CONNECTICUT RIVER FLOOD CONTROL PROJECT

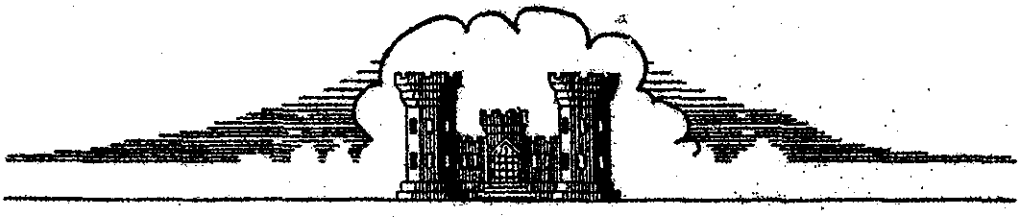
# EAST HARTFORD, CONN.

CONNECTICUT RIVER CONNECTICUT

## ANALYSIS OF DESIGN FOR LOCAL PROTECTION WORKS

ITEMS EH. 3 TO 5 INCL.

NORTH OF R.R. AND FROM STA. 170 ALONG HOCKANUM RIVER



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CORPS OF ENGINEERS, U. S. ARMY

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

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CONNECTICUT RIVER FLOOD CONTROL

ANALYSIS OF DESIGN

EAST HARTFORD DIKE

NORTH OF RAILROAD AND FROM STATION 170
ALONG HOCKANUM RIVER

CONNECTICUT RIVER

CONNECTICUT

CORPS OF ENGINEERS, UNITED STATES ARMY

UNITED STATES ENGINEER OFFICE PROVIDENCE, RHODE ISLAND

EAST HARTFORD DIKE

ANALYSIS OF DESIGN

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# EAST HARTFORD DIKE

## PERTINENT DATA

**Location** Connecticut River, East Hartford, Connecticut

| | |
|---|---|
| Area protected. . . . . | 750 acres |
| Limits of this contract . . . . . | (Sta. 31+50 to 99+40 and<br>(Sta. 170+00 to 241+ 15 |
| Limits of previous dike construction | (Sta. 99+40 to 170+00 |

**Elevations** (above mean sea level)

| | |
|---|---|
| Top of dike (near Green Terrace and Main Street . . | 43.0 |
| Top of dike (at Sta. 47+73) . . . . . | 43.0 |
| Top of railroad stop-log structure (at Sta. 98+00). | 42.5 |
| Top of railroad stop-log structure (at Sta. 98+30). | 40.7 |
| (Dike constructed under previous contract between Sta. 99+40 and 170+00) | |
| Top of dike (at Sta. 170+00) . . . . . | 39.1 |
| Top of dike (high ground near Brewers Lane and Central Avenue) . . . . . | 39.1 |

**Embankment**

| | |
|---|---|
| Maximum height of dike . . . . . | 37 feet |
| Total length of dike . . . . . | 13,900 feet |
| Total impervious fill . . . . . | 177,000 cu. yds. |
| Total pervious and random fill . . . . . | 838,000 cu. yds. |
| Total sheet piling . . . . . | 52,800 sq. ft. |
| Total riprap (hand placed). . . . . | 17,300 cu. yds. |
| Total gravel bedding. . . . . | 17,100 cu. yds. |
| Total topsoil . . . . . | 34,500 cu. yds. |

Concrete Stop-Log Structures

Maximum height (above stop-log sill) . . . . . 9 feet

Concrete Quantities

Total . . . . . 1,300 cu.yds.

# I. INTRODUCTION

# I. INTRODUCTION

A. AUTHORIZATION AND PAST REPORTS. - The flood protection work for the sections known as the North and South Sections is a part of the local protection works for the Town of East Hartford, Connecticut. The original project is included in the Comprehensive Plan of Flood Control for the Connecticut River as described in House Document No. 455, 75th Congress, 2nd session, and is authorized under the Flood Control Act, approved June 28, 1938.

B. NECESSITY FOR THE PROTECTION. - An important area of East Hartford, consisting approximately of 750 acres north of the Hockanum River and west of Main Street centering about Connecticut Boulevard, was inundated during numerous floods in the Connecticut River including the great flood of March 1936 and the slightly lesser flood of September 1938. A pronounced bank divides this area, the lower portion being referred to as the meadow and the upper as the terrace. Development on the terrace consists of residences of medium class construction and several small industries and commercial establishments. Development on the meadow, except along the Connecticut Boulevard which crosses the meadow on a fill approximately level with the elevation of the terrace, is principally low cost residences, small boat clubs, and a bulk oil terminal. Commercial establishments of good construction are located on and adjacent to the Connecticut Boulevard. The low meadow land would, without dike protection, be subject to frequent flooding. The flood protection covered in this analysis completes encirclement of the area, dike construction from the railroad to station 170+00 having already been completed.

C. PROVISION FOR PUMPING FACILITIES. - The construction of the protection works for the area just described will prevent the natural surface drainage within the area from reaching the Connecticut and Hockanum Rivers during high river stages. For the purpose of discharging the accumulated surface drainage including that from local storm runoff from within the protected area and seepage through the dikes or their foundations, and sanitary sewage, three pumping stations are necessary. The construction of the pumping stations are accomplished under separate contracts. Discussion of the pumping stations in this Analysis of Design is confined to the selection of sites and capacities.

D. CONSULTATIONS WITH TOWN, RAILROAD, AND OTHER OFFICIALS. - Before and during the actual design of the protective works, consultations were held with representative officials of the Town of East Hartford, and the New York, New Haven and Hartford Railroad. The alignment of the protective works, the drainage features, the disposition of underground structures and river regulation works at and above the railroad bridge were the main subjects of discussion. Policies governing clearances and other requirements of railroad stop-log structures as developed through conferences on past work were adhered to. The final design for these protective works have been prepared with a view toward a minimum disturbance to existing developments and to cause minimum interference with any future developments of the area.

E. DESCRIPTION OF PROTECTION WORKS. -

1. General. - Plate No. 1 shows the general location of this project. Two sections, known as the "Initial Fiscal Year 1939 Unit" and "Fiscal Year 1939 Section," now completed, were recommended in a subproject

dated November 16, 1938, revised December 14, 1938, and approved December 23, 1938 by the Chief of Engineers. These sections were covered in Analysis of Design designated as E.H.2 and consists of dike protection work from the railroad to a point 7060 feet southward. The remaining embankment necessary to complete the dike protection, known as the North and South Sections, is covered in this Analysis of Design.

2. North Section. - The North Section, an earth embankment, starts at high ground near Main Street north of Green Terrace and projects across the terrace and meadow in a westerly direction, and then bends southerly and westerly, following the east bank of the Connecticut River to join the "Fiscal Year 1939 Section" at the railroad embankment. The total length of this section is about 6,785 feet. The top width is 10 feet and the maximum height is 30 feet. Ample foreshore is provided at the river bank. Concrete abutments and sill, supporting a timber stop-log barrier, provide passage of the Willimantic Branch of the New York, New Haven and Hartford Railroad through the dike. A ramp located at Station 70+00 provides access to the foreshore.

3. South Section. - The South Section begins at Station 170+00, the point where the dike bends easterly away from the Connecticut River to cross the swale and follow the bank of the terrace along the Hockanum River, terminating at high ground near the intersection of Central Avenue and Brewer Lane. The protection works is an earth embankment about 7,090 feet long, has a top width of 10 feet and a maximum height of 37 feet. A concrete stop-log structure permits the passage of Main Street travelway including a railroad track extension through the dike. An extended wing-

wall on the west side of the stop-log structure permits the continued use of present development along Main Street. Three ramps are provided to maintain access to lands cut off by the dike construction. For location, and general plans see Plates Nos. 1, 31 to 45 inclusive.

# II. SELECTION OF ALIGNMENT AND TYPE OF PROTECTION

## II. SELECTION OF ALIGNMENT AND TYPE OF PROTECTION

A. SELECTED ALIGNMENT. - The alignment adopted for the North Section is the modified alignment approved by the Chief of Engineers January 11, 1939 and included in the report published as Senate Document No. 32, 76th Congress, 1st session. Ample foreshore is allowed for the improvement of hydraulic characteristics of the river channel and for the prevention of undermining the dike foundation. The alignment of the South Section is essentially the same as set forth in the approved project. Details of construction and design caused only minor changes in the alignment.

B. OTHER ALIGNMENTS CONSIDERED. - The former approved alignment of the North Section followed the railroad to high ground. Reexamination of the flood situation of East Hartford after the 1938 flood indicates that damages to be anticipated exceed the original estimates and protection of the area north of the railroad is warranted. Further modification was made in that greater foreshore requirements were necessary to insure the safety of the embankment and allow for a larger river channel area.

Alternate alignments were considered at Main Street, one crossing on high ground at the intersection of Pitkin and Main Streets, and another eliminating the U-bend in the dike west of Main Street. The former alternative, although slightly less in cost, excluded valuable property and involved an additional stop-log structure. The latter alternative compared unfavorably in cost with the selected alignment and had the disadvantage of poorer foundation and necessitated the filling in of a large pocket behind the dike for drainage.

C. SELECTION OF TYPES OF PROTECTION. - Pervious materials for construction of an earth dike are readily available in abundance at the site and impervious materials are within a reasonable hauling distance. Furthermore, foundation conditions, required height of protection, and available space for permanent construction make an earth structure well suited to the site. The use of a short section of concrete wall west of Main Street is necessary because of clearance requirements around existing structures.

# III. GEOLOGICAL INVESTIGATIONS

## III. GEOLOGICAL INVESTIGATIONS

A. NATURE OF VALLEY. - The flood plain of the Connecticut River, within the area to be enclosed by proposed and completed levees, varies in width from about 0.3 mile to 0.8 mile. The valley bottom stands throughout much of its extent at an elevation between 15 and 18 feet above mean sea level. In its easterly portion, bordering a terrace, there is an elongated depression or swale, at about Elevation 12. In time of flood this swale serves as a natural floodway carrying flood waters into the tributary Hockanum River at a point near its confluence with the Connecticut River. A large part of the flood plain area lying between the swale and the river is highly developed. Bedrock is deeply buried throughout the area.

B. METHOD AND EXTENT OF EXPLORATIONS. - Subsurface explorations were made by means of dry sample borings, auger borings, and test pits. In addition several 6-inch diameter borings, for undisturbed sampling, were completed. Borings were made (1) to determine the character and thickness of overburden forming the dike foundations, (2) to investigate sediments in the Connecticut River as a possible source of pervious embankment material, and (3) to investigate materials to be excavated in the storage pond adjacent to the proposed pumping station at the swale near the Hockanum River. Several test pits were excavated to investigate organic deposits occurring in the foundation at the northerly end of the project, and to determine the character of fill materials available for stop-log structure foundations at the railroad and highway crossings. The location and records of these explorations are shown on Plates Nos. 4 to 9, inclusive, entitled "Subsurface Explorations".

C. SITE. - The dike, at its northerly and southerly ends, will tie into a terrace formation, comprised of fine, medium and coarse sand. This terrace is terminated on the west, adjacent to the flood plain of the Connecticut River and on the south, adjacent to the Hockanum River, by a well-defined erosional slope or bank about 15 feet to 20 feet high.

Sediments beneath the flood plain, in their order of occurrence, are made up of (1) alluvial silt and sand immediately below the surface, (2) medium and coarse sand, and (3) glacial varved clay and silt. Compact glacial till occurs beneath the varved clay and on the deeply buried rock. Throughout the swale section, at the northerly end of the project, extensive organic accumulations occur. The top of the varved clay and silt formation, adjacent to the Connecticut River, ranges between Elevations -15 and -25. Beneath the terrace formation, adjacent to the Hockanum River, this same varved clay and silt formation occurs at about Elevation 20. Several deep borings, made to develop the full thickness of these deposits, indicated that the underlying rock surface dips toward the east, and correspondingly that the thickness of the clay and silt formation increases in this direction. One boring located in the Hockanum River valley penetrated this formation for a depth of 200 feet, without locating any essentially different material, whereas farther west, adjacent to the Connecticut River, borings showed considerably less thickness. The distribution of the various overburden materials is shown on Plates Nos. 4 to 9, inclusive.

D. NATURE OF EXCAVATIONS. - Excavations, exclusive of those required for embankment materials, will be made for toe trenches, drains

and storage pond, and stripping of topsoil throughout the foundation area. Excavations to a depth greater than usual will be required in the foundation at the northerly end of the project, in order to remove unstable deposits containing large amounts of organic material. Excavation of the storage pond, involving approximately 127,000 cubic yards will be carried to a depth of 6 to 12 feet in a very moist deposit of silt and fine sand.

E. SUBSURFACE LEAKAGE. - Seepage through the dike foundation will be controlled by providing drainage, and held to a minimum by utilizing to best advantage the natural conditions supplemented by impervious constructions. Where the alluvial deposits are sufficiently thick and uniformly distributed to form a natural impervious blanket, no special treatment is proposed except to provide drainage and adequate joining of impervious dike blanket with the natural impervious soil. Where these alluvial deposits have been partially eroded, causing the natural foreshore blanket to be of inadequate quality, an impervious blanket will be constructed, as for example in the stretch of dike between Station 174+50 and 184+50. Throughout the easterly end, adjacent to the Hockanum River, the impervious dike cut-off will contact an impervious varved clay and silt formation. At concrete stop-log structures, steel sheet piling will be used.

# IV. FLOOD HYDRAULICS

## IV. FLOOD HYDRAULICS

A. DESIGN FLOOD. - The design flood on which the dike grade is based is the maximum predicted flood reduced by the 20 reservoirs included in the Comprehensive Plan. The determination of the maximum predicted flood is discussed in Appendix 1 of "The Report of Survey and Comprehensive Plan for the Connecticut River," dated March 20, 1937. It has a peak discharge at Hartford of 318,000 c.f.s., approximately 10 percent greater than the maximum flood of record. See Section VII, Paragraph A.

B. FREEBOARD. - The survey report proposed a uniform freeboard of 3 feet for both concrete walls and earth embankment. This was based on considerations of wave fetch and velocity. The Board of Engineers for Rivers and Harbors recommended that, since the entire reservoir plan might not be effective for some time, the earth section be raised 2 feet. The freeboard as designed is therefore 5 feet for the earth dike and 3 feet for the concrete walls.

C. LOCAL CONDITIONS. - During major floods a portion of the discharge leaves the main river channel, flows down the East Hartford swale, and rejoins the river below East Hartford, thus dividing the Town of East Hartford into two parts. It is estimated that in a major flood such as that of 1936 as much as 25 percent of the total flow at the time of peak discharge is by-passed through the swale. Upon completion of the entire proposed East Hartford dike, the flow down the swale will be cut off, and all the flow will be confined in the main river channel, between the Hartford dikes on the right side of the

river, and the East Hartford dikes on the left. Flood stages between the two cities and at points upstream will be somewhat higher because of this confinement until the reservoirs are constructed. These increases in flood heights were considered in fixing the dike grades.

The Hartford dikes on the right side of the river are being constructed with a top elevation approximately 6 feet above the official grades established by the Board of Engineers for Rivers and Harbors. The additional costs of raising the elevation of the local protection works is being contributed by the City of Hartford.

# V. LABORATORY AND FIELD INVESTIGATION OF SOILS

## V. LABORATORY AND FIELD INVESTIGATION OF SOILS

A. CLASSIFICATION OF MATERIALS. - The Providence District has adopted a convenient system of soil classification having rigidly standardized terms. In this classification soils are divided into 16 classes as shown graphically on Plate No. 12 and described in Table No. 1. Soils of uniform grain size are designated by even numbers, soils of variable grain size by odd numbers, and grain size limits of materials follow the M. I. T. Classification except that size demarcation between silt and coarse clay is not 0.002 mm. but varies from 0.006 mm. to 0.0006 mm.

B. GRAIN-SIZE ANALYSIS. - Grain-size curves of samples were obtained by sieve and hydrometer tests run on representative samples for each stratum encountered, generally in each exploration. These materials were classified and grouped into sedimentary units as shown on Plates Nos. 4 to 9, inclusive, entitled, "Subsurface Explorations." Plates Nos. 13, 14, and 15 show typical grain-size curves for the various materials selected for embankment use.

C. WATER CONTENT AND VOID RATIO. - Water contents and void ratios were determined by means of paraffined soil cores. In addition, water contents were determined by sealed jar samples representing foundation strata and borrow areas.

D. PERMEABILITY. - Coefficients of permeability for foundation and embankment materials were determined by falling head tests using deaerated water. This water was obtained by spraying tap water into a vacuum chamber, after the system developed by Bertram.

TABLE NO. 1

PROVIDENCE SOIL CLASSIFICATION
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

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

E. CONSOLIDATION. - Consolidation tests were run on undisturbed samples 4-1/4" in diameters obtained in ten 6" bore holes scattered throughout the Hartford area. These ten bore holes sampled the same general stratum of gray varved clay overlying red varved clay and all results were considered in the analysis. A special series of consolidation tests were run with 3" diameter rings and loaded to 20 tons per square foot to determine the preconsolidation load for use in settlement analysis. Consolidation characteristics for a typical sample are shown on Plates Nos. 16 and 17.

F. SHEAR. - Shearing resistance of embankment materials was determined by direct shear tests. After the sample had completely consolidated under the normal load, horizontal strains were applied at a constant rate of 0.06" per minute. Typical results for the impervious and pervious materials are shown in Plates Nos. 18 and 19.

Shearing resistance of the soft clay in the foundation was determined by means of unconfined compression quick tests on undisturbed samples coated with vaseline to avoid capillary pressures. Results of a typical test are shown in Plate No. 20. The clay was also tested by direct shear and Plate No. 21 shows a shear test envelope obtained by plotting all results of direct shear tests on the Hartford varved clay.

G. COMPACTION. - Compaction tests based on the Proctor analysis procedure and on Terzaghi's relative density method were performed on impervious and pervious embankment materials respectively. Plate No. 22 is a typical compaction curve for the impervious material. In addition to preliminary tests on borrow materials, much data were available from control tests giving compacted weights actually attained with these same

materials in pervious embankment work. These data were considered in compiling the compaction characteristics as summarized in Table No. 4 entitled, "Summary of Materials Available."

H. FILTER TESTS. - Model filter tests were run in Lucite tubes to determine specification limits for a two layer protective filter beneath the toe drains. Table No. 2, entitled, "Results of Filter Tests," summarizes these investigations. Plate No. 23 shows grain-size curves of the samples used in the tests. Plate No. 24 shows recommended specifications for the filter as derived from these tests.

I. OTHER TESTS. - Other tests included specific gravity, organic content as measured by loss on ignition, atterberg limits, and a special series of consolidation tests run on peat from the swamp area at the north section of dike.

J. SETTLEMENT. - Settlement of the dike will occur due to consolidation of the soft clay in the foundation. Consolidation tests used to determine the preconsolidation load indicate that in the past this clay has carried a greater load than that of the present overburden. The magnitude of this past load is represented by a former land surface at about Elevation 36, which is approximately the elevation of the present bluff. It is fortunate that the clay has been subjected to this past load as it can be reloaded to the former load with only minor settlement resulting. Only when the new load exceeds the past or preconsolidation load is the settlement per unit of load large. Settlements of this dike in general are minor as the new load is but little above the preconsolidation load.

## TABLE NO. 2

EAST HARTFORD DIKE, EH.3 to EH.5, INCLUSIVE
RESULTS OF FILTER TESTS

| TEST NO. | BASE MATERIAL | | | FILTER MATERIAL | | | GRADIENT OF TEST | DURATION OF TEST | RESULT | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE | PROTOTYPE | VOID RATIO IN TEST | SAMPLE | PROTOTYPE | VOID RATIO IN TEST | | | | |
| 1 | East Hartford BA-C141, B4 Class 13-11 | Foundation Silt (finer portion) | 1.47 | North Meadows HF-30, L3R Class 2 | River Sand (coarser portion) | 0.38 | 16 | 2 hrs. | stable | |
| 2 | North Meadows HF-30, L3R Class 2 | River Sand (coarser portion) | 0.44 | Gravel Sample #1 Class 1 | Gravel Bedding (Upper limit) | 0.27 | 10.8 | 2 hrs. | stable | At start of test base washed slightly into filter layer under influence of vibration. This due largely to an unduly high accumulation of voids at top of filter. |
| 3 | East Hartford BA-C141, B4 Class 13-11 | Foundation Silt (finer portion) | 1.44 | Gravel Sample #2 Class 3-1 | Gravel Bedding (Lower limit) | 0.18 | 24 | 3 days | stable | Base material showed cracking along bottom where in contact with filter. Combination considered on borderline of stability. |
| 4 | East Hartford BA-C141, B4 Class 13-11 | Foundation Silt (finer portion) | 1.4 | Gravel Sample #3 Class 1 | Gravel Bedding | 0.35 | 18.6<br>35.8 | 1 day<br>2 days<br>3 days Total | Partial Failure | Base material penetrated filter at least 1/2 in. Sample reduced in length to increase gradient and increased disturbance of base noticed. |
| 5 | East Hartford BA-C141, B4 Class 13-11 | Foundation Silt (finer portion) | 1.6 | Gravel Sample #4 | Gravel Bedding (upper limit) | Moderately dense | 24 | 1 day | Failure | Failure appeared at start as base material washed through filter layer and was accelerated by vibration. At end of test base material was distributed through filter and approx. 50 gms. had washed through into pan. |

Plate No. 25 shows an analysis for settlements of the Main Street stop-log structure. The original highway fill was gradually installed from 1875 to 1932 and is assumed to have reached ultimate settlement. Recent fill, added on the west side in the period of 1932 to 1940, is still settling. Additional loads contributed by dike and concrete wall will result in further settlement. This plate shows simplified rectangular loads, triangular loads, and line loads used to approximate the actual loadings. Stresses due to these simplified loadings were computed from charts based on the theory of elasticity prepared by Jurgenson, Nemark, and Fadum, and are plotted in the stress diagrams in the lower half of the plate. Settlements were then computed from the relation

$$\Delta H = \frac{a_v \ \Delta p}{1+e} H$$

where

$\Delta H$ = settlement

$H$ = thickness of clay

$\Delta p$ = load increase determined from stress diagrams

$a_v$ = coefficient of compressibility determined from consolidation tests

$e$ = void ratio of clay

From the results of numerous consolidation tests on the Hartford clay, average values of $a_v$ were determined as:

For loads greater than the preconsolidation load: $1.2 \times 10^{-5}$ cm²/gm.

For loads less than the preconsolidation load: $6.6 \times 10^{-5}$ cm²/gm.

The term $\Delta pH$ represents an area function on the stress diagram. Appropriate areas were determined on Plate No. 25 and combined with the proper value of $a_v$ to give the settlement.

Rate of settlement is based on actual rate observed at the South Meadows Station of the Hartford Electric Company which rests on 50 feet of this same clay. The rate at the Main Street stop-log structure was adjusted for a thickness of 100 feet of clay in proportion to the squares of the thickness.

The final settlement is composed of two parts: that due to the recent fill and that due to the new dike and wall. Plates Nos. 26, 27, and 28 show the combination of these two influences into a final time-settlement curve for 3 points at ends and center of the concrete structure.

Information on available records for settlement of the highway fill was sought from city officials and the highway department. None were available. However, water mains have been functioning in this fill since 1890 and have exhibited no leaks due to marked settlement. From this information it is considered that settlements computed for the stop-log structure represent a reasonable estimate.

Settlements have been estimated at other points on the dike as shown in Table No. 3 entitled, "Estimated Settlements." These settlements vary with the thickness of clay and all are relatively minor.

K. STABILITY. - A stability problem exists in the south portion at the stop-log structure where the dike rests on the flood plain on both sides of Main Street. Here a 32-foot dike is founded on about 5 feet of sand beneath which is 100 feet of soft clay. The clay is divided into 2 layers with red clay underlying a gray clay. The gray clay is slightly weaker than the red clay and in analyzing the stability of this section, failure surfaces have been considered for a deep slide

TABLE NO. 3

ESTIMATED SETTLEMENTS ON ℄ DIKE

EAST HARTFORD DIKE, EH. 3-5

| POINT | HEIGHT OF DIKE | THICKNESS OF CLAY | THICKNESS OF OVERBURDEN | ESTIMATED ULTIMATE SETTLEMENT* |
|---|---|---|---|---|
| Station 45+00 | 38' | 100' Assumed | 24' | 6" |
| Station 65+00 | 27' | 65' | 34' | 5" |
| Station 90+00 | 27' | 20' | 34' | 2" |
| Station 189+00 | 25' | 60' | 35' | 8" |
| Station 193+50 | 39' | 80' | 0 | 11" |
| Main Street Stop-Log Structure (see detailed estimate) | | | | |
| West End of Wall | - | 100' | - | 4-1/2" |
| Center of Fill | - | 100' | - | 2-1/2" |
| East End of Wall | - | 100' | - | 3-1/2" |

* All values ± 25%.

passing to the bottom of the gray clay. Plate No. 29 shows the results of a stability analysis by the Swedish Method of sliding surfaces for a section similar to that finally adopted. The factor of safety is given for 2 cases ranging from 1.04 to 1.39 depending upon the average shearing resistance of the clay. The lower value corresponds to shearing resistance of the clay of 0.28 tons per square foot which is an average of unconfined compression tests. It is reasonably certain that the clay has at least this strength as this amount is needed to maintain equilibrium on existing slopes of the bluff. The higher value corresponds to an average resistance in the clay of 0.375 tons per square foot which has been taken as a conservative average of direct shear test results (see Plate No. 21). The best estimate of stability factor of safety lies between these two values given. The effects of several other types of berms were also analyzed. Plate No. 34 shows the adopted section which employs a foreshore berm whose weight provides resistance against overturning.

A similar stability problem occurs at Station 193+60 where the dike crosses the lowest portion of the flood plain and rests directly on 85 feet of the same soft clay. At this point berms have been added on both sides of the dike to maintain stability. Stability factors of safety for this case are approximately 1.1 for rapid drawdown on the riverside and 1.2 for steady seepage on the landside. Both values are for the lower shearing resistance of the clay of 0.28 tons per square foot and will be higher for the upper value of 0.375 tons per square foot.

L. BORROW AREAS. - Two borrow areas are proposed as shown on Plate No. 10, entitled, "Borrow Areas."

Borrow Area "A" located in the Connecticut River bed north of the railroad will be the available source of pervious materials for embankment construction. This area was previously used in the construction of North Meadows Dike, Hartford, on the opposite side of the river. These river sediments are composed of coarse to fine sand, Classes 2 and 4, interstratified with beds of mixed materials graded from gravel to fine sand and coarse silt, chiefly Class 5. They occur to a depth of 5 to 15 feet below the river bottom. The quantity available is far in excess of that required for construction. Cross sections of these areas are shown on Plate No. 11, entitled, "River Cross Sections."

The principal source of impervious materials is Borrow Area "E" located in a thickly wooded section approximately 4-1/2 miles east of the center of operations. The formation is composed of compact, mixed materials graded from gravel and coarse sand to fine silt, chiefly Classes 9 and 11. The natural water content is only slightly above that necessary for maximum compaction. This pit was used on construction of East Hartford Dike, Item EH.2, in 1939-1940. No trouble should be experienced in placing this material. The quantity available is in excess of that required for construction.

An additional source of material is the excavation for the storage pond in the south portion of the dike. This area contains a flood plain deposit of silt, Classes 8, 10, and 13-11. The natural water content is very high, about 38 percent, which is approximately 14 percent above

TABLE NO. 4

SUMMARY OF MATERIALS AVAILABLE

SITE EAST HARTFORD DIKE, EH.3-5

ESTIMATE NO. 2 DATE DECEMBER 26, 1940

| MATERIALS REQUIRED | | MATERIALS AVAILABLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TYPE | QUANTITY, CU.YDS. | SOURCE | QUANTITY, CU. YDS. EXCAV.MEAS. | CLASS AND TYPE | PERMEABILITY COEFFICIENT k = CM.SEC. x $10^{-4}$ | ANGLE OF INTERNAL FRICTION, $\phi$ | COMPACTION CHARACTERISTICS: OPTIMUM WATER CONTENT, % | COMPACTED DRY WEIGHT, LBS. PER CU. FT. | NATURAL WATER CONTENT |
| Impervious (Riverside blanket on dike) | 214,000 Fill Meas. 220,000 Excav. Meas. | Borrow Area "E" | Ample 250,000+ | Cohesive glacial till Classes 9, 11 & 11-13 | Range 0.003 to 0.1 Avg. of 8 tests 0.02 | Range 26° - 35° Avg. of 5 tests 29° 30' | Range 8 to 11 Avg. 9.5 | Range 121 to 134 Avg. of 62 tests 127.7 | Range 8 to 15 Avg. of 46 tests 12.0 |
| | | | | | Based on prelim. laboratory tests plus field results obtained on E. Hartford, 1939 Section EH.2 | | | | |
| Pervious (Body of Dike) | | | Ample | Coarse to Medium Sand Classes 2, 4-2 & 4 | | | | | |
| | | | | | Based on prelim. laboratory tests plus field results obtained on E. Hartford, 1939 Section EH.2 and No. Meadows, 1939 Section Ht.4 | | | | |
| North Portion Dredged into place | 437,000 Fill Meas. | Borrow Area "$A_1$" from Conn. River | When dredged directly into place and without rolling. | | Range 180 to 560 Avg. 250 | 34° - 0' | - - - | Range 92 - 109 Avg. 100.0 | - - - |
| South Portion Dredged to stockpile, hauled into place and rolled. | 220,000 Fill Meas. | | When hauled into place and compacted by rolling. | | Range 35 to 110 Avg. 70 | 35° - 30' | - - - | Range 100 - 116 Avg. 109 | - - - |
| | 657,000 Total | | | | | | | | |
| Misc. Fill | | | | | Properties when compacted - obtained from tests on similar material in Borrow Area "C" | | | | |
| Uncompacted impervious foreshore blanket, Sta.174-185 and berms each side of Main St. & at Sta. 193. | 63,000 Fill Meas. 75,000 Excav. Meas. | Storage Pond Excavation Borrow Area "M" | 108,000+ | Flood plain silt. Classes 8, 10 and 13-11. | 0.001 to 0.01 Estimated | 25° - 0' | Range 18 to 34 Avg. 24.5 | Range 80 to 102 Avg. of 18 tests 93 | Range 19 to 67 Avg. 38.5 |
| | | | | Material to be placed in spoil berms and foreshore blanket without particular compaction requirements. Full compaction not feasible due to high natural water content. | | | | | |
| Topsoil | | | | | | | | | |
| North Portion | 20,000 | Borrow Area "C" | Ample | | | | | | |
| South Portion | 17,000 | Storage Pond Excavation Borrow Area "M" | 20,000 + | | | | | | |

optimum. Results of grain-size tests and a typical compaction test are shown on Plates Nos. 15 and 30 respectively.

Amounts of materials available and their suitability are summarized in Table No. 4. Grain-size curves of typical materials in Areas "A" and "E" are shown on Plates Nos. 13, 14, and 15.

M. FOUNDATION CONDITIONS. - The major portion of dike is founded upon the flood plains of the Connecticut and Hockanum Rivers where the foundation can be divided into five general layers as follows:

1. A natural silt blanket from 1 to 20 feet thick forms the uppermost stratum. This is composed of random impervious silty sands and silts, Classes 6, 6-8, 10, and 13-11. Coefficient of permeability range is 0.01 to 2.5 x $10^{-4}$ cm/sec. Where this blanket is of substantial thickness, it will effectively reduce underseepage.

2. Beneath this silt blanket is a fairly continuous layer of random pervious material consisting of fine silty sand, Classes 4 and 6. Coefficient of permeability range is 1.0 to 15 x $10^{-4}$ cm/sec.

3. Below the random pervious stratum is a pervious layer of medium to coarse sand which communicates with the sand in the bed of the river. This layer is continuous under those sections of dike on the flood plain and consists of Classes 2, 4, and 9-5. Coefficient of permeability range is 25 to 100 x $10^{-4}$ cm/sec.

4. The thickest foundation deposit is a stratum of soft varved clay varying from 20 to 120 feet thick. It has a natural void ratio of about 1.5 and its water content of 40 to 60 percent is about equal to the liquid limit. Results of typical tests for consolidation, unconfined compression, and direct shear are shown on Plates Nos. 16, 17, 20, and 21 respectively.

Values of the preconsolidation load, determined from consolidation tests, show that in the past this clay supported a load greater than the present overburden. The former load carried by the clay has been estimated as that due to an old land surface at elevation 36 which represents a continuation of the present bluffs on which the City of East Hartford is located.

5. The bottom soil layer is a thin stratum of compact glacial till overlying rock.

At the north portion of the project, approximately between Stations 40+00 and 53+00, the dike crosses a swamp where the surface deposit is a layer of soft peat from 5 to 12 feet thick. This peat is exptremely compressible and possesses a very low shearing resistance. The natural water content ranges from 100 to 212 percent and the organic content as measured by loss on ignition ranges from 20 to 60 percent. This peat is a very unstable foundation material and will be completely removed from within the confines of the dike.

At both ends of the project the dike becomes a low embankment running across the present bluff. Here the clay is relatively close to the surface and is overlain by an overburden of pervious to random pervious sand.

The railroad fill is composed of a medium sand, Classes 2 and 4, and is reasonably compact. Borings on the sides of this fill consistently encountered riprap and large stone a few feet below the surface. The railroad grade has been raised in past years and it is probable that this stone served as facing on the original embankment.

The east side of the Main Street fill beneath the highway is a moderately compact sand which was used in construction of the original roadway and street car embankment. In recent years this fill has been extended by dumping rubbish on the west side. The outer portion of the west edge is a loose rubbish fill which will be removed to solid material. The inner portion of the fill is composed of silty gravel, clay, and some silt, with occasional pockets of rubbish. This inner section of the fill is more compact and will be satisfactory for the light load of the wall.

# VI. EARTH EMBANKMENT DESIGN

## VI. EARTH EMBANKMENT DESIGN

A. MATERIALS AVAILABLE. - The materials available for embankment construction and their suitability have been discussed in detail in Section V, Paragraph L.

B. ECONOMY OF CONSTRUCTION. - Borrow area investigations and construction costs based on dike construction by this District in Hartford and East Hartford, Connecticut, indicate that pervious borrow material can be obtained most economically by dredging from the river. Factors contributing to the selection of dredged borrow material are noted below.

1. The source of borrow material for the pervious embankment is located conveniently in the bed of the Connecticut River adjacent to the dike.

2. Ample water is available for sluicing operations.

3. Water content of the material does not effect the continuity of operations as would be the case with rolled material from borrow pits on shore.

4. All materials sluiced are used to the best advantage.

5. There is insufficient volume of borrow material for rolled pervious embankment within reasonable access, except in the terraces north and south of East Hartford. The river terraces are not a desirable source as this land is valuable for raising tobacco and for housing developments which are rapidly spreading due to activity of aircraft plants in East Hartford.

6. The materials from the river bed will have a more favorable coefficient of permeability, thus rendering the dike safer by rapid drainage.

The pervious materials dredged from the river bed are limited to

Borrow Area "A", the available material in the river bed below the Memorial Bridge being reserved for construction purposes in Hartford. The method of construction anticipated for the "North Section" includes pumping of dredged materials directly to the dike, raising the embankment in layers and allowing the fill to drain with a minimum of spreading or compacting operations. In this method excess water and fines will be wasted over a wasteway and deposition of materials will be controlled, if necessary, by baffles. Sluicing directly into the dike is not considered practicable for the "South Section" due to the distance from the river and dredged sand will be stockpiled and then hauled and placed in the embankment by rolled fill methods.

It is estimated that about 25 percent of the material excavated from the storage pond, which is the portion lying above the normal water table, will be placed as random fill in the embankment section. An allowance for a shrinkage of about 15 percent has been made in the estimate. The remaining material below the water table as stated in Section V, Paragraph L, contains a high water content and past experience indicates that the material cannot be economically or properly compacted. It is planned however to utilize this material for the spoil berms which have been added on each side of Main Street and between Stations 192+00 and 194+00 to increase dike stability. This material will also be used in an impervious foreshore blanket between Stations 174+50 and 184+50. For these uses complete compaction is not necessary for stability and the material will be placed without rolling other than that contributed by trucks and bulldozers in the placing and spreading operations.

C. GENERAL DESIGN AND CRITERIA. - The design of the embankment in general is based on standard sections adopted by the Providence District

and found to be particularly suitable for this Connecticut River area. The standard sections were adopted after considerable stability analyses determined that they were stable under the worst possible conditions of sudden drawdown of river, lubrication of soil particles in the riverside slope and inappreciable cohesion between the particles. The dike founded entirely on soil will consist of a large volume of sand dredged from the Connecticut River provided with an impervious rolled fill blanket on the riverside face contacting either a horizontal blanket or cutoff at the riverside toe of dike. A small rolled filled section of random material from the cutoff trench and storage pond excavations will provide a transition from the blanket to the pervious section. Typical cross sections of the dike as designed are shown on Plates Nos. 32 to 36, inclusive. Some seepage will occur through the dike, but owing to the marked difference in permeability between the impervious blanket on the riverside and the free-draining pervious body of the dike, the line of saturation will be well within the landside toe, and any seepage flow will pass harmlessly into the toe-trench drain. Seepage through the foundation will be controlled by the use of adequate steel sheet pile, blankets and cutoff trenches. The several types of cutoffs are discussed in Paragraph D-2. The toe drains and drainage system are adequate to carry away the seepage. The dike will be constructed to satisfy the following design criteria:

(1) The crest of the dike is at such a grade that there is no danger of overtopping when the design flood occurs. (See Section IV, Paragraph A.)

(2) The freeboard is sufficient to greatly reduce the danger of overtopping by waves. (See Section IV, Paragraph B.)

(3) The slopes of the dike are such that, with the materials used in construction, they will be stable under all conditions. (See Paragraph C.)

(4) The line of saturation is well within the landside toe. (See Paragraph C.)

(5) Water which passes through and under the dike will, when it comes to the surface, have a velocity so small that it is incapable of moving any of the material of which the dike or its foundation is composed. (See Paragraph C.)

(6) There is no possibility for the free passage of water from the riverside to the landside face. (See Section III, Paragraph E, and Section VI, Paragraph D-2.)

(7) No material soluble in water is used in any part of the dike. (See Section V.)

(8) The foundation is sufficiently stable to resist undue stresses caused by the embankment load. (See Section V, Paragraph K.)

(9) Seepage through the dike and its foundation will be reduced to a total quantity well within economic pumping limitations. (See Section VII, Paragraph C.)

D. EMBANKMENT AND FOUNDATION TREATMENT. - The surface of the existing ground along the dike alignment varies from Elevation 3.0 to Elevation 43.0 mean sea level datum and the top of dike grade varies from Elevation 43.0 to 39.1. Allowing a freeboard of 5 feet the dike will be subjected to a maximum head of 32 feet. The embankment design provides a top width of 10 feet throughout its entire length, and side slopes varying as follows:

Station 31+50 to 38+50; 1 vertical on 2 horizontal both sides.

Station 39+00 to 99+40; 1 on 3 both sides.

Station 170+00 to 199+10; 1 on 3 both sides.

Station 200+40 to 207+10; 1 on 2-1/2 riverside and 1 on 2 landside.

Station 208+60 to 221+20; 1 on 3 riverside and 1 on 2 landside.

Station 222+10 to 241+15; 1 on 2-1/2 riverside and 1 on 2 landside.

Transition sections are provided at the change in side slopes. Slopes are to be dressed with topsoil and sodded and seeded except where riprap slope protection is provided. Special features of the embankment and foundation treatment are explained in the following paragraphs.

1. Riprap slope protection. - High velocity flows in the river make it necessary to provide riprap protection for the slopes of the dike at several locations to prevent erosion. A study of the flows in the river, with allowance made for the new conditions and resulting higher velocities, indicated that the riprap was required at the following locations: From Station 47+50 to Station 99+40; from Station 170+00 to Station 174+00 and at the ends of the embankment on either side of Main Street stop-log and wall. Protection of the railroad embankment which is exposed to the river is provided by riprap on both upstream and downstream slopes. The riprap will be hand-placed to a thickness of 12 inches and will rest on a 6-inch bed of gravel which is designed to prevent undercutting of the riprap. Gutters paved with grouted riprap will prevent surface water from undercutting where the riprap slopes contact the original ground surface at either side of Main Street.

2. Under seepage control.-Various types of treatment are used to control underseepage depending upon foundation conditions. These

come under the general classification of cut-off trenches, blankets, berms and sheet pile cutoffs which are described in detail in the following paragraphs:

a. Type A. - Between Stations 225+30 to 240+90 and 193+60 to 208+20 a stratum of material composed of sand, silt and some fill overlies a relatively impervious material which necessitates the use of a deep cutoff trench through the pervious material to prevent excessive seepage. The width of trench in excess of design requirements for the thickness at the impervious cutoff will be backfilled with pervious material to permit as much economy as possible.

b. Type B. - A shallow cutoff trench about 5 feet in depth will be used to penetrate a natural silt blanket existing along the dike alignment between Stations 54+50 to 96+40 and 184+50 to 192+50. The primary use is for inspection of the dike foundation.

c. Type C. - Between Stations 174+50 and 184+50 it was found that a satisfactory and economical cutoff could be obtained by the use of a blanket extending laterally about 200 feet beyond the riverside toe of the dike. The blanket ranges in thickness from 5 to 3 feet and follows the undulating surface of the land. Material from the storage pond excavation will be utilized for this blanket.

d. Type D. - Between Station 39+30 and Station 54+50 a blanket type cutoff was found to be satisfactory and economical. A horizontal impervious blanket about 60 feet wide extending from the riverside toe of the dike over the existing ground surface and varying in depth from 3 feet at the dike to 2 feet at the riverside edge of the blanket, which will be reinforced by an additional blanket of spoil

material that will be obtained from the excavation necessary to obtain a suitable foundation for the dike, will be placed over the impervious blanket. This upper blanket will extend from the dike over the foreshore from 150 to 200 feet. The depth will vary from 3 to 10 feet at the riverside edge of the impervious blanket and will be sloped away from the dike. The spoil materials used are well adapted to growing vegetation and will be seeded. It is believed the extra thick layer of this spoil material, although not select impervious, will prove satisfactory as a blanket. As this material comes from adjacent spoil its use should result in economy. At Station 39+30 the impervious section of the blanket will be extended over the slope of the bluff to Station 37+60 to reduce seepage under the dike.

e. Type E. - Foundation soil in the vicinity of Main Street is unstable and a berm is used to provide stability. The berm extends along the riverside of dike between Stations 208+00 and 221+20 and will have a 50-foot top width. A similar berm is used at the south swale crossing between Stations 192+00 and 194+00 except the top width is about 70 feet. The top of berm will be sloped from the dike and is about 15 feet above the original ground surface. The side slope will be 1 vertical on 4 horizontal. No additional protection against seepage is necessary due to the increased path of seepage effected by the berm. A complete cut-off is purposely omitted to permit drainage of the portion of the dike located below the level of the drain. Also the lower part of the impervious blanket is placed within the body of the dike to prevent a blow as water drains out of the dike after sudden recession of the flood.

f. Type F. - It was found necessary to use sheet piling between Stations 170+00 and 177+00 as the upper or impervious stratum of the foundation has been removed by erosion or other agents, exposing the layer of Class 2 and 4 sands which is open to the river. Between Stations 220+30 and 225+30 sheet piling was necessary because of the pervious nature of the material under the dike.

3. Toe drains. - Landside toe drains are provided throughout the entire length of the dike, their function being to insure the line of saturation within the pervious section will be kept well away from the landside slope. At the extremities of the embankment where the dike heights are less than 5 feet no drains are provided. To prevent fine silt washing into and clogging the drain a two-layer filter will be provided. This filter will consist of a coarse gravel bedding adjacent to the drain with an intermediate layer of sand to prevent the foundation silt washing into the gravel bedding. The pervious material, Class 2 sand, as dredged from the Connecticut River, is satisfactory for this intermediate layer and no special selection will be needed. In places where the gravel bedding is within the body of the dike or is in contact with foundation soils coarser than Class 4, the first filter layer of sand will be omitted.

4. Special foundation treatment. - At the north portion of the project approximately between Stations 40+00 to 53+00 the dike crosses the swale where the surface deposit is a layer of soft peat ranging from 5 to 12 feet in thickness. This peat is a very unstable foundation material and will be completely removed from within the confines of the dike. The explosive method as used for removing peat

in highway construction was studied but was inapplicable due to the extreme width of the area to be excavated. Consequently the peat will be excavated by the usual methods and spoiled in front of the dike as mentioned in Paragraph 2 d.

Foreshore berms are provided to improve the stability of the dike foundation in the vicinity of Main Street and at the south swale crossing. Design analysis for the solution of this problem is treated in detail in Section V.

5. Access ramps. - Ramps are provided which will permit access to the meadows and property adjacent to Saunders Street and Brewer Lane. These ramps are necessary for fire protection and access to lands adjacent to the dikes. Ramp No. 1 at Station 70+40 and Ramp No. 2 at Station 175+30 provide access to the meadows. Ramp No. 3 at Brewer Lane provides access to Saunders Street from Central Avenue which would otherwise be interrupted by the dike construction. Ramp No. 4 permits access to the property on the riverside of Brewer Lane. Ramps Nos. 1 and 2 have a maximum grade of 7 percent and top width of 10 feet with side slopes 1 vertical on 2-1/2 horizontal. The road surface of Ramp No. 1 will be macadamized on the riverside of the dike to prevent erosion by river currents. The dike and ramp slopes forming a gutter will be paved with grouted riprap. Ramp No. 3, located at Station 239+80, will have a top width of 20 feet and a macadamized road surface 16 feet wide with side slopes 1 on 1-1/2. A maximum grade of 5 percent occurs at the Saunders Street end of the ramp. At the intersection of the dike and ramp slopes, a grouted riprap gutter will be provided. No. 4 ramp, located at Station 240+50, will have a top width of 10 feet and a grade of 10 percent, with side slopes 1 on 1-1/2.

6. Removal of old sewer pipes. - In the preparation of the foundation for the dike various drainage and sewer pipes will be encountered. In the case of storm sewer pipes, connection will be made to the dike drainage system and the sanitary sewer will be provided with an outlet conduit under the dike which can be closed during flood periods.

Pumping stations will be provided for pumping sewage and storm water during periods of flood.

# VII. HYDRAULIC DESIGN

## VII. HYDRAULIC DESIGN

A. DESIGN GRADE AND FREEBOARD. - The elevations to which the dike and wall have been designed were based on the greatest predicted flood, as modified by the approved Comprehensive Plan of twenty reservoirs, plus a design freeboard of approximately 5 feet for embankments and 3 feet for concrete walls, as recommended by the Board of Engineers for Rivers and Harbors.

The following table lists the adopted grades for the tops of the dikes. Grades are straight lines between the stations shown. These grades apply to all of the dikes included in the dike protection for East Hartford. Dike constructed under previous contract is so indicated.

TABLE NO. 5

DESIGN GRADES

| Location | Dike Type | Station | Grade |
|---|---|---|---|
| North end of dike (high ground near Green Terrace) | Earth | 31 + 55 (±) | 43.0 |
| Bend in dike at Conn. River | " | 47 + 73.2 | 43.0 |
| Just upstream of R.R. Bridge | " | 96 + 85.2 | 42.5 |
| Just downstream of R.R.Bridge | " | 99 + 40 | 40.7 |
| High ground N. of Conn. Blvd. | " | 129 + 50 | 40.5 |
| High ground S. of Conn. Blvd. (Sta. 144+60.7 to Sta. 150+12.7 concrete wall 2 ft. below earth dike) | " | 130 + 70 | 39.9 |
| Bend in dike at Conn. River | Earth | 170 + 00 | 39.1 |
| Bend in dike at Conn. River | " | 170 + 00 | 39.1 |
| South end of dike (high ground near Saunders Street) | " | 240 + 88 (±) | 39.1 |

Note: The data included between the broken lines apply to a portion of the East Hartford Dike constructed under one separate contract.

B. SPECIAL PROTECTION. - In the zone of the railroad bridge, protection of the riverbank upstream of the bridge to prevent ultimate undermining of the dike, protection of the bridge itself against scour by excessive river velocities, and general improvement of flow conditions in order to reduce maximum velocities and provide better utilization of the free area under the bridge, are necessary to insure the safety of the dike. For general plan and details see Plates Nos. 37 and 38. Four elements in the general construction scheme are adopted to accomplish the desired protection: (1) timber-pile groins projecting from the present riverbank are designed to halt recession of the left bank due to erosion, (2) a dumped rock blanket on the river bed underneath the railroad bridge to prevent dangerous scouring action, (3) comprehensive borrow excavation in the river channel to promote more even velocity distribution as the flow approaches the bridge opening, and (4) the removal of all trees and growth along the riverbank on the Hartford side (right bank) of the river. The fourth item is not covered by this contract, but the work will be carried out as a separate project.

The work proposed under Item (3) involves practically no additional cost since the material excavated will be used in the dike. It is necessary only to fix the limits of the borrow area in such a manner that two spans of the bridge that are not carrying much flow now will be more effective in carrying their share of the total river discharge.

The work planned under Item (4) will improve approach and retreat conditions near the two end spans of the bridge.

C. DRAINAGE SYSTEMS

1. Sewers

a. General. - Provision has been made to collect the

seepage passing through and under the dike together with local runoff and discharge it back into the river by gravity ordinarily and by means of pumping during flood periods. The seepage is concentrated in the toe drains on the landside of the dike. The dike toe drains in the northern section will drain into an existing ditch through the swale to the storage pond. It will be necessary to enlarge and regrade the existing ditch. The dike toe drains in the southern section are connected by laterals to a common collector drain located outside the toe of the dike. The collector drains discharge into the storage pond adjacent to the pumping station at the swale.

b. Amount of flow. - Computations were made to determine the probable amount of seepage under and through the dike and the local runoff that could be expected. These quantities were increased materially in order to provide adequate factors of safety and for other local runoff connections in the future. Where the dike intercepts concentrated natural surface drainage, catch basins are provided. Catch basins are provided to drain the water from all low spots created by the construction of the dike, except that at several points these low undrained places were filled to avoid having excessively deep sewer trenches. Existing storm sewers are intercepted by the collector drains. The sewers have sufficient capacities to take care of storm runoff, sanitary flow and seepage.

c. Collector drains. - The collector drains, of concrete pipe, run parallel to the landside toe of the dike between the dike and the right of way line, except a section west of Main Street where the drain follows Pitkin Street and discharges into the swale, which drains

to the storage pond and outfall. The Town of East Hartford will contribute the costs of intercepting their storm sewers and the proportionate part of the drainage system due to such interception.

d. Toe drains. - Rock toe drains were selected for the dike between Stations 40+00 and 96+00. The toe of the dike at this location is about level with the maximum water surface in the storage pond during periods of flood. Draining water from the toe drains would not be practical under such circumstances. The natural ground slopes from the toe drain toward the drainage ditch in the swale, which will permit natural drainage except during flood periods when the storage pond is filled to maximum elevation. In general, a gravel filled toe drain with vitrified clay pipe is used. Every third length of pipe is perforated. The greater portion of the toe drains contact fine silt and to prevent clogging of the drain, a filter is used. The dimensions and proportions of the toe drains are based on the standards adopted by this office.

2. Pumping stations. - The drainage area enclosed by the completed dikes is divided into three separate tributary drainage areas which require three pumping stations. The E.H.2 Analysis of Design describes the Cherry Street and Pitkin Street Stations. These stations, together with the Meadow Hill pumping station will be built under separate contracts.

a. Meadow Hill pumping station. - This station was located after studies were made to determine the most practical and economical site. The south end of the swale was selected as it is the lowest point in the drainage area and is the existing outlet for the greater part of the drainage in this area.

It will be required to handle the storm run-off and sanitary sewage from 980 acres, of which 450 acres are low-lying meadow land entirely undeveloped, and 530 acres are developed (commercial and residential). A storage pond 40 acre-feet in capacity will be constructed in order to reduce the required pump capacity.

The developed area is served by a separate system of storm drains running normal to Prospect Street and discharging directly into the swale. The total maximum capacity of all these drains is estimated to be 98 c.f.s. According to local authorities the existing system is adequate. The existing 30-inch intercepting sewer running along Prospect Street and discharging into the Hockanum River collects all the sanitary sewage from the area tributary to Meadow Hill Pumping Station. For the present state of development it is estimated that the maximum flow is 14 c.f.s.

Since 46 percent of the total area is not provided with drains, the sewer capacity cannot be considered a criterion of pump capacity. It was necessary to construct a storm hydrograph based on drainage area characteristics.

Installed pumps for storm run-off will have a maximum capacity of 156 c.f.s., divided between three units. The station will be built to accommodate a fourth unit if, through future development, added capacity is found to be necessary. A small pump capable of discharging 15 c.f.s. at maximum head will be provided to handle sanitary sewage only. If in the event future improvements are made to the present sanitary sewer systems, which will eliminate the functions of this pump, the installation will be of value to the station for additional capacity and flexibility for handling storm drainage and seepage.

3. Outfalls.

a. General. - There will be 4 outfalls constructed under the dike to discharge the drainage from the protected areas. The Pitkin Street and Cherry Street outfalls have been built. The Meadow Hill outfall at the swale will be constructed adjacent to the Meadow Hill pumping station prior to the building of the dike at this location. An existing 30-inch vitrified clay pipe sanitary sewer will be replaced under the dike by a cambered cast iron pipe with a flexible coupling to permit settlement without danger of breaking.

b. Swale drainage outfall. - The outfall at the Meadow Hill pumping station will discharge all drainage, including sanitary sewage under pressure during flood stages and surface drainage and seepage by gravity during normal river stages. A concrete pressure conduit will be constructed to discharge the drainage from within the protected area. This conduit will be built in conjunction with the Meadow Hill pumping station which is to be a separate contract.

c. Sanitary sewer outfall. - A 30-inch vitrified clay pipe sanitary sewer passes through the dike alignment and discharges into the swale on the riverside of the dike. A 30-inch cast iron pipe installed with a camber and flexible joint which will permit settlement without danger of breaking will replace the vitrified clay pipe under the dike. A valve chamber built on the landside of the dike will permit discharge through the pumping station during flood periods or gravity discharge through the sanitary sewer conduit during normal periods. The conduit will be imbedded in impervious material with concrete seep rings constructed to prevent piping. The sanitary sewer cast iron conduit

replacing the vitrified clay pipe will be built under this contract and will precede the embankment construction at this location.

4. Storage pond. - A storage pond comprising about 7 acres of the swale area will be located on the north side of the Meadow Hill pumping station. Factors contributing to the inclusion of a storage pond in conjunction with the pumping station are:

(a) Low cost of land.

(b) Use of materials in embankment.

(c) Reduction in installed pumping capacity.

(d) Greater efficiency and regulation in the operation of the pumping station.

The elevation of the original surface at the site of the storage pond varies from 4 to 15 feet and will be excavated to Elevation 4.0, mean sea level datum. Considering the maximum elevation of water surface in the pond is Elevation 10.0, the capacity will be 40 acre-feet. The determination of pumping capacities did not consider effective the existing storage in the swale, which is about 27 acre-feet below Elevation 10.0, as this would place restrictions on the future development in this area.

5. Brook diversion ditch. - The dike is built across the bed of an existing brook near the foot of the bluff at Green Terrace. A diversion ditch will be excavated on the riverside of the dike cutting off the bend in the stream bed which will be under the dike. The ditch will be excavated 10 feet wide on the bottom with side slopes 1 vertical on 1-1/2 horizontal and will be about 950.0 feet long and 7.0 ± feet deep.

# VIII. STOP-LOG STRUCTURES

## VIII. STOP-LOG STRUCTURES

### A. RAILROAD STOP-LOG STRUCTURE.

1. Location. - The dike alinement determined the location of the railroad stop-log structure on the New York, New Haven and Hartford Railroad embankment. For general plan and sections, see Plates Nos. 42 and 43.

2. Base elevation. - Auger borings were taken at the railroad embankment to determine the nature and bearing ability of the fill. Owing to some doubt as to the bearing ability of the railroad embankment fill, it was decided to design the stop-log structure with its base slab bearing upon the original soil at the base of the railroad fill. Railroad service will be maintained by using sheet steel shoring as shown on Plate No. 43.

3. Width of opening. - The width of the stop-log opening was based on the railroad requirements of 9 feet on either side of the center line of track. Further adjustments were made to provide additional width of opening on account of curvature and superelevation. These resulted in an increase of 1 foot, making the opening 19 feet wide.

4. Wingwalls. - The stop-log structure is connected to the embankment on either side by cantilever type wingwalls constructed with seep fins for preventing seepage of water along the concrete.

5. Cut-off. - It was necessary to use a sheet pile cut-off under the stop-log structure to control the uplift under the base slab and to satisfy requirements for economy. A blanket cut-off would not have given a long enough path of seepage to sufficiently dissipate the head. Suitable drains have been provided to carry off the seepage.

6. Shelter site for stop-log timbers. - A convenient site for the stop-log shelter was provided by constructing a berm on the landside of the dike adjacent to the stop-log structure. This area was provided without additional cost, as the fill is a part of the normal dike section.

B. MAIN STREET STOP-LOG STRUCTURE.

1. Location. - Economic studies in conjunction with conferences with representatives of the Town were made to determine the most feasible alinement of the dike and stop-log structure at this point. The location selected for the stop-log structure across Main Street near the Hockanum River will protect as much property as economically possible. For general plans and sections, see Plates Nos. 44 and 45.

2. Foundation. - Subsurface investigations at the site of the stop-log structure have disclosed the existence of a deep deposit of plastic clay commencing a few feet below the original ground surface under the highway fill and extending to bedrock 100 feet down. An appreciable amount of settlement is anticipated and computations indicate a varying degree of settlement at different points. (See Section V, Paragraph J.) Because of the great depth of plastic clay below the structure the economical solution is to control rather than prevent settlement of the structure. The design provides for bearing piles of average length under the ends of the structure and special vertical joints within the structure, the functions of which are to control stresses within and the movement of the structure. The top of the stop-log structure and the wingwalls were raised 6 inches above the design grade to provide for settlement.

3. Width of opening. - The Main Street stop-log is designed to accommodate two traffic lanes each 29-1/2 feet in width, an island 10

feet in width containing a railroad track and two sidewalks approximately 5-1/2 feet in width, giving a total width of the stop-log opening of 80 feet. The adopted plan having seven openings of equal length and six structural steel posts was found economical and has the advantage of permitting closure of some of the openings in anticipation of a flood without undue interference to traffic.

4. Wingwalls. - The area in which the stop-log is constructed contains restaurants and filling stations and the clear spaces are necessary for the normal operation of these places of business. For this reason the concrete wingwall for the stop-log structures is justified as occupying less space than would be occupied by a dike. At the ends of the wingwalls the sheet pile is brought up to the elevation of the top of the wall and carried beyond the wall in either direction, reducing elevation with steps, until it ends at the impervious toe of the embankment. This sheet pile is provided, in addition to the embankment core and the seep fins on the concrete wingwalls, to control seepage and secure the ends of the concrete against being washed around during floods.

5. Cut-off. - The design provides for a steel sheet pile cut-off driven to impervious material under the stop-log structure. An existing telephone conduit under the stop-log structure necessitates the construction of a concrete manhole to permit driving a continuous sheet pile cut-off.

6. Toe drains. - Seepage will be drained by extending the dike drains along the base of the concrete structure. The drains slope from the center of Main Street to the embankment drainage system on either side.

7. Shelter site for stop-log timbers and supports. - An area on the east side of Main Street and on the landside of the dike 300 feet from the stop-log opening has been provided for the erection of a shelter to house the stop-log timber and steel post supports. This site was produced by filling an otherwise undrained pocket adjacent to Main Street and locates the shelter at a convenient distance from the stop-log structure. No other satisfactory site is available.

# IX. STRUCTURAL DESIGN

## IX. STRUCTURAL DESIGN

A. GENERAL. - The East Hartford Dike, Items EH. 3 to 5, includes two stop-log structures, one to permit the New York, New Haven and Hartford Railroad to pass through the dike at Station 97+68 and the other to allow passage of Main Street (U. S. Highway No. 44) through the dike at Station 213+33. Each structure consists of two wingwalls and a barrier of timber logs supported by vertical grooves in the wingwalls. The highway structure also has six removable supports. The ends of the wingwalls have seep fins attached to form a cut-off into the earth dike. The wingwalls are connected across the railroad by a sill, which is really a cap on the steel sheet piling. This sill drops under the tracks and clears the base of rail by 4 inches, a dimension requested by the railroad. The bottom log fits onto this sill. Across the highway, the wingwalls are connected by a base slab which has six transverse beams in it at 11' 7" cc. The removable supports connect to these beams. A sill runs across the entire base, flush with the road surface, for the bottom logs to rest on.

The span of the railroad stop-log structure is 19' 0" and a 12" log will carry the water load for this width. The span of the highway stop-log structure, however, is 80'± and this is broken up into seven shorter spans of 11' 7" by the use of six removable steel supports which fit into sockets in the roadway. An 8" log is used for this structure.

B. GENERAL DESIGN DATA.

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

structural steel.

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

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

3. Earth pressures. - In computing active earth pressures, equivalent fluid pressures computed by the use of Rankine's formula were used. They are as follows:

Equivalent liquid pressure of dry earth = 35 pounds per cubic foot.

Equivalent liquid pressure for saturated earth = 80 pounds per cubic foot.

In computing passive resistances, Rankine's formula was used with the coefficient of internal friction = 35 degrees.

4. Hydrostatic uplift.

a. Riverside of sheet piling.

Full head due to headwater.

b. Landside of sheet piling

(1) At landward toe, full head due to tailwater.

(2) At sheet piling, full head due to tailwater plus one-half the difference between headwater and tailwater.

(3) At intermediate points, the uplift was assumed to vary uniformly with the distance from the toe.

5. Overturning. - The resultant of all external loads, including hydrostatic uplift and excluding base pressure, does not fall

within the middle third under every condition but under no condition is the allowable bearing value of the soil exceeded. For walls with bearing piles, the resultant falls within the rear pile. In every case the pile specified is of sufficient strength to carry the maximum loading.

6. Sliding. - In general, the total horizontal forces due to external loads shall not exceed the resistance available from friction and passive resistance. The coefficient of friction used is 0.45. For walls with bearing piles, the horizontal forces due to external loads shall not exceed the resistance available from passive pressure and shear on the piles.

7. Bearing. - The total bearing pressure, equal to the sum of hydrostatic pressure plus the remaining effective base pressure, shall in no case exceed the maximum allowable soil pressure, or pile loading.

8. Frost cover. - All footing bases shall lie at least 4 feet beneath the ground surface to avoid heaving by frost action.

9. Path of percolation. - Except where the steel sheet piling is either driven to rock or extended a minimum distance of 3 feet into an underlying stratum of impervious clay, the minimum path of percolation shall be four times the head of water.

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

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

with the "Joint Code of the American Concrete Institute and the Reinforcing Steel Institute for the Design of Concrete and Reinforced Concrete" issued in 1928.

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

| | Lbs. per sq. in. |
|---|---|
| b. Flexure ($f_c$) - | |
| Extreme fibre stress in compression | 800 |
| c. Shear (v) - | |
| Beams with no web reinforcement and without special anchorage . . . . . | 60 |
| Beams with no web reinforcement but with special anchorage of longitudinal steel . . . . . | 90 |
| Beams with properly designed web reinforcement but without special anchorage of longitudinal steel . . . . . | 180 |
| Beams with properly designed web reinforcement and with special anchorage of longitudinal steel . . . . . | 270 |
| d. Bond (u) - | |
| In beams, slabs, and one way footings | 150 |
| Where special anchorage is provided | 300 |
| The above stresses are for deformed bars. | |
| e. Bearing ($f_c$) - | |
| Where a concrete member has an area at least twice the area in bearing. . | 500 |

f. Axial compression ($f_c$) - Lbs. per sq. in.

Columns with lateral ties. . . . . 450

g. Steel stresses -

Tension . . . . . 18000

Web reinforcement . . . . . 16000

h. Protective concrete covering -

| Type of members | Minimum cover in inches |
|---|---|
| Members poured directly against the ground | 4 |
| Members exposed to earth or water but poured against forms . . . . . | 3 |

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

C. BASIC ASSUMPTIONS FOR DESIGN

1. Loadings. - In general, each member is designed to resist the most unfavorable combination of loadings. The design flood elevation for the railroad stop-log structure is Elevation 42.5, and for the highway structure Elevation 39.1. The head is reduced due to the constrictions at the railroad and the Memorial bridges; this accounts for the difference in design elevations. The principal load on the structures is from the flood water, but the wingwalls are also designed to retain the saturated dike when the river has receded.

2. Main Street stop-log structure. - The highway stop-log structure is designed as a counterfort wall, the removable supports being the counterforts. The logs carry the water load into the removable supports which in turn transfer the load to the beams across the base,

these beams then transfer the load into the base slab. The beams are designed to carry the concentrated thrusts from the supports and the slab is designed continuously under the beams. The timber logs are designed as simple beams supported at the ends. The wingwalls are designed as typical cantilever flood walls, except at the seep fins where the walls are designed with the fins as counterforts. The ends of the wingwalls which tie into the dike are placed on concrete piles as the bearing value of the ground is poor. To allow for differential settlement, a slip joint is provided in each wingwall near the seep fins. The removable support is designed as an "A" frame to resist the direct load and overturning moment from the logs. The support is made so that the post and strut can be separately pinned to their base castings and then swung together for the final connecting pin to be driven in. Four small removable hoist frames facilitate the handling of the logs, and lateral bracing is provided to hold the "A" frames vertical during erection.

3. Railroad stop-log structure. - The railroad stop-log structure has no removable supports and the entire water load is carried by the logs into the wingwalls. The wingwalls are designed as typical cantilever flood walls, except at the seep fins where the wall is considered counterforted. The thrust of the logs on the wingwalls causes an eccentricity longitudinally along the base. This changes the base pressures slightly and the bases are designed accordingly. The timber logs are designed as simple beams supported at the ends. Two removable hoist frames are provided to facilitate the handling of the logs.

# X. CONSTRUCTION PROCEDURE

## X. CONSTRUCTION PROCEDURE

A. SEQUENCE OF OPERATIONS. - Assuming that the contract for the work will be let on or before April 1, 1941 and construction will commence on April 10, 1941, it is contemplated that the work will be completed by November 15, 1941, including sodding, seeding and cleaning up, although it is possible that these latter items may have to be deferred until the spring of 1942. To avoid the possibility of impounding water in the swale the schedule will be arranged so that at all times during the construction of the embankment a larger opening will be maintained in the dike across the swale at the downstream end than at the upstream end or north crossing. In addition, the construction of the conduit from the Meadow Hill pumping station, not a part of this contract, will precede the placing of embankment materials at this location. It is contemplated that the conduit will be completed by September 1, 1941, thus allowing from September 15 to November 15, 1941 for the completion of the embankment closure.

The following schedule shows the major items of work involved, the approximate quantities, and planned construction period for each. The schedule considers the effect of river stage fluctuations, a continuous record of which has been kept for more than 40 years. Plates Nos. 2 and 3 are hydrographs for the Connecticut River at Hartford, Connecticut, continuous from 1917 to 1938.

(Table on following page)

TABLE NO. 6
EAST HARTFORD DIKE
Station 31+50 to 99+40 and Station 170 to 241+15
CONSTRUCTION PROGRAM

| Item | Starting Date | Finishing Date | Work Days | Quantity | Daily Rate |
|---|---|---|---|---|---|
| First Season | | | | | |
| Preparation of Site | Apr.10,1941 | Aug.31, 1941 | 95 | 58 A. | 0.61 acre/day |
| Stripping | Apr.10,1941 | Oct. 1, 1941 | 120 | 55,000 cy | 460 c.y./day |
| Common Excavation | May 1, 1941 | Oct.15, 1941 | 120 | 276,000 cy | 2,300 c.y./day |
| Embankment, pervious | May 1, 1941 | Nov. 1, 1941 | 130 | 790,000 cy | 6,100 c.y./day |
| Embankment, impervious | May 1, 1941 | Nov. 1, 1941 | 130 | 175,000 cy | 1,350 c.y./day |
| Sodding and Seeding | July 1,1941 | Oct. 1, 1941 | 60 | 27 A. | 0.45 acre/day |
| Steel Sheet Piling | May 1, 1941 | Oct. 1, 1941 | 110 | 53,000 sf | 480 s.f./day |
| Riprap, hand placed | June 1,1941 | Nov. 1, 1941 | 100 | 17,000 cy | 170 c.y./day |
| Drainage | May 1, 1941 | Sept.15,1941 | 90 | - | - |
| Concrete Structures | June 1,1941 | Sept. 1,1941 | 60 | 1,300 cy | 22 c.y./day |
| Groins | June 1,1941 | Sept. 1,1941 | 60 | 1,100 tons | 20 tons/day |
| Special protection at RR bridge, dumped rock | Aug. 1,1941 | Sept.15,1941 | 40 | 8,500 tons | 210 tons/day |

Contract to be let on or before April 1, 1941

Completion of work - November 15, 1941

Number of calendar days for construction - 220

1. Preparation of site. - The work involved is (1) clearing; (2) grubbing; (3) removal of masonry foundations and structures. Clearing consists of the removal of trees, brush and shrubs, and removal of buildings under the dike site. Grubbing consists of the removal of stumps, roots and vegetable growth over the area cleared and under the site of the dike. Removal of any cellar foundations, culverts or other small structures will then be accomplished.

2. Stripping. - When the site is cleared and grubbed, all undesirable material under the dike site is then removed by stripping.

3. Excavation. - While the site is being cleared, grubbed and stripped, excavations for the foundation of the concrete structures may be accomplished. Upon completion of the stripping, the toe trenches may be excavated, one for drains and the other for exploration and cut-off. Material from these excavations may be used in the random fill section of the embankment.

4. Steel sheet piling. - The steel sheet piling will be driven in those portions of the dike where it is required before placement of fill is started. Under the concrete structures it will be driven before concrete is placed.

5. Embankment construction. - As soon as the foundation and toe trenches have been prepared and the toe drain constructed, the embankment construction will take place. The Southern Section of the embankment will be constructed entirely by the rolled fill method and in the Northern Section as much of the pervious portion of the embankment as practicable will be constructed by the hydraulic fill method. The pervious fill will be obtained from Borrow Area "A". The impervious

fill will be obtained from Borrow Area "E". The random fill will come from excavations on the site provided the material is suitable. Rock for the hand-placed riprap may be obtained from nearby quarries. It is expected that the rock will be placed as soon as practicable on the embankment fill. Use of modern construction equipment and standard methods of construction are contemplated throughout. The rolled fill will be placed by truck or crawler wagons and rolled by sheep's-foot, cylindrical, or disc rollers, as may be required. Pneumatic hand tampers will be used in corners or near structures. The embankment is to be built in one season, except sodding and seeding which will be completed the following season.

6. Drainage system. - The construction of the drainage systems should start as soon as practicable. It will be necessary to build the outfall conduits first so that no delay will be caused to the construction of the dike proper. Excavation, pipe laying, and backfill may be completed before the manholes and valve chamber are finished.

7. Stop-log structures. - Excavation for the stop-log structures and wingwalls will be started at the beginning of the season. The construction of the wall and related structures will then be started and will be finished in advance of placing embankment at these locations.

8. Miscellaneous. - The placing of sod and riprap will follow the construction of the dike. The job will be cleaned up as soon as practicable.

B. LABORATORY AND FIELD TESTS DURING CONSTRUCTION.

1. Embankment construction. - The District Soils Laboratory at Providence, Rhode Island, and the field soils laboratory at East

Hartford, Connecticut, will perform all tests necessary to investigate and record the characteristics of the types of soil used in construction. Tests will be performed to determine grain size classifications of soils, water contents and density of material in place, and compaction characteristics of borrow materials. Supplementary shear and permeability tests will also be made. Materials used for embankment and their placement will be subject to close control before and during construction. Screened gravel for the toe-drain and riprap backing will be obtained from commercial sources and will be subject to check laboratory tests.

2. Foundation observations. - As the various foundation strata are exposed in excavations, samples will be obtained for natural density and record purposes. Settlement observations will be made to check actual settlements against predicted values.

3. Concrete construction. - Materials used in the making of concrete will be tested at the Central Concrete Testing Laboratory, West Point, New York. The field tests will principally be used for control of the quality of concrete during construction. Facilities will be available for grading the aggregates, designing mixes, making of slump tests and for casting and curing concrete cylinders for compression tests.

Cement will be tested by a recognized testing laboratory and results of these tests will be known before the cement is used. Only one brand will be used throughout at each location. Fine and coarse aggregates will be obtained from approved commercial sources. The amount of water used for each batch of concrete will be predetermined: it will

in general, be the minimum amount necessary to produce a plastic mixture of the strength specified. Storage of cement and aggregates, mixing and placing of concrete as well as placing of reinforcement steel will be supervised by Government inspectors.

# XI. SUMMARY OF COSTS

## XI. SUMMARY OF COSTS

The total construction cost of the East Hartford Dike from Station 31+50 to Station 99+40 and Station 170+00 to Station 241+15 has been estimated at $1,315,000.00, including 10 percent for contingencies and 15 percent for engineering and overhead. This summary does not include the cost of any pumping stations. These costs have been distributed as follows:

| | | |
|---|---|---|
| a. | Embankment | $950,000 |
| b. | Concrete features | 45,000 |
| c. | Drainage systems | 54,000 |
| d. | Steel sheet piling | 84,000 |
| e. | Riprap and dumped rock | 167,000 |
| f. | Miscellaneous | 15,000 |

a. The embankment item consists of all excavation and fill for the dike with cut-off trench and toe drains, gravel bedding, topsoil, sodding and seeding, bituminous macadam road surfacing and ramps.

b. The concrete features consist of all excavation and backfill, cement, concrete, reinforcing steel, structural steel, copper water stops and concrete bearing piles.

c. The drainage systems consist of all excavation and backfill, tile pipe, reinforced concrete pipe, cast iron pipe, gates, valves, care of sewage and water during construction and drainage structures.

d. The sheet piling includes furnishing, placing and driving the piles.

e. The hand-placed riprap consists of gravel bedding, furnishing and placing the rock for riprap and furnishing and placing dumped rock.

f. Miscellaneous items include preparation of site, miscellaneous fill and all other items not included under above Items a, b, c, d, and e.

# XII. PLATES

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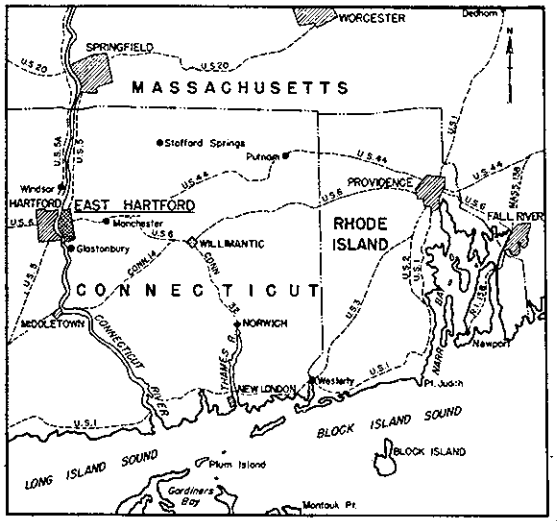
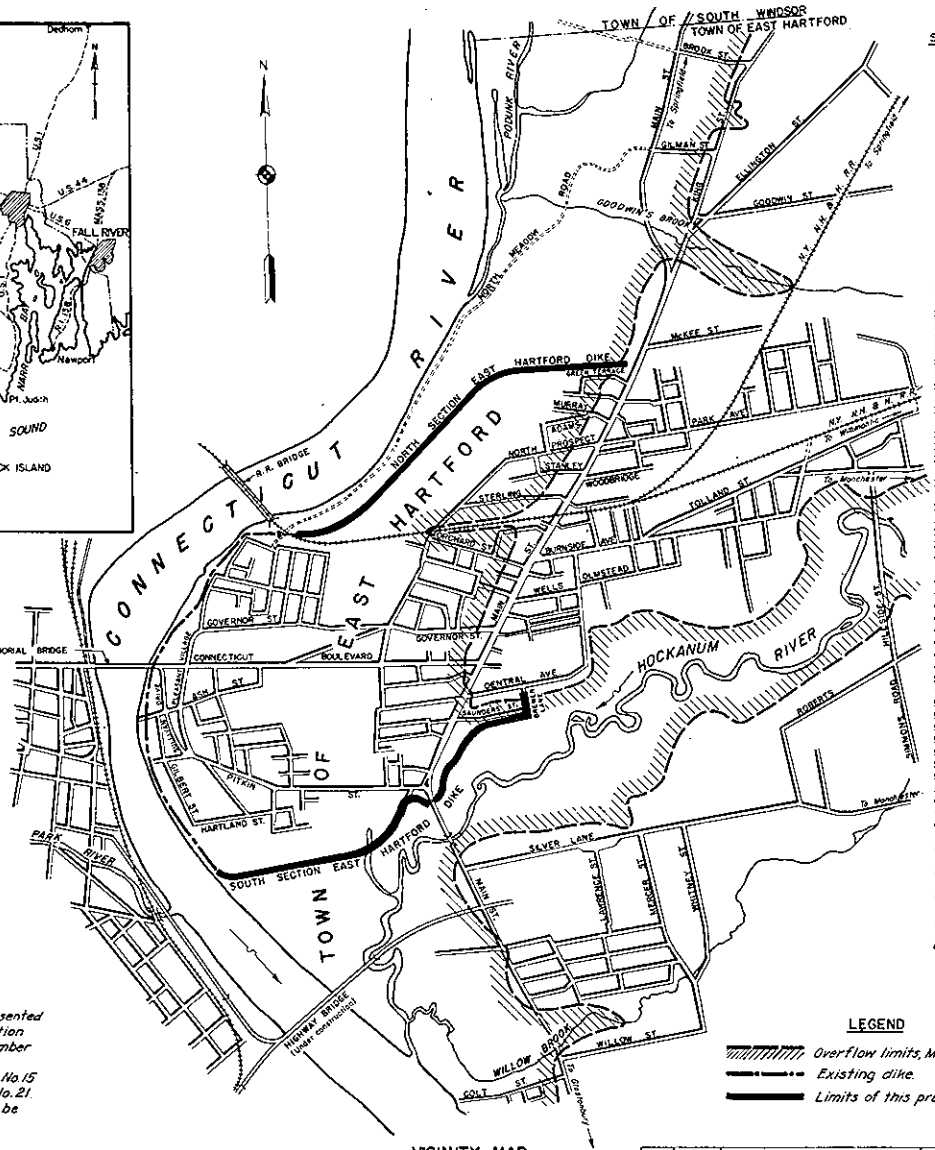
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




LOCATION MAP

SCALE: 1" = 10 MI.

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| 10 | SUBSURFACE EXPLORATIONS NO. 6 | CT-2-1317 |
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| 17 | PLAN AND PROFILE NO. 3 | CT-4-2786 |
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| 20 | PLAN AND PROFILE NO. 6 | CT-4-2789 |
| 21 | EMBANKMENT DETAILS NO. 1 | CT-4-2790 |
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| 31 | RAMP NO. 1 | CT-4-2800 |
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| 34 | PROTECTION OF RIVER BED AND BANK – GENERAL PLAN AND SECTIONS | CT-4-2803 |
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| 36 | STEEL SHEET PILING | CT-4-2805 |
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### EXPLANATION OF SECTION DESIGNATION

*The section designations used are represented by fractions, the numerator of which is the section reference and the denominator the sheet number on which the section is taken or shown.*

*Example: Section A is taken on Sheet No. 15 and the section is actually shown on Sheet No. 21. On Sheet No. 15 the section reference would be noted $\frac{A}{21}$ and on Sheet No. 21 the section would be noted $\frac{A}{15}$.*

### LEGEND

- *Overflow limits, March 1936 flood.*
- *Existing dike.*
- *Limits of this project.*

VICINITY MAP

SCALE: 1" = 1000'

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

CONNECTICUT RIVER FLOOD CONTROL

# EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

## PROJECT LOCATION AND INDEX

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1" = 1000 FT. — SHEET NO. 1

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: Chief, Design Section, Head, Design Section — APPROVAL RECOMMENDED: Principal Engineer, Chief, Engineering Div. — APPROVED: Lt. Col., Corps of Engineers, District Engineer

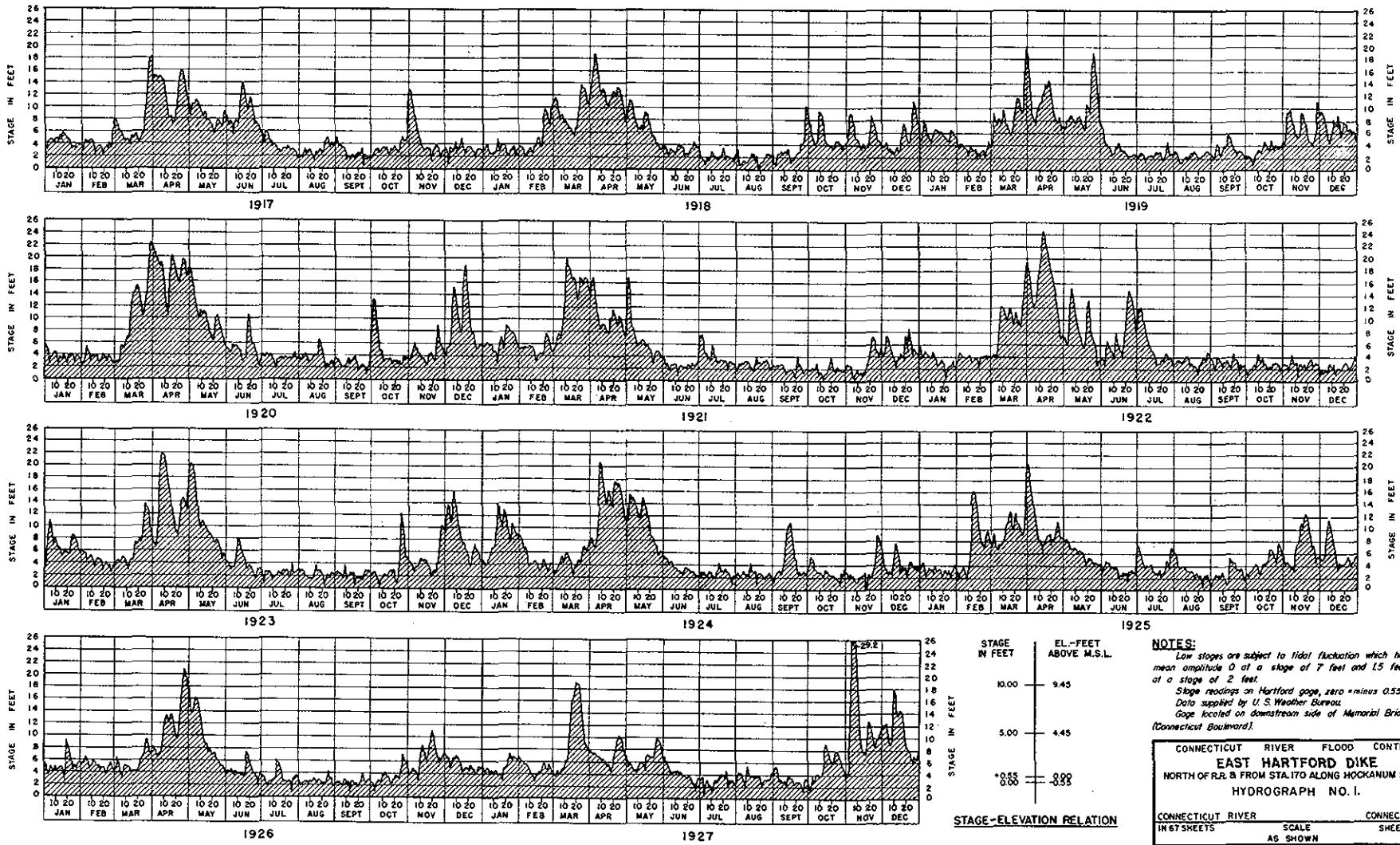
DESIGNED: Asst. Engineer — DRAWN: G.K.M. — TRACED: J.J.B. — CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-4-2782

PLATE NO. 1

EH. 3 to 5 incl.

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY.




| STAGE IN FEET | EL.-FEET ABOVE M.S.L. |
|---|---|
| 10.00 | 9.45 |
| 5.00 | 4.45 |
| +0.55 | 0.00 |
| 0.00 | -0.55 |

STAGE-ELEVATION RELATION

**NOTES:**

*Low stages are subject to tidal fluctuation which has a mean amplitude 0 at a stage of 7 feet and 1.5 feet at a stage of 2 feet.*

*Stage readings on Hartford gage, zero = minus 0.55' M.S.L.*

*Data supplied by U. S. Weather Bureau.*

*Gage located on downstream side of Memorial Bridge (Connecticut Boulevard).*

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

HYDROGRAPH NO. 1.

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE AS SHOWN — SHEET NO. 3

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

APPROVAL RECOMMENDED: P. B. Burns, PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV.

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

COMPILED: [signature], ASSOC. ENGINEER

DRAWN BY: W.R.V. & F.D.T.
TRACED BY: P.J.G.
CHECKED BY: [signature]

FISCAL YEAR 1941
FILE NO. CT-3-1186

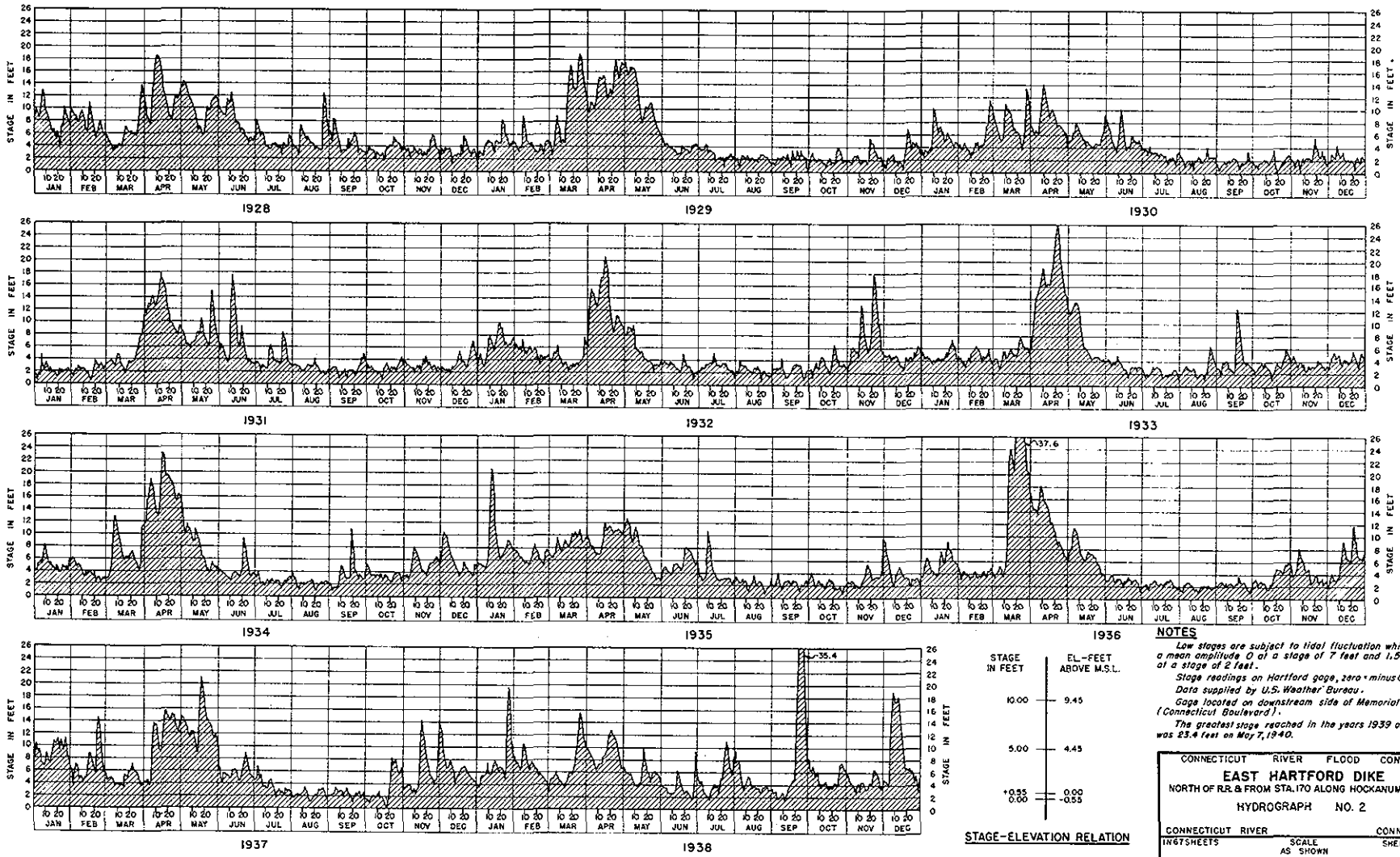
| KEY | DATE | REVISION (Indicated by △) | REV. BY | CK. BY | AP. BY |
|---|---|---|---|---|---|

EH. 3 to 5 incl.

PLATE NO. 2

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY




| STAGE IN FEET | EL.-FEET ABOVE M.S.L. |
|---|---|
| 10.00 | 9.45 |
| 5.00 | 4.45 |
| +0.55 | 0.00 |
| 0.00 | -0.55 |

STAGE-ELEVATION RELATION

## NOTES

*Low stages are subject to tidal fluctuation which has a mean amplitude 0 at a stage of 7 feet and 1.5 feet at a stage of 2 feet.*

*Stage readings on Hartford gage, zero = minus 0.55' M.S.L.*

*Data supplied by U.S. Weather Bureau.*

*Gage located on downstream side of Memorial Bridge (Connecticut Boulevard).*

*The greatest stage reached in the years 1939 and 1940 was 23.4 feet on May 7, 1940.*

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

HYDROGRAPH NO. 2

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE AS SHOWN — SHEET NO. 4

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: John B. Drake, ENGINEER, HEAD, HYDRAULICS SECTION CHIEF — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: George H. Mitchell, ASSOC. ENGINEER — DRAWN BY: W.W.V. & F.C.T. TRACED BY: W.H.M. CHECKED BY: [illegible] — FISCAL YEAR 1941 — FILE NO. CT-3-1187

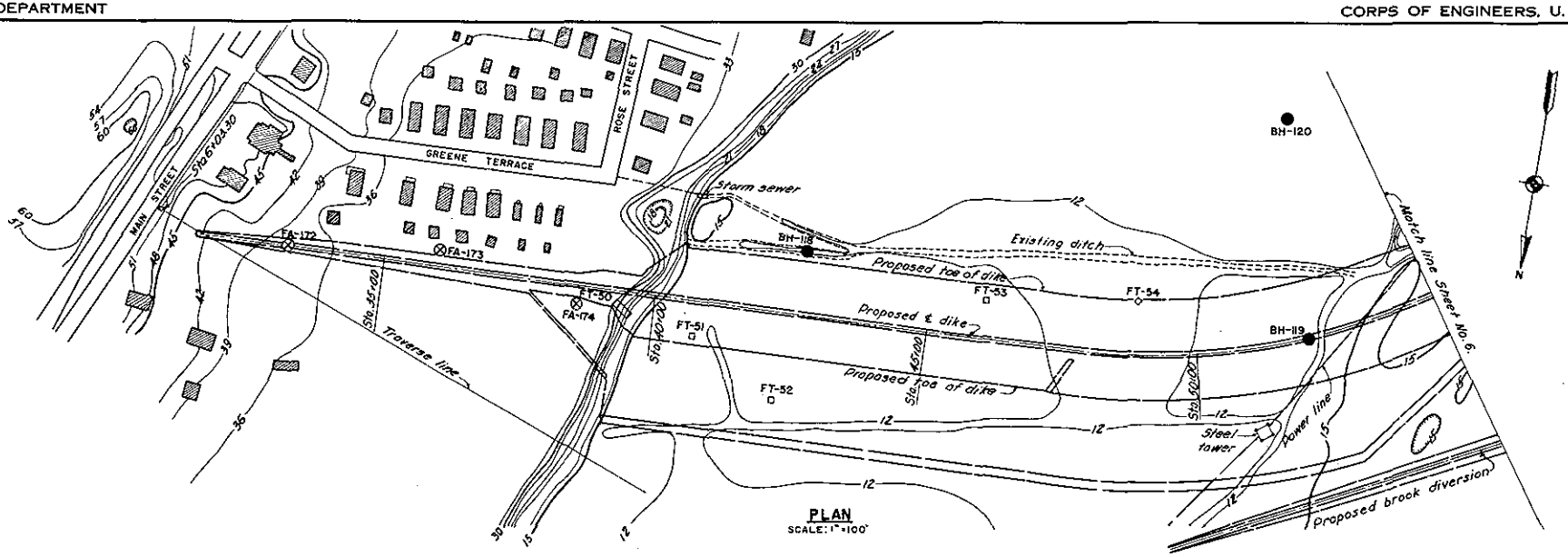
| KEY | DATE | REVISION (Indicated by Δ) | REV. BY | CK. BY | AP. BY |
|---|---|---|---|---|---|

EH. 3 to 5 incl.

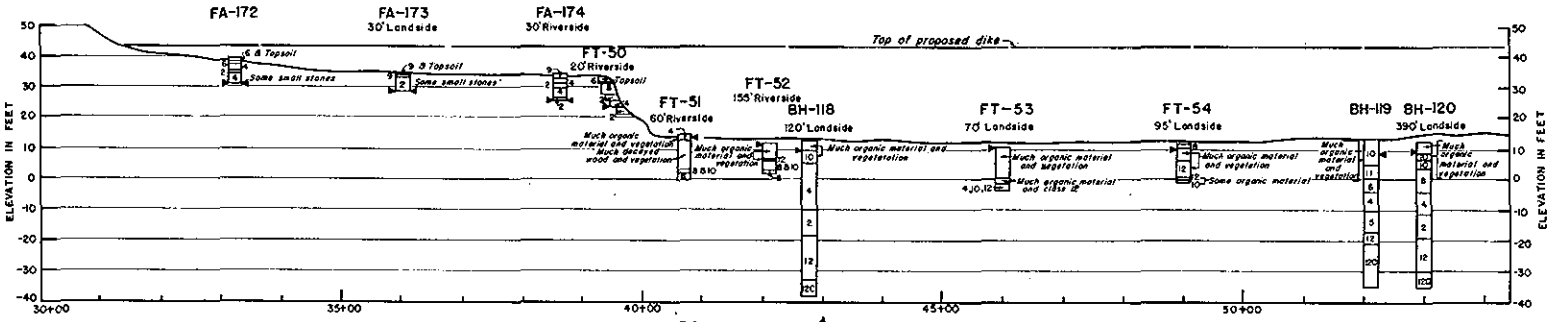
PLATE NO. 3

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




PLAN
SCALE: 1" = 100'




PROFILE ALONG ℄ DIKE
SCALE: HOR. 1" = 100' VERT. 1" = 20'

NOTE
For general notes, legend and description of soil classes, see "Subsurface Explorations No. 6," Sheet No. 10.

| KEY | DATE | REVISION (indicated by △) | REV. BY | CK. BY | AP. BY |
|---|---|---|---|---|---|

CONNECTICUT RIVER FLOOD CONTROL
EAST HARTFORD DIKE
NORTH OF R.R.8 FROM STA. 170 ALONG HOCKANUM RIVER
SUBSURFACE EXPLORATIONS NO. 1

CONNECTICUT RIVER — CONNECTICUT
IN 6 SHEETS — SCALE 1 IN. = 100 FT. — SHEET NO. 5

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

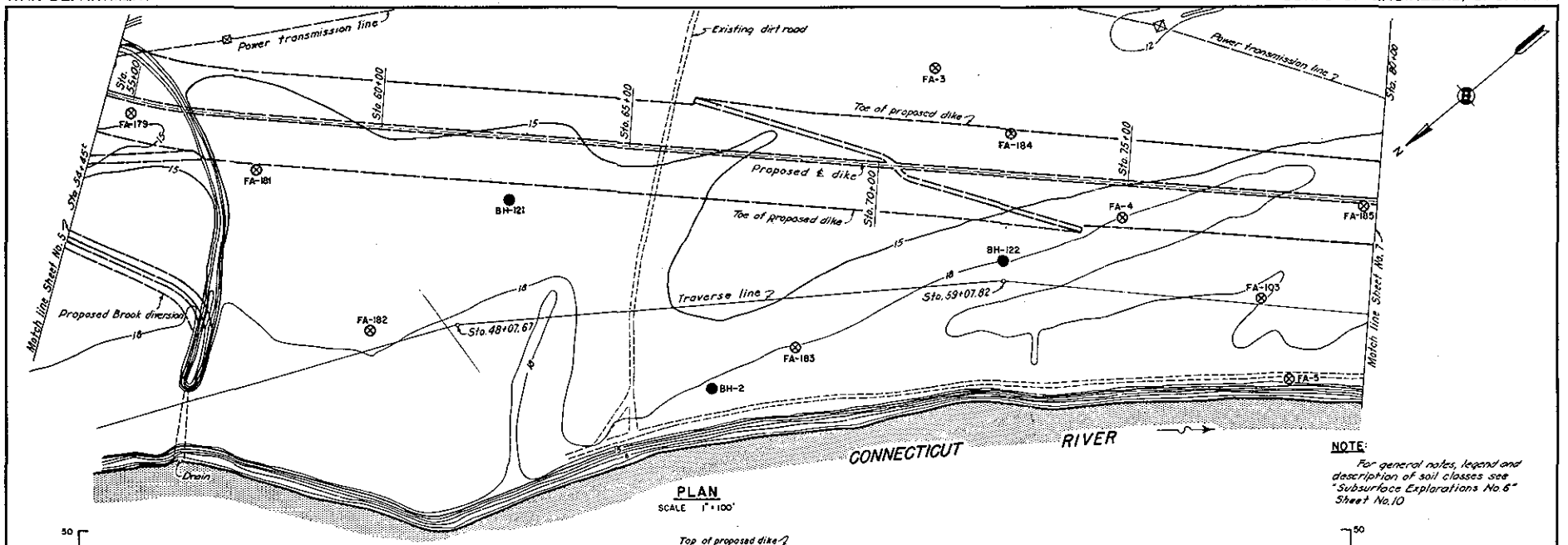
COMPILED: ASST. ENGINEER — DRAWN: H.G.L. TRACED: A.J.H. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-2-1312

EH. 3 to 5 incl.

PLATE NO. 4

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

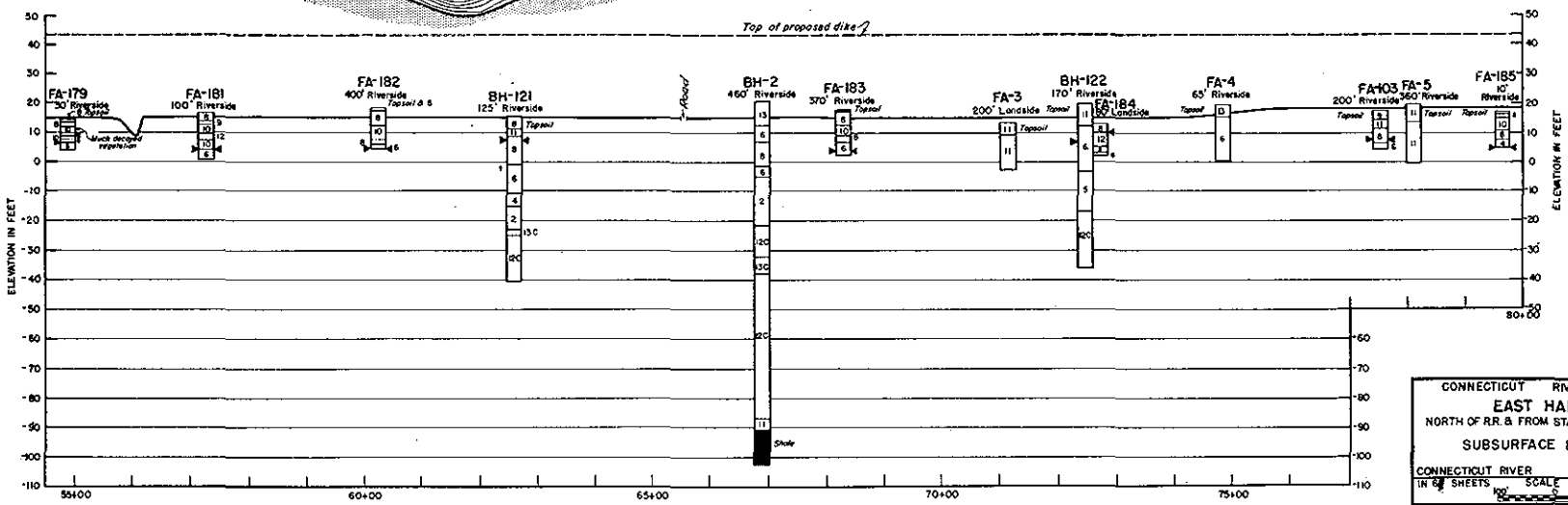



PLAN

SCALE 1" = 100'

NOTE:

For general notes, legend and description of soil classes see "Subsurface Explorations No. 6" Sheet No. 10




PROFILE ALONG ℄ DIKE

SCALE: HOR. 1" = 100' VERT. 1" = 20'

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

SUBSURFACE EXPLORATIONS NO. 2

CONNECTICUT RIVER — CONNECTICUT

IN 6 SHEETS — SCALE 1 IN. = 100 FT. — SHEET NO. 6

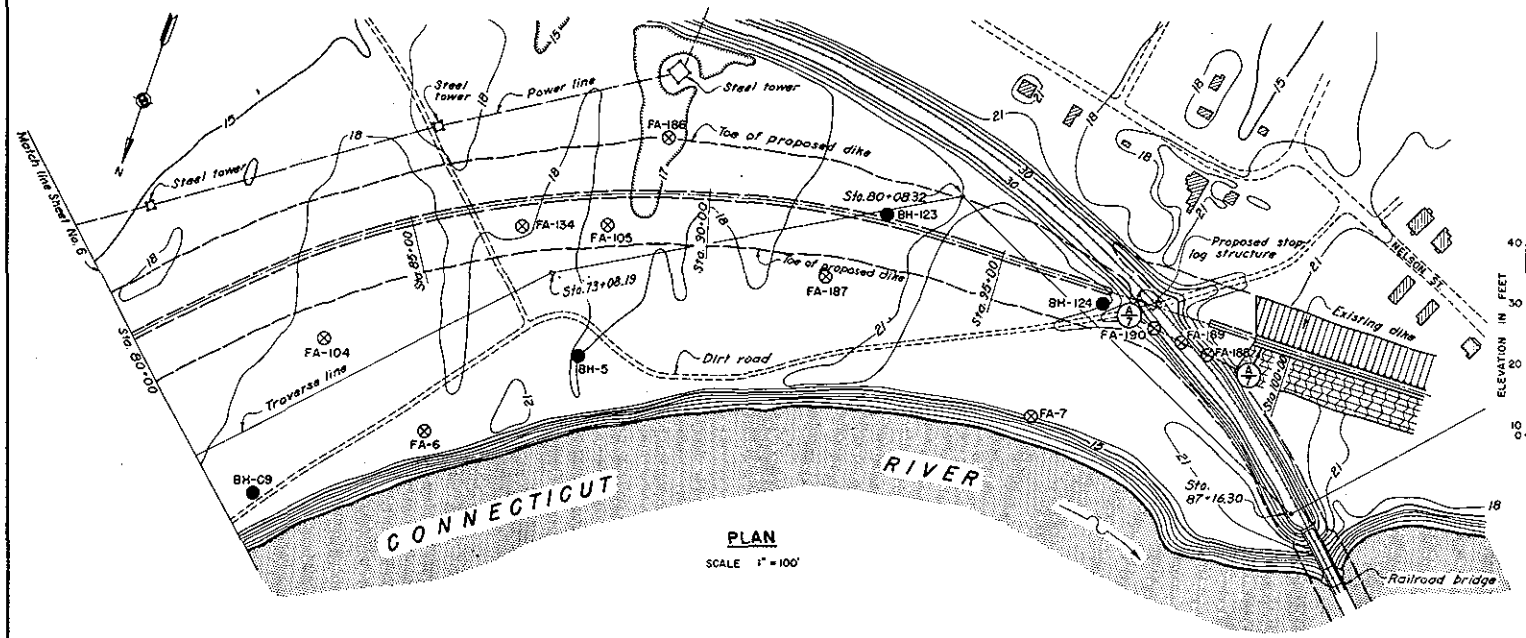
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. FEB. 1941

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

COMPILED: ASST. ENGINEER — DRAWN: H.G.L. TRACED: H.H.L. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-2-1313

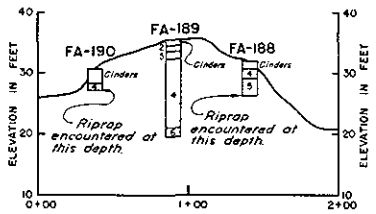
PLATE NO. 5

EH. 3 to 5 incl.



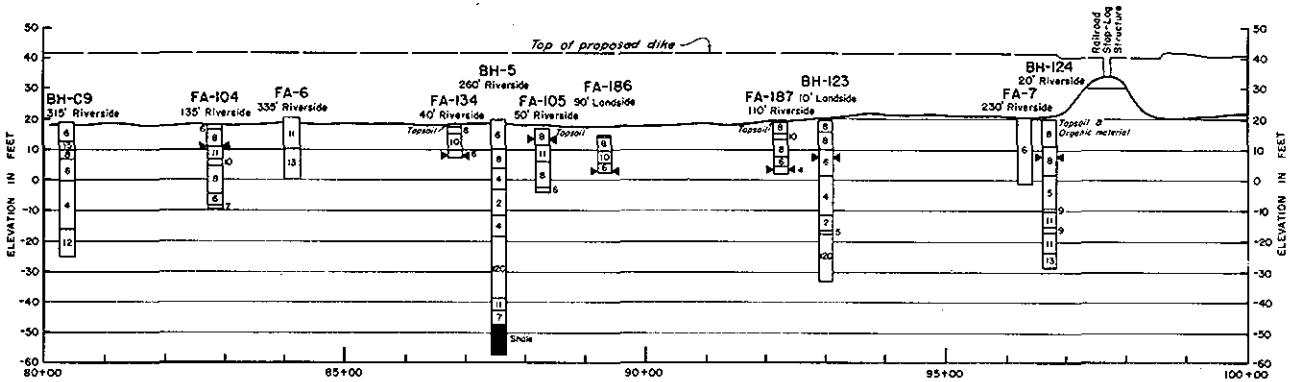

PLAN

SCALE 1" = 100'




SECTION A/7

SCALE: HOR. 1" = 40'
VERT. 1" = 10'




PROFILE ALONG ℄ DIKE

SCALE: HOR. 1" = 100'
VERT. 1" = 20'

NOTES

*For general notes, legend, and description of soil classes, see "Subsurface Explorations No. 5," Sheet No. 10.*

*For explanation of Section designations see Sheet No. 1*

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF RR. & FROM STA. 170 ALONG HOCKANUM RIVER

SUBSURFACE EXPLORATIONS NO. 3

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 100 FT. — SHEET NO. 7

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. FEB. 1941

SUBMITTED: LYON BUSSERT, HEAD, GEOLOGY SECTION

APPROVED: RECOMMENDED: CHIEF, ENGINEERING DIVISION

APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASST. ENGINEER

DRAWN: H.R.L. TRACED: C.W.B. CHECKED:

FISCAL YEAR 1941

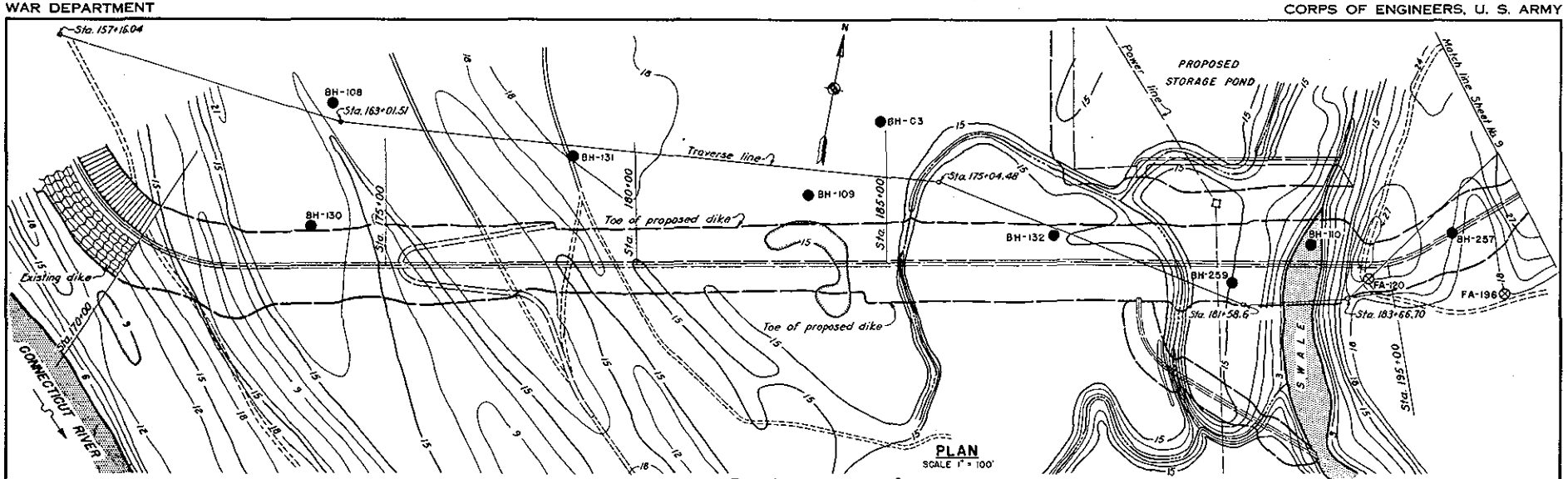
FILE NO. CT-2-1314

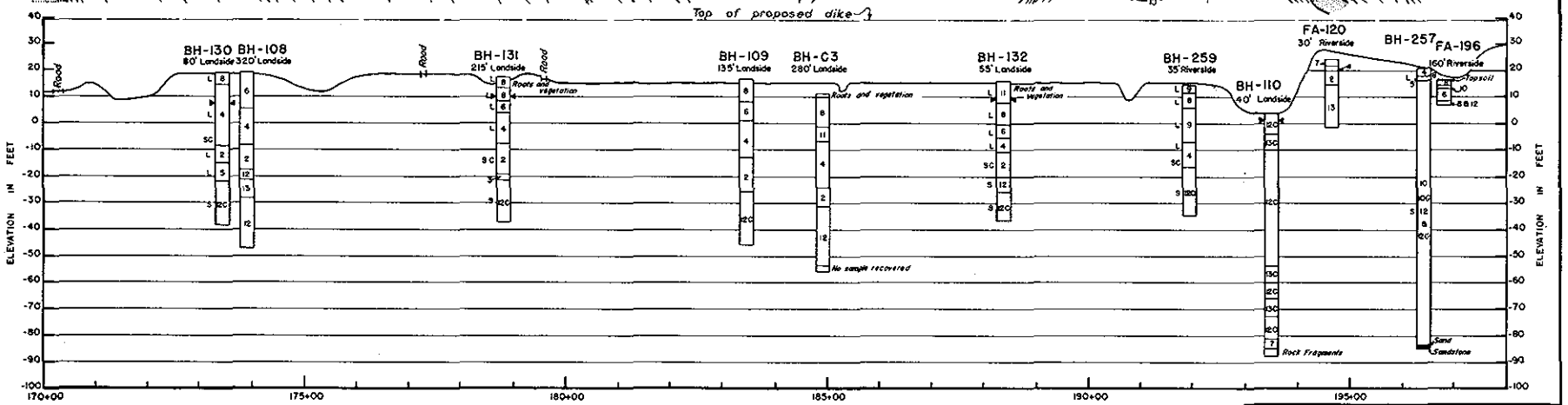
EH.3 to 5 incl.

PLATE NO. 6

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




## PROFILE ALONG ℄ DIKE

SCALE: HOR. 1" = 100'
VERT. 1" = 20'

NOTE

For general notes, legend, and description of soil classes see "Subsurface Explorations No. 6." Sheet No. 10.

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

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

SUBSURFACE EXPLORATIONS NO. 4

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 100 FT. (100' 0 100' 200') — SHEET NO. 8

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

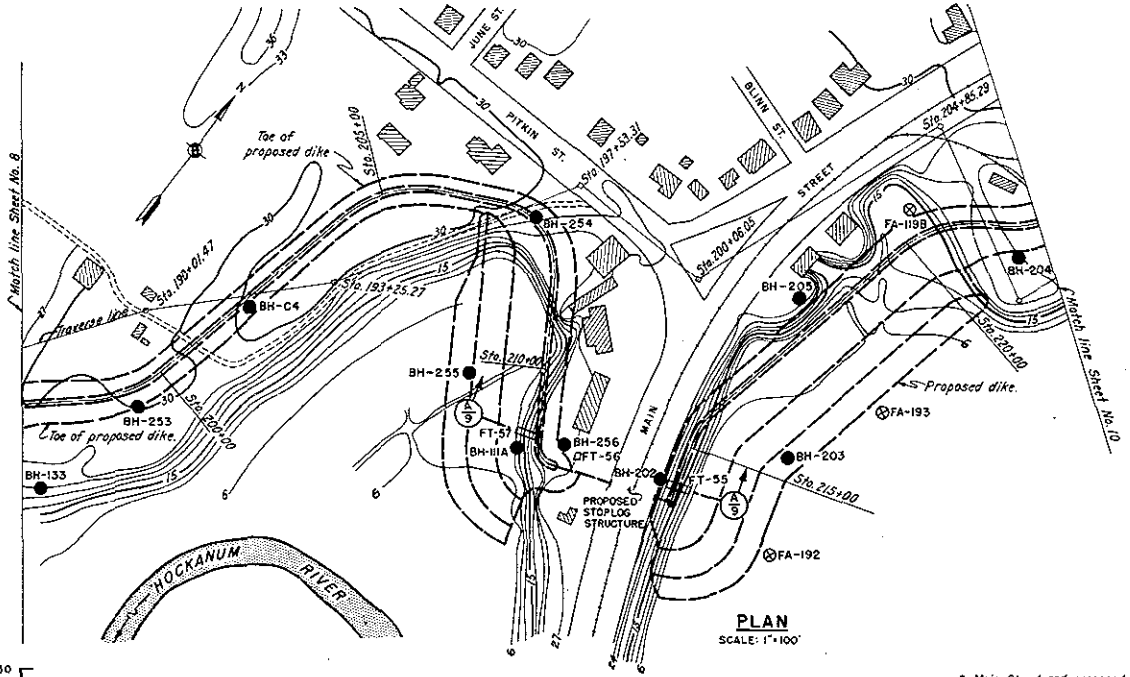
COMPILED: ASST. ENGINEER — DRAWN: H.R.L. TRACED: H.R.L. CHECKED

FISCAL YEAR 1941

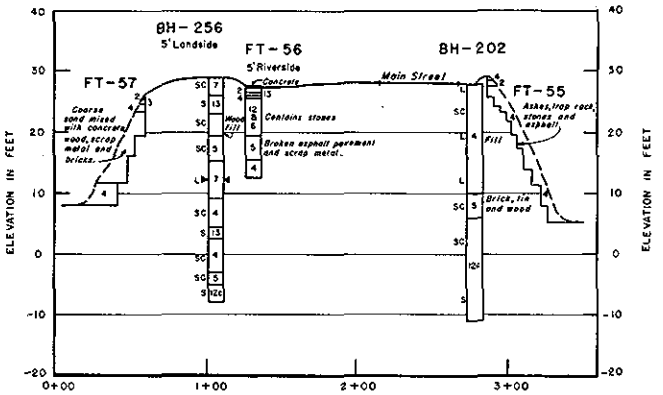
FILE NO. CT-2-1315

PLATE NO. 7

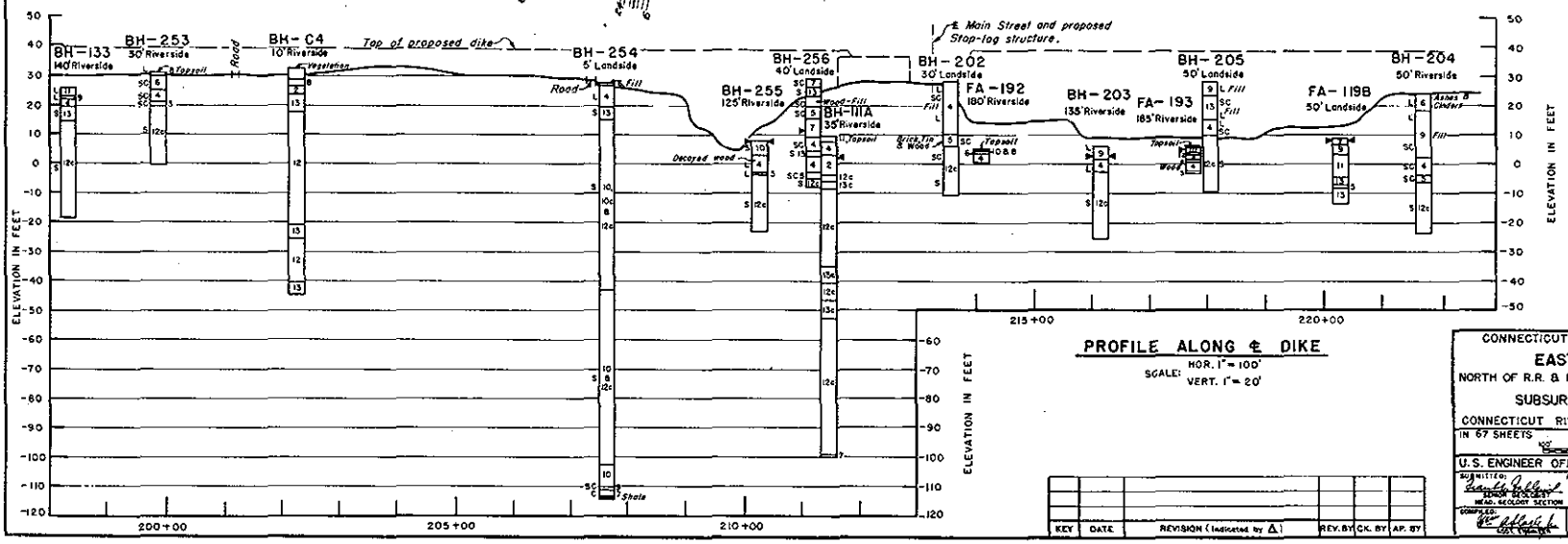
EH. 3 to 5 incl.




**PLAN**
SCALE: 1" = 100'




**SECTION A/S**
SCALE: HOR. 1" = 40'
VERT. 1" = 10'




**PROFILE ALONG ℄ DIKE**
SCALE: HOR. 1" = 100'
VERT. 1" = 20'

**NOTE**

*For general notes, legend, and description of soil classes, see "Subsurface Explorations No. 6", Sheet No. 10.*

*For explanation of Section designations see Sheet No. 1*

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

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

SUBSURFACE EXPLORATIONS NO. 5

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1 IN. = 100 FT. — SHEET NO. 9

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: Henry Ahlquist, HEAD, GEOLOGY SECTION — APPROVAL RECOMMENDED: [illegible], CHIEF, ENGINEERING DIV. — APPROVED: [illegible], LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

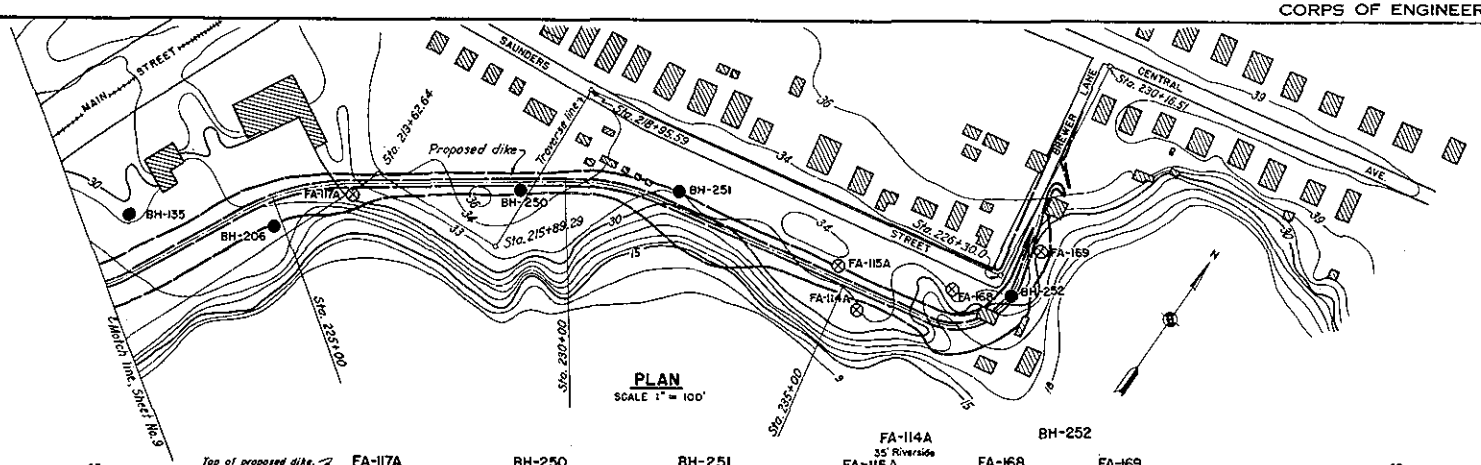
COMPILED: [illegible] — DRAWN: R. G. L. — TRACED: R. J. S. — CHECKED: [illegible] — FISCAL YEAR 1941 — FILE NO. CT-2-1316

PLATE NO. 8

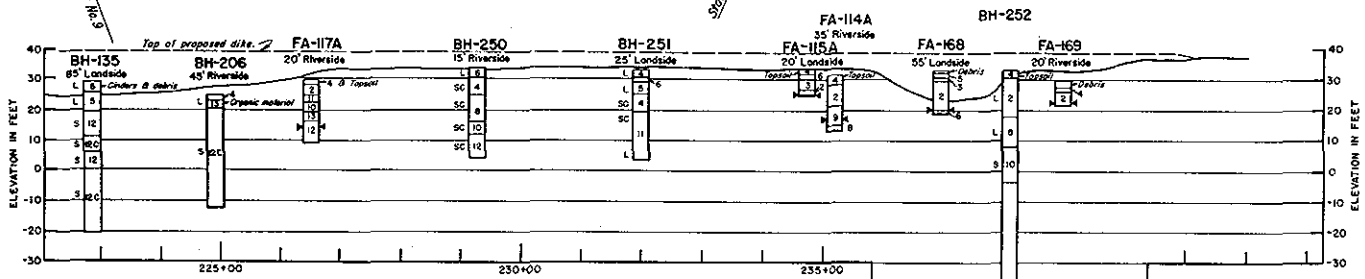
EH. 3 to 5 incl.

WAR DEPARTMENT

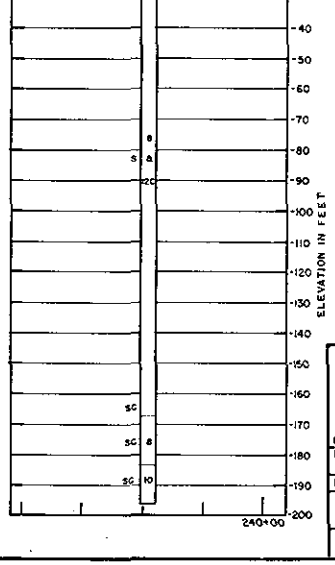
CORPS OF ENGINEERS, U. S. ARMY




PLAN
SCALE 1" = 100'




PROFILE ALONG ℄ DIKE
SCALE HOR. 1" = 100'
VERT. 1" = 20'




## DESCRIPTION OF SOIL CLASSES

1. Graded from Gravel to Coarse Sand - Contains little medium sand.
2. Coarse to Medium Sand - Contains little gravel and fine sand.
3. Graded from Gravel to Medium Sand - Contains little fine sand.
4. Medium to Fine Sand - Contains little coarse sand and coarse silt.
5. Graded from Gravel to Fine Sand - Contains little coarse silt.
6. Fine Sand to Coarse Silt - Contains little medium sand and medium silt.
7. Graded from Gravel to Coarse Silt - Contains little medium silt.
8. Coarse to Medium Silt - Contains little fine sand and fine silt.
9. Graded from Gravel to Medium Silt - Contains little fine silt.
10. Medium to Fine Silt - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.

10C Medium Silt to Coarse Clay - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.

11. Graded from Gravel or Coarse Sand to Fine Silt - Contains little coarse clay.
12. Fine Silt to Clay - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.

12C Clay - Contains little silt. Possesses behavior characteristics of clay.

13. Graded from Coarse Sand to Clay - Contains little fine clay (colloids). Possesses behavior characteristics of silt.

13C Clay - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

## LEGEND

- ● BH - Dry sample bore hole.
- ⊗ FA - Foundation auger boring.
- □ FT - Foundation test pit.
- S - Soft material.
- L - Loose material.
- SC - Slightly compact material.
- C - Compact material.
- VC - Very compact material
- ⊳| |⊲ - Water table at time of exploration

## NOTES

*Elevations refer to Mean Sea Level Datum.*

*Compactness was determined by the number of blows required to drive a 2 inch O.D. sample spoon one foot with a 300 pound hammer dropped 18 inches.*

*Classes 8, 10, 10C, 12, 12C, 13 and 13C indicated in the bore hole records generally occur in alternating bands, having thin layers of clay interbedded with thicker layers of silt.*

*The logs, samples and test results pertaining to the above investigations may be inspected at the United States Engineer Office, Providence, Rhode Island.*

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. 8 FROM STA. 170 ALONG HOCKANUM RIVER

SUBSURFACE EXPLORATIONS NO. 6

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 100 FT. — SHEET NO. 10

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

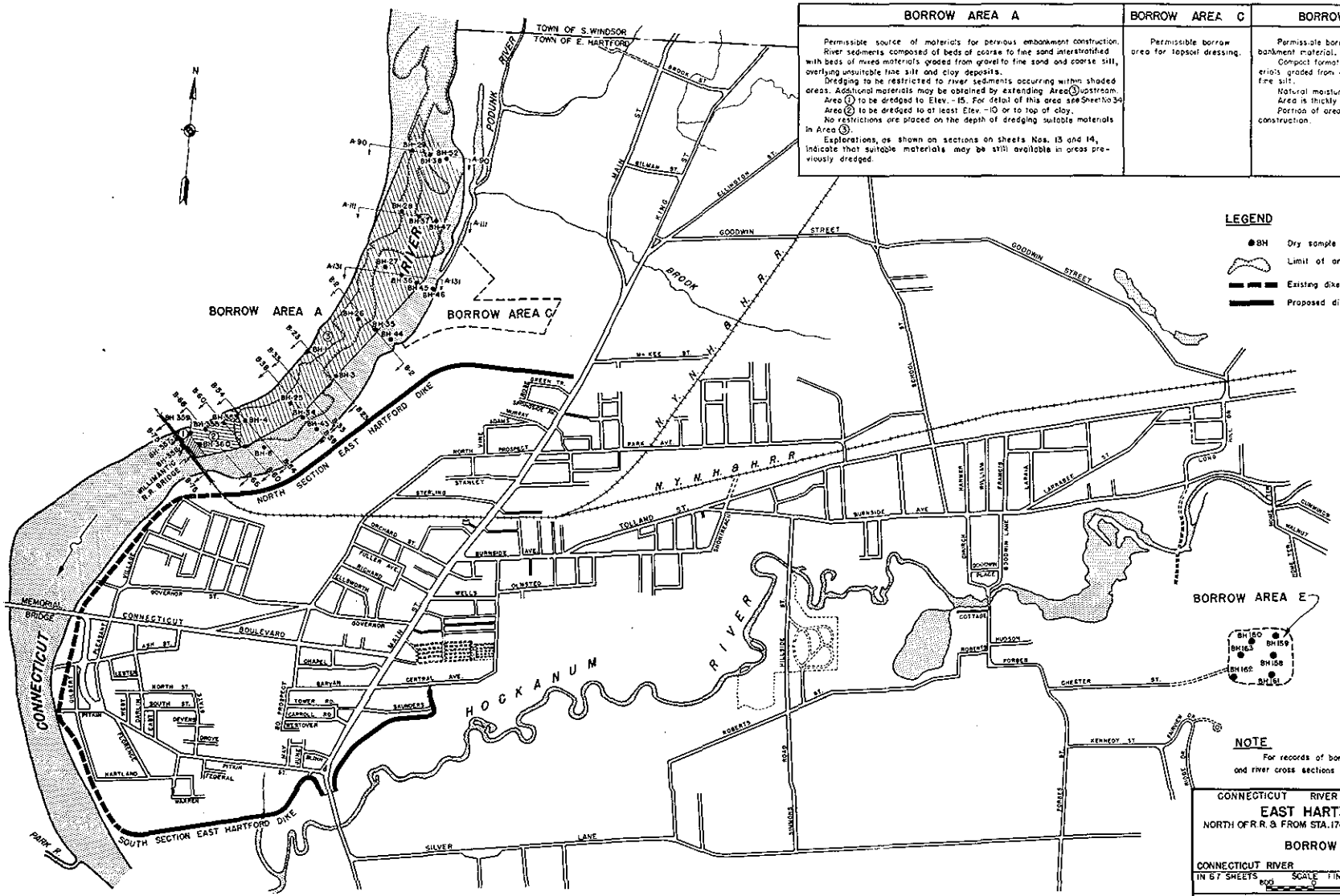
SUBMITTED: SENIOR GEOLOGIST, HEAD, GEOLOGY SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASST. ENGINEER — DRAWN: H.W.L. TRACED: G.C.W. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-2-1317

EH. 3 to 5 incl.

PLATE NO. 9

| BORROW AREA A | BORROW AREA C | BORROW AREA E |
|---|---|---|
| Permissible source of materials for pervious embankment construction. River sediments composed of beds of coarse to fine sand interstratified with beds of mixed materials graded from gravel to fine sand and coarse silt, overlying unsuitable fine silt and clay deposits.<br>Dredging to be restricted to river sediments occurring within shaded areas. Additional materials may be obtained by extending Area (3) upstream.<br>Area (1) to be dredged to Elev. -15. For detail of this area see Sheet No 34<br>Area (2) to be dredged to at least Elev. -10 or to top of clay.<br>No restrictions are placed on the depth of dredging suitable materials in Area (3).<br>Explorations, as shown on sections on sheets Nos. 13 and 14, indicate that suitable materials may be still available in areas previously dredged. | Permissible borrow area for topsoil dressing. | Permissible borrow area for impervious embankment material.<br>Compact formation composed of mixed materials graded from gravel and coarse sand to fine silt.<br>Natural moisture content varies.<br>Area is thickly wooded.<br>Portion of area previously used for dike construction. |




## LEGEND

- ● BH — Dry sample bore hole.
- Limit of area previously dredged.
- Existing dike.
- Proposed dike.

## NOTE

For records of borings in borrow areas and river cross sections see sheets No. 13 & 14.

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

CONNECTICUT RIVER FLOOD CONTROL

# EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

## BORROW AREAS

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 800 FT. — SHEET NO. 12

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: LOUIS SCHUCHERT, HEAD, GEOLOGY SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

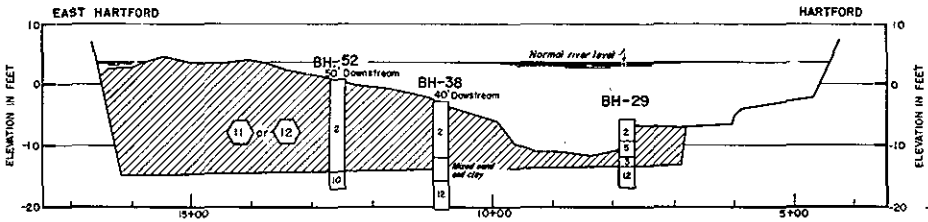
COMPILED: — DRAWN: R.H.S. TRACED: D.E.R. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-2-1319

PLATE NO. 10

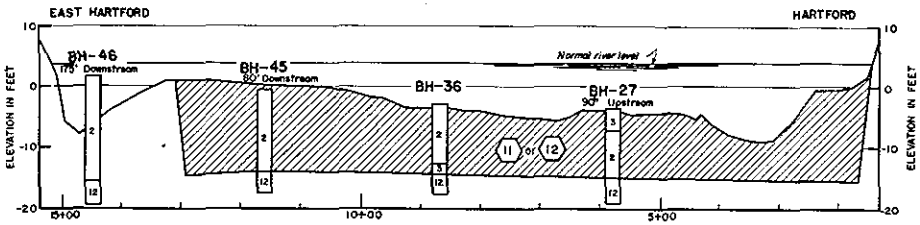
EH. 3 to 5 incl.

WAR DEPARTMENT

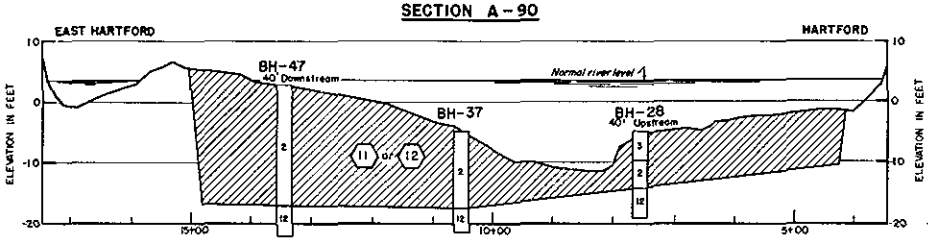
CORPS OF ENGINEERS, U. S. ARMY



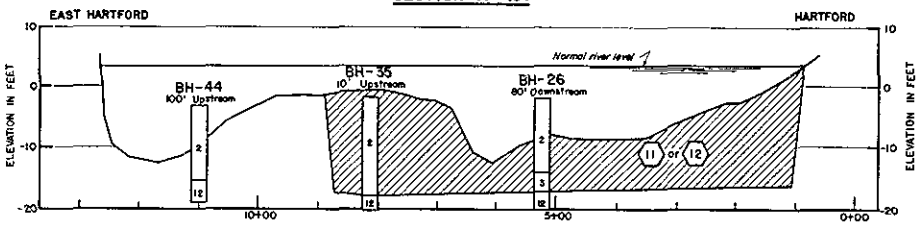

SECTION A-90



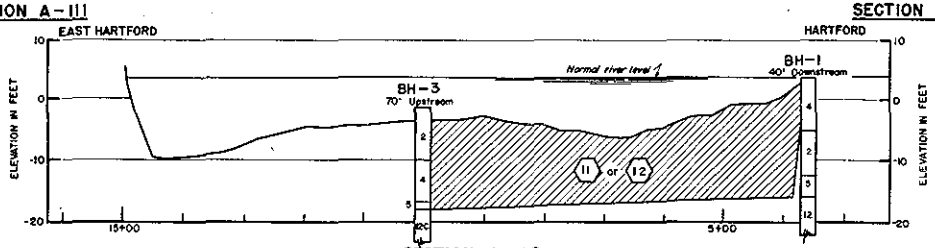

SECTION A-131



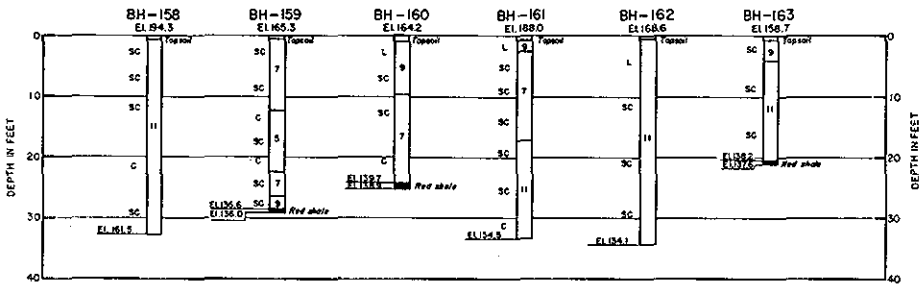

SECTION A-111




SECTION B-2




SECTION B-23




RECORD OF BORE HOLES IN BORROW AREA "E"

## NOTES

For general notes, legend and description of soil classes see "Subsurface Explorations No. 6," Sheet No. 10.

For locations of borings and river cross sections see "Borrow Areas," Sheet No. 12.

Borings in the river were completed in 1937 and 1938, prior to dredging for construction of North Meadows dike, Hartford. Borings in Borrow Area E were completed in 1939, prior to opening the pit for use in constructing portions of East Hartford Dike.

River cross sections were made after dredging was completed.

Shaded areas indicate approximate limits of permissible borrow. The top of clay, as shown, is definite only at points of exploration.

Figures in hexagons indicate item numbers under which payment will be made.

Additional river cross sections are available for inspection of the United States Engineer Offices at Providence, R.I., and East Hartford, Conn.

| KEY | DATE | REVISION | REV. BY | CK. BY | AP. BY |
|---|---|---|---|---|---|

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

RECORD OF BORROW EXPLORATIONS AND RIVER CROSS-SECTIONS NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: HOR. 1" = 100' VERT. 1" = 10' — SHEET NO. 13

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

COMPILED: ASST. ENGINEER — DRAWN: K.G.L. TRACED: N.K.L. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-2-1320

PLATE NO. 11

# PROVIDENCE DISTRICT SOIL CLASSIFICATION

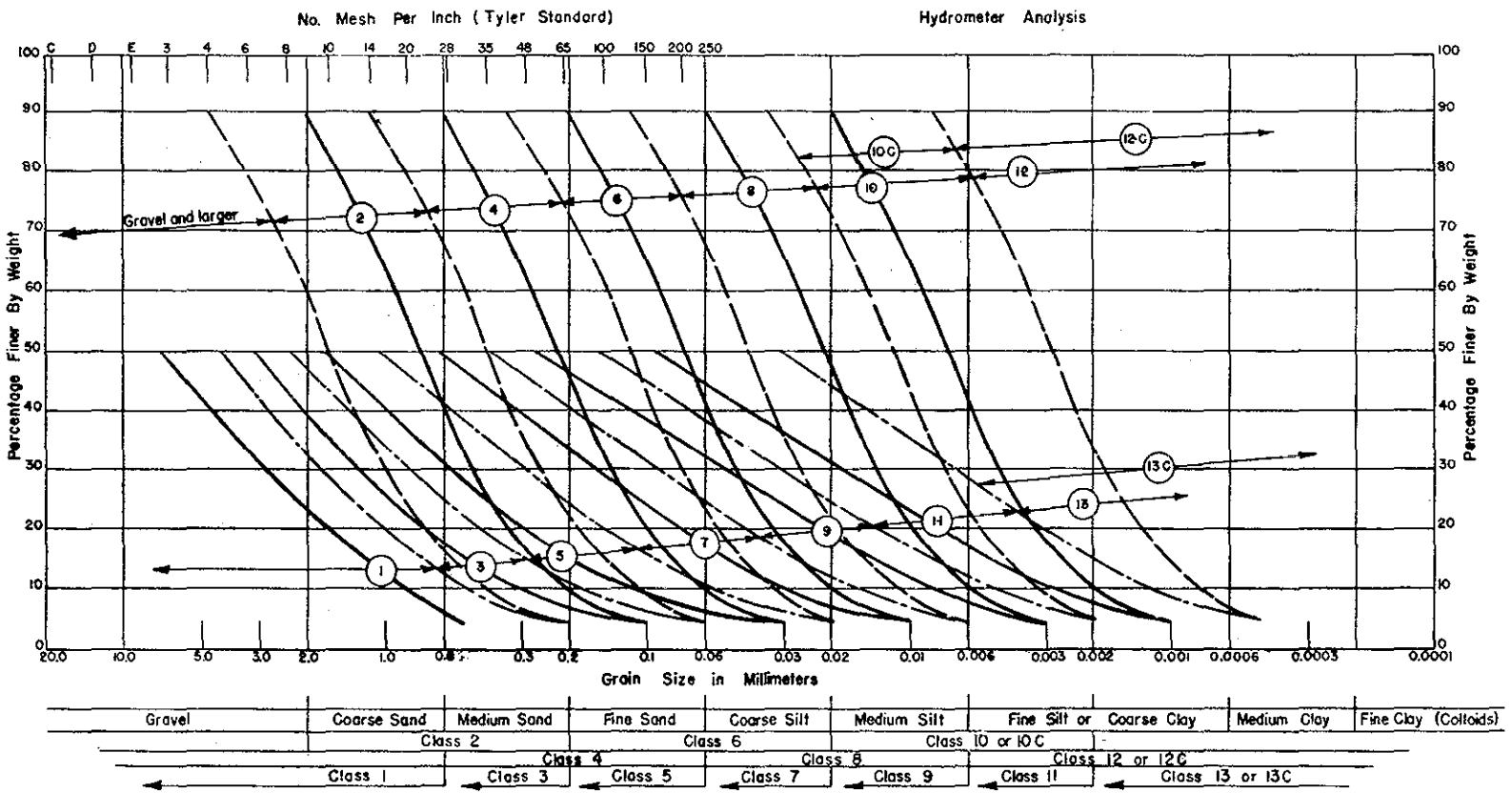
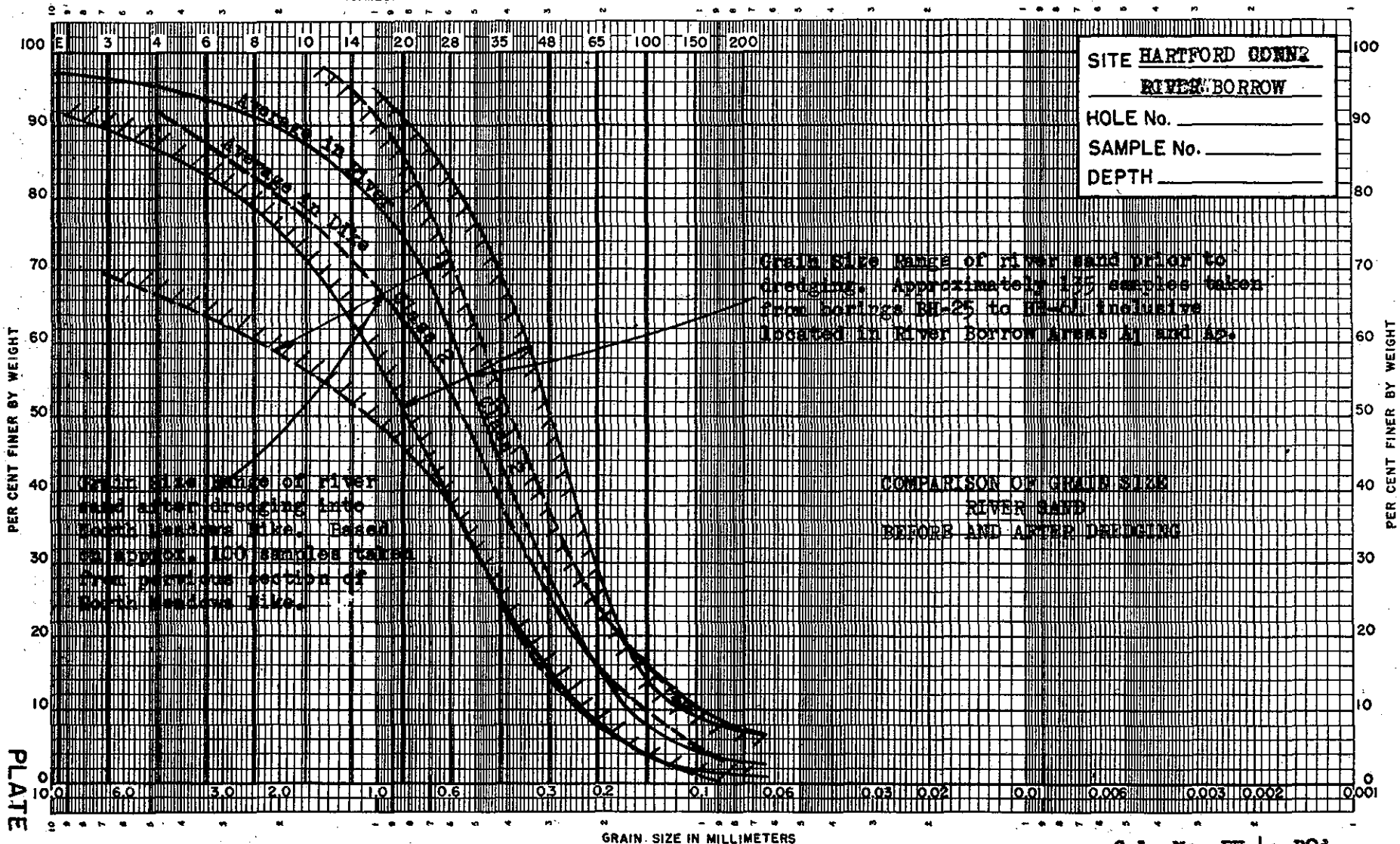



DIAGRAM SHOWING LIMITS OF SOIL CLASSES

PLATE NO. 12

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



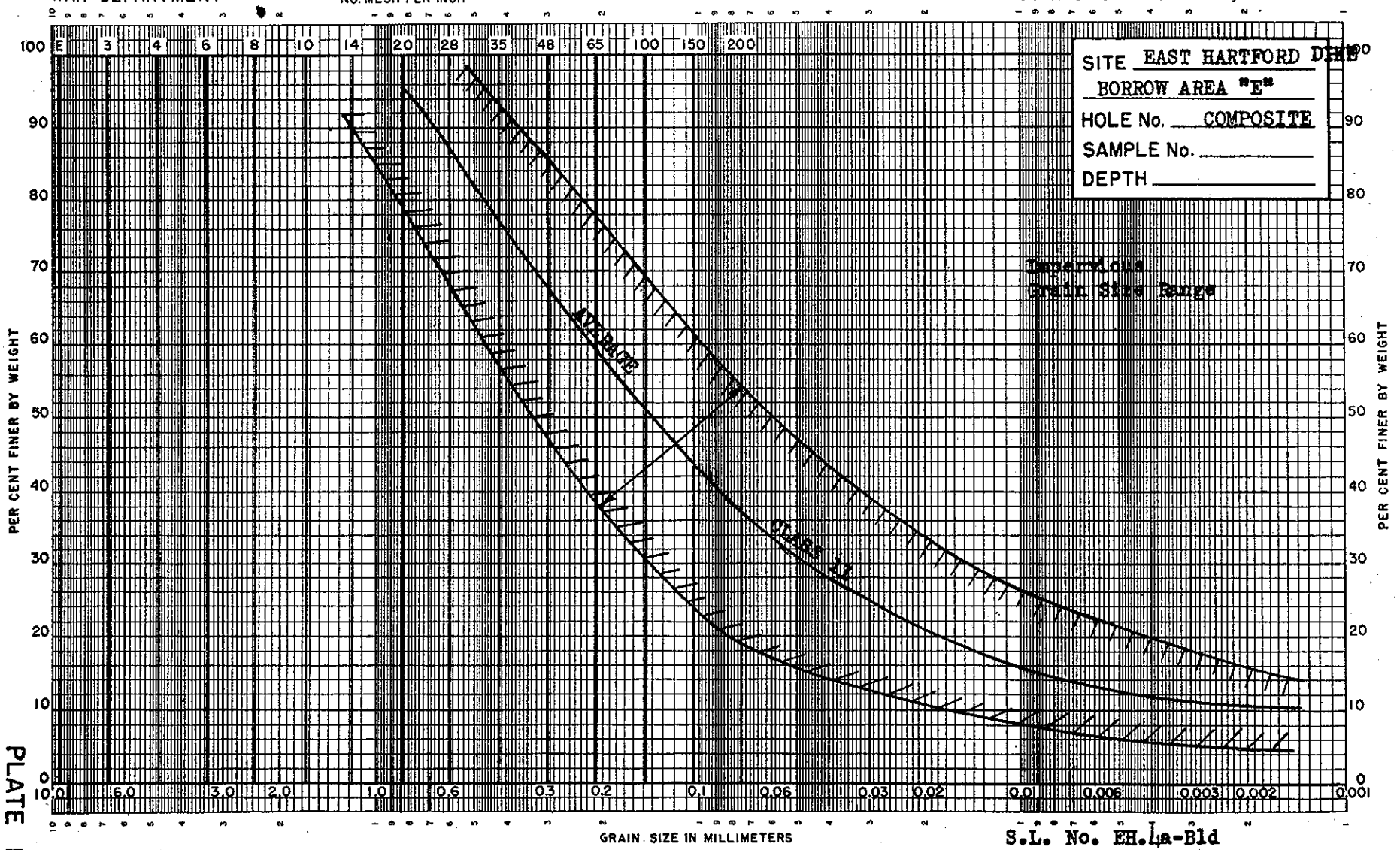

S.L. No. EH.4a-B2d

| Gravel | Coarse Sand | Medium Sand | Fine Sand | Coarse Silt | Medium Silt | Fine Silt or | Coarse Clay |
|---|---|---|---|---|---|---|---|
| Class 1 | Class 2 | | Class 6 | | Class 10 or 10C | | Class 12 or 12C |
| | | Class 4 | | Class 8 | | | |
| | Class 3 | | Class 5 | Class 7 | Class 9 | Class 11 | Class 13 or 13C |

PLATE NO. 13

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




S.L. No. EH.La-Bld

| Gravel | Coarse Sand | Medium Sand | Fine Sand | Coarse Silt | Medium Silt | Fine Silt or | Coarse Clay |
|---|---|---|---|---|---|---|---|
| Class 1 | Class 2 | | Class 6 | | Class 10 or 10C | | Class 12 or 12C |
| | | Class 4 | | Class 8 | | | |
| | Class 3 | | Class 5 | Class 7 | Class 9 | Class 1. | Class 13 or 13C |

SOILS LABORATORY

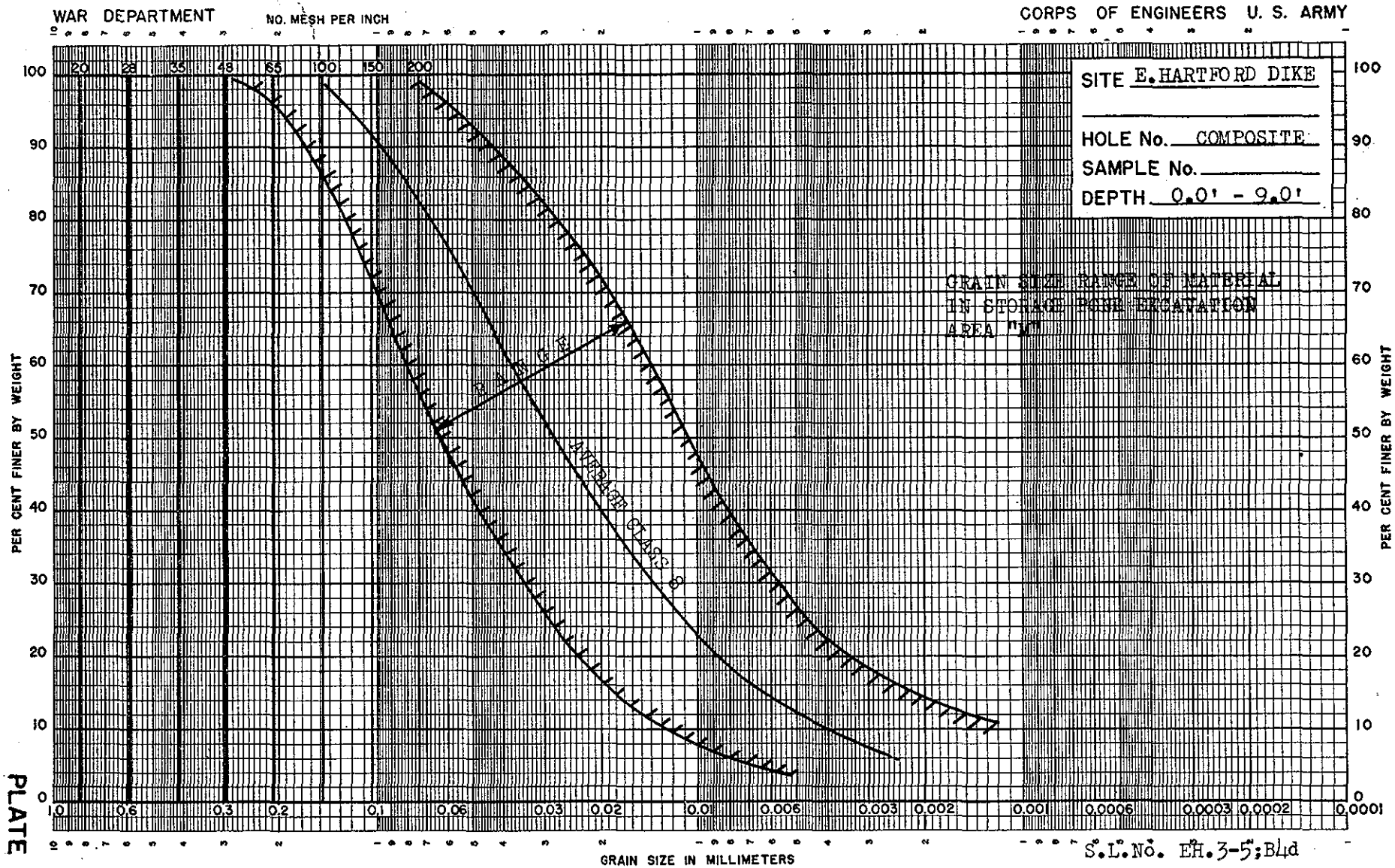
MECHANICAL ANALYSIS

PROVIDENCE, R.I.

PLATE NO. 14

WAR DEPARTMENT

CORPS OF ENGINEERS U. S. ARMY




S.L.No. EH.3-5;B4d

| Coarse Sand | Medium Sand | Fine Sand | Coarse Silt | Medium Silt | Fine Silt or Coarse Clay | Medium Clay | Colloids |
|---|---|---|---|---|---|---|---|
| Class 2 | | Class 6 | | Class 10 or 10C | | Class 12 or 12C | |
| | Class 4 | | Class 8 | | | | |
| Class 3 | Class 5 | Class 7 | Class 9 | Class 11 | Class 13 or 13C | | |

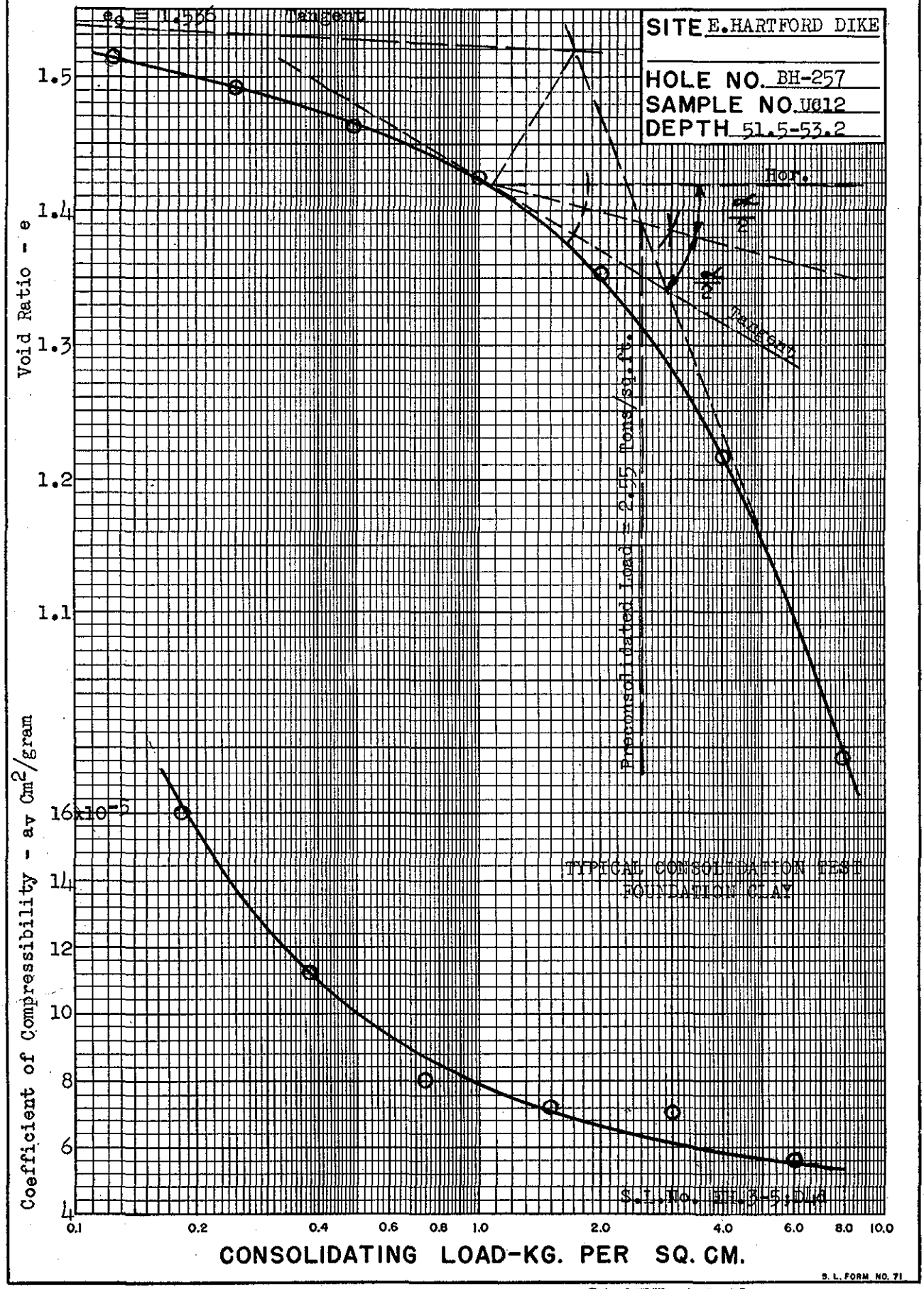
SOILS LABORATORY

MECHANICAL ANALYSIS

PROVIDENCE, R.I.

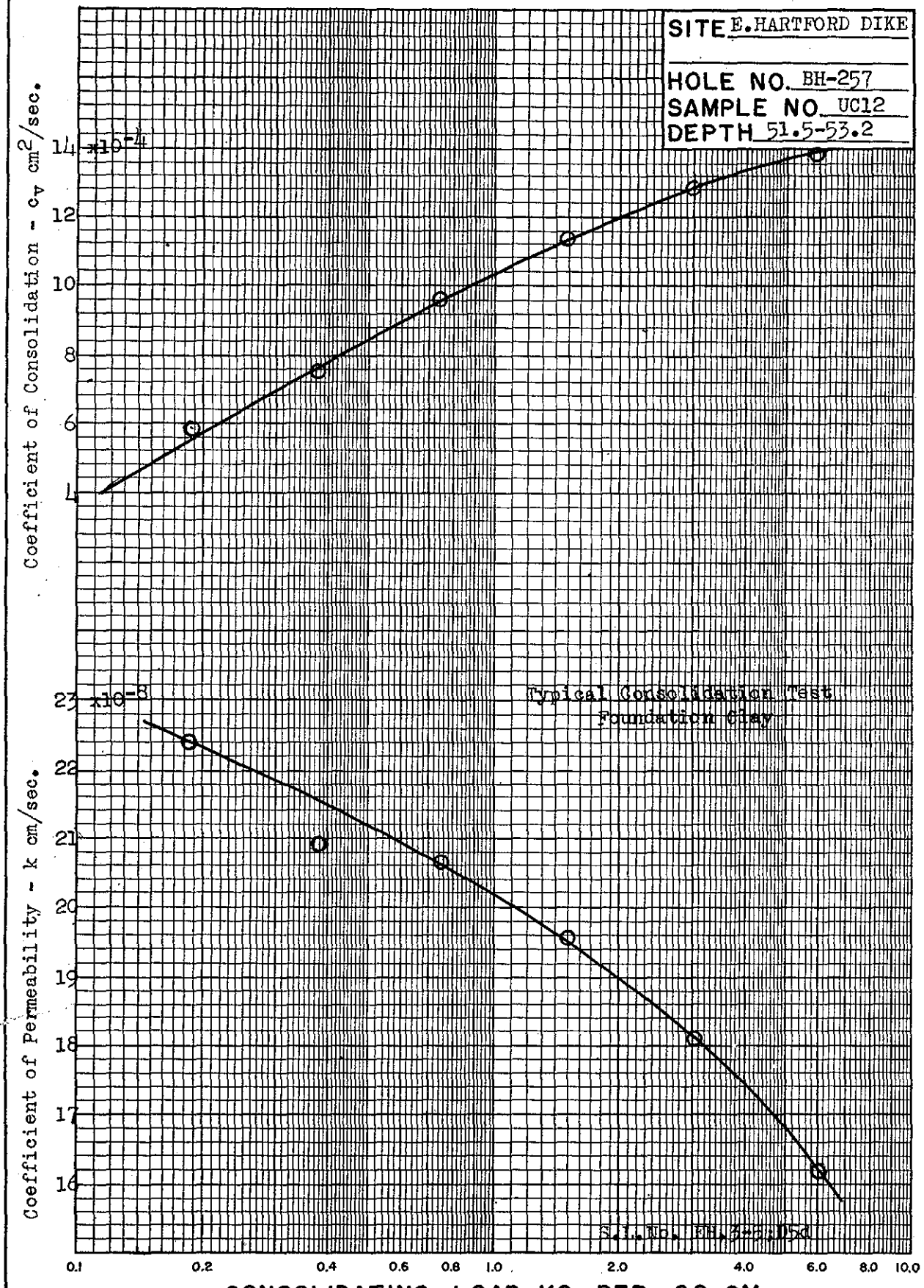
PLATE NO. 15

# CONSOLIDATION CHARACTERISTICS




S. L. FORM NO. 71

# CONSOLIDATION CHARACTERISTICS




S. L. FORM NO. 71

# SHEAR TEST

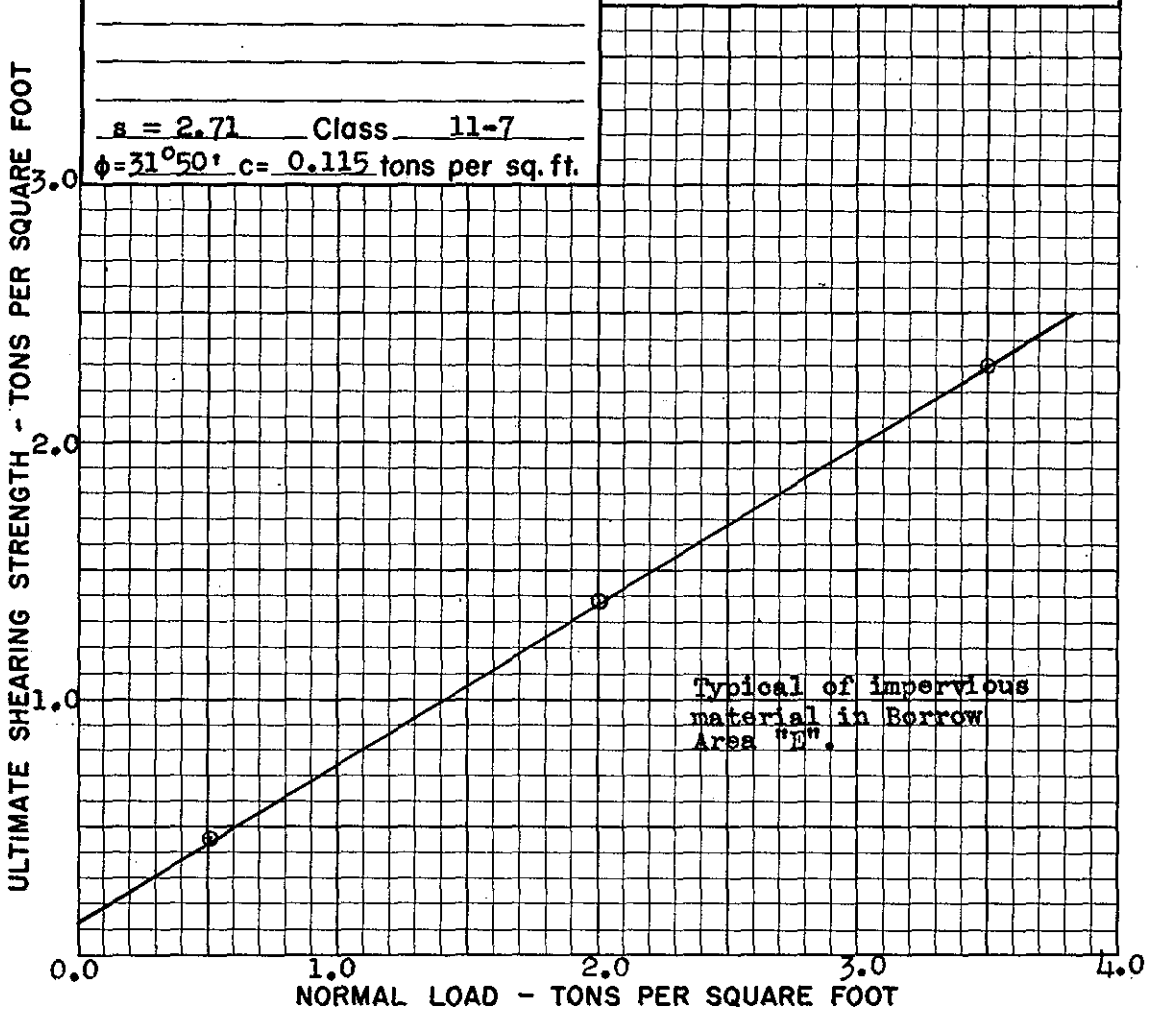
**SUPPLEMENTARY DATA**

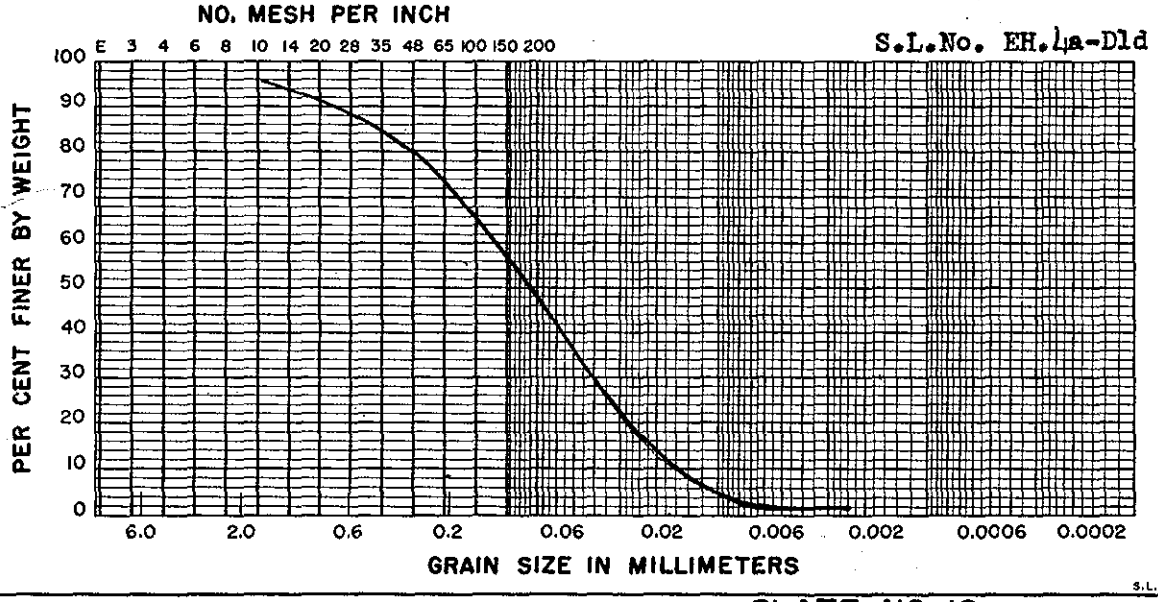
Rate of strain 0.06+ in./min.
Consolidation Full
Shear Plane Dry
Remarks e at w(opt) = 0.499

s = 2.71 Class 11-7
$\phi = 31^\circ 50'$ c = 0.115 tons per sq. ft.

SITE EAST HARTFORD DIKE

HOLE NO. BT-E10
SAMPLE NO. B2
DEPTH 3.2 - 4.0




S.L. FORM NO. 66

# SHEAR TEST

**SUPPLEMENTARY DATA**

Rate of strain 0.06+ in./min.

Consolidation Full

Shear Plane Dry

Remarks Sample placed dry and at density of 111.6 #/cu.ft.

Class 2

$\phi = 36^\circ 00'$ c= 0 tons per sq. ft.

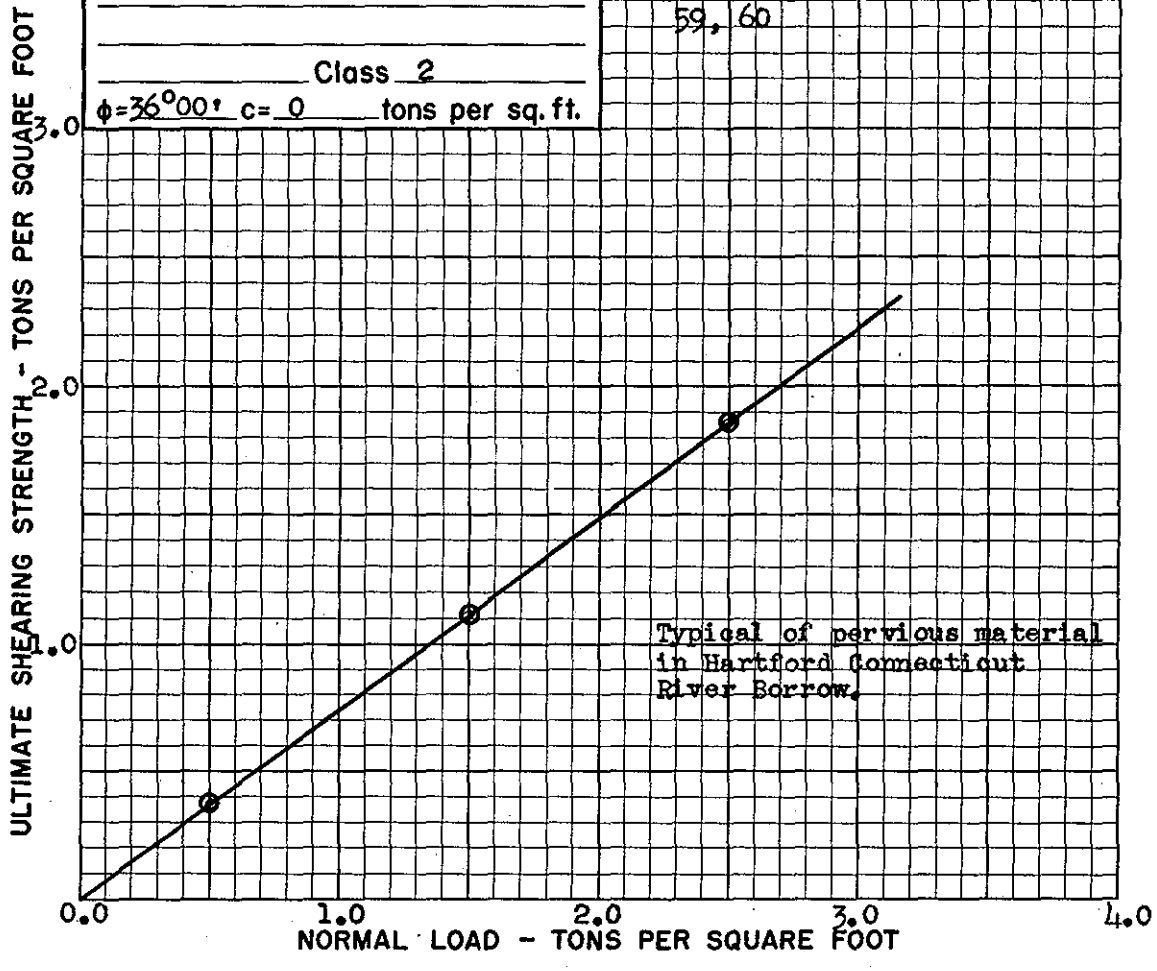
SITE HARTFORD CONNECTICUT RIVER BORROW

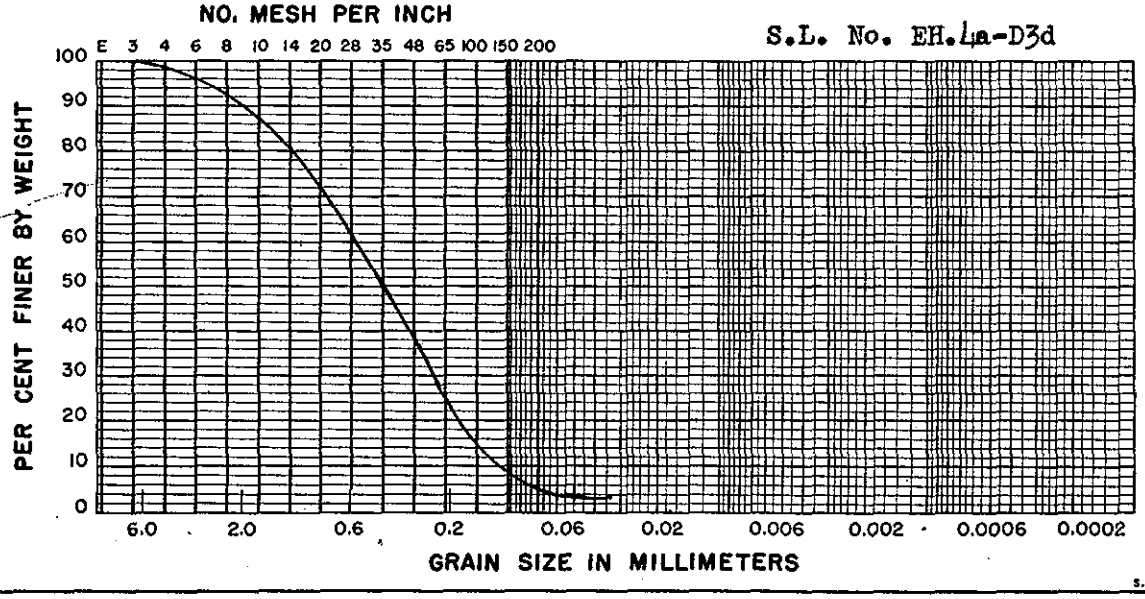
HOLE NO. **

SAMPLE NO. LB8

DEPTH

** Composite of BH-57, 58, 59, 60




S.L. FORM NO. 66

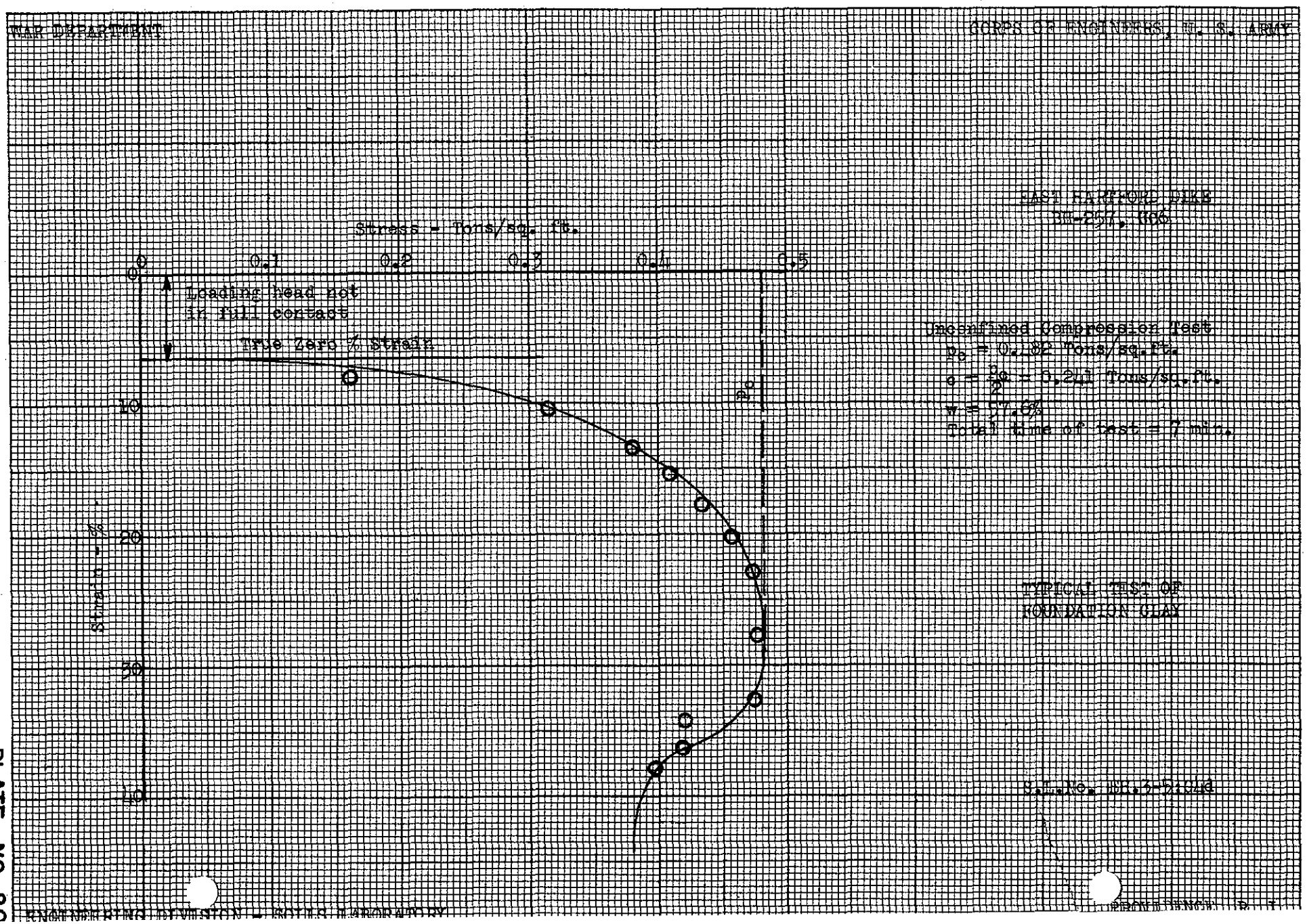

WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
EAST HARTFORD DIKE
BH-257, U06
Stress - Tons/sq. ft.
0
0.1
0.2
0.3
0.4
0.5
Loading head not
in full contact
True Zero % Strain
Strain - %
0
10
20
30
40
$p_c$
Unconfined Compression Test
$p_c$ = 0.482 Tons/sq.ft.
$c = \frac{p_c}{2}$ = 0.241 Tons/sq.ft.
w = 57.6%
Total time of test = 7 min.
TYPICAL TEST OF
FOUNDATION CLAY
S.L.No. EH.3-5:04d
ENGINEERING DIVISION - SOILS LABORATORY
PROVIDENCE, R. I.

PLATE NO. 20

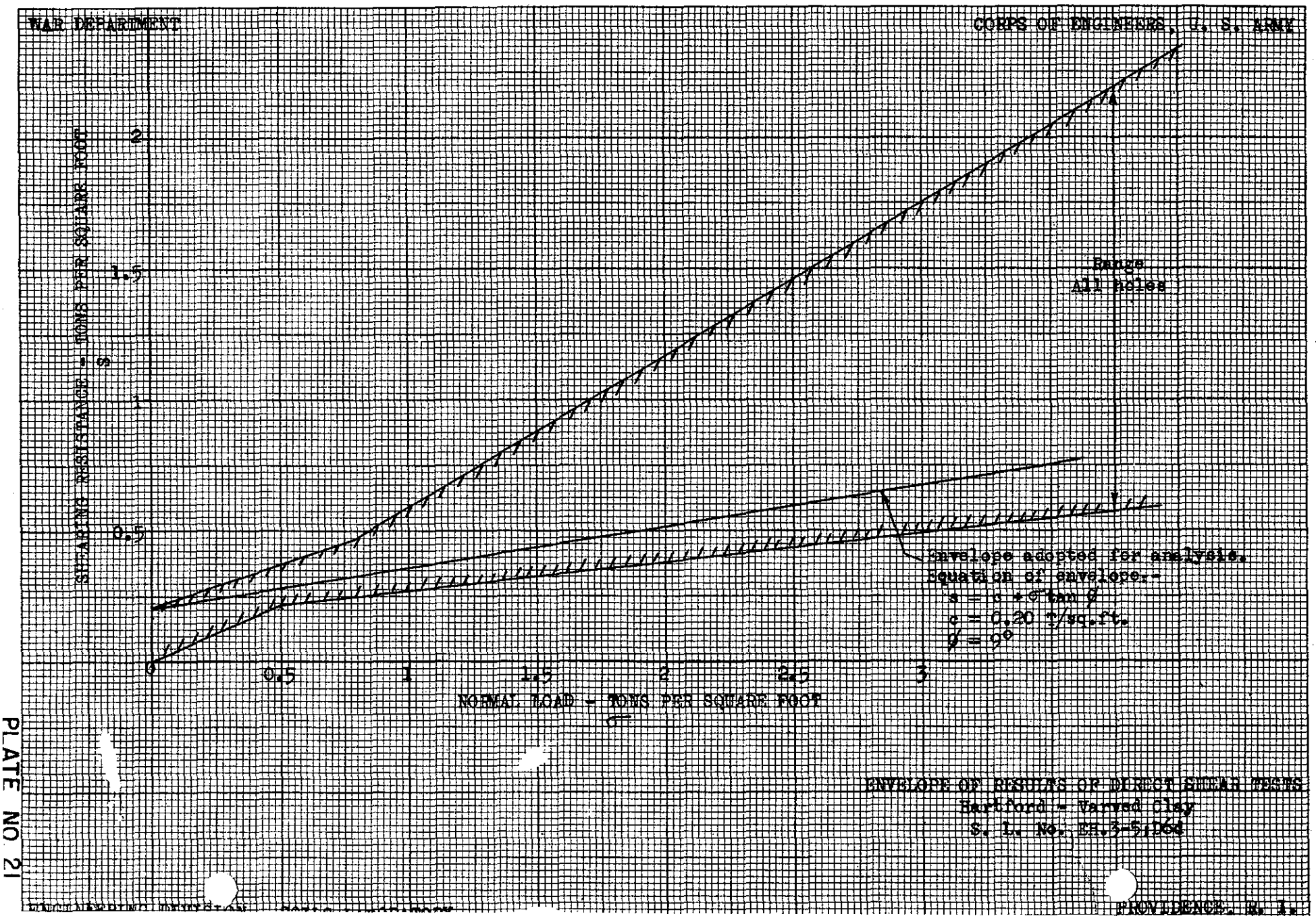
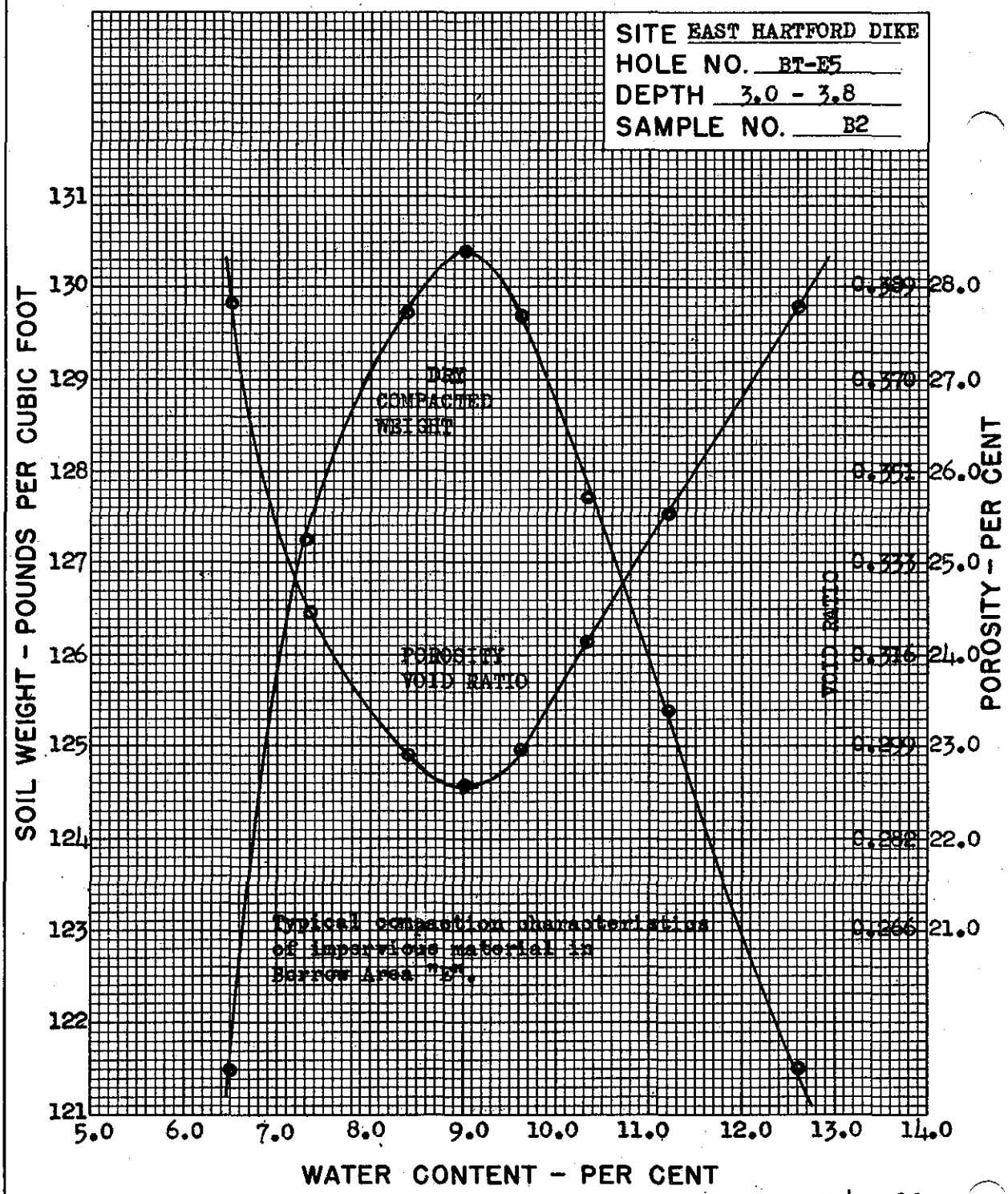

WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
SHEARING RESISTANCE - TONS PER SQUARE FOOT
s
2
1.5
1
0.5
0
0.5
1
1.5
2
2.5
3
NORMAL LOAD - TONS PER SQUARE FOOT
σ
Range
All holes
Envelope adopted for analysis.
Equation of envelope:-
s = c + σ tan φ
c = 0.20 T/sq.ft.
φ = 9°
ENVELOPE OF RESULTS OF DIRECT SHEAR TESTS
Hartford - Varved Clay
S. L. No. EH.3-5;D6d
PROVIDENCE, R. I.

PLATE NO. 21

# COMPACTION CHARACTERISTICS




Class 11

S.L.No. EH.4a-C1d

**MATERIAL SCREENED OUT**

Minimum Size, mm. 0.0

Per Cent by weight 0.0

No. Blows/Layer 25

Area of Tamper, sq. in. 3.1416

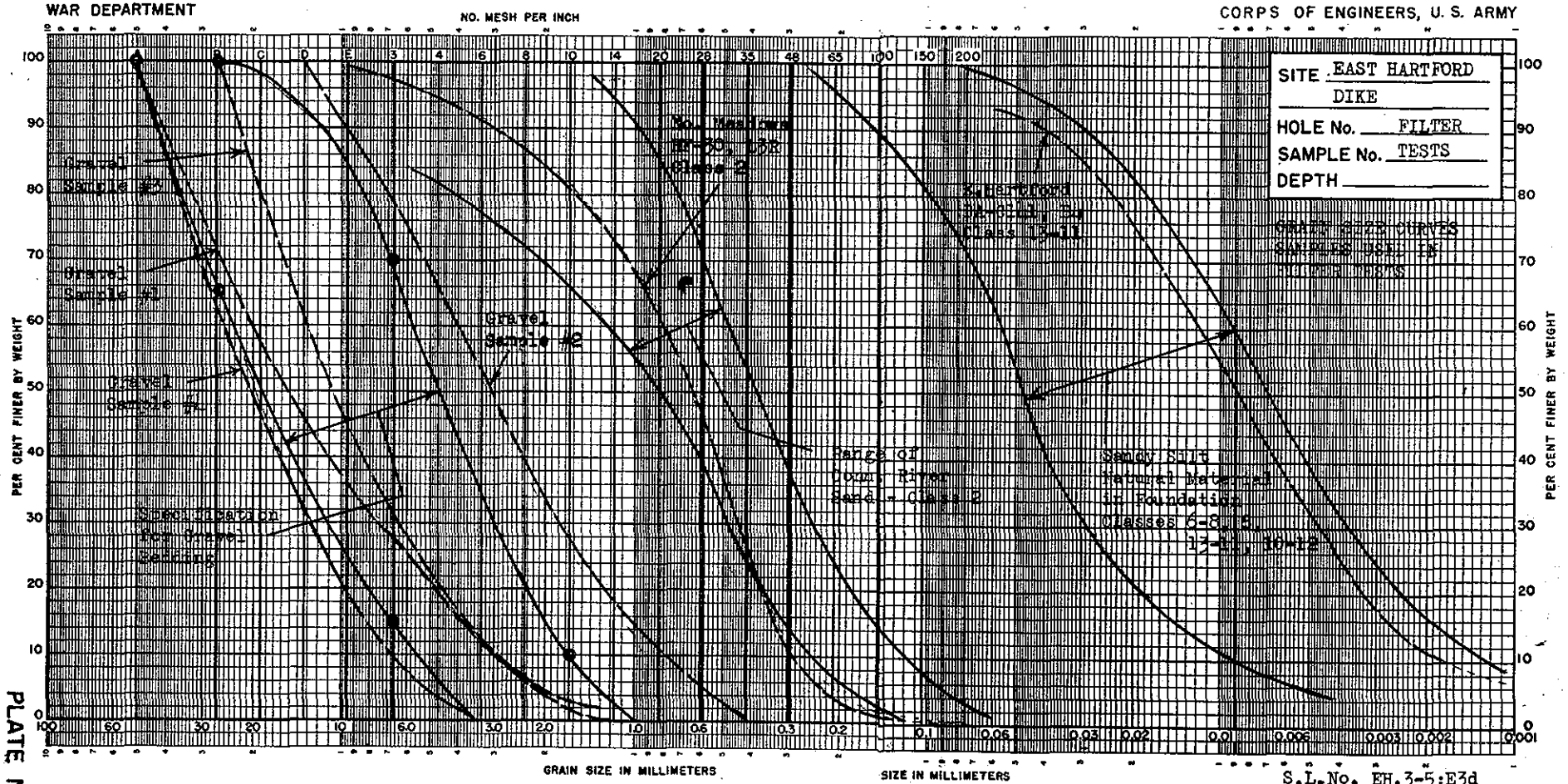
Weight of Tamper, lbs. 5.5

Fall of Tamper, in. 12.0

e at w(opt) = 0.292

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




S.L.No. EH.3-5;E3d

| Gravel | Coarse Sand | Medium Sand | Fine Sand | Coarse Silt | Medium Silt | Fine Silt or | Coarse Clay |
|---|---|---|---|---|---|---|---|
| Class 1 | Class 2 | | Class 6 | | Class 10 or 10C | | Class 12 or 12C |
| | | Class 4 | | Class 8 | | | |
| | Class 3 | | Class 5 | Class 7 | Class 9 | Class 11 | Class 13 or 13C |

SOILS LABORATORY

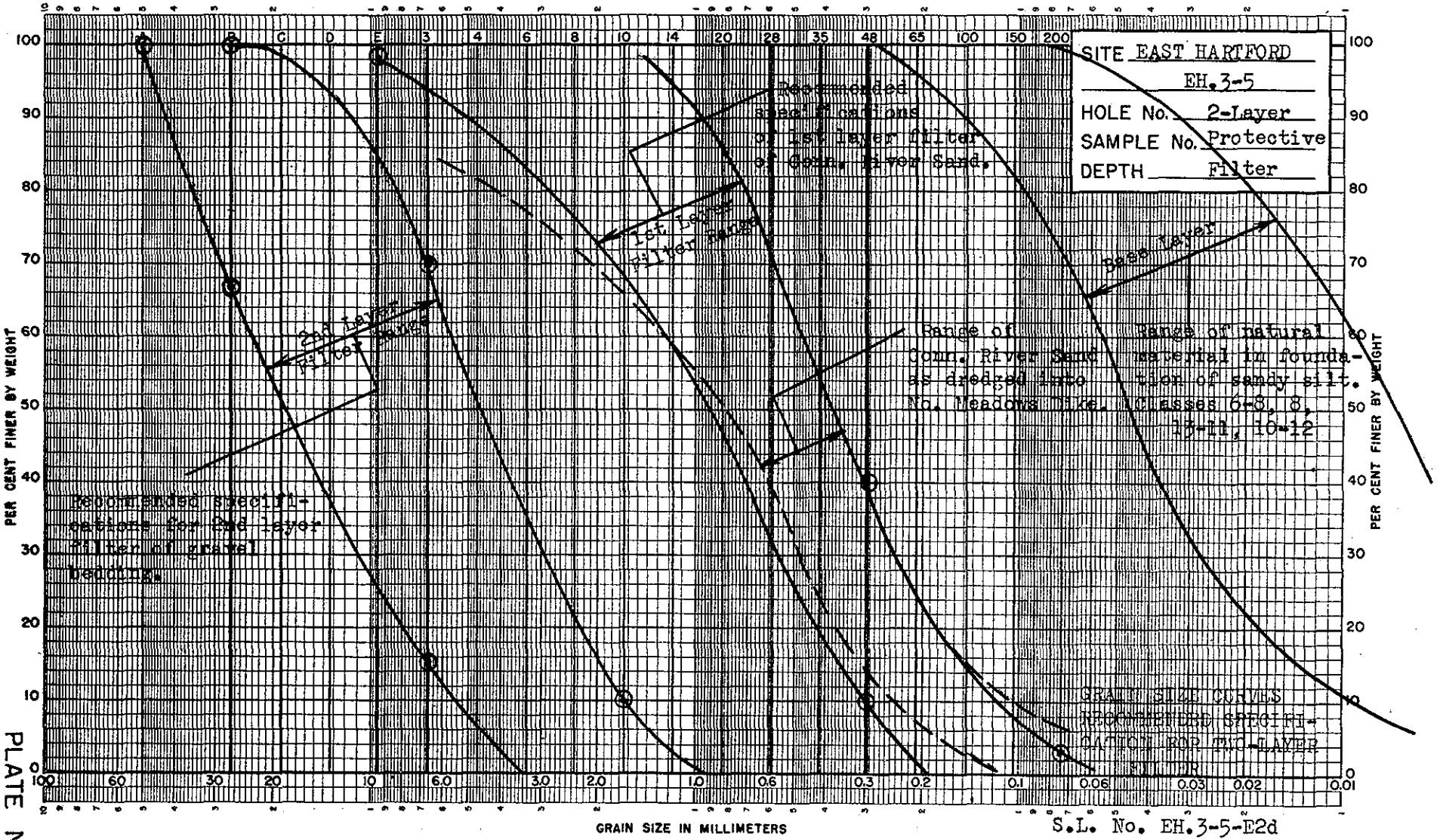
MECHANICAL ANALYSIS

PROVIDENCE, R.I.

PLATE NO. 23

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY




S.L. No. EH.3-5-E2d

| Gravel | Coarse Sand | Medium Sand | Fine Sand | Coarse Silt | Medium Silt |
|---|---|---|---|---|---|
| Class 1 | Class 2 | | Class 6 | | |
| | | Class 4 | | Class 8 | |
| | Class 3 | | Class 5 | Class 7 | Class 9 |

PLATE NO. 24

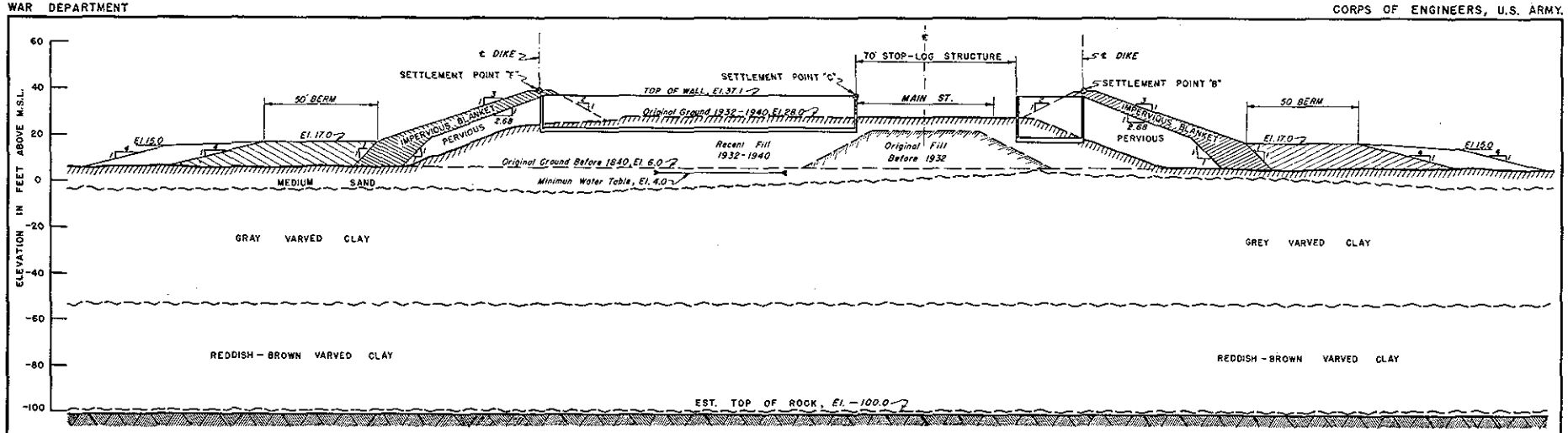
SOILS LABORATORY

MECHANICAL ANALYSIS

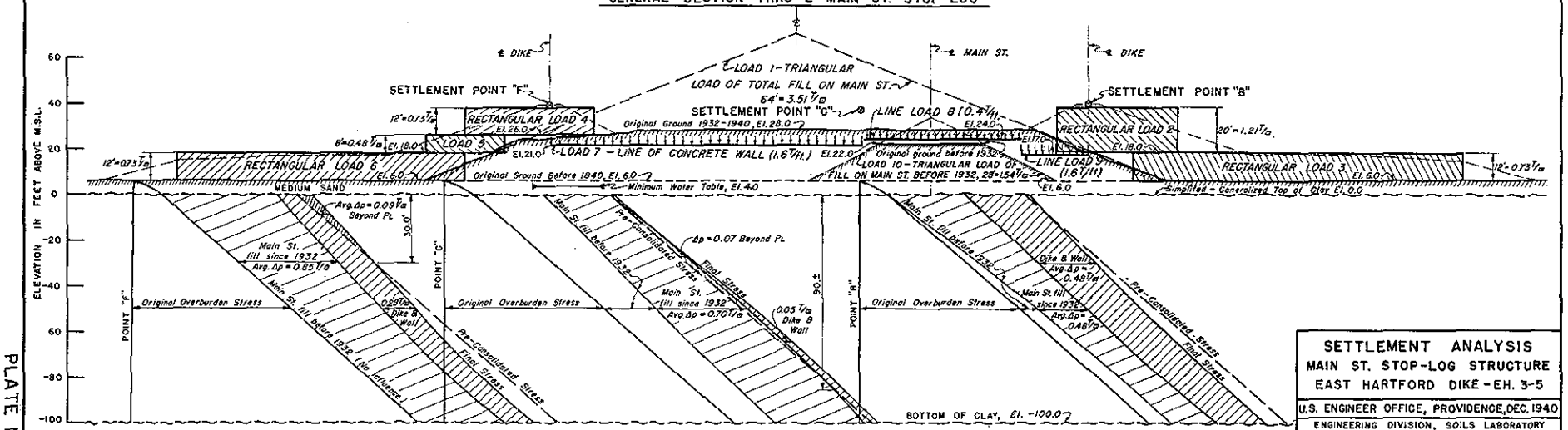
PROVIDENCE, R.I.

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY.




GENERAL SECTION THRU ℄ MAIN ST. STOP-LOG




LOADING AND STRESS DIAGRAM

STRESS SCALE: 1 INCH = 0.40 TONS PER SQ.FT.

| | |
|---|---|
| SETTLEMENT ANALYSIS<br>MAIN ST. STOP-LOG STRUCTURE<br>EAST HARTFORD DIKE - EH. 3-5 | |
| U.S. ENGINEER OFFICE, PROVIDENCE, DEC. 1940 | |
| ENGINEERING DIVISION, SOILS LABORATORY | |
| SCALE: 1 IN. = 20 FT. | |
| SUBMITTED BY: | DRAWN BY: K.W.M.<br>TRACED BY: R.J.G. |
| ANALYSIS BY: K.W.M. & K.S.L. | FILE NO. CT-9-1057 |

PLATE NO. 25

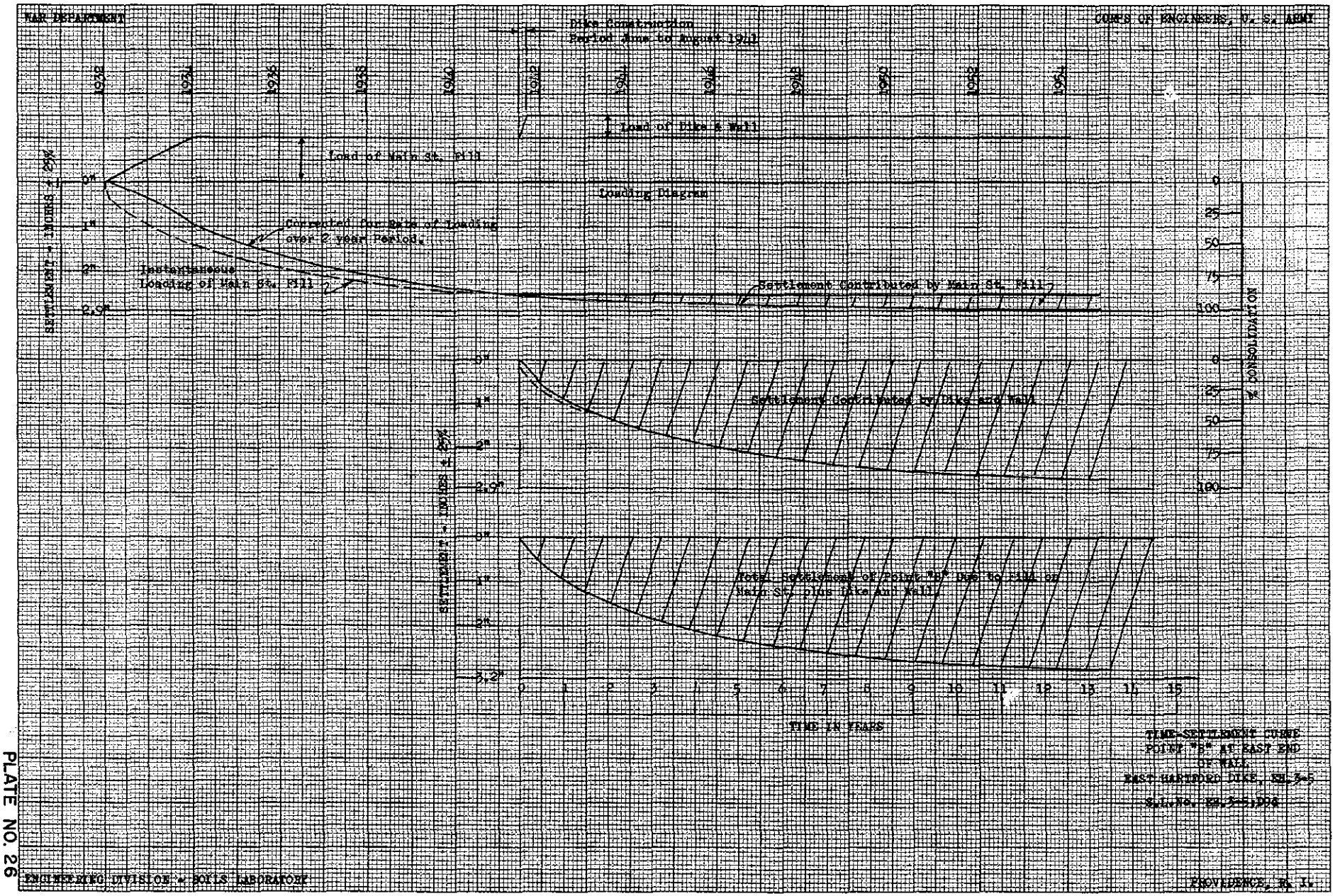

WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
Dike Construction
Period June to August 1941
1932
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
Load of Dike & Wall
Load of Main St. Fill
Loading Diagram
Corrected for Rate of Loading over 2 year Period.
Instantaneous Loading of Main St. Fill
Settlement Contributed by Main St. Fill
Settlement Contributed by Dike and Wall
Total Settlement of Point "B" Due to Fill on Main St. plus Dike and Wall
SETTLEMENT - INCHES ± 25%
% CONSOLIDATION
TIME IN YEARS
TIME-SETTLEMENT CURVE
POINT "B" AT EAST END OF WALL
EAST HARTFORD DIKE, EH.3-5
S.L.No. EH.3-5;D96
ENGINEERING DIVISION - SOILS LABORATORY
PROVIDENCE, R. I.

PLATE NO. 26

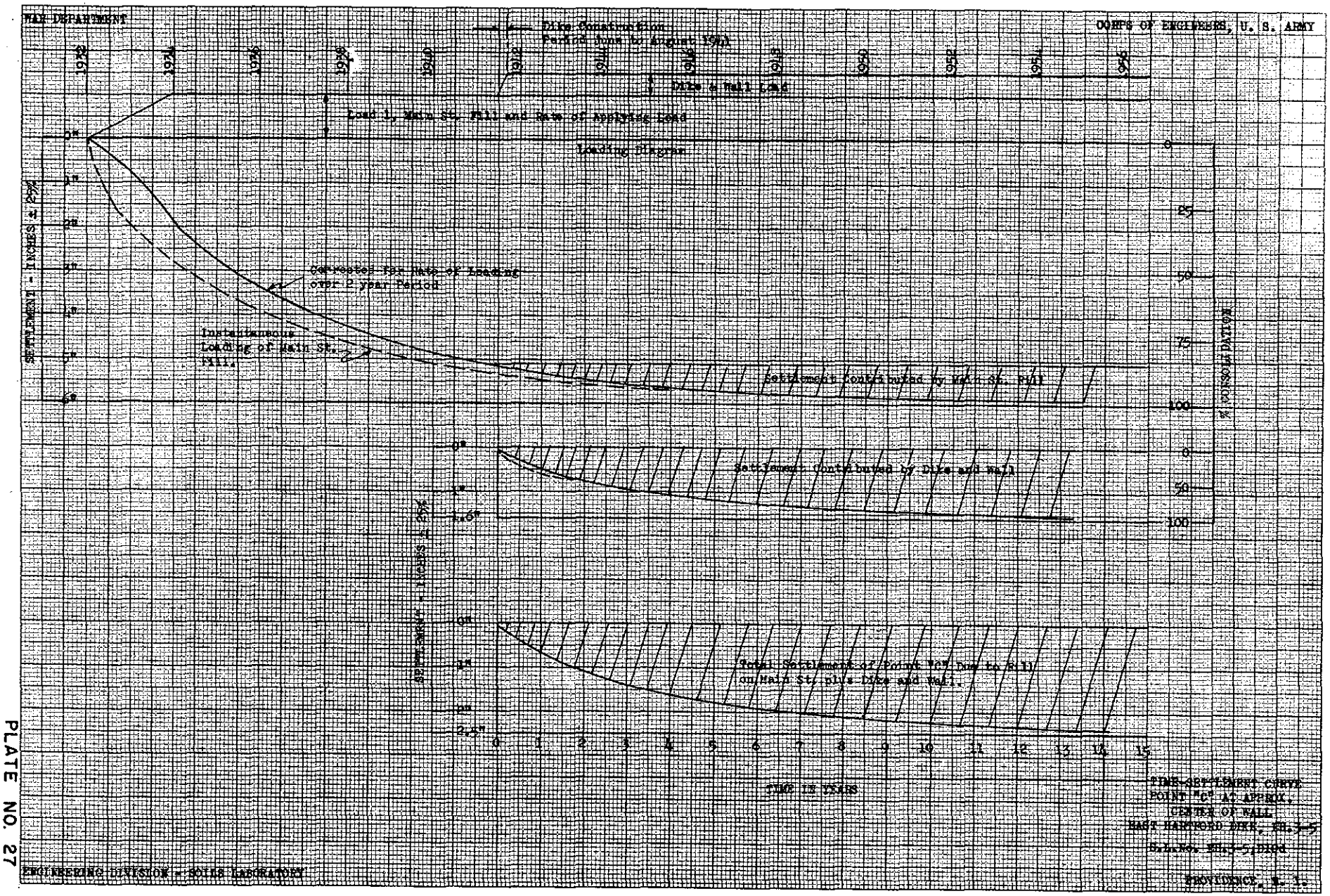
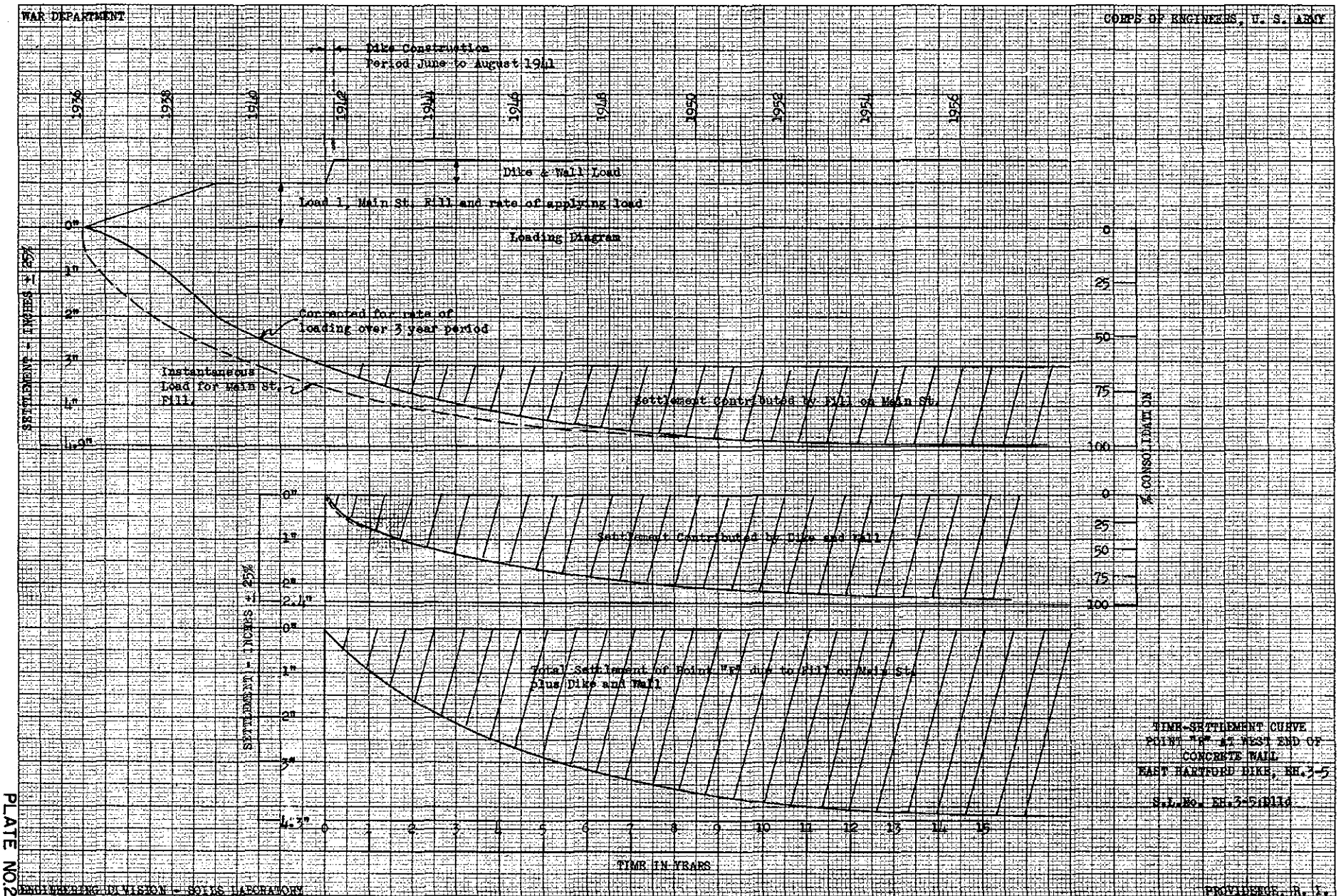
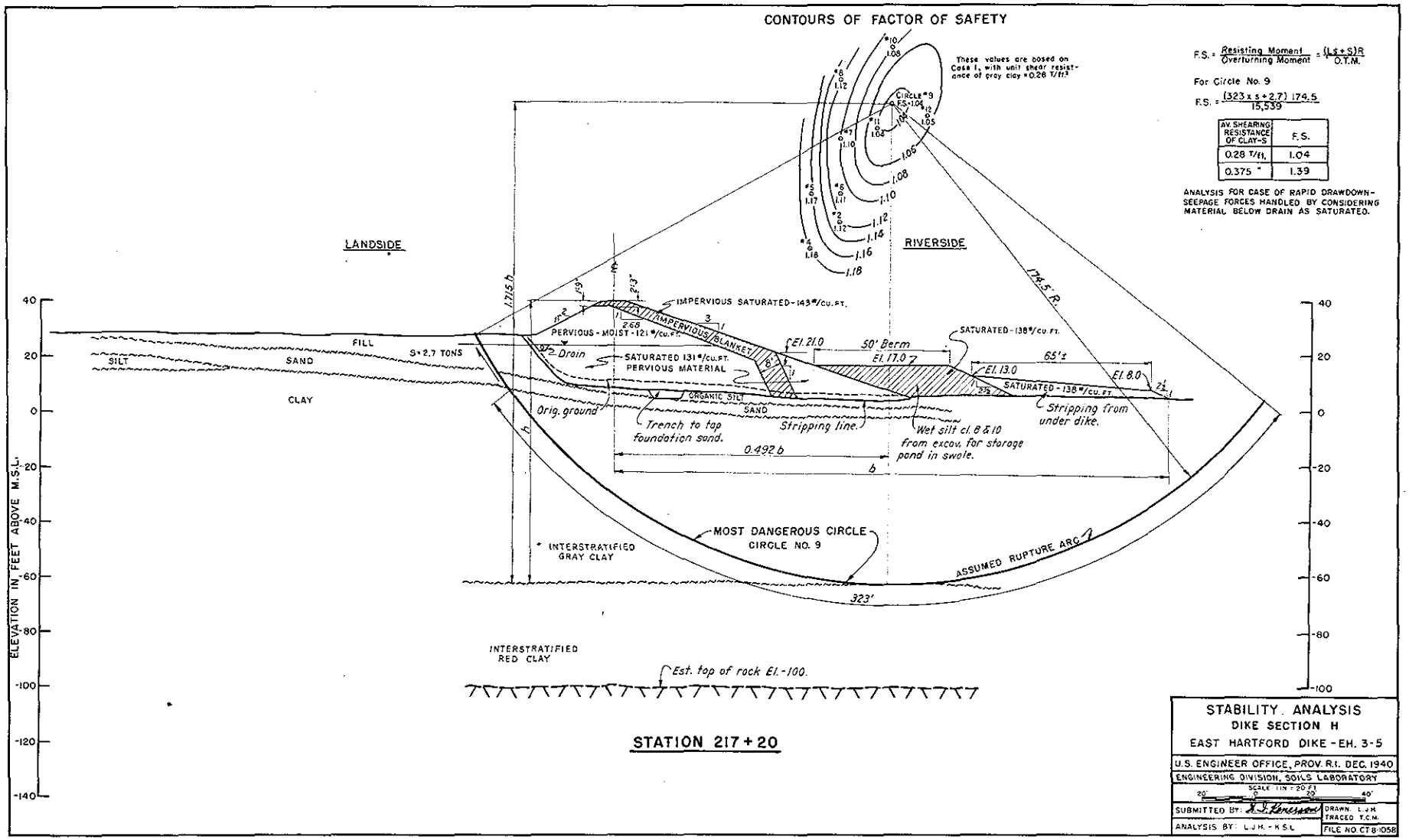

WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
Dike Construction
Period June to August 1941
Dike & Wall Load
Load 1, Main St. Fill and Rate of Applying Load
Loading Diagram
Corrected for Rate of Loading over 2 year Period
Instantaneous Loading of Main St. Fill.
Settlement Contributed by Main St. Fill
Settlement Contributed by Dike and Wall
Total Settlement of Point "C" Due to Fill on Main St. plus Dike and Wall.
SETTLEMENT - INCHES ± 25%
% CONSOLIDATION
TIME IN YEARS
TIME-SETTLEMENT CURVE
POINT "C" AT APPROX.
CENTER OF WALL
EAST HARTFORD DIKE, EH.3-5
S.L.No. EH.3-5,D10d
PROVIDENCE, R. I.
ENGINEERING DIVISION - SOILS LABORATORY

PLATE NO. 27




TIME-SETTLEMENT CURVE
POINT "F" AT WEST END OF
CONCRETE WALL
EAST HARTFORD DIKE, EH.3-5

S.L.No. EH.3-5(R)1d




$$F.S. = \frac{\text{Resisting Moment}}{\text{Overturning Moment}} = \frac{(L s + S)R}{O.T.M.}$$

For Circle No. 9

$$F.S. = \frac{(323 \times s + 2.7)\ 174.5}{15{,}539}$$

| AV. SHEARING RESISTANCE OF CLAY-S | F.S. |
|---|---|
| 0.28 T/ft. | 1.04 |
| 0.375 " | 1.39 |

ANALYSIS FOR CASE OF RAPID DRAWDOWN-SEEPAGE FORCES HANDLED BY CONSIDERING MATERIAL BELOW DRAIN AS SATURATED.

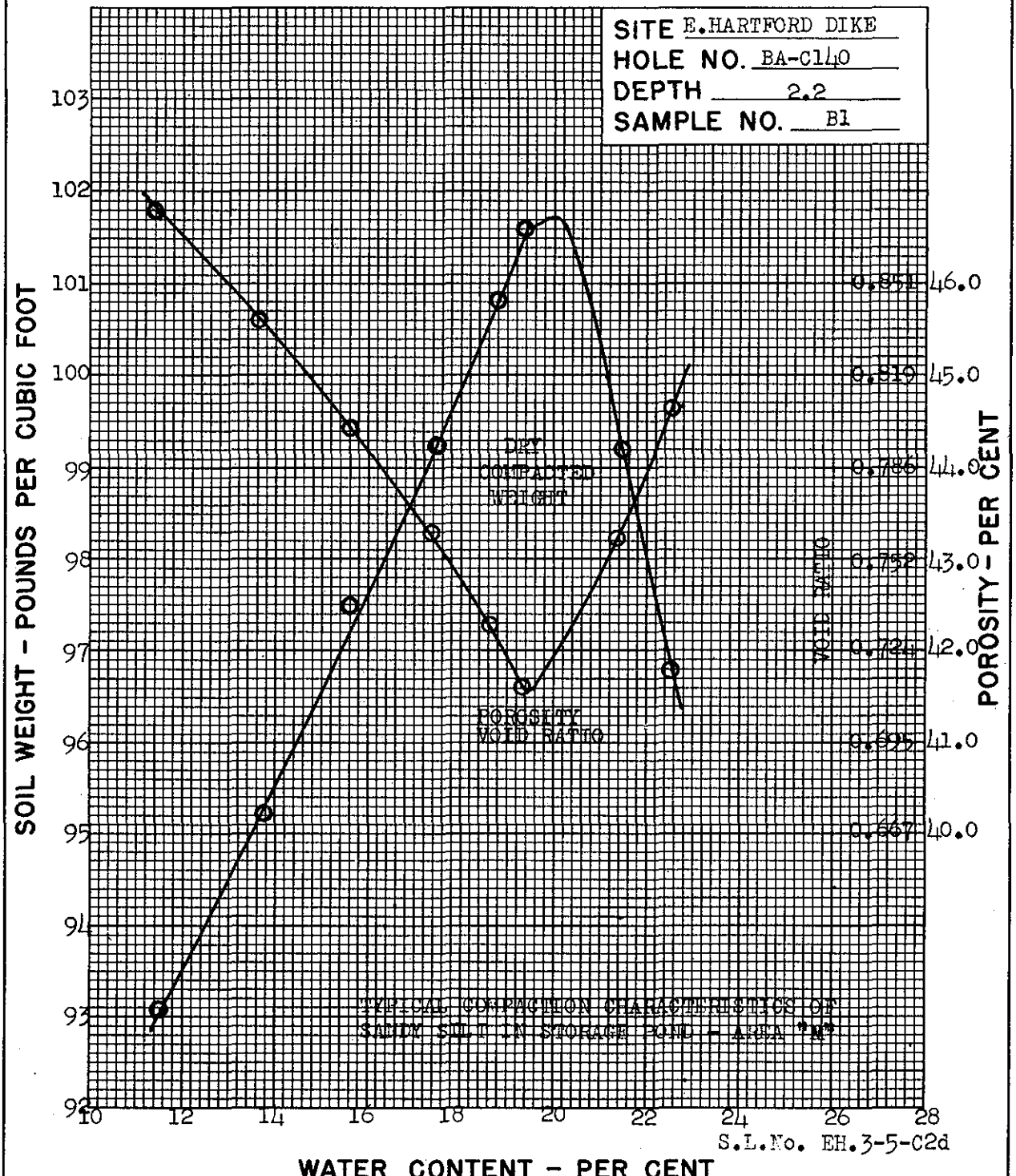
STATION 217 + 20

STABILITY ANALYSIS
DIKE SECTION H
EAST HARTFORD DIKE - EH. 3-5

U.S. ENGINEER OFFICE, PROV. R.I. DEC. 1940
ENGINEERING DIVISION, SOILS LABORATORY
SCALE 1 IN = 20 FT
SUBMITTED BY: [signature]
DRAWN: L.J.H.
TRACED: T.C.M.
ANALYSIS BY: L.J.H. - K.S.L.
FILE NO. CT-8-1058

PLATE NO. 29

# COMPACTION CHARACTERISTICS




Class 8

**MATERIAL SCREENED OUT**

Minimum Size, mm. 0.0

Per Cent by weight 0.0

No. Blows/Layer 25

Area of Tamper, sq. in. 3.1416

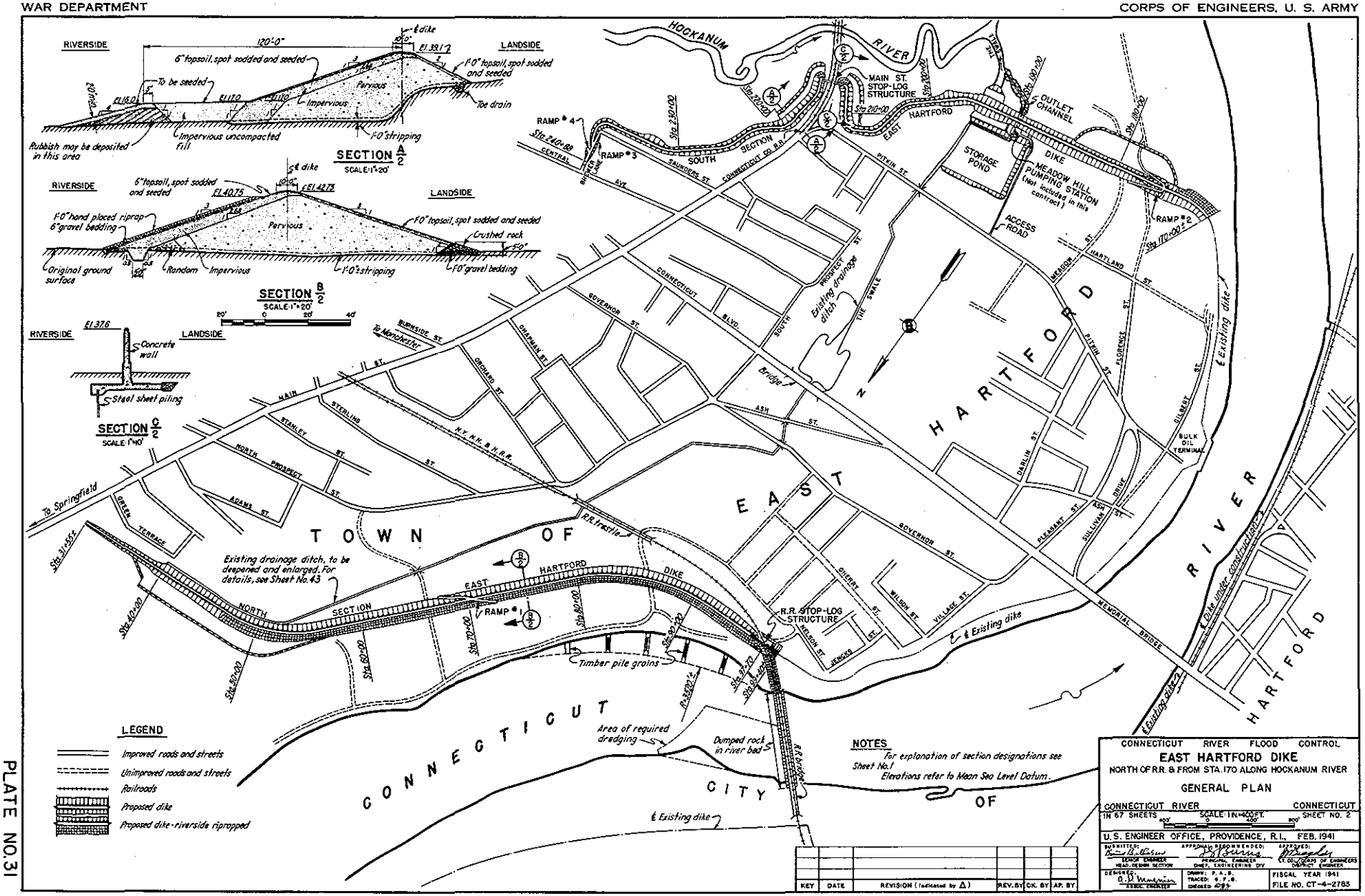
Weight of Tamper, lbs. 5.5

Fall of Tamper, in. 12.0

e at w(opt) = 0.720

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




NOTES

For explanation of section designations see Sheet No. 1

Elevations refer to Mean Sea Level Datum.

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

GENERAL PLAN

CONNECTICUT RIVER — IN 67 SHEETS — SCALE: 1 IN. = 400 FT. — CONNECTICUT — SHEET NO. 2

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

SUBMITTED: R. J. Wilson, Senior Engineer, Head, Design Section

APPROVED: RECOMMENDED: L. A. Jones, Principal Engineer, Chief, Engineering Div.

APPROVED: Wm. Hopkins, Lt. Col., Corps of Engineers, District Engineer

DESIGNED: G. J. Murphy, Assoc. Engineer

DRAWN: P. A. B. TRACED: R. F. B. CHECKED: J. J. S.

FISCAL YEAR 1941

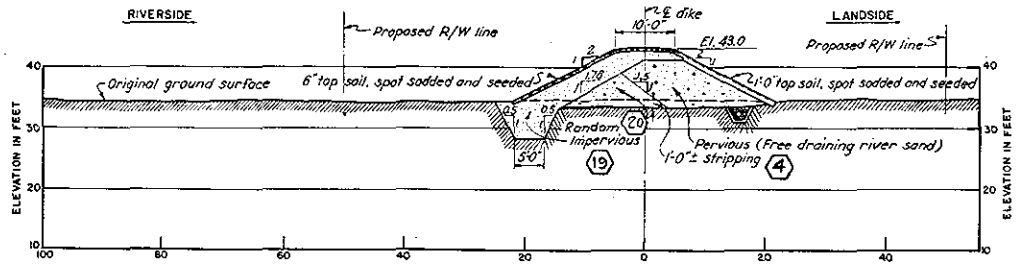
FILE NO. CT-4-2783

PLATE NO. 31

EH. 3 to 5 incl.

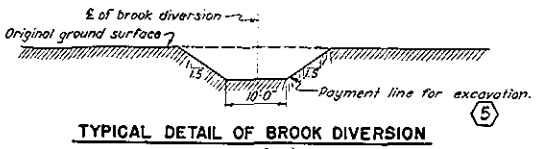
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



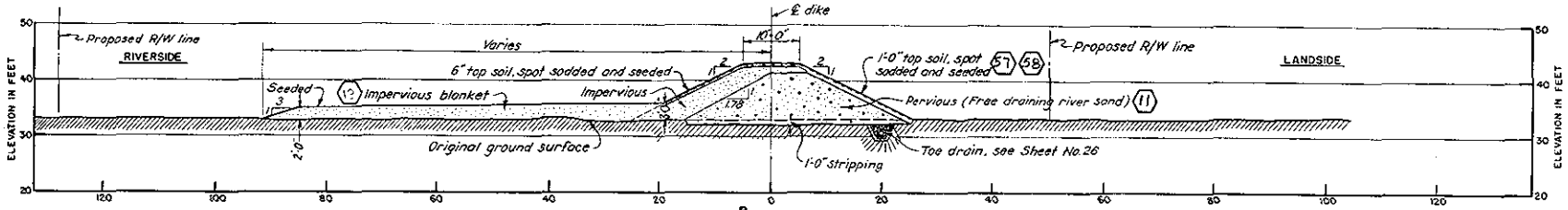

SECTION A/15 AT STA. 36+00

SCALE: 1" = 10'



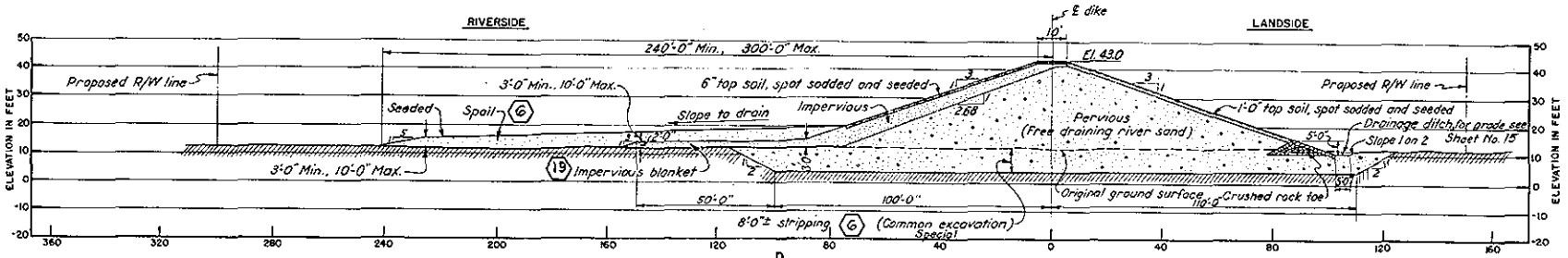

TYPICAL DETAIL OF BROOK DIVERSION

SCALE 1" = 10'



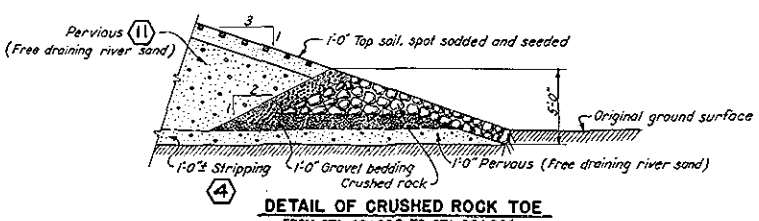

SECTION B/15 AT STA. 38+50

SCALE: 1" = 10'




SECTION D/15 AT STA. 47+00

SCALE: 1" = 20'




DETAIL OF CRUSHED ROCK TOE

FROM STA. 40+00± TO STA. 96+00±

SCALE 1/4" = 1'-0"

NOTES

For explanation of section designations see Sheet No. 1

Elevations refer to Mean Sea Level Datum.

For details of top of dike, cutoff trench, and toe drains, see Sheet No. 26

Figures in hexagons indicate item numbers under which payment will be made.

All suitable excavated materials may be used in the dike within the limits indicated for random fill. See Sheet No. 26

Dike grade is at shoulders of dike crown. The 3" crown is above dike grade.

For location of sections see Sheets No. 15 to 20 inclusive.

For location and profile of Brook Diversion, see Sheet No. 15

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

EMBANKMENT DETAILS NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 10 FT. — SHEET NO. 21

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

DESIGNED: AEROC. ENGINEER — DRAWN: J. B. M. TRACED: S. C. W. CHECKED: G. W. H.

FISCAL YEAR 1941

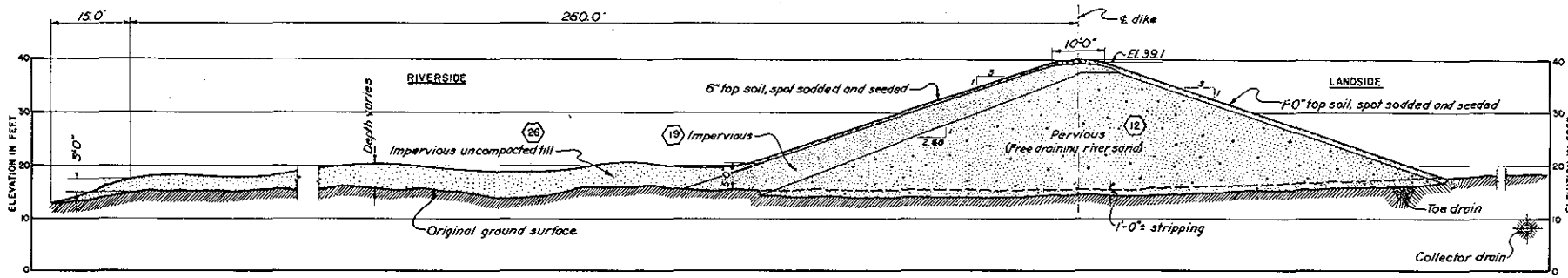
FILE NO. CT-4-2790

EH. 3 to 5 incl.

PLATE NO. 32

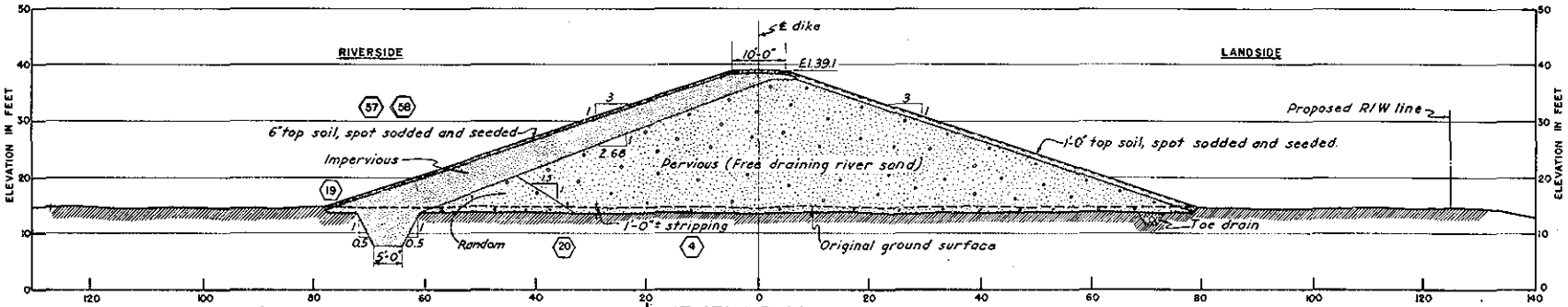
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



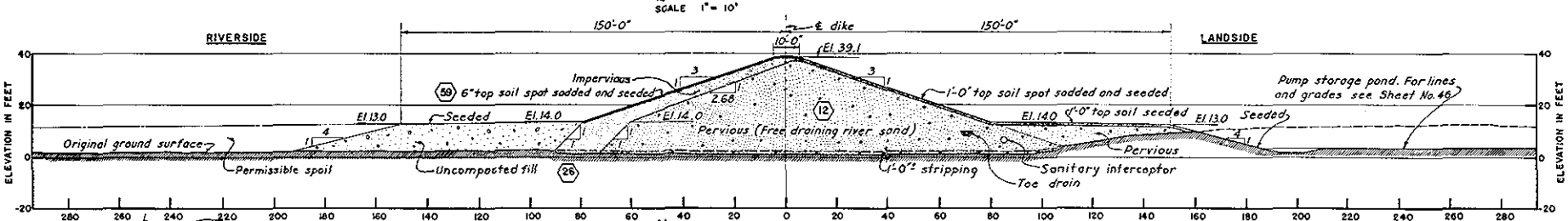

SECTION K/18 AT STA. 181+00

SCALE 1" = 10'



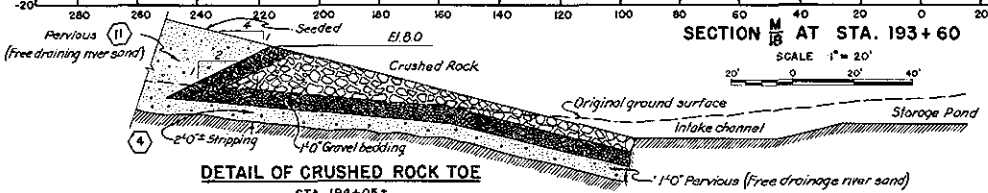

SECTION L/18 AT STA. 187+00

SCALE 1" = 10'




SECTION M/18 AT STA. 193+60

SCALE 1" = 20'




DETAIL OF CRUSHED ROCK TOE

STA. 194+05±

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

NOTE:

For general notes applying to details on this sheet, see Sheet No. 21.

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

EMBANKMENT DETAILS NO. 3

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 10 FT. — SHEET NO. 23

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

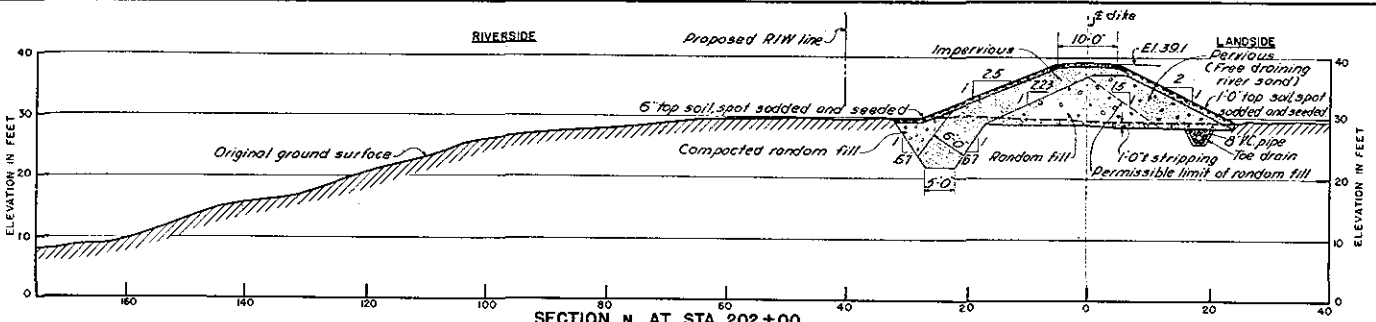
DESIGNED: ASSOC. ENGINEER — DRAWN: J.D.M. TRACED: G.A.L. & O.E.R. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-4-2792

EH. 3 to 5 Incl.

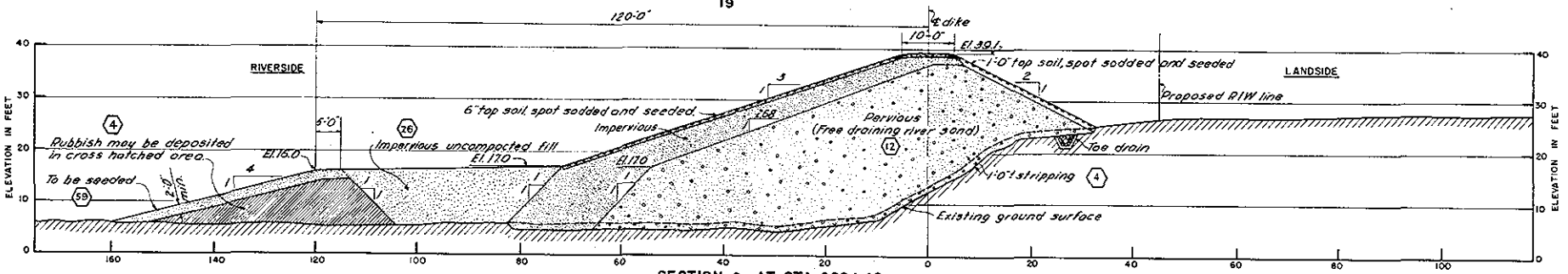
PLATE NO. 33

WAR DEPARTMENT

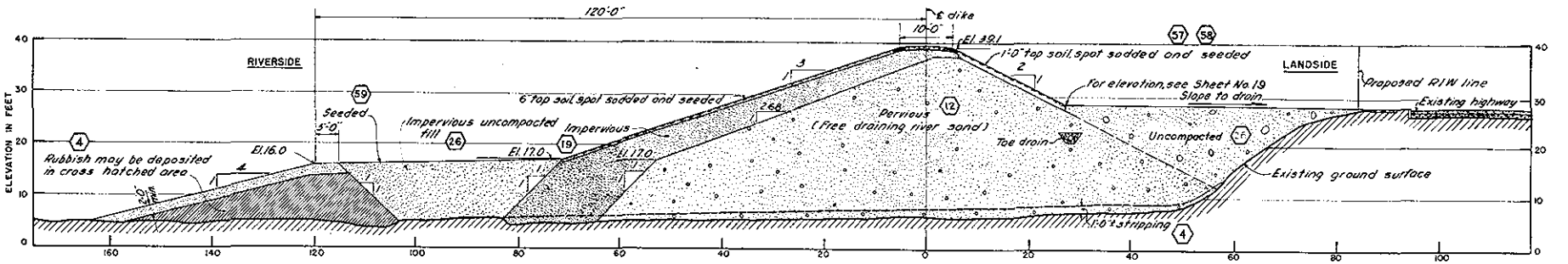
CORPS OF ENGINEERS, U. S. ARMY




SECTION N/19 AT STA. 202+00




SECTION O/19 AT STA. 209+40




SECTION P/19 AT STA. 217+00

NOTE:
For general notes applying to details on this sheet, see Sheet No. 21.

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. 8 FROM STA. 170 ALONG HOCKANUM RIVER

EMBANKMENT DETAILS NO. 4

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1 IN. = 10 FT. — SHEET NO. 24

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

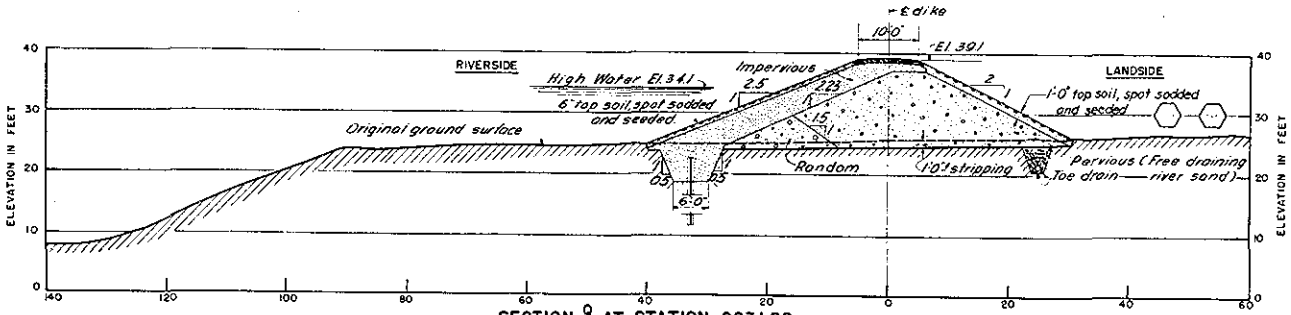
DESIGNED: ASSOC. ENGINEER — DRAWN: J. B. M. TRACED: A. J. H. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-4-2793

EH. 3 to 5 incl.

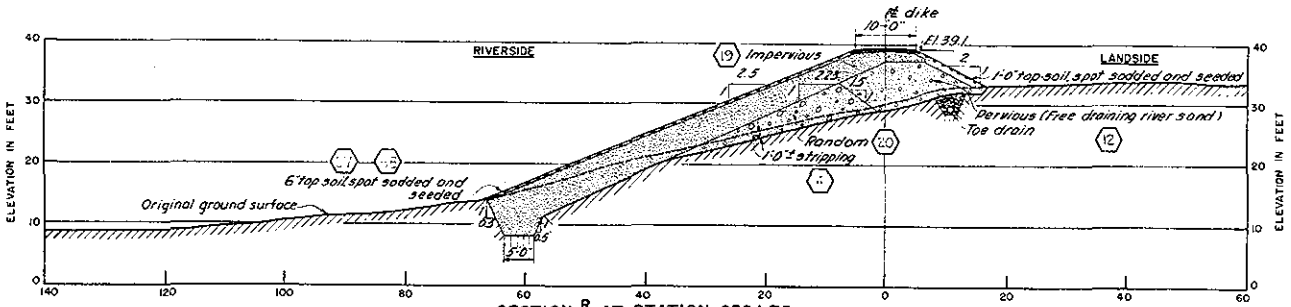
PLATE NO. 34

WAR DEPARTMENT

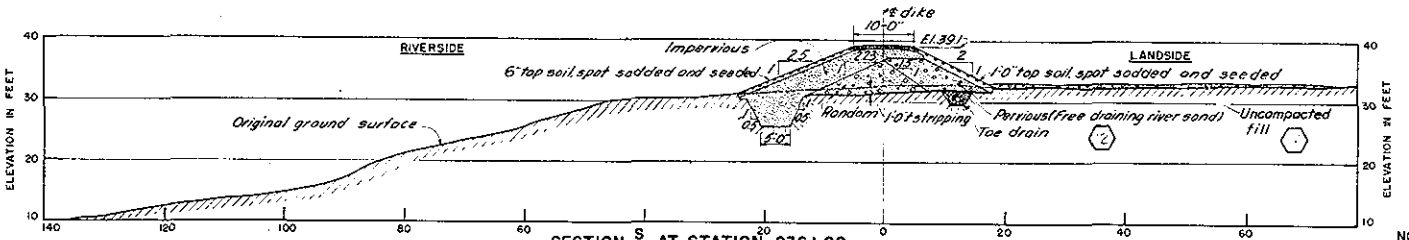
CORPS OF ENGINEERS, U. S. ARMY



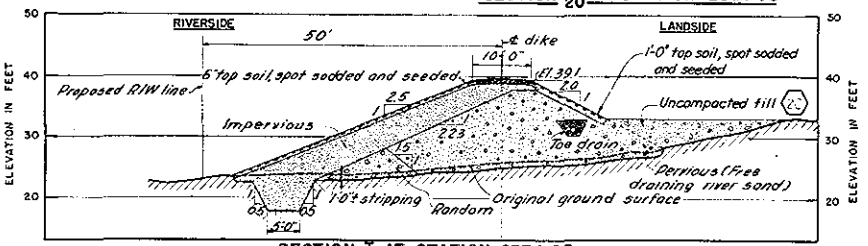

SECTION $\frac{O}{20}$ AT STATION 223+20




SECTION $\frac{R}{20}$ AT STATION 232+75




SECTION $\frac{S}{20}$ AT STATION 236+00




SECTION $\frac{T}{20}$ AT STATION 237+25

NOTE

*For general notes applying to details on this sheet see Sheet No. 21*

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

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

EMBANKMENT DETAILS NO. 5

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 10 FT. — SHEET NO. 25

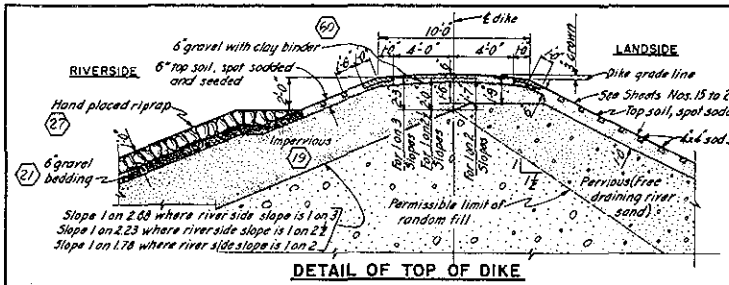
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

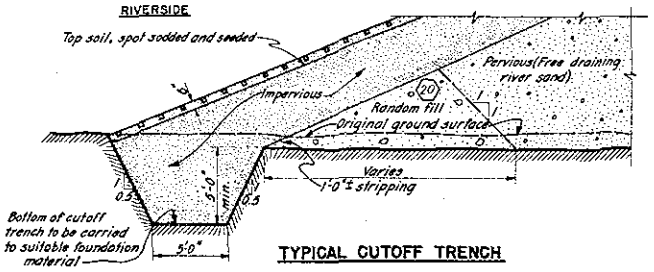
DESIGNED: ASSOC. ENGINEER — DRAWN: J.B.W. TRACED: A.J.H. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-4-2794

PLATE NO. 35

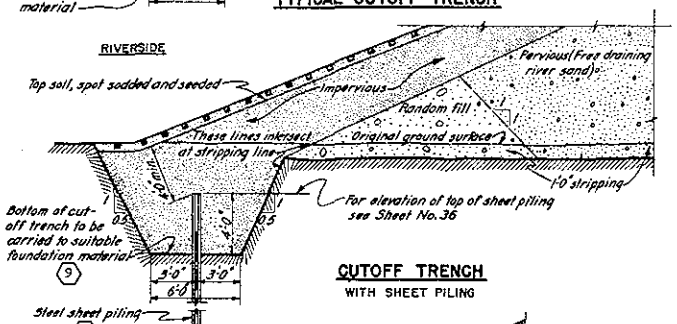
E.H. 3 to 5 incl.



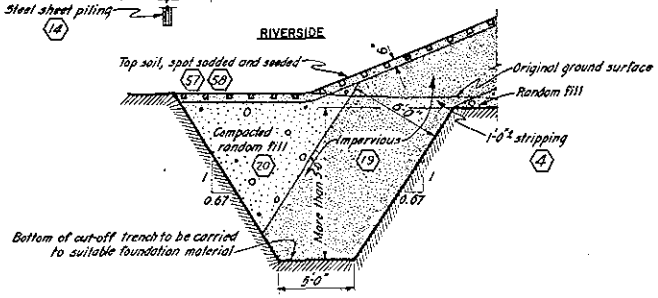

DETAIL OF TOP OF DIKE



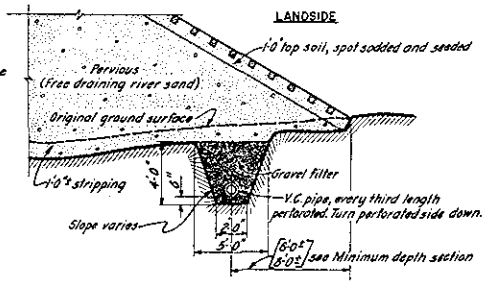

TYPICAL CUTOFF TRENCH



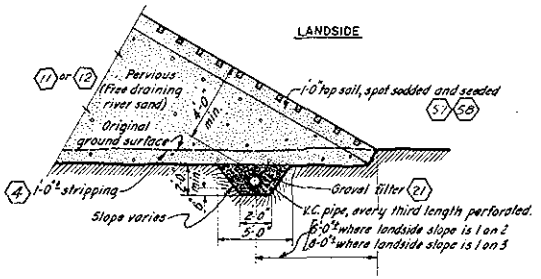

CUTOFF TRENCH
WITH SHEET PILING



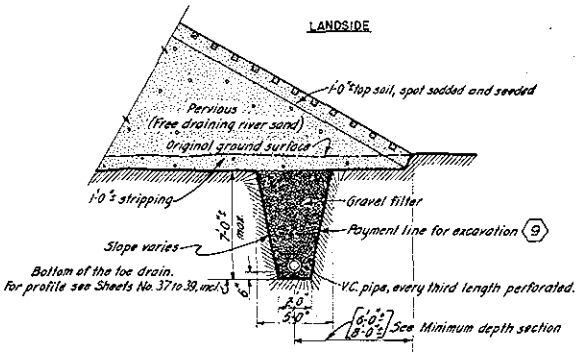

SPECIAL CUTOFF TRENCH




AVERAGE DEPTH

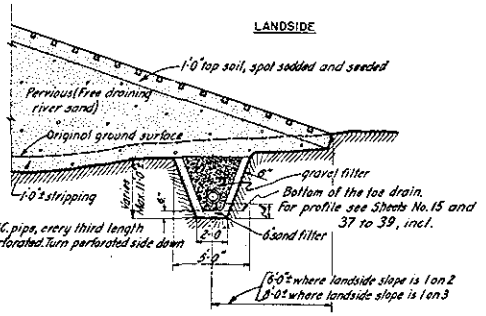



MINIMUM DEPTH

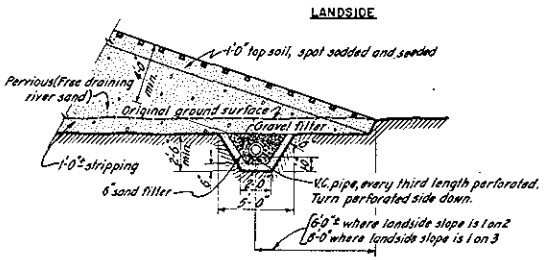



MAXIMUM DEPTH

TYPE "A" DRAIN




AVERAGE DEPTH




MINIMUM DEPTH

TYPE "B" DRAIN

NOTES

For general notes applying to details on this sheet see Sheet No. 21.
For details of toe drains from Sta. 33+50± to Sta. 96+00± see Sheet No. 21.
For location of Collector drain and laterals see Sheets No. 37 to 39, incl.

TYPICAL TOE DRAIN CROSS SECTIONS

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

EMBANKMENT DETAILS NO. 6

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 26

U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — FEB. 1941

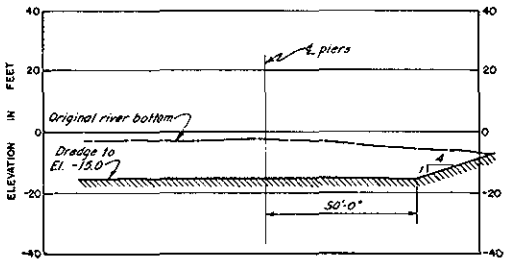
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASSOC. ENGINEER — DRAWN: W.A.G. TRACED: H.N.V. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT.-4-2795

PLATE NO. 36

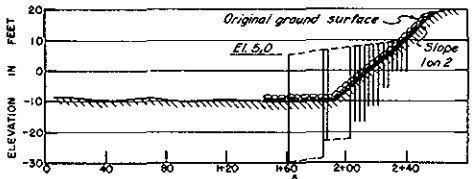
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

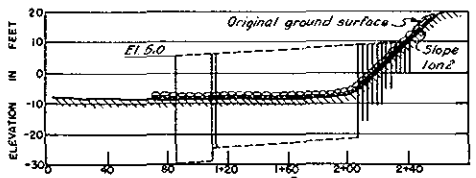



SECTION $\frac{G}{34}$

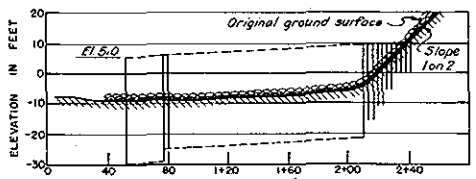
SCALE: 1" = 20'



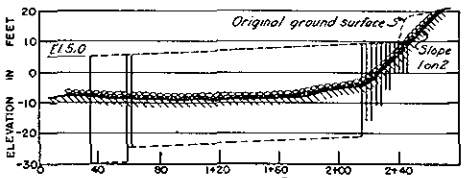

SECTION $\frac{A}{34}$



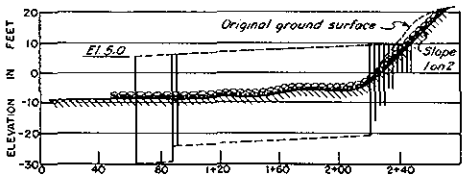

SECTION $\frac{B}{34}$




SECTION $\frac{C}{34}$



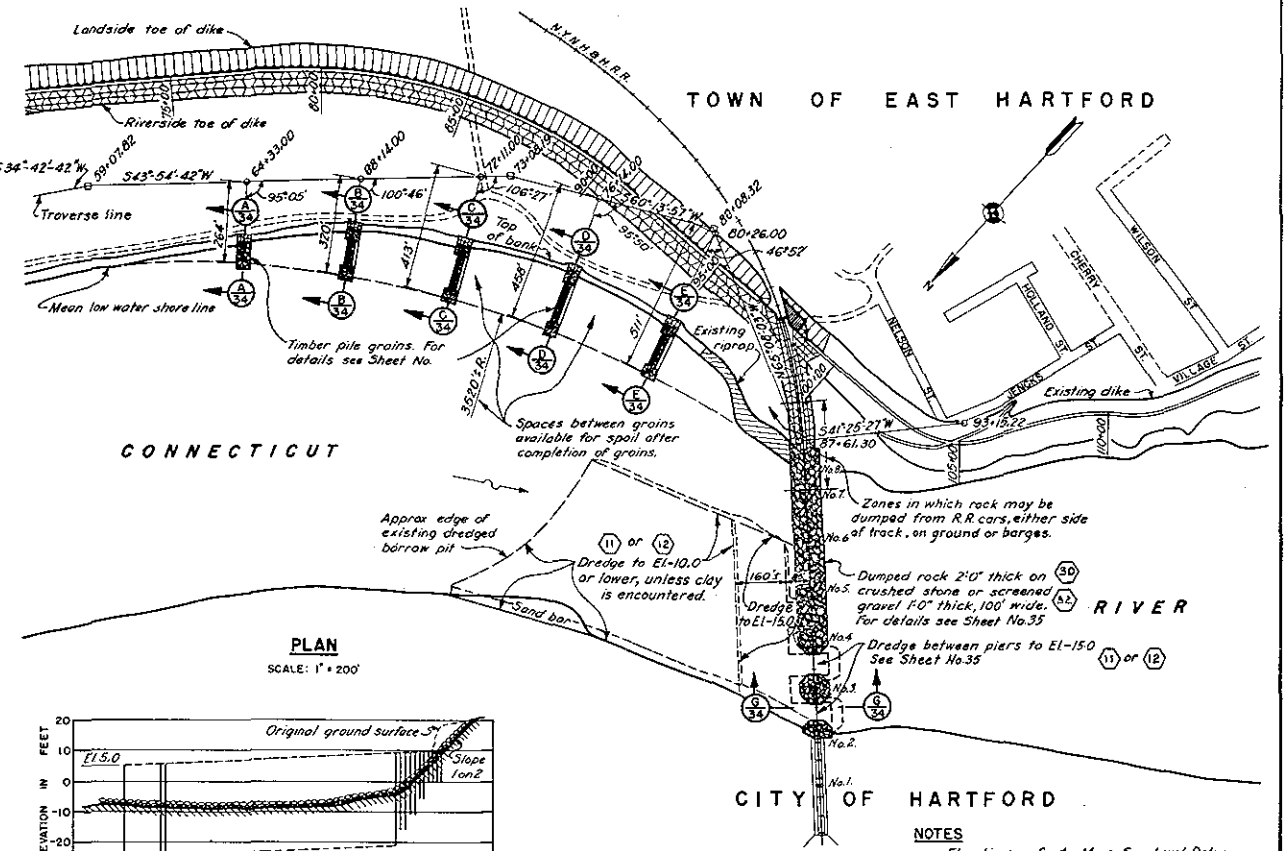

SECTION $\frac{D}{34}$




SECTION $\frac{E}{34}$

SECTIONS ALONG ℄ GROINS

SCALE: HOR. 1" = 40' VERT. 1" = 20'




PLAN

SCALE: 1" = 200'

NOTES

Elevations refer to Mean Sea Level Datum.

Figures in hexagons indicate item numbers under which payment will be made.

For details not shown on this sheet see Sheet No.35

SCHEDULE OF PILES

| NO. OF PILES | APPROX. LENGTH IN FEET | AVER. PENETRA. | REMARKS |
|---|---|---|---|
| 20 | 10 | 7 | |
| 10 | 15 | 8 | |
| 12 | 20 | 10 | |
| 10 | 25 | 13 | |
| 180 | 30 | 15 | |
| 95 | 35 | 20 | Including batter piles. |

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

PROTECTION OF RIVER BED AND BANK

GENERAL PLAN AND SECTIONS

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1 IN. = 200 FT. — SHEET NO. 34

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: [signature] ENGINEER, HEAD, HYDRAULICS SECTION — APPROVAL RECOMMENDED: [signature] PRINCIPAL ENGINEER, CIVIL ENGINEERING DIV. — APPROVED: [signature] LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

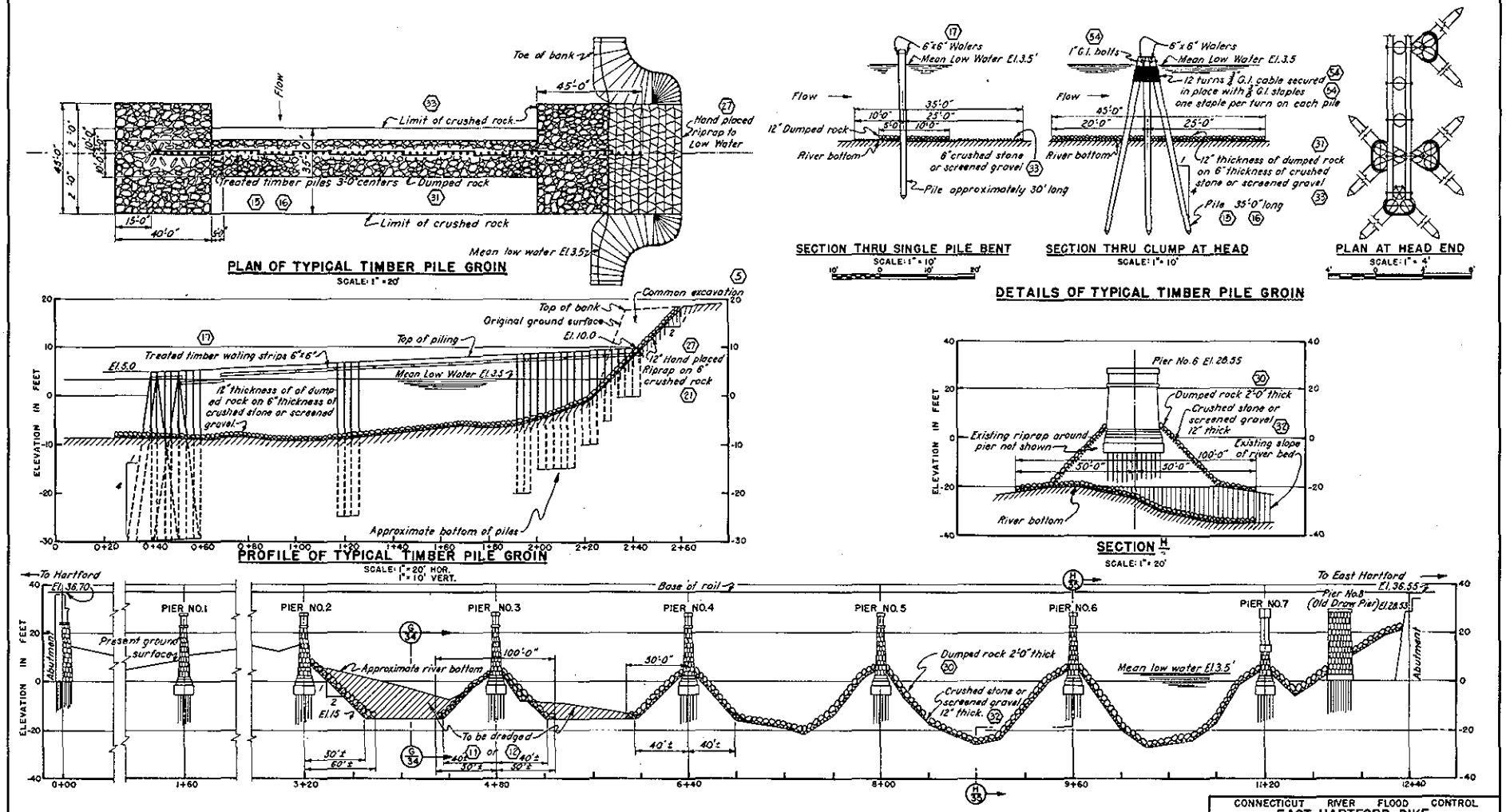
DESIGNED: G. D. Mugnier, ASSOC. ENGINEER — DRAWN: I.K.B. TRACED: K.H.R. CHECKED: C.C.F.

FISCAL YEAR 1941

FILE NO. CT-4-2803

EH. 3 to 5 incl.

PLATE NO. 37




NOTES

Elevations refer to Mean Sea Level Datum

Figures in hexagons indicate item numbers under which payment will be made.

For general plan, see Sheet No. 34

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

PROTECTION OF RIVER BED AND BANK

DETAILS OF GROINS AND RIPRAP

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1 IN. = 20 FT. — SHEET NO. 35

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: John B. Clarke, ENGINEER, HEAD, HYDRAULICS SECTION — APPROVAL RECOMMENDED: [signature], PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: [signature], LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

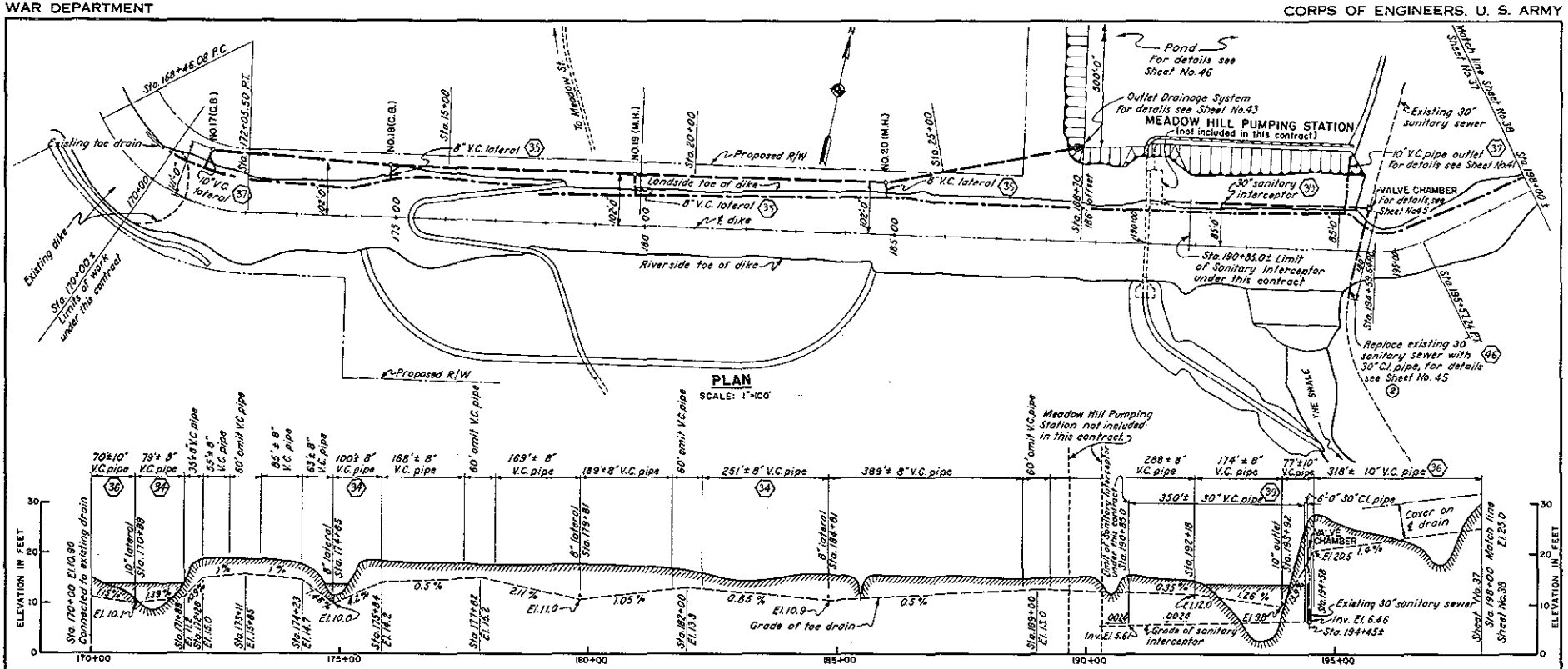
DESIGNED: [signature], ASSOC. ENGINEER — DRAWN: L.B.L. TRACED: H.A.V. CHECKED: C.C.F. — FISCAL YEAR 1941 — FILE NO. CT-4-2804

EH. 3 to 5 incl.

PLATE NO. 38

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




## NOTES

Elevations refer to Mean Sea Level Datum.

For details of drainage structures see Sheets No. 40 to 46 inclusive.

Offset distances to drains are from ℄ dike to center of manhole. Distances are approximate and are measured normal to ℄ dike or radially on curves.

All existing drains within limits of dike to be removed except as noted

For dimensions giving location of toe drains see Sheet No. 26

Toe drains shown on this sheet shall be Type "B" except between Sta. 194+58 and Sta. 197+40 which shall be Type "A".

For explanation of section designations see Sheet No. 1.

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

CONNECTICUT RIVER FLOOD CONTROL

# EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

DRAINAGE SYSTEM

PLAN AND PROFILE NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SHEET NO. 37

SCALE: 1 IN. = 100 FT. (100' 0 100' 200')

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

DESIGNED: ASSOC. ENGINEER — DRAWN: G.A.K. TRACED: H.A.V. CHECKED:

FISCAL YEAR 1941

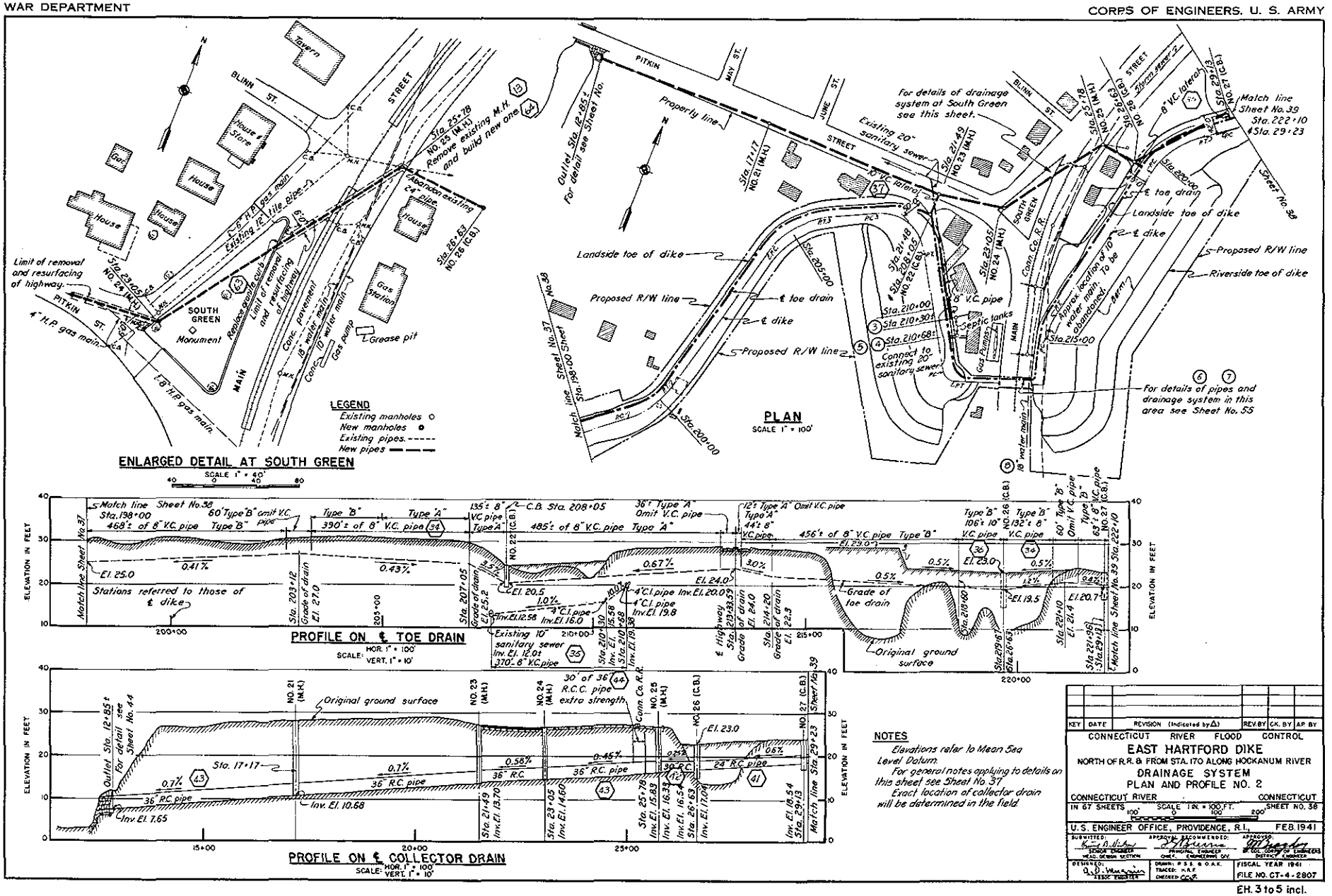
FILE NO. CT-4-2806

PLATE NO. 39

EH. 3 to 5 Incl.

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




NOTES

Elevations refer to Mean Sea Level Datum.

For general notes applying to details on this sheet see Sheet No. 37

Exact location of collector drain will be determined in the field.

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

DRAINAGE SYSTEM

PLAN AND PROFILE NO. 2

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1 IN. = 100 FT. — SHEET NO. 38

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

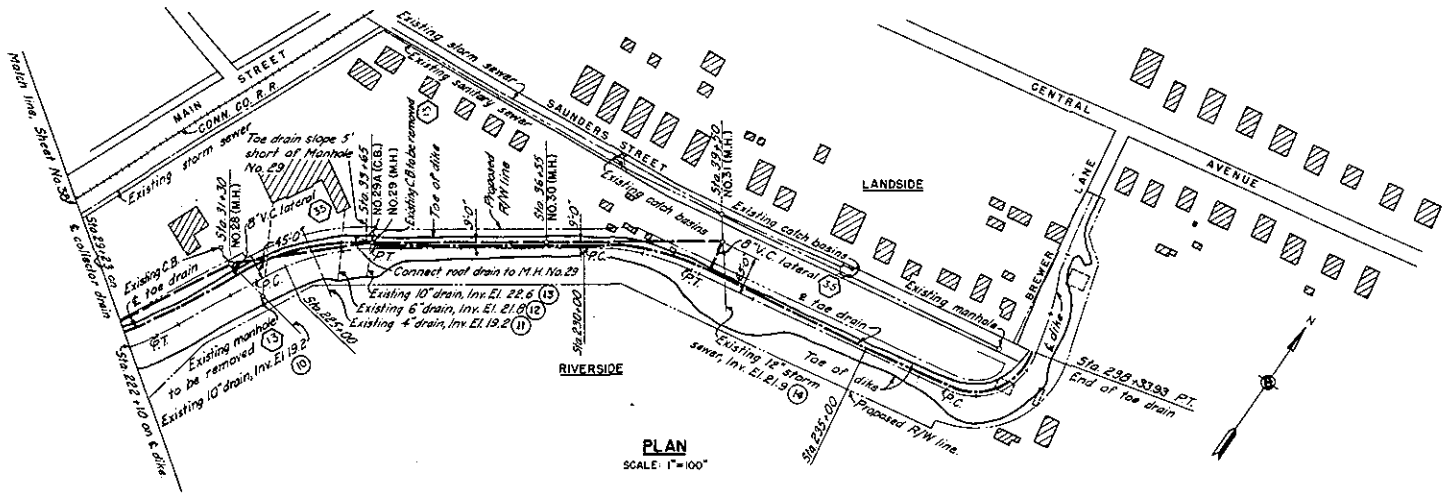
DESIGNED: ASSOC. ENGINEER — DRAWN: P.S.S. & O.A.K. TRACED: H.R.F. CHECKED: C.C.F.

FISCAL YEAR 1941

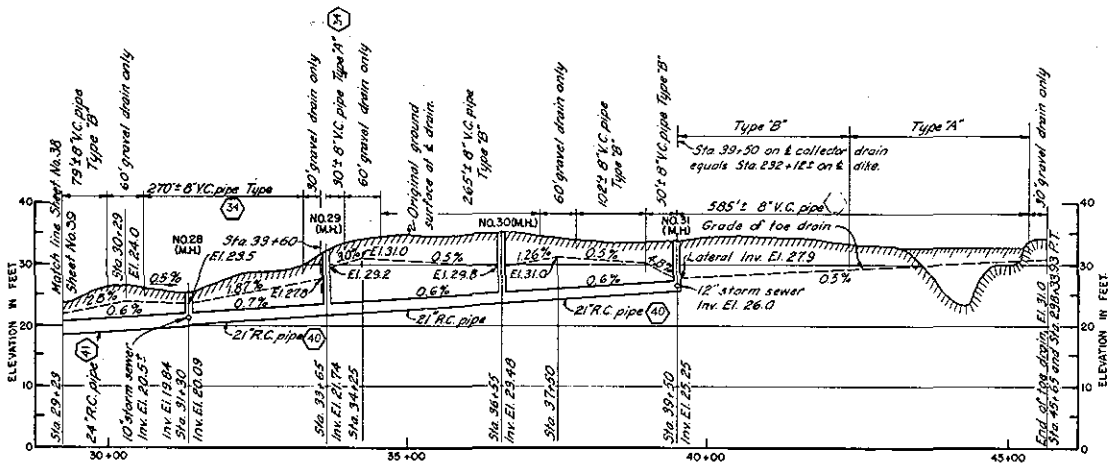
FILE NO. CT-4-2807

EH. 3 to 5 incl.

PLATE NO. 40




PLAN
SCALE: 1" = 100'




PROFILE ON ℄ COLLECTOR DRAIN
SCALE: HOR. 1" = 100'
VERT. 1" = 10'

NOTES

*Elevations refer to Mean Sea Level Datum.*
*For general notes applying to details on this sheet, see Sheet No. 37.*

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

CONNECTICUT RIVER FLOOD CONTROL
**EAST HARTFORD DIKE**
NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER
DRAINAGE SYSTEM
PLAN AND PROFILE NO. 3

CONNECTICUT RIVER — CONNECTICUT
IN 57 SHEETS — SCALE: 1 IN = 100 FT. — SHEET NO. 39

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

DESIGNED: ASSOC. ENGINEER — DRAWN: W.C.B. & O.A.K. — TRACED: H.R.L. — CHECKED: O.C.F.

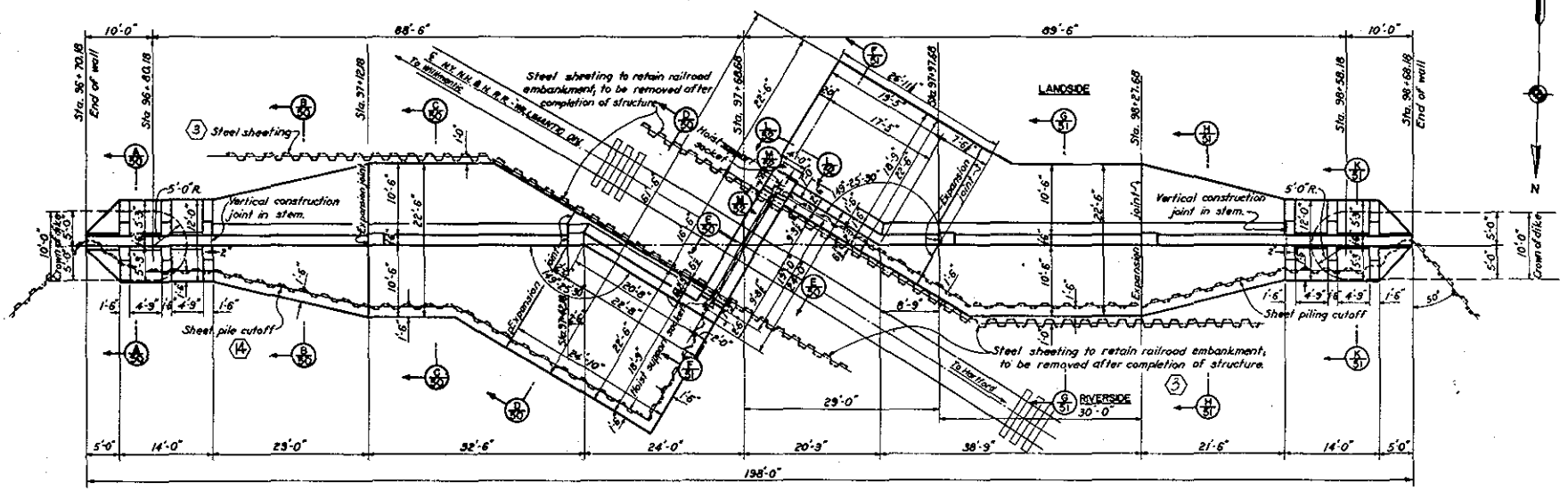
FISCAL YEAR 1941
FILE NO. CT-4-2808

EH. 3 to 5 incl.

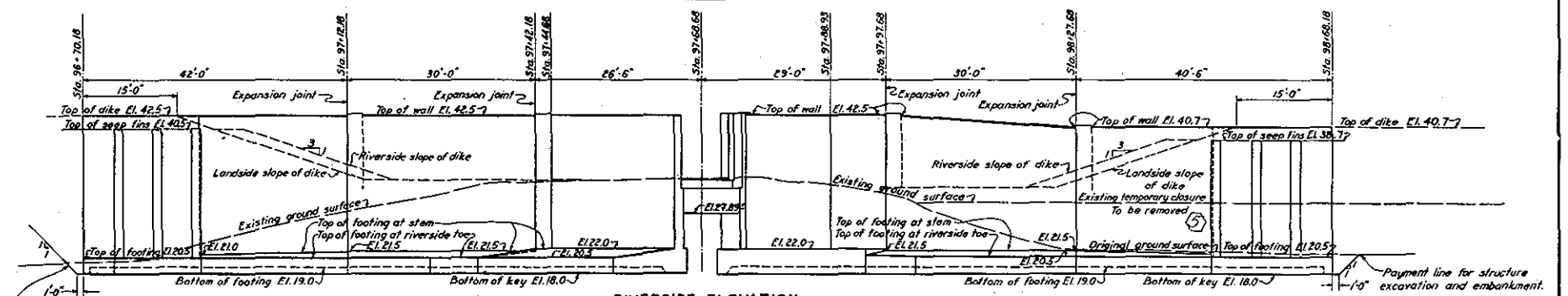
PLATE NO. 41

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




## PLAN




## RIVERSIDE ELEVATION

Payment line for structure excavation and embankment. (5) (11)

**NOTES**

Elevations refer to Mean Sea Level Datum.

All stations are on ℄ of dike, and riverside face of wall is on ℄ of dike except between Sta. 97+44.68 and Sta. 97+88.93.

All exposed corners shall be chamfered 1" or as directed by the contracting officer.

Location of construction joints may be changed with the approval of the contracting officer.

All cost for supporting railroad track, including the cost of all necessary sheet piling to maintain track in service will be paid for under Item No. 3.

For details of removable stop-log hoist supports (2 required) see Sheet No. 66.

All stop-logs shall be White Oak, structural grade and creosoted, and will be paid for under Item No. 56.

All concrete shall be Class "A" and will be paid for under Item No. 49.

For additional concrete details see Sheets No. 50 to 52 inclusive.

For steel reinforcement details see Sheets No. 53 and 54.

For location plan see Sheets No. 2, 17 and 27.

For layout of steel sheet piling see Sheet No. 36.

Figures in hexagons indicate item numbers under which payment will be made.

For explanation of section designations, see Sheet No. 1

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

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

RAILROAD STOP-LOG STRUCTURE

PLAN AND PROFILE

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1/8 IN. = 1 FT. — SHEET NO. 49

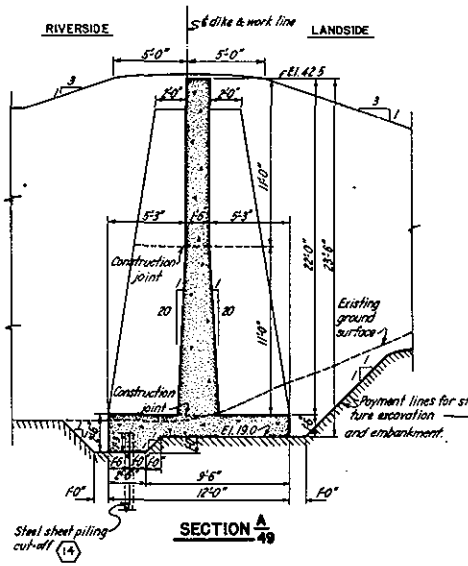
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

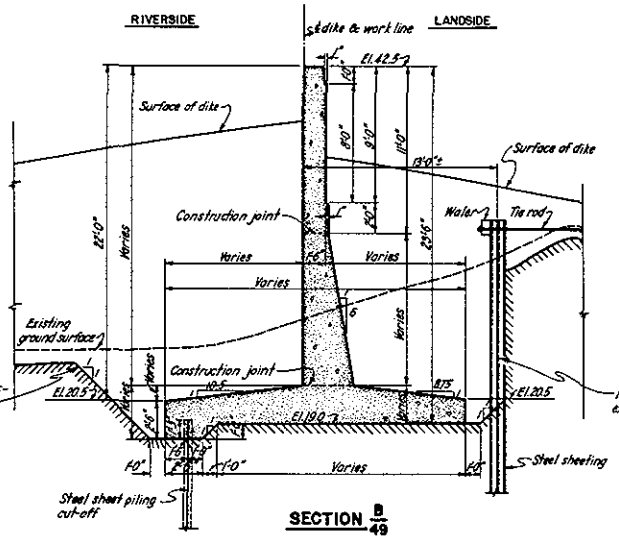
DESIGNED: A. J. Wilson, ASSOC. ENGINEER — DRAWN: R. R. T. TRACED: H. S. T. CHECKED — FISCAL YEAR 1941 — FILE NO. CT-4-2818

PLATE NO. 42

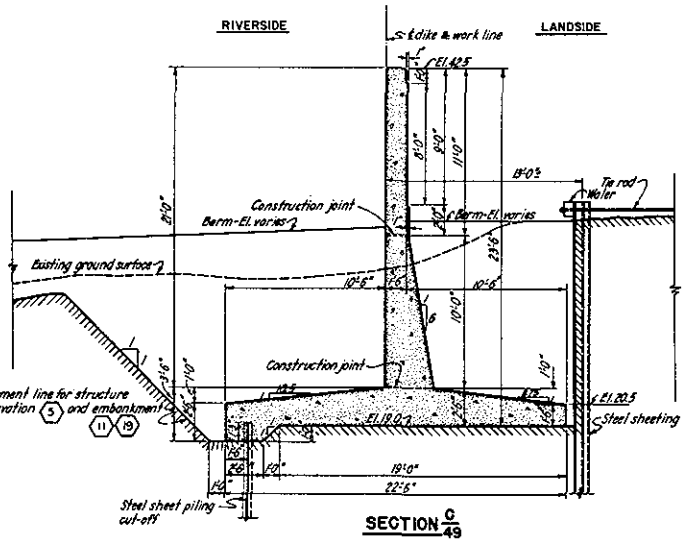
EH. 3 to 5 incl.



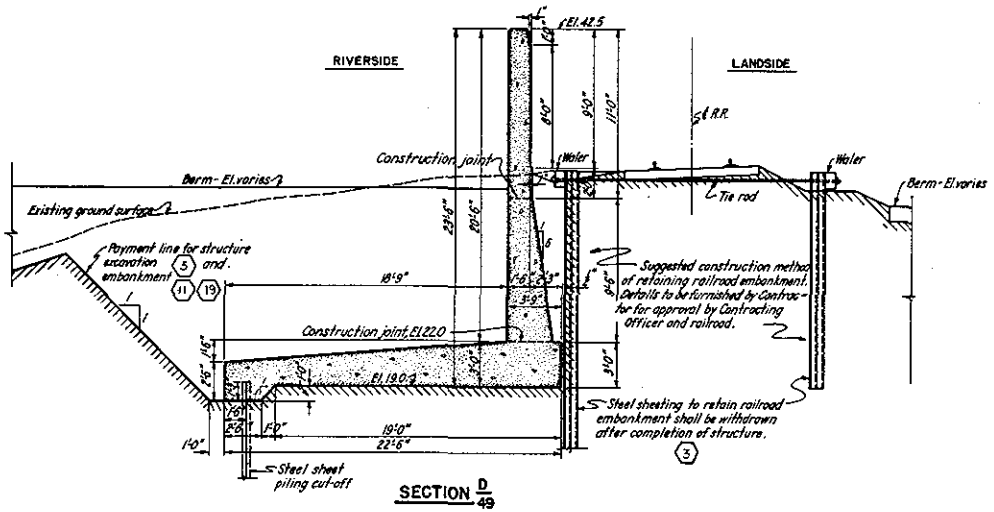

SECTION A/49



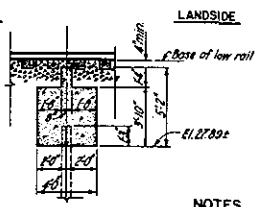

SECTION B/49




SECTION C/49




SECTION D/49




SECTION E/49

**NOTES**

For general notes applying to details on this sheet, see Sheet No. 49.

For additional concrete details, see Sheets No. 49, 51, & 52.

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

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

RAILROAD STOP-LOG STRUCTURE

DETAILS NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 50

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

DESIGNED: C. D. Wurzbacher, ASSOC. ENGINEER — DRAWN: R.E.T. — TRACED: G.F.B. — CHECKED: J.W.M.

FISCAL YEAR 1941

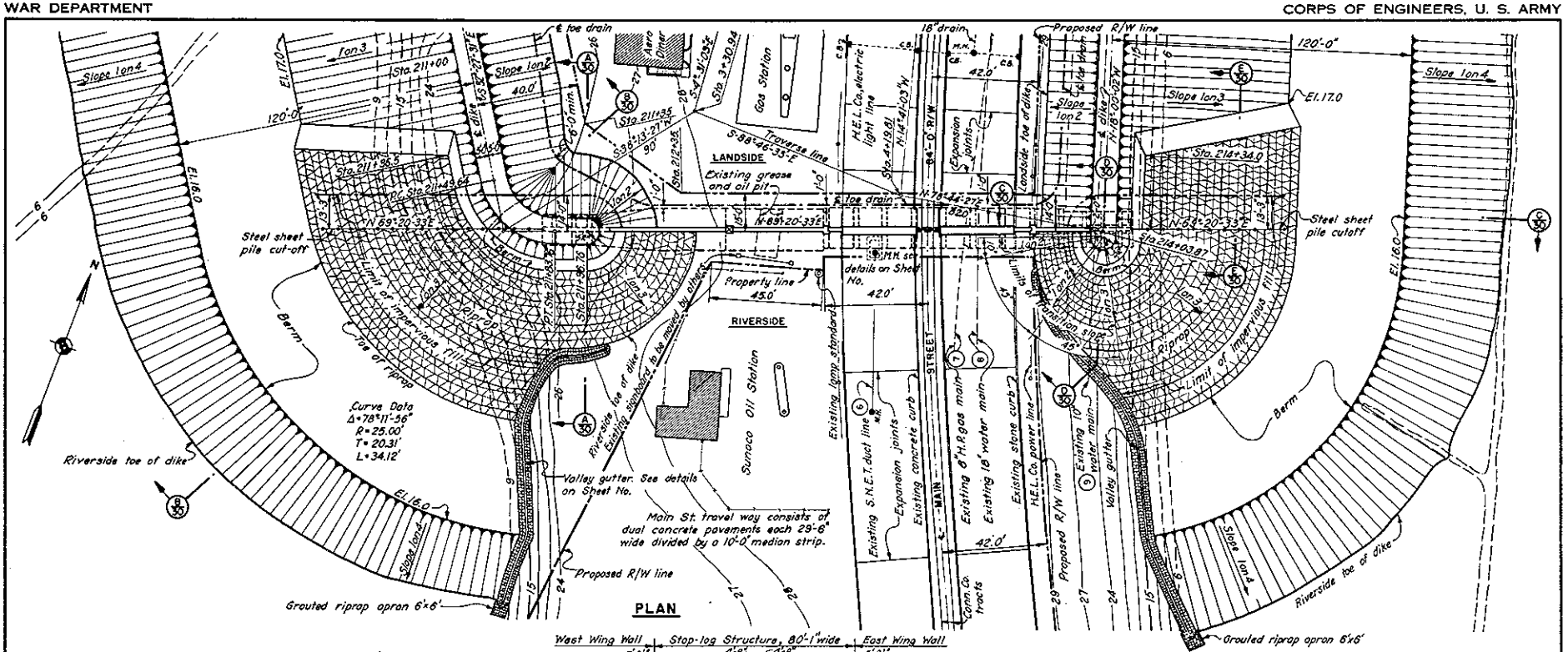
FILE NO. CT-4-2819

PLATE NO. 43

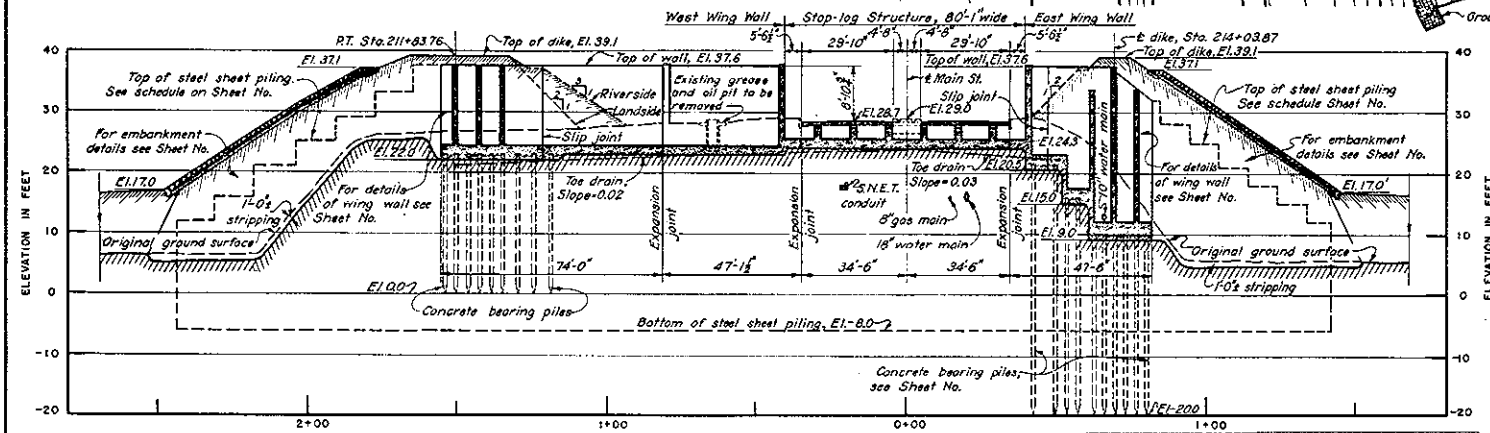
EH. 3 to 5 incl.

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY




PLAN




PROFILE

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

**NOTES**

Elevations refer to Mean Sea Level Datum.

Locations of underground structures are approximate only.

Dike stationing is along riverside face of wall.

Existing grease and oil pit to be removed and paid for under Item No. 8.

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

CONNECTICUT RIVER FLOOD CONTROL

**EAST HARTFORD DIKE**

NORTH OF R.R. 8 FROM STA. 170 ALONG HOCKANUM RIVER

MAIN STREET STOP-LOG STRUCTURE

GENERAL PLAN

CONNECTICUT RIVER CONNECTICUT

IN 67 SHEETS SCALE: 1 IN. = 20 FT. SHEET NO. 55

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

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

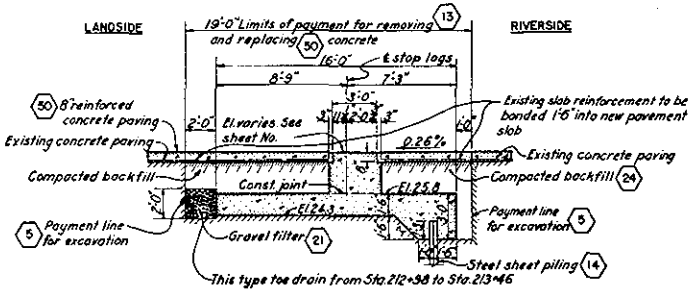
DESIGNED: ASSOC. ENGINEER — DRAWN: D.C. TRACED: P.J.B. CHECKED: W.R.K.

FISCAL YEAR 1941

FILE NO. CT-4-2824

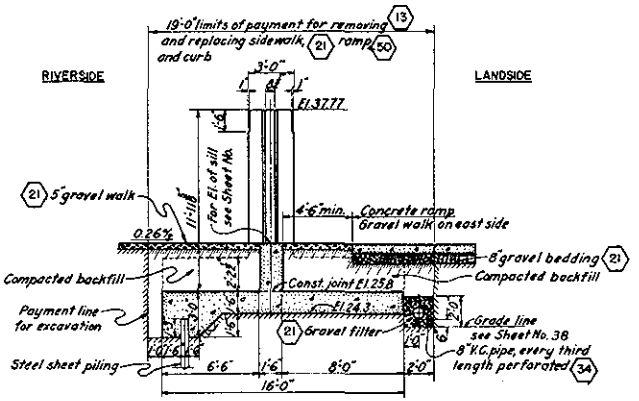
EH. 3 to 5 incl.

PLATE NO. 44



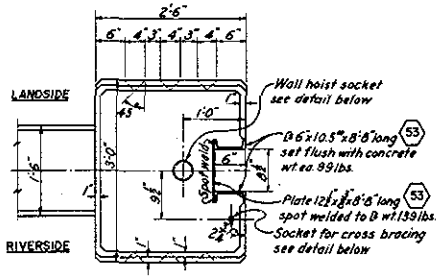

SECTION A/59

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



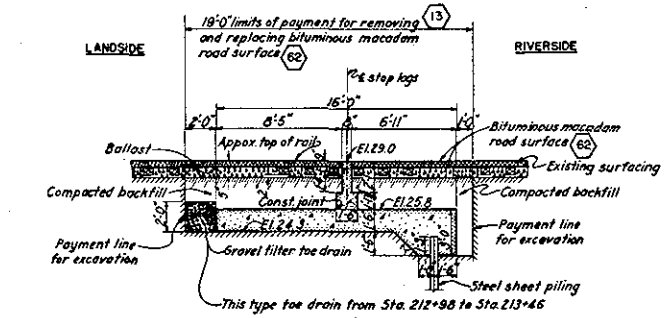

SECTION C/59

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



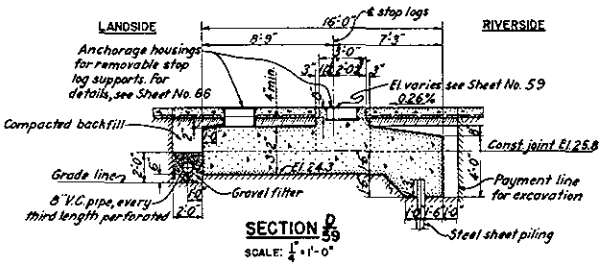

DETAIL OF STOP-LOG PILASTER

SCALE: 1" = 1'-0"



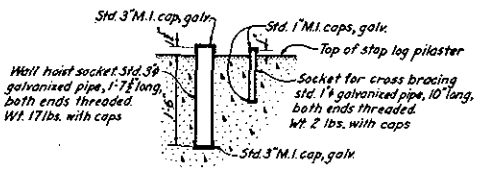

SECTION B/59

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




SECTION D/59

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

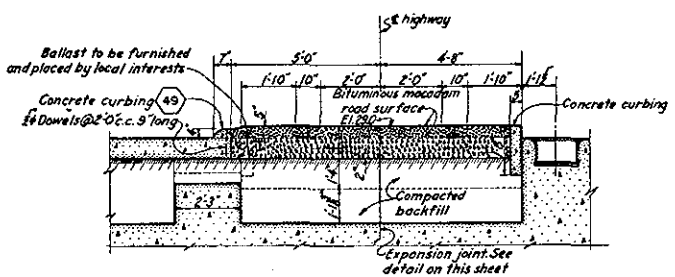



DETAILS OF SOCKETS IN STOP-LOG PILASTER

SCALE: 1" = 1'-0"

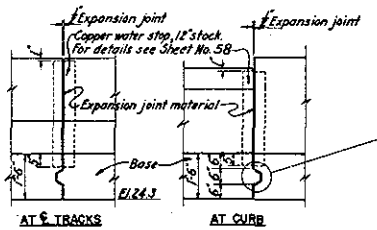
NOTES

For general notes applying to details on this sheet, see Sheet No. 56




SECTION G/59

SCALE: 1/2" = 1'-0"




DETAIL OF EXPANSION JOINTS IN STOP-LOG STRUCTURE

SCALE: 1/2" = 1'-0"

DETAIL OF KEY

SCALE: 1" = 1'-0"

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD DIKE

NORTH OF R.R. & FROM STA. 170 ALONG HOCKANUM RIVER

MAIN STREET STOP-LOG STRUCTURE

DETAILS OF BASE NO. 2

CONNECTICUT RIVER — CONNECTICUT

IN 67 SHEETS — SCALE 1/4 IN. = 1 FT. — SHEET NO. 60

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1941

SUBMITTED: Chief, Design Section — APPROVAL RECOMMENDED: Principal Engineer, Chief, Engineering Div. — APPROVED: Lt. Col., Corps of Engineers, District Engineer

DESIGNED: — DRAWN: — TRACED: — CHECKED:

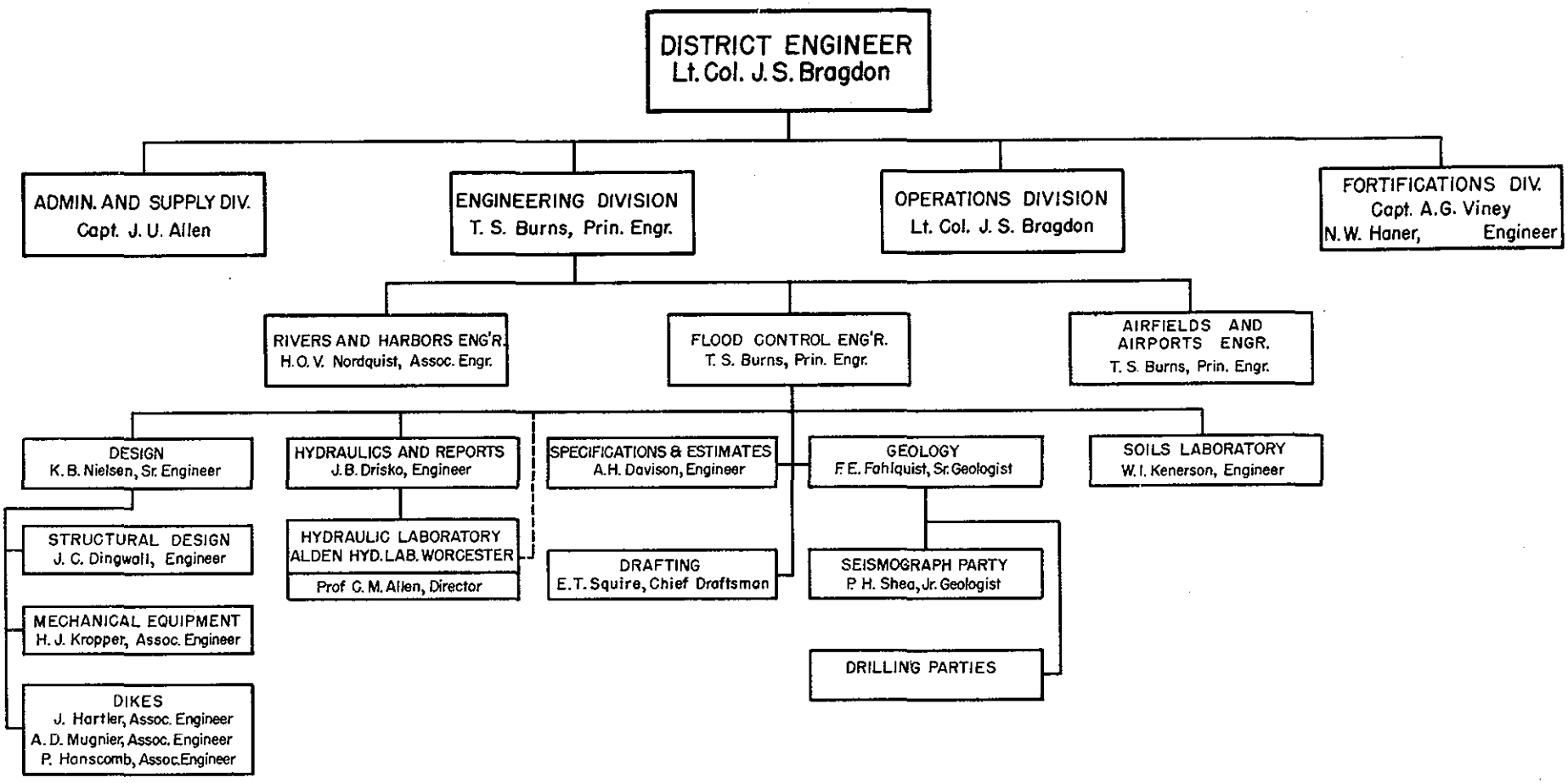
FISCAL YEAR 1941

FILE NO. CT-4-2829

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

PLATE NO. 45

EH. 3 to 5 incl.




ORGANIZATION CHART
ENGINEERING DIVISION
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
FEBRUARY, 1941

PLATE NO. 46

CONNECTICUT RIVER FLOOD CONTROL PROJECT

# EAST HARTFORD, CONN.

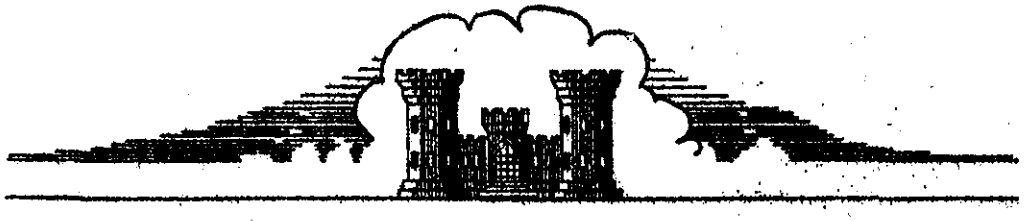
CONNECTICUT RIVER CONNECTICUT

## ANALYSIS OF DESIGN FOR LOCAL PROTECTION WORKS

ITEMS EH. 3 TO 5 INCL.

NORTH OF R.R. AND FROM STA. 170 ALONG HOCKANUM RIVER

APPENDIX A



FEBRUARY 1941

CORPS OF ENGINEERS, U. S. ARMY

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

**WAR DEPARTMENT**

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

Page 1

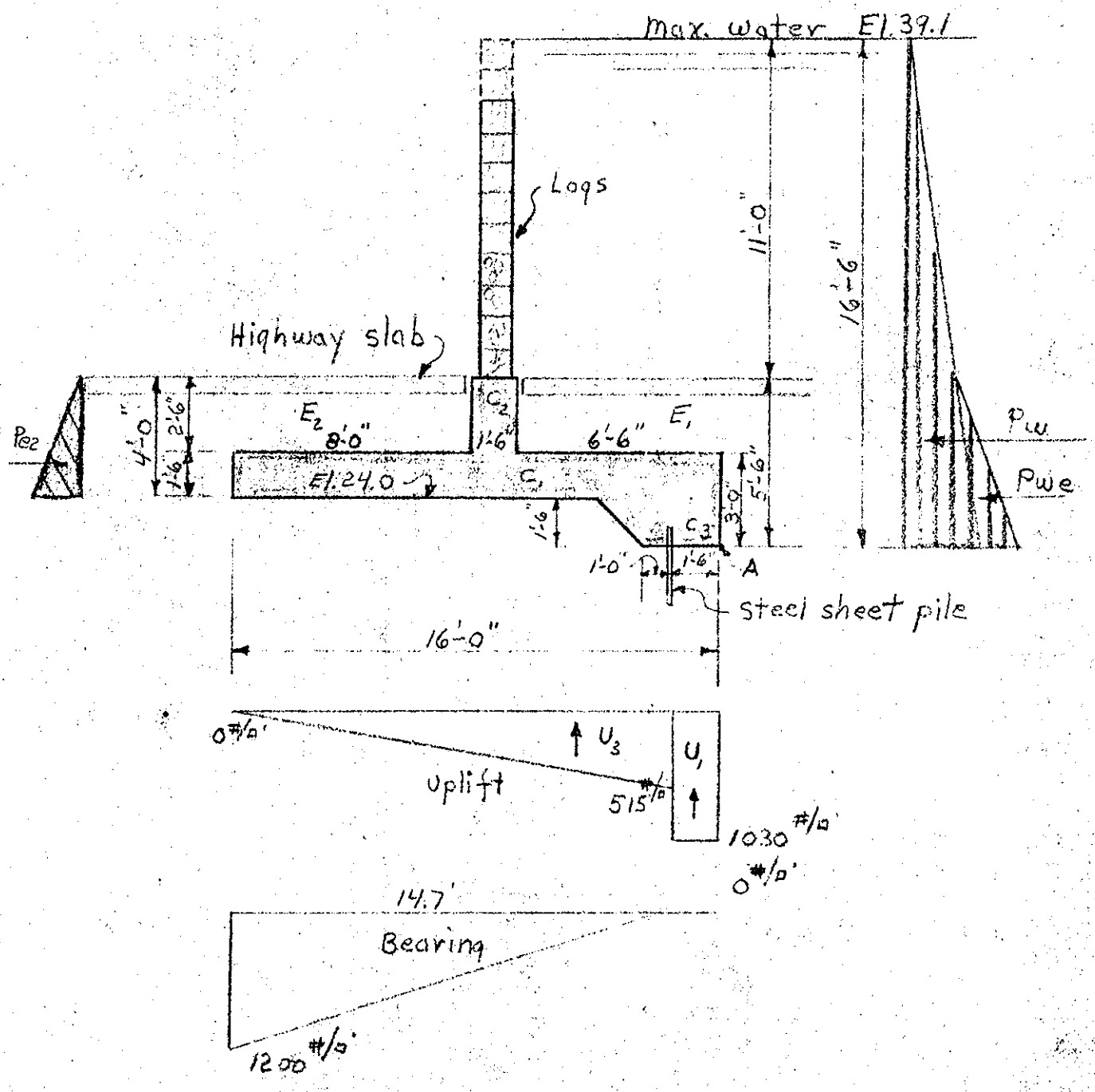
Project: East Hartford, Conn.

Computation: Main St. Stop Log Structure

Computed by: W. S. Jr. Checked by: Date: 11/6/40

U. S. GOVERNMENT PRINTING OFFICE 3—10538

# Stability of Typical Section



Subject: East Hartford, Conn.

Computation: Main St. Stop Log

Computed by: W.S.Jr. Checked by: Date: 11/6/40

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 16 x 1.5 x 150 | 3600 | | | | 8.0 | | 28,800 |
| $C_2$ | 2.5 x 1.5 x 150 | 561 | | | | 7.25 | | 4060 |
| $C_3$ | 1.5 x 3.25 x 150 | 730 | | | | 1.62 | | 1180 |
| $E_1$ | 6.5 x 2.5 x 125 | 2040 | | | | 3.25 | | 6620 |
| $E_2$ | 8 x 2.5 x 100 | 2000 | | | | 12.0 | | 24000 |
| W | 7 x 11 x 62.5 | 4810 | | | | 3.5 | | 16900 |
| L | 11 x .667 x 50 | 368 | | | | 7.25 | | 2660 |
| | | | | | | | | |
| $P_w$ | $16.5^2 \times 1/2 \times 62.5$ | | | | 8500 | 5.5 | | 46,700 |
| $P_{we}$ | $5.5^2 \times 1/2 \times 17.5$ | | | | 265 | 1.8 | | 477 |
| | | | | | | | | |
| | | | | | | | | |
| $P_{e2}$ | $5.5^2 \times 1/2 \times 35$ | | | 530 | | 1.8 | 950 | |
| $F_r$ | $.45 \times \Sigma V$ | | | 4000 | | 0 | | |
| $P_p$ | Passive Press. | | | 4235 | | 1.8 | 7600 | |
| | | | | | | | | |
| | | | | | | | | |
| $U_1$ | 1030 x 1.5 | | 1540 | | | .75 | 1160 | |
| $U_3$ | 515 x 1/2 x 14.5 | | 3730 | | | 6.33 | 23600 | |
| | | | | | | | | |
| | | 14109 | 5270 | 8765 | 8765 | | 33,310 | 131,397 |
| | | $\Sigma V = 8839$ | | $\Sigma H = 0$ | | | $\Sigma M = 98,087$ | |

Position of Resultant $= \frac{\Sigma M}{\Sigma V} = 11.1'$ $\quad 16 - 11.1 = 4.9$ outside middle $\frac{1}{3}$ but o.k.

$$\text{Bearing} = \frac{8839}{3 \times 4.9} \times \begin{matrix} 2 \\ 0 \end{matrix} = \begin{matrix} 1200 \\ 0 \end{matrix} \ \#/\square'$$

**WAR DEPARTMENT**

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



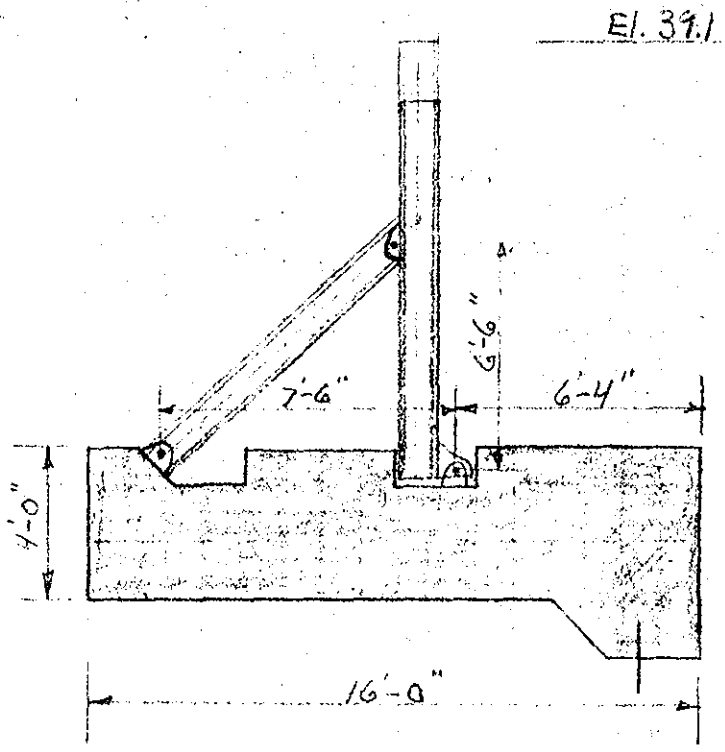
Subject: East Hartford, Conn.

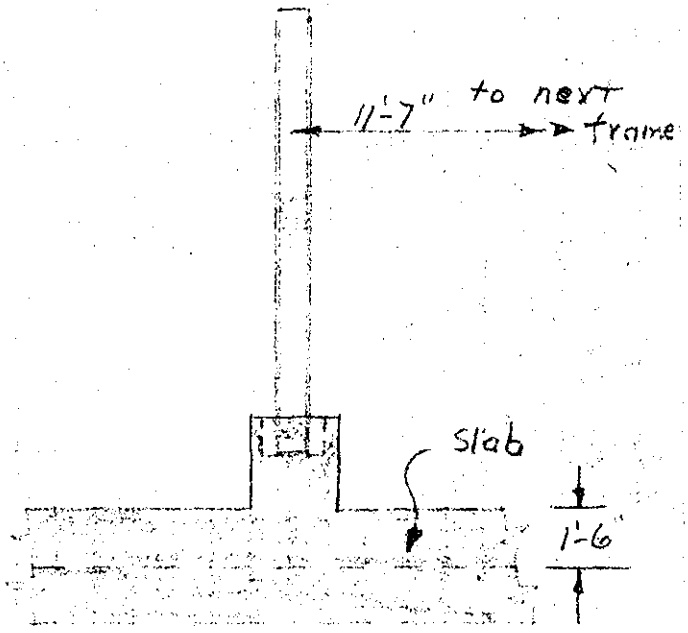
Computation: Main St. Stop Log

Computed by: W. S. Jr. Checked by: Date: 11/6/40

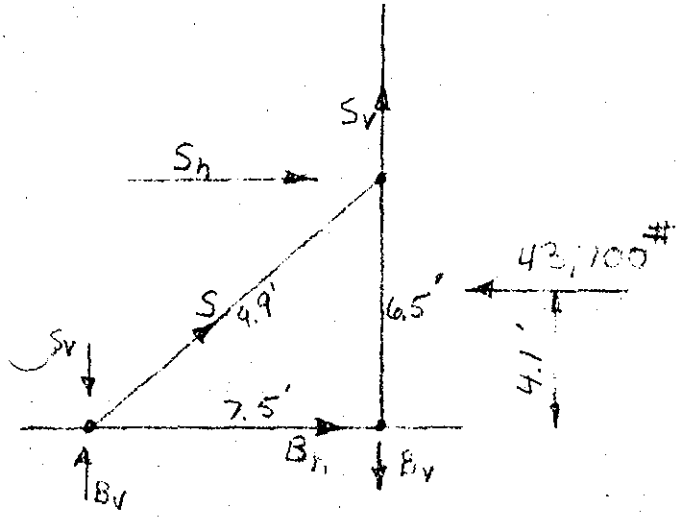
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of beam under "A" frame.




Pressure on frame $= 11^2 \times \frac{1}{2} \times 62.5 \times 11.58 = 43{,}700^{\#}$




$S_h \times 6.5 = 43{,}700 \times 4.1$

$S_h = 27{,}600^{\#}$

$S = \frac{9.9}{7.5}\, 27{,}600 = 36{,}400^{\#}$

$B_h = 43{,}700 - 27{,}600 = 16{,}100^{\#}$

$S_v = B_v = \frac{6.5}{7.5}\, 27{,}600 = 24{,}000^{\#}$

This diagram is not exact but is on the safe side.

**WAR DEPARTMENT**

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

Page 4

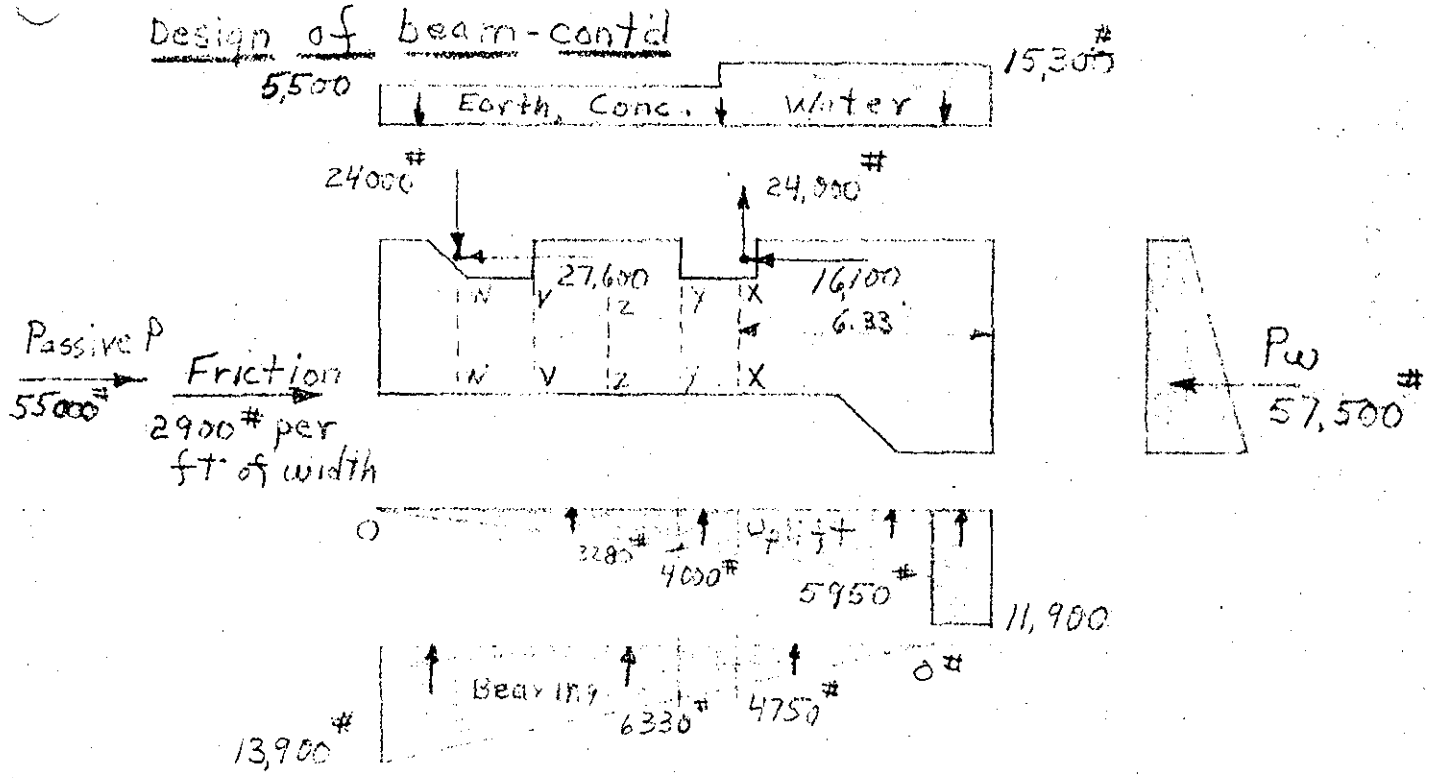
Subject: East Hartford, Conn.

Computation: Main St. Stop Log

Computed by: W. S. T. Jr. Checked by: Date: 11/9/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of beam-cont'd




moment at X-X

Water, Earth, Conc. ↓ 15,300 × 6.33 = 97,000# × 3.16 = 306,000'# ↻

Friction ← 2900 × 6.33 = 18,400# × 3.5 = 64,400'# ↺

Passive P, Pw ← 57,500 − 55000 = 2500# × .3 = 750'# ↺

Uplift ↑ 11,900 × 1.5 = 17,850# × 5.50 = 99,500'# ↺

" ↑ 4000 × 4.83 = 19,300# × 2.41 = 46,600'# ↺

" ↑ 1950 × 2.41 = 4,700# × 3.22 = 15,100'# ↺

Bearing ↑ 4750 × 5.03/2 = 12,100# × 1.67 = 20,000'# ↺

ΣV = 45,150# ↓ ΣM = 59,650'# ↻

**WAR DEPARTMENT**

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



Project: East Hartford, Conn.
Computation: Main St. Stop Log
Computed by: W.S. Jr. Checked by: Date: 11/12/40

U. S. GOVERNMENT PRINTING OFFICE 3—10693

Design of beam – cont'd

moment at y-y

| | | | |
|---|---|---|---|
| Water, Earth, Conc. ↓ | 15300 x 7 = 107 000# | x 4.5 = | 480,000'# |
| | 5500 x 1 = 5,500# | x .5 = | 2,750'# |
| Friction ⇄ | 2900 x 8 = 23,200# | x 3.5 = | 81,000'# |
| Passive P, Pw | ← 57,500 − 55000 = 2500# → | x .3 = | 750'# |
| Center Post Pull ↑ | = 24000# | x 1.67 = | 40,000'# |
| Uplift ↑ | 11900 x 1.5 = 17,850# | x 7.25 = | 129,200'# |
| " | 3280 x 6.5 = 21,300# | x 3.25 = | 69,200'# |
| " | 2670 x 6.5/2 = 8,660# | x 4.33 = | 37,600'# |
| Bearing ↑ | 6330 x 6.7/2 = 21,200# | x 2.23 = | 47,300'# |
| | ΣV = 19490# ↓ | ΣM = | 77,700'# |

moment at z-z

| | | | |
|---|---|---|---|
| Water, Earth, Conc | 15,300 x 7 = 107,000# | x 6.5 = | 695,000'# |
| | 5500 x 3 = 16,500# | x 1.5 = | 24,800'# |
| Friction | 2900 x 10 = 29000# | x 3.5 = | 101,500'# |
| Passive P, Pw | ← 54,500 − 52000 = 2500# → | x .3 = | 750'# |
| Ctr. Post Pull | = 24000# | x 3.67 = | 88,000'# |
| Uplift ↑ | 11900 x 1.5 = 17850# | x 9.25 = | 165,000'# |
| " | 2460 x 8.5 = 20,900# | x 4.25 = | 89,000'# |
| " | 3490 x 8.5/2 = 14,850# | x 5.67 = | 84,000'# |
| Bearing ↑ | 8720 x 8.7/2 = 37,900# | x 2.9 = | 111,000'# |
| | ΣV = 8,000# ↓ | ΣM = | 80,550'# |

Project East Hartford, Conn.
Computation Main St. Stop Log
Computed by W.S. Jr. Checked by Date 11/12/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of beam cont'd

moment at V-V

Water, Earth, Conc } 15300 x 7 = 107,000# x 8.5 = 910,000'# ↻
Conc 5500 x 5 = 27,300# x 2.5 = 68,000 ↻

Friction 2900 x 12 = 35,000 x 3.5 = 123,000'# ↺

Passive P, Pw } 54500 - 52000 = 2500# x .3 = 750'# ↺

Ctr. post pull = 24000# x 5.67 = 136,000'# ↺

Uplift ↑ 11900 x 1.5 = 17850# x 11.75 = 210,000'# ↺
" 1640 x 10.5 = 17200# x 5.25 = 90,000'# ↺
" 4310 x 10.5/2 = 22600# x 7.0 = 158,000 ↺

Bearing ↑ 10100 x 10.1/2 = 54000# x 3.6 = 195,000'# ↺
ΣV = 38,850 ↑# ΣM = 65,250'# ↻

moment at W-W

Earth, Conc } ↓ 5500 x 2 = 11000# x 1 = 11,000'#

Bearing ↑ 13000 x 2 = 26000# x 1 = 26,000'#
ΣV = 15,000# ↑ ΣM = 15,000'# ↻

max. mom. in beam = 80,550'#

$d_{req'd} = \sqrt{\frac{80,550 \times 12}{123 \times 27}} = 17''$ $d_{provided} = 30''$ O.K.

$A_s = \frac{80,550 \times 12}{18000 \times .884 \times 30} = 2.01 \square''$ per beam

Shear $= \frac{43150}{27 \times .884 \times 30} = 61$ #/□" O.K. Bond $= \frac{43150}{8 \times .884 \times 30} = 200$ #/□" OK
use spec. anch.

**WAR DEPARTMENT**

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



ect EH.4a South Main St. Stop Log

omputation Slab Steel

omputed by J. H. Q. Checked by Date Nov. 9 1940

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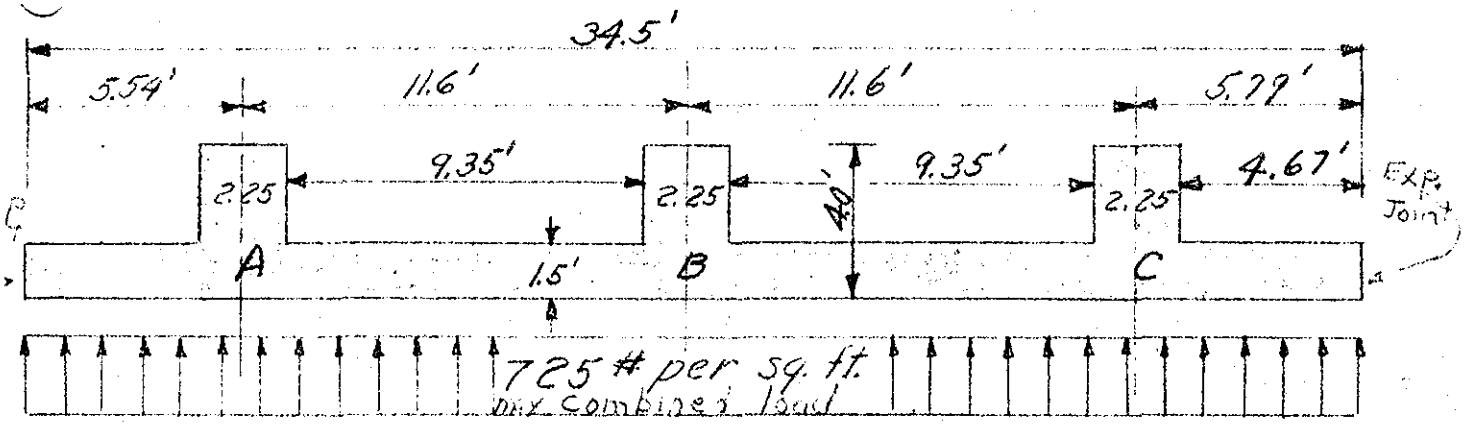



| | | | | | |
|---|---|---|---|---|---|
| +7.9 | -7.9 | +8.02 | -8.02 | +7.9 | -7.9 |
| | | -.11 | +.11 | | |
| | +0.23 | 0 | 0 | -0.23 | |
| +7.9 | -8.13 | +8.13 | -8.13 | +8.13 | -7.9 |
| A | | B | | C | |

$$\frac{1}{12} w\ell = \frac{1}{12} \times 11.6 \times 725 \times 11.6 = 8{,}130'^{\#}$$

$$4.67 \times 725 \times \frac{4.67}{2} = 7900'^{\#}$$

Steel required at A + C $M = 7900'^{\#}$

$$A_s = \frac{7900}{1325 \times 13.5} = .441\square'' \text{ in bottom}$$

$$d = \sqrt{\frac{7900}{123}} = 8'' + 4.5 < 18'' \text{ O.K.}$$

$$v = \frac{4.67 \times 725}{.884 \times 12 \times 13.5} = 23.6^{\#} < 60^{\#} \text{ O.K.}$$

Steel required at B

$$A_s = \frac{8020}{1325 \times 13.5} = .447\square'' \text{ in bottom}$$

Use $\frac{7}{8}''\phi$ @12" c.c. Top and Bottom longitudinals in base slab - $\frac{1}{2}''\square$ @12" c.c. transverse temp. bars

ect East Hartford, Conn.
mputation Main St. Stop Log
mputed by W. S. Jr. Checked by Date 11/13/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of Logs

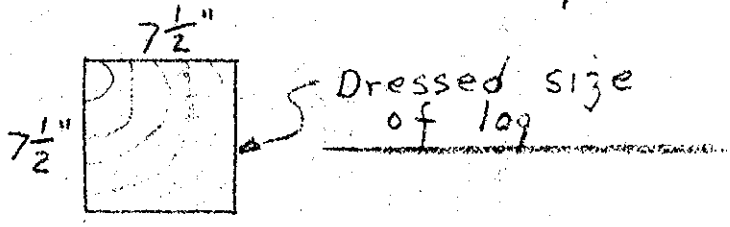
Simple beam span = 11.6'
max. water head = 11.0'

$$\text{max beam mom.} = \frac{(11 \times 62.5) \times 11.6^2}{8} = 11{,}600'^{\#} = 139{,}000''^{\#}$$

$$f = \frac{M}{S} \qquad 1750 = \frac{139{,}000}{S} \qquad S = 80''^3$$

$$S = \frac{bd^2}{6} = \frac{12d^2}{6} \qquad 80 = 2d^2 \qquad d^2 = 40 \qquad d = 6.4''$$

use 8x8 select white oak logs S-4-S




Shear

$$\frac{wL}{2} = 4000^{\#} \qquad V = \frac{3}{2} \times \frac{V}{A} = \frac{3}{2} \times \frac{4000}{12 \times 7.5} = \underline{66}^{\#/\square''} \text{ O.K.}$$

Bearing

Assume 4" of log is in slot.

$$A = 4 \times 12 = 48'' \qquad \frac{4000}{48} = \underline{84}^{\#/\square''} \text{ O.K.}$$

Handling Wt

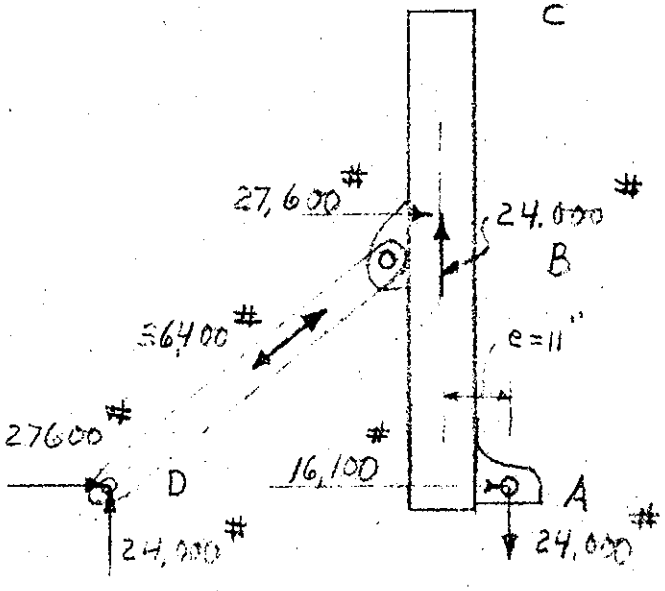
$$50 \times \frac{7.5}{12} \times \frac{7.5}{12} \times 12.6 = \underline{245}^{\#}/\text{log}$$

Project East Hartford, Conn.
Computation Main St. Stop Log
Computed by W. S. Jr. Checked by Date 11/13/40

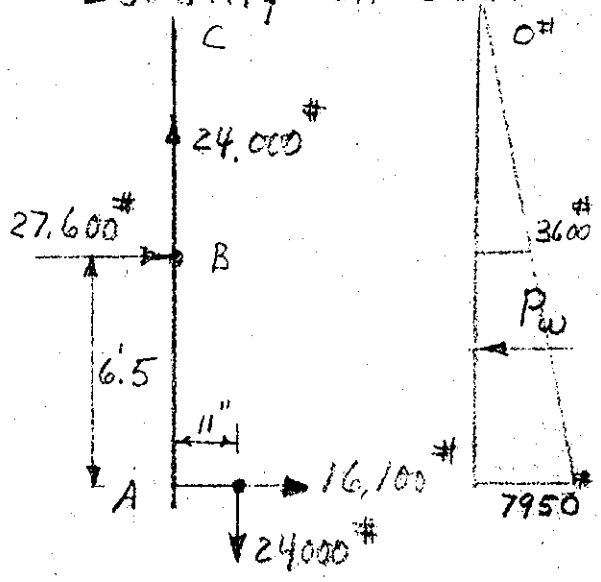
U. S. GOVERNMENT PRINTING OFFICE 3—10598

Design of "A" frame center post.

see page three for loads.




Loading on beam




max. mom is at B

3600 x 6 x 3 = 65,000 '#
4350 x 6/2 x 4 = 52,000 '#
24000 x 11/12 = 22,000 '#
139,000 '#

16100 x 6.5 = 104,000 '#

max mom = 35,000 '#

$S = \frac{M}{f} = \frac{35000 \times 12}{18000} = 24''^3$

Size of log governs

Use 10" WF @ 49 #/'

$f = \frac{P}{A} + \frac{M}{S}$

$= \frac{24000}{14.4} + \frac{35,000 \times 12}{54.6}$

max stress = 9,470 #/□"

O.K.

ect East Hartford, Conn.
omputation Main St. Stop Log
omputed by W. S. Jr. Checked by Date 11/13/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of "A" frame strut

Load in strut = 36,400#
Length of strut = 9.9'

Strut will be a small "H" section.

Try a 6" H @ 20 #/' It would be impractical to use a smaller section, as some allowance must be made for rusting.

Area = 5.89 □" Least r = 1.51"

$$f = \frac{18000}{1+\frac{1}{18000}\left(\frac{L}{r}\right)^2} = 14{,}000 \ \#/\square''$$

$$\frac{36{,}400}{14000} = 2.6 \ \square'' \text{req'd} \quad \text{O. K.}$$

Use a 6" H @ 20#/'

---

Pin Plates on both ends of strut.

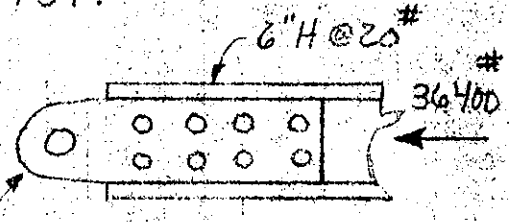
Assume 2" dia. pin

Load per plate = 18,200#

thickness required

$$t = \frac{P}{bf} = \frac{18200}{2 \times 20{,}000}$$

$t = .45''$ use $\frac{1}{2}''$ plates




$\frac{1}{2}''$ Pin plates with web of beam in middle.

7/8 rivets, web bearing = 5250# $n = \frac{36{,}400}{5250} = 7$ rivets req'd

Strut is same on both ends

ect East Hartford Conn.
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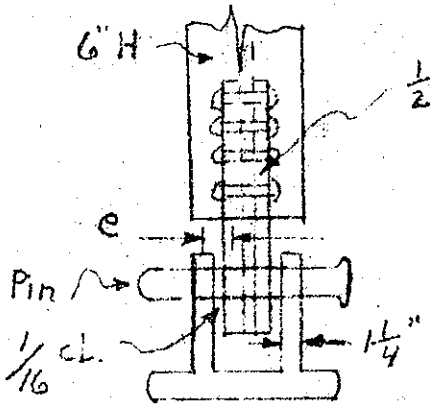
Pin thru lower end of strut




Eccentricity $e = \frac{1}{4} + \frac{1}{16} + \frac{5}{8} = \frac{15}{16}''$

mom. in pin $= 18200 \times \frac{15}{16}$

" " " $= 17000''^{\#}$

Req'd dia for mom $= 1\frac{1}{4}''$ } Carnegie handbook P 329
" " " Shear $= 1\frac{1}{2}''$

Use a 2" pin

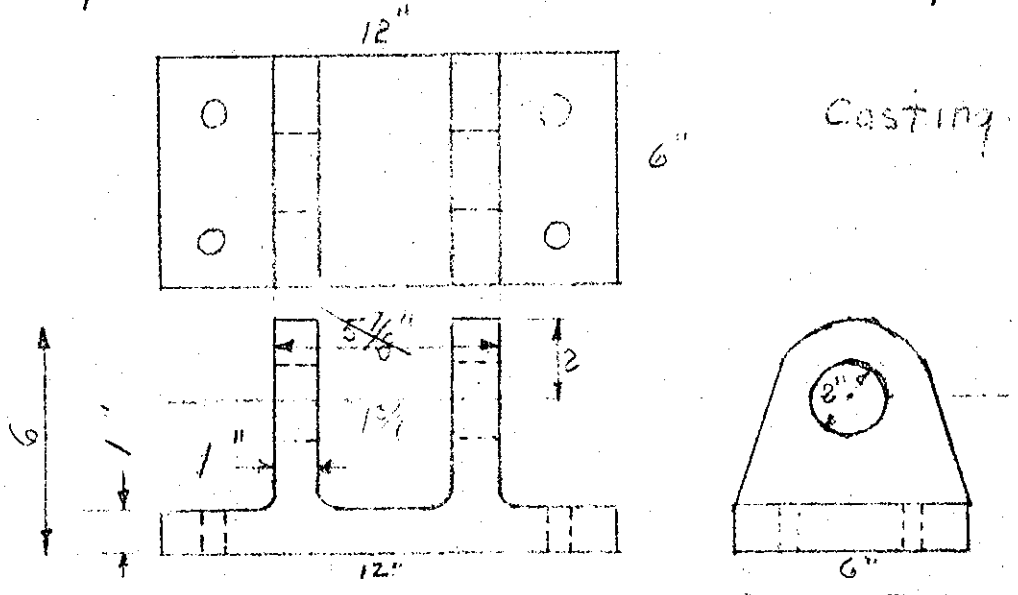
Lower Strut Casting

min. thickness for pouring cast steel $= 1\frac{1}{4}''$

Load $= 36400^{\#}$ Bearing on concrete $= 600^{\#}/\square''$

$\frac{36400}{600} = 61^{\square''}$ use a 12"x6" base

Bearing on cast steel O.K. by inspection.



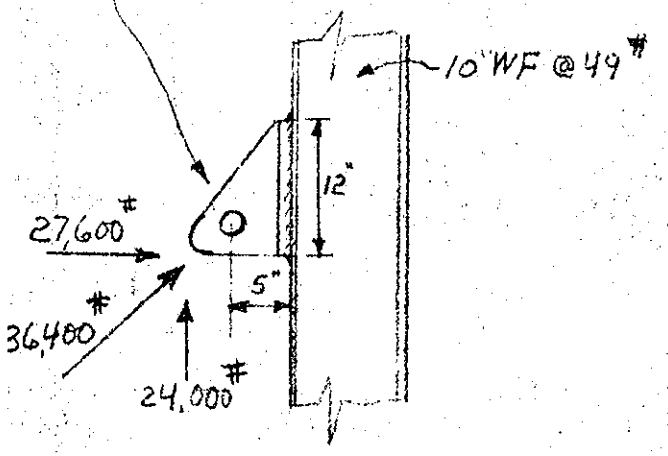

Casting C-1

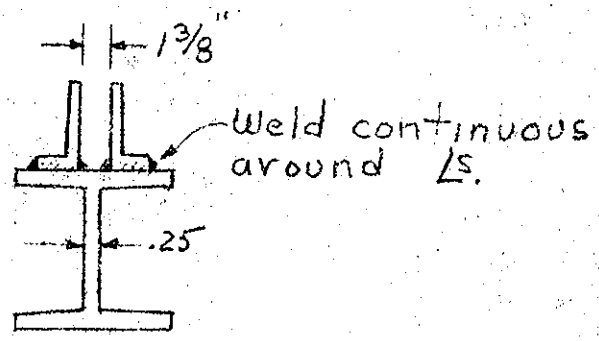
ect East Hartford, Conn.
omputation Main St. Stop Log
omputed by W. S. Jr. Checked by Date 11/27/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Strut connection on "H" beam

Use 2 Ls 8x4 x 3/4" 12" long cut as shown.




Direct thrust on beam = 27,600#

Sliding action of Ls on beam = 24,000#

Bending in flange due to thrust

$\frac{27600}{2} = 13,800$#/angle  mom. = $13800 \times \frac{7}{8} = 12,000$"#

fibre stress = $\frac{MY}{I} = \frac{12,000 \times .28}{\frac{12 \times .56^3}{12}} = 19000$ #/□" O.K.

Length of weld for sliding = $\frac{24000}{2000} = 6"$ O.K.

Use continuous 3/8" fillet welds.

Project East Hartford Conn.
Computation Main St. Stop Log
Computed by W. S. Jr. Checked by Date 11/28/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

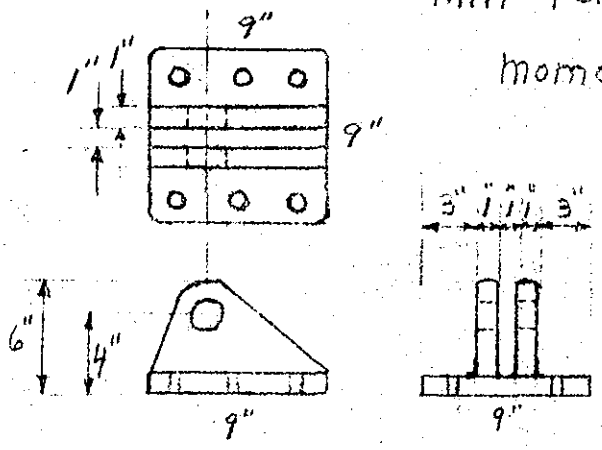
## Base Casting for Centerpost

Load = 29,800# 29,800 24000# 16,100#

Cast steel, tension = 16,000 #/□" shear = 12,000 #/□"

$\frac{29,800}{16,000}$ = 1.9 □" needed for direct tension.

min tension area = 2 (1x2) = 4 □" O.K.




moment = $\frac{24,000}{2}$ x 2" = 24000 "#

$f = \frac{24,000 \times .5}{9 \times \frac{1^3}{12}} = 16,000$ #/□" O.K.

Vertical pull = 24000#

$\frac{24000}{6}$ = 4000# pull / bolt.

shear = 16100#

$\frac{16100}{6}$ = 2700 #/bolt

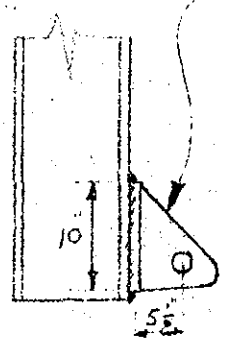
Use 6 - 7/8 ϕ bolts, washers & nuts.

---

## Connection on Centerpost

Load = 29,800#

cut from I-15a @ 75#, weld all around 3/8" f.



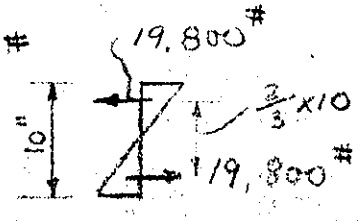

Web "t" = .868" min. tension area = 2x.868 = 1.7 □"

1.7 x 18000 = 33,000# O.K.

Downward load = 24,000#

mom. = 24,000 x 5.5 = 132,000 "#

$\frac{132,000}{\frac{2}{3} \times 10}$ = 19,800#




$6.27f + 2\left(5 \times \frac{f}{2}\right) = 19,800$# $f = 1700$ #/" O.K.

Direct tension = 16,100#

$\frac{16,100}{34}$ = 420 #/" of weld.

combined stress in weld = 2120 #/" O.K.

**WAR DEPARTMENT**

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

Page 14

Subject East Hartford, Conn.

Computation main St. Stop Log Structure

Computed by W. S. Jr. Checked by Date 11/30/40

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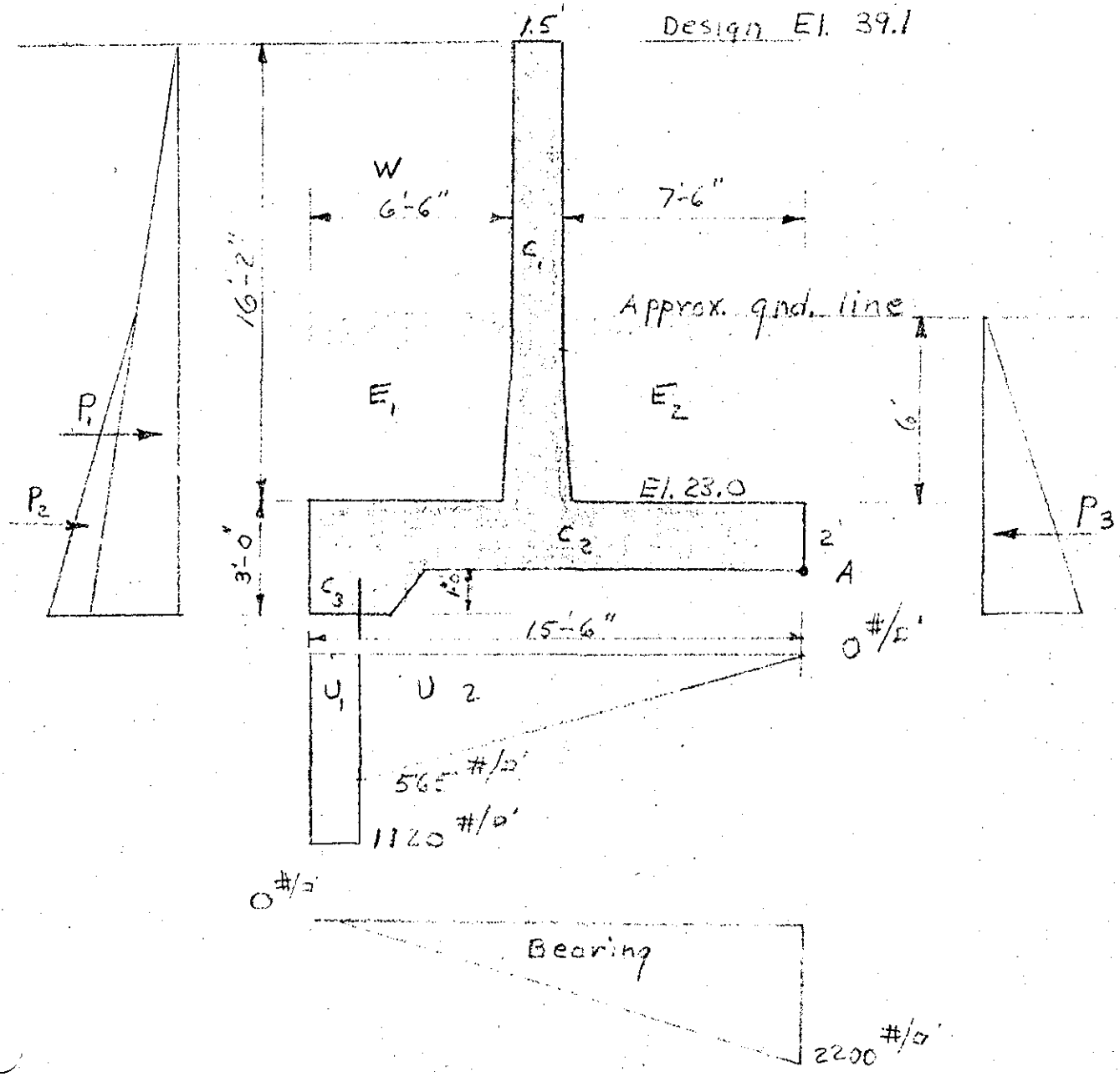
East Abutment (See contract drawings)



Subject East Hartford, Conn.
Computation Main St. Stop Log Structure
Computed by W.S. Jr. Checked by _____ Date 12/2/40

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 16.17x1.5x150 | 3630 | | | | 8.25 | | 30000 |
| $C_2$ | 15.5x2x150 | 4650 | | | | 7.75 | | 36000 |
| $C_3$ | 1x3x150 | 450 | | | | 14.0 | | 6300 |
| $E_1$ | 6.5x6x125 | 4880 | | | | 12.25 | | 60000 |
| $E_2$ | 7.5x6x100 | 4500 | | | | 3.75 | | 16900 |
| W | 6.5x10.17x62.5 | 4130 | | | | 12.25 | | 50600 |
| | | | | | | | | |
| | | | | | | | | |
| $P_1$ | $19.17^2 \times 62.5 \times \frac{1}{2}$ | | | 11500 | | 5.39 | 62000 | |
| $P_2$ | $9^2 \times \frac{1}{2} \times 17.5$ | | | 710 | | 2.0 | 1420 | |
| | | | | | | | | |
| $P_3$ | $9^2 \times \frac{1}{2} \times 35$ | | | | 1420 | 2.0 | | 2840 |
| | | | | | | | | |
| $U_1$ | 1220x1.5 | | 1830 | | | 14.75 | 27000 | |
| $U_2$ | 565x½x14 | | 3960 | | | 9.34 | 37000 | |
| | | | | | | | | |
| Fr. | 16450x.45 | | | | 7400 | 0 | — | |
| Pp | | | | | 3390 | 2.0 | | 6780 |
| | | | | | | | | |
| | | 22240 | 5,790 | 12210 | 12210 | | 127,420 | 209,420 |
| | | ΣV=16,450 | | ΣH= 0 | | | ΣM= 82,000 | |

Position of Resultant $= \frac{\Sigma M}{\Sigma V} = 5.0'$ O.K.

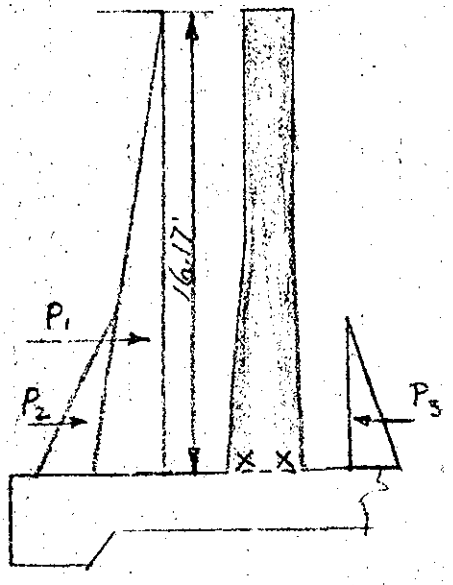
$$\text{Bearing} = \frac{16450}{3 \times 5} \times \begin{matrix} 2 \\ 0 \end{matrix} = \begin{matrix} 2200^{\#} \\ 0^{\#} \end{matrix}$$

Project: East Hartford Conn.
Computation: Main St. Stop Log Structure
Computed by: Checked by: Date:

U. S. GOVERNMENT PRINTING OFFICE 3—10528

## East Abutment

### Design of stem




moments at x-x

$P_1 = 16.17^2 \times \frac{1}{2} \times 62.5 = 8150 \times 5.4 = 44{,}000'^{\#}$

$P_2 = 6^2 \times \frac{1}{2} \times 17.5 = 315 \times 2 = 630$

$8465 \qquad 44630$

$P_3 = 6^2 \times \frac{1}{2} \times 35 = 630 \times 2 = 1260'^{\#}$

$\Sigma H = 7{,}835^{\#} \qquad 43{,}370'^{\#}$

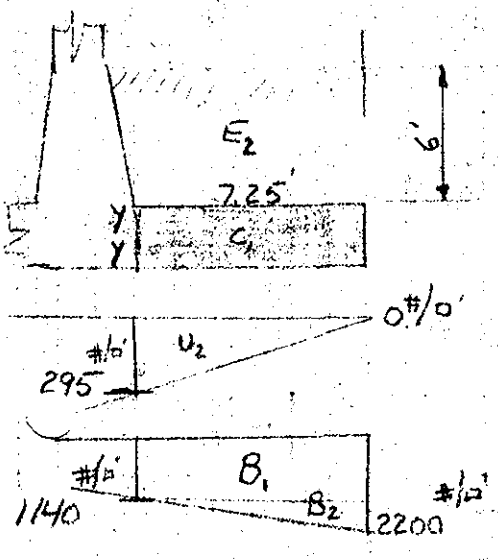
$d = \sqrt{\frac{43{,}370 \times 12}{123 \times 12}} = 18.6''$ req'd O.K.

$A_s = \frac{43{,}370 \times 12}{18000 \times .884 \times 21} = 1.56 \square''$ use 1" ϕ @ 6"

Bond $= \frac{7835}{6.3 \times .884 \times 21} = 67^{\#/\square''}$ O. K.

Shear O. K.

### Landside base




moments at y-y

$E_2 = 7.25 \times 6 \times 100 = 4350^{\#} \times 3.6 = 15{,}700'^{\#}$

$C_1 = 7.25 \times 2 \times 150 = 2180^{\#} \times 3.6 = 7{,}850$

$6530^{\#}\downarrow \qquad 23{,}550'^{\#}$

$U_2 = 7.25 \times \frac{1}{2} \times 295 = 1070^{\#} \times 2.4 = 2{,}580'^{\#}$

$B_1 = 1140 \times 7.25 = 8250^{\#} \times 3.6 = 29{,}900'^{\#}$

$B_2 = 1060 \times \frac{1}{2} \times 7.25 = 3840^{\#} \times 4.8 = 18{,}600$

$13{,}160^{\#}\uparrow \qquad 50{,}980'^{\#}$

$\Sigma V = 6{,}630^{\#}\uparrow \qquad 27{,}430'^{\#}$

$d = \sqrt{\frac{27{,}430 \times 12}{123 \times 12}} = 15''$ O. K.

$A_s = \frac{27{,}430 \times 12}{18000 \times .884 \times 20} = 1.05 \square''$ use 7/8 & 3/4 @ 6" cc

Bond & shear O.K.

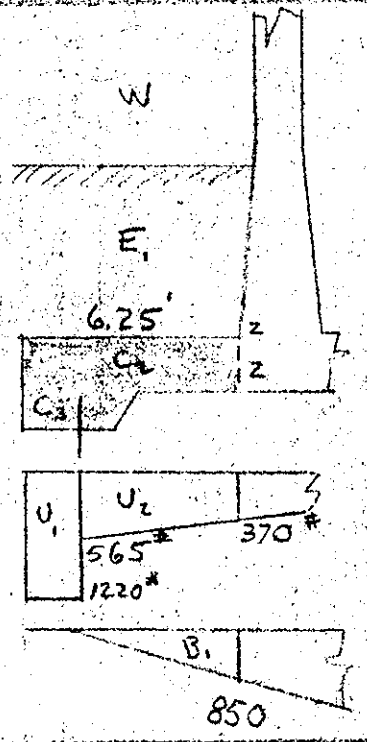
(If concrete piles are used, 1" ϕ @ 6 cc are needed)

Project: East Hartford, Conn.
Computation: Main St. Stop Log Structure
Computed by: W. S. Jr. Checked by: Date: 12/2/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

## East Abutment

Riverside base




moments at z-z

$W = 10.17 \times 6.25 \times 62.5 = 3970^{\#} \times 3.12 = 12{,}400'^{\#}$
$E_1 = 6.25 \times 6 \times 125 = 4700^{\#} \times 3.12 = 14{,}700'^{\#}$
$C_2 = 2 \times 6.25 \times 150 = 1875^{\#} \times 3.12 = 5{,}850'^{\#}$
$C_3 = 1 \times 3 \times 150 = 450^{\#} \times 4.75 = 2{,}140$

$10{,}995^{\#}\downarrow \quad 35{,}090'^{\#}\circlearrowright$

$U_1 = 1220 \times 1.5 = 1830^{\#} \times 5.5 = 10{,}100'^{\#}$
$U_2 = 370 \times 4.75 = 1760^{\#} \times 2.37 = 4{,}160'^{\#}$
$U_2 = 195 \times \frac{1}{2} \times 4.75 = 463^{\#} \times 3.2 = 1{,}480'^{\#}$
$B_1 = 850 \times \frac{1}{2} \times 5.75 = 2440^{\#} \times 1.9 = 4{,}640'^{\#}\circlearrowleft$

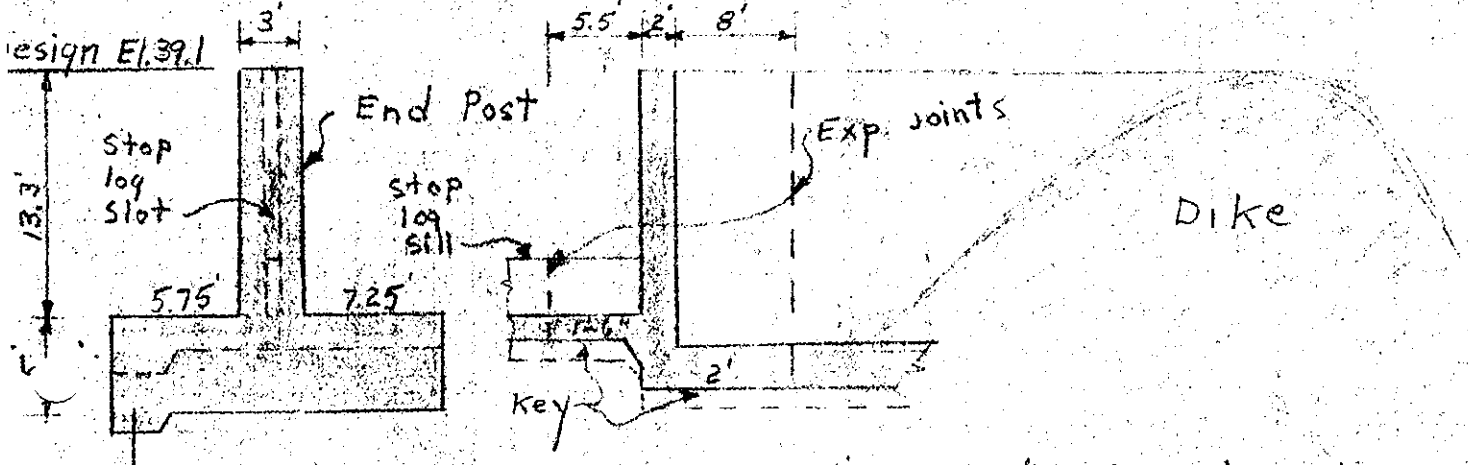
$6{,}493^{\#}\uparrow \quad 20{,}380'^{\#}\circlearrowleft$

$\Sigma V = 4{,}502^{\#}\downarrow \quad \Sigma M = 14{,}710'^{\#}\circlearrowright$

$A_s = \frac{14{,}710 \times 12}{18000 \times .884 \times 20} = .56^{\square''}$ O.K. use $\frac{7}{8}\phi$

Bond and shear O.K.

## Design of "End Post" for stop logs. (See contract drawings)




End post is 3'x2' and carries load of stop logs from sill to top of wall. Stop log span is 11.58', ½ of which goes to end post.

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## East Abutment

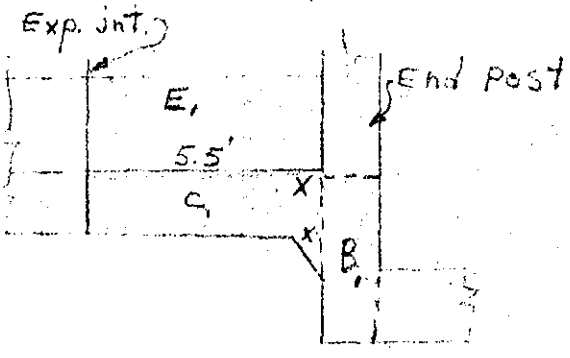
### Design of End Post (cont'd.)

moment from stop logs $= 11^2 \times \frac{1}{2} \times 62.5 \times \frac{11.58}{2} = 21,300^{\#} \times 6.27 = 137,000^{\#}$

$d = \sqrt{\frac{137000 \times 12}{123 \times 24}} = 23.6''$ O.K. 33" provided

$A_s = \frac{137,000 \times 12}{18000 \times .884 \times 33} = 3.13 \square''$ Use $4 - 1'' \square$

### Design of base at End Post




Base cantilevers 5.5' from beam B,

moment at x-x
on a 1' strip at rear of base

$E_1 = 2.5 \times 1 \times 5.5 \times 100 = 1370^{\#} \times 2.75 = 3780'^{\#}$
$C_1 = 1.5 \times 1 \times 5.5 \times 150 = 1240^{\#} \times 2.75 = 3400'^{\#}$
$2,610^{\#} \downarrow \quad 7,180'^{\#}$

$B_1 = 1400 \times 1 \times 5.5 = 7,700 \times 2.75 = 21,200'^{\#}$
$B_2 = 340 \times 1 \times 5.5 \times \frac{1}{2} = 940 \times 1.8 = 1,700'^{\#}$
$8,640^{\#} \uparrow \quad 22,900'^{\#}$

$\Sigma V = 6,030^{\#} \uparrow \quad \Sigma M = 15,720'^{\#}$

| | |
|---|---|
| 1400#/□' B 1740#/□' | Bearing at rear of base |

(Combine bearing from stop log with abutment bearing)

$A_s = \frac{15,720 \times 12}{18000 \times .884 \times 13.5} = .88 \square''$ Bond and shear O.K.

moment at x-x
on a 1' strip behind sheet pile.

| | |
|---|---|
| B+U 655# 685# | Bearing and uplift behind sheet pile |

$W = 5.5 \times 1 \times 11 \times 62.5 = 3780^{\#} \times 2.75 = 10,400'^{\#}$
$E_1 = 1.5 \times 1 \times 5.5 \times 125 = 1020^{\#} \times 2.75 = 2,800'^{\#}$
$C_1 = 1.5 \times 1 \times 5.5 \times 150 = 1240^{\#} \times 2.75 = 3,400$
$6040^{\#} \quad 16,600'^{\#}$

$B+U = 670 \times 1 \times 5.5 = 3700^{\#} \times 2.75 = 10,200'^{\#}$

$A_s = \frac{6400 \times 12}{18000 \times .884 \times 13.5} = .36 \square''$ | $\Sigma V = 2,340^{\#} \quad \Sigma M = 6,400'^{\#}$

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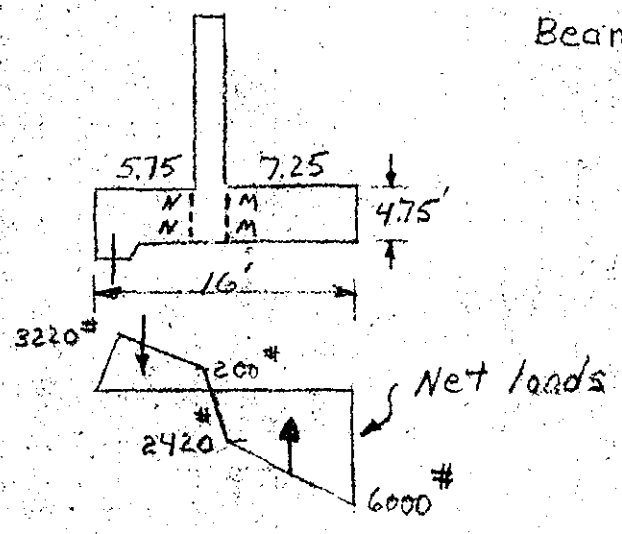
# East Abutment

## Design of beam under "End Post".




Beam takes load from cantilevered slab.

Mom. at M-M

$2420 \times 7.25 = 17,500^{\#} \times 3.62 = 63,500'^{\#}$
$3580 \times 7.25 \times \frac{1}{2} = 13,000^{\#} \times 4.80 = 62,300'^{\#}$
$30,500^{\#} \qquad 125,800'^{\#}$

$$\text{Shear} = \frac{30,500}{24 \times .884 \times 53} = 27^{\#/\square''}$$

$$A_s = \frac{125,800 \times 12}{18000 \times .884 \times 53} = 1.8^{\square''}$$

Mom. at N-N

$200 \times 5.75 = 1150^{\#} \times 2.87 = 3,300'^{\#}$
$3020 \times 5.75 \times \frac{1}{2} = 8,700^{\#} \times 3.83 = 33,200'^{\#}$
$9,850^{\#} \qquad 36,500'^{\#}$

Shear O.K.

$$A_s = \frac{36500 \times 12}{18000 \times .884 \times 53} = .52^{\square''}$$

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omputation Main St. Stop Log Structure
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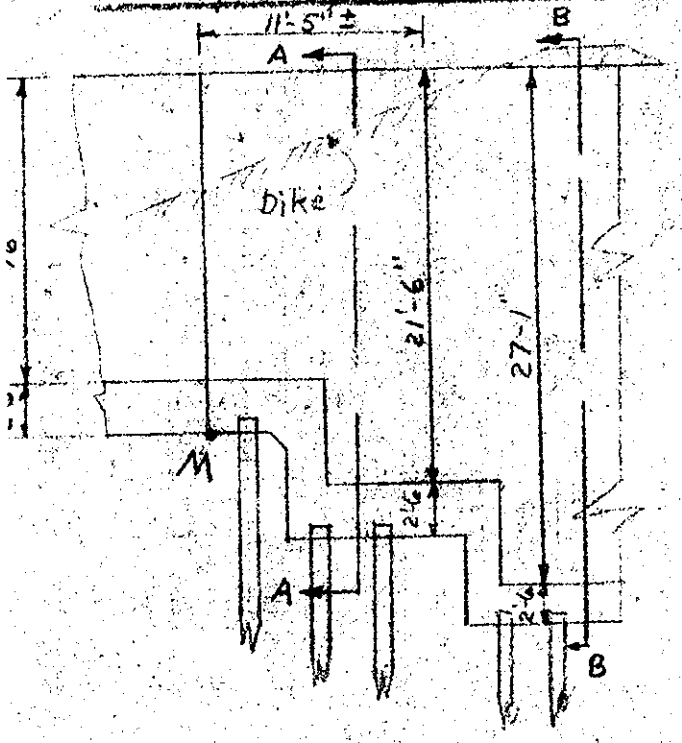
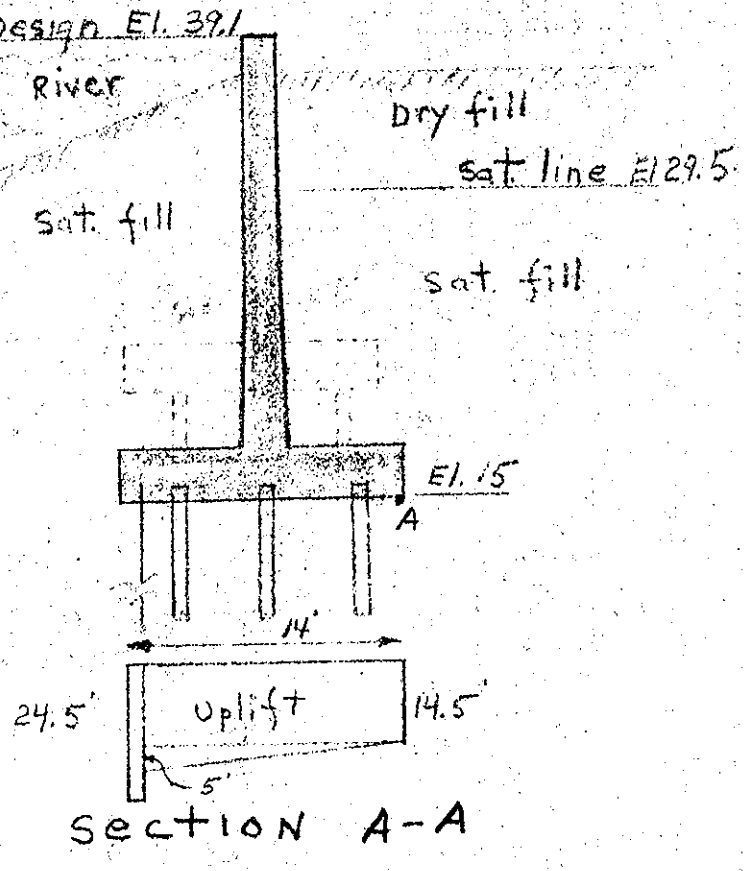
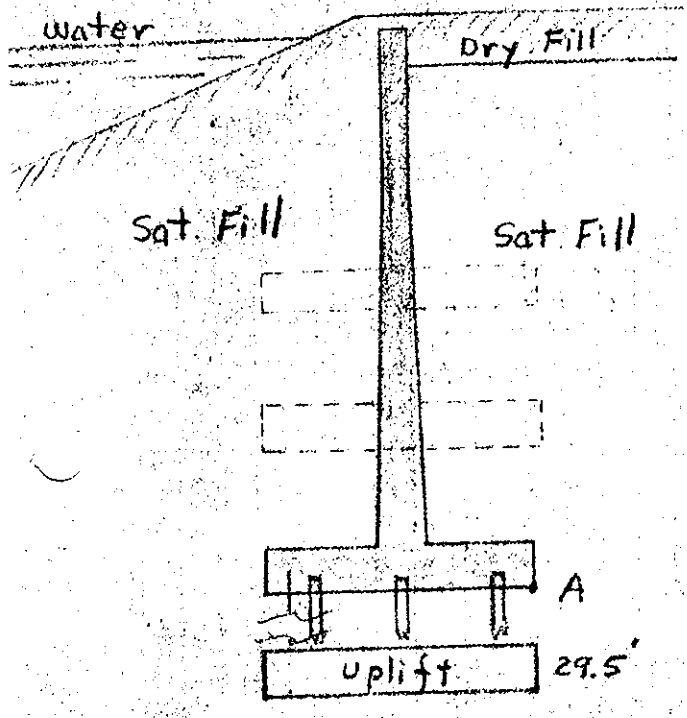
## East Abutment

Design of second section on piles. ("A")




Section A-A




Section B-B

Subject East Hartford, Conn.
Computation main St. Stop Log Structure
Computed by W. S. Jr. Checked by _____ Date 12/5/40

A-A Stability - Case I River UP

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 21.5×1.5×150 | 4840 | | | | 7.00 | | 33,800 |
| $C_2$ | 2.5×14×150 | 5250 | | | | 7.00 | | 36,800 |
| $E_1$ | 16×6.25×125 | 12500 | | | | 10.9 | | 136,000 |
| W | 5.25×6.25×125 | 4100 | | | | 10.9 | | 44,800 |
| $E_2$ | 4×6.25×100 | 2500 | | | | 3.12 | | 7,800 |
| $E_3$ | 12×6.25×125 | 9400 | | | | 3.12 | | 29,300 |
| | | | | | | | | |
| | | | | | | | | |
| $P_w$ | $24^2 \times \frac{1}{2} \times 62.5$ | | | 18000 | | 8.0 | 144000 | |
| $P_{e_1}$ | $19^2 \times \frac{1}{2} \times 17.5$ | | | 3160 | | 6.3 | 19900 | |
| | | | | | | | | |
| $P_{e_2}$ | $19^2 \times \frac{1}{2} \times 35$ | | | | 6300 | 6.3 | | 39,600 |
| $P_{e_3}$ | $14.5^2 \times \frac{1}{2} \times 45$ | | | | 4750 | 4.8 | | 22,800 |
| | | | | | | | | |
| | | | | | | | | |
| $U_1$ | 24.5×1.5×62.5 | | 2300 | | | 13.25 | 30400 | |
| $U_2$ | 14.5×12.5×62.5 | | 11300 | | | 6.25 | 70500 | |
| $U_3$ | $5 \times \frac{1}{2} \times 12.5 \times 62.5$ | | 1940 | | | 8.34 | 16200 | |
| | | | | | | | | |
| Fr | | | | | 10,110 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | 38,590 | 15,540 | 21,160 | 21,160 | | 281,000 | 350,900 |
| | | $\Sigma V = 23,050$ | | $\Sigma H = 0$ | | | $\Sigma M = 69,900$ | |

Position of Resultant $= \frac{\Sigma M}{\Sigma V} = 3.02'$

Subject East Hartford, Conn.
Computation main St. Stop Log Structure
Computed by W.S.Jr. Checked by _____ Date _____

A-A Stability - Case II River Down, Sat. Fill

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | | 4840 | | | | 7.00 | | 33,800 |
| $C_2$ | | 5250 | | | | 7.00 | | 36,800 |
| $E_1$ | 16x6.25x100 | 10,000 | | | | 10.9 | | 109,000 |
| $E_2$ | 9.6x6.25x100 | 6000 | | | | 3.12 | | 18,700 |
| $E_3$ | 6.5x6.25x125 | 5,100 | | | | 3.12 | | 16,000 |
| | | | | | | | | |
| | | | | | | | | |
| $Pe_1$ | $19^2 \times \frac{1}{2} \times 35$ | | | 6300 | | 6.3 | 39,600 | |
| | | | | | | | | |
| $Pe_2$ | $19^2 \times \frac{1}{2} \times 35$ | | | | 6300 | 6.3 | | 39,600 |
| $Pe_3$ | $9^2 \times \frac{1}{2} \times 45$ | | | | 1820 | 3.0 | | 5,450 |
| | | | | | | | | |
| | | | | | | | | |
| $U_2$ | 9x62.5x14.0 | | 7900 | | | 7.0 | 55,300 | |
| | | | | | | | | |
| $F_r$ | | | | 1820 | | | | |
| | | 31,190 | 7900 | 8120 | 8120 | | 94,900 | 259,350 |
| | | $\Sigma V = 23,290$ | | $\Sigma H = 0$ | | | $\Sigma M = 164,450$ | |

Position of Resultant $\Big\} = \frac{\Sigma M}{\Sigma V} = 7.05$ O.K.

Subject East Hartford, Conn.
Computation Main St. Stop Log Structure
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Section B-B

Stable by inspection Resultant is 7'-0" from "A"

Vertical loads.

$E = 29.5 \times 12.5 \times 125 = 46,000$ #
$C_1 = 27.1 \times 1.5 \times 150 = 6,100$ #
$C_2 = 14 \times 2.5 \times 150 = 5,250$ #
57,350 #
$U = 29.5 \times 14 \times 62.5 = 25,800$ #
31,550 #/.

Find position of resultant for entire section

About axis "M" (see page 20)
Use load per ft. from pages 15, 21, & 23.

| | | |
|---|---|---|
| $4 \times 16450 = 66,000$ | $\times 2 = 132,000$ | |
| $9.5 \times 23050 = 218,000$ | $\times 8.75 = 1,900,000$ | |
| $20.5 \times 31550 = 645,000$ | $\times 23.75 = 15,300,000$ | |
| 929,000 # | 17,332,000 | |

$\frac{\Sigma M}{\Sigma V} = 18.7'$ mid point = 17.0' e = 1.7' about "M"

About axis "A". (see pages 14, & 20)
Use resultant for each section, pages 15, 21, & 23.

$5 \times 4' = 20$
$3 \times 9' = 27$
$7 \times 21 = 147$
34' 194

$\frac{\Sigma M}{\Sigma V} = \frac{194}{34} = 5.7'$ mid point = 7.0'
e = 1.3' about "A"

Project East Hartford Conn
Computation Main St. Stop Log Structure
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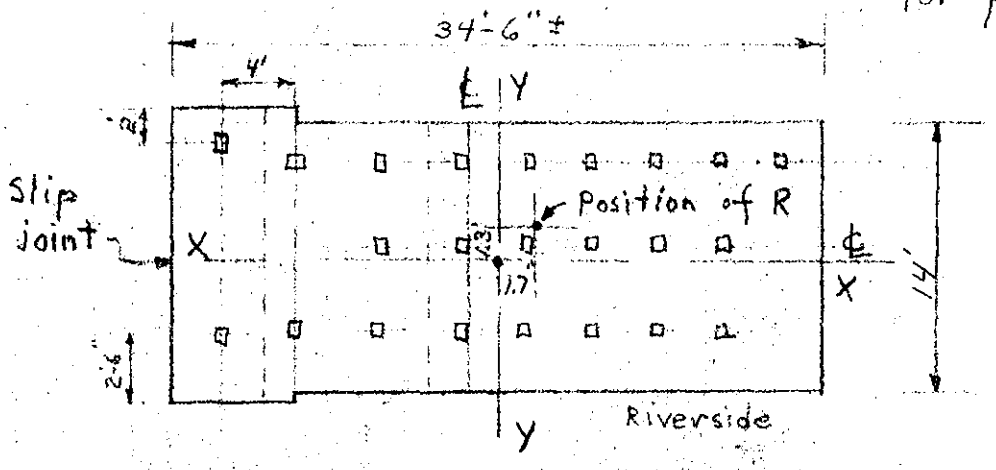
Plan of East Abutment (see contract dwgs for pile spacing)




Find C of G of pile group

moments about slip joint

| | |
|---|---|
| 2 × 2.5' | = 5.0 |
| 2 × 6.5' | = 13.0 |
| 3 × 11.0' | = 33.0 |
| 3 × 15.3' | = 45.9 |
| 3 × 18.7' | = 56.1 |
| 3 × 22.2' | = 66.6 |
| 3 × 25.7' | = 77.0 |
| 3 × 29.2' | = 87.5 |
| 1 × 32.7' | = 32.7 |
| 23 | 416.8 |

$\frac{416.8}{23} = \underline{18.1'}$ to C. of G. of piles.

moments about Riverside

| | |
|---|---|
| 2 × 3.25' | = 6.5' |
| 7 × 3.5' | = 24.5' |
| 6 × 7.75' | = 46.5' |
| 8 × 12.0' | = 96.0' |
| 2 × 13.25' | = 26.5' |
| 25 | 200.0 |

$\frac{200}{25} = \underline{8.0'}$ to C. of G. of piles.

mom. of I of piles about C. of G.

| | | |
|---|---|---|
| | $3P \times 4.0^2 = 48P$ | $P \times 4.7^2 = 22P$ |
| $2P \times 15.6^2 = 485P$ | $3P \times 7.5^2 = 168P$ | $7P \times 4.5^2 = 141P$ |
| $2P \times 11.6^2 = 268P$ | $3P \times 11.0^2 = 362P$ | $6P \times .2^2 = .24P$ |
| $3P \times 7.2^2 = 155P$ | $P \times 14.5^2 = 210P$ | $8P \times 4^2 = 128P$ |
| $3P \times 3.0^2 = 27P$ | | $P \times 5.2^2 = 27P$ |
| $3P \times .5^2 = .75P$ | $I_1 = 1723.75'^4$ | $I_2 = 318.24P'^4$ |
| | $= 35{,}600{,}000''^4$ | $= 6{,}600{,}000''^4$ |

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Computation: Main St. Stop Log Structure
Computed by: W. S. J. Jr. Checked by: Date: 12/11/40

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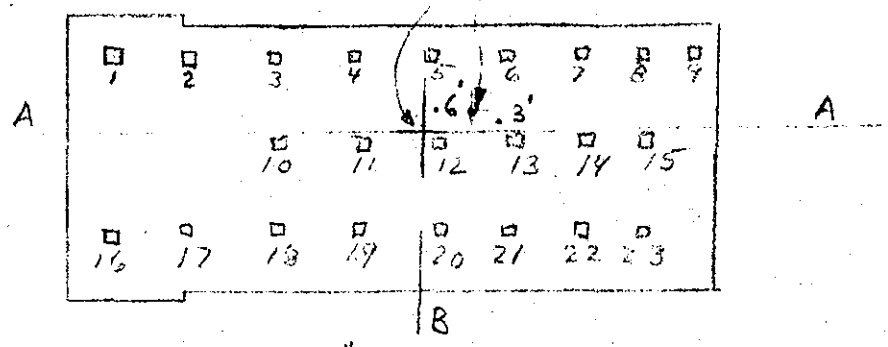
Load on Piles, river up.




$e_{A-A} = .3'$

$e_{B-B} = .6'$

$\Sigma V = 929{,}000^{\#}$ Mom A-A $= 280{,}000^{\#}$ Mom B-B $= 555{,}000^{\#}$

$\frac{929{,}000}{23} = 40{,}400^{\#}$ direct load per pile

Load on pile #9 from moments

$\text{Load} = \frac{MY}{I}$ $L = \frac{280{,}000 \times 12 \times 4 \times 12}{6{,}600{,}000} = 24^{\#}$ from $M_{A-A}$

$L = \frac{555{,}000 \times 12 \times 14.5 \times 12}{35{,}600{,}000} = 30^{\#}$ from $M_{B-B}$

Eccentricity is negligable, load per pile = 20 tons

With river down, eccentricity is negligable also, and load per pile = 20 tons ±.

Project East Hartford, Conn.
Computation Main St. Stop Log Structure
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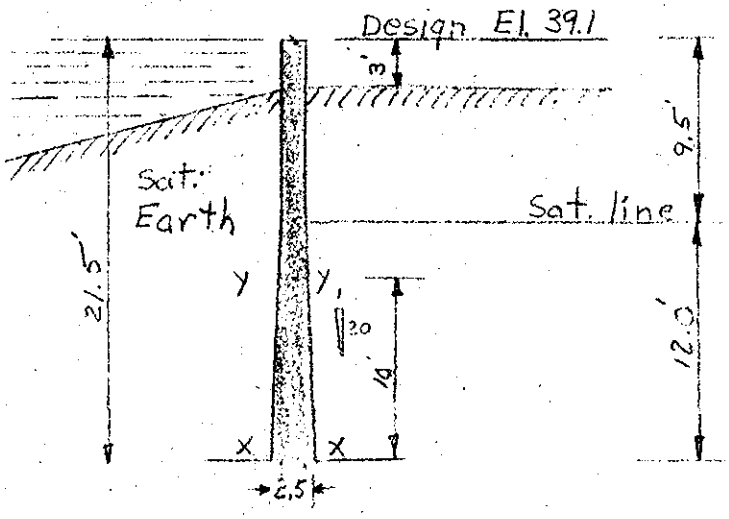
## Design of 21.5' stem




mom. X-X

→ $21.5^2 \times \frac{1}{2} \times 62.5 = 14{,}500^{\#} \times 7.16 = 103{,}000'^{\#}$
→ $18.5^2 \times \frac{1}{2} \times 17.5 = 3{,}000 \times 6.16 = 18{,}500$
$17{,}500^{\#}$ $121{,}500'^{\#}$

← $18.5^2 \times \frac{1}{2} \times 35 = 6000^{\#} \times 6.16 = 37{,}000'^{\#}$
← $12^2 \times \frac{1}{2} \times 45 = 3240 \times 4.0 = 13{,}000$
$9240^{\#}$ $50{,}000'^{\#}$

$\Sigma = 8{,}260^{\#} \rightarrow 71{,}500'^{\#}$

$d = \sqrt{\frac{71{,}500 \times 12}{123 \times 12}} = 24''$ O.K.

$A_s = \frac{71{,}500 \times 12}{18000 \times .884 \times 26} = 2.08^{\square''}$

Shear $= \frac{8260}{12 \times .884 \times 26} = 30^{\#/\square''}$

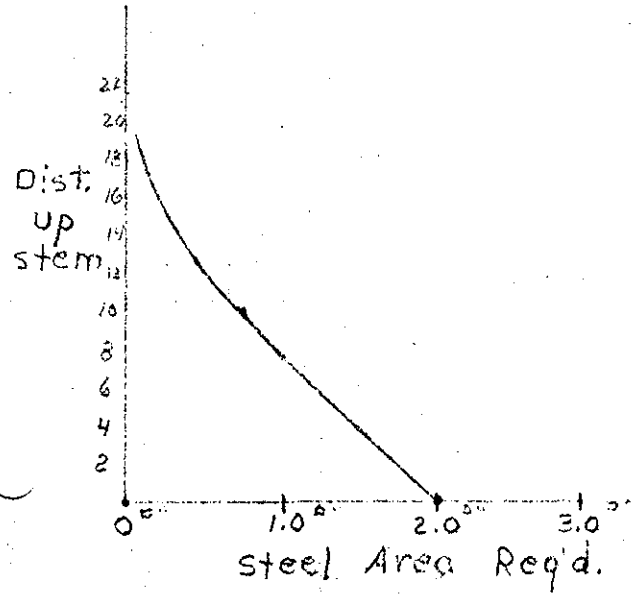
mom. Y-Y

→ $11.5^2 \times \frac{1}{2} \times 62.5 = 4120^{\#} \times 3.8 = 15{,}800'^{\#}$
→ $8.5^2 \times \frac{1}{2} \times 17.5 = 630 \times 2.8 = 1{,}700$
$4750^{\#}$ $17{,}500'^{\#}$

← $8.5^2 \times \frac{1}{2} \times 35 = 1260^{\#} \times 2.8 = 3520'^{\#}$
← $2^2 \times \frac{1}{2} \times 45 = 90 \times .6 = 54$
$1350^{\#}$ $3574'^{\#}$

$\Sigma = 3400^{\#} \rightarrow 13{,}926'^{\#}$

$A_s = \frac{13{,}926 \times 12}{18000 \times .884 \times 14} = .75^{\square''}$




Use 1" □ @ 6" cc at bottom.
Cut one off 11' up, splice the other to 3/4" ϕ 15' up.

Project: East Hartford, Conn.
Computation: Main St. Stop Log Structure.
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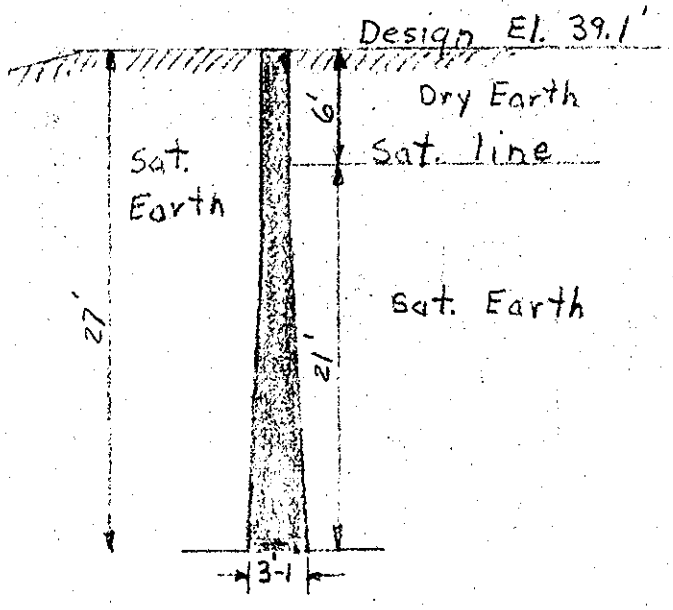
Design of 27' stem. (Seep fins form counterforts 7.25' c.c.)




5' down

→ 5 × 80 = 400 #/□'
← 5 × 35 = 175 #/□'
225 #/□' →

$$mom = \frac{wl^2}{10} = \frac{225 \times 7.25^2}{10} = 1180'^{\#}$$

Use $\frac{1}{2}$"□ @ 1'-0" c.c.

10' down

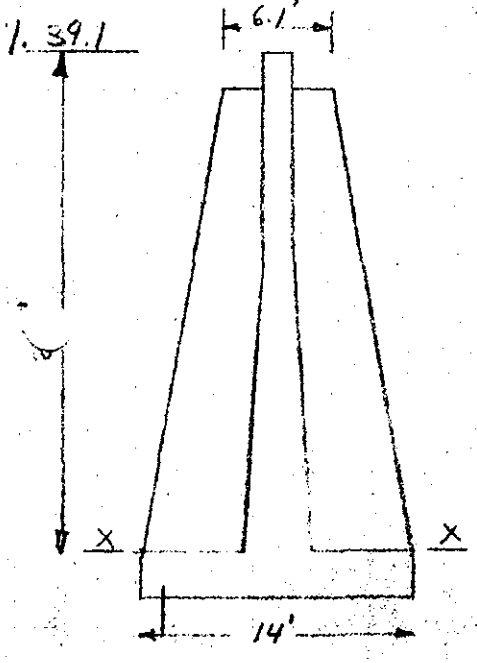
→ 10 × 80 = 800 #/□'
← 6 × 35 = 210 #/□'
← 4 × 80 = 320 #/□'
270 #/□' → ←

$$mom = \frac{wl^2}{10} = \frac{270 \times 7.25^2}{10} = 1,400'^{\#}$$

Use $\frac{1}{2}$"□ @ 1'-0" c.c.

Use $\frac{1}{2}$"□ @ 1'-0" cc, horizontal and vertical in stem.

Design of seep fins, as counterforts.




Seep fin takes load from 7.25' of stem loaded as shown above.

mom. X-X

$27^2 \times \frac{1}{2} \times 80 \times 7.25 = 210,000^{\#} \times 9 = 1890,000'^{\#}$

$27^2 \times \frac{1}{2} \times 35 \times 7.25 = 90,000^{\#} \times 9 = 810,000'^{\#}$

$21^2 \times \frac{1}{2} \times 45 \times 7.25 = 72,000^{\#} \times 7 = 505,000'^{\#}$

$\Sigma = 48,000^{\#} \rightarrow$ $585,000'^{\#}$

$$d = \sqrt{\frac{585,000 \times 12}{123 \times 18}} = 56'' \text{ O.K.}$$ 170" provided

$$A_s = \frac{585,000 \times 12}{18000 \times .884 \times 165} = .27\,\square''$$

use $\frac{1}{2}$"□ in seep fins

Project: East Hartford, Conn.
Computation: Main St. Stop log Structure
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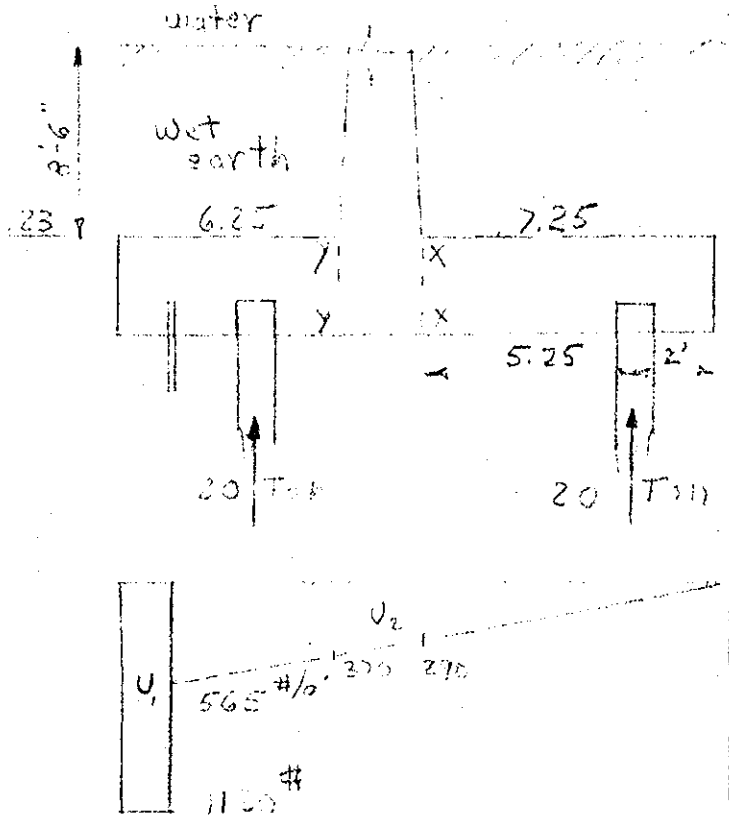
Design of base

Section with top of base at El. 23




Pile supports strip of base 4.5' wide

mom X-X

4.5x8.5x7.25x100 = 27,800# x 3.62 = 100,000'#
4.5x2.5x7.25x150 = 12,200# x 3.62 = 44,000'#
40,000# 144,000'#

4.5x290x7.25x½ = 4750# x 2.4 = 11,400'#
20 x 2,000 = 40,000# x 5.25 = 210,000'#
44,750 221,400'#

ΣV = 4,750# ↑ ΣM = 77,400'#

$\frac{77,400}{4.5}$ = 17,300'#/ft.

$A_s = \frac{17,300 \times 12}{18000 \times .884 \times 24}$ = .55 □"

mom Y-Y

4.5x7.5x6.25x62.5 = 13,200# x 3.1 = 41,000'#
4.5x8.5x6.25x125 = 30,300# x 3.1 = 93,000
4.5x2.5x6.25x150 = 10,500 x 3.1 = 32,500
53,700# 166,500'#

1120x1.5x4.5 = 7550# x 5.5 = 41,500'#
370x4.75x4.5 = 7900 x 2.37 = 18,700
195x $\frac{4.75}{2}$x4.5 = 2100 x 1.9 = 4,000
20 x 2000 = 40,000 x 2.75 = 110,000
56,550# 174,200'#

ΣV = 2,850 ΣM = 7,500'#

neglect

Project: East Hartford, Conn.
Computation: main St. Stop Log structure
Computed by: W. S. Jr. Checked by: Date: 12/13/40

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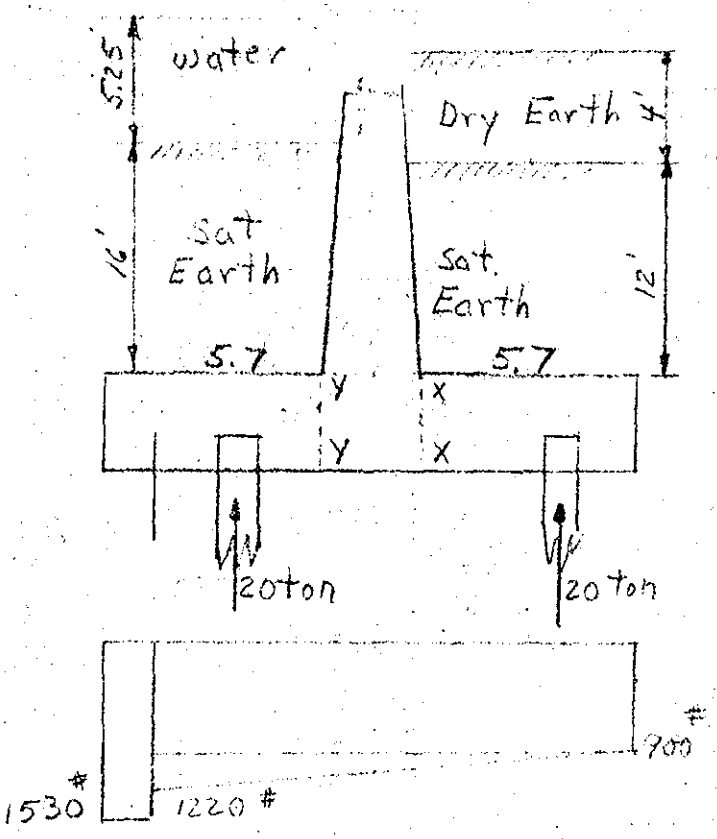
Design of base

Section with top of base at El. 17.5




mom. X-X

$4 \times 5.7 \times 100 = 2230^{\#} \times 2.85 = 6,500^{\#}$
$12 \times 5.7 \times 125 = 8550 \times 2.85 = 24,400$
$1.5 \times 5.7 \times 150 = 1280 \times 2.85 = 3,640$
$12,110 \quad 34,540$

$900 \times 5.7 = 5130^{\#} \times 2.85 = 14,600^{\#}$
$145 \times 5.7/2 = 410 \times 1.9 = 780^{\#}$
$\frac{40,000}{4.4} = 9100 \times 3.7 = 33,600^{\#}$
$14,640 \quad 48,980^{\#}$

$\Sigma V = 2,530^{\#} \quad \Sigma M = 14,440^{\#}$

$A_s = \frac{14,440 \times 12}{18000 \times .884 \times 26} = .43 \square''$

mom. Y-Y

$5.25 \times 5.7 \times 62.5 = 1870^{\#} \times 2.85 = 5320^{\#}$
$16 \times 5.7 \times 125 = 11300 \times 2.85 = 32400$
$1.5 \times 5.7 \times 150 = 1280 \times 2.85 = 3640$
$14,450^{\#} \quad 41,360^{\#}$

$1530 \times 1.5 = 2300^{\#} \times 5 = 11,500^{\#}$
$1110 \times 4.2 = 4660 \times 2.1 = 9,800$
$1.0 \times 4.2/2 = 230 \times 2.8 = 630$
$\frac{40,000}{4.4} = 9100 \times 2.2 = 20,000$
$16,290^{\#} \quad 41,930^{\#}$

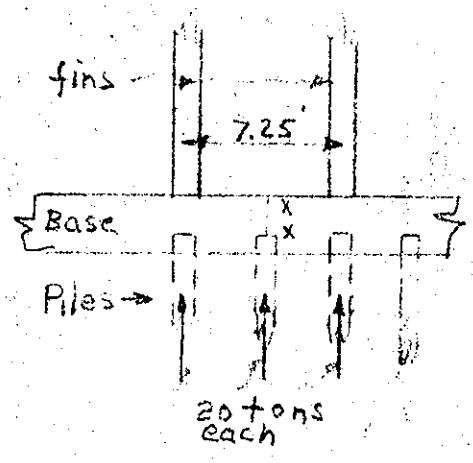
$\Sigma V = 2840, \quad \Sigma M = 570$

O. K.

ect East Hartford, Conn.
omputation Main St. Stop Log Structure
omputed by W. S. Jr. Checked by Date 11/12/40

U. S. GOVERNMENT PRINTING OFFICE 2—10528

Design of base under seep fins




mom. x-x (At rear pile)

$\downarrow \frac{wl^2}{12} = \frac{3850 \times 7.25^2}{12} = 17,000'\#$

$\uparrow \frac{Pl}{8} = \frac{\frac{40,000}{4} \times 7.25}{8} = 9,000'\#$

$\uparrow \frac{wl^2}{12} = \frac{1400 \times 7.25^2}{12} = 6,100'\#$

$1,900'\#$ O.K.

mom x-x (At front pile)

$\downarrow \frac{wl^2}{12} = \frac{3350 \times 7.25^2}{12} = 17,000'\#$

$\uparrow \frac{Pl}{8} = \frac{\frac{40,000}{4} \times 7.25}{8} = 9000'\#$

$\uparrow \frac{wl^2}{12} = \frac{1870 \times 7.25^2}{12} = 8,200'\#$

$200'\#$

Use temp. steel.

Note: This entire abutment is subject to settlement, due to the heavy dike load on the adjacent soil, so 3/4 ϕ @ 1'-0" cc will be used for longitudinal steel to give more rigidity to the structure.

Subject EH.3-5
Computation Snap Log Structure
Computed by J.H.P. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528

West Abutment

End post design is same as east abutment.

The design for the first section of wall, Sta. 212+62 ± to Sta. 252+62 ±, is taken from Holyoke, Mass., H2.2, Page D-118 Analysis of Design - Appendix D.

The remainder of the west abutment is designed on the following pages

**WAR DEPARTMENT**

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

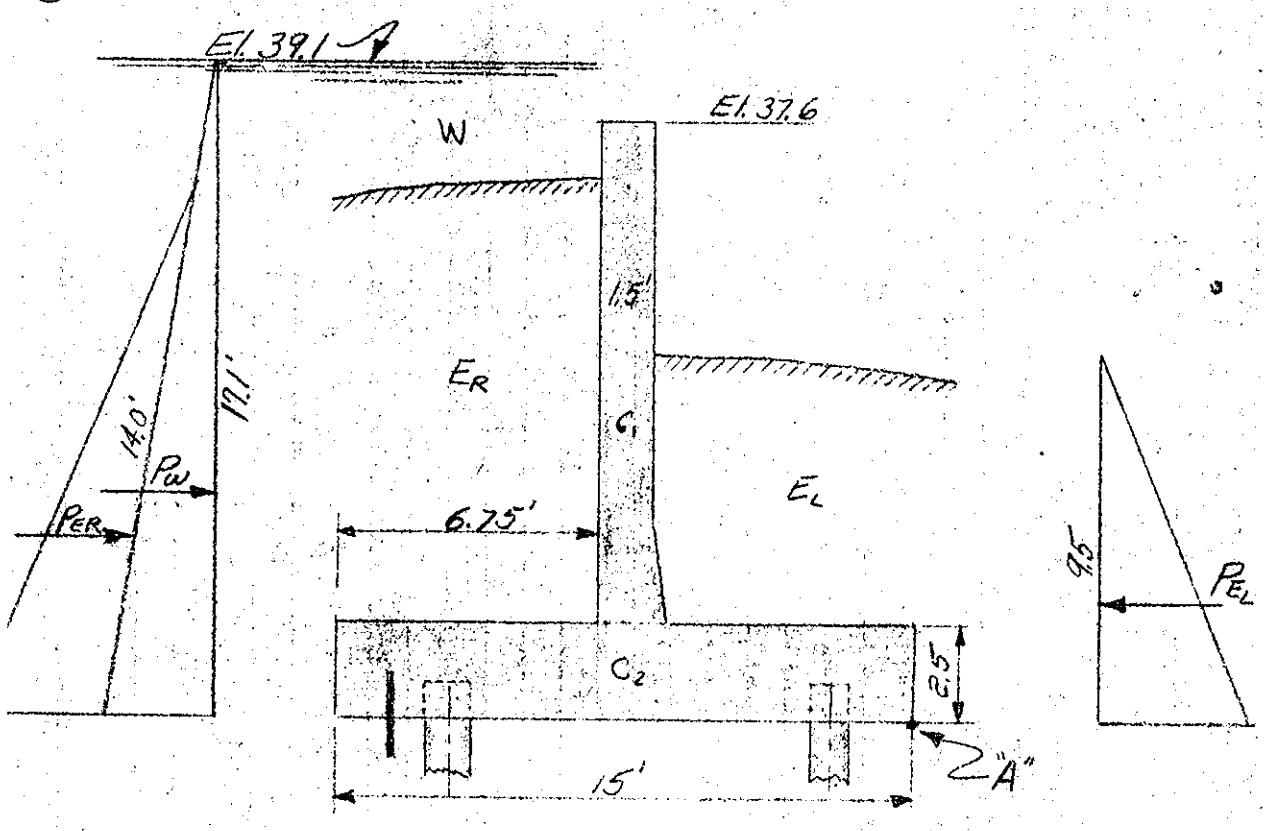


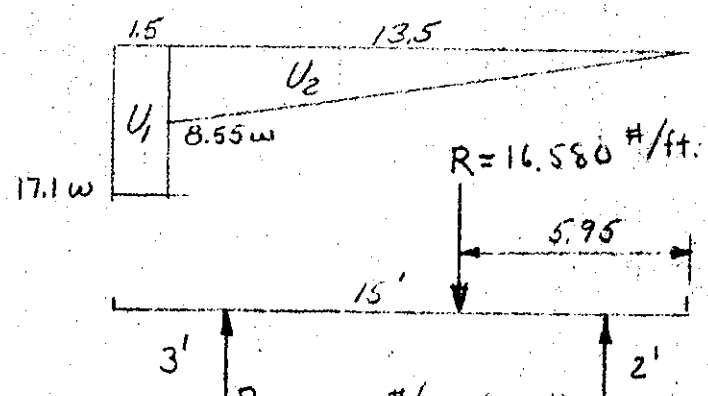
Project: East Hartford Dike EH 3-5

Computation: Sect. between Sta. 211+78± and 212+19± West Abutment

Computed by: J. N. L. Checked by: Date:

U. S. GOVERNMENT PRINTING OFFICE 3—10628




$P_2$ = 6560 #/ft. of wall
36,100 # total

$P_1$ = 10,020 #/ft. of wall
= 55,200 # total (pile space 5.5')

Subject EH. 3-5

Computation Sect. between Sta. 211+78± and 212+19± West Abutment

Computed by J. H. L. Checked by _____ Date _____

Stability - water up to El. 391

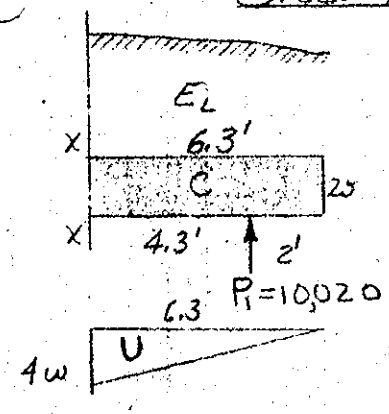
| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 150 × 12.1 × 1.5 | 2720 | | | | 7.5 | | 20,400 |
| $C_2$ | 150 × 15 × 2.5 | 5380 | | | | 7.5 | | 40,300 |
| $E_L$ | 100 × 6.75 × 7.0 | 4720 | | | | 3.5 | | 16,500 |
| $E_R$ | 125 × 6.75 × 11.5 | 9700 | | | | 11.5 | | 111,500 |
| W | 62.5 × 6.75 × 3 | 1270 | | | | 11.5 | | 14,600 |
| $U_1$ | 62.5 × 17.1 × 1.5 | | 1600 | | | 14.25 | 22,800 | |
| $U_2$ | 62.5 × 8.55 × 13.5 × ½ | | 3610 | | | 9.0 | 32,500 | |
| | | | | | | | | |
| $P_W$ | 62.5 × (17.1)² × ½ | | | 9150 | | 5.7 | 52,100 | |
| $P_{ER}$ | 17.5 × (14.0)² × ½ | | | 1710 | | 4.67 | 8,000 | |
| | | | | | | | | |
| $P_{EL}$ | 35 × (9.5)² × ½ | | | | 1560 | 3.17 | | 4900 |
| | | | | | | | | |
| $F_R$ | .45 × 16,580 | | | | 7470 | — | | |
| | | | | | | | | |
| $P_R$ | Passive Resist. | | | | 1830 | 3.17 | | 5800 |
| | | | | 10860 | 10860 | | 115,400 | 214,000 |
| | | ΣV = 16,580 | | ΣH = 0 | | | ΣM = 98,600 | |

Position of Resultant $= \frac{\Sigma M}{\Sigma V} = \frac{98,600}{16,580} = 5.95'$ from A (inside middle third)

ject EH 3-5
omputation West Abutment Sta. 211+78 to 212+19±
omputed by J.M.L. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528

## Steel in Landside Base

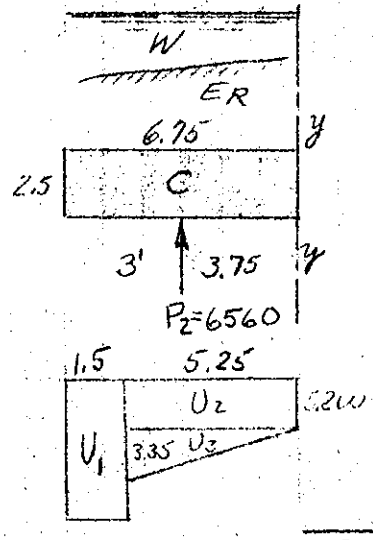



| Force | ↓ | ↑ | Arm | ↻ | ↺ |
|---|---|---|---|---|---|
| $E_L$ | 4720 | | 3.15 | 14850 | |
| C 150×6.3×2.5 | 2360 | | 3.15 | 7430 | |
| $P_1$ | | 10020 | 4.3 | | 43,100 |
| U ½×4×62.5×6.3 | | 790 | 2.1 | | 1,600 |
| | | | | | EM = 22,400 |

Req'd Depth = $\sqrt{\frac{22400}{123}}$ = 13.5" O.K.

$A_s = \frac{22,400}{1325 \times 17} = 1.0$ □" in bottom (above piles)

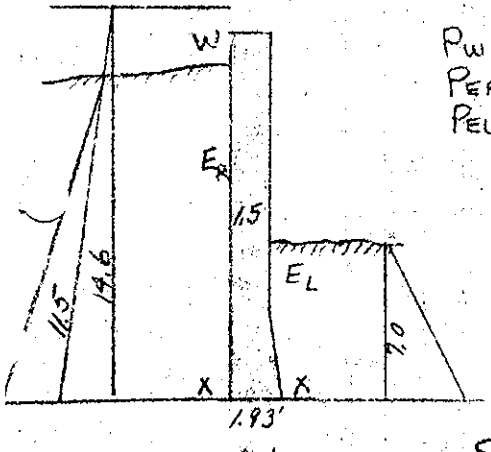
## Steel in Riverside Base




| Force | ↓ | ↑ | Arm | ↻ | ↺ |
|---|---|---|---|---|---|
| W | 1270 | | 3.37 | 4280 | |
| $E_R$ | 9700 | | 3.37 | 32700 | |
| C 150×2.5×6.75 | 2530 | | 3.37 | 8530 | |
| $P_2$ | | 6560 | 3.75 | | 24,600 |
| $U_1$ | | 1600 | 6.00 | | 9,600 |
| $U_2$ 62.5×5.2×5.25 | | 1710 | 2.63 | | 4500 |
| $U_3$ 62.5×3.35×5.25×½ | | 550 | 3.50 | | 1930 |
| | | | | EM = 6,880 | |

$A_s = \frac{6880}{1325 \times 26.5} = .195$ □" in Top

## Steel in Stem




| Force | → | ← | Arm | ↻ | ↺ |
|---|---|---|---|---|---|
| $P_W$ 62.5 × ½ × $14.6^2$ | 6650 | | 4.87 | 32,400 | |
| $P_{ER}$ 17.5 × ½ × $11.5^2$ | 1160 | | 3.83 | 4,400 | |
| $P_{EL}$ 35 × ½ × $7.0^2$ | | 860 | 2.33 | | 2000 |
| | EH = 6950# → | | | EM = 34,800 ↻ | |

Unit Shear = $\frac{6950}{.884 \times 12 \times 19.5}$ = 33.6 #/□"

Thickness req'd = $\sqrt{\frac{34,800}{123}}$ = 16.7" + 3.5 < 23" o.k.

At X-X Steel $A_s = \frac{34,800}{1325 \times 19.5} = 1.50$ □" landside face

**WAR DEPARTMENT**

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

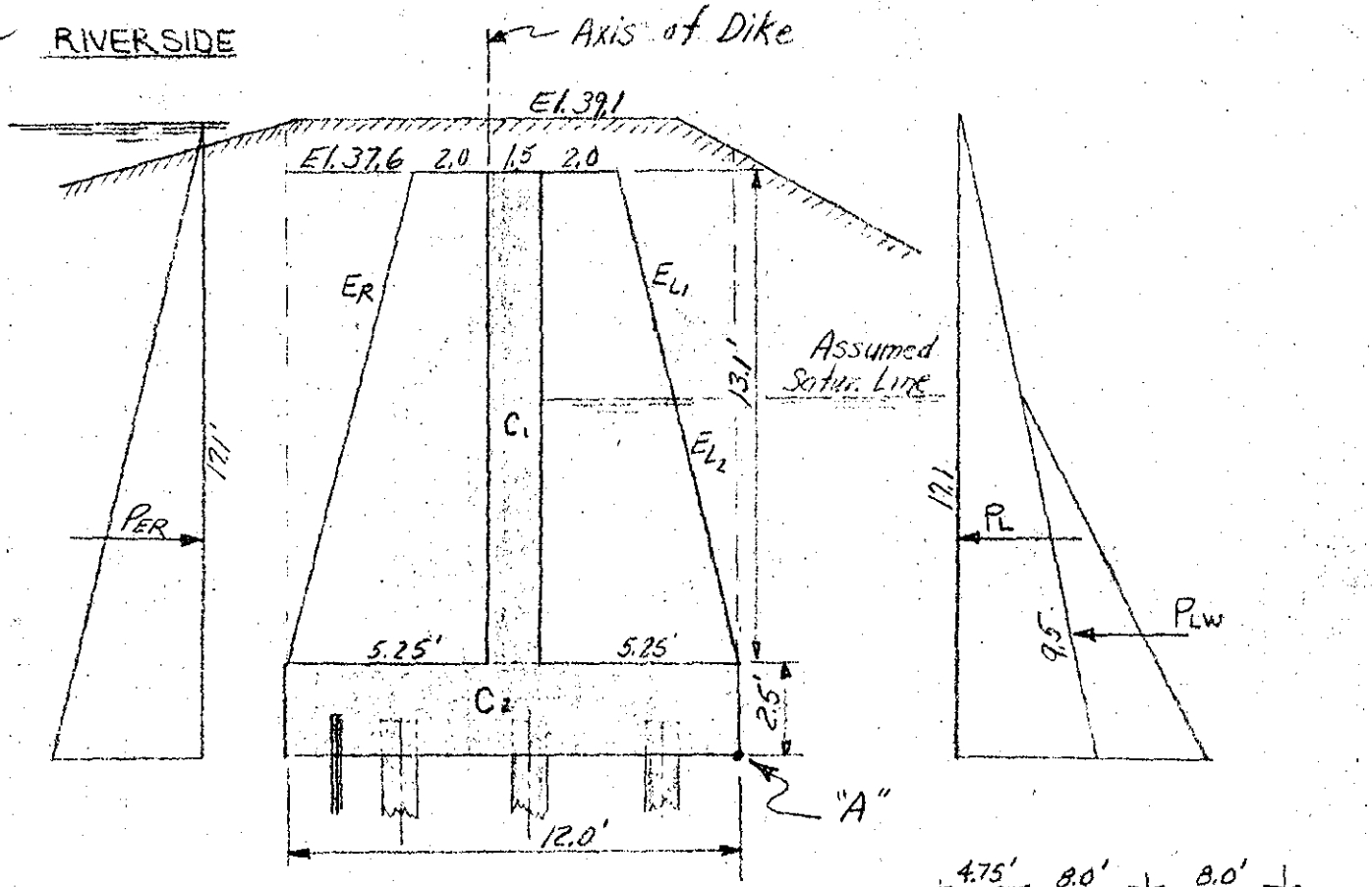


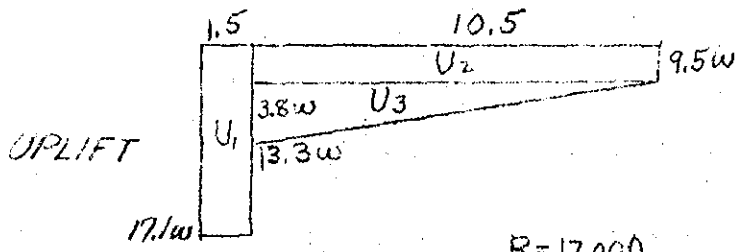
Project EH. 3-5

Computation Sect. between Sta. 211+78.78 and 212+00.28 West Abutment

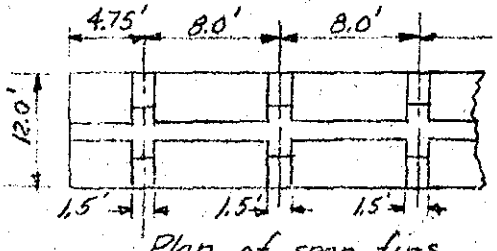
Computed by J. H. T. Checked by ..... Date .....

U. S. GOVERNMENT PRINTING OFFICE 3—10328

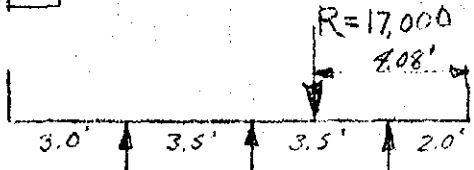



UPLIFT




Plan of seep fins (act as counterforts)




BEARING

$P_1$=2230 $P_2$=5670 $P_3$=9110 #/ft. of wall

8,920 22,680 36,440 #/4 ft. of wall

Subject EM 3-5

Computation Sect. between Sta. 211+78.78 and 212+00.28

Computed by J. H. S. Checked by _____ Date _____

Water up to top of dike, earth on landside semi-saturated

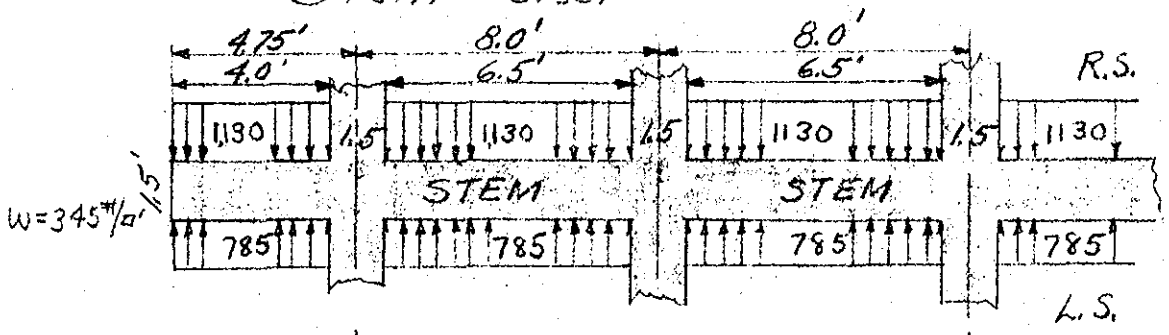
| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 150×13.1×1.5 | 2950 | | | | 6.0 | | 17,700 |
| $C_2$ | 150×12×2.5 | 4500 | | | | 6.0 | | 27,000 |
| $E_R$ | 125×14.6×5.25 | 9580 | | | | 9.4 | | 90,000 |
| $E_{L1}$ | 100×7.6×5.25 | 3990 | | | | 2.62 | | 10,400 |
| $E_{L2}$ | 125×7×5.25 | 4600 | | | | 2.62 | | 12,100 |
| $U_1$ | 62.5×17.1×1.5 | | 1600 | | | 11.25 | 18,000 | |
| $U_2$ | 62.5×9.5×10.5 | | 6230 | | | 5.25 | 32,700 | |
| $U_3$ | 62.5×3.8×10.5×½ | | 1250 | | | 7.0 | 8,700 | |
| $P_{ER}$ | 80×17.1×17.1×½ | | | 11,700 | | 5.7 | 66,700 | |
| $P_L$ | 35×17.1×17.1×½ | | | | 5,130 | 5.7 | | 29,300 |
| $P_{LW}$ | 45×9.5×9.5×½ | | | | 2,030 | 3.17 | | 6,400 |
| S.F. | $\frac{1.5}{8.0}(150-125)\times 7.25\times 13.1$ | 450 | | | | 6.0 | | 2,700 |
| $F_R$ | Friction | | | | 4540 | — | | |
| | | 26,070 | 9080 | 11,700 | 11,706 | | 126,100 | 195,600 |
| | | ΣV = 17,000 | | ΣH = 0 | | | ΣM = 69,500 | |

Position of Resultant $= \frac{\Sigma M}{\Sigma V} = 4.08'$ O.K. $\frac{12}{3} = 4.00$

ject EH. 3-5
mputation Sect. between Sta. 211+78.78 and 212+00.28
mputed by J.N.O. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Stem steel




Lateral loading at El. 25.0

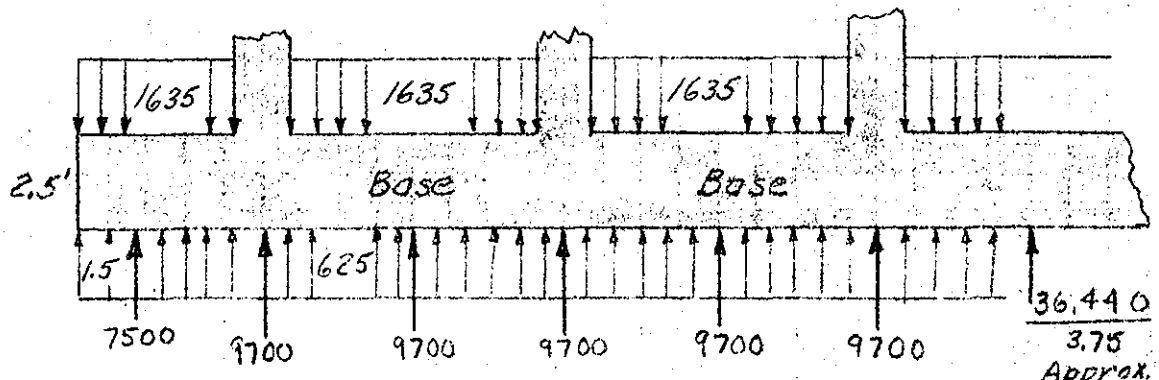
| 4.0' | 6.5' | | 6.5' | |
|---|---|---|---|---|
| -2.75 | +1.21 | -1.21 | +1.21 | -1.21 | +1.21 |
| 0 | +1.54 | 0 | 0 | 0 | 0 |
| | | -.77 | +.77 | | |

$-2.75^k$ $2.75^k$ $1.98^k$ $1.98^k$

Steel $A_s = \frac{2750}{1325 \times 14.5} = .143 \square''$

use $\frac{1}{2}''\square$ @12" c.c. longitudinal in stem, both faces

Base steel




$\frac{36,440}{3.75} = 9700$
Approx. pile load per foot on 3.75' of L.S. base

| 4.0 | 6.5 | | 6.5 | |
|---|---|---|---|---|
| +10.7 | -4.35 | +4.35 | -4.35 | |
| 0 | -6.35 | 0 | 0 | |
| | | +3.17 | | |
| +10.7 | -10.7 | +7.52 | | |

Subject EH. 3-5
Computation Sect. between Sta. 211+78.78 and 212+00.28
Computed by J. N. L. Checked by Date

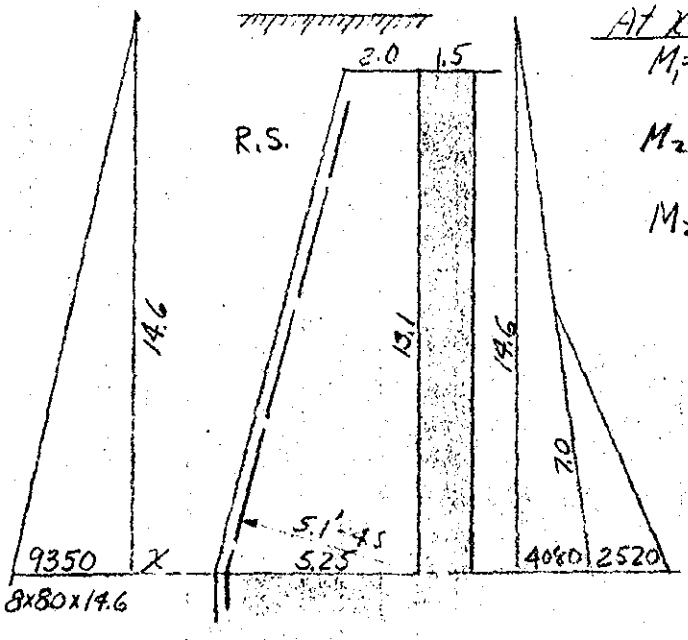
U. S. GOVERNMENT PRINTING OFFICE 3—10028

## Base Steel - Continued

Steel $A_s = \frac{10,700}{1325 \times 25.5} = .32$ □" in bottom

use $\frac{3}{4}$"φ @12"c.c. top and bottom, longitudinal in base

## Steel for Counterforts (Seep fins)




At X-X

$M_1 = \frac{1}{2} \times 9350 \times 14.6 \times \frac{14.6}{3} = 332,000'\#$

$M_2 = \frac{1}{2} \times 4080 \times \frac{14.6 \times 14.6}{3} = 145,000$

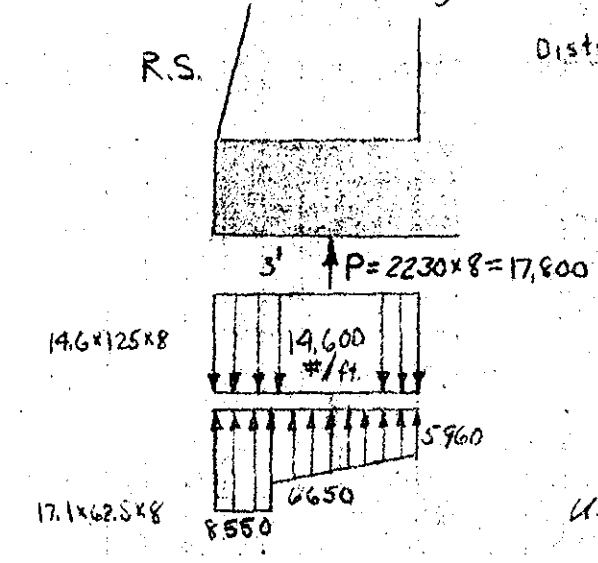
$M_2 = \frac{1}{2} \times 2520 \times 7 \times \frac{7}{3} = 20,500$

$\Sigma M = 166,500'\#$

Steel $A_s = \frac{166,500}{1325 \times 140} = 1.0$ □"

use temp. steel

## Bonding steel - base to counterfort




Distribute Pile Load over 4.75' of riverside base

$\frac{17,900}{4.75} = 3,750$ #/ft.

$14,600 - 6300 - 3750 = 4550\#$

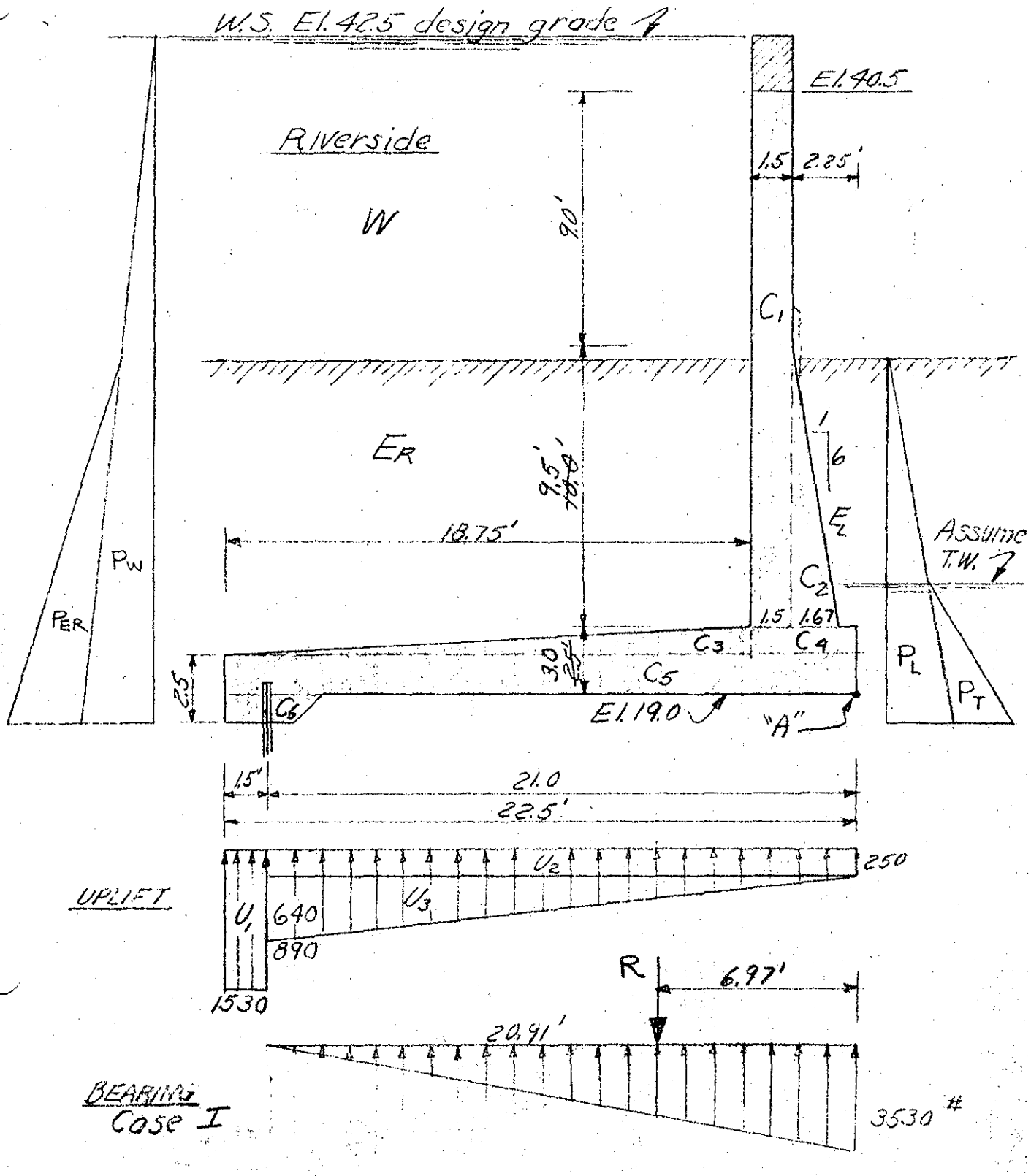
$\frac{4550}{18000} = .253$ □" or .13□" each face

use $\frac{1}{2}$"□ @12"c.c. each face of counterfort - vertical

use same for horiz. to stem

Project EH 3-5
Computation R.R. stop-log structure - South Abutment
Computed by J.H.L. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Subject EM 3-5

Computation R.R. stop log

Computed by J. H. L. Checked by Date

Stability - Case I - River up

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 150 x 1.5 x 19 | 4270 | | | | 3.0 | | 12,800 |
| $C_2$ | 50 x 10 x 1.67 x ½ | 420 | | | | 1.7 | | 700 |
| $C_3$ | 25 x 18.7 x 1.0 x ½ | 230 | | | | 10.0 | | 2,300 |
| $C_4$ | 150 x 1 x 3.75 | 560 | | | | 1.89 | | 1,000 |
| $C_5$ | 150 x 1.5 x 22.5 | 5060 | | | | 11.25 | | 57,000 |
| $C_6$ | 150 x 3 x 1 | 450 | | | | 21.0 | | 9,500 |
| W | 62.5 x 11.5 x 18.75 | 13,450 | | | | 13.13 | | 176,500 |
| $E_R$ | 125 x 10.5 x 18.75 | 24,600 | | | | 13.13 | | 323,000 |
| $E_L$ | 100 x 2.25 x 9.5 | 2140 | | | | 1.12 | | 2400 |
| $U_1$ | 62.5 x 24.5 x 1.5 | | 2300 | | | 21.75 | 50,000 | |
| $U_2$ | 62.5 x 4 x 21.0 | | 5250 | | | 10.5 | 55,200 | |
| $U_3$ | 62.5 x 10.25 x 21.0 x ½ | | 6730 | | | 14.0 | 94,200 | |
| $P_W$ | 62.5 x $\overline{24.5}^2$ x ½ | | | 18,700 | | 7.17 | 134,000 | |
| $P_{ER}$ | 17.5 x $\overline{13.0}^2$ x ½ | | | 1480 | | 3.33 | 4,900 | |
| $P_L$ | 35 x $\overline{13.0}^2$ x ½ | | | | 2960 | 3.33 | | 9,900 |
| $P_T$ | 45 x $\overline{5}^2$ x ½ | | | | 560 | .67 | | 400 |
| $F_R$ | | | | | 16,660 | | | |
| | | | | 20,180 | 20,180 | | | |
| | | ΣV = 36,900 | | ΣH = 0 | | | ΣM = 257,200 | |

Position of Resultant $= \frac{\Sigma M}{\Sigma V} = 6.97'$ $\quad \frac{22.5}{3} = 7.5$ Resultant is .53' outside middle ⅓

Bearing $= \frac{2 \times 36,900}{3 \times 6.97} = 3,530^{\#}$

Subject EH 3-5

Computation R.R. Stop log

Computed by J.H.L. Checked by _____ Date _____

Stability - Case II - water down

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | | 4270 | | | | | | 12,800 |
| $C_2$ | | 420 | | | | | | 700 |
| $C_3$ | | 340 | | | | | | 3,400 |
| $C_4$ | | 560 | | | | | | 1,000 |
| $C_5$ | | 5060 | | | | | | 57,000 |
| $C_6$ | | 450 | | | | | | 9,500 |
| $E_R$ | 18.75 x 10.5 x 100 | 19,700 | | | | 13.13 | | 259,000 |
| $E_L$ | | 2140 | | | | | | 2400 |
| U | 250 x 21.0 | | 5250 | | | 10.5 | 55,100 | |
| $P_T$ | $45 \times 5^2 \times \frac{1}{2}$ | | | | 560 | .67 | | 400 |
| $F_R$ | | | | 560 | | | | |
| | | $\Sigma V = 27,690$ | | $\Sigma H = 0$ | | | $\Sigma M = 291,100$ | |

Position of Resultant $\Big\} = \frac{\Sigma M}{\Sigma V} = 10.5'$ from A

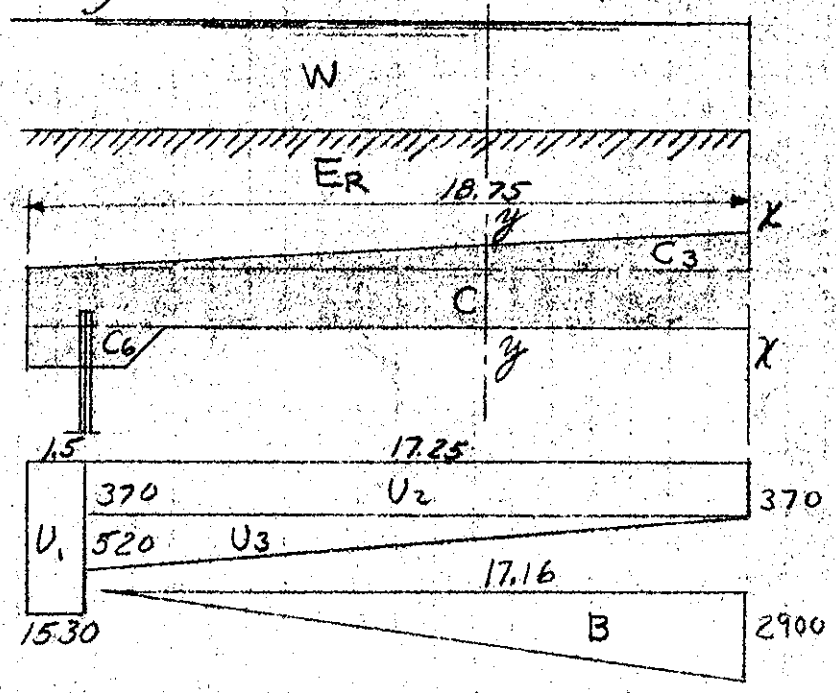
$e = 11.25 - 10.5 = .75$

Bearing $\frac{27690}{22.5}\left[1 \pm \frac{6 \times .75}{22.5}\right] = 1230\left[\begin{matrix}1.2\\.8\end{matrix}\right] = \begin{matrix}1480^{\#}\\985^{\#}\end{matrix}$

Subject EH. 3-5
Computation R.R. Stop log
Computed by J. H. L. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Design of Riverside Base




| | Force | ↓ | ↑ | Arm | Moments at x-x ↙ | ↖ |
|---|---|---|---|---|---|---|
| W | | 13,450 | | 9.38 | 126,000 | |
| $E_R$ | | 24,600 | | 9.38 | 231,000 | |
| C | 150 x 1.5 x 18.75 | 4,220 | | 9.38 | 39,600 | |
| $C_3$ | | 230 | | 6.25 | 1,400 | |
| $C_6$ | | 450 | | 17.25 | 7,800 | |
| $U_1$ | | | 2300 | 18.0 | | 41,300 |
| $U_2$ | 370 x 17.25 | | 6380 | 8.63 | | 55,000 |
| $U_3$ | 520 x 17.25 x 1/2 | | 4490 | 11.5 | | 51,700 |
| B | 2900 x 17.16 x 1/2 | | 24900 | 5.72 | | 142,500 |

$\Sigma V = 4,880^{\#}$ ↓ $\Sigma M = 115,300$ ↙

Req'd. depth $= \sqrt{\dfrac{115,300}{123}} = 30.6 + 3.5 = 34.1'' > 30''$

Increase depth at x-x to 3'-0"

Shear $v = \dfrac{4880}{.884 \times 12 \times 31.5} = 14.6^{\#}/\square''$ O.K.

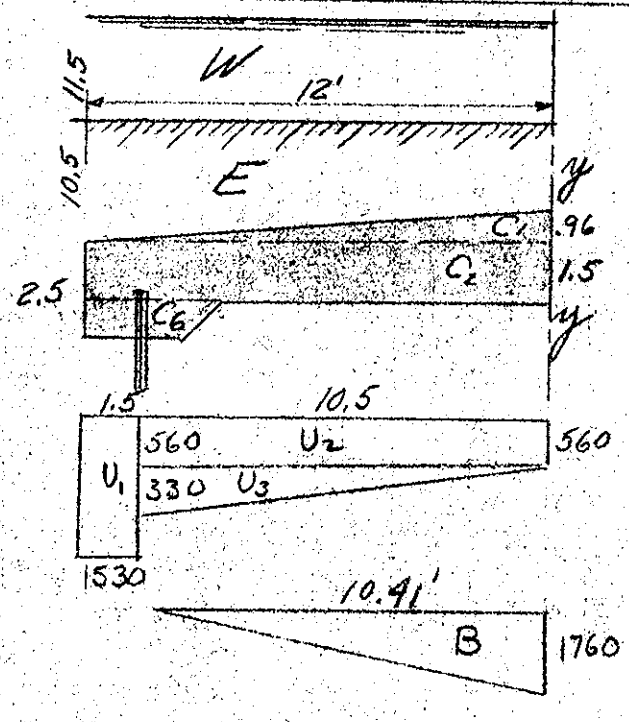
Steel $A_s = \dfrac{115,300}{1325 \times 32.5} = 2.68\ \square''$ in top

use $1\frac{1}{8}''\square$ @ 6" c.c. $= 1.54\ \square''$

Project EH. 3-5
Computation R.R. Stop log
Computed by J.H.L. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Riverside Base - continued




Moments at y-y

| | Force | ↓ | ↑ | Arm | ↓ | ↑ |
|---|---|---|---|---|---|---|
| W | 62.5×12×11.5 | 8630 | | 6.0 | 51,700 | |
| E | 125×10.5×12 | 15,730 | | 6.0 | 94,400 | |
| $C_1$ | 25×12×.96×½ | 140 | | 4.0 | 600 | |
| $C_2$ | 150×12×1.5 | 2700 | | 6.0 | 16,200 | |
| $C_6$ | | 450 | | 10.5 | 4,700 | |
| $U_1$ | | | 2300 | 11.25 | | 25,900 |
| $U_2$ | 560×10.5 | | 5870 | 5.25 | | 30,800 |
| $U_3$ | 330×10.5×½ | | 1730 | 7.0 | | 12,100 |
| B | 1760×10.41×½ | | 9160 | 3.47 | | 31,800 |
| | | ΣV = 8590 ↓ | | | ΣM = 67,000 ↶ | |

Req'd depth $= \sqrt{\frac{67000}{123}} = 23.3 + 3.5 = 26.8 < 29.5$ O.K.

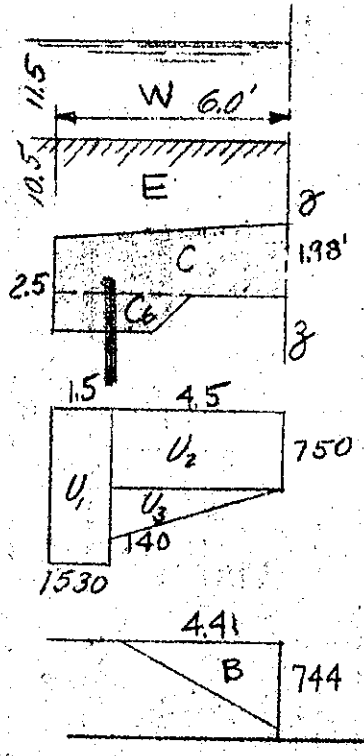
Unit Shear $= \frac{8590}{.884 \times 12 \times 26} = 31.2^{\#}$ O.K.

Steel $A_s = \frac{67,000}{1325 \times 26} = 1.95 \square''$ in top

Project EH. 3-5
Computation R.R. Stop log
Computed by J. H. O. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528

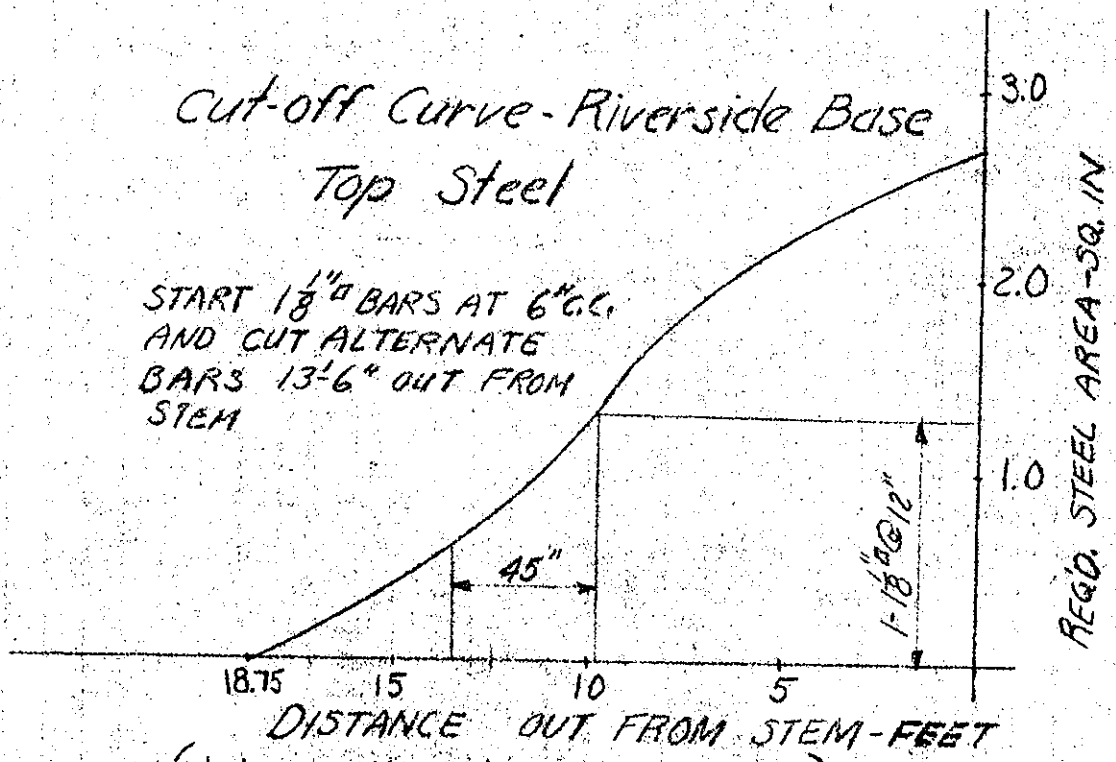
## Riverside Base - continued




| | Forces | ↓ | ↑ | Moments at 3-3 Arm | ↙ | ↖ |
|---|---|---|---|---|---|---|
| W | 62.5×11.5×6 | 4310 | | 3.0 | 12,900 | |
| E | 125×10.5×6 | 7880 | | 3.0 | 23,600 | |
| C | 150×1.5×6 | 1350 | | 3.0 | 4,100 | |
| $C_6$ | | 450 | | 4.5 | 2,000 | |
| $U_1$ | | | 2300 | 5.25 | | 12,100 |
| $U_2$ | 750×4.5 | | 3370 | 2.25 | | 7,600 |
| $U_3$ | 140×4.5×½ | | 310 | 3.0 | | 900 |
| B | 744×4.41×½ | | 1640 | 1.47 | | 2,400 |
| | | ΣV = 6370 ↓ | | ΣM = 19,600 ↙ | | |

$$\text{Unit Shear} = \frac{6370}{.884 \times 12 \times 20.3} = 29.6\ \#/\square''$$

$$\text{Steel } A_s = \frac{19,600}{1325 \times 20.3} = .73\ \square''$$

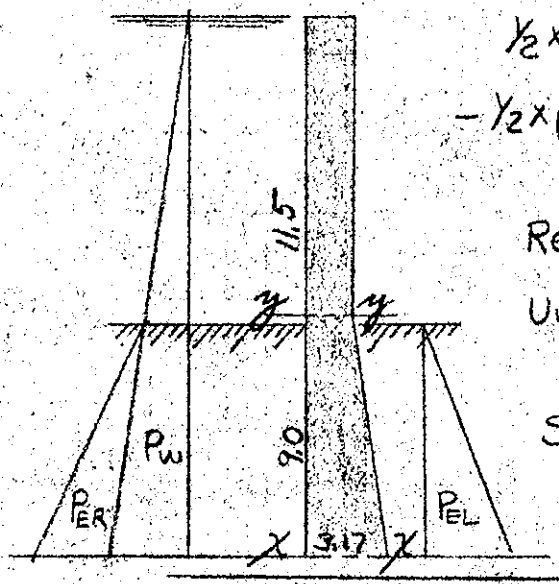



(Note: Turn to page 57)

Project EH. 3-5
Computation R.R. Stop-log
Computed by J.H.L. Checked by ..... Date .....

U. S. GOVERNMENT PRINTING OFFICE 3—10528

# Design of Stem




Moments at x-x

$\frac{1}{2} \times 62.5 \times \overline{20.5}^2 = 13{,}100 \rightarrow \times \frac{20.5}{3} = 89{,}500$

$-\frac{1}{2} \times (35-17.5) \times \overline{9}^2 = 700 \leftarrow \times \frac{9}{3} = 2{,}100$

$12{,}400 \rightarrow \qquad 87{,}400$

Req'd. "d" = O.K. by inspection

Unit shear $= \frac{12{,}400}{.884 \times 12 \times 34.5} = 34^{\#}/\square''$ o.k.

Steel $A_s = \frac{87{,}400}{1325 \times 34.5} = 1.91 \square''$ in river face

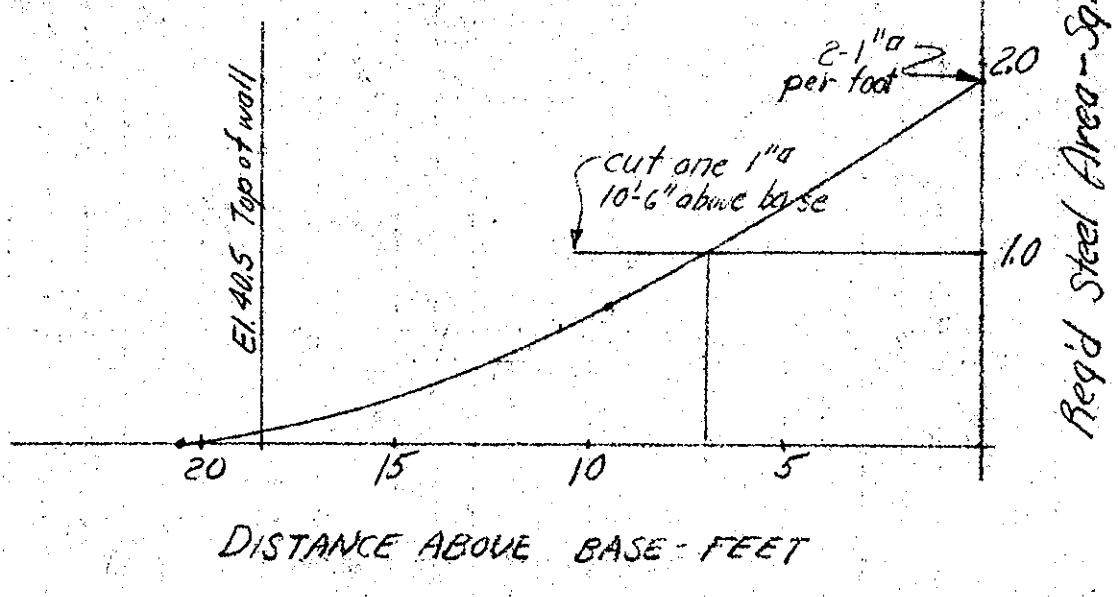
use 1"□ @6" c.c.

Moments at (y-y) 9.5' above base

$\frac{1}{2} \times 62.5 \times 11^2 \times \frac{11}{3} = 13{,}900^{1\#}$

Steel $A_s = \frac{13900}{1325 \times 14.5} = .73 \square''$ in river face

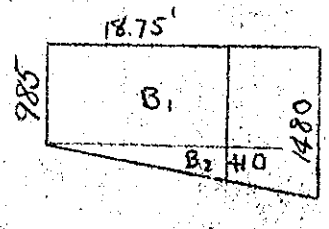
Cut-off curve - Stem steel
Riverside face



Project E.H. 3-5
Computation R.R. Stop log
Computed by J.H.L. Checked by ..... Date .....

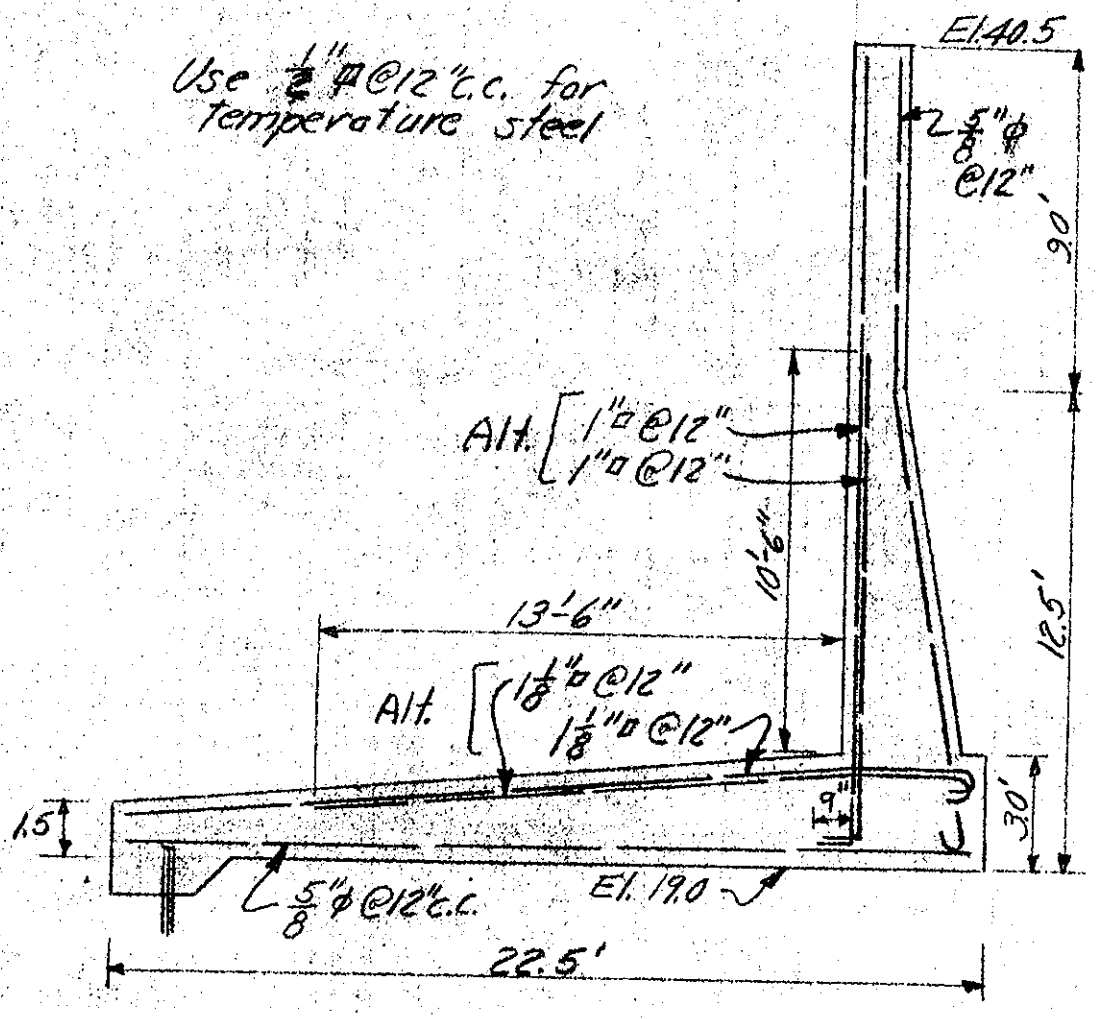
U. S. GOVERNMENT PRINTING OFFICE 3—10528

# Design of Riverside Base - Case II




| | Force | Moments ↓ | Moments ↑ | Arm | Moments ↙ | Moments ↖ |
|---|---|---|---|---|---|---|
| $E_R$ | | 19,700 | | 13.13 | 185,000 | |
| $C_3$ | | 340 | | 6.25 | 2,100 | |
| $C$ | | 4,220 | | | 39,600 | |
| $C_6$ | | 450 | | | 7,800 | |
| $U$ | 17.25 X 250 | | 4310 | 8.63 | | 37,200 |
| $B_1$ | 985 X 18.75 | | 18,500 | 9.38 | | 174,000 |
| $B_2$ | 1/2 X 410 X 18.75 | | 3,840 | 6.25 | | 24,000 |
| | | $\Sigma V$ = 19,940 ↑ | | | $\Sigma M$ = 800 ↖ | |

Case I governs



**WAR DEPARTMENT**

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

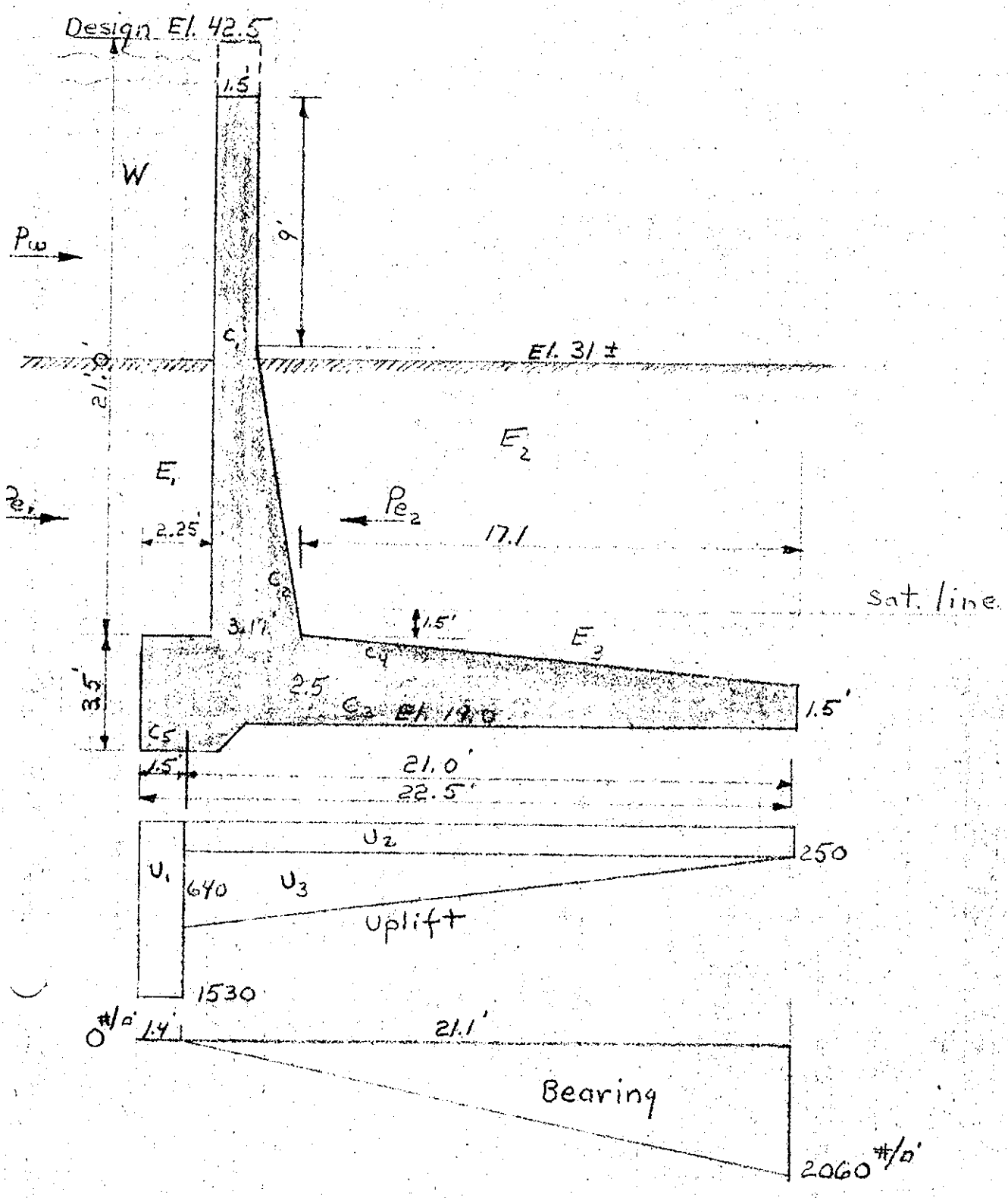
Page 47

Project: East Hartford, Conn.

Computation: R. R. Stop Log Structure, South Abutment

Computed by: W. S. Jr. Checked by: Date: 12/17/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Subject East Hartford, Conn.
Computation R.R. Stop Log Structure, South Abutment
Computed by W.S. Jr. Checked by _____ Date 12/17/40

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 21×1.5×150 | 4710 | | | | 19.5 | | 92,000 |
| $C_2$ | 10×1.7×½×150 | 1270 | | | | 18.2 | | 23,100 |
| $C_3$ | 22.5×1.5×150 | 5060 | | | | 11.25 | | 57,000 |
| $C_4$ | 22.5×½×150 | 1690 | | | | 15.0 | | 25,400 |
| $C_5$ | 3×1×150 | 450 | | | | 21.0 | | 9,440 |
| | | | | | | | | |
| $E_1$ | 2.25×9.5×125 | 2670 | | | | 21.4 | | 57,100 |
| $E_2$ | 17.9×8×100 | 14300 | | | | 8.95 | | 128,000 |
| $E_3$ | 1.5×17.1×125 | 3210 | | | | 8.55 | | 27,400 |
| $E_4$ | 1×½×17.1×125 | 1070 | | | | 5.7 | | 6,100 |
| | | | | | | | | |
| W | 2.25×11.5×62.5 | 1620 | | | | 21.4 | | 34,600 |
| | | | | | | | | |
| $P_w$ | $24.5^2$×½×62.5 | | | 18700 | | 7.2 | 135,000 | |
| $P_{e_1}$ | $13^2$×½×17.5 | | | 1470 | | 3.3 | 4,860 | |
| | | | | | | | | |
| $P_{e_2}$ | $13^2$×½×35 | | | | 2960 | 3.3 | | 9750 |
| $P_{e_3}$ | $5^2$×½×45 | | | | 564 | .67 | | 378 |
| | | | | | | | | |
| $U_1$ | 1530×1.5 | | 2300 | | | 21.75 | 50,000 | |
| $U_2$ | 250×21 | | 5250 | | | 10.5 | 55,000 | |
| $U_3$ | 640×½×21 | | 6700 | | | 14.0 | 93,800 | |
| | | | | | | | | |
| $F_r$ | | | | | 10,000 | 0.0 | | |
| $P_{ip}$ | | | | | 6646 | 3.3 | | 21,900 |
| | | | | | | | | |
| | | 36050 | 14250 | 20170 | 20170 | | 338,660 | 492,160 |
| | | ΣV = 21,800 | | ΣH = 0 | | | ΣM = 153,500 | |

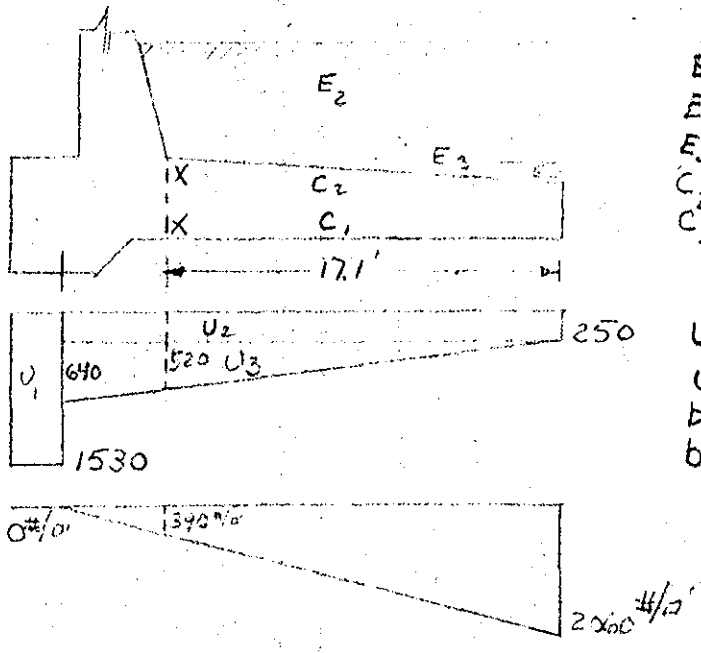
Position of Resultant $= \frac{\Sigma M}{\Sigma V} = 7.03$ O.K.

Bearing $= \frac{21,800}{3 \times 7.03} = 1030 \times 2 = 2060$ #/□'
$\times 0 = 0$ #/□'

Project East Hartford, Conn.
Computation R. R. Stop Log Structure, South Abutment
Computed by W. S. Jr. Checked by Date 12/19/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

## Design of base




moment at x-x

$E_2 = 17.1 \times 8 \times 100 = 13700 \times 8.5 = 116,500$
$E_3 = 17.1 \times 1.5 \times 125 = 3200 \times 8.5 = 27,200$
$E_4 = 17.1 \times 1 \times \frac{1}{2} \times 125 = 1070 \times 11.4 = 32,800$
$C_2 = 17.1 \times 1 \times \frac{1}{2} \times 150 = 1280 \times 5.7 = 7,300$
$C_3 = 17.1 \times 1.5 \times 150 = 3850 \times 8.5 = 32,700$
$23,100^{\#}\downarrow \quad 216,500'^{\#}\circlearrowright$

$U_2 = 250 \times 17.1 = 4270 \times 8.5 = 36,300$
$U_3 = 520 \times 17.1 \times \frac{1}{2} = 4450 \times 5.7 = 25,400$
$b_1 = 390 \times 17.1 = 6660 \times 8.5 = 56,600$
$b_2 = 1070 \times 17.1 \times \frac{1}{2} = 14300 \times 11.4 = 163,000$
$27,680^{\#}\uparrow \quad 281,300'^{\#}\circlearrowleft$

$\Sigma V = 6,580^{\#}\uparrow \quad \Sigma M = 65,300^{\#}\circlearrowleft$

$$d = \sqrt{\frac{65,300 \times 12}{123 \times 12}} = 23'' \quad \text{OK.}$$

$$A_s = \frac{65,300 \times 12}{18000 \times .884 \times 31^{*}} = 1.6\,\square'' \quad (1''\square + 7/8''\phi)$$

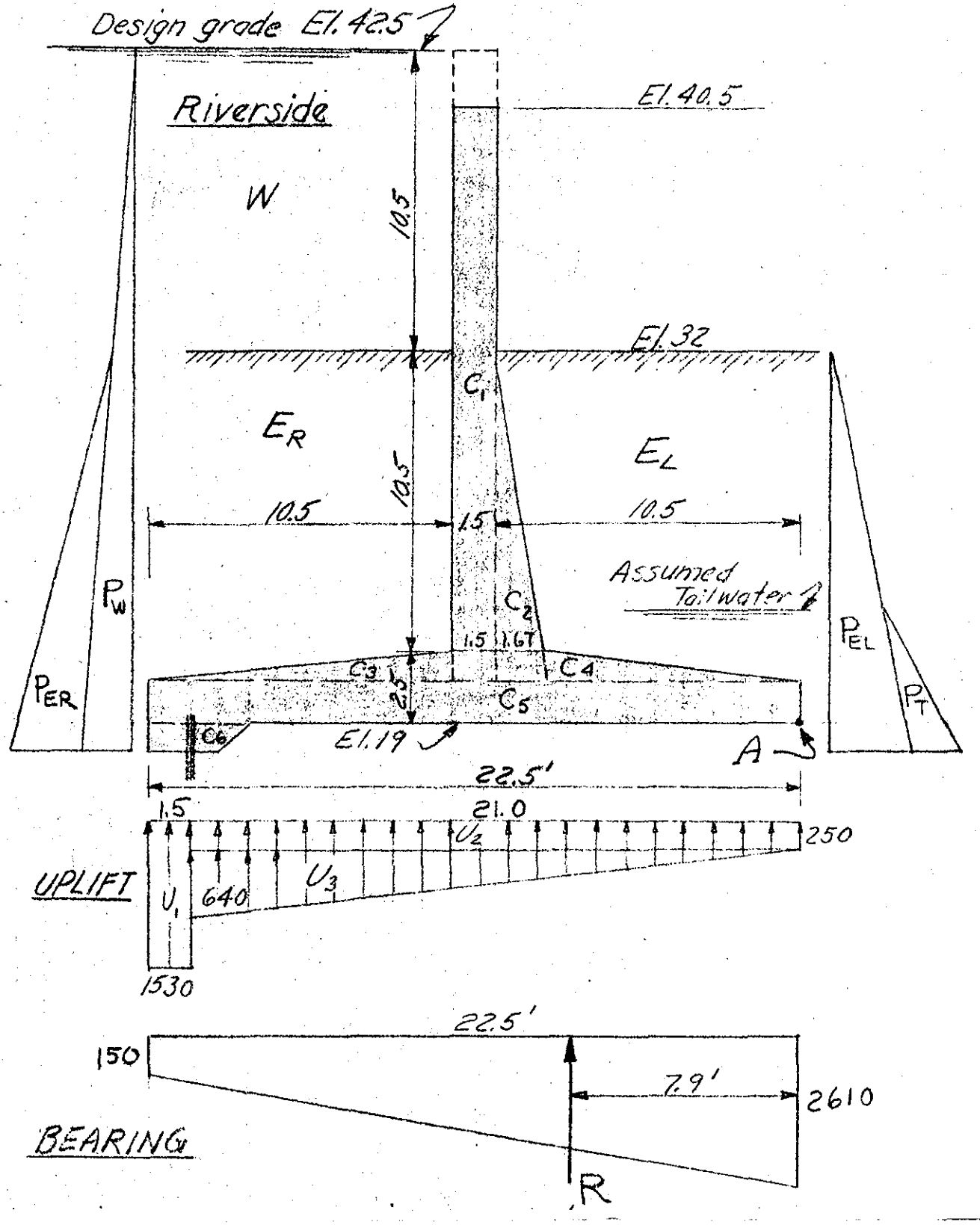
*(Base thickness at x-x changed to 3'-0")

Shear and bond O.K.

Stem design is same as north abutment, page 45.
With river down, the stresses are negligable.

ect EH. 3-5
mputation R. R. Stop Log Structure, Sta. 97+15± and 98+20±
mputed by J. Y. O. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Subject EH. 3-5

Computation

Computed by J.H.L. Checked by Date

Stability - water up

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 150 x 1.5 x 20 | 4500 | | | | 11.25 | | 50,700 |
| $C_2$ | 50 x 1.67 x 11 | 910 | | | | 9.94 | | 9,100 |
| $C_3$ | 25 x 1.0 x 10.5 x ½ | 130 | | | | 15.5 | | 2,000 |
| $C_4$ | 50 x 1.0 x 9.0 x ½ | 230 | | | | 6.0 | | 1400 |
| $C_5$ | 150 x 1.5 x 22.5 | 5060 | | | | 11.25 | | 56,900 |
| $C_6$ | 150 x 3 x 1.0 | 450 | | | | 21.0 | | 9,500 |
| W | 62.5 x 10.5 x 10.5 | 6900 | | | | 17.25 | | 119,000 |
| $E_R$ | 125 x 10.5 x 11.5 | 15,100 | | | | 17.25 | | 260,500 |
| $E_L$ | 100 x 10.5 x 11.5 | 12,100 | | | | 5.25 | | 63,500 |
| $U_1$ | 1530 x 1.5 | | 2300 | | | 21.75 | 50,000 | |
| $U_2$ | 250 x 21 | | 5250 | | | 10.5 | 55,100 | |
| $U_3$ | 640 x 21 x ½ | | 6720 | | | 14.0 | 94,000 | |
| | | | | | | | | |
| $P_W$ | 62.5 x $24.5^2$ x ½ | | | 18,700 | | 7.17 | 134,000 | |
| $P_{ER}$ | 17.5 x $14^2$ x ½ | | | 1700 | | 3.67 | 6,200 | |
| $P_{EL}$ | 35 x $14^2$ x ½ | | | | 3400 | 3.67 | | 12,500 |
| $P_T$ | 45 x $4^2$ x ½ | | | | 200 | .33 | | — |
| | | | | | | | | |
| FR | | | | | 16,800 | | | |
| | | ΣV = 31,110 | | ΣH = 0 | | | ΣM = 245,800 | |

Position of Resultant $\Big\} = \frac{\Sigma M}{\Sigma V} = 7.9'$

$\frac{22.5}{3} = 7.5'$

R is .4' inside middle ⅓

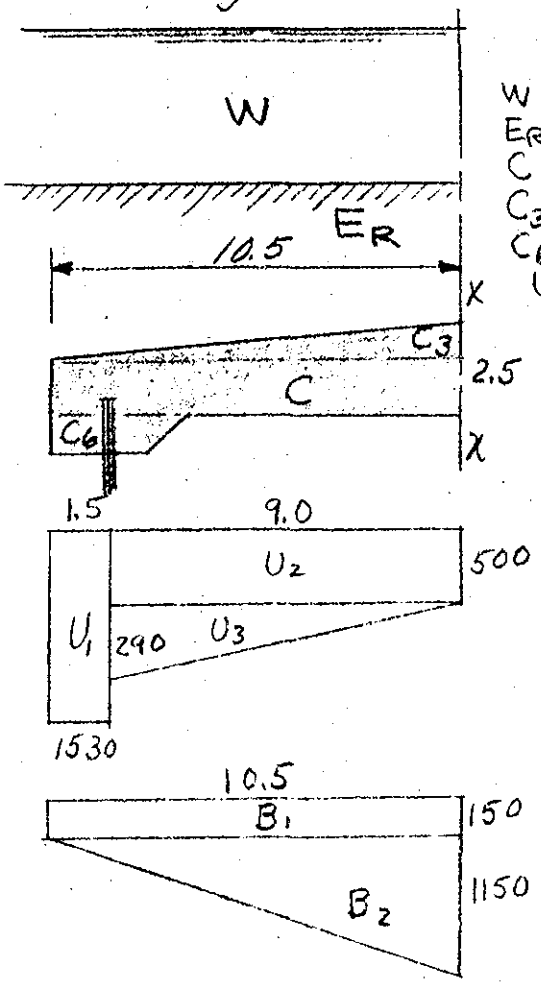
$e = 11.25 - 7.9 = 3.35$

$$\text{Bearing} = \frac{31,110}{22.5}\left[1 \pm \frac{6 \times 3.35}{22.5}\right] = 1380\begin{bmatrix}1.89\\.11\end{bmatrix} = \begin{bmatrix}2610\\150\end{bmatrix}$$

Subject EH 3-5
Computation
Computed by J. H. L. Checked by Date

U. S. GOVERNMENT PRINTING OFFICE 3—10528

# Design of Riverside Base




| | Force | ↓ | ↑ | Moments at X-X Arm | ↙ ↖ |
|---|---|---|---|---|---|
| W | | 6,900 | | 5.25 | 36,200 |
| $E_R$ | | 15,100 | | 5.25 | 79,200 |
| C | 150×10.5×1.5 | 2360 | | 5.25 | 12,400 |
| $C_3$ | | 130 | | 3.5 | 500 |
| $C_6$ | | 450 | | 9.0 | 4050 |
| $U_1$ | | | 2300 | 9.75 | 22,400 |
| $U_2$ | 500×9 | | 4500 | 4.5 | 20,200 |
| $U_3$ | 290×9×½ | | 1300 | 6.0 | 7800 |
| $B_1$ | 150×10.5 | | 1570 | 5.25 | 8,200 |
| $B_2$ | 1150×10.5×½ | | 6030 | 3.5 | 21,100 |

$\Sigma V = 9240 \downarrow \quad \Sigma M = 52,650$

Req'd depth $= \sqrt{\frac{52650}{123}} = 20.7''$ O.K.

Shear $= \frac{9240}{1884 \times 12 \times 26.5} = 33^{\#}/\square''$ O.K.

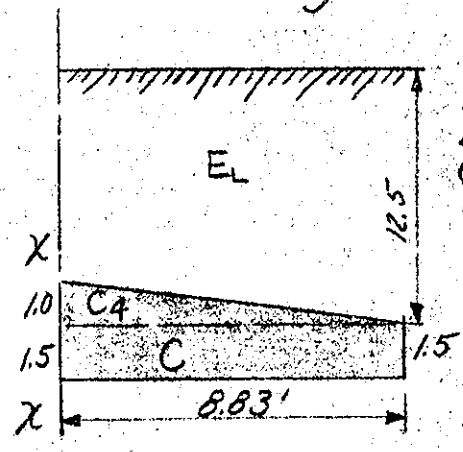
Steel $A_s = \frac{56,650}{1325 \times 26.5} = 1.61\square''$ in top

Alt. 1"□ and 7/8"φ @ 6"

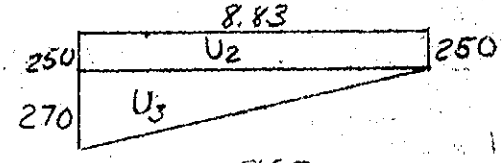
Project EH. 3-5
Computation
Computed by J. H. X. Checked by Date

U.S. GOVERNMENT PRINTING OFFICE 3—10628

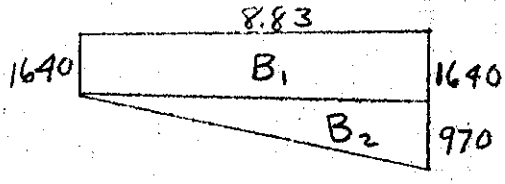
# Design of Landside Base




| Forces | ↓ | ↑ | Arm | Moments at X-X ↻ | ↺ |
|---|---|---|---|---|---|
| $E_L$ 100×8.83×12.5 | 11,050 | | 4.41 | 48,800 | |
| $C_4$ | 230 | | 2.94 | 700 | |
| C 150×8.83×1.5 | 1990 | | 4.41 | 8,800 | |
| $U_2$ 250×8.83 | | 2210 | 4.41 | | 9,700 |
| $U_3$ 270×8.83×½ | | 1190 | 2.94 | | 3,500 |
| $B_1$ 1640×8.83 | | 14,500 | 4.41 | | 64,000 |
| $B_2$ 970×8.83×½ | | 4,280 | 5.88 | | 25,200 |
| | | ΣU=8910 ↑ | | ΣM=44,100 ↻ | |




$$\text{Req'd. "d"} = \sqrt{\frac{44,100}{123}} = 18.9'' \text{ O.K.}$$




$$\text{Steel } A_s = \frac{44,100}{1325 \times 25.5} = 1.31 \text{ □}'' \text{ in bottom}$$

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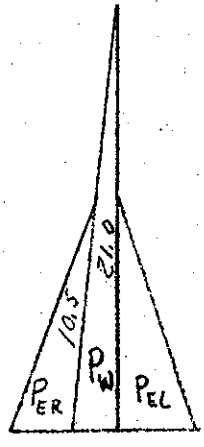
# Design of Stem




$$\tfrac{1}{2} \times 62.5 \times \overline{21}^2 = 13,800 \rightarrow \times \frac{21}{3} = 96,600 \curvearrowright$$

$$-\tfrac{1}{2} \times 17.5 \times \overline{10.5}^2 = 960 \leftarrow \times \frac{10.5}{3} = 3,400 \curvearrowleft$$

$$\Sigma H = 12,840 \qquad \Sigma M = 93,200 \curvearrowright$$

$$\text{Req'd "d"} = \sqrt{\frac{93,200}{123}} = 27.5'' + 3.5 < 38'' \text{ O.K.}$$

$$\text{Unit } v = \frac{12,840}{.884 \times 12 \times 34.5} = 35^{\#}/\square''$$

$$\text{Steel } A_s = \frac{93200}{1325 \times 34.5} = 2.04 \text{ □}'' \text{ in riverside face}$$

**WAR DEPARTMENT**

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

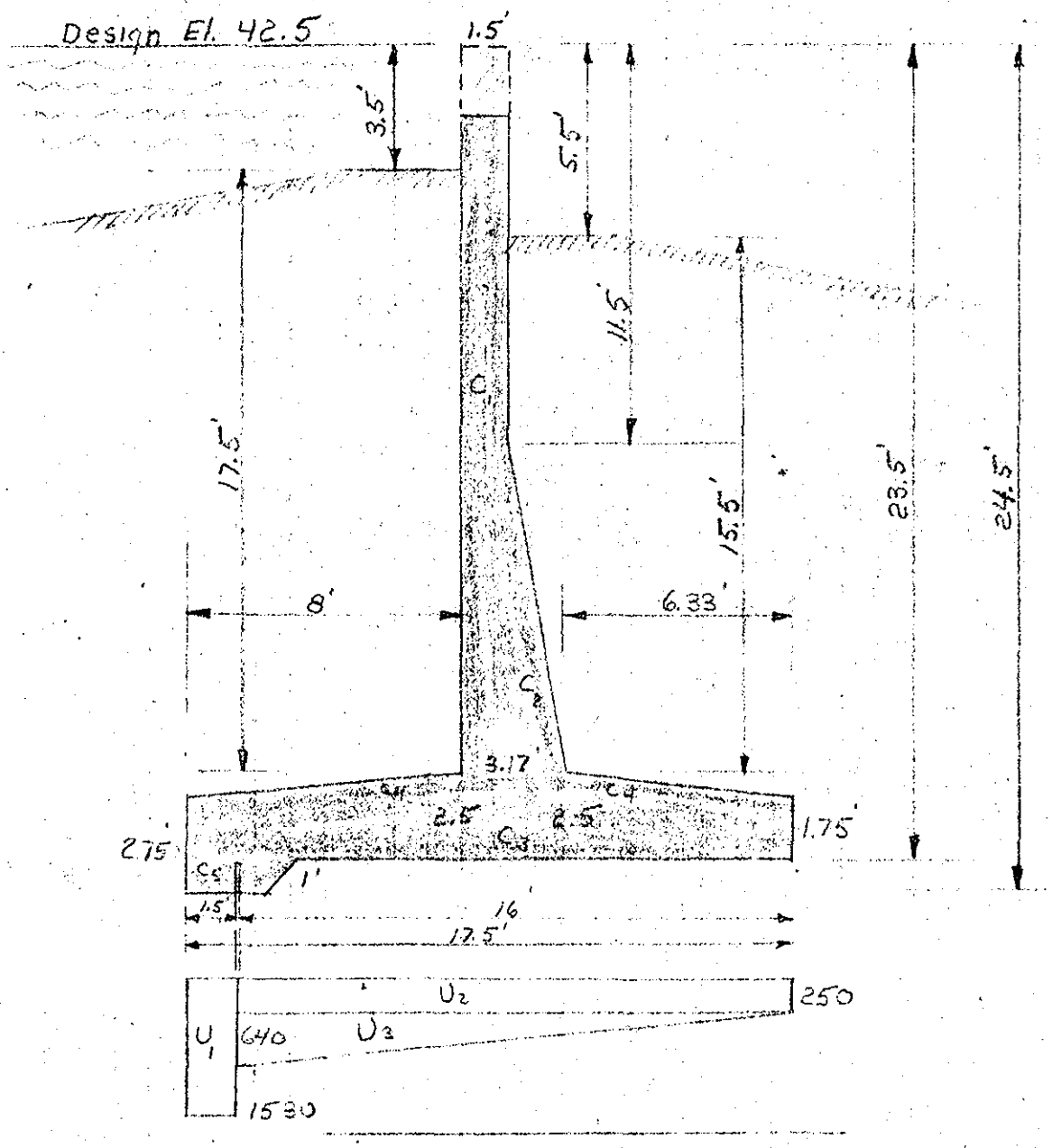
Page 54

Project East Hartford, Conn.

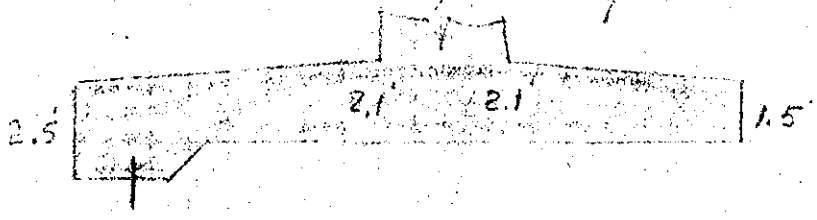
Computation R. R. Stop Log Structure Section at Sta 97+0± or 98+40±

Computed by W. S. Jr. Checked by Date 12/20/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528




Note: Base changed as shown below, but no change in stability req'd.



Subject East Hartford, Conn.
Computation R. R. Stop Log Structure
Computed by W. S. Jr. Checked by _____ Date 12/21/40

| FORCES ACTING | | ↓ | ↑ | → | ← | ARM | MOMENTS ABOUT A ↻ | MOMENTS ABOUT A ↺ |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | 21x1.5x150 | 4710 | | | | 8.75 | | 41,200 |
| $C_2$ | 9.5x1.67/2x150 | 1190 | | | | 7.44 | | 8,850 |
| $C_3$ | 1.75x17.5x150 | 4600 | | | | 8.75 | | 40,300 |
| $C_4$ | .75x17.5x150x½ | 980 | | | | 8.75 | | 8,550 |
| $C_5$ | 1x3x150 | 450 | | | | 16.0 | | 7,200 |
| | | | | | | | | |
| $E_1$ | 18x8x125 | 18000 | | | | 13.5 | | 243,000 |
| W | 3.5x8x62.5 | 1750 | | | | 13.5 | | 23,600 |
| | | | | | | | | |
| $E_2$ | 7.5x14x100 | 10,500 | | | | 3.75 | | 39,400 |
| $E_3$ | 2x6.33x125 | 1580 | | | | 3.16 | | 5,000 |
| | | | | | | | | |
| $P_w$ | $24.5^2$x½x62.5 | | | 18750 | | 7.16 | 134,000 | |
| $P_{E_1}$ | $21^2$x½x17.5 | | | 3850 | | 6.0 | 23,100 | |
| | | | | | | | | |
| $P_{E_2}$ | $19^2$x½x35 | | | | 6300 | 5.3 | | 33,400 |
| $P_{E_3}$ | $5^2$x½x.45 | | | | 563 | .7 | | 394 |
| | | | | | | | | |
| $U_1$ | 1530x1.5 | | 2300 | | | 16.75 | 38,500 | |
| $U_2$ | 250x16 | | 4000 | | | 8.0 | 32,000 | |
| $U_3$ | 640x½x16 | | 5120 | | | 10.7 | 54,800 | |
| | | | | | | | | |
| $E_r$ | .45x32,340 | | | | 14,500 | | | |
| $P_p$ | | | | | 1237 | 5.3 | | 6550 |
| | | | | | | | | |
| | | | | | | | | |
| | | 43760 | 11420 | 22600 | 22600 | — | 282,400 | 457,444 |
| | | ΣV = 32,340 | | ΣH = 0 | | | ΣM = 175,044 | |

$$\left.\begin{array}{l}\text{Position of}\\ \text{Resultant}\end{array}\right\} = \frac{\Sigma M}{\Sigma V} = 5.42'$$

$$\text{Bearing} = \frac{32,340}{3 \times 5.42} \times \begin{array}{l} 2 = 4000 \ \#/\square' \\ 0 = 0 \ \#/\square' \end{array}$$

Project East Hartford, Conn.
Computation R. R. Stop Log Structure
Computed by W. S. Jr. Checked by Date 12/21/42

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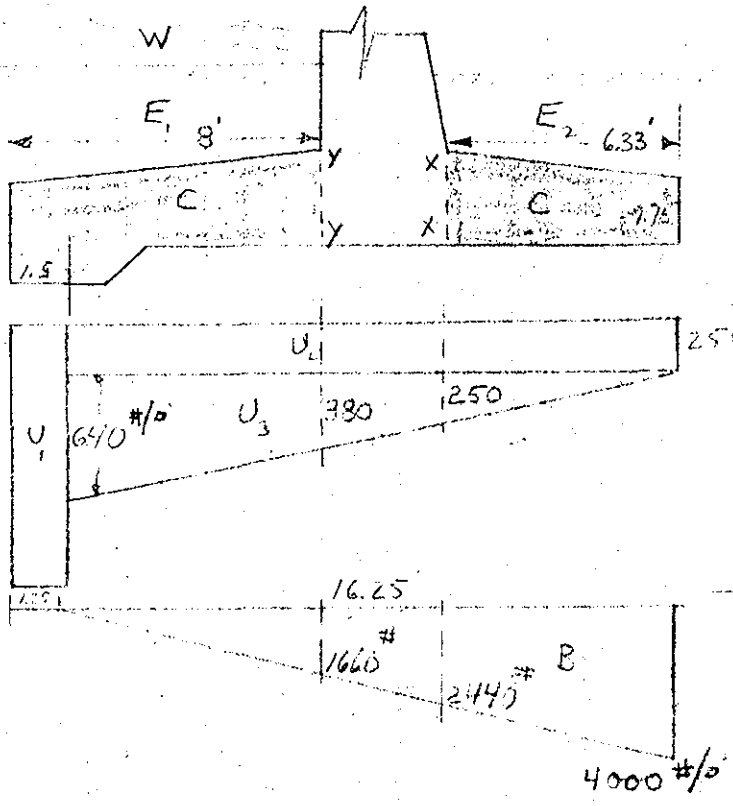
## Design of base




moment at x-x

$E_2 = 6.33 \times 16 \times 100 = 10{,}100 \times 3.16 = 31{,}900$
$C_1 = 1.75 \times 6.33 \times 150 = 1{,}670 \times 3.16 = 5{,}260$
$C_2 = .75 \times \frac{6.33}{2} \times 150 = 356 \times 2.1 = 750$
$12{,}126^{\#}$ $37{,}910^{\#}$

$U_2 = 250 \times 6.33 = 1580 \times 3.16 = 5{,}000$
$U_3 = 250 \times 6.33/2 = 790 \times 2.1 = 1{,}660$
$B_1 = 2440 \times 6.33 = 15{,}500 \times 3.16 = 49{,}000$
$B_2 = 1560 \times 6.33/2 = 4{,}950 \times 4.2 = 20{,}800$
$22{,}820^{\#}$ $76{,}460^{\#}$

$\Sigma V = 10{,}634^{\#}$ $\Sigma M = 38{,}550^{\#}$

$A_s = \frac{38{,}550 \times 12}{18000 \times .884 \times 21} = 1.39^{\square''}$ O.K

moment at y-y

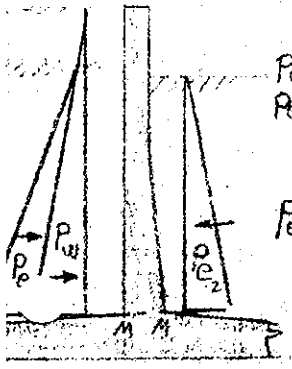
$E_1 = 8 \times 18 \times 125 = 18000 \times 4.0 = 72{,}000$
$C_1 = 3 \times 1.75 \times 150 = 2100 \times 4 = 8{,}400$
$C_2 = .75 \times 8/2 \times 150 = 450 \times 2.6 = 1{,}070$
$C_3 = 3 \times 1 \times 150 = 450 \times 6.5 = 2{,}920$
$21{,}000^{\#}$ $84{,}390^{\#}$

$U_1 = 1530 \times 1.5 = 2300 \times 7.25 = 16{,}700$
$U_2 = 630 \times 8 = 5040 \times 4 = 20{,}160$
$U_3 = 260 \times 8/2 = 1040 \times 5.3 = 5{,}500$
$B_1 = 1660 \times 8/2 = 6640 \times 2.7 = 18{,}000$
$15{,}020^{\#}$ $60{,}360^{\#}$

$\Sigma V = 5900^{\#}$ $\Sigma M = 24{,}030^{\#}$

$A_s = \frac{24{,}030 \times 12}{18000 \times .884 \times 21} = .86^{\square''}$ O.K

## Design of stem




moment at M-M

$P_w = 21^2 \times \frac{1}{2} \times 62.5 = 13800 \times 7 = 96{,}600$
$P_e = 17.5^2 \times \frac{1}{2} \times 17.5 = 2680 \times 5.8 = 15{,}600$
$16{,}480^{\#}$ $111{,}600^{\#}$

$P_{e_2} = 15.5^2 \times \frac{1}{2} \times 35 = 4200^{\#} \times 5.2 = 21{,}800$
$\Sigma H = 12{,}280^{\#}$ $\Sigma M = 89{,}800^{\#}$

$A_s = \frac{89{,}800 \times 12}{18000 \times .884 \times 34} = 2.0^{\square''}$

Shear and bond O.K.

ect East Hartford, Conn.
mputation R. R. Stop Log Structure
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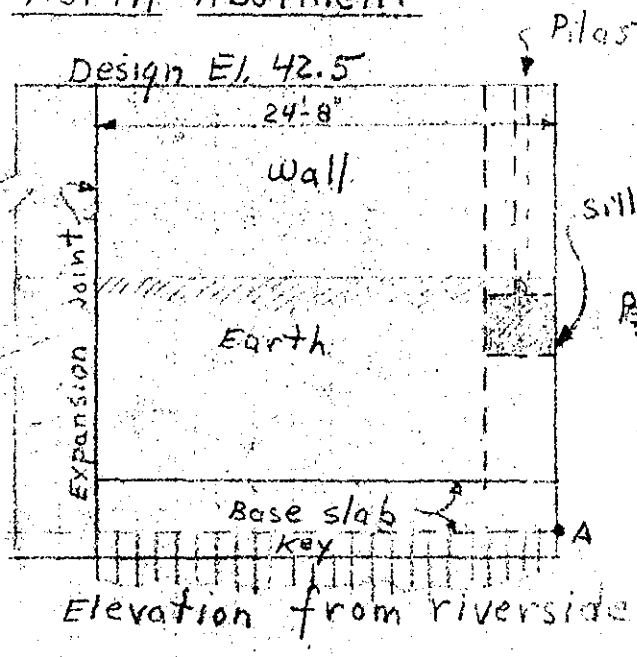
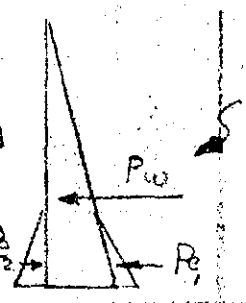
## Effect of Stop logs on abutments

### North Abutment




Push on wall from 12' of logs ($\frac{1}{2}$ of 24' span)

Take moments about "A":

$P_w = 15^2 \times \frac{1}{2} \times 62.5 \times 12 \times 13 = 1{,}100{,}000'^{\#}$ ↻
$P_{e_1} = 5^2 \times \frac{1}{2} \times 17.5 \times 12 \times 9.67 = 25{,}300'^{\#}$ ↻
$P_{e_2} = 5^2 \times \frac{1}{2} \times 80 \times 12 \times 9.67 = 115{,}000'^{\#}$ ↻
$\Sigma M = 1{,}010{,}300'^{\#}$ ↻

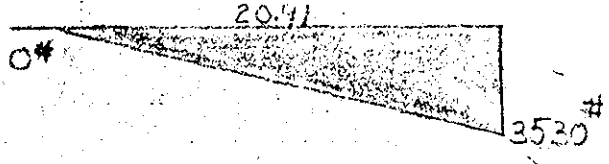
Weight of 1'-0" strip of wall = 36,900# (Page 40)

moment of wall about A
$36{,}900 \times 24.67 = 910{,}000^{\#} \times 12.33 = 11{,}200{,}000'^{\#}$

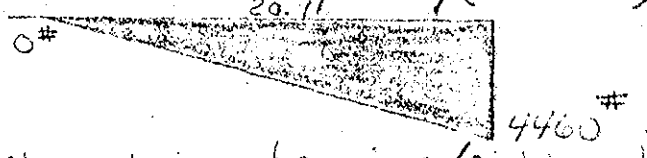
Total mom. about A = 11,200,000 + 1,010,300 = 12,210,300'#

$\frac{\Sigma M}{\Sigma V} = \frac{12{,}210{,}300}{910{,}000} = 13.4'$ from A  $13.4 - 12.33 = 1.1' = "e"$

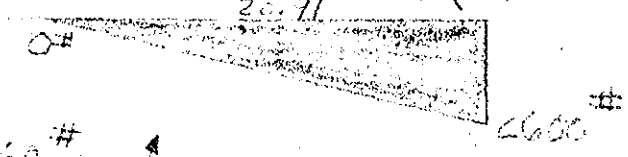
Normal bearing (Page 40)




New max. bearing (Left end)




New min. bearing (Right end)




New bearing $= 3530\left(1 \pm \frac{6 \times 1.1}{24.67}\right) = \begin{matrix} 4460^{\#} \\ 2600^{\#} \end{matrix}$

ect East Hartford, Conn.
mputation R. R. Stop Log Structure
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At the right end of the base, the max. mom is not 115,300'# as shown on page 42, — it changes due to less base pressure. The figures for the bearing moment are now —

B = 2160 × 17.16 × ½ = 18500# × 5.72 = 106,000'#
B mom on page 42 = 142,000'#
difference = 38,000'#

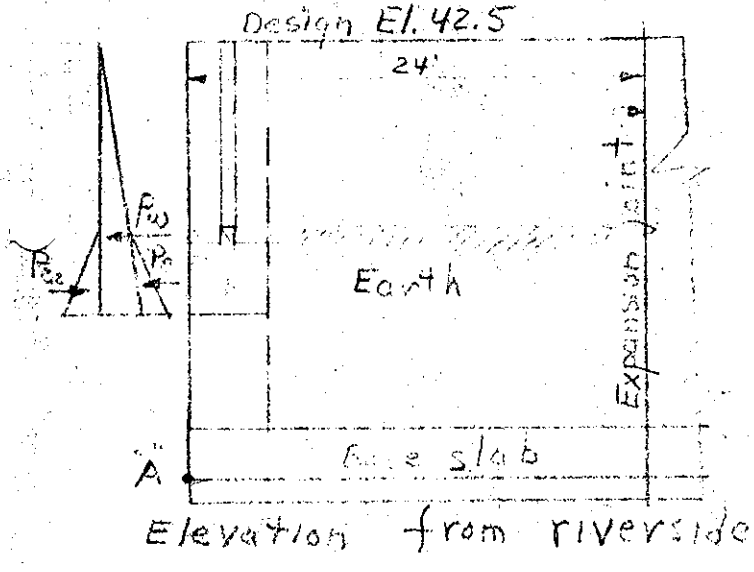
max. base mom. is now 38,000 + 115,300 = 153,300'#

$d_{req'd} = \sqrt{\frac{153,300 \times 12}{123 \times 12}} = 35''$  $d_{provided} = 36 - 3 = 33''$
Low, but O.K.

$A_s = \frac{153,300 \times 12}{18000 \times .884 \times 33} = 3.48 \square''$ at right end of base, in top of slab

The steel required in the base decreases towards the left end, due to the increase in bearing; in no case will the steel provided be less than 2.68 □" the amount required in a typical section. (See page 42)

South Abutment




Elevation from riverside

Push on wall from 12' of logs.
(½ of 24' span)

moments about "A" are the same as North Abutment, page 57
1,010,300'#

ect East Hartford, Conn.
omputation R. R. Step Log
omputed by W. S. Jr. Checked by Date 12/27/40

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South Abutment

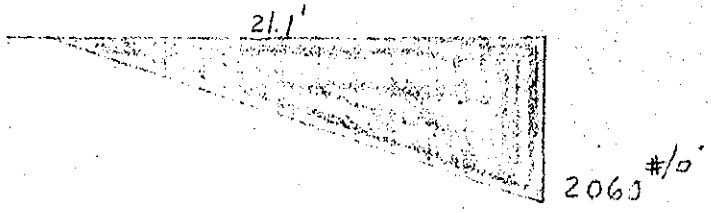
Weight of 1'-0" strip of wall = 21,800# (page 48)

Moment of wall about "A"
21,800 x 24 = 524,000 x 12 = 6,300,000'#

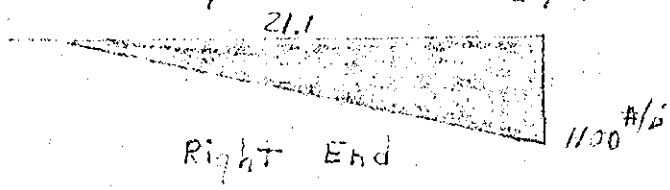
Total mom. about A = 6,300,000 − 1,010,300 = 5,289,700'#

$\frac{\Sigma M}{\Sigma V} = \frac{5,289,700}{524,000} = 10.1'$  12 − 10.1 = 1.9' = e

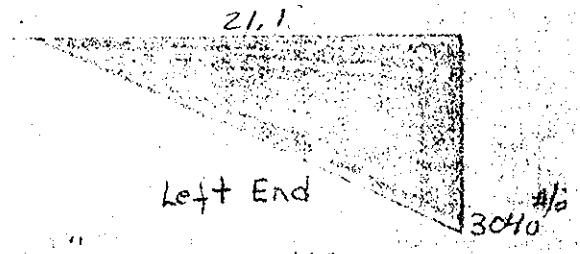
Normal bearing (Page 47)




New bearing = $2060\left(1 \pm \frac{6 \times 1.9}{24}\right) = 3040$ #/□', 1100 #/□'




Right End




Left End

Referring to "moment at x-x", page 49

$b_1$ is now 570 x 17.1 = 9800# x 8.5 = 83,000'#
$b_2$ is now 2470 x 17½ = 21100 x 11.4 = 240,000'#
323,000'#
$b_1 + b_2$ on page 49 = 219,600
difference = 103,400'#

max. base mom is now 65,300 + 103,400 = 168,700'#

$d = \sqrt{\frac{168,700 \times 12}{123 \times 12}} = 36''$  $A_s = \frac{168,700 \times 12}{18000 \times .884 \times 33} = 3.8\ \square''$

d provided = 33" low but o.k.

**WAR DEPARTMENT**

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



ect East Hartford, Conn.

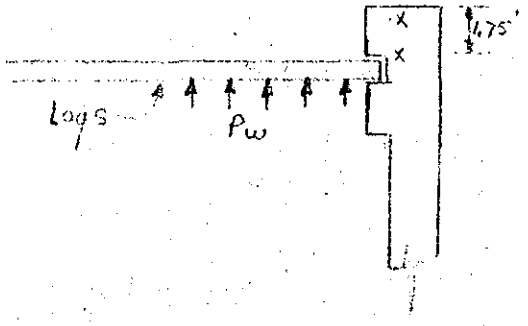
omputation R. R. Stop Log

omputed by W. S. Jr. Checked by Date 12/23/40

U. S. GOVERNMENT PRINTING OFFICE 3—10528

The steel required in the base decreases towards the right end due to the decrease in bearing; in no case will the steel provided be less than 1.6 □" the amount required in a typical section. (See page 49)

Loading on slot from stop logs.




Load on bottom log = 62.5 x 9 = 562 #/'

$562 \times \frac{19}{2} = 5330^{\#} \uparrow$

Shear across x-x = $\frac{5330}{21 \times 12} = 21^{\#/\square''}$ O.K.

Steel for direct tension = $\frac{5330}{18{,}000} = .29^{\square''}$

Seep: fins on each end are stable by inspection and comparison with other jobs. Use $\frac{1}{2}$" □ @ 1'-0" c.c. for reinforcement.

**WAR DEPARTMENT**

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



Project: East Hartford, Conn.
Computation: Concrete Piles
Computed by: W. S. Jr. Checked by: Date: 12/30/40

U.S. GOVERNMENT PRINTING OFFICE 3—10548

Concrete Piles under abutments of highway stop log structure.

Lengths are 41.5', 36', 30', and 23'.

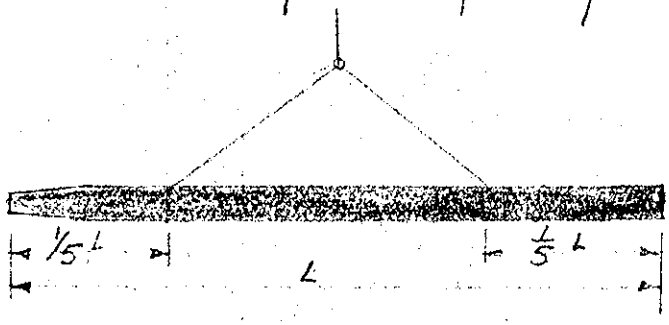
maximum load is 25 tons per pile.

Use 14" x 14" square precast piles, 196 □" = Area

$\frac{50,000}{196} = 260$ #/□" bearing, O.K.

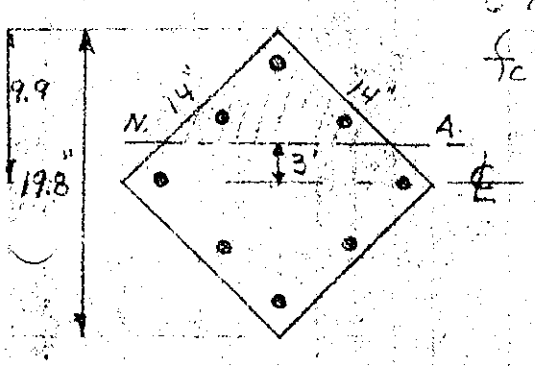
Wt. per ft. of pile $= \frac{196 \times 12}{1728} \times 150 = 204$ #/'

Use two point pile pickup.




When $L = 41.5'$ $\frac{1}{5}L = 8.3'$ $mom = \frac{wl^2}{2} = \frac{204 \times 8.3^2}{2} = 7000'^{\#}$

Assume 8 - 5/8" ⌀ bars




$f_c = 800$ $f_s = 18000$ $n = 12$

Assume neutral axis is 3" from ℄

Trial

| | | | |
|---|---|---|---|
| Concrete | = 6.9x6.9 = 47.5□" | x 5.3 = | 252 |
| Steel | = .93x11 = 10.2□" | x 5.2 = | 53 |
| Steel | = .63x12 = 7.4□" | x 0 = | 0 |
| Steel | = .93x12 = 11.2□" | x -5.2 = | -58 |
| | 76.3□" | | 247 |

$\frac{247}{76.3} = 3.2''$ O.K.

WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
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ect East Hartford, Conn.
omputation Concrete Piles
omputed by W. S. Fro Checked by Date 12/30/40

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Use 3.2" as dist from ℄ to N.A.

Moment of I

$\frac{1}{12}(2 \times 6.7) \times 6.7^3 = 337$

$3.4 \times 4.2^2 = 60$

$6.3 \times .7^2 = 3$

$7.4 \times 3.2^2 = 76$

$7.4 \times 7.1^2 = 370$

$3.7 \times 11.1^2 = 455$

$I = 1311''^2$

Resisting mom. for conc. $= 800 \times \frac{1311}{9.9-3.2} = 156,000''\#$

" " " steel $= \frac{18000}{12} \times \frac{1311}{7.9+3.2} = 176,000''\#$

Conc. governs $156,000''\# = 13,000'\#$ O.K.

Use 8-5/8 ϕ rods, this will give extra moment for impact. (Use this steel for all piles)

Use 1/4 ϕ hoops, @ 8" c.c. in body of pile, and 4" c.c. in head and nose.

This pile design is similar to that used in the "Portland Cement Co." pamphlet. The steel required checks with their tables.