HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

LOCAL PROTECTION

NAUGATUCK RIVER, CONNECTICUT

DESIGN MEMORANDUM NO.8

PUMPING STATION

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

JULY 1966

ENGCW-EZ (27 Jul 66) 1st Ind
SUBJECT: Ansonia-Derby Local Protection Project, Naugatuck River, Connecticut - Design Memorandum No. 8 - Pumping Stations

DA, CofEngrs, Washington, D. C., 20315, 13 September 1966

TO: Division Engineer, New England Division

1. Reference is made to 1st indorsement ENGCW-EZ, 10 May 1963 to letter NEDGW, 10 April 1963 subject "Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations."

2. Design Memorandum No. 8 is approved subject to the following comments:

a. Paragraph 26. As previously pointed out in paragraph 2e(2) of the indorsement referenced in paragraph 1 above, a diesel engine is not a satisfactory pump drive for those pumping stations that have limited sump capacity (such as in the instant case) and the pumps will be required to cycle "ON" and "OFF" every 5 to 26 minutes when the flows are less than the design flow. To alleviate this undesirable operating condition, bypasses should be provided as described in subparagraph 6d of EM 1110-2-3102. All bypass valves should be arranged for manual operation since a reliable source of electric power is not available.

b. Paragraph 26a. Information in Design Memorandum No. 1 (Table 1-8) indicates that the design discharge for River Street Pumping Station should be 20 cfs in lieu of 10 cfs inplied in this paragraph. The apparent discrepancy should be reviewed and the proposed pumping station capacity revised or supported.

FOR THE CHIEF OF ENGINEERS:

Thomas B. Wilkie

wd Incl

WENDELL E. JOHNSON
for Chief, Engineering Division
Civil Works

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

IN REPLY REFER TO:
NEDED-D

27 July 1966

SUBJECT: Ansonia-Derby Local Protection Project, Naugatuck River, Connecticut - Design Memorandum No. 8 - Pumping Stations

TO: Chief of Engineers
ATTN: ENGCW-E

There is submitted herewith, for review and approval, Design Memorandum No. 8 - Pumping Stations, for the Ansonia-Derby Local Protection Project, Naugatuck River Basin, in accordance with EM 1110-2-1150.

FOR THE DIVISION ENGINEER:

John Wm. Leslie

JOHN Wm. LESLIE
Chief, Engineering Division

Incl (10 cys)
Des Memo No. 8

FLOOD CONTROL PROJECT

ANSONIA-DERBY LOCAL PROTECTION PROJECT
NAUGATUCK RIVER
HOUSATONIC RIVER BASIN
CONNECTICUT

DESIGN MEMORANDA INDEX

No.	Title	Date Submitted	Date Approved
1	Hydrology and Interior Drainage	30 Apr 65	16 Jun 65
2	Omitted		
3	General Design and Site Geology	14 Jan 66	1 Apr 66
4	Concrete Materials	16 Feb 66	29 Mar 66
5	Omitted		
6	Embankments, Foundations and Channel Improvements	28 Feb 66	11 Apr 66
7	Detailed Design of Structures	29 Apr 66	9 Jun 66
8	Pumping Stations	27 Jul 66	
9	Hydraulic Analysis		

FLOOD CONTROL PROJECT

ANSONIA-DERBY LOCAL PROTECTION PROJECT
NAUGATUCK RIVER
HOUSATONIC RIVER BASIN
CONNECTICUT

DESIGN MEMORANDUM NO. 8

PUMPING STATIONS

CONTENTS

Paragraph	Subject	Page No.
	A. PERTINENT DATA	
1	Purpose	1
2	Project Location	1
3	Drainage Areas	1
4	River Street Pumping Station	1
5	Maple Street Pumping Station	1
6	Front Street Pumping Station	2
7	Division Street Pumping Station	2
	B. INTRODUCTION	
8	Purpose	2
9	Scope	2
	C. HYDROLOGY AND INTERIOR DRAINAGE	
10	General	2
11	Interior Drainage	2
	D. MODEL STUDY	
12	Model Study	3
	E. HYDRAULIC ANALYSIS	
13	Hydraulic Analysis	3
	F. GEOLOGY	
14	Geology	3

Paragraph	Subject	Page No.
	G. FOUNDATIONS	
15	Foundations	3
	H. CONCRETE MATERIALS	
16	Concrete Materials	3
	I. ARCHITECTURAL DESIGN	
17	Architectural Design	4
	J. STRUCTURAL DESIGN	
18	Purpose	4
19	Design Criteria	4
	a. General	4
	b. Concrete	4
	c. Reinforcement	4
	d. Structural Steel	5
	e. Increase in Normal Working Stresses	5
	f. Waterstops	5
20	Basic Data and Assumptions	6
	a. Loads	6
	b. External Water Pressure	6
	c. Earth Pressure	6
	d. Earthquake Forces	6
	e. Frost Protection	6
	f. Location of Resultant	6
	g. Sliding	7
21	River Street Pumping Station	7
	a. General	7
	b. Stability	7
	c. Roof Slab	7
	d. Superstructure - Framework	7
	e. Operating Floor	7
	f. Substructure	7
22	Maple Street Pumping Station	7
	a. General	7
	b. Stability	7

Paragraph	Subject	Page No.
	c. Roof Slab and Superstructure	8
	d. Operating Floor	8
	e. Substructure	8
23	Division Street Pumping Station	8
	a. General	8
	b. Roof Slab and Superstructure	9
	c. Operating Floor	9
	d. Stability	9
	e. Substructure	9
24	Front Street Pumping Station	9
	K. MECHANICAL DESIGN	
25	General	9
26	Pumping Equipment	9
	a. River Street Pumping Station	10
	b. Maple Street Pumping Station	10
	c. Front Street Pumping Station	10
	d. Division Street Pumping Station	10
27	Sluice Gate	11
28	Traveling Crane	11
29	Sump Pump	11
30	Heating and Dehumidification	11
31	Ventilation	11
32	Water Level Indicators	11
	L. ELECTRICAL DESIGN	
33	Electric Service	12
	a. Wiring System	12
	b. Communication System	12
	c. Emergency Lighting	12
	d. Electric Load Data	12

LIST OF PLATES

Plate No.	Title
8- 1	General Plan
8- 2	River Street Pumping Station - Architectural Details
8- 3	Maple Street Pumping Station - Architectural Details
8- 4	Front Street Pumping Station - Architectural Details
8- 5	Pumping Stations - Structural Details
8- 6	River & Maple Streets Pumping Stations - Mechanical Details
8- 7	Front Street Pumping Station - Mechanical Details
8- 8	Division Street Pumping Station - Mechanical Details
8- 9	River & Maple Streets Pumping Stations - Electrical - Plans and Schedules
8-10	Front & Division Streets Pumping Stations - Electrical - Plans and Schedules

APPENDICES

No.	Title
A	STRUCTURAL DESIGN COMPUTATIONS
B	MECHANICAL DESIGN COMPUTATIONS
C	CURRENT COST ESTIMATE

FLOOD CONTROL PROJECT

ANSONIA-DERBY LOCAL PROTECTION PROJECT
NAUGATUCK RIVER
HOUSATONIC RIVER BASIN
CONNECTICUT

DESIGN MEMORANDUM NO. 8

PUMPING STATIONS

JULY 1966

A. PERTINENT DATA

1. Purpose. — Flood Protection

2. Project Location.

State	Connecticut
County	New Haven
Cities	Ansonia and Derby
River	Naugatuck

3. Drainage Areas.

River Street Pumping Station	13 Acres
Maple Street Pumping Station	43 "
Front Street Pumping Station	125 "
Division Street Pumping Station	180 "

4. River Street Pumping Station.

Number of Pumps	2
Capacity (each)	3,000 gpm @ 18.0 Static Head
Approximate Horsepower	22.5
Building Size	13'-6" x 16'-6"

5. Maple Street Pumping Station.

Number of Pumps	2
Capacity (each)	18,000 gpm @ 19.8 Static Head
Approximate Horsepower	122.
Building Size	18'-0" x 18'-6"

6. Front Street Pumping Station.

Number of Pumps	3
Capacity (each)	19,500 gpm @ 23.7 Static Head
Approximate Horsepower	162.
Building Size	19'-0" x 34'-4"

7. Division Street Pumping Station.

Number of Pumps	3
Capacity (each)	20,200 gpm @ 25.1 Static Head
Approximate Horsepower	190.
Building Size	19'-0" x 34'-4"

B. INTRODUCTION

8. Purpose.

The purpose of this memorandum is to summarize and record the basic features of the design of the four pumping stations for the Ansonia-Derby Local Protection Project, to facilitate review and provide a convenient reference.

9. Scope.

This memorandum presents basic design, including preliminary plans and discussion. Design criteria, typical computations for pump sizes, station stability and stresses, and other pertinent data are included.

C. HYDROLOGY AND INTERIOR DRAINAGE

10. General.

Hydrology and Interior Drainage are presented in Design Memorandum No. 1 - Hydrology and Interior Drainage, which was submitted 30 April 1965 and was approved as a basis for further planning on 16 June 1965.

11. Interior Drainage.

Design Memorandum No. 1 - Hydrology and Interior Drainage, contains the detailed information and criteria for storm drains. The intercepting drains along the line of protection have been designed to carry the runoff from a 10-year storm without surcharge. The gravity outlets at the Pumping Stations have been designed to pass runoff from a 100-year storm.

The Pumping Stations are designed to discharge the runoff produced by a rainfall rate of 1.5 inches per hour. This rate of runoff is less than the rate produced by the 10-year storm so the capacity of the interior drains is more than adequate to handle the flows which will occur concurrently with the high river stages.

D. MODEL STUDY

12. Model Study.

The U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, is currently constructing an undistorted model at the scale of 1:120.

E. HYDRAULIC ANALYSIS

13. Hydraulic Analysis.

The Hydraulic Analysis will be presented in Design Memorandum No. 9 - Hydraulic Analysis, which will be submitted approximately 30 days after the results of the model study are known.

F. GEOLOGY

14. Geology.

General site geology is presented in Design Memorandum No. 3 - General Design and Site Geology, which was submitted 14 January 1966 and approved 1 April 1966.

G. FOUNDATIONS

15. Foundations.

The characteristics of foundation materials, foundation treatment, foundation stability and seepage control for the Pumping Station structures are described in Design Memorandum No. 6, "Embankments, Foundations and Channel Improvements". That memorandum was submitted on 28 February 1966 and approved on 11 April 1966.

H. CONCRETE MATERIALS

16. Concrete Materials.

Concrete materials were covered in detail in Design Memorandum No. 4, "Concrete Materials", submitted 16 February 1966 and approved 29 March 1966.

I. ARCHITECTURAL DESIGN

17. Architectural Design.

Architectural design of the pumping stations is in accordance with Engineering Manual, EM 1110-2-3103, "Architectural Design of Pumping Stations", dated February 1960. Architectural treatment is shown on Plates 8-2, 8-3, and 8-4.

J. STRUCTURAL DESIGN

18. Purpose.

This section of the design memorandum presents the design criteria, basic data and assumptions, and procedure used in the structural design of the pumping stations. Typical computations, including stability analyses are included showing the maximum loading conditions and design of critical sections. Presented herein are the pumping stations at Maple Street, River Street and Division Street. The pumping station at Front Street is the same, but opposite hand to Division Street and is not included.

19. Design Criteria.

a. General. - All working stresses conform to those specified in the Engineering Manual EM 1110-1-2101, dated 1 November 1963. General loading conditions, design assumptions and other design criteria are based on the following applicable parts of the Engineering Manual for Civil Works: Standard Practice for Concrete (EM 1110-2-2000, December 1965) and Structural Design of Pumping Stations (EM 1110-2-3104, dated June 1958).

b. Concrete. - Concrete working stresses will be in general accordance with ACI Standard Building Code Requirements for reinforced concrete, using concrete with a minimum ultimate compressive strength of 3000 lbs per square inch.

Flexure (Extreme fiber stresses in comp.)	P.S.I.
Roof and Floor Systems of Pumping Station	1350
All other concrete	1050

c. Reinforcement. -

(1) Grade and Working Stresses. - All reinforcement in the structures, including temperature and shrinkage reinforcement

is designed for the working stresses of new billet steel, intermediate grade, deformed bars which is 20,000 p.s.i. in flexual tension. The reinforcement shall conform to the requirements of Federal Specification QQ-S-632, Type II, Grade C and to ASTM A-305-56T.

(2) Spacing. - The clear distances between parallel bars will not be less than 1-1/2 times the diameter of round bars except that in no case will the clear distance between parallel bars be less than 1-inch, or 1-1/2 times the maximum size of the coarse aggregate.

(3) Minimum Cover for Reinforcement. -

Item	Min.Cover(Inches)
Interior Slabs	3/4
Interior Girders and Beams	1-1/2
Exposed Concrete (water or atmosphere below grade)	3
Bottom of Base Slab	4
Concrete above Grade (Interior)	2

(4) Splices. - All splices will be in accordance with the ACI Building Code and as set forth in Table 14c of Reinforced Concrete Design Handbook, ACI Publication SP-3.

(5) Temperature and Shrinkage Reinforcement. - Temperature and shrinkage reinforcement will be provided where the main reinforcement extends in only one direction. Such reinforcement will provide for a ratio of steel area to concrete area (bd) of 0.002 with a minimum of .0012 in each face up to a maximum of #6 bars at 12" cc.

d. Structural Steel. - Structural steel is designed for the working stresses of bridge and building steel with a yield point of 36,000 psi minimum (A36). Design conforms to the latest specification for the Design Fabrication and Erection of Structural Steel for Buildings and to EM 1110-1-2101. Basic working stress is 22,000 psi.

e. Increase in Normal Working Stresses.- Allowable working stresses are increased 33-1/3% only where wind loads are used.

f. Waterstops. - Rubber or polyvinyl waterstops are used in joints where retaining walls abut the pumping stations. Where vertical construction joints are necessary in the pumping station walls, steel plate waterstops will be used.

20. Basic Data and Assumptions.

a. Loads. -

(1) Dead Loads

Concrete	150 p.c.f.
Steel	490 p.c.f.
Soil, Saturated	130 p.c.f.
Soil, Submerged	67 p.c.f.

(2) Live Loads. - The following live loads are used:

Water	62.5 p.c.f.
Wind	50 p.s.f.
Design Load on Roof Slabs	30 p.s.f.
Design Load on Floor Slabs	
Maple Street	300 p.s.f.
River Road	870 p.s.f.
Division Street & Front Street	400 p.s.f.
Design Load on Floor Beams	
Maple Street, Division Street & Front Street	100 p.s.f. plus equip. loads
River Road	300 p.s.f. plus equip. loads
Crane Loads	
Division, Front & Maple Streets	3 tons each
River Road	1 ton

b. External Water Pressure. - Except at Maple Street, the hydrostatic pressure under each station is assumed as the head-to-ground surface evenly distributed over the base slab areas. At the Maple Street Station, which is part of the flood wall, hydrostatic pressure under maximum flood condition is taken as full pressure at the riverside heel and varying to zero at the ground surface on the landside by the creep method.

c. Earth Pressure. - Earth pressures are determined in general accordance with EM 1110-2-2502, Retaining walls dated 29 May 1961.

d. Earthquake Forces. - Earthquake forces are considered to be of no consequence on these structures and have been neglected.

e. Frost Protection. - All structures are buried deep enough to prohibit any frost action.

f. Location of Resultant. - In the design of the structures, the resultant has been held within the middle third of the base, except at Maple Street where under full water load to the top of the wall, there is a small area of the base not under bearing.

g. Sliding. - Sliding will not be a factor except at Maple Street. At Maple Street, a projection in the riverside base matching the adjacent flood walls is utilized. Passive pressure on the landside wall is utilized to resist the unbalanced horizontal forces.

21. River Street Pumping Station.

a. General. - This station is a brick and concrete pumping station, 13'-6" x 16'-6" outside dimension, located in back of the flood protection. Discharge and intake will be by pipe conduits thus making the station rectangular without any concrete appendages. The base slab is founded on earth, and discharge will be by two (2) 12-inch steel pipes over the dike.

b. Stability. - Stability is not a problem due to the constant hydrostatic head over the entire base slab. Maximum soil bearing pressure will be 2,280 lbs per square foot uniform over the entire area.

c. Roof Slab. - The roof slab is designed as a two-way, 6-inch minimum slab pitched to drain to the middle of the roof. Because of the small slab area, steel requirements are minimum.

d. Superstructure - Framework. - Steel spandrel beams at the roof level will support the roof slab. Spandrel beams and crane brackets will be supported by steel columns located at the four corners. Columns and beams are all nominal in size.

e. Operating Floor. - The operating floor is slab and beam construction. Because of the short span lengths, equipment requirements dictate a live load of 870 lbs per square foot. However, this results in a 6-inch slab with minimum reinforcement requirements. Floor beams are designed for a reduced live load of 300 lbs per square foot plus equipment loads.

f. Substructure. - Because of the small dimensions, the substructure walls are designed as a horizontal frame, and the base slab as a two-way slab assuming the ends fixed at the outside walls.

22. Maple Street Pumping Station.

a. General. - The station will be located in the flood wall with discharge through the wall. The superstructure dimension will be 18'-0" by 20'-0", while the base area including a riverside apron will be 28'-0" by 36'-0". The structure will be founded on earth.

b. Stability. - The station was investigated for the following conditions of loading:

Condition No. I. - River down, no water inside the station, dead loads only plus a 50 lbs per square foot wind load from landside.

Condition No. II. - Maximum flood condition with river to top of adjacent flood wall, uplift varying from full head at riverside heel to zero at landside ground surface by creep method. Water in sump varying from maximum pumping condition to minimum pumping condition. Resultant to fall within approximately mid-half of station. Normal stresses used in the design.

Condition No. III. - Design flood with water lowered 3 feet same as Condition II, except water inside station taken at minimum pumping condition. Resultant to fall in mid-third of base area.

Under the above conditions of loading, maximum bearing pressure is 1,880 lbs per square foot under Case I loading.

c. Roof Slab and Superstructure. - The roof slab is designed on a two-way slab, 6 inches minimum thickness, and pitched to drain to the center of the slab. The roof slab is also designed to carry the storage of the stop logs for the gate slots. Design of steel columns and crane beams is similar to River Street.

d. Operating Floor. - The operating floor is slab and beam construction with beams framing each pump opening. A live load of 300 lbs per square foot plus equipment loads was used for the design of the floor slab. Design live load in the floor beams was reduced to 100 lbs per square foot plus equipment loads.

e. Substructure. - The riverside wall is designed horizontally with the wall being supported on the end walls and the pier projections between gates. The piers are designed vertically and supported at the floor and base slabs. Transversely, the base slab and rear wall was designed as an "L" frame with supports at the riverside wall and operating floor at the rear. The base slab load is distributed two-ways. Parallel with the river, a continuous vertical frame is utilized in the design.

23. Division Street Pumping Station.

a. General. - This station is located in back of the protection and will be subjected to the same type of loading as the River Street Station. It will be brick and concrete, 34'-6" by 19'-0" outside dimensions of the superstructure. The intake chamber will be 7'-0" by approximately 13', while the gravity flow discharge will be in a 6'-0" wide chamber leading to a 72-inch pipe. Flood discharge will be by three (3) 30-inch steel pipe carried over the dike.

b. Roof Slab and Superstructure. - The roof slab will be a six-inch minimum slab sloped to drain at the center of the slab. The slab will be supported on steel spandrel beams encased in concrete and utilizes one transverse steel beam at the center of the structure. Steel columns will be utilized to support the roof framing plus the crane beams which is designed to support a three ton crane.

c. Operating Floor. - The operating floor is slab and beam construction with beams framing each pump opening. The floor slab is designed for a 400 lbs per square foot live load while the beams are designed for 100 lbs per square foot plus equipment loads. The exterior deck is designed for a nominal live load of 100 lbs per square foot plus a gate leaf load located at mid-span.

d. Stability. - Stability computatinns were made assuming the station empty above minimum pumping elevation and with ground water on the exterior-to-ground surface. The station will also be investigated for the intake and discharge chambers full and the pump chamber empty. Presentation is for first condition only which is considered to be the most critical.

e. Substructure. - The substructure is designed by utilizing a vertical transverse frame with top of frame supported at the floor slab. The outside end walls are designed as supported at the floor slab and fixed at the base. The wall between the discharge chamber and pump chamber is also designed as supported at the floor and fixed at the base with a full water load in the discharge chamber.

24. Front Street Pumping Station.

This station is the same as the Division Street Station except that it is opposite hand. Design, therefore, will be the same as for Division Street.

K. MECHANICAL DESIGN

25. General.

Plates 8-6, 8-7, and 8-8 show the general arrangement of pumps and other mechanical equipment and pages M-1 through M-31 show pump computations and curves. Electric service is not considered adequately reliable at any of the stations for electric motor drive.

26. Pumping Equipment.

All pumps will be driven by diesel engines through right angle gear units. The pumps will be vertical, fixed blade, propeller or mixed-flow type of standard construction using steel columns and discharge elbows, cast iron bowls and suction bells, bronze

impellers, stainless steel pump shafts and bronze bearings. Each pump will be provided with manually operated centralized lubrication system. All pumps will be capable of operation against all river stages up to the top of the dike. Because of the small size of the required pumps, a two pump station is the most economical selection for the River Street and Maple Street sections.

Trash racks are not required at any of the stations as all inlets to the drains leading to the sumps are adequately screened.

a. River Street Pumping Station. - Two pumps will be provided with each pump having a capacity of 6.7 cfs. (3000 gpm), two-thirds of required station capacity, against the standard project flood with suction sump at low water elevation. Each pump will discharge over the top of the dike. Station sump will be dry except when sluice gate in adjacent drain manhole is opened to activate the station after closing sluice gate in gravity flow conduit.

b. Maple Street Pumping Station. - Two pumps will be provided with each pump having a capacity of 40 cfs (18000 gpm), two-thirds of the required station capacity, against the standard project flood with suction sump at low water elevation. The flood wall will form one wall of the station and each pump will discharge through the flood wall with a flap valve on the end of the discharge. Because of the limited space between the flood wall and the existing railroad tracks, the centerline through the two pumps is at right angles to the flood wall and one pump discharge is offset under the floor. This arrangement permits the gravity flow to pass directly past one side of the station with a sluice gate in the flood wall to shut off the river and a gate in the wall of the station sump so water will enter the sump at right angles to the line of pumps and no above ground appurtenances between the station and the railroad tracks are required. Provisions will be made for installation of stop logs on the river side of each flap valve and the gravity discharge gate.

c. Front Street Pumping Station. - Three pumps will be provided with each pump having a capacity of 43.3 c.f.s. (19,500 gpm), one-third of the required station capacity, against the standard project flood with suction sump at low water elevation. Each pump will discharge over the top of the dike. Three sluice gates, one located in front of each pump, will seal off the pump sump except when opened for activation of the station. A sluice gate will be provided on the river side of the dike to close off the gravity flow conduit.

d. Division Street Pumping Station. - Three pumps will be provided with each pump having a capacity of 45 c.f.s. (20,200 gpm), one-third of the required station capacity, against the standard project flood with station sump at low water level. Station arrangement will be essentially the same as the Front Street Pumping Station.

27. Sluice Gates.

All sluice gates at the pumping stations will be seating pressure type of standard cast iron construction with bronze seals. Manually operated floorstands will be installed for operation of each gate. A portable electric operator for attachment to the hand crank shaft will be provided at Maple, Front and Division Street Stations to reduce the time required to operate the gates.

28. 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.

29. Sump Pump.

An electric motor operated wet pit type sump pump will be provided in each pumping station for dewatering and for handling any leakage into the sump.

30. Heating and Dehumidification.

A dehumidifier will be installed in the River Street and the Maple Street Pumping Stations for control of condensation on walls and equipment. The larger stations, Front Street and Division Street, will be equipped with gas or oil fired warm air furnaces, thermostatically controlled to maintain inside temperature at 55°F and in addition, a humidistat will override the thermostat to operate the heater as necessary to maintain the relative humidity at not higher than 50 percent.

31. Ventilation.

A small fan with ductwork will be provided for ventilation of the sump at each station. The diesel engines will be radiator cooled with each radiator connected to exterior wall louver by ductwork to prevent short circuiting of cooling air. Inlet louvers will be provided for air supply to the radiators.

32. Water Level Indicators.

Indicators for both the station sump and the river water levels will be provided in each station.

L. ELECTRICAL DESIGN

33. Electric Service.

Electric service will be obtained from the United Illuminating Company at 120/240 v, 3 phase, 4-wire. (See Plates No. 8-9 and 8-10). The service will be extended from existing lines overhead to the stations.

a. Wiring System. - All conductors will have heat and moisture resisting type 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 in providing telephone service.

c. Emergency Lighting. - Battery operated emergency lighting units will be provided.

d. Electric Load Data. -

Item	Division Street		Maple Street		River Street		Front Street	
	Conn.	Demand	Conn.	Demand	Conn.	Demand	Conn.	Demand
Sluice Gate*	2.6 hp		1 hp		.33 hp		2.6 hp	
Sump Pump	1/3 hp		1/3 hp		1/3 hp		1/3 hp	
Fan	1/4 hp		1/4 hp		1/4 hp		1/4 hp	
Furnace	1/2 hp	.5 kva					1/2 hp	.5 kva
Dehumidifier			1.2 kva	1.2 kva	1.2 kva	1.2 kva		
Lighting & Receptacles	3 kva	2 kva	2 kva	1.5 kva	2 kva	1.5 kva	3 kva	2 kva
		2.5 kva		2.7 kva		2.7 kva		2.5 kva

* All sluice gates within the pumping stations are to be manually operated and those outside of the station are to be electrically operated.

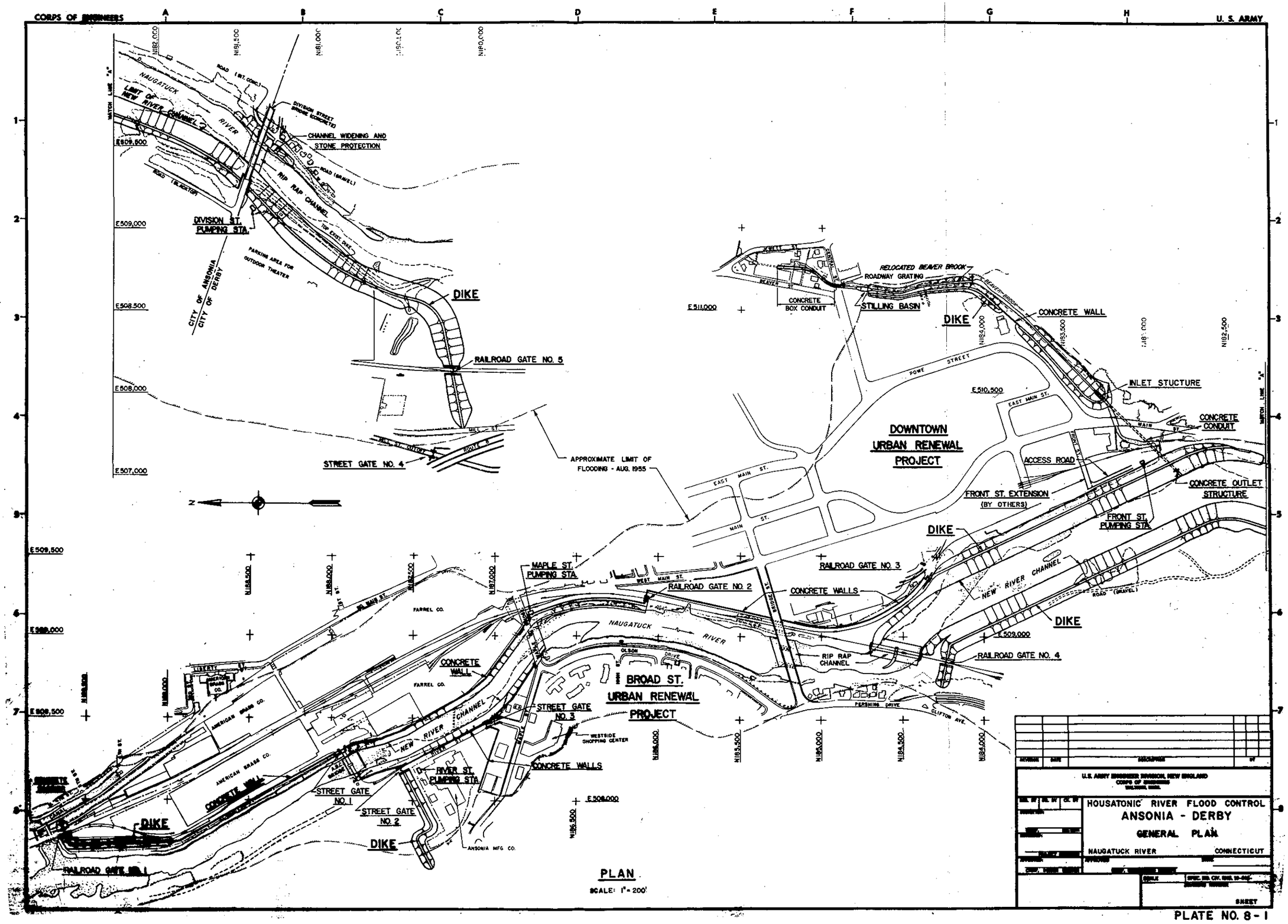
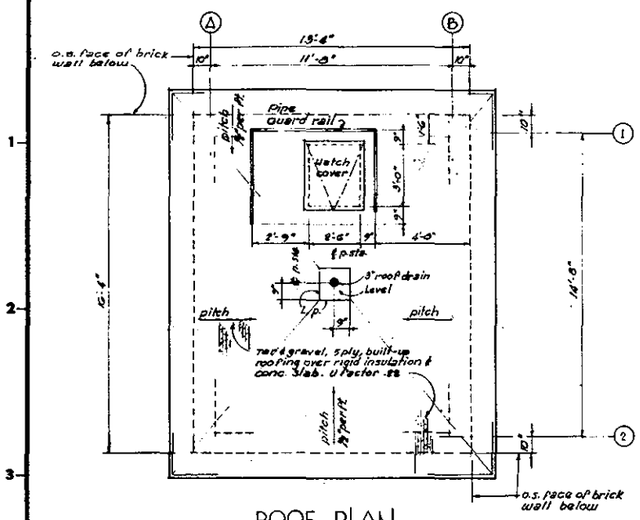

CORPS OF ENGINEERS
U. S. ARMY
NAUGATUCK RIVER
LIMIT OF NEW RIVER CHANNEL
CHANNEL WIDENING AND STONE PROTECTION
DIVISION STREET BRIDGE (CONCRETE)
RIP RAP CHANNEL
DIVISION ST. PUMPING STA.
CITY OF ANSONIA
CITY OF DERBY
PARKING AREA FOR OUTDOOR THEATER
DIKE
RAILROAD GATE NO. 5
STREET GATE NO. 4
APPROXIMATE LIMIT OF FLOODING - AUG. 1955
RELOCATED BEAVER BROOK
ROADWAY GRATING
CONCRETE BOX CONDUIT
STILLING BASIN
CONCRETE WALL
INLET STUCTURE
CONCRETE CONDUIT
DOWNTOWN URBAN RENEWAL PROJECT
ACCESS ROAD
FRONT ST. EXTENSION (BY OTHERS)
CONCRETE OUTLET STRUCTURE
FRONT ST. PUMPING STA.
RAILROAD GATE NO. 3
CONCRETE WALLS
NEW RIVER CHANNEL
RAILROAD GATE NO. 4
RIP RAP CHANNEL
MAPLE ST. PUMPING STA.
RAILROAD GATE NO. 2
BROAD ST. URBAN RENEWAL PROJECT
STREET GATE NO. 3
WESTSIDE SHOPPING CENTER
RIVER ST. PUMPING STA.
STREET GATE NO. 1
STREET GATE NO. 2
ANSONIA MFG. CO.
AMERICAN BRASS CO.
FARREL CO.
RAILROAD GATE NO. 1
PLAN
SCALE: 1" = 200'
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
GENERAL PLAN
NAUGATUCK RIVER
CONNECTICUT
SHEET

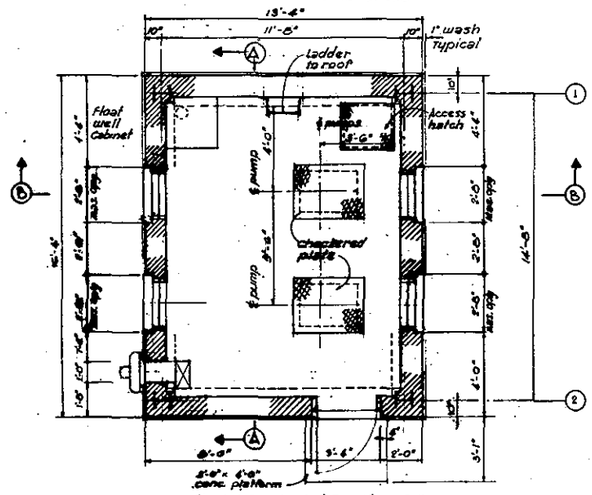
PLATE NO. 8-1

CORPS OF ENGINEERS — U. S. ARMY



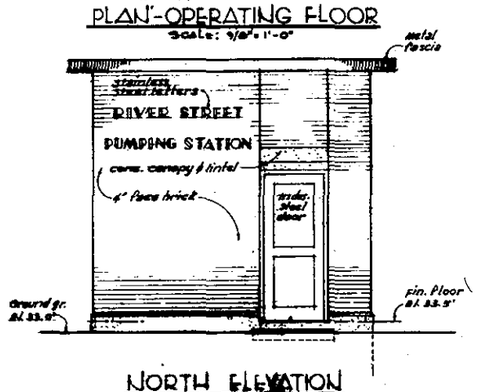
ROOF PLAN

SCALE: 3/16" = 1'-0"



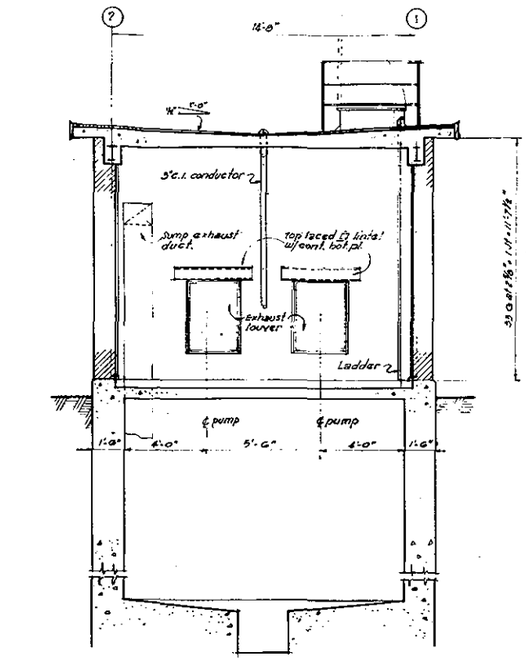
PLAN-OPERATING FLOOR

SCALE: 3/16" = 1'-0"



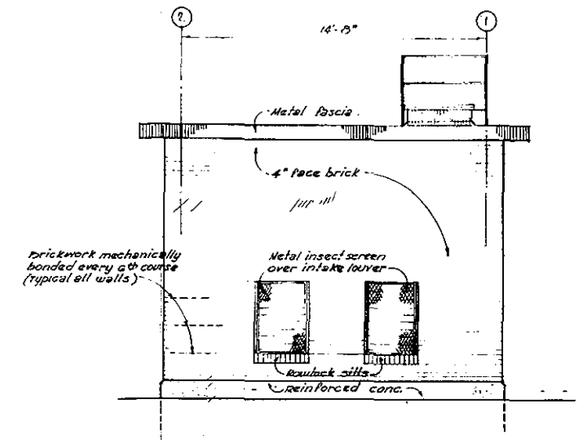
NORTH ELEVATION

SCALE: 3/16" = 1'-0"



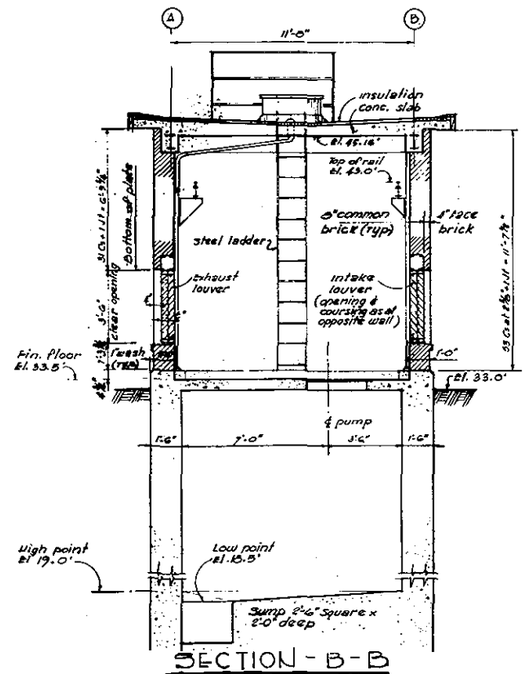
SECTION-A-A

SCALE: 3/16" = 1'-0"



EAST ELEVATION

SCALE: 3/16" = 1'-0"



SECTION-B-B

SCALE: 3/16" = 1'-0"

GRAPHIC SCALES

3/16" = 1'-0"

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
RIVER STREET PUMPING STATION
ARCHITECTURAL
DETAILS

NAUGATUCK RIVER — CONNECTICUT

APPROVED — DATE

CHIEF, ENGINEERING DIVISION

SCALE

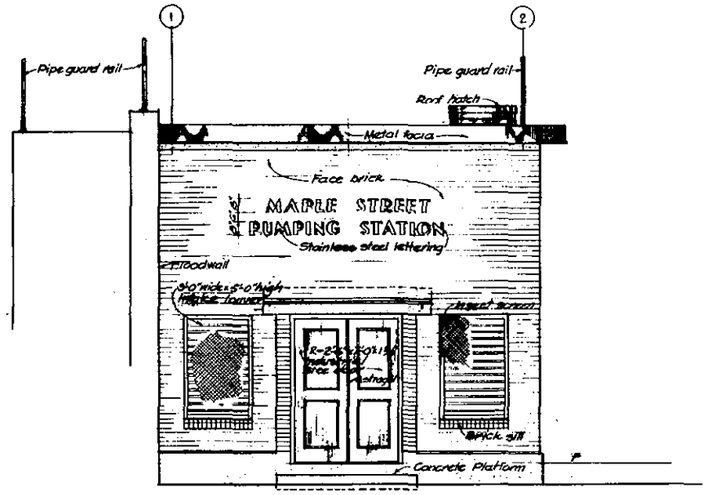
SPEC. NO. CIV. ENG. 19-016-

DRAWING NUMBER

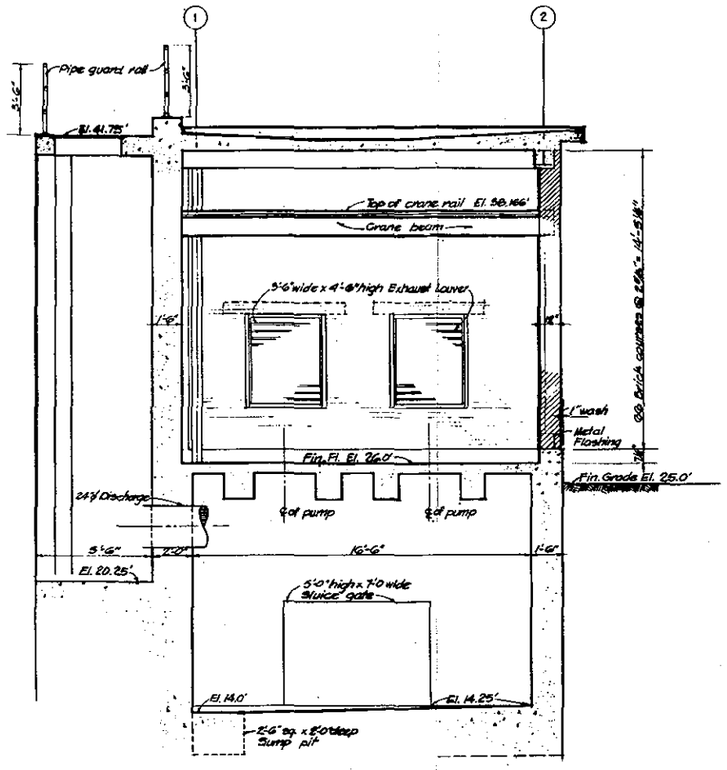
SHEET

PLATE NO. 8-2

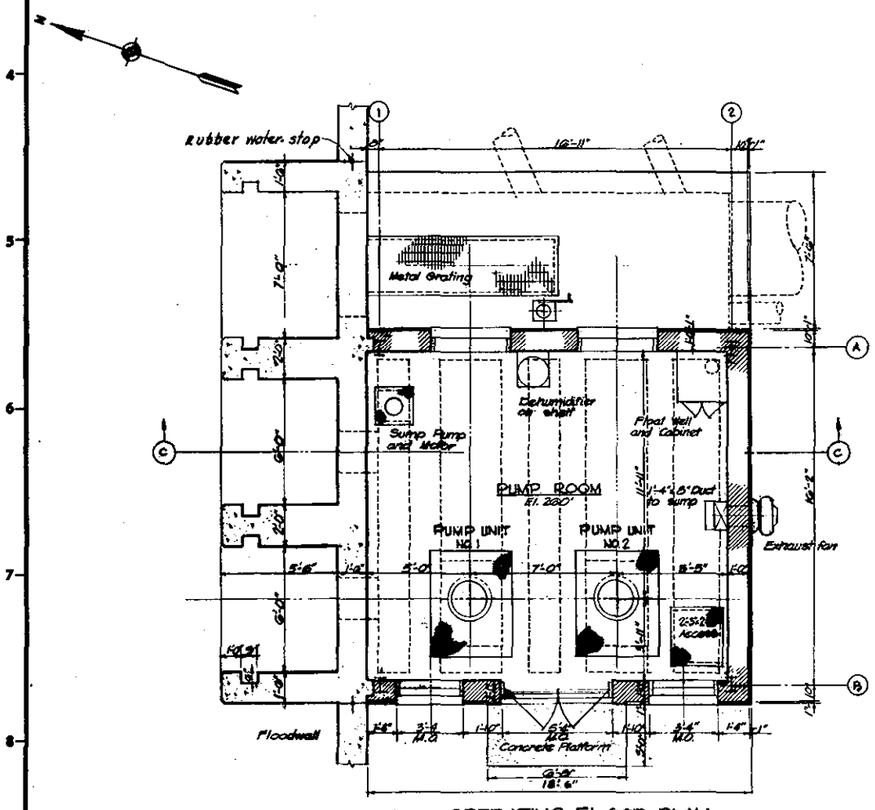
CORPS OF ENGINEERS — U. S. ARMY



FRONT ELEVATION
SCALE: 3/8" = 1'-0"



SECTION C - C
SCALE: 3/8" = 1'-0"



OPERATING FLOOR PLAN
SCALE 3/8" = 1'-0"

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

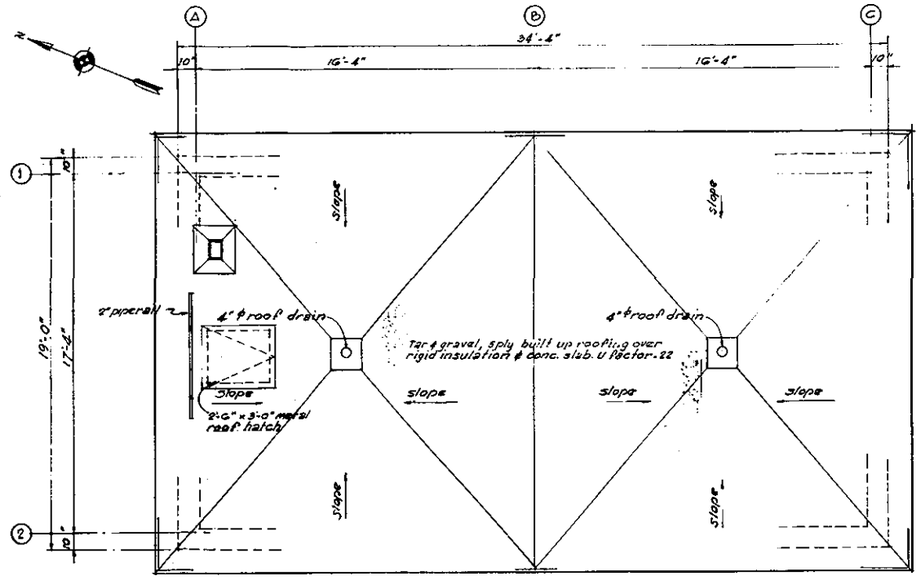
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
MAPLE STREET PUMPING STATION
ARCHITECTURAL DETAILS
NAUGATUCK RIVER — CONNECTICUT
APPROVED: DATE
CHIEF, ENGINEERING BRANCH

SCALE | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

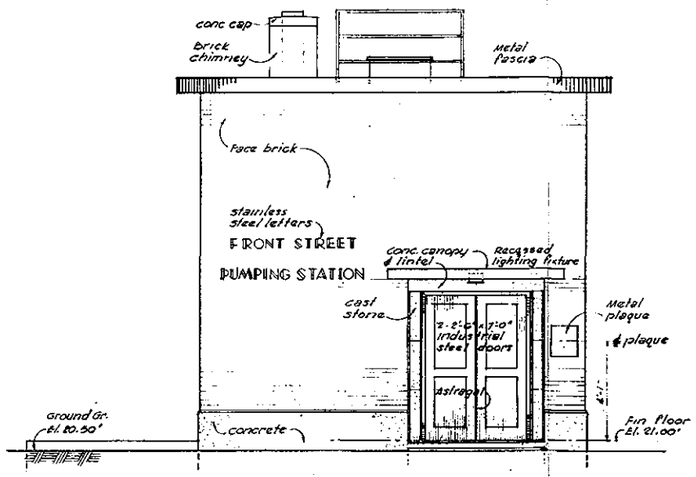
PLATE NO. 8-3

CORPS OF ENGINEERS — U. S. ARMY



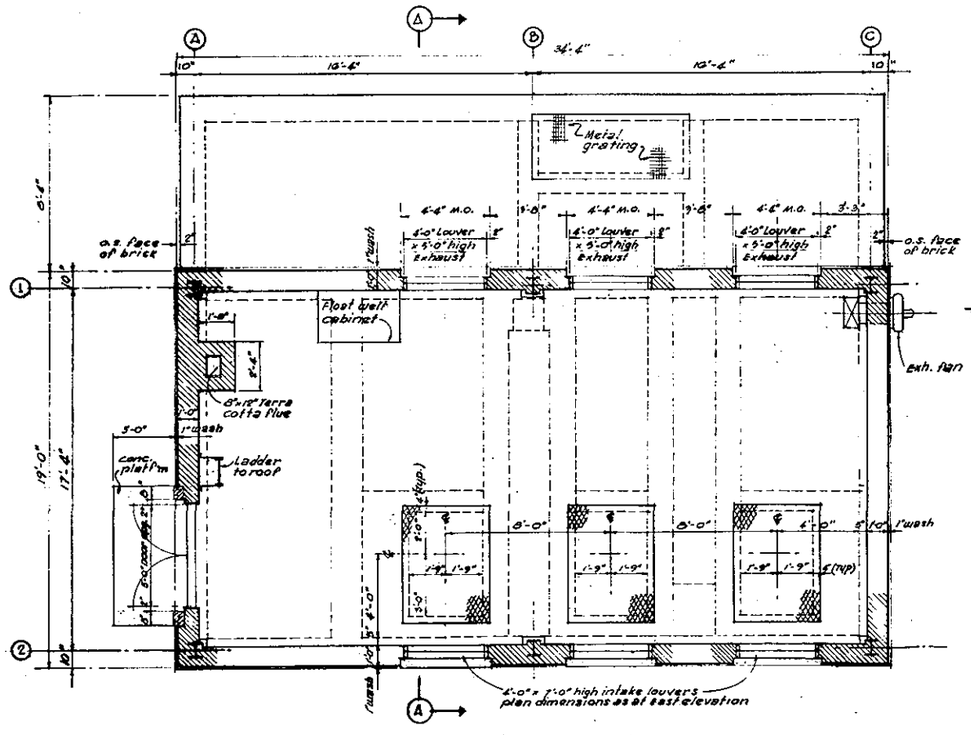
ROOF PLAN

scale: 1/8" = 1'-0"



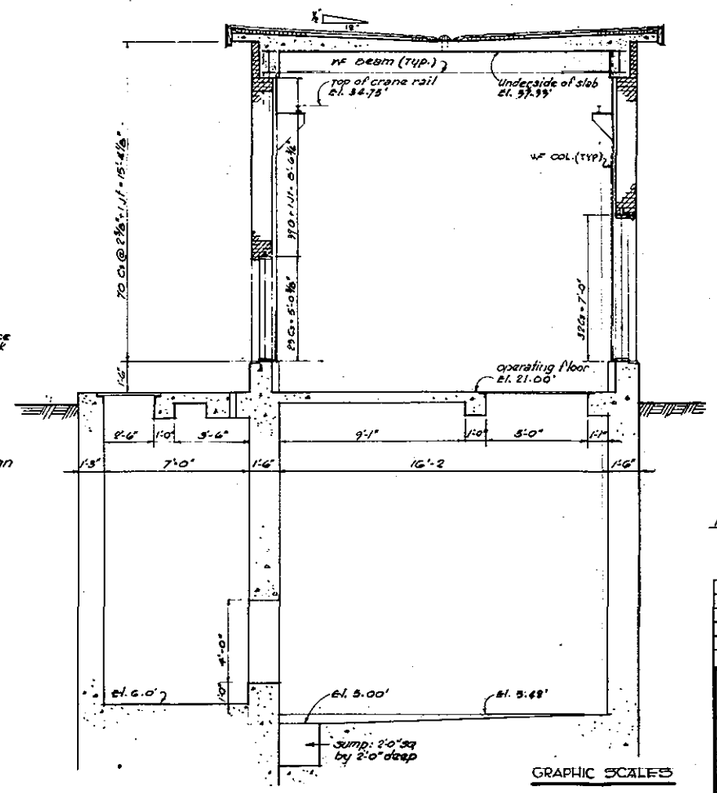
NORTH ELEVATION

scale: 1/8" = 1'-0"



OPERATING FLOOR PLAN

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



SECTION A-A

scale: 1/8" = 1'-0"

GRAPHIC SCALES

1/8" = 1'-0"

NOTE:
Division st. pumping station similar but opposite hand.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY W.C. | DR. BY W.C. | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

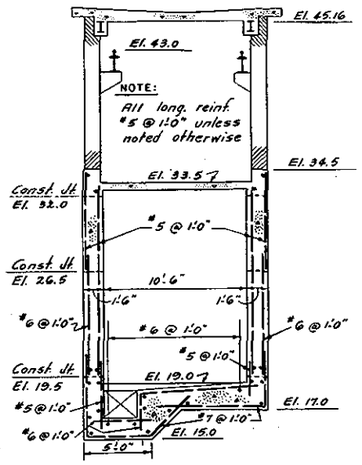
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
FRONT STREET PUMPING STATION
ARCHITECTURAL DETAILS
NAUGATUCK RIVER — CONNECTICUT

APPROVED — DATE
CHIEF, ENGINEERING DIVISION

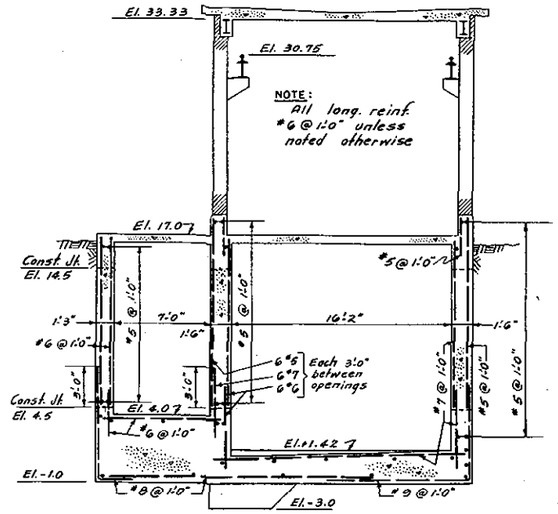
SCALE | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 8-4

CORPS OF ENGINEERS — U. S. ARMY

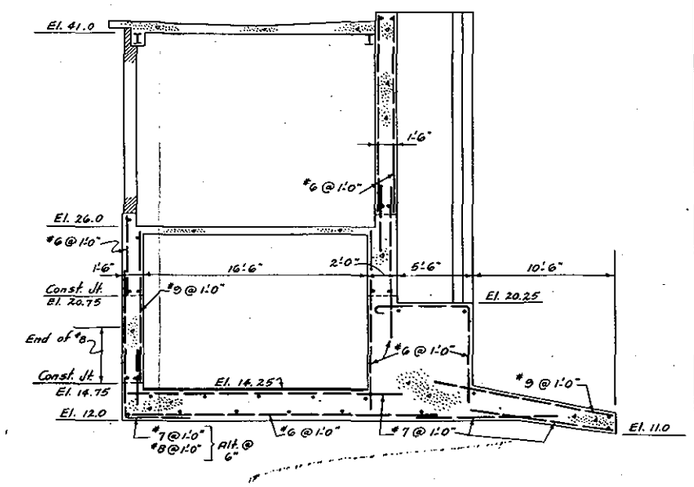


RIVER ST. PUMPING STATION

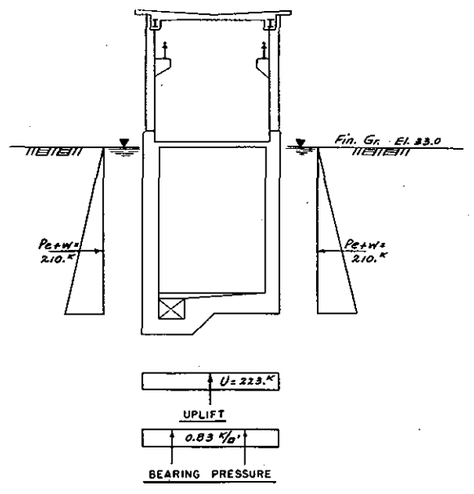


DIVISION ST. PUMPING STATION

NOTE— FRONT STREET PUMPING STATION SIMILAR BUT OPPOSITE HAND



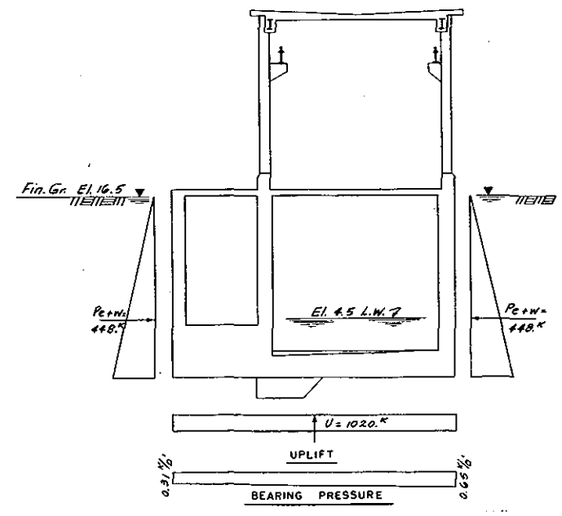
MAPLE ST. PUMPING STATION



LOADING ASSUMPTIONS

a. Dead load of structure and equipment.
b. Water at El. + 33.0
c. Uplift on base to water elevation
d. No water in interior.

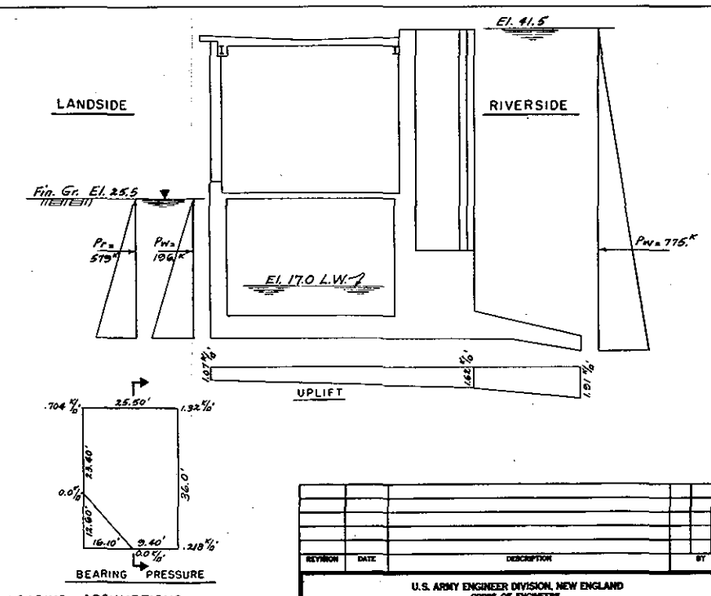
CASE I FLOOD CONDITION



LOADING ASSUMPTIONS

a. Dead load of structure and equipment.
b. Water at El. + 16.5
c. Uplift on base to water elevation.
d. Water in pump and flow chambers at El. + 4.5

CASE I PROJECT FLOOD CONDITION



LOADING ASSUMPTIONS

a. Dead load of structure & equipment.
b. Water on riverside to El. + 41.5
c. Water on landside to El. + 25.5
d. Water in pump and flow chambers at El. + 17.0
e. Uplift varying with path of creep starting with full head of bottom of base slab on riverside and ending at ground surface on landside.

CASE IIA MAX. FLOOD CONDITION

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY Carter | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

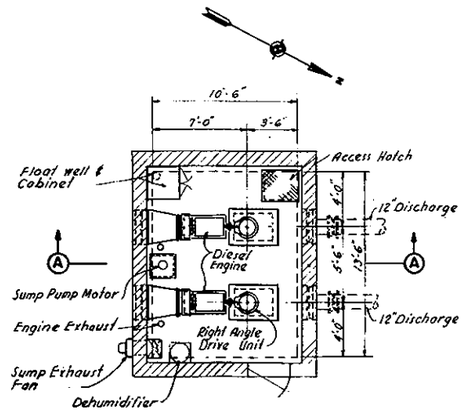
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
PUMPING STATIONS
STRUCTURAL DETAILS
NAUGATUCK RIVER — CONNECTICUT

APPROVED: — DATE
CHIEF, ENGINEERING DIVISION

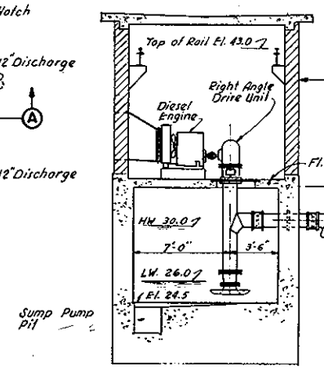
SCALE | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 8-5

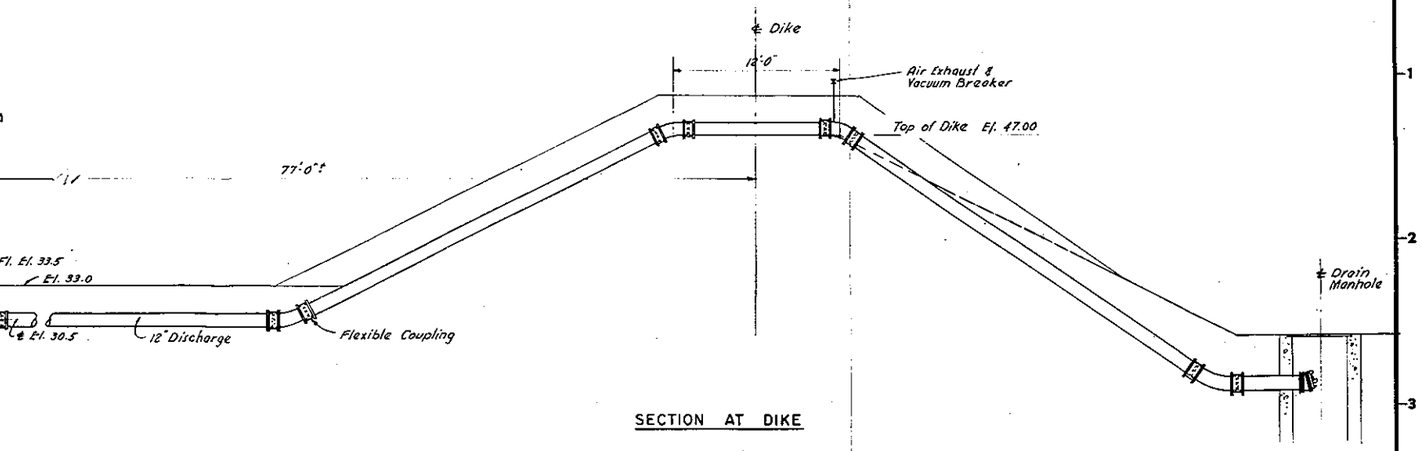
CORPS OF ENGINEERS — U. S. ARMY



PLAN—PUMP ROOM



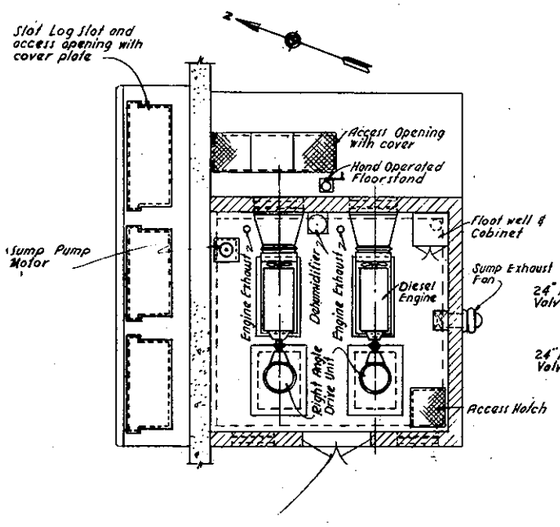
SECTION A-A



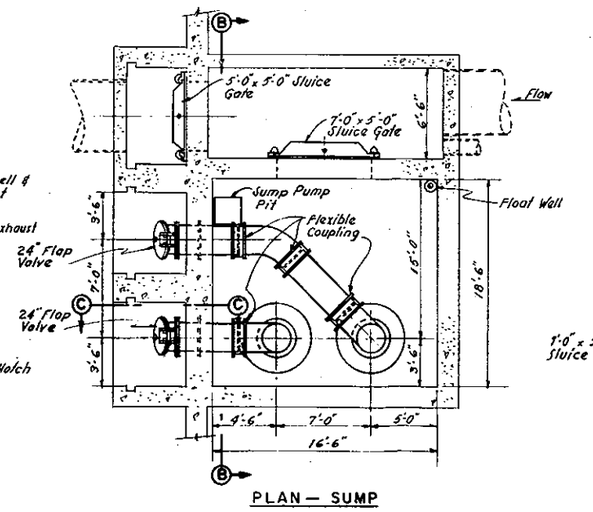
SECTION AT DIKE

DETAILS RIVER STREET PUMPING STATION

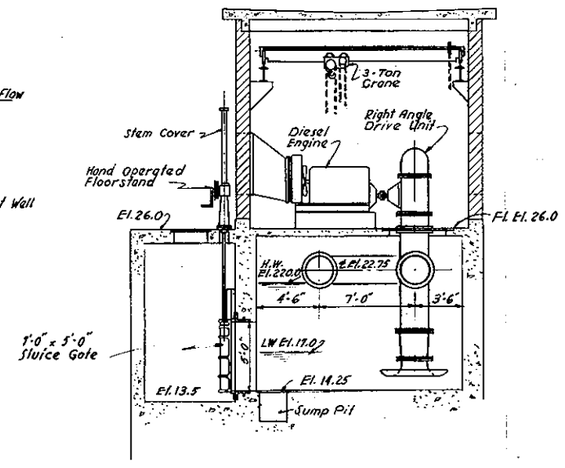
SCALE 1/4" = 1'-0"



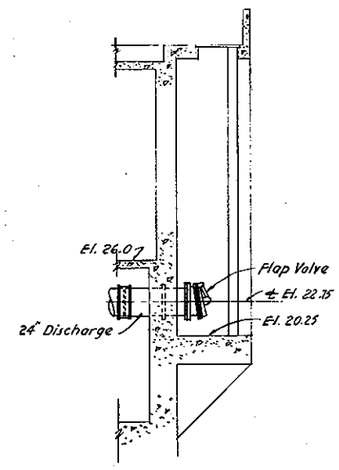
PLAN— PUMP ROOM



PLAN— SUMP



SECTION B-B



SECTION C-C

DETAILS MAPLE STREET PUMPING STATION

SCALE 1/4" = 1'-0"

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

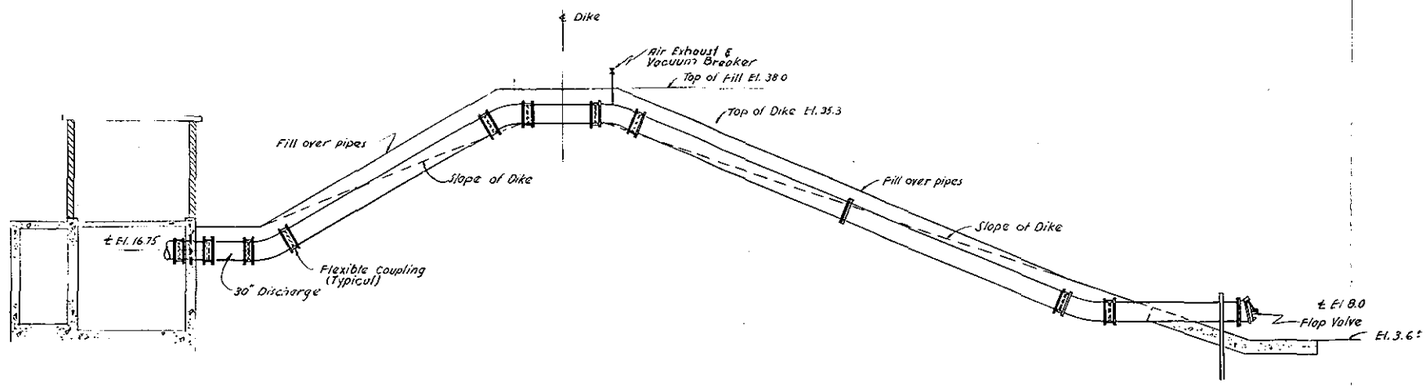
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
RIVER ST. & MAPLE ST. PUMPING STATIONS
MECHANICAL - DETAILS
NAUGATUCK RIVER — CONNECTICUT

APPROVED: CHIEF, ENGINEERING DIVISION — DATE

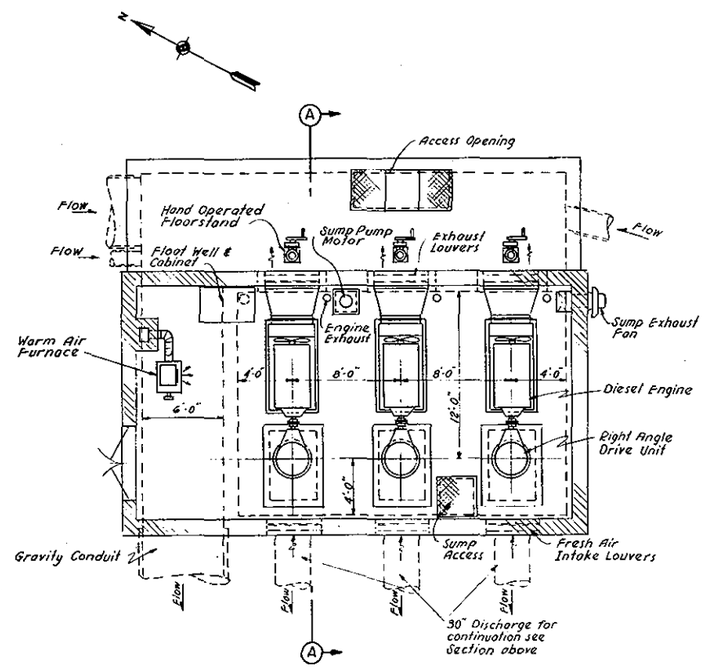
SCALE | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 8-6

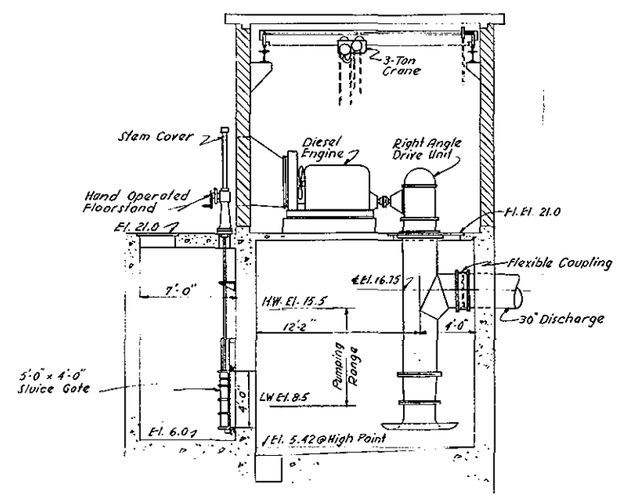
CORPS OF ENGINEERS — U. S. ARMY



SECTION AT DIKE
SCALE 1/8" = 1'-0"



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



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

NOTE:
Division st. pumping station similar but opposite hand.

GRAPHIC SCALES
1/8" = 1'-0" 4' 0 4' 8' 12' 16' 20'
1/4" = 1'-0" 4' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

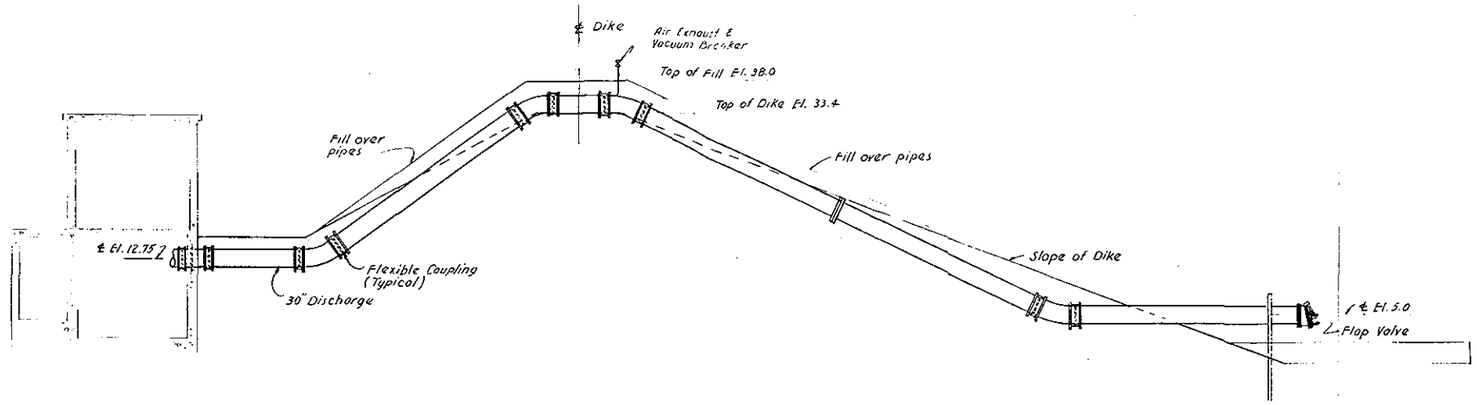
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA – DERBY
FRONT STREET PUMPING STATION
MECHANICAL - DETAILS
NAUGATUCK RIVER — CONNECTICUT

APPROVED — DATE
CHIEF, ENGINEERING DIVISION

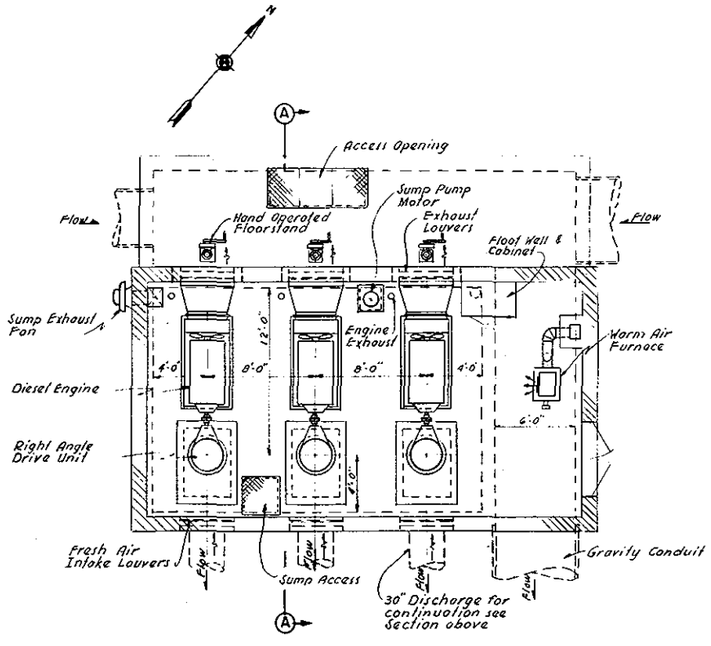
SCALE
SPEC. NO. CIV. ENG. 19-018-
DRAWING NUMBER
SHEET

PLATE NO. 8-7

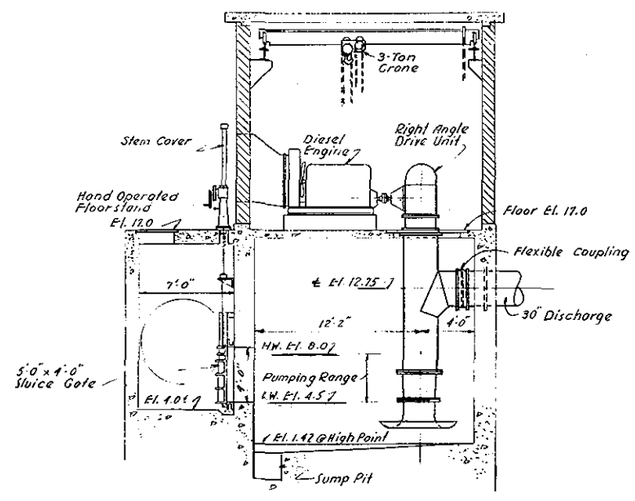
CORPS OF ENGINEERS — U. S. ARMY



SECTION AT DIKE
SCALE 1/8" = 1'-0"



PLAN
SCALE 1/4 = 1'-0"



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

NOTE:
Front st. pumping station similar but opposite hand.

GRAPHIC SCALES
1/8" = 1'-0" 4' 0 4' 8' 12' 16' 20'
1/4" = 1'-0" 4' 0 4' 8'

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

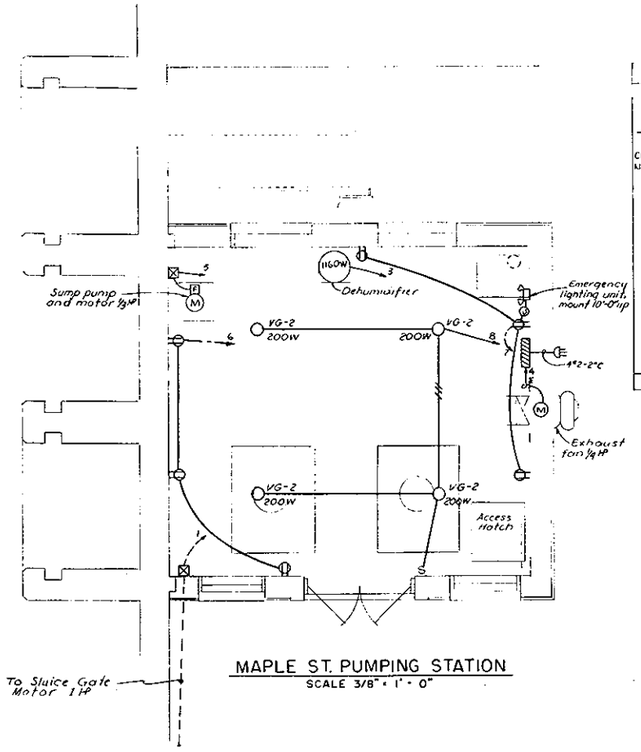
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
DIVISION STREET PUMPING STATION
MECHANICAL DETAILS
NAUGATUCK RIVER — CONNECTICUT

APPROVED: CHIEF, ENGINEERING DIVISION — DATE

SCALE | SPEC. NO. CIV. ENG. 19-016- | DRAWING NUMBER | SHEET

PLATE NO. 8-8

CORPS OF ENGINEERS — U. S. ARMY

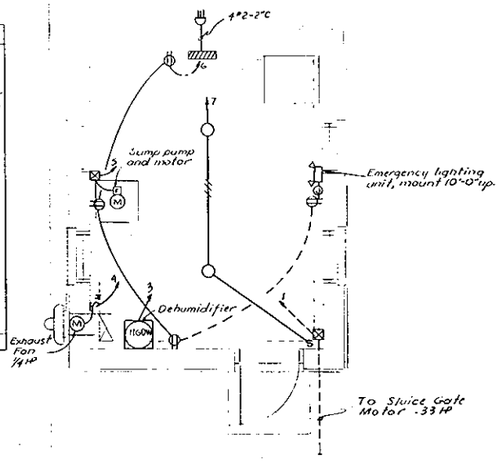


MAPLE ST. PUMPING STATION

SCALE 3/8" = 1'-0"

PANEL "M"				
120/240 V. 3Φ 4 WIRE 100 AMP MAIN BREAKER				
CIRCUIT NUMBER	BREAKER SIZE AMPS	NUMBER OF POLES	SERVES	CONNECTED LOAD VA
1.	20	3	Sluice Gate	1.0
2.	↓	3	Spare	—
3.	↓	1	Dehumidifier	1.2
4.	↓	↓	Fan	.3
5.	↓	↓	Sump Pump	.4
6.	↓	↓	Receptacles	.5
7.	↓	↓	Receptacles	.5
8.	↓	↓	Lighting	.8
9.	↓	↓	Spare	—
10.	↓	↓	Spare	—
TOTAL CONNECTED LOAD				4.7

PANEL "R"				
120/240V. 3Φ 4 WIRE 100 AMP MAIN BREAKER				
CIRCUIT NUMBER	BREAKER SIZE AMPS	NUMBER OF POLES	SERVES	CONNECTED LOAD VA
1.	20	3	Sluice Gate	.4
2.	↓	3	Spare	—
3	↓	1	Dehumidifier	1.2
4.	↓	↓	Fan	.3
5.	↓	↓	Sump Pump	.4
6.	↓	↓	Receptacles	.6
7.	↓	↓	Lighting	.4
8.	↓	↓	Spare	—
9.	↓	↓	Spare	—
10.	↓	↓	Spare	—
TOTAL CONNECTED LOAD				3.3



RIVER ST. PUMPING STATION

SCALE 3/8" = 1'-0"

GRAPHIC SCALES

3/8" = 1'-0" 4" 0 4'

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: CHIEF, SECTION

REVIEWED: PROJECT ENGINEER

APPROVED: CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
RIVER ST. & MAPLE ST. PUMPING STATIONS
ELECTRICAL
PLANS AND SCHEDULES
NAUGATUCK RIVER CONNECTICUT

APPROVED: CHIEF, ENGINEERING DIVISION DATE

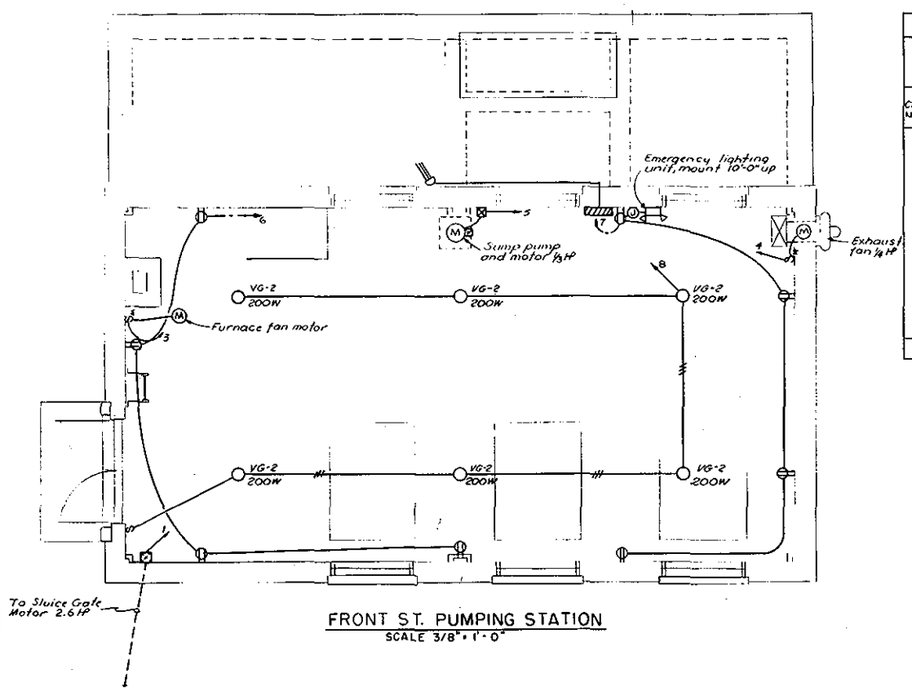
SCALE | SPEC. NO. CIV. ENG. 19-016-

DRAWING NUMBER

SHEET

PLATE NO. 8-9

CORPS OF ENGINEERS — U. S. ARMY



FRONT ST. PUMPING STATION
SCALE 3/8" = 1'-0"

PANEL "F"

120/240 V. 3 Φ 4 WIRE
100 AMP MAIN BREAKER

CIRCUIT NUMBER	BREAKER SIZE AMPS	NUMBER OF POLES	SERVES	CONNECTED LOAD V.A.
1.	20	3	Sluice Gate	2.6
2.	↓	3	Spare	—
3	↓	1	Furnace	.4
4.	↓	↓	Fan	.3
5.	↓	↓	Sump Pump	.4
6.	↓	↓	Receptacles	.6
7.	↓	↓	Receptacles	.6
8.	↓	↓	Lighting	1.2
9.	↓	↓	Spare	—
10.	↓	↓	Spare	—
TOTAL CONNECTED LOAD				6.1

NOTE:
Division St. Pumping Station similar but opposite hand.

GRAPHIC SCALES
3/8" = 1'-0" 4' 0 4'

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
FRONT ST. & DIVISION ST. PUMPING STATIONS
ELECTRICAL
PLANS AND SCHEDULES
NAUGATUCK RIVER CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 8-10

APPENDIX A

STRUCTURAL DESIGN COMPUTATIONS

INDEX TO SHEETS

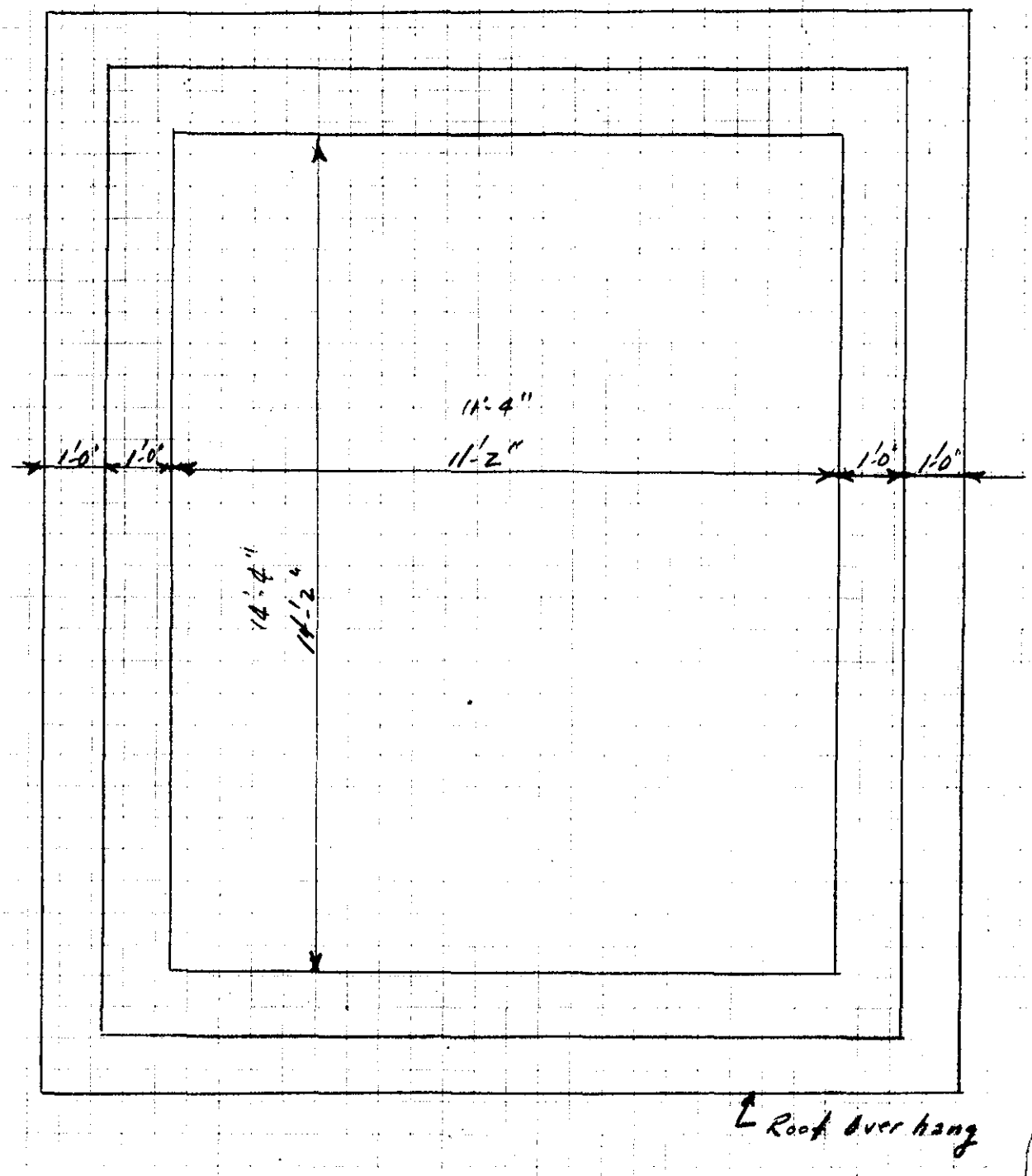
Title	Page No.
River Street Pumping Station	DM- 1 - DM-19
Maple Street Pumping Station	DM-20 - DM-54
Division Street Pumping Station	DM-55 - DM-72

NED FORM 225
27 Sept 49

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

PAGE DM-1

SUBJECT ANSONIA DERBY
COMPUTATION RIVER ROAD PUMPING STATION
COMPUTED BY EPG CHECKED BY DATE DEC 1965



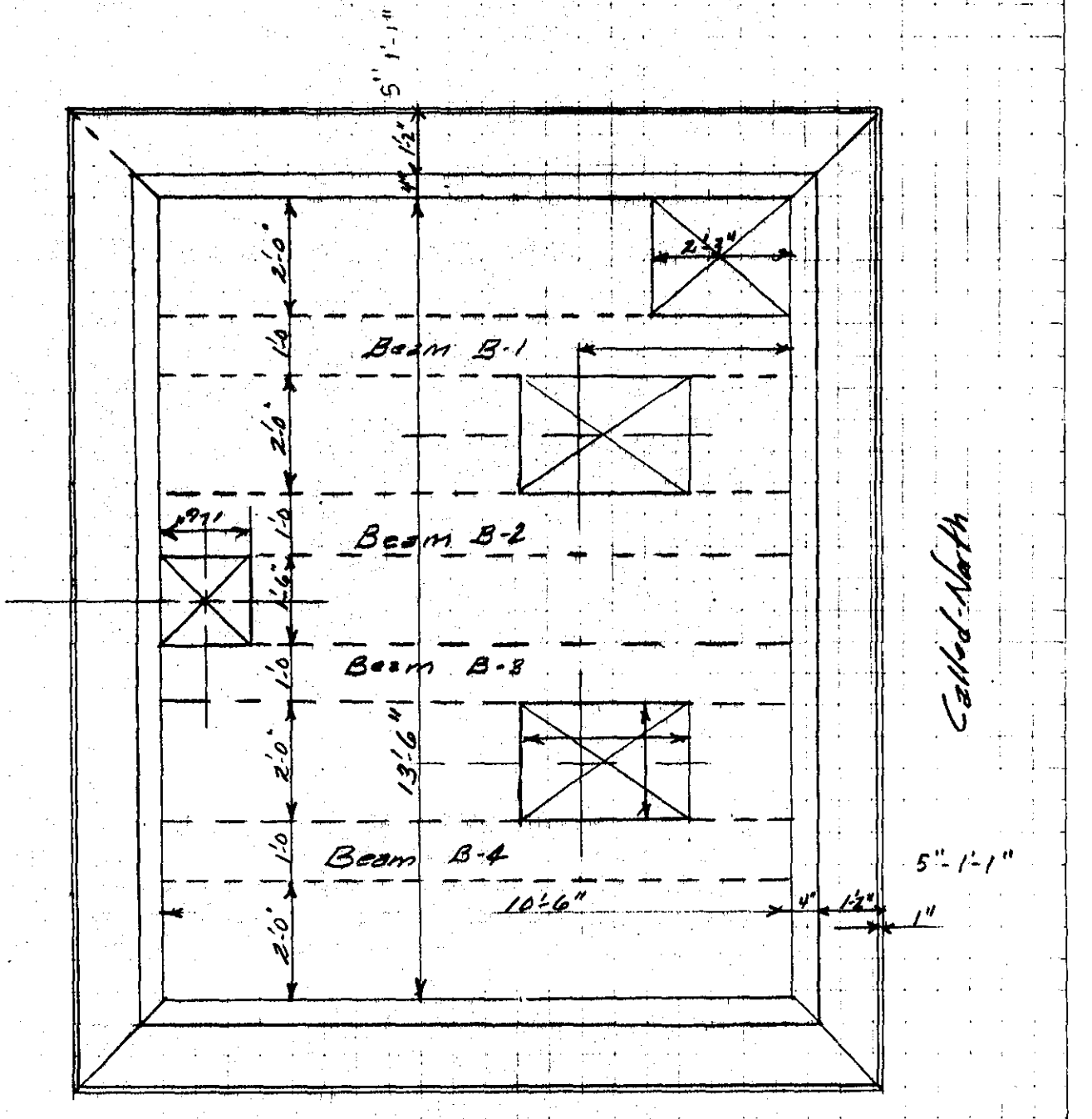
PLAN: Roof
Scale - 3/8" = 1'-0"

NED FORM 223
27 Sept 49

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

PAGE DM-2

SUBJECT ANSONIA DERBY
COMPUTATION RIVER ROAD PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY R DATE DEC 1965



PLAN Operating Floor
Scale - 3/8" - 1'-0"

NED FORM 223
27 Sept 49

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CORPS OF ENGINEERS, U. S. ARMY

PAGE DM-3

SUBJECT ANSONIA DERBY
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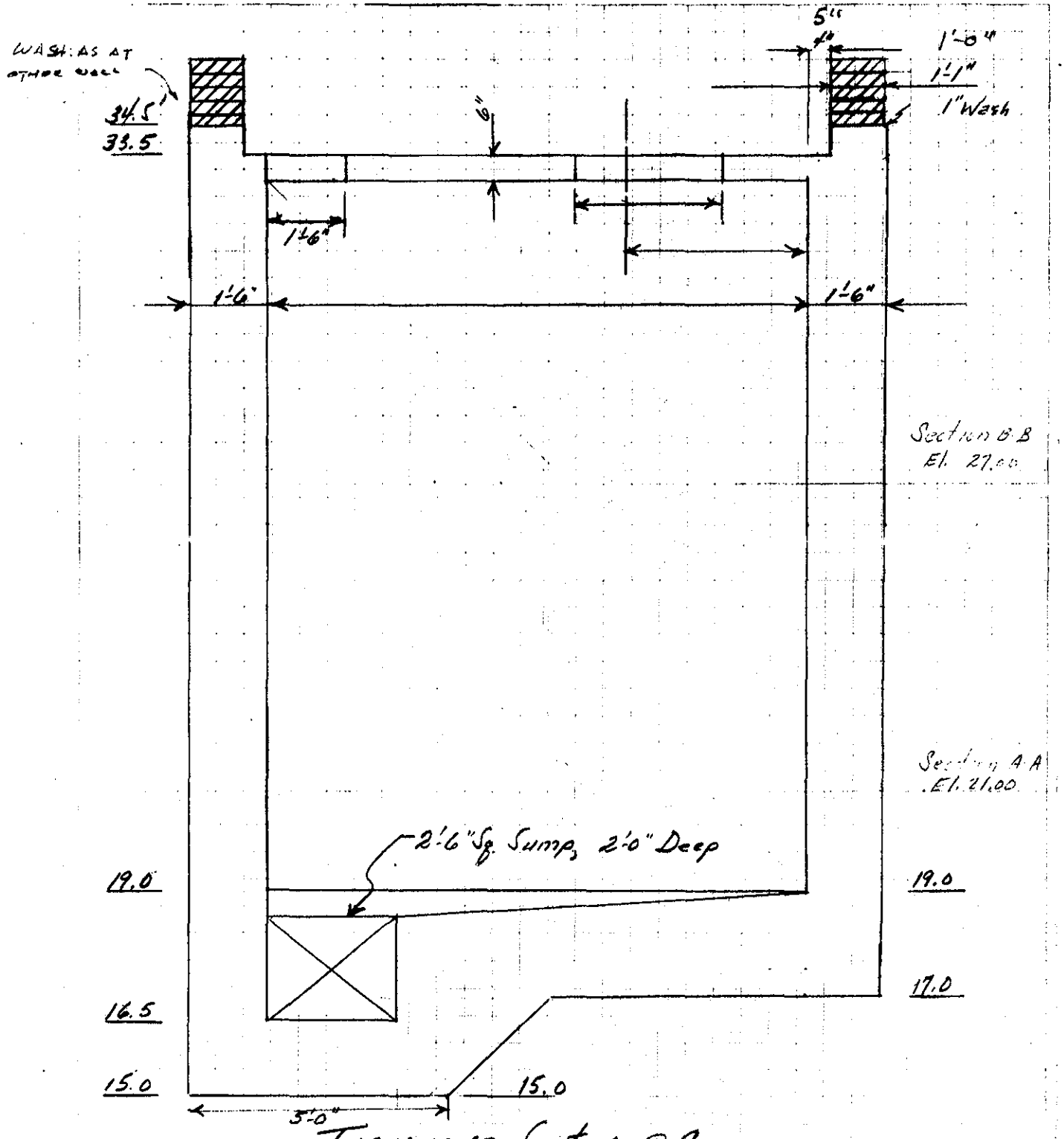


Transverse Section @ a
Scale 3/8" = 1'-0"

SUBJECT ANSONIA DERBY

COMPUTATION RIVER ROAD PUMPING STATION

COMPUTED BY E.P.G CHECKED BY A DATE DEC 1965

Equipment Weights

Pump 2@ 1.1 kips ea.

Pump Thrust .9 kips ea. - Say 1.0

Gear Unit & Base .8 " ea. Say 1.0

Crane 1.0 kips 2.0 kips Cap.
Max. wheel Load 1.3k
Wheel spacing 3'-6".

Engine 2 @ 1.0 Ea

Above from J.W.F. Nov. 24, 1965

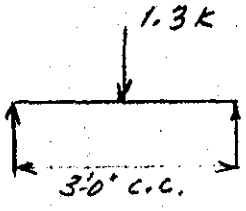
Design of Operating Floor:

All slab areas will span from side to side one way action.

Each beam will carry the load from 1/2 of each adjecent slab area, & 1/2 the load from the pump adjecent to the beam.

Equiv. floor load.

Max. Equip. Wt. 1.3k.



$M = 1/4 \times 1.3 \times 3.0 = .975$ k/'

$1/8\, wL^2 = .975$

$w = \frac{.975 \times 8}{9} = .870$ k/sf.

Typical Slab Section

$t = 6''$ $w = .075$ k/sf
L.L. + D.L. = .950 k/sf
$M = +\frac{1}{8} wL^2 = \frac{1}{8} .950 \times 3^2 = 1.07$ 'k

$dm = \sqrt{\frac{1070}{236}} = 2.0''$ ok have 4'-0"

$As = \frac{1.07 \times 6}{.88 \times 4.5} = .16$ si Use min As #~~5 @ 10~~" .31 □"/' t.& B.
#4 @ 12

$V = 2 \times .950 / 2 = .950$

$v = \frac{.950}{12 \times 4.5} = 17.5$ psi ok

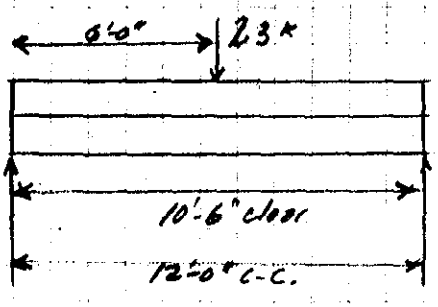
$u = \frac{.950}{1.96 \times .88 \times 4.5} = 122$ psi ok

SUBJECT ANSONIA DERBY
COMPUTATION RIVER ROAD PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY A DATE DEC. 1965

Design of Operating Floor Cont.

Since Loadings on all beams are similar only one beam needs to be designed.

Use live load on slab of .300 #/sf
Dead load of .5x.150 = .075 #/sf
Use MAX WT. of equipment @ 1 of beam (pump & gear unit) L = 2.3 kips.
When operating the load from pump, gear unit thrust & motor L = 4.1 kips will be spread over 2 beams. 2.05 k/beam



L.L. = 3x.300 k/ft. .900 k/ft.

D.L. 3.0x.5x.150 = .225 k/ft
1.0x.5x.150 = .075 k/ft.
L = 1.200 k/ft.

$$M = \frac{1}{8}wL^2 + \frac{Pl}{4} = \frac{1}{8}\times 1.200\times 12^2 + \frac{2.3\times 12.0}{4} = 21.6 + 6.9 = 28.5'k$$

$$A_s = \frac{28.5\times .6}{.88\times 10} = \frac{17.1}{8.8} = 1.95 \text{ si./each beam. (for 12" deep)}$$

A minimum of 2#9 or 3#8 will be required in the bottom of of each beam. For rigidity of floor slab it is reccomended that the beams be made square below the floor slab. Beams will be 1-0" wide by 1'-6" deep. (From top. of operating slab)

Use 18" Deep Section:
Revised $M_s = 28.5 + \frac{1}{8}wL^2 = 28.5 + \frac{1}{8}\times .075\times 12^2 = 29.85'k$

$$A_s = \frac{29.85\times .6}{.88\times 15} = 1.36 \text{ si./beam.}$$

Use min of 3#7 in bottom of each beam.
or 2#7 - 1#6

SUBJECT AMSONIA DERBY
COMPUTATION RIVER ROAD PUMPING STATION
COMPUTED BY EPG CHECKED BY D DATE DEC. 1965

Estimated Weights

Item	Factors	↓ K.	
Roof	14.5x17.5x.67x.150	25.5	NOTE: This station is rectangular (16.5x13.5). All loads except for the mechanical equipment, the additional concrete around the small sump, & other small loads are symmetrical about the ℄ lines. Therefor the vertical loads have been computed & the distributed uniformly over the base for determination of the soil bearing pressure.
Roof Bm	1.0x1.0x.10.5x.150	1.6	
Walls No.	13.5x11.5x1.1x.120	20.5	
" So	" " " "	20.6	
" East	14.3 x 11.5x1.1x.120	21.7 ~~19.0~~	
" West	14.3 x 11.5x1.1x.120	21.7 ~~19.0~~	
Op. Floor	10.5x13.5x1.0x.150	10.7 ~~21.3~~	
" " Bms.	1.0x1.6x10.5x.150 (4)	6.4	
Sump N. Wall	16.5x15.5x1.5x.150	57.5	
" S "	" " " "	57.5	
" E. "	18.5x15.5x1.5x.150	36.6	
" W. "	18.5x15.5x1.5x.150	36.6	
Base Slab	13.5x16.5x2.0x.150	66.8	
Sump —		13.1	
	Σ of Dead Load.	~~Total~~	
		396.7	
Eng & Misc		4.2	Conc. & Equip.
Pump		2.6	$\frac{408.5}{13.5 \times 16.5} = \frac{408.5}{222.8} = 1.83$ k/sf
Gear Unit		2.0	
Crane		3.0	
	Σ D.L & Equip	408.5	Conc., Equip & Max. Water Load
Water to El. 26.0	10.5x13.5x70x.0625	62.0	$\frac{507.9}{222.8} = 2.28$ k/sf
	Σ =	470.5	2.28 k/sf will be max. combined load of uplift & soil bearing pressure.
Water to El. 30.0	10.5x13.5x4.0x.0625	35.4	
	Pump Thrust	2.0	
		507.9	Ground elev. = 33.0 Bottom of Base = 17.0 16.0 16.0x.0625 = 1.00 k/sf uplift.

NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA - DERBY
COMPUTATION RIVER STREET PUMPING STATION
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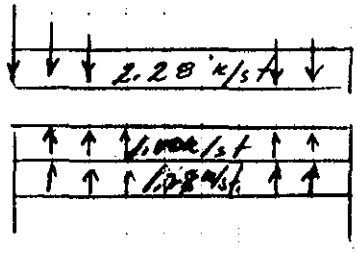
Determination of S.B.P. & Loads on base.



Total wt. of Sta. 2.28 k/sf

Uplift (33.0 - 17.0) = 16.0 x .0625 = 1.00 k/sf

Total S.B.P. = 2.28 - 1.00 = 1.28 k/sf

Net S.B.P on Base Slab =
1.28 - (2 x .150) = 1.00 k/sf.

Total uplift = .0625 x 16 x 13.5 x 16.5 = 223.^{k}

P_{e+w} = 62.5 + .5(135 - 62.5) = 99. #/cu/

P_{e+w} = .099 x $\frac{\pi 6^2}{12}$ x $\frac{1}{2}$ x 16.5' = 210.^{k} ⇄

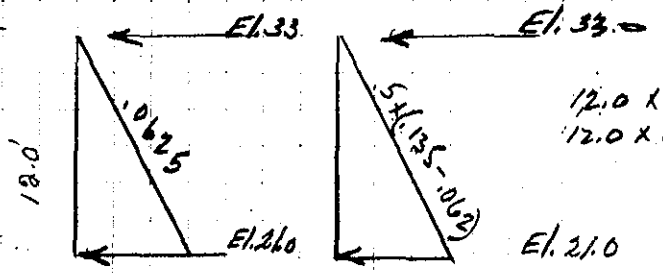
SUBJECT Ansonia Derby
COMPUTATION River Road Pumping Station
COMPUTED BY E. P. G. CHECKED BY AD DATE Nov. 1965

Design of Walls

Span Lengths - Vertical 14.0' clear 15.5' c.c.
Horizontal 13'-6" " 15.0' c.c.
" 10'-6" " 12.0' c.c.

Take trial horizontal section 2'-0" up from base. Section @ El. 21+00.

Loading. -



$12.0 \times .0625 = .750$ k/sf
$12.0 \times .0365 = .440$ k/sf

$\Sigma = 1.190$ k/sf
SAY 1.20 k/sf

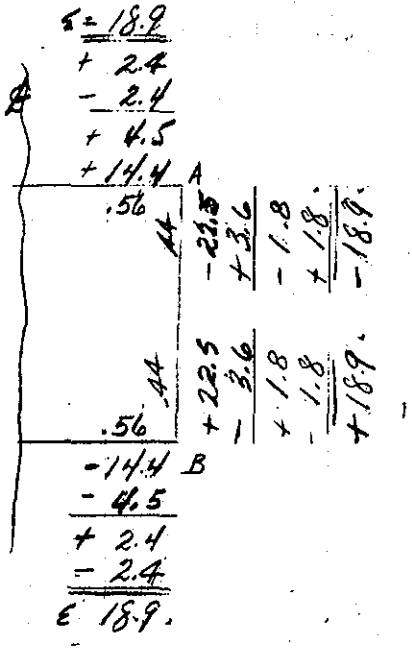
$FEM_{A-B} = 1/12\ wL^2 = 1/12 \times 1.20 \times 15.0^2 = 22.5$ 1/k'

$FEM_{B-C} = 1/12\ wL^2 = 1/12 \times 1.20 \times 12.0^2 = 14.4$ 1/k'

	d	d^3	L	d^3/L
A-B	1.0	1.0	15.0	1/15.0
B-C	1.0	1.0	12.0	1/12.0

Joint A

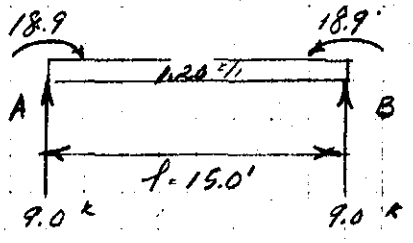
$\frac{12.0}{27.0} = .445$ $\frac{15.0}{27.0} = .555$



SUBJECT Ansonia Derby
COMPUTATION River Road Pumping Station
COMPUTED BY E. P. G. CHECKED BY A DATE Nov. 1965

Design of Walls Cont.

Span A-B



$R_A = R_B = 15.0 \times 1.20 \times 1/2 = 9.0'k$

$V = 0$ @ ℄

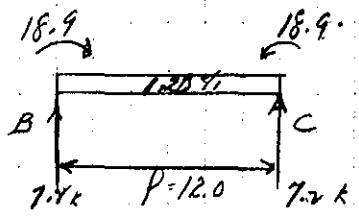
ΣM @ ℄

$M = +R_a \times 7.5 - \frac{7.5^2}{2} \times 1.20 - 18.9 =$

$M = +9.0 \times 7.5 - 33.7 - 18.9 =$

$M = +67.5 - 33.7 - 18.9 = 14.9$ '/k ℄

Span B-C



$R_B = R_C = 12.0 \times 1.20 \times 1/2 = 7.2'k$

$V = 0$ @ ℄

ΣM @ ℄

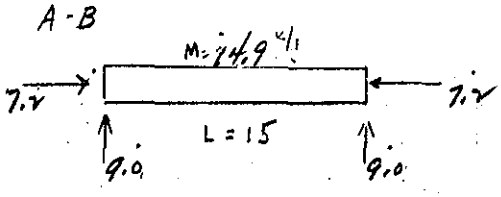
$M = +R_B \times 6.0 - \frac{6.0^2}{2} \times 1.20 - 18.9 =$

$M = 7.2 \times 6.0 - 21.6 - 18.9 = 2.7$ '/k

Design of Members.-

$t = 18''$ $d'' = 3.5''$ $t/2 - 3.5 = 5.5$

A-B



$M_s = M + \frac{d''N}{12} = 14.9 + 5.5 \times \frac{7.2}{12} = 18.2$ '/k

$A_s = \frac{18.2 \times 1.6}{.88 \times 14.5} - \frac{7.2}{20} = .86 - .36 = .50$ si/ft.

Use #7 @ 1'-0"

$A_s = \frac{14.4 \times 1.6}{.88 \times 14.5} = .68$ si/ft. = #8 @ 1'-0"

Using direct stresses $M_s = 14.4 + \frac{d''N}{12} = 14.4 + 3.3 = 17.7$ '/k

$A_s = \frac{17.7 \times 1.6}{.88 \times 14.5} - \frac{7.2}{20} = .83 - .36 = .47$ si/ft.

$v = V/bd = 19.0/12 \times 14.5 = 57$ psi

$u = \frac{9.0}{3.14 \times .88 \times 14.5} = 224$ psi ok

Neg. $A_s = \frac{18.9 \times 1.6}{.88 \times 14.5} = .89$ si/ft. N.G.
Reduce mom.

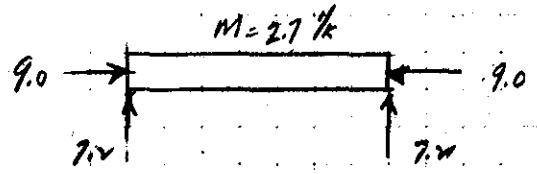
Reduce Neg. Mom.

$18.9 - 1/3\, V_a = 18.9 - \frac{1}{3}\, 9.0 \times 1.5 =$

$M_s = 18.9 - 4.5 = 14.4$ '/k

SUBJECT ANSONIA DERBY
COMPUTATION RIVER ROAD PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY A DATE NOV. 1965

Design of Members Cont.



$t = 18''$ $d'' = 3.5''$ $t/2 - d'' = 9'' - 3.5'' = 5.5''$

$M_s = M + \frac{d''N}{12} = 2.7' + \frac{5.5 \times 9.0}{12} = 6.8'/k$

$A_s = \frac{6.8 \times 1.6}{.88 \times 14.5} = .32$ si/ft. #6@1'-0"

possible #5@1'-0"
$A_s = .31$ si/ft.

$v = \frac{V}{bd} = \frac{7.2}{12 \times 14.5} = 41$ psi ok

$u = \frac{V}{\Sigma o j d} = \frac{7.2}{1.96 \cdot .88 \cdot 14.5} = 286$ psi ok

Pos. Mom. @ midspan - use min As. —

NED FORM 223
27 Sept 49

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

PAGE D14-12

SUBJECT Ansonia Derby

COMPUTATION

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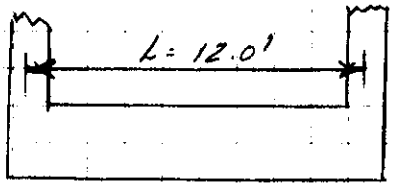
Design of Base Slab: for use with horizontal Sections



↑ Uplift = 1.00 k/sf
↑ S.B.P. 1.28 k/sf
Σ 2.28
Conc 2x.150 = .300
2.00 k/sf. Not Loading on Base Slab

Span = 12.0'
Ends - fixed.

$M = 1/12\, wL^2 = 1/12 \times 2.0 \times 12.0^2 = 24.0$ 'k @ ends.

$A_s = \frac{24.0 \times 12}{.88 \times 19.5} = .84$ si/ft. outside @ ends.

@ ℄ $M = wL^2/24 = 12.0$ 'k. As reqd. = .42 s.i.

NED FORM 223
27 Sept 49

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

PAGE DM-13

SUBJECT ANSONIA DERBY

COMPUTATION

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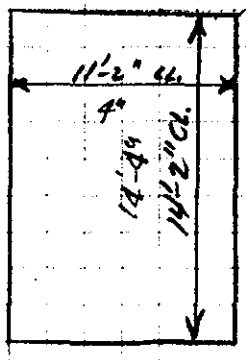
Design of Roof Slab
Use ACI Method #2 Section A2002

Case 5 4 sides discontinuous



$m = \frac{12.16}{15.16} = .80$

Short Span
Neg mom. coeff. .043
Pos. " " .064

Long Span
Neg mom coeffs .033
Pos. " " .050

loads
roof dins. = 10.
conc. est 5" = 100.
L.L. 30.
.140 k/sf

$S = 12.16'$ $w = .140$ k/sf

$M = CwS^2 = .064 \times .140 \times 12.16^2 = 1.33$ '/k
" $= .043 \times 20.70 = .89$ '/k

" $= .033 \times 20.70 = .68$ '/k
" $= .050 \times 20.70 = 1.03$ '/k

$A_s = \frac{1.33 \times .6}{.89 \times 5} = .18$ si/ft. Use #4 @ 1'-0"

Edge Loading
Short Span $= \frac{wS}{3} = \frac{.140 \times 12.16}{3} = .567$ k/ft.

Long Span $= \frac{wS}{3}\left(\frac{3-m^2}{2}\right) = .567\left(\frac{3-.8^2}{2}\right) = .670$ k/sf

$v = \frac{670}{12 \times 5} = 11.1$ psi ok

$w = \frac{670}{1.57 \times .89 \times 5} = 96$ psi

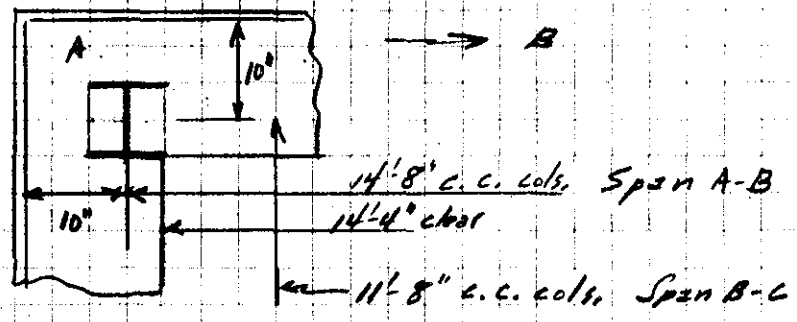
SUBJECT Ansonia Derby

COMPUTATION

COMPUTED BY E.P.G. CHECKED BY R DATE Dec. 1965

The Roof and crane will be supported by structural frame. The frame will consist of four columns connected by horizontal beam at the eave.

For purposes of design say column lines are 10" from the exterior faces of the walls. The exact positioning of columns will depend on requirements of the brick work.

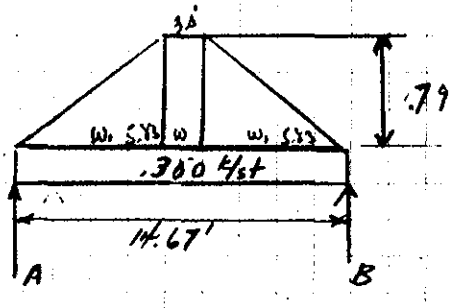


Typical Col. Location
Not to Scale.

Design of Roof Beams
Beam A-B = RB ①

Dead Load Bm. 1.0 x 1.0 x .150 = .150 k/'
Roof Overhang. = .150 k/'
.300 k/'

Max. Slab Load @ ℄
5.67 x .140 = .794 k



$V_L = V_R = .300 \times 7.33 + 1.5 \times .794 + 5.83/2 \times .794$
$= 2.2 + 1.19 + 2.31 = 5.71$ kips

$\Sigma M @ ℄ = 7.33 \times 3 + \frac{5.83 \times .794}{2} \times \left(\frac{5.83}{3} + 1.50\right) + 1.50 \times .794 \times .75 - 5.7 \times 7.33$

$= 21.70 + 8.05 + 7.95 + .90 = 24.90$

req'd. S = $\frac{24,900}{22,000} \times 12 = 13.1$ Use 8 WF 17

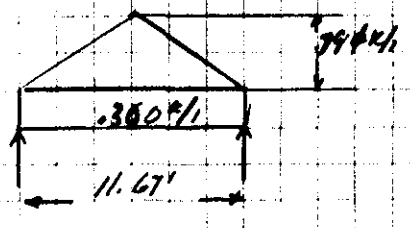
SUBJECT Ansonia Derby

COMPUTATION

COMPUTED BY EPG CHECKED BY A DATE Dec. 1965

Beam - B-C Short Span

Dead Load of Beam = .150 k/l
Max. Slab Load @ ℄ = 7.08 x .140 = .990



$V_L = V_R = .300 \times \frac{11.67}{2} + .794 \times \frac{11.67}{2} \times \frac{1}{2} =$

$1.75 + 2.37 = 4.07$ k

$M = 1/8\, wL^2 + \frac{WL}{6} = 1/8 \times .300 \times 11.67^2 + .794 \times \frac{11.67}{2} \times \frac{11.67}{6} =$

$M = 5.1 + 9.01 = 14.1$ 'k

reqd. $S = 18.1 / 22{,}000 \times 12 = 9.35$ Use 8 WF 17

Crane Beam.

Capacity of Crane = 2.0k Wheel Spacing = 3'-6"
Bridge wt. = 1.0k.
Hoist Wt. = 1.0k. Est. Assume Crane is hand
Max. Wheel Load = 1.3 kips. operated, so impact may be omitted.

Long. P = 10% Lat. P = 10%

Design Crane beam for Span A-B.

Longitudinal force = .1 x 2 x 1300 = 260#

Lat. force .10 x .75 x = =

SUBJECT Ansonia Derby

COMPUTATION

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Design of Crane & Runway

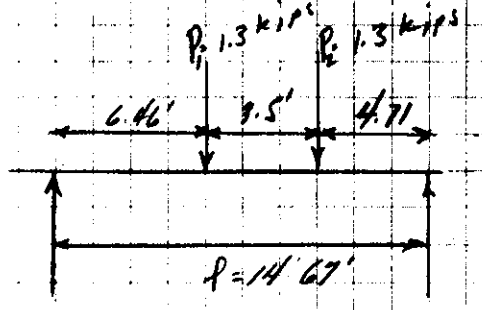
Crane Capacity = 2.0 k
Bridge wt = 1.0 k
Hoist wt = 1.0 k Est.
Max. Wheel Load = 1.3 kips

Wheel Spacing = 3'-6"

No Impact (Manual Operation) (see note below)

Long. Forces 10% of max. wheel load (Applied @ Top of rail)

Lateral Forces 10% of Trolly wt. + rated Crane Capacity 3/4 of this amount to be distributed equally among crane wheels @ either side of runway & applied @ top of rail.



Impact figured in computations

Max. M occurs @ x

$$x = \frac{L - a/2}{2} = \frac{14.67 - 3.5/2}{2} = 6.46'$$

Vert. Loads - D.L. Assume 40# WF
40# Rail 13#/'
Σ = 53#/'

D.L. Moment =
$= 1/8\, WL^2 = 1/8 \times .053 \times 14.67^2 = 1.42$

L.L. Mom. $= \frac{1.3}{2 \times 14.67}\left(14.67 - \frac{3.5}{2}\right)^2 = 7.40$

Impact = .10 × 7.4 = .74

Long. Force = .10 × 2 × 1.3 × 0.67 = .17 k

9.73 k = M xx

Lateral Load. w = .1(100 + 2000) = 300#

On each wheel 3/4 × 300 × 1/2 = 112# acting on top of rail.

$$M_{yy} = \frac{112}{2 \times 14.67}\left(14.67 - \frac{3.5}{2}\right)^2 = 640\ \#'$$

SUBJECT ANSONIA DERBY

COMPUTATION

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M_{xx} @ ℓ = 9.73 '/k'

M_{yy} = .875 '/k

Try 8" WF 24 S_{xx} = 20.8 S_{yy} = 5.6 $\frac{d}{bt}$ = 3.07

$\frac{Ld}{bt}$ = 14.67 x 12 x 3.07 = 540 Allowable f_a = $\frac{12,000,000}{540}$ = 22,300 psi

hor. f_b = $\frac{.875 \times 12}{5.6 \times .5}$ = 375. psi AISC Limit = .60 Fy = 22,000 psi
O.C.E. Limit = .85 (22,000) = 18,700 psi

Vert f_b = $\frac{9.73 \times 12}{20.8}$ = 5600. psi
5975 < 18700 ok Use 8 WF 24 unless a larger size is required for framing.

Check Deflection:

$\frac{L}{d}$ = $\frac{14.67 \times 12}{7.93}$ = 22.1

$\frac{\Delta}{L}$ = $\frac{22.1}{20} \times \frac{5.6}{20} \times \frac{1}{360}$ = $\frac{1}{1165}$

Δ = $\frac{14.67 \times 12}{1165}$ = .15"

Δ = $\frac{PL^3}{48EI}$ = $\frac{2600 \times 1.728 \, (14.67)^3}{48 \times 29,000,000 \times 82.5}$ =

Δ = 0.125

Allowable Δ = $\frac{L}{1000}$ = $\frac{14.67 \times 12}{1000}$ = .176 > .17 ok use 8 WF 24

Use 30# Rail

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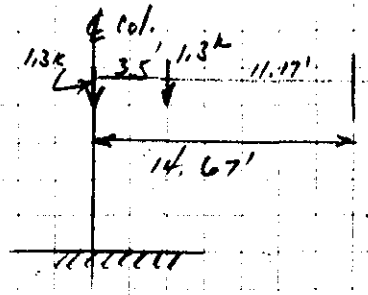
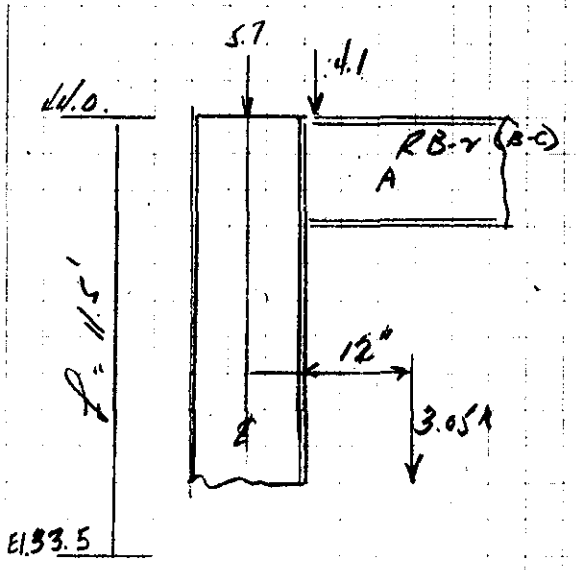
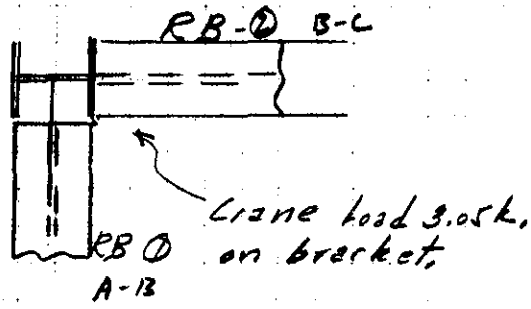
Design of Columns.

For maximum load on col. place a crane wheel over the bracket.



D.L = 14.67 x .055 x 1/2 = .405
L.L. = 1.3 (2 - 3.5/14.67) = 2.280
Impact (2.28) x .16 = .365
3.050 k MAX. Crane R.





Assume 8" WF 17 Cols.
MAX. M. = 3.1 x 4.0 + 3.1 x 16.0 = 16.4 + 49.5 = 66. '/k.
V = 5.7 + 4.1 + 3.1 = 12.9 kips
fa = 12.9/5.00 = 2.8 k/si
ℓ/r = 11.5x12/1.16 = 119. ok. Ld/bt = 119 x 8.0/5.25 x .31 = 584 < 600
Cc = 126.1
Fa = 16.43 #/si Fe' = 10 550 #/si

fb = M/S = 66,000/14.1 = 4700 psi. Fb = .60 x 36000 = 21,600.

NED FORM 223
27 Sept 49

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

PAGE DM-19

SUBJECT ANSONIA DERBY

COMPUTATION

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Design of Columns Cont.

$\frac{f_a}{F_a} = \frac{2600}{10430} = .251 \quad .251 > 0.15$ therefor

$\frac{f_a}{F_a} + \frac{C_m f_b}{\left(1 - \frac{f_a}{F'_c}\right) F_b} \leq 1.0 \qquad \frac{2600}{10430} + \frac{.85 \times 4300}{\left(1 - \frac{2600}{10,550}\right) 21600.} = .251 + .23$

$= .48 < 1.0$ ok Use 6WF17

NED FORM 223
27 Sept 49

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SUBJECT Ansonia Derby
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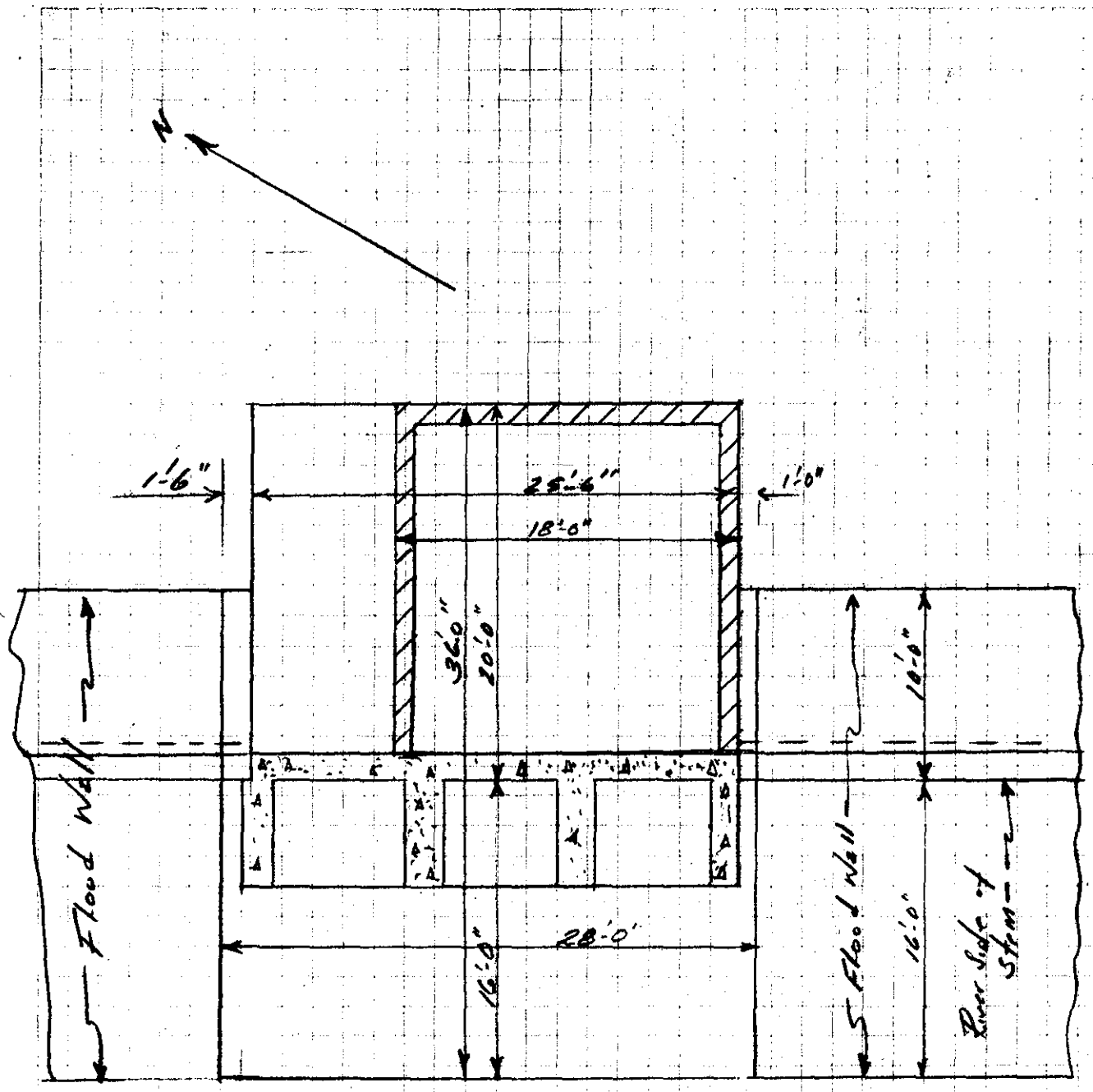

Plan View
Scale 1/8" = 1'-0"

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27 Sept 49

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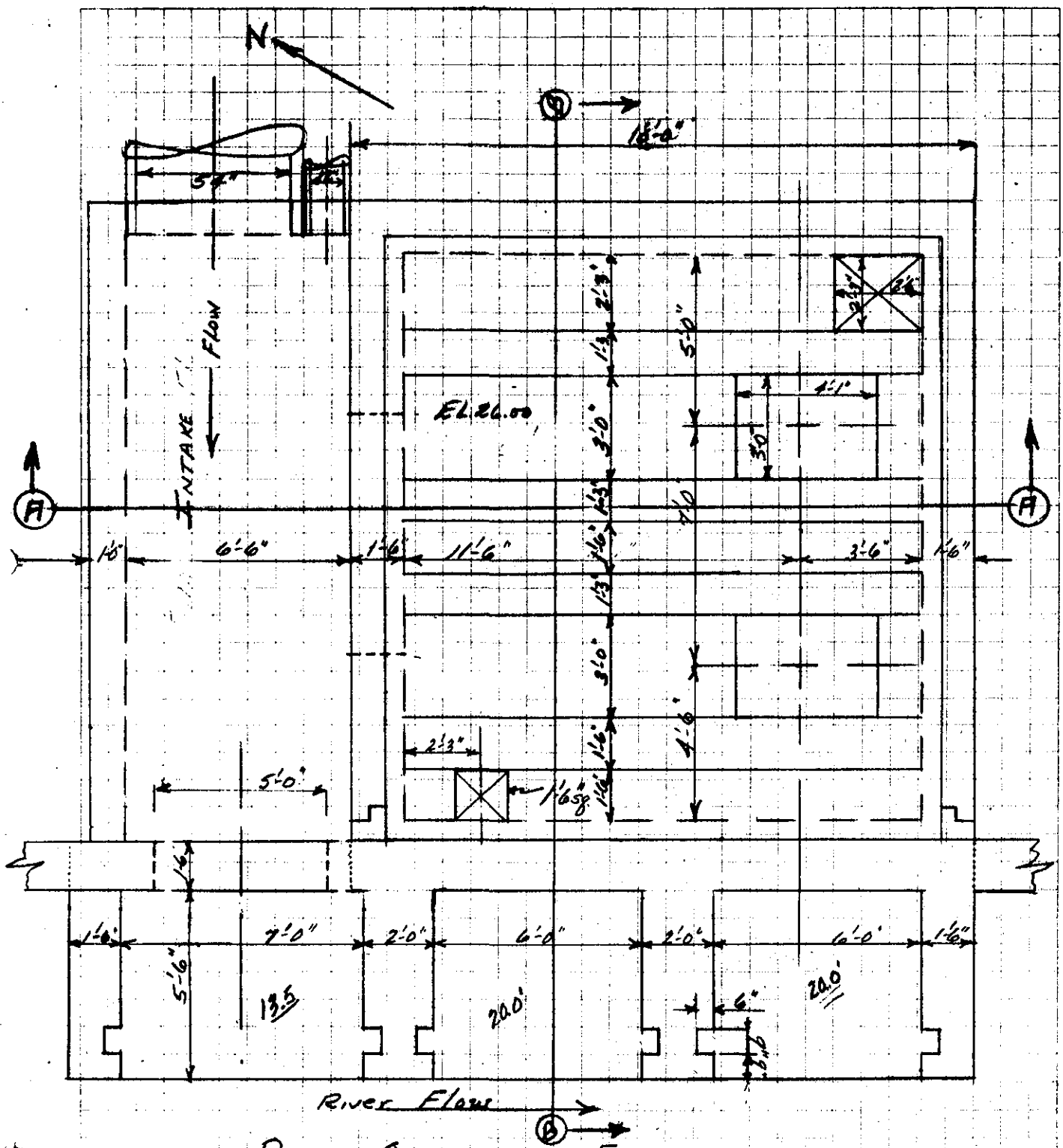

PLAN OPERATING FLOOR
Scale 1/4" = 1'-0"

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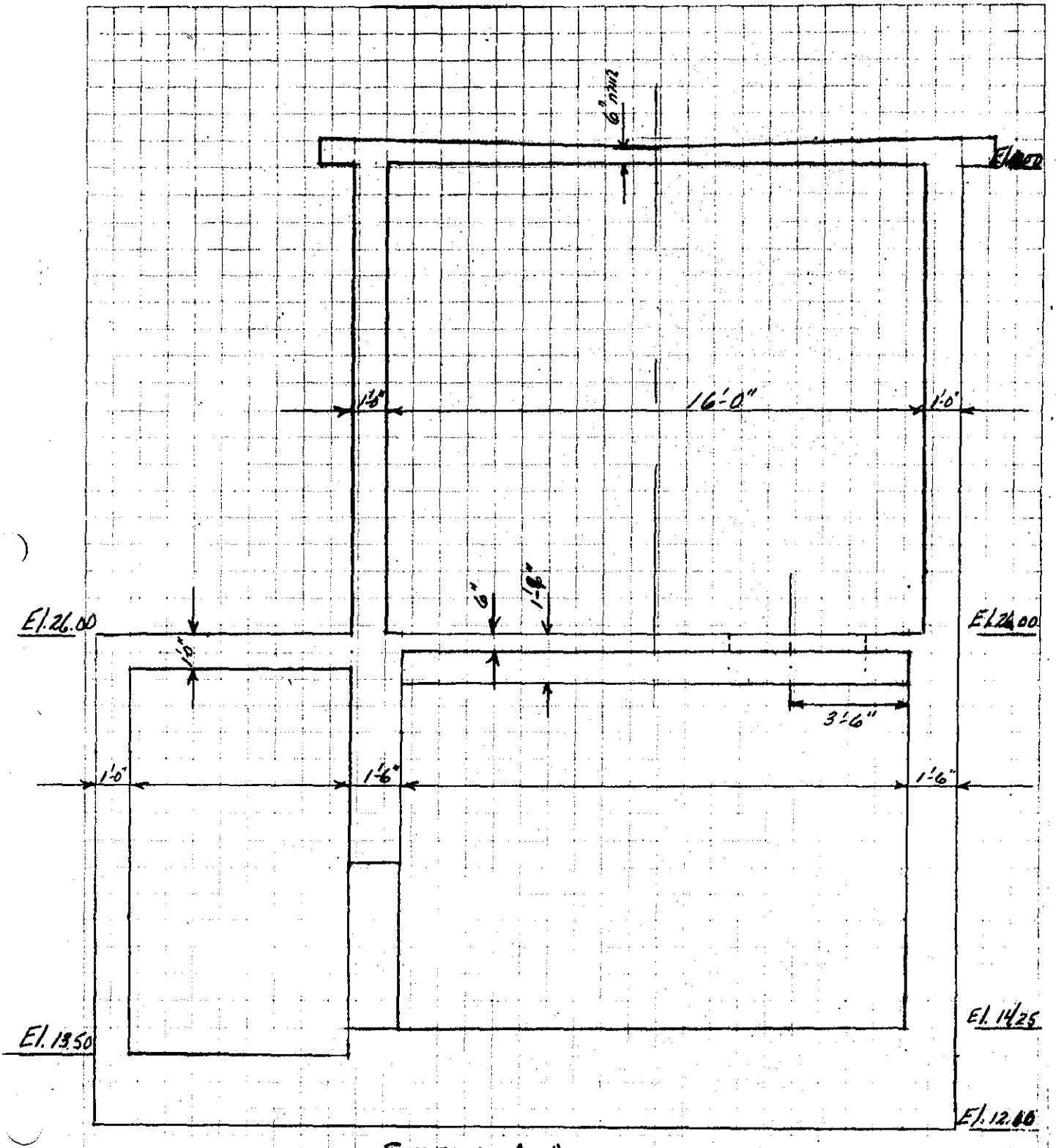

SECTION A-A
SCALE 1/4" = 1'-0"

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27 Sept 49

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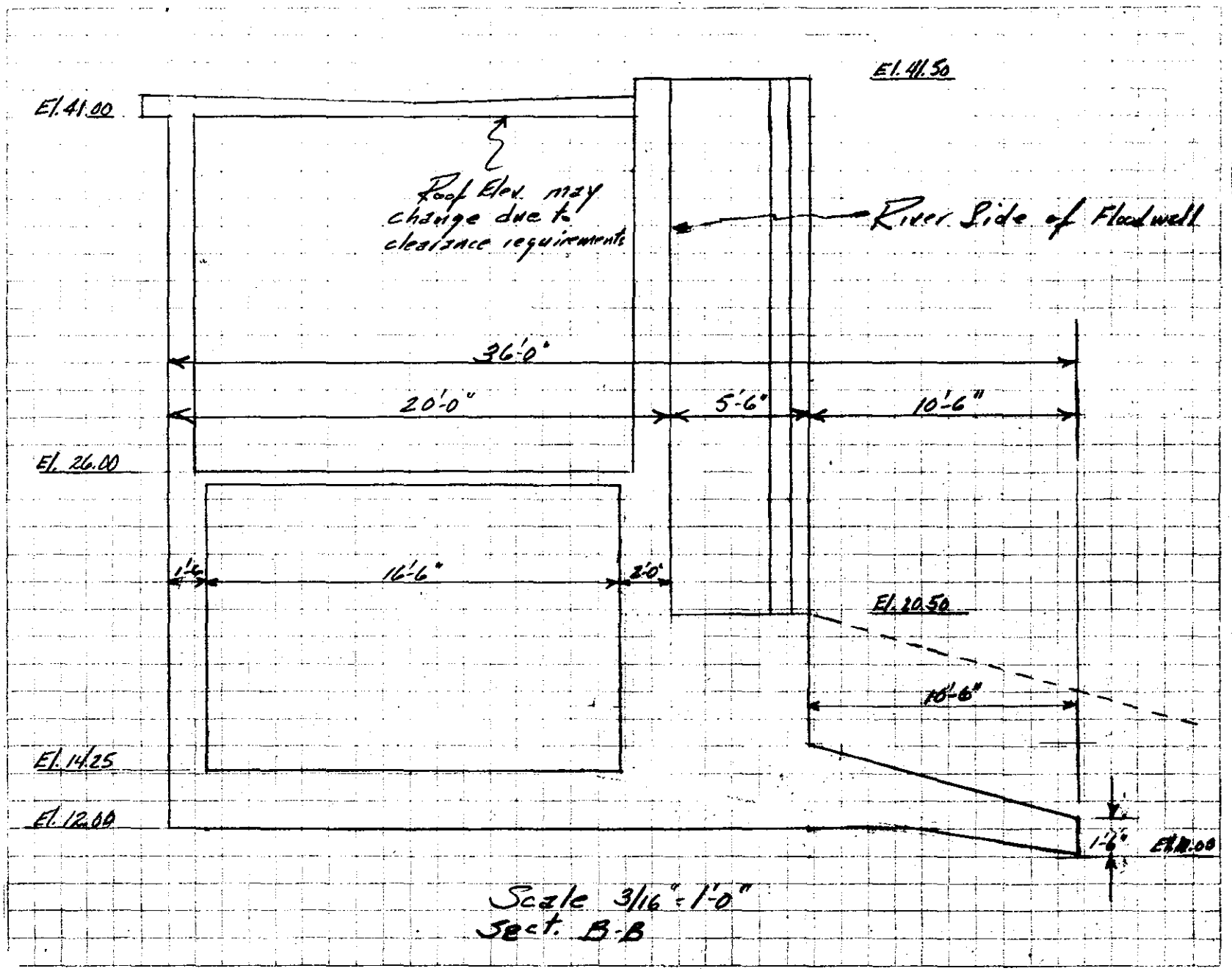
SUBJECT ANSONIA DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY DATE JAN 1966

PAGE DM-23



Scale 3/16" = 1'-0"
Sect. B-B

NED FORM 223
27 Sept 49

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

PAGE DM-27

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
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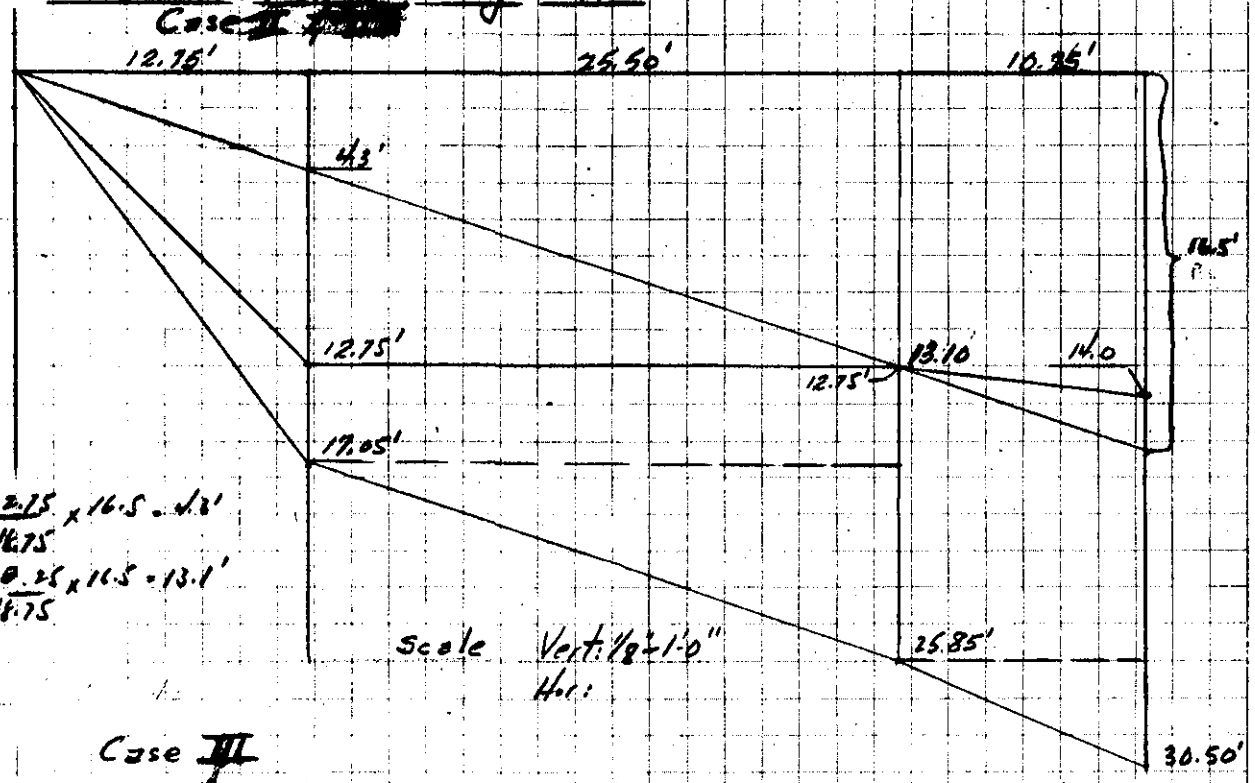
Creep Path & Uplift Diagrams:
Case II

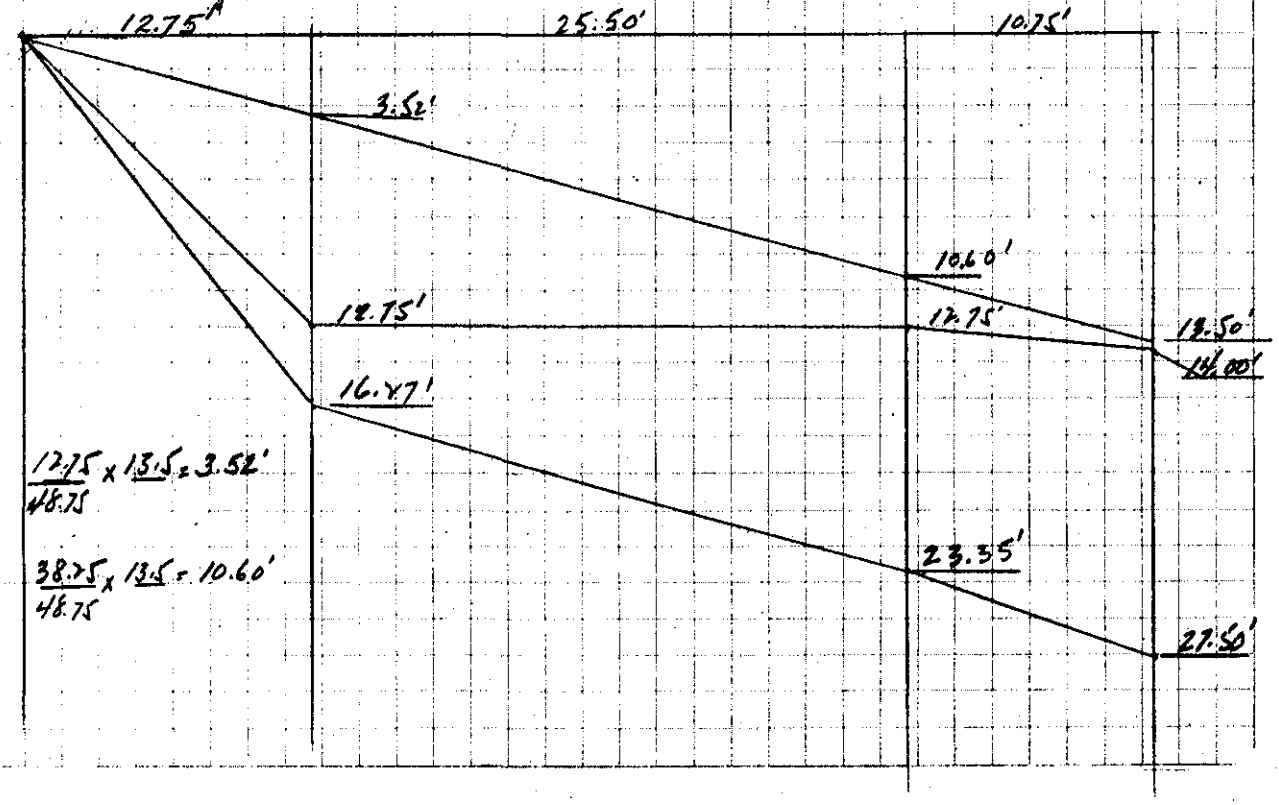


$\frac{12.75}{48.75} \times 16.5 = 4.3'$

$\frac{38.25}{48.75} \times 16.5 = 13.1'$

Scale Vert: 1/8" = 1'-0"
Hor:

Case III



$\frac{12.75}{48.75} \times 13.5 = 3.52'$

$\frac{38.25}{48.75} \times 13.5 = 10.60'$

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COMPUTATION MAPLE STREET PUMPING STATION
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Design of Roof Slab:

Use ACI Method II four sides discontinuous

Long Span - 17'-6" clear 18'-6" c.c.
Short Span - 16'-0" clear 17'-0" c.c.

$m = \frac{17.0}{18.5} = .918$ Say .90.

Loading
Conc. Min 6" Max. 10½" ± (slope of ½"/ft.) Ave 8½" Say 9."

Conc. .75 x .150	=	112
Roofing	=	10
Live Load	=	30
		152 Say .150 #/sf.

$M = C w s^2$

Short Span	Neg. @ edge	$M = .038 \times .150 \times \overline{17.0}^2$	=	1.65 '/k
"	" Pos. @ ℄	$M = .057 \times .150 \times \overline{17.0}^2$	=	2.47 '/k
Long "	Neg. @ edge	$M = .033 \times .150 \times \overline{17.0}^2$	=	1.43 '/k
" "	Pos. @ ℄	$M = .050 \times .150 \times \overline{17.0}^2$	=	2.17 '/k

$A_s = \frac{2.47 \times .6}{.89 \times 4.5} = .37$ si/ft. #5 @ 10" Bot. Short Span

$A_s = \frac{2.17 \times .6}{.89 \times 4.5} = .33$ si/ft. #5 @ 10" Bot. Long Span

$A_s = \frac{1.65 \times .6}{.89 \times 4.5} = .25$ si/ft. #5 @ 12" Top. Both Ways.

Edge Loading
Short Span $\frac{ws}{3} = \frac{.150 \times 17.0}{3} = .850$ k/'

Long Span $\frac{ws}{3}\left(\frac{3-m^2}{2}\right) = .850 \times \left(\frac{3-\overline{.90}^2}{2}\right) = .850 \times 1.09 = .925$ k/'

Check V $v = \frac{V}{b\,d} = \frac{.975}{12 \times 7.5} = 16$ psi ok.

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Design at Operating Floor

Maximum Wt. of Single Equipment Unit 5000.# Each Pump

Determine Equivalent Uniform floor Load

Maximum Span between floor beams - 3'-0.
Say pump base is 2'x2'. 5000/4 = 1250# point load.
If pump is over 2' load on 4th. section will be 250#.

$\frac{Pl}{4} = \frac{2.5 \times 4.0}{4} = 2.5^{k}$

$2.5^{k} = \frac{1}{8} w L^2$

$2.5 = \frac{1}{8} w (4-0)^2$

$w = \frac{2.5 \times 8}{4 \times 4}$

$w = 1.25$ #/sf. Note this is

excessive for floor loading
so use actual equipment loads
& Live load of 300#/sf.

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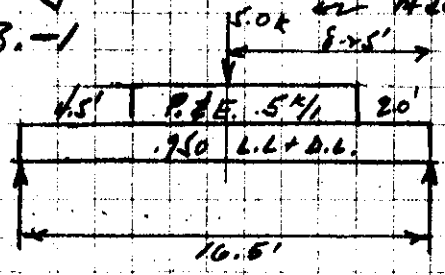
Design of Operating Floor

FB.-1



Add. pump. Slab width
1'-1½ + 1'-3 + 1'-6 = 3'-10½ Say 4.0'

DL = 1.40 x .75 x 1.75 x .150 = .534
LL = 4.0 x .100 = .400
.934 k/'
Say .950 k/'
(use for all beams)

$R_A = \frac{.950 \times 16.5}{2} + \frac{5.0}{2} + \frac{.5 \times 10\,(2 \times 2 + 10)}{2 \times 16.5} = 7.83 + 2.5 + 2.12 = 12.45^k$

$R_B = 7.83 + 2.5 + .5 \times 10\left(\frac{2 \times 4.5 + 10}{2 \times 16.5}\right) = 13.21^k$

$\Sigma M @ V = 0 \quad 12.45 \times 8.25 - .950 \times \frac{8.25^2}{2} - \frac{3.75^2}{2} \times .5 = M$

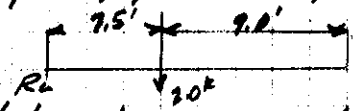
$M = 102.5 - 32.3 - 3.5 = 67.0^{k'}$

$d_m = \sqrt{\frac{67.0}{236 \times 15}} \frac{12}{} = 15.1''$ req'd. have 21" total o.k.

$A_s = \frac{67.0 \times 6}{18.5 \times .89} = 2.42\ si$ Use 2#8 & 1#9

FB-2 Make Similar to FB-1

FB-3 Similar to FB-1 & FB-2 with possibility of additional load of 2.0k from pipe under floor Slab.



Additional Ra Σ of Ra = 13.55, R_B = 14.11k V=0 @ ℄

Ra $\frac{9.0}{16.5} \times 2.0 = 1.1$

$\Sigma M\ 13.55 \times 8.25 - 32.3 - 3.5 - 2.0 \times .75 = 74.2^{k'}$

RB $\frac{7.5}{16.5} \times 2.0 = .9^k$

As Req'd. $\frac{74.2 \times 6}{18.5 \times .89} = 2.74\ si$ 2#9 - 1#8

FB-4 Loading is similar to FB-3 & Beam is 1'-6" vs 1'-3" for FB-3

Since all beams are similar depth and loading use same reinforcing in all beams. i.e. 2#9 & 1#8

NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA DERBY
COMPUTATION MAPLE STREET PUMPING STATION
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D.L. + L.L. = .075 + .300 = .375 k/sf

	A		B		C		D		E		F
	3'-0"		4'-4"		2'-9"		4'-3"		3'-6"		
		.41	.59	.61	.39	.39	.61	.55	.45		
	+.28	-.28	+.59	-.59	+.24	-.24	+.56	-.54	+.38	-.38	
	+.28	-.11	-.17	+.21	+.14	-.13	-.19	+.18	+.18	+.38	
	-.06	-.14	+.11	-.09	-.07	+.07	+.05	-.09	+.19	+.04	
	+.06	+.02	-.02	+.10	+.06	-.05	-.07	-.05	-.05	-.04	
-M =	-.00	-.51	+.51	-.37	+.37	-.35	+.35	-.60	+.60	-.00	
V =	+.39k	+.73	+.84	+.78	+.53	+.51	+.86	-.74	+.83	+.49	
+M =		.17'k		.43'k		.04'k		.38'k		.28'k	

FEM: A-B = B-A = 1/12 wL² = 1/12 x .375 x 3.0² = .28 'k
B-C = CB = 1/12 wL² = 1/12 x .375 x 4.83² = .59 'k
C-D = DC = 1/12 wL² = 1/12 x .375 x 2.75² = .24 'k
D-E = ED = 1/12 wL² = 1/12 x .375 x 4.25² = .56 'k
E-F = FE = 1/12 wL² = 1/12 x .375 x 3.5² = .38 'k

Neg As @ E: As = $\frac{.60 \times .6}{.89 \times 5.0}$ = .08 si/ft.

Pos. Mom. As = $\frac{.43 \times .6}{.89 \times 5.0}$ = .058 si/ft.

∴ From above use #4 top & bottom each way in floor slab.

*Independent Check for Steel #4 @ 12

SUBJECT ANSONIA DERBY
COMPUTATION MAPLE STREET PUMPING STATION
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Design of Spandrel Beams:

Edge Loading of Slab.

short span $\frac{wS}{3} = \frac{150 \times 17}{3} = 850$ #/'

Long span $\frac{wL}{3}\left(3 - \frac{m^2}{2}\right) = \frac{150 \times 17}{3}\left(3 - \frac{.9^2}{2}\right) = 890$ #/'

Use additional load of 2(150) for roof over wall & roof overhang. Since both loadings are close use maximum & make beams similar in design

.890 + .300 = 1.190 #/' Say 1.2 k/ft.

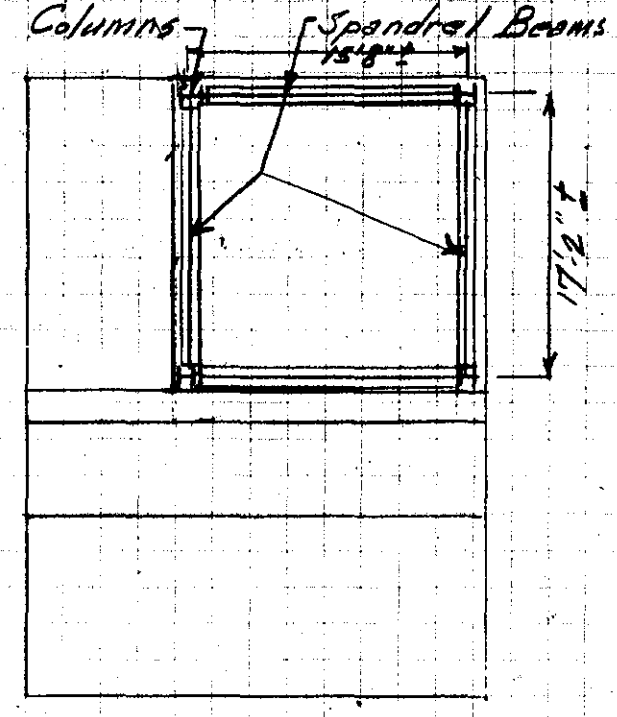
$M = \frac{1}{8} wL^2 = \frac{1}{8} \times 1.20 \times 18.5^2 = 51.1$ '/k $S_{req'd} = \frac{51 \times 12{,}000}{22{,}000} = 27.8$

Use 8x8 WF 35 for all Spandrel Beams.

Beam Loads to Columns

$\frac{18.5 \times 1.20}{2} = 10.9$ = R = SB #1

$\frac{16.67 \times 1.20}{2} = 10.0$ k, R = SB #2



SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
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Crane Design

The crane rails will run from East to West. The rails will be supportted @ each corner by the structural steel columns.

Span c.c. Columns - 16'-6"
Crane Capacity - 6000#
Bridge Weight - 1000#
Hoist Weight - 400#
Clear ℄ rail to wall 6" min
Wheel Spacing 3'-6"

Impact - None for hand operated cranes (EM 1110-2-3104)
Long Factor 10%
Lateral " 10% of (trolly wt. & rated cap.) 3/4 of this dist. to rails on each side @ top of rail.

Total trolly load
Trolly - 400.
Load - 6000.
6400. #

Crane beam Load

6400 x 14.25/15.00 = 6100.
Bridge 1000 x 1/2 = 500.
6600. #

Longitudinal Force
.10 x 6600 = 660# @ 9" ℄ of crane beam (3" rail + 1/2 of 12" beam)

Lateral Force
(.10 x 3/4 x 6600) = 495# 2 wheels.

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COMPUTATION Maple Street Pumping Station
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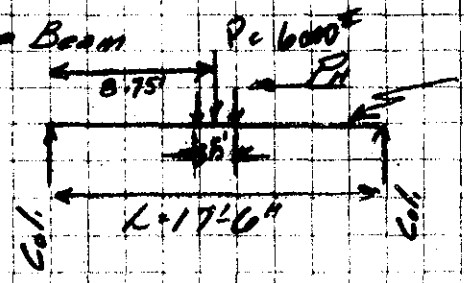
Crane Design

Crane Beam



Est. 70# Beam & 30#/rail
L = 100#/LF

Reaction of Bm.
$6600 + \frac{17.5 \times .100}{2} = 7.475$

Say 7.5 K.

$$\text{Max MQ } \Delta = \frac{6.6 \times 17.5}{4} + .660 \times .75 + \frac{1}{8} \times .100 \times 17.5^2 =$$

$$M_{xx} = 28.0 + .5 + 3.8 = 33.1 \text{ '/k}$$

$$M_{yy} = .495 \times 17.5 \times 1/4 = 2.17 \text{ '/k}$$

Trial Section 12" WF 36

$$f_{xx} = \frac{33.1 \times 12.0}{45.9} = 8700 \text{ \#/si}$$

$$f_{yy} = \frac{2.170 \times 12}{7.2 \times .5} = 7300 \text{ \#/si} \quad S = 16,000$$

OCE Limit $= .85 \times 22000 = 18,700$

Check Deflection ✓

$$\Delta = \frac{PL^3}{48EI} + \frac{5wL^4}{384EI} = \frac{6600 \times 17.50^3 \times 1728}{48 \times 29 \times 10^6 \times 281} + \frac{5 \times .100 \times 17.50^4 \times 1728 \times}{384 \times 29 \times 10^6 \times 281} =$$

$$= \frac{6.1 \times 10^{10}}{39.1 \times 10^{10}} + \frac{8.1 \times 10^{10}}{313 \times 10^{10}} = .157 + .026 = .183'' \checkmark$$

$$\text{Allowable } \Delta = \frac{L}{1000} = \frac{17.50 \times 12}{1000} = \frac{.210}{1000} = .210'' > .183'' \text{ O.K.}$$

SUBJECT Ansonia - Derby
COMPUTATION Maple Street Pumping Station
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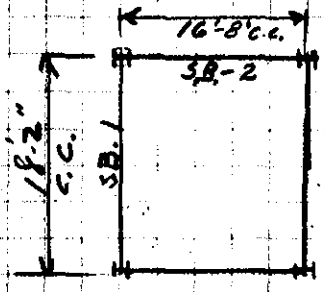
Column Design

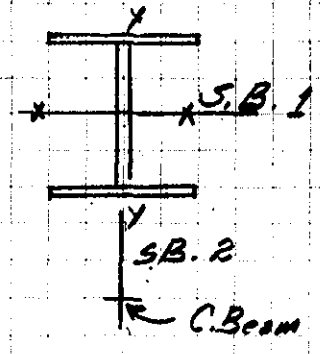
All columns will be similar. There will be one located in each corner of the structure.

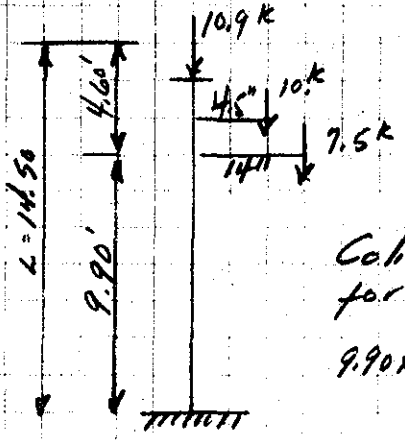


Loads on Columns.

		V	Arm.
Sp. Beam #1	+	10.9 k	1/2"
" " #2	−	10.0 k	4 1/2"
Crane	−	7.5 k	14"

Try 8" WF 31

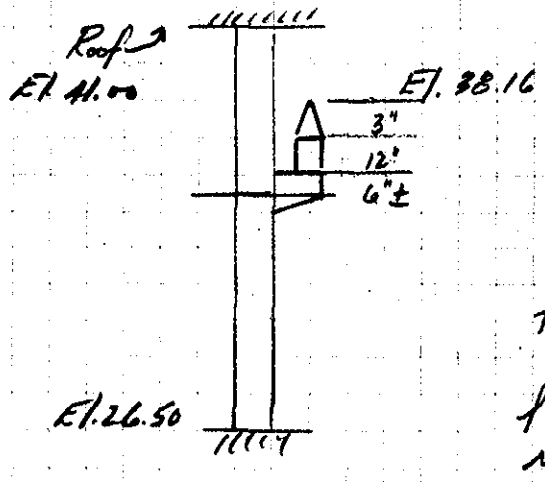




Loading Diagram

Col is unrestrained for 9.90'

9.90 x 12 = 118.5"



M_{x-x} =
C.B. x 14" + S.B. x 4.5' =
7.5 x 14" + 10.0 x 4.5 = 150"/k

$V = 7.5 + 10.0 + 10.9 = 28.4^k$

$f_a = \frac{V}{a} = \frac{28400}{9.12} = 3110.$ #/si

$l = 12 \times 14.50 \times .75 = 130$ (partially restrained)
$r = 2.01$ (of 3.4)

$l/r = 130/2.01 = 65 < 126.1$

NED FORM 223
27 Sept. 49

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

SUBJECT: ANSONIA DERBY
COMPUTATION: MAPLE STREET PUMPING STATION
COMPUTED BY: E.P.G. CHECKED BY: R DATE: April 1966

* Min Fe

Column Design Cont.

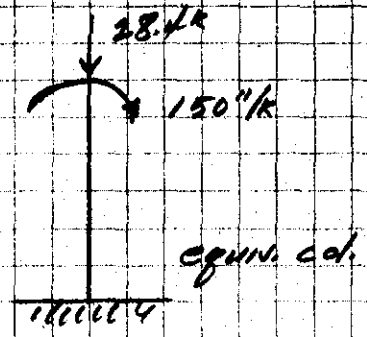
$C_c = 126.1$

$F_a = .85(16.94) = 14.4$ ksi

* $F'_e = 35.29$

$F_y = 36{,}000$

$f_t = \frac{150000}{27.4} = 5500$



$\frac{l_t}{r_t} = \frac{120 \times 8.0}{8.0 \times .43} = 303 < 600$

$F_t = .60 \times 36{,}000 = 21600$

$\frac{f_a}{F_a} = \frac{C_m f_t}{\left(1 - \frac{f_a}{F'_e}\right) F_t} = \frac{3110}{14400} + \frac{.85 \times 5500}{\left(1 - \frac{3110}{35{,}290}\right) 21600}$

$= .216 + \frac{4680}{.912 \times 21600} = .216 + .237 = .453 < 1.0$ ok

SUBJECT ANSONIA - DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY R DATE FEB 1966

Summary of Loading Conditions

1. Normal Operating Condition
   A. Concrete (Including Extension)
   B. Earth Backfill to El. 26.0
   C. No Water in Sump

1A. Normal Operating Condition with Wind
   A. Concrete
   B. Earth Backfill to El. 26.0
   C. No Water in Sump
   D. Wind from Land Side @ 50 #/s.f.

2. Maximum Flood Condition
   A. Concrete
   B. Backfill to El. 26.0
   C. Water in Sump to El. 22.0
   D. Water on Riverside to El. 41.50
   E. Uplift Varing by creep method from full to groundlevel

2A. Maximum Flood Condition
   A. Concrete
   B. Backfill to El. 26.0
   C. Water in Sump to El. 17.0
   D. Water on Riverside to El. 41.50
   E. Uplift varing by creep method from full to groundlevel

3. Design Flood
   A. Concrete
   B. Backfill to El. 26.0
   C. Water in Sump to El. 22.0
   D. Water on River Side to El. 38.5
   E. Uplift Varying by creep method from full to groundlevel

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY E.P.G. CHECKED BY A DATE Jan. 1966

Stability - Concrete Structure

Item	Factor	Wt.	y	Mx	x	My
1. Roof Slab	20.0 x 19.5 x .75 x .150	43.9	8.5	373.	16.5	725.
2. No. Wall	18.0 x 14.0 x 1.0 x .150	37.8	.75	28.	16.5	624.
3. E. Wall	17.5 x 14.0 x 1.0 x .150	36.8	9.75	359.	25.00	920.
4. W. Wall	17.5 x 14.0 x 1.0 x .150	36.8	9.75	359.	0.00	894.
5. Op. Fl. Bm. 1.	1.25 x 1.25 x 15.0 x .150	3.5	4.37	15.	16.50	58.
6 " 2	1.25 x 1.25 x 15.0 x .150	3.5	8.62	30.	16.50	58.
7 " 3	1.25 x 1.25 x 15.0 x .150	3.5	11.37	40.	16.50	58.
8 " 4	1.50 x 1.25 x 15.0 x .150	4.5	15.75	71.	16.50	75.
9. Op. Floor Slab.	15.0 x 14.5 x .5 x .150	18.6	9.75	181.	16.50	307.
10. E. Sump Wall	16.5 x 11.75 x 1.5 x .150	43.6	9.75	425.	24.75	1080.
11. N. " "	16.5 x 11.75 x 1.5 x .150	43.6	9.75	425.	8.25	360.
12. N. " "	18.0 x 11.75 x 1.5 x .150	47.6	.75	36.	16.50	785.
13. Opening West W.	-5.0 x 7.0 x 1.5 x .150	- 7.9	9.75	- 77.	8.25	- 65.
14. Intake N. Wall	7.5 x 11.5 x 1.0 x .150	12.9	.50	6.	4.25	55.
15 " W. "	16.5 x 11.5 x 1.0 x .150	28.5	19.25	263.	.50	14.
16 " Roof	7.5 x 18.5 x 1.0 x .150	20.8	9.25	187.	3.75	76.
17. Flood Wall						
So. El. 445 hole	26.0 x 15.5 x 1.5 x .150	90.7	19.25	1746.	12.50	1134.
18. do. El. 260	28.0 x 8.6 x 1.5 x .150	63.4	19.00	1206.	16.50	1047.
19. do. @ Intake	8.0 x 1.5 x 18.5 x .150	22.5	19.25	433.	3.75	84.
20. Gate Opening	5.0 x 5.0 x 1.50 x .150	- 5.6	19.25	- 108.	4.50	- 25.
21. Base of deck ch.	5.5 x 17.5 x 8.5 x .150	122.7	22.75	2792.	16.75	2056.
22. East Wing	1.5 x 5.5 x 21.0 x .150	26.0	22.75	591.	24.75	643.
23. Stop. Pier	2.0 x 5.5 x 21.0 x .150	34.7	22.75	788.	17.00	589.
24. Stop " "	2.0 x 5.5 x 21.0 x .150	34.7	22.75	788.	9.00	312.
25. West Wing	1.5 x 5.5 x 28.0 x .150	34.7	22.75	788.	0.25	9.
26. Base Slab Sta.	18.0 x 20.0 x 2.12 x .150	114.5	10.00	1145.	16.50	1889.
27. " Intake	7.5 x 18.5 x 1.5 x .150	31.2	9.25	288.	3.75	117.
28. " "	7.0 x 8.5 x 1.5 x .150	13.4	22.00	295.	3.75	50.
		960.9 K		13479. ft.K		13931. ft.K

$\Sigma \frac{M_{yy}}{V} = \frac{13931}{960.9} = 13.87' = x$

$\Sigma \frac{M_{xx}}{V} = \frac{13479}{960.9} = 14.03' = y$

$e_x = 13.87 - \frac{25.50}{2} = 1.12'$

$e_y = 14.03 - \frac{25.50}{2} = 1.28'$

The base slab is rectangular with the exception of a small area @ the S.W. corner (i.e. 6' x 7.0') which may be neglected. The c.g. of the base slab will be on the ℄s.

NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA - DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY A DATE JAN. 1966

Stability - Equipment & Exterior Loads,

ITEM	FACTOR	Wt.	y	Mx	x	My
Haunches	4 x 1.0 x 1.0 x 1.25 x .150	.8	9.75	7.5	16.50	12.7
Crane Bm & Rail	2 @ 70#/ft (Est.) x 17.0'	2.4	9.75	23.2	16.50	39.3
Engines	2 @ 3.0 k	6.0	10.0	60.0	14.75	88.5
Gear Units	2 @ .8 k.	1.6	10.0	16.0	20.50	32.8
Pumps	2 @ 5.0 k.	10.0	10.0	100.0	20.50	205.0
Flap Valves	2 @ .6 k	1.6	10.0	16.0	17.00	27.2
Wall Pieces	2 @ 1.4	2.8	10.0	28.0	17.00	47.6
Disch. Pipe	1 @ 2.0	2.0	11.3	22.6	15.75	31.5
Gate 7x5						
Wall piece	1.8	1.8	9.75	17.6	7.5	13.5
Frame	2.8	2.8	9.75	27.3	7.5	21.0
Leaf & Stem	4.0	4.0	9.75	39.0	7.5	30.0
Floor stand	.3	.3	9.75	2.9	7.5	2.2
Gate 5x6						
Wall Piece	1.5	1.5	20.0	30.0	4.25	6.4
Frame	2.3	2.3	20.0	46.0	4.25	9.8
Leaf & Stem	2.5	2.5	20.0	50.0	4.25	10.6
Floor stand	.3	.3	20.0	6.0	4.25	1.3
Conc. Mat.						
So. Side	10.5 x 26.0 x 2.00 x .150	81.9	30.5	2498.-	13.0	1065.-
	Sub Total, —	124.6		2990.-		1644.4
Fill on Mat	10.5 x 17.5 x 5.0 x .135	124.0	30.5	3782.-	17.25	2139.-
Pe North	14.0' x .135 x ½ x .5 x 26.0	172.-	+ 4.8	825.6	—	—
Pe East	14.0' x .135 x ½ x .5 x 18.5	122.-			- 4.8	- 585.-
Pe West	14.0' x .135 x ½ x .5 x 18.5	122.-			+ 4.8	585.-
Pe South	6.5 x .135 x ½ x .5 x 17.5	25.0	- 1.2	- 30.0	—	—
		248.6		7567.7		3783.4

$\Sigma Pe(E-W) = 0$
$\Sigma Pe(N-S) = 157.2$ k. N.

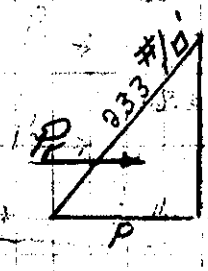
NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA-DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY R DATE JAN 1965

Stability - Exterior Water Loads - Maximum Flood Condition

		Wt.	y	Mxx	x	My-y
Vertical Water Loads						
W1 Intake	17.5x6.5x8.5x.062x5	60.4	9.75	588.	4.25	257.
W2 Sump	16.5x15.5x7.75x.0625	123.9	9.75	1208.	16.50	2044.
W3 Dis. Chamb 1	6.0x5.5x21.25x.0625	43.8	22.75	996.	21.00	920.
W4 " Chamb. 2	6.0x5.5x21.25x.0625	43.8	22.75	996.	13.50	591.
W5 Bypass Dis.	7.0x5.5x28.25x.0625	68.0	22.75	1547.	5.00	340.
W6 Dth Mat. -	10.5x2.0x.5x26x.0625	17.1	32.50	556.	12.50	214.
W7 Dn Mat.	10.5x26.0x27.25x.0625	465.-	30.75	14300	12.50	5812.
Uplift	17.05x36.0x25.5x.0625	-4978.-	18.0	-17604.-	12.62	-12342.-
"	13.45x36.0x24.25x.0625	-3385.0	24.0	-9260.-	12.62	-4870.-
East & West Lateral Loads Are Equal & Opposite						
Pe North	(Used as Passive Resistance)					
*Pe South	6.5x.073x½x.5x17.5	-+13.5	1.17	-16.-		
* To be omitted.						
Pw North	17.05x14.0x.062x½x26.0	+895.5	4.67	+913.-		
Pw South	30.75²x.062x½x26.0	-+774.5	9.25	-7160.-		
Σ of Unbalanced Hor. Loads 592.5		ΣV = 9541.8		-12934.-		-7034.-
592.5/26 = 22.8 lb per foot		ΣH = -592.5				



Pr & H = Pe 22.8
P = 3.26 k/'

Pr = 1.40x3.26x.5x26.0 = 592.5 4.9 + 2919.-

Σ = -1

542.- -10167.- -7034.-

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia-Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY EPG CHECKED BY R. DATE Feb. 1966

Stability - Exterior Water Loads - Design Flood Condition

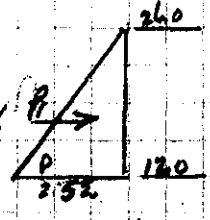
		Wt	y	M_{x-x}	x	M_{yy}
Vertical Water Loads						
W1 Intake	17.5 x 6.5 x 8.5 x .0625	604	9.75	588.-	4.25	257.-
W2 Sump	16.5 x 15.5 x 7.75 x .0625	123.9	9.75	1208.-	16.50	2044.-
W3 Dis. Ch. 1	6.0 x 5.5 x 18.25 x .0625	37.6	22.75	855.-	21.00	790.-
W4 Dis Ch. 2	6.0 x 5.5 x 18.25 x .0625	37.6	22.75	855.-	13.50	508.-
W5 By Pass.-	7.0 x 5.5 x 25.25 x .0625	60.8	22.75	1383.-	5.00	304.-
W6 On MAT	10.5 x 2.0 x .5 x 26 x .0625	17.1	32.50	556.-	12.50	214.-
W7 On MAT	10.5 x 26.0 x 24.25 x .0625	419.8	30.75	12724.-	12.50	5272.-
Uplift	16.27 x 36.0 x 25.5 x .0625	↑933.5	18.0	-16803.-	12.62	-11781.-
Uplift	11.23 x 36.0 x ½ x 25.5 x .0625	↑322.1	24.0	-7730.-	12.62	-4065.-
East and West Lateral loads are Equal & Opposite						
Pe North	(Used as Passive Resistance)					
Pe South	6.5 x .073 x ½ x .5 x 17.5	← 13.5	1.17	-16.-	—	—
Pw North	16.27 x 14.0 x .063 x ½ x 26.0	→ 186.4	4.67	+870.-	—	—
Pw South	27.75 x .063 x ½ x 26.0	← 630.8	8.17	-5153.-	—	—
	Σ =	↑ -504.4		-10663.-		-6557.-
	ΣH =	← 457.9				

Σ of Unbalanced Hor. Loads = 458.2 ←

$\frac{458}{26} = 17.62\%$

$P_R = \frac{14}{2} P = 17.62\%$

$p = \frac{35.24}{14} = 2.52\%$



$P_r = 2.52 \times 14 \times .5 \times 26.0$ → 458.- | 4.67 | +2139.-

Σ = +504.4 | -8524.- | -6557.-

NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA-DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY A DATE FEB 1966

Case 1	Normal Operating Cond.	Wtk	y	Mxx	x	Myy
1. From Sh ___	Σ of Conc.	960.9		13479		13331.—
2. From Sh ___	Σ of Equipment					
	Base & Earthfill	248.6		7567.7		3783.—
	Σ =	1209.5		21046.7		17114.—

Σ of horizontal = 157.0k from Landside

$\frac{\Sigma M_{yy}}{V} = \frac{17114}{1210} = 14.10' = \bar{x}$ $e_x = 14.14 - \frac{28.50}{2} = 1.39'$

$\frac{\Sigma M_{xx}}{V} = \frac{210467}{1210} = 17.40 = \bar{y}$ $e_y = 17.40 - \frac{36.00}{2} = 0.60'$

$\frac{\Sigma H}{V} = \frac{157.0}{1209} = .13$ ok Unbalance will be taken out by friction

Case I A	Normal Operating Cond with Wind					
1. Wind	Σ from above	1209.5		21046.7		17114.—
	18.0×16.0×.050 144k		22.0	316.0		—
		1209.5		21362.7		17114.—

Σ of Horizontal = 171.4k from Landside

$\frac{M_{yy}}{V} = \frac{17114}{1209} = 14.14 = \bar{x}$ $e_x = 14.14 - \frac{28.50}{2} = 1.39'$

$\frac{M_{xx}}{V} = \frac{21362.7}{1209} = 17.60 = \bar{y}$ $e_y = 17.60 - \frac{36.00}{2} = .40'$

$\frac{\Sigma H}{\Sigma V} = \frac{171.4}{1209} = .141$ ok Unbalance will be taken out by friction.

NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY EPG. CHECKED BY AD DATE FEB 1966

		Wt. x	y	Mx-x	x	My-y
Case III	Maximum Flood Condition Sump @ 22.0					
1.	Σ from Sh — Conc.	960.9		13479.-		13331.-
2.	Σ from Sh — Equip	124.6		2990.-		1664.4
3.	Σ from Sh — Waterloads & Passive Resistance	-504.4		-10162.-		-7034.-
	Σ =	+543.6		+6307.-		+7941.4
	$\frac{M_{yy}}{V} = \frac{7941}{544} = 14.60'$	$e_x = 14.60 - \frac{25.50}{2} = 1.85'$				
	$\frac{M_{xx}}{V} = \frac{6307}{544} = 11.58'$	$e_y = 11.58 - 18.00 = 6.42'$				
Case IIIA	Maximum Flood Condition Sump					
1.	Σ from Sh - Case	543.6		6302.-		7941.4
2.	Σ Change in Waterloads from Elev. 22.0 to 17.0	-115.4		-1125.-		-1469.-
	Σ =	+428.0		5177.-		6472.4
	$\frac{M_{yy}}{V} = \frac{6472}{428} = 15.09$	$e_x = 15.09 - 12.75 = 2.34'$				
	$\frac{M_{xx}}{V} = \frac{5177}{428} = 12.09$	$e_y = 12.09 - 18.00 = 5.91'$				
Case III	Design Flood Condition					
1.	Σ of Conc.	960.9		13479.-		13331.-
2.	Σ of Equip & Base Ext.	124.6		2990.-		1664.4
3.	Σ of Ext. Water Loads & Passive Resistance	-504.4		-8524.-		-6557.-
	Σ =	+581.1		+7945.		+8438.4
	$\frac{\Sigma M_{yy}}{V} = \frac{8438.4}{581.1} = 14.52'$	$e_x = 14.52 - \frac{25.50}{2} = 1.77'$				
	$\frac{\Sigma M_{xx}}{V} = \frac{7945}{581.1} = 13.67'$	$e_y = 13.67 - 18.00 = 4.33'$				

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY E. P. G. CHECKED BY R DATE Feb 1966
Independent CK

Soil Bearing Pressure

$\bar{e}_x = 1.39'$, $\bar{e}_y = 0.60'$

$f = \frac{P}{A} \pm \frac{P e_y c_y}{I_{xx}} \pm \frac{P e_x c_x}{I_{yy}}$

Case 1

$I_{yy} = \frac{bh^3}{12} = \frac{36.0 \times 25.5^3}{12} = 49,600 \text{ ft}^4$

$I_{xx} = \frac{bh^3}{12} = \frac{25.5 \times 36.0^3}{12} = 99,100 \text{ ft}^4$

$f_a = \frac{1210}{25.5 \times 36.0} + \frac{1210 \times .60 \times 18.0}{99,000} + \frac{1210 \times 1.39 \times 12.75}{49,600} =$

$f_a = 1.318 + .132 + .432 = 1.882$

$f_b = 1.318 - .132 + .432 = 1.618$

$f_c = 1.318 - .132 - .432 = .754$

$f_d = 1.318 + .132 - .432 = 1.018$

SBP Case II

$f_a = \frac{544}{25.5 \times 36.0} + \frac{544 \times 6.44 \times 18}{99,000} + \frac{544 \times 1.85 \times 12.75}{49,600} = 1.49 \text{ k/sf}$

$f_b = .593 - 0.635 + .259 = +.217 \text{ k/sf}$

$f_c = .593 - 0.635 - .259 = -.301 \text{ k/sf}$

$f_d = .593 + 0.635 - .259 = +.969 \text{ k/sf}$

SBP Case IIA

$f_a = \frac{428}{25.5 \times 36.0} + \frac{428 \times 5.91 \times 18.0}{99,000} + \frac{428 \times 2.34 \times 12.75}{49,600} = 1.17 \text{ k/sf}$

$f_b = .466 - .460 + .248 = .26 \text{ k/sf}$

$f_c = .466 - .460 - .248 = -.24 \text{ k/sf}$

$f_d = .466 + .460 - .248 = .66 \text{ k/sf}$

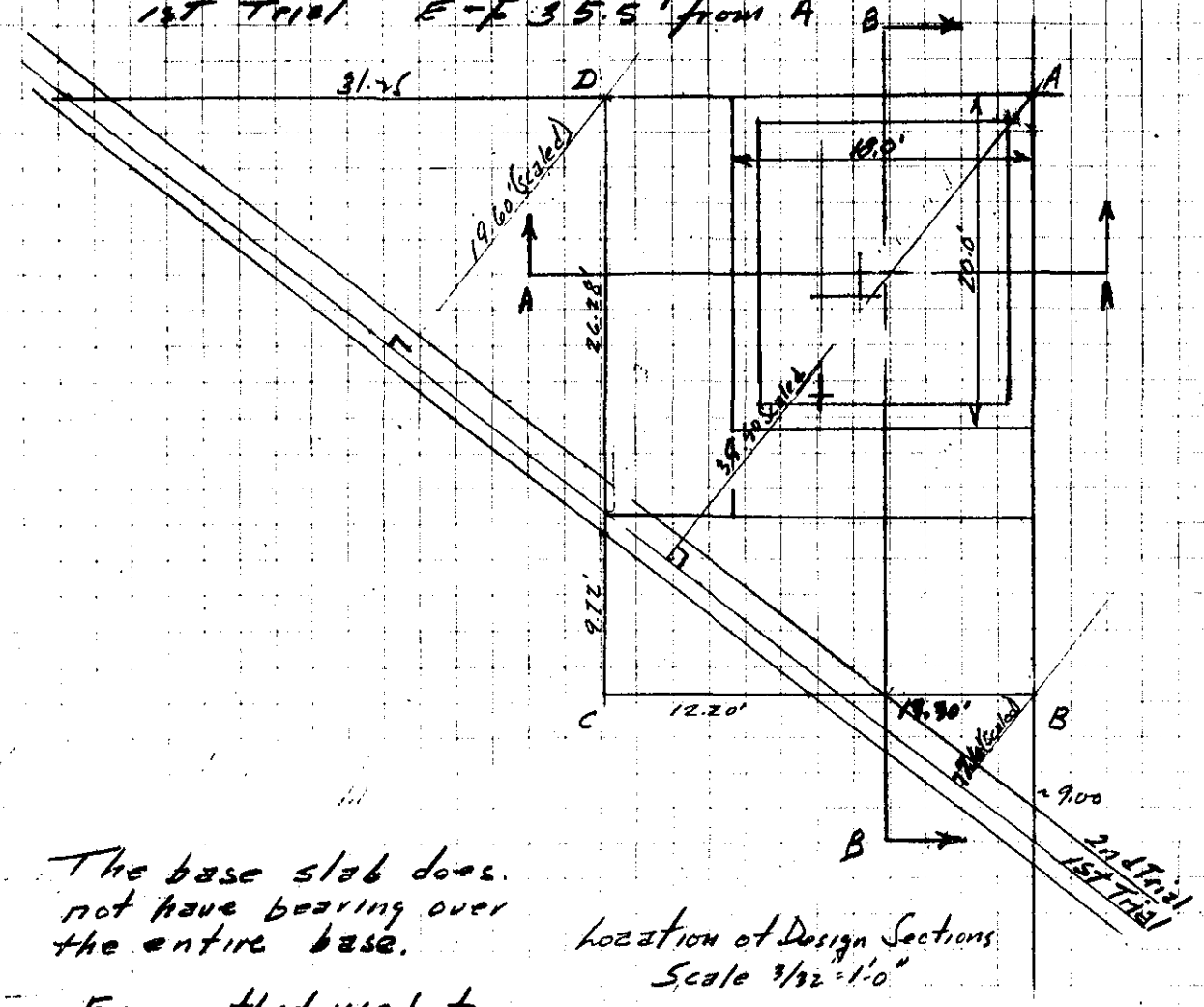
NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Maple St. Pumping Station
COMPUTED BY E.P.G. CHECKED BY R DATE Mar. 1966

Not Used R

Determination of Actual S.B.P. Case IVa
1st Trial E-F 35.5' from A



Location of Design Sections
Scale 3/32" = 1'-0"

The base slab does not have bearing over the entire base.

For method used to determine the design values of S.B.P. see

Foundations of Structures
by Dunham - McGraw Hill Pub.
2nd Edition pgs 247 - 249.

NED FORM 223
27 Sept 49

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

SUBJECT: ANSONIA - DERBY
COMPUTATION: MAPLE STREET PUMPING STATION
COMPUTED BY: E.P.G. CHECKED BY: [illegible] DATE: MAR. 1966

Determination of Soil Bearing Pressure Case III
2nd Trial Set E-F 34.0' from Pt. A.

$\frac{b}{18.0} = \frac{25.5+b}{34.0}$ $\frac{a}{5.60} = \frac{36.0+a}{34.0}$

16.00 (neglect)
~~15.50~~ $b = 459$ $28.40\,a = 201.6$
$b = \cancel{29.61}\ 28.7$ $a = 7.10'$

$J = \frac{(1-y/y_1)A}{A/x} = \frac{(1-25.5/55.1)\,36.0}{36.0/43.10} = \frac{.54 \times 36.0}{.83} = 23.40'$

$K = \frac{(1-A/x)B}{B/y} = \frac{(1-.83)\,25.50}{.46} = \frac{.17 \times 25.50}{.46} = 9.40'$

$L_1 = \sqrt{y^2+x^2} = \sqrt{55.1^2+43.10^2}$ $I_1 = \frac{bh^3}{12} = \frac{70.0 \times 34.0^3}{12} = 229,000.$

$L_1 = \sqrt{4894} = 69.96'$

$L_2 = \sqrt{y^2+x^2} = \sqrt{29.6^2+23.4^2}$ $I_2 = \frac{bh^3}{12} = \frac{37.7 \times 18.10^3}{12} = 18,600$

$L_2 = \sqrt{1423.8} = 37.73'$

$L_3 = \sqrt{y^2+x^2} = \sqrt{7.10^2+9.40^2}$ $I_3 = \frac{bh^3}{12} = \frac{11.8 \times 5.60^3}{12} = 170$

$L_3 = \sqrt{138.8} = 11.78'$ $\Sigma I = 210,200.$ ✓

$P_1 = \frac{(420 \times \cancel{19.50}\ 18.00)\,34.0}{210,200} = \frac{278,000}{210\ 200} = \cancel{1.39}\ 1.22$ k/sf $\frac{1.32}{34} = \cancel{.039}\ .036$

$\Sigma = 542 - 93 - 26 = 423$ k

Tot. Ld $= \frac{\cancel{22.99}\ 70.0 \times 34.0^2}{6} \times \cancel{.039}\ .036 = \cancel{542}\ 485.$ k

$P_{Ld} = 18.10 \times .039 = .704$ k/sf

$Ld_2 = \frac{\cancel{37.24}\ 37.7 \times \cancel{18.00}\ 18.10^2}{6} \times \cancel{.039}\ .036 = \cancel{95.7}\ 74.$ k

$P_{Ld} = 5.60 \times .039 = .218$ k/sf

$Ld_3 = \frac{\cancel{12.96}\ 11.8 \times 5.60^2}{6} \times \cancel{.039}\ .036 = \cancel{26.9}\ 2.$ k

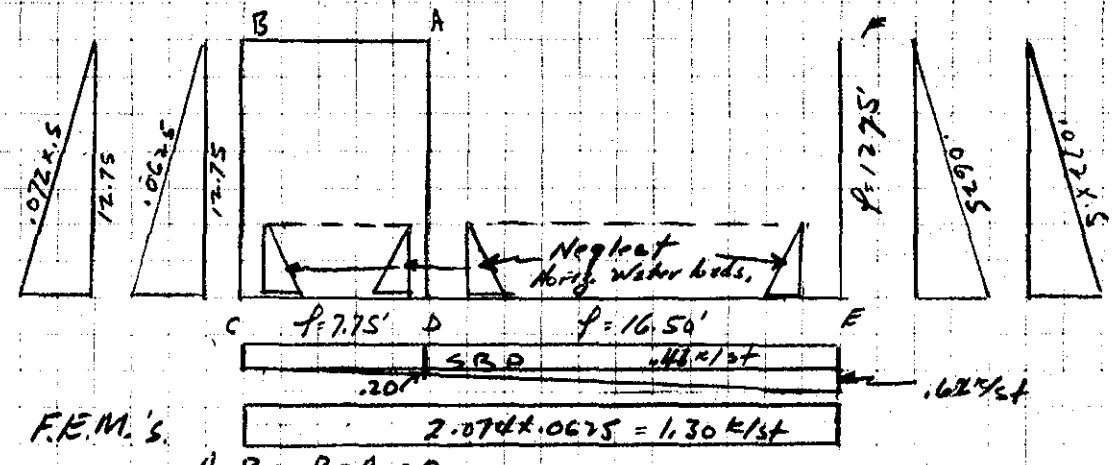
$\Sigma = 409$ vs. 420.
The value used 1.32 V 1.22 k/sf will give a conservative loading.

SUBJECT: ANSONIA DERBY
COMPUTATION: MAPLE STREET PUMPING STATION
COMPUTED BY: E.P.G. CHECKED BY: A DATE: MAR. 1966

Design of Walls & Base Slab

Section A-A Case II A

Member	L	d	d^3	d^3/L	K
A-B	7.75	12.0	1728	18.6	1.65
B-C	12.75	12.0	1728	11.3	1.00
C-D	7.75	18.0	5832	62.7	5.55
D-E	16.50	24.0	13800	69.7	6.16
E-F	12.75	18.0	5832	38.1	3.37
A-D	12.75	18.0	5832	38.1	3.37



F.E.M.'s

A-B = B-A = 0

$$B\text{-}C = \frac{wL^3}{30} = \frac{.0985 \times \overline{12.75}^3}{30} = 6.8'/k$$

$$C\text{-}B = \frac{wL^3}{20} = \frac{.0985 \times \overline{12.75}^3}{20} = 10.2'/k$$

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY E.P.G. CHECKED BY R. DATE

Design of Walls Cont.
Section A-A Cont. Case II A

FEM's Cont.

C-D

Water 3.5 x .0625 =	.220 k	
Conc 1.5 x .150	= .225 k	
S.B.P.	.41 k	
Uplift	-1.30 k	
Σ	= 1.26 k	

$M_{C-D} = 1/12\, wL^2 = 1/12 \times 1.26 \times 7.75^2 = 6.3$ '/k

$M_{CD} = 1/30\, wL^2 = 1/30 \times .20 \times 7.75^2 = .4$ '/k

$M_{D-C} = 1/20\, wL^2 = 1/20 \times .20 \times 7.75^2 = .6$ '/k

MD-E

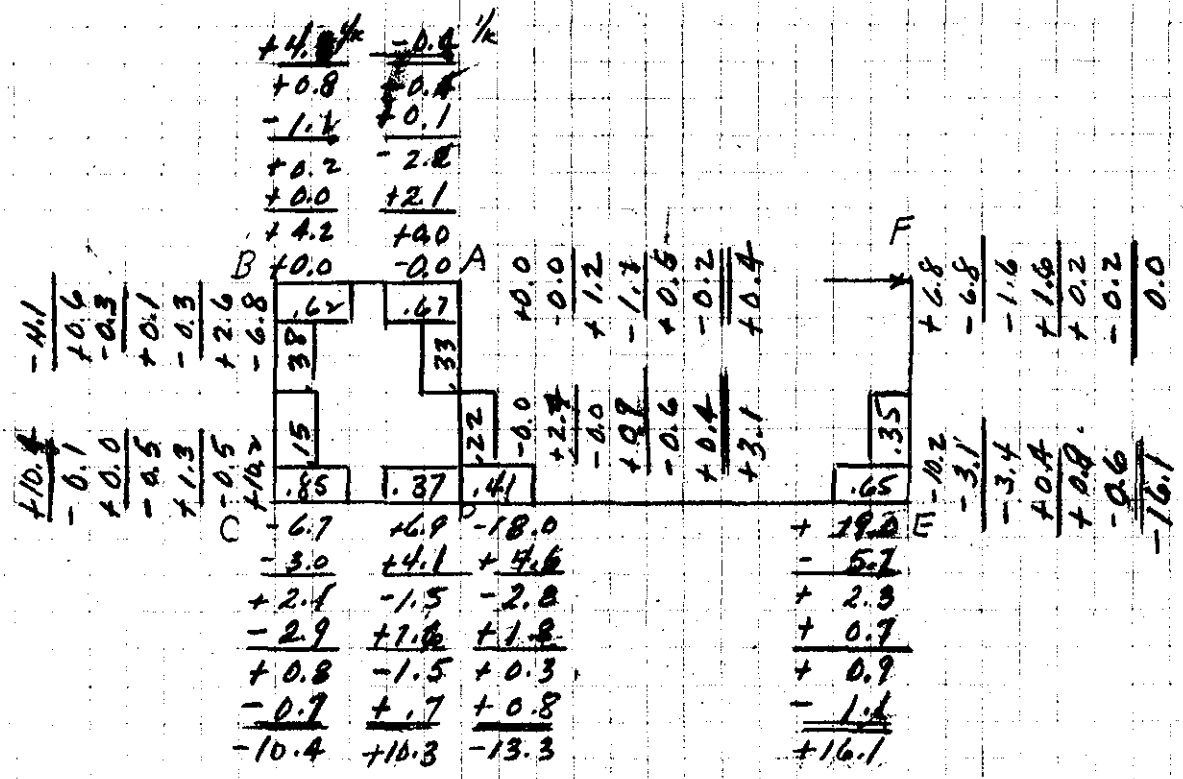
Water 3.0 x .0625 =	.185 k
Conc 2.0 x .150 =	.300 k
SBP	.61 k
Uplift	-1.300 k
Σ =	1.47 k

$M_{DE} = 1/12\, wL^2 = 1/12 \times .71 \times 16.5^2 = 16.1$ '/k

$M_{DE} = 1/30\, wL^2 = 1/30 \times .21 \times 16.5^2 = 1.9$ '/k

$M_{ED} = 1/20\, wL^2 = 1/20 \times .21 \times 16.5^2 = 2.9$ '/k

Reduce this net loading by 50% for 2 way action on base slab.

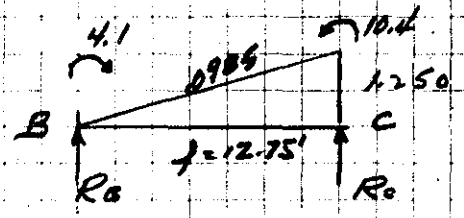


SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY E.P.G. CHECKED BY D DATE MAR 1966

Design of Members

For Section A-A the loadings for case IIA were critical.

Section A-A - Member B-C.



Note: for ease of computations the interior water load has been neglected on member bc.

$$\Sigma M_{R_B} = -12.75 R_c + \frac{12.75^2 \times .0985 \times 2}{2 \times 3} + 6.3 = 0$$

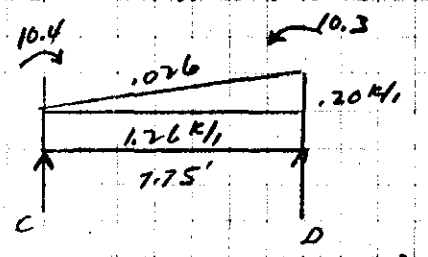
$$R_c = 5.3 + .49 = 5.8\ ^k/_k$$

$$R_B = \frac{12.75^2 \times .0985}{2 \times 3} - \frac{6.3}{12.75} + 2.7 - .49 = 2.2^k$$

$$V = 0 \text{ @ } 2.2 - \frac{.098}{2}x^2 \qquad x^2 = \frac{4.4}{.098} \qquad x = 6.7' \text{ from B}$$

$$+M = 2.2 \times 6.7 - \frac{.098 \times 6.7^3}{2 \times 3} - 4.1 = 14.8 - 4.9 - 4.1 = 5.8\ ^k/_k$$

Section A-A Member C-D



$$V = 0 \text{ @ } 5.2 - 1.26x - \frac{.03x^2}{6} =$$

$$.03x^2 + 7.55x = 31.2$$

$$x = 3.7'$$

$$\Sigma M_C = 0$$

$$5.2 \times 3.7 - \frac{1.26 \times 3.7^2}{2} - \frac{.03 \times 3.7^3}{6} - 10.4 = M$$

$$M = 19.2 - 8.6 - .2 - 10.4 = 0$$

No Pos. Moment.

$$\Sigma M_c = 7.75 R_d + \frac{1.26 \times 7.75^2}{2} + \frac{7.75^2 \times .03}{3} - 1 =$$

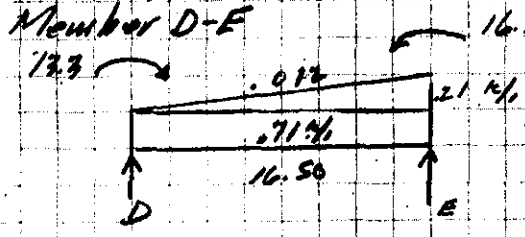
$$R_d = 4.9 + .6 - 0 = 5.5^k$$

$$R_c = 4.9 + .3 + 0 = 5.2^k$$

SUBJECT ANSONIA DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY EPG CHECKED BY R DATE MAR 1966

Design of Members Cont.
Section A-A

Member D-E



$$\Sigma M_D = 16.50 R_E - \frac{.71 \times 16.5^2}{2} - \frac{16.50}{2} \times .01 \times \frac{16.50^2}{3} \times 2 + 2.8$$

$$R_E = -5.9 - 1.2 + 2.8/16.5 = 7.3\ ^k/_k$$

$$R_d = -5.9 - .6 + 2.8/16.5 = 6.3\ ^k/_k$$

$$V=0 \text{ @ } 7.3 - .71x - .012\frac{x^2}{2} = 0$$

$$7.3 - .71x - .01x^2 = 0$$

$$x = 8.6'$$

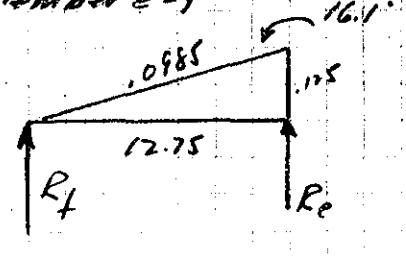
ΣM @ $V=0$

$$-6.3 \times 8.6 - \frac{.71 \times 8.6^2}{2} + \frac{.012 \times 8.6^3}{6} \times 2 + 13.3$$

$$= -54 + 26.2 + 2.5 + 13.3 = 12.0\ ^k/_k$$

Section A-A

Member e-f



$$\Sigma M_f = 12.75 R_e - \frac{.0985 \times 12.75^3}{6} \times 2 - 16.1 = 0$$

$$R_e = +5.35 + 1.27 = 6.62^k$$

$$R_f = \frac{5.35}{2} - 1.27 = 1.41^k$$

$$V=0 \text{ @ } 1.41 - \frac{.098}{2} x^2$$

$$.049x^2 = 1.41$$

$$x^2 = 28.8$$

$$x = 5.35'$$

ΣM @ $V=0$

$$M = 1.41 \times 5.35 - \frac{.098 \times 5.35^3}{6} =$$

$$M = 7.55 - 2.5 = 5.05\ ^k/_k$$

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY E.P.G. CHECKED BY A DATE MAR 1966

Design of Members
Section A-A
Selection of Reinforcing

Member B-C

Mid Span $A_s = \frac{5.8 \times 1.6}{.89 \times 8.5} = .46$ use #6 @ 1'-0"

Neg $M_{BC} = 10.4$ $M_s = \frac{M + d''N}{12} = 10.4 + \frac{5.2 \times 40}{12} = 10.4 + 17.9 = 12.1$

$A_s = \frac{.6 \times 12.1}{.89 \times 8.5} - \frac{5.2}{20} = .96 - .26 = .70$ use #8 @ 1'-0"

Member C-D $t = 18"$ $d = t/2 = 13.5 - 9 = 4.5"$

No Pos. M. use #6 @ 1'-0" top.

Neg As @ C. $M_s = 10.4 + \frac{5.8 \times 4.5}{12} = 10.4 + 2.5 = 12.9$

$A_s = \frac{12.9 \times .6}{.89 \times 13.5} - \frac{5.8}{20} = .69 - .29 = .40$ As reqd.

Use #8 @ 1'-0" from above member B-C.

Neg As @ D

$M_s = 10.3 - 1/3\, V_a = 10.3 - \frac{5.5 \times 1.5}{3} = 10.3 - 2.8 = 7.5$

$A_s = \frac{7.5 \times .6}{.89 \times 13.5} = .38$ use #6 @ 1'-0" Bottom

Check v @ D

$v = 5.5k$

$v = \frac{5500}{12 \times 13.5} = 34$ psi ok

$u = \frac{5500}{.89 \times 3.54} = 175$ ok

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY EPG CHECKED BY AP DATE MAR 1966

Design of Members

Section A-A
Member D-E

$M_s = 13.3 - \frac{1}{3} V_a = 13.3 - \frac{1}{3} 6.3 \times 1.5 =$

Neg As @ D $= 13.3$ $= 13.3 - 3.1 = 10.2$

$A_s = \frac{10.2 \times .6}{.89 \times 19.5} = .35$ si/ft Use same @ D for C-D.

Pos. $A_s = \frac{12.0 \times .6}{.89 \times 19.5} = .42$ si/ft Use #6 @ 1'-0"

Neg As @ E $M = 16.1 - \frac{1}{3} V_a = 16.1 - \frac{1 \times 7.3 \times 1.5}{3} = 16.1 - 3.6 = 12.5$ '/k

$M_s = 12.5 + \frac{6.6 \times 7.5}{12} = 12.5 + 4.1 = 16.6$

$A_s = \frac{16.6 \times .6}{.89 \times 19.5} - \frac{6.6}{20} = .58 - .33 = .25$ si/ft

Member E-F

Pos $A_s = \frac{5.05 \times .6}{.89 \times 13.5} = .25$ si/ft

Neg As @ E

$M = 16.1 - \frac{1}{3} V_a = 16.1 - \frac{1 \times 6.6 \times 1.5}{3} = 16.1 - 3.3 = 12.8$

$M_s = 12.8 + \frac{7.3 \times 5.5}{12} = 12.8 + 3.3 = 16.2$

$A_s = \frac{16.2 \times .6}{.89 \times 13.5} - \frac{7.3}{20} = .80 - .36 = .44$ si/ft.

Use #6 @ 1'-0"

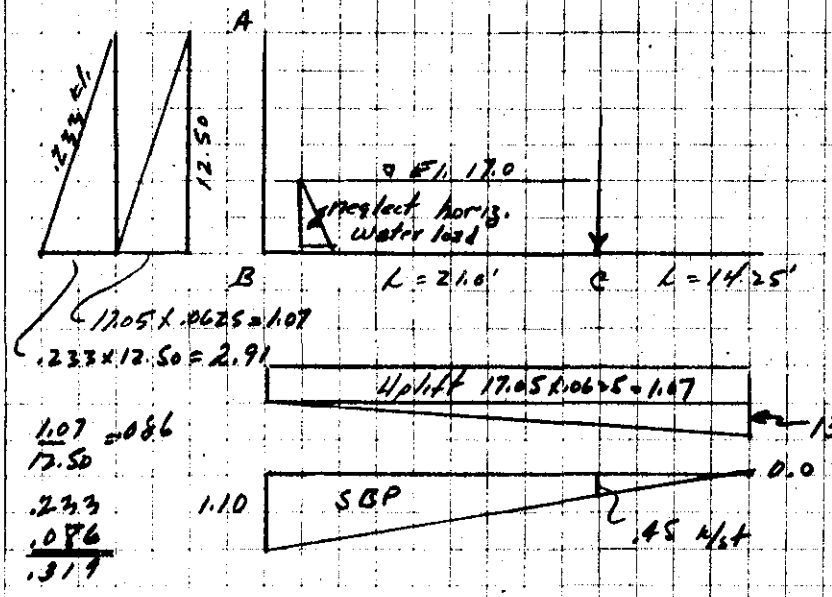
NED FORM 223
27 Sept 49

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

SUBJECT Ansonia - Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY E.P.G. CHECKED BY AP DATE MAR 1966

Design of Walls & Base Slab.

Section B-B Case II A



1.07 / 12.50 = .086

.233
.086
.319

Σ of Uplift & SBP

@ B	@ C
1.07	1.57
1.10	.45
2.17	2.02

Ave 2.10 k/sf

FEM's

A-B = 1/30 wL² = 1/30 x 3.98 x 12.50² = 20.8 '/k

B-A = 1/10 wL² = 1/10 x 3.98 x 12.50² = 31.2 '/k

B-C water 3.0 x .0625 = .187 ↓
Conc 2.0 x .150 = .300 ↓
Uplift & SBP 2.160 ↑
Σ = 1.613 k/sf

This may be reduced by 50% for 2 way action of base slab.

FEM

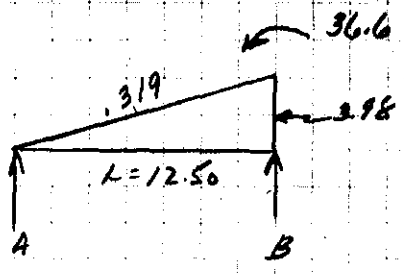
BC = 1/12 wL² = 1/12 x .807 x 21.0² = 29.5 '/k

C-B = B-C = 29.5 '/k

SUBJECT: Ansonia-Derby
COMPUTATION: Maple Street Pumping Station
COMPUTED BY: EPG CHECKED BY: R DATE: Mar 1966

Section B-B

							A
							0.0
							+2.2
							-2.2
							+10.4
							-0.4
							+20.8
							-20.8
36.6							
-0.1							
+0.2							
-4.4							
+10.4							
-0.7							
+31.2							
						.42	
						.58	
					B	-29.5	+29.5 C
						-1.6	0.0
						0.0	-0.5
						-6.0	0.0
						0.0	-3.0
						+0.1	0.0
						36.6	26.0



$$\Sigma M_{RA} = 12.50\,R_b - 3.98 \times \frac{12.50 \times 2}{2 \times 3} - 36.6 = 0$$

$$R_b = +16.60 + 2.93 = 19.53$$

$$R_a = +\frac{16.60}{2} - 2.93 = 8.30 - 2.93 = 5.37^k$$

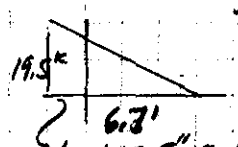
$$V = 0 \quad 5.4 - \frac{.319x^2}{2}$$

$$.319x^2 = 10.8$$
$$x^2 = 33.9$$
$$x = 5.8'$$

@ V = 0

$$M = 5.8 \times 5.4 - \frac{.319 \times 5.8^3}{6} =$$
$$= 31.3 - 10.4 = 20.9$$

$$v = \frac{19530}{12 \times 18} = 90$$ more "2" dist from face.



1.0 + 13.5 = 2.12'

6.7
2.1
4.6'

$\frac{4.6}{6.7} \times 19.5 = 13.4^k$

$$v = \frac{13.4}{12 \times 13.5} = 83 \text{ psi ok.}$$

$$u = \frac{19530}{.89 \times 13.5 \times 5.9} = 90 \text{ psi}$$

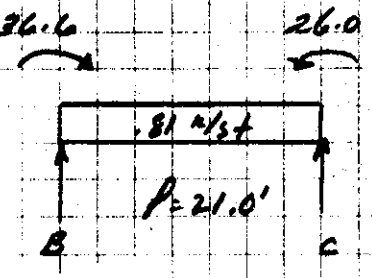
ok.

Note: If necessary this wall may be tapered in final design to furnish required depth for shear.

SUBJECT Ansonia Derby
COMPUTATION Maple Street Pumping Station
COMPUTED BY EPG CHECKED BY A DATE MAR 1966

Design of Members

Section B-B
Member B-C.



$V = 0 @ 8.0 - .81x = 0$
$x = 9.9'$ from B

$\Sigma M @ V=0$

$9.9 \times 80 - \frac{.81 \times 9.9^2}{2} - 26.0 = 0$

$792 - 39.7 - 26.0 = 0$
$M = 13.5$ '/k ✓

$\Sigma M_{RB} = \frac{.81 \times 21^2}{2} - 21 R_C - 10.6 =$

$R_B = 8.5 + .51 = 9.0$ k

$R_C = 8.5 - .51 = 8.0$ k

Section B-B -
Member AB Selection of Reinforcing

Pos. $A_s = \frac{20.9 \times .6}{.89 \times 13.5} = 1.0$ sq/ft Use #9 @ 1'-0" Inside face

Neg. As. Reduce M to face $36.6 - \frac{19.5 \times 1.0}{3} = 36.6 - 6.5 = 30.1$

$M_s = 30.1 + \frac{9.0 \times 5.5}{12} = 30.1 + 4.1 = 34.2$ '/k $t = 1'-6"$
$t/2 - \text{cov.} = 9" - 3.5 = 5.5"$

$A_s = \frac{34.2 \times .6}{.89 \times 13.5} - \frac{9.0}{20} = 1.71 - .45 = 1.26$ sq/ft. Use #7 & #8 @ 6"

See preceding sheet for v & u

B-C Pos. $A_s = \frac{13.5 \times .6}{.89 \times 19.5} = .47$ sq/ft. Use #7 @ 1'-0"

Neg A_{s_B} = Reduce to face $36.6 - \frac{9.0 \times 1.5}{3} = 36.3 - 4.5 = 31.8$

$M_s = 31.8 + \frac{19.3 \times 7.5}{12} = 31.8 + 12.0 = 43.8$ '/k

$A_s = \frac{43.8 \times .6}{.89 \times 19.5} - \frac{19.3}{20} = 1.51 - .96 = .55$ Use #7 & #8 from above.

$v = \frac{19.53}{12 \times 24} = .67$ OK when reduced to face.

SUBJECT ANSONIA DERBY
COMPUTATION MAPLE STREET PUMPING STATION
COMPUTED BY E.P.G. CHECKED BY R DATE MAR 1966

Design of Stop Log Piers, & Wall Between Piers.

Base of outlet @ 20.0 Top of wall @ 41.50
head: 21.50' 21.50 x 62.5 = 1.34 k/sf

Span = 6.0 + 2.0 = 8.0'

$M = 1/10\ wL^2 = 1/10 \times 1.34 \times 8.0^2 = 8.55$ k'

$A_s = \frac{8.6 \times 6}{.89 \times 14.5} = .40$ si/ft. Use #6 @ 1'-0" on inside face of wall horizontal to elev. 26.0. #5 @ 1'-0" above 26.0.

Span over bypass channel
Span = 7.0 + 1.0 + .75 = 8.75'
Head = 41.50 - 18.50 = 23.0'

23.0 x .0625 = 1.44 k/sf

$M = 1/10\ wL^2 = 1/10 \times 1.44 \times 8.75^2 = 11.0$ k'

$A_s = \frac{11.0 \times 6}{.89 \times 14.5} = .51$ Use #7 @ 1'-0" to El. 26.0 Horizontal Inside face

Above El. 26.0 41.50 - 26.00 = 15.50' head.
15.50 x .0625 = .970 k/sf

$M = 1/10\ wL^2 = 1/10 \times .970 \times 8.75^2 = 7.5$ 'k

$A_s = \frac{7.5 \times 6}{.89 \times 14.5} = .35$ si/ft. Use #6 @ 1'-0".

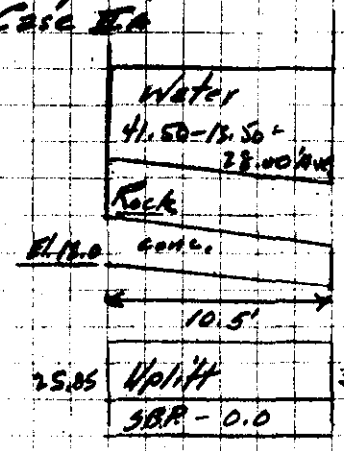
NED FORM 223
27 Sept 49

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

PAGE DM-54

SUBJECT Ansonia
COMPUTATION Maple Street Pumping Station
COMPUTED BY E.R.G. CHECKED BY R DATE Mar 1966

Design of Cantilever Projection -
Case IIA



El 41.50. Section taken in area of minimum S.B.P.

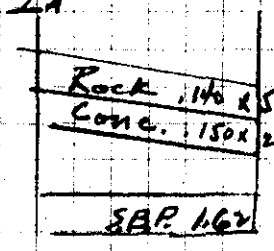
Zm → Water.	10.5 x 28.0 x .0625 =	18.4 x 5.25 =	96.5
Rock.	10.5 x 5.0 x .077 =	4.1 x 5.25 =	21.5
Conc.	10.5 x 2.5 x .150 =	4.0 x 5.25 =	21.0
		25.7k	139.0k
Zm ← Uplift.	10.5 x 28.17 x .0625 =	18.6 x 5.25 =	97.0k
			97.0k

30.5
25.85
2)56.35
28.17 A

$$As = \frac{41.6 \times 6}{.89 \times 31.5} = .88 \text{ si/ft}$$

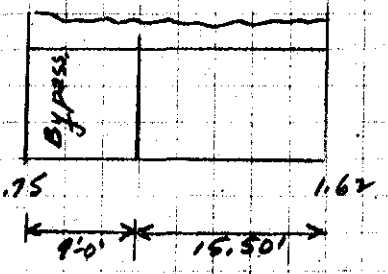
Use #9 @ 1'-0" on top.

Case IA



Net = .545 ↑

Take section at area of maximum S.B.P. for maximum Bottom moment.



$$M_c = 10.5 \times .545 \times \frac{10.5}{2} = 30.6^k$$

$$As = \frac{30.0 \times 6}{.89 \times 31.5} = .65 \text{ si/ft}$$ Use #7 @ 1'-0" Bottom.

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
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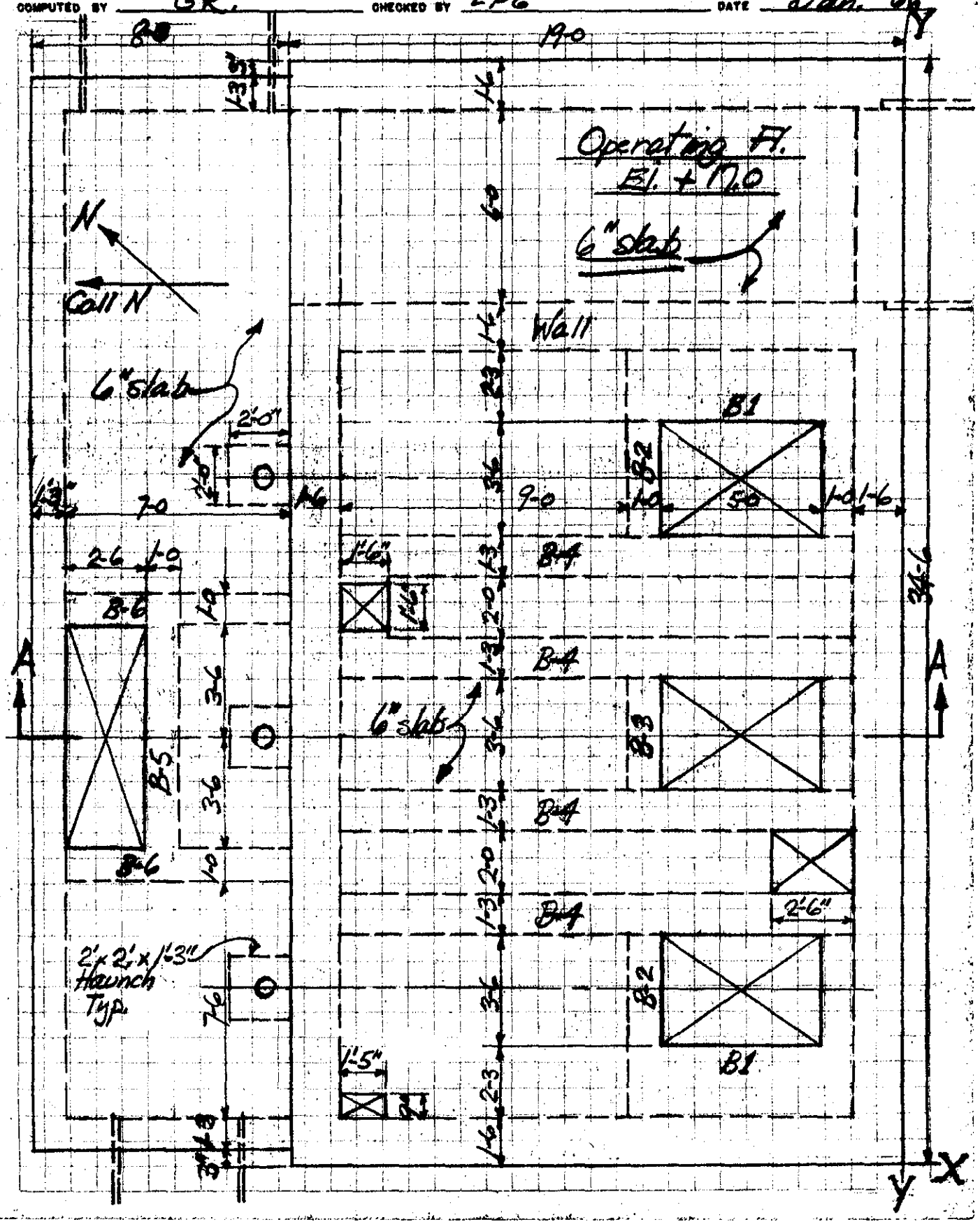
SUBJECT ANSONIA-DERBY
COMPUTATION Division St. Pumping Sta.
COMPUTED BY G.R. CHECKED BY EPG DATE Jan. 66



NED FORM 223
27 Sept 49

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

PAGE 0-1-56 (3)

SUBJECT: Ansonia-Derby
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: G.R. CHECKED BY: EPG DATE: Jan. 16

Determine floor live ld.

Max. wgt. of equip. to be lifted by crane = 6000.# (pg. 1)

Assume load is spread 4'x4'± — $\frac{6000}{16}$ = 375 Say 400.#/□'

Design floor for 400.#/□' live ld.

Design beams for 100.#/□' plus equipm. concentrations.

f'_c = 3000., n = 9.2

fc = 1350, K = 226, j = .87

6'-0" Slab + Engine Slab

L.L. = 400

6"sl = $\frac{75}{475.}$

$+M = \frac{1}{10} \times 475 \times 7^2 = 2300.$ $d = \sqrt{\frac{2300}{226}} = 3.2" < 5."$ ok

$-M = \frac{1}{9} \times 475 \times 6^2 = 1900.$

$A_s = \frac{2.3}{1.44 \times 5} = .32$ #5@12 = .31

$u = \frac{475 \times 3}{2.0 \times .87 \times 5} = 164. < 298.$ ok.

~~Engine Slab~~

~~$\frac{1000}{6.5 \times 3.5}$ = 175.~~

18" Conc. = $\frac{225}{400.} < 475.$

Use 6" slab throughout interior with #5@12" T+B. #4@12" Bot perp. temp As

Exterior slab

Gate leaf + stem = $\frac{2100.\#}{4'}$ = 500.#/'

LL = 100

6"slab = $\frac{75}{175.}$ #/□'

$M = 500 \times \frac{7.5}{4} = 1000.$

$\frac{1}{8} \times 175 \times 7.5^2 = 1200$

M = 2200.'#

Use 6" slab same as above.

Cantilever slab at Bm B1

Equip ld = $\frac{6000}{4}$ = 1500.#/' M = 1.5 × 2 = 3.0 'k/'

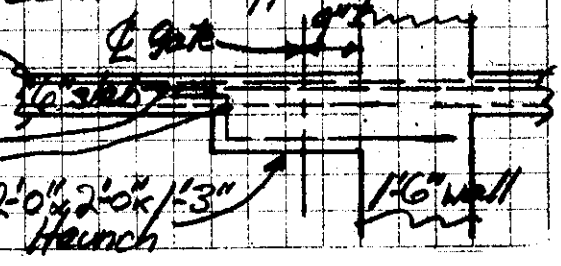
$A_s = \frac{3.0}{1.44 \times 5} = .41$ — Use #5@6" Top at Cantilevers opposite B1

Bracket for Sluice Gates

Leaf + stem + Thrust = 8900.#

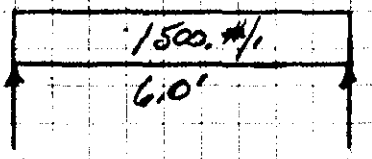
M = 8.9 × 1.5 = 12.'k

$A_s = \frac{12}{1.44 \times 13} = .65$



SUBJECT: ANSONIA-DERBY
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: G.R. CHECKED BY: E.P.G. DATE: Jan. 66

Beam B-1



$V = 1.5 \times 2.5 = 3.8^k$

$M = \frac{1}{8} \times 1.5 \times 6^2 = 6.8^{'k}$

$d = \sqrt{\frac{6800 \times 12}{24 \times 226}} = 4''$

12" total depth ok.

$A_s = \frac{6.8}{1.44 \times 10} = 0.5 \square''$

$v = \frac{3800}{24 \times 10} = 16.$

$\frac{3.6}{3.4} = 150.$
$\frac{3.4}{3.4} = 625.$
775.

Gear unit = 1600.
Pump = 6000.
Thrust = 6000
Total = 13600. #

Dist. long direct. $= \frac{150}{775} \times \frac{13600}{2} = 1300.\#$

" short " $= \frac{625}{775} \times$ " $= 5500.\#$

load per ft. short direct. $= \frac{5500}{6} = 920.$

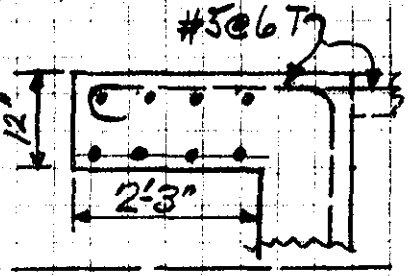
Bm. - $150 \times 2.25 \times 1.0$ = 340.

LL. - 100×2.3 = 240

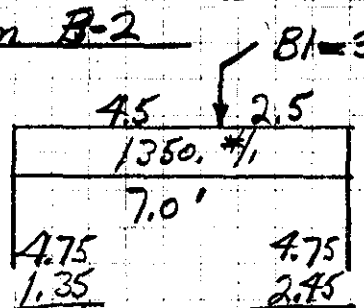
Total = 1500. #/'

$u = \frac{3800}{5.9 \times .87 \times 10} = 74.\#/\square''$

Use 27" x 12" Bm. B-1
4 - #5 Top & Bot.
No stirrups



Bm B-2



Pump ld. per ft. long direct. $= \frac{1300}{4.5} = 300.$

Bm. - $150 \times 1.0 \times 1.0$ = 150.

Engine + slab - $400 \times \frac{6.75}{8}$ = 900.

Total = 1350. #/'

$+M = 6.1 \times 4.5 = 27.4$
$-1.35 \times 4.5^2/2 = 13.4$
$+M = 14.0^{'k}$

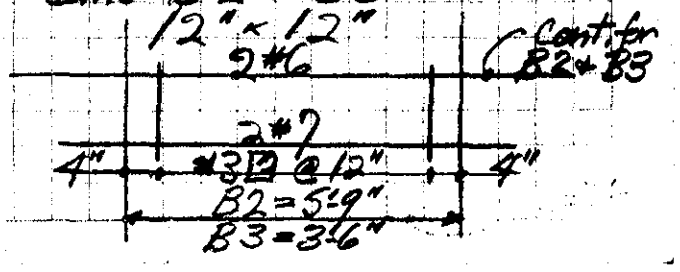
$d = \sqrt{\frac{14000 \times 12}{12 \times 226}}$
$= 8'' < 9.5''$ ok

$v = \frac{6100}{12 \times \frac{9.5}{1.4}} = 54.$

$A_s = \frac{14.}{1.44 \times 9.5} = 1.0 \square'' - 2\#7 = 1.2$

$u = \frac{6100}{4.7 \times .87 \times 9.5} = 160. < 250$

Bms B2 & B3 ←



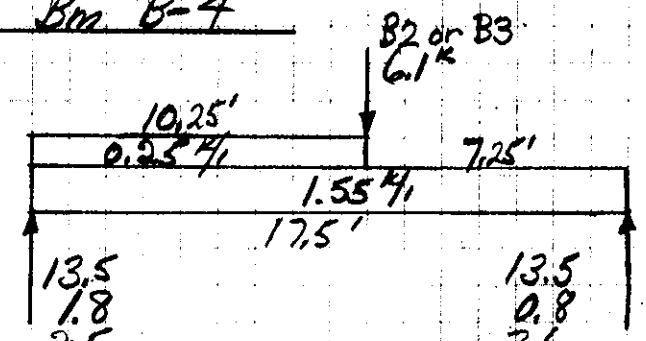
NED FORM 223
27 Sept 49

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

PAGE DM-58 (5)

SUBJECT: ANSONIA-DERBY
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: GR. CHECKED BY: E.P.G. DATE: Jan. 66

Bm B-4



D.L. slab - 75 x 1 = 75.
Bm - 150 x 1.25 x 2 = 375.
Ld per ft. short direct. 5500/6 = 900
Live ld - 100 x 2 = 200
1550. #/'

Engine slab ld.

$400 \times \frac{6.75}{3} \times \left[\frac{3-\left(\frac{6.75}{6}\right)^2}{2}\right] = 1150.$ (1.27)

Bm + DL slab (above) = 650
1800. #/'

$V=0 \quad \frac{17.8}{1.8} = 9.9'$

$+M = 17.8 \times \frac{9.9}{2} = 88.^{1k}$

Try 15" x 21" Bm.

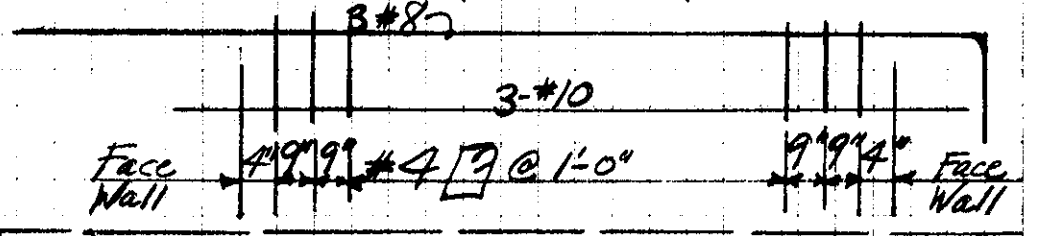
$d = \sqrt{\frac{88000 \times 12}{15 \times 226}} = 17.5" + T$ bm action ok.

$v = \frac{17900}{15 \times 18.5} = 65.$ #/□" - Use ½"φ stirrups (277)

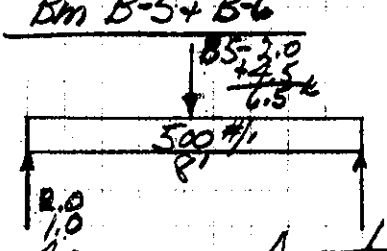
$+A_s = \frac{88}{1.44 \times 18.5} = 3.3$ □" - 3#10 Bot = 3.8 □"

$u = \frac{17900}{9.4 \times .87 \times 18.5} = 118. < 186.$ ok - 3#8 Top = 2.4 □" + 9.4"

Bm B-4 15" x 21"



Bm B-5 + B-6



Gate leaf + stem = 2100.#
Frame = 4500.#

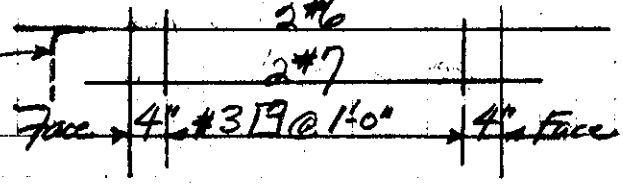
DL slab - 75 x 2 = 150.
DL Bm - 150 x 1 x 1' = 150.
LL - 100 x 2 = 200.
500 #/'

$M = \frac{1}{8} \times .5 \times 8^2 = 4.0$
$\frac{6.5 \times 8}{4} = 13.0$
17.0k

$A_s = \frac{17}{1.44 \times 12.5} = 1.0$

$v = \frac{7000}{12 \times 12.5} = 47.$ (15)

B5 + B6 - 12" x 15"



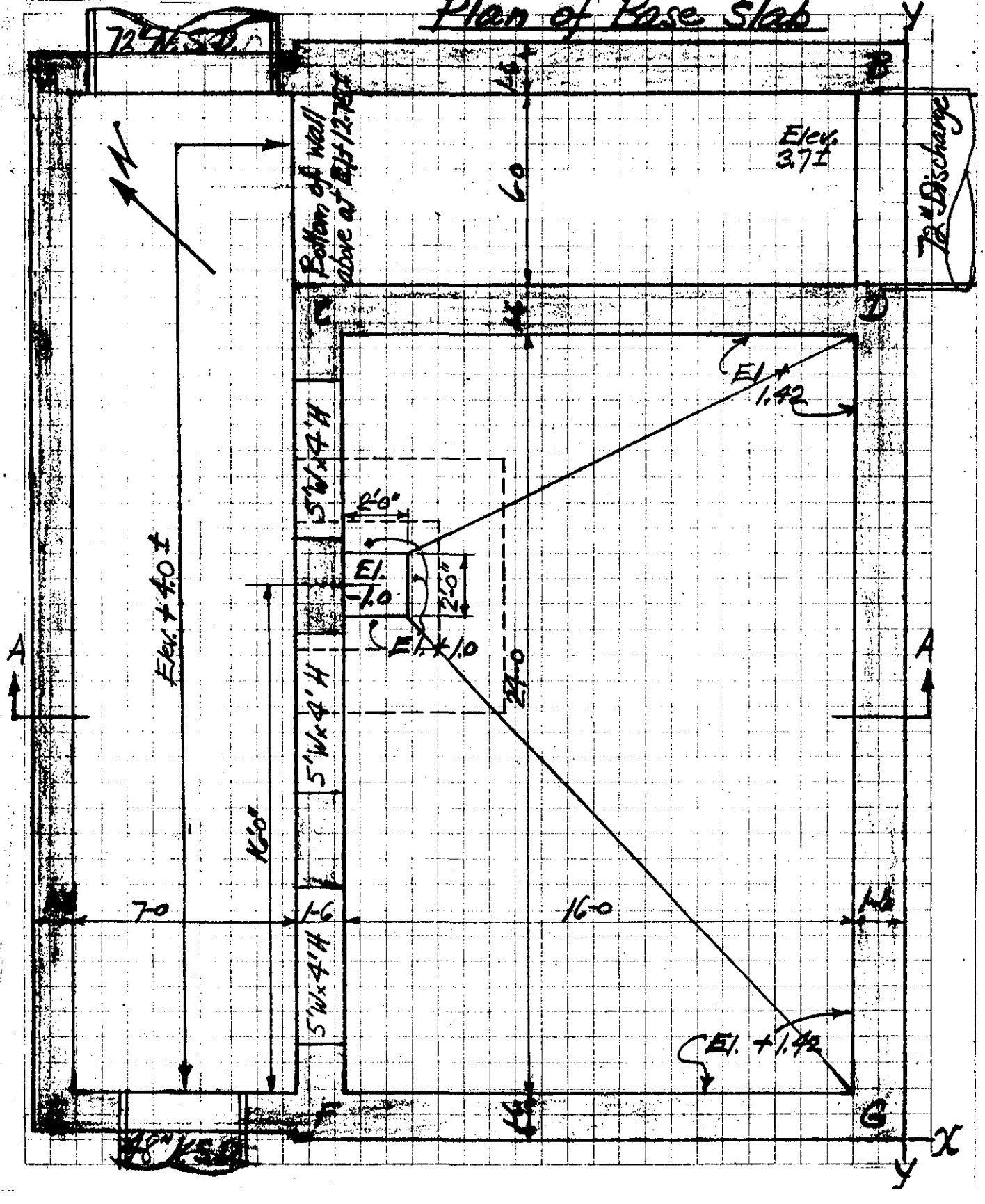
NED FORM 223
27 Sept 49

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

PAGE DM-59 (6)

SUBJECT ANSONIA - DERBY
COMPUTATION Division St. Pumping Sta.
COMPUTED BY G.R. CHECKED BY E.P.G DATE March 66

Plan of Base Slab

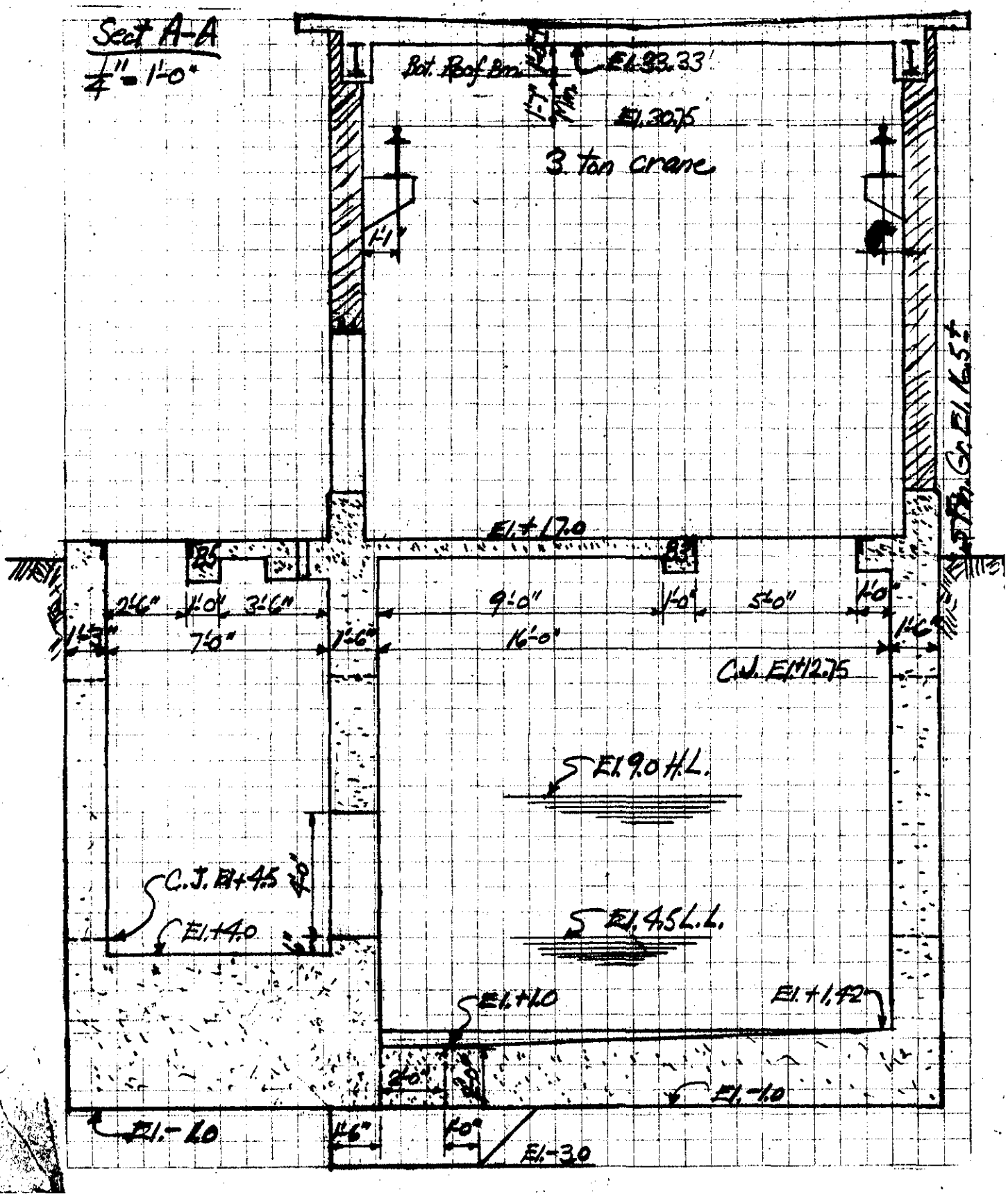


NED FORM 223
27 Sept 49

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

PAGE DM-60

SUBJECT: ANSONIA - DERBY
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: GR. CHECKED BY: EPG DATE: March 66



NED FORM 223
27 Sept 49

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

SUBJECT: ANSONIA - DERBY
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: G.R. CHECKED BY: E.P.G DATE: March 66

Stability Item	Factor	Kips Wgt.	Ft. y	Ft.K. Mx	Ft. x	Ft.K. My
Roof slab (Peak ht)	105 × 21. × 36.5	80.5	17.25	1390.	9.5	765.
Roof Bm - center of bldg	30 × 17'	0.5	17.25	9.	9.5	5.
Brick Wall + bm - N.	120 × 34.5 × 15.5 + (70 × 32.5)	66.6	"	1150.	18.4	1230.
" " N. - outs	3 × 120 × 4.0 × 5.0 × 1.0	- 7.2	13.5	- 97.	18.4	- 132.
" " + bm - S.	120 × 34.5 × 15.5 + (70 × 32.5)	66.6	17.25	1150.	0.6	40.
" " S - outs	3 × 120 × 9.84	- 10.0	13.5	- 135.	0.6	- 6.
" " + bm. - E.	120 × 17. × 15.5 + (70 × 32.5)	34.0	33.9	1150.	9.5	323.
" " E - window out	120 × 14. × 2.5	- 4.2	33.9	- 142.	9.5	- 40.
" " " - door out	120 × 5. × 8.	- 4.8	33.9	- 162.	5.3	- 25.
" " " - 4" Br. out	40. × 9. × 7	- 2.5	34.25	- 85.	12.0	- 30.
" " " + bm - W.	120. × 17. × 15.5 + (70 × 32.5)	34.0	0.6	20.	9.5	323.
" " Chim + flue	250# × 19'	4.8	32.0	153.	17.0	81.
Crane bms.	80# × 33'	2.7	17.25'	47.	9.5	26.
Operating Fl.						
6" Floor slab	75 × 19. × 34.5	49.2	17.25	850.	9.5	466.
" " "	75 × 8.25 × 34.	21.0	17.25	362.	23.13	486.
12" Thick areas	75 × 7. × 5.75	3.0	22.6	68.	5.0	15.
" " "	75 × 7. × 3.5	1.8	13.5	24.	5.0	9.
" " "	75 × 7. × 5.75	3.0	4.4	13.	5.0	15.
" " " outs	150 × 5. × 3.5	- 2.6	21.5	- 56.	5.0	- 13.
" " " "	" " "	- 2.6	13.5	- 35.	5.0	- 13.
" " " "	" " "	- 2.6	5.5	- 14.	5.0	- 13.
6" " " "	75 × 2.5 × 2.	- 0.4	9.5	- 4.	2.75	- 1.
B4	4 × 150 × 1.25 × 1.25 × 16.	15.0	13.5	203.	9.5	143.
B6.	2 × 150 × 1. × .75 × 7.	1.6	13.5	22.	22.5	36.
B5	150 × 1. × .75 × 7.	0.8	13.5	11.	23.	18.
Conc. wall - N.	150 × 12.5 × 34. × 1.25	80.0	17.25	1380.	26.6	2130.
" " - Inter.	150 × 12.5 × 34.5 × 1.5	97.0	17.25	1680.	18.25	1770.
" " " outs	3 × 150 × 5. × 4. × 1.5	- 13.5	13.5	- 182.	18.25	- 246.
" " " "	150 × 6. × 8. × 1.5	- 10.8	30.0	- 324.	18.25	- 197.
" " - Inter.	150 × 12.5 × 16 × 1.5	45.	26.25	1180.	9.5	428.
" " - S.	150 × 15.1 × 25.5 × 1.5	86.6	12.75	1110.	0.75	65.
" " " "	150 × 12.8 × 9.0 × 1.5	26.	30.0	780.	0.75	20.
" " " - E.	150 × 12.65 × 16 × 1.5	45.5	33.75	1530.	9.5	430.
" " " "	150 × 7. × 12.5 × 1.25	16.	33.6	535.	22.5	360.
" " " - W.	150 × 15.1 × 16 × 1.5	54.5	0.75	40.	9.5	515.
" " " "	150 × 7. × 12.5 × 1.25	16.	0.9	14.	22.5	360.
Base slab	150 × 22.25 × 34.5 × 2.0	282.	17.25	4860.	13.6	3840.
" "	150 × 16 × .4 × .5 × 24	11.5	12.	138.	8.	92.
" " Sump	150 × 50 cu. ft.	7.5	17.5	131.	16.5	124.
" " Flow pg.	150 × 9.75 × 3 × 34.	150.	17.25	2580.	22.4	3360.
" " "	150 × 17.5 × 9 × 2.85	67.5	30.0	2020.	9.0	610.
		1304.K		23,370.K		17,370.K

SUBJECT ANSONIA-DERBY
COMPUTATION Division St. Pumping Sta.
COMPUTED BY GR. CHECKED BY EPG DATE March 66

Stability – Equipment loads

Item	Wgt.	y	Mx	x	My
3 ton crane	1.7	17.	29.	9.5	16.
3 Engines	12.0	13.5	162.	11.75	142.
Pumps + gears	23.	13.5	311.	5.5	127.
Misc. pieces	5.	13.5	68.	1.	5.
3 Sluice gates	25.	13.5	340.	19.5	490.
	66.7 k		910 ft k		780 ft k
	1309.		23370.		17370.
	1376. k		24,300 ft k		18200 ft k

$y = \frac{24300}{1376.} = 17.7'$ $\qquad x = \frac{18200.}{1376.} = 13.2'$

Center Grav. – Base

$19 \times 34.5 = 655 \times 9.5 = 6230.$
$8.25 \times 34. = 280 \times 23.13 = 6480.$
$935.\ ^{D'}$ $\qquad 12710.$

$\bar{x} = \frac{12710}{935} = 13.6'$

$\bar{y} = \frac{34.5}{2} = 17.25'$

$I_{\bar{x}} = \frac{1}{12} \times 19. \times \overline{34.5}^3 + \frac{1}{12} \times 8.25 \times \overline{34.}^3 = 65000 + 27000 = \underline{92000.}$

$I_{\bar{y}} = \frac{1}{12} \times 34.5 \times 19^3 + (655 \times 4.1^2) + \frac{1}{12} \times 34 \times 8.25^3 + (280 \times 9.5^2)$

$= 19700. + 11000. + 1600. + 25200. = \underline{57500.}$

Case I – Total dead ld. of structure. Water at ground level El. 16.5 all around. Pumps operating. Water in gravity flow and intake chambers at low level El. 4.5, 100% uplift based on water at El. 16.5.

			Mx		Mx
Water in inter. –	$62.4 \times .5 \times 7. \times 31.5 = 6.9$	$\times 17.25 =$	119.	$\times 22.5 =$	155.
" " " –	$62.4 \times .65 \times 6. \times 17.5 = 4.3$	$\times 30. =$	129.	$\times 10. =$	43.
" " " –	$62.4 \times 3.3 \times 16. \times 24. = 79$	$\times 13.5 =$	1070.	$\times 10. =$	790.
	90.2 k		1318.		988.
	1376.		24300.		18200.
Totals =	1466. k		25,620. ft k		19,190. ft k

$B_p = P/A \pm \frac{Pe\,c}{I_{\bar{x}}} \pm \frac{Pe\,c}{I_{\bar{y}}}$ $\qquad y = \frac{25620}{1466} = 17.5'$

$x = \frac{19190}{1466} = 13.1'$

B_p = Base pressure incl. uplift.

SUBJECT: ANSONIA DERBY
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: GR. CHECKED BY: EPG DATE: April 66

Base press. (Cont.) (See pg. 6)

$$Pt.\ A = \frac{1466}{935.}^{1.57} - \frac{1466 \times 0.5 \times 13.65}{57500.}^{.17} + \frac{1466 \times .25 \times 17.}{92000}^{.07} = 1.47^k/\square'$$

$$Pt.\ B = 1.57 + .17 + .07 = 1.81^k/\square'$$

$$Pt.\ C = 1.57 - \frac{1466 \times .5 \times 5.4}{57500}^{.07} + \frac{1466 \times .25 \times 9.75}{92000}^{.04} = 1.54^k/\square'$$

$Pt.\ D = 1.57 + .17 + .04 = 1.78^k/\square$; $Pt.\ E = 1.57 - .17 - .07 = 1.33^k/\square'$

$Pt.\ F = 1.57 - .07 - .07 = 1.43^k/\square$; $Pt.\ G = 1.57 + .17 - .07 = 1.67^k/\square$

Net Bearing press. - 100% uplift

$Pt.\ A = 1.47 - .0624 \times 17.5 = .38^k/\square$ (1.09), $Pt.\ B = 1.81 - 1.09 = .72^k/\square$

$Pt.\ C = 1.54 - 1.09 = .45^k/\square$, $Pt.\ D = 1.78 - 1.09 = .69^k/\square$, $Pt.\ E = 1.33 - 1.09 = .24^k/\square$

$Pt.\ F = 1.43 - 1.09 = .34^k/\square$, $Pt.\ G = 1.67 - 1.09 = .58^k/\square$

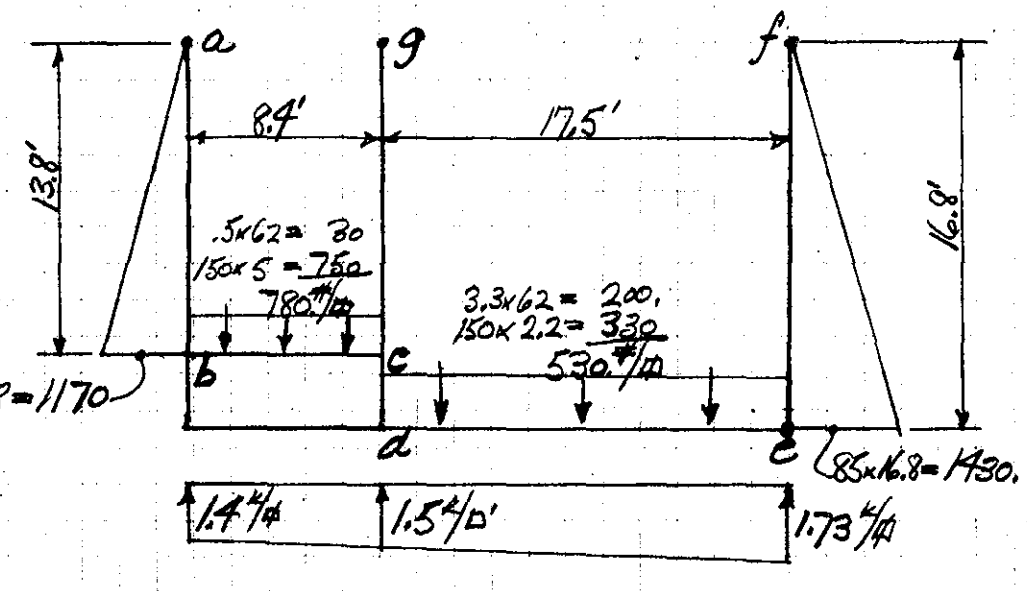
Boyancy

$161. = 19. \times 34.5 \times 17.5 = 11500.$
$8.25 \times 34. \times 17.5 = 4900.$
$16400.\ \Delta'$

$.0624 \times 16400. = 1020.^k \uparrow$
Bldg. + equip. wgt. $= 1466.^k \downarrow$
Surplus $= 446.^k = 30\%$ over ok.

$\gamma_{dry} = 120.$
$\gamma_{moist} = 125.$
$\gamma_{sat.} = 130.$
$\gamma_{sub.} = 68.$
$K_a = .33$

$p = .33 \times 68 + 62. = 85.\ \#/\square'$

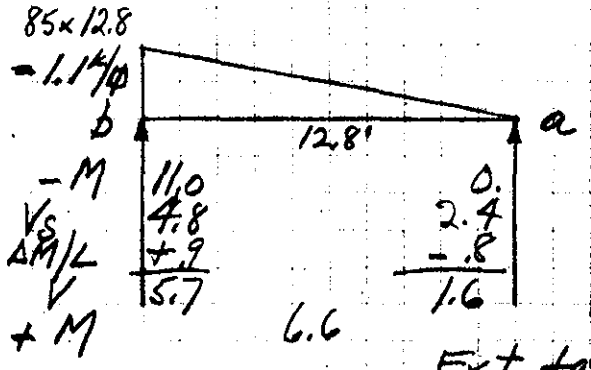


SUBJECT: Ansonia D.
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: G.R. CHECKED BY: E.P.G DATE: April 66

Case I (cont)

Conc. Design - $f'_c = 3000$, $f_c = 1050$, $n = 9.2$
$K = 152$, $v = 60$, $f_s = 20{,}000$.

Member ab



$M_{ba} = \frac{1}{15} \times 1.0 \times \overline{12.8}^2 = 11.0^{\,1k}$

$V = 0$ @ 6.2' ± from a

$+M = 1.6\,(6.2 - 2.1) = 6.6^{\,1k}$

Req. $d = \sqrt{\frac{11000}{152}} = 8.5'' < 11.5''$ ok

Ext. face @ El. +4.0

$-A_s = \frac{11.}{1.44 \times 11.5} = .67^{\square''}$ $\quad u = \frac{5700}{3.1 \times .88 \times 11.5} = 182. < 260$ ok

Use #8 @ 1-0 = .79 @ El. +4.0 Ext.

Extend 3'-6" above El. 4.0

At El. +5.0 Ext. face

$-M = -11.0 + \frac{1}{3} \times 5.7 \times 2.0 = 7.2^{\,1k}$

$V = 5.7 - 1.0 \times 1.0 = 4.7^{\,k}$

$-A_s = \frac{7.2}{1.44 \times 11.5} = .44$

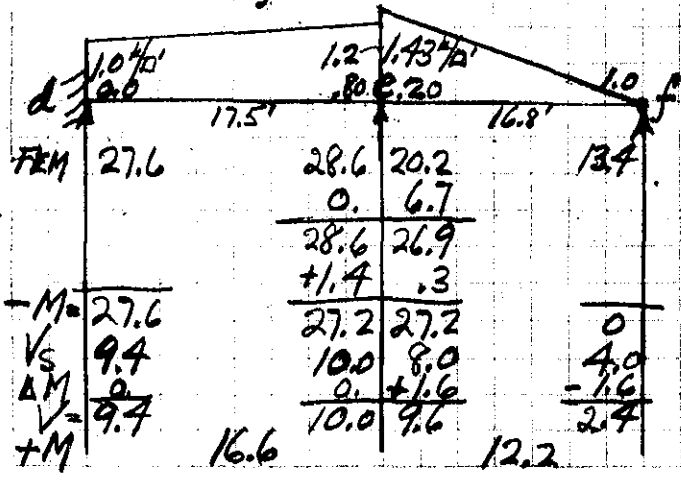
$u = \frac{4700}{2.4 \times .88 \times 11.5} = 194 < 350.$

Use #6 @ 1-0 = .44 @ El. +5.0 Ext.

Inter face $-+A_s = \frac{6.6}{1.44 \times 11.5} = .40$

Use #6 @ 1-0 = .44 Int. face

Member def



Memb. de

$1d$ @ $d = 1.5 - .53 = 1.0$ k/□'

$1d$ @ $e = 1.73 - .53 = 1.2$ "

$M^F_{de} = \frac{1}{12} \times 1.0 \times \overline{17.5}^2 + \frac{1}{20} \times 0.2 \times \overline{17.5}^2 = 27.6$ (25.5, 2.1)

$M^F_{ed} = 25.5 + \frac{1}{20} \times 0.2 \times \overline{17.5}^2 = 28.6$

$M^F_{ef} = \frac{1}{20} \times 1.43 \times \overline{16.8}^2 = 20.2$, $M^F_{fe} = 13.4$

$de - \frac{2.2^3}{17.5} = .605 - .8$

$ef - \frac{1.5^3}{16.8} \times .75 = .152 - .2$

.757

SUBJECT: Arsonia D
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: GR. CHECKED BY: EPG DATE: April 66

Case I - Memb. def (cont.)

Positive Mom.

For de

V=0 @ 9'± from d

$9.4 \times (9-4.3) = 44.2$
$= 27.6$
$+M = 16.6^{1k}$

Memb. de

At face d $-M = 27.6 - \frac{1}{3} \times 9.4 \times 1.5$
$= 23.0^{1k}$

$V = 9.4 - .7 = 8.7^k$

$-A_s = \frac{23.}{1.44 \times 19.5} = .82$ $u = \frac{8700}{3.1 \times .88 \times 19.5} = 164$ < 260. ok.

#8@1-0 = .79 Bottom @ d

$+A_s = \frac{16.6}{1.44 \times 19.5} = .59$

#7@1-0 = .60 at top slab de

At Joint e

For ed $-M = 27.2 - \frac{1}{3} \times 10 \times 1.5$
$= 22.2$

$V = 10.0 - .8 = 9.2^k$

#9@1-0 = 1.0 Bottom @ ed

For ef $-M = 27.2 - \frac{1}{3} \times 9.6 \times 2$
$= 20.8^{1k}$

$V = 9.6 - 1.2 = 8.4^k$

$-A_s = \frac{20.8}{1.44 \times 14.5} = 1.0$ $u = \frac{8400}{3.5 \times .88 \times 14.5} = 188.$ < 230. ok.

$d = \sqrt{\frac{20800}{152.}} = 12'' < 14.5''$

#9@1-0 = 1.0□" @ ef ext. face

At El. +4.5

$-M = -20.8 - 1.2 \times 3 \times 1.5 + 8.4 \times 3$
$= -1.2^{1k}$ ±

$V = 8.4 - 1.1 \times 3 = 5.0^k$

$-A_s = \frac{2.0}{1.44 \times 14.5} = .10$ $u = \frac{5000}{2.0 \times .88 \times 14.5} = 195.$ < 420. ok

#5@1-0 = .31□" @ ef ext. face from El. +4.5 to 17.

$+A_s = \frac{12.2}{1.44 \times 14.5} = .59$

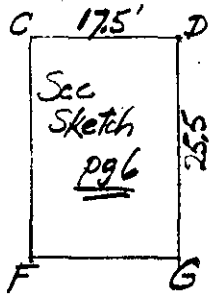
#7@1-0 = .60 @ ef int. face full hgt.

V=0 @ ef 7.6'± from f.

$+M = 2.4(7.6 - 2.5) = 12.2^{1k}$

SUBJECT: ANSONIA D
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: G.R. CHECKED BY: E.P.G DATE: April 66

Two way action of bottom slab CDFG



$\frac{17.5}{25.5} = 0.7$

For long sp, use 0.7 of short sp. on pg. 12

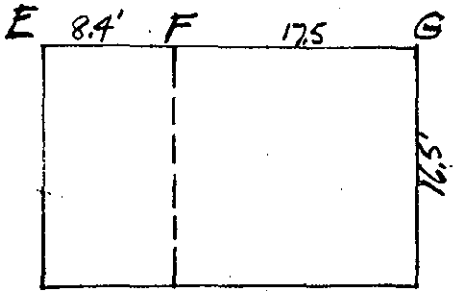
For long sp. use same sect. as short sp.

$-A_s = .82 \times .7 = .57$ — #7@1-0 = .60 bottom @ d'

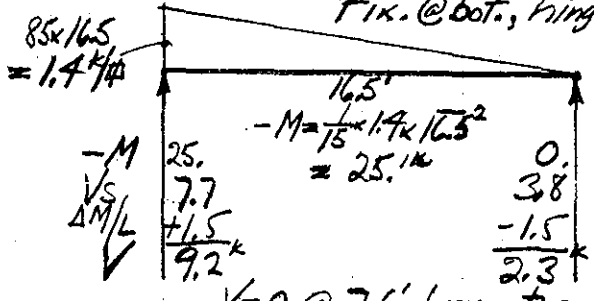
$+A_s = .59 \times .7 = .42$ — #6@1-0 = .44 top slab d'e'

$-A_s = 1.0 \times .7 = .70$ — #8@1-0 = .79 bot + ext. @ e'

Vert. panel EFG



Vertical ld. on panel FG.
Fix. @ bot., hinge @ top.



V = 0 @ 7.6' from top.
$+M = 2.3(7.6 - 2.5) = 11.7'^k$

For 2 way action - Assume vert. takes approx. 2/3 of load.

$-A_s = \frac{25.}{1.44 \times 14.5} = 1.2 \times \frac{2}{3} = .80$ — #8@1-0 = .79 @ exten. bot. to El. +4.0 for Panel FG - Vert.

$u = \frac{9200 \times .67}{3.1 \times .88 \times 14.5} = 155 < 260.$

At El. +4.5 $-M = 25 - (\frac{1}{3} \times 9.2 \times 2) + (1.2 \times 3 \times 1.5) - 8. \times 3.$
$= 25 + 5.4 - 6.1 - 24. = 0.3'^k$ Negl.

#5@1-0 vert. @ ext. face from El. +4.5 to 17. Panel EF + FG - Vert

$+A_s = \frac{11.7}{1.44 \times 14.5} = .56 \times \frac{2}{3} = .37 \square''$

#6@1-0 = .44 @ inter. face full hgt. - panel FG vert.

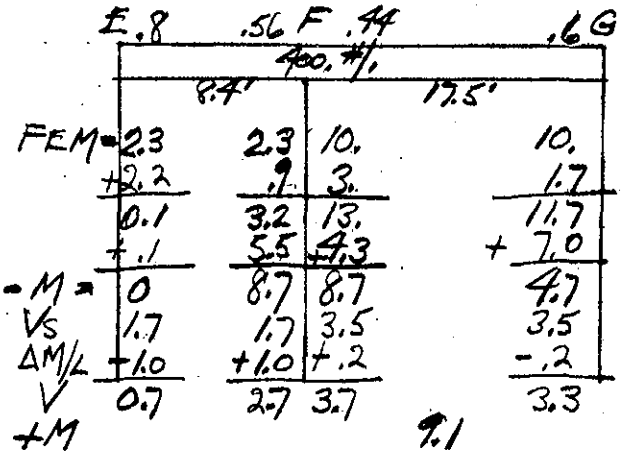
SUBJECT ANSONIA D
COMPUTATION Division St. Pumping Sta.
COMPUTED BY G.R. CHECKED BY E.P.G DATE April 66

Horiz. panel EFG (cont.)

Design for horiz. load – Assume a ld. of 2/3 of max. acting 50% each way.

$P = \left(\frac{2}{3} \times 1.4\right) \frac{1}{2} = \text{Say } 400\#/'$

Acts horiz. E to F to G.



FEM =	2.3	2.3	10.	10.
	+2.2	.1	3.	1.7
	0.1	3.2	13.	11.7
	+.1	5.5	4.3	+ 7.0
−M =	0	8.7	8.7	4.7
Vs	1.7	1.7	3.5	3.5
ΔM/L	+1.0	+1.0	+.2	−.2
V	0.7	2.7	3.7	3.3
+M			9.1	

$\frac{1.25^3}{8.4} = .24 = .56$

$\frac{1.3^3}{17.5} = \frac{.19}{.43} = .44$

$\frac{1}{12} \times .4 \times \overline{8.4}^2 = 2.3; \frac{1}{12} \times .4 \times \overline{17.5}^2 = 10.$

$V = 0, \frac{3300}{400} = 8.25'$

$3.3 \times 8.25 = 27.3$
$.4 \times 8.25^2/2 = -13.5$
-4.7
$+M = 9.1^{1k}$

At F $-M = 8.7 - \frac{1}{3} \times 2.7 \times 1.5 = 7.3^{1k}$

$-A_s = \frac{7.3}{1.44 \times 11.5} = .44 \quad u = \frac{2400}{2.4 \times .88 \times 11.5} = 100.$

$-M = 8.7 - \frac{1}{3} \times 3.7 \times 1.5 = 6.9^{1k} \quad -A_s = \frac{6.9}{1.44 \times 14.5} = .34$

$u = \frac{3400}{2.4 \times .88 \times 14.5} = 112.$

Panel EFG
Horiz. reinf.
#5@1-0 horiz ext. & int. for full hgt.

Panel AB Vertical

Same as vert ab design on pg. 11 except 18" instead of 15".

Where wall is 15" thick on East face, use vert. reinf. on pg. 11.

$-A_s = \frac{11.}{1.44 \times 14.5} = .52 \quad \#7@1\text{-}0 = .60$

For 18" East wall vert. reinf.
Use #7@1-0 @ El. +4.0 Ext. face

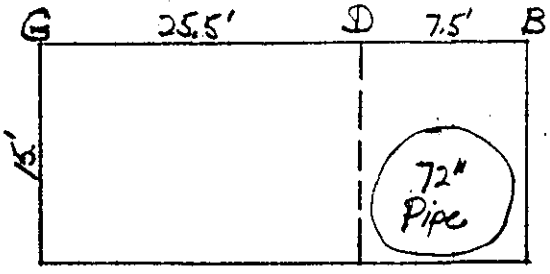
At El. +4.5:
$-M = -11.0 + \frac{1}{3} \times 5.7 \times 1. = 9.$

$-A_s = \frac{9.0}{1.44 \times 14.5} = .43$ — Use #6@1-0 above El +4.5 Ext. face

$+A_s = \frac{6.6}{1.44 \times 14.5} = .31$ — Use #5@1-0 Int. face full hgt.

SUBJECT: ANSONIA D
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: GR. CHECKED BY: EPG DATE: April 66

Vert. Panel BDG - Horiz.



Subearth $p = 85 \times 15 = 1.3^k/\square'$

Use load $= 1.3 \times .6 = 800.\#/'$ assumed to be distributed in 2 directions

See ACI - 2 way slabs 318 - 130

$\frac{15.}{25.5} = .6$

Long sp - Disc @ G & D

$-M = .033 \times 800 \times \overline{15}^2 = 6.0^{'k}$

$-A_s = \frac{6.0}{1.44 \times 14.0} = .30$

$u = \frac{800 \times 15 \times .33}{2.0 \times .88 \times 14.} = 163. < 420.$ ok.

Upper - $-M = .058 \times 1.3 \times .5 \times \overline{15}^2 = 8.5$

$-A_s = \frac{8.5}{1.44 \times 14.} = .42$

$+M = .05 \times 800 \times \overline{15}^2 = 9.0$, $+A_s = \frac{9.}{1.44 \times 14} = .41$

Horiz reinf. - Panel BDG

Lower @ Corners G & D
#5@1-0 Ext. face

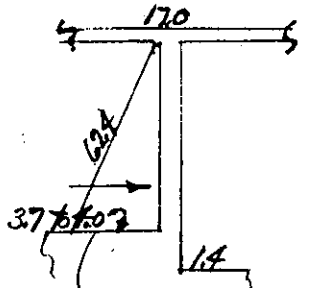
#5@1-0 Ext. face @ G full hgt.

#6@1-0 Ext. face above pipe from D to B.

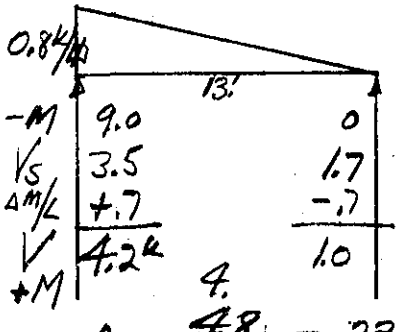
#5@1-0 intern face from G to D.

Case II - Dead ld. of struct. Water to top of Flow chambers. No water in Pump chamber. Uplift based on water at El. 6.0± (river level). Moist. earth above El. 6.0. (Case II based on 100 yr. flood)

Inter. 18" West wall (has no openings)



$p = 62.4 \times 13 = 800.\#/\square$



$-M = \frac{1}{15} \times .8 \times \overline{13}^2 = 9.$

$+M = 1.0 \times (6 - 2) = 4.$

At El+5. $-M = 9 - 4.2 \times 1. = 4.8$

At Flow chamber side - Vert

#6@1-0 up to 3' above El. +4.0 then #5@1-0 for balance.

$-A_s = \frac{9}{1.44 \times 14.5} = .43$

$u = \frac{4200}{2.4 \times .88 \times 14.5} = 137.$ ok.

$-A_s = \frac{4.8}{1.44 \times 14.5} = .23$

$+A_s = \frac{4}{1.44 \times 14.5} = .19$

#5@1-0 vert @ pump rm. side

Horiz. = #5@1-0 E.F.

NED FORM 223
27 Sept 49

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

PAGE [illegible]

SUBJECT ANSONIA D
COMPUTATION Division St. Pumping Sta
COMPUTED BY G.R. CHECKED BY E.P.G DATE April 66

Int. 18" wall with openings

At El. 4.0
$-A_s = .43 \times 8 = 3.4\square''$ 6-#7 = 3.6□"

At El. 5.0
$-A_s = .23 \times 8 = 1.84\square''$ 6#5 = 1.86
$+A_s = .19 \times 8 = 1.6$ - 6#6

3' conc. betw. 5' openings
Prov. reinf. in 3' for 8" width.

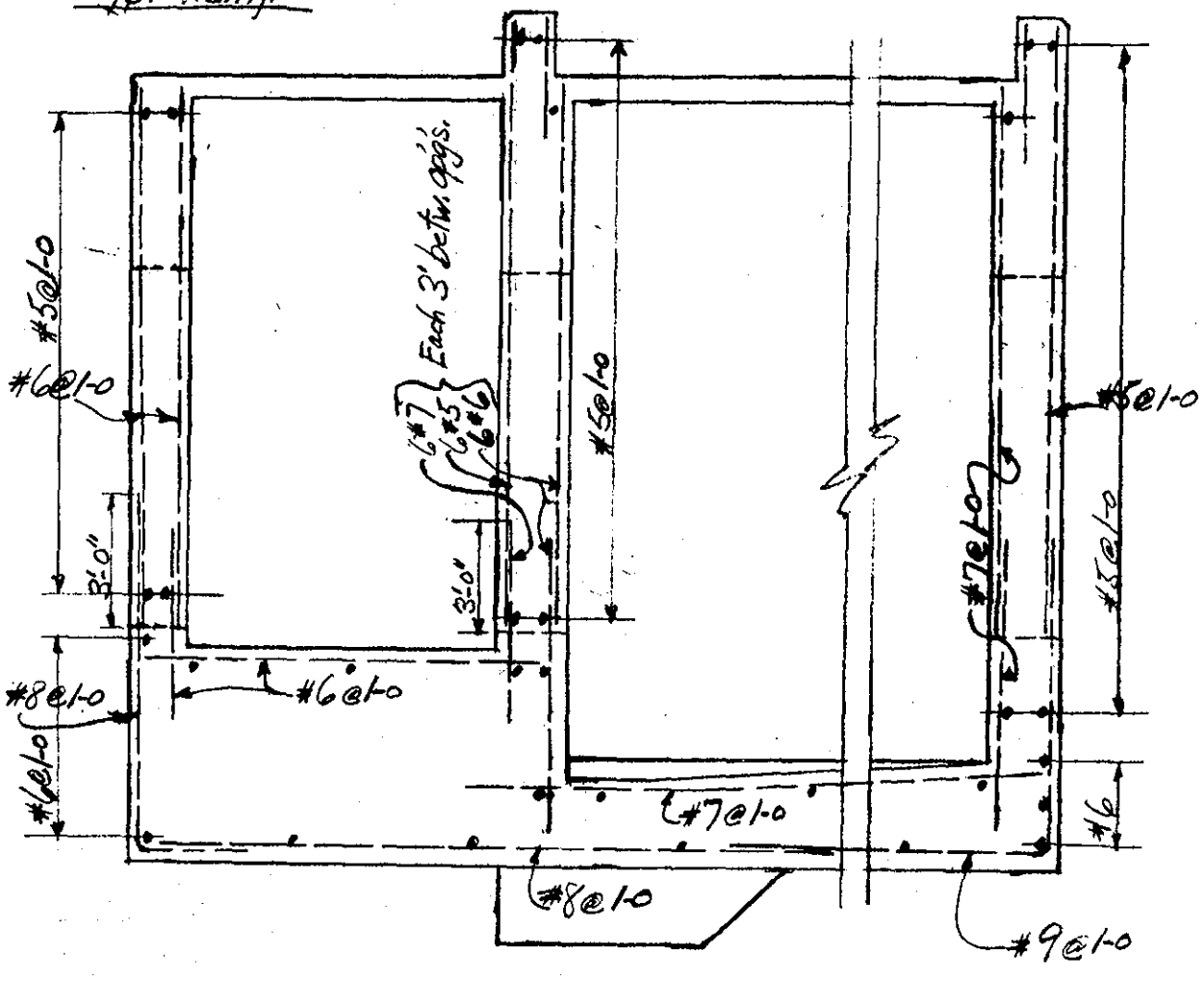
Vert. reinf - Flow chamber side - 36" piers

Use 6-#7 to 3' above El. +4.0
then 6-#5 for balance.

6#5 @ Pump Rm. side - full hgt.

Horiz - #5 @ 1-0 E.F. generally.

Typ. Reinf.



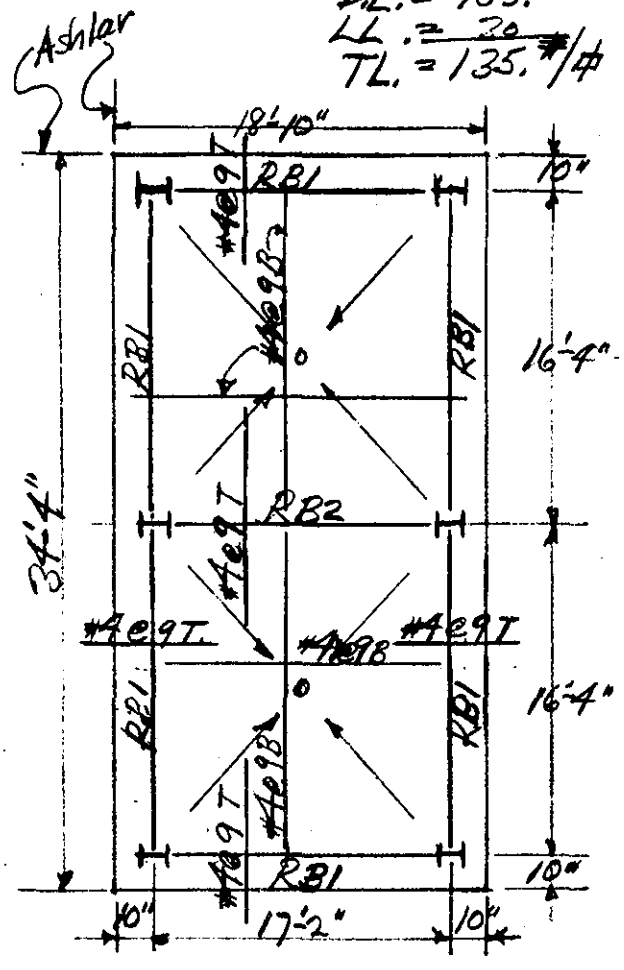
NED FORM 223
27 Sept 49

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

SUBJECT: ANSONIA D
COMPUTATION: Division St. Pumping Sta
COMPUTED BY: GR. CHECKED BY: EPG DATE: April 66

Roof Slab

6" @ center = 75.
½" Pitch – Add 2" avg. = 24.
Roofing = 6
D.L. = 105.
LL = 30
TL. = 135. #/□



Stresses etc same as floor slab – (pg 3).

See ACI – pg 130

$m = \frac{16.33}{17.17} = .95$ 3 edges disc.

Short span

$-M$ ext. $= .031 \times 135 \times \overline{16.3}^2 = 1.1$ 'k
$-M$ int. $= .062 \times$ " " $= 2.2$
$+M$ $= .047 \times$ " " $= 1.7$

Long span

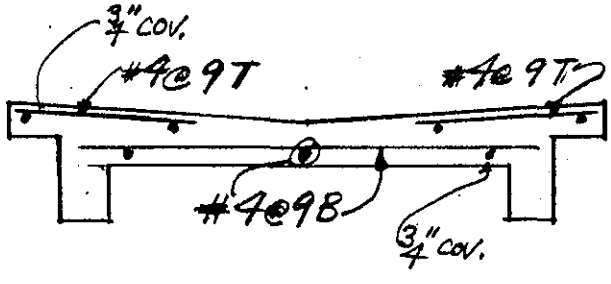
$-M$ ext. $= .029 \times$ " " $= 1.1$
$+M$ $= .044 \times$ " " $= 1.6$

Min As @ bms. $= .002 \times 12 \times 10.5 = .25$

$-As = \frac{1.1}{1.44 \times 7.5} = .10$ – #4 @ 9 Top at RB1 all sides

$-As = \frac{2.2}{1.44 \times 7.5} = .20$ – #4 @ 9 Top at RB2

$+As = \frac{1.7}{1.44 \times 4.9} = .24$
$+As = \frac{1.6}{1.44 \times 4.3} = .26$
} #4 @ 9 Bot each way. = .27



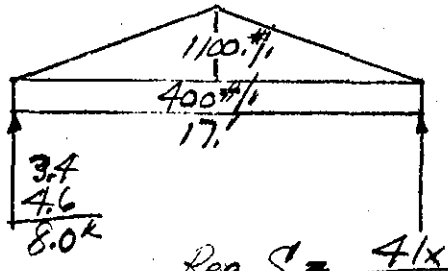
6" Min slab.

SUBJECT: ANSONIA D
COMPUTATION: Division St. Pumping Sta.
COMPUTED BY: GR. CHECKED BY: EPG DATE: April 66

Roof Bms. - RB1

Slab ld. Δ = 135 × 8.2 = 1100.

Overhang - 100 × 1.8 = 180.
Bm + F.P. = 220
400.



$1100 \times 8.5 \times \frac{17}{6} = 26.5$

$\frac{1}{8} \times 400 \times 17^2 = 145$

$M = 41.'k$

Req $S = \frac{41 \times 12}{22.} = 22.5$

RB1 - 12WF27

RB2

Slab ld Δ = 135 × 16.4 = 2200.

React = $2.2 \times \frac{8.5}{2} = 9.3^k$

$2200 \times 8.5 \times \frac{17}{6} = 53$

$\frac{1}{8} \times 30 \times 17^2 = 1.$

$M = 54.'k$

Req $S = \frac{54 \times 12}{22} = 30.$

12WF27 = 34.

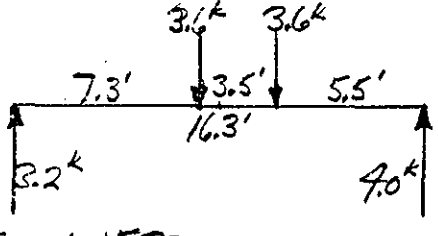
RB2 - 12WF27

Crane Bms

Cap = 3 tons
Bridge = 1400.# ±
Trolley = 600.# ±

Wheel spacing = 3'-6"
Wheel ld. = 3600.# ±

Longt. F = .10 × 7200 = 720.#, Lat. F = .075 × 6600 × .5 = 250.# at each wheel.



$R_L = \frac{(3.6 \times 5.5) + (3.6 \times 9.)}{16.3} = 3.2^k$

$M_x = 3.2 \times 7.3 = 24. + 1.(Bm) = 25$

$M_y = \frac{.25}{3.6} \times 24 = 1.7'k$

Try 10WF33

$f_x = \frac{12 \times 25}{35.} = 8.6$

$f_y = \frac{12 \times 1.7}{9.2 \times .5} = \frac{4.5}{13.1}$ k/□"

Allow = $\frac{12000000}{16.3 \times 12 \times 2.83} = 21.6$ k/□" > 12.8 ok.

Use 10WF33

Crane Bms.

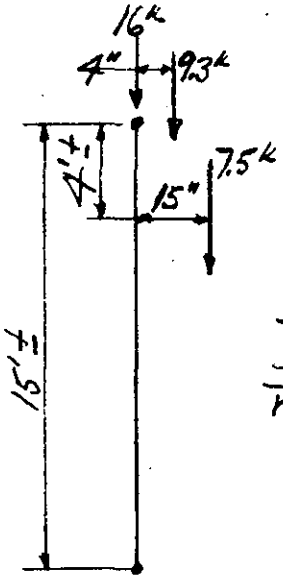
SUBJECT: ANSONIA D
COMPUTATION: Division St. Pumping Sta
COMPUTED BY: GR. CHECKED BY: E.P.G. DATE: April 66

Columns
Design center critical col.

RB1 - 2×8 = 16.^{k} RB2 = 9.3^k Crane = $2 \times 3.6 \times \frac{14.6}{16.3}$ = 6.5

Bmt rail 50×16 = 1.0

7.5^k



16.0
9.3
7.5
.2
P = 33.0^k

9.3×4 = 37.
7.5×15 = 113.
M = 150.^{11k}

Try 8WF24

$\frac{l}{r_y} = \frac{15 \times 12}{1.61} = 112$; $F_a = 11.4$ $f_a = \frac{33}{7.06} = 4.7^k/\square''$

$f_b = \frac{150}{20.8} = 7.2^k/\square''$ $\frac{f_a}{F_a} = \frac{4.7}{11.4} = .41$

$\frac{Kl}{r_x} = \frac{15 \times 12}{3.4} = 53.$ $F'_e = 53.$ $C_m = .85$

$F_b = \frac{12000\,000}{15 \times 12 \times 3.07} = 22.$
550

$$\frac{4.7}{11.4} + \frac{.85 \times 7.2}{\left(1 - \frac{4.7}{53}\right)22.} = .41 + .31 = .72 < 1.0$$

Use 8WF24 cols

APPENDIX B

MECHANICAL DESIGN COMPUTATIONS

INDEX TO SHEETS

Title	Page No.
River Street Pumping Station	M- 1 - M- 5
Maple Street Pumping Station	M- 6 - M-13
Front Street Pumping Station	M-14 - M-21
Division Street Pumping Station	M-22 - M-31

SUBJECT ANSONIA-DERBY FLOOD PROTECTION
COMPUTATION RIVER STREET PUMPING STATION
COMPUTED BY _____ CHECKED BY JWF DATE Feb '66

STATION DESIGN CAPACITY

10 c.f.s.
Standard Project Flood Elev 44.0
Top of Dike " 47.0
Suction Chamber High water Elev. 30.0
" " Low " " 26.0
Two (2) Pumps. (Each to handle 2/3 of total)

PUMP DESIGN CONDITION POINT

$\frac{10 \times 2}{3} = 6.66$ cfs = 3000 GPM.

Dia of Disch. $\sqrt{\frac{4 \times 6.66}{12\pi}} = .84' = 10.1''$

USE 12" Pipe Discharge (see SYSTEM LOSSES BELOW)

Head:
Pool to pool 44.0 − 26.0 = 18.0
Vel. hd $\frac{8.6^2}{64.4}$ = 1.15
Pipe friction 2.25 x 1.80 = 4.05
TOTAL HEAD = 23.20 FEET

SYSTEM LOSSES (Each Pump)

For 10" Disch. Pipe (using C = 130 + 15% & 180' Equiv. lg.)

GPM	Vel. Hd	Pipe H_f	TOTAL
2000	1.03	4.65	5.68
2200	1.24	5.48	6.72
2500	1.62	6.92	8.54
3000	2.31	9.90	12.21
3500	3.14	13.17	16.31
4000	4.12	18.10	22.22

For 12" Disch. Pipe (using C = 130 + 15% & 180' Equiv. lg.)

2000	.51	1.82	2.33
2200	.61	2.23	2.84
2500	.80	2.90	3.70
3000	1.15	4.05	5.20
3500	1.56	5.22	6.78
4000	2.04	6.75	8.79

Loss for 10" Discharge pipe too high - Use 12"

PUMP OPERATING CYCLE

PIPE STORAGE	4700 GALLONS
SUMP "	4250 "
TOTAL	8950

AVE. PUMP CAPACITY 3000 GPM

Operating time (no inflow) $\frac{8950}{3000}$ = 3 Minutes

Min pump operating cycle (operating at full speed)
(inflow = 50% pump capacity)

Time to empty $\frac{8950}{1500}$ = 6 Minutes

Time to refill $\frac{8950}{1500}$ = 6 "

Minutes between starts 12 Min.

This is not too frequent starting, however the pumps are diesel engine driven and may be operated at less than full speed so that capacity approx. matches infow, if desired, to essentially eliminate intermittent operation.

SUMMARY

Computations and curves, Pages M-3 & M-5 show that a pump with 10" discharge and 8.98" dia. impeller satisfactory meets requirements when using 12" pipe line over dike. To eliminate requirements for increaser in pipe line, 12" pump discharge will be specified making the size increase in the pump diffuser or pump column.

SUBJECT ANSONIA - DERBY FLOOD PROTECTION
COMPUTATION RIVER STREET PUMPING STATION
COMPUTED BY _____ CHECKED BY JWF DATE FEB '66

FROM PAGE M-4

AT 23.2 FT $Q = 13550$ GPM

$$D_p = D_m \left(\frac{Q_p}{Q_m}\right)^{1/2} = 20\left(\frac{3000}{13550}\right)^{1/2} = 9.45''$$

Try 10" $Q_m = \dfrac{3000}{\left(\frac{10}{20}\right)^2} = 12000$

Model condition

$H = 23.2$ $Q_c = 12{,}000$ GPM

AT $H = 25$ $Q = 12000\left(\frac{25}{23.2}\right)^{1/2} = 12450$

AT $H = 27$ $Q = 12000\left(\frac{27}{23.2}\right)^{1/2} = 12950$

Model speed $N_m = N_x\left(\frac{Q_c}{Q_x}\right) = 974\left(\frac{12000}{12750}\right) = 917$ RPM (.943)

PROTOTYPE PUMP $H_p = H_m$

$$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{917}{974}\right)\left(\frac{10}{20}\right)^2 = 2.36\,Q_x$$

$$H_p = H_m = H_x\left(\frac{917}{974}\right)^2 = .89\,H_x$$

$$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{917}{974}\right)^3\left(\frac{10}{20}\right)^2 = 2.1\,P_x$$

Values from Curve			Prototype Values			
H	Q	P	H_p	Q_p	P_p	Eff.
31	11200	109	27.6	2640	22.9	80.4 %
25.5	13000	98 (Max Eff)	22.7	3070	20.6	85.5
20	14300	87.5	17.8	3370	18.4	82.5
15	15250	77.5	13.4	3580	16.3	74.4
10	16100	67	8.9	3800	14.1	60.4
5	16850	56	4.5	3980	11.8	38.3

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 917\left(\frac{20}{10}\right) = 1830$ RPM

$$N_s = \frac{\sqrt{GPM} \times RPM}{H^{3/4}} = \frac{\sqrt{3070} \times 1830}{22.7^{3/4}} = 9{,}750$$

SUCTION LIFT = 2 FT.

PUMP OK SEE Curve Page M-5 & Summary Page M-2

20" AXIAL FLOW MODEL PUMP - ZERO SUBM

FROM PLATE 18 EM 110-2-3[illegible]

RIVER STREET PUMPING STA.

K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

STATION DESIGN CAPACITY

60 cfs
Standard Project Flood Elev. 36.8
Top of Dike " 42.0
Suction Chamber High Water Elev. 22.0
" " Low " " 17.0
Two (2) Pumps. (Each to handle 2/3 of total)

PUMP DESIGN CONDITION POINT

$\frac{60 \times 2}{3} = 40$ cfs $= 18{,}000$ G.P.M.

Dia. of Disch. $\sqrt{\frac{4 \times 40}{12\pi}} = 2.06' = 24.7''$

USE 24" Discharge

Head:

Pool to pool 36.8 − 17.0	=	19.8
Vel. Hd.	=	2.53
Disch. pipe & Flap Valve	=	.43
TOTAL HEAD		22.76

SYSTEM LOSSES (For longest Disch. Pipe)
(Useing C=130+15% & 20' Equiv. lg)

GPM	Vel. Hd.	Pipe & Flap V.	Total
14000	1.53	.28	1.81
15000	1.76	.31	2.07
16000	2.00	.35	2.35
18000	2.53	.43	2.96
20000	3.13	.52	3.65
22000	3.78	.64	4.42
24000	4.50	.78	5.28

PUMP OPERATING CYCLE

PIPE STORAGE	37500	Gallons
SUMP "	13250	"
TOTAL	50750	"

AVE PUMP CAPACITY 20,000 GPM

operating time (no inflow) $\frac{50750}{20000}$ = 2.5 Minutes

Min Pump operating cycle (operating at full speed)
(inflow = 50% pump capacity)

Time to empty $\frac{50750}{10000}$ = 5 Minutes

Time to refill $\frac{50750}{10000}$ = 5 "

Minutes between Starts = 10

This is not too frequent starting, however the pumps are diesel engine driven and may be operated at less than full speed so that capacity approximately matches inflow, if desired, to practically eliminate intermittent operation.

SUMMARY

Computations and curves, Pages M-8 thru M-13 show that a pump with 24" discharge will satisfactorily meet requirements. Pump based model curves Page M-10, performance shown on curves Page M-11, operating at 775 RPM is best selection because of its capability to perform at 3 Ft suction lift.

SUBJECT ANSONIA-DERBY FLOOD PROTECTION
COMPUTATION MAPLE STREET PUMPING STATION.
COMPUTED BY _____ CHECKED BY _____ DATE Feb 66

FROM PAGE M-10

AT 22.8 FT $Q = 13,600$ GPM

$$D_p = D_m \left(\frac{Q_p}{Q_m}\right)^{1/2} = 20\left(\frac{18000}{13600}\right)^{1/2} = 23''$$

Try 24" $Q_m = \dfrac{18000}{\left(\frac{24}{20}\right)^2} = 12,500$ G.P.M.

Model Condition

$H = 22.8$ $Q_c = 12,500$

AT $H = 25$ $Q = 12500\left(\frac{25}{22.8}\right)^{1/2} = 13,100$

AT $H = 27$ $Q = 12500\left(\frac{27}{22.8}\right)^{1/2} = 13,600$

Model Speed $N_m = N_x\left(\frac{Q_c}{Q_x}\right) = 974\left(\frac{12500}{13,100}\right) = \underline{930 \text{ RPM}}$ .954

PROTOTYPE PUMP $H_p = H_m$

$$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{930}{974}\right)\left(\frac{24}{20}\right)^2 = 1.375\,Q_x$$

$$H_p = H_m = H_x\left(\frac{930}{974}\right)^2 = .91\,H_x$$

$$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{930}{974}\right)^3\left(\frac{24}{20}\right)^2 = 1.25\,P_x$$

Values from Curve			Prototype Values			
H	Q	P	H_p	Q_p	P_p	Eff.
31	11200	109	28.2	15400	136	80.7%
25.5	13000	98 (Max Eff)	23.2	17900	122.5	85.5
20	14300	87.5	18.2	19600	109.5	82.
15	15250	77.5	13.6	20950	97	74
10	16100	67	9.1	22100	83.7	57
5	16850	56	4.5	23150	70	37.5

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 930\left(\frac{20}{24}\right) = 775$ R.P.M.

$$N_s = \frac{\sqrt{GPM} \times RPM}{H^{3/4}} = \frac{\sqrt{17900} \times 775}{23.2^{3/4}} = 9860$$

SUCTION LIFT = 3 FT.

FROM PAGE M-12

AT 22.8 FT $Q = 12150$ GPM

$$D_p = D_m \left(\frac{Q_p}{Q_m}\right)^{1/2} = 20\left(\frac{18000}{12150}\right)^{1/2} = 24.3''$$

Try 24" $Q_m = \dfrac{18000}{\left(\frac{24}{20}\right)^2} = 12\,500$ GPM

Model Condition

$H = 22.8 \quad Q_c = 12{,}500$

AT $H = 20 \quad Q = 12500\left(\frac{20}{22.8}\right)^{1/2} = 11{,}700$

Model Speed $N_m = N_x\left(\frac{Q_c}{Q_x}\right) = 1037\left(\frac{12500}{12300}\right) = 1054$ RPM (1,016)

PROTOTYPE PUMP $H_p = H_m$

$$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{1054}{1037}\right)\left(\frac{24}{20}\right)^2 = 1.462\,Q_x$$

$$H_p = H_m = H_x\left(\frac{1054}{1037}\right)^2 \rightarrow 1.032\,H_x$$

$$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{1054}{1037}\right)^3\left(\frac{24}{20}\right)^2 = 1.51\,P_x$$

Values from Curve			Prototype Values			
H	Q	P	H_p	Q_p	P_p	Eff.
32.5	9550	97	33.6	13960	146.5	80.6
30	10400	95	31.0	15200	143.5	83.2
25	11600	86 (Max Eff)	25.8	17000	130	85.4
20	12650	77	20.7	18400	116	83.0
15	13500	67	15.5	19700	101	76.2
10	14200	58	10.3	20800	87.5	61.8
5	14800	48	5.2	21600	72.5	39.2

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 1054\left(\frac{20}{24}\right) = 880$ RPM.

$$N_s = \frac{\sqrt{17000 \times 880}}{25^{3/4}} = 10{,}300$$

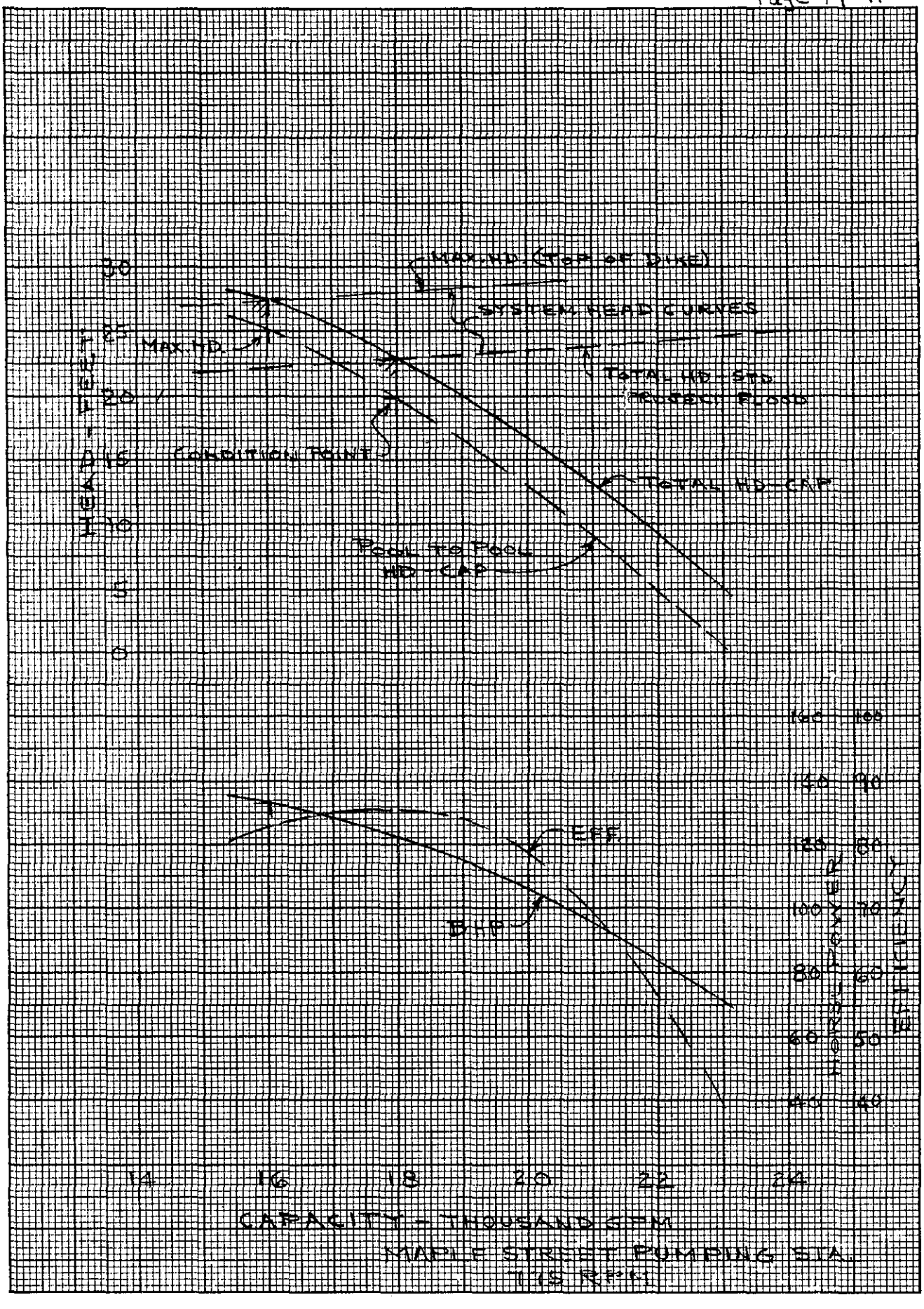
SUCTION LIFT = 0 FT.

26" AXIAL FLOW MODEL PUMP - ZERO SUBM.

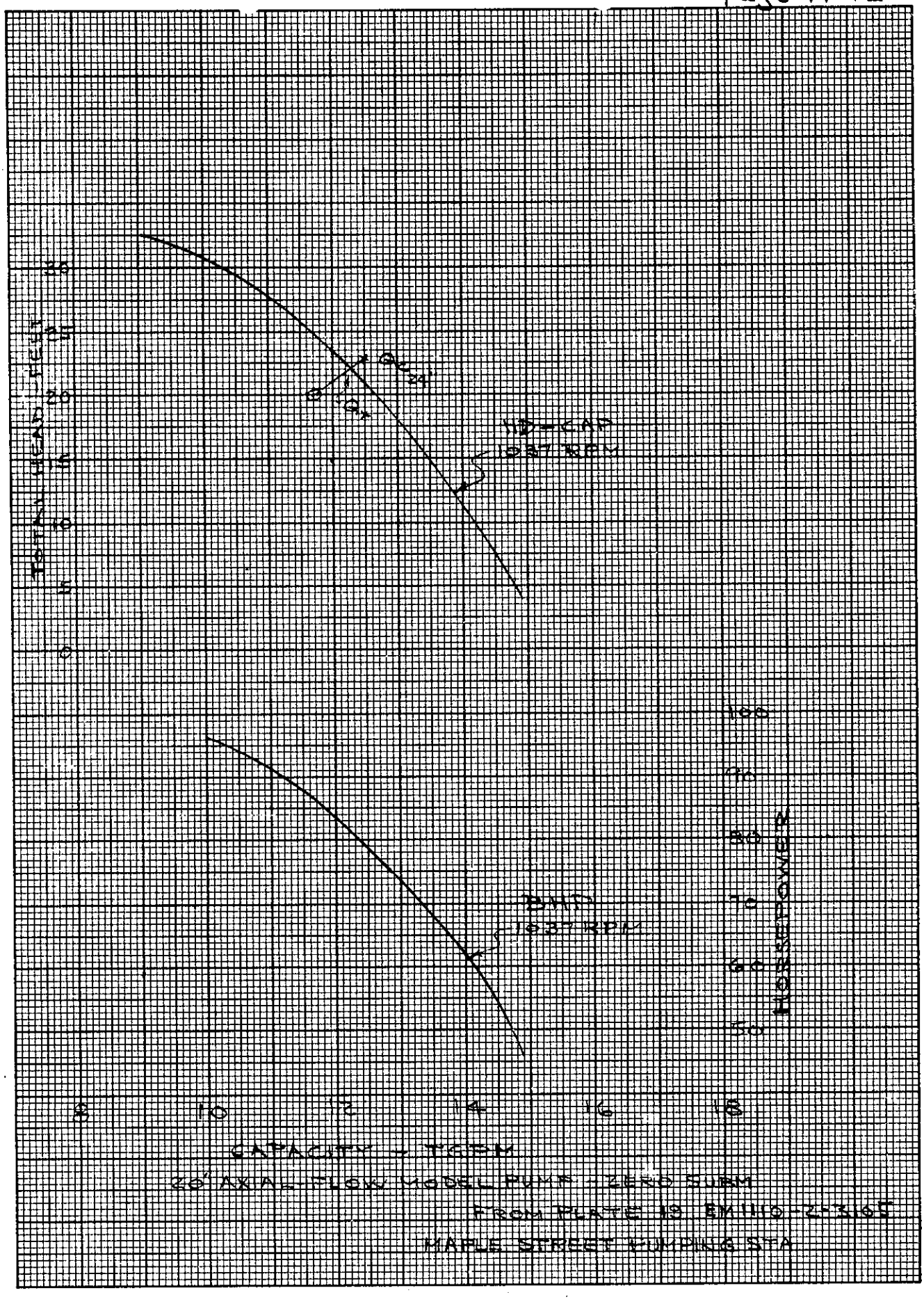
FROM PLATE 18 EM.110-2-3105

MAPLE STREET PUMPING STA.

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.



K&E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.



K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

SUBJECT ANSONIA-DERBY FLOOD PROTECTION
COMPUTATION FROIYT STREET PUMPING STATION
COMPUTED BY _____ CHECKED BY _____ DATE Feb '66

STATION DESIGN CAPACITY

130 cfs
Standard Project Flood Elev 32.2
Top of Dike " 35.2
Suction Chamber High water " 15.5
" " Low " " 8.5
Three (3) Pumps (Each to handle 1/3 of total)

PUMP DESIGN CONDITION POINT

$\frac{130}{3} = 43.3$ c.fs. = 19,500 GPM

Dia. of Disch. $\sqrt{\frac{4 \times 43.3}{12\pi}} = 2.14' = 26''$

USE 30" Pipe Discharge

Head:

Pool to pool	32.2 − 8.5	= 23.7
Vel. Hd $\frac{9.46^2}{64.4}$		= 1.39
Pipe friction		= 2.75
	TOTAL	= 27.86 FEET

SYSTEM LOSSES (each Pump)

(For 30" Disch. Pipe (using C=130 +15% & 300' Equiv. lg)

GPM	Vel. Hd.	Pipe H_f	TOTAL
16000	.94	1.89	2.83
17000	1.06	2.13	3.19
18000	1.19	2.37	3.56
19000	1.32	2.61	3.93
20000	1.47	2.88	4.35
25000	2.29	4.44	6.73

PUMP OPERATING CYCLE

PIPE STORAGE	250000	Gallons
SUMP "	33000	"
TOTAL	283,000	"

AVE PUMP CAPACITY 22000 GPM.

operating time (no inflow) $\frac{283000}{22000}$ = 13 MINUTES

Min. Pump operating cycle (operating at full speed)
(inflow = 50% pump capacity)

Time to empty $\frac{283000}{11000}$ = 26 Minutes

Time to refill $\frac{283000}{11000}$ = 26 Minutes

Minutes between starts 52

The large storage capacity eliminates any necessity for operating the engines at less than full speed.

SUMMARY

Computations and curves, Pages M-17, M-20 & M-21 show that pump with 30" discharge and 24.25" propeller diameter based on model curves from Page M-20 will satisfactorily meet requirements operating at 758 RPM. See performance curve Page M-21

FROM PAGE M-18

AT 27.9 FT $Q = 12,300$ GPM

$$D_p = D_m\left(\frac{Q_p}{Q_m}\right)^{1/2} = 20\left(\frac{19500}{12300}\right)^{1/2} = 25.2''$$

Try 26' $Q_m = \dfrac{19500}{\left(\frac{26}{20}\right)^2} = 11,530$

Model Condition

$H = 27.9$ $Q_c = 11,530$

AT $H = 30$ $Q = 11,530\left(\frac{30}{27.9}\right)^{1/2} = 11,950$

Model speed $N_m = N_x\left(\frac{Q_c}{Q_x}\right) = 974\left(\frac{11530}{11820}\right) = 952$ RPM

PROTOTYPE PUMP $H_p = H_m$

$$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{955}{974}\right)\left(\frac{26}{20}\right)^2 = 1.65\,Q_x$$

$$H_p = H_m = H_x\left(\frac{955}{974}\right)^2 = .955\,H_x$$

$$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{955}{974}\right)^3\left(\frac{26}{20}\right)^2 = 1.575\,P_x$$

Values from Curve			Prototype Values		
H	Q	P	H_p	Q_p	P_p
31	11200	109	29.6	18500	171.7
25.5	13000	98 (Max Eff)	24.4	21450	154.5
20	14300	87.5	19.1	23600	138
15	15250	77.5	14.4	25200	122
10	16100	67	9.5	26600	105.7
5	16850	56	4.8	27800	91.4

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 952\left(\frac{20}{26}\right) = 752$ RPM.

$$N_s = \frac{\sqrt{21400} \times 752}{24.4^{3/4}} = 9950$$

SUCTION LIFT 1 FT.

Pump not satisfactory. Max head (Top of dike) above usable range of pump. See performance curves, Page M-19

SUBJECT ANSONIA-DERBY FLOOD PROTECTION
COMPUTATION FRONT STREET PUMPING STATION
COMPUTED BY _____ CHECKED BY _____ DATE Feb '66

FROM PAGE M-20

AT 27.9 FT. $Q = 11{,}000$ GPM

$$D_p = D_m\left(\frac{Q_p}{Q_m}\right)^{1/2} = 20\left(\frac{19500}{11000}\right)^{1/2} = 26.6''$$

Try 27" (24.25" dia. Prop) $Q_m = \dfrac{19500}{\left(\frac{27}{26}\right)^2} = 10700$

Model condition

$H = 27.9 \quad Q_c = 10{,}700$

AT $H = 30 \quad Q = 10700\left(\frac{30}{27.9}\right)^{1/2} = 11{,}100$

Model speed $N_m = N_x\left(\frac{Q_c}{Q_x}\right) = 1037\left(\frac{10700}{10850}\right) = 1022$ RPM

PROTOTYPE PUMP $H_p = H_m$

$$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{1022}{1037}\right)\left(\frac{27}{20}\right)^2 = 1.792\ Q_x$$

$$H_p = H_m = H_x\left(\frac{1022}{1037}\right)^2 = .972\ H_x$$

$$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{1022}{1037}\right)^3\left(\frac{27}{20}\right)^2 = 1.747\ P_x$$

Values from Curve			Prototype Values			
H	Q	P	H_p	Q_p	P_p	Eff.
32.5	9550	97	31.6	17120	169.5	80.4
30	10450	95	29.2	18800	166	83.5
25	11600	86 (Max Eff)	24.4	20800	150	85.5
20	12650	77	19.4	22700	134.5	82.7
15	13500	67	14.6	24200	117	76.5
10	14200	58	9.7	25500	101.5	61.5
5	14800	48	4.8	26500	84	38.3

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 1022\left(\frac{20}{27}\right) = 758$ RPM

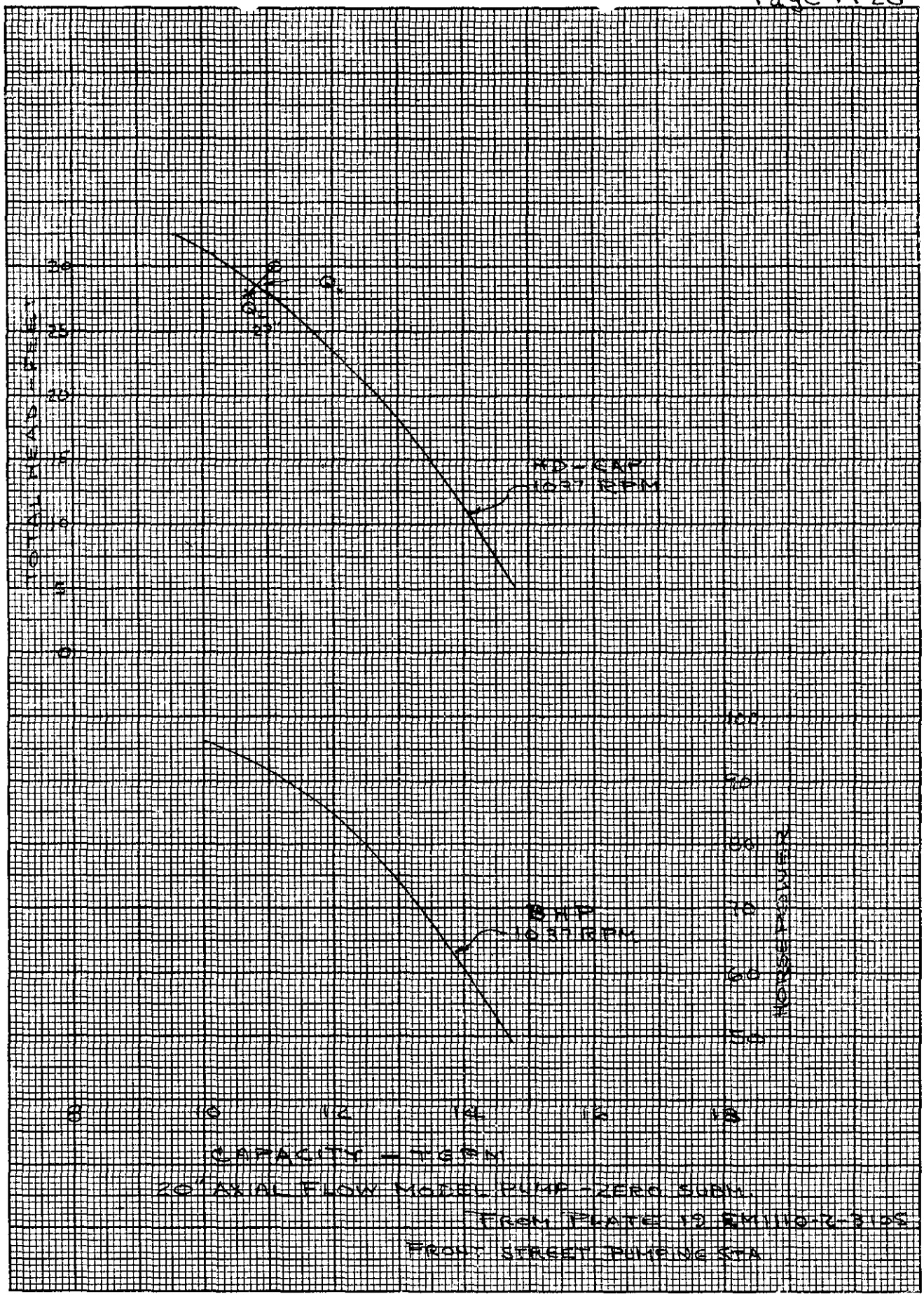
$$N_s = \frac{\sqrt{20800} \times 758}{24.3^{3/4}} = 9870$$

SUCTION LIFT 2 FT

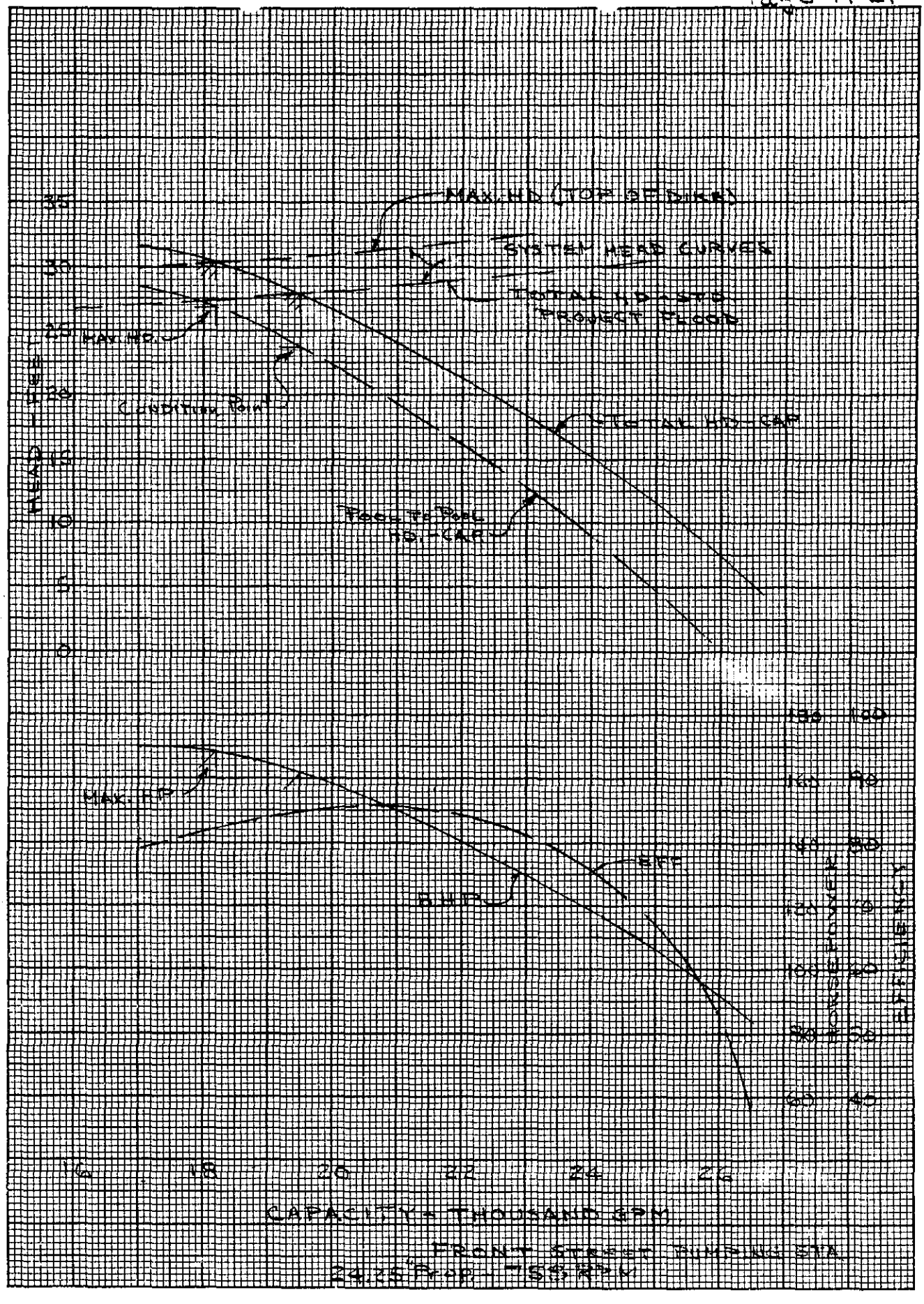
20" AXIAL FLOW MODEL PUMP - ZERO SUBM
FROM PLATE 18 EM1110-2-3105
FRONT STREET PUMPING STA

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.



K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.



K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.

SUBJECT ANSONIA-DERBY FLOOD PROTECTION
COMPUTATION DIVISION STREET PUMPING STATION
COMPUTED BY _____ CHECKED BY _____ DATE Feb 66

STATION DESIGN CAPACITY

135 c.f.s
Standard Project Flood Elev 29.6
Top of Dike " 33.1
Suction Chamber High Water " 8.0
" " Low " " 4.5
Three (3) Pumps (Each to handle 1/3 of total)

PUMP DESIGN CONDITION POINT

$\frac{135}{3} = 45$ c.f.s $= 20{,}200$ GPM

Dia of Disch. $\sqrt{\frac{4 \times 45}{12\pi}} = 2.18' = 26.2''$

USE 30" Pipe Discharge

Head:

Pool to pool	29.6 − 4.5	= 25.1
Vel. Hd. $\frac{9.81^2}{64.4}$		= 1.49
Pipe friction		= 2.94
	TOTAL	= 29.53 FEET

SYSTEM LOSSES (Each Pump)

(For 30" Disch. Pipe (using C=130 +15% & 300' Equiv. lg.)

GPM	Vel Hd	Pipe H_f	TOTAL
16000	.94	1.89	2.83
17000	1.06	2.13	3.19
18000	1.19	2.37	3.56
19000	1.32	2.61	3.93
20000	1.47	2.88	4.35
25000	2.29	4.44	6.73

PUMP OPERATING CYCLE

PIPE STORAGE	78000	Gallons
SUMP "	16500	"
TOTAL =	94500	"

AVE PUMP CAPACITY 22000 G.P.M.

Operating time (no inflow) $\frac{94500}{22000} = 4.3$ minutes

Min. Pump operating cycle (operating at full speed)
(inflow = 50% of pump capacity)

Time to empty $\frac{94500}{11000} = 8.5$ minutes

Time to refill $\frac{94500}{11000} = 8.5$ "

Minutes between Starts 17

This is not to frequent starting, however the pumps are diesel engine driven and may be operated at less than full speed so that capacity approximately matches inflow, if desired, to practically eliminate intermittent operation

SUMMARY

Computations and curves, Pages M-24, M-25, M-27, M-28, & M-29 show that propeller pump based on model curves, Pages M-27 & M-28 will not meet required max head (top of dike). Mixed-flow type pump based on Page M-30 will meet requirements with 20.964" impeller operating at 832 RPM and discharging through a 30" pipe. See performance curves Page M-31.

SUBJECT ANSONIA-DERBY FLOOD PROTECTION
COMPUTATION DIVISION STREET PUMPING STATION
COMPUTED BY _____ CHECKED BY _____ DATE Feb '66

FROM PAGE M-27

AT 29.5 FT $Q = 9{,}800$ GPM

$$D_p = D_m \left(\frac{Q_p}{Q_m}\right)^{1/2} = 20 \left(\frac{20200}{9{,}800}\right)^{1/2} = 28.7''$$

Try 30" $Q_m = \dfrac{20200}{\left(\frac{28}{20}\right)^2} = 10600$

Model Condition

$H = 29.5$ $Q = 10600$

AT $H = 31$ $Q = 10600\left(\frac{31}{29.5}\right)^{1/2} = 10{,}860$

Does not cross model curve - Head to high of this model pump.

FROM PAGE M-28

AT 29.5 FT $Q = 10{,}550$ G.P.M.

$$D_p = D_m\left(\frac{Q_p}{Q_m}\right)^{1/2} = 20\left(\frac{20200}{10{,}550}\right)^{1/2} = 27.6''$$

Try 28" $Q_m = \dfrac{20200}{\left(\frac{28}{20}\right)^2} = 10{,}300$

Model Condition

$H_c = 29.5$ $Q_c = 10{,}300$

AT $H = 31$ $Q = 10300\left(\frac{31}{29.5}\right)^{1/2} = 10{,}550$

Model Speed $N_m = N_x\left(\frac{Q_c}{Q_x}\right) = 1037\left(\frac{10300}{10400}\right) = 1027$ RPM

PROTOTYPE PUMP $H_p = H_m$

$$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{1027}{1037}\right)\left(\frac{28}{20}\right)^2 = 1.94\,Q_x$$

$$H_p = H_m = H_x\left(\frac{1027}{1037}\right)^2 = .98\,H_x$$

$$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{1027}{1037}\right)^3\left(\frac{28}{20}\right)^2 = 1.92\,P_x$$

Values from Curve			Prototype Values		
H	Q	P	H_p	Q_p	P_p
32.5	9550	97	31.8	18500	186
30	10450	95	29.4	20300	182.5
25	11600	86 (Max Eff)	24.5	22500	165
20	12650	77	19.6	24550	148
15	13500	67	14.7	26200	129
10	14200	58	9.8	27500	112
5	14800	48	4.9	28700	92

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 1027\left(\frac{20}{28}\right) = 735$ RPM

$$N_s = \frac{\sqrt{22500} \times 735}{24.5^{3/4}} = 10\,000$$

SUCTION LIFT 1 FT.

Pump not satisfactory. Max head (Top of Dike) above usable range of pump. See curves Page M-29
Try mixed-flow model pump.

FROM PAGE M-30

AT 29.5 FT $Q = 8,300$ GPM

$D_p = D_m\left(\frac{Q_p}{Q_m}\right)^{1/2}$ $D_p = 13.438\left(\frac{20200}{8,300}\right)^{1/2} = 20.964''$ Prop.

Model condition

$H_c = 29.5$ $Q_c = 8300$ GPM

Model speed $N_c = N_x\left(\frac{Q_c}{Q_x}\right) = 1298\left(\frac{8300}{8300}\right) = 1298$ RPM

PROTOTYPE PUMP $H_p = H_m$

$Q_p = Q_m\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{1298}{1298}\right)\left(\frac{29.964}{13.438}\right)^2 = 2.434\,Q_x$

$H_p = H_m = H_x\left(\frac{1298}{1298}\right)^2 = H_x$

$P_p = P_m\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{1298}{1298}\right)^3\left(\frac{29.964}{13.438}\right)^2 = 2.434\,P_x$

Values from Curve			Prototype Values			
H	Q	P	H_p	Q_p	P_p	Eff
37.5	6570	76.7	37.5	16000	186	81.6%
35.0	7230	77.8 (Max Eff.)	35	17600	189.5	82.3
32.5	7800	78	32.5	18700	190	80.8
30.0	8230	78	30	20000	190	79.7
25	8970	75.5	25	21800	184	74.8
20	9530	72	20	23200	175	67
15	9880	67	15	24000	163	56
10	10130	62.5	10	24700	152	41
8	10200	60.5	8	24800	147	34

SPEED $N_p = N_m\left(\frac{D_m}{D_p}\right) = 1298\left(\frac{13.438}{20.964}\right) = 832$ RPM.

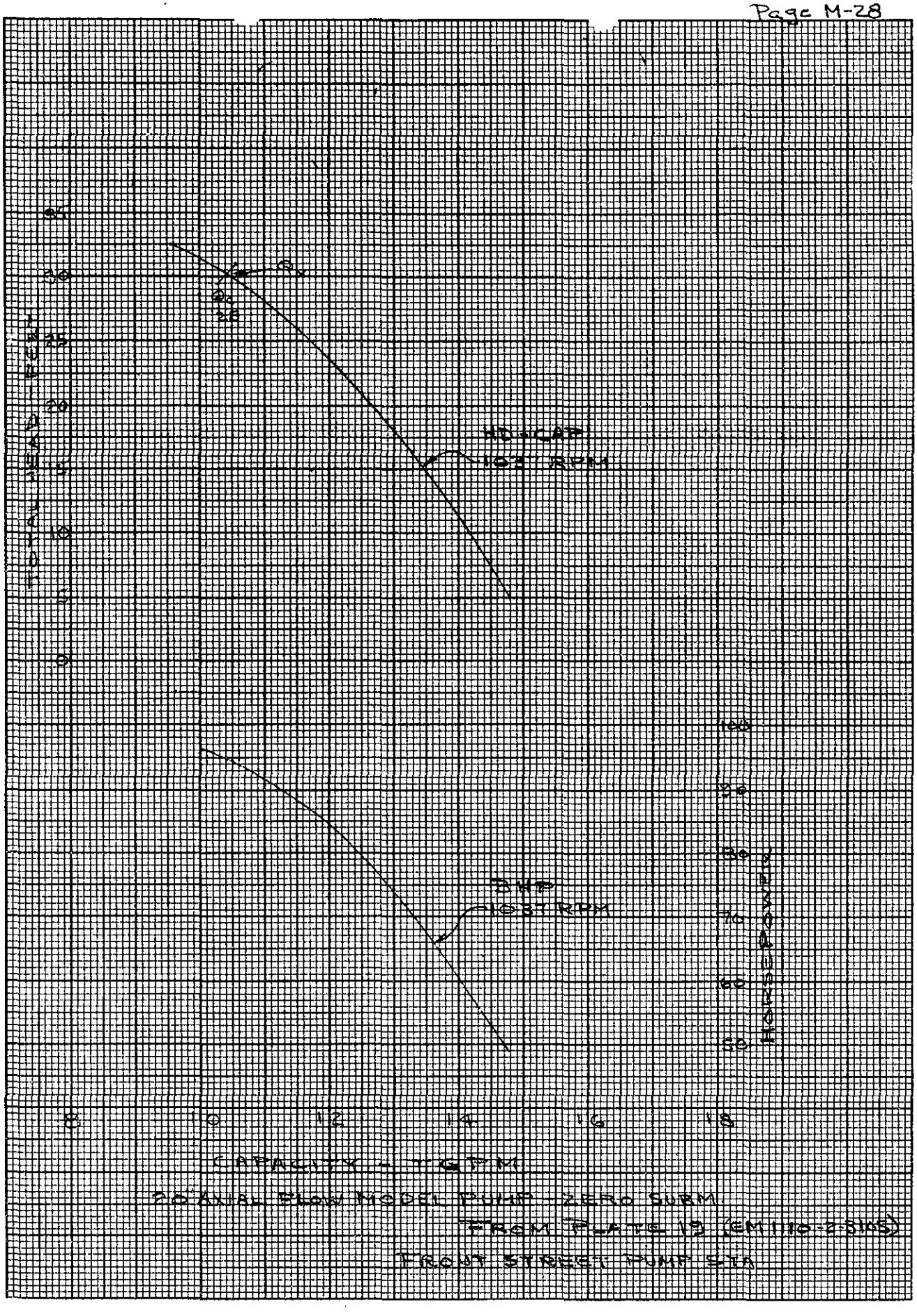
$N_s = \frac{\sqrt{17600} \times 832}{35^{3/4}} = 7600$

SUCTION LIFT 2 FT

"30" AXIAL FLOW MODEL PUMP - 7800 GPM

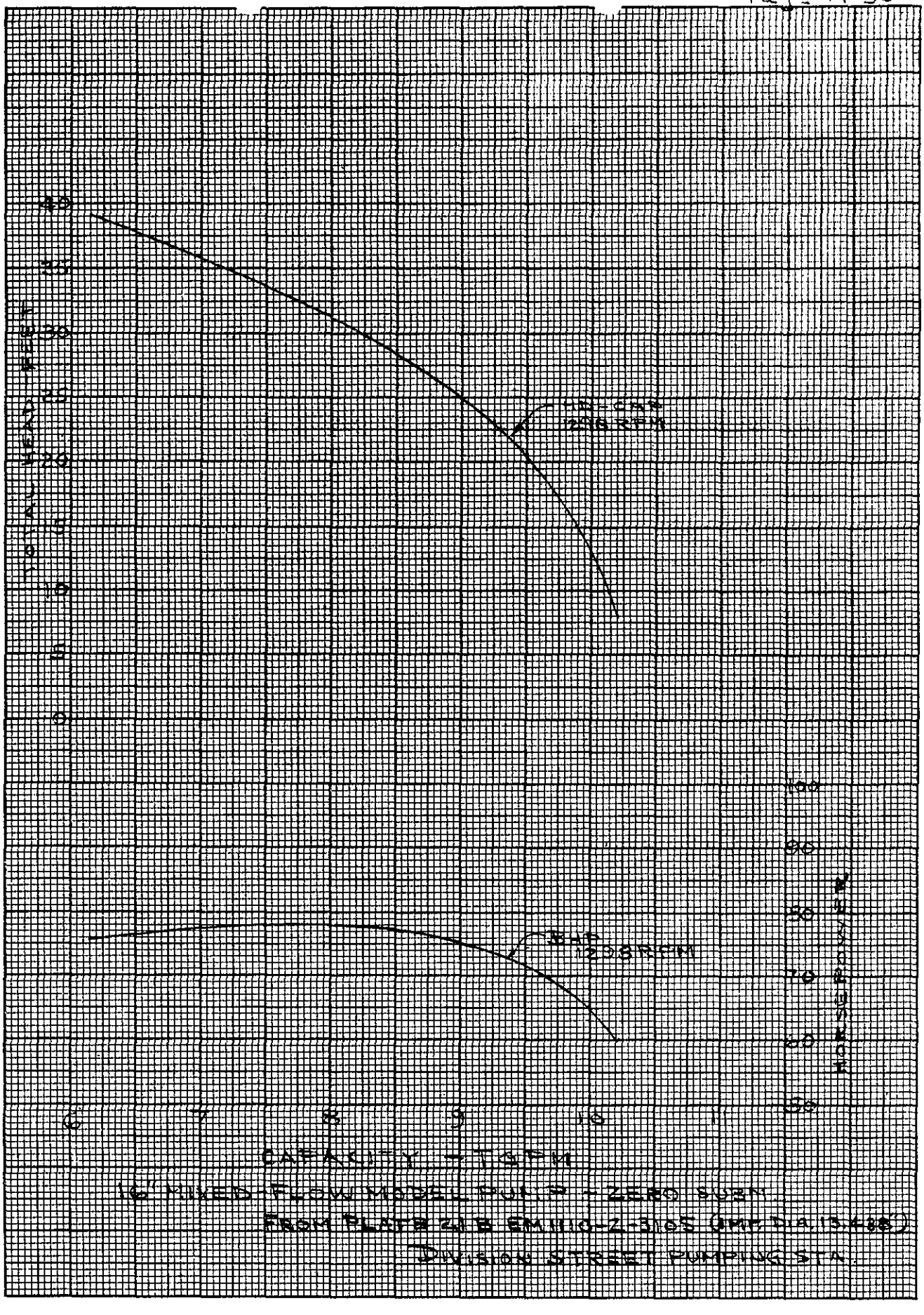
FROM PLATE 18 EN 110-2-3102

DIVISION STREET PUMPING STA.



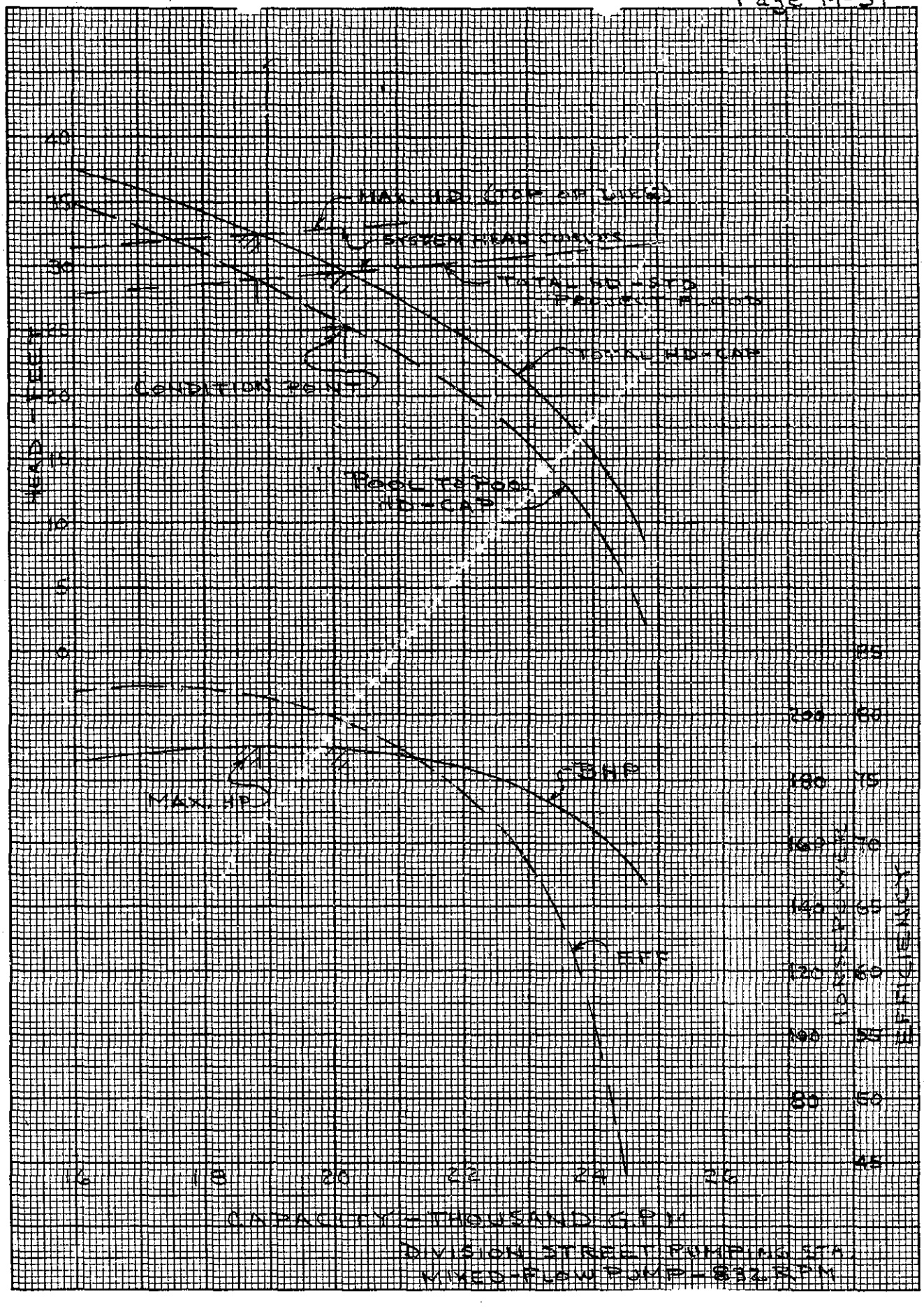
K&E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.



16" MIXED-FLOW MODEL PUMP - ZERO SUCTION
FROM PLATE 21B EM1110-2-3105 (IMP. DIA. 13.438")
DIVISION STREET PUMPING STA.

K&E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.



K&E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.

APPENDIX C

CURRENT COST ESTIMATE

ANSONIA-DERBY LOCAL PROTECTION

(3) Other local costs, in project area for bridges replaced since the 1955 floods, total $1,444,000.

COMPARISON OF ESTIMATES

The following tabulation shows the comparison of the current cost estimate with the latest estimate as submitted in Design Memorandum No. 7, "Detailed Design of Structures", submitted 29 April 1966 and approved 9 June 1966.

Cost Account No.	Project Feature	D.M. #7 Estimate	Current Estimate
09.	Channels & Canals	$ 738,000	$ 738,000
11.	Levees & Flood Walls	7,240,000	7,240,000
13.	Pumping Plants	825,000	527,000(1)
30.	Engineering & Design	795,000	795,000
31.	Supervision & Admn.	690,000	690,000
	TOTAL Federal Cost	$10,288,000	$9,990,000
01.	Lands & Damages	$ 720,000	$ 720,000
02.	Relocations	147,000	147,000
	Non-Federal Contributions	0	0
	TOTAL Local Interests Cost	$ 867,000	$ 867,000
TOTAL ESTIMATED PROJECT COST		$11,155,000	$10,857,000

(1) Revision of estimate based upon the detailed studies presented in this Design Memorandum.

TABLE III

DETAILED COST ESTIMATE

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
13. PUMPING PLANTS (Federal Cost)				
River Street Station				
Earthwork				
Excavation	800	C.Y.	$ 1.30	$ 1,040
Backfill	670	C.Y.	1.80	1,210
Discharge Line	1	L.S.	600.00	600

TABLE III (Contd)

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
Stainless Steel Letters	24	Ea.	$ 20.00	$ 480
Structural Steel	1.6	Tons	500.00	800
Water Level Recorder	1	Ea.	1,100.00	1,100
Stop Logs	1	Set	350.00	350
Other Work	1	L.S.	1,000.00	1,000
Site Work	1	L.S.	3,000.00	3,000
Mechanical Work	1	L.S.	52,000.00	52,000
Electrical Work				
Interior	1	L.S.	950.00	950
Service	1	L.S.	3,450.00	3,450
		Sub-Total		$91,640
Front Street Station				
Earthwork				
Excavation	1,900	C.Y.	$ 1.30	$ 2,470
Backfill	1,300	C.Y.	1.80	2,340
Dewatering	1	L.S.	12,000.00	12,000
Discharge Line	1	L.S.	500.00	500
Reinforced Concrete				
Concrete in Place	265	C.Y.	32.00	8,480
Form Work	6,600	S.F.	1.30	8,580
Reinforcing Steel	33,000	Lbs.	.15	4,950
Superstructure				
Brick Walls	1,450	S.F.	4.50	6,530
Ladder	16	L.F.	8.00	130
Pipe Railing	24	L.F.	9.00	220
Access Cover & Frame	60	S.F.	7.50	450
Grating	22	S.F.	7.00	150
Doors & Frame	1	Pr.	450.00	450
Plaque	1	Ea.	300.00	300
Roofing	750	S.F.	.75	560
Eaves & Flashing	120	L.F.	2.50	300
Stainless Steel Letters	24	Ea.	20.00	480
Structural Steel	5	Tons	500.00	2,500
Chimney	20	L.F.	12.00	240
Water Level Recorder	1	L.S.	1,100.00	1,100
Other Work	1	L.S.	1,000.00	1,000
Site Work	1	L.S.	4,000.00	4,000
Mechanical Work	1	L.S.	93,000.00	93,000
Electrical Work				
Interior	1	L.S.	1,250.00	1,250
Service	1	L.S.	3,300.00	3,300
		Sub-Total		$155,280

TABLE III (Contd)

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
Division Street Station				
Earthwork				
Excavation	1,900	C.Y.$	1.30	$ 2,470
Backfill	1,300	C.Y.	1.80	2,340
Dewatering	1	L.S.	14,000.00	14,000
Discharge Line	1	L.S.	500.00	500
Reinforced Concrete				
Concrete in Place	290	C.Y.	32.00	9,280
Form Work	6,400	S.F.	1.30	8,320
Reinforcing Steel	35,000	Lbs.	.15	5,250
Superstructure				
Brick Walls	1,450	S.F.	4.50	6,530
Ladder	16	L.F.	8.00	130
Pipe Railing	24	L.F.	9.00	220
Access Cover & Frame	60	S.F.	7.50	450
Grating	22	S.F.	7.00	150
Doors & Frame	1	Pr.	450.00	450
Plaque	1	Ea.	300.00	300
Roofing	750	S.F.	.75	560
Eaves & Flashing	120	L.F.	2.50	300
Stainless Steel Letters	27	Ea.	20.00	540
Structural Steel	5	Tons	500.00	2,500
Chimney	20	L.F.	12.00	240
Water Level Recorder	1	L.S.	1,100.00	1,100
Other Work	1	L.S.	1,000.00	1,000
Site Work	1	L.S.	2,500.00	2,500
Mechanical Work	1	L.S.	96,000.00	96,000
Electrical Work				
Interior	1	L.S.	1,250.00	1,250
Service	1	L.S.	3,400.00	3,400
		Sub-Total		$159,780
Sub-Total, Four Pumping Stations				$458,210
Contingencies				68,790
TOTAL, PUMPING PLANTS (Federal Cost)				$527,000