CONNECTICUT RIVER FLOOD CONTROL PROJECT

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CHICOPEE, MASS.

CONNECTICUT RIVER, MASSACHUSETTS

ANALYSIS OF DESIGN FOR PADEREWSKI PUMPING STATION

ITEM C.5b - CONTRACT

APRIL, 1940

CORPS OF ENGINEERS, U.S. ARMY

U. S. ENGINEER OFFICE, PROVIDENC'

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I. INTRODUCTION

I. INTRODUCTION.

A. AUTHORIZATION. - The Paderewski Pumping Station is a part of the local protection works for the City of Chicopee. The Chicopee Dike project is a part of Connecticut River flood control plan included in the Comprehensive Plan of Flood Control for the Connecticut River as described in House Document No. 455, 75th Congress, 2nd Session and authorized under the Flood Control Act approved June 28, 1938.

B. NECESSITY FOR THE STATION. - To complete the flood protection works from the Willimansett Section of Chicopee to the Chicopee River, it is necessary to provide gates on the several outfall sewers one of which is at Paderewski Street. The existing Paderewski Street sewer passes under the dike and it is necessary to provide pumping facilities to prevent the accumulation of water behind the dike during periods of high water. During periods of normal river stage, the sewage from a drainage area of 260 acres will flow to the river by gravity. Pumping will be necessary when the river stage exceeds Elevation 52.0 Mean Sea Level datum.

C. CONSULTATION WITH THE CITY OF CHICOPEE. - Preliminary to and during the actual design of the Paderewski Pumping Station, consultations were held with officials representing the City of Chicopee. These latter include the Mayor, the City Engineer, the head of the Sewer Department and others. The pumping station design as finally developed, meets with the approval, in its essentials, of the City of Chicopee.

D. BRIEF DESCRIPTION OF THE STATION. - The building which will house the pumps and other equipment will consist of a reinforced concrete substructure and a one-story superstructure of structural steel and brick. The portions of the riverside facade and end walls of the superstructure

below the top of dike will be of reinforced concrete. The superstructure will have glass block panels to serve as windows. The concrete roof slab of the building will be covered directly with a built-up type roof composed of four-ply asphalt membrane covered with gravel. The portion of the existing gravity sewer adjacent to the north wall of the proposed pumping station will be reconstructed to prevent joint leakage under the dike and will be provided with a service gate for back water near the centerline of the dike. The present sewer from the riverside face of the proposed pumping station to the Connecticut River outfall will be retained intact. A reinforced concrete entrance chamber will be provided on the land side of the building for racking purposes. A gate will be installed in the entrance chamber to keep the wet well dry during periods when no pumping is required. There will be installed two 30-inch propeller type pumps and one 16-inch voluto pump. Space has been provided for the installation of a future 30-inch propeller type pump. The 16-inch pump will utilize the entrance chamber as a suction well. The engine room will contain the gasoline engines and right angle gear units for the two 30-inch pumps and the electric motor for the 16-inch pump. An overhead crane will be installed for handling the equipment.

II. SELECTION OF SITE

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The pumping station is located adjacent to and downstream of the Paderewski Street sewer and on the centerline of the dike. This location was chosen for the following principal reasons: first, the existing sewer discharges at this point; second, it was found not economically feasible to divert the sewage to be pumped at any other point; third, foundation conditions are satisfactory.

III. SOIL INVESTIGATION

III. SOIL INVESTIGATIONS.

The foundation conditions were determined mainly by 2-1/2-inch drive sample borings and auger borings. One 6-inch hole was also explored near the site of the pumping station from which undisturbed samples were obtained and used in consolidation tests. Plate No. 5 shows location of the various borings. Class numbers for the various types of materials are those of the Providence Soil Classification represented graphically on Plate No. 6 and described in Table No. 1. Generalized foundation conditions are presented in a geologic section along the center line of conduit, Plate No. 7. Slightly compressible material, silt, clay, and fine sand interstratified, occurs in a layer approximately 66 feet thick underneath the station.

The existing dike was constructed in the period June to October 1939. Settlement due to this dike is now completed as this silt layer consolidates at a rapid rate. The average dead load bearing pressure of the station is approximately 1.1 tons per square foot with no water in the wet well. During times of flood this is increased by the load of water in the wet well by approximately 0.3 tons per square foot. This load is similar to a temporary live load and does not contribute to settlement. The load released by excavation and by removal of the existing dike under the station area plus hydrostatic uplift is nearly equal to the 1.1 tons per square foot dead load of the station. The stress increase caused by the net station dead load at the center line of the clay stratum is less than 0.1 tons per square foot. For this small load increase settlements will be negligible, estimated to be 1/4 inch. Differential settlements will be less than this and should cause no damage to the structure.

PROVIDENCE SOIL CLASSIFICATION
U. S. ENGINEER OFFICE
PROVIDENCE, R. I.

CLASS	DESCRIPTION OF MATERIAL
1	Graded from Gravel to Coarse Sand. - Contains little medium sand.
2	Coarse to Medium Sand. - Contains little gravel and fine sand.
3	Graded from Gravel to Medium Sand. - Contains little fine sand.
4	Medium to Fine Sand. - Contains little coarse sand and coarse silt.
5	Graded from Gravel to Fine Sand. - Contains little coarse silt.
6	Fine Sand to Coarse Silt. - Contains little medium sand and medium silt.
7	Graded from Gravel to Coarse Silt. - Contains little medium silt.
8	Coarse to Medium Silt. - Contains little fine sand and fine silt.
9	Graded from Gravel to Medium Silt. - Contains little fine silt.
10	Medium to Fine Silt. - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10 C	Medium Silt to Coarse Clay. - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11	Graded from Gravel or Coarse Sand to Fine Silt. - Contains little coarse clay.
12	Fine Silt to Clay. - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12 C	Clay. - Contains little silt. Possesses behavior characteristics of clay.
13	Graded from Coarse Sand to Clay. - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13 C	Clay. - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

IV. HYDROLOGY

IV. HYDROLOGY

A. DRAINAGE AREA CHARACTERISTICS. - The drainage area of 260 acres, as shown on Plate 1, consists at the present time of approximately 20 acres of fully developed residential area and 240 acres of partially developed and undeveloped residential area. The drainage area is a part of the present flood plain of the Connecticut River and is almost level. It has been determined from the sewer map of the City of Chicopee that approximately 60 acres or 25 percent of the total drainage area is, or can be, served by the existing sewer system. The outfall sewer which will feed the pumping station is a 60-inch-circular concrete sewer laid in Paderewski Street for a length of approximately 1500 feet and has a normal capacity (that is, without surcharge) of 120 c.f.s. One 36-inch and one 30-inch sewer having a combined normal capacity of approximately 50 c.f.s. are the main sewers which feed the outfall. Although the normal capacity of the present system is approximately 50 c.f.s., the construction of future mains and laterals will permit the development of the ultimate normal capacity of the existing system of 120 c.f.s., which is the normal capacity of the Paderewski Street outfall sewer.

B. RAINFALL RECORDS. - The following table derived from data presented in Misc. Pub. #204 U.S.D.A., "Rainfall Intensity-Frequency Data" by D.L.Yarnell, presents the best available analysis of rainfall rates for different frequencies and durations to be expected at Chicopee, Massachusetts.

MAXIMUM AVERAGE HOURLY RAINFALL RATES AT CHICOPEE, MASSACHUSETTS

Frequency years	Duration of storm in minutes			
	30	60	120	240
2	1.96	1.16	0.65	0.50
5	2.50	1.60	0.92	0.62
10	3.00	1.85	1.12	0.75
25	3.90	2.42	1.46	0.94
50	4.10	2.70	1.70	1.06

C. DIKE SEEPAGE. - The seepage flow through the dike and the surface drainage intercepted by the dike will be small and is estimated to contribute 10 c.f.s. to the total run-off.

D. RUN-OFF RECORDS. - Records of the type that would be useful in estimating the run-off from the drainage area at Chicopee are not available.

E. DESIGN RUN-OFF. - In computing the maximum rate of run-off, the average intensity of precipitation used was that for the two hours of most intense rainfall of a storm having a frequency of 10 years for the City of Chicopee, according to the Yarnell relations. The use of a 10-year 2-hour storm has been adopted by the Providence District as a standard for the Connecticut River local protection works for the most intense storm for which it is economically justifiable to provide pumping capacity even in highly developed urban areas. There is evidence that this standard is more severe than similar standards adopted by numerous principal cities for use in designing storm water drains. The probability of occurrence of a 10-year storm concurrently with a stage in the Connecticut River high enough to require pumping is sufficiently remote to furnish a fairly high factor of safety from local flooding.

Run-off coefficients are determined from consideration of the size, shape and slopes of the drainage area, the types of development,

the existence and type of natural or constructed drainage courses and the surface and subsurface storage. All of these factors are weighted to give the adopted figure which is, in the final analysis, based upon judgment and experience. The drainage area was divided into three types for both the present state of development and an estimated future state of development. The three types are fully developed commercial and industrial, fully developed residential, and partially developed residential.

In computing the run-off from the drainage area the product of the rainfall intensity and the run-off coefficient is modified by introducing a multiplier which is called the relative-protection-factor. When providing protection from run-off for a composite area it is not necessary to furnish the same degree of protection for a partially developed residential area as a fully developed industrial area. Allowance for this fact is made by introducing the relative-protection-factor (R.P.F.) which is the index of the amount of protection from run-off which one area warrants relative to another. The relative-protection-factor is defined as the ratio of the intensity of precipitation used in computing the run-off from a given area to the intensity of precipitation of the basic design storm. In other words, the adopted basic rainfall intensity multiplied by the R.P.F. gives the rainfall intensity for which protection is provided. The R.P.F. is a function of the amount of local flooding of short duration, which can be tolerated on the different types of drainage area, and of the relative topographic positions, in the drainage area, of the divisions having different types and state of development. An R.P.F. of 1.0 was used for fully developed industrial and commercial areas, 0.8 for fully developed residential areas, and 0.6 for partially developed areas.

A relative-protection-factor of 0.8 corresponds to a 5-year storm as compared to 1.0 for a 10-year storm and 0.6 corresponds to a 2-year storm.

It may occur that a partially developed portion of the drainage area, or one fully developed that is not provided with a complete system of storm drains, is so topographically situated that lines of natural drainage will prevent local ponding, and will concentrate excess run-off in other areas where additional ponding cannot be tolerated. In such cases the relative-protection-factor cannot be considered as a function of the type of development only and it may be desirable in exceptional cases to increase the factor to more than 1.0.

The following divisions of the drainage area, together with appropriate rainfall rates and run-off coefficient were used for the existing and estimated future states of development of the drainage area. Type "A" areas are fully developed industrial and/or commercial, type "B" areas are fully developed residential and type "C" areas are partially developed.

State of development	Type	Area acres	Rainfall in./hr.	Run-off Coeff.	R.P.F.	Run-off c.f.s.
Present	A	0	1.12	0.65	1.0	0.0
"	B	20	1.12	0.50	0.8	9.0
"	C	240	1.12	0.30	0.6	48.4
					Total	57.4
Future	A	15	1.12	0.65	1.0	10.9
"	B	140	1.12	0.50	0.8	62.8
"	C	105	1.12	0.30	0.6	21.2
					Total	94.9 c.f.s.

The maximum dry-weather flow was computed on the basis of estimated future development as a combined sewer system as follows:

Type	Area acres	Maximum rate of flow	Maximum discharge c.f.s.
A	15	20,000 gal. per acre daily	0.5
B	140	5,000 " " " "	1.1
C	105	2,000 " " " "	0.3
Infiltration	260	1,000 " " " "	0.4
		Total	2.3 c.f.s.

Type "B" areas are assumed to have 25 persons per acre and type "C" areas are assumed to have 10 persons per acre. The maximum rate of flow is assumed as 200 gallons per capita daily.

V. REQUIRED DISCHARGE CAPACITY

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A. PUMP CAPACITY REQUIRED. - The pumps will be required to discharge storm flow or dry-weather flow whenever the Connecticut River stage exceeds Elevation 52, which corresponds to the 2-year-frequency peak stage on the Connecticut River after the 20-reservoir plan, and which is at present equalled or exceeded for a total of 7 days per average year as shown on the stage duration curve (Plate 13). The following table includes values obtained from the studies explained under Section IV. Hydrology, including seepage flow through and under the dike, together with other pertinent data:

Dry-weather flow	3 c.f.s.
Maximum storm flow based on present development	60 c.f.s.
Maximum storm flow based on estimated future development	100 c.f.s.
Capacity of existing outfall sewer	120 c.f.s.
Estimated maximum dike seepage	10 c.f.s.
Top of dike	El. 72.4 m.s.l.
Connecticut River design flood stage	El. 67.4 m.s.l.
Normal intake water surface at pump (crown of existing outfall sewer)	El. 49.0 m.s.l.
Maximum permissible intake water surface	El. 52.0 m.s.l.
Design maximum static head 67.4 - 49.0	18.4 feet
4-year peak stage on Connecticut River (after 20-reservoir plan)	El. 54.0 m.s.l.
10-year peak stage on Connecticut River (after 20-reservoir plan)	El. 57.0 m.s.l.

In order to meet the requirements under the existing development of the drainage area, the pumps are required, then, to discharge a total of 60 c.f.s. against the static head corresponding to a river stage of Elevation 57.0 m.s.l. At the maximum river stage of 67.4, the pumps shall discharge approximately 40 percent of the maximum storm flow of 60 c.f.s. plus 10 c.f.s. of dike seepage or 34 c.f.s. A further requirement is that the ultimate pumping station should develop the full capacity of the existing outfall, viz., 120 c.f.s. plus 10 c.f.s. of dike seepage brought to the station by the toe drains.

B. INSTALLED PUMPING CAPACITY. - The pumping station is designed to discharge the full capacity of the existing outfall sewer, 120 c.f.s., plus 10 c.f.s. of dike seepage against a static head of approximately 5 feet imposed by a 4-year modified peak stage on the Connecticut River. The initial installation will consist of two pumps having a maximum capacity of 55 c.f.s., each, and a small dry weather flow pump with a capacity of 10 c.f.s. This provides sufficient capacity, with ample provision for mechanical failure, to discharge the maximum design storm flow of 60 c.f.s. based on the existing development of the drainage area. Space will be provided for the future installation of an additional pump of 55 c.f.s. maximum capacity to care for future requirements (plus allowance for mechanical failure) when the outfall sewer may be taxed to its full capacity of 120 c.f.s. The initial installation, including the 10 c.f.s. low flow pump, is sufficiently large, if there is no mechanical failure, to discharge the normal flow (that is, without surcharge) of the existing outfall sewer.

The discharge capacity of the pumps will be less against the maximum

static head of approximately 18 feet imposed by the Connecticut River design flood stage, Elevation 67.4 m.s.l. This design is considered conservative in view of the extremely rare occurrence of peak stage on the Connecticut River coincident with maximum storm run-off from the local drainage area.

VI. MECHANICAL DESIGN

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A. PUMP DRIVE. - The Paderewski Pumping Station is one of seven pumping stations to be constructed in Chicopee. Prior to the design of any of the stations an investigation was made of the available electric power facilities with the view of employing electric motor drive for the pumps. The results of the investigation indicated that suitable power was available. However, the City of Chicopee was unable to come to an agreement with the power companies on the question of rates and eventually requested this office to provide gasoline engine drive. (See Analysis of Design Jones Ferry Pumping Station, Chicopee, Mass.).

The gasoline engines for the Paderewski Pumping Station will be of the heavy-duty industrial type capable of continuously driving the pumps at their rated speed under any head condition developed. The engines will not use over 85 percent of their developed horsepower. They will be mounted on concrete bases and directly connected through flexible couplings to the right angle gear units.

B. PUMPS. - From the ultimate required pumping capacity of 130 c.f.s., as determined in Section V, it was determined that provisions should be made to install three pumps. To install a larger number of pumps would materially increase the cost of the station without resulting in any great advantage and a smaller number would seriously limit the operating flexibility and reliability of the station. Inasmuch as the present pumping requirements are considerably less than that required in the future, only two pumps will be installed at this time.

No provisions were made in the capacity determined in Section V for

possible mechanical failure of equipment. To provide for this contingency, it is considered necessary that any two pumps should be capable of delivering about 85 percent of the 130 c.f.s., or 110 c.f.s. This factor will make an ultimate station capacity of 165 c.f.s. A study of equipment indicated that three 30-inch propeller type pumps would be required; each pump to have a capacity of 25,000 G.P.M., or 55 c.f.s., against a total head of 8 feet. In addition, one 16-inch mixed flow type of pump having a capacity of 6500 G.P.M. against a total head of 23.5 feet was provided to pump the dry weather flow and dike seepage at such periods when the river is at flood stage and no storm water is to be pumped from within the protected area.

C. RIGHT ANGLE GEAR UNITS. - The gear units will be of the self-contained type designed for transmitting the power from the horizontal engine shaft through a gear train to the vertical pump shaft. The units will be inclosed in a cast iron and structural steel housing and will have a service factor of not less than 1.25 times the maximum power required to drive the pumps under any condition of head.

D. STANDBY GENERATOR UNIT. - A gasoline engine-driven generator will be provided to furnish electric power in the event of failure of commercial power. The unit will have a normal full load capacity of 93.8 kva, which will be sufficient to start and run the 16-inch pump motor as well as maintain in operation the other electrical auxiliaries and the station lighting system.

E. CRANE. - A five ton overhead crane will be installed in the engine room to facilitate the repairing of any item of equipment. The crane will be of standard construction and hand operated throughout.

F. SLUICE GATES. - A motor-operated sluice gate will be located at the entrance to the pump sump. This gate will normally be kept closed to prevent water from collecting in the sump. It will be opened only at such periods when it is necessary to operate the storm water pumps. A second motor-operated sluice gate will be located in the gravity discharge conduit to prevent back flow during periods of high water. This gate will normally be kept open to permit water to flow by gravity to the river.

G. WATER SYSTEM. - The city water supply will be connected to the pumping station and the water used for cooling the gasoline engines and station service. In addition, the sump pump will be so connected that it can be employed to furnish engine-cooling water in times of emergency.

H. GASOLINE SYSTEM. - Gasoline will be stored in a 2,300-gallon tank buried in the ground adjacent to the pumping station. Each engine will be supplied through an individual line running directly to the tank. Drip pans will be provided on each engine and connected to a common header running back to the tank. All gasoline piping will be 3/4-inch I.D. copper tubing with flared joint connections. At such points where the gasoline lines are imbedded in concrete or pass through beams, they will be protected by wrought iron pipe sleeves.

I. SUMP PUMP. - A motor-operated sump pump of 50 G.P.M. capacity will be provided in the wet sump for the purpose of drying it up after the pumping station has been in operation.

J. VALVES. - A flap valve will be installed on the end of each pump discharge line to facilitate the starting of the pump and to prevent backflow through it when the river is at flood stage. Intermittent starting and stopping of the pumps will, however, subject the flap valves

to considerable slamming which in time may result in their failure. In view of this fact, a gate valve will be provided in each discharge line so that they may be closed should a flap valve fail.

K. FIRE EXTINGUISHING SYSTEM. - A carbon dioxide fire extinguishing system will be installed and so arranged that any gasoline engine can be blanketed with gas by tripping a valve located just inside the main entrance to the building. Portable extinguishers will be provided to take care of any other emergencies.

L. HEATING SYSTEM. - The heating system will be of the two pipe gravity type consisting of an oil-fired boiler supplying steam to two unit heaters located at opposite ends of the engine room. The oil burner will be of the rotary type with electric ignition. The unit heaters will be of ample capacity to heat the engine room under the coldest weather condition.

M. SWITCHBOARD AND CONTROL EQUIPMENT. - The switchboard will be of the steel-enclosed, low-voltage, dead-front, light duty type with all controls mounted on the front. All circuit breakers will be manually operated. Circuit breakers for the generator and incoming feeder will be the air-break type rated at 600 volts, 60-cycles, A.C., having an interrupting capacity of 20,000 amperes, provided with three instantaneous and time-delay magnetic overcurrent trips, and magnetic lockout attachments on each so that only one can be in the closed position at any time. This lockout feature will be provided to prevent the connection of the generator in parallel with the outside source.

All controls for operating the 16-inch pump motor will be located at the switchboard in order to centralize them with those of the outside

source and standby generator. The external resistance of the rotor will be varied through a drum controller to provide speed regulation at one-half, three-quarters, and full load speeds. The speed reduction will be used to provide continuous operation during periods when the flow to the pump is less than full load capacity at rated speed. The secondary resistors will be mounted on the wall to allow free circulation of air for dissipating the heat generated. The primary of the pump motor will be controlled by a magnetic contactor, fed from the main bus through a feeder circuit breaker, interlocked with the "off" position of the drum controller so the motor cannot be started without having all of the resistance in the rotor circuit at the time of starting. Feeder protective circuit breakers for the pumping station auxiliary equipment will be mounted on the switchboard, and each circuit breaker will be rated at 600 volts, 60 cycles, A.C., having an interrupting capacity of 10,000 amperes and provided with thermal and instantaneous magnetic trips.

VII. STRUCTURAL DESIGN

VII. STRUCTURAL DESIGN

A. SPECIFICATIONS FOR STRUCTURAL DESIGN. -

1. General. - The structural design of the Paderewski pumping station has been executed in general in accordance with standard practice. The specifications which follow cover the conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5 # per cubic foot
Dry earth	100 # per cubic foot
Saturated earth	125 # per cubic foot
Concrete	150 # per cubic foot

3. Earth pressures. - For computing earth pressure caused by dry earth Rankine's formula was used. For saturated soils an equivalent liquid pressure of 80 pounds per square foot per foot of depth was assumed.

4. Structural steel. - The design of structural steel was carried out in accordance with the Standard Specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

5. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937.

a. Allowable working stress. - The allowable working stress in concrete used in the design of the pump house and appurtenant structures is based on a compressive strength of 3,000 pounds per square inch in 28 days.

b. Flexure (f_c). - Lbs. per sq.in.

Extreme fibre stress in compression 800

Extreme fibre stress in compression adjacent to supports of continuous or fixed beams or rigid frames 900

c. Shear (v). -

Beams with no web reinforcement and without special anchorage. 60

Beams with no web reinforcement but with special anchorage of longitudinal steel 90

Beams with properly designed web reinforcement but without special anchorage of longitudinal steel. 180

Beams with properly designed web reinforcement and with special anchorage of longitudinal steel. 270

Footings where longitudinal bars have no special anchorage. 60

Footings where longitudinal bars have special anchorage 90

d. Bond (u). -

In beams, slabs, and one way footings 100

Where special anchorage is provided. 200

The above stresses are for deformed bars.

e. Bearing (f_c). -

Where a concrete member has an area at least twice the area in bearing 500

f. Axial compression (f_c). -

	Lbs. per sq.in.
Columns with lateral ties.	450

g. Steel stresses. -

Tension.	18000
Web reinforcement.	16000

h. Protective concrete covering. -

Type of members	Minimum cover in inches
Interior slabs	1-1/2
Interior beams	2
Members poured directly against the ground	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature and spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

B. BASIC ASSUMPTIONS FOR DESIGN. -

1. Roof slab. - The roof slab is of reinforced concrete. It is designed to carry the full dead load plus a live load of 40# per square foot of roof surface.

2. Roof beams. - The roof beams are of structural steel encased in concrete fireproofing. They are designed to carry the full dead load, plus the full live load of 40# per square foot of roof surface. In addition to taking up the roof load, these beams, together with the columns to which they are connected, form portal frames which take up wind load and crane thrusts on the building. The end connections are designed to take up all such horizontal loads.

3. Columns. - Structural steel columns in the side walls and end walls of the superstructure take up the direct roof loads as well as

all wind loads on the sides of the superstructure. In addition, the columns in the side walls carry crane brackets which support the crane runway. These columns are designed to carry full live and dead load from the roof; dead load, live load and impact effect from the traveling crane; bending due to eccentrically applied loads, and bending due to wind load on the building. No point of inflection was considered in the column design, a pin-ended condition at the base being assumed.

4. Engine room floor. - The engine room floor is designed to carry all engines, motors, etc., actually to be placed on that floor, as well as a uniform load.

The following assumptions were made for design purposes:

a. For the floor slab, the design loads are the estimated dead loads plus a uniform live load of 300# per square foot.

b. For the removable steel floor plates, the design loads are the estimated dead load plus a uniform load of 300# per square foot.

c. For the floor beams, the design loads are the estimated dead loads, the actual machinery loads, a concrete base slab load under the gasoline engine, and a uniform load of 200# per square foot on the unoccupied portion of the floor slabs which contribute loads to the beams under consideration. For the machinery loads, an impact factor of 100 percent has been added.

5. Pump room side walls. -

a. The station is so located that the building and its adjoining earth dikes form a part of the flood protection. The riverside wall and the end walls are designed of reinforced concrete

below Elevation 72.9 and of brick and steel construction above Elevation 72.9. The landside wall is designed of brick and steel construction above Elevation 66.33 and reinforced concrete below Elevation 66.33.

b. In designing the wet pump room side walls, account was taken of the effect of the thrust of the water against the building with the river at flood stage. To provide for horizontal pressures the walls were designed simply supported at the engine room floor level and continuous with the pump room floor. At the operating floor level the walls are supported by horizontal beams which transfer their reactions into the end wall and the division wall between the wet and dry pump rooms.

c. In the dry pump room, the riverside wall, the landside wall, the end wall, and the wall between the wet sump and the dry pump room were designed as a rigid horizontal frame.

d. The portion of the riverside wall and end walls extending from the engine room floor to Elevation 72.9 were designed as cantilever walls.

e. The loading consisted of the vertical loads due to the weight of the structure; the vertical live and impact loads from the engine room floor; the roof live load; and the thrusts against the walls from high water on the riverside and saturated earth pressures on the landside.

From the loadings noted, bending moments were computed in the walls, pump room floor slab, and engine room floor beams.

6. Pump room end walls. - The pump room end walls were designed to resist the vertical loads, and thrusts due to earth pressure.

7. Conduit. - The conduit is designed only for gravity flow. Starting as a single rectangular tube 5' x 5' where it joins the backwater chamber of the existing sewer, the conduit Y-s to join a trash rack chamber, 11 feet wide, where a hinged movable rack is provided for screening the flow during high river stages. This chamber was designed as a continuous box section for dead load, and a type H-12 truck load on the chamber roof.

8. Conduit expansion joints. - An expansion joint is provided between the conduit and the pump house substructure.

9. Trash racks. - There is one trash rack in the conduit. The rack consists of two leaves which are hinged 8 feet vertically above the bottom of the rack and which revolve on a 6" diameter pipe acting as a pin or trunnion. The rack can be raised into a horizontal position for cleaning. Cast iron bearings in the conduit side walls provide support for the pipe trunnion while cast iron stops anchored into the conduit floor slab hold the rack in alignment when it is in position for screening.

10. Stairways and ladders. - An open grating stairway leads from the engine room floor to the dry pump room and into the boiler room. Access to the wet sump from the engine room floor is obtained through a hatch in the engine room floor slab and ladder in the pump room wall. A ladder is also provided on the outside of the building for access to the roof of the building.

C. ARCHITECTURE. - The pumping station will be a building of modern design in keeping with the architectural treatment used on similar projects elsewhere on the Connecticut River. This design will give a

pleasing appearance without undue emphasis being placed on purely decorative features.

The pumping station will be a flat-roofed, brick and glass block structure approximately 22 feet by 51 feet inside. The 12.5 inch thick brick walls, capped with a cast stone coping, extend above the roof slab to form a parapet wall around the entire roof. A flat type roof was chosen as being economical and in keeping with the architectural design, as well as serving as a location for the engine exhaust mufflers. The roof system consists of steel beams encased in concrete and supported by steel columns. The roof slab will be 5 inches thick, covered with a cinder concrete fill sloped to drain. There are no outside pilasters. Inside the building there are pilasters at the chimney and at each structural steel column, the pilasters forming fire-proof column encasements. The engine room floor will be an 8.5-inch structural concrete slab, with a monolithic finish. A hand-operated traveling crane of 5 tons lifting capacity will operate for the full length of the building and will be used for installing and moving pumps and machinery. Access for the crane hoist to the pump room will be had through openings in the operating room floor, these openings being normally covered with removable floor plates.

There is no window sash in the building. Light will be admitted through large glass block panels, glass blocks being chosen in preference to sash because of the exposed location of the pumping station near the river banks. The well-diffused and uniform light which they provide and their appearance is also in keeping with the spirit of the architectural design. To provide ventilation, movable louvres have been placed low in the brick walls and a motor operated exhaust ventilator has been placed on the roof.

The main entrance door, 5' wide by 8' high, consists of two leaves of hollow steel construction and gives entrance directly to the operating room floor. It is large enough to provide adequate clearance for any replacement of mechanical equipment which may be required in the future.

VIII. CONSTRUCTION PROCEDURE

VIII. CONSTRUCTION PROCEDURE

A. SEQUENCE OF OPERATIONS. - The schedule of work will require the contractor to complete the pumping station substructure, wing walls, the reinforced concrete portion of the end and riverside walls of the superstructure, the gate well and the replacement of the existing earth dike in 100 calendar days and to complete all work within 220 calendar days.

B. CONSTRUCTION PERIOD. - A study of hydrographs plotted from data recorded by the United States Weather Bureau from 1919 to 1939, a total of 21 consecutive years, shows that the majority of floods at Chicopee occur in the months of March, April, and May. The original ground surface at the site of the pumping station is at Elevation 65.0 mean sea level, and has been flooded twice in the 21 years of record. Normal low water is at 41.5 mean sea level.

Consideration of this matter leads to the conclusion that if work on the pumping station begins after June 15, protection to Elevation 52.0 during construction will probably be sufficient. To take advantage of the period of low floods it is planned to award the contract for the construction of the pumping station so that the whole contract may be completed not later than February 1, 1941.

The contractor will be responsible for all damage by floods to Elevation 52.0, while the Government will be responsible for damage by floods which may exceed Elevation 52.0. The contractor will be required to repair all such damage at contract unit prices.

C. CONCRETE CONSTRUCTION.

1. Composition of concrete. - The concrete will be composed of cement, fine aggregate, coarse aggregate, and water so proportioned and

mixed as to produce a plastic, workable mixture. All concrete except the pumping station base slab will be Class "A" as designated in the specifications, and will have an average compressive strength of not less than 3,400 lbs. per square inch, in accordance with a standard 28-day test. The pumping station base will be Class "B" concrete and will have an average compressive strength of not less than 3,000 lbs. per square inch, in accordance with a standard 28-day test. Concrete aggregates will have to be of suitable quality and will be tested by the Central Concrete Testing Laboratory at West Point.

2. Laboratory control. - A small concrete testing laboratory will be available in the area for use to control the quality of concrete during construction. The tests performed here will supplement those made at the Central Laboratory of the North Atlantic Division at West Point. Facilities will be available for testing the grading of aggregates, designing concrete mixtures, mixing of trial concrete batches for the purpose of developing actual relations between compressive strength and water cement ratio, controlling workability of concrete by slump tests, and casting of concrete cylinders for compressive strength tests.

a. Cement. - Cement will be tested by a recognized testing laboratory and results of these tests shall be known before the cement is used. True Portland cement of a well known and acceptable brand will be used throughout.

b. Fine aggregate. - Natural sand will be used as fine aggregate. The aggregate will be subject to a careful, thorough analysis, including magnesium sulphate soundness tests, and tests made on mortar specimens for compressive strength.

c. Coarse aggregate. - Washed gravel or crushed stone of required sizes will be used as coarse aggregates. It must consist of hard, tough and durable particles free from adherent coating and must be free from vegetable matter. Only a small amount of soft, friable, thin or elongated particles will be allowed. The aggregate will be subject to accelerated freezing and thawing tests and to careful, thorough analysis, including magnesium sulphate tests for soundness.

d. Water. - The amount of water used per bag of cement for each batch of concrete will be predetermined; in general, it will be the minimum amount necessary to produce a plastic mixture of the strength specified. Slump tests will be required in accordance with specifications.

3. Field control.

a. Storage. - The concrete components will be stored in a thoroughly dry, weather-tight, and properly ventilated building. The fine and coarse aggregates will be stored in such manner that inclusion of foreign material will be avoided.

b. Mixing. - The exact proportions of all materials in the concrete will be predetermined. The mixing will be done in approved mechanical mixers of a rotating type, and there must be adequate facilities for accurate measurement and control of each of the materials used in the concrete. Mixing will be done in batches of sizes as directed and samples will be taken for slump tests and for compressive strength tests. Inspectors will at all times supervise and inspect the mixing procedure.

c. Placing. - Concrete will be placed before initial set has occurred. Forms will be clean, oiled, rigidly braced and of ample strength. Concrete poured directly against the ground will be placed on

clean damp surfaces. Mechanical vibrators will be used to consolidate the concrete, and forking or hand-spading will be applied adjacent to forms on exposed surfaces to insure smooth, even surfaces. Location of vertical and horizontal construction joints, as well as contraction and expansion joints and location of copper water stops, are indicated on the drawings. The locations of construction joints are tentative and may be changed to suit conditions in the field. Before placing concrete, all reinforcing steel will be inspected and pouring of the concrete will be supervised and directed by Government inspectors. Adequate precautions will be taken if concrete is to be placed in cold or hot weather.

D. STRUCTURAL STEEL CONSTRUCTION. - Structural steel construction consists of the frame work for the superstructure; the walkways and stairway in the pump room; the steady beam for the volute pump shaft, the trash rack, and the miscellaneous frames, angles, checkered plates, crane rails, railings, and ladders.

1. Superstructure framework. - The superstructure framework consists of beams and columns which will form a skeleton frame for the exterior walls and roof, and will provide a runway for the hand-operated crane. The columns will be securely anchored to the concrete walls and will be connected to the roof beams with web connection angles and wind bracing connections. The crane rails will be fastened to the crane runway beams with bent hook bolts. Crane stops at each end of the runway will prevent the traveling crane from running into the end walls.

2. Walkways and stairways. - The grating for the walkways and stairway treads in the pump room will be supported on structural steel channels. Wrought-iron pipe railings are to be fastened to the top

flanges of the stairway channels.

3. Steady beam. - The steady beam will consist of two channels with the flanges connected with lattice bars and button plates. The pump shaft will pass through an opening between the middle batten plates and will be supported sidewise by a bearing bolted to the top flanges of the channels. Holes for bolting the bearing to the steady beam will be drilled in the field. The steady beam will be bolted to the substructure side walls with four 7/8-inch anchor bolts. The steady beam will be held rigidly in place with horizontal and vertical knee braces. The beam is designed to take a side thrust of 1,000 lbs. applied at the shaft bearing.

4. Trash racks. - The trash racks are made up of structural channel frames which support 4-inch by 3/8-inch grating bars, spaced 2-5/8 inches in the clear. The racks are welded throughout. A pair of hand-operated drum hoists are provided for lifting the racks out of the waterway to aid in clearing them of debris or to permit the pumping station to operate at flood times if the racks become clogged with debris.

5. Removable floor plates. - Access for the crane to the pump room will be obtained by removing checkered floor plates. The removable covers consist of 1/4-inch checkered plates welded to 3 inch x 2-1/2 inch x 5/16 inch angles. Each opening in the floor is covered with 2 sections. Lifting rings are provided in the plates for easy removal.

6. Miscellaneous angles and frames. - Miscellaneous structural steel such as door frames, angles, grilles, etc., will be erected and placed as indicated on the drawings and at such time as required.

IX. SUMMARY OF COST

IX. SUMMARY OF COST

The total construction cost of the Paderewski pumping station, including the conduit, pump house and mechanical equipment, has been estimated to be $107,000 including 10 percent for contingencies and 15 percent for engineering and overhead.

This amount has been distributed as follows:

(1)	Pumping station. -	
	a. Concrete	$23,400
	b. Superstructure	9,000
	c. Miscellaneous	12,400
		$44,800
(2)	Conduit. -	
	a. Concrete	$ 4,400
	b. Miscellaneous	1,000
		$ 5,400
(3)	Mechanical equipment	$56,800

(1) a. The concrete included under the pumping station consists of the building foundation and interior partitions.

(1) b. The superstructure consists of the complete building above the operating floor.

(1) c. Miscellaneous items are common excavation and backfill, miscellaneous iron and steel, trash racks, and other items not included in (1) a. and (1) b.

(2) a. The concrete is the concrete in the conduit and intake structure.

(2) b. Miscellaneous items are common excavation and backfill, riprap, permanent steel sheet piling and random fill.

(3) The mechanical equipment consists of pumps, gas engines, gear units, crane, generating units, valves and piping.

ANALYSIS OF DESIGN

PADEREWSKI STREET PUMPING STATION

INDEX FOR PLATES.

Plate No. 1	Project location and index
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Plate No. 3	Stage hydrograph No. 1
Plate No. 4	Stage hydrograph No. 2
Plate No. 5	Subsurface Explorations
Plate No. 6	Providence District Soil Classification
Plate No. 7	Geologic Section
Plate No. 8	Pump House Plans - Architectural
Plate No. 9	Intake Chamber and Conduit Details
Plate No. 10	General Arrangement of Equipment No. 1
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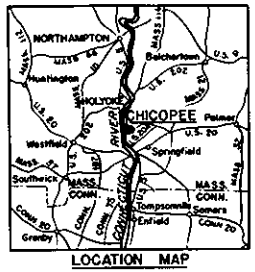
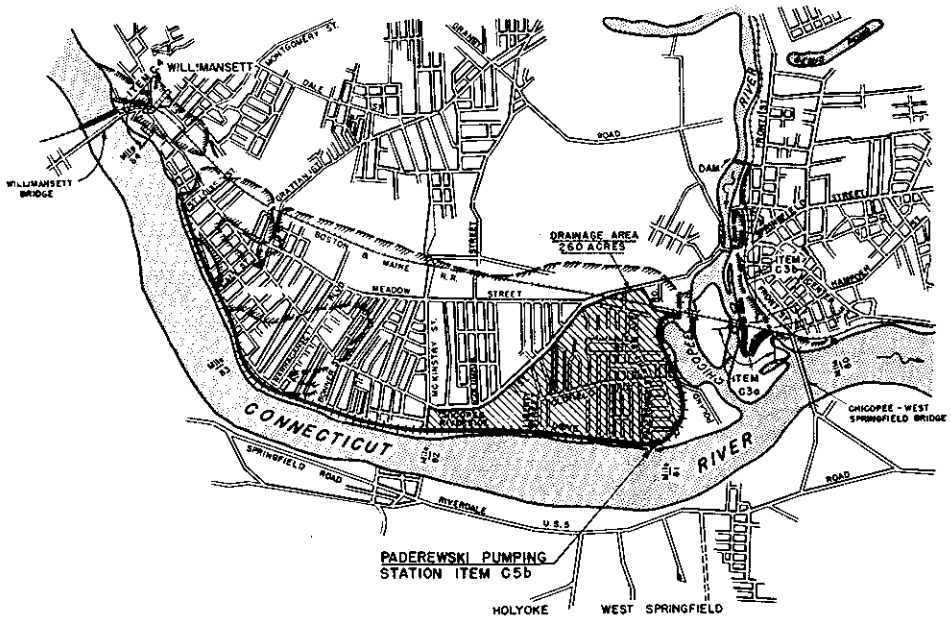
Plate No. 12	Stage Duration Curve
Plate No. 13	Pumping Capacity
Plate No. 14	Organization Chart

X. PLATES



LOCATION MAP

SCALE 1"=8 MILES



VICINITY MAP

SCALE 1"=1500'

INDEX TO DRAWINGS

SHEET NO.	TITLE	DRAWING NO.
1	PROJECT LOCATION AND INDEX	CT-4-2238
2	GENERAL PLAN	CT-4-2239
3	STAGE HYDROGRAPH NO.1	CT-3-1136
4	STAGE HYDROGRAPH NO.2	CT-3-1137
5	SUBSURFACE EXPLORATIONS	CT-2-1260
6	BORROW AREAS	CT-2-1259
7	INTAKE CHAMBER AND CONDUIT DETAILS	CT-4-2240
8	WING WALL DETAILS	CT-4-2241
9	INTAKE CHAMBER AND CONDUIT REINFORCEMENT NO.1	CT-4-2242
10	INTAKE CHAMBER AND CONDUIT REINFORCEMENT NO.2	CT-4-2243
11	INTAKE CHAMBER AND CONDUIT REINFORCEMENT NO.3	CT-4-2244
12	STEEL SHEET PILING AND RAMP DETAILS	CT-4-2245
13	MISCELLANEOUS DETAILS	CT-4-2246
14	PUMP HOUSE PLANS - ARCHITECTURAL	CT-4-2247
15	PUMP HOUSE ELEVATIONS NO.1 ARCHITECTURAL	CT-4-2248
16	PUMP HOUSE ELEVATIONS NO.2 ARCHITECTURAL	CT-4-2249
17	PUMP HOUSE SECTIONS ARCHITECTURAL	CT-4-2250
18	PUMP HOUSE DETAILS NO.1 ARCHITECTURAL	CT-4-2251
19	PUMP HOUSE DETAILS NO.2 ARCHITECTURAL	CT-4-2252
20	ROOF SLAB-STEEL REINFORCEMENT	CT-4-2253
21	ENGINE ROOM FLOOR-STEEL REINFORCEMENT NO.1	CT-4-2254
22	ENGINE ROOM FLOOR-STEEL REINFORCEMENT NO.2	CT-4-2255
23	ENGINE ROOM FLOOR-STEEL REINFORCEMENT NO.3	CT-4-2256
24	BASE SLAB REINFORCEMENT	CT-4-2257
25	VERTICAL SECTIONS	CT-4-2258
26	HORIZONTAL SECTIONS	CT-4-2259
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37	MISCELLANEOUS STRUCTURAL STEEL DETAILS NO.3	CT-4-2270
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39	GENERAL ARRANGEMENT OF EQUIPMENT NO.1	CT-4-2273
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48	ELECTRIC LIGHT AND POWER SYSTEM NO.1	CT-4-2282
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50	ELECTRIC LIGHT AND POWER SYSTEM NO.3	CT-4-2284

LEGEND

- Item C1 & C2 Completed Dikes
- Item C3a Fiscal Year 1940 Unit, West of B & M R.R. South Bank Chicopee River
- Item C3b Future Construction, Fiscal Year 1940 Unit, South Bank Chicopee River
- Item C4 Fiscal Year 1940 Section Willimansett Dike
- Overflow Limits, March 1936 Flood.

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

PROJECT LOCATION AND INDEX

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SCALE 1 IN = 1500 FT. — SHEET NO. 1

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PERSONAL ENGINEER, CHIEF, F.C. ENGINEERING BRY — APPROVED: COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ARCH. ENGINEER — DRAWN: T.S.B. TRACED: E.A.M. CHECKED: W.K.M.

FISCAL YEAR 1940

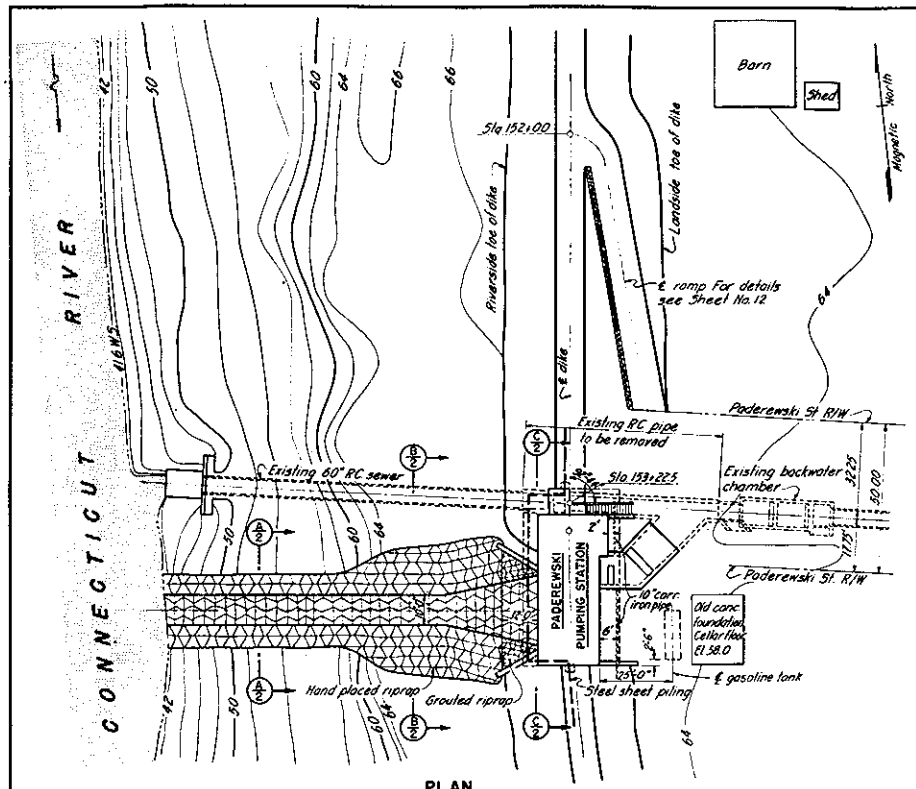
FILE NO. CT-4-2238

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY

C5b

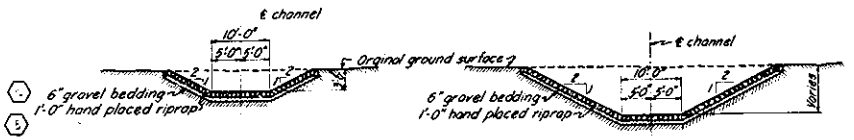
1

PLATE NO. 1



PLAN

SCALE: 1" = 20'

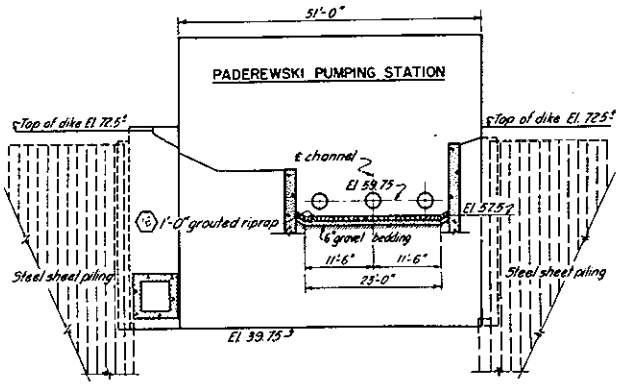


SECTION A/2

SCALE: 1" = 10'

SECTION B/2

SCALE: 1" = 10'



SECTION C/2

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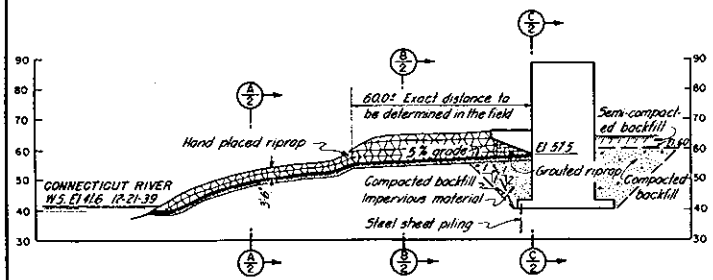
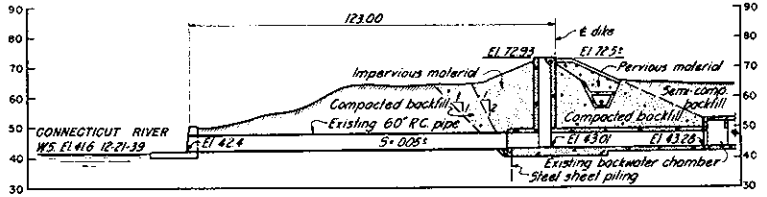


PROFILE ALONG ℄ CHANNEL

SCALE: 1" = 20'



PROFILE ALONG ℄ EXISTING PIPE

SCALE: 1" = 20'

NOTE

Elevations refer to Mean Sea Level Datum.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

GENERAL PLAN

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SCALE: 1 IN. = 20 FT. — SHEET NO. 2

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: Senior Engineer, Head, Design Section — APPROVAL RECOMMENDED: Principal Engineer, Chief, F.C. Engineering Div. — APPROVED: Colonel, Corps of Engineers, District Engineer

DESIGNED: P. C. Lapointe, Asst. Engineer — DRAWN: W.R.D. TRACED: L.A.D. CHECKED: F.F.R.

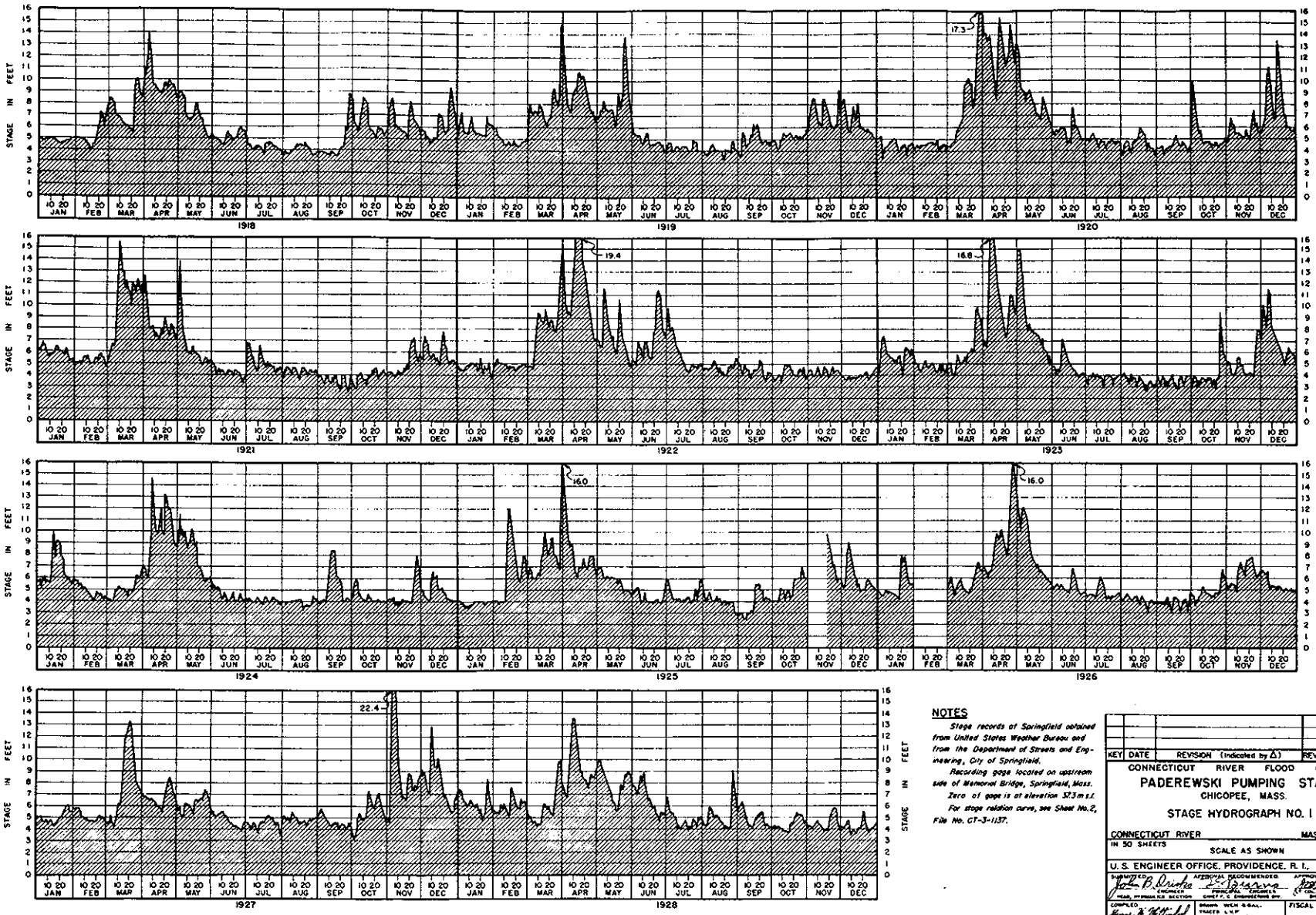
FISCAL YEAR 1940

FILE NO. CT-4-2239

PLATE NO. 2

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

Stage records of Springfield obtained from United States Weather Bureau and from the Department of Streets and Engineering, City of Springfield.

Recording gage located on upstream side of Memorial Bridge, Springfield, Mass.

Zero of gage is at elevation 37.3 m s.l.

For stage relation curve, see Sheet No. 2, File No. CT-3-1137.

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

STAGE HYDROGRAPH NO. 1

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SHEET NO. 3

SCALE AS SHOWN

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., APRIL, 1940

SUBMITTED: John B. Drisko, ENGINEER, HEAD, HYDRAULICS SECTION

APPROVAL RECOMMENDED: E. Burns, PRINCIPAL ENGINEER, CHIEF, C. ENGINEERING DIV.

APPROVED: [signature], LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: [signature], ASSOC. ENGINEER

DRAWN: WCH & GAL. TRACED: L.K.P. CHECKED: N.C.M.

FISCAL YEAR 1940

FILE NO. CT-3-1136

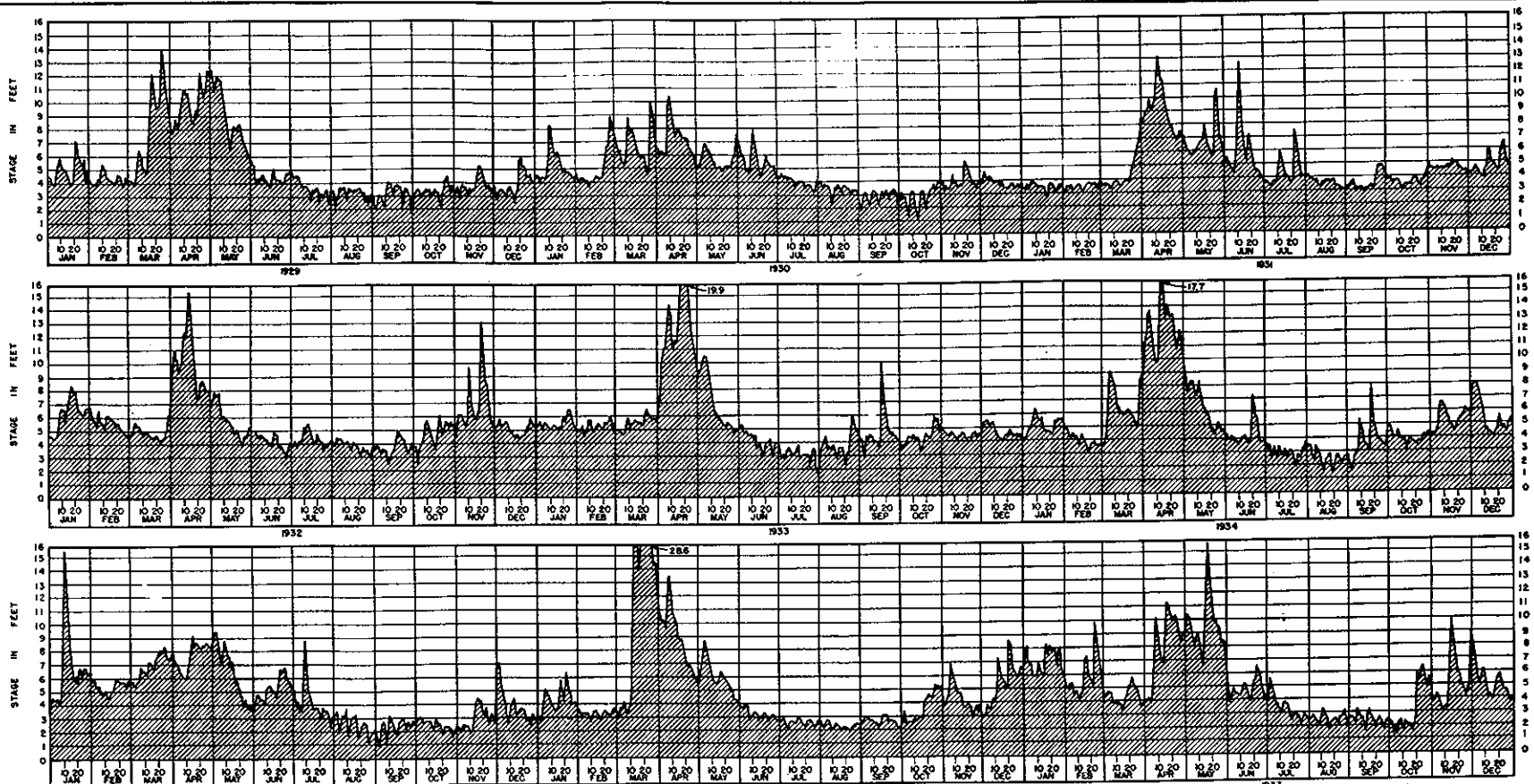
C.5b

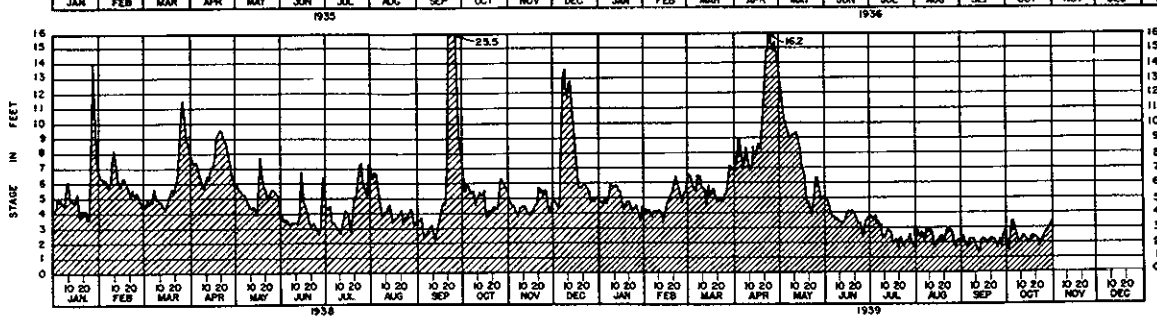
3

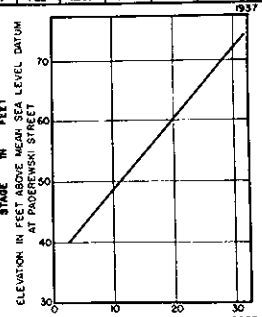
PLATE NO. 3

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY







NOTE

For notes pertaining to this sheet see Sheet No. 1, File No. CT-3-1136

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

STAGE HYDROGRAPH NO. 2

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SHEET NO. 4

SCALE AS SHOWN

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. APRIL, 1940

SUBMITTED: John B. Drisko, ENGINEER, HEAD, HYDRAULICS SECTION

APPROVAL RECOMMENDED: [signature], PRINCIPAL ENGINEER, CHIEF, F. & ENGINEERING DIV.

APPROVED: [signature], COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: [signature], ASSOC. ENGINEER

DRAWN: W.E.N. & G.A.L.
TRACED: F.E.M.
CHECKED: [illegible]

FISCAL YEAR 1940

FILE NO. CT-3-1137

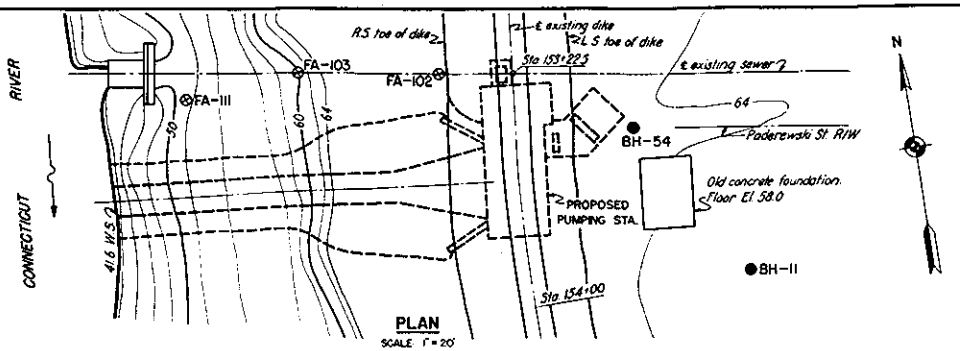
C.5b

4

PLATE NO. 4

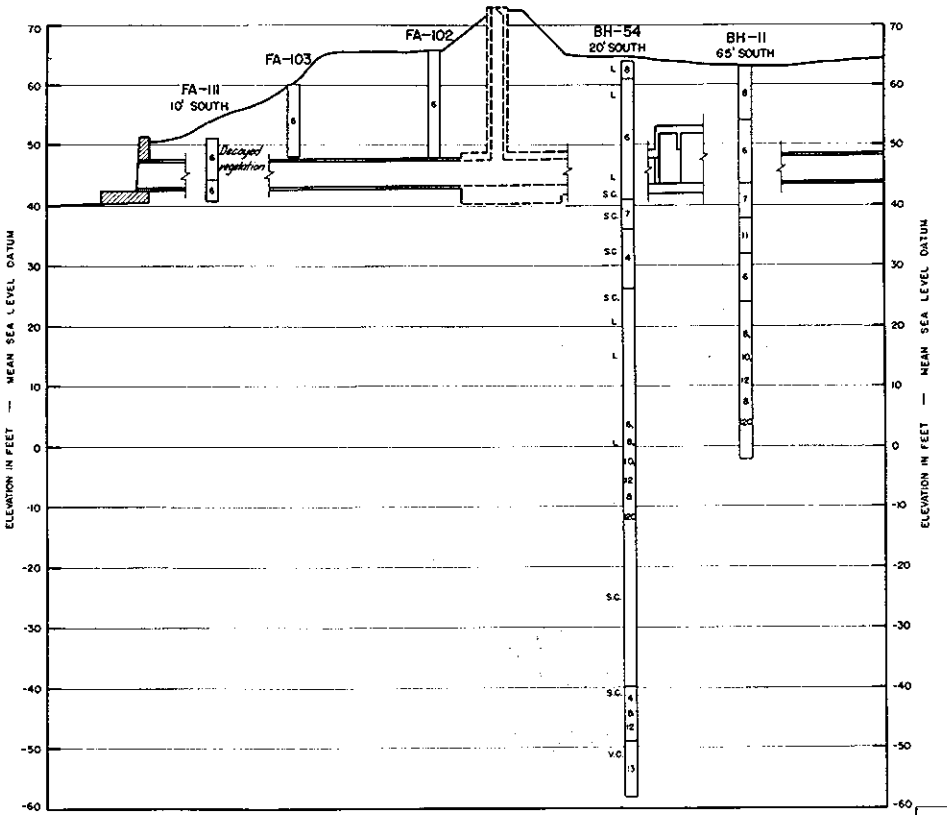
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN

SCALE: 1" = 20'



PROFILE ALONG ℄ EXISTING SEWER

SCALE: HOR., 1" = 20'
VERT., 1" = 10'

DESCRIPTION OF SOIL CLASSES

1. Graded from Gravel to Coarse Sand – Contains little medium sand.
2. Coarse to Medium Sand – Contains little gravel and fine sand.
3. Graded from Gravel to Medium Sand – Contains little fine sand.
4. Medium to Fine Sand – Contains little coarse sand and coarse silt.
5. Graded from Gravel to Fine Sand – Contains little coarse silt.
6. Fine Sand to Coarse Silt – Contains little medium sand and medium silt.
7. Graded from Gravel to Coarse Silt – Contains little medium silt.
8. Coarse to Medium Silt – Contains little fine sand and fine silt.
9. Graded from Gravel to Medium Silt – Contains little fine silt.
10. Medium to Fine Silt – Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10C. Medium Silt to Coarse Clay – Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11. Graded from Gravel or Coarse Sand to Fine Silt – Contains little coarse clay.
12. Fine Silt to Clay – Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12C. Clay – Contains little silt. Possesses behavior characteristics of clay.
13. Graded from Coarse Sand to Clay – Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13C. Clay – Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

LEGEND

- ● BH – *Drive sample bore hole.*
- ⊕ FA – *Foundation auger boring.*
- L – *Loose material.*
- S.C. – *Slightly compact material.*
- C – *Compact material.*
- V.C. – *Very compact material.*

NOTES

Proposed construction shown by heavy, broken line.

Classes 8, 10, 12, & 12C indicated in bore hole records generally occur in alternating bands, having thin layers of fine clay interbedded with thicker layers of silt or fine sand.

Samples, test results, and logs pertaining to the materials from the subsurface explorations are available for inspection by interested parties at the U. S. Engineer Office, Providence, R.I.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

SUBSURFACE EXPLORATIONS

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SCALE: 1 IN. = 20 FT. — SHEET NO. 5

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: SENIOR GEOLOGIST, HEAD, GEOLOGY SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASST. ENGINEER — DRAWN: J. MCL. TRACED: J. E. O. CHECKED: — FISCAL YEAR 1940 — FILE NO. CT-2-1260

C.5b

5

PLATE NO. 5

PROVIDENCE DISTRICT SOIL CLASSIFICATION

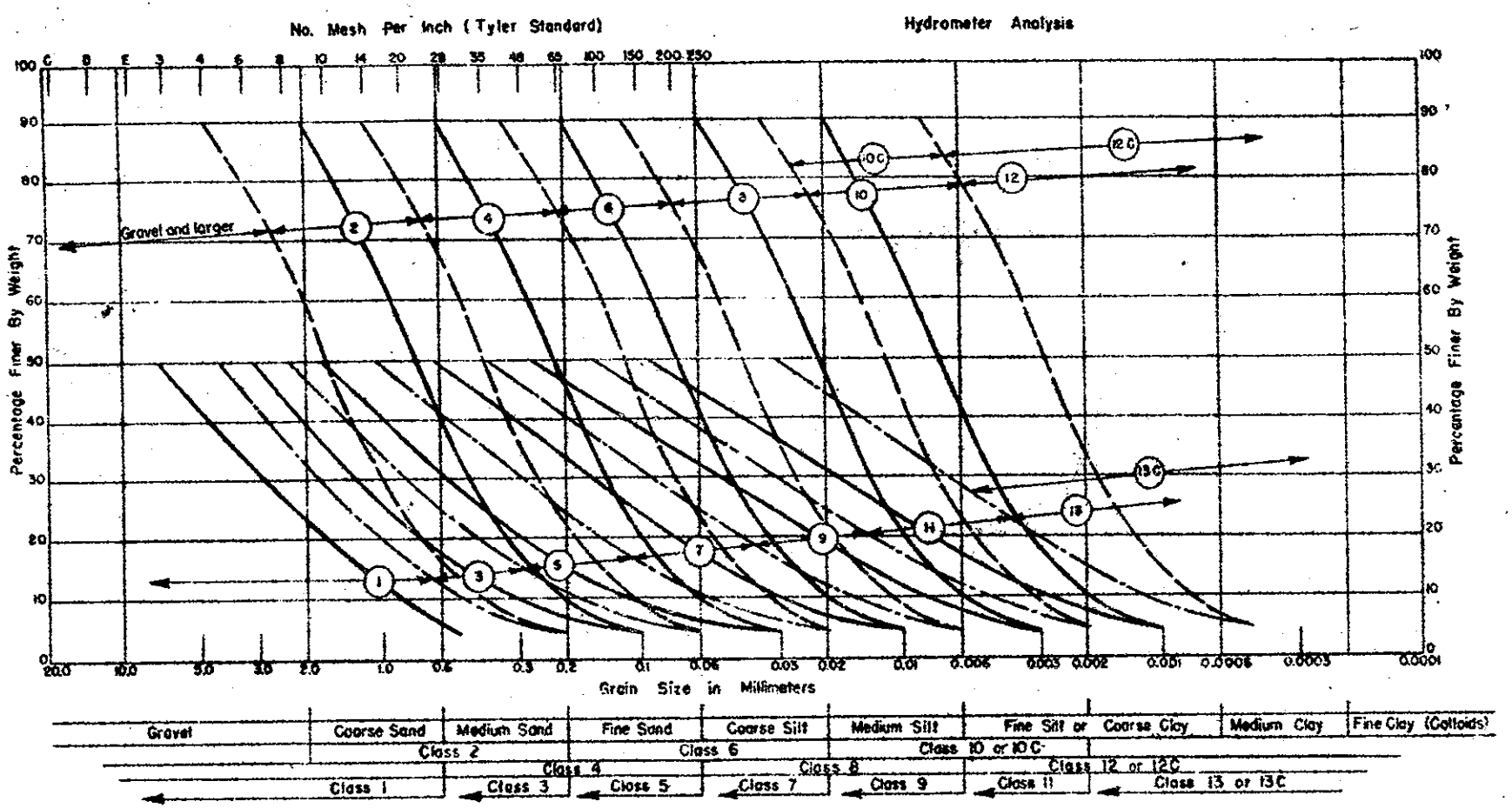
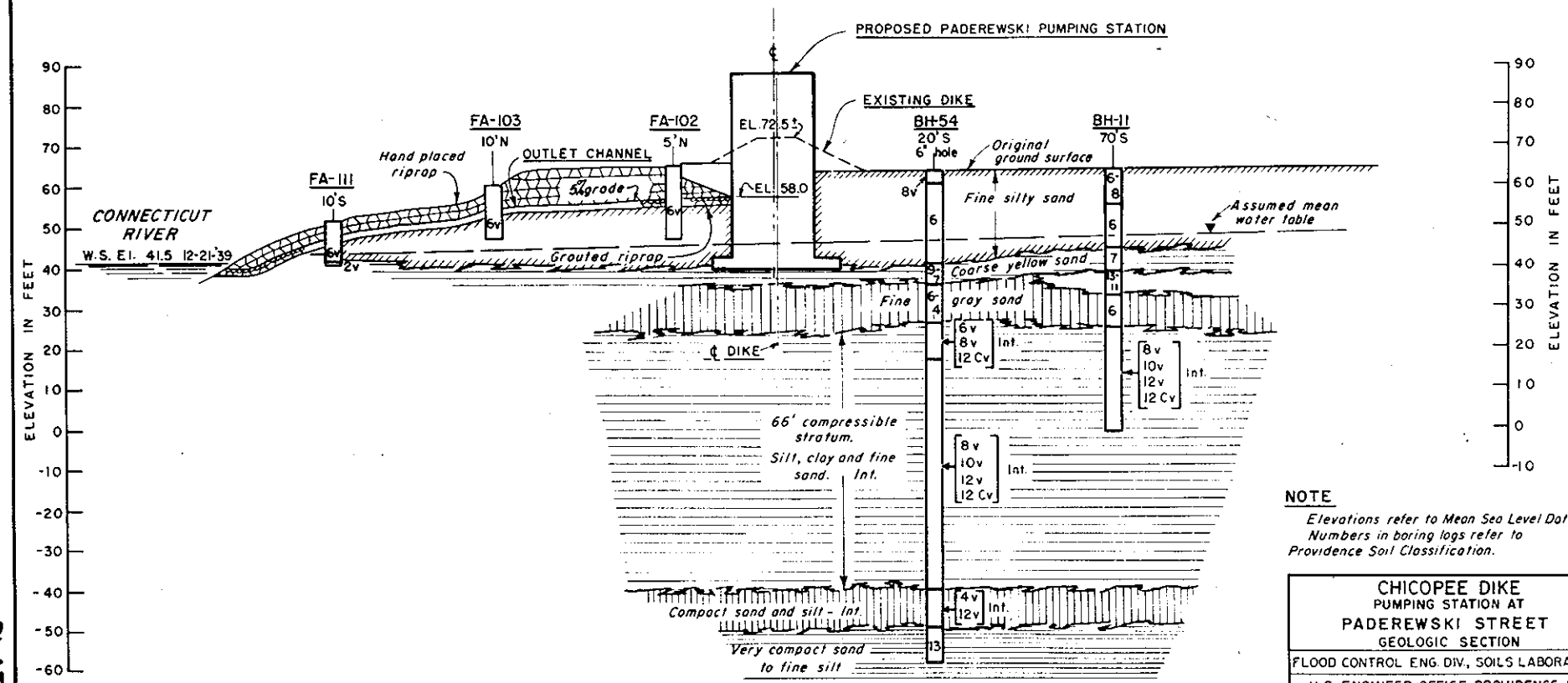


DIAGRAM SHOWING LIMITS OF SOIL CLASSES

PLATE NO. 6



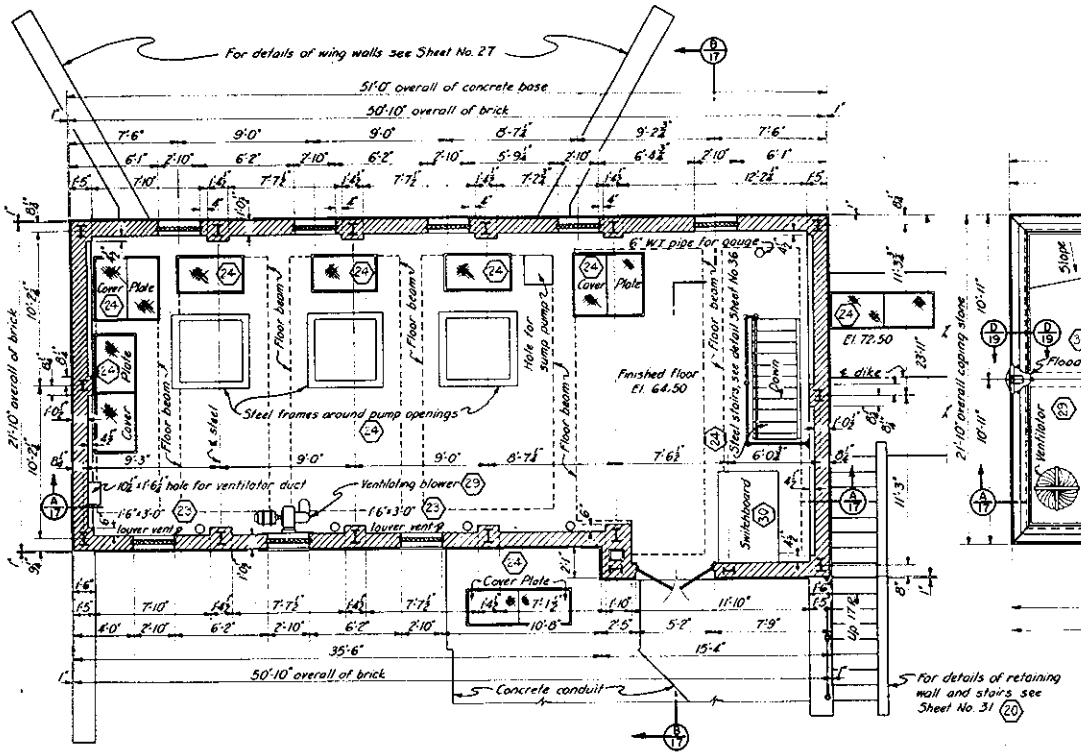
SECTION ℄ OUTLET CHANNEL

NOTE

Elevations refer to Mean Sea Level Datum. Numbers in boring logs refer to Providence Soil Classification.

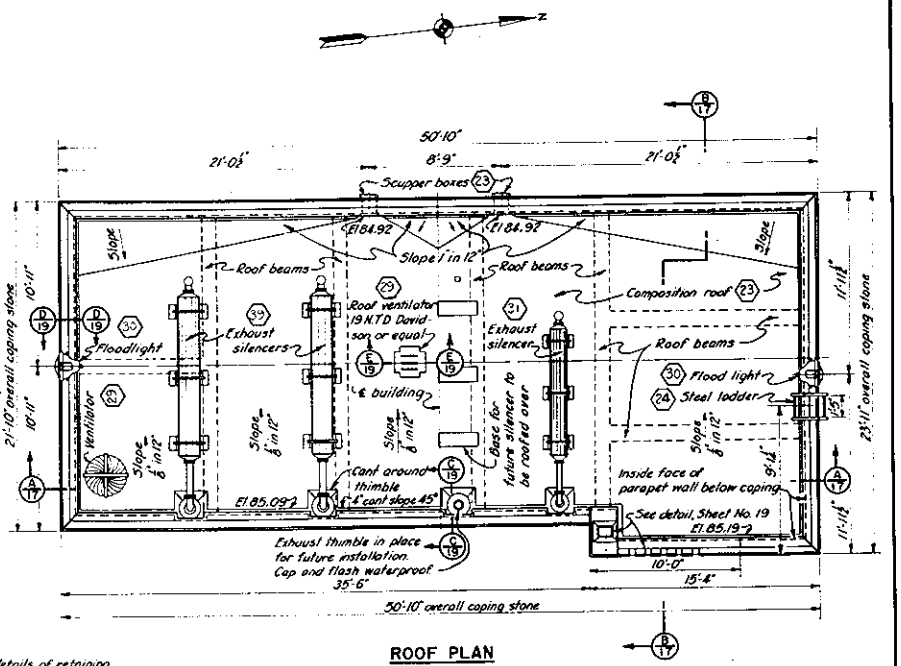
CHICOPEE DIKE PUMPING STATION AT PADEREWSKI STREET GEOLOGIC SECTION	
FLOOD CONTROL ENG. DIV., SOILS LABORATORY	
U.S. ENGINEER OFFICE, PROVIDENCE R.I.	
SUBMITTED BY: W.I.K.	SCALE: 1 IN.=20FT.
ANALYSIS BY: K.S.L.	
DRAWN BY: R.D.S.	S.L. NO. C.5b – A1d
DATE: MARCH 20, 1940	PLATE NO. 7

PLATE NO. 7



ENGINE ROOM FLOOR PLAN

Note: East wall is sectioned below elevation of top of flood wall
Remaining walls are sectioned above elevation of flood wall.



ROOF PLAN

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
PADEREWSKI PUMPING STATION
CHICOPEE, MASS.
PUMP HOUSE PLANS
ARCHITECTURAL

CONNECTICUT RIVER — MASSACHUSETTS
IN 50 SHEETS — SCALE 1/4 IN = 1 FT — SHEET NO. 14

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

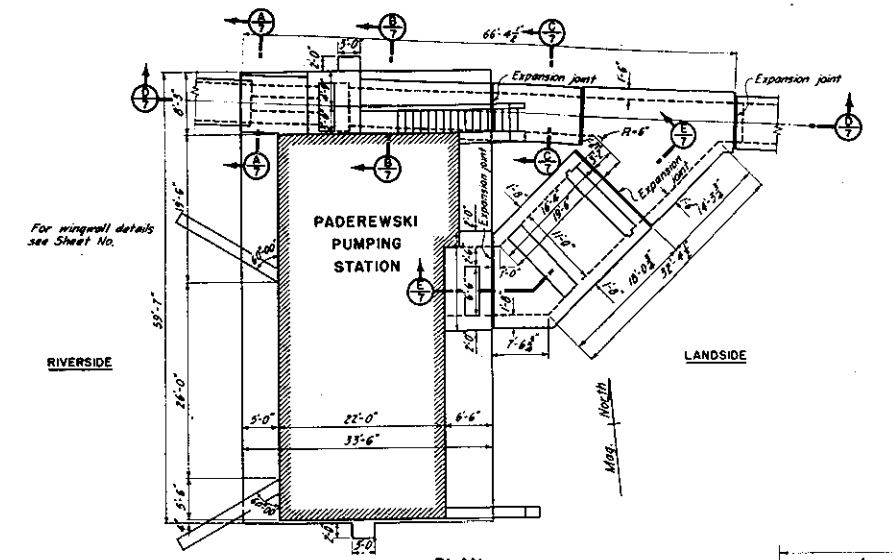
DESIGNED: STRC. ENGINEER — DRAWN: W.A.B. — TRACED: — CHECKED:

FISCAL YEAR 1940
FILE NO. CT-4-2247

C.5b

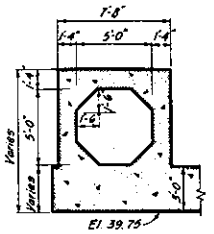
(14)

PLATE NO. 8



PLAN

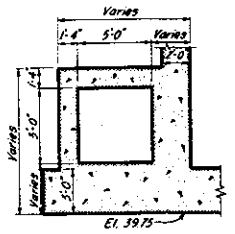
SCALE $\frac{1}{8}$ = 1'-0"



SECTION $\frac{A}{7}$

SCALE $\frac{1}{4}$ = 1'-0"

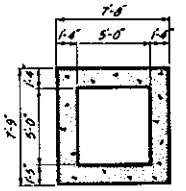
TYPICAL RIVERWARD OF GATE STRUCTURE



SECTION $\frac{B}{7}$

SCALE $\frac{1}{4}$ = 1'-0"

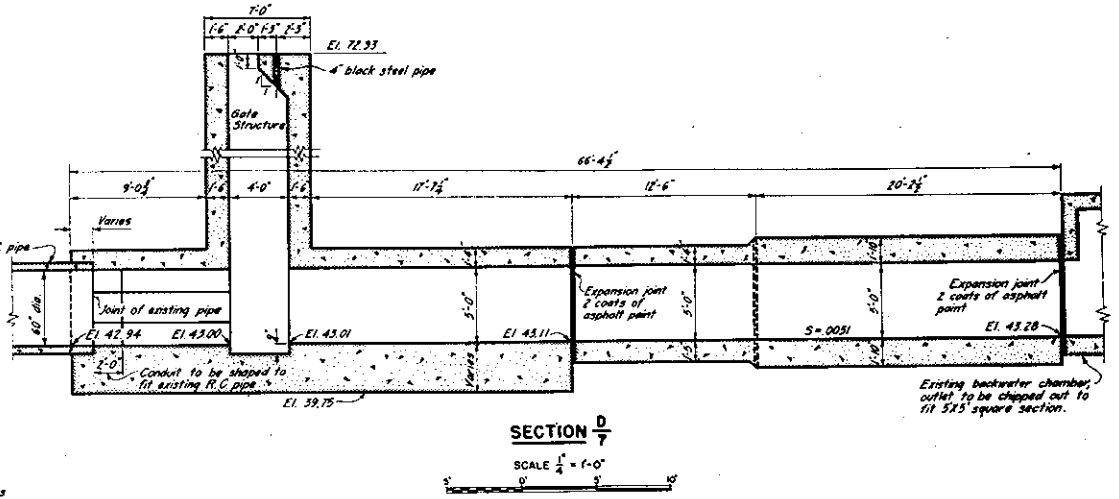
TYPICAL ADJACENT TO BUILDING AND LANDWARD OF GATE STRUCTURE



SECTION $\frac{C}{7}$

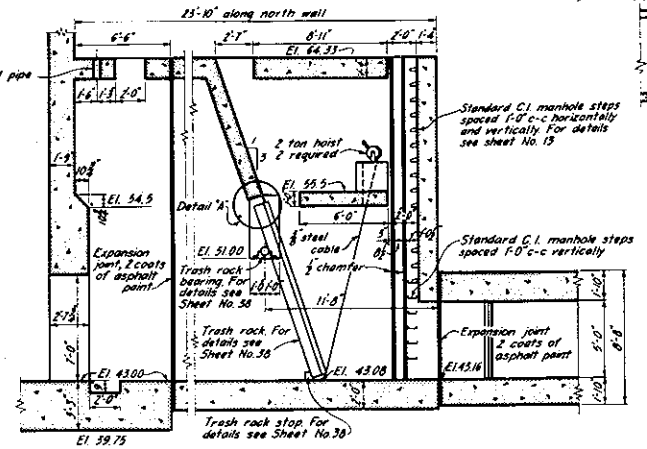
SCALE $\frac{1}{4}$ = 1'-0"

TYPICAL LANDSIDE OF BUILDING



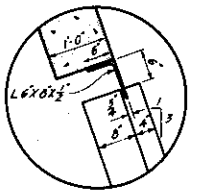
SECTION $\frac{D}{7}$

SCALE $\frac{1}{4}$ = 1'-0"



SECTION $\frac{E}{7}$

SCALE $\frac{1}{4}$ = 1'-0"



DETAIL A

SCALE 1" = 1'-0"

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

INTAKE CHAMBER AND CONDUIT DETAILS

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SCALE 1/8" = 1'-0" — SHEET NO. 7

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: RESIDENT ENGINEER — APPROVED: HEAD, DESIGN SECTION — APPROVED: DISTRICT ENGINEER

DESIGNED: DRAWN: W. E. P. TRACED: W. L. CHECKED: W. F. A.

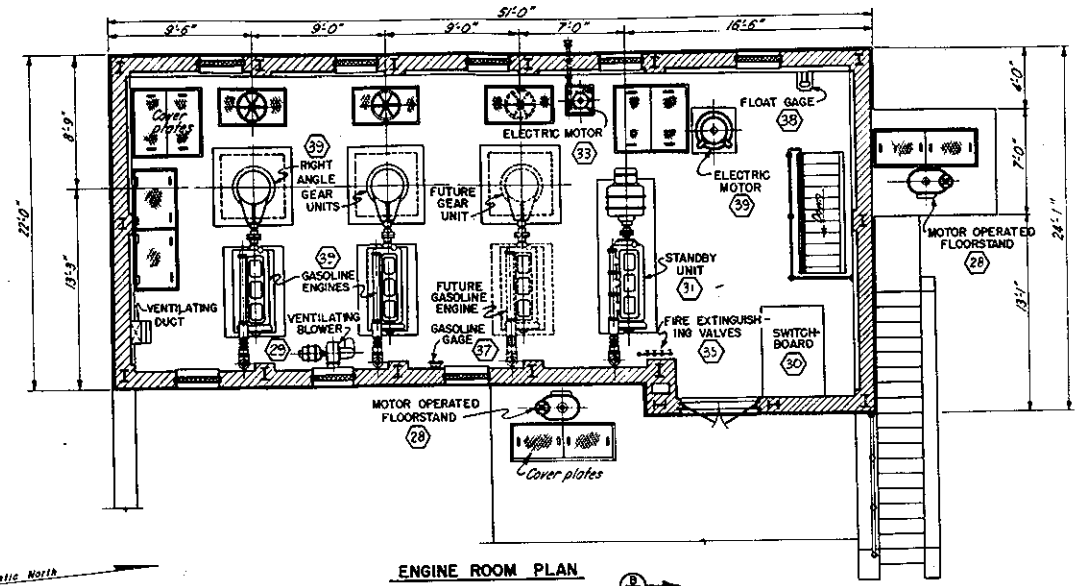
FISCAL YEAR 1940

FILE NO. CT-4-2240

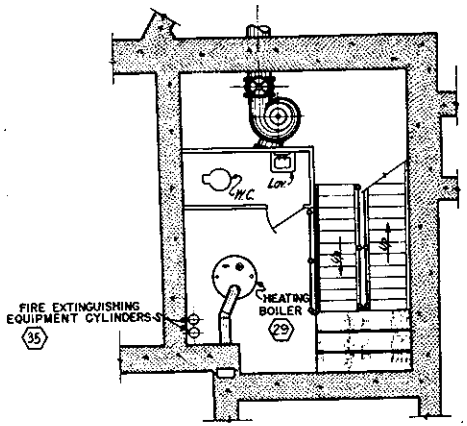
C5b

7

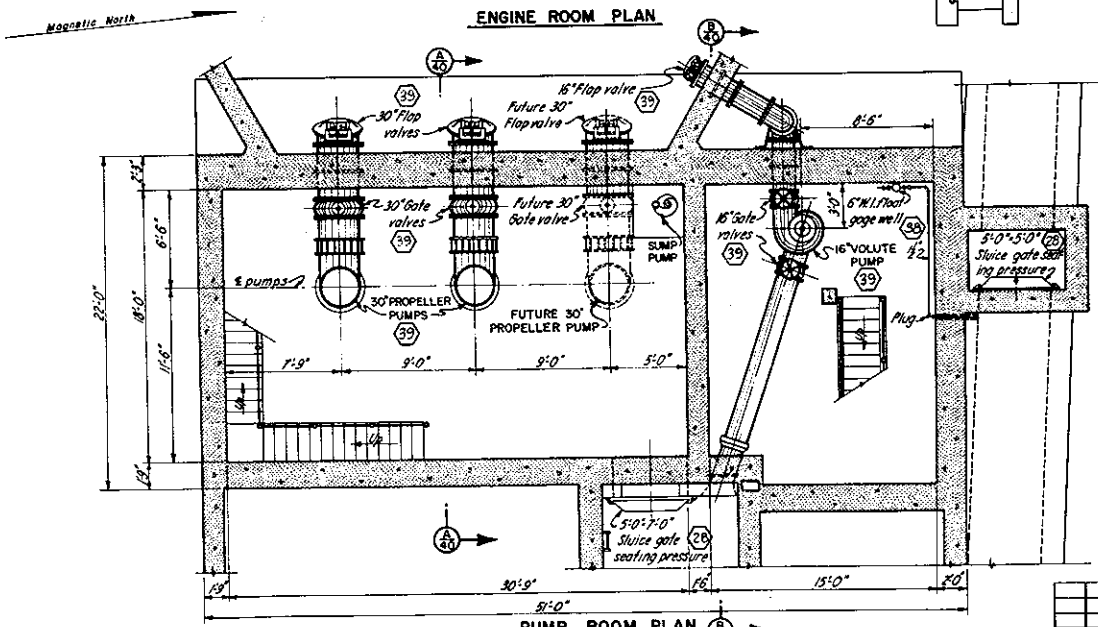
PLATE NO. 9



ENGINE ROOM PLAN



BOILER ROOM PLAN



PUMP ROOM PLAN

KEY	DATE	REVISION 1 indicated by Δ 1	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

GENERAL ARRANGEMENT OF EQUIPMENT NO. 1

CONNECTICUT RIVER — MASSACHUSETTS

IN 50 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 39

U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — APRIL, 1940

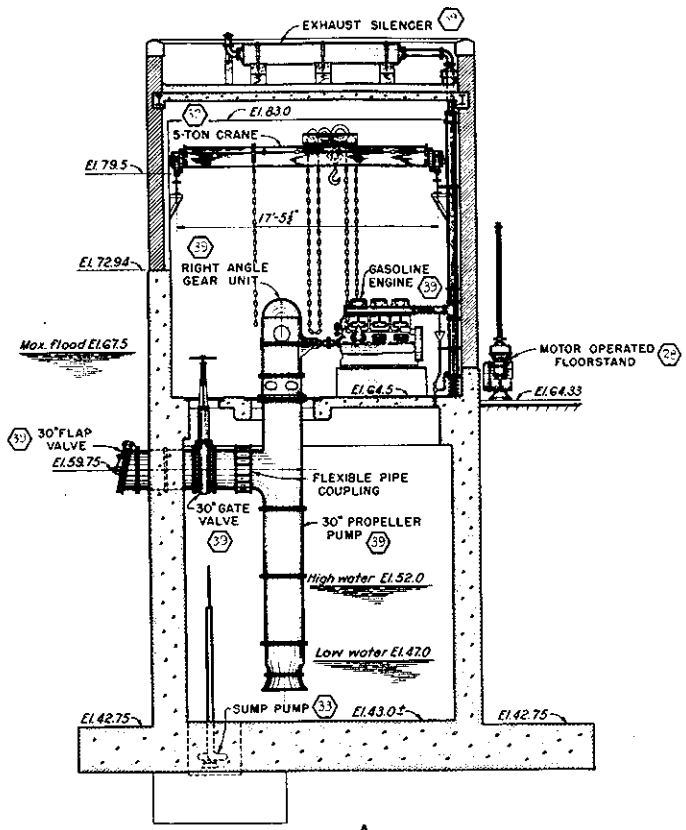
SUBMITTED: — APPROVAL RECOMMENDED: — APPROVED:

FISCAL YEAR 1940

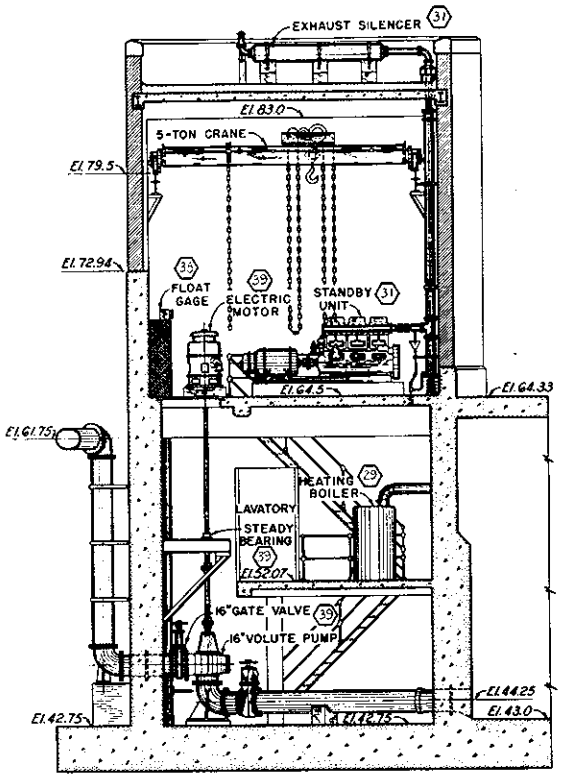
FILE NO. CT-4-2273

C.5b

PLATE NO. 10



SECTION A/39



SECTION B/39

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PADEREWSKI PUMPING STATION

CHICOPEE, MASS.

GENERAL ARRANGEMENT OF EQUIPMENT NO. 2

CONNECTICUT RIVER — MASSACHUSETTS

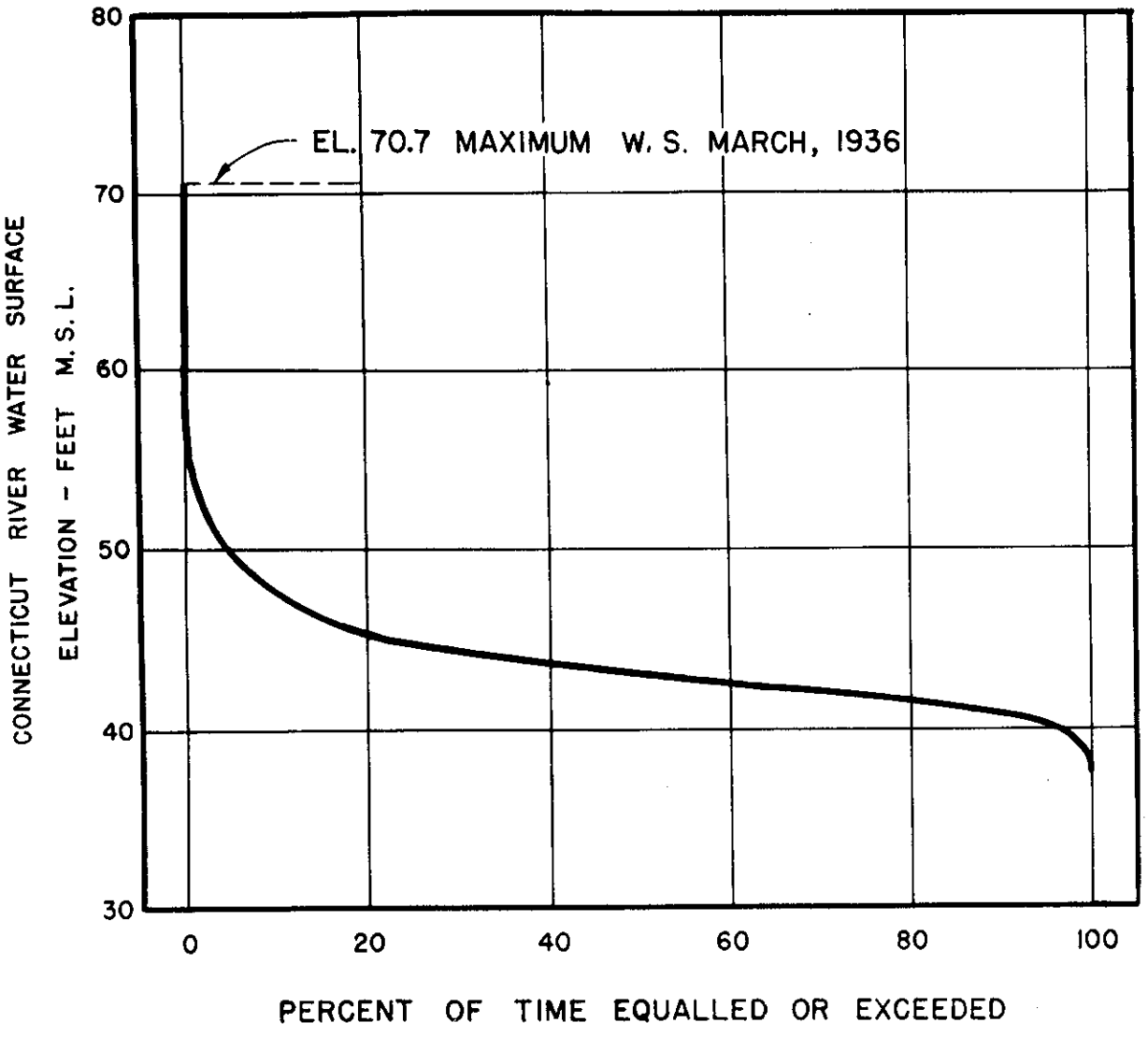
IN 50 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 40

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, P.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: — DRAWN: J.M.T.-D.P. TRACED: J.T. CHECKED: — FISCAL YEAR 1940 — FILE NO. CT-4-2274

C.5b



PADEREWSKI STREET PUMPING STATION

STAGE DURATION CURVE

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940

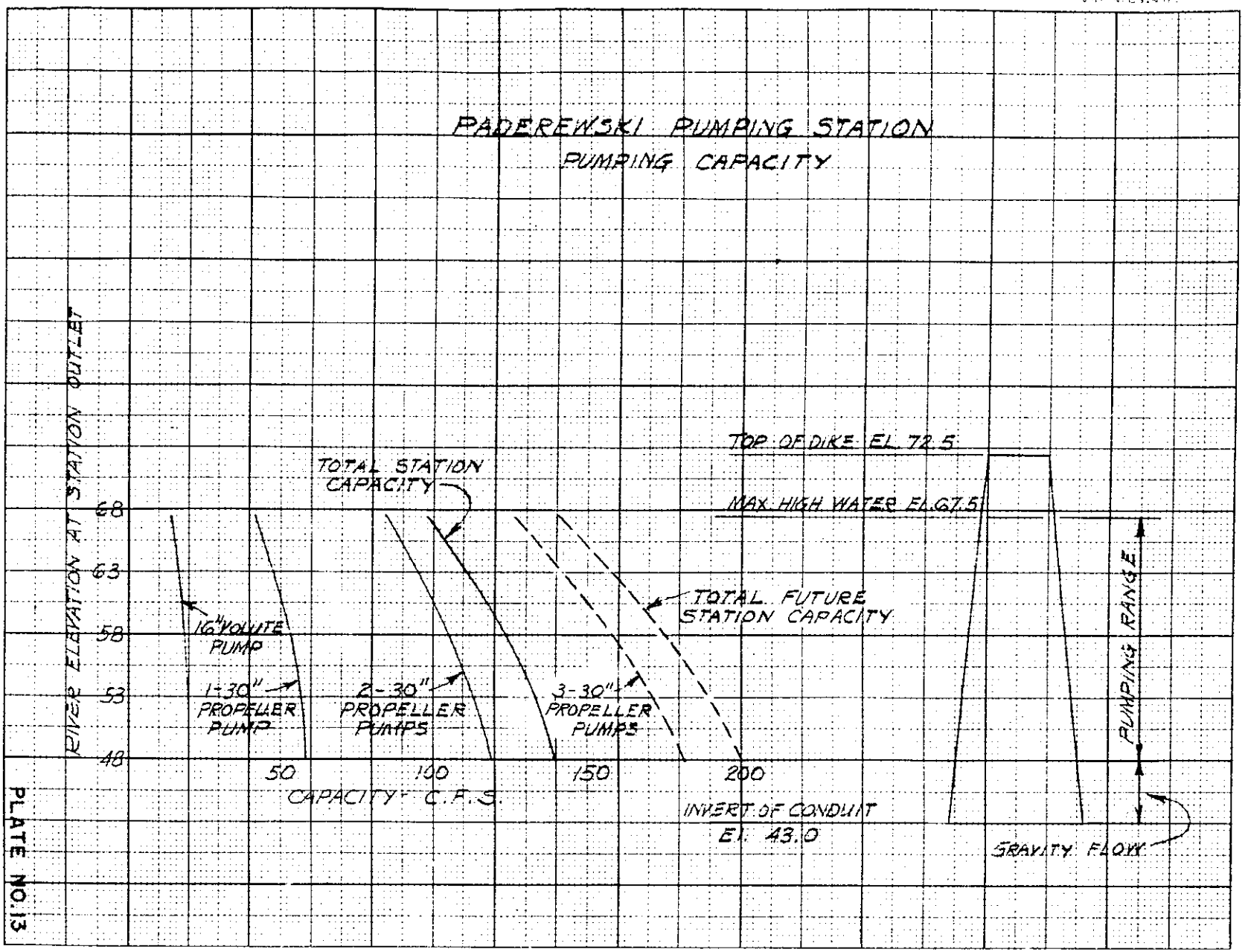
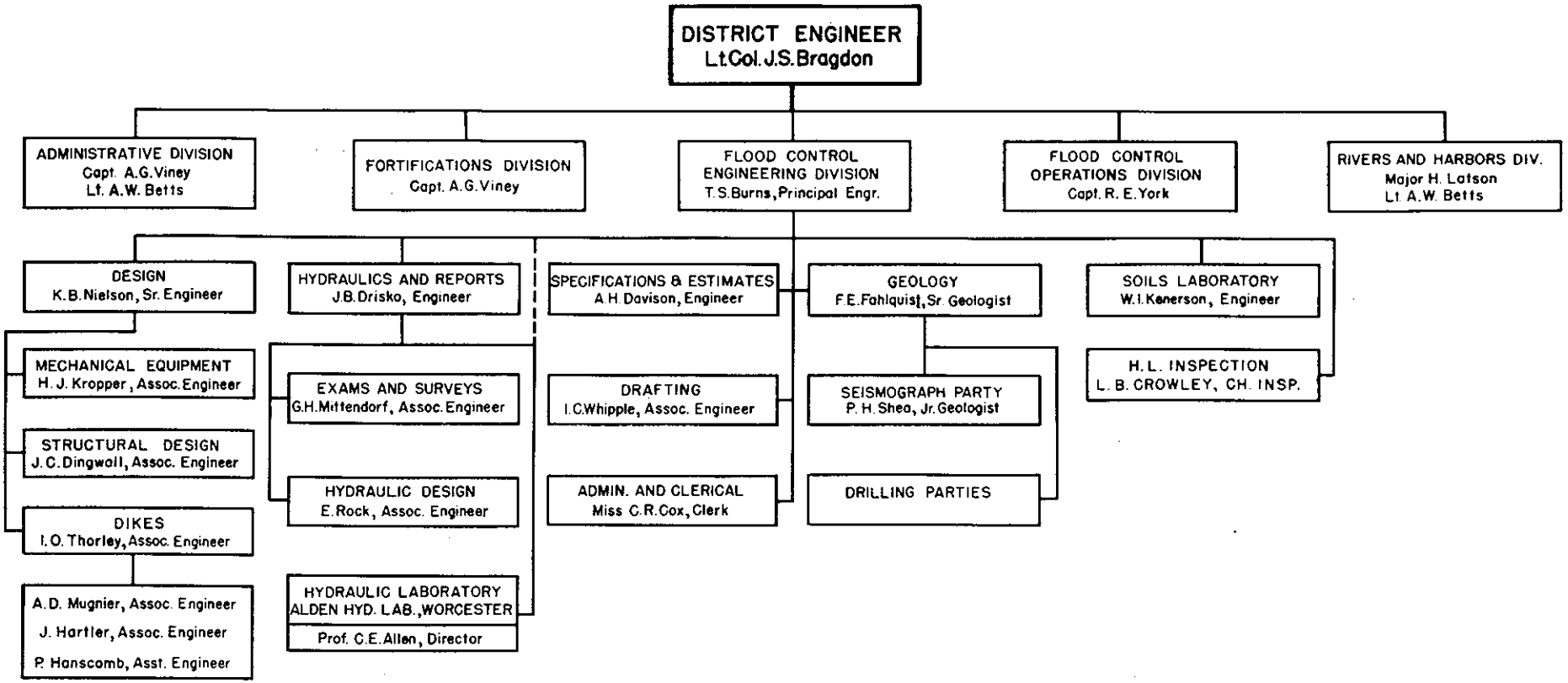

PADEREWSKI PUMPING STATION
PUMPING CAPACITY
RIVER ELEVATION AT STATION OUTLET
68
63
58
53
48
50
100
150
200
CAPACITY - C.F.S.
TOTAL STATION CAPACITY
TOP OF DIKE EL. 72.5
MAX. HIGH WATER EL. 67.5
TOTAL FUTURE STATION CAPACITY
16" VOLUTE PUMP
1-30" PROPELLER PUMP
2-30" PROPELLER PUMPS
3-30" PROPELLER PUMPS
INVERT OF CONDUIT EL. 43.0
PUMPING RANGE
GRAVITY FLOW

PLATE NO. 13



ORGANIZATION CHART
FLOOD CONTROL
ENGINEERING DIVISION
U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

PLATE NO. 14

CONNECTICUT RIVER FLOOD CONTROL PROJECT

CHICOPEE, MASS.

CONNECTICUT RIVER, MASSACHUSETTS

ANALYSIS OF DESIGN FOR PADEREWSKI PUMPING STATION

ITEM C.5b - CONTRACT

APPENDIX A

APRIL, 1940

CORPS OF ENGINEERS, U.S. ARMY

U. S. ENGINEER OFFICE, PROVIDENCE R.I.

APPENDIX "A"

PADEREWSKI PUMPING STATION

Structural Design

PADEREWSKI PUMPING STATION

APPENDIX "A" STRUCTURAL DESIGN

INDEX

Section	Designation	Page
A	Specifications for structural design	1
B	Basic assumptions for design	3
C	Computations	6
	Column layout and roof slab	7
	Roof slab	8
	Steel roof beams	9
	Crane beams	12
	Columns	16
	Crane brackets	28
	Weight of equipment	32
	Operating floor design	33
	Stability of structure	56
	Traverse section at wet sump	62
	Dry pump room	68
	Design of substructure sections	75
	Base slab in dry pump room	87
	Horizontal beams to resist hydrostatic thrust . . .	90
	End wall in wet sump	93
	Mezzanine floor in dry pump room	97
	Conduit at building	99
	Conduit on ground	103

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	Gate chamber at wet sump	107
	Trash rack well	108
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	Gate chamber and trash rack well	113
	Design of sections:	
	Trash rack well	117
	Conduit transition to trash rack chamber	122
	Steel beams in roof and base slabs of transition chamber	129
	Landside wing walls	130
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PADEREWSKI PUMPING STATION

APPENDIX "A" - STRUCTURAL DESIGN

A. SPECIFICATIONS FOR STRUCTURAL DESIGN

1. General. - The structural design of the Paderewski pumping station has been executed in general in accordance with standard practice. The specifications which follow cover the conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5#	per	cubic	foot
Dry earth	100 #	"	"	"
Saturated earth	125 #	"	"	"
Concrete	150 #	"	"	"

3. Earth pressures. - For computing earth pressure caused by dry earth Rankine's formula was used. For saturated soils an equivalent liquid pressure of 80 pounds per square foot per foot of depth was assumed.

4. Structural steel. - The design of structural steel was carried out in accordance with the Standard Specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

5. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937.

a. Allowable working stress. - The allowable working stress in concrete used in the design of the pump house and appurtenant structures is based on a compressive strength of 3,000 pounds per square inch in 28 days.

b. Flexure (f_c). - Lbs. per sq. in.

Extreme fibre stress in compression 800

Extreme fibre stress in compression adjacent to supports of continuous or fixed beams or rigid frames 900

c. Shear (v). -

Beams with no web reinforcement and without special anchorage 60

Beams with no web reinforcement but with special anchorage of longitudinal steel 90

Beams with properly designed web reinforcement but without special anchorage of longitudinal steel 180

Beams with properly designed web reinforcement and with special anchorage of longitudinal steel 270

Footings where longitudinal bars have no special anchorage 60

Footings where longitudinal bars have special anchorage 90

d. Bond (u). -

In beams, slabs, and one way footings 100

Where special anchorage is provided. 200

The above stresses are for deformed bars.

e. Bearing (f_c). - Lbs. per sq. in.

Where a concrete member has an area at least twice the area in bearing 500

f. Axial compression (f_c).

Columns with lateral ties. 450

g. Steel stresses. -

Tension 18000

Web reinforcement 16000

h. Protective concrete covering. -

Type of members	Minimum cover in inches
Interior slabs	1-1/2
Interior beams	2
Members poured directly against the ground	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature and spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

B. BASIC ASSUMPTIONS FOR DESIGN. -

1. Roof slab. - The roof slab is of reinforced concrete. It is designed to carry the full dead load plus a live load of 40# per square foot of roof surface.

2. Roof beams. - The roof beams are of structural steel encased in concrete fireproofing. They are designed to carry the full dead load, plus the full live load of 40# per square foot of roof surface. In addition to taking up the roof load, these beams together

with the columns to which they are connected, form portal frames which take up wind load and crane thrusts on the building. The end connections are designed to take up all such horizontal loads.

3. Columns. -

a. Structural steel columns in the side walls and end walls of the superstructure take up the direct roof loads as well as all wind loads on the sides of the superstructure. In addition, the columns in the side walls carry crane brackets which support the crane runway. These columns are designed to carry full live and dead load from the roof; dead load, live load, and impact effect from the traveling crane; bending due to eccentrically applied loads, and bending due to wind load on the building. No point of inflection was considered in the column design, a pin-ended condition at the base being assumed.

b. Wall columns in ends of building designed for full dead load and live load from roof, plus wind load on the building.

c. Allowable stress in columns figured from formula

$$P/A = \frac{18000}{1 + \frac{l^2}{18000\ r^2}}$$

with a maximum allowable stress of 15,000# per square inch for dead load plus live load, and a maximum allowable stress of 20,000# per square inch for combined dead load, live load, and wind load; l/r limited not to exceed 120.

4. Engine room floor. - The engine room floor is designed to carry all engines, motors, etc., actually to be placed on that floor, as well as a uniform load.

The following assumptions were made for design purposes:

a. For the floor slab, the design loads are the estimated dead loads plus a uniform live load of 300# per square foot.

b. For the removable steel floor plates, the design loads are the estimated dead load plus a uniform load of 300# per square foot.

c. For the floor beams, the design loads are the estimated dead loads, the actual machinery loads, a concrete base slab load under the gasoline engine, and a uniform load of 200# per square foot on the unoccupied portion of the floor slabs which contribute loads to the beams under consideration. For the machinery loads, an impact factor of 100 percent has been added.

5. Pump room side walls and engine room floor. -

a. The station is so located that the building and its adjoining earth dikes form a part of the flood protection. The riverside wall and the end walls are designed of reinforced concrete below elevation 72.9 and of brick and steel construction above elevation 72.9. The landside wall is designed of brick and steel construction above elevation 66.33 and reinforced concrete below elevation 66.33.

b. In designing the wet pump room side walls, account was taken of the effect of the thrust of the water against the building with the river at flood stage. To provide for horizontal pressures the walls were designed simply supported at the engine room floor level and continuous with the pump room floor. At the operating floor level the walls are supported by horizontal beams which transfer their reactions into the end wall and the division wall between the wet and dry pump rooms.

c. In the dry pump room, the riverside wall, the landside wall, the end wall and the wall between the wet sump and the dry pump room were designed as a rigid horizontal frame.

d. The portion of the riverside wall and end walls extending from the engine room floor to elevation 72.9 were designed as cantilever walls.

e. The loading consisted of the vertical loads due to the weight of the structure; the vertical live and impact loads from the engine room floor; the roof live load; and the thrusts against the walls from high water on the riverside and saturated earth pressures on the landside.

From the loadings noted, bending moments were computed in the walls, pump room floor slab and engine room floor beams.

6. Pump room end walls. - The pump room end walls were designed to resist the vertical loads, and thrusts due to earth pressure.

7. Conduit. - The conduit is designed for gravity flow only. Starting as a single rectangular tube 5' x 5' where it joins the backwater chamber of the existing sewer, the conduit Y-s to join a trash rack chamber, 11 feet wide, where a hinged movable rack is provided for screening the flow during high river stages. This chamber is designed as a continuous box section for dead load, and a type H-12 truck load on the chamber roof.

C. COMPUTATIONS.

WAR DEPARTMENT

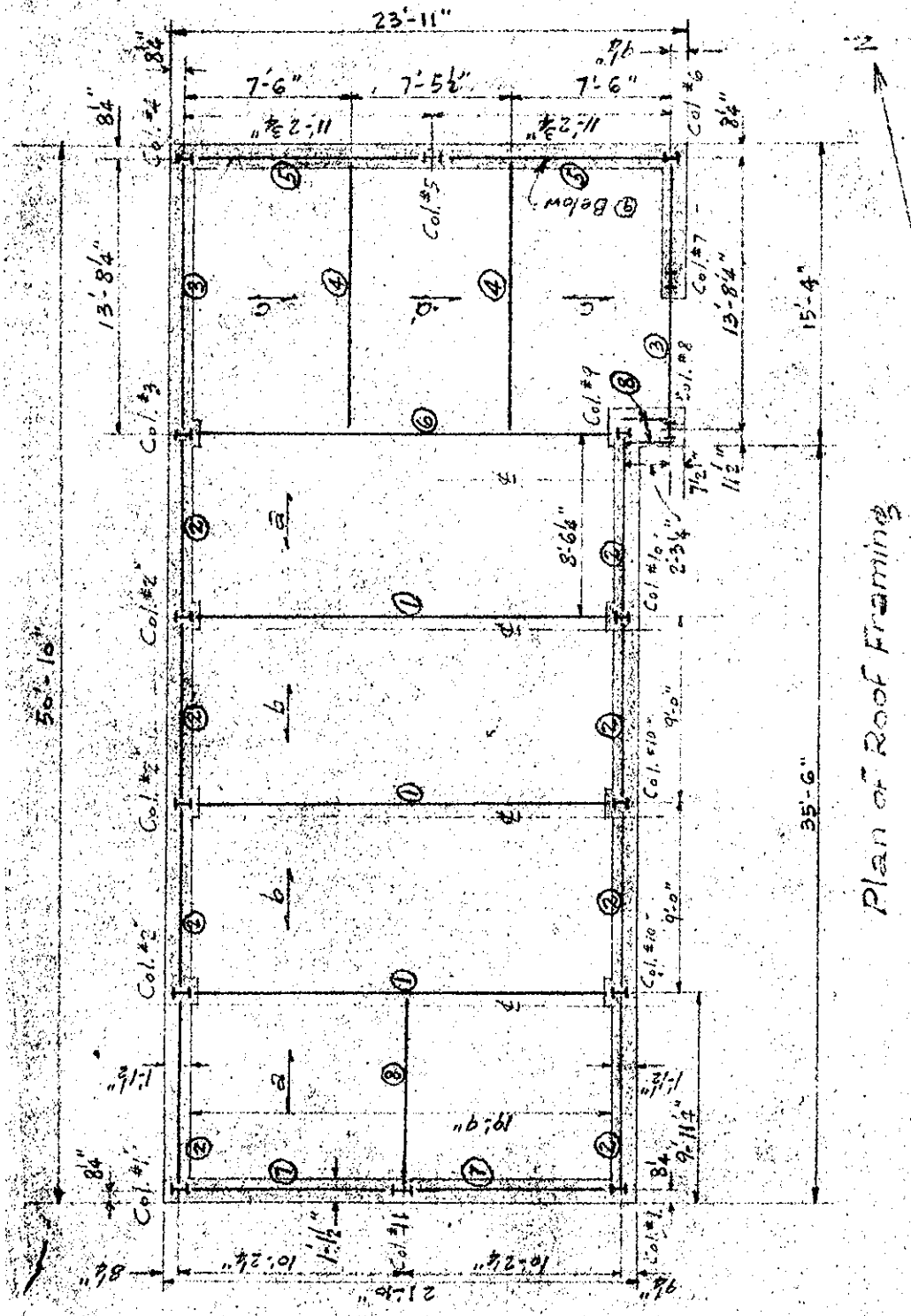
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project Paderewski St. Pumping Sta.

Computation Column Layout & Roof Slab.

Computed by W. W. Z. Checked by ..... Date 3-12-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Page 8.

Project Paderewski St. Pumping Sta.

Computation Roof Slab

Computed by W. W. Z. Checked by ..... Date 3-13-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Loads

5" Concrete Slab	=	63 #/□'
4½" Aver. Cinder Fill	=	38
Roofing	=	6
Live Load	=	40
Total	=	147 #/□'

$M = Kbd^2$

for positive moment

$K = 138.3$

Slab "a" (end span)

Clear Span = 8'-6"

$M = \frac{1}{10} \times 147 \times (8.5)^2 = 1060$ '#

$d^2 = \frac{M}{Kb} = \frac{1060 \times 12}{138.3 \times 12}$ $d = 2.77"$

actual $d = 5" - 1\frac{1}{2}" = 3.5"$

$A_s = \frac{1060 \times 12}{\frac{7}{8} \times 3.5 \times 18000} = 0.23$ □"

½"φ @ 8" o.c.

$u = \frac{147 \times 4.25}{1.52 \times 1.57 \times 3.5 \times \frac{7}{8}} = 72$ #/□" ok.

Slab "b" (interior span)

Clear Span = 8'-0"

$M = \frac{1}{12} \times 147 \times (8.0)^2 = 785$ '#

$d^2 = \frac{M}{Kb} = \frac{785 \times 12}{138.3 \times 12}$ $d = 2.38"$

actual $d = 5 - 1\frac{1}{2} = 3\frac{1}{2}"$

$A_s = \frac{785 \times 12}{\frac{7}{8} \times 3.5 \times 18000} = 0.17$ □"

½"φ @ 8" o.c. ok.

Slab "c" (end span)

Clear Span = 6'-7"

$M = \frac{1}{10} \times 147 \times (6.42)^2 = 605$ '#

$A_s = \frac{605}{1060} \times 0.23 = 0.13$ □"

Slab "d" (interior span)

Clear Span = 6'-7"

$M = \frac{1}{12} \times 147 \times (6.58)^2 = 530$ '#

$A_s = \frac{530}{1060} \times 0.23 = 0.12$ □"

Roof Slab = 5"
Use ½"φ Bars @ 8" o.c.
Conc. cover to bottom steel = 1½" clear
Conc. cover to top steel = 1" clear

Project Paderewski St. Pumping Sta.
Computation Steel Roof Beams
Computed by W. W. Z. Checked by Date 3-13-40

U. S. GOVERNMENT PRINTING OFFICE 3—10523

Roof beam ①

Span say 20'-4" c. to c.
Load from roof slab (D.L. + L.L.) = 147 × 9 = 1320 #/'
Beam Fireproofing + 16" WF 36# = 270
Total = 1590 #/'

$M = \frac{1}{8} WL = \frac{1}{8} \times 1590 \times (20.33)^2 = 82000$ '# $R_L = 1590 \times 10.33 = 16420$ #

$S = \frac{82000 \times 12}{18000} = 55$ in³

$\delta = \frac{L}{360} = \frac{20.33 \times 12}{360} = 0.68$" allowable

For 16" WF 36 # $\delta = \frac{5}{384} \times \frac{(1590 \times 20.33) \times (20.33)^3 \times 1728}{30\,000\,000 \times 446.3} = 0.46$" OK.

Roof beam ②

Span say 9'-11" c. to c.
Parapet Wall 12" × 3.5' @ 120# = 420 #/'
Bm. Fireproofing + 8" WF 17# = 170
590 #/' $R_L = R_R = \frac{590}{2} \times 9.92 = 2930$ #

$M = \frac{1}{8} \times 590 \times (9.91)^2 = 7250$ '#

$S = \frac{7250 \times 12}{18000} = 4.9$ in³ Use 8" WF 17#

Roof beam ③

Span say 13'-8" c. to c.
Roof Load (D.L. + L.L.) = 147 × 3.5 = 520 #/'
Bm. Fireproofing + 8" WF 17# = 170
690 #/'

$M = \frac{1}{8} \times 690 \times (13.67)^2 = 16100$ '#

$S = \frac{16100 \times 12}{18000} = 10.7$ in³

Use 8" WF 17#

Corner Col. #6
Bm ③ $R = \frac{3}{8} \times 690\# \times 8.75' = 2200$ # for Col #6.
Bm ③ $R = \frac{1}{2} \times 690 \times 13.67 = 4720$ # for Col #4

Subject: Paderewski St. Pumping Sta.
Computation: Steel Roof Beams
Computed by: W. W. Z. Checked by: Date: 3-13-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Roof Beam (4)

Span = 13'-8" c. to c.

Roof Load = 147 × 7.58' = 1120 #/'
Fireproofing + 8" WF 19# = 170
1290 #/'

$M = \frac{1}{8} \times 1290 \times (13.67)^2 = 30100$ '#

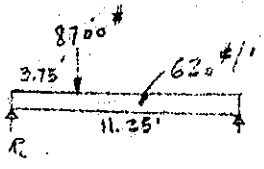
$S = \frac{30100 \times 12}{18000} = 20.0$ ins³

$R_L = R_R = 1290 \times 6.75 = 8700$ #

Use 10" WF 21#

Roof Beam (5)

Span = say 11-3" c. to c.



Parapet Load = 420 #
Firep'g + 10" WF 21# = 200
620

R_L: $\frac{1}{2} \times 620 \times 11.25 = 3500$
$\frac{7.50}{11.25} \times 8700 = 5800$
9300

$R_R = 6400$

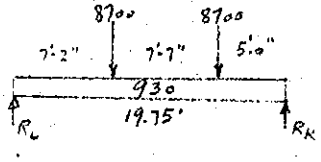
$M_o = 9300 \times 3.75 - \frac{1}{2} \times 620 \times \overline{3.75}^2 = 30400$ '#

$S = \frac{30400 \times 12}{18000} = 20.4$ ins³

Use 10" WF 21#

Roof Beam (6)

Span = say 19'-9"
Roof Load = 147 × 4.5 = 660 #/'
Firep'g + 16" WF 50# = 270
930 #/'



R_L: $\frac{1}{2} \times 930 \times 19.75 = 9200$ #
$\frac{13.58}{19.75} \times 8700 = 5540$
$\frac{5.00}{19.75} \times 8700 = 2200$
16940

$M_o = (\overset{150000}{16940 \times 8.86}) - (\overset{14700}{8700 \times 1.69}) - (\overset{26500}{\frac{1}{2} \times 930 \times \overline{8.86}^2}) = 98800$ '#

$S = \frac{98800 \times 12}{18000} = 66$ ins³

Max. Mom. 8.86' from R_L
Max. δ @ 8.86' from R_L

Allow. $\delta = \frac{1}{360} L = \frac{1}{360} \times 19.75 \times 12 = 0.66''$

Subject Paderewski St. Pumping Sta.
Computation Steel Roof Beams
Computed by W. W. Z. Checked by ..... Date 3-13-40

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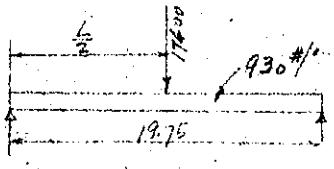

For deflection of Beam ⑥ assume loading shown.

Try 16" WF 45# $I = 583.3 \text{ in}^4$

For dist. load:

$$\delta_1 = \frac{5}{384} \times \frac{930 \times 19.75 \times \overline{19.75}^3 \times 1728}{EI} = \frac{318 \times 10^7}{EI}$$

For conc. load:

$$\delta_2 = \frac{17400 \times \overline{19.75}^3 \times 1728}{48\ EI} = \frac{483 \times 10^7}{EI}$$

$$\delta = \delta_1 + \delta_2 = \frac{801 \times 10^7}{583.3 \times 10^7 \times 3} = 0.46'' \text{ OK.}$$

Use 16" WF 45#

Roof Beam ⑦ Span say = 10'-2"

Roof load = 147 × 4.5 = 660 #/'
Parapet Wall = 420
1080 #/'
Firep'f + 10" WF 21# = 200
Total = 1280 #/'

$R = \frac{1280}{2} \times 10.19 = 6500\#$

$M = \frac{1}{8} \times 1280 \times (10.17)^2 = 16600'\#$

$S = \frac{16600 \times 12}{18000} = 11.0 \text{ in}^3$

Use 8 WF 17#

Roof Beam ⑧ - Special Detail Struts.

Parapet Wall = 420 #/'

Subject Paderewski St. Pumping Sta.
Computation Crane Beams
Computed by W.W.Z. Checked by Date 3-14-40

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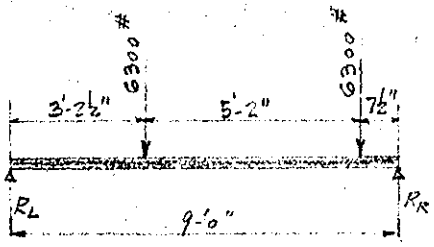

Vertical Loads Moment:

L.L. Moment $= 12600 \times \frac{3.21}{9.0} \times 3.21 = 14400$ '#

Impact 25% $= 3800$

D.L. Mom. $= \frac{1}{8} \times 50 \times (9.0)^2 = 500$

18700 '#

5 TON CRANE - HORIZON. THRUST = 20% CAPACITY = 500#/WHEEL

Horizontal Crane Thrust each wheel = 500#

Lateral L.L. Moment $= \frac{500}{6300} \times 14400 = 1150$ '#

Try 10" WF 29#

Allowable Stress $= f = \frac{20000}{1 + \frac{L^2}{2000\, b^2}} = \frac{20000}{1 + \frac{(108)^2}{(2000)(5.8)^2}} = 17340$ #/□"

Unit Stress due to vertical loads $= \frac{18700 \times 12}{30.8} = 7290$ #/□"

do. horiz. $= \frac{1150 \times 12}{\frac{1}{2} \times 5.2} = 5310$

12600 #/□ < 17340 #/□"

Try 10" WF 21#

Allow. $f = \frac{20000}{1 + \frac{(108)^2}{2000 \times (5.75)^2}} = 17640$ #/□"

$\frac{18700 \times 12}{21.5} = 10440$ #/□"

$\frac{1150 \times 12}{\frac{1}{2} \times 3.4} = 8120$

18560 #/□ > 17640 #/□"

Use 10" WF 29#

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski St. Pumping Sta.

Computation: Crane Beams

Computed by: W. W. Z. Checked by: Date: 3-14-40

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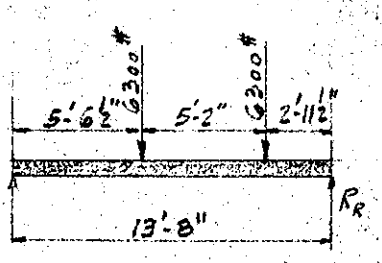

Vert. Load Moment:

L.L. Mom. $= 12600 \times \frac{5.54^2}{13.67} = 28400$ '#

Impact 25% $= 7100$

D.L. Mom. $\frac{1}{8} \times 50 \times (13.67)^2 = 1200$

Total $= 36700$ '#

Horizontal Thrust each crane wheel = 500#

Lateral L.L. Moment $= \frac{500}{6300} \times 28400 = 2260$ '#

Allow. $F = \dfrac{20000}{1 + \dfrac{(13.67 \times 12)^2}{2000 \times (7.96)^2}} = 14100$ #/□"

Try 10" WF 45#

For Vert. Loads $f = \dfrac{(36700)12}{49.1} = 8980$ #/□"

For Horiz. Loads $f = \dfrac{(2260)12}{\frac{1}{2} \times 13.3} = 4070$

13050 #/□" < 14100 #/□" OK.

Use 10" WF 45#

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Paderewski St. Pumping Sta.

Computation Crane Beams.

Computed by W. W. Z. **Checked by** **Date** 3-14-40

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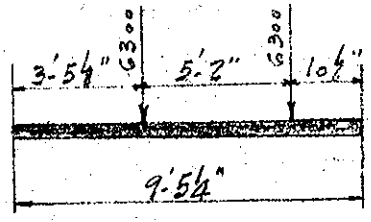

Vert. Load $M = 12600 \times \frac{(3.43)^2}{9.44} = 15700$ '#

Impact 25% $= 3925$

D.L. Mom $= \frac{1}{8} \times 50 \times (9.44)^2 = 550$

20175 '#

Lateral L.L. Mom. $= \frac{500}{6300} \times 15700 = 1250$ #

Try 10" WF 29#

Allow. $f = \frac{20000}{1 + \frac{(9.44 \times 12)^2}{2000 \times (5.8)^2}} = 16800$ #/□"

Vert. Loads $f = \frac{20200 \times 12}{30.8} = 7870$ #/□"

Horiz. Loads $f = \frac{1250 \times 12}{2 \times 5.2} = 5770$

13640 #/□" < 16800 #/□" OK.

Use 10" WF 29#

Note:
Span revised to 9'-3" Use 10" WF 29#

Subject Pederewski St. Pumping Sta.
Computation Beam Supporting Crane Beam. (9)
Computed by W. W. Z. Checked by Date 3-13-40.

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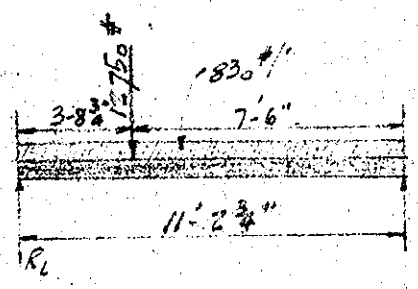

Crane bm. reaction (sheet #7) 10200 #
Impact 2550
12750 #

Supporting 5'-2" ± 12½" Brick wall @ 120 #/'
5.17 × 120 = 620 #/'
Beam @ 50
Fireproof - 160
830 #/'

$R_L = \frac{1}{2} \times 830 \times 11.23' = 4660\#$
$\frac{7.50}{11.23} \times 12750 = 8520$
$13180\#$

$M_o = 13180 \times 3.73 - \frac{1}{2} \times 830 \times (3.73)^2 = 43420'\#$

$S = \frac{43420 \times 12}{18000} = 29 \text{ in.}^3$

Use 10" I - 40#

Allowable $\frac{L}{b} = 40$

$\frac{L}{b} = \frac{7.50 \times 12}{5.09} = 18$ OK.

$f = \frac{43420 \times 12}{31.6} = 16500 \#/\square''$ OK.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski St. Pumping Sta.

Computation: Typical Bent - Crane Columns

Computed by: W. W. Z. Checked by: Date:

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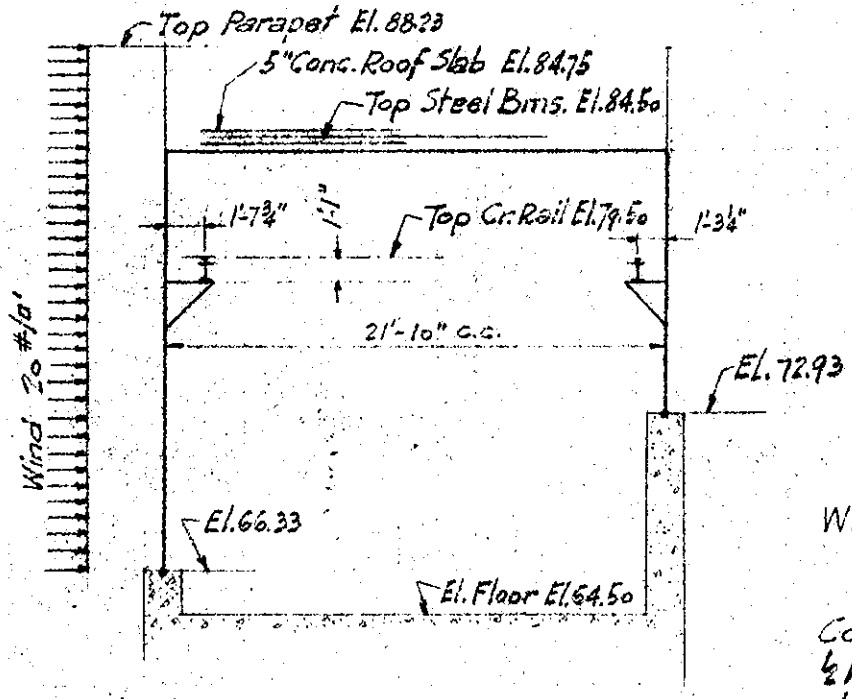
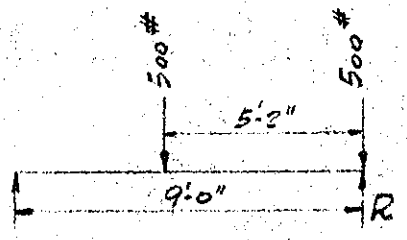


Horizontal Crane Thrust (T)



$T = 20\%$ Crane Capacity

$R = 500 + \frac{3.83}{9.00} \times 500 = 710\#$

Wind -

$20\#/\square' \times 9.0' = 180\#/'$

$180 \times 21.90 = 3940\#$

Columns Pin Ended

½ Wind Reaction at each column

$\frac{1}{2} \times 3940 = 2000\#$

LOADS

Roof Load 16400#

Crane Bracket

L.L. $6300 + \frac{3.83}{9.00} 6300 = 9000\#$

Impact 25% = 2300

Crane Rail, Bm. etc. 600 11900

28300 #

Subject: Paderewski St. Pumping Sta.
Computation: Crane Columns #10
Computed by: W. W. Z. Checked by: Date: 3-18-40

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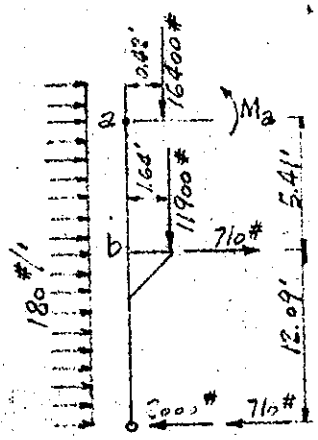

Moments about pt. a

$$+\ 16400 \times 0.42 = +\ 6900\ '\#$$
$$+\ 11900 \times 1.64 = +\ 19500$$
$$-\ 710 \times 5.41 = -\ 3850$$
$$+\ 2710 \times 17.50 = +\ 47500$$
$$+\ 180 \times \frac{(4.40)^2}{2} = +\ 1750$$
$$-\ 180 \times \frac{(17.50)^2}{2} = -\ 27600$$
$$-\ M_a \quad +\ 75650 \quad -\ 31450 = 0$$
$$M_a = 44200\ '\#$$

Moments @ b

$$+2710 \times 12.09 = +32700\ '\#$$
$$-\frac{11900 \times 1.64 \times 12.09}{17.50} = -13500$$
$$-\frac{6900 \times 0.42 \times 12.09}{17.50} = -4800$$
$$+\frac{44200 \times 12.09}{17.50} = +30500$$
$$M_b = 44900\ '\#$$

Try 10" WF 41 #

$A = 12.06\ \square'' \quad S = 44.5''^3 \quad r = 1.99$
$L = 16.83' \times 12 = 202''$
$\frac{L}{r} = \frac{202}{1.99} = 101.5$

$$\text{Allow. } f = 1.33 \left[\frac{18000}{1 + \frac{(101.5)^2}{18000}} \right] = 15200\ \#/\square''$$

$$\frac{P}{A} = \frac{28300}{12.06} = 2350\ \#/\square''$$

$$\frac{M}{S} = \frac{12(44900)}{44.5} = 12100$$

$$14450\ \#/\square''$$

Use 10" WF 41 #

Subject Paderewski St. Pumping Sta
Computation Crane Columns #2
Computed by W.W.Z. Checked by Date 3-18-40

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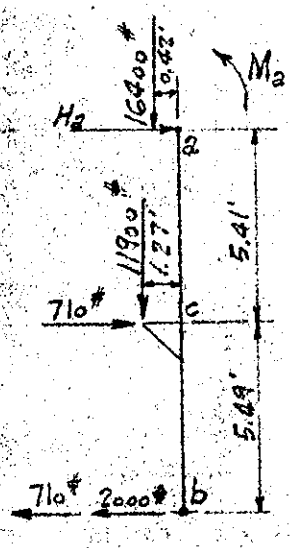

Moments about a –

$$-16400 \times 0.42 = -6900'\#$$
$$-11900 \times 1.27 = -15100$$
$$-710 \times 5.41 = -3850$$
$$+2710 \times 10.90 = +29500$$
$$-M_a \qquad -25850 + 29500 = 0$$
$$M_a = +3600'\#$$

Moments about b –

$$-16400 \times 0.42 = -6900'\#$$
$$-11900 \times 1.27 = -15100$$
$$-M_a = -3600$$
$$+710 \times 5.49 = +3900$$
$$+H_a \times 10.90 = \qquad -25600 + 3900 = 0$$
$$+10.90 H_a$$
$$H_a = 2000\#$$

Moment @ Bracket –

$$+2710 \times 5.49 = 14900'\#$$
$$\frac{11900 \times 1.27}{10.09} \times 5.49 = 7600$$
$$\frac{16400 \times 0.42}{10.09} \times 5.49 = 3500$$
$$\frac{3600}{10.09} \times 5.49 = 1800$$
$$27800'\#$$

Try 8" WF 27 $\quad A = 7.93''^2 \quad S = 23.4''^3 \quad r = 1.62$

$$L = 9.42 \times 12 = 113'' \qquad \frac{L}{r} = \frac{113}{1.62} = 70$$

$$\text{Allow. } f = 1.33\left[\frac{18000}{1 + \frac{(70)^2}{18000}}\right] = 18800\ \#/\square''$$

$$\frac{P}{A} = \frac{28300}{7.93} = 3600\ \#/\square''$$

$$\frac{M}{S} = \frac{27800 \times 12}{23.4} = 14000\ \#/\square''$$

$$17600\ \#/\square'' < 18800\ \#/\square'' \quad \text{OK}$$

Use 8" WF 27#

Subject: Paderewski St. Pumping Sta.
Computation: Corner Column #1
Computed by: W. W. Z. Checked by: Date: 3-18-40

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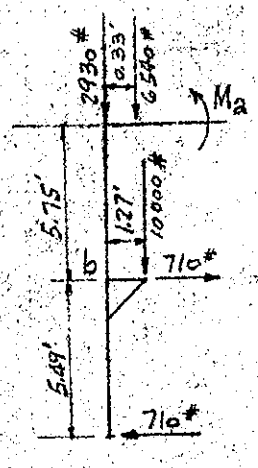
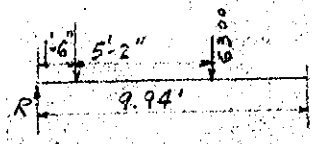


Reaction Bm. ② = 2930#
do. ⑦ = 6540
do Crane = 7500
Impact 25% = 1900
Cr. Bm, Rail etc. = 600
19470#



$R = 12600 \times \frac{5.86}{9.94} = 7500^{\#}$

Note: Wind Stress Assumed Taken by End Wall

Moments about a –

$+6540 \times 0.33 = +2160'^{\#}$
$+10000 \times 1.27 = +12700$
$+710 \times 11.24 = +8000$
$-710 \times 5.75 = -4080$
$-Ma \quad +22860 - 4080 = 0$

$Ma = 18800'^{\#}$

Moments about b –

$+710 \times 5.49 = +3900'^{\#}$
$-\frac{10000 \times 1.27}{11.24} \times 5.49 = -6200$
$-\frac{6540 \times 0.33}{11.24} \times 5.49 = -1050$
$+\frac{18800}{11.24} \times 5.49 = +9200$

$Mb = +5850'^{\#}$

Try 8" WF 24# $\quad A = 7.06\,\square'' \quad S = 20.8''^3 \quad r = 1.61$
$L = 10.91 \times 12 = 131'' \quad \frac{L}{r} = \frac{131}{1.61} = 81.4$

$$\text{Allow. } f = \left[\frac{18000}{1 + \frac{(81.4)^2}{18000}}\right] = 13300\ \#/\square''$$

$$\frac{P}{A} = \frac{19470}{7.06} = 2760\ \#/\square''$$

$$\frac{M}{S} = \frac{18800 \times 12}{20.8} = 10800$$

$13560\ \#/\square'' > 13300\ \#/\square''$

Use 8" WF 27#

Subject Paderewski St. Pumping Sta.
Computation End Column #11
Computed by W.W.Z. Checked by Date 3-18-40

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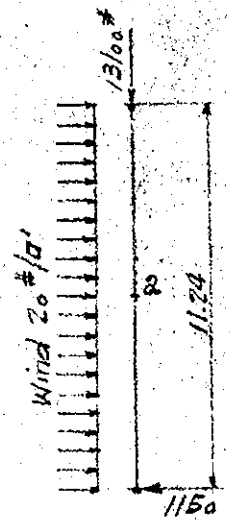


Reaction Bm ⑦ 2×6500 = 13000 #
do. ⑧ = 100 "
13100

Wind 20 × 10.19 = 200 #/'
200 × 11.24 × ½ = 1150 #

$M_B = 1150 \times 5.62 - 200 \times \frac{(5.62)^2}{2} = 3290$ '#

Try 8" WF 17 # A = 5.00 □" S = 14.1 "³ r = 1.16
L = 10.91 × 12 = 131 "
$\frac{L}{r} = \frac{131}{1.16} = 113$

$$\text{Allow. } f = 1.33 \left[\frac{18000}{1 + \frac{(113)^2}{18000}} \right] = 14000 \text{ \#/□"}$$

$$\frac{P}{A} = \frac{13100}{5.00} = 2600 \text{ \#/□"}$$

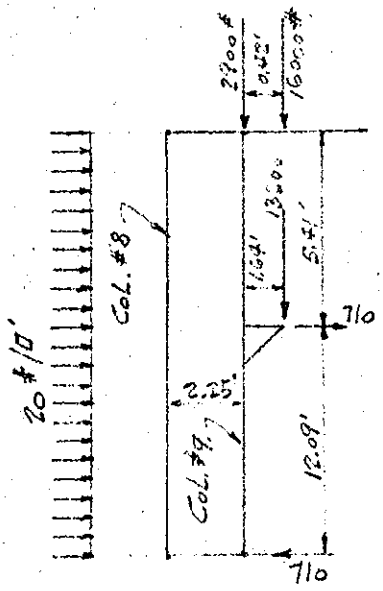
$$\frac{M}{S} = \frac{3300 \times 12}{14.1} = 2800$$

5400 #/□" < 14000 #/□"

Use 8" WF 17 #

Subject Paderewski St. Pumping Sta.
Computation Crane Column #9 & #8
Computed by W. W. Z. Checked by ..... Date 3-19-40

U. S. GOVERNMENT PRINTING OFFICE 3—10533

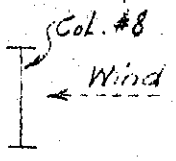


Wind = $\frac{1}{2} \times 20^{\#} \times 13.58' = 140^{\#}/'$
$140 \times 17.50 = 2450^{\#}$

Wind Thrust at each Column = $\frac{2450}{2} \times \frac{1}{2} = 600^{\#}$

Col. #8

$M = 0.125 \times 140 \times (17.50)^2 = 5350'^{\#}$



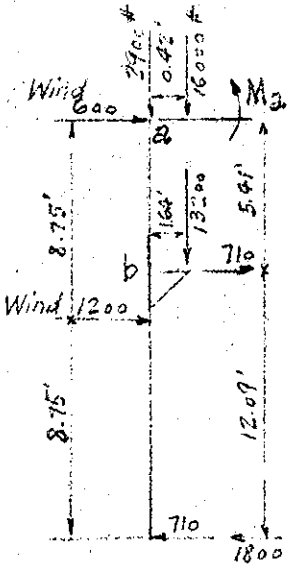
Reaction Bm ③ = 5400# e = 4"
do 2 Bm ③ = 1000
6400#

Try 8" WF 17# A = 5.0□" S = 14.1"³ r = 1.16

$\frac{P}{A} = \frac{6400}{5.0} = 1300^{\#}/\square''$

$\frac{M}{S} = \frac{5400 \times 0.33 \times 12}{14.1} = 1530^{\#}/\square''$

Unit Stresses low Use 8" WF 17#



Col. #9

Wind Thrust carried from Col. #8 by 2 Struts
Wind Load = 2450#
¼ × 2450 = 600#

P
2900#
16000
13200
32100#

Moment at a –

+16000 × 0.42	=	+6750'#	
+13200 × 1.64	=	+21700	
+2510 × 17.50	=	+43800	
− 710 × 5.41	=		− 3840
− 1200 × 8.75	=		−10500
− Ma		+ 72250	− 14340 = 0

$M_a = 57900'^{\#}$

Moment @ b

$-\frac{6750}{17.50} \times 12.09 = 4650'^{\#}$

$-\frac{21700}{17.50} \times 12.09 = 15000$

$-1200 \times 3.34 = 4000$

23650'#

$+\frac{57900}{17.50} \times 12.09 = 40000'^{\#}$

$+2510 \times 12.09 = 30300$

70300'#

− 23700

$M_b = 46600'^{\#}$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Pederewski St. Pumping Sta.

Computation: Crane Column #9.

Computed by: W. W. Z. Checked by: Date: 3-19-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Try 10" WF 45# $A = 13.24 \square''$ $S = 49.1''^3$ $r = 2.00$

$L = 16.83 \times 12 = 202''$

$\frac{L}{r} = \frac{202}{2} = 101$

$$\text{Allow. } f = 1.33\left[\frac{18000}{1+\frac{(101)^2}{18000}}\right] = 15300 \#/\square''$$

$$\frac{P}{A} = \frac{32100}{13.24} = 2400 \#/\square''$$

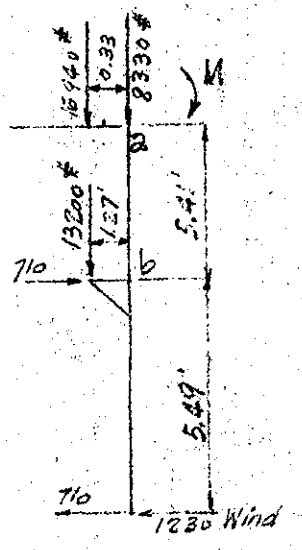
$$\frac{M}{S} = \frac{57900 \times 12}{49.1} = 14100 \#/\square''$$

$$16500 \#/\square'' > 15300 \#/\square''$$

Use 10" WF 49#

Subject Paderewski St Pumping Sta.
Computation Crane Column #3
Computed by W. W. Z. Checked by Date 3-20-40

U. S. GOVERNMENT PRINTING OFFICE 3—10529



Reaction Bm. ③ = 5400#
do. ④ = 2930
do. ⑤ = 16940
do. Crane = 13200
38500#

Moments @ a

$-16940 \times 0.33 = -5600$#
$-13200 \times 1.27 = -16750$
$+1940 \times 10.90 = +21300$#
$+ M_a$
$-710 \times 5.41 = -3840$
$+M_a - 26200 + 21300 = 0$
$M_a = 4900$#

Moment @ b

$+1940 \times 5.49 = +10650$#
$+\frac{5600}{10.90} \times 5.49 = 2800$
$+\frac{16750}{10.90} \times 5.49 = 8450$
$-\frac{4900}{10.90} \times 5.49 = -2450$

$M_b = 21900 - 2450 = 19450$#

Try 8" WF 27#

$A = 7.93$ □" $S = 23.4$ "³ $r = 1.62$
$L = 12 \times 9.42 = 113$"
$\frac{L}{r} = \frac{113}{1.62} = 70$

$$\text{Allow. } f = 133\left[\frac{18000}{1+\frac{(70)^2}{18000}}\right] = 18900 \text{ \#/□"}$$

$$\frac{P}{A} = \frac{38500}{7.93} = 4850 \text{ \#/□"}$$

$$\frac{M}{S} = \frac{19450 \times 12}{23.4} = 10000$$

$$14850 \text{ \#/□"}$$

Use 8" WF 27#

WAR DEPARTMENT

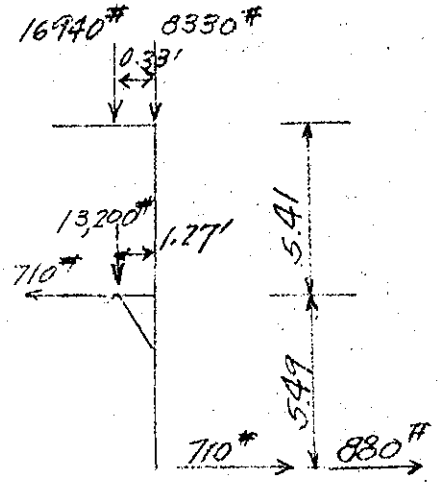
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project: Paderewski

Computation: Crane column #3

Computed by: RSM Checked by: Date: 3-25-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Wind R = 1755/2 = 880#

Reactions

Bm ③	5,400#
" ②	2,930
" ⑥	16,940
Crane	13,200
	38,500#

Moments at bkt.

16,940 × .42 =	7,100 '#
13,200 × 1.27 × 5.49 / 10.9 =	8,450
1590 × 5.49 =	8,750
	24,300 '#

Try 8WF31 A = 9.12 S = 27.4 r = 2.01 $\frac{l}{r} = \frac{113}{2.01} = 57$

Allow $f = 1.33 \dfrac{18000}{1 + \frac{(57)^2}{18000}} = 20,200$ #/□"

$\frac{P}{A} = \frac{38,500}{9.12} = 4230$

$\frac{M}{S} = \frac{24300 \times 12}{27.4} = 10650$

14880 #/□" OK.

Without wind stresses.

M = 15,550 '#

$\frac{M}{S} =$ 10650

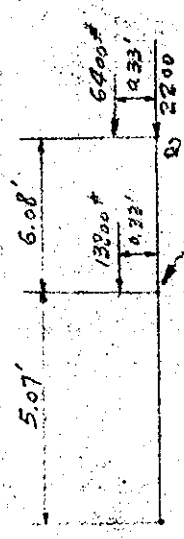
$P/A =$ 4230

Actual stress 14880 #/□"

Allowable $f = \dfrac{18000}{1 + \frac{(57)^2}{18000}} = 15,300$ #/□" OK

Subject Paderewski St. Pumping Sta.
Computation Corner Column #6
Computed by W. W. Z. Checked by Date 3-20-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Wind Stress taken by End Wall

Reaction	Bm ⑤	6400#
do.	⑨	13200#
do.	③	2200
		21800#

Assume no moment at this point.

Moment @ 2 –

$$\frac{13200 \times 0.33}{11.15} \times 11.15 = 4360'\#$$

$$\frac{6400 \times 0.33}{11.15} \times 11.15 = 2110'\#$$

$$6470'\#$$

Try 8" WF 17# $A = 5.0\,\square''$ $S = 14.1''^3$ $r = 1.16$

$L = 4.86 \times 12 = 59''$

$\frac{L}{r} = \frac{59}{1.16} = 50$ (low)

$$\text{Allow. } f = \frac{18000}{1 + \frac{(50)^2}{18000}} = 15700\ \#/\square''$$

$$\frac{P}{A} = \frac{21800}{5.0} = 4350\ \#/\square''$$

$$\frac{M}{S} = \frac{6470 \times 12}{14.1} = 5500\ \#/\square''$$

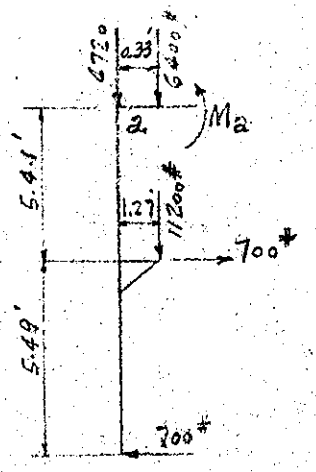
$$9850\ \#/\square''$$

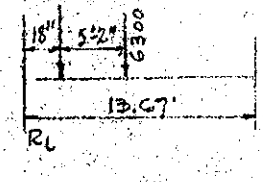
Use 8" WF 17#

Subject Paderewski St. Pumping Sta.
Computation Corner Column #4
Computed by W. W. Z. Checked by Date 3-20-40

U. S. GOVERNMENT PRINTING OFFICE 3—10838

Wind taken by end wall





$R_L = \frac{9.59}{13.67} \times 12600 = 8850^{\#}$

Impact 25% = 2210
Crane bm. etc = 600
11200 #

Horiz. thrust $= \frac{1000}{12600} \times 8850 = 700^{\#}$

Reaction Bm. ③ = 4720#
do Bm ⑤ = 6400#
do Cr. Bm = 13100
24220#

Moments @ a –

+6400 × 0.33	= + 2110 '#	
+11200 × 1.27	= + 14200	
+ 700 × 10.90	= + 7650	
− 700 × 5.44	=	− 3800
− Ma	+ 24000	− 3800 = 21200 '#

Try 8" WF 31# A = 9.120" S = 27.4 ins³ r = 2.01

$L = 10.69 \times 12 = 128''$

$\frac{L}{r} = \frac{128}{2.01} = 64$

Allow. $f = \frac{18000}{1 + \frac{(64.0)^2}{18000}}$

$= 14700 \#/\square''$

$\frac{P}{A} = \frac{24220}{9.12} = 2700 \#/\square''$

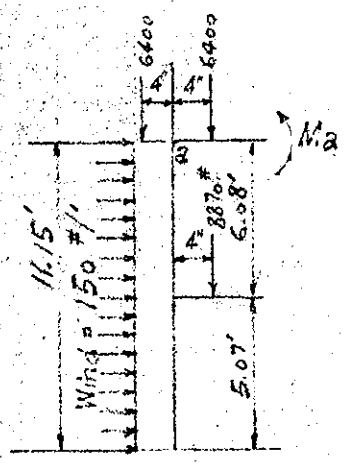
$\frac{M}{S} = \frac{12 \times 21200}{27.4} = 9300 \#/\square''$

$12000 \#/\square'' < 14700 \#/\square''$ OK

Use 8" WF 31#

Object Paderewski St. Pumping Sta.
Computation End Column #5
Computed by W. W. Z. Checked by Date 3-20-40.

U. S. GOVERNMENT PRINTING OFFICE 2—10528



Reaction Bm. 5 (2) = 6400 # e = 4"
do. Bm 9 = 8870 e 4
Total = 21670 #

Wind: $20^{\#}/\square' \times 7.5' = 150\ \#/'$
$M_a = 8870 \times 0.33 = 2920\ '\#$

Moment due to wind $= M_2 = \frac{1}{8} \times 150 \times (11.15)^2 = 2330\ '\#$

Try 8" WF 17 # $A = 5.0\ \square''$ $S_1 = 14.1\ in^3$ $r_1 = 3.36$
$S_2 = 2.6\ in^3$ $r_2 = 1.16$

$$\frac{L}{r} = \frac{4.86 \times 12}{1.16} = 47.5$$

$$\text{Allow. } f = 1.33 \left[\frac{18000}{1 + \frac{(47.5)^2}{18000}} \right] = 21300\ \#/\square''$$

$$\frac{P}{A} = \frac{21670}{5.0} = 4340\ \#/\square''$$

$$\frac{M_1}{S_1} = \frac{2920 \times 12}{14.1} = 2500$$

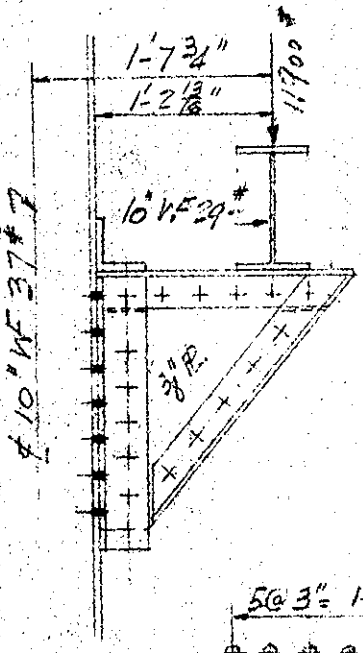
$$\frac{M_2}{S_2} = \frac{2330 \times 12}{2.6} = 10750$$

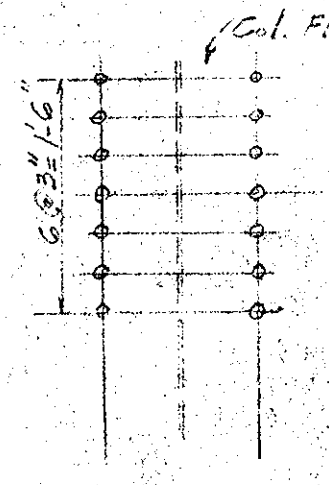
$17600\ \#/\square'' > 21300\ \#/\square''$

Use 8" WF 17 #

Subject Paderewski St. Pumping Sta.
Computation Crane Brackets (10" WF 37#)
Computed by W. W. Z. Checked by ..... Date 3-21-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528





S = rivet Stress

$2 \times 2 \times 9.0\,S = 36.0\,S$ "#

$2 \times 2 \times \frac{(6.0)^2}{9.0} S = 16.0\,S$

$2 \times 2 \times \frac{(3.0)^2}{9.0} S = 4.0\,S$

$56.0\,S$ "#

Moment $= 11900^{\#} \times (1'\text{-}2\tfrac{13}{16}")$

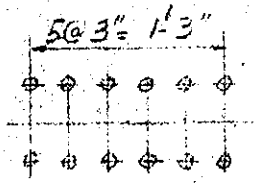
$= 11900 \times 1.234 = 176300$ "#

$56.0\,S = 176300$

$S = 3160^{\#}$

Vert. Shear $= \frac{11900}{14} = 850^{\#}$

Actual Stress $= \sqrt{(3160)^2 + (850)^2} = 3280^{\#}$



12 rivets for shear

Try 5 spaces @ 3" = 1'-3"

S = rivet stress

$2 \times 2 \times 7.5\,S = 30.0\,S$ "#

$2 \times 2 \times \frac{(4.5)^2}{7.5} S = 10.8\,S$

$2 \times 2 \times \frac{(1.5)^2}{7.5} S = 1.2\,S$

$42.0\,S$ "#

$42.0\,S = 176300$ "#

$S = 4200^{\#}$

For Vertical Shear: Stress per rivet $= \frac{11900}{12} = 990^{\#}$

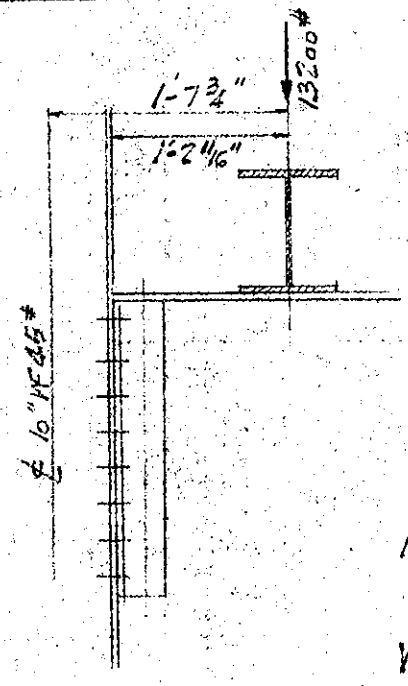
Allow. Stress for ¾" rivet $= 0.4418 \times 13500^{\#} = 5960^{\#}$

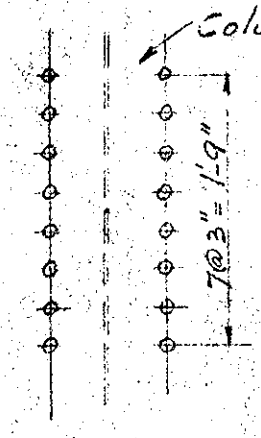
Actual Stress $= \sqrt{(4200)^2 + (990)^2} = 4120^{\#}$

Use 14 rivets
Bracket connection to column

Subject Paderewski St. Pumping Sta.
Computation Crane Brackets (10" WF 45# Col.)
Computed by W. W. Z. Checked by Date 3-21-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528





S = Rivet Stress

$2 \times 2 \times 10.5\ S = 42.0\ S$ "#

$2 \times 2 \times \frac{(7.5)^2}{10.5}\ S = 21.4\ S$

$2 \times 2 \times \frac{(4.5)^2}{10.5}\ S = 7.7\ S$

$2 \times 2 \times \frac{(1.5)^2}{10.5}\ S = 0.9\ S$

$72.0\ S$

Moment = 13200# × 1.224 = 194 000 "# = 72.0 S
S = 2700 #

Vertical Shear $\frac{13200\#}{16} = 825\#$

Allow. Stress for ¾" rivet = 0.4418 × 13500 = 5960 #

Actual Combined Stress $\sqrt{(2700)^2 + (825)^2} = 2830\#$ (low)

Try 6 spaces @ 3"

$2 \times 2 \times 9.0\ S = 36\ S$

$2 \times 2 \times \frac{(6.0)^2}{9}\ S = 16\ S$

$2 \times 2 \times \frac{(3.0)^2}{9}\ S = 4\ S$

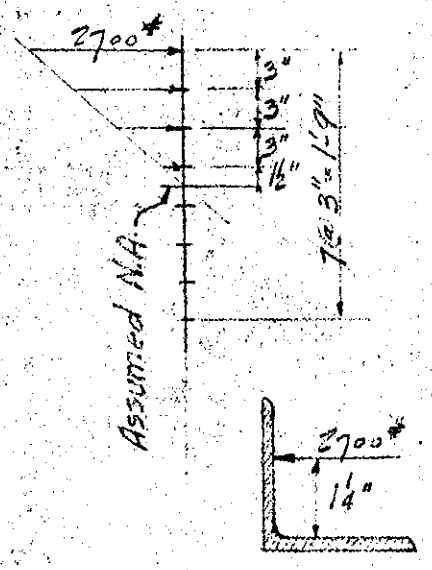
$56\ S$

56 S = 194 000 "#
S = 3470 #
Vert. Shear = $\frac{13200}{14} = 950\#$

Actual Stress = 3600 #
Use 16 rivets - bracket connection to column.

Subject Paderewski St. Pumping Sta.
Computation Crane Brackets (Angle size)
Computed by W. W. Z. Checked by Date 3-21-40

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Stress on outermost rivet = 2700#

$S_1 = \frac{7.5}{10.5} \times 2700 = 1930$

$S_2 = \frac{4.5}{10.5} \times 2700 = 1160$

$S_3 = \frac{1.5}{10.5} \times 2700 = 385$

Moment = 385×1.5 + 1160×4.5 + 1930×7.5 + 2700×10.5
= 560 + 5220 + 14480 + 28400
= 48700 "#

$S = \frac{M}{f} = \frac{48700}{18000} = 2.70$ ins³ required

4"×4"×¾" L S = 2.8 ins³

M = 2700 × 1¼ = 3880 "#

$S = \frac{1}{6} bh^2$ where b = 3" (rivet spacing)
$= \frac{1}{6} \times 3 \times (\frac{3}{4})^2$ h = ¾"

$f = \frac{M}{S} = \frac{3880}{\frac{9}{32}} = 12000$ #/□" OK.

Use ¾" L

WAR DEPARTMENT

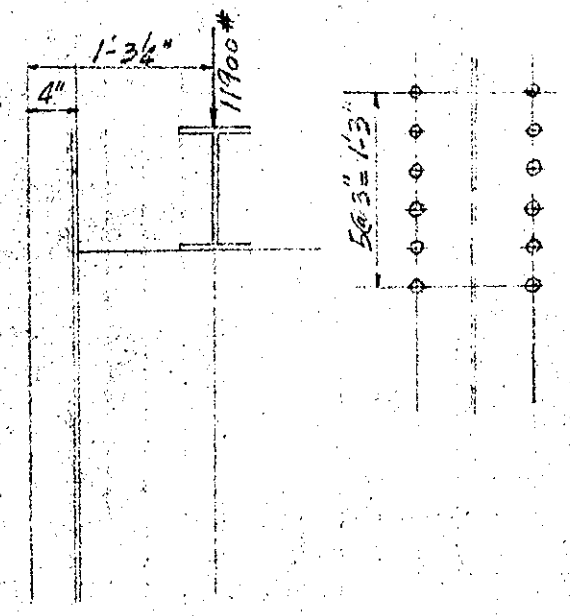
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski St. Pumping Sta.

Computation: Crane Bracket (8" WF 27#)

Computed by: W.W.Z. Checked by: Date: 3-21-40

U. S. GOVERNMENT PRINTING OFFICE 3—10628



s = rivet stress

$2 \times 2 \times 7.5\,s = 30.0\,s$

$2 \times 2 \times \frac{(4.5)^2}{7.5}\,s = 10.8\,s$

$2 \times 2 \times \frac{(1.5)^2}{7.5}\,s = 1.2\,s$

$42.0\,s$

Moment = 11900 × 11.25 = 134000 "#

$42.0\,s = 134000$

$s = 3190\,\#$

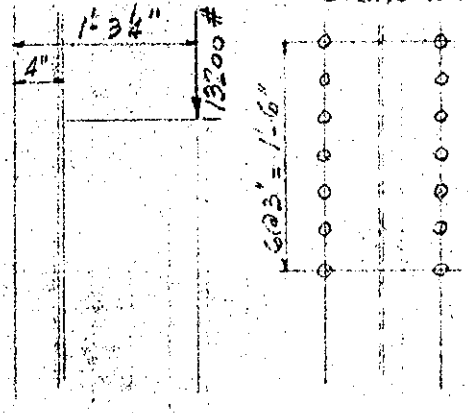
Shear = $\frac{11900}{12} = 990\,\#$

Actual Combined Stress =

$\sqrt{(3190)^2 + (990)^2} = 3320\,\# < 5960\,\#$

Use 12 rivets

Crane Bracket @ Col. #3.



$2 \times 2 \times 9.0\,s = 36.0\,s$

$2 \times 2 \times \frac{(6.0)^2}{9}\,s = 16.0\,s$

$2 \times 2 \times \frac{(3.0)^2}{9} = 4.0\,s$

$56.0\,s$

$56\,s = 13200 \times 11.25 = 148500$ "#

$s = 2650\,\#$

Shear = $\frac{13200}{14} = 940\,\#$

Stress = $\sqrt{(2650)^2 + (940)^2} = 2820\,\#$

Use 14 rivets

Project Paderewski Pumping Station. C.5b.
Computation Weight of Equipment.
Computed by E.M.V. Checked by ..... Date Feb. 1, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10828

Weight of equipment -

1. Gasoline engine	6,000 #
2. Concrete base under gasoline engine 4'-0" x 6'-6" x 1'-6" (about)	6,000
3. Gear reduction unit	4,000
4. Propeller pump	8,000
5. Thrust on propeller pump	7,000
6. Gate valve and discharge pipe full of water	7,800
7. Motor for volute pump	1,800
8. Concrete block under volute pump motor 3'-0" x 3'-0" x 0'-6"	700
9. Thrust on volute pump	4,000
10. Standby unit	14,000
11. Concrete block under standby unit 11'-6" x 4'-9" x 0'-6"	5,000
12. Switchboard	4,000
13. Crane capacity	10,000
14. Crane wheel loads, wheels 5'-2" o.c.	6,300
15. Volute pump	4,000
16. Boiler	2,000

WAR DEPARTMENT

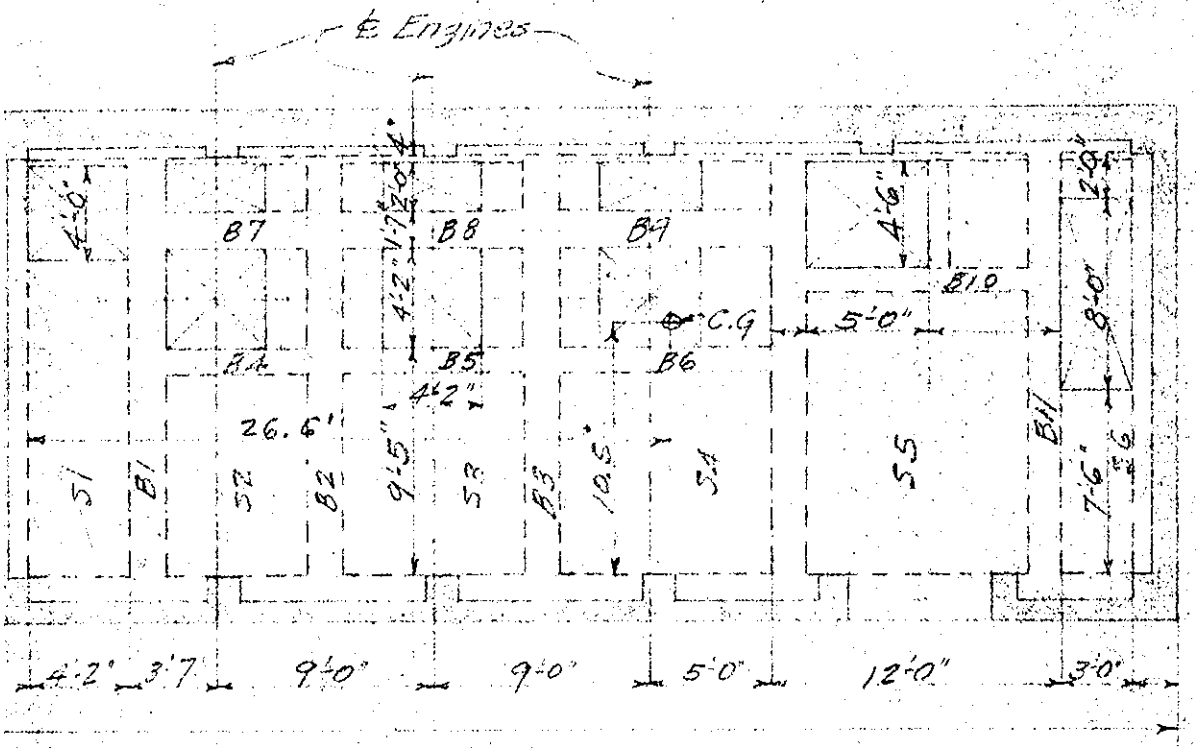
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project Paderewski Pumping Station C56

Computation Operating Floor

Computed by E.M.Y. Checked by R.S.M. Date Feb. 1, 1942.

U. S. GOVERNMENT PRINTING OFFICE 3—10523



Plan of Operating Floor Framing

Uniform L.L. for slab design -

Shortest span = 6'-0".

Mom. due to engine on slab = 500 × 3.0 - 500 × 0.5 = 1250 #.

Equiv. uniform load = $\frac{1}{8}$ w × 36 = 1250 #; w = 278 #/ft.; say 300 #/ft.

Mom. due to engine on brm. = 3000 × 9.75 - 3000 × 1.5 = 24,800 #.

Equiv. uniform load = $\frac{1}{8}$ w $(19.5)^2$ = 24,800; w = 522 #/lin. ft.

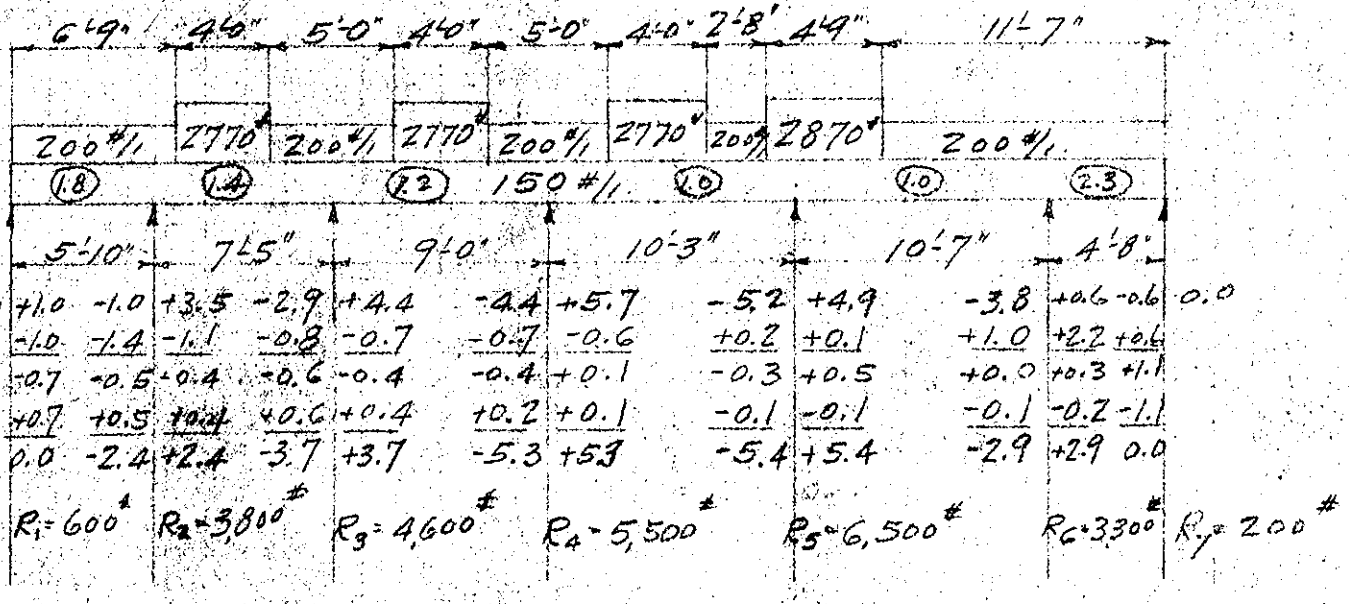
Use a uniform load of 200 # per sq. ft. of floor for brms. and for slabs as an additional load to the machinery loads.

Subject Paderewski Pumping Station Csb.
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb. 7, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Slabs S1-S2-S3-S4-S5-S6.

Load on slabs = dead load + machinery load + impact + uniform live load on unoccupied part of floor.



Wt. of gasoline engine = 6,000#

Impact = 6,000

Conc. base under engine = 6000

Total = 18,000#

Load per lin. ft. of engine base = $\frac{18000}{6.5}$ = 2,770#

Assume floor slab 1'-0" thk. the slab weighs 150#/□'

Wt. of standby unit = 14,000#

Impact = 14000

Conc. base under = 5,000

Total = 33,000# = 2870# per lin. ft.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project Paderewski Pumping Station C5b

Computation Operating Floor

Computed by E.M.V. Checked by RSM Date Feb. 8, 1940

U.S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #34)

$R_1 = \frac{350 \times 5.83 \times 2.92 - 2400}{5.83} = 600^{\#}$

$R_2 = \frac{\frac{1}{2} \times 350 \times 13.25^2 + 492 \times 4.0 \times 4.5 - 600 \times 13.25 - 3700}{7.42} = 3{,}800^{\#}$

R_3 - 350 × 22.25 × 11.13 =	86,700	
492 × 8.0 × 9.0 =	35400	
600 × 22.25 =		13,300
3,800 × 16.42 =		62500
	46300	
Deduct	5300	
Net =	41,000	

$R_3 = \frac{41000}{9.0} = 4600^{\#}$

R_4 - 350 × 32.5 × 16.25 =	184,600	
492 × 12.0 × 14.75 =	86,800	
600 × 32.5 =		19,500
3,800 × 26.67 =		101,500
4,600 × 19.25 =		88500
	61,900	
Deduct	5400	
Net =	56,500	

$R_4 = \frac{56{,}500}{10.25} = 5{,}500^{\#}$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station. C5b

Computation: Operating Floor

Computed by: E.M.Y. Checked by: RSM Date: Feb. 8, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10538

(Continued from sheet #35)

R_5 - 350 x 43.08 x 21.54	= 324,000	
492 + 12.0 x 25.33	= 149,200	
404 x 4.75 x 9.29	= 17,800	
600 x 43.08	=	25,900
3,800 x 37.25	=	141,500
4,600 x 29.83	=	137,400
5500 x 20.83	=	114,600
	71,600	
Deduct	2900	
	Net = 68,700	

$$R_5 = \frac{68700}{10.58} = 6500^{\#}$$

$$R_7 = \frac{350 \times 4.67 \times 2.34 - 2700}{4.67} = 200^{\#}$$

R_6 - 350 x 15.25 + 7.63	= 40,800	
404 x 3.67 x 1.83	= 2700	
200 x 15.75	=	3200
	40300	
Deduct	5400	
	Net = 34,900	

$$R_6 = \frac{34900}{10.58} = 3300^{\#}$$

Proj Paderewski Pumping Station
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb. 8 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #36)

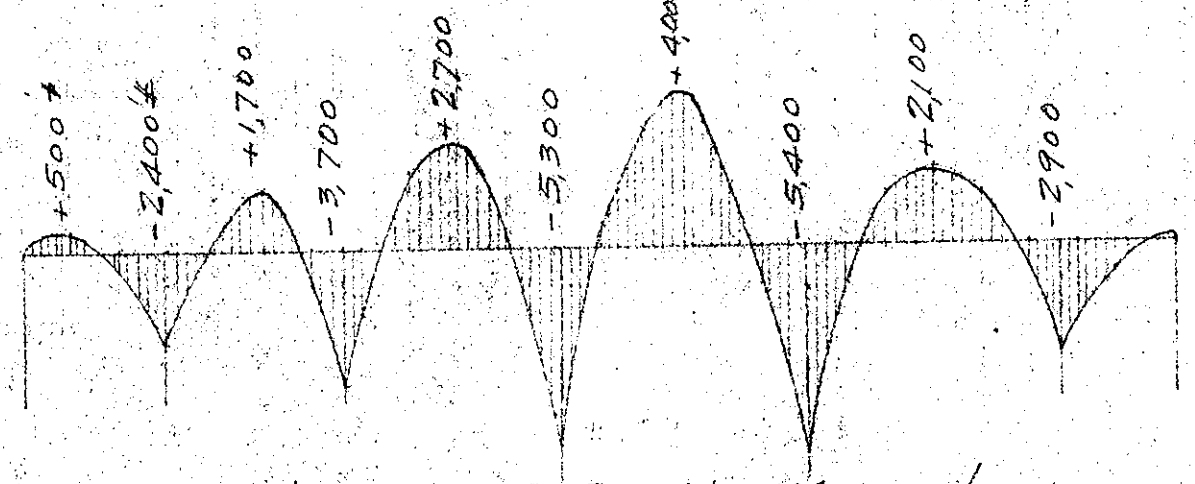


Diagram of Bending Moments.

From the diagrams of loads and bending moms.

max. pos. mom. = 4,000 #, max. neg. mom.

= 5300 - 2700 × 0.33 = 4,400 #.

Depth of slab req'd = $\sqrt{\frac{5400}{122.8}}$ = 6.6

Max. shear = 350 × 15.25 + 404 × 3.67 - 3500 = 3300 #

Unit shear = $\frac{3300}{12 \times \frac{7}{8} \times 6.6}$ = 47.6 #/□" O.K.

Assume total depth of slab = 8½"

$A_s = \frac{4400 \times 12}{\frac{7}{8} \times 6.6 \times 18{,}000}$ = 0.51 □" Try ⅝"φ bars 6½" c.c.

Unit bond stress = $\frac{3300}{1.85 \times 1.96 \times \frac{7}{8} \times 6.6}$ = 158 #/□"

Space bars 6" c.c. top and bot from third to fifth support 1'-0" beyond pts. of inflection. Use 1'-0" spacing to ends. Use ⅝"φ bars. Slab 8½" thk.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

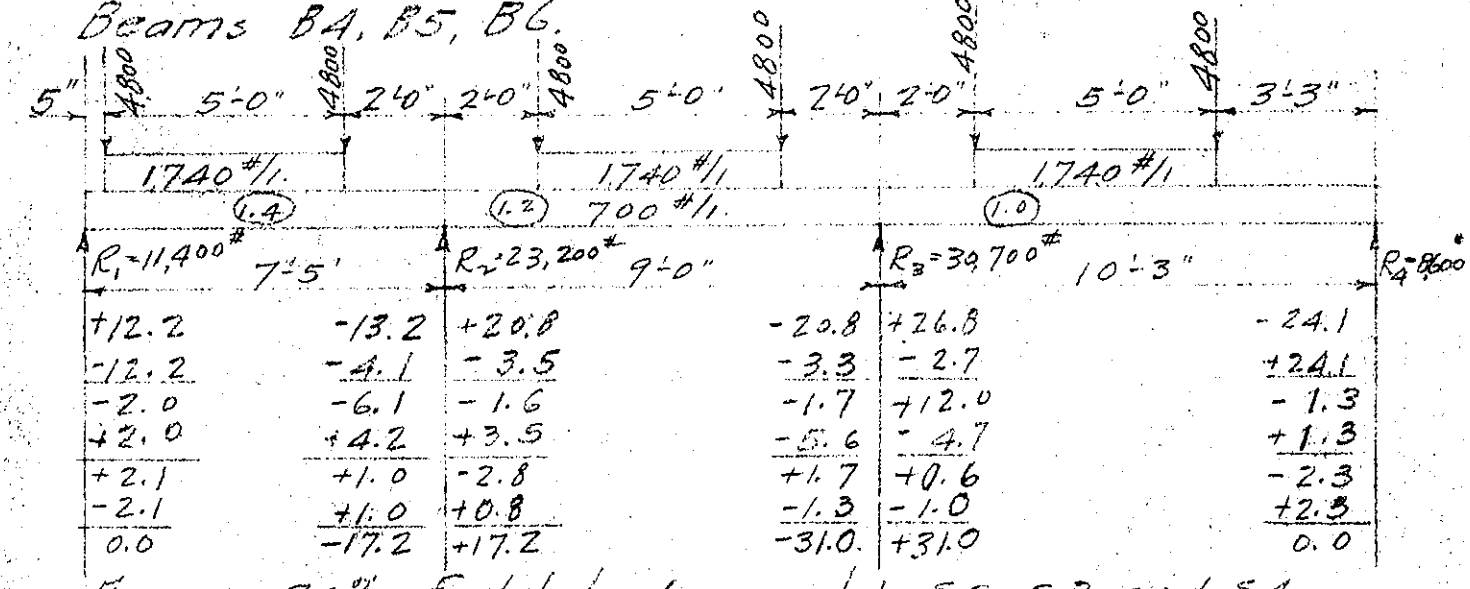
Project: Paderewski Pumping Station. C5b

Computation: Operating Floor

Computed by: E.M.V. Checked by: RSM Date: Feb. 8. 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beams B4, B5, B6.



Assume 20% of slab loads on slab S2, S3 and S4 as coming on bms. (L.L. = 200 #/□') = 0.20 × 8.42 × 300 = 500 #/'

Total uniform load = 200 + 500 = 700 # per ft. of bm.

Load from gear reduct. unit	= 4000 #
" " pump	= 8000
Impact	= 12,000
Thrust	= 7000
Gate valve & discharge pipe	= 3900
Total	= 34,900 #. on 4-bms.

Load on each bm. = 8700 #

= 1740 #/'

Project Paderewski Pumping Station C5b
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb 9, 1940.

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Bms. B4, B5, B6 (Continued from sheet #38).

$$R_1 = \frac{700 \times 7.42 \times 3.71 + 8700 \times 4.5 - 17200 + 9600 \times 4.5}{7.42} = 11{,}400^{\#}$$

$$R_2 = \frac{700 \times 16.42 \times 8.21 + 17400 \times 9.0 + 19{,}200 \times 9.0 - 31{,}000 - 11400 \times 16.42}{9.0}$$

$$= 23{,}200^{\#}$$

$$R_4 = \frac{700 \times 10.25 \times 5.12 + 8{,}700 \times 4.5 + 9600 \times 4.5 - 31200}{10.25} = 8{,}600^{\#}$$

$$R_3 = \frac{700 \times 19.25 \times 9.63 + 36{,}600 \times 9.0 - 8600 \times 19.25 - 17{,}200}{9.0} = 30{,}700^{\#}$$

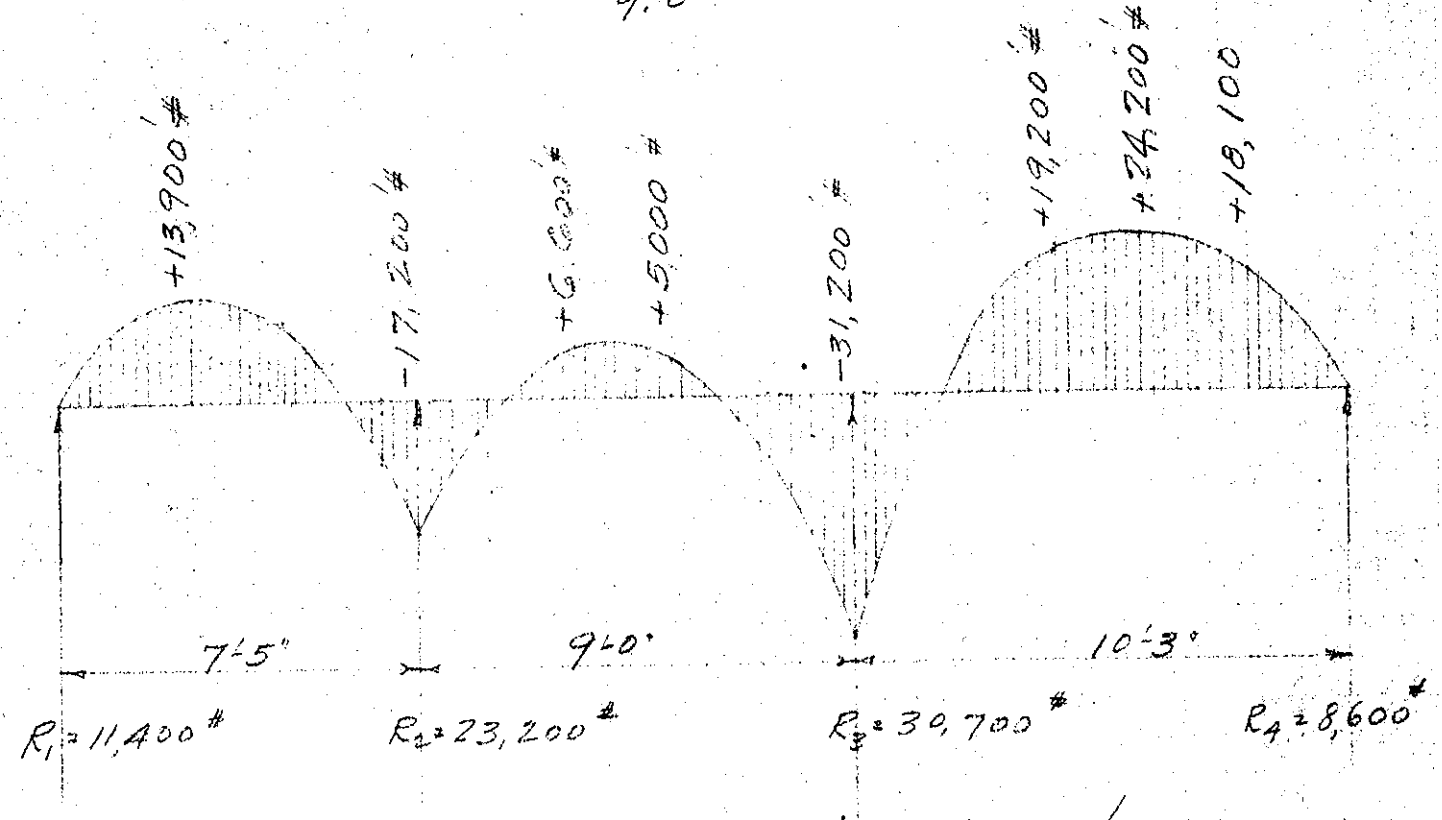


Diagram of Bending Moments.

Project: Paderewski Pumping Station Csb.
Computation: Operating Floor
Computed by: E.M.V. Checked by: RSM Date: Feb. 9, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Bms. B4, B5, B6 (Continued from sheet #39)

Max. neg. mom. = 31,200'#
" pos. " = 24,200'#
" shear = 16,900#

d' req'd by neg. mom. = $\sqrt{\frac{31,200 \times 12}{123 \times 14}}$ = 14.9'

Unit shear = $\frac{16900}{14 \times \frac{7}{8} \times 15.7}$ = 95 #/□"

Make beam 1'-6" deep, "d" = 15.7"

Bm. B4 - A_s for pos. mom. = $\frac{14000 \times 12}{\frac{7}{8} \times 15.7 \times 18,000}$ = 0.69 □"

A_s " neg. " = $\frac{17,200 \times 12}{\frac{7}{8} \times 15.7 \times 18,000}$ = 0.84 □"

Bm. B5 - A_s " pos. " = $\frac{7000}{14000} \times 0.69$ = 0.35 □"

A_s " neg. " = $\frac{31,200}{14,000} \times 0.69$ = 1.54 □"

Bm. B6 - A_s for pos. mom. = $\frac{24,200}{14,000} \times 0.69$ = 1.20 □"

For Bm. B6 use 2-3/4"φ & 1-5/8"φ for pos. mom.
" " B5 " 1-5/8"φ & 1-3/4"φ " " "
2-3/4"φ & 1-7/8"φ " neg. "
" " B4 " 1-5/8"φ & 1-3/4"φ " pos. "
2-3/4"φ for neg. mom.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project: Paderewski Pumping Station Csb.

Computation: Operating Floor

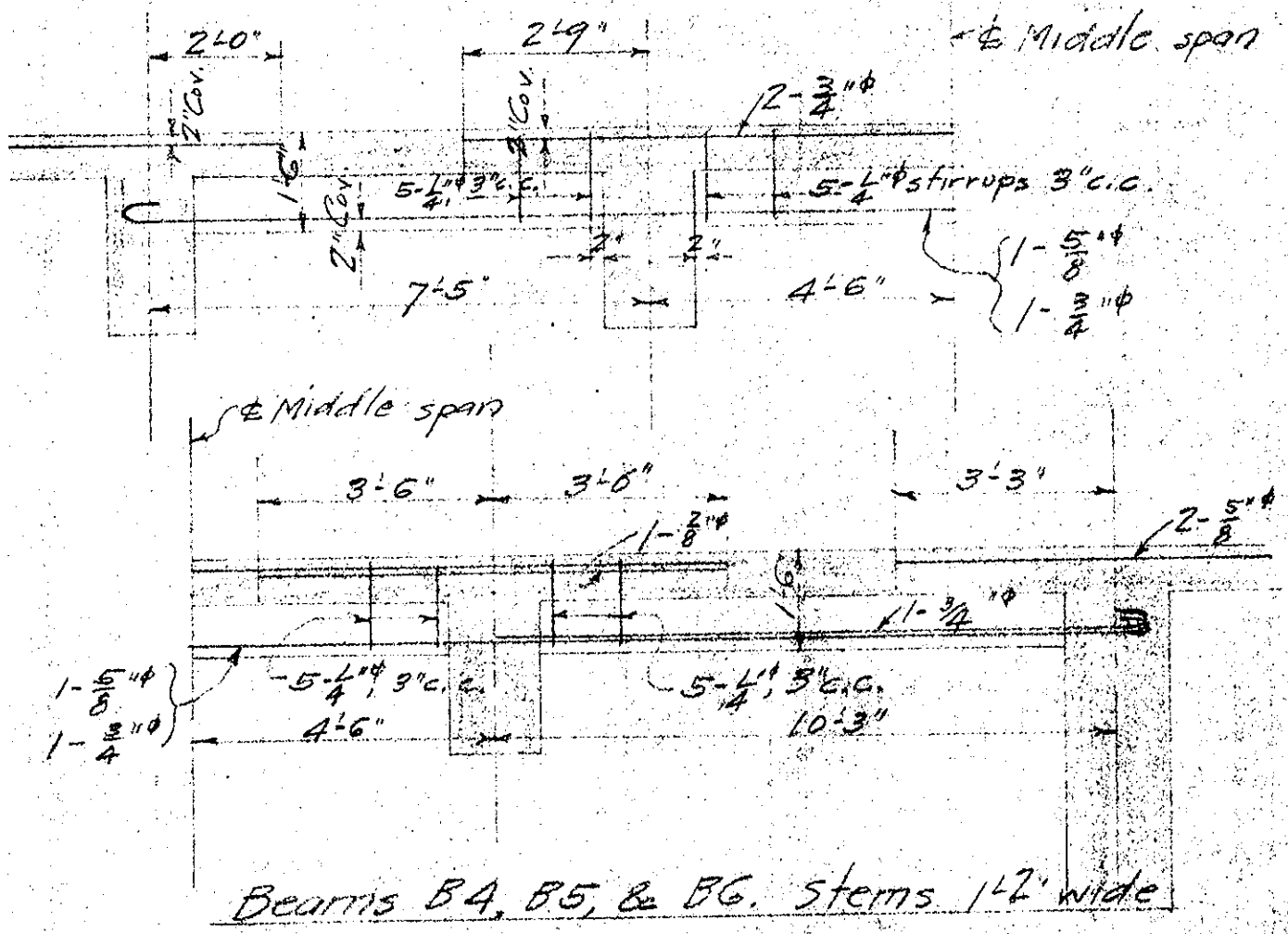
Computed by: E.M.V. Checked by: RSM Date: Feb. 10, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10526

Bms. B4, B5, B6 (Continued from sheet #40)

For Bm. B6 no. of $\frac{1}{4}$"ϕ stirrups reqd. $= \frac{(16900 - 11600)\,24}{\frac{2}{3} \times 15.7 \times 16000 \times 0.05 \times 2} = 5$

Use 5-$\frac{1}{4}$"ϕ stirrups 3" c.c. at interior end.

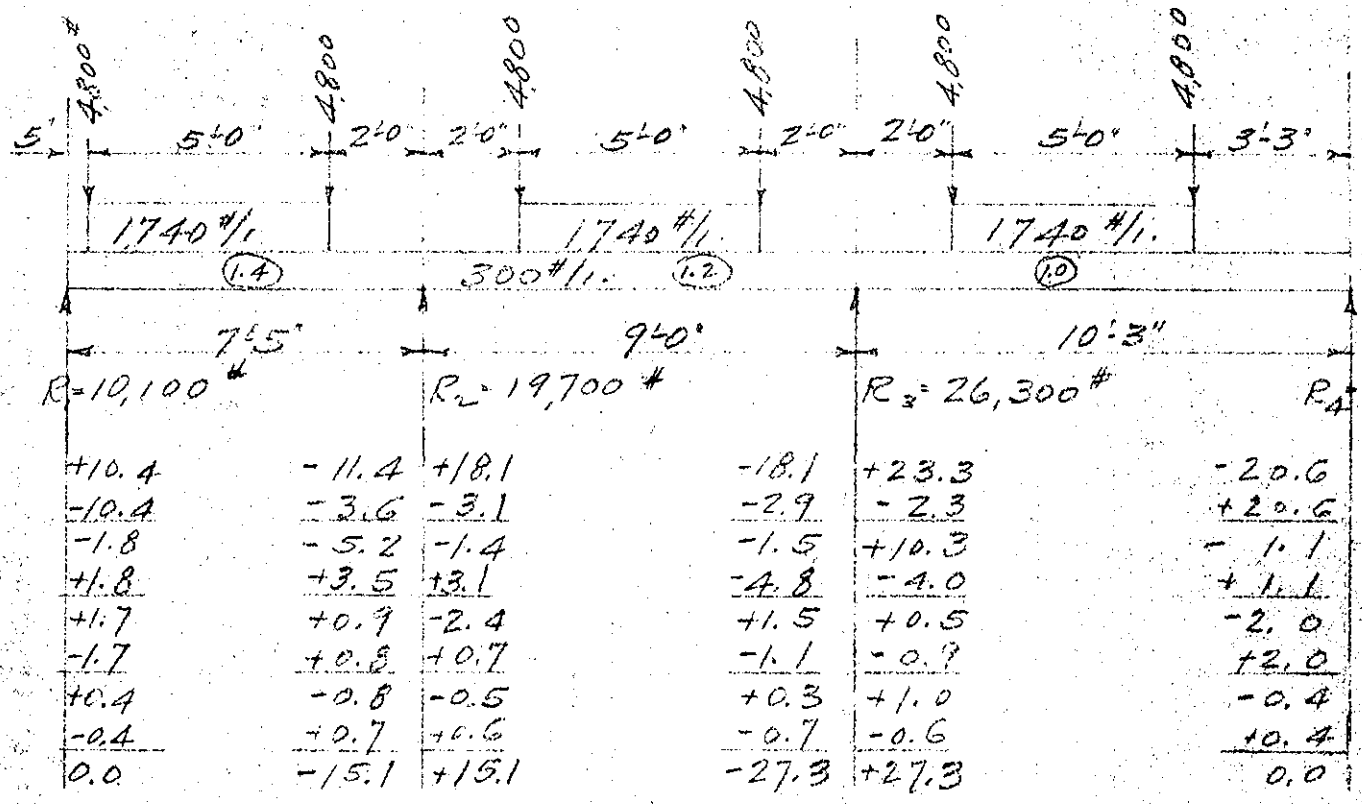


Beams B4, B5, & B6. Stems 1'-2" wide

Project: Paderewski Pumping Station
Computation: Operating Floor
Computed by: E.M.V. Checked by: RSM Date: Feb. 12, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Beams B7, B8, B9.



+10.4	-11.4	+18.1	-18.1	+23.3	-20.6
-10.4	-3.6	-3.1	-2.9	-2.3	+20.6
-1.8	-5.2	-1.4	-1.5	+10.3	-1.1
+1.8	+3.5	+3.1	-4.8	-4.0	+1.1
+1.7	+0.9	-2.4	+1.5	+0.5	-2.0
-1.7	+0.8	+0.7	-1.1	-0.9	+2.0
+0.4	-0.8	-0.5	+0.3	+1.0	-0.4
-0.4	+0.7	+0.6	-0.7	-0.6	+0.4
0.0	-15.1	+15.1	-27.3	+27.3	0.0

$$R_1 = \frac{300 \times 7.42 \times 3.71 + 18{,}300 \times 4.5 - 15{,}100}{7.42} = 10{,}100^{\#}$$

$$R_2 = \frac{300 \times 16.42 \times 8.21 + 36{,}600 \times 9.0 - 27300 - 10100 \times 16.42}{9.0} = 19{,}700^{\#}$$

$$R_4 = \frac{300 \times 10.25 \times 5.12 + 18{,}300 \times 4.5 - 27{,}300}{10.25} = 6{,}900^{\#}$$

$$R_3 = \frac{300 \times 19.25 \times 9.63 + 36{,}600 \times 9.0 - 6{,}900 \times 19.25 - 15{,}100}{9.0} = 26{,}300^{\#}$$

Project Paderewski Pumping Station.
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb. 12, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Brms. B7, B8, B9 (Continued from sheet #42)

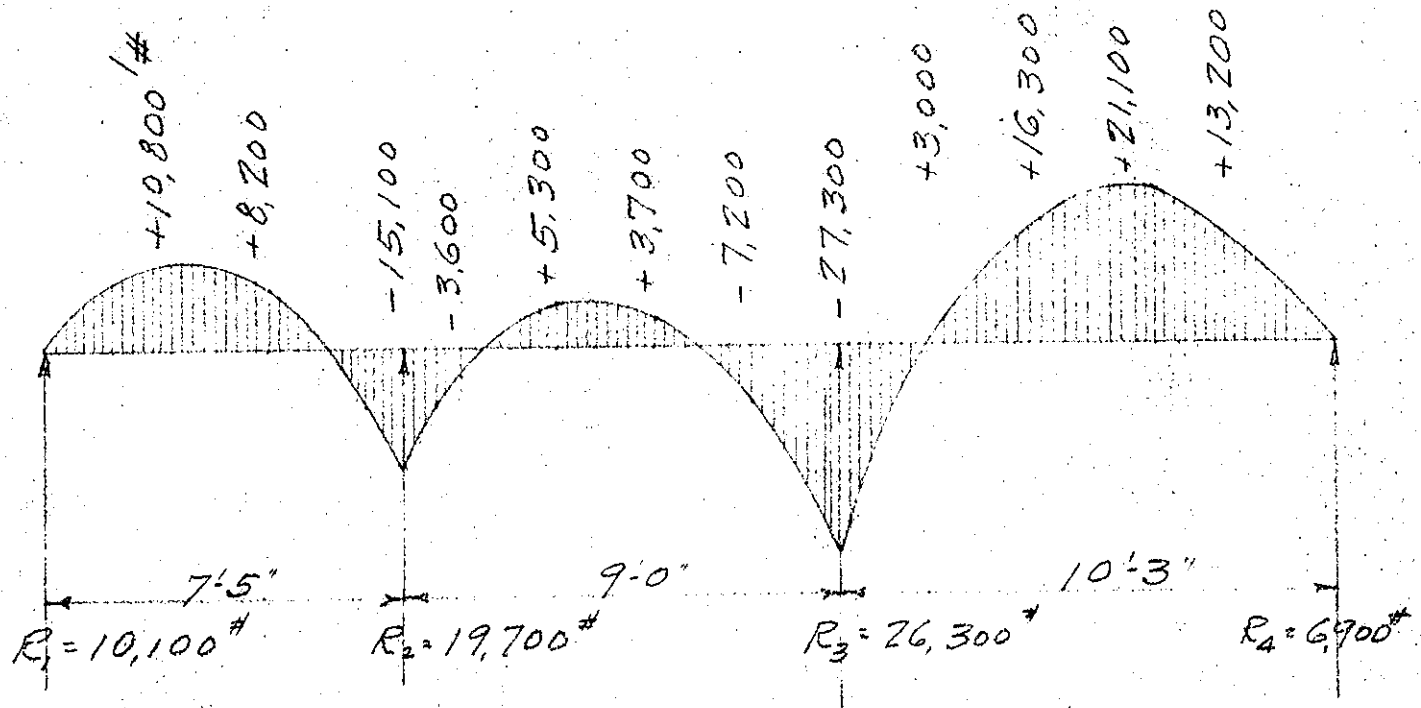


Diagram of Bending Moments.

Max. neg. mom. = 27,300'#.
" pos. " = 21,100'#
" shear = 14,500#

With bm 1'-5" wide $d = \sqrt{\frac{27,300 \times 12}{122.8 \times 17}} = 12.5"$

Unit shear = $\frac{14500}{17 \times \frac{7}{8} \times 12.5} = 78$ #/□". Special anchorage.

With beam 1'-2" wide $d = \sqrt{\frac{27,300 \times 12}{122.8 \times 14}} = 13.8"$

Unit shear = $\frac{14500}{14 \times \frac{7}{8} \times 13.8} = 86$ #/□"

Make brm. 1'-6" deep. d = 15.7"

Project: Paderewski Pump
Computation: Operating Floor
Computed by: E.M.V. Checked by: RSM Date: Feb. 13, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10823

Bms. B7, B8, B9 (Continued from sheet #43)

Bm. B7 - A_s for pos. mom. $= \dfrac{10{,}800 \times 12}{\frac{7}{8} \times 15.7 \times 18{,}000} = 0.53\,\square''$

A_s for neg. " $= \dfrac{15{,}100 \times 12}{\frac{7}{8} \times 15.7 \times 18{,}000} = 0.73\,\square''$

Bm. B8 - A_s for pos. mom. $= \dfrac{5500 \times 12}{\frac{7}{8} \times 15.7 \times 18{,}000} = 0.27\,\square''$

A_s for neg. " $= \dfrac{27{,}300 \times 12}{\frac{7}{8} \times 15.7 \times 18{,}000} = 1.32\,\square''$

Bm. B9 - A_s for pos. mom. $= \dfrac{21{,}100 \times 12}{\frac{7}{8} \times 15.7 \times 18{,}000} = 1.02\,\square''$

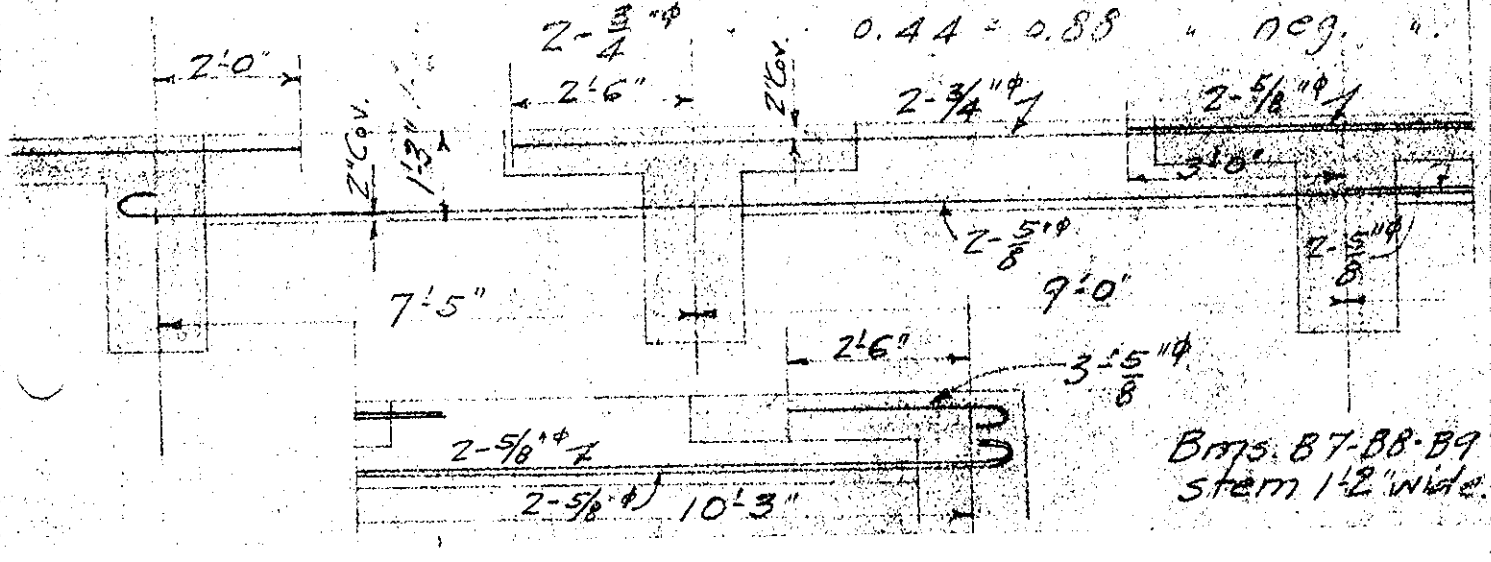
For Bm. B9 - use 4-$\frac{5}{8}$"ϕ bars @ 0.306 □" = 1.22 □" for pos. mom.

" " B8 " 2-$\frac{5}{8}$"ϕ " " 0.306 = 0.61 □" " " "

2-$\frac{3}{4}$"ϕ, 2-$\frac{5}{8}$"ϕ " " 0.44 = 1.44 □" " neg. "

" " B7 " 2-$\frac{5}{8}$"ϕ " " 0.306 = 0.61 " pos. "

2-$\frac{3}{4}$"ϕ " 0.44 = 0.88 " neg. "

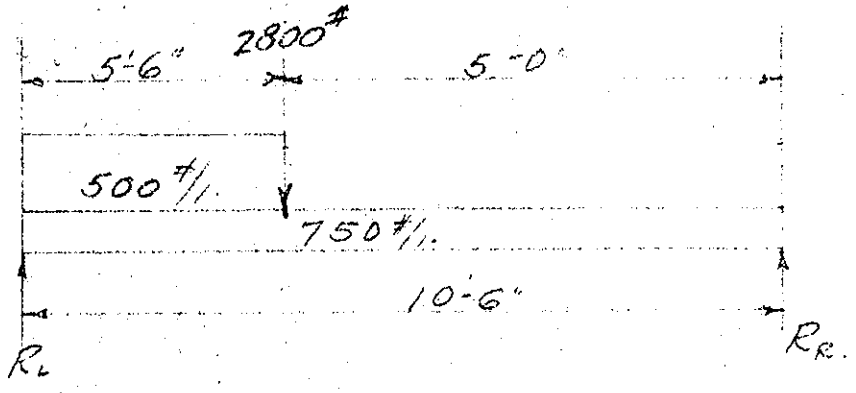


Bms. B7-B8-B9 stem 1'-2" wide.

Project: Paderewski Pumping Station
Computation: Operating Floor
Computed by: E.M.V. Checked by: RSM Date: Feb. 13, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam "B10".



$R_L = 750 \times 5.25 + \frac{2800 \times 5.0}{10.5} + \frac{500 \times 5.5 \times 7.75}{10.5} = 7300$

$R_R = 6,100$ #

Max. mom. $= 7,300 \times 5.5 - 1250 \times 5.5^2/2 = 21,100$ '#

$d = \sqrt{\frac{21,100 \times 12}{122.8 \times 14}} = 12.1"$

Unit shear $= \frac{7,300}{12 + \frac{7}{8} \times 12.5} = 56$ #/□"

Make bm. 1'-3" deep; "d" = 12.5"

$A_s = \frac{21,100 \times 12}{\frac{7}{8} \times 12.5 \times 18,000} = 1.29$ □" Use 3-$\frac{3}{4}$"ϕ @ 0.4418 = 1.33 □"

Unit bond stress $= \frac{7300}{3 \times 2.36 \times \frac{7}{8} \times 12.5} = 95$ #/□" Bm. stem 14".

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

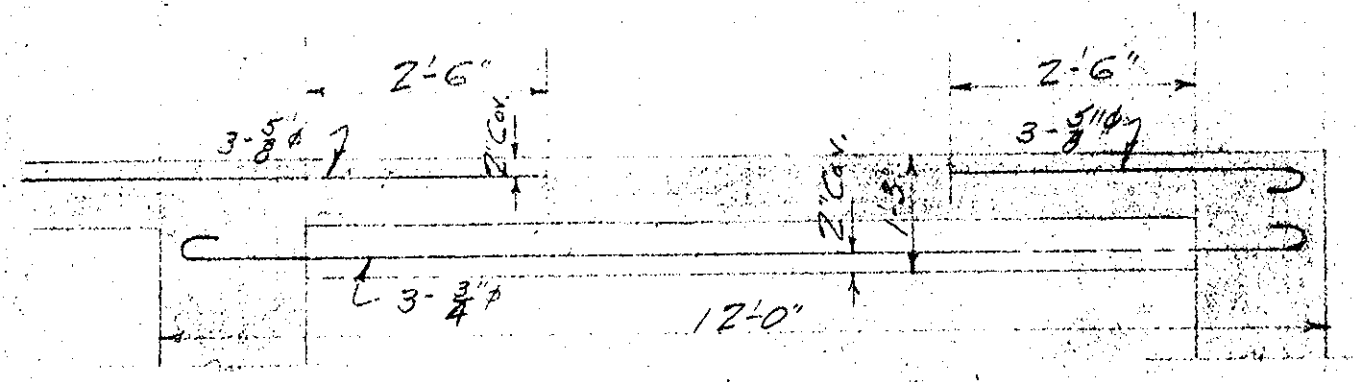
Project: Paderewski Pumping Station

Computation: Operating Floor

Computed by: E.M.V. Checked by: RSM Date: Feb. 13, 1940.

U. S. GOVERNMENT PRINTING OFFICE 8—10523

Beam "B10" (Continued from sheet #45).

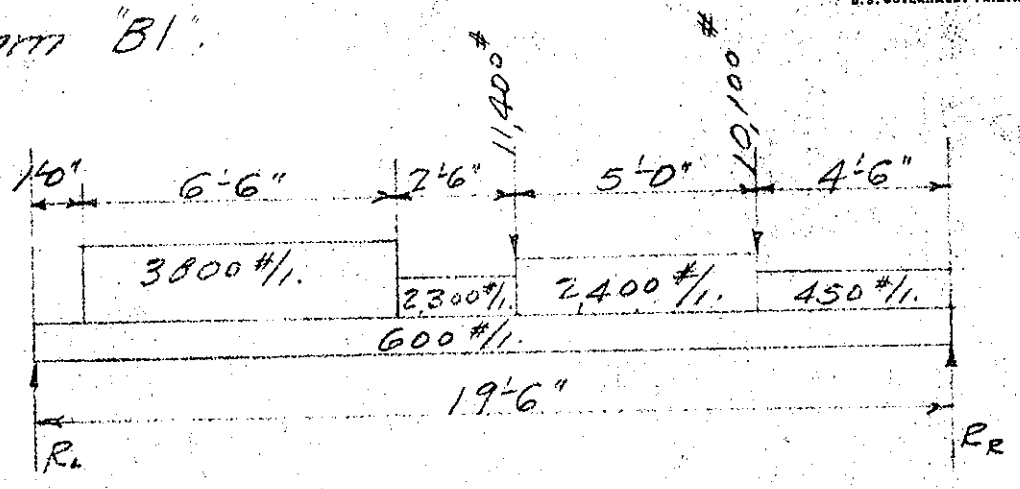


Bm. B10. Stem 1'-2" wide

Project: Paderewsky Pumping Station
Computation: Operating Floor
Computed by: E.M.V. Checked by: PSM Date: Feb. 13, 1940

U. S. GOVERNMENT PRINTING OFFICE 2—10528

Beam "B1".



R_L - 450 × 4.5 × 2.25 = 4,500

2,400 × 5.0 × 7.00 = 84,100

10,100 × 4.5 = 45,400

11,400 × 9.5 = 108,300

2,300 × 2.5 × 10.75 = 61,800

3,800 × 6.5 × 15.25 = 376,000

600 × 19.5 × 9.75 = 114,200

794,300

$R_L = \frac{794,300}{19.5} = 40,800^{\#}$

$R_R = 37,000^{\#}$

Pt. of max. mom. = 10'-0" to right of R_L.

$M = 40,800 \times 10 - 3,800 \times 6.5 \times 5.75 - 2,300 \times 2.5 \times 1.25 - 600 \times 10.0 \times 5$

$= 229,000'^{\#}$

$d = \sqrt{\frac{229,000 \times 12}{122.8 \times 18}} = 35.2"$

Project Paderewski Pumping Station
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb. 14, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Bm. "B1" (Continued from sheet #47)

Unit shear = $\frac{40,800}{18 \times \frac{7}{8} \times 35.2}$ = 73.5 #/□" at left end.

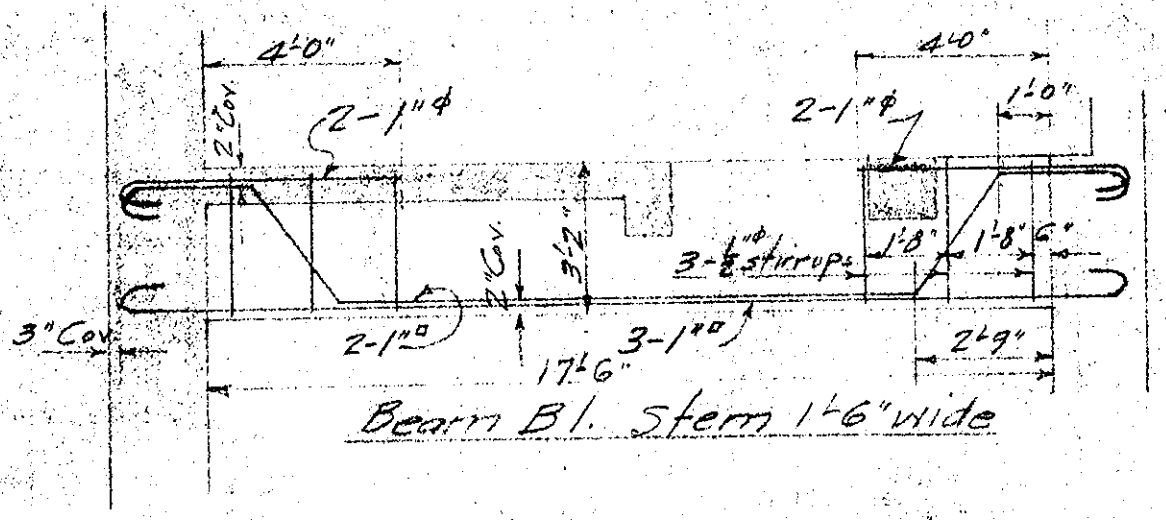
" " = $\frac{37.0}{40.8} \times 73.5 = 66.5$ #/□" " right "

$A_s = \frac{229,000 \times 12}{\frac{7}{8} \times 35.2 \times 18,000} = 4.96$ □" Try 5-1"□ bars = 5.00 □"

With 2-bars bent up unit bond = $\frac{40,800}{3 \times 4.0 \times \frac{7}{8} \times 35.5}$ = 109 #/□" O.K.

Pts. for bending up steel -

$40,800x - 600\frac{x^2}{2} - 3800\frac{(x-1)^2}{2} = 0.60 \times 229,000$; $x = 3.8'$

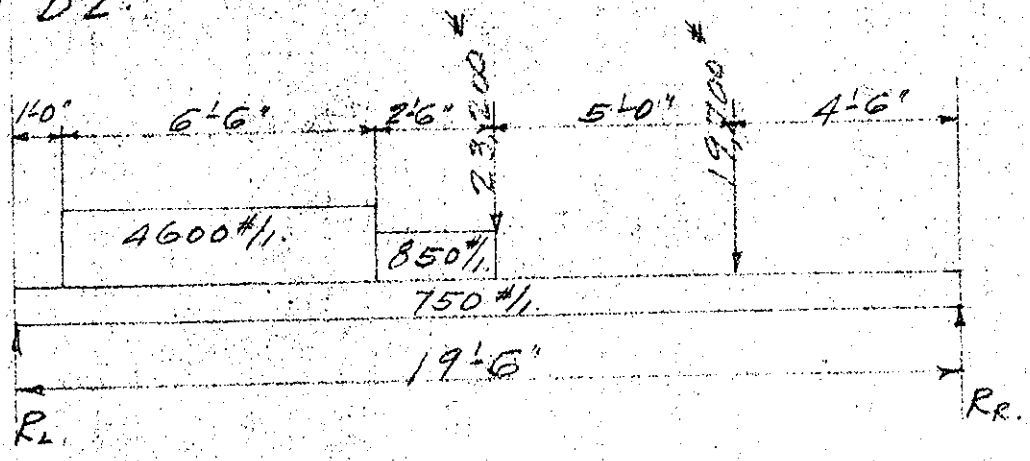


Beam B1. Stem 1'-6" wide

Object: Paderewski Pumping Station
Computation: Operating Fiber
Computed by: E.M.V. Checked by: RSM Date: Feb. 14, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam "B2".



R_L - 4,600 × 6.5 × 15.25 = 455,000

8.50 × 2.5 × 10.75 = 22,800

23,200 × 9.5 = 220,400

19,700 × 4.5 = 88,700

7.50 × 19.5 × 9.75 = 142,800

Total = 929,700

$R_L = \frac{929700}{19.5} = 47,700^{\#}$

$R_R = 41,800^{\#}$

Max. mom. = 41,800 × 9.5 − 19,700 × 5.0 − 750 $\left(\frac{9.5}{2}\right)^2$ = 264,000'#

Assume "d" = 35.5"; t = 8.5"; $\frac{t}{d}$ = 0.24; K = 113.

$d = \sqrt{\frac{264000 \times 12}{113 \times 58}} = 22.'$ $\frac{t}{d} = \frac{8.5}{22.0} = 0.387$; K = 123

$d = \sqrt{\frac{264000 \times 12}{123 \times 58}} = 21.2"$

With stem 1'-4" wide unit shear = $\frac{47700}{16 + \frac{7}{8} + 21}$ = 162 #/□"

Project: Paderewski Pumping Station
Computation: Operating Floor
Computed by: E.M.V. Checked by: RSM Date: Feb. 14, 1940.

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Bm. "B2" (Continued from sheet #49)

$A_s = \frac{264000 \times 12}{\frac{7}{8} \times 21.0 \times 18000} = 9.58 \square''$

Try "d" = 35.5". Unit shear = $\frac{47700}{18 \times 0.90 \times 35.5} = 83.0$ #/□".

$A_s = \frac{264,000 \times 12}{0.90 \times 35.5 \times 18,000} = 5.52 \square''$ Use 3-1"□ @ 1.00□" = 3.00□"

2-1⅛"□ @ 1.26 = 2.52

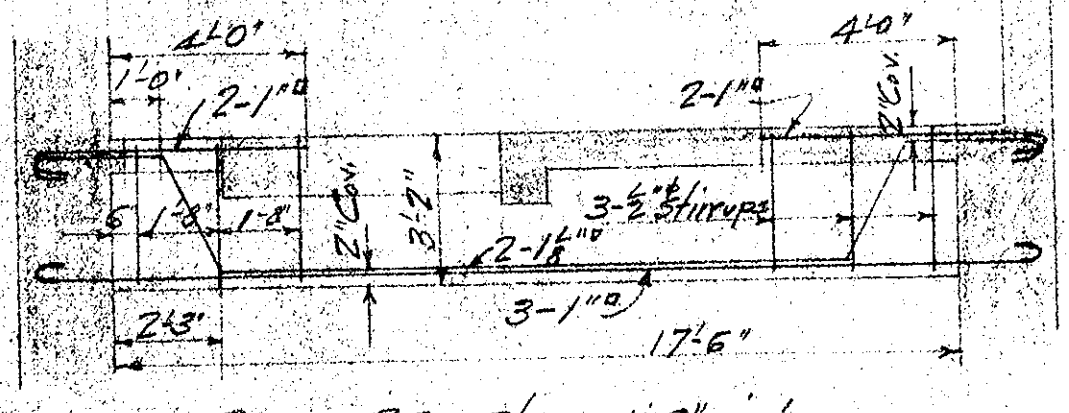
Total = 5.52□"

With 2-1⅛"□ bars bent up unit bond = $\frac{47700}{3 \times 4.0 \times 0.9 \times 35.5} = 124$ #/□".

Pts. for bending up steel -

$47,700x - 750\frac{x^2}{2} - 4600\frac{(x-1)^2}{2} = 138,000$, $x = 3.25'$

$41,800x - 750\frac{x^2}{2} = 138,000$, $x = 3.5'$



Beam B2. Stem 1'-6" wide

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

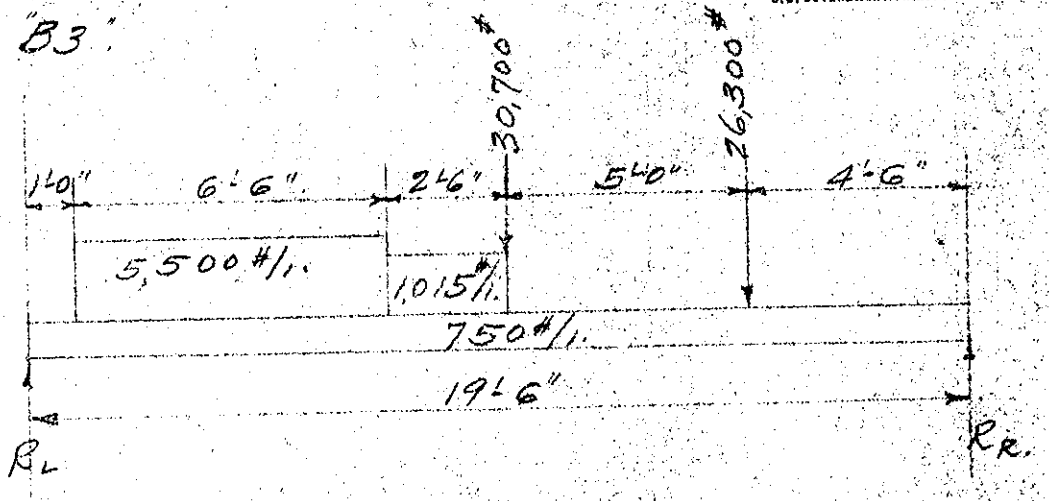
Object: Paderewski Pumping Station

Computation: Operating Floor

Computed by: E.M.V. Checked by: RSM Date: Feb. 14 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam "B3".



R_L - 1,015 × 2.50 × 10.75 = 27,300

5,500 × 6.50 × 15.25 = 548,000

26,300 × 4.5 = 118,300

30,700 × 9.5 = 292,000

750 × 19.5 × 9.75 = 144,000

1,129,600

$R_L = \frac{1129600}{19.5} = 58,000$ #

$R_R = 51,900$ #

Max. mom. = 51900 × 9.5 − 26,300 × 5.0 − 750 $\frac{(9.5)^2}{2}$ = 326,700 #

Assume d = 35.5" t = 8.5" $\frac{t}{d} = 0.24$ K = 113

$d = \sqrt{\frac{326700 \times 12}{113 \times 58}} = 24.4"$ Make d = 35.5"

Unit shear = $\frac{58000}{18 \times 0.90 \times 35.5} = 100$ #/□" Stirrups reqd.

$A_s = \frac{326,700 \times 12}{\frac{7}{8} \times 35.5 \times 18,000} = 7.00$ □" 3-1⅛"□ @ 1.2656 = 3.7968
2-¼"□ = 1.5625 = 3.1250
6.9218

Use 3-1⅛"□ 2-¼"□ } Make bm. 1'-8" wide.

Project Paderewski Pumping Station
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb. 16, 1940

U.S. GOVERNMENT PRINTING OFFICE 2—10628

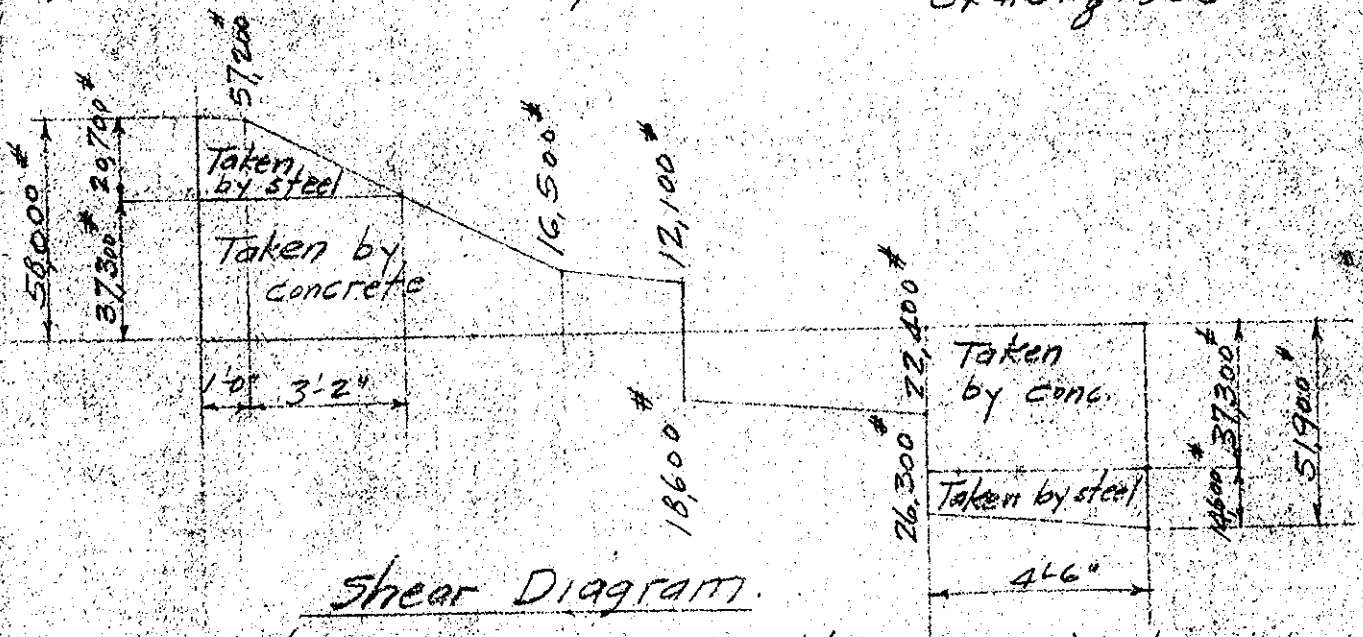
Beam "B3" (Continued from sheet #51)

Unit shear at $R_L = \frac{58000}{\frac{7}{8} \cdot 18 \times 35.5} = 103.5$ #/□"

" " " $R_R = \frac{51900}{58000} \times 103.5 = 93.5$ #/□"

} Use stirrups.

With 2-1¼"□ bars bent up, max. bond $= \frac{58000}{3 \times 4.5 + \frac{7}{8} \times 355} = 138$ #/□"



Shear Diagram.

No. of ½"□ stirrups, left end, $= \frac{\frac{1}{2}(20,700 + 20,000)12 + \frac{1}{2} \times 20,700 \times 38}{2 \times 0.196 \times 14,000 \times 35.5}$
$= 3.3$, say 4 stirrups

No. of ½"□ stirrups, right end, $= \frac{\frac{1}{2}(14,600 + 11,400) \times 54}{2 \times 0.196 \times 14,000 \times 35.5} = 3.6$,
say 4.

At left end, first stirrup 2½" from face of wall, then 6", 6", 10".

At right end 4" from face of wall, then 3 @ 11".

Project Paderewski Pumping Station
Computation Operating Floor
Computed by E.M.V. Checked by RSM Date Feb. 16, 1940

U.S. GOVERNMENT PRINTING OFFICE 3—10628

Bm. "B3" (Continued from sheet #52)

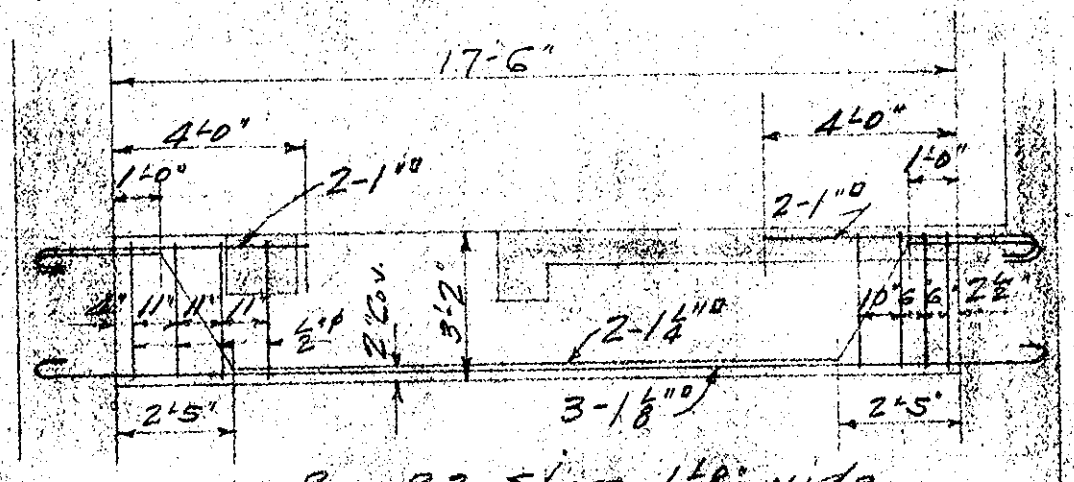
Pts. for bending up 2-1¼" bars.

At left end-

$$58{,}000x - 750\frac{(x)^2}{2} - 5500\frac{(x-1)^2}{2} = 179{,}000;\ x = 3.4'$$

At right end-

$$51{,}900x - 750\frac{(x^2)}{2} - 179{,}000 = 0;\ x = 3.7'$$

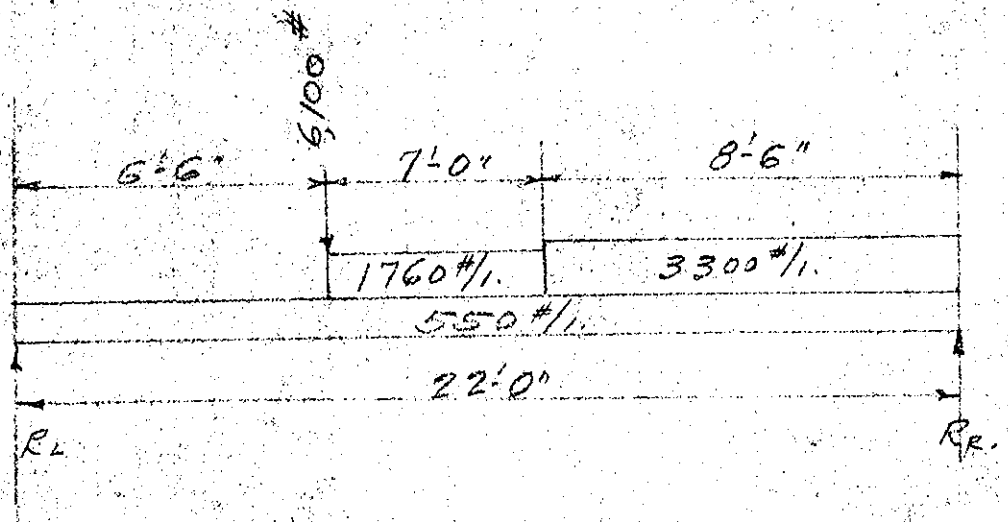


Bm. B3. Stem 1⅛" wide

Project: Paderewski Pumping Station
Computation: Operating Floor
Computed by: E.M.V. Checked by: RSM Date: Feb. 17, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam "B11"



R_L - 3,300 × 8.50 × 4.25 = 119,000
1,760 × 7.0 × 12.00 = 148,000
6,100 × 15.50 = 94200
550 × 22.0 × 11.00 = 133200
Total = 494,400

$R_L = \frac{494400}{22.0} = 22,400\#$

$R_R = 36,100\#$

Pt. of max. mom. occurs 12.1' to right of R_L.

$M = 36,100 \times 9.9 - 550 \frac{(9.9)^2}{2} - 3,300 \times 8.5 \times 5.65 - 1760 \times 1.4 \times .7$
$= 171,000\#.$

$d = \sqrt{\frac{171,000 \times 12}{122.8 \times 16}} = 32.3"$

Unit shear $= \frac{36100}{16 \times \frac{7}{8} \times 32.3} = 80\#/\square"$ No stirrups reqd.

WAR DEPARTMENT

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Subject: Paderewski Pumping Station

Computation: Operating Floor

Computed by: E.M.V. Checked by: RSM Date: Feb. 17, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam "B11" (Continued from sheet #54)

$A_s = \frac{171,000 \times 12}{\frac{7}{8} \times 35.5 \times 18,000} = 3.68 \square''$ Use 4-1" □ bars.

With 2-bars bent up unit bond $= \frac{36,100}{2 \times 4.0 + \frac{7}{8} \times 35.5} = 145$ #/□"

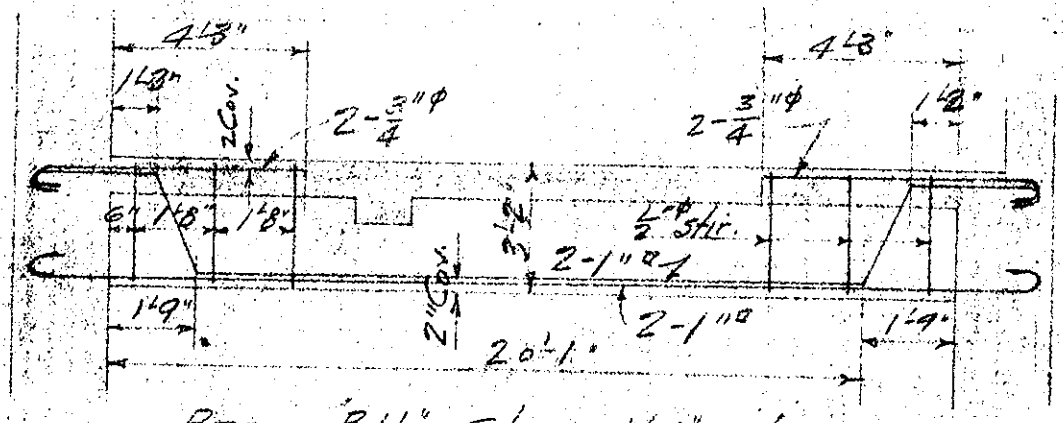
Pts. for bending up 2-bars –

At R_L, $22,400x - 550\frac{x^2}{2} = 85,500$; $x = 4.0'$

At R_R $36,100x - 3850\frac{x^2}{2} = 85,500$; $x = 2.8'$

Make bm. 1'-4" × 3'-2" deep.

Use 4-1" □ bars.



Beam B11. Stem 1'-4" wide.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project Paderewski Pumping Station C5b

Computation Stability of Structure

Computed by E.M.V. Checked by Date Feb. 28, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Description	Dimensions & Unit Weight	Weight in Kips	Arm "Y"	Moment Abt X-Axis	Arm "X"	Moment Abt Y-Axis
Roof Slab	18.5×47.8×0.46×150	60.9	10.3	628.0	26.1	1,587.0
Roof Fill	18.5×47.8×0.33×90	26.2	10.3	270.0	26.1	682.0
Roofing	18.5×47.8×6.0	5.3	10.3	53.6	26.1	138.2
Brick wall	47.8×23.0×1.0×120	132.0	0.8	105.6	26.1	3,440.0
" "	47.8×15.0×1.0×120	86.2	19.3	1664.0	26.1	2,245.0
" "	2×19.5×23.0×1.0×120	107.8	9.8	1055.0	26.1	2,810.0
Floor slab	47.8×17.5×0.71×150	89.2	11.0	981.0	26.1	2,300.0
Brms. B1 & B2	2.46×1.5×17.5×150	9.7	11.0	106.6	10.8	104.8
" B3	2.46×1.7×17.5×150	11.0	11.0	121.0	23.5	258.2
" B11	2.04×1.33×17.5×150	7.1	11.0	78.2	44.3	314.2
" B4-5-6	0.79×1.0×26.1×150	3.1	11.2	34.7	20.9	64.8
" B7-8-9	0.54×1.42×26.1×150	3.0	16.6	49.8	20.9	62.7
" B10	0.54×1.17×9.0×150	0.9	14.4	13.0	39.0	35.1
Conc. Wall	2.25×47.8×20.3×150	327.0	1.12	366.2	26.1	8,530.0
" "	2.25×47.8×28.3×150	456.0	20.9	9520.0	26.1	11,900.0
" "	2×2.0×22.0×20.3×150	268.0	11.0	2948.0	26.1	7,000.0
Int. Conc. Wall	1.5×19.5×17.5×150	76.8	11.0	845.0	33.8	2,595.0
Conc. base	26.5×57.8×3.0×150	690.0	13.3	9180.0	29.0	20000.0
		2364.2		27,259.2		64,067.0

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project: Paderewski Pumping Station C.5b

Computation: Stability of Structure

Computed by: E.M.V. Checked by: Date: Feb. 29, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Description	Dimensions & Unit Weight	Weight in Kips	Arm Y	Moment Abt X-Axis	Arm X	Moment Abt Y-Axis
Gate chamb.	6.0×12.8×3.0×150	34.6	-3.0	-103.8	32.0	1,108.0
" "	2×1.5×6.0×20.3×150	64.8	-3.0	-194.4	32.0	2,075.0
" "	6.0×12.8×1.5×150	17.3	-3.0	-51.9	32.0	554.0
Conduit	1.3×16.5×72.5×150	72.5	13.3	962.0	53.0	3,830.0
Gate Chamb.	1.5×13.0×13.8×150	40.3	14.6	588.0	53.0	2,135.0
" "	1.5×7.0×20.3×150	32.0	14.6	467.0	57.0	1,824.0
" "	1.5×4.0×6.5×150	5.9	14.6	86.0	53.0	312.4
Fill on toe	125×5.0×14.0×51.0	447.0	24.5	10,920.0	24.3	10,850.0
" " conduit	125×7.0×13.8×19.5	235.5	13.3	3,130.0	53.0	12,595.0
Roof Bms.	6×47.8×19.0	5.5	10.3	56.6	26.1	123.8
Bm. Encasm't	15×47.8×19.0	13.6	10.8	148.0	26.1	355.0
Cols.	8×47.8×19.0	7.3	10.8	79.0	26.1	192.0
Col. Encasm't	9×47.8×19.0	8.2	10.8	88.5	26.1	214.0
Crane Bms.	35×96	3.4	10.3	35.0	26.1	88.7
Gas Engines	3×6,000	18.0	6.8	122.5	19.0	342.0
Bases	3×6,000	18.0	6.8	122.5	19.0	342.0
Gear Units	3×4,000	12.0	13.5	162.0	19.0	228.0
Pumps	3×8,000	24.0	13.5	324.0	19.0	456.0
		1,059.7		17,241.0		37,624.7

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project: Paderewski Pumping Station — Csb

Computation: Stability of Structure

Computed by: E.M.V. Checked by: Date: Feb. 29, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Description	Dimensions & Unit Weights.	Weight in Kips	Arm "Y"	Moment Abt X-Axis	Arm "X"	Moment Abt Y-Axis
Valves & pipes	3 × 7,800	23.4	18.0	422.0	19.0	444.0
Vol. pump mot.	1,800	1.8	16.8	30.2	41.0	73.8
Conc. base	700	0.7	16.8	11.8	41.0	28.7
Vol. pump	4,000	4.0	16.0	64.0	41.0	164.0
Standby	14,000	14.0	9.0	126.0	35.0	490.0
Conc. base	5,000	5.0	9.0	45.0	35.0	175.0
Switchboard	4,000	4.0	5.5	22.0	44.5	178.0
Crane	4,000	4.0	10.3	41.2	26.1	104.4
Boiler	2,000	2.0	6.0	12.0	37.5	75.0
Boiler Rm. Slab	7.5 × 12.5 × 0.5 × 150	7.0	8.5	59.5	38.3	268.0
Stairs	6.0 × 15.0 × 25.0	2.3	9.5	21.8	46.8	107.5
Water in sump	9.0 × 17.5 × 30.6 × 62.5	303.5	11.0	3340.0	17.6	5350.0
Water on toe	5 × 14.5 × 62.5	4.5	24.5	110.2	24.3	109.2
		376.2		4,3054		7,567.6

$\bar{X} = \frac{109,259.5}{3,796.1} = 28.8'$

$\bar{Y} = \frac{48,605.6}{3,796.1} = 12.8$

Load per lin. ft. of foundation $= \frac{3,796.1}{58.0} = 65.4$ Kips

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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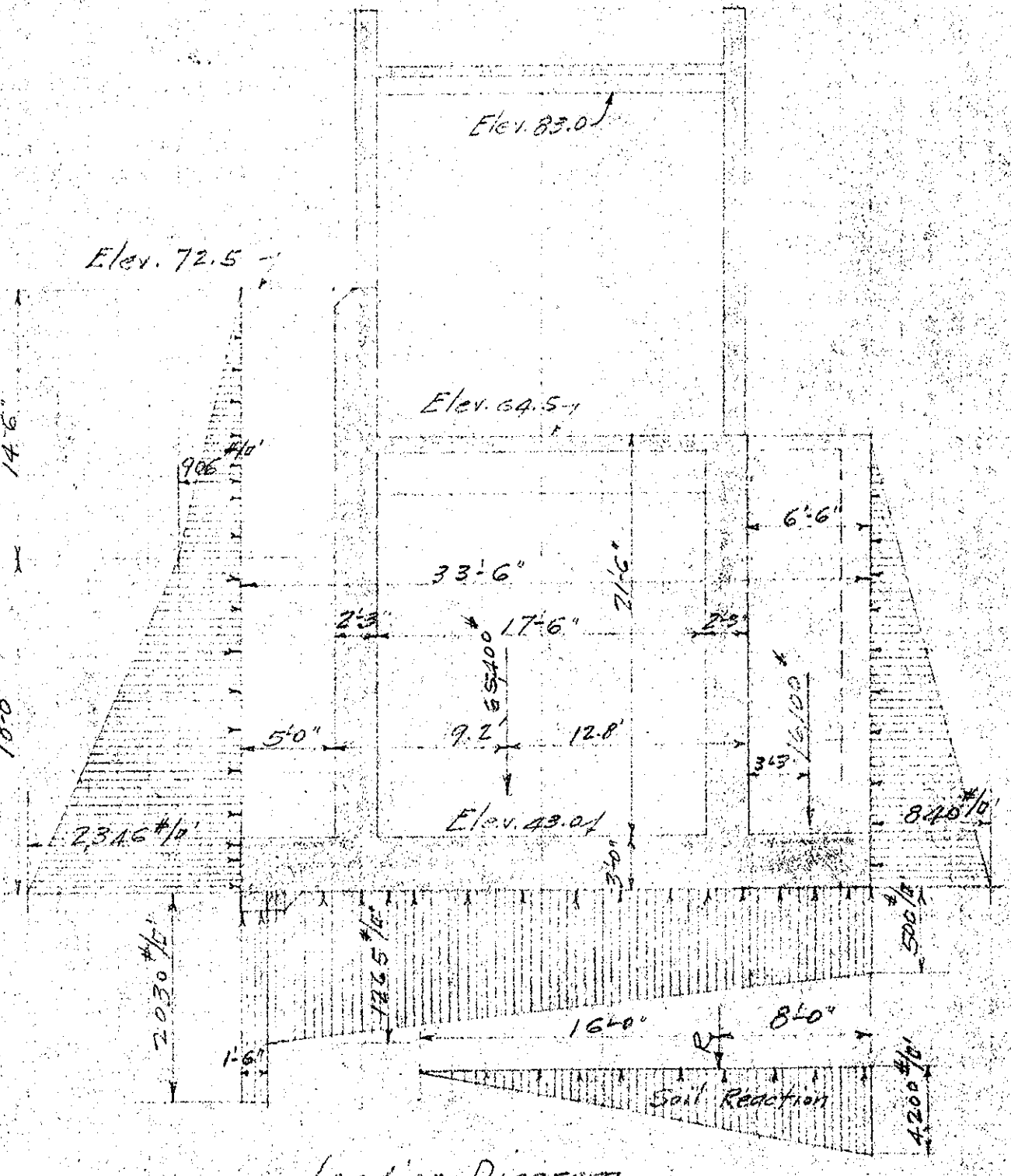
Project Paderewski Pumping Station C5b

Computation Stability of Structure

Computed by E.M.V. Checked by Date March 2, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Loading Diagram

Subject Paderewski Pumping Station C56
Computation Stability of Structure
Computed by E.M.V. Checked by Date March 6, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10523

Forces Acting	↓	↑	→	←	Mom. Arm	Moms. Abt. Riv. Edge ↻	↺
½ × 906 × 14.5			6.6		22.8	150.3	
906 × 18.0			16.3		9.0	146.7	
½ × 1440 × 18.0			13.0		6.0	78.0	
½ × 840 × 24.0				10.1	8.0		80.8
1.5 × 2030		3.0			0.8		2.4
500 × 25.5		12.8			14.3		183.0
½ × 765 × 25.5		9.8			10.0		98.0
Building & Equipment	65.4				14.2	928.0	
		25.6	35.9	10.1		1303.0	364.2

$\Sigma V = 39.8 \downarrow$ $\Sigma H = 25.8 \rightarrow$ $\Sigma M = 938.8 \circlearrowright$

Position of vertical resultant $= \frac{938.8}{39.8} = 24.2'$ to right of riverside edge.

To keep the resultant closer to the center of the base extend the base landward 6'6"; then added load

$= 3.0 \times 6.5 \times 150 + 6.5 \times 21.0 \times 100 = 16,100^{\#}$

Project Poderewski Pumping Station C56.
Computation Stability of Structure
Computed by E.M.V. Checked by Date March 6, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #60)

Forces Acting	↓	↑	→	←	Mom. Arm	Moms. Abt Riv. Edge ↺	↻
½ × 906 × 14.5			6.6		22.8	150.3	
906 × 18.0			16.3		9.0	146.7	
½ × 1440 × 18.0			13.0		6.0	78.0	
½ × 840 × 24.0				10.1	8.0		80.8
1.5 × 2030		3.0			0.8		2.4
500 × 32.0		16.0			17.5		280.0
½ × 765 × 32.0		12.3			12.2		150.0
Bldg & equipment	65.4				14.2	928.0	
Base extension	16.1				30.3	488.0	
	81.5	31.3	35.9	10.1		1,791.0	513.2

$\Sigma V = 50.2$, $\Sigma H = 25.8$, $\Sigma M = 1,277.8$

Position of vertical resultant $= \frac{1277.8}{50.2} = 25.5'$ to right of riverside edge.

Eccentricity $= \frac{33.5}{2} - 25.5 = 8.75'$

Max. soil pressure $\frac{50200}{24} \times 2 = 4,200$ #/□'

$\frac{H}{V} = \frac{25.8}{50.2} = 0.51$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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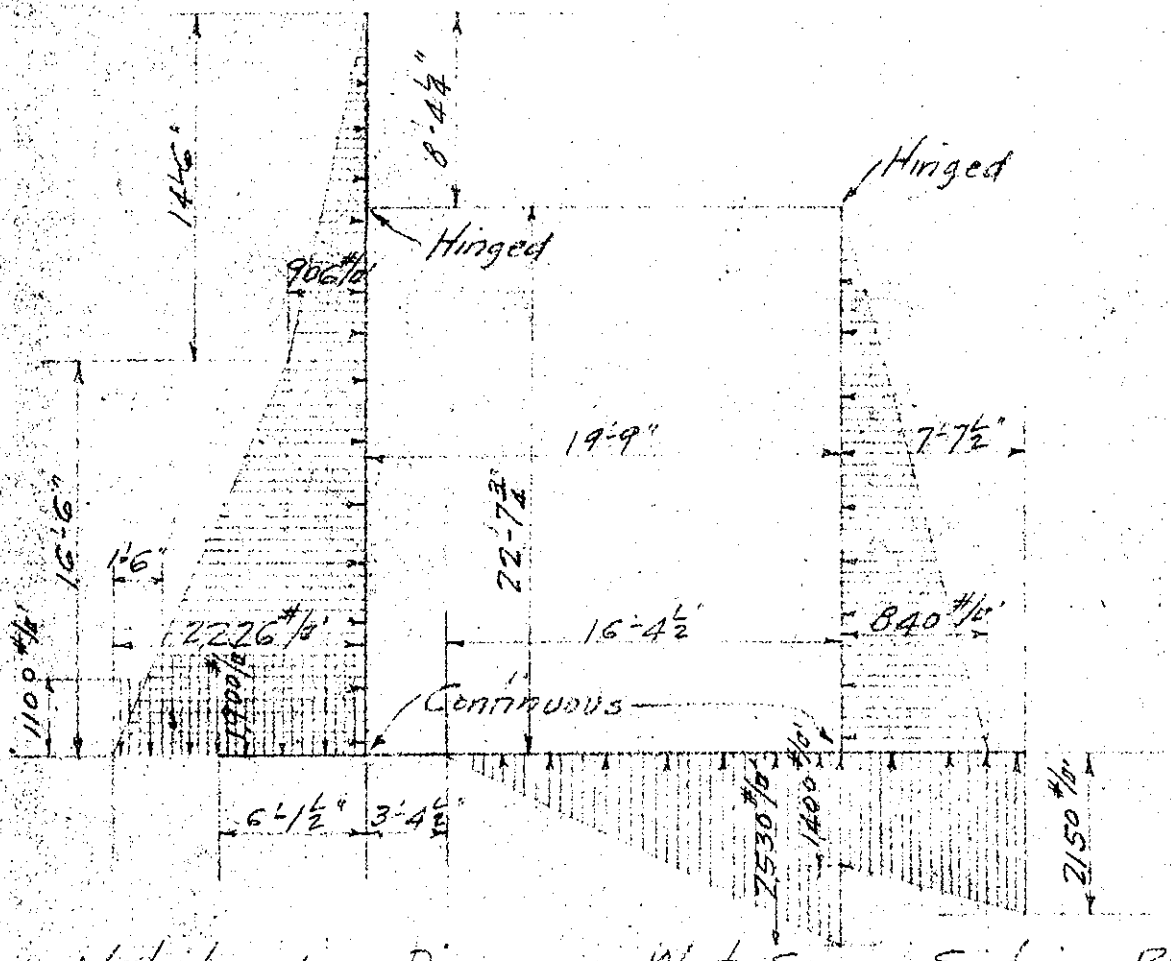
Subject Paderewski Pumping Station C5b

Computation Transverse Section at Wet Sump.

Computed by E. M. V. Checked by _____ Date March 7, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Net Loading Diagram - Wet Sump Section - River Up

I for base slab = 36 × 36 × 36 = 46,600 "⁴ } $\frac{I}{l}$ = 197

l " " " " 237"

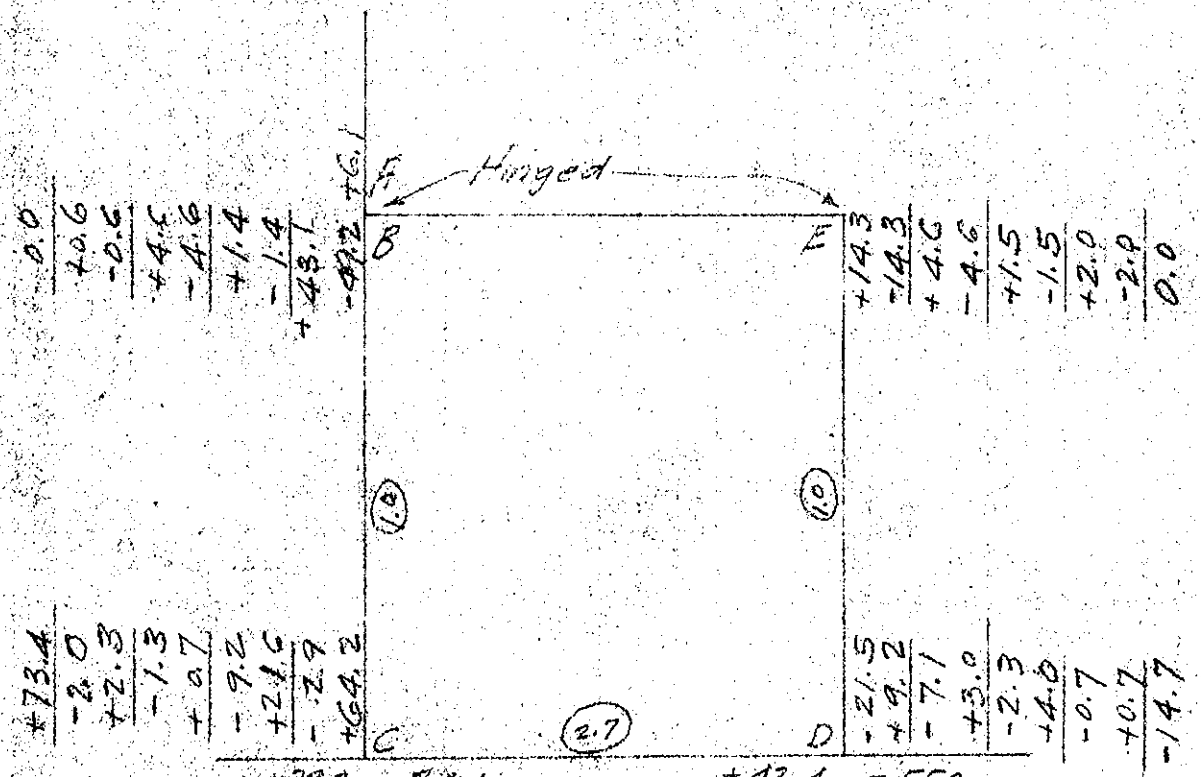
I " walls = 27 × 27 × 27 = 19,620 } $\frac{I}{l}$ = 72

l " " " 272"

Subject Paderewski Pumping Station C5b
Computation Transverse Section at Wet Sump
Computed by E. M. V. Checked by Date March 8, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #62)



-29.2 -24.1 +42.4 -55.0

-24.1	+42.4
-8.0	+24.9
+12.4	-4.0
-24.8	+8.1
+4.0	-12.4
-3.4	+10.7
+5.3	-1.7
-5.6	+1.7
-44.2	+69.7

Moment Distribution Diagram - River Up.

Shear at A $= \frac{1}{2} \times 62.5 \times \overline{8.35}^2 = \underline{2200}$#

" " B $= 522 \times 11.32 + \frac{1}{3} \times 1408 \times 11.32 + \frac{1}{2} \times 296 \times 16.5 \times \frac{5.5}{22.64}$

$+ \frac{6100 - 73,400}{22.64} = \underline{8,800}$ #

" " C for cantilever $= 1100 \times 1.5 + 1900 \times 4.62 = \underline{10,400}$ #

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project Paderewski Pumping Station C56

Computation Transverse Section at Wet Sump

Computed by E.M.V. Checked by Date March 9, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #63)

Shear at C for wall = 21,200#

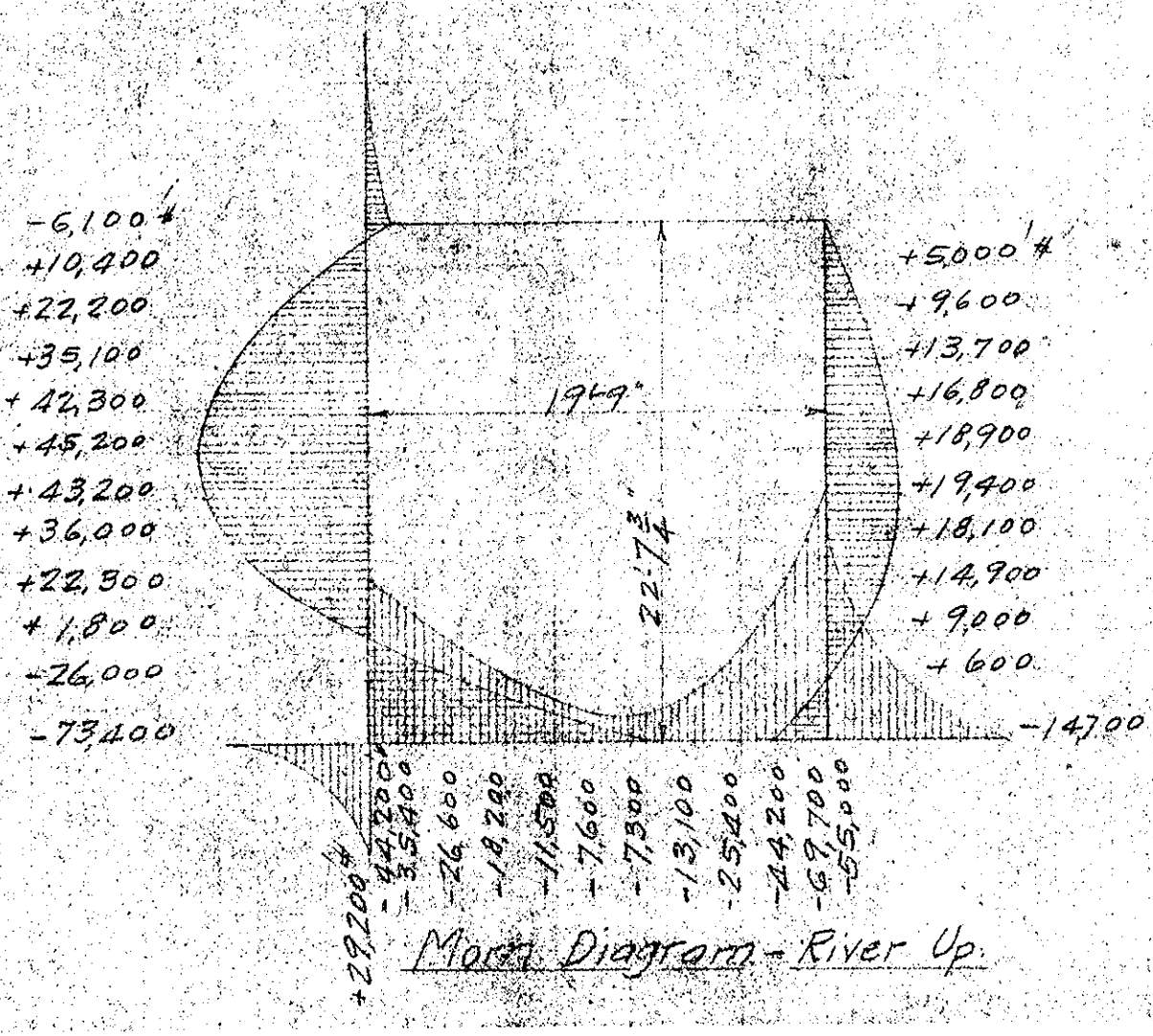
Shear at C for base $= \frac{1}{2} \times 2530 \times 16.37 \times \frac{5.46 - 25500}{19.75} = 4400$#

" " D " " $= \frac{1}{2} \times 2530 \times 16.37 - 4400 = 16,300$#

Shear at D " cantilever $= \frac{1}{2}(1400 + 2150) \times 7.62 = 13,500$#

" " D " wall $= \frac{1}{2} \times 840 \times 22.64 \times \frac{2}{3} + \frac{14700}{22.64} = 7,000$#

" " E " 2,500#



Mom. Diagram - River Up.

WAR DEPARTMENT

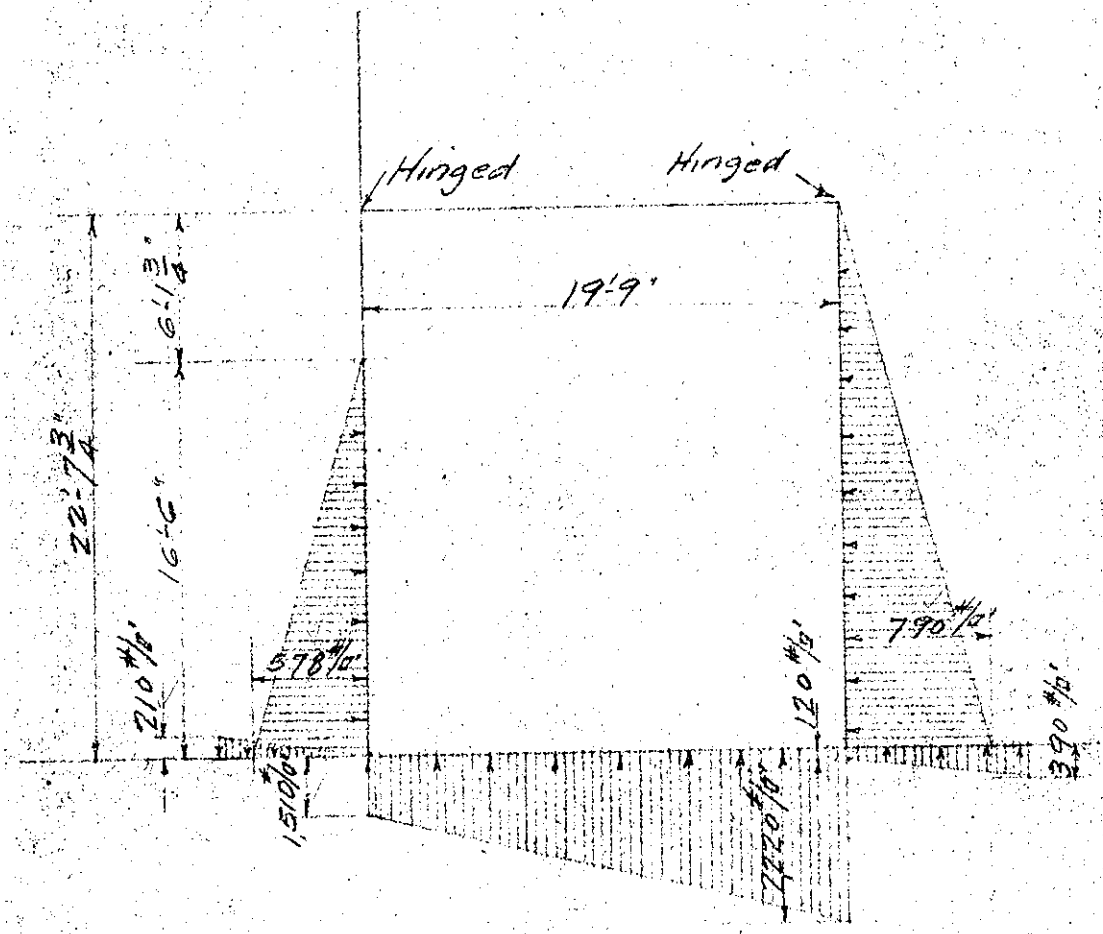
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project Paderewski Pumping Station Csb.

Computation Transverse Section at Wet Sump.

Computed by E.M.V. Checked by Date March 11, 1940

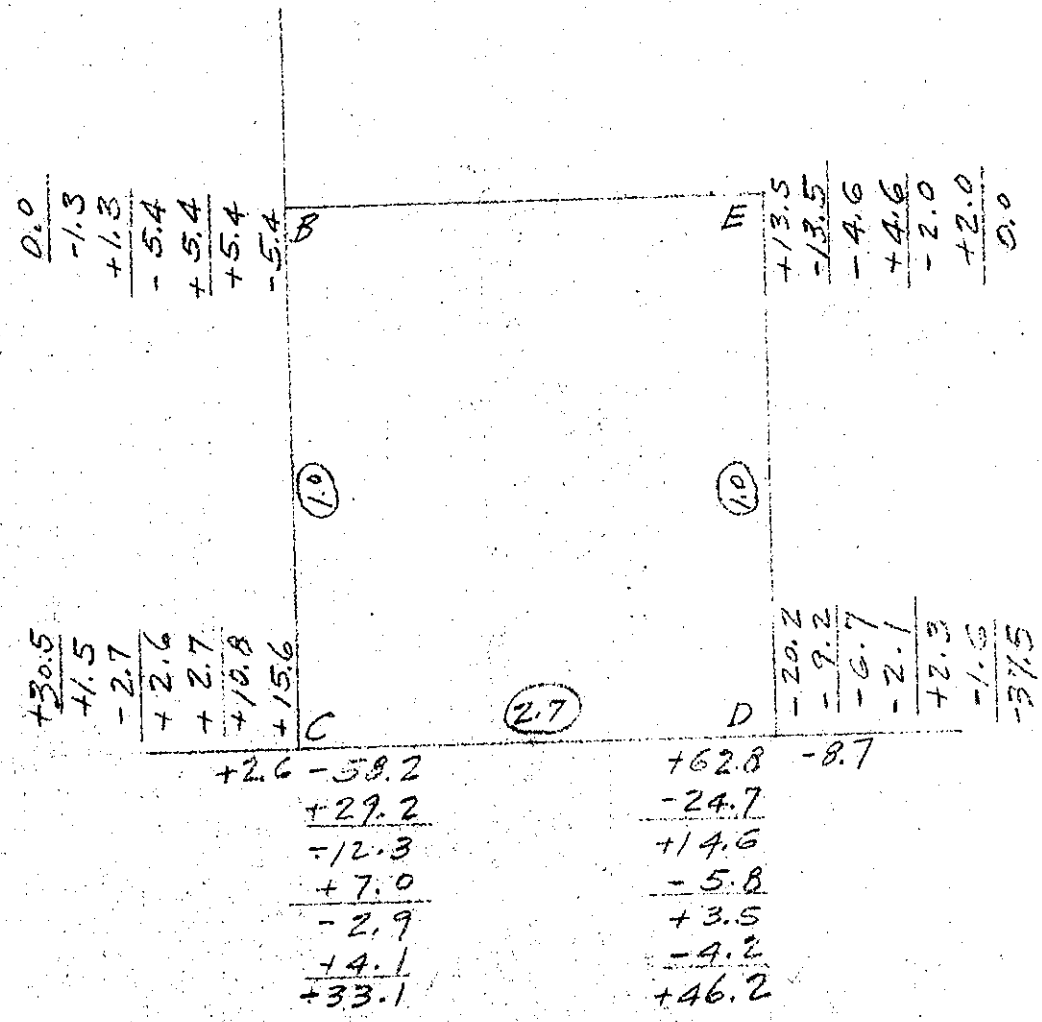
U. S. GOVERNMENT PRINTING OFFICE 3—10528



Net Loading Diagram - Wet Sump - River Down

Subject: Paderewski Pumping Station C5b.
Computation: Transverse Section at Wet Sump
Computed by: E. M. V. Checked by: Date: March 11, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Moment Dist. Diagram - River Down.

Shear at "B" = $\left[\frac{1}{2} \times 578 \frac{(16.5)^2}{3} - 30{,}500\right] \frac{1}{22.64}$ = $-190^{\#}$

" " C for wall = $\frac{1}{2} \times 578 \times 16.5 + 190$ = $+4950^{\#}$

" " C for slab = $1{,}510 \times 9.67 + \frac{1}{3} \times \frac{1}{2} \times 710 \times 19.75 - \frac{13100}{19.75}$ = $16500^{\#}$

= $20{,}200^{\#}$

" " D " " "

" " D " wall = $\frac{1}{2} \times \frac{2}{3} \times 790 \times 22.64 + \frac{37500}{22.64}$ = $7700^{\#}$

= $1300^{\#}$

" " E " " "

WAR DEPARTMENT

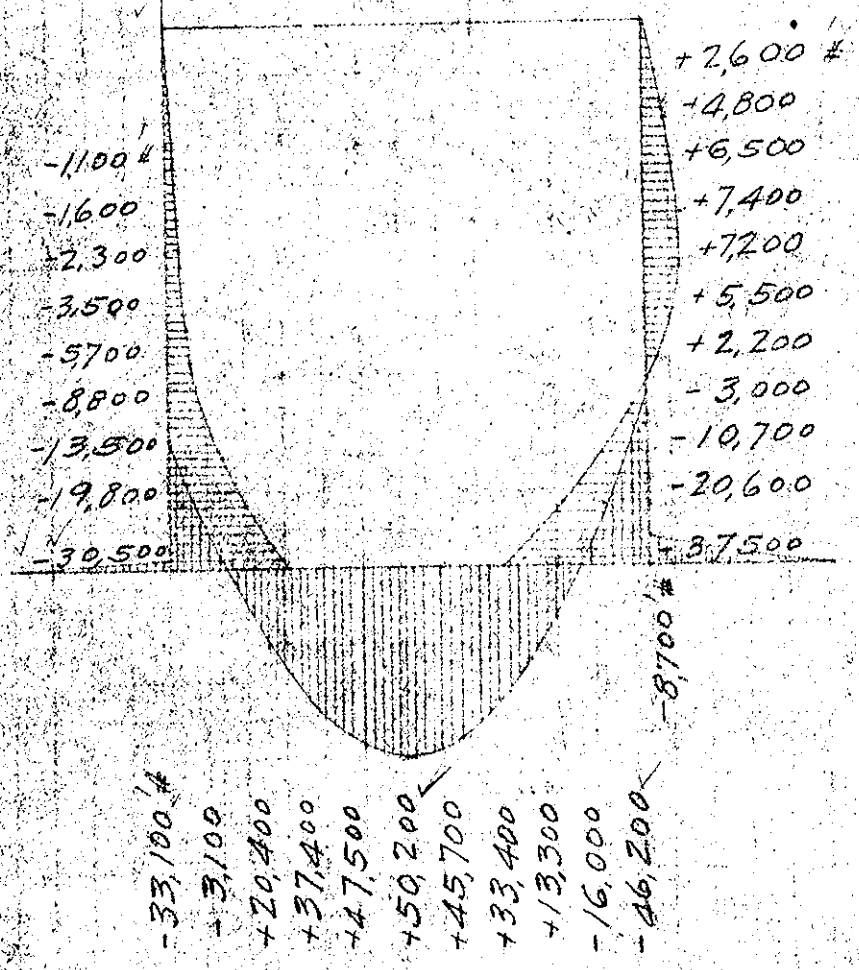
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Paderewski Pumping Station C.6b.

Computation Transverse Section at Wet Sump

Computed by E.M.V. Checked by ..... Date March 11, 1940.

U. S. GOVERNMENT PRINTING OFFICE 2—10538

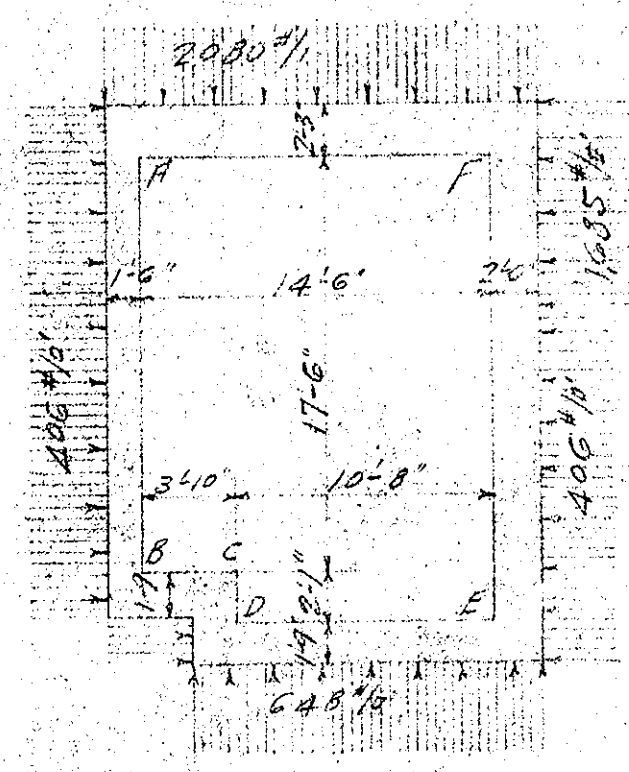


Bending Mom. Diagram - River Down.

Subject Paderewski Pumping Station C5b
Computation Dry Pump Room
Computed by F. M. V. Checked by ..... Date March 12, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

It is assumed that the 4-walls of the dry pump room will form a continuous rectangular horizontal frame. Where the sluice gate chamber meets the pump room wall, the sluice gate chamber is figured integrally with the pump room frame.



Loading Diagram at Elev. 45.5

$\begin{cases} I \text{ for } A\text{-}B = (18.0)^3 = 5830^{in^4} \\ \frac{I}{l} \text{ " " } = \frac{5830}{234} = 25 \end{cases}$

$\begin{cases} I \text{ for } B\text{-}C = (21.0)^3 = 9250^{in^4} \\ \frac{I}{l} \text{ " " } = \frac{9250}{45} = 205 \end{cases}$

$\begin{cases} I \text{ " } C\text{-}D = 9250^{in^4} \\ \frac{I}{l} \text{ " " } = \frac{9250}{25} = 370 \end{cases}$

$\begin{cases} I \text{ " } D\text{-}E = 9250^{in^4} \\ \frac{I}{l} \text{ " " } = \frac{9250}{151} = 61 \end{cases}$

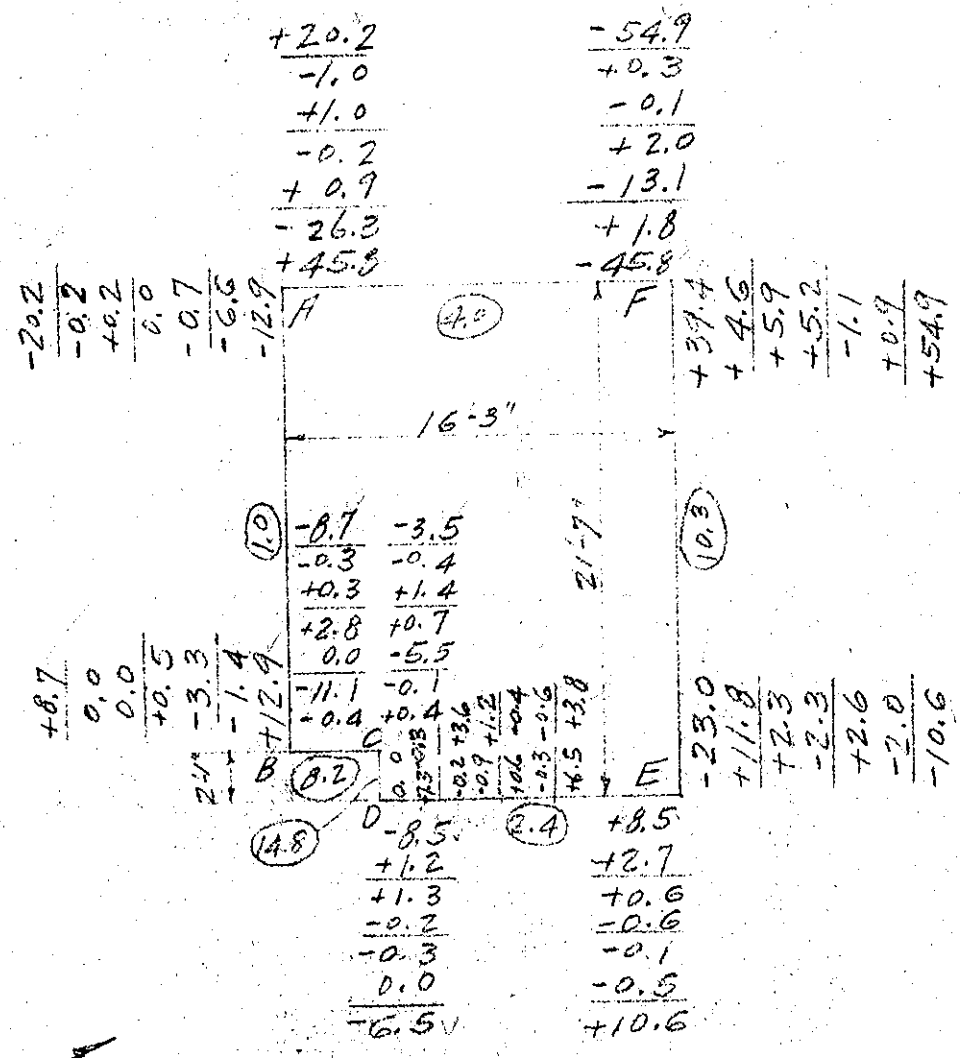
$\begin{cases} I \text{ " } E\text{-}F = (24.0)^3 = 13{,}800 \\ \frac{I}{l} \text{ " " } = \frac{13800}{259} = 53 \end{cases}$

$\begin{cases} I \text{ " } F\text{-}A = (27.0)^3 = 19{,}670 \\ \frac{I}{l} \text{ " " } = \frac{19670}{195} = 101 \end{cases}$

Subject Paderewski Pumping Station C5b.
Computation Dry Pump Room
Computed by E. M. V. Checked by Date March 12, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10523

(Continued from sheet #68)



Mom. Distribution Diagram - Elev. 45.5

Member A-B. Shear at "A" = 4,600#

" " B = 3,400

Member B-C: " " B = 3,200

" " C = 3,200

" C-D " " C = 5,100

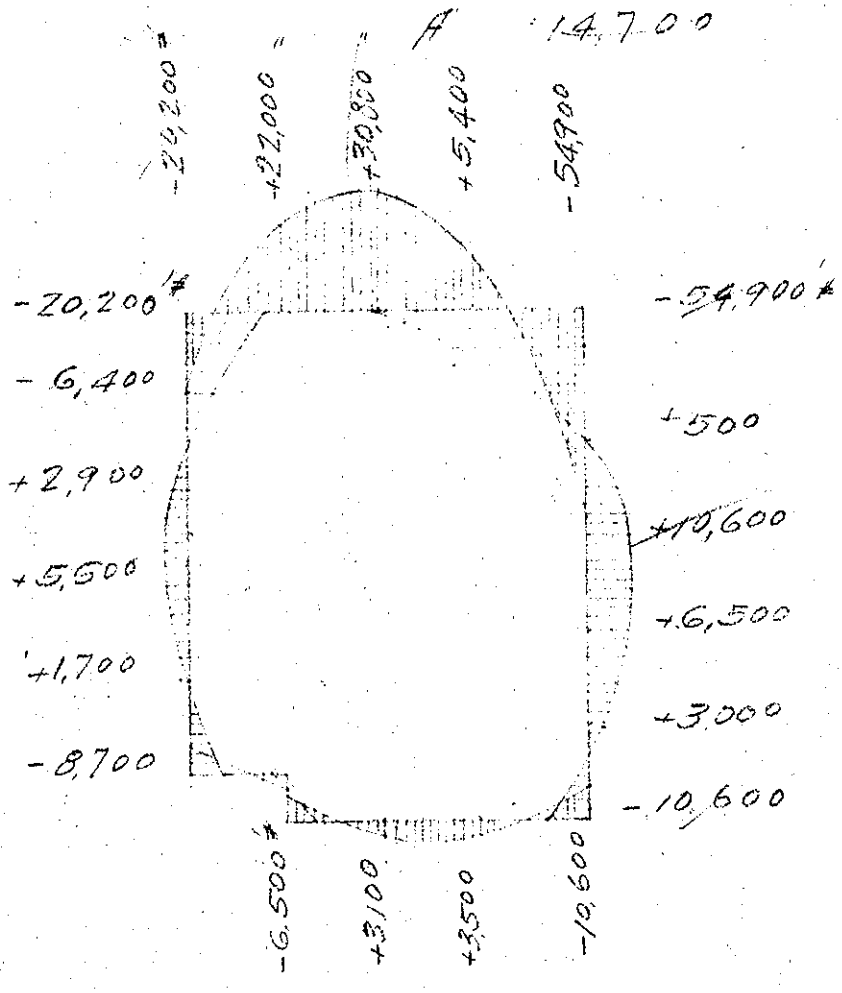
" " D = 5,100

Subject Paderewski Pumping Station
Computation Dry Pump Room
Computed by E. M. V. Checked by Date March 12, 1940

U. S. GOVERNMENT PRINTING OFFICE 2—10528

(Continued from sheet # 69)

Member D-E	Shear at D	=	3,800#
	" " E	=	4,400
" E-F	" " E	=	4,200
	" " F	=	14,800
" F-A	" " F	=	18,900
	" " A	=	14,700



Bending Mom. Diag. - Elev. 45.5

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

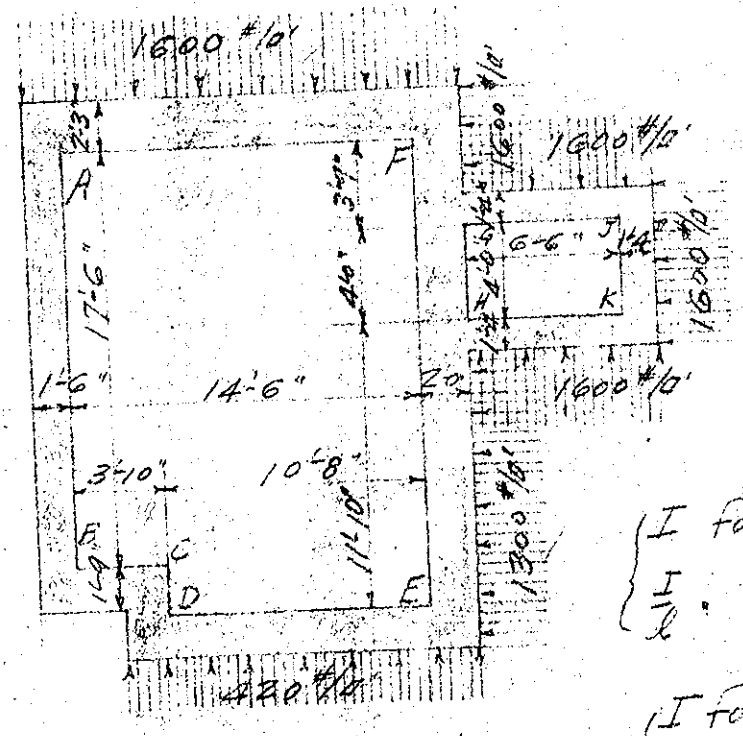
Subject: Paderewski Pumping Station

Computation: Dry Pump Room — Date: March 13, 1940

Computed by: E.M.Y. — Checked by:

U. S. GOVERNMENT PRINTING OFFICE 3—10628

Horizontal section in dry pump room at Elev. 52.0



Loading Diagram at Elev. 52.0

I for G-J & H-K $= (16.0)^3 = 4096''^4$

$\frac{I}{l}$ " " " " $= \frac{4096}{98} = 42$

I for J-K $= 4,096''^4$

$\frac{I}{l} = \frac{4096}{64} = 64$

$\frac{I}{l}$ for F-G $= \frac{13800}{50} = 276$

" " G-H $= \frac{13800}{64} = 215$

" " H-E $= \frac{13800}{146} = 95$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

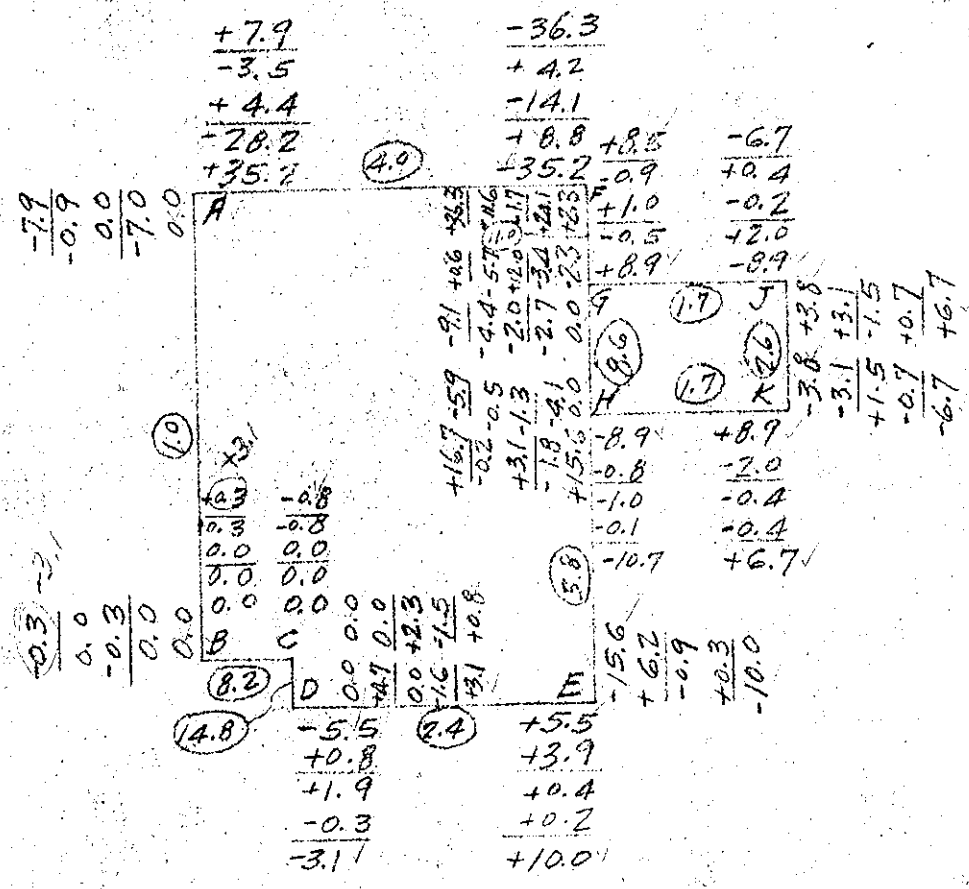
Subject: Paderewski Pumping Station

Computation: Dry Pump Room

Computed by: E.M.V. Checked by: Date: March 13, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10538

(Continued from sheet #71)



Mom. Distribution Diagram - Elev. 52.0

Member A-B.	Shear at	A	=	565 #
	" "	B	=	400
" B-C.	" "	B	=	130
	" "	C	=	130
" C-D	" "	C	=	1,900
	" "	D	=	1,900

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Dry Pump Room.

Computed by: E.M.V. Checked by: Date: March 14, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10538

(Continued from sheet #72)

Member	D-E	Shear at	D	=	2,100#
		" "	E	=	3,200
"	E-H	" "	E	=	7,200#
		" "	H	=	8,400
"	H-G	" "	H	=	~~2,800~~ 580
		" "	G	=	~~2,800~~ 580
"	G-F	" "	G	=	5,200
		" "	F	=	11,900
"	H-K	" "	H	=	~~7,200~~ 7000
		" "	K	=	~~6,200~~ 6100
"	K-J	" "	K	=	4300
		" "	J	=	4,300
"	J-G	" "	J	=	~~6,200~~ 6100
		" "	G	=	~~7,200~~ 6800
"	F-A	" "	F	=	~~15,100~~ 14800
		" "	A	=	~~10,900~~ 11200

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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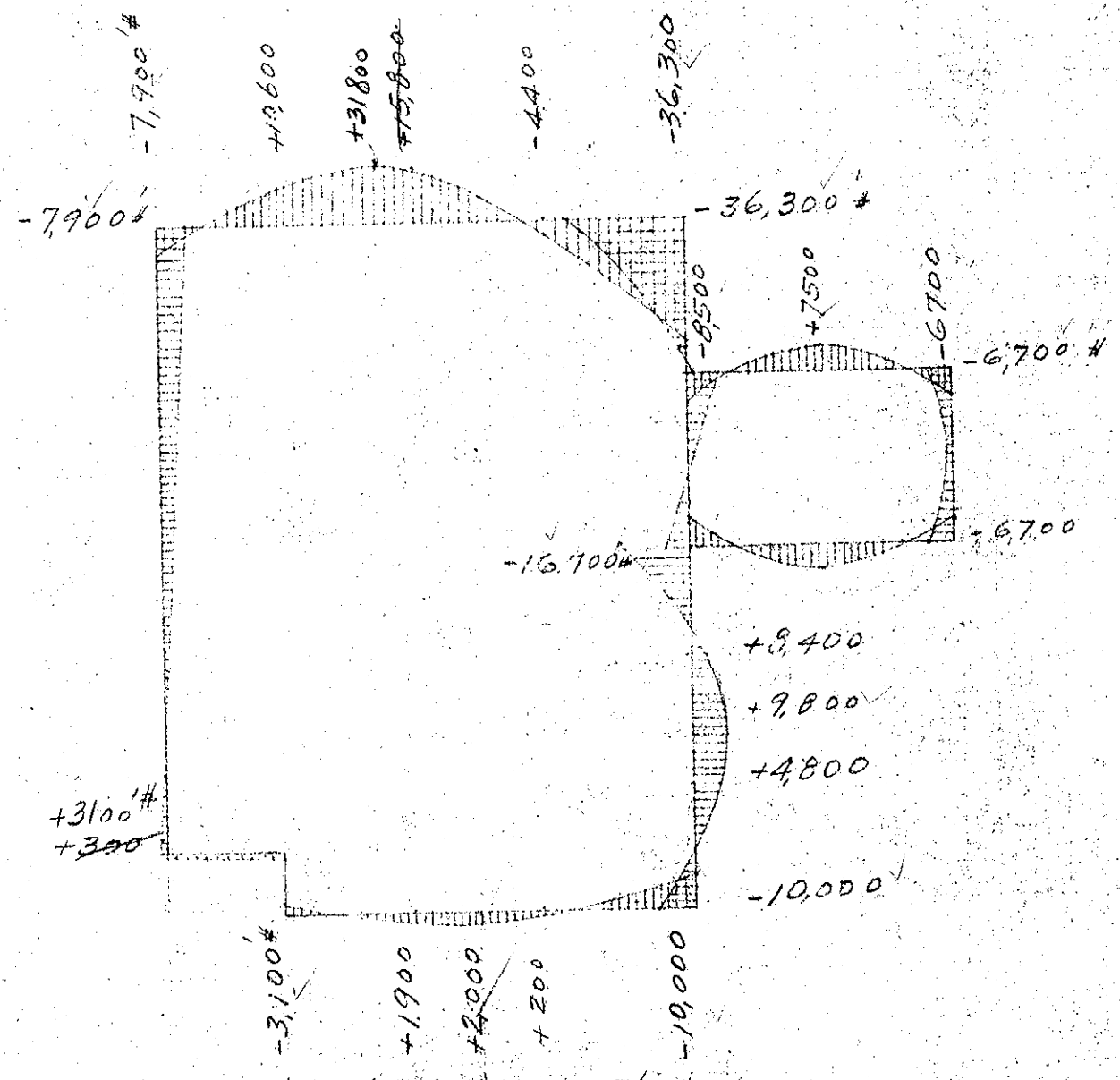
Subject Paderewski Pumping Station - Csb

Computation Dry Pump Room

Computed by E. M.V. Checked by Date March 14, 1940

U.S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet # 73)



Bending Moment Diagram - Elev. 52.0

Note:- Bending moments between Elev. 52.0 and Elev. 64.5 are proportional to height.

Project Paderewski Pumping Station
Computation Design of Substructure Sections.
Computed by E. M. V. Checked by Date March 14, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of transverse section of wet sump -

1. Riverside wall -

Max. pos. mom. = 45,200'#, when river is up.
" neg. " = 73,400'#, " " " "

2. Landside wall -

Max. pos. mom. = 19,400'#, when river is up.
" neg. " = 37,500'# " " " down.

3. Base slab -

Max. pos. mom. = 50,200'# when river is down
" neg. " = 69,700'# " " " up.

Base slab, $d = \sqrt{\frac{69700}{122.8}} = 23.8''$

Make base slab 3'-0" thk. "d" = 31.5"

Unit shear $= \frac{16300}{12 \times \frac{7}{8} \times 31.5} = 49\#/\square''$ O.K.

A_s for pos. mom. $\frac{50,200 \times 12}{\frac{7}{8} \times 31.5 \times 18,000} = 1.21\square''$

A_s for neg. mom. at riverside $= \frac{44,200 \times 12}{\frac{7}{8} \times 31.5 \times 18,000} = 1.06\square''$

" " " " " landside $= \frac{69700 \times 12}{\frac{7}{8} \times 31.5 \times 18,000} = 1.68\square''$

Subject: Paderewski Pumping Station
Computation: Design of Substructure Section
Computed by: E. M. V. Checked by: Date: March 14, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10529

(Continued from sheet # 75)

A_s for riverside cantilever $= \frac{29200 \times 12}{\frac{7}{8} \times 31.5 \times 18{,}000} = 0.70\square''$

" " landside " $= \frac{55000}{\frac{7}{8} \times 31.5 \times 18{,}000} = 1.32\square''$

For pos. mom. use $1\frac{1}{8}''\square$ bars 1'-0" c.c. = $1.26\square''$, hooked.

For neg. mom., riverside, use $1''\square$ bars 1'-0" c.c. = $1.00\square''$

" " " landside " $1''\square$ & $\frac{7}{8}''\phi$, each 12" c.c., alt.

and extend to end of cantilever.

Riverside wall, shear at bot. of wall = 21,200#; bending mom. at base of wall $= 73{,}400 - 21{,}200 \times \frac{0.4 \times 31.5}{2 \times 12} = 62{,}300$ #

$d = \sqrt{\frac{62300}{122.8}} = 22.5''$

Make wall 2'-3" thk $d = 23.5''$.

Unit shear $= \frac{21200}{12 \times \frac{7}{8} \times 23.5} = 86$ #/□" O.K. since wall steel will be provided with special anchorage.

A_s for pos. mom. $= \frac{45{,}200 \times 12}{\frac{7}{8} \times 23.5 \times 18000} = 1.46\square''$

A_s for neg. mom. $= \frac{73{,}400 \times 12}{\frac{7}{8} \times 23.5 \times 18{,}000} = 2.37\square''$

For pos. mom. use $1\frac{1}{8}''\square$ bars $10\frac{1}{2}$" c.c.

For neg. mom. bend up $1''\square$ @ 12" c.c. from base and add $1\frac{1}{8}''\square$ @ 12" c.c. to stagger with the $1''\square$. Extend the

Subject: Paderewski Pumping Station
Computation: Design of Substructure Sections
Computed by: E. M. V. Checked by: Date: March 14, 1940

U. S. GOVERNMENT PRINTING OFFICE 8—10538

(Continued from sheet # 76)

$1\frac{1}{8}$" bars down into the base slab and hook, extend up into the wall 9'9" from bottom of base slab.

Landside wall; mom. at base of wall = -37,500 #

$d = \sqrt{\frac{37,500}{122.8}} = 17.5$" Make wall 19" thk.

A_s for pos. mom. $= \frac{19400 \times 12}{\frac{7}{8} \times 17.5 \times 18,000} = 0.85$ □"/'

A_s for neg. mom. $= \frac{37500 \times 12}{\frac{7}{8} \times 17.5 \times 18,000} = 1.63$ □"/'

Use 1"φ bars @ 12" c.c. for pos. mom.

Use 1"φ " @ 6" c.c. for neg. mom.

Unit shear $= \frac{7700}{12 \times \frac{7}{8} \times 17.5} = 42$ #/□" O.K.

Unit bond stress $= \frac{7700}{2 \times 3.14 \times \frac{7}{8} \times 17.5} = 80$ #/□" O.K.

WAR DEPARTMENT

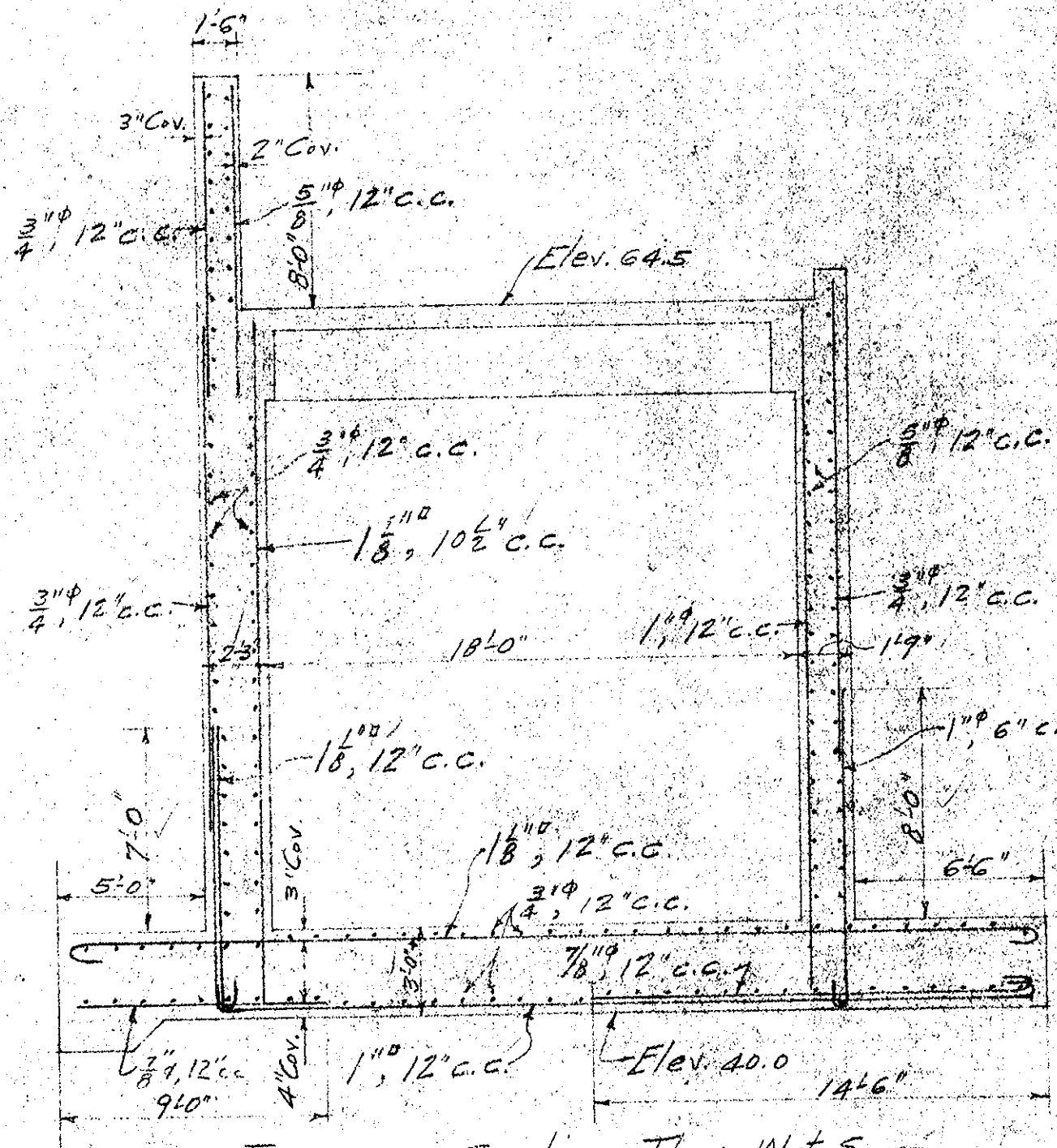
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Design of Substructure Sections

Computed by: E. M. V. Checked by: Date: March 14, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10023



Transverse Section Thru Wet Sump

Subject Paderewski Pumping Station C56
Computation Design of Substructure Sections
Computed by E.M.Y. Checked by Date March 15, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10525

Design of horizontal sections - dry pump room - Elev. 42.5°

1. Wall between wet sump and dry pump room.

Max. pos. moment = 5,500'#

" neg. " = 20,200'#

" shear = 4,600#

$d = \sqrt{\frac{20,200}{123}} = 12.8''$. Make wall 1'-6" thk. d = 14.5"

Unit shear $= \frac{4600}{12 \times \frac{7}{8} \times 14.5} = 30\#/\square''$ O.K.

A_s for pos. mom. $= \frac{5,500 \times 12}{\frac{7}{8} \times 14.5 \times 18,000} = 0.29\square''$

A_s for neg. mom., riverside, $= \frac{20,200 \times 12}{\frac{7}{8} \times 14.5 \times 18,000} = 1.06\square''$

A_s for neg. " , landside, $= \frac{8,700 \times 12}{\frac{7}{8} \times 14.5 \times 18,000} = 0.46\square''$

Use $\frac{5}{8}$"φ bars 12" c.c. in face in dry pump room.

Use $\frac{3}{4}$"φ " 12" " " " " wet sump.

Use $\frac{7}{8}$"φ " 12" " " for neg. mom. at river end and stagger with $\frac{3}{4}$"φ bars.

Use $\frac{5}{8}$"φ, 12" c.c. for neg. mom. at landside end.

Sub't Paderewski Pumping Station, Csb.
Computation Design of Substructure Sections
Computed by E.M.V. Checked by Date March 15, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #79)

2. Riverside Wall.

Max. pos. mom. = 30,800#

Max. neg. " = 54,900#

" shear = 18,900#

$d = \sqrt{\frac{54900}{123}} = 21.1''$. Make wall 2'-3" thk., d = 23.5"

Unit shear = $\frac{18,900}{12 \times \frac{7}{8} \times 23.5} = 77$ #/□" O.K.

A_s for pos. mom. = $\frac{30,800 \times 12}{\frac{7}{8} \times 23.5 \times 18,000} = 1.00$ □"

A_s " neg. mom. = $\frac{54900 \times 12}{\frac{7}{8} \times 23.5 \times 18,000} = 1.78$ □"

A_s " " " at end near wet sump = $\frac{20,200 \times 12}{\frac{7}{8} \times 23.5 \times 18,000} = 0.65$ □"

For pos. mom. use 1"□ bars 12" c.c.

" max. neg. mom. use 1"□ bars 6" c.c.

" neg. mom. at wet sump end use $\frac{7}{8}$"Φ bars 12" c.c.

Subject: Paderewski Pumping Station
Computation: Design of Substructure Sections
Computed by: E. M. V. Checked by: Date: March 15, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10628

(Continued from sheet # 80)

3. Wall next to conduit.

Max. pos. mom. = 11,000#
" neg. " = 54,900#.
" shear = 14,800#.

A_s for pos. mom. = $\frac{11,000 \times 12}{\frac{7}{8} \times 20.5 \times 18,000} = 0.41\square''$

A_s for neg. mom. at river end = $\frac{54,900 \times 12}{\frac{7}{8} \times 20.5 \times 18,000} = 2.04\square''$

A_s for neg. mom. at landside end = $\frac{10,600 \times 12}{\frac{7}{8} \times 20.5 \times 18,000} = 0.40\square''$

For pos. mom. use $\frac{3}{4}''\phi$, 12" c.c.
" neg. " at river end use 1"□ bars 6" c.c.
" " " " landside end use $\frac{3}{4}''\phi$ bars 12" c.c.

4. Landside wall.

Max. pos. mom. = 3,500#
" neg. " = 10,600#
" shear = 4,400#

Use $5/8''\phi$ bars 12" c.c. for pos. mom.
Use $3/4''\phi$ bars 12" " " neg. mom.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

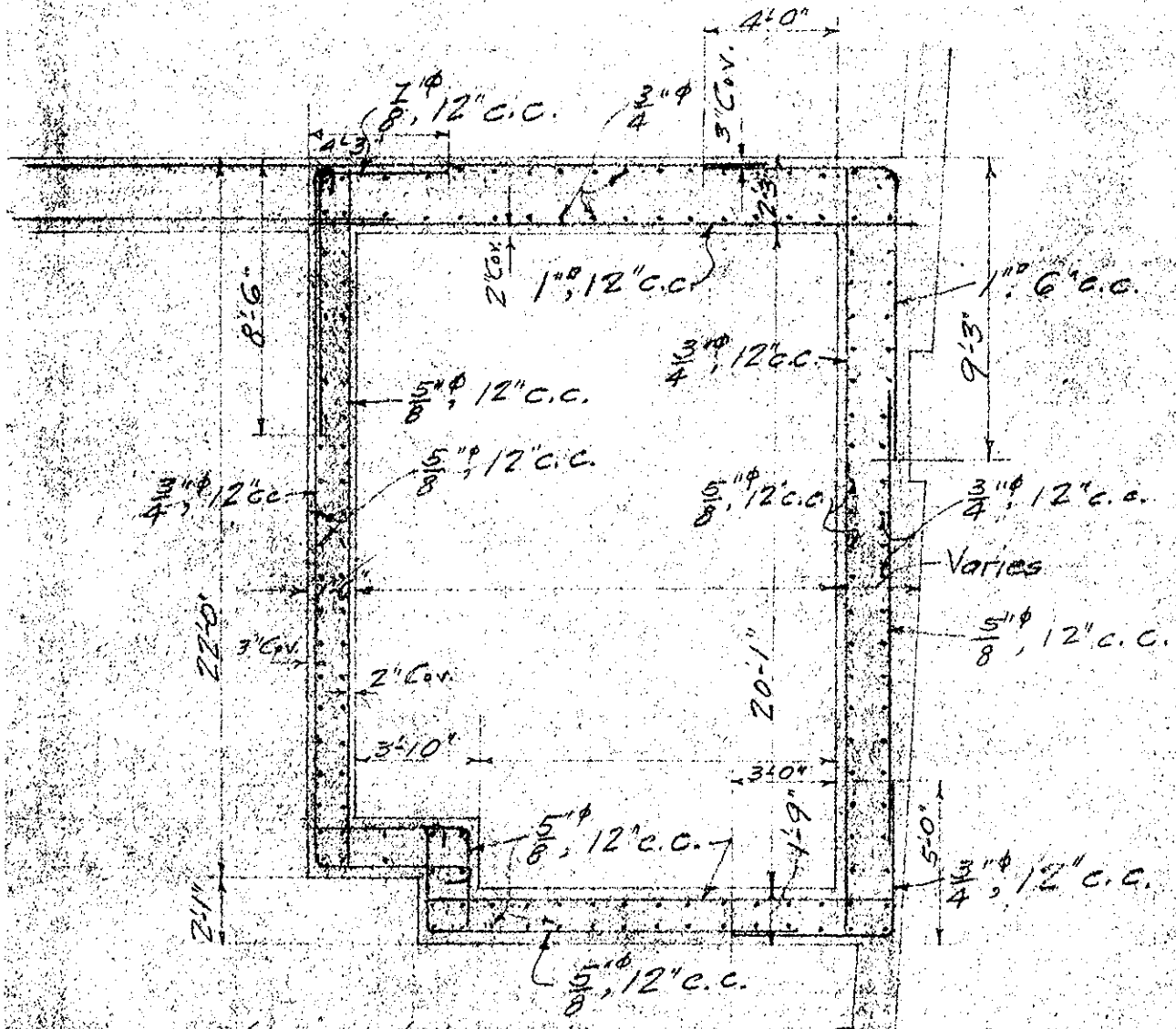
Subject: Paderewski Pumping Station

Computation: Design of Substructure Sections

Computed by: E. M. V. Checked by: Date: March 15, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10628

Design of horizontal section in dry pump room at El. 45.5



Horizontal Section in Dry Pump Room

From Elev. 43.0 to Elev. 49.5

Subject Paderewski Pumping Station Csb
Computation Design of Substructure Sections
Computed by E.M.V. Checked by Date March 15, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of horizontal sections - dry pump room - Elev. 52.0

1. Wall between wet sump and dry pump room.

Max. mom. = 7,900'#

$A_s = \frac{7,900 \times 12}{\frac{7}{8} \times 14.5 \times 18,000} = 0.42 \square''$

Use $\frac{3}{4}''\phi$ bars 12" c.c. on wet sump side

" $\frac{5}{8}''\phi$ " 12" c.c. " dry pump room side.

2. Riverside wall.

Max. pos. mom. = ~~15,800'#~~ 31,800'#

" neg. " = 36,300'#

A_s for pos. mom. = $\frac{\cancel{15,800}\ 31,800 \times 12}{\frac{7}{8} \times 23.5 \times 18,000} = \cancel{0.51}\ 1.02 \square''$

A_s for neg. mom. = $\frac{36,300 \times 12}{\frac{7}{8} \times 23.5 \times 18,000} = 1.18 \square''$

Use $1''\square$ $\frac{1}{8}''\phi$ bars 12" c.c. for pos. mom.

Use $\frac{7}{8}''\phi$ bars 6" c.c. for neg. mom.

Subject Paderewski Pumping Station, Csb
Computation Design of Substructure Sections
Computed by E.M.V. Checked by Date March 15, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10638

(Continued from sheet #83)

3. Wall next to conduit

Max. pos. mom. = 9,800#

" neg. " = 36,300#

A_s for pos. mom. $= \frac{9800 \times 12}{\frac{7}{8} \times 20.5 \times 18{,}000} = 0.36\square''$

A_s for neg. mom. at river end $= \frac{36{,}300 \times 12}{\frac{7}{8} \times 20.5 \times 18{,}000} = 1.35\square''$

A_s for " " " gate chamber $= \frac{16{,}700 \times 12}{\frac{7}{8} \times 20.5 \times 18{,}000} = 0.62\square''$

A_s " " " " landside end $= \frac{10{,}000 \times 12}{\frac{7}{8} \times 20.5 \times 18{,}000} = 0.37\square''$

Use $\frac{3}{4}''\phi$ bars 12" c.c. for pos. mom.

Use $\frac{7}{8}''\phi$ " 6" " " neg. " at river end.

" $\frac{7}{8}''\phi$ " 12" " " " " " gate chamber

" $\frac{3}{4}''\phi$ " 12" " " " " landside end.

4. Landside wall

Use $\frac{3}{4}''\phi$ bars 12" c.c. for neg. mom. at conduit end.

" $\frac{5}{8}''\phi$ " 12" all other points.

Subject Paderewski Pumping Station. C5b.
Computation Design of Substructure Sections.
Computed by E.M.V. Checked by Date March 15, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10523

(Continued from sheet #84)

5. Gate chamber walls.

Max. pos. mom. = 7,500 #
" neg. " = 8500 #
" shear = 7,200 #

$d = \sqrt{\frac{8500}{123}} = 8.3''$ Make walls 16" thk; d = 12.5"

Unit shear $= \frac{7200}{12 \times \frac{7}{8} \times 12.5} = 55\#/\square''$ O.K.

A_s for pos. mom. $= \frac{7500 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.46\square''$

A_s for neg. mom. $= \frac{8500 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.52\square''$

Use $\frac{3}{4}''\phi$ bars 12" c.c. for pos. & neg. moments.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Design of Substructure Sections

Computed by: E. M. V. Checked by: Date: March 16, 1940.

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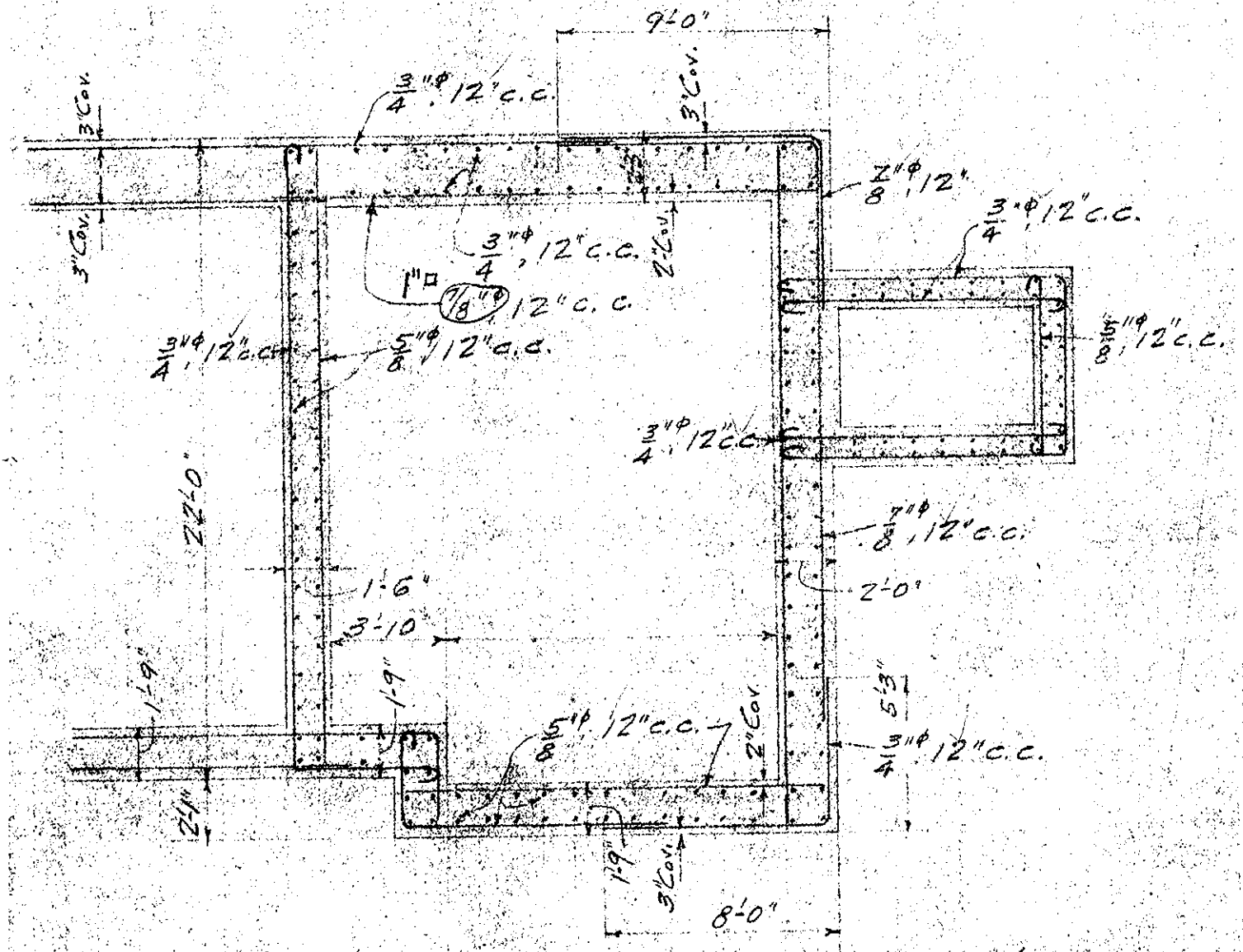


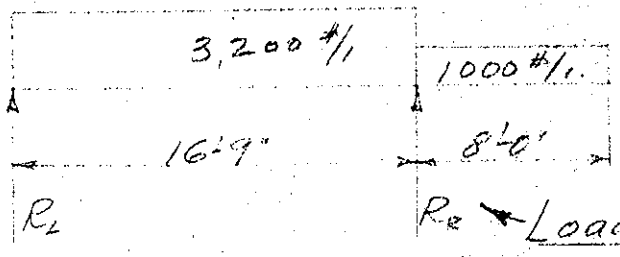
Horizontal Section in Dry Pump Room-Elev. 52.0

Subject: Paderewski Pumping Station
Computation: Base Slab in Dry Pump Room
Computed by: E.M.V. Checked by: Date: March 18, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10523

It is assumed that the base slab in the dry pump room spans from the division wall between the wet and dry pump rooms to the end wall next to the conduit.

Max. load on slab = 3,200 #/□'
Min. " " " = 1,510 #/□'



Loading Diagram for Max. Loading

$R_L = \frac{3200 \times 16.75 \times 8.37 - 1000 \times 8.0 \times 4.0}{16.75} = 24{,}900\#$

$R_R = 28{,}700\#$

Assuming simple supports.

Max. pos. mom. $= 24{,}900 \times \frac{7.8}{2} = 97{,}200$ '#

Max. neg. " $= 1{,}000 \times 8.0 \times 4.0 = 32{,}000$ '#

Max. shear $= 24{,}900\#$

Effective depth $= \sqrt{\frac{97200}{12 \times 3}} = 28.1''$. Use 31.5"

Unit shear $= \frac{24900}{12 \times \frac{7}{8} \times 31.5} = 75$ #/□"

Subject Paderewski Pumping Station
Computation Base Slab in Dry Pump Room
Computed by E.M.V. Checked by Date March 18, 1940.

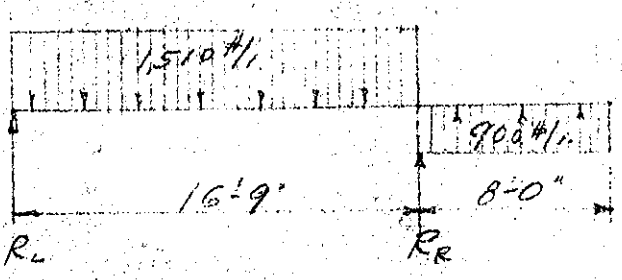
U. S. GOVERNMENT PRINTING OFFICE 3—10633

(Continued from sheet #87)

A_s for pos. mom. $= \dfrac{97200 \times 12}{\frac{7}{8} \times 31.5 \times 18000} = 2.36''^2$

A_s for neg. mom. $= \dfrac{32000 \times 12}{\frac{7}{8} \times 31.5 \times 18000} = 0.77''^2$

For max. load.



Loading Diag. for Min. Loading

$R_L = 1510 \times 8.37 + 900 \times 8.0 \times \dfrac{4.0}{16.75} = 14,300\#$

$R_R = 800\#$

Max. mom. $= 14300 \times \dfrac{9.5}{2} = 68,000'\#$

Cantilever mom. $= 900 \times 8.0 \times 4.0 = 28,800'\#$

A_s for pos. mom. $= \dfrac{68000 \times 12}{\frac{7}{8} \times 31.5 \times 18000} = 1.64''^2$

A_s for cantilever mom. $= \dfrac{28800 \times 12}{\frac{7}{8} \times 31.5 \times 18000} = 0.70''^2$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Base Slab in Dry Pump Room

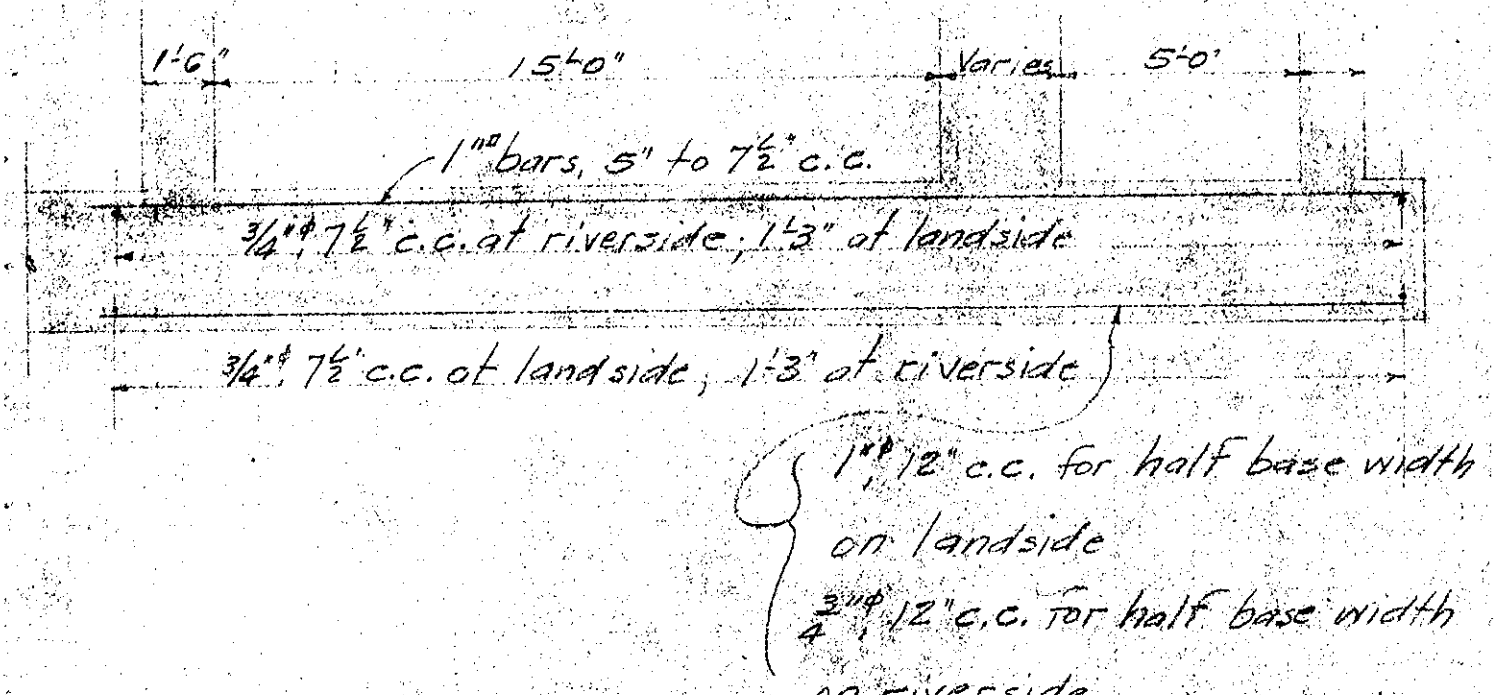
Computed by: ..... Checked by: ..... Date: March 18, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #88)

For pos. mom. use 1" bars and vary spacing from 5" at landside to 7½" at riverside.

For neg. mom. use ¾" bars; vary spacing from 7" c.c. to 12" c.c.



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Horizontal Bms. to Resist Hydrostatic Thrust.

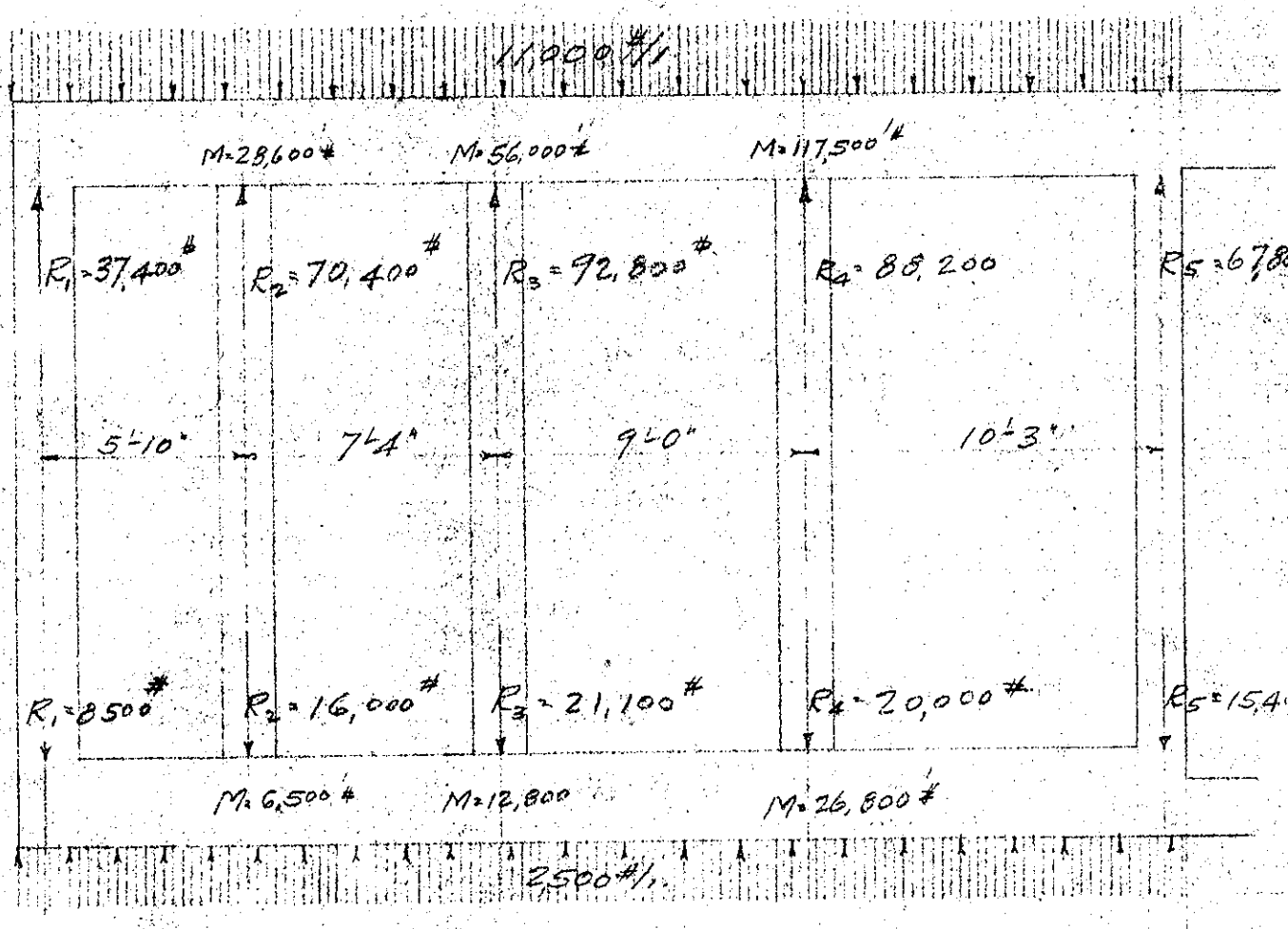
Computed by: E.M.V. Checked by: Date: March 18, 1940

U. S. GOVERNMENT PRINTING OFFICE 8—10528

Thrust on riverside = 11,000# per lin. ft. of building

" " landside = 2,500 " " " " "

Net = 8,500# " " " " "



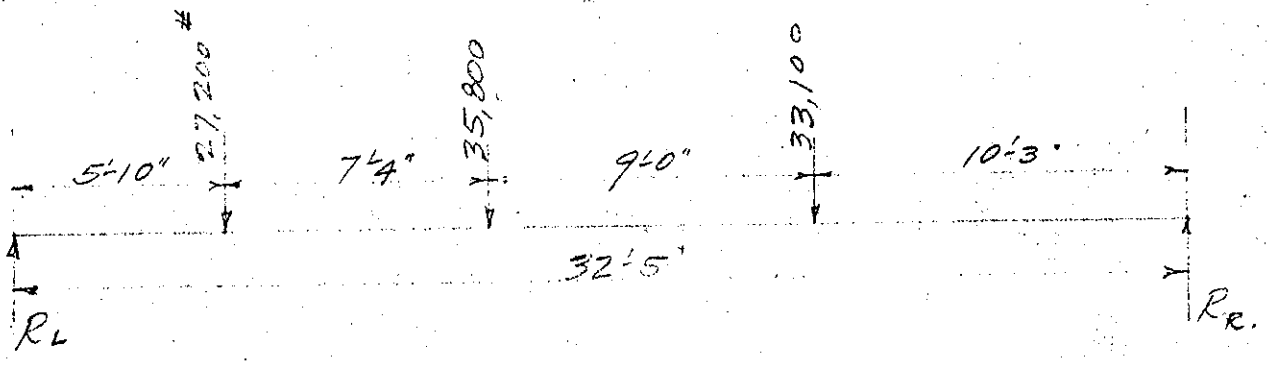
Loading Diagram, Reactions & Neg. Moms.

Subject Paderewski Pumping Station
Computation Horizontal Bms. to Resist Hydrostatic Thrust
Computed by E. M. V. Checked by Date March 18, 1940

U. S. GOVERNMENT PRINTING OFFICE 9—10523

(Continued from sheet # 90)

It is assumed that the difference in reactions is taken up by 2 bms., one bm. being located on the riverside of the building and one bm. on the landside. The net thrust on the floor bms. is assumed to be equally divided between the horizontal bms.



$R_L = 33{,}100 \times 10.25 = 340{,}000$

$35{,}800 \times 19.25 = 688{,}000$

$27{,}200 \times 26.58 = 718{,}000$

$1{,}746{,}000$

$R_L = \frac{1{,}746{,}000}{32.42} = 53{,}800^{\#}$

$R_R = 42{,}300^{\#}$

$M = 53{,}800 \times 13.17 - 27{,}200 \times 7.33 = 511{,}000\ \#.$

$d = \sqrt{\frac{511{,}000 \times 12}{123 \times 38}} = 36.2''$

The effective depth as furnished is 27.5". This is considered O.K. since a part of the load will be

Subject: Paderewski Pumping Station
Computation: Horizontal Brns. to Resist Hydrostatic Thrust
Computed by: E.M.Y. Checked by: Date: March 18, 1940

U.S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #91)

taken out by the floor slab.

Unit shear for riverside wall $= \frac{42,300 + 59,600}{27 + \frac{2}{3} \times 27.5} = 157\ \#/\square''$

Unit shear for landside wall $= \frac{53,800 - 15,400}{38 \times \frac{7}{8} \times 27.5} = 42\ \#/\square''$

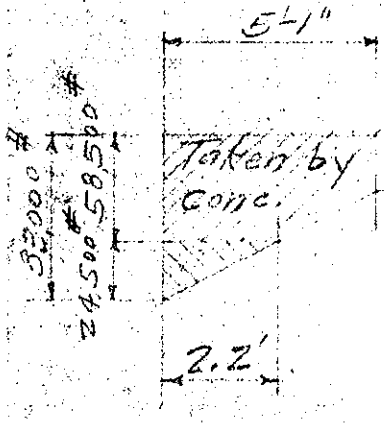
A_s for riverside wall $= \frac{(511000 - 56000)12}{\frac{7}{8} \times 27.5 \times 18,000} = 12.6\ \square''$

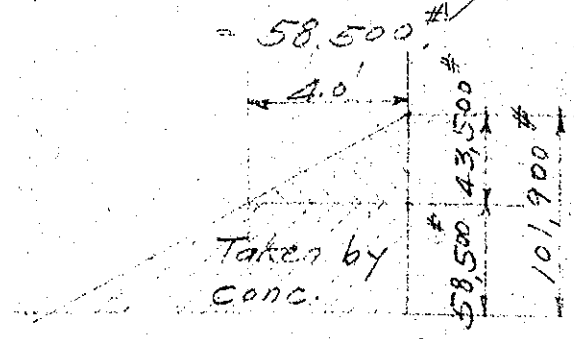
A_s for landside " $= \frac{(511,000 + 12,800)12}{\frac{7}{8} \times 27.5 \times 18,000} = 14.5\ \square''$

Use 7-1¼" bars for the riverside brn.

" 9-1¼" " " " landside brn.

For riverside brn. shear taken by conc. $= 27.5 \times 27.0 \times \frac{7}{8} \times 90$
$= 58,500\ \#$





No. of stirrups req'd at right end @ ⅞"φ

$= \frac{43,500 \times 48 \times \frac{1}{2}}{0.11 \times 2 \times 16000 \times \frac{7}{8} \times 27.5} = 12$, spaced 1" @ 2½", 3 @ 3½"

1 @ 6", 1 @ 7".

No. of stirrups at left end $= \frac{12,300 \times 27}{0.11 \times 2 \times 16000 \times \frac{7}{8} \times 27.5} = 4$

spaced 2", 2 @ 4", 1 @ 7".

WAR DEPARTMENT

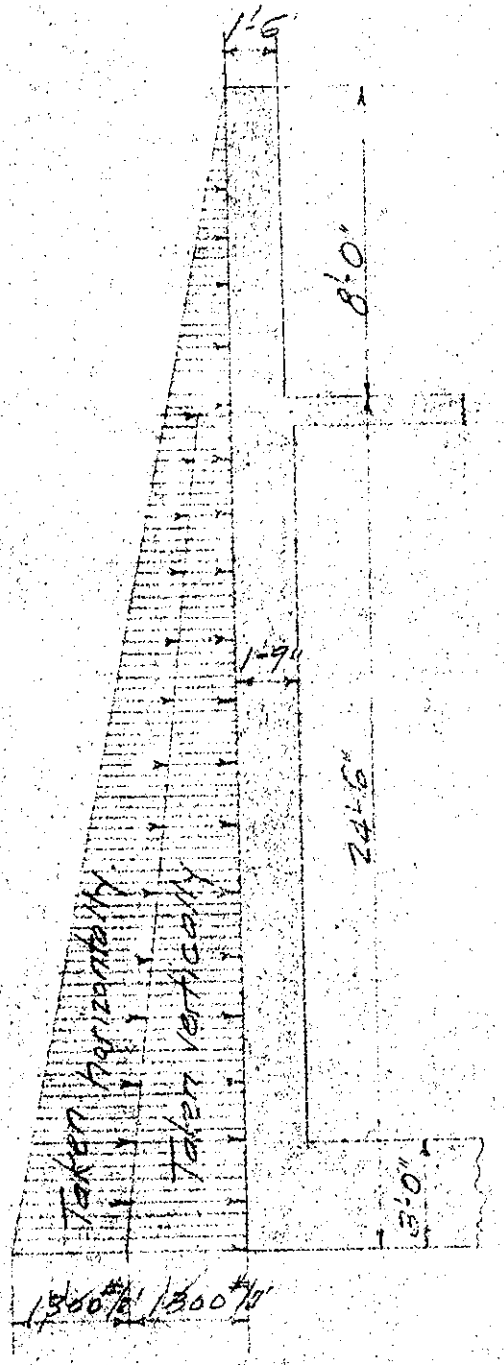
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: End Wall in Wet Sump

Computed by: E. M. V. Checked by: Date: March 19, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528



It is assumed that the earth is saturated to top of embankment.

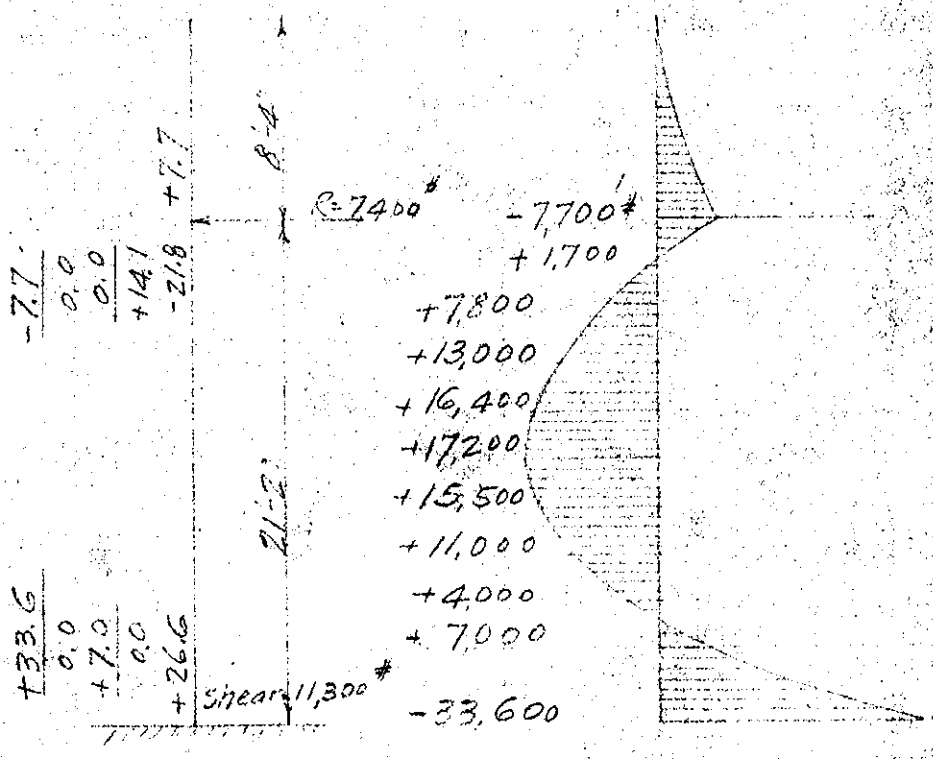
It is further assumed that the wall is fixed at the bottom and simply supported at operating floor level.

Also, since the center to center distance between the riverside and landside walls - 20'-0" - is approximately equal to the diston from top of base slab to operating floor slab it may be assumed that the load against the wall is divided proportionately between horizontal and vertical elements. This assumption is hereby made.

Subject Paderewski Pumping Station
Computation End Wall in Wet Sump
Computed by E.M.V. Checked by Date March 19, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #93)



Moment Dist. Diagram & Bending Mom. Diagram for Vertical Elements.

Moments on horizontal elements –

At Elev. 44.0, $M = \frac{1}{8} \times 1140 \times 400 = 57{,}000$#

" " 49.0 " $= \frac{1}{8} \times 940 \times 400 = 47{,}000$

" " 54.0 " $= \frac{1}{8} \times 740 \times 400 = 37{,}000$

" " 60.0 " $= \frac{1}{8} \times 540 \times 400 = 27{,}000$

Subject: Paderewski Pumping Station
Computation: End Wall in Wet Sump.
Computed by: E. M. V. Checked by: Date: March 19, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #94)

Effective depth $= \sqrt{\frac{57000}{123}} = 21.5''$ at Elev. 44.0

Effective depth $= \sqrt{\frac{37000}{123}} = 17.2''$ at Elev. 54.0

Make wall 24" thick to Elev. 54.0

" " 1'-9" " from Elev. 54.0 to Elev. 64.5

1. A_s for horizontal elements -

Elev. 43.0 to Elev. 49.0, $A_s = \frac{57000 \times 12}{\frac{7}{8} \times 21.5 \times 18{,}000} = 2.01''^2$ per ft.

" 49.0 " " 54.0, $A_s = \frac{47000}{57000} \times 2.01 = 1.66''^2$ " "

" 54.0 " " 60.0 $A_s = \frac{37000 \times 12}{\frac{7}{8} \times 17.5 \times 18{,}000} = 1.61''^2$ " "

" 60.0 " " 64.5, $A_s = \frac{27000}{37{,}000} \times 1.61 = 1.17''^2$ " "

2. A_s for vertical elements -

A_s for neg. mom. $= \frac{33{,}600 \times 12}{\frac{7}{8} \times 21.5 \times 18{,}000} = 1.19''^2$

" " pos. " $= \frac{17{,}200 \times 12}{\frac{7}{8} \times 17.5 \times 18{,}000} = 0.75''^2$

Unit shear $= \frac{11{,}300}{12 \times \frac{7}{8} \times 21.5} = 50$ #/□" O.K.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: End Wall in Wet Sump

Computed by: E. M. Y. Checked by: Date: March 17, 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #95)

1. For horizontal elements –

Use 1" ϕ bars 6" c.c. from Elev. 43.0 to Elev. 49.0

" 1" ϕ " 6" c.c. " " 49.0 to " 54.0

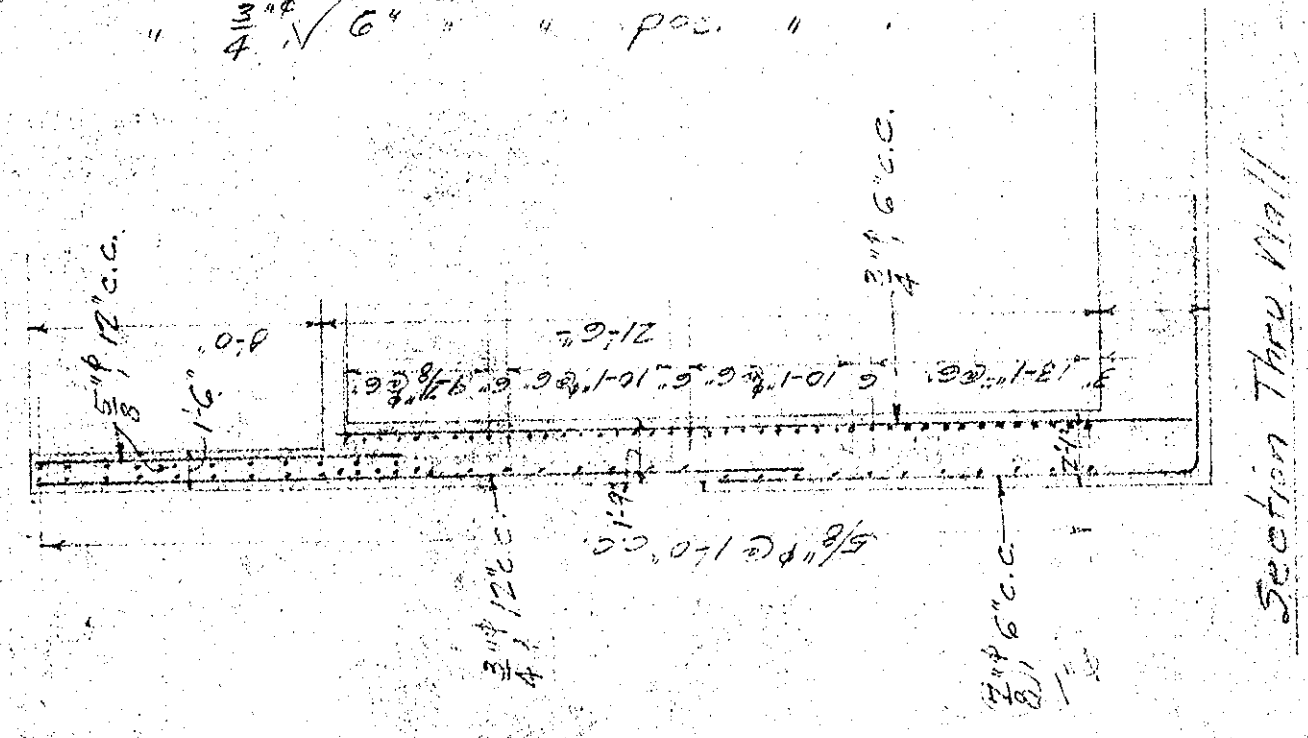
" 1" ϕ " 6" c.c. " " 54.0 " " 60.0

" 7/8" ϕ " 6" c.c. " " 60.0 " " 64.5

2. For vertical elements –

Use 1" ϕ (7/8" ϕ), 6" c.c. for neg. moment.

" 3/4" ϕ 6" " " pos. "



Subject: Paderewski Pumping Station
Computation: Mezzanine Floor in Dry Pump Room
Computed by: E.M.V. Checked by: Date: March 19, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10508

Slab Design

Wt. of boiler = 2,000#, diameter of boiler = 3'-0".

Boiler assumed placed in center of span.

Span = 8'-0".

Width of distribution = 0.6×8 + 2×3.0 = 10.8', say 10'-0".

Boiler load on 1'-0" width = 200# for 3'-0".

Therefore assume a live load of 100#/□' of floor.

Assume slab 6" thk. = 75#/□'

Total = 175#/□'.

$M = \frac{1}{8} \times 175 \times 64 = 1{,}400$ #

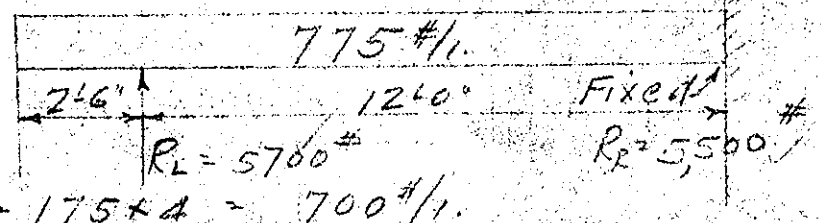
$d = \sqrt{\frac{1400}{123}} = 3.4"$. Make slab 6" thk. d = 4.2".

$A_s = \frac{1400 \times 12}{\frac{7}{8} \times 4.2 \times 18{,}000} = 0.25\square"$, say ½"φ bars 9" c.c.

Unit shear = $\frac{175 \times 4}{12 \times \frac{7}{8} \times 4.2} = 16$ #/□'.

Bond stress = $\frac{175 \times 4}{1.33 \times 1.57 \times \frac{7}{8} \times 4.2} = 9.1$ #/□".

Beam. —



Slab L+D = 175×4 = 700#/l.
Bm., say 75
Total = 775#/l.

Subject Paderewski Pumping Station
Computation Mezzanine Floor in Dry Pump Room.
Computed by E. M. V. Checked by Date March 19, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet # 97)

Max. pos. mom. occurs 4.9' to right of R_L.

" " " $= 5700 \times 4.9 - 775\frac{(7.3)^2}{2} = 7,300$ #.

" neg. " " 12,800 #

$d = \sqrt{\frac{12,800}{123}} = 10.4''$ Make bm 13" deep.

Unit shear $= \frac{5500}{12 \times \frac{7}{8} \times 10.4} = 50$ #/□"

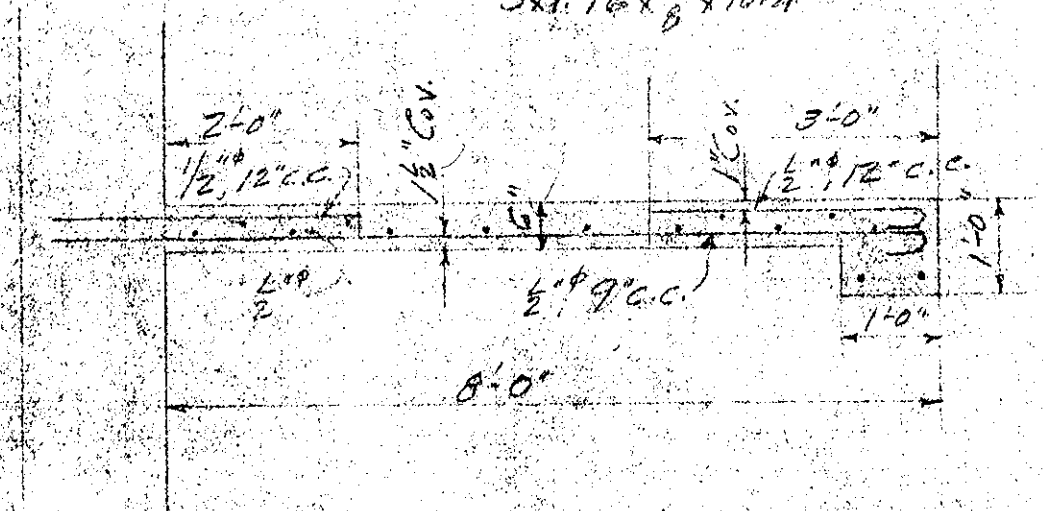
A_s for pos. mom. $= \frac{7,300 \times 12}{\frac{7}{8} \times 10.4 \times 18,000} = 0.52$ □"

A_s for neg. mom. $= \frac{12,800 \times 12}{\frac{7}{8} \times 10.4 \times 18,000} = 0.93$ □"

Use 2-5/8"φ bars ea. 31 = 0.62 □" for pos. mom.

" 3-7/8"φ bars ea. 31 = 0.93 □" " neg. " .

Unit bond $= \frac{5,500}{3 \times 1.96 \times \frac{7}{8} \times 10.4} = 103$ #/□"



For column carrying mezzanine floor use 12"×12" with 4-7/8"φ bars & 1/4" col. ties spaced 8" c.c.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

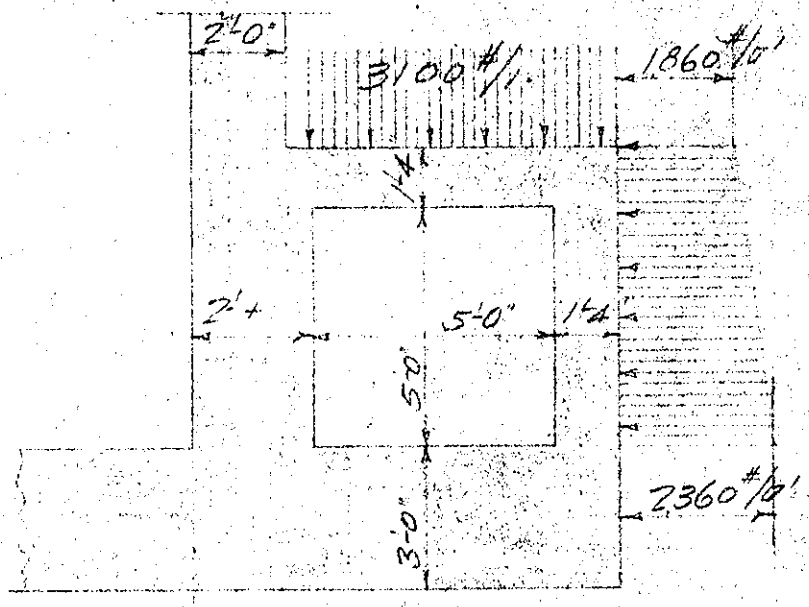
Subject: Paterenski Pumping Station

Computation: Conduit at Building

Computed by: E. M. Y. Checked by: Date: March 20, 1940

U. S. GOVERNMENT PRINTING OFFICE 2—10523

Conduit section = 5'-0" × 5'-0"



Loading Diagram on Conduit at Building.

Load on conduit roof –

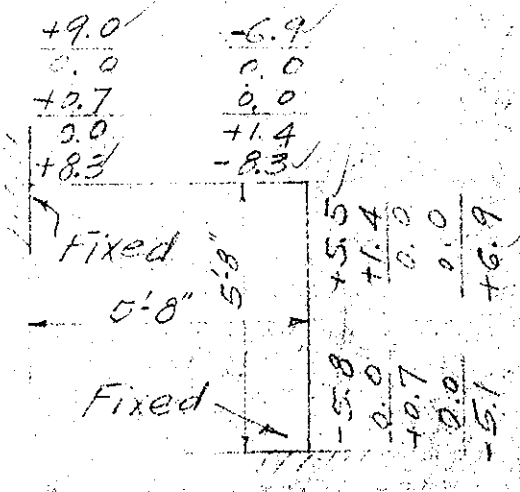
Fill = 23.2 × 125 = 2,900 #

Slab 200

Total = 3,100 #/□'

Horizontal pressure at top of conduit = 80 × 23.2 = 1,860 #/□'

Horizontal pressure at bot. of conduit = 80 × 29.5 = 2,360 #/□'



For roof slab –

Max. neg. mom. for top = 9,000 #

" pos. " " " = 4,400 #

" shear = 9,200 #

For sidewall –

Max. neg. mom. = 6,900 #

" pos. " = 1,600 #

" shear = 6,000 #

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Pawtuxet Pumping Station

Computation: Conduit at Building

Computed by: E.M.V. Checked by: Date: March 29, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #99)

$d = \sqrt{\frac{9000}{123}} = 8.5''$ Make slab and wall 1'-4" thk.

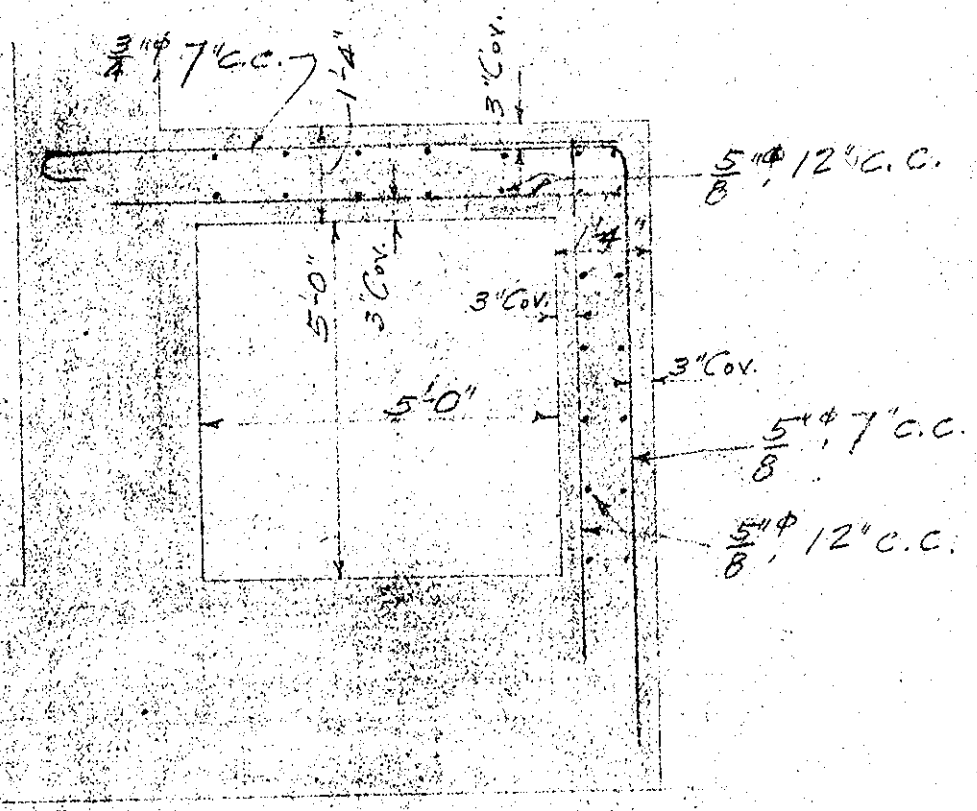
Unit shear $= \frac{9200}{12 \times \frac{7}{8} \times 12.5} = 70\#/\square''$ O.K. with special anchorage.

For slab A_s for neg. mom. $= \frac{9000 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.55\square''$

A_s for pos. mom. $= \frac{4400}{9000} \times 0.55 = 0.27\square''$

For pos. mom. use $\frac{5}{8}''\phi$ bars 12" c.c. in slab & wall

For neg. mom. use $\frac{3}{4}''\phi$, 7" c.c. in slab, & $\frac{5}{8}''\phi$, 7" c.c. in wall.



WAR DEPARTMENT

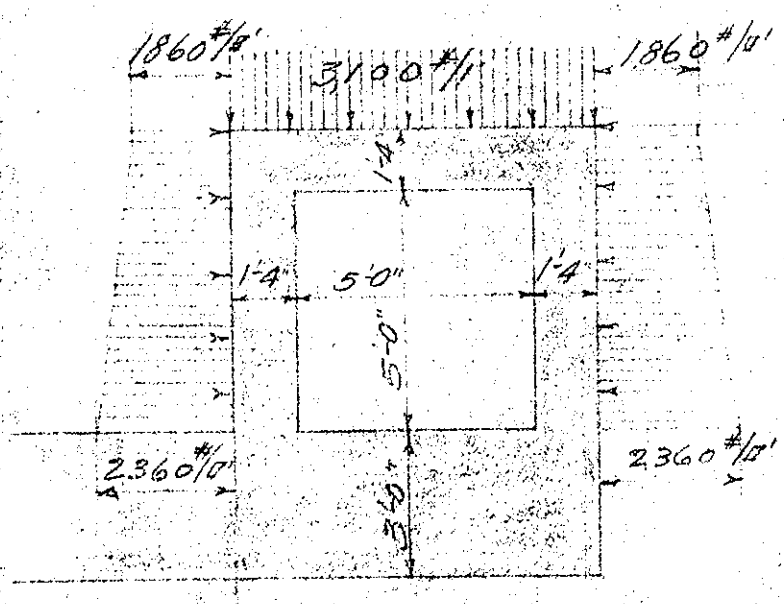
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Pederewski Pumping Station

Computation: Conduit at Building.

Computed by: E. M. V. Checked by: Date: March 20, 1940.

U. S. GOVERNMENT PRINTING OFFICE 8—10528



In top slab -

Max. pos. mom. = 6,600#

" neg. " = 8,900#

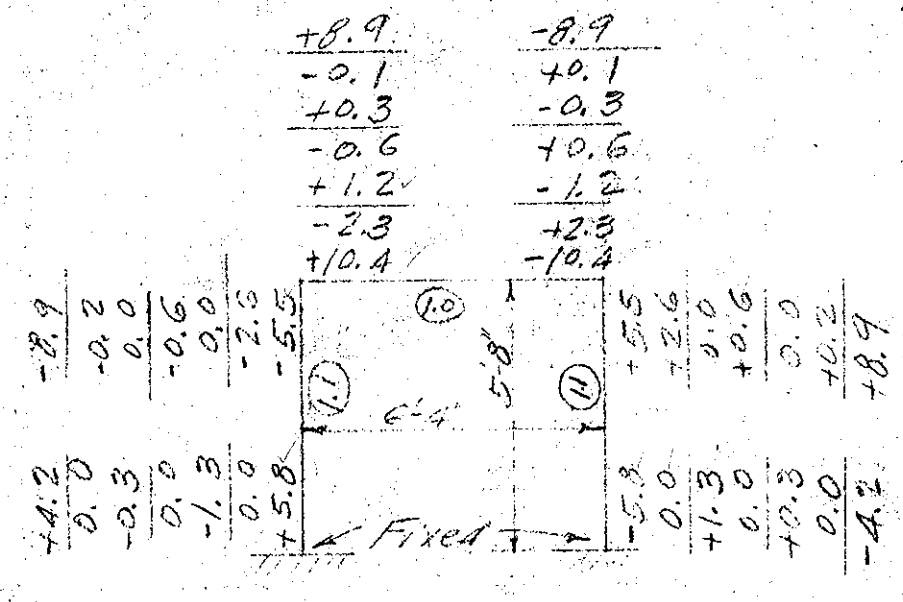
" shear = 9,800#

In sidewalls -

Max. pos. mom. = 1,400#

" neg. " = 8,900

" shear = 6,600#



Mom. Dist. Diagram.

Subject Paderewski Pumping Station
Computation Conduit at Building
Computed by E. M. V. Checked by Date March 20, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #101)

For roof slab A_s for pos. mom. $= \frac{6600 \times 12}{\frac{7}{8} \times 12.5 \times 18{,}000} = 0.40\square''$

A_s " neg. " $= \frac{8900 \times 12}{\frac{7}{8} \times 12.5 \times 18{,}000} = 0.54\square''$

For sidewalls A_s for pos. " $= \frac{1400 \times 12}{\frac{7}{8} \times 12.5 \times 18{,}000} = 0.09\square''$

A_s " neg. " $= 0.54\square''$

For roof slab use $\frac{3}{4}''\phi$ bars 12" c.c. for pos. mom.
" sidewalls " $\frac{5}{8}''\phi$ " 12" " " " "
" roof slab " $\frac{3}{4}''\phi$ " 7" " " neg. "
" sidewalls " $\frac{3}{4}''\phi$ " 7" " " " "

Details similar to sketch shown on sheet #69.

WAR DEPARTMENT

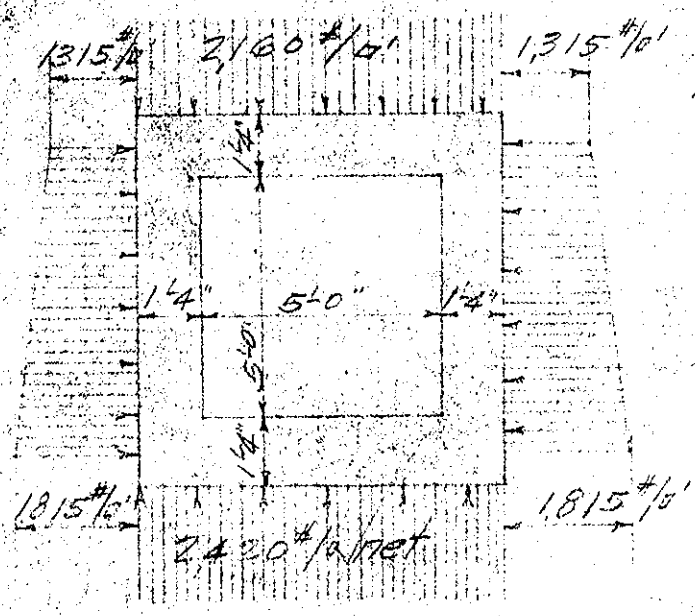
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Conduit on Ground

Computed by: E. M. V. Checked by: Date: March 20, 1940.

U. S. GOVERNMENT PRINTING OFFICE 2—10528



Loading Diagram

Load on conduit -

Fill = 15.7 × 125 = 1,960#/□'

Slab = 200

Total = 2,160#/□'

Top slab -

Max pos. mom. = 4700'#

" neg. " = 6,100'

" shear = 5,400#

Bot. slab -

Max. pos. mom = 5,300'#

" neg. " = 6,900

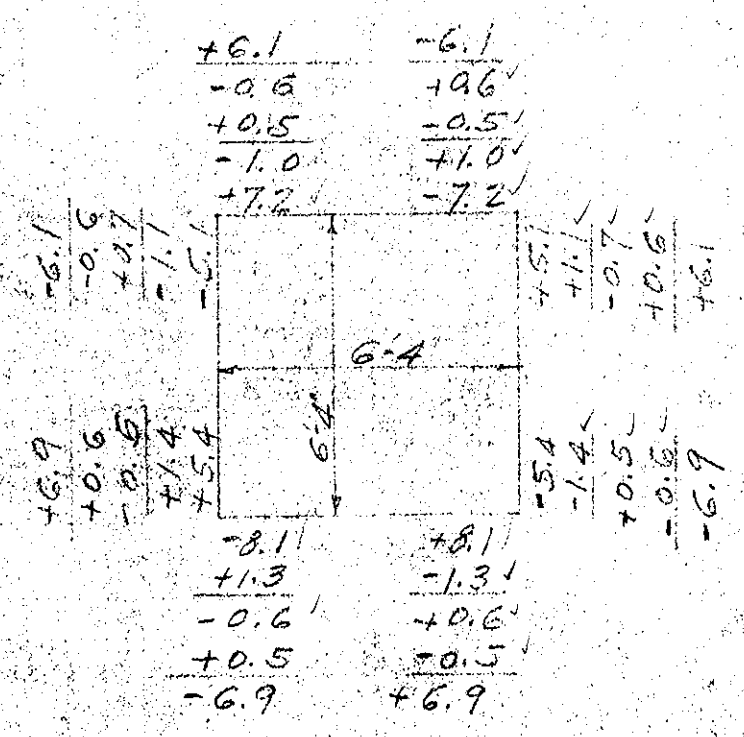
" shear = 6,100#

Sidewalls -

Max. pos. mom = 2,500'#

" neg. " = 6,900

" shear = 5,100#



Mom. Dist. Diagram

Subject Paderewski Pumping Station
Computation Conduit on Ground
Computed by E.M.Y. Checked by Date March 21, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #103)

Top slab - A_s for pos. mom. $= \frac{4700 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.29\square''$

A_s " neg. " $= \frac{6100 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.39\square''$

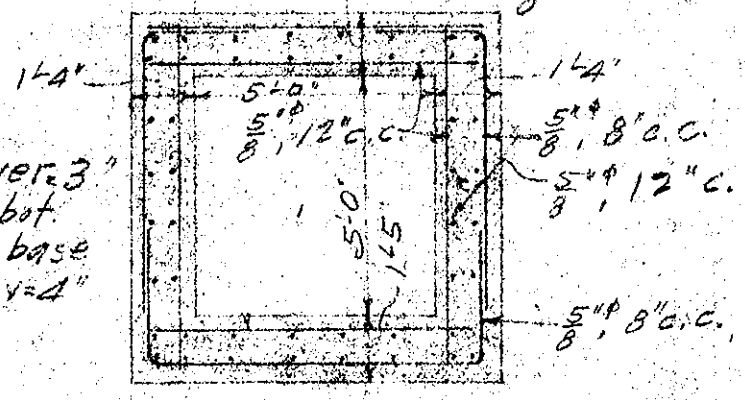
Bot. slab - A_s " pos. " $= \frac{5300 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.32\square''$

A_s " neg. " $= \frac{6900 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.42\square''$

Sidewall - A_s " pos " $= \frac{2500 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.15\square''$

A_s " neg. " $= \frac{6900 \times 12}{\frac{7}{8} \times 12.5 \times 18000} = 0.42\square''$

For top & bot. slabs use $\frac{5}{8}''\phi$ bars, 12" c.c. for pos. mom.
" $\frac{5}{8}''\phi$ " 8" c.c. " neg. " .
" sidewalls " $\frac{5}{8}''\phi$ " 12" c.c. " pos. "
" $\frac{5}{8}''\phi$ " 8" c.c. " neg. " .



Min. cover = 3" except bot. steel in base where cov = 4"

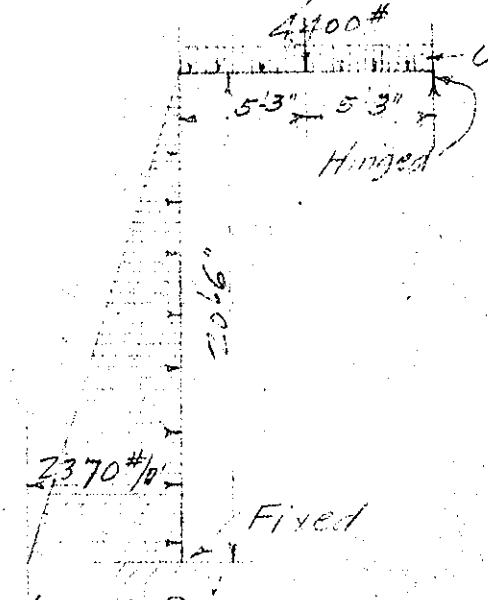
WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
Page 105

Subject Paderewski Pumping Station
Computation Gate Chamber at Wet Sump Inlet
Computed by E. M. V. Checked by Date March 22, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Soil assumed fully saturated from ground surface down.
Pull on sluice gate assumed to be 12,000#.
Live load on chamber roof slab assumed to be 1-12 ton truck, type H-12. No live load impact.

Distance from outside face of wet sump wall to expansion joint = 6'-6".
Since there is a 2-ft. slot in the top slab over the gate chamber it may be assumed that the earth pressure over the width of 6'-6" will be concentrated on a width of 6'-6" - 2'-0" = 4'-6".
With fill 20'-6" deep pressure at bot. of wall for section next to wet sump = $80 \times 20.5 \times \frac{6.5}{4.5} = 2{,}370$#/□'.
Pressure at ground surface = 0.



Load Diagram

Top slab assumed 1'-4" thk.
Sidewall " 2'-0" thk.

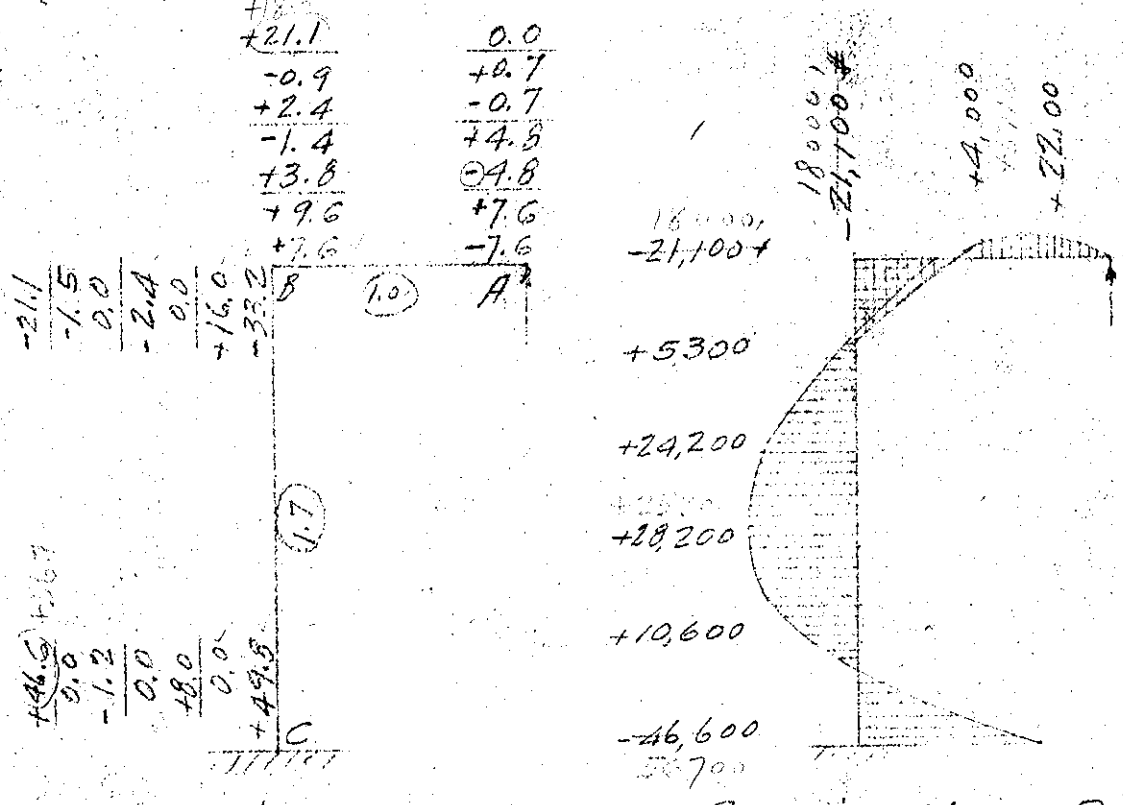
I for slab = $(16.0)^3$ = 4,096"⁴
l " " = 126"
$\frac{I}{l} = 32.5$

I " wall = $(24.0)^3$ = 13,824"⁴
l " " = 246
$\frac{I}{l} = 56.2$

Subject Paderewski Pumping Station
Computation Gate Chamber at West Sump Inlet
Computed by E.M.V. Checked by Date March 22, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10523

(Continued from sheet #105)



Mom. Dist. Diagram. Bending Mom. Diagram.

Shear at A = ~~1,300~~ 1500 #

" " B for slab = ~~5,300~~ 6200 #

" " B " wall = ~~6,900~~ 5900 #

" " C ~~17,400~~ 18100

WAR DEPARTMENT

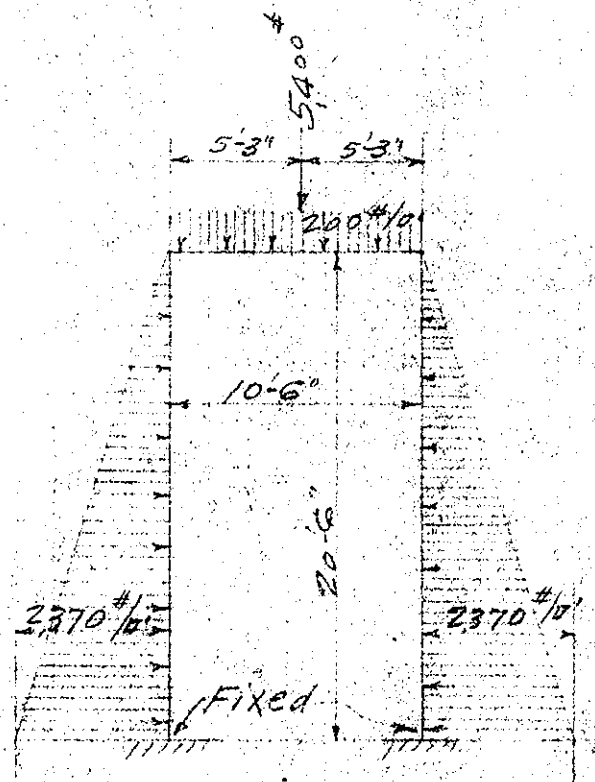
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Gate Chamber at Wet Sump

Computed by: E. M. Y. Checked by: Date: March 22, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

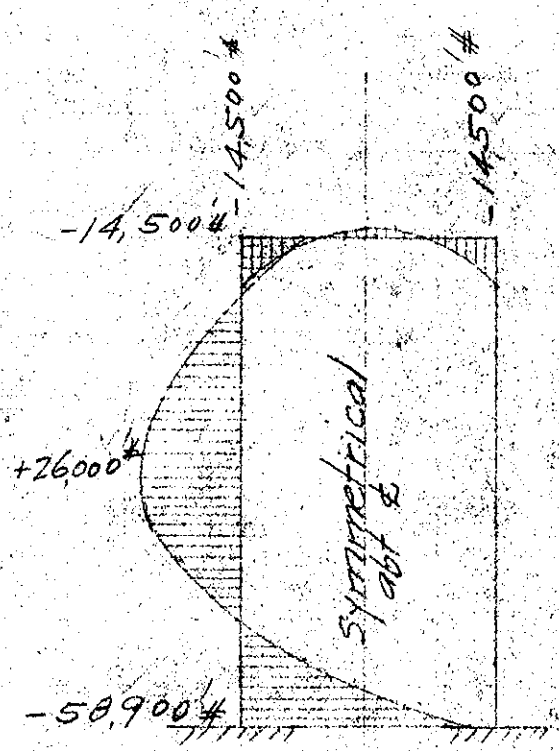


Loading Diagram.

Shear at ends of slab = 3,800#

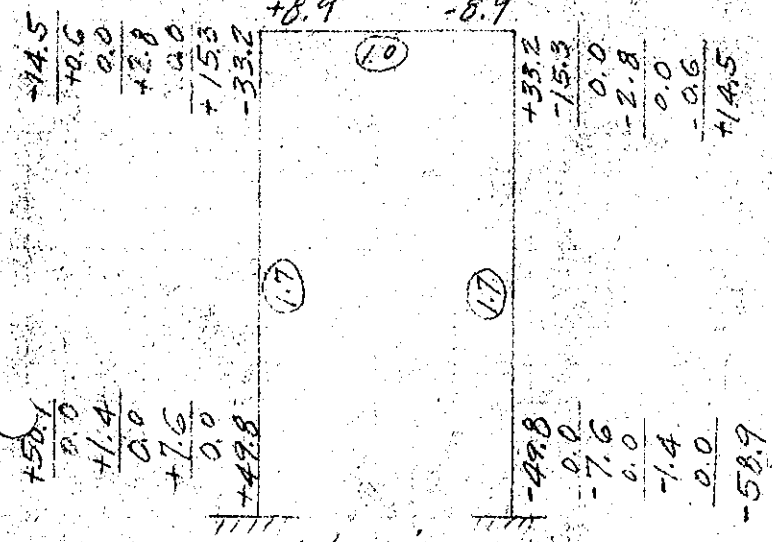
Shear at top of wall = 5,900#

" " bot. " " = 18,400#



Bend Mom. Diagram.

+14.5	-14.5
+0.3	-0.3
-0.9	+0.9
+1.7	-1.7
-4.5	+4.5
+9.0	-9.0
+8.9	-8.9



Mom. Dist. Diagram

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Paderewski Pumping Station

Computation Trash Rack Well

Computed by E. M. V. Checked by _____ Date March 22, 1940.

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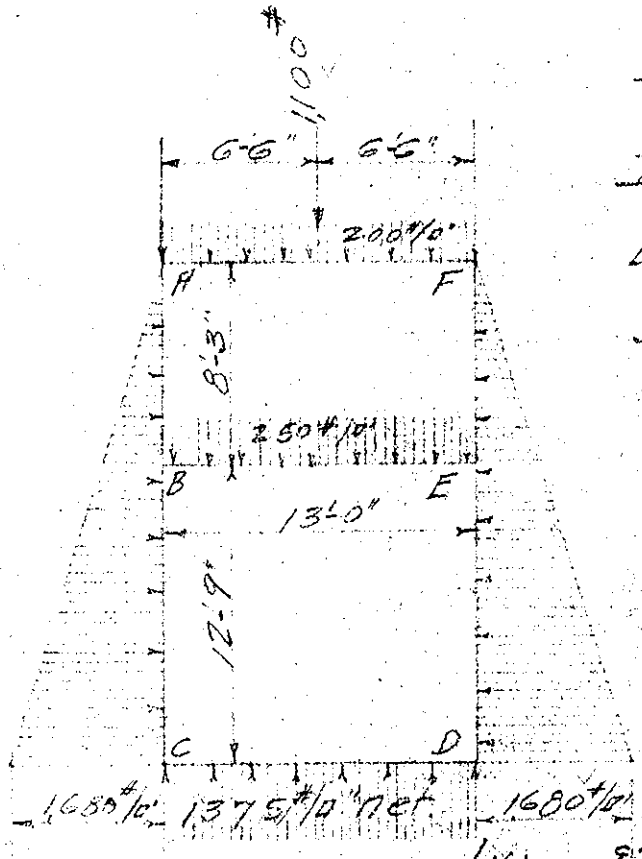


Top slab assumed 1'-4" thk.

Interior slab " 1'-0" "

Bot. slab " 2'-0" "

Sidewalls " 1'-8" "

I for top slab = 4,096"⁴ } $\frac{I}{l}$ = 26.2

l " " " = 156" }

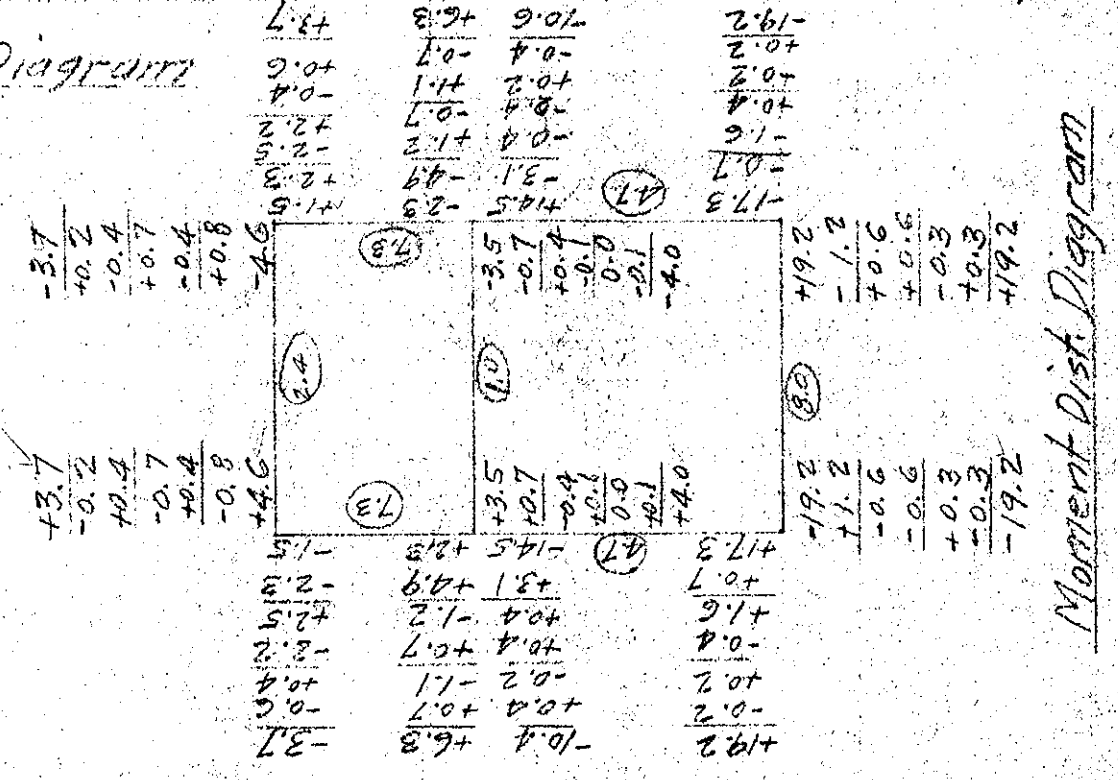
I " interior slab = 1728 } $\frac{I}{l}$ = 11.1

l " " " = 156" }

I " bot. " = 13,824"⁴ } $\frac{I}{l}$ = 88.7

l " " " = 156 }

Loading Diagram



Moment Dist. Diagram

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Trash Rack Well.

Computed by: E. M. V. Checked by: Date: March 22, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10523

(Continued from sheet #108)

Shear at "A" top slab = 1,900#

" " B, interior slab = 1,600

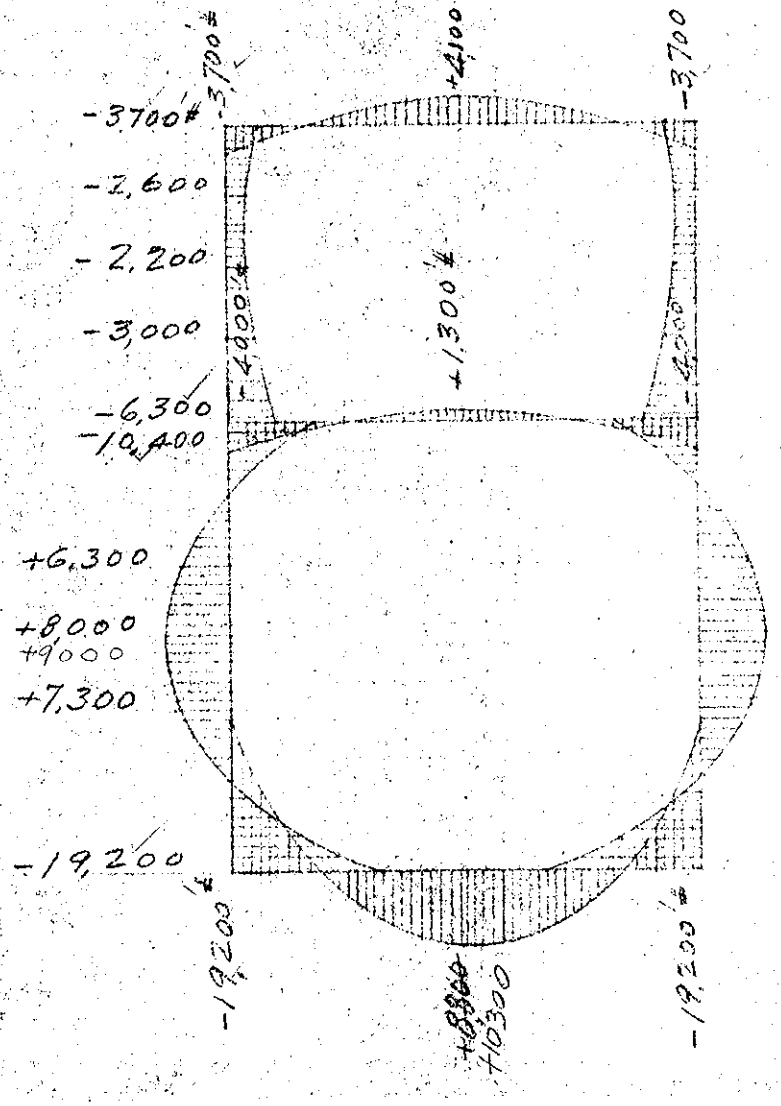
" " C, bot. slab = 9,000

" " A, upper wall = 600

" " B, " " = 2,100

" " B, lower " = 5,700

" " C, " " = 9,200



Bending Mom. Diag.

Subject Paderewski Pumping Station
Computation Trash Rack Well
Computed by E.M.V. Checked by Date March 23, 1940.

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End wall -

Pressure at bot. of wall = 14.0 × 80 = 1120 #/□'

Assume partial restraint, then

$M = \frac{1}{10} \times 1120 (13.0)^2 = 19{,}000$ #.

$d = \sqrt{\frac{19000}{123}} = 12.6''$ Make wall 1'-4" thk.

$A_s = \frac{19000 \times 12}{\frac{7}{8} \times 12.6 \times 18000} = 1.03 \square''$

Max. shear = 1120 × 6.5 = 7,300 #.

Use $\frac{7}{8}$"φ bars, 6" c.c. for lowest 4'-0.
Use $\frac{3}{4}$"φ " 6" " " next 5'-0".
" $\frac{3}{4}$"φ " 12" " " to top of wall.

Use the above steel for pos. & neg. mom.

Trash rack apron wall -

Make wall 1'-0" thk.

Use $\frac{1}{2}$"□ bars 12" c.c. both faces, both ways.

Subject Paderewski Pumping Station
Computation Trash Rack Well
Computed by E. M. V. Checked by ..... Date March 23, 1940.

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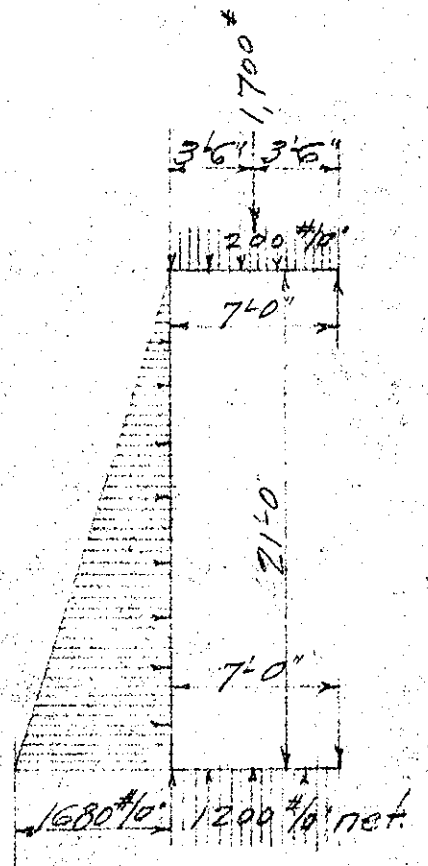
Section at bend in chamber.



Loading Diagram

It is assumed that the top slab is supported on the wall at one end and on the conc. apron wall at the other end. Also, that the bot. slab is supported by the wall at one end and by a strip of the bot. slab acting as a bm. and parallel to, and directly under the top edge of the apron wall. The loading is taken on an average section.

Top slab assumed 1'4" thk.
Wall " 1'8" "
Bot. slab " 2'0" "

$\frac{I}{l}$ for top slab $= \frac{4096}{84} = 48.7$ K = 1.5

$\frac{I}{l}$ " wall $= \frac{8000}{252} = 31.7$ K = 1.0

$\frac{I}{l}$ " bot. slab $= \frac{13824}{84} = 165.$ K = 5.2

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

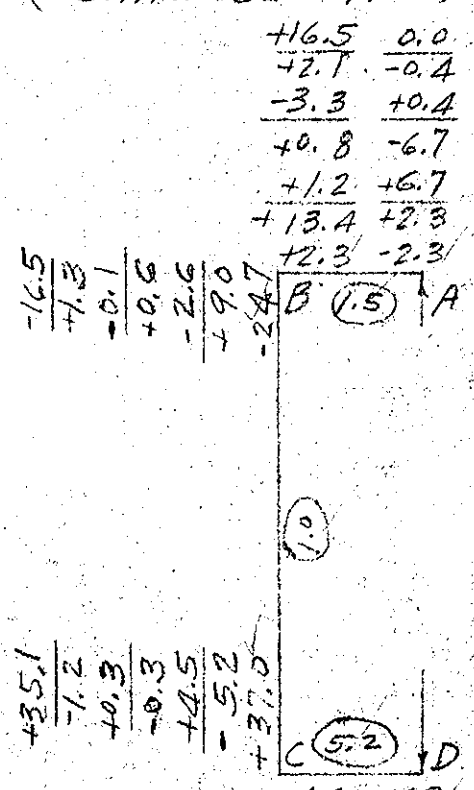
Subject: Paderewski Pumping Station

Computation: Trash Rack Well

Computed by: E. M. V. Checked by: Date: March 25, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #111)



Mom. Dist. Diagram

Shear at "A" = -800#

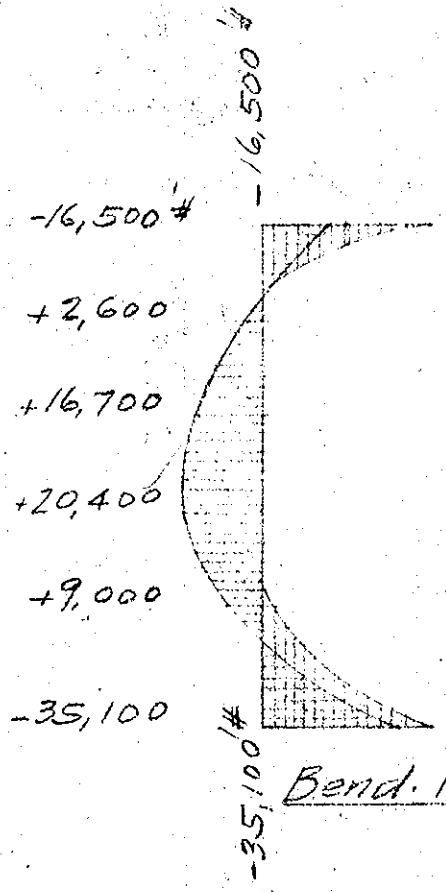
" " "B" for slab = +3,900#

" " "B" " wall = +5,000

" " "C" " " = 12,600

" " "C" " slab = 9,200

" " "D" " " = -800



Bend. Mom. Diag.

Subject Paderewski Pumping Station
Computation Design of Sections - Gate Chamber & Trash Rack Well.
Computed by E.M.V. Checked by Date March 25, 1940.

U. S. GOVERNMENT PRINTING OFFICE 8—10528

Gate chamber at wet sump inlet.

1. Roof slab-

Max. pos. mom. = ~~6,000~~ 5100 #.

" neg. " = ~~21,100~~ 18000 #.

" shear = ~~5,300~~ 6200 #.

$d = \sqrt{\frac{21,100}{123}} = 13.2''$ Make slab 14" thk. d = 13.5"

Unit shear = $\frac{5,300}{\frac{7}{8} \times 12 \times 13.5} = 37$ #/□" O.K.

A_s for pos. mom. = $\frac{6000 \times 12}{\frac{7}{8} \times 13.5 \times 18,000} = 0.34$□"

A_s for neg. mom. = $\frac{21100 \times 12}{\frac{7}{8} \times 13.5 \times 18,000} = 1.19$□"

2. Sidewall-

Max. pos. mom. = ~~28,200~~ 25200 #.

" neg. " = ~~46,600~~ 56700 #

" shear = ~~17,400~~ 18100 #

$d = \sqrt{\frac{46,600}{123}} = 19.4''$ Make wall 24" thk. d = 20.5"

Unit shear = $\frac{17400}{12 \times \frac{7}{8} \times 20.5} = 81$ #/□" O.K.

A_s for pos. mom. = $\frac{28,200 \times 12}{\frac{7}{8} \times 20.5 \times 18,000} = 1.05$□"

Subject Paderewski Pumping Station
Computation Design of Sections - Gate Chamber & Trash Rack Well
Computed by E.M.V. Checked by Date March 25, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #113)

A_s for neg. mom. = $\frac{46,600 \times 12}{\frac{7}{8} \times 20.5 \times 18,000}$ = 1.73□".

For pos. steel in slab use $\frac{5}{8}$"φ bars 10" c.c.
" neg. " " " use $\frac{7}{8}$"φ " 6" c.c. } For section
" pos. " " wall use $\frac{7}{8}$"φ " 6" c.c. } nearest to
" neg. " " wall " 1"□ " 6" c.c. } building.

Gate chamber at wet sump inlet - section nearest to trash rack chamber.

1. Roof slab -

Max. pos. mom. = 4,000'#
" neg. " = 14,500'#
" shear = 3,800#

Make a slab 1'-4" thk.

A_s for pos. mom. = $\frac{4000 \times 12}{\frac{7}{8} \times 13.5 \times 18,000}$ = 0.22□"

A_s " neg. mom. = $\frac{14500 \times 12}{\frac{7}{8} \times 13.5 \times 18,000}$ = 0.82□"

Subject Paderewski Pumping Station
Computation Design of Sections - Gate Chamber & Trash Rack Well
Computed by E. M. V. Checked by Date March 25, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #114)

2. Side Walls -

Max. pos. mom. = 26,000'#
" neg. " = 58,900'#
" shear = 18400#

$d = \sqrt{\frac{58900}{123}} = 21.8''$. Make wall 24.0" thk; d = 20.5"
d = 20.5" may be used since the mom. at the top of slab = 58,900 - 18400 × 0.4 = 51,500'#.

A_s for pos. mom. = $\frac{26000 \times 12}{\frac{7}{8} \times 20.5 \times 18000} = 0.96 \square''$

A_s for neg. " = $\frac{58900 \times 12}{\frac{7}{8} \times 20.5 \times 18000} = 2.18 \square''$

For pos. steel in slab use $\frac{5}{8}$"φ bars 10" c.c.
" neg. " " " " 1"φ " 10" c.c.
" pos. " " walls " 1"φ " 10" c.c.
" neg. " " " " 1"φ " 5" c.c.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Paderewski Pumping Station

Computation Design of Sections-Gate Chamber & Trash Rack Well.

Computed by E. M. V. Checked by ..... Date March 25, 1940.

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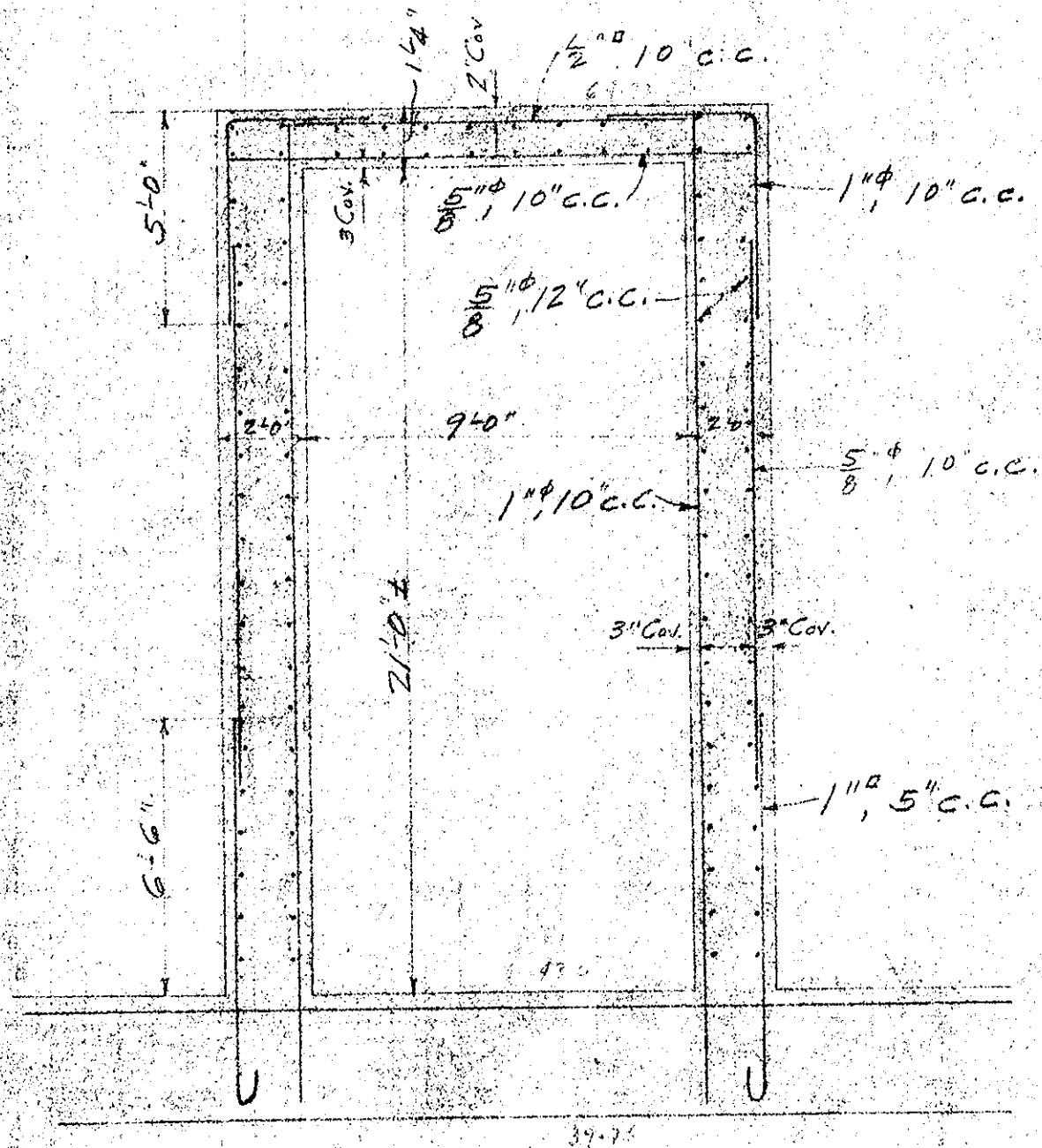

Section Thru Gate Chamber

Subject Paderewski Pumping Station
Computation Design of Sections - Trash Rack Well.
Computed by E. M. V. Checked by ..... Date March 26, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Trash rack well -

1. Top slab - 1'-4" deep.

Max. pos. mom. = 4,100 #

" neg. " = 3,700 #

" shear = 1,900 #

A_s for pos. mom. = $\frac{4100 \times 12}{\frac{7}{8} \times 12.5 \times 18,000}$ = 0.23 □"

" " neg. " = $\frac{3,700 \times 12}{\frac{7}{8} \times 13.5 \times 18,000}$ = 0.21 □"

2. Interior slab - 1'-0" deep.

Max. pos. mom. = 1,300 #

" neg. " = 4,000 #

" shear = 1,600 #

A_s for pos. mom. = $\frac{1300 \times 12}{\frac{7}{8} \times 8.5 \times 18,000}$ = 0.12 □"

A_s " neg. " = $\frac{4000 \times 12}{\frac{7}{8} \times 8.5 \times 18,000}$ = 0.36 □"

3. Bot. slab -

Max. pos. mom. = ~~8,800~~ 10300 #

" neg. " = 19,200 #

" shear = 9,000 #

Subject: Paderewski Pumping Station
Computation: Design of Sections - Trash Rack Well.
Computed by: E.M.V. Checked by: Date: March 26, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #117)

Effective depth req'd. $\sqrt{\frac{19200}{123}} = 12.5'$

Make slab 2'-0" thk. d = 19.5".

A_s for pos. mom. $= \frac{\overset{10,000}{8800} \times 12}{\frac{7}{8} \times 19.5 \times 18,000} = \overset{0.40}{0.34}$"

A_s for neg. mom. $= \frac{19,200 \times 12}{\frac{7}{8} \times 19.5 \times 18,000} = 0.75$"

4. Sidewalls -

Max. pos. mom. = $\overset{9,000}{8,000}$ #

Max. neg. " = 19,200 #

Max. shear = 9,200 #

Make walls 1'-8" thk; d = 16.5".

Unit shear $= \frac{9200}{12 \times \frac{7}{8} \times 16.5} = 51$ #/□". O.K.

A_s for pos. mom. $= \frac{\overset{9,000}{8,000} \times 12}{\frac{7}{8} \times 16.5 \times 18,000} = \overset{0.42}{0.37}$"

A_s for neg. mom. at interior platform $= \frac{10,400 \times 12}{\frac{7}{8} \times 16.5 \times 18,000} = 0.48$"

" " " " " bot. $= \frac{19,200 \times 12}{\frac{7}{8} \times 16.5 \times 18,000} = 0.89$"

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Design of Sections - Trash Rack Well

Computed by: E.M.V. Checked by: Date: March 26, 1940.

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(Continued from sheet #118)

Top slab, use $\frac{1}{2}$" bars 12" c.c. for pos. & neg. steel.

Interior slab use $\frac{1}{2}$" bars 12" c.c. for pos. mom.

" " " $\frac{3}{4}$" " 12" c.c. " neg. "

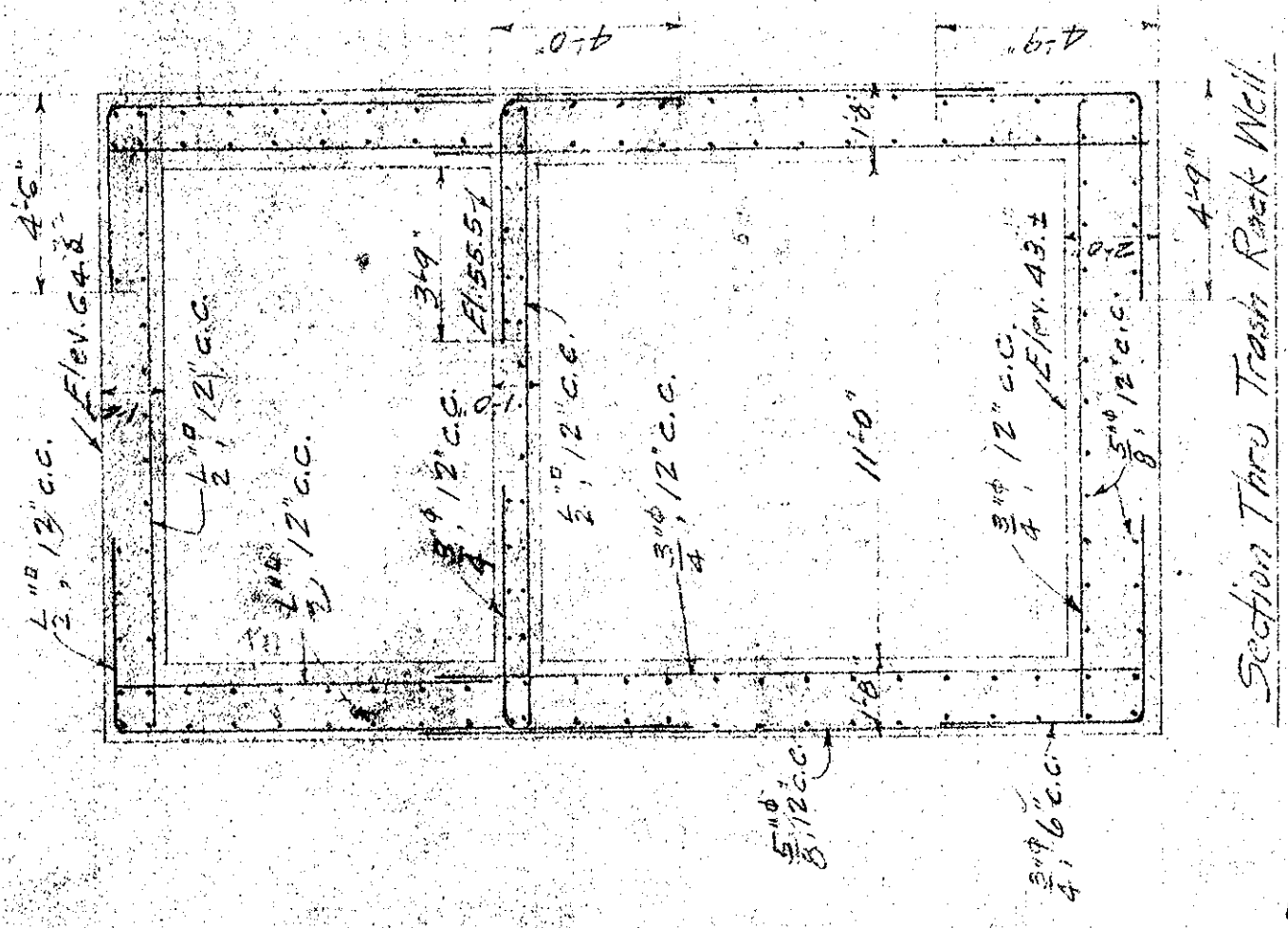
Upper wall, use $\frac{1}{2}$" bars, 12" c.c. for pos. & neg. steel.

Lower wall, use $\frac{3}{4}$" " 12" c.c. for pos. mom.

" " " $\frac{3}{4}$" " 6" c.c. for neg. mom. at bot.

Bot. slab " $\frac{3}{4}$" " 12" c.c. " pos. "

" " " $\frac{3}{4}$" " 6" c.c. " neg. mom.



Section Thru Trash Rack Well

Subject Paderewski Pumping Station
Computation Design of Sections - Trash Rack Well
Computed by E. M. V. Checked by Date March 26, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10523

Section at bend in chamber.

1. Top slab -

Positive mom. = 0

Max. neg. mom. = 16,500 #

Max. shear = 3,900

$d = \sqrt{\frac{16500}{123}} = 11.6''$ Make slab 1'4" thk, d = 13.5"

$A_s = \frac{16,500 \times 12}{\frac{7}{8} \times 13.5 \times 18,000} = 0.93 \square''$

2. Bot. slab -

Positive mom. = 0

Neg. mom. = 35,100 #

$d = \sqrt{\frac{35100}{123}} = \cancel{14.3}\ 16.9''$ Make slab 2'-0" thk, d = 19.5"

$A_s = \frac{35,100 \times 12}{\frac{7}{8} \times 19.5 \times 18,000} = 1.37 \square''$

3. Sidewall -

Max. pos. mom. = 20,400 #

" neg. " = 35,100 #

" shear " = 12,600 #

Unit shear = $\frac{12600}{12 \times \frac{7}{8} \times 16.5} = 73$ #/□"

Subject: Paderewski Pumping Station
Computation: Design of Sections - Trash Rack Well.
Computed by: E.M.V. Checked by: Date: March 26, 1940

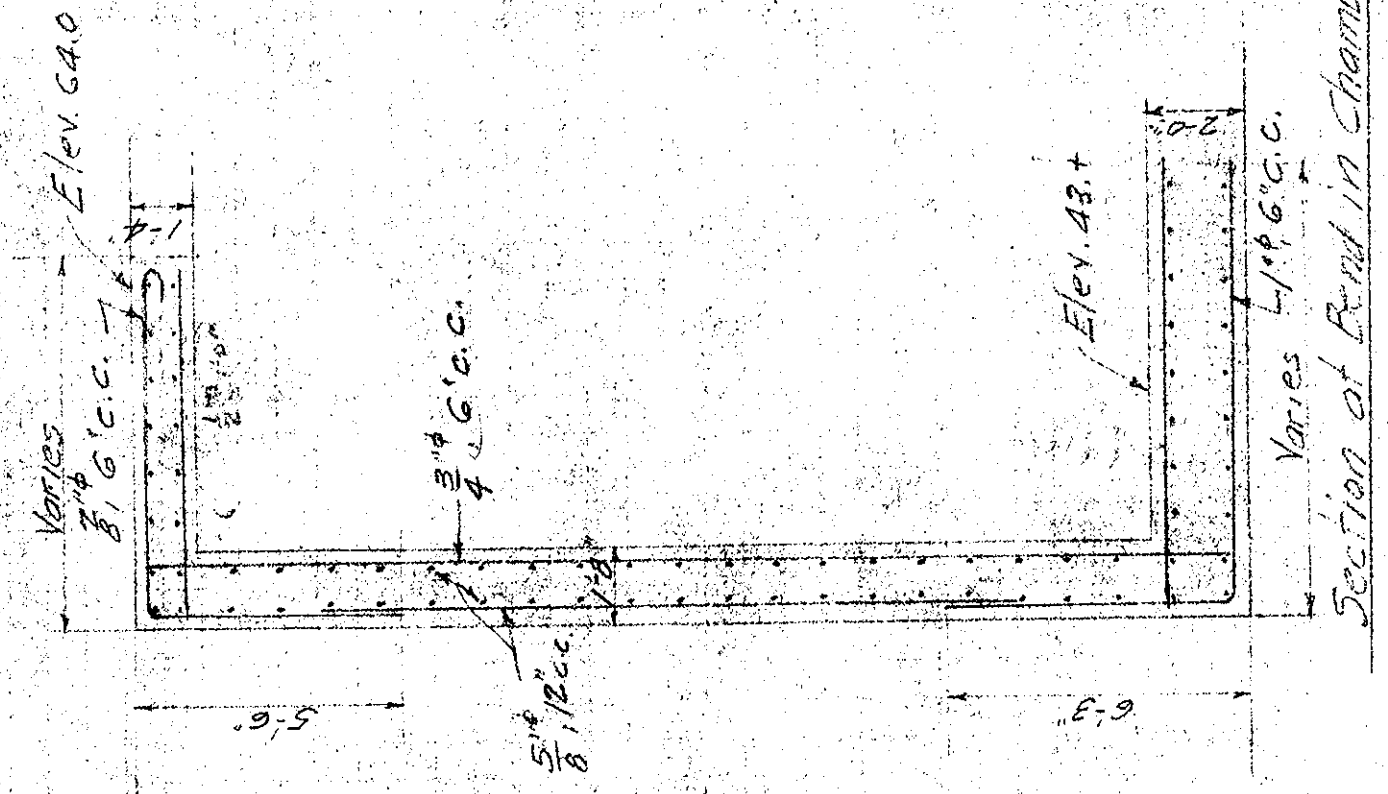
U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #120)

A_s for pos. mom. $= \dfrac{20,400 \times 12}{\frac{7}{8} \times 16.5 \times 18,000} = 0.94''^2$

A_s for neg. " $= \dfrac{35,100 \times 12}{\frac{7}{8} \times 16.5 \times 18,000} = 1.62''^2$

For top slab use $\frac{7}{8}''\phi$ bars 6" c.c.
" bot. " " $1''\phi$ " 6" "
" pos. mom. in wall use $\frac{3}{4}''\phi$ bars 6" c.c.
" neg. " " " " $1''\phi$ 6" c.c.



Subject Paderewski Pumping Station
Computation Conduit Transition to Trash Rack Chamber
Computed by E. M. V. Checked by ..... Date March 27, 1940.

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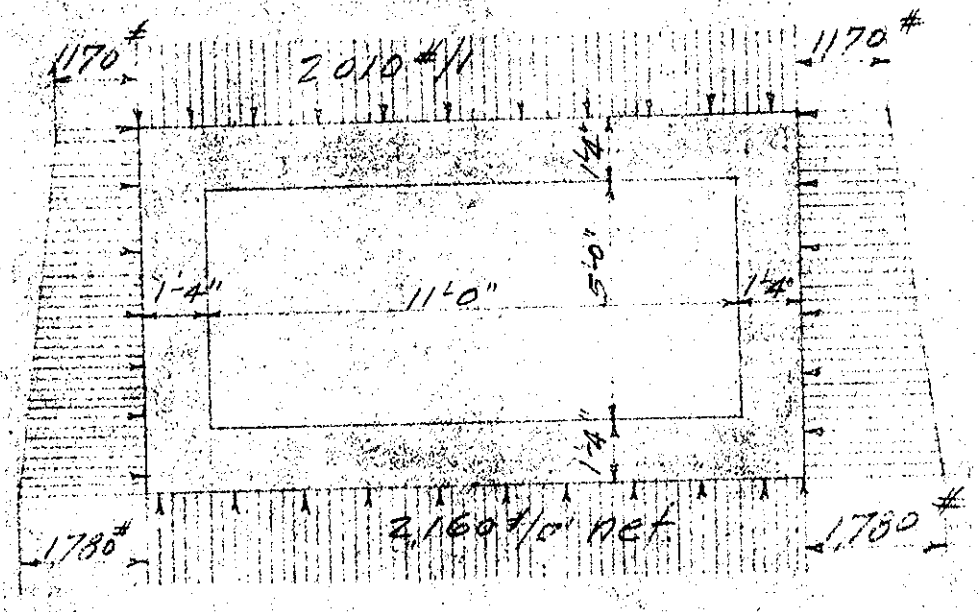


Earth fill on top of conduit transition = 14'-6" deep.

Wt. of fill @ 125# per cu. ft. = 1810#/□'

Wt. of conc. roof slab = 200

Total = 2010#/□'

Wt. of sidewalls = 5 × 200 × 2 = 2000# = 147

Total = 2157#/□', say 2160#

With soil assumed saturated, horizontal pressure at top of conduit = 80 × 14.67 = 1,170#/□'

Horizontal pressure at bot. of conduit = 1,780#/□'

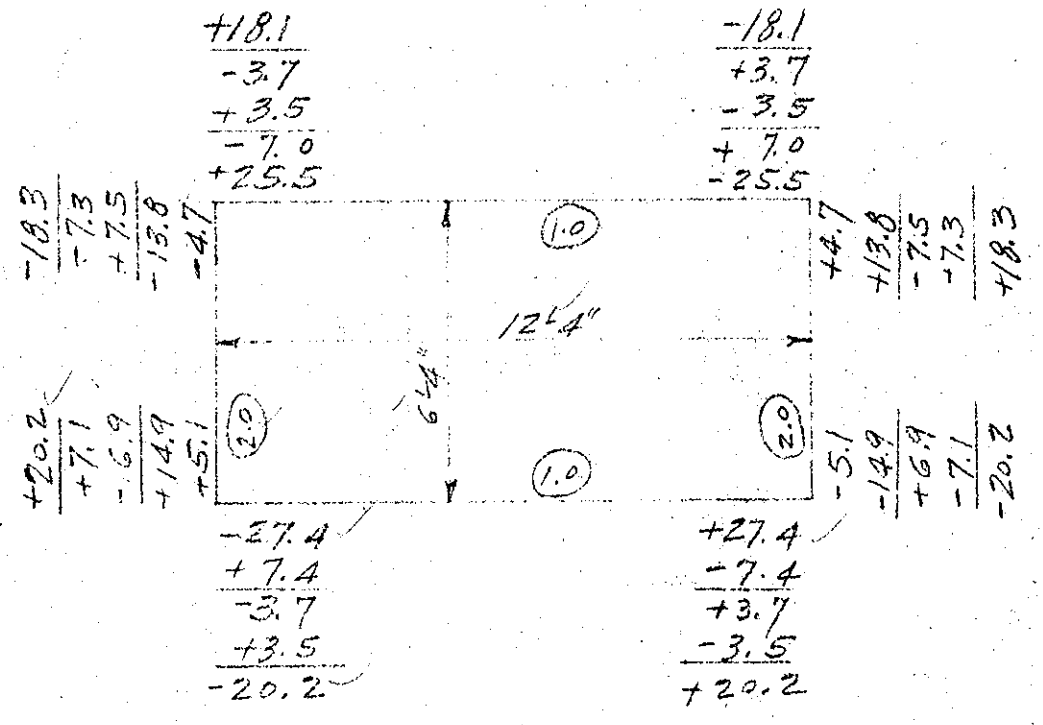
$\frac{I}{l}$ for top & bot. slabs = $\frac{I}{12.33}$

$\frac{I}{l}$ for walls = $\frac{I}{6.33}$

Subject: Paderewski Pumping Station
Computation: Conduit Transition to Trash Rack Chamber
Computed by: E.M.V. Checked by: Date: March 27, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10628

(Continued from sheet #122)



Moment Distribution Diagram.

Shear, ends of top slab = 12,400#

" " " bot. " = 13,300#

" at top of walls = ~~4,700~~ 4000#

" " bot. " " = ~~6,600~~ 5300

Unit shear in top slab = $\frac{2010 \times 5.5}{12 \times \frac{7}{8} \times 12.5} = 84$ #/□" O.K.

" " " bot. " = $\frac{2160}{2010} \times 84 = 90$ #/□" O.K.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

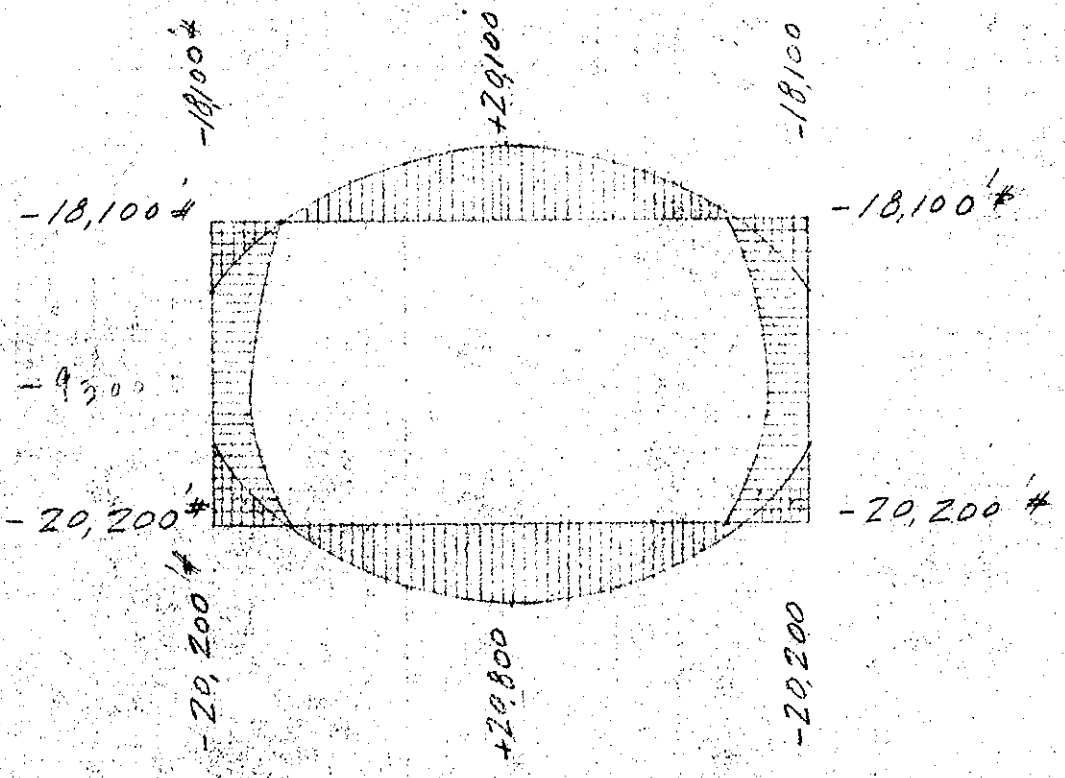
Subject: Paderewski Pumping Station

Computation: Conduit Transition to Trash Rack Chamber

Computed by: E.M.V. Checked by: Date: March 28, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #123)



Bending Mom. Diagram.

"d" req'd by bend mom. = $\sqrt{\frac{20800}{123}}$ = 13."

Make walls & top slab 1'-5" thk.
" bot. slab 1'-6" "

$A_s = \frac{20,800 \times 12}{\frac{7}{8} \times 13.5 \times 18,000} = 1.17\square''$. Use $\frac{7}{8}''\phi$ bars 6" c.c.

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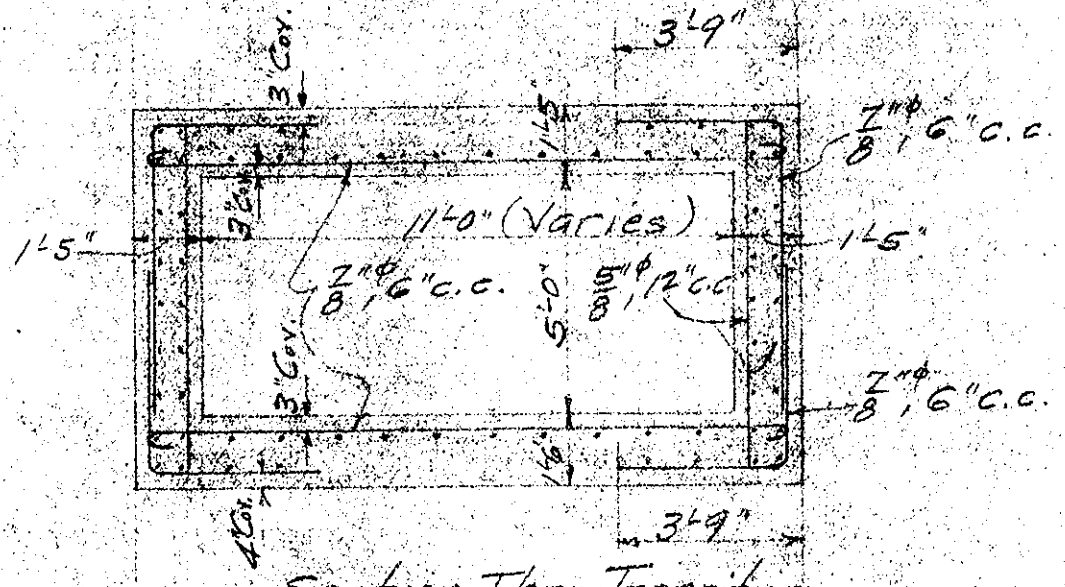
Subject: Paderewski Pumping Station

Computation: Conduit Transition to Trash Rack Chamber

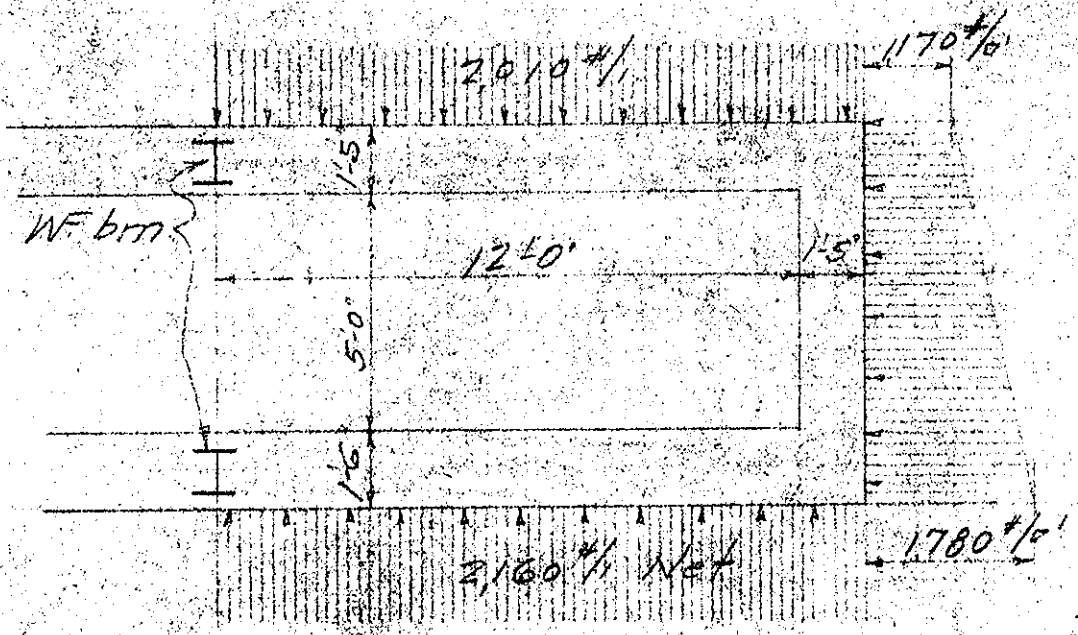
Computed by: E. M. V. Checked by: Date: March 28, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10628

(Continued from sheet #124)



Section Thru Transition



Loading Diagram of Transition

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

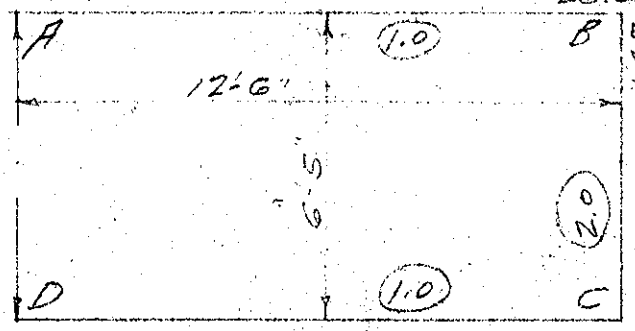
Computation: Conduit Transition to Trash Rack Chamber

Computed by: E. M. V. Checked by: Date: March 28, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #125)

0.0	-24.0
-3.5	+3.0
+3.5	-1.8
-3.6	+6.9
+3.6	-13.1
-26.2	+7.2
+26.2	-26.2



+4.7	-5.1
+14.3	-15.4
-7.7	+7.2
+13.9	-14.2
-7.1	+7.0
+5.9	-5.9
+24.0	-26.4

-28.2	+28.2
+28.2	-7.7
-3.9	+14.1
+3.9	-7.1
-3.6	+1.9
+3.6	-3.0
0.0	+26.4

Mom. Distribution Diag.

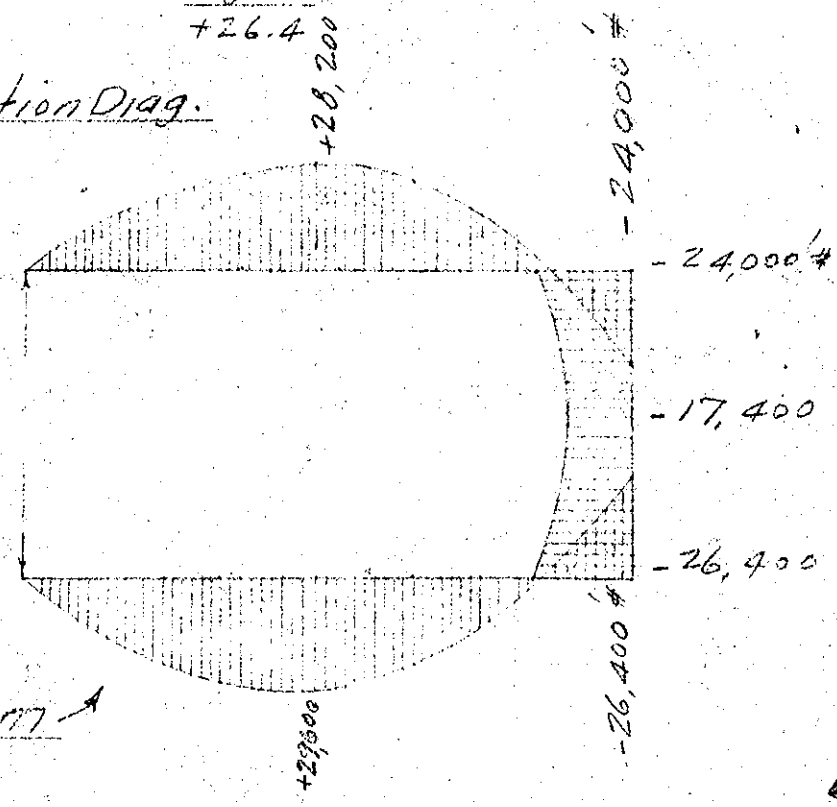
For slabs:

Shear at "A" = 10,700#

" " B = 14,500#

" " C = 15,600#

" " D = 11,400#



Mom. Diagram

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Subject Paderewski Pumping Station
Computation Conduit Transition to Trash Rack Chamber
Computed by E.M.V. Checked by Date March 29, 1940.

U.S. GOVERNMENT PRINTING OFFICE 3—10638

(Continued from sheet #126)

Top slab, $d = \sqrt{\frac{28200}{123}} = \cancel{14.8}$ 15.2 Make slab 1'-6" thk.

Bot. slab, $d = \sqrt{\frac{29600}{123}} = 15.5"$ " " 1'-8" thk.

Sidewall - $d = \sqrt{\frac{26,400}{123}} = 14.6"$ " wall 1'-6" thk.

Unit shear, top slab $= \frac{13100}{12 \times \frac{7}{8} \times 14.8} = 84\#/\square"$ O.K.

" " , bot. " $= \frac{14000}{12 \times \frac{7}{8} \times 15.5} = 86\#/\square"$ O.K.

A_s for pos. mom., top slab, $= \frac{28200 \times 12}{\frac{7}{8} \times \cancel{14.8}\ 15.2 \times 18,000} = \cancel{1.45}\ 1.41\ \square"$

" " neg. " " " " $= \frac{24000 \times 12}{\frac{7}{8} \times \cancel{14.8}\ 15.2 \times 18,000} = \cancel{1.24}\ 1.20\ \square"$

" " pos. " bot. slab, $= \frac{29,600 \times 12}{\frac{7}{8} \times 15.5 \times 18,000} = 1.45\ \square"$

" " neg. " " " $= \frac{26,400 \times 12}{\frac{7}{8} \times 15.5 \times 18000} = 1.29\ \square"$

" " sidewall $= \frac{26400 \times 12}{\frac{7}{8} \times 14.6 \times 18,000} = 1.38\ \square"$

For pos. mom., top slab, use 1"φ bars 6" c.c.

" neg. " " " " $\frac{7}{8}$"φ " 6" c.c.

" pos. " bot. " " 1"φ " 6" c.c.

" neg. " " " " $\frac{7}{8}$"φ " 6" c.c.

" " " in wall " 1"φ " 6" c.c.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

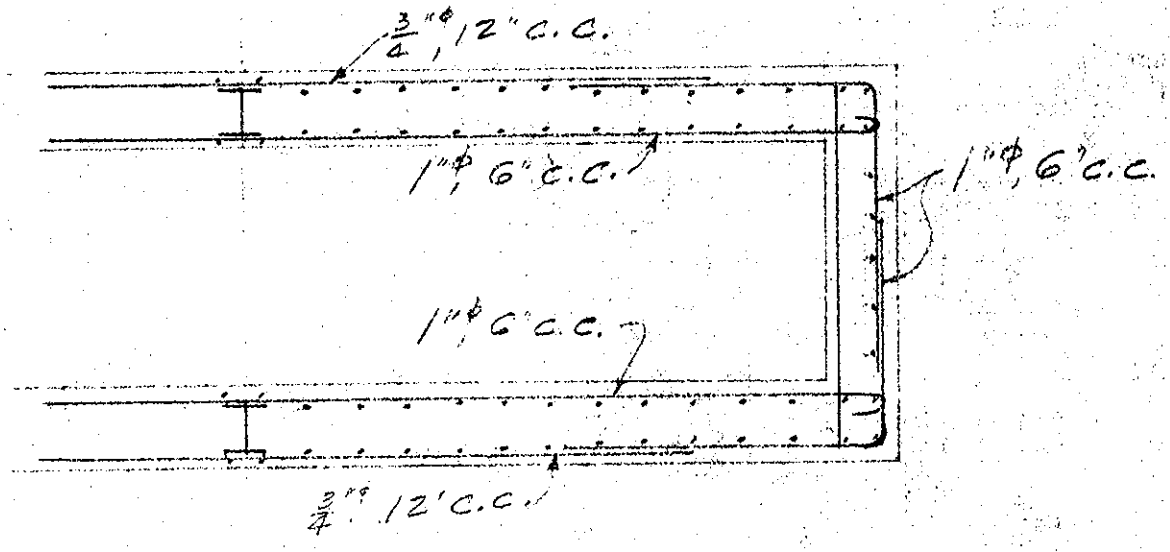
Subject Paderewski Pumping Station

Computation Conduit Transition to Trash Rack Chamber

Computed by E.M.V. Checked by ..... Date March 29, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #127)



WAR DEPARTMENT

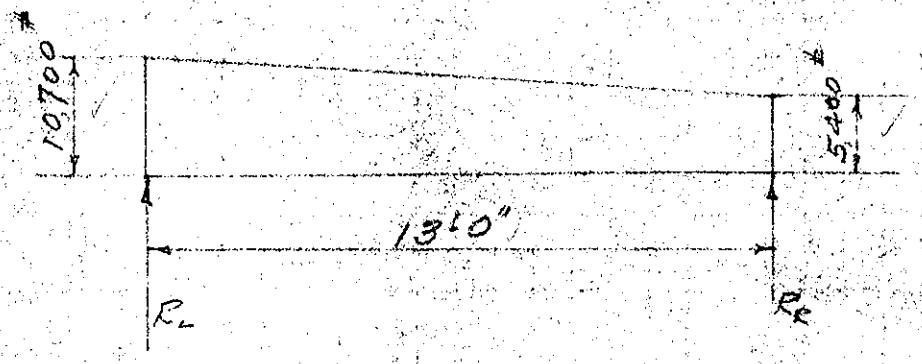
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Paderewski Pumping Station

Computation: Steel Beams in Roof & Base Slabs of Transition Chamber

Computed by: E. M. Y. Checked by: Date: April 2, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10598



$R_L = 5400 \times 6.5 + \frac{1}{2} \times 5300 \times \frac{13.0}{3} = 58,000$ #

$R_R = 46,500$ #

Max. mom. $= 46,500 \times 6.8 - 5400\frac{(6.8)^2}{2} - \frac{1}{2} \times 2770 \times \frac{(6.8)^2}{3}$

$= 169,700$ #.

Sect. mod. req'd. $= \frac{169,700 \times 12}{18,000} = 113''^3$

Use 1-10" WF 100# S. M. = 112.4 $''^3$ in conduit roof

Bending mom. in conduit base slab steel beam

$= \frac{11,400}{10,700} \times 169,700 = 180,800$ #

Sect. mod. req'd. $= \frac{180,800 \times 12}{18,000} = 120''^3$

Use 1-10" WF 100#

WAR DEPARTMENT

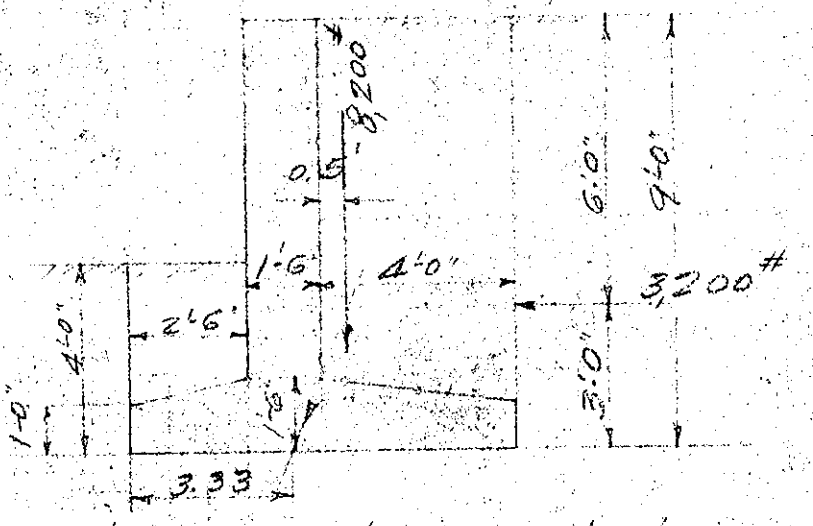
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

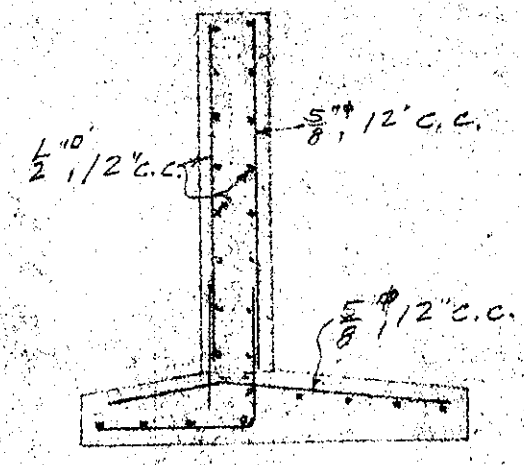
Subject: Paderewski Pumping Station

Computation: Landside Wing Walls

Computed by: E.M.V. Checked by: Date: March 29, 1940

U. S. GOVERNMENT PRINTING OFFICE 3—10538





Position of vertical resultant -

$1.5 \times 8.5 \times 150 \times 3.25 = 6,200$

$1.0 \times 8.0 \times 150 \times 4.00 = 4,800$

$4.75 \times 0.5 \times 150 \times 4.00 = 1,400$

$2.50 \times 2.75 \times 125 \times 1.25 = 1,100$

$4.00 \times 7.75 \times 125 \times 6.00 = 23,300$

$36,800$

$C.g. = \frac{36,800}{8,200} = 4.5'$ = position of resultant.

Max. soil pressure $= \frac{8200}{8.0} + \frac{8200 \times 0.67 \times 6}{64} = 1025 + 515$
$= 1540\#/\square'$

Min. " " $= 1,025 - 515 = 510\#/\square'$

Subj. Paderewski Pumping Station
Computation Landside Wing Walls.
Computed by E.M.V. Checked by Date March 30 1940.

U.S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #130)

Bending mom. in stem = $80 \times \frac{7.5^2}{2} \times 2.5 = 5600$ #.

"d" = $\sqrt{\frac{5600}{123}} = 6.7$". Make stem 1'-6" wide "d" = 14.5"

$A_s = \frac{5600 \times 12}{\frac{7}{8} \times 14.5 \times 18{,}000} = 0.29$ □" Use $\frac{5}{8}$"φ bars 12" c.c.

Unit bond stress = $\frac{80 \times 7.5 \times 3.75}{1.96 \times \frac{7}{8} \times 14.5} = 91$ #/□" O.K.

Bending mom. in heel = $1.25 \times \times 4.0 \times 150 \times 2.0 = 1500$
$4.0 \times 7.75 \times 125 \times 2.0 = 7750$

Deduct $\begin{cases} 510 \times 4.0 \times 2.0 = 4080 \\ \frac{1}{2} \times 515 \times 4.0 \times 1.33 = 1350 \end{cases}$

3800 #

$A_s = \frac{3800 \times 12}{\frac{7}{8} \times 14.5 \times 18{,}000} = 0.20$ □". Use $\frac{5}{8}$"φ, 12" c.c.

Make heel slab 1'-0" thk. at edge and 1'-6" thk. at stem.

Bending mom. in toe = $710 \times 2.5 \times 1.25 = 1900$
$\frac{1}{2} \times 320 \times 2.5 \times 1.67 = 700$

Deduct $\begin{cases} 2.75 \times 125 \times 2.5 \times 1.25 = 1100 \\ 1.25 \times 2.5 \times 150 \times 1.25 = 600 \end{cases}$

800 #

Make slab 1'-0" thk. at edge and 1'-6" thk. at stem.
Use $\frac{5}{8}$"φ, 12" c.c.

Subject Paderewski Pumping Station
Computation Riverside Wing Walls.
Computed by E. M. V. Checked by Date April 1, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

1. Wing wall for 16" discharge pipe.

Max. mom. on wingwall which cantilevers out from the building will occur at the bot. of the wall, acting as a cantilever loaded horizontally.

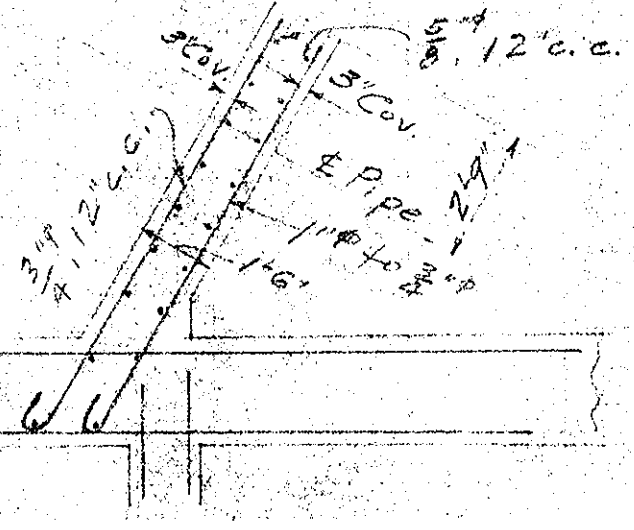
$M = 11.0 \times 80 \times 8 \times 4.0 = 28{,}200\#$

$d = \sqrt{\frac{28{,}200}{12\,3}} = 15.''$ Make 1'-6" thk.

Unit shear $= \frac{11.0 \times 80 \times 8.0}{12 \times \frac{7}{8} \times 14.5} = 46\#/\square''$ O.K.

$A_s = \frac{28{,}200 \times 12}{\frac{7}{8} \times 14.5 \times 18{,}000} = 1.48\square''$

Use 1"ϕ bars 6" c.c. for lowest 4'-0" of cantilever
" 1"ϕ " 10" c.c. " next 4'-0" " "
" 3/4"ϕ " 12" c.c. " top 3'-0" " "



Subject: Paderewski Pumping Station
Computation: Riverside Wing Walls
Computed by: E.M.V. Checked by: Date: April 1, 1940

U.S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #133)

From figure on sheet #133 eccentricity on base = 1'-3".

Max. soil pressure = $\frac{13100}{10.0} + \frac{13100 \times 1.25 \times 6}{10 \times 10} = 1{,}310 + 980$
$= 2290$ #/□'

Min. soil pressure = 1,310 − 980 = 330 #/□'

Bending mom. in stem = 11.5 × 80 × 5.75 × 3.83 = 20,300 #.

$d = \sqrt{\frac{20{,}300}{123}} = 12.8"$ Make stem 1'-6" thk.

$A_s = \frac{20{,}300 \times 12}{\frac{7}{8} \times 14.5 \times 18{,}000} = 1.07\square''$

Bending mom. in heel = 125 × 5.0 × 11.8 × 2.50 = 18,400
$\frac{1}{2}(1.0 + 1.5)5.0 \times 150 \times 2.50 =$ 2,300
20,700

Deduct 330 × 5.0 × 2.5 = 4100
$\frac{1}{2} \times 980 \times 5.0 \times 1.67 =$ 4100
12,500 #

$A_s = \frac{12{,}500 \times 12}{\frac{7}{8} \times 13.5 \times 18{,}000} = 0.71\square''$

Bending mom. in toe = 1600 × 3.5 × 1.75 = 9,800
$\frac{1}{2} \times 690 \times 3.5 \times 1.17 =$ 1400
11,200

Deduct 125 × 2.75 × 1.75 × 3.5 = 2100
$\frac{1}{2}(1.0 + 1.50)3.5 \times 150 \times 1.75 =$ 1,200
7,900 #

Subject: Paderewski Pumping Station
Computation: Riverside Wing Walls
Computed by: E.M.V. Checked by: Date: April 2, 1940.

U. S. GOVERNMENT PRINTING OFFICE 3—10528

(Continued from sheet #102)

$$A_s = \frac{7900 \times 12}{\frac{7}{8} \times 13.5 \times 18000} = 0.45 \square''$$

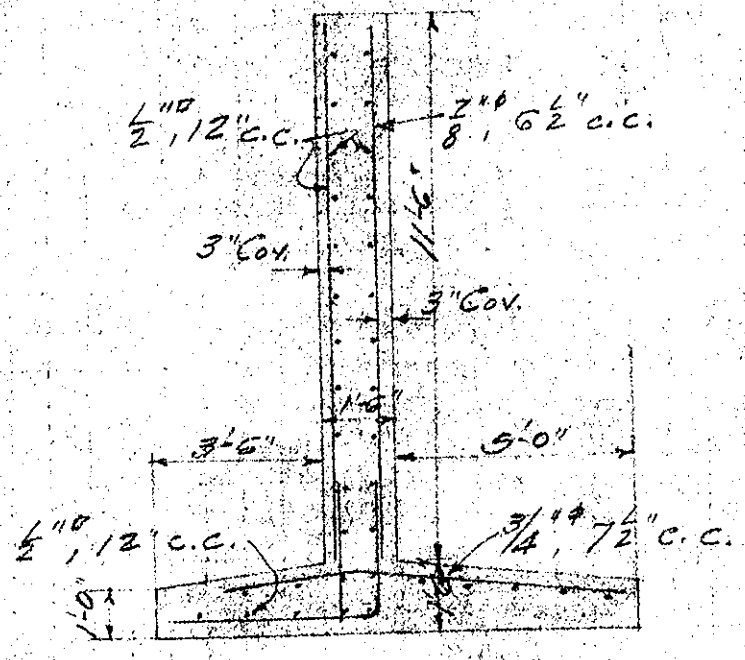
For stem use $\frac{7}{8}''\phi$ bars $6\frac{1}{2}''$ c.c.

Bond stress in stem $= \frac{5300}{1.8 \times 2.75 \times \frac{7}{8} \times 14.5} = 84\ \#/\square''$ O.K.

For heel use $\frac{3}{4}''\phi$ bars $7\frac{1}{2}''$ c.c.

Bond stress $= \frac{4100}{1.6 \times 2.36 \times \frac{7}{8} \times 13.5} = 92\ \#/\square''$ O.K.

For toe try $\frac{3}{4}''\phi$, 12" c.c.

Bond stress $= \frac{4900}{2.36 \times \frac{7}{8} \times 13.5} = 176\ \#/\square''$

Bend down steel from stem.