REPORT ON

SUBSOIL INVESTIGATIONS

AND

FOUNDATION RECOMMENDATIONS

REPORT ON
SUBSOIL INVESTIGATIONS
AND
FOUNDATION RECOMMENDATIONS
FOR THE
NEW YORK STATE OFFICE BUILDINGS
AT THE
CAMPUS SITE
ALBANY, NEW YORK

JULY 1954

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
NEW YORK

MORAN · PROCTOR · MUESER · & · RUTLEDGE
Consulting Engineers
420 LEXINGTON AVENUE
NEW YORK 17, N. Y.

CARLTON S. PROCTOR
WILLIAM H. MUESER
PHILIP C. RUTLEDGE
PAUL M. WENTWORTH
ROBERT C. JOHNSTON

JAMES D. PARSONS
JOHN P. COONEY

July 16, 1954.

Mr. Bertram D. Tallamy
Supt., Department of Public Works
State of New York
Albany, New York

Dear Sir:

In compliance with the terms of our agreement with you dated 23 December 1953, Comptroller's Contract No. 010733, we submit our report and recommendations based on our study and analyses of subsoil conditions for the Campus Site for the proposed State Office Buildings, Albany, New York, said site lying generally northwest of Brevator Street, between Western and Washington Avenues.

PURPOSE AND SCOPE OF INVESTIGATION

The purpose of our investigation has been to determine the subsoil and geological conditions obtaining over all areas of the site; to establish predictable consolidations under land fills and structural loads; to recommend areas where contemplated structures may be installed on foundations of minimum cost as contrasted to areas of greater foundation cost for the same structure; to recommend foundation methods and types for varying structures based on comparative foundation design studies.

Therefore we have directed our studies and analyses to the major overall considerations of the suitability and general adaptability of the site for the improvements and structural installations proposed. We have given principal consideration to the problems of assured stability such that permanent, monumental type structures may receive foundation supports that will assure that differential settlements will not produce cracks or structural damage and that total settlements will be within acceptable, predetermined limits. On those fundamental premises, we have determined the comparative economies of recommended foundation types and procedures, for varying shapes and heights of structures and as foundation costs are influenced by existant subsoil conditions.

With the exception of the special consideration given to the foundation design for the Civil Service and Commerce Buildings, as defined in our interim report to you of April 21, 1954 and as amplified in our letter of June 14, 1954, our studies and analyses have not envisioned specific structures at specific locations and our recommendations as hereinafter given do not include design criteria intended for any specific structure's foundation design. As provided in our agreement with you whereby we may be called upon to prepare specific foundation designs under future contract, this report contemplates and its recommendations call for, detailed additional site investigations as a basis for definitive recommendations and design for each future structure.

To meet the criteria as above defined, our studies and analyses have included a soils laboratory testing program providing visual examination and routine tests on 32 exploratory borings, and elaborate soil mechanics tests on samples from three undisturbed borings; our study of reference literature, the geology of the site, and case history of structures supported on comparable soils in the area; interpretation of test results with particular concentration on consolidation properties of compressible soils, intensive settlement analyses including investigation of variations in building load, shape and balancing excavations at soil profile typical of the area, extensive settlement analyses including investigation of the effect of grading operations throughout this site and the effect of the variations in soil profile on building settlements; and economic studies.

CONCLUSIONS AND RECOMMENDATIONS

Based on our studies and investigations as hereinafter described and amplified in detail, we submit the following summary of our conclusions and recommendations:

Conclusions

(1) Consolidation test data indicate that the entire profile of compressible soils at the Campus Site has been preconsolidated to at least 3 tsf in excess of the existing overburden pressure for a shallow ground water table.

(2) The present position of the ground water table in the fine grained sediments has not been definitely established. This uncertainty has an important influence on possible building settlements and dictates conservative foundation designs.

(3) Long narrow structures induce minimum influence on the more compressible deep soils, such influence being a function of the width of the building.

(4) To the limits of load intensity hereinafter set forth, structures may be supported on mat foundations at no substantial economic penalty over normal foundation costs.

(5) Foundation mats may be installed on or within the windlaid sand stratum if all windlaid sand below foundation level is re-compacted, or such mats may be founded at the level of the base of windlaid sand stratum if ground water is controlled by well points or pumping to preclude hydrostatic pressures on the floor of the excavation.

(6) Excavation of basements to remove a soil weight equal to the weight of structure as a method of foundation mat installation will be controlled by the location of the structure as influenced by the thickness of sand cover over compressible soils. The sand strata will serve as distributing media to the deeper more compressible soils, hence balanced excavation should not extend into the compressible soils. Permissible weights of buildings will be controlled by thickness of sand cover over compressible soils and by the shape factor of the building.

(7) The limiting heights for structures supported on foundation mats under most ideal conditions of location, foundation design and method of installation will be such that the total load intensity of structures, including

the weight of foundations, will not exceed 1.2 tons per square foot, corresponding to a height of approximately 12 stories including basements. Lower intensities will control in many areas.

(8) Any structure whose load intensity exceeds the above defined limits must be supported on piles extending down to the deep glacial till, at costs which may prove prohibitive.

(9) Settlements of all structures may be affected by the grading operation for the site, where new fills will produce consolidations and new cuts will permit soil swell.

(10) In consideration of ideal facility for dispersion of structures over broad landscaped areas and hence the absence of demand for very high buildings or considerable concentration of load, and in view of the opportunity here presented for grading operations, site preparation to include compaction of the superficial sands and soil storage pre-loading, the Campus Site is appropriate for the purposes intended from considerations of adaptability, economy and adequate foundation support.

Recommendations

(1) That the ultimate grading operation over the site be accomplished at the earliest practicable date such that its influence may be substantially spent before building operations begin.

(2) That where future building locations can be definitely pre-established, at least one year in advance of construction, the windlaid sand deposit be recompacted, either by its removal and recompaction in thin lifts or by adequate vibrating equipment, or a combination of both, and that after such compaction of windlaid sands a surcharge be placed upon the building site of a weight at least equal to and preferably greater than that of the proposed structure.

(3) That from economic consideration all structures on this site be of maximum height and maximum load intensity such that they may be safely supported on mat foundations. This provision will require specific evaluations at sites of all future structures and furthermore that no structure have an overall weight in excess of 1.2 tons per square foot.

(4) In locations where both the windlaid sand and the water laid sand strata are relatively thick, compensating excavation may be employed and the foundation mat installed at the level where weight of excavated material equals weight of structure.

(5) Where the sand strata are thick and the surface of underlying silt deep, the windlaid sands may be removed and recompacted to receive surface mat foundations. In such soil profile locations, buildings 80' wide and of permissible heights up to 12 stories over all, reducing to 7 stories overall for buildings 200' wide may be built if subsequent ground water determination establishes the position of the ground water table in the superficial sands.

(6) No excavation for foundations should penetrate into the compressible silt deposits. Where the sand cover over compressible silts is thin and therefore only shallow compensating excavation is feasible, the building will be limited to gross weight intensity of 1/2T per sq. ft. approximating 4 stories in height.

(7) The most favorable shape of building to produce minimum settlements and for control of differential settlement is the long narrow structure when the building is articulated to effectuate independently acting units and to reduce longitudinal differential settlement, and where transverse stiffness to reduce transverse differential settlement is built into the foundations.

(8) For large heavy buildings where the length to width ratio is 2 to 1 or less, the foundation mat should be placed at a depth such that the weight of excavated soil will equal the weight of building and the substructure should be designed to incorporate the Vierendeel truss principle to reduce differential settlements. The intensity of loading for such structures will be limited by total and differential settlements determined for each such building.

(9) Completed and proposed site grading operations will induce settlement and swell. In some areas the settlements so induced equal the limiting permissible values for building foundations. Residual values of fill-induced settlements and swells must be superimposed on foundation settlement computations. Buildings placed partially over fill and partially over cut will induce maximum differential settlements. Therefore most careful consideration must be given to selection of building sites and choice of foundation design, with detailed evaluation and study in each case.

INFORMATION AVAILABLE FOR THIS STUDY

The following information was made available to us for use in our investigation.

Information Obtained from The New York State Dept. of Public Works

1. Logs and soil samples of 32 dry sample borings made by the New York State Department of Public Works and the Giles Drilling Corporation between June 1953 and May 1954.

2. Results of seismic investigations made by the New York State Department of Public Works.

3. Plan of campus site showing surface features and contours of surface elevation as of 1948 entitled "General Plot Plan".

4. "Master Plan for the Development of the Site for State Office Buildings in Albany", report prepared by Charles H. Sells - Skidmore, Owings & Merrill in 1951.

5. Tentative Grading Plan by C. H. Sells showing proposed final grade, and Revised Profiles Drawings Nos. 53-111 to 53-115 showing finished grades in southeastern portion of the site.

6. Preconsolidation test data from nine sites in the Albany area investigated by the New York State Department of Public Works.

7. Plasticity limit data from 14 sites in the Albany area investigated by the New York State Department of Public Works.

8. Map of location of sites in Albany area investigated by the New York State Department of Public Works.

Information Obtained from Moran, Proctor, Mueser & Rutledge Files on Projects in the Albany Area

1. Time-settlement observations on the State Office Building in Albany, New York.

2. Time-settlement observations on the New York Telephone Company Building in Albany, New York.

3. Investigation of retaining walls at Veterans' Administration Hospital at Albany, New York.

Undisturbed Sample Borings

1. 59, 3-inch diameter fixed piston type undisturbed samples obtained from three undisturbed borings made by the Gow Division of Raymond Concrete Pile Company.

2. Logs of the three undisturbed borings prepared by our Resident Engineer, Mr. Edward Sanel.

Information on Lake Albany Clays and Behavior of Structures in Albany Available in Reference Literature

1. A. Casagrande, "Structure of Clay in Foundation Engineering", BSCE-"Contributions to Soil Mechanics 1925-1940" pp. 73-126.

2. G. W. Glick, "Rigid Rectangular Frame Foundation for Albany Telephone Building", ENR, Nov. 27, 1930.

3. G. P. Tschebotarioff, J. R. Schuyler "Comparison of the Extent of Disturbance Produced by Driving Piles into Plastic Clay to the Disturbance Caused by an Unbalanced Excavation", 2nd International Soils Conference Proceedings Vol II, pp. 199-205, 1948.

4. G. W. Glick, "Foundations of the New Telephone Building, Albany, N. Y.", 1st International Soils Conference Proceedings, Vol. I, pp. 278-294, 1936.

5. Various Bulletins of the New York State Museum, Department of Education, relating to the glacial geology of the Capital District.

ILLUSTRATIONS ACCOMPANYING THIS REPORT

The following drawings and photographs illustrate the studies discussed in this report. They are bound in the order listed following the text of the report.

Drawing No. 1 - Boring Location Plan

Drawing GS-1 - Geological Sections AA, BB, CC

Drawing GS-2 - Geological Sections DD, EE, FF

Drawing GS-3 - Geological Sections GG, HH, LL, MM

Drawing GS-4 - Geological Sections II, JJ, KK

Drawing No. 2 - Contours of Surface of Glacial Till

Drawing No. 3 - Contours of Thickness of Varved Clay Formations

Drawing No. 4 - Contours of Ground Water Elevation

Table I - Summary of Laboratory Test Data, Boring 8U

Table II - Summary of Laboratory Test Data, Boring 16U

Table III - Summary of Laboratory Test Data, Boring 25U

Drawing No. 5 - Soil Properties Profile, Boring 8U

Drawing No. 6 - Soil Properties Profile, Boring 16U

Drawing No. 7 - Soil Properties Profile, Boring 25U

Drawing No. 8 - Plasticity Chart

Drawing No. 9 - Summary of Pressure-Void Ratio Diagrams, Brown Silty Clay

Drawing No. 10 - Summary of Pressure-Void Ratio Diagrams, Gray Clay and Pink Clay

Drawing No. 11 - Summary of Pressure-Void Ratio Diagrams, Varved Brown Gray Silty Clay and Brown Silt

Drawing No. 12 - Summary of Pressure-Void Ratio Diagrams, Blue Gray Silty Clay

Drawing No. 13 - Photographs of Thin Sections of Varved Clays

Drawing No. 30 - Gradients of Differential Settlements

Drawing No. 31 - " " " "

Drawing No. 32 - Contours of Settlement and Swell Due to Grading Operations

Drawing No. 33 - Contours of Settlement at Center of 60' x 400' Building Loaded to 1 tsf.

Drawing No. 34 - Depth to Top of Varved Brown Silt from Final Grade.

Drawing No. 35 - Cost Studies - Balancing Excavation -Silt Deposit Near Surface

Drawing No. 36 - Cost Studies - H-Pile Foundation - Shallow

Drawing No. 37 - Cost Studies - Excavation and Recompaction - Silt Deposit Deep

Drawing No. 38 - Cost Studies - Balancing Excavation - Silt Deposit Deep.

Drawing No. 39 - Cost Studies - H-Pile Foundation - Deep

Drawing No. 40 - Cost Studies - Pre-load

Drawing No. 41 - Cost Index Graph

Drawing No. 42 - Contours of Estimated Pile Lengths

Drawing No. 43 - Mat Foundations - Location of Maximum Building Heights.

The following plates summarizing consolidation test data are included at the end of the report.

Plate 1 - Consolidation Test Curves-Boring 8U, Sample 5U, Brown Silty Clay

Plate 2 - Consolidation Test Curves, Boring 8U, Brown Silty Clay

Plate 3 - Consolidation Test Curves, Boring 8U, Sample 8U, Brown Silt

Plate 4 - Consolidation Test Curves, Boring 8U, Sample 11U, Brown Silty Clay

Plate 5 - Consolidation Test Curves, Boring 8U, Sample 13U, Gray Clay

Plate 6 - Consolidation Test Curves, Boring 8U, Sample 15U, Varved Gray Clay and Brown Silty Clay

Plate 7 - Consolidation Test Curves, Boring 8U, Sample 18U, Blue Gray Silty Clay

Plate 8 - Consolidation Test Curves, Boring 16U, Sample 2U, Brown Silty Clay

Plate 9 - Consolidation Test Curves, Boring 16U, Sample 11U, Gray Clay

Plate 10 - Consolidation Test Curves, Boring 16U, Sample 13U, Brown Silty Clay

Plate 11 - Consolidation Test Curves, Boring 16U, Sample 17U, Gray Brown Silty Clay and Clayey Silt

Plate 12 - Consolidation Test Curves, Boring 16U, Sample 19U, Blue Gray Silty Clay

Plate 13 - Consolidation Test Curves, Boring 25U, Sample 5U, Brown Silt.

Plate 14 - Consolidation Test Curves, Boring 25U, Sample 13U, Gray Clay

Plate 15 - Consolidation Test Curves, Boring 25U, Sample 13U, Brown Silty Clay

Plate 16 - Consolidation Test Curves, Boring 25U, Sample 14U, Pink Clay

Plate 17 - Consolidation Test Curves, Boring 25U, Sample 19U, Gray Brown Silty Clay and Clayey Silt,

GEOLOGICAL HISTORY OF THE AREA

The deposits overlying bedrock at the Campus Site are predominantly of glacial origin dating from the most recent, Wisconsin stage, and may be as young as 10,000 years in age. Before the southerly movement of the glaciers, the area was occupied by an irregular surface of moderate relief in soft shales eroded by water courses adjusted to the level of the deep gorge of the Hudson River. The Campus Site overlies the western slope of the pre-glacial Colonie Channel in the shales at a point northeast of its intersection with the Mohawk Channel.

In their southern advance the ice masses plastered till and boulder clay in varying thickness on the shale surface. One high mound of glacial till encountered in explorations at the site may have originated as a drumlin.

The melting of the ice and the recession of glaciers from the area exposed the irregular till deposits, probably at a lower elevation with respect to sea level than at present. An obstruction of the Hudson River, most likely a remnant ice tounge in the gorge plus outlying moraines, dammed the drainage normally escaping by this route to the sea. As a consequence there formed in the region an extensive and nearly continuous body of water, known as Lake Albany, occupying an elongated triangle extending from just west of Schenectady to about two miles east of the Hudson and a number of miles south of the present Mohawk along the Hudson. Melt waters pouring into the lake carried loads of fine grained particles which were deposited as deltas extending outward from the points at which the rapidly flowing streams entered the lake. The principal delta was that of the Mohawk River which issued into the lake several miles west of Schenectady on the line of its present course. This source is presumed to have furnished sediments to the area between Schenectady and Albany including the Campus Site. The materials probably were derived from the products of erosion by ice and redeposition of the argillaceous rocks in the Mohawk's drainage area. The most extensive Mohawk deposition occurred during its flooded or "Iroquoian" when it carried the entire drainage of the eastern Great Lakes of that time. The appearance of samples recovered from borings at the site suggest that at some intermediate stage of lake filling density currents flowed over the delta eroding channels causing slides and disturbance of the soft sediments.

With the further retreat of the ice masses the southern slopes of the Adirondacks became freed of ice and the streams tributary to the Mohawk from the north contributed loads of coarser materials derived from gneiss and other crystalline Pre-Cambrian rocks. As the Lake Albany deposits became thicker and the depth of water shallower the sandy materials advanced outward on the delta forming an upper stratum of increasing coarseness. Periodic changes in the flow interlayered in the sand thin varves of silt and clay which became less numerous as the sediments rose.

When the runoff of glacial water subsided sands were exposed over the Lake Albany area. In post-glacial times the wind moved surface sands southeastward on the Mohawk delta, denuding a flat area at South Schenectady and piling dunes and drifts to form the irregular topography of the surface immediately northwest of Albany. The principal recent erosive activity has been headward gullying from the main water courses. There is no evidence of general erosion at the Campus Site. Instead, transportation by the wind has added material on top of the Lake Albany deposits. As an isostatic adjustment to removal of the ice load, the land in the Lake Albany area has risen with respect to sea level. There is no evidence to indicate that the water level in the fine grained lake sediments has been at a lower level in the past than it is at the present time.

SUBSURFACE EXPLORATION PROGRAM

Boring Program

In order to accurately define the subsurface formations at the Campus Site, thirty-five borings were made in the area. These borings were referenced to a grid system whose origin lies at the intersection of Washington Avenue and Brevator Street at the southeastern corner of the site. The holes were spaced at intervals of approximately 600 feet with a few additional ones located near the proposed Civil Service Building. The boring layout is shown on Drawing No. 1, "Boring Location Plan". The average depth of all thirty-five borings was 195 feet. Twenty-seven of them were carried through the sands and clays and extended into the glacial till to a depth sufficient to establish the character of the till. Eight borings were made through the glacial till and into the bedrock to a depth sufficient to determine its character and soundness.

Three borings of the former group were of the undisturbed type from which 3-inch diameter samples were secured with a fixed piston sampler thereby minimizing disturbance due to the sampling operations. The undisturbed borings were made under the supervision of our Resident Engineer, Mr. Edward Sanel. These borings, Nos. 8U, 16U and 25U, were located at three widely spaced points to obtain samples representative of the soils at all depths and to enable us to determine variations in physical properties of the soils over a significant portion of the site.

The remaining thirty-two borings were of the ordinary dry sample type from which samples were obtained at five foot intervals by a 2-inch diameter spoon sampler. The spoon was forced into the soil by blows from a drop hammer. The number of blows required to drive the spoon one foot is termed the penetration resistance and is taken as an indication of the compactness of the layer sampled. All the dry sample borings were made under the supervision of the New York State Department of Public Works.

Seismic Survey

During the exploratory program, a seismic survey was performed at our request by the Bureau of Soil Mechanics of the New York State Department of Public Works in an attempt to determine the elevations of the surface of the glacial till and shale underlying the Campus Site. A few seismic points were run at boring locations to give an indication of the margin of error to be expected in the seismic data. Examination of the results indicated that the depth to bedrock could be determined to within five feet by seismic methods but extreme caution would have to be exercised in interpolating between seismic points because of the irregularity of the bedrock surface. The seismic survey was unable to define the depth to glacial till within the limits needed for this investigation. Therefore, all borings were extended into the glacial till.

GENERAL SUBSOIL CONDITIONS

The subsoil formations at the Campus Site determined from the results of the exploratory and undisturbed sample borings are shown on the geological sections, Drawings GS-1 through GS-4. These sections also show the bedrock surface as encountered in eight borings and as outlined generally by the seismic survey of the New York State Department of Public Works. The locations of the sections are given on Drawing No. 1, "Boring Location Plan". The major north-south sections are Sections AA and BB on Drawing GS-1, and DD and EE on Drawing GS-2. North-south Sections CC and FF intersect smaller portions of the site. Sections GG and HH in the east-west direction, shown on Drawing GS-3, cover the south end while Sections LL and MM on the same drawing pass through the north end of the site. Sections II, JJ and KK on Drawing GS-4 are east-west sections across the central portion of the site. In general, the ground surface slopes east to west from a high of approximately Elev. +260 along Washington Avenue to a low of Elev. +220 east of Western Avenue. There is no significant general slope in the ground surface in a north-south direction. The entire area is broken by numerous topographic irregularities consisting of dunes, ponds and swamps.

The major divisions of the soil profile are summarized in sequence of depth as follows:

Windlaid Sands

A. The greater part of the surface of Campus Site is covered with a deposit of reddish brown fine to medium sand containing a trace of silt, shown in red on the geologic sections. This material was wind-drifted southeastward on the Mohawk Delta following recession of the glaciers and exposure of the Lake Albany deposits. The irregular topography of dunes, drifts and ponds reflects the shifting of sands by wind action. This windlaid sand is loose in its natural state with penetration resistance increasing with depth and averaging 7 blows per foot. It varies greatly in thickness from a maximum of 26 feet and is entirely absent in some areas. Its bottom surface ranges from Elev. +240 on the eastern edge of the site to Elev. +225 in the central and western portions. The grading program includes leveling the dunes and filling the ponds and swamps with this material.

Glacial Lake Deposits

B. Underlying the dune sand is a layer of brown silty fine sand 5' to 27' thick, extending to an average elevation of ±225, colored yellow on the geologic sections. Occasional varves of brown sandy silt and clay in samples of this material indicate its origin as a waterlaid deposit. This sand is loose to medium compact with penetration resistance averaging 11 blows per foot and was found to be sensitive to any type of vibration in the boring operations.

C. Directly beneath the silty fine sand and extending to an average elevation of +170 is a layer of varved brown silt containing some thin layers of brown silty fine sand and brown and gray clay, colored brown on the geologic sections. The thickness of this layer averages 50' and varies from 70' at Boring No. B22 to 14' at Boring No. B1. Within the formation concentrations of sands and clays were found, whose locations are indicated on the geological sections by appropriate symbols for these materials. The maximum thickness of the individual clay varves was less than 1" and the average thickness of all varves was less than 1/2". The clays recovered in undisturbed samples of this formation were very brittle. In comparison with the underlying varved clays it has considerably larger percentages of fine sand and silt and is a much less plastic material.

D. Beneath the brown silt stratum and extending to the glacial till is a thick formation of varved brown silty clay with some thin layers of brown silt and gray clay, colored orange on the geological sections; and a relatively thin stratum of varved blue gray silty clay with occasional thin layers of gray clay and blue gray silt, shown in blue on the sections. These clay strata include some concentrations of brown silt and blue gray silt as indicated on the geological sections. The upper surface of the clay is at a rather uniform elevation, averaging +170 but its total thickness varies greatly because of the irregular surface of the underlying glacial till. The general variation in total thickness of this layer is shown on Drawing No. 3, "Contours of Thickness of Varved Clays".

Glacial Till

E. The base material on which the Lake Albany varved silts and clays have been deposited is a compact glacial till, shown in green on the geological sections. The till varies from a sand and gravel with clay binder to a boulder clay with rock fragments and at many points it was necessary to core drill to advance the boring in this material. The extreme variability in the elevation of its upper surface is shown on the geological sections and is illustrated by the pattern of Drawing No. 2, "Contours of Surface of Glacial Till". This drawing shows a relatively high and steep mound of till cresting at a depth of approximately 90' below ground surface near the proposed location for the Civil Service Building. From this height the surface of the glacial till slopes downward sharply to below Elev. 0 in the southeast corner of the site and to Elev. +20 in the west central portion. The thickness of till over bedrock also varies greatly ranging from less than 10' in some northern portions of the site to over 100' in the south central areas. Except at the hill in the glacial till surface and an upslope in the northwest corner of the site, the wind and waterlaid deposits over the till are generally 200' or more in thickness.

Bedrock

F. The bedrock underlying the entire Campus Site is shale. The shale was cored in 8 borings with moderately good percentages of recovery. The borings, the seismic survey and the bedrock geology of the area all indicate that the buried rock surface is irregular and has been dissected by pre-glacial water courses. Geological studies show bedrock below Elev. -100 less than a mile south of the Campus Site. Within the Campus Site there appears to be no definite relationship between elevations of the bedrock surface and the thickness of glacial till overlying the shale.

Below the waterlaid brown silty fine sand the distinctive Lake Albany varved silts and clays extend for depths varying from 80' to over 200'. Because of the varved character of this thick compressible deposit, our laboratory investigations as far as practicable have been made on the materials constituting individual varves. By testing the materials within the varves and by determining the percentage thickness of varves of each soil type in the entire stratum it has been possible to estimate the physical properties of the gross soil profile of varved materials. For this reason the laboratory program discussed in sections to follow is designed to identify the materials within the varves and to determine the properties of each type.

GROUND WATER CONDITIONS

Observations of ground water levels were made in all 35 borings of the exploratory program at the Campus Site. The elevations measured are noted and contoured and the principal bodies of open water located on Drawing No. 4, "Contours of Ground Water Elevations". The water table parallels the general surface topography and lies in the upper sand strata at an average depth of 7 feet. It slopes west to east from about Elev. +255 on Washington Avenue to Elev. +230 in the low swampy area on Western Avenue. Several of the ponds form mounds on the water table while the swamps and marshes are in ground water depressions.

Our laboratory test results plus test data supplied by the Bureau of Soil Mechanics of the Department of Public Works indicate that at some past time the water level was as low as Elev. +140 to 160 in the varved brown silty clay stratum at the Campus Site. There is no geological evidence to suggest that water levels have risen from a low in ~~immediate~~ post-glacial times to a high level at the present. On the contrary, it appears that the effect of isostatic uplift of the land would be to continuously lower the water table with respect to the ground surface. In two borings, Nos. 9 and 25U, observations were made while the casing extended through the upper permeable sands which indicated water levels substantially lower than those present in the sands. These readings were not continued over a sufficient time to measure accurately the equilibrium water levels in the varved clay. However, they support the possibility that the water table in the clay is still depressed to its lowest past elevation deduced from consolidation test data. Such a depressed water table could be maintained separate from the shallow one observed in the upper sands by the low vertical permeability of the intervening varved brown silt stratum. This possibility has a significant effect on the settlement of buildings at the site and it has been evaluated in our settlement analyses. To resolve the uncertainty it would be desirable to install piezometers deep in the varved clay sealed against any contact with the shallow water table in order to measure pore water pressures in the compressible materials.

LABORATORY TESTING PROGRAM

All undisturbed and dry samples obtained in the boring operations were shipped directly to our soils laboratory for examination and testing. The testing programs for both groups of samples are summarized in the following section.

Undisturbed Samples

Fifty-nine 3-inch diameter undisturbed samples were obtained in the three undisturbed Borings Nos. 8U, 16U and 25U at the Campus Site. These samples, approximately 24 inches in length, were sealed with paraffin and capped to prevent drying in shipment. Upon arrival in our laboratory the samples were cut into 6-inch sections, extruded and subjected to classification and physical properties tests. The identification and classification tests consisted of visual examination and determinations of natural water content and density, plasticity limits and specific gravity of soil solids. The only physical property test performed in this investigation was the consolidation test.

Tables I, II, and III list the basic data of all the laboratory tests performed on undisturbed samples from Borings Nos. 8U, 16U and 25U, respectively. The results of the consolidation tests are presented as pressure void-ratio diagrams and time-compression curves in Plates 1 through 17 at the end of the report.

Visual Examination - Each sample was carefully examined and a detailed description recorded. Individual silt and clay varves were classified and their thicknesses measured so that the percentage of each soil type in the samples would be available for the appraisal of the properties of entire stratum.

Natural Water Content Determinations - The natural water content of a soil expressed as a percentage of its dry weight assists in grouping soils of similar plasticity and compressibility characteristics. Water content tests were made on the materials as they were removed from the sample tubes. Since the samples were sealed against drying in shipment, these water contents are assumed to be representative of the in-place condition.

Plasticity Limits - The liquid limit and plastic limit of a soil show the range of water content over which the soil is plastic. The plasticity limits assist in separating soil groups having similar consolidation characteristics, and when combined with their natural water contents, provide an estimate of the relative magnitude of stresses applied to the soil in the past. Plasticity limit tests were performed on typical samples of every soil type.

Specific Gravity of Solids - The specific gravity of the soil solids is necessary for computing natural unit weights of saturated soils from their water contents. Specific gravities were determined for representative samples of each compressible soil.

Natural Densities - The unit weights of typical samples of the brown silty fine sands overlying the varved brown silts were determined for use in overburden pressure computations and as an aid in estimating the compactness of these sands.

Consolidation Tests - Past experience with the Lake Albany clays has indicated that the principal foundation problem arises from settlements due to volumetric consolidation under net stress increases. The most reliable basis for a settlement prediction is the volume change - applied stress relationship obtained from consolidation tests on undisturbed samples of the compressible materials. Seventeen consolidation tests performed on the silt and clay varves were distributed among the soil types as follows:

Summary of Consolidation Tests

Compressible Stratum	Individual Varve	Number of Tests
Varved brown silt	Brown silt	2
	Brown silty clay	5
	Gray clay	1

Varved brown silty clay	Brown silty clay	1
	Gray clay	4
	Gray brown silty clay and clayey silt (varves distorted)	2
Varved blue gray silty clay	Blue gray silty clay	2

The consolidation tests were equally divided among the three undisturbed borings and the test samples were spaced in depth to assure a preconsolidation profile for each boring. Great care was taken in selecting the test specimen in order that each test result would represent the properties of a single varve and not a combination of different varves.

Photographs of Varved Clays - Photographs of thin vertical slices of the varved clays taken after drying to the point of maximum color contrast are given in Drawings Nos. 13 and 14. The rapidly drying sands and silts are light in color as compared to the slow drying clays. The photographs of Sample 16U, Boring 8U; Sample 16U, Boring 16U; and Sample 17U, Boring 16U, illustrate the distortion probably caused by movements in the lake bottom during deposition. This natural disturbance was noted in each of the undisturbed borings at approximately the same depths.

Disturbances Due to Sampling and Shipment - As even the best "undisturbed" samples are somewhat disturbed, it is essential to estimate the amount of damage that may have occurred to the sample to consider its effect on the laboratory test results.

The thin tube samples of the varved brown silty clay were received in the laboratory in excellent condition. The edges of the varves show very little drag or curvature resulting from forcing the sampling tube into the soil. The absence of disturbance is disclosed by the five photographs of the horizontally varved materials. Consolidation tests on the clays corroborated this conclusion.

The thin tube samples of varved brown silt and brown silty fine sand arrived in the laboratory in various stages of disturbance. All samples with high percentages of sand contained free water and void spaces where the sand had been vibrated to a more dense state. The silts were slightly disturbed but very little free water was present. The thin varves of clay in the silt were very brittle and consolidation tests indicated relatively small amounts of disturbance. However, the consolidation test curves showed that the clay varves swelled while in the sample tubes by absorbing water from the more easily disturbed silt. These observations indicate that any disturbance was the result of vibration and shocks during shipment and not due to faulty sampling procedure.

Dry Samples

All dry samples taken from the thirty-two exploratory borings and the dry samples taken at elevations between the thin tube samples in the undisturbed sample borings were subjected to visual examination and water content determinations. The types of clay varves in each sample and their percentages were noted and water contents determined for varves of sufficient thickness for a test. These data for the varved brown silt formation and for the varved brown clay and blue gray silty clay strata have been averaged at each boring. The averages are summarized at each boring location in the plan of Drawing No. 15.

SIGNIFICANCE OF LABORATORY TESTS RESULTS

On the basis of identification, classification and consolidation tests, the individual materials of the Lake Albany deposits were divided into the following soil types, listed in the order of greatest to least compressibility, plasticity and natural water contents:

- Gray clay, including occasional pink clay
- Brown silty clay
- Blue gray silty clay (properties overlapping with brown silty clay)
- Gray brown silty clay and clayey silt (varves distorted and materials mixed)
- Brown silt and blue gray silt
- Brown silty fine sand

The plasticity chart of Drawing No. 8 presents a plot of results of the Atterberg limit determinations, values which reflect the percentages and toughness of the colloidal fractions in the plastic soils. The test results fall near a straight line parallel to and above the A-line at almost the exact position and range assigned to other glacial lake clays of the northern United States and Canada. This alignment of values indicates that the same parent materials, conditions of weathering and of sedimentation have been involved in the formation of all the clays in the Lake Albany deposits. Only the gray clay can be classified as a CH clay of high compressibility and plasticity. The other plastic materials are CL clays of low to medium compressibility and plasticity. Within this latter broad category there is overlap of limits between the individual soil types but the grouping is fairly distinctive. Both of the silts encountered are non-plastic and have the appearance and physical characteristics of rock flour.

The distinctions between soil types are clearly apparent in the profiles of natural water contents for the three undisturbed borings in Drawings Nos. 5, 6 and 7. Except where they reflect large past stresses, the natural water contents of the gray clay range from about 47 to 55 per cent, those of the brown and blue gray silty clays from 31 to 37 per cent, the silts from 24 to 26 per cent. The gray brown silty clay and clayey silt is a composite material in which the distortion of varves have made a more exact distinction impossible. Their properties are intermediate between a silt and the brown silty clay.

The distribution of percentages of the individual soil types within the major strata at the undisturbed borings are shown graphically at the right in Drawings Nos. 5, 6 and 7. Considering relative compressibility and frequency of materials, the brown silty clay is the soil making the greatest contribution to consolidation under wide spread surface loads.

The void-ratio pressure curves derived from the consolidation tests are grouped according to soil type in Drawings Nos. 9, 10, 11, and 12. As would be expected from the difference in classification properties these soil types show fairly distinctive compressibility characteristics reflecting the plasticity of the materials. The highly plastic CH, gray clay is the most compressible material, followed by the other soils in order of their liquid limits. Relationships between compressibility and natural water content of the test specimens included within each major soil type were derived for fise in the settlement analyses.

Variations of Materials Over the Campus Site

Dry samples from the thirty-two exploratory borings were examined and tested and their constituent soils classified in the categories described above. Drawing No. 15 summarizes average water contents for the individual soil types, percentages of silt and sand in the varved brown silt layer, and the percentage of silt in the varved brown silty clay stratum determined for each exploratory boring. The residual percentages in either stratum represent the proportion of combined brown and gray clays. By applying the compressibility-water content relationships derived from the consolidation tests to the data of Drawing No. 15, the overall compressibilities of the major strata were determined at each boring on the Campus Site.

These detailed sample examinations gave no indication of a systematic variation in the composition of the major strata over the site as might be expected of a deltaic deposit. Information on this subject has been provided us by the Bureau of Soil Mechanics of the New York State Department of Public Works. Atterberg plasticity limits determined by the Bureau at 14 sites on the Lake Albany materials are tabulated in Table IV. The locations of the sites investigated are shown in Drawing No. 18. These plasticity limit tests were performed on composite samples of the varved brown silty clay which included both clay and silt varves in the test specimen. The results indicate the relative proportions of these two materials in the stratum and show clearly that the lake sediments become less silty and more clayey in a southeast direction towards Albany from the head of the Mohawk delta at Schenectady . The Campus Site does not encompass a sufficiently large area to include any discernable portion of this trend. However, the fine grained sediments at the Campus Site should be noticeably less clayey and compressible than the same strata at downtown Albany, an area known for foundation difficulties arising from consoldiation settlements.

Preconsolidation Characteristics

The consolidation tests provide data for computation of settlements due to volume change of the compressible materials under load. The semilogarithmic pressure-void ratio programs show characteristics common to those of other plastic sediments. The curves progress on a relatively flat, straight or convex slope to a point where they move sharply into a steep, straight or slightly concave section. In the flat segment the soil is being recompressed in the test at pressures lower than those it has sustained in nature. The steep section represents the range of "virgin consolidation" where the sample is loaded to greater stresses than it has experienced in situ. The boundary between these two stages is at greatest pressure to which the soil has been loaded in its natural condition, the "preconsolidation stress". Its minimum possible value is at the intersection of the recompression slope with the backward projection of the virgin compression curve. Its maximum possible value is determined from shape of the pressure -void ratio curve near the point of maximum curvature.

The estimated maximum and minimum test values of preconsolidation stresses are plotted on Drawings Nos. 5, 6 and 7 and preconsolidation profiles interpolated from these data. It is apparent that stresses of at least 3 tsf in excess of the existing effective overburden pressures were present at one time throughout the glacial lake sediments. Apparently these past stresses were produced by the lowering of the ground water table to between Elevs. +140 to 160 or to a level slightly below the base of the varved brown silt stratum. This resulted in consolidation by large effective capillary stresses above the water table and by somewhat smaller effective stresses below this level caused by the decrease in hydrostatic uplift of the overburden load. Only for the soil profile at Boring No. 16U it is necessary to assume a slightly greater height of overburden to account for the entire preconsolidation.

This quantitative evidence of the preconsolidation condition is substantiated by the profiles of natural water contents and the position of these values relative to the liquid and plastic limits, as shown on Drawings Nos. 5, 6 and 7. In the zone of dessication, particularly within the varved brown silt stratum, the plastic gray clay varves were brittle, their water contents were notably less and closer to the plastic limit than for this material at greater depths. The same characteristics were noted for the brown silty clay to a less pronounced degree. The position of natural water contents below the liquid limit throughout the deposit indicates the sediments are preconsolidated rather than normally consolidated under existing overburden pressures. There is some scattered test data to indicate that drying affected the sediments below Elev. +100, a circumstance which might be connected with an erosion process producing the distortion of varves at this depth.

Profiles of total effective stresses including the increment of pressures added by representative buildings loaded to 1 tsf are shown on Drawing No. 5. It is apparent that these added pressures fall below the preconsolidation stresses. Thus the consolidation produced by such building loads will occur as recompression in the flat segment of the pressure-void ratio curves.

The Bureau of Soil Mechanics of the Department of Public Works has provided us with a valuable series of preconsolidation test data derived from investigations of nine sites in the Lake Albany area at the locations shown on Drawing No. 18. These data are presented in Drawing No. 19 arranged in order of the position of the sites from north to south. The estimated preconsolidation stress profiles confirm that the Lake Albany deposits have been loaded at some past time under the conditions of a depressed water table which may have sloped from north to south in the sediments. Tests for the Russell Road site near the Campus corroborate a ground water lowering to Elev. +140 to 160 in this area. As at the Campus Site it is not necessary to assume that erosion has removed overburden in order to account for the preconsolidation stresses. However, since some of the sites tested are near recent erosion features this conclusion is questionable.

The geologic history and the ground water observations at the Campus Site suggest the possibility that the water table in the compressible materials is still depressed to its lowest past elevation, between Elev. +140 and 160. In this case the materials beneath this level would simply be compressed to a high existing overburden pressure and not presently under a lower effective overburden pressure than existed in the past. Then added stresses would produce a virgin consolidation of these materials and this possibility must be considered in the building settlement analyses.

SETTLEMENT ANALYSES

Scope of Analyses

A series of investigations have been made to determine the influence on consolidation settlements of the following factors:

(a) Building load,

(b) Building shape,

(c) Balancing excavation,

(d) Position of the ground water table,

(e) Variations in soil conditions over the Campus Site, and,

(f) Grading operations.

The term "balancing excavation," means that a weight of soil equal to the total weight of the superimposed building including foundations and basements is excavated and replaced by the load of the structure. The procedure in these analyses has been to investigate the effect of building shape, load and balancing excavation on consolidation at a single location typical of the site. To appraise the influence of variations in soil conditions throughout the site a typical building has been moved about the area, its settlements computed and contoured on a plan of the Campus. Consolidation and rebound resulting from grading operations were determined for the entire site independently of the settlements produced by building loads. Several years may elapse between grading and building construction and fill settlements could be substantially completed in this time, but any consolidation which remains to take place must be superimposed on settlements from building loads alone to obtain the total effect.

For the intensive investigation, settlements were computed at the center of the long side, corner and center of the following buildings, selected from the Sells-Skidmore report, placed on the soil profile of Boring No. 8U, approximately the average subsurface conditions of the site:

A. Buildings 200' x 200', 300' x 80', 400' x 60' and 600' x 80' loaded at the ground surface to 0.5, 1.0, 1.5 and 2.0 tsf gross area pressures without excavation and with the ground water level at Elev. +236 as observed;

B. Buildings 200' x 200' and 400' x 60' loaded to 0.5, 1.0, 1.5 and 2.0 tsf gross area pressures with sufficient excavation to balance these pressures, with the ground water level at Elev. +236;

C. Building 400' x 60' loaded at the ground surface to 0.5, 1.0, 1.5 and 2.0 tsf gross area pressures without excavation, and with sufficient excavation to balance these loads, assuming a ground water table depressed in the clay to Elev. +158.

To appraise the characteristics of the area as a whole, the following computations were made at each boring on the Campus Site for the subsoil conditions disclosed by these borings:

D. Settlements at the center of the 400' x 60' building loaded to 1.0 tsf gross area pressures with sufficient excavation to exactly balance this load;

E. Settlement under fills, and swell from cuts, involved in the grading operations completed in the southeast portion of the site and the grading program currently planned for the balance of the area.

Assumptions and Computation Procedures

The following assumptions and computation procedures were used in the settlement analyses:

(1) The buildings are perfectly flexible and the gross pressures are applied uniformly over the area of the building, at the ground surface without excavation, or over the bottom of the pit with excavation.

(2) To equate gross area load to height of building in stories the following schedule of building loads were assumed:

For building on the ground surface:

Foundation mat:	400 psf minimum
Permanent live load of first floor on mat:	50 psf
Dead load plus permanent live load of additional stories:	150 psf
Dead load plus permanent live load of roof:	120 psf

For building with balancing excavation:

Foundation mat:	400 psf minimum
Permanent live load of lowest basement on mat:	120 psf
Dead load plus permanent live load for each additional basement story:	200 psf
Dead load for first floor:	80 psf
Additional floors and roof taken as listed above.	

(3) For settlement analyses A., B. and C. above, the soil profile was assumed to be uniform beneath the entire area of the building and equal to that at Boring No. 8U.

(4) According to the test evidence of preconsolidation cited previously, additional stresses up to 3 tsf in excess of the existing effective overburden pressures recompress the foundation materials for the ground water conditions of settlement analyses A., B., D. and E.

(5) The recompression portions of the semi-logarithmic pressure-void ratio curves are straight lines above and below the existing effective overburden pressure. The slope of this straight line in the semi-log plot is defined by the value, C_r, the recompression index. Recompression taking place under the building load after balancing excavation is assumed to equal exactly the swell accompanying excavation.

(6) A characteristic ratio of C_r, to natural water content was determined for individual soil types from an examination of the recompression and rebound slopes of the pressure-void ratio curves. These ratios were found to be the following:

Material	C_r/ Natural water content
Gray Clay	0.23
Blue gray silty clay	0.27
Brown silty clay	0.20
Brown silt	Independent of natural water content, C_r= 0.026

All sands incompressible in volumetric consolidation.

(7) Consolidation settlements, ΔH, were computed from the expression:

$$\Delta H = 2H\left(\frac{C_r}{1+e_o}\right)\log P_2/P_1$$

where e_o = natural void ratio,
P_1 = effective overburden pressure before addition of load,
P_2 = effective pressure after addition of load and completion of consolidation,
2H = total thickness of compressible materials.

(8) A composite value of the soil parameter $\left(\frac{C_r}{1+e_o}\right)$ was determined for every major stratum of the geologic sections at each boring on the Campus Site. This composite parameter, computed from the relationships of (5) above, was based on the proportions of sand, brown silt, and brown, gray and blue-gray clay in each stratum plus the water contents of the clays, as disclosed by sample examinations and tests.

(9) In the settlement analyses C. the ground water level was taken at Elev. +158, its lowest past position according to test values of preconsolidation. Increases in stress produce a virgin compression of the materials below this elevation.

(10) For settlement analysis C. a ratio of the virgin compression index, C_c, to natural water content was determined for individual soil types from a study of the virgin compression slopes of the semi-log pressure-void curves. These ratios were as follows:

Material	C_c/Natural Water Content
Gray Clay	1.75
Blue silty clay	1.62
Brown silty clay	1.52
Brown silt	Independent of natural water content, C_c=0.11

Time-Consolidation Characteristics

The most significant information on time-consolidation characteristics of the Lake Albany clays is in the settlement record of the State Office Building in Albany. This structure incorporates at its center a 34 story tower, 130' x 130' in plan. A 24' basement beneath the tower is underlain by approximately 100' of the typical varved glacial clays. The gross area load of the tower is 4.5 tsf, reduced to a net load of 3 tsf by excavation. The time-settlement curve observed for the tower is shown on the semi-logarithmic diagram of Drawing No. 20, in terms of per cent primary consolidation. One-hundred per cent primary consolidation, equivalent to approximately 8.5" of settlement, was reached in 6 years after construction.

A study of laboratory time-consolidation curves for the brown silty clay, the dominant compressible material at the Campus Site, indicates fairly constant time-consolidation characteristics as reflected in values of the coefficient of consolidation c_v. This coefficient averages 55 ft.^{2}/year over appropriate stress increments and it is only slightly greater for a process of swell under decreasing stress. Taking c_v equal to 55 ft.^{2}/year, a theoretical time-consolidation curve is plotted in Drawing No. 20 for a 100' clay layer assuming only vertical drainage of pore water in the consolidation process. Using the same value of c_v a second theoretical time-consolidation curve is plotted which includes not only vertical but also horizontal drainage of pore water during consolidation. This latter curve is for a building with shortest dimension equal to the thickness of the compressible material, and permeability 4 times greater horizontally than vertically. The position of the two theoretical curves relative to the observed time-consolidation curve emphasizes the importance of horizontal drainage of pore water in accelerating consolidation of the thick varved clays and silts. It appears that the varved clay may be at least 20 times more permeable horizontally than vertically.

Because of the complexity of a theoretical time-settlement analysis allowing for horizontal drainage, the consolidation curve observed for the State Office Building is utilized for predicting time rates of settlement and rebound at the Campus Site. In Drawing No. 21 this curve is reproduced in terms of per cent of ultimate consolidation for a clay layer 100' thick. The possible extreme time curves for 50 and 150 foot strata are obtained from the following theoretical relationship for drainage of pore water in the vertical direction only:

$$\frac{t_{50}}{t_{100}} = \frac{(50)^2}{(100)^2}$$

where: t_{50} and t_{100} are the times required for a given per cent consolidation of 50 and 100 foot strata, respectively.

For a particular building area the accelerating influence of horizontal drainage increases with the thickness of the layer and the slenderness of the building. The solid curves representing the probable range of time rates for 50' and 150' strata are estimated within the possible extremes. There can be a considerable variation from these probable curves among the buildings considered here because of the influence of size and shape on the flow of pore water during consolidation. Consequently the estimates of time rates of settlement are only approximate and are much less reliable than the computed values of ultimate settlement.

Building Load and Shape

The results of the intensive settlement analyses at Boring No. 8U are summarized in Table V. Settlements at the center, corner and center of the long side of the four buildings placed on the ground surface at Boring No. 8U are presented as load-settlement curves in Drawing Nos. 22 to 25. Gradients of differential settlements on the long exterior walls and on the transverse axes of the buildings are plotted in Drawings Nos. 28 to 31 as inches of differential settlement per 20 feet of length versus gross area pressures. The vertical scale at the right in each of these drawings provides the equivalent of the gross area loads in the height of building in stories.

The increase of settlement with load is generally at a rate somewhat less than linear. The settlement under a particular load intensity on a uniform soil profile depends on the size and shape of the loaded area. In the consolidation process the buildings create a significant stress increase in the subsoil to a depth below the foundation 1.5 to 2 times the minimum building dimension. Consequently for the thick compressible strata at the Campus Site settlements increase with the building's minimum dimension and are rather unimportantly affected by the length of the structure. This conclusion is supported by the values of Table V which show maximum settlements for 1 tsf surface loading of 3.5, 3.9, 4.0 and 5.5 inches for the 400' x 60', 300' x 80', 600' x 80' and 200' x 200' buildings, respectively. For a given building area the more nearly equidimensional structure yields higher general settlements, and, in a perfectly flexible structure, higher differential settlements between analogous locations, than the shape with greater difference in dimensions. This fact is illustrated by a comparison of the load-settlement curves of the 400' x 60' and the 300' x 80' buildings placed at ground surface.

Differential settlements between center and corner at 1tsf load average 2.2" for the three slender buildings and equals 3.6" for the 200' x 200' building. Drawing No. 28 summarizes gradients of differential settlements of all four buildings placed on the ground surface at Borings No. 8U. Gradients of settlement on the long exterior wall decrease with building length, ranging from 0.27" per 20' for the 200' x 200' building to 0.09" per 20' for the 600' x 80' building at 1 tsf. In every case the gradient of settlements between center of the building and center of the long side is larger than the gradient on the long exterior wall. The slope of the settlement profile on the transverse axis does not differ greatly among the shapes considered here but increases somewhat with the slenderness, ranging at 1 tsf from 0.44" to 0.54" per 20' for the 200' x 200' and 400' x 60' buildings, respectively. The slope of the settlement profile on the short exterior wall has not been computed but is generally about two-thirds that on the transverse axis.

Balancing Excavation

To appraise the effect of balancing excavation settlements were computed at Boring No. 8U for the 400' x 60' and 200' x 200' buildings with sufficient excavation to balance their gross area loads. The compression caused in replacing the excavated soil by the building load is considered to be equal to the rebound which occurs in the period between excavation and building construction. Since the swell is a time-delayed process analogous to volumetric consolidation it is necessary to estimate what proportion of the ultimate rebound will occur in this interval. The accuracy of the estimate is limited by uncertainties in the time-consolidation analysis. However, if swell occurs rapidly and a considerable percentage of the ultimate value takes place before building construction the recompression also will be rapid and will be importantly advanced before interior finishing and exterior facing are undertaken. For this analysis an eight month period is assumed between excavation and the mid-point of building construction. In eight months the soil profile at Boring No. 8U will complete 27 percent of its total potential swell according to Drawing No. 21.

Ultimate rebounds are shown in parenthesis in Table V coupled with their 27 percent values. The load-settlement curves for balancing excavation based on 27 percent rebound, are plotted in Drawing Nos. 24 and 25 for the 400' x 60' and the 200' x 200' buildings, respectively. Corresponding gradients of differentials are shown in Drawings 29 and 30. For loads less than about 1 tsf the recompression following balancing excavation is between one-third and one-half of the settlement under surface loading. As pressures rise above 1 tsf and the plane of loading is depressed closer to the compressible materials the settlements for balancing excavation increase in percentage of the corresponding values for surface loading. This tendency is especially important in its effect on the gradients of differential settlements on the transverse axes of the buildings.

Position of the Ground Water Table

As discussed previously, it is possible that the ground water table which once was as low as Elev. +140 to +160 in the clay is still depressed to this level and is isolated from the shallow water table observed in the upper sands. Then the clay below about Elev. +150 would be "normally consolidated" to a high existing overburden pressure rather than being preconsolidated. Instead of recompressing the clays below Elev. +150 the building load would produce a virgin consolidation of these materials.

Drawing No. 26 contrasts the settlement of the 400' x 60' building placed at ground surface for a water table at Elev. +236 against the values for a water table depressed to Elev. +158. Under the latter condition the general settlements are almost double those for the shallow water table. The differential settlements, contrasted on Drawing No. 31, are not as drastically increased by the change in position assumed for the ground water, since, with a depressed water table the principal source of consolidation is deep beneath the foundation at levels where the added pressures are distributed rather uniformly over the building plan.

Balancing excavation changes the consolidation of the clay below the depressed water table from the virgin compression produced by surface loading to recompression. Consequently, the balancing excavation greatly reduces the general and differential settlements from the corresponding values for surface loading as shown in Drawing Nos. 27 and 31, a percentage reduction larger than that produced by excavation under the condition of a shallow water table.

Variation in Soil Profile Over the Site

To evaluate the effect of variations in soil profile over the Campus Site settlements were computed at every boring location for the center of the 400' x 60' building loaded to 1 tsf with balancing excavation. Ground elevations were taken at the final graded surface of Drawing No. 17. Eight months were assumed as the period between excavation and building construction in which rebound from excavation would occur. Percentages of the total potential swell completed in this eight month interval were estimated for the soil profile at each boring point from the curves of Drawing No. 21. Contours of settlement of the center of the 400' x 60' buildings are plotted in Drawing No. 33 from the rebound-recompression values computed for each boring point. For the 1 tsf load the maximum settlement in the area is 2.6" compared to a value of 1.2" at Boring No. 8U, approximately the average soil profile of the site.

Settlements of other points on a 400' x 60' building cannot be taken directly from this plot but can be estimated from the results of the Boring No. 8U analysis summarized in Table V, in the following manner:

$$\text{Settlement of corner of 400' x 60' building} = \frac{0.4}{1.2} \times \left(\text{Settlement value from Drawing No. 33 at location of corner}\right)$$

Contours of depth from final grade to the top of the varved brown silt, the uppermost compressible materials, are shown in Drawing No. 34. A comparison of Drawings Nos. 33 and 34 suggests that settlements are controlled principally by the thickness of sand covering the silt and that settlements are greatest where the excavation reaches the silt. Since the building consolidates the subsoil to a depth of only about 1.5 to 2 times its width, the main contributions to the settlement of slender buildings are obtained at relatively shallow depths. Thus, for the slender buildings the thickness of sand cover is more important than the total thickness of compressible materials in its influence on settlements.

The configuration of maximum settlements of other narrow buildings loaded to 1 tsf with balancing excavation is similar to the contour pattern of Drawing No. 33. It may be inferred from the investigations at Boring No. 8U that the settlements of the 300' x 80' and the 600' x 80' buildings are about 15 per cent greater than the values shown in Drawing No. 33. The maximum differential settlements of slender buildings are found near the location of the proposed Civil Service Building. By the relationship cited above, the differentials between center and corner at this location are approximately 2" for the 400' x 60' structure, 2" for the 300' x 80' building, and 3" for the 600' x 80' building. The differential settlements are influenced by the building length since this dimension controls the amount of variation in the soil profile included beneath the foundation.

As the minimum building dimension increases a deeper soil column is stressed by the building load and the pattern of maximum settlements will reflect the contours of thickness of the clay shown in Drawing No. 3. Maximum settlements of the 200' x 200' building loaded to 1 tsf with balancing excavation are probably in excess of 3.5 inches and occur between Borings Nos. 16U and 20 where the thickness of clay is maximum and the sand cover relatively thin.

Detailed changes in the percentages and water contents of individual soil types in the varved brown silt and the brown silty clay strata are relatively unimportant within the area. No systematic influence of these factors is apparent on the pattern of settlements over the Campus Site.

Grading Operations

The site development requires an extensive grading operation to level the dunes, fill the swampy low areas and the surface drainage channels and to prepare for roads across the site. Settlements produced by fills can equal those under the load of a medium sized building. An eight foot fill constitutes a load equal to that of a four story building placed on the ground surface. A sixteen foot cut can cause a heave equivalent to the swell accompanying excavation for a nine story building. In addition grading and the installation of drainage facilities may alter existing ground water levels. This effect must be considered if it is presumed that pore pressures in the clays communicate with the shallow ground water table since a two foot depression in water level would then produce a stress increase equal to that of a foot of fill.

Our studies of the grading operations are based on profiles of the final graded surface in the southeastern portion of the site supplied by the New York State Department of Public Works and the tentative grading plan by C. H. Sells, shown in Drawing No. 17. Finished grades slope from about Elev. +265 along Washington Avenue to Elev. +230 on Western Avenue. Drawing No. 32 presents values of ultimate settlement and swell resulting from these grading operations and estimated changes in ground water level computed at each boring on the Campus Site. Contours, which are necessarily approximate, have been interpolated between boring points. Fills are generally lower in height than the cuts are deep and the fills are distributed more uniformly over wider areas. The levelling of steep dunes have produced a number of deep, concentrated cuts. In general the gradients of settlements in filled areas are less severe than the gradients of heave in many of the cuts. The principal change in ground water levels has been assumed to occur in the southeastern area where periodic flooding by storm drainage will raise the water level, reducing settlements to be caused by filling operations in this area.

Between 30 and 50 per cent of the ultimate settlements will be completed in one year after grading and from 50 to 70 per cent in two years. It may not be possible to space grading and building construction to entirely eliminate these settlements and some percentage of the values of Drawing No. 32 must be added to the consolidation under building load alone to obtain the total effect. For example, Drawing No. 32 shows that the proposed Civil Service and Commerce Buildings are located on boundaries between low cuts and fills and are not severely influenced by the grading operations. Assuming a time interval of 2 years between grading in early 1953 and the mid-point of building construction, approximately one-third of the values of Drawing No. 32 must be included in the building settlements. Accordingly, the differential settlements of the Civil Service Building will be increased by about 1/4" center to corner and differentials of the Commerce Building increased by 1/4" on the transverse axis.

BEARING CAPACITY

The settlements due to shear strain immediately beneath the foundation must be considered in addition to those settlements from deep seated volumetric consolidation. Shear strains occur with almost no time delay upon application of load and are of no serious consequence to the structure at pressures up to the "allowable bearing capacity". Settlements increase drastically with loads in excess of this limiting stress until the point is reached where the overloaded portion of the foundation loses support entirely. Considering the various foundation schemes between surface loading and balancing excavation, the following soils may contribute shear strains to building settlement: fill, windlaid sands, waterlaid sands, and the varved brown silts and clays. No laboratory determinations of the shear strain characteristics of these materials were performed on which to base allowable bearing capacities. The following recommendations are derived from our experiences with similar materials and from tests conducted for other projects in the Albany area. We believe they are in general agreement with the standards of the Bureau of Soil Mechanics of the Department of Public Works for construction in this area.

The fills included in the grading program at the site are not compacted with control of placement moisture and density. Structures should be carried through the loose fill unless it is removed from beneath the foundation and recompacted in thin lifts with quality control.

The uppermost natural soil over much of the site is the windlaid brown fine to medium sand with a trace of silt. This material generally is cohesionless and relatively loose in place. For buildings loaded up to 0.5 tsf on the dune sands, the sand should be removed and recompacted to a depth of several feet beneath the foundation. For buildings loaded at the surface in excess of 0.5 tsf the entire underlying layer of windlaid material should be removed and recompacted. In those cases where the dune sands are found beneath the water table they may be densified most efficiently by vibratory methods without requiring excavation. With these provisions the allowable bearing capacity of windlaid sands for surface loading will be 2.0 tsf, and this consideration will not limit the gross area building loads.

The waterlaid brown silty fine sand is considerably denser than the overlying dune sands and it contains a binder of silt. For foundations reaching the waterlaid sands at a distance of about half a story below ground surface, its bearing capacity is 1.5 tsf. A sufficient thickness of material directly beneath the building should be compacted to provide a uniformly firm support for the foundations.

Because of the relatively low allowable bearing capacities of these shallow sands, buildings on them will require reinforced mat foundations utilizing the entire building area for the distribution of load. Then the unit loads on shallow mat foundations placed on the sands prepared according to the above recommendations, will be limited by the magnitude of settlements from time-delayed volumetric consolidation.

Our experiences and field bearing tests on the varved brown silts and clays on sites at lower elevations in the Albany area where these materials occur near the surface, indicate that their allowable bearing capacity is approximately 1.0 tsf for surface loading. Founding structures directly upon these fine grained materials would be unwise because of the disturbance to them by construction activity.

The preceding consolidation settlement analyses indicate that compensating the weight of the structures by excavation may be desirable or necessary. In this situation the surcharge of soil remaining in place around the pit balances the shear stresses produced by the application of the building load. Then the soil supporting the foundation need provide only the necessary bearing capacity for eccentric foundation loading due to wind and transient live loads. With balancing excavation and building pressures distributed on a foundation mat the bearing capacity is not a significant factor in limiting the allowable gross area load on the structure.

DISCUSSION OF FOUNDATION REQUIREMENTS

The preceding analyses have considered separately the influence on building settlements of load, shape of structure, balancing excavation, position of the ground water table, changes in soil profile over the site, and grading operations. The height of buildings and the foundation design must be such that the consolidation settlements and the differentials from all sources do not reach values damaging to the structures. From our experiences with buildings of the type contemplated for the Campus Site, permanent, monumental structures with ornamental facades, we have established the following criteria of allowable consolidation settlements: 4 inches maximum settlement; 2 inches total differential settlement, gradients of settlements on exterior walls less than 0.25 inches per 20 feet, gradients of settlements between interior columns or between interior and exterior columns of 0.30 inches per 20 feet.

Building Load and Shape

The intensive settlement analyses for the average subsoil conditions of the site indicate that the principal influence on settlements under a given load is the minimum building dimension. Buildings up to 80 feet in width, loaded at the ground surface on the average soil profile, will exceed the allowable maximum settlements, total differentials and gradients of differentials on the exterior wall at gross area loads above 1 tsf. However, their gradients of settlements on the transverse axis exceed 0.3" in 20' at about 0.5 tsf. This conslusion indicates that transverse stiffening of the foundation is of major importance in the design of narrow buildings. Buildings 200 feet in width, loaded at the ground surface on the average soil profile, will exceed the allowable settlement criteria at gross area loads of about 0.7 tsf or at a height of 6 or 7 stories.

These analyses are conservative in one important respect since they neglect the influence of stiffness of the building frame and foundation in redistributing pressures on the foundation and in equalizing settlements. The choice of a structural design to minimize differential settlements is influenced by building shape. The settlement characteristic limiting the allowable height of slender buildings is generally the gradient of differential settlements in the transverse direction. The longitudinal gradient of differentials will become critical only if the length of the building overlies a considerable change in soil profile. For buildings narrower than about 2 to 1 in ratio of dimensions, the threat of differentials is countered most effectively by providing transverse expansion joints extending through the height of the building to segment the structure into short units, and by including transverse stiffening of the foundation and extra reinforcement of the longitudinal walls between expansion joints. Buildings more nearly equidimensional than 2 to 1 in plan are best stiffened by providing a heavily reinforced foundation mat plus sufficient moment connections in the building frame so that the mat and the frame combine as a Vierendeel truss in two directions.

Balancing Excavation

The settlement analyses of buildings at Boring No. 8U have not included the effects of grading operations and variations in the soil profile over the site. In order to insure that settlements are kept within tolerable limits when these factors are superimposed, sufficient excavation to balance all or part of the gross area load of the building may be considered. Studies for the average soil profile indicate that a balancing excavation reduces the general settlements of both the long narrow buildings and the large square building to between one-half and one-third of the corresponding values for surface loading. In this situation the limiting settlement characteristic is the gradient of differentials on the transverse axis. For the average soil profile the allowable gradient of 0.3 inches per 20 feet is exceeded at gross area loads of about 1.2 tsf on both the narrow buildings and the large square buildings. Excavations 18 to 20 feet in depth would be required to completely balance these gross area loads. Drawing No. 34 shows that in much of the southwestern portion of the site there is insufficient cover of sand above the compressible silt to permit excavations of this depth without cutting into the silt. It would be unwise to found directly upon the compressible materials since they would necessarily be disturbed by construction activity. In order that a suitable cover of waterlaid sands be available above the silt, buildings requiring excavations to balance gross area loads greater than about 0.5 tsf should not be considered for that southwestern area of the site shaded on Drawing No. 43.

Position of Ground Water Table

This analysis has not resolved the uncertainty as to the present position of the ground water table in the varved brown silty clay. Instead it has demonstrated the importance of this factor in the appraisal of building settlements. If the water table is still depressed to the low level which provided the high preconsolidation stresses evidenced in laboratory test results, the general settlements for surface loading will be doubled and the differentials very substantially increased. With the depressed water table the narrow buildings placed at ground surface on the average soil profile exceed the tolerable settlements at a load of about 0.5 tsf or a four story height.

Balancing excavation for the depressed water table affects a marked reduction in maximum and differential settlements. Under these conditions the general settlements for a 1 tsf. are only two-thirds of the contour values shown on the plan of Drawing No. 33. With balancing excavation the narrow buildings on the average soil profile exceed the allowable settlements at a load of about 1.2 tsf, the limiting factor again being the gradients of differentials on the transverse axis. For both of the possible ground water levels, the load limit is 1.2 tsf or a 10-story height with two basements for either narrow or equidimensional structures. At areas of the site where the subsoil conditions are less favorable than average, the allowable gross area loads are substantially below these limiting values.

Variation in Soil Profile

Buildings 60 to 80 feet in width cause significant consolidation of a highly precompressed soil profile to depths of only about 120 to 150 feet beneath their foundations. For this reason the character of the soil profile at shallow depths, especially the thickness of sand cover above the compressible silt, is most important in determining the pattern of settlements of narrow buildings over the site. Drawing No. 33, which presents contours of settlement of the 400' x 60' structure shows that the maximum value is double that for the average subsoil conditions at Boring No. 8U. Maximum differential settlements are two to three times as great as those on the average soil profile. Areas more favorable than average for founding narrow buildings are enclosed by contours of settlement less than 1.2" on Drawing No. 33 and are shaded on the eastern portion of the site on Drawing No. 43.

The larger equidimensional buildings will stress a deeper soil column and the pattern of equal settlements will be somewhat altered from that of Drawing No. 33. For buildings with minimum dimension as great as 200 feet, variations in total thickness of the varved clay shown on Drawing No. 3 would influence the pattern of settlements over the site. The least favorable position for a 200' x 200' building would be several hundred feet west of the location of maximum settlements on Drawing No. 33. The magnitude of settlements at this point may be somewhat less than twice those of the 200' x 200' building at Boring No. 8U while differentials may be twice as great.

Grading Operations

Ultimate settlements and swell resulting from the completed and proposed grading operations are shown on Drawing No. 32. In many areas these settlements reach the limiting values permitted under building loads alone. The greatest concentration of fill and the largest settlements are in the least favorable area for foundations, the southwestern portion of the site. Because of the loose condition of the fills it appears necessary to carry building foundations through this material or to remove and recompact it. Although this will eliminate the earth load precisely at the building location, a considerable fill surrounding a building will add to its general settlement though it will not necessarily accentuate differentials. Considering the effects of the grading operations, a building is in its worst location at a transition between deep cuts and fills where differentials are maximum.

Data on the time rates of settlement and swell indicate that if one and one-half to two years elapse between grading operations and building construction, approximately 50 per cent of the values of settlement and swell shown on Drawing No. 32 will have been completed. However, unless the building site is carefully chosen with reference to the contours of Drawing No. 32, differentials of several inches may be superimposed on the settlements for building load alone. This possibility dictates a conservative foundation design and a detailed evaluation of individual building sites as plans for the development of the Campus are advance.

FIELD CONTROLS

It is essential that adequate provision be made to assure the dewatering of all sites in advance of excavation for basements and foundations to assure that the floor of excavation is dry and that underlying soils are not disturbed by hydrostatic flow.

Excavations should be bottomed out in restricted sections and their floors immediately protected by a 4" lean concrete working mat to protect against disturbance of supporting soils.

ECONOMIC COMPARISONS

Drawings Nos. 35 to 43 inclusive are appended to show the economic comparison for varying building heights and shapes at varying soils profile locations. The minimum permissible building height for the least favorable portions of the site is four stories, including basements. Drawing No. 35 illustrates typical soil profile where such minimum permissible building heights will obtain because here the sand deposit is thin and the surface of silt deposit is close to the ground surface. Here the foundation costs are minimum and are therefore adopted as the basic unit of cost index.

As noted on drawing No. 41 the cost index in each case is per square foot of building area. The per square foot cost for an 80' wide building four stories high under average conditions depicted on Drawing No. 35 is adopted as the unity of cost index and Drawing No. 35 indicates that the cost index under similar conditions for a 200' wide building would be 1.3 times that of an 80' wide building.

Drawing No. 36 depicts the same soil profile as shown on Drawing No. 35 but where five or more stories may be required. This drawing shows that the cost index for soil profile where the shortest piles may be employed is 1.6 and increases 0.2 per additional story beyond five.

Drawing No. 37 indicates the soil profile where maximum building pressures and therefore maximum story heights will obtain, due to the available depth for recompacting windlaid sands, and to the depth of underlying silt deposit below final grade. Here, buildings up to 80' in width may be twelve stories in height reducing to approximately seven stories in height for the same profile for buildings 200' in width. The cost index is as indicated, i.e., 1.7 for buildings 80' wide and twelve stories high and the same, i.e., 1.7 for buildings 200' wide and seven stories high. For such surface loading the maximum allowable intensities prescribed assume ground water table in the sands.

Drawing No. 38 assumes the same soil profile as that of Drawing No. 37, but in Drawing No. 38 the principle of balancing excavation is employed rather than recompacting. The same overall height of structure applies as for Drawing No. 37, i.e., twelve stories including basement or ten stories above grade. For such a design the cost index for foundations for maximum height structures of ten stories above grade and 80' wide, is 1.6 and for the same height of structure 200' wide, the cost index is 1.9. The principal point of comparison between Drawings Nos. 37 and 38 lies in the fact that for the balancing excavation principle of foundations the maximum permissible story height applies for either high or low ground water table and allowable intensity is not reduced for increased width up to 200', although the cost index increases. For the excavation and recompaction method indicated on Drawing No. 37, permissible story heights reduce as building width increases above 80', and permissible intensities are influenced by actual ground water table.

Drawing No. 39 indicates the drastic increase in cost for structures of total height exceeding twelve stories where the building must be supported on long piles. This drawing illustrates the high cost of foundations for the thirteen story building as contrasted to an overall twelve story building, the cost index at thirteen stories being 6.8.

Drawing No. 40 illustrates the foundation principle of compacting windlaid sands and preloading the area of the structure for a sufficient period of time to induce subsoil consolidations under the influence of the preloaded soil weight, a minimum of one year. As indicated, this foundation treatment applies to all soil conditions and permits maximum story heights for all widths of building if the time period of preloading is adequate. For this solution the cost index varies only from 1.5 for buildings 80' wide to 1.8 for buildings 200' at twelve story heights for either width.

Drawing No. 41 is a graph of comparative foundation costs per story of height for the foundation types illustrated on Drawings Nos. 35 to 40 inclusive. For the varying types of mat foundation indicated by the steeper graphs on the left hand side of the drawing, and for the pile foundations for varying lengths of piles as indicated by the flatter graphs on the right hand side of the drawing, the slope of graph indicates the cost per floor for foundations.

Drawing No. 42 indicates the approximate lengths of piles required for pile supported structures in all areas of the site; the contour lines indicate pile lengths.

Drawing No. 43 indicates the approximate areas of limitation in story heights or maximum load intensities for all structures supported on mat foundations by other than the preload method.

SUMMARY

1. The deposits overlying bedrock are predominantly glacial lake sediments, covered by a relatively ~~thin stra~~- tum of windlaid sands.

2. The ground water level has not been accurately determined. The effective level may be loaated in the brown silty clay stratum between Elevs. +140 and 160, separated from a perched water table in the superficial sands by the relatively impervious intervening varved brown silt stratum.

3. Consolidation test data indicate that the entire profile of compressible soils has been preconsolidated to at least 3 tsf in excess of the existing effective overburden pressure for a water table near the ground surface. In this case all building loads will produce a reconsolidation of the compressible materials.

4. The uncertainty as to the present position of the ground water table in the fine grained sediments has not been resolved by this investigation. Assuming the ground water at its lowest past position, the materials beneath the water table will undergo virgin consolidation under building loads.

5. The first subsoil encountered in depth offering satisfactory resistance for the support of heavily loaded piles or other types of extended foundation is the glacial till. Over a major portion of the site the depth to this material is in the order of 200 or more feet.

6. While it is possible to drive steel H-piles to the glacial till for the support of tall and heavily loaded buildings, we question the economic soundness of this procedure in a non-congested area such as is available at this site. If buildings with gross area loads exceeding 1.2 tons per square foot on the most favorable sites and with most favorable shape factors, (with lesser maximum intensities in less favorable sites) are desired, deep piles or some other form of extended

foundation carrying the building loads to the underlying glacial till will be required, to keep both total and differential settlements within acceptable limits.

7. Long narrow buildings will be less influenced by consolidations in the deep compressible soils than will large equidimensional structures.

8. Mat foundations in which the building loads are carried in the upper sand deposits either below windlaid sand or after such sands are recompacted, result in acceptable values of both total and differential settlement when gross area loads are restricted as hereinbefore defined.

9. If the principle of balancing excavation for a building with gross area weight not exceeding 1.2 tons per square foot is employed, in which a weight of soil equal to the weight of building is excavated and replaced by building basement, and providing that such excavations do not penetrate the pre-consolidated silt strata, then both total and differential settlements are reduced to acceptable values, even though the ground water table in the varved clay may now be at its deepest probable value and although considerable variations in subsoil conditions may exist within the area of one building. It is believed that the principle of balancing excavation is one method of providing insurance against uncertainties in the subsoil conditions which have not been resolved by this investigation and some of which probably could not be resolved by an even more detailed investigation.

10. An alternate procedure which would accomplish this same result would be to excavate the windblown sand deposits, to recompact these materials over the building area, compacting in layers with full compaction control to assure uniformly high densities and then to preload the building area with earth fill to a weight at least slightly greater than the anticipated weight of the building. If this earth fill could be left in place one year or longer, computations indicate that a considerable reduction in both total and differential settlements would be obtained, providing the construction of the building proceeded immediately following removal of the surcharge fill.

11. In view of the considerable variations in subsoil conditions over this site, the long narrow buildings present the advantage

that their performance is little affected by the presence of compressible soils at depths greater than approximately 1-1/2 to 2 times the building width. For slender buildings the thickness of sand cover is more important than the total thickness of underlying compressible materials in its influence on settlements. Such buildings are more seriously affected by variations in soil conditions in the upper portion of the soil profile and are particularly largely affected by thickness of sand and varved silt under the foundations. To minimize effects of subsoil variations for the long narrow buildings, we recommend that such buildings be articulated by expansion joints extending throughout the full height of the buildings, and that transverse stiffness be built into the foundations.

12. While the differential settlements for the case of buildings with gross area loads not greater than one ton per square foot and spread foundations are within tolerable limits, the dangers of concentration of differential settlements due to subsoil conditions can be minimized by providing beam strength in the foundations to prevent any such concentration of differential settlement. In long narrow buildings this can be accomplished by the reinforcing of exterior longitudinal basement walls as beams and by providing transverse stiffening and distribution members designed as beams, girders or rigid frame truss members. The principle of design of these members should be that they have sufficient strength so as not to be overstressed by the anticipated differential settlement deflections and have sufficient rigidity to partially reduce the completely flexible differential settlements by causing a redistribution of load to the underlying soil. This type of design can be accomplished effectively only when the ratio of length to width of building is in the order of 2.0 or less. Hence, long narrow buildings can be effectively designed on this basis only when articulated. Large square buildings and buildings with towers or setbacks will require special treatment which can probably be best accomplished by a Vierendeel truss principle of design within the foundations.

13. Settlement andswell resulting from grading operations may seriously effect settlements and differential settlements due to building loads and must be considered in the choice of building location and foundation design.

14. Ground water control is essential to assure against hydrostatic flow in floors of all excavations for foundations.

15. Economic comparisons indicate the substantial increase in cost of foundations requiring pile supports and therefore the advisability of limiting story heights.

16. In view of all of the complexities in the foundation conditions for this site, as demonstrated by this general study, it is recommended that a specific study be made of the foundation requirements for each particular building as it is being designed, in order to assure that the most desirable and economical foundation solution is selected to meet both the subsoil conditions and the building requirements.

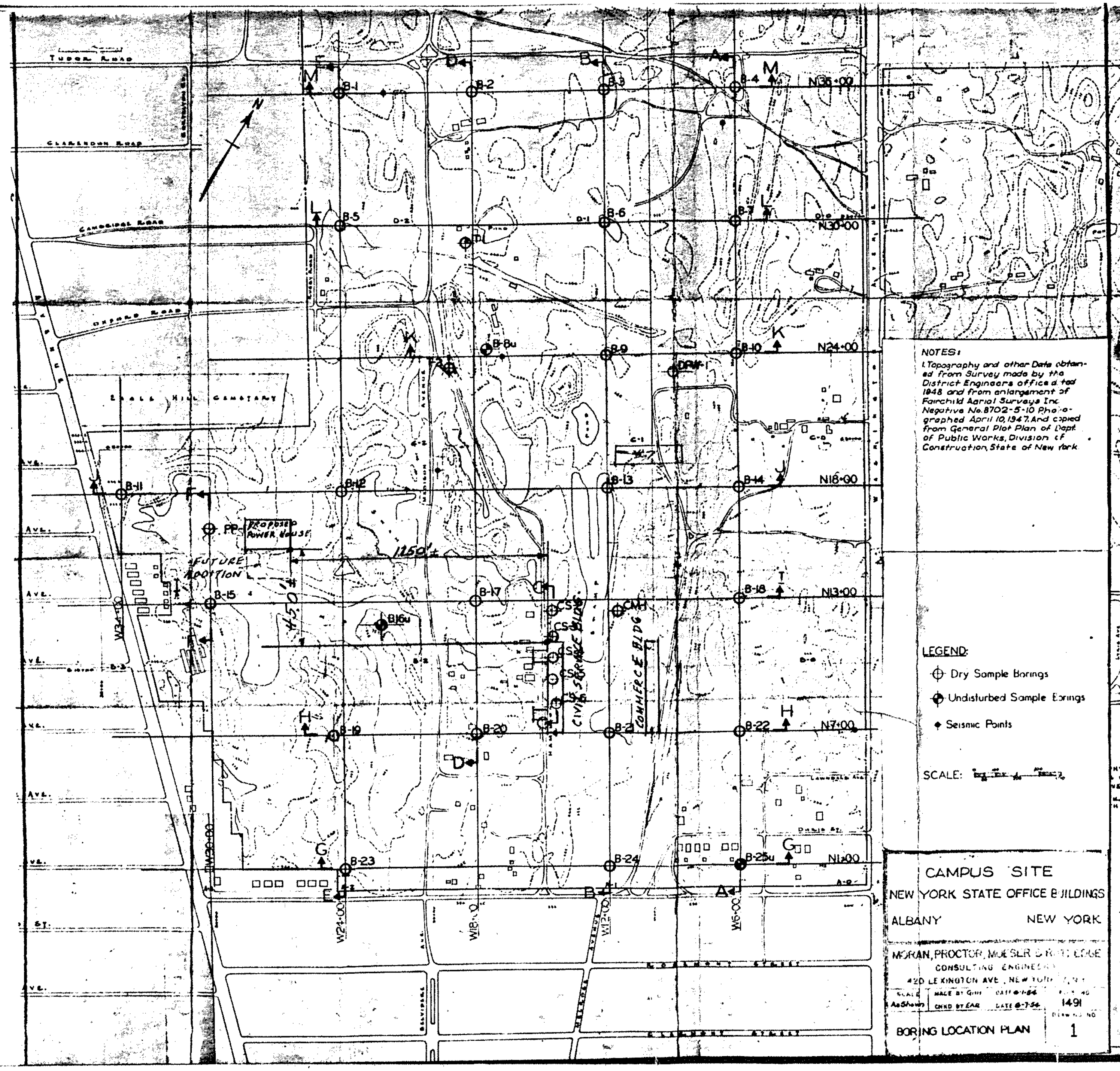
Respectfully submitted,

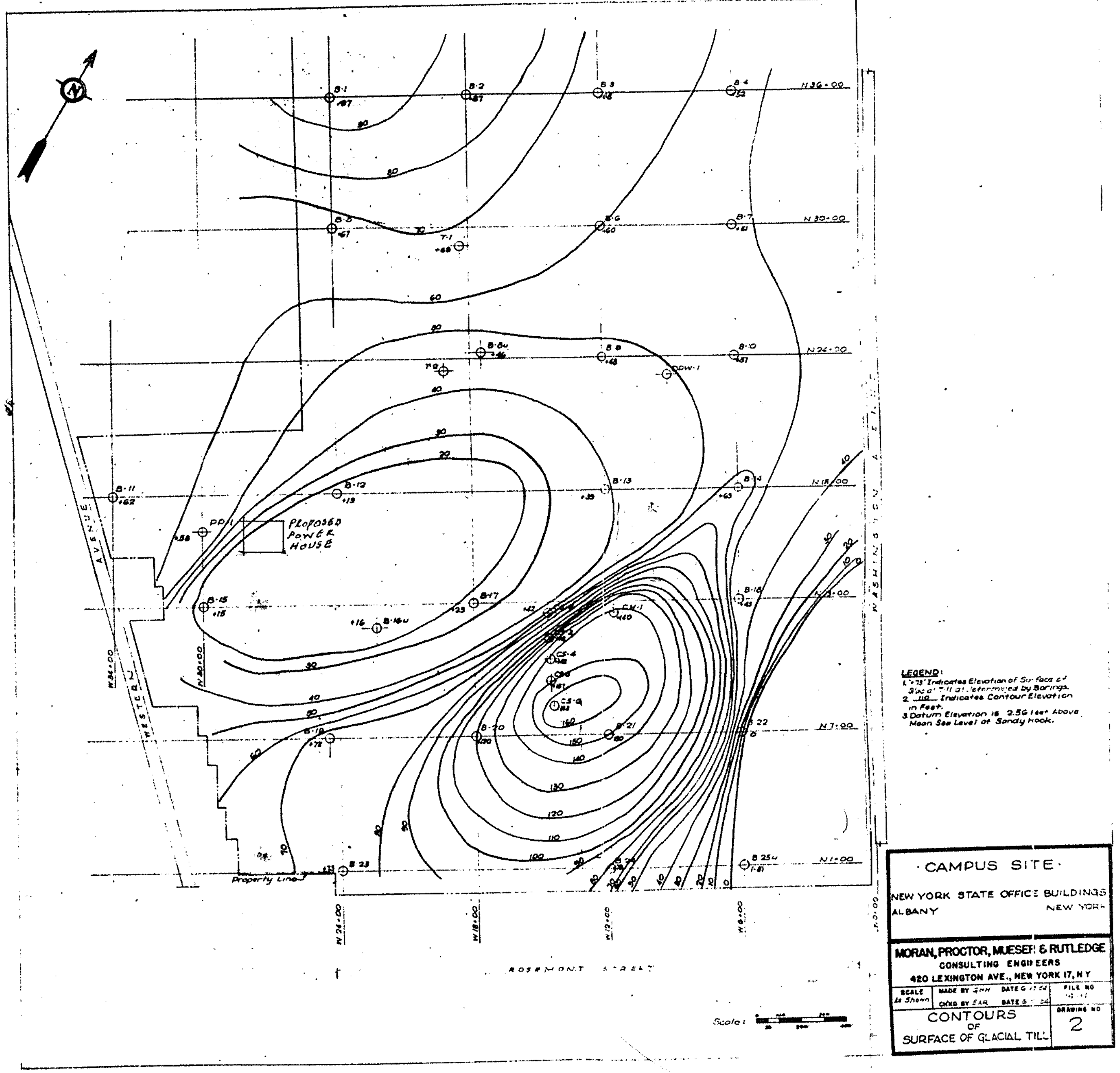
MORAN, PROCTOR, MUESER & RUTLEDGE

By Carlton S. Proctor

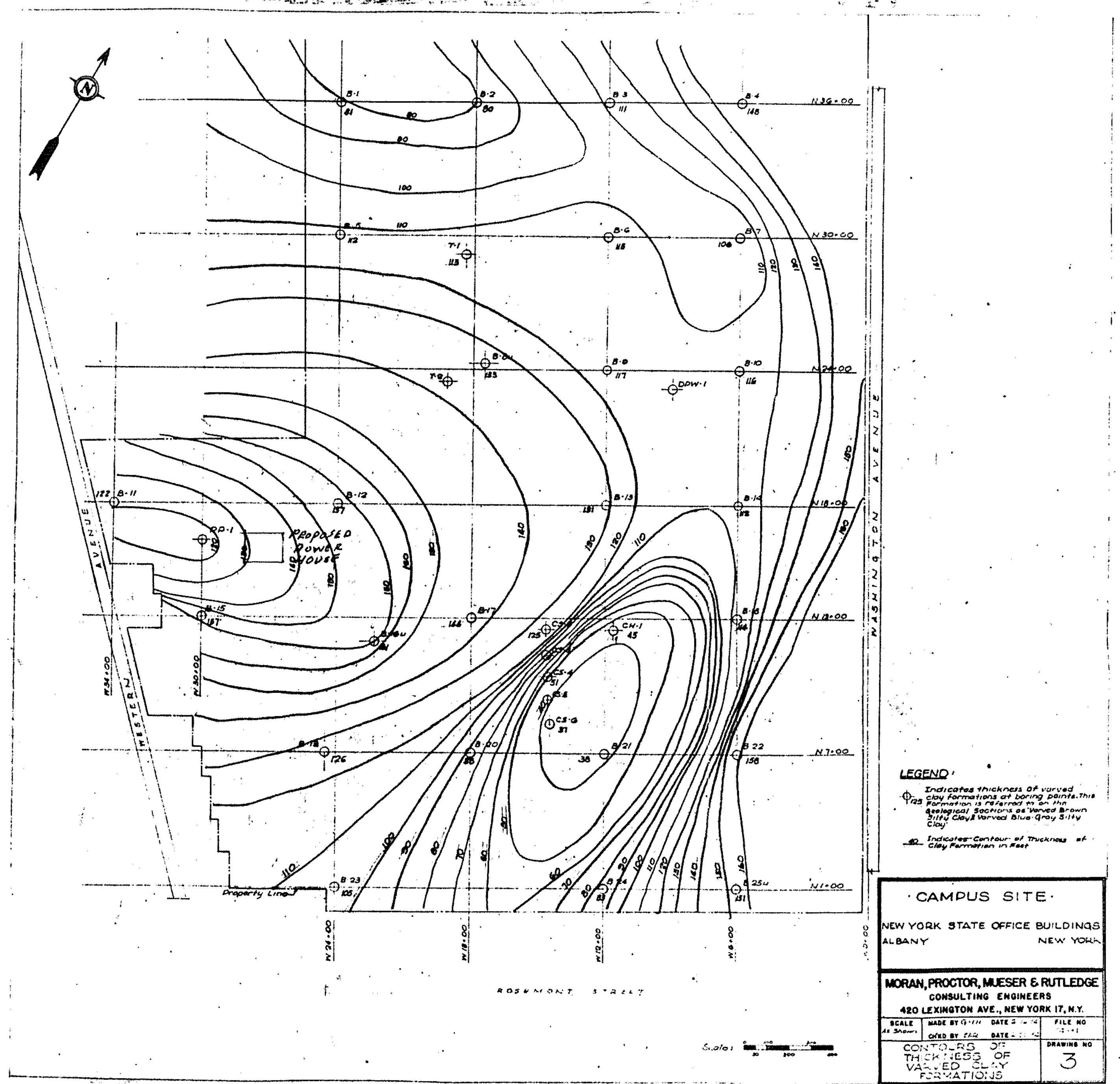
Carlton S. Proctor

CSP:es

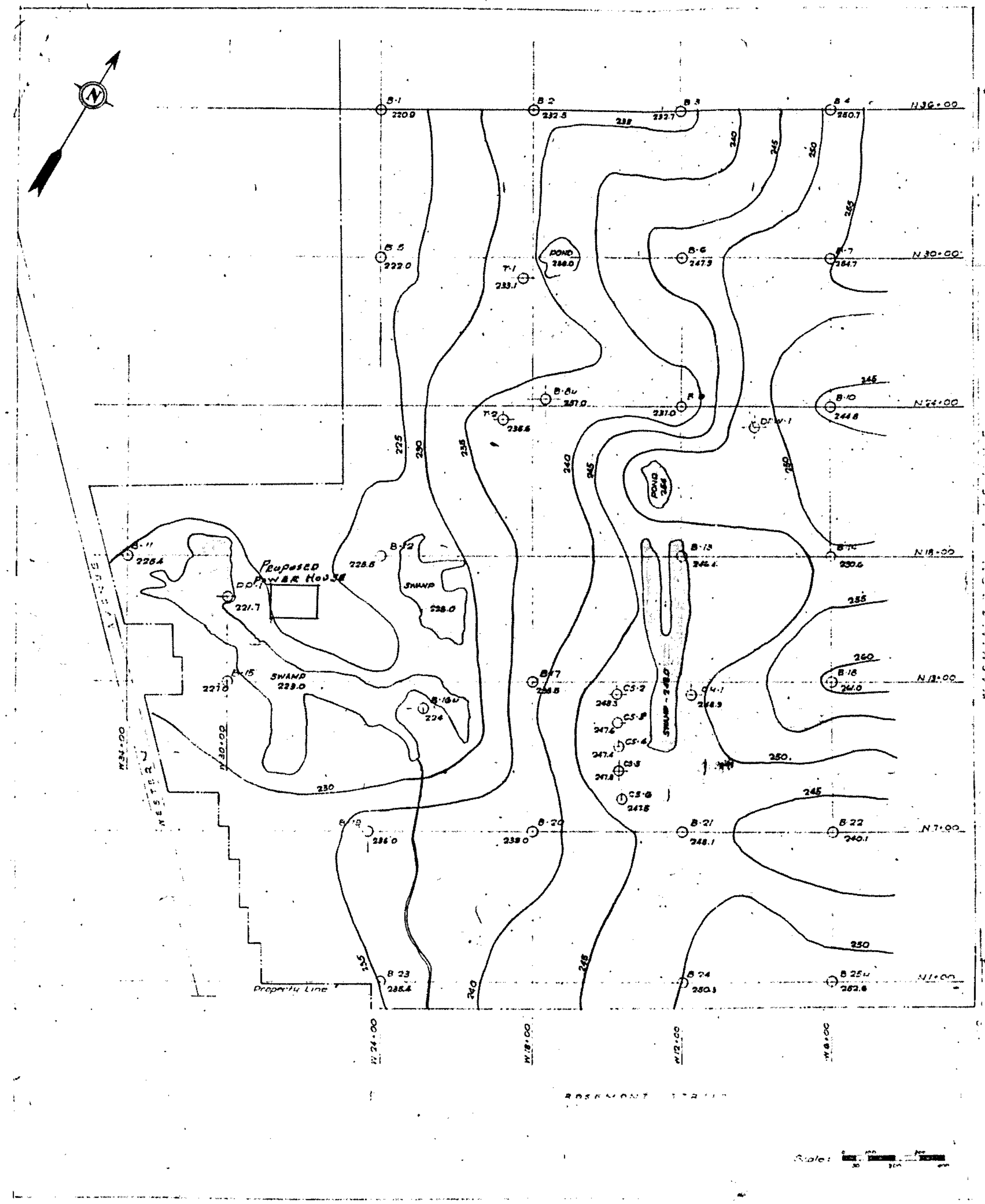

TUDOR ROAD
CLARENDON ROAD
CAMBRIDGE ROAD
OXFORD ROAD
N
B-1
B-2
B-3
B-4
N35+00
B-5
B-6
B-7
N30+00
B-8u
B-9
B-10
N24+00
B-11
B-12
B-13
B-14
N18+00
PROPOSED POWER HOUSE
FUTURE ADDITION
1150'±
450'±
B-15
B16u
B-17
B-18
N13+00
CIVIL SERVICE BLDG.
COMMERCE BLDG.
B-19
B-20
B-21
B-22
N7+00
B-23
B-24
B-25u
N1+00
W34+00
W30+00
W24+00
W18+00
W12+00
W6+00
NOTES:
1. Topography and other Data obtained from Survey made by the District Engineers office dated 1948 and from enlargement of Fairchild Aerial Surveys Inc Negative No. 8702-5-10 Photographed April 10, 1947. And copied from General Plot Plan of Dept. of Public Works, Division of Construction, State of New York
LEGEND:
Dry Sample Borings
Undisturbed Sample Borings
Seismic Points
SCALE:
CAMPUS SITE
NEW YORK STATE OFFICE BUILDINGS
ALBANY NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK, N.Y.
SCALE As Shown
MADE BY GHH DATE 6-1-54
CHKD BY EAR DATE 6-7-54
FILE NO 1491
DRAWING NO 1
BORING LOCATION PLAN



B-1
B-2
B-3
B-4
N 36+00
B-5
T-1
B-6
B-7
N 30+00
B-8u
B-9
B-10
N 24+00
B-11
B-12
PP-1
PROPOSED
POWER
HOUSE
B-13
B-14
N 18+00
B-15
B-16u
B-17
CM-1
B-18
C-S-4
C-S-9
B-19
B-20
B-21
B-22
N 7+00
B-23
B-25u
N 1+00
Property Line
AVENUE
WESTERN
WASHINGTON AVE.
ROSEMONT STREET
W 24+00
W 18+00
W 12+00
W 6+00
Scale:
LEGEND:
1. "+75" Indicates Elevation of Surface of Glacial Till as Determined by Borings.
2. 110 Indicates Contour Elevation in Feet.
3. Datum Elevation is 2.56 feet Above Mean Sea Level at Sandy Hook.
·CAMPUS SITE·
NEW YORK STATE OFFICE BUILDINGS
ALBANY
NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N Y
SCALE As Shown
MADE BY
CH'KD BY
DATE
FILE NO
DRAWING NO
2
CONTOURS
OF
SURFACE OF GLACIAL TILL



PROPOSED POWER HOUSE
WESTERN AVENUE
WASHINGTON AVENUE
ROSEMONT STREET
Property Line
LEGEND:
Indicates thickness of varved clay formations at boring points. This Formation is referred to on the Geological Sections as "Varved Brown Silty Clay & Varved Blue-Gray Silty Clay"
Indicates Contour of Thickness of Clay Formation in Feet
· CAMPUS SITE ·
NEW YORK STATE OFFICE BUILDINGS
ALBANY NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE As Shown
MADE BY
CH'KD BY
DATE
FILE NO
CONTOURS OF THICKNESS OF VARVED CLAY FORMATIONS
DRAWING NO 3



LEGEND

1. (280) Indicates Estimated Exposed Ground Water Elevation of Surface Feature Shown (1948).

2. Indicates Ground Water Elevation Given on Department of Public Works Boring Logs

3. 250 Indicates Contours of Elevation of Ground Water Surface.

4. Datum Elevation is 2.56 Feet Above Mean Sea Level at Sandy Hook.

CAMPUS SITE

NEW YORK STATE OFFICE BUILDINGS

ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N Y

SCALE	MADE BY GHH	DATE [illegible]	FILE NO
As Shown	CH'KD BY ZAR	DATE [illegible]	

CONTOURS OF GROUND WATER ELEVATION

DRAWING NO 4

TABLE I

SUMMARY OF LABORATORY TEST DATA

BORING 8U

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES						PHYSICAL PROPERTIES: STRENGTH						PHYSICAL PROPERTIES: CONSOLIDATION				
										Unconfined Compression			Triaxial Compression							
Boring No.	Sample No.	Depth Ft.	Soil Type	Natural Water Content % Average Of Entire Sample	Liquid Limit	Plasticity Index	Natural Water Content Of Limit Samples %	Specific Gravity Of Solids	Natural Wet Density pcf	Compressive Strength T/Sq. Ft.	Water Content At End Of Test %	Strain At Failure %	Deviator Stress (σ_1-σ_3) T/Sq. Ft.	Confining Pressure (σ_3) T/Sq. Ft.	Water Content At End Of Test %	Natural Water Content %	Existing Overburden Stress T/Sq. Ft.	Estimated Probable Preconsolidation Stress T/Sq. Ft.	Compression Index C_c	Coefficient Of Consolidation C_v X 10
8U	1U	5'10"	G	24.3					115											
			F	24.0																
	2U	10'7"	G	24.8					128											
	3U	15'4"	G	31.5					128											
	4U	18'9"	F&G																	
	5U	25'0"	B	31.1	43.5	22.5	27.4	2.70								34.9	.85	7.2	0.58	
			F	27.4																
	6U	30'0"	F&G																	
	7U	35'0"	F&G																	
	8U	40'0"	A	47.1	58.2	3.10	40.3													
			B	29.0				2.70								30.6	1.27	7.1	0.42	
			F	27.8				2.64								26.6	1.28	-	-	
	9U	44'11"	AF&G	Entire Sample Disturbed																
	10U	50'2"	B	35.3	31.8	10.0	32.1													
	11U	60'0"	B	34.6				2.73								36.7	1.91	5.8	0.47	
			F	25.1																
	12U	75'0"	A	53.8	72.9	40.5	57.7													
			B	33.2																
			F	28.9																
	13U	90'0"	A	52.1	53.9	25.7	47.5	2.77								49.3	2.76	5.4	0.98	
			B	34.4																
	14U	105'1"	A	48.9																
			B	33.0																
			F	25.0																
	15U	130'0"	A	44.8																
			B	29.6	33.3	12.5	31.2	2.73								45.0	3.82	10.5	0.94	
			F	25.0																
	16U	146'0"	A	46.1																
			C	26.9																
			F	24.5																
	17U	161'0"	C	25.2																
	18U	181'0"	A	41.1																
			D	28.7	40.6	19.4	34.2	2.77								42.5	5.34	9.2	1.10	

Notes:

1. Description of soil types

   A - Gray Clay
   B - Brown Silty Clay
   C - Grayish Brown Silty Clay & Clayey Silt (Varves Distorted)
   D - Blue Gray Silty Clay
   E - Pink Clay
   F - Brown Silt
   G - Brown Fine Sand

2. The sample depth listed above is the average depth of the sample recovered.

3. Ground Surface Elevation +240.0.

4. Compression Index C_c : $e = e_o - C_c \log P/P_o$

Moran, Proctor, Mueser & Rutledge
Consulting Engineers
New York, New York

Campus Site
New York State Office Building
Albany, New York
File 1491.

TABLE II

SUMMARY OF LABORATORY TEST DATA

Boring 16U

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES						PHYSICAL PROPERTIES										
										STRENGTH						CONSOLIDATION				
										Unconfined Compression			Triaxial Compression							
Boring No.	Sample No.	Depth Ft.	Soil Type	Natural Water Content % Average Of Entire Sample	Liquid Limit	Plasticity Index	Natural Water Content Of Limit Samples %	Specific Gravity Of Solids	Natural Wet Density pcf	Compressive Strength T/Sq.Ft.	Water Content At End Of Test %	Strain At Failure %	Deviator Stress $(\sigma_1-\sigma_3)$ T/Sq.Ft.	Confining Pressure (σ_3) T/Sq.Ft.	Water Content At End Of Test %	Natural Water Content %	Existing Overburden Stress T/Sq.Ft.	Estimated Probable Preconsolidation Stress T/Sq.Ft.	Compression Index C_c	Coefficient Of Consolidation C_v X10
16U	1U	11'0"	G																	
	2U	16'0"	B	35.4	43.4	23.7	35.4	2.70								35.4	.59	8.5	0.60	
	3U	21'1"	A	52.1																
			B	36.3																
			F	26.7																
	4U	26'0"	A	49.8																
			B	29.1																
			F	28.7																
	5U	31'0"	A	51.9																
			B	31.3																
			F	27.8																
	6U	35'4"	A	54.4																
			F	24.9																
	7U	41'0"	A	59.8																
	8U	46'1"	B&G	-	Sample Greatly Disturbed															
	9U	51'1"	A	57.8																
			B	29.9																
			F	27.6																
	10U	56'0"	A	44.1																
			B	32.0																
			F	26.4																
	11U	71'0"	A	50.7	68.4	41.1	51.0	2.74								49.5	2.19	5.5	0.81	
			B	39.1																
	12U	86'0"	B	36.8																
	13U	101'0"	A	54.8																
			B	35.0	39.1	17.3	32.5	2.74								42.4	3.02	7.5	0.69	
	14U	116'0"	B	35.1																
	15U	131'0"	C	31.7																
	16U	146'0"	A	49.3																
			B	38.2																
			F	25.1																
	17U	161'0"	C	26.4	29.6	10.7	24.8	2.72								26.2	4.71	9.7	0.25	
	18U	176'0"	B	24.7																
			C	22.3																
			F	24.6																
	19U	191'0"	A	41.9																
			D	36.0	45.4	23.3	35.2	2.76								39.7	5.60	9.0	0.66	

Notes:

1. Description of soil types

   A - Gray Clay
   B - Brown Silty Clay
   C - Grayish Brown Silty Clay & Clayey Silt (Varves Distorted)
   D - Blue Gray Silty Clay
   E - Pink Clay
   F - Brown Silt
   G - Brown Fine Sand

2. The sample depth listed above is the average depth of the sample recovered.
3. Ground Surface Elevation +226.4.
4. Compression Index C_c : $e = e_o - C_c \ \text{Log}\ P/P_o$

Moran, Proctor, Mueser & Rutledge
Consulting Engineers
New York, New York

Campus Site
New York State Office Building
Albany, New York
File 1491.

TABLE III

SUMMARY OF LABORATORY TEST DATA

Boring 25U

Sample Identification: Boring No.	Sample No.	Depth Ft.	Soil Type	Classification Properties: Natural Water Content % Average Of Entire Sample	Liquid Limit	Plasticity Index	Natural Water Content Of Limit Samples %	Specific Gravity Of Solids	U.S. Bureau Of Soils Classification: Natural Wet Density pcf	Physical Properties – Strength – Unconfined Compression: Compressive Strength T/Sq. Ft.	Water Content At End Of Test %	Strain At Failure %	Triaxial Compression: Deviator Stress $(\sigma_1 - \sigma_3)$ T/Sq. Ft.	Confining Pressure (σ_3) T/Sq. Ft.	Water Content At End Of Test %	Consolidation: Natural Water Content %	Existing Overburden Stress T/Sq. Ft.	Estimated Probable Preconsolidation Stress T/Sq. Ft.	Compression Index C_c	Coefficient Of Consolidation C_v X10
25U	1U	16'0"	G	24.9					120											
	2U	20'10"	G	-																
	3U	27'10"	G	24.7					122											
	4U	31'0"	F	25.6																
	5U	36'0"	B	36.9																
			F	25.1				2.76								30.3	1.21	7.8	0.20	
	6U	43'0"	G	-																
	7U	45'11"	G																	
	8U	51'0"	B	30.1																
			F	24.6																
	9U	55'11"	F	18.6																
	10U	66'0"	A	46.0																
			B	27.8																
			F	24.6																
	11U	71'0"	F	23.6																
	12U	76'2"	A	46.4	71.2	40.8	46.4													
			B	27.8																
			F	27.6																
	13U	81'0"	A	45.2				2.72								48.3	2.62	10.1	0.94	
			B	27.9	37.6	16.4	26.2	2.73								30.5	2.57	10.4	0.46	
			F	27.5																
	14U	96'1"	E	61.2				2.74								61.2	3.05	6.8	.98	
			F	26.6																
	15U	111'0"	A	50.2																
			B	35.8	52.5	26.4	37.6													
	16U	126'0"	A	47.9																
			B	33.6																
			F	25.2																
	17U	146'0"	A	51.3																
			B	30.6																
			F	26.7																
	18U	166'0"	A	51.9	73.9	42.5	50.5													
			B	34.5																
			C	28.1																
	19U	186'0"	A	58.6																
			C	32.0	44.6	21.3	32.2	2.73								34.6	5.54	8.5	0.48	
	20U	206'0"	B	28.5																
			D	25.3																
	21U	226'0"	D	28.4	38.0	16.9	27.3													
	22U	246'0"	D	24.8																
			F	20.5																

Notes:

1. Description of soil types

   A - Gray Clay
   B - Brown Silty Clay
   C - Grayish Brown Silty Clay & Clayey Silt (Varves Distorted)
   D - Blue Gray Silty Clay
   E - Pink Clay
   F - Brown Silt
   G - Brown Fine Sand

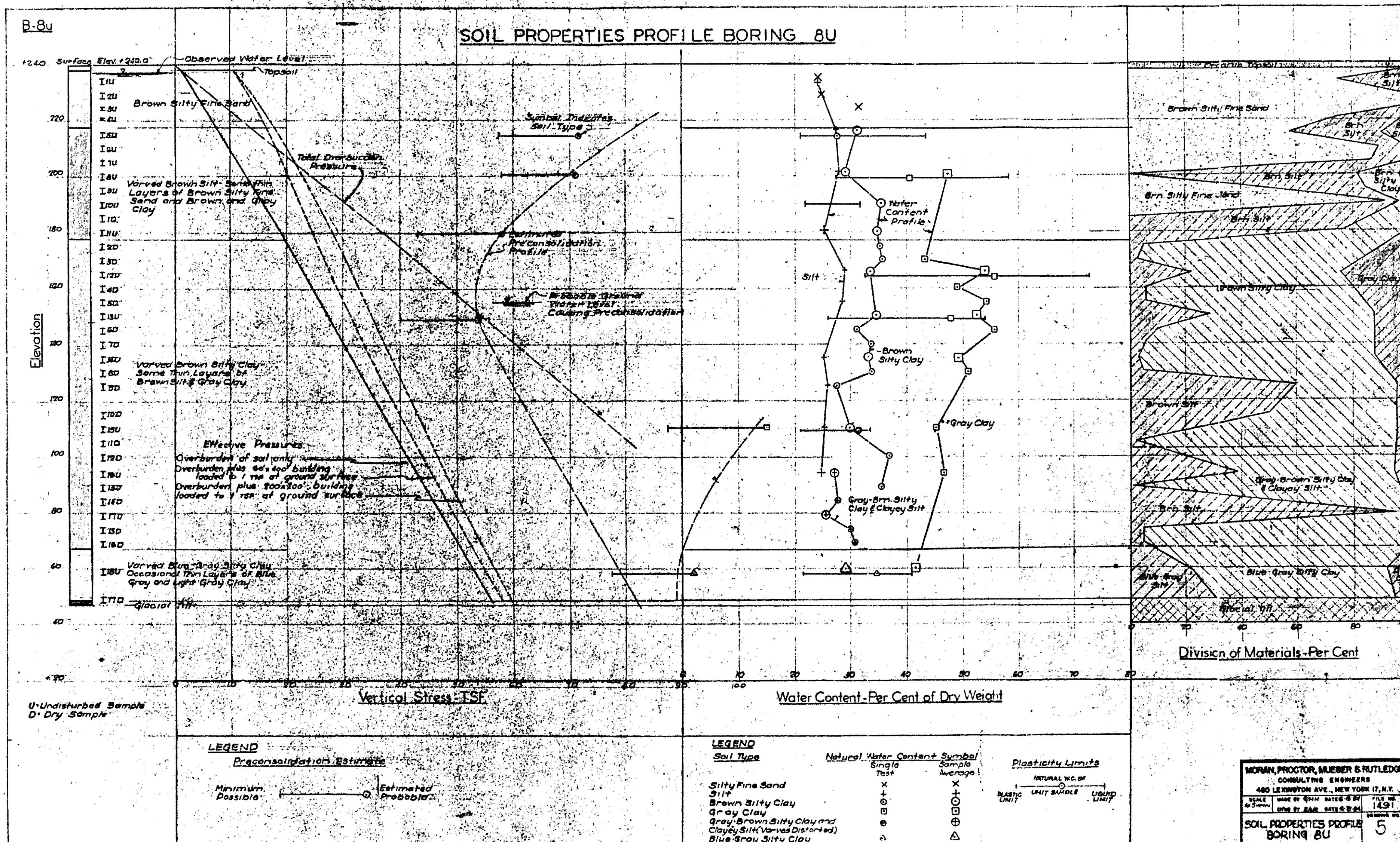
2. The sample depth listed above is the averagedepth of the sample recovered.

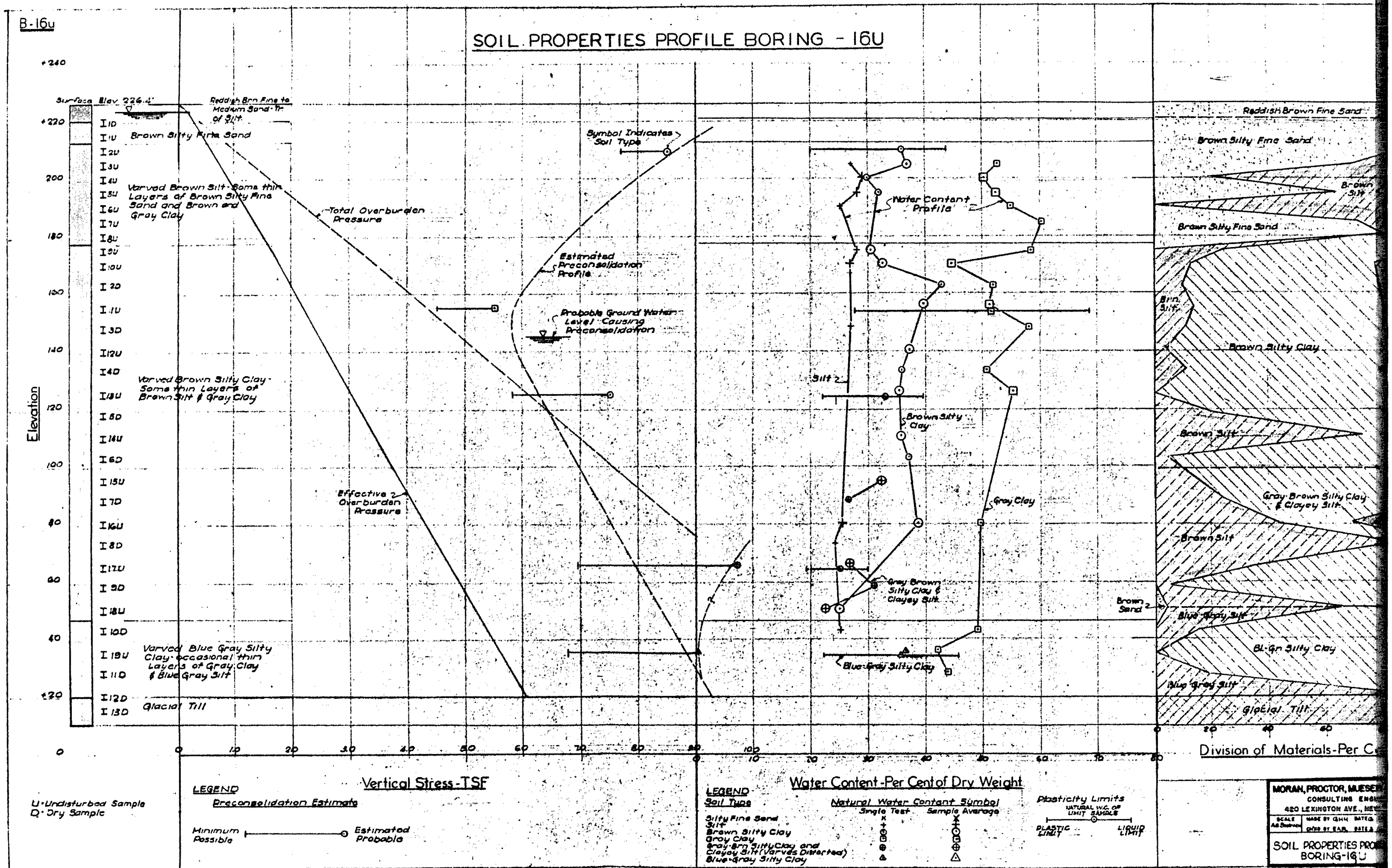
3. Ground Surface Elevation +255.6.

4. Compression Index C_c : $e = e_o - C_c \quad \log P/P_o$

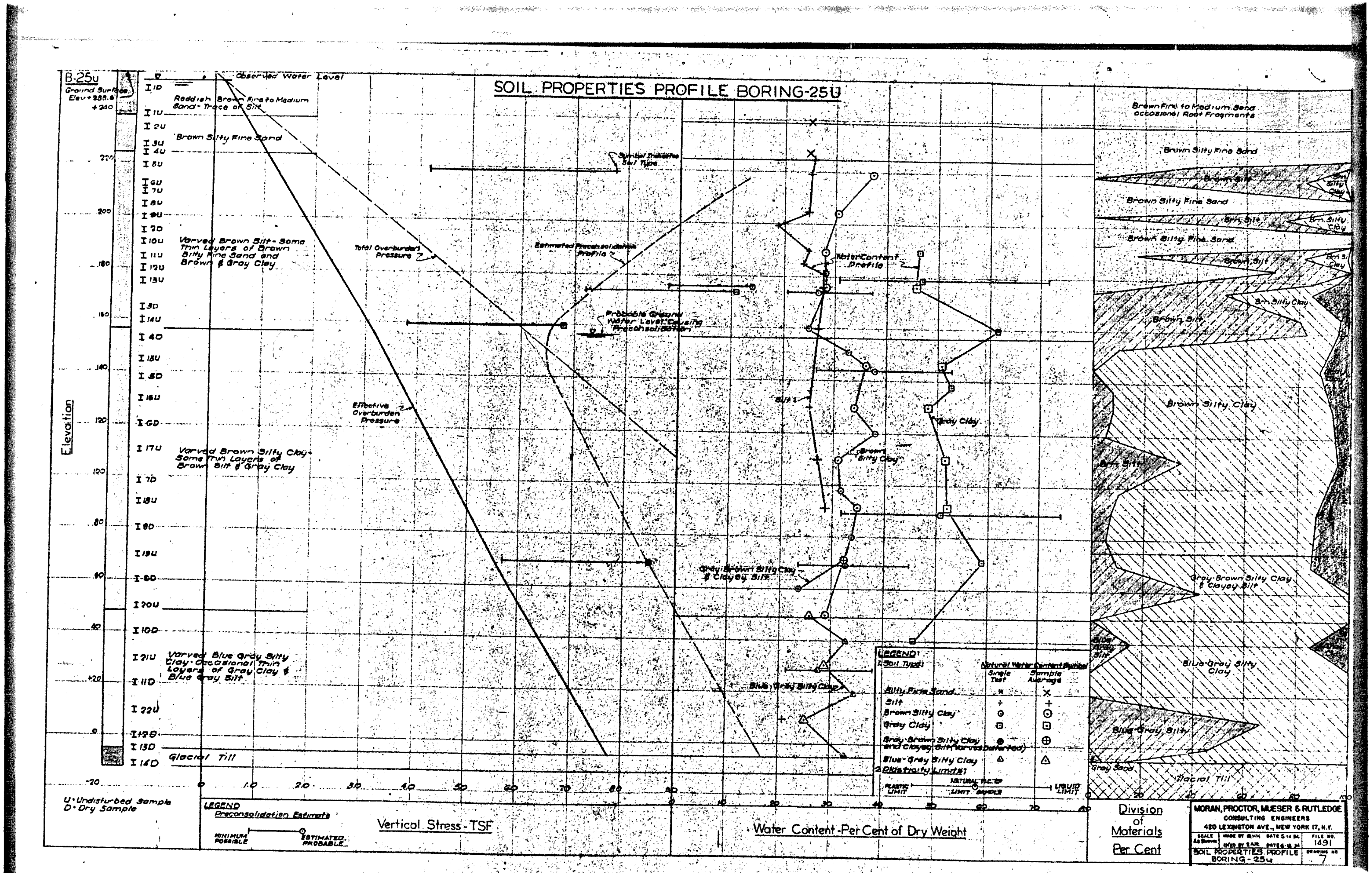
Moran, Proctor, Mueser & Rutledge
Consulting Engineers
New York, New York

Campus Site
New York State Office Building
Albany, New York
File 1491.

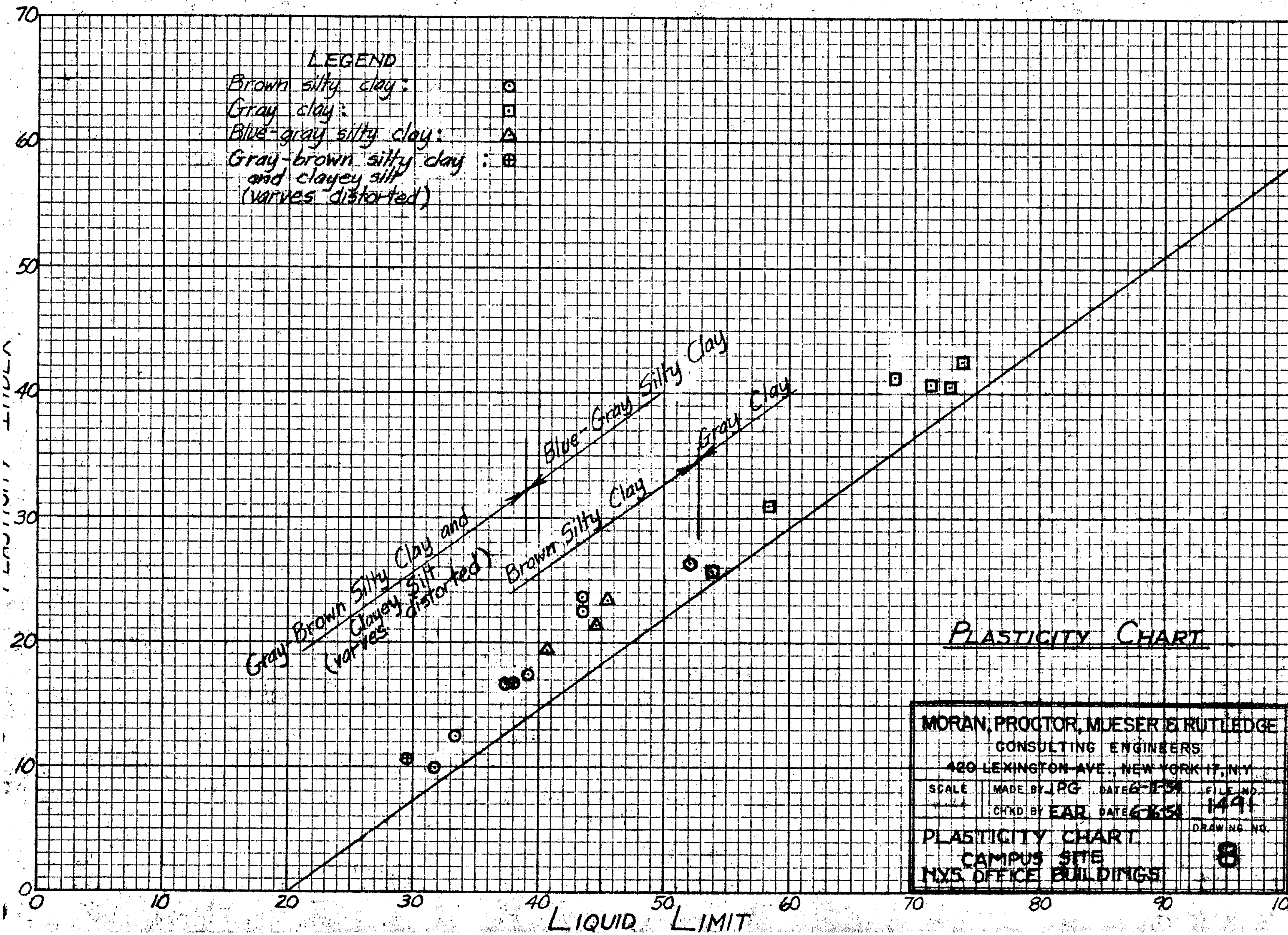

B-8u
SOIL PROPERTIES PROFILE BORING 8U
Surface Elev. +240.0'
Observed Water Level
Topsoil
Brown Silty Fine Sand
Symbol Indicates Soil Type
Total Overburden Pressure
Varved Brown Silt - Some thin Layers of Brown Silty Fine Sand and Brown and Gray Clay
Estimated Preconsolidation Profile
Varved Brown Silty Clay - Some Thin Layers of Brown Silt & Gray Clay
Effective Pressures
Overburden of soil only
Overburden plus 60'x400' building loaded to 1 TSF at ground surface
Overburden plus 200'x200' building loaded to 1 TSF at ground surface
Varved Blue-Gray Silty Clay - Occasional Thin Layers of Blue Gray and Light Gray Clay
Glacial Till
Elevation
Vertical Stress - TSF
U - Undisturbed Sample
D - Dry Sample
LEGEND
Preconsolidation Estimate
Minimum Possible
Estimated Probable
Water Content Profile
Silt
Brown Silty Clay
Gray Clay
Gray-Brn. Silty Clay & Clayey Silt
Water Content - Per Cent of Dry Weight
LEGEND
Soil Type
Natural Water Content Symbol
Single Test
Sample Average
Silty Fine Sand
Silt
Brown Silty Clay
Gray Clay
Gray-Brown Silty Clay and Clayey Silt (Varves Distorted)
Blue-Gray Silty Clay
Plasticity Limits
NATURAL W.C. OF UNIT SAMPLE
PLASTIC LIMIT
LIQUID LIMIT
Brown Silty Fine Sand
Brn Silty Fine Sand
Brn. Silt
Brown Silty Clay
Gray Clay
Brown Silt
Gray-Brown Silty Clay & Clayey Silt
Blue-Gray Silty Clay
Glacial Till
Division of Materials - Per Cent
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
NEW YORK
FILE NO. 1491
SOIL PROPERTIES PROFILE
BORING 8U
5

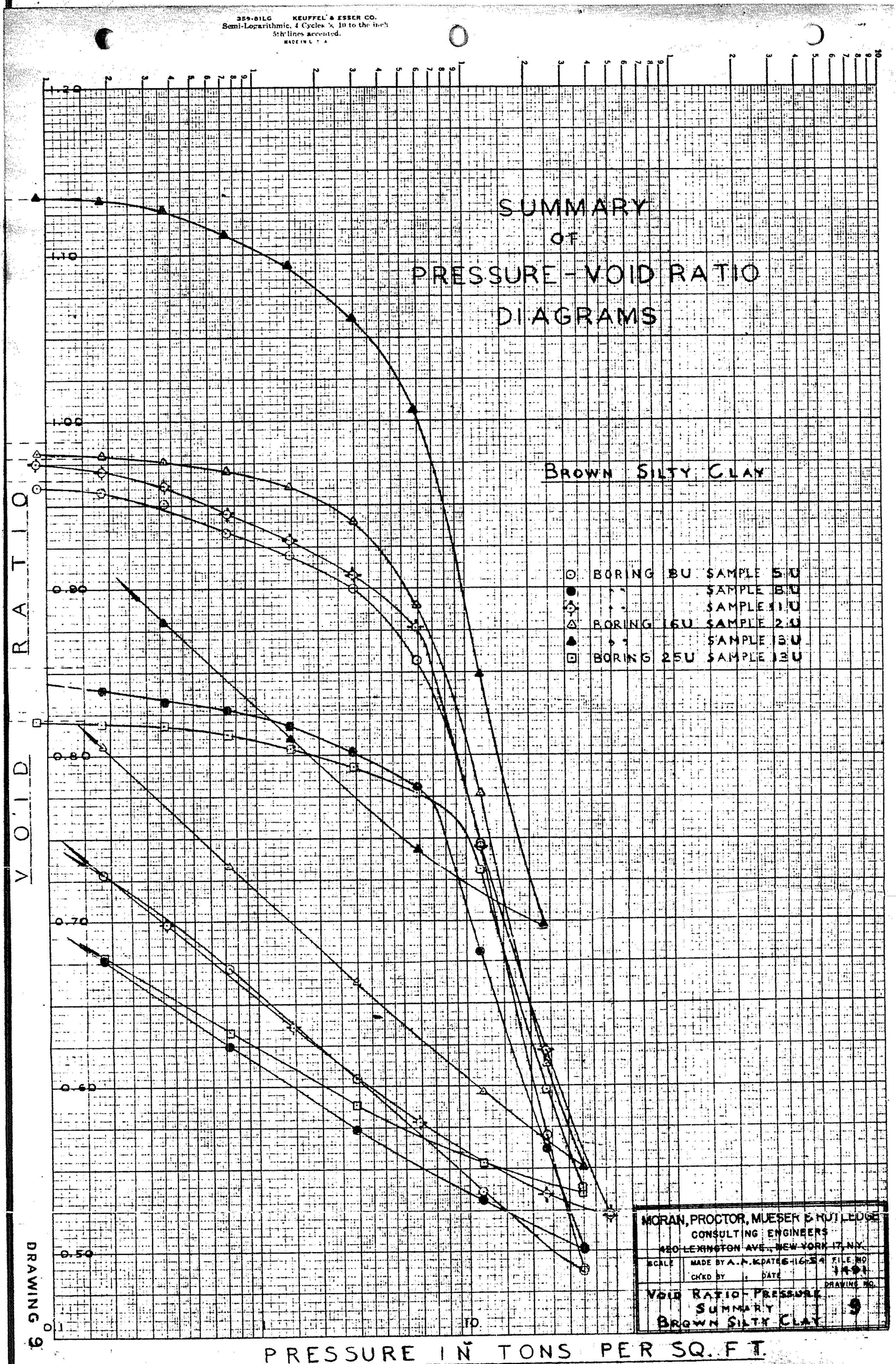


B-16u
SOIL PROPERTIES PROFILE BORING - 16U
Surface Elev. 226.4'
Reddish Brn Fine to Medium Sand - Tr of Silt
Brown Silty Fine Sand
Varved Brown Silt - Some thin Layers of Brown Silty Fine Sand and Brown and Gray Clay
Varved Brown Silty Clay - Some thin Layers of Brown Silt & Gray Clay
Varved Blue Gray Silty Clay - occasional thin Layers of Gray Clay & Blue Gray Silt
Glacial Till
Elevation
Total Overburden Pressure
Effective Overburden Pressure
Estimated Preconsolidation Profile
Probable Ground Water Level Causing Preconsolidation
Symbol Indicates Soil Type
Water Content Profile
Silt
Brown Silty Clay
Gray Clay
Gray Brown Silty Clay & Clayey Silt
Brown Sand
Blue-Gray Silty Clay
Reddish Brown Fine Sand
Brown Silt
Brown Silty Fine Sand
Brn. Silt
Brown Silty Clay
Gray-Brown Silty Clay & Clayey Silt
Blue Gray Silt
Bl-Gn Silty Clay
Glacial Till
Vertical Stress-TSF
Water Content-Per Cent of Dry Weight
Division of Materials-Per C
U-Undisturbed Sample
D-Dry Sample
LEGEND
Preconsolidation Estimate
Minimum Possible
Estimated Probable
LEGEND
Soil Type
Silty Fine Sand
Silt
Brown Silty Clay
Gray Clay
Gray-Brn Silty Clay and Clayey Silt (Varves Distorted)
Blue-Gray Silty Clay
Natural Water Content Symbol
Single Test
Sample Average
Plasticity Limits
PLASTIC LIMIT
LIQUID LIMIT
MORAN, PROCTOR, MUESER
CONSULTING ENG
420 LEXINGTON AVE., NEW
SOIL PROPERTIES PRO
BORING-16U


SOIL PROPERTIES PROFILE BORING-25U
B-25u
Ground Surface Elev + 238.6'
Observed Water Level
Reddish Brown Fine to Medium Sand - Trace of Silt
Brown Silty Fine Sand
Varved Brown Silt - Some Thin Layers of Brown Silty Fine Sand and Brown & Gray Clay
Varved Brown Silty Clay - Some Thin Layers of Brown Silt & Gray Clay
Varved Blue Gray Silty Clay - Occasional Thin Layers of Gray Clay & Blue Gray Silt
Glacial Till
Elevation
Symbol Indicates Soil Type
Total Overburden Pressure
Estimated Preconsolidation Profile
Probable Ground Water Level Causing Preconsolidation
Effective Overburden Pressure
Water Content Profile
Silt
Gray Clay
Brown Silty Clay
Gray-Brown Silty Clay & Clayey Silt
Blue-Gray Silty Clay
U - Undisturbed Sample
D - Dry Sample
LEGEND
Preconsolidation Estimate
MINIMUM POSSIBLE
ESTIMATED PROBABLE
Vertical Stress - TSF
Water Content - Per Cent of Dry Weight
LEGEND
1 Soil Type
Natural Water Content Symbol
Single Test
Sample Average
Silty Fine Sand
Silt
Brown Silty Clay
Gray Clay
Gray-Brown Silty Clay and Clayey Silt (Varves Distorted)
Blue-Gray Silty Clay
2 Plasticity Limits
PLASTIC LIMIT
NATURAL W.C. OF LIMIT SAMPLE
LIQUID LIMIT
Brown Fine to Medium Sand occasional Root Fragments
Brown Silty Fine Sand
Brown Silt
Brn. Silty Clay
Brown Silty Clay
Brn. Silt
Gray-Brown Silty Clay & Clayey Silt
Blue-Gray Silt
Blue-Gray Silty Clay
Blue-Gray Silt
Gray Sand
Glacial Till
Division of Materials Per Cent
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
FILE NO. 1491
SOIL PROPERTIES PROFILE BORING - 25u
DRAWING NO. 7

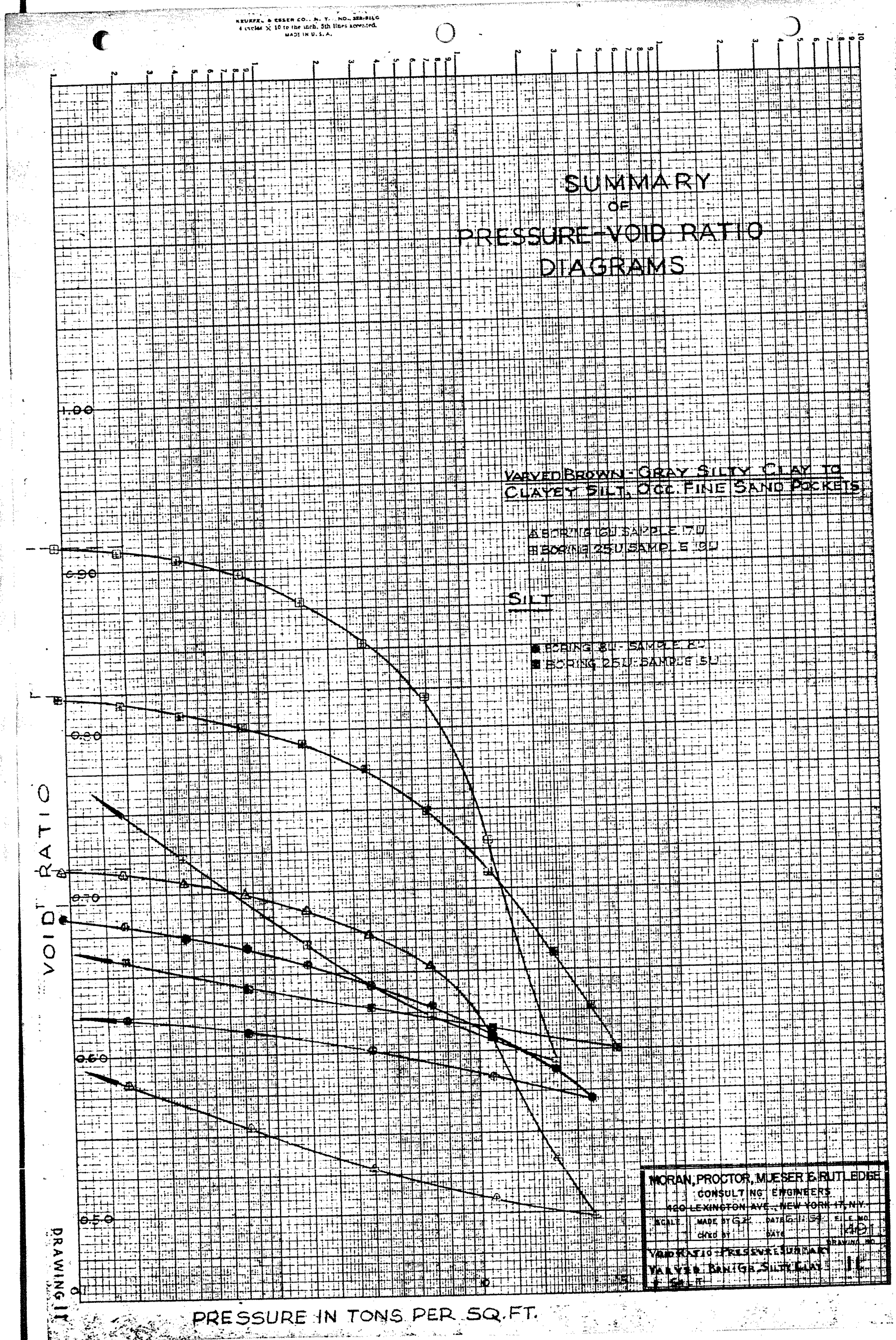
359-5DG KEUFFEL & ESSER CO.
10 X 10 to the Inch, ½ in. lines accented.
MADE IN U.S.A.



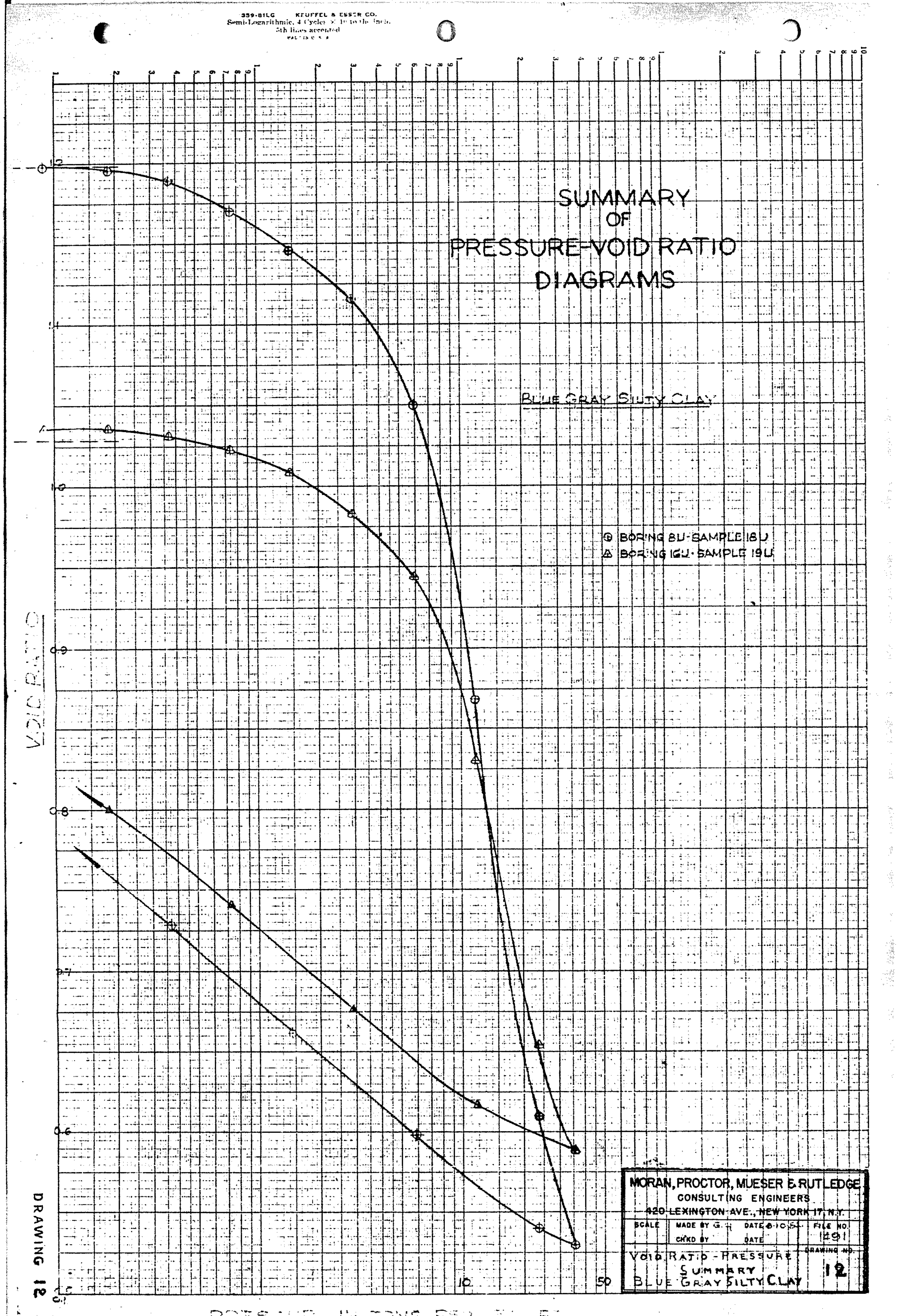


359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles X 10 to the inch
5th lines accented.
MADE IN U.S.A.
SUMMARY
OF
PRESSURE - VOID RATIO
DIAGRAMS
BROWN SILTY CLAY
BORING 8U SAMPLE 5U
SAMPLE 8U
SAMPLE 11U
BORING 16U SAMPLE 2U
SAMPLE 13U
BORING 25U SAMPLE 13U
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
VOID RATIO
PRESSURE IN TONS PER SQ. F.T.
0.1
1.0
10
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE
MADE BY A.A.K. DATE 6-16-54
CH'KD BY
DATE
FILE NO 1491
DRAWING NO.
VOID RATIO-PRESSURE
SUMMARY
BROWN SILTY CLAY
9

DRAWING 9

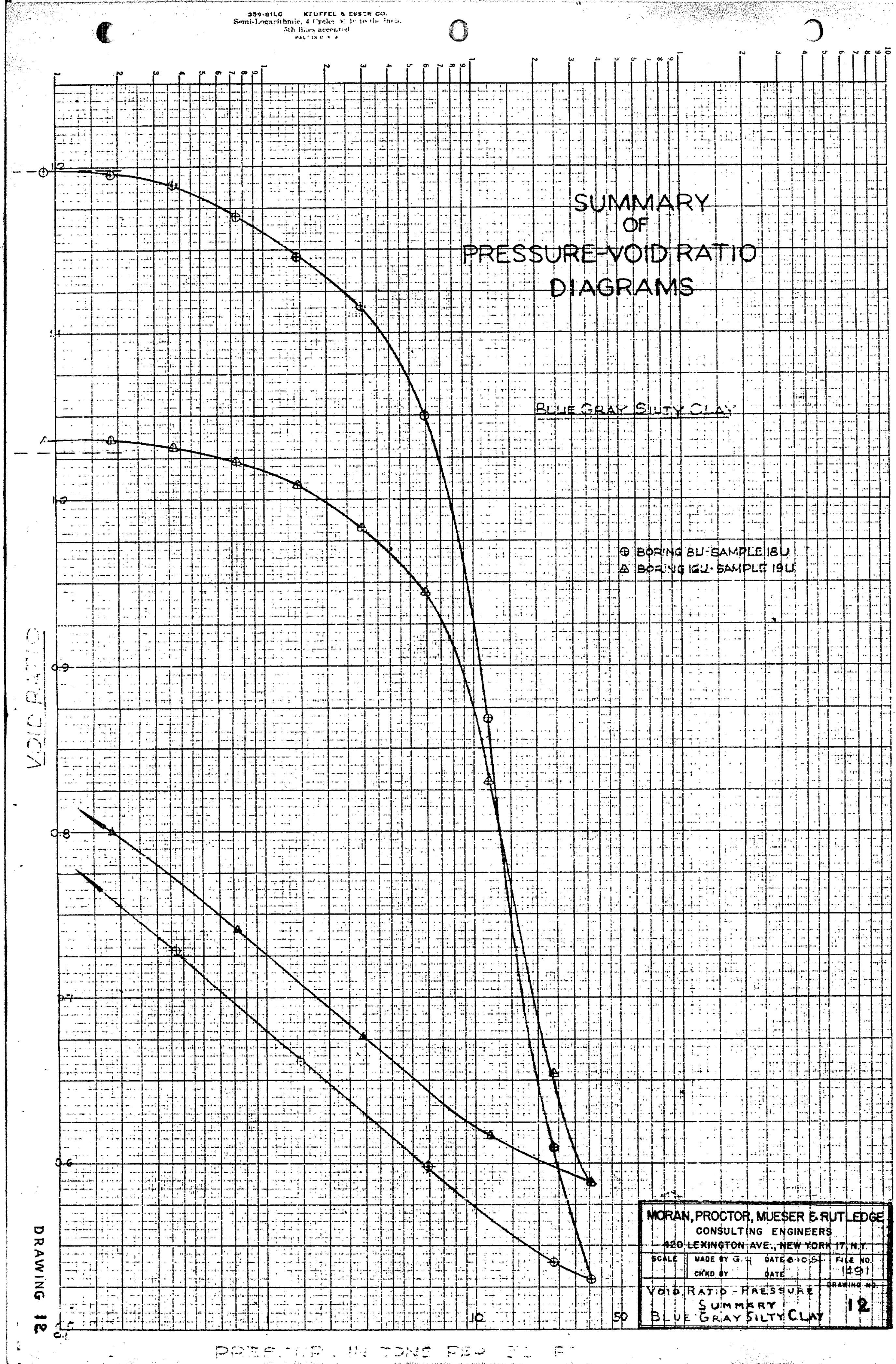

SUMMARY
OF
PRESSURE-VOID RATIO
DIAGRAMS
VARVED BROWN-GRAY SILTY CLAY TO
CLAYEY SILT, OCC. FINE SAND POCKETS
BORING 16U SAMPLE 7U
BORING 25U SAMPLE 9U
SILT
BORING 8U SAMPLE 8U
BORING 25U SAMPLE 5U
1.00
0.90
0.80
0.70
0.60
0.50
VOID RATIO
PRESSURE IN TONS PER SQ. FT.
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE
MADE BY G.K.
DATE 6-11-59
CHKD BY
DATE
FILE NO.
1491
DRAWING NO.
VOID RATIO-PRESSURE SUMMARY
VARVED BRN.-GR. SILTY CLAY & SILT
11

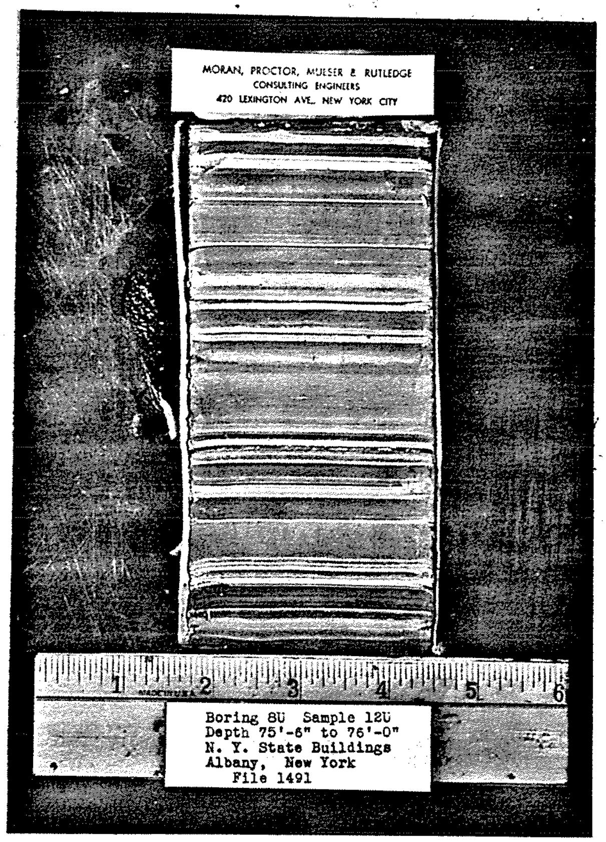
DRAWING 11

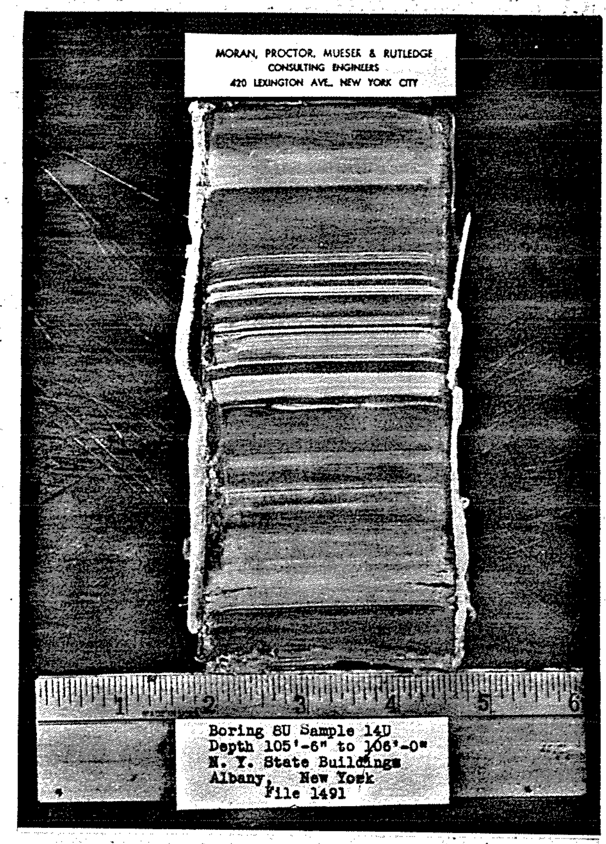


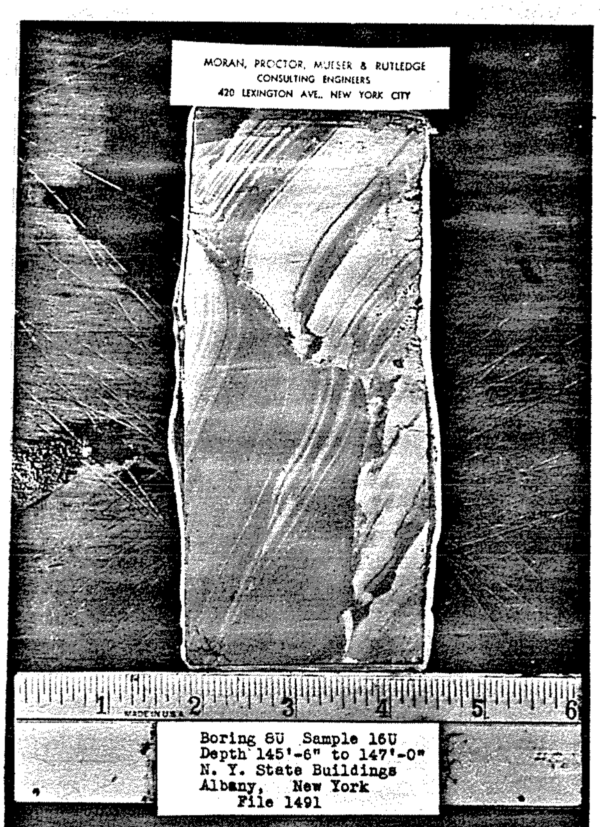
SUMMARY
OF
PRESSURE-VOID RATIO
DIAGRAMS
BLUE GRAY SILTY CLAY
⊕ BORING 8U-SAMPLE 18U
△ BORING 16U-SAMPLE 19U
VOID RATIO
1.2
1.1
1.0
0.9
0.8
0.7
0.6
10
50
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE
MADE BY G.H.
DATE 8-10-54
FILE NO. 491
CHKD BY
DATE
VOID RATIO - PRESSURE
SUMMARY
BLUE GRAY SILTY CLAY
DRAWING NO. 12

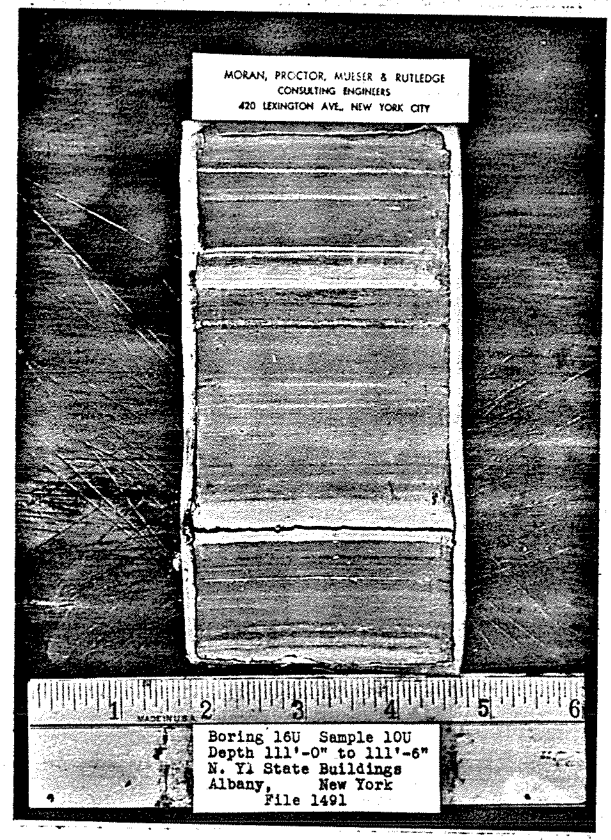
DRAWING 12


SUMMARY
OF
PRESSURE-VOID RATIO
DIAGRAMS
BLUE GRAY SILTY CLAY
⊕ BORING 8U-SAMPLE 18U
△ BORING 16U-SAMPLE 19U
VOID RATIO
1.2
1.0
0.9
0.8
0.7
0.6
10
50
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE
MADE BY G.H.
DATE 8-10-54
FILE NO. 1291
CH'KD BY
DATE
DRAWING NO. 12
VOID RATIO - PRESSURE
SUMMARY
BLUE GRAY SILTY CLAY
DRAWING 12
359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles × 10 to the inch.
5th lines accented


MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
Boring 8U Sample 12U
Depth 75'-6" to 76'-0"
N. Y. State Buildings
Albany, New York
File 1491

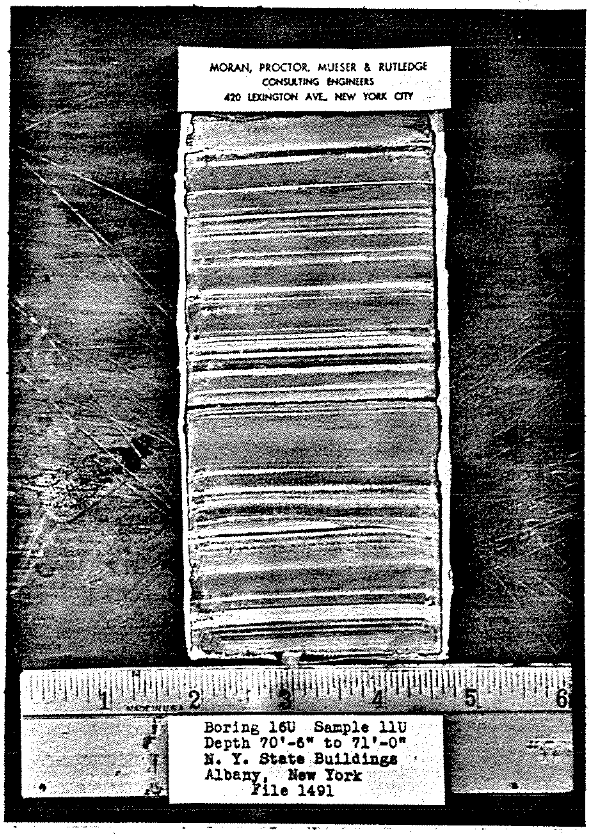

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
Boring 8U Sample 14U
Depth 105'-6" to 106'-0"
N. Y. State Buildings
Albany, New York
File 1491

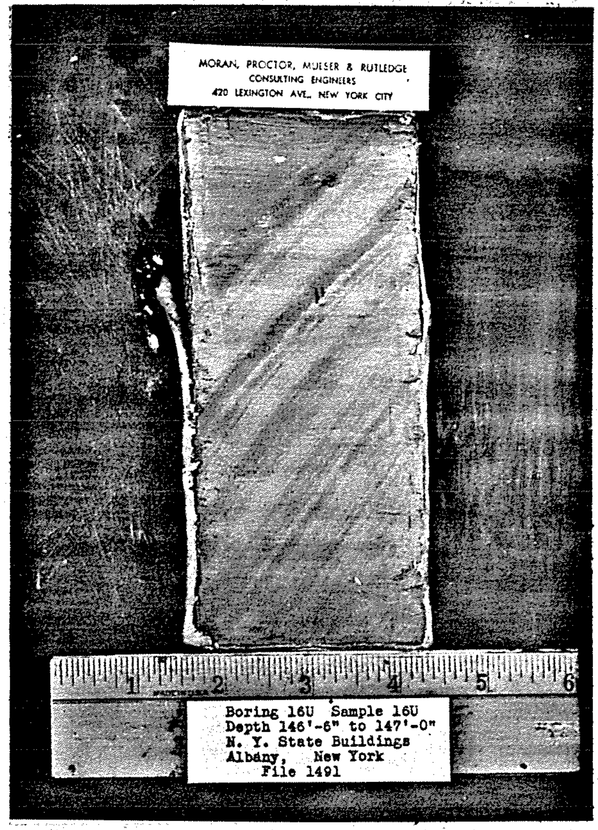

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
Boring 8U Sample 16U
Depth 145'-6" to 147'-0"
N. Y. State Buildings
Albany, New York
File 1491

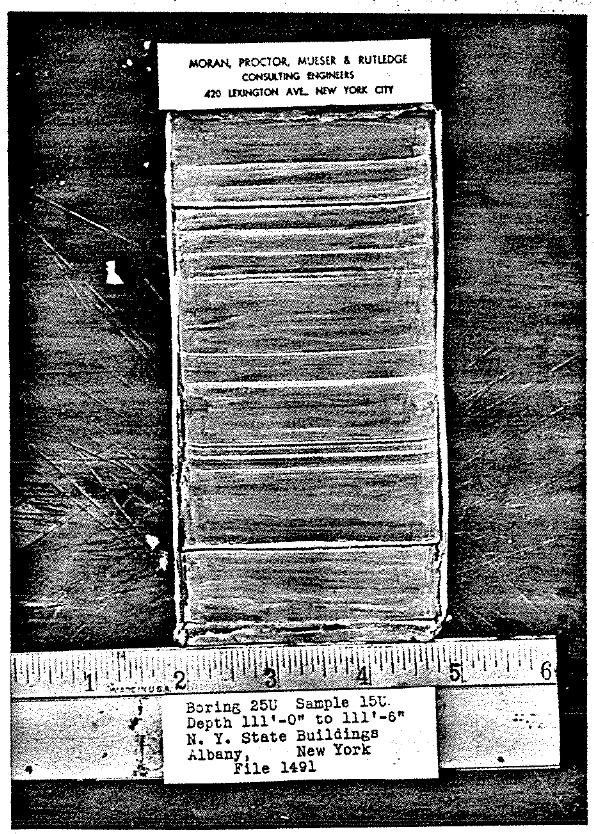

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
Boring 16U Sample 10U
Depth 111'-0" to 111'-6"
N. Y1 State Buildings
Albany, New York
File 1491

DWG. NO. 13

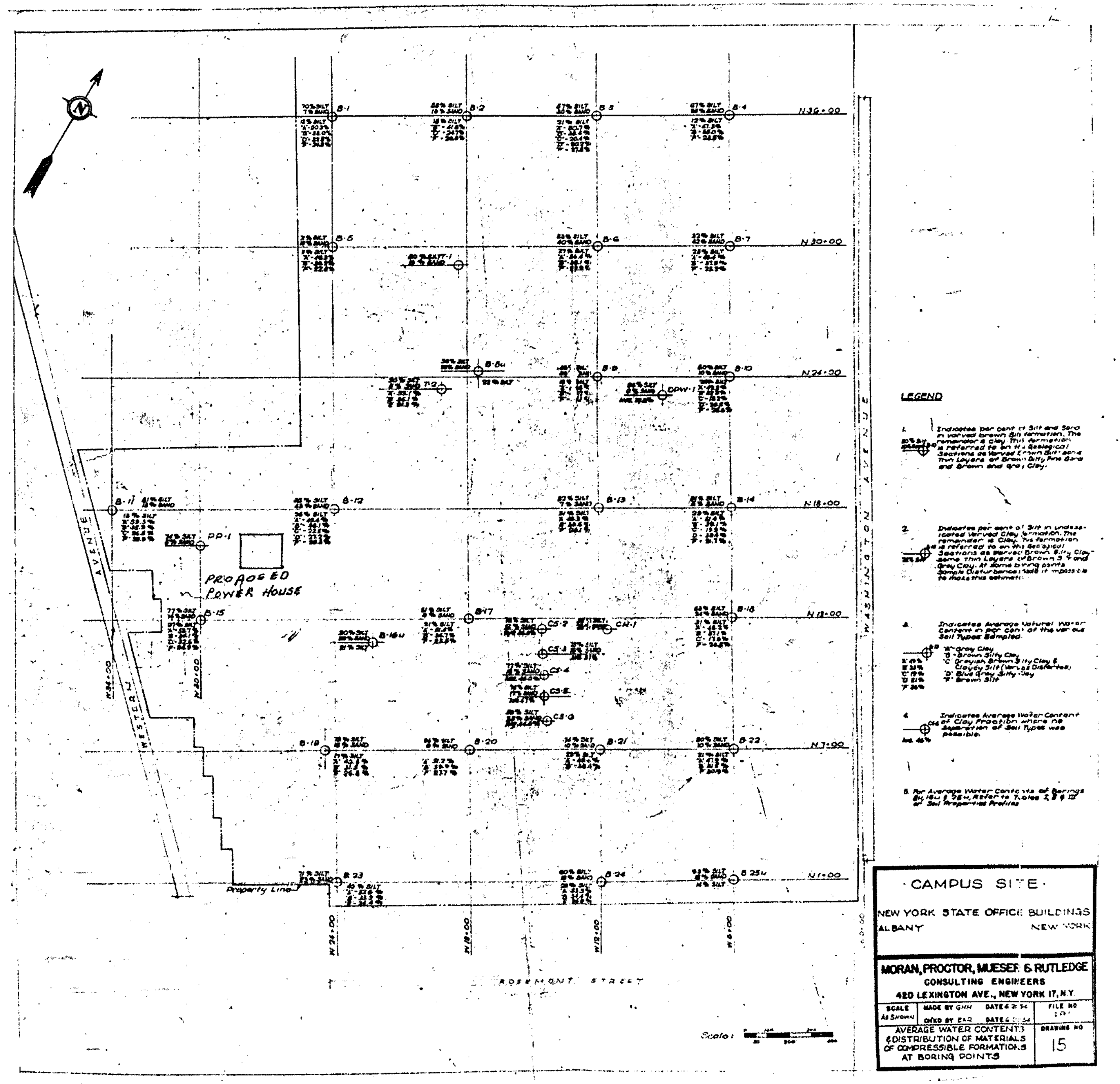
MORAN, PROCTOR, MUESER & RUTLEDGE



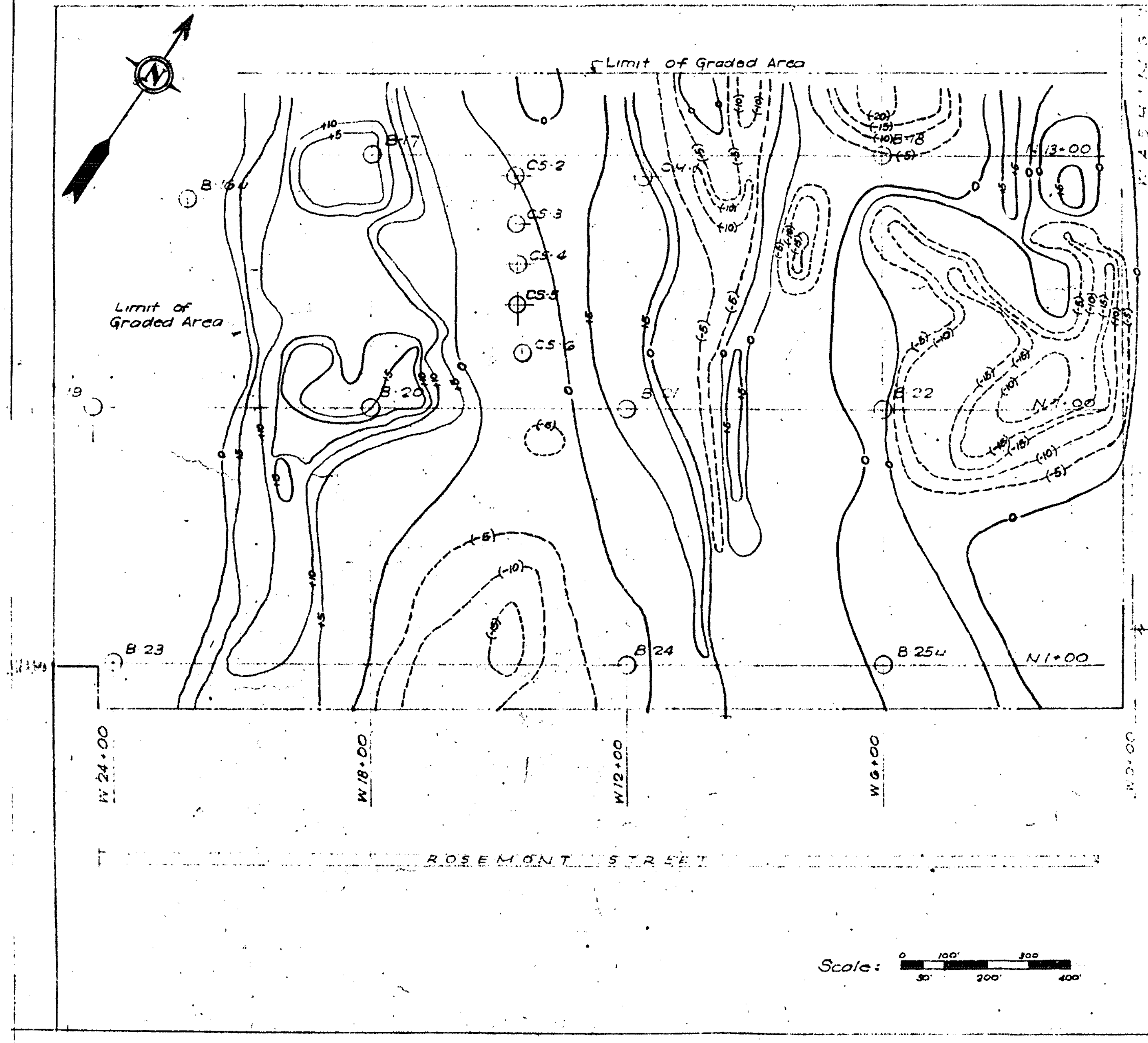




DWG NO. 14



LEGEND
PROPOSED POWER HOUSE
Property Line
WESTERN AVENUE
WASHINGTON AVENUE
ROSEMONT STREET
Scale
CAMPUS SITE
NEW YORK STATE OFFICE BUILDINGS
ALBANY
NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE As Shown
MADE BY GHH
CHKD BY EAR
FILE NO
AVERAGE WATER CONTENTS & DISTRIBUTION OF MATERIALS OF COMPRESSIBLE FORMATIONS AT BORING POINTS
DRAWING NO 15



NOTES!

1. —+5— Indicates Contour of Thickness of Fill.

2. ---(-5)--- Indicates Contour of Depth of Cut.

3 Contours were drawn from Revised Profiles, Drawings Nos. 53-111 to 53-115. Showing Existing & Finished Grades Received from the New York State Department of Public Works, Division of Construction

4 Contours are only approximate and should not be used for quantity estimates.

· CAMPUS SITE ·

NEW YORK STATE OFFICE BUILDINGS

ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE

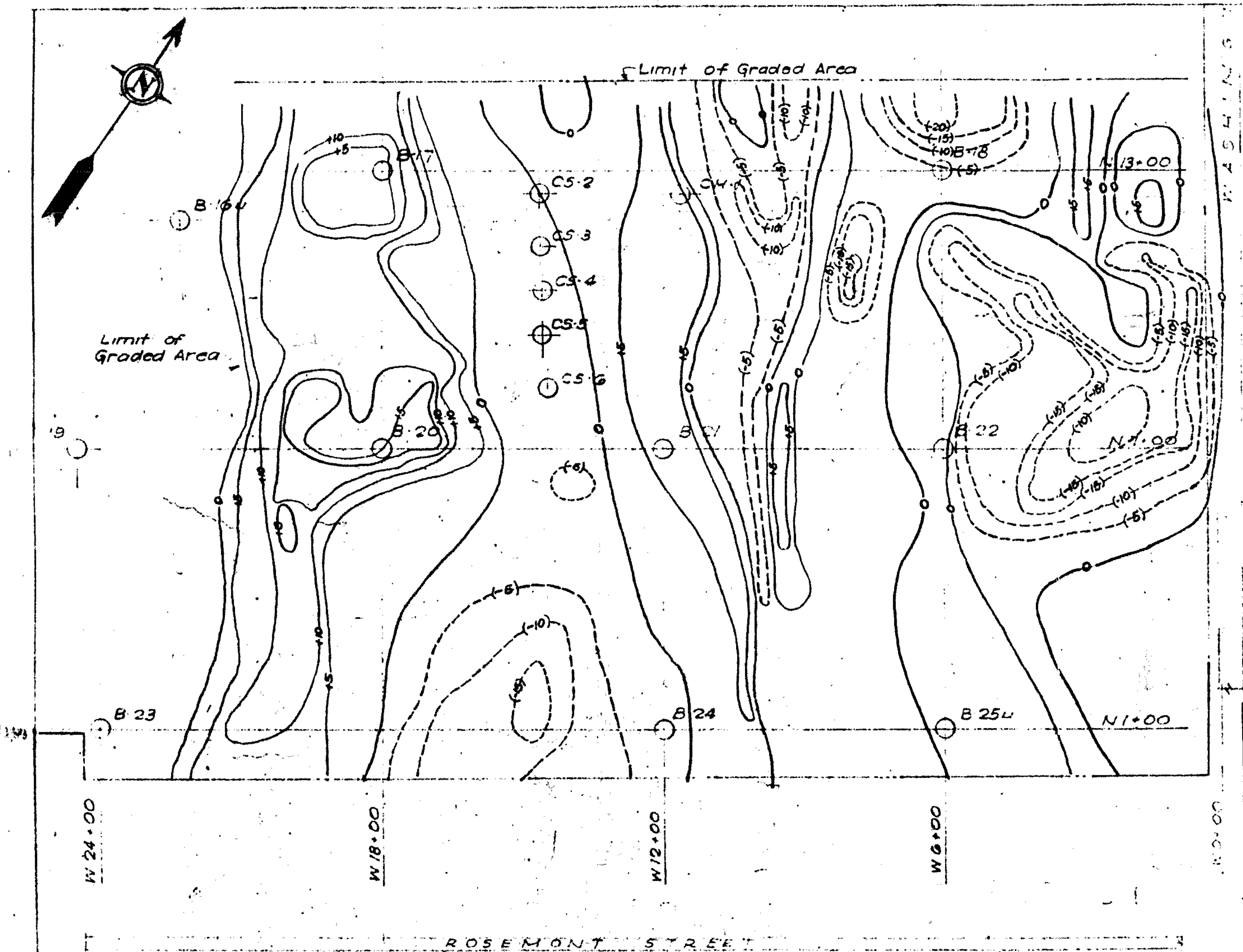
CONSULTING ENGINEERS

420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY GHH DATE 6-18-54	FILE NO.
As Shown	CH'KD BY EAR DATE 6-21-54	491

CONTOURS OF CUT & FILL OF GRADED AREAS

DRAWING NO. 16



NOTES!

1. —+5— Indicates Contour of Thickness of Fill.

2. - - -(-5)- - - Indicates Contour of Depth of Cut.

3. Contours were drawn from Revised Profiles, Drawings Nos. 53-111 to 53-115, Showing Existing & Finished Grades Received from the New York State Department of Public Works, Division of Construction.

4. Contours are only approximate and should not be used for quantity estimates.

Scale: 0 100' 300' / 50' 200' 400'

CAMPUS SITE

NEW YORK STATE OFFICE BUILDINGS

ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE

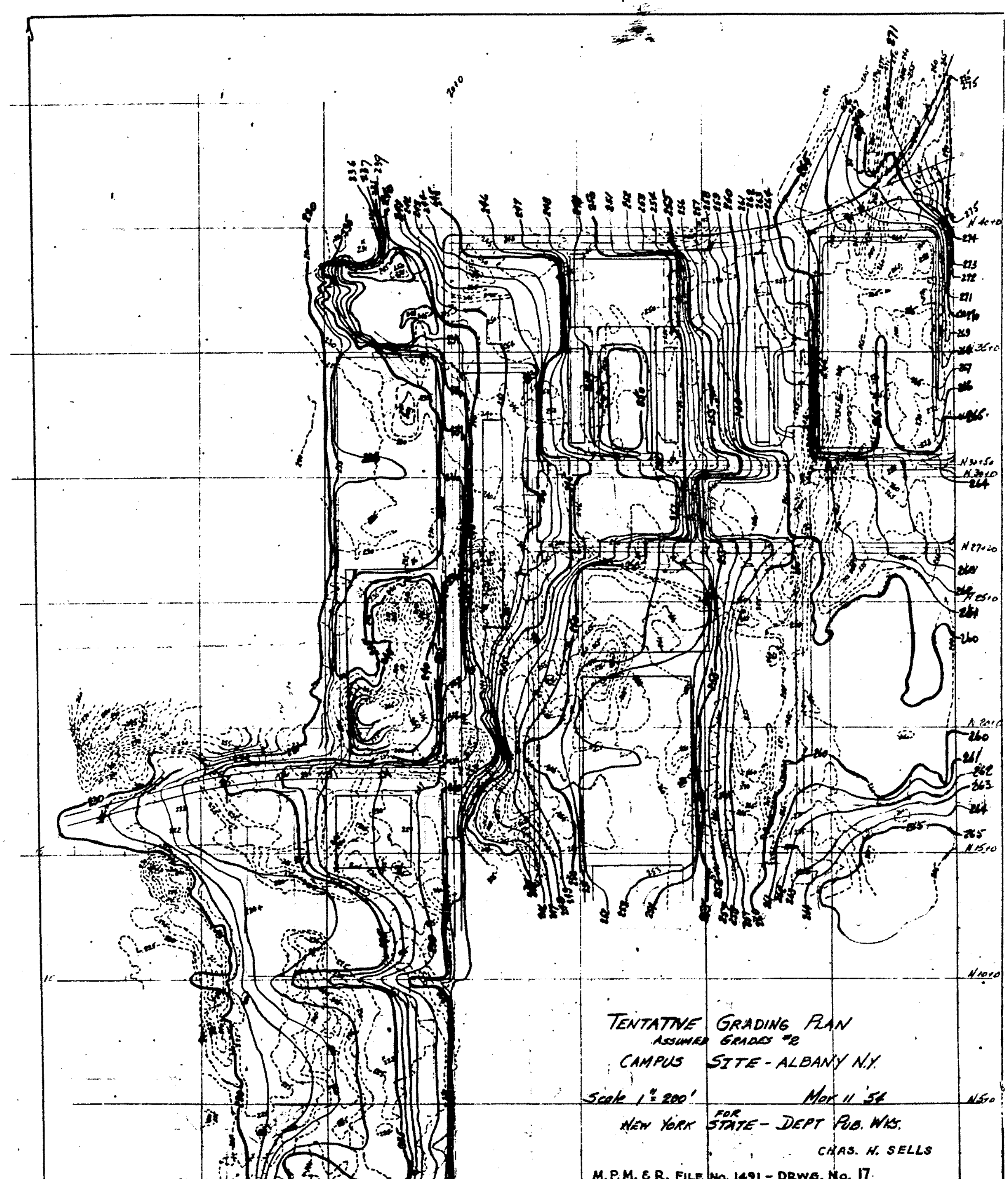
CONSULTING ENGINEERS

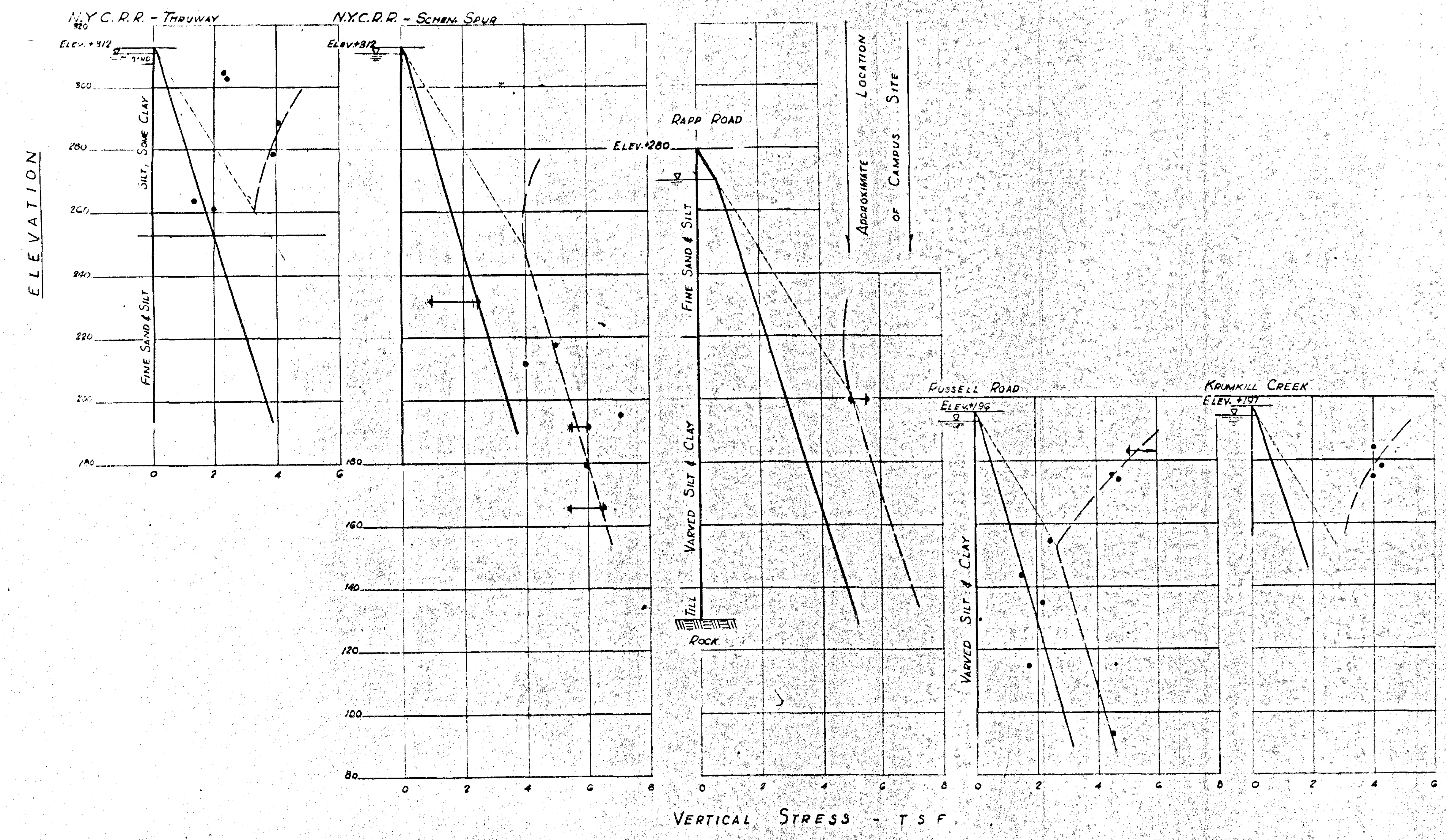
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY	DATE	FILE NO.
As Shown	GHH	6-18-54	1491
	CH'KD BY EAR	DATE 6-22-54	

CONTOURS OF CUT & FILL OF GRADED AREAS

DRAWING NO. 16


TENTATIVE GRADING PLAN
ASSUMED GRADES #2
CAMPUS SITE - ALBANY N.Y.
Scale 1" = 200'
Mar 11 '54
NEW YORK STATE - DEPT PUB. WKS.
FOR
CHAS. H. SELLS
M.P.M. & R. FILE No. 1491 - DRWG. No. 17

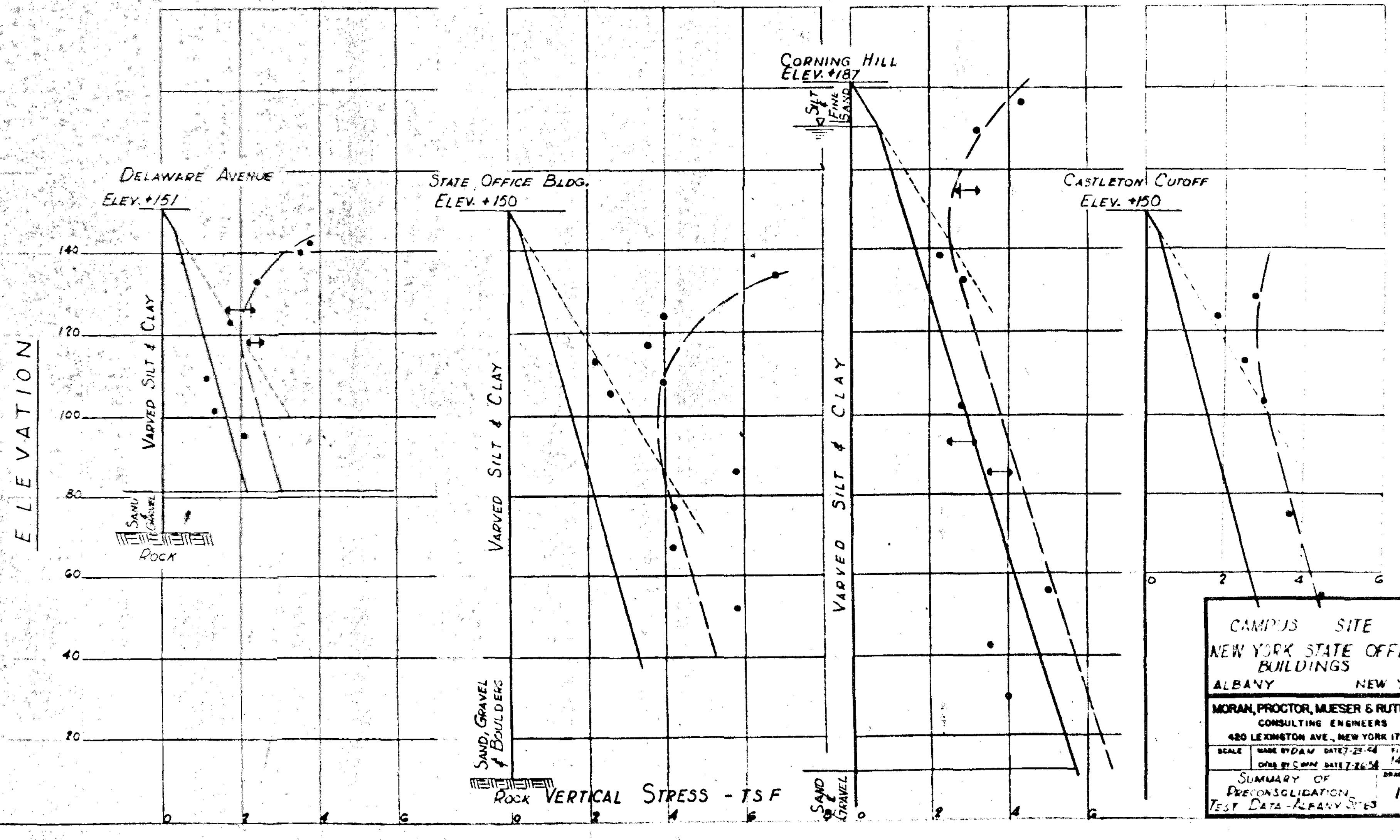


NOTES

1. ALL DATA OBTAINED FROM THE BUREAU OF SOIL MECHANICS, NEW YORK STATE DEPARTMENT OF PUBLIC WORKS.
2. WHERE GROUND WATER ELEVATION IS UNKNOWN, IT IS NOT NOTED BUT ASSUMED IN EFFECTIVE PRESSURE PLOTS TO BE 5 FEET BELOW GROUND SURFACE.
3. FOR SITE LOCATIONS, SEE DRAWING NO. 18.

LEGEND

- • INDICATES PRECONSOLIDATION PRESSURE OBTAINED FROM TEST.
- — — INDICATES ESTIMATED PRECONSOLIDATION PRESSURE.
- —— INDICATES EFFECTIVE OVERBURDEN PRESSURE.
- - - - INDICATES TOTAL OVERBURDEN PRESSURE.



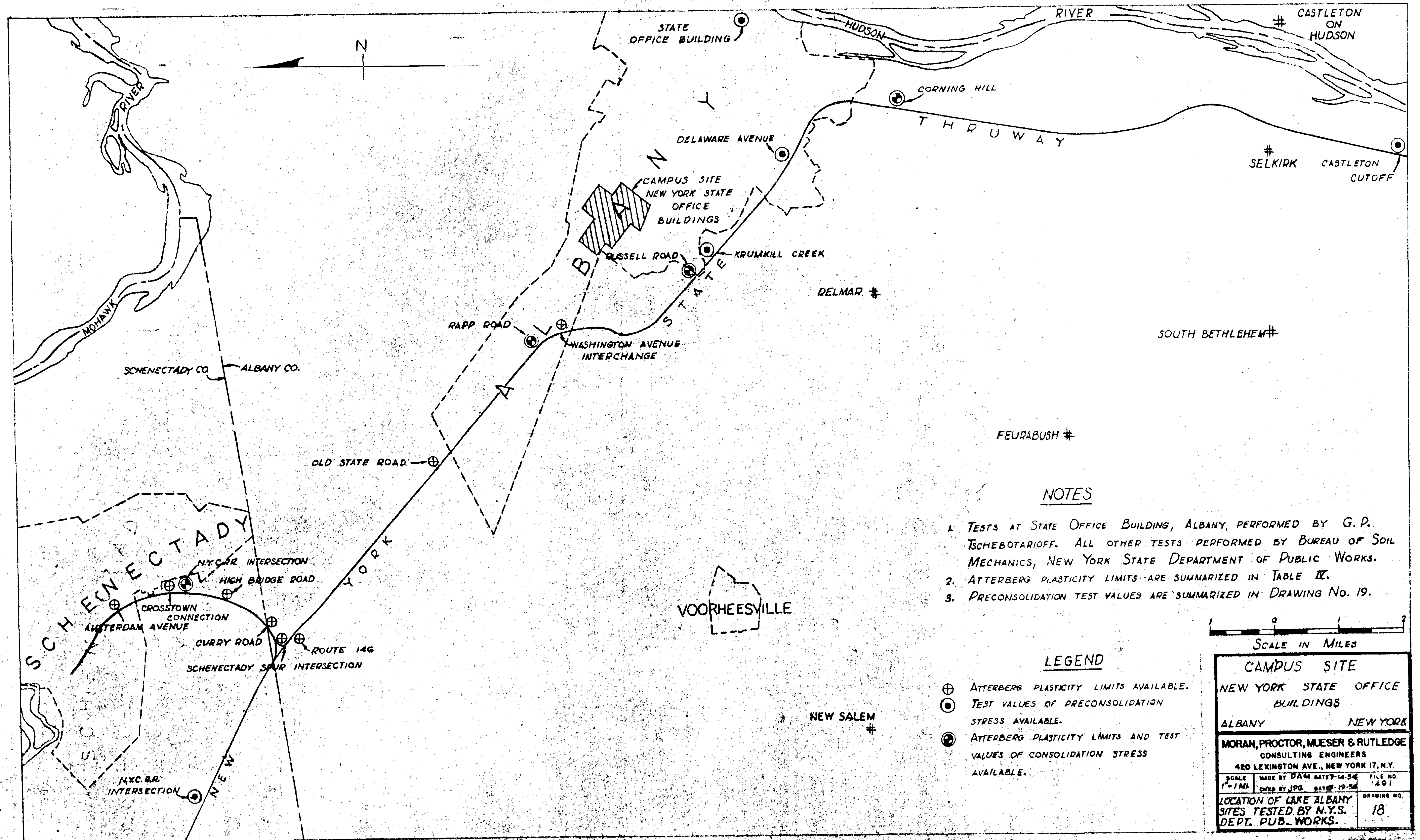
CAMPUS SITE
NEW YORK STATE OFFICE BUILDINGS
ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY DAM DATE 7-23-54 / CHKD BY CWM DATE 7-26-54	FILE NO 149'

SUMMARY OF PRECONSOLIDATION TEST DATA - ALBANY SITES

DRAWING NO 19



NOTES

1. Tests at State Office Building, Albany, performed by G. P. Tschebotarioff. All other tests performed by Bureau of Soil Mechanics, New York State Department of Public Works.
2. Atterberg plasticity limits are summarized in Table IV.
3. Preconsolidation test values are summarized in Drawing No. 19.

1 0 1 2

Scale in Miles

LEGEND

⊕ Atterberg plasticity limits available.

◉ Test values of preconsolidation stress available.

◉ Atterberg plasticity limits and test values of consolidation stress available.

CAMPUS SITE

NEW YORK STATE OFFICE BUILDINGS

ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE 1" = 1 MI.	MADE BY DAM DATE 7-14-54 CHKD BY JPG DATE 7-19-54	FILE NO. 1491
LOCATION OF LAKE ALBANY SITES TESTED BY N.Y.S. DEPT. PUB. WORKS.		DRAWING NO. 18

TABLE IV

ATTERBERG PLASTICITY LIMITS FOR SITES IN SCHENECTADY-ALBANY AREA

	LOCATION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
SCHENECTADY SPUR	Amsterdam Avenue	26	17	9
	Crosstown Connection	25	19	6
	N. Y. C. R. R. Intersection	25	18	7
	High Bridge Road	28	18	10
	Curry Road	28	18	10
	Schenectady Spur Intr.	28	18	10
THRUWAY, ALBANY TO SCHENECTADY	Route 146 Intersection	28	18	10
	Mohawk Intersection	26	17	9
	Old State Road	41	23	18
	Rapp Road	37	22	15
	Washington Ave. Intr.	39	21	18
	Washington Ave. Control	37	21	16
	Russell Road	37	22	15
	Corning Hill	37	20	17

NOTES

1. All data provided by Bureau of Soil Mechanics, New York State Department of Public Works.
2. Atterberg plasticity limits were performed on composite samples of varved brown silty clay stratum.

TABLE V

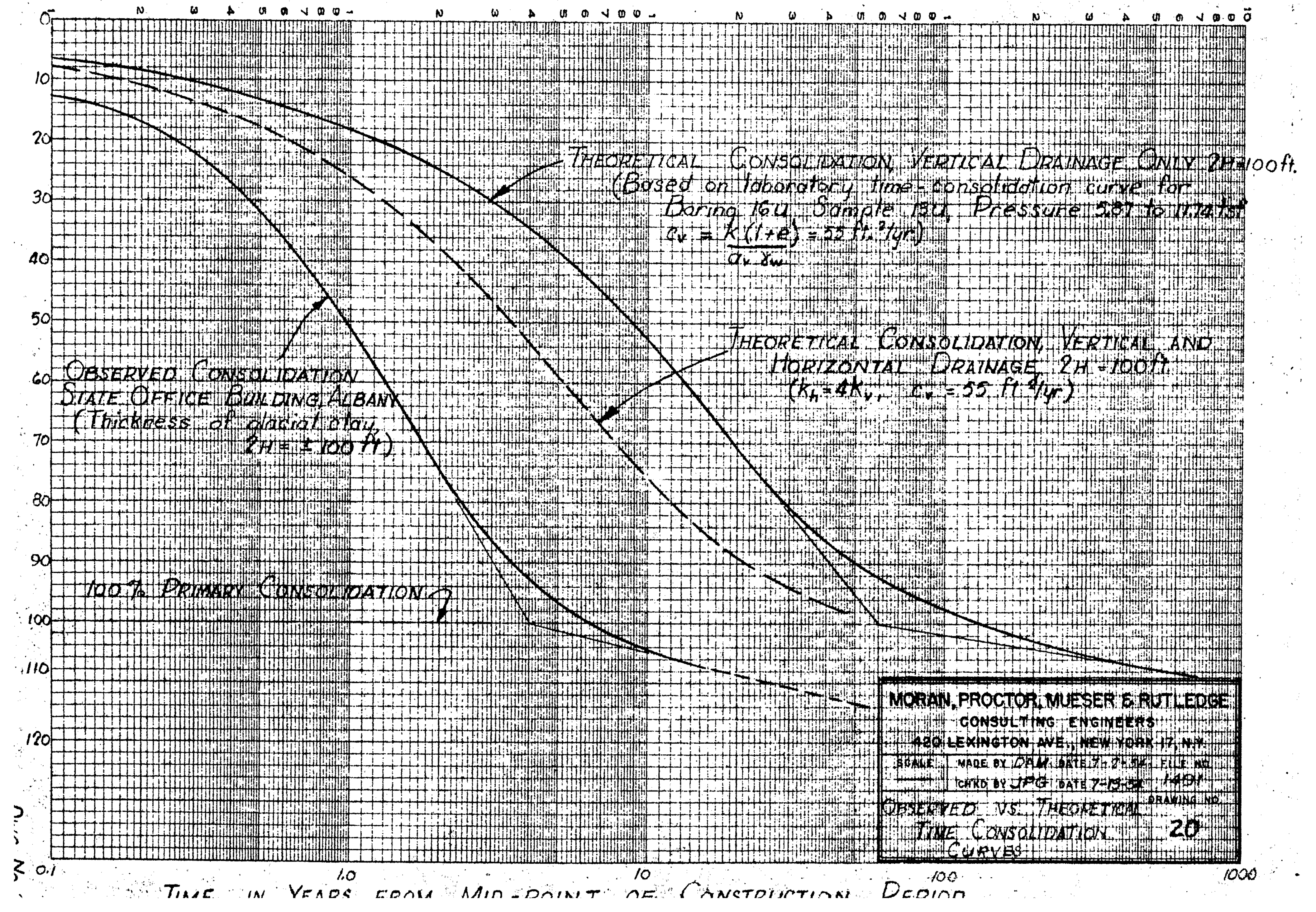
SUMMARY OF ULTIMATE SETTLEMENTS

Building Dimensions in Feet	Building Location	Ground Water Level (Elevation)	Foundation Depth in Feet	Settlement in Inches: Point A Center of Building, Applied Stress 0.5 TSF	Point A 1.0 TSF	Point A 1.5 TSF	Point A 2.0 TSF	Point B Center of Long Side, Applied Stress 0.5 TSF	Point B 1.0 TSF	Point B 1.5 TSF	Point B 2.0 TSF	Point C Corner of Building, Applied Stress 0.5 TSF	Point C 1.0 TSF	Point C 1.5 TSF	Point C 2.0 TSF	Loading Condition
400' x 60'	8U	236	0	1.9	3.5	5.0	6.3	1.4	2.7	3.9	5.0	0.8	1.5	2.2	2.8	Surface Loading
		236	8	*(1.8) **0.5				(1.3) 0.3				(0.7) 0.2				Balancing Excavation
			16		(4.3) 1.2				(2.9) 0.8				(1.4) 0.4			
			24			(7.5) 2.0				(4.6) 1.2				(2.2) 0.6		
			32				(10.6) 2.9				(6.4) 1.7				(2.9) 0.8	
		158	0	3.5	7.0	10.5	13.7	2.9	5.9	9.2	12.3	1.6	3.2	4.8	6.4	Depressed Water Table — Surface Loading
		158	8	(1.3) 0.3				(1.0) 0.3				(0.5) 0.1				Depressed Water Table — Balancing Excavation
			16		(3.1) 0.8				(1.9) 0.5				(0.9) 0.2			
			24			(5.2) 1.4				(3.0) 0.8				(1.5) 0.4		
			32				(6.9) 1.9				(3.9) 1.0				(2.0) 0.5	
600' x 80'	8U	236	0	2.3	4.0	5.8	7.4	1.6	3.0	4.5	5.9	0.9	1.7	2.6	3.2	Surface Loading
300' x 80'	8U	236	0	2.1	3.9	5.6	7.2	1.6	3.0	4.3	5.6	0.9	1.6	2.5	3.1	Surface Loading
200' x 200'	8U	236	0	3.0	5.5	7.7	9.6	1.7	3.3	4.8	6.0	1.0	1.9	2.9	3.6	Surface Loading
		236	8	(2.9) 0.8				(1.5) 0.4				(0.8) 0.2				Balancing Excavation
			16		(7.2) 1.9				(3.3) 0.9				(1.9) 0.5			
			24			(12.4) 3.4				(5.6) 1.5				(3.0) 0.8		
			32				(19.4) 5.2				(7.6) 2.1				(3.8) 1.0	

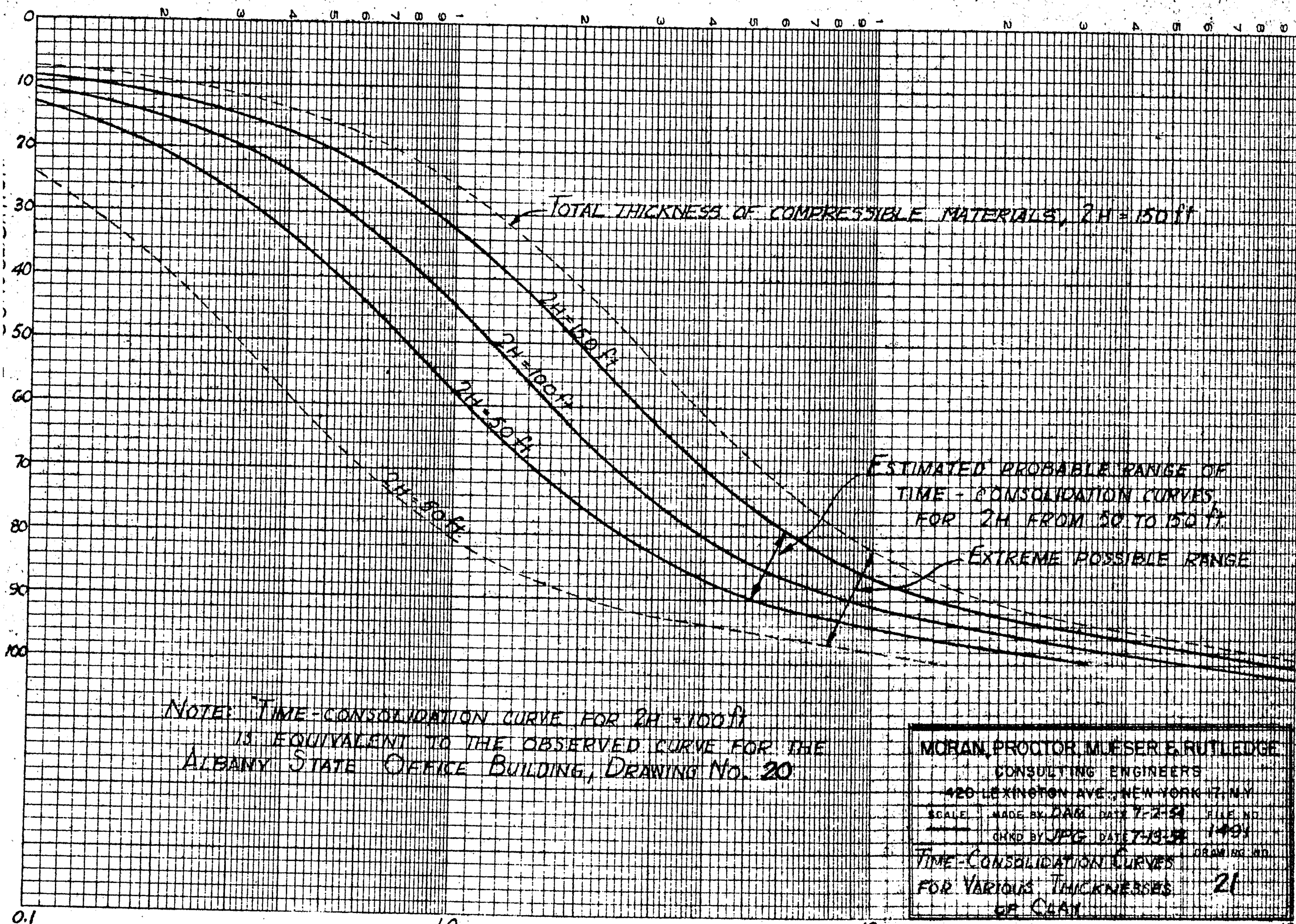
NOTES:

*(1.8) Indicates Ultimate Settlement if 100% Rebound is Allowed to Occur.

**0.5 Indicates Most Probable Settlement (27% of Ultimate Settlement)



1. 34 O DI N. GI PAPE
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.
THEORETICAL CONSOLIDATION, VERTICAL DRAINAGE ONLY 2H=100ft.
(Based on laboratory time-consolidation curve for
Boring 16U, Sample 15U, Pressure 5.87 to 11.74 t/sf
$c_v = \frac{k(1+e)}{a_v \gamma_w} = 55$ ft.²/yr.)
THEORETICAL CONSOLIDATION, VERTICAL AND
HORIZONTAL DRAINAGE 2H = 100 ft.
($k_h = 4k_v$, $c_v = 55$ ft.²/yr.)
OBSERVED CONSOLIDATION
STATE OFFICE BUILDING, ALBANY
(Thickness of glacial clay,
2H = ± 100 ft.)
100 % PRIMARY CONSOLIDATION
0
10
20
30
40
50
60
70
80
90
100
110
120
0.1
1.0
10
100
1000
TIME IN YEARS FROM MID-POINT OF CONSTRUCTION PERIOD
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE
MADE BY DAM DATE 7-2-54
FILE NO. 1491
CHKD BY JPG DATE 7-13-54
DRAWING NO.
20
OBSERVED VS. THEORETICAL
TIME CONSOLIDATION
CURVES



TIME IN YEARS FROM MIDPOINT OF CONSTRUCTION

SEMI-LOGARITHMIC 3 CYCLES X 10 DIVISIONS

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

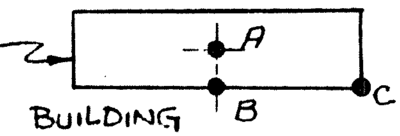
CAMPUS SITE
FOR N.Y. STATE OFFICE BUILDINGS

SHEET No.
FILE 1491
MADE BY DMD DATE JUNE 30, 1954
CHECKED BY JPG DATE JULY 9, 1954

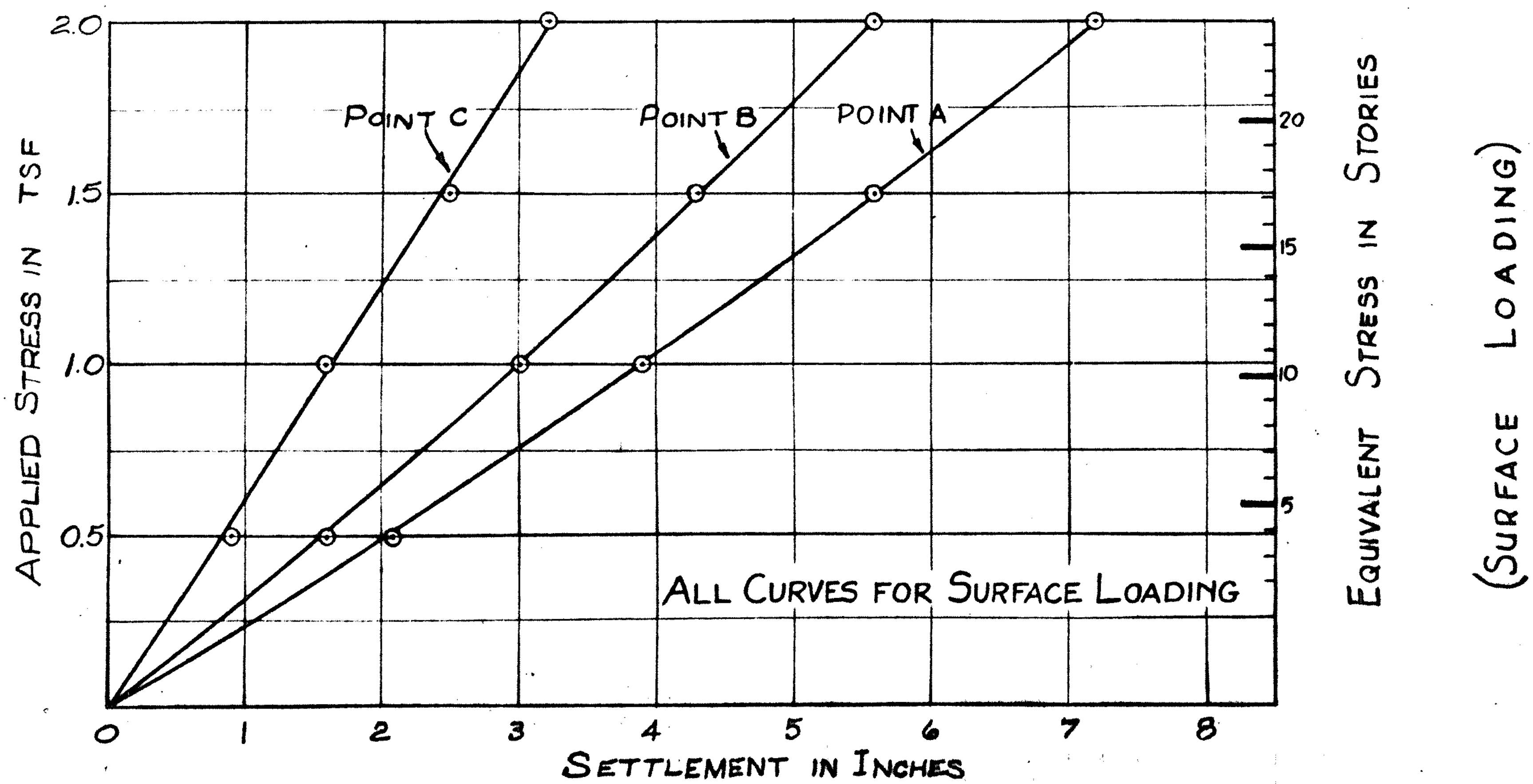
COMPUTED ULTIMATE SETTLEMENTS
300' x 80' BUILDING

NOTES:

1. BUILDING PLAN SHOWING SETTLEMENT POINTS



2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE ENTIRE BUILDING EQUAL TO THAT AT BORING 8U (N24+27, W17+50 ELEVATION 239.9)
3. ASSUMED GROUND WATER ELEVATION 236'



DWG. No. 22

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

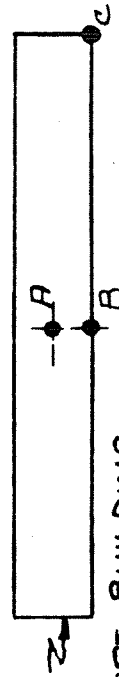
CAMPUS SITE
FOR N.Y. STATE OFFICE BUILDINGS

SHEET No. OF
FILE 1491
MADE BY DMD DATE JUNE 30, 1954
CHECKED BY JPG DATE JULY 9, 1954

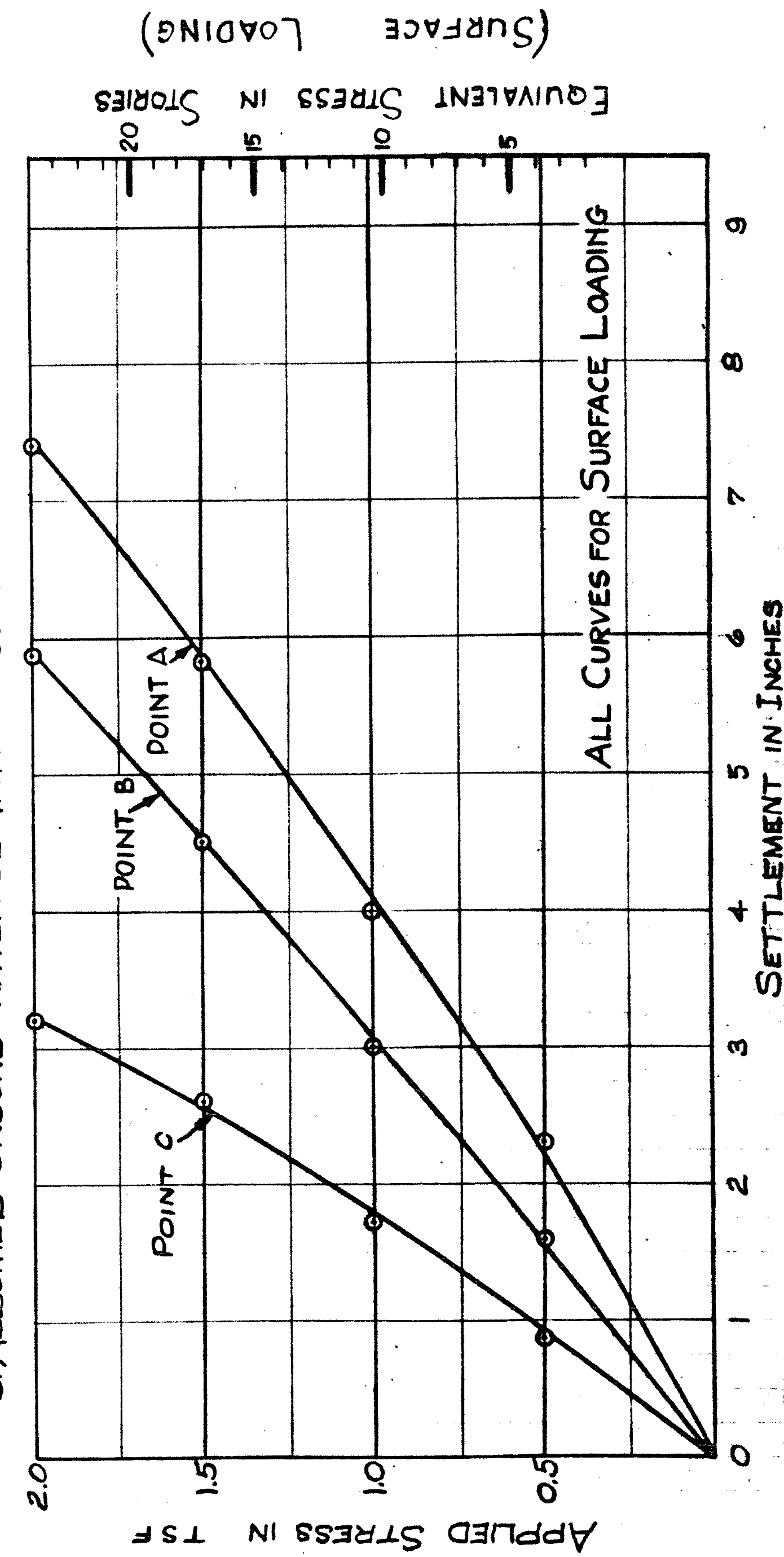
COMPUTED ULTIMATE SETTLEMENTS
600'x80' BUILDING

NOTES:

1. BUILDING PLAN SHOWING SETTLEMENT POINTS



2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE ENTIRE BUILDING EQUAL TO THAT AT BORING 8U (N24+27, W17+50; ELEVATION 239.9)
3. ASSUMED GROUND WATER ELEVATION 236'



MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

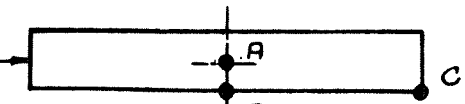
CAMPUS SITE
FOR N.Y. STATE OFFICE BUILDINGS

Sheet No. Of
File 1491
Made By DMD Date JUNE 30, 1954
Checked By JPG Date JULY 9, 1954

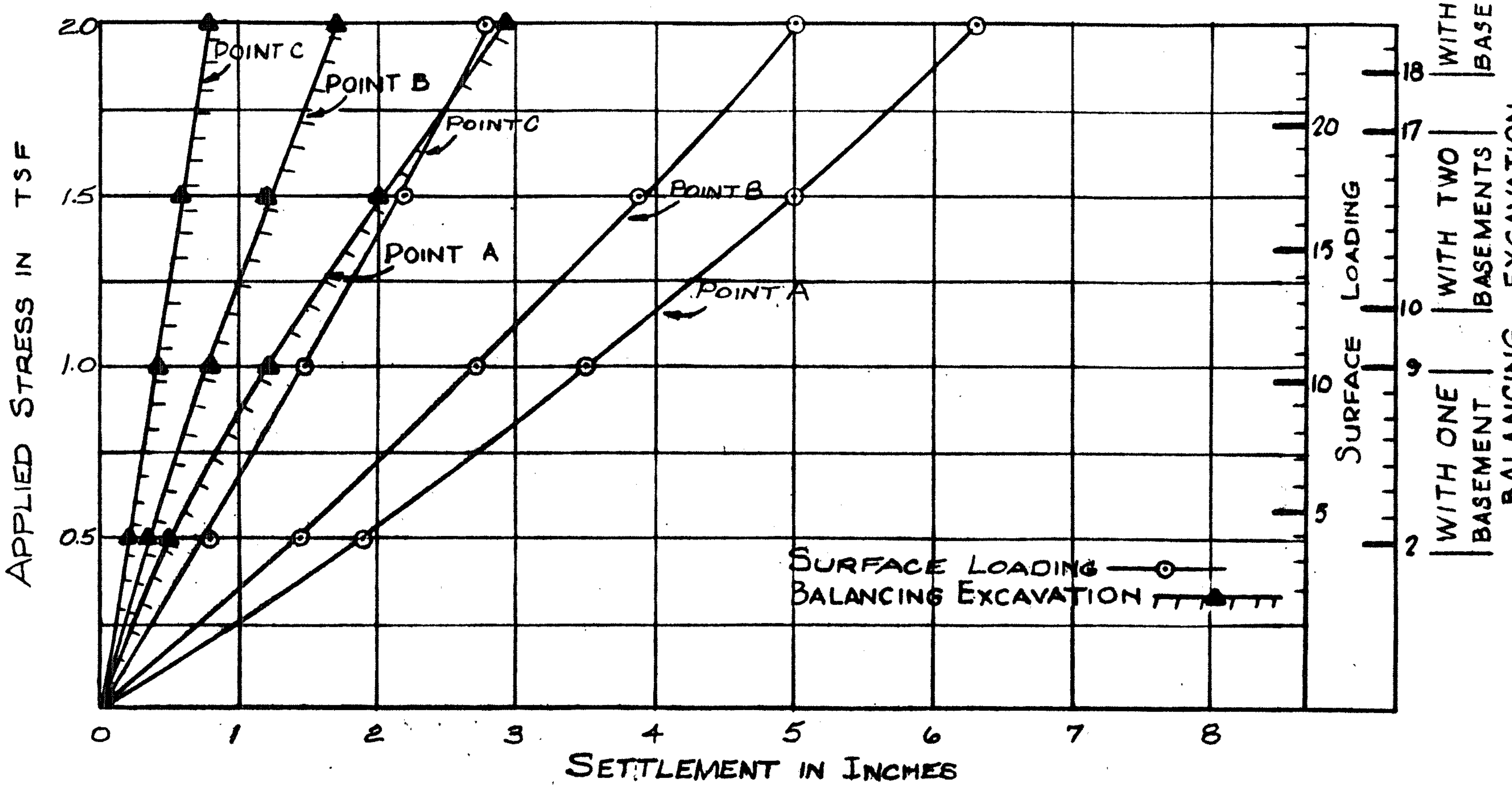
COMPUTED ULTIMATE SETTLEMENTS
400' x 60' BUILDING

NOTES:

1. BUILDING PLAN SHOWING SETTLEMENT POINTS



2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE ENTIRE BUILDING EQUAL TO THAT AT BORING 8U (N24+27, W17+50, ELEVATION 239.9')
3. ASSUMED GROUND WATER ELEVATION 236'



MORAN, PROCTOR, MUESER & RUTLEDGE

CONSULTING ENGINEERS

CAMPUS SITE

FOR N.Y. STATE OFFICE BUILDINGS

SHEET No. OF

FILE 1491

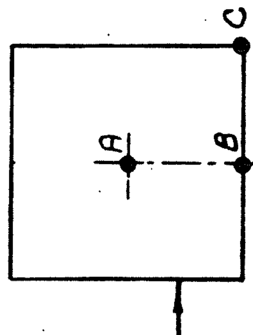
MADE BY DMD DATE JUNE 30, 1954

CHECKED BY JPG DATE JULY 9, 1954

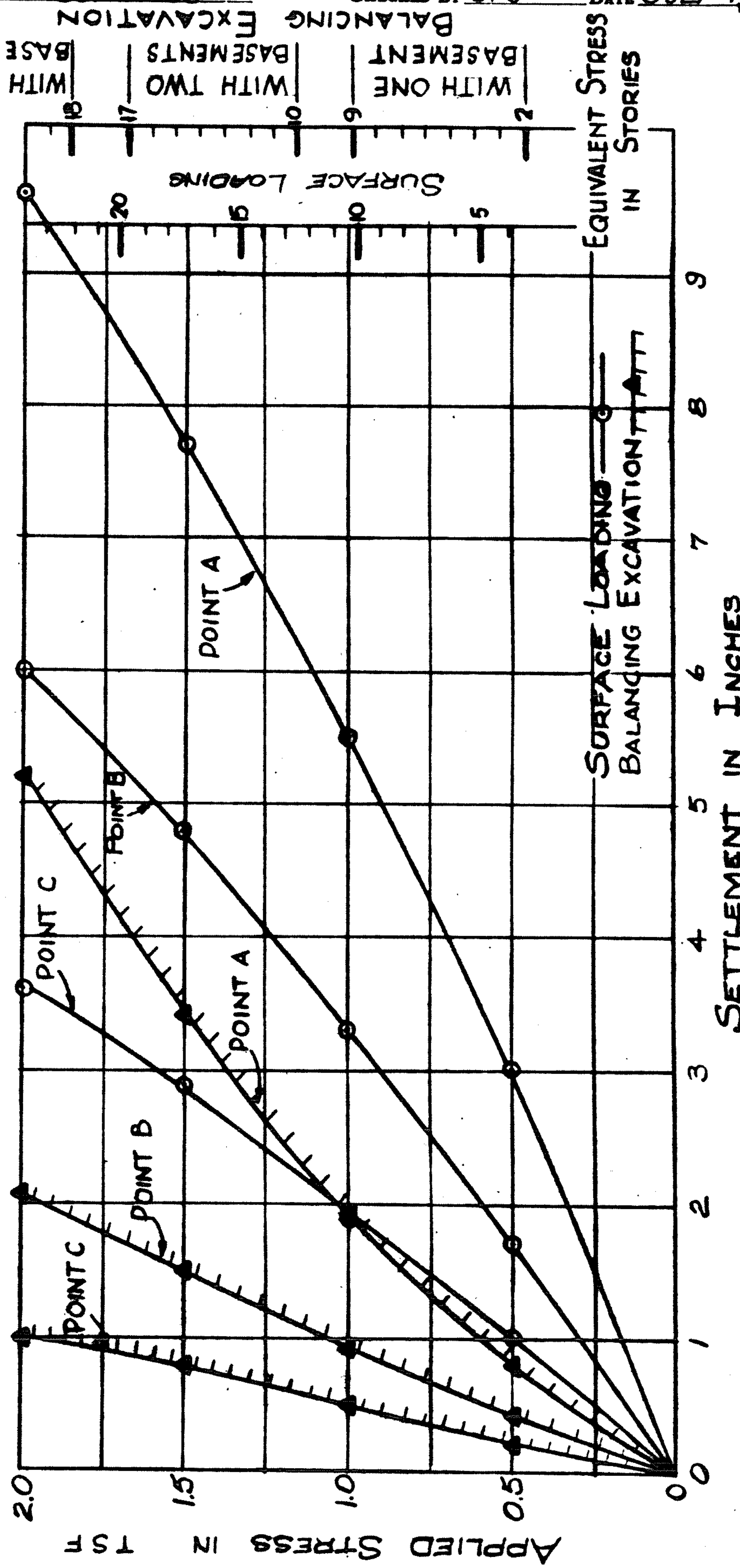
COMPUTED ULTIMATE SETTLEMENTS
200' x 200' BUILDING

NOTES:

1. BUILDING PLAN SHOWING SETTLEMENT POINTS



2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE ENTIRE BUILDING EQUAL TO THAT AT BORING 8U (N24+27, W17+50, ELEVATION 239.9')
3. ASSUMED GROUND WATER ELEVATION 236'



DWG No. 2

MORAN, PROCTOR, MUESER & RUTLEDGE

CONSULTING ENGINEERS

CAMPUS SITE

FOR N.Y. STATE OFFICE BUILDINGS

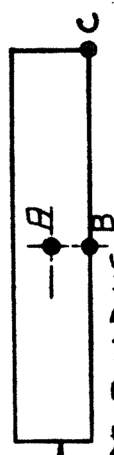
SHEET No. OF

FILE 1491

MADE BY DMD DATE JUNE 30, 1954

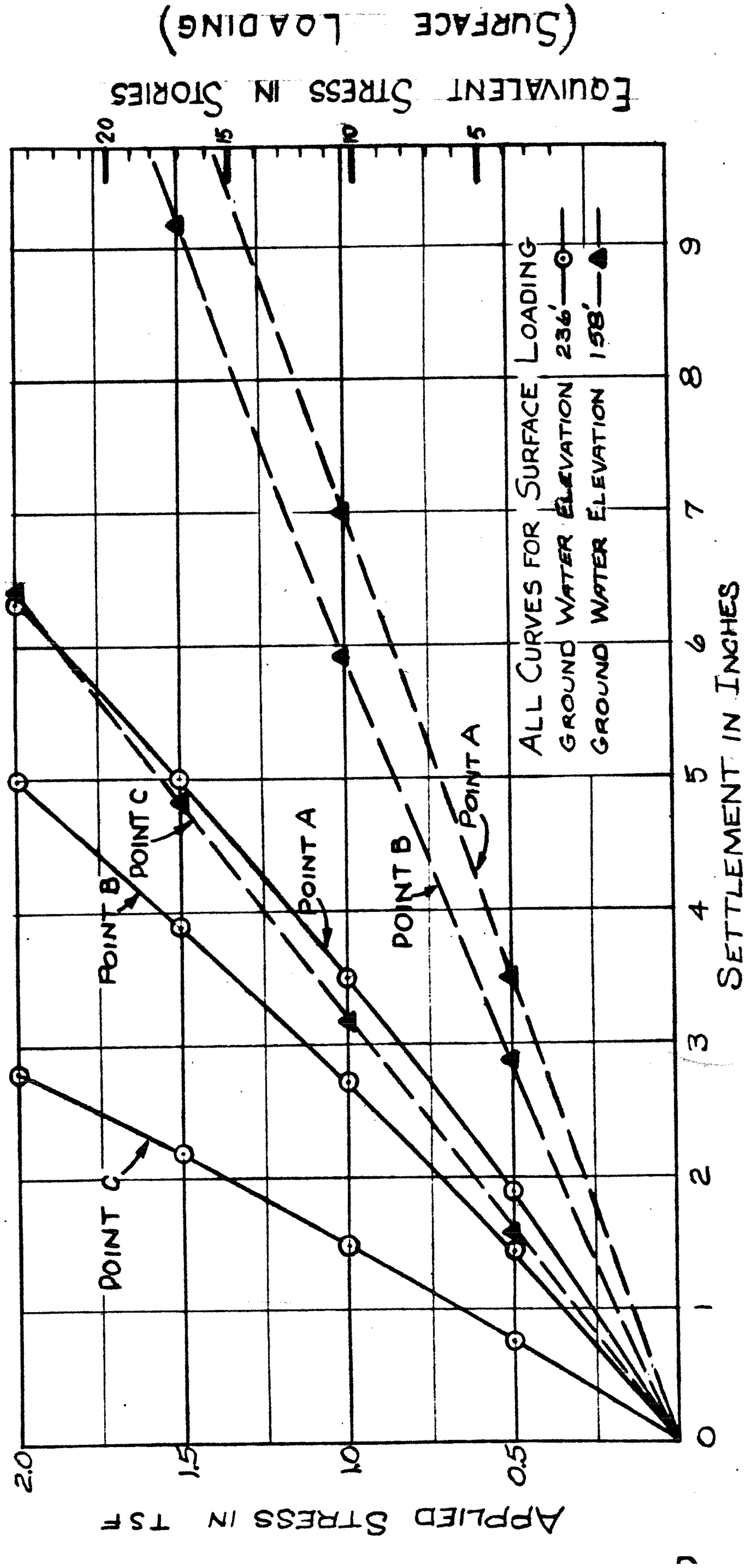
CHECKED BY JPG DATE JULY 9, 1954

COMPUTED ULTIMATE SETTLEMENTS
400'x60' BUILDING



NOTES:

1. BUILDING PLAN SHOWING SETTLEMENT POINTS
2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE ENTIRE BUILDING EQUAL TO THAT AT BORING 8U (N24+27, W17+50 ; ELEVATION 239.9')
3. ASSUMED GROUND WATER ELEVATIONS AS INDICATED



MORAN, PROCTOR, MUESER & RUTLEDGE

CONSULTING ENGINEERS

CAMPUS SITE

FOR N.Y. STATE OFFICE BUILDINGS

SHEET No. OF

FILE 1491

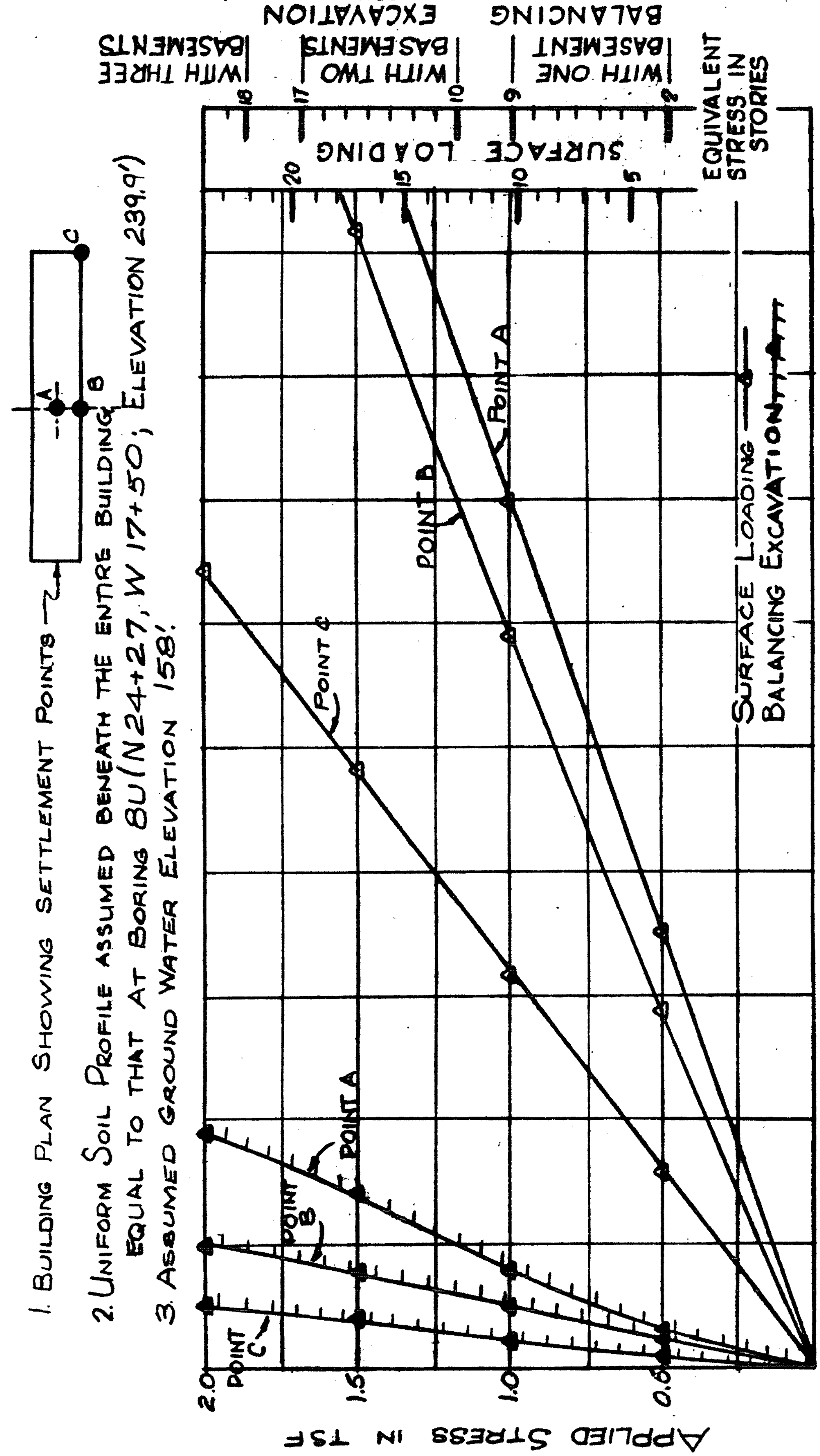
MADE BY DMD DATE JUNE 30, 1954

CHECKED BY JPG DATE JULY 9, 1954

COMPUTED ULTIMATE SETTLEMENTS
400' x 60' BUILDING

NOTES:

1. BUILDING PLAN SHOWING SETTLEMENT POINTS
2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE ENTIRE BUILDING EQUAL TO THAT AT BORING 8U (N 24+27, W 17+50; ELEVATION 239.9')
3. ASSUMED GROUND WATER ELEVATION 158'



MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

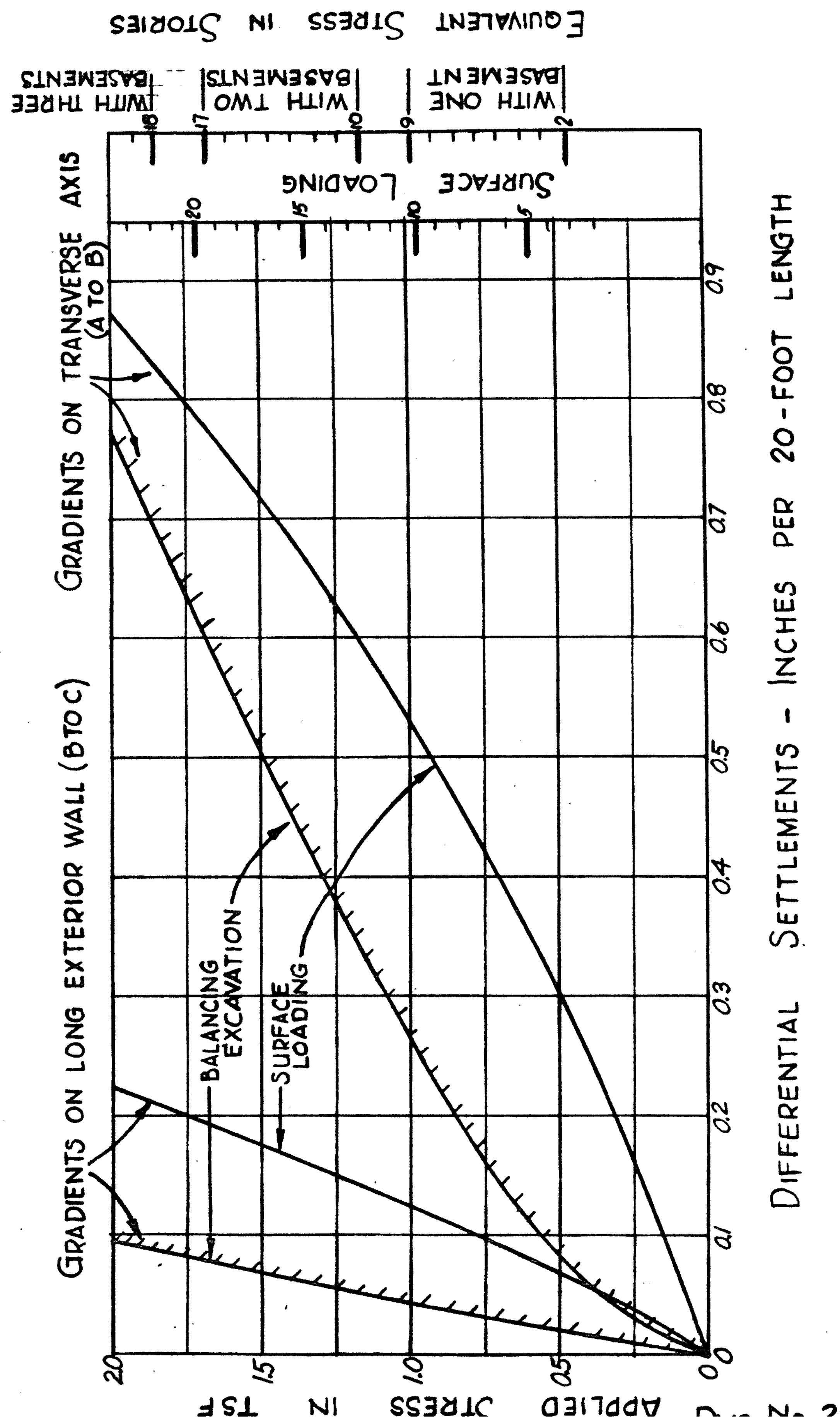
CAMPUS SITE
FOR N. Y. STATE OFFICE BUILDINGS

SHEET No. OF
FILE 1491
MADE BY JPG DATE JULY 7, 1954
CHECKED BY DMD DATE JULY 8, 1954

GRADIENTS OF DIFFERENTIAL SETTLEMENTS

NOTES:

1. VALUES SHOWN ARE FOR 400'x 60' BUILDING AT GROUND SURFACE AND WITH BALANCING EXCAVATION.
2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE BUILDINGS EQUAL TO THAT AT BORING 8U.
3. ASSUMED GROUND WATER ELEVATION 236.



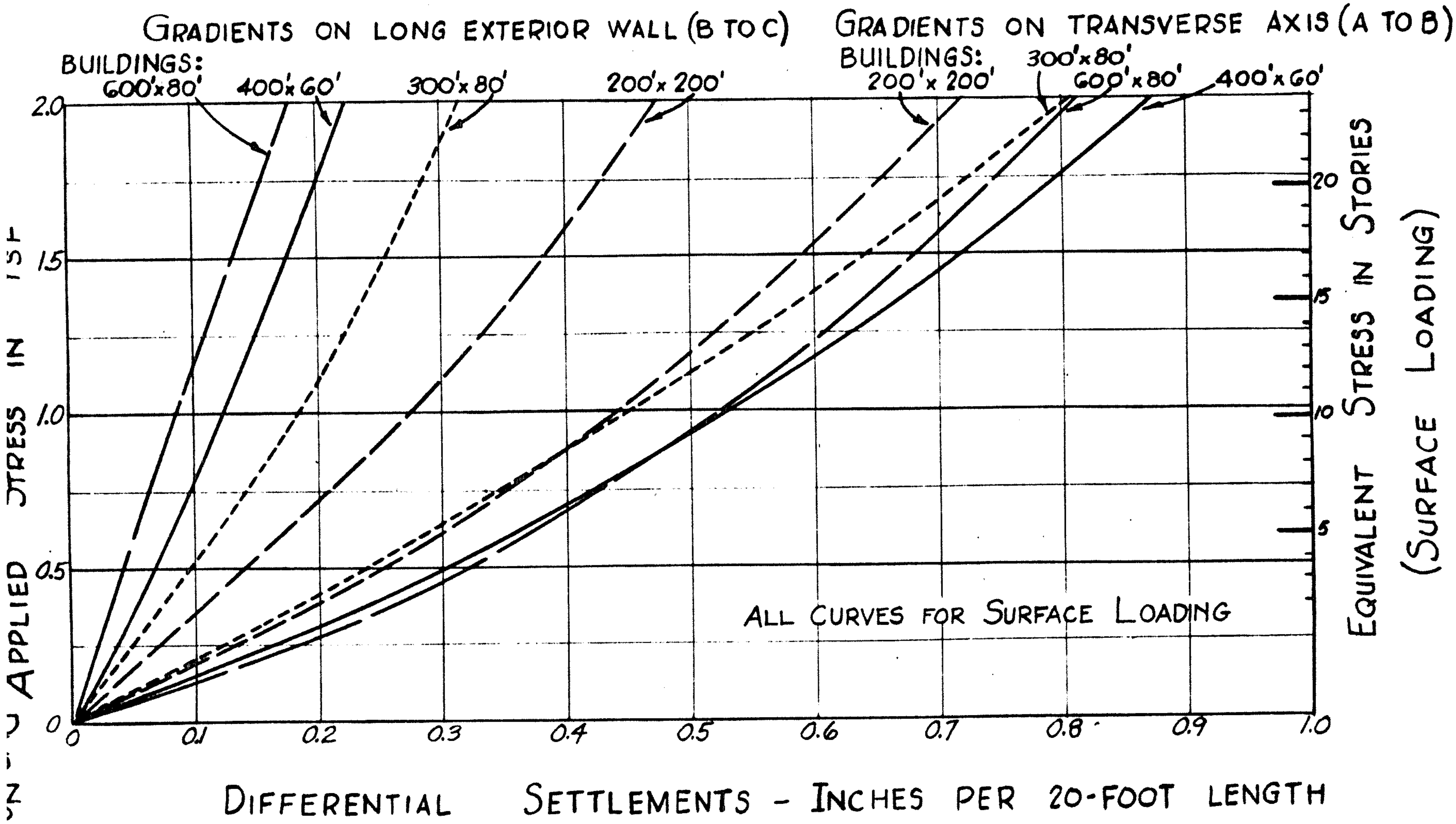
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
CAMPUS SITE
FOR N.Y. STATE OFFICE BUILDINGS

Sheet No. Of
File 1491
Made By JPG Date JULY 7, 1954
Checked By DMD Date JULY 8, 1954

GRADIENTS OF DIFFERENTIAL SETTLEMENTS

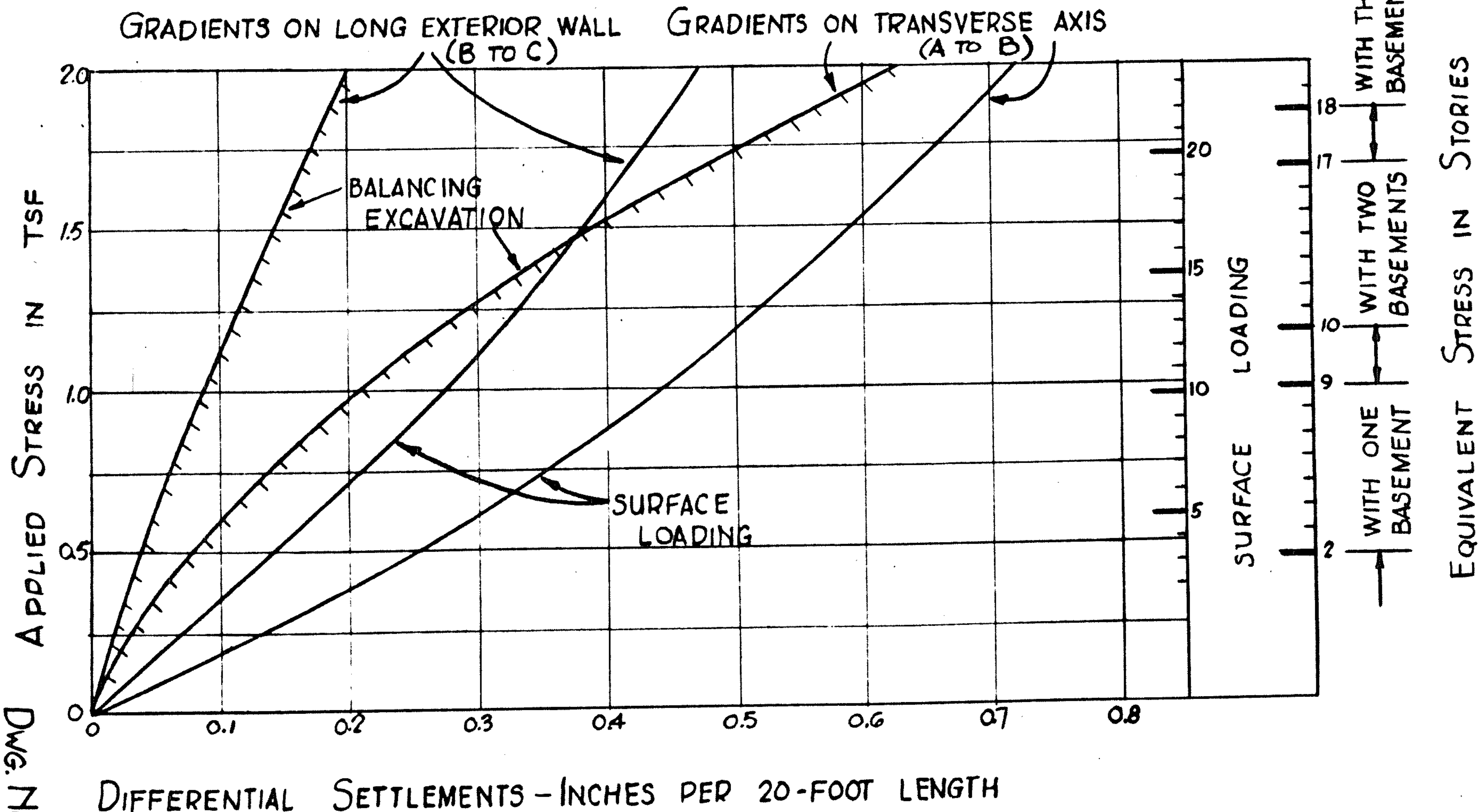
NOTES:

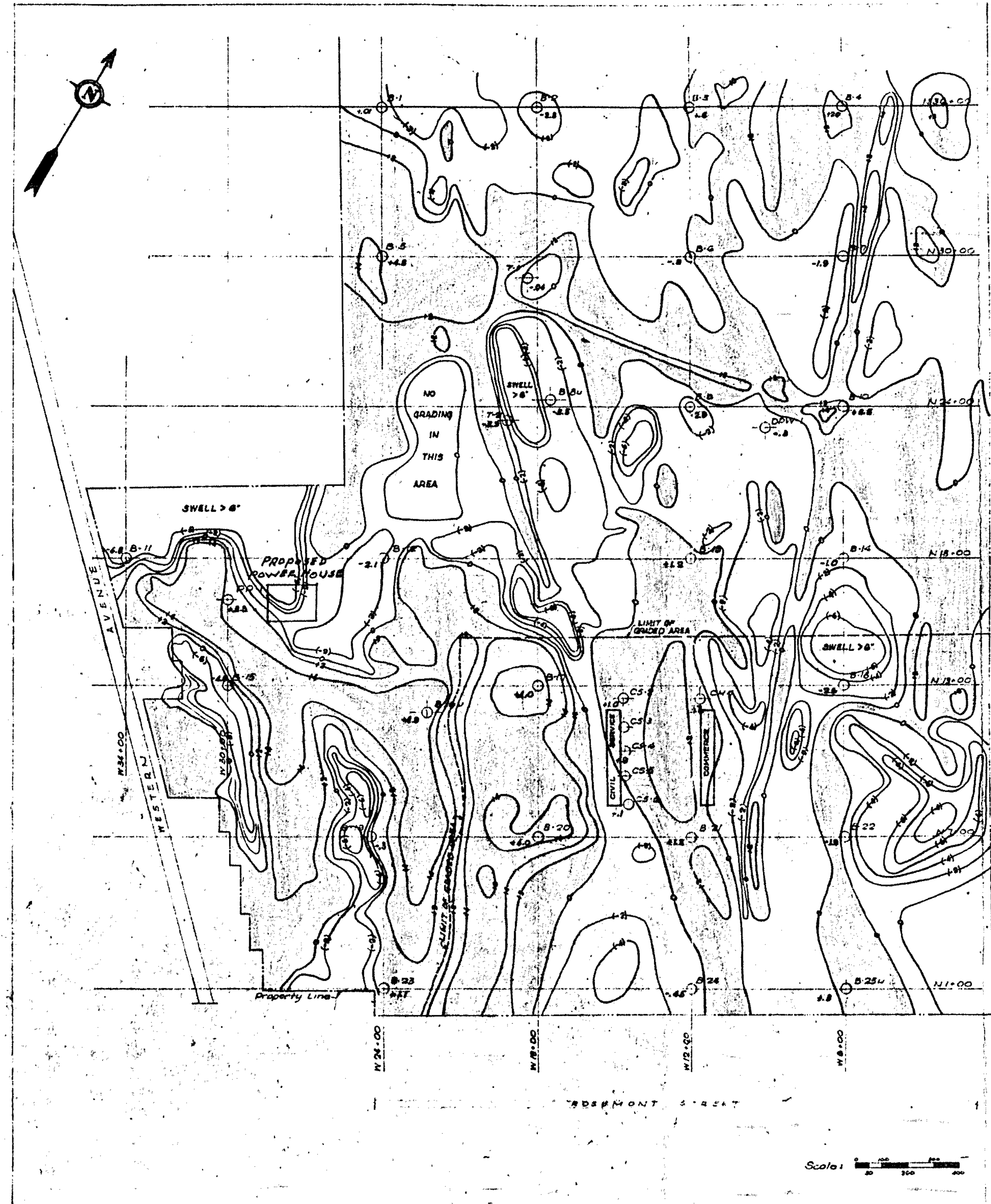
1. VALUES SHOWN ARE FOR BUILDINGS PLACED AT GROUND SURFACE.
2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE BUILDINGS EQUAL TO THAT AT BORING 8U.
3. ASSUMED GROUND WATER ELEVATION 236.



GRADIENTS OF DIFFERENTIAL SETTLEMENTS

NOTES:
1. VALUES SHOWN ARE FOR 200' x 200' BUILDING AT GROUND SURFACE AND WITH BALANCING EXCAVATION.
2. UNIFORM SOIL PROFILE ASSUMED BENEATH THE BUILDING EQUAL TO THAT AT BORING 8U.
3. ASSUMED GROUND WATER ELEVATION 236.





NOTES

1. Original topography obtained from plan of campus site showing surface features and contours of surface elevation as of 1948 entitled 'General Plot Plan', provided by New York State Department of Public Works.
2. Elevations of Final Grade were taken from 'Tentative Grading Plan, Assumed Grades #2 Campus Site, Albany, N.Y.' as prepared by Chas. H. Sells, Dwg No. 17.
3. Settlement Contours in Southeast area within dashed lines are based on Dwg No. 15 showing Contours of Cut and Fill of Graded Areas.
4. Contours of settlement and swell at the two building locations are for the effects of rough grading operations only.

LEGEND

—+2— Indicates Contours of Computed Ultimate Settlement in inches.

—(-2)— Indicates Contours of Computed Ultimate Swell in inches.

Indicates Computed Ultimate Settlement or Swell at Boring Point.

Indicates Areas of Settlement

Indicates Areas of Swell

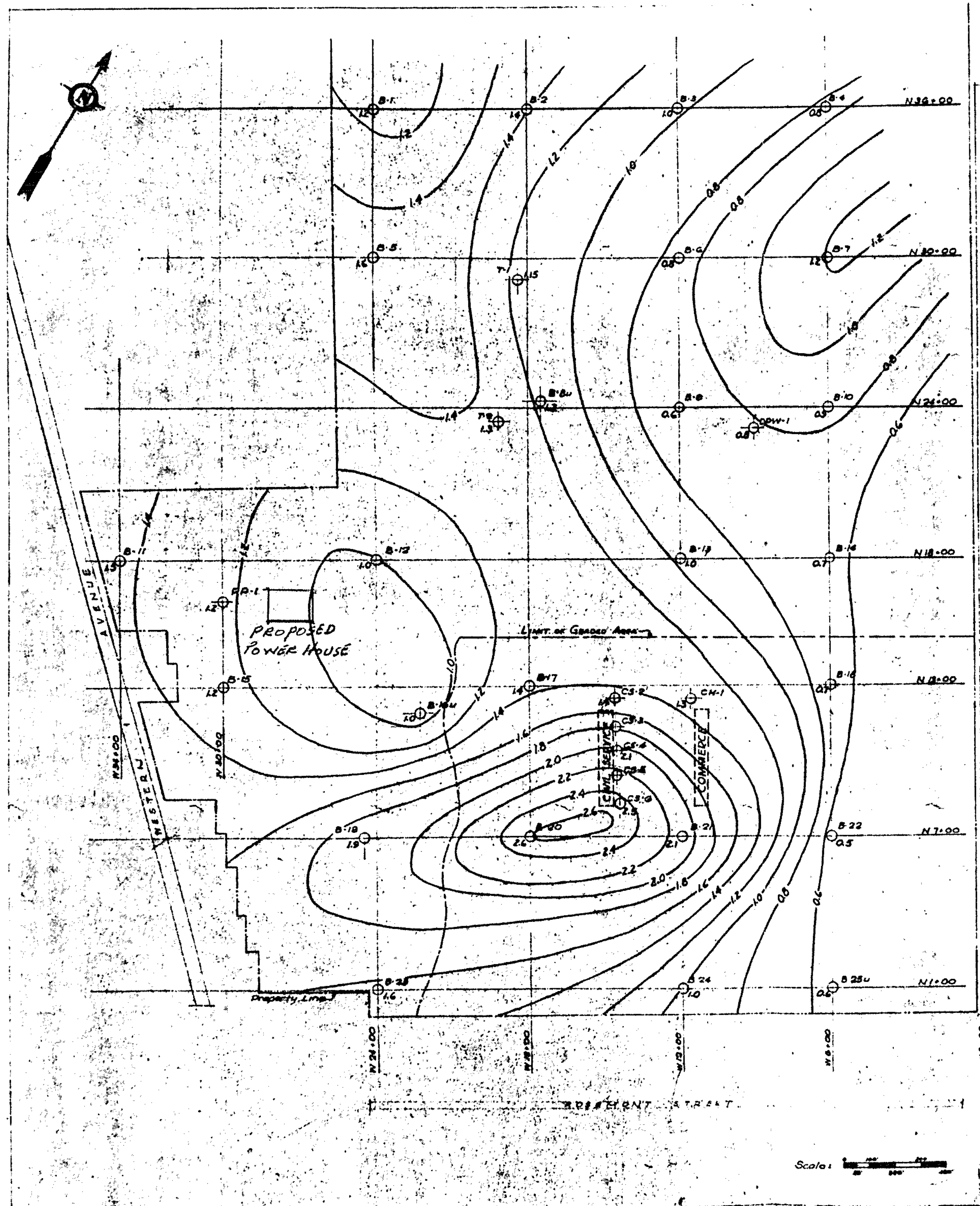
· CAMPUS SITE ·

NEW YORK STATE OFFICE BUILDINGS

ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE As Shown	MADE BY J.H. DATE 7-9-54 / CH'KD BY JPG DATE 7-14-54	FILE NO. 1491
CONTOURS OF SETTLEMENT AND SWELL DUE TO GRADING OPERATIONS		DRAWING NO. 32



NOTES

1. Contours of settlement are for the center of a 60' x 400' building loaded to 1 TSF with balancing excavation extending to a depth of 16' below final grade.

2. Elevations of final grade in southeast area within dashed lines were taken from Revised Profiles, Drawings Nos. 53-111 showing Existing and Finished Grades received from the New York State Department of Public Works, Division of Construction.

3. Remaining elevations of final grade were taken from "Tentative Grading Plan, Assumed Grades #2, Campus Site, Albany, New York" as prepared by Charles H. Sells.

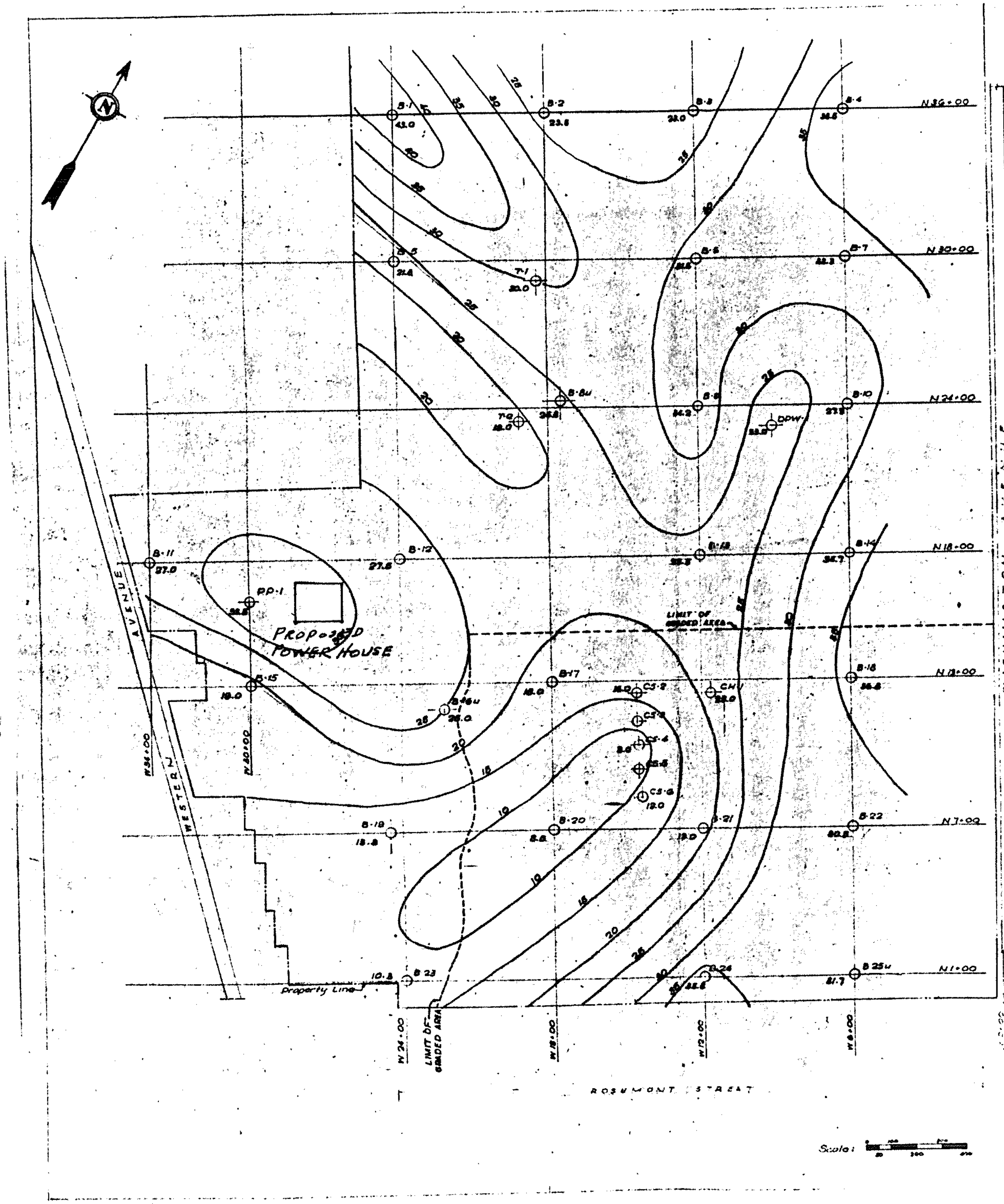
4. Settlement contours do not apply to the two proposed buildings shown on the drawing.

LEGEND:

—0.8— Indicates settlement in inches at the center of a 60' x 400' building.

2.1 ⊕ Indicates settlement at center of a 60' x 400' building located at boring point.

CAMPUS SITE NEW YORK STATE OFFICE BUILDINGS ALBANY NEW YORK		
MORAN, PROCTOR, MUESER & RUTLEDGE CONSULTING ENGINEERS 420 LEXINGTON AVE., NEW YORK 17, N.Y.		
SCALE As Shown	MADE BY C.W.N. DATE 7-19-5? CH'KD BY J.P.G. DATE 7-19-5?	FILE NO. 1491
CONTOURS OF SETTLEMENT AT CENTER OF 60' x 400' BUILDING LOADED TO 1 TSF		DRAWING NO. 33



NOTES

1. Elevations of Final Grade in Southeast area within dashed lines were taken from Revised Profiles, Drawings Nos. 53-11 showing Existing & Finished Grades received from the New York State Department of Public Works, Division of Construction.

2. Remaining elevations of Final Grade were taken from "Tentative Grading Plan Assumed Grades #2, Campus Site, Albany, New York" as prepared by Charles H. Sells.

LEGEND:

10 — Indicates Depth to top of Varved Brown Silt in Feet.

⌖ 18.0 — Indicates Depth to top of Varved Brown Silt at Boring Point

· CAMPUS SITE ·

NEW YORK STATE OFFICE BUILDINGS
ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY G.H.H. DATE 7-6-54	FILE NO.
As Shown	CH'KD BY J.P.G. DATE 7-14-54	1491
· DEPTH TO TOP OF VARVED BROWN SILT FROM FINAL GRADE ·		DRAWING NO. 34

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

SHEET No. 35 OF

FILE 1491

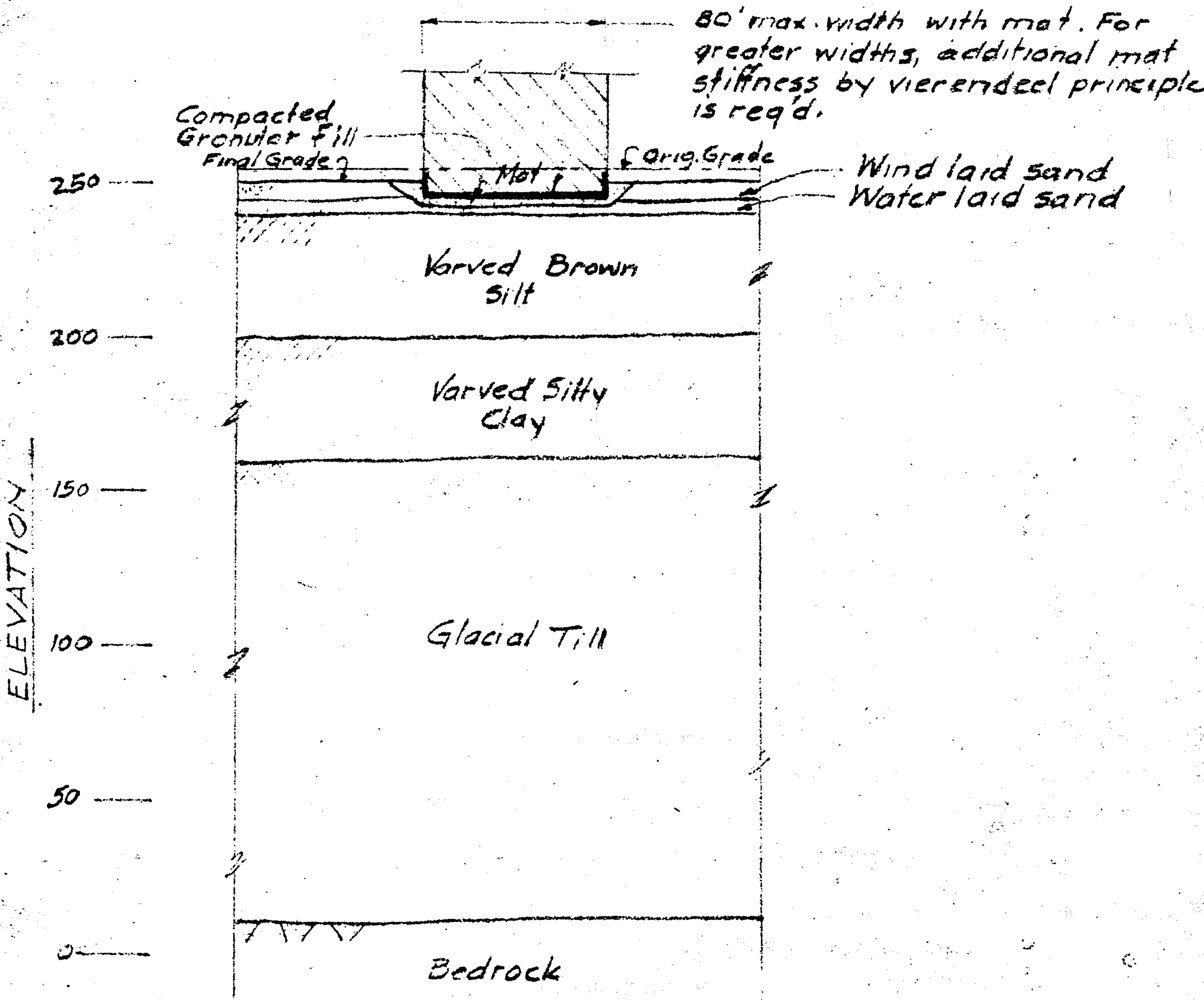
MADE BY EMB DATE 7-19-54

CHECKED BY JPG DATE 7-26-54

FOR State Office Bldgs.

-COST STUDIES-

SILT DEPOSIT NEAR SURFACE



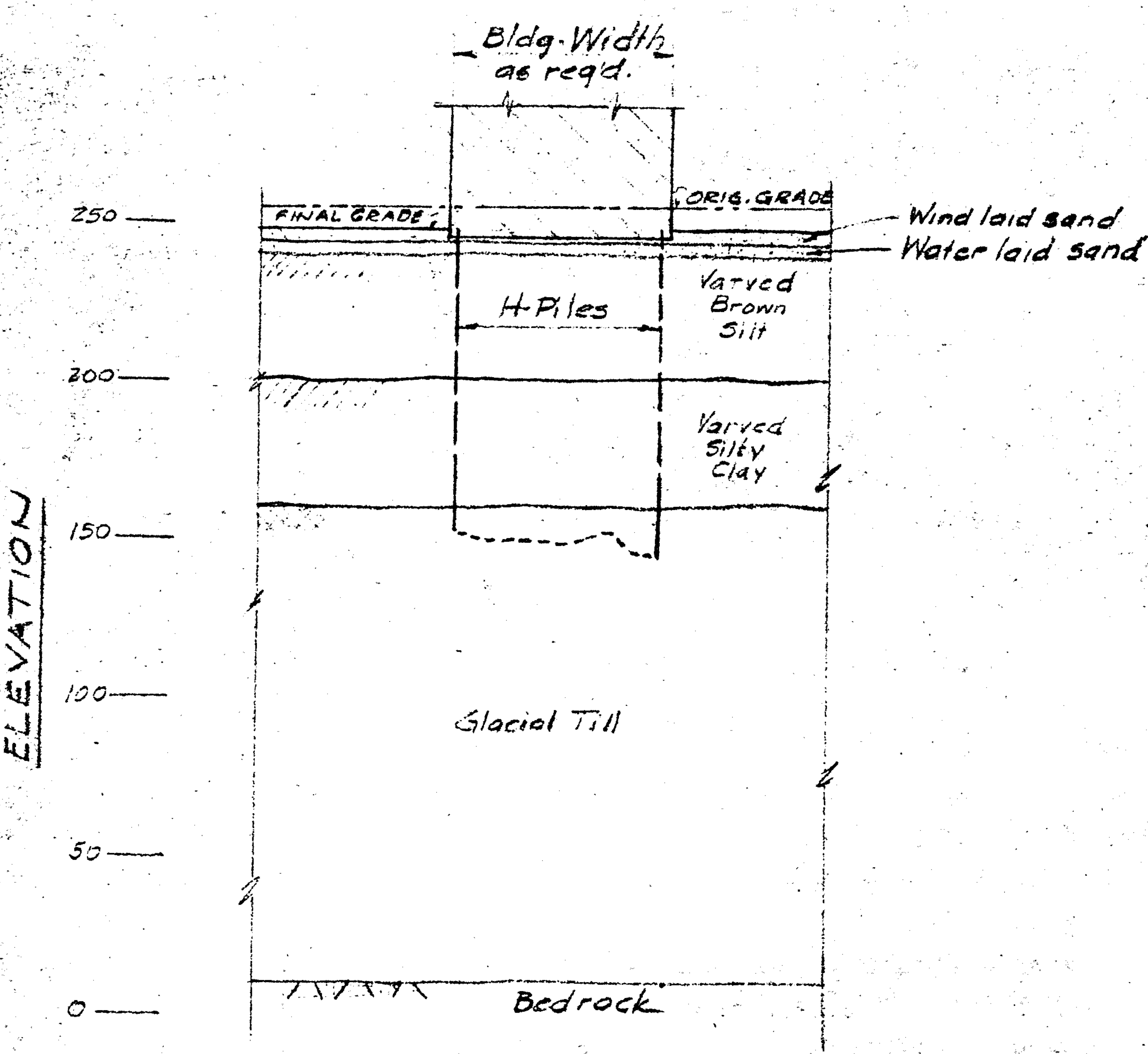
BALANCING EXCAVATION

Max. Bldg. Pressure = 0.5± Tsf = 4± stories above grade
Foundation Cost Index at 4 stories = 1.00 (80' width)
Foundation Cost Index at 4 stories = 1.3± (200' width)

NOTE - For bldg. ht. criteria see graph dwg. no. 29
For additional cost index data see dwg. no. 41

FOR State Office Bldgs.
~COST STUDIES~

H-PILE FOUNDATION



H-PILE FOUNDATION - SHALLOW

For bldg. hts. more than 4 stories above grade
Foundation Cost Index at 5 stories = 1.6± (100' pile length)
Increase in Cost Index per story = 0.2 ± (100' pile length)
(see graph dwg. no. 41)

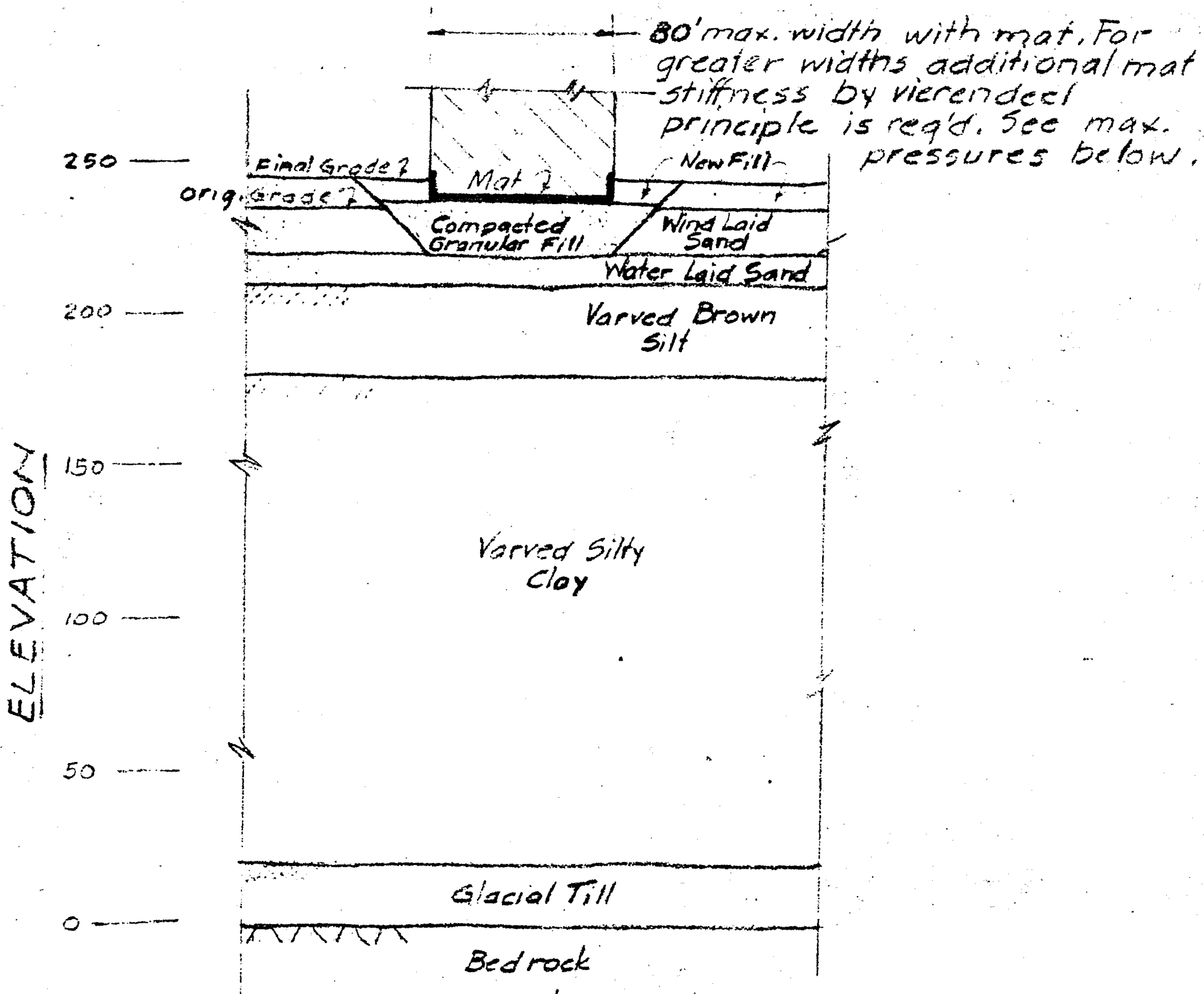
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

SHEET NO. 37 OF
FILE 1491
MADE BY EMB DATE 7-19-54
CHECKED BY JPG DATE 7-26-54

FOR State Office Bldgs.

-COST STUDIES-

SILT DEPOSIT DEEP BELOW SURFACE



EXCAVATION & RECOMPACTION

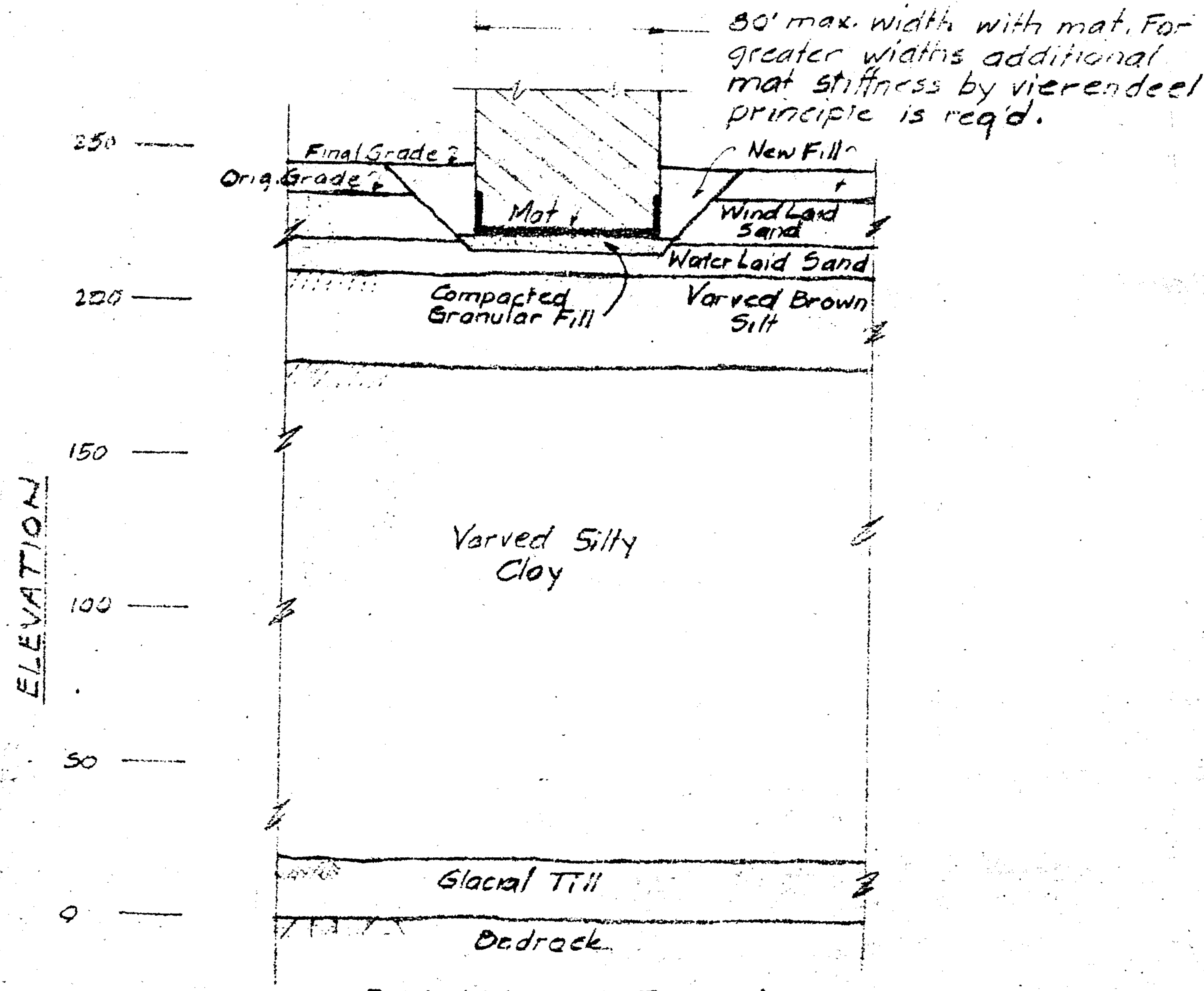
Max. Bldg. Pressure = 1.2± Tsf = 12± stories above grade (up to 80' width)
Varying to: Max. Bldg Pressure = 0.7± Tsf = 7± stories above grade (200' width)
Foundation Cost Index at 12 stories = 1.7± (80' width)
Decrease in Cost Index per story = 0.05± (80' width)
(see Graph dwg. no. 41)
Foundation Cost Index at 7 stories = 1.7± (200' width)
Decrease in Cost Index per story = 0.05± (200' width)

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

Sheet No. 38 Of
File 1491
Made By EMB Date 7-20-54
Checked By JPG Date 7-26-54

FOR State Office Bldgs.

—COST STUDIES—
SILT DEPOSIT DEEP BELOW SURFACE



BALANCING EXCAVATION

Max. Bldg. Pressure = 1.2± Tsf = 10± stories above grade (all widths)
Foundation Cost Index at 10 stories = 1.6± (80' width)
Decrease in Cost Index per story = 0.07± (80' width)
(See Graph dwg. no. 41)
Foundation Cost Index at 10 stories = 1.9± (200' width)
Decrease in Cost Index per story = 0.07± (200' width)
(See Graph dwg. no. 41)

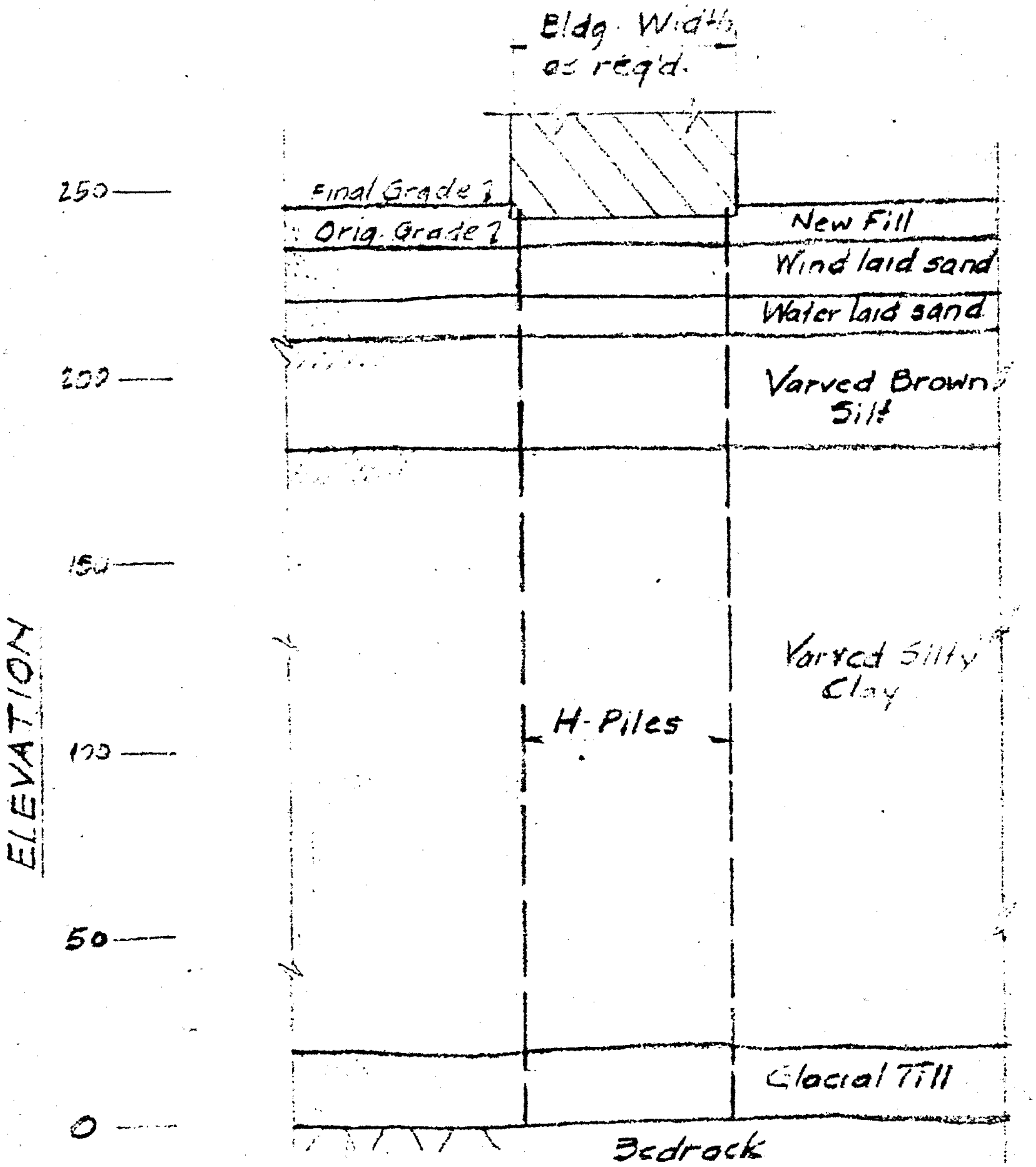
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

Sheet No. 39 Of
File 1491
Made By EMB Date 7-19-54
Checked By TPG Date 7-26-54

For State Office Bldgs.

-Cost Studies-

H-PILE FOUNDATION



H-PILE FOUNDATION - DEEP

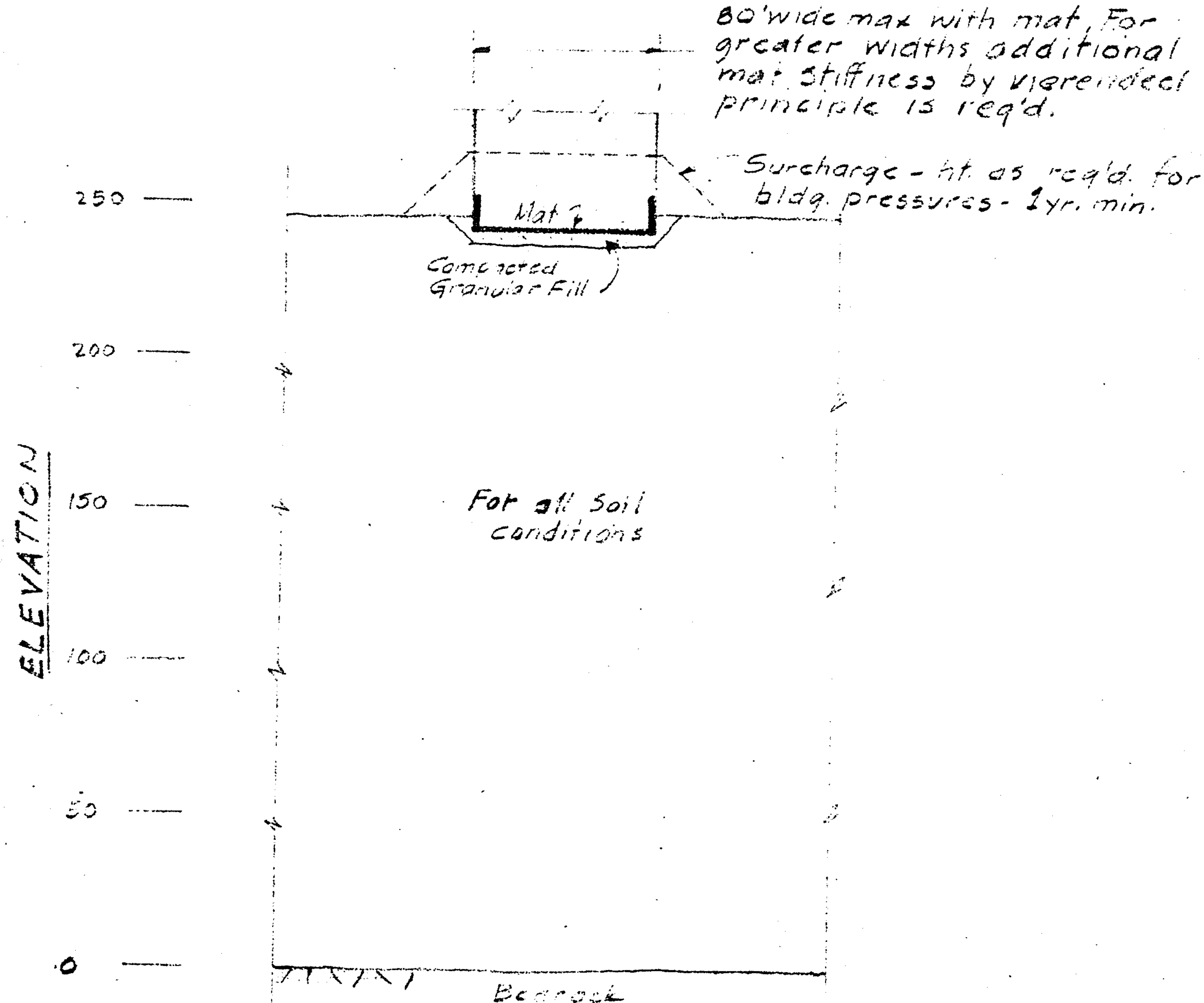
For bldg. ht's. more than 12 stories above grade
Foundation Cost Index at 13 stories = 6.8± (250' pile length)
Increase in Cost Index per story = 0.3± (250' pile length)

For additional cost index data see dwg no. 41

FOR State Office Bldgs.
MADE BY EMB DATE 7-22-54
CHECKED BY JPG DATE 7-26-54

- COST STUDIES -

PRELOAD



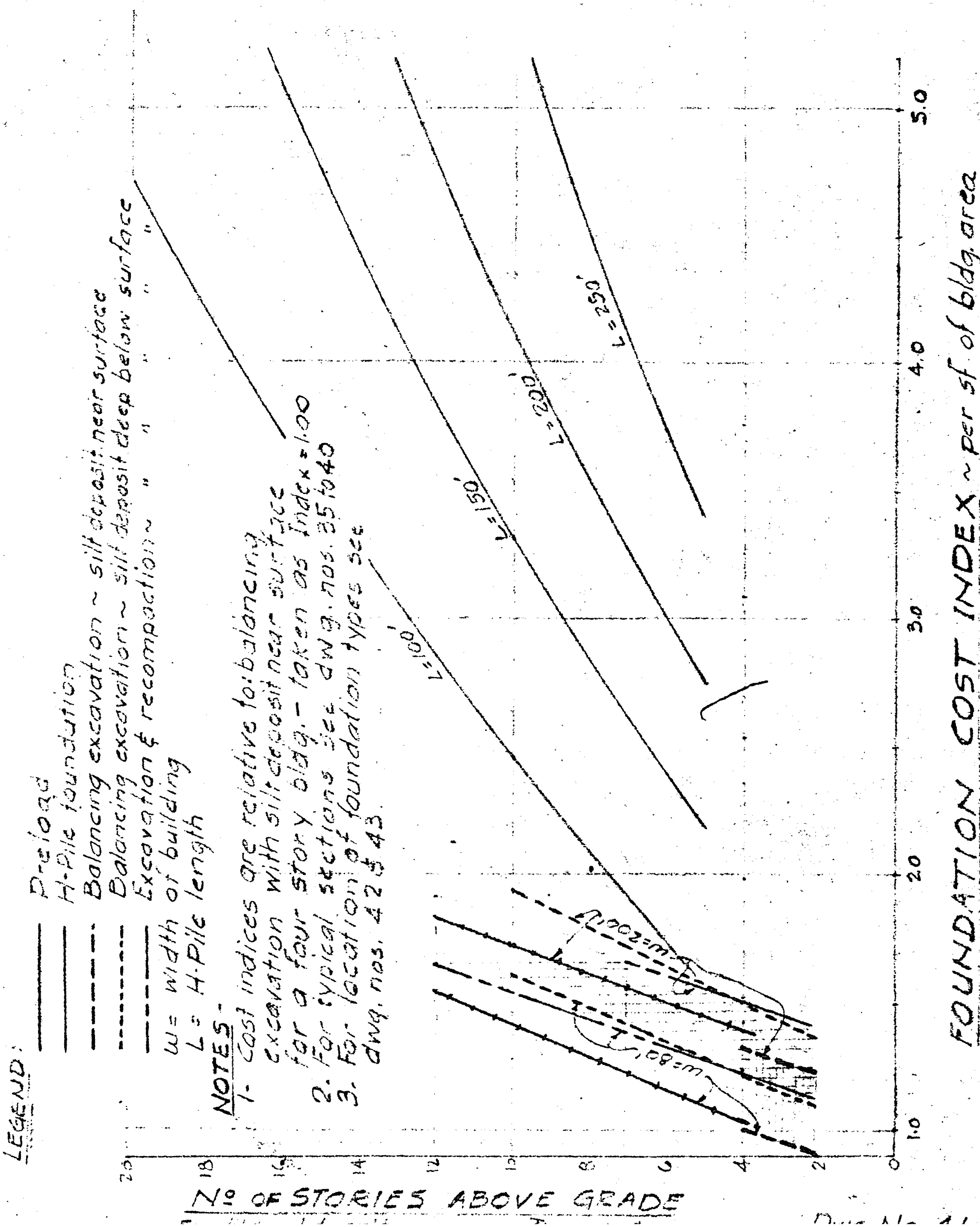
PRELOAD

Max. Bldg. Pressure = 1.2±TSF = 12± stories above grade
Foundation Cost Index at 12 stories = 1.5 ± (80' wide)
Decrease in Cost Index per story = .06± "
Foundation Cost Index at 12 stories = 1.8± (200' wide)
Decrease in Cost Index per story = .06± "
(See Graph dwg no. 41)

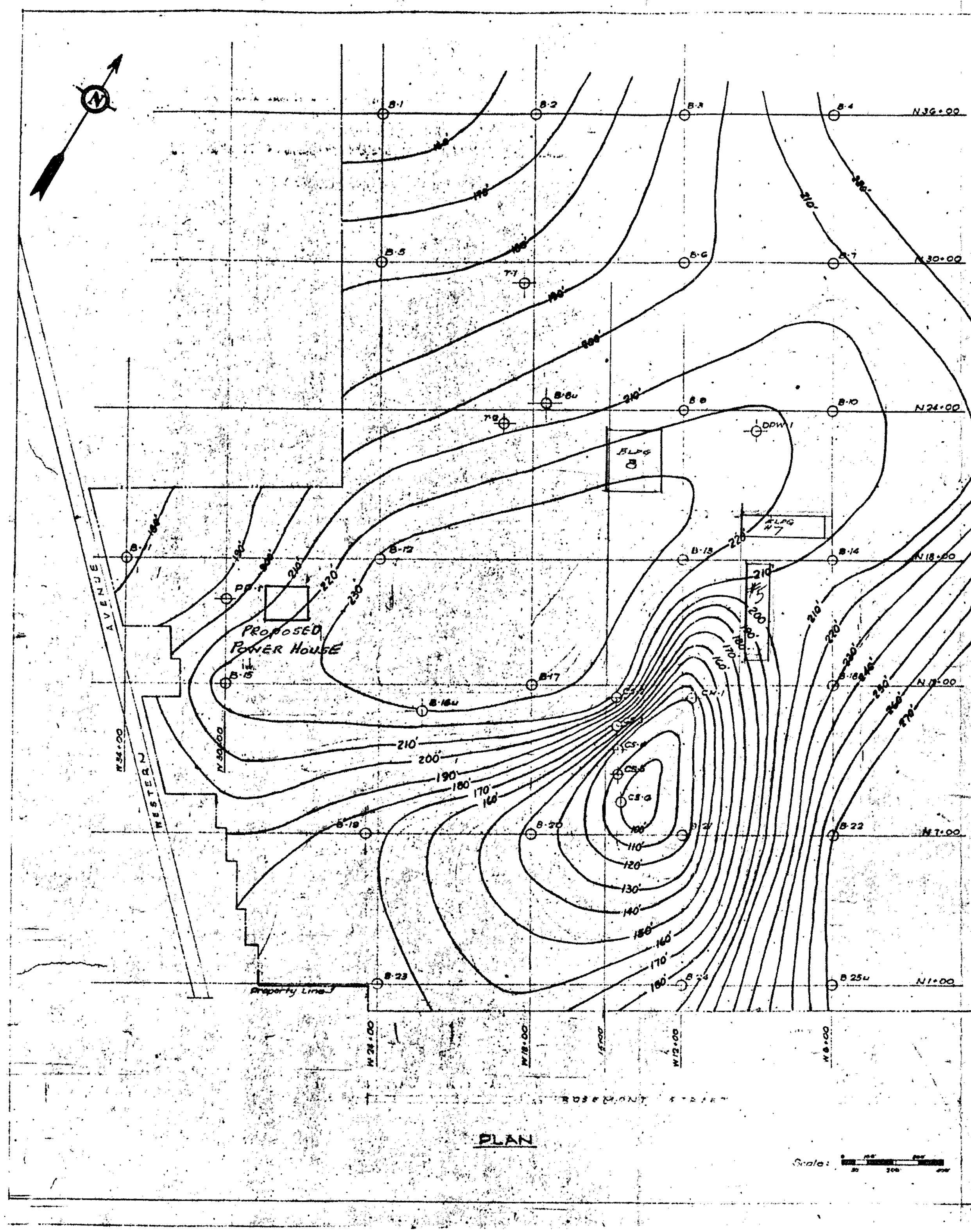
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS

Sheet No. 41 Of
File 1491
Made By EMB Date 7-20-54
Checked By JPG Date 7-26-54

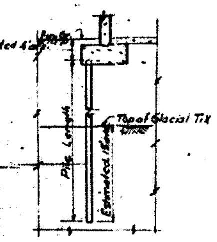
FOR State Office Bldgs.



Dwg. No. 41



NOTES
Pile lengths are estimated using the section below, Dwg no. 2: "Contours of Surface of Glacial Till" and "Tentative Grading Plan" dated Mar. 11, 1954, by Chas H. Sells.



TYPICAL SECTION

LEGEND:
1. —210— Indicates contour of pile length in feet.
2. ⊕ B-6 Indicates boring location & number.

·CAMPUS SITE·

NEW YORK STATE OFFICE BUILDINGS

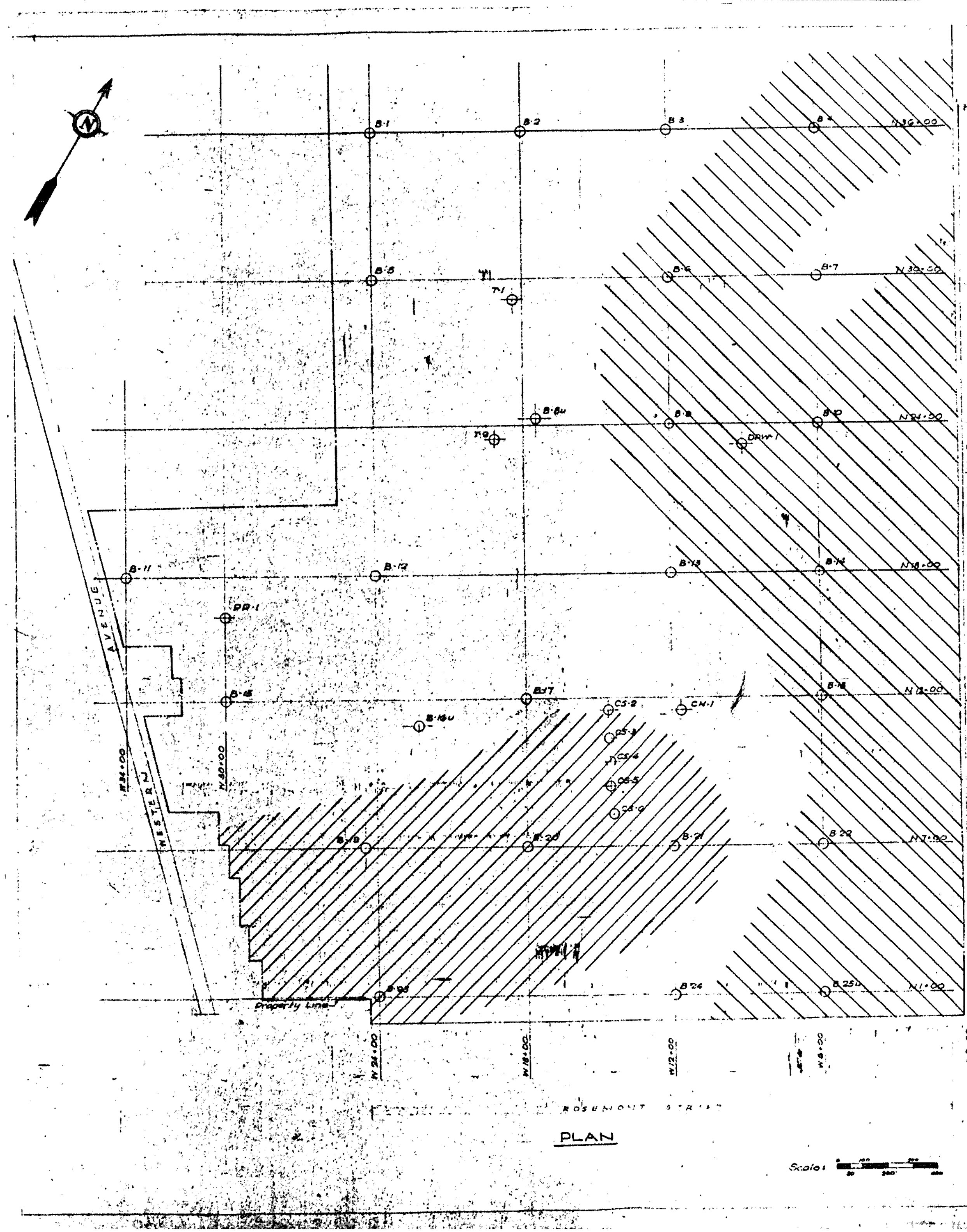
ALBANY — NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY	DATE	FILE NO.
As shown	MADE BY EMB	DATE 7-23-54	[illegible]
	CHKD BY CWA	DATE 7-27-54	

CONTOURS OF ESTIMATED PILE LENGTHS

DRAWING NO. 42



PLAN

Scale:

NOTES

Legend:

- Max. Bldg. Height = 4± stories (0.5±Tsf) including basement.
- Max. Bldg. Heights between 4± (0.5±Tsf) and 12± (1.2±Tsf) including basements.
- Max. Bldg. Height = 12± stories (1.2±Tsf) including basements.
- B-3 = Boring location & number.

Locations shown of limits of building intensities are approximate. Actual limits will be influenced by shape and other factors and can only be determined after detailed evaluation at each site.

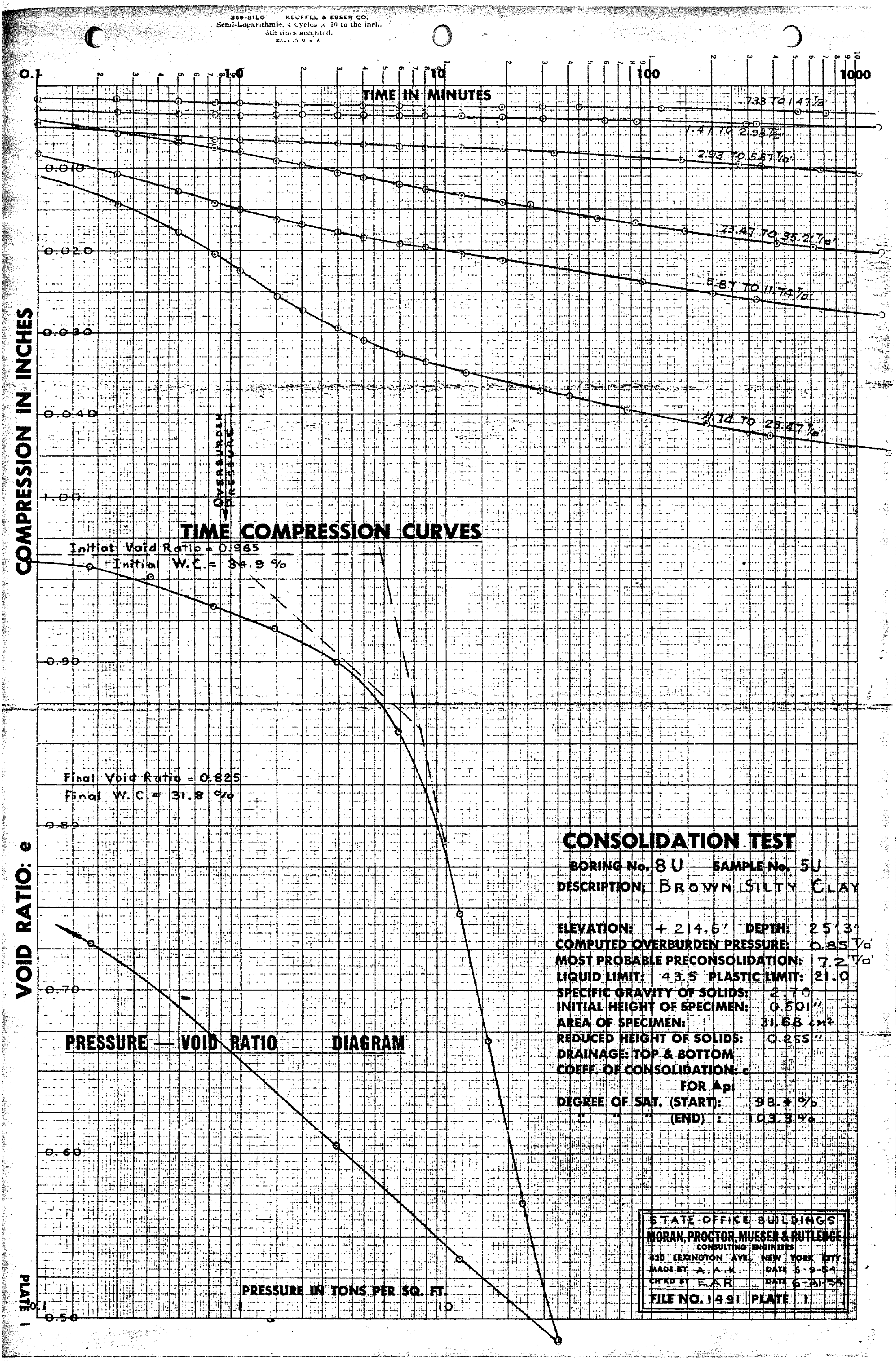
CAMPUS SITE

NEW YORK STATE OFFICE BUILDINGS

ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY EMS DATE 7-22-54	FILE NO
As shown	CH'KD BY JPG DATE 7-22-54	
MAT FOUNDATIONS LOCATION OF MAXIMUM BUILDING HEIGHTS		DRAWING NO. 43



CONSOLIDATION TEST

BORING No. 8U SAMPLE No. 5U

DESCRIPTION: Brown Silty Clay

ELEVATION: + 214.6' DEPTH: 25' 3"

COMPUTED OVERBURDEN PRESSURE: 0.85 T/□'

MOST PROBABLE PRECONSOLIDATION: 7.2 T/□'

LIQUID LIMIT: 43.5 PLASTIC LIMIT: 21.0

SPECIFIC GRAVITY OF SOLIDS: 2.70

INITIAL HEIGHT OF SPECIMEN: 0.501"

AREA OF SPECIMEN: 31.68 cm²

REDUCED HEIGHT OF SOLIDS: 0.255"

DRAINAGE: TOP & BOTTOM

COEFF. OF CONSOLIDATION: c

FOR Δp:

DEGREE OF SAT. (START): 98.4 %

" " " (END) : 103.3 %

STATE OFFICE BUILDINGS

MORAN, PROCTOR, MUESER & RUTLEDGE

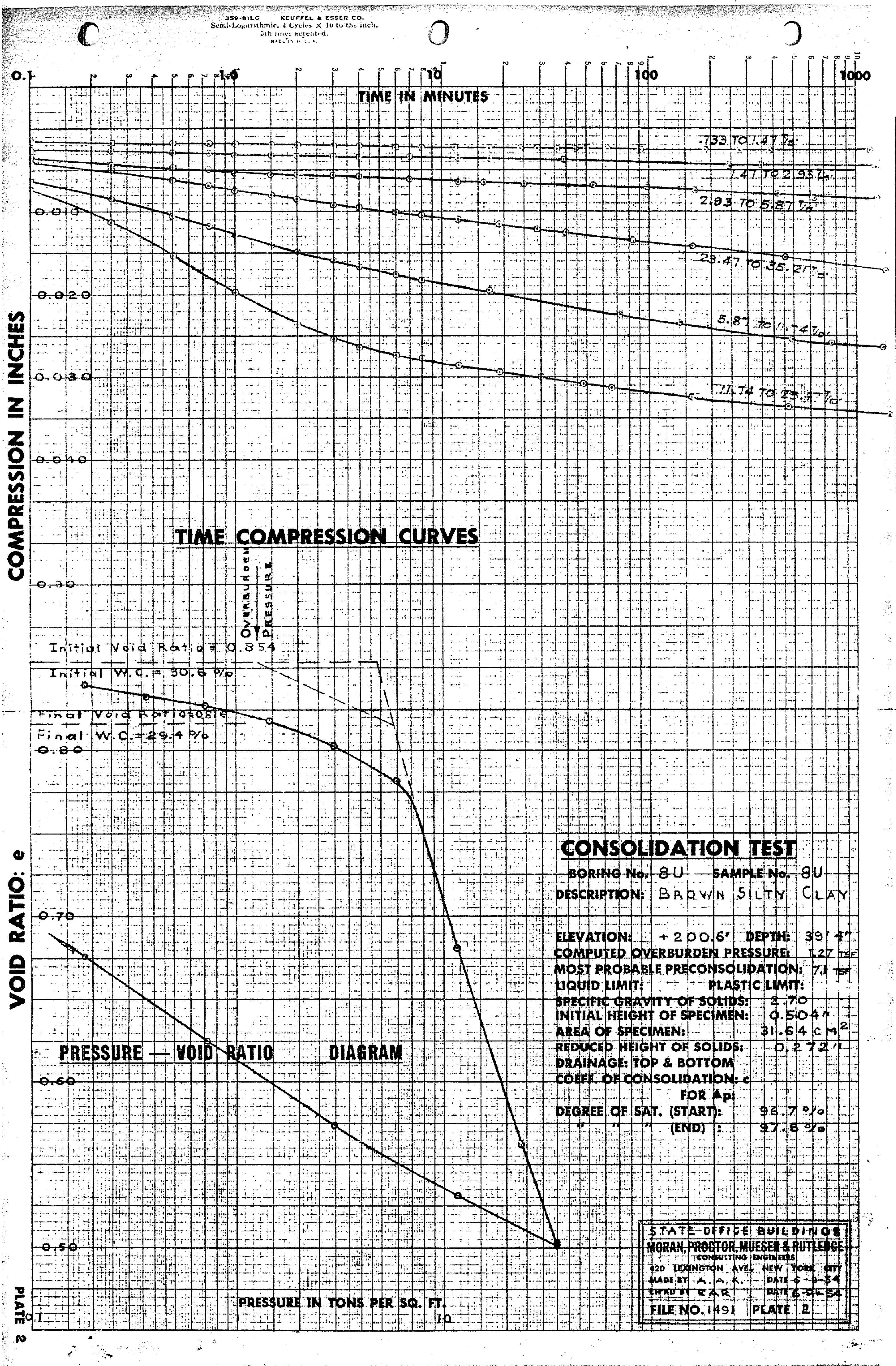
CONSULTING ENGINEERS

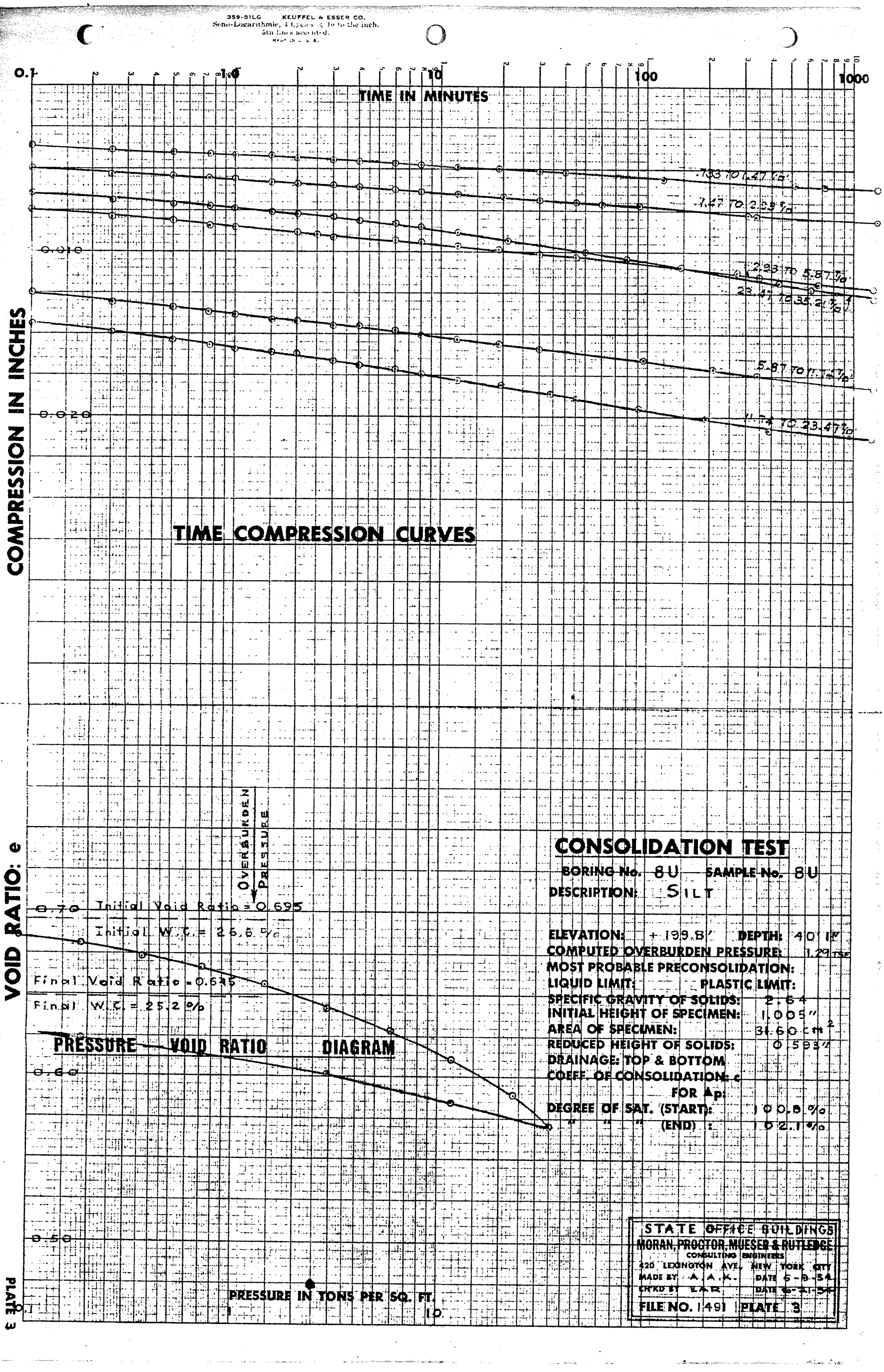
420 LEXINGTON AVE., NEW YORK CITY

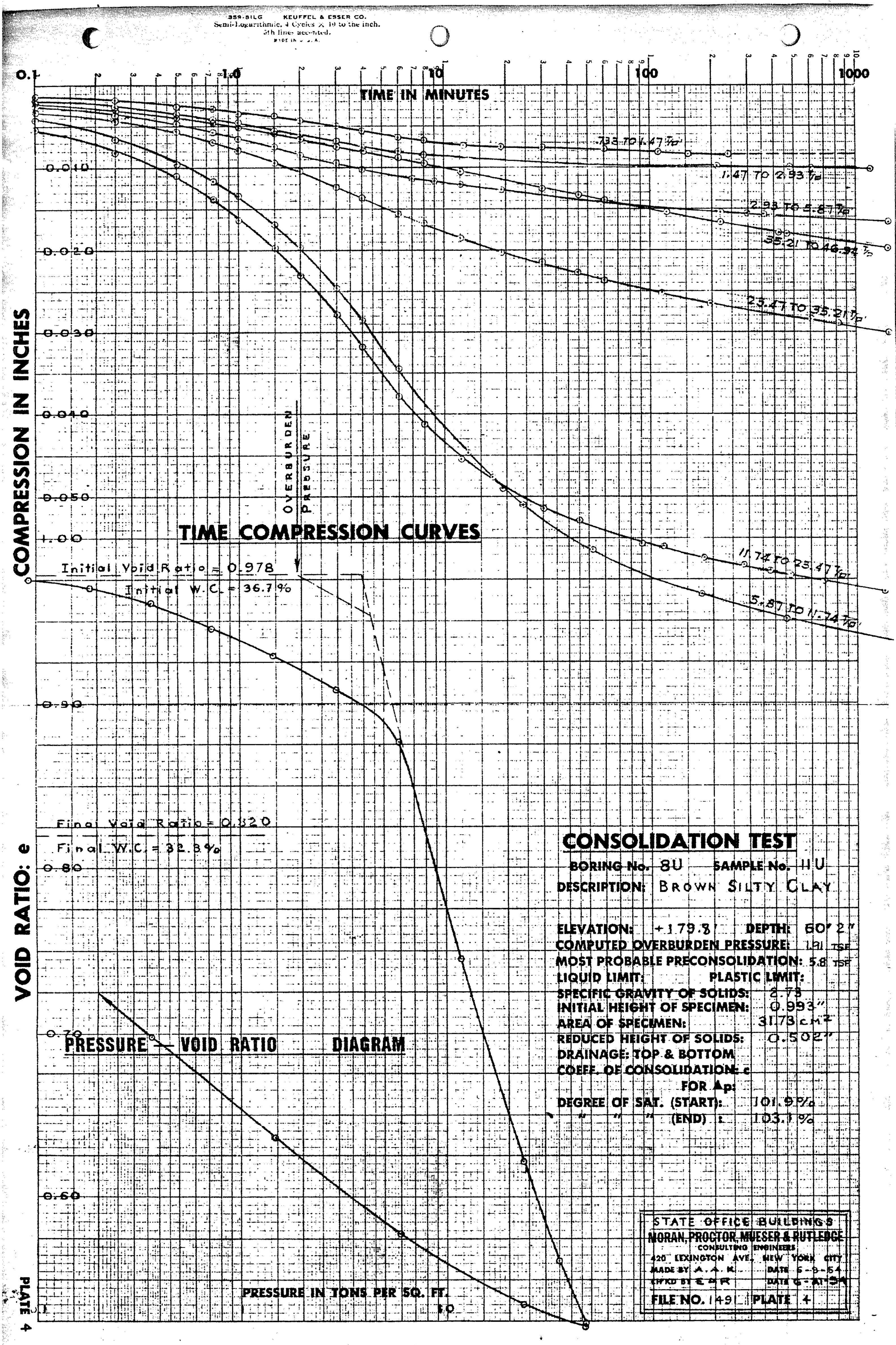
MADE BY A.A.K. DATE 5-9-54

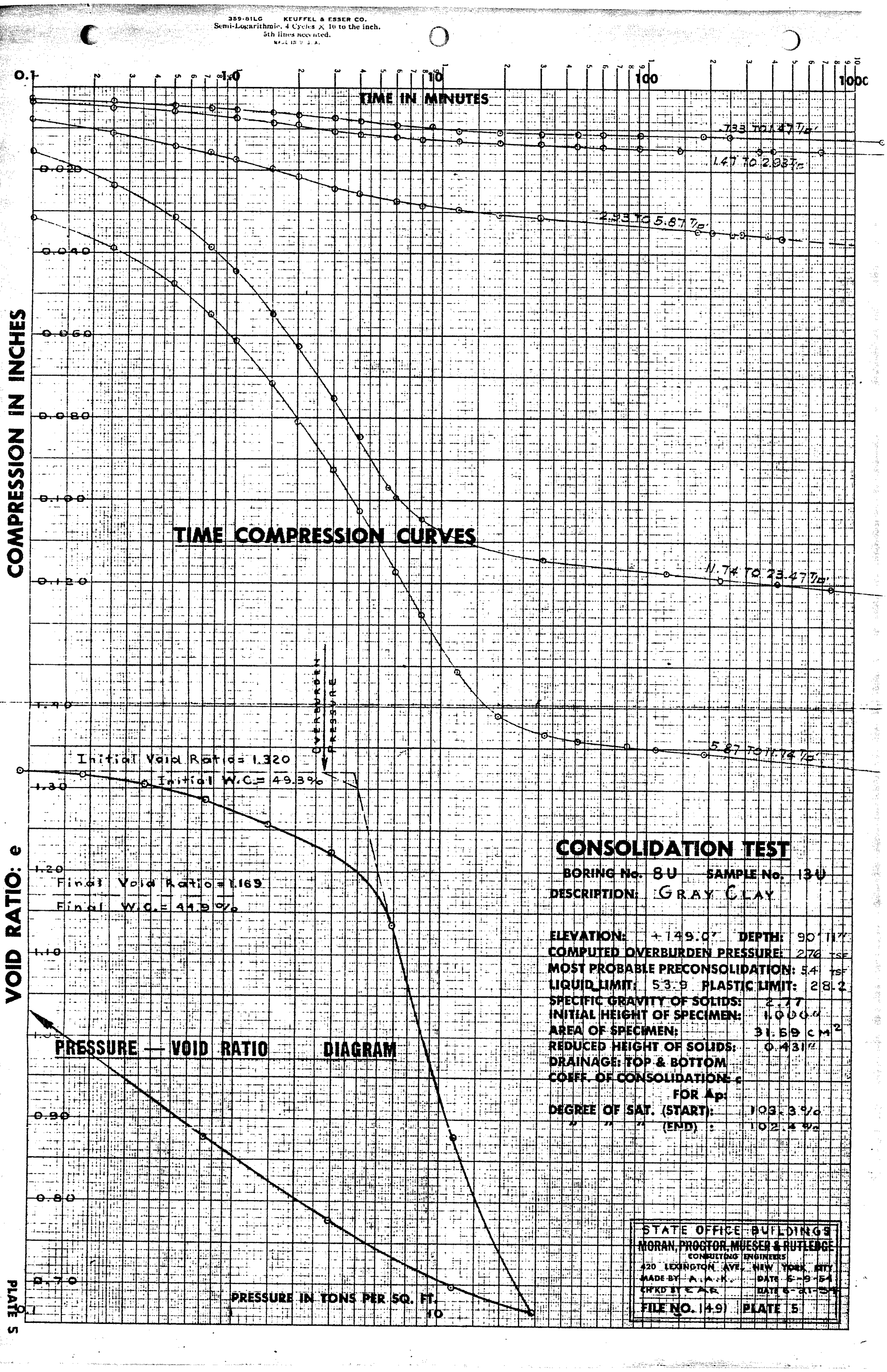
CH'KD BY E.A.R. DATE 6-21-54

FILE NO. 1491 PLATE 1

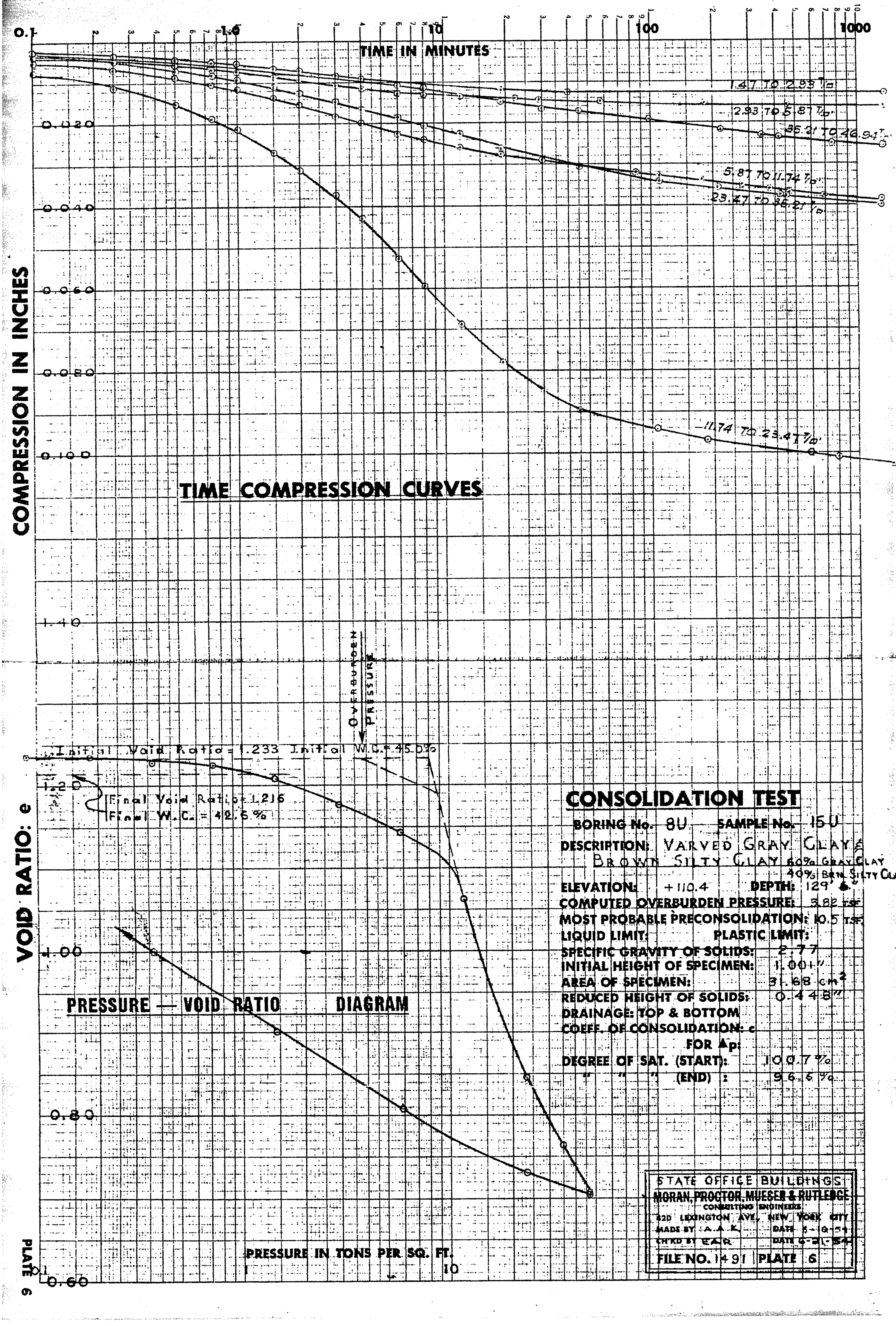

359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles X 10 to the inch.
5th lines accented.
TIME IN MINUTES
COMPRESSION IN INCHES
.733 TO 1.47 T/ft²
1.47 TO 2.93 T/ft²
2.93 TO 5.87 T/ft²
23.47 TO 35.21 T/ft²
5.87 TO 11.74 T/ft²
11.74 TO 23.47 T/ft²
TIME COMPRESSION CURVES
OVERBURDEN PRESSURE
Initial Void Ratio = 0.854
Initial W.C. = 30.6 %
Final Void Ratio = 0.816
Final W.C. = 29.4 %
VOID RATIO: e
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 8U SAMPLE No. 8U
DESCRIPTION: BROWN SILTY CLAY
ELEVATION: +200.6' DEPTH: 39' 4"
COMPUTED OVERBURDEN PRESSURE: 1.27 TSF
MOST PROBABLE PRECONSOLIDATION: 7.1 TSF
LIQUID LIMIT: PLASTIC LIMIT:
SPECIFIC GRAVITY OF SOLIDS: 2.70
INITIAL HEIGHT OF SPECIMEN: 0.504"
AREA OF SPECIMEN: 31.64 cm²
REDUCED HEIGHT OF SOLIDS: 0.272"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 96.7 %
" " " (END) : 97.8 %
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK CITY
MADE BY A. A. K. DATE 6-9-54
CHK'D BY EAR DATE 6-21-54
FILE NO. 1491 PLATE 2

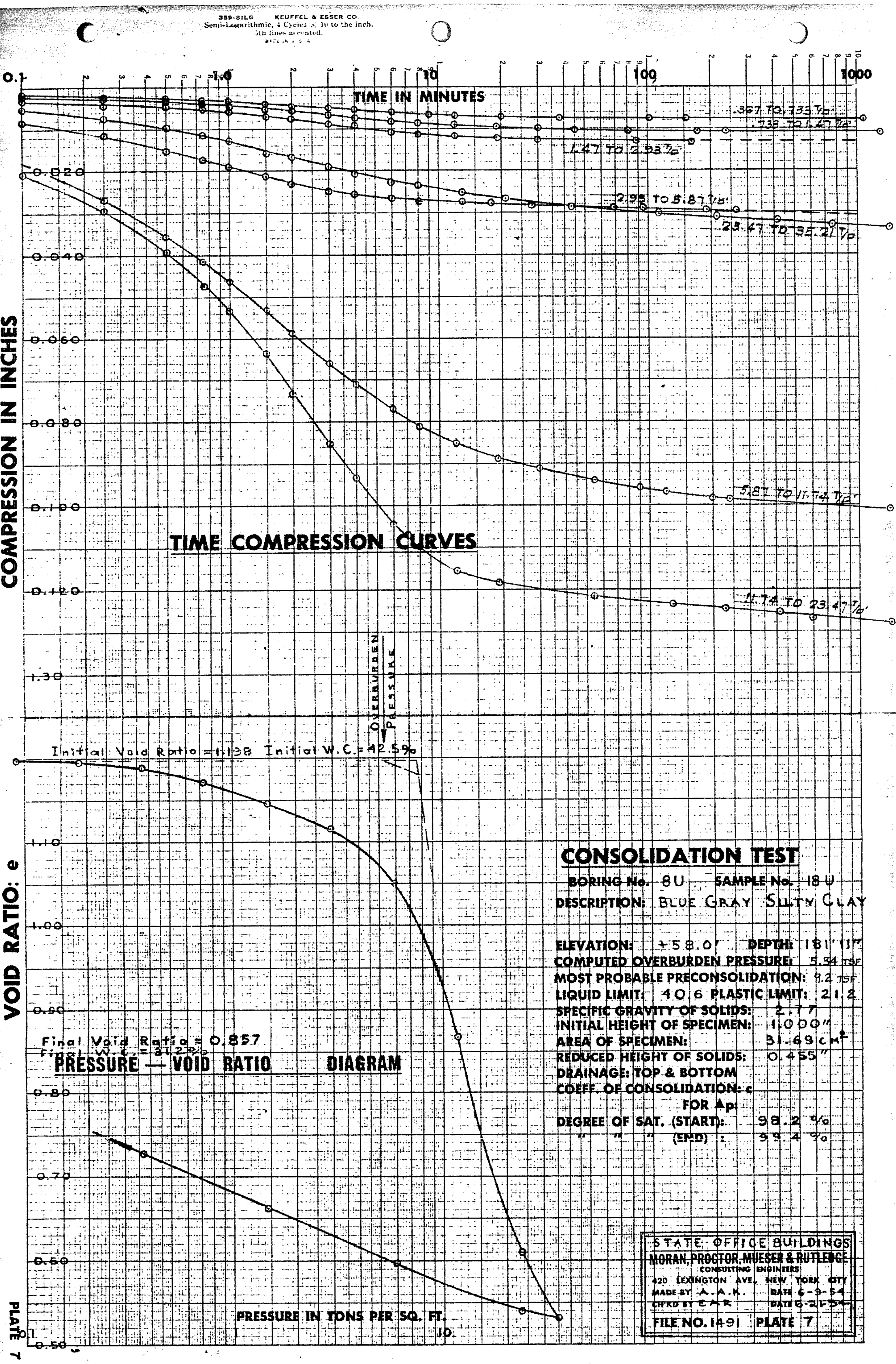

359-51LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles X 10 to the inch.
TIME IN MINUTES
COMPRESSION IN INCHES
.733 TO 1.47 T/□'
1.47 TO 2.93 T/□'
2.93 TO 5.87 T/□'
23.47 TO 35.21 T/□'
5.87 TO 11.74 T/□'
11.74 TO 23.47 T/□'
TIME COMPRESSION CURVES
VOID RATIO: e
OVERBURDEN PRESSURE
Initial Void Ratio = 0.695
Initial W.C. = 26.6 %
Final Void Ratio = 0.635
Final W.C. = 25.2 %
PRESSURE - VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 8U SAMPLE No. 8U
DESCRIPTION: SILT
ELEVATION: +199.8' DEPTH: 40'1"
COMPUTED OVERBURDEN PRESSURE: 1.29 TSF
MOST PROBABLE PRECONSOLIDATION:
LIQUID LIMIT: PLASTIC LIMIT:
SPECIFIC GRAVITY OF SOLIDS: 2.64
INITIAL HEIGHT OF SPECIMEN: 1.005"
AREA OF SPECIMEN: 31.60 cm²
REDUCED HEIGHT OF SOLIDS: 0.593"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 100.8 %
" " " (END) : 102.1 %
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE, NEW YORK CITY
MADE BY A.A.K. DATE 6-8-54
CH'KD BY E.A.R. DATE 6-21-54
FILE NO. 1491 PLATE 3


359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles × 10 to the inch.
5th lines accented.
MADE IN U.S.A.
TIME IN MINUTES
COMPRESSION IN INCHES
VOID RATIO: e
.733 TO 1.47 T/ft²
1.47 TO 2.93 T/ft²
2.93 TO 5.87 T/ft²
35.21 TO 46.94 T/ft²
23.47 TO 35.21 T/ft²
11.74 TO 23.47 T/ft²
5.87 TO 11.74 T/ft²
OVERBURDEN PRESSURE
TIME COMPRESSION CURVES
Initial Void Ratio = 0.978
Initial W.C. = 36.7%
Final Void Ratio = 0.820
Final W.C. = 32.3%
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 8U SAMPLE No. 11U
DESCRIPTION: BROWN SILTY CLAY
ELEVATION: +179.3' DEPTH: 60' 2"
COMPUTED OVERBURDEN PRESSURE: 1.91 TSF
MOST PROBABLE PRECONSOLIDATION: 5.8 TSF
LIQUID LIMIT: PLASTIC LIMIT:
SPECIFIC GRAVITY OF SOLIDS: 2.73
INITIAL HEIGHT OF SPECIMEN: 0.993"
AREA OF SPECIMEN: 31.73 cm²
REDUCED HEIGHT OF SOLIDS: 0.502"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 101.9%
" " " (END): 103.1%
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
MADE BY A.A.K. DATE 5-3-54
CH'KD BY E.A.R. DATE 6-11-54
FILE NO. 1491 PLATE 4

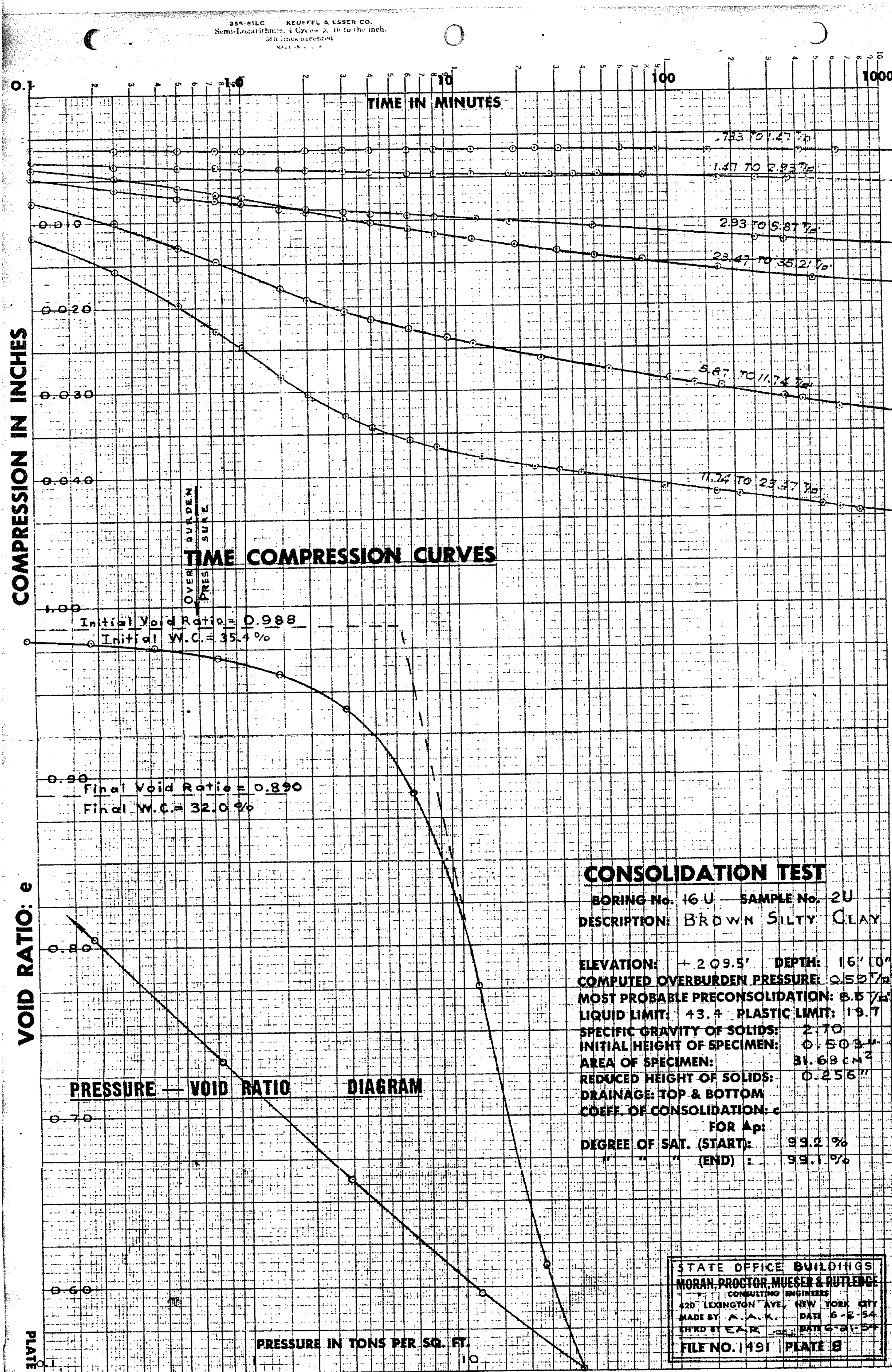

359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles X 10 to the inch.
5th lines accented.
TIME IN MINUTES
COMPRESSION IN INCHES
.733 TO 1.47 T/□'
1.47 TO 2.93 T/□'
2.93 TO 5.87 T/□'
11.74 TO 23.47 T/□'
5.87 TO 11.74 T/□'
TIME COMPRESSION CURVES
OVERBURDEN PRESSURE
Initial Void Ratio = 1.320
Initial W.C. = 49.3%
Final Void Ratio = 1.169
Final W.C. = 44.9%
VOID RATIO: e
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 8U SAMPLE No. 13U
DESCRIPTION: GRAY CLAY
ELEVATION: +149.0' DEPTH: 90' 11"
COMPUTED OVERBURDEN PRESSURE: 2.76 TSF
MOST PROBABLE PRECONSOLIDATION: 5.4 TSF
LIQUID LIMIT: 53.9 PLASTIC LIMIT: 28.2
SPECIFIC GRAVITY OF SOLIDS: 2.77
INITIAL HEIGHT OF SPECIMEN: 1.000"
AREA OF SPECIMEN: 31.69 cm²
REDUCED HEIGHT OF SOLIDS: 0.431"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 103.3%
" " " (END): 102.4%
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
MADE BY A.A.K. DATE 6-9-54
CHKD BY E.A.R. DATE 6-21-54
FILE NO. 1491 PLATE 5
PLATE 5

359-31LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles × 10 to the inch.
5th lines accented.
MADE IN U.S.A.

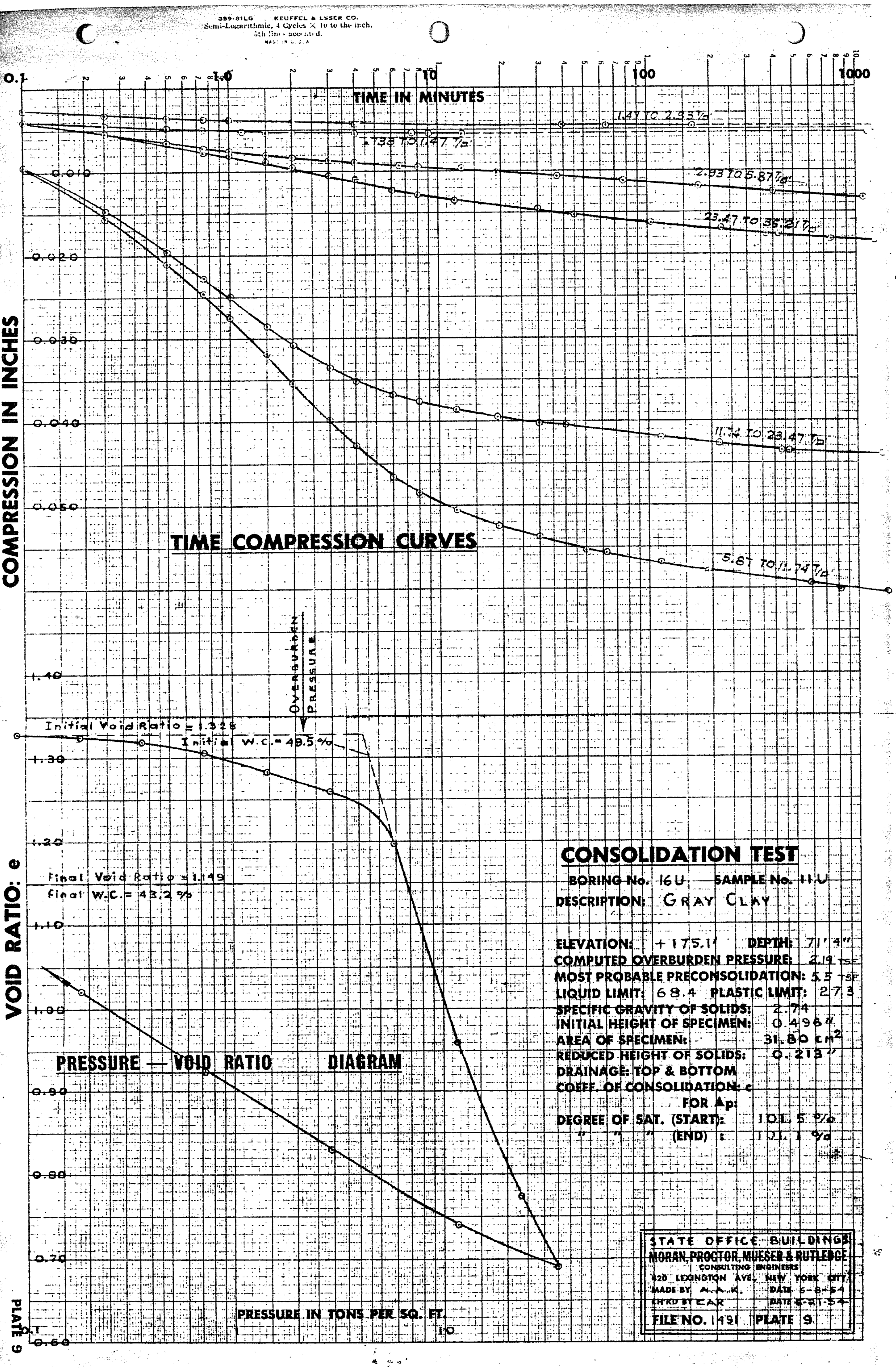




359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles X 10 to the inch.
5th lines accented.
TIME IN MINUTES
TIME COMPRESSION CURVES
COMPRESSION IN INCHES
.367 TO .733 T/○'
.733 TO 1.47 T/○'
1.47 TO 2.93 T/○'
2.93 TO 5.87 T/○'
5.87 TO 11.74 T/○'
11.74 TO 23.47 T/○'
23.47 TO 35.21 T/○'
OVERBURDEN PRESSURE
Initial Void Ratio = 1.138 Initial W.C. = 42.5%
Final Void Ratio = 0.857
Final W.C. = 31.2%
PRESSURE — VOID RATIO DIAGRAM
VOID RATIO: e
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 8U SAMPLE No. 18U
DESCRIPTION: BLUE GRAY SILTY CLAY
ELEVATION: +58.0' DEPTH: 181' 11"
COMPUTED OVERBURDEN PRESSURE: 5.34 TSF
MOST PROBABLE PRECONSOLIDATION: 9.2 TSF
LIQUID LIMIT: 40.6 PLASTIC LIMIT: 21.2
SPECIFIC GRAVITY OF SOLIDS: 2.77
INITIAL HEIGHT OF SPECIMEN: 1.000"
AREA OF SPECIMEN: 31.69 CM²
REDUCED HEIGHT OF SOLIDS: 0.455"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 98.2 %
" " " (END) : 99.4 %
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
MADE BY A.A.K. DATE 6-9-54
CHKD BY E.A.R. DATE 6-21-54
FILE NO. 1491 PLATE 7



359-81LC KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles X 10 to the inch.
TIME IN MINUTES
0.1
1.0
10
100
1000
COMPRESSION IN INCHES
0.010
0.020
0.030
0.040
.733 TO 1.47 T/□'
1.47 TO 2.93 T/□'
2.93 TO 5.87 T/□'
23.47 TO 35.21 T/□'
5.87 TO 11.74 T/□'
11.74 TO 23.37 T/□'
TIME COMPRESSION CURVES
OVERBURDEN PRESSURE
Initial Void Ratio = 0.988
Initial W.C. = 35.4 %
Final Void Ratio = 0.890
Final W.C. = 32.0 %
VOID RATIO: e
1.00
0.90
0.80
0.70
0.60
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
0.1
1
10
CONSOLIDATION TEST
BORING No. 16 U SAMPLE No. 2U
DESCRIPTION: BROWN SILTY CLAY
ELEVATION: + 209.5' DEPTH: 16' 10"
COMPUTED OVERBURDEN PRESSURE: 0.50 T/□'
MOST PROBABLE PRECONSOLIDATION: 8.5 T/□'
LIQUID LIMIT: 43.4 PLASTIC LIMIT: 19.7
SPECIFIC GRAVITY OF SOLIDS: 2.70
INITIAL HEIGHT OF SPECIMEN: 0.503"
AREA OF SPECIMEN: 31.69 cm²
REDUCED HEIGHT OF SOLIDS: 0.256"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 99.2 %
" " " (END): 99.1 %
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE, NEW YORK CITY
MADE BY A.A.K. DATE 6-2-54
CH'KD BY EAR DATE 6-21-54
FILE NO. 1491 PLATE 8



CONSOLIDATION TEST

BORING No. 16U SAMPLE No. 11U

DESCRIPTION: GRAY CLAY

ELEVATION: +175.1' DEPTH: 71' 4"

COMPUTED OVERBURDEN PRESSURE: 2.19 TSF

MOST PROBABLE PRECONSOLIDATION: 5.5 TSF

LIQUID LIMIT: 68.4 PLASTIC LIMIT: 27.3

SPECIFIC GRAVITY OF SOLIDS: 2.74

INITIAL HEIGHT OF SPECIMEN: 0.496"

AREA OF SPECIMEN: 31.80 cm²

REDUCED HEIGHT OF SOLIDS: 0.213"

DRAINAGE: TOP & BOTTOM

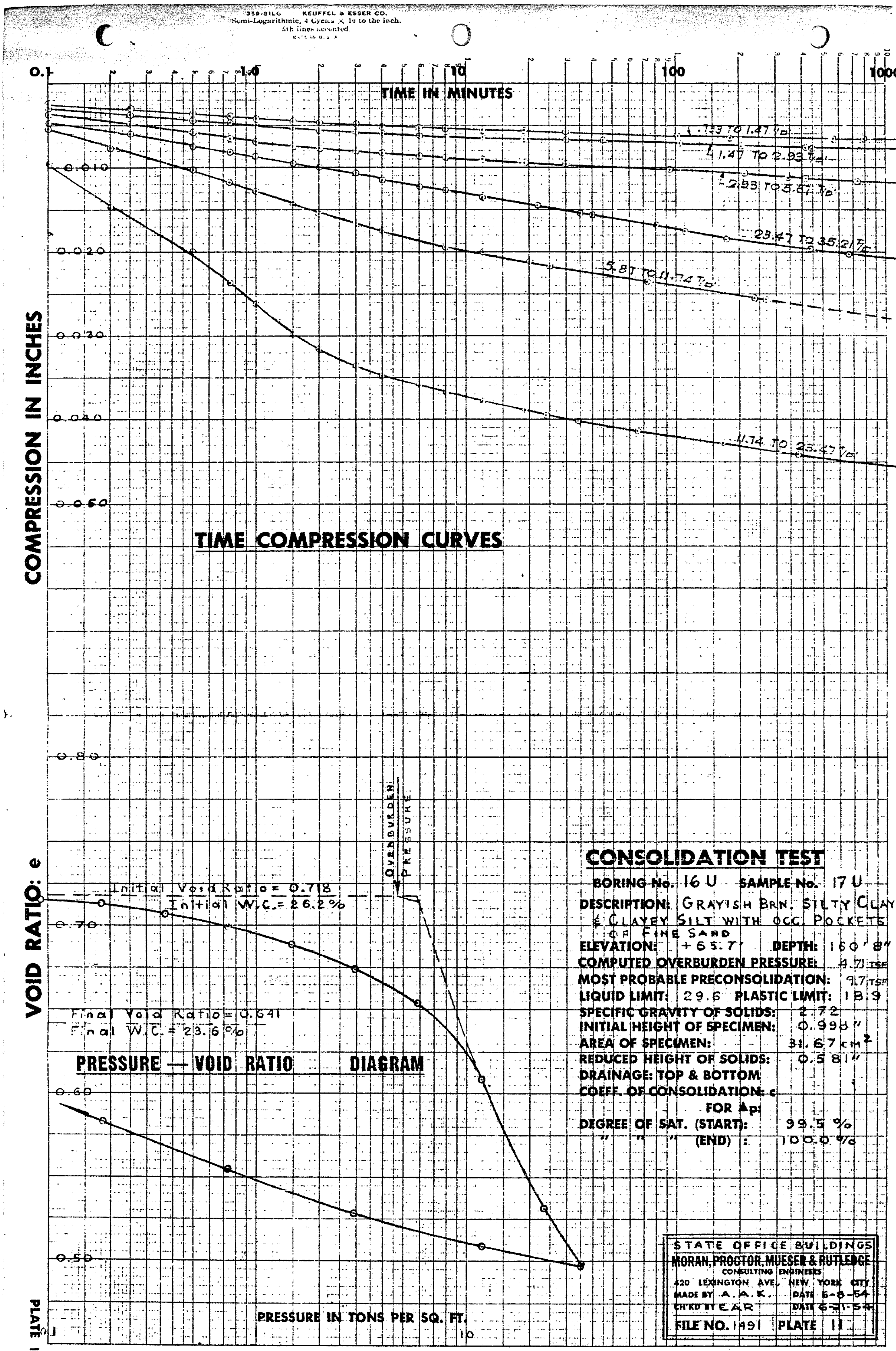
COEFF. OF CONSOLIDATION: c

FOR Δp:

DEGREE OF SAT. (START): 101.5 %

" " " (END) : 101.1 %

STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE, NEW YORK CITY
MADE BY A.A.K. DATE 5-8-54
CHKD BY EAR DATE 6-21-54
FILE NO. 1491 PLATE 9



CONSOLIDATION TEST

BORING No. 16 U **SAMPLE No.** 17 U

DESCRIPTION: GRAYISH BRN. SILTY CLAY & CLAYEY SILT WITH OCC. POCKETS OF FINE SAND

ELEVATION: +65.7' **DEPTH:** 160' 8"

COMPUTED OVERBURDEN PRESSURE: 4.71 TSF

MOST PROBABLE PRECONSOLIDATION: 9.7 TSF

LIQUID LIMIT: 29.6 **PLASTIC LIMIT:** 18.9

SPECIFIC GRAVITY OF SOLIDS: 2.72

INITIAL HEIGHT OF SPECIMEN: 0.998"

AREA OF SPECIMEN: 31.67 cm²

REDUCED HEIGHT OF SOLIDS: 0.581"

DRAINAGE: TOP & BOTTOM

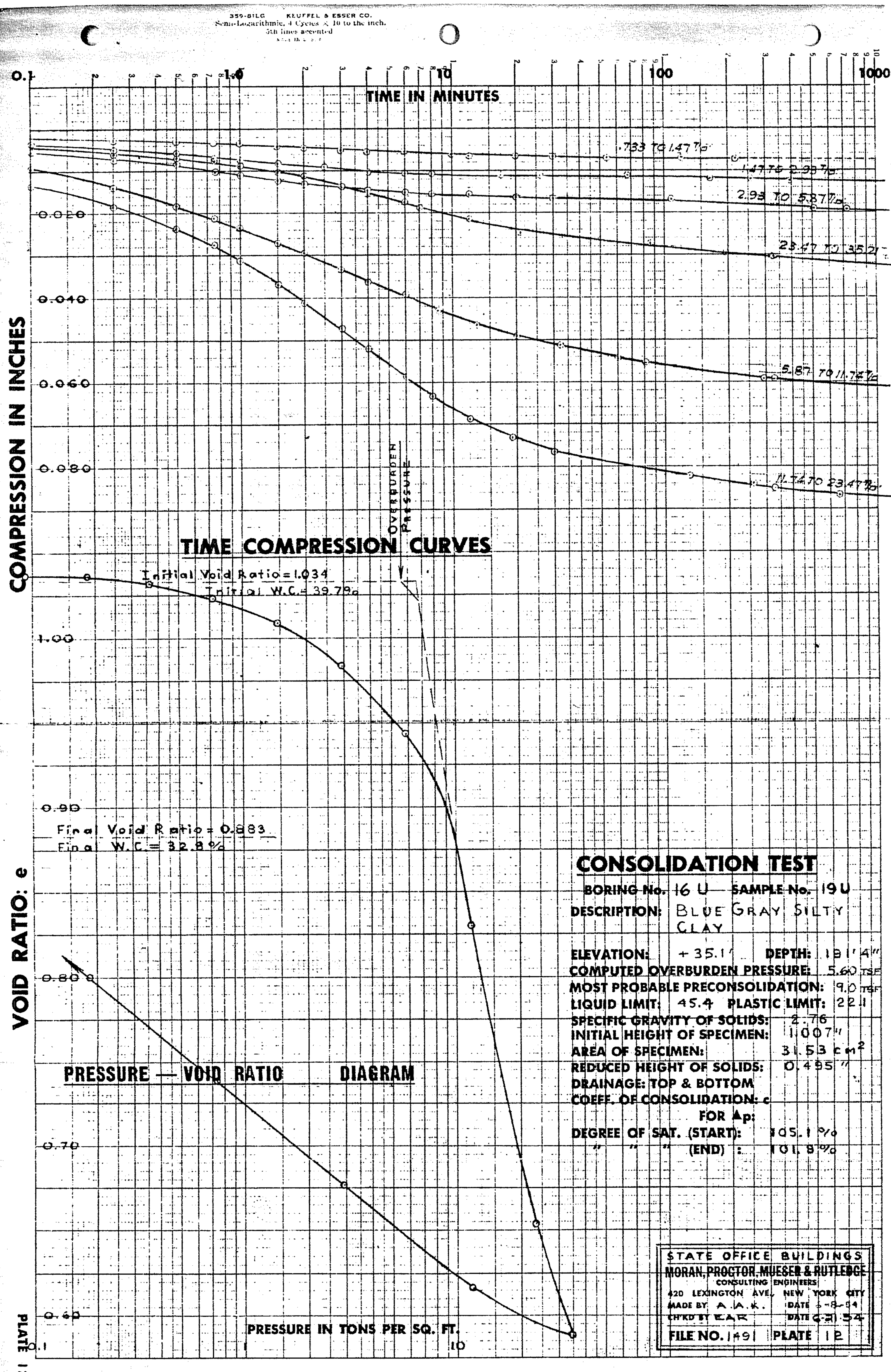
COEFF. OF CONSOLIDATION: c

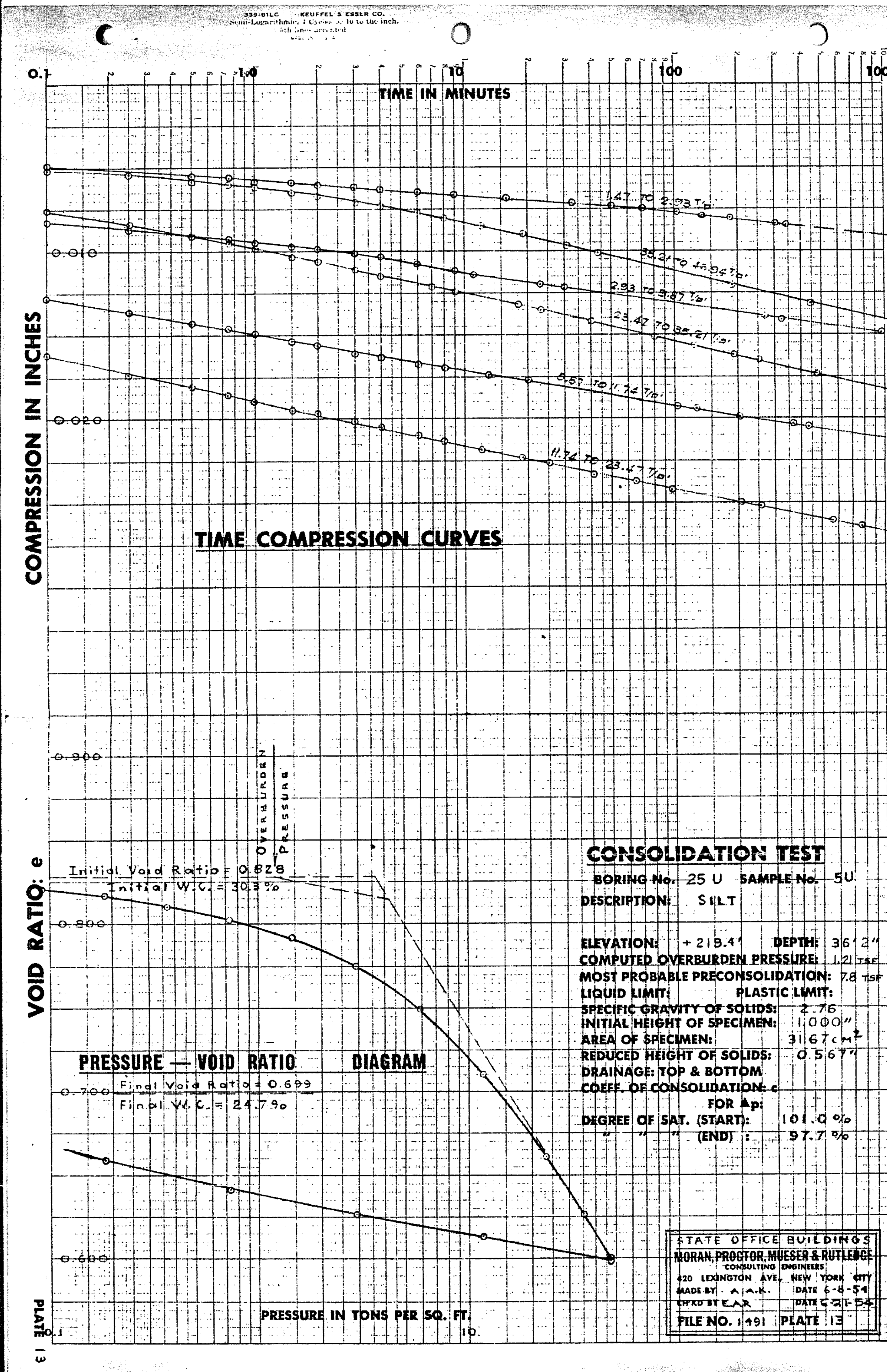
FOR Δp:

DEGREE OF SAT. (START): 99.5 %

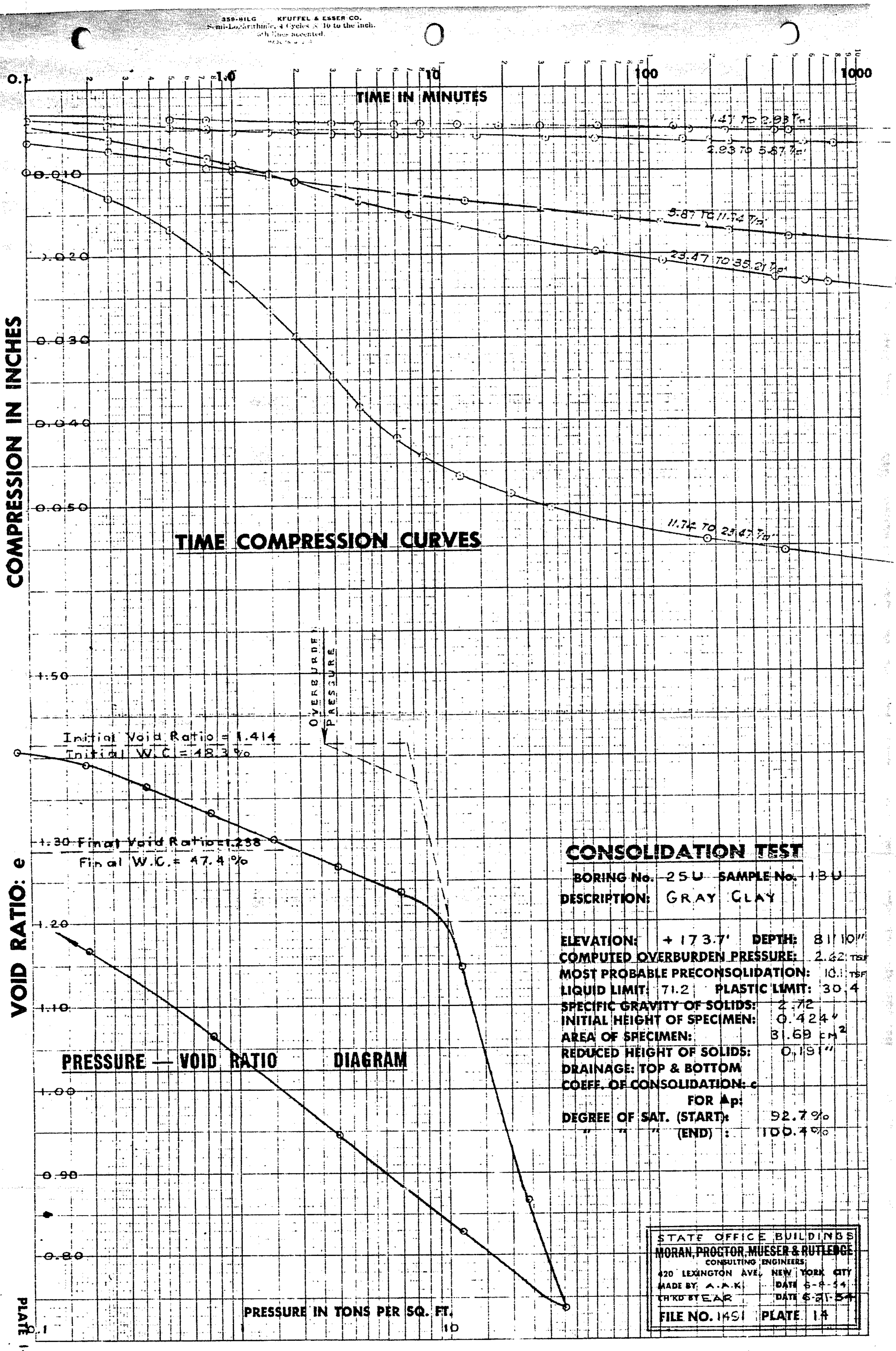
" " " (END): 100.0 %

STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK CITY
MADE BY A.A.K. DATE 6-8-54
CH'KD BY E.A.R. DATE 6-21-54
FILE NO. 1491 PLATE 11


359-81LG KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles × 10 to the inch.
5th lines accented
TIME IN MINUTES
COMPRESSION IN INCHES
VOID RATIO: e
.733 TO 1.47 T/□
1.47 TO 2.93 T/□
2.93 TO 5.87 T/□
23.47 TO 35.21
5.87 TO 11.74 T/□
11.74 TO 23.47 T/□
TIME COMPRESSION CURVES
OVERBURDEN PRESSURE
Initial Void Ratio = 1.034
Initial W.C. = 39.7%
Final Void Ratio = 0.883
Final W.C. = 32.8%
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 16 U SAMPLE No. 19 U
DESCRIPTION: BLUE GRAY SILTY CLAY
ELEVATION: +35.1' DEPTH: 19' 4"
COMPUTED OVERBURDEN PRESSURE: 5.60 TSF
MOST PROBABLE PRECONSOLIDATION: 9.0 TSF
LIQUID LIMIT: 45.4 PLASTIC LIMIT: 22.1
SPECIFIC GRAVITY OF SOLIDS: 2.76
INITIAL HEIGHT OF SPECIMEN: 1.007"
AREA OF SPECIMEN: 31.53 cm²
REDUCED HEIGHT OF SOLIDS: 0.495"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 105.1%
" " " (END): 101.8%
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE, NEW YORK CITY
MADE BY A.A.K. DATE 5-8-54
CH'KD BY E.A.R. DATE 5-21-54
FILE NO. 1491 PLATE 12



359-61LC KEUFFEL & ESSER CO.
Semi-Logarithmic, 4 Cycles × 10 to the inch.
TIME IN MINUTES
COMPRESSION IN INCHES
TIME COMPRESSION CURVES
1.47 TO 2.93 T/□'
35.21 TO 46.94 T/□'
2.93 TO 5.87 T/□'
23.47 TO 35.21 T/□'
5.87 TO 11.74 T/□'
11.74 TO 23.47 T/□'
0.010
0.020
0.900
0.800
0.700
0.600
VOID RATIO: e
OVERBURDEN PRESSURE
Initial Void Ratio = 0.828
Initial W.C. = 30.3 %
PRESSURE — VOID RATIO DIAGRAM
Final Void Ratio = 0.699
Final W.C. = 24.7 %
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 25 U SAMPLE No. 5U
DESCRIPTION: SILT
ELEVATION: + 218.41 DEPTH: 36' 2"
COMPUTED OVERBURDEN PRESSURE: 1.21 TSF
MOST PROBABLE PRECONSOLIDATION: 7.8 TSF
LIQUID LIMIT: PLASTIC LIMIT:
SPECIFIC GRAVITY OF SOLIDS: 2.76
INITIAL HEIGHT OF SPECIMEN: 1.000"
AREA OF SPECIMEN: 31.67 cm²
REDUCED HEIGHT OF SOLIDS: 0.567"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 101.0 %
" " " (END) : 97.7 %
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY
MADE BY A.A.K. DATE 6-8-54
CHKD BY E.A.R. DATE 6-21-54
FILE NO. 1491 PLATE 13



CONSOLIDATION TEST

BORING No. 25U SAMPLE No. 13U

DESCRIPTION: GRAY CLAY

ELEVATION: + 173.7' DEPTH: 81' 10"

COMPUTED OVERBURDEN PRESSURE: 2.42 TSF

MOST PROBABLE PRECONSOLIDATION: 10.1 TSF

LIQUID LIMIT: 71.2 PLASTIC LIMIT: 30.4

SPECIFIC GRAVITY OF SOLIDS: 2.72

INITIAL HEIGHT OF SPECIMEN: 0.424"

AREA OF SPECIMEN: 31.69 cm²

REDUCED HEIGHT OF SOLIDS: 0.191"

DRAINAGE: TOP & BOTTOM

COEFF. OF CONSOLIDATION: c

FOR Δp:

DEGREE OF SAT. (START): 92.7%

" " " (END) : 100.4%

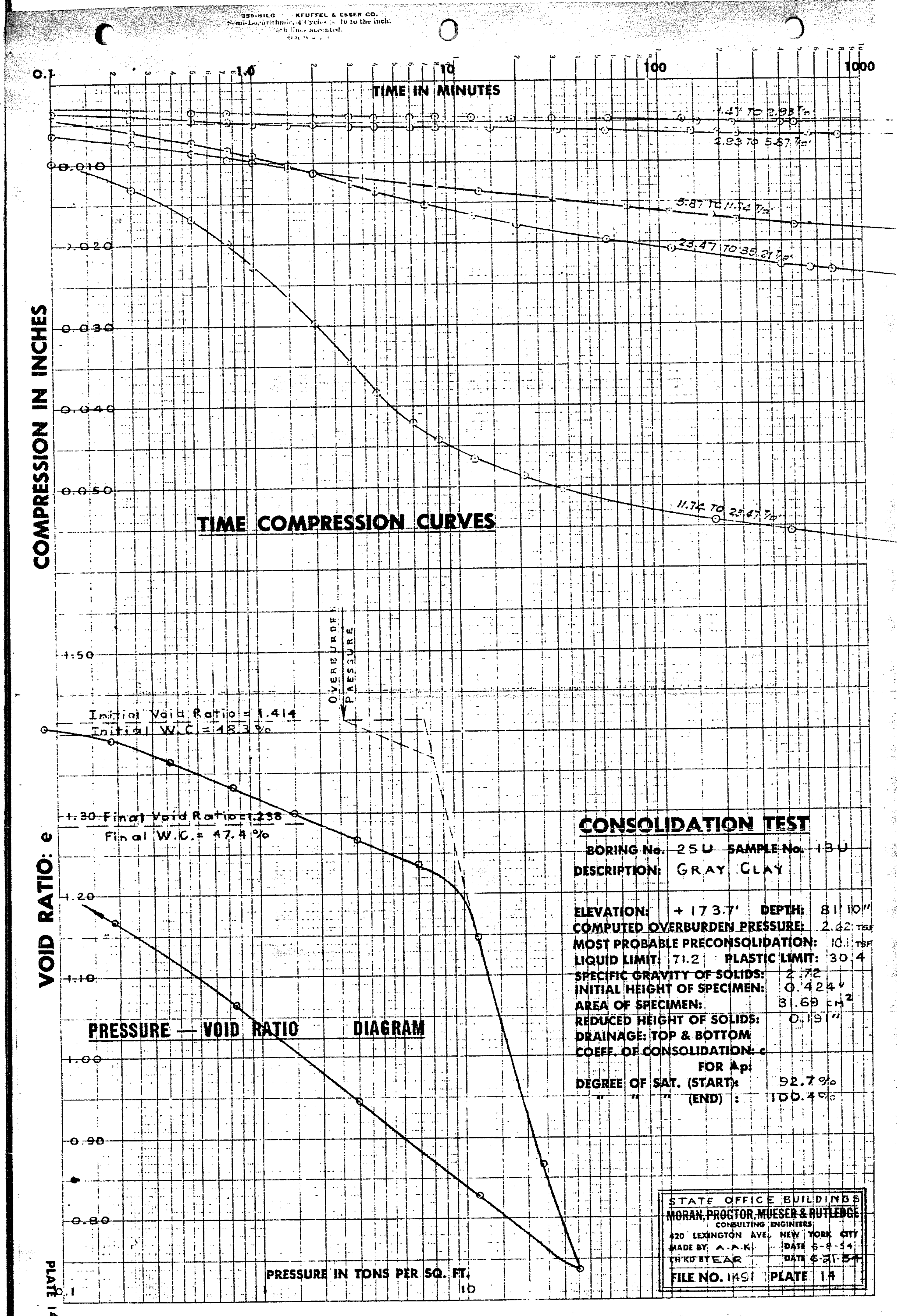
STATE OFFICE BUILDINGS

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE. NEW YORK CITY

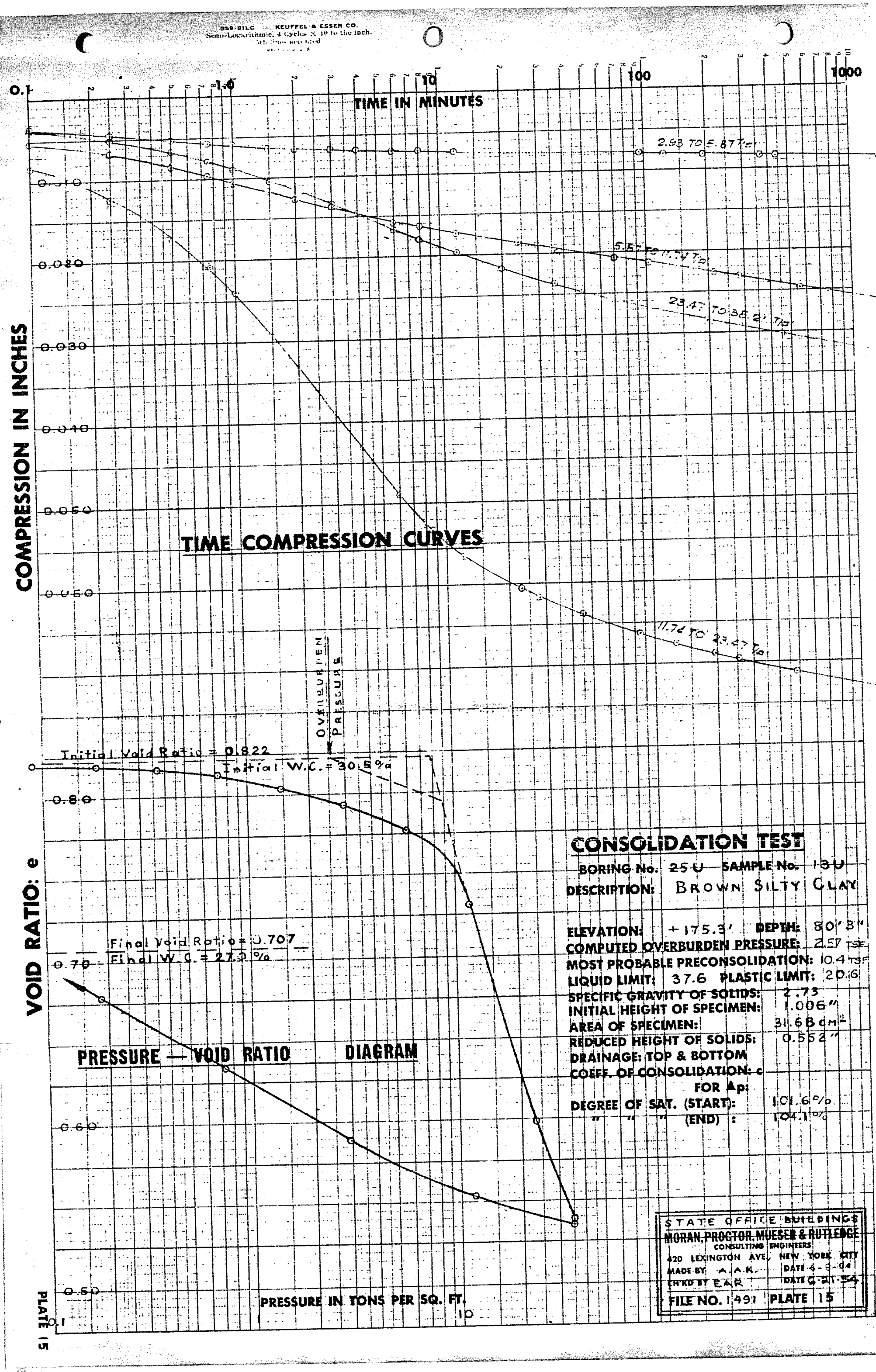
MADE BY A.A.K. DATE 6-8-54

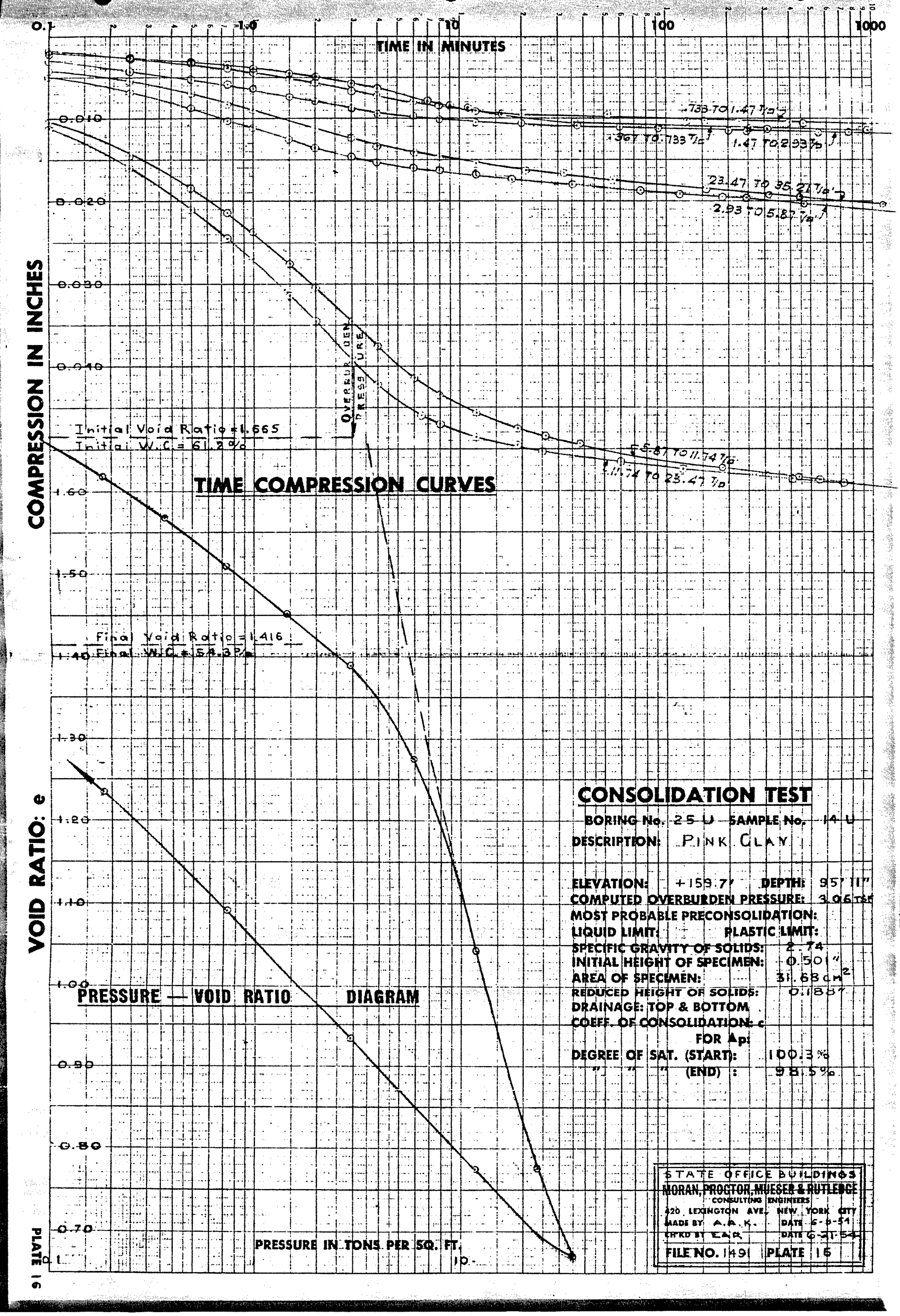
CHKD BY E.A.R. DATE 6-21-54

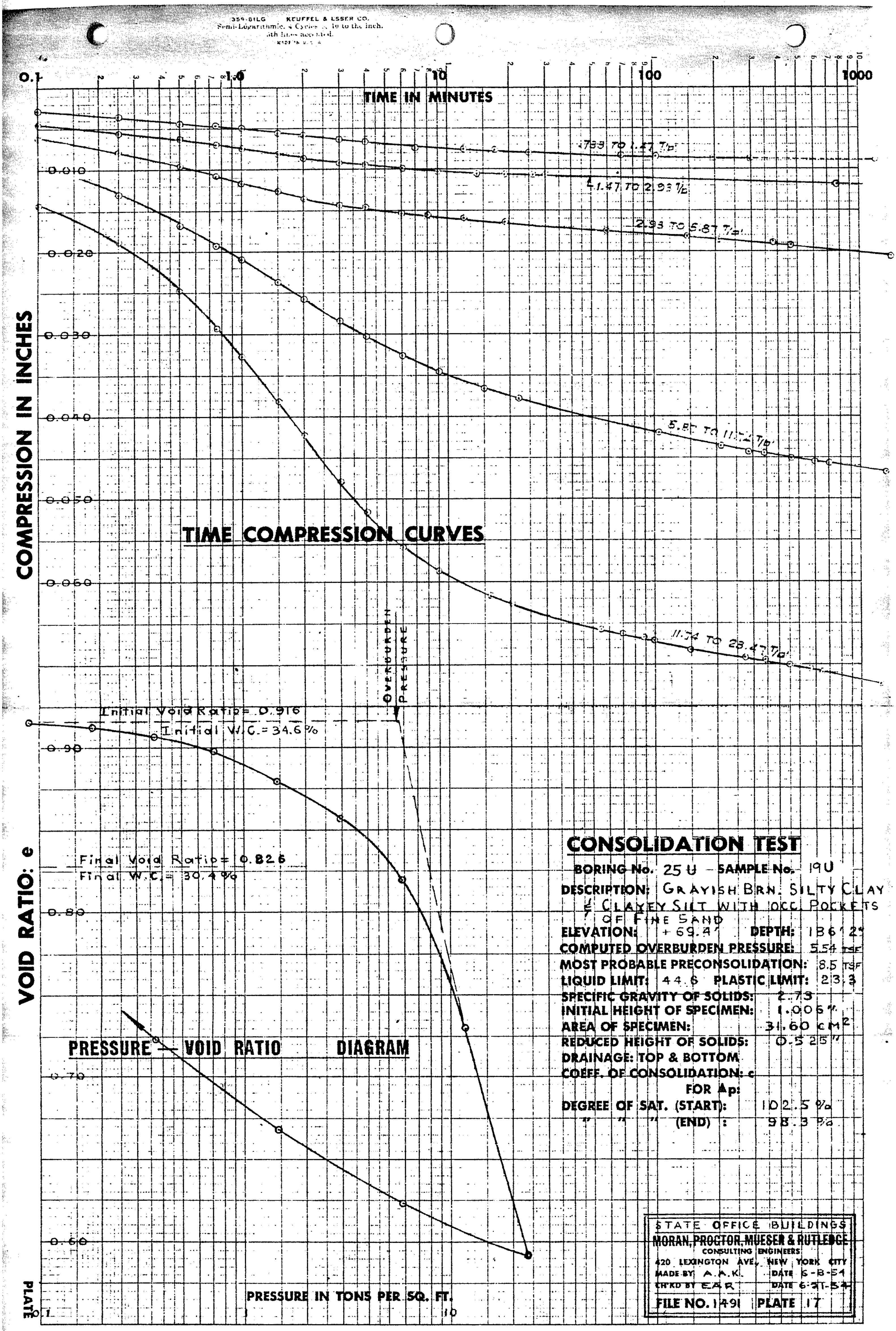
FILE NO. 1451 PLATE 14



TIME IN MINUTES
COMPRESSION IN INCHES
TIME COMPRESSION CURVES
1.47 TO 2.93 T/ft
2.93 TO 5.87 T/ft
5.87 TO 11.74 T/ft
23.47 TO 35.21 T/ft
11.74 TO 23.47 T/ft
OVERBURDEN PRESSURE
Initial Void Ratio = 1.414
Initial W.C. = 48.3%
Final Void Ratio = 1.238
Final W.C. = 47.4%
VOID RATIO: e
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 25U SAMPLE No. 13U
DESCRIPTION: GRAY CLAY
ELEVATION: +173.7' DEPTH: 81' 10"
COMPUTED OVERBURDEN PRESSURE: 2.42 TSF
MOST PROBABLE PRECONSOLIDATION: 10.1 TSF
LIQUID LIMIT: 71.2 PLASTIC LIMIT: 30.4
SPECIFIC GRAVITY OF SOLIDS: 2.72
INITIAL HEIGHT OF SPECIMEN: 0.424"
AREA OF SPECIMEN: 31.69 cm²
REDUCED HEIGHT OF SOLIDS: 0.191"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 92.7%
" " " (END): 100.4%
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK CITY
MADE BY A.A.K. DATE 6-9-54
CH'KD BY EAR DATE 6-21-54
FILE NO. 1451 PLATE 14


TIME IN MINUTES
COMPRESSION IN INCHES
TIME COMPRESSION CURVES
2.93 TO 5.87 T/Ft
5.87 TO 11.74 T/Ft
23.47 TO 35.21 T/Ft
11.74 TO 23.47 T/Ft
OVERBURDEN PRESSURE
Initial Void Ratio = 0.822
Initial W.C. = 30.5 %
Final Void Ratio = 0.707
Final W.C. = 27.0 %
VOID RATIO: e
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
CONSOLIDATION TEST
BORING No. 25 U SAMPLE No. 13 U
DESCRIPTION: BROWN SILTY CLAY
ELEVATION: + 175.3' DEPTH: 80' 3"
COMPUTED OVERBURDEN PRESSURE: 2.57 TSF
MOST PROBABLE PRECONSOLIDATION: 10.4 TSF
LIQUID LIMIT: 37.6 PLASTIC LIMIT: 20.6
SPECIFIC GRAVITY OF SOLIDS: 2.73
INITIAL HEIGHT OF SPECIMEN: 1.006"
AREA OF SPECIMEN: 31.68 cm²
REDUCED HEIGHT OF SOLIDS: 0.552"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c FOR Δp:
DEGREE OF SAT. (START): 101.6 %
" " " (END) : 104.1 %
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE, NEW YORK CITY
MADE BY A.A.K.
CH'KD BY E.A.R.
FILE NO. 1491 PLATE 15


TIME IN MINUTES
COMPRESSION IN INCHES
VOID RATIO: e
TIME COMPRESSION CURVES
PRESSURE — VOID RATIO DIAGRAM
PRESSURE IN TONS PER SQ. FT.
Initial Void Ratio = 1.665
Initial W.C. = 61.2%
Final Void Ratio = 1.416
Final W.C. = 54.3%
OVERBURDEN PRESSURE
.733 TO 1.47 T/□'
.367 TO .733 T/□'
1.47 TO 2.93 T/□'
23.47 TO 35.21 T/□'
2.93 TO 5.87 T/□'
5.87 TO 11.74 T/□'
11.74 TO 23.47 T/□'
CONSOLIDATION TEST
BORING No. 25 U SAMPLE No. 14 U
DESCRIPTION: PINK CLAY
ELEVATION: +159.7' DEPTH: 95' 11"
COMPUTED OVERBURDEN PRESSURE: 3.06 TSF
MOST PROBABLE PRECONSOLIDATION:
LIQUID LIMIT: PLASTIC LIMIT:
SPECIFIC GRAVITY OF SOLIDS: 2.74
INITIAL HEIGHT OF SPECIMEN: 0.501"
AREA OF SPECIMEN: 31.68 cm²
REDUCED HEIGHT OF SOLIDS: 0.188"
DRAINAGE: TOP & BOTTOM
COEFF. OF CONSOLIDATION: c
FOR Δp:
DEGREE OF SAT. (START): 100.3%
" " " (END) : 98.5%
STATE OFFICE BUILDINGS
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK CITY
MADE BY A.A.K. DATE 6-6-54
CH'KD BY E.A.R. DATE 6-21-54
FILE NO. 1491 PLATE 16



CONSOLIDATION TEST

BORING No. 25 U — **SAMPLE No.** 19U

DESCRIPTION: GRAYISH BRN. SILTY CLAY & CLAYEY SILT WITH OCC. POCKETS OF FINE SAND

ELEVATION: +69.4' **DEPTH:** 18'6"-2'

COMPUTED OVERBURDEN PRESSURE: 5.54 TSF

MOST PROBABLE PRECONSOLIDATION: 8.5 TSF

LIQUID LIMIT: 44.6 **PLASTIC LIMIT:** 23.3

SPECIFIC GRAVITY OF SOLIDS: 2.73

INITIAL HEIGHT OF SPECIMEN: 1.006"

AREA OF SPECIMEN: 31.60 CM²

REDUCED HEIGHT OF SOLIDS: 0.525"

DRAINAGE: TOP & BOTTOM

COEFF. OF CONSOLIDATION: c FOR Δp:

DEGREE OF SAT. (START): 102.5%

" " " (END): 98.3%

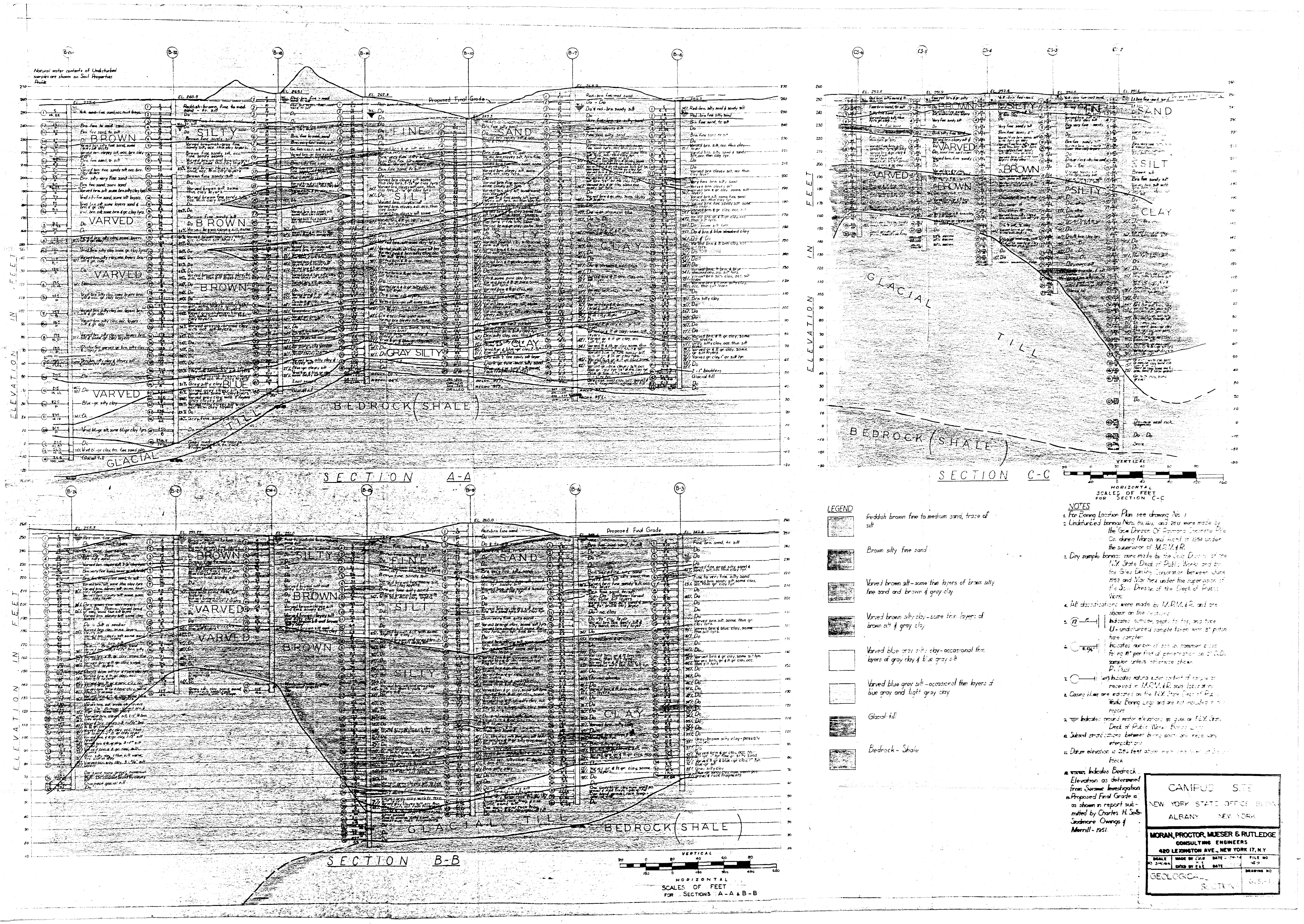
STATE OFFICE BUILDINGS

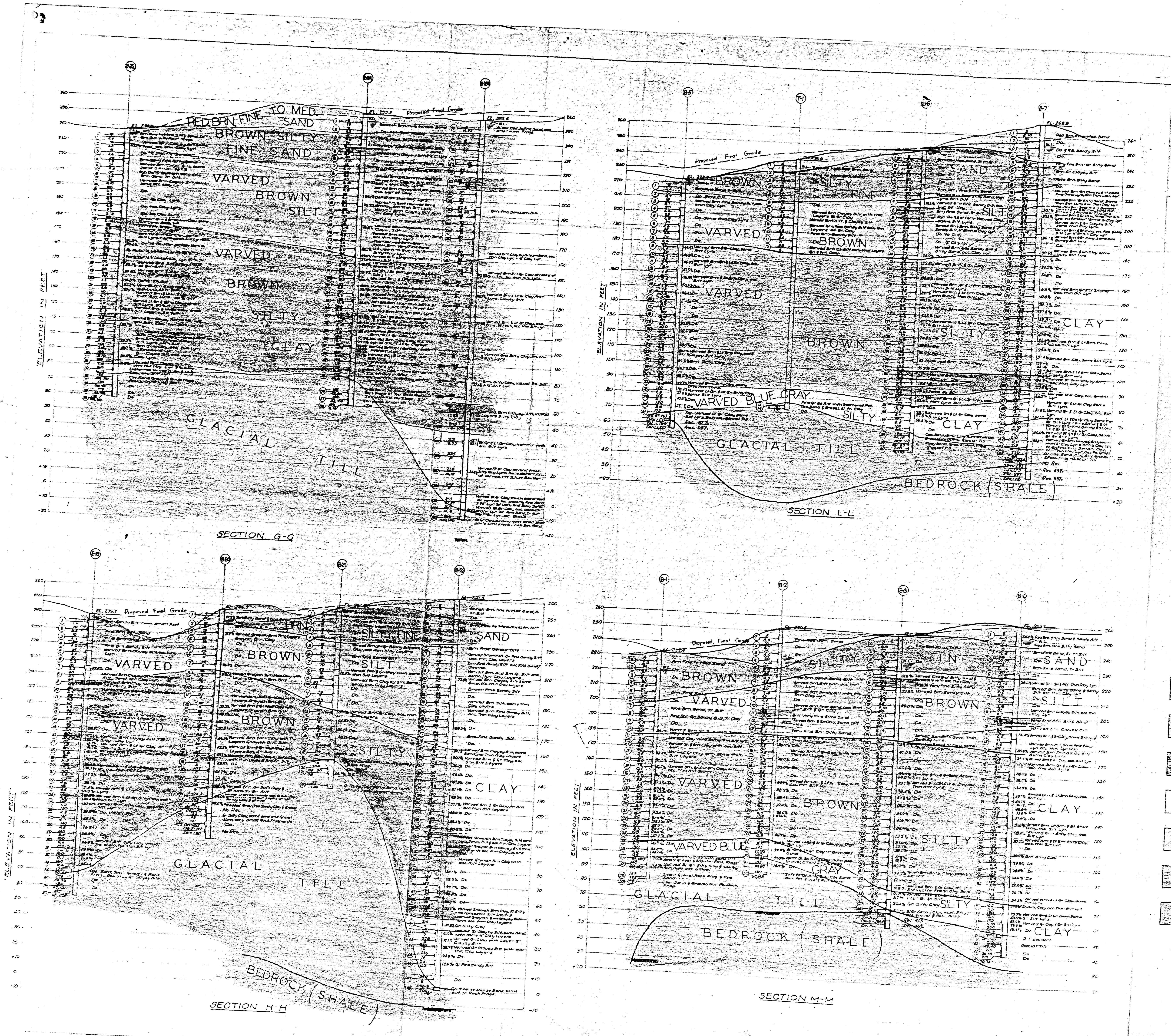
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK CITY

MADE BY A.A.K. DATE 6-8-54

CH'KD BY E.A.R. DATE 6-21-54

FILE NO. 1491 **PLATE** 17


Natural water contents of Undisturbed samples are shown on Soil Properties Profile
Proposed Final Grade
BROWN
SILTY
FINE
SAND
VARVED
SILT
CLAY
GRAY SILTY
BLUE
GLACIAL TILL
BEDROCK (SHALE)
ELEVATION IN FEET
SECTION A-A
SECTION B-B
SECTION C-C
VERTICAL
HORIZONTAL
SCALES OF FEET FOR SECTIONS A-A & B-B
SCALES OF FEET FOR SECTION C-C
LEGEND
Reddish brown fine to medium sand, trace of silt
Brown silty fine sand
Varved brown silt - some thin layers of brown silty fine sand and brown & gray clay
Varved brown silty clay - some thin layers of brown silt & gray clay
Varved blue gray silty clay - occasional thin layers of gray clay & blue gray silt
Varved blue gray silt - occasional thin layers of blue gray and light gray clay
Glacial till
Bedrock - Shale
NOTES
1. For Boring Location Plan see drawing No. 1
Indicates Bedrock Elevation as determined from Seismic Investigation
Proposed Final Grade is as shown in report submitted by Charles H. Sells - Skidmore Owings & Merrill - 1951.
CAMPUS SITE
NEW YORK STATE OFFICE BLDG
ALBANY NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
SCALE AS SHOWN
MADE BY
CHKD BY
DATE
FILE NO
DRAWING NO
GEOLOGICAL SECTIONS



VERTICAL

HORIZONTAL

SCALES OF FEET

LEGEND

- Reddish brown fine to medium sand, trace of silt
- Brown silty fine sand
- Varved brown silt - some thin layers of brown silty fine sand and brown & gray clay
- Varved brown silty clay - some thin layers of brown silt & gray clay
- Varved blue gray silty clay - occasional thin layers of gray clay & blue gray silt
- Varved blue gray silt - occasional thin layers of blue gray and light gray clay
- Glacial till
- Bedrock - Shale

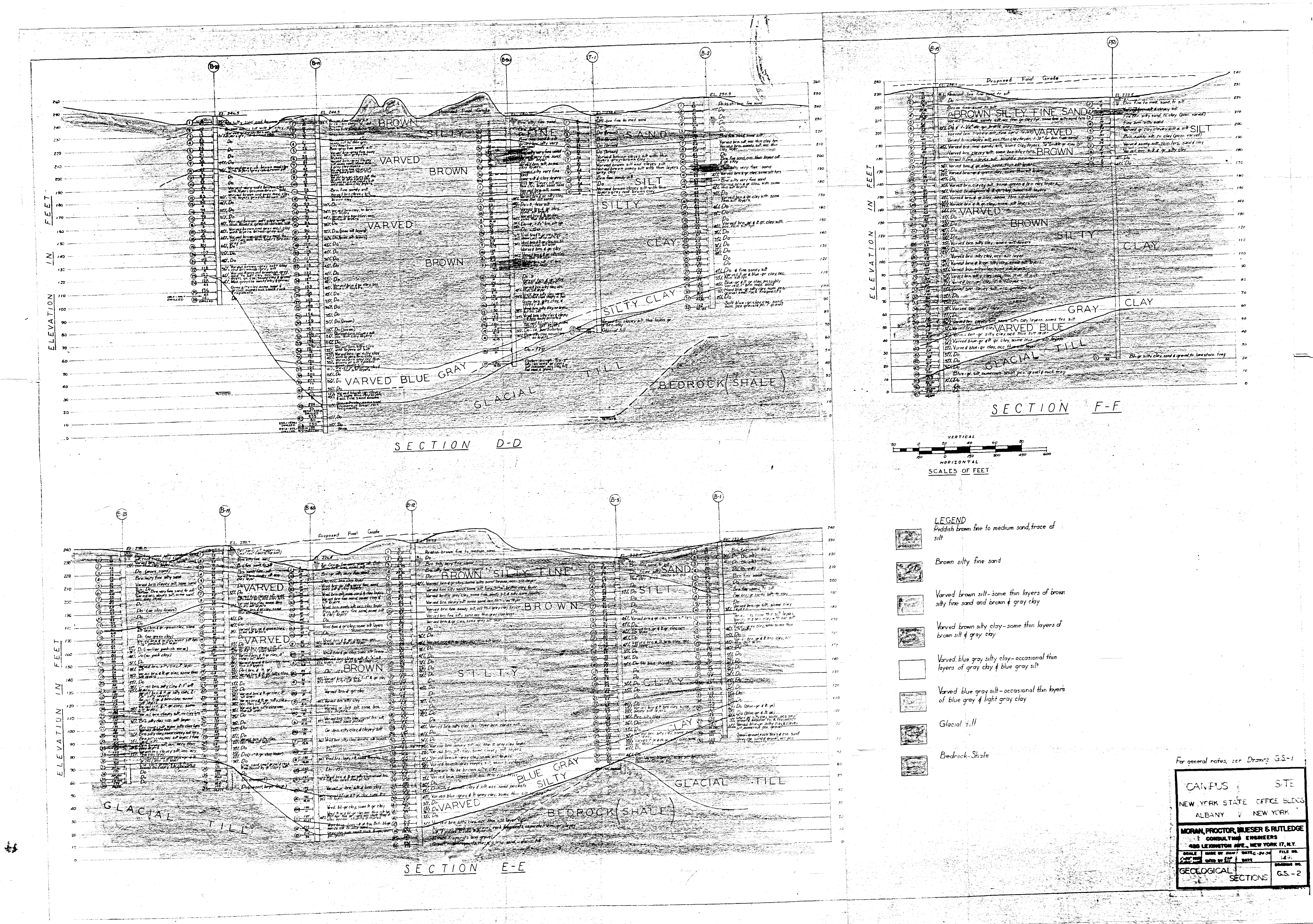
For general notes, see Drawing G.S.-1

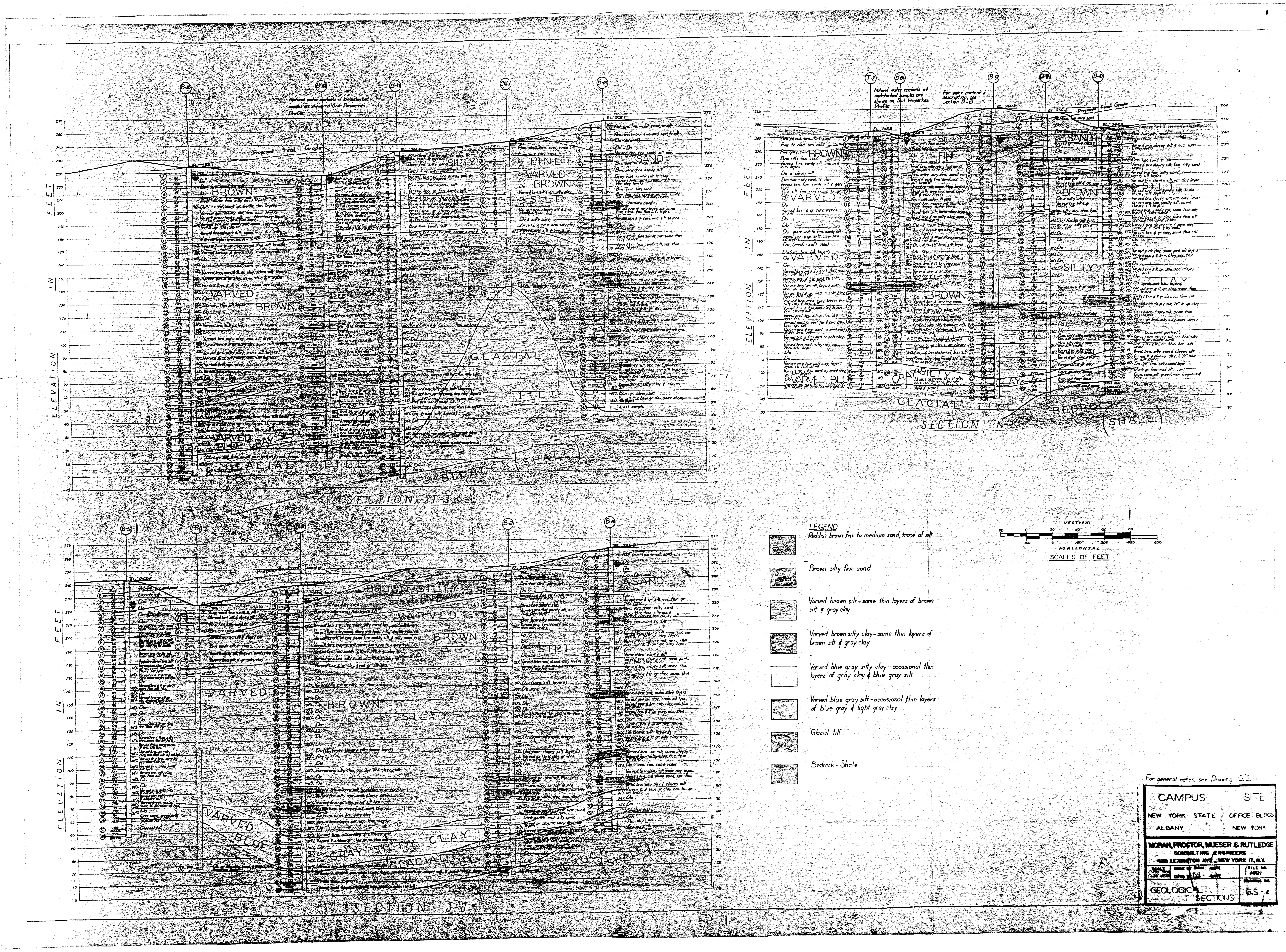
CAMPUS SITE
NEW YORK STATE OFFICE ...
ALBANY NEW YORK

MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.

SCALE	MADE BY	DATE	FILE NO.
	CH'D BY	DATE	1491

GEOLOGICAL SECTIONS — DRAWING NO. G.S.-3


SECTION D-D
SECTION E-E
SECTION F-F
ELEVATION IN FEET
BROWN SILTY FINE SAND
VARVED BROWN SILTY CLAY
VARVED BLUE GRAY SILTY CLAY
GLACIAL TILL
BEDROCK (SHALE)
Proposed Final Grade
VERTICAL
HORIZONTAL
SCALES OF FEET
LEGEND
Reddish brown fine to medium sand, trace of silt
Brown silty fine sand
Varved brown silt - some thin layers of brown silty fine sand and brown & gray clay
Varved brown silty clay - some thin layers of brown silt & gray clay
Varved blue gray silty clay - occasional thin layers of gray clay & blue gray silt
Varved blue gray silt - occasional thin layers of blue gray & light gray clay
Glacial till
Bedrock-Shale
For general notes, see Drawing G.S-1
CAMPUS SITE
NEW YORK STATE OFFICE BLDGS
ALBANY NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
NEW YORK 17, N.Y.
SCALE
DATE
FILE NO.
DRAWING NO.
GEOLOGICAL SECTIONS
G.S. - 2



SECTION I-I
SECTION K-K
SECTION J-J
BROWN SILTY FINE SAND
VARVED BROWN SILTY CLAY
VARVED BLUE GRAY SILTY CLAY
GLACIAL TILL
BEDROCK (SHALE)
ELEVATION IN FEET
Proposed Final Grade
LEGEND
Reddish brown fine to medium sand, trace of silt
Brown silty fine sand
Varved brown silt - some thin layers of brown silt & gray clay
Varved brown silty clay - some thin layers of brown silt & gray clay
Varved blue gray silty clay - occasional thin layers of gray clay & blue gray silt
Varved blue gray silt - occasional thin layers of blue gray & light gray clay
Glacial till
Bedrock - Shale
VERTICAL
HORIZONTAL
SCALES OF FEET
For general notes, see Drawing G.S.-1
CAMPUS SITE
NEW YORK STATE OFFICE BLDGS.
ALBANY NEW YORK
MORAN, PROCTOR, MUESER & RUTLEDGE
CONSULTING ENGINEERS
420 LEXINGTON AVE., NEW YORK 17, N.Y.
GEOLOGICAL SECTIONS
G.S.-4