CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE FALLS
LOCAL PROTECTION PROJECT

CHICOPEE RIVER, MASSACHUSETTS

DESIGN MEMORANDUM NO. 6

PUMPING STATIONS

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

APRIL 1963

ENGCW-EZ (10 Apr 63) 3rd Ind
SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

Office, Chief of Engineers, Washington D. C. 20315, 2 Aug 1963

TO: Division Engineer, U. S. Army Engineer Division, New England

The actions taken in regard to the OCE comments contained in the preceding OCE 1st indorsement dated 10 May 1963 are satisfactory.

FOR THE CHIEF OF ENGINEERS:

2 Incls
1. Plate No. 7 (marked in green)
2. Cy of Spec - Entrance Doors

HORACE A. JOHNSON
Acting Chief, Engineering Division
Civil Works

Messrs. Coffin/Fowler/Haines/Whittemore/lc/515

Mr Coffin

[illegible] (10 Apr 63) 2nd Ind
SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

U.S. Army Engineer Division, New England, Waltham, Mass. [illegible] July 1963

TO: Chief of Engineers, ATTN: , Washington, D. C.

Submitted below are comments, referenced to paragraph numbers of 1st Indorsement.

Par. 2a. Add to Paragraph 7. - "This pumping station is located at the toe of slope on the land side of an earth dike. Seepage beneath the pumping station is controlled by features of the adjoining dike section and by the minimum depth of adjoining fill which equals approximately the hydraulic head, assuming the tail water at the top of the fill. The adjoining dike section provides for a foundation cut-off and also for relief of foundation seepage pressures by the large gravel fill section along the north and south walls of the pumping station".

Par. 2b. Rock anchors at the Main Street pumping station have been deleted.

Par. 2c. The bar racks have been checked and corrected to agree with the requirements set forth in paragraph 8b of EM 1110-2-3104. Spacing of bars will be 1-3/4 inches.

Par. 2d. Contract specifications require hydraulic starters.

Par. 2e(1). Contract specifications permit either mixed flow or propeller type pumps and the specified heads are as requested.

Par. 2e(2). The gravity conduit discharge gates can readily serve as [illegible] during marginal inflow. Moreover, the pump engines will be equipped with governors permitting adjustable speed settings, to accommodate variable flow conditions. As agreed in recent telephone discussion between Messrs. W. Farrar and E. Creden, additional by-pass provisions are not required.

Par. 2e(3). Pump intake areas have been approximately doubled.

Par. 2f. Electric motor sluice gate operators were provided on all pumping stations previously constructed by the Corps in Chicopee. City desires similar arrangement at these stations to conserve manpower during flood emergencies. Savings resulting from use of manual operators and portable hoist are not considered sufficient to justify change.

NEDOB (10 Apr 63) 2nd Ind 25 July 1963
SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

Par. [illegible]. Fuel tanks have been changed to above ground installation.

Par. [illegible]. Dehumidifiers have been added in each station.

Par. [illegible]. The pumping station entrance doors will be approved industrial steel paneled doors as called for in the contract plans and specifications.

Par. 21(1). The suggested reduction of 1½ feet on the riverside base cannot be made as this would shorten the creep ratio of the adjacent tee walls. The large extension on the riverside matches the heel extension on both adjacent tee walls. Inasmuch as the riverside distance cannot be shortened there is no apparent need for extending the base on the landside out under the 30-inch RCP pipe.

Par. 21(2). The use of steel channels for stop log slots is undesirable. The slots formed into the concrete are easy to form, will require no maintenance, and have little likelihood of being used. The suggested channels will require maintenance that may be difficult due to possible water conditions at the lower part and will protrude out into the pump discharge which is not considered desirable.

Par. [illegible]. Investigation has been made for additional steel required to resist the application of passive pressure to the landside wall.

FOR THE DIVISION ENGINEER:

2 Incls
nc

JOHN WM. LESLIE
Chief, Engineering Division

cc: Mr. Leslie
Mr. Groden
Mr. Coffin
Mr. Fowler
Mr. Haines
Mr. Whittemore
Eng. Div. File

ENGCW-EZ (10 Apr 63) 1st Ind
SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

Office, Chief of Engineers, Washington 25, D. C., 10 May 1963

TO: Division Engineer, U. S. Army Engineer Division, New England

1. Reference is made to NED letter dated 19 April 1963, same subject.

2. Design Memorandum No. 6 is approved subject to changes included in NED letter referenced in paragraph 1 above, and to the following comments:

a. Paragraph 7 should be expanded to discuss the means of controlling underseepage.

b. Paragraph 18, last sentence. Consideration should be given to deleting rock anchors at the Main Street station since the passive pressure of the deep earth embedment is adequate to develop resistance to the unbalanced horizontal forces.

c. Paragraph 19. Bar racks should be designed in accordance with the criteria set forth in subparagraph 8b of EM 1110-2-3104.

d. Paragraph 21. The engines should be provided with hydraulic starters as described in paragraph 12b(2) of EM 1110-2-3105.

e. Paragraph 24.

(1) The contract specifications should permit the furnishing of axial flow pumps with either the mixed flow or propeller type of impeller. In specifying the performance for the pumps to be installed in the Main Street Station, the specification should state: "Rating. Each pump shall be capable of operating and delivering not less than 9900 gpm at a pool to pool head of 7.7 feet and not less than 9000 gpm at a pool to pool head of 19.4 feet.". In this case, as the pumps discharge directly into the river, pool to pool head is the difference in elevation between the water surface at minimum sump and the water surface of the river at low water stage or at design flood. It is not considered that the pumps will be required to operate at river stages above design flood. For the Oak Street Station, the specification should state: "Rating. Starting with a static head of 11.1 feet each pump shall be capable of operating and delivering not less than 8600 gpm at a pool to pool head of _ _ _ feet and starting with a static head of 21.0 feet each pump shall be capable of operating and delivering not less than 7000 gpm at a pool to pool head of _ _ _ feet.". Static head is the difference in elevation between the water surface at minimum sump and the river water surface at low water or at design flood when there is no flow through the

outfall. Pool to pool head is the sum of the static head and the losses for a given flow between the discharge chamber and the river when there is flow through the outfall. A curve giving these losses for various flows should be included in the specification.

(2) As previously pointed out, a diesel engine is not too satisfactory a pump drive for those pump stations that have limited sump capacity (such as in the instant case) and the pumps will be required to cycle "ON" and "OFF" every four to six minutes when the flows are less than the design flow. To alleviate this undesirable operating condition, a station bypass should be provided as described in subparagraph 6d of EM 1110-2-3102. The usable sump volume of the Main Street Station could be increased by the use of a longer pump column that would place the pump intake bell at the accepted distance above the sump floor.

(3) The size of the sump intakes should be increased.

f. Paragraph 26. All sluice gates should be provided with manually operated type floorstands and a portable power-driven wrench provided at each station for the operation of the sluice gates. Information covering this feature is given in paragraph 18c of EM 1110-2-3105, 10 December 1962.

g. Paragraph 27. In order to prevent damage to the fuel storage tank from corrosion, it should be placed in a covered concrete pit rather than buried in the ground. The pit should be provided with an adequate drain, the tank painted with a cold applied coal tar, placed on saddles and anchored, and the pit filled with coarse sand or pea gravel.

h. Paragraph 30. In view of the type heating system to be installed, dehumidification equipment should be provided to remove moisture from the station during inoperative periods. Information covering the design of the dehumidification facility is covered in paragraph 22 of EM 1110-2-3105.

i. Plate No. 6. Inclosed (Inclosure No. 2) is a copy of the specification for pumping station entrance doors to be used as a guide in the preparation of the specification covering doors for the subject pumping stations. This type door has been used by the St. Louis District in most of the pumping stations constructed as a part of the St. Louis Project.

j. Plate No. 7.

(1) Since it will be necessary to extend the excavation on the eastern side of the pump station to include the 30-inch R.C.P. bypass main, consideration should be given to extending the base slab approximately 8 feet

ENGCW-EZ (10 Apr 63) 1st Ind 10 May 1963
SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

outside of the station on this side so as to permit a reduction of approximately 14 feet in the long slab extension on the other side and to avoid encroachment of the excavation into the river channel. No major change in slab thickness or reinforcement is considered necessary.

(2) Stop log slots should be constructed using steel channels as indicated in green on the drawing (Inclosure No. 1). This type of slot should also be used on the Oak Street Station.

k. Page A-28. Consideration should be given to increasing the load on the landside wall to include passive pressure from the external earth to resist sliding.

FOR THE CHIEF OF ENGINEERS:

2 Incls
1. Plate No. 7 (marked in green)
2. Cy of Spec - Entrance Doors (Incl 1 w/d)

for WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

Mr. B./Cma/rs

[illegible]

17 April 19[illegible]

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

TO: Chief of Engineers
ATTN: [illegible]
Department of the Army
Washington 25, D. C.

1. [illegible] is made to our letter dated 10 April 19[illegible], submitting the subject memorandum. Please note two corrections which should be made therein:

Page 9 - Paragraph 22 is deleted in its entirety and the following is substituted therefor: "Alternate Pump Drives. A cost comparison to determine the most economical pump drive was made. Based on these comparisons as shown below, diesel engine drive was selected".

Page 12 - Paragraph 37 is deleted and the following is substituted therefor: " [illegible] and [illegible] All interior and exterior wiring is in steel [illegible] Conductors are copper with insulation conforming to Civil Works Guide Specification C.E. [illegible]".

FOR THE DIVISION ENGINEER:

JOHN WM. LESLIE
Chief, Engineering Division

cc: Mr. Leslie
Mr. Graden
Mr. Coffin
Engr Div Files

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDGW

10 April 1963

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

TO: Chief of Engineers
ATTENTION: ENGCW-E
Department of the Army
Washington 25, D. C.

There is submitted for review and approval Design Memorandum No. 6 - Pumping Stations, for the Chicopee Falls Local Protection Project, Chicopee River, Massachusetts, in accordance with EM 1110-2-1150. The contract award for construction of this project is scheduled for May, 1963, and an early receipt of your review comments will be appreciated in order that the plans and specifications may be completed on schedule.

FOR THE DIVISION ENGINEER:

JOHN WM. LESLIE
Chief, Engineering Division

Incl (10 cys)
Des. Memo No. 6

FLOOD CONTROL PROJECT
CHICOPEE FALLS LOCAL PROTECTION PROJECT
CHICOPEE RIVER
CHICOPEE RIVER BASIN
MASSACHUSETTS

DESIGN MEMORANDA INDEX

Number	Title	Submission Date	Approved
1	(Omitted)		
2	General Design, Hydrology, Hydraulics & Geology	21 Dec 1962	22 Jan 1963
3	Real Estate	29 Mar 1963	
4	Concrete Materials	9 Nov 1962	23 Nov 1962
5	Embankment & Foundations	6 Mar 1963	21 Mar 1963
6	Pumping Stations	10 Apr 1963	
7	Detailed Design of Flood-walls & Structures	13 Mar 1963	

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Main Street Pumping Station

Oak Street Pumping Station

FLOOD PROTECTION

CHICOPEE FALLS

LOCAL PROTECTION PROJECT

CHICOPEE RIVER, MASSACHUSETTS

DESIGN MEMORANDUM NO. 9

PUMPING STATIONS

APRIL, 1963

A. PERTINENT DATA

a.	Number of Stations	2 - Main and Oak Streets	
b.	Purpose	To pass combined storm run-off, industrial waste water and sanitary sewage originating below the protection elevation through the dike and floodwall at high river stages.	
c.	Location of Stations		
	(1) State	Massachusetts	
	(2) City	Chicopee	
	(3) Area of City	Chicopee Falls	
	(4) River	Chicopee River, left bank downstream from Deady Memorial Bridge.	
		Main Street	Oak Street
d.	Drainage Area	20.5A	17.8A
e.	Sanitary and Industrial Wastes	4 c.f.s.	20 c.f.s. max.
f.	Allowance for Underseepage	6 c.f.s.	6 c.f.s.

g. Pumping Stations	Main Street	Oak Street
(1) Type	Wet Pit	Wet Pit
(2) Size	17'x21'	21'x28'
(3) Architectural Treatment	Concrete superstructures	
(4) Rated Capacity		
High River Stage	40.0 c.f.s.	46.6 c.f.s.
Low River Stage	44.0 c.f.s.	57.0 c.f.s.
(5) Pumps		
(a) Type	Mixed Flow	Axial Flow
(b) Number	2	3
(c) Size	16-inch (18-in.discharge)	16-inch (16-in. discharge)
(d) Performance, each, River at high stage		
1. Capacity	9000 gpm	7000 gpm
2. Static Head	19.4 ft.	21.1 ft.
3. Total Dynamic Head	21.4 ft.	23.5 ft.
(e) Performance, each, River at low stage		
1. Capacity	9900 gpm	8600 gpm
2. Static Head	7.7 ft.	7.0 ft.
3. Total Dynamic Head	10.1 ft.	10.8 ft.
(f) Drive		
1. Type	Diesel	Diesel
2. Horsepower	85 hp	75 hp
(6) Sump Water Elevations, MSL		
(a) Maximum w.l.	83.0	80.0
(b) Minimum w.l.	78.37	75.0

B. INTRODUCTION

1. Purpose. The purpose of this memorandum is to summarize and record the basic features of the design for two pumping stations for the Chicopee Falls Local Protection Project, to facilitate review and provide a convenient reference.

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

3. Construction Schedule. These stations will be constructed under a continuing type contract to be advertised in the Spring of 1963. The contract will include channel work, dikes, flood walls, etc., for the project. Construction of the pumping stations will be scheduled for 1963.

C. HYDROLOGY AND HYDRAULICS

4. Hydrology and Hydraulics are presented in Design Memorandum No. 2, General Design, Hydrology, Hydraulics and Geology, as are the Pumping Station Design Concepts summarized in A above.

D. GEOLOGY

5. General site geology is presented in Design Memorandum No. 2, General Design, Hydrology, Hydraulics and Geology.

6. The Main Street Station is founded on sound shale bedrock, as is the adjacent flood wall. Rock anchors are used to eliminate differential movement relative to the adjoining anchored tee walls.

7. The Oak Street Station is founded on granular soil, about three feet above a stratum of dense glacial till.

E. CONCRETE MATERIALS

8. Concrete Aggregate. Six commercial sources of sand and crushed stone were considered: five are recommended as satisfactory. A complete discussion of sources and costs with test results is included in Design Memorandum No. 4, Concrete Aggregates.

F. ARCHITECTURAL DESIGN

9. General. Architectural design of the pumping stations is in accordance with the Engineering Manual, EM 1110-2-3103, "Architectural Design of Pumping Stations," dated February 1960. Architectural treatment is shown on Plates 6, 7, 10 and 11.

10. Architectural Design. The superstructures of the pumping stations are cast-in-place reinforced concrete. The roofs are pitched to the pump discharge chambers, which are carried full height of the building. Roof construction is concrete slab with rigid insulation and 5-ply built-up roofing. Access to the roofs is by interior ladder. Stop log storage is provided on the roofs. Metal cabinet enclosures are used to provide security for the sluice gate operators.

G. STRUCTURAL DESIGN

11. General. This section presents the design criteria, basic data and assumptions used in the design of the pumping stations. A brief discussion of the stations is included as background for the structural computations which are presented in Appendices A and B.

12. Design Criteria.

a. General. All working stresses conform to those specified in the Engineering Manual for Civil Works, EM 1110-1-2101, "Working Stresses for Structural Design" dated 6 January 1958. Loading conditions, design assumptions, and other design criteria are based on the following applicable parts of the Engineering Manual for Civil Works: Standard Practice for Concrete (EM Part CXX - October 1953); Pumping Stations - Structural Design (EM 1110-2-3104 - 9 June 1958); and Wall Design - Flood Walls (EM 1110-2-2501 - January 1948 with changes 1 and 2 and Supplement). Accepted practice has been followed where the Engineering Manual for Civil Works does not apply.

b. Concrete. The following table lists the concrete and reinforced concrete working stresses used in the design of structures.

Description	p.s.i.
(Based on f_c = 3,000 p.s.i.)	
Flexure - (f_c)	
Extreme Fiber stress in compression	1050

Description (Cont'd)	p.s.i.
Shear - (v)	
Beams - no web reinforcement	90
Beams with properly designed web reinforcement	240
Flat Slab at critical section	90
Bond - (u)	
Deformed Bars	
Top bars	210
All others	300
Bearing - (f_c)	
Load on entire area	750
Load on 1/3 area or less (Maximum permissible)	1125
(When loaded area is greater than 1/3, the stress coefficient should vary lineally between the above values.)	
Modular Ratio - (n)	10

c. Reinforcement.

(1) Grade and Working Stresses. All reinforcement in the structures including temperature and shrinkage reinforcement is designed for the working stresses of new billet steel, intermediate grade, deformed bars: 20,000 p.s.i. in flexural tension. Reinforcement will conform to the requirements of Federal Specifications QQ-S-632, Type II and to ASTM A305.

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

(3) Minimum Cover for Main Reinforcement

	Min. Cover (Inches)
Bottom of base slabs	4
Top of base slabs	3
Foundation walls, both faces	3
Exterior walls above grade	2
Floor and roof slabs	3/4
Interior girders	2
Interior floor beams	1-1/2

The concrete covering of stirrups, spacer rods, and similar reinforcement may be reduced by the diameter of such rods.

(4) Splices. All splices are lapped 24 diameters to develop, by bond, the total working strength of the bars. Splices in the main reinforcement at points of maximum moment are avoided in the design.

(5) Temperature and Shrinkage Reinforcement. Temperature and shrinkage reinforcement is provided in slabs and walls where the main reinforcement extends in only one direction. Such reinforcement, based on deformed bars, provides for a minimum ratio of steel area to concrete area (bd) of 0.002 with a minimum of .001 in each face up to a maximum of #6 bars @ 12" center-to-center.

d. Structural Steel. Structural steel is designed in accordance with the specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, issued by the American Institute of Steel Construction. Allowable design working stresses conform to those given in the Engineering Manual for Civil Works using a basic stress of 20,000 p.s.i.

e. Increase in Normal Working Stresses. Normal allowable working stresses will be increased by 33-1/3 per cent for water at the top of the flood wall.

13. Basic Data and Assumptions.

a. Controlling Elevations

Controlling Elevations	Main St.	Oak St.
Engine room floor slab	90.0	86.06
Sump floor slab	74.0	73.0
Water elevation riverside	102.0	97.0
Water elevation landside	88.5	83.5
Maximum elevation of water in sump	83.0	80.0
Minimum elevation of water in sump	78.37	75.0
Finished ground elevation	88.5	83.5-89.0

b. Loads

(1) Dead Loads. The following unit weights for materials have been used:

Material	Pounds per cubic foot
Water	62.5
Dry earth	125
Saturated earth	135
Submerged earth	72.5
Concrete	150

(2) Live Loads. The following live loads have been used:

	Pounds per square foot
Wind	50
Equipment	As furnished by manufacturers
Snow on roof	40
Engine room floor	100 plus equipment loads

c. External Water Pressure. In cases where hydraulic pressure affects the design of a structure, it has been assumed to act over the entire area in question under the full head available. Specific uplift assumptions for the structure are described in a later paragraph.

d. Earth Pressure. Earth pressure against the pumping station walls has been assumed at 40 lbs. per square foot equivalent liquid pressure for dry earth and 24 lbs. per square foot for submerged earth.

14. General Description of Pumping Stations.

a. General. The pumping stations consist of reinforced concrete structures. Discharge chamber required top elevations are nearly at the roofs; they are, therefore, carried to the full building height. Both stations contain gravity by-pass, wet sumps, engine rooms and discharge chambers. Sluice gates are seating type against river pressures. Stop log slots are provided in the discharge chamber to allow pumps or flap valves to be removed for servicing.

b. Main Street Pumping Station. This station is an integral part of the flood wall. The station is located in the yard of the Chicopee Manufacturing Company.

c. Oak Street Pumping Station. This station is located on the landside of the dike. It is on the riverside of the existing river wall at the U. S. Rubber Company.

15. Extent of Design. Design has been carried to an extent which determined a workable layout. A transverse section through the station has been designed for the maximum conditions affecting critical structural framing. The same design procedure will be followed wherever a change in loading or in section is made. Modifications will be made as prescribed by detailed layout and design.

16. Superstructure. The roof slabs are 6-inch, 2-way slabs supported on reinforced concrete walls. Crane loads are carried directly by the concrete walls. Impact load of the cranes is taken as 25% and lateral load is 20% of the live load.

17. Engine Room Floor. Live load on engine room floors is taken as 100 p.s.i. plus equipment concentrations. Slab is of uniform (12") thickness at Main Street. A beam-and-slab arrangement was used at Oak Street.

18. Substructure. Substructures are of reinforced concrete consisting of intake chambers, junction chambers, discharge chambers and sumps. Loads consist of horizontal earth and water pressures, bearing pressures and hydraulic uplifts. Hydrostatic head was determined by the line of creep method for design river levels, with tailwater at ground level. Substructures were designed as monolithic. The Main Street Station adjoins flood walls with rock anchored footings; for this reason, the station base slab is anchored to the rock to limit creep of the structure to match the walls.

19. Trash Racks. Steel trash racks have been provided in the intake chambers, with provision for raking. Racks are designed for full hydrostatic pressure halfway to the top of the chambers.

H. MECHANICAL DESIGN

20. General. This section presents pertinent information concerning the mechanical design of the pumping stations, including pumps, drives, cranes, gates and heating.

21. Pump Drives. Pumps are driven by industrial diesel power units capable of operating the pumps at rated speed at any head conditions that may develop. Required horsepower is less than the continuous engine rating. Drives are mounted on concrete bases and connected to right angle gear units through flexible couplings.

22. Alternate Pump Drives. Consideration was given to provision of reliable electric service from commercial power with dual service or standby power. Due to the length of secondary between stations and from the stations to a reliable underground source, diesel drives are substantially less expensive:

Diesel drives, gear units, fuel systems, aerial service for lighting, etc., for all units at both stations.	$29,300
Single aerial power service, transformers, switch gear, starters, motors, etc., plus diesel generator sets at each station	$61,000
Dual underground service, transformers, switch gear, starters, motors, etc. This includes savings due to reduction in building size.	$72,500

An important consideration in these small stations was the flexibility of operation provided by the variable speed available with diesel drives with adjustable governors. A curve sheet showing the effect of varying speed is included in Appendix C for each station, for the pump selected.

23. Right Angle Gear Units. The gears are of the self-contained type designed for transmitting power from the horizontal engine shaft through a gear train to the vertical pump shaft. The units are enclosed in a cast-iron and structural steel housing and have service factors of not less than 1.25 times the maximum power required to drive the pumps.

24. Pumps.

a. Main Street Station. Two pumps are required. To provide a reasonable capacity in the event of failure of a pump, two 16-inch mixed-flow pumps with a combined capacity of 40.0 c.f.s. against high river stage are provided. Design concepts for both stations are discussed in detail in Design Memorandum No. 2, "General Design Hydrology, Hydraulics and Geology."

b. Oak Street Station. Three 16-inch axial-flow pumps are required at this station to pass maximum process water flow plus storm water from a rainfall approaching a five-year storm at high river stage. At all river stages not requiring pumping of the process water from intermediate plant levels, there is a capacity for pumping storm runoff of 100-year frequency or more.

c. The type, size and general characteristics of pumps required were computed by the procedures outlined in EM 1110-2-3105 dated 10 December 1962. Computations are appended as Appendix C.

25. Crane. A two-ton overhead crane is provided in the engine room of each station to facilitate moving or repair of equipment. Cranes are of standard construction, hand-operated throughout.

26. Sluice Gates. Motor operated sluice gates will be located at the entrance of the sumps; these will be normally closed, except when pumping. Gates on the riverside of the by-pass

opening into the discharge chamber will normally be open except when pumping. At Oak Street, a third gate is provided to allow flows of process water from intermediate levels to by-pass the station while flows from lower areas are pumped. This gate will normally be open when not pumping, closed when pumping against low or moderate river stages, and open at high river stages.

27. Diesel Fuel System. Diesel fuel supply is stored in tanks, buried in the ground adjacent to the pumping stations; approximately 600 gallons at each station. Each engine is supplied through an individual line running directly to the tank. Drip pans are provided on each engine and connected to a common header running back to the tank. All fuel pipe is copper tubing with flared joint connections. At points where lines are embedded in concrete or pass through walls, they are protected by wrought-iron sleeves.

28. Sump Pump. Motor operated sump-pumps of 50 g.p.m. capacity are provided in the wet sumps for the purpose of drying them up after the pumping stations have been in operation.

29. Valves. A flap valve is 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. Stop log slots and logs are provided to close pump discharge lines in the event of flap valve failure.

30. Heating System. The heating system consists of electric powered unit heaters, sized for 50° F. temperature rise. Control is by thermostat with an overriding humidistat, to keep the temperature above the dew point. The use of diesel-oil fired unit heaters was considered with a resulting saving of $400 per year in power costs. However, the City Engineer requested that electric heat be provided to reduce maintenance inspection costs.

I. ELECTRICAL DESIGN

31. Electric Service. Electric service from the City of Chicopee Electric Light Department is overhead from a pole at Blake and Main Streets. The Municipal Electric Light Department has proposed to install electric service for $3,800.

Service poles and transformers will be the responsibility of the Electric Light Department. Service is 120-/240 three wire, single phase, 60 cycle.

32. Distribution. Utility secondary metering and a service entrance breaker is installed at the pumping station. A panel is furnished to serve motor, small power, lighting and receptacle loads in the pumping station. The wiring diagram is shown on Plates 10 and 16.

33. Telephone Service. Conduit, pull wire, and terminal box is provided for the installation of telephone service by the New England Telephone and Telegraph Company.

34. Motors.	Main Street	Oak Street
Floor stands	2 @ 1 HP	3 @ 1 HP
Wet sump exhaust fan	1 @ 1/7 HP	1 @ 1/7 HP
Sump pump	1 @ 2 HP	1 @ 2 HP
Heating Unit	1 @ 7.5 KW	1 @ 15 KW

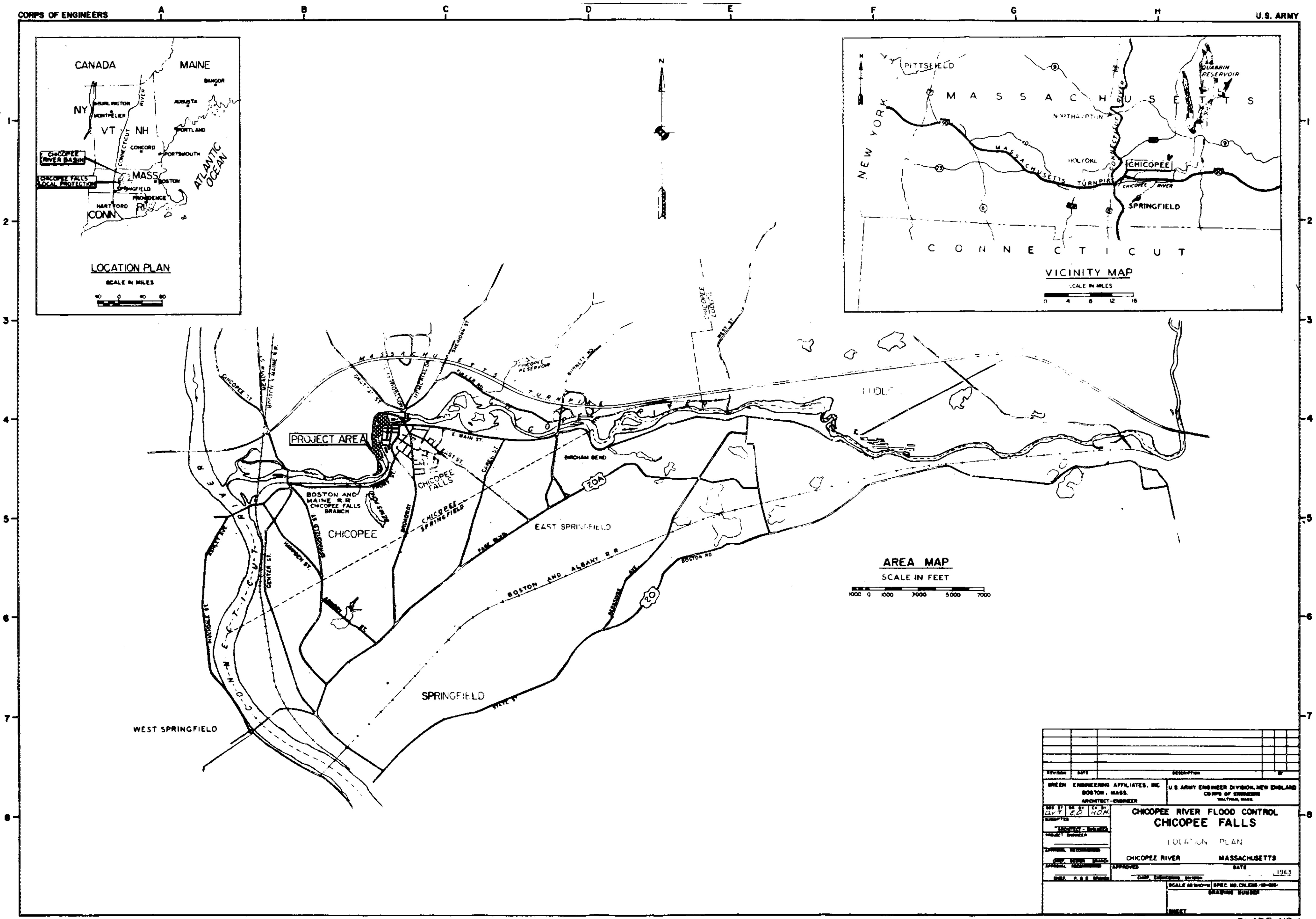
35. Heating. The unit heater with blower is thermostatically controlled with overriding humidistat.

36. Ground System. All conduit, equipment and the neutral conductor are grounded in accordance with the National Electric Code.

37. Conduit and Cables. All interior and exterior wiring are in steel conduit. Copper conductors with 600-volt RHW insulation is used for all wiring.

38. Motor Controllers. Motor controllers suitable for the intended application are installed as required.

39. Electrical Load. The electrical load is expected to create an estimated maximum demand of 11 KW at Main Street and 18 KW at Oak Street.


CORPS OF ENGINEERS
U.S. ARMY
CANADA
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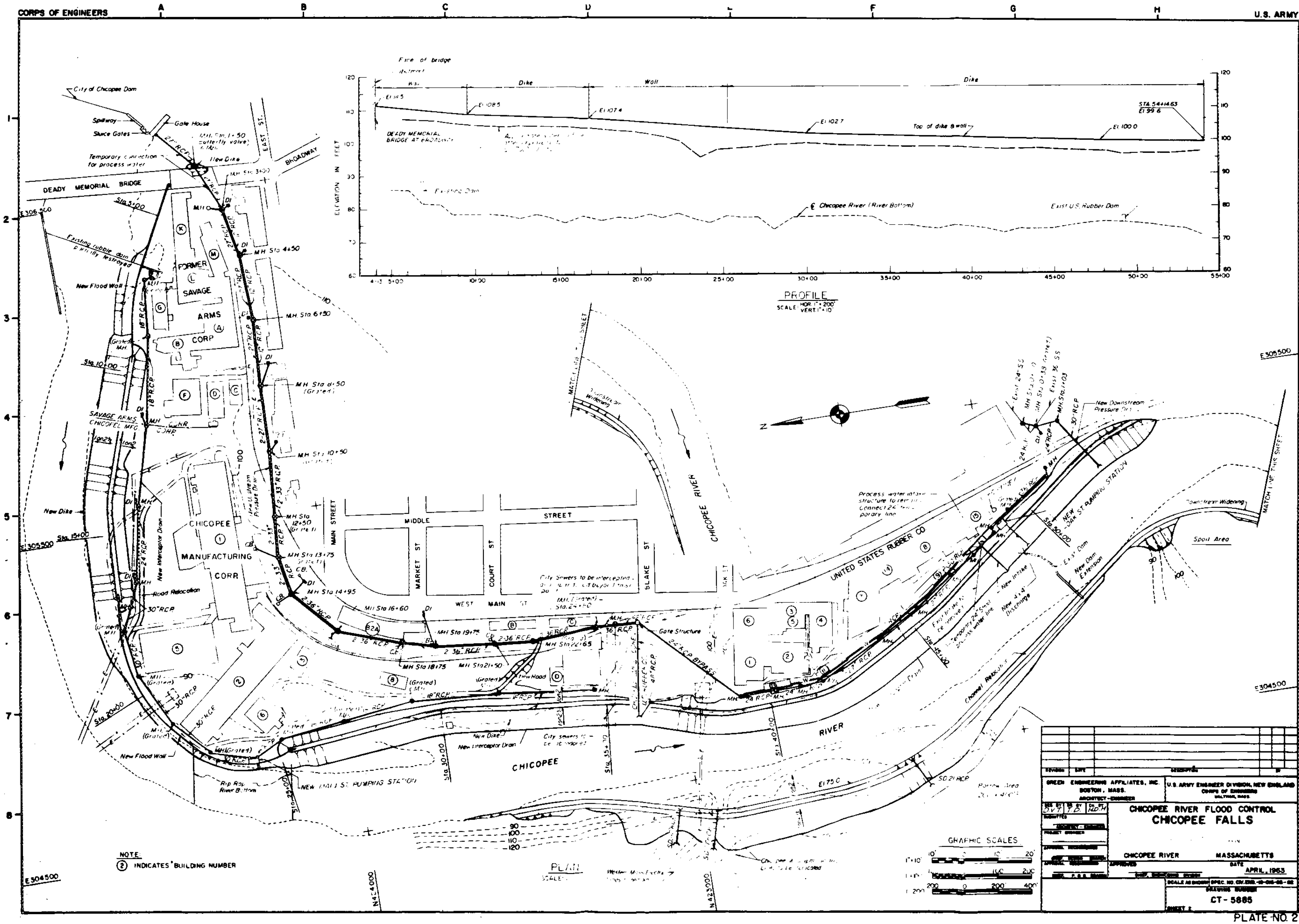
RI
ATLANTIC OCEAN
CHICOPEE RIVER BASIN
CHICOPEE FALLS LOCAL PROTECTION
BURLINGTON
MONTPELIER
CONCORD
PORTLAND
PORTSMOUTH
BOSTON
SPRINGFIELD
HARTFORD
PROVIDENCE
BANGOR
AUGUSTA
LOCATION PLAN
SCALE IN MILES
PITTSFIELD
MASSACHUSETTS
NEW YORK
QUABBIN RESERVOIR
NORTHAMPTON
HOLYOKE
CHICOPEE
CHICOPEE RIVER
SPRINGFIELD
MASSACHUSETTS TURNPIKE
CONNECTICUT
VICINITY MAP
SCALE IN MILES
PROJECT AREA
BOSTON AND MAINE R.R. CHICOPEE FALLS BRANCH
CHICOPEE FALLS
CHICOPEE
EAST SPRINGFIELD
BIRCHAM BEND
BOSTON AND ALBANY R.R.
SPRINGFIELD
WEST SPRINGFIELD
CONNECTICUT RIVER
CHICOPEE SPRINGFIELD
BOSTON RD
20A
20
AREA MAP
SCALE IN FEET
1000 0 1000 3000 5000 7000
GREEN ENGINEERING AFFILIATES, INC
BOSTON, MASS.
ARCHITECT-ENGINEER
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
LOCATION PLAN
CHICOPEE RIVER
MASSACHUSETTS
1963

PLATE NO. 1



CORPS OF ENGINEERS
U.S. ARMY
PROFILE
SCALE: HOR. 1" = 200' VERT. 1" = 10'
ELEVATION IN FEET
Dike
Wall
DEADY MEMORIAL BRIDGE AT BROADWAY
Top of dike & wall
Chicopee River (River Bottom)
Existing Dam
Exist. U.S. Rubber Dam
STA. 54+14.63 El. 99.6
El. 102.7
El. 100.0
City of Chicopee Dam
Spillway
Sluice Gates
Gate House
Temporary connection for process water
New Dike
DEADY MEMORIAL BRIDGE
BROADWAY
EAST ST.
FORMER SAVAGE ARMS CORP
SAVAGE ARMS CHICOPEE MFG. CORP.
CHICOPEE MANUFACTURING CORP
New Flood Wall
New Interceptor Drain
Road Relocation
MAIN STREET
MIDDLE STREET
MARKET ST
COURT ST
BLAKE ST
WEST MAIN ST
CHICOPEE RIVER
UNITED STATES RUBBER CO
NEW OAK ST. PUMPING STATION
NEW MAIN ST. PUMPING STATION
Gate Structure
24" RCP BYPASS
New Downstream Pressure Drain
Downstream Widening
Spoil Area
MATCH LINE THIS SHEET
Channel Relocation
Borrow Area
Rip Rap River Bottom
CHICOPEE
RIVER
NOTE:
(2) INDICATES BUILDING NUMBER
PLAN
GRAPHIC SCALES
GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS. ARCHITECT-ENGINEER
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT-5865

PLATE NO. 2

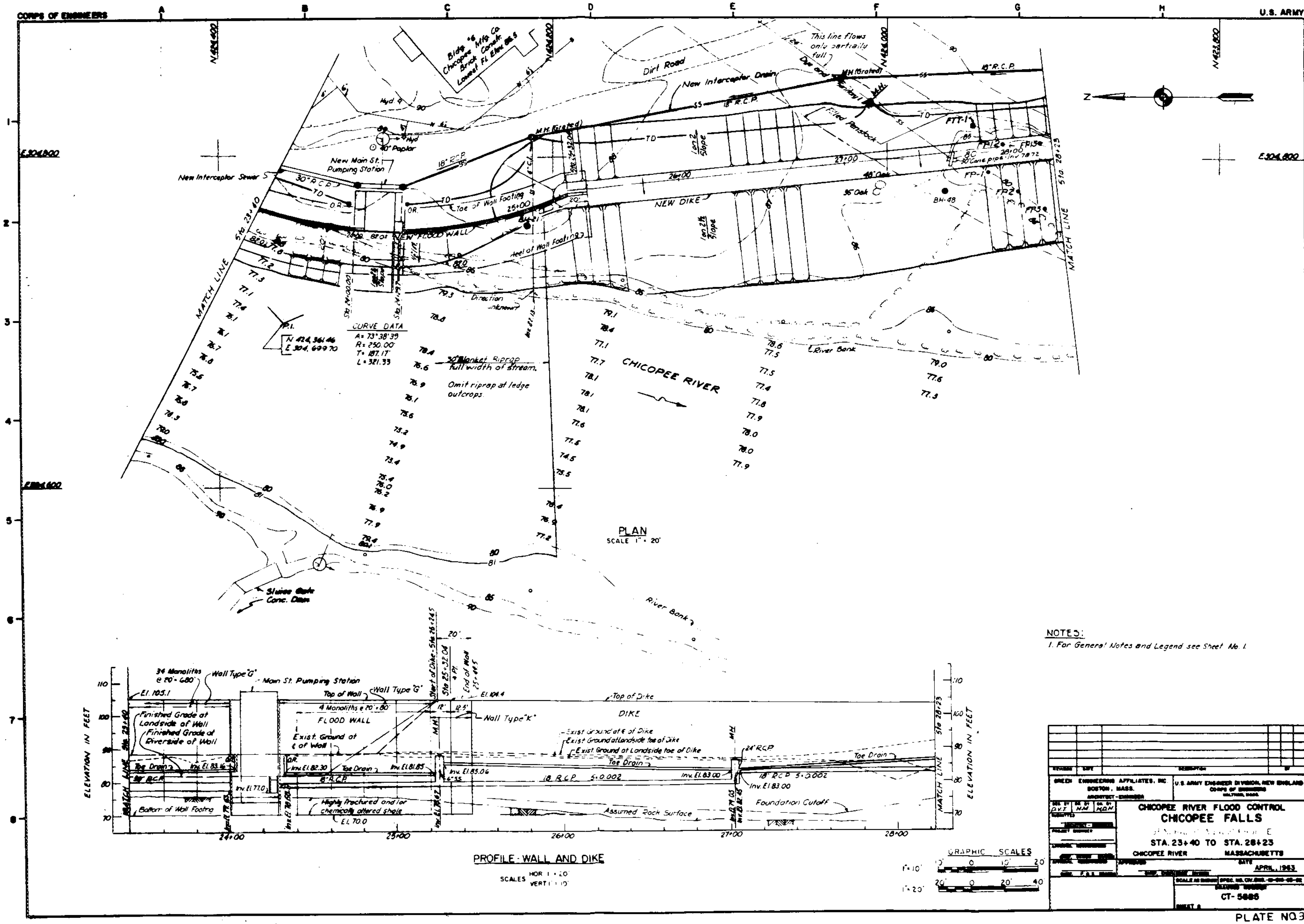
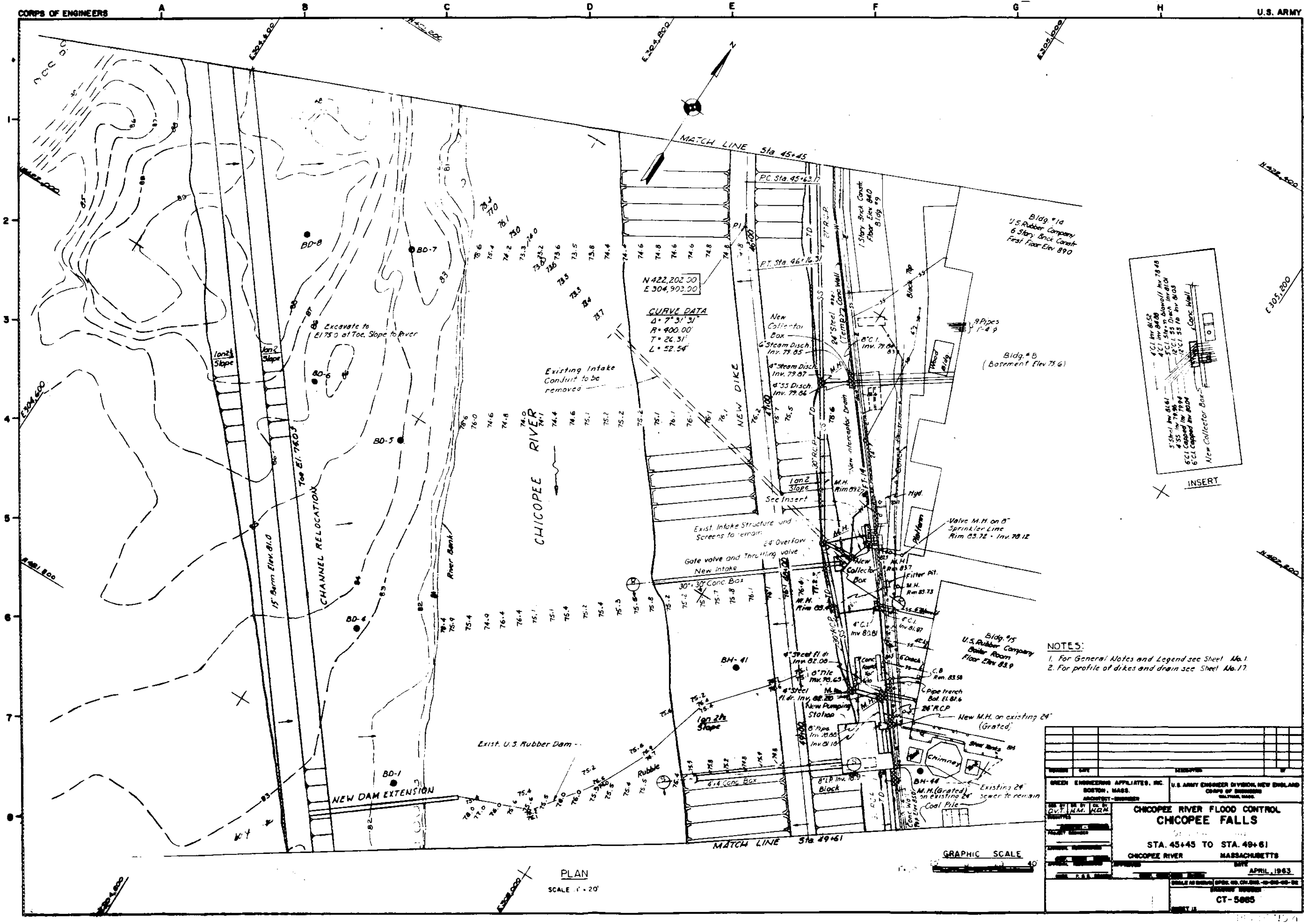
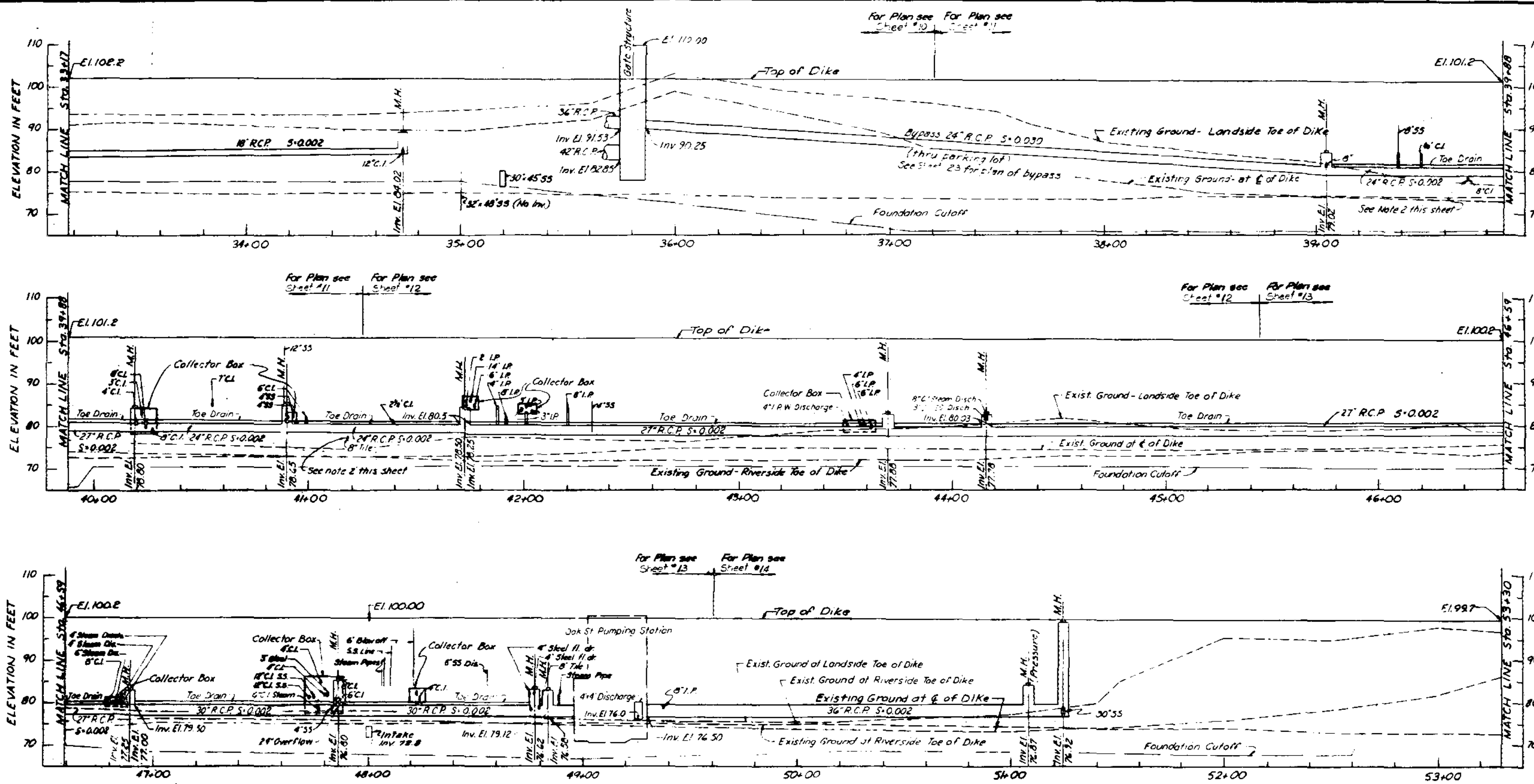

CORPS OF ENGINEERS
U.S. ARMY
New Interceptor Sewer
New Main St. Pumping Station
NEW FLOOD WALL
NEW DIKE
New Interceptor Drain
Dirt Road
This line flows only partially full
Filled Penstock
MATCH LINE
Sta. 23+40
Sta. 28+23
CURVE DATA
A = 73°38'39
R = 250.00'
T = 187.17'
L = 321.33
30" Blanket Riprap full width of stream.
Omit riprap at ledge outcrops.
CHICOPEE RIVER
River Bank
Sluice Gate Conc. Dam
PLAN
SCALE 1" = 20'
NOTES:
1. For General Notes and Legend see Sheet No. 1.
PROFILE - WALL AND DIKE
SCALES HOR 1" = 20' VERT 1" = 10'
ELEVATION IN FEET
Main St. Pumping Station
Wall Type "G"
Top of Wall
FLOOD WALL
DIKE
Top of Dike
Wall Type "K"
Toe Drain
18" R.C.P. S = 0.002
Foundation Cutoff
Assumed Rock Surface
Bottom of Wall Footing
Highly fractured and/or chemically altered shale
EL 70.0
GRAPHIC SCALES
GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS. ARCHITECT - ENGINEERS
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
STA. 23+40 TO STA. 28+23
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT-5685

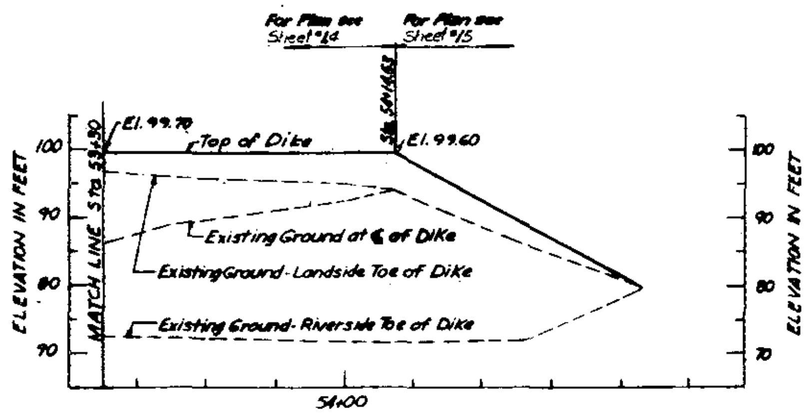
PLATE NO.3



CORPS OF ENGINEERS
U.S. ARMY
MATCH LINE Sta 45+45
MATCH LINE Sta 49+61
PC Sta 45+63.17
PT Sta 46+16.31
N 422,202.00
E 304,903.00
CURVE DATA
Δ = 7° 31' 31"
R = 400.00'
T = 26.31'
L = 52.54'
BD-8
BD-7
BD-6
BD-5
BD-4
BD-1
BH-41
BH-44
Excavate to El 75.0 at Toe, Slope to River
1 on 2½ Slope
1 on 2 Slope
Toe El. 76.0
15' Berm Elev. 81.0
CHANNEL RELOCATION
River Bank
CHICOPEE RIVER
NEW DIKE
Existing Intake Conduit to be removed
Exist. Intake Structure and Screens to remain
24" Overflow
Gate valve and Throttling valve
New intake
30" x 30" Conc Box
4'x4' Conc Box
New Collector Box
New Interceptor Drain
New Pumping Station
Exist. U.S. Rubber Dam
NEW DAM EXTENSION
Rubble
1 on 2½ Slope
See Insert
Bldg. #14
U.S. Rubber Company
6 Story Brick Constr.
First Floor Elev. 89.0
Bldg. #8
(Basement Elev 73.6)
Bldg. #15
U.S. Rubber Company
Boiler Room
Floor Elev. 83.9
1 Story Brick Constr.
Floor Elev. 84.0
Bldg. #9
Valve M.H. on 8" Sprinkler Line
Rim 83.72 - Inv. 78.12
New M.H. on existing 24" (Grated)
M.H. (Grated) on existing 24"
Existing 24" sewer to remain
Coal Pile
Chimney
Filter Pit
INSERT
New Collector Box
NOTES:
1. For General Notes and Legend see Sheet No. 1
2. For profile of dikes and drain see Sheet No. 17
PLAN
SCALE 1" = 20'
GRAPHIC SCALE
GREEN ENGINEERING AFFILIATES, INC.
BOSTON, MASS.
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
STA. 45+45 TO STA. 49+61
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT-5865

CORPS OF ENGINEERS | U.S. ARMY





NOTES:

1. For Plans see Sheets Nos. 10, 11, 12, 13 and 14
2. Rework roofleader piping for gravity connections. Install sump pumps for basement pits at U.S. Rubber Bldgs.

PROFILE — DIKE

SCALES HOR. 1"=20' VERT. 1"=10'

GRAPHIC SCALES

1"=10' 10' 0 10' 20'

1"=20' 20' 0 20' 40'

GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS. ARCHITECT-ENGINEER

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

CHICOPEE RIVER FLOOD CONTROL

CHICOPEE FALLS

STA. 33+17 TO STA. 54+14.63

CHICOPEE RIVER MASSACHUSETTS

APRIL, 1963

CT-5885

SHEET 17

PLATE 11-5

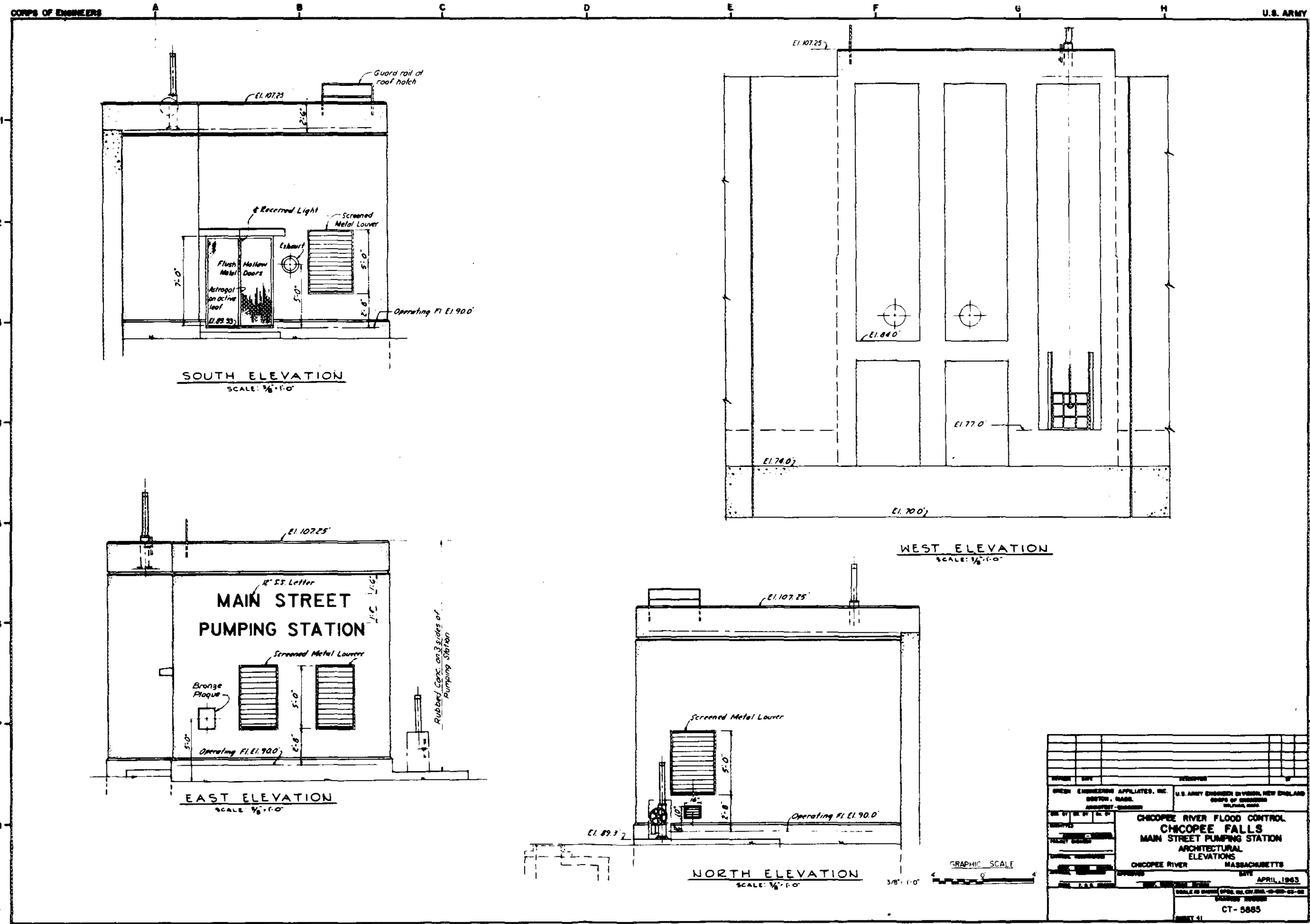
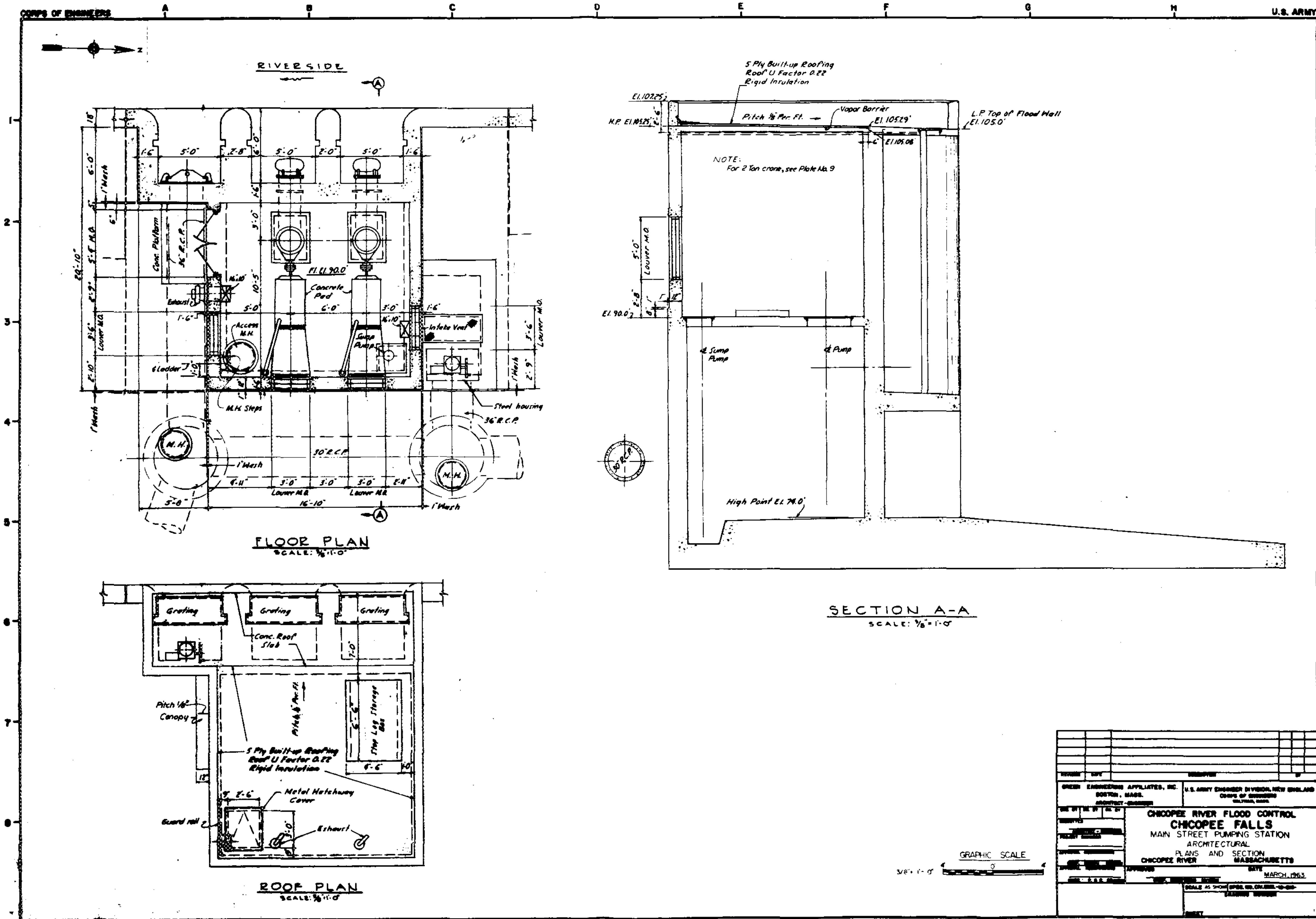
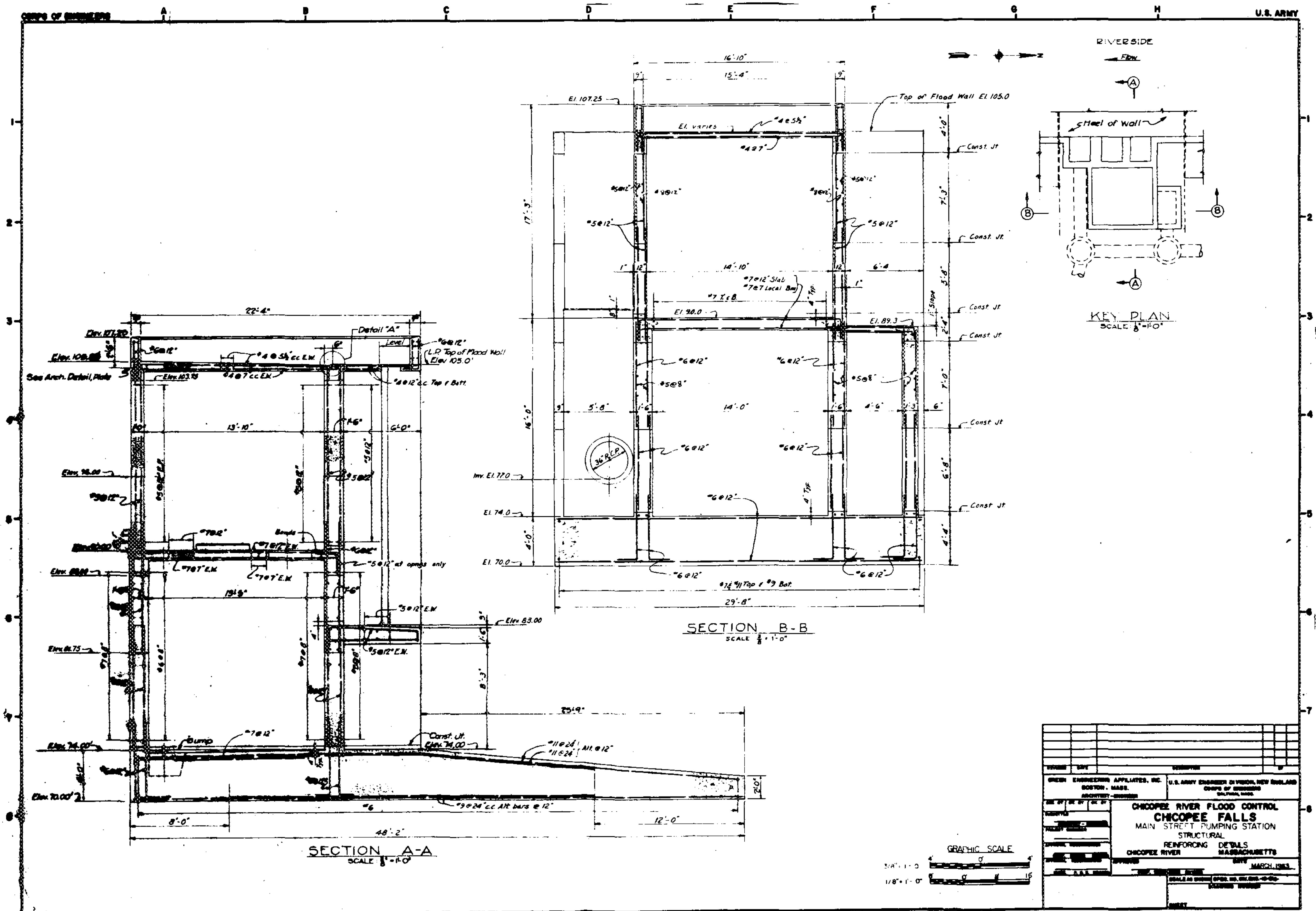

CORPS OF ENGINEERS
U.S. ARMY
El. 107.25
Guard rail at roof hatch
℄ Recessed Light
Screened Metal Louver
Flush Metal Hollow Doors
Astragal on active leaf
Exhaust
Operating Fl. El. 90.0'
SOUTH ELEVATION
SCALE: 3/8"=1'-0"
El. 84.0'
El. 77.0'
El. 74.0'
El. 70.0'
WEST ELEVATION
SCALE: 3/8"=1'-0"
El. 107.25'
12" S.S. Letter
MAIN STREET
PUMPING STATION
Screened Metal Louver
Bronze Plaque
Operating Fl. El. 90.0'
Rubbed Conc. on 3 sides of Pumping Station
EAST ELEVATION
SCALE 3/8"=1'-0"
El. 107.25'
Screened Metal Louver
Operating Fl. El. 90.0'
El. 89.3'
NORTH ELEVATION
SCALE: 3/8"=1'-0"
GRAPHIC SCALE
3/8"=1'-0"
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
MAIN STREET PUMPING STATION
ARCHITECTURAL
ELEVATIONS
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT- 5885

PLATE NO. 6



CORPS OF ENGINEERS
U.S. ARMY
RIVERSIDE
FLOOR PLAN
SCALE: 1/8"=1'-0"
ROOF PLAN
SCALE: 1/8"=1'-0"
SECTION A-A
SCALE: 1/8"=1'-0"
5 Ply Built-up Roofing
Roof U Factor 0.22
Rigid Insulation
Vapor Barrier
L.P. Top of Flood Wall El. 105.0'
NOTE:
For 2 Ton crane, see Plate No. 9
High Point El. 74.0'
Grating
Conc. Roof Slab
Stop Log Storage Box
Metal Hatchway Cover
Exhaust
Guard rail
Conc. Platform
Concrete Pad
Sump Pumps
Access M.H.
M.H. Steps
Intake Vent
Steel housing
36" R.C.P.
30" R.C.P.
Louver M.O.
GRAPHIC SCALE
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
MAIN STREET PUMPING STATION
ARCHITECTURAL
PLANS AND SECTION
CHICOPEE RIVER
MASSACHUSETTS
MARCH, 1963

PLATE NO. 7



U.S. ARMY
RIVERSIDE
Flow
Heel of Wall
KEY PLAN
SCALE 1/8" = 1'-0"
SECTION B-B
SCALE 3/8" = 1'-0"
Top of Flood Wall El. 105.0
Const. Jt.
36" R.C.P.
SECTION A-A
SCALE 1/8" = 1'-0"
Detail "A"
L.P. Top of Flood Wall Elev. 105.0'
See Arch. Detail, Plate
GRAPHIC SCALE
GREEN ENGINEERING AFFILIATES, INC.
BOSTON, MASS.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
MAIN STREET PUMPING STATION
STRUCTURAL
REINFORCING DETAILS
CHICOPEE RIVER
MASSACHUSETTS
MARCH, 1963

PLATE NO. 8

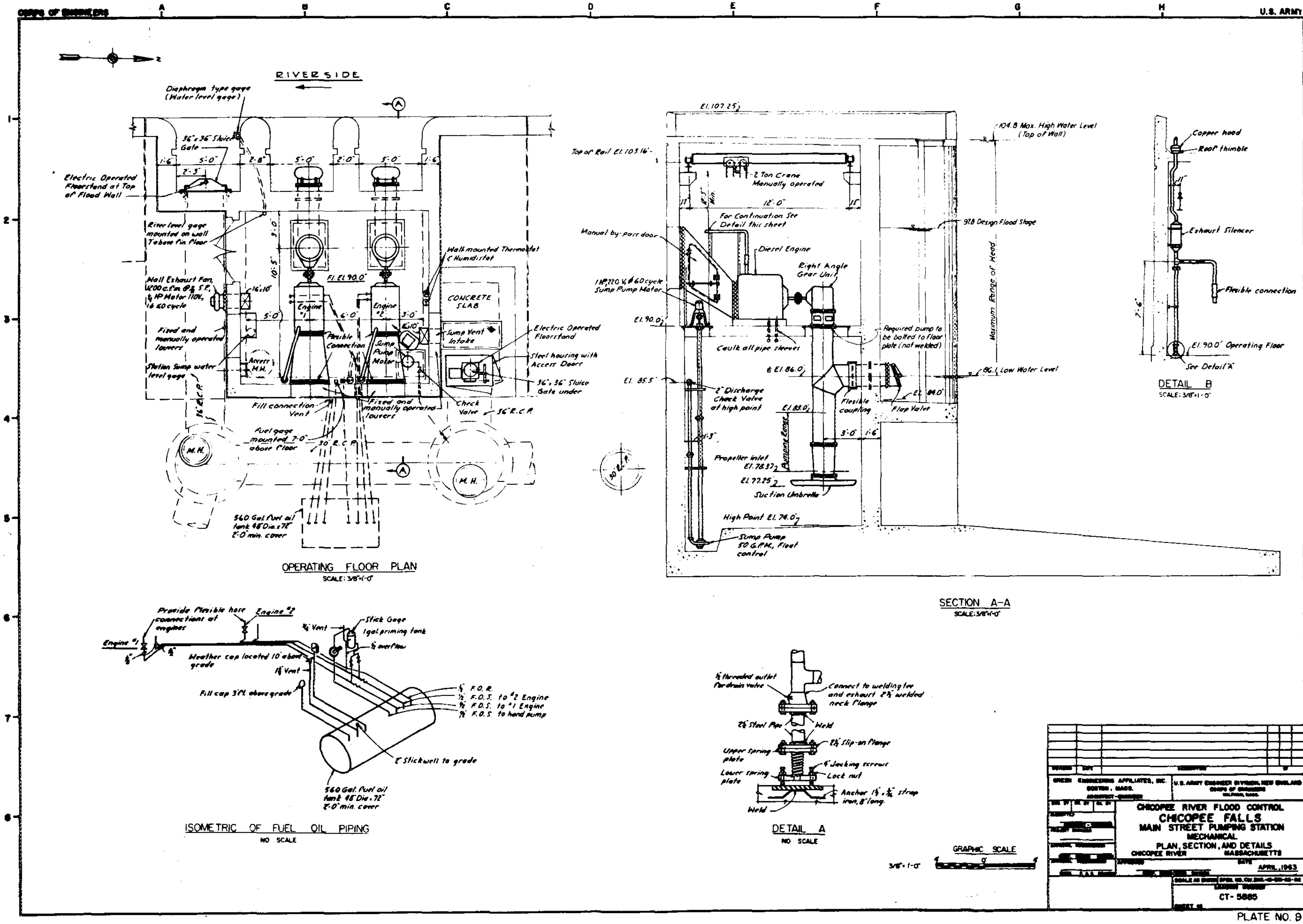
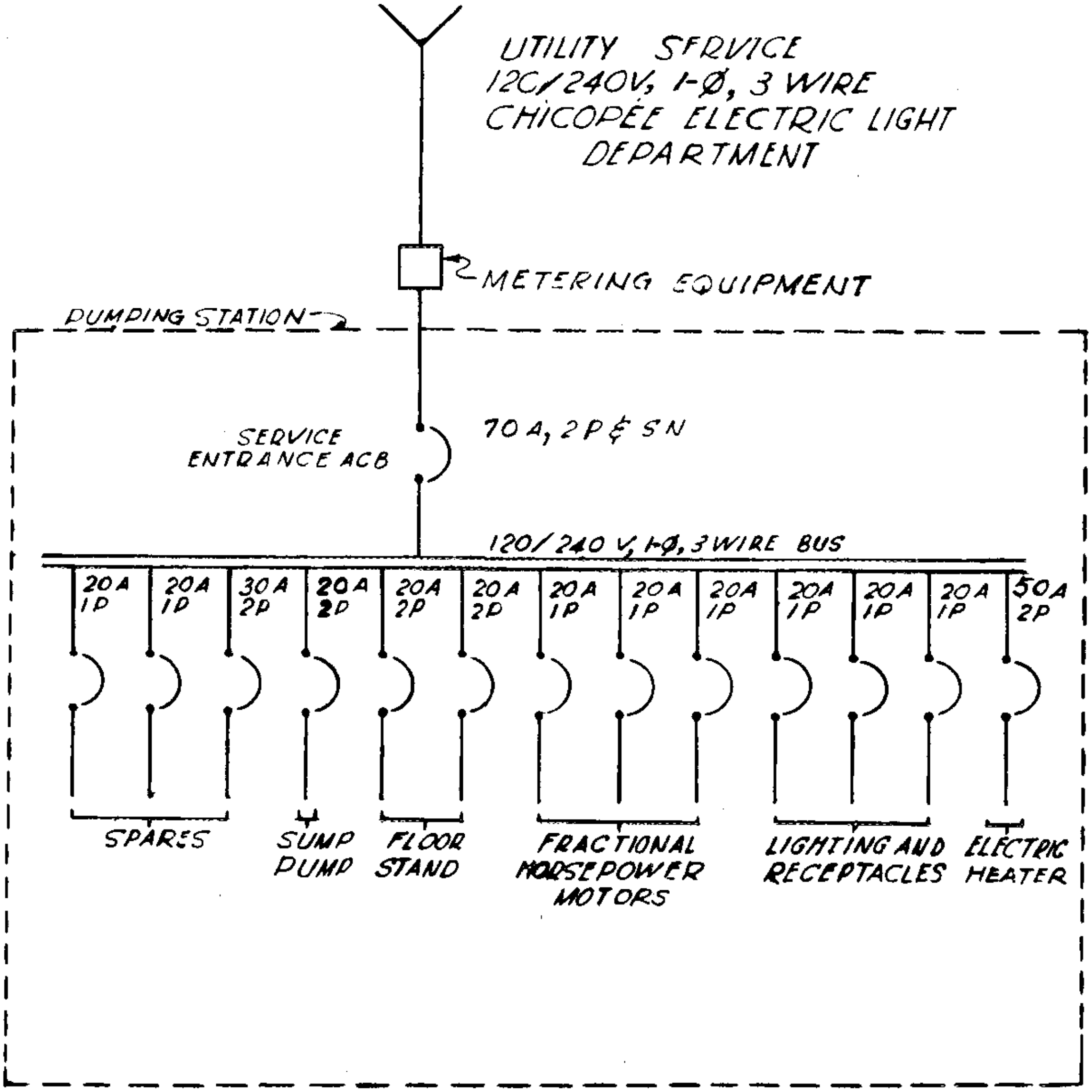

CORPS OF ENGINEERS
U.S. ARMY
RIVERSIDE
Diaphragm type gage (Water level gage)
36" x 36" Sluice Gate
Electric Operated Floorstand at Top of Flood Wall
River level gage mounted on wall 7' above fin. floor
Wall Exhaust Fan, 1200 c.f.m. @ ⅛" S.P., ¼ HP Motor 110V, 1φ 60 cycle
Fixed and manually operated louvers
Station Sump water level gage
Fl. El. 90.0'
Engine #1
Engine #2
Flexible Connection
Sump Pump Motor
Wall mounted Thermostat & Humidistat
CONCRETE SLAB
Sump Vent Intake
Electric Operated Floorstand
Steel housing with Access Doors
36" x 36" Sluice Gate under
Check Valve
36" R.C.P.
Fill connection
Vent
Fixed and manually operated louvers
Fuel gage mounted 7'-0" above floor
30" R.C.P.
M.H.
560 Gal. fuel oil tank 48" Dia. x 72" 2'-0" min. cover
OPERATING FLOOR PLAN
SCALE: 3/8"=1'-0"
El. 107.25
Top of Rail El. 103.16
2 Ton Crane Manually operated
104.8 Max. High Water Level (Top of Wall)
For Continuation See Detail this sheet
Manual by-pass door
Diesel Engine
Right Angle Gear Unit
97.8 Design Flood Stage
1 HP, 220 V, 1φ 60 cycle Sump Pump Motor
El. 90.0
Caulk all pipe sleeves
Required pump to be bolted to floor plate (not welded)
Maximum Range of Head
El. 86.0
86.1 Low Water Level
El. 85.5
2" Discharge Check Valve at high point
El. 83.0
Flexible coupling
El. 84.0
Flap Valve
Pumping Range
Propeller inlet El. 78.37
El. 77.25
Suction Umbrella
30" C.I.P.
High Point El. 74.0
Sump Pump 50 G.P.M., Float control
SECTION A-A
SCALE: 3/8"=1'-0"
Copper hood
Roof thimble
Exhaust Silencer
Flexible connection
El. 90.0' Operating Floor
See Detail "A"
DETAIL B
SCALE: 3/8"=1'-0"
Provide flexible hose connections at engines
Engine #2
Engine #1
¾" Vent
Stick Gage
1 gal. priming tank
¾" overflow
Weather cap located 10' above grade
1½" Vent
Fill cap 3'-0" above grade
¾" F.O.R.
½" F.O.S. to #2 Engine
½" F.O.S. to #1 Engine
¾" F.O.S. to hand pump
2" Stickwell to grade
560 Gal. fuel oil tank 48" Dia. x 72" 2'-0" min. cover
ISOMETRIC OF FUEL OIL PIPING
NO SCALE
¾" threaded outlet for drain valve
Connect to welding tee and exhaust 2½" welded neck flange
2½" Steel Pipe
Weld
2½" Slip-on flange
Upper spring plate
Lower spring plate
¾" Jacking screws
Lock nut
Anchor 1½" x ¾" strap iron, 8" long.
DETAIL A
NO SCALE
GRAPHIC SCALE
3/8"=1'-0"
GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS.
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
MAIN STREET PUMPING STATION
MECHANICAL
PLAN, SECTION, AND DETAILS
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT-5885

PLATE NO. 9



MAIN ST. PUMPING STATION

ELECTRICAL DISTRIBUTION
ONE-LINE DIAGRAM

PLATE NO. 10

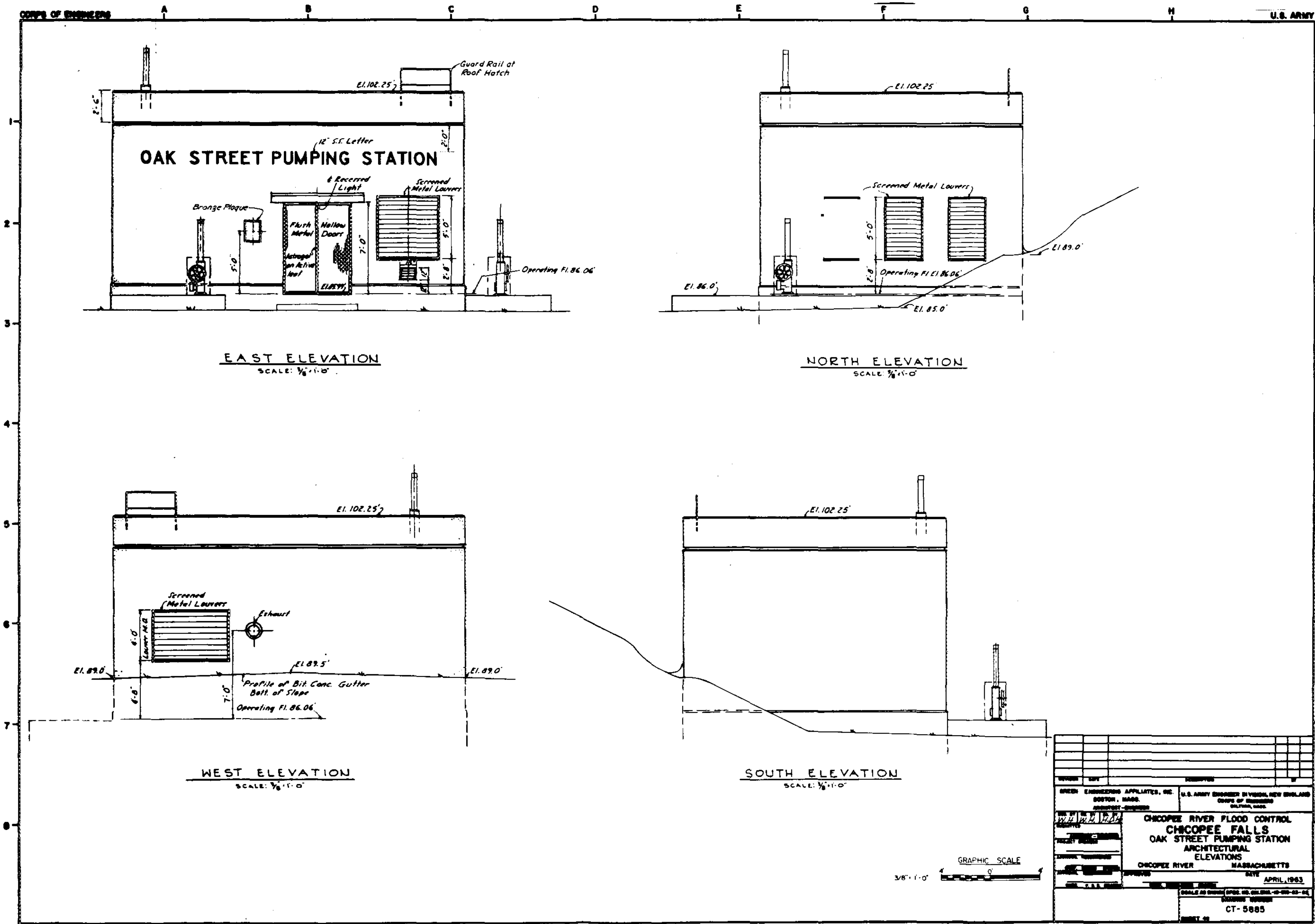

CORPS OF ENGINEERS
U.S. ARMY
OAK STREET PUMPING STATION
12" S.S. Letter
Guard Rail at Roof Hatch
El. 102.25'
¢ Recessed Light
Screened Metal Louvers
Bronze Plaque
Flush Metal
Hollow Doors
Astragal on Active leaf
El. 85.91
Operating Fl. 86.06'
EAST ELEVATION
SCALE: 3/8"=1'-0"
El. 86.0'
El. 85.0'
El. 89.0'
Operating Fl. El. 86.06'
NORTH ELEVATION
SCALE: 3/8"=1'-0"
Exhaust
Louver M.O.
El. 89.5'
El. 89.0'
Profile of Bit. Conc. Gutter Bott. of Slope
Operating Fl. 86.06'
WEST ELEVATION
SCALE: 3/8"=1'-0"
SOUTH ELEVATION
SCALE: 3/8"=1'-0"
GRAPHIC SCALE
3/8"=1'-0"
GREEN ENGINEERING AFFILIATES, INC.
BOSTON, MASS.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
OAK STREET PUMPING STATION
ARCHITECTURAL
ELEVATIONS
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT-5885

PLATE NO. 11

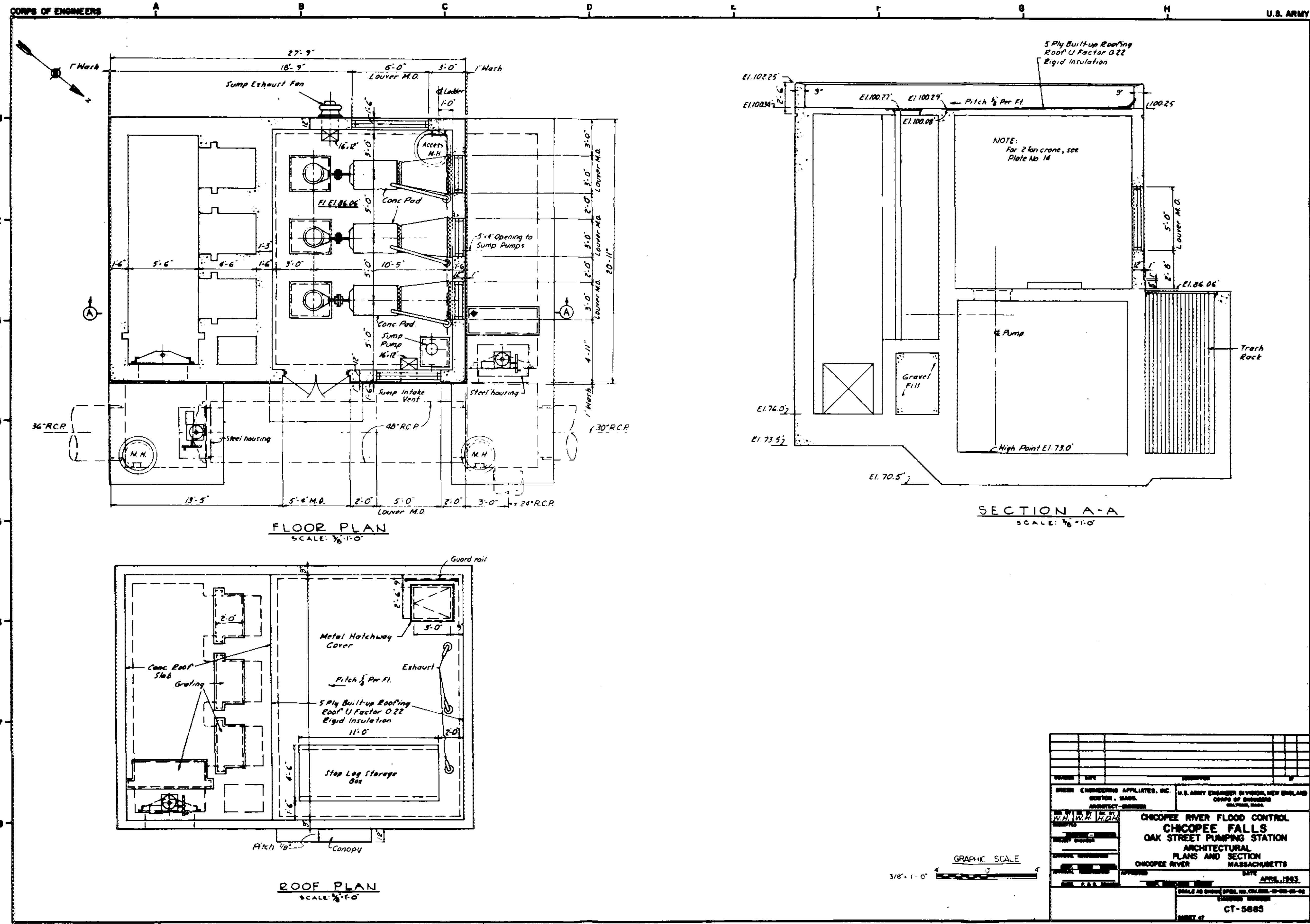
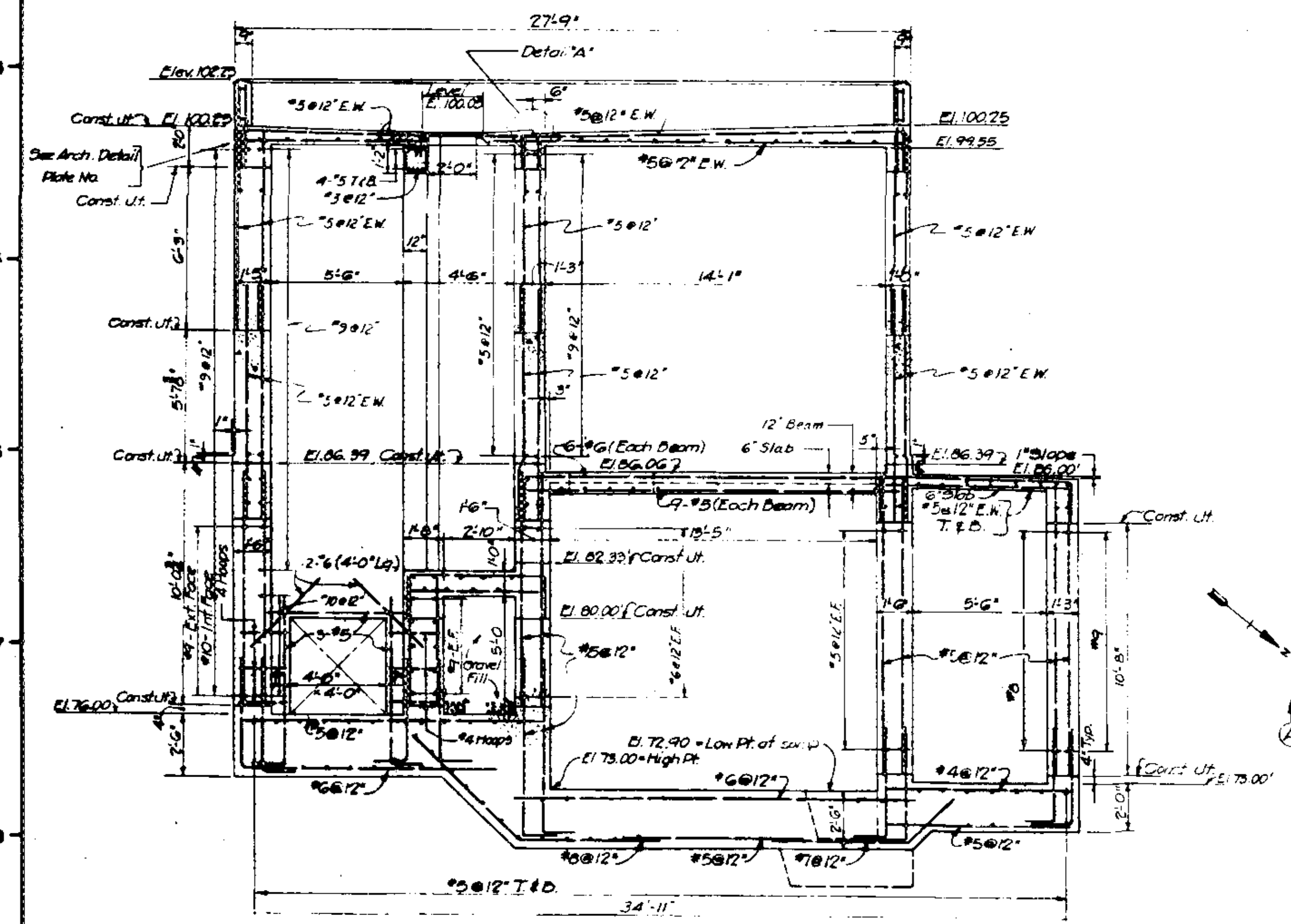
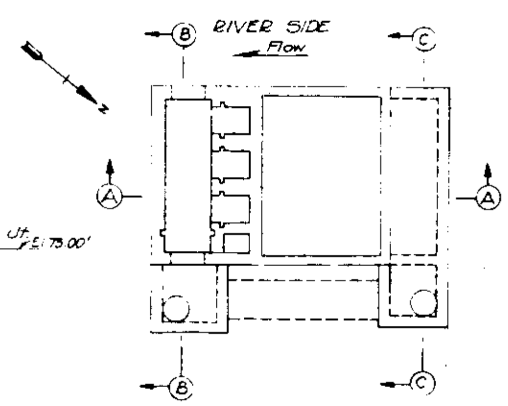

CORPS OF ENGINEERS
U.S. ARMY
27'-9"
18'-9"
6'-0"
3'-0"
1" Wash
Louver M.O.
Sump Exhaust Fan
℄ Ladder
Access M.H.
Fl. El. 86.06
Conc Pad
5'-4" Opening to Sump Pumps
Sump Pump
Sump Intake Vent
Steel housing
36" R.C.P.
48" R.C.P.
30" R.C.P.
24" R.C.P.
M.H.
20'-11"
13'-5"
5'-4" M.O.
FLOOR PLAN
SCALE: 3/8"=1'-0"
5 Ply Built-up Roofing
Roof U Factor 0.22
Rigid Insulation
El. 102.25
El. 100.34
El. 100.27
El. 100.29
Pitch 1/8" Per Ft.
El. 100.08
100.25
NOTE:
For 2 Ton crane, see Plate No. 14
Louver M.O.
El. 86.06
℄ Pump
Gravel Fill
Trash Rack
El. 76.0
El. 73.5
High Point El. 73.0
El. 70.5
SECTION A-A
SCALE: 3/8"=1'-0"
Guard rail
Metal Hatchway Cover
Exhaust
Conc Roof Slab
Grating
Pitch 1/8" Per Ft.
5 Ply Built-up Roofing
Roof U Factor 0.22
Rigid Insulation
11'-0"
Stop Log Storage Box
Pitch 1/8"
Canopy
ROOF PLAN
SCALE: 3/8"=1'-0"
GRAPHIC SCALE
3/8" = 1'-0"
W.H.
W.H.
H.O.H.
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
OAK STREET PUMPING STATION
ARCHITECTURAL
PLANS AND SECTION
CHICOPEE RIVER
MASSACHUSETTS
APRIL, 1963
CT-5885

PLATE NO. 12

CORPS OF ENGINEERS | U.S. ARMY



SECTION A-A
SCALE 1/8"=1'-0"



KEY PLAN
SCALE 1/8"=1'-0"

GRAPHIC SCALE
3/8" = 1'-0"
1/8" = 1'-0"

GREEN ENGINEERING AFFILIATES, INC.
BOSTON, MASS.
ARCHITECT-ENGINEER

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

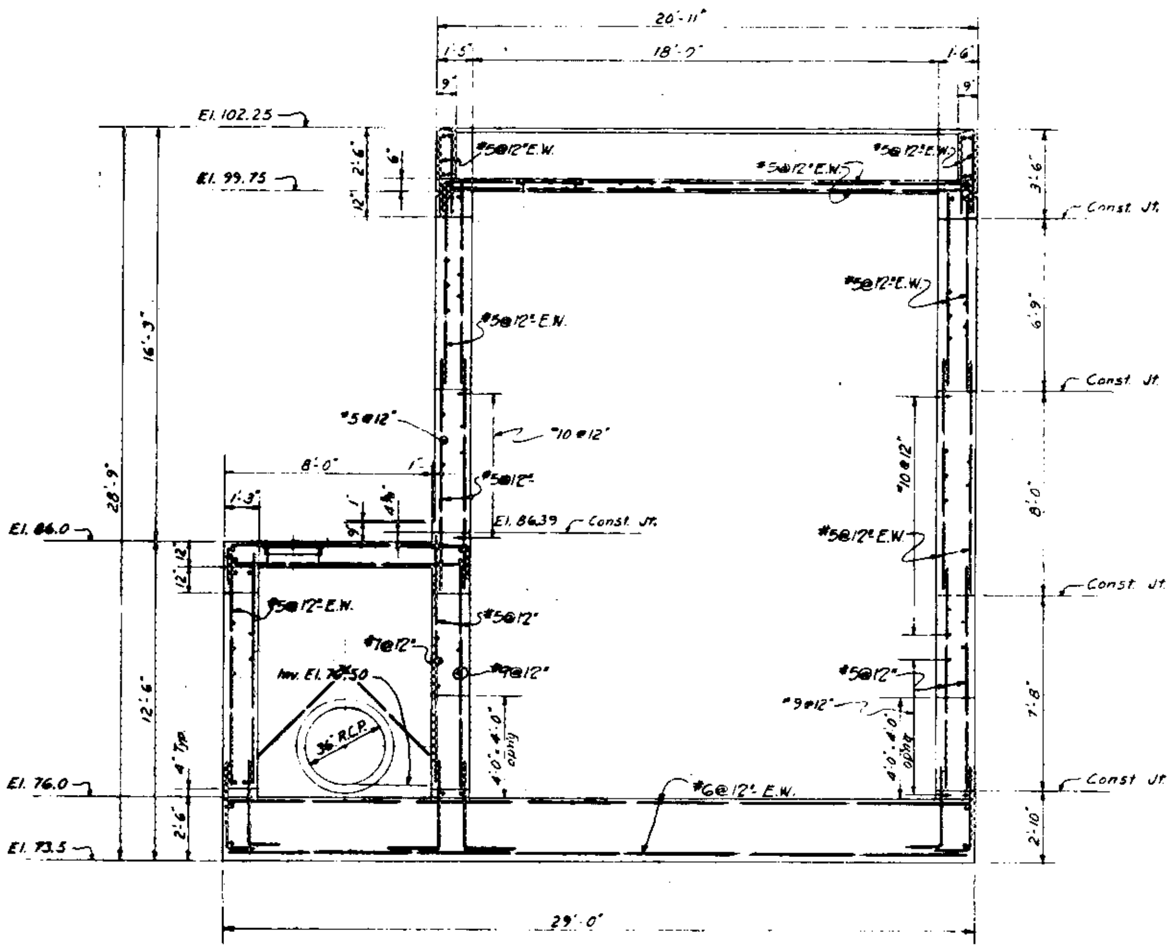
CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
OAK STREET PUMPING STATION
STRUCTURAL
REINFORCING DETAILS
CHICOPEE RIVER | MASSACHUSETTS

DATE: APRIL, 1963

CT-5885

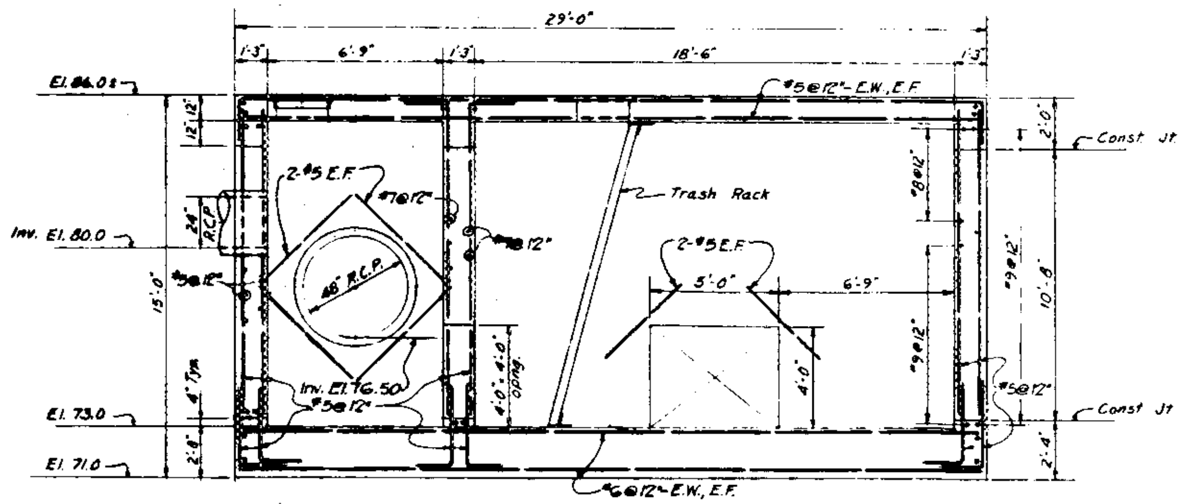
PLATE NO. 13

CORPS OF ENGINEERS — U.S. ARMY



SECTION B-B

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



SECTION C-C

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

GREEN ENGINEERING AFFILIATES, INC.
BOSTON, MASS.
ARCHITECT - ENGINEER

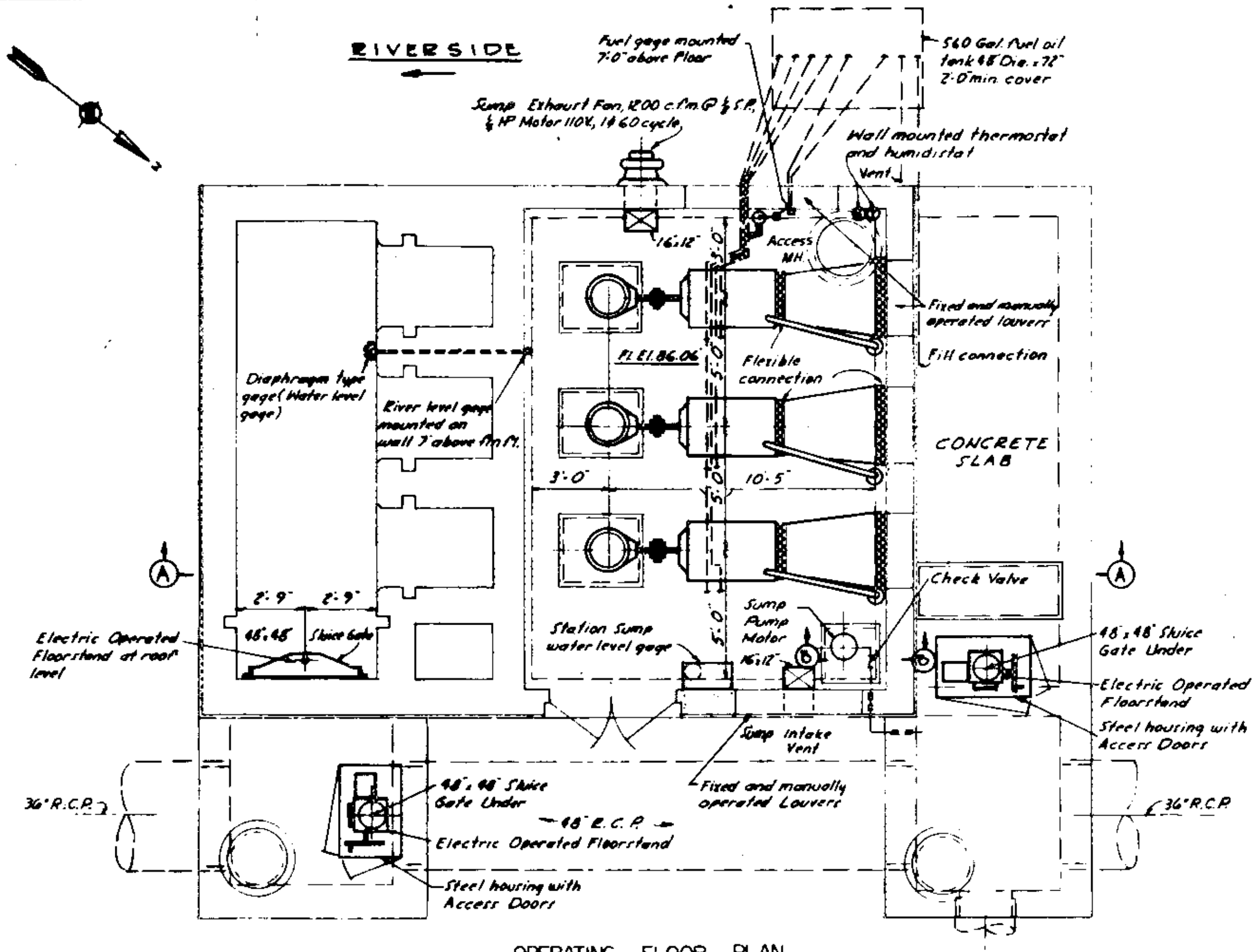
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
OAK STREET PUMPING STATION
STRUCTURAL
REINFORCING DETAILS NO. 2
CHICOPEE RIVER MASSACHUSETTS

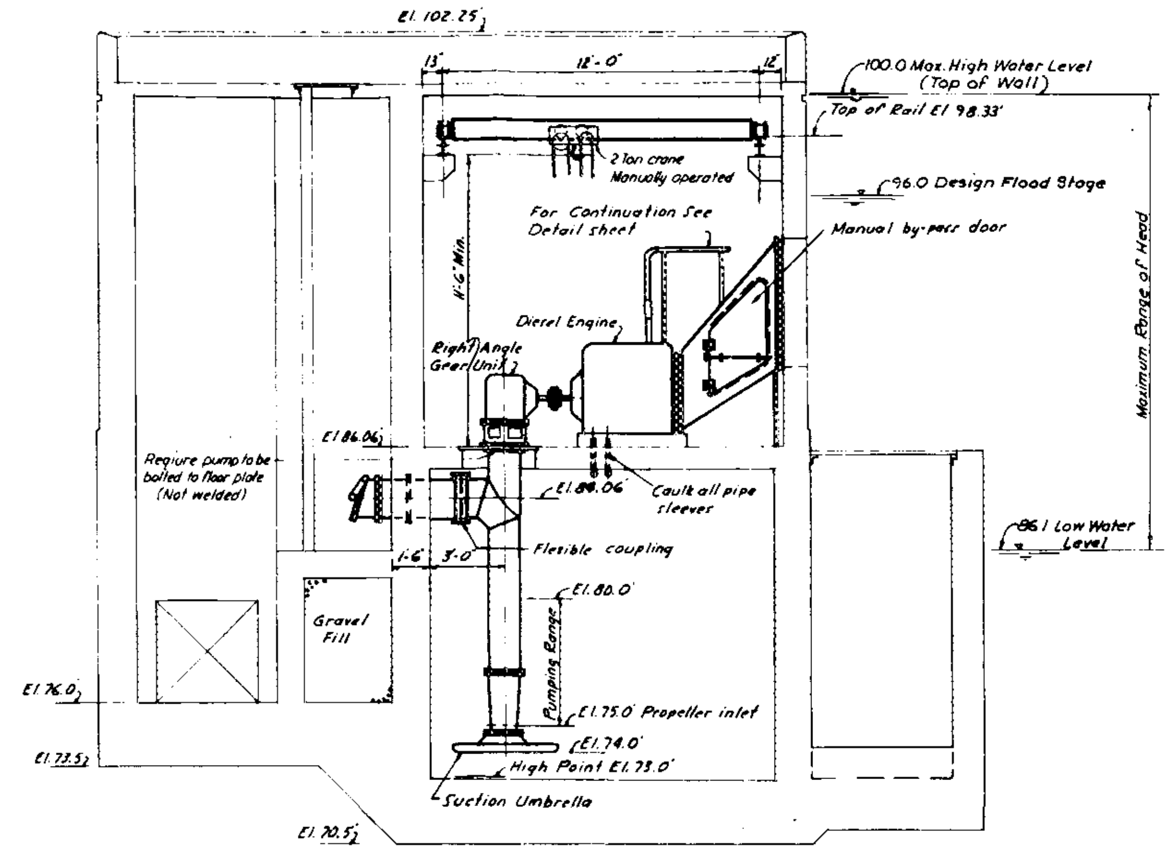
DATE APRIL, 1963

CT-5885

PLATE NO. 14

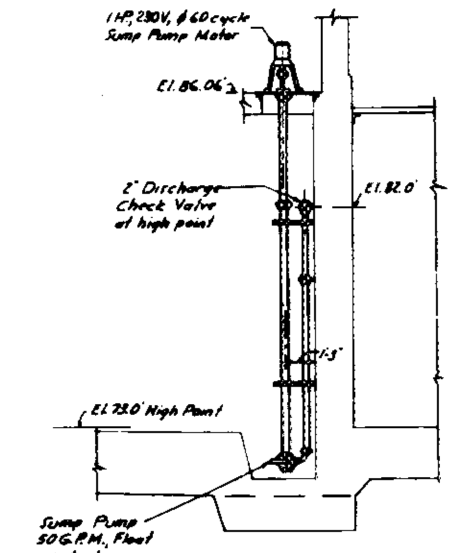


OPERATING FLOOR PLAN
SCALE: 3/8"=1'-0"



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

NOTE:
For Isometric of Fuel Oil Piping, see Main Street Pumping Station Plan



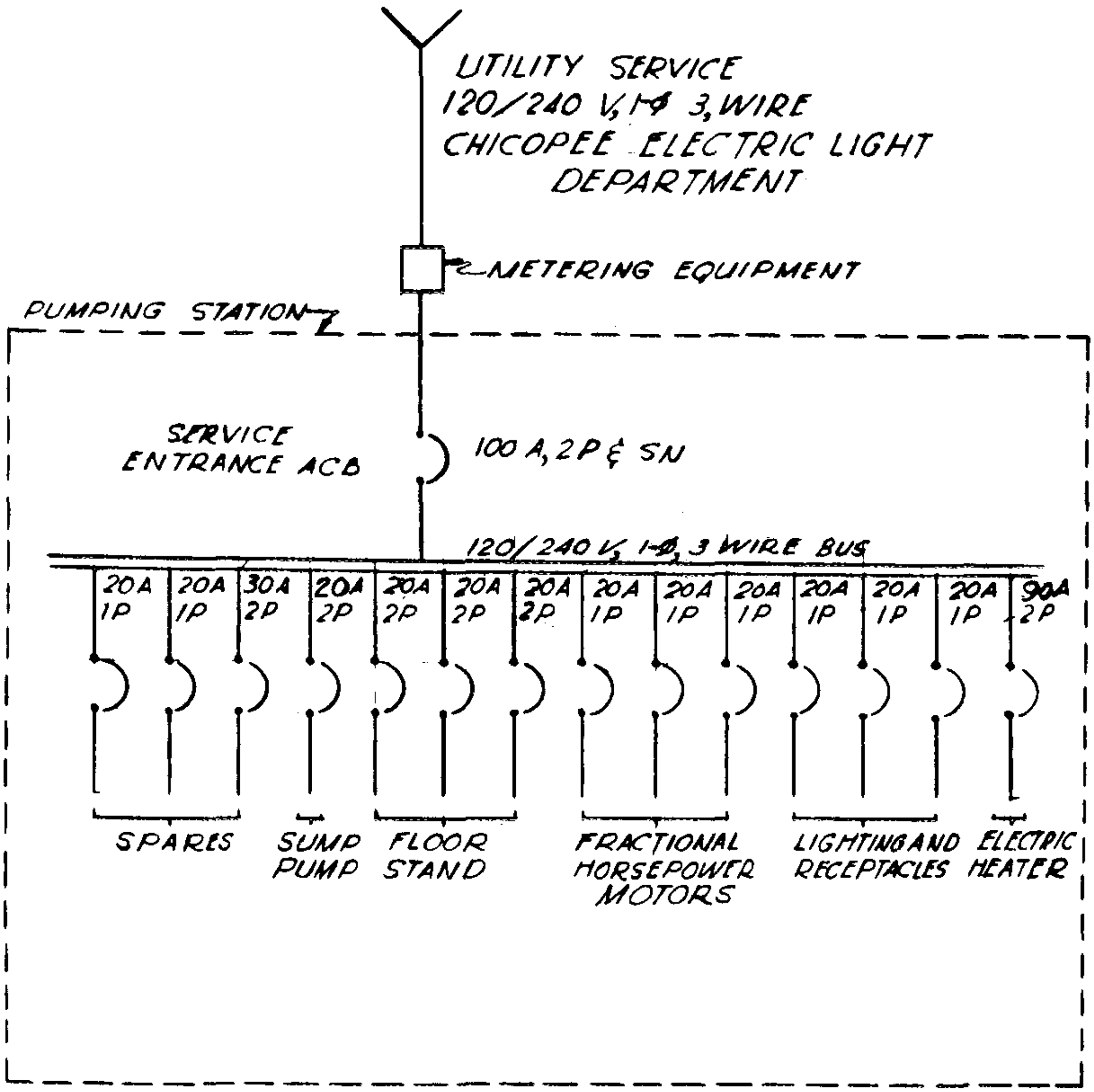
SECTION B-B
SCALE: 3/8"=1'-0"

GRAPHIC SCALE
3/8" = 1'-0"

GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS.	U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

CHICOPEE RIVER FLOOD CONTROL
CHICOPEE FALLS
OAK STREET PUMPING STATION
MECHANICAL
PLAN, SECTIONS, AND DETAILS
CHICOPEE RIVER MASSACHUSETTS
APRIL, 1963
CT-5885

PLATE NO. 15



OAK ST. PUMPING STATION

ELECTRICAL DISTRIBUTION

ONE-LINE DIAGRAM

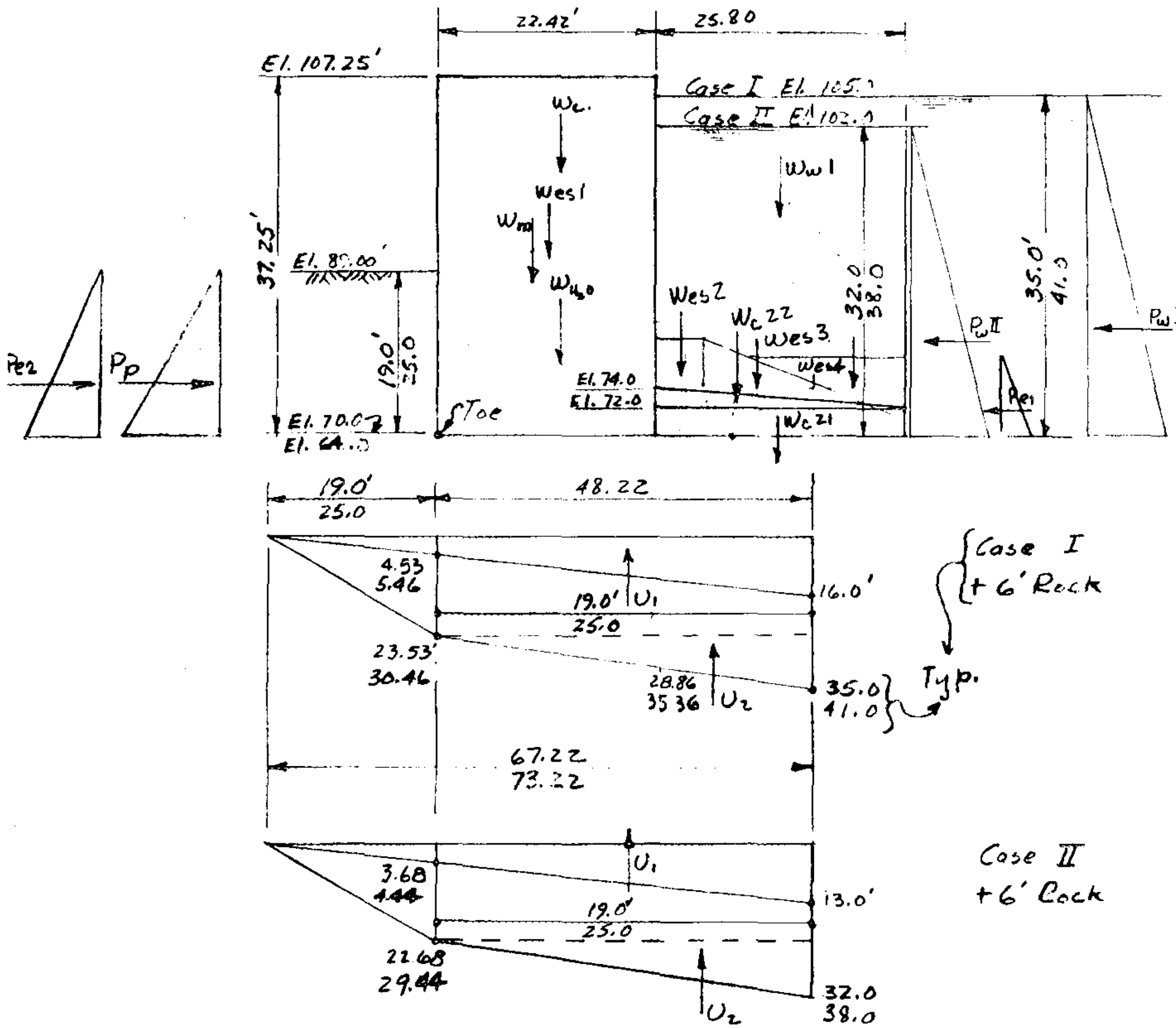
PLATE NO. 16

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. ______ OF ______
DATE ______
COMPUTED BY RC Palmer
CHECKED BY JDA

PROJECT Chicopee Falls

SUBJECT Main Street Pump Station



GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Main Street Pump Station

PROJECT NO. 6205
SHEET NO. 1 OF
DATE Feb 5, 1963
COMPUTED BY LZK
CHECKED BY GR

Center of Gravity of Conc. Struct. only. Moments about land face of pump sta.

	Calculation (L×W×H)	Volume ↓	Volume ↑	Arm	Moment ↷	Moment ↶
Total	22.42 × 29.75 × 37.25	24850		11.21	278500	
①	13.42 × 14.00 × 15.00		2820	8.21		23100
②	13.83 15.00 × 14.75		3060	8.00		24500
③	14.33 × 15.00 × 2.00		430	8.25		3540
④	6.00 × 10.00 × 9.00		495	19.42		9610
⑤	6.00 × 10.00 × 21.00		1260	19.42		24500
⑥	6.00 × 5.00 × 28.00		840	19.42		16300
⑦	6.00 × 21.92 × 2.25		296	19.42		5750
⑧	16.42 × 3.00 × 3.00		148	8.21		1220
⑨	14.92 × 4.25 × 26.00		1650	7.46		12300
⑩	14.92 × 2.50 × 33.25		1240	7.46		9621
⑪	6.00 × 1.50 × 33.25		299	17.92		5370
⑫	9.00 × 4.50 × 14.00		568	5.75		3270
⑬	11.50 × 5.75 × 18.00		1190	5.75		6850
⑭	9.42 × 5.75 × 33.25		1800	16.21		29150
⑯	1.00 × 6.00 × 5.00		30	.50		15
⑰	3.50 × 2.00 × 5.00		35	4.60		161
⑱	5.0 × 1.00 × 7.00		35	11.75		410
⑲	4.0 × 1.50 × 3.00		18	8.25		149
		24850 16214	16214		278500 175815	175,815
W_c		8636		11.86	102,685	

A-2

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 2 OF
DATE Feb 7, 1963
COMPUTED BY [illegible]
CHECKED BY [illegible]

PROJECT Chicopee Falls
SUBJECT Main Street Pump Station

Center of Gravity of Earth Fill only. Moments about land face of pump sta.

		Volume ↓	Volume ↑	Arm	Moment ↷	Moment ↶
⑨	14.92 × 4.25 × 7.75	490		7.46	3660	
⑩	14.92 × 2.50 × 15.00	561		7.46	4180	
⑪	6.00 × 1.50 × 15.00	135		17.92	2420	
⑭	9.42 × 5.75 × 15.00	812		16.21	13150	
⑤	6.0 × 10.0 × 8.0	480		19.42	9320	
		2478		13.20	32,730	

Center of Gravity of Water to El. 105.00 Case I

		Volume ↓	Volume ↑	Arm	Moment ↷	Moment ↶
①	13.42 × 14.00 × 9.00	1690		8.21	13870	
⑤		1260			24500	
⑥		840			16300	
⑧		148			1220	
⑫	9.00 × 4.50 × 9.00	365		5.75	2100	
		4303		13.48	57,990	

Center of Gravity of Water to El. 102.00 Case II

		Volume ↓	Volume ↑	Arm	Moment ↷	Moment ↶
①		1690			13,870	
⑤	6.00 × 10.00 × 18.00	1080		19.42	20,970	
⑥	6.00 × 5.00 × 25.00	750		19.42	14560	
⑧		148			1220	
⑫		365			2100	
		4033		13.12	52,720	

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Main St. Pump Sta.

PROJECT NO.
SHEET NO. 3 OF
DATE
COMPUTED BY RAP
CHECKED BY WR

Center of Gravity of Misc. Equipment & Items.

		Weight ↓	Weight ↑	Arm	Moment ↷	Moment ↶
Prime Mover	2 × 2.0k	4.0		7.0	28	
Crane	Unit	2.0k		15.12±	30	
Stop Logs	.5×.5×5.0 ×.055 × 60EA	4.0		14.00	56	
Sluice Gate	Unit	1.0		17.18	17	
Sluice Gate	Unit	1.0		2.0'	2	
Pump	2 × 3.0	6.0		11.92	71	
Gear Unit	2 × 1.0	2.0		11.92	24	
Pump Thrust	2 × 3.0	6.0		11.92	71	
L.L. Floor	14.08 × 15.00 × .100	21.10		8.12	172	
L.L. Roof	14.33 × 15.00 × .050	10.75		8.25	89	
W_m		57.85		9.70	560	

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT NO. ___
SHEET NO. 4 OF ___
DATE Feb.
COMPUTED BY K. [illegible]
CHECKED BY [illegible]

PROJECT Chicopee Falls

SUBJECT Main Street Pump Sta.

Case I (wt per foot of LOADS)

		↓	↑	→	←	Arm	↷	↶
W_c	$8630 \times \frac{.150}{29.75}$	43.40				11.86	515	
W_{es1}	$2478 \times \frac{.135}{29.75}$	11.23				13.20	148	
W_{H_2O}	$4303 \times \frac{.0625}{29.75}$	9.04				13.48	122	
W_m	$\frac{57.85}{29.75}$	1.94				9.70	19	
W_{w1}	$25.80 \times 31.0 \times .0625$	50.00				35.32	1765	
W_{w2}	$2.00 \times 25.8 \times \frac{1}{2} \times .0625$	1.61				39.62	64	
W_{es2}	$5.0 \times 8.0 \times (.135 - .0625)$	2.90				24.92	71	
W_{es3}	$\frac{1}{2} \times 8.0 \times 20.8 (.0725)$	6.00				34.35	206	
W_{es4}	$\frac{1}{2} \times 12.5 \times 6.5 (.0725)$	2.94				44.06	130	
W_{c21}	$25.80 \times 2.0 \times .150$	7.74				35.32	273	
W_{c22}	$\frac{1}{2} \times 25.8 \times 2.00 \times .150$	3.87				31.02	120	
U_1	$23.53 \times 48.22 \times .0625$		71.00			24.11		1710
U_2	$\frac{1}{2} \times 48.22 \times 11.47 \times .0625$		17.28			32.15		555
P_{e1}	$\frac{1}{2} \times 0.0725 \times 12^2 \times \frac{1}{3}$				1.7	4.00		7
$P_w I$	$\frac{1}{2} \times .0625 \times \overline{35.0}^2$				38.3	11.67		446
P_{e2}	$\frac{1}{2} \times 0.0725 \times 19^2 \times 0.50$			6.5		6.33	41	
P_{w2}	$\frac{1}{2} \times 19.0 \times 23.53 \times .0625$			14.0		6.33	89	
		140.67	88.28	20.5	40.0		3563	2718
		88.28					2718	
		52.39				$\bar{x} = 16.1$	845	

$e = 8.1$ ← MID 1/3 BASE

$$\frac{\Sigma H}{\Sigma V} = \frac{19.5}{52.4} = 0.372$$

$$p = \frac{52.39}{48.22}\left[1 \pm \frac{6 \times 8.1}{48.22}\right] = 1.09\left[1 \pm 1.005\right]$$

$$= 2.18 \text{ KSF}, \approx 0 \text{ KSF NET}$$

★ Note: Rock anchors will be provided, similar to wall sects. adj. to pump sta, to prevent differential movement between the pumping station and adjacent walls

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT: Chicopee Falls
SUBJECT: Main St. Pump St.

PROJECT NO. ____
SHEET NO. 5 OF ____
DATE ____
COMPUTED BY RQP
CHECKED BY [illegible]

Case II

		↓	↑	→	←	Arm	↻	↺
W_c		43.40					515	
W_{es1}		11.23					148	
W_{H_2O}	$4033 \times \frac{.0625}{29.75}$	8.47				13.12	111	
W_m		1.94					19	
W_{w1}	25.80 × 28.0 × .0625	45.20				35.32	1593	
W_{w2}		1.61					64	
W_{es2}		2.90					71	
W_{es3}		6.00					206	
W_{es4}		2.94					130	
W_{c21}		7.74					273	
W_{c22}		3.87					120	
U_1	22.68 × 48.22 × .0625		68.40			24.11		1648
U_2	$\frac{1}{2}$ × 48.22 × 9.32 × .0625		14.03			32.15		452
P_{wII}	$\frac{1}{2} \times .0625 \times \overline{32.0}^2$				32.0	10.67		341
P_{w2}	½ × 19 × 22.68 × .0625			1345		6.33	-85	
P_{e1}					1.7			7
P_{e2}				6.5			41	
		135.30	92.43	19.95	33.7	17.5	3376	2448

135.30 − 82.43 = 52.87

ℓ = 6.6′

3376 − 2448 = 928

RESULTANT IN MID ⅓ BASE

$$p = \frac{52.87}{48.22}\left[1 \pm \frac{6 \times 6.6}{48.22}\right] = 1.10(1 \pm .823)$$

= 2.00 KSF, +.19 KSF

* See note case I

$$\frac{\Sigma H}{\Sigma V} = \frac{13.75}{52.87} = .260$$

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Main St Pump Sta.

PROJECT NO.
SHEET NO. 6 OF
DATE
COMPUTED BY DOP
CHECKED BY [illegible]

Case II + 6' Rock (WALL ON BOTH SIDES WILL BE ANCHORED)

		↓	↑	→	←	Arm	↻	↺
W_c		43.40					515	
W_{es1}		11.23					148	
W_{H_2O}		8.47					111	
W_m		1.94					19	
W_{w1}		45.20					1593	
W_{w2}		1.61					64	
W_{es2}		2.90					71	
W_{es3}		6.00					206	
W_{es4}		2.94					130	
W_{c21}		7.74					273	
W_{c22}		3.87					120	
W_{Rock}	6.0 × 48.22 × .170	49.20				24.11	1185	
U_1	29.44 × 48.22 × .0625		88.90			24.11		2140
U_2	$\frac{1}{2}$ × 8.56 × 48.22 × .0625		12.90			32.15		415
P_{e1}	$\frac{1}{2}$ × .0725 × 18^2 × $\frac{1}{3}$				3.9	6.00		24
P_{w} II	$\frac{1}{2}$ × .0625 × $\overline{38.0}^2$				45.1	12.67		571
P_{e2}	$\frac{1}{2}$ .0725 × 25 × 0.5			11.3		8.33	95	
P_p	½ × 25.0 × 29.44 × .0625			23.0		8.33	192	
	*	184.50	101.80	34.3 ★	49.0 ★		4722	3150
		101.80					3150	
		82.70				$\bar{x}$ = 19.0	1572	

BY FRICTION : 49.0 − 11.3 − 23.0 = 14.7 < 0.3 × 82.70 (taken by friction)

★ See note Case I

$$\frac{\Sigma H}{\Sigma V} = \frac{14.7}{82.7} = 0.178$$

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls
SUBJECT Main St. Pump Sta.

PROJECT NO.
SHEET NO. 7 OF
DATE
COMPUTED BY [illegible]
CHECKED BY [illegible]

Case I + 6' Rock

		↓	↑	→	←	Arm	↻	↺
W_c		43.40					515	
W_{es1}		11.23					148	
W_{H_2O}		9.04					122	
W_m		1.94					19	
W_{w1}		50.00					1765	
W_{w2}		1.61					64	
W_{es2}		2.90					71	
W_{es3}		6.00					206	
W_{es4}		2.94					130	
$W_{c\,21-22}$	7.74 + 3.87 = 11.61	11.61					393	
W_{Rock}		49.20					1185	
U_1	30.46 × 48.22 × .0625		91.80			24.11		2215
U_2	$\frac{1}{2}$ × 10.54 × 48.22 × .0625		15.90			32.15		511
P_{e1}					3.90	—		24
$P_w I$	$\frac{1}{2}$ × .0625 × $\overline{41.0}^2$				52.50	13.67		718
P_{e2}				11.30		—	95	
P_P				23.80		8.33	198	
		189.87	107.70	35.10 ★	56.40 ★	17.6	4911	3468
		107.70					3468	
		82.17				> 12.06	1443	
						e = 6.5		

BY FRICTION = 56.40 − 35.10 = 21.30 K < .4 × 82.17 (by friction)
.3 × 133% = .4

BOTTOM OF ROCK $p = \frac{82.17}{48.22}\left[1 \pm \frac{6.5 \cdot 6}{48.22}\right] = 1.705(1 \pm .810)$

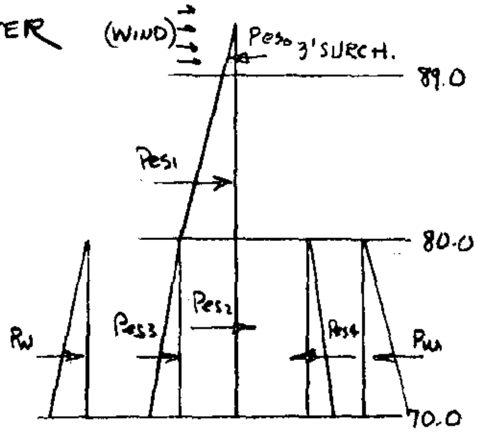
= 3.08 KSF, 0.32 KSF

★ See note case I

PROJECT CHICOPEE FALLS

SUBJECT MAIN ST. PUMP STATION

Center of Gravity of structure with NORMAL WATER
WATER AT 80.0 ELEVATION
3 FT SURCHARGE
GROUND AT 89.0 EL.
WIND AT 50 #/FT²



LOADING #3

		↓	↑	→	←	ARM	M ↓	M ↑
$W_{c-21,22}$	(PAGE 4)	55.01				—	908	
W_{es1}	≈ (PAGE 4) = 11.23 ±	11.23					148	
W_{w1}	.0625 × 6 × 25.80	9.68				35.32	342	
W_{w2}		1.61				39.62	64	
$W_{es2-3-4}$		11.84					387	
P_{es1}	.130 × 1/3 × 12² × 1/2			3.12		14.00	43.7	
P_{es2}	.130 × 1/3 × 12 × 10			5.20		5.00	26.0	
P_{es3}	.0725 × 1/3 × 10² × 1/2			1.21		3.33	4.0	
WIND	.05 × 18.25			0.91		28.12	25.6	
U	.0625 × 10 × 48.12		30.20			24.11		728
W_M	(PAGE 34)	1.94				9.70	19.0	
P_{es4}					1.72	4.00		8
		91.31 30.20 61.11	30.20	10.44	1.72		1967.3 736.0 1231.3	736

RESULTANT AT $\frac{1231.3}{61.11} = 20.2$ FT.

$e = 3.9'$

$$p = \frac{61.11}{48.22}\left[1 \pm \frac{6 \times 3.9}{48.22}\right] = 1.270\left[1 \pm 0.486\right]$$

= 1.89, .65 KSF NET
.62, .62 UPLIFT

2.51 KSF 1.27 KSF

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 9 OF
DATE [illegible] 63
COMPUTED BY [illegible]
CHECKED BY RCP

PROJECT CHICOPEE FALLS
SUBJECT MAIN ST. PUMPING STATION

ROCK ANCHORS { REFER NOTE ON PAGE 4 }

LOADING #1 : (REFER P4)

RESULTANT AT 16.1' FROM LAND FACE

$E = 24.1L - 16.1 = 8.0$ FT.

$P = \frac{52.39}{48.22}\left[1 \pm \frac{6 \times 8.0}{48.22}\right] = 1.09\left[1 \pm 1.005\right]$

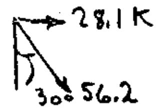
= 2.18	0.00	KSF	NET
1.42	2.19	KSF	UPLIFT
3.65	2.19	KSF	TOTAL

NOTE :
SHEAR WILL ALLOW 37.7K
AND THE COMPONENT in TENSION ALLOWS 28.1K, SHEAR 37.7K.
SINCE THE BAR IS AT 30° with Vertical we ASSUMED
THAT the BAR will tend to be PULLED IN TENSION RATHER
THAN BE SHEARED OFF. THIS IS A CONSERVATIVE ASSUMPTION

UNBALANCED HORIZ : $40.0 - 20.5 - 0.2 \times 52.39 = 9.0$ K : TRY 4 BARS (#11)

TENSION = $A_s F_s = 1.56 \times 36.0 = 56.2$ K

SHEAR = $A_s F_s = 1.56 \times 18.2 \times 1.33 = 37.7$ K



$\frac{4 \times 28.1\text{K}}{9.0\text{K}} = 12.5$ ' spacing

(AXIAL COMPONENT GOVERNS)

LOADING #2 (REFER P5)

RESULTANT AT 17.50' FROM LAND FACE

$E = 24.11 - 17.5 = 6.6$ FT.

$P = \frac{52.87}{48.22}\left[1 \pm \frac{6 \times 6.6}{48.22}\right] = 1.10\left[1 \pm 0.823\right]$

= 2.00	+.19	KSF	NET
1.42	2.00		UPLIFT
3.42 KSF	2.19 KSF		

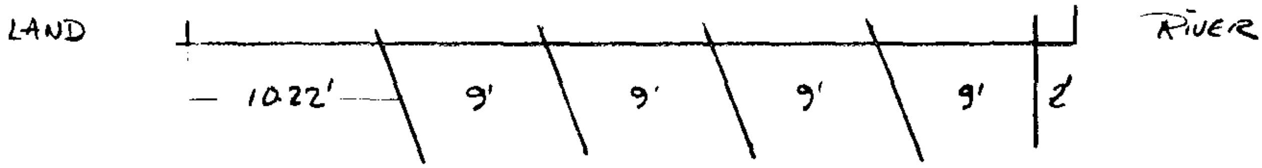
UNBALANCED HORIZONTAL :

$33.7 - 19.75 - 0.2 \times 52.87 = 3.2$ K

$T = A_s f_s = 1.56 \times 27{,}000 = 42.1$ K

$(42.1)\frac{1}{2} = 21.05$ K = component

$\frac{4 \times 21.05}{3.2} = 26.3$ '



LOAD 1 GOVERNS **USE 9' SPACING** (9'x9' type)

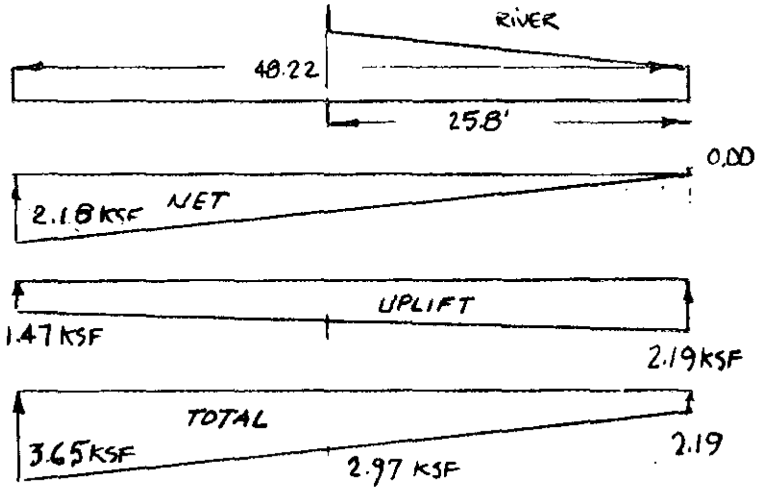
A-10

PROJECT CHICOPEE FALLS

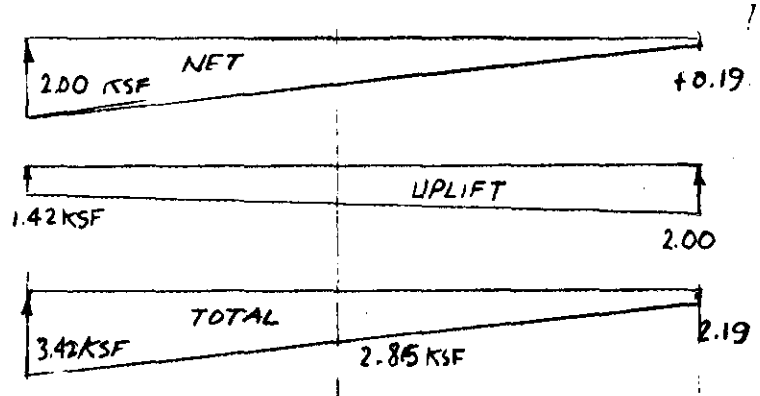
SUBJECT MAIN ST PUMPING STATION

PRESSURES (AT BOTTOM OF CONCRETE)

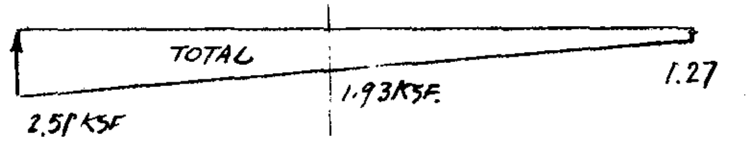
LOADING #1 (P-4,9)



LOADING #2 (P5,9)

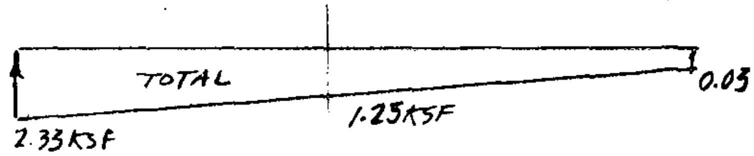


LOADING #3 (P8)



CONSTRUCTION (P.4)

$W_c =$	55.01	908
$W_m =$	1.94	19

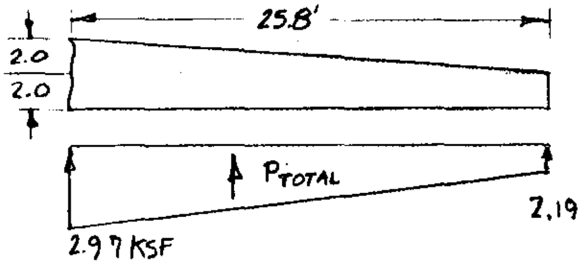


$$\frac{927}{56.95} = 16.3' \quad e = 7.8'$$

$$p = \frac{56.95}{48.22}\left[1 \pm \frac{6 \times 7.8}{48.22}\right] = 1.18(1 \pm .972)$$

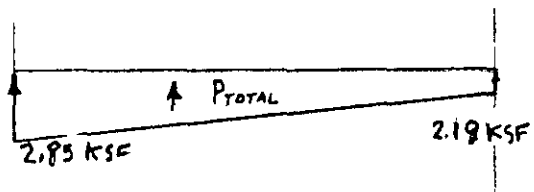
HEEL APRON

LOADING #1 (P.4)



		SHEAR		MOMENT
	W_{w1} =	50.00	x 12.90 =	645.0
	W_{es2} =	2.90	x 2.50 =	7.2
	W_{es3} =	6.00	x 11.93 =	71.6
	W_{es4} =	2.94	x 21.63 =	63.6
	W_{c21} =	7.74	x 12.90 =	100.0
	W_{c22} =	3.87	x 8.60 =	33.3
	W_{w2} =	1.61 (75.06) ↓	x 17.20 =	27.7
2.19 x 25.80	= P_{T1} =	56.60 ↑	x 12.90 =	730.0
0.78 x 25.80 x .5	= P_{T2} =	10.06	x 8.60 =	86.6
		8.40 ↓		131.8

LOADING #2 (P5)



		SHEAR		MOMENT
	W_{w1} =	45.20	x 12.90 =	583.0
	W_{es2} → W_{w2} etc =	25.06 ↓	— =	303.4
2.19 x 25.8	= P_{T1} =	56.60 ↑	x 12.90 =	730.0
0.66 x 25.8 x .5	= P_{T2} =	8.52	x 8.60 =	73.3
		5.14 ↓		83.1 K

LOADING #1. (GOVERNS BY INSPECTION) $d = 48 - 4 = 44''$ ±

$$A_s = \frac{131{,}800}{.907 \times 27{,}000 \times 44} = .1213 \text{ in}^2/\text{in}$$

#11 @ 12 used

AT P.S. : USE : #8 - 6" C-C .(.131 in²/in) (TOP)

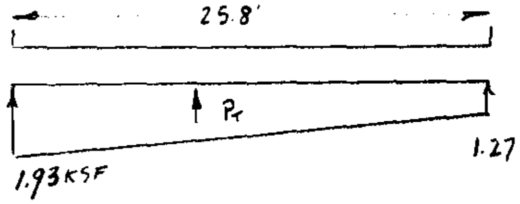
1.57 □"/ft

AT MID HEEL: USE: #8 - 12" C-C (TOP)

A-12

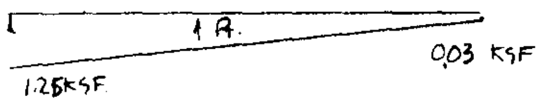
HEEL APRON

LOADING #3 (P8,11)



		SHEAR			MOMENT
	W_{W1} =	9.68 ↓	× 12.90	=	124.8 ↻
W_{C21} → W_{ES2} →	W_{W2} =	25.06 ↓	× —	=	303.4 ↻
1.27 × 25.8	= P_1 =	32.75 ↑	× 12.90	=	422.0 ↺
0.66 × 25.8 × .5	= P_2 =	8.52 ↑	× 8.60	=	73.3 ↺
		6.53 ↑			67.1 ↺

CONSTRUCTION:



		SHEAR			MOMENT
	W_{C21-22} =	11.61 ↓	—	=	133.3 ↻
0.03 × 25.8	= P_1 =	0.78 ↑	× 12.90	=	10.0 ↺
1.22 × 25.8 × .5	= P_2 =	15.73 ↑	× 8.60	=	135.0 ↺
		4.90 ↑			11.7 ↺

LOADING #3

$$A_s = \frac{67.1}{1.44 \times 43} = 1.08\ \square''/ft.$$

AT P.S : USE #9 - 12" C-C A_s = 1.00 (BOTTOM)

AT MID HEEL : USE #9 - 24" C-C (BOTTOM)

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 13 OF
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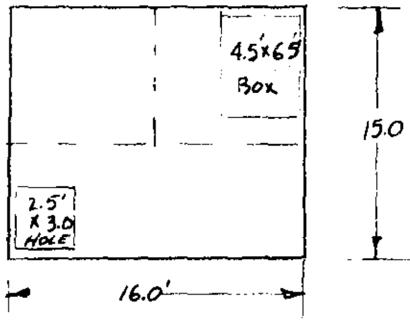
PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

ROOF SLAB: E-W: 14'-1" + ½[12"+15"] = 15.2 FT ± (BELOW PARAPET)
N-S: 17'-0 − ½[12+12"] = 16.0 FT ±

USING 15'×16' FOR DESIGN

$\frac{\ell_1}{\ell_2} = \frac{15}{16} = .94$



CASE 4 - ACI m = .94

	Short	Long
C. NEGATIVE MOMENT	= 0.063	0.058
D. NEGATIVE MOMENT	0.031	0.029
POSITIVE MOMENT	= 0.048	0.044

$W_{CONC} = 6/12 \times .150 = .075$ KSF
$W_{LL} = .080$ KSF
$W_{ROOFING} = .010$ KSF
$W_{WOOD} = .062$ KSF
.227 KSF

= WOOD WT.
60 pieces @ 50 #/FT³ ½×½×5'
Volume = 60 × 1.25 ft³ = 75 ft³
.05 × 75 = 3.75K ±
OVER ¼ AREA ∴ 3.75 ÷ ¼ AREA = .062

SHORT SPAN:

$-M = .063 \times .227 \times 15^2 \times 12 = 38.5$ "K/FT.

$d^2 = \frac{38,500}{160 \times 12}$ ∴ d = 4.50" USE d = 5.0

$A_s = \frac{38,500}{20,000 \times .885 \times 5.0} = 0.44$ in²/FT USE: #4-5½"c-c (short SPAN)

#6 @ 12

LONG SPAN:

$-M = \frac{.058}{.063}(38.5) = 35.5$ "K/FT

$d^2 = \frac{35,500}{160 \times 12}$ ∴ d = 4.30" ∴ 4.3" + #4 BAR = 4.8"
∴ USE d = 5.0" in SHORT SPAN
USE d = 4.5" in LONG SPAN

$A_s = \frac{35,500}{20,000 \times .885 \times 4.5} = 0.44$ in²/FT.

USE #4-5½" c-c (LONG SPAN)

[illegible]

ROOF SLAB : (Continued)

SHORT SPAN:

$+M = .048 \times .227 \times 15^2 \times 12 = 29.4$ in k/FT $\qquad d = 4.25 - \#4 = 3.75''$

$A_s = \dfrac{29,400}{.885 \times 20,000 \times 5.00} = .334$ in²/FT $\qquad$ USE #4-7" C-C

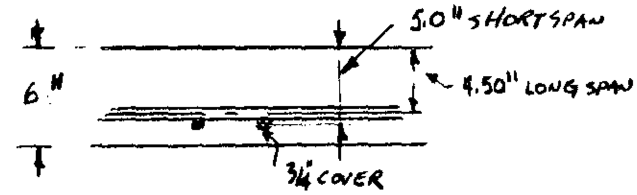
#6 @ ...

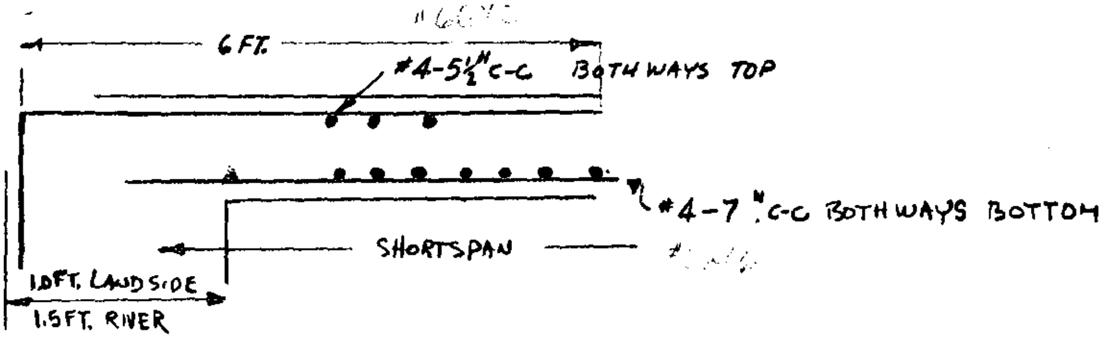
LONG SPAN

$+M = \dfrac{.044}{.048}(29.4) = 27.0$ in k/FT

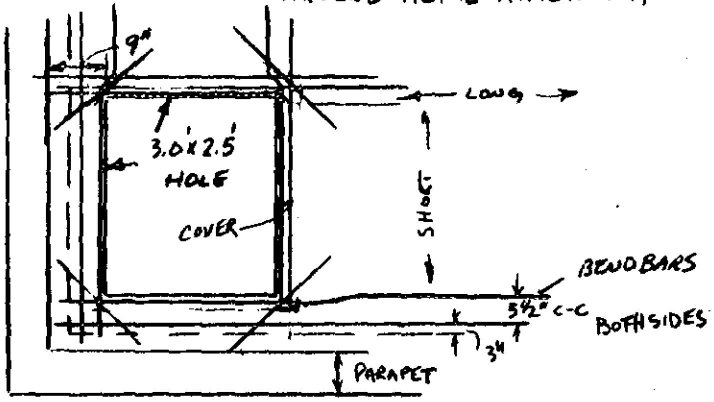
$A_s = \dfrac{27,000}{.885 \times 20,000 \times 4.50} = .340$ in²/FT $\qquad$ USE #4-7" C-C

#6 @ 6

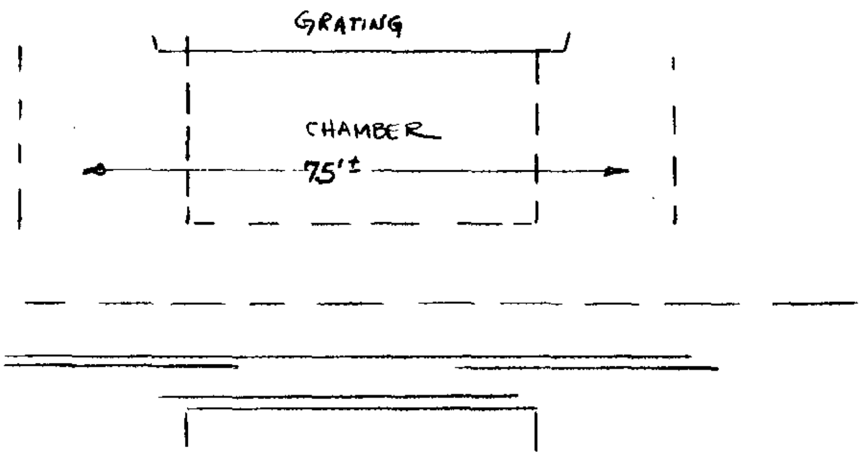




AROUND METAL HATCHWAY



TOP SLAB - OVER 2 CHAMBERS (north side)



USING 6" SLAB

$+M = 1/14\ wl^2$

$-M = 1/9\ wl^2$

FROM P13 W = .227 KSF
less 1/2 WOOD = .031 KSF
.196 KSF

WT/FT = .196 K/FT²

$+M = 1/14(.196)(7.5)^2 = .787^{\prime}K/FT$

$A_s = \dfrac{787 \times 12}{(20000)(.885)(5)} = .107\ in^2/FT$

#4-12" C-C

$-M = 1/9(.196)(7.5)^2 = 1.23^{\prime}K$

$A_s = \dfrac{1230 \times 12}{(20000)(.885)5} = .167\ in^2/3FT$

#4-12" C-C

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PROJECT NO. 6205-2
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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

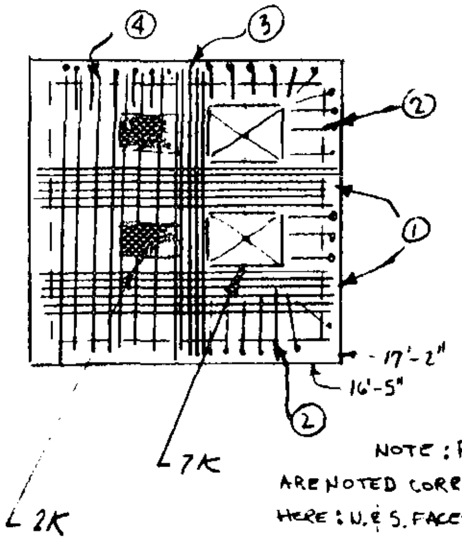
OPERATING FLOOR SLAB:

PUMPENGINE :	2K	
GEAR UNIT :	1K	7K
PUMP :	3K	
THRUST :	3K	

$D.L = .150 \times \frac{12}{12} = .150$ KSF

$L.L = .100$ KSF

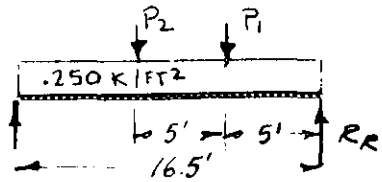
$D.L + L.L = .250$ KSF



NOTE: PADS + PUMPS ARE NOTED CORRECTLY ON P. 20 HERE: N. & S. FACES SHOULD BE REVERSED

① MAIN BAND OF STEEL THROUGH OPENINGS AND ON THE SIDE WHERE THE CANTILEVER WOULD BE TOO GREAT TO ASSUME CANTILEVER DESIGN OF THE STEEL

LENGTH SAY = 16.5 FEET
WIDTH = 3.5 FEET



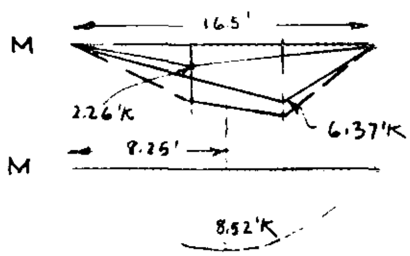
$P_1 = \frac{1}{2}(7+7) = 7K$

$P_2 = \frac{1}{2}(2+2) = 2K$

FOR 1FT SECTION: $\frac{wl^2}{8} = .25 \times 16.5^2 \times \frac{1}{8} = 8.52$ 'K @ ℄

M under P_1 : $M = \frac{10.5}{16.5}(7)(5)\frac{1}{3.5'} = 6.37$'K

M under P_2 : $M = \frac{6.5}{16.5}(2)(10)\frac{1}{3.5'} = 2.26$'K



MAX MOMENT BETWEEN 5 & 8.25' LT RT. SUPPORT.
SAY 7' FROM RT SUPPORT. :

$M_{MAX} = .250 \frac{7'}{2}(16.5-7') + \left[\frac{7(5')9.5'}{16.5} + \frac{2(6.5)(7)}{16.5}\right]\frac{1}{3.5'}$

$M_{MAX} = 8.25 + 5.75 + 1.57 = 15.6$'K

$d^2 = \frac{15,600 \times 12}{160 \times 12} = 9.8''$ USE 12" SLAB

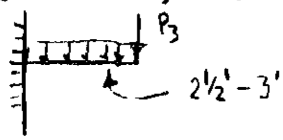
$d = 12'' - \frac{3}{4}'' - \frac{1}{2}$ #7 $= 10.8$

$A_s = \frac{15,600}{20,000 \times .885 \times 10.8} = .082$ in²/in

BOTTOM: USE #7-7"c-c =(.086 in²/in)

OPERATING SLAB FLOOR (CONTINUED) (REFER PREVIOUS PAGE)

(2) CANTILEVER:



L.L.+D.L = .250 KSF

7K ÷ 2[4'+3'] = .50 K/FT ALONG EDGES OF A 4'x3' HOLE = P_3

FOR 1 FT SECTION:

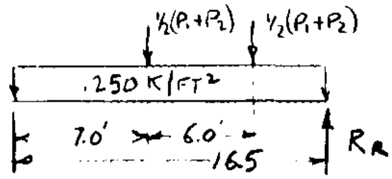
M = .50 x 3 = 1.5 'K
M = .250 x 3 x 1.5 = 1.125 'K
2.7 'K

$A_s = \frac{2{,}700}{20{,}000 \times .885 \times 10.5} = .0146 \text{ in}^2/\text{in}$

USE #5-12" c-c (TOP) (SEE NEXT PAGE)

(3) MAIN BAND OF STEEL FOR SAY 4 FT. AS IN (1)

LENGTH SAY = 16.5 FT.
WIDTH SAY = 4.0 FT.
REFER PREVIOUS PAGE

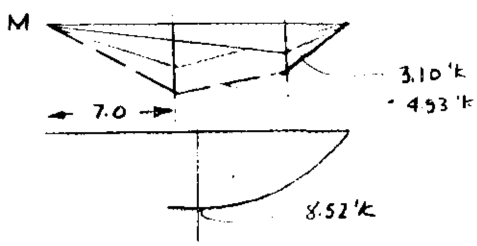


$\frac{1}{2}(P_1+P_2) = \frac{1}{2}(7+2) = 4.5K$

ONE FT. SECTION $wl^2/8 = .25 \times 16.5^2 \times 1/8 = 8.51'K$ @ ℄

M UNDER LOADS: $M = \frac{13}{16.5}(4.5)(3.5) \; 1/4.0' = 3.10'K$

$M = \frac{7}{16.5}(4.5)(9.5) \; 1/4.0' = 4.53'K$



MAX MOMENT AT 7'± FROM LEFT END

$M_{MAX} = 8.5 + 4.53 + \frac{7}{13}(3.10)$

$M_{MAX} = 8.5 + 4.53 + 1.67 = 14.7'K$

$d = 10.8'' - 0.9 = 9.9''$

$A_s = \frac{14{,}700}{20{,}000 \times .885 \times 9.9}$ .084 in²/in

BOTTOM USE #7-7"C-C (.086 in²/in)

GREEN ENGINEERING AFFILIATES
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PROJECT: CHICOPEE FALLS
SUBJECT: MAIN ST PUMPING STATION

PROJECT NO. 6205-2
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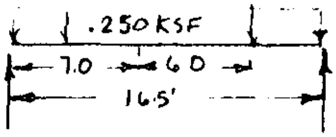
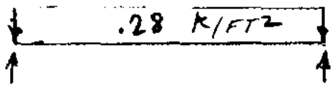
OPERATING FLOOR SLAB (cont.)

(4) Length SAY 16.5 FT
WIDTH SAY 6 FT



P_2 taken care of previously but
ADD $1/2\ P_2$ to entire floor remaining
$2K \div 5' \times 15' = .03\ KSF^{+}$



$+M = \frac{1}{14} w l^2 = \frac{1}{14} \times .280 \times 16.5^2 = 5.4\ 'K$

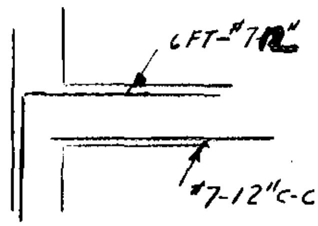
$-M = \frac{1}{9} w l^2 = \frac{1}{9} \times .280 \times 16.5^2 = 8.5\ 'K$

$+A_s = \frac{5400}{20{,}000 \times .885 \times 9.9} = .031\ in^2/in$

USE #7-12" c-c BOTTOM (.05 in²/in)

$-A_s = \frac{8{,}500}{20{,}000 \times .885 \times 9.9} = .049\ in^2/in$

USE #7-12" c-c (TOP)



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PROJECT NO. 6205-2
SHEET NO. 20 OF
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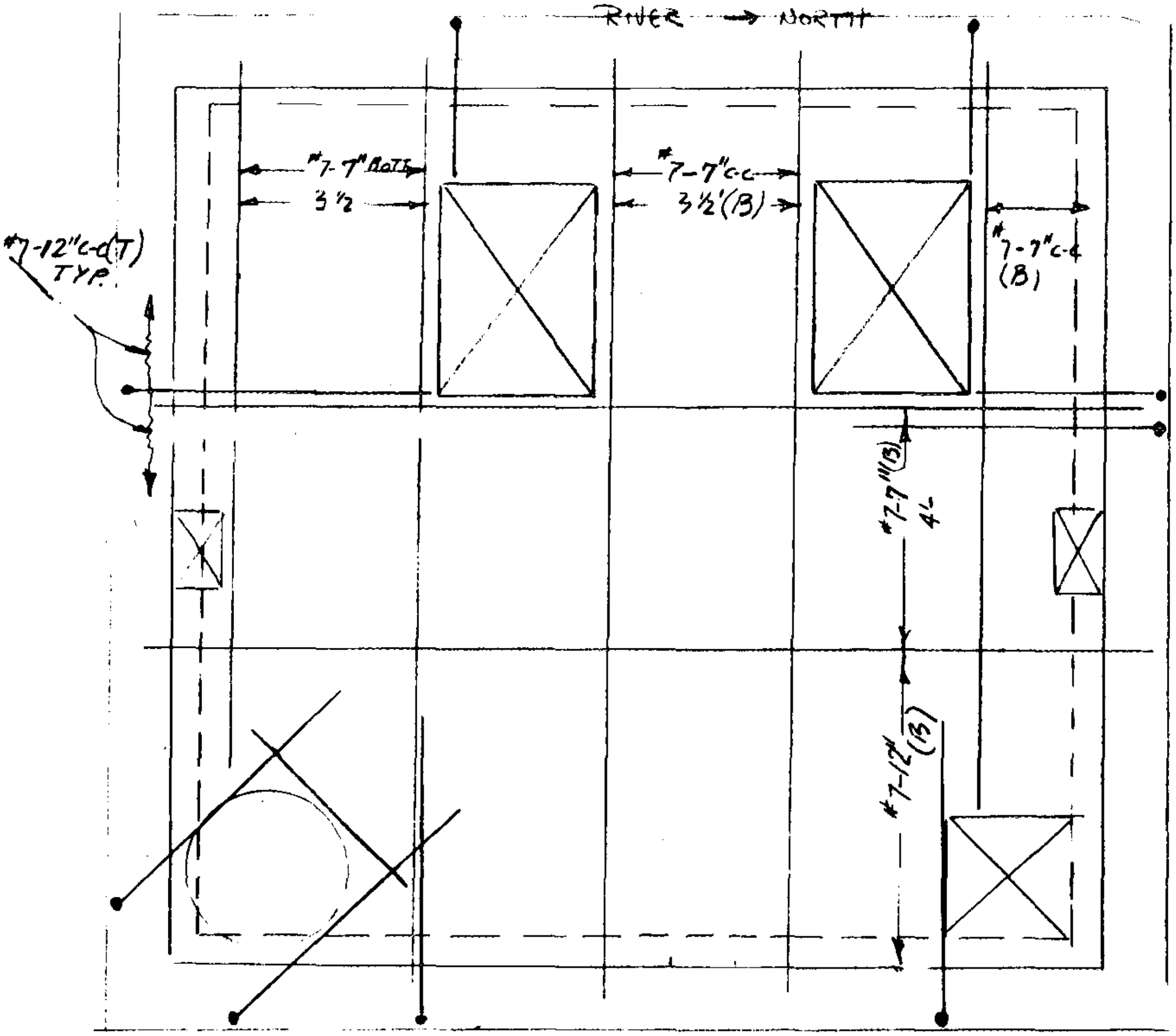
PROJECT CHICOPEE FALLS
SUBJECT MAIN ST PUMPING STATION

OPERATING ROOM SLAB 3/8" = 1'

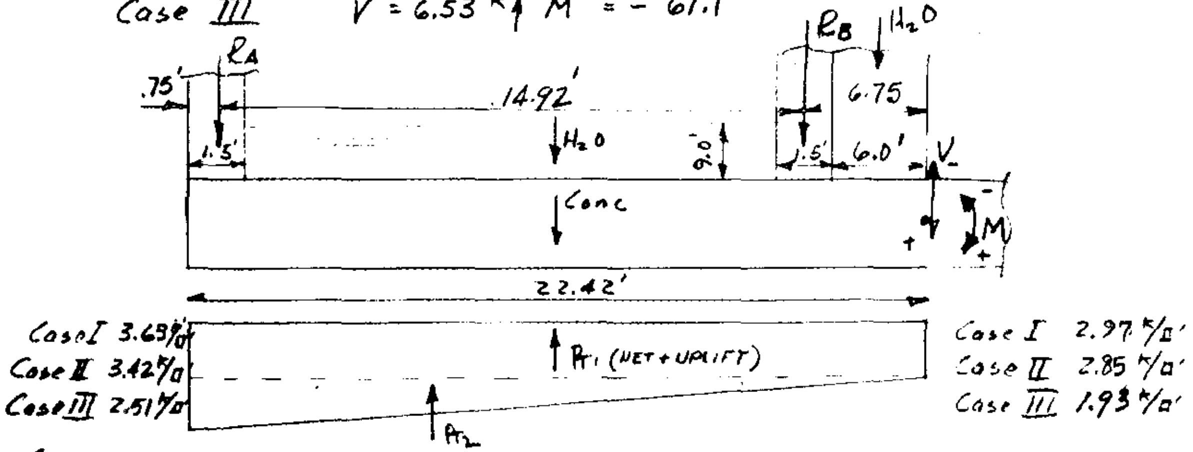


(T) #5-12" SHRINKAGE

Base Slab Design

Shears & Moments at Riverside of Wall from Heel design

Case I $V = 8.40^k \downarrow$ $M = +131.8^{1k}$
Case II $V = 5.14^k \downarrow$ $M = +83.1^{1k}$
Case III $V = 6.53^k \uparrow$ $M = -67.1^{1k}$

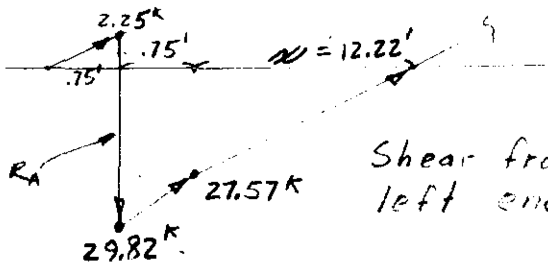


Case I

$\Sigma M R_A$ out H_2O	$= .0625 \times 31.0 \times 6.0$		$+ 11.63 \times 18.67$	$= +217.0$
in H_2O	$= .0625 \times 13.42 \times 9.00$	$=$	$+ 7.55 \times 7.46$	$= +56.3$
Conc	$= .150 \times 22.42 \times 4.00$	$=$	$+ 13.45 \times 10.46$	$= +140.8$
P_{T1}	$= 2.97 \times 22.42$	$=$	$- 66.70 \times 10.46$	$= -695.0$
P_{T2}	$= \frac{1}{2} \times .68 \times 22.42$	$=$	$- 7.63 \times 6.72$	$= - 51.3$
V	$=$		$+ 8.40 \times 21.67$	$= +182.0$
M				$= +131.8$
			-33.30^k	$- 18.4^{1k}$

$R_B = \frac{18.4}{14.92} = +1.23^k$ $R_A = -33.30 + 1.23 = 0$ $R_A = +32.07$

$V_U = (3.65 - .60)x - .033\frac{x^2}{2} = 3.05x - .0165x^2$



Shear from left end

$V = 0 = .0165x^2 - (3.05 - .56)x + 27.57$ $.0165x^2 - 2.49x + 27.57$

$x = \frac{2.49 - \sqrt{6.20 - (4 \times .0165 \times 27.57)}}{.033} = 12.22'$

ΣM_x

R_A	32.07×12.97	=	-416.0
Conc	$\frac{.60 \times \overline{13.72}^2}{2}$	=	-56.5
P_{T_1}	$3.65 \times \frac{\overline{13.72}^2}{2}$	=	$+343.0$
P_{T_2}	$.0165 \times \frac{\overline{13.72}^3}{3}$	=	-14.2
H_2O	$.0625 \times 9.0 \times \frac{\overline{12.22}^2}{2}$	=	-41.9
			-185.6

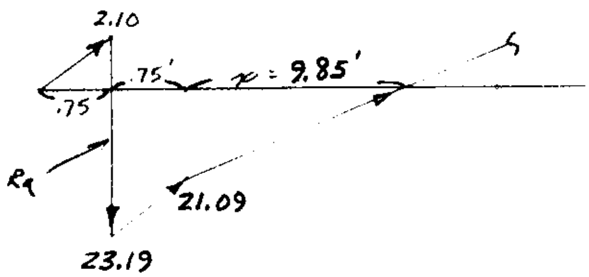
$A_s = \frac{185.6}{2.00 \times 44} = 2.11 \square''$ Top #11 @ 9" $A_s = 2.08$

Case II

outside H_2O	=	$.0625 \times 28.0 \times 6.0$ =	$+10.50 \times 18.67$	=	$+196.0$
inside H_2O	=		$+7.55$		$+56.3$
Conc	=		$+13.45$		$+140.8$
$P_{T\,1}$	=	2.85×22.42 =	-63.80×10.46	=	-668.0
$P_{T\,2}$	=	$\frac{1}{2} \times .57 \times 22.42$ =	-6.38×6.72	=	-42.8
V	=	=	$+5.14 \times 21.67$	=	$+111.5$
M	=				$+83.1$
			-33.54		-123.1

$R_B = \frac{123.1}{14.92} = +8.25^k$ $R_A = 33.54 - 8.25 = 25.29^k$

$V_u = (3.42 - .60)x - .0254\frac{x^2}{2} : 2.82x - .0127x^2$



$V_o = 21.09 - (2.80 - .56)x + .0127x^2 = .0127x^2 - 2.26x + 21.09 = 0$

$x = \frac{2.26 - \sqrt{5.10 - (4 \times .0127 \times 21.09)}}{.0254} = 9.85'$

GREEN ENGINEERING AFFILIATES
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PROJECT Chicopee Falls
SUBJECT Main St. Pump Sta.

PROJECT NO.
SHEET NO. OF
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ΣM_x R_A = 25.29 × 10.60' = − 268.0

Conc = .160 × $\frac{11.35^2}{2}$ = − 38.6

P_{T1} = 3.42 × $\frac{11.35^2}{2}$ = + 220.0

P_{T2} = .0127 $\frac{11.35^3}{3}$ − 6.2

H_2O = .0625 × 9.00 × $\frac{9.85^2}{2}$ = − 27.3

− 120.1 K

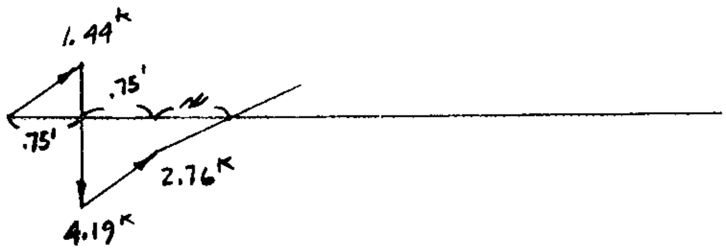
$A_s = \frac{120.1}{1.44 \times 44} = 1.89\ \square''$

Case III $\Sigma M R_A$

P_{T1}	= 1.93 × 22.42	= −43.30K × 10.46	= − 452.0'K
P_{T2}	= ½ × .58 × 22.42	= − 6.50 × 6.72	= − 43.7
Conc	=	= + 13.45	= + 140.8
outside H_2O	= .0625 × 6.0 × 6.0	= + 2.25 × 18.67	= + 42.0
V	=	− 6.53 × 21.67	= − 141.8
M	=		− 67.1
		−40.63	− 521.8

$R_B = \frac{521.8}{14.92} = +35.0^K$ $R_A = 40.63 - 35.0 = + 5.63^K$

$V_u = (2.51 - .60)x - .0258\frac{x^2}{2} = 1.91x - .0129x^2$



$V = .0129x^2 - 1.91x + 2.76 = 0$

$x = \frac{1.91 - \sqrt{3.65 - (4 \times .0129 \times 2.76)}}{.0258} = 1.55'$

$R_A = 5.63 \times 3.51 \qquad - 19.8$

$Conc = .60 \times \frac{4.26^2}{2} \qquad - 5.4$

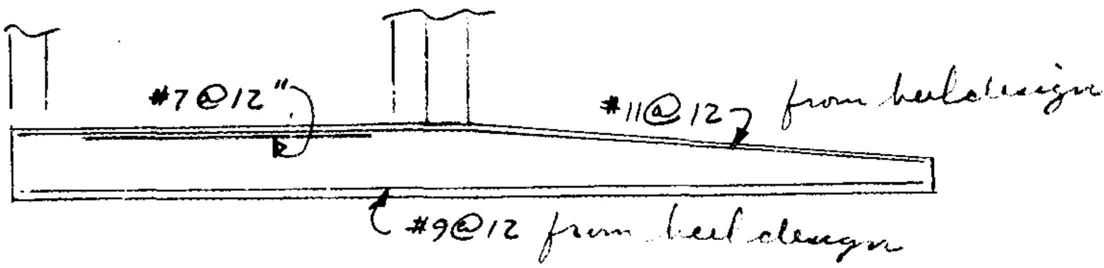
$P_{T1} = 2.51 \times \frac{4.26^2}{2} = \qquad + 22.8$

$P_{T2} = .0129 \times \frac{4.26^3}{3} = \qquad - 0.3$

$\qquad - 2.7'^{K}$

$A_s = \frac{2.7}{1.44 \times 44} = .04 \square''$

$\min A_s = .002 \times 12 \times 48 = 1.15 \square''$



2.11 □" reg @ pump well

#11@12 $\qquad A_s = \frac{1.56 \square}{.55}$ $\qquad$ #7@12

GREEN ENGINEERING AFFILIATES
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PROJECT NO. 620
SHEET NO. 23 OF
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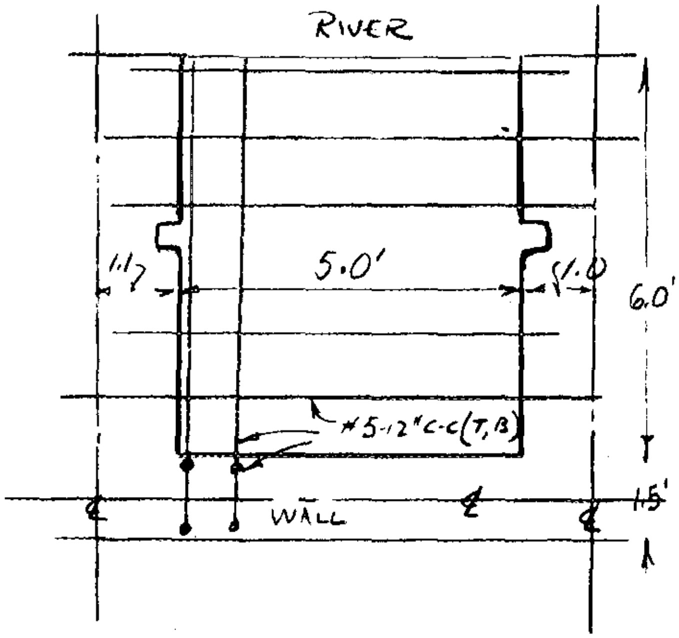
PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

SLAB - OVER FILLED CHAMBERS



FLOOR ELEVATION 84.0
HI. WATER ELEVATION 105.0
∴ WATER = 21.0 FT.

INSIDE DIMENSIONS $6' \times 5.0'$

$21.0 \times .0625 = 1.31$ KSF

$+M = 1/14 (1.31)(5+2)^2 = 4.59$ 'K

$-M = 1/9 (1.31)(7)^2 = 7.14$ 'K

$d^2 = \frac{7,140 \times 12}{160 \times 12} = 6.7 \text{ in}^2$

USING 12" SLAB , $d = 10^{\pm}$

$+ \quad A_s = \frac{4,590}{.885 \times 20,000 \times 10} = .026 \text{ in}^2/\text{in}$ #5 @ 12" c-c

$- \quad A_s = \frac{7,140}{.885 \times 20,000 \times 10} = .040 \text{ in}^2/\text{in}$ #6 @ 12" c-c

SHEAR $V = 1.15\,w\ell = 1.15 \times 1.31 \times 7 = 10.5$K

$v = \frac{10,500}{(12)\times(.9)\times(10)} = 97.5 \text{ psi} > 90 \text{ psi}$

∴ USE 15" SLAB $d = 13.5$ ACTUAL SLAB = 18" USED

(∥ to RIVER :) $+A_s = .026 \times \frac{10}{13.5} = .0193 \text{ in}^2/\text{in}$ #5-12" c-c (BOTTOM)

$-A_s = .040 \times \frac{10}{13.5} = .0296 \text{ in}^2/\text{in}$ #5-11" c-c (TOP)

$v = 97.5 \times \frac{10}{13.5} = 72 \text{ psi}$ (OK)

USE #5-12" BOTH WAYS TOP + BOTTOM

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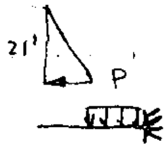
PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

STOPLOG COLUMNS   MIN WIDTH 2'-0"

CONTINUE WALL DESIGN ADJACENT TO STATION TO TIE INTO STATION USING THE 1'-6" DESIGN BEFORE - REFER TO WALL DESIGN

CONSIDERING 1 CHAMBER FULL AND ONE EMPTY. WITH 21± FT OF WATER PRESSING ABOVE SLAB (AT EL 84) 3 FT. CANTILEVER FOR UNIFORM LOAD



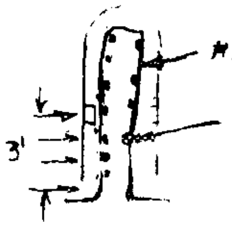
$P = .0625 \times 21' = 1.31$ K/FT UNIFORM LOAD

$M = 1.31 \times 3' \times 1.5' = 5.9'K$

CA. FACE - VERTICAL STEEL:

$$A_s = \frac{5,900}{(.907)(27,000)(20)} = .0121 \text{ in}^2/\text{in}$$ AT BOTTOM

[#6-12" ALL THE WAY UP]



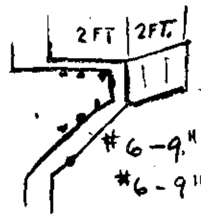
HOIST SLAB OR HAUNCH

36" INTAKE - 11,600 # AT STALL (MACMILLAN, MILLS)
SAY - 900 # APPARATUS
12,500 #

GATE SUPPORT APP. 1'-0 FROM WALL   SLAB WIDTH OF 2FT.

$M = 12,500 \times 1.0 = 12,500$ '#

$$d = \sqrt{\frac{12,500 \times 12}{160 \times 12}} = 8.8''$$



BENT BARS:

$$A_s = \frac{12,500}{.885(20,000)(8.8)(2FT)} = .040 \text{ in}^2/\text{in}$$

USE #6-9" c-c (.049 in²/in)

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PROJECT CHICOPEE FALLS

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LOADING #1 (BOTTOM FOOT) EL 75. FT

WATER @ 105.0 : 105-75 = 30 FEET WATER

W = .0625 x 30' = 1.875 K/FT/FT. (RIVER SIDE)

WATER IN SOIL @ 89.0 : 89-75 = 14 FEET WATER

W = .0625 x 14' = 0.875 K/FT/FT.

LATERAL EARTH (14') SATURATED. $\frac{1}{3}[.135 - .0625] = .0242\ K/FT^3$

E = .0242 x 14 = 0.340 K/FT/FT. (LAND SIDE)

E = .0242 x 7 = 0.170 K/FT/FT (RIVER SIDE)

WATER IN STATION = NEGLIBLE ≈ 0 (FOR WORST CASE)

LOADING #1 (EL. 91. FT.)

WATER @ 105.0 : 105-91 = 14 FEET WATER

W = .0625 x 14 = 0.875 K/FT/FT.

WATER IN SOIL @ 91 gives NO WATER PRESSURE
NO SOIL PRESSURE

LOADING #2 (BOTTOM FOOT) (EL. 75 FT.)

WATER @ 102.0 : 102-75 = 27 FEET WATER

*W = .0625 x 27 = 1.69 K/FT/FT

WATER IN SOIL = 0.875 K/FT/FT

LATERAL EARTH = 0.340 K/FT/FT. & 0.170 K/FT/FT

WATER IN STATION = NEGLIBLE ≈ 0 (WORST CASE)

LOADING #2 (EL 91 FEET)

WATER @ 102.0 : 102-91 = 11 FEET WATER

W = .0625 x 11 = 0.69 K/FT/FT

LOADING #3 (EL 75.0 BOTTOM FOOT) (REFER P8)

WATER AT 80.0 EL. 80-75 = 5 FEET WATER

W = .0625 x 5 = 0.312 K/FT/FT

(continued)

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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

LOADING #3 (continued) BOTTOM FOOT.

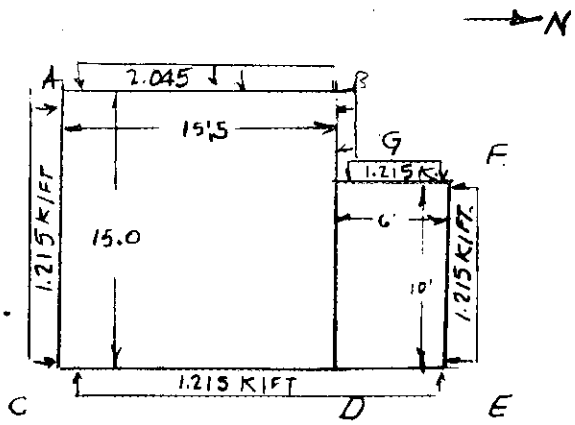
P_{es} : EARTH AT 89.0 ADD 3' SURCHARGE
WATER AT 80.0

(PAGE 8) P_{es1} : $.130 \times 1/3 \times 12 = .520$ K/FT/FT ORDINATE
P_{es2} : $.0725 \times 1/3 \times 5 = .121$ K/FT/FT ORDINATE

LATERAL (E) = 0.641 K/FT/FT. LAND SIDE
LATERAL E = 0.17 K/FT/FT WATERSIDE
WATER INSIDE STATION = NEGLIBLE

LOADING #1

REFER to P 24 cc



I's are ≈ the SAME

$FEM_{AB-BA} = 1/12 (2.045)(15.5)^2 = \mp 40.9$ 'K & $K_{AB-BA} = \frac{100}{15.5} = 6.45$

$FEM_{AC-CA} = 1/12 (1.215)(15.)^2 = \mp 22.8$ 'K & $K_{AC-CA} = \frac{100}{15.} = 6.67$

$FEM_{CD-DC} = 1/12 (1.215)(15.5)^2 = \mp 24.3$ 'K & $K_{CD-DC} = \frac{100}{15.5} = 6.45$

$FEM_{DE-ED} = 1/12 (1.215)(6)^2 = \mp 3.6$ 'K & $K_{ED-DE} = \frac{100}{6} = 16.67$

$FEM_{EF-FE} = 1/12 (1.215)(10)^2 = \mp 10.1$ 'K & $K_{EF-FE} = \frac{100}{10} = 10.0$

$FEM_{FG-GF} = 1/12 (1.215)(6)^2 = \mp 3.6$ 'K & $K_{FG-GF} = \frac{100}{6} = 16.67$

$FEM_{GB-BG} = 1/12 (1.215)(5.)^2 = \mp 2.5$ 'K & $K_{GB-BG} = \frac{100}{5.0} = 20$

& $K_{GD-DG} = \frac{100}{10} = 10$

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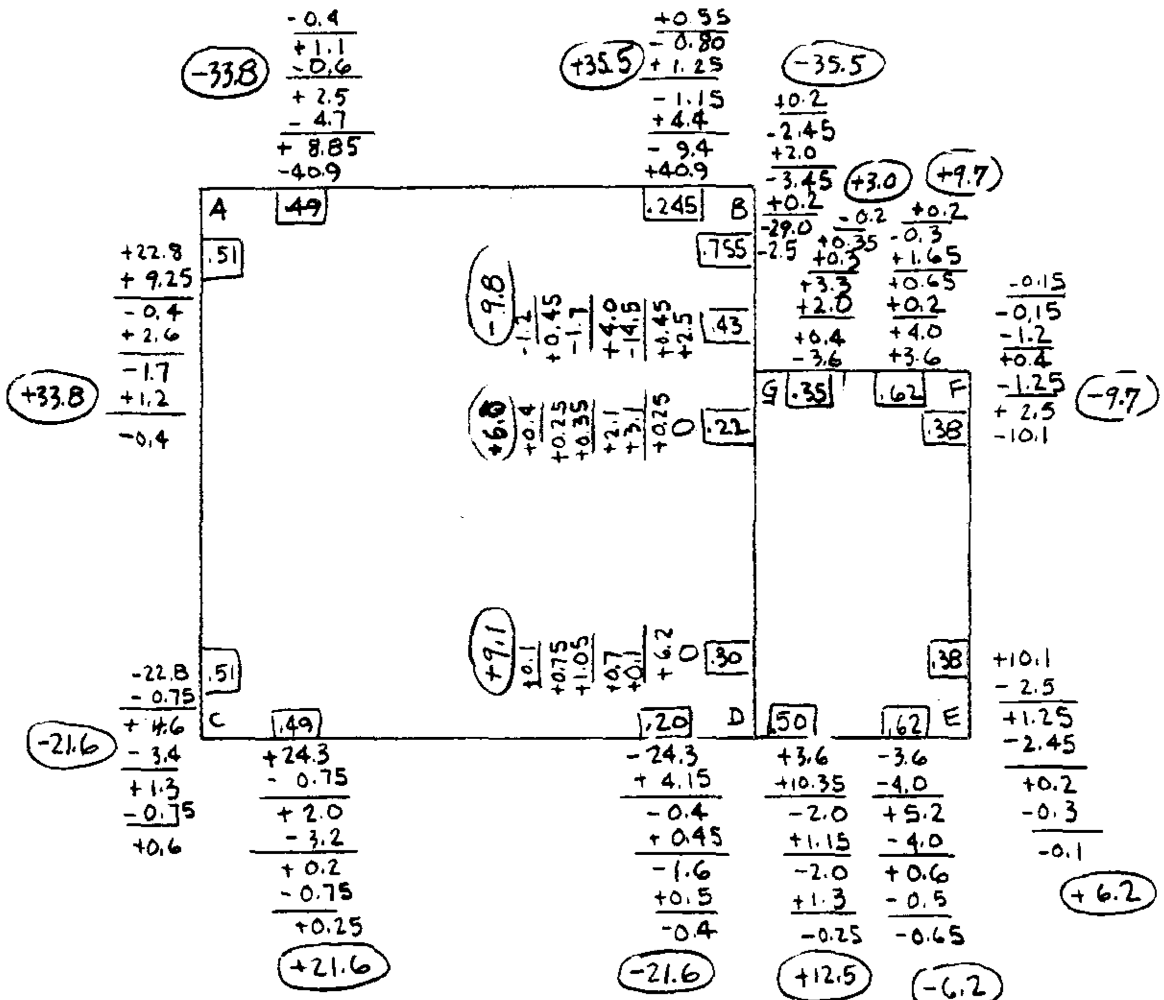

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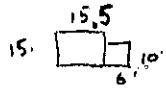
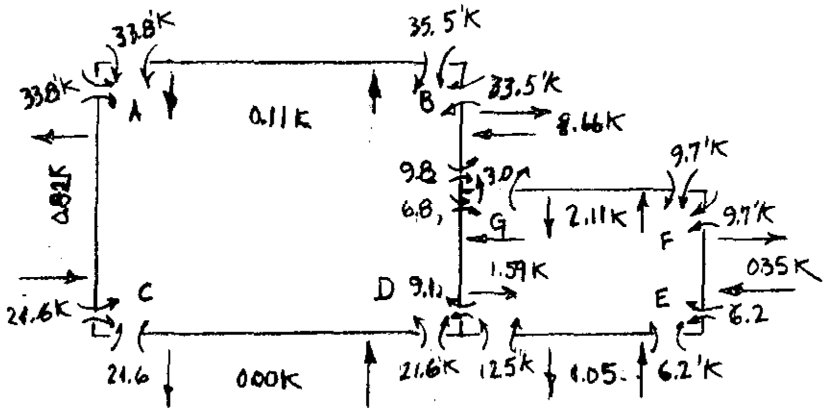
PROJECT CHICOPEE FALLS

SUBJECT MAIN ST. PUMPING STATION

LOADING # 1 (BOTTOM FOOT)





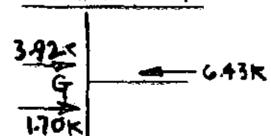
SHEAR FROM UNIFORM LOADS PLUS ABOVE SHEAR:

[UNBALANCE ASSUMED TAKEN BY this RIGID STRUCTURE - DISCUSSED THAT THERE WILL BE AN UNBALANCE But IT WILL ENTER THE BASE WITH MINOR CHANGES IN MOMENT]

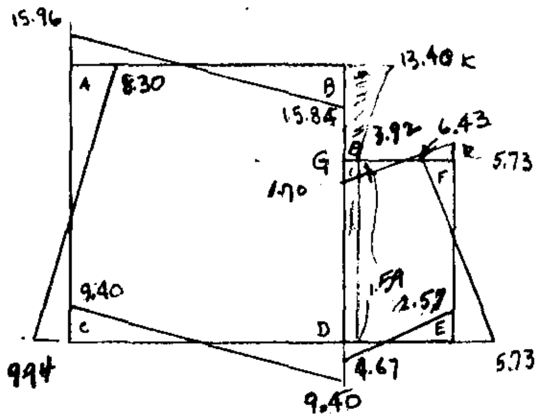
$wl/2$ + SHEAR:

AB =	15.85K ↑	± 0.11 K
AC =	9.12K	∓ 0.82 K
CD =	9.40K ↓	± 0.00 K
DE =	3.62K ↓	∓ 1.05 K
EF =	6.08K →	∓ 0.35 K
FG =	3.62K ↑	∓ 2.11 K
GB =	8.66 K	∓ 4.74 K
GD =	0	± 1.59 K

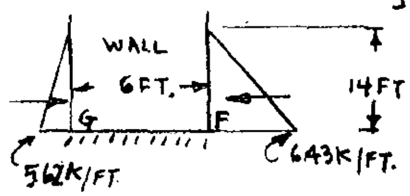
BOTTOM FOOT:



NET = 0.81K BOTTOM FT.



[ASSUMING IF POSSIBLE "G" VERTICALLY CAN MOVE FREELY]



(NEGLIBLE)

M = 14/3 × 0.81 × 14/2 = 26.4K'

$A_S = \frac{26,4000}{.907 \times 27,000 \times 68''} = .016\ in^2/in$

∴ MIN STEEL VERTICALLY @ F

(SEE LATER SHEETS)

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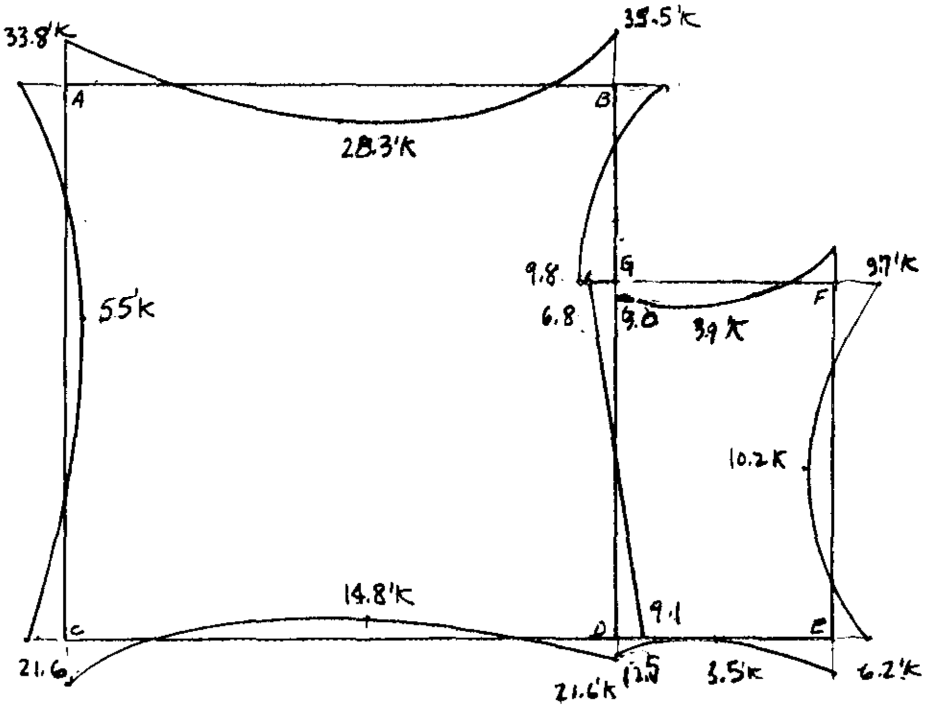
TENSION SIDE   LOADING #1 BOTTOM FOOT



(FROM P27)

A-B → $\frac{15.96}{x_L} = \frac{31.90}{15.5}$; $x_L = 7.78'$ ≡ (15.96)(½)(7.78) = 62.1 − 33.8 → 28.3'K @ 7.78'

A-C → $\frac{8.30}{x_R} = \frac{18.24}{15.0}$; $x_R = 6.82'$ ≡ (8.30)(½)(6.82) = 28.3 − 33.8 → 55'K @ 6.82'

C-D → $x_L = 7.75'$ ≡ (9.40)(½)(7.75) = 36.4 − 21.6 → 14.8'K @ 7.75

D-E → $\frac{2.57}{x_R} = \frac{7.24}{6'}$; $x_R = 2.12'$ ≡ (2.12)(½)(2.57) = 2.7 − 6.2 → 3.5'K @ 2.12'

E-F → $\frac{5.73}{x_L} = \frac{12.16}{10}$; $x_L = 5.72'$ ≡ (5.72)(½)(5.73) = 16.4 − 6.2 → 10.2'K @ 5.72'

G-F → $\frac{5.73}{x_R} = \frac{7.24}{6'}$; $x_R = 4.75'$ ≡ (5.73)(½)(4.75) = 13.6 − 9.7 → 3.9'K @ 4.75'

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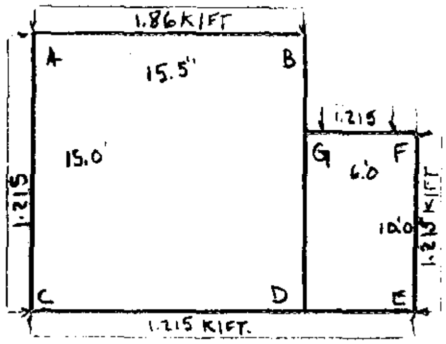
PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

LOADING #2 (REFER TO P24 ETC.)



$FEM_{AB-BA} = \frac{1}{12}(1.86)(15.5)^2 = \mp 37.3$ 'K

$FEM_{AC-CA} = \mp 22.$[illegible] 'K

$FEM_{CD-DC} = \mp 24.3$ 'K

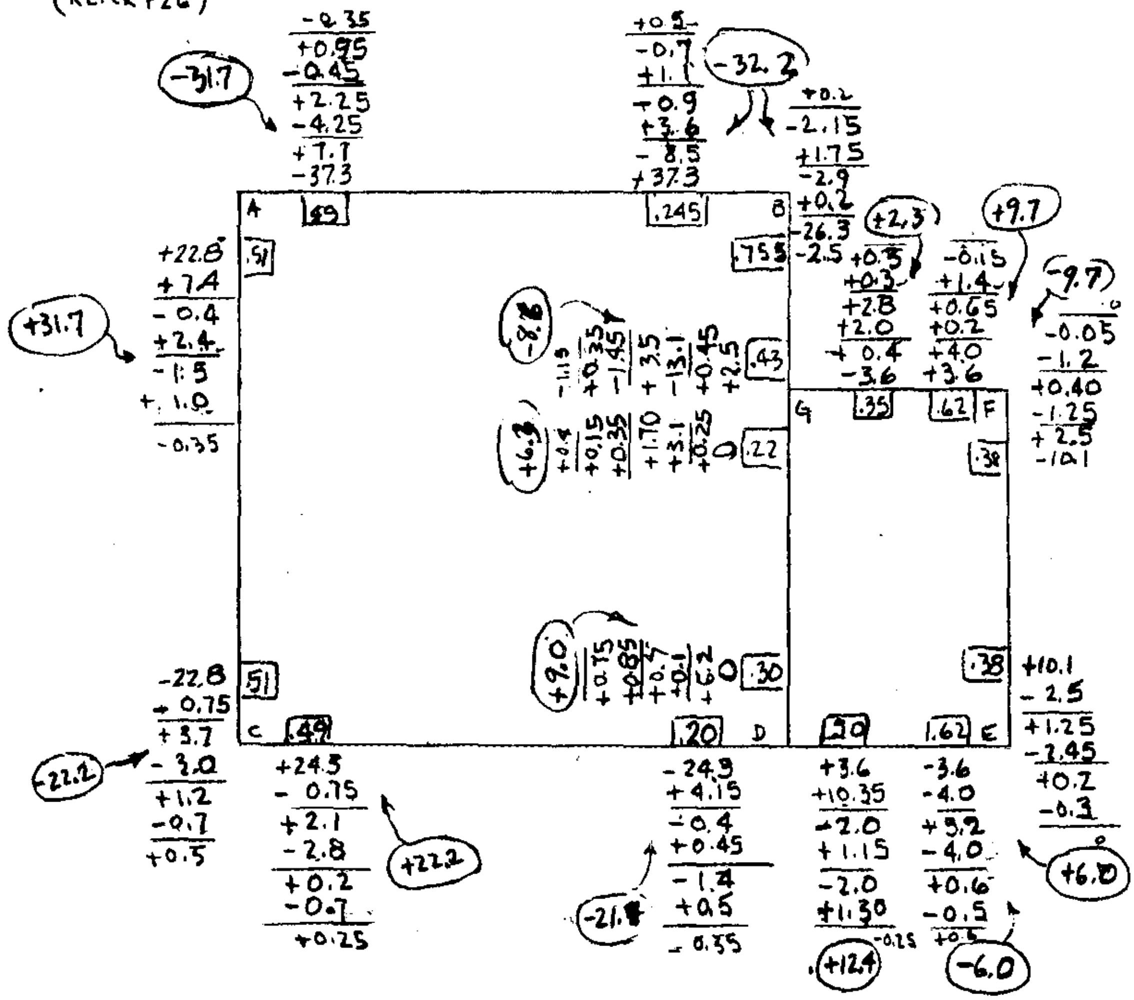
$FEM_{DE-ED} = \mp 3.6$ 'K

$FEM_{EF-FE} = \mp 10.1$ 'K

$FEM_{FG-GF} = \mp 3.6$ 'K

$FEM_{GB-BG} = \mp 2.5$ 'K

(REFER P26)



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PROJECT CHICOPEE FALLS

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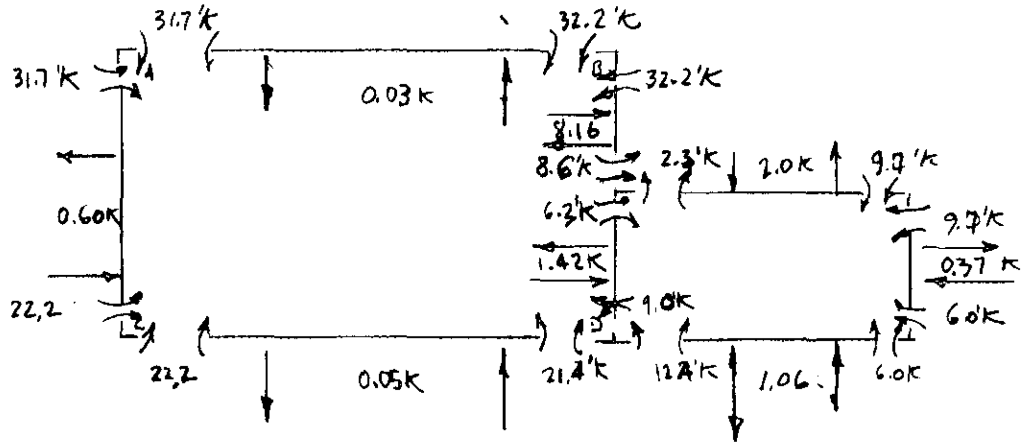
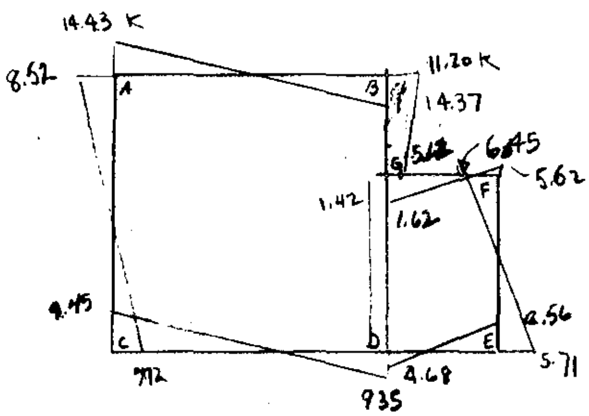
LOADING #2 (BOTTOM FOOT)



wl/2 + SHEAR :

AB	=	14.40K ↑	± 0.03K
AC	=	9.12K →	∓ 0.60K
CD	=	9.40K ↓	∓ 0.05K
DE	=	3.62K ↓	± 1.06K
EF	=	6.08K →	∓ 0.37K
FG	=	3.62K ↑	∓ 2.00K
GB	=	3.04K →	∓ 8.16K
GD	=	0	± 1.42K



BOTTOM FOOT:

NET = 0.12K →

(NEGLIBLE)

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PROJECT CHICOPEE FALLS

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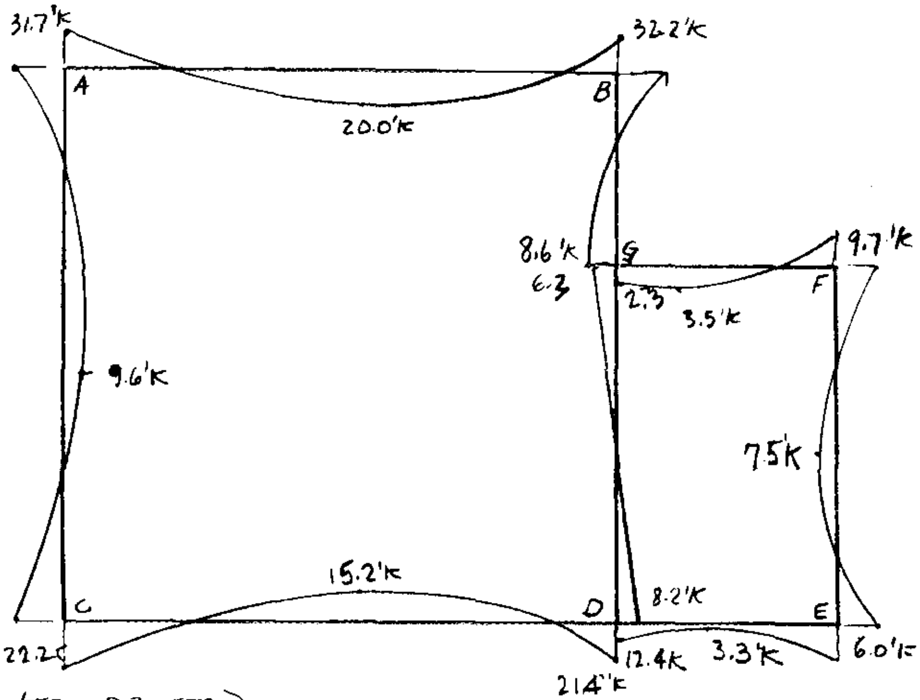
TENSION SIDE   LOADING I BOTTOM FOOT.



(FROM P 30 ETC.)

AB → $\frac{14.43}{x_L} = \frac{28.80}{15.5}$ & $x_L = 7.78'$ ∴ $(14.43)(1/2)(7.78) = 55.6'k - 31.7 = 23.9'k$ @ 7.78'

AC → $\frac{9.72}{x_L} = \frac{18.24}{15.0}$ & $x_R = 8.00'$ ∴ $(9.72)(1/2)(8.00) = 38.9 - 22.2 = 16.7'k$ @ 8.00'

CD → $\frac{9.45}{x_L} = \frac{18.80}{15.5}$ & $x_L = 7.80'$ ∴ $(9.45)(1/2)(7.80) = 36.9 - 22.2 = 14.7'k$ @ 7.80'

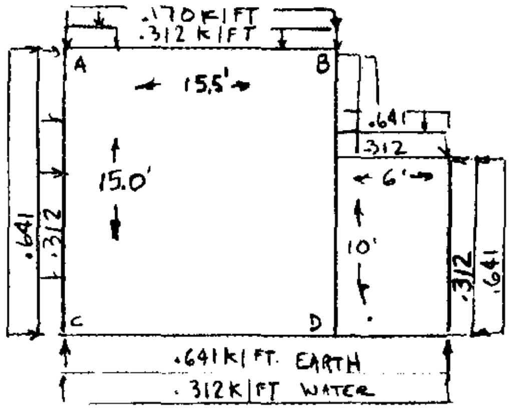
DE → $\frac{4.68}{x_L} = \frac{7.24}{6.0}$ & $x_L = 3.88'$ ∴ $(3.88)(1/2)(4.68) = 9.1 - 12.4 = -3.3k$ @ 3.88'

EF → $\frac{5.71}{x_L} = \frac{12.16}{10}$ & $x_L = 4.71'$ ∴ $(4.71)(1/2)(5.71) = 13.5 - 6.0 = 7.5k$ @ 4.71'

GF → $\frac{1.62}{x_L} = \frac{7.24}{6}$ & $x_L = 1.34'$ ∴ $(1.34)(1/2)(1.62) = 1.2 + 2.3 = 3.5'k$ @ 1.34'

LOADING #3

(REFER P24,25)



COMPARING LOADING #3 – LOADING #2

ALL LOADINGS UNDER #3 ARE LESS AND THE WALLS BEND SIMILARLY.

$FEM_{AB} = 1/12(.482)(15.5)^2 = 9.6'K$ VS. 40.9'K etc.

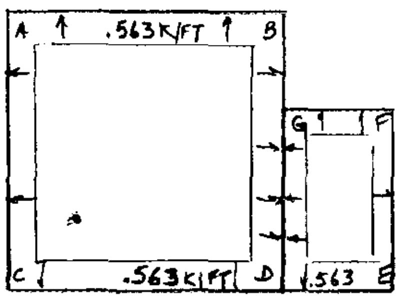
A STATEMENT CAN BE MADE SAYING THAT Ld. #2 LOADS AND BENDING WILL GOVERN AS COMPARED to Ld. #3.

ADDITIONAL LOADING: (BOTTOM FOOT)

[TO BE ADDED TO MAKE MAX. CONDITIONS WHERE NEEDED]

WATER ON INSIDE CHAMBERS AT EL. 83.0 ∴ 9 FEET OF WATER

$.0625 \times 9 = .5625$ K/FT/FT.



$FEM_{AB-BA} =$
$FEM_{CD-DC} =$ $1/12(.563)(15.5)^2 = 11.2'K$

$FEM_{AC-CA} = 1/12(.563)(15.)^2 = 10.5'K$

$FEM_{DE-ED} =$
$FEM_{GF-FG} =$ $1/12(.563)(6)^2 = 1.7'K$

$FEM_{FE-EF} = 1/12(.563)(10)^2 = 4.7'K$

$FEM_{BG-GB} = 1/12(.563)(5.)^2 = 1.2'K$

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ADDITIONAL LOAD: (BOTTOM FOOT)

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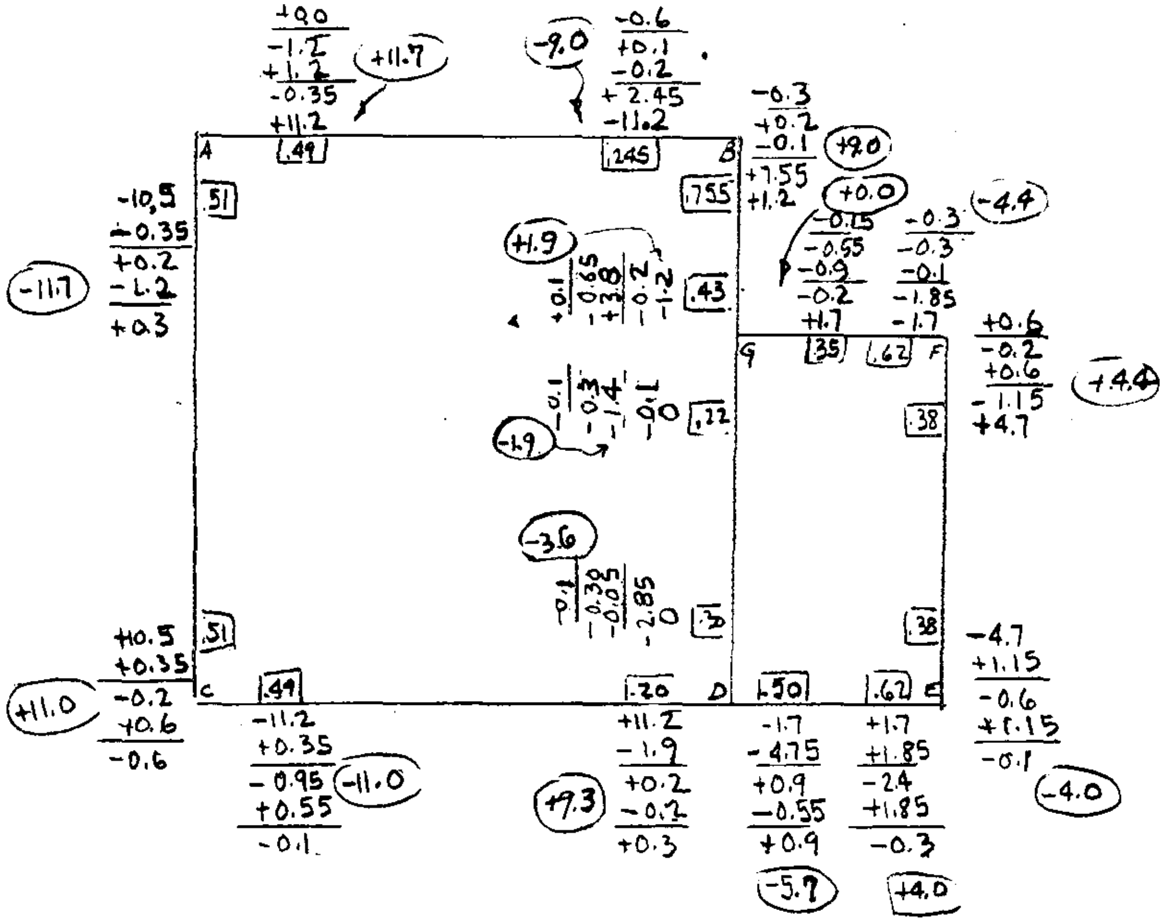

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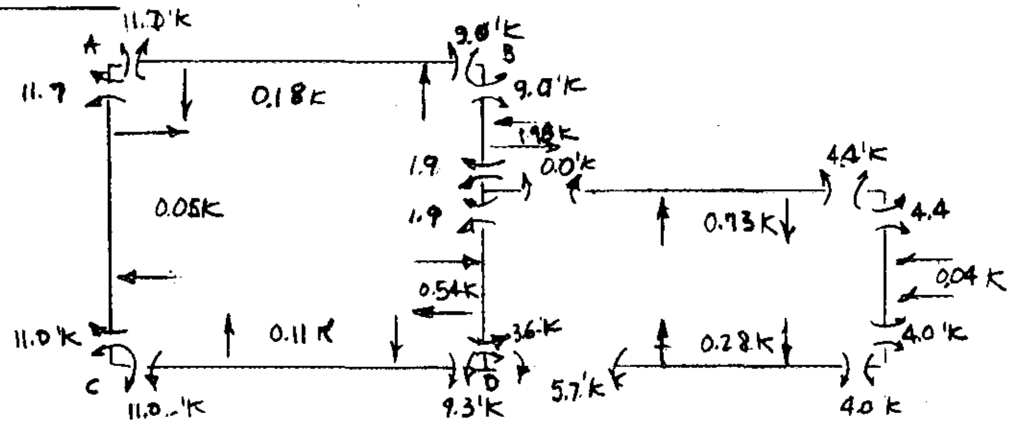
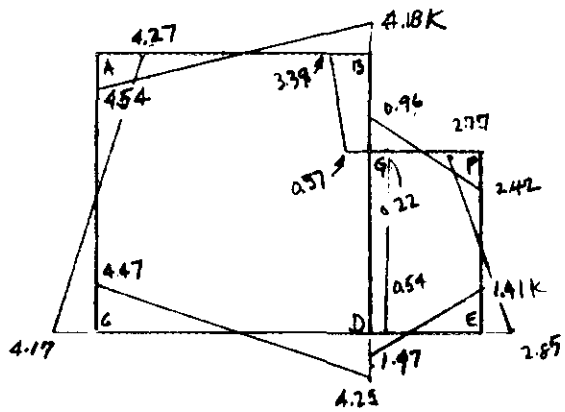
ADDITIONAL LOAD (BOTTOM FOOT)

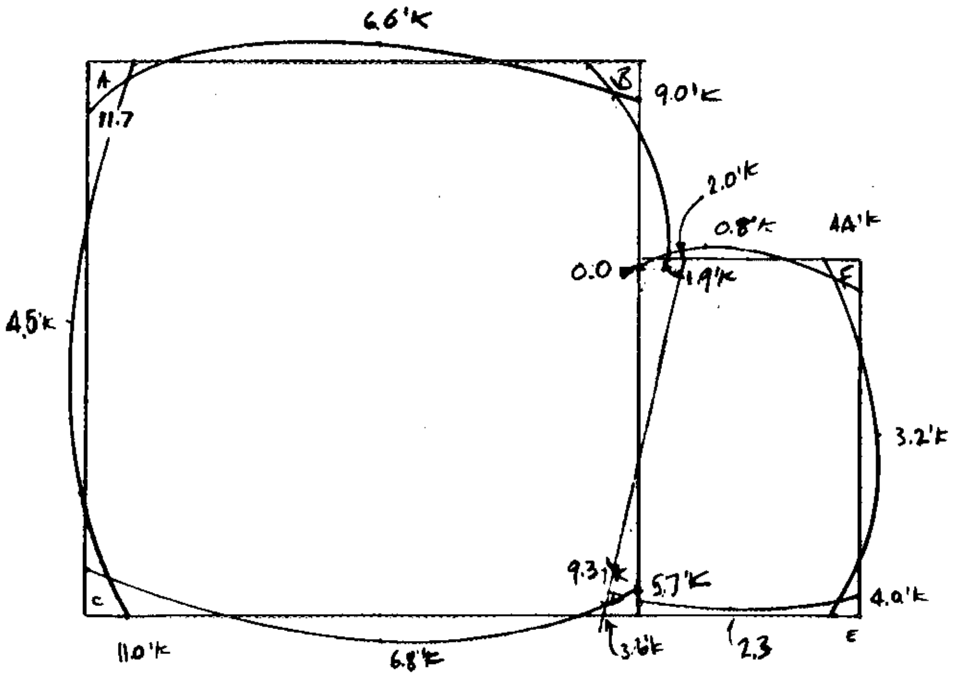


$wl/2$ + SHEAR :

AB =	4.36 K ↓	± 0.18 K
AC =	4.22 K →	∓ 0.05 K
CD =	4.36 K ↑	± 0.11 K
DE =	1.69 K ↑	∓ 0.28 K
EF =	2.81 K ←	± 0.04 K
FG =	1.69 K ↓	± 0.73 K
BG =	1.41 K ←	∓ 1.98 K
GD =	0	± 0.55 K



TENSION SIDE (LOADING ADDITIONAL)



AB → $\frac{4.54}{X_L} = \frac{8.82}{15.5}$ $X_L = 8.07'$ ∴ $(4.54)(\frac{1}{2})(8.07) = 18.3 - 11.7 = 6.6'k$ @ $8.07'$

AC → $\frac{4.27}{X} = \frac{8.44}{15}$ $X_L = 7.62'$ ∴ $(4.27)(\frac{1}{2})(7.62) = 16.2 - 11.7 = 4.5'k$ @ $7.62'$

CD → $\frac{4.47}{X_L} = \frac{8.72}{15.5}$ $X_L = 7.95'$ ∴ $(4.47)(\frac{1}{2})(7.95) = 17.8 - 11.0 = 6.8'k$ @ $7.95'$

DE → $\frac{1.97}{X_L} = \frac{3.38}{6}$ $X_L = 3.50'$ ∴ $(1.97)(\frac{1}{2})(3.50) = 3.4 - 5.7 = -2.3'k$ @ $3.50'$

EF → $\frac{2.85}{X_L} = \frac{5.62}{10}$ $X_L = 5.08'$ ∴ $(2.85)(\frac{1}{2})(5.08) = 7.2 - 4.0 = 3.2'k$ @ $5.08'$

G-F → $\frac{0.96}{X_L} = \frac{3.38}{6}$ $X_L = 1.70'$ ∴ $(0.96)(\frac{1}{2})(1.70) = 0.8 - 0.0 = 0.8'k$ @ $1.70'$

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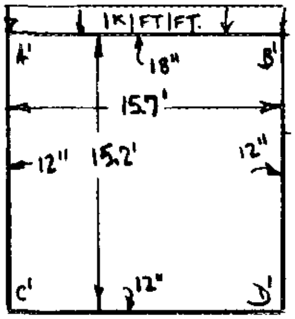
UNIT LOADING : {WALL DESIGN EL. 91.0}

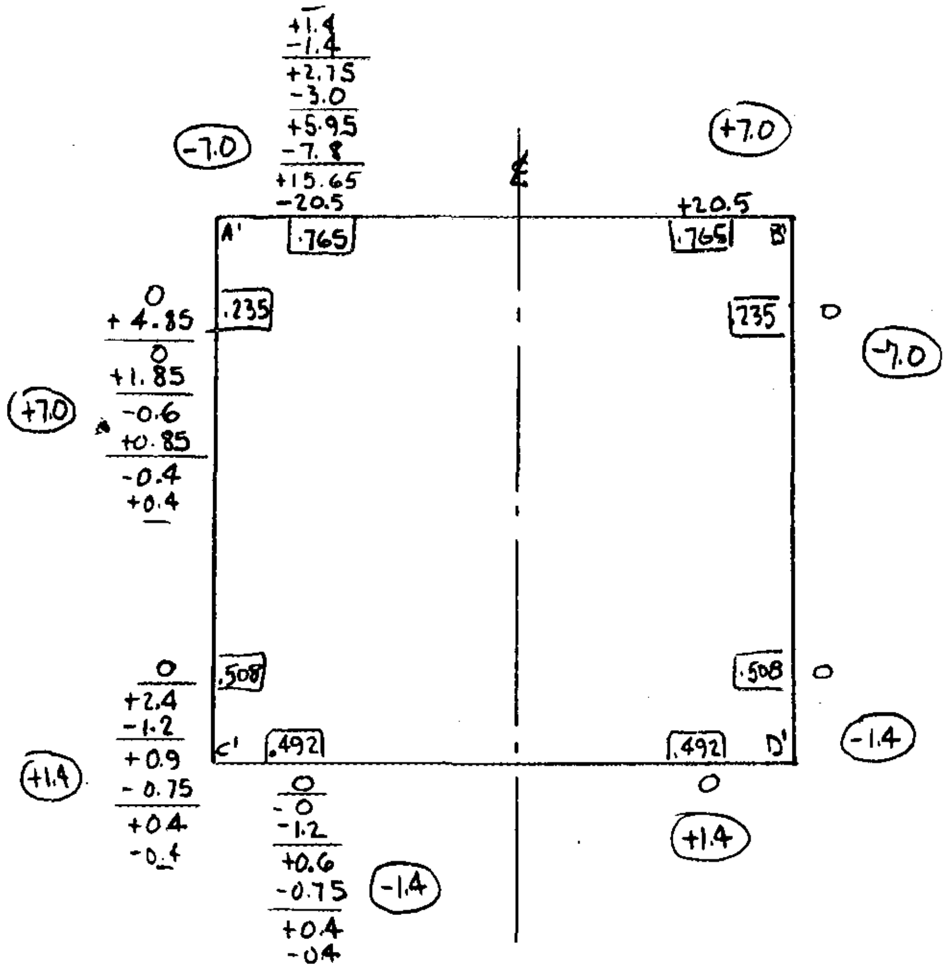


$FEM_{A'B'-B'A'} = \frac{1}{12}(1)(15.7)^2 = 20.5'^K$

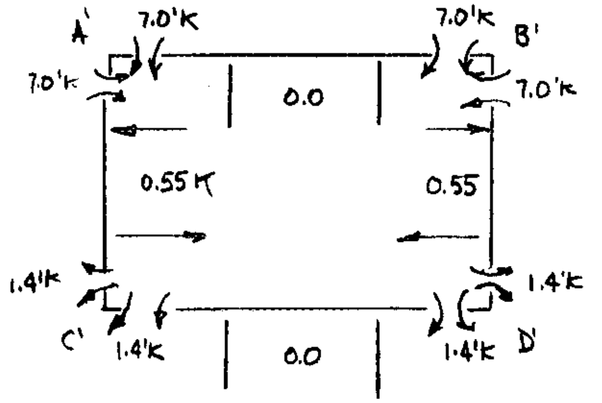
$K_{AB-BA} = \frac{100}{15.7} = 6.38$

$K_{AC-CA} = K_{BD-DB} = \left(\frac{12}{18}\right)^3\left(\frac{100}{15.2}\right) = 1.95$

$K_{CD-DC} = \left(\frac{12}{18}\right)^3\left(\frac{100}{15.7}\right) = 1.89$



WALL DESIGN EL 91.0 (UNIT LOADING)



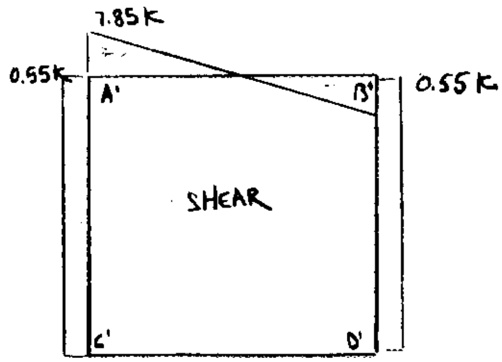
$wl/2$ + shear

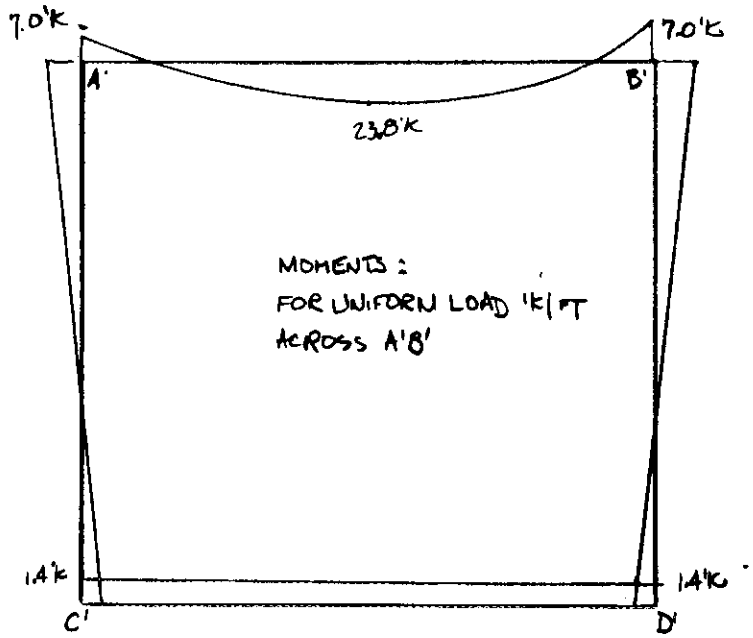
A'B' = 7.85↑ ± 0 K

A'C' = 0 ± 0.55K

C'D' = 0 ± 0.00

B'D' = 0 ± 0.55K





AB → $(7.85)(1/2)\left(\frac{15.7}{2}\right) = 30.8$'K

$30.8 - 7.0 = 23.8$'K

GREEN ENGINEERING AFFILIATES
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PROJECT: CHICOPEE FALLS
SUBJECT: MAIN ST. PUMPING STATION

PROJECT NO. 6205
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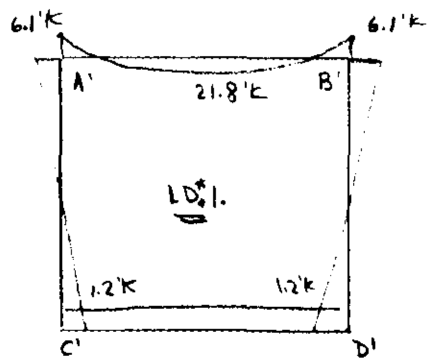
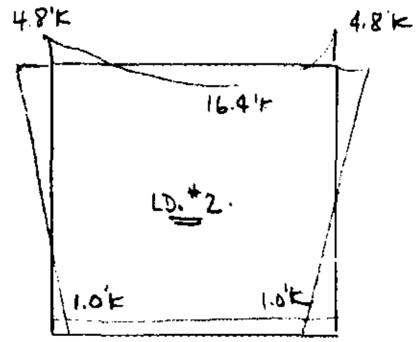
DATE MAR 63
COMPUTED BY DR
CHECKED BY PP

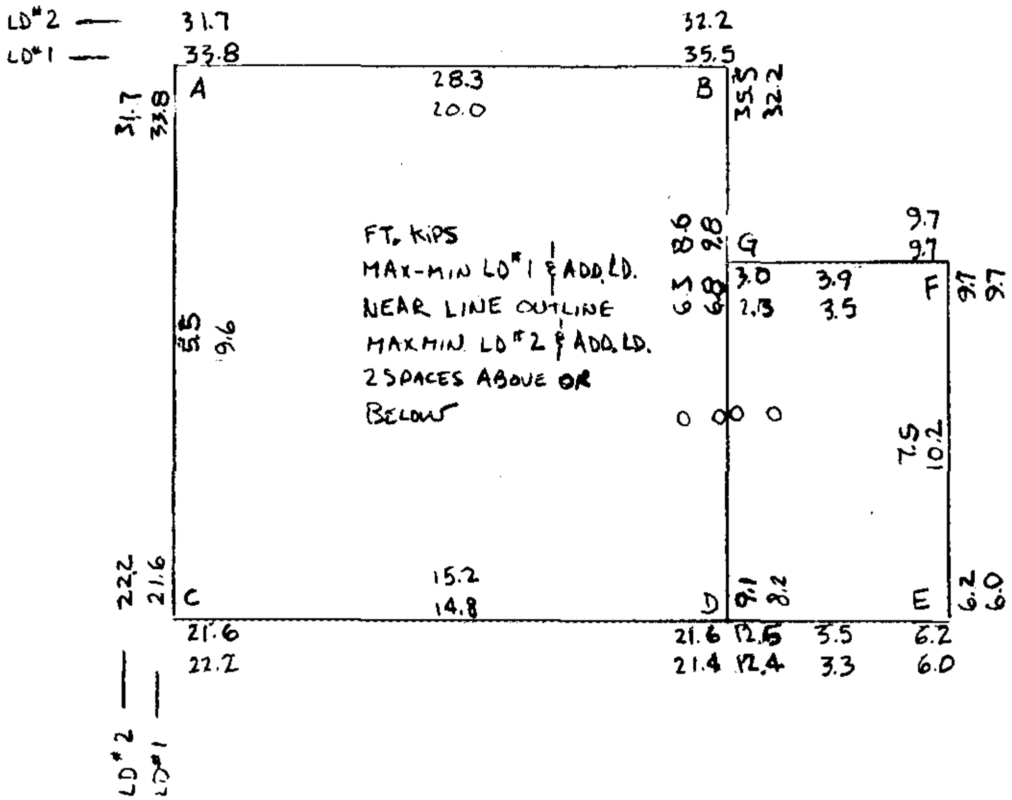
LOADING #1 @ EL 91.0 (REFER P. 37) 0.875 K/FT ACROSS A'B'
[∴ 7.0 × .875 = 6.1'K IN A'B']

LOADING #2 @ EL. 91.0 (REFER P 37) 0.69 K/FT ACROSS A'B'





SUMMARY: (BOTTOM FOOT) REFER PREVIOUS PAGES (MAX-MIN) [ON TENSION SIDE]
(ADDITIONAL LOAD USED P32)*



Vertical Reinf in walls

12" Wall

$A_s = .002 \times 12 \times 12 = .29 \square''$ or $.15 \square''$ ea face

18" wall

$A_s = .002 \times 12 \times 18 = .43 \square''$ or $.22 \square''$ ea face

} Use #6@12" ea face
USE #5-12" ABOVE EL. 90.0

Base slab

Min $A_s = .002 \times 12 \times 48 = 1.15$ ~~#11@16"~~

USE: MAX #6-12" c-c

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SHEET NO. ____ OF ____
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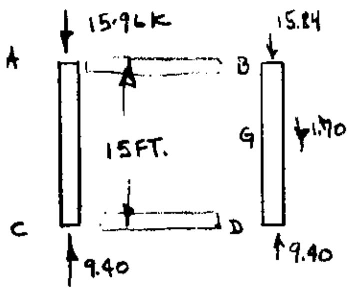
CHECKED BY ____

PROJECT CHICOPEE FALLS

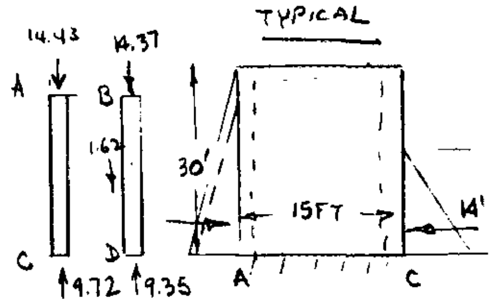
SUBJECT MAIN ST PUMPING STATION

BOTTOM FT. ~ UNBALANCED SHEAR

P.A 30 -



P A-33



$V = 15.9 \times 30/2 - 9.40 \times 14/2 = 172K$

$v = \frac{172{,}000}{15 \times 1.5 \times 144} = 53$ psi (OK)

AVE LD. AT BOTTOM FT.

↓ $(17.54 + 15.96)\,1/2 = 16.75K$ ↓

↑ 9.40K

$M = 16.75 \times 30^2/6 - 9.40 \times 14^2/6$

$M = 2510'K - 307'K = 2203'K$

$V = 14.43 \times 27/2 - 9.72 \times 14/2 = 127K$

< 90 psi

AVE LD. AT BOTTOM FT.

↓ $[14.43 + 15.99]\,1/2 = 15.21K$

↑ $(9.72 + 9.35)\,1/2 = 9.53K$

$M = 15.21 \times 27^2/6 - 9.53 \times 14^2/6$

$M = 1850 - 311 = 1539'K$

CONSIDERING THE BOX  to be  T BEAM

REFER P4. R.C. HAND BOOK:

$f_s = 27{,}000$ psi

$f_c = 1400$ psi

$d = 15FT - 9''$ AVE $= 14.2$ FT

$b = 15.5$ FT.

$M = 2203'K$

$t = 1.5'$ $t/d = .105$

$k = 115$ (TABLE 8)

$b \times d = 220 \times 144 = 31{,}700$

$F = \frac{bxd^2}{12{,}000} = 451.$

$M = 2203 = 2203$

$KF = 115 \times 451 = 51900$

$M - KF = 49{,}700$

$a = 2.14$ (table 8)

$A_s = \frac{2203}{2.14 \times 14.2' \times 12} = 6.07\ in^2/15.5FT.$

$A_s = 0.39\ in^2/FT$ < #6@12" BOTH FACES ARE OK.

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PROJECT: CHICOPEE FALLS

SUBJECT: MAIN ST PUMPING STATION

354,000

STEEL REFER to P. 38 $d = 18" - 3.5 = 14.5"$

@A OUTSIDE: $A_s = \frac{31{,}700}{(14.5)(20{,}000)(.885)} = 0.124 \text{ in}^2/\text{in}$ (257,000) LD#2
[#9-8" or #8-6 c-c]

AB ℄ MID PT: (INSIDE) $A_s = \frac{28{,}300}{(14.5)(27{,}000)(.91)} = 0.0798 \text{ in}^2/\text{in}$ (355,000) LD#1
[#8-9 ½ or #7-7½"]

@B OUTSIDE: $A_s = \frac{32{,}200}{257{,}000} = 0.125 \text{ in}^2/\text{in}$ LD#2
[#9-8" or #8-6" c-c]

AC ℄ MID PT. (INSIDE) $A_s = \frac{9{,}600}{355{,}000} = 0.027 \text{ in}^2/\text{in}$ LD#1
[#5-12"]

@C OUTSIDE $A_s = \frac{22{,}000}{257{,}000} = 0.0868 \text{ in}^2/\text{in}$ LD#2
[#8-9" ETC]

CD ℄ MID PT (OUTSIDE) $A_s = \frac{15{,}200}{257{,}000} = 0.0592 \text{ in}^2/\text{in}$ LD#2
[#7-10" or #6-7½"]

@D OUTSIDE LT. $A_s = \frac{21{,}400}{257{,}000} = 0.0513 \text{ in}^2/\text{in}$ LD#2
[#6-8½" or #7-11.7"]

@D OUTSIDE RT $A_s = \frac{12{,}400}{(11.5)(20{,}000)(.885)} = 0.0608 \text{ in}^2/\text{in}$ (204,000) LD#2
[#7-10"]

DE ℄ MID PT : #5-12" (INSPECTION)

@E OUTSIDE : $A_s = \frac{6{,}000}{204{,}000} = 0.0294 \text{ in}^2/\text{in}$ LD#2
[#5-11"]

EF ℄ MID PT : $A_s = \frac{7{,}500}{204{,}000} = 0.0368 \text{ in}^2/\text{in}$ LD#2
[#6-12"]
[#5-8"]

STEEL BOTTOM FOOT CONTINUED

@ F outside $A_S = \frac{9{,}700}{207{,}000} = 0.0475\ in^2/in$ [#6 - 9" c-c] 40#2

FG MIDPOINT [#5-12" c-c]

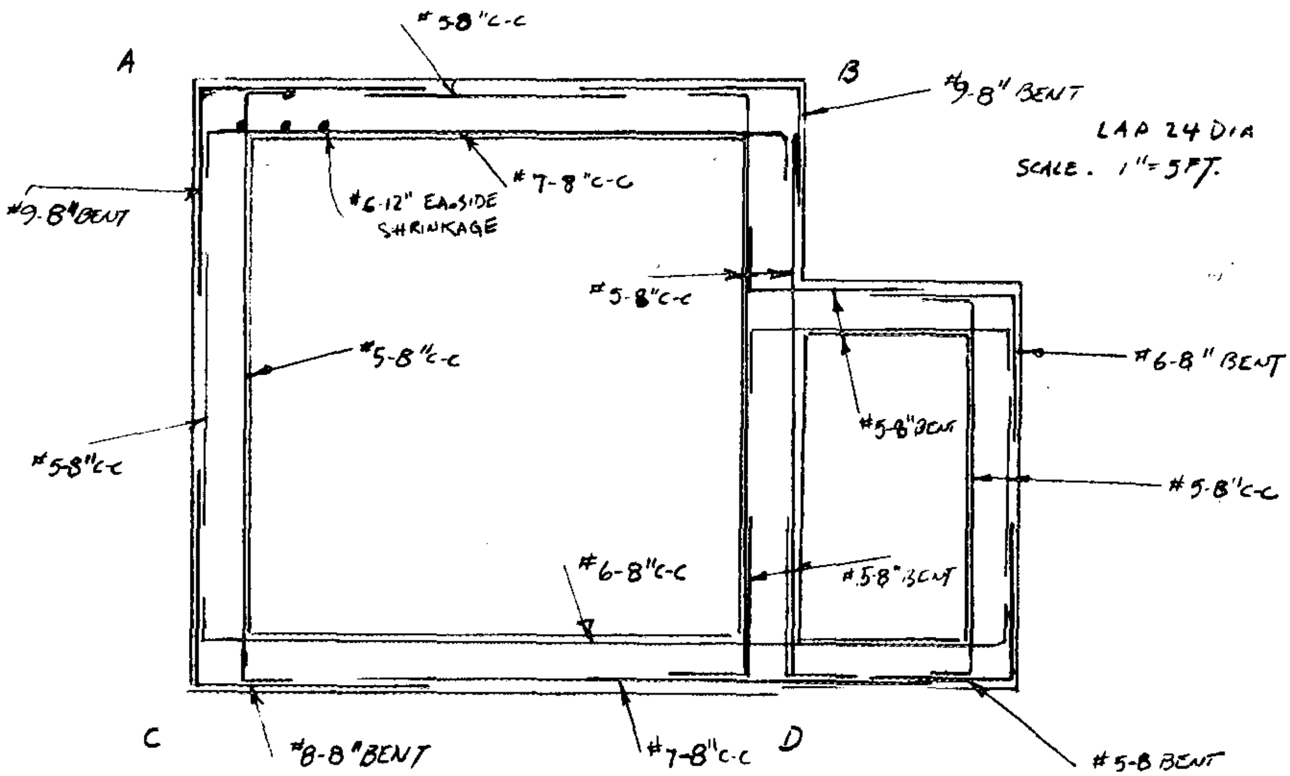
@G INSIDE [#5-12" c-c]

GD MIDPOINT 0

@ G SOUTH SIDE $A_S = \frac{9{,}800}{257{,}000} = 0.038\ in^2/in$ [#6-11½" c-c]

@D NORTH SIDE $A_S = \frac{8{,}200}{257{,}000} = 0.0319\ in^2/in$ [# 5-10" c-c]

RIVERSIDE - BOTTOM FOOT TO EL. 91.0



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PROJECT NO. 6205-2
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COMPUTED BY
CHECKED BY

PROJECT CHICOPEE FALLS
SUBJECT MAIN ST PUMPING STATION

EL. 91.0 AND UP REFER P38 $d = 12 - \frac{\#6}{2} - 1\frac{1}{2}" = 10^{\pm}$

@ A' outside

$A_s = \frac{6,100}{(907)(27,000)(10)} = 0.025 \text{ in}^2/\text{in}$ LD#1 -

$A_s = \frac{4,800}{(.885)(20,000)(10)} = 0.0271 \text{ in}^2/\text{in}$ LD#2 - #5-12

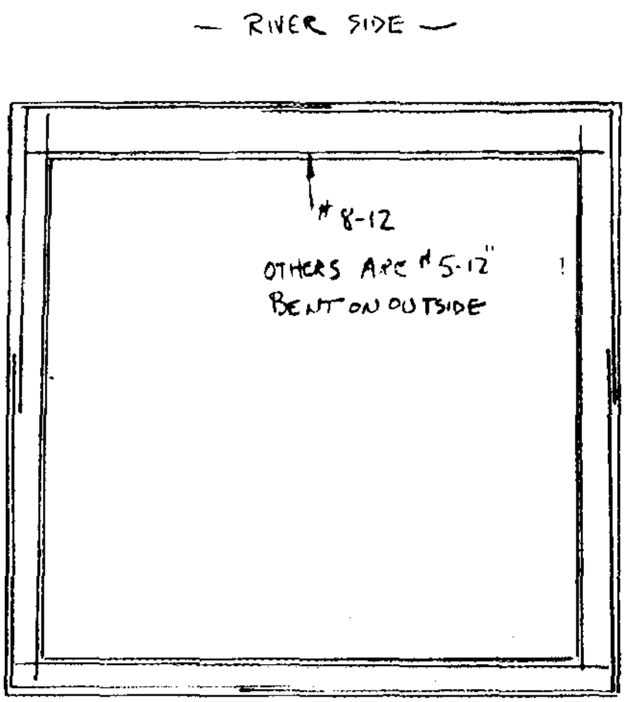
- A'B' -

$A_s = \frac{16,400}{257,000} = 0.0638 \text{ in}^2/\text{in}$ LD#2

[#8-12"]

d = 18" - 3.5" AS BELOW

d = 18" - 3" - .5± = 14.5"



LAP = 24 DIA
1" = 5' SCALE
#5-12" SHRINKAGE

GREEN ENGINEERING AFFILIATES
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PROJECT NO. 6205-2
SHEET NO. 1 OF
DATE FEB 18, 1962
COMPUTED BY ENW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS
SUBJECT OAK ST PUMPING STATION

I. DEAD LOAD ONLY
EAST-WEST DIRECTION
MOMENTS AT WEST WALL

REF ARCH. PLATES #11 & 12

MARK	FACTORS	↓	↑	ARM	M↻	M↺
BASE SLAB C_1	0.15×2.5×21.0×27.92	219		10.5	2300	
do C_2	0.15×3.0×3.0×21.0	28		10.5	294	
do C_3	0.15×2.0×6.75×21.0	42		10.5	441	
do C_4	0.15×2.0×2×8.0×8.0	38		25.0	935	
W. WALL OUTLET CH.	0.15×1.5×12.67×24.25	69		0.75	52	
do SUMP	0.15×1.5×15.17×13.06	44		0.75	33	
do PUMP	0.15×1.0×15.08×14.19	32		0.5	16	
HOLE - FAN	0.15×1.0×2.5×2.5		1	0.5		1
W. WALL INTAKE	0.15×1.25×6.75×13.0	16		0.62	10	
do LOUVER	0.15×1.5×4.0×6.0		5	0.75		4
E. WALL OUTLET	0.15×1.5×12.67×13.37	31		20.25	625	
do do	0.15×1.42×12.67×13.52	36		20.2	730	
HOLE - GATE	0.15×1.5×4.0×4.0		5	20.25		101
E. WALL - SUMP	0.15×1.5×15.17×13.06	45		20.25	910	
do - PUMP	0.15×1.0×15.08×14.19	32		20.42	653	
DOOR	0.15×1.0×5.0×7.0		5	20.42		103
WINDOW	0.15×1.0×5.0×5.0		3	20.42		70
HOLE	0.15×1.0×1.0×1.3		1	20.42		20
CENTER WALL	0.15×1.5×18.0×10.73	44		10.5	460	
do	0.15×1.25×18.0×14.19	48		10.5	500	
HOLES	3×0.15×1.5×2×2		3	9.5		28
		724 23 701	23		7922 -327 7595	327

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GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 2 OF
DATE Feb. 18, 1963
COMPUTED BY FHW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

MARK	FACTORS	↓	↑	ARM	M↻	M↺
S. WALL	0.15×1.5×18.0×10.73	44		10.5	460	
do	0.15×1.42×18.0×13.52	52		10.5	545	
N. WALL	0.15×1.5×18.0×13.06	53		10.5	545	
do	0.15×1.0×18.92×14.19	41		10.5	430	
HOLES	0.15×1.5×5×3×2		7	7.5		52
do	0.15×1.0×5×3×3		7	9.5		67
N. WALL INTAKE	0.15×1.25×26.5×13.0	64		14.5	930	
EAST END	0.15×1.25×6.0×13.0	15		28.38	425	
GATE WALL	0.15×1.25×5.5×13.0	13		20.38	262	
HOLE	0.15×1.25×4×4		3	20.36		61
S. WALL INTAKE	0.15×1.25×6.75×13.0	16		24.38	390	
HOLE	$0.15\times1.25\times\pi\times2^2$		2	24.38		49
COVER	0.15×0.5×5.5××26.5	11		14.50	160	
HOLE	0.15×0.5×5.5×2.0		1	16.0		16
E. INTAKE	0.15×1.25×10×10	19		28.38	540	
	0.15×1.25×6.75×10.2	25		24.38	610	
HOLES	$0.15\times1.25\times\pi\times2^2\times2$		5	24.38		122
COVER	0.15×0.5×5.5×6.75	3		24.38	73	
DISCHARGE	0.15×1.0×4.5×18.0	12		10.5	126	
"	0.15×1.0×5.0×18.0	14		10.5	147	
GRAVE	0.135×3.5×5.0×18.0	42.5		10.5	445	
PIERS	0.15×4.5×6.25×18.25	77		9.6	740	
STOP LOGS	36/4×1×4.17×.04	1.5		10.5	16	
do	48/4×1×6.5×.04	3		17.25	51	
INTAKE COVERS	0.15×0.5×3×3×2		1	26		26
		506	26		6895	393
		26			393	
		480			6502	

Omitted (A) Arm M

.15×2.25×1.5×18.25 = 9 18.37 = 165

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GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 3 OF
DATE Feb. 19, 1963
COMPUTED BY FNW
CHECKED BY MA

I. Cont. Dead Load. East-West Direction. Moments at West Wall.

Mark	Factors	↓	↑	Arm	M ↻	↺ M
Roof	0.15 × 0.5 × 18.0 × 10'	13.5		10.5	142	
do	0.15 × 0.5 × 14.08 · 18.83	19.8		10.5	208	
Holes	0.15 × 0.5 × 2.0 × 3.0 × 3		1.3	9.0		12
do	0.15 × 0.5 × 2.0 × 6.0		1.	18		18
do	0.15 × 0.5 × 3.5 × 2.5		0.7	2.5		2
Parapet	0.15 × 1.0 × 2.0 × 94 = (2 × 28 + 2 × 19)	28.2		10.5	296	
Crane Rails	(.031 + .035) × 55'	3.5		10.5	37	
Pump Rm Floor	0.15 × 1.0 × 14.08 × 18.93	40.		10.5	420	
Holes	0.15 × 1.0 × 2' × 2' × 3		1.8	9.5		17
do	0.15 × 1.0 × 1 × 1.25 × 2		0.4	10.5		4
do	0.15 × 1.0 × 2.5 × 2.5		1.0	18.		18
do	0.15 × 1.0 × π · 3²/4		1.0	3.		3
		105	7.2		1103	74
		−7			−74	
		98			1029	
		712			7842	
		481			6527	
		1291			15398	

See Below

→ PUMP RM FLOOR. ARM M
.15 × 13.42 × 18.0 = 36.2 10.5 380

	↓	M
CORRECT. PUMP RM. FL.	− 4	− 40
ADDITION, (A)	+ 9	+ 165
	1296	15523

Note: For purposes of weight, pump room floor is considered to be a 12" slab.

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GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 4 OF
DATE Feb. 19. 1963
COMPUTED BY FNW
CHECKED BY M. A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

I. Dead Load Only.
North-South Direction.
Moments at South Wall

Mark	Factors	↓	↑	Arm	M ↻	↺ M
Base slab		219		13.96	3060	
do		28		11.5	322	
do		42		30.5	1280	
do		38		17.65 17.33	670 660	
W. Wall		69		6.33	437	
do		44		20.33	892	
do		32		20.3	650	
Hole			1	16		16
W. Wall		16		31.3	500	
Hole			5	4.25		21
E. Wall		31		6.38	198	
do		36		6.38	229	
Hole			5	4.25		21
E. Wall		45		20.3	913	
do		32		20.3	650	
Door			5	16.25		81
Window			3	23.25		70
Hole			1	23.25		23
Center wall		44		12.25	538	
do		48		12.13	580	
Holes			3	12.25		37
		724	23		10909	269
		23			269	
		701			10640	

PROJECT NO. 6205
SHEET NO. 5 OF
DATE Feb. 19, 1963
COMPUTED BY FNW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STATION.

I. Cont. Dead Load Only.
North-South Direction.
Moments at South Wall.

Mark	Factors	↓	↑	Arm	M↻	↺M
S. Wall		44		0.75	33	
do		52		0.81	42	
N. Wall		53		27.17	1440	
do		41		27.34	1120	
Holes			7	27.17		190
"			7	27.34 34.5	2160	191
N. Intake		64		(24.05)	1540	
do		15		30.67	460	
do		13		30.67	398	
Hole			3	30.67	435	92
N. Intake		16		27.30	(417)	
Hole			2	27.30		55
cover		11		30.67	336	
Hole			1	30.67		31
E. Intake		19		4.0	76	
do		25		4.0	100	
Holes			5	4.0		20
cover		3		4.0	12	
Dischge		12		9.25	112	
F		14		7.5	105	
Gravel		42.5		10.0	425	
Piers		77.		9.25	716	
Stop Logs		1.5		8.	12	
do		3.		4	12	
Intake covers			1	18		18
		506	26		7994	597

Corrections, p.6. 480 → 506 − 26 = 480; 7994 − 597 = 7397

GREEN ENGINEERING AFFILIATES
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PROJECT NO. 6205
SHEET NO. 6 OF
DATE Feb. 19, 1963
COMPUTED BY EMW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

I. Cont. Dead Load. North-South Direction
Moments at South Wall.

Mark	Factors	↓	↑	Arm	M↓	↺M
Roof		13.5		6.5	88	
do		19.8		19.79	391	
Holes			1.3	9.		12
do			1.0	4.		4
do			0.7	25.5		20
Parapet		28.2		14.	394	
Crane Rails		3.5		19.79	69	
Pump Rm Floor		40.		19.79	792	
Holes			1.8	16.		29
do			0.4	20.5		8
do			1.0	25.		25
do			1.0	25		25
		105	7		1734	123
		7			123	
		98			1611	
		712			10691	
		481			6885	
		1291			19187	
	CORRECTIONS,					
	BASE SLAB, MOM.				−10	
	N. INTAKE				+620	
	N. INTAKE				+18	
	(A)	+9		7.75	+70	
	PUMP RM. FLOOR	−4		19.79	−79	
		1296			19806	

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GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 7 OF
DATE Feb. 20. 1963
COMPUTED BY FNW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

Revised to El. 75.0 See Sheets 7A, 7B & 7C

II. Live Load Only. East-West Direction
Moments at West Wall.

Mark	Factors	↓	↑	Arm	M↻	↺M
Snow	.040 × 18 × 26 (20.83 × 27.75)	(19) 23.1		10.5	(200)	242
Water El. 80.0	.0625 × 7 × 13.5 × 18	106		10.5	1110	
Dischge chamber	.0625 × 5.5 × 18 × 23.75	147		10.5	1540	
do	.0625 × 4.5 × 3.17 × 17.75 × 3	48		(9.42) 9.25	(451)	444
Crane		4		10.5	42	
Pumps	3 × 3	9		(9.42)	85	
Gear-Unit	3 × 1	3		9.42	28	
Thrust	3 × 3	9		9.42	85	
Engine	3 × 2	6		9.42	57	
		351			3598	
WATER IN	N. INTAKE .0625 × 7 × 5.5 × 25.75	620		14.12	875	
WATER IN	E. " .0625 × 4 × 5.5 × 6.75	20.8		24.37	510	
CORRECTION	SNOW & DISCH. CHAMBER	+ 4.1			+ 35	
		437.9			5018	

II LIVE LOAD ONLY N.-S. DIRECTION MOMENTS AT SOUTH WALL

Mark		↓	↑	Arm	M↻	↺M
Snow		19		14	266	
Water		106		19.75	2090	
do		147		4.25	624	
do		48		9.25	443	
Crane		4		19.75	79	
Pumps		9		16.	144	
Gears		3		16	48	
Thrust		9		16	144	
Exhaust		6		21	126	
		351			3964	
WATER IN N. INTAKE		63.6		30.67	1950	
" " E. "		20.8		4.50	94	
CORRECTION SNOW		4.1		14.00	57	
		439.5			6065	

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GREEN ENGINEERING AFFILIATES
ENGINEERS
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PROJECT NO. 6205-2
SHEET NO. 74 OF
DATE APR. 1 1963
COMPUTED BY M. A.
CHECKED BY RCP

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

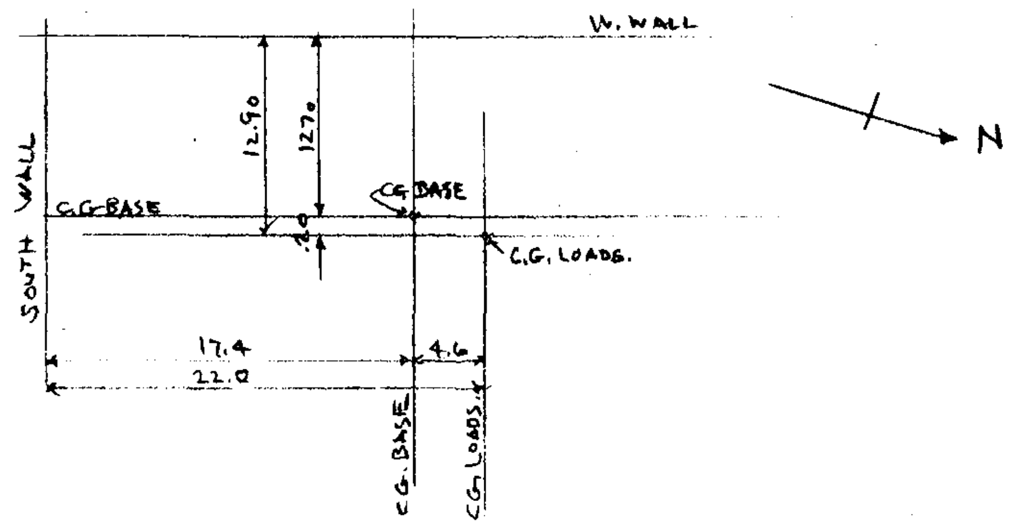
COMPUTATION FOR DIFFERENCE OF 5'-0" (80.0 TO 75.0 FT)
IN W.L. IN SUMP BAY AND N. INTAKE BAY.
THIS WILL BE A REDUTION IN LIVE LOAD.
.0625 × 5 = .313 K P.S.F.
USING FIGURES ON P 7 & 8 FOR AREAS AND ARMS.
E-W- DIRECTION MOMENTS AT W. WALL.

		↓	↑	ARM.	M ↻	↺ M
WATER IN SUMP.	.313 × 13.5 × 18	76.		10.5	798	
N. INTAKE	.313 × 5.5 × 25.25	44.		13.87	610	
E "	.313 × 5.5 × 6.75	12		24.37	292	
		132			1700.	
	N.-S. DIRECTION MOMENTS AT SOUTH WALL.					
WATER IN SUMP		76		19.75	1500	
N. INTAKE		44		30.67	1350	
E INTAKE		12		4.50	54	
		132			2904	

SOIL PRESSURES FROM 5'-0" OF WATER ABOVE.

C.G OF LOADS FROM N-S AXIS $\frac{1700}{132} = 12.90$ $\bar{x} = 12.90 - 12.70 = .20$ TOWARD EAST.

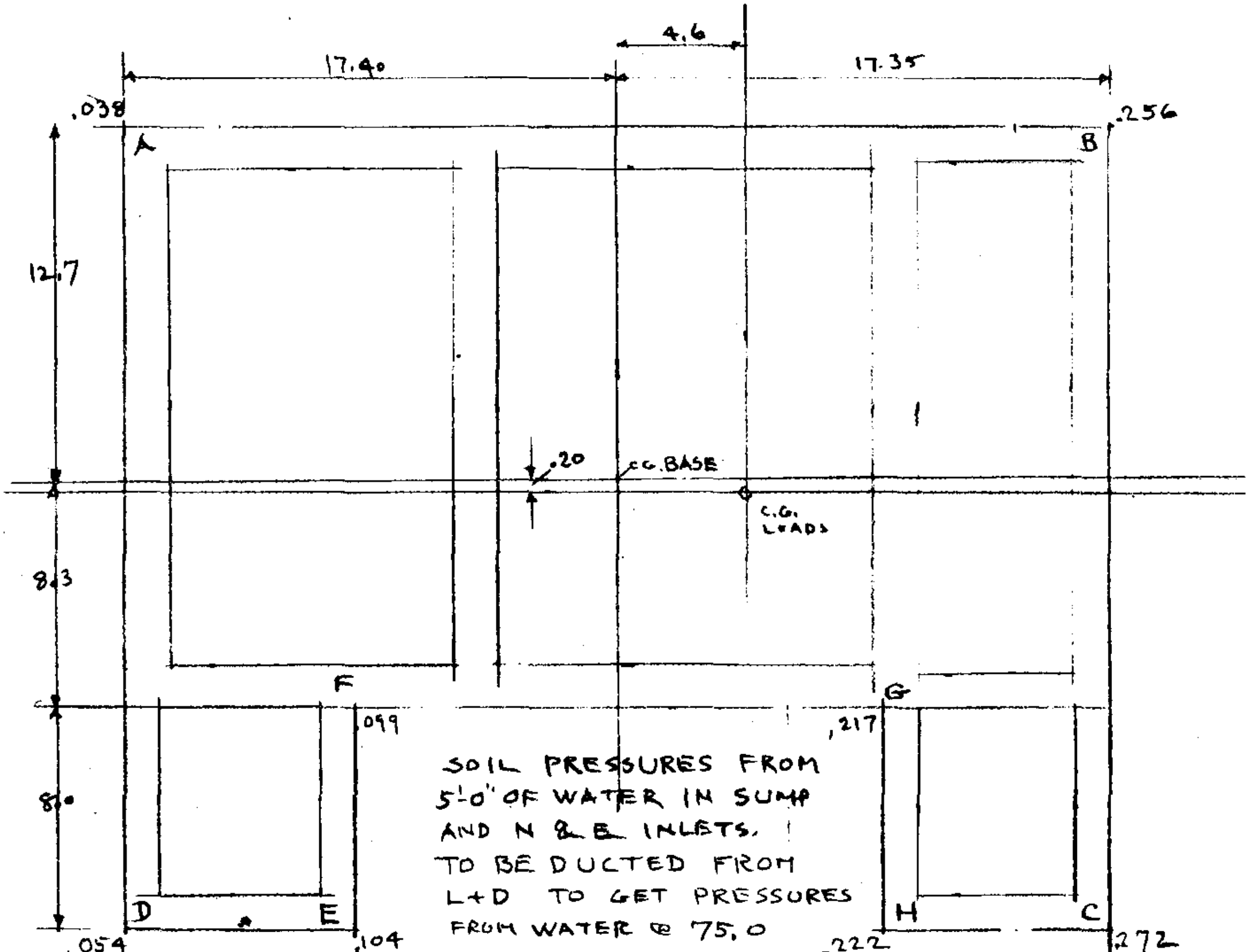
C.G. OF LOADS FROM E.W. AXIS $\frac{2904}{132} = 22.00$ $\bar{x} = 22.00 - 17.40 = 4.60$ TOWARD NORTH.



GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 7B OF
DATE APR. 2, 1963
COMPUTED BY M.A.
CHECKED BY [illegible]

PROJECT CHICOPEE FALLS,
SUBJECT OAK ST. PUMPING STA.



SOIL PRESSURES FROM 5'-0" OF WATER IN SUMP AND N & E INLETS. TO BE DUCTED FROM L+D TO GET PRESSURES FROM WATER @ 75.0

A	$\frac{132}{858}$	+	$\frac{132 \times 4.6 \times 17.4}{96900}$	−	$\frac{132 \times .20 \times 12.7}{49600}$	=	
	.154	−	.109	−	.007	=	.038
B	.154	+	$\frac{132 \times 4.6 \times 17.35}{96,900}$	−	.007	=	
	.154	+	.109	−	.007	=	.256
C	.154	+	.109	+	$\frac{132 \times .20 \times 16.3}{49600}$	=	
	.154	+	.109	+	.009	=	.272
D	.154	−	.109	+	.009	=	.054
E	.154	−	$\frac{132 \times 4.6 \times 9.4}{96900}$	+	.009		
	.154	−	.059	+	.009	=	.104
F	.154	−	.059	+	$\frac{132 \times .20 \times 8.3}{49600}$		
	.154	−	.059	+	.004	=	.099
G	.154	+	$\frac{132 \times 4.6 \times 9.35}{96900}$	+	.004		
	.154	+	.059	+	.004	=	.217
H	.154	+	.059	+	.009	=	.222

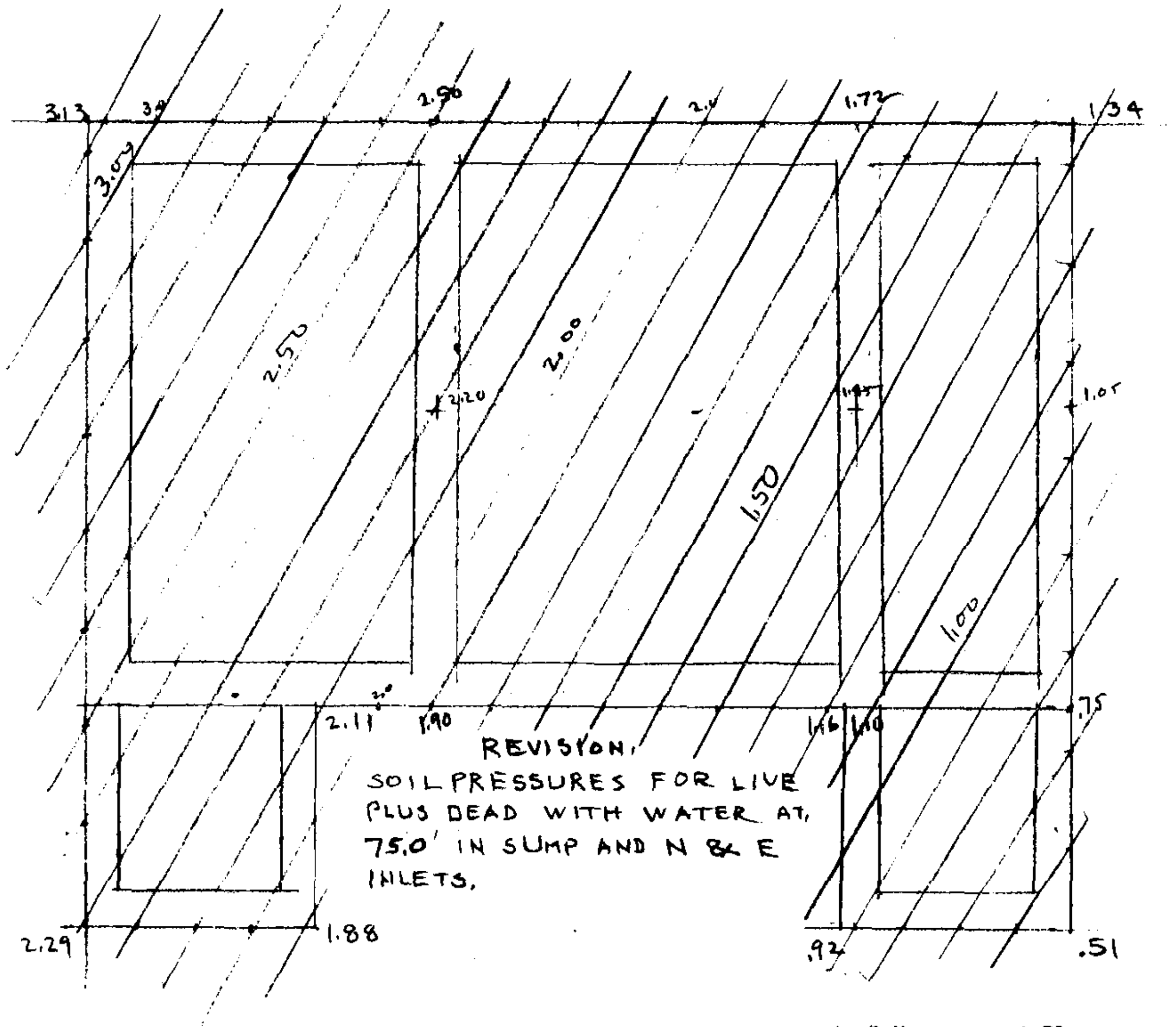
B-9

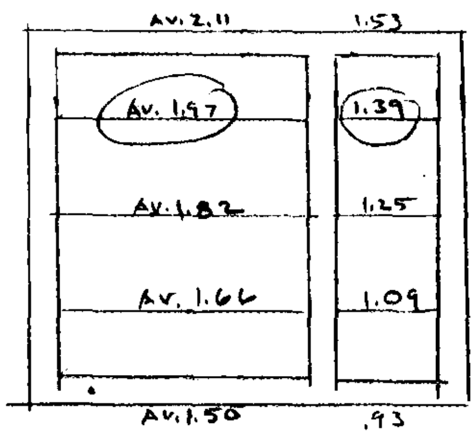
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 7C OF
DATE APR. 2, 1963
COMPUTED BY M.A.
CHECKED BY [illegible]

PROJECT CHICOPEE FALLS,

SUBJECT OAK ST. PUMPING STA.





GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 8 OF
DATE Feb 20, 1963
COMPUTED BY F.N.W.
CHECKED BY M.A.

C.G. From West Wall

D.	1296	15523
L.	440	5052
D+L	1736	20575

Dead $\bar{x} = \frac{15523}{1296} = 11.97$

D+L $\bar{x} = \frac{20575}{1736} = 11.85$

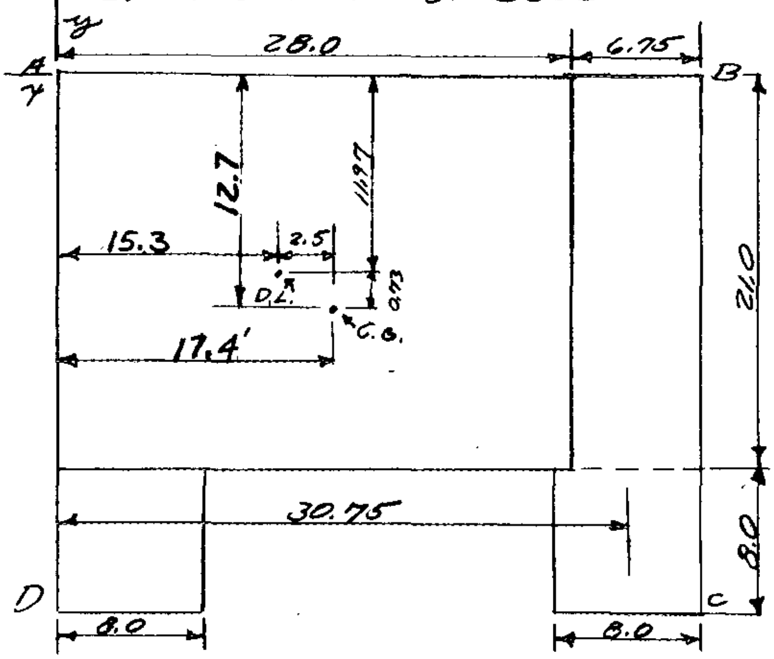
C.G. From South Wall

D.	1296	19806
L.	440	6054
D+L	1736	25860

Dead $\bar{x} = \frac{19806}{1296} = 15.3$

D+L $\bar{x} = \frac{25860}{1736} = 14.9$

C. G. and I of Base



About E-W Axis

21×28 = 588 × 14 = 8230
6.75×21 = 142 × 31.38 = 4450
8×8 = 64 × 30.75 = 1970
8×8 = 64 × 4 = 256
858 14906

C.G = $\frac{14906}{858}$ = 17.4

About N-S Axis

21×28 = 588 × 10.5 = 6170
6.75×21 = 142 × 10.5 = 1490
8×8×2 = 128 × 25 = 3200
858 10860

C.G = $\frac{10860}{858}$ = 12.7

I About E-W Axis

$21 \times 34.75^3/12 = 73400$
$8 \times 8^3/12 = 342$
$8 \times 8^3/12 = 342$
74084

$730 \times .02 = \text{Zero}$
$64 \times 13.35^2 = 11400$
$64 \times 13.4^2 = 11450$
22850
74084
96934

I About N.S. Axis

$34.75 \times 21^3/12 = 26700$
$2 \times 8 \times 8^3/12 = 684$
27384

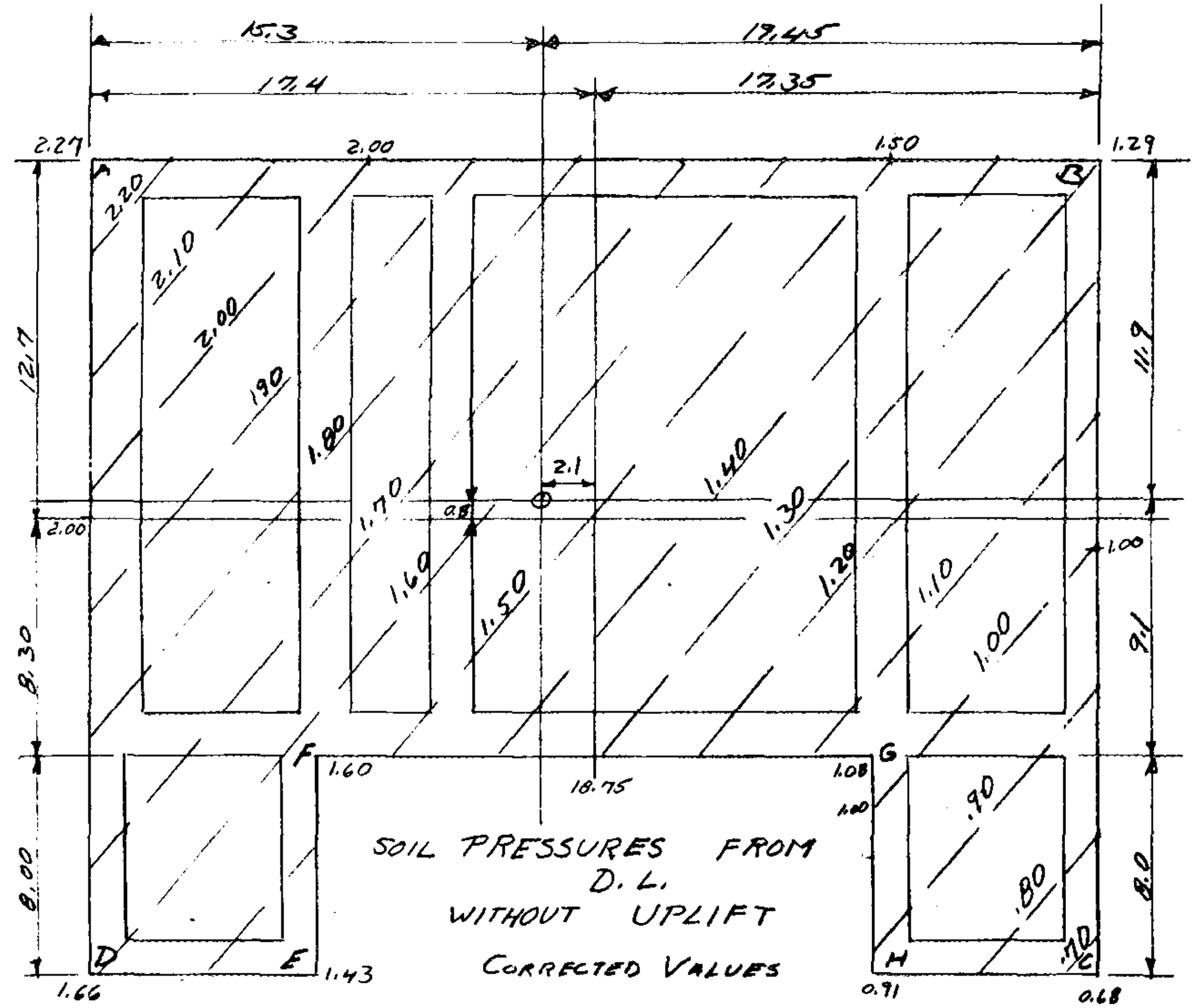
$588 \times 2.2^2 = 2840$
$2 \times 64 \times 12.3^2 = 19360$
22200
27384
49584

B-11

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 8A OF
DATE Mar. 1, 1963
COMPUTED BY M.A.
CHECKED BY F.M.W.

PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STA



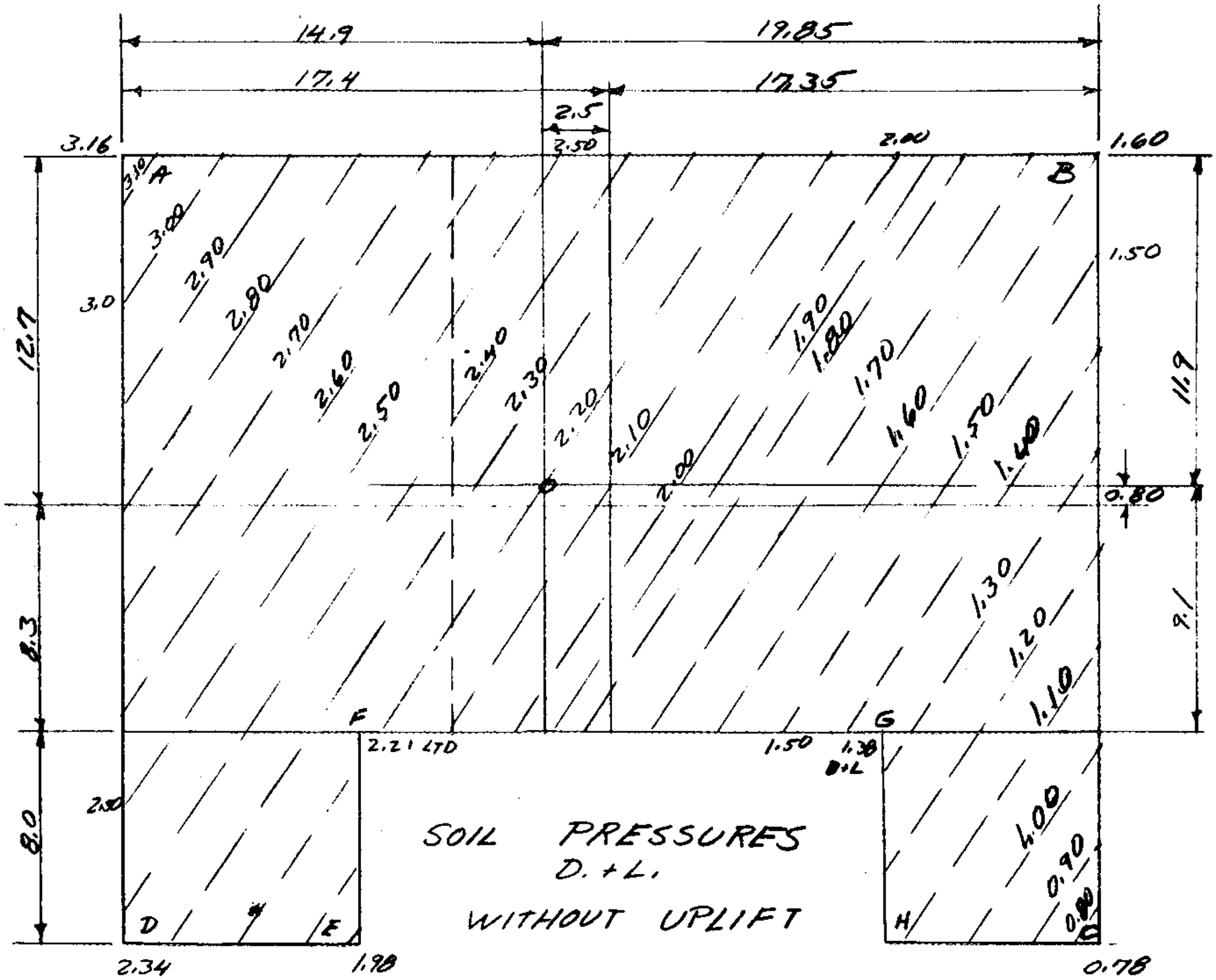
A. $\frac{1296}{858}$	$+\frac{1296 \times 2.1 \times 17.4}{96934}$	$+\frac{1296 \times .80 \times 12.7}{49584}$		
1.51	+0.49	+0.27	=	2.27
B. 1.51	$-\frac{1296 \times 2.1 \times 17.35}{96934}$ (0.49)	+0.27	=	1.29
C. 1.51	−0.49	$-\frac{1296 \times 0.8 \times 16.3}{49584}$ (0.34)	=	0.68
D. 1.51	+0.49	−0.34	=	1.66
E. 1.51	$+\frac{1296 \times 2.1 \times 9.4}{96934}$ (0.26)	−0.34	=	1.43
F. 1.51	+0.26	$-\frac{1296 \times 0.8 \times 8.3}{49584}$ (0.17)	=	1.60
G 1.51	$-\frac{1296 \times 2.1 \times 9.35}{96934}$ (0.26)	−0.17	=	1.08
H 1.51	−0.26	−0.34	=	0.91

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 8B OF
DATE 3/1/63
COMPUTED BY MA
CHECKED BY RDP

PROJECT CHICOPE FALLS

SUBJECT OAK ST. PUMPING STATION



A.	$\frac{1736}{858}$ (2.02)	$+ \frac{1736 \times 2.5 \times 17.4}{96934}$ (0.78)	$+ \frac{1736 \times 0.8 \times 12.7}{49584}$ (0.36)	= 3.16
B.	2.02	$- \frac{1736 \times 2.5 \times 17.35}{96934}$ (0.78)	+ 0.36	= 1.60
C	2.02	− 0.78	$- \frac{1736 \times 0.8 \times 16.3}{49584}$ (0.46)	= 0.78
D.	2.02	+ 0.78	− 0.46	= 2.34
E.	2.02	$+ \frac{1736 \times 2.5 \times 9.4}{96934}$ (0.42)	− 0.46	= 1.98
F	2.02	+ 0.42	$- \frac{1736 \times 0.8 \times 8.3}{49584}$ (0.22)	= 2.21
G	2.02	$- \frac{1736 \times 2.5 \times 9.35}{96934}$ (0.42)	− 0.22	= 1.38
H	2.02	− 0.42	− 0.46	= 1.14

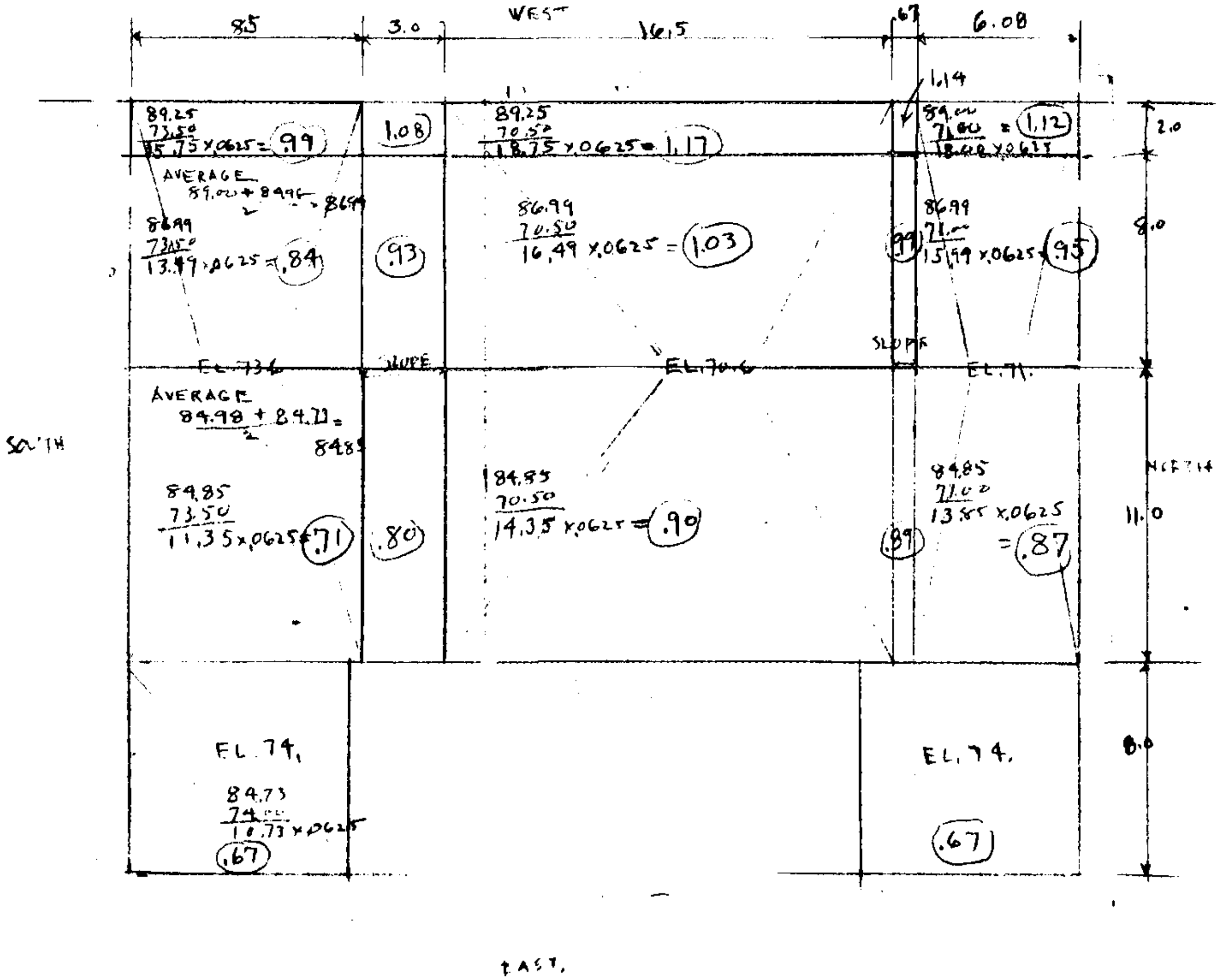
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 9E OF
DATE MAR. 2, 1963
COMPUTED BY MA
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

UPLIFT RIVER SIDE



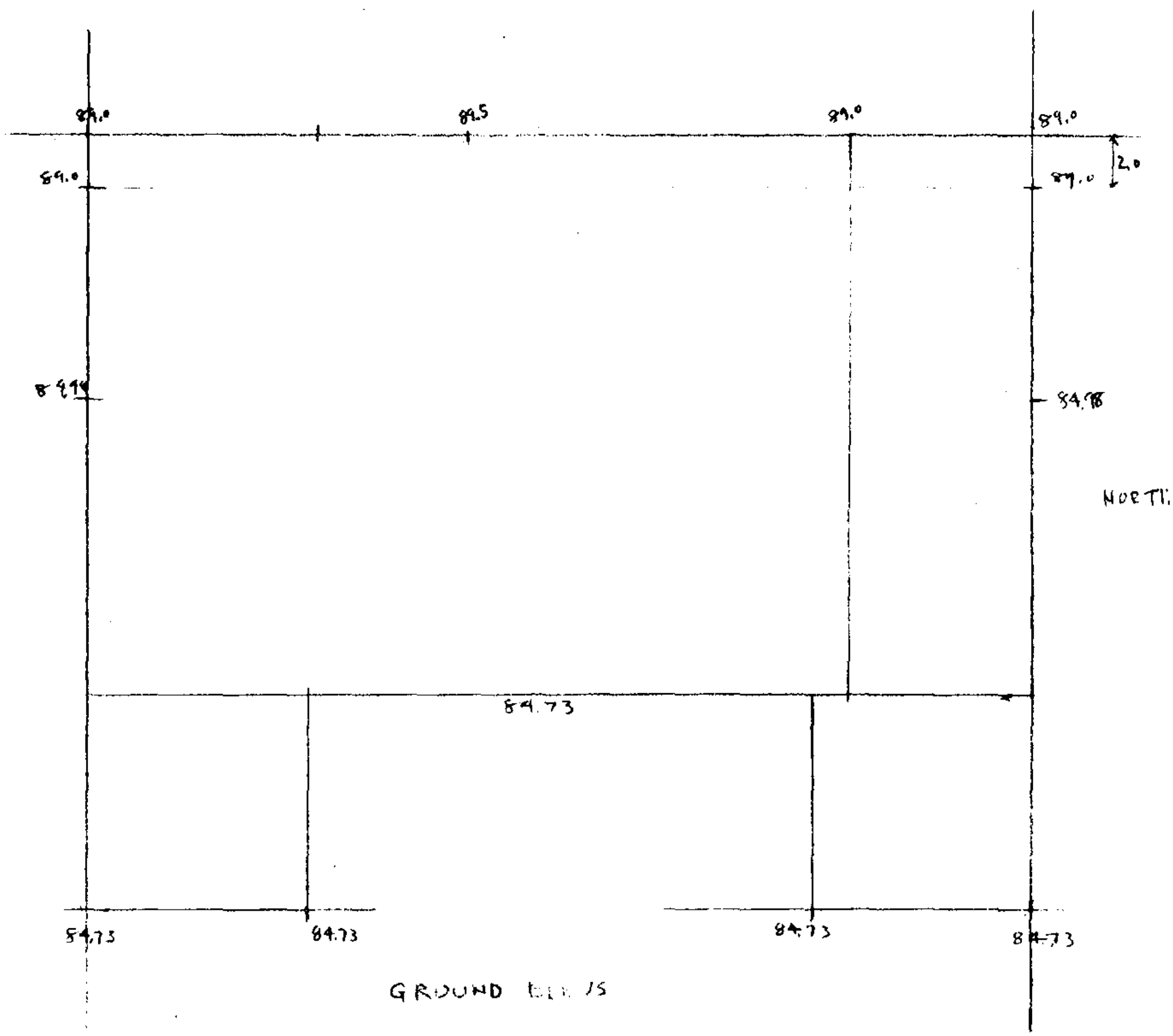
B-14

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 9F OF
DATE MAR 2 1963
COMPUTED BY M.A
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.



B-15

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 9G OF
DATE MAR. 3, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA

UPLIFT MOMENTS AT WEST WALL

	UPLIFT	ARM	↶M
.99 × 8.5 × 2 =	16.8	1.00	
1.08 × 3 × 2 =	6.5		
1.17 × 16.5 × 2 =	38.6		
1.14 × .67 × 2 =	1.5		
1.12 × 6.08 × 2 =	13.6		
	77.0		77.
.84 × 8.5 × 8 =	57.2	6.00	
.93 × 3 × 8 =	22.3		
1.03 × 16.5 × 8 =	135.7		
.99 × .67 × 8 =	5.3		
.95 × 6.08 × 8 =	46.2		
	266.7		1600.
.71 × 8.5 × 11 =	66.4	15.5	
.80 × 3. × 11 =	26.4		
.90 × 16.5 × 11 =	163.5		
.89 × .67 × 11 =	6.5		
.87 × 6.08 × 11 =	58.0		
	320.8		4980.
.74 × 8 × 8 × 2	94.7	25.	2370
Σ UPLIFT	759.2		9027

CENTROID FROM WEST WALL

$$\frac{9027}{759.2} = 11.90$$

UPLIFT MOMENTS AT SOUTH WALL

	UPLIFT.	ARM.	M
.99 × 8.5 × 2	16.8	4.25	
.84 × 8.5 × 8	57.2		
.71 × 8.5 × 11	66.4		
	140.4		597.
1.08 × 3 × 2	6.5	10	
.93 × 3 × 8	22.3		
.80 × 3 × 11	26.4		
	55.2		552.
1.17 × 16.5 × 2	38.6	19.75	
1.03 × 16.5 × 8	135.7		
.90 × 16.5 × 11	163.5		
	337.8		6660.
1.14 × .67 × 2	1.5	28.33	
.99 × .67 × 8	5.3		
.89 × .67 × 11	6.5		
	13.3		376.
1.12 × 6.08 × 2	13.6	31.71	
.95 × 6.08 × 8	46.2		
.87 × 6.08 × 11	58.0		
	117.8		3730
.74 × 8 × 8 × 2	99.7	17.37	1643
Σ UPLIFT.	759.2		13,558.

CENTROID FROM SOUTH WALL

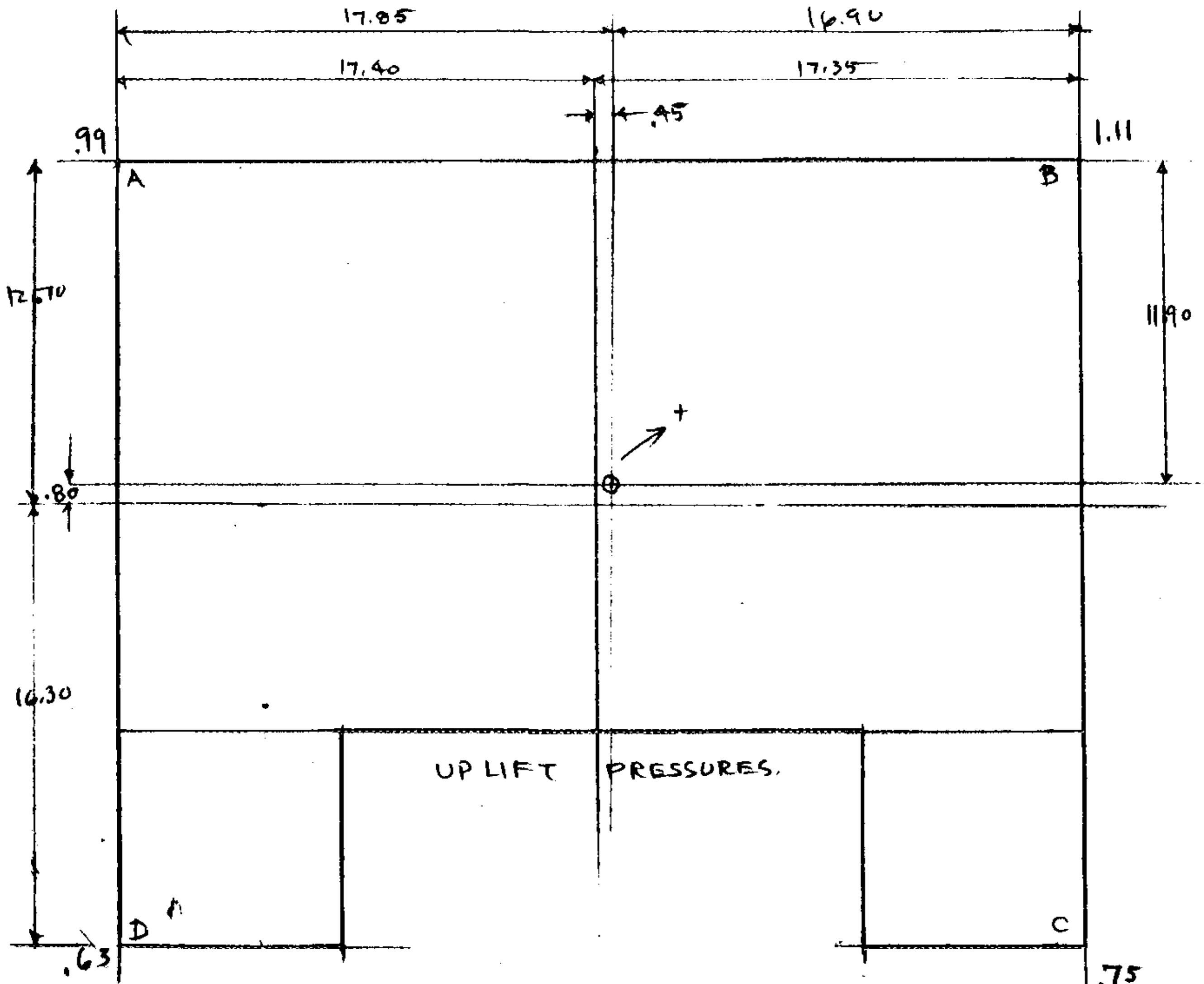
$$\frac{13558}{759.2} = 17.85$$

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 9 I OF
DATE MAR. 2 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.



A $\frac{759.2}{858.} - \frac{759.2 \times .45 \times 17.40}{46934} + \frac{759.2 \times .80 \times 12.70}{49584}$

.89 − .06 + .16 = .99

B .89 + .06 + .16 = 1.11

C .89 + .06 − $\frac{759.2 \times .80 \times 16.30}{49584}$ = .75

D .89 − .06 − .20 − .20 = .63

COMPARING RESULTS WITH VALUES FOR DEAD LOAD WE SEE THAT LOAD ON CORNERS A, B & D IS GREATER THAN UPLIFT. CORNER C HAS .75 UPLIFT AND .68 LOAD. THIS WILL AFFECT A VERY SMALL AREA AT CORNER AND WILL DO NO PARTICULAR HARM.

B-18

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 10A OF
DATE MAR. 4, 1963
COMPUTED BY MA
CHECKED BY ENW.

PROJECT CHICOPEE LOCATION

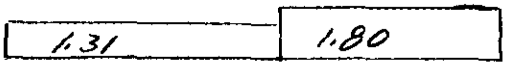
SUBJECT OAK ST. PUMPING STATION

10 REVISED

PRESSURE TAKEN = 3.16 WAS FOR DEAD PLUS LIVE
Slab = 0.37
2.79 We should also take out
① Water .0625 × 23.75 1.48 Water in discharge Chamber
1.31 Net uplift for 6'-0" span

The 5'-0" span should have uplift reduced by weight of gravel fill

2.85 − 0.37 2.48
Gravel 0.135 × 5 .68
1.80 Net uplift



FEM 1/12 × 1.31 × 6² = 3.93
FEM 1/12 × 1.80 × 5² = 3.75

For D+L

② On the other hand using Dead Load
Corrected Value Max p = 2.27
Slab 0.37
1.90 Net 6'-0" span
For 5'-0" span 2.05 − .37 = 1.68
Take out gravel .68
1.00

FEM 1/12 × 1.90 × 6² = 5.70
1/12 × 1.00 × 5² = 2.08

D+L

		.45	.55	
	+3.93	−3.93	+3.75	−3.75
		+.13	+.15	
		−3.80	+3.90	
	+.06			+.07
M	+3.99			−3.68
R	3.94	3.94	4.50	4.50
	+.03	−.03	+.24	−.24
	3.97	3.91	4.74	4.26
		8.65		

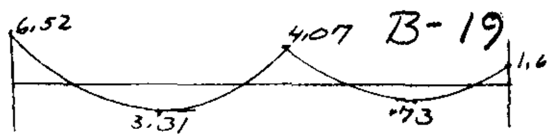
0 shear 3.97/1.31 = 3.03 4.26/1.80 = 2.36

Span M 3.97 × 3.03/2 = 6.02 4.26 × 2.36/2 = 5.03
End M 3.99 3.68
Span M 2.03 1.35

	.45	.55	
+5.70	−5.70	+2.08	−2.08
	+1.63	+1.99	
+.82	−4.07	+4.07	+1.00
+6.52			−1.08
5.70	5.70	2.50	2.50
+.41	−.41	+.60	−.60
6.11	5.29	3.10	1.90
	8.39		

6.11/1.90 = 3.22 1.90/1.00 = 1.90

6.11 × 3.22/2 = 9.83 1.90 × 1.90/2 = 1.81
6.52 1.08
3.31 .73



B-19

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 10B OF
DATE Mar. 4, 1963
COMPUTED BY M.A.
CHECKED BY F.N.W.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

REVISED DESIGN FLOOR - DISCHARGE CHANNEL

Max Pos M. (Bottom steel) 6.52

$\frac{M}{K} = \frac{6.52}{160} = 0.040$ Min d-6½ we have 25½

$A_s = \frac{6.52}{1.44 \times 25\frac{1}{2}} = 0.18$ #5 @ 18 = 0.21

Max neg. M. 3.21 (top steel)

$A_s = \frac{3.31}{1.44 \times 26\frac{1}{2}} = 0.087$ #5 @ 18 = 0.21

Min steel $0.001 \times 12 \times 25\frac{1}{2} = 0.31$ #5 @ 12 = 0.31

Max. $v = \frac{6110}{12 \times \frac{7}{8} \times 25\frac{1}{2}} = 23 < 90$

$u = \frac{6110}{2 \times \frac{7}{8} \times 25\frac{1}{2}} = 137 < 300$

#5 @ 12 T & B will be O.K.

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 12A OF
DATE APR. 2, 1963
COMPUTED BY M.A.
CHECKED BY [illegible]

PROJECT CHICOPEE FALLS.
SUBJECT OAK ST. PUMPING STA.

REVISION OF DESIGN FOR FLOOR OF SUMP AND N. INLET, WITH WATER AT 75.0

THIS SHEET REVISES SHEET 12

LOADS

SUMP - DEAD, 1.23 K.S.F. NET UP } AS BEFORE
INLET - DEAD .99 " " " " " }

SUMP D+L. 1.97 - .37 - 2×.0625 = 1.48 NET UP.
INLET. 1.39 - .30 - 2×.0625 = .97

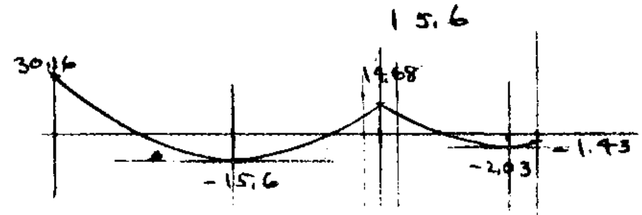
IT WOULD SEEM THAT A LOAD OF 1.50 IN THE SUMP COMBINED WITH A LOAD OF 1.00 IN INLET WOULD BE OK.

$\frac{1}{12} \times 1.50 \times \overline{14.17}^2 = 25.0$ $\qquad \frac{1}{12} \times 1.00 \times \overline{6.88}^2 = 3.94$

		.49	.51	
	+25.00	-25.00	+3.94	-3.94
	+5.16	+10.32	+10.74	+5.37
M.	+30.16	-14.68	+14.68	+1.43
R.	10.63	10.63	3.44	3.44
	+1.09	-1.09	+2.34	-2.34
	11.72	9.54	5.78	1.10

ZERO SHEAR. $\frac{11.72}{1.50} = 7.80$
SPAN M. $11.72 \times \frac{7.80}{2} = 45.8$
END M. 30.2
15.6

ZERO SHEAR. $\frac{1.10}{1.0} = 1.10$
SPAN M. $1.10 \times \frac{1.10}{2} = .60$
END M. 1.43
2.03



BOTTOM STEEL
LEFT, As. $\frac{30.16}{1.44 \times 25\frac{1}{2}} = .82$ #9@12
CEN. SUPPT. $A_s = \frac{14.68}{1.44 \times 19\frac{1}{2}} = .52$ #7@12
TOP STEEL $A_s = \frac{15.6}{1.44 \times 26\frac{1}{2}} = .41$ #6@12
$A_s = \frac{2.03}{1.44 \times 20\frac{1}{2}} = .07$ #4@12

$v = \frac{11,720}{12 \times \frac{7}{8} \times 25\frac{1}{2}} = 44 < 90$ $\qquad v = \frac{5,78}{12 \times \frac{7}{8} \times 19\frac{1}{2}} = 28$

$u = \frac{11,720}{3.5 \times \frac{7}{8} \times 25\frac{1}{2}} = 150 < 300$ $\qquad u = \frac{5,780}{2.8 \times \frac{7}{8} \times 19\frac{1}{2}} = 121.$

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

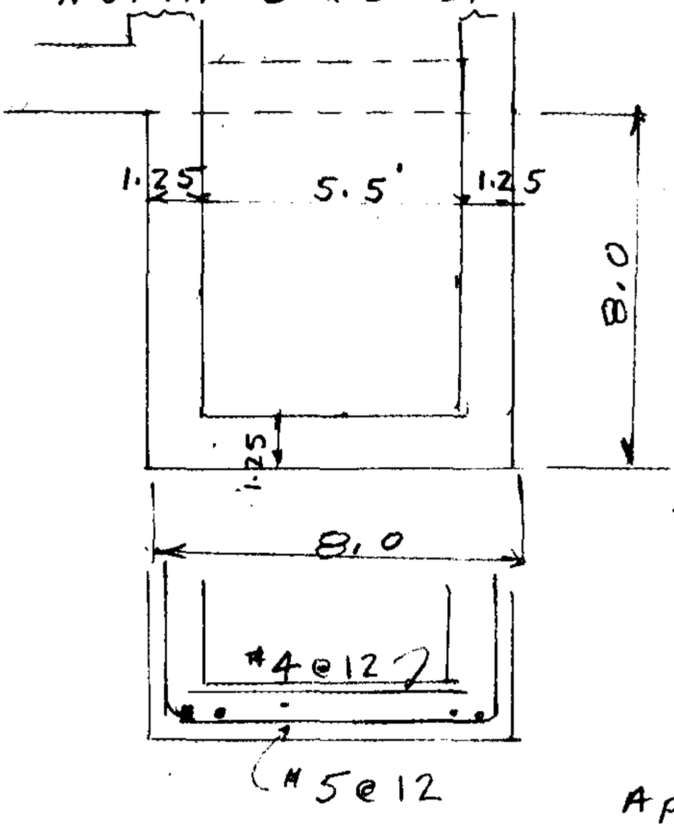
PROJECT NO. 6205
SHEET NO. 14 OF
DATE Feb. 21, 1963
COMPUTED BY FNW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

(Sh. 13 deleted)

North 8' x 8' Intake.



p. 11. pressure = 0.90
0.88
0.63
0.93
3.34

$w = 3.34/2 = 1.67$

$.15 \times 2 \quad .30$

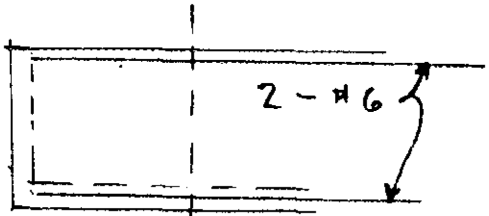
1.37

$M = 1.37 \times \frac{6.75^2}{10} = 6.24$

$A_s = \frac{6.24}{1.44 \times 19.5} = 0.22$

#5 @ 12 = 0.3 Both ways.

Side Walls as Cantilevers



Approx. Load.

$1.37 \times 8 \times 8 = 87.5$

Walls. $0.15 \times 13' \times 1.25 \times 8 \times 2 = 39$

" $0.15 \times 13 \times 1.25 \times 5.5 = 13.5$

Cover $0.15 \times 0.5 \times 5.5 \times 6.75 = 2.8$

55.3

CANT. MOM. 32.2

REINF. IN CANTILEVER WALLS.

$A_s = \frac{32.2}{1.44 \times 150^{\pm}}$

$A_s = 0.149$

Run two #6 top + bot. along walls.

South 8' x 8' Intake.

Pressure = 3.10 − 0.30 = 2.80

$M = 2.8 \times \frac{6.75^2}{10} = 12.75$

$A_s = \frac{12.75}{1.44 \times 19.5} = 0.455''$

$= 0.23''$ for 2-way steel.

Use #5 @ 12 both ways.

#4 @ 12 top

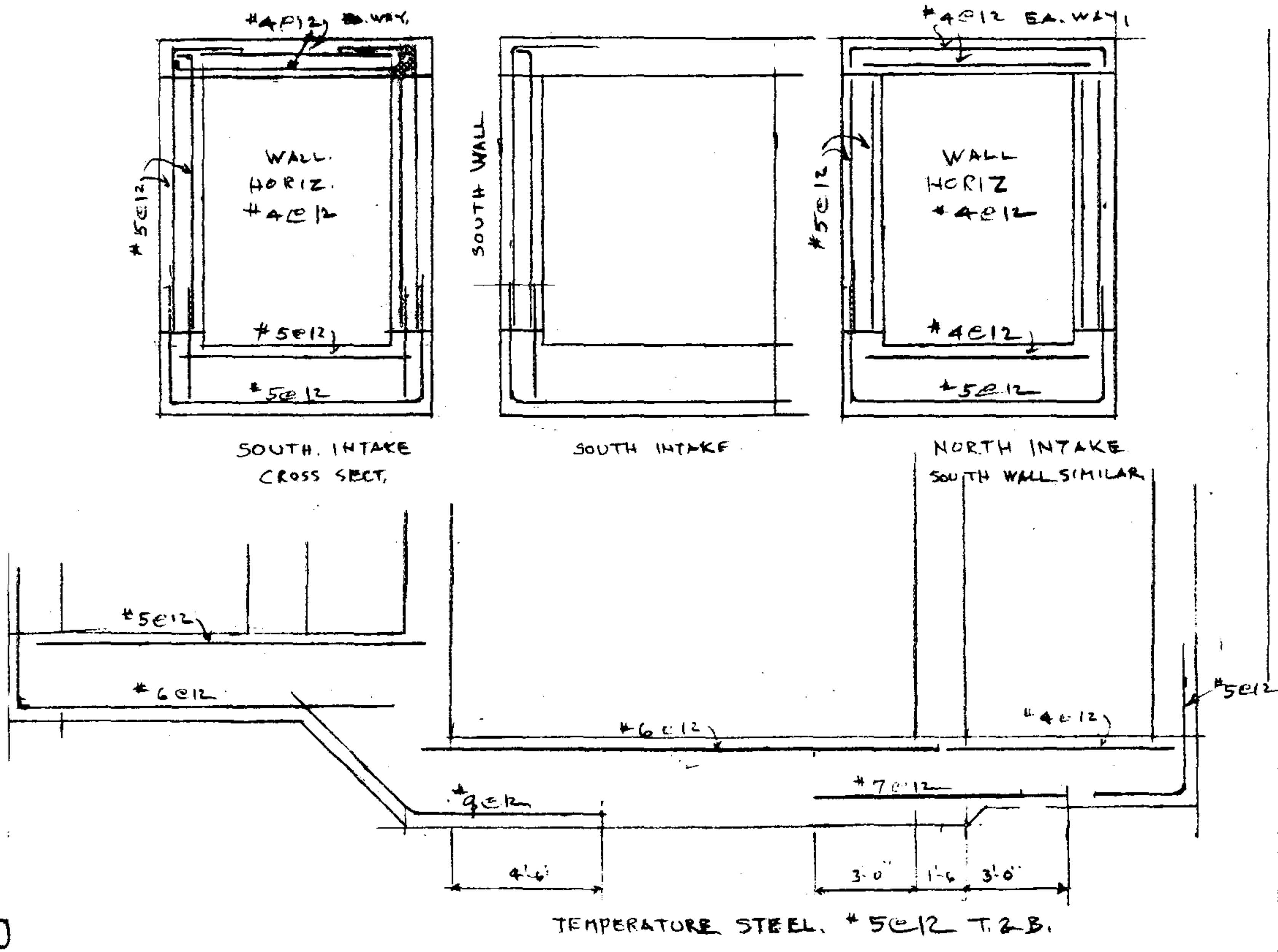
B-22

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

SUBJECT OAK ST PUMPING STA.

PROJECT MASS. CHICOPEE FALLS.

PROJECT NO. 6205-2
SHEET NO. 14A OF
DATE MAR. 4, 1963
COMPUTED BY M.A.
CHECKED BY FNW



B-23

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 14 B OF
DATE MAR. 5, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.

BURSTING IN SOUTH INTAKE

AT CORNER. HOR. STEEL. $M_y = .025 \times .284 \times \overline{5.50}^3 = 1.18$

$A_s = \frac{1.18}{1.44 \times 11\frac{1}{2}} = .071$

SEE BULLETIN ST63
PORTLAND CEM. ASSOC.

VERT. STEEL. $M_x = .005 \times .284 \times \overline{5.50}^2 = .235$

$A_s = \frac{.235}{1.44 \times 11\frac{1}{2}} = .014$

AT MIDDLE HOR. $M_y = .011 \times .284 \times \overline{5.50}^3 = .52$

$A_s = \frac{.52}{1.44 \times 11\frac{1}{2}} = .031$

VERT. $M_x = .009 \times .284 \times \overline{5.50}^3 = .43$

$A_s = \frac{.43}{1.44 \times 11\frac{1}{2}} = .026$

FOR 1'-3 WALL
TEMP. STEEL $.001 \times 12 \times 11\frac{1}{2} = .138$ MIN.

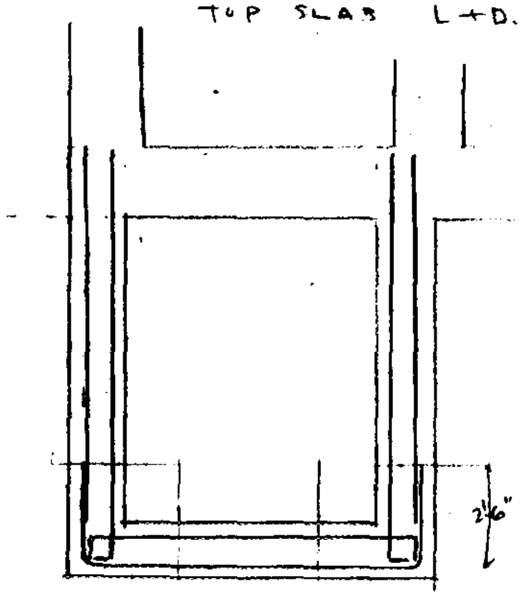
USE #4 @ 12 HOR. = .20
#5 @ 12 VERT. = .31

THE TOP SLAB HAS AN UP LOAD OF 1.00
12" SLAB .15
NET .85

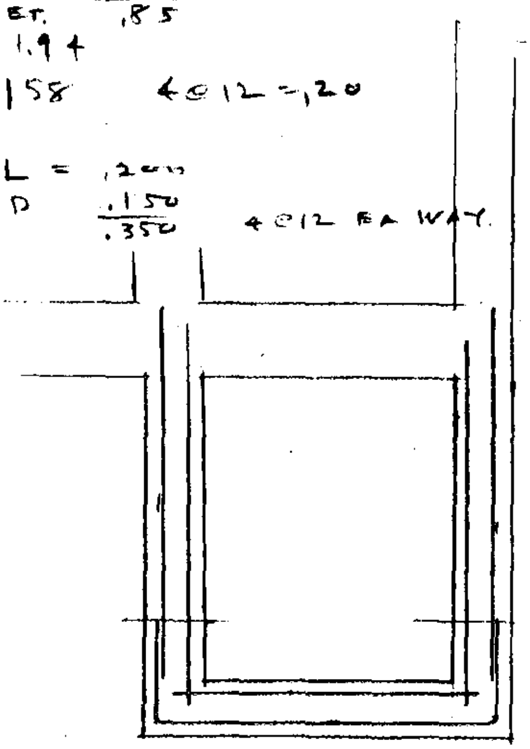
2 WAY. $M = .05 \times .85 \times \overline{6.75}^2 = 1.94$

$A_s = \frac{1.94}{1.44 \times 8\frac{1}{2}} = .158$ 4 @ 12 = .20

TOP SLAB L + D. DOWN. L = .200
D .150
.350 4 @ 12 EA WAY.



HORIZ. SECT.
SOUTH INTAKE



HORIZ. SECT.
N. INTAKE

DESIGN OF WALLS

1. As ring at El. 770

Due to submerged earth pressure. No water inside the structure

Saturated earth pressure @ 135 #/CF 135 − 62.5 = 72.5

Horiz = 0.0625
+ 1/3 × 0.723 = 0.0242
0.0867 = 0.087 #/□'

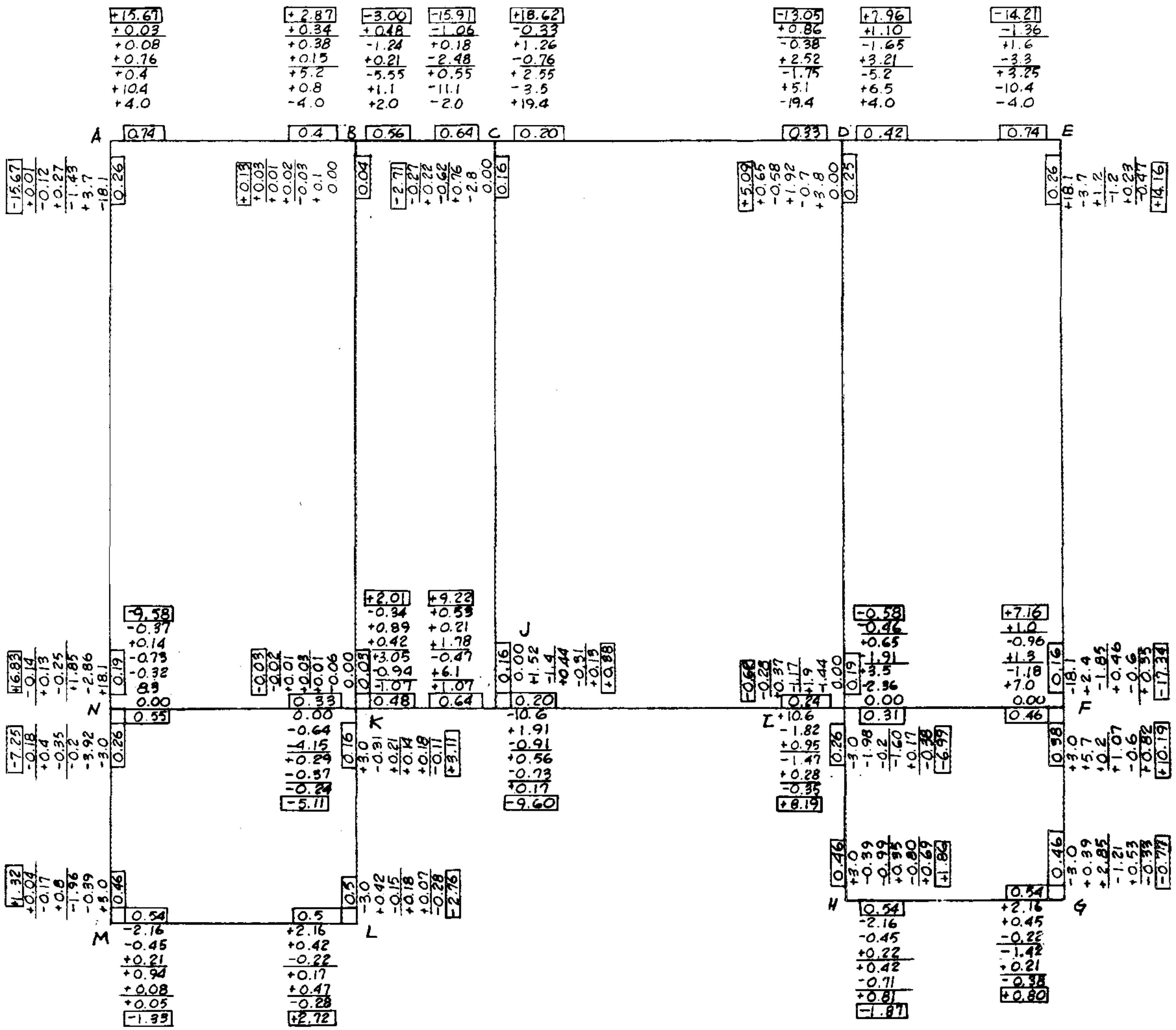
On West Side pres. = 89.0 − 77.0 = 0.087 × 12 = 1.05

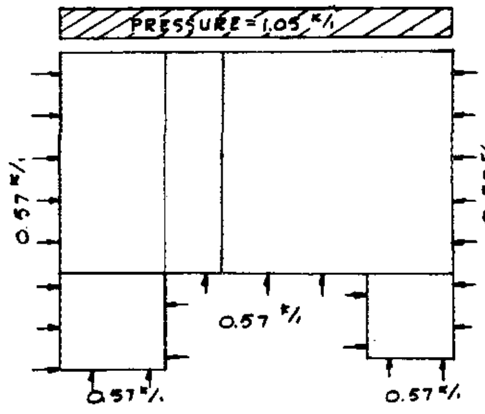
On Other Sides 83.5 − 77.0 = 0.087 × 6.5 = 0.57

84.73 − 78.0 = 6.73

SPANS (See Sh. 23 for dimensions)

AB	$M = 1.05 \times 6.75^2/12$	= 4.0	$I/2 = 1.5^3/6.75$	= 0.5
BC	$M = 1.05 \times 4.75^2/12$	= 2.0	$I/2 = 1.5^3/4.75$	= 0.71
CD	$M = 1.05 \times 14.92^2/12$	= 19.4	$I/2 = 1.5^3/14.92$	= 0.226
DE	$M = 1.05 \times 6.82^2/12$	= 4.1	$I/2 = 1.25^3/6.75$	= 0.29
EF	$M = 0.57 \times 19.5^2/12$	= 18.1	$I/2 = 1.25^3/19.5$	= 0.1
FG	$M = 0.57 \times 8.0^2/12$	= 3.0	$I/2 = 1.25^3/8.0$	= 0.244
GH	$M = 0.57 \times 6.75^2/12$	= 2.16	$I/2 = 1.25^3/6.75$	= 0.29
HI	$M = 0.57 \times 8.0^2/12$	= 3.0	$I/2 = 1.25^3/8.0$	= 0.244
IJ	$M = 0.57 \times 14.92^2/12$	= 10.6	$I/2 = 1.5^3/14.92$	= 0.226
JK	$M = 0.57 \times 4.75^2/12$	= 1.07	$I/2 = 1.5^3/4.75$	= 0.71
KL	$M = 0.57 \times 8.0^2/12$	= 3.0	$I/2 = 1.25^3/8.0$	= 0.244
LM	$M = 0.57 \times 6.75^2/12$	= 2.16	$I/2 = 1.25^3/6.75$	= 0.29
MN	$M = 0.57 \times 8.0^2/12$	= 3.0	$I/2 = 1.25^3/8.0$	= 0.244
NA	$M = 0.57 \times 19.5^2/12$	= 18.1	$I/2 = 1.5^3/19.5$	= 0.174
CJ	M =	= 0.0	$I/2 = 1.5^3/19.5$	= 0.174
BK	M =	= 0.0	$I/2 = 1.0^3/19.5$	= 0.051
DI	M =	= 0.0	$I/2 = 1.5^3/19.5$	= 0.174
IF	M =	= 0.0	$I/2 = 1.25^3/6.75$	= 0.29
NK	M =	= 0.0	$I/2 = 1.5^3/6.75$	= 0.5




LOADING DIAGRAM

OAK STREET PUMPING STATION

MOMENT DISTRIBUTION AT ELEVATION 77.0 NO WATER

NO SCALE

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 16 OF
DATE Feb. 25, 1963
COMPUTED BY FNW
CHECKED BY M.A.

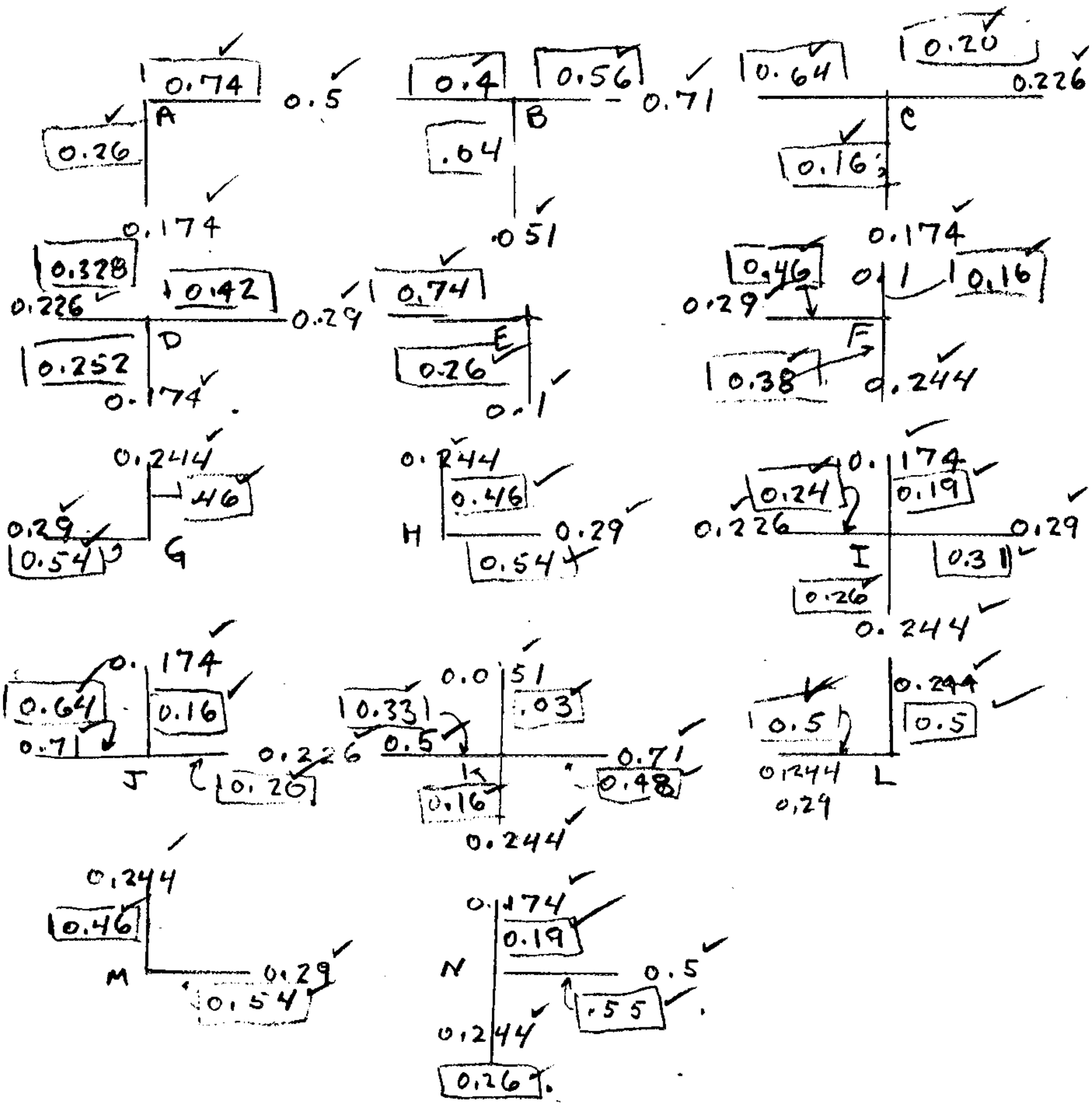
PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

Design of Walls.

1. As Ring at El. 77.0 Inward Pressure.

Distribution and Carry-Over Factors.



B-27

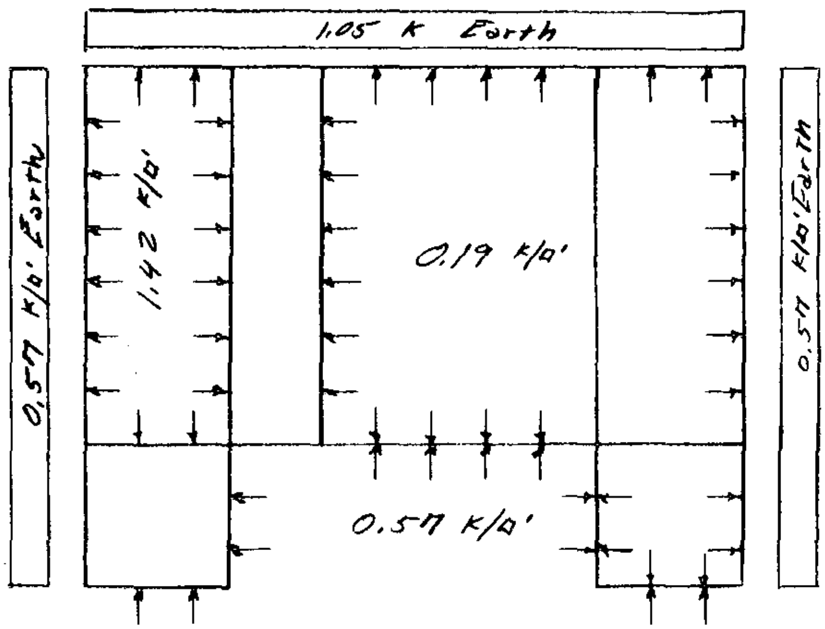
DESIGN OF WALLS

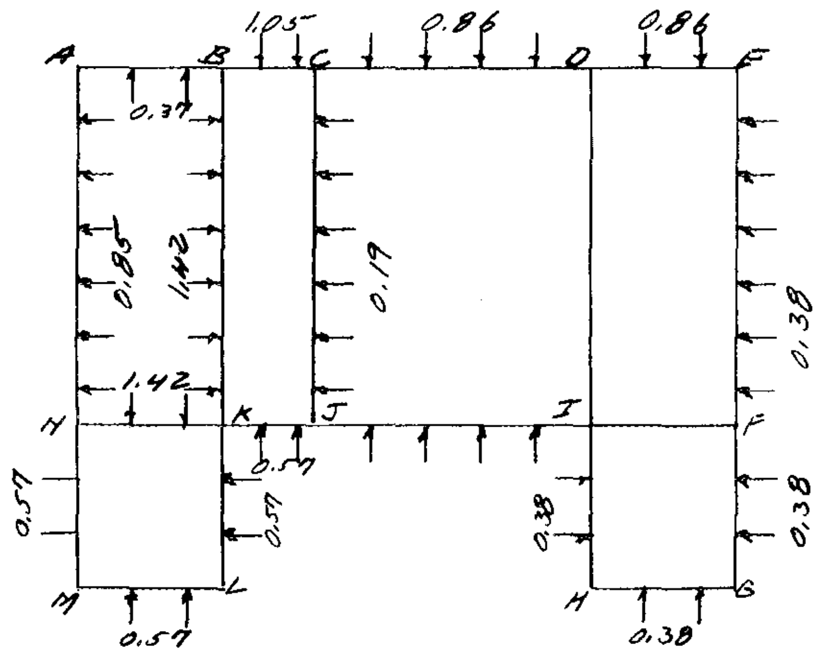
1. As Ring @ El. 77.0 Outward Pressure

In discharge bay $p = (99.75 - 77)\,0.0625 = 1.42^{\#/}$

In sump bay $p = (80 - 77)\,0.0625 = 0.19$

Pressures from saturated earth as before





NET PRESSURES

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 18 OF
DATE Feb. 27, 1963
COMPUTED BY FNW
CHECKED BY M. A.

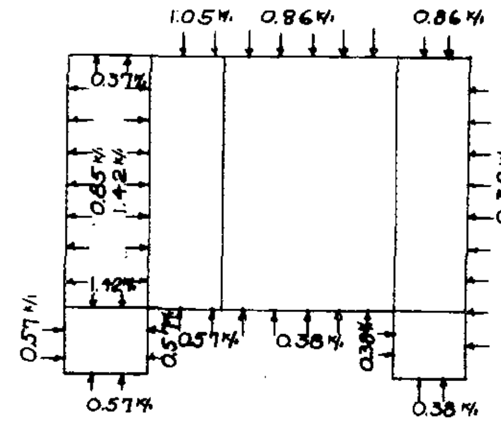
Design of Walls.

1. As Ring at El. 77.0 With Outward Pressure.

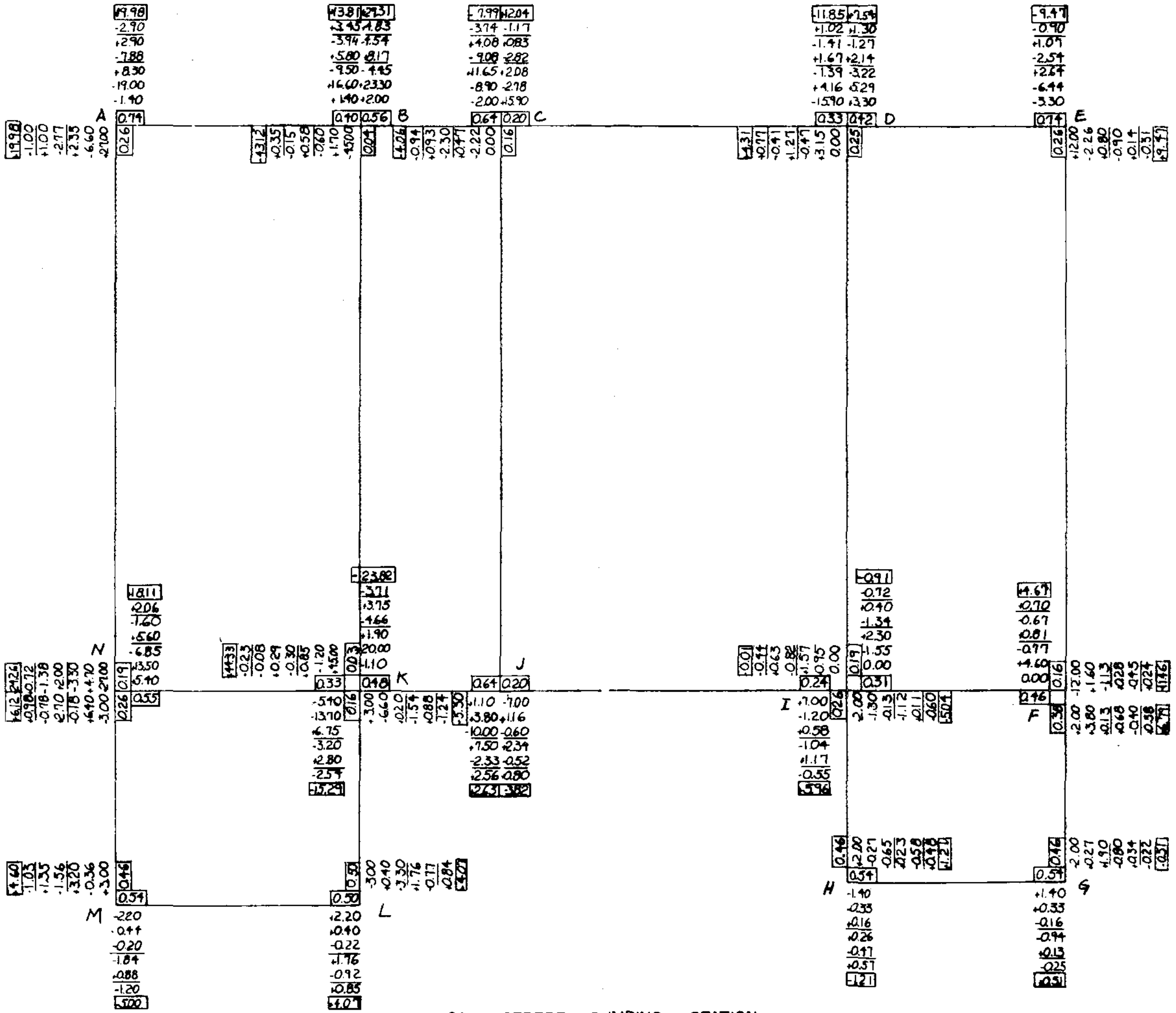
Fixed End Moments.

Spans.

AB.	$M = 0.37 \times 6.75^2/12$	=	1.4 ✓	OUT.
BC.	$M = 1.05 \times 4.75^2/12$	=	2.0 ✓	IN.
CD	$M = 0.86 \times 14.92^2/12$	=	15.9 ✓	IN
DE	$M = 0.86 \times 6.75^2/12$	=	3.3 ✓	IN.
EF	$M = 0.38 \times 19.5^2/12$	=	12.0 ✓	IN.
FG	$M = 0.38 \times 8.0^2/12$	=	2.0 ✓	IN
GH	$M = 0.38 \times 6.75^2/12$	=	1.4 ✓	IN
HI	$M = 0.38 \times 8.0^2/12$	=	2.0 ✓	IN
IJ	$M = 0.38 \times 14.92^2/12$	=	7.0 ✓	IN.
JK	$M = 0.57 \times 4.75^2/12$	=	1.1 ✓	IN
KL	$M = 0.57 \times 8^2/12$	=	3.0 ✓	IN
LM	$M = 0.57 \times 6.75^2/12$	=	2.2 ✓	IN
MN	$M = 0.57 \times 8^2/12$	=	3.0 ✓	IN.
NA	$M = 0.85 \times 19.5^2/12$	=	27. ✓	OUT
CJ	$M = 0$ NOT CONSIDERED			
BK.	$M = 1.42 \times 19.5^2/12$	=	45. ✓	OUT.
DI	$M = 0$			
IF	$M = 0$			
NK	$M = 1.42 \times 6.75^2/12$	=	5.4 ✓	OUT.



LOADING DIAGRAM

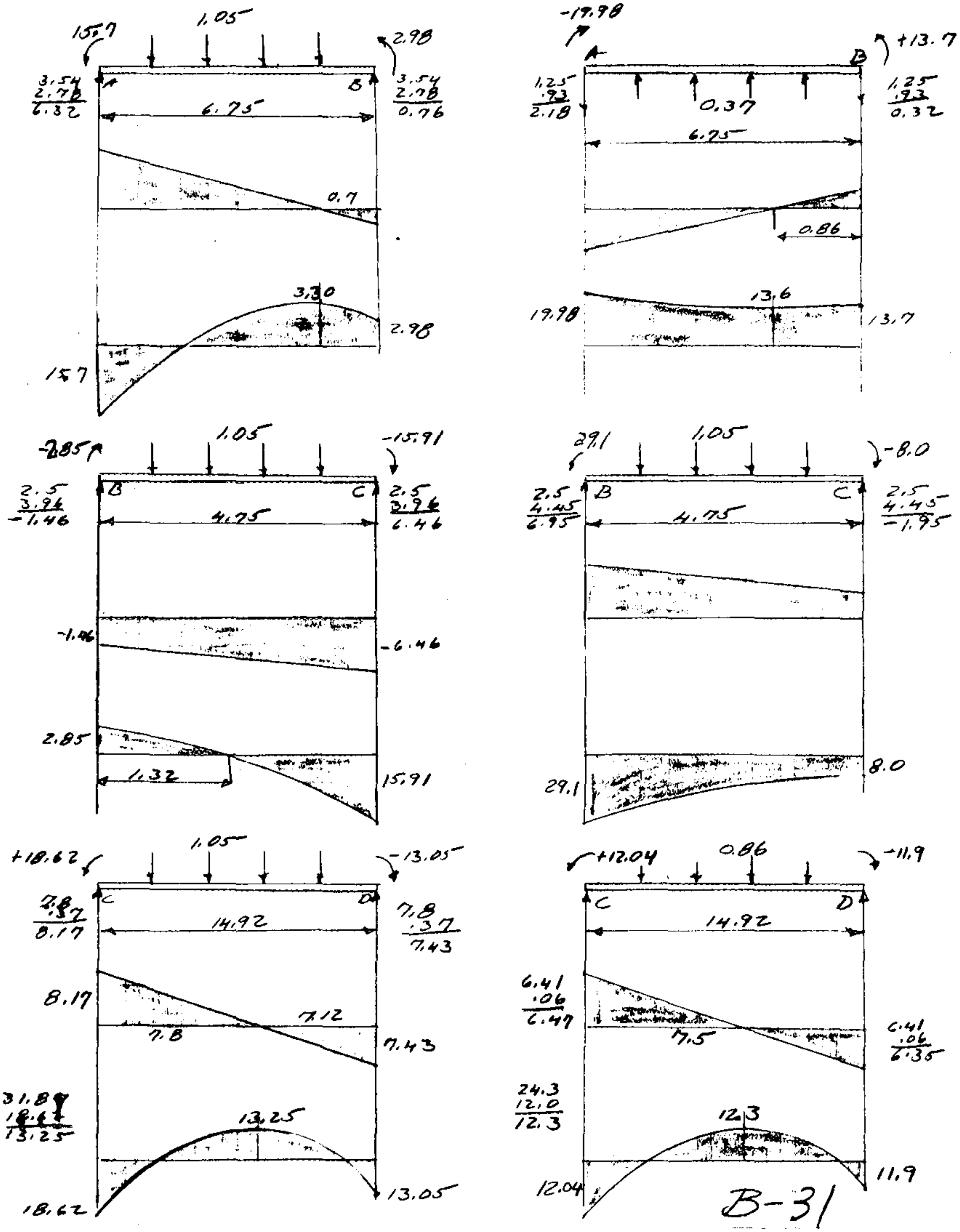


OAK STREET PUMPING STATION

MOMENT DISTRIBUTION AT ELEVATION 77.0 WITH WATER

NO SCALE

DESIGN OF WALLS El. 77.0



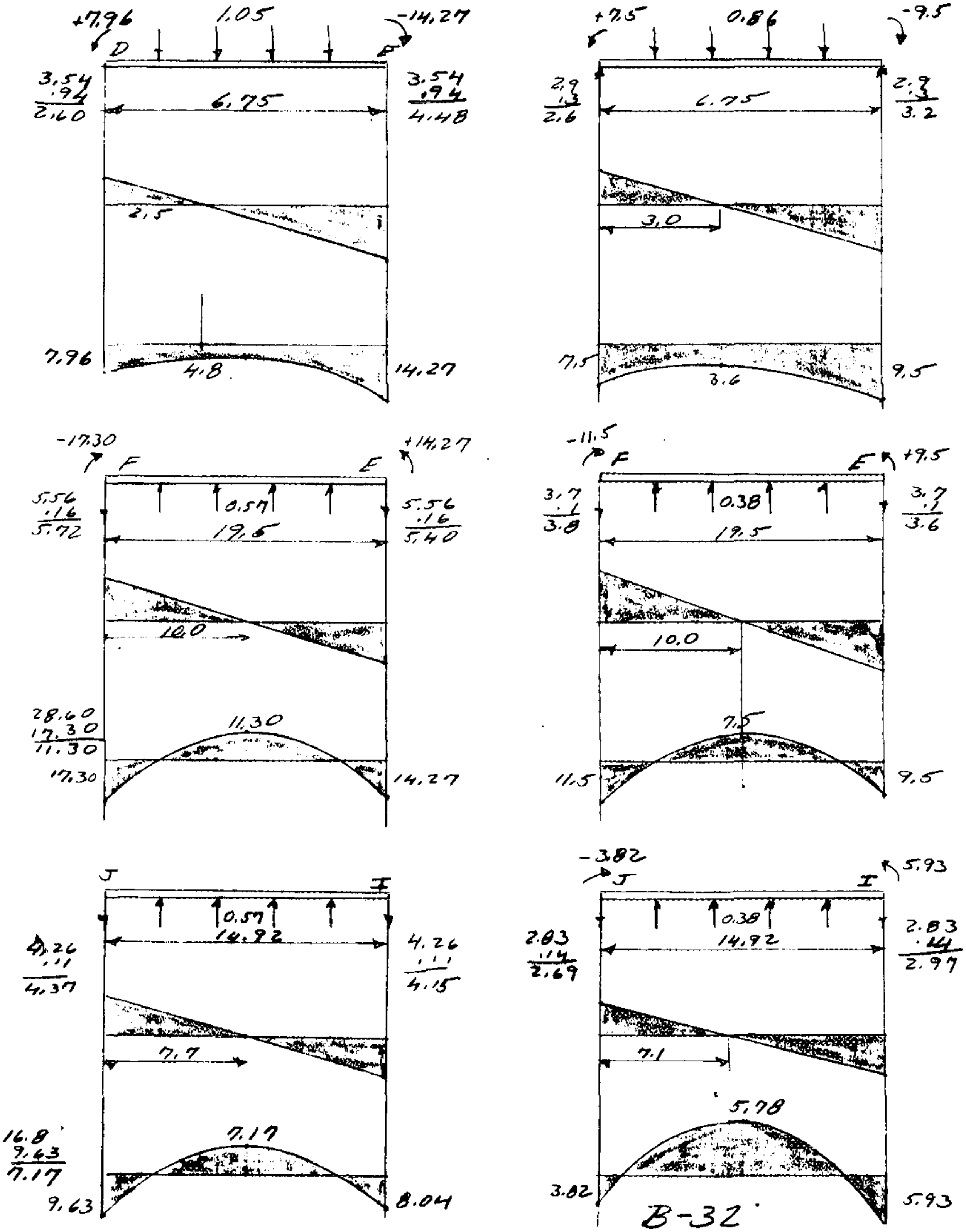
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 20 OF
DATE Mar. 4, 1963
COMPUTED BY E.N.W.
CHECKED BY M.A.

PROJECT Chicopee Falls

SUBJECT Oak St. Pumping Station

Design of Walls El. 77.0'



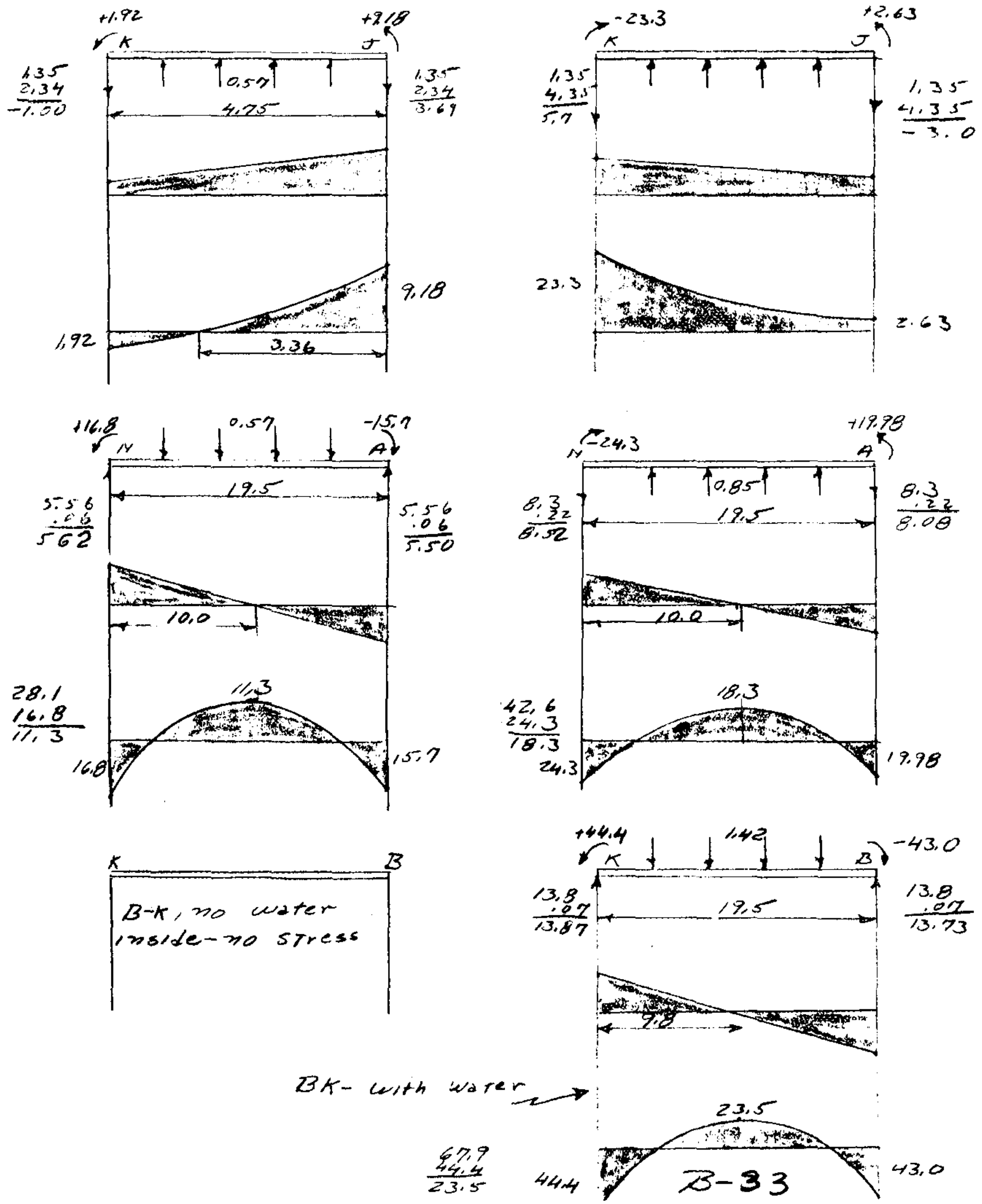
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 21 OF
DATE Mar 4, 1963
COMPUTED BY FHW
CHECKED BY M.A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

DESIGN OF WALLS El. 77.0



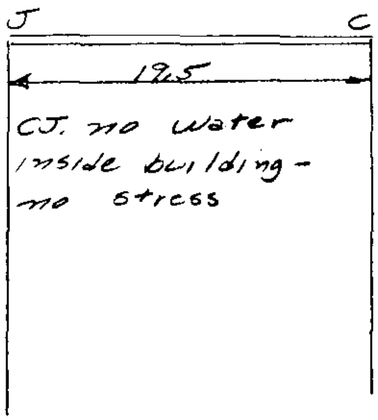
B-33

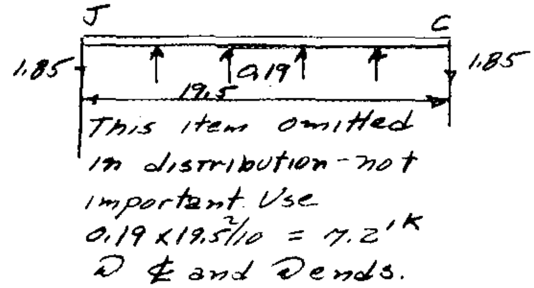
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

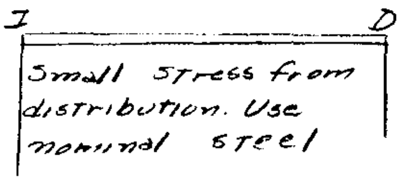
PROJECT: Chicopee Falls
SUBJECT: Oak St Pumping Station

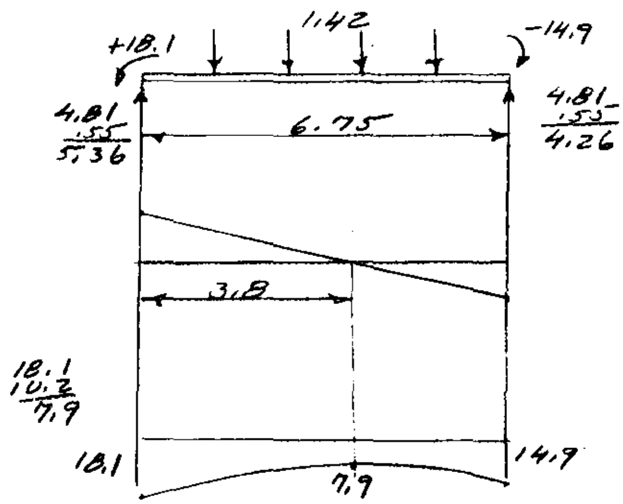
PROJECT NO. 6205-2
SHEET NO. 22 OF
DATE Mar. 4, 1963
COMPUTED BY E.N.W.
CHECKED BY M.A.

DESIGN OF WALLS









8'x8' Intakes.
Run #5 @ 12" ea. face
except @ joint F,
where steel from EF
will extend into FG.

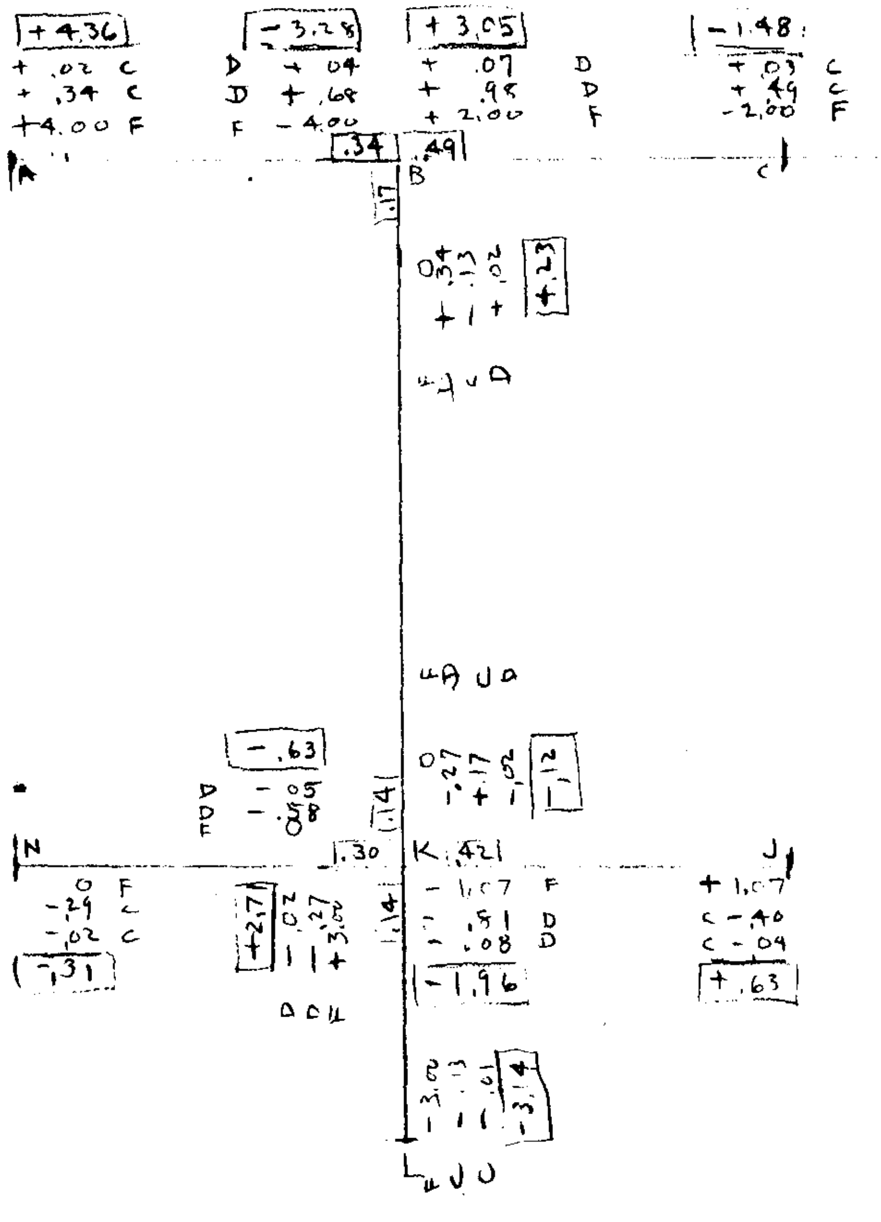
PROJECT NO. 6205-2
SHEET NO. 22 A. OF
DATE MAR. 8 1963
COMPUTED BY McA
CHECKED BY ENW

PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

REVISED DISTRIBUTION AT EL. 77 @ B & K.

STRESS ANALYSIS OF K-B FOR WATER INSIDE SHOWS A 20" WALL NEEDED TO CARRY MOMENT AS FOUND USING A 12" WALL. SUCH A CHANGE IN THICKNESS WILL CAUSE QUITE A CHANGE IN MOMENT DISTRIBUTION IN K-B AND ALL ADJACENT WALLS. WE SHALL REFIGURE THE MOMENT DISTRIBUTION ASSUMING FIXED ENDS ON ALL ADJACENT BEAMS AT FAR END.



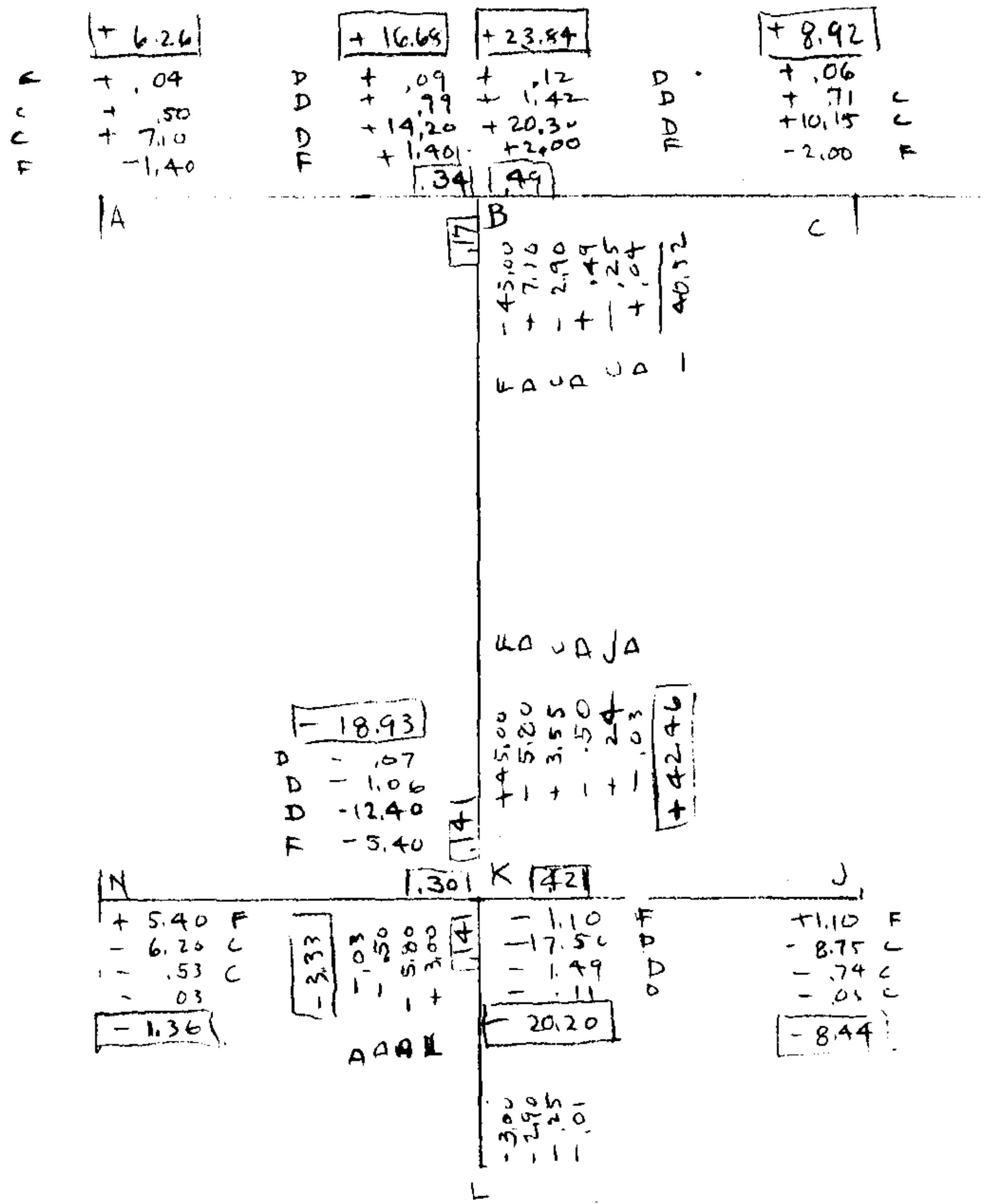
EXTERNAL PRESSURES

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 22 C OF
DATE MAR. 8, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.



WATER + EXTERNAL PRESSURE

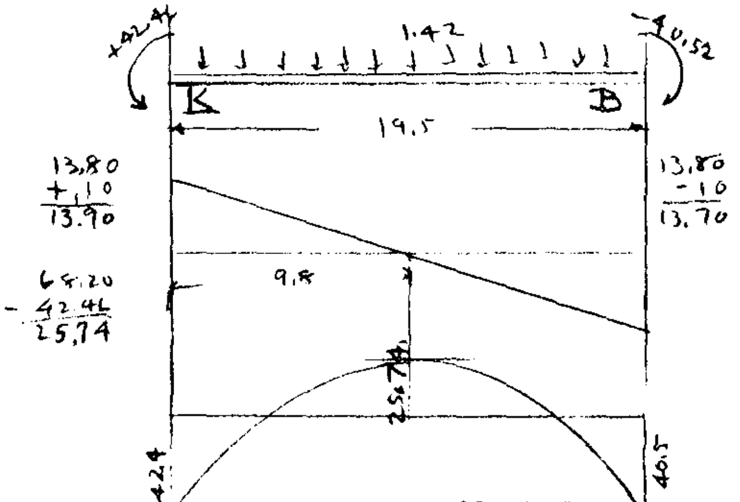
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 22E OF
DATE MAR. 8, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS

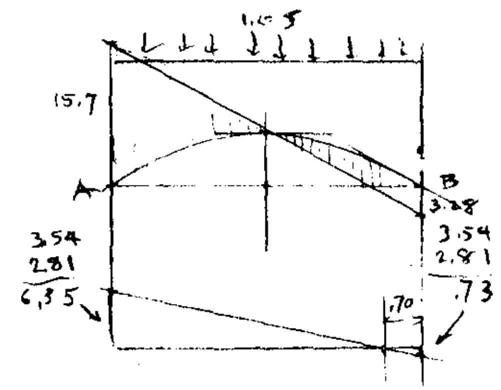
SUBJECT OAK ST. PUMPING STA.

REVISED MOMENTS.



COMBINED PRESSURES

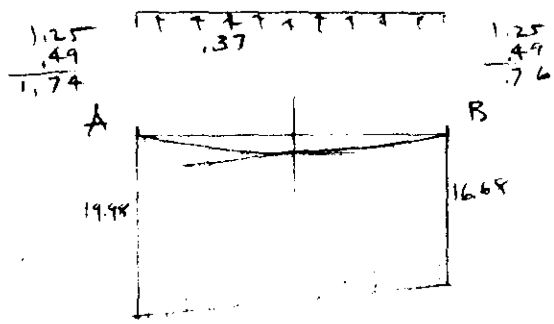
FOR THE REMAINDER OF THE BEAMS. WE SHALL USE THE END MOMENT ADJACENT TO KB AS JUST FOUND BUT SHALL USE THE PREVIOUS MOMENT FOR THE FAR END.



EXTERNAL LOADS

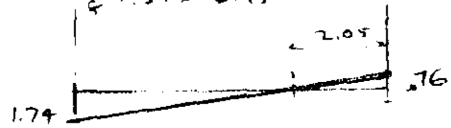
$\frac{1}{8} \times 1.05 \times \overline{6.75}^2 = 5.98$

MAX. POS. $.73 \times \frac{.70}{2} = .25$
3.28
3.53



COMBINED LOADS

$\frac{1}{8} \times .37 \times 6.75^2$ 2.10



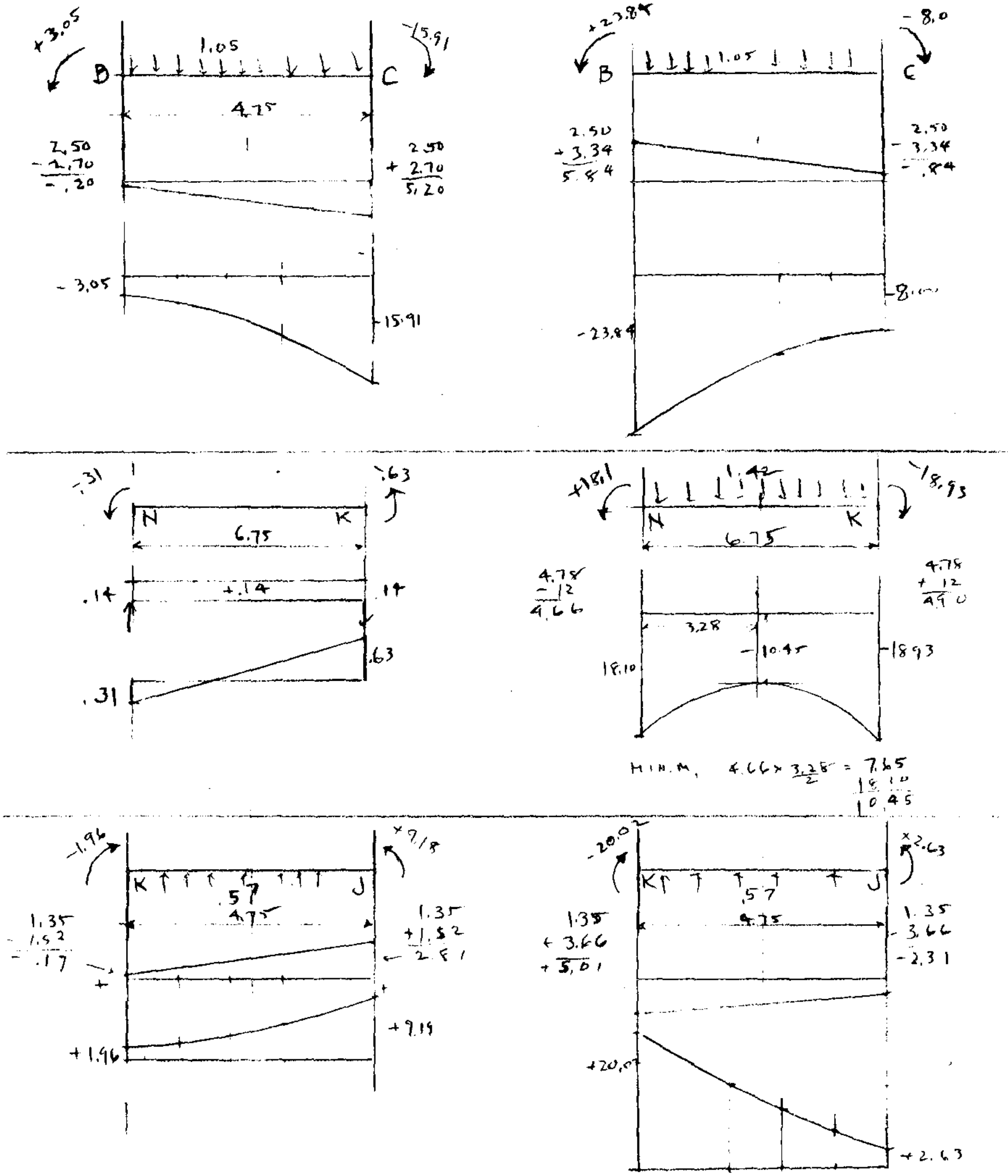
$.76 \times \frac{2.05}{2} = .78$
16.68
MIN MOM. 15.90

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 22 F OF
DATE MAR. 8, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.
REVISED MOMENTS

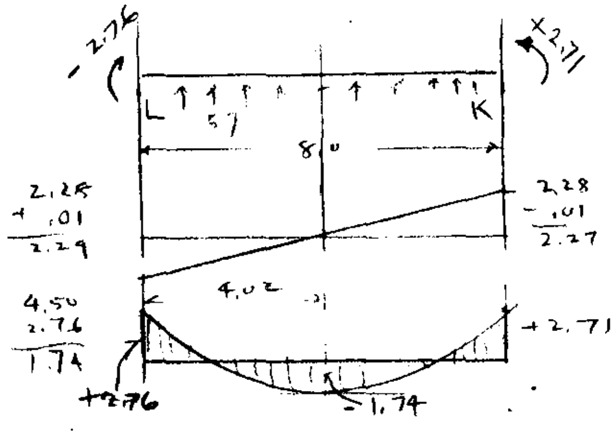


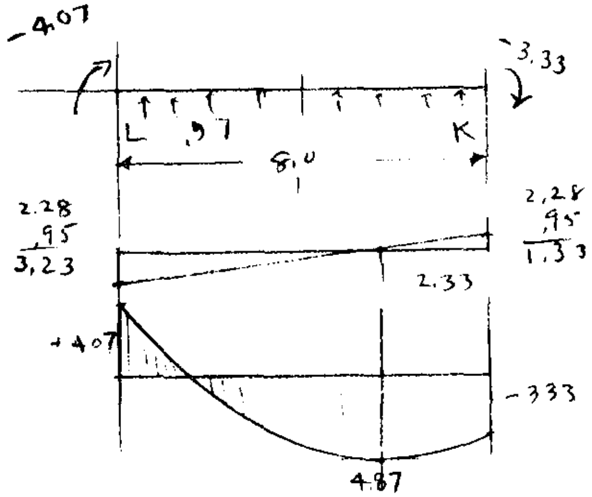
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 22G OF
DATE MAR. 8, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.

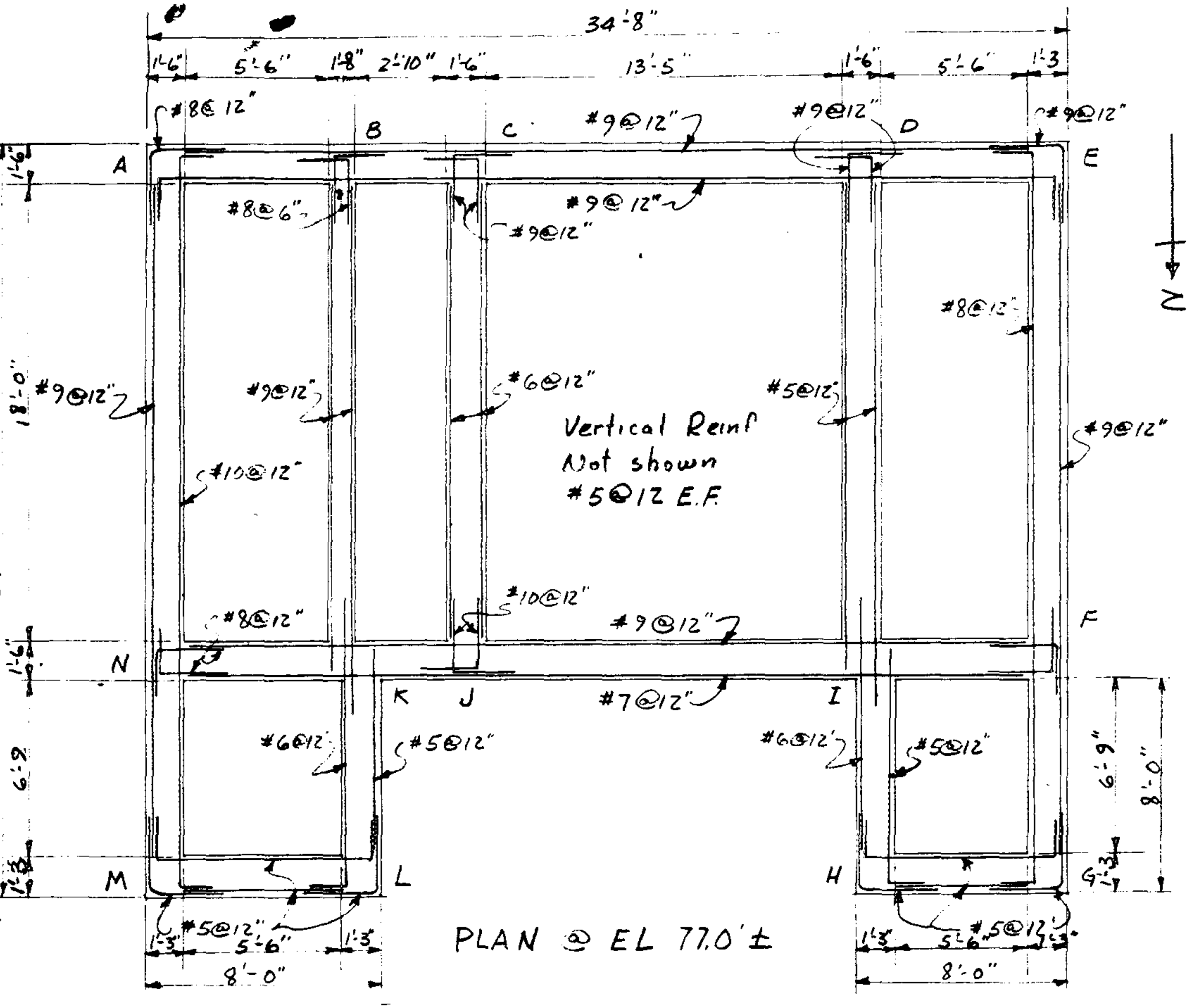




GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls
SUBJECT Oak St. Pumping Sta.

PROJECT NO. 6205
SHEET NO. 23 OF
DATE Mar 4, 1963
COMPUTED BY F.N.W.
CHECKED BY M.A.



B-40

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 24 OF
DATE Mar. 4, 1963
COMPUTED BY F.M.W.
CHECKED BY M.A.

DESIGN OF WALLS El. 77.0

AB	$\frac{15.7}{1.44 \times 14.5} = 0.76^{\square''}$	(OUT)	#8 @ 12
	$\frac{19.90}{1.44 \times 14.5} = 0.96$	(in)	#9 @ 12
BC	29.1/(1.44×14.5) = 1.4	(out)	#8 @ 6
CD	18.62/(1.44×14.5) = 0.9	(OUT)	#8 @ 12
DE	7.96/(1.44×11.5) = 0.48	(out)	#7 @ 12
	14.27/(1.44×11.5) = 0.86	(OUT)	#9 @ 12
EF	11.3/(1.44×11.5) = 0.68	(in)	#8 @ 12
	17.3/(1.44×11.5) = 1.04	(OUT)	#9 @ 12
IJ	9.63/(1.44×14.5) = 0.46	(out)	#6 @ 12
	7.17/(1.44×14.5) = 0.35	(in)	#6 @ 12
JK	23.3/(1.44×14.5) = 1.12	(OUT)	#10 @ 12
HK	18.93/(1.44×14.5) = 0.91		#9 @ 12
HA	24.3/(1.44×14.5) = 1.17	(in)	#10 @ 12
	16.8/(1.44×14.5) = 0.81	(out)	#8 @ 12
	11.3/(1.44×14.5) = 0.55	(in)	#7 @ 12
	18.3/(1.44×14.5) = 0.88	(out)	#9 @ 12

BK $d = \sqrt{\frac{44400 \times 12}{160 \times 12}} = 16.5 + 3.5 = 20$

44.4/(1.44×16.5)	= 1.88	#9 @ 6
25.7/(1.44×16.5)	= 1.06	#9 @ 12

CJ 7.2/(1.44 × 14.5) = 0.346 #6 @ 12

Intakes 6.8/(1.44×11.5) = 0.41 = max

If $M \leq 5.0$'K use #5 @ 12

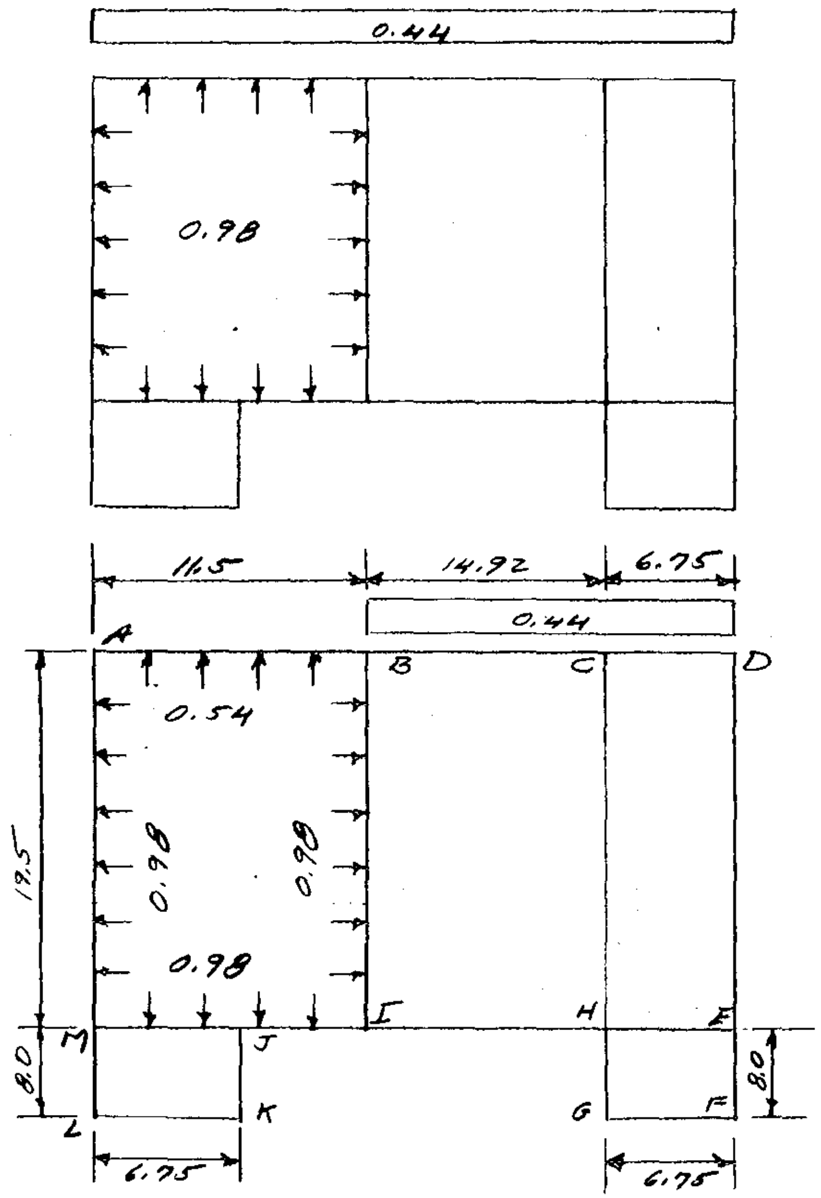
Design of Walls El. 84.0 As Ring.

In discharge bay $p = (99.75 - 84.0)\,0.0625 = 0.98$

West Wall Earth pres. $= (89.0 - 84.0)\,0.087 = 0.44$

Submerged Earth $(135 - 62.5)\,1/3 = 0.0625 + 0.0242 = 0.087$

Earth on other sides exerts no pressure



GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 26 OF
DATE Mar [illegible] 19[illegible]
PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STATION
COMPUTED BY [illegible]
CHECKED BY M.A.

Design of Walls. Ring at El. 84.0

AB. $M = 0.54 \times 11.5^2/12 =$ 5.9 — $I/l = 1.5^3/11.5 = 0.294$

BC $M = 0.44 \times 14.92^2/12 =$ 8.2 — $I/l = 1.5^3/14.92 = .226$

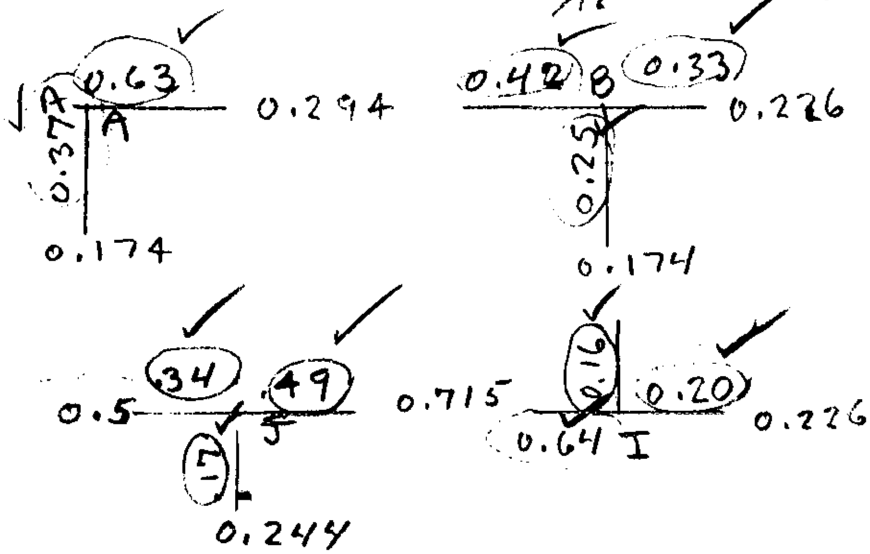
CD $M = 0.44 \times 6.75^2/12 =$ 1.7

IJ $M = 0.98 \times 4.75^2/12 =$ 1.9 — $I/l = 1.5^3/4.75 = 0.715$

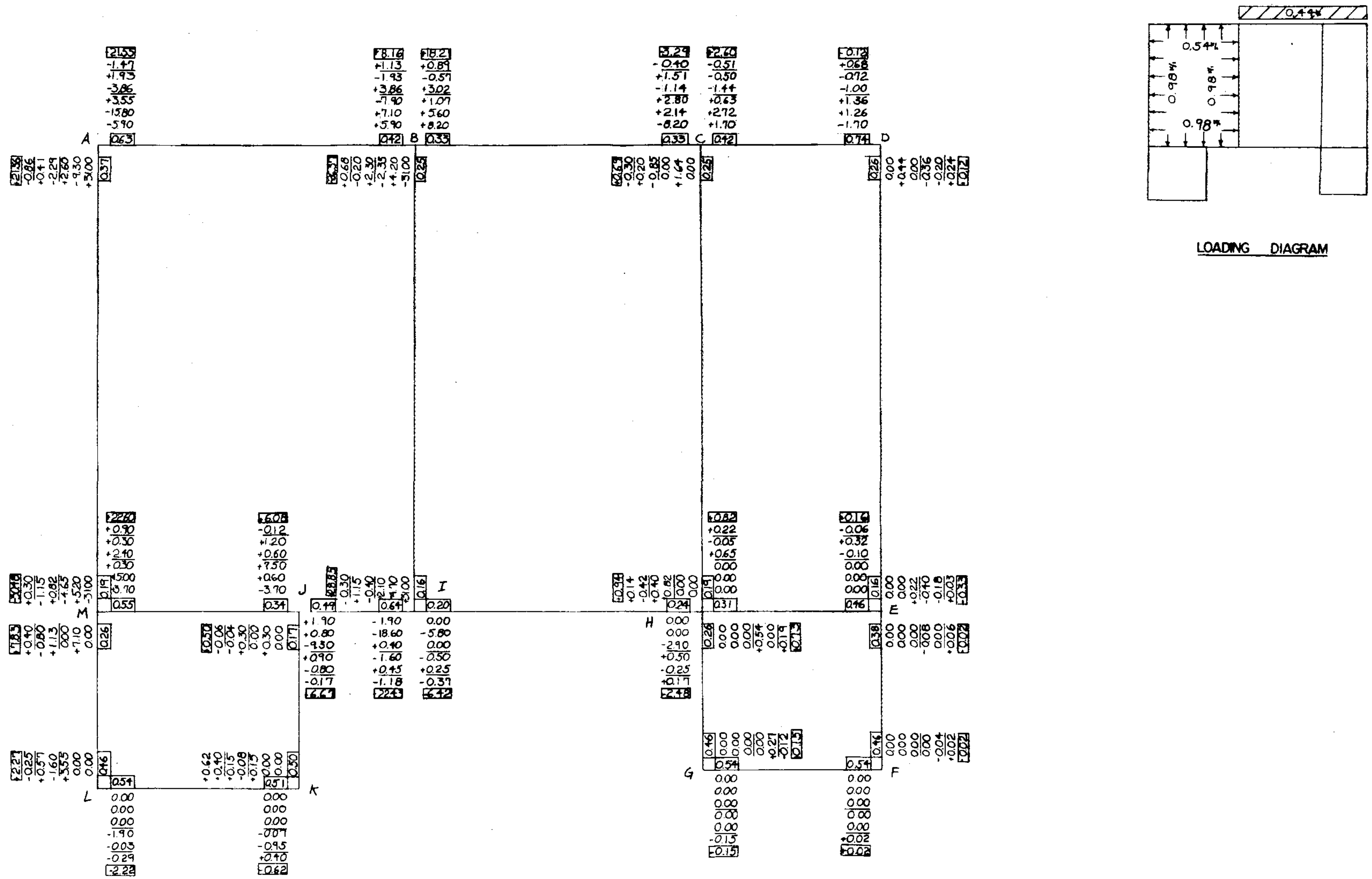
JM $M = 0.98 \times 6.75^2/12 =$ 3.7 — $I/l = 1.5^3/6.75 = 0.5$

MH $M = 0.98 \times 19.5^2/12 =$ 31 — $I/l = 1.5^3/19.5 = .174$

BI, $M = 0.98 \times 19.5^2/12 =$ 31 — $I/l = 1.5^3/19.5 = 0.174$



Other values as at El. 77.0



OAK STREET PUMPING STATION

MOMENT DISTRIBUTION AT ELEVATION 84.0 WITH WATER

NO SCALE

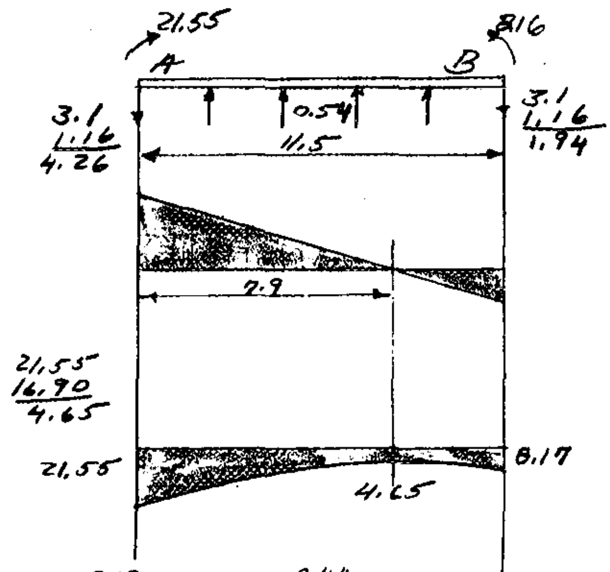
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

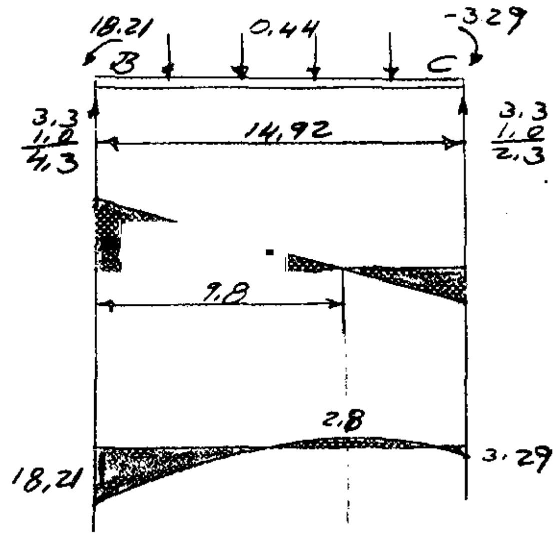
PROJECT CHKOPEE FALLS

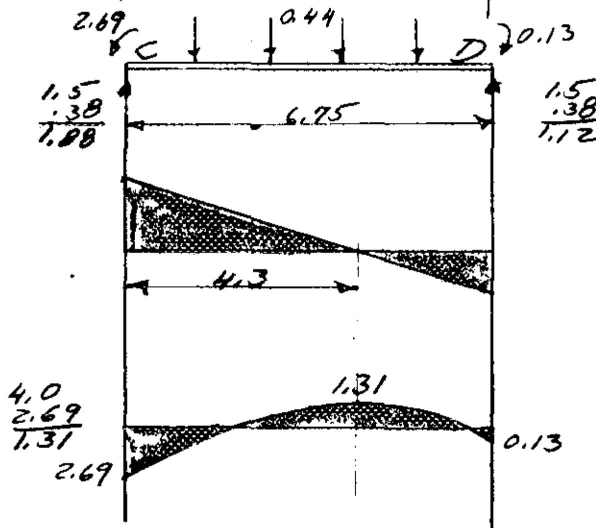
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 27 OF
DATE Mar. 5, 1963
COMPUTED BY EHW.
CHECKED BY M.A.

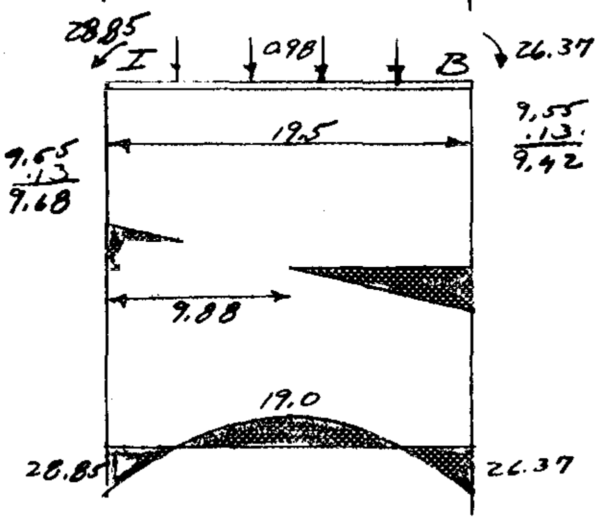
DESIGN OF WALLS. RING @ El. 84.0

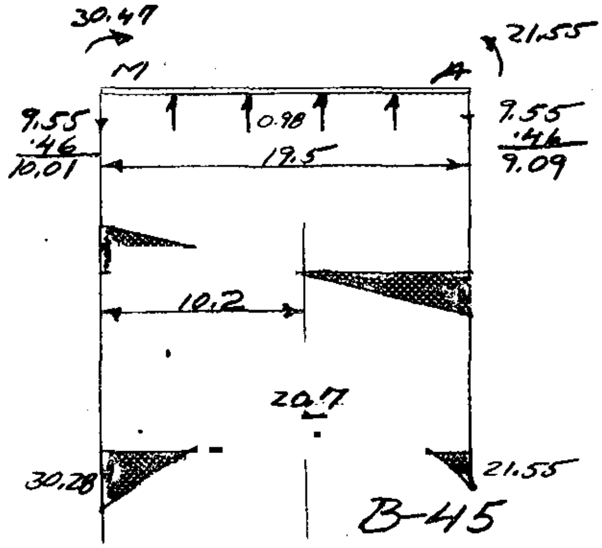






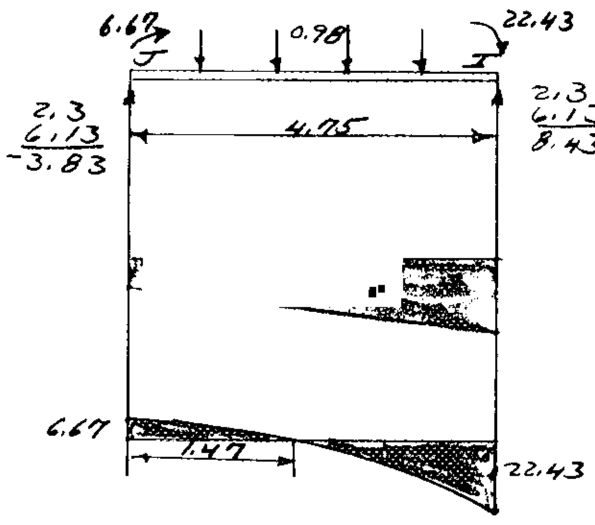
Nominal steel in DE, EF, FG, GH, HE, CH, HI, JK, KL

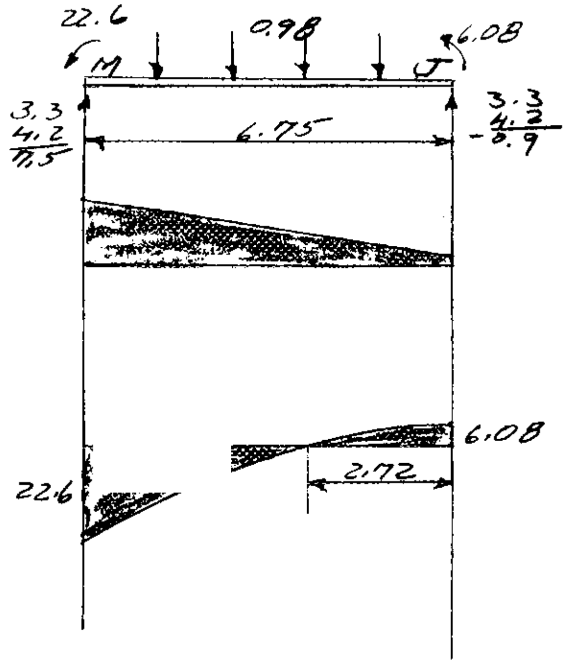


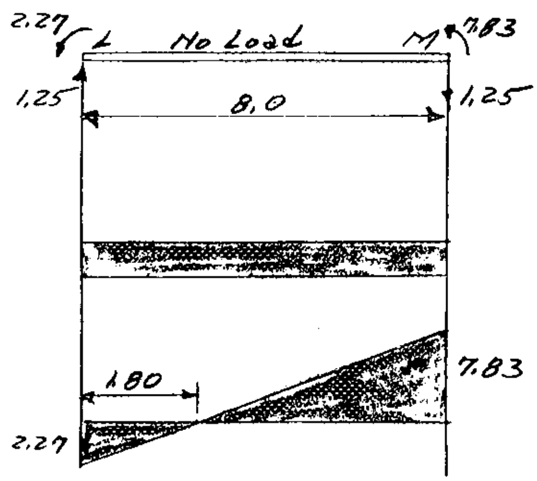


B-45

DESIGN OF WALLS @ El. 84.00







GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 29 OF
DATE Mar. 6, 1963
COMPUTED BY FHW
CHECKED BY M.A.

DESIGN OF WALLS, RING @ El 84.0

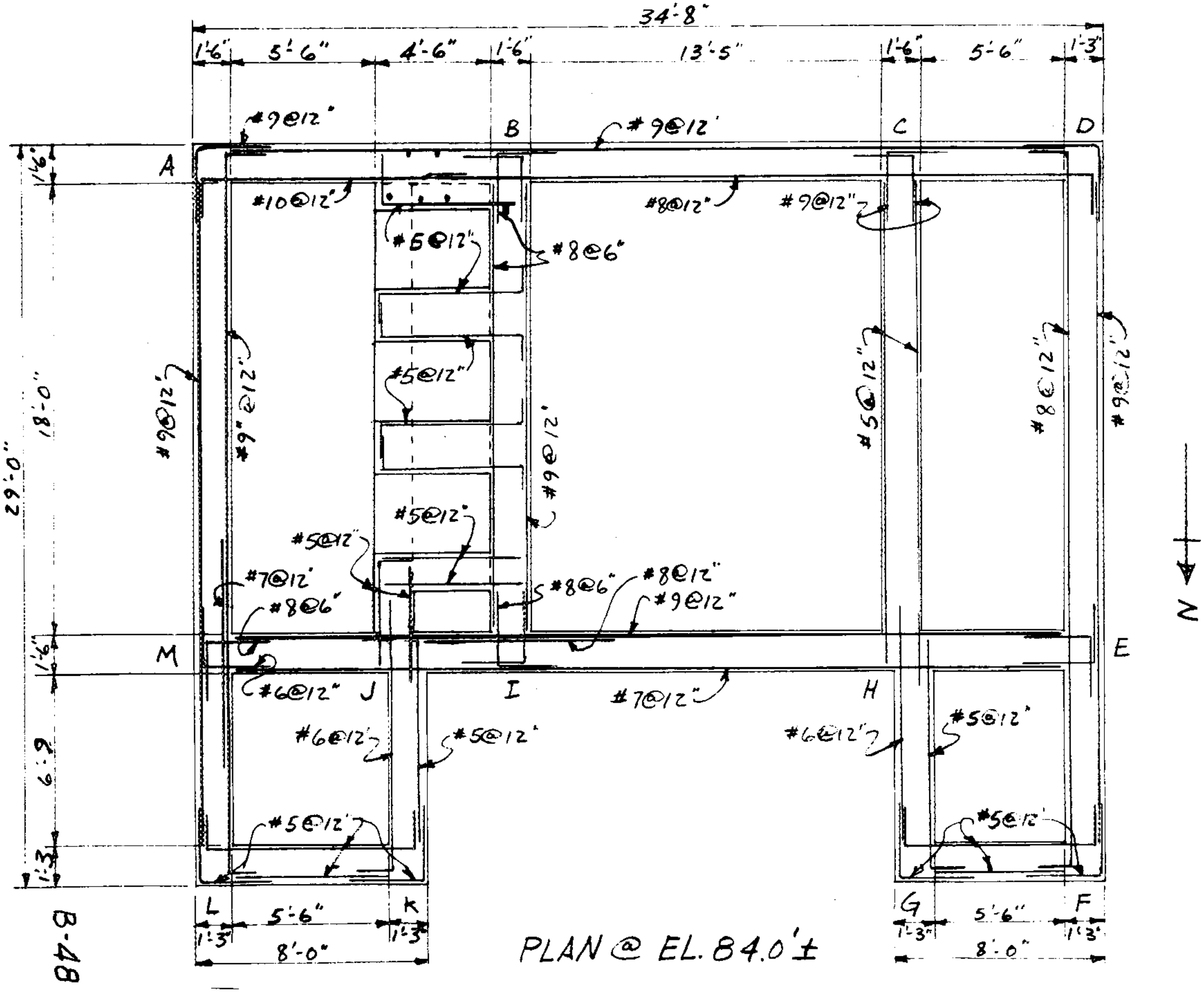
AB	21.55/(1.44×14.5)	= 1.04	#9 @ 12
BC	18.21/(1.44×14.5)	= 0.88	#9 @ 12
CD	Nominal		
BI	28.85/(1.44×14.5)	= 1.38	#8 @ 6
	19.75/(1.44×15.5)	= 0.88	#9 @ 12
	26.37/(1.44×14.5)	= 1.26	#10 @ 12
MA	30.28/(1.44×14.5)	= 1.45	#8 @ 6
IJ	6.67/(1.44×15.5)	= 0.30	#5 @ 12
	22.43/(1.44×15.5)	= 1.00	#9 @ 12
MJ	22.6/(1.44×14.5)	= 1.08	#10 @ 12
LM	7.83/(1.44×12.5)	= 0.43	#6 @ 12

COVER ALL WALLS 3" + d/2 @ THIS ELEV.

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls
SUBJECT Oak St. Pumping Sta.

PROJECT NO. 6205
SHEET NO. 29A OF
DATE 3/6/63
COMPUTED BY FNW
CHECKED BY KQR



PLAN @ EL. 84.0'±

THE QUESTION OF AXIAL TENSION IN RING @ EL. 84
THE RESULTS OF CONSIDERATION OF AXIAL TEN. IN RING AT EL. 87
MAKE IT SEEM THAT TEN. IN LONG SIDES IS UNIMPORTANT,
TENSION IN SHORT SIDES DOES HAVE A SIGNIFICANT EFFECT.
WE THEREFORE CONSIDER TENSION IN AB, M-J AND JI
TEN IS SHEAR IN MA - 9.15 @ A 10.05 AT M.

A - B. M @ A = 21.55 N = -9.15 d" = 9 - 3½ - 5½

$e = \frac{12M}{N} + 5\frac{1}{2} = \frac{12 \times 21.55}{-9.15} + 5\frac{1}{2} = -28.2 + 5.5 = -22.7$ E = 1.89

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-22.7}} = \frac{1}{1 + .56} = .64$ NE = 17.3

$A_s = \frac{17.3}{1.44 \times 14.5 \times .64} = 1.30$ #10 @ 12

A - B, M @ B, 8.17 N = -9.15

$e = \frac{12 \times 8.17}{-9.15} + 5.5 = -10.70 + 5.5 = -5.20$ E = .433 NE = 3.96

$i = \frac{1}{1 - \frac{.875 \times 14.5}{5.20}} = \frac{1}{1 + 2.44} = .29$

$A_s = \frac{3.96}{1.44 \times 14.5 \times .29} = .65$ #8 @ 12

AB. M IN MIDDLE = 4.65

$e = \frac{12 \times 4.65}{-9.15} + 5.5 = -6.10 + 5.5 = -.60$ E = .05 NE = .46

$i = \frac{1}{1 - \frac{.875 \times 14.5}{.60}} = \frac{1}{1 + 21.2} = .045$

$A_s = \frac{.46}{1.44 \times 14.5 \times .045} = .49$ #7 @ 12

SAME SIDE AS ENDS.

BM. M - J MOM. @ M = 22.6 N = 10.05

$e = \frac{12 \times 22.6}{-10.05} + 5.5 = -27.0 + 5.5 = -21.5$ E = 1.79 NE = 18.00

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-21.5}} = \frac{1}{1 + .59} = .63$

$A_s = \frac{18.00}{1.44 \times 14.5 \times .63} = 1.37$ #8 @ 6

MOM @ J = 6.08

$e = \frac{12 \times 6.08}{-10.05} + 5.5 = -7.25 + 5.50 = -1.75$ E = .146 NE = 1.47

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-1.75}} = \frac{1}{1 + 7.25} = .121$

$A_s = \frac{1.47}{1.44 \times 14.5 \times .121} = .58$ #7 @ 12

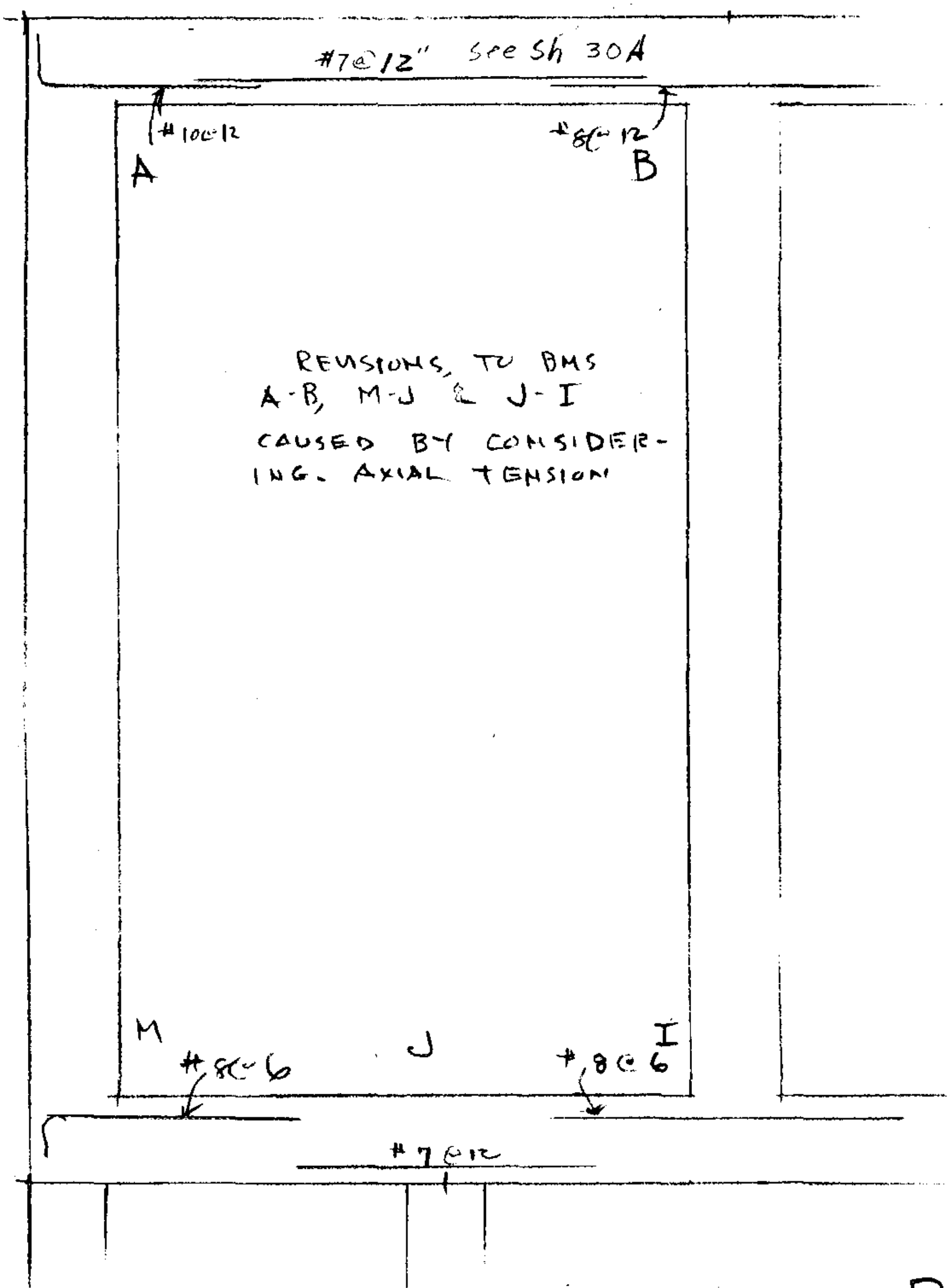
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 30 B OF
DATE MAR. 12, 1963
COMPUTED BY M.A.
CHECKED BY FNW

PROJECT MASS, CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STA.
RING @ 84

BM. J.I. AT J SIMILAR TO END J OF BM. M-J
@ I. M = 22.43 N = 10.05

$e = \frac{12 \times 22.43}{-10.05} + 5.50$ VERY SIMILAR TO END M OF BEAM, M-J - SAME STEEL.



GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 31 OF
DATE Mar. 6. 1963
COMPUTED BY F. N. W.
CHECKED BY M. A.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

Design of Walls. Ring at El. 87.0

In discharge bay, p = (99.75 − 87.0) · .0625 = 0.8

AB, CD: $M = 0.8 \cdot 11.5^2/12 = 8.8$

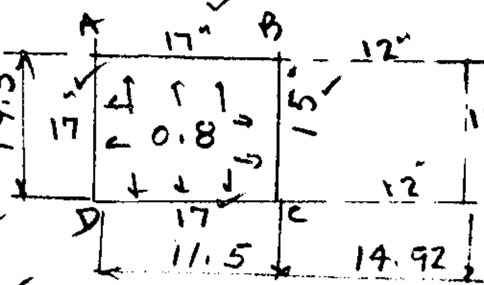
$\frac{I}{l} = \frac{1.42^3}{11.5} = 0.250$

AD. $M = 0.8 \cdot 19.5^2/12 = 25.4$

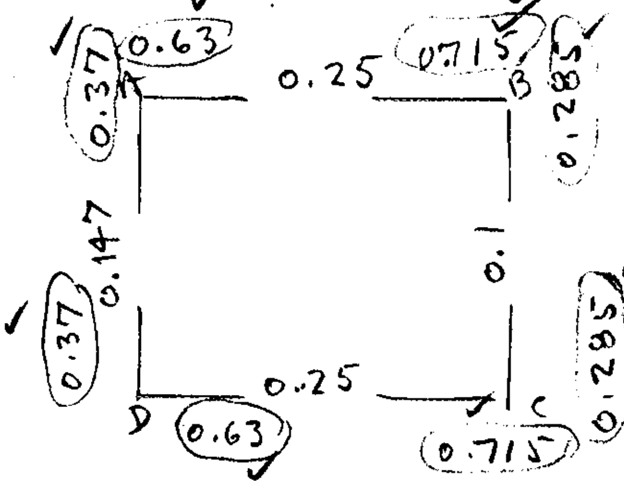
$\frac{I}{l} = \frac{1.42^3}{19.5} = 0.147$

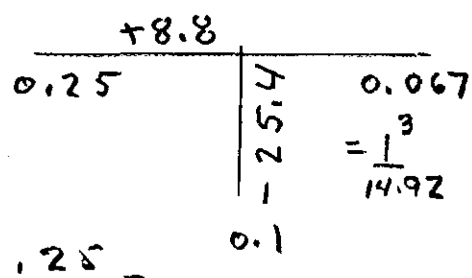
BC $M = 0.8 \cdot 19.5^2/12 = 25.4$

$\frac{I}{l} = \frac{1.25^3}{19.5} = 0.1$



Neglect pump room bay - no load. With 12" walls effect from discharge bay will be small.





0.25
.067
.10
0.417

0.25/.417 = 0.66
0.1/.417 = .24
.067/.417 = .16

25.4
8.8
16.6 × 0.16 = 2.65"
= #5 @ 12.

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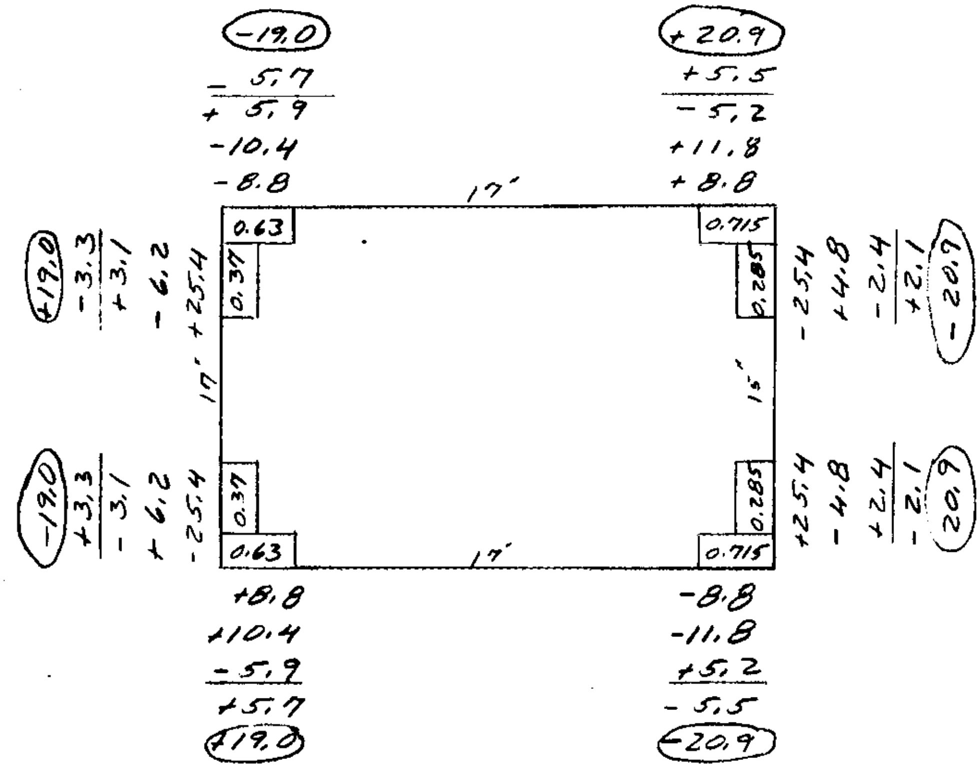
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205
SHEET NO. 32 OF
DATE Mar. 6, 1963
COMPUTED BY E.M.W.
CHECKED BY M.A.

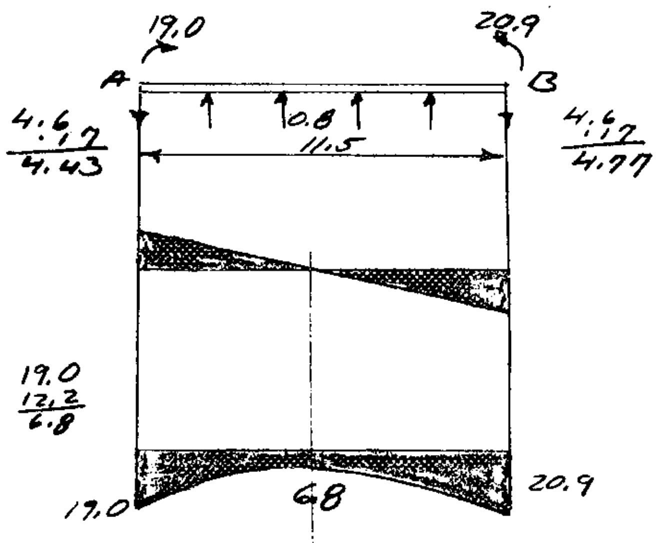
PROJECT CHICOPEE FALLS

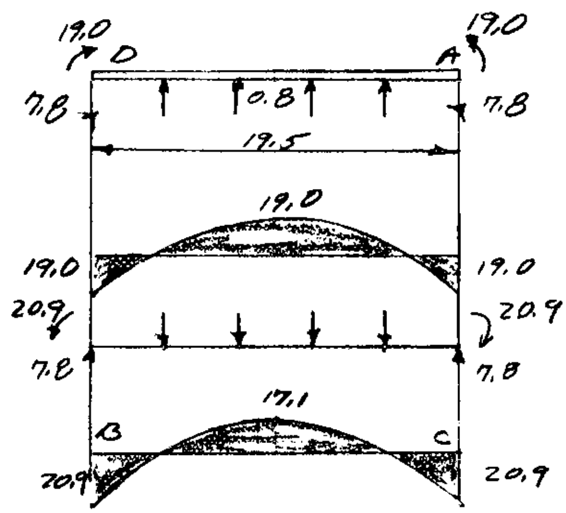
SUBJECT OAK ST. PUMPING STATION

DESIGN OF WALLS. RING @ El. 87.0

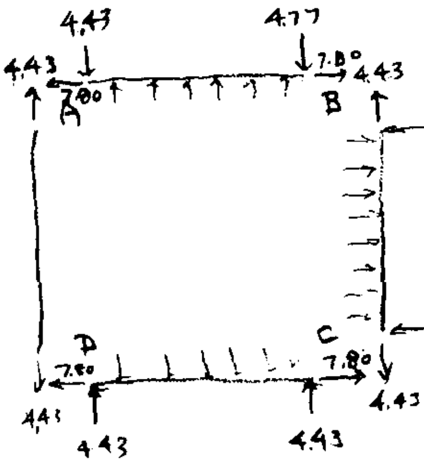


Cover 2" + d/2
= 14.5 & 12.5





RING AT ELEV. 87.0 CONSIDERING RING AT EL. 87
WITH AXIAL TENSION.



AB & CD - M = 20.9 H = 7.80 RIGHT. END

$e = \frac{12M}{N} + d'' = \frac{12 \times 20.9}{-7.80} + 6'' = -26.1$ E = -2.17

K = 160
F = .21

NE = (-7.80)×(-2.17) = 16.9
KF = 160×.21 = 33.6 O.K.

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-26.1}} = \frac{1}{1 + .49} = .67$

$A_s = \frac{16.9}{1.44 \times 14.5 \times .67} = 1.20$ #10 @ 12

LEFT END

$e = \frac{12 \times 19.}{-7.80} + 6'' = -29.3 + 6 = -23.3$ E = -1.94

NE = 1.94 × 7.80 = 15.1

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-29.3}} = \frac{1}{1 + .55} = .65$

$A_s = \frac{15.1}{1.44 \times 14.5 \times .65} = 1.11$ #10 @ 12

MIDDLE -

$e = \frac{12 \times 6.8}{-7.80} - 6'' = -10.4 + 6 = -4.4$ E = -.367

NE = 2.86

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-4.4}} = \frac{1}{1 + 2.88} = .258$

$A_s = \frac{2.86}{1.44 \times 14.5 \times .258} = .53$ #7 @ 12

DA - ENDS M = 19.0 N = 4.43

$e = \frac{12 \times 19.0}{-4.43} + 6'' = -51.5 + 6 = -45.5$ E = -3.79 NE = 16.75

$i = \frac{1}{1 - \frac{.875 \times 14.5}{-45.5}} = \frac{1}{1 + .28} = .78$

$A_s = \frac{16.75}{1.44 \times 14.5 \times .78} = 1.03$ #9 @ 12 OK.

DA - MIDDLE SAME —

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BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 35 OF
DATE MAR. 12, 1963
COMPUTED BY M. A.
CHECKED BY FNW

PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST PUMPING STA.

RING @ EL. 87 CONSIDERING AXIAL TEN.
C - B

ENDS $M = 20.9$ $N = 4.43$ $d'' = 7\frac{1}{2} - 2\frac{1}{2} = 5''$

$e = \frac{12 \times 20.9}{-4.43} + 5'' = -56.7 + 5'' = -51.7$ $E = -4.31$

$NE = 19.1$

$i = \frac{1}{1 - \frac{.875 \times 12.5}{-51.7}} = \frac{1}{1 + .21} = .825$

$A_s = \frac{19.1}{1.44 \times 12.5 \times .825} = 1.27$ #10@12 O.K

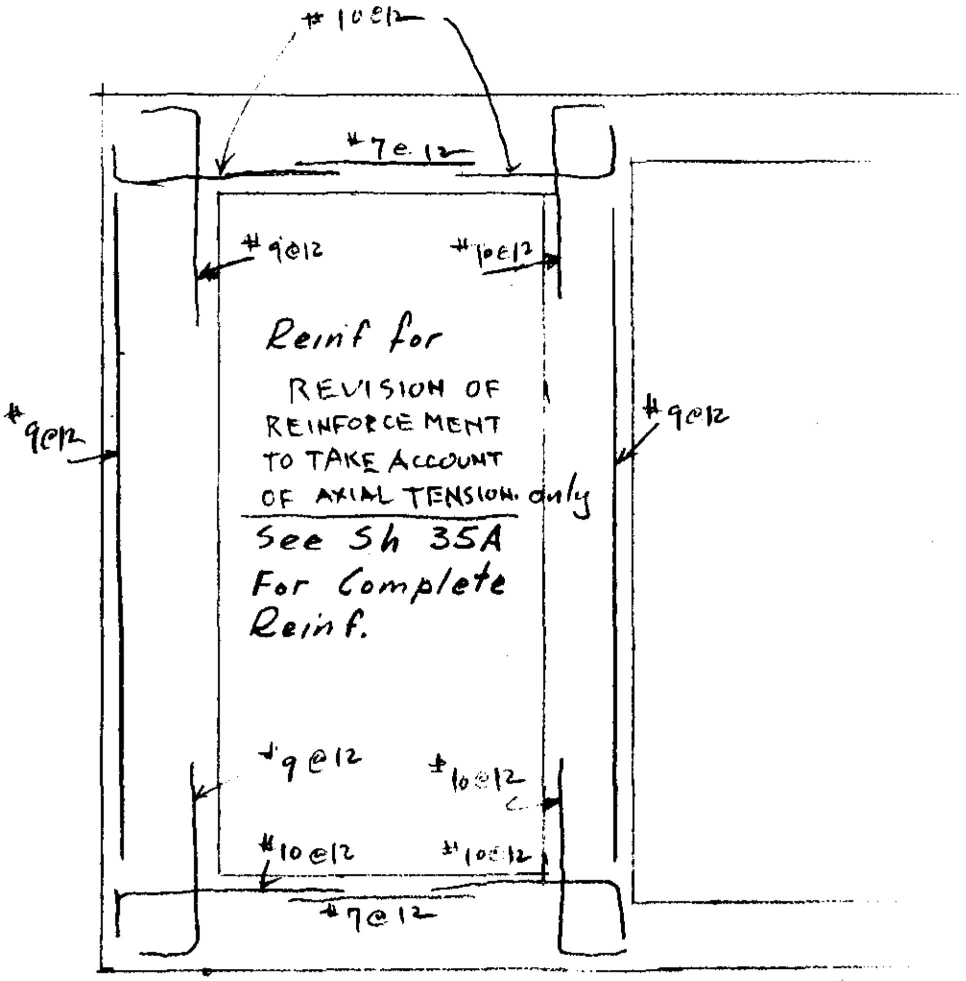
MIDDLE $M = 17.1$ $N = 4.43$

$e = \frac{12 \times 17.1}{-4.43} + 5'' = -46.5 + 5'' = -41.5$ $E = 3.45$ $NE = 15.3$

$i = \frac{1}{1 - \frac{.875 \times 12.5}{-41.5}} = \frac{1}{1 + .26} = .80$

$A_s = \frac{15.3}{1.44 \times 12.5 \times .80} = 1.06$ # 9@12 ok.

#



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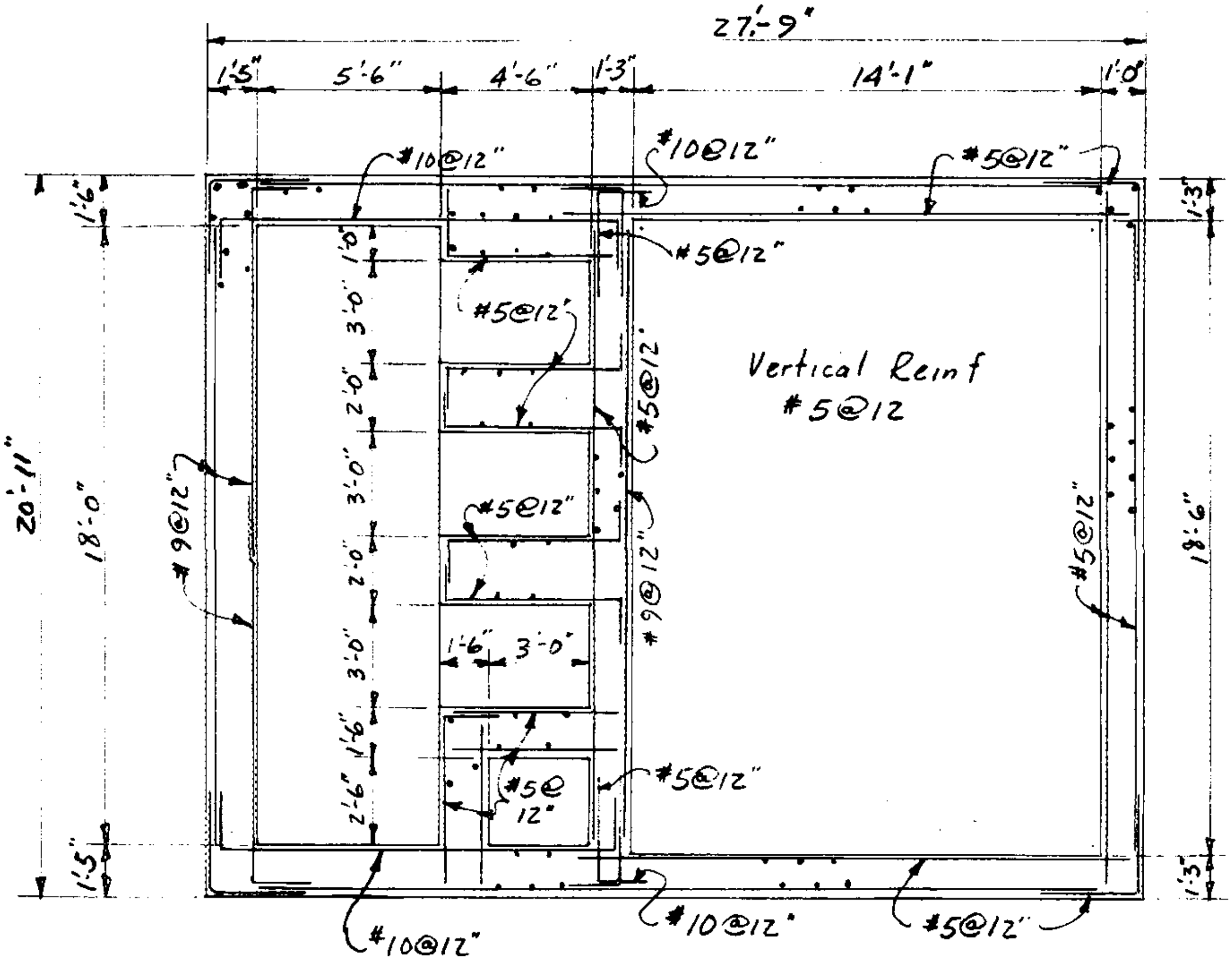
PROJECT Chicopee Falls
SUBJECT Pumping Sta. Oak St.

PROJECT NO. 6205
SHEET NO. 35A OF
DATE 4/2/63
COMPUTED BY [illegible]
CHECKED BY [illegible]



PLAN @ EL. 87.0'±

B-55

ROOF OVER DISCHARGE BAY

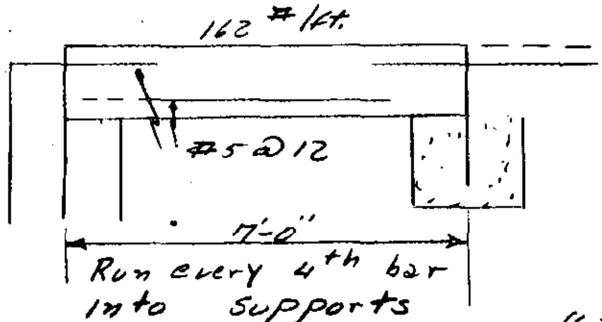
Note: A row of openings prevents the use of two way steel. Run a beam between the stop-log piers. The resulting slab has length ratios of 3:1. One-way steel is mandatory, except for spacers & temp. & shrinkage.

LOADS

Tar & Gravel	6.5
6" slab	75.0
40" snow + 20" gate	60.0
Stop logs	20.0
	162.0

Cover: $3/4 + d/2 = 1.0''$
$d = 6'' - 1'' = 5''$

SLAB



At ℄ $M = 0.162 \times 7^2/8 = 1.0'^k$

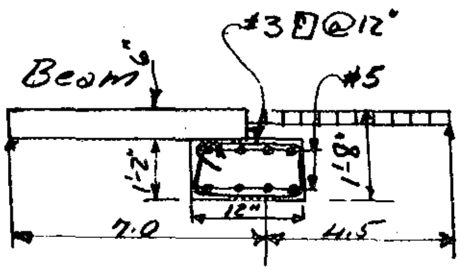
$A_s = \frac{1.0}{1.44 \times 5} = 0.14$

Use #5 @ 12 = $0.30\square''$ at supports, neg. steel, #5 @ 12 min.

By Using Gate Load as Follows:

(Gate Vertical) $\frac{3000}{3.0 \times 5.5} = 180$ #/ft.

T & G	= 6
Slab	= 75
Gate	= 180
Live	= 50
	311 #/'



$311\left(\frac{7.0+4.5}{2}\right) = 1790$

wt. $\frac{8 \times 6}{144} \times 150 = 50$

1840

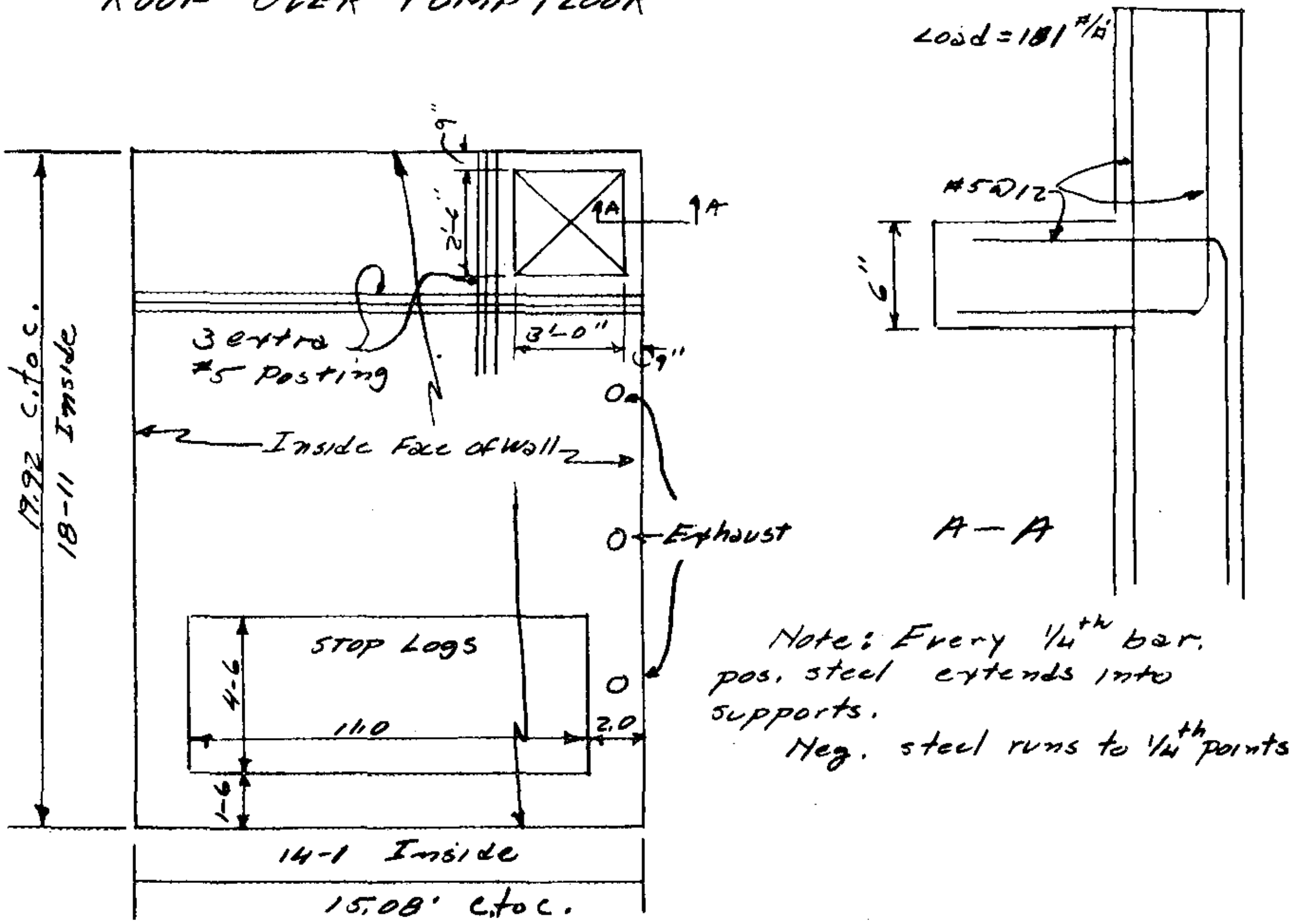
Span = 3'-2" Clear = 3.17'

$M = \frac{1}{10} \times 1.840 \times \overline{3.17}^2 = 18.5'^k$

$F = \frac{18.5}{160} = .115$ b = 12" d = 11" t = 14"

$A_s = \frac{18.5}{1.44 \times 11} = 1.17\square''$ 4 - #5 T & B $A_s = 1.24\square''$

ROOF OVER PUMP FLOOR



Note: Every 1/4th bar, pos. steel extends into supports.
Neg. steel runs to 1/4th points

ACI Bldg. Code p. 945 $\quad M = \frac{15.08}{19.92} = 0.75$

Short Span { Neg = cws^2 . $0.0515 \times 181 \times 15.08^2 = 2115'^{\#}$
Pos. $0.0385 \times 181 \times 15.08^2 = 1580'^{\#}$

Long Span { Neg. $0.033 \times 181 \times 15.08^2 = 1355'^{\#}$
Pos. $0.025 \times 181 \times 15.08^2 = 1025'^{\#}$

$d = \sqrt{\frac{2115 \times 12}{160 \times 12}} = 3.63''$ $\quad$ Have $d = 5''$

$A_s = \frac{2.115}{1.44 \times 5} = .294 \,\square''$ $\quad$ Use #5@12 for pos. & neg.

GREEN ENGINEERING AFFILIATES
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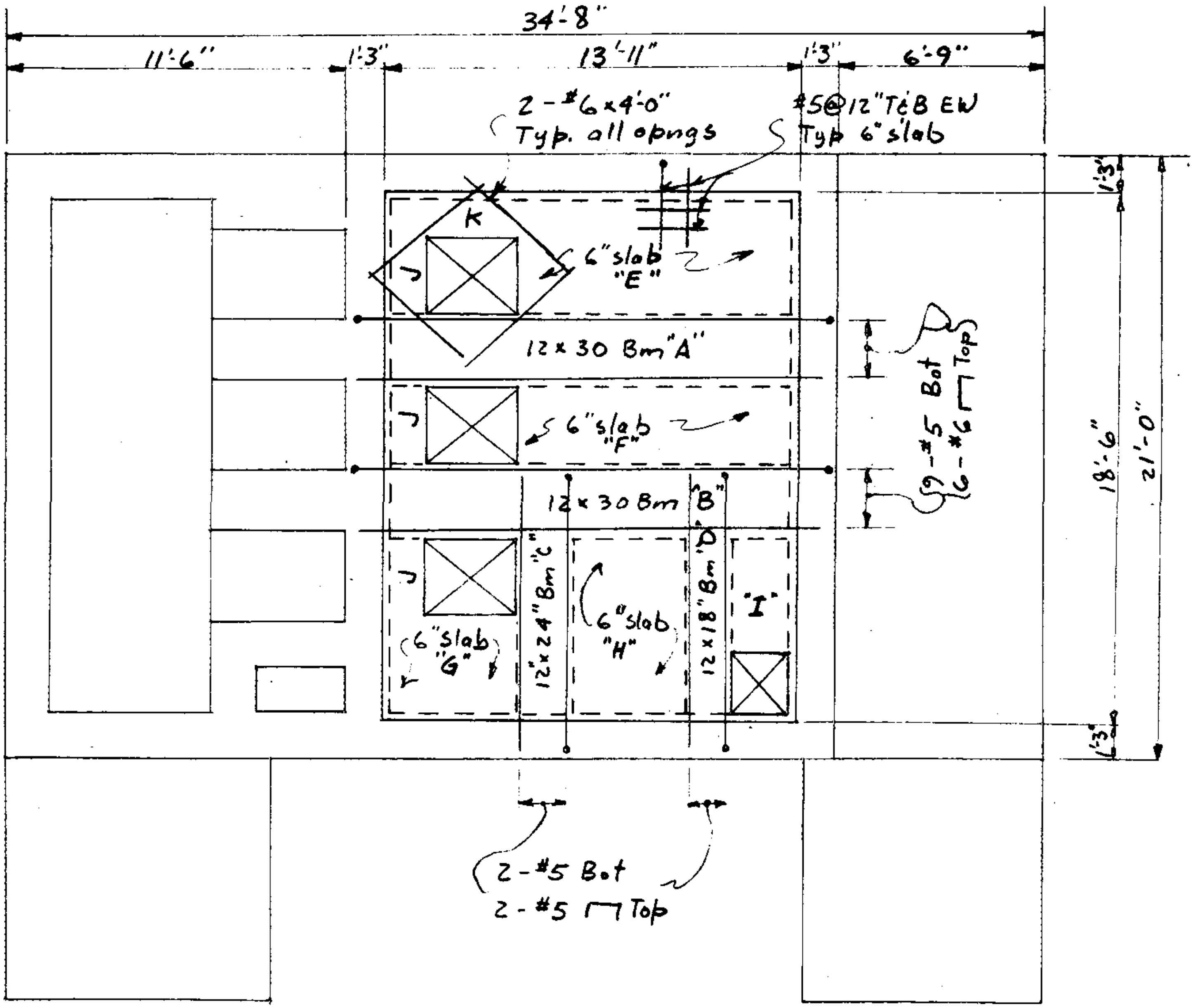
BOSTON, MASS.

SUBJECT Oak St. Pumping Sta.

PROJECT Chicopee Falls

PROJECT NO. 6205
SHEET NO. 38 OF -
DATE
COMPUTED BY ENW
CHECKED BY [illegible]



Plan Operating Floor
EL. 86.06'

B-58

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 39 OF
DATE Mar. 11, 1963
COMPUTED BY FNW
CHECKED BY RDP

PUMP ROOM FLOOR

Loads: D.L. 100 #/□'
L.L. 100 #/□'

BEAMS

+3 pump & thrust @ 6
3 prime movers @ 3
+ on slab only
3^K over 4'x3' = 0.25

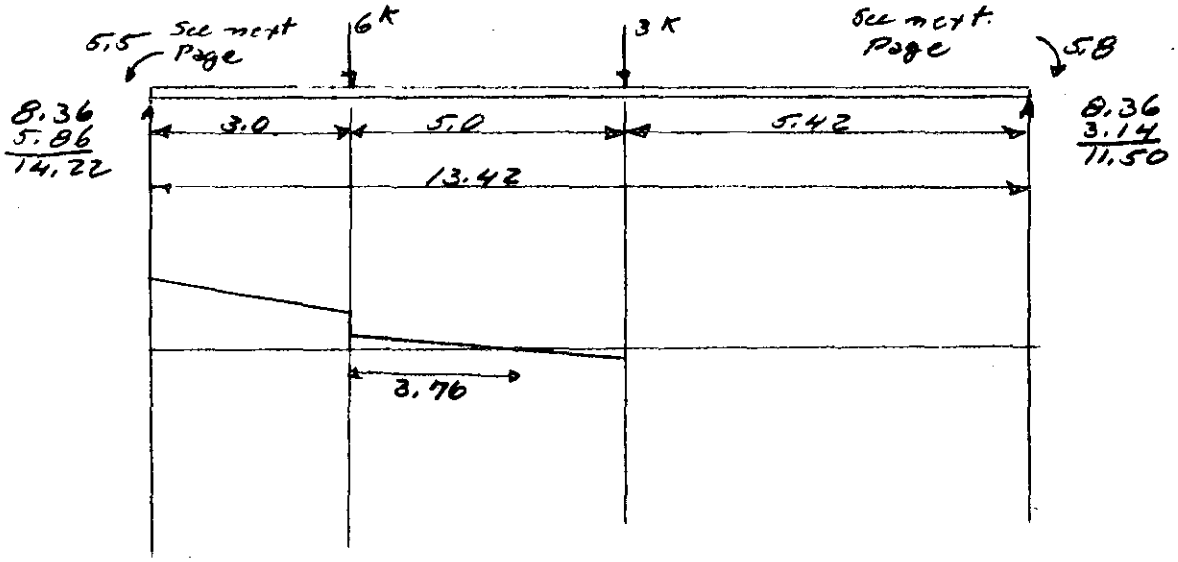
Bms. 5.0' o.c.

Take unif load as 100+100=200 #/□',
Plus Concen. loads of 6^K & 3^K.

Bm "A" is most heavily loaded

Unif load = 200(5/2+7.5/2) = 200×6.25 = 1250 #/'

Compute as simple beam, then allow for fixed ends.



$M = 14.22 \times 6.76 = 96.0$

$-1.25 \times 6.76^2/2 = 28.6$ 56.7

$-6.0 \times 3.76 = 22.6$ 39.3 = Max Pos. Mom.

ML   5.5 / 56.7

PUMP ROOM FLOOR

BEAMS To determine amount of fixed-end moments

$$M_L = \frac{Pab^2}{L^2} = 3 \times 6 \times \frac{10.42^2}{13.42^2} = 10.8$$

$$3 \times 8 \times \frac{5.42^2}{13.42^2} = \frac{3.9}{14.7}$$

$$+ 1.25 + \frac{13.42^2}{12} = \frac{18.8}{33.5}$$

$$M_R = Pb\frac{a^2}{L^2}$$

Unif = 18.8

$$3 \times 5.42 \times \frac{8^2}{13.42^2} = 5.8$$

$$6 \times 10.42 \times \frac{3^2}{13.42^2} = 3.2$$

27.8

PUMP ROOM FLOOR

BEAMS. width = 2-6" @ openings

$d = \sqrt{\dfrac{39300 \times 12}{160 \times 12}} = 9.9'' + 2.0 = 11.9 = 12.0''$
$d = 10''$

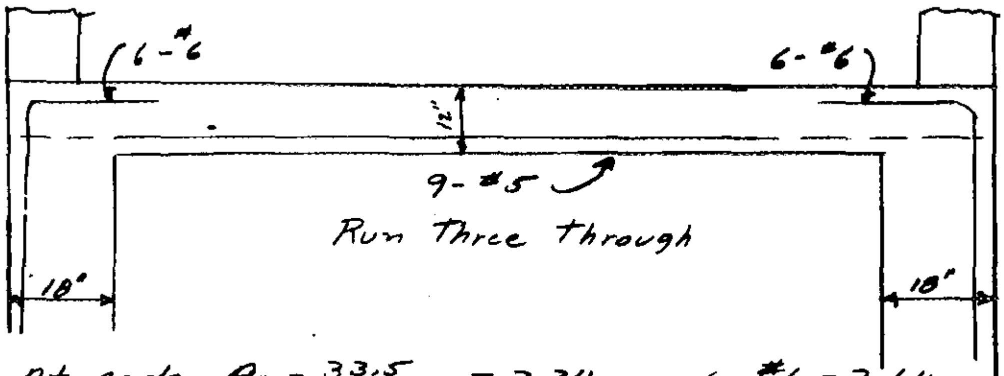
Cover, interior floor beam, 1½ + ½ = 2"

Cover, slabs ¾ + ¼ = 1.0"

Pos M., $A_s = \dfrac{39.3}{1.44 \times 10} = 2.74^{\square''}$ 9 - #5 = 2.79

$v = 14{,}200/(30 \times .86 \times 10) = 55\ ^{\#/\square''}$

$u = 200 = 14{,}200/(\Sigma o \times .86 \times 10)$ ∴ $\Sigma o = 8.2''$ to provide



At ends, $A_s = \dfrac{33.5}{1.44 \times 10} = 2.34$ 6 = #6 = 2.64

Effect on Wall of Floor Beam

$p(wall) = \dfrac{2.64}{60 \times 14.5} = 0.00304$ $k = 0.22$, $j = 0.93$

$33{,}500 \times 12 = \tfrac{1}{2} f_c (0.22)(0.93) \times 60 \times 14.5^2$

$f_c = 310\ \%$

From bending as ring, $p = \dfrac{1.0}{18 \times 12} = 0.0046$ $k = 0.25$, $j = 0.92$

$20{,}000 \times 12 = \tfrac{1}{2} f_c (0.25 \times 0.92) 12 \times 14.5^2$

$f_c = 830\%$ $v = 260$, but there is two way steel

P.S. — the two fc's act on diff. sides

PUMP ROOM FLOOR

D.L. Allow 150 #/□'
L.L. $\frac{3000}{4\times3}$ 250
400
Regular L.L. 100
500 #/□'

SLAB

Load Beam "C"
D.L. = 150
Reg. LL. = 250
Pump, L.O. = 500
12 lin ft. 900

$M = 0.9 \times \frac{6.25^2}{12} = 2.94 \quad + \quad 2\times0.9\times\frac{6.25}{4} = 2.82$

$M = 5.76$, $d = 6.0$, this section of floor to be 12"

$A_s = \frac{5.76}{1.44\times10} = 0.4^{\square''}$ Two #5 pos & neg. in this beam = 0.6□"

Slab "E" between bm. "A" and East wall

D.L. = 100

Equip LL. = 250 = 3000/(4×3)

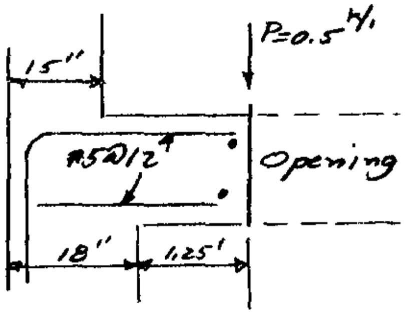
Reg L.L. = 100

450 #/□' × $\frac{6.25^2}{12}$ = M = 1.46'k

$d = \sqrt{\frac{1460\times12}{160\times12}} = 3''$ Use 6" slab d = 5"

$A_s = \frac{1.46}{1.44\times5} = 0.2^{\square''}$ Use #5 @ 12 min.

Cantilevers "J"



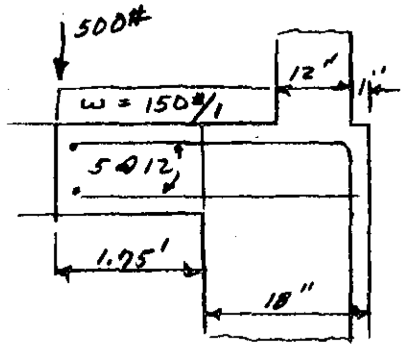
$P = \frac{6000}{12} = 500$ #/

Wt. $= 0.15\times1.25^2/2 = 0.12$
$0.5\times1.25 = 0.63$
0.75

$A_s = \frac{0.75}{1.44\times10} = 0.052$
= Negligible

Use #5 @ 12

PUMP ROOM FLOOR



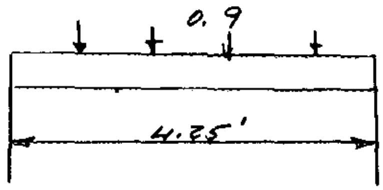
Cantilever "K"

$M = 0.15 \times 1.75^2/2 = 0.23$
$ 0.5 \times 1.75 = \underline{0.88}$
1.11

$A_s = \frac{1.11}{1.44 \times 10} = 0.08$

Use #5 @ 12

Beam D. Local Bm.



Using w = 0.9 = heavy

$M = 0.9 \times 4.25^2/12 = 1.36$

6" slab o.k.

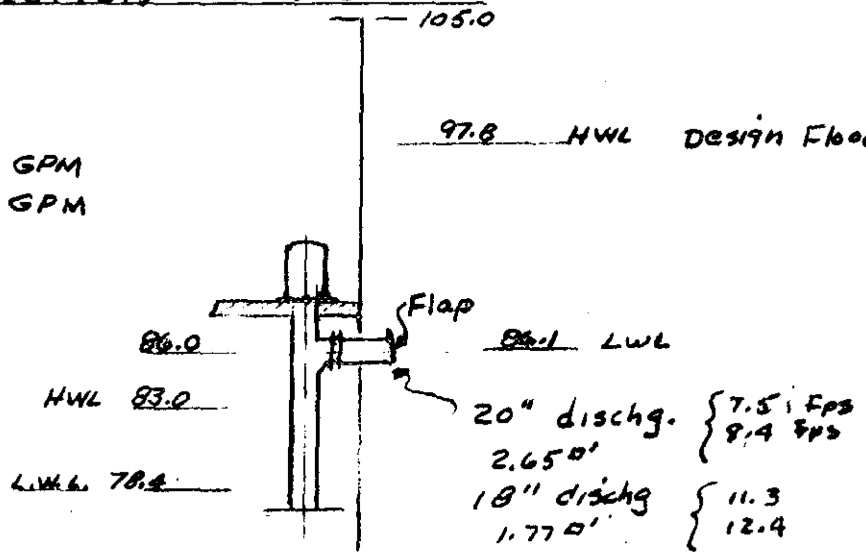
$A_s = \frac{1.36}{1.44 \times 5} = 0.19$

Use #5 @ 12

No special beam needed

MAIN ST.

Q = HWL 9000 GPM
LWL 9900 GPM



		Low	High
dynamic losses - 18" column -	velocity head -	2.4	2
	flap - ½ h_v	.024	.02
		2.43	2.02

Total Head	Low stage	High stage
static	7.7	19.4
dynamic (18")	2.4	2.0
	10.1'	21.4'

Use 18" column.

Flap losses from hydraulic design chart 340-1.

K = 0.01, from curve

$H_L = K \frac{V^2}{2g} = .01 \times 2.4 = 0.024'$ for low head.

$= .01 \times 2.0 = 0.02'$ for high head.

Static head at top of local protection - 29.0' ±

REV. 3-21

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. 2 OF 33
DATE 2-25-63
COMPUTED BY ROP
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump selection - Main St.

Condition #1 head = 10.1 ft Q_1 = 9900 GPM = 22.1 cfs

Condition #2 head = 21.4 ft Q_2 = 9000 GPM = 20.1 cfs

#1 Discharge dia : $\sqrt{\frac{4 \times 22.1 \times 144}{12 \times \pi}} = 18.4''$
use chart 21B

#3 $D_P = D_m \left(\frac{Q_P}{Q_m}\right)^{\frac{1}{2}} = 16 \left(\frac{9900}{10,140}\right)^{\frac{1}{2}} = 15.95''$ use 16" Mixed

#4 & #5 $Q_m = \frac{Q_P}{\left(\frac{D_P}{D_m}\right)^2} = \frac{9900}{\left(\frac{16.00}{16.00}\right)^2} = 9900$ GPM

$H = 8$ ft $Q_x = Q_c\left(\frac{H_x}{H_c}\right)^{\frac{1}{2}} = 9900 \left(\frac{8}{10.1}\right)^{\frac{1}{2}} = 8800$ GPM

$H = 12$ ft $Q_x = 9900 \left(\frac{12}{10.1}\right)^{\frac{1}{2}} = 10800$ GPM

$N_c = N_x \left(\frac{Q_c}{Q_x}\right) = 1298 \left(\frac{9900}{10,125}\right) = 1269$

$Q_c = Q_x\left(\frac{N_c}{N_x}\right) = Q_x \times \left(\frac{1269}{1298}\right) = Q_x \times .980$

$H_c = H_x\left(\frac{N_c}{N_x}\right)^2 = H_x \times \left(\frac{1269}{1298}\right)^2 = H_x \times .960$

$P_c = P_x\left(\frac{N_c}{N_x}\right)^3 = P_x \times \left(\frac{1269}{1298}\right)^3 = P_x \times .941$

EFF. = $\frac{QH}{3960 P}$

H_x	Q_x	P_x	H_P / H_c	Q_P / Q_c	P_P / P_c	EFF.
10.0	10150	62	9.6	9950	58	41.5
12.5	10050	64	12.0	9850	60	
15.0	9900	67	14.4	9700	63	56.0
17.5	9700	69	16.8	9500	65	
20.0	9500	72	19.2	9300	68	66.0
22.5	9250	74	21.6	9050	70	70.5
25.0	8975	75	24.0	8800	71	75.0
35.0	7250	77	33.6	7100	72	Max. Eff. 83.5

#9 For $H = 33.7$ $N_s = 7725$ ∴ Suction Lift = 1.4 Ft. (Plate #16)

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PROJECT NO. 6265-2
SHEET NO. 3 OF 33
DATE 2-25-63
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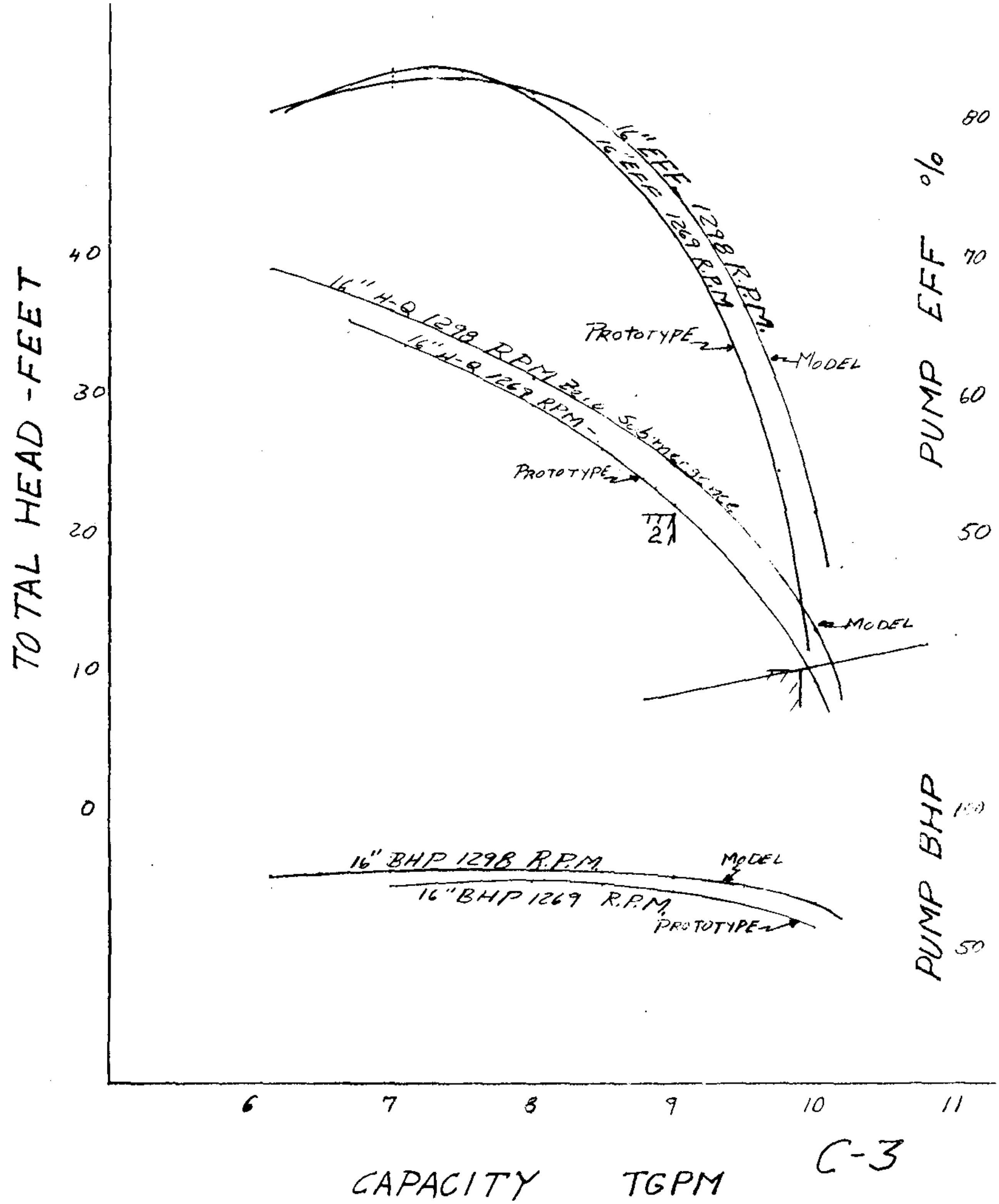
PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.



C-3

REF PLATE # 21B
16" MIXED

Try 18" Pump Mixed Flow $H = 10.1$ $Q = 9900$

#4 (Thru pt. #1)

$$Q_m = \frac{Q_p}{\left(\frac{D_p}{D_m}\right)^2} = \frac{9900}{\left(\frac{18}{16}\right)^2} = 7830$$

$H = 10 ft$ $\quad Q_x = Q_c\left(\frac{H_x}{H_c}\right)^{1/2} = 7830\left(\frac{10}{10.1}\right)^{\frac{1}{2}} = 7800$

$H = 15.0'$ $\quad Q_x = 7830\left(\frac{15.0}{10.1}\right)^{\frac{1}{2}} = 9580$

$H = 20.0$ $\quad Q_x = 7830\left(\frac{20}{10.1}\right)^{\frac{1}{2}} = 11050$

$H = 22.5$ $\quad Q_x = 7830\left(\frac{22.5}{10.1}\right)^{\frac{1}{2}} = 11750$

$$N_c = N_x\left(\frac{Q_c}{Q_x}\right) = 1298\left(\frac{7830}{9850}\right) = 1035$$

$$Q_c = Q_x\left(\frac{N_c}{N_x}\right) = Q_x\left(\frac{1035}{1298}\right) = .796\, Q_x$$

$$H_c = H_x\left(\frac{N_c}{N_x}\right)^2 = H_x\left(\frac{1035}{1298}\right)^2 = .632\, H_x$$

$$P_c = P_x\left(\frac{N_c}{N_x}\right)^3 = P_x\left(\frac{1035}{1298}\right)^2 = .505\, P_x$$

(See "x" values previous p.)

H_c	Q_c	P_c	H_p	Q_p	P_p	
6.3	8100	31.4	6.3	10,250	40	40.8
7.9	8000	32.3	7.9			
9.5	7880	33.8	9.5	10,000	43	55.8
11.0	7710	34.8	11.0			
12.6	7560	36.4	12.6	9,600	46.3	66.0
14.2	7350	37.4	14.2			
15.8	7120	37.8	15.8	9,080	48.0	75.5
22.1	5780	38.9	22.1	7,330	49.5	82.8
23.7	5200	38.5	23.7	6,600	49.0	80.5

#5

$H_p = H_m$

$$N_p = \left(\frac{D_m}{D_p}\right)N_m = \frac{16}{18} \times 1035 = 920$$

$$Q_p = Q_m\left(\frac{18}{16}\right)^2 = 1.268\, Q_m$$

$$P_p = P_m\left(\frac{18}{16}\right)^2 = 1.268\, P_m$$

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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

PROJECT NO. 6265-2
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DATE 2-26-63
COMPUTED BY RD
CHECKED BY HDI

#6 H-Q Curve 3HP Curve thru Condition Point #2

18" Mixed Flow

$H = 21.4 \quad Q = 9000$

$Q_m = Q_P \left(\frac{D_m}{D_P}\right)^2 = 9000\left(\frac{16}{18}\right)^2 = 7120$

$Q_x = 7120\left(\frac{H_x}{H_c}\right)^{\frac{1}{2}}$

$H_x = 27.5 \qquad Q_x = 7120\left(\frac{27.5}{21.4}\right)^{\frac{1}{2}} = 8100$

$H_x = 32.5 \qquad Q_x = 7120\left(\frac{32.5}{21.4}\right)^{\frac{1}{2}} = 8820$

$N_c = 1298\left(\frac{7120}{8370}\right) = 1103 \text{ RPM}$

$Q_c = Q_x \times \left(\frac{1103}{1298}\right) = .85 \; Q_x$

$H_c = H_x \left(\frac{1103}{1298}\right)^2 = .723 \; H_x$

$P_c = P_x \left(\frac{1103}{1298}\right)^3 = .614 \; P_x$

H_c	Q_c	P_c	H_P	Q_P	P_P	Eff.
7.2	9650	38.0	7.2	11,000	48.3	41.4
9.1	8570	39.4	9.1	10,850	50.0	50.
10.8	8400	41.1				
12.7	8250	41.5	12.7	10,450	52.8	64.
14.4	8100	44.2				
16.2	7870	45.5	16.2	10,000	57.8	71
18.0	7610	46.0	18.0	9700	58.5	75
25.3	6180	47.3	25.3	7,850	60.0	83.5
27.1	5580	47.0	27.1	7,100	59.7	81.5

$H_P = H_m$

$N_s = 7725 \quad H = 25.3 \quad 10' \text{ lift}$

$Q_P = 1.268 \; Q_m$

$P_P = 1.268 \; P_m$

$N_P = \frac{16}{18} \times 1103 = 982$

This has unknown capacity with river at top of protection works_ apparently not high except at the top sump level.

C-5

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PROJECT NO. 6205-2
SHEET NO. ____ OF ____
DATE 2/26/62
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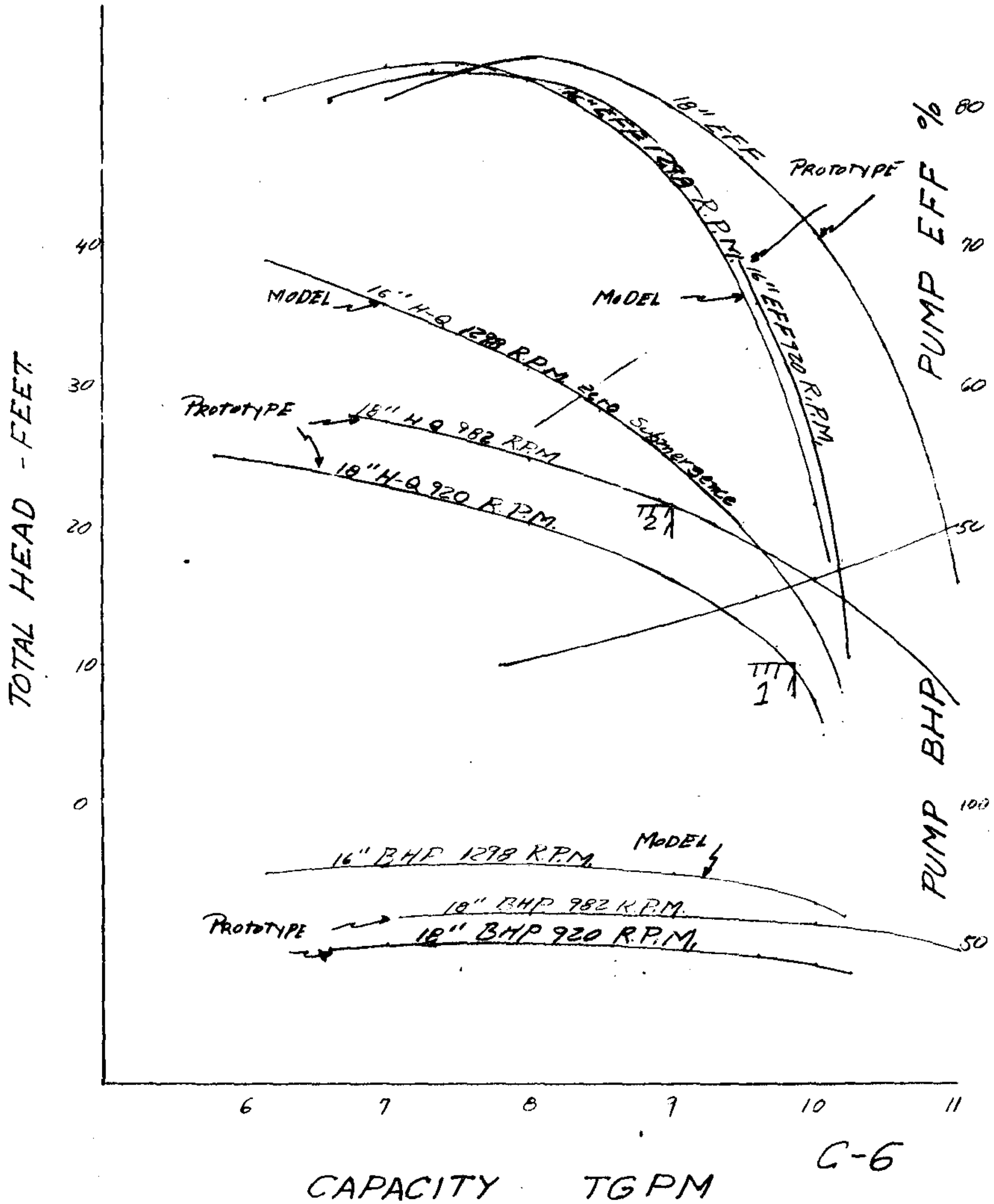
PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.



C-6

REF PLATE #21B
18" MIXED

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PROJECT NO. 6205-2
SHEET NO. 1 OF
DATE 3-21-63
COMPUTED BY HDH
CHECKED BY [initials]

PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION – MAIN ST.

From sh. 3A, 18" pump would be controlled at the high head point. This could ultimately shift control partially to a case with water at the top of the wall, H = 31–32' total. It is desirable that significant capacity be available at this head.

To meet this requirement using Plate No 21B would be difficult, and would involve overcapacity at point 1 and probably at point 2, since it would be necessary to design for a point at 31.5' head as a point 3.

Say pt. 3 = 31.5', 5500 gpm

$$Q_m = \frac{5500}{\left(\frac{18}{16}\right)^2} = 4350$$

H = 20' $Q_x = 4350 \frac{20}{31.5} = 2760$
40' $Q_x = 4350 \frac{40}{31.5} = 5520$
50' $Q_x = 4350 \frac{50}{31.5} = 6900$
} this is beyond the curves Pl. 21B.

Try 31.5', 6000

$$Q_m = \frac{6000}{\left(18/16\right)^2} = 4740$$

H = 30', $Q_x = 4740 \frac{30}{31.5} = 4500$
H = 40' $Q_x = 4740 \frac{40}{31.5} = 6000$
H = 50' $Q_x = 4740 \frac{50}{31.5} = 7500$
} also beyond Curves, Pl. 21B

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PROJECT NO. 6205-2
SHEET NO. 5 OF
DATE 3-22-63
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump selection, Main St.

20" Mixed-Flow, Curve 21A

Thru pt. #2 - 21.4', 9000 gpm

$$Q_m = \frac{Q_p}{(D_p/D_m)^2} = \frac{9000}{(\frac{20}{16})^2} = 5760$$

$$H = 20, \quad Q_x = Q_m\left(\frac{H_x}{H_c}\right)^{1/2} = 5760\left(\frac{20}{21.4}\right)^{1/2} = 5580$$

$$35, \quad Q_x = \quad 7360$$

$$40, \quad Q_x = \quad 7870$$

$$N_c = N_x\left(\frac{Q_c}{Q_x}\right) = \frac{5760}{7525}(1288) = 985 \text{ RPM}$$

$$\frac{Q_p}{Q_m} = \frac{P_p}{P_m} = \left(\frac{D_p}{D_m}\right)^2 = \left(\frac{20}{16}\right)^2 = 1.56$$

$$Q_p = 1.56\,Q_c = 1.56\left(\frac{985}{1288}\right)Q_x = 1.195\,Q_x$$

$$H_p = H_c = \left(\frac{960}{1288}\right)^2 H_x = .585\,H_x$$

$$P_p = 1.56\,Q_c = 1.56\left(\frac{985}{1288}\right)^3 P_x = .700\,P_x$$

$$N_p = \frac{D_m}{D_p}N_m = \frac{16}{20}(985) = 788$$

H_x	Q_x	P_x	H_p	Q_p	P_p	Eff.
45	5550	80.9	26.3	6640	56.6	78.0
37*	7450	82.5	21.7	8900	57.7	82.1
30	8450	81.0	17.5	10100	56.7	78.7
10	9800	65.0	5.9	11830	45.5	38.8

$N_s = 7400$ $\quad H = 21.7$ $\quad$ 13' lift

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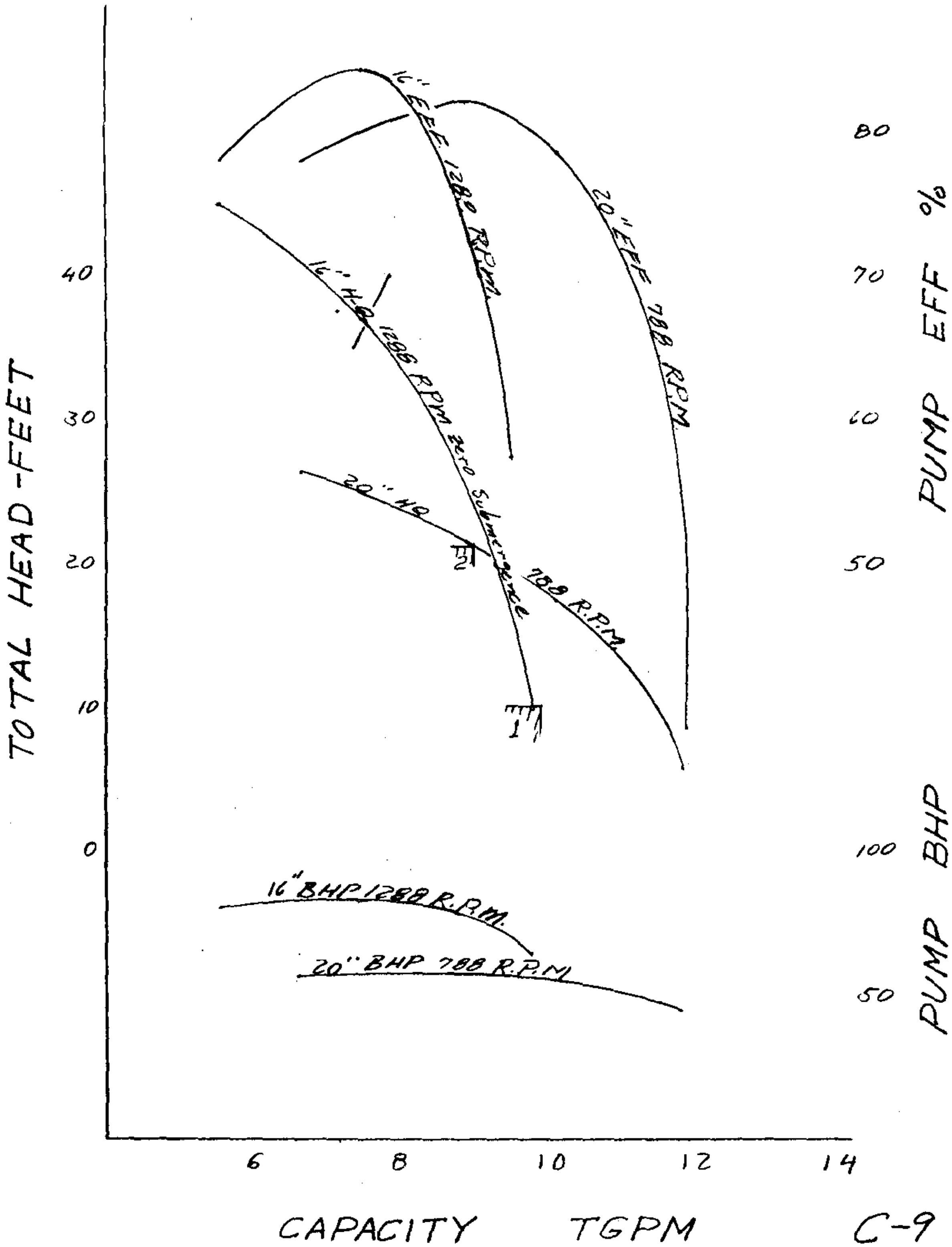
PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION MAIN ST.

PROJECT NO. 620SE2
SHEET NO. ______ OF ______
DATE 3/22/63
COMPUTED BY DDP
CHECKED BY ______



C-9

20" Mixed Flow

REF. PLATE #21A

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PROJECT NO. 6205
SHEET NO. ____ OF ____
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

18" Axial Flow Pump - Plate #19

Condition Pt. #1 $H = 10.1$ $Q = 9900$

$$D_p = 20\left(\frac{9900}{14250}\right)^{\frac{1}{2}} = 16.7 \qquad \text{Try } 18''$$

$$Q_m = 9900\left(\frac{20.0}{18.0}\right)^2 = 12230$$

$H_x = 10.0$ $\quad Q_x = 12230\sqrt{\frac{10.0}{10.1}} = 12800$

$H_x = 15.0$ $\quad Q_x = 12230\sqrt{\frac{15.0}{10.1}} = 14900$

$H_x = 12.5$ $\quad Q_x = 12230\sqrt{\frac{12.5}{10.0}} = 13600$

$$N_c = 1037 \times \frac{12230}{13800} = 920$$

$$Q_p = Q_x \times \left(\frac{920}{1037}\right)\left(\frac{18.0}{20.0}\right)^2 = .719\, Q_x$$

$$H_p = H_x \times \left(\frac{920}{1037}\right)^2 = .788\, H_x$$

$$P_p = P_x \times \left(\frac{920}{1037}\right)^3\left(\frac{18.0}{20.0}\right)^2 = .567\, P_x$$

$$\text{Eff} = \frac{Q \times H}{3960 \times P}$$

H_x	Q_x	P_x
32.5	9500	97.0
25.25	11650	86.0
15.25	13500	68.0
4.00	14900	46.0

H_p	Q_p	P_p	Eff.	
25.6	6830	55.0	80.3	
19.9	8380	48.8	86.4	Max
12.0	9720	38.6	76.3	
3.2	10710	26.1	33.2	

$$N_p = \frac{20}{18} \times 920 = 1021$$

$N_s = 9930$ $\quad H = 19.9$ $\quad$ 7' lift

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PROJECT NO. 6205
SHEET NO. ____ OF ____
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

18" Axial Flow Pump - Plate #19

Condition Pt. #2 $H = 21.4$ $Q = 9000$ 18" Pump

$$Q_m = 9000\left(\frac{20.0}{18.0}\right)^2 = 11120$$

$H_x = 25.0$ $Q_x = 11120\sqrt{\frac{25.0}{21.4}} = 12000$

$H_x = 22.5$ $Q_x = 11120\sqrt{\frac{22.5}{21.4}} = 11400$

$$N_c = 1037 \times \frac{11120}{11800} = 975$$

$$Q_p = Q_x\left(\frac{975}{1037}\right) \times .81 = .763\ Q_x$$

$$H_p = H_x\left(\frac{975}{1037}\right)^2 = .887\ H_x$$

$$P_p = P_x\left(\frac{975}{1037}\right)^3 \times .81 = .676\ P_x$$

H_p	Q_p	P_p	Eff.	
28.8	7250	65.5	80.4	
22.4	8900	58.2	86.5	max
13.5	10300	45.9	76.4	
3.6	11400	31.1	33.3	

$$N_p = \frac{20}{18} \times 975 = 1085$$

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SHEET NO. ____ OF ____
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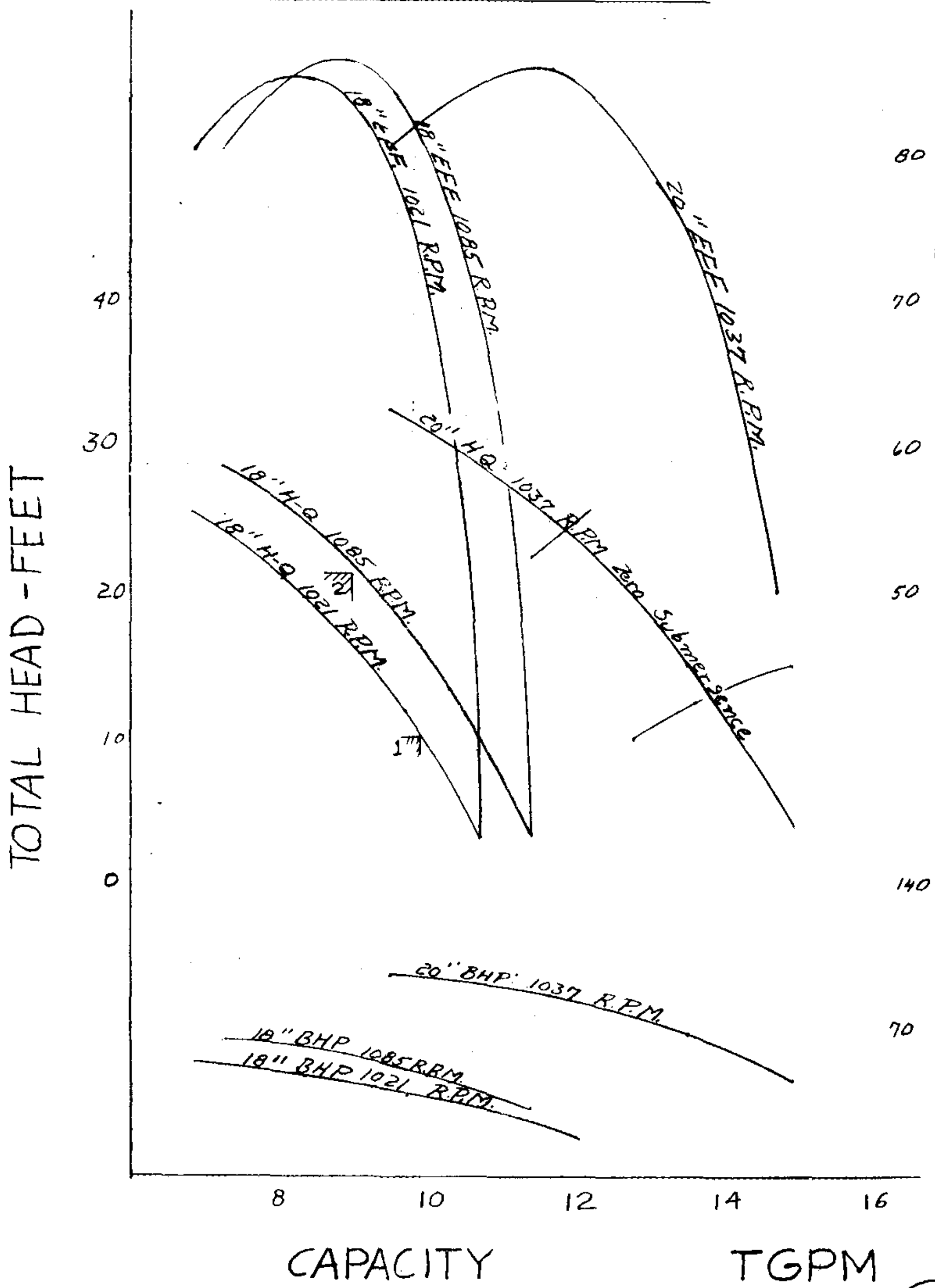
PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT

PUMP SELECTION - MAIN St.



18" Axial Flow

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REF. PLATE #19

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SHEET NO. ____ OF ____
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PROJECT Chicopee Falls

SUBJECT Local Protection Project.
Pump Selection - Main St.

20" Axial Flow Pump Plate #19

Condition Pt. #2 $H = 21.4'$ $Q = 9000$ 20" Pump

$Q_m = 9000\left(\frac{20.0}{20.0}\right)^2 = 9000$

$H_x = 27.5$ $Q_x = 9000\left(\frac{27.5}{21.4}\right)^{1/2} = 10200$

$H_x = 30.0$ $Q_x = 9000\left(\frac{30.0}{21.4}\right)^{1/2} = 10650$

$N_c = 1037 \frac{9000}{10550} = 885$

$Q_p = Q_x\left(\frac{885}{1037}\right)\left(\frac{20.0}{20.0}\right)^2 = .853\ Q_x$

$H_p = H_x\left(\frac{885}{1037}\right)^2 = .727\ H_x$

$P_p = P_x\left(\frac{885}{1037}\right)^3\left(\frac{20.0}{20.0}\right)^2 = .621\ P_x$

H_x	Q_x	P_x
32.5	9500	97.0
25.25	11650	86.0
15.25	13500	68.0
4.0	14900	46.0

H_p	Q_p	P_p	Eff.	
23.6	8100	60.2	80.2	
18.4	9950	54.5	84.8	Max
11.1	11530	42.2	76.5	
2.9	12710	28.6	32.6	

$N_p = 885$

$N_s = 9930$ $H = 18.4$ 8' lift

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PROJECT NO. 6205-2
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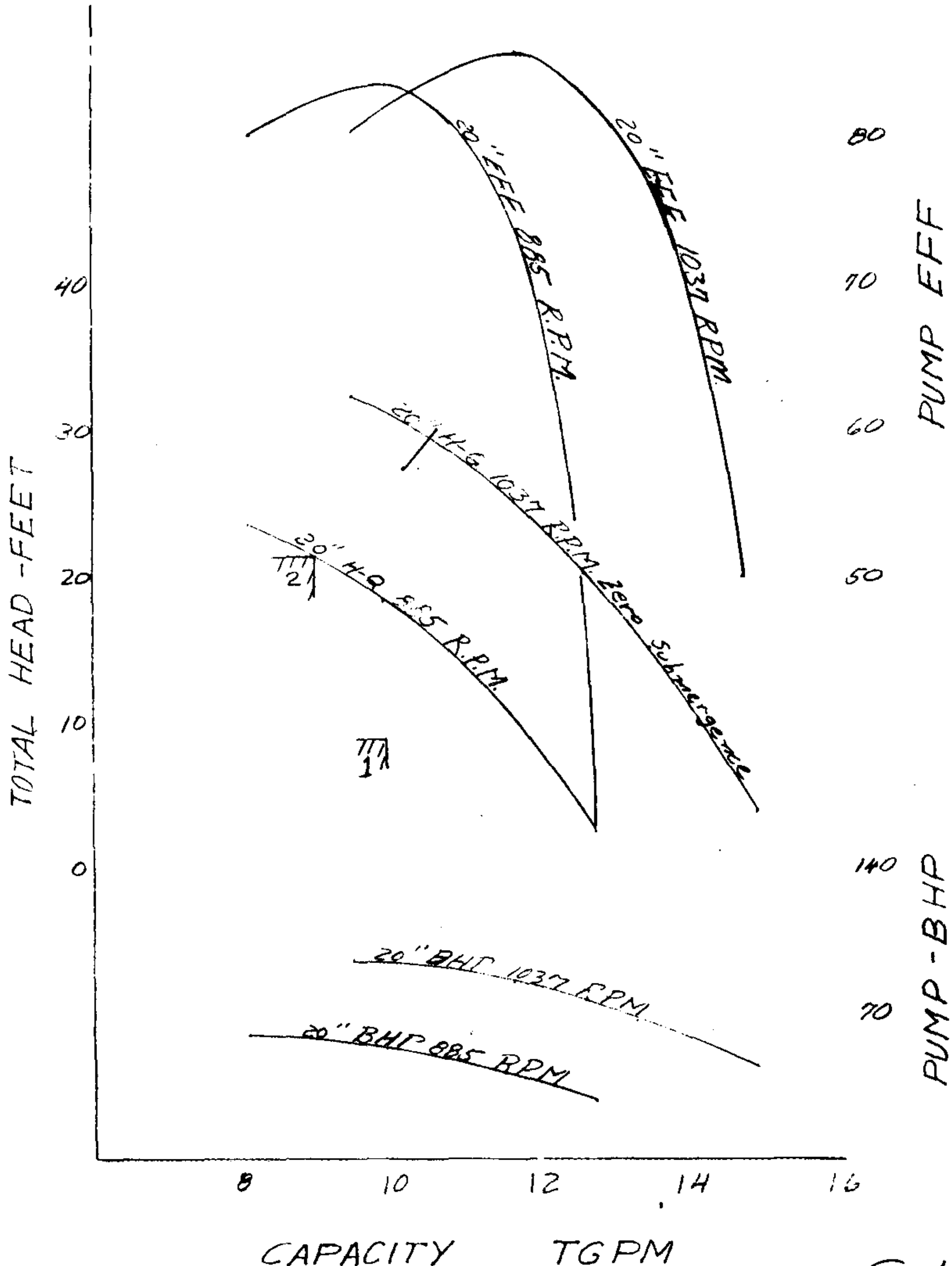
PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.



20" Axial Flow

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REF. PLATE #19

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PROJECT NO. 6205-2
SHEET NO. ______ OF ______
DATE 3-26-63
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

22" Axial Flow Pump - Plate #19

Condition Pt. #2 $H = 21.4$ $Q = 9000$ 22" Pump

$$Q_m = 9000\left(\frac{20.0}{22.0}\right)^2 = 7440$$

$$H_x = 32.5 \qquad Q_x = 7440\left(\frac{32.5}{21.4}\right)^{\frac{1}{2}} = 9170$$

$$H_x = 30.0 \qquad Q_x = 7440\left(\frac{30.0}{21.4}\right)^{\frac{1}{2}} = 8820$$

Note: The line of constant specific speed lies beyond the limits of the H-Q Curve.
A pump can not be selected on this basis without extrapolating from the H-Q curves.
No further selection will be attempted.

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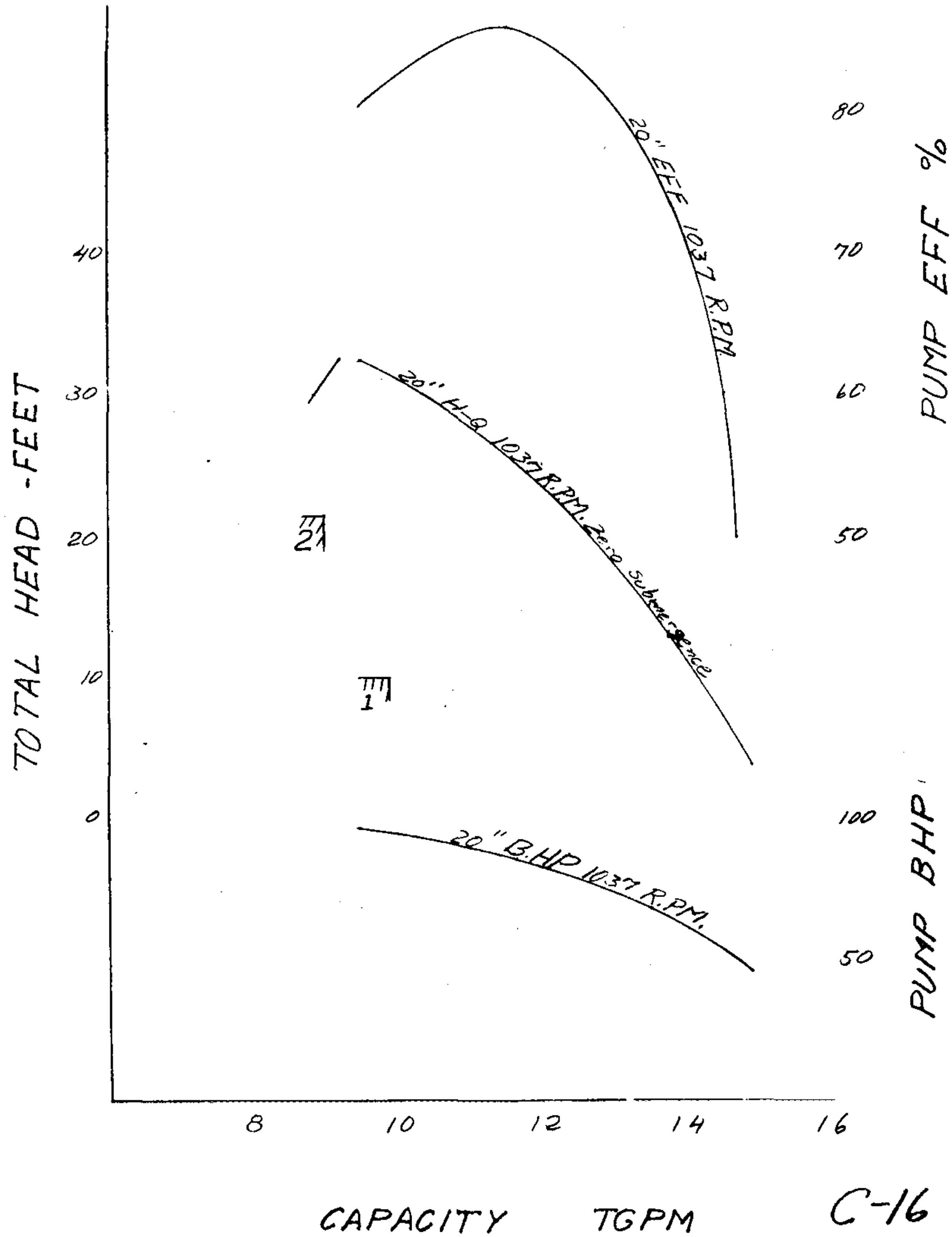
BOSTON, MASS.

PROJECT NO. 6205-2
SHEET NO. ______ OF ______
DATE 3/26/63
COMPUTED BY RCP
CHECKED BY ______

PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION

PUMP SELECTION - MAIN ST.



C-16

REF. PLATE #19

GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT Chicopee Falls
SUBJECT Local Protection Project
Pum. Selection - Main St.

PROJECT NO. 6205
SHEET NO. ____ OF ____
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Pump Type	Pump Size (Inches)	Pump Speed RPM	Condition Pt. #1				Condition Pt. #2				Top of Local Protection				Submergence
			GPM	Head	BHP	Eff.	GPM	Head	BHP	Eff.	GPM	Head	BHP	Eff.	
Mixed 1,2 (21B)	16"	1263	9900	10.1	60	56.5	9000	21.4	65	75	7900	30.0	66.5	82.5	1.4' lift
		Comparitive Cost = $1200													
Mixed 3,4,5 (21B)	18"	982	10750	10.1	51.5	56	9000	21.4	60	80	Does	not	Reach		10.0' lift
Mixed 7,8 (21A)	20"	788	11400	10.1	50	53.5	9000	21.4	58	82	Does	not	Reach		13.0' lift
Axial 9,10 11 (19)	18"	1085	10350	10.1	50	82.5	9000	21.4	57	86	Does	not	Reach		7.0' lift
Axial 12,13 (17)	20"	885	11700	10.1	40	74.5	9000	21.4	58	83	Does	not	Reach		8.0' lift
Axial (19) 27,30	22"	See note sheet #C-15													

C-17

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PROJECT NO. 6205-2
SHEET NO. 6 OF
DATE 2-19-63
COMPUTED BY HH
CHECKED BY RDP

PROJECT CHICOPEE FALLS

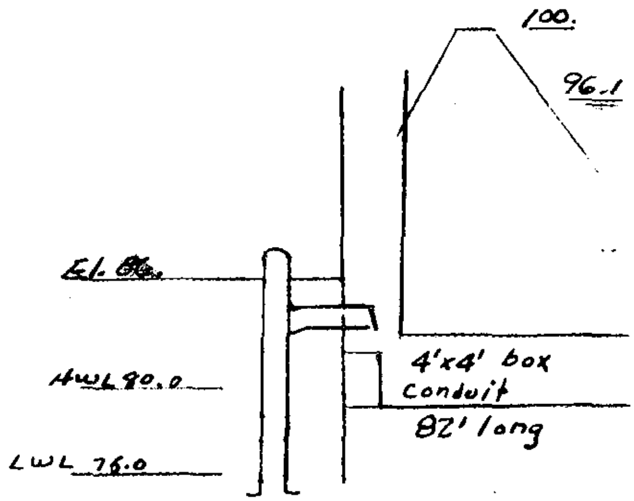
SUBJECT Local Protection Project
Pump Selection – OAK ST.

OAK ST.

Q – H.W.L. 7000 gpm
L.W.L. 8600 "

Static Heads
HWL – 21.1
LWL – 7.0

Project Design Elev.
HWL = 96'
LWL = 82'



16" col., V = 13.5 fps, L.WL
11.1 fps, H.WL
Conduit velocity, 3 pumps –
2.9 fps HWL
3.55 fps LWL
(size set for by-pass gravity flow)

TDH ≐ Static + $H_{v\,Col.}$ + .01 $H_{v\,col}$ (Flap) + $H_{v\,Conduit}$ + ½ $H_{v\,conduit}$ (dischg. chamber & entrance)

+ $H_{f\,conduit}$

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PROJECT Chkopee Falls

PROJECT NO. 6205-2
SHEET NO. 7 OF
DATE 2-26-63
COMPUTED BY RAP
CHECKED BY HDH

SUBJECT Local Protection Project
Pump Selection - Oak St.

Condition #1

Static head =		7.0'
Col Hv	$= \frac{\overline{13.5}^2}{2g} =$	2.83
Flap Hv	$= .01 \times \frac{\overline{13.5}^2}{2g} =$	0.03
Conduit Hv	$= \frac{\overline{3.55}^2}{2g} =$	0.20
Ent. Disch. Chamber	$= \frac{1}{2} \frac{\overline{3.55}^2}{2g} =$	0.10
Conduit Hf	$= 2.87 \times (0.013)^2 \times \frac{82 \times \overline{3.55}^2}{\overline{4.52}^{4/3}} =$	0.67
		10.83

TDH = 10.8'

Condition #2

Static Head =		21.10'
Col Hv =	$\frac{\overline{11.1}^2}{2g} =$	1.93
Flap Hv =	$.01 \frac{\overline{11.1}^2}{2g} =$	0.02
Conduit Hv =	$\frac{\overline{2.9}^2}{2g} =$	0.13
Ent. Disch. Chamber =	$\frac{1}{2} \frac{\overline{2.9}^2}{2g} =$	0.07
Conduit Hf	$= 2.87 \times (0.013)^2 \times \frac{82 \times \overline{2.9}^2}{\overline{4.52}^{4/3}} =$	0.28
		23.53

TDH = 23.5'

Note: Revising Flap valve losses & pump col size increased TDH, ea. cond., by only 1/10 of a foot. Changes on subsequent sheets not made because changes are insignificant for preliminary pump selection

Try 16" Pump - Plate 21C Mixed

#1

Discharge Dia. $= \sqrt{\frac{4 \times 17.6 \times 144}{12\pi}} = 16.4"$

#2

Condition #1 $H_1 = 10.8'$ $Q_1 = 8600$ GPM

$H_2 = 23.5'$ $Q_2 = 7000$ GPM

#3

$$D_p = D_m \left(\frac{Q_p}{Q_m}\right)^{\frac{1}{2}} = 16\left(\frac{8600}{9425}\right)^{\frac{1}{2}} = 15.30"$$ Use 16' Pump

#4

$$Q_m = \frac{Q_p}{\left(\frac{D_p}{D_m}\right)^2} = \frac{8600}{\left(\frac{16}{16}\right)^2} = 8600$$

$$Q_x = Q_c\left(\frac{H_x}{H_c}\right)^{\frac{1}{2}}$$

for $H_x = 10.0$ $\quad Q_x = 8600\left(\frac{10.0}{10.7}\right)^{\frac{1}{2}} = 8310$

$H_x = 12.5$ $\quad Q_x = 8600\left(\frac{12.5}{10.7}\right)^{\frac{1}{2}} = 9290$

$H_x = 15.0$ $\quad Q_x = 8600\left(\frac{15.0}{10.7}\right)^{2} = 10200$

$$N_c = N_x\left(\frac{Q_c}{Q_x}\right) = 1378\left(\frac{8600}{9275}\right) = 1278$$

$$Q_c = Q_x\left(\frac{N_c}{N_x}\right) = Q_x\left(\frac{1278}{1378}\right) = .927\, Q_x$$

$$H_c = H_x\left(\frac{N_c}{N_x}\right)^2 = H_x\left(\frac{1278}{1378}\right)^2 = .859\, H_x$$

$$P_c = P_x\left(\frac{N_c}{N_x}\right)^3 = P_x\left(\frac{1278}{1378}\right)^3 = .796\, P_x$$

H_x	Q_x	P_x	H_c	Q_c	P_c	EFF.
44.5	4750	68.5	38.2	4400	54.5	77.8
36.0	6650	68.5	30.9	6160	54.5	Max. 88.3
25.0	8075	63.5	21.5	7480	50.5	80.4
10.0	9475	53.5	8.6	8780	42.6	44.8

$N_p = 1278$

$N_s = 7650$ $\quad H = 30.9$ $\quad$ Submergence = 5.0' lift.

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PROJECT NO. 6205-2
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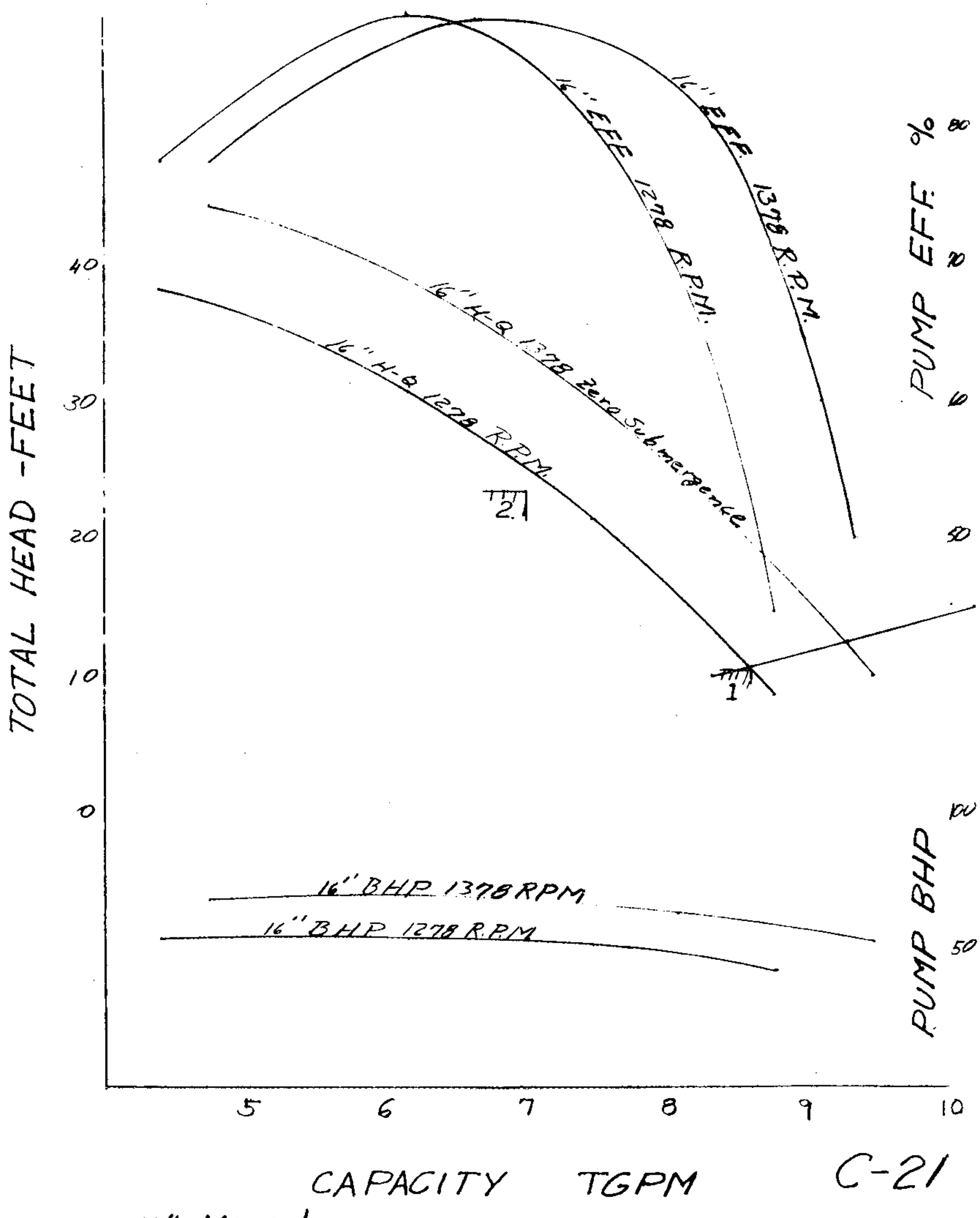
PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.



C-21

16" Mixed

REF. PLATE #21C

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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak St.

PROJECT NO. 6205
SHEET NO. 10 OF
DATE 2-27-63
COMPUTED BY ROP
CHECKED BY IDT

Try 18" pump - Plate 21C Pt. #1 $H = 10.8'$ $Q = 8600$
#4

$$Q_m = Q_p \left(\frac{D_m}{D_p}\right)^2 = 8600\left(\frac{16}{18}\right)^2 = 6790$$

$$Q_x = Q_c\left(\frac{H_x}{H_c}\right)^{\frac{1}{2}}$$

$H_x = 17.5$ $\quad Q_x = 6790\left(\frac{17.5}{10.7}\right)^{\frac{1}{2}} = 8800$

$H_x = 20.0$ $\quad Q_x = 6790\left(\frac{20.0}{10.7}\right)^{\frac{1}{2}} = 9290$

$$N_c = N_x\left(\frac{Q_c}{Q_x}\right) = 1378\left(\frac{6790}{8850}\right) = 1058$$

$$Q_p = Q_x\left(\frac{N_c}{N_x}\right)\left(\frac{D_p}{D_m}\right)^2 = \left(\frac{1058}{1378}\right)\left(\frac{18.0}{16.0}\right)^2 Q_x = .971\, Q_x$$

$$H_p = H_x\left(\frac{N_c}{N_x}\right)^2 = \left(\frac{1058}{1378}\right)^2 H_x = .588\, H_x$$

$$P_p = P_x\left(\frac{N_c}{N_x}\right)^3\left(\frac{D_p}{D_m}\right)^2 = \left(\frac{1068}{1378}\right)^3\left(\frac{18.0}{16.0}\right)^2 P_x = .572\, P_x$$

H_p	Q_p	P_p	Eff.	
26.2	4610	39.2	78.8	
21.2	6470	39.2	88.4	Max.
14.7	7840	36.3	80.2	
5.9	9200	30.3	45.2	

$$N_p = 1058\left(\frac{16.0}{18.0}\right) = 939$$

$N_s = 7650$ $\quad H = 21.2$ $\quad$ Submergence = 13 ft. lift.

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PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Oak St.

PROJECT NO. 6205
SHEET NO. 11 OF
DATE -27-63
COMPUTED BY RQP
CHECKED BY TDT

18" Pump ℄ 21C Pt. #2 H = 23.5 Q = 7000

#6

$$Q_m = 7000\left(\frac{16}{18}\right)^2 = 5530$$

$$Q_x = Q_c\left(\frac{H_x}{H_c}\right)^{\frac{1}{2}}$$

$H_x = 37.5$ $\quad Q_x = 5530\left(\frac{37.5}{23.4}\right)^{\frac{1}{2}} = 7000$

$H_x = 35.0$ $\quad Q_x = 5530\left(\frac{35.0}{23.4}\right)^{\frac{1}{2}} = 6770$

$$N_c = N_x\left(\frac{Q_c}{Q_x}\right) = 1378\left(\frac{5530}{6770}\right) = 1125$$

$$Q_p = Q_x\left(\frac{N_c}{N_x}\right)\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{1125}{1378}\right)\left(\frac{18.0}{16.0}\right)^2 = 1.035\,Q_x$$

$$H_p = H_x\left(\frac{N_c}{N_x}\right)^2 = H_x\left(\frac{1125}{1378}\right)^2 = .668\,H_x$$

$$P_p = P_x\left(\frac{N_c}{N_x}\right)^3\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{1125}{1378}\right)^3\left(\frac{18.0}{16.0}\right)^2 = .691\,P_x$$

H_p	Q_p	P_p	EFF.	
29.7	4920	47.3	78.0	
24.2	6890	47.3	89.0	Max
16.7	8360	43.8	80.5	
6.7	9810	36.9	45.0	

$$EFF = \frac{H_p\,Q_p}{P_p \times 3960}$$

$$N_p = \frac{16}{18}\,1125 = 1000$$

$N_s = 7650$ $\quad H = 24.2$ $\quad$ Submergence = 11' lift

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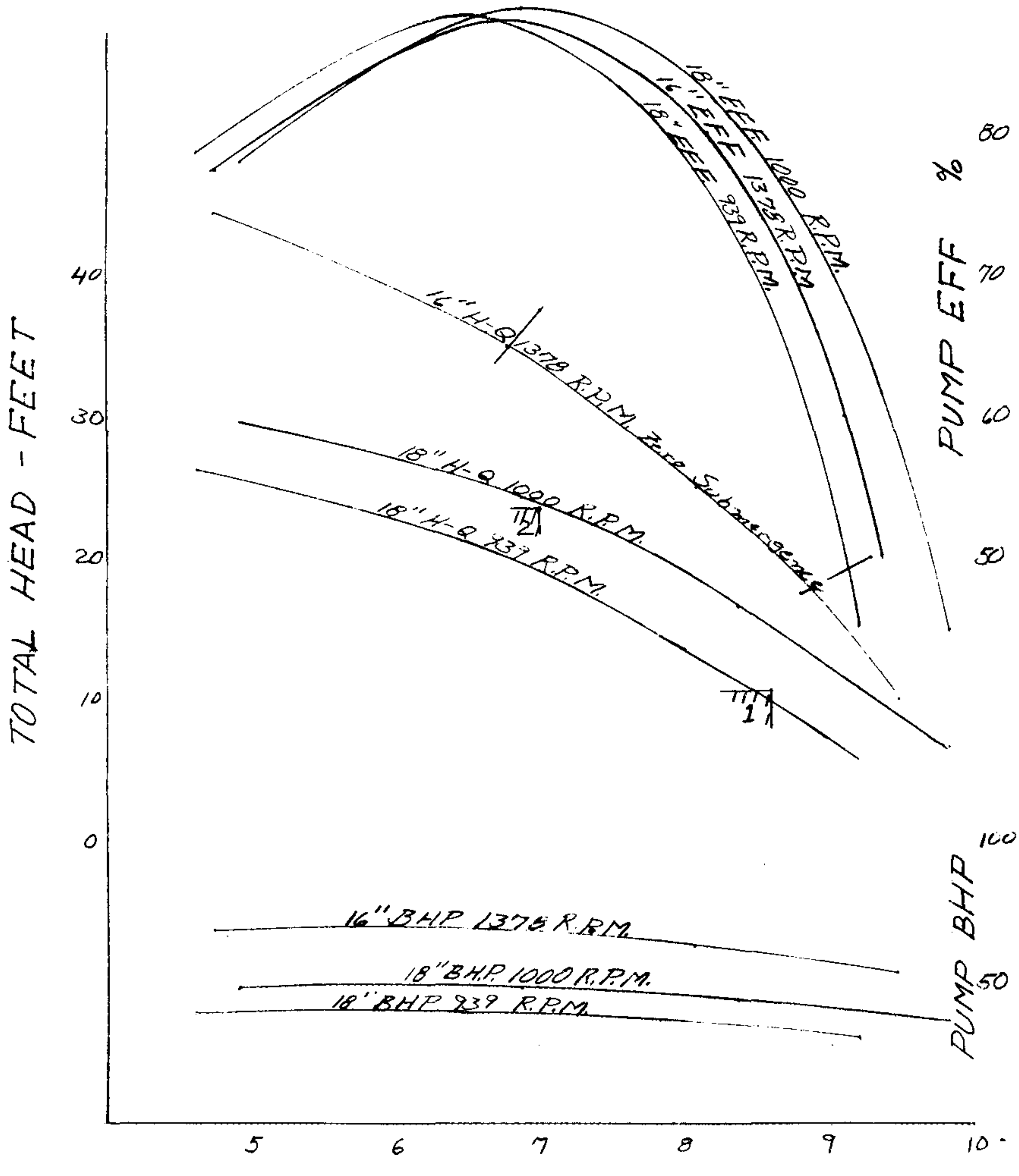
PROJECT NO. 6205-2
SHEET NO. ____ OF ____
DATE 2/27/63
COMPUTED BY RCX
CHECKED BY ____

PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT

PUMP SELECTION - OAK ST



C-24

CAPACITY TGPM

18" Mixed

REF. PLATE #21C

Try 20" Mixed Flow $H = 10.8$ $Q = 8600$ Pt #1

#4

$$Q_m = Q_p\left(\frac{D_m}{D_p}\right)^2 = 8600\left(\frac{16.0}{20.0}\right)^2 = 5500$$

$$Q_x = Q_c\left(\frac{H_x}{H_c}\right)^{\frac{1}{2}}$$

$$H_x = 25.0 \quad Q_x = 5500\sqrt{\frac{25.0}{10.8}} = 8360$$

$$H_x = 22.5 \quad Q_x = 5500\sqrt{\frac{22.5}{10.8}} = 7940$$

$$N_c = N_x\left(\frac{Q_c}{Q_x}\right) = 1378\left(\frac{5500}{8175}\right) = 926$$

$$Q_p = Q_x\left(\frac{N_c}{N_x}\right)\left(\frac{D_p}{D_m}\right)^2 = Q_x\left(\frac{926}{1378}\right)\left(\frac{20.0}{16.0}\right)^2 = 1.052\ Q_x$$

$$H_p = H_x\left(\frac{N_c}{N_x}\right)^2 = H_x\left(\frac{926}{1378}\right)^2 = .453\ H_x$$

$$P_p = P_x\left(\frac{N_c}{N_x}\right)^3\left(\frac{D_p}{D_m}\right)^2 = P_x\left(\frac{926}{1378}\right)^3\left(\frac{20.0}{16.0}\right)^2 = .476\ P_x$$

$$Eff = \frac{Q \times H}{3960 \times P}$$

H_x	Q_x	P_x
44.50	4750	69.0
36.00	6650	69.0
25.75	8000	64.0
10.00	9475	54.0

H_p	Q_p	P_p	Eff.	
20.2	5000	32.8	78	
16.3	7000	32.8	88	[illegible]
11.7	8420	30.4	82	
4.5	9975	25.6	44	

$$N_p = \frac{16}{20} \times 926 = 742$$

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PROJECT NO. 2205
SHEET NO. ____ OF ____
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak St.

20" Mixed Flow $H = 23.5$ $Q = 7000$ Pt #2

#6

$$Q_m = 7000\left(\frac{16.0}{20.0}\right)^2 = 4480$$

$H_x = 42.5$ $Q_x = 4480\sqrt{\frac{42.5}{23.5}} = 6025$

$H_x = 40.0'$ $Q_x = 4480\sqrt{\frac{40.0}{23.5}} = 5850$

$$N_c = 1378\left(\frac{4480}{5850}\right) = 1055$$

$$Q_P = \left(\frac{1055}{1378}\right)\left(\frac{20.0}{16.0}\right)^2 Q_x = 1.197\ Q_x$$

$$H_P = \left(\frac{1055}{1378}\right)^2 H_x = .586\ H_x$$

$$P_P = \left(\frac{1055}{1378}\right)^3\left(\frac{20.0}{16.0}\right)^2 P_x = .702\ P_x$$

H_p	Q_p	P_p	Eff.	
26.1	5680	48.4	77.4	
21.1	7960	48.4	87.6	Max.
15.1	9575	44.9	81.3	
5.9	11350	37.9	44.6	

$$N_P = \frac{16}{20} \times 1055 = 845$$

$N_s = 7650$ $H = 21.1$ 14' lift

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PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

PROJECT NO. 6205-2
SHEET NO. ____ OF ____
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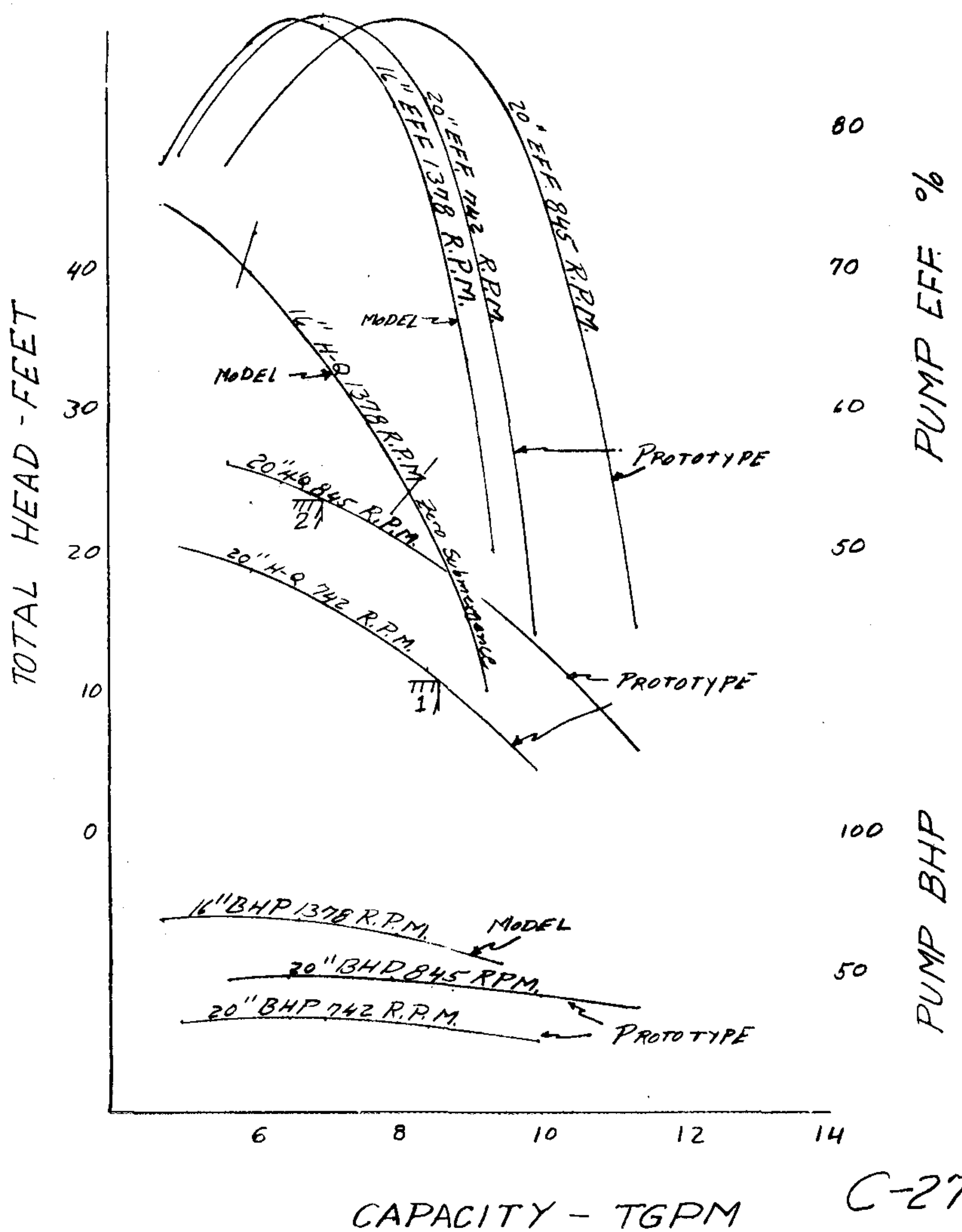

C-27

REF PLATE #21C
20" MIXED

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PROJECT NO. 6205
SHEET NO. ______ OF ______
DATE 3/26/63
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak St.

16" Axial Flow - Pump Selection   Plate 19

#3 Condition Point #1 $H = 10.8$ $Q = 8600$

$$D_p = 20\left(\frac{8600}{14625}\right)^{\frac{1}{2}} = 15.3'' \quad \text{Use } 16''$$

$$Q_m = 8600\left(\frac{20.0}{16.0}\right)^2 = 13450$$

$H = 12.5$ $$Q_x = 13450\left(\frac{12.5}{10.8}\right)^{\frac{1}{2}} = 14470$$

$H = 10.0$ $$Q_x = 13450\left(\frac{10.0}{10.8}\right)^{\frac{1}{2}} = 12950$$

$$N_c = 1037\left(\frac{13450}{14000}\right) = 995$$

$$Q_p = Q_x\left(\frac{995}{1037}\right)\left(\frac{16.0}{20.0}\right)^2 = .615\,Q_x$$

$$H_p = H_x\left(\frac{995}{1037}\right)^2 = .922\,H_x$$

$$P_p = P_x\left(\frac{995}{1037}\right)^3\left(\frac{16.0}{20.0}\right)^2 = .566\,P_x$$

H_x	Q_x	P_x
32.5	9500	98.5
23.75	12000	83.0
11.75	14000	61.0
4.00	14900	43.0

H_p	Q_p	P_p	Eff.
30.0	5850	55.7	79.5
21.9	7380	46.1	88.6 Max.
10.8	8610	34.5	64.5
3.7	9170	24.3	35.3

$$N_p = \frac{20}{16} \times 995 = 1245$$

$N_s = 9930$ $H = 21.9$ 5' lift

C-28

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PROJECT CHKOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

PROJECT NO. 6205-2
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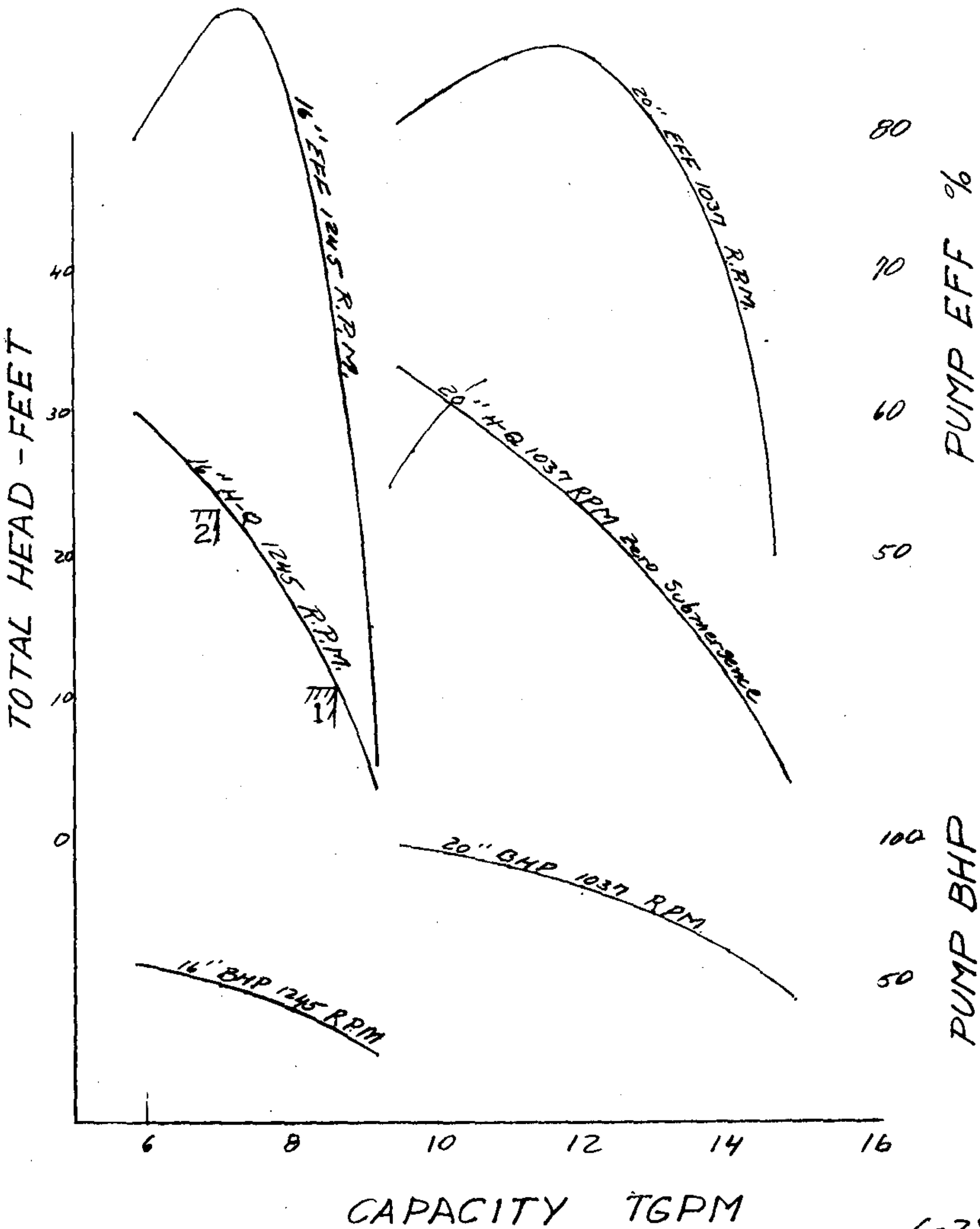

C-29

REF PLATE #19
16" Axial

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PROJECT NO. 6205
SHEET NO. ______ OF ______
DATE 3/26/63
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CHECKED BY ______

PROJECT Chicopee Falls
SUBJECT Local Protection Project
Pump Selection - Oak St.

18" Axial Flow - Pump Selection   Plate 18 & 19

Condition Point # 2   Try 18"

$$Q_m = 7000 \left(\frac{20.0}{18.0}\right)^{\frac{1}{2}} = 7380$$

$H_x = 25.0$ $Q_x = 7380 \left(\frac{25.0}{23.5}\right)^{\frac{1}{2}} = 7620$

$H_x = 35.0$ $Q_x = 7380 \left(\frac{35.0}{23.5}\right)^{\frac{1}{2}} = 9000$

$H_x = 32.5$ $Q_x = 7380 \left(\frac{32.5}{23.5}\right)^{\frac{1}{2}} = 8670$

Note: The line of constant specific speed lies beyond the limits of the H-Q curve. A pump can not be selected on this basis without extrapolating from the H-Q curves.
No further selection will be attempted.

20" Axial Flow - Selection not attempted
No Curves Drawn

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PROJECT NO. 6205
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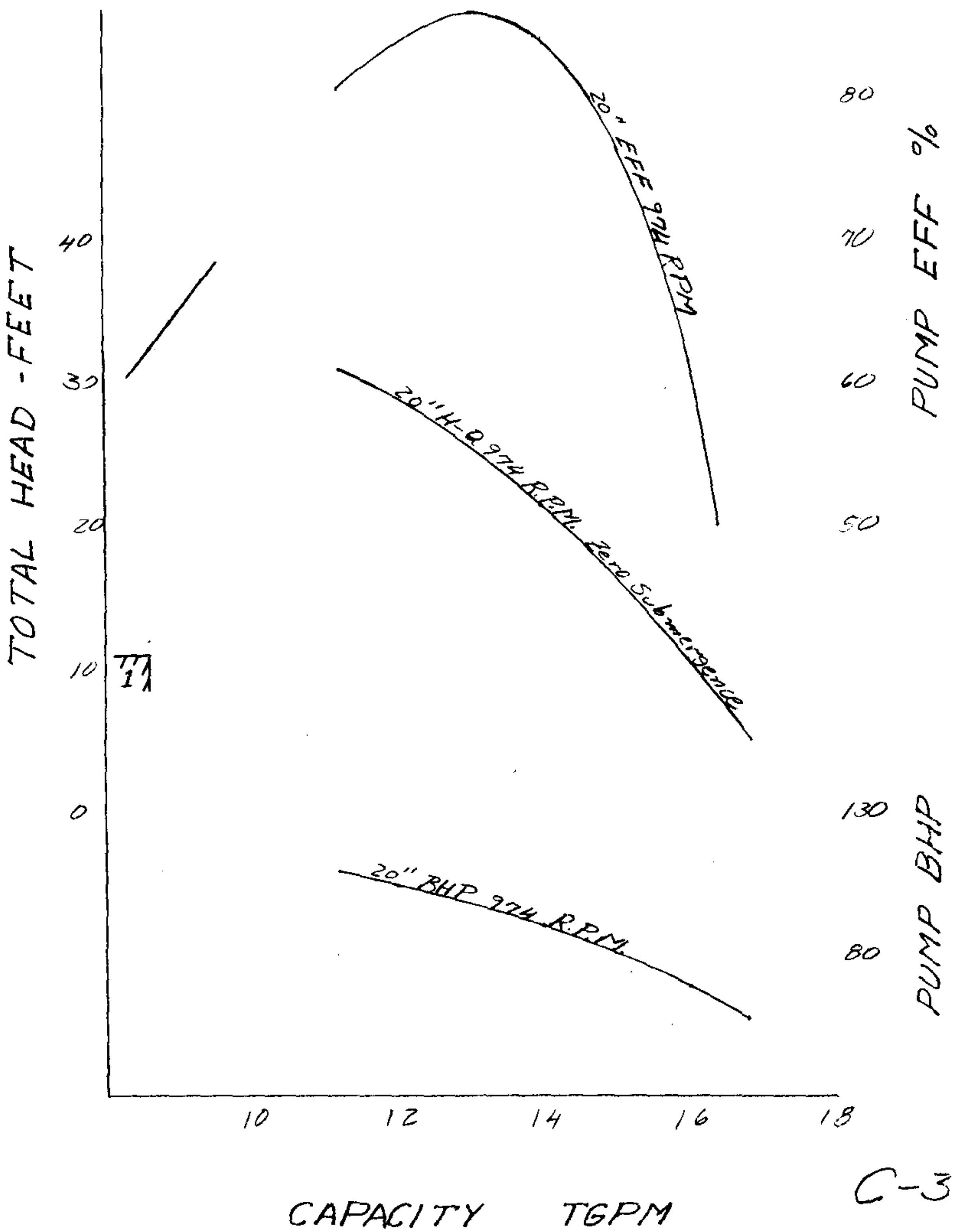
PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.



C-31

18" Axial

REF. PLATE #19

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PROJECT NO. 6205-2
SHEET NO. ____ OF ____
DATE 3/26/63
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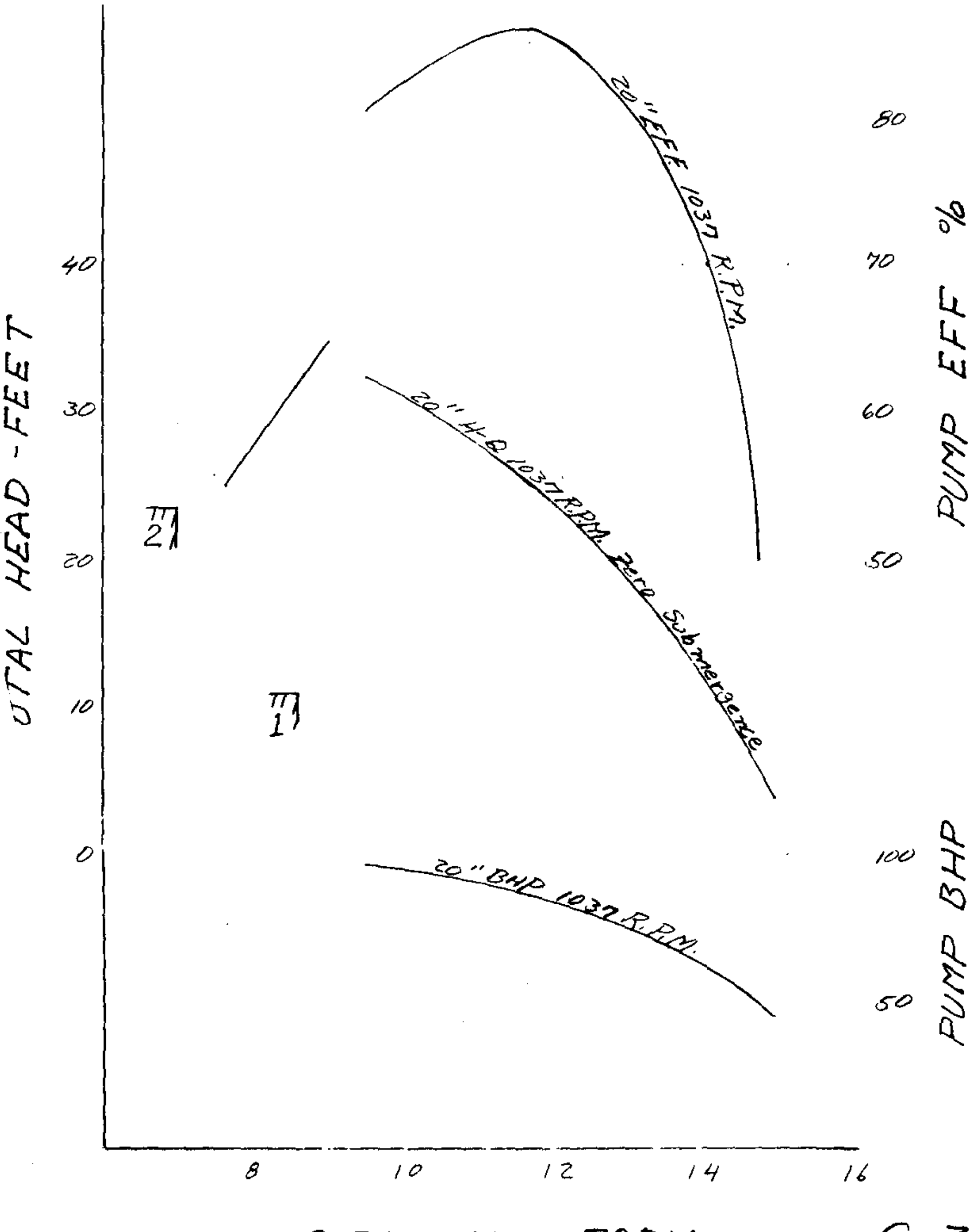
PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT

PUMP SELECTION - OAK ST



C-32

18" Axial

REF PLATE #19

Pump Type	Pump Size Inches	Pump Speed RPM	Condition Pt. #1				Condition Pt. #2				Top of Local Protection				Submergence
			GPM	Head	BHB	EFF.	GPM	Head	BHP	EFF	GPM	Head	BHP	EFF	
Mixed	16"	1278	8600	10.8	46	53	7250	23.5	52	82.5	6800	27.0	53.5	86	5' lift
		Comparitive Cost = $1200													
Mixed	18"	1000	9250	10.8	40	65	7000	23.5	48	88.5	6000	27.0	49	87	11.0' lift
		Comparitive Cost = $1400													
Mixed	20"	845	10400	10.8	42	71	7000	23.5	49	86.5	Does not Reach				14.0' lift
Axial	16"	1245	8600	10.8	34.5	64.5	7100	23.5	44	88.5	6500	27.0	56	86	5.0' lift
		Comparitive Cost = $1100													
Axial	18"	See note sh.# C-29													
Axial	20"	See note sh.# C-29													

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PROJECT Chicopee Falls
SUBJECT Local Protection Project
Pump Selection - Oak St.

PROJECT NO. 6205
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PROJECT NO. 6205-Z
SHEET NO. 30 OF
DATE 4-2-63
COMPUTED BY
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PROJECT CHICOPEE FALLS

SUBJECT Local Protection Project

Pump Selection - Main St.

Effect of Varying speed

N_p = 1269 RPM

H_p (1269)	Q_p (1269)	H (1200)	Q_p (1200)	H (1000)	Q (1000)
9.6	9950	8.6	9350	5.9	7850
14.4	9700	12.8	9100	8.9	7650
19.2	9300	17.1	8750	11.9	7350
24.0	8800	21.4	8300	14.8	6900
33.6	7100	30.0	6700	20.8	5600

$Q_{1200} = \frac{1200}{1269} Q_p = .94\ Q_p$

$H_{1200} = \left(\frac{1200}{1269}\right)^2 H_p = .89\ H_p$

$Q_{1000} = \frac{1000}{1269} Q_p = .79\ Q_p$

$H_{1000} = \left(\frac{1000}{1269}\right)^2 H_p = .62\ H_p$

$Q_{800} = \frac{800}{1269} Q_p = .63$

$H_{800} = \left(\frac{800}{1269}\right)^2 H_p = .4$

H_{800}	Q_{800}
3.8	6300
5.8	6100
7.7	5850
9.6	5500
13.1	4500

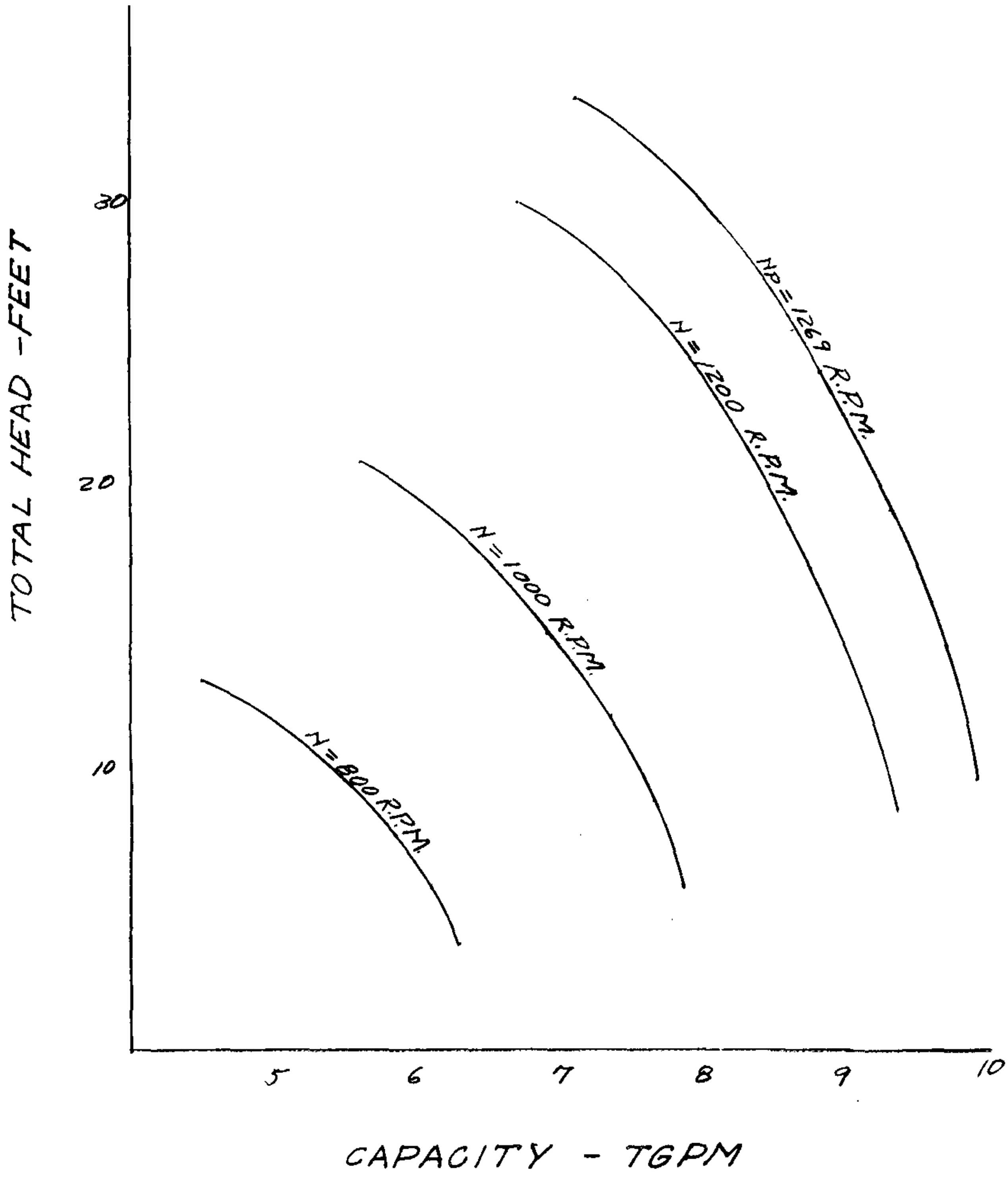
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT NO. 1205-2
SHEET NO. ______ OF ______
DATE 4/2/63
COMPUTED BY ______
CHECKED BY ______

PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION – MAIN ST.

EFFECT OF VARYING SPEED



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PROJECT Chicopee Falls

PROJECT NO. 6205-2
SHEET NO. 32 OF
DATE 4-2-63
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CHECKED BY

SUBJECT Local Protection Protection
Pump Selection - Oak St.

Effect of varying speed

$N_p = 1245$ RPM

H_p	Q_p	H_{1100}	Q_{1100}	H_{800}	Q_{800}
30	5850	23.5	5150	12.3	3750
21.9	7380	17.0	6500	9.0	4700
10.8	8610	8.5	7600	4.4	5500
3.7	9170	2.9	8100	1.5	5850

$$Q_{1100} = Q_p \frac{1100}{1245} = .88\ Q_p$$

$$H_{1100} = H_p \left(\frac{1100}{1246}\right)^2 = .78\ H_p$$

$$Q_{800} = Q_p \frac{800}{1245} = .64\ Q_p$$

$$H_{800} = H_p \left(\frac{800}{1245}\right)^2 = .41\ H_p$$

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PROJECT NO. 6205-2
SHEET NO. ______ OF ______
DATE 4/2/63
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PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

EFFECT OF VARYING SPEED