HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

LOCAL PROTECTION

NAUGATUCK RIVER, CONNECTICUT

DESIGN MEMORANDUM NO.7

DETAILED DESIGN OF STRUCTURES

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

APRIL 1966

6

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

IN REPLY REFER TO:

NEDED-D

29 April 1966

SUBJECT: Ansonia-Derby Local Protection Project, Naugatuck River, Connecticut - Design Memorandum No. 7 - Detailed Design of Structures

TO: Chief of Engineers
ATTN: ENGCW-E

There is submitted herewith, for review and approval, Design Memorandum No. 7 - Detailed Design of Structures, for the Ansonia-Derby Local Protection Project, Housatonic River Basin, in accordance with EM 1110-2-1150.

FOR THE DIVISION ENGINEER:

Incl (10 cys)
Des Memo No. 7

JOHN Wm. LESLIE
Chief, Engineering Division

FLOOD CONTROL PROJECT

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

DESIGN MEMORANDA INDEX

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

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FLOOD CONTROL PROJECT

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

DESIGN MEMORANDUM NO. 7

DETAILED DESIGN OF STRUCTURES

APRIL 1966

A. PERTINENT DATA

1. Purpose — Flood Protection

2. Project Location

State	Connecticut
County	New Haven
Cities	Ansonia and Derby
River	Naugatuck

3. Drainage Areas

Naugatuck River	312. square miles
Beaver Brook	3.6 square miles

4. Project Design Floods

Naugatuck River	75,000 c.f.s.
Beaver Brook	2,500 c.f.s.

5. Flood Protection Structures

a. Flood Walls

Type	Reinforced T-wall
Length	6,420 L.F.
Total Height	Varies, 20' to 38'-6"
Freeboard	3'

b. Railroad Gates

Type	Swing, single leaf, steel
Number	5
Area	1,850 S.F.

5. Flood Protection Structures (Cont'd)

c. Street Gates

Type	Miter, steel
Number	4
Area	1,660 S.F.
Freeboard	3'

d. Beaver Brook Conduit

Type	Reinforced Concrete Box
Length	1,042 L.F.
Area	8' x 14.5'

B. INTRODUCTION

1. Purpose. The purpose of this memorandum is to facilitate the review by higher authority of the structural design of the various features of the Ansonia-Derby Local Protection Project. The basic criteria, typical design computations, data pertinent to the design and cost estimates are presented herein.

2. Scope. This memorandum covers the following structures: flood walls, street gate structures, railroad gate structures, the Beaver Brook Conduit, stilling basin and "U" type channel sections. The design of the Pumping Stations will be covered in Design Memorandum No. 8 - Pumping Stations.

3. Previous Reports. A detailed report on the design of the structural features for this project has not been previously submitted. The latest previous description of the proposed structures is contained in the recommended project plan in Design Memorandum No. 3 - General Design and Site Geology, submitted 14 January 1966 and approved 1 April 1966.

4. Location of Project. The Ansonia-Derby Local Protection Project is located in the Cities of Ansonia and Derby, New Haven County, Connecticut, on the Naugatuck River and Beaver Brook tributary. The flood protection project will extend 2 miles along the Naugatuck River, beginning 1,300 feet below the Division Street bridge in the City of Derby, and terminating near the American Brass Company hydroelectric plant in the City of Ansonia. A line of protection will also be constructed on Beaver Brook from 432 feet above Central Street to its confluence with the Naugatuck River.

5. Description of Project.

a. Naugatuck River. The proposed plan for containing the main river flow requires about 8,700 linear feet of dikes and 6,230 linear feet of flood walls, about 6,100 linear feet of channel improvement, and the construction of four pumping stations. Miscellaneous utility work will be required including the reconstruction of one sanitary sewer siphon under the river. Several alignments were studied and the adopted plan is the most suitable for the location. Detailed features of the project are shown on the plates accompanying this memorandum.

b. Beaver Brook. The proposed plan for containing the tributary flow requires about 1,700 linear feet of dikes and 190 linear feet of flood walls, about 1,300 linear feet of channel improvement, and the construction of approximately 1,042 linear feet

of conduit. Miscellaneous utility work will be required including the reconstruction of one sanitary sewer siphon under the brook. Several dike, channel and conduit alignments were studied and the adopted plan is the most suitable for the location.

6. Coordination of Work with Railroad. The construction of railroad swing gate at five locations across the tracks of the New York, New Haven and Hartford Railroad Company will require cooperative work by the railroad.

Railroad Gate Nos. 1, 2, 4 and 5 will be at a main line, freight and passenger, and Railroad Gate No. 3 will be at a freight yard track.

The railroad has established minimum side clearances required for structures to be erected adjacent to its tracks. The clearances presented in this design memorandum were determined in conjunction with the New York, New Haven and Hartford Railroad Company.

The railroad requires that it design, install and remove temporary falsework to insure continuous operation on the tracks and to permit construction by the Government of permanent substructures for the support of the railroad gates.

Railroad Gate No. 5 will probably be eliminated when the Derby project is started. Should it become necessary to construct Railroad Gate No. 5, a siding parallel to the main track will be relocated to a closer spacing with the main track to reduce the clear opening for this gate.

At locations where flood wall construction will be close to a railroad track, protection of railroad operation will be required by the railroad with its own inspection and flagging personnel.

C. HYDRAULIC ANALYSIS

7. General. The design of the Ansonia-Derby Local Protection Project is based on hydraulic analyses using conventional methods, standard formulae and assumed values for friction and other head

loss factors. The computed data will be verified and supplemented by a hydraulic model study to be conducted at the Waterways Experiment Station.

The Naugatuck River portion of the project is designed for the standard project flood discharge of 75,000 c.f.s. in the Naugatuck River and a concurrent flow of 145,000 c.f.s. in the Housatonic River with an abnormal tide in Long Island Sound. The allowance for abnormal tide is two feet above the backwater produced by a normal high tide.

The Beaver Brook structures are designed for two conditions; namely, a discharge of 2,500 c.f.s. in the brook and normal flow in the Naugatuck River, and a flow of 1,000 c.f.s. in the brook coincident with 75,000 c.f.s. in the Naugatuck River.

8. Hydraulics of River Channels.

a. Naugatuck River. The project design (standard project flood) water surface was computed by conventional methods as outlined in EM 1110-2-1409 "Backwater Curves in River Channels", assuming a roughness coefficient of 0.035 for river channel and 0.050 for overbank flow. Additional head losses were assumed at the bridges where changes in channel section and alignment were considered extreme. Profiles of the project design flood and top of protection are shown on Plate No. 7-29.

Computed average velocities for the design flood are 8-10 fps from the lower end of the protective works to the New York, New Haven and Hartford railroad bridge, except at Division Street bridge where the velocity is about 12 fps. Velocities average 17 fps under the railroad bridge and 10-13 fps in the reach from the railroad bridge to Maple Street. From Maple Street bridge to the American Brass Company bridge, computed velocities are 17 to 18.5 fps. Above the American Brass Company bridge, velocities decrease from 17 fps at the bridge to 9 fps at the upstream end of the protective works near the American Brass Company hydroplant.

Upstream of the American Brass Company bridge, backwater profiles were computed for two conditions of flow: the floodway confined to the main channel section, and the floodway comprised of the main channel and the right overbank area. Although overbank flow will occur with the proposed project, it is assumed that the right overbank area will be excluded from the floodway at some future date. Thus, the height of protection on the left bank, from the American Brass Company bridge to the hydroplant, is designed for both conditions of flow described above.

A relocated channel with a 220 to 225-foot bottom width with 1 on 3 side slopes will be excavated between the mouth of Beaver Brook and the New York, New Haven and Hartford railroad bridge. Upstream of Maple Street, between the American Brass Company and Ansonia Manufacturing Company, a channel with a bottom width of approximately 120 feet with 1 on 2 side slopes will be constructed between adjacent concrete flood walls approximately 175 feet apart.

b. Beaver Brook. An 8 x 14.5-foot concrete box conduit will be constructed on Beaver Brook between the factory building and Central Street. It will flow nearly full with a design discharge of 2,500 c.f.s. at a velocity of 28 fps, assuming a Manning's "n" of 0.015. Open channel flow will occur in this conduit under design conditions. The roof will confine flow around the curves. The conduit will discharge into a stilling basin downstream of Central Street where the velocity will be reduced from 32 to 8 fps. The trapezoidal channel will extend below the stilling basin to the head of the downstream conduit. The channel will generally have a 10-foot bottom width and 1 on 2 and 1 on 2.5 side slopes. The average velocity in the channel section for the design flow of 2,500 c.f.s. will be 12 fps assuming a Manning's "n" of 0.035. The 8 x 14.5-foot conduit at the lower end of Beaver Brook is approximately 610 feet long and is designed for pressure flow.

The design flow of 2,500 c.f.s. in Beaver Brook, concurrent with a low stage in the Naugatuck River, will produce a headwater elevation of 29 feet, mean sea level. The design flood stage of 32 feet, mean sea level, in the Naugatuck River (75,000 cfs) and a concurrent flow of 1,000 c.f.s. in Beaver Brook will result in a headwater elevation of 35 feet, mean sea level. The latter flow condition was therefore used as the design stage for determining height of protection in the lower reach of Beaver Brook.

c. Emergency Closure. Structural provisions that would facilitate emergency closure of the pressure conduit on Beaver Brook were considered as prescribed in EM 1110-2-1410. Studies indicate, however, that providing for emergency closure would be impractical.

Beaver Brook has a drainage area of 3.6 square miles and closure of the pressure conduit would subject the protected area to a threat of flooding from the brook.

The damage potential from flooding as the result of rupture of the pressure conduit is considered to be moderate. The protected area is relatively flat and a considerable volume of storage is contained in the lower 1 to 2 feet of depth.

The Naugatuck River rises and falls very rapidly so that the duration of the stage above the ground level in the vicinity of the conduit is short. During the design flood, the Naugatuck River would be above elevation 20 feet mean sea level only about 15 hours.

The maximum submergence above the lower invert of the conduit would be about 28 feet during the design flood.

Chart D-3 of EM 1110-2-1410 indicates that under the above noted conditions structural provisions without access would be required. However, since the velocity at the exit portal would probably be too high to permit placement of emergency stoplogs or a bulkhead safely, access would also be necessary. Further, as noted in paragraph 4-11c of the Engineer Manual, appropriate pressure relief features to function in the event runoff from the interior drainage area (Beaver Brook) should create high ponding levels, would also be necessary.

The design conditions do not constitute an unusually high-risk situation. The problems of providing a suitable operational emergency gate (8' x 14.5') on the pressure conduit, together with appropriate pressure relief features would result in disproportionately high costs for the amount of usage to be reasonably expected.

The Front Street pumping station is located in the area of the pressure conduit and will have discharge lines over the dikes. In the event that emergency closure of the pressure conduit were desirable as a last resort, the Front Street pumping station could be operated to reduce inundation and prevent catastrophic damage.

d. Freeboard. A minimum of 3 feet of freeboard is provided throughout the project as prescribed in Civil Works Engineer Bulletin 54-14. Moreover, between Maple Street and American Brass Company bridges, where the velocity head exceeds 3 feet, the freeboard is equal to the velocity head. Additional freeboard was also added for superelevation at the bends just upstream and downstream of Maple Street.

The upstream portion of the project will have a somewhat higher degree of protection than the lower reach due to the freeboard allowance included in the selected top grade of the tieback dikes. The minimum freeboard of 3 feet provides about 2 feet of height above the computed energy gradient due to the relatively low velocity of the water adjacent to the dikes. The selected freeboard allowance in the high velocity section is equal to the velocity

head except for the superelevation in the vicinity of Maple Street bridge. Therefore, initial overflow would probably occur downstream from the tie-back dikes in the event of a larger than design flood.

D. FOUNDATION STABILITY AND SEEPAGE CONTROL FOR FLOOD WALLS, CONDUITS, AND RAILROAD AND STREET GATE STRUCTURES

9. Flood Walls.

a. Characteristics of Foundation Materials. The characteristics of the foundation materials in the foundation areas of the flood walls are described in Design Memorandum No. 6, "Embankments, Foundations and Channel Improvements", which was submitted 28 February 1966 and was approved 11 April 1966.

b. Foundation Treatment. The typical sections of the flood walls and adjoining fill and drainage features are shown on Plates 7-3 through 7-7 and 7-14. The base slabs of the flood walls are founded at or below the bottom of unsuitable man-made fills on sands, gravelly sands and sandy gravels, except for the base slab of the flood wall in the reach of the alignment parallel to Maple Street which is founded on about 5 feet of cinders and ashes that overlie moderately compact to compact sands and gravelly sands. The cinders and ashes are considered adequate for the foundation of this flood wall with no detrimental consolidation expected of these materials since they have been in place for several years and the wall has been designed for low bearing pressures. Foundation treatment of all walls will include the removal of unsuitable man-made fill materials below wall base elevations if these materials are encountered during the excavation for the walls. Areas requiring over-excavation will be brought to grade by constructing compacted sand fill.

c. Foundation Seepage Control. Pervious zones of sand fill are provided on the land side of the walls extending down to the elevations of the bases of the walls to insure seepage control except for the right bank wall between Station 57+65 and 13+00 where the depth of wall bury on the land side is greater than the hydrostatic head. Flow net analyses indicate that detrimental uplift of the soil at the toes of the walls will not occur. No flow net analysis was made for the left bank wall between Station 8+00 and 20+50 since: (1) an analysis of the foundation stability for shear is not required; (2) the depth of wall bury on the land side is equal to the hydrostatic head; (3) a pervious land side zone is provided; and (4) the existing material above the base elevation is either nearly as pervious or more pervious than the soil below the base elevation. Subdrains in pervious zones of sand fill on the land side of the walls are provided to carry foundation seepage

water to pumping stations and to prevent (1) water from exiting at the surface, (2) blow up of overlying pavements, and (3) blow up of the surface of the sand fill if it becomes clogged with dirt, ice, or frost. The subdrains are composed of a perforated pipe and filter stone (3/4" to 1/4" size) constructed within pervious sand fill zones. For ease of construction, the sand fill zone is extended to the full width of the excavation. The sand fill material will consist of fine concrete aggregate or bank run gravelly sand material. The bank run material will be well graded so that of the component passing the 3-inch screen, between 5 to 25 percent, by weight, will be retained on the No. 4 Sieve and of the component of the material passing the No. 4 Sieve, between 0 and 10 percent, by weight of particles will pass the No. 200 Sieve.

d. Foundation Stability Analyses. The flood wall sections, flow nets and trial failure arcs for each section analyzed for foundation stability are shown on Plate Nos. 7-22 through 7-28. These sections were selected as the most critical in various reaches from the standpoint of foundation stability and uplift of the soil at the toes of the walls. No foundation stability analyses were made or considered necessary for the right bank wall between Stations 7+65 and 13+00 and the left bank wall between Stations 8+00 and 20+50. In these reaches, the depth of wall bury on the land side of the right bank wall is about 50% greater than the hydrostatic head and the passive resistance on the left bank wall will be due to sandy gravels and gravelly sands and the depth of wall bury on the land side is approximately equal to the hydrostatic head. The flow nets have been drawn on the basis that soils and backfill materials above the impervious boundary are the same. It is assumed that the vertical permeability of the sand fill zone will compensate for any lesser permeability of the material forming the existing surficial deposit. It is also assumed that the existing steel sheet piling and building walls and foundations on the landside of the left bank wall between approximate Stations 23+00 and 34+00, as shown by the section at Station 23+50 on Plate 7-23, will not affect significantly the flow net. The minimum factors of safety against foundation shear failure and for uplift of the soil at the toes of flood walls as shown on the plates are adequate according to the present design criteria.

10. Conduits and Railroad and Street Gate Structures. The characteristics of foundation materials, foundation treatments, foundation stability and seepage control for conduits, street gate structures and railroad gate structures, except the foundation treatment and seepage control for Railroad Gate No. 3, are described in Design Memorandum No. 6, "Embankments, Foundations and Channel Improvements." Foundation treatment for Railroad Gate No. 3 and adjoining walls on the river side of the gate will include

the removal of unsuitable man-made fills within the foundation area of the structure. Compacted sand fill will be constructed to provide a firm foundation below the base of the structure which will be at about elevation 14.0. The limits of foundation treatment are in conformance with the requirements set forth in EM 1110-2-2501, Flood Walls. Seepage through the foundation of the structure will be controlled by a landside drainage zone containing a perforated pipe which will serve to carry seepage water to the pumping station.

E. CONCRETE

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

F. STRUCTURAL DESIGN

12. Purpose and Scope. This section presents the design criteria, basic data, assumptions and procedure used in the structural design of flood walls, street gate structures, railroad gate structures, the Beaver Brook Conduit, stilling basin and "U" type channel sections.

13. Preparation of Computations. Typical computations are included in Appendix A, showing maximum loading conditions and steel design for typical structures. Computations for other structures similar in configuration and loading will be made using the same procedures. Computations for the tee-type walls, and box culvert at Beaver Brook were prepared using a Mathatron Computer where a previously prepared and checked program on paper tape was utilized. These computations are readily recognized as in all instances they will appear as typewritten matter.

14. Design Criteria.

a. General. All working stresses conform to those specified in the Engineering Manual EM 1110-1-2101, dated 1 November 1963. General loading conditions, design assumptions and other design criteria are based on the following applicable parts of the Engineering Manual for Civil Works: Standard Practice for Concrete (EM 1110-2-2000, December 1965), Wall Design (Part CXXV, Chapter 1, Change 2, dated 15 March 1961), Retaining Walls (EM 1110-2-2502, dated May 1961), and Conduits, Culverts and Pipes (Draft EM 1110-2-2902, March 1966).

b. Concrete. Concrete working stresses are in general accordance with ACI Standard Building Code Requirements for reinforced concrete using concrete with a minimum ultimate compressive

strength of 3,000 lbs. per square inch except for the conduits, which will be 4,000 lbs. per square inch. All structures are hydraulic structures, subject to exposure and submergence and therefore a working flexual stress of 1,050 lbs. per square inch is used except for the conduits which is 1,800 lbs. per square inch.

c. Reinforcement.

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

(2) Spacing - The clear 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 1 inch, or 1-1/2 times the maximum size of the coarse aggregate.

(3) Minimum Cover for Reinforcement -

Item	Min. Cover (inches)
Concrete poured against forms	3"
Concrete poured against earth	4"

(4) Splices - All splices shall be in accordance with the ACI Standard Building Code and as set forth in Table 14c of Reinforced Concrete Design Handbook, ACI Publication SP-3. Lap splices will not be used in bars larger than #11 in size and splicing will be accomplished by thermit welding.

d. Structural Steel. Structural steel working stresses are in general accordance with the requirements of EM 1110-1-2101, Working Stresses for Structural Design using column B, which is for hydraulic structures. Steel conforming to the requirements of ASTM A-36 will be used for the framing members of the street and railway gates. Skin plates for the street and railway gates will conform to ASTM A-441.

e. Cast Steel. Hinge shoe castings for street and railway gates will be made of cast steel conforming to QQS-681d, class 70 - 36 having a minimum yield strength of 36,000 p.s.i. and a working strength of 18,000 p.s.i.

f. Bushings and Pins. Hinge bushings will be a bronze self lubricating type, and the pins will be of corrosion resistant steel.

g. Increase in Normal Working Stresses. Allowable working stresses have not been increased for any loading conditions. Wind loads are of such minor consequence that no increased stresses are used.

h. Waterstops. Rubber or polyvinl waterstops will be used in all wall and conduit contraction joints. Details will conform to those indicated in the engineering manual for wall design using the "U" and 2-inch center dumbell for the walls and a 3/4" center dumbell for the conduits.

15. Basic Data and Assumptions.

a. Loads.

(1) Dead Loads -

Concrete	150	p.c.f.
Steel	490	p.c.f.
Soil, dry	120	p.c.f.
Soil, saturated	130	p.c.f.
Soil, submerged	67	p.c.f.

(2) Live Loads -

Water	62.5	p.c.f.
Wind	50	p.s.f.

b. External Water Pressure. Hydrostatic pressure under maximum flood condition is taken as full pressure on riverside and varying from full head at bottom of riverside base to zero at ground surface at the landside by the creep method.

c. Earth Pressure. Earth pressures are determined in general accordance with EM 1110-2-2502, Retaining Walls, dated 20 May 1961.

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

e. Frost Protection. All structures will have a minimum of 4'-0" cover for frost protection.

f. Location of Resultant. In the investigations for stability of the walls, the resultant of the horizontal and vertical forces has been held within the middle half when flood is at the top of the wall and within the middle third when the flood is within three feet of the top of the wall.

g. Sliding. Sliding will be resisted either by friction on the base slab when it is within allowable limits or by passive pressure. Passive pressure resistance is assumed acting in a manner that will give the most critical bearing pressure and requirements for steel reinforcement. For the flood walls, the safety factor against sliding may be found in the soils section of this memorandum.

h. Allowable Soil Bearing. The maximum soil bearing under any structure will not exceed 3,000 p.s.f. which is well within the allowable bearing pressures.

16. Tee-Type Flood Walls.

a. General. Tee-type flood walls will be utilized for approximately 6,420 feet of the protection. In general, a sloping base section has been selected as the most practical to fit the ground configuration and to best resist the horizontal forces. In all instances, the walls will be founded upon soil. In general, a 3'-0" surcharge is included on the landside of the stem to allow for parking and vehicular loading. At Station 37+50, a five-foot surcharge is included to allow for a possible 5'-0" high berm. This berm is being considered as a means to stop a railway car that could jump the track at a derail device and damage the wall.

b. Loading Conditions.

(1) Loading I - Channel full, water surface to top of wall. Path of creep for uplift considerations, considered starting at the bottom of the base slab and ending at the ground surface on the landside. Resultant to fall within the middle half of the base.

(2) Loading II - Same as I except water surface 3 feet below the top of the wall and the resultant to fall within the middle third of the base.

(3) Loading III - Channel empty, 50 lbs. per square foot wind load applied from landside and parking lot surcharge applied where applicable.

c. Typical Design Sections. Design computations are included in the appendix for typical sections of wall. These sections

represent the most critical areas, and other wall sections will follow the same procedure. In no instance is the allowable soil bearing pressure exceeded with resultants falling within allowable limits and an adequate factor of safety against sliding is available. Splices in critical stress steel will be staggered.

17. Street Gates.

a. General. There are four highway gates in the project. However, Gate No. 4 will probably be eliminated when the Derby project starts and is not given consideration in this memo. In general, they are similar with the exception of height, depth of footings and except where located in a dike or a floodwall or a combination of both. The clear opening for all gates will be 32 feet which allows for a 26-foot roadway and a 6-foot sidewalk. A miter-type steel gate was selected as being the most practical and economical. When the gates are in a closed position, they will have a base angle of 30° with the horizontal and when folded back into the abutment, the skin plate side will be the exposed side, thus presenting a pleasing appearance. On all three gates, short tee-type sections will be used to hold the embankment or provide a pocket for the end of the gate. The design of these sections will be similar to the tee-walls presented herein.

b. Elevations and Dimensions. The following are critical elevations and dimensions for each gate:

Item	Gate No. 1	Gate No. 2	Gate No. 3
Elev. of top of sill	35.0	32.5	32.5
Elev. of top of gate	47.0	47.0	42.0
Elev. of bottom of base slab	25.0	17.0	17.0
Height of gate leaf	12.0	14.5	9.5

c. Loading Conditions.

(1) Loading I - Storm condition with water to the top of the gate, uplift varying from full head at bottom of the base on riverside by creep method to zero at ground surface on landside. Resultant to fall within the mid-half.

(2) Loading II - Storm condition with water three feet from top of the gate, uplift as in Loading I and resultant to fall in mid-third.

(3) Loading III - Normal condition with water down, and H 20-16 highway loading in 2 lanes.

(4) Loading IV - Water down, gate closed 50 lbs. per square foot wind load from landside when applicable. Gate in various conditions of closure.

d. Concrete Abutment Design. The abutments sill and base slab for all three street gates are similar, except for depth and applied loads. Stability computations are included herein only for Street Gate No. 3. The other two gate structures will be investigated in a similar manner. The base slab of Street Gate No. 3 has been divided into a series of strips, and the landside edge strip analyzed for Case I loading assuming the strip is a beam on an elastic foundation and the end reactions taken by the abutments. The computations were made using E. P. Popov's method of "Successive Approximations for Beams on Elastic Foundations", (ASCE papers 1950). Reinforcement requirements in the transverse direction are minimum. Computations included in the appendix show the design investigations for this strip under Case I loading. The other strips and similar strips in Gates 1 and 2 will be investigated for Case I and all other Cases of loading. It is expected that prior to this, we will develop a program covering this type analysis and they all can be analyzed by a computer.

e. Steel Gate Design. The skin plate is designed to span continuously over the supporting wide flange members. In order to keep the dead weight at a minimum, A441 steel is used. Design requirements are such that 3/8" plate is used for the bottom two spans and 1/4" for the upper portion. A minimum thickness of 1/4-inch is considered advisable. The top and bottom horizontal members are designed for the skin plate reactions plus the axial loads imposed at the miter end by the opposite leaf. These axial loads are then taken out directly to the concrete abutment through the hinge fittings. The intermediate horizontal members spanning between the vertical posts carry only skin plate reactions. Torsional stress effects in the gate leafs were investigated and found to be of no consequence. Computations included herein are for Gate No. 3. The other two gates will be similar.

18. Railway Gates.

a. General. There are five railroad closure gates in the project. However, Gate No. 5 will probably be eliminated when the Derby project is started and will not be given consideration in this memorandum. The gates will be of the swing gate type, but because of difficulties in placing the gate sill between the tracks and track ties, it is necessary to use a single flat leaf hinged on one end and bearing against the abutment on the other. Gates No. 1, No. 2 and No. 4 will have a 30-foot clear opening

while Gate No. 3 is a 24-foot clear opening. These opening widths were determined in conjunction with the New York, New Haven and Hartford Railroad Company, considering such things as critical sight distances and proximity of switches. The height of the gates vary as shown in the table under the paragraph below. The concrete sill will extend across the opening and project up between the railroad ties to approximately the top of rail. The gates will then be hung with a 2-inch clearance between the top of sill and the gate. This opening along with the necessary openings for the rails will be sandbagged.

b. Critical Elevations and Dimensions. The following are the critical elevations and dimensions for each gate:

Item	Gate No. 1	Gate No. 2	Gate No. 3	Gate No. 4
Elev. of top of rail	39.58	27.25	23.65	28.08
Elev. of top of gate	51.0	40.5	35.8	39.0
Elev. of bottom of base slab	30.0	15.0	14.0	18.0
Height of gate leaf	11'-3"	13'-1"	12'-0"	10'-9"
Clear opening	30'-0"	30'-0"	24'-0"	30'-0"

c. Concrete Abutment Design. The abutments for all four gates will be similar and will follow the design procedures outlined for the street gates. For this reason design computations are not included.

d. Steel Gate Design. The skin plate is designed to span continuously over the supporting wide flange members using A441 steel to reduce the weight. The plate will be 1/4" thick for Railroad Gate No. 4. On Gates Nos. 1, 2 and 3, it may be necessary to use a slightly thicker plate for the lower portion due to the increased height of gate. The horizontal wide flange members span between end posts on each side of the gate. At the hinge end, the end post spans as a beam between top and bottom hinges where the reaction will be taken into the abutment. At the opposite end, the vertical post will transmit the load directly to the abutment by means of a bearing bar. Computations included herein are for Gate No. 4. The remaining gates will follow a similar procedure.

19. Beaver Brook Conduit.

a. Description. The Beaver Brook portion of the project will consist of two sections of 8' x 14'-6" conduit including an intake and outlet section for each portion. In addition, there will be a section of "U" type channel, a stilling basin and a tee-type retaining wall to hold back the dike fill.

b. Conduit Sections. The conduit sections will be 8' x 14'-6" inside dimension with 1'-0" x 2'-0" haunches in each corner. The wall, roof and base thickness will be 1'-6" except under deep fill where they will be 2'-0". Where the conduit passes beneath roadways or the railroad, it will be investigated for the superimposed fill, plus highway and railroad loading distributed in accordance with the latest AASHO and AREA specifications. The conduit is designed to have a minimum superimposed fill of five feet and the lower end of the conduit is designed as a pressure conduit. Investigation of the conduit will consist of the following two cases.

(1) Case I - Conduit empty, maximum superimposed earth loads with earth saturated.

(2) Case II - Conduit full with internal pressure to Elevation 35.0 and superimposed earth loading a minimum of 2 feet.

c. Intake, Outlet Structures and Channel Sections. The intake, outlet structures and channel sections will be "U" type sections designed with side walls cantilevering from the base slab. The critical loading of these sections will be with fill in back of the section saturated and no water in the channel. Retaining walls will be tee-type and will be designed to take a saturated fill behind the wall with channel empty.

d. Stilling Basin. The stilling basin is a "U" type section with maximum inside width of 25 feet and walls projecting 17 feet above the base slab. The wingwalls will be tee-type walls designed to take a saturated fill behind the wall with the channel empty.

e. Dike Retaining Wall. The dike retaining wall will be a tee-type section with flat base designed similar to the other tee-sections.

f. Stream Deflector. The stream deflector at the railroad bridge has not been included herein. The hydraulic model study will indicate whether there is a need for the deflector and if such is the case, it will be designed as an I-wall with a 6-foot differential head.

g. Gravity Training Wall at Hydro Station. At the hydro station, near the upstream end of the project, there will be a gravity type training wall to prevent storm water from flowing down an old raceway. This training wall will extend from the hydro station weir to the embankment across the raceway. The wall is founded on rock and is designed for storm water to the top of the wall with minimum water in the raceway. It is also designed to withstand water in the tailrace at normal level, and the other side pumped dry.

APPENDIX A

TYPICAL DESIGN COMPUTATIONS

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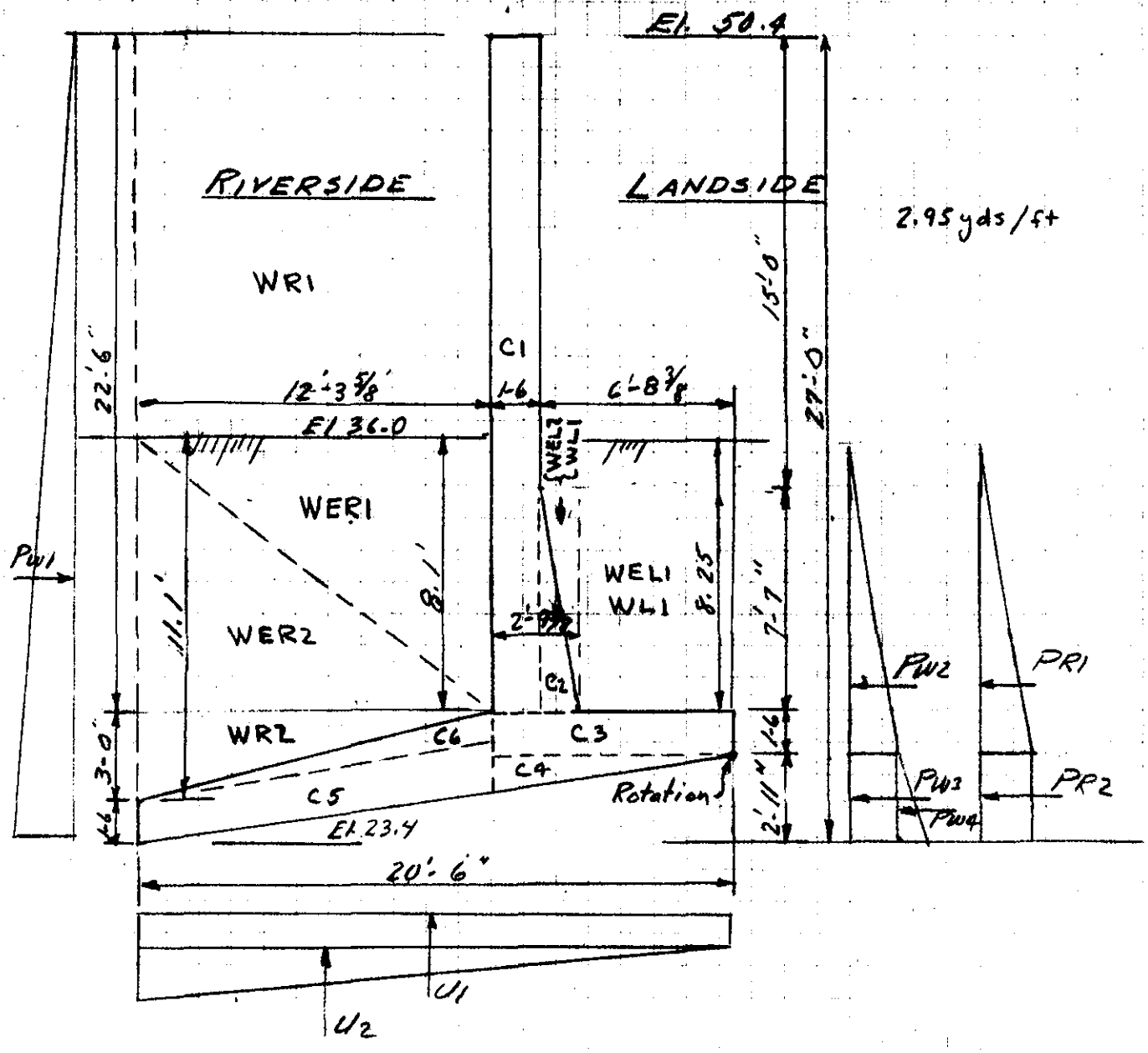
SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls STA 7+20 - Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Mar 66

CONDITION No 1 & DIMENSIONS



STA 7+20

Case I Loading shown
Case II " same except water down 3 ft
" III " No water and 3 ft surcharge on landside

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 7+20 Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Mar 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	5081.25	37855.31
C2 =	718.83	4513.36
C3 =	1845.00	7564.50
C4 =	717.50	3922.33
C5 =	2767.50	39713.62
C6 =	1153.12	14183.43
CONC=	12283.21	107752.57

CUBIC YARDS/LF OF WALL = 3.03

CONDITION #1:----
CREEP RATIO = 2.12

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	12283.21				107752.5	
WEL1=	3004.8				8167.2	
WEL2=	349.3				2046.0	
WER1=	3337.6				41052.5	
WER2=	4573.7				75009.5	
WR1 =	17296.8				248210.1	
WR2 =	1153.1				18911.2	
WL1 =	2802.9				7618.6	
WL2 =	325.8				1908.6	
UI =		18371.2				188305.0
U2 =		8111.2				110853.9
PW1 =			22781.2			138585.9
PW2 =				4368.7	14198.4	
PW3 =				2613.7		3811.7
PW4 =				1154.0		2243.9
PR1 =				9162.6	29778.7	
PR2 =				5481.9		7994.5
SUMS=	45127.5	26482.4	22781.2	22781.2	554653.9	451795.1
SUMV=	18645.0					
SUMH=			.0			
SUMM=					102858.7	
M/V =	5.5					
SBL=	2169.5PSF					
SBR=	-350.4PSF					

IF SBR IS NEGATIVE THEN SBR =0 & SBL = 2253.1PSF
BEARING LENGTH= 16.5FT.

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CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 7+20 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Mar 66

CONDITION #2:

CREEP RATIO = 2.6

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	12283.2				107752.5	
WEL1=	3004.8				8167.2	
WEL2=	349.3				2046.0	
WER1=	3337.6				41052.5	
WER2=	4573.7				75009.5	
WR1 =	14990.6				215115.4	
WR2 =	1153.1				18911.2	
WL1 =	2802.9				7618.6	
WL2 =	325.8				1908.6	
UI =		17140.7				175692.4
U2 =		6804.6				92996.6
PW1 =			18000.0			91500.0
PW2 =				4076.1	13247.4	
PW3 =				2438.7		3556.4
PW4 =				968.1		1882.4
PR1 =				6580.1	21385.4	
PR2 =				3936.8		5741.2
SUMS=	42821.2	23945.3	18000.0	18000.0	512214.9	371369.3
SUMV=	18875.9					
SUMH=			-.0			
SUMM=					140845.6	
M/V =	7.4					
SBL=	1672.2PSF					
SBR=	169.3PSF					

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls - Sta 7+20
COMPUTED BY H.E.W CHECKED BY DATE Mar 66

CONDITION #3:-----
WEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=11.25

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	12283.2				107752.5	
WEL1=	7950.3				21609.3	
WEL2=	924.2				5413.5	
WER1=	6475.9				79654.1	
WER2=	8874.4				145540.9	
WIND=				566.6	10436.1	
PEL1=				3486.9	14819.6	
PEL2=				1595.3		2326.5
PEL3=				182.4		354.8
SUMS=	36508.1			5831.4	385226.3	2681.3
SUMV=	36508.1					
SUMH=				-5831.4		
SUMM=					382545.0	
H/V =	-.1					
M/V =	10.4					
SBL =	1661.8PSF					
SBR =	1899.9PSF					

Because of the deep fill the effect of balancing the horiz. forces will be negligable. If it is a triangular dist. the resultant force will fall 1.3 ' above the origin This would slightly increase the bearing pressure on the landside and relieve it on riverside
The above pressures will give the more critical steel requirements

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 7+20 - Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Mar 66

CASE 1 LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =8.1
HEIGHT OF WATER R.S. =22.5
HEIGHT OF EARTH L.S. =8.251
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		29.66	15793.01	118540.76	2.69	39.68
1/5=	4.50	20.66	10112.72	60727.44	1.97	
2/5=	9.00	14.50	5695.31	25628.90	1.19	
3/5=	13.50	14.50	2531.25	7593.75	.35	

CASE 3 LOADING - STEM
ENTER FOLLOWING
WEIGHT OF EARTH =130
HEIGHT OF EARTH L.S.=11.25
HEIGHT OF " R.S.=8.1
HEIGHT OF WIND LOAD =14.4

0 =		29.66	2027.43	17396.56	.39	
1/5=	4.50	20.66	1419.32	9641.36	.31	
2/5=	9.00	14.50	720.00	4536.00	.21	
3/5=	13.50	14.50	450.00	2025.00	.09	

CASE I LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS
LENGTH OF BEARING =16.5
BEARING =2253.1
HEIGHT OF WATER =27.00
" " EARTH =8.25
WEIGHT OF EARTH =67

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		22.78	-8326.18	-24227.97	-.71	-34.18
1/3=	1.81	19.68	-5942.47	-11241.15	-.38	
2/3=	3.62	16.59	-3167.08	-2928.58	-.11	

CASE 3 LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS:
WEIGHT OF EARTH =130
HEIGHT OF EARTH =1.2511.25
BEARING P (HEEL) =1899.9
BEARING P (TOE) =1661.8

STEM=		22.78	283.42	640.16&01	.18	

CASE I LOADING RIVERSIDE BASE

STEM=		29.50	7742.27	53805.17	1.22	24.55
1/3=	4.10	24.50	6336.26	27124.39	.74	
2/3=	8.20	19.50	3774.39	7609.65	.26	

CASE 3 LOADING RIVERSIDE BASE

STEM=		29.50	-3219.15	-19045.89	-.43	
1/3=	4.10	24.50	-2064.59	-5188.35	-.14	

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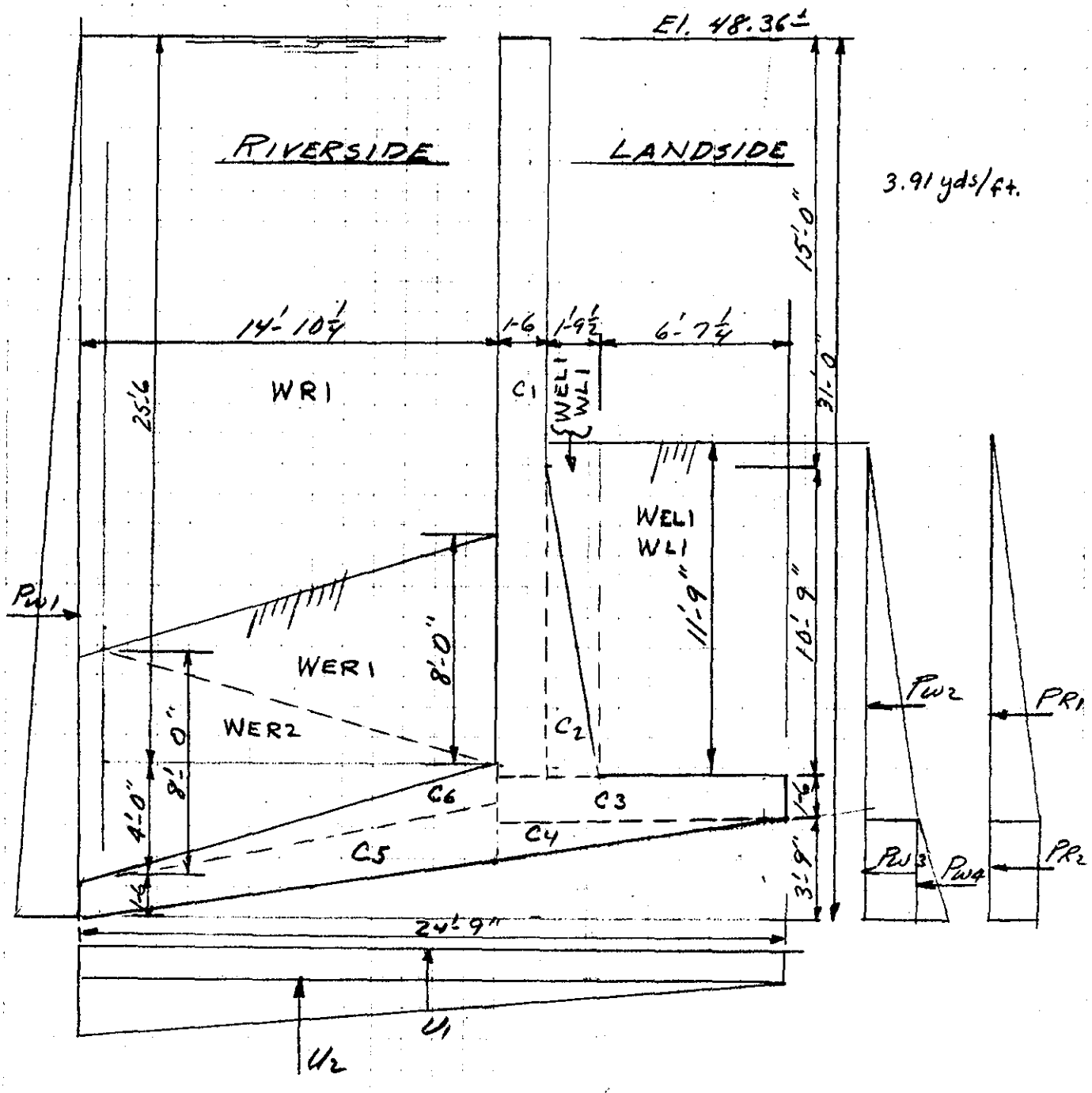
SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 13+70 Left Bank
COMPUTED BY _____ CHECKED BY _____ DATE _____



STA. 13+70

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls - Sta 13+70 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Mar 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	5793.75	53012.81
C2 =	1444.53	11271.35
C3 =	2227.50	11026.12
C4 =	1113.75	7350.75
C5 =	3341.25	57887.15
C6 =	1949.06	28943.57
CONC=	15869.84	169491.77

CUBIC YARDS/LF OF WALL = 3.91

CONDITION #1:----
CREEP RATIO = 2.7

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15869.8				169491.7	
WEL1=	5202.4				17189.6	
WEL2=	705.2				5081.6	
WER1=	3979.8				59100.0	
WER2=	3979.8				78800.0	
WR1 =	23667.1				410034.0	
WR2 =	1856.2				36753.7	
WL1 =	4852.9				16035.1	
WL2 =	657.8				4740.3	
UI =		27991.5				346395.6
U2 =		9980.7				164682.8
PW1 =			30031.2			197705.7
PW2 =				7492.6	33092.7	
PW3 =				4241.1		7952.1
PW4 =				1512.2		3780.5
PR1 =				10718.2	47338.9	
PR2 =				6066.9		11375.4
SUMS=	60771.4	37972.3	30031.2	30031.2	877658.0	731892.4
SUMV=	22799.0					
SUMH=			.0			
SUMM=					145765.5	

M/V = 6.3
SBL= 2256.9PSF
SBR= -414.5PSF
IF SBR IS NEGATIVE THEN SBR =0 & SBL = 2377.3PSF
BEARING LENGTH= 19.1FT.

Soils Note:
The structure is considered safe against detrimental foundation seepage pressures and foundation overstress since adequate seepage path has been provided for the maximum 14-foot differential hydrostatic head that can develop and there is sufficient earth fill behind the wall to develop required passive earth pressures to resist sliding.

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 13+70 Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Mar 66

CONDITION #2:

CREEP RATIO = 3.4

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15869.8				169491.7	
WEL1=	5202.4				17189.6	
WEL2=	705.2				5081.6	
WER1=	3979.8				59100.0	
WER2=	3979.8				78800.0	
WR1 =	20882.8				361794.7	
WR2 =	1856.2				36753.7	
WL1 =	4852.9				16035.1	
WL2 =	657.8				4740.3	
UI =		26385.3				326519.2
U2 =		8463.5				139648.6
PW1 =			24500.0			136791.6
PW2 =				7062.7	31193.8	
PW3 =				3997.7		7495.8
PW4 =				1282.3		3205.8
PR1 =				7762.9	34286.4	
PR2 =				4394.1		8238.9
SUMS=	57987.0	34848.9	24500.0	24499.9	814467.3	621900.2
SUMV=	23138.0					
SUMH=			.0			
SUMM=					192567.1	
M/V =	8.3					
SBL=	1853.3PSF					
SBR=	16.4PSF					

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27 Sept 49

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

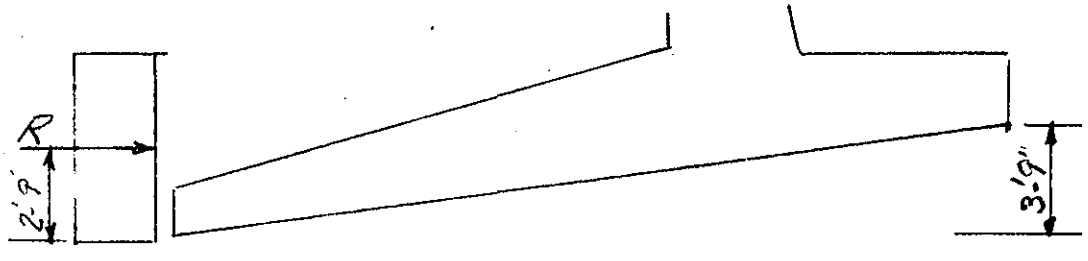
SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Wall Sta 18+10 Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Mar 66

CONDITION #3:-----
WEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=14.75

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15869.8				169491.7	
WEL1=	12671.4				41868.6	
WEL2=	1717.7				12377.4	
WER1=	7722.0				114671.7	
WER2=	7722.0				152895.6	
WIND=				550.0	11962.5	
PEL1=				5664.1	30680.7	
PEL2=				2614.2		4901.6
PEL3=				301.6		754.1
SUMS=	45703.0			9130.0	533948.4	5655.7
SUMV=	45703.0					
SUMH=				-9130.0		
SUMM=					528292.6	
H/V =	-.1					
M/V =	11.5					
SBL =	2211.7PSF					
SBR =	1481.4PSF					

Assume unbalanced horiz. force balanced as follows



	+Vert	-Vert	+Horiz	-Horiz	+Moment	-Moment
Prev Totals	+45703.0			9130.0	528292.6	
R			9130.0		9130.0	
	45703.0		9130	9130.	537422.6	

$\Sigma H = 0$

$\Sigma \frac{M}{V} = \frac{537422.6}{45703.0} = 11.75$

SBL = 2130
SBR = 1565

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 18+10 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Mar 66

CASE 1 LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =8.0
HEIGHT OF WATER R.S. =25.5
HEIGHT OF EARTH L.S. =11.75
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		36.00	19501.55	168631.44	3.15	41.14
1/5=	5.10	25.80	12609.09	87440.19	2.28	
2/5=	10.20	15.60	7315.31	37308.09	1.61	
3/5=	15.30	14.50	3251.25	11054.25	.51	

CASE 3 LOADING - STEM
ENTER FOLLOWING
WEIGHT OF EARTH =130
HEIGHT OF EARTH L.S.=14.75
HEIGHT OF " R.S.=6.0
HEIGHT OF WIND LOAD =12.19

0 =		36.00	4504.01	33227.63	.62	
1/5=	5.10	25.80	2589.60	15138.90	.39	
2/5=	10.20	15.60	609.50	5610.44	.24	
3/5=	15.30	14.50	510.00	2601.00	.12	

CASE I LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS
LENGTH OF BEARING =19.1
BEARING =2377.3
HEIGHT OF WATER =31.00
" " EARTH =11.75
WEIGHT OF EARTH =67

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		25.51	-9139.12	-32953.33	-.86	-33.50
1/3=	2.20	21.51	-6648.84	-15462.56	-.48	
2/3=	4.40	17.50	-3602.46	-4069.79	-.15	

CASE 3 LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS:
WEIGHT OF EARTH =130
HEIGHT OF EARTH =14.75
BEARING P (HEEL) =1565
BEARING P (TOE) =2130

STEM=		25.51	1077.31	2464.05	.06	

CASE I LOADING RIVERSIDE BASE

STEM=		35.50	8327.15	65743.36	1.24	21.94
1/3=	4.95	28.50	6621.74	32751.28	.77	
2/3=	9.90	21.50	3712.43	8850.39	.27	

CASE 3 LOADING RIVERSIDE BASE

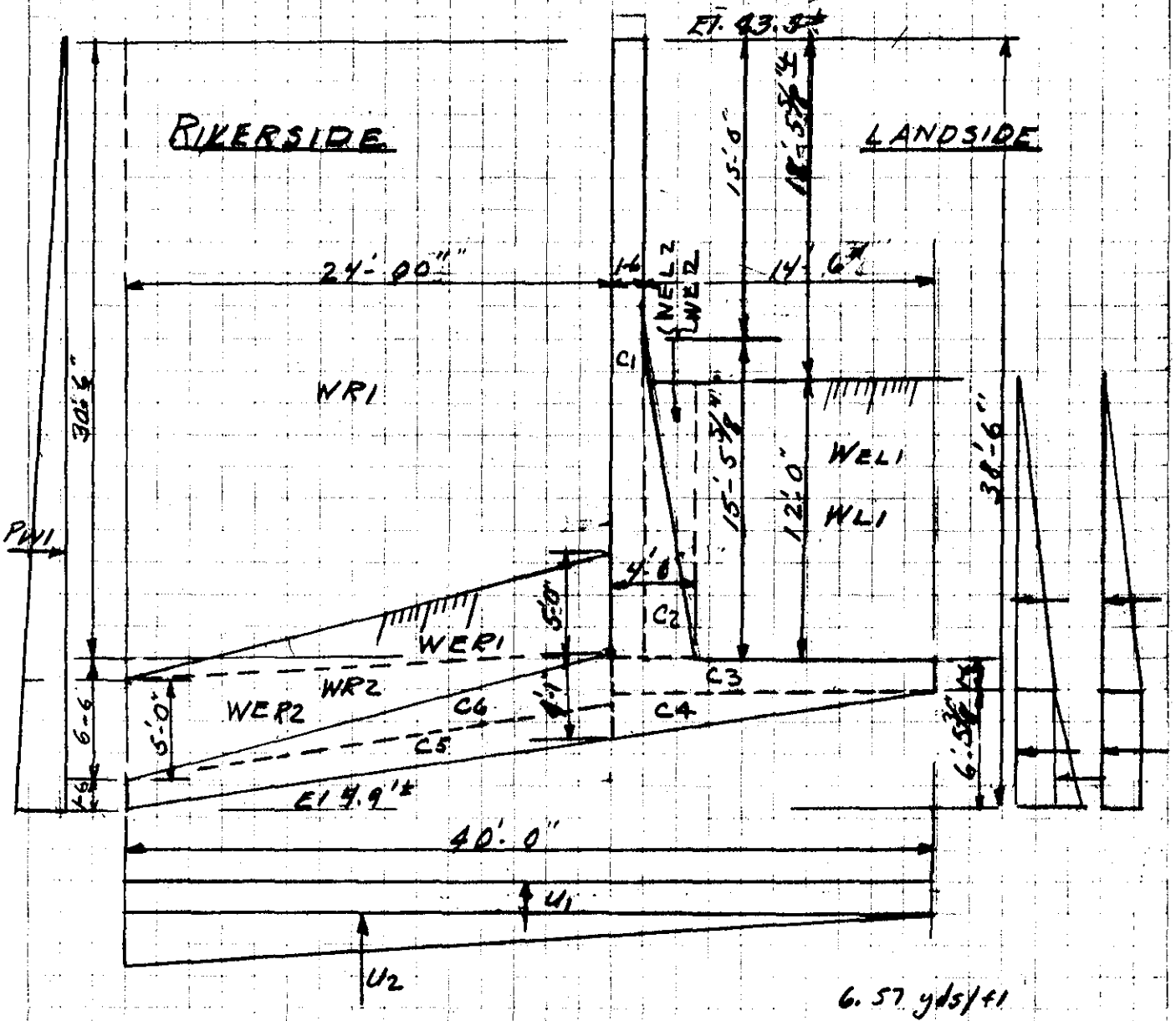
STEM=		35.50	-5023.01	-35890.03	-.68	
1/3=	4.95	28.50	-3222.45	-9613.14	-.22	

NED FORM 223
27 Sept 49

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

PAGE DM-11

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 23+51 . Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66



NED FORM 223
27 Sept 49

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

PAGE D-12

SUBJECT: Ansonia Derby
COMPUTATION: Toe Type Flood Walls Sta 23+51 Left Bank
COMPUTED BY: H.E.W. CHECKED BY: DATE: Feb 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	6856.25	104557.81
C2 =	2992.37	40817.23
C3 =	3600.00	28800.00
C4 =	3133.33	33422.22
C5 =	5400.00	151200.00
C6 =	4649.99	111599.99
CONC=	26631.95	470397.26

CUBIC YARDS/LF OF WALL = 6.57

CONDITION #1:----
CREEP RATIO = 2.9

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	26631.9				470397.2	
WEL1=	9584.7				57131.1	
WEL2=	1036.6				13249.1	
WER1=	4020.0				96480.0	
WER2=	4020.0				128640.0	
WR1 =	45750.0				1281000.0	
WR2 =	4875.0				156000.0	
WL1 =	8940.9				53293.9	
WL2 =	967.0				12359.2	
UI =		45288.9				905778.2
U2 =		25480.5				679481.2
PW1 =			46320.3			292075.3
PW2 =				7642.5	34391.2	
PW3 =				7390.8		24123.0
PW4 =				4158.2		18096.2
PR1 =				13791.3	62060.9	
PR2 =				13337.2		43531.4
SUMS=	105826.3	70769.4	46320.3	46320.3	2365003.0	1963085.4
SUMV=	35056.8					
SUMH=			-.0			
SUMM=					401917.6	

M/V = 11.4
SBL= 1998.4PSF
SBR= -245.6PSF
IF SBR IS NEGATIVE THEN SBR =0 & SBL = 2038.5PSF
BEARING LENGTH= 34.3FT.

NED FORM 223
27 Sept 49

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

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls - Sta. 23+51 Left Bank
COMPUTED BY H. E. W. CHECKED BY DATE Feb 66

CONDITION #2:

CREEP RATIO = 3.4

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	26631.9				470397.2	
WEL1=	9584.7				57131.1	
WEL2=	1036.6				13249.1	
WER1=	4020.0				96480.0	
WER2=	4020.0				128640.0	
WR1 =	41250.0				1155000.0	
WR2 =	4875.0				156000.0	
WL1 =	8940.9				53293.9	
WL2 =	967.0				12359.2	
UI =		43414.9				868298.4
U2 =		22667.5				604467.7
PW1 =			39382.8			208947.6
PW2 =				7326.2	32968.2	
PW3 =				7085.0		23124.8
PW4 =				3699.2		16098.4
PR1 =				10814.1	48663.6	
PR2 =				10458.1		34134.1
SUMS=	101326.3	66082.4	39382.8	39382.8	2224182.6	1755071.3
SUMV=	35243.8					
SUMH=			-.0			
SUMM=					469111.3	

M/V = 13.31
SBL= 1765.2PSF
SBR= -3.0PSF
IF SBR IS NEGATIVE THEN SBR =0 & SBL = 1765.2PSF
BEARING LENGTH= 39.9FT.

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

PAGE [illegible]

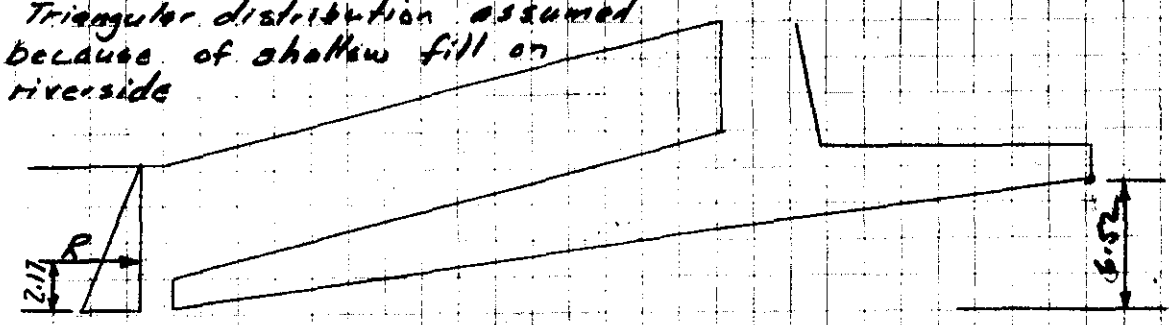
SUBJECT: Ansonia Derby
COMPUTATION: Toe Type Flood Walls - Sta 23+31
COMPUTED BY: H.E.W. CHECKED BY: DATE: Feb 66

CONDITION #3:-----
WEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=15.0

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	26631.9				470397.2	
WEL1=	23246.5				138564.3	
WEL2=	2514.2				32134.1	
WER1=	7800.0				187200.0	
WER2=	7800.0				249600.0	
WIND=				773.6	18749.3	
PEL1=				5839.7	32118.6	
PEL2=				4620.6		15081.4
PEL3=				914.0		3977.7
SUMS=	67992.7			12148.0	1128763.7	19059.1
SUMV=	67992.7					
SUMH=				-12148.0		
SUMM=					1109704.6	
H/V =	-.1					
M/V =	16.3					
SBL =	2637.8PSF					
SBR =	761.7PSF					

Assume unbalanced horiz. force is balanced as follows
Triangular distribution assumed because of shallow fill on riverside



	+Vert	-Vert	+Horiz	-Horiz	+Moment	-Moment
Prev Totals	67992.7			-12148.0	1109704.6	
R			+12148.0		52843.8	
	67992.7		12148.0	12148.0	1162548.4	

$\Sigma H = 0$

$\frac{M}{V} = 17.10'$

SBL = 2439.2
SBR = 960.4

These bearing pressures are only critical on riverside

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27 Sept 49

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

PAGE DM15

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 23+51 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66

CASE 1 LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =3.0
HEIGHT OF WATER R.S. =30.5
HEIGHT OF EARTH L.S. =12
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		45.44	27577.88	289279.99	4.28	46.95
1/5=	6.10	33.24	18220.17	150563.84	3.04	
2/5=	12.20	21.04	10465.31	63838.40	2.04	
3/5=	18.30	14.50	4651.25	18915.08	.87	

CASE 3 LOADING - STEM
ENTER FOLLOWING
WEIGHT OF EARTH =130
HEIGHT OF EARTH L.S.=15.0
HEIGHT OF " R.S.=0
HEIGHT OF WIND LOAD =15

0 =		45.44	5576.25	41381.25	.61	
1/5=	6.10	33.24	2449.05	17715.52	.35	
2/5=	12.20	21.04	750.00	8100.00	.25	
3/5=	18.30	14.50	610.00	3721.00	.17	

CASE I LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS
LENGTH OF BEARING =34.3
BEARING =2038.5
HEIGHT OF WATER =38.5
" " EARTH =12
WEIGHT OF EARTH =67

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		36.84	-12891.82	-84193.74	-1.53	-32.73
1/3=	3.97	29.06	-9416.62	-39597.24	-.91	
2/3=	7.94	21.28	-5119.34	-10443.76	-.33	

CASE 3 LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS:
WEIGHT OF EARTH =130
HEIGHT OF EARTH =15
BEARING P (HEEL) =761.7
BEARING P (TOE) =2637.8

STEM=		36.84	-444.89	-12729.87	-.23	

CASE I LOADING RIVERSIDE BASE

STEM=		45.50	10186.49	126251.92	1.86	20.94
1/3=	8.00	35.16	7702.80	60974.96	1.16	
2/3=	16.00	24.83	4724.22	17571.25	.47	

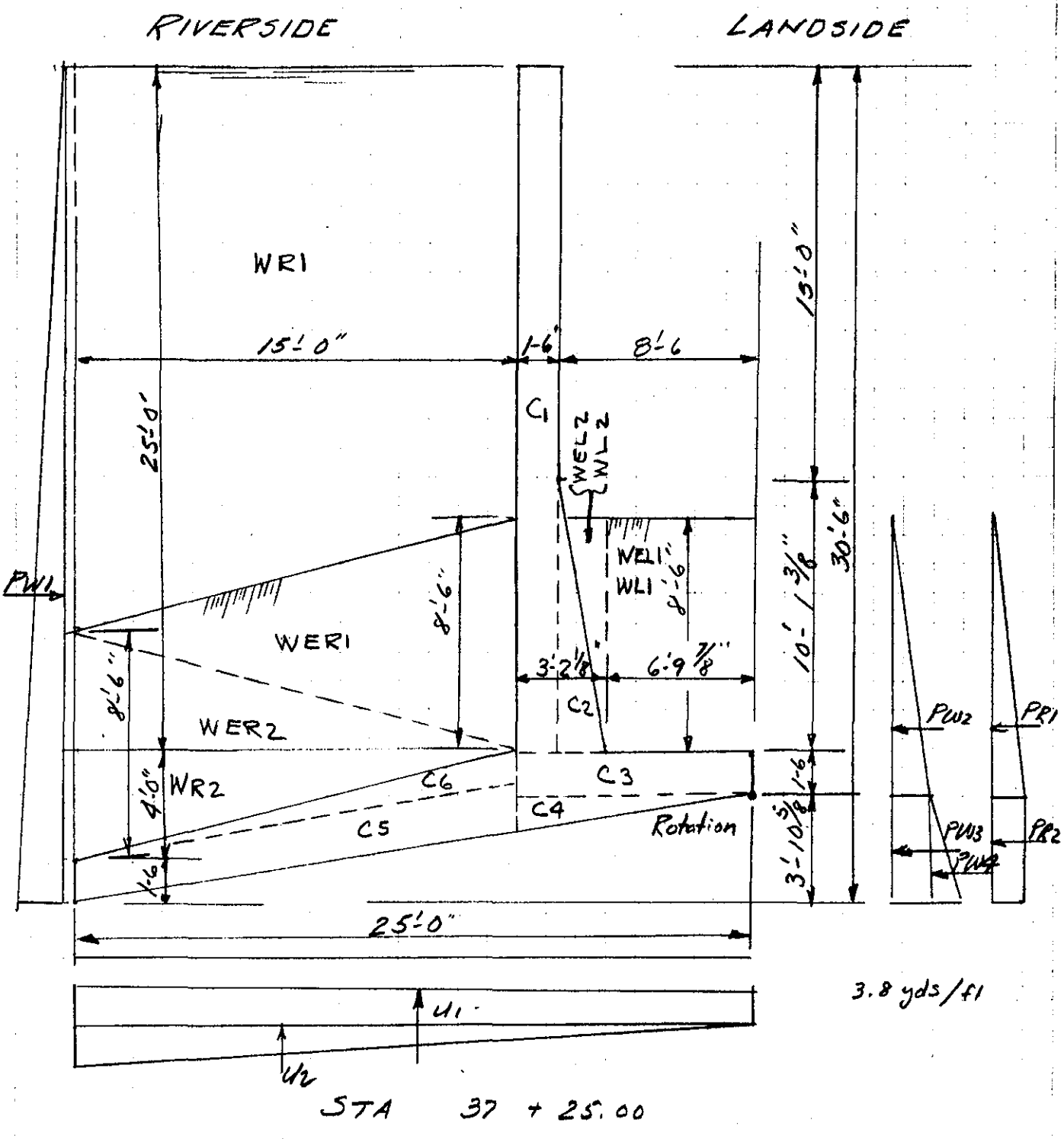
CASE 3 LOADING RIVERSIDE BASE

STEM=		45.50	-9204.96	-81838.08	-1.21	
1/3=	8.00	35.16	-4546.56	-26565.12	-.50	

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 37+25.00 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66



NED FORM 223
27 Sept 49

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

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SUBJECT Ansonia Derby
COMPUTATION Toe Wall Sta 37+25.00 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	5650.0	52262.5
C2 =	1277.9	10144.5
C3 =	2250.0	11250.0
C4 =	1166.6	7777.7
C5 =	3375.0	59062.5
C6 =	1875.0	28125.0
CONC=	15594.5	168622.3

CUBIC YARDS/LF OF WALL = 3.8

CONDITION #1:----
CREEP RATIO = 2.1

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15594.5				168622.3	
WEL1=	3881.0				13224.2	
WEL2=	479.8				3539.6	
WER1=	4271.2				64068.7	
WER2=	4271.2				85425.0	
WR1 =	23437.5				410156.2	
WR2 =	1875.0				37500.0	
WL1 =	3620.3				12336.0	
WL2 =	447.6				3301.9	
UI =		22977.5				287218.9
U2 =		12339.3				205656.1
PW1 =			29070.3			182496.9
PW2 =				4595.5	15318.3	
PW3 =				3574.2		6949.9
PW4 =				1919.4		4976.3
PR1 =				10676.8	35589.5	
PR2 =				8304.2		16147.0
SUMS=	57878.4	35316.8	29070.3	29070.3	849082.1	703445.4
SUMV=	22561.6					
SUMH=			-.0			
SUMM=					145636.7	

M/V = 6.4
SBL= 2211.7PSF
SBR= -406.8PSF
IF SBR IS NEGATIVE THEN SBR =0 & SBL = 2330.1PSF
BEARING LENGTH= 19.3FT.

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27 Sept 49

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

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 32+25.00 Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Feb 66

CONDITION #2:

CREEP RATIO = 2.5

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15594.5				168622.3	
WEL1=	3881.0				13224.2	
WEL2=	479.8				3539.6	
WER1=	4271.2				64068.7	
WER2=	4271.2				85425.0	
WR1 =	20625.0				360937.5	
WR2 =	1875.0				37500.0	
WL1 =	3620.3				12336.0	
WL2 =	447.6				3301.9	
U1 =		21649.6				270620.4
U2 =		10659.5				177659.2
PW1 =			23632.8			124728.7
PW2 =				4329.9	14433.0	
PW3 =				3367.7		6548.3
PW4 =				1658.1		4298.9
PR1 =				8030.8	26769.3	
PR2 =				6246.1		12145.3
SUMS=	55065.9	32309.1	23632.8	23632.8	790158.0	596001.1
SUMV=	22756.7					
SUMH=			.0			
SUMM=					194156.9	
M/V =	8.5					
SBL=	1777.1PSF					
SBR=	43.3PSF					

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

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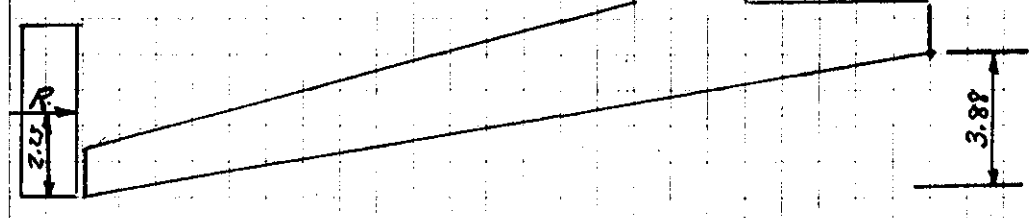
SUBJECT: Ansonia Derby
COMPUTATION: Tee Type Flood Walls. Sta 37+25.00 Left Bank
COMPUTED BY: H.E.W CHECKED BY: DATE: Feb 66

CONDITION #3:-----
WEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=13.5 (5'0" surch. to allow for possible 5'6" prot. berm)

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15594.5				168622.3	
WEL1=	11960.0				40752.5	
WEL2=	1478.7				10908.0	
WER1=	8287.5				124312.5	
WER2=	8287.5				165750.0	
WIND=				580.5	12078.7	
PEL1=				4826.2	24131.2	
PEL2=				2502.5		4865.9
PEL3=				324.3		841.0
SUMS=	45608.3			8233.7	546555.5	5707.0
SUMV=	45608.3					
SUMH=				-8233.7		
SUMM=					540848.5	
H/V =	-.1					
M/V =	11.8					
SBL =	2105.1PSF					
SBR =	1543.4PSF					

Assume unbalanced horiz force is balanced as follows



	+ Vert	- Vert	+ Horiz	- Horiz	+ Moment	- Moment
Prev. Tot.	45608.3	0		8233.7	+540848.5	
R			+8233.7	1.63	13420.9	
	45608.3		8233.7	8233.7	554269.4	

$\Sigma H = 0$

$\frac{M}{V} = 12.15$

SBL = 1977.6
SBR = 1671.1

Use these bearing values in computing steel

NED FORM 223
27 Sept 49

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

SUBJECT: Ansonia Derby
COMPUTATION: Tee Type Flood Walls Sta 37+25.00 Left Bank
COMPUTED BY: H.E.N CHECKED BY: DATE: Feb 66

CASE 1 LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =8.5
HEIGHT OF WATER R.S. =25.00
HEIGHT OF EARTH L.S. =8.5
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		34.72	19531.25	162760.41	3.15	42.58
1/5=	5.00	24.72	12500.00	83333.33	2.26	
2/5=	10.00	14.72	7031.25	35156.25	1.60	
3/5=	15.00	14.50	3125.00	10416.66	.48	

CASE 3 LOADING - STEM
ENTER FOLLOWING
WEIGHT OF EARTH =130
HEIGHT OF EARTH L.S.=13.5
HEIGHT OF " R.S.=6.0
HEIGHT OF WIND LOAD =11.6

0 =		34.72	3717.06	27183.28	.52	
1/5=	5.00	24.72	2108.31	12619.84	.34	
2/5=	10.00	14.72	580.00	5336.00	.24	
3/5=	15.00	14.50	500.00	2500.00	.11	

CASE I LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS
LENGTH OF BEARING =19.3
BEARING =2330.1
HEIGHT OF WATER =30.5
" " EARTH =8.5
WEIGHT OF EARTH =67

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		26.18	-10674.97	-39099.20	-1.00	-38.13
1/3=	2.27	21.95	-7655.25	-18192.51	-.55	
2/3=	4.54	17.72	-4096.92	-4751.90	-.18	

CASE 3 LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS:
WEIGHT OF EARTH =130
HEIGHT OF EARTH =13.5
BEARING P (HEEL) =1671.1
BEARING P (TOE) =1977.6

STEM=		26.18	840.44	1926.36	.04	

CASE I LOADING RIVERSIDE BASE

STEM=		34.42	9713.69	74846.61	1.46	26.39
1/3=	5.00	27.78	7363.65	36224.66	.87	
2/3=	10.00	21.14	3996.49	9580.61	.30	

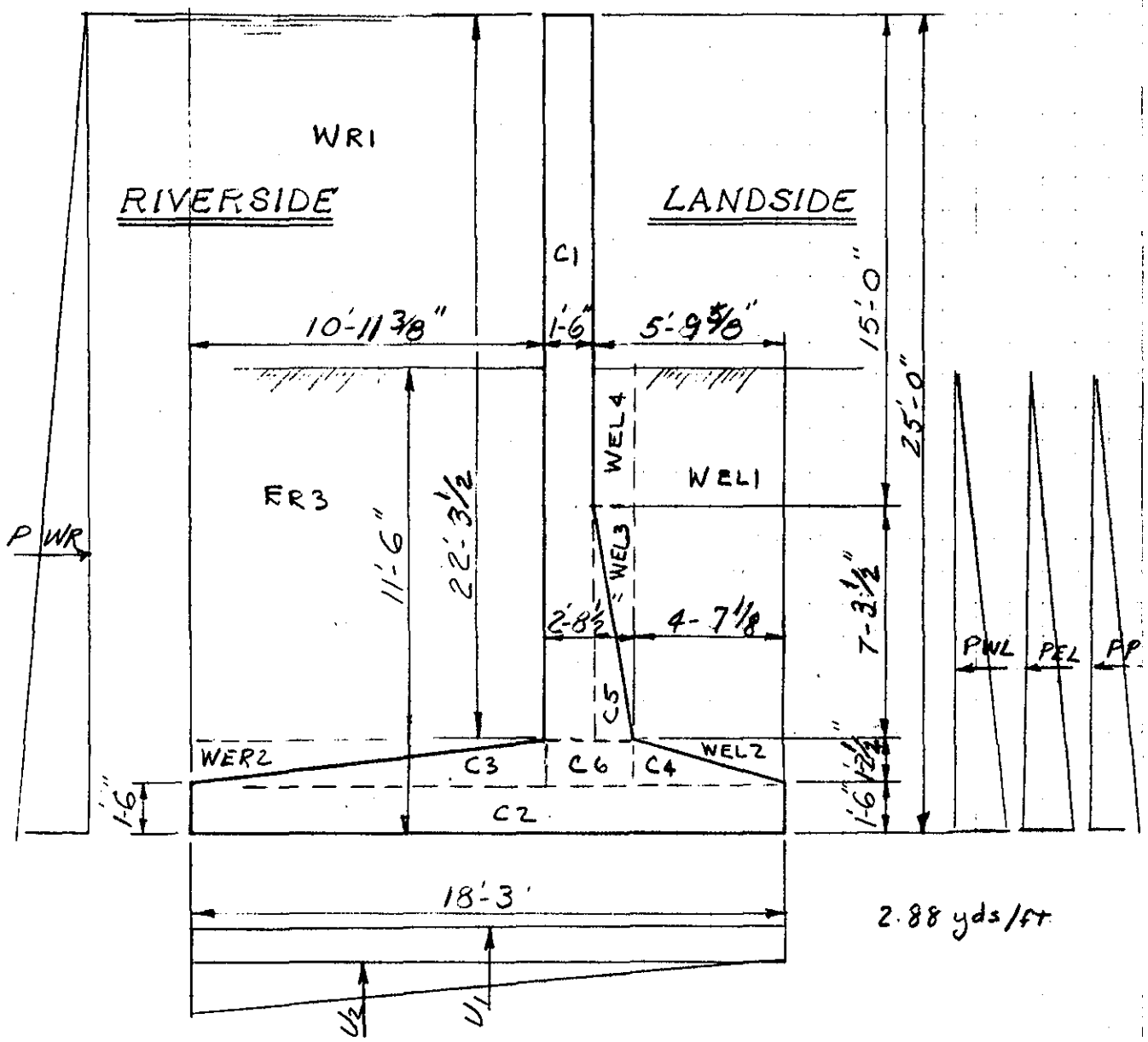
CASE 3 LOADING RIVERSIDE BASE

STEM=		34.42	-4628.25	-35932.50	-.70	
1/3=	5.00	27.78	-3194.00	-9187.49	-.22	

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls - STA 45+15 Left Bank
COMPUTED BY C. M. T. CHECKED BY DATE Mar 66



Note - Deep embedment req'd to reach an allowable bearing

STA 45 +15

NED FORM 223
27 Sept 49

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

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls STA 45+15 Left Bank
COMPUTED BY C.M.T CHECKED BY DATE Mar. 66

CONCRETE ONLY:------

	LOAD#	MOMENT#FT
C1 =	5014.28	58667.14
C2 =	4106.25	37469.53
C3 =	997.23	7279.79
C4 =	417.62	6344.95
C5 =	663.52	8529.39
C6 =	494.38	6084.50
CONC=	11693.30	124375.31

CUBIC YARDS/LF OF WALL= 2.88

CONDITION #1:------

CREEP RATIO= 2.2

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	11693.3				124375.3	
WR1 =	15251.7				83503.5	
WER2=	360.9				3142.4	
ER3 =	6445.6				35289.8	
WEL1=	5217.3				83254.7	
WEL2=	360.5				6028.9	
WEL3=	572.8				7595.5	
WEL4=	235.8				3079.8	
U1 =		19069.5				174009.4
U2 =		4723.0				28731.8
PWR =			19531.2		162760.4	
PWL =				6008.2		23031.4
PEL =				1462.0		5604.4
PP =				12061.0		46233.9
SUMS=	40638.3	23792.5	19531.2	19531.2	509030.6	277611.0
SUMV=	16845.7#					
SUMH=			-.0#			
SUMM=					231419.5#FT	

H/V =%41 -.0
M/V = 13.7FT
SBPL= 2322.8PSF
SBPR= -476.7PSF
IF SBPR IS NEGATIVE, THEN SBPR=0 & SBPL= 2488.7PSF
BRGL= 13.5FT

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CORPS OF ENGINEERS, U.S. ARMY

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls - STA 45+15 Left Bank
COMPUTED BY C.M.T. CHECKED BY DATE Mar

CONDITION #2 W/ PASSIVE PRES. :------

CREEP RATIO= 2.8

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	11693.3	..	..	..	124375.3	
WR1 =	13198.6	..	..	..	72262.6	
WER2=	860.9	..	..	..	3142.4	
ER3 =	6445.6	..	..	..	35289.8	
WEL1=	5217.3	..	..	..	83254.7	
WEL2=	360.5	..	..	..	6028.9	
WEL3=	572.8	..	..	..	7595.5	
WEL4=	235.8	..	..	..	3079.8	
U1 =	..	17746.7	..	..	..	161939.3
U2 =	..	3673.4	..	..	..	22347.0
PWR =	..	..	15125.0	..	110916.6	
PWL =	..	..	..	5591.4	..	21433.8
PEL =	..	..	..		..	
PP =	..	..	..	9533.5	..	36545.2
SUMS=	38585.2	21420.2	15125.0	15125.0	445946.0	242265.5
SUMV=	17164.9#					
SUMH=	..	..	-.0#			
SUMM=	..	..	..	..	203680.4#FT	
H/V =&41	-.0					
M/V =	11.8FT					
SBPL=	1788.1PSF					
SBPR=	92.9PSF					

CONDITION #3 :-------

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	11693.3	..	..	..	124375.3	
WER2=	364.2	..	..	..	3154.5	
ER3 =	12506.4	..	..	..	68472.8	
WEL1=	5237.5	..	..	..	83576.1	
WEL2=	361.9	..	..	..	6052.2	
WEL3=	575.0	..	..	..	7624.9	
WEL4=	236.7	..	..	..	3091.7	
PEL =	..	..	..	2836.7	..	10874.2
PER =	..	..	2836.7	..	10874.2	
PWND=	..	..	..	675.0	..	12318.7
PSUR=	..	..	..	1430.0	..	3510.2
SUR =	2262.0	..	..	..	34721.7	
PP =	..	..	..		..&41	.0
SUMS=	33737.3		2836.7	4991.8	341943.7	31703.2
SUMV=	33737.3#					
SUMH=	..	..	-2155.0#			
SUMM=	..	..	..	..	310240.5#FT	
H/V =	-.0					
M/V =	9.1FT					
SBPL=	1891.6PSF					
SBPR=	1305.6PSF					

NED FORM 223
27 Sept 49

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

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls
COMPUTED BY C. M. T. CHECKED BY DATE Mar. 66

WALL DESIGN (PER LINEAR FOOT) :-------CONDITION 1

INSTRUCTIONS:----SET MAG 7,DEC 1,AUX READER OFF
SIGN CONVENTION: +V=DOWN +M=CLOCKWISE +H=TOWARD LAND

STEM DESIGN:
X MEASURED FROM TOP OF STEM @ 1/5 PT'S, REINF @R.S.FACE, 3.5"MIN COV.

X FT	SHEAR#	MOMENT#FT	D REQD"	D GIV"	SHEAR,PSI	REINFX10
-22.2	12013.5	105022.0	26.2	29.0	34.4	25.0
-17.8	9081.5	57798.5	19.5	20.1	37.5	19.9
-13.3	5586.7	24899.8	12.7	14.5	32.1	11.9
-8.9	2482.7	7376.6	6.9	14.5	14.2	3.5
-4.4	620.5	921.6	2.4	14.5	3.5	.4

TOE DESIGN:
X MEASURED FROM L.S. TOE @ 1/3 PT'S, REINF @ BOT FACE, 4.5" MIN COV.

-4.5	-7541.9	-18584.2	11.0	28.0	22.3	4.5
-3.0	-5403.2	-8640.5	7.5	23.2	19.3	2.5
-1.5	-2888.4	-2254.0	3.8	18.3	13.1	.8

HEEL DESIGN:
X MEASURED FROM R.S. HEEL @ 1/3 PT'S, REINF @ TOP FACE, 3.5" MIN COV.

-10.9	7034.0	-47299.0	17.6	29.0	20.1	11.2
-7.2	6049.2	-22795.9	12.2	24.2	20.8	6.5
-3.6	3126.6	-5578.7	6.0	19.3	13.4	2.0

WALL DESIGN (PER LINEAR FOOT) :------CONDITION 3

STEM DESIGN:
X MEASURED FROM TOP OF WALL @ 1/3 PT'S,REINF@L.S.FACE,3.5"MIN COV.

X FT	SHEAR#	MOMENT#FT	D REQD"	D GIV"	SHEAR,PSI	REINFX10
-22.2	-1805.5	-15451.0	10.0	29.0	5.1	3.6
-14.8	-849.2	-5588.3	6.0	14.5	4.9	2.7
-7.4	-371.2	-1391.4	3.0	14.5	2.1	.6

TOE DESIGN:
X MEASURED FROM L.S. TOE @ 1/3 PT'S, REINF@TOP FACE IF +M, 3.5"MIN COV.

-4.5	212.4	406.5	1.6	29.0	.6	.0
-3.0	118.1	156.8	1.0	24.2	.4	.0
-1.5	47.3	33.2	.4	19.3	.2&01	.1

HEEL DESIGN:
X MEASURED FROM R.S. HEEL @ 1/3 PT'S, REINF@BOT FACE IF +M, 4.5"MIN COV.

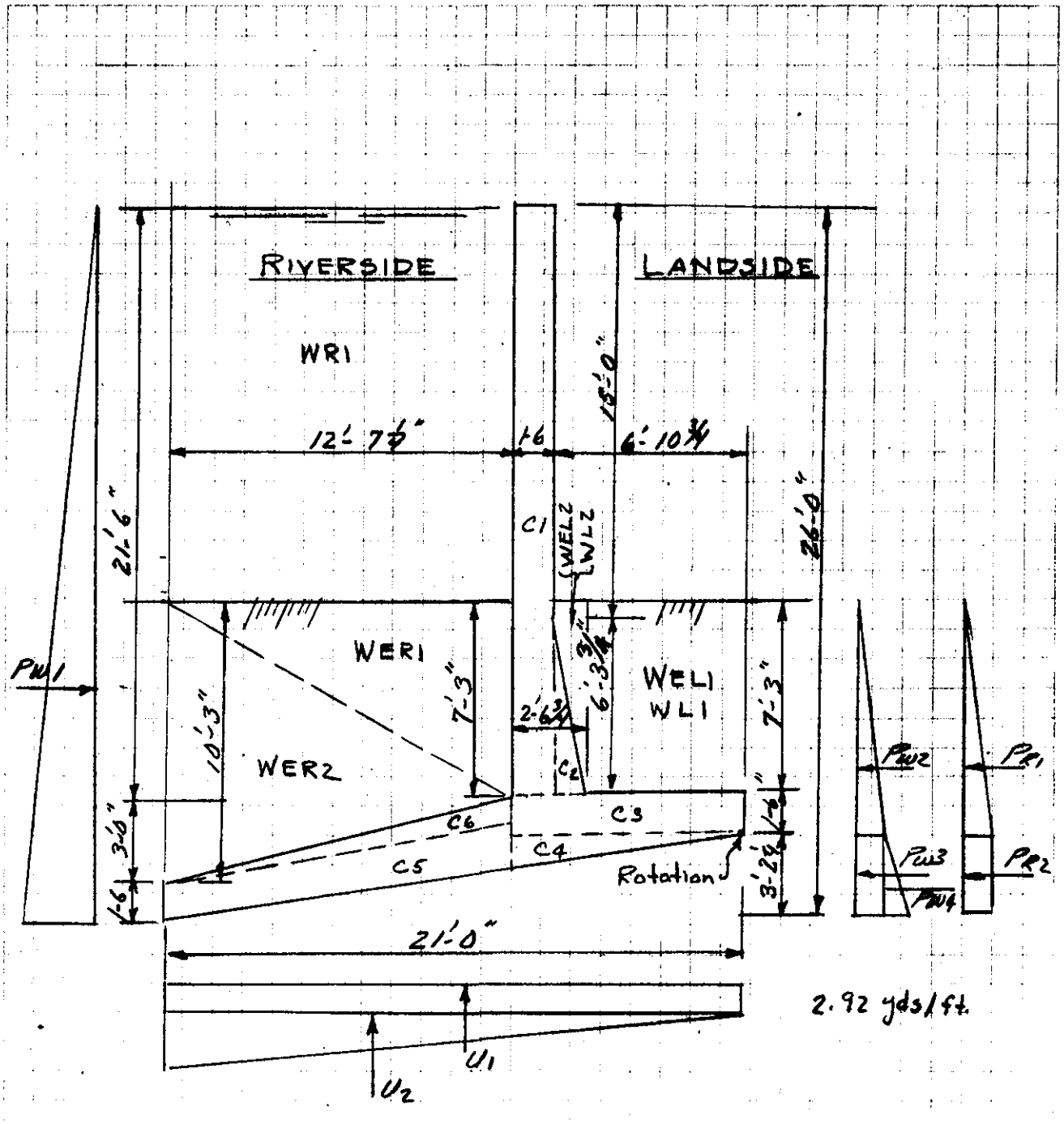
-10.9	-3222.1	17367.0	10.6	28.0	9.5	4.2
-7.2	-2114.5	7635.7	7.0	23.2	7.5	2.2
-3.6	-1040.2	1887.2	3.5	18.3	4.7	.7

NED FORM 223
27 Sept 49

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

PAGE DM-26

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 55+15 Left Bank
COMPUTED BY H.E.W CHECKED BY DATE Mar 66



STA. 55 + 15

NED FORM 223
27 Sept 49

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

PAGE DH-26

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 55+15 Left Bank
COMPUTED BY H. E. W. CHECKED BY DATE Mar 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	4793.75	36672.18
C2 =	497.00	3255.19
C3 =	1890.00	7938.00
C4 =	805.00	4508.00
C5 =	2835.00	41674.50
C6 =	1023.75	12899.25
CONC=	11844.50	106947.13

CUBIC YARDS/LF OF WALL = 2.92

CONDITION #1:----
CREEP RATIO = 2.1

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	11844.5				106947.1	
WEL1=	2841.1				8309.1	
WEL2=	255.2				1582.3	
WER1=	3060.2				38558.8	
WER2=	4326.5				72685.6	
WR1 =	16931.2				248889.3	
WR2 =	1181.2				19845.0	
WL1 =	2650.3				7751.0	
WL2 =	238.1				1476.0	
U1 =		16866.5				177098.5
U2 =		8629.2				120809.3
PW1 =			21125.0			115600.6
PW2 =				3513.8	10248.7	
PW3 =				2565.6		4097.9
PW4 =				1312.6		2795.4
PR1 =				7937.3	23150.5	
PR2 =				5795.5		9256.7
SUMS=	43328.6	25495.7	21125.0	21125.0	539443.8	429658.6
SUMV=	17832.8					
SUMH=			-.0			
SUMM=					109785.2	

M/V = 6.1
SBL= 1903.0PSF
SBR= -204.6PSF
IF SBR IS NEGATIVE THEN SBR =0 & SBL = 1931.1PSF
BEARING LENGTH= 18.4FT.

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 55+15 Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Mar 66

CONDITION #2:

CREEP RATIO = 2.7

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	11844.5				106947.1	
WEL1=	2841.1				8309.1	
WEL2=	255.2				1582.3	
WER1=	3060.2				38558.8	
WER2=	4326.5				72685.6	
WR1 =	14568.7				214160.6	
WR2 =	1181.2				19845.0	
WL1 =	2650.3				7751.0	
WL2 =	238.1				1476.0	
UI =		15717.7				165036.5
U2 =		7234.8				101288.1
PW1 =			16531.2			73931.4
PW2 =				3274.5	9550.7	
PW3 =				2390.9		3818.8
PW4 =				1100.5		2343.7
PR1 =				5644.1	16462.0	
PR2 =				4121.1		6582.3
SUMS=	40966.1	22952.6	16531.2	16531.2	497328.6	353001.0
SUMV=	18013.5					
SUMH=			-.0			
SUMM=					144327.6	
M/V =	8.0					
SBL=	1467.5PSF					
SBR=	248.0PSF					

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

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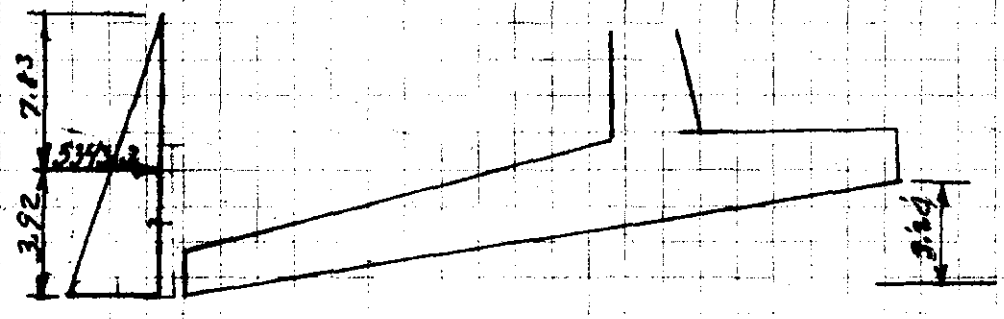
SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 55+15 Left Bank
COMPUTED BY H.E.W. CHECKED BY DATE Mar 66

CONDITION #3:-----
WEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=10.25

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	11844.5				106947.1	
WEL1=	7793.8				22793.5	
WEL2=	700.1				4340.6	
WER1=	5937.7				74815.6	
WER2=	8394.7				141031.8	
WIND=				552.7	9550.7	
PEL1=				2961.4	11598.9	
PEL2=				1610.2		2571.9
PEL3=				218.8		466.1
SUMS=	34671.0			5343.3	371078.5	3038.0
SUMV=	34671.0					
SUMH=				-5343.3		
SUMM=					368040.4	
H/V =	-.1					
M/V =	10.6					
SBL =	1596.6PSF					
SBR =	1705.3PSF					

Assume unbalanced horiz force is resisted as follows



The force is so close to origin of moments that its effect will have only minor effect on bearing values and can be neglected. A triangular resisting force is assumed because of deep fill

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 55+15 East Bank
COMPUTED BY _____ CHECKED BY _____ DATE _____

CASE 1 LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =7.25
HEIGHT OF WATER R.S. =21.5
HEIGHT OF EARTH L.S. =7.25
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		27.11	14445.31	103524.74	2.57	39.32
1/5=	4.30	18.51	9245.00	53004.66	1.92	
2/5=	8.60	14.50	5200.31	22361.34	1.03	
3/5=	12.90	14.50	2311.25	6625.58	.30	

CASE 3 LOADING - STEM
ENTER FOLLOWING
WEIGHT OF EARTH =130
HEIGHT OF EARTH L.S.=10.25
HEIGHT OF " R.S.=7.25
HEIGHT OF WIND LOAD =11.0

0 =		27.11	1676.12	13775.05	.34	
1/5=	4.30	18.51	1122.71	7757.55	.28	
2/5=	8.60	14.50	550.00	4070.00	.13	
3/5=	12.90	14.50	430.00	1649.00	.08	

CASE I LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS
LENGTH OF BEARING =18.4
BEARING =1931.1
HEIGHT OF WATER =26
" " EARTH =7.25
WEIGHT OF EARTH =67

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		24.17	-7669.19	-23906.85	-.66	-29.67
1/3=	1.94	20.61	-5449.71	-11063.19	-.36	
2/3=	3.89	17.05	-2693.32	-2875.26	-.11	

CASE 3 LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS:
WEIGHT OF EARTH =130
HEIGHT OF EARTH =10.25
BEARING P (HEEL) =1705.3
BEARING P (TOE) =1596.6

STEM=		24.17	73.06	~~-30.43802~~	neg. ~~-.22~~	

CASE I LOADING RIVERSIDE BASE

STEM=		27.50	6741.97	49960.55	1.22	22.93
1/3=	4.20	23.16	5590.02	25271.74	.73	
2/3=	8.40	18.83	3622.56	7476.51	.26	

CASE 3 LOADING RIVERSIDE BASE

STEM=		27.50	-2884.64	-16026.29	-.39	
1/3=	4.20	23.16	-1695.90	-3754.65	-.10	

NED FORM 223
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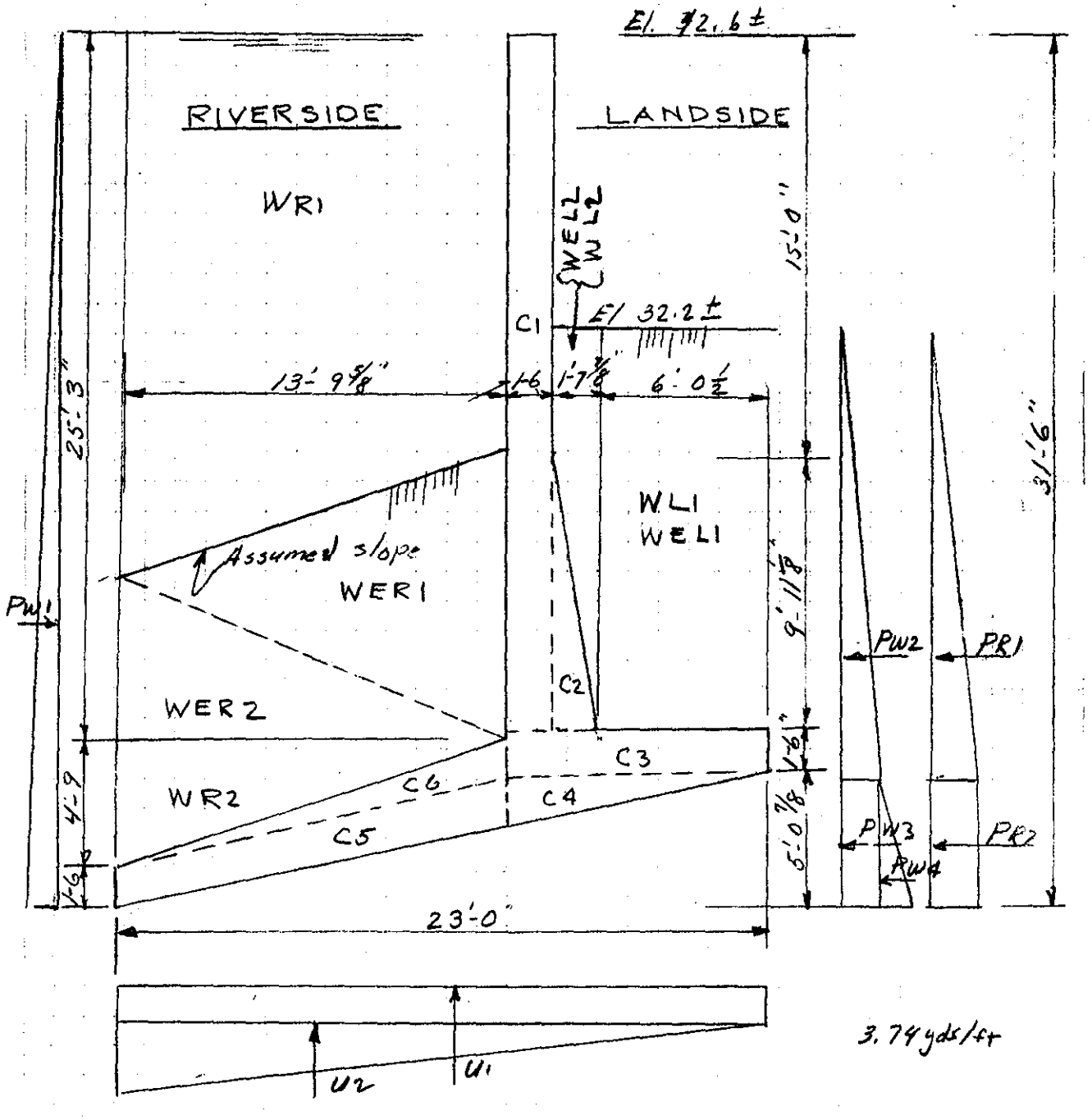
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 10+00 Right Bank
COMPUTED BY H. E. W. CHECKED BY DATE Feb 66



Wall @ Sta. 10+00
Right Bank

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 10+00 Right Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	5609.37	47399.21
C2 =	1232.69	8811.70
C3 =	2070.00	9522.00
C4 =	1399.16	8581.55
C5 =	3105.00	49990.50
C6 =	1768.12	24400.12
CONC=	15184.36	148705.10

CUBIC YARDS/LF OF WALL = 3.74

CONDITION #1:----
CREEP RATIO = 3.7

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15184.3				148705.1	
WEL1=	5811.8				17566.1	
WEL2=	795.6				5248.5	
WER1=	4854.1				66987.2	
WER2=	4854.1				89316.3	
WR1 =	21778.1				350627.8	
WR2 =	2048.4				37691.2	
WL1 =	5421.5				16386.3	
WL2 =	742.2				4896.0	
U1 =		28902.6				332380.1
U2 =		8189.3				125569.5
PW1 =			31007.8			168389.6
PW2 =				9958.8	52615.8	
PW3 =				6370.4		16147.3
PW4 =				1805.0		6100.2
PR1 =				7851.2	41480.7	
PR2 =				5022.2		12730.0
SUMS=	61490.4	37091.9	31007.8	31007.8	831521.4	661316.9
SUMV=	24398.5					
SUMH=			-.0			
SUMM=					170204.5	

M/V = 6.9
SBL= 2312.7PSF
SBR= -191.1PSF
IF SBR IS NEGATIVE THEN SBR =0 & SBL = 2331.6PSF
BEARING LENGTH= 20.9FT.

Soils Note:
The structure is considered safe against detrimental foundation seepage pressures and foundation overstress since adequate seepage path has been provided for the maximum 11-foot differential hydrostatic head that can develop and there is sufficient earth fill behind the wall to develop required passive earth pressures to resist sliding.

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 10+00 Right Bank
COMPUTED BY H.E.W. CHECKED BY DATE Feb 66

CONDITION #2:

CREEP RATIO = 5.1

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15184.3				148705.1	
WEL1=	5811.8				17566.1	
WEL2=	795.6				5248.5	
WER1=	4854.1				66987.2	
WER2=	4854.1				89316.3	
WR1 =	19190.6				308969.0	
WR2 =	2048.4				37691.2	
WL1 =	5421.5				16386.3	
WL2 =	742.2				4896.0	
UI =		27167.8				312430.3
U2 =		6900.4				105806.8
PW1 =			25382.8			112459.9
PW2 =				9361.0	49457.8	
PW3 =				5988.0		15178.1
PW4 =				1520.9		5140.1
PR1 =				5191.6	27429.4	
PR2 =				3321.0		8417.8
SUMS=	58902.9	34068.3	25382.8	25382.8	772653.3	559433.3
SUMV=	24834.6					
SUMH=			-.0			
SUMM=					213219.9	
M/V =	8.5					
SBL=	1900.7PSF					
SBR=	258.8PSF					

NED FORM 223
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NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

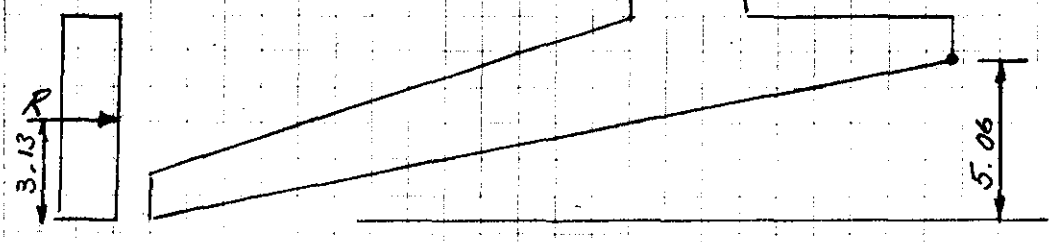
SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta. 10+00 Right Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66

CONDITION #3:-----
WEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=17.35

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	15184.3				148705.1	
WEL1=	13634.2				41209.0	
WEL2=	1866.5				12312.7	
WER1=	9418.5				129975.3	
WER2=	9418.5				173300.4	
WIND=				379.0	8581.2	
PEL1=				7621.6	47889.4	
PEL2=				4099.4		10391.0
PEL3=				551.2		1363.0
SUMS=	49522.1			12651.4	561973.3	12254.0
SUMV=	49522.1					
SUMH=				-12651.4		
SUMM=					549719.2	
H/V =	-.2					
M/V =	11.1					
SBL =	2377.5PSF					
SBR =	1928.7PSF					

Assume unbalanced horiz force is balanced as follows



	+Vert	-Vert	+Horiz	-Horiz	+Moment	-Moment
Prev. Tot.	49522.1			12651.4	549719.2	
R			12651.4		1.93 24417.2	
	49522.1		12651.4	12651.4	574136.4	

$\Sigma H = 0$
M/V = 11.59
SBL = 2102.6
SBR = 2203.7

Use these pressures in figuring steel

NED FORM 223
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NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

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SUBJECT Ansonia Derby
COMPUTATION Tee Type Flood Walls Sta 10+00 Right Bank
COMPUTED BY H.E.W CHECKED BY DATE Feb 66

CASE 1 LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =10.5
HEIGHT OF WATER R.S. =25.25
HEIGHT OF EARTH L.S. =14.35
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		34.36	18866.16	161068.93	3.15	41.52
1/5=	5.05	24.26	12123.46	83490.88	2.31	
2/5=	10.10	14.50	7172.57	36221.52	1.68	
3/5=	15.15	14.50	3187.81	10732.30	.49	

CASE 3 LOADING - STEM
ENTER FOLLOWING
WEIGHT OF EARTH =130
HEIGHT OF EARTH L.S.=17.35
HEIGHT OF " R.S.=6.0
HEIGHT OF WIND LOAD =7.9

0 =		34.36	6079.73	44211.69	.86	
1/5=	5.05	24.26	3620.81	19717.81	.54	
2/5=	10.10	14.50	498.81	4500.13	.20	
3/5=	15.15	14.50	505.00	2550.25	.11	

CASE I LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS
LENGTH OF BEARING =20.9
BEARING =2331.6
HEIGHT OF WATER =31.5
" " EARTH =14.35
WEIGHT OF EARTH =67

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		29.48	-7020.42	-23311.07	-.53	-22.27
1/3=	2.01	24.15	-5141.75	-10980.37	-.30	
2/3=	4.02	18.82	-2801.61	-2900.06	-.10	

CASE 3 LOADING LANDSIDE BASE
ENTER FOLLOWING ITEMS:
WEIGHT OF EARTH =130
HEIGHT OF EARTH =17.35
BEARING P (HEEL) =1~~988.71~~ 2203.7
BEARING P (TOE) =~~2377.5~~ 2102.6

STEM=		29.48	1583.18	3817.34	.08	

CASE 1 LOADING RIVERSIDE BASE

STEM		35.00	6551.68	56632.69	1.08	17.51
1/3	4.60	28.16	5776.31	29489.57	.70	
2/3	9.20	21.33	4136.27	9286.17	.26	

CASE 3 LOADING RIVERSIDE BASE

STEM=		35.00	-6291.00	-48417.46	-.93	
1/3=	4.60	28.16	-4678.01	-12072.06	-.28	

NED FORM 223
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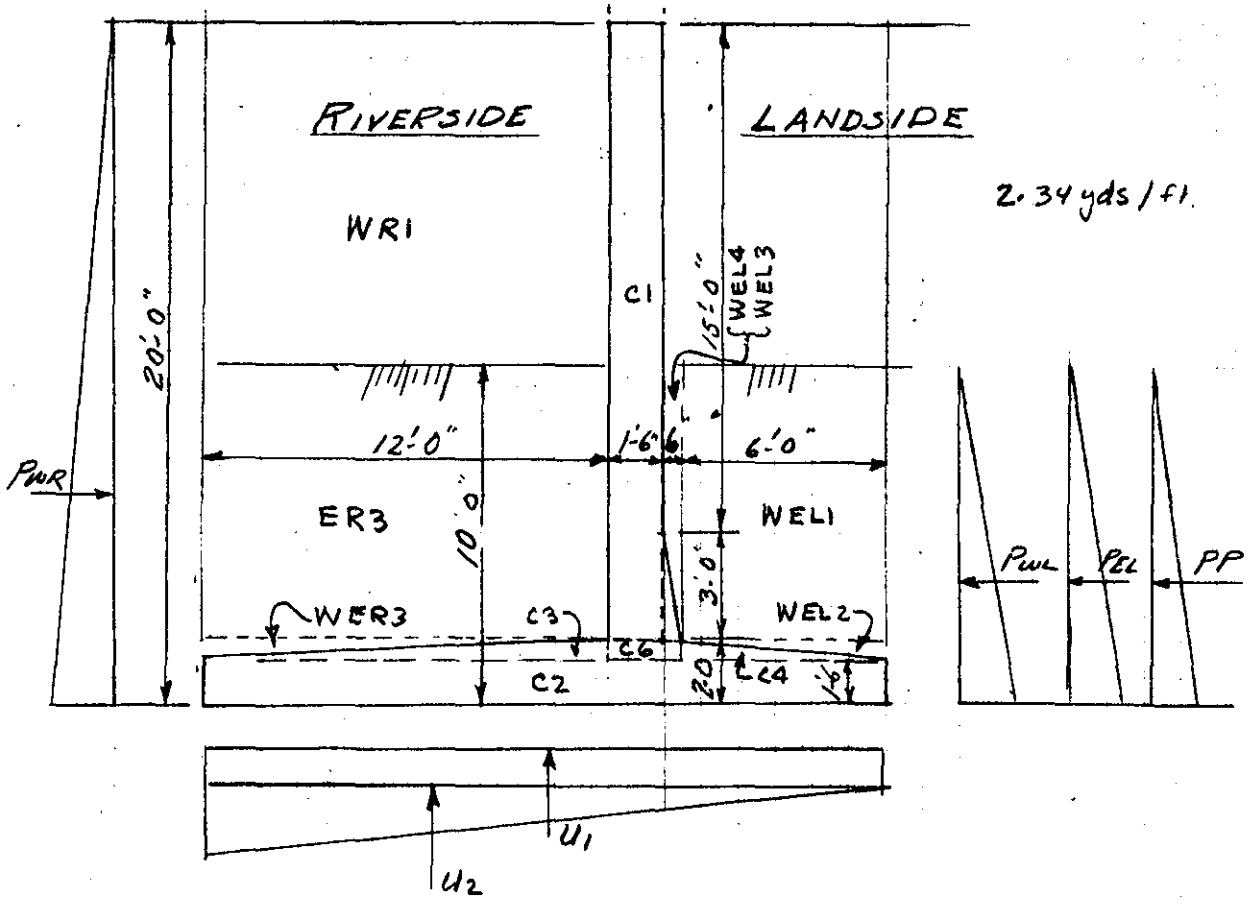
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Ansonia Derby
COMPUTATION T- Type Flood Wall @ Maple Street - Right Bank
COMPUTED BY _____ CHECKED BY _____ DATE _____

Condition I Loading & Dimensions



2.34 yds / ft.

Note - Base of wall must be set 10'-0" below grade in order to reach good material
Base width is required in order to obtain a foundation sliding factor of safety of at least 1.5

An I wall was also considered but not used due to proximity of buildings and possible damage to them from pile driving operation

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION T-Type Flood Walls @ Maple Street -
COMPUTED BY C.M.T. CHECKED BY DATE Mar 66

CONCRETE ONLY:------

	LOAD#	MOMENT#FT
C1 =	4050.00	51637.50
C2 =	4500.00	45000.00
C3 =	450.00	3600.00
C4 =	225.00	3600.00
C5 =	112.50	1537.50
C6 =	150.00	1950.00
CONC=	9487.50	107325.00

CUBIC YARDS/LF OF WALL= 2.34

CONDITION #1:------

CREEP RATIO= 3.00
INSTRUCTIONS:-------SET DECIMAL 1

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	9487.5				107325.0	
WR1 =	13500.0				81000.0	
WER2=	388.5				1554.0	
ER3 =	6432.0				38592.0	
WEL1=	6216.0				105672.0	
WEL2=	194.2				3496.5	
WEL3=	97.1				1343.5	
WEL4=	323.7				4451.5	
U1 =		16666.6				166666.6
U2 =		4166.6				27777.7
PWR =			12500.0		83333.3	
PWL =				4166.6		13888.8
PEL =				1115.5		3718.5
PP =				7217.7		24059.2
SUMS=	36639.1	20833.3	12500.0	12500.0	426767.9	236111.1
SUMV=	15805.7#					
SUMH=			-.0#			
SUMM=					190656.8#FT	

H/V =&41 -.0
M/V = 12.0FT
SBPL= 1279.2PSF
SBPR= 301.3PSF
IF SBPR IS NEGATIVE, THEN SBPR=0 & SBPL= 1327.5PSF
BRGL= 23.8FT

Condition #2 not critical

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION T-Type Flood Walls @ Maple Street
COMPUTED BY C.M.T. CHECKED BY DATE Mar. 66

CONDITION #3 :-------

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	9487.5	..	..	..	107325.0	
WER2=	390.0	..	..	..	1560.0	
ER3 =	12480.0	..	..	..	74880.0	
WEL1=	6240.0	..	..	..	106080.0	
WEL2=	195.0	..	..	..	3510.0	
WEL3=	97.5	..	..	..	1348.7	
WEL4=	325.0	..	..	..	4468.7	
PEL =	..	..	..	2164.5	..	7214.9
PER =	..	..	2164.5	..	7214.9	
PWND=	..	..	..	500.0	..	7500.0
PSUR=	..	..	..	1298.7	..	6493.5
SUR =	2535.0	..	..	..	42461.2	
PP =	..	..	..		..&41	.0
SUMS=	31750.0		2164.5	3963.2	348848.7	21208.4
SUMV=	31750.0#					
SUMH=	..	..	-1798.7#			
SUMM=	..	..	..	..	327640.2#FT	
H/V =	-.0					
M/V =	10.3FT					
SBPL=	1739.6PSF					
SBPR=	1435.3PSF					

WALL DESIGN (PER LINEAR FOOT) :-------CONDITION 1

INSTRUCTIONS:----SET MAG 7,DEC 1,AUX READER OFF
SIGN CONVENTION: +V=DOWN +M=CLOCKWISE +H=TOWARD LAND

STEM DESIGN:
X MEASURED FROM TOP OF STEM @ 1/5 PT'S, REINF @R.S.FACE, 3.5"MIN COV.

X FT	SHEAR#	MOMENT#FT	D REQD"	D GIV"	SHEAR,PSI	REINFX10
-17.9	7458.2	53637.5	18.7	20.4	30.3	18.1
-14.3	5673.1	29918.8	14.0	14.5	32.6	14.3
-10.7	3618.0	13112.9	9.2	14.5	20.7	6.2
-7.1	1619.6	3886.8	5.0	14.5	9.3	1.8
-3.5	404.7	485.6	1.7	14.5	2.3	.2

TOE DESIGN:
X MEASURED FROM L.S. TOE @ 1/3 PT'S, REINF @ BOT FACE, 4.5" MIN COV.

-5.9	-5945.0	-16609.8	10.4	19.4	25.4	5.9
-3.9	-3690.7	-7017.4	6.7	17.4	17.5	2.7
-1.9	-1708.6	-1662.3	3.3	15.4	9.1	.7

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION T-Type Flood Walls @ Maple Street
COMPUTED BY C.M.T. CHECKED BY DATE

CONDITION No 1 (cont.)

HEEL DESIGN:
X MEASURED FROM R.S. HEEL @ 1/3 PT'S, REINF @ TOP FACE, 3.5" MIN COV

-11.9	2834.0	-20920.9	11.7	20.4	11.5	7.0
-7.9	2324.5	-10456.5	8.2	18.4	10.4	3.9
-3.9	1379.3	-2901.9	4.3	16.4	6.9	1.2

WALL DESIGN (PER LINEAR FOOT) :------CONDITION 3

INSTRUCTIONS:----MAG 7, DEC 1, AUX READER OFF
SIGN CONVENTION: +V=DOWN +M=CLOCKWISE +H=TOWARD LAND

STEM DESIGN:
X MEASURED FROM TOP OF WALL @ 1/3 PT'S,REINF@L.S.FACE,3.5"MIN COV.

X FT	SHEAR#	MOMENT#FT	D REQD"	D GIV"	SHEAR,PSI	REINFX10
-17.9	-1538.8	-10653.9	8.3	20.4	6.2	3.6
-11.9	-759.4	-3757.9	4.9	8.4	7.4	3.0
-5.9	-299.8	-898.9	2.4	14.5	1.7	.4

TOE DESIGN:
X MEASURED FROM L.S. TOE @ 1/3 PT'S, REINF@TOP FACE IF +M, 3.5"MIN COV.

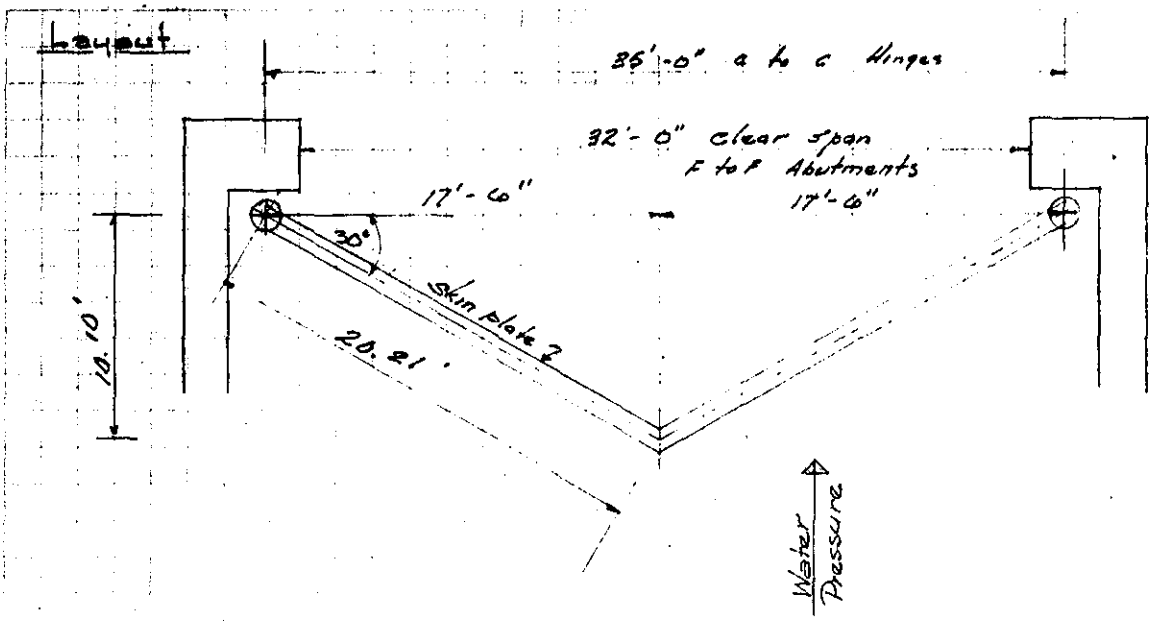
-5.9	186.1	254.6	1.2	20.4	.7	.0
-3.9	56.5	23.1	~~.3~~	~~18.4~~	~~.2801~~	~~.0~~
~~-1.9~~	~~-5.4~~	~~-16.6~~	~~.3~~	~~15.4801~~	~~.2801~~	~~.0~~

HEEL DESIGN:
X MEASURED FROM R.S. HEEL @ 1/3 PT'S, REINF@BOT FACE IF +M, 4.5"MIN COV.

-11.9	-2299.6	11727.2	8.7	19.4	9.8	4.1
-7.9	-1302.8	4597.4	5.4	17.4	6.2	1.8
-3.9	-536.2	995.2	2.5	15.4	2.8	.4

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Steel Gate
COMPUTED BY R.A.K. CHECKED BY A GR DATE Oct. 1965

Layout



General Notes

The gate is to be of the miter type with the skinplate placed on the landside. Water tightness is to be obtained by utilizing rubber seals along the vertical joints and sand bagging the bottom.

The gate is to be designed for the following loading conditions:

Case I - Flood Condition: Water @ El. 43.8, jacks @ gate center engaged. Normal Stresses

Case IA Same as case I, except jacks not engaged (Note this case will be investigated @ a later date) Increased Stresses.

Case II - Gates swinging in position, No water no jack, dead load.

$$app. = \tan 30° \times 17.5' = 17.5 \times 0.57735 = 10.10'$$

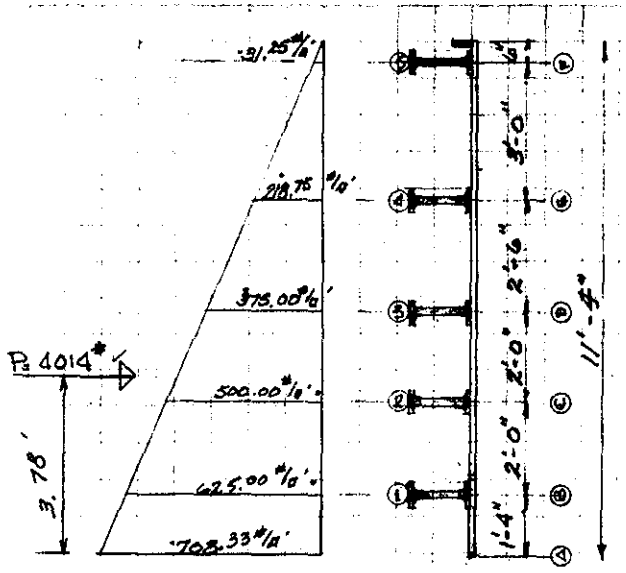
$$Hyp. = 17.5 \div \cos 30° = 17.5 \div .86603 = 20.21'$$

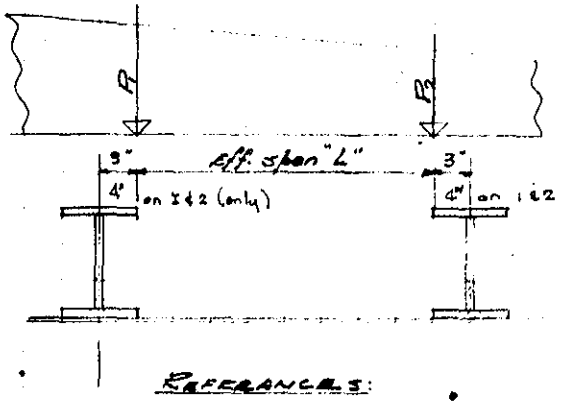
Note Subsequent to preparation of computations the height of gate was reduced from 11'-4" to 9'-6" Final computations will be made reflecting this reduction. Computations presented are typical for the design of all street gates

SUBJECT Ansonia - Derby

COMPUTATION Street Gate No. 3 Steel Gate

COMPUTED BY R. A. K. CHECKED BY GR. DATE Oct. 1965

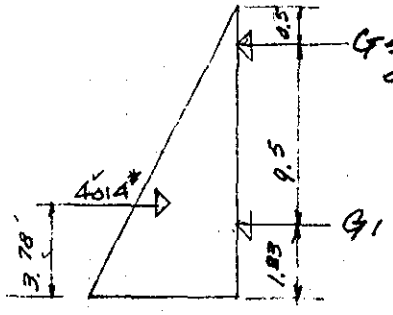




REFERENCES:

E.M. 1110-1-2101
"Working Stresses for Structural Design"
Bureau of Reclamations
Reinf. Conc. Design Data Eng'g. Mono. #10

		- 1.		.5 .5		.56 .44		.55 .46		1. -
	1.33'	(1)	2.0'	(2)	2.0'	(3)	2.5'	(4)	3.0'	(5) 0.5'
T.E.M.	+602.°	-192.°	+183	-150	+142	-163	+146	-108	+80	-1.3
		-410.°	-166.5	-16.5	+11.8	+9.2	-20.9	-17.1	-78.7	
		-8.2	-205.9	+5.9	-8.2	-10.4	+4.6	-39.4	-8.6	
		+8.2	+99.5	+99.5	+10.4	+8.2	+19.1	+15.7	+8.6	
		+49.8	+4.1	+5.2	+49.8	+9.6	+4.1	+4.3	+7.8	
		-49.8	-4.6	-4.6	-33.3	-26.1	-4.6	-3.8	-7.8	
		-2.3	-24.9	-16.7	-2.3	-2.3	-13.1	-3.9	-1.9	
		+2.3	+20.8	+20.8	+2.6	+2.0	+9.4	+7.6	+1.9	
-M	+602.°	-602.°	+156.4	-56.4	+172.8	-172.8	+144.6	-144.6	+1.3	-1.3
R	886.7	856.1	268.9	400.1	474.9	414.9	327.2	282.2	42.9	7.21
+M		14.4		109.5		73.2		67.4		



Axial load to be taken by members G1 & G5 only and not by intermediate members.

G1 & G5 = 4014#

$9.5\,G_5 = 4014 \times 2.45'$

$G5 = 1035\#$ ∴ G1 = 2979

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 (Steel Gate)
COMPUTED BY R.A.K. CHECKED BY A GR. DATE Oct. 1965

Fixed End Moments:-

(Cantilever)

@ ① $\frac{wl^2}{2} + \frac{wl^3}{3} = 625 \times \frac{1.33^2}{2} + 83.33 \times \frac{1.33^2}{3} = 602\#/ft$

① to ② $= \frac{l^2}{60}(3w_1 + 2w_2) = \frac{2.0^2}{60}(3 \times 625 + 2 \times 500) = 191.67$

② to ① $= \frac{l^2}{60}(2w_1 + 3w_2) = \frac{2.0^2}{60}(2 \times 625 + 3 \times 500) = 183.33$

② to ③ $= \frac{2.0^2}{60}(3 \times 500 + 2 \times 375) = 150.00$

③ to ② $= \frac{2.0^2}{60}(2 \times 500 + 3 \times 375) = 141.67$

③ to ④ $= \frac{2.5^2}{60}(3 \times 375 + 2 \times 218.75) = 162.76$

④ to ③ $= \frac{2.5^2}{60}(2 \times 375 + 3 \times 218.75) = 146.48$

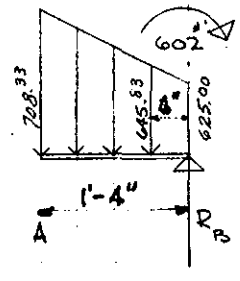
④ to ⑤ $= \frac{3.0^2}{60}(3 \times 218.75 + 2 \times 31.25) = 107.81$

⑤ to ④ $= \frac{3.0^2}{60}(2 \times 218.75 + 3 \times 31.25) = 79.69$

(Cantilever)

⑤ $\frac{wL^3}{6} = 31.25 \times \frac{0.5^2}{6} = 1.3$

Beam Action (A-B)



Reaction (R) $= (625 + 708.33) \times \frac{1.33}{2} = \underline{886.7\#}$

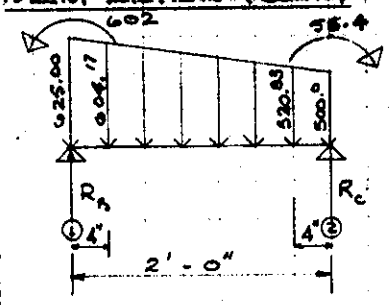
$-M$ reduced to face $= (1'\text{-}4'' \text{ minus } 4'')^2 \frac{(645.83)}{2} + (1.0)^2 \frac{(62.5)}{3}$
(4" from ℄)

$= 323 + 21 = \underline{344\#'}$

Reaction @ face $= (645.83 + 708.33) \times \frac{1.0}{2} = \underline{677\#}$

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Structural Supports
COMPUTED BY R.A.R. CHECKED BY CR. DATE Oct. 1965

BEAM ACTION (cont.)



$R_C = (500.0 \times 2.0)\frac{1}{2} + (625-500)\times 2 \times \frac{1}{2} \times \frac{1}{3} - \left(\frac{602-56.4}{2.0}\right)$

$= 500.0 + 41.7 - 272.8 = \underline{268.9}^{\#}$

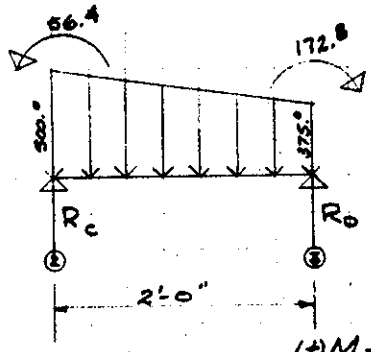
$R_B = 500.0 + (125)\times\frac{2}{3} + 272.8 = \underline{856.1}^{\#}$

Point of zero shear $= 268.9 - 500(x) - 62.5(x)(\frac{x}{2}) = 0.52'$

Positive (+) M $= .52 \times 268.9 - 500(\frac{.52}{2})^2 - 62.5(\frac{0.52}{6})^3 - 56.4 = \underline{14.4}^{k'}$

(-) M e_1 reduced to face $= 602 - \frac{1}{3} \times 754 \times \frac{8}{12} = \underline{435}^{\#'}$ ✓

R_B @ face $= 856.53^{\#} - (625.0 + 604.17)\times \frac{1}{2} \times \frac{4}{12} = 651.67^{\#}$



$R_C = (375.0 \times 2.0)\frac{1}{2} + (500.0 - 375.0)\times 2 \times \frac{1}{2} \times \frac{2}{3} - \left(\frac{172.8-56.4}{2}\right)$

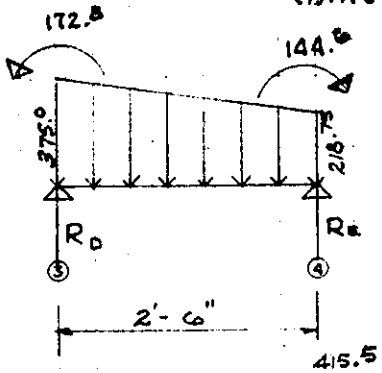
$= 375.0 + 83.33 - 58.2 = \underline{400.1}$

$R_D = 375.0 + 125 \times \frac{1}{3} + 58.2 = \underline{474.9}$

Point of zero shear $= 474.9 - 375(x) - 62.5(\frac{x}{2})^2 = 1.16'$

$550.9 - 282.3 - 16.3$

(+) M $= 474.9(1.16) - 375(\frac{1.16}{2})^2 - 62.5(\frac{1.16}{6})^3 - 172.8 = \underline{109.5}$



$R_D = (218.75 \times 2.5)\frac{1}{2} + (375 - 218.75)\frac{2.5}{2} \times \frac{2}{3} + \left(\frac{172.8-144.6}{2.5}\right)$

$= 273.4 + 130.2 + 11.3 = \underline{414.9}$

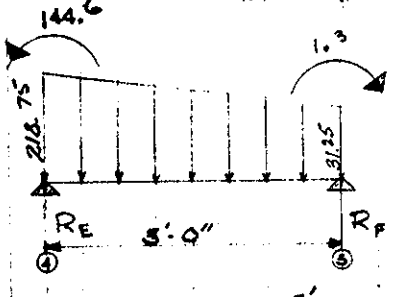
$R_E = 273.4 + 130.25 \times \frac{1.25}{3} - 11.3 = \underline{327.2}$

POINT OF ZERO SHEAR $= 327.2 - (218.75)(x) - 62.5(\frac{x}{2})^2 = 1.27'$

$- 176.4 - 21.3$

(+) M $= 327.2(1.27) - 218.75(\frac{1.27}{2})^2 - 62.5(\frac{1.27}{6})^3 - 144.6 = \underline{73.2}$

415.5



$R_E = (31.25 \times 3.0)\frac{1}{2} + (218.75 - 31.25)\frac{3.0}{2} \times \frac{2}{3} + \left(\frac{144.6-1.3}{3}\right)$

$= 46.9 + 187.5 + 47.8 = 282.2$

$R_F = 46.9 + (187.5)\frac{3.0}{2} \times \frac{1}{3} - 47.8 = 92.9$

93.8

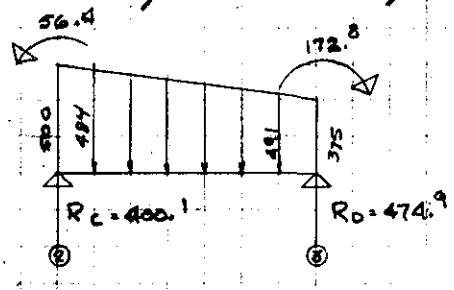
$99.4 - 17.9 - 12.8$

Pt. of zero shear $= 1.07'$ (+) M $= 92.9(1.07) - 31.25(1.07)^2/2 - (62.5)(1.07)^3/6 - 1.3 = 67.4^{k'}$ ✓

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Steel Gate
COMPUTED BY R.A.K. CHECKED BY G.R. DATE Oct. 1965

From E.M. 110-1-2101 Basic Stresses type B (Hydraulic)

Bending = 0.50 × 36,000 = 18,000 #/□"



R_D reduced to face = $474.9 - \frac{2''}{12} \times \left(\frac{491 + 375}{2}\right) = 366.7$ #

− M reduced to face

$172.8 - \frac{1}{3} \times \left(\frac{474.9 + 366.7}{2}\right) \times \frac{6}{12} = 103$ #'

Section Modulus Required = $\frac{-103 \times 12}{18{,}000} = 0.069$ ✓

Reduction of Positive Moment by $\frac{1}{6}$ Va with unbalanced loading and Shear reactions

Reduction Factor = $\frac{V_L a L}{6} + \left[\frac{V_R a R}{6} - \frac{V_L a L}{6}\right] \frac{l_1}{L}$ where l_1 = dist. to pos. M from face of ⊥; V = shear of face of ⊥

$= \frac{327 \times \frac{6''}{12}}{6} + \left[\frac{423 \times \frac{6''}{12}}{6} - \frac{337 \times \frac{6''}{12}}{6}\right] \frac{0.91}{1.3} = 28.08 + 4.35 = 32.43$

(+)M reduced = (+)M − $\frac{1}{6}$ VaL = 109.5 − 32.43 = 77.07 #'

Section Modulus Req'd = (+) $\frac{77.07 \times 12}{18000}$ = 0.073 in³ (for A36 steel)

109.5* * HEW does not allow red. of + M.

thickness req'd = $12 \times \frac{t^2}{6}$ = 0.073 in³

t^2 = 0.0365 in² ∴ t = 0.191 "

∴ Use a 1/4" ⊥

Sect. Mod. Req'd (for A441 steel) = $\frac{109.5 \times 12}{25{,}000}$ = 0.053 in³

Section Mod. of 1/4" ⊥ = 12" wide × $\frac{0.25^2}{6}$ = 0.125 in³

∴ Use a 1/4" ⊥ A 441 steel for upper spans and
3/8" ⊥ A 441 " " Lower spans

✓

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NEW ENGLAND DIVISION
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SUBJECT ANSONIA - DERBY
COMPUTATION STREET GATE No. 8" (SMALL GATE)
COMPUTED BY R.A.K. CHECKED BY R.C.K. DATE OCT. 1948

From E.M 1110-1-2101 Basic Stresses Type B (Hydraulic)

Bending: = 0.50 F_y = 0.50 × 50,000 #/□" = 25,000 #/□" ✓

Sect Mod. req'd @ joint ① = $\frac{-488^{\#'} \times 12^{\#}/in}{25{,}000\ \#/in^2}$ = 0.2088 in^3 ✓

thickness req'd = $12 \times \frac{t^2}{6}$ = 0.2088 in^3

t^2 = 0.1044 ∴ t = 0.32"

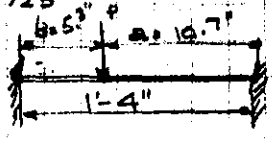
∴ Use a 3/8" PL A441 steel ✓

Check Deflection @ Cantilever w = 680# × 1/12 = 56.7 #/in

$\Delta = \frac{56.7\ \#/in \times 12^4\ in}{8 \times 29 \times 10^6 \times .0527\ in^4}$ = .096" or 1/125

I of 3/8" PL = $\frac{12 \times 0.375^3}{12}$ = .0527 in^4

Check Deflection between ① and ②

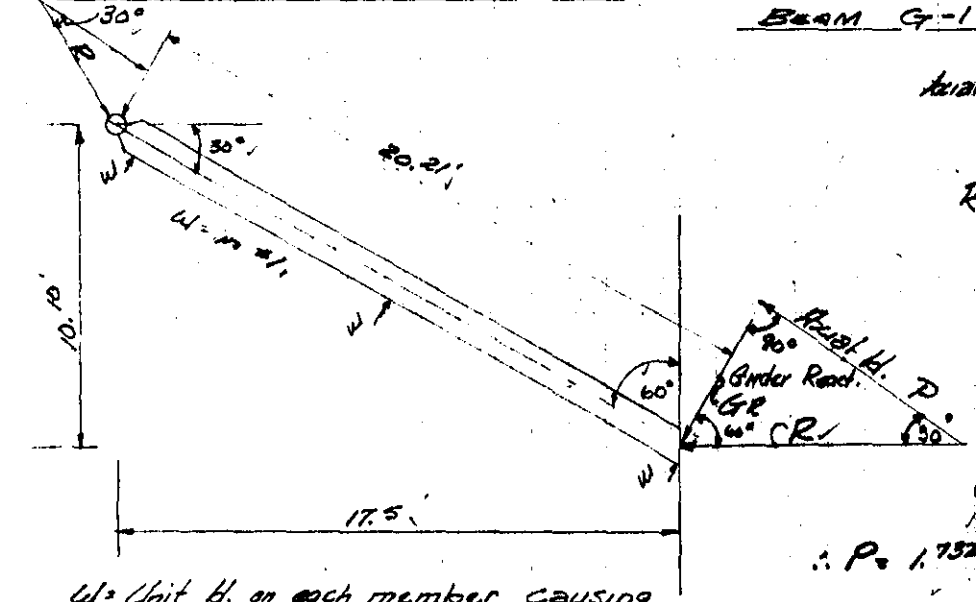


P = $\frac{(604+521)}{2} \times 1.33$ = 760#

$\Delta = \frac{2 \times 760^{\#} \times 10.7^3 \times 6.3^2}{3 \times 29 \times 10^6 \times .0527\ (3 \times 10.7 + 6.3)^2}$ = .080" (37.4)

HORIZONTAL BEAM DESIGN

BEAM G-1



Axial lb. = P = $\frac{GR}{\tan 30°}$ = 1.73205 GR

R = $\sqrt{GR^2 + 1.73205\,GR}$

= 2.0 GR ✓

Mom = $\frac{1}{8} w \times 20.21^2$

= 51.0555 w ✓

GR = 10.105 w ✓

∴ P = 1.73205 (10.105) w = 17.5 w ✓

∴ R = 2.0 (10.105) w = 20.21 w ✓

w = Unit lb. on each member causing horiz. bending.
W = total load causing axial lbs on G1 & G5

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27 Sept 49

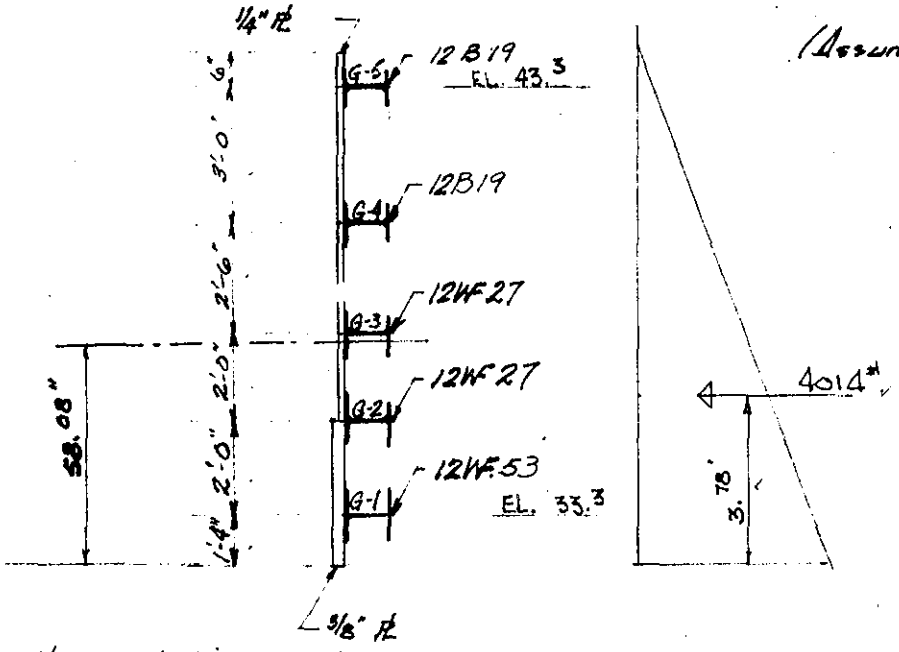
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Steel Gate
COMPUTED BY R.A.K. CHECKED BY GR. DATE Oct. 1965

Horizontal Beam Design

Table No. 1

	Unit load "w"	Total Unit Load "W"	Moment 51.0855 w	Reaction GR 10.105 w	Axial Load 17.50 W	Resultant 20.21 W
G1	1.743 k/'	2.979 k/'	89.01 'k	17.6 k	52.1	60.2 k
G2	.669 k/'	—	34.21 'k	6.8 k	—	—
G3	.890 k/'	—	45.41 'k	9.0 k	—	—
G4	.609 k/'	—	31.1 'k	6.1 k	—	—
G5	.101 k/'	1.035 k/'	5.2 'k	1.0 k	1.8 k	20.9 k
				Total Resultant "R" for one leaf. = (check 4.014 x 20.21 = 81.1)		81.1 k



(Assumed Gate Structure)

Horizontal Framing

Gate framing will be designed so that all axial loads on the horizontal members will be taken on the top and bottom members. Hinge fittings will be located @ the top and bottom members on the hinge post. ∴ the axial loads will thus be taken out directly into the concrete abutment thru the hinge fittings.

NED FORM 223
27 Sept 49

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

PAGE DM 46 (8)

SUBJECT Ansonia - Derby
COMPUTATION Sprent Gate Design : Steel Gate
COMPUTED BY R. A. K. CHECKED BY P. G.R. DATE Oct. 1965

ITEM	AREA A	y	PRODUCT Ay	I₀ of MEMBER	Ay²
12WF 53 ✓ G1	15.79 ✓	16" ✓	249	96.1	3,991
12WF 27 ✓ G2	17.97 ✓	40" ✓	319	16.6	12,752
12WF 27 ✓ G3	7.97 ✓	64" ✓	510	16.6	32,645
12B 19 ✓ G4	5.62 ✓	94" ✓	528	3.67	49,658
12B 19 ✓ G5	5.62 ✓	130" ✓	731	3.67	94,978
3/8" PL x 40"	15	20"	300	2000	6,000
1/4" PL x 96"	24	88"	2112	18,432	185,856
	81.77 ✓		4,749 ✓	20,569	385,880

$\bar{y} = \frac{4,749}{81.77} = (+)58.08"$ ✓

Total I about reference axis = 385,880 + 20,569 = 406,449

Transfer term $A\bar{y}^2$ = 4,749 x 58.08 = 275,822

$I - A\bar{y}^2$ = 130,627 ✓

$I_{N.A.} = 130,627^{IN^4}$

APPROXIMATE VERTICAL WEIGHT

G1-G5 = 145# ✓
1/4" PL = 82#
3/8" PL = 51#
Vert drag @ 6' = 50# ✓
Diag's etc = 20# ✓
D.L = 348#
+ 25% = 87#
485 ✓

Say 450#/'

WITH GATE SUPPORTED @ MITRE END BY JACKS

$M = \frac{1}{8} \times 450^{\#} \times 20.21^2 = 22,975^{\#'}$ ✓

$V = 450 \times \frac{20.21}{2} = 4.55^K$

$f_a = \frac{22,975 \times 12 \times 71.92}{130,627} = 151.8\#/\square"$ G5 comp.

$f_a = \frac{22,975 \times 12 \times 85.92}{130,627} = 75.4\#/\square"$ G4 Comp.

$f_a = \frac{22,975 \times 12 \times 5.92}{130,627} = 12.5\#/\square"$ G3 Comp

$f_a = \frac{22,975 \times 12 \times 28.08}{130,627} = 38.2\#/\square"$ G2 Tension

$f_a = \frac{22,975 \times 12 \times 42.08}{130,627} = 88.8\#/\square"$ G1 Tension ✓

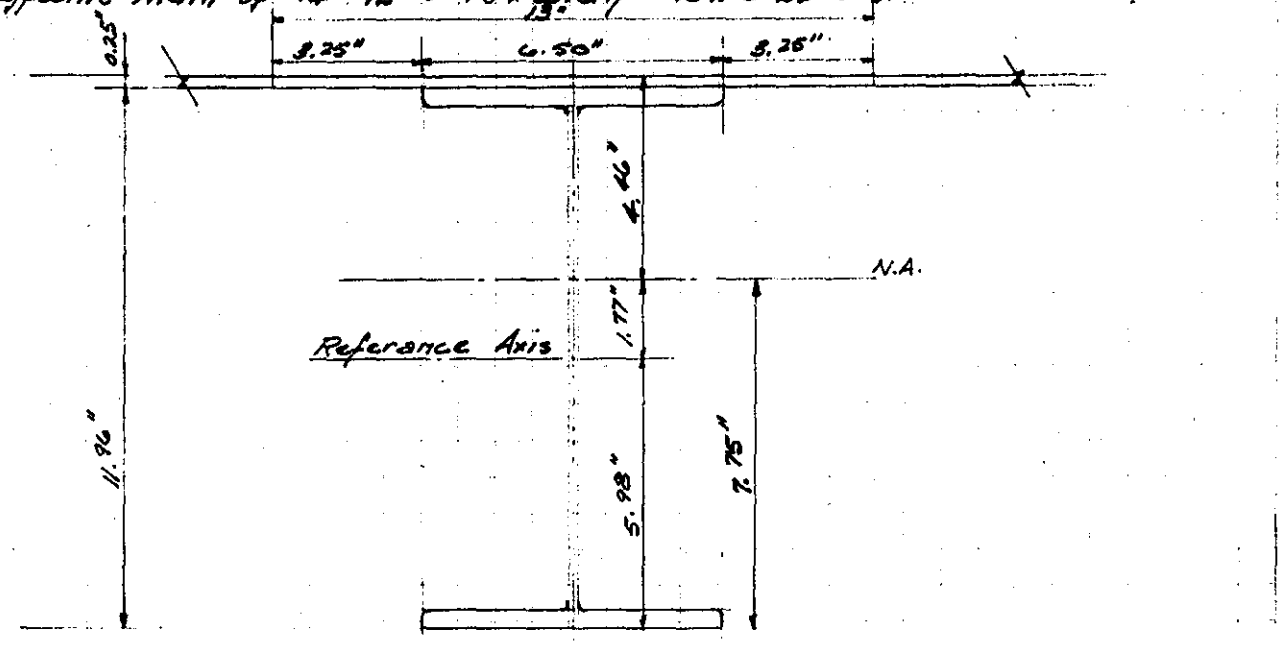
NED FORM 223
27 Sept 49

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

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Steel Gate
COMPUTED BY R.A.K. CHECKED BY R.G.R. DATE Nov. 1965

G2 & G3 1.) Try a 12WF 27
(from AISC Sect. 1.9 pg 5-96)

Effective Width of 1/4" PL = 13 × width = 13 × 0.25 = 3.25"



Item	Area	y	Product Ay	Ay^2	I_o of Section
12WF 27	7.97 ✓	0	0	0	204.1
1/4" PL	3.25	6.105	19.84	121.13	0.017
	11.22		19.84	121.13	204.117

$\bar{y} = \frac{19.84}{11.22} = 1.77$ in

Total I about the reference axis = 204.117 + 121.13 = 325.247
Transfer term $A\bar{y}^2$ = 19.84 × 1.77 = 35.117
$I - A\bar{y}^2$ = 290.13

Section Modulus = $\frac{I}{c} = \frac{290.13}{7.75} = 37.44$ in³ (compression) @ flange

$= \frac{I}{c} = \frac{290.13}{4.46} = 65.05$ in³ (Tension @ PL)

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 2 , Sector Gate
COMPUTED BY R.A.K. CHECKED BY GR DATE Nov. 1963

from the Horizontal Beam Design Table No. 1
G3 (+) M = 45.4 ; G2 (+) M = 36² ; GR₃ = 9,000#

Combined Shear Stress on Skin Pl

Horizontal Bending ($f_{b\,hor}$) = $\frac{48.1^{\#} \times 12}{65.05}$ = 8.9 #/□" (tension)

Vertical Bending of Pl
(where stress of Pl taken at end of flange) = $\frac{103'^{\#} \times 12}{0.125\,IN^3}$ = 9,900 #/IN² (comp.)
$M_{vert.}$ = see page #5 - M reduced to face

where
Sect. Modulus @ 1/4" Pl = 12" Wide x 0.25^2 = 0.125 IN³

Max. Shearing Stress ($\tau_{max} = \frac{1}{2}(\sigma_{max} - \sigma_{min})$)

$\tau_{max} = \frac{1}{2}[-9{,}900 - (+8{,}400)] = 9{,}150$ #/IN² < 16,500 #/IN² allow.

Bending on the effective member

$f_{b_x} = \frac{45{,}400'^{\#} \times 12''/'}{37.44\,IN^3} = 14{,}550$ #/IN² < 18,000

∴ Use a 12WF27 for G-2, & G-3 A36 Steel

SUBJECT Ansonia - Derby

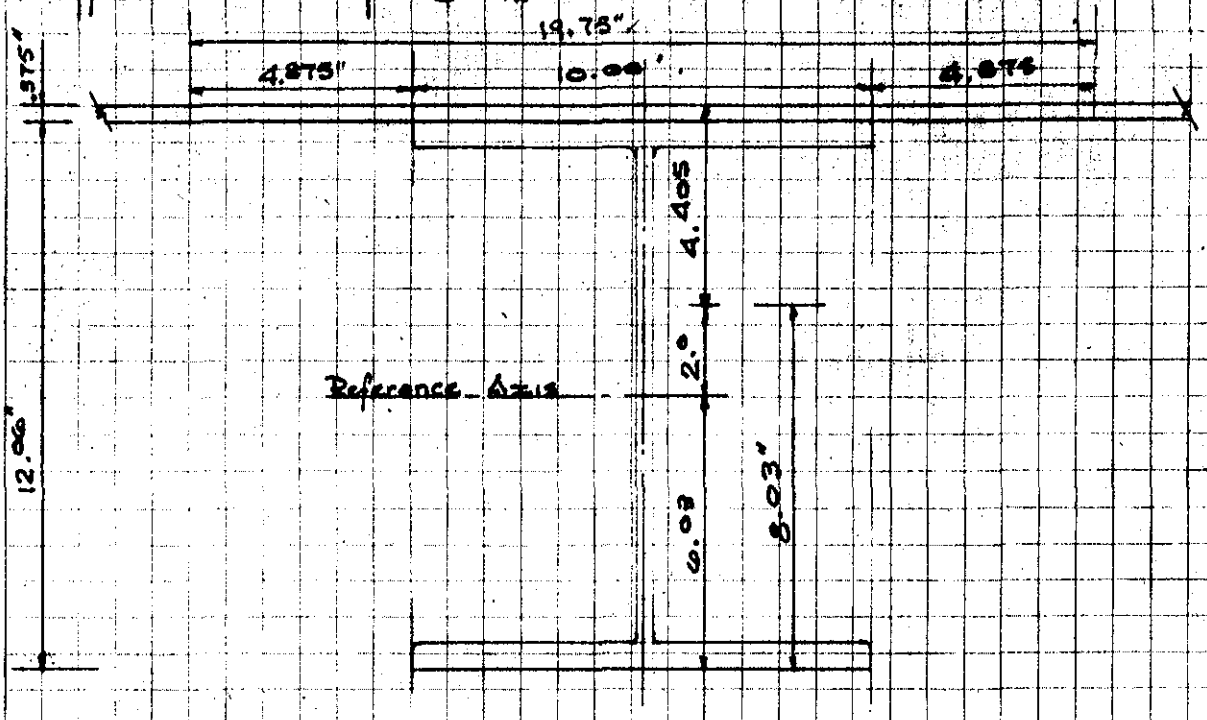
COMPUTATION Street Gate No. 3 — Stress in Gate

COMPUTED BY R.A.K. CHECKED BY A.G.R. DATE Nov. 1965

GIRDER G-1

Assume a 12WF 53

* Effective width of 3/8" PL = 13 × WIDTH = 13 × 0.375" = 4.875"



ITEM	AREA	y	Product Ay	Ay^2	I_o of SECTION
12WF53	15.59	0	0	0	426.2
3/8" PL	7.406	6.2175	46.05	286.3	0.087
	23.0		46.05	286.3	426.287

$\bar{y} = \frac{46.05}{23.0} = 2.0"$

Total I about the reference axis = 426.3 + 286.3 = 712.6

Transfer term $A\bar{y}^2$ = 46.05 × 2.0 = 92.1

$I - A\bar{y}^2$ = 620.5 IN⁴

Section Modulus of top of PL = $\frac{I}{c} = \frac{620.5}{4.405} = 140.86$

Section Modulus of bottom flange = $\frac{I}{c} = \frac{620.5}{8.03} = 77.27$

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 8 Steel Gate
COMPUTED BY R.A.K. CHECKED BY D.G.R. DATE Nov. 1965

12WF 53 for G-1 (cont.)

COMBINED BENDING AND AXIAL LOAD ON MEMBER

① Axial Load $= \frac{P}{A} = \frac{52.1}{23.0} = 2.265\ K/\square'' = f_a$

② Bending $= f_b = \frac{89.0 \times 12}{77.27} = 13.822\ K/IN^2$

$r_{xx} = \sqrt{\frac{I_{xx}}{A}} = \sqrt{\frac{620.8}{23.0}} = 5.2$

$\frac{L}{r_{xx}} = \frac{20.21 \times 12}{5.2} = 46.64$

I_{yy} of SECTION $= I_o + A\bar{d}^2 = 96.1 + 0 + 240.7 + 0 = 336.8$

$r_{yy} = \sqrt{\frac{I_{yy}}{A}} = \sqrt{\frac{336.8}{23.0}} = 3.83$

Note:- Assume the skin ⊥ along may not be sufficient to brace the member & that there will be intermediate stiffener posts @ 6'-0" on center.

$\frac{L}{r_{yy}} = \frac{6.0 \times 12}{3.83} = 18.8$

Now check stresses using values for the A36 steel member (AISC pg. 5-67 1.5.1)
$C_c = 126.1$ $K = 1.0$ (AISC pg. 5-117)
From EM 1110-1-2101 pg. 7)

$$F.S. = \frac{5}{3} + \frac{3}{8}\left(\frac{KL/r}{C_c}\right) - \left(\frac{KL/r}{8C_c^3}\right)^3 = \frac{5}{3} + \frac{3}{8}\left(\frac{1.0 \times 46.64}{126.1}\right) - \left(\frac{1.0 \times 46.64}{8(126.1)^3}\right)^3 = 1.80$$

(From EM 1110-1-2101 ¶ 11.(c) pg. 7)

$$K_1 = \frac{1 - \left[\frac{(KL/r)^2}{2C_c^2}\right]}{F.S.} = \frac{1 - \left[\frac{(46.64)^2}{2(126.1)^2}\right]}{1.80} = 0.518$$

$\therefore F_a = 0.83 \times 0.518 \times 36{,}000 = 15{,}478$

$\frac{f_a}{F_a} = \frac{2.265}{15.478} = 0.146 < 0.15$ $\therefore$ use $\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$

$\frac{2.265}{15.478} + \frac{13.822}{18.0} = 0.146 + 0.768 = 0.914 < 1$ $\therefore$ Sat.

COMBINED SHEAR STRESS ON SKIN PL

Horizontal Bending (f_b hor) = $\frac{89.0 \times 12}{140.86}$ = 7.582 #/in² (tension)

Axial Load $f_a = \frac{P}{A} = \frac{52.1}{23.0} = 2.265$ #/in² (compression)

total f_b (hor) = 7.582 − 2.265 = 5.317 #/in² (tension)

Sect. Mod. of 3/8" PL = 12" wide × $\frac{.375^2}{6}$ = 0.28 in³ ; of flange + PL = 12 × $\frac{.951^2}{6}$ = 1.81 in³

Vertical Bending of Plate PL = $\frac{602 \times 12}{1.81 \text{ in}^3}$ = 4.0 #/in²

(−) M reduced to face of flange ± = $\frac{435 \times 12}{0.28}$ = 18,643 #/in²

Max shearing Stress ($\tau_{max} = \frac{1}{2}(\sigma_{max} - \sigma_{min})$)

$\tau_{max} = \frac{1}{2}[-18{,}643 - (+5{,}317)] = 11{,}980$ #/in² < 0.33 × 50 = 16,500 #/in² allow.

∴ USE A 12WF 53 FOR G-1. A36 STEEL

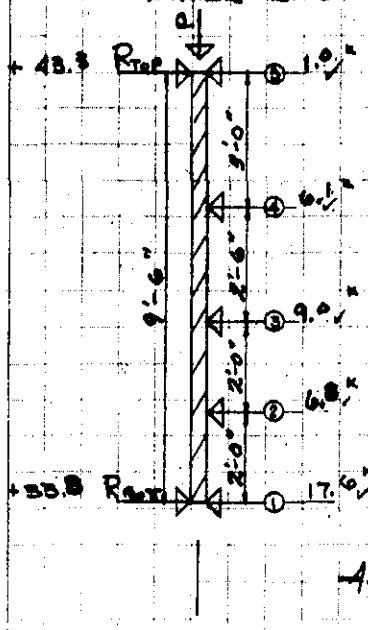
SUBJECT Ashokan - Derby

COMPUTATION Secret Gate No. 3 Steel Gate

COMPUTED BY R.A.K. CHECKED BY GR. DATE Nov. 1965

Loading on Vertical End Members

Note:-
All horizontal members will frame into vertical posts with web to web connections. Vertical posts will be supported at El. 45.3 and El. 33.3 at both hinged and miter end.



$R_T = \frac{4.8 \times 2.0 + 9.0 \times 4.0 + 6.1 \times 6.8 + 1.0 \times 9.5}{9.5} = 10.4^k$

$R_B = \frac{6.1 \times 3.0 + 9.0 \times 5.6 + 6.8 \times 7.5 + 17.6 \times 9.5}{9.5} = 30.1^k$

$M_{max} = 30.1 \times 4.0 - 17.0 \times 4.0 - 6.8 \times 2.0 = 26.4^k$ (120.4)

Section Modulus req'd $= \frac{26.4 \times 12}{18.0} = 26.4^{in^3}$

Vertical Member @ hinge and will take dead load of gate axially.

Assume Gate Weight 450#/1 (See pg. 10) x 20.2' = 9,095#

Try a 12WF 31 A = 9.12 S = 39.4 r_{x-x} = 5.11

$f_a = \frac{9{,}095^{\#}}{9.12} = 997^{\#}/\square''$

$\frac{L}{r_{x-x}} = \frac{9'\text{-}6'' \times 12''/1}{5.11} = 22$

$f_b = \frac{36{,}400'^{\#} \times 12}{39.4} = 11{,}100^{\#}/in^2$

Check stresses using values for the A36 Steel member (AISC pg. 5-67 1.5.1)
$C_c = 126.1$, $K = 1.0$ (AISC pg. 5-117)

(From EM 1110-1-2101 pg. 7)

$F.S. = \frac{5}{3} + \frac{3}{8}\left(\frac{KL/r}{C_c}\right) - \frac{(KL/r)^3}{8C_c^3} = \frac{5}{3} + \frac{3}{8}\left(\frac{1.0 \times 22}{126.1}\right) - \frac{(1.0 \times 22)^3}{8(126.1)^3} = 1.73$

(From EM 1110-1-2101 ¶ 11(c) pg. 7)

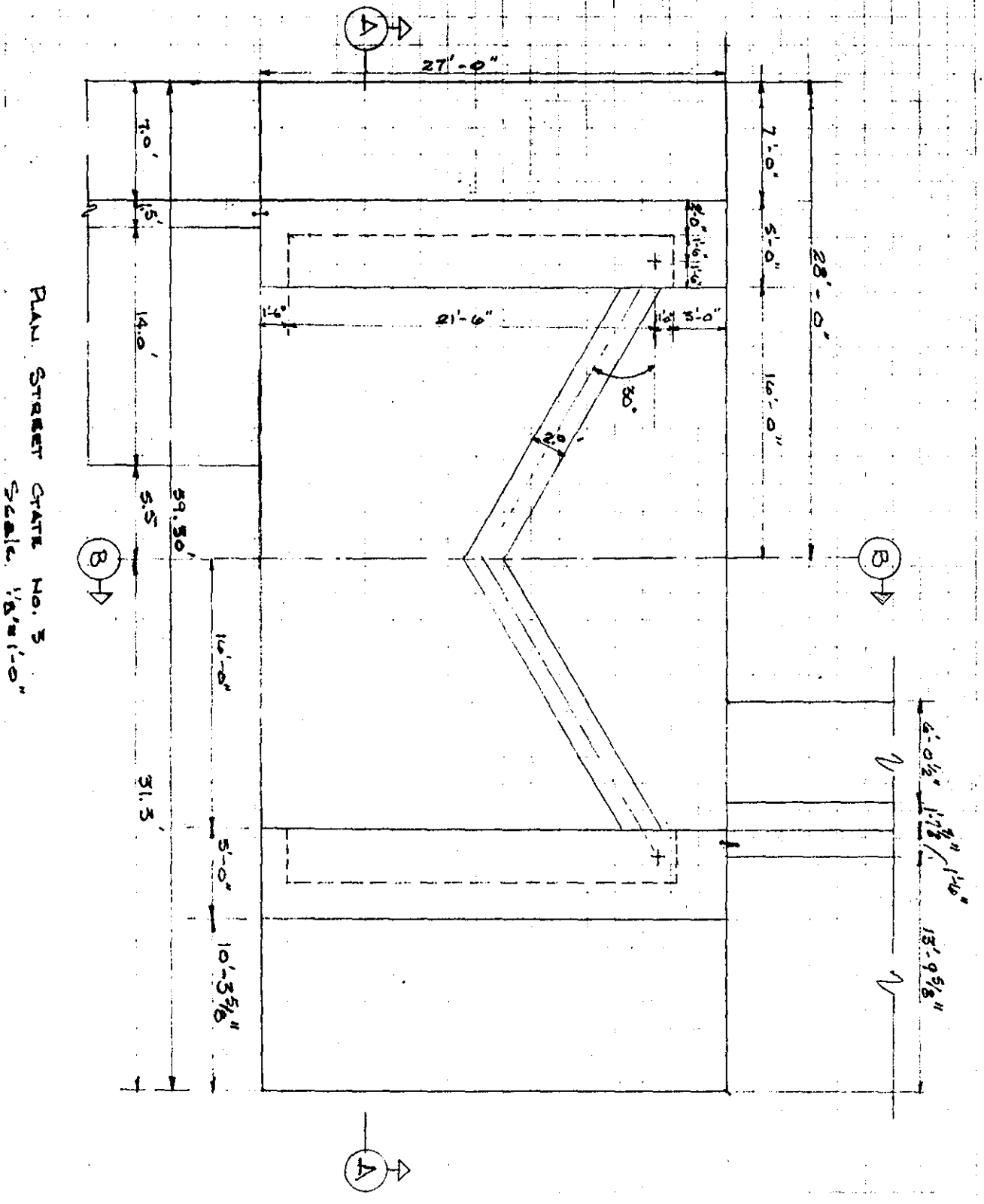
$K_1 = \frac{1 - \left[\frac{(KL/r)^2}{2C_c^2}\right]}{F.S.} = \frac{1 - \left[\frac{(22)^2}{2(126.1)^2}\right]}{1.73} = 0.569$

$\therefore F_a = 0.83 \times 0.569 \times 36{,}000 = 17{,}000^{\#}/in^2$

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3, Concrete Abut.
COMPUTED BY Karlson CHECKED BY EPG DATE April 1966



PLAN STREET GATE No. 3
SCALE 1/8" = 1'-0"

NED FORM 223
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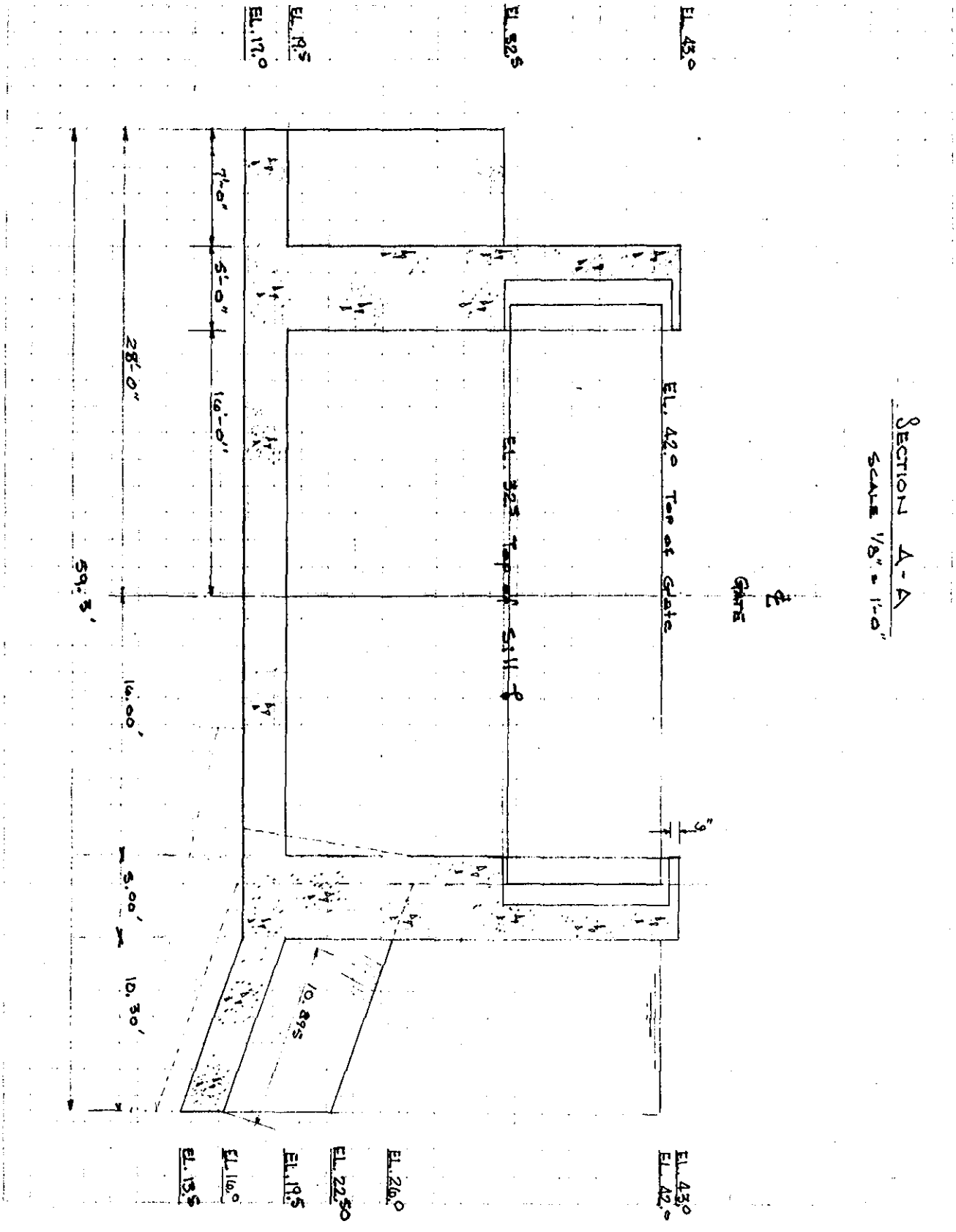
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3, Concrete Abut
COMPUTED BY Karlsen CHECKED BY EPG DATE April 1966



Section A-A
Scale 1/8" = 1'-0"

SUBJECT Ansonia - Derby

COMPUTATION Street Gate No. 3, Concrete Abut.

COMPUTED BY Karlsen CHECKED BY EPG DATE April 1960

Assumptions

(Soil Data was obtained from Mr. A.F. Mancini of the F. & M. Sections)

$\gamma_{submerged}$	= 67.5	ϕ	= 30°	Weight of Conc.	150 #/□'
γ_{moist}	= 125.0	$K_{e_{Rest}}$	= 0.50	Weight of Water	62.5 #/□'
$\gamma_{saturated}$	= 130.0	K_{Active}	= 0.33	Weight of Steel	490 #/□'
$E_{soil\ submerged}$	= 120 #/L.F.	4 Ft. Min. Frost Depth			
$E_{soil\ moist}$	= 200 #	Maximum Soil Bearing			

Loading Conditions

Case I

Storm Condition with water to top of the gate, elev. 42.0 Uplift will vary from full head @ the bottom of the base on the riverside to zero at ground surface on the landside by the "path of creep method. Resultant should fall in the mid-½.

Case II

Storm Condition with water down 3' from the top of the gate. Uplift and loadings similar to Case I. Resultant should fall mid-½

Case III

Traffic Condition with 2-lanes, H20-16, Gate open, no water

Case IV

Normal Condition with water down, fill in place with the gate across the road, not jacked with a 50 #/□' wind load from landside

Case V

Normal Condition (Case IV) but no wind and gates in pocket jacked.

Case VI

Similar to Case IV but no wind load and gates in pocket not jacked.

Design Stresses

f_c' = 3000 #/in²
f_c = 1050 #/in²
f_s = 20000 #/in²
a = 1.485
j = 0.891
n = 9.2
k = 0.326
K = 152
v = 60

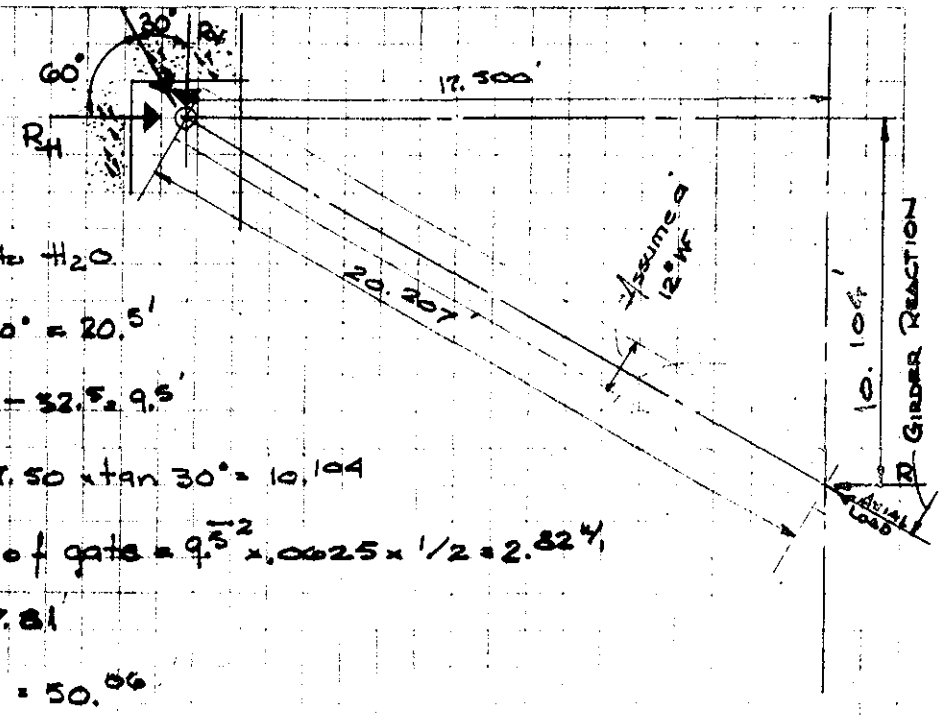
Nomenclature

W_w = weight of Water
C_1 = Weight of Concrete
E_1 = " " Earth
P_W = Hydrostatic Pressure of H_2O
P_E = Horizontal Pressure of Earth
P_R = Passive Resistance
U = Uplift

SUBJECT Ansonia - Derby

COMPUTATION Street Gate No. 3, Concrete Anch.

COMPUTED BY Karlson CHECKED BY EPG DATE April 1960



Length of gate

$= \frac{17.5}{\cos 30°} = 20.207$

∴ total length exposed to H_2O

$= 20.207 + 0.500' \times \tan 30° = 20.5'$

Depth of Gate $= 42.0 - 32.5 = 9.5'$

Distance from back $= 17.50 \times \tan 30° = 10.104$

Force (w) per foot of gate $= 9.5^2 \times .0625 \times 1/2 = 2.82$ #/'

$R = 20.5' \times 2.82 = 57.81$

$R_V = 57.81 \times \cos 30° = 50.06$

$R_H = 57.81 \times \sin 30° = 28.90$

WEIGHT OF GATE LIFT

MEMBERS = 200#
PL's = 100#
VERTICAL DIAPHRAM = 50#
DIAGNALS (etc) = 50#
400#/1

Water Load $= 9.5' - 1.0'$ for bottom $\times 1.00 \times .0625 = 550$ #/1

∴ Total Load = 950 #/1 Say 1000 #/1

ASSUME EACH GATE WEIGHTS

DRY $= 20.5 \times 400 = 8200$

LOADED $= 20.5 \times 1000$ #/1 $= 20,500$

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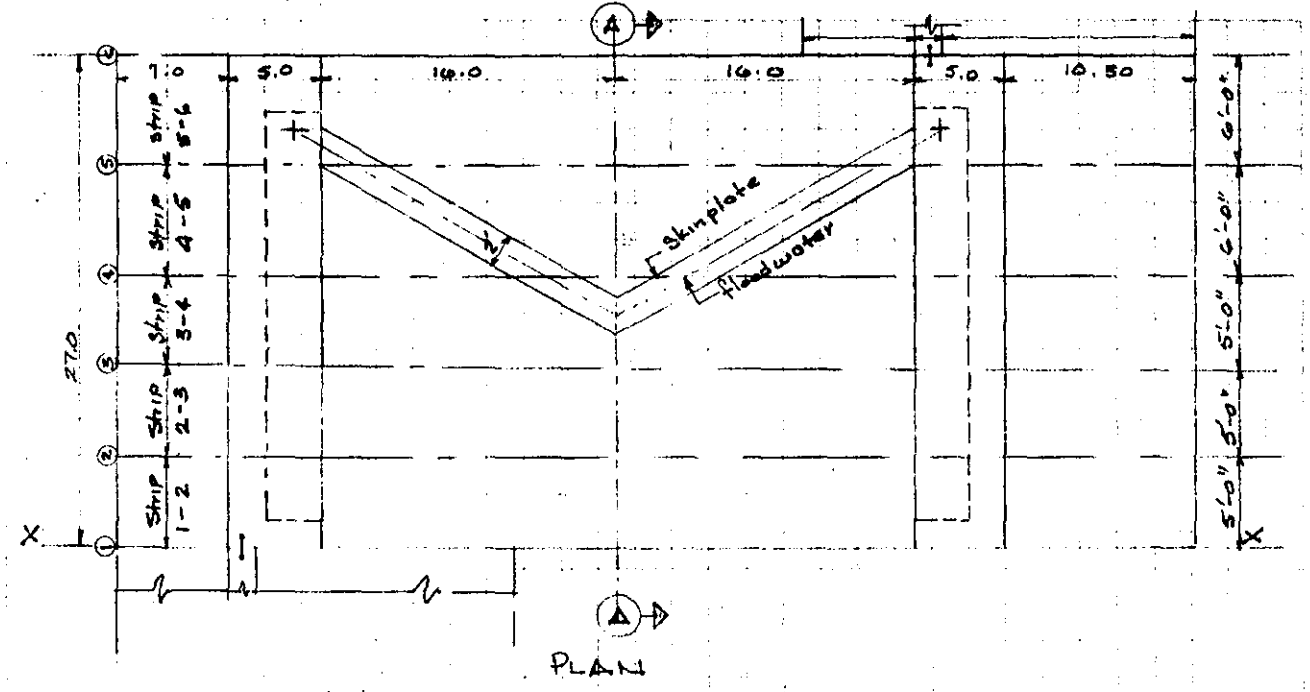
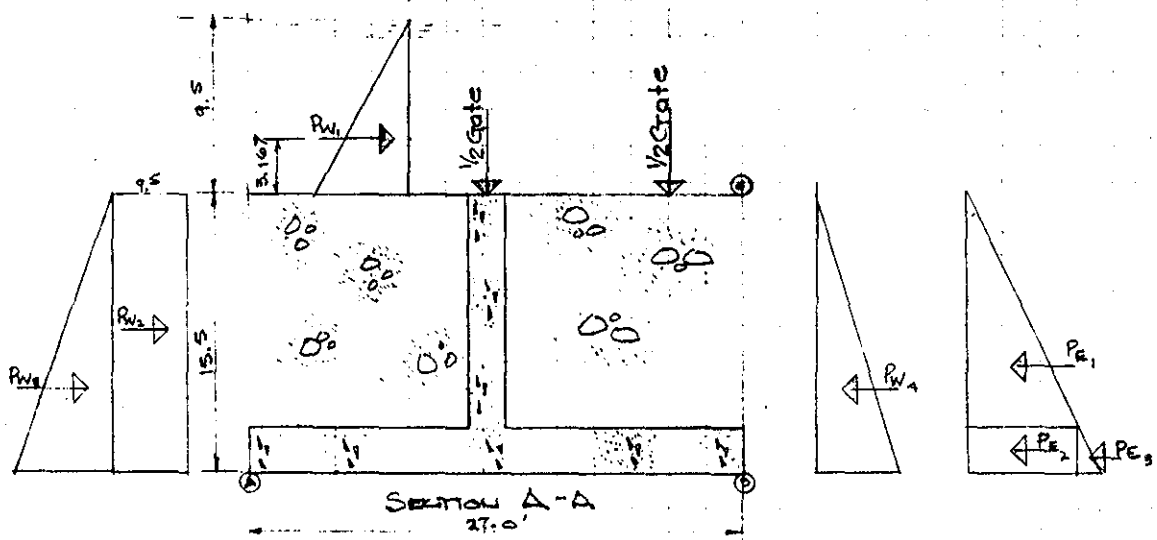
27 Sept 49

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

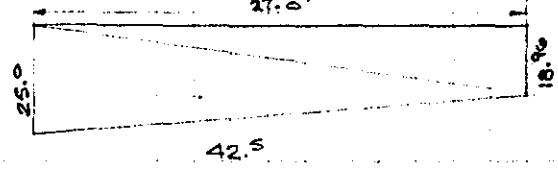
SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Concrete Apron
COMPUTED BY Karlson CHECKED BY EPG DATE April 1966

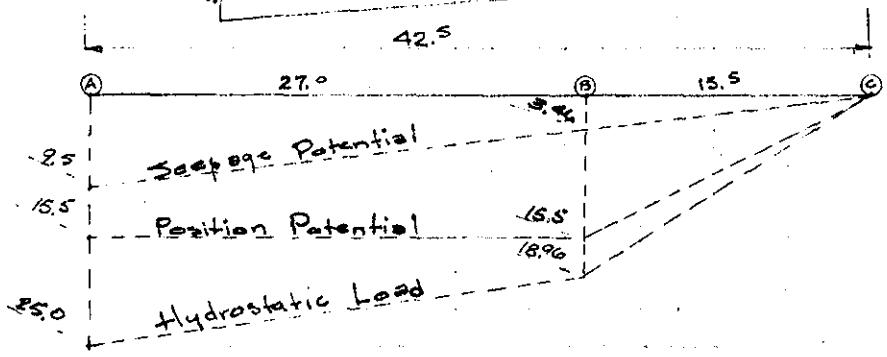


PLAN



Section A-A





NED FORM 223
27 Sept 49

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

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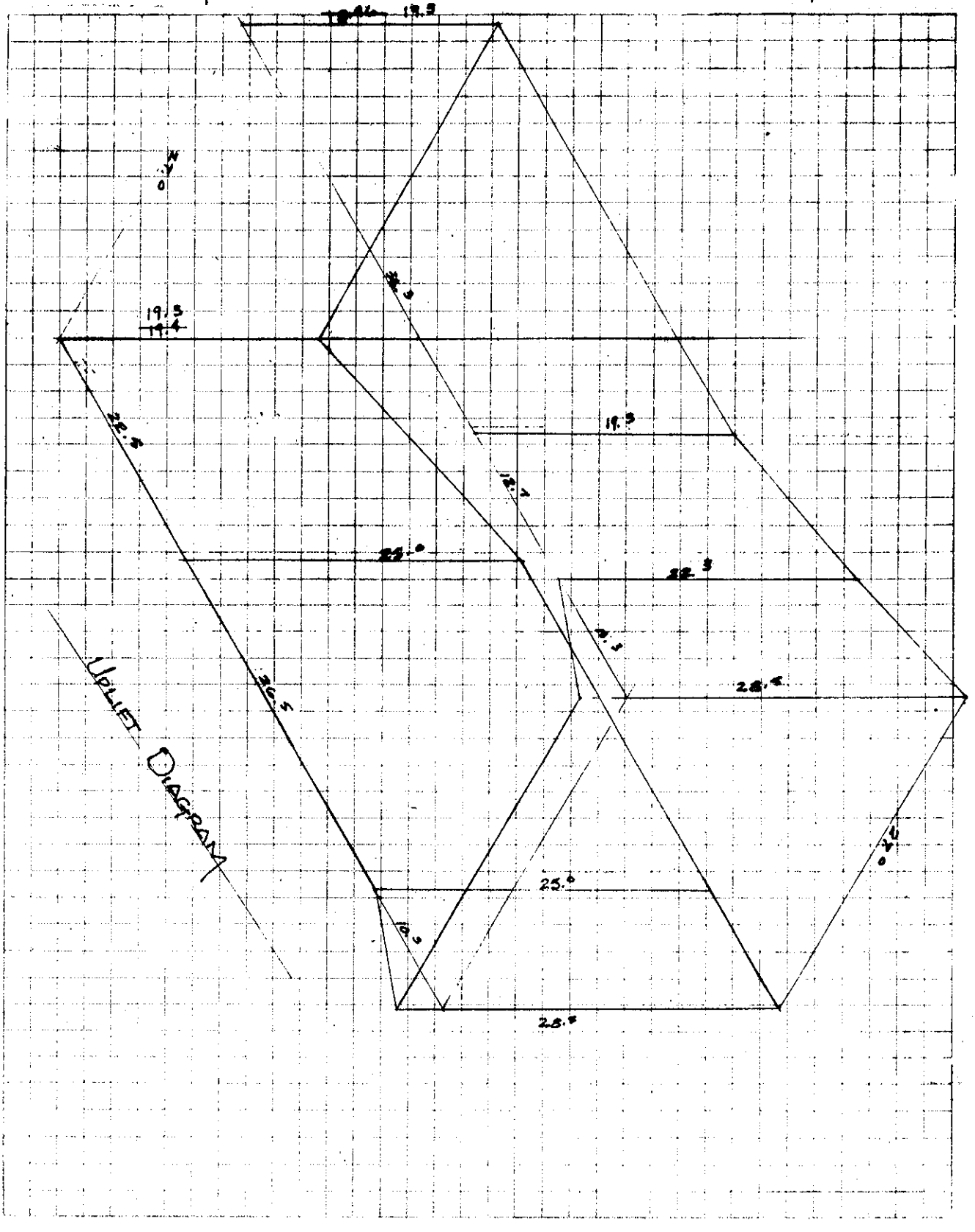
SUBJECT Amoskeag - Derry

COMPUTATIONS Sargent Gorge Dam, Connecticut River

COMPUTED BY [illegible] CHECKED BY EPO DATE [illegible] 1966



NED FORM 223
27 Sept 49

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

SUBJECT Ansonia - Derby

COMPUTATION Street Gate No. 5 Concrete Apron

COMPUTED BY Karlson CHECKED BY EPG DATE April 1960

STABILITY CASE I (TAKE MOMENTS ABOUT LINE X-X)

No.	Factor	↓	↑	→	←	Arm	↻	↺
Pylon C_1	.150 x 5.0 x 25.5 x 27.0 x 2	951.75				13.5	12,849	
− Pocket Minus Sills C_2	.150 x 3.0 x 10.0 x 22.5 x 2		202.5			12.75		2,582
Side Pt. C_3	.150 x 18.475 x 2.0 x 13.0 x 2	144.10				17.815	2524	
Side Pt. C_4	.150 x 2.5 x 49.0 x 27.0	496.12				13.5	6698	
Lt. Side C_5	.150 x 2.5 x 10.50 x 27.0	104.29				13.5	1408	
Rt. Side C_6	.150 x 7.0 x 13.0 x 27.0	319.41				13.5	4312	
C_7	.150 x 10.50 x 6.5 x 27.0	235.00				13.5	3172	
C_8	.150 x 32.0 x 13.0 x 27.0	1460.16				13.5	19712	
− Sill Minus	.150 x 18.475 x 2.0 x 13.0 x 2		124.89			17.815		2187
Pocket W_1	.0625 x 9.5 x 1.5 x 21.5 x 2	38.30				12.25	469	
Center W_2	.0625 x 38.0 x 9.5 x 12.90	268.08				6.45	1729	
W_3	.0625 x 17.5 x 10.10 x 9.5 x ½ x 2	104.94				12.27	1307	
Lt. Side W_4	.0625 x 10.3 x 3.5 x ½ x 27.0	30.42				13.5	411	
Rt. Side W_5	.0625 x 10.3 x 16.0 x 27.0	278.10				13.5	3754	
Gate G_1	20.5 x 1.0 x ½ x 2	20.5				12.90	264	
Gate G_2	20.5 x 1.0 x ½ x 2	20.5				23.0	472	
− U_1	.0625 x 19.5 x 59.3 x 27.0		1931.33			13.5		26,075
− U_2	[.0625 x 5.7 x 22.5 x ½] x ⅓ x 27.0		36.07			6.75		245
− U_3	[.0625 x 5.7 x 27.0 x ½] x ⅓ x 22.5		36.07			13.50		487
− U_4	.0625 x 5.7 x 27.0 x ½ x 36.5		176.98			9.0		1584
− U_5	.0625 x 5.7 x 23.0 x ½ x ⅓ x 27.0		36.87			20.25		747
− U_6	.0625 x 5.7 x 27.0 x ⅙ x 23.0		36.87			13.50		498
− U_7	.0625 x 3.5 x 10.3 x ½ x 27.0		30.42			13.50		411
P_{W_1}	2.82 x 37.0			104.34		18.667	1948	
P_{W_2}	.0625 x 9.5 x 16.5 x 37.0			340.52		7.75	2639	
P_{W_3}	.0625 x 15.5²/2 x 37.0			277.79		5.17	1436	
− P_{W_4}	.0625 x 19.3 x 15.5 x ½ x 37.75				352.90	5.17		1824
− P_{E_1}	.0675 x 13.0²/2 x 37.0 x 0.33				69.64	6.833		476
− P_{E_2}	.0675 x 13.0 x 2.5 x 36.5 x 0.33				26.28	1.25		33
− P_{E_3}	.0675 x 0.33 x 2.5²/2 x 36.5				2.53	0.833		2
		4471.67	2612.00	722.65	451.35		65,504	37,147
		1859.67		271.30			28,357	

$\Sigma M / \Sigma V = 28,357 / 1859.67 = 15.248 > 5.08$ but < 10.17 ∴ falls in mid ⅓

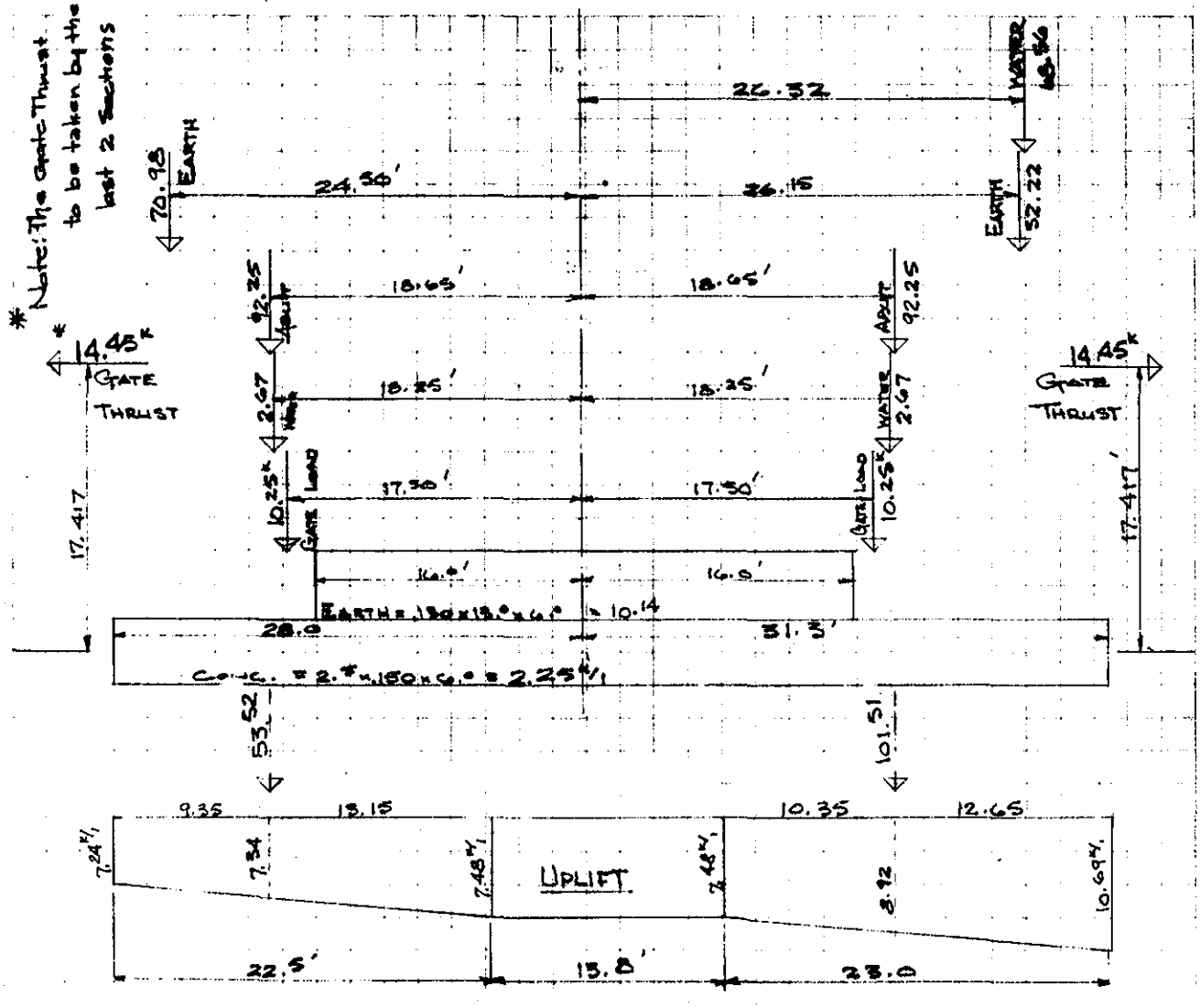
Soil Bearing Pressure $= \dfrac{1859.67}{27.9 \times 59.3} \left(1 \pm \dfrac{6 \times 1.748}{27.0}\right) = 1.613$ on Landside, 0.710 on Riverside

16 ϕ 1.10

NED FORM 223[illegible]
27 Sept 49

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

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 5 Conc. Abut.
COMPUTED BY Karlsen CHECKED BY EPG DATE April 1966



Soil Bearing Pressure = 1.51 x 6.0 = 9.06 k/'

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Conc Abut
COMPUTED BY Karlson CHECKED BY Cmt DATE April 1966

Unbalanced Vertical Force Right

(+)

+ 2.67 × 0.40	=	1.07
+ 10.25 × 1.15	=	11.79
+ 10.14 × 32.0 × 18.65	=	6051.55
+ 2.25 × 49.95 × 24.975	=	2806.88
+ 10.25 × 36.15	=	370.54
+ 2.67 × 36.9	=	98.52
+ 92.25 × 37.3	=	3440.92
+ 52.22 × 44.8	=	2339.46
+ 68.56 × 44.97	=	3083.14
+ 7.34 × 9.35 × 1/2 × 3.12	=	106.95
+ 7.24 × 9.35 × 1/2 × 6.23	=	210.98
+ 9.06 × 9.35 × 4.675	=	396.92
		18,917.82

(−)

− 2.25 × 9.35² / 2	=	98.35
− 70.98 × 5.85	=	415.23
− 7.34 × 13.15 × 1/2 × 4.3833	=	211.54
− 7.48 × 13.15 × 1/2 × 8.7667	=	431.15
− 7.48 × 13.8 × 20.05	=	2069.64
− 7.48 × 23.0 × 1/2 × 34.6166	=	2977.72
− 10.69 × 23.0 × 1/2 × 42.2834	=	5198.11
− 9.06 × 49.95² / 2	=	11302.36
	(−)	22,704.10
	(+)	18,917.82
37.3 R_R =	(−)	3,786.28

∴ R_R = 101.51

Unbalanced Vertical Force Left

(−)

− 68.56 × 7.67	=	525.86
− 52.22 × 7.50	=	391.65
− 8.92 × 10.35 × 1/2 × 3.45	=	159.26
− 7.48 × 10.35 × 1/2 × 6.90	=	267.09
− 7.48 × 13.8 × 17.25	=	1780.61
− 7.48 × 22.5 × 1/2 × 31.65	=	2663.35
− 7.24 × 22.5 × 1/2 × 39.15	=	3188.77
− 9.06 × 46.65² / 2	=	9858.29
− 2.25 × 12.65² / 2	=	180.02
	(−)	19,014.90
	(+)	17,018.44
37.3 R_L =	(−)	1,996.46

(+)

+ 2.67 × 0.40	=	1.07
+ 10.25 × 1.15	=	11.79
+ 10.14 × 32.0 × 18.65	=	6051.56
+ 2.25 × 46.65² / 2	=	2448.25
+ 10.25 × 36.15	=	370.54
+ 2.67 × 36.90	=	98.52
+ 92.25 × 37.3	=	3440.92
+ 70.98 × 43.15	=	3062.79
+ 8.92 × 12.65 × 12.65 / 2	=	713.70
+ 1.77 × 12.65 × 1/2 × 12.65 × 2/3	=	94.41
+ 9.06 × 12.65 × 12.65 × 1/2	=	724.90
		17,018.44

∴ R_L = 53.52

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Conc. Abut.
COMPUTED BY Karlson CHECKED BY Cmt DATE April 1966

Analysis of a 6 Foot Longitudinal Section, Strip (3) to (6) for Condition No. I

The method of "Succesive Approximations for beams on an elastic foundation" by E. P. Popov, ASCE papers of 1950 will be utilized here to give a more accurate base pressure. Since the reaction of the gate results in concentrated loads @ the pylons and the distance between pylons is so large, the bearing pressure cannot be assumed as being uniform across the base. Due to overturning the longitudinal strips are not in equilibrium and a balancing force must be added to keep the strip in equilibrium. This balancing force represents the actual transfer of shear from one strip to another. Since the greatest transfer of shear occurs at the pylons, the balancing forces are added @ the pylons.

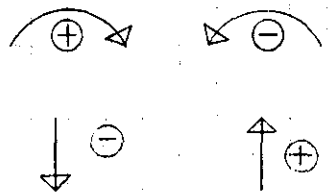
Moment of Inertia of a 6 Foot Section and a 2'-6" Slab

$$I = \frac{bh^3}{12} = \frac{6.0' \times 2.5^3}{12} = 7.8125$$

Foundation Modulus of Submerged Earth = 120

Section	Factor	Force	Arm	Moment
9.35' from lt. end	Earth	-70.98	5.85	-415
Conc.	2.25 × 9.35	-21.04	4.675	-98
Gate Thrust	14.45 × 17.417			-252
Uplift ①	7.34 × 9.35 × 1/2	34.31	9.35/3	107
Uplift ②	7.24 × 9.35 × 1/2	33.85	9.35 × 2/3	211
S.B.P.	9.06 × 9.35	84.71	9.35/2	396
		60.85		-51
22.5' from lt. end				-51
		60.85	13.15	800
	Abut. + Unbal. Ld. "F"	-145.77	13.15	-1917
	Water	-2.67	12.75	-34
	Gate Load	-10.25	12.00	-123
Earth	10.14 × 10.5	-106.47	5.25	-559
Conc.	2.25 × 13.15	-29.59	6.575	-194
Uplift ③	7.48 × 13.15 × 1/2	49.18	13.15/3	216
Uplift ④	7.34 × 13.15 × 1/2	48.26	13.15 × 2/3	423
S.B.P.	9.06 × 13.15	119.14	13.15 × 1/2	783
		-17.32		-656

Sign Convention



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27 Sept 49

NEW ENGLAND DIVISION
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SUBJECT Ansonia – Derby
COMPUTATION Street Gate No. 3 Conc. Abut.
COMPUTED BY Karlson CHECKED BY Cmt DATE April 1966

Section	Factor	Force	Arm	Moment
28.0' from				- 656
rt. end ℄		-17.32	5.5	- 95
℄ Gate	10.14 x 5.5	+55.77	2.75	- 153
Conc	2.25 x 5.5	- 12.38	2.75	- 34
Uplift	7.48 x 5.5	41.14	2.75	113
S.B.P	9.00 x 5.5	49.83	2.75	137
		+ 5.50		- 688
12.65' from	Water	-68.36	7.67	- 526
rt. end	Earth	-52.22	7.50	- 391
Conc	2.25 x 12.65	- 28.46	12.65/2	- 180
Gate Thrust	14.45 x 17.417			- 252
Uplift ①	8.92 x 12.65 x 1/2	54.42	12.65 x 1/3	238
Uplift ②	10.69 x 12.65 x 1/2	67.61	12.62 x 2/3	569
S.B.P.	9.00 x 12.65	114.61	12.65/2	725
		+ 89.40		+ 183
23.0' from				+ 183
rt. end		+ 89.40	10.35	+ 925
	Abut + Hinge Load	-193.76	10.35	- 2005
	Water	- 2.67	9.95	- 27
	Gate Load	-10.25	9.20	- 94
Earth	10.14 x 7.7	- 78.08	7.7 x 1/2	- 301
Conc	2.25 x 10.35	- 23.29	10.35 x 1/2	- 120
Uplift ①	7.48 x 10.35 x 1/2	38.71	10.35 x 1/3	133
Uplift ②	8.92 x 10.35 x 1/2	46.16	10.35 x 2/3	318
S.B.P.	9.00 x 10.35	93.77	10.35 x 1/2	485
		+ 40.01		- 503
31.3' from				- 503
rt. end ℄		- 40.01	8.3	- 332
Earth	10.14 x 8.3	- 84.16	4.15	- 349
Conc	2.25 x 8.3	- 18.68	4.15	- 78
Uplift	7.48 x 8.3	62.08	4.15	258
S.B.P.	9.00 x 8.3	75.20	4.15	312
		- 5.57		- 692

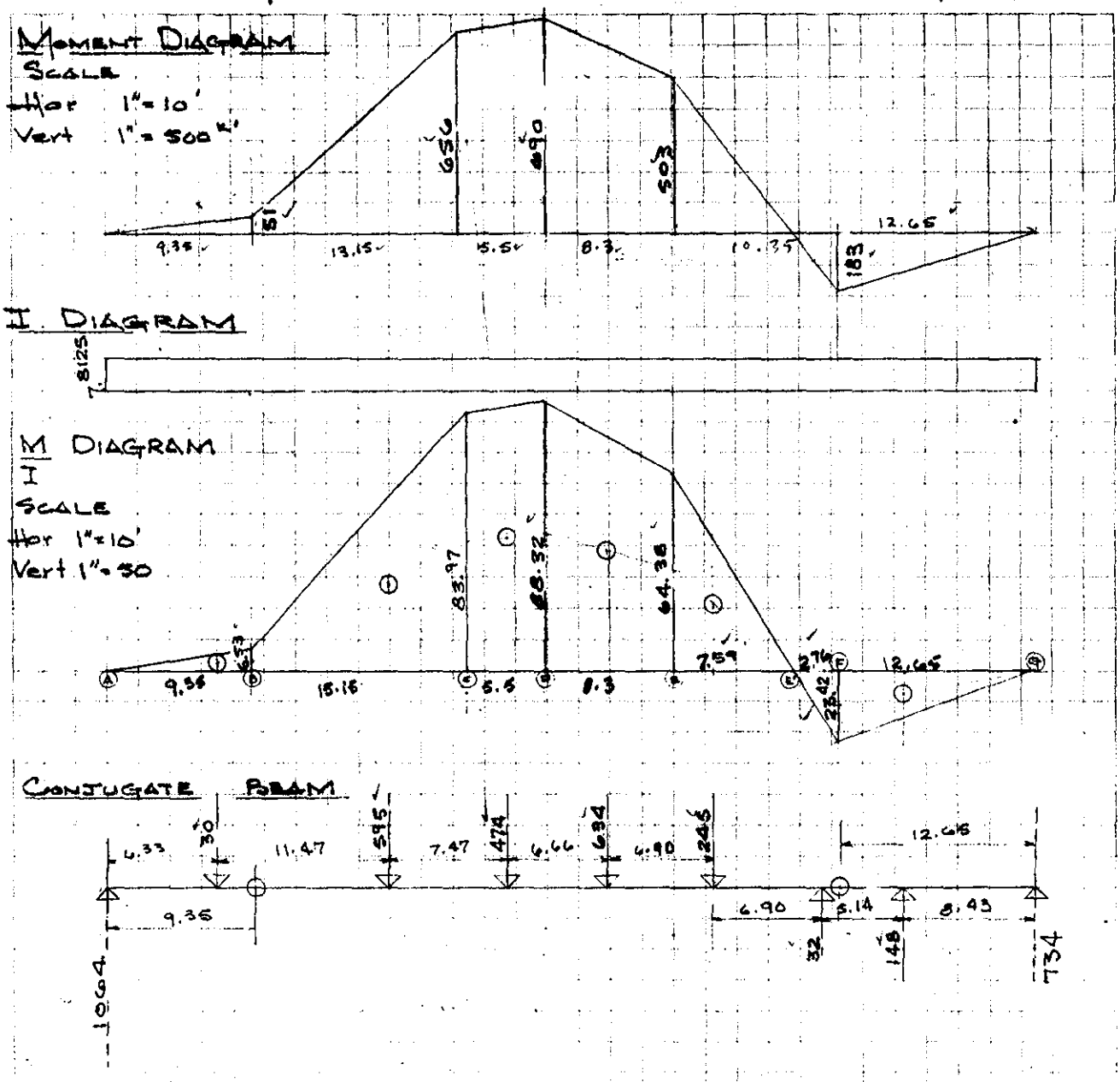
Modulus of Elasticity of Concrete

$$E_c = w^{1.5} \times 33\sqrt{f_c'} = 145^{1.5} \times 33 \times 3000^{1/2}$$

$$= 1746 \times 33 \times 54.78 = 5,160,000\ \#/\square''$$

or $455,000\ \#/\square ft$

SUBJECT Ansonia - Derby
COMPUTATION Sluice Gate No. 3 Gonl. Abut.
COMPUTED BY Karlsson CHECKED BY Cmt DATE April 1966



D to E = $(88.32 + 64.38) \times \frac{1}{2} \times 8.3 = 633.70$

E to F = $7.59 \times 64.38 \times \frac{1}{2} = 245.32$

E' to F = $2.76 \times 23.42 \times \frac{1}{2} = 32.32$

F to G = $12.65 \times 23.42 \times \frac{1}{2} = 148.13$

A to B = $9.35 \times 6.53 \times \frac{1}{2} = 30.53$

B to C = $(6.53 + 83.97) \times \frac{1}{2} \times 13.15 = 595.04$

C to D = $(83.97 + 88.32) \times \frac{1}{2} \times 5.5 = 473.80$

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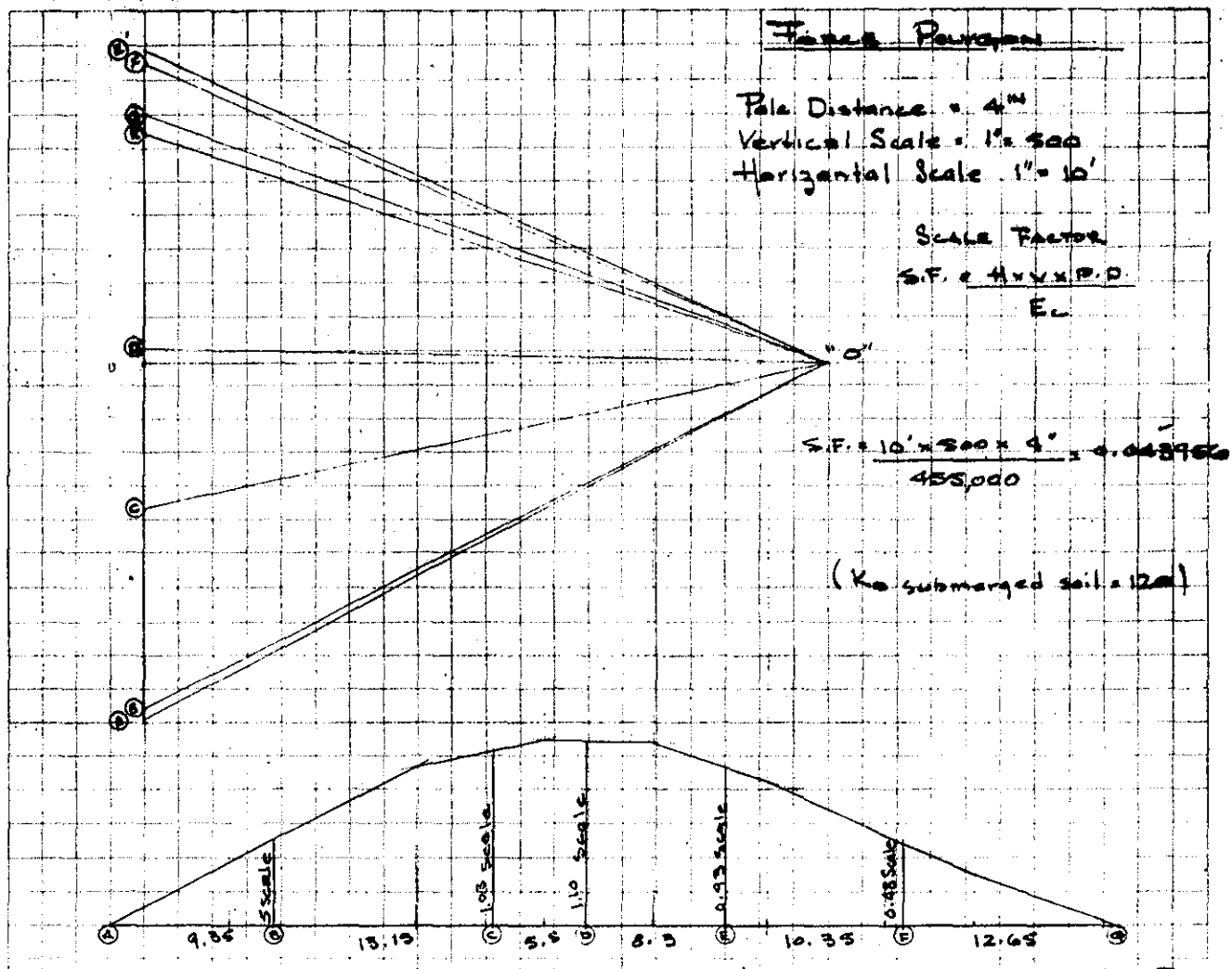
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Ansonia - Derby

COMPUTATION Sluice Gate No. 3 Const. Abut.

COMPUTED BY K. Carlson CHECKED BY CMK DATE April 1966



DEFLECTION (Scale Factor x Scale Dist.) x FOUNDATION MODULUS = FOUNDATION PRESS.

@									
A	0.043956	x	0"	=	0	x	120	=	0
B	"	x	.50"	=	.02198	x	120	=	2.64
C	"	x	1.03"	=	.04528	x	120	=	5.43
D	"	x	1.10"	=	.04836	x	120	=	5.80
E	"	x	0.93"	=	.04088	x	120	=	4.91
F	"	x	0.48"	=	.02110	x	120	=	2.53
G	0.043956	x	0"	=	0	x	120	=	0

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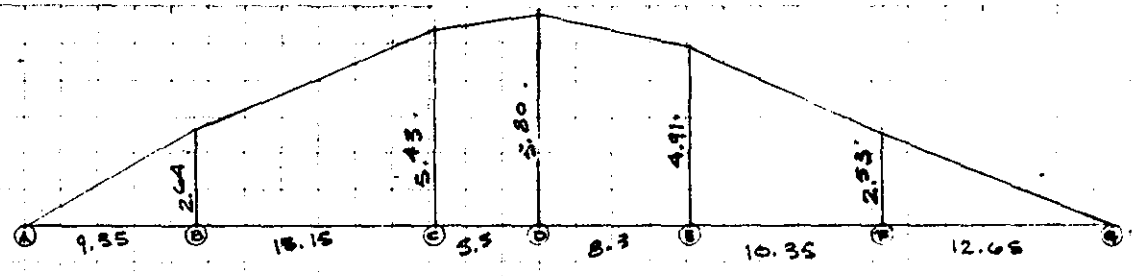
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Ansonia – Derby
COMPUTATION Street Gate No. 3 Conc. Abut
COMPUTED BY K. Karlson CHECKED BY Cmt DATE April 1966



$$\text{Area} = \frac{1}{2}\Big[9.35 \times 2.64 + (2.64 + 5.43)13.15 + (5.43 + 5.80)5.5 + (5.80 + 4.91)8.3 + (4.91 + 2.53) \times 10.35 + 2.53 \times 12.65\Big] = 195.236$$

(Note: Because the bending is upward, add the unbalanced force to the orig. soil bearing Press., This gives the effect of holding the center of the slab on the ground and letting the ends deflect into the soil.)

$$\therefore P = 195.236 + (9.06 \times 59.3) = 732.494 \quad (537.258)$$

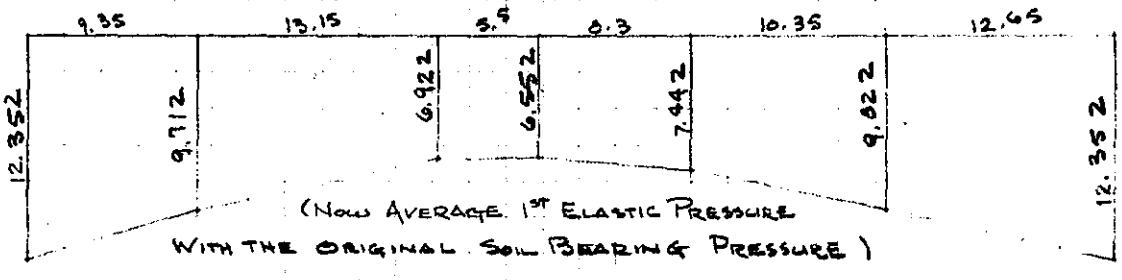
$$P \div L = 732.494 \div 59.3 = (-)12.352$$ (Add this algebraically to the preceeding deflections)

Points

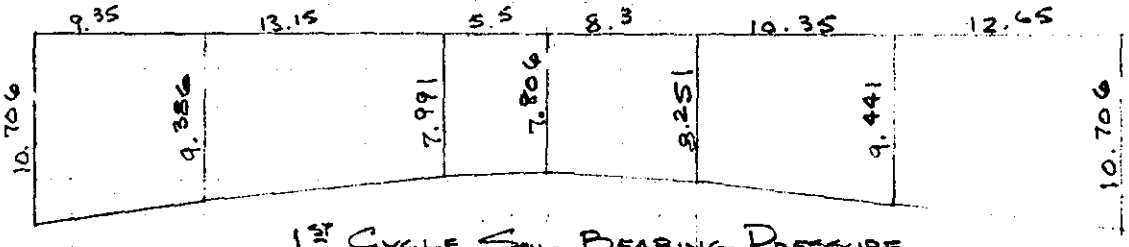
A =	−12.352	+ 0	=	−12.352
B =	"	+ 2.64	=	−9.712
C =	"	+ 5.43	=	−6.922
D =	"	+ 5.80	=	−6.552
E =	"	+ 4.91	=	−7.442
F =	"	+ 2.53	=	−9.822
G =	−12.35	+ 0	=	−12.352

Check Area = 537.25

1st Cycle Elastic Pressure



(Now Average 1st Elastic Pressure
With the Original Soil Bearing Pressure)



1st Cycle Soil Bearing Pressure
Area = 537.25

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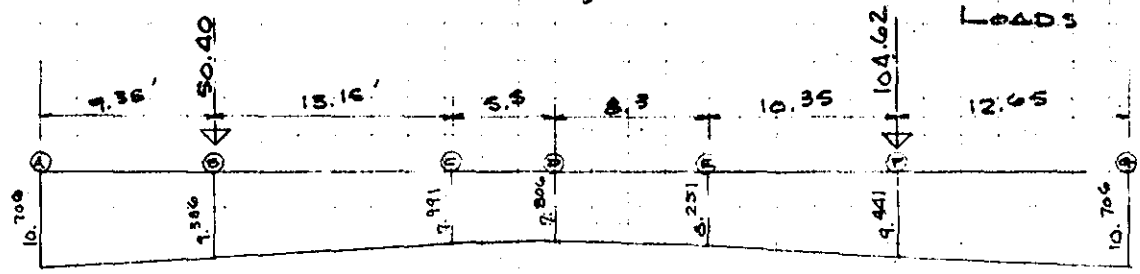
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Conc. Abut.
COMPUTED BY Karlson CHECKED BY Crist DATE April 1966

With New Soil Bearing Pressures, Now Obtain New Unbalanced Loads



Unbalanced Vertical Force Right

(+)

		18,521.8
$9.^{386} \times 9.35 \times 1/2 \times 9.35 \times 1/3$	=	136.76
$10.706 \times 9.35 \times 1/2 \times 9.35 \times 2/3$	=	311.98
		(+) 18,970.54

(−)

		11,401.74
$9.^{386} \times 13.15 \times 1/2 \times 13.15 \times 1/3$	=	270.51
$7.^{991} \times 13.15 \times 1/2 \times 13.15 \times 2/3$	=	460.61
$7.^{991} \times 5.5 \times 1/2 \times 14.983$	=	329.26
$7.^{806} \times 5.5 \times 1/2 \times 16.817$	=	361.00
$7.^{806} \times 8.3 \times 1/2 \times 21.417$	=	693.80
$8.^{251} \times 8.3 \times 1/2 \times 24.183$	=	828.06
$8.^{251} \times 10.35 \times 1/2 \times 30.40$	=	1298.05
$9.^{441} \times 10.35 \times 1/2 \times 33.85$	=	1653.82
$9.^{441} \times 12.65 \times 1/2 \times 41.517$	=	2479.16
$10.706 \times 12.65 \times 1/2 \times 45.733$	=	3096.83
		(−) 22,872.84

(−) 22,872.84
(+) 18,970.54
(−) 3,902.30 = $37.^3 R_R$

$\therefore R_R = 104.^{62}$

Unbalanced Vertical Force Left

(−)

		9156.61
$9.^{441}\ 10.35 \times 1/2 \times 3.45$	=	168.56
$8.^{251} \times 10.35 \times 1/2 \times 6.90$	=	294.62
$8.^{251} \times 8.3 \times 1/2 \times 13.117$	=	449.15
$7.^{806}\ 8.3 \times 1/2 \times 15.883$	=	514.53
$7.^{806} \times 5.5 \times 1/2 \times 20.483$	=	439.70
$7.^{991} \times 5.5 \times 1/2 \times 22.317$	=	490.42
$7.^{991} \times 13.15 \times 1/2 \times 28.533$	=	1499.15
$9.^{386} \times 13.15 \times 1/2 \times 32.917$	=	2031.40
$9.^{386} \times 9.35 \times 1/2 \times 40.417$	=	1773.48
$10.706 \times 9.35 \times 1/2 \times 43.533$	=	2178.85
		(−) 18,996.47

(+)

		16,293.54
$9.^{441} \times 12.65 \times 1/2 \times 4.217$	=	251.82
$10.706 \times 12.65 \times 1/2 \times 8.433$	=	571.94
		17,116.40

(−) 18,996.47
(+) 17,116.40
(−) 1,880.07 = $37.^3 R_L$

$\therefore R_L = 50.40$

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

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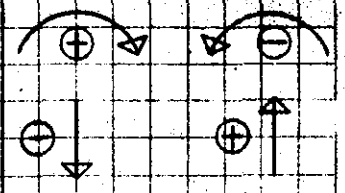
SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Conc. Abut.
COMPUTED BY Karlson CHECKED BY Cmt DATE April 1966

Second Cycle Moments

Section	Factor	Force	Arm	Moment
9.86' from	Earth	-70.98		-416
R. end	Conc.	-21.04		-98
	Gate Thrust			-252
	Uplift ①	54.31		107
	Uplift ②	35.85		211
S.B.P ①	9.886 9.86 x 1/2	43.88	3.117	137
S.B.P ②	10.706 x 9.86 x 1/2	50.05	6.233	312
		+70.07		+ 2
22.5' from				+ 2
R. end		+70.07	13.15	+ 921
	Abut. + unbal. Lo. "F"	-142.65	13.15	-1876
	Water	- 2.67		- 34
	Gate Load	-10.25		-123
	Earth	-106.47		-559
	Concrete	-29.59		-194
	Uplift ②	49.18		216
	Uplift ③	48.26		423
S.B.P ③	7.991 x 13.15 x 1/2	52.44	4.383	230
S.B.P ④	9.880 x 13.15 x 1/2	61.71	8.767	541
		- 9.87		-453
28.0' from				-453
R. end		+9.87	5.5	+ 54
	Earth	-55.77		-153
	Concrete	-12.38		- 34
	Uplift	41.14		113
S.B.P ⑤	7.806 x 5.5 x 1/2	21.47	1.833	39
S.B.P ⑥	7.991 x 5.5 x 1/2	21.98	3.667	81
		+6.57		-461



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

SUBJECT Ansonia - Derby
COMPUTATION Sluice Gate No. 3 Conc. Abut.
COMPUTED BY Karlsen CHECKED BY Cut DATE April 1966

Second Cycle Moments

Section	Factor	Force	Arm	Moment	Sign Convention
12.65' from rt. end	Water	-68.56		-826	
	Earth	-82.22		-991	
	Concrete	-28.46		-180	
	Gate Thrust			-252	
	Uplift ⊖	96.42		238	
	Uplift ⊕	67.61		469	
S.B.P. ⊖	$9.^{441} \times 12.^{65} \times 1/2$	59.71	4.217	252	
" ⊕	$10.^{706} \times 12.65 \times 1/2$	67.72	8.433	571	
		+102.22		+281	
28.0' from lt. end				+281	
		+102.22	10.35	+1058	
	Abut + unbal. ld. "A"	-196.87	10.35	-2038	
	Water	-2.47		-27	
	Gate Load	-10.25		-94	
	Earth	-78.08		-301	
	Concrete	-28.29		-120	
	Uplift ⊖	38.71		133	
	Uplift ⊕	46.16		318	
S.B.P. ⊖	$8.^{251} \times 10.35 \times 1/2$	42.70	3.45	147	
S.B.P. ⊕	$9.^{441} \times 10.35 \times 1/2$	48.86	6.90	337	
		-32.51		-306	
51.5' from rt. end @ ℄ Gate				-306	
		-32.51	8.3	-270	
	Earth	-84.16		-349	
	Concrete	-18.68		-78	
	Uplift	62.08		258	
S.B.P. ⊖	$7.^{806} \times 8.3 \times 1/2$	32.39	2.767	90	
S.B.P. ⊕	$8.^{251} \times 8.3 \times 1/2$	34.24	5.533	189	
		-6.64		-466	

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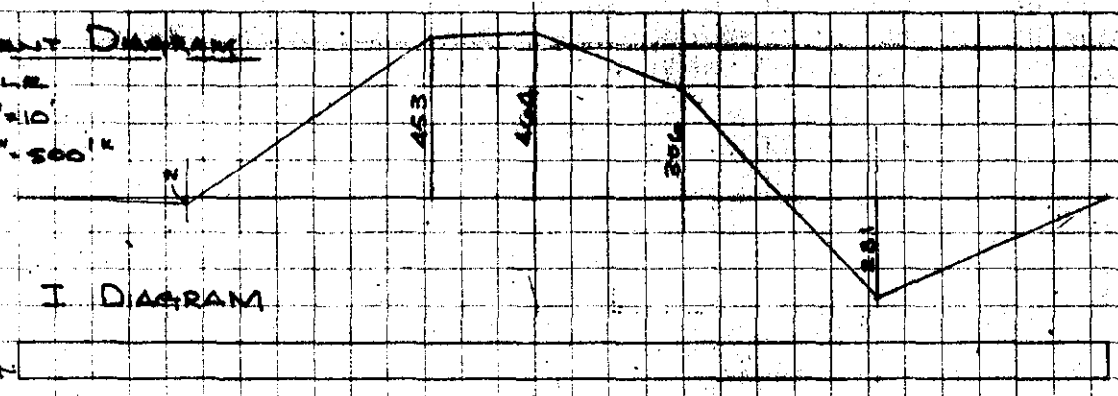
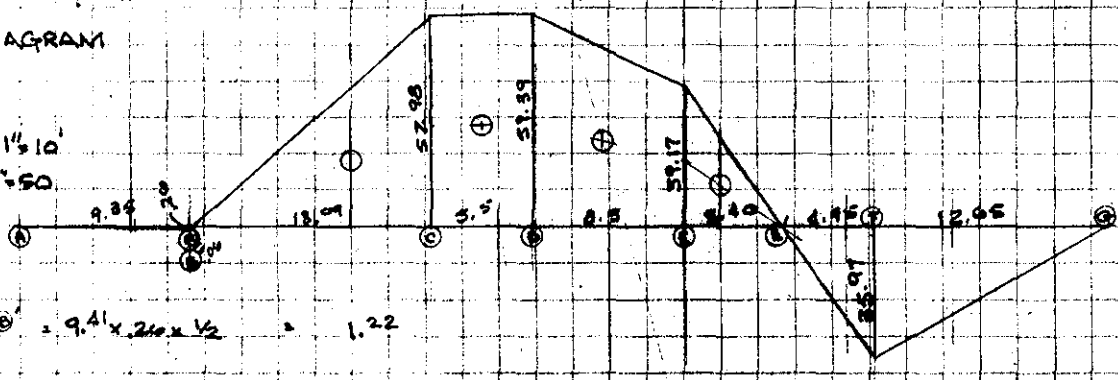
SUBJECT Ansonia - Derby
COMPUTATION Street Gate No. 3 Const. Joint
COMPUTED BY Kaylsen CHECKED BY Cmt DATE April 1966

Moment Diagram
Scale
Hor. 1" = 10'
Vert 1" = 500'k



M/I Diagram
Scale
Hor. 1" = 10'
Vert. 1" = 50



Ⓐ to Ⓑ' = 9.41 × .260 × 1/2 = 1.22

Ⓑ' to Ⓒ = 57.16 × 13.09 × 1/2 = 379.48

Ⓒ to Ⓓ = (57.98 + 59.39) × 1/2 × 5.5 = 322.77

Ⓓ to Ⓔ = (59.39 + 59.170) × 1/2 × 8.3 = 409.02

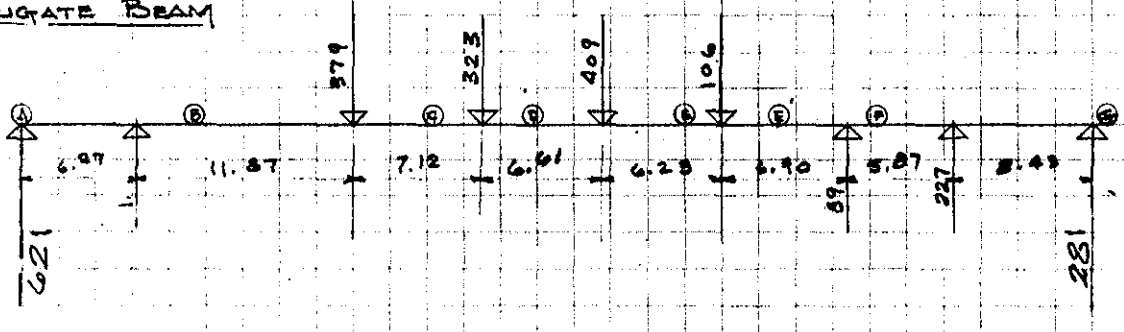
Ⓔ to Ⓔ' = 59.17 × 5.40 × 1/2 = 105.76

Ⓔ' to Ⓕ = 35.97 × 4.95 × 1/2 = 89.03

Ⓕ to Ⓖ = 35.97 × 12.65 × 1/2 = 227.51

Conjugate Beam Reactions

Conjugate Beam



NED FORM 223
27 Sept 49

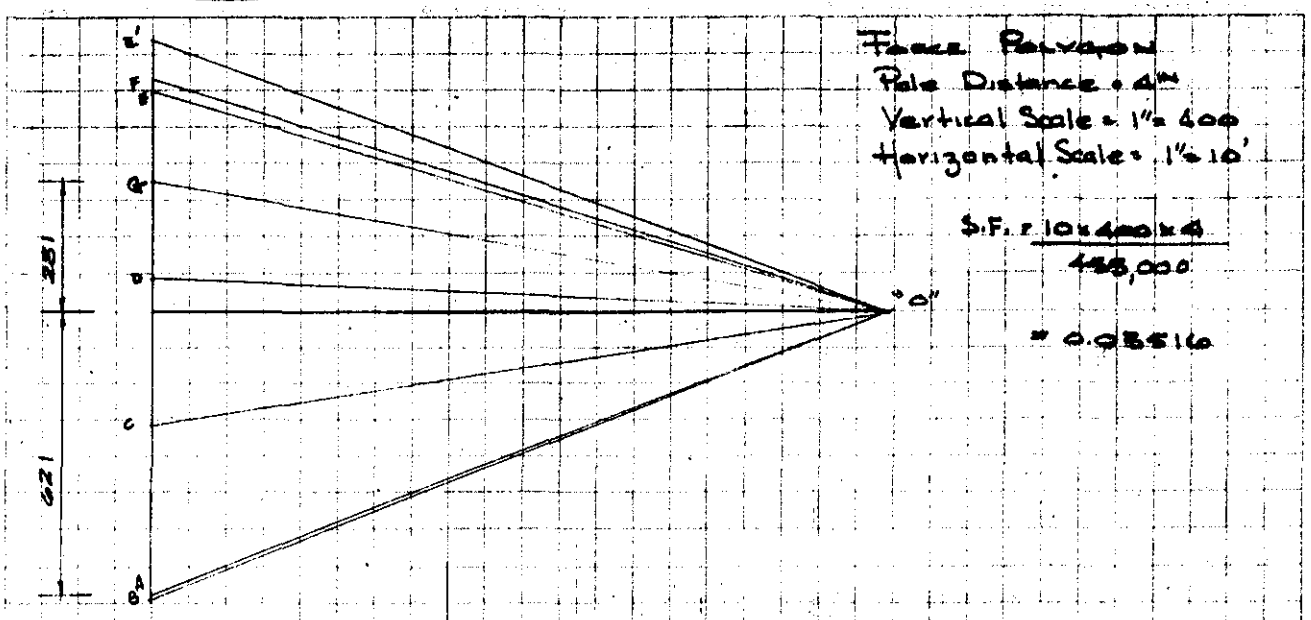
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

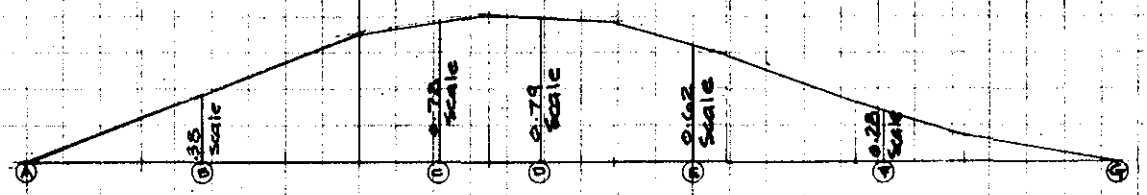
PAGE DM-71 (23)

SUBJECT Ansonia - Derby

COMPUTATION Sheet Piling No. 3 Force Diagram

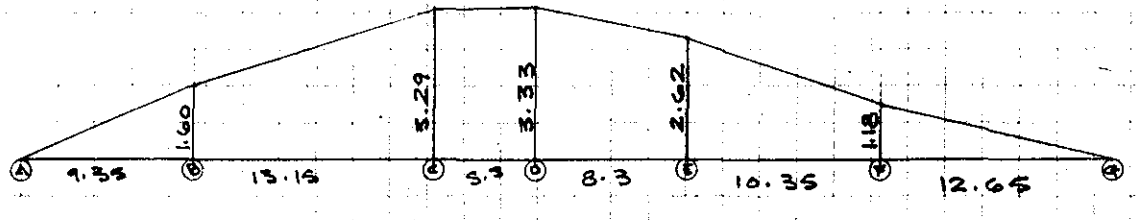
COMPUTED BY Karlson CHECKED BY Cmt DATE April 1966





Deflection (Scale Factor x Scale Dist.) x Foundation Modulus = Foundation Press

A	0.03516	x	0"	=	0	x	120	=	0
B	"	x	0.38"	=	.01336	x	"	=	1.60
C	"	x	0.78"	=	.02742	x	"	=	3.29
D	"	x	0.79"	=	.02778	x	"	=	3.33
E	"	x	0.62"	=	.02180	x	"	=	2.62
F	"	x	0.28"	=	.00984	x	"	=	1.18
G	0.03516	x	0	=	0	x	120	=	0



$$\text{Area} = \frac{1}{2}\left[1.60 \times 9.35 + (1.60 + 3.29) \times 13.15 + (3.29 + 3.33) \times 5.5 + (3.33 + 2.62) \times 8.3 + (2.62 + 1.18) \times 10.35 + 1.18 \times 12.65\right] = 109.66$$

SUBJECT Antonia - Derby

COMPUTATION Street Gate No. 3 Const. Joint.

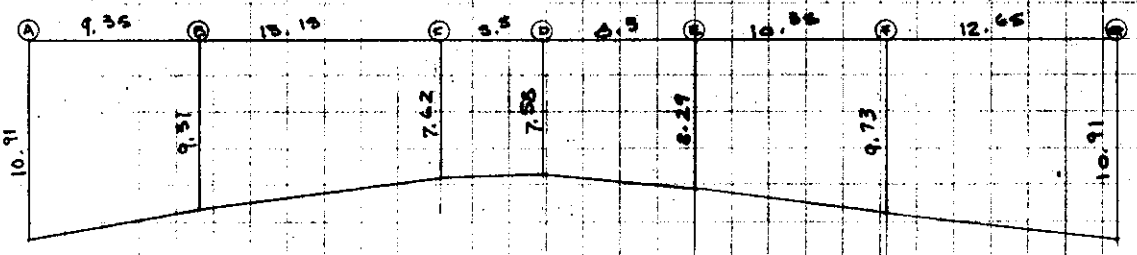
COMPUTED BY Karlsen CHECKED BY Croft DATE April 1966

$P = 109.658 + (9.00 \times 59.5) = 646.916$

$P \div L = 646.916 \div 59.5 = (-)10.91$

A = -10.91 + 0 = -10.91
B = -10.91 + 1.60 = -9.31
C = -10.91 + 3.29 = -7.62
D = -10.91 + 3.33 = -7.58
E = -10.91 + 2.62 = -8.29
F = -10.91 + 1.18 = -9.73
G = -10.91 + 0 = -10.91

2ND CYCLE ELASTIC PRESSURE



Note: - This is so close to our last assumption that a new cycle need not be made.

SUMMARY OF SLAB FOUNDATION DESIGN FOR STRIP 5 to 6

Section	Moment	Mom/Ft	"d" req'd = $\sqrt{M/152}$	Shear V	$v = \frac{V}{bd}$	$A_s = \frac{M}{1.486d}$ = .0254M	Suggested Steel Design
9.35 from H. end	2.	.33	1.5"	70.07k	37	.008 in²	# 6 @ 12" Top
22.5 from H. and	453	75.50	22.3"	9.87k	5.2	1.92 in²	# 9 @ 6" top
28.5 from H. end & Gate	464	77.33	22.6"	6.6	3.5	1.96 in²	# 9 @ 6" top
23.5 from rt. end	306	51.00	18.3"	32.51	17.0	1.30 in²	# 9 @ 9" top
12.65 from rt. end	(+) 281	(+) 46.83	17.6"	(+) 102.22	58.7	1.24 in²	# 10 @ 12" bot.

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NEW ENGLAND DIVISION
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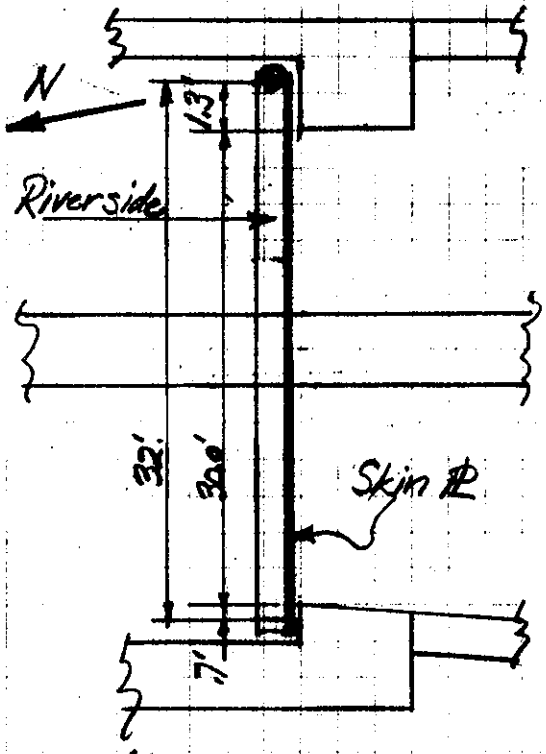
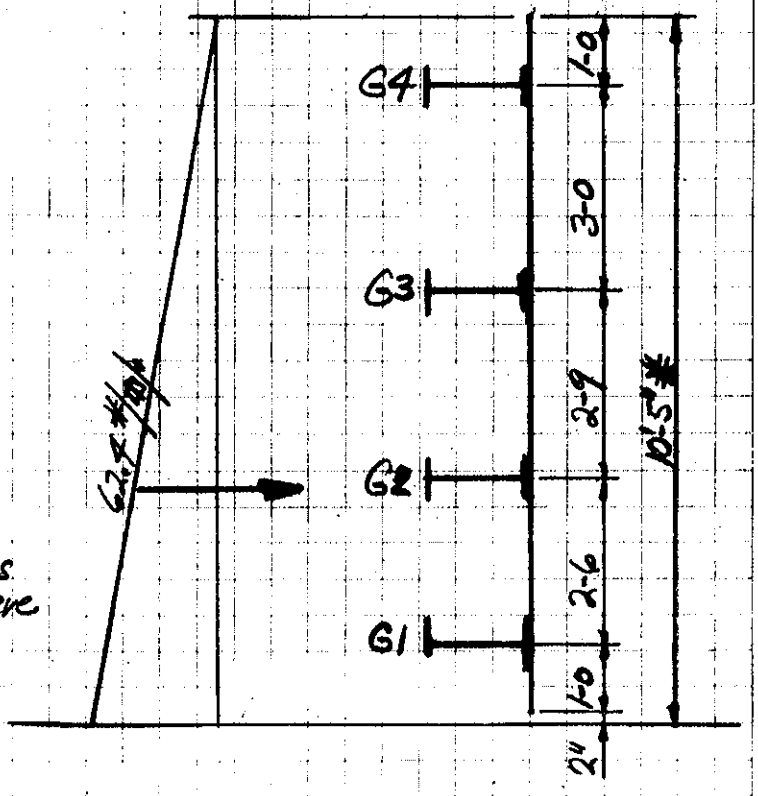
PAGE DM-73 (J)

SUBJECT ANSONIA - DERBY
COMPUTATION R.R. Gate No. 4
COMPUTED BY G.R. CHECKED BY R DATE Feb. '66



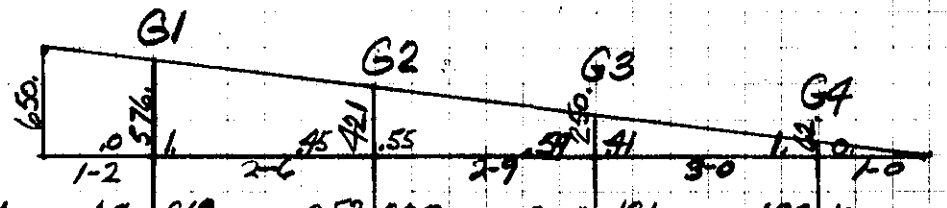
Design stresses - Per EM 1110-1-2101.

Case I - Water to top of gate. Normal stresses. Use Hydr. "B" with basic stress of 0.50 Fy.



* Note:
Subsequent to preparation of calculations the height of gate was increased to 10'-11". This will have minor effects and will be used in the final design.

Skin PL



	G1		G2		G3		G4	
FEM	450	269.	253.	223.	201.	131.	103.	10.
			+90	21	+8	46		
			163	244	193.	177.		
			37	44	9	7		
−M =	450.	450.	200	200.	184.	184.	10	10.
V_s =	740.	655.	590	500.	420	280.	190	30.
ΔM/L =		+100	(*) 60	+10.		+60	−60	
V =	740	755.	530	510.	420.	340	130.	30.
Bm. ld.		1500. #/		1040. #/		760. #/		160. #/

(*) Sand Bag Effect
R

SUBJECT: ANSONIA-DERBY
COMPUTATION: R.R. Gate No. 4
COMPUTED BY: G.R. CHECKED BY: R DATE: Feb. '66

Skin Pl (cont.)

At lower flg. G1 (Pg. 1)

$595 \times .8 \times .4 = 190$
$55. \times .8 \times \frac{1}{2} \times .53 = 10$
$-M = 200.$

Max. mom.

At upper flg. G1

$-450.$
$755 \times 1.0 \times \frac{1}{3} = +250.$
$-M = 200.$

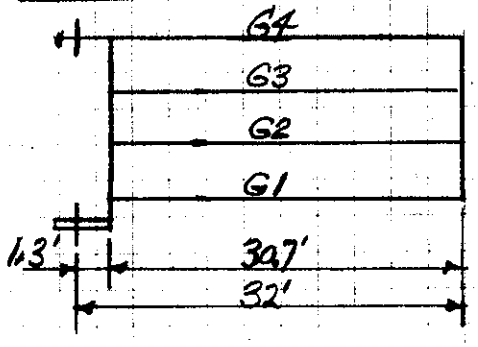
$\frac{1}{4}''$ Pl - $S.M. = \frac{12 \times .25^2}{6} = .125 \text{ in}^3$ $\quad fb = \frac{12 \times 200}{.125} = \pm 19200.$

Allow $.50 \times 50 = 25.0$ k/in - Use $\frac{1}{4}''$ Skin Pl A441 ←

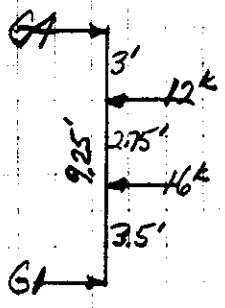
Check combined stresses — (Pg 4)

Design G1

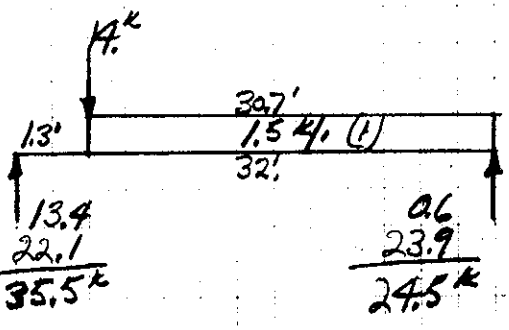
Load on G1



$G3 = 760 \times 30.7/2 = 12.^k$
$G2 = 1040 \times \text{"} = 16.^k$



$G1 = \frac{(12 \times 3) + (16 \times 5.75)}{9.25} = 14.^k$



$\frac{24.5}{1.5} = 16.4'$

$M = 24.5 \times \frac{16.4}{2} = 202.'^k$

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27 Sept 49

NEW ENGLAND DIVISION
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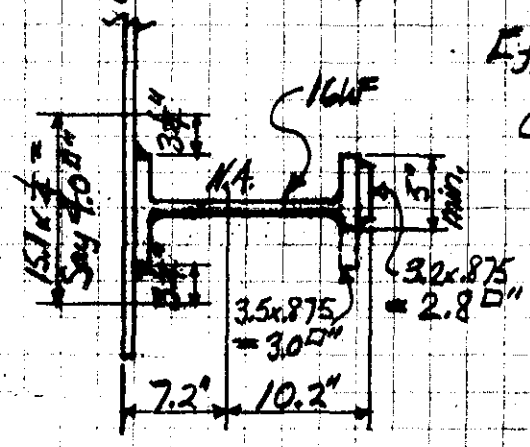
SUBJECT: ANSONIA-DERBY
COMPUTATION: R.R. Gate No. 4
COMPUTED BY: G.R. CHECKED BY: P DATE: Feb. '66

Design G1 (cont.)

Try 16 WF 78 – A36.

Eff. $\frac{1}{4}$" (A441) Pl. width $= 13 \times \frac{1}{4} = 3\frac{1}{4}$"

Cut lower flg. & reuse as shown.



$4.0 \times 17.3 = 69.$
$22.9 \times 9.04 = 207.$
$2.8 \times .44 = 1.$
29.7
$- 3.0 \times 1.3$
26.7 □"

$277.$
$- 4.$
$273.$

$\frac{273.}{26.7} = 10.2$"

$4.0 \times \overline{7.1}^2 = 200.$
$22.9 \times \overline{1.2}^2 = 33.$
$2.8 \times \overline{9.8}^2 = 268.$
$1042.$
$1543.$
$3.0 \times \overline{8.9}^2 = -233.$
$I_{N.A.} = 1310.$

M – 202.'k (2)

$f_b = \frac{12 \times 202 \times 10.2}{1310.} = +13.3$ k/□" -19.0

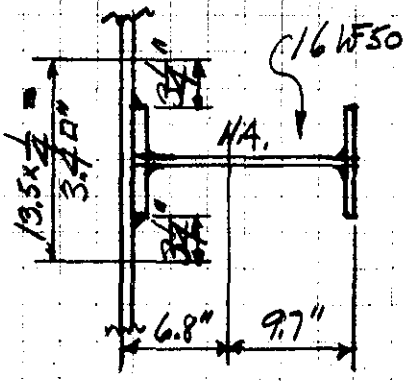
Allow $f_b = 0.5 \times 36 = 18.0$ k/□"

$f_b = +11.8$ & -16.5 k/□" → For G1 – Use 16WF 88-A36 plus welded Pl. ←

Design G2

Load = 1.04 k/' (1)

$M = \frac{1}{8} \times 1.04 \times \overline{31}^2 = 126.$'k



$3.4 \times 16.4 = 56.$
$14.7 \times 8.13 = 120.$
18.1 □"
176

$\frac{176}{18.1} = 9.7$"

$3.4 \times \overline{6.7}^2 = 152.$
$14.7 \times \overline{1.6}^2 = 38.$
$655.$
$I = 845.$

$f_b = \frac{12 \times 126 \times 6.8/9.7}{845.}$

$= +12.2$ & -17.4 k/□"
< 18.0 ok.

Bracing G1–G4 comp. flg.

$l_b \leq 13 \times 5 = 65$" or
$545 \times (5 \times .88)/17.4 = 138.$"

Max. spacing for comp. flg. bracing = 65."

For G2 – Use 16WF50-A36 ←

SUBJECT: ANSONIA-DERBY
COMPUTATION: R. R. Gate No. 4
COMPUTED BY: GR. CHECKED BY: R DATE: Feb. '66

Design G3 $L_d = 760.\#/'$ (1) $M = \frac{1}{8} \times 760 \times 31^2 = 92.'^k$

Try 16WF 36.

$13\frac{1}{2}$" width of $\frac{1}{4}$" Pl
same as G2 (pg 3)

$3.4 \times 16 = 54.$
$10.6 \times 7.93 = 84.$
$14.0\ \square''$ $\quad 138.$

$\frac{138.}{14.} = 9.9''$

$3.4 \times 6.1^2 = 127.$
$10.6 \times 2.0^2 = 42.$
$I = 615.$

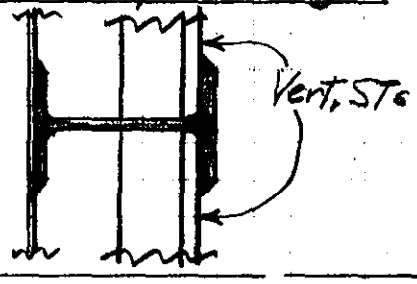
$16.1 - 9.9 = 6.2''$

$f_b = \frac{12 \times 92 \times \frac{6.2}{9.9}}{615.} = +11.2 \ k/\square''$, -17.8

< 18.0 ok

For G3 - Use 16WF 36 - A36
Load = 160.#/' → For G4 - Use 16B 31 - A36

Vert. Diaph. Bracing



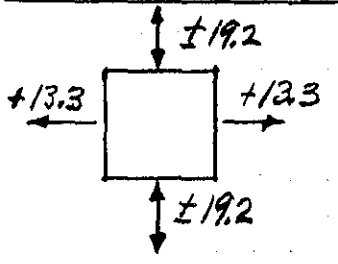
Dist. betw. vert. end posts = 30'-8" ±

$\frac{30.67}{6} = 5'-1''\pm = 61''\pm < 65''$ ok.

ST 8B13 - $\frac{l}{r} = \frac{36-6}{1.07} = 30$ ok.

Use ST 8B13

Skin Pl - combined stresses



At flg. edge of G1 - $f_b = \pm 19.2\ k/\square''$ (pg. 2) - Vert. bending
" " " " " $f_b = +13.3\ k/\square''$ (pg. 3) - horiz. "

max. tens. = $19.2 < 25.0\ k/\square''$

max. shear = $\frac{13.3 - (-19.2)}{2} = 16.3\ k/\square''$ ok

Allow = $.33 \times 50. = 16.7\ k/\square''$

Diagonals

Skin Pl - $10.3' \times \frac{1}{4}'' = 105.$
4-16WF bms, +L = 210.
Vert. bracing = 50.
Diagonals = 25.
Wgt. of gate = 390.

Total wgt. = $390. \times 31' =$ Say 12.^{k}

End diag. = $12 \times \frac{16'\pm}{10'\pm} = 19.^k$

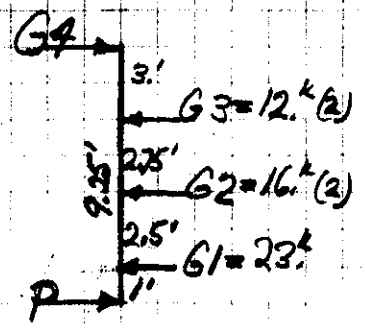
$\frac{19}{18} = 1.1\ \square''$ requ.

4L 7.25 $\quad \frac{l}{r} = \frac{72}{.46} = 157.$

Use 4L 7.25 diagonals
welded to ext. flanges of 16WF.

SUBJECT: ANSONIA-DERBY
COMPUTATION: R.R. Gate No. 4
COMPUTED BY: G.R. CHECKED BY: R DATE: Feb. 66

Vert. end post - adj. to hinges



$P = 34.4^k$ $G4 = 16.6^k$

$M = 34.4 \times 3.5 - 23 \times 2.5 = 63.'^k$

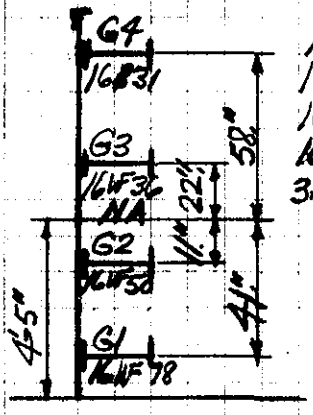
16WF36. - $f_b = \frac{12 \times 63.}{36.} = 13.5$ #/□" ok.

Axial ld. if all gate ld. acts on end post

$= \frac{12000.}{10.6} = 1100.$ #/□" negl.

For vert. end posts use 16WF36 or 40-A36

Vertical ld. effect.



Skin pl.	31 × 5/1 =	158.
16WF78	22.7 × 1.0 =	23.
16WF50	14.7 × 3.5 =	52.
16WF36	10.6 × 6.25 =	66.
16B31	9.1 × 9.25 =	84.
3×3×1/4 L	1.4 × 10.25 =	14.
	89.5□"	397.

$\frac{397}{89.5} = 4.42'$ from bottom pl.

$\frac{1}{12} \times \frac{1}{4} \times 123^3$	=	38700.
31×9^2	=	2500.
22.7×41^2	=	38200.
14.7×11^2	=	1800.
10.6×22^2	=	5100.
9.1×58^2	=	30600.
1.4×69^2	=	6700.
I_{NA}	=	123,600.

If gate hangs as cantilever

$M = 12^k \times \frac{31}{2} = 186.'^k = 186000.'^\#$

Top Bm - $f_a = \frac{186000 \times 12 \times 58}{123600.} = +1050.$ #/□" Negl.

Bottom Bm. $f_a = \frac{186000 \times 12 \times 41}{123600.} = -740.$ #/□" Negl.

Mom @ 3/4 pt. $= 390 \times 23.2 \times 11.6 = 105000.'^\#$

Bot. Bm. - $f_a = \frac{105000. \times 12 \times 41.}{123600.} = -400.$ #/□"

From (pg. 3) total stress @ outer flange $= -19.0 - 0.4 = -19.4$ #/□" for 16WF78

16WF88 used - ok.

Beyond 3/4 pt. horiz. bending stresses reduce so that combined horiz. & vert. stresses are below mid. sp. max.

If gate supported each end: $M = \frac{1}{8} \times 390 \times 32^2 = 50000.'^\# < 186000.$ ok.

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
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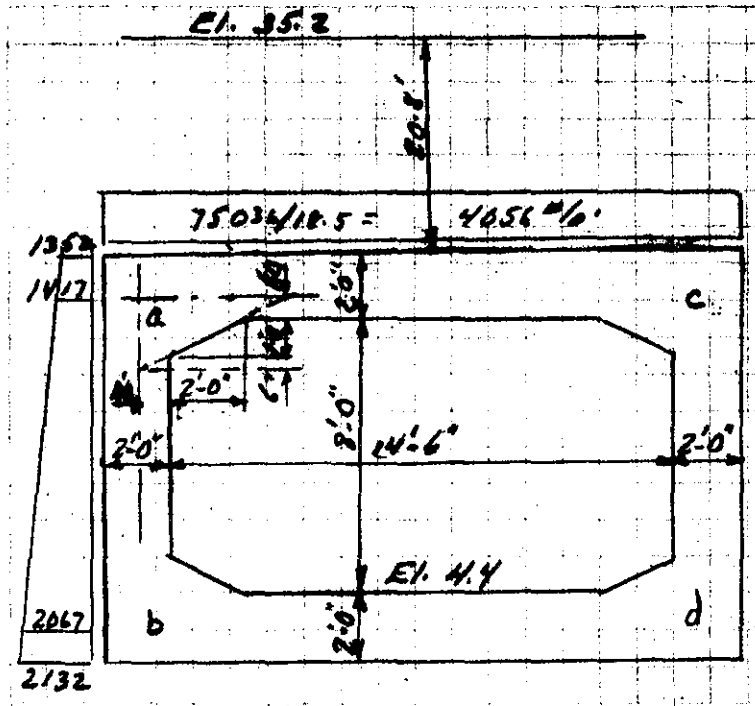
PAGE DM-II

SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit @ & Dike
COMPUTED BY H.E.W CHECKED BY DATE Mar 1966



Condition No 1
Conduit empty, earth sat. Condition III application of loads no external or internal water max. sat. earth fill on roof

Condition No 2
Max int. pressure in conduit with water to El. 36.0. external load assumed same as Case I

Condition No 1

Weight of fill on roof = 1.5×20.8×18.5×130 = 75,036
Horiz pressure @ a = 20.8×130×.5 = 1352
" " @ b = 32.8×130×.5 = 2132

Weight of Conduit = 150(18.5+8.0)4 + 1×2×2×150 = 16,500

Bear P = (75036+16,500)/18.5 = 4947 #/□'

Frame constants from PCA Handbook of Frame Constants

ac = $a_A = a_C = \frac{3.0}{16.5} = .181$ $r_A = r_B = \frac{1.5}{2.0} = .750$

ab . $a_A = a_B = \frac{1.5}{10.} = .151$ $r_A = r_B = \frac{3.0}{2.0} = 1.33$ (4.0 / 2.00)

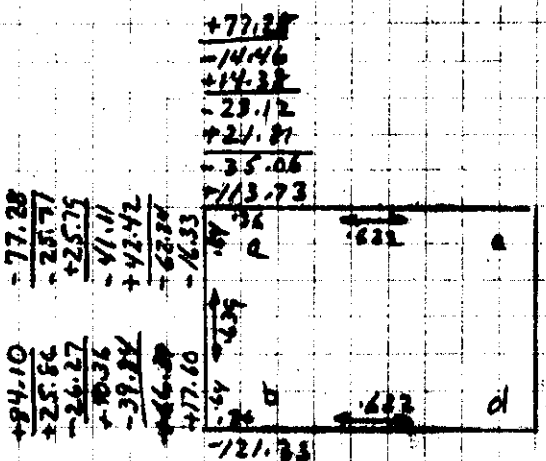
Member ac.
Carry over factor = .622
Stiffness " = 6.82
F.E.M. coef = .0959

Member ab
Carry over factor = .639 (.662)
Stiffness " = 7.21 (8.08)
F.E.M. coef = .0974 (.1083)
(neglect effect of error)

Relative stiffness ac = $\frac{6.82}{16.5} = .411$ ab = $\frac{7.21}{10} = .721$

FEM ac = .0959 × 4356 × 16.5^2 = 113.73
" ab = $.0974 \times 1417 \times 10^2 + \frac{1}{15} \times \frac{.0974}{.0833} \times 650 \times \frac{10^2}{2}$ = 16.[illegible]
" ba = $.0974 \times 1417 \times 10^2 + \frac{1}{10} \times \frac{.0974}{.0833} \times 650 \times \frac{10^2}{2}$ = 17.[illegible]
" bd = .0959 × 4648 × 16.5^2 = 121.33

SUBJECT: Ansonia Derby
COMPUTATION: Beaver Brook Conduit c & Dike
COMPUTED BY: H.E.W CHECKED BY: DATE: Mar 1966



Reactions

Member ac

$V_a = V_c = 4356 \times 8.25 = 35.94^k$

Member bd

$V_b = V_d = 4647 \times 8.25 = 38.34$

Member ab

$H_a = 1417 \times 5 + 650 \times \frac{10}{6} - \frac{6.82}{10} = 7.49$

$H_b = 1417 \times 5 + 650 \times \frac{10}{3} + \frac{6.82}{10} = 9.93$

Thrust on walls $= 4356 \times 9.25 = 40.29^k$

Thrust on roof $= 1352 \times 6 + 780 \times \frac{12}{6} - \frac{6.82}{10} = 8.99^k$

Thrust on base $= 1352 \times 6 + 780 \times \frac{12}{3} + \frac{6.82}{10} = 11.91$

Member ac

$+M = \frac{1}{8} \times 4356 \times 16.5^2 = 77.28 - \frac{1}{6} 35.94 \times 2 = 58.90^{ik}$

f'_c =	4000
f_c =	1400
K =	324
j =	.86
a =	1.44

$+M_s = 58.900 + 8990 \times \frac{8.5}{12} = 65.360^{ik}$

req'd $d = \sqrt{\frac{65360}{324}} = 14.2 < 20.5''$ OK

$+A_s = \frac{65360}{1.44 \times 20.5} = \frac{8990}{20,000} = 1.76^{\square''}$ Use #11 @ 8" 2.34

$-M$ at face V @ face $= 4356 \times 7.25 = 31,580$

$-M = 77.280 - \frac{1}{3} 35.94 \times 2 = 53,320^{ik}$

$-M_s = 53.320 + 8990 \times \frac{14.5}{12} = 64,170^{ik}$

$+A_s = \frac{64170}{1.44 \times 20.5} = \frac{8990}{20,000} = .92^{\square''}$

Note: In computing shear F.S. use M @ face as it more nearly conforms to U of Ill. assumptions

$M = 58.900 x - 4356 \frac{x^2}{2} - 53.320$ $x = 2.03$

$V = 8.28 \times 4356 = 22.650^k$

Check shear S.F. by Univ. Ill. report No. 164

$p = \frac{2.34}{12 \times 24.21} = .0081 = .81\%$ $\frac{A}{d} = \frac{10.7 \times 12}{20.5} = 6.09$ $\frac{N}{V} = \frac{8990}{22.650} = .40$

$\frac{4356}{12} = .363^{k/\square''}$ $W_c = \frac{231(.0081 + .008)(12 + .40)}{6.09 \times 25.09} = 1.016$

$F.S. = \frac{1.016}{.363} = 2.80 > 2.5$ OK

SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit @ ℄ Dike
COMPUTED BY H.E.W CHECKED BY DATE Mar 1966

Member bd.

$+M = \frac{1}{8} \times 4{,}647 \times 16.5^2 - 84{,}100 - \frac{1}{6} \times 38.34 \times 2 = 62{,}260^{'K}$

$+Ms = 62{,}260 + 11{,}910 \times \frac{8.5}{12} = 70.760^{'K}$

reqd $d = \sqrt{\frac{70{,}760}{324}} = 14.7 < 20.5$ OK

$+As = \frac{70.760}{1.44 \times 20.5} - \frac{11{,}910}{20{,}000} = 2.79 - .60 = 1.81$ use #11@8"

- M @ face - V @ face $= 4647 \times 7.25 = 33600$

$-M = 84{,}100 - \frac{1}{3}\, 38340 \times 2 = 58{,}540$

$-Ms = 58{,}540 + 11{,}910 \times \frac{13.5}{12} = 71{,}940^{'K}$

$-As = \frac{71.940}{1.44 \times 31.5} - \frac{11{,}910}{24{,}000} = .99$ in² Use #10@10"

Check Shear S.F

$M_0 = 33600x - 4647\frac{x^2}{2} - 58540 \qquad x = 2.03'$

$V = 522 \times 4647 = 24.20^K$

$p = .81\% \quad \frac{l'}{d} = \frac{10.44 \times 12}{20.5} = 6.12 \qquad \frac{N}{V} = \frac{11{,}910}{24.20} = .49$

$w = \frac{4647}{12} = .387^{K/ft} \qquad w_c = \frac{231(.0464 + .008)(12 + .49)}{6.12 \times 25.12} = 1.012$

$F.S = \frac{1.012}{.387} = 2.62 > 2.5$ OK

Note
The following 2 pages show the same analysis as performed by computer. The slight variations in results are due to the greater accuracy of the computer and because it made five distributions of the moments

Remaining sections to be by the computer

Condition 2 Loading

Internal pressure at bot of roof = $22.6 \times 62.5 = 1412^{\#/\square'}$
" " " invert = $30.6 \times 62.5 = 1912^{\#/\square'}$

These pressures do not over come external pressures so Condition 2 will not be critical

SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit @ & Dike
COMPUTED BY C. M. T. CHECKED BY H. E. W DATE Mar 66

BOX CULVERT W/ HAUNCHES IN EARTH EMBANKMENT:-----

U.S.A. ENGINEERS,N.E.D. BY C.M.TERZIAN DEC.2,1965
REFERENCE: PRELIM. EM PART CXXIX CHAPTER 2
EQUIPMENT: MATHATRON W/ APS&PTP

DESCRIPTION:-THIS PROGRAM DETERMINES REQUIRED RE-STEEL DUE BENDING AND DIRECT STRESSES FOR TOP SLAB,WALLS & BASE SLAB.

ALLOWABLE STRESSES: F'C=4000PSI
FC=1800PSI
FS=20000PSI
~~V=60PSI~~

ALL UNITS IN POUNDS-FEET

ENTER FOLLOWING ITEMS:----

PROJECT NAME	=ANSONIA-DERBY
STATION	=BEAVER BROOK
DATE	=3/31/66
CLEAR HEIGHT OF CONDUIT OPENING	=8
CLEAR WIDTH " " "	=14.5
THICKNESS,TOP SLAB	=2
" ,WALLS	=2
" ,BASE SLAB	=2
HEIGHT OF WATER TO TOP OF CONDUIT	=0
HGT, EARTH(~~SUB~~ Sat) TO TOP OF CONDUIT	=20.8
HEIGHT OF EARTH(MOIST)	=0
WEIGHT OF WATER	=0
" " EARTH(~~SUB~~ Sat.)	=130
" " EARTH(MOIST)	=0
EMBANKMENT LOAD FACTOR	=1.5
LATERAL PRESSURE FACTOR	=.333
ROOF CARRY OVER FACTOR	=.622
ROOF STIFFNESS FACTOR	=6.82
ROOF FEM COEFF.	=.0959
WALL CARRY OVER FACTOR	=.639
WALL STIFFNESS FACTOR	=7.21
WALL FEM COEFF.	=.0974

NED FORM 223
27 Sept 49

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

PAGE DM-82

SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit @ & Dike
COMPUTED BY C.M.T. CHECKED BY H.E.W DATE Mar 66

CENTER LINE	ROOF	WALLTOP	WALLBOT	BASE
FEM MOMENT=	113729.8	-16317.6	17582.5	-120503.9
FINAL MOM.=	78800.0	-78800.0	84980.0	-84980.0
-1	3432.8	6761.7	-6757.5	-3434.9
WALMD MOM@=	4.7	-.0	-.....&	
SHEAR =	35937.0	7181.4	9138.9	38077.5

DESIGN:--------

ROOF HAUNCH DEPTH =1
WALL " " =2

	MS#FT	SHEAR#	AXIAL#	D REQD"	SHEAR,PSI	REINF.X10
ROOFB=	63586.1	-.0	8524.8	14.0	-.0	17.3
ROOFT=	60967.1	31581.0	8524.8	13.7	80.9	8.8
WALTP=	102962.9	5744.1	40293.0	17.8	14.7	1.9
WALMD=	-34338.1	-.0	41493.0	-25.2	-.0	-32.4
WALBT=	109562.3	7312.0	42692.9	18.3	18.7	2.1
BASEB=	66235.0	33462.0	10799.8	14.2	88.5	9.2
BASET=	67156.9	-.0	10799.8	14.3	-.0	17.4

IF REINF. IS (-) USE MIN. STEEL
IF " " " AND DREQD IS > D GIVEN, DESIGN IS OK

END

NED FORM 223
27 Sept 49

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

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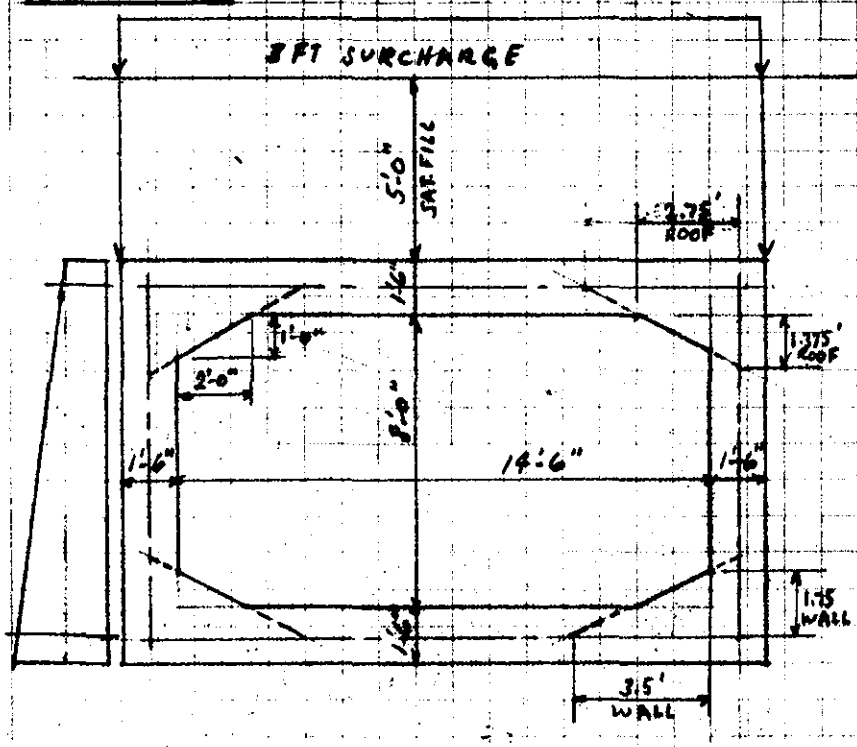
7

SUBJECT: ANSONIA DERBY
COMPUTATION: BEAVER BROOK CONDUIT - Upper Conduit
COMPUTED BY: CMT CHECKED BY: WZW DATE: 3/31/65

CONDITION I:



1. CONDUIT EMPTY
2. 5 FT EARTH SAT.
3. 3 FT SURCHARGE
4. NO EXTERNAL WATER
5. NO INTERNAL WATER
6. LOAD FACTOR = 1.25/.85 = 1.29
7. Expa...

℄ SPANS USED

FRAME CONSTANTS: - (SEE PCA HAND-BOOK OF FRAME CONSTANTS)

ROOF & BASE SLAB (a = .172', Ra = 1.0')	WALLS (a = .184', Ra = 2.00)
CARRY-OVER FACTOR = .639	C.O. = .695
STIFFNESS " = 7.17	STIFF. = 9.42
FEM " = .0974	FEM = 0.1024

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27 Sept 49

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

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SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit Upper Section
COMPUTED BY C.M.T. CHECKED BY DATE Mar 66

Sections with 5'-6" fill plus 3'-0" surcharge - No Int. pressure

BOX CULVERT W/ HAUNCHES IN EARTH EMBANKMENT:-----

U.S.A. ENGINEERS,N.E.D. BY C.M.TERZIAN · DEC.2,1965
REFERENCE: PRELIM. EM PART CXXIX CHAPTER 2
EQUIPMENT: MATHATRON W/ APS&PTP

DESCRIPTION:-THIS PROGRAM DETERMINES REQUIRED RE-STEEL DUE BENDING AND DIRECT STRESSES FOR TOP SLAB,WALLS & BASE SLAB.

ALLOWABLE STRESSES: F'C=4000PSI
FC=1800PSI
FS=20000PSI
~~V=60PSI~~

ALL UNITS IN POUNDS-FEET

ENTER FOLLOWING ITEMS:----

PROJECT NAME	=ANSONIA-DERBY
STATION	=BEAVER BROOK, LOW FILL SEC., COND 1
DATE	=3/31/66
CLEAR HEIGHT OF CONDUIT OPENING	=8
CLEAR WIDTH " " "	=14.5
THICKNESS,TOP SLAB	=1.5
" ,WALLS	=1.5
" ,BASE SLAB	=1.5
HEIGHT OF WATER TO TOP OF CONDUIT	=0
HGT, EARTH(~~SUB~~ sat) TO TOP OF CONDUIT	=8
HEIGHT OF EARTH(MOIST)	=0
WEIGHT OF WATER sat	=0
" " EARTH(~~SUB~~)	=130
" " EARTH(MOIST)	=0
EMBANKMENT LOAD FACTOR	=1.28
LATERAL PRESSURE FACTOR	=.333
ROOF CARRY OVER FACTOR	=.639
ROOF STIFFNESS FACTOR	=7.17
ROOF FEM COEFF.	=.0974
WALL CARRY OVER FACTOR	=.695
WALL STIFFNESS FACTOR	=9.42
WALL FEM COEFF.	=.1024

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27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit - Upper Section
COMPUTED BY C M T. CHECKED BY DATE Mar 66

CENTER LINE	ROOF	WALLTOP	WALLBOT	BASE
FEM MOMENT=	38802.9	-6426.7	7399.6	-43932.2
FINAL MOM.=	27802.4	-27802.4	32583.3	-32583.3
-1	1376.2	3581.0	-3564.4	-1382.6
WALMD MOM@=	4.2	-.0	-.....&	
SHEAR =	12449.6	2450.9	4108.5	14095.3

DESIGN:--------

ROOF HAUNCH DEPTH =1
WALL " " =2

	MS#FT	SHEAR#	AXIAL#	D REQD"	SHEAR,PSI	REINF.X10
ROOFB=	20203.0	-.0	2807.8	7.8	-.0	8.3
ROOFT=	22897.0	11282.4	2807.8	8.4	35.4	4.6
WALTP=	32975.6	2075.1	13616.7	10.0	6.5	1.8
WALMD=	-16316.8	-.0	14516.7	-11.3	-.0	-15.1
WALBT=	37773.6	3448.6	15416.7	10.7	10.8	2.2
BASEB=	27239.1	12773.8	4687.3	9.1	41.7	5.1
BASET=	22476.7	-.0	4687.3	8.3	-.0	8.4

IF REINF. IS (-) USE MIN. STEEL
IF " " " AND DREQD IS > D GIVEN, DESIGN IS OK

MS#FT:----CORRECTED TO FACE OF SUPPORT FOR CORNER MOM. W/ AXIAL LD& VA/3
" FOR MID-SPAN MOMENT WITH AXIAL LOAD & VA/6
SHEAR#:--- " TO FACE OF SUPPORT
SHEAR,PSI: " " " " "
REINF:----(MS)/(FS)XJXD-N/(FS)=(AS)
DIVIDE GIVEN VALUE BY 10

Shear safety factor not investigated because of low unit shear values

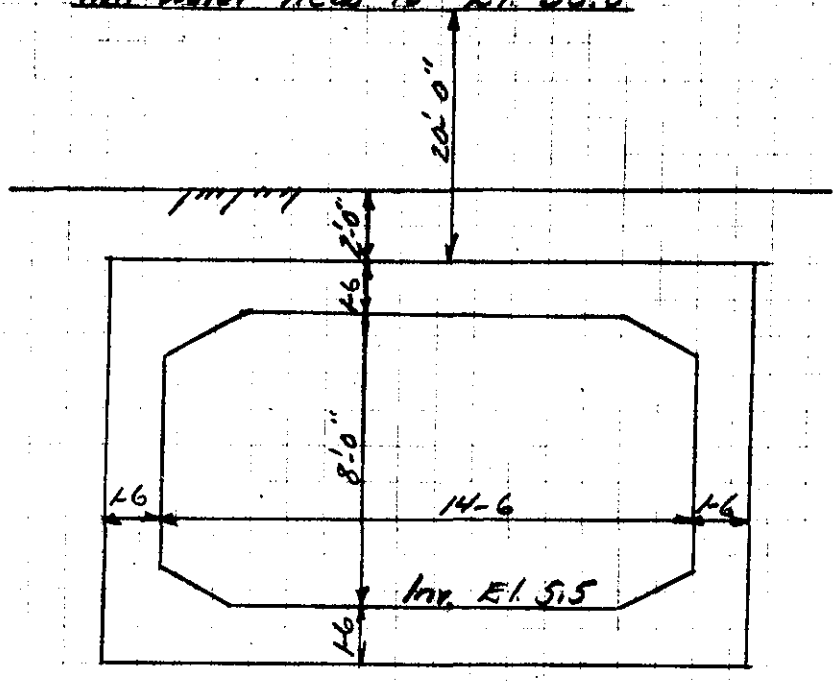
Sections under roadways and higher fill to be investigated for necessary changes in thickness and steel reinf.

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Beaver Brook Conduit - Lower Conduit as a Pressure Conduit
COMPUTED BY C. M. T. CHECKED BY DATE April 66

Int. water Head to El. 35.0



Investigate conduit for an internal pressure to Elev. 35.0 assuming a min of 2'-0" of fill on conduit roof.

Frame constants will be the same as for the upper conduit.

BOX CULVERT W/ HAUNCHES IN EARTH EMBANKMENT:-----

U.S.A. ENGINEERS,N.E.D. BY C.M.TERZIAN DEC.2,1965
REFERENCE: PRELIM. EM PART CXXIX CHAPTER 2
EQUIPMENT: MATHATRON W/ APS&PTP

DESCRIPTION:-THIS PROGRAM DETERMINES REQUIRED RE-STEEL DUE BENDING
AND DIRECT STRESSES FOR TOP SLAB,WALLS & BASE SLAB.

INSTRUCTIONS: PUT PROGRAM TAPE ON OUTBOARD READER
ANSWERS ONLY ON, AUTO TAB,MAG8, DEC1, PROG.&CONTROL AUTO
PUT LEADER FROM PUNCH TO INBOARD READER

ALLOWABLE STRESSES: F'C=4000PSI
FC=1800PSI
FS=20000PSI
V=60PSI

ALL UNITS IN POUNDS-FEET

ENTER FOLLOWING ITEMS:----

PROJECT NAME =ANSONIA-DERBY
STATION =BEAVER BROOK
DATE =4/9/66

PART 1:-----DESIGN FOR INTERNAL LOADS(PRESSURE CONDUIT)
(CONTINUE W/ PART 2 FOR EXTERNAL LOADING)
CONDITION STATEMENT =COND 2

CLEAR HEIGHT OF CONDUIT OPENING =8
CLEAR WIDTH " " " =14.5
THICKNESS,TOP SLAB =1.5
" ,WALLS =1.5
" ,BASE SLAB =1.5
HGT, EXT. WATER TO TOP OF CONDUIT=0
HGT, INT. " " " " " =20
HGT, EARTH(~~SUB~~ SAT.) TO TOP OF CONDUIT=2
HEIGHT OF EARTH(MOIST) =0
WEIGHT OF WATER =62.5
" " EARTH(~~SUB~~ SAT.) =130
" " EARTH(MOIST) =0
EMBANKMENT LOAD FACTOR =1
LATERAL PRESSURE FACTOR =.333
ROOF CARRY OVER FACTOR =.639
ROOF STIFFNESS FACTOR =7.17
ROOF FEM COEFF. =.0974
WALL CARRY OVER FACTOR =.695
WALL STIFFNESS FACTOR =9.42
WALL FEM COEFF. =.1024

PART ONE (Cont.)

CENTER LINE	ROOF	WALLTOP	WALLBOT	BASE	
FEM MOMENT=	33077.6	-13736.3	14677.6	-45385.6	
FINAL MOM.=	25325.0	-25325.0	36698.0	-36698.0	
-1	460.3	1196.4	-1192.3	-461.9	..
SHEAR @ CL=	9742.1	4897.1	7852.8	13367.1	
WALMD MOM@=	4.1	.....&			
MOM @ FACE=	18018.3	-21652.1	30808.3	-26672.6	

	MS#FT	SHEAR#	AXIAL#
ROOFM=	15052.5	.0	4897.1
ROOFC=	15773.8	9742.1	4897.1
WALTP=	17186.9	4897.1	9742.1
WALMD=	-18473.7	.0	11554.6
WALBT=	24681.7	7852.8	13367.1
BASEC=	23727.8	13367.1	7852.8
BASEM=	18184.1	.0	7852.8

PART 2:-------DESIGN FOR EXTERNAL LOADS
(EXT. EARTH, WATER, & CONCRETE)

FEM MOMENT=	12093.1	-2620.4	3380.5	-17222.5	
FINAL MOM.=	8443.6	-8443.6	13213.6	-13213.6	
-1	214.5	557.1	-555.5	-215.1	..
WALMD MOM@=	3.6	1.1	.....&		
SHEAR =	3880.0	714.5	2369.8	5525.7	

DESIGN:-------

	MS#FT	SHEAR#	AXIAL#
ROOFM=	6494.6	.0	847.1
ROOFC=	6891.9	3516.2	847.1
WALTP=	10031.4	613.0	4243.7
WALMD=	-5007.9	.0	5143.7
WALBT=	14798.7	1988.3	6043.7
BASEC=	11472.3	5007.6	2724.3
BASEM=	8756.4	.0	2724.3

FINAL DESIGN:------FOR COMBINED LOADINGS

ROOF HAUNCH DEPTH =1
WALL " " =2

	MS#FT	SHEAR#	AXIAL#	D REQD"	SHEAR,PSI	REINF.X10
ROOFM=	8557.9	.0	4050.0	5.1&41	.0	6.1
ROOFC=	8881.9	6225.9	4050.0	5.2	19.5	4.3
WALTP=	7155.5	4284.0	5498.4	4.6	9.2	4.0
WALMD=	-13465.8	.0	6410.9	6.4&41	.0	3.2
WALBT=	9883.0	5864.4	7323.4	5.5	12.6	5.4
BASEC=	12255.4	8359.5	5128.5	5.5	-.4	5.2
BASEM=	9427.7	.0	5128.5	5.3&41	.0	7.1

VALUES OF NEGATIVE SIGN (-) INDICATE EXTERNAL LOADS GOVERN (SEE BELOW)

ROOFM=ROOF SLAB@MID-SPAN IF -MS THEN REINF@ BOTTOM
ROOFC=ROOF SLAB@CORNER IF -MS THEN REINF@ TOP
WALTP=WALL TOP " " " " " OUTSIDE FACE
WALMD=WALL MID-SPAN " " " " " INSIDE FACE
WALBT=WALL BOTTOM " " " " " OUTSIDE FACE
BASEC=BASE SLAB@CORNER " " " " " BOTTOM
BASEM=BASE SLAB@MID-SPAN " " " " " TOP

IF +MS THEN LOCATE REINF IN OPPOSITE FACE AS GIVEN ABOVE
MINIMUM COVER 3" FOR ALL EXCEPT BASE SLAB@BOTTOM= 4"

MS#FT:----CORRECTED FOR MID-SPAN MOMENT WITH AXIAL LOAD & VA/6
" TO FACE OF SUPPORT FOR CORNER MOM W/ AXIAL LD & VA/3
SHEAR#:--- " TO FACE OF SUPPORT
SHEAR,PSI: " " " " "
REINF:----(MS)/(FS)XJXD-N/(FS)=(AS)
DIVIDE GIVEN VALUE BY 10

END

Note - Use Sect for Upper Conduit except for heavier steel where required

27 Sept. [redacted]

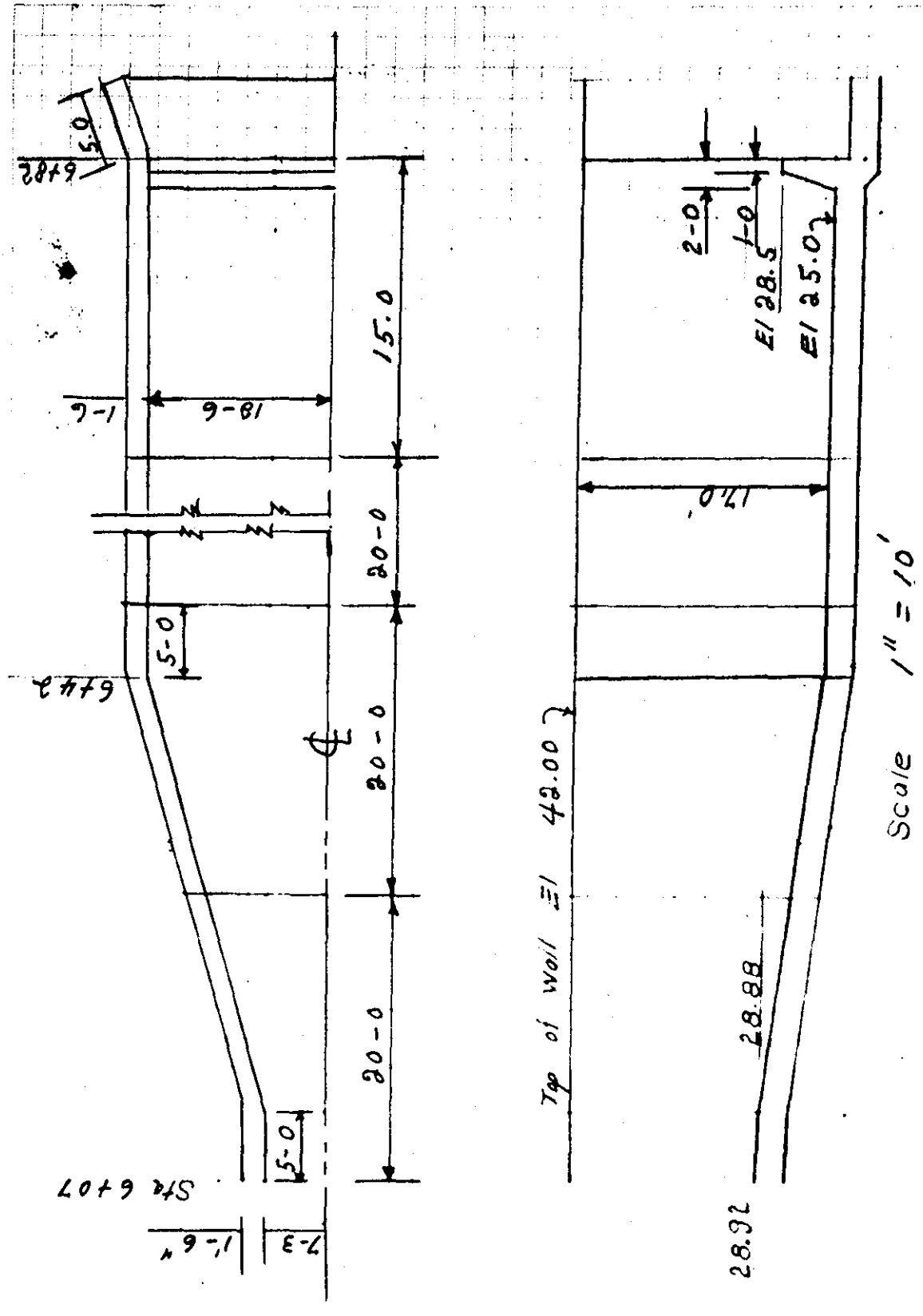
CORPS OF ENGINEERS, U. S. ARMY

PAGE DM 90

SUBJECT ANSONIA DERBY

COMPUTATION BEAVER BROOK — STILLING BASIN

COMPUTED BY A CHECKED BY E.P.G DATE March 1966



NED FORM 223
27 Sept 49

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

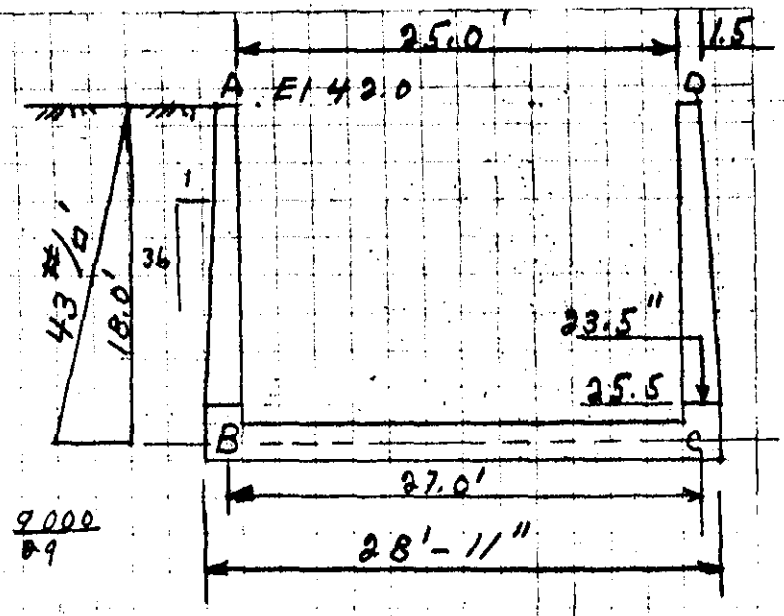
PAGE DM-91

SUBJECT: ANSONIA DERBY
COMPUTATION: BEAVER BROOK STILLING BASIN
COMPUTED BY: R CHECKED BY: E.P.C DATE: March 1966

Cond I
Moist Earth - No Uplift
$w = 130\ \#/\square'$ $k = .33$
$h = 9.2$ $f_c = 1050$
$f_s = 20000$
$K = 33$ $J = .89$
$a = \frac{f_s}{12} \times J = 1.48$

$\Sigma H(AB) = 43 \times 18 \times 9 = 6970\ \#$
$M_{BA} = 7.0 \times 6 = 42.0\ ^{1K}$

$M(BC) = 42.0\ ^{1K} = M_{BA}$
Net Load on BC
$\frac{Wall}{29} = \frac{2(1.5+2.0)0.5 \times 17 \times 150}{29} = \frac{9000}{29}$
$= 310\ \#/\square'$



Floor BC Bars
$\Sigma N = \frac{WL^2}{8} - M_{BC} = \frac{310 \times (27)^2}{8} - 42 = 28.4 - 42.0 = -13.6\ ^{1K}$
No Steel for Stress

M_B at Wall face $= M - \frac{Va}{3} = 42.0 - \frac{1.5}{3}(31 \times 12.5) = 40.1\ ^{1K}$

$M_S = M_B + \frac{d''}{12} N = 40.1 + \frac{8}{12} \times 7.0 = 44.8$ Foot K, p

$A_s = \frac{M}{ad} - \frac{N}{f_s} = \frac{44.8}{1.48 \times 19.5} - \frac{7.0}{20} = 1.55 - 0.35 = 1.20$
#7 at 6"
$v = \frac{3900}{12 \times 19.5} = 18\ \#/\square''$

Wall Bars

y	y^2	ΣH $.0315 x^2$	Mom	d	a.d	As Outside Face Wall
17.0	289	6.3 K	35.7	20.0	29.6	1.20 #7@6 As = 1.2 Σ 5.5
14.0	196	4.2	19.6	19.2	28.4	0.69
11.5	132	2.84	10.9	18.3	27.0	0.41
8.0	64	1.38	5.3	17.1	25.5	0.21
13.0	169	3.63	15.8			

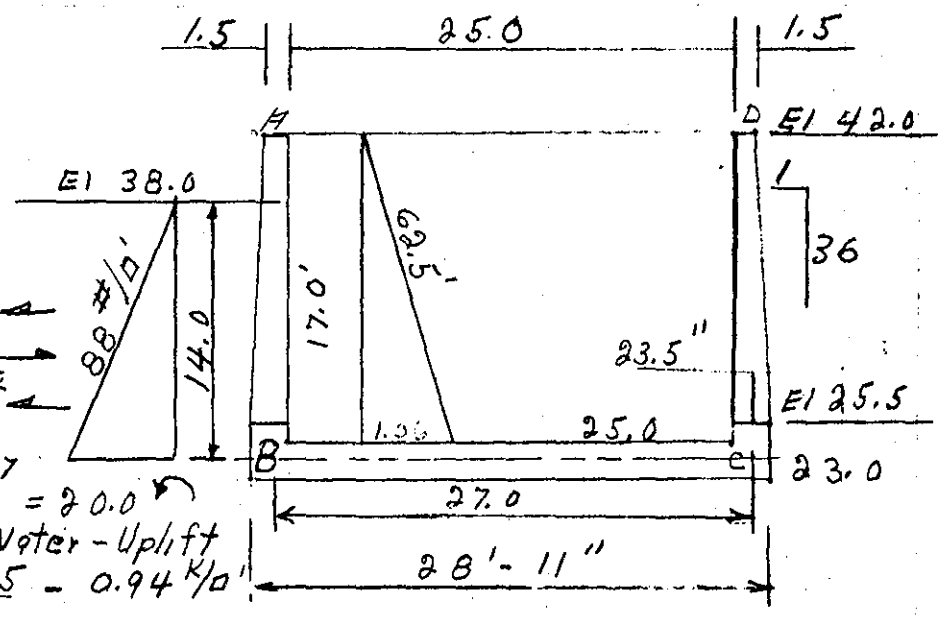
$v = \frac{V}{Bd} = \frac{6300}{12 \times 20} = 26\ \#/\square''$

SUBJECT ANSONIA DERBY

COMPUTATION BEAVER BROOK STILLING BASIN

COMPUTED BY A CHECKED BY E.P.G. DATE March 1966

Cond II
Submerged Earth
$W = 78.5$ $K = 33$
P = Rounded 88 #/□'
$K = 33$ $J = .89$
$a = 1.48$
Mom BA
ΣH
$62.5 \times 17 \times 8.5 = 9.0$
$88 \times 14 \times 7.6 = 8.6$
$N = -0.4^K$



$M_{BA} = 9 \times 6.67 - 8.6 \times 4.67$
$= 60.0 - 40.0 = 20.0$

Floor: Wall + Floor + Water − Uplift

$\frac{9.0^K + 0.3 \times 29 + 1.06^K \times 25}{29} - 0.94^K/\square'$

$SBP = \frac{44.2}{29} - 0.94 = 1.53 - 0.94 = 0.59^K/\square'$

Net $= 1.53 - (1.06 + 0.3) = .170^K/st$

$\mathcal{C}M = \frac{wL^2}{8} + 20.0 = \frac{.170 \times 27^2}{8} + 20 = 15.5 + 20.0 = 35.5^K$

$N = -0.4$ $M_s = M - \frac{Nd''}{12} = 35.5 - \frac{0.4 \times 8}{12} = 32.8^K$

$A_s = \frac{M_s}{ad} + \frac{N}{f_s} = \frac{32.8}{14 \times 20.5} + \frac{.4}{20} = 1.07 + 0.02 = 1.05$

#7 @ 6

Bottom of Floor Slab Bars Cond I Governs

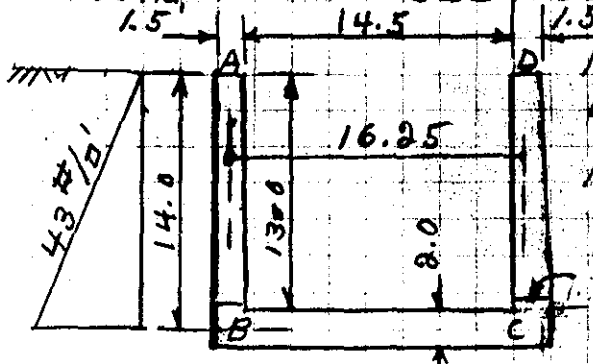
Wall Bars x = Dist from Top

$M = 0.0625\frac{(x)^3}{6} - \frac{0.088}{6}(x-4)^3$

x	$x-4$	x^3	$(x-4)^3$	M	ad	A_s
17	13.0	4913	2197	51.2 − 32.2 = 19.0	27.6	0.67
14	10.0	2744	1000	28.6 − 14.7 = 13.9	26.4	0.49
11.5	7.5	1521	422	15.9 − 6.2 = 9.7	21.9	0.36
8.0	4.0	512	64	5.3 − 1.0 = 4.3	25.5	0.18

SUBJECT: ANSONIA DERBY
COMPUTATION: BEAVER BROOK CONC CHANNEL
COMPUTED BY: A CHECKED BY: EPG DATE: April

Cond I – See Computations for Stilling Basin



Net Load on Floor
$\frac{1.5 \times 8 \times 1.50 \times 13}{18} = 325$ #/□'

Mom BA
$\Sigma H = 43 \times 14 \times 7 = 4200$ #
$M_{BA} = 4.2 \times 4.67 = 19.6$ Foot Kip

1.75' El 29.0
El 27.0

Floor Mom & Bars F = 0.380 Max M = 58'K No Bars

℄ Mom $= \frac{WL^2}{8} - 19.6 = 325 \times \frac{(16.25)^2}{8} = 10.8 - 19.6 = -8.8$ 'K

Mat Face of Wall $= M_{BC} - \frac{1}{3} V a = 19.6 - \frac{1.5}{3}(.335 \times 7.25) = 18.4$

$M_s = M + \frac{Nd''}{12} = 18.4 + \frac{8}{12} \times 4.2 = 21.2$ 'K $A_s = \frac{M}{ad} - \frac{N}{f_s} = \frac{21.2}{(1.48)19.5} - \frac{4.2}{20}$

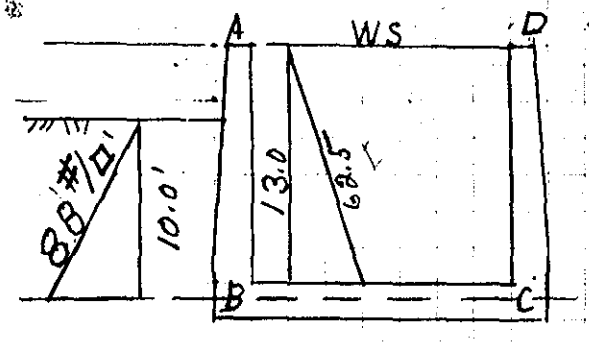
$A_s = 0.73 - 0.21 = 0.52$ □' #7 @ 12 Bottom Bars
or 5 @ 6

Wall Bars X = Dist From Top d = 14.5 a = 1.48

Y	x^2	ΣH	M	d	ad	As
13.0	169	3.63	15.7	17.5	26	0.60 □" #7@12
9.0	81	1.75	5.25	16.7	24.8	0.22
10	100	2.15	7.2	16.9	25.0	0.29 #5@12

$V = \frac{3630}{12 \times 17.5} = 18$ #/□'

Cond II



See Comps for Stilling Basin
Dimensions of Conduit Same as for Cond I

Mom BA	ΣH #		
62.5 X 13 X 6.5 =	5300 ←	5.33	-28.2
88.0 X 10 X 5.0 =	4400 →	3.33	+14.6 'K
ΣH & ΣM	0.9 K ←		13.6 'K

Net Up on floor = 170 #/□'
Cond I Governs for Reinf bars on Floor Bottom

Mom Floor ℄
d = 20.5 Top Bars $\frac{WL^2}{8} + M_{BC} = 170 \times \frac{(16.25)^2}{8} + 13.6 = 5.6 + 13.6 = 19.2$ 'K

$M_s = M - \frac{8}{12} N = 19.2 - \frac{8}{12} \times 0.9 = 18.6$ $A_s = \frac{M}{ad} + \frac{N}{f_s} = \frac{18.6}{1.48 \times 20.5} + \frac{0.9}{20} = 0.61$

Top Bars #7 @ 12

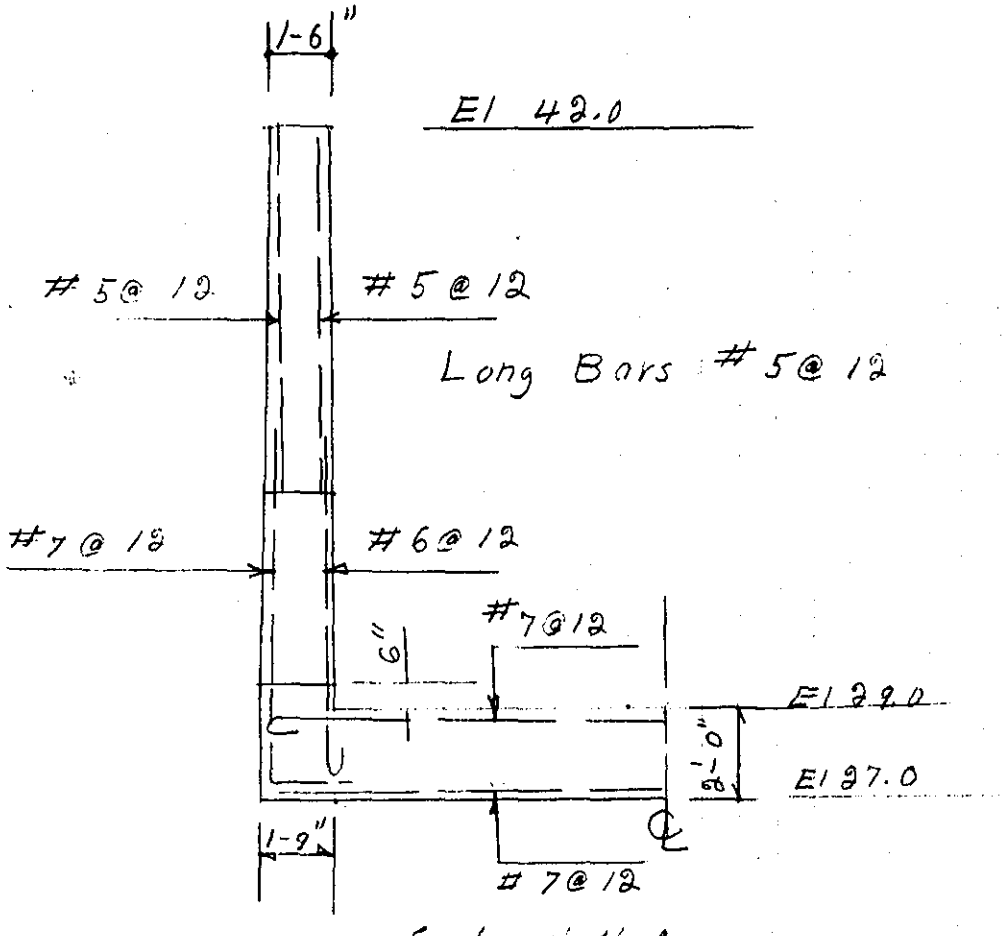
NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA DERBY
COMPUTATION BEAVER BROOK CONC CHANNEL
COMPUTED BY _____ CHECKED BY EPG DATE _____

Cond II Wall Reinf Bars
Inside face $\Sigma H = .0625 x^2 \times 0.5 - 0.088 \times (x-4)^2 \times 0.5$

x	x-4	x^2	$(x-4)^2$	ΣH	M Foot Kip	Cond I ad	
13	9	169	81	5.3 - 3.6	23.0 - 10.8 = 12.2	26.0	0.47 □"
9	5	81	25	2.5 - 1.1	7.5 - 1.8 = 5.7	24.8	0.23
10	6	100	36	3.1 - 1.6	10.4 - 3.2 = 7.2	25.0	0.29

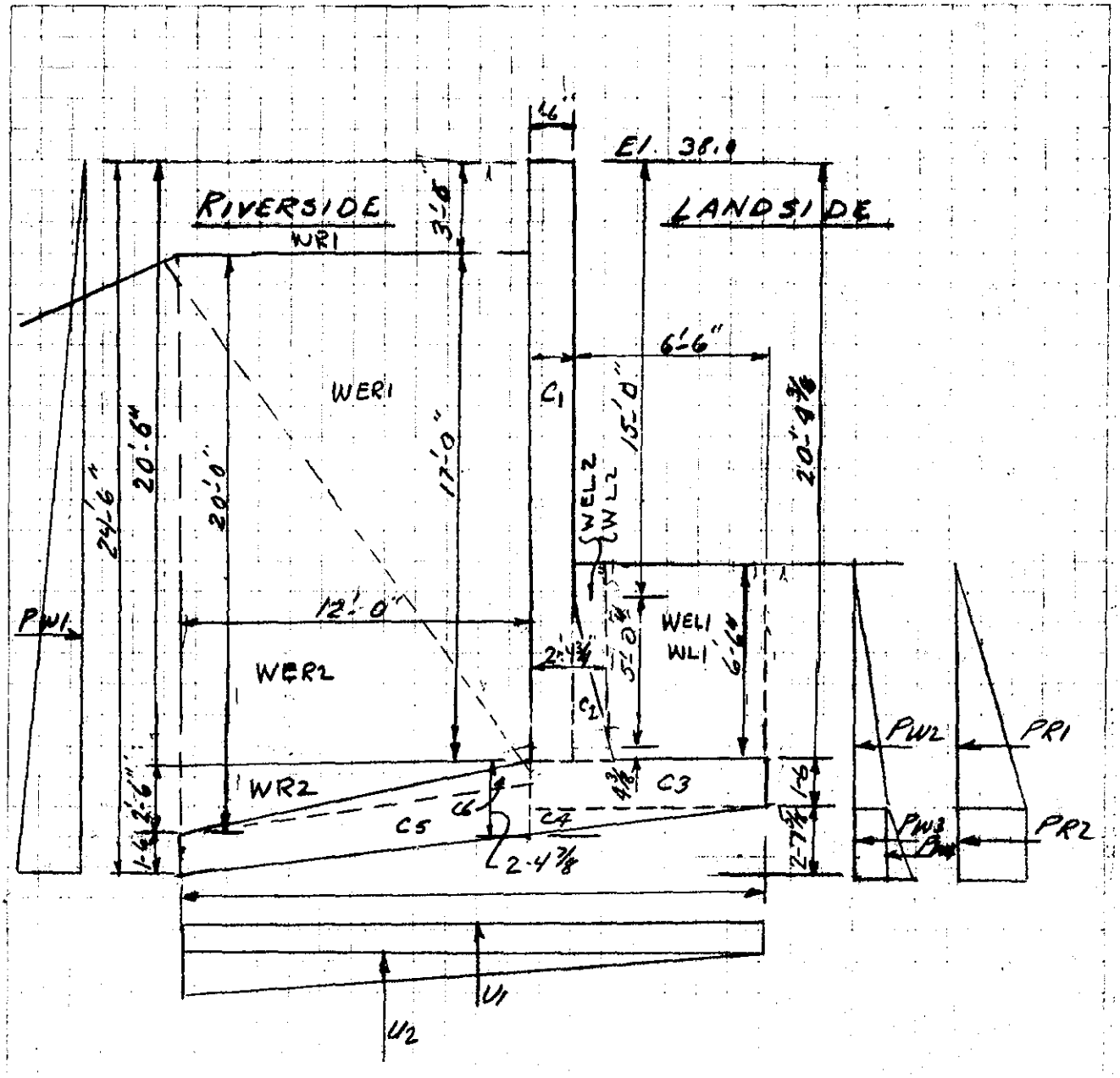


Scale 1:4'.0"

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Wall Beaver Brook
COMPUTED BY C.M.T. CHECKED BY DATE Mar 66



BEAVER BROOK

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Tee Type Walls Beaver Brook
COMPUTED BY H.E.W CHECKED BY DATE Mar 66

CONCRETE ONLY:----

	LOAD#	MOMENT#FT
C1 =	4581.25	33214.06
C2 =	359.26	2228.24
C3 =	1800.00	7200.00
C4 =	633.33	3377.77
C5 =	2700.00	37800.00
C6 =	825.00	9900.00
CONC=	10898.85	93720.08

CUBIC YARDS/LF OF WALL = 2.69

CONDITION #1:----
CREEP RATIO = 2.0

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT	-MOMENT#FT
CONC=	10898.8				93720.0	
WEL1=	2441.6				6344.4	
WEL2=	194.5				1148.7	
WER1=	6334.0				82003.0	
WER2=	8040.0				128640.0	
WR1 =	15375.0				215250.0	
WR2 =	937.5				15000.0	
WL1 =	2277.6				6334.7	
WL2 =	131.4				1071.6	
UI =		14919.9				149199.3
U2 =		7852.5				104700.4
PW1 =			18757.8			103639.0
PW2 =				2933.9	7957.3	
PW3 =				1968.6		2597.4
PW4 =				1036.0		1822.7
PR1 =				7693.5	20516.0	
PR2 =				5075.5		6696.9
SUMS=	47130.6	22772.4	16757.8	18757.8	578541.0	363706.0
SUMV=	24408.1					
SUMH=			-.0			
SUMM=					209835.0	
M/V =	8.5					
SBL=	1734.1PSF					
SBR=	706.7PSF					

IF SBR IS NEGATIVE THEN SBR =0 & SBL = 1392.7PSF
BEARING LENGTH= 25.7FT.

Note Condition #2 not critical

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27 Sept 49

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

PAGE DM-97

SUBJECT: Anchorage Dock, Tide Table Flood Walls Berner Bank
COMPUTATION:
COMPUTED BY: H.E.M. CHECKED BY: DATE:

CONDITION #3:-----
HEIGHT OF EARTH(SAT.)=130
HEIGHT OF EARTH LANDSIDE PLUS SURCHARGE=9.5

NO CREEP

	+VERT#	-VERT#	+HORIZ#	-HORIZ#	+MOMENT#FT.	-MOMENT#FT
CONC=	10898.8				93720.0	
WEL1=	6924.0				19409.6	
WEL2=	551.7				3257.6	
WER1=	13260.0				159120.0	
WER2=	15600.0				249600.0	
WIND=				543.0	8922.7	
PEL1=				2595.4	9516.6	
PEL2=				1245.2		1643.0
PEL3= PERI			9.55	149.3		41780 ~~262.7~~
SUMS=	47234.6		9.55	4533.1	543546.7	~~1905.8~~ 43,655
SUMV=	47234.6		6.02	~~4533.1~~	~~49891.0~~ ~~541640.9~~	
SUMH=						
SUMM=						
H/V =	~~.0~~ .11					
M/V =	~~11.4~~ 10.65					
SBL =	~~1322~~ 1788.3PSF					
SBR =	~~3401~~ 2820.1PSF					

CASE I LOADING - STEM

ENTER FOLLOWING ITEMS:----
HEIGHT OF EARTH R.S. =17.00
HEIGHT OF WATER R.S. =20.5
HEIGHT OF EARTH L.S. =6.5
WEIGHT OF EARTH =67

	DIST	D IN	V LBS	M FT LBS	AS SQ IN	V #/SQ IN
0 =		25.22	15860.63	106833.29	2.85	46.01
1/5=	4.10	17.02	10180.98	53806.94	2.12	
2/5=	8.20	14.50	4972.01	19766.61	.91	
3/5=	12.30	14.50	2101.25	5743.41	.26	

CASE I LOADING LANDSIDE BASE

	DIST	D IN	V #	M FT LBS	AS SQ IN	V #/SQ IN
STEM=		22.37	-7961.66	-23114.04	-.69	-33.28
1/3=	1.86	19.41	-5496.98	-10508.63	-.36	
2/3=	3.73	16.45	-2843.09	-2686.09	-.10	

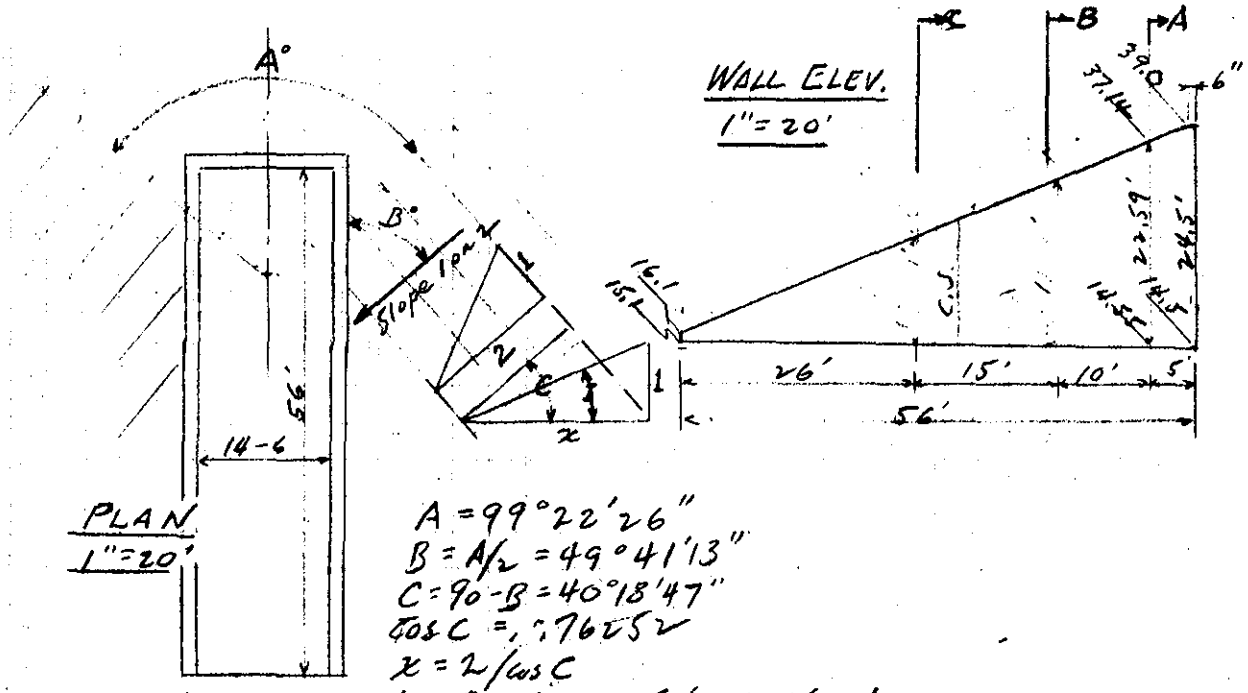
CASE I LOADING RIVERSIDE BASE

STEM=		25.50	7627.14	65818.58	1.73	27.97
1/3=	4.00	21.83	6487.60	32993.61	1.01	
2/3=	8.00	18.16	6052.60	11993.46	.44	

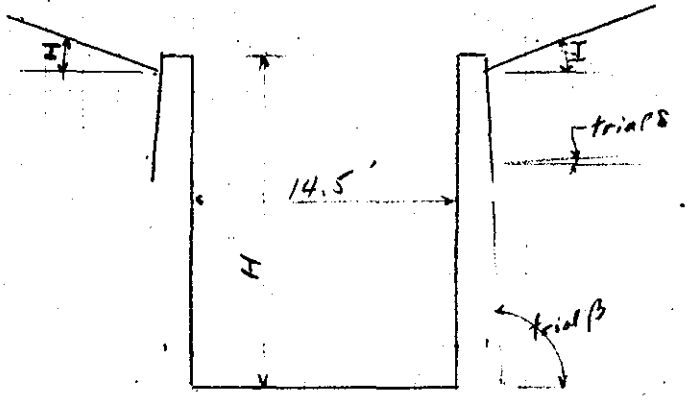
NED FORM 223
27 Sept 49

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

SUBJECT ANSONIA DERBY - BEAVER BROOK
COMPUTATION CONDUIT INTAKE
COMPUTED BY S.C.C. CHECKED BY DATE 2-18-66



$A = 99°22'26''$
$B = A/2 = 49°41'13''$
$C = 90 - B = 40°18'47''$
$\cos C = .76552$
$x = 2/\cos C$
$\tan I = 1/x = \cos C/2 = .38126$
$I = 20.87°$



TYP. SEC.
1"=10'

FOR K-ACTIVE PROGRAM	
Beta	= 92°
Theta	= 30°
Delta	= -2°
I	= 20.87°
K-Active	= .476

FOR LINSYM CHANNEL SEC. PROGRAM			
SECTION	A	B	C
Chan. W.	14.5	14.5	14.5
High W.	22.59	18.36	12.01
Low W.	22.59	18.36	12.01
B.f.sl., H.W.	.381	.381	.381
B.f.sl., L.W.	.381	.381	.381
Backf. Wt	135	135	135
K-Active	.476	.476	.476

Note - K active determined in accordance with methods in retaining wall manual and by use of program developed for Mathatron Computer

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

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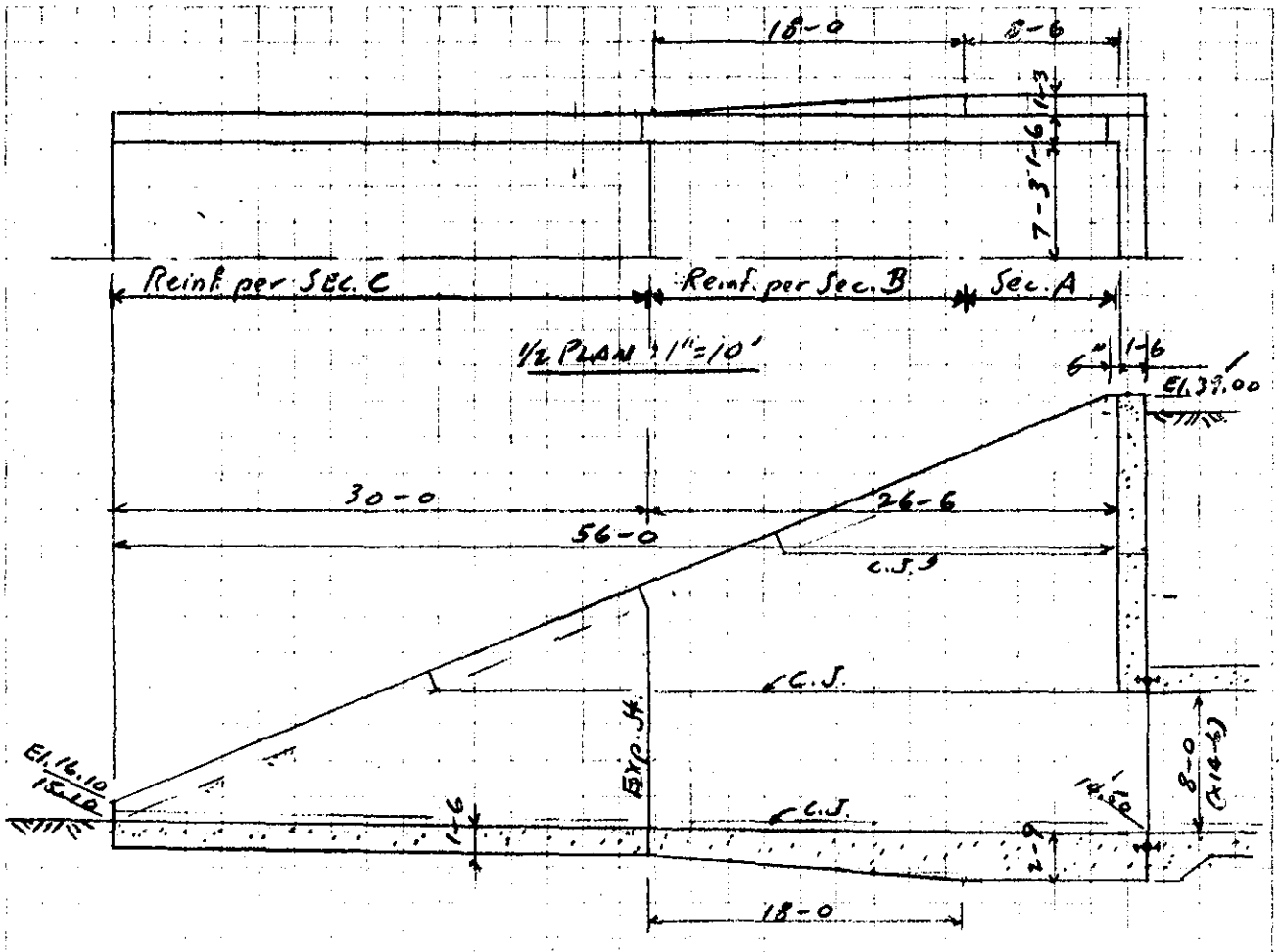
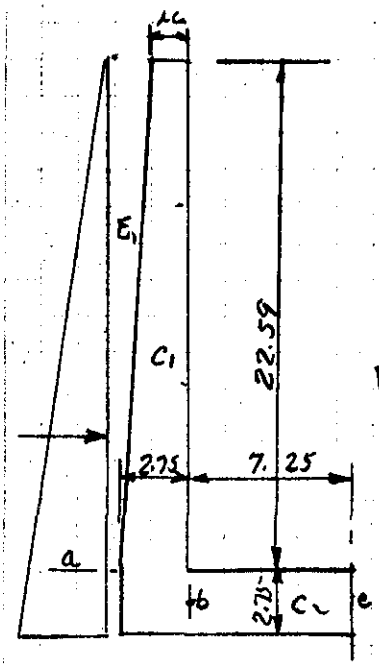
SUBJECT ANSONIA DERBY - BEAVER BROOK
COMPUTATION CONDUIT INTAKE
COMPUTED BY C.C.C. CHECKED BY DATE 2-23-66



NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby - Beaver Brook
COMPUTATION Conduit Intake
COMPUTED BY H.E.W. CHECKED BY DATE Mar - 66



Base Pressure

C1	1.5 x 22.59 x 150 + 1.25 x 22.59 x .5 x 150	= 7200
C2	2.75 x 10 x 150	= 4125
E1	1.25 x 22.59 x 130 x .5	= 1835
		13,160

Bear. P = 13,160 / 10 = 1316 #/□'

P = 25.34² x 135 x .476 x .5 = 20,631

Pt a) M @ a = 22.59³/6 x 135 x .476 = 123,460

He a = 22.59²/2 x 135 x .476 = 16,396#

req'd d = $\sqrt{\frac{123460}{152}}$ = 29.4" < 29.5 OK

$v = \frac{16\,396}{12 \times 29.5 \times .891} = 52$ #/□"

$A_s = \frac{123,460}{1.44 \times 29.5} = 2.90$ □"

Pt. b $M_s = 123,460 + \frac{29.5}{12} \times 20,631 = 174,178$ '#

$A_s = \frac{174.178}{144 \times 28.5} - \frac{20,631}{20,000} = 3.22$ □"

Pt c $M = 20,631 \times 7.08 - 9035 \times 8.60 + 904 \times 10 \times 5 = 114,000$

$M_s = \frac{114,000}{} + \frac{29.5}{12} \times 20,631 = 164,000$

$A_s = \frac{164,000}{144 \times 28.5} - \frac{20,631}{20,000} = 2.96$ □"

For Max Steel in top of slab - use 1/6 w/e

$\frac{1}{16} \times 904 \times 19.50^2 = 11,900$ '# requires min steel

use #6 @ 1'0"

Note - Two additional sections @ B & C to be designed to reduce steel requirements

NED FORM 223
27 Sept 49

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

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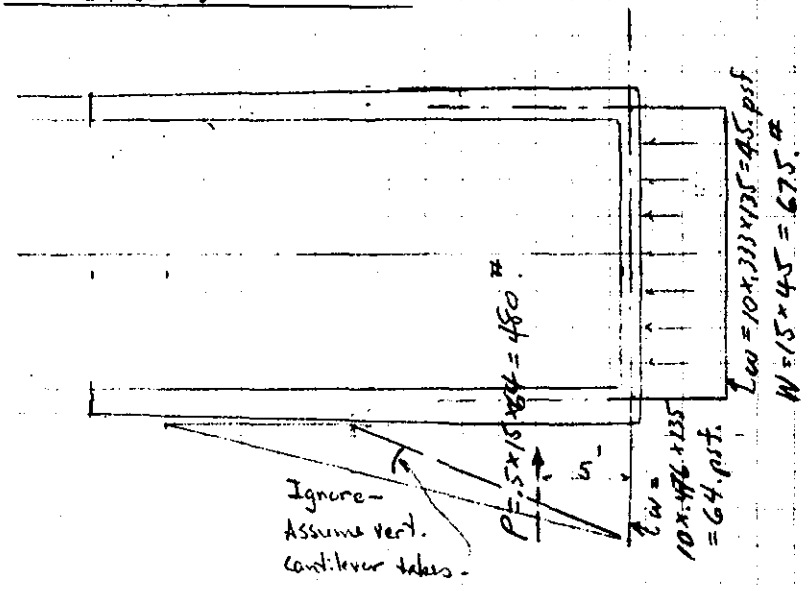
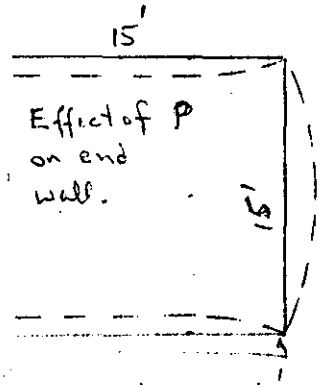
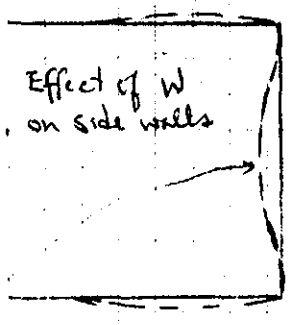
SUBJECT ANSONIA DERBY - BEAVER BROOK
COMPUTATION CONDUIT INTAKE
COMPUTED BY C.C.E. CHECKED BY DATE 2-4-66

HORIZ. SEC. @ EL. 28.00 :







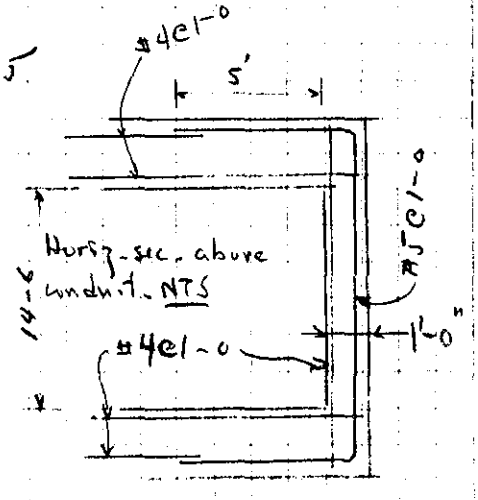
$M = P \times 5' = 2400\ \#'$

$M = \frac{Wl}{12} = 844\ \#'$

Reqd $d = \sqrt{2.4/.226} = 3.3''$ use $18 - 3.5 = 14.5$

$A_s = 2.4/1.4 \times 14.5 = .12\ \square''/'$

Would use #5 on outer face, above conduit



All other horiz. steel #4@1'-0 E.F.

NED FORM 223
27 Sept 49

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

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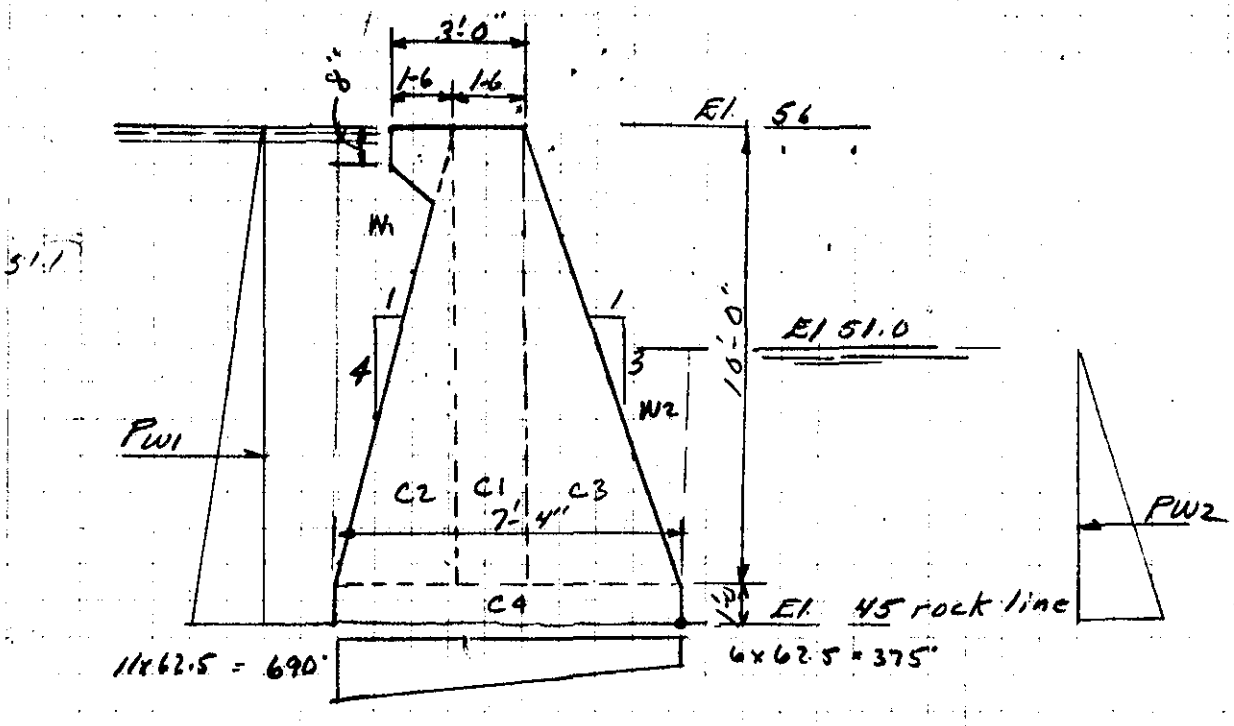
SUBJECT Ansonia Derby
COMPUTATION Gravity Wall @ Power Station
COMPUTED BY H.E.W CHECKED BY AP DATE April 66



Condition #1 - Flood condition with water to top of wall and water on backside at El. 51.0.

Condition #2 - Water drawn down on backside and at normal level of 51.0 on upstream

	Force	↓	↑	→	←	Arm	↷	↶
C1	1.5x10x150	2.25				4.08		9.19
C2	2.5x10x.5x150	1.87				5.73		10.72
C3	3.33 x10x.5 x 150	2.50				2.22		5.55
C4	7.33 x1.0x 150 =	1.10				3.58		3.95
C5		0.15				5.43		0.82
		7.87						30.23

NED FORM 223
27 Sept 49

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

SUBJECT Ansonia Derby
COMPUTATION Gravity Wall @ Power Station
COMPUTED BY A.E.W. CHECKED BY A DATE April 66

Condition #1

	Force	↓	↑	→	←	Arm	↷	↶
	Concrete	7.87						30.23
W1	2.5×10×62.5	1.56				6.50		10.15
	-		62.5			5.43	0.34	
W2	5×1.67×62.5×.5	0.26				0.56		0.15
U1	375×7.33		2.75			3.58	9.83	
U2	315×7.33×.5		1.15			4.89	5.65	
Pw1	690×11×.5			3.80		3.67	13.92	
Pw2	375×6×.5				1.12	2.00		2.24
		9.69	3.96	3.80	1.12		29.74	42.77
		~~6.33~~ 5.73		2.68			~~13.03~~ 12.54	

$\Sigma \frac{M}{V} = \frac{\cancel{13.03}\ 12.54}{\cancel{6.33}\ 5.73} = 2.06 < 1.84$ OK in the mid half (2.23)

Bear P.: $\frac{6.33 \times 2}{3 \times 2.06} = \cancel{2,450}\ 1,710$ #/□'

Condition #2 $\frac{\Sigma H}{\Sigma V} = 0.47$

	Force	↓	↑	→	←	Arm	↷	↶
	Concrete	7.87						30.23
W1	5×1.33×62.5×.5	1.21				6.89		1.43
U1	375×7.33×.5		1.37			4.89	6.71	
Pw1	375×6×.5			1.12		2.00	2.24	
		8.08	1.37				8.95	31.66
		6.71		1.12				22.71

$\Sigma \frac{M}{V} = \frac{22.71}{6.71} = 3.38$ inside mid third.

Bear P $= \frac{6.71}{7.33}\left(1 \pm \frac{6 \times .29}{7.33}\right) =$ 1135 Toe, 700 Heel

$\frac{\Sigma H}{\Sigma V} = 0.17$

APPENDIX B

CURRENT COST ESTIMATE

ANSONIA-DERBY LOCAL PROTECTION

APPENDIX B

CURRENT COST ESTIMATE

CURRENT COST ESTIMATE

The total estimated cost of the Ansonia-Derby Local Protection Project is $11,155,000. A summary of the costs of the various features of the work described in this memorandum and in previously submitted memoranda are shown in Tables I and II below. A breakdown of the estimate is shown in Table III below.

TABLE I

SUMMARY OF FEDERAL COSTS

	Project Feature	Cost
09.	Channels and Canals	$ 738,000
11.	Levees and Flood Walls	7,240,000
13.	Pumping Plants	825,000
30.	Engineering and Design	795,000
31.	Supervision and Administration	690,000
	TOTAL Estimated Federal First Costs	$10,288,000

LOCAL INTERESTS FIRST COST

The estimated local interests first cost in connection with the Ansonia-Derby Local Protection Project is $867,000. A summary of the cost of the various features of the work is shown in Table II below:

TABLE II

SUMMARY OF LOCAL INTERESTS COST

	Project Feature	Cost
01.	Lands and Damages	$ 720,000*
02.	Relocations	147,000
	TOTAL Estimated Local Interests First Costs	$ 867,000**

* (1) Total land costs based on fair market value. Because local interests own a portion of the right-of-way, the estimated out-of-pocket land cost is $600,000.

** (2) Estimated local interests out-of-pocket first cost is $747,000.

(3) Other local costs, in project area for bridges replaced since the 1955 floods, total $1,444,000.

COMPARISON OF ESTIMATES

The following tabulation shows the comparison of the current cost estimate with the latest estimate as submitted in Design Memorandum No. 6, "Embankments, Foundations and Channel Improvements", submitted 28 February 1966 and approved 11 April 1966.

Cost Account No.	Project Feature	D. M. #6 Estimate	Current Estimate
09.	Channels & Canals	$ 738,000	$ 738,000
11.	Levees & Flood Walls	6,891,000	7,240,000(1)
13.	Pumping Plants	825,000	825,000
30.	Engineering & Design	795,000	795,000
31.	Supervision & Admn.	690,000	690,000
	TOTAL Federal Cost	$ 9,939,000	$10,288,000
01.	Lands and Damages	$ 720,000	$ 720,000
02.	Relocations	185,000	147,000(1)
	Non-Federal Contributions	0	0
	TOTAL Local Interests Cost	$ 905,000	$ 867,000
TOTAL ESTIMATED PROJECT COST		$10,844,000	$11,155,000

(1) Revision of estimate based upon the detailed studies presented in this Design Memorandum.

TABLE III

DETAILED COST ESTIMATE

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
01	LANDS, DAMAGES & ACQUISITION (Local Interests Cost)				
	TOTAL LANDS, DAMAGES & ACQUISITION				$ 720,000
02	RELOCATIONS (Local Interests Cost)				
	30" Sanitary Sewer Siphon (incl. inlet & outlet struct. with sluice gate)	1	L.S.	$35,000.00	35,000

02 RELOCATIONS (Local Interests Cost) (Cont)

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
15" Sanitary Sewer Siphon (under storm drain pressure conduit in Farrel Corp. Yard)	1	L.S.	$1,200.00	$ 1,200
Sanitary Sewer Siphons (under Beaver Brook)	2	Each	1,500.00	3,000
Relocate Sanitary Sewer (Ansonia Mnfg. Co.)	1	L.S.	500.00	500
Relocate Sanitary, Gas & Waterlines (Main St. & Beaver Brook Conduit)	1	L.S.	1,000.00	1,000
Relocate 12" Waterline (E. Bank S. of Maple Street Bridge)	1	L.S.	600.00	600
Lower 4" gas & 6" & 8" Waterlines (Beaver Brook @ Central Street)	1	L.S.	1,000.00	1,000
Relocate 8" gas & 10" Waterlines (River St. near flood wall)	1	L.S.	12,000.00	12,000
Relocate Hydrant & Valve (@ Station 9+50)	1	L.S.	100.00	100
Relocate 3" Gas & 8" Waterlines (3rd St. for 36" S.D.)	1	L.S.	3,000.00	3,000
Relocate 6" Gas Main & Meter House (S. of Bridge St. @ flood wall)	1	L.S.	2,500.00	2,500
Relocate Sanitary Sewer (@ R.R. Gate #3)	1	L.S.	1,500.00	1,500
Relocate 24" CI Sewer & Sluice Gate (@ R.R. Gate #4)	1	L.S.	8,000.00	8,000
Electrical Relocations	1	Job	L.S.	32,000
Railroad Relocations	1,600	L.F.	5.00	8,000
		Sub-Total		$ 109,400
		Contingencies		16,600
		Sub-Total		$ 126,000
		Engineering & Design		11,000
		Supervision & Administration		10,000
TOTAL, RELOCATIONS (Local Interests Cost)				$ 147,000

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
09	CHANNELS & CANALS (Federal Cost)				
	Excavation, General	354,000	C.Y.	$ .80	$ 283,200
	Excavation, Stream Deflector	200	C.Y.	15.00	3,000
	Pumping	1	Job	L.S.	5,000
	Concrete (Reinf.)	1,670	C.Y.	70.00	116,900
	Concrete (Mass)	500	C.Y.	40.00	20,000
	Steel Sheeting (Temp)	3,100	S.F.	3.00	9,300
	Stone, Riprap	19,000	C.Y.	8.50	161,500
	Gravel Bedding	11,000	C.Y.	2.50	27,500
	Gravel, Channel Prot.	6,000	C.Y.	2.50	15,000
			Sub-Total		$ 641,400
			Contingencies		96,600
	TOTAL, CHANNELS & CANALS (Federal Cost)				$ 738,000
11	LEVEES & FLOOD WALLS (Federal Cost)				
	Site Preparation	45	Acre	$100.00	$ 4,500
	Stream Control	1	Job	L.S.	50,000
	Building Removal	1	Job	L.S.	15,000
	Concrete Removal	1	Job	L.S.	4,000
	R.R. Track Removal	1	Job	L.S.	2,000
	R.R. Trestle Removal	1	Job	L.S.	2,000
	Excavation, General	199,500	C.Y.	.80	159,600
	Excavation, Structural	101,400	C.Y.	1.00	101,400
	Impervious Borrow	250,000	C.Y.	1.60	400,000
	Impervious Fill, Comp.	160,000	C.Y.	.35	56,000
	Sand Fill, Compacted	35,500	C.Y.	5.50	195,250
	Pervious Fill, Comp.	275,000	C.Y.	.35	96,250
	Random Fill, Comp.	84,500	C.Y.	.35	29,580
	Gravel Fill, Comp.	18,500	C.Y.	.50	9,250
	Filter Sand	10,000	C.Y.	2.00	20,000
	Filter Stone	5,100	C.Y.	8.50	43,350
	Crushed Stone Fill	45,000	C.Y.	7.50	337,500
	Gravel Bedding	39,000	C.Y.	2.00	78,000
	Stone Slope Protection	67,000	C.Y.	8.50	569,500
	Concrete, T-Walls	25,800	C.Y.	45.00	1,161,000
	Concrete, Conduits	3,700	C.Y.	45.00	166,500
	Concrete, Stilling Basin	700	C.Y.	45.00	31,500
	Cement	49,000	Bbl.	5.00	245,000
	Steel Reinforcement	4,132,000	Lbs.	.15	619,800
	Sheeting, Left in Place	70,000	S.F.	4.20	294,000
	Sheeting, Pulled	7,500	S.F.	3.00	22,500
	Street Gates	1,660	S.F.	85.00	141,100
	R.R. Gates	1,850	S.F.	203.00	375,550

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
11	LEVEES & FLOOD WALLS (Federal Cost)(Cont)				
	Chain Link Fence, 4 Ft.	200	L.F.	$ 3.00	$ 600
	Road Gravel	2,400	C.Y.	2.00	4,800
	Bit. Conc. Pavement	7,000	S.Y.	2.50	17,500
	P. C. Conc. Pavement	200	S.Y.	8.00	1,600
	Topsoiling	16,000	C.Y.	4.50	72,000
	Seeding & Mulching	15	Acre	775.00	11,630
	Storm Drains				
	6" R.C.	65	L.F.	4.00	260
	12" R.C.	1,723	L.F.	8.00	13,780
	18" R.C.	425	L.F.	11.25	4,780
	24" R.C.	1,665	L.F.	15.00	24,980
	30" R.C.	1,640	L.F.	20.00	32,800
	36" R.C.	1,185	L.F.	25.00	29,630
	42" R.C.	1,595	L.F.	30.00	47,850
	48" R.C.	2,935	L.F.	40.00	117,400
	54" R.C.	755	L.F.	50.00	37,750
	60" R.C.	1,975	L.F.	55.00	108,630
	72" R.C.	365	L.F.	70.00	25,550
	Standard Drain Manholes	55	Ea.	700.00	38,500
	Curb Inlet	1	Ea.	700.00	700
	Special Manholes	5	Ea.	5,000.00	25,000
	Trench Grating Structures	120	L.F.	50.00	6,000
	Plug Tailrace @ Sta. 33+00	1	L.S.	600.00	600
	Reinforced Concrete Aprons	2	Ea.	2,000.00	4,000
	Modifications to Existing Manholes	2	Ea.	150.00	300
	Paved Gutter	1	Ea.	350.00	350
	Drainage Ditch & Intake Struct.	1	L.S.	3,000.00	3,000
	Sluice Gate Structures				
	72"	2	Ea.	25,000.00	50,000
	60"	2	Ea.	20,000.00	40,000
	48"	1	Ea.	15,000.00	15,000
	36"	1	Ea.	10,000.00	10,000
	24"	2	Ea.	5,000.00	10,000
	Connect. Existing S. D.'s to New Drain Manholes	15	Ea.	50.00	750
	Under Drains				
	6" BCCM	8,240	L.F.	3.00	24,720
	8" BCCM	4,325	L.F.	4.00	17,300
	10" BCCM	1,477	L.F.	5.00	7,390
	12" BCCM	1,218	L.F.	6.00	7,310
	15" BCCM	895	L.F.	7.00	6,270
	Under Drain Manholes	19	Ea.	250.00	4,750
	Observation Risers	49	Ea.	100.00	4,900

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
11	LEVEES & FLOOD WALLS (Federal Cost)(Cont)				
	Pressure Conduits, Storm				
	60" R.C.	1,210	L.F.	$ 75.00	$ 90,750
	48" R.C.	1,618	L.F.	54.00	87,370
	42" R.C.	520	L.F.	42.00	21,840
	36" R.C.	405	L.F.	36.00	14,580
	Pressure Manholes, Storm	12	Ea.	1,000.00	12,000
	Remove Existing Utility Lines under Protection	1,670	L.F.	2.00	3,340
	Connect. Existing S.D. to New Interceptor S.D.	18	Ea.	50.00	900
	RC Barrier for Headrace at Hydro Plant	1	Job	L.S.	6,000
		Sub-Total			$ 6,295,290
		Contingencies			944,710
	TOTAL, LEVEES AND FLOOD WALLS (Federal Cost)				$ 7,240,000
13	PUMPING PLANTS (Federal Cost)				
	River Street Station	1	Job	L.S.	$ 43,000
	Maple Street Station	1	Job	L.S.	174,000
	Front Street Station	1	Job	L.S.	235,000
	Division Street Station	1	Job	L.S.	265,000
		Sub-Total			$ 717,000
		Contingencies			108,000
	TOTAL, PUMPING PLANTS (Federal Cost)				$ 825,000
30	ENGINEERING AND DESIGN (Federal Cost)				$ 795,000
31	SUPERVISION AND ADMINISTRATION (Federal Cost)				$ 690,000

SUMMARY OF FIRST COSTS

Estimated Federal First Costs	$10,288,000
Estimated Local Interests First Costs	867,000
TOTAL ESTIMATED PROJECT COST	$11,155,000

CORPS OF ENGINEERS — U. S. ARMY

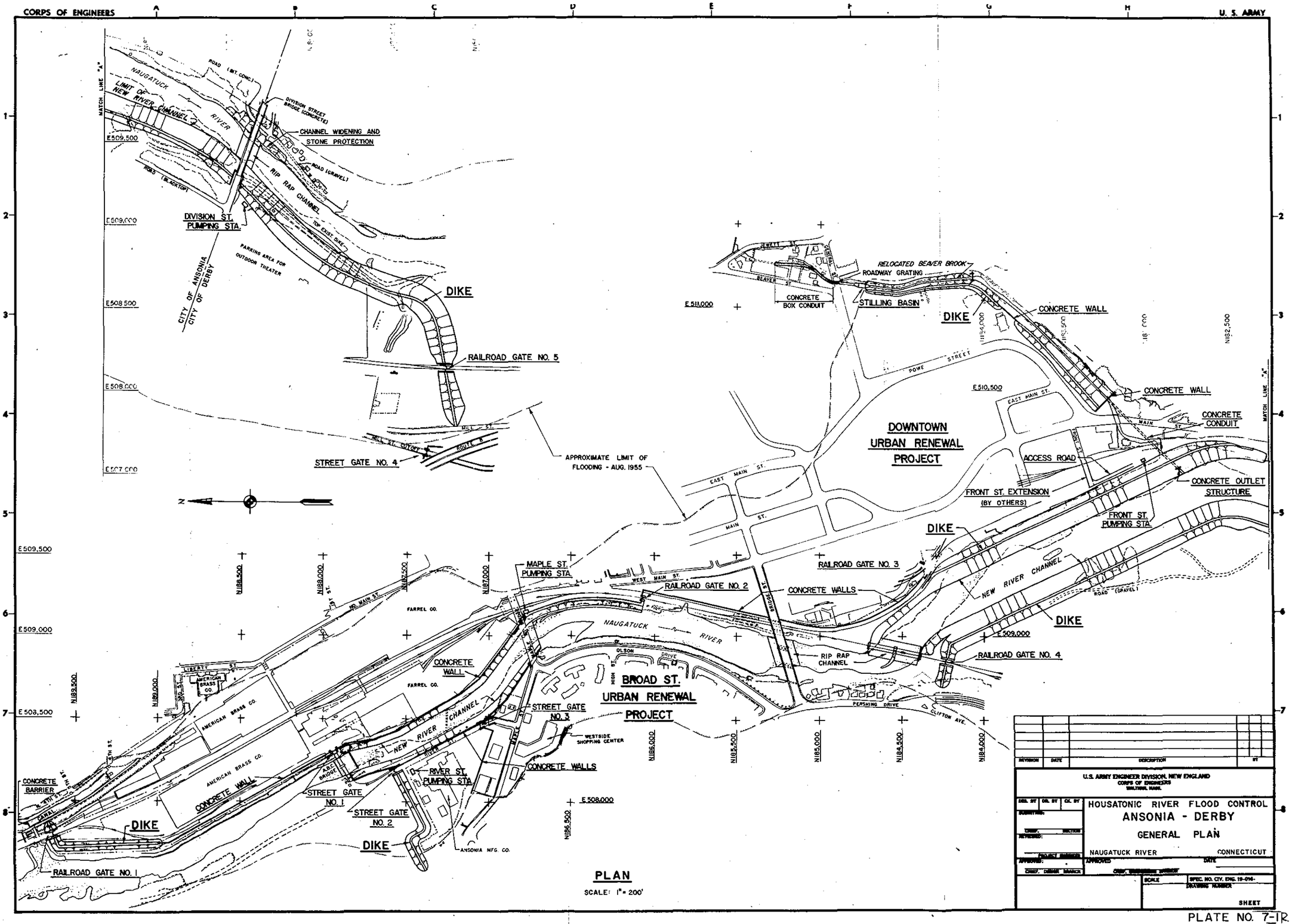
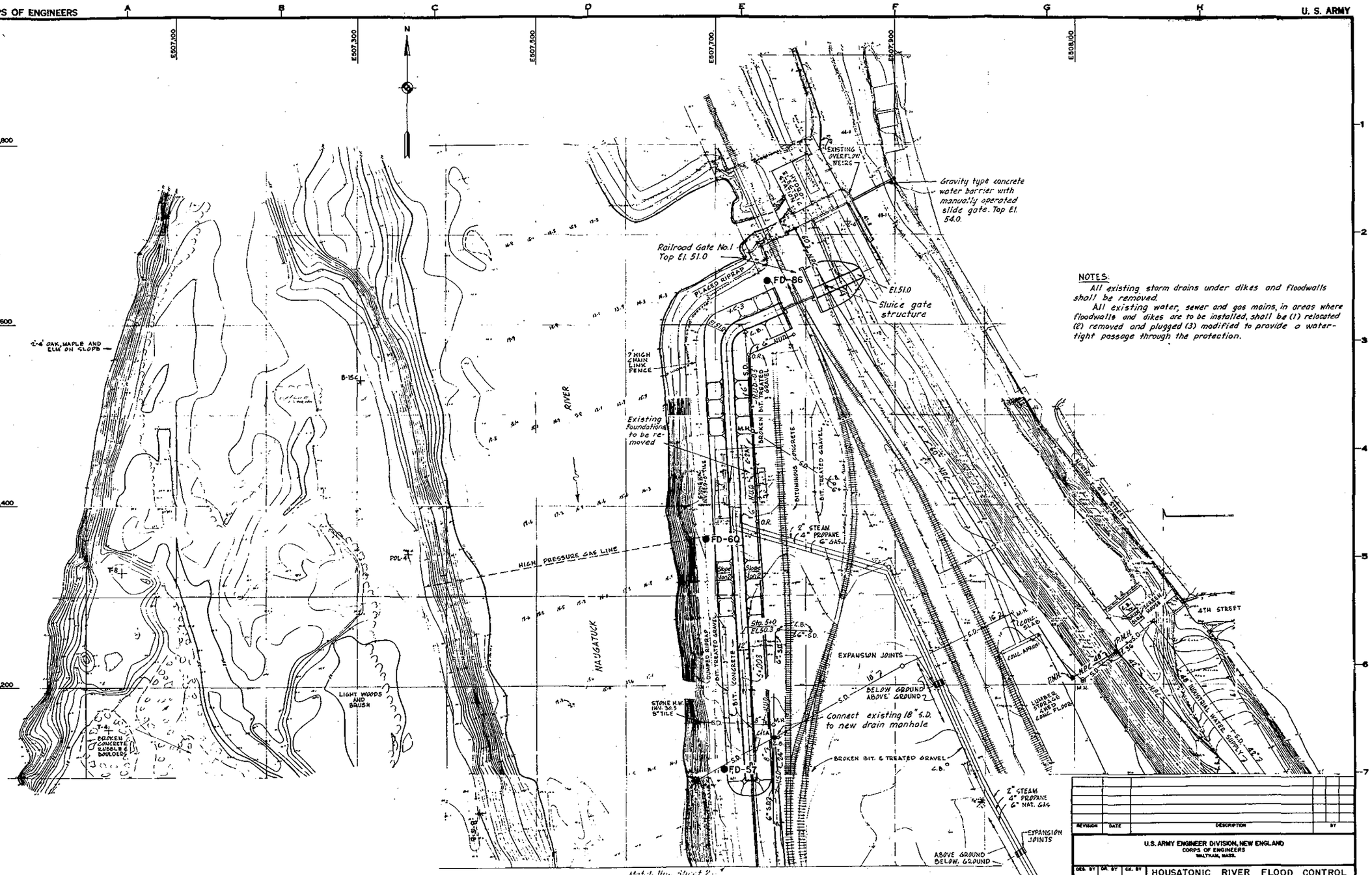


PLATE NO. 7-1R

CORPS OF ENGINEERS — U. S. ARMY



NOTES:

All existing storm drains under dikes and floodwalls shall be removed.

All existing water, sewer and gas mains, in areas where floodwalls and dikes are to be installed, shall be (1) relocated (2) removed and plugged (3) modified to provide a water-tight passage through the protection.

PLAN

SCALE 1" = 40'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN AND SECTION NO. 1

NAUGATUCK RIVER — CONNECTICUT

APPROVED: DATE:

CHIEF, ENGINEERING DIVISION

SCALE: AS SHOWN | SPEC. NO. CIV ENG. 19-016-

DRAWING NUMBER

SHEET 1

PLATE NO. 7-2

CORPS OF ENGINEERS — U. S. ARMY

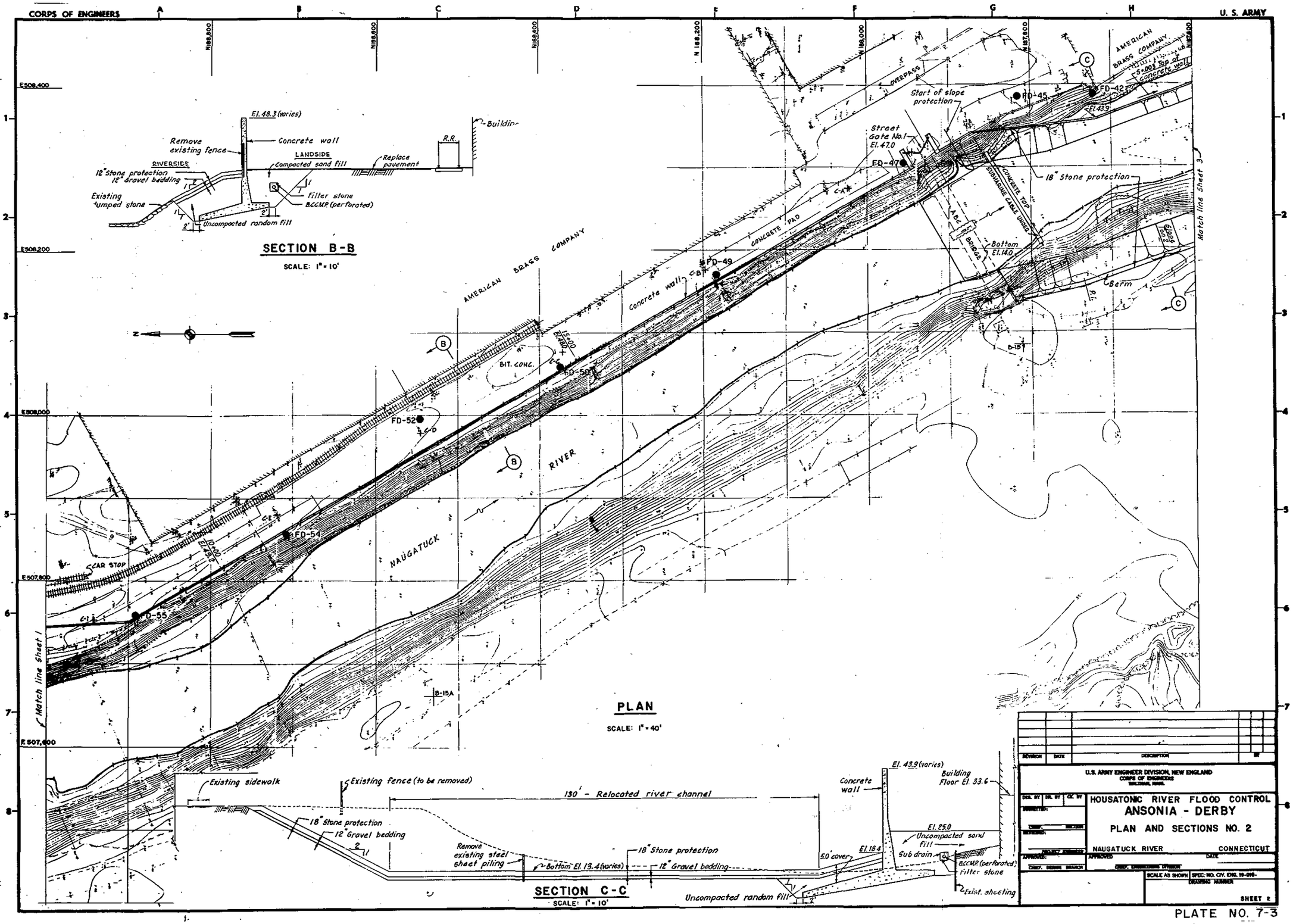
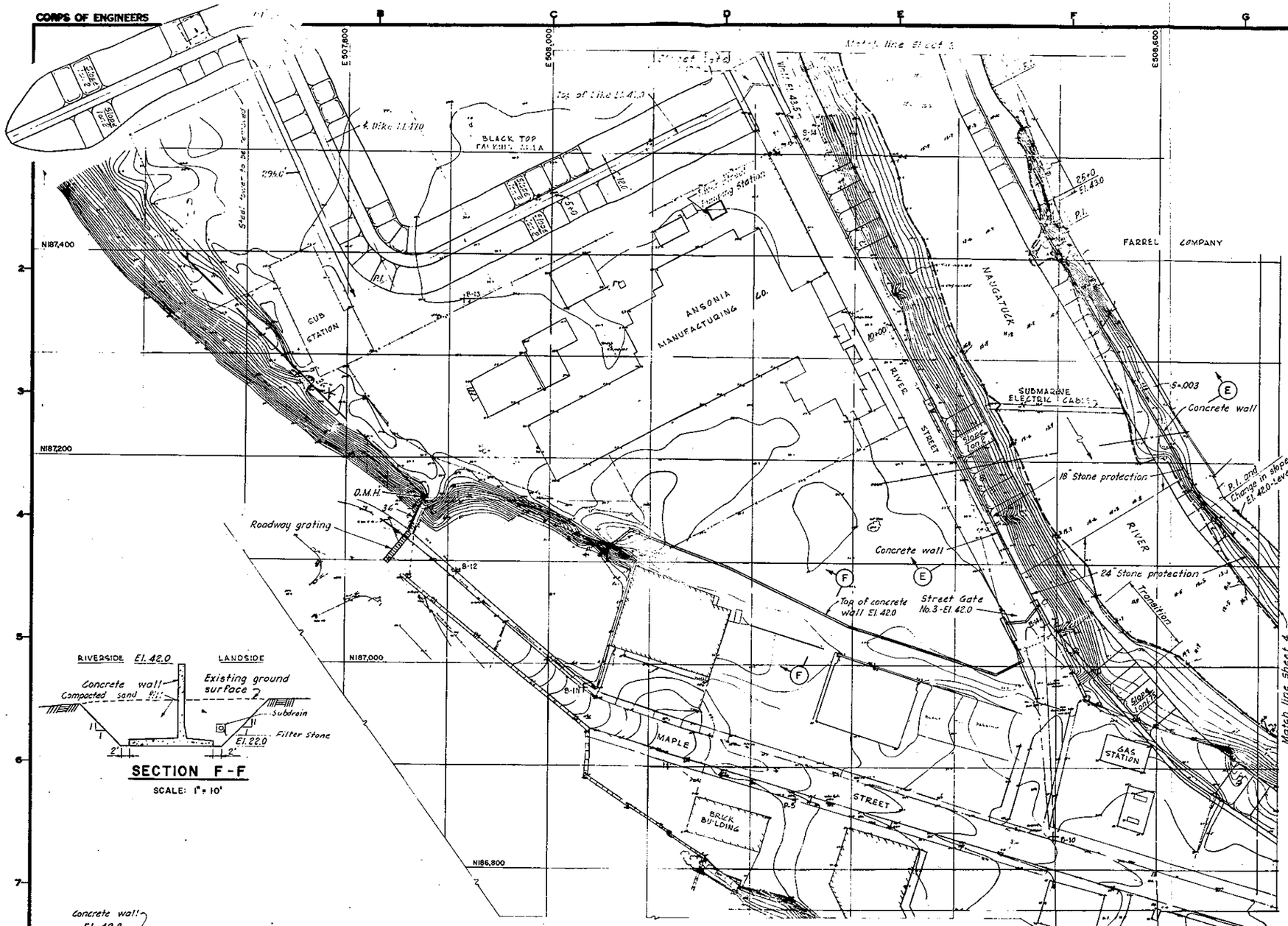


PLATE NO. 7-3

CORPS OF ENGINEERS

U. S. ARMY

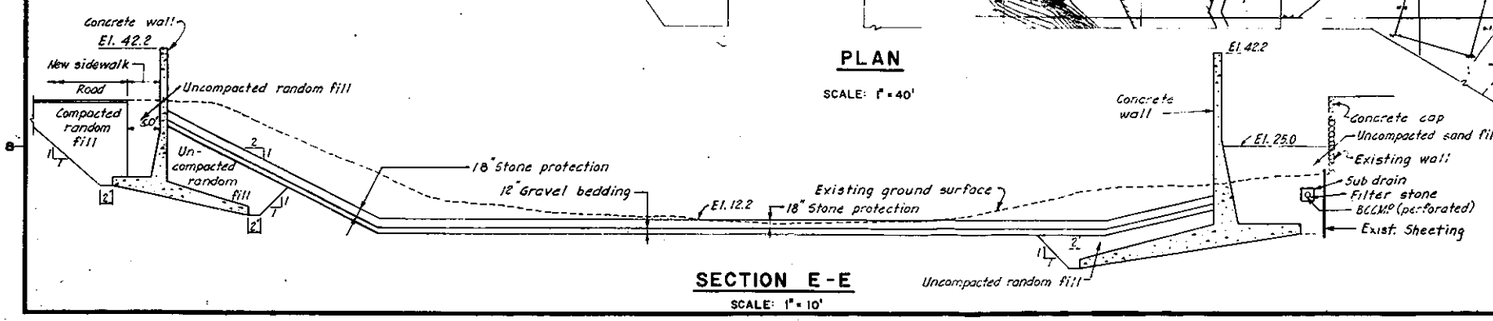


PLAN

SCALE: 1" = 40'

SECTION F-F

SCALE: 1" = 10'



SECTION E-E

SCALE: 1" = 10'

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

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

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN AND SECTIONS NO. 3

NAUGATUCK RIVER — CONNECTICUT

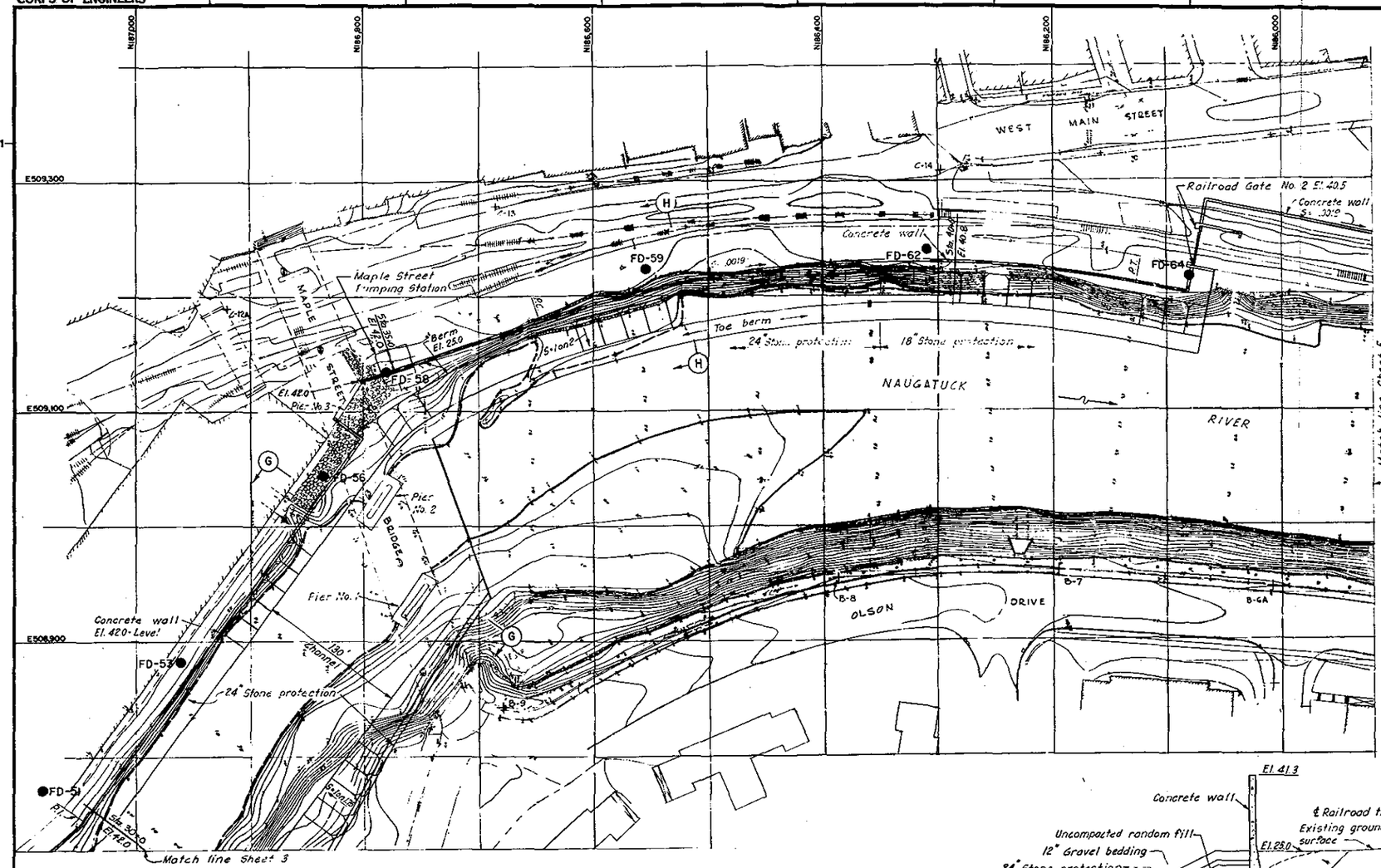
APPROVED: DATE:
CHIEF, ENGINEERING DIVISION

SCALE: AS SHOWN | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER

SHEET 3

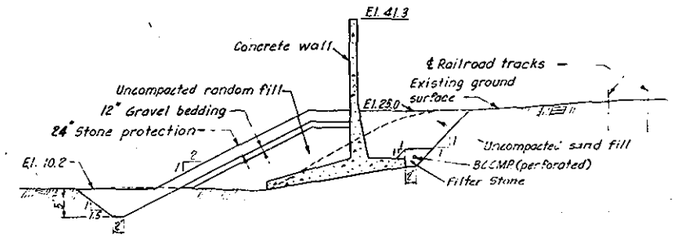
PLATE NO. 7-4

CORPS OF ENGINEERS U. S. ARMY



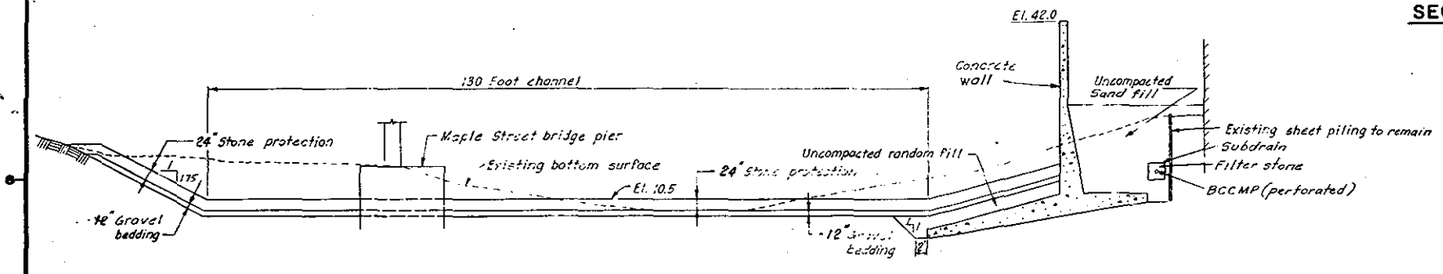
PLAN

SCALE 1" = 40'



SECTION H-H

SCALE: 1" = 10'



SECTION G-G

SCALE: 1" = 10'

REVISION	DATE	DESCRIPTION	BY

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

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

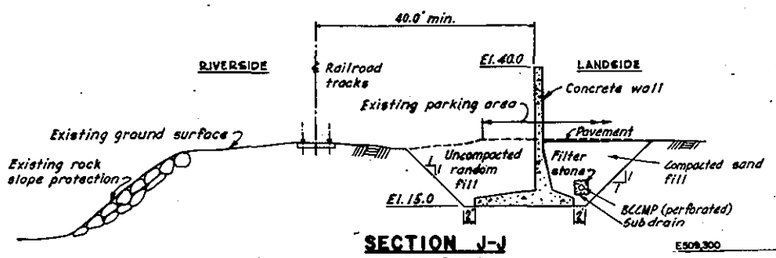
PLAN AND SECTIONS NO. 4

NAUGATUCK RIVER CONNECTICUT

SCALE: AS SHOWN SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET 4

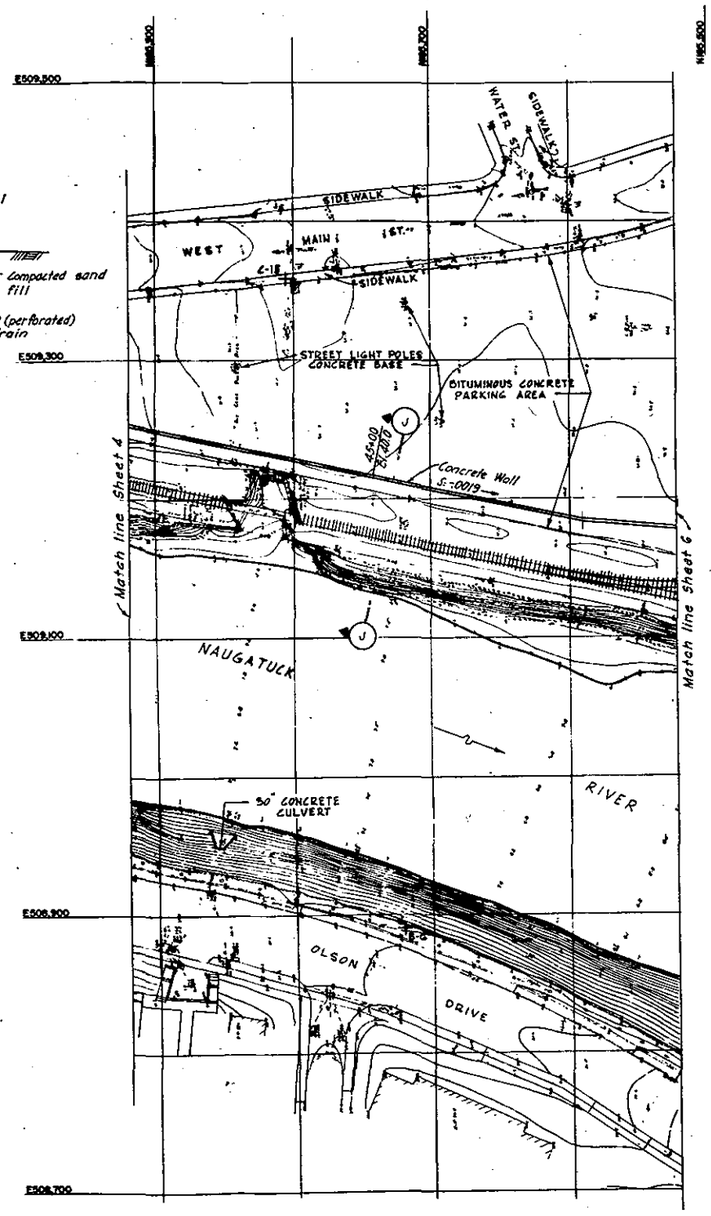
PLATE NO. 7-5

CORPS OF ENGINEERS U. S. ARMY



SECTION J-J

SCALE: 1" = 10'



PLAN

SCALE: 1" = 40'

REVISION	DATE	DESCRIPTION	BY

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

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

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

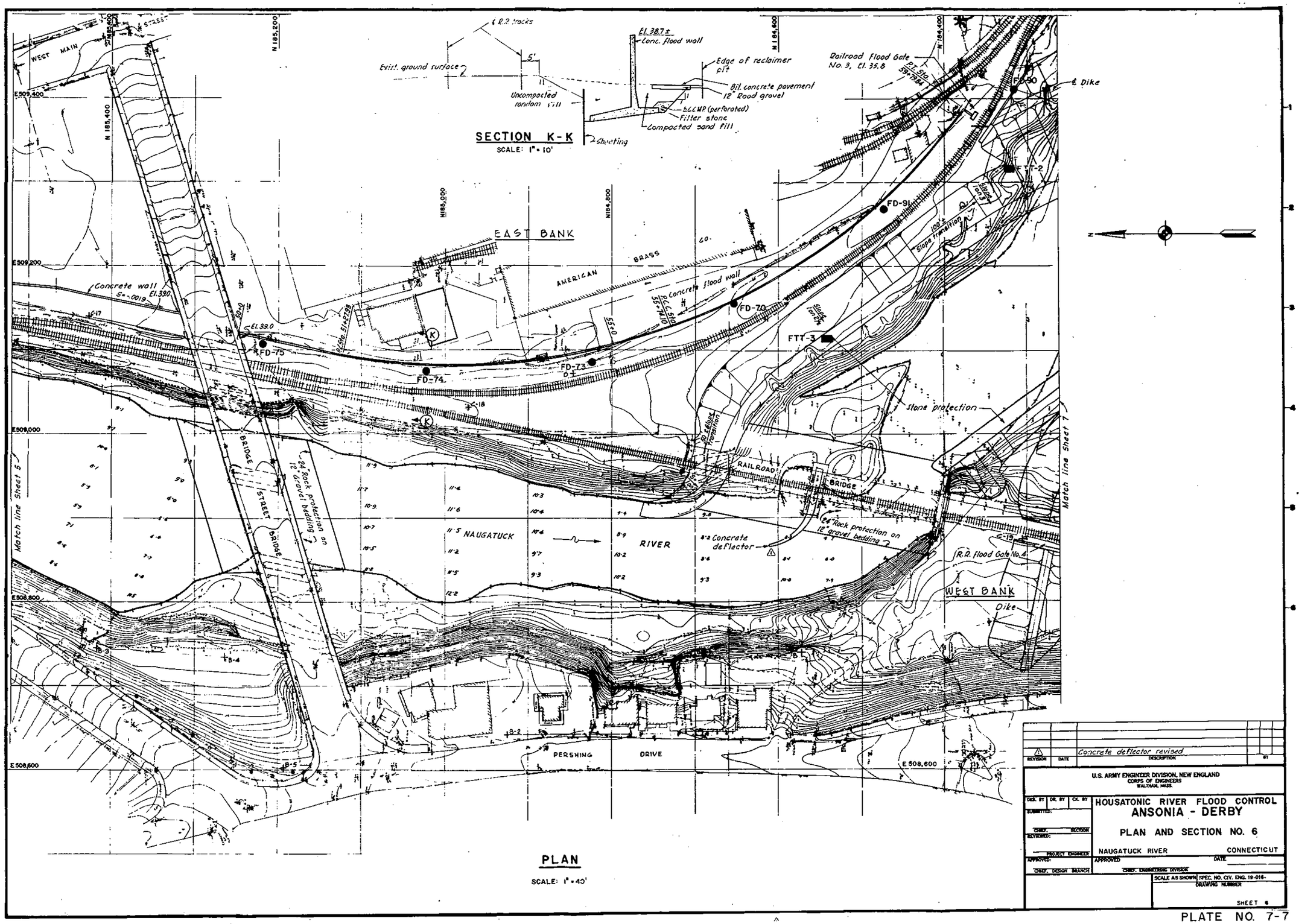
PLAN AND SECTION NO. 5

NAUGATUCK RIVER CONNECTICUT

APPROVED: DATE:
CHIEF, ENGINEERING DIVISION

SCALE: AS SHOWN | SPEC. NO. CIV. ENG.19-ONE-
DRAWING NUMBER
SHEET 5

PLATE NO. 7-6



REVISION	DATE	DESCRIPTION	BY
1		Concrete deflector revised	

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

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

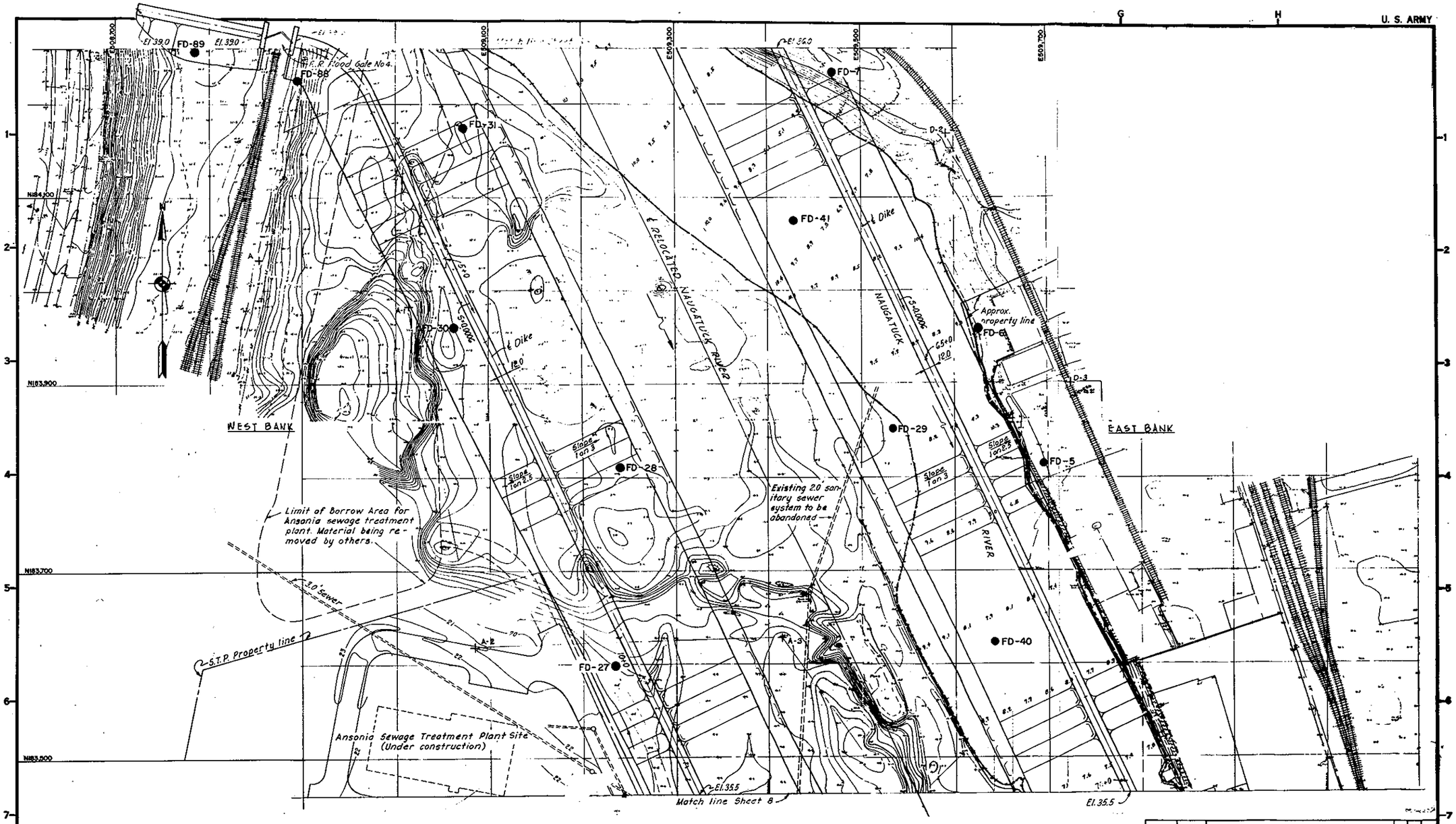
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
PLAN AND SECTION NO. 6

NAUGATUCK RIVER — CONNECTICUT

APPROVED: DATE:
CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET 6

PLATE NO. 7-7



PLAN

SCALE: 1" = 40'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, DESIGN BRANCH

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, ENGINEERING DIVISION

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN AND SECTIONS NO. 7

NAUGATUCK RIVER — CONNECTICUT

APPROVED: — DATE:

CHIEF, ENGINEERING DIVISION

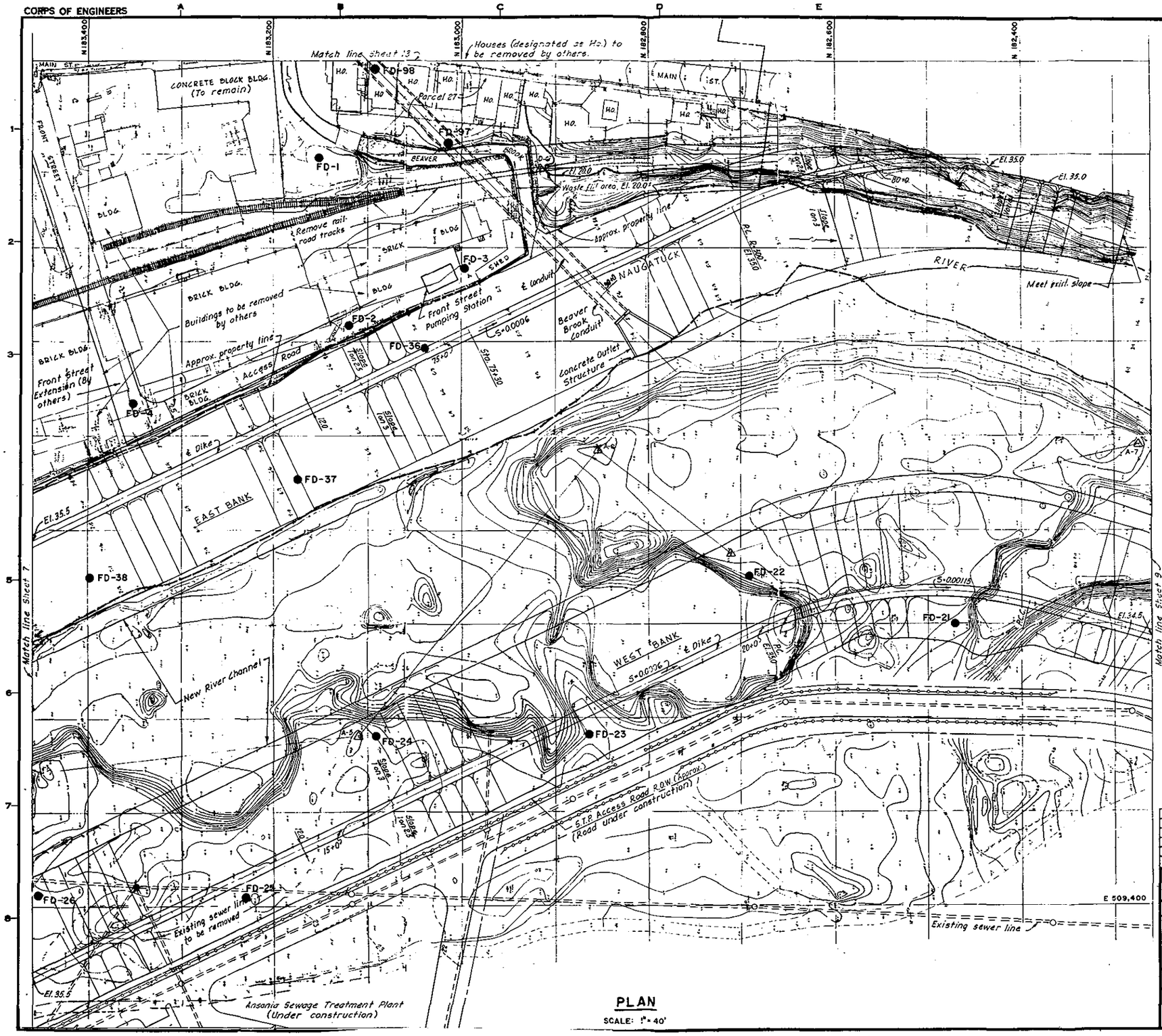
SCALE: AS SHOWN | SPEC. NO. CIV. ENG. 19-080-

DRAWING NUMBER

SHEET 7

PLATE NO. 7-8

CORPS OF ENGINEERS U. S. ARMY



PLAN

SCALE: 1" = 40'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN NO. 8

NAUGATUCK RIVER CONNECTICUT

APPROVED: DATE:

CHIEF, ENGINEERING DIVISION

SCALE: AS SHOWN SPEC. NO. CIV. ENG.19-016-

DRAWING NUMBER

SHEET 8

PLATE NO. 7-9

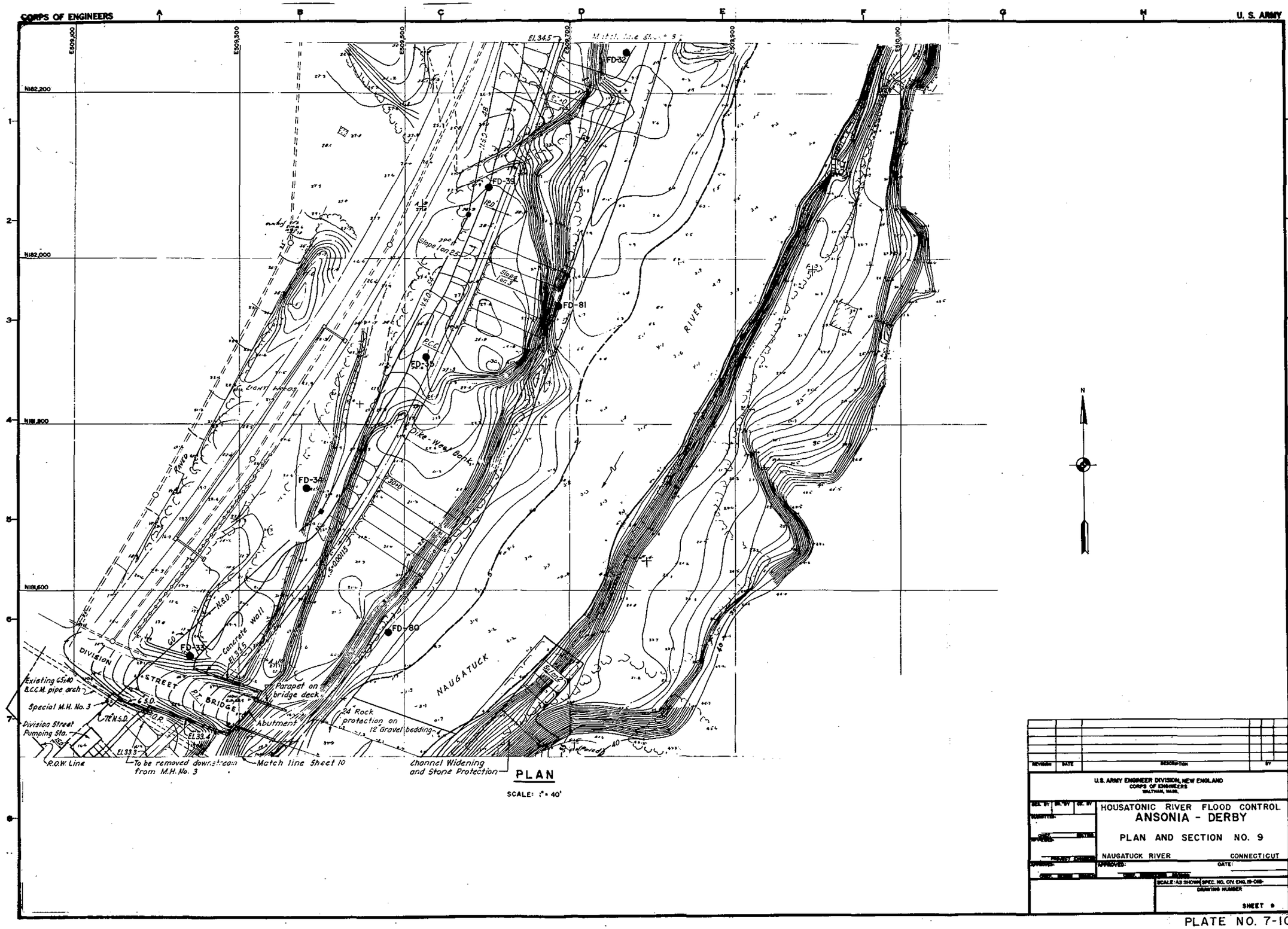
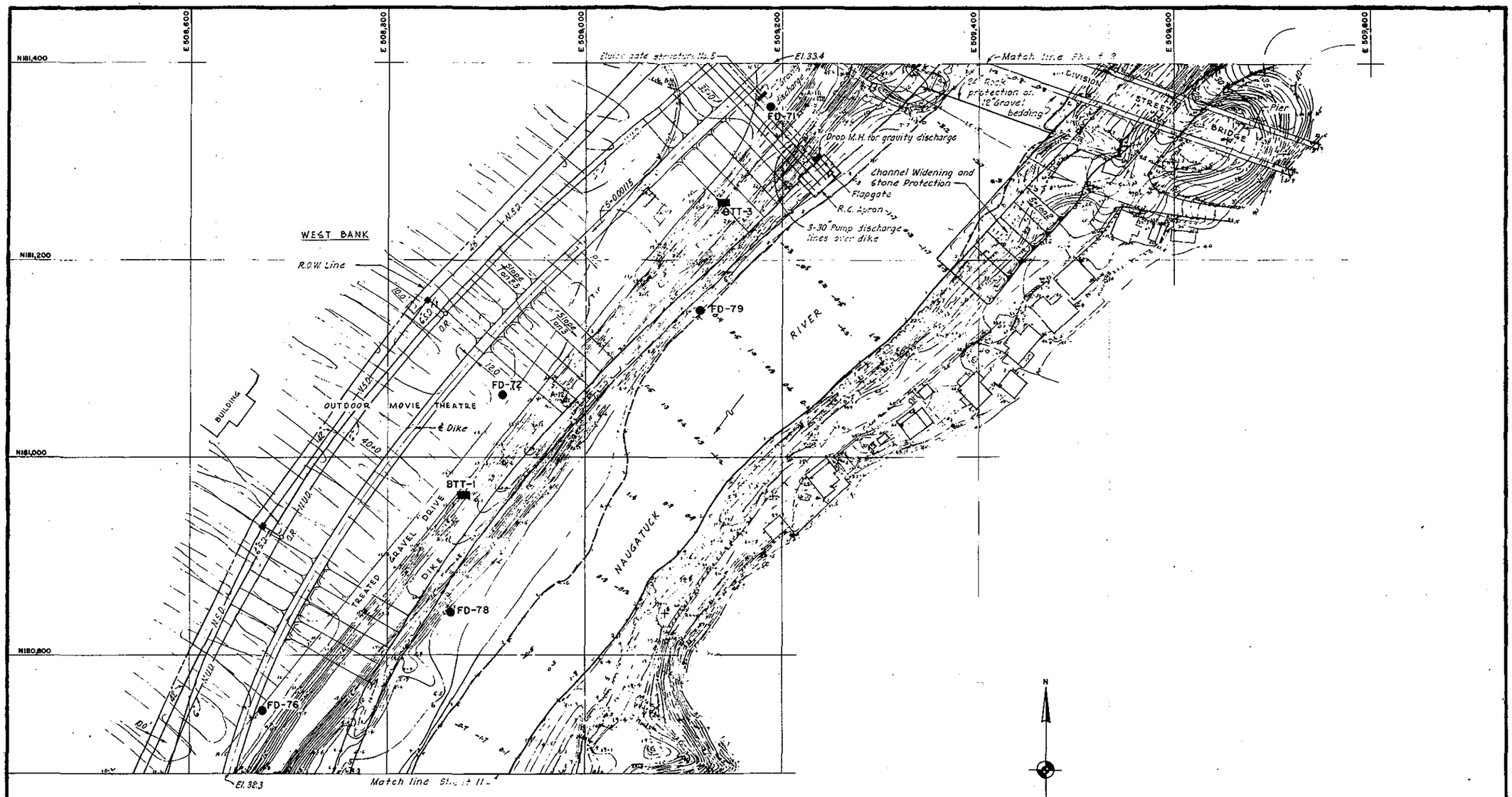

CORPS OF ENGINEERS
U. S. ARMY
NAUGATUCK
RIVER
DIVISION
STREET
BRIDGE
Pike-West Bank
Slope 1 on 2.5
Slope 1 on 3
Concrete wall
Parapet on bridge deck
Abutment
24" Rock protection on 12" Gravel bedding
Existing 65x40 B.C.C.M. pipe arch
Special M.H. No. 3
Division Street Pumping Sta.
R.O.W. Line
To be removed downstream from M.H. No. 3
Match line Sheet 10
Channel Widening and Stone Protection
FD-32
FD-39
FD-81
FD-35
FD-34
FD-80
FD-33
N182,200
N182,000
N181,800
N181,600
E509,100
E509,300
E509,500
E509,700
E509,900
E510,100
N
PLAN
SCALE: 1" = 40'
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
PLAN AND SECTION NO. 9
NAUGATUCK RIVER
CONNECTICUT
SHEET 9

PLATE NO. 7-10



PLAN

SCALE: 1" = 40'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN AND SECTION NO. 10

NAUGATUCK RIVER CONNECTICUT

APPROVED DATE

CHIEF, ENGINEERING DIVISION

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

DRAWING NUMBER

SHEET NO.

PLATE NO. 7-11

CORPS OF ENGINEERS — U. S. ARMY

PLAN

SCALE: 1" = 40'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
PLAN AND SECTIONS NO. 11

NAUGATUCK RIVER — CONNECTICUT

APPROVED: DATE:

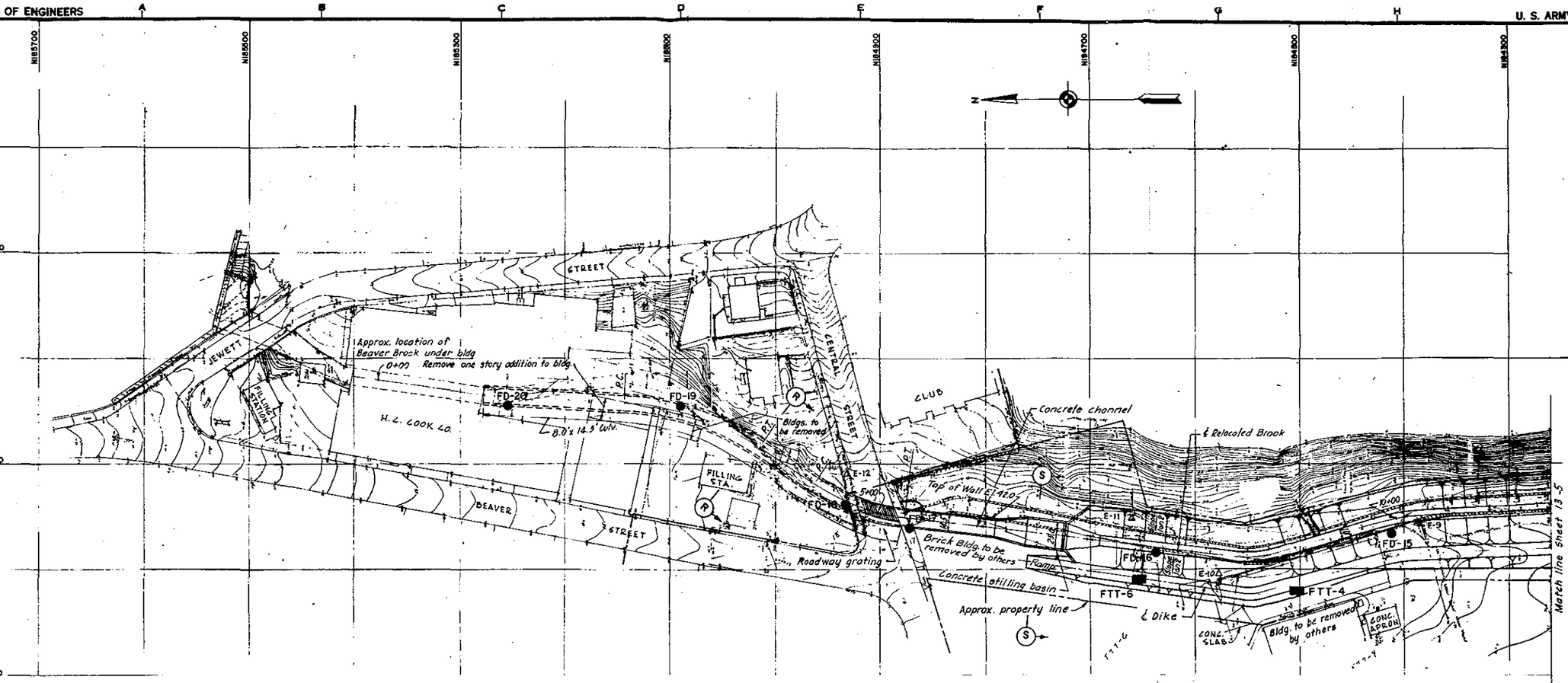
SCALE: AS SHOWN | SPEC. NO. CIV. ENG. 19-000-
DRAWING NUMBER

SHEET 11

PLATE NO. 7-12

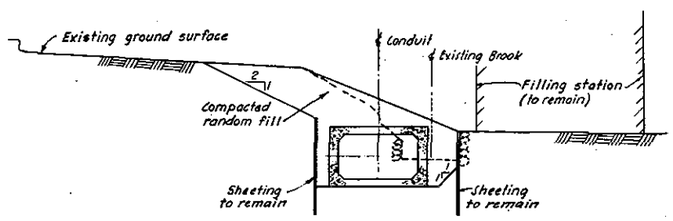
CORPS OF ENGINEERS

U. S. ARMY



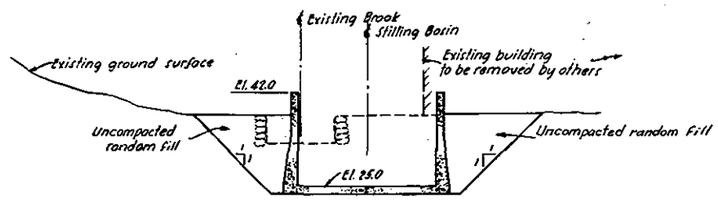
PLAN

SCALE 1" = 40'



SECTION R-R

SCALE: 1" = 10'



SECTION S-S

SCALE: 1" = 10'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN AND SECTIONS NO. 12

NAUGATUCK RIVER CONNECTICUT

APPROVED: DATE:

CHIEF, ENGINEERING DIVISION

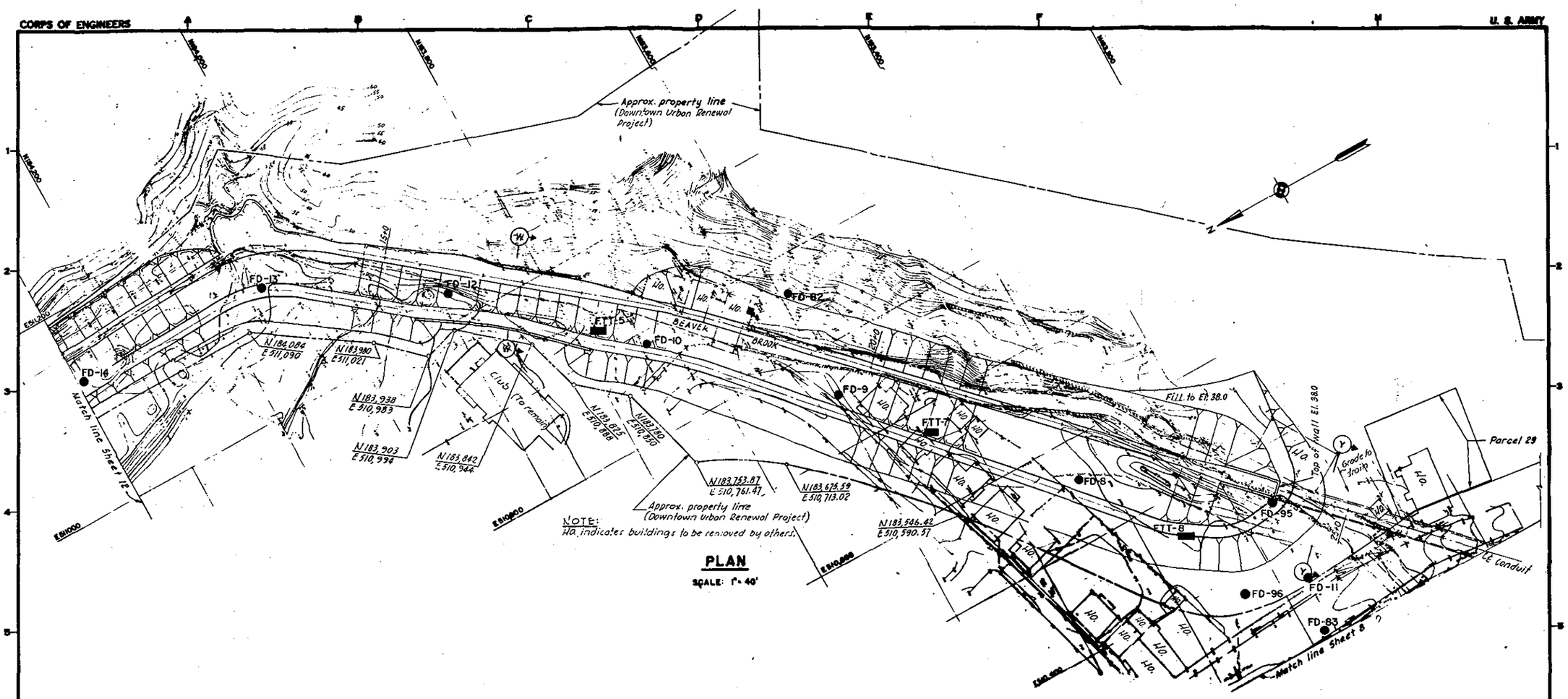
SCALE: AS SHOWN | SPEC. NO. CIV. ENG. 19-010-

DRAWING NUMBER

SHEET 12

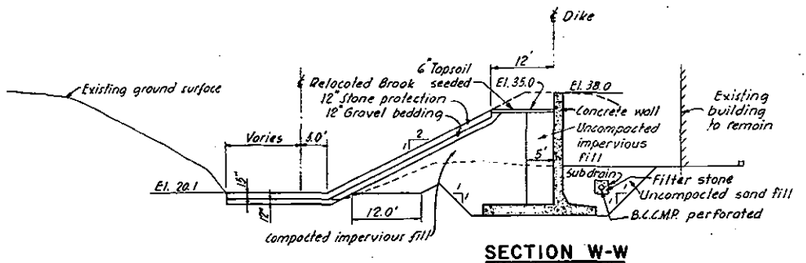
PLATE NO. 7-13

CORPS OF ENGINEERS U. S. ARMY



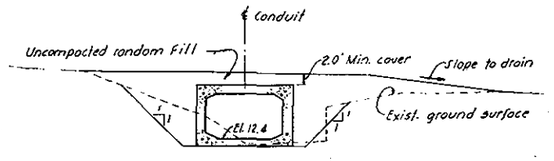
PLAN

SCALE: 1" = 40'



SECTION W-W

SCALE 1" = 10'



SECTION Y-Y

SCALE: 1" = 10'

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

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN AND SECTIONS NO. 13

NAUGATUCK RIVER CONNECTICUT

APPROVED: DATE:

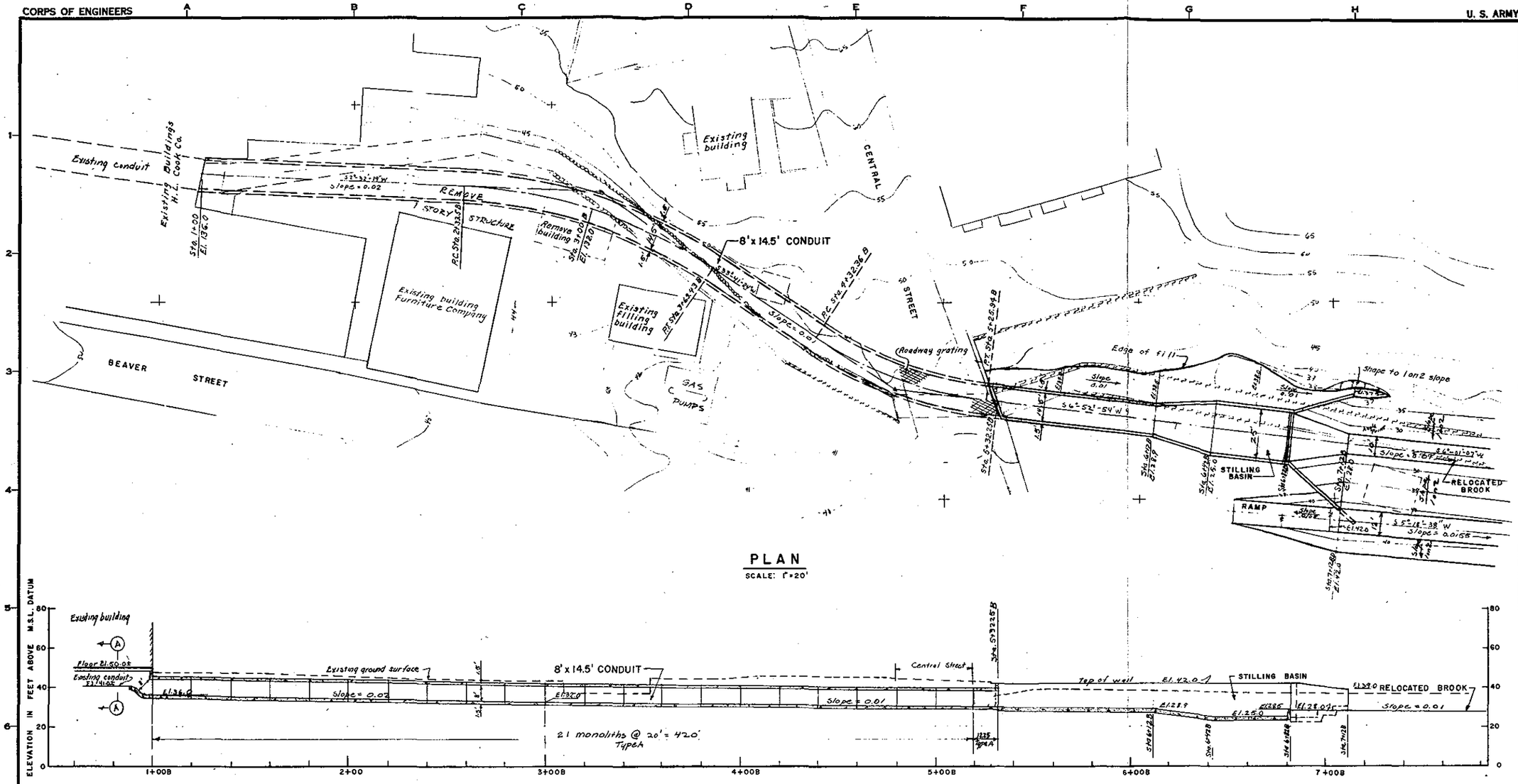
SCALE: AS SHOWN SPEC. NO. CIV. ENG. 10-010

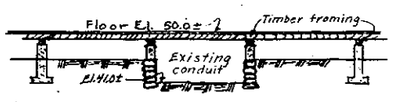
DRAWING NUMBER

SHEET 13

PLATE NO. 7-14

CORPS OF ENGINEERS — U. S. ARMY





SECTION A-A

SCALE: 1" = 10'

GRAPHIC SCALES

1" = 20' — 20' 0 20' 40'

1" = 10' — 10' 0 10' 20'

REVISION	DATE	DESCRIPTION	BY

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

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, SECTION

REVIEWED:

PROJECT ENGINEER

APPROVED:

CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
BEAVER BROOK
UPPER CONDUIT
PLAN AND PROFILE
NAUGATUCK RIVER — CONNECTICUT

APPROVED: — DATE:

CHIEF, CONSTRUCTION BRANCH

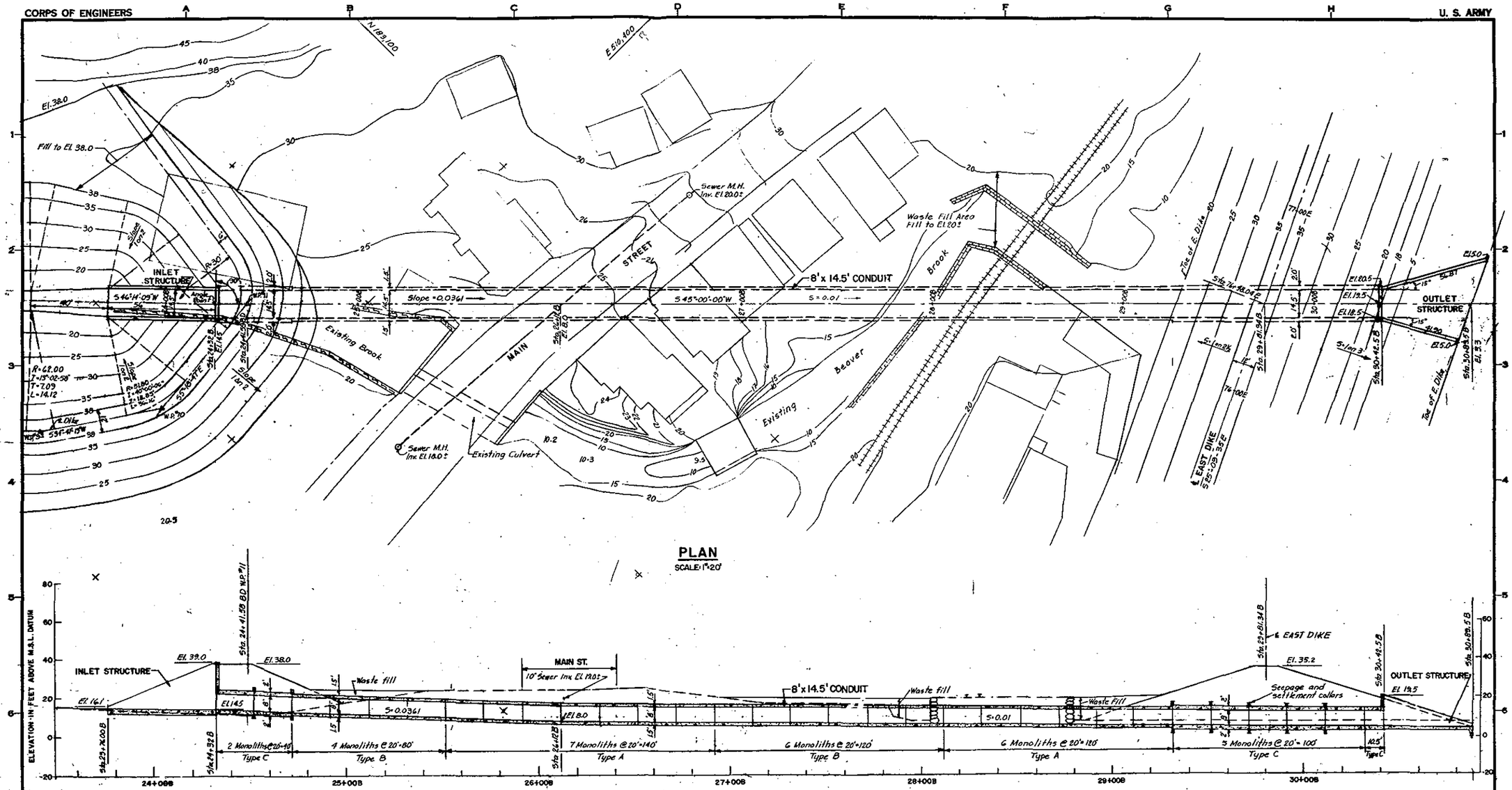
SCALE: AS SHOWN | SPEC. NO. CIV. ENG. 19-016-

DRAWING NUMBER

SHEET

PLATE NO. 7-15

CORPS OF ENGINEERS U. S. ARMY



REVISION	DATE	DESCRIPTION	BY

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

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

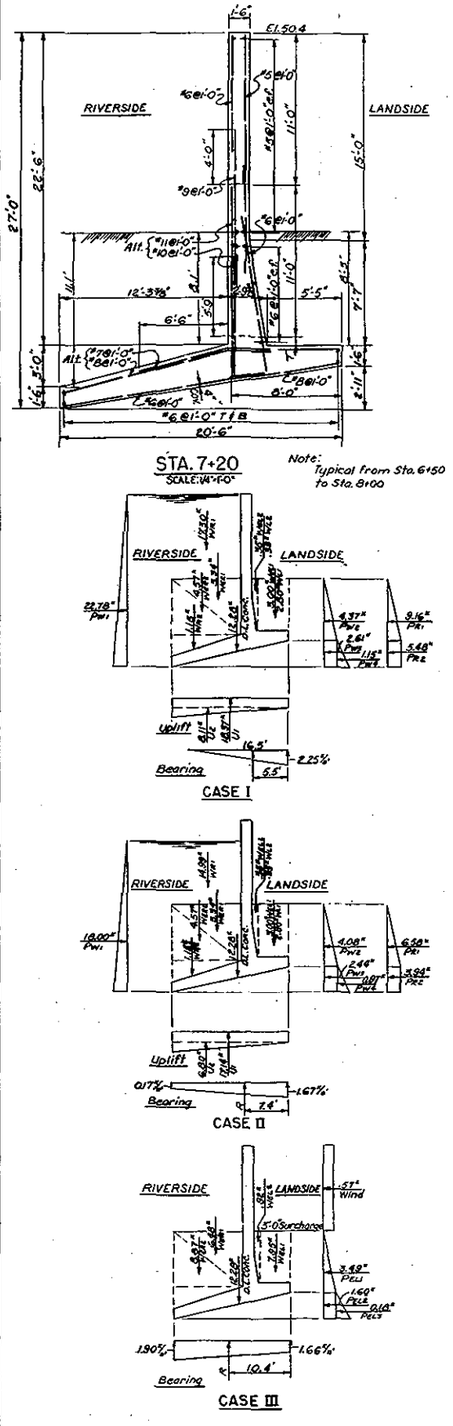
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA DERBY
BEAVER BROOK
LOWER CONDUIT
PLAN AND PROFILE
NAUGATUCK RIVER CONNECTICUT

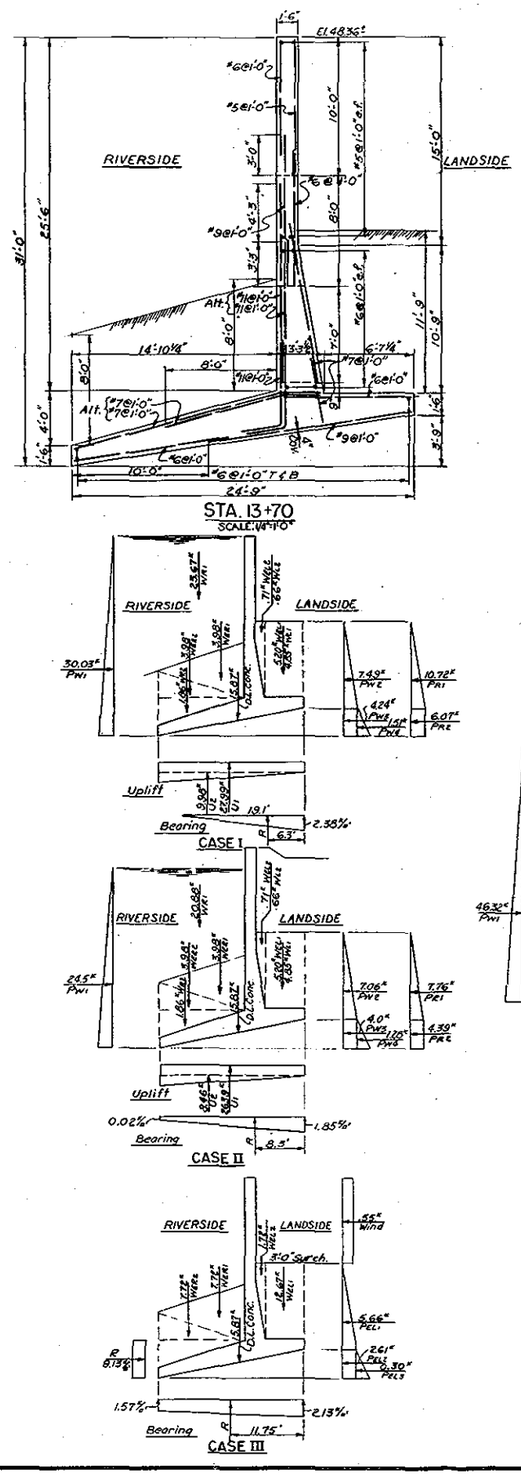
APPROVED: DATE:
CHIEF, ENGINEERING DIVISION

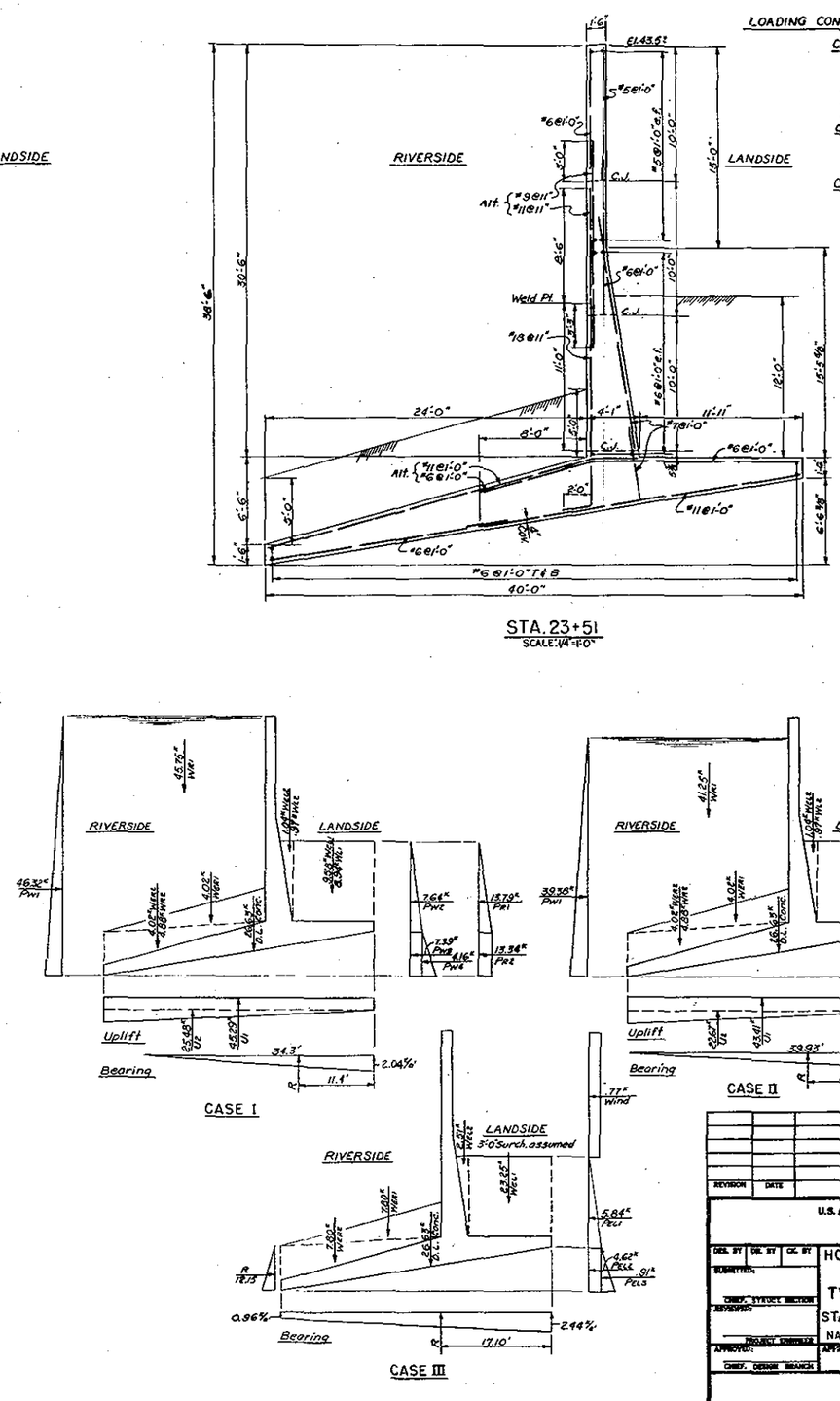
SCALE: SPEC. NO. CIV. ENG. 19-066-
DRAWING NUMBER
SHEET

PLATE NO. 7-16

CORPS OF ENGINEERS — U. S. ARMY







LOADING CONDITIONS

CASE I
Water to top of wall, uplift varying from full head at riverside heel to 0 at landside ground surface by creep method. Resultant to fall in middle half. Normal design stresses.

CASE II
Same as Case I except water down 3'-0" feet and resultant to fall in the middle third.

CASE III
Water down. 50 #/□' wind load applied to landside and 3'-0" equivalent surcharge applied on landside.

NOTES:
Cover for steel reinforcement shall be 3" except as noted.
All walls are on Left Bank.

REVISION	DATE	DESCRIPTION	BY

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

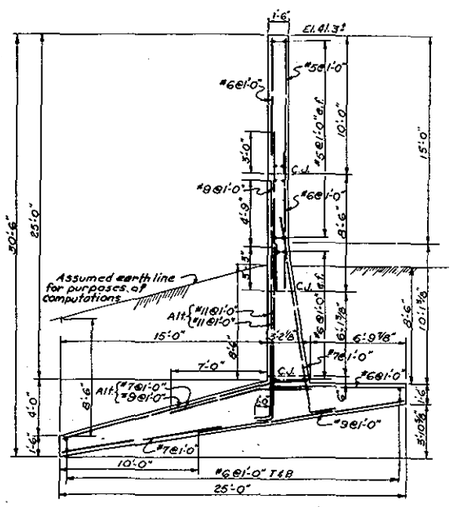
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, STRUCT. SECTION
REVIEWED:
PROJECT ENGINEER
APPROVED:
CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
TYPICAL TEE-TYPE FLOOD WALLS
STABILITY AND STRUCTURAL DETAILS NO. 1
NAUGATUCK RIVER — CONNECTICUT

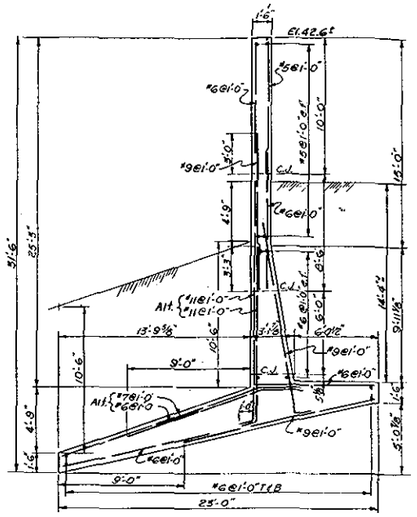
APPROVED: CHIEF, ENGINEERING DIVISION — DATE
SCALE
SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 7-17

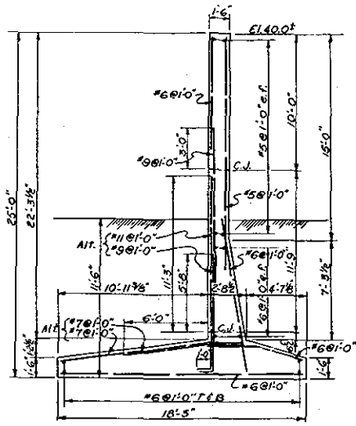
CORPS OF ENGINEERS — U. S. ARMY



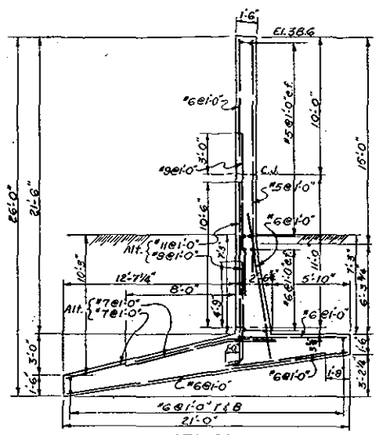
STA. 37+25
SCALE: 1/4" = 1'-0"



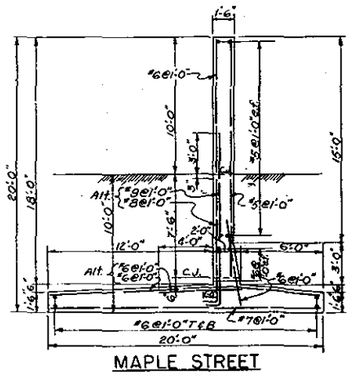
STA 10+00
RIGHT BANK
SCALE: 1/4" = 1'-0"



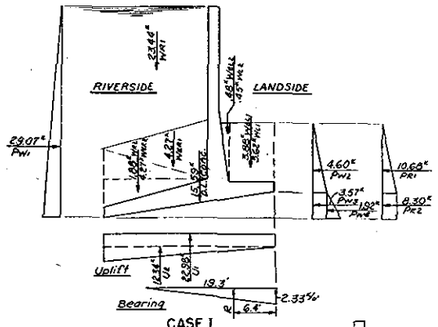
STA. 45+15
SCALE: 1/4" = 1'-0"



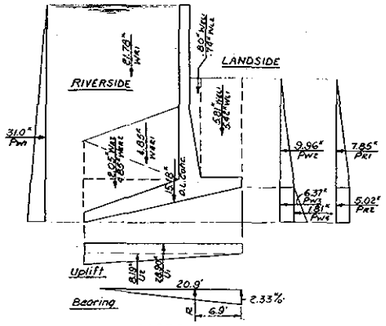
STA. 52+00
SCALE: 1/4" = 1'-0"



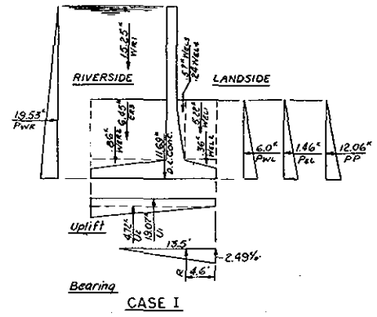
MAPLE STREET
RIGHT BANK
SCALE: 1/4" = 1'-0"



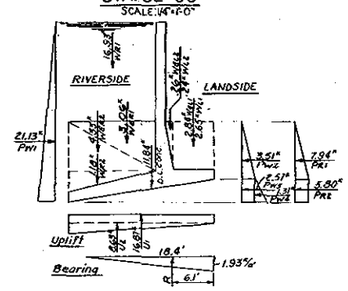
CASE I



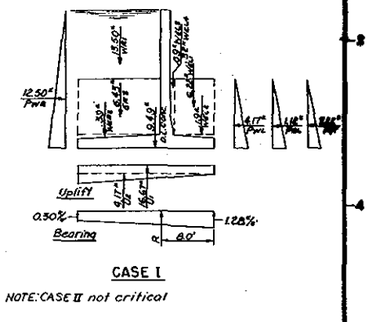
CASE I



CASE I

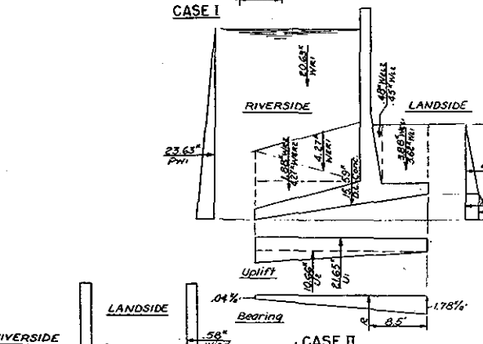


CASE I

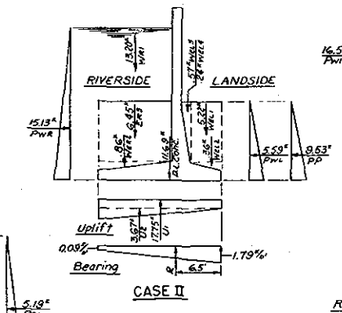


CASE I

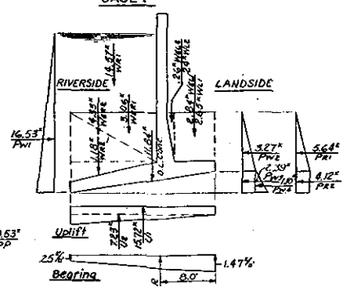
NOTE: CASE II not critical



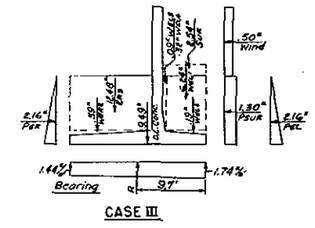
CASE II



CASE II

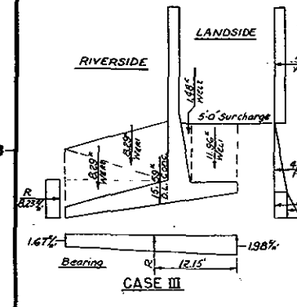


CASE II

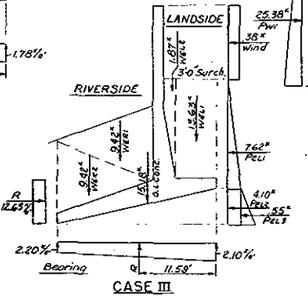


CASE III

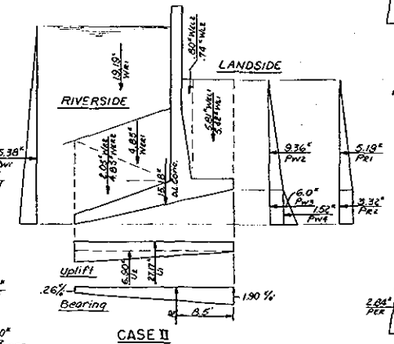
NOTE: All walls are on the left bank unless otherwise noted.



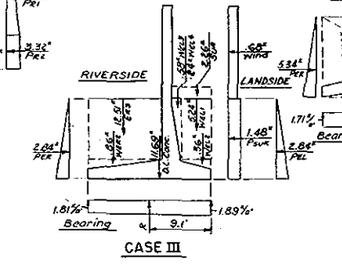
CASE III



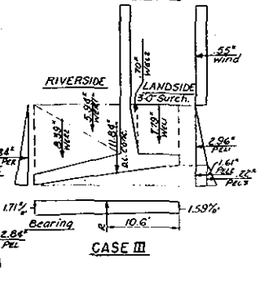
CASE III



CASE II



CASE III



CASE III

REVISION	DATE	DESCRIPTION	BY

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

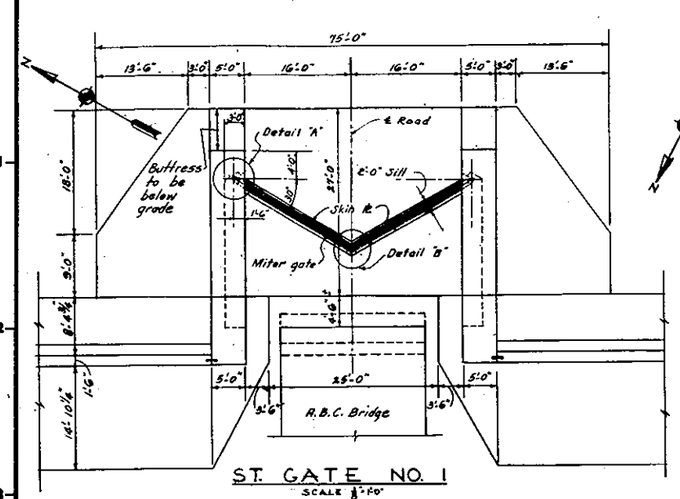
DES. BY | DR. BY | CK. BY
SUBMITTED: CHIEF, STRUCT. SECTION
REVIEWED: DIVISION ENGINEER
APPROVED: CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
TYPICAL TEE - TYPE FLOOD WALLS
STABILITY AND STRUCTURAL DETAILS NO. 2
NAUGATUCK RIVER — CONNECTICUT

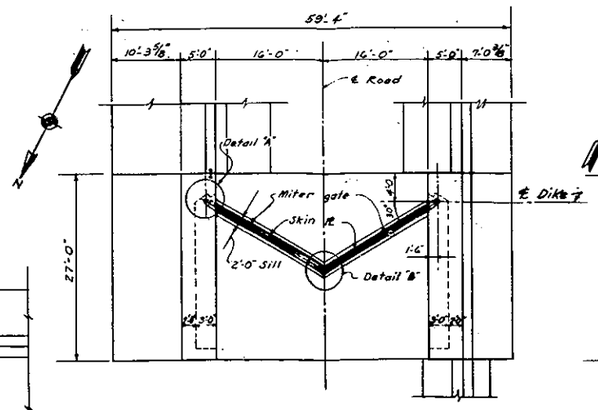
APPROVED: CHIEF, ENGINEERING DIVISION — DATE
SCALE — SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 7-18

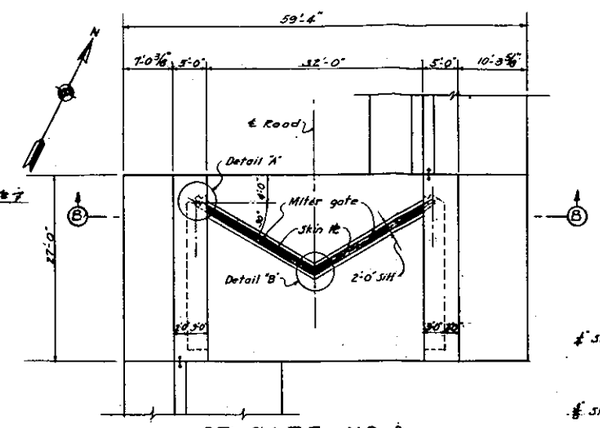
CORPS OF ENGINEERS — U. S. ARMY



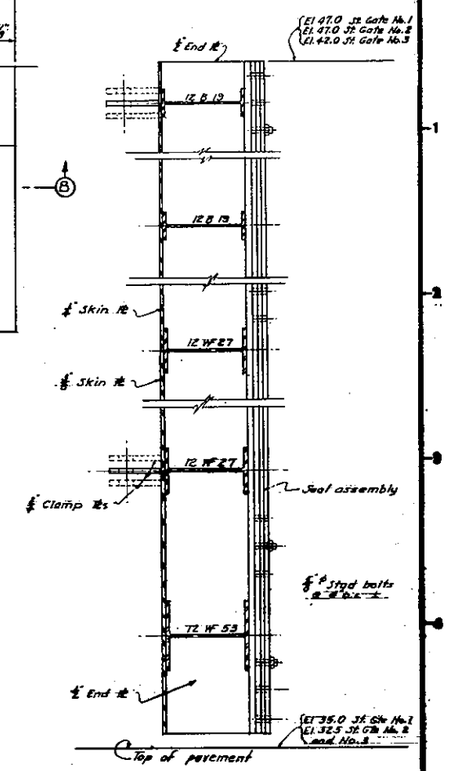
ST. GATE NO. 1
SCALE 1/8" = 1'-0"



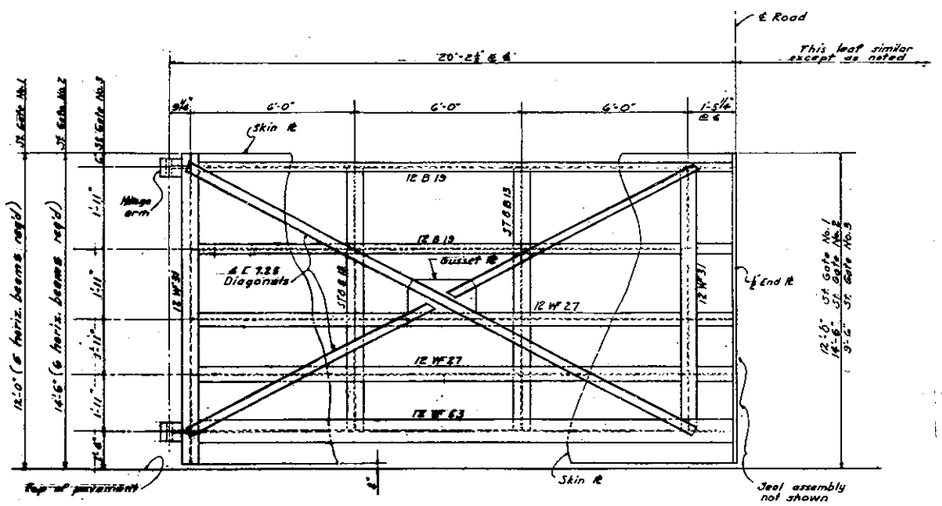
ST. GATE NO. 2
SCALE 1/8" = 1'-0"



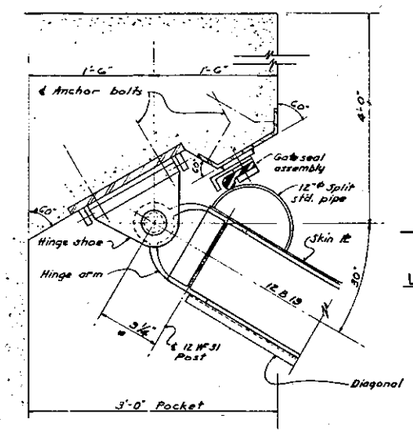
ST. GATE NO. 3
SCALE 1/8" = 1'-0"



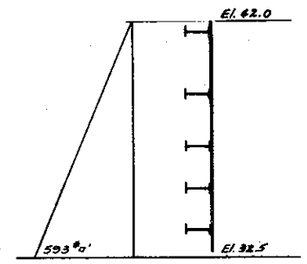
SECTION A-A
SCALE 1/2" = 1'-0"



ELEVATION — GATE NO. 3
NO. 1 & NO. 2 SIMILAR EXCEPT AS NOTED
SCALE 1/8" = 1'-0"

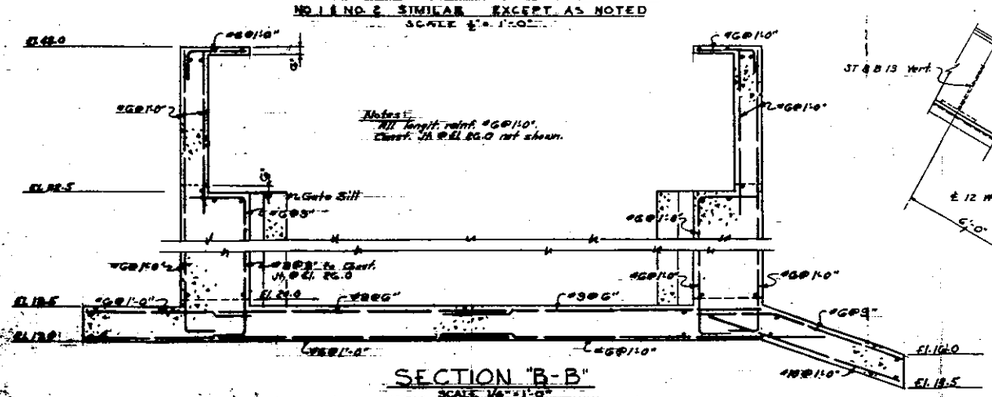


DETAIL "A"
SCALE 1 1/2" = 1'-0"

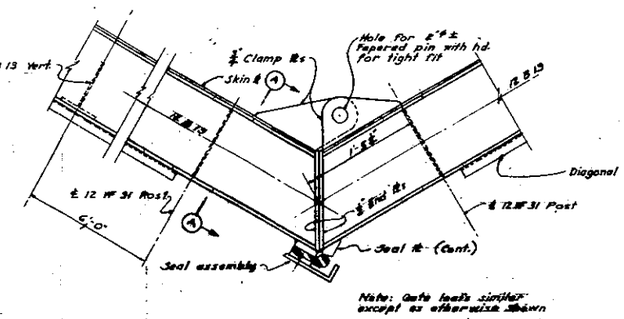


LOADING DIAGRAM
GATE No. 3

NOTE:
Skin plate to be A441 steel. All other steel to be A36.



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



DETAIL "B"
SCALE 1 1/2" = 1'-0"

REVISION	DATE	DESCRIPTION	BY

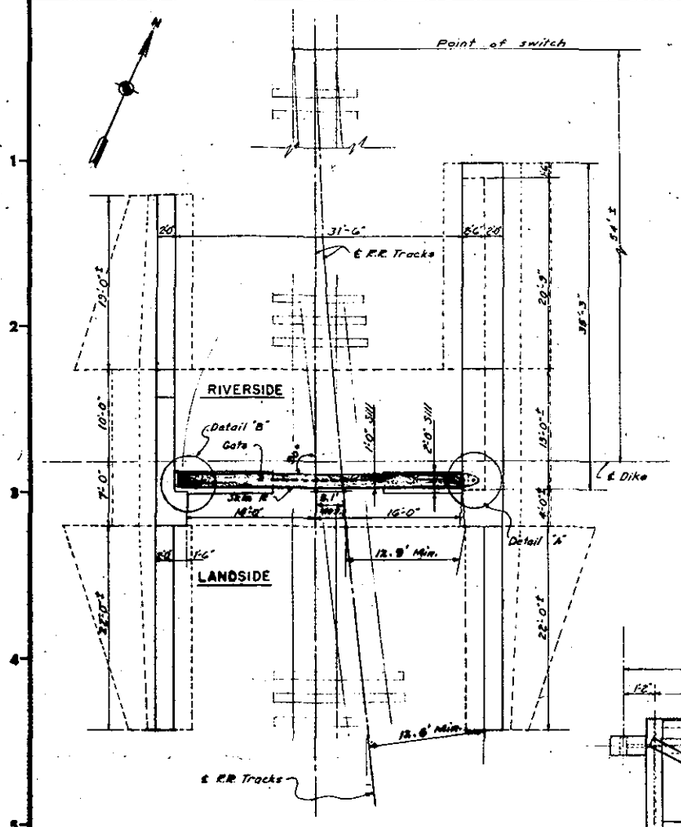
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
HIGHWAY STREET GATES
STRUCTURAL DETAILS
NAUGATUCK RIVER — CONNECTICUT

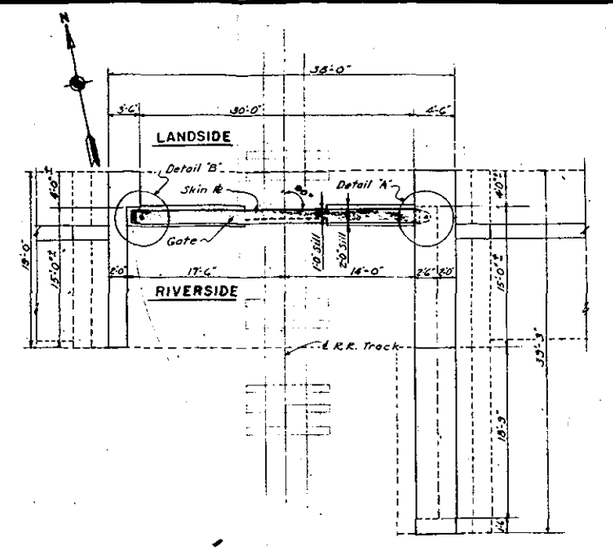
SCALE AS SHOWN SPEC. NO. CIV. ENG. 19-049-
DRAWING NUMBER
SHEET

PLATE NO. 7-19

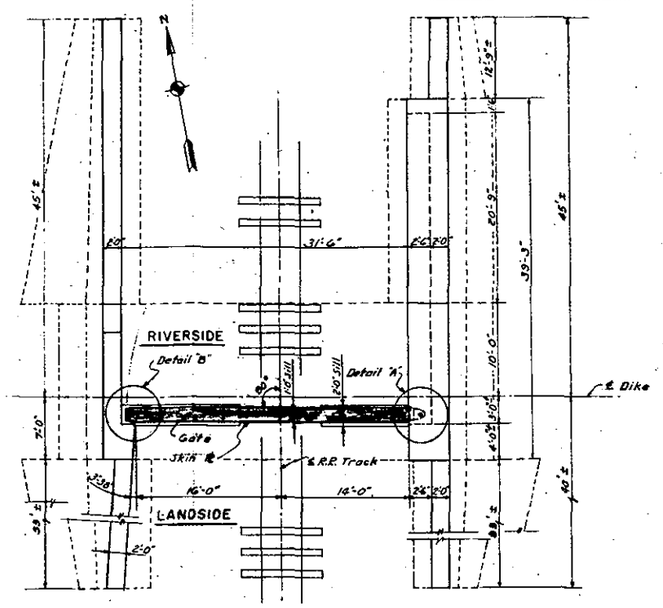
CORPS OF ENGINEERS — U. S. ARMY



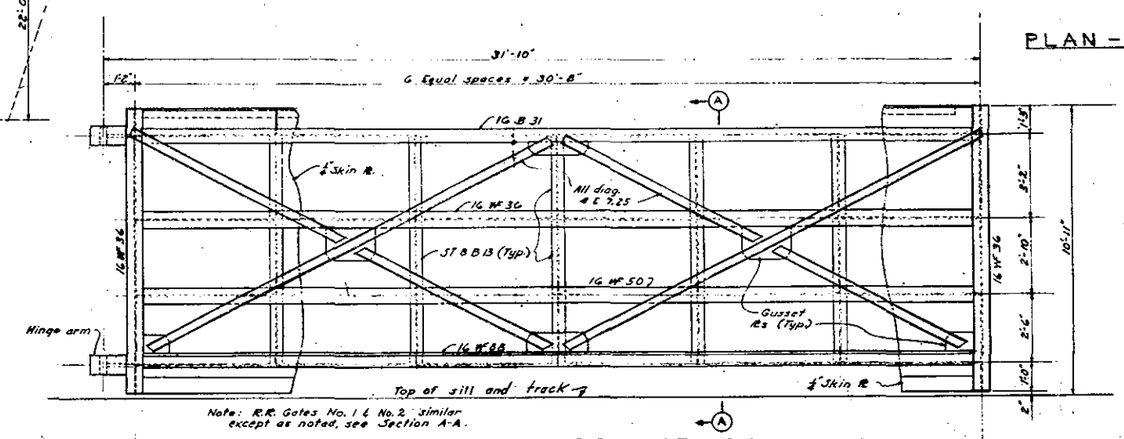
PLAN – R.R. GATE NO. 1
SCALE 1" = 6'



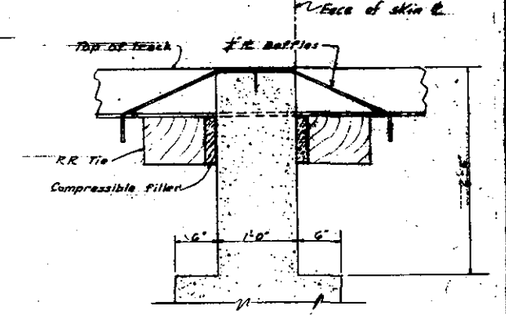
PLAN – R.R. GATE NO. 2
SCALE 1" = 6'



PLAN – R.R. GATE NO. 4
SCALE 1" = 6'

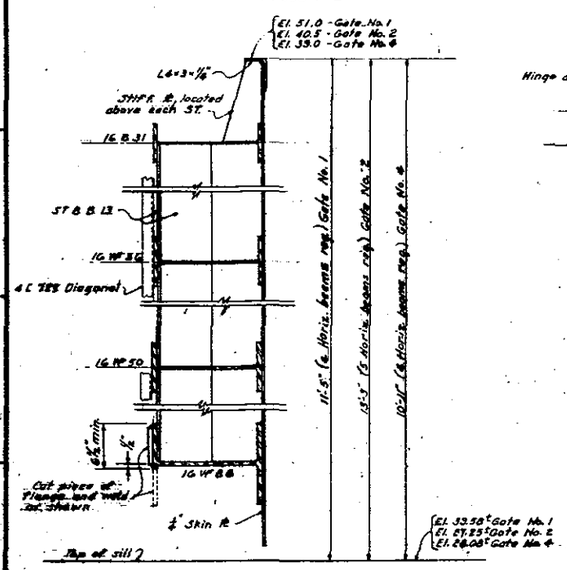


ELEVATION – R.R. GATE NO. 4
SCALE 1/4" = 1'-0"

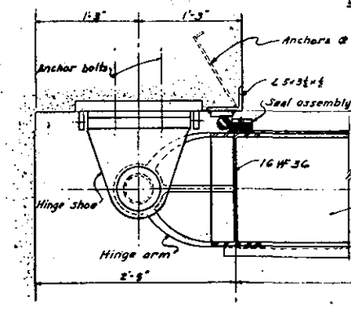


TYP. SILL SECTION AT TRACK
SCALE 1½" = 1'-0"

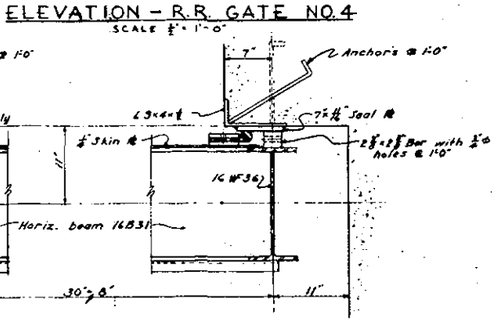
NOTE:
Skin plate to be A 441 steel. All other steel to be A 36.



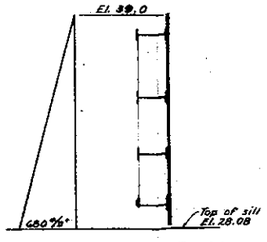
SECTION A-A
SCALE 1/4" = 1'-0"



DETAIL "A"
SCALE 1½" = 1'-0"



DETAIL "B"
SCALE 1½" = 1'-0"



LOADING DIAGRAM
R.R. GATE NO. 4

REVISION	DATE	DESCRIPTION	BY

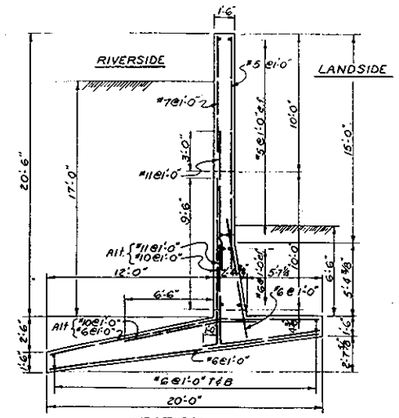
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
RAILROAD GATES
STRUCTURAL DETAILS
NAUGATUCK RIVER — CONNECTICUT

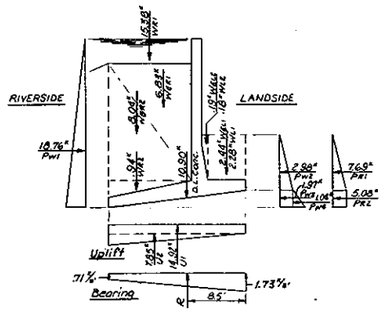
SCALE — SPEC. NO. CIV. ENG. 19-016- — DRAWING NUMBER — SHEET

PLATE NO. 7-20

CORPS OF ENGINEERS — U. S. ARMY

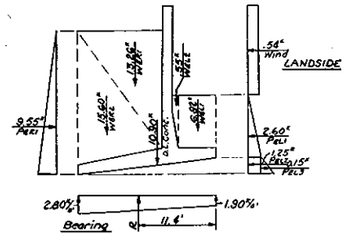


SECTION
SCALE: 1/4" = 1'-0"

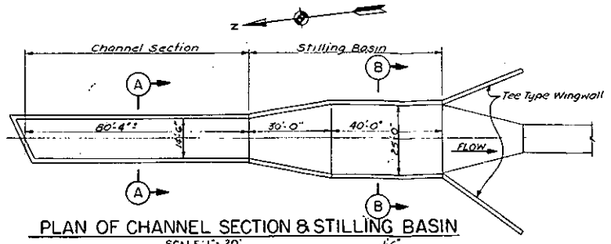


CASE I

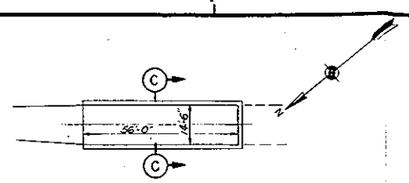
NOTE: Case II not Critical



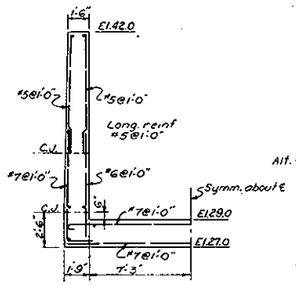
CASE III



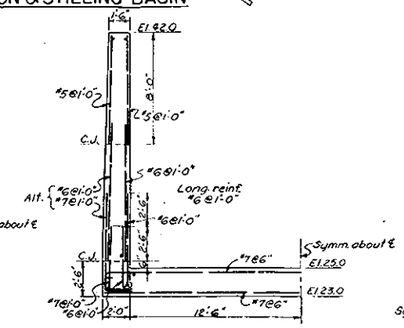
PLAN OF CHANNEL SECTION & STILLING BASIN
SCALE: 1" = 20'



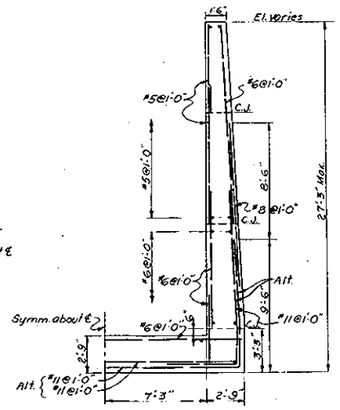
PLAN - INLET STRUCTURE
LOWER CONDUIT
SCALE: 1" = 20'



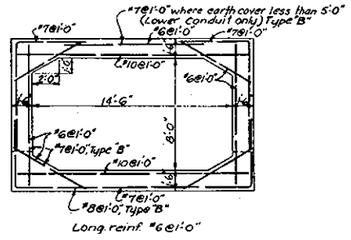
SECTION A-A
SCALE: 1/4" = 1'-0"



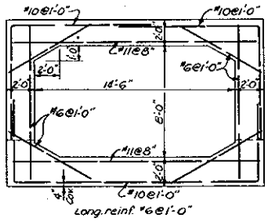
SECTION B-B
SCALE: 1/4" = 1'-0"



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



TYPE "A" CONDUIT
(TYPE "B" CONDUIT SIMILAR EXCEPT AS NOTED)



TYPE "C" CONDUIT

Notes:
For location of conduit sections see Plates Nos. 7-15 and 7-16.

REVISION	DATE	DESCRIPTION	BY

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

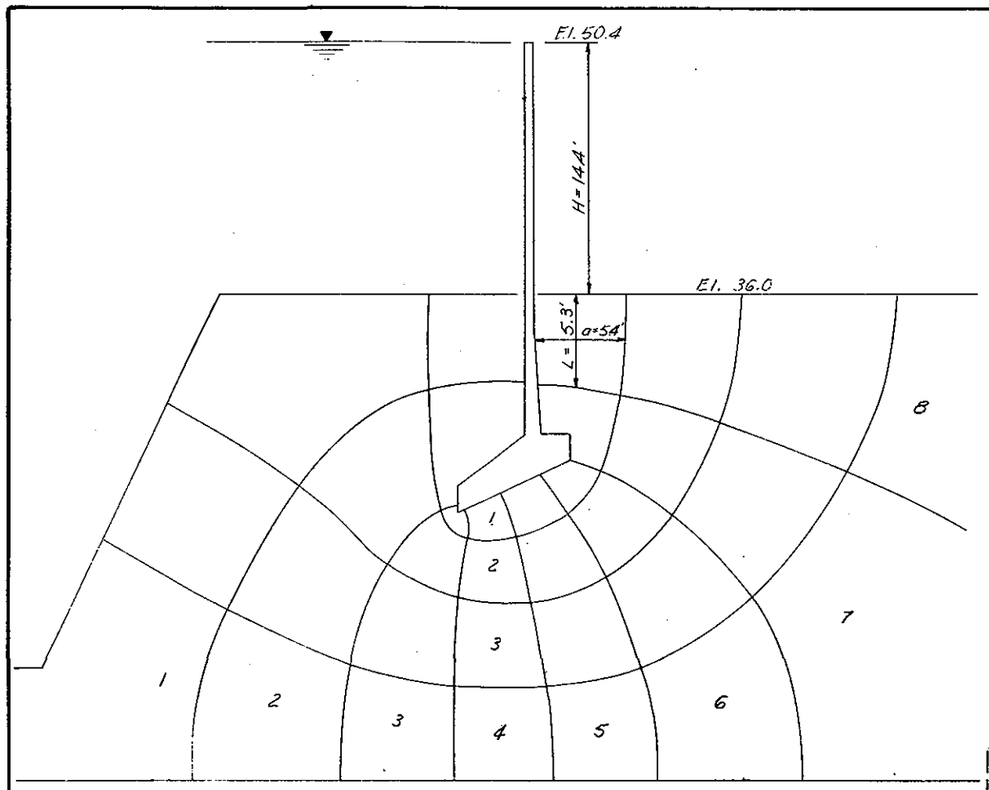
DES. BY | DR. BY | CK. BY
SUBMITTED: CHIEF, STRUCT. SECTION
REVIEWED: PROJECT ENGINEER
APPROVED: CHIEF, DESIGN BRANCH

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
BEAVER BROOK
STRUCTURAL DETAILS
NAUGATUCK RIVER — CONNECTICUT

APPROVED: CHIEF, ENGINEERING DIVISION — DATE

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

PLATE NO. 7-21



TRANSFORMED FLOW NET

SCALE Hor. 1" = 15'
Vert. 1" = 5'

$N_e = 8$
$N_f = 4$

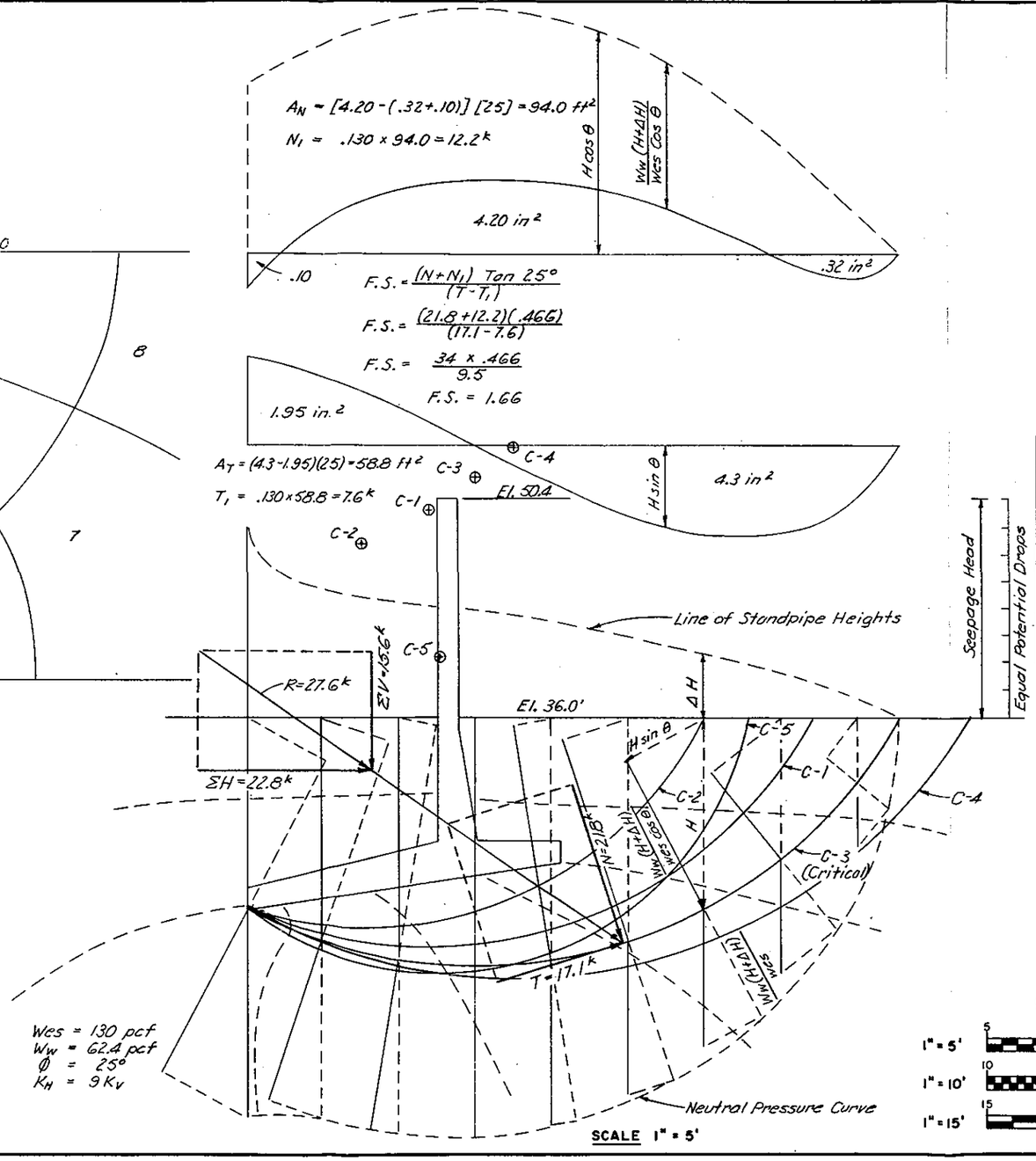
$\Delta H = \frac{14.4}{8} = 1.80$

$i = \frac{\Delta H}{L} = \frac{1.80}{5.3} = .34 < 1.0$ No Piping

Seepage Force $= iA\gamma_w$
$= .34 \times 5.3 \times 5.4 \times 62.4 = 608$ #/ft

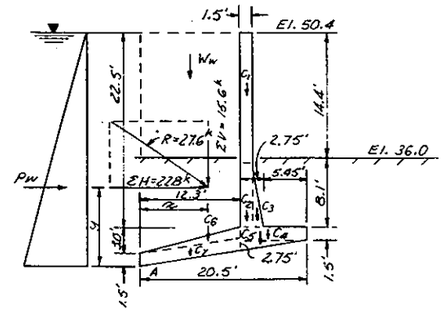
Resisting Force $= aL\gamma b$
$= 5.3 \times 5.4 \times 67 = 1920$ #/ft

$F.S. = \frac{1920}{608} = 3.16 > 2.0$ No. Boiling



$W_{es} = 130$ pcf
$W_w = 62.4$ pcf
$\phi = 25°$
$K_H = 9K_V$

SCALE 1" = 5'



SCALE 1" = 10'

Force	Factors	Force - Kips ↓	Force - Kips →	Arm Ft.	Mom @ A Ft.-Kips
C_1	1.5 × 15.0 × .150	3.37		13.05	44.00
C_2	1.5 × 7.5 × .02	.23		13.05	3.00
C_3	.5 × 1.25 × 7.5 × .02	.09		14.21	1.28
C_4	1.5 × 8.2 × .02	.25		16.40	4.10
C_5	.5 × 1.25 × 8.2 × .02	.10		15.03	1.50
C_6	.5 × 1.25 × 12.3 × .02	.15		8.20	1.23
C_7	1.5 × 12.3 × .02	.37		6.15	2.27
W_w	12.3 × 14.4 × .0624	11.00		6.15	67.60
P_w	.5 × .0624 × 27 × 27		22.80	9.00	206.00
		$\Sigma V = 15.56^k$			$\Sigma M_V = 124.98'^k$
			$\Sigma H = 22.80^k$		$\Sigma M_H = 206.00'^k$

Location of Resultant

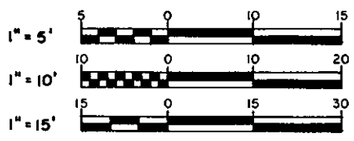
$x = \frac{\Sigma M_V}{\Sigma V} = \frac{124.98}{15.56} = 8.05'$

$y = \frac{\Sigma M_H}{\Sigma H} = \frac{206.0}{22.8} = 9.0'$

SUMMARY STABILITY ANALYSIS

Circle No.	Factor of Safety
1	2.03
2	2.46
3	1.66
4	1.73
5	2.58

GRAPHIC SCALES



HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
FOUNDATION STABILITY ANALYSIS
T-TYPE FLOOD WALL
LEFT BANK
STATION 7+20
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 7-22

$N_c = 10$

$N_f = 6$

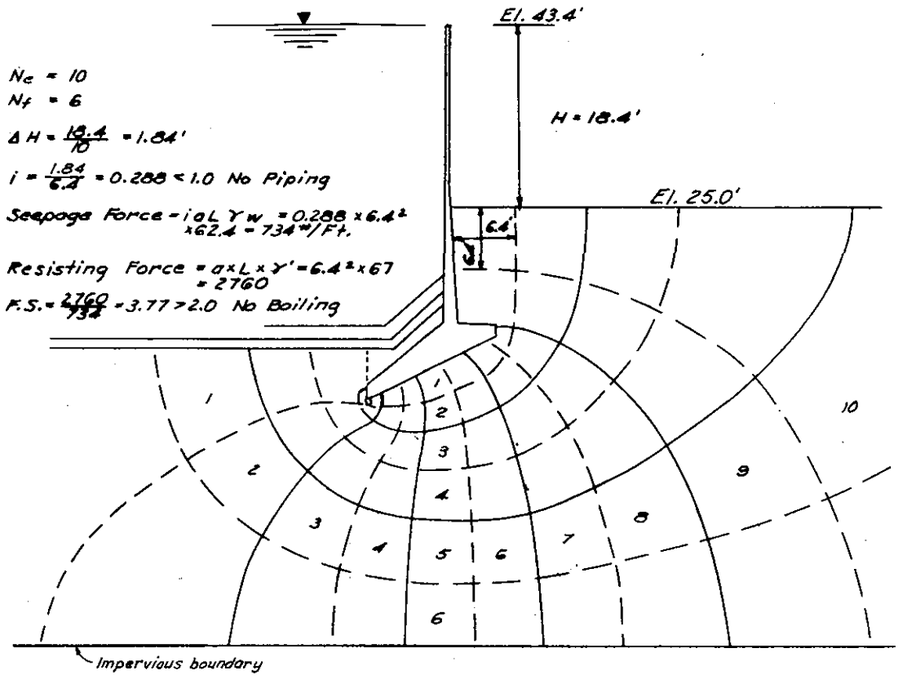
$\Delta H = \frac{18.4}{10} = 1.84'$

$i = \frac{1.84}{6.4} = 0.288 < 1.0$ No Piping

Seepage Force $= i a L \gamma_w = 0.288 \times 6.4^2 \times 62.4 = 734^{\#}/Ft.$

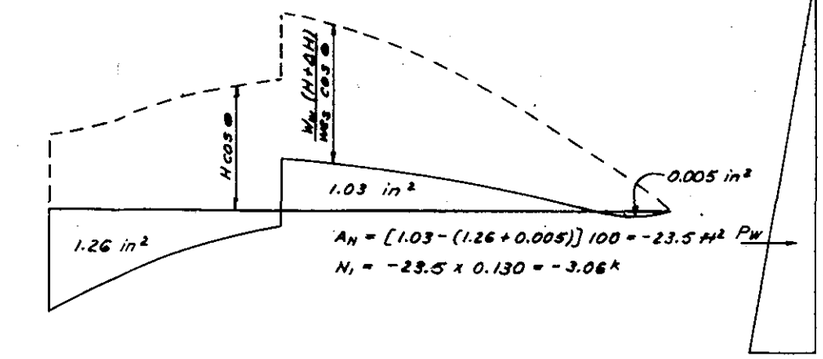
Resisting Force $= a \times L \times \gamma' = 6.4^2 \times 67 = 2760$

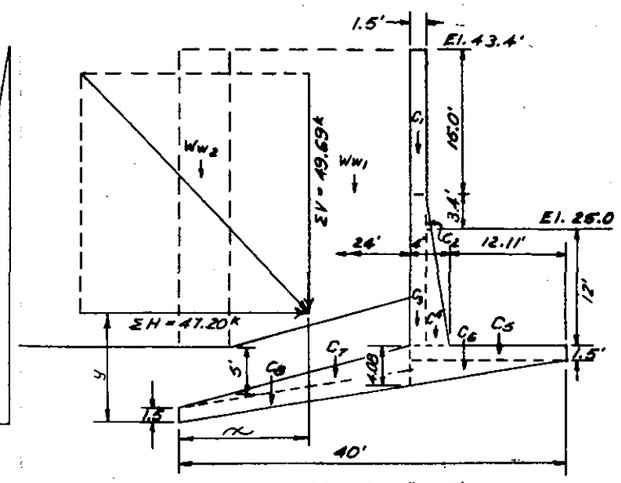
F.S. $= \frac{2760}{734} = 3.77 > 2.0$ No Boiling



TRANSFORMED FLOW NET

SCALE Hor. 1" = 30'
Vert. 1" = 10'



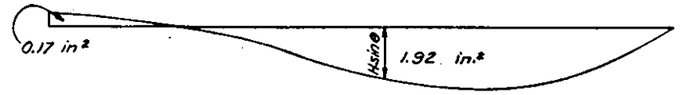


SCALE 1" = 10'

⊕ C-1

⊕ C-3

⊕ C-2



$A_T = (1.92 - 0.17)(100) = 175\ ft^2$

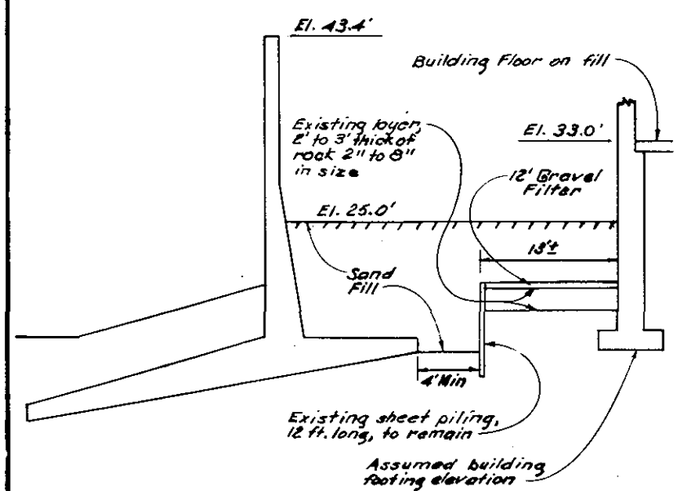
$T_1 = 175 \times 0.130 = 22.8^k$

Force	Factors	Force-Kips ↓	Force-Kips →	Arm Ft.	Mom @ A Ft.-Kips
C_1	18.4×1.5×.150 =	4.14		24.75	100.2
C_2	1/2×.9×3.5×.150 =	.24		25.80	6.1
C_3	12×1.5×.020 =	.36		24.75	8.9
C_4	$\frac{2.5+.9}{2}$×12×.020 =	.41		26.34	10.7
C_5	16.16×1.5×.020 =	.48		31.33	15.2
C_6	1/2×2.58×16.16×.020 =	.42		28.92	12.0
C_7	1/2×2.58×24×.020 =	.62		16.00	9.9
C_8	1.5×24×.020 =	.72		12.00	8.6
W_{w1}	18.5×28.0×.0624 =	32.40		14.45	467.
W_{w2}	5.2×30.5×.0624 =	9.90		2.60	25.8
Pw	1/2×38.8²×.0624 =		47.20	11.65	550.0
	ΣV = 49.69				ΣM_V = 664.4
	ΣH = 47.20				ΣM_H = 550.0

Location of Resultant

$x = \frac{\Sigma M_V}{\Sigma V} = \frac{664.4}{49.69} = 13.4'$

$y = \frac{\Sigma M_H}{\Sigma H} = \frac{550.0}{47.20} = 11.65'$



SECTION

STA. 23+50

SCALE 1" = 10'

$F.S. = \frac{(N+N_1)\tan 30°}{T - T_1}$

$F.S. = \frac{(56.0 - 3.06)(0.577)}{(39.5 - 22.8)}$

$F.S. = \frac{52.94 \times 0.577}{16.7}$

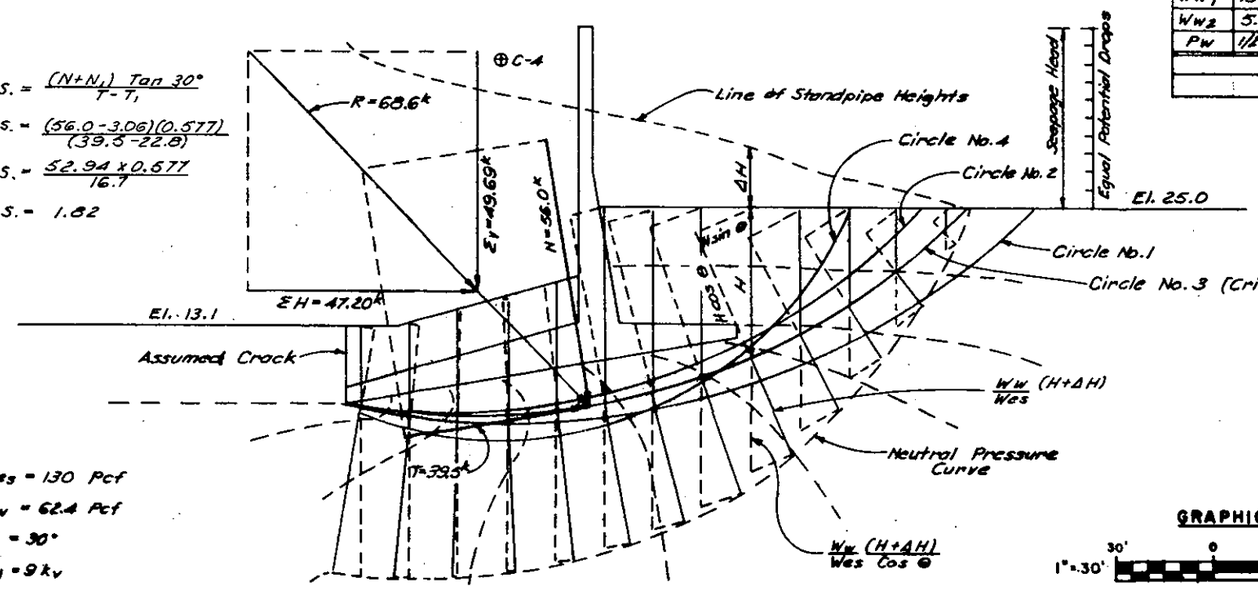
$F.S. = 1.82$

$W_{es} = 130$ Pcf

$W_w = 62.4$ Pcf

$\phi = 30°$

$K_H = 9\ k_V$



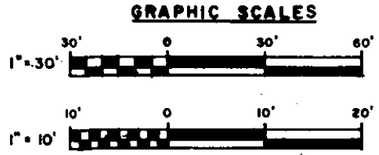
SCALE

1" = 10'

SUMMARY
STABILITY ANALYSIS

Circle No.	Factor of Safety
1.	3.12
2.	2.08
3.	1.82
4.	2.67

GRAPHIC SCALES



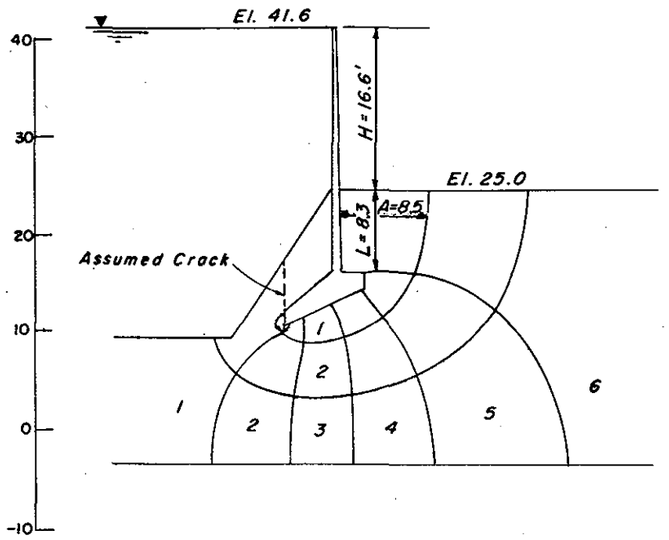
HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

FOUNDATION STABILITY ANALYSIS

T-TYPE FLOOD WALL
LEFT BANK
STATION 23+50

NAUGATUCK RIVER CONNECTICUT



TRANSFORMED FLOW NET

SCALE Hor. 1" = 30'
Vert. 1" = 10'

$N_e = 6$

$N_f = 3$

$\Delta H = \frac{16.6}{6} = 2.77$

$i = \frac{\Delta H}{L} = \frac{2.77}{8.30} = .334 < 1.0$ No piping

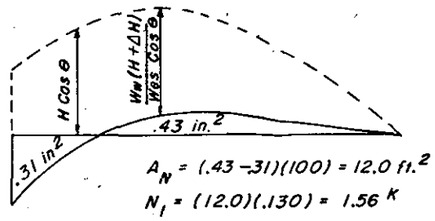
Seepage Force $= i A \gamma_w$

$= .334 \times 8.3 \times 8.5 \times 62.4 = 1470^{\#}/Ft.$

Resisting Force $= a L \gamma'$

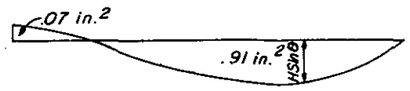
$= 8.3 \times 8.5 \times 6.7 = 4720^{\#}/Ft.$

$F.S. = \frac{4720}{1470} = 3.21 > 2.0$ No boiling



$A_N = (.43 - .31)(100) = 12.0\ ft.^2$

$N_1 = (12.0)(.130) = 1.56^K$

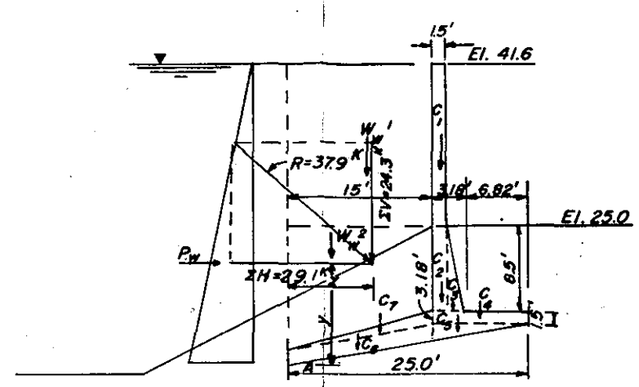


$A_T = (.91 - .07)(100) = 84.0\ ft.^2$

$T_1 = (84.0)(.130) = 10.9^K$

$F.S. = \frac{(N + N_1)\ Tan\ 30°}{T - T_1}$

$F.S. = \frac{(31.1 + 1.56)(.577)}{(21.0 - 10.9)} = \frac{(32.66)(.577)}{10.1} = 1.86$



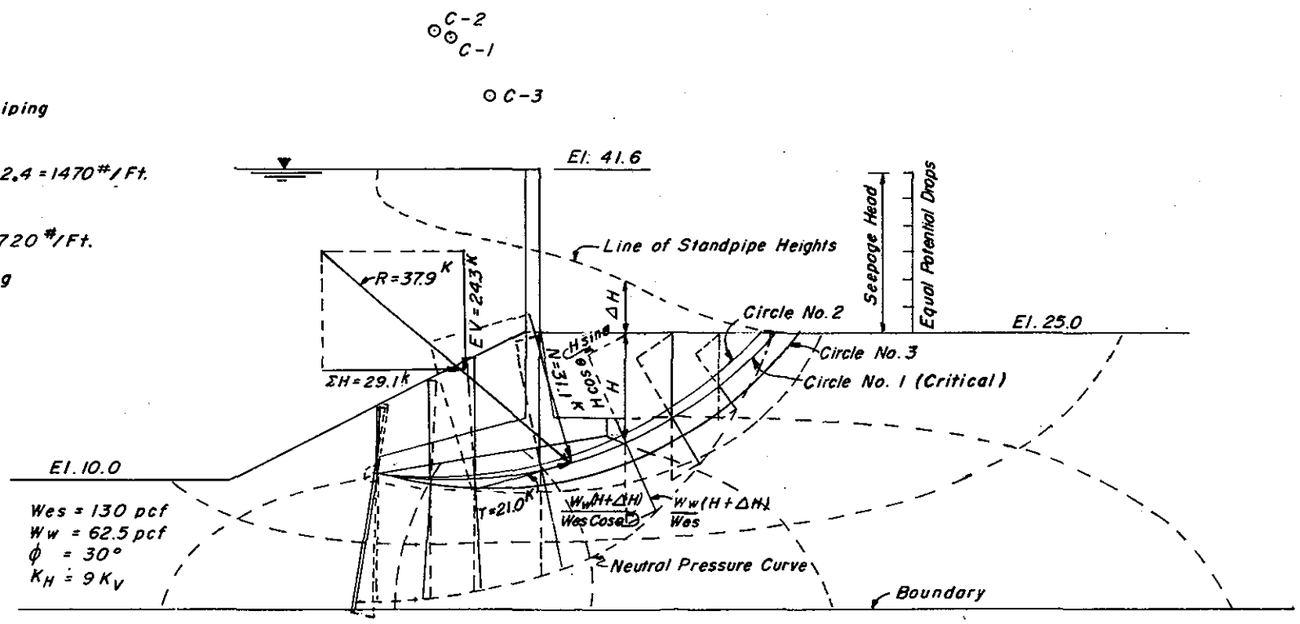
SCALE 1" = 10'

Force	Factors	Force-Kips ↓	Force-Kips →	Arm Ft.	Mom @ A Ft.-Kips
C_1	1.5 x 16.6 x 150	3.73		16.50	61.6
C_2	1.5 x 8.5 x .02	0.26		16.50	4.3
C_3	.5 x 1.68 x 8.5 x .02	0.14		17.06	2.4
C_4	1.5 x 10.0 x .02	0.30		20.00	6.0
C_5	.5 x 1.68 x 10.0 x .02	0.17		18.33	3.1
C_6	1.5 x 15.0 x .02	0.45		7.50	3.4
C_7	.5 x 15 x 1.68 x .02	0.25		10.00	2.5
W_w^1	15 x 16.6 x .0624	15.50		7.50	116.0
W_w^2	.5 x 15 x 7.5 x .0624	3.51		5.00	17.6
P_w	.5 x .0624 x 30.5 x 30.5		29.1	10.17	295.0
		$\Sigma V = 24.31$	$\Sigma H = 29.1$		$\Sigma M_V = 216.9$
					$\Sigma M_H = 295.0$

Location of Resultant

$x = \frac{\Sigma M_V}{\Sigma V} = \frac{216.9}{24.31} = 8.91'$

$y = \frac{\Sigma M_H}{\Sigma H} = \frac{295.0}{29.1} = 10.17'$



SCALE
1" = 10'

SUMMARY STABILITY ANALYSIS	
Circle No.	Factor of Safety
1	1.86
2	2.01
3	2.15

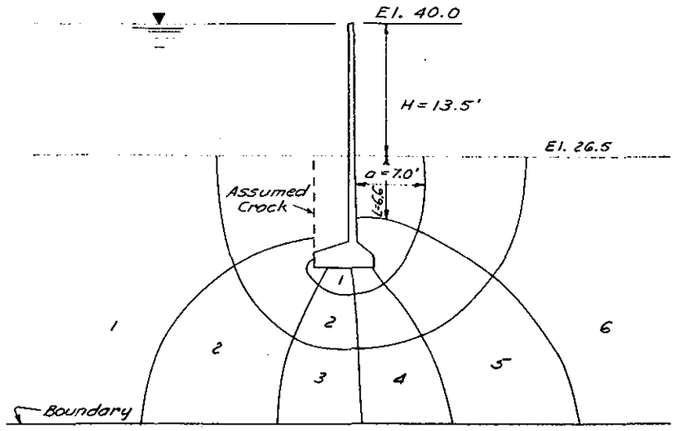
GRAPHIC SCALES

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

FOUNDATION STABILITY ANALYSIS
T-TYPE FLOOD WALL
LEFT BANK
STATION 37+25

NAUGATUCK RIVER CONNECTICUT



TRANSFORMED FLOW NET

Scale Hor. 1" = 30'
Vert. 1" = 10'

$N_f = 3 \qquad N_e = 6$

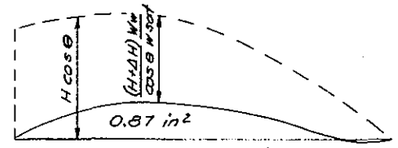
$\Delta H = \frac{13.5}{6} = 2.25'$

$i = \frac{\Delta H}{L} = \frac{2.25}{6.6} = .341 < 1.0$ No Piping

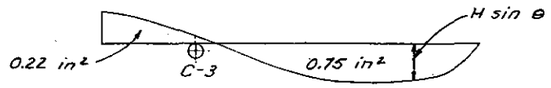
Seepage Force $= i a L \gamma_w$
$= .341 \times 6.6 \times 7.0 \times 62.4 = 980\#/ft.$

Resisting Force $= a L \gamma'$
$= 7.0 \times 6.6 \times 67.6 = 3120\#/ft.$

$F.S. = \frac{3120}{980} = 3.18 < 2.0$ No. Boiling



$A_N = (.87)(100) = 87.0\ ft^2$
$N_1 = 87.0 \times .130 = 11.3^k$



$A_T = (.75 - .22)(100) = 53.0\ ft^2$
$T_1 = 53.0 \times .130 = 6.88^k$

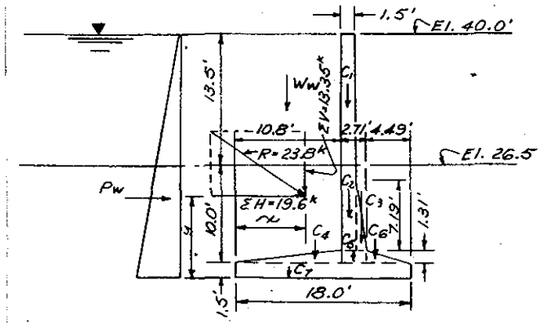
Factor of Safety

$F.S.\ (Crit) = \frac{(N+N_1)\ Tan\ 30^\circ}{(T - T_1)}$

$F.S.\ (Crit) = \frac{(18.0 + 11.3)\ .577}{(15.8 - 6.88)}$

$F.S.\ (Crit) = \frac{(29.3)(.577)}{8.92}$

$F.S.\ (Crit) = 1.88$



Scale
1" = 10'

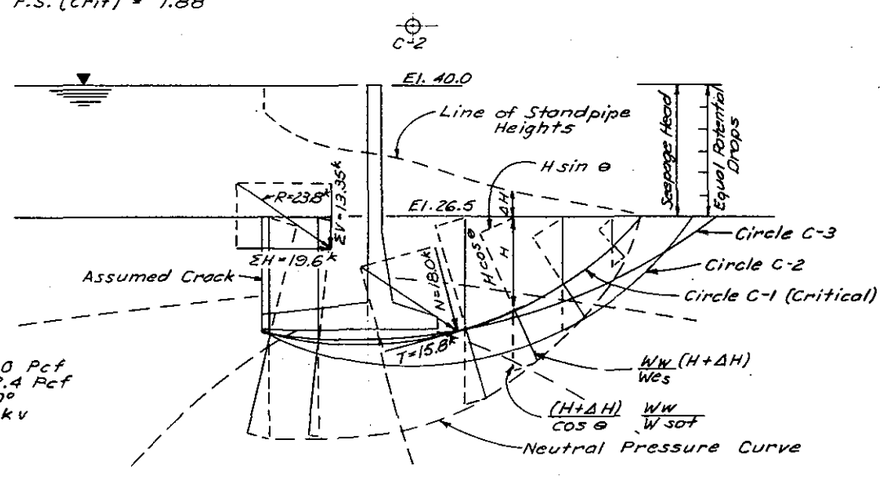
Force	Factors	Force-Kips ↓	Force-Kips →	Arm Ft.	Mom @ A Ft.-Kips
C_1	1.5 x 13.5 x .150	3.04		11.55	35.00
C_2	1.5 x 10.19 x .020	.31		11.55	3.59
C_3	0.5 x 1.21 x 7.19 x .020	.09		12.70	1.14
C_4	0.5 x 1.31 x 10.8 x .020	.14		7.20	1.01
C_5	1.31 x 2.71 x .020	.07		12.15	.85
C_6	0.5 x 1.31 x 4.49 x .020	.06		15.01	.90
C_7	1.5 x 18.0 x .020	.54		9.00	4.86
Ww	10.8 x 13.5 x .0625	9.10		5.40	49.14
Pw	0.5 x .0625 x 25 x 25		19.60	8.33	164.00
		$\Sigma V = 13.35^k$			$\Sigma M_H = 164.00'^k$
			$\Sigma H = 19.60^k$		$\Sigma M_V = 96.49'^k$

Location of Resultant

$x = \frac{\Sigma M_V}{\Sigma V} = \frac{96.49}{13.35} = 7.23'$

$y = \frac{\Sigma M_H}{\Sigma H} = \frac{164.0}{19.6} = 8.33'$

SUMMARY STABILITY ANALYSIS	
Circle No.	Factor of Safety
1	1.88
2	2.10
3	1.89



Wes = 130 Pcf
Ww = 62.4 Pcf
φ = 30°
K_H = .9kv

Scale
1" = 10'

GRAPHIC SCALES

1" = 30' : 30' 0 30' 60'

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

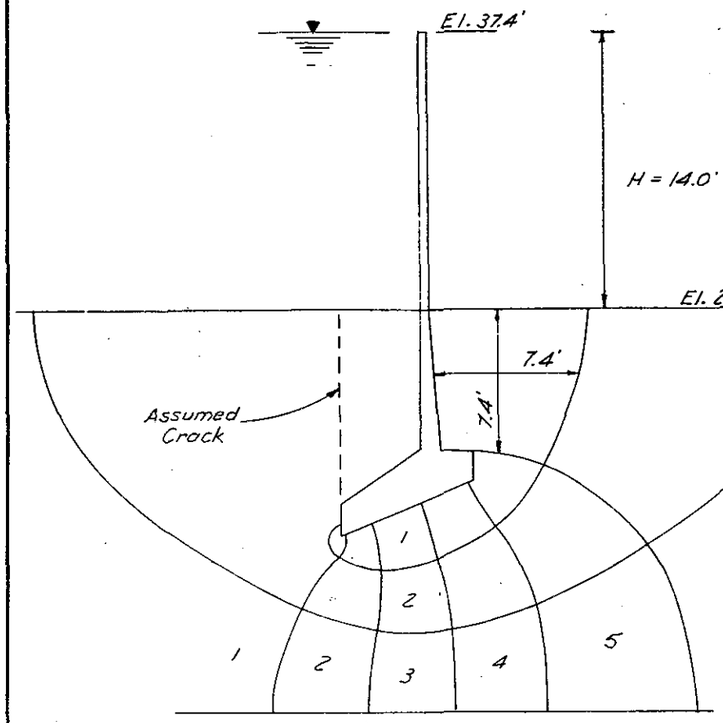
HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

FOUNDATION STABILITY ANALYSIS
T-TYPE FLOOD WALL
LEFT BANK
STATION 45+15

NAUGATUCK RIVER CONNECTICUT

PLATE NO 7-25



TRANSFORMED FLOW NET

SCALE Hor 1" = 15'
Vert 1" = 5'

$N_e = 6$
$N_f = 3$

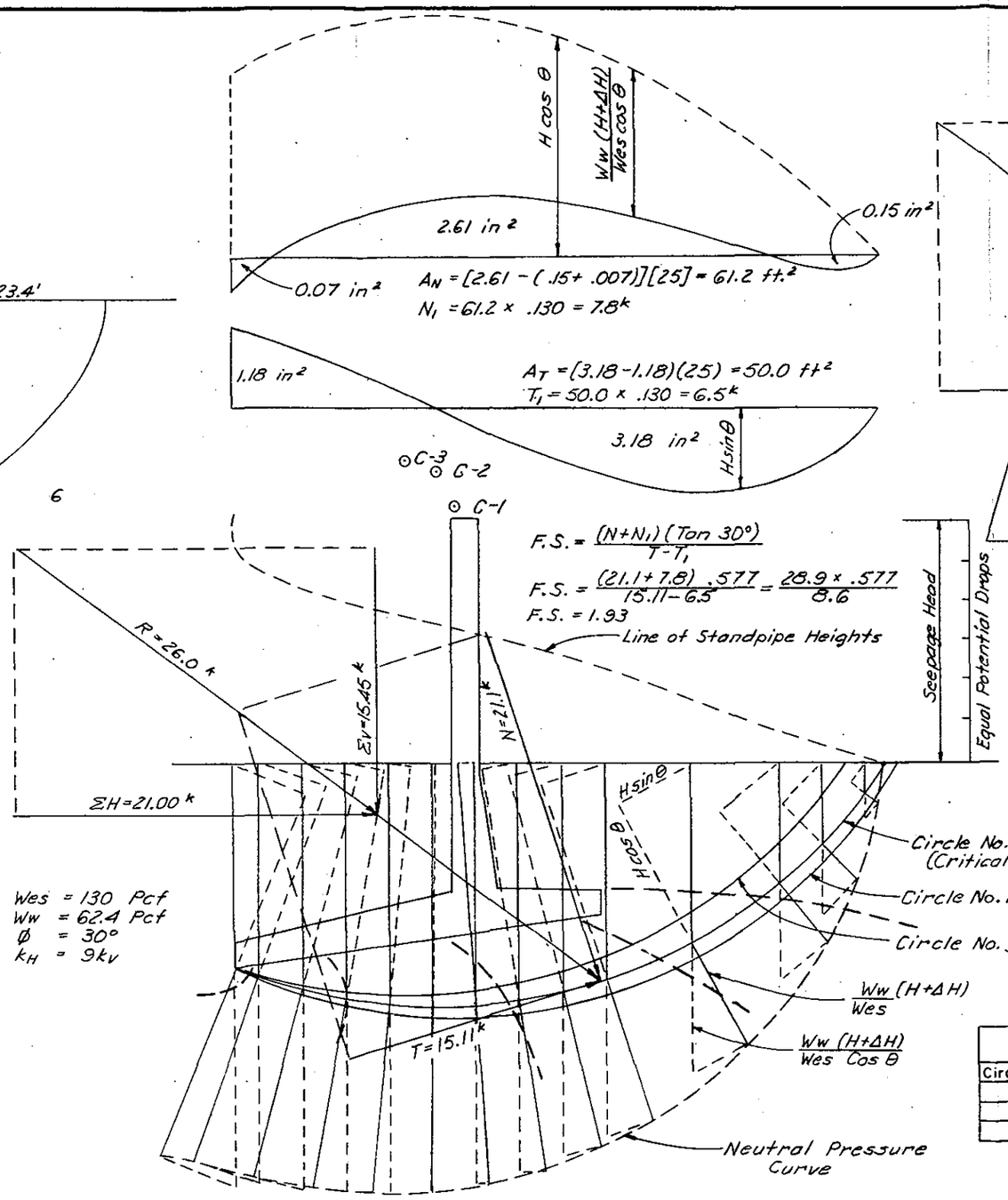
$\Delta H = \frac{14}{6} = 2.33'$

$i = \frac{\Delta H}{L} = \frac{2.33'}{7.4} = .313 < 1.0$ No. Piping

Seepage Force $= i A \gamma_w = i a L \gamma_w$
$= .313 \times 7.4 \times 7.4 \times 62.4 = 1070\#/Ft.$

Resisting Force $= a \times L \times \gamma_b$
$= 7.4 \times 7.4\,(130 - 62.5) = 3700\#/Ft.$

$F.S. = \frac{3700}{1070} = 3.47 > 2.0$ No Boiling



$A_N = [2.61 - (.15 + .007)][25] = 61.2\ ft.^2$
$N_1 = 61.2 \times .130 = 7.8^k$

$A_T = (3.18 - 1.18)(25) = 50.0\ ft^2$
$T_1 = 50.0 \times .130 = 6.5^k$

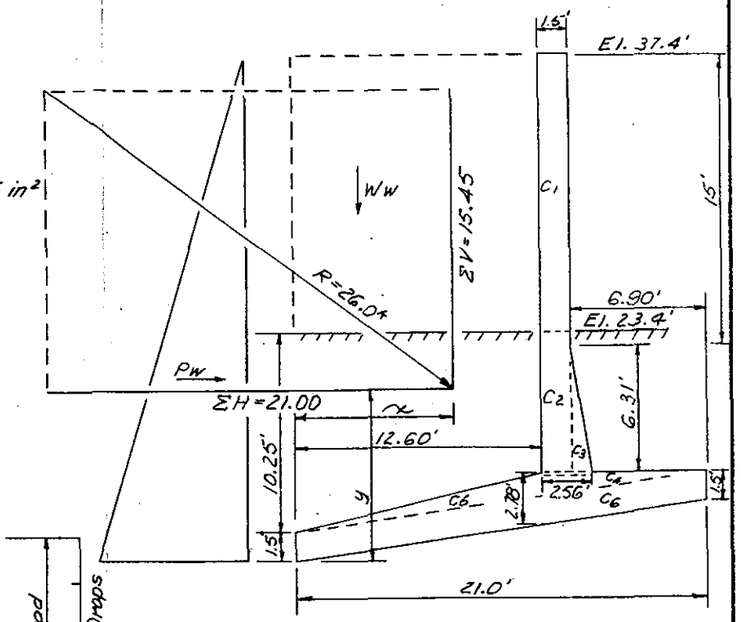
$F.S. = \frac{(N+N_1)(Tan\ 30°)}{T - T_1}$

$F.S. = \frac{(21.1 + 7.8)\ .577}{15.11 - 6.5} = \frac{28.9 \times .577}{8.6}$

$F.S. = 1.93$

Wes = 130 Pcf
Ww = 62.4 Pcf
ϕ = 30°
k_H = 9kv

SCALE
1" = 5'



SCALE
1" = 5'

Force	Factors	Force-Kips ↓	Force-Kips →	Arm Ft.	Mom @ A Ft.-Kips
C_1	1.4 × 1.5 × .150	3.15		13.35	42.0
C_2	7.5 × 1.5 × .020	.22		13.35	3.0
C_3	.5 × 7.5 × 1.06 × .020	.08		14.44	1.1
C_4	.5 × 8.40 × 1.28 × .020	.11		15.40	1.7
C_5	.5 × 12.60 × 1.28 × .020	.16		8.40	1.6
C_6	1.5 × 21 × .020	.63		10.50	6.6
W_w	12.60 × 14 × .0625	11.10		6.30	70.0
P_w	.5 × 26² × .0625		21.00	8.67	182.0
		$\Sigma V = 15.45^k$			$\Sigma M_V = 126.0^{f\text{-}k}$
			$\Sigma H = 21.00^k$		$\Sigma M_H = 182.0^{f\text{-}k}$

Location of Resultant

$x = \frac{\Sigma M_V}{\Sigma V} = \frac{126.0}{15.45} = 8.2'$

$y = \frac{\Sigma M_H}{\Sigma H} = \frac{182.0}{21.00} = 8.7'$

SUMMARY STABILITY ANALYSIS	
Circle No.	Factor of Safety
1	1.96
2	1.93
3	2.06

GRAPHIC SCALES

1" = 5' : 5' 0 5' 10'
1" = 15' : 15' 0 15' 30'

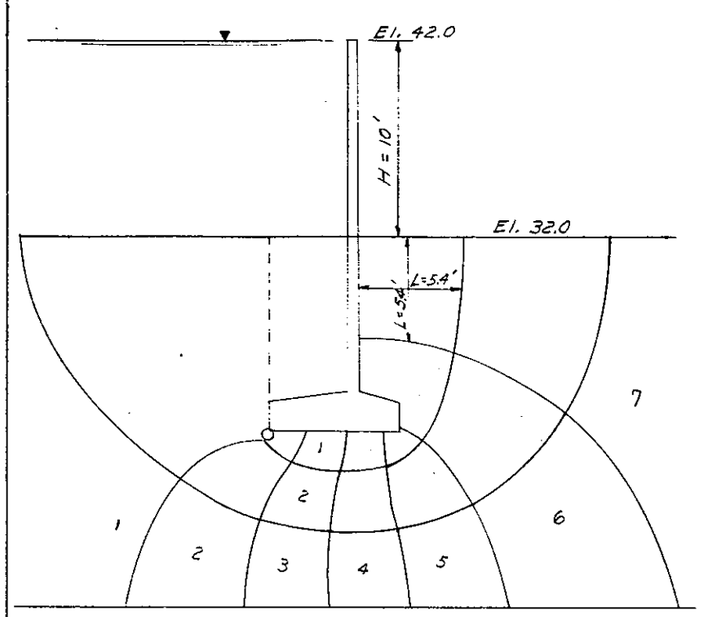
HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

FOUNDATION STABILITY ANALYSIS

T-TYPE FLOOD WALL
LEFT BANK
STATION 55+15

NAUGATUCK RIVER — CONNECTICUT



TRANSFORMED FLOW NET

SCALE Hor 1" = 15'
Vert 1" = 5'

$N_e = 7$

$N_f = 3$

$\Delta H = \frac{10}{7} = 1.43$

$i = \frac{\Delta H}{L} = \frac{1.43}{5.4} = .265 < 1.0$ No Piping

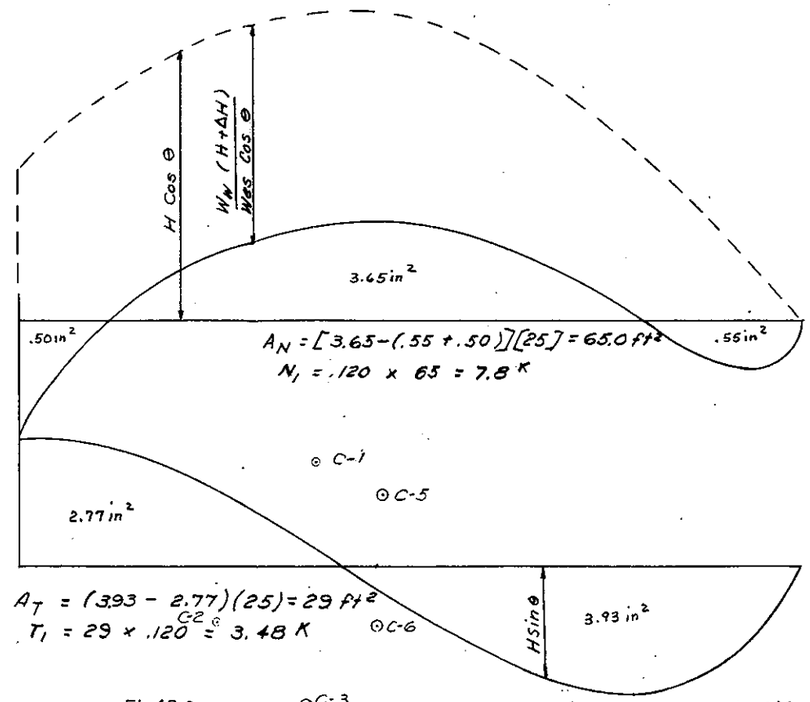
Seepage Force $= i A \gamma_w$

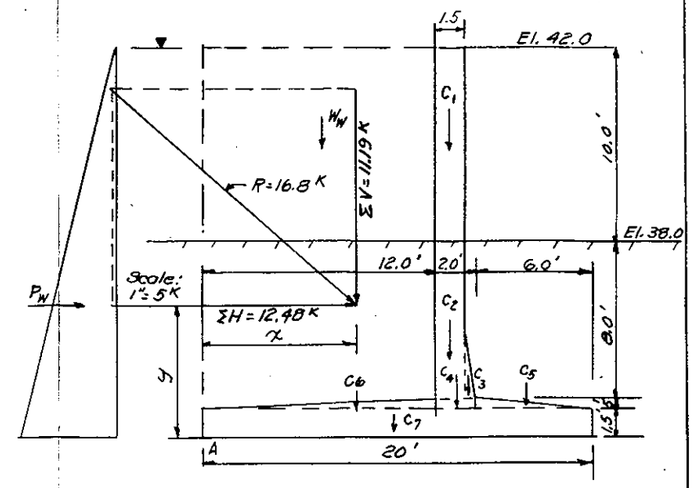
$= .265 \times 5.4 \times 5.4 \times 62.4 = 484$ #/ft.

Resisting Force $= a L \gamma b$

$= 5.4 \times 5.4 \times 58 = 1690$ #/ft.

$F.S. = \frac{1690}{484} = 3.5 > 2.0$ No Boiling





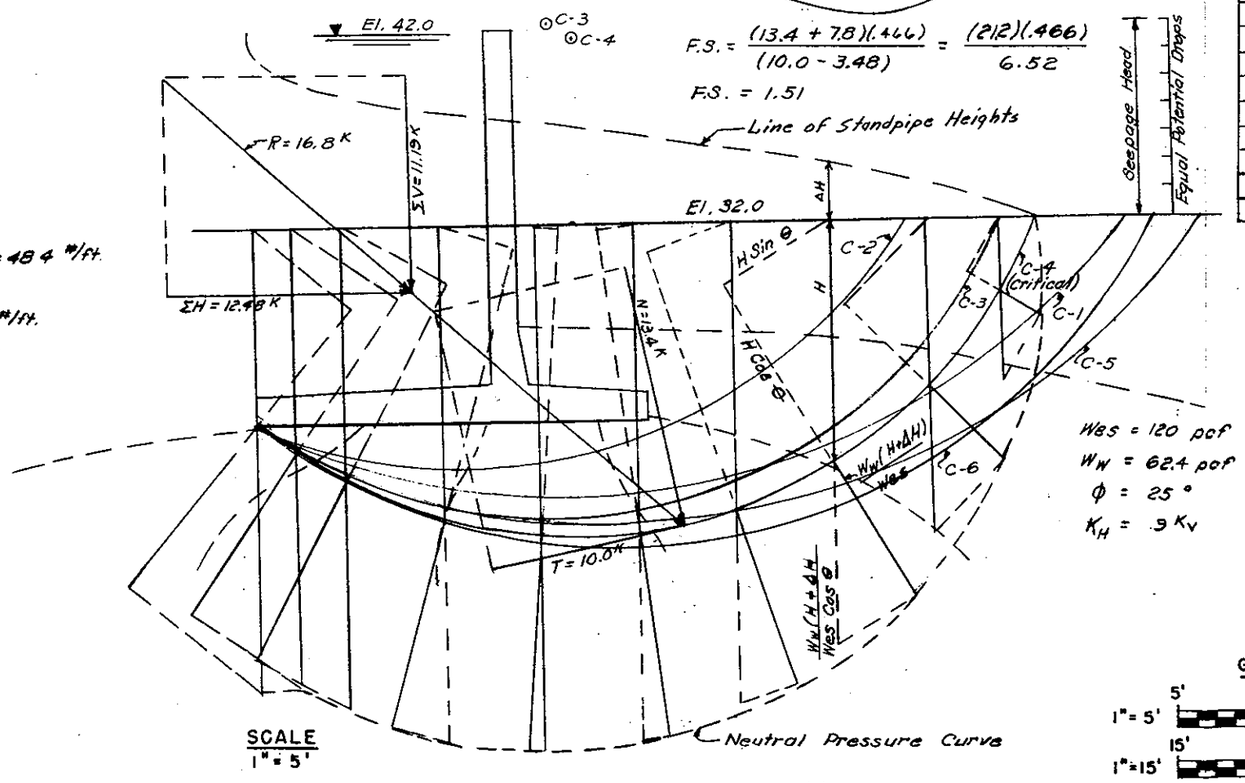
SCALE
1" = 5'

Force	Factors	Force-Kips ↓	Force-Kips →	Arm Ft.	Mom @ A Ft.-Kips
C_1	1.5 x 10.0 x .150	2.25		12.75	28.60
C_2	1.5 x 8.0 x .03	.36		12.75	4.58
C_3	.5 x .5 x 3.0 x .03	.02		13.66	.27
C_4	.5 x 2.0 x .03	.03		13.00	.39
C_5	.5 x .5 x 6.0 x .03	.05		16.00	.80
C_6	.5 x .5 x 12.0 x .03	.09		8.00	.72
C_7	1.5 x 20.0 x .03	.90		10.00	9.00
W_w	10 x 12. x .0624	7.49		6.00	44.94
P_w	.5 x .0624 x 20 x 20		12.48	6.67	83.00
$\Sigma V = 11.19$ K					$\Sigma M_V = 89.3$ ' K
		$\Sigma H = 12.48$ K			$\Sigma M_H = 83.0$ ' K

Location of Resultant

$x = \frac{\Sigma M_V}{\Sigma V} = \frac{89.3}{11.19} = 8.0'$

$y = \frac{\Sigma M_H}{\Sigma H} = \frac{83.0}{12.48} = 6.67'$



$W_{es} = 120$ pcf

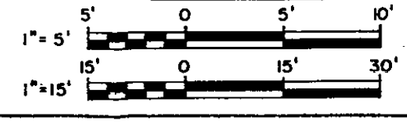
$W_w = 62.4$ pcf

$\phi = 25°$

$K_H = .9 K_V$

SCALE
1" = 5'

GRAPHIC SCALES



SUMMARY STABILITY ANALYSIS	
Circle No.	Factor of Safety
1	1.69
2	1.82
3	1.66
4	1.51
5	1.56
6	1.63

HOUSATONIC RIVER FLOOD CONTROL

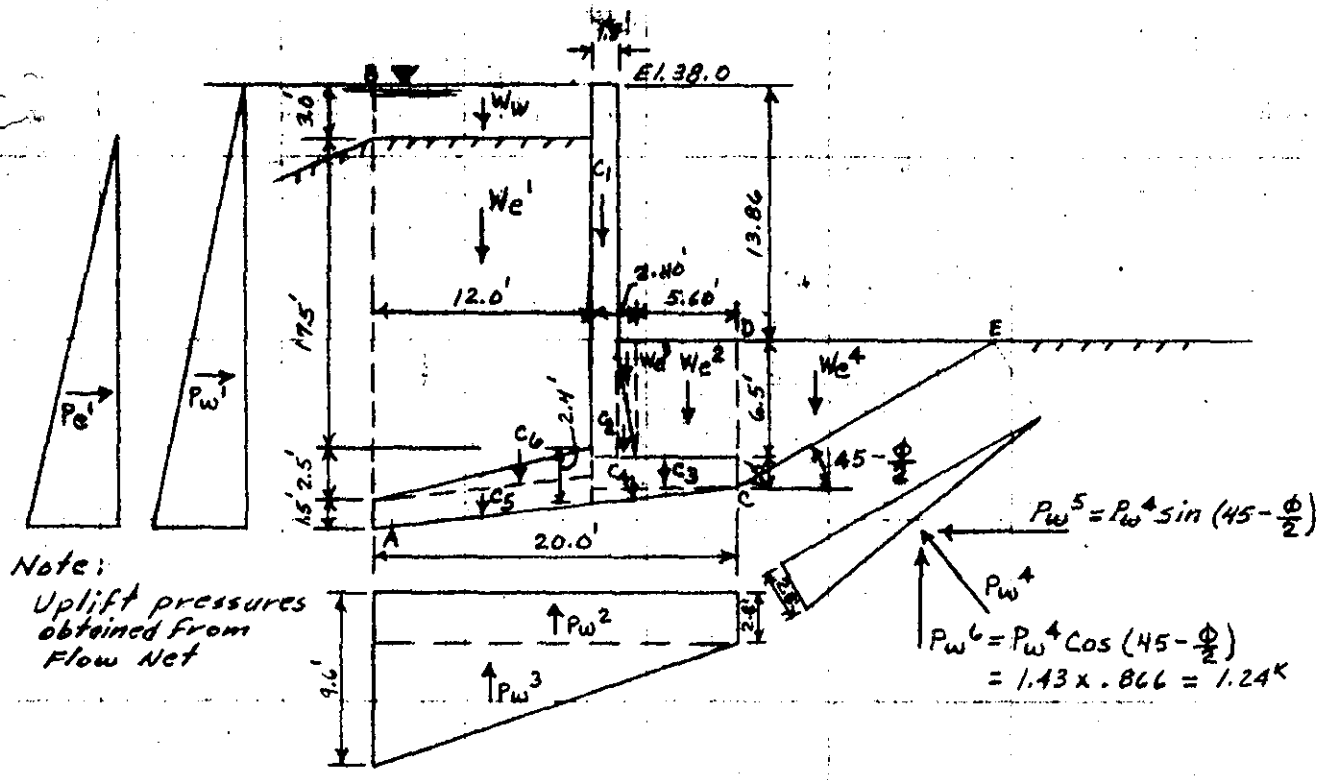
ANSONIA - DERBY

FOUNDATION STABILITY ANALYSIS

T-TYPE FLOOD WALL

MAPLE STREET

NAUGATUCK RIVER CONNECTICUT



Note:
Uplift pressures obtained from Flow Net

Force	Factors	Force - Kips ↓	↑	→	←	↖
C_1	1.5 x 20.36 x .150	4.58				
C_2	0.5 x .90 x 5.36 x .150	.36				
C_3	1.5 x 8.0 x .150	1.80				
C_4	0.5 x .90 x 8.0 x .150	.54				
C_5	1.5 x 12.0 x .150	2.70				
C_6	0.5 x .90 x 12.0 x .150	.81				
We^1	12.0 x 18.75 x .130	29.20				
We^2	5.60 x 6.5 x .130	4.72				
We^3	0.5 x .90 x 6.5 x .130	.38				
Ww	3.0 x 12.0 x .0624	2.25				
		47.34				
Pw^2	2.8 x 20.0 x .0624		3.50			
Pw^3	0.5 x 6.8 x 20.0 x .0624		4.25			
			7.75			
Pw^1	0.5 x .0624 x 24.5 x 24.5			18.80		
Pe^1	0.5 x .0676 x 21.5 x 21.5 x .31			4.76		
We^4	0.5 x 8.0 x 14.0 x .130	7.29				
Pw^4	0.5 x 2.8 x 16.4 x .0624					1.43
Pw^5	1.43 x .50				.72	

Sliding Block BACD: $\Sigma V = 47.34 - 7.75 = 39.59$

$F = 39.58 \times .577 = 22.8$

Eff. Wt. of Soil $= \dfrac{We^4 - Pw^6}{\text{Area CDE}} = \dfrac{7.29 - 1.24}{.5 \times 8 \times 14} = .108$

Pass. Press. $= Pp = .5 \times .108 \times 8^2 \times 3.0 = 10.4^K$

$F.S. = \dfrac{Pp + F}{Pw^1 + Pe^1 - Pw^5} = \dfrac{10.4 + 22.8}{18.8 + 4.76 - .72} =$

$F.S. = \dfrac{33.20}{22.84} = 1.5$

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

FOUNDATION STABILITY ANALYSIS

T-TYPE FLOOD WALL

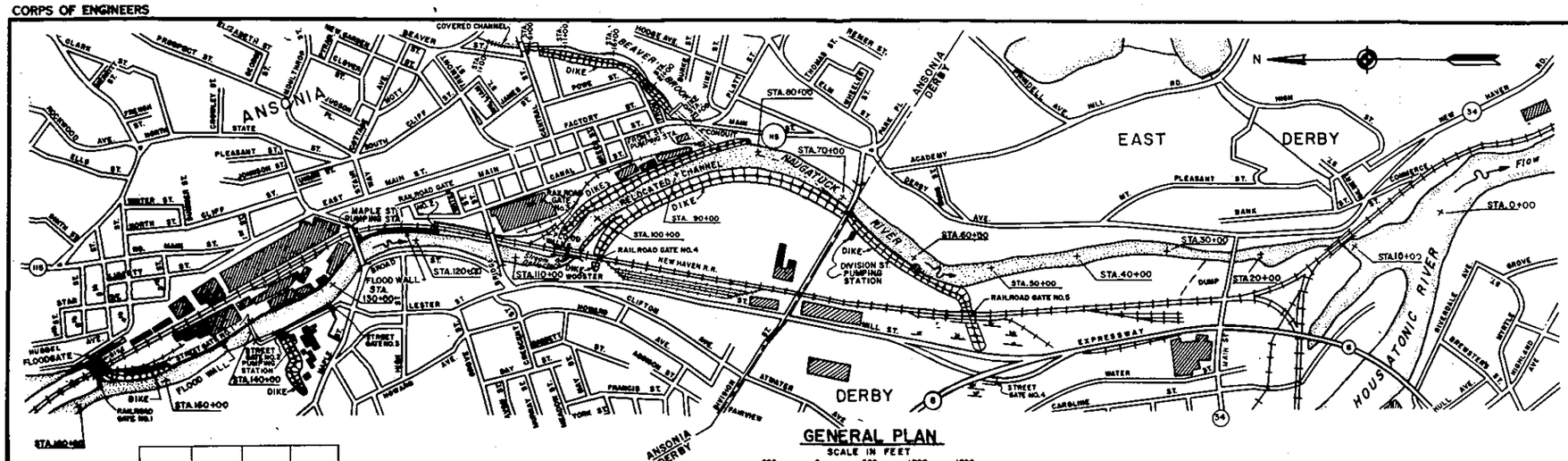
BEAVER BROOK

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 7-28

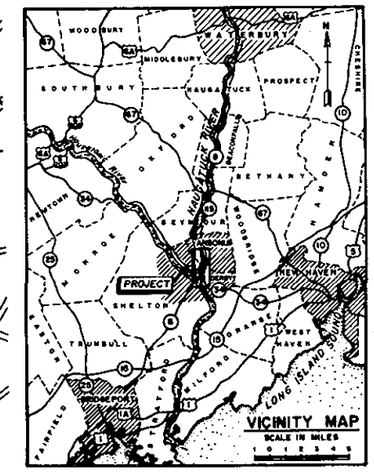
CORPS OF ENGINEERS

U. S. ARMY



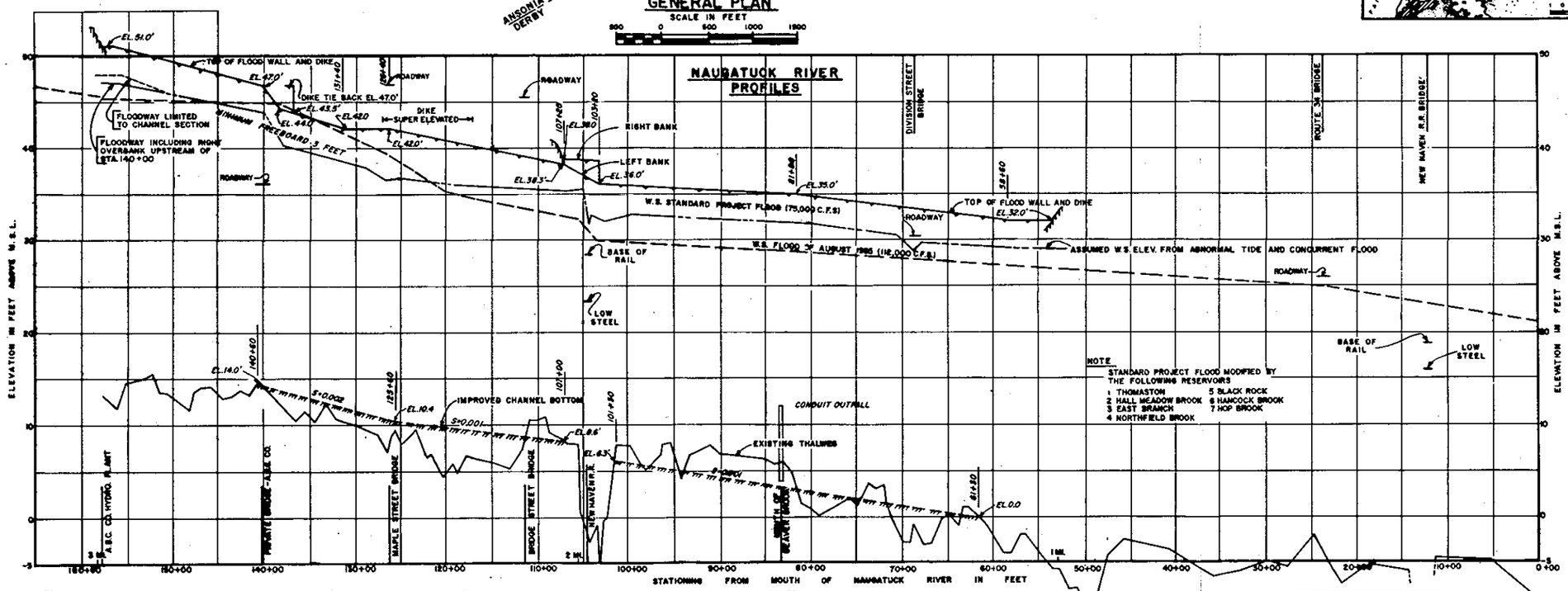
GENERAL PLAN

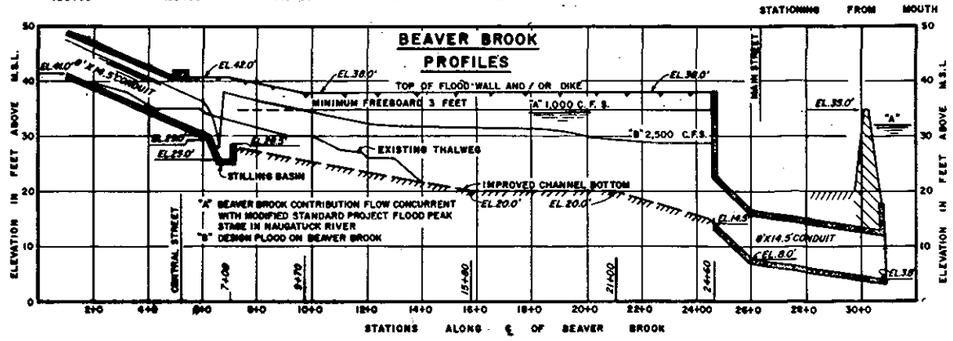
SCALE IN FEET



VICINITY MAP

SCALE IN MILES





LEGEND

- TOP OF DIKE AND / OR FLOOD WALL
- MODIFIED STANDARD PROJECT FLOOD PROFILE
- FLOOD OF AUGUST 1955 PROFILE
- IMPROVED CHANNEL BOTTOM
- EXISTING THALWEG

REVISION	DATE	DESCRIPTION	BY

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

DR. BY | TR. BY | CK. BY

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY CONNECTICUT

LOCAL PROTECTION
PLAN & PROFILES

NAUGATUCK RIVER, CONN.

APPROVED: DATE:
CHIEF ENGINEERING DIVISION

SCALE: AS SHOWN

DRAWING NUMBER
HC-1-1381

PLATE NO. 7-29