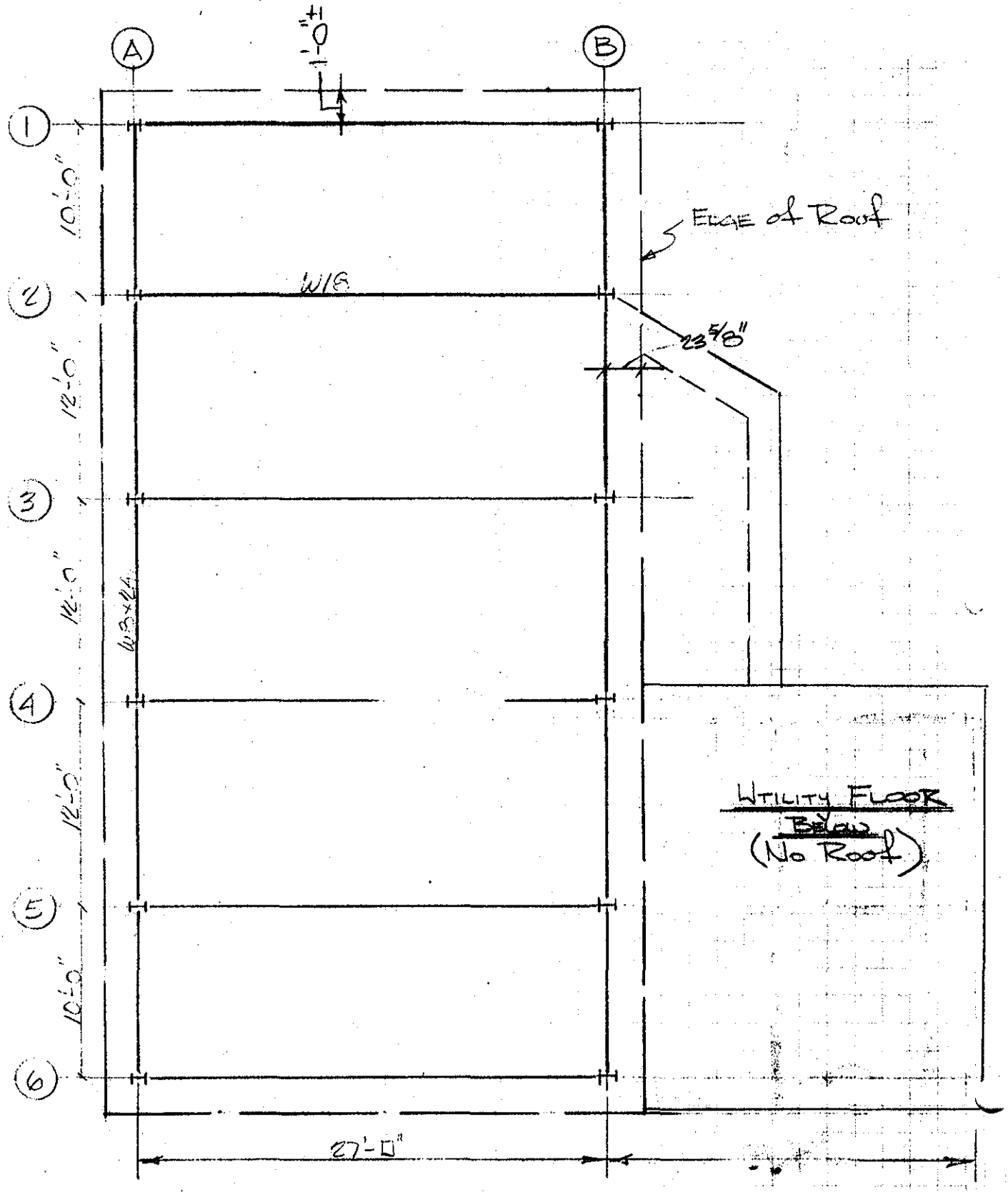
SUBJECT [illegible] - ARMORY
COMPUTATION ENGINE ROOM FLOOR PLAN
COMPUTED BY W. Rodger CHECKED BY CJM DATE 30 Aug 74



NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARM

SUBJECT: [illegible] - ARMORY
COMPUTATION: Roof Fall
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 30 Aug 74

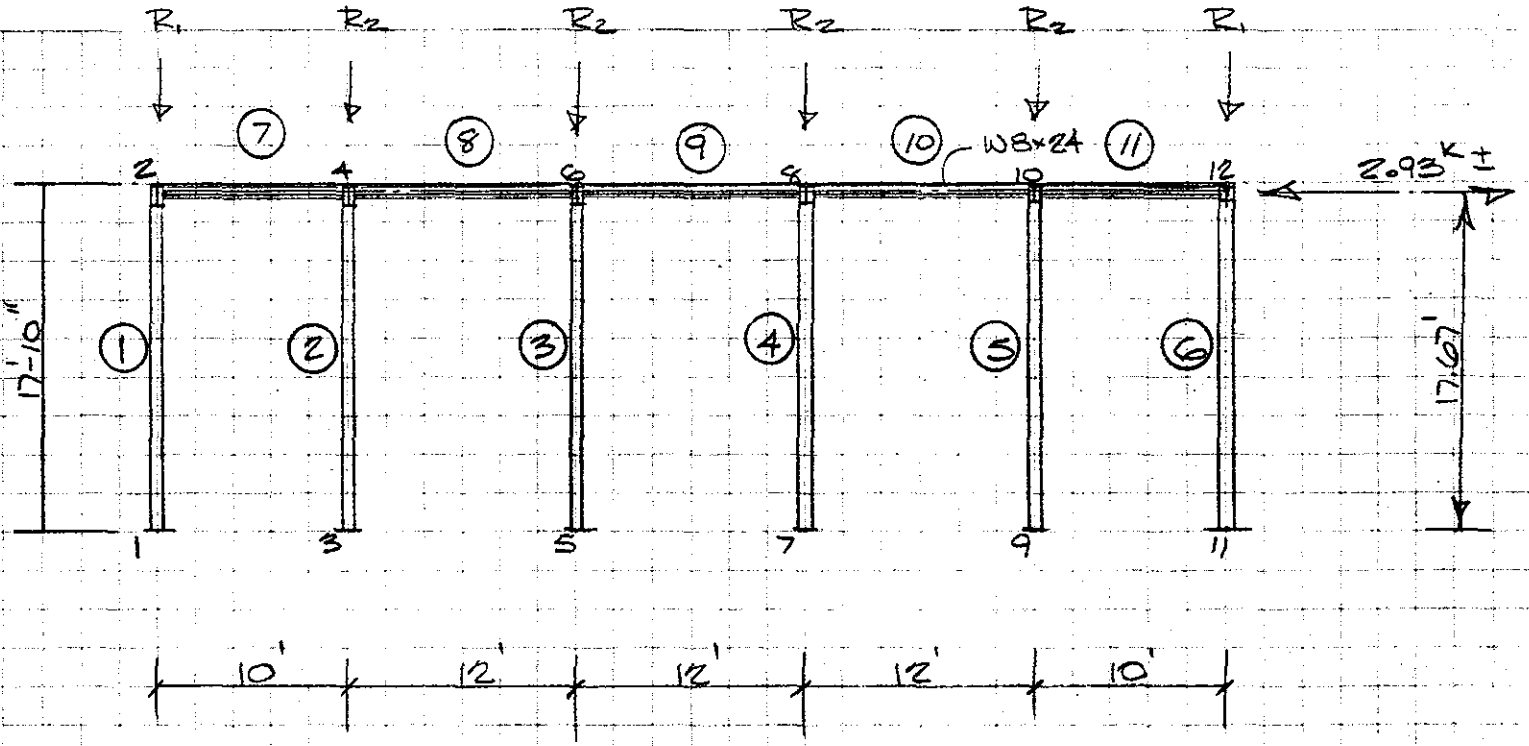


NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Frank Crane Park
COMPUTATION
COMPUTED BY W. Rodger CHECKED BY CJW DATE 30 Oct 74

PAGE A-23



WIND LOAD = .02 × (15') × 17.33/2 = 2.67K ✓

*SEISMIC = V_A, V_B (Pg P-5) = 2.75 + .18 TORSIONAL SHEARS = 2.93K ← GOVERNS

COL W10×60 A = 17.7 = .123 FT² I_{xx} = 116 = .0056 FT⁴

BEAM W8×24 A = 7.06 = .049 FT² I_{xx} = 82.5 = .0040 FT⁴

W = SAY 2' × .150 + 2' × .03 + .024 = .384 D+L

R_{2D} = 26.8K $R_{2\,D+L}$ = 31.7K + 1K for COL
R_{1D} = 13.4K $R_{1\,D+L}$ = 15.9K

NED FORM 223
27 Sept 49

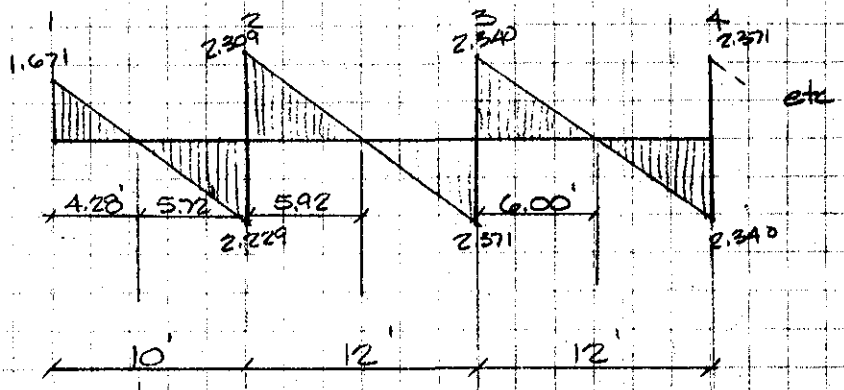
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Moments & Shears (From Computer)
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 30 Oct 74

CONSIDER SPANDRELS

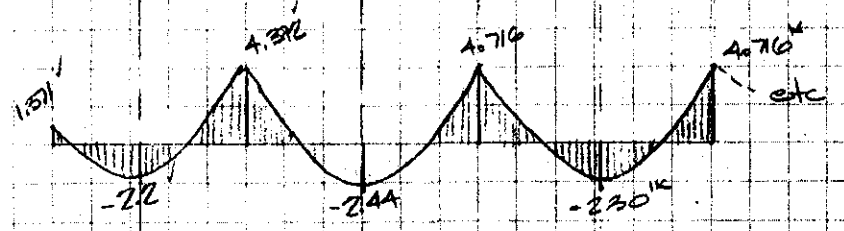
$W_{DL} = .390$

LC-1



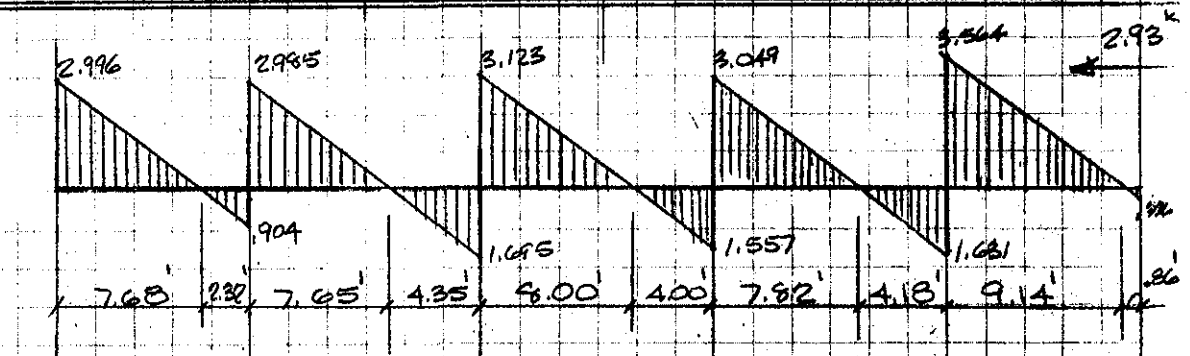
SHEARS

N = 0
$V_{MAX} = 2.4^k$
$M_{MAX} = 5.0'^k$

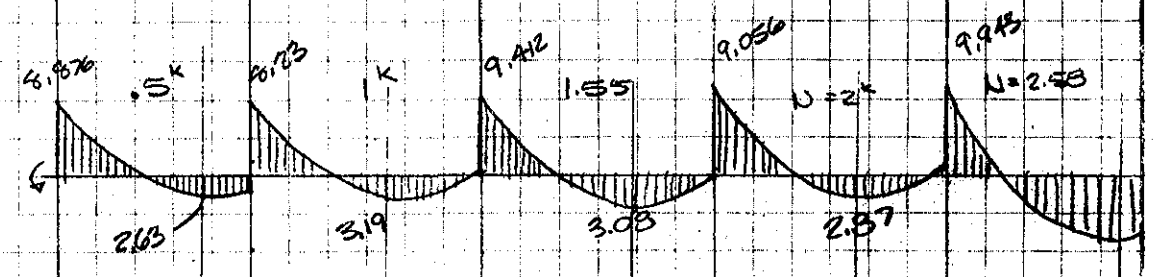


Moments

LC-2



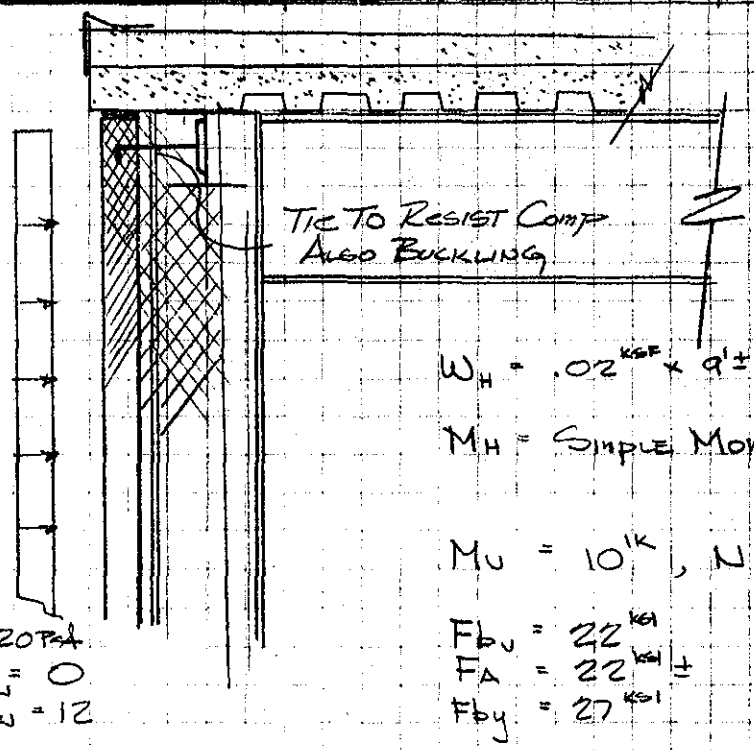
SHEARS



$M_{MAX} = 10'^k$
$N = 2.6^k$
$V = 3.564^k$

SUBJECT: Armory Pump Station
COMPUTATION: Design Spandrel
COMPUTED BY: W. Rodger CHECKED BY: C.J.W. DATE: 3 Oct 74

Consider Spandrel Beam Design



Assume Torsion Is Neg
Due To Detail Used

$W_H = .02^{KSF} \times 9' \pm = .180^{K/'}$

M_H = Simple Moment $= \frac{.180(12)^2}{8} = 3.24^{'K}$ $\quad V_H = 1.08^K$

$M_U = 10^{'K}$, $N = 2.6^K$, $V_U = 3.564^K$

$F_{bu} = 22^{KSI}$
$F_A = 22^{KSI} \pm$
$F_{by} = 27^{KSI}$

W8x24 $\quad A = 7.06^{in^2}$
$S_x = 20.8$
$S_y = 5.61$
$L_c = 6.9 \quad L_u \div 15.1$

$f_A = \frac{2.6^K}{7.06} = .368^{KSI}$ $\quad \frac{f_A}{F_A} = \frac{.368}{14.32} = .026 < .15$

$\frac{KL}{r_y} = \frac{1 \times 12 \times 12}{1.61} = 89$ $\quad f_{bv} = 5.77^{KSI}$
$f_{bH} = 6.93$

$F_A = 14.32$

Allow Increase for Wind

Pg 5-22 (1.6-2) $\quad \frac{f_A}{F_A} + \frac{f_{bv}}{F_{bv}} + \frac{f_{bH}}{F_{bH}} = < 1 \times 1.33$

$\frac{.368}{14.32} + \frac{5.77}{22} + \frac{6.93}{12^{KSI}} = .865 < 1.333$

* From Appendix "B" Fatigue Loading Condition 3
Stress Category A
From Table B3 Pg 5-111
$F_{SR} = 24^{KSI}$
$F_{\oplus} + F_{\ominus} = F_{SR}$
$F_+ = F_{\ominus} = 12^{KSI} \pm$

(LC-1 - D+L Is Less Critical)

W8x24 Is OK

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: ALTERNATE ROOF DESIGN
COMPUTED BY: W. Rodger CHECKED BY: C.J.W. DATE: 30 OCT 74

CONSIDER METAL DECK

* TWO SPAN CONDITION MINIMUM, IN METAL DECK LAYOUT

∴ DESIGN $M_{\ominus} = \frac{WL^2}{8}$

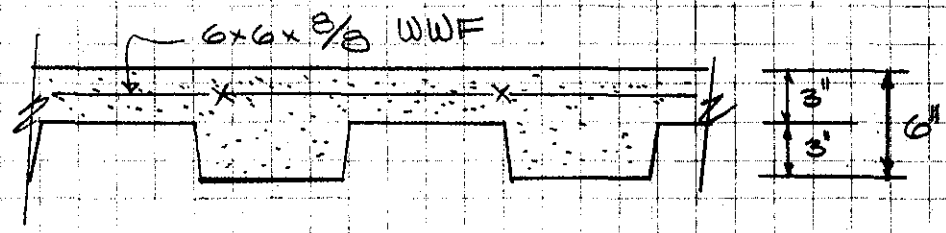
$M_{\oplus} = \frac{WL^2}{12}$ $\Delta_{MAX} = \frac{3WL^4}{384EI}$

CHECK - CONSTRUCTION LOADS
DL - METAL DK + CONC. 6" TOTAL = 60 PSF
LL - CONSTRUCTION = 20 PSF
80 PSF

(A) 3" - 18GA ∴ $M_{\ominus} = 1.44^{IK}$ $M_{\oplus} = .96^{IK}$
($I = 1.31 \text{ in}^4$) $S_{\ominus} = .86$ $S_{\oplus} = .58^{IK}$

$\Delta = \frac{3(.08)(12)^4 \times 1728}{384(29000)(1.31)} = .589''$ MAX

$\Delta_{MAX} = \frac{L}{180} = \frac{12 \times 12}{180} = .800''$



NORMAL CONC = 4½/12 × .150 = .056 + .004 = 60 PSF
LWGT CONC 4½/12 × .110 = .041 + .004 = 45 PSF

USE 3" DECK

DL = CONC & DECK = 60 PSF
4" - LWGT FILL FOR PITCH = 37 PSF
INSULATION = 5 PSF
ROOFING = 6 PSF
LL 30
138 PSF

NED FORM 223
27 Sept 49

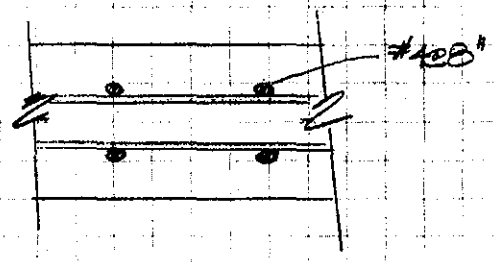
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Investigate Exist Engine Room Floor
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 4 Oct 74

8" Slab

Reinf = #4@8" Top & Bot
Dist = #4@15" Top & Bot
$A_s = .30 \text{ in}^2/\text{ft}$

*Assume
$f'_c = 3000^{psi}$
$f_s = 20^{ksi}$
$a = 1.44$



$d = 8" - 2" - .25 = 5.75"$

$M = A_s a d = .30(1.44)(5.75) = 2.48^k$

$M_{\oplus} = \frac{wL^2}{10} = \quad w = .619$

$M_{\ominus} = \frac{wL^2}{9} = \quad w = .557$

$M_{\ominus} = \frac{wL^2}{8} \quad w = 495^{psf}$

Say Max Allowable Load

Conc Slab = 100 psf
2" Covering-Flr = 20 psf
120

Allow SLL = 495 - 120 = **375 psf**

12" Slab

#6@7 Bot (.75) #6@8 Top (.66)

2" Cov $d_{\oplus} = d_{\ominus} = 12" - 2" - .38 = 9.62"$

$M_{\oplus} = \frac{wL^2}{8} =$

$w = 600^{psf} \pm$

$M = .66(1.44)(9.62) = 9.14$

Conc = 150
2" Flr 20
170

Allow LL = 600 - 170 = **430 psf**

(1) Engine Room LL = 100 psf
or
(2) Equip. Load = 350 psf

} Slabs are ok

Note: For Slabs Only - Equip. Loads Due Not Act Concurrent With Live Load

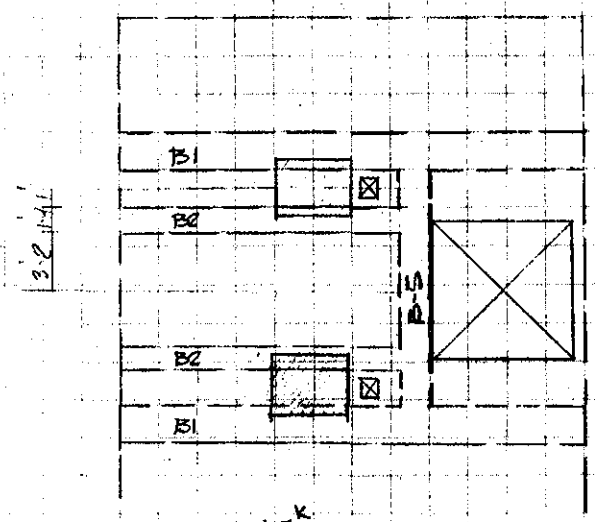
∴ Max $w = 350^{psf}$

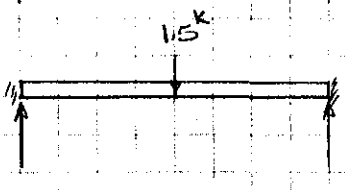
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

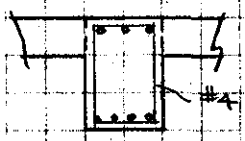
SUBJECT: Armory Pump Station
COMPUTATION: Investigate Floor Beams
COMPUTED BY: W. Rodger CHECKED BY: DATE: 4-Oct 74

Consider Beam Layout





(B-2) 1'-4" × 2'-4"



$d_{\oplus} = d_{\ominus} = 28" - 2" - .5" - .5"$
$= 25^{+}$

$M_{\oplus} = 2.37(1.44)(25) = 85^{'k}$

$M_{\ominus} = 3.16(1.44)(25) = 113^{'k}$

$W_{DL} = (1 + 1.33 + 3.17) = 5.50'$ (Area)

Slab = 4.50 × .100 = .450 k/'
Beam = 1.67 × 1.33 × .15 = .333 k/'
Fnr = .02 (5.50) = .110 k/'
.893 k/'

$M_{\ominus} = 85^{'k} = \frac{1.5(16)}{8} + \frac{.893(16)^2}{12} + \frac{W_{LL}(16)^2}{12}$

$85 = 3 + 19.05 + 21.33w$

$W_{+} = 2.95$ $2.95/5.5 = \underline{.536^{psf}}$

Actual $R_L = R_R = 11.5^{k}$

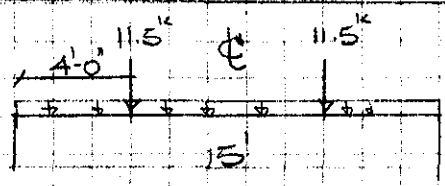
$M_{\ominus} = 113 = \frac{1.5(16)}{8} + \frac{.893(16)^2}{12} + \frac{W_{LL}(16)^2}{12}$

$w = \underline{.775^{psf}}$

$v = 29^{psi}$

Actual Live Load = 5.5 × 100 = 550 psf (Say ok)
($M_{\ominus} = 149^{'k}$)

B-5



LL = .100 (4' + 1.67) = .567
DL$_s$ = 5.67 (.100) = .567
DL$_{Bm}$ 2.03 × 1.67 (.150) = .520
1.654 k/'

$M_{\ominus} = \frac{1.654(15)^2}{8} + 11.5(4) = 92.5^{'k}$

$V_L = V_R = 11.5 + 12.41 = 24$

$v = \frac{24}{30 \times 20} = 40^{psi}$

$M_{cap} = 3.16(1.44)(33 - 2.5 - .5)$ (30)
$= 136^{'k}$

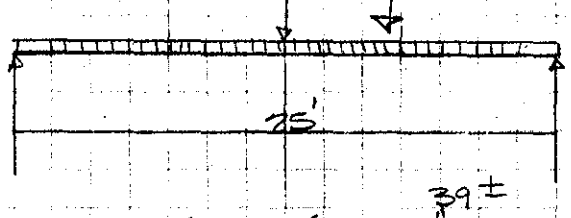
B-5 is More than Adequate

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: ARMORY PUMP STATION
COMPUTATION: INVESTIGATE FLOOR BEAMS
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 4 OCT 74

B-1



Approx Method 12' of Slab + Beam

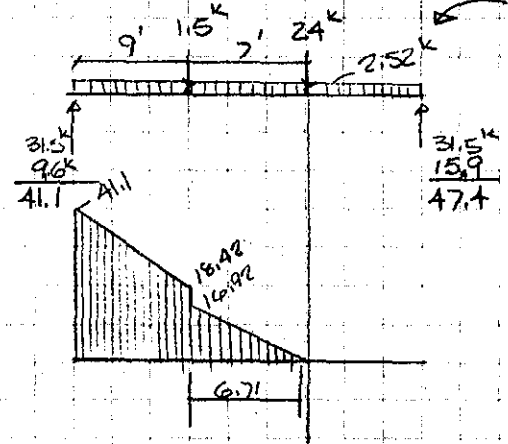
$D_L = .150(12) = 1.800^{k/'}$
$D_{L_B} = 3 \times 2 \times .15 = .900$
$LL = .100(12 = 1.200^{k/'}$
$DL = .02(12) = .240$
4.14

$M_{\oplus} = 8.00(1.44)(44 - 2 - .5 - 1.13 - 1)$ (39±)
$= 449^{'k}$

$V = 52.5^{k}$

$M_S = \frac{4.14(25)^2}{8} + \frac{3.0(25)}{4} = 342^{'k}$ Approx

Exact Check ± B-1 is Ok



$LL = .100(6) = .600$
$DL = .150(6) = .900$
$+ .900$
$DL = .02(6) = .120$
2.52

$M = \frac{(41.1 + 18.42)}{2} \times 9 + \frac{1}{2}(16.92)(6.71) = 325^{'k}$ B-1 is still ok

For B3 $W_{TOT} = 4.14 + 6'(4''/12)(.150) = 4.44$

$M_S = 366^{'k}$

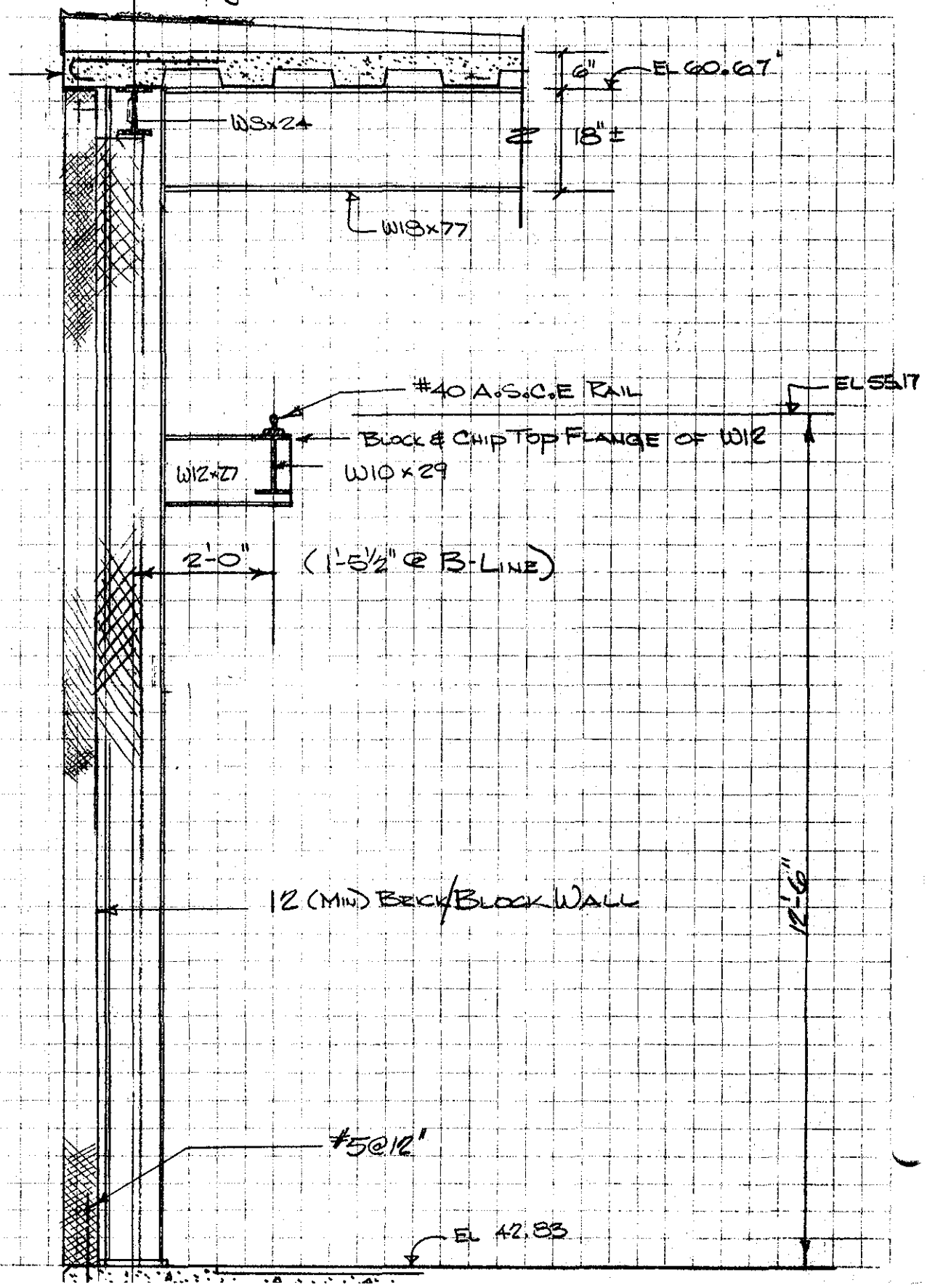
B-3 is ok By Inspection

All Floor Beams Are Adequate

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

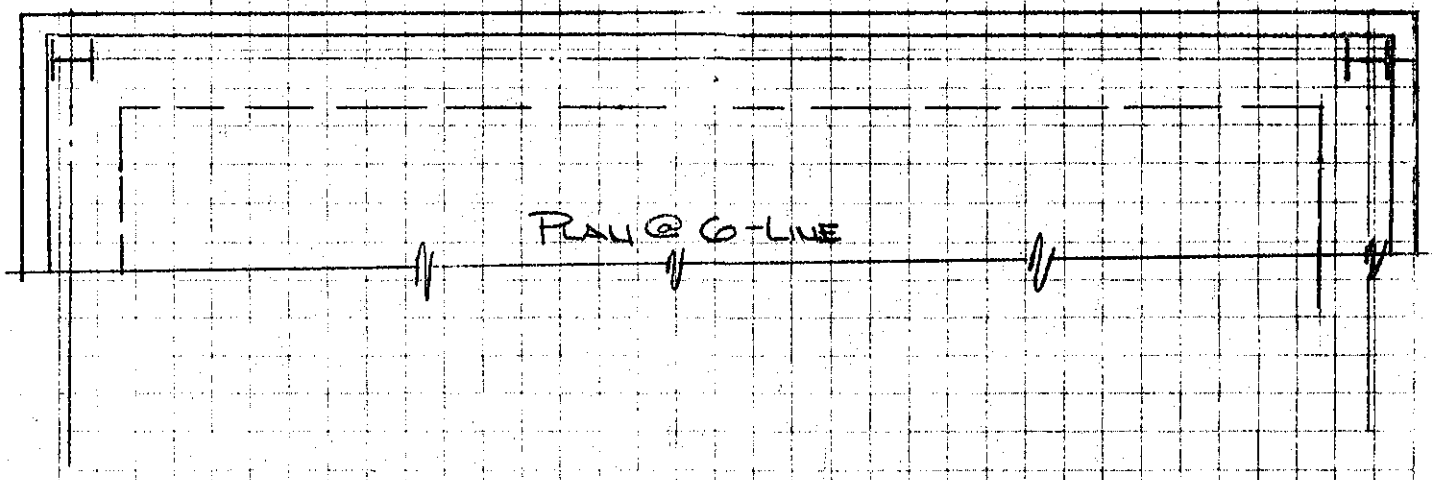
SUBJECT: Armory Pump Station
COMPUTATION: Vertical Section
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 30 Oct 74

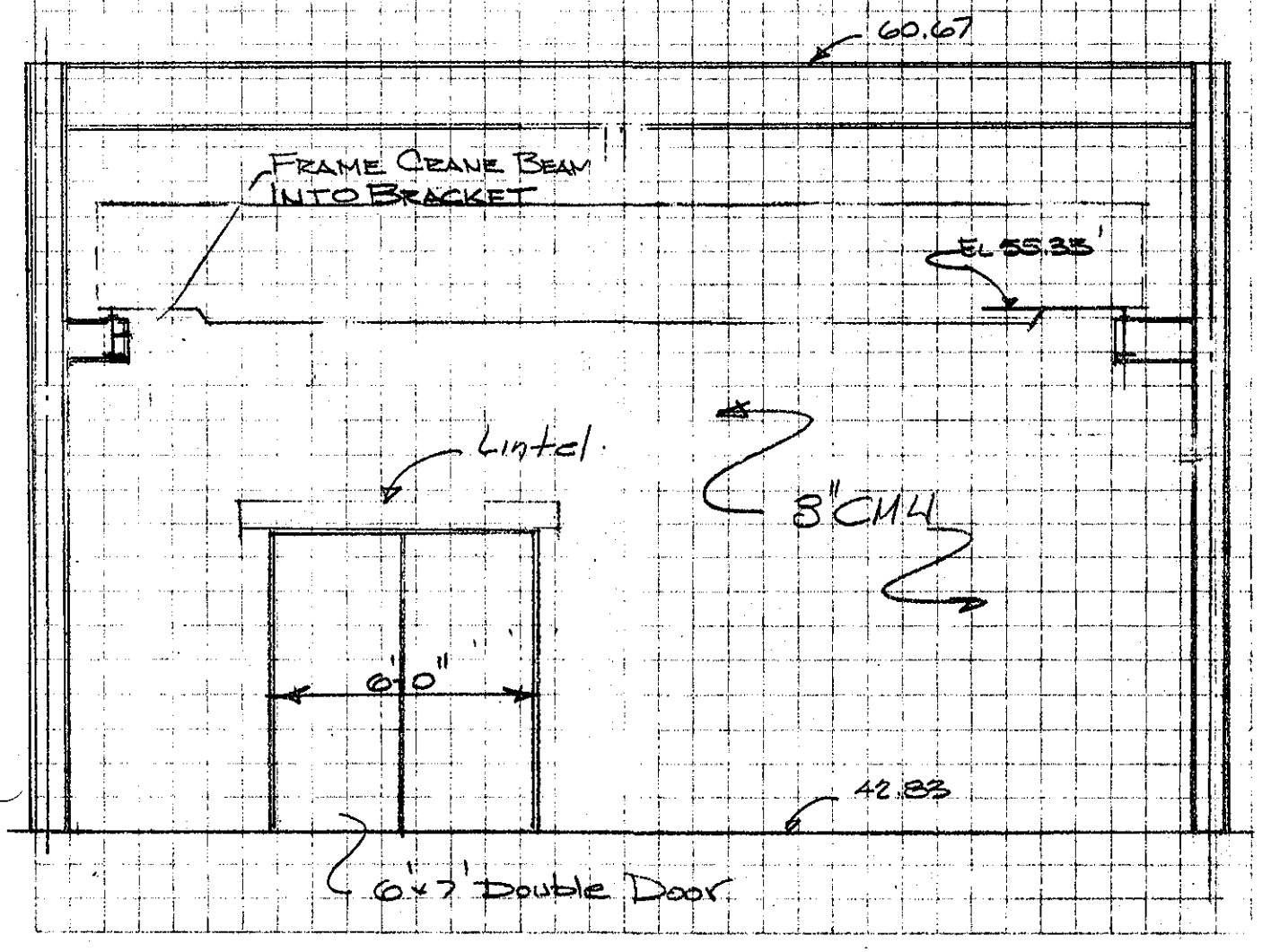


NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: PARK RIVER - ARMORY
COMPUTATION: END FRAME
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 7 OCT 74





SUBJECT: Armory Pump Station
COMPUTATION: Masonry Wall
COMPUTED BY: W. Rodger CHECKED BY: DATE: Oct 74

Span of 12" Brick & Block

Span 18' $M_{MAX} = .02(18^2)/8 = .810^{1K}$

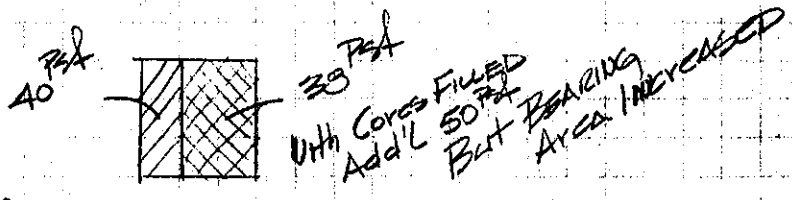
(A-6-1) $f_m = .20 f'_m \left(1 - \left(\frac{h}{40t}\right)^3\right)$

$= .20(1350)\left(1 - \left(\frac{18 \times 12}{40 \times 12}\right)^3\right) = 245$ PSI

$S = \frac{bd^2}{6} = 288$ $f_{1,EXT} = \pm \frac{.810^{1K} \times 12}{288}$

$= .034^{KSI}$

@ Center of Wall P_D =



$f_{m_{BRICK}} = \frac{.04(9)'(1)}{.8(4'' \times 12)} = .009^{KSI}$

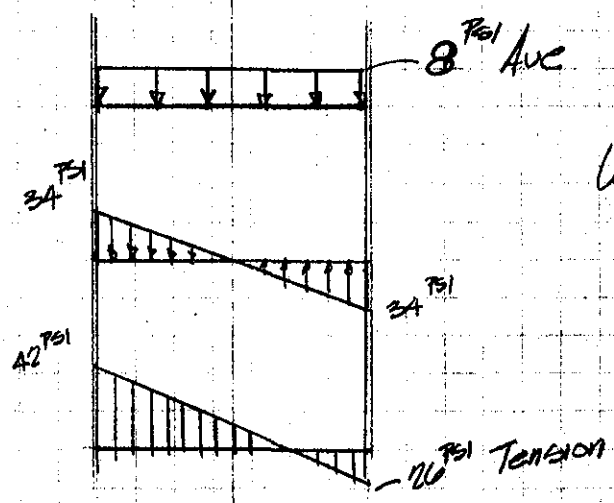
$f_{m\,BLK} = \frac{.039(9)(1)}{.5(8 \times 12)} = .007^{KSI}$

NOTE TM 5-809-3 Allows 10 PSI Tension

Wall Will Be Reinf'd

@ Center of Span

Stress



CORPS OF ENGINEERS, U. S. ARMY

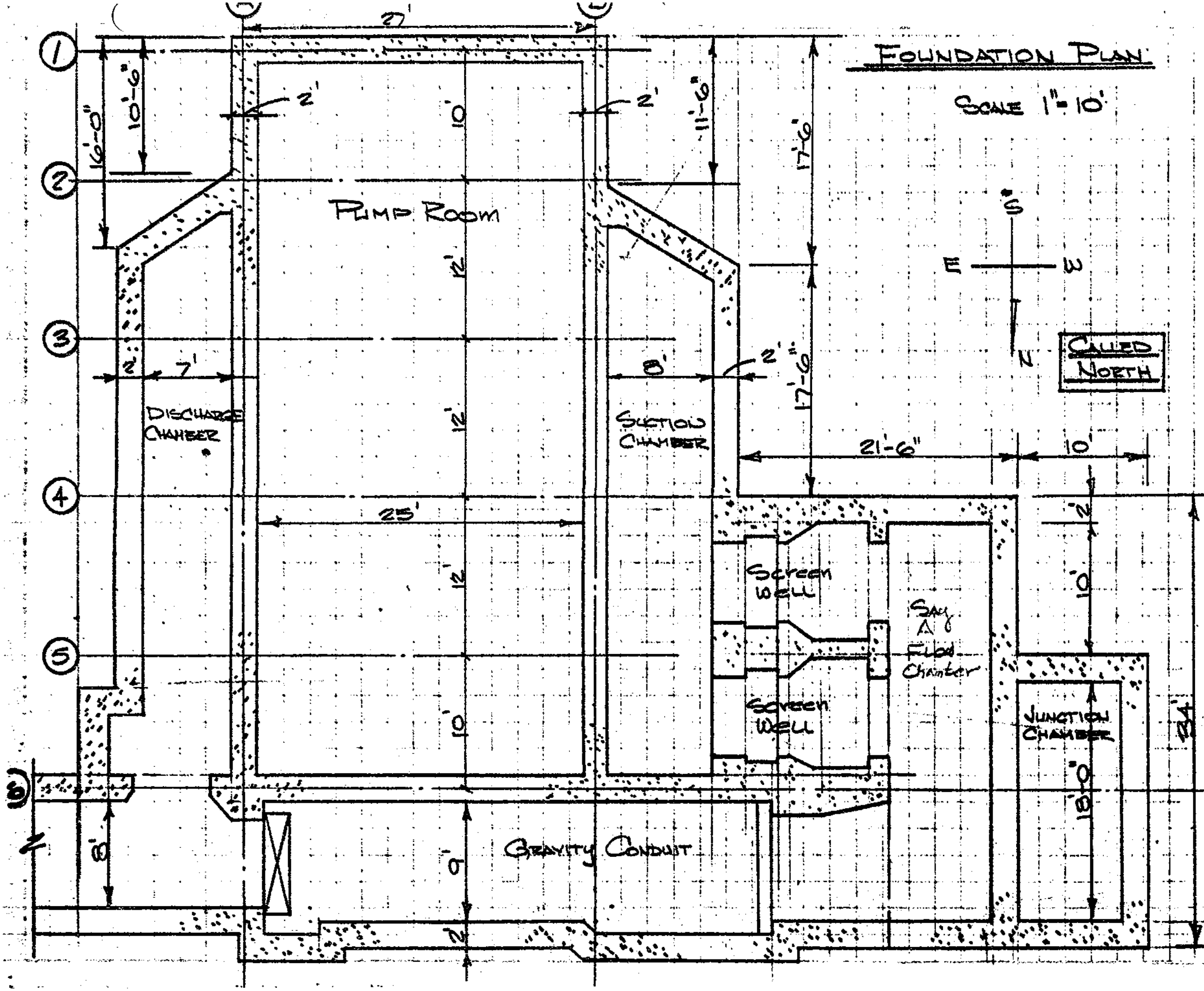
SUBJECT Armory Pump Station

COMPUTATION Stability (Buoyancy) Check

COMPUTED BY W. Rodger CHECKED BY CJW DATE 7 Oct 74

27 Sept 49

PAGE A-33



27 Sept 49

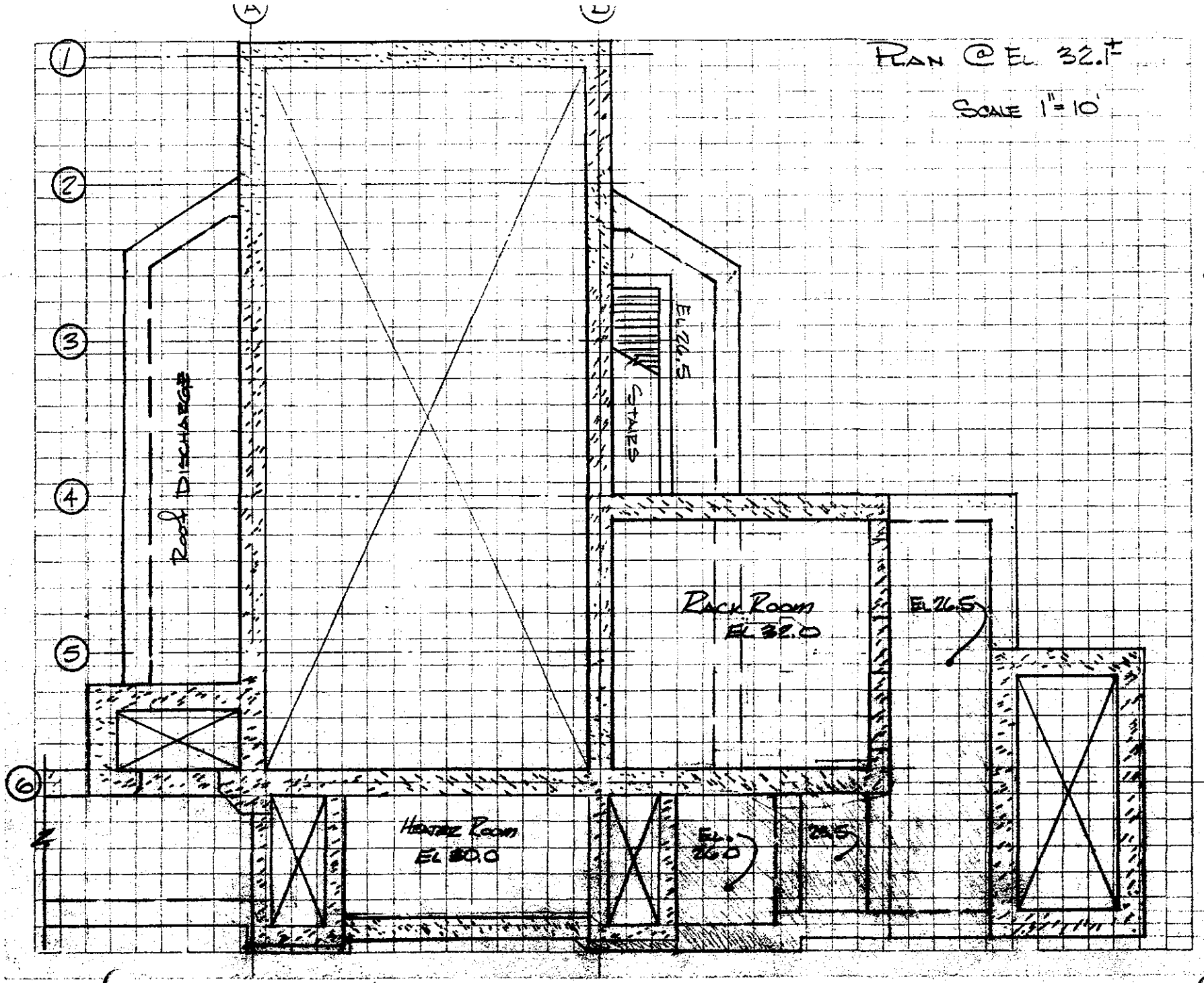
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Armory Pump Station

COMPUTATION Stability (Buoyancy) Check

COMPUTED BY W. Rodger CHECKED BY CJW DATE 7 Oct 74

PAGE A-24



27 Sept 49

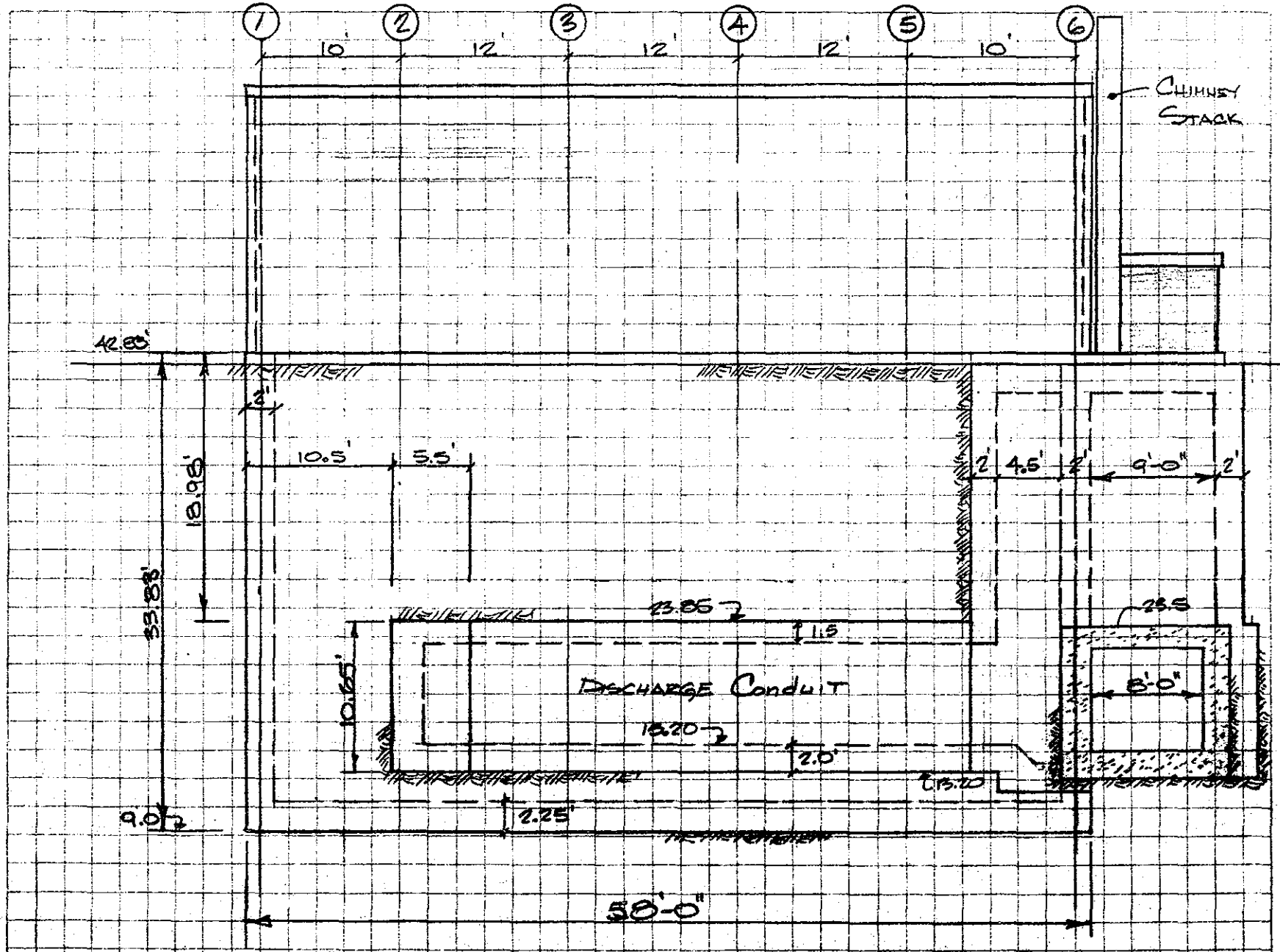
SUBJECT _____ COMPUTATION _____ COMPUTED BY W. Rodger CHECKED BY CJW DATE Oct 74

CORPS OF ENGINEERS, U.S. ARMY

HRMOYU POWER STATION

EAST ELEVATION

PAGE A-35

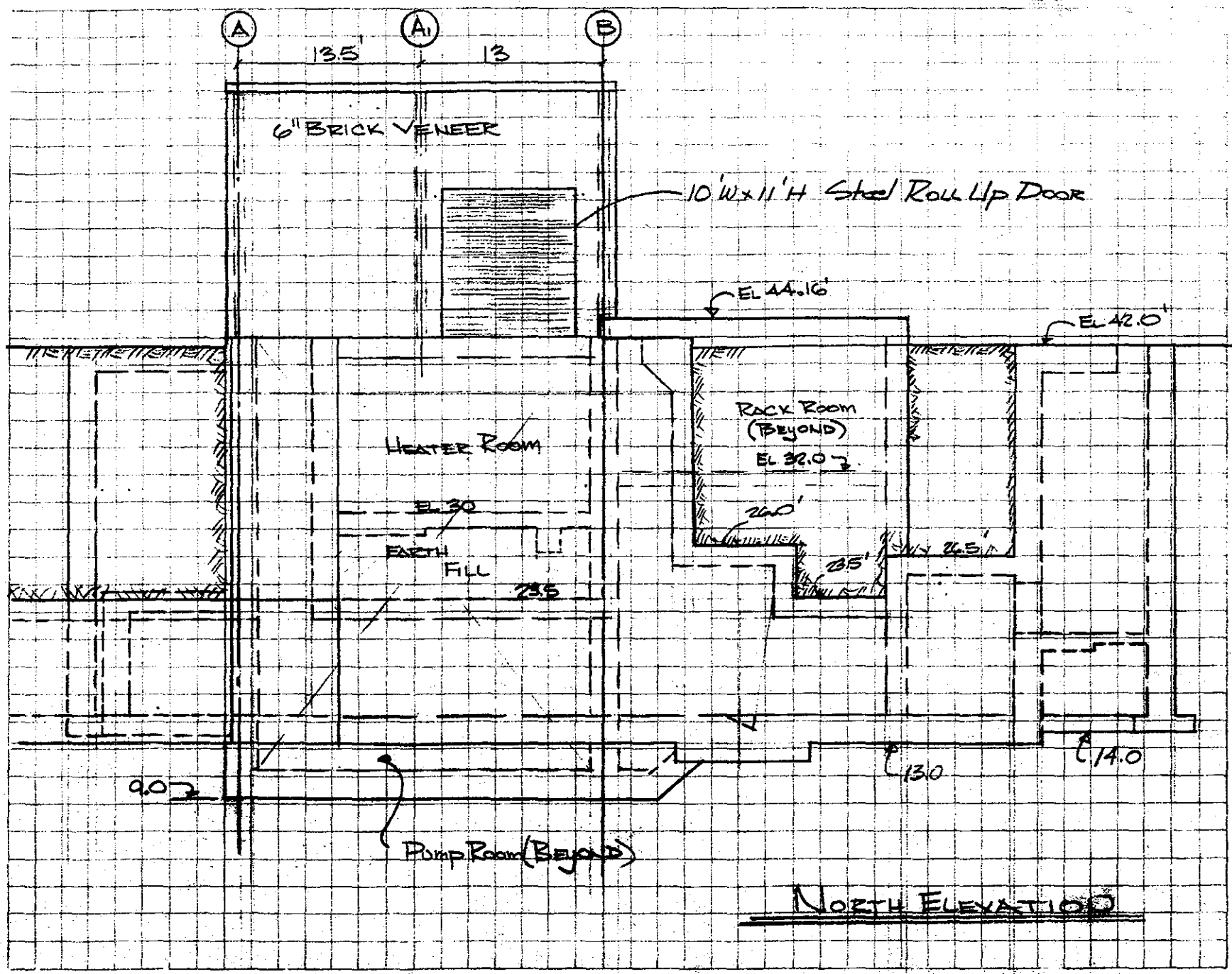


EAST ELEVATION

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Arnoy Pump Station
COMPUTATION North Elevation
COMPUTED BY W. Rodger CHECKED BY CJV DATE Oct 74
PAGE A-56



27 Sept 49

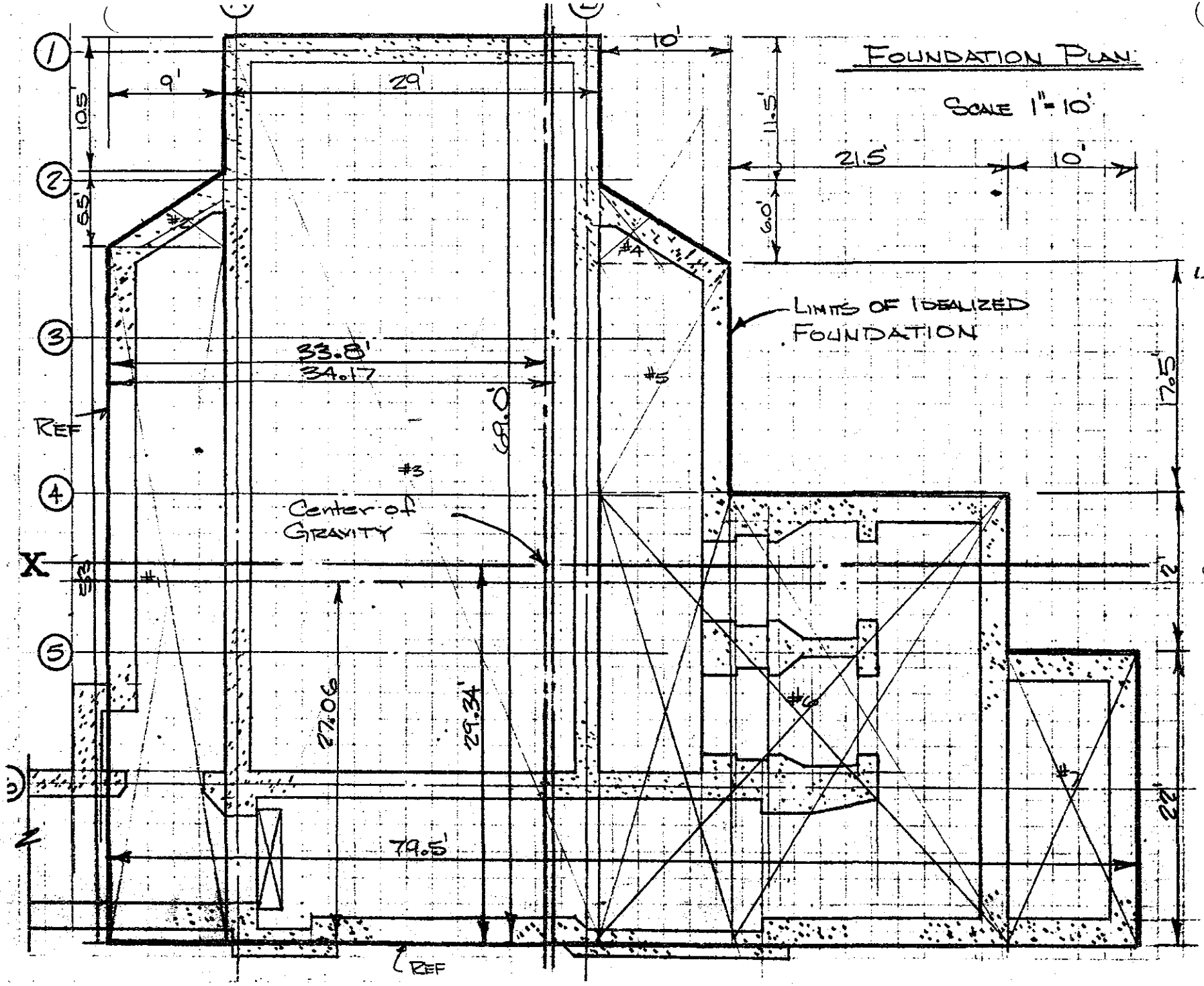
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Armory Pump Station

COMPUTATION Stability (Buoyancy) Check

COMPUTED BY W. Rodger CHECKED BY JW DATE 7 Oct 74

PAGE A-37



NED FORM 225
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Center Of Gravity of Mat
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 8 Oct 74

Element	Area		X	Y	Ax	Ay
#1	53×9 =	477.00	4.50	26.5	2146.5	12640.5
2	1/2×5.5×9 =	24.75	6.00	54.83	48.5	1357.0
3	29×69 =	2001.00	23.5	34.50	47023.5	69034.5
4	1/2×6×10 =	30.00	41.33	53.50	1240.0	1605.0
5	10×51.5 =	515.00	43.00	42.75	22145.0	22016.3
6	31.5×34 =	1071.00	53.75	17.00	57566.3	18207.0
7	10×22 =	220.00	74.50	11.00	16390.0	2420.0
		4338.75			146,659.8	127,280.3

$$\bar{X} = \frac{\Sigma A_x}{\Sigma A} = \frac{146,659.8}{4338.75} = 33.8' \text{ Right of Ref.}$$

$$\bar{Y} = \frac{\Sigma A_y}{\Sigma A} = \frac{127,280.3}{4338.75} = 29.34' \text{ Above Ref.}$$

Compute I_{xx} & I_{yy}

$I = I_o + Ad^2$ $\quad I_o = \frac{bd^3}{12}$ $\quad I_\Delta = \frac{bd^3}{36}$

Element	Area	$(\bar{Y}-y)$ d	I_o	Ad^2
1	477.0	2.84	111658	3847
2	24.75	25.49	41	16081
3	2001.0	5.16	793897	53278
4	30.0	24.16	60	17511
5	515.0	13.41	4466	92611
6	1071.0	12.34	103173	163087
7	220.0	18.34	3873	73998
			1,022,168 +	420,413

$I_{xx} = 1442581 \text{ Ft}^4$

Element	Area	$(\bar{X}-x)$ d	I_o	Ad^2
1	477.0	29.3	3220	409500
2	24.75	27.8	111	19128
3	2001.0	10.3	140237	212286
4	30.0	7.53	167	1701
5	515.0	9.20	1453	43590
6	1071.0	19.95	88558	426260
7	220.0	40.70	1833	364428
			235,584	1,476,893

$I_{yy} = 1,712477 \text{ Ft}^4$

27 Sept 49

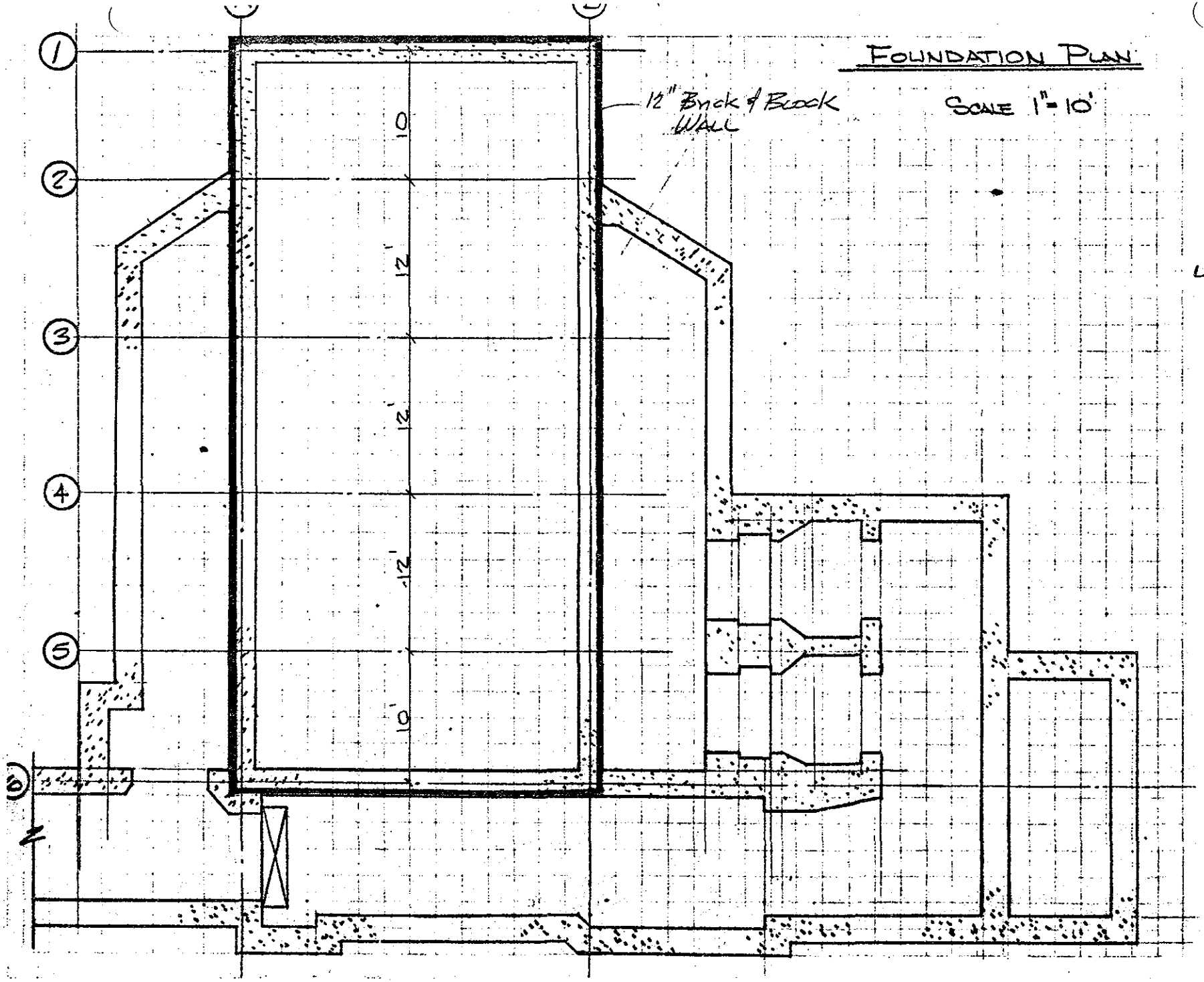
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Armory Pump Station

COMPUTATION Stability (Buoyancy) Check

COMPUTED BY W. Rodger CHECKED BY CJJ DATE 7 Oct 74

PAGE A-29



NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Dead + Live Loads - Armory
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: Oct 74

Consider Loads For Super Structure (Inc Brick Veneer Around Edge of Foundation)
The Resultant Load Can Be Taken To Act Midway Between Lines A & B & Lines 3 & 4

Block/Brick Wall = $1.065^{k/'}$ (29'+29'+57'+57') = 183.18^k

Roof
Conc+Deck - 60^{PSF}
4" Lgh Wgt Fill - 37
Insulation - 5
Roofing - 6
108^{PSF}

Ave Framing = Girder & Cols

$(20' \times .057 \times 2) + .077 \times 27'/29 \times 12$ = Say 13^{PSF}

Total DL_R = Say $.125^{KSF}(58' \times 29')$ = 210.25^k
+ Spandrel Beams LS = 9.00^k

P_{DL} = 402.43 Say 410^k

LL = .030(58×29) = 50.5^k

P_{D+L} = 460^k

Floor El 42.83
2" Fin. Floor = 20^{psf}
8" Slab = 8/12 × .150 = 100 psf
Ave Framing = $\frac{.900}{.150 \times 12}$ = .50' Conc = 75 psf
Say $.220^{KSF}$ (For Floor

$P_{FLR_{DL}}$ = .220 × 29(58) = 370^k + 3(8^k Edge) = 379^k

$P_{FLR_{D+L}}$ = .320 × 29(58) = 538^k + 9 = 547^k

Base Walls - Pump Room 2' th = $.300^{KSF}$ h_{eff} = 42.83 - 9 - 2.25 = 31.58

W_{walls} = $.300^{KSF}(31.58')(29+29+54+54)$ = 1573^k

B_{slab} = 2.25' × .150 × 29 × 58 = 568^k

SUBJECT Armory Pump Station

COMPUTATION Weight Comps

COMPUTED BY W. Podger CHECKED BY CJW DATE 10 Oct 74

Discharge Chamber

Roof 1.5' = .525 ksf (9' × 36) = 170^k

Base Slab 2.0'

Walls = .300 (7.15' Ht) (34 + 10) = 94^k

D_c = 264^k
D_s = 706^k

Vol of Earth Above = EL 42.0 − 23.85 = 18.15'

A = (9 × 36) = 324

W = 324 × 18.15 × .120 k/ft³ = 706^k (Soil)

Well @ End Discharge Chamber

Wall = EL 42 − EL 13.20 = 28.8'

So W = 28.8 (12' + 12' + 4.5) × .300 = 246^k

Base Slab = .300 (12 × 6.5) = 23.4

Roof Slab = .300 (10 × 4.5) = 13.5

Total = 283^k Conc Only

Suction Chamber

EL 26.5 − EL 9.5 = 17.0' Total

Roof = 1.6" + Base 2.0' = 3.5' × .150 (10) × 21 (To Wall) = 110.25^k

Walls = (11 + 17.5) × .300 × 13.5 = 115.43^k

Remaindder Base Slab = .300 × 10 × 23' = 69.00^k

12" Wall = .150 (4.5 + 17.17) × 10.77' high = 35.^k

Beams = 2 [2 × 1.33] × .150 × 10 = 8.0^k

Run 12" ± (19') (.150) × 3.5' Wide = 10.0^k

Volume Earth = (42.0 − 26.5) (21 × 10 − 17.17 × 4.5)
Height 132.7
= 2056.85

W_s = 2056.85 (.120) = 246^k

~~504~~

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Weight Comps.
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 10 October 74

Screen Well & Upper Levels — Inc. Portion of Wall on G-Line Not Inc. w. Suction Chamber

2' Wall G-Line 8' - 23.33' high = 80.0^k

3-Int. W 2'-5"± × 13.5' × .150 × 16'± = 78.0^k
3'-0"± × 13.5' × .150 × 16'± = 97.0^k
Coll'd Rack Room 3'-3"± × 13.5' × .150 × 16'± = 105.0^k
- EL 31.0
31-15 = 16'-0

Slab @ EL 13 2' × .150 × 23 × 13.5 = 93.2^k
EL 32 Rack Room Flr 1' × .150 × 19' × 20.0' = 57.0^k

Walls From 31' to 42.83

2' × .150 × 22' × 11.83 = 78^k
2' × .150 × 22' × 11.83 = 78^k
1.5' × .150 × 22' × 11.83 = 58.6^k

Slab @ 42.83 Ave t = 12"

1' × .150 × 19 × 20 = 57.0^k
781.6^k

Consider Area Called Flow Chamber

Roof @ EL 26.5' Area Roof 34 × 10 = 340 ft²

Wgt Fill = (42 - 26.5) × 340 × .120 = 632^k
(15.5)

Base Slab 2' × 340 × .150 = 102^k
Roof Slab 1.5 × 340 × .150 = 76.5^k
Walls (10' + 10' + 15') 10' × .300 = 105^k
915.5^k

Consider Junction Chamber

No Fill Above

Walls = .300 (26.75)(10 + 10 + 18 + 19) = 449^k

Roof & Base Slab = 3.5' (.150)(18)(8) = 75^k
524^k

27 Sept 49

CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Park River Local Protection

COMPUTATION: Weight Comps

COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 11 Oct 74

GRAVITY CONDUIT L = 53'

Weight of Wall Along (6)-Line is Already Included in Other Structures

Base Slab = 2(.150)(11' × 53) = 175 K ±

REFER TO NORTH ELEVATION

Soil Area = (15' × 11') Ave Ht = 17' × .120 = 337 K ±

Perimeter Wall = .300 (53 + 11)(Ave Ht 23'.0) = 442 K ±

Int Wall = 3 × [.300 × 9' wide × 22' high] = 219 K ±

Conduit Roof = .300 (9' wide × 53 ±) = 143 K ±

Fill Between Heater Room & Roof of Conduit
9 × 18 × 5 × .120 = 97 K ±

Heater Room
9 × 18 . .200 = 32 K

Roof @ EL 42.0 LS → = 50 K

1495 K

Add'l Weights

Pump Room Floor

Conc Pad + Pump & Pipes etc = 15 K Pad + 10 K = 25/EA.

or 100 K Total Pump Room

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: Armory Pump Station
COMPUTATION: Stability Check - Buoy
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: Oct 74

No Live Loads Included in Weight Comp, No Side Friction Assumed to Resist Uplift Forces

Only Dead Load of Conc, Soil & Machinery

ELEMENT	WEIGHT
Super Structure	410
Flr @ 42.83	379
Base Walls	1573
Base Slabs	569
Dis. Chamber	970
End Wall D.C	283
Suction Chamber	594
Screen Wall + Upper Level	782
Flow Chamber	916
Junc. Chamber	524
Gravity Cond	1495
Pumps & Ped	100 K
Trash Bars	20 K
	8614 K

Area of Base = 4338.75

Ave Base for Pump Station
El 11

$\therefore h_{w_{max}} = 34.5$ (Fin Grade) $- 11 = 23.5$ ft

$U = 4338.75 (23.5)(.0625)$

$= 6372$ K

$SF = \frac{8614}{6372} = 1.35$

- Assuming Ground Water Mounding Between Section 1 Conduit Drain and Top of Conc.
- Neglecting Side Friction

This is Very Conservative

Buoyancy is No Problem

27 Sept 49

CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Armory Pump Station

COMPUTATION: Bearing Pressures

COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 11 Oct 24

Consider Max Bearing Pressures Will Occur at Peak Flood With All Chamber Filled With Water But Uplift Equal To Zero, & Live Load Acting.

Element	Weight	X±	Y±	Wx	Wy
Sup. Struct	460K	24.5	41.0	11270	18860
Flr. 42.83	547K	24.5	41.0		
Base Walls	1573K	24.5	41.0	65856	110208
Base Slabs	568K	24.5	41.0		
Dis. Cham	970K	4.0'	36.0	3880	34920
H_2O 7×40×7.15	W—125K	5.5	36.0	687.5	4500
Well @ End	283K	4.0	15.0	1132	4245
Suc. Cham.	594	45.0	35.0	26730	20790
H_2O 13.5(8)40	W—270K	43.0	35.0	11610	9450
Screen Well	782	55.0	21.0	43010	16422
H_2O 14(13)(8)	W—91K	55.0	21.0	5005	1911
Flow Cham	916	66.0	17.5	60456	16030
H_2O 10×8(30)	W—150K	64.0	17.5	9600	2625
Junc. Cham	524	75.0	11.0	39300	5764
H_2O 18(8)(5)	W—45K	75.0	11.0	3375	495
Gravity Con (Dry)	1495	26.5	4.5'	39617.5	6727.5
Pumps	100	25.25'	41.0	2525	4100
Bar Racks	20	50.00'	21.0	1000	420
W_{D+L+W}	9513K			325054	257467.5

For Weights

$$\bar{X} = \frac{\Sigma Wx}{\Sigma W} = \frac{325054}{9513} = 34.17'$$

$$\bar{Y} = \frac{\Sigma Wy}{\Sigma W} = \frac{257467.5}{9513} = 27.06$$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Park River
COMPUTATION: Bearing Pressure
COMPUTED BY: W. Rodger CHECKED BY: CJW DATE: 11 OCT 74

$e_x = 34.17 - 33.8 = .37'$ To Right

$e_y = 29.34 - 27.06 = 2.28$ Down

$$q_{AVE} = \frac{9513^k}{4338\pm} = 2.2^{KSF}$$

$$q_x = \frac{Q}{A} \pm Q\frac{e_y}{I_x}y \pm Q\frac{e_x}{I_y}x$$

Max Pressure @ NW Corner

$$\therefore q_{NW} = \frac{9513}{4338} + \frac{9513(2.28)}{1,442,581}(29.34) + \frac{9513(.37)}{1,712,477}(45.70)$$

$$= 2.20^{KSF} + .440 + .094$$

$$\underline{q_{MAX} = 2.73^{KSF}}$$

$$q_{SE} = \frac{9513}{4338} - .015y - .0021x$$

@ Corner A & 1 Lines

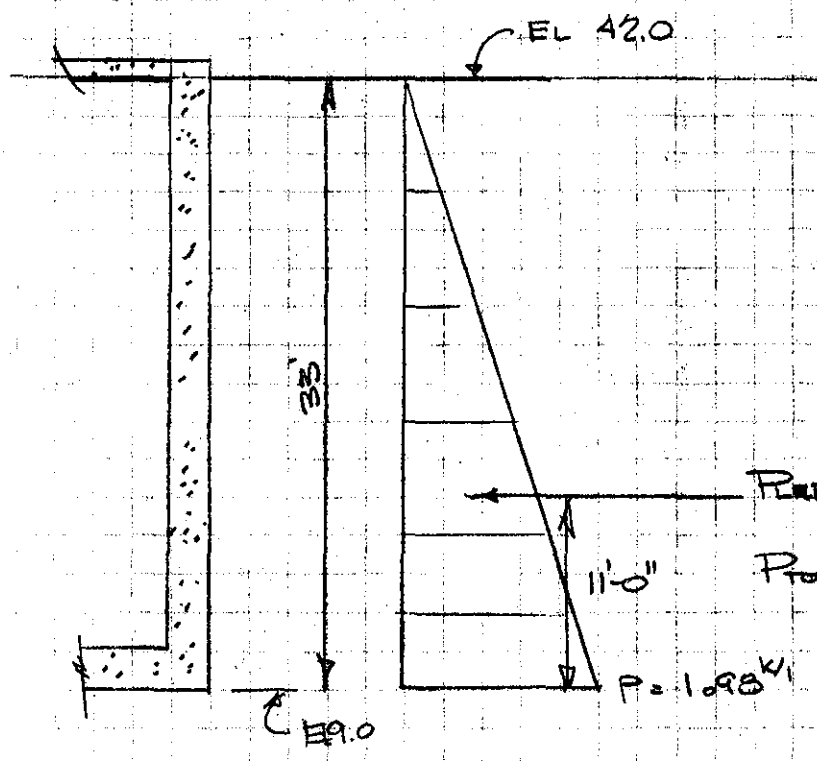
$$= 2.20 - .595 - .05$$

$$\underline{q_{MIN} \approx 1.555^{KSF}}$$

SUBJECT: Armory Station

COMPUTATION: Lat. Earth Pressure

COMPUTED BY: W. Rodger CHECKED BY: DATE: 20 Nov 74



$\gamma = 120$ $\phi = 30$

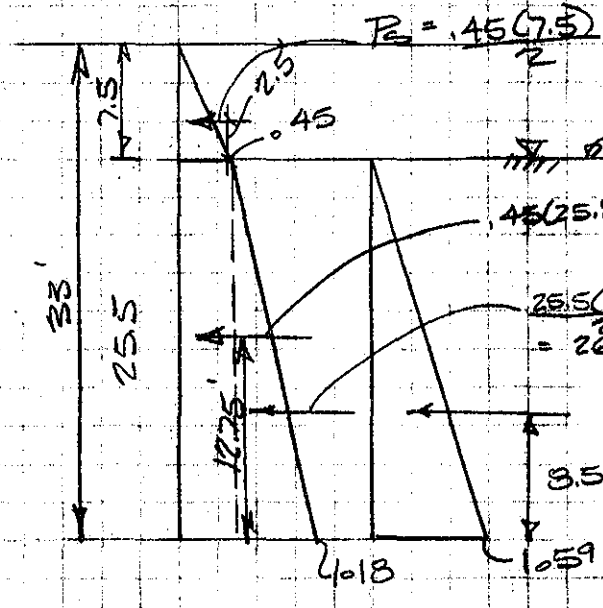
$K_a = .33$

Total Length = 29'

$K\gamma_{eff} = .06$ k/cf

$P_{EP} = \frac{1.98 \times 33}{2} = 32.67$ k/LF

$P_{TOT} = 32.67 \times 29 = 947.43$ k



$P_s = \frac{.45(7.5)}{2} \times 29 = 43.9$ k

$K\gamma = .06$

$.45(25.5)(29) = 332.8$ k

$K\gamma = .0288$

$\frac{25.5(.72)(29)}{2} = 269.9$

$\gamma_w = .0625$

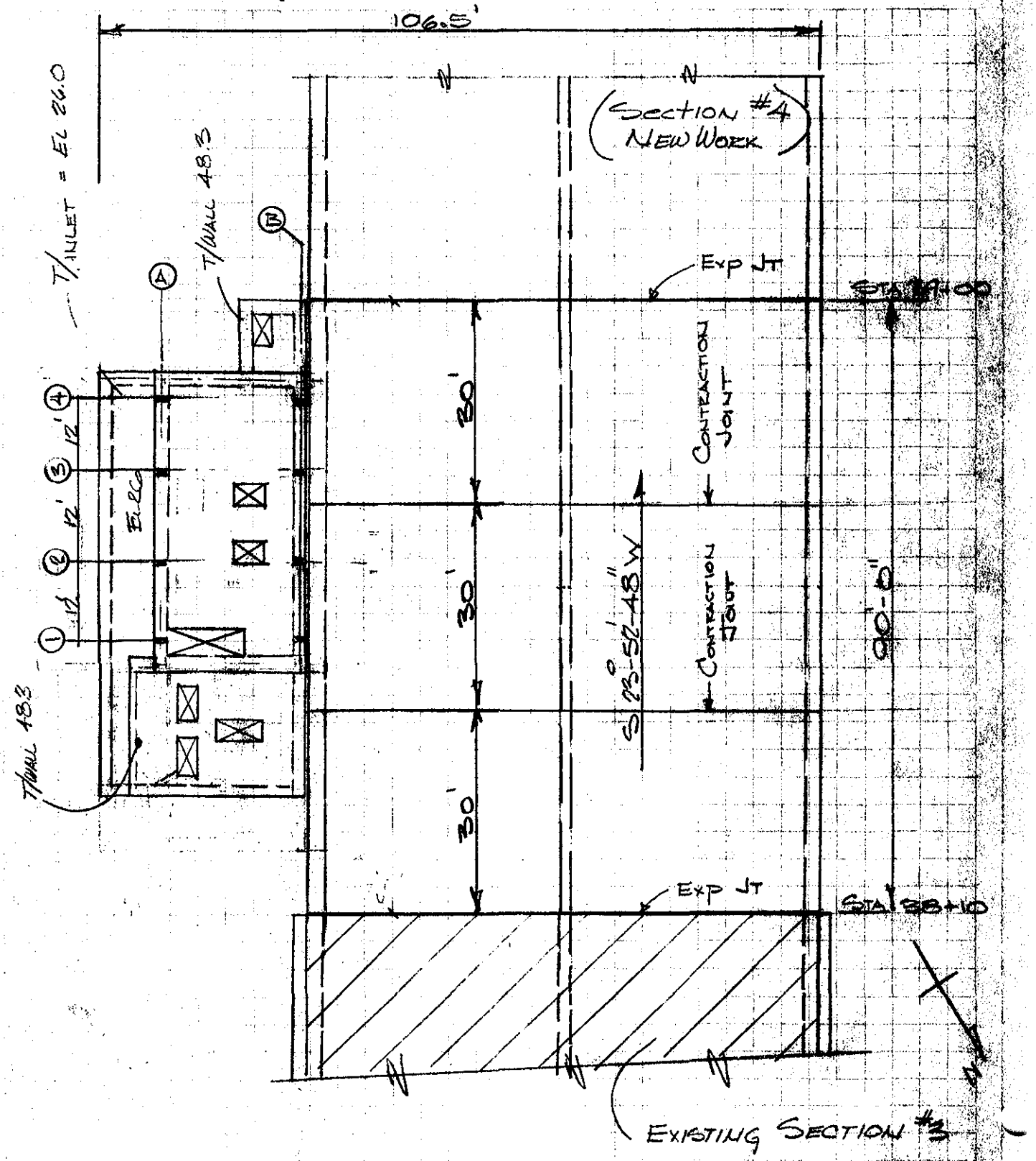
$20.27(29) = 587.8$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

PAGE A-48

SUBJECT Pope Park
COMPUTATION Pump Station P-1
COMPUTED BY W. Rodger CHECKED BY DATE 16 Oct 74



NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Section - Screen Room & Conduit
COMPUTATION Port Park
COMPUTED BY W. Rodney CHECKED BY DATE 16 Oct 74
PAGE P. 2

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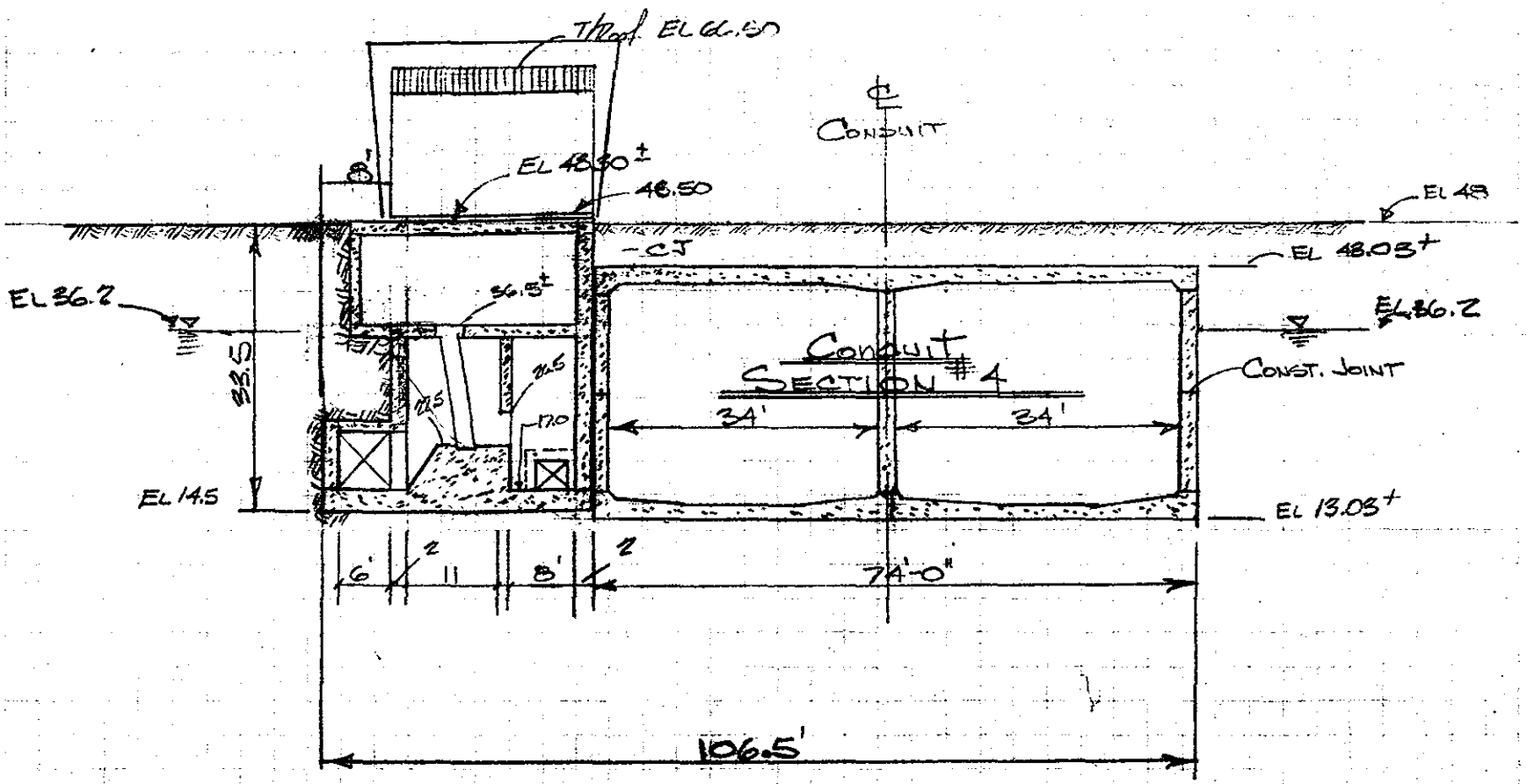

SECTION A-A
1'-0" = 20'

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Pope Park Pump Station - Section
COMPUTATION
COMPUTED BY W. Rodger CHECKED BY DATE 16 Oct 74
PAGE P-3

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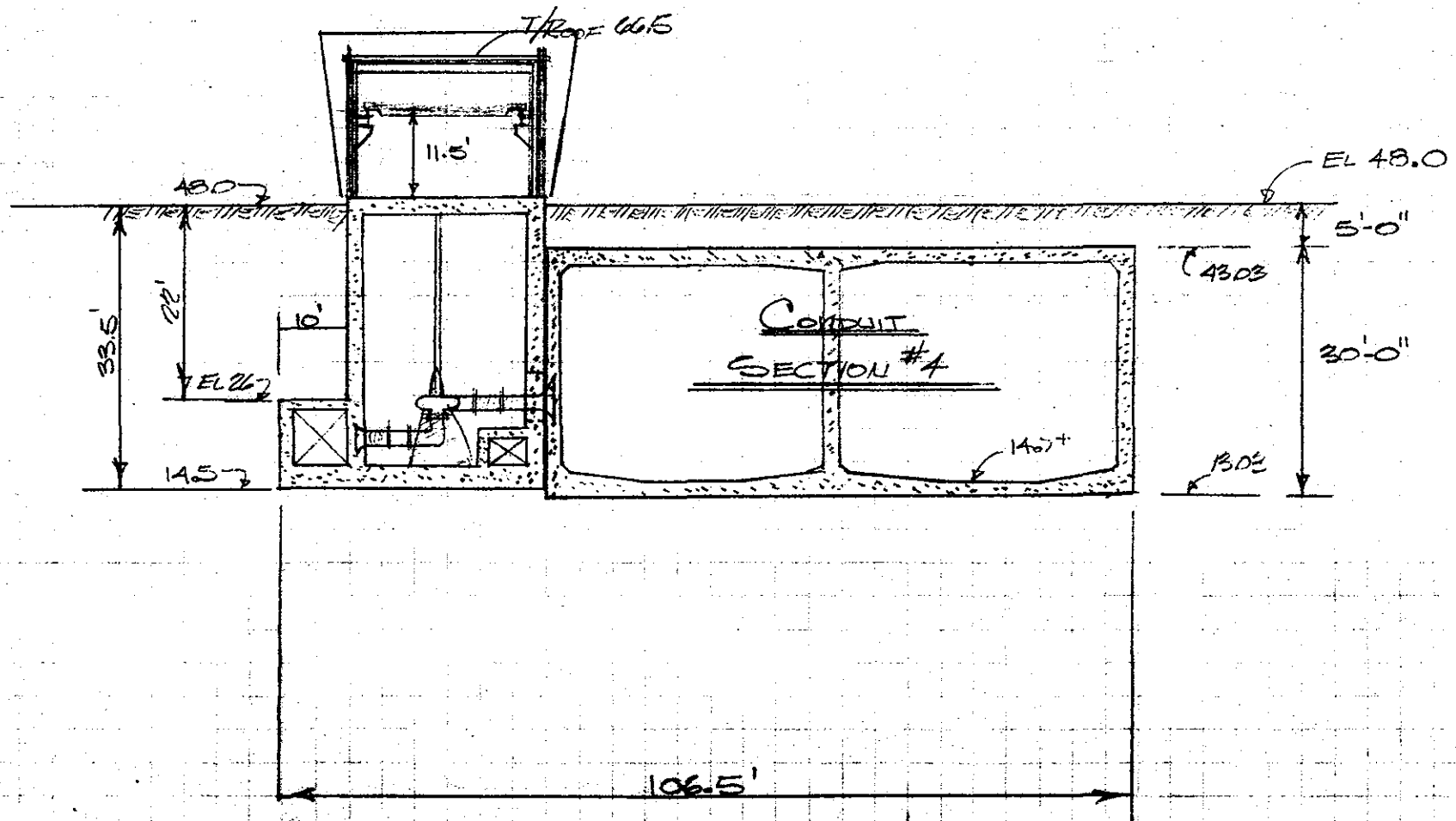
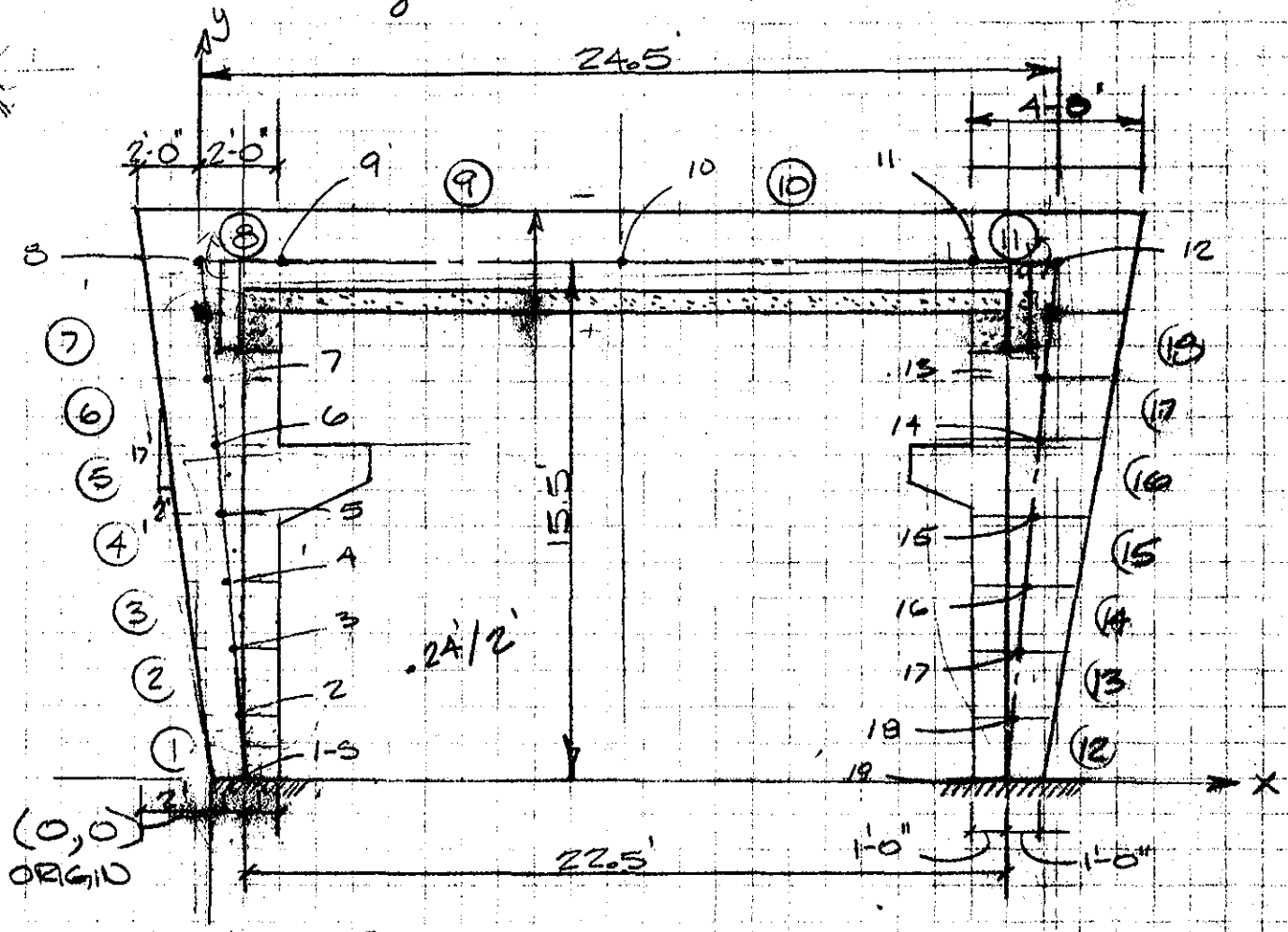


Section BB

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: POPE PARK
COMPUTATION: MAIN FRAME
COMPUTED BY: W. Rodger CHECKED BY: DATE: Nov 74



JOINT COORDINATES

	X	Y
1	1.00	0.0
2	.88	2.0
3	.76	4.0
4	.64	6.0
5	.52	8.0
6	.40	10.0
7	.28	12.0
8	0.00	15.50
9	2.00	15.50
10	12.25	15.50
11	22.50	15.50
12	24.50	15.50
13	24.22	12.00
14	24.10	10.00
15	23.98	8.00
16	23.86	6.00
17	23.74	4.00
18	23.62	2.00
19	23.50	0.00

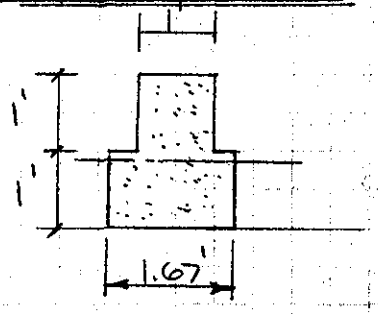
	I	J	A	I
1	1	2	2.67	.85
2	2	3	3.02	1.37
3	3	4	3.26	1.84
4	4	5	3.49	2.38
5	5	6	3.83	3.00
6	6	7	4.12	3.72
7	7	8	4.71	5.58
8	8	9	3.00	2.25
9	9	10	3.00	2.25
10	10	11	3.00	2.25
11	11	12	3.00	2.25
12	19	18	4.71	5.58
13	18	17	4.12	3.72
14	17	16	3.83	3.00
15	16	15	3.49	2.38
16	15	14	3.26	1.84
17	14	13	3.02	1.37
18	13	12	2.67	.85

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Pope Park
COMPUTATION: Member Properties
COMPUTED BY: W. Rodger CHECKED BY: DATE: Nov 74

Member 1 & 18



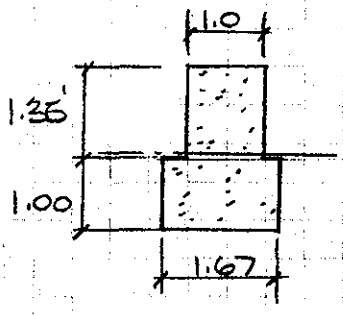
A	×	y	Ay	d
1.0		1.5	1.5	.625
1.67		.5	.835	.375
2.67			2.335	

$y = \frac{2.335}{2.67} = .875'$ from 1 of.

$I_{xx} = 1.0(.625)^2 + \frac{1}{12}(1)(1)^3 + 1.67(.375)^2 + \frac{1}{12}(1.67)(1)^3$
$= .039 + .083 + .235 + .139$
$= \underline{.847 \text{ Ft}^4}$

Member 2 & 17

$d = 2' + \frac{3}{17}(2) = 2.35'$



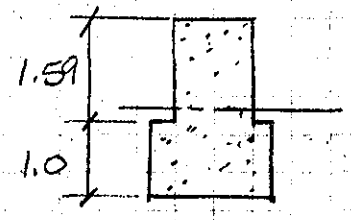
			d
1.35 × 1.675	=	2.26	.650
1.67 × .5	=	.835	.525
		3.095	

$y = \frac{3.095}{3.02} = 1.025'$

$I_{xx} = 1.35(.650)^2 + \frac{1}{12}(1)(1.35)^3 + 1.67(.525)^2 + \frac{1}{12}(1.67)(1)^3$
$= .570 + .205 + .460 + .139$
$= \underline{1.374 \text{ Ft}^4}$

Member 3 & 16

$d = 2' + \frac{5}{17}(2) = 2.59'$



			d
1.59 × 1.795	=	2.854	= .665
1.67 × .5	=	.835	= .630
3.26		3.689	

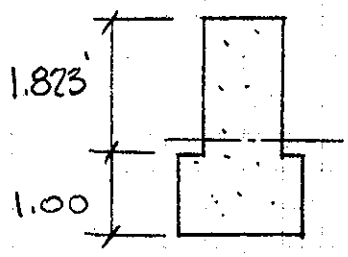
$y = 1.13'$

$I_{xx} = 1.59(.665)^2 + \frac{1}{12}(1)(1.59)^3 + 1.67(.630)^2 + \frac{1}{12}(1.67)(1)^2$
$= .703 + .335 + .663 + .139$
1.84 Ft^4

SUBJECT: Pope Park
COMPUTATION: Member Properties
COMPUTED BY: W. Rodger CHECKED BY: DATE: Nov 74

Member 4 & 15

$d = 2 + \frac{2}{17}(2) = 2.823$



				d
=	1.823 × 1.91	=	3.48	.670
	1.670 × .50	=	.84	.740
	3.493		4.32	

$y = 1.24$

$I_{xx} = 1.823(.67)^2 + \frac{1}{12}(1)(1.823)^3 + 1.67(.74)^2 + \frac{1}{12}(1.67)(1)^3$
$= .818 + .505 + .914 + .139$
$= 2.376 \text{ Ft}^4$

Mem 5 & 14

$d = 2 + \frac{9}{17}(2) = 3.058$ $\quad I_{AVE} = \frac{1.25 \times (3.058)^3}{12} = 2.978$

$A = 3.83 \text{ Ft}^2$

Member 6 & 13

$d = 2 + \frac{11}{17}(2) = 3.294$ $\quad I_{AVE} = 3.723$
$A = 4.12$

Member 7 & 12 $= 3.77$ $\quad I_{AVE} = 5.58$
$A = 4.71$

$d = 2 + \frac{15}{17}(2)$

Member 8 thru 11 $\quad A = 1 \times 3 = 3.0$
$I = \frac{1}{12}(1)(3)^3 = 2.25$

SUBJECT: Pope Park
COMPUTATION: Loads Dead, Live, Wind
COMPUTED BY: W. Rodger CHECKED BY: DATE: Nov 74

Assume - Masonry Span Horizontally Supported on Spandrel

Roof DL

Girder = 3 × .150 — .450 k/'

LW fill, Roof T&G, Insulat = .05(×11') — .55 k/'

8" Conc Slab = .100(×11') — 1.10 k/'

2.10 k/'

LL = .030 × 12' — .36 k/'

2.46 k/'

Spandrel = 1 × 2.6' = 2.5 × .150 = .375

Precast = .5 × 3.0 × .150 = .225

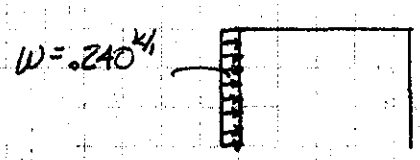
.600

P_{COL} = .600(11) = 6.6^k Say 7^k/Col

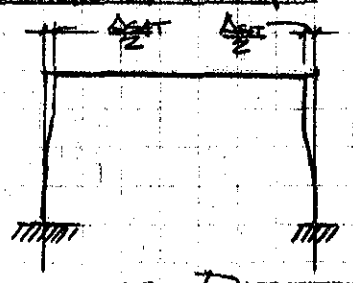
Col Weight = 4.0 (Ave ft²) × .15 (kcf) × 15' = 9^k / Col

Wind Load = 20 psf

or .02(12) Strip = .240 k/' Horizontally



Shrinkage & Creep ε_s = .0005



ΔS = .0005(22.5) = .011'

$\frac{\Delta S}{2}$ = .0055'

Temperature Differential In the Frame Will Also Have To Be Considered in the Final Design of Pope Park Pumping Station

SUBJECT: Roosevelt

COMPUTATION: Design Main Girder - (From Computer Results)

COMPUTED BY: W. Rodger CHECKED BY: DATE: 19 Nov 74

Consider Design of Concrete Frame - By Ultimate Strength

$f'_c = 3000^{PSI}$

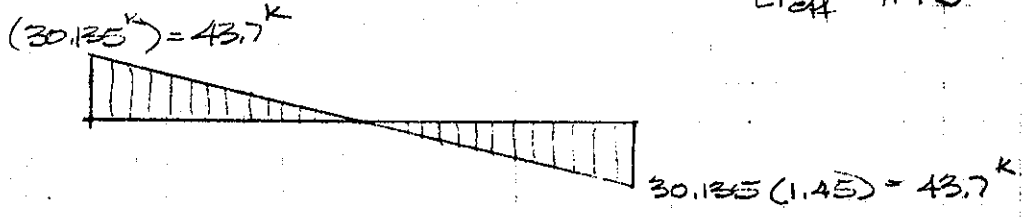
$f_y = 40{,}000^{PSI}$

DL = 2.10
LL = .136

Include Associated "Locked" in Temp Stresses

Load Factors: 1.4 DL
1.7 LL

$LF_{eff} = 1.45$



$V_u = 43.7^K - 2.5(3.57) = 34.078^K$

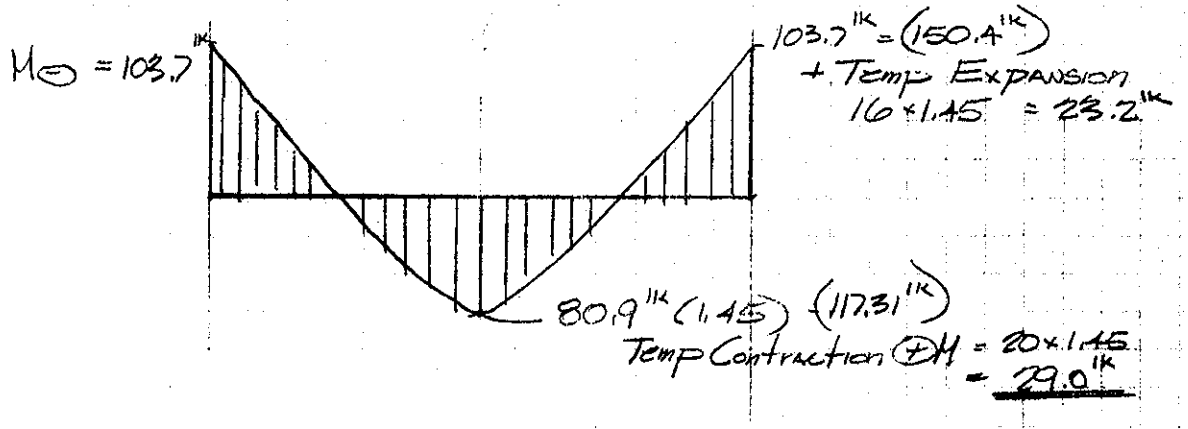
$v = \frac{35^K}{.85 \times 12 \times 30} = .114^{KSI}$ $\qquad 2\sqrt{f'_c} = 109.55^{PSI}$

$\frac{A_{v\,min}}{S} = 50\frac{b_w}{f_y} = \frac{50(12")}{40000} = .015^{in^2/in}$

#3 $A_v = 2(.11) = .22$ $\qquad S = 14.67"$

#4 $A_v = 2(.20) = .40$ $\qquad S = 26.67"$

#3@12" Stirrups



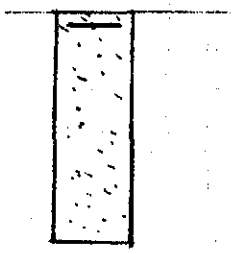
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Roof Frame
COMPUTATION: MAIN GIRDER
COMPUTED BY: W. Rodger CHECKED BY: DATE: 19 Nov 74

$M_{\ominus} = 150.4^{'k} + 23.2^{'k} = 173.2$ $\qquad f = \frac{12(33)^2}{12000} = 1.089$

Comp Negligible



$d'_{\ominus} = -2'' - .5'' - .5'' = -3''$
$d = 36 - 3 = 33''$

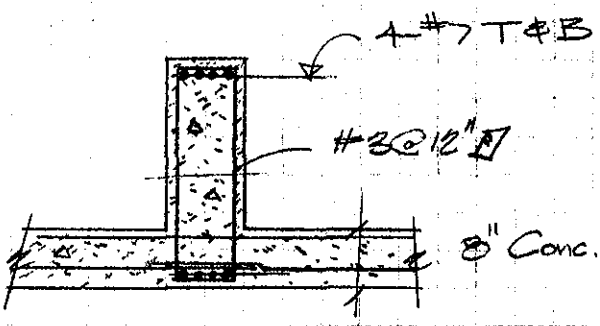
$K_u = \frac{M_u}{f} = \frac{173.2^{'k}}{1.089} = 159 < 181_{min}$

$A_{s\,REQ} = .0053(12)(33) = 2.10\ in^2$

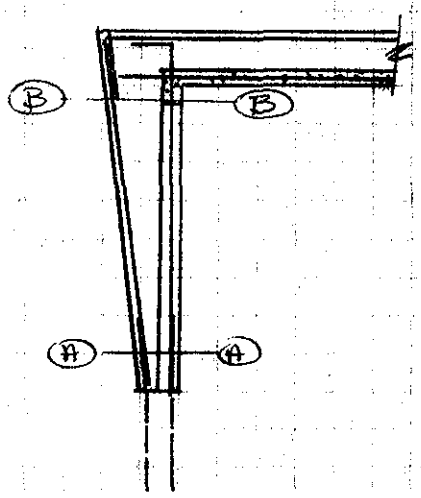
$3 - \#8 = 2.37\ in^2$
$4 - \#7 = 2.40\ in^2$

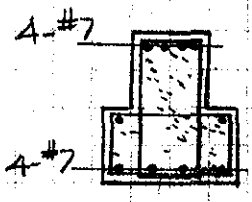
$M_{\oplus\,TOTAL} = 146.31^{'k}$ Use Same Steel Bottom

Section 10.6.3 ACI-71 Need Not Be Checked Section of Z factor



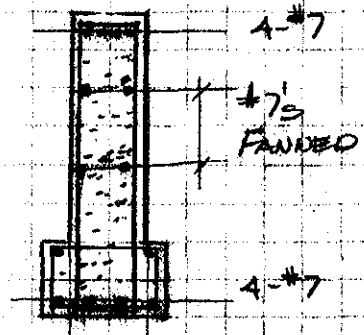
COLUMN DESIGN





$A_c = 2.67$

P_{min} $\quad 3.85\ in^2$



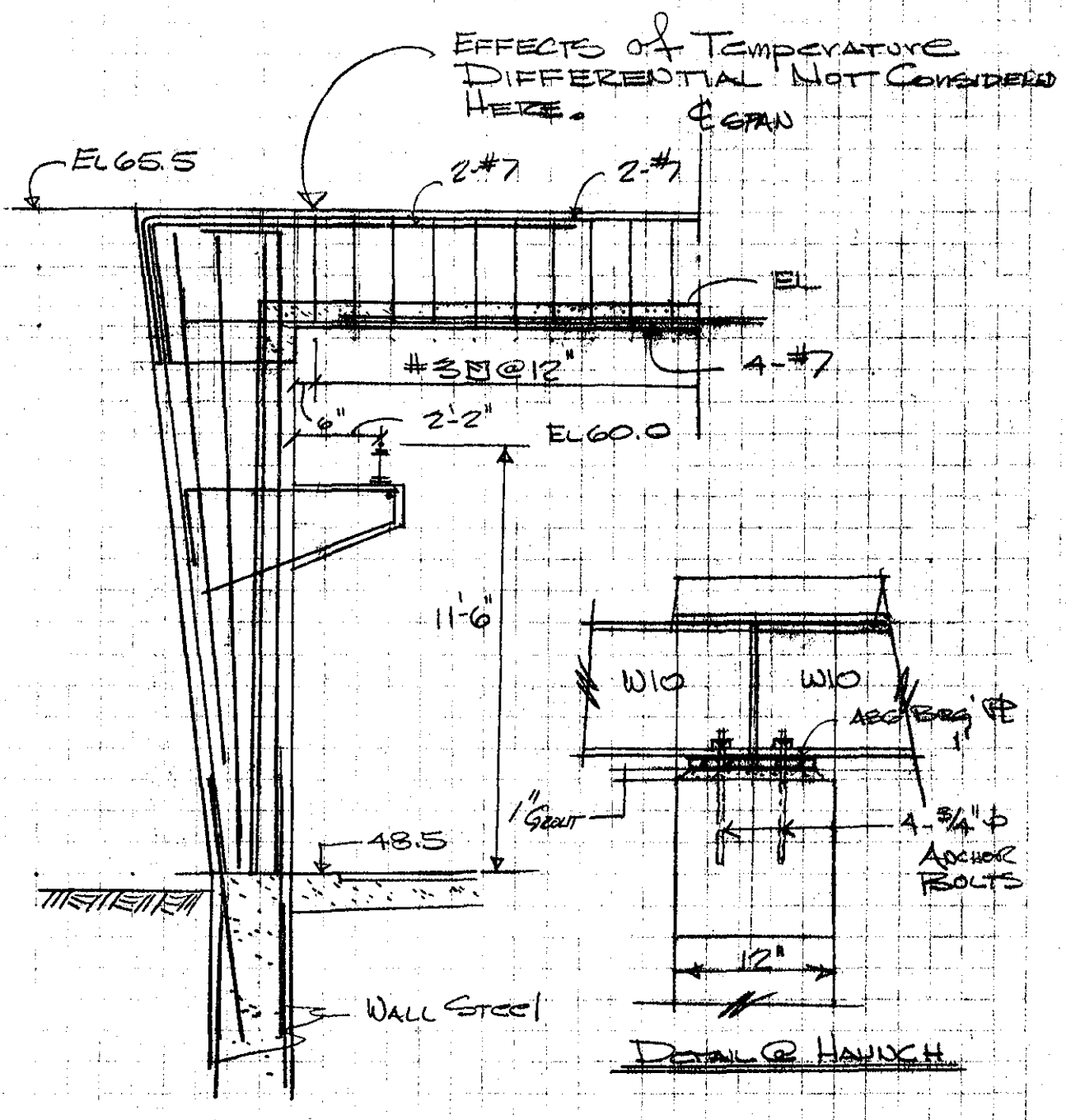
4.71

$6.78\ in^2$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

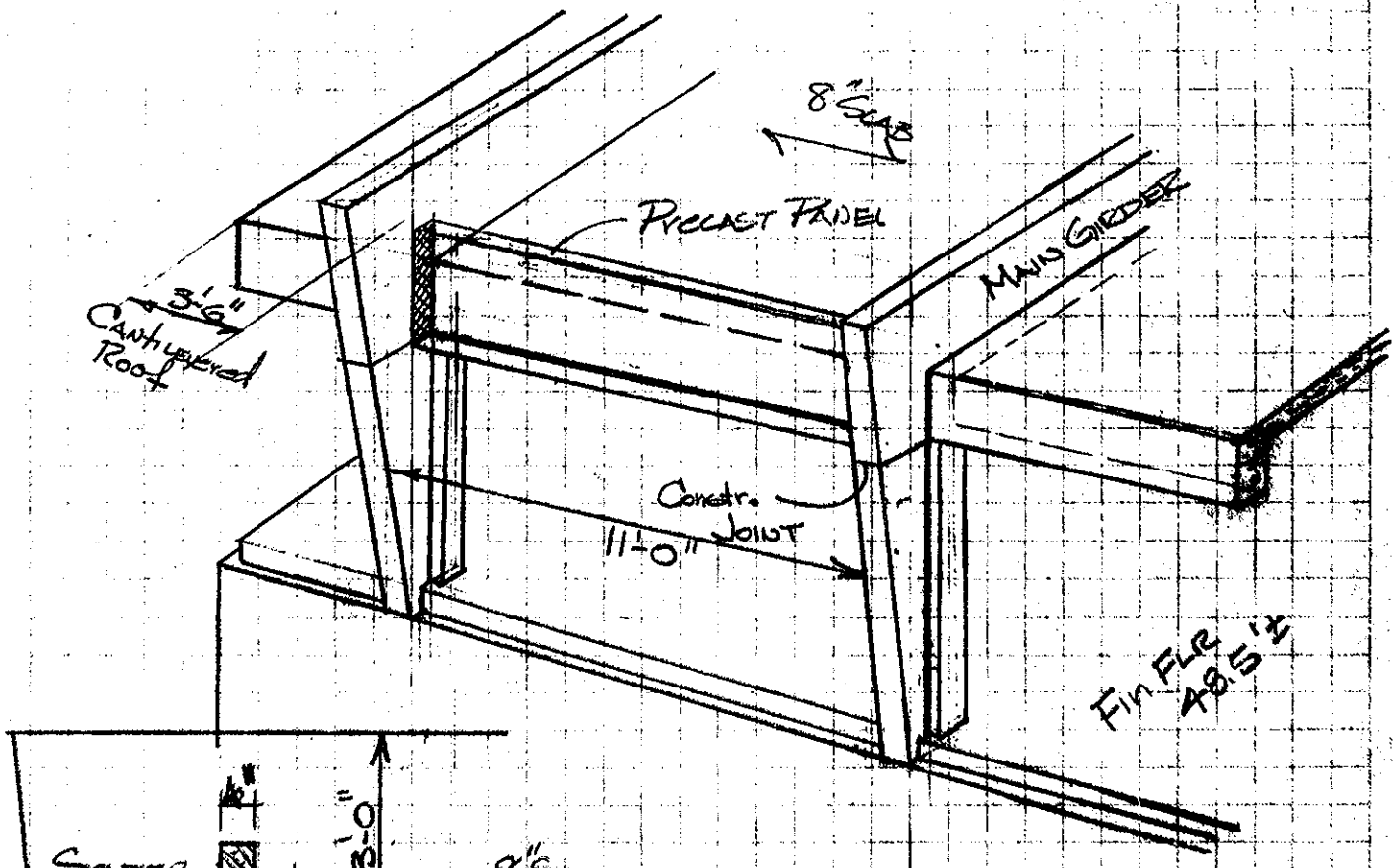
SUBJECT Fort Kent
COMPUTATION Reinf. Detail
COMPUTED BY W. Rodger CHECKED BY DATE 19 Nov 74

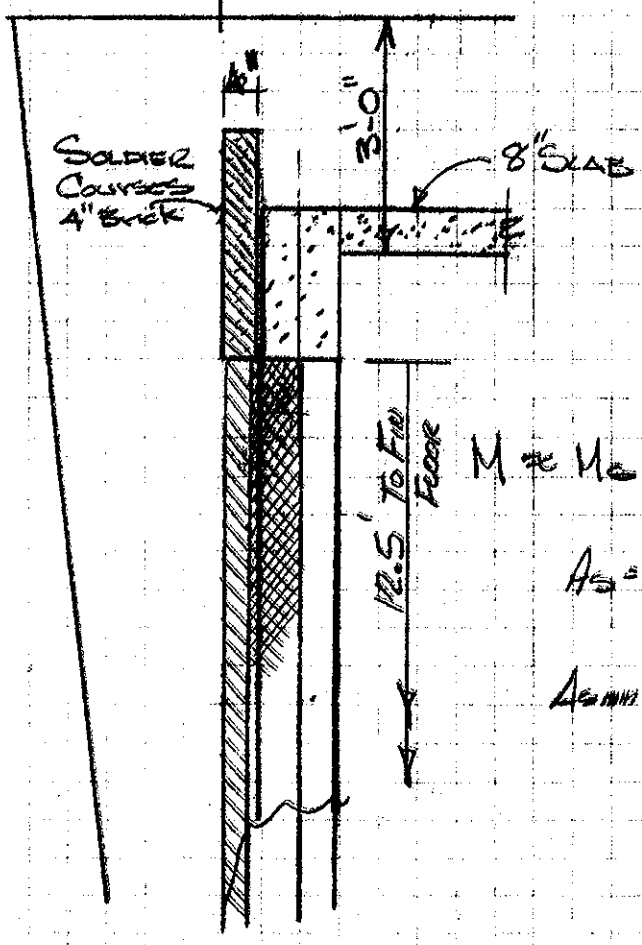


NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Pope Park
COMPUTATION: Spandrel Beam
COMPUTED BY: W. Rodger CHECKED BY: DATE: 20 Nov 74





	=	.225
LL	=	.060
Fill	=	.100
3" Slab	=	.300
PC Beam	=	.300
		.985

$M = M_c = \frac{wL^2}{8} = .985(11)^2/8 = 15^{1k}$

$A_s = \frac{15}{1.44 \times 21''} = .50 \text{ in}^2$

$A_{s\,min} = .0033(12)(21) = 1.34 \text{ in}^2$

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Pole Barn
COMPUTATION: 12" Masonry Wall
COMPUTED BY: W. Rodger CHECKED BY: DATE: 20 Nov 74

12" Masonry Wall 4" Brick / 8" Block $S = 288 \text{ in}^3$

Horizontal Span $L = 11'-0"$

Wind > Seismic = 20 psf

(A) $M_{WALL\ HORIZ} = .02(11)^2/8 = .303^{1K} = 303^{1\#}$

(B) → USE $M_{WALL\ VERT} = .02(12.5)^2/8 = .391^{1K} = 391^{1\#}$

Wall Must Have Zero Tension !!

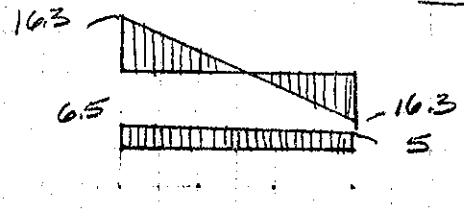
@ 6.25'

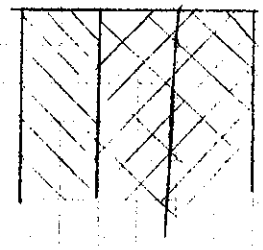
(FA)

Brick = 6.25(.04 KSF) = .250 K 6.5 psi Comp

Block = 6.25(.038) = .238 K 5.0 psi Comp

Flexural Stress = $\frac{391^{1\#} \times 12}{288} = 16.29$ psi





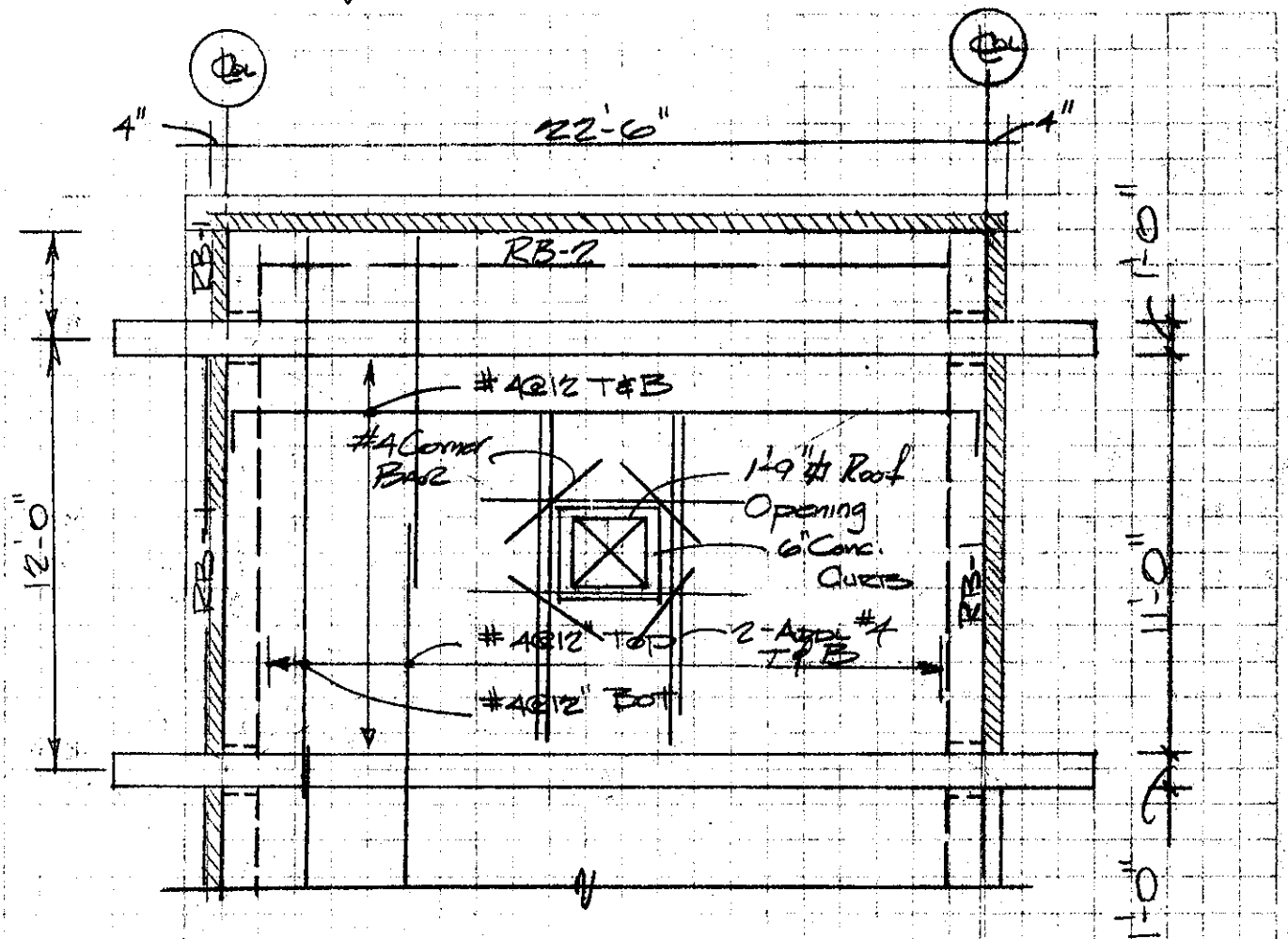
Notes:

Wall To Be Reinf For Excess Tension

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Pope Parks
COMPUTATION Roof Plan
COMPUTED BY W. Rodger CHECKED BY DATE 22 Nov 74



PART PLAN ROOF

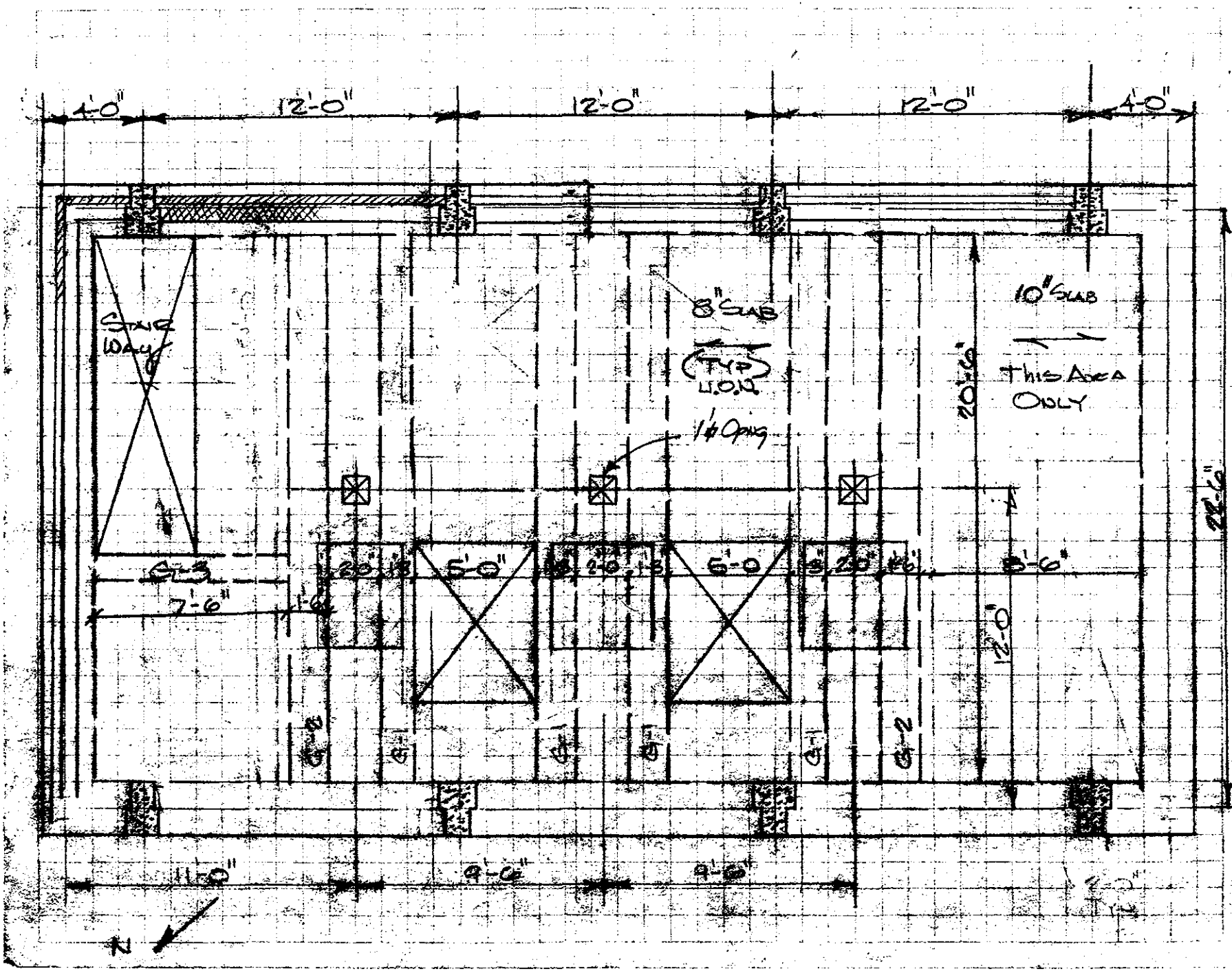
27 Sept 49

CORPS OF ENGINEERS, U.S. ARMY

SUBJECT _____ PAGE A-61

COMPUTATION Engine Room Floor

COMPUTED BY W. Rodgers CHECKED BY _____ DATE Nov 74



SUBJECT: Pope Parks

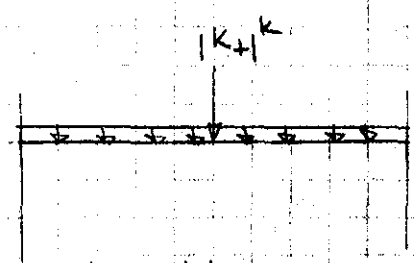
COMPUTATION: Floor Beams

COMPUTED BY: W. Rodger CHECKED BY: DATE: Nov 74

Consider Span 20'-6"

Engine 1900# Gear

G-1 (4) 8" Slab = .100
2" Flr = .020
.120 × 5' = .600
LL .100 × 5 = .500
+ BM .300 ±
1.400



Say $M_{\oplus} = M_{\ominus}$ $\frac{Pl}{8} + \frac{wl^2}{10} = \frac{2(20.5)}{8} + \frac{1.4(20.5)}{10}$

D = 18" $d_{\oplus} = d_{\ominus} = 15.5$ 5.13^K + 58.84^K ≈ 64^K

$A_s = \frac{64^K}{1.44 \times 15.5} = 2.87 \text{ in}^2$ 5-#7 or 4-#8

$\rho_{min} = .0053bd = 1.23$ $w_{TL} = 281 \approx .300$ Assumed

$I_g = \frac{15 \times 18^3}{12} = 7290$ $v = \frac{151}{15 \times 15.5} = 65$ PSI Nominal Stirrups

$\Delta = \frac{5wl^4}{384EI} = \frac{5(1.4)(20.5)^4(1728)}{384(3122)(7290)} = .25$ in ✓

G-2 (2) 10" Slab .125
2" Flr .020
.145 × 7 = 1.015
LL .100 × 7 .700
DL BM .400
2.115

$M = \frac{wl^2}{10} = 89^K + 5.13 = \text{Say } 95^K$

D = 24" d = 21.5 $A_s = \frac{95}{1.44 \times 21.5} = 3.07 \text{ in}^2$

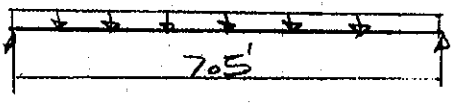
$V = 22^K$ $v = \frac{22}{18 \times 21.5} = 56$ PSI Nominal Stirrups

SUBJECT Pope Park

COMPUTATION Preliminary

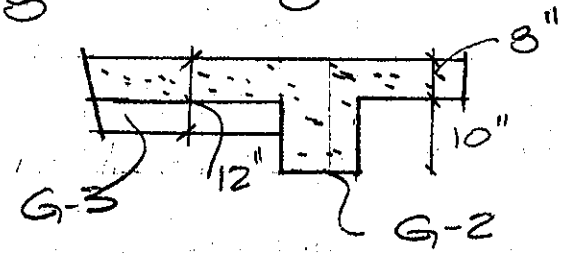
COMPUTED BY W. Rodger CHECKED BY DATE 21 Oct 74

G-3 Span ± b = 12"±

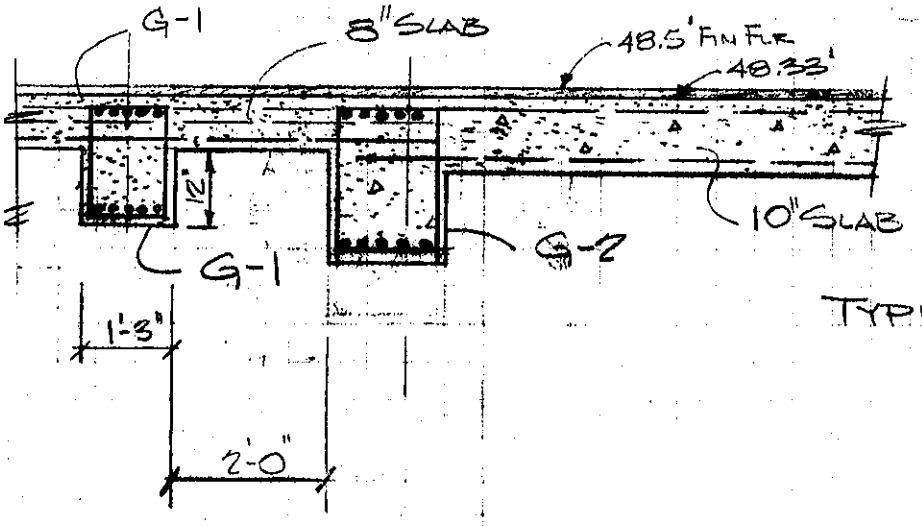


LL = 4' × .100 = .40
FLY = 4' × .100 = .40
.20±
1.00

$M = \frac{wL^2}{8} = 1(7.5)^2/8 = 7.03^{1k}$



Use d = 12"



TYPICAL

*- Main Slab Steel - Top - To Be Continuous over Beams Steel
- Bottom Slab Steel To Be Spliced @ Beam Centerlines As Shown
- Top Steel In Beams G-1 & G-2
- Maintain 'A' Min 1½" Cover For All Steel.

27 Sept 49 CORPS OF ENGINEERS, U.S. ARMY PAGE A-64

SUBJECT Pope Park

COMPUTATION Slab Design

COMPUTED BY W. Rodger CHECKED BY DATE Nov 74

SLAB

#4@10" 1.10 / .002(12)(10) = .24 in²

Equip = 350 PSF

Say 10" SLAB = 125 PSF

475

d = 10" - 2" - .5 = 7.5

.284 #/in³

$M_O = M_{MAX} = \frac{WL^2}{9} = \frac{.475(8)^2}{9} = 3.38^{IK}$

$A_s = \frac{3.38}{1.44 \times 7.5} = .313 \text{ in}^2$ #5@12" T&B

(DIST. .668# 1.043")

#/CY yd³ = .031 = 110 #/yd³

Equip = 350

8" Conc = 100

450

$M_O = M_{MAX} = \frac{WL^2}{9} = \frac{.450(8)^2}{9} = 3.20^{IK}$

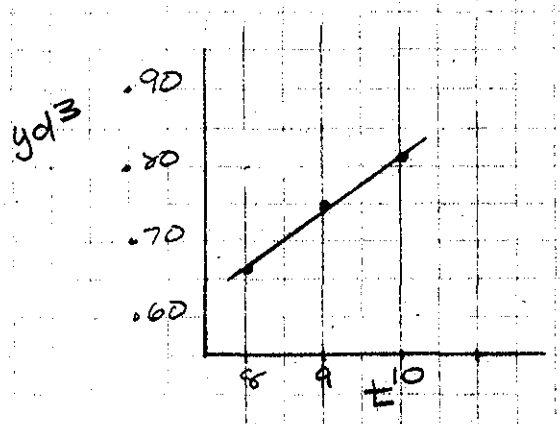
d = 8 - 2.5 = 5.5

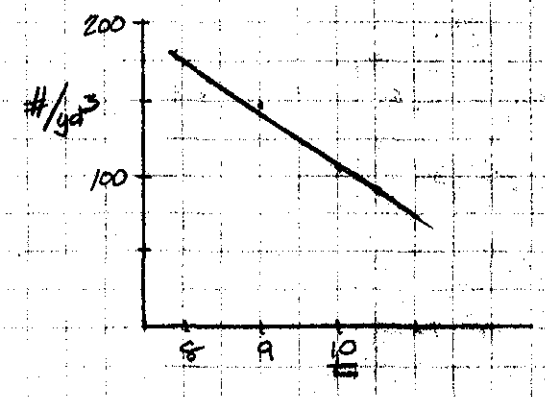
$A_s = \frac{3.20}{1.44 \times 5.5} = .404^{in^2}$ #4@6 #5@9 #6@12

(.668# + 1.502)

#/CY .025 174

9" M = 3.29 A_s = .35 in² .028 #5@10





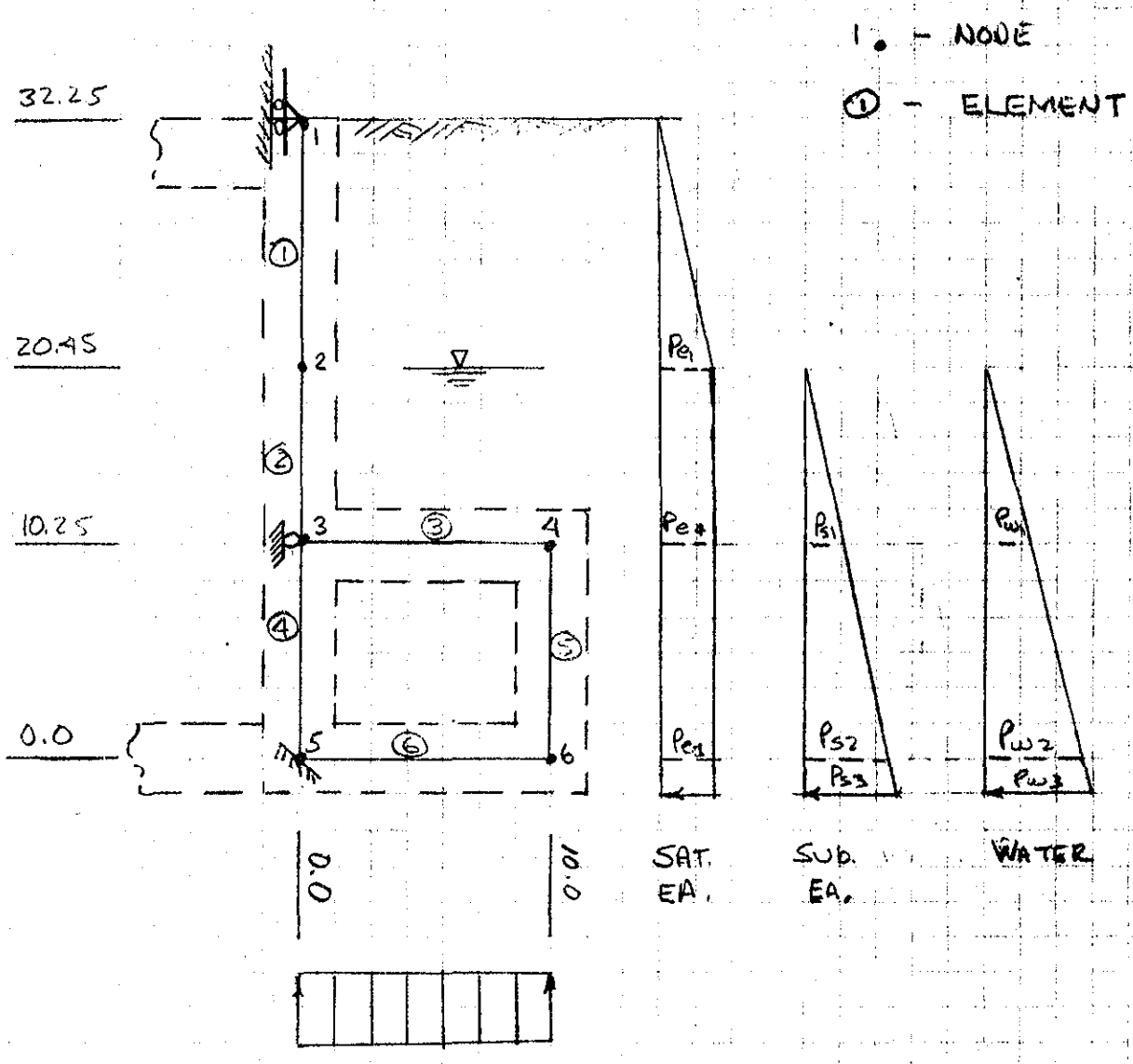
Use 10" SLAB for 8' SPAN

8 SLAB - ALL OTHER AREAS

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATIONS

COMPUTED BY: VRF CHECKED BY: DATE: 11/19/79



UPLIFT = 1.36 ksf

P_{e1} = 0.33 x 0.12 x 11.8 = 0.47
P_{s1} = 0.33 x 0.06 x 10.2 = 0.20
P_{s2} = 0.33 x 0.06 x 20.45 = 0.40
P_{s3} = 0.33 x 0.06 x 21.70 = 0.43
P_{w1} = 0.0625 x 10.2 = 0.64
P_{w2} = 0.0625 x 20.45 = 1.28
P_{w3} = 0.0625 x 21.70 = 1.36

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION

COMPUTED BY JRF CHECKED BY DATE 11/19/74

RESULTS FROM COMPUTER ANALYSIS

NODE	Shear (K)	Moment (K·ft)	
1	0.04	0.0	VERTICAL WALL @ X=0
2	0.04	0.4	
3	6.5	44.2	
5	6.5	22.1	
4	3.8	35.8	VERTICAL WALL @ X = 10'
6	13.9	8.4	
3	25.9	84.1	HORIZONTAL SLAB @ Y = 10.25'
4	2.0	35.8	

VERTICAL WALL @ X=0

$t = 24'' - 4'' - 0.5'' = 19.5''$

$M_c = 0.225 \times 19.5^2$

$M_c = 85.6$ K·ft ∴ MOMENTS OK

$A_s(-) = \frac{44.2}{1.44 \times 19.5}$

$A_s(-) = 1.57$ in^2 #11 @ 12" ($A = 2.56$ in^2)

$A_s(+) = \frac{22.1}{1.44 \times 19.5}$

$A_s(+) = 0.79$ in^2 #8 @ 12" ($A = 0.79$ in^2)

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION

COMPUTED BY JRF CHECKED BY DATE 11/19/74

$V = 6.5^K$

$v = \frac{6500}{12 \times 19.5}$

$v = 27.8$ psi < 60 psi $\therefore$ OK

VERTICAL WALL @ $x = 10'$

$A_s(-) = \frac{35.8}{1.44 \times 19.5}$

$A_s(-) = 1.27$ in^2 #10@12"

$A_s(+) = \frac{8.4}{1.44 \times 19.5}$

$A_s(+) = 0.30$ #5@12"

$V = 13.9 - \frac{2.96}{2}(1.31 + 1.55)$

$V = 9.7$

$v = \frac{9700}{12 \times 19.5}$

$v = 41.4$ psi < 60 psi $\therefore$ OK

HORIZONTAL WALL

$M = 84.1 - \frac{1}{3}(25.9)(2)$

$M = 66.8$ k·ft

$A_s = \frac{66.8}{1.44 \times 19.5}$

$A_s = 2.38$ in.^{2} #10@6"

$V = 25.9 - 2.79 \times 2.96 = 17.6^K$

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION

COMPUTED BY: VRF CHECKED BY: DATE: 11/10/79

$v = \frac{17600}{12 \times 19.5}$

$v = 75.2$ psi $>$ 60 psi $\therefore$ N.G.

INCREASE slab thickness to 30" d = 25.5"

$v = \frac{17600}{12 \times 25.5}$

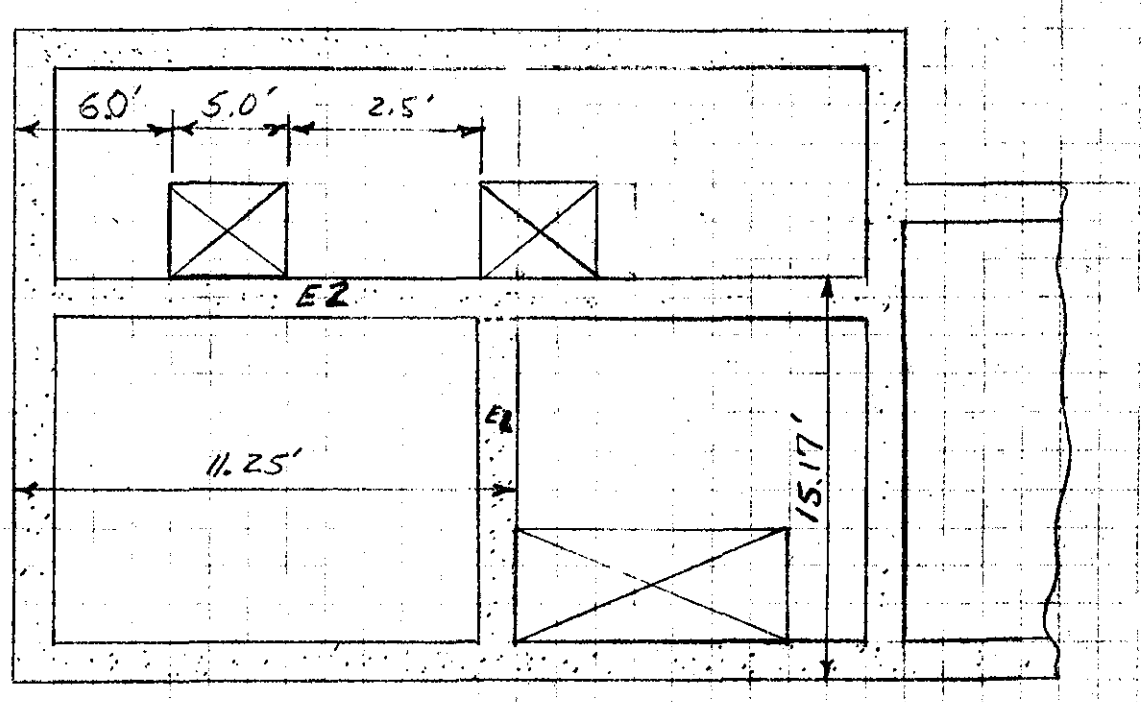
$v = 57.5$ psi $<$ 60 psi $\therefore$ OK

SUBJECT PARK RIVER

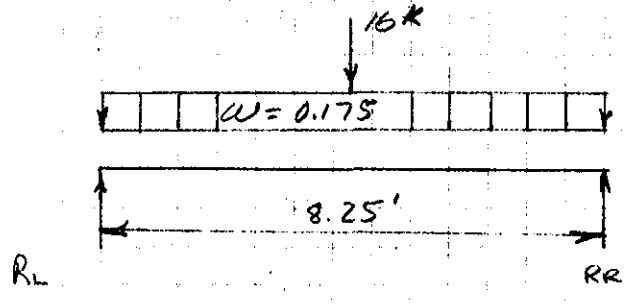
COMPUTATION FORE PARK PUMPING STATION 9

COMPUTED BY JRF CHECKED BY DATE 11/18/74

EXTERIOR SLAB @ EL. 48.3



SLAB (ASSUME TWO WAY)



D.L = .5 x 0.15 = 0.075
L.L = 0.10
w = 0.10 + 0.075
w = 0.175 k/ft

$\frac{S.S}{L.S} = \frac{8.25}{12.17} = 0.68$

$R_L = 8 + 0.175 \times \frac{8.25}{2} = 8.72^K = R_R$

$M = 0.175 \times \frac{8.25^2}{8} + 16 \times \frac{8.25}{4}$

M = 34.5 K.ft

$d = \sqrt{\frac{34.5}{.225}} = 12.4''$ USE 14" SLAB

$A_s\,(s.s.) = \dfrac{34.5}{1.44 \times 12.5}$

$A_s(s.s.) = 1.92\ in^2$ #9 @ 6 in

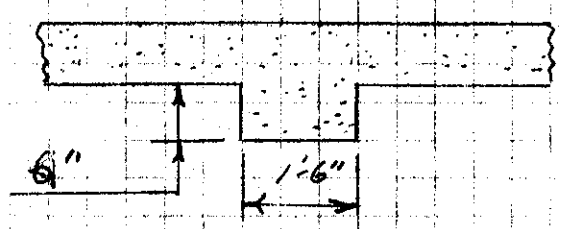
$A_s(L.S.) = 1.92 \times 0.68$

$A_s(L.S.) = 1.31\ in^2$ #9 @ 9" (1.33 in.²)
#8 @ 6" (1.58 in.²)
#10 @ 12" (1.27 in²)

$v = \dfrac{8720}{12 \times 12.5}$

$v = 58.1$ psi < 60 psi ∴ OK

BEAM E1



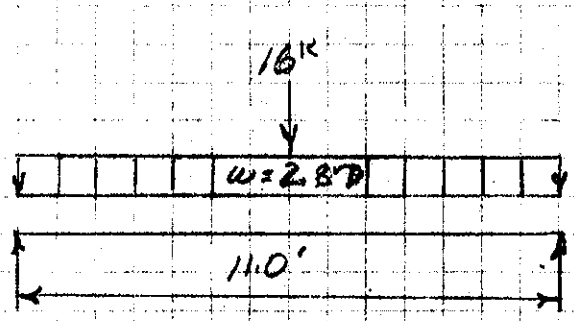
$w_{DL} = 0.15 \times \frac{14}{12}\,[(4.375 + 3.875)]$

$0.15 \times 1.5 \times 2.0$

$w_{DL} = 1.89$ Klf

$w_{DL} = 0.98$ klf

$w_T = 2.87$ klf



$M = \dfrac{2.87 \times 11^2}{8} + \dfrac{16 \times 11}{4}$

$M = 87.4$ K.FT

$d_{REQ} = \sqrt{\dfrac{87.4}{0.225 \times 1.5}}$

$d_{REQ} = 16.8$ in

USE $t = 20$", $d = 17.5$"

$R_L = 4 + 2.87 \times 11.0 - 2$
$R_L = 19.8$ K

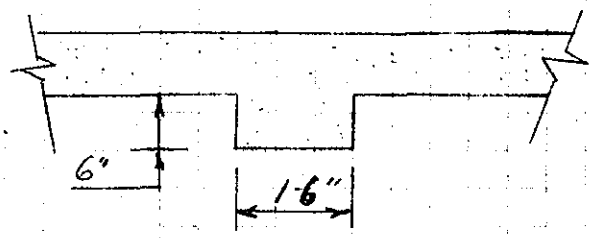
$A_s = \frac{87.4}{1.44 \times 17.5}$

$A_s = 3.47 \text{ in}^2$ USE 3 #10 (A = 3.81)

$v = \frac{19800}{18 \times 17.5}$

$v = 62.9$ psi $\not> 60$ psi ∴ OK

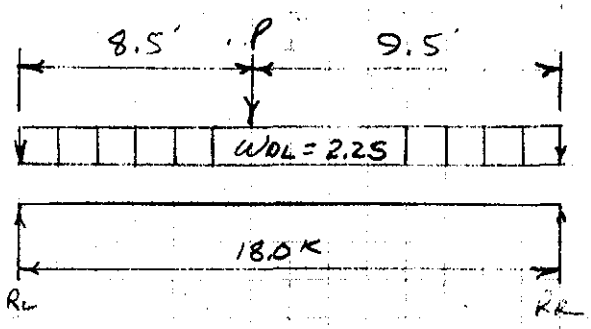
BEAM E2



$w_{DL} = 0.15 \times \left(\frac{14}{12} \times 6.25 + 1.5 \times \frac{20}{12}\right) = 1.47$

$w_{LL} = 0.10 \times (6.25 + 1.5) = 0.78$

$w_T = 1.47 + 0.78 = 2.25$ k/lf



V = 0 @ LOAD P

$M = 37 \times 8.5 - 2.25 \times \frac{8.5^2}{2}$

M = 233.2 K·FL

$P = 16 + 2.81 \times \frac{11}{2}$

P = 31.8K

$d_{REQ} = \sqrt{\frac{233.2}{1.5 \times 0.225}}$

$d_{REQ} = 26.3''$

$R_L = 2.25 \times \frac{18}{2} + 31.8 \times \frac{9.5}{18}$

USE t = 30", d = 28"

$R_L = 20.25 + 16.8 = 37.0$ K, $R = 20.2 + 15.0 = 35.2$ K

$A_s = \frac{233.2}{1.44 \times 28.0}$

$A_s = 5.78 \text{ in}^2$ USE 4 #11 (6.24)

$V = 37.0 - 2.25 \times \frac{28.0}{12} = 31.8^K$

$V = \frac{31800}{18 \times 28.0}$

$V = 63.1 > 60$ ∴ INCREASE beam SIZE TO $b = 24''$

$w_{DL} = 0.15(\frac{14}{12} \times 6.25 + 1.5 \times \frac{30}{12}) = 1.66$

$w_{LL} = 0.10(6.25 + 2.0) = 0.82$

$w_T = 1.66 + 0.82 = 2.48$ k/f

$R_L = 2.48 \times \frac{18}{2} + 31.8 \times \frac{9.5}{18}$

$R_L = 22.3 + 16.8 = 39.1^K$

$M_{MAX} = 39.1 \times 8.5 - 2.48 \times \frac{8.5^2}{2}$

$M_{MAX} = 242.8$ K.ft

$d_{REQ} = \sqrt{\frac{242.8}{20 \times .225}}$

$d_{REQ} = 23.2$ in

USE $t = 26''$ $d = 24''$

$A_s = \frac{242.8}{1.44 \times 24.0}$

$A_s = 7.02 \text{ in}^2$ 5-#11 = ($A = 7.80$ in^2)

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION 13

COMPUTED BY: JRF CHECKED BY: DATE: 11/18/74

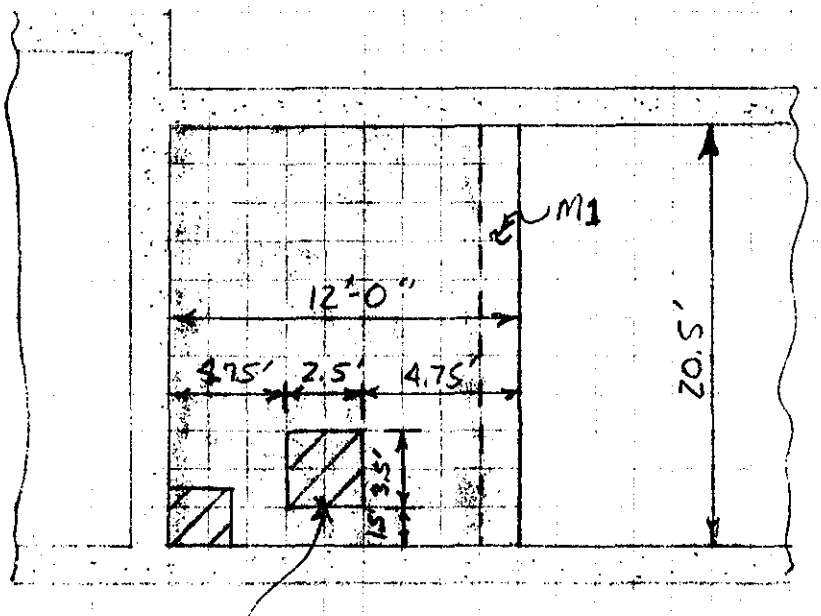
$V = 39.1 - 2.48 \times 2$

$V = 34.1^{K}$

$v = \frac{34\,100}{24 \times 24}$

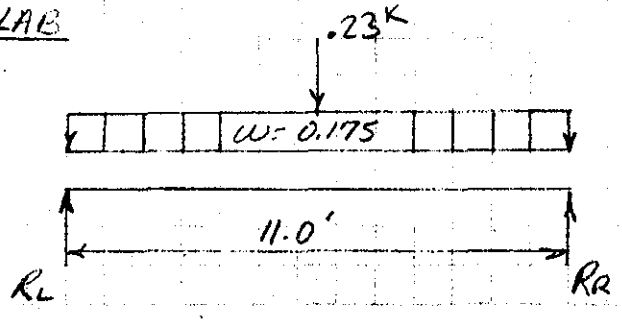
$v = 59.2$ psi $< 60.$ psi $\therefore$ OK

MEZZANINE FLOOR EL. 36.5



BOILER - MAX WT. 800 lb
FROM J. Shaughnessy
Mechanical Section 11/18/74

SLAB



$w_{DL} = 0.15(0.5) = 0.075$

$w_{LL} = 0.10\ (1) = 0.100$

$w_T = \quad = 0.175$

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION A

COMPUTED BY JRF CHECKED BY DATE 11/18/74

$R_L = 0.175 \times \frac{11}{5} + \frac{.23}{2}$

$R_L = 1.08^K = R_R$

$M = 0.175 \times \frac{11^2}{8} + 0.23 \times \frac{11}{4}$

$M = 3.3$ k·ft.

$d_{REQ} = \sqrt{\frac{3.3}{0.225}}$

$d_{REQ} = 3.82$ in

USE slab $t = 6''$ $d = 4.75''$

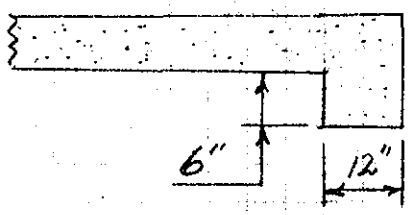
$A_s = \frac{3.3}{1.44 \times 4.75}$

$A_s = 0.48$ USE #7@12 in.

slab does not require a beam for boiler

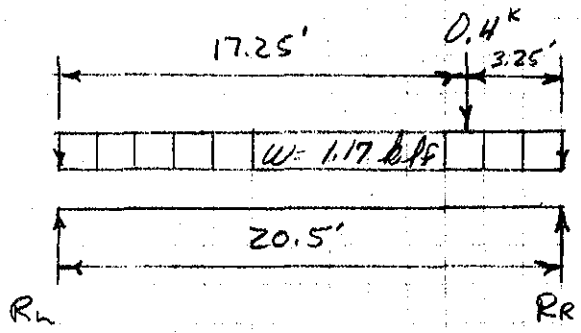
<u>BEAM M1</u>

$w_{DL} = 0.15[\frac{11}{2}(\frac{5}{12}) + 1.0 \times 1.5] = 0.57$ k/ft



$w_{LL} = 0.10 \times 6 = 0.60$ k/ft

1.17 k/ft



V=0 @ x from R_L

$x = \frac{12.1}{1.17} = 10.3'$

$M_x = 12.1 \times 10.3 - 1.17 \times \frac{10.3^2}{2}$

$M_x = 62.6$ k·ft

$d_{REQ} = \sqrt{\frac{62.6}{.225}}$

$d_{REQ} = 16.8$ in.

$R_L = 1.17 \times \frac{20.5}{2} + 0.4 \times \frac{3.25}{20.5} = 12.1^K$

$R_R = 1.17 \times \frac{20.5}{2} + 0.4 \times \frac{17.25}{20.5} = 12.3^K$

SUBJECT Park River

COMPUTATION Pope Park Pumping Station 15

COMPUTED BY JRF CHECKED BY DATE 11/18/74

USE $t = 20''$ $d = 18''$

$W_{DL} = 0.15\left(\frac{11}{2}\left(\frac{5}{12}\right) + 1.0 \times \frac{20}{12}\right] = 0.59$

$W_{LL} = 0.60$

$W_T = 1.19$ k/ft

$R_L = 1.19 \times \frac{20.5}{2} + 0.4 \times \frac{3.25}{20.5}$

$R_L = 12.3^K$

$R_R = 12.5^K$

$V = 0$ @ x from R_L

$x = \frac{12.3}{1.19} = 10.3'$

$M_x = 12.3 \times 10.3 - 1.19 \times \frac{10.3^2}{2}$

$M_x = 63.6$ k·ft

$A_s = \frac{63.6}{1.44 \times 18}$

$A_s = 2.45$ in^2 use 2 - #10 ($A = 2.54$ in.^{2})

$V = 12.5 - 1.19 \times 1.5$

$V = 15.8^K$

$v = \frac{10800}{12 \times 18}$

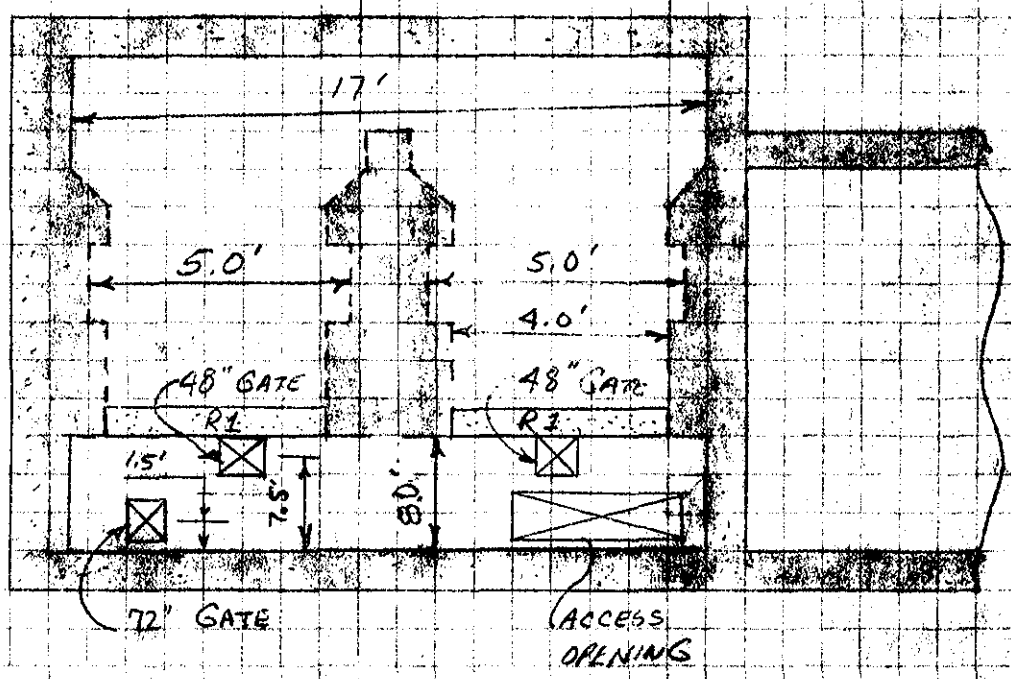
$v = 49.5$ psi < 60 psi $\therefore$ OK

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION 16

COMPUTED BY JRF CHECKED BY DATE 11/18/79

RACK FLOOR @ EL. 36.5



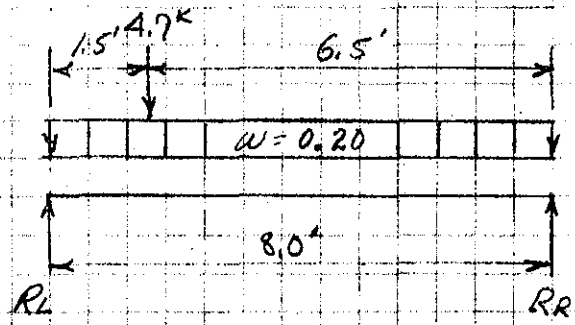
72" GATE – SHAFT – 286
LEAF – 3500
OPERATOR – 935
4721#

TOTAL WT. OF GATE (LEAF, FRAME, etc.) = 6360 lb.

48" GATE – Shaft – 286
LEAF – 1150
Operator – 750
2186#

TOTAL WT. OF GATE (LEAF, FRAME etc.) = 3060 lb.

SLAB (ASSUME 8" SLAB)



$w_{DL} = 0.15\left(\frac{8}{12}\right) = 0.10$

$w_{LL} = 0.100 = 0.10$

$w_{TOT} = 0.20$

$R_L = 0.20 \times \frac{8.0}{2} + 4.7 \times \frac{6.5}{8}$

$R_L = 4.62^K$

$R_R = 0.20 \times \frac{8.0}{2} + 4.7 \times \frac{1.5}{8}$

$R_R = 1.68^K$

$V = 0$ @ 4.7^K LOAD

$M = 4.62 \times 1.5 - 0.2 \times \frac{1.5^2}{2}$

$M = 6.70$ K·ft

$d_{REQ} = \sqrt{\frac{6.70}{.225}}$

$d_{REQ} = 5.50$ in. ∴ 8" SLAB OK

$A_s = \frac{6.7}{1.44 \times 6.5}$

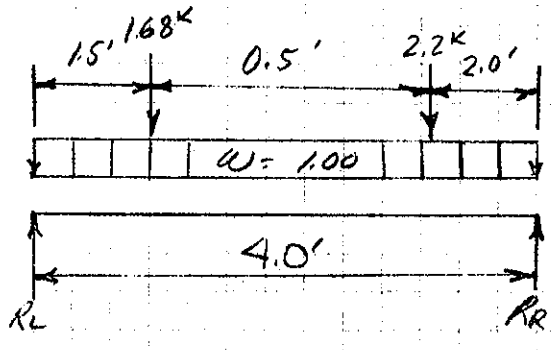
$A_s = 0.72$ in² USE #8 @12 in.

$V = 4.62 - 0.2 \times \frac{6.5}{12} = 4.51$

$v = \frac{4510}{12 \times 6.5}$

$v = 57.8$ psi ∴ OK

BEAM R1 (Assume 12" x 12" beam)



$w_{DL} = 0.15(1 \times 1 + 4 \times \frac{8}{12}) = 0.55$

$w_{LL} = 0.10(4 + 0.5) = 0.45$

$w_T = 0.55 + 0.45 = 1.00$ k/f

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (18)

COMPUTED BY JRF CHECKED BY DATE 11/15/74

$R_L = 1.00 \times \frac{4}{2} + 1.68 \times \frac{2.5}{4} + 2.2 \times \frac{2}{4}$

$R_L = 4.15^K$

$R_R = 1.00 \times \frac{4}{2} + 1.68 \times \frac{1.5}{4} + 2.2 \times \frac{2}{4}$

$R_R = 3.73^K$

$M_{max} = 4.15 \times 2.47 - 1.0 \times \frac{2.47^2}{2} - 1.68 \times 0.97$

$M_{max} = 5.57$ K ft

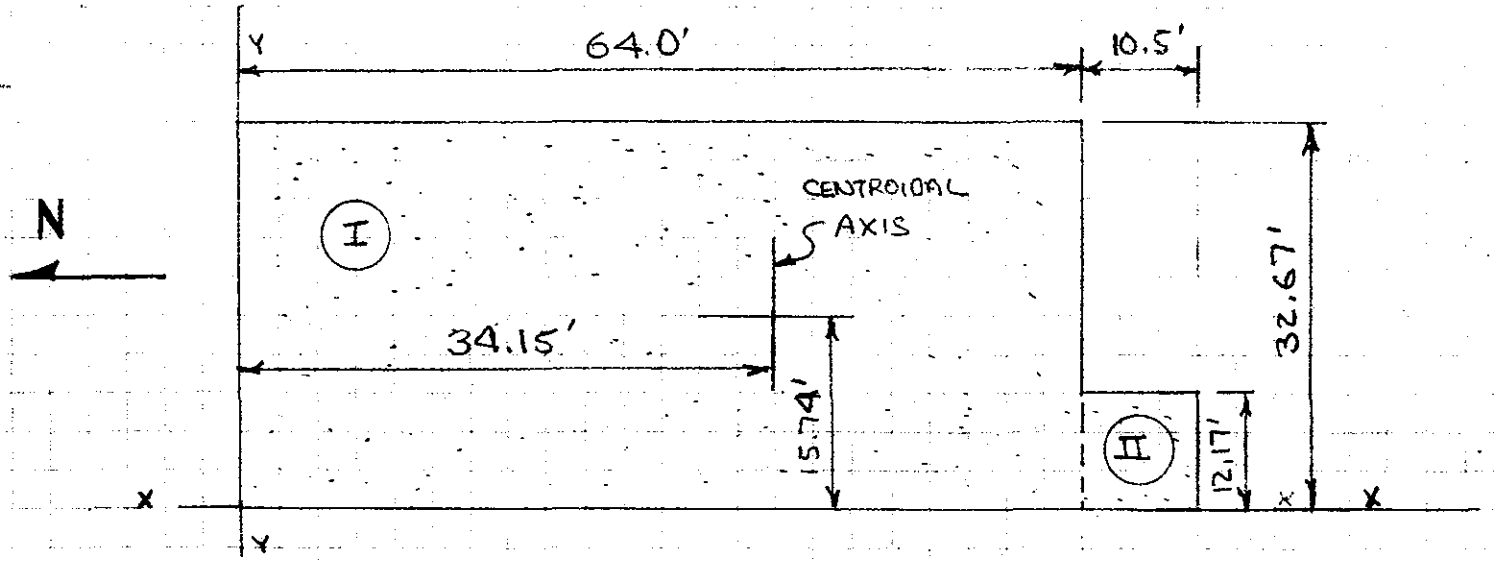
$d_{REQ} = \sqrt{\frac{5.57}{.225}}$

$d_{REQ} = 5.00$ in $\therefore$ 12" x 12" BEAM OK

$A_s = \frac{5.57}{144 \times 10}$

$A_s = 0.39$ in^2 use #6 @ 12"

BASE PROPERTIES



SECT.	A (ft²)	$\bar{x}$ (ft)	$\bar{y}$ (ft)	$A\bar{x}$ (ft³)	$A\bar{y}$ (ft³)	$\bar{I}_x$ (ft⁴)	$\bar{I}_y$ (ft⁴)	d_x (ft)	d_y (ft)	$A \cdot d_x^2$ (ft⁴)	$A \cdot d_y$ (ft⁴)
I	2090.9	32.0	16.33	66908.8	34144.4	185971.4	713687.1	2.15	0.59	9665.2	727.8
II	127.8	69.25	6.08	8850.1	777.0	1577.2	1174.0	35.1	9.66	157450.9	11925.7
Σ	2218.7	—	—	75758.9	34921.4	187548.6	714861.1	—	—	167116.1	12653.5

$\bar{x} = \frac{75758.9}{2218.7} = 34.15$ ft.

$\bar{y} = \frac{34921.4}{2218.7} = 15.74$ ft.

$I = \Sigma \bar{I} + \Sigma A d^2$

$I_x = 187548.6 + 167116.1 = \underline{354664.7 \text{ ft}^4}$

$I_y = 714861.1 + 12653.5 = \underline{727514.6 \text{ ft}^4}$

$\bar{I}_{xI} = \frac{1}{12}(64)(32.67)^3 = 185971.4$

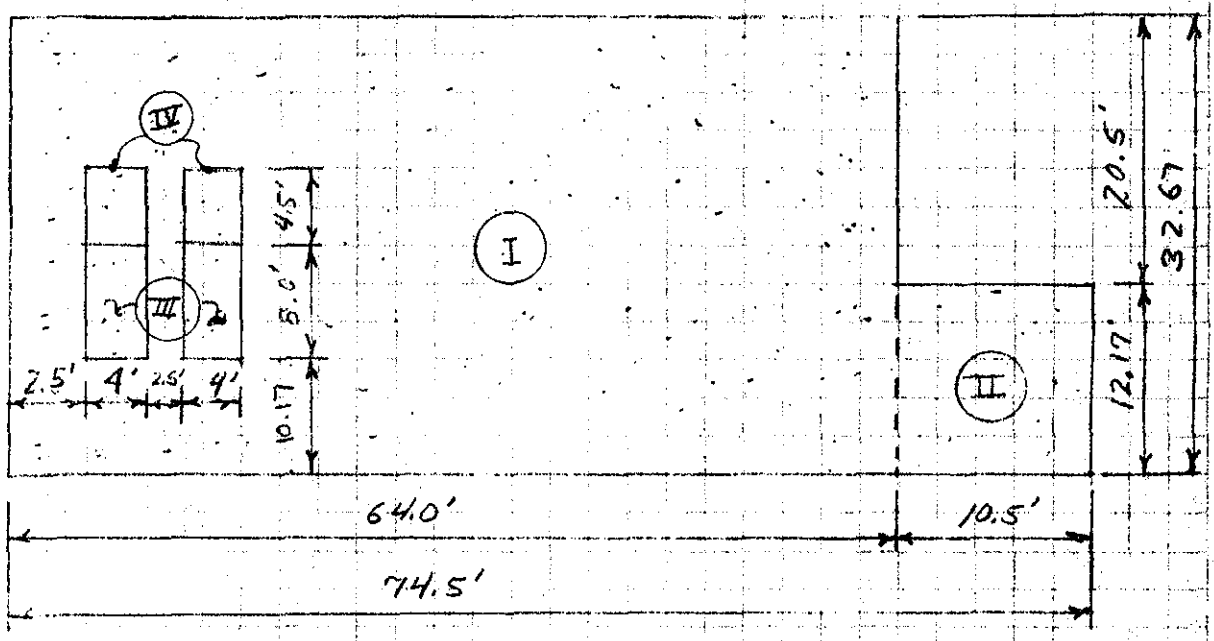
$\bar{I}_{xII} = \frac{1}{12}(10.5)(12.17)^3 = 1577.2$

$\bar{I}_{yI} = \frac{1}{12}(32.67)(64)^3 = 713687.1$

$\bar{I}_{yII} = \frac{1}{12}(12.17)(10.5)^3 = 1174.0$

SUBJECT: PARK RIVER,
COMPUTATION: POPE PARK PUMPING STATION (STABILITY) (1)
COMPUTED BY: JRF CHECKED BY: DATE 11/8/79

BASE SLAB EL. 17.0



SECTION	FORCE COMPUTATION	V (K)	x (ft.)	y (ft.)	Mx (k.ft)	My (k.ft)
I	0.15(64 x 32.67 x 2.5)	784.1	-2.15	0.59	462.6	-1685.8
II	0.15(10.5 x 12.17 x 2.5)	47.9	35.1	-9.66	-462.7	1681.3
III	0.15(8 x 8 x 5.5)	52.8	-26.4	-1.57	- 82.9	-1393.9
IV	0.15(½ x 8 x 4.5 x 5.5)	14.8	-26.4	3.93	58.2	- 390.7
Σ	———	899.6	——	——	-24.8	- 1789.1

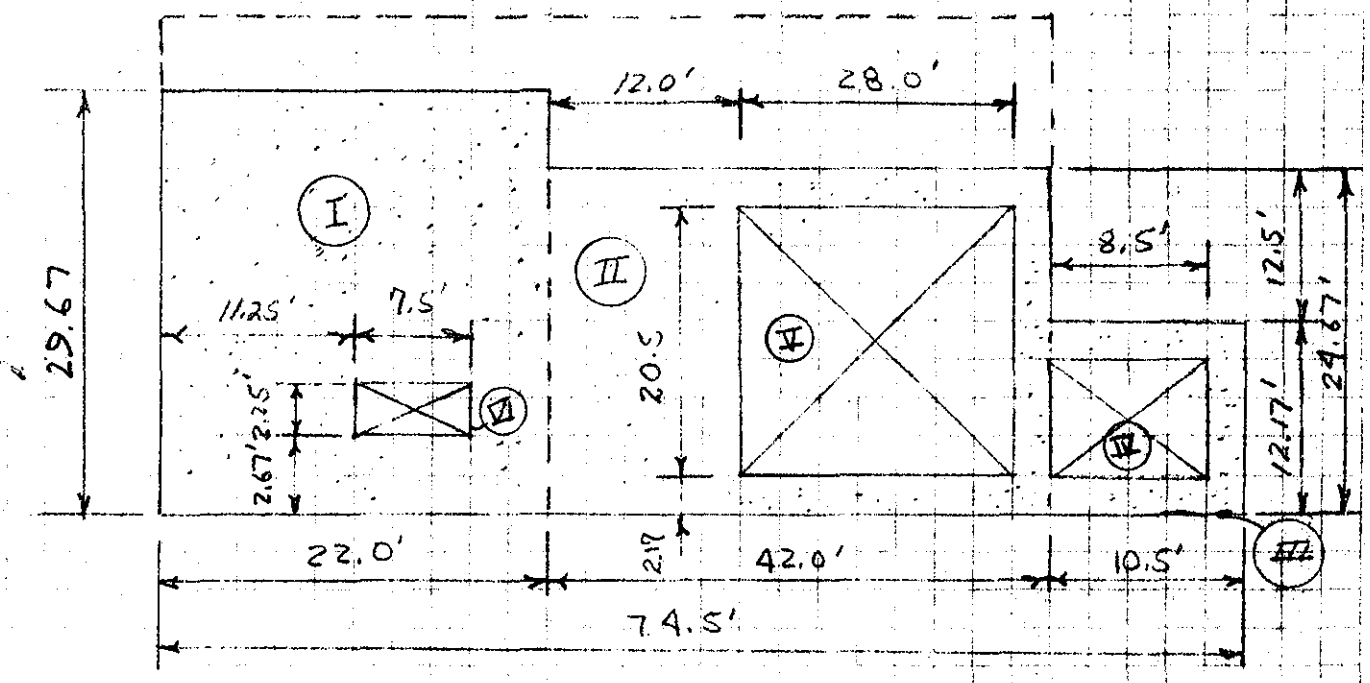
NOTE: x & y are distances to centroidal axis from centroid of SECTION. (ALL SECTIONS SIMILAR)

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION (STABILITY) (2)

COMPUTED BY: JRF CHECKED BY: DATE: 11/8/79

SLAB @ EL 36.5



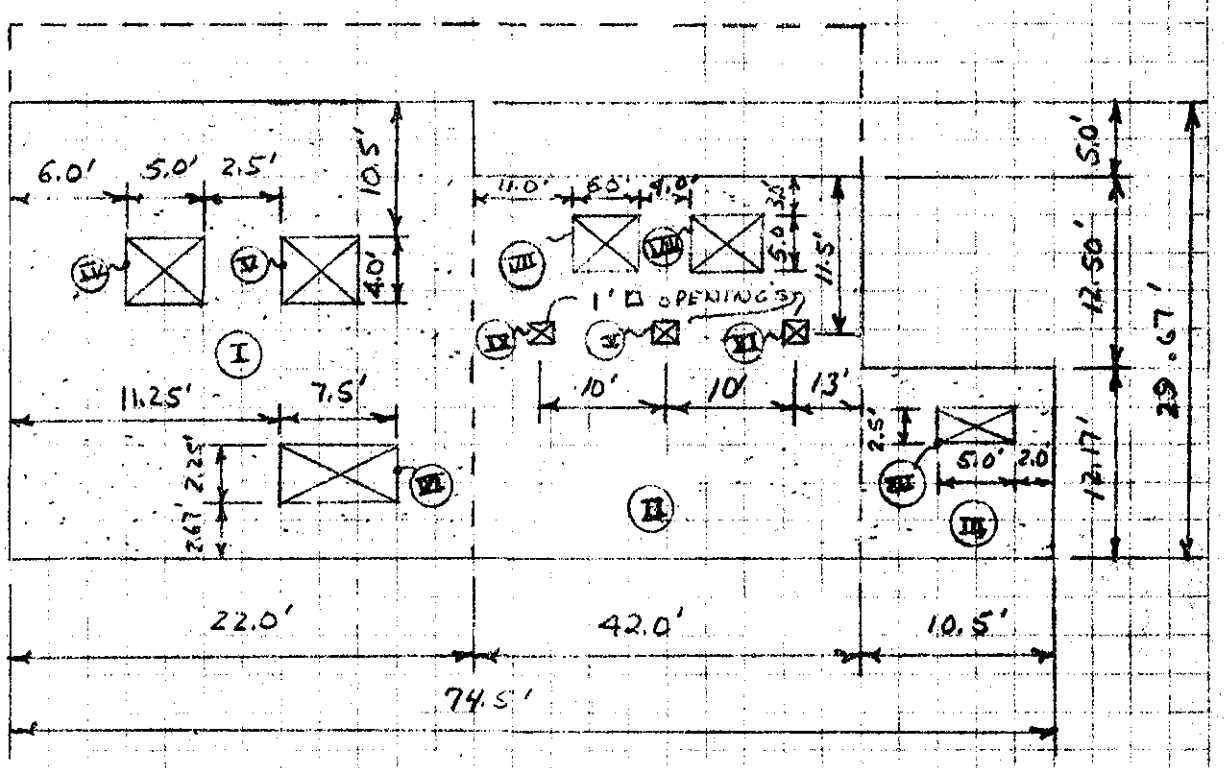
SECT.	FORCE COMPUTATION	V (K)	X (Ft.)	y (Ft.)	Mx (K.Ft)	My (K.Ft)
I	0.15(29.67 x 22.0 x 0.5)	49.0	-23.15	-0.91	-44.59	-1134.3
II	0.15(24.67 x 42.0 x 0.5)	77.7	8.85	-3.41	-264.9	687.6
III	0.15(12.17 x 10.5 x 0.5)	9.6	35.1	-9.66	-92.7	337.0
IV	-0.15(8.0 x 8.5 x 0.5)	-5.1	34.1	-9.57	48.8	-173.9
V	-0.15(20.5 x 28 x 0.5)	-43.0	13.85	-3.32	142.8	-595.6
VI	-0.15(2.25 x 7.5 x 0.5)	-1.3	-19.15	-11.94	15.5	24.9
Σ		86.9			-195.1	-854.3

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (3)

COMPUTED BY VRF CHECKED BY DATE 11/8/79

SLAB @ EL 48.5



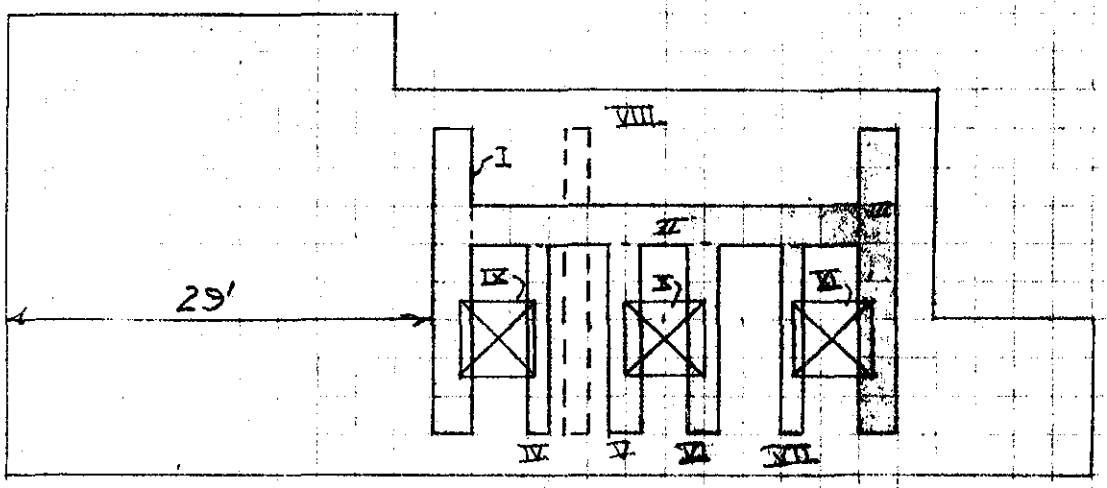
SECT.	FORCE COMPUTATION	V (K)	x (ft)	y (ft)	M_x (K·ft)	M_y (K·ft)
I	0.15 (0.67 × 22 × 29.67)	65.3	-23.15	-0.91	-59.4	-1511.7
II	0.15 (0.67 × 42 × 24.67)	103.6	8.85	-3.41	-353.3	916.9
III	0.15 (0.83 × 10.5 × 12.17)	15.9	35.10	-9.66	-153.6	558.1
IV	-0.15 (0.67 × 5 × 4)	- 2.0	-25.65	1.43	- 2.9	51.3
V	-0.15 (0.67 × 5 × 4)	- 2.0	-18.15	1.43	- 2.9	36.3
VI	-0.15 (0.67 × 7.5 × 2.25)	- 1.7	-19.15	-11.94	20.3	32.6
VII	-0.15 (0.67 × 6 × 5)	- 3.0	- 0.15	3.43	- 10.3	0.5
VIII	-0.15 (0.67 × 6 × 5)	- 3.0	11.85	3.43	- 10.3	- 35.5
IX	-0.15 (0.67 × 1 × 1)	- 0.1	- 3.15	-2.57	0.3	0.3
X	-0.15 (0.67 × 1 × 1)	- 0.1	6.85	-2.57	0.3	- 0.7
XI	-0.15 (0.67 × 1 × 1)	- 0.1	16.85	-2.57	0.3	+ 1.7
XII	-0.15 (0.83 × 5 × 2.5)	- 1.6	35.85	-6.82	10.9	- 57.4
Σ		171.2			-560.6	- 11.0

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (4)

COMPUTED BY JRF CHECKED BY DATE 11/11/79

INTERIOR BEAMS & EQUIPMENT PADS



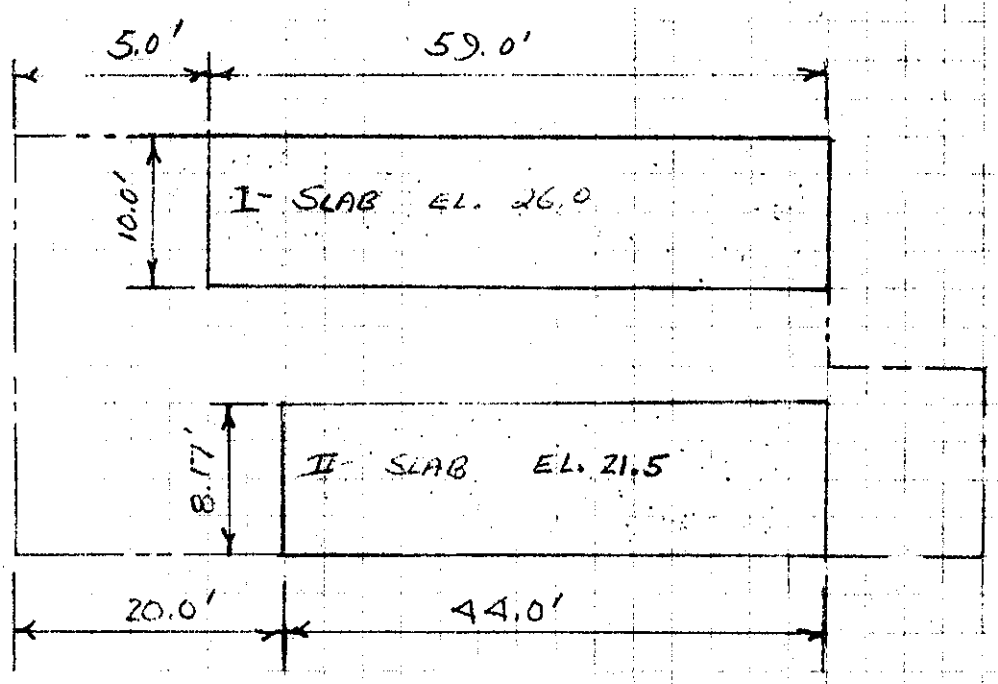
SECT.	FORCE COMPUTATION	V (K)	X (ft)	y (ft)	M_x (K·ft)	M_y (K·ft)
I	0.15(20.5 x 2.0 x 2.17)	13.3	-4.15	-3.32	-44.2	-55.2
II	0.15(21.0 x 1.5 x 2.0)	9.4	7.35	-0.07	-0.7	69.1
III	0.15(20.5 x 2.0 x 2.17)	13.3	17.85	-3.32	-44.2	237.4
IV	0.15(12.5 x 1.25 x 1.0)	2.3	-1.52	-7.32	-16.8	-3.5
V	0.15(12.5 x 1.25 x 1.0)	2.3	4.72	-7.32	-16.8	10.9
VI	0.15(12.5 x 1.25 x 1.0)	2.3	7.98	-7.32	-16.8	18.3
VII	0.15(12.5 x 1.25 x 1.0)	2.3	14.22	-7.32	-16.8	32.7
VIII	0.15(20.5 x 1.0 x 0.5)	1.5	-0.15	-3.32	-5.0	-0.2
IX	0.15(3.5 x 5 x 0.5)	1.3	-2.65	-7.57	-9.8	-3.4
X	0.15(3.5 x 5 x 0.5)	1.3	6.85	-7.57	-9.8	8.9
XI	0.15(3.5 x 5 x 0.5)	1.3	16.35	-7.57	-9.8	21.2
Σ		50.6			-190.7	336.2

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (5)

COMPUTED BY JRF CHECKED BY DATE 11/11

MISCELLANEOUS SLABS



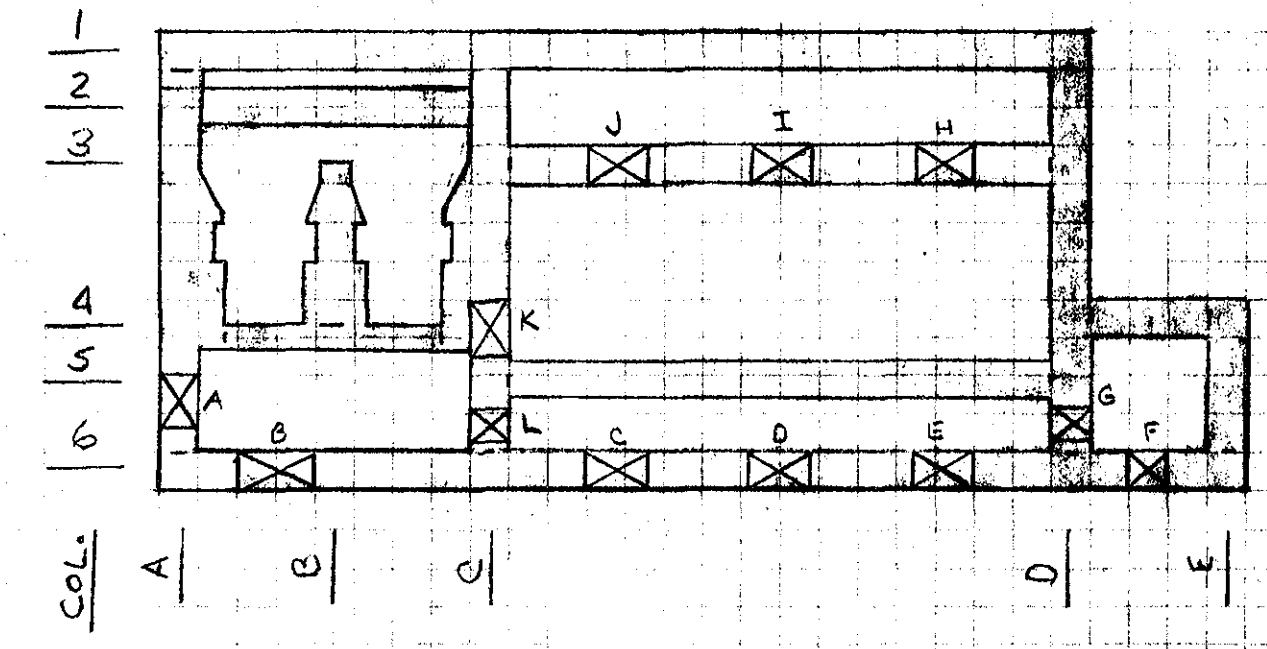
SECT.	FORCE COMPUTATION	V (K)	x (ft)	y (ft)	Mx (K·ft)	My (K·ft)
I	0.15(59 x 10 x 0.5)	44.2	0.35	11.93	527.3	15.5
II	0.15(44 x 8.17 x 0.5)	27.0	7.85	-11.66	-314.8	211.9
Σ	———	71.2	——	——	212.5	227.4

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION (STABILITY) (6)

COMPUTED BY: JRF CHECKED BY: DATE: 11/8/79

Walls



I - 1/AD
II - 6/AE
III - A/16
IV - D/16
V - 4/DE
VI - E/46
VII - 2/AC
VIII - 3/CD
IX - 5/CD
X - 4/AC
XI B/34
XII C/16

SECT.	FORCE COMPUTATION	V (K)	x (ft)	y (ft)	Mx (K·ft)	My (K·ft)
I	0.15(2×61×8)	146.4	-2.15	7.93	1161.0	-314.8
II	0.15(2.17×74.25×30.5	737.1	3.10	-14.66	-10805.9	2285.0
→ III a	0.15(2×2×8)	4.8	-33.15	12.93	62.1	-159.1
III b	0.15(2×20.5×30)	184.5	-33.15	-3.32	-612.5	-6116.2
III c	0.15(3×20.5×14.5)	133.8	-30.65	-3.32	-444.2	-4101.0
IV a	0.15(2×6×8.5)	15.3	28.85	10.93	167.2	441.4
IV b	0.15(2×22.5×30.8)	207.9	28.85	-2.32	-482.3	5997.9
V	0.15(2×30.8×10.5)	97.0	34.10	-4.57	-443.3	3307.7
VI	0.15(2×30.8×10.0)	92.4	39.35	-8.57	-791.9	3635.9
VII	0.15(2×11.3×16)	54.2	-23.15	12.93	700.8	-1254.7
VIII	0.15(2×40×31)	372.0	8.85	7.93	2950.0	3292.2
IX	0.15(2×40×4)	48.0	8.85	-8.57	-411.4	424.8
X	0.15(2×11.5×5.5)	19.0	-23.15	-4.57	-86.8	-439.8
XI	0.15(2.5×14.5×19)	103.3	-23.15	0.68	70.2	-2391.4
XII a	0.15(2×20.5×30)	184.5	-13.15	-3.32	-612.5	-2426.2
XII b	0.15(1.5×18.0 19)	34.2	-13.15	10.93	373.8	-449.7

SUBJECT PARK RIVER

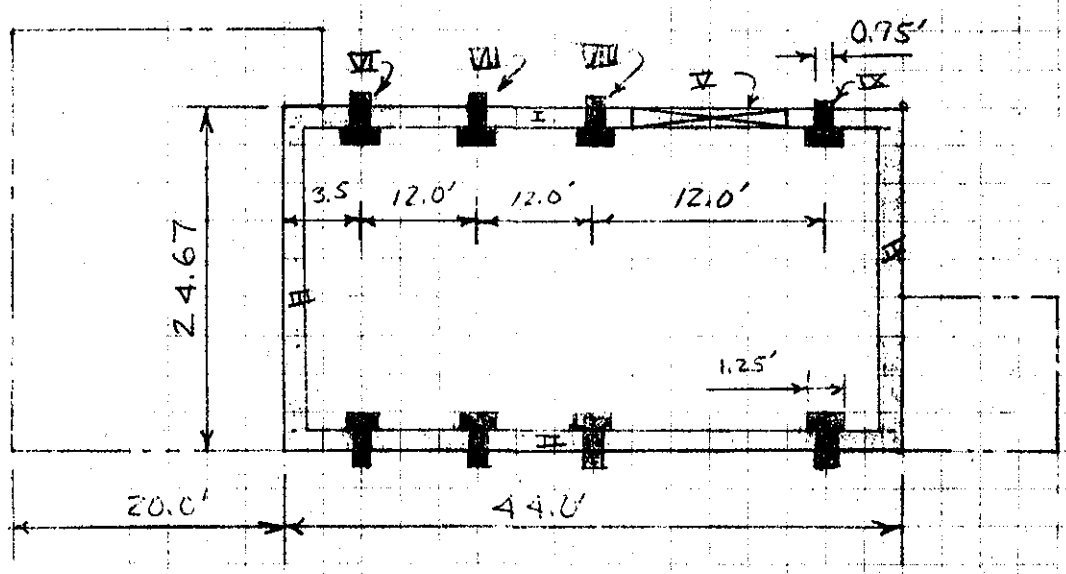
COMPUTATION POPE PARK PUMPING STATION (STABILITY) (7)

COMPUTED BY JRF CHECKED BY DATE 11/11/74

(CONT'D)

SECT.	FORCE COMPUTATION	V (K)	x (ft)	y (ft)	Mx (K·ft)	My (K·ft)
A	-0.15 (2.0 × π × 3²)	- 8.5	-33.15	-8.57	72.8	281.8
B	-0.15 (2.17 × 6 × 6)	- 11.7	-27.15	-14.66	171.5	317.7
C	-0.15 (2.17 × π × .83²)	- 0.7	- 7.15	-14.66	10.3	5.0
D	-0.15 (2.17 × π × .83²)	- 0.7	2.35	-14.66	10.3	- 1.6
E	-0.15 (2.17 × π × .83²)	- 0.7	11.85	-14.66	10.3	- 8.3
F	-0.15 (2.17 × 3.5 × 3.5)	- 4.0	33.85	-14.66	58.6	- 135.4
G	-0.15 (2.0 × 3.5 × 3.5)	- 3.7	28.85	-10.42	37.9	- 106.7
H	-0.15 (2.0 × π × .83²)	- 0.6	10.85	7.93	- 4.8	- 6.5
I	-0.15 (2.0 × π × .83²)	- 0.6	1.35	7.93	- 4.8	- 0.8
J	-0.15 (2.0 × π × .83²)	- 0.6	- 8.15	7.93	- 4.8	4.9
K	-0.15 (2.0 × 3.5 × 3.5)	- 3.7	-13.15	- 8.24	30.5	48.7
L	-0.15 (2.0 × 7 × 3)	- 6.3	-13.15	-10.24	64.5	82.8
Σ		2392.6			- 8753.4	2213.3

SUPERSTRUCTURE

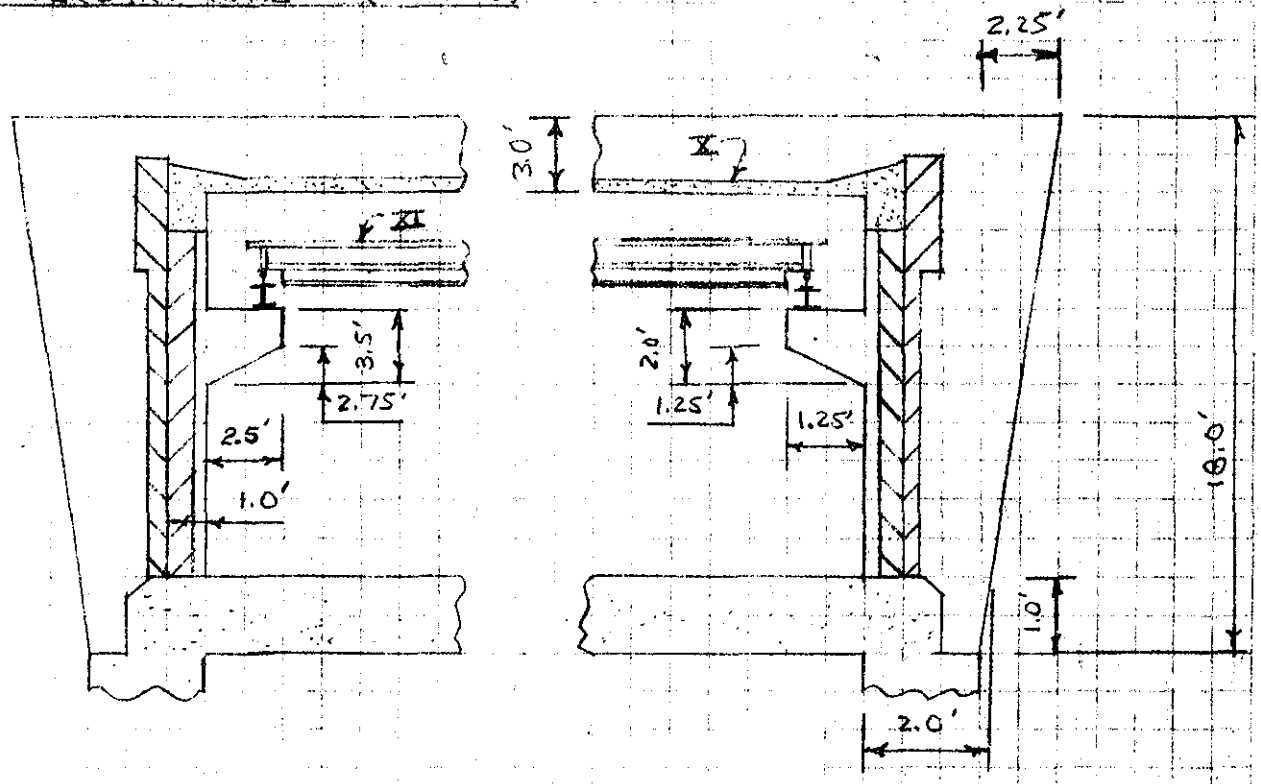


SUBJECT: PARK RIVER.

COMPUTATION: POPE PARK PUMPING STATION (STABILITY) (8)

COMPUTED BY: JRF CHECKED BY: DATE: 11/4/74

SUPERSTRUCTURE (CONT'D)



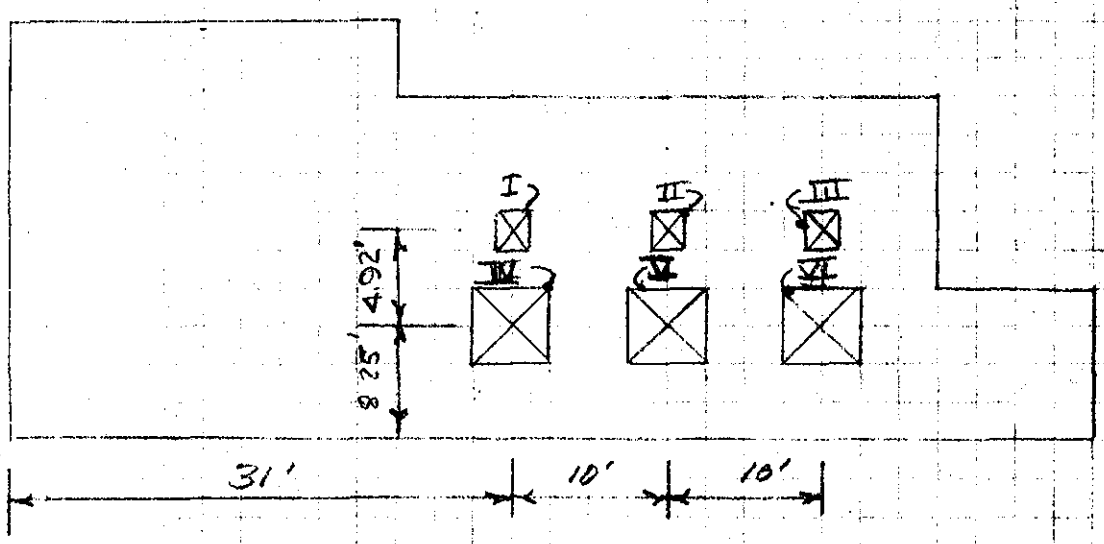
SECT.	FORCE COMPUTATION	V (K)	x (Ft)	y (Ft)	Mx (K·Ft)	My (K·Ft)
I	.094 [(44-3.0)17]	65.5	7.85	8.43	552.2	514.2
II	.094 [(44-3.0)17]	65.5	7.85	-14.24	- 932.7	519.2
III	.094 (22.67 x 17)	36.2	-13.65	- 3.41	- 123.4	- 494.1
IV	.094 (22.67 x 17)	36.2	29.35	- 3.41	- 123.4	1062.5
V	.094 (6 x 7)	- 3.9	19.35	8.43	- 32.9	- 75.5
VI	0.15 x 169.8	22.5	-10.65	-3.41	- 76.7	- 239.6
VII	0.15 x 169.8	22.5	1.35	-3.41	- 76.7	30.4
VIII	0.15 x 169.8	22.5	13.35	-3.41	- 76.7	300.4
IX	0.15 x 169.8	22.5	25.35	-3.41	- 76.7	570.4
X	0.082 [20.67 (44-3)]	66.1	7.85	-3.41	- 225.4	518.9
XI	0.15 [2 x 1 x 22.67]	6.8	7.85	-3.41	- 23.2	53.4
Σ		362.4			- 1215.6	2755.2

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (9)

COMPUTED BY JRF CHECKED BY DATE 11/11/74

EQUIPMENT



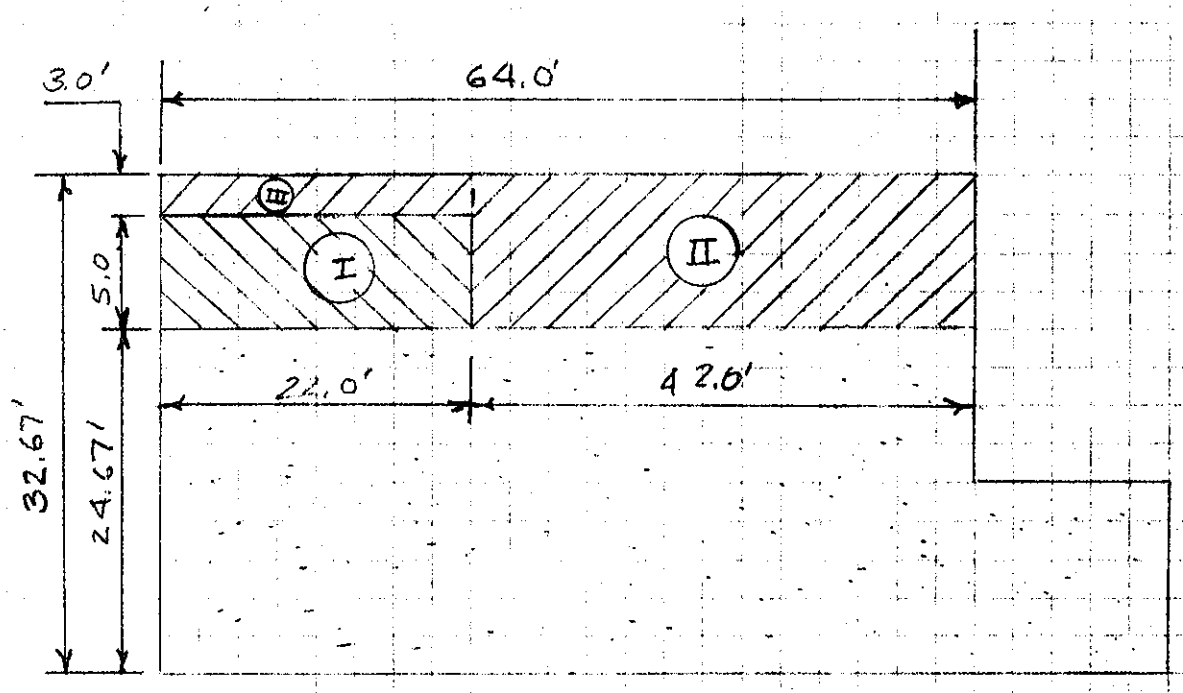
SECT.	V (K)	x (FT)	y (FT)	Mx (K·FT)	My (K·FT)
I	7.6	-3.15	-2.57	-19.5	-23.9
II	7.6	6.85	-2.57	-19.5	52.1
III	7.6	16.85	-2.57	-19.5	128.1
IV	1.9	-3.15	-7.49	-14.2	-6.0
V	1.9	6.85	-7.49	-14.2	13.0
VI	1.9	16.85	-7.49	-14.2	32.0
Σ	28.5	—	—	-101.1	195.3

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (10)

COMPUTED BY JRF CHECKED BY DATE 11/12/79

EARTH FILL



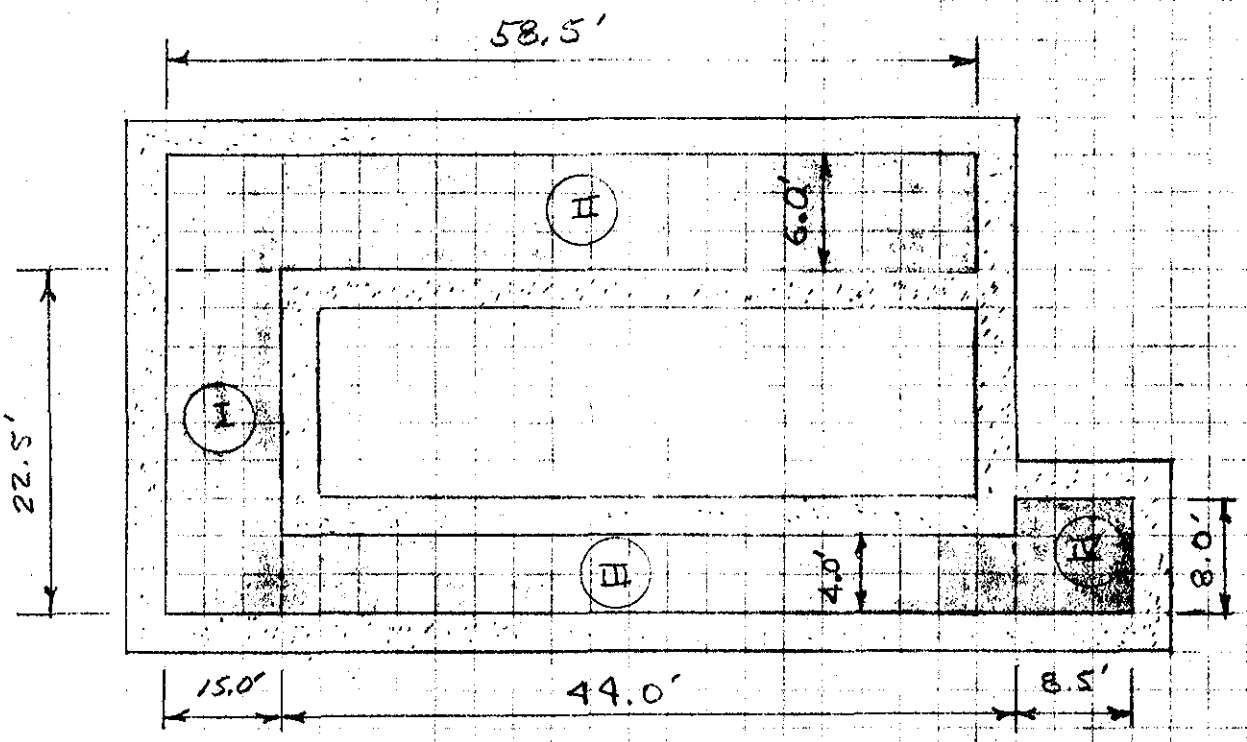
SECT.	FORCE COMPUTATION	V (K)	x (ft)	y (ft)	Mx (ft)	My (ft)
I	0.12 (22 x 5 x 100)	132.0	-23.15	11.43	1508.8	- 3055.8
II	0.12(42 x 8 x 22.0)	887.0	8.85	12.93	11468.9	7850.0
III	0.12(22 x 3 x 22.0)	174.2	-23.15	15.43	2687.9	- 4032.3
Σ		1193.2			15665.6	761.5

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (11)

COMPUTED BY VRF CHECKED BY DATE 11/14/74

WATER INSIDE STATION



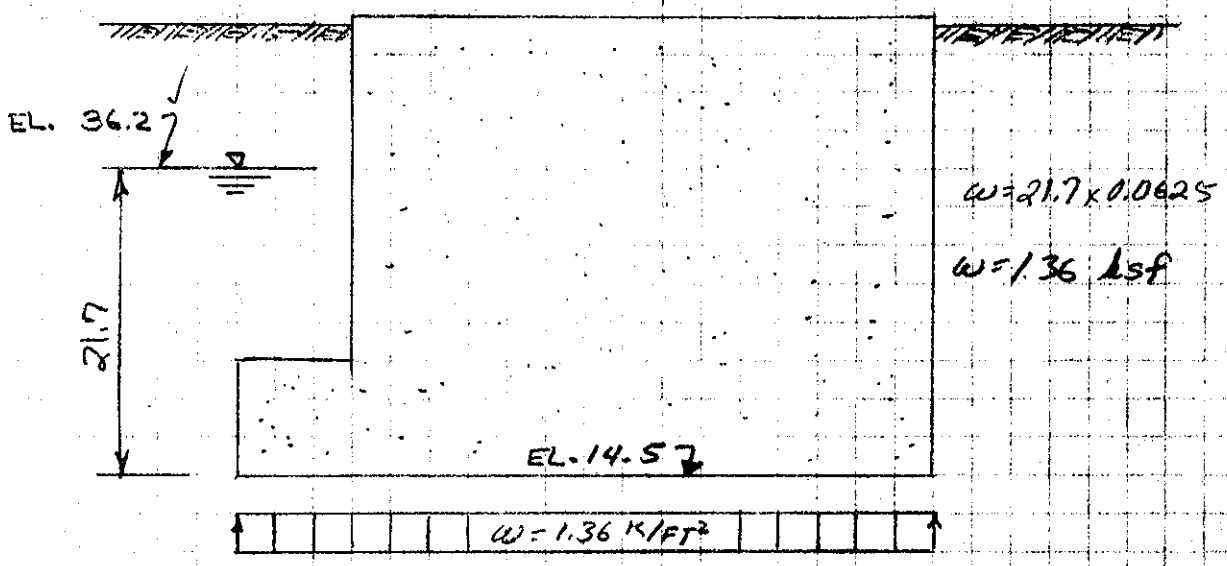
SECT.	FORCE COMPUTATION	V (K)	x (ft)	y (ft)	Mx (K·ft)	My (K·ft)
I	0.0625 (15 x 22.5 x 13.0)	274.2	-23.15	-2.32	- 636.1	-6347.7
II	0.0625 (58.5 x 6.0 x 8.0)	175.5	- 1.40	11.93	2093.7	+ 245.7
III	0.0625 (44 x 4 x 3.5)	38.5	7.85	-11.57	- 445.4	302.2
IV	0.0625 (8.5 x 8 x 13.0	55.2	34.1	-9.57	- 528.3	1882.3
Σ		543.4	—	—	+483.9	-4408.9

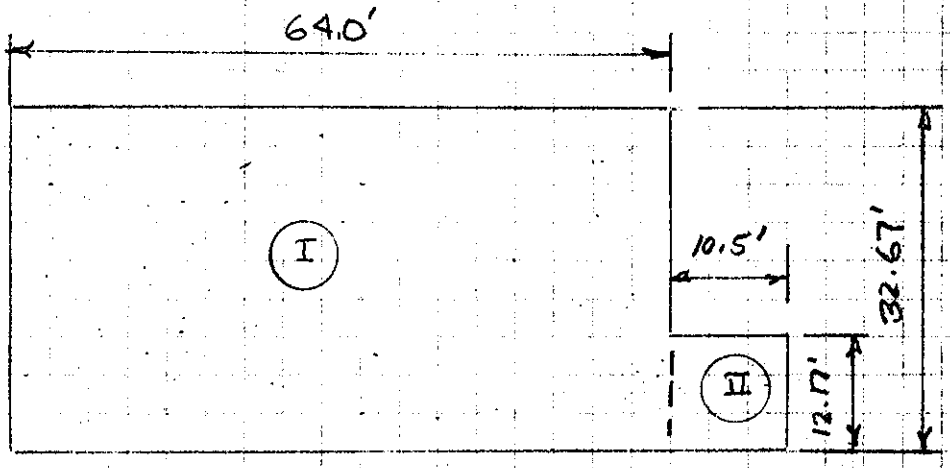
SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION (STABILITY) (12)

COMPUTED BY: JRF CHECKED BY: DATE: 11/12/79

UPLIFT





SECT.	FORCE COMPUTATION	V (K)	X (ft)	Y (ft)	Mx (K·ft)	My (K·ft)
I	1.36 x 64 x 32.67	-2843.6	-2.15	0.59	-1677.7	6113.7
II	1.36 x 10.5 x 12.17	-173.8	35.1	-9.66	1678.9	-6100.4
Σ		-3017.4			1.2	13.3

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (13)

COMPUTED BY JRF CHECKED BY DATE 11/12/74

STATION w/o EQUIPMENT

ITEM	ΣV (K)	ΣMx (K·ft)	ΣMy (K·ft)
SLAB @ EL. 17.0	899.6	- 24.8	- 1789.1
" " " 36.5	86.9	- 195.1	- 854.3
" " " 48.5	171.2	- 560.6	- 11.0
INT. BEAMS & PADS	50.6	- 190.7	336.2
Miscell. Slabs	71.2	212.5	227.4
Walls	2392.6	- 8753.4	2213.3
Super Structure	362.4	- 1215.6	2755.2
EARTH FILL	1193.2	15665.6	761.5
TOTAL	5227.7	4937.9	3639.2

LC-1 - STATION EMPTY, OUTSIDE WATER EL. 36.2 (UPLIFT)

ASSUME LATERAL FORCES ARE EQUAL & OPPOSITE
∴ ΣH = 0. (FOR ALL CASES.)

ITEM	ΣV (K)	Mx (K·ft)	My (K·ft)
STATION (EMPTY)	5227.7	4937.9	3639.2
UPLIFT	- 3017.4	1.2	13.3
TOTAL	2210.3	4939.1	3652.5

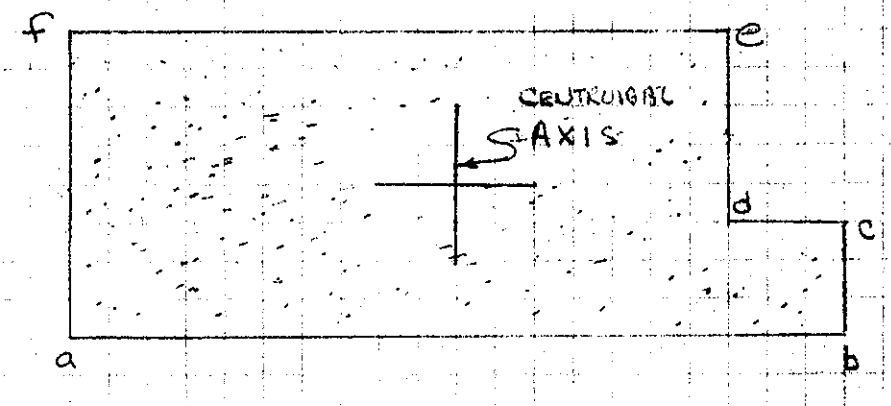
UPLIFT F.S. = $\frac{5227.7}{3017.4}$ = 1.73 ∴ OK

SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (STABILITY) (14)

COMPUTED BY JRF CHECKED BY DATE 11/12/74

BEARING PRESSURE



$$BP = \pm \frac{P}{A} \pm \frac{M_x (y)}{I_x} \pm \frac{M_y (x)}{I_y}$$

$$\frac{P}{A} = \frac{2210.3}{2218.7} = 1.00 \text{ ksf}$$

$$\frac{M_x}{I_x} = \frac{4939.1}{354664.7} = 0.0139$$

$$\frac{M_y}{I_y} = \frac{3652.5}{727519.6} = 0.0050$$

SECTION	x	y	P/A	$\frac{M_x}{I_x}(y)$	$\frac{M_y}{I_y}(x)$	BP (KSF)
a	-34.15	-15.74	1.00	-0.22	-0.17	0.61
b	40.35	-15.74	1.00	-0.22	0.20	0.98
c	40.35	-3.57	1.00	-0.05	0.20	1.15
d	29.85	-3.57	1.00	-0.05	0.15	1.10
e	29.85	16.93	1.00	0.24	0.15	1.39
f	-34.15	16.93	1.00	0.24	-0.17	1.07

SUBJECT: PARK RIVER,
COMPUTATION: POPE PARK Pumping STATION (STABILITY) (15)
COMPUTED BY: URF CHECKED BY: DATE 11/14/79

LC-2 STATION W/EQUIPMENT, NO WATER OUTSIDE, WATER INSIDE UP TO EL. 30.0

ITEM	ΣV (K)	Mx (K·Ft)	My (K·Ft)
STATION	5227.7	4937.9	3639.2
EQUIPMENT	28.5	- 101.1	195.3
WATER (INSIDE)	543.4	483.9	- 4408.9
TOTAL	5799.6	5320.7	- 574.4

$$P/A = \frac{5799.6}{2218.7} = 2.61$$

$$\frac{M_x}{I_x} = \frac{5320.7}{354664.7} = 0.015$$

$$\frac{M_y}{I_y} = \frac{-574.4}{727514.6} = -0.00079$$

SECTION	P/A (KSF)	$\frac{M_x}{I_x}\cdot(y)$ (K·SF)	$\frac{M_y}{I_y}(x)$ (KSF)	B.P. (KSF)
a	2.61	- 0.24	0.03	2.40
b	2.61	- 0.24	- 0.03	2.34
c	2.61	- 0.05	- 0.03	2.53
d	2.61	- 0.05	- 0.03	2.53
e	2.61	0.25	- 0.03	2.83
f	2.61	0.25	0.03	2.89

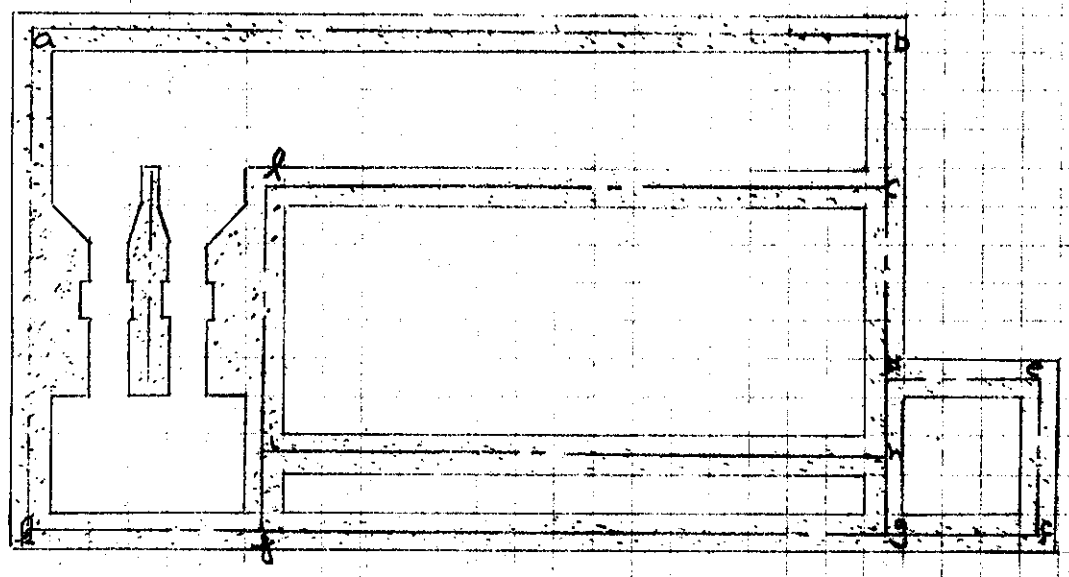
BP_{max} = 2.89 ksf

SUBJECT PARK RIVER

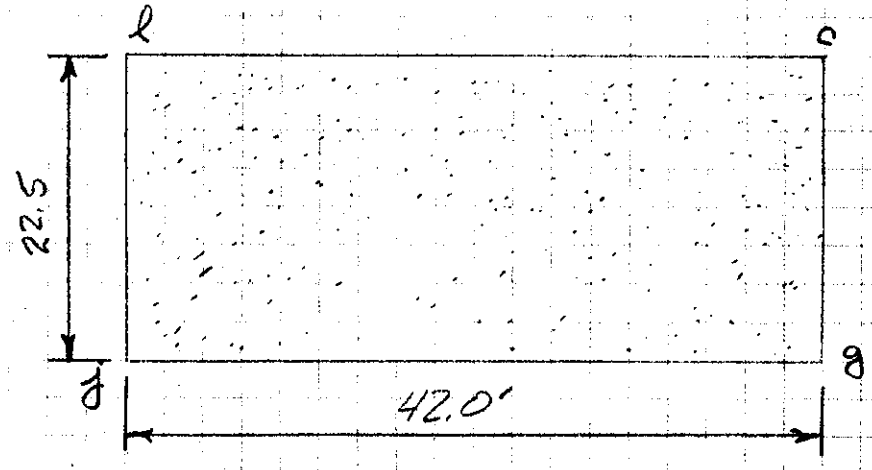
COMPUTATION POPE PARK PUMPING STATION (16)

COMPUTED BY JRF CHECKED BY DATE 11/13/79

BASE SLAB DESIGN

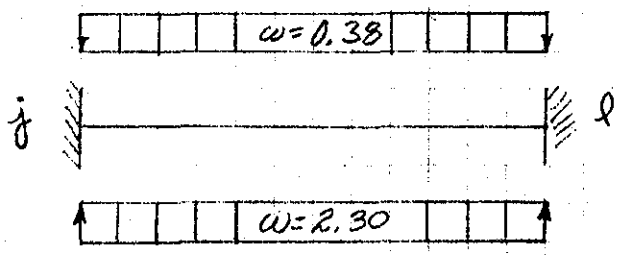


SLAB cfjg (TYPICAL FOR ENTIRE BASE)



f'c = 3000 psi
fc = 1050 psi

SUBJECT PARK RIVER.
COMPUTATION POPE PARK PUMPING STATION (117)
COMPUTED BY JRF CHECKED BY DATE 11/13/74



$R_j = \frac{22.5}{2}(1.92) = 21.6^K$

$V = 21.6 - 2.5 \times 1.92$
$V = 16.8^K$

$M(-) = \frac{1}{12}\omega l^2$

$M(-) = \frac{1}{12}(2.30 - 0.38)(22.5)^2$

$M(-) = 81.0$ k.ft

$M(+) = \frac{1}{14}\omega l^2$

$M(+) = \frac{1}{14}(1.92)(22.5)^2$

$M(+) = 69.4$ k.ft.

$\frac{S.S.}{L.S.} = \frac{22.5}{42.0} = 0.54$

USE 54% of short span moments for long span moments.

@ face j g

$M(-) = 81.0 - \frac{1}{3}(21.6)(2.0)$

$M(-) = 66.6$ k.ft

$v = \frac{16800}{12 \times 23.5}$

$v = 59.6$ psi < 60 psi OK

Short Span

$As(-) = \frac{66.6}{1.44 \times 23.5}$

$As(-) = 1.97$ in²

$As(+) = \frac{69.4}{1.44 \times 25.5}$

$As(+) = 1.89$ in²

LONG SPAN

$As(-) = 0.54 \times 1.97$

$As(-) = 1.06$ in²

$As(+) = 0.54 \times 1.89$

$As(+) = 1.02$ in²

$u = \frac{16800}{(2 \times 3.54) \times 0.88 \times 23.5}$

$u = 114.7 < 264$ ∴ OK

USE #9 @ 6" T } S.S.
#9 @ 6" B }

#9 @ 12" T } L.S.
#9 @ 11" B }

SUBJECT PARK RIVER,
COMPUTATION POPE PARK PUMPING STATION (1B)
COMPUTED BY JRF CHECKED BY DATE 11/13/74

DESIGN BASED ON METHOD 3 ACI 318-63 APPENDIX A

$A = 20.5'$, $B = 40.0'$ } Clear Span

$W_{DL} = -0.38$ klf
$W_{LL} = 2.30$ klf
$W_T = 1.92$ klf

$m = \frac{20.5'}{40.0'} = 0.51$ say 0.50

$M_A = C_A \omega A^2$ $V_A = \frac{W_A A}{2}$ $W_A = C_A W_T$

$M_B = C_B \omega B^2$ $V_B = \frac{W_B B}{2}$ $W_B = C_B W_T$

NEGATIVE MOMENTS (CASE 2 - TYPICAL)

$C_{ANEG} = 0.086$ $M_{ANEG} = 0.086 \times 1.92 \times 20.5^2 = 69.4$ K·FT
$C_{BNEG} = 0.006$ $M_{BNEG} = 0.006 \times 1.92 \times 40^2 = 18.4$ K·FT

POSITIVE MOMENTS

$C_{ADL-POS} = 0.037$
$C_{BDL-POS} = 0.002$

$C_{ALL-POS} = 0.066$
$C_{BLL-POS} = 0.004$

$M_{A\,POS} = [0.037 \times (-0.38) + 0.066 \times (2.30)]20.5^2 = 57.9$ K·FT

$M_{B\,POS} = [0.002(-0.38) + 0.004(2.30)]40^2 = 13.5$ K·FT

Shear Load

$C_{AV} = 0.94$ $W_A = 0.94 \times 1.92 = 1.80$ klf
$C_{AB} = 0.06$ $W_B = 0.06 \times 1.92 = 0.12$ klf

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION (19)

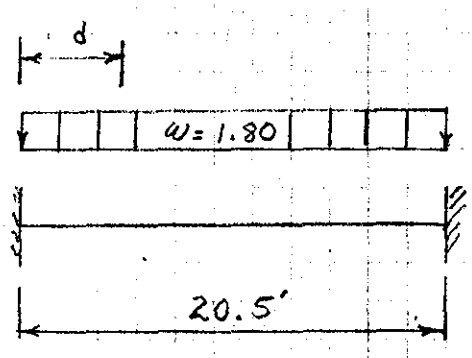
COMPUTED BY: VRF CHECKED BY: DATE: 11/13/79

$d_{NEG} = 23.5''$
$d_{POS} = 25.5''$

SHORT SPAN

$$As(-) = \frac{69.4}{1.44 \times 23.5} = 2.05 \text{ in}^2 \quad \#9@6''$$

$$As(+) \quad \frac{57.9}{1.44 \times 25.5} = 1.58 \text{ in}^2 \quad \left.\begin{matrix}\#9@12'' \\ \#7@12''\end{matrix}\right\} \text{Alt.}$$



$$R_L = \frac{1.80}{2}(20.5) = 18.4^K$$

$$V = 18.4 - 1.80 \times \frac{23.5}{12}$$

$$V = 14.9^K$$

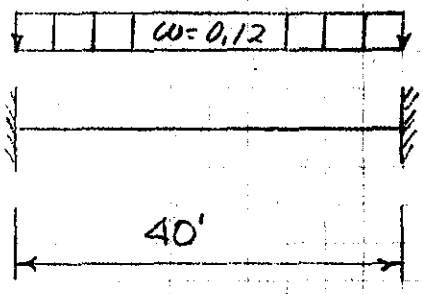
$$v = \frac{14.9}{12 \times 23.5} = 52.8 \text{ psi} < 60 \text{ psi} \quad \therefore \text{OK}$$

$d = 1.96'$

LONG SPAN

$$As(-) = \frac{18.4}{1.44 \times 23.5} = 0.54 \text{ in}^2 \quad \#7@12''$$

$$As(+) = \frac{13.5}{1.44 \times 25.5} = 0.37 \text{ in}^2 \quad \#6@12''$$



$$R_L = 0.12 \times \frac{40}{2} = 2.4^K$$

$$V = 2.4 - 1.96 \times 0.12$$
$$V = 2.16$$

$$v = \frac{2160}{12 \times 23.5} = 7.6 \text{ psi} < 60 \text{ psi} \quad \therefore \text{OK}$$

$d = 1.96'$

SUBJECT PARK RIVER,
COMPUTATION POPE PARK PUMPING STATION (20)
COMPUTED BY URF CHECKED BY DATE 11/13/79

SLAB defg

A = 8.0
B = 8.5
m = 0.94 say 0.95

w_{DL} = -0.38 k/f
w_{LL} = 2.37 "
w_T = 1.99 "

NEGATIVE MOMENTS

C_{ANEG} = 0.050 M_{ANEG} = 0.050 x 1.99 x 8.0² = 6.4 k·ft
C_{BNEG} = 0.041 M_{BNEG} = 0.041 x 1.99 x 8.5² = 5.9 k·ft

POSITIVE MOMENTS

C_{APOS} DL = 0.020
C_{BPOS} DL = 0.016

C_{APOS} LL = 0.030
C_{BPOS} LL = 0.025

$M_{A\,POS}$ = [0.020(-0.38) + 0.030(2.37)] 8.0² = 4.1 k·ft.

$M_{B\,POS}$ = [0.016(-0.38) + 0.025(2.37)] 8.5² = 3.8 k·ft.

Shear Load

C_{AV} = 0.55 w_A = 1.99 x 0.55 = 1.09 k/f
C_{BV} = 0.45 w_B = 1.99 x 0.45 = 0.90 k/f

Shear & moments are less than those for slab cfg ∴ CONTINUE REINF. INTO slab defg

27 Sept 49

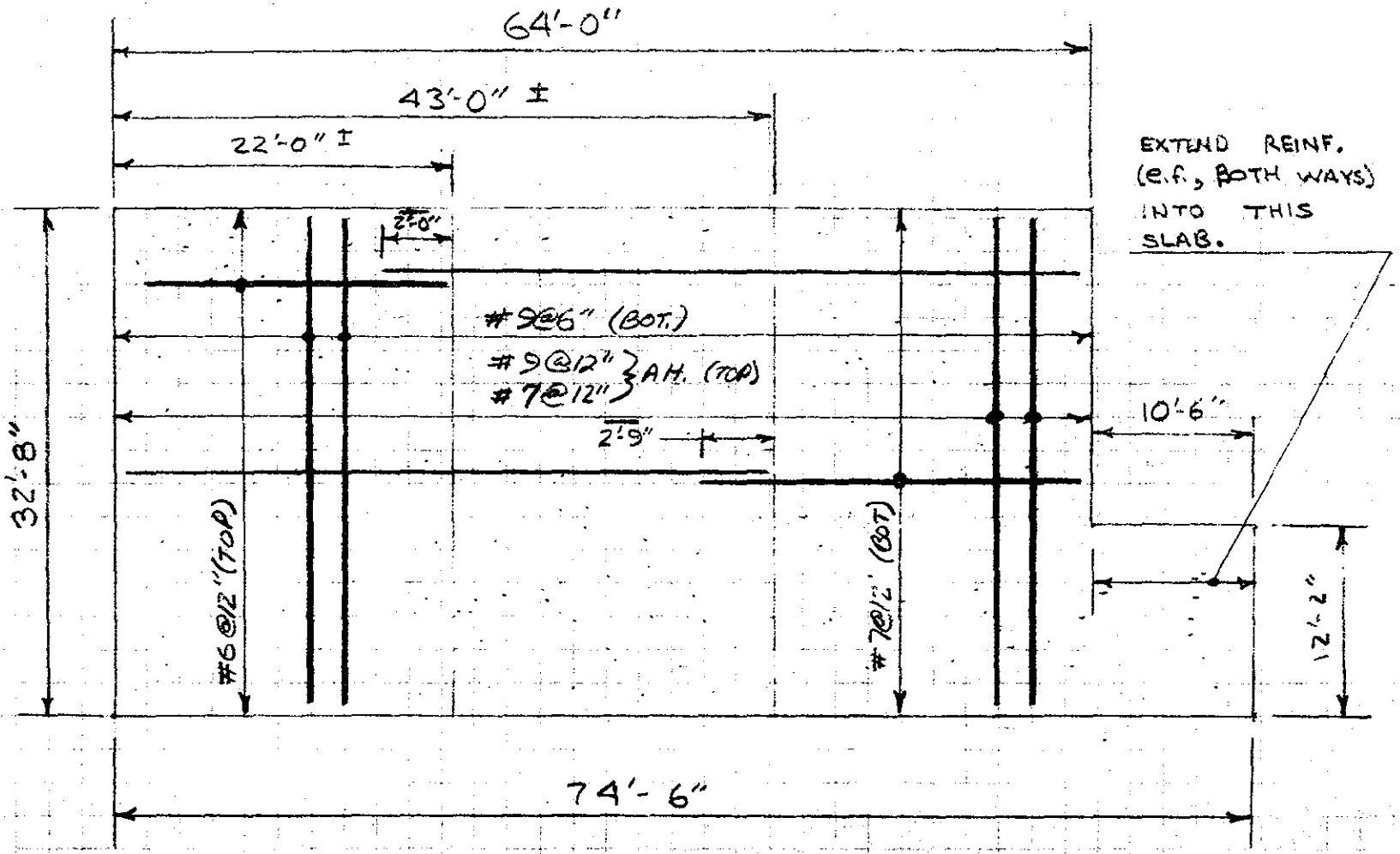
SUBJECT PARK RIVER

COMPUTATION POPE PARK PUMPING STATION (21)

COMPUTED BY JRF CHECKED BY DATE 11/13/74

CORPS OF ENGINEERS, U.S. ARMY

PAGE A100



PLAN - BASE SLAB @ EL. 17.0

SCALE: 3/32" = 1'-0"

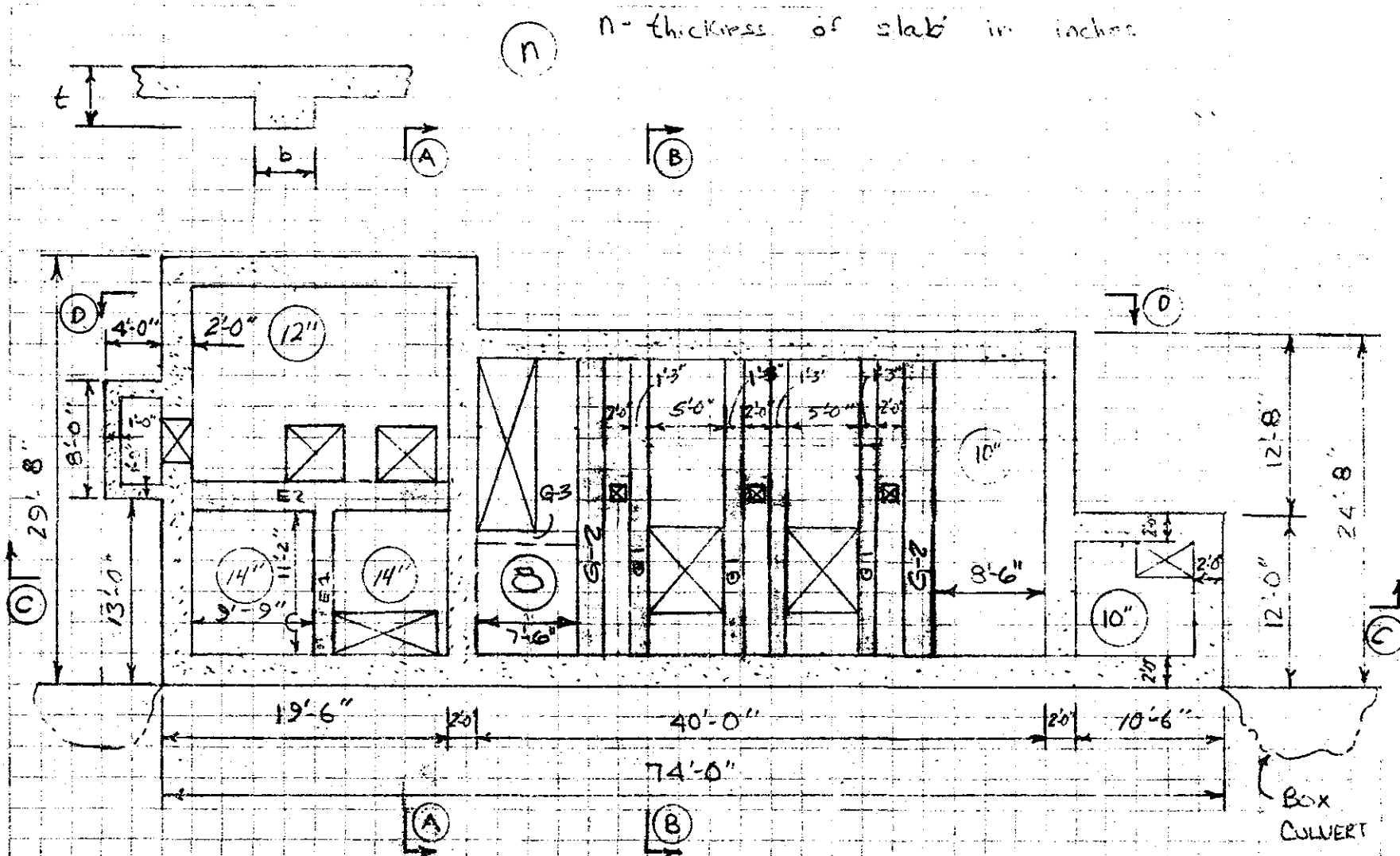
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT PARK RIVER
COMPUTATION POPE PARK PUMPING STATION
COMPUTED BY JRE CHECKED BY DATE 11/20/74

PAGE A-101

n - thickness of slab in inches



PLAN ENGINE RM

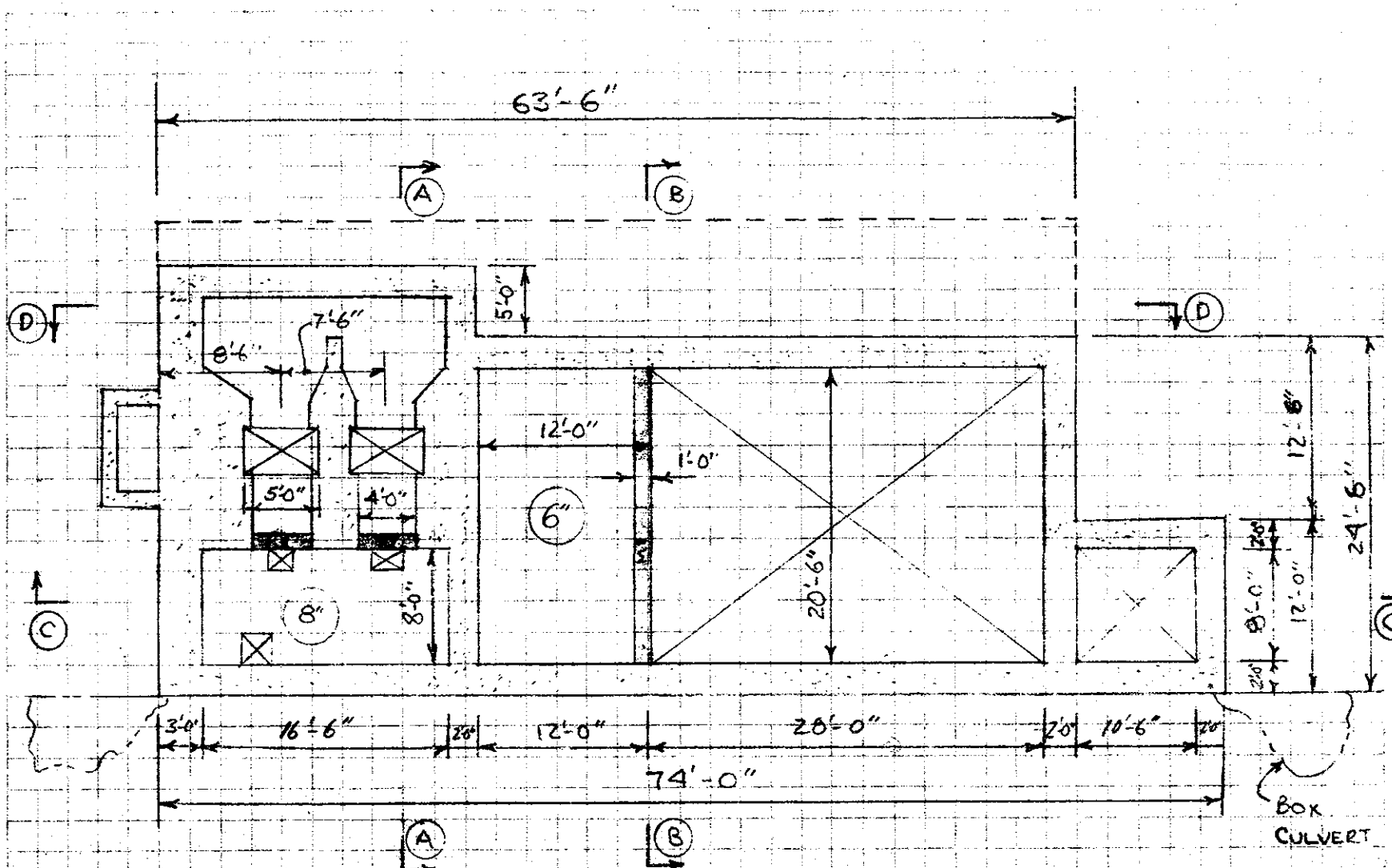
SCALE : 3/32" = 1'-0"

BEAM	b	t
G1	1'-3"	1'-8"
G2	2'-0"	2'-2"
G3	2'-0"	3'-0"
E1	1'-6"	1'-8"
E2	2'-0"	2'-6"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: PARK RIVER
COMPUTATION: POPE PARK PUMPING STATION
COMPUTED BY: JRF
CHECKED BY:
DATE: 11/20/74
PAGE: A-108



BEAM	b	t
M1	1'-0"	1'-0"
R1	1'-0"	1'-0"

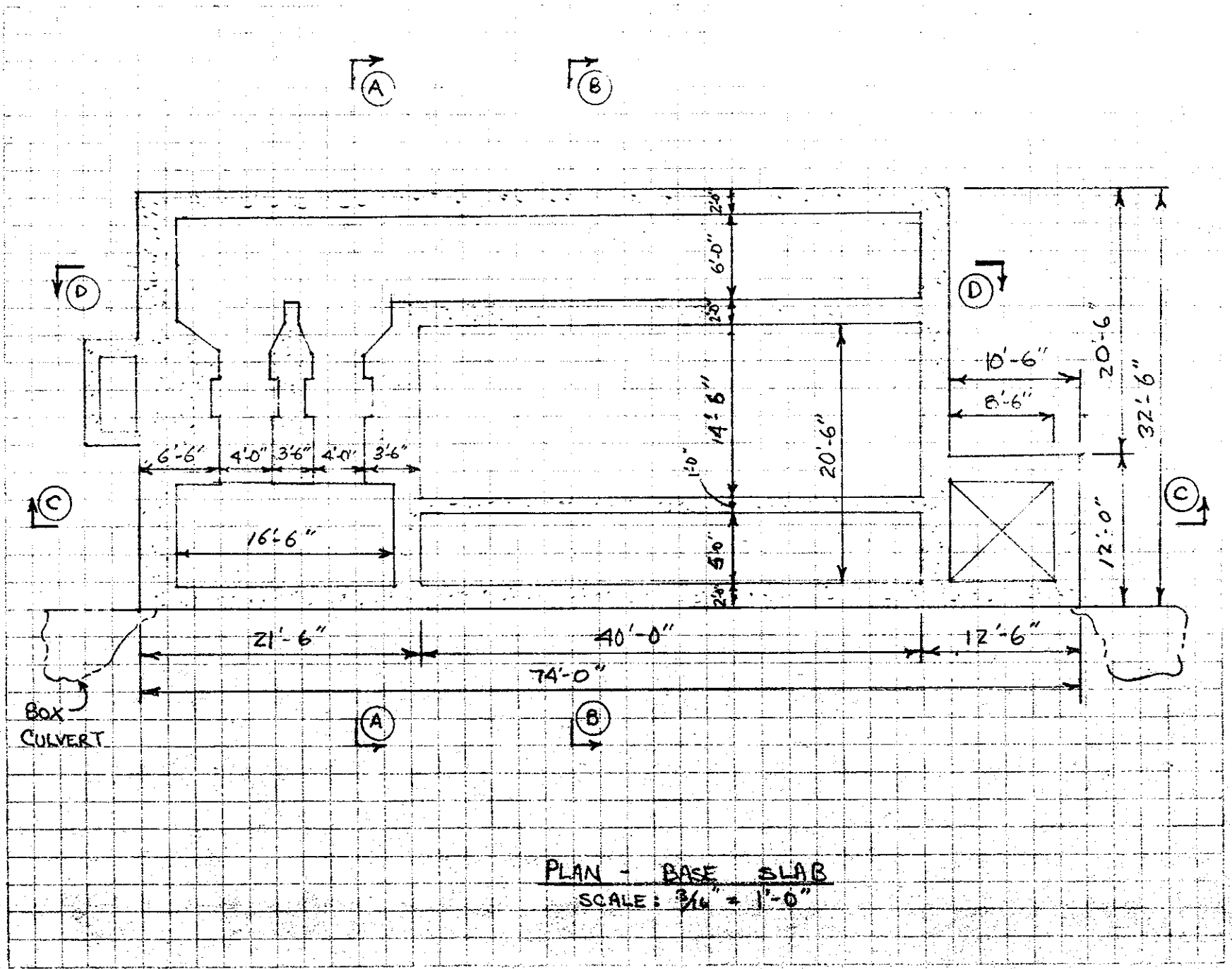
MEZZANINE FLOOR PLAN

SCALE: 3/32" = 1'-0"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: Pope River
COMPUTATION: Pope Park Pumping Station
COMPUTED BY: JRF
CHECKED BY:
DATE: 11/20/74

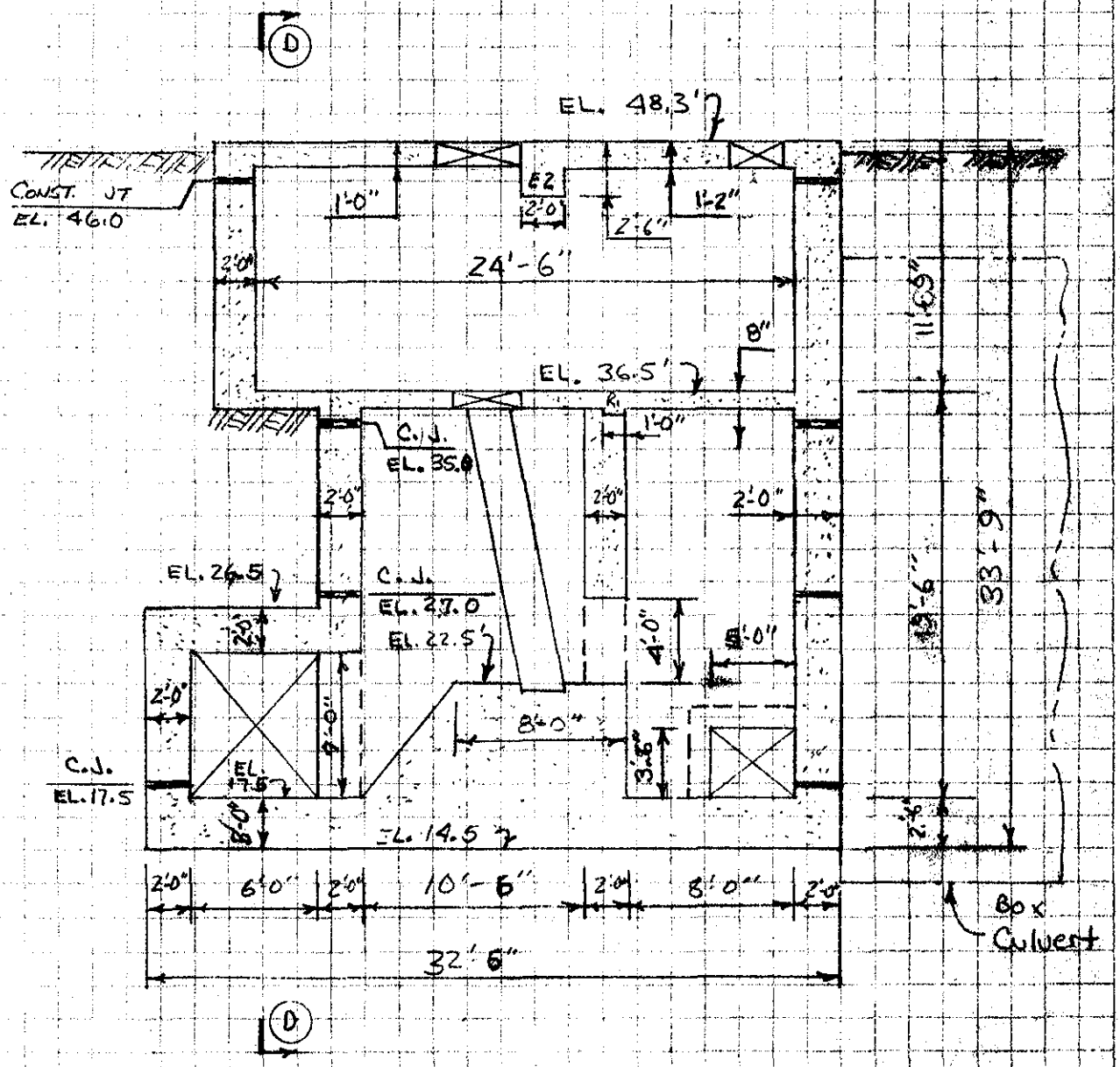


PLAN - BASE SLAB
SCALE: 3/4" = 1'-0"

SUBJECT: PARK RIVER

COMPUTATION: POPE PARK PUMPING STATION

COMPUTED BY: VRT CHECKED BY: DATE: 11/20/79



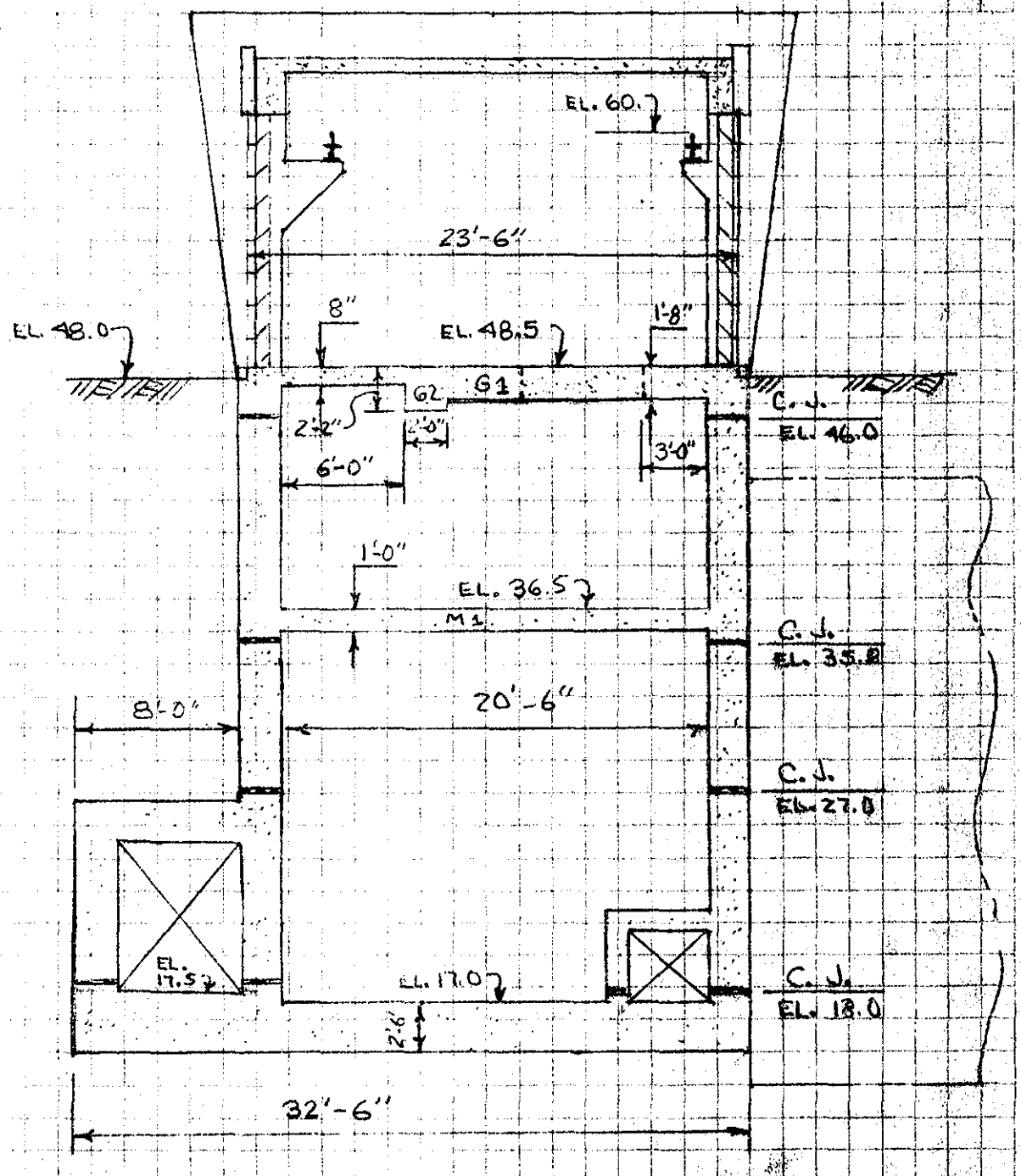
SECTION (A) (A)

SCALE: 1/8" = 1'-0"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT PARK RIVER
COMPUTATION POPE PARK PUMPING STATION
COMPUTED BY VRF CHECKED BY DATE 11/20/79



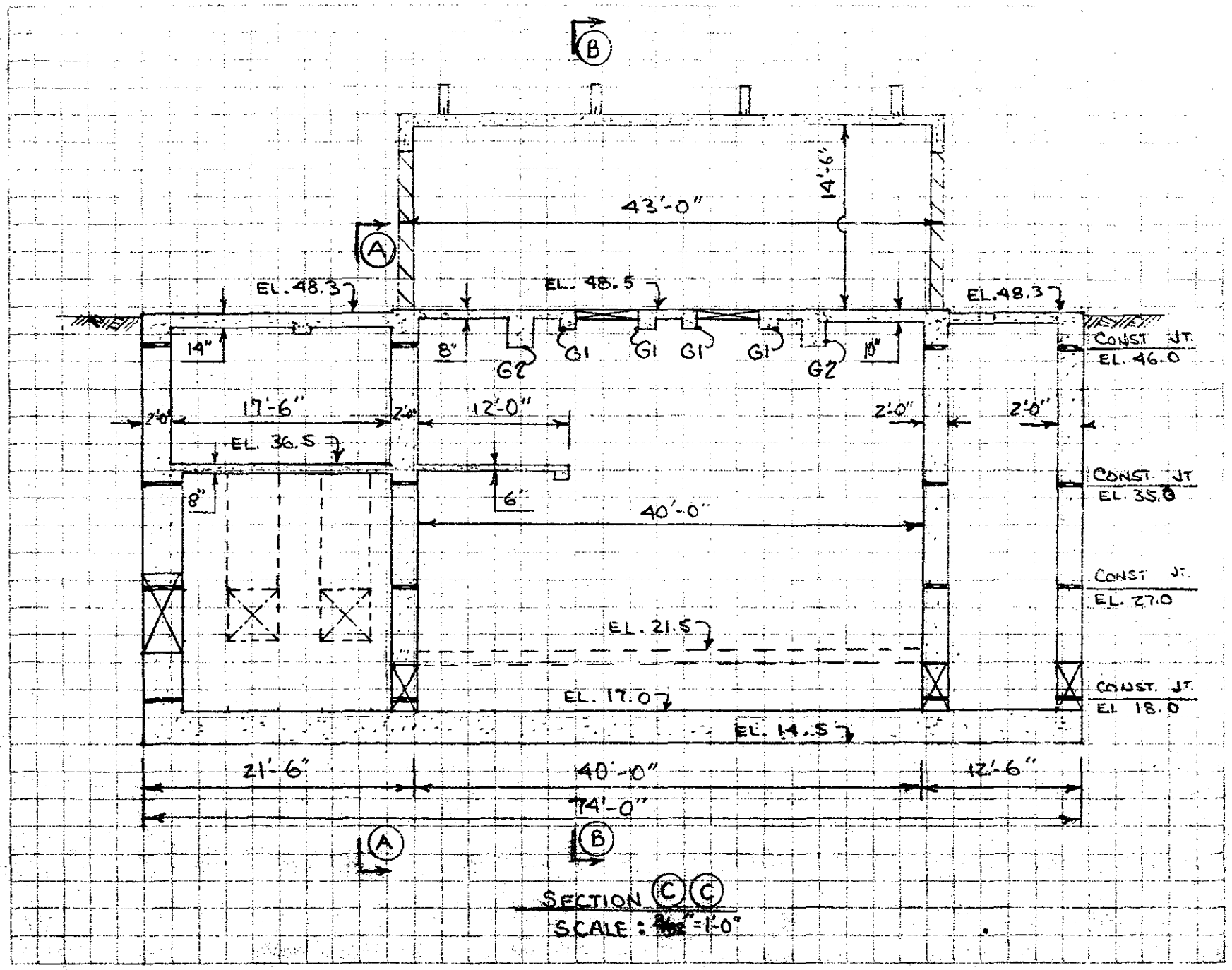
SECTION (B) (B)
SCALE: 1/8" = 1'-0"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT PARK RIVER
COMPUTATION PORE PARK PUMPING STATION
COMPUTED BY JRF CHECKED BY DATE 11/20/79

PAGE A-106



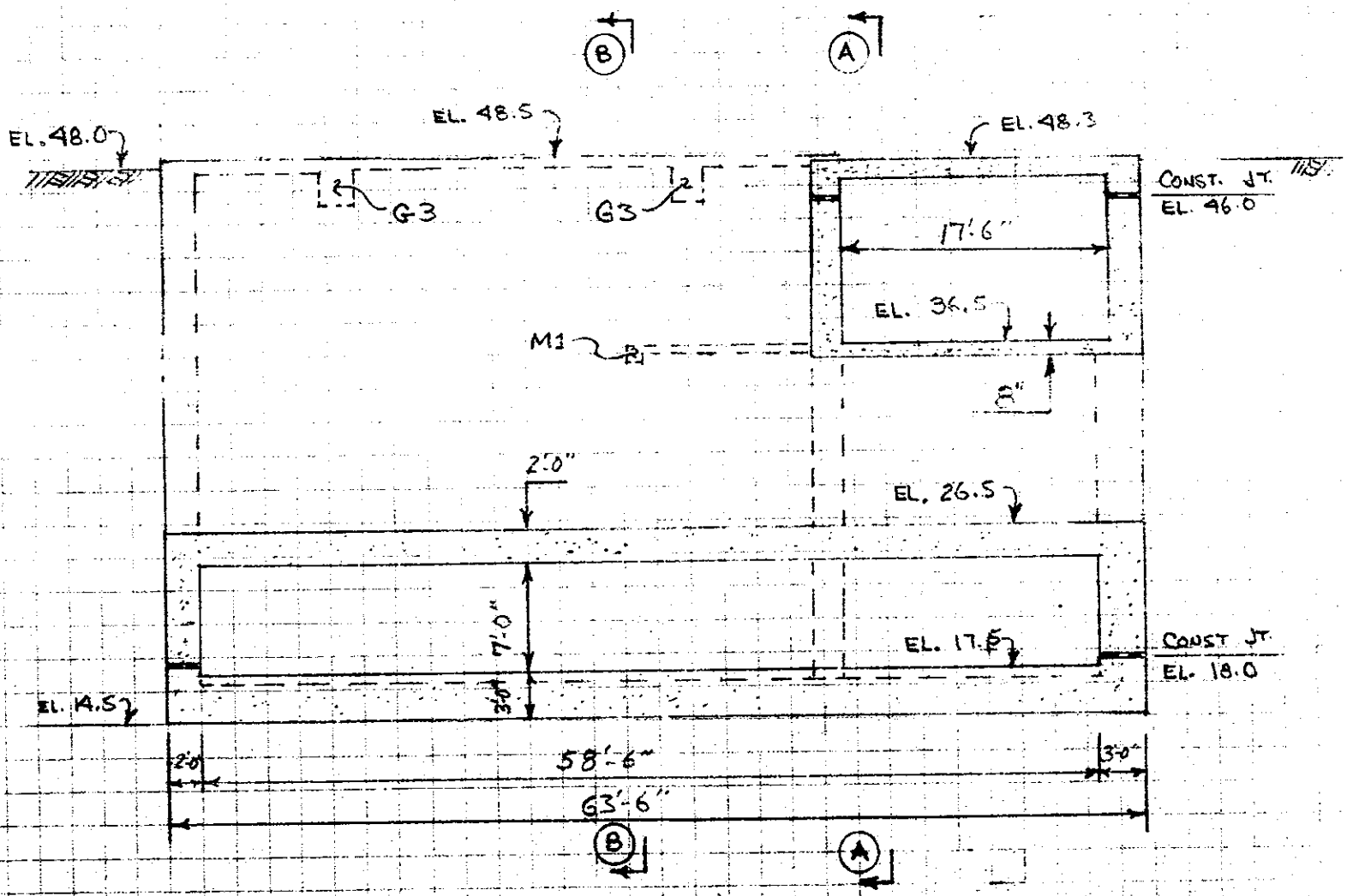
SECTION (C)(C)
SCALE : 1/4" = 1'-0"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT PARK RIVER
COMPUTATION PARK FALLS PUMPING STATION
COMPUTED BY JRF CHECKED BY DATE 11/20/74

PAGE A-107

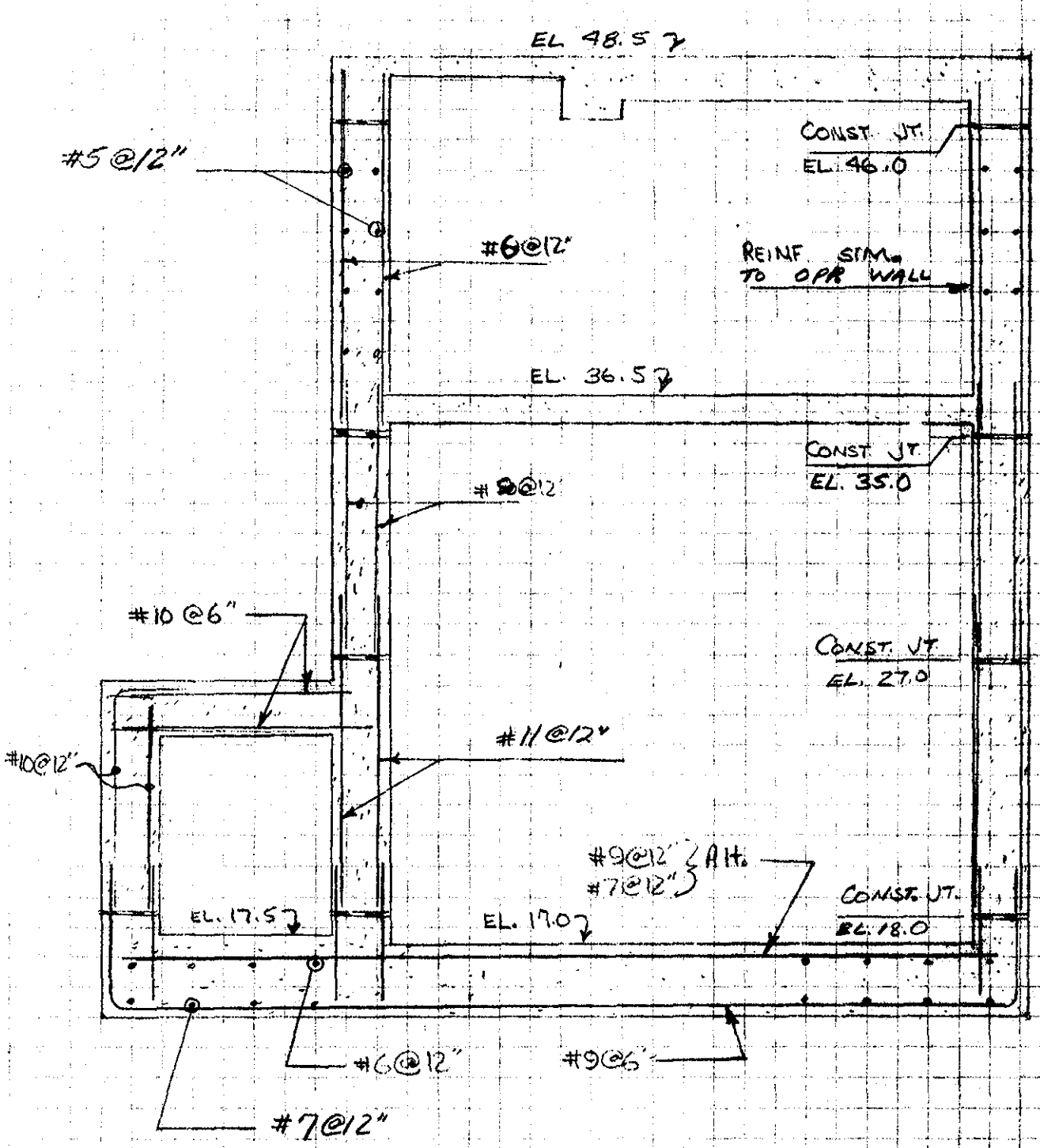


SECTION (D) (B)
SCALE: 3/32" = 1'-0"

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: PARK RIVER
COMPUTATION: POPE PARK PUMPING STATION
COMPUTED BY: VRF CHECKED BY: DATE: 11/22/79



SIM. SECTION (B)(B)

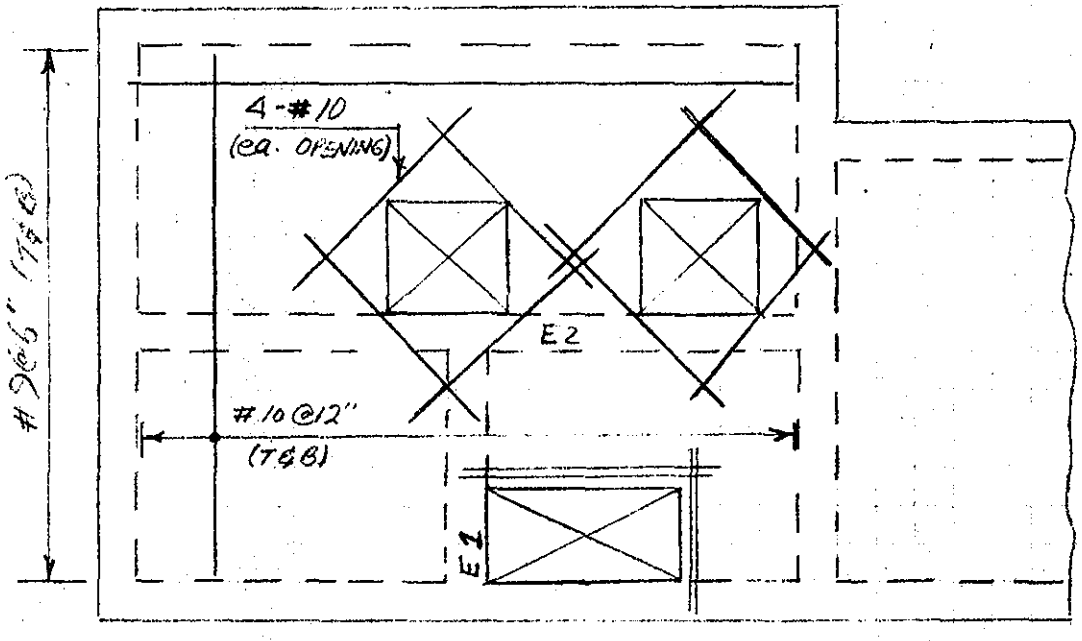
SCALE: 3/16" = 1'-0"

NED FORM 223
27 Sept 49

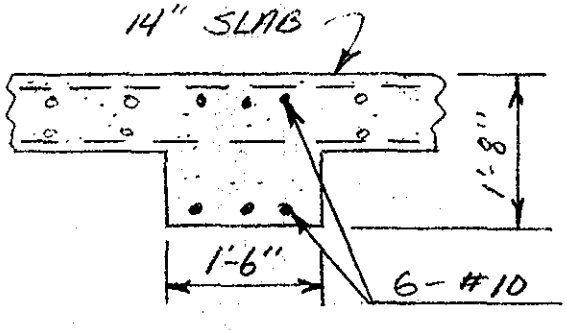
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT PARK RIVER
COMPUTATION POPE PARK PUMPING STATION
COMPUTED BY JRF CHECKED BY DATE 11/22/79

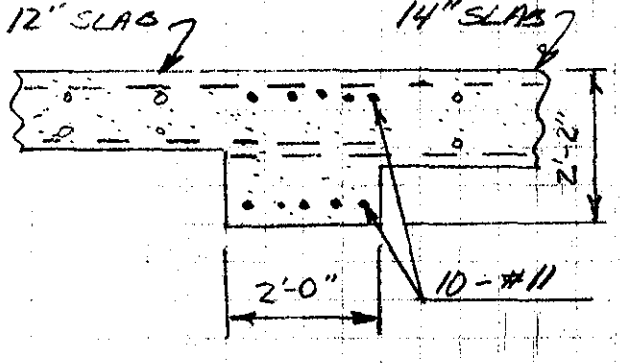
SLAB @ EL. 48.3 (EXTERIOR)



PARTIAL PLAN



DETAIL BEAM E1



DETAIL BEAM E2

NED FORM 223
27 Sept 49

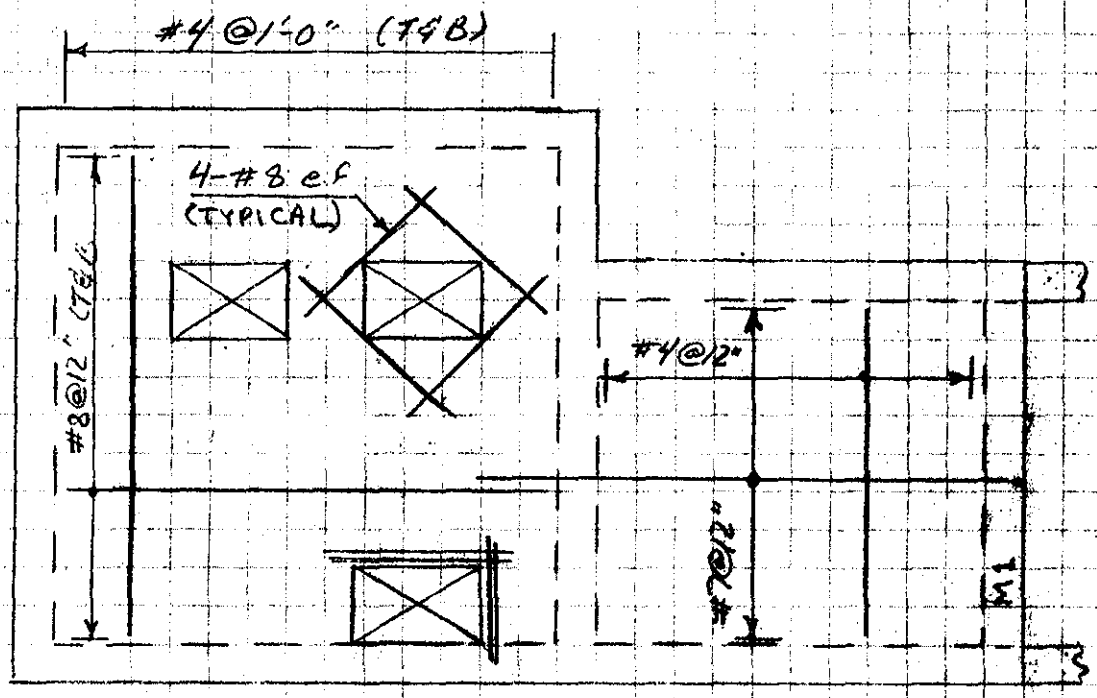
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: PARK RIVER

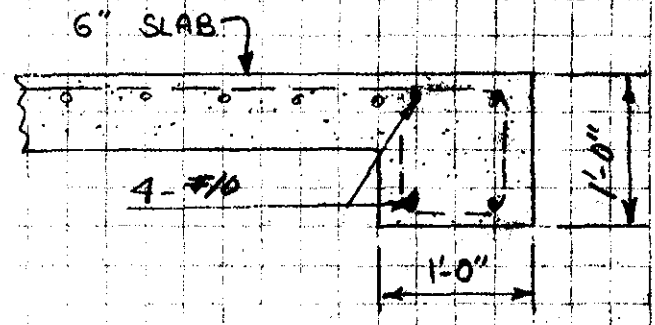
COMPUTATION: POPE PARK PUMPING STATION

COMPUTED BY: VRF CHECKED BY: DATE: 11/22/74

SLAB @ EL 36.5



PLAN - MEZZANINE FLOOR
N.T.S.



DETAIL BEAM M1
N.T.S.

APPENDIX B

MECHANICAL DESIGN COMPUTATIONS

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT: PARK RIVER
COMPUTATION: ARMORY PUMPING STATION
COMPUTED BY: JTS CHECKED BY: DATE: Oct 74

STATION DESIGN CAPACITY

120 cfs

Hydraulic Grade Line Elevation Design Flood	45.3
Pump Activation	23.5
Pump Stop	20.0
Drain Piping Entering Station	15.0
Conduit Invert at Station	13.0

3 Pumps

PUMP DESIGN CONDITION POINT

120/3 = 40 cfs = 18,000 gpm

Diam. of disch. = $\sqrt{\frac{4 \times 40}{12\pi}}$ = 2.06' = 24.72"

Head at Q = 18,000 gpm

Pump Start to Hydr. Grade Line (45.3 - 23.5)	=	21.8
Velocity Hd	=	2.53
Piping Loss	=	4.73
Total Head	=	29.06'

SYSTEM LOSSES - 24" DISCHARGE PIPE

Gpm	Vel	Vel. Hd.	Pipe Hf.	Total
8,000	5.67	0.50	0.97	1.47
9,000	6.38	0.63	1.22	1.85
10,000	7.09	0.78	1.50	1.35
12,000	8.51	1.13	2.15	3.28
14,000	9.93	1.53	2.92	4.45
16,000	11.35	2.00	3.76	5.76
18,000	12.76	2.53	4.73	7.26
20,000	14.20	3.13	5.81	8.94

SUBJECT: PARK RIVER
COMPUTATION: ARMORY PUMPING STATION
COMPUTED BY: JTS CHECKED BY: DATE: Oct. 74

VALUE FROM PUMP CURVE

	Qm	Hm	Pm
	8,000	37.7	109
	10,000	36.0	116
	12,000	33.8	122
	14,000	31.0	127
Cond. Pt.	15,200	29.0	128
	16,000	26.8	127
	17,000	24.0	124

ACTUAL MODEL RATIO

24" Pump Discharge $MR^2 = \frac{18,000}{15,200} = 1.184$; $MR = 1.088$

PROTOTYPE VALUES

	Qp	Hp	Pp
	9,470	37.7	129
	11,840	36.0	137
	14,210	33.8	144
	16,580	31.0	150
Cond Pt.	18,000	29.0	152
	18,950	26.8	150
	20,130	24.0	147

$N = \frac{500}{1.088} = 460$ rpm

Impeller diam $= 25.25 \times 1.088 = 27.47''$

From plotted curve
- Q = 18,000 gpm
- P @ rated Q = 152 HP
- BHP required by pump = 152
- +10% = 167
- Loss in reduct. gear +4% = 7
- BHP at engine coupling = 174 HP (Continuous Rating)

SUBJECT POPE PARK

COMPUTATION ARSONAL PUMPING STATION

COMPUTED BY _____ CHECKED BY _____ DATE Oct 74

PUMP OPERATING CYCLE

Pipe Storage = 13,600 ft^3 = 101,735 gals.

Pump Capacity = 18,000 gpm

Operating time (no inflow) = 101,735/18,000 = 5.6 gpm

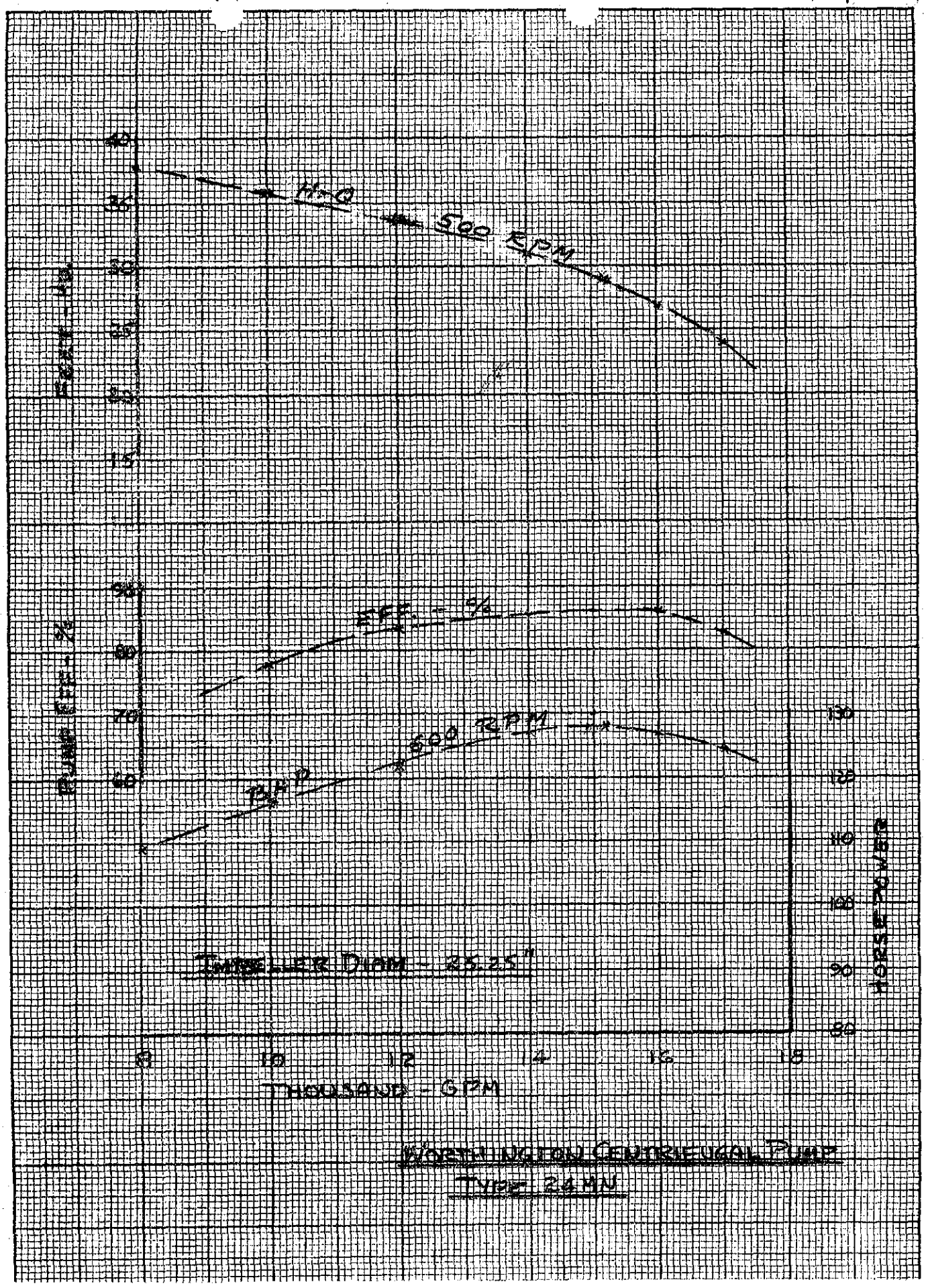
Min. pump operating cycle (operating at full speed)
(Inflow = 50% of pump capacity)

Time to empty = 101,735/9000 = 11.3

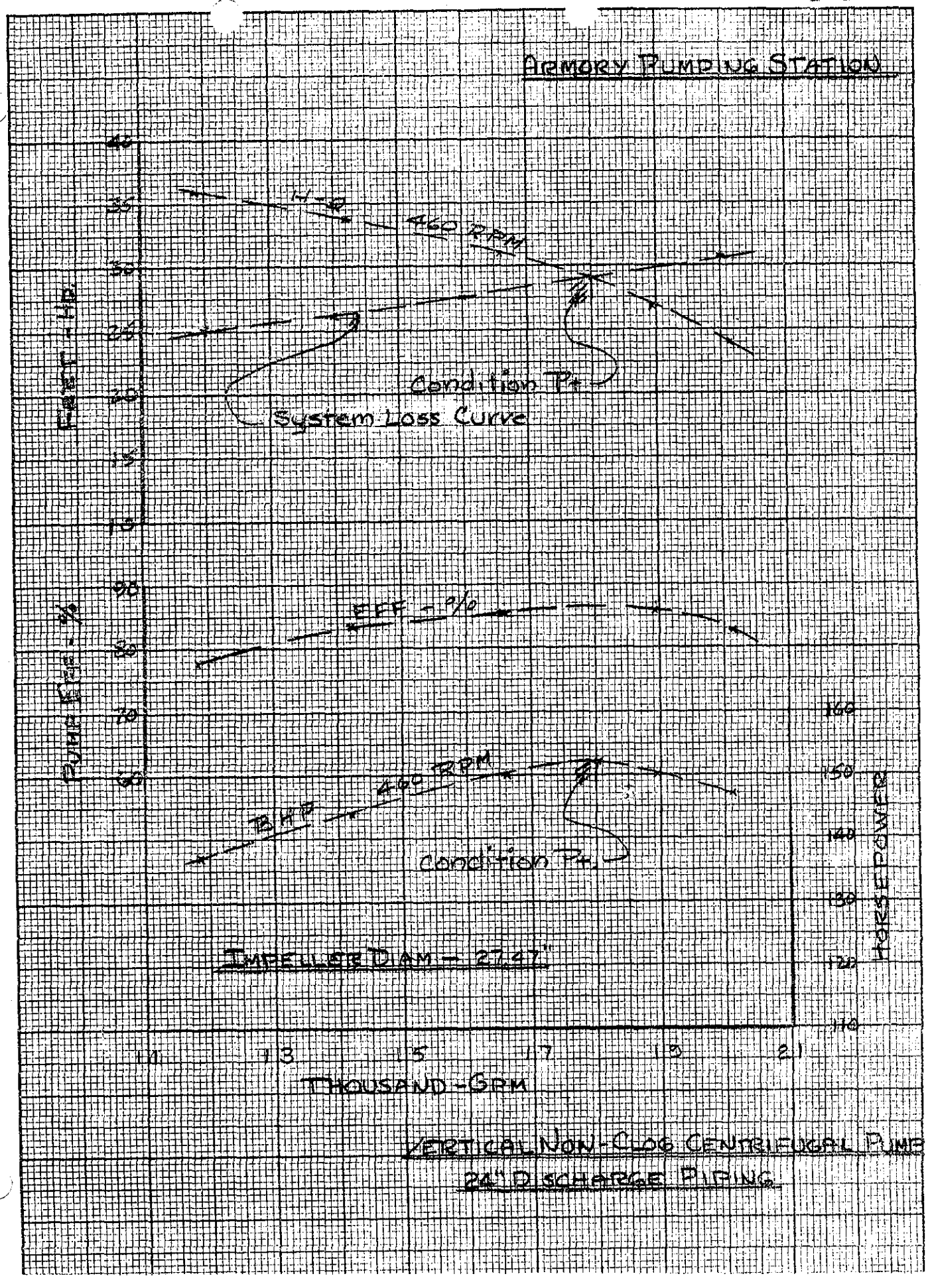
Time to refill = 101,735/9000 = 11.3

Time between engine starts = 22.6 mins.

This is not too frequent starting of an engine, however the time can be further increased for each engine by alternate starting and operation of each engine. The time elapsed between starting of an individual engine would be increased to (6 x 11.3) 67.8 mins.



WORTHINGTON CENTRIFUGAL PUMP
TYPE 24 MN


ARMORY PUMPING STATION
HEAD - FT.
40
35
30
25
20
15
10
H-Q
460 RPM
Condition Pt.
System Loss Curve
PUMP EFF. - %
90
80
70
60
EFF - %
BHP
460 RPM
Condition Pt.
160
150
140
130
120
110
HORSEPOWER
IMPELLER DIAM - 27.47"
11
13
15
17
19
21
THOUSAND - GPM
VERTICAL NON-CLOG CENTRIFUGAL PUMP
24" DISCHARGE PIPING

STATION DESIGN CAPACITY

75 cfs

Hydraulic Grade Line Elevation Design Flood	47.5
Pump Activation	30.0
Pump Stop	25.0
Drain Piping Entering Station (Inv)	20.5
Conduit Invert at Station	14.8

3 pumps

PUMP DESIGN CONDITION POINT

75/3 = 25 cfs = 11,250 gpm

Diam. of disch $= \sqrt{\frac{4 \times 25}{12\pi}} = 1.63' = 19.54''$

Head at Q = 11,250 gpm

Pump Start to Hydr Grade Line (47.5 − 30.0)	17.50
Velocity Hd	2.06
Piping Loss	3.75
Total Head =	23.31

SYSTEM LOSSES – 20" DISCHARGE PIPE

GPM	Vel	Vel. Hd.	Pipe Hf.	Total
6,000	6.13	0.58	1.09	1.67
7,000	7.15	0.79	1.47	2.26
8,000	8.17	1.04	1.91	2.95
9,000	9.19	1.31	2.41	3.72
10,000	10.20	1.62	2.96	4.58
11,250	11.51	2.06	3.75	5.81
12,000	12.30	2.33	4.22	6.55
14,000	14.30	3.18	5.71	8.89

SUBJECT: PARK RIVER
COMPUTATION: POPE PARK PUMPING STATION
COMPUTED BY: JTS CHECKED BY: DATE: Oct. 74

VALUE FROM PUMP CURVE

	Q_m	H_m	P_m
	6,000	29.5	58
	7,000	28.5	62
	8,000	27.2	65
	9,000	25.5	67.5
Max. Eff.	9,100	25.2	68
Cond. Pt.	9,800	23.3	69
	10,000	22.7	69
	11,000	19.0	67.5

ACTUAL MODEL RATIO

20" Pump Discharge $\overline{MR}^2 = \frac{11,250}{9800} = 1.148$ MR = 1.071

PROTOTYPE VALUES

Q_p	H_p	P_p
6,890	29.5	66.6
8,040	28.5	71.2
9,180	27.2	74.6
10,330	25.5	77.5
10 450	25.2	78.1
11.250	23.3	79.2
11,480	22.7	79.2
12,630	19.0	77.5

$N = \frac{705}{1.07} = 658$ rpm

Impeller diam = 19.0 x 1.07 = 20.33"

From plotted curve
Q = 11,250 gpm
P @ rated Q = 79.2 HP
BHP required by pump = 79.2
+10% = 87.1
Loss in reduct gear +4% = 3.5
BHP at engine coupling = 90.6 (Continuous Rating)

SUBJECT: PARK RIVER
COMPUTATION: POPE PARK PUMPING STATION
COMPUTED BY: _____ CHECKED BY: _____ DATE: Oct. 74

PUMP OPERATING CYCLE

Pipe Storage = 12,200 ft^3 = 91,262 gals

Pump Capacity = 11,250 gpm

Operating time (no inflow) = 91,262/11,250 = 8.1 mins

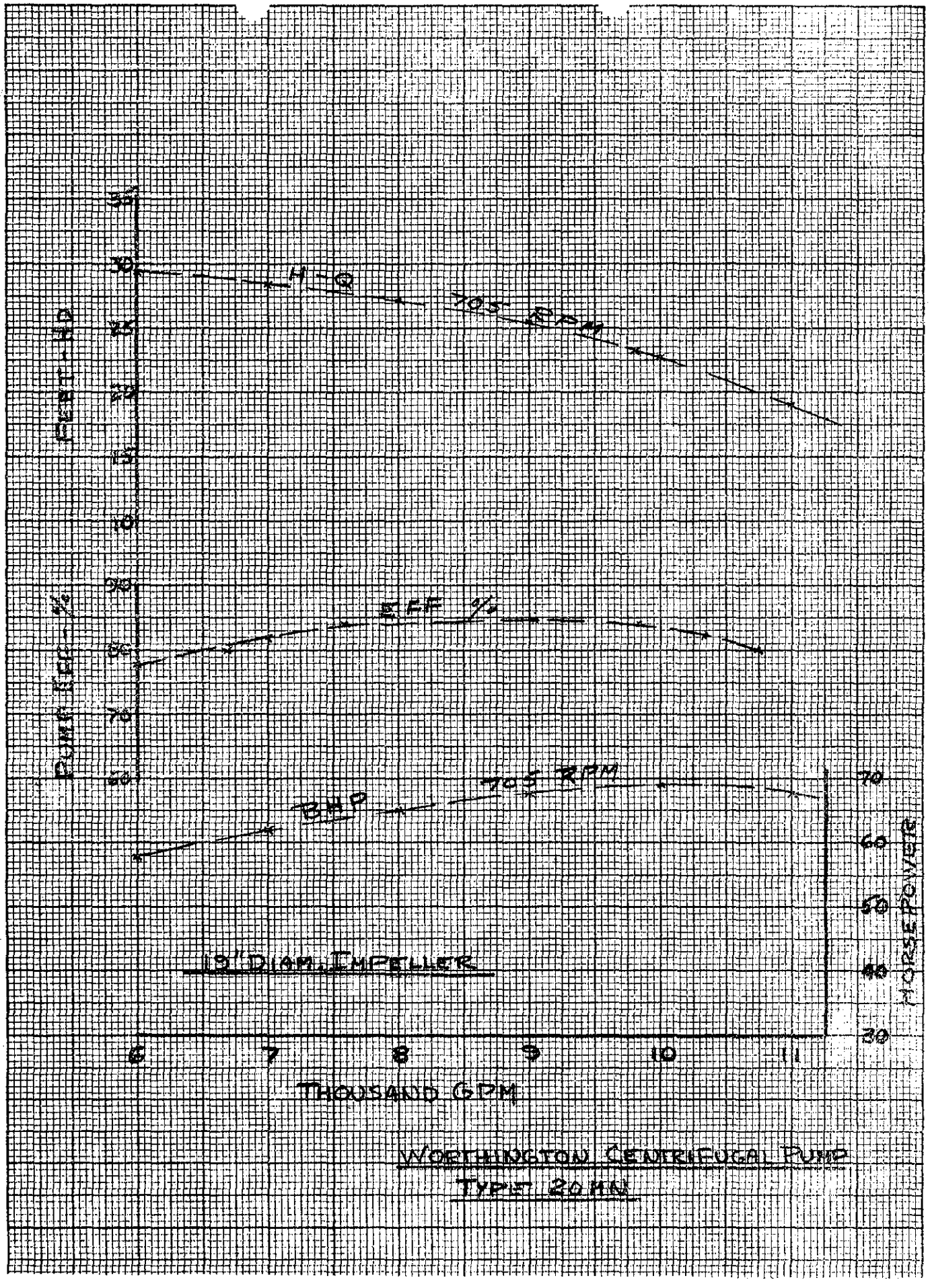
Min. pump operating cycle (operating at full speed)
(Inflow = 50% of pump capacity)

Time to empty = 91,262 / 5625 = 16.2 mins

Time to refill = 91,260/5625 = 16.2 "

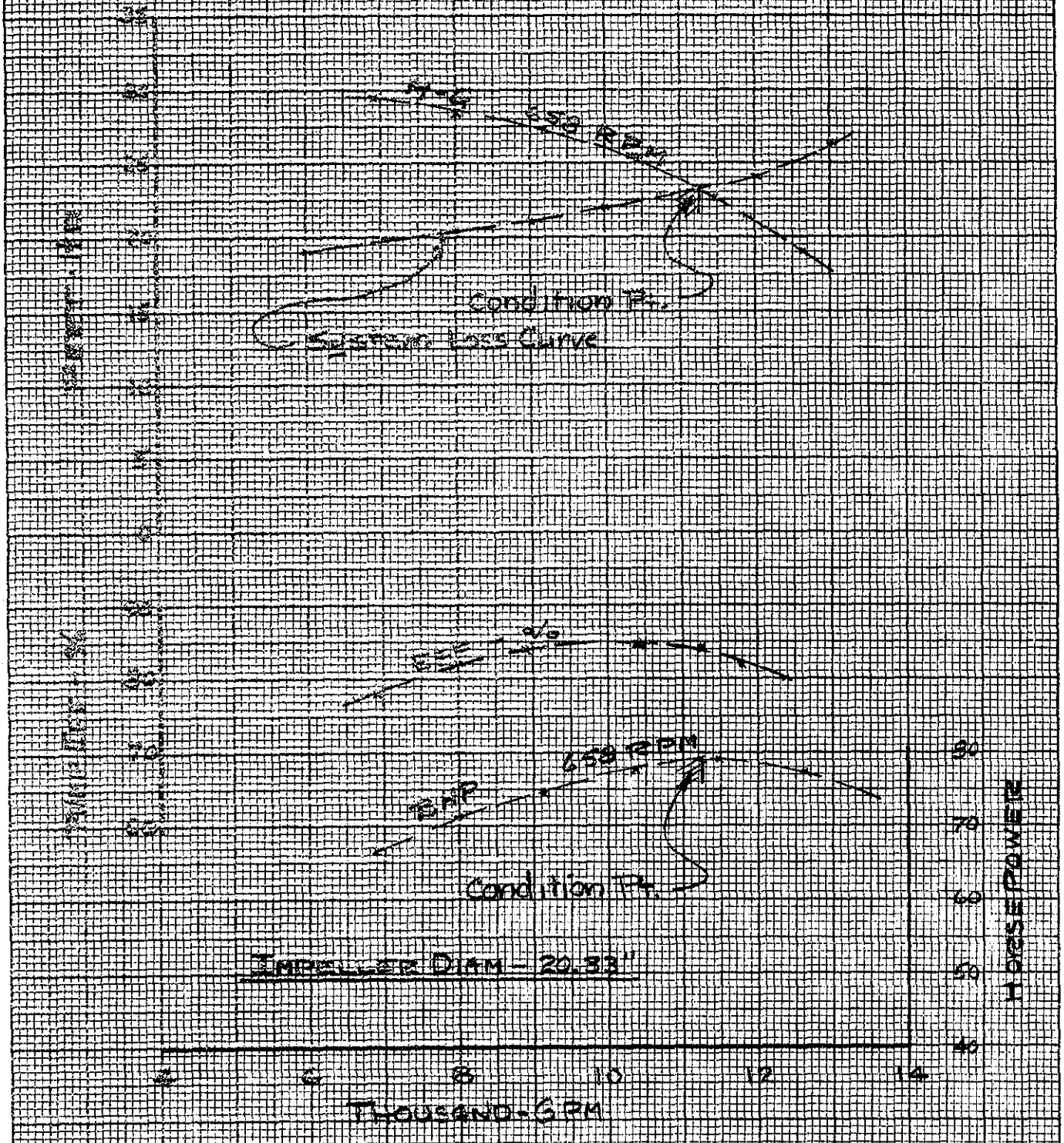
Time between engine starts = 32.4 mins

This is not too frequent starting of an engine, however the time can be further increased for each engine by alternate starting and operation of each engine. The time elapsed between starting of an individual engine would be increased to (6 x 16.2) 97.2 mins.



WORTHINGTON CENTRIFUGAL PUMP
TYPE 20MN

POPE PARK PUMPING STATION

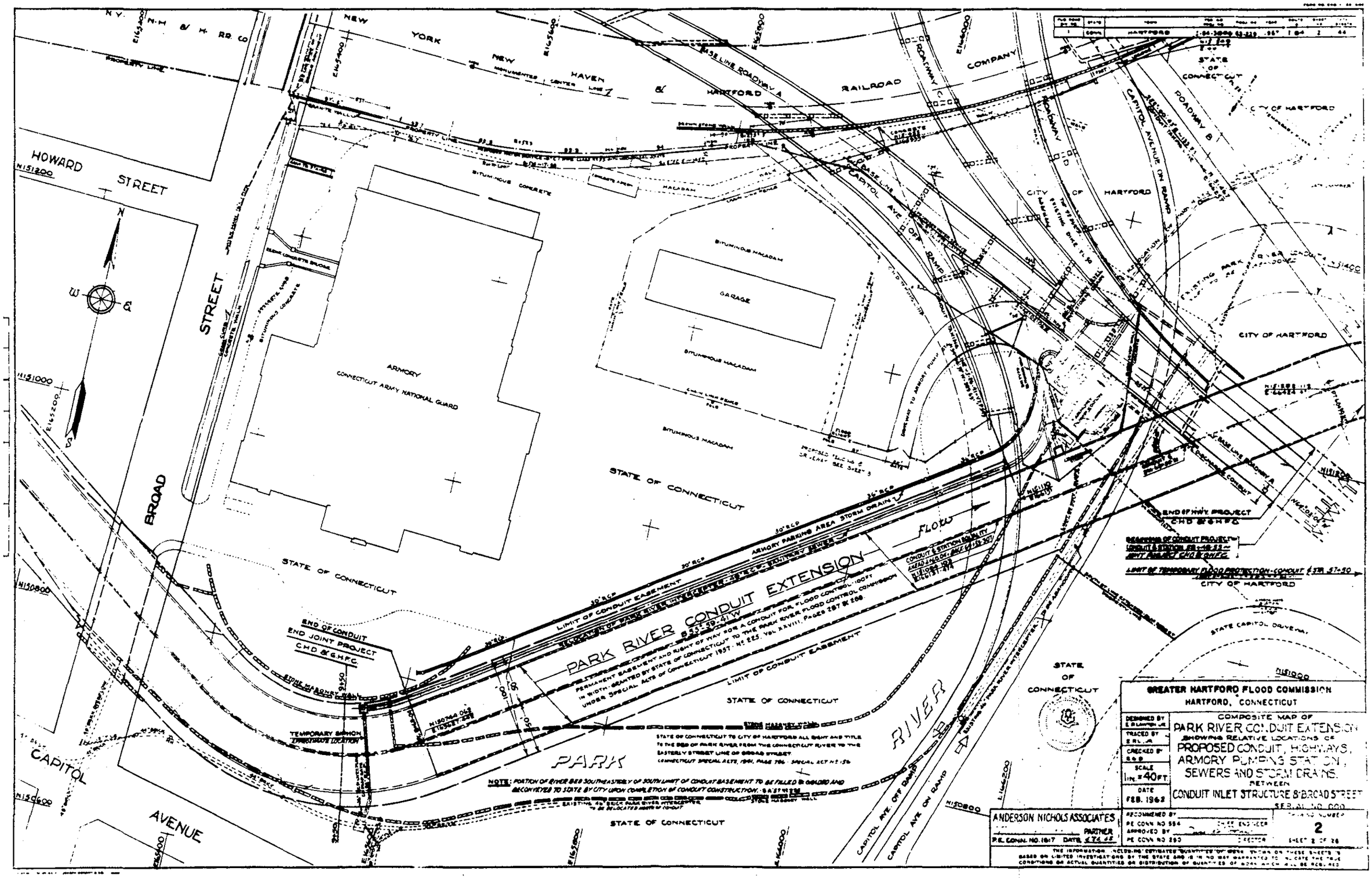


VERTICAL NON-CLOG CENTRIFUGAL PUMP
20" DISCHARGE PIPING

APPENDIX C

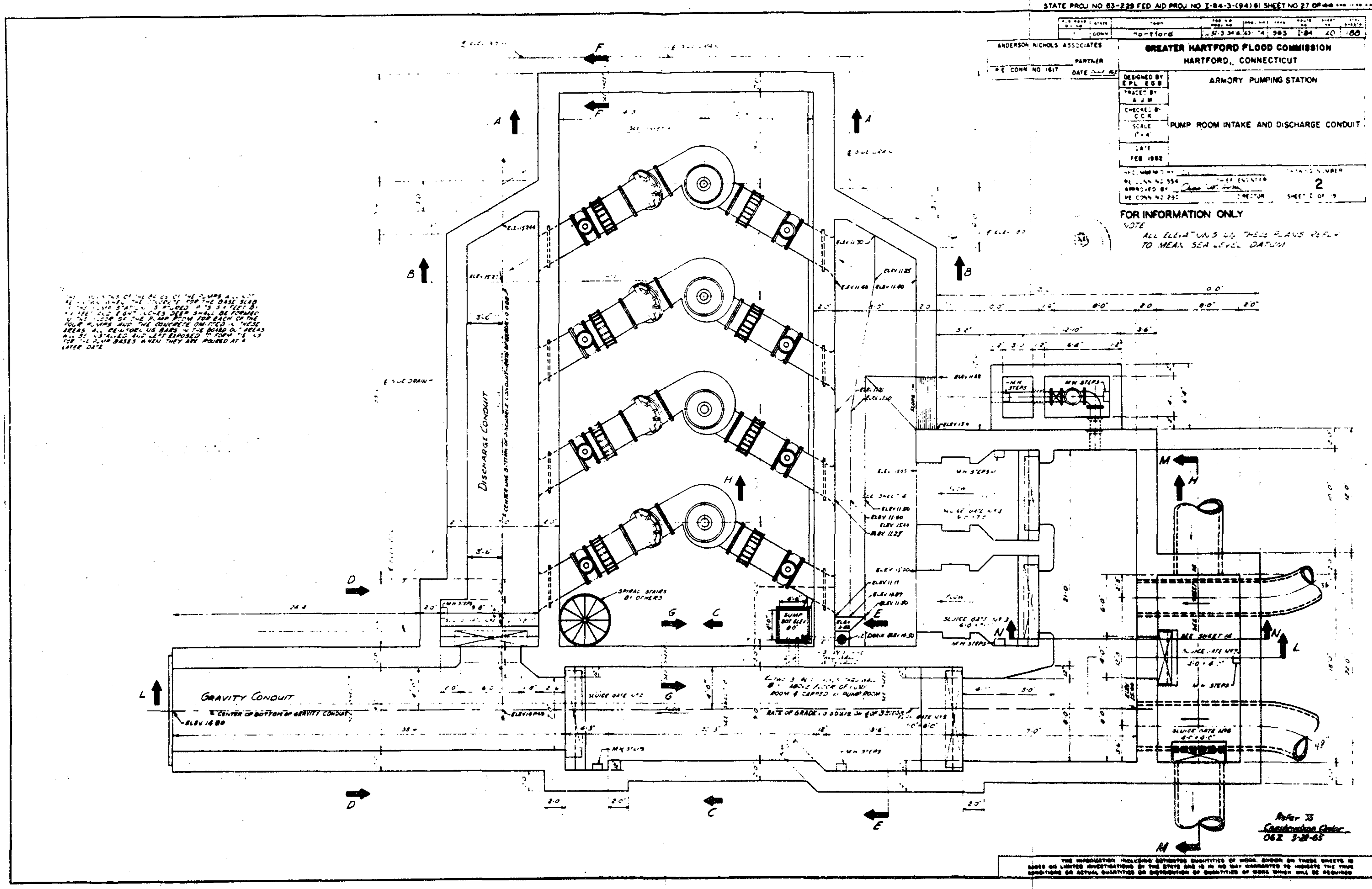
CONTRACT DRAWINGS - ARMORY STATION SUBSTRUCTURE

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY



THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84-3-(94)81 SHEET NO 27 OF 44



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STATE PROJ. NO 63-229 FED AID PROJ NO I-84-3 (94) 81 SHEET NO 26 OF 44

PUB ROAD SECTION	STATE	TOWN	PROJECT NO	FEDERAL AID NO	YEAR	TOTAL SHEETS	SHEET NO
1	CONN	Hartford	IM 3-5(6) 63-76		1963	84	8

ANDERSON NICHOLS ASSOCIATES

PARTNER

P.E. CONN NO 1817 DATE

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION

HARTFORD, CONNECTICUT

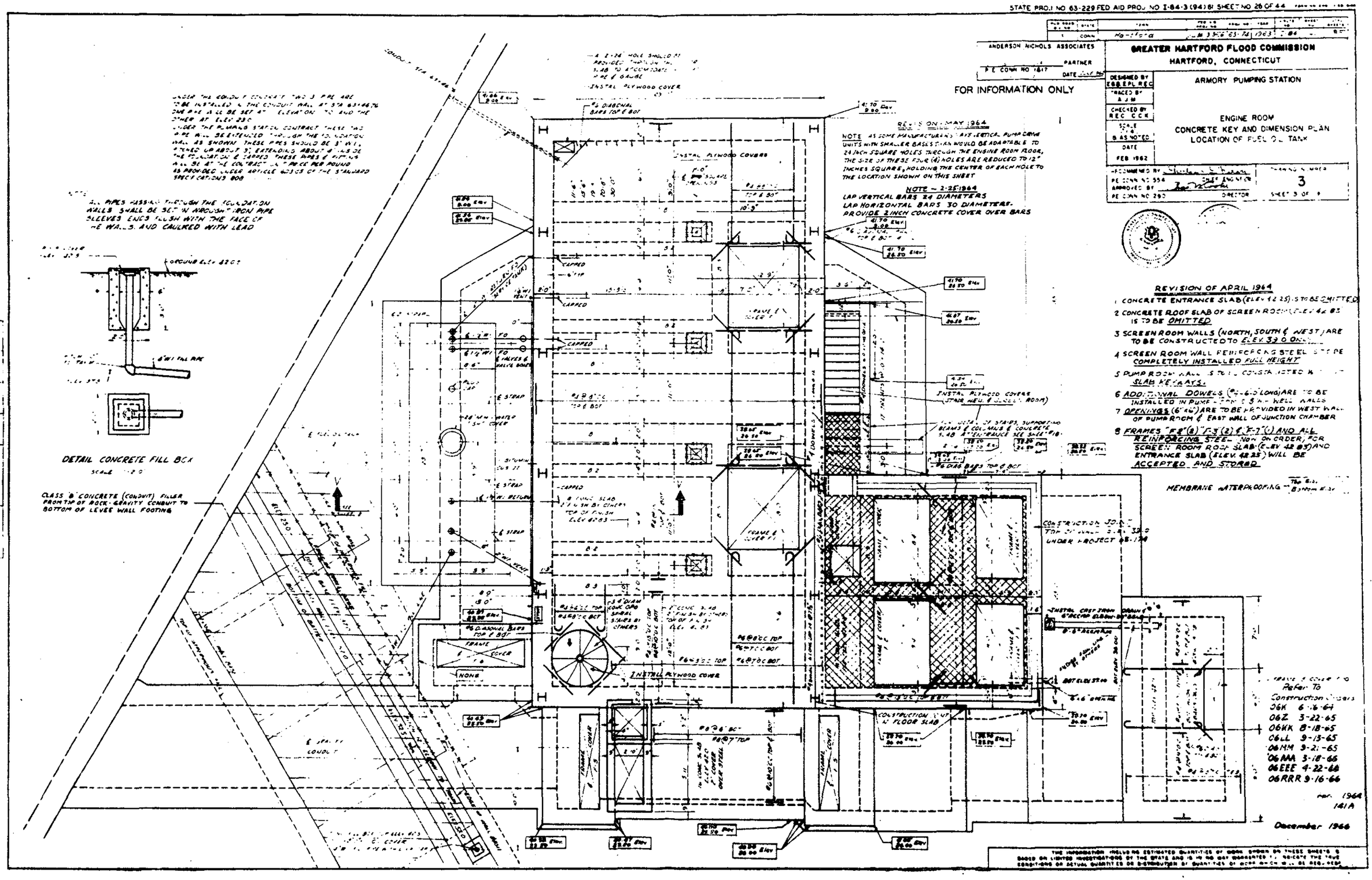
ARMORY PUMPING STATION

ENGINE ROOM
CONCRETE KEY AND DIMENSION PLAN
LOCATION OF FUEL OIL TANK

DESIGNED BY E.G.B. E.P.L. REC
TRACED BY A.J.M.
CHECKED BY REC C.C.K.
SCALE 1/4" = 1' & AS NOTED
DATE FEB 1962

RECOMMENDED BY
P.E. CONN NO 554 CHIEF ENGINEER
APPROVED BY
P.E. CONN NO 290 DIRECTOR

DRAWING NUMBER 3
SHEET 3 OF 9



REVISION OF APRIL 1964

1 CONCRETE ENTRANCE SLAB (ELEV 42.25) IS TO BE OMITTED
2 CONCRETE ROOF SLAB OF SCREEN ROOM (ELEV 42.83) IS TO BE OMITTED
3 SCREEN ROOM WALLS (NORTH, SOUTH & WEST) ARE TO BE CONSTRUCTED TO ELEV 33.0 ONLY
4 SCREEN ROOM WALL REINFORCING STEEL SHALL BE COMPLETELY INSTALLED FULL HEIGHT
5 PUMP ROOM WALLS SHALL BE CONSTRUCTED IN SLAB KEYWAYS.
6 ADDITIONAL DOWELS (#8-6'-0" LONG) ARE TO BE INSTALLED IN PUMP ROOM & SUMP WELL WALLS
7 OPENINGS (6" x 6") ARE TO BE PROVIDED IN WEST WALL OF PUMP ROOM & EAST WALL OF JUNCTION CHAMBER
8 FRAMES "F8" (8) "F-3" (2) & "F-7" (1) AND ALL REINFORCING STEEL — NOW ON ORDER, FOR SCREEN ROOM ROOF SLAB (ELEV. 42.83) AND ENTRANCE SLAB (ELEV. 42.25) WILL BE ACCEPTED AND STORED

THE INFORMATION INCLUDED ESTIMATED QUANTITIES OF WORK SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY GUARANTEED TO INDICATE THE TRUE CONDITIONS OR ACTUAL QUANTITIES OR DISTRIBUTION OF QUANTITIES OF WORK ON THE SITE OR ELSEWHERE

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84-3(941)1 SHEET NO 29 OF 44

FED. AID PROJ. NO.	STATE	TOWN	PROJ. NO.	PROJ. NO.	YEAR	PROJECT NO.	SHEET NO.	TOTAL SHEETS
1	CONN	HARTFORD	[illegible]	03-170	1963	1-84	188	188

ANDERSON NICHOLS ASSOCIATES
PARTNER
P.E. CONN. NO 1617 DATE [illegible]

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

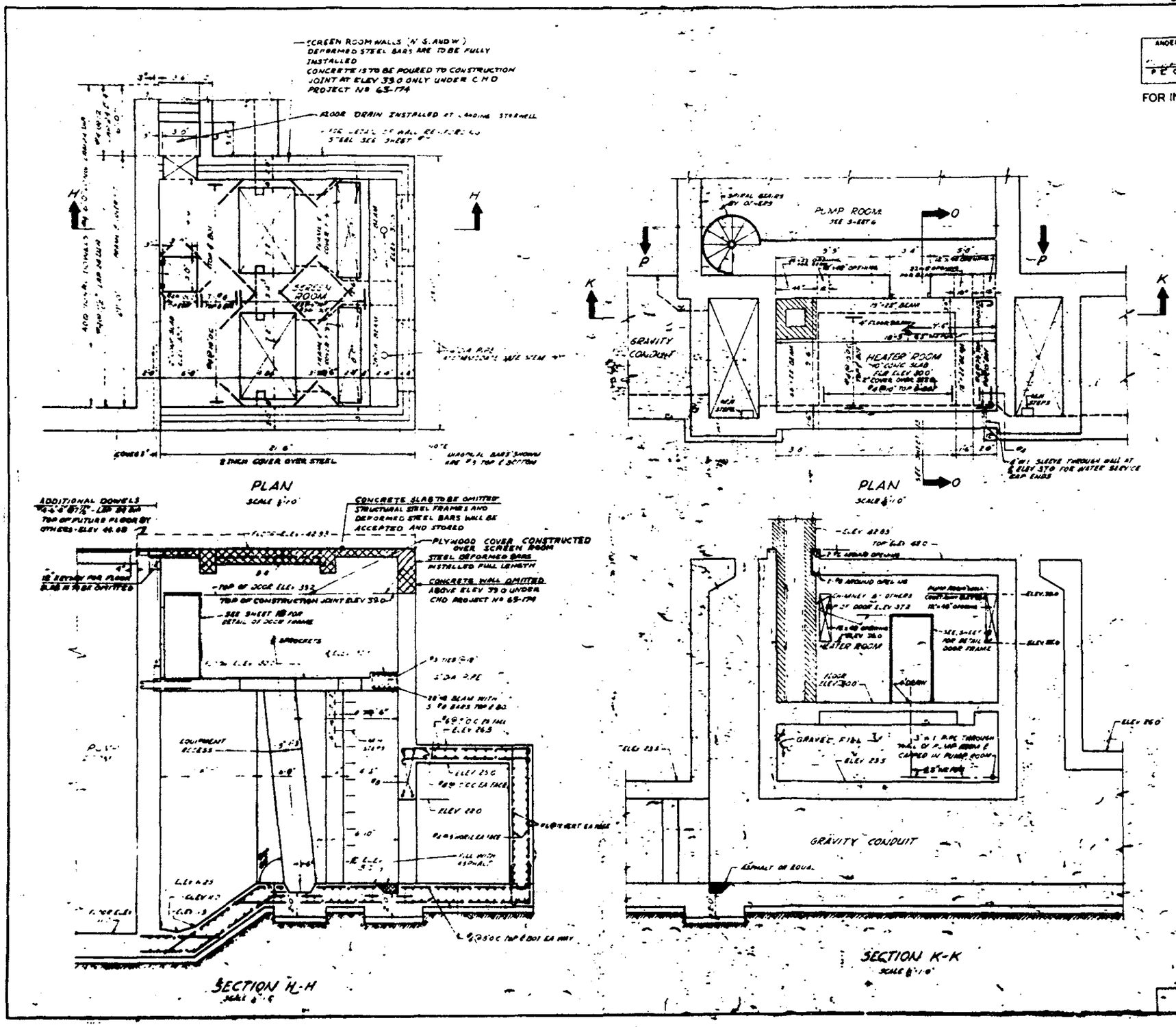
DESIGNED BY R.E.C. A.J.W. C.C.K.
TRACED BY A.J.M.
CHECKED BY R.E.C. C.C.K.
SCALE 1"=1' & AS NOTED
DATE JUNE 1962

ARMORY PUMPING STATION

SCREEN CHAMBER PLAN AND ELEVATION
HEATER ROOM PLAN AND ELEVATION

RECOMMENDED BY [illegible] CHIEF ENGINEER
PE CONN NO 5546
APPROVED BY [illegible] DIRECTOR
PE CONN NO 293

DRAWING NUMBER 4
SHEET 4 OF 19



Refer To Construction Orders
062 3-22-65
066K 8-18-65
066M 9-21-65
066RR 9-16-66

4-20-64
142A

December 1966

THE INFORMATION, INCLUDING ESTIMATES (QUANTITIES OF WORK) SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE OWNER AND IS NOT GUARANTEED TO INDICATE THE TRUE CONDITIONS OF ACTUAL EXISTENCE OR DISTRIBUTION OF CONDITIONS OR QUANTITIES OF WORK WHICH WILL BE ENCOUNTERED.

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-228 FED AID PROJ NO I-94-3(84)61 SHEET NO 30 OF 44

PLG GROUP	STATE	TOWN	FED AID PROJ NO	PROJ NO	YEAR	PLATE NO	SHEET NO	TOTAL SHEETS
1	Conn	HARTFORD	I-94-3(84)61	63-228	1968	184	145	180

ANDERSON NICHOLS ASSOCIATES
PARTNER –
PE CONN NO 1617 DATE

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

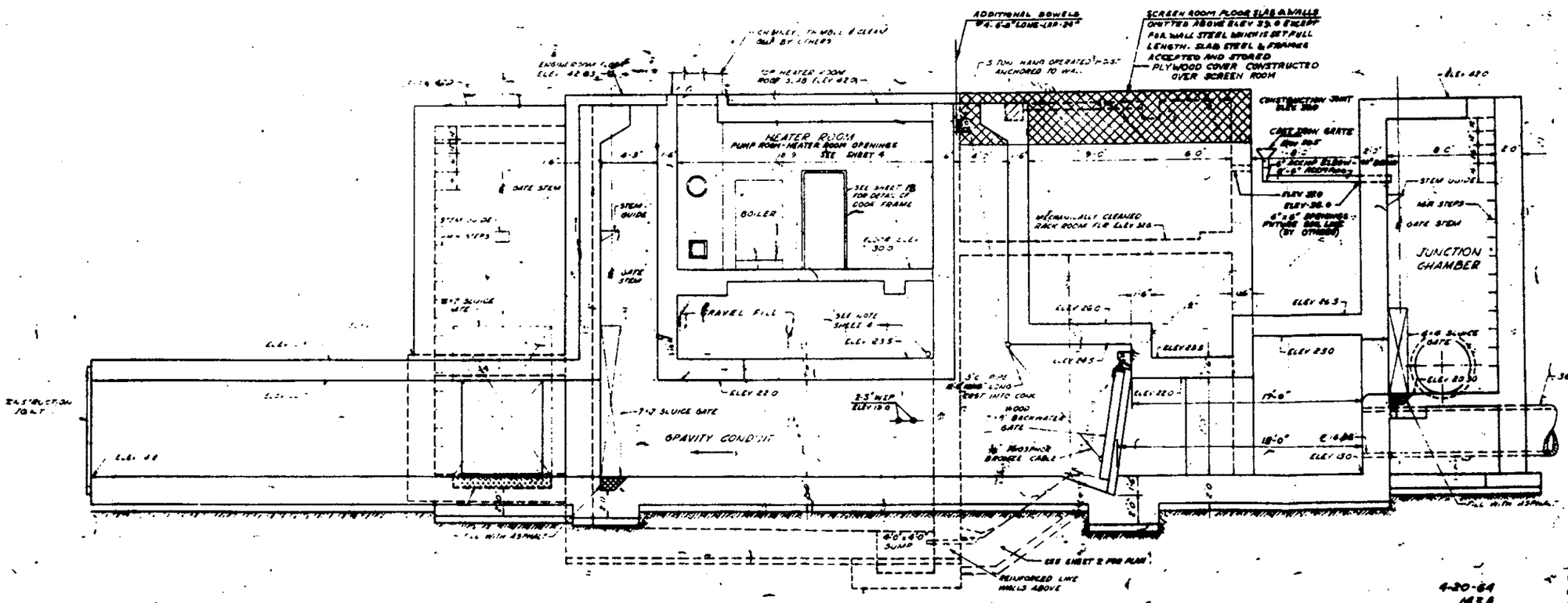
DESIGNED BY A.E.C. C.C.K.
TRACED BY A.J.M.
CHECKED BY A.E.C. C.C.K.
SCALE 1" = 6'
DATE FEB. 1962

ARMORY PUMPING STATION

VERTICAL SECTION OF STATION ON CENTER OF GRAVITY CONDUIT

RECOMMENDED BY
PE CONN NO 594 CHIEF ENGINEER
APPROVED BY
PE CONN NO 280 DIRECTOR

DRAWING NUMBER 5
SHEET 5 OF 19



SECTION ON CENTER LINE OF GRAVITY CONDUIT
SECTION L-L

Refer To Construction Orders
OBZ 3-22-65
OBKK 8-18-65
OBLL 9-13-65
OBMM 9-21-65
& OBRR 3-15-66

4-20-64
(93A)

December 1968

APRIL 1964 REVISED TO SHOW: OPENINGS (6'x6') FOR FUTURE SOIL LINE & SCREEN ROOM CONCRETE ROOF ELEV 32.0
UNDER FED PROJECT NO 63-170

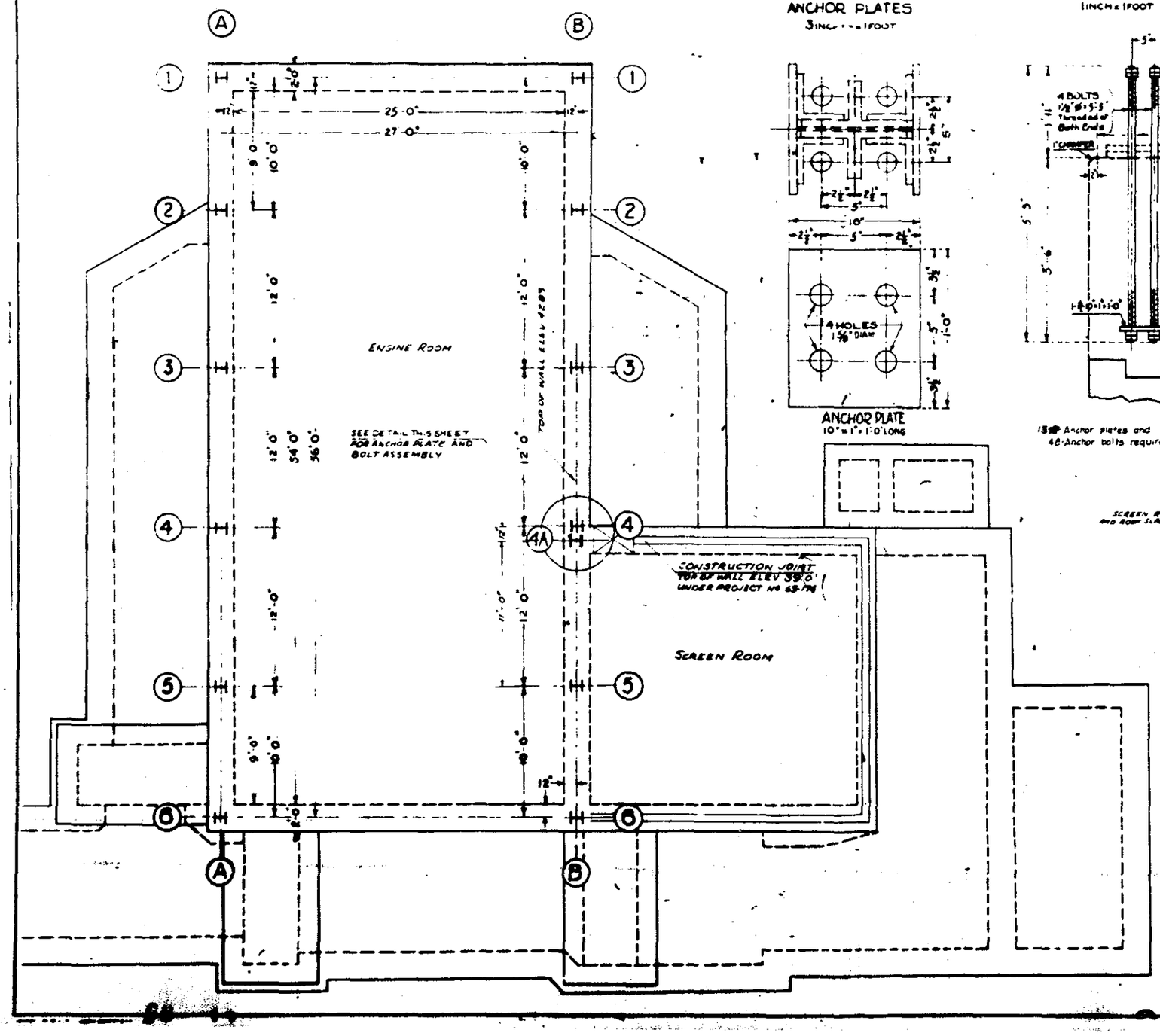
THE INFORMATION, INCLUDING ESTIMATES OF WORK COSTS, IS BASED SOLELY ON BORING DATA OR LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY GUARANTEED TO INDICATE THE CONDITIONS OR ACTUAL REQUIRED EXCAVATION OF MATERIALS TO BE ENCOUNTERED.

THIS PRINT HAS BEEN REDUCED IN SIZE — SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I 84-3(94)6; SHEET NO 3 OF 44

COLUMN LOCATION PLAN

1 INCH = 4 FEET



ANCHOR BOLT DETAILS

BOLT SETTING AND ANCHOR PLATES

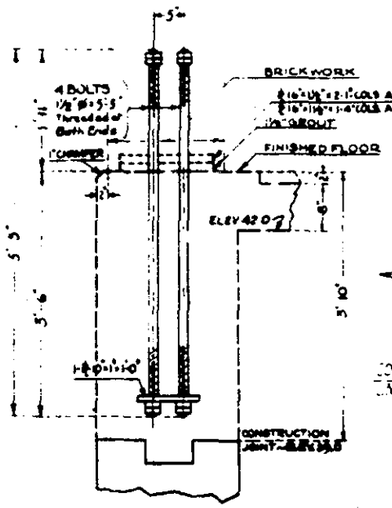
3 INCHES = 1 FOOT

ANCHOR PLATE

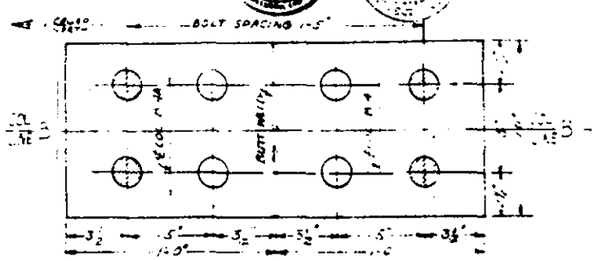
10" x 1" x 1'-0" LONG

BOLT ASSEMBLY

1 INCH = 1 FOOT



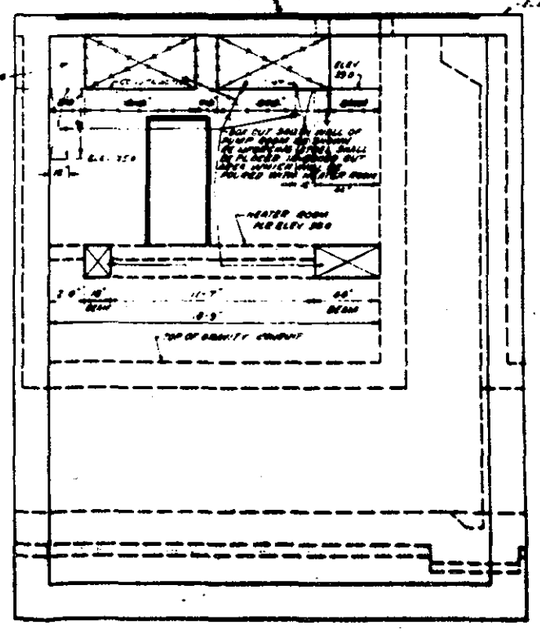
15 Anchor plates and 48 Anchor bolts required



SPECIAL ANCHOR PLATE ASSEMBLY FOR COLUMN B-4 & COLUMN B-4A ANCHOR BOLTS

3 INCHES = 1 FOOT

SCREEN ROOM WALLS ABOVE ELEV 39.0 AND ROOF SLAB TO BE CONSTRUCTED BY OTHERS



SECTION P-P

Refer to Construction Order 062 5-22-65 Ob.4M 5-21-65

4-20-64 HAA

December 1966

FOR INFORMATION ONLY

ANDERSON NICHOLS ASSOCIATES

PARTNER

DATE

GREATER HARTFORD FLOOD COMMISSION

HARTFORD, CONNECTICUT

ARMORY PUMPING STATION

PLAN SHOWING LOCATION OF STRUCTURAL STEEL COLUMNS AND ANCHOR BOLT DETAILS

DESIGNED BY E.P.L.

TRACED BY E.P.L.

CHECKED BY C.C.K.

SCALE 1" = 4'

DATE JUNE 1962

RECOMMENDED BY CHIEF ENGINEER

APPROVED BY DIRECTOR

DRAWING NUMBER 6

SHEET 3 OF 9

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84-3(94)61 SHEET NO 32 OF 44

PROJ NO	STATE	TOWN	PROJ NO	FED NO	TOWN	ROUTE NO	SHEET NO	TOTAL SHEETS
1	CONN.	Hartford	63-14		363	84	45	44

ANDERSON NICHOLS ASSOCIATES
PARTNER
P.E. CONN. NO 10167
DATE JUNE 1968

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

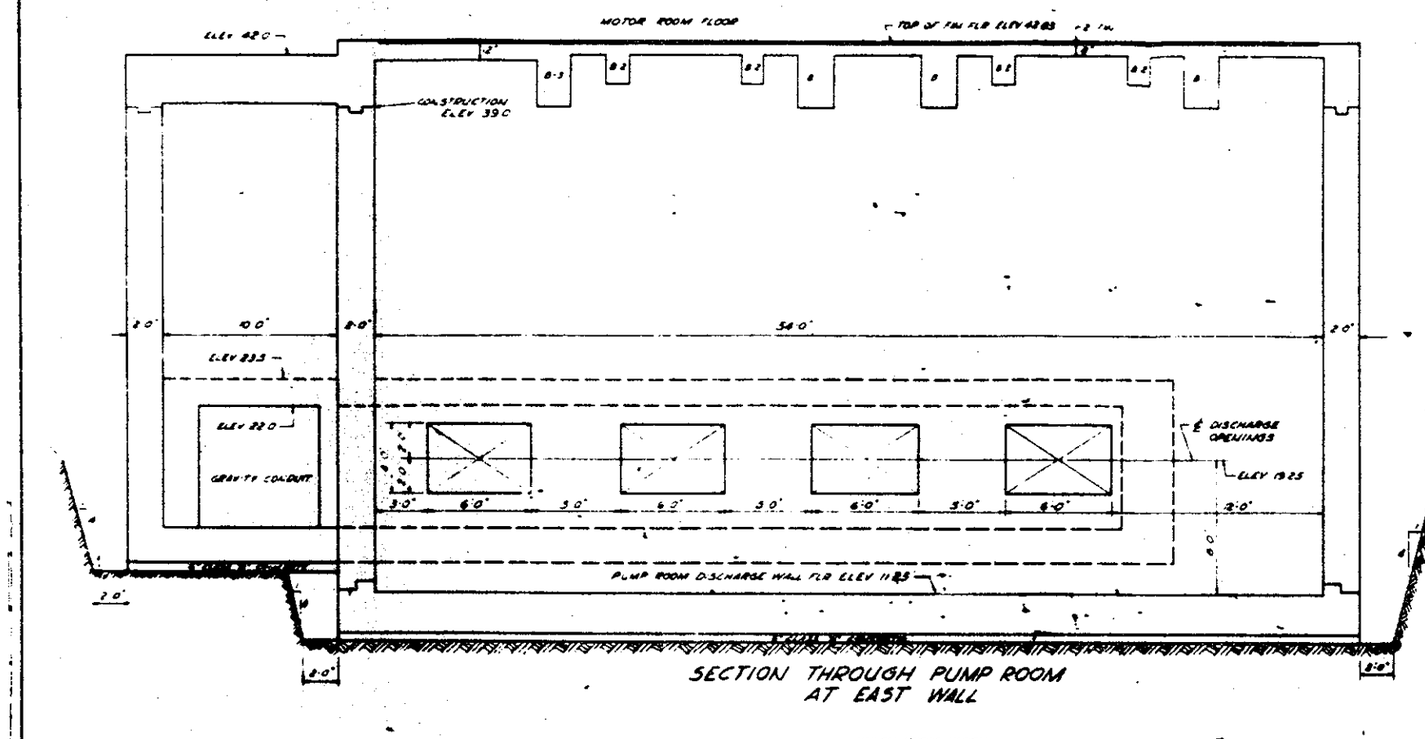
DESIGNED BY E.P.L.
TRACED BY A.J.B.
CHECKED BY E.P.L. E.S.B.
SCALE 1"=4'
DATE JUNE 1968

ARMORY PUMPING STATION

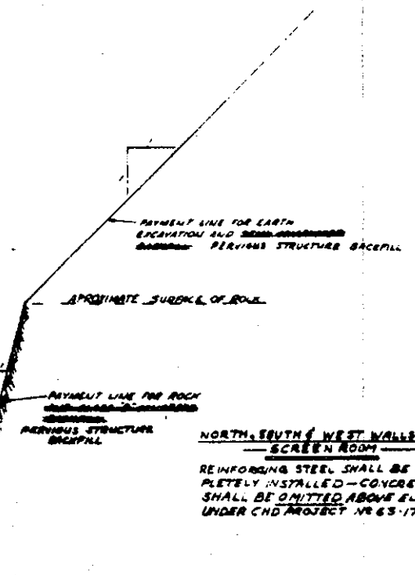
NORTH AND SOUTH SIDE WALLS OF PUMP ROOM SHOWING OPENINGS FOR PUMP SUCTION AND DISCHARGE PIPES

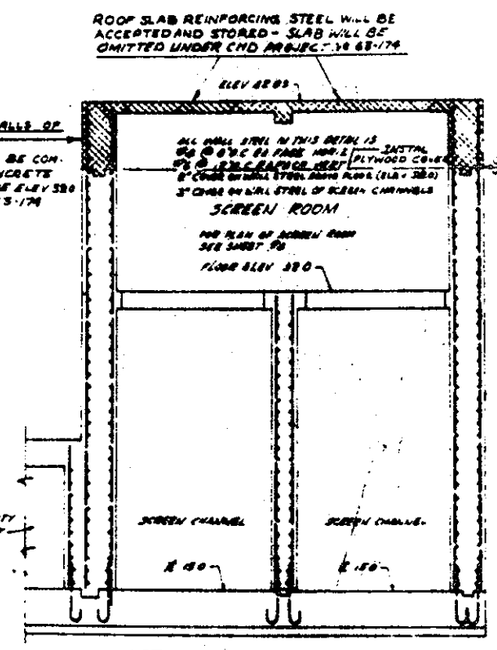
RECOMMENDED BY PE CONN. NO 8864 — PROJ ENGINEER
APPROVED BY PE CONN. NO 930 — DIRECTOR

DRAWING NUMBER 7
SHEET 7 OF 9



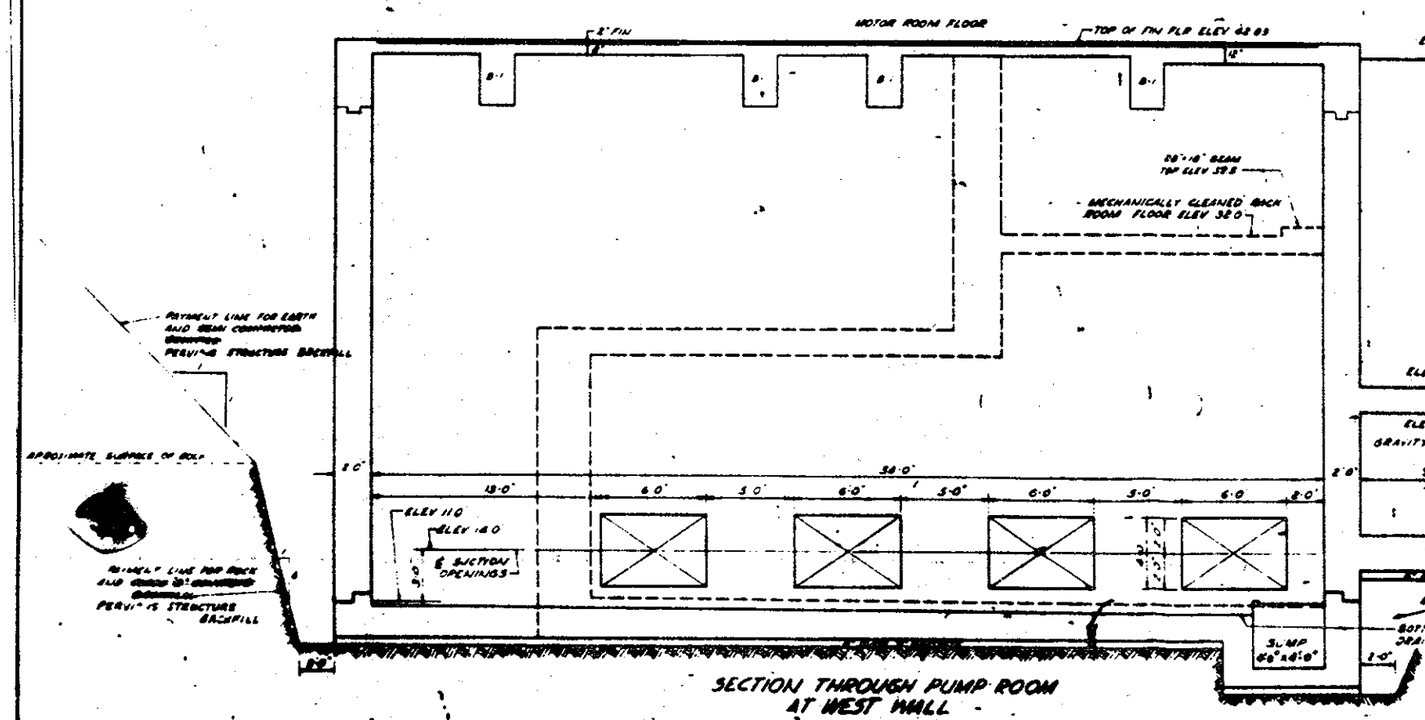
SECTION THROUGH PUMP ROOM AT EAST WALL





DETAIL OF SCREEN ROOM WALLS REINFORCING STEEL

NOTE: LAP VERTICAL BARS 36 DIAMETERS
LAP HORIZONTAL BARS 30 DIAMETERS



SECTION THROUGH PUMP ROOM AT WEST WALL

Refer To - Construction Orders
06 6-16-64
06Z 3-22-65
06WW 8-18-65
06MM 9-21-65
06-00 11-16-65
06RRR 9-16-66

4-20-64
145 A

December 196

APRIL 1969 REVISED TO SHOW OMISSION OF SCREEN ROOM ROOF SLAB AND WALLS ABOVE ELEV. 39.0 UNDER C.H.D. PROJECT No 63-174

THE INFORMATION INCLUDING ESTIMATED QUANTITIES OF WORK SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY GUARANTEED TO INDICATE THE TRUE CONDITIONS OR ACTUAL QUANTITIES OF CONSTRUCTION OR QUANTITIES OF WORK WHICH WILL BE REQUIRED

MS. 145A

THIS PRINT HAS BEEN REDUCED IN SIZE — SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 83-228 FED AID PROJ NO I-84-3(94)(8) SHEET NO 33 OF 44

ANDERSON NICHOLS ASSOCIATES
PARTNER
P E CONN NO 16 7
DATE

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

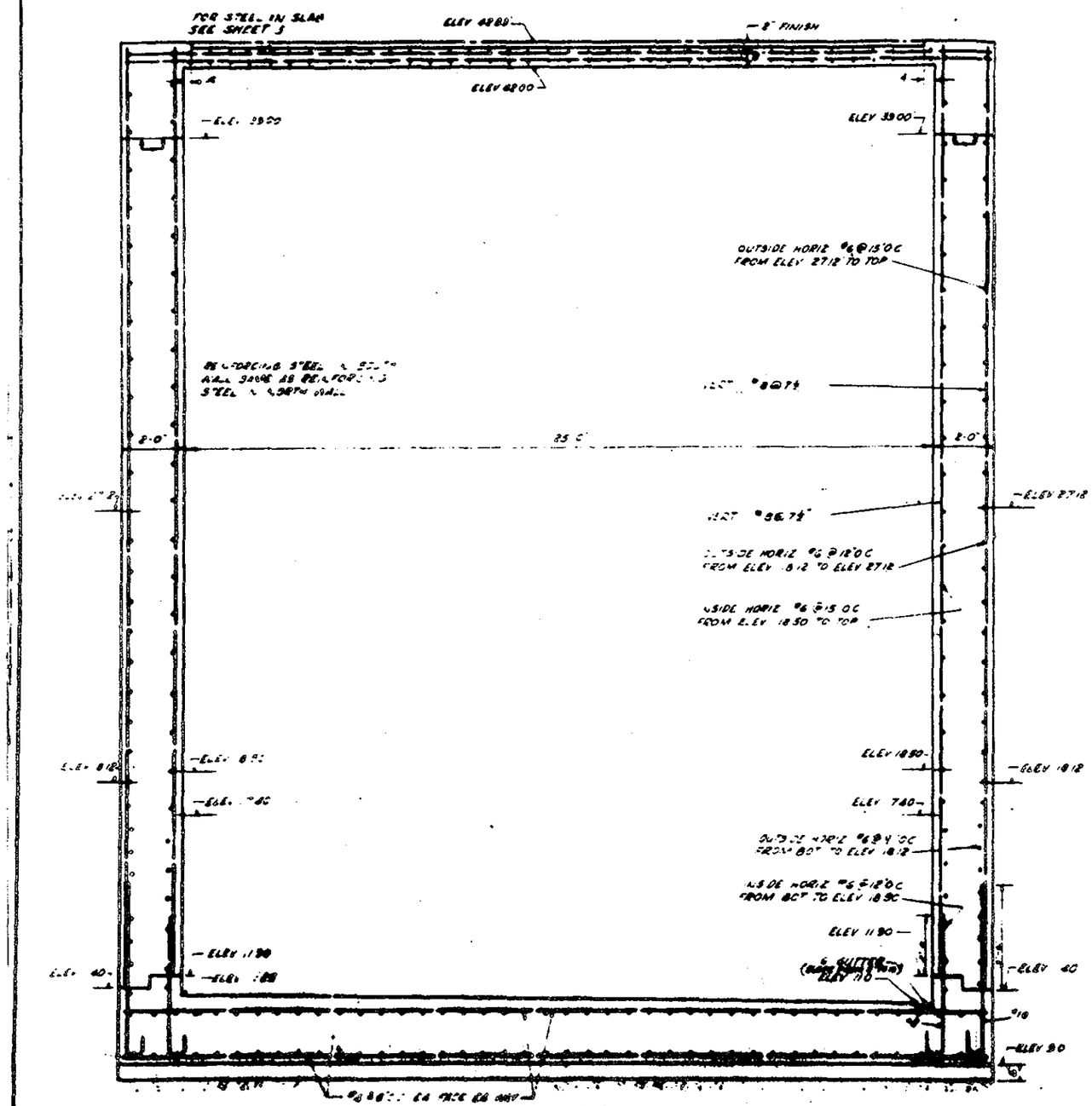
ARMORY PUMPING STATION

SECTIONS OF PUMP ROOM AND GRAVITY CONDUIT SHOWING REINFORCING STEEL DETAILS

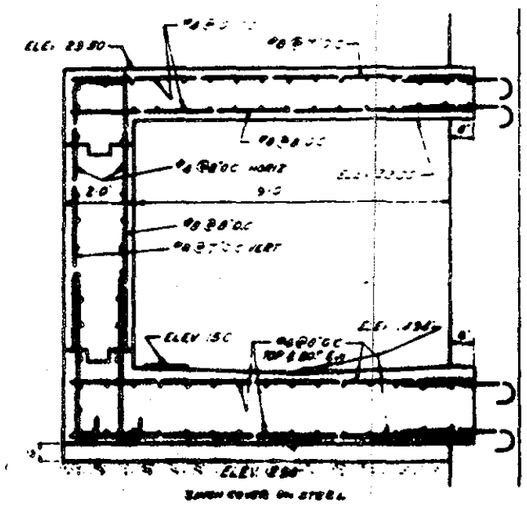
DESIGNED BY REC CCK
TRACED BY AJM
CHECKED BY REC
SCALE 1" = 2'
DATE JUNE 1962

RECOMMENDED BY ENGINEER
PE CONN NO 5968
APPROVED BY DIRECTOR
PE CONN NO 293

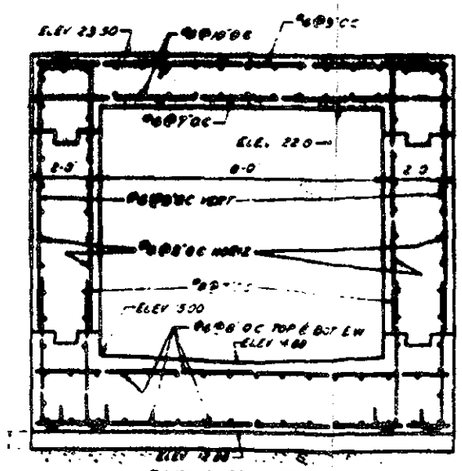
DRAWING NUMBER 8
SHEET 8 OF 9



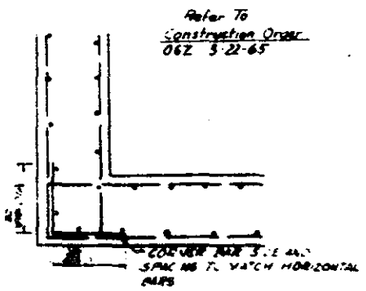
SECTION A-A



SECTION C-C



SECTION D-D



TYPICAL CORNER STEEL

NOTE: LAP VERTICAL BARS 50 DIAMETERS
LAP HORIZONTAL BARS 50 DIAMETERS

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84 3(041) SHEET NO 34 OF 44

PLG DWG	STATE	TOWN	PROJ NO	YEAR	DRAWING NO	SHEET NO	TOTAL SHEETS
	CONN	HARTFORD	63 176	1963	1.84	14	189

ANDERSON NICHOLS ASSOCIATES
PARTNER
DATE

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

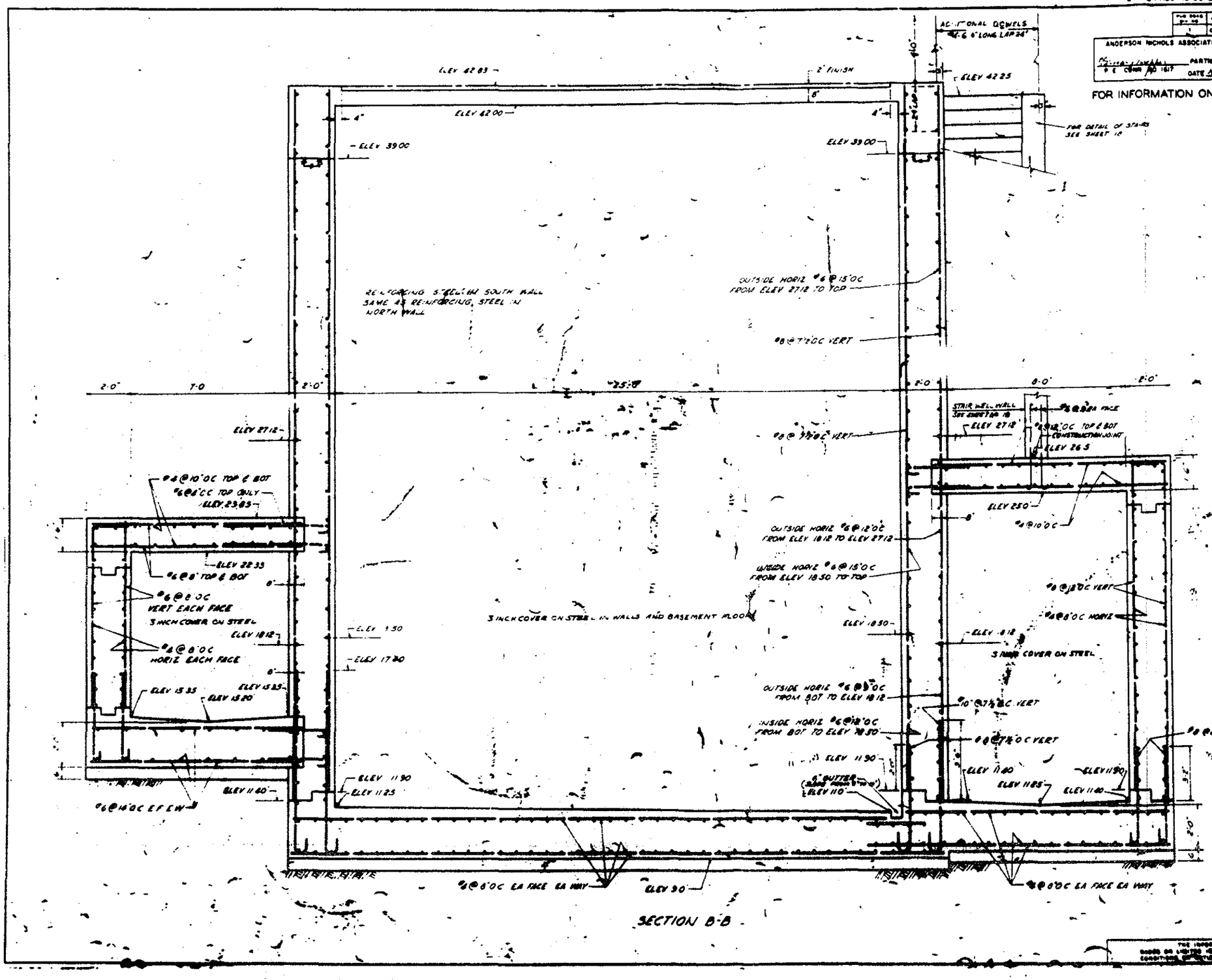
DESIGNED BY R.E.C. E.C.K.
TRACED BY A.J.M.
CHECKED BY R.E.C.
SCALE 1"=2'
DATE JUNE 1962

ARMORY PUMPING STATION

SECTIONS OF PUMP ROOM, SUCTION CONDUIT AND DISCHARGE CONDUIT SHOWING REINFORCING STEEL DETAILS

RECOMMENDED BY
PE CONN NO 506 CHIEF ENGINEER
APPROVED BY
PE CONN NO 290 DIRECTOR

DRAWING NUMBER 9
SHEET 9 OF 10



SECTION B-B

NOTE: LAP VERTICAL BARS 24 DIAMETERS
LAP HORIZONTAL BARS 30 DIAMETERS

THE INFORMATION INCLUDED, INCLUDING QUANTITIES OF WORK SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS OF THE SITE SHOWN AND MAY BE INADEQUATE TO INDICATE THE TRUE CONDITIONS. ACTUAL QUANTITIES OF EXCAVATION OR QUANTITIES OF WORK MAY VARY OR BE REQUIRED

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO

ANDERSON NICHOLS ASSOCIATES
PARTNER
DATE

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

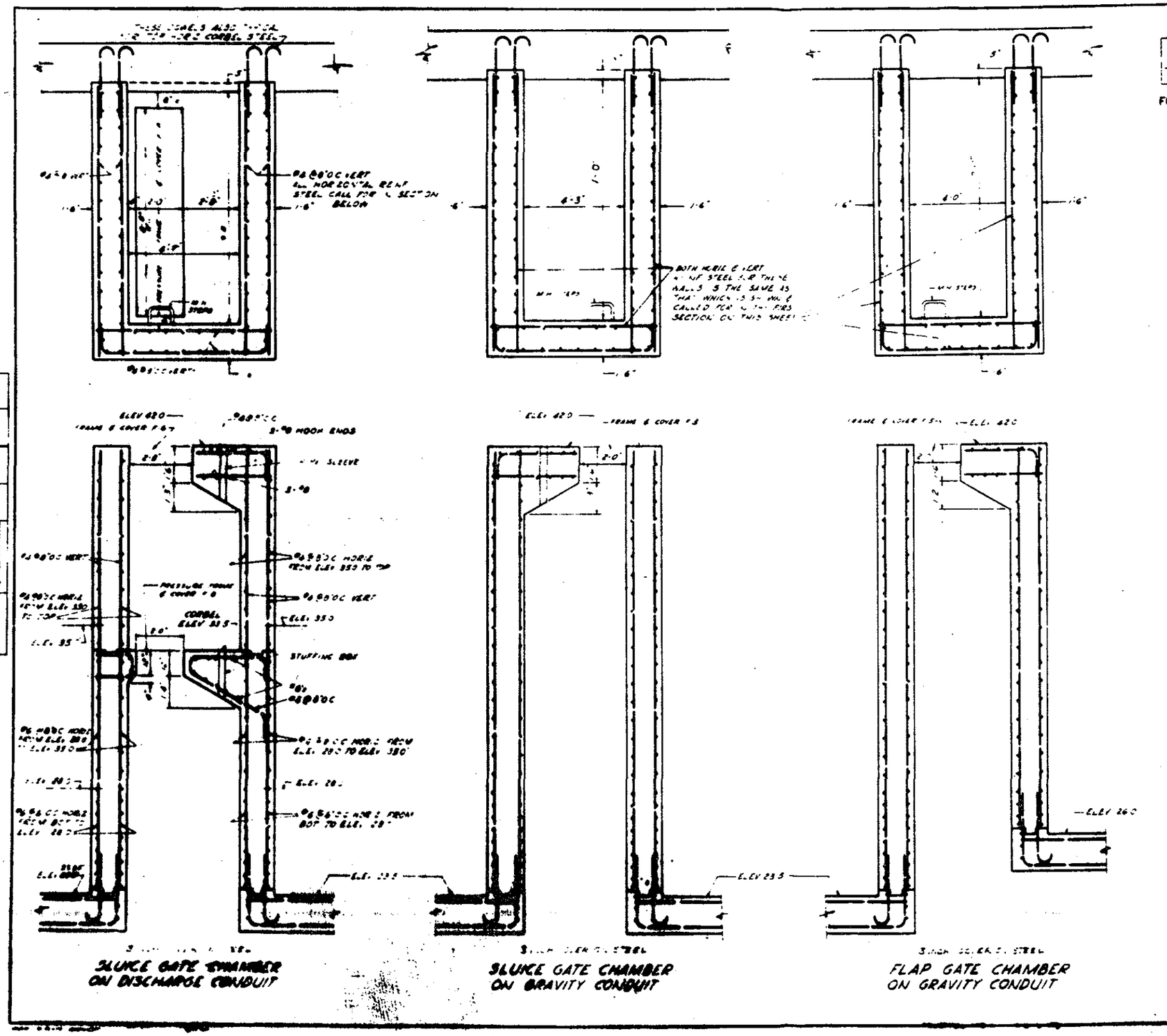
ARMORY PUMPING STATION

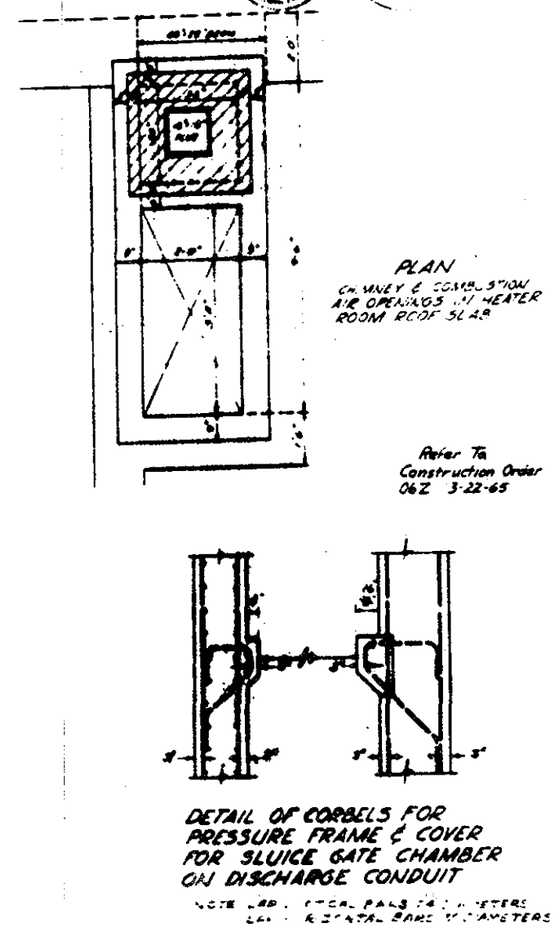
MISCELLANEOUS REINFORCING STEEL DETAILS

DESIGNED BY R.E.C. C.E.R.
TRACED BY
CHECKED BY R.E.C.
SCALE 1"=5'
DATE JUNE 1966

RECOMMENDED BY ENGINEER
APPROVED BY DIRECTOR

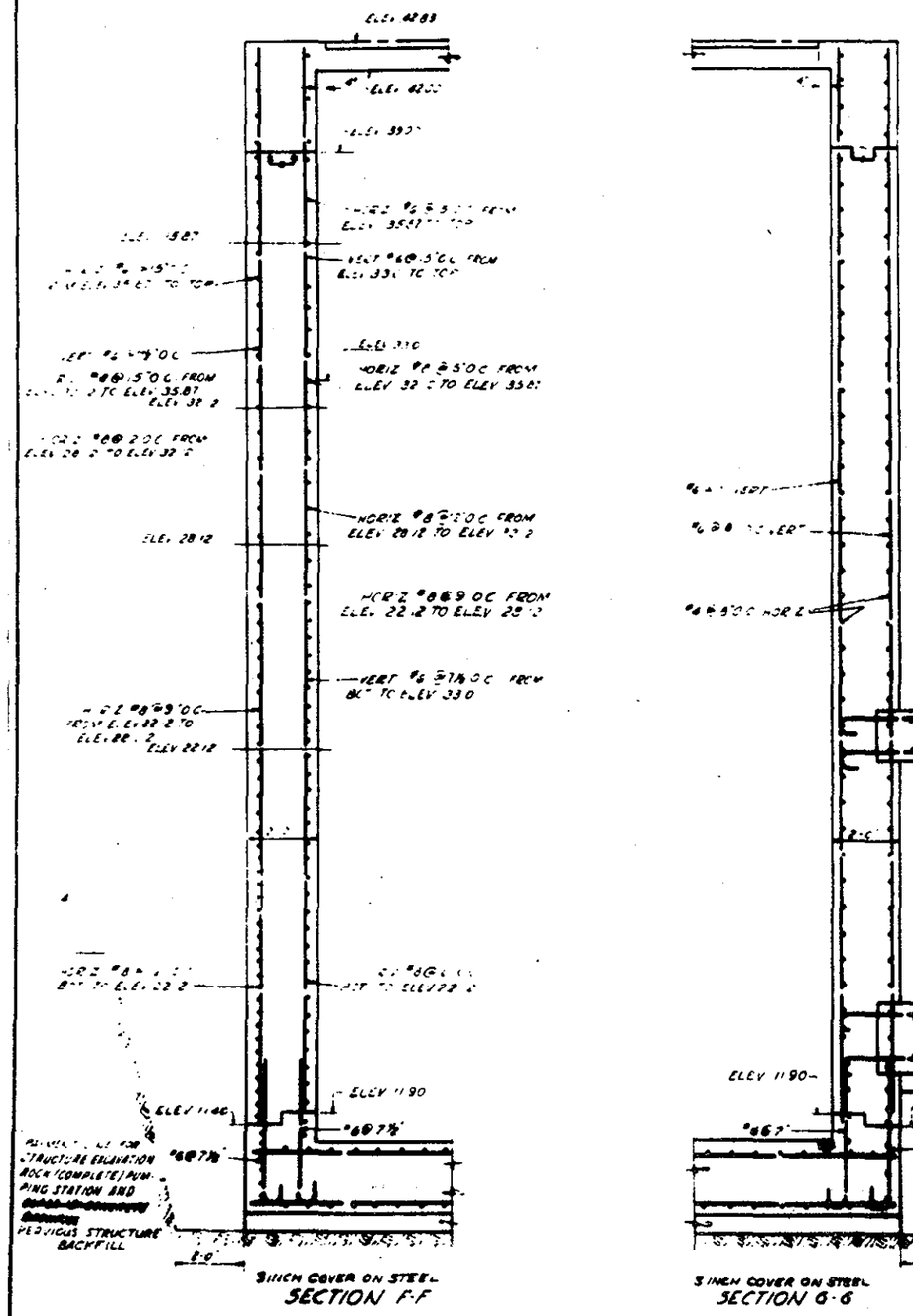
DRAWING NUMBER 10
SHEET 10 OF 13

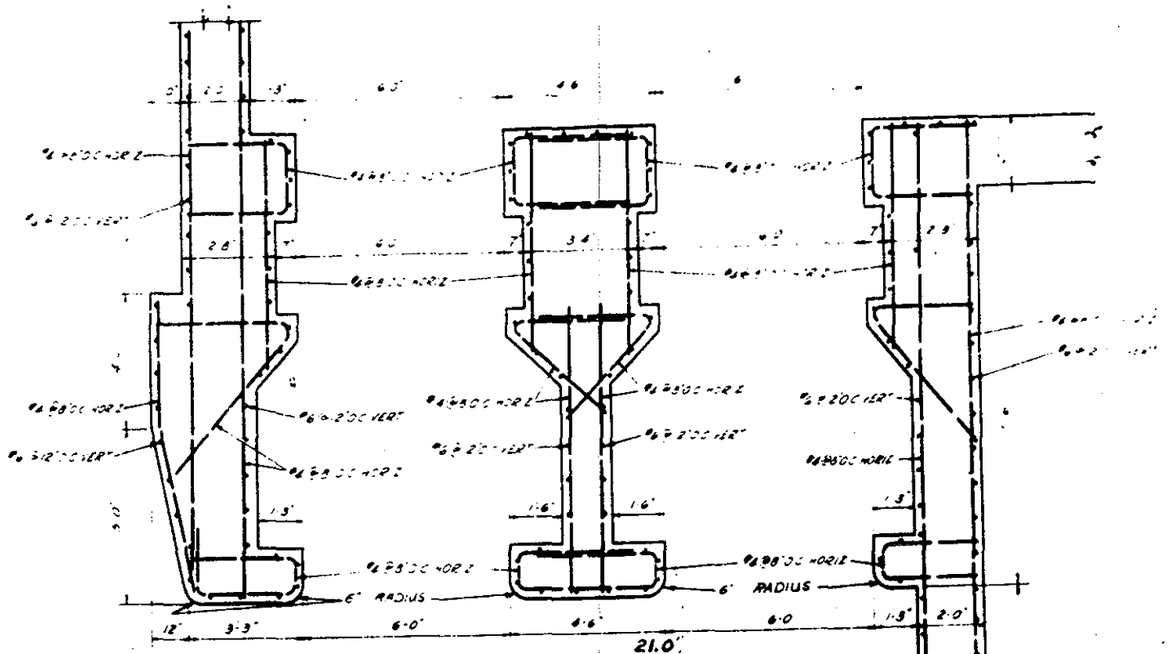


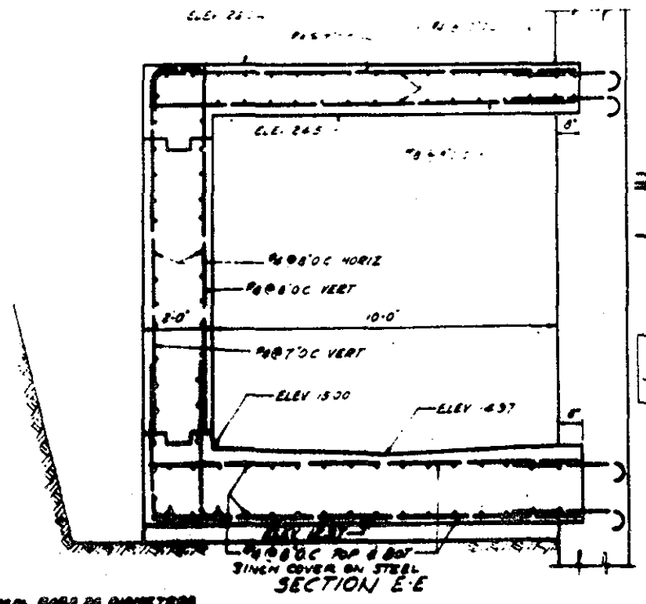


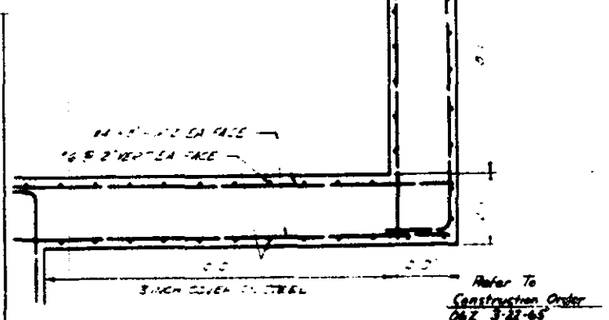
THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

FOR INFORMATION ONLY









Refer To Construction Order 062 3-27-65

NOTE LAP VERTICAL BARS 30 DIAMETERS
LAP HORIZONTAL BARS 30 DIAMETERS

ANDERSON NICHOLS ASSOCIATES
PARTNER
P.E. CONN. NO. 7617 DATE

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

DESIGNED BY R.E.C. C.C.K.
TRACED BY A.J.M.
CHECKED BY R.E.C.
SCALE 1"=5'
DATE JUNE 1962

ARMORY PUMPING STATION

MISCELLANEOUS REINFORCING STEEL DETAILS

RECOMMENDED BY
DIRECTOR
DRAWING NUMBER 11
SHEET OF

THE INFORMATION INCLUDING ESTIMATED QUANTITIES OF WORK SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY GUARANTEED TO INDICATE THE TRUE CONDITIONS OR ACTUAL QUANTITIES OR DISTRIBUTION OF QUANTITIES OF WORK WHICH SHALL BE REQUIRED.

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ. NO 63-228 FED AID PROJ. NO. I-84-3(941) SHEET 37 OF 44

ANDERSON NICHOLS ASSOCIATES
PARTNER
P.E. CONN. NO. 817 DATE

FOR INFORMATION ONLY

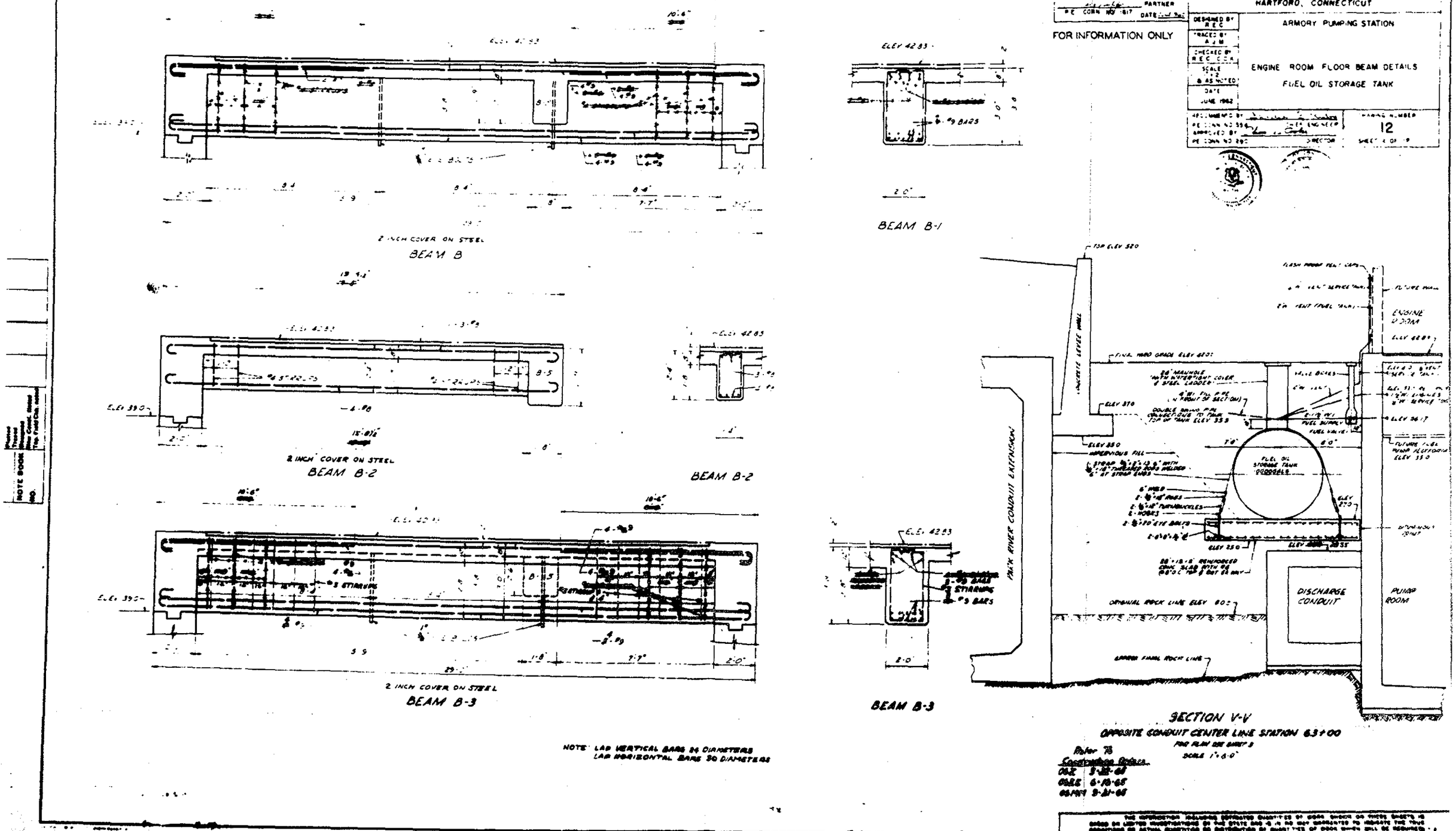
GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

DESIGNED BY R.E.C.
TRACED BY A.J.M.
CHECKED BY R.E.C.
SCALE 1"=2' & AS NOTED
DATE JUNE 1962

ARMORY PUMPING STATION

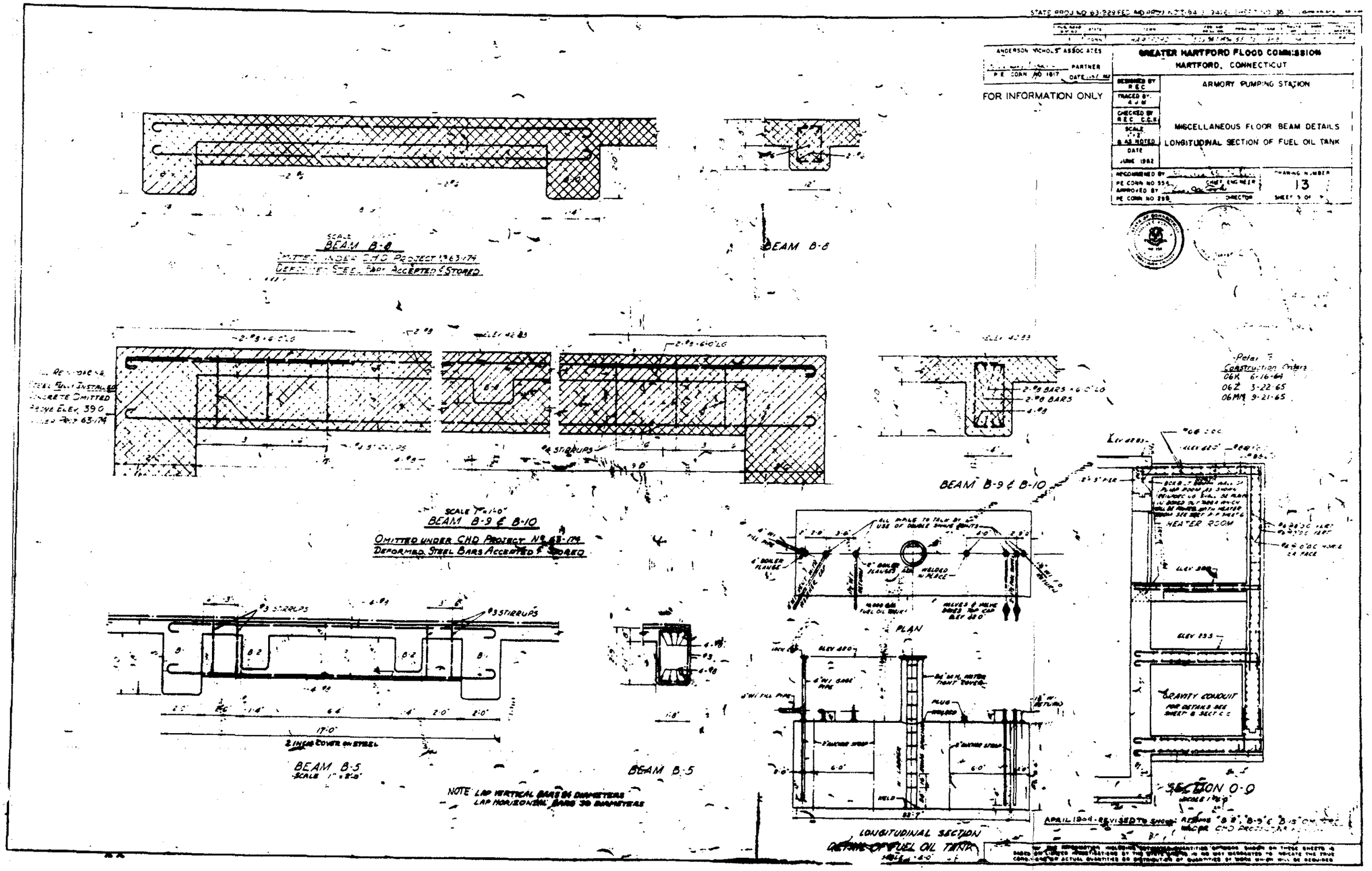
ENGINE ROOM FLOOR BEAM DETAILS
FUEL OIL STORAGE TANK

DRAWING NUMBER 12
SHEET 2 OF 9



Rev. 78
Construction Office
OK.E 3-22-66
OK.E 6-10-65
OK.INT 3-21-66

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY



THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ I-84-3(94)61 SHEET NO 39 OF 44

APRIL 1964 REVISION AND CO 63-179 06K (6-16-64) FLOOR SLAB (ELEV 42.83) AND WALL TO BE OMITTED ABOVE ELEV. 39.0. WALL STEEL TO BE FULLY INSTALLED. SLAB STEEL TO BE ACCEPTED AND STORED

ELEV 39.0

6"x6" OPENINGS FOR SOIL LINE (SEE SHEET 14 FOR PLAN) (BY OTHERS)

ELEV. 34.0

ELEV. 34.55

#4 @ 9" O.C. FROM ELEV 34.55 TO TOP

#4 @ 9" O.C. EA FACE VERT

#4 @ 9" O.C. FROM ELEV 27.55 TO ELEV 34.55

ELEV 27.55

SLUICE GATE

#4 @ 9" O.C. FROM BOT TO ELEV 27.55

#4 @ 9" O.C. EA FACE

ELEV 25.0

3 INCH COVER ON STEEL IN WALLS AND BOTTOM SLABS

#4 @ 9" O.C. EA FACE

RECESS FOR GATE FRAME

ELEV 19.0

SECTION N-N

#4 @ 9" O.C. 29'-2" BEAM

3" BEAM

ELEV 34.55

INSTAL TEMP 6" ACCESS

ELEV 34.0

6"x6" OPENING FOR FUTURE SOIL LINE (BY OTHERS)

3 INCH COVER ON STEEL IN WALLS AND BOTTOM SLABS

#4 @ 9" O.C. EA FACE VERT

#4 @ 9" O.C. FROM ELEV 27.55 TO ELEV 34.55

ELEV 27.55

#4 @ 9" O.C. FROM BOT TO ELEV 27.55

#4 DIAGONAL BARS EA FACE (TYPICAL FOR ALL WALL OPENINGS)

OPENING TO ACCOMMODATE 4'-0" DIA CI FLANGED PIPE

8" CONC SLAB

ELEV 20.30

4'-0" x 8'-0" GATE OPENING

#4 @ 9" O.C. EA FACE

RECESS FOR GATE FRAME

RECESS FOR GATE FRAME

#4 @ 9" O.C. EA FACE

48" RCP

36" RCP

SECTION M-M

ANDERSON NICHOLS & ASSOCIATES
PARTNER
P.E. CONN NO 1617 DATE

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

ARMORY PUMPING STATION

MISCELLANEOUS REINFORCING STEEL DETAILS OF JUNCTION CHAMBER, MANHOLE STEPS

DESIGNED BY R.E.C.
TRACED BY
CHECKED BY R.E.C.
SCALE 1/2" = 1'-0" AS NOTED
DATE JUNE 1962

RECOMMENDED BY
P.E. CONN NO 554 CHIEF ENGINEER
APPROVED BY
P.E. CONN NO 29 DIRECTOR

DRAWING NUMBER 14
SHEET 4 OF 9

FOR INFORMATION ONLY

DETAIL OF MANHOLE STEPS
BROUGHT FOR GALVANIZED
SCALE 3" = 1'-0"

NOTE LAP VERTICAL BARS 24 DIAMETERS
LAP HORIZONTAL BARS 30 DIAMETERS

Refer to Construction Orders
06Z 3-22-64
06LL 9-15-65
06K 6-16-64

4-20-64
152A

December 1966

THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84-3(94)6 SHEET NO 40 OF 44

PUB ROAD SYS NO	STATE	TOWN	FED AID PROJ NO	PROJ NO	YEAR	SHEETS NO	SHEET NO	TOTAL SHEETS
1	CONN	HARTFORD	I-84-3(94)6	63-174	1963	104	95	98

ANDERSON NICHOLS & ASSOCIATES
P.E. CONN NO. 6617 DATE

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

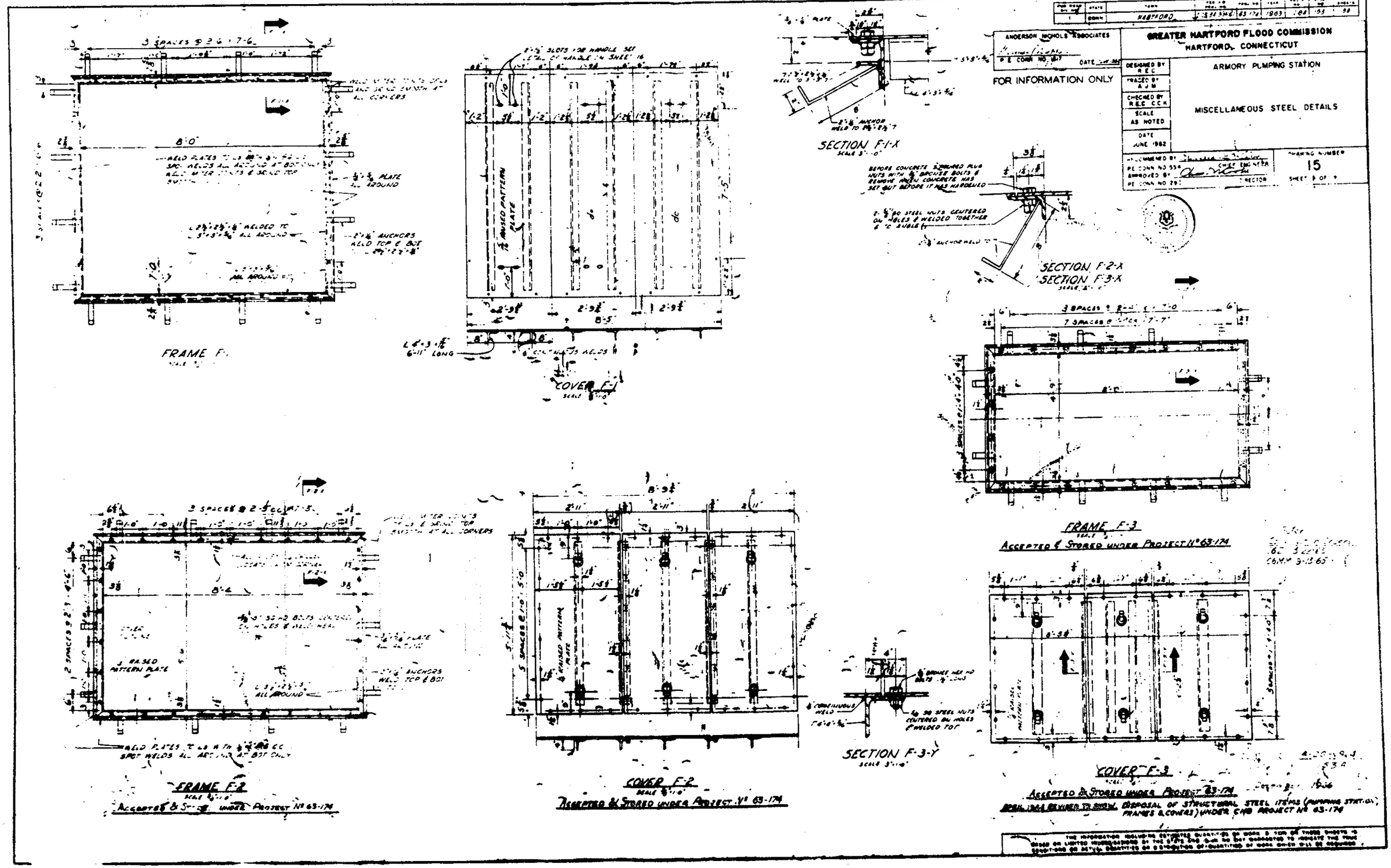
ARMORY PUMPING STATION

MISCELLANEOUS STEEL DETAILS

DESIGNED BY R.E.C.
TRACED BY A.J.M.
CHECKED BY R.E.C. C.C.K.
SCALE AS NOTED
DATE JUNE 1962

RECOMMENDED BY CHIEF ENGINEER
PE CONN NO 5594
APPROVED BY DIRECTOR
PE CONN NO 292

DRAWING NUMBER 15
SHEET 8 OF 9



THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84-3(84)61 SHEET NO 41 OF 44

FED. ROAD DIV. NO.	STATE	TOWN	FED. AID PROJ. NO.	PROJ. NO.	YEAR	SHEETS NO.	SHEET NO.	TOTAL SHEETS
1	CONN.	HARTFORD	I-84-3(84)61	63-174	1963	184	154	188

ANDERSON NICHOLS ASSOCIATES
PARTNER
P.E. CONN. NO. 1817
DATE

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

ARMORY PUMPING STATION

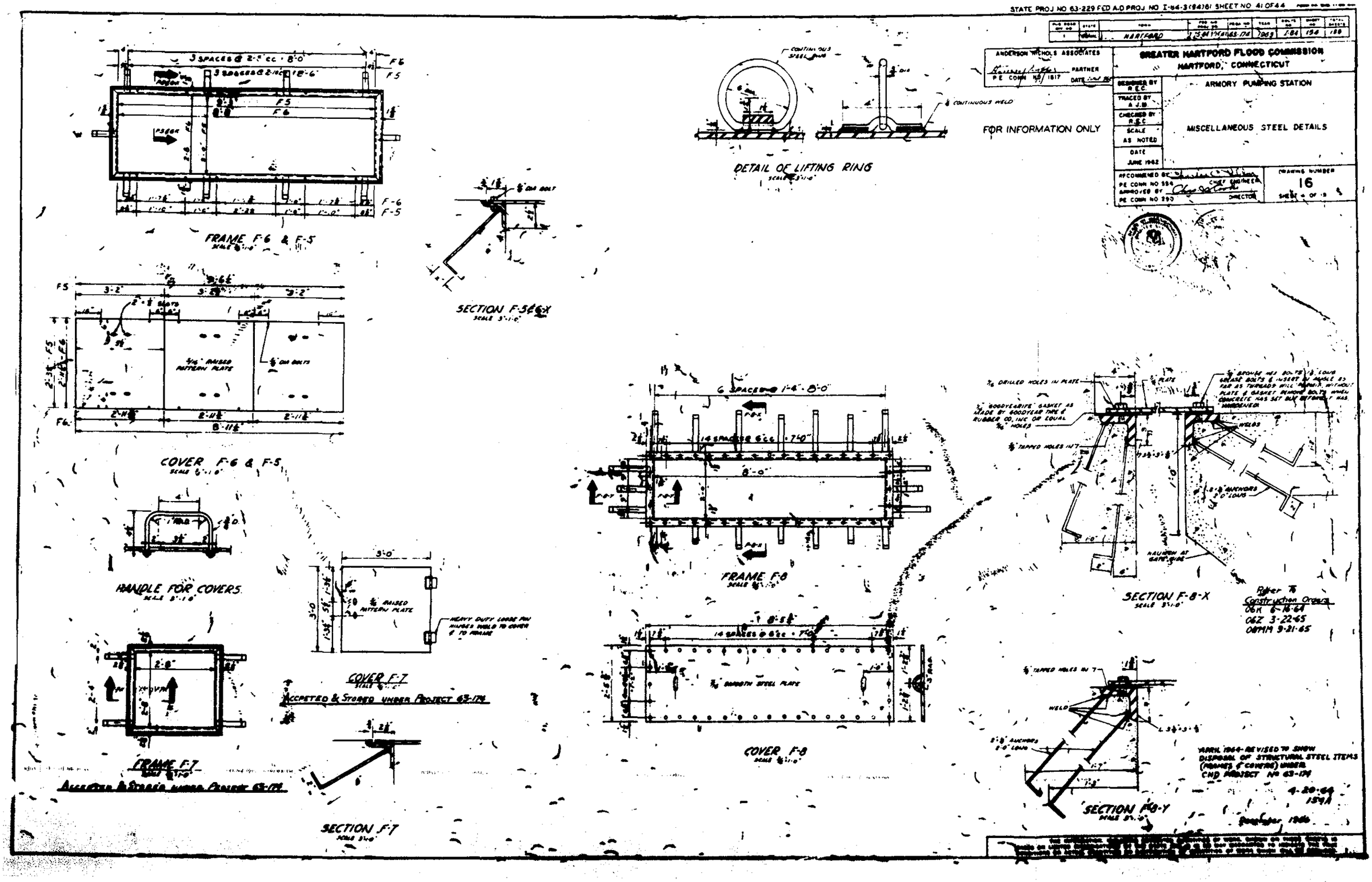
MISCELLANEOUS STEEL DETAILS

DESIGNED BY R.E.C.
TRACED BY A.J.B.
CHECKED BY R.E.C.
SCALE AS NOTED
DATE JUNE 1962

RECOMMENDED BY P.E. CONN. NO. 594 CHIEF ENGINEER
APPROVED BY P.E. CONN. NO. 293 DIRECTOR

DRAWING NUMBER 16
SHEET 4 OF 13

FOR INFORMATION ONLY



THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 93-229 FED AID PROJ NO T-64-3(94)61 SHEET NO 42 OF 44

FILE CODE & S.P. NO	STATE	TOWN	PROJ NO	YEAR	SHEET NO	TOTAL SHEETS
1	CONN.	HARTFORD	[illegible]	1963	153	156

ANDERSON NICHOLS ASSOCIATES
PARTNER
P.E. CONN NO 9817 DATE [illegible]

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

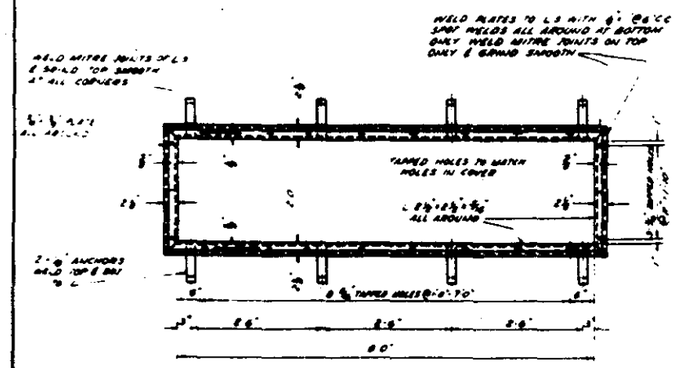
ARMORY PUMPING STATION

MISCELLANEOUS STEEL DETAILS AND FLAP GATE

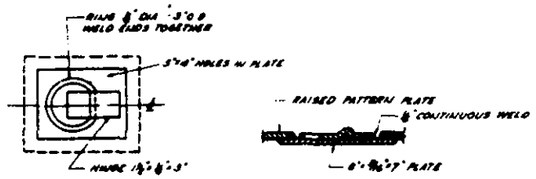
DESIGNED BY R.E.C.
TRACED BY A.J.M.
CHECKED BY R.E.C.
SCALE AS NOTED
DATE JUNE 1962

RECOMMENDED BY [illegible] CHIEF ENGINEER
P.E. CONN NO 554
APPROVED BY [illegible] DIRECTOR
P.E. CONN NO 890

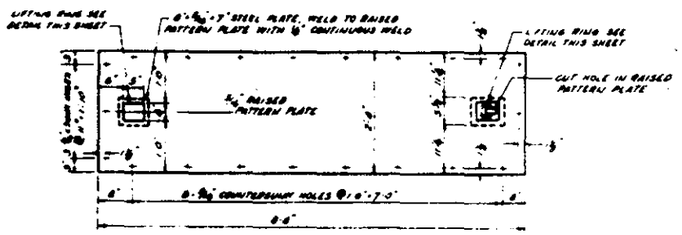
DRAWING NUMBER 17
SHEET 17 OF 19



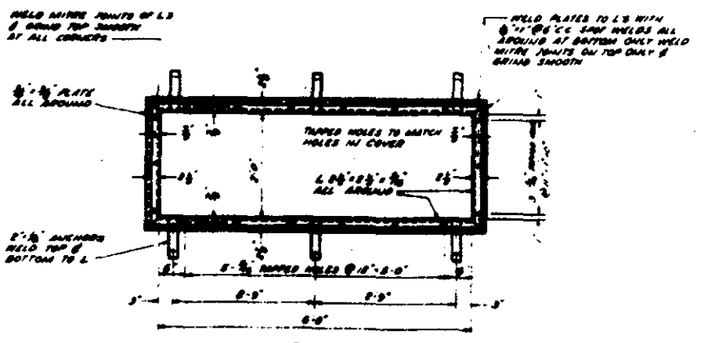
FRAME F-9
SCALE 3/4"=1'-0"



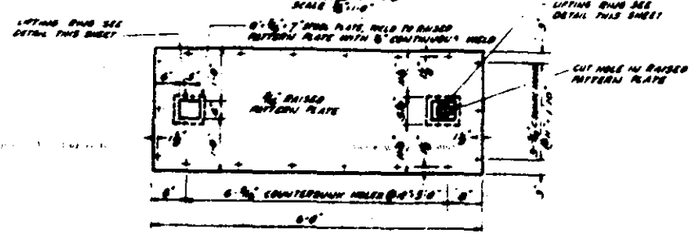
DETAIL OF LIFTING RING
SCALE 3"=1'-0"



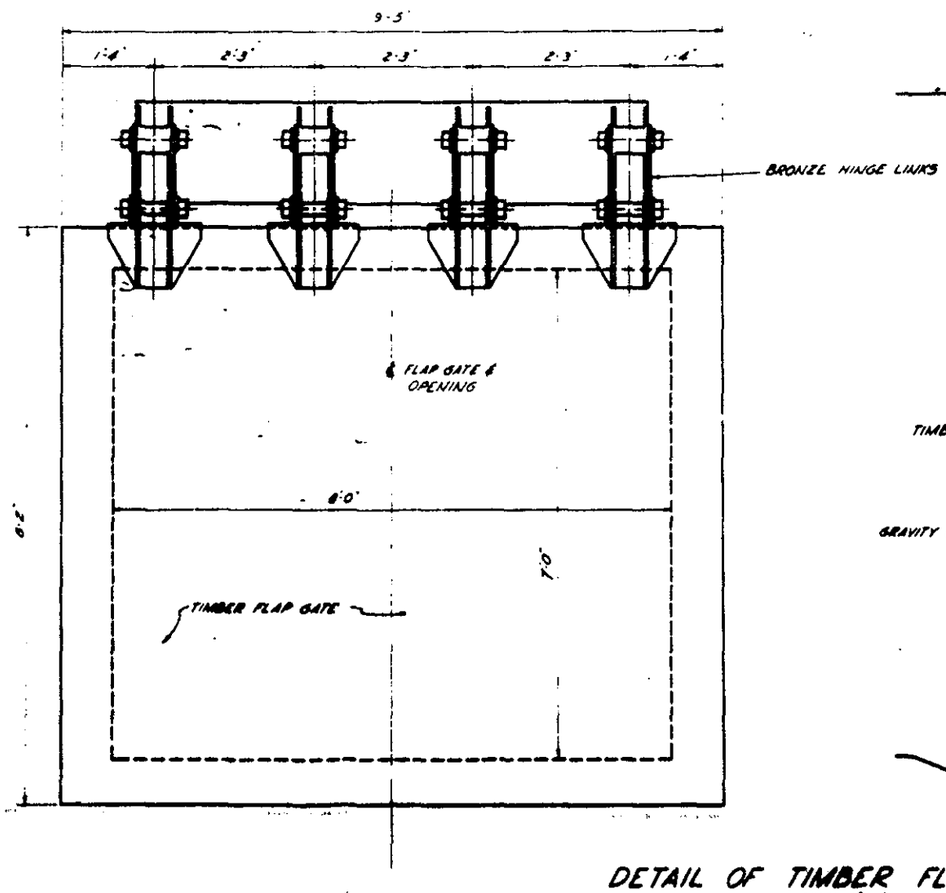
COVER F-9
SCALE 3/4"=1'-0"

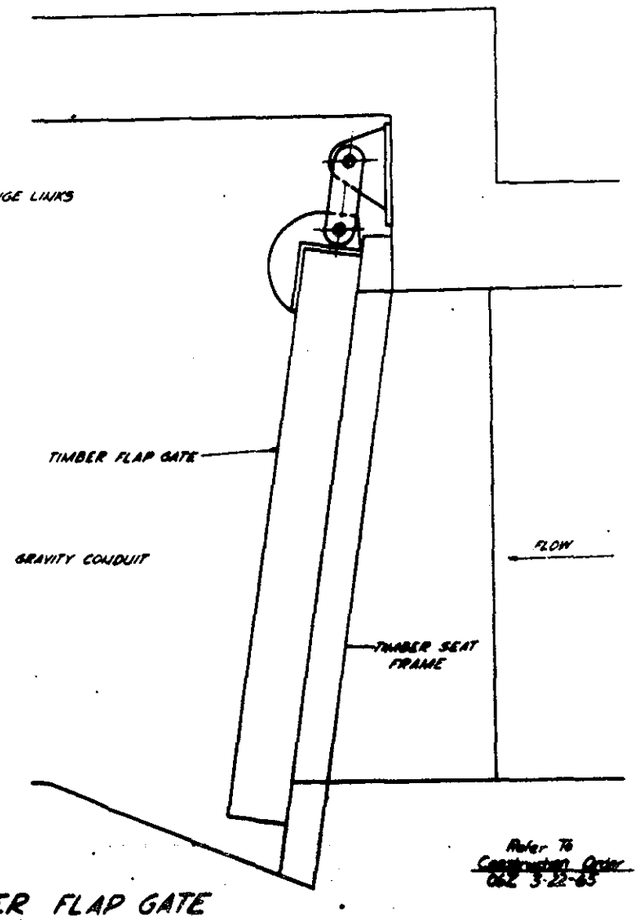


FRAME F-10
SCALE 3/4"=1'-0"



COVER F-10
SCALE 3/4"=1'-0"





DETAIL OF TIMBER FLAP GATE
SCALE 1"=1'

Refer To Construction Order
OKZ 5-22-63

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STATE PROJ NO 63-229 FED AID PROJ NO I-84-3(94)6 SHEET NO 43 OF 66

	STATE							
1	CONN	HARTFORD	63	229	205	92	56	18

ANDERSON NICHOLS ASSOCIATE
PARTNER
P E CONN 1817 DATE JUNE 1962

FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

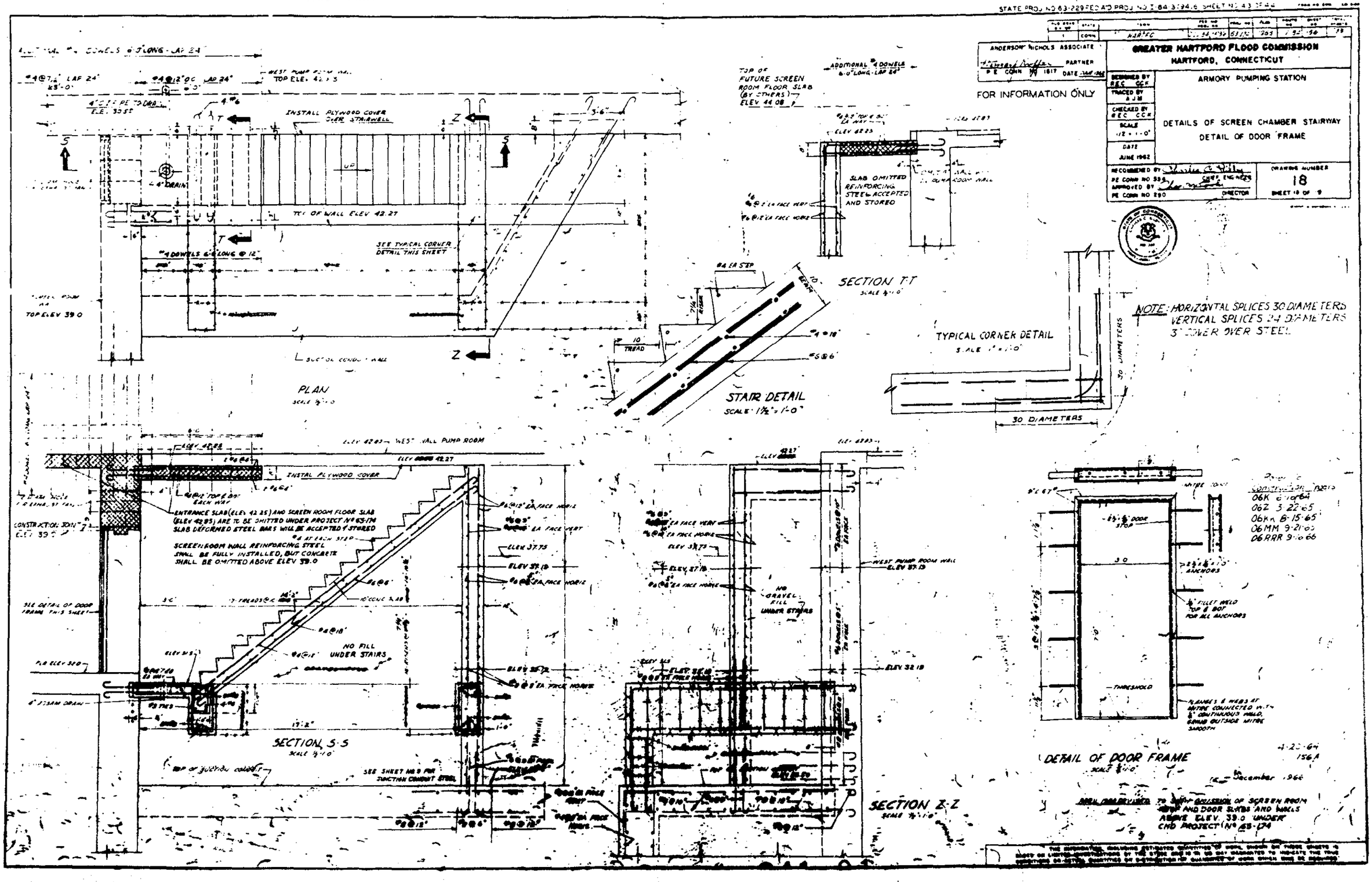
DESIGNED BY REC CCK
TRACED BY AJM
CHECKED BY REC CCK
SCALE 1/2" = 1'-0"
DATE JUNE 1962

ARMORY PUMPING STATION

DETAILS OF SCREEN CHAMBER STAIRWAY
DETAIL OF DOOR FRAME

RECOMMENDED BY
PE CONN NO 3354 CHIEF ENGINEER
APPROVED BY
PE CONN NO 290 DIRECTOR

DRAWING NUMBER 18
SHEET 18 OF 9



THIS PRINT HAS BEEN REDUCED IN SIZE – SCALES SHOWN APPLY TO ORIGINAL SIZE PRINT ONLY

STATE PROJ NO 63-229 FED AID PROJ NO I-84 & 94-6 SHEET NO 44 OF 44

ANDERSON NICHOLS ASSOCIATES

PE CONN NO 7617 – PARTNER

DATE

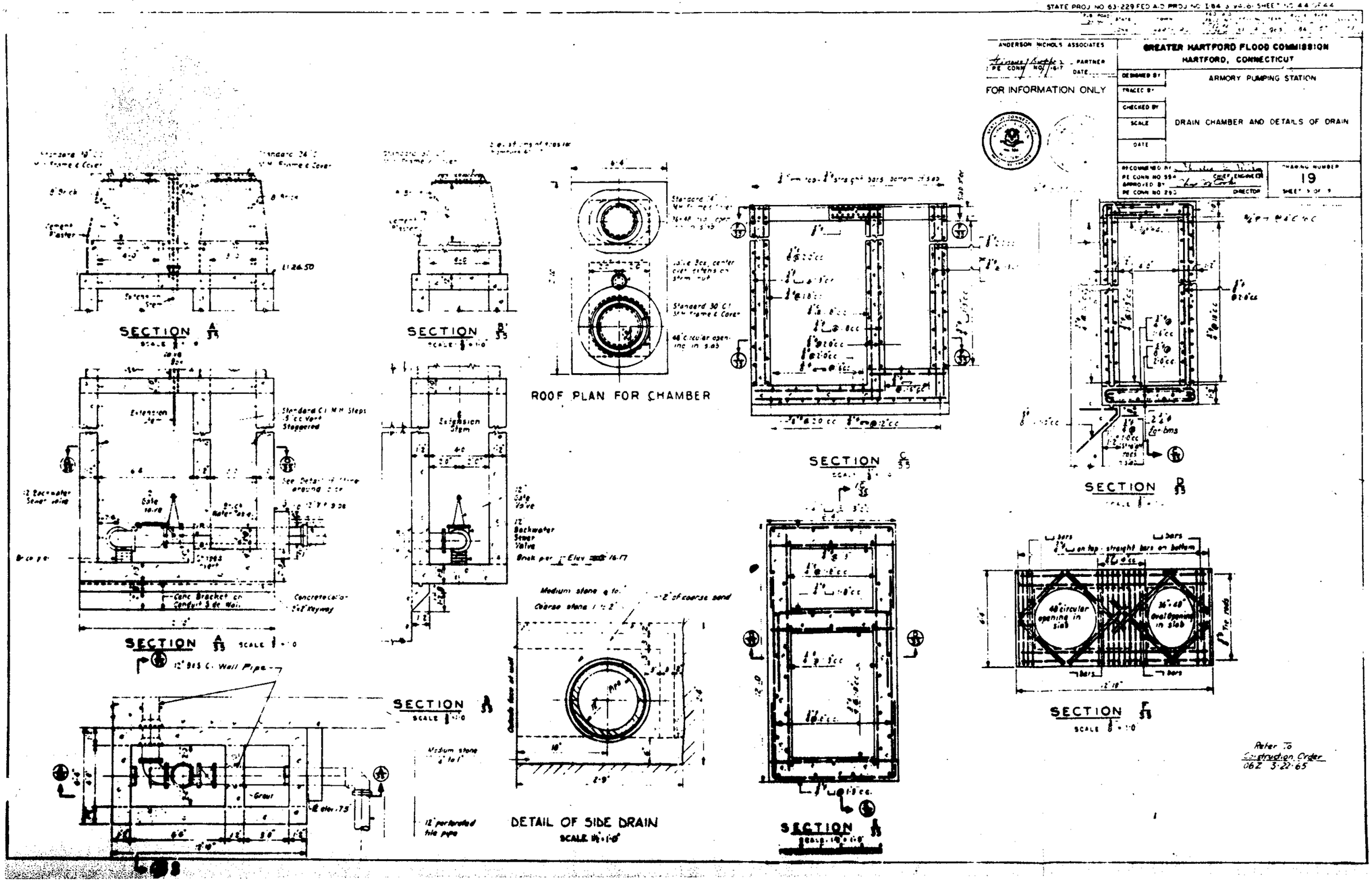
FOR INFORMATION ONLY

GREATER HARTFORD FLOOD COMMISSION
HARTFORD, CONNECTICUT

DESIGNED BY	ARMORY PUMPING STATION
TRACED BY	
CHECKED BY	DRAIN CHAMBER AND DETAILS OF DRAIN
SCALE	
DATE	

RECOMMENDED BY PE CONN NO 594 CHIEF ENGINEER
APPROVED BY PE CONN NO 293 DIRECTOR

DRAWING NUMBER 19
SHEET 9 OF 9



APPENDIX D

COST ESTIMATE

PARK RIVER-LOCAL PROTECTION

PUMPING STATIONS

APPENDIX D

COST ESTIMATE

COMPARISON WITH PREVIOUS ESTIMATE

The current estimated cost of the pumping stations exclusive of engineering, design, supervision and administration is $1,127,000 (Armory Station -$500,000, Pope Park Station -$627,000). This compares with a lump sum cost for pumping stations of $667,000 (Armory Station - $335,000, Pope Park Station $312,000) carried in the project cost estimate contained in Design Memorandum No. 2, Phase II - "Project Design, Site Geology and Interior Drainage Part 1 - Box Conduit". That estimate was based on July 1974 price levels. The current estimate is based on preliminary drawings and actual quantities and on November 1974 price levels.

DETAILED CURRENT COST ESTIMATE

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
ARMORY PUMPING STATION				
Sub-Structure				Existing
Superstructure	1	Job	L.S.	$ 74,800
Site Work	1	Job	L.S.	29,200
Mechanical Work	1	Job	L.S.	366,000
Electrical Work				
Interior	1	Job	L.S.	22,700
Service	1	Job	L.S.	7,300
		TOTAL		$500,000
POPE PARK PUMPING STATION				
Sub-Structure				
Earthwork				
Excavation	3,200	C.Y.	4.00	$ 12,800
Backfill	2,600	C.Y.	3.00	7,800

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
Concrete	850	C.Y.	40.00	34,000
Forms - vertical	14,500	S.F.	1.80	26,100
Forms - supported	1,400	S.F.	2.50	3,500
Reinf. steel	88	Ton	800.00	70,400
		SUB-TOTAL		$154,000
Superstructure	1	Job	L.S.	46,000
Site Work	1	Job	L.S.	20,400
Mechanical Work	1	Job	L.S.	382,000
Electrical Work				
Interior	1	Job	L.S.	17,500
Service	1	Job	L.S.	6,500
		TOTAL		$627,000