79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

TRAFFIC ENGINEERING
DEPARTMENT
CITY OF MINNEAPOLIS

August 17, 1979

St. Anthony

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MINNEAPOLIS/ST. PAUL 6800 S. County Rd. 18, P.O. Box 35108, Mpls., MN / 612-941-5600
NORTHERN MINNESOTA 3219 E. 19th Avenue, Hibbing, MN 55746
CENTRAL MINNESOTA 1520 - 24th Ave. N., P.O. Box 189, St. Cloud, MN 56301
DULUTH/SUPERIOR 5431 Airpark Blvd., Duluth, MN 55811
SOUTHERN MINNESOTA 40 - 16th St. S.E., Rochester, MN 55901

J.S. BRAUN P.E., *President*
P.H. ANDERSON, *Vice Pres. Operations*
C.G. KRUSE P.E., *Vice Pres. Engineering*
D.R. HAUSLER P.E., *Associate*

August 17, 1979

Traffic Engineering Department
City Of Minneapolis
211 City Hall
Minneapolis, MN 55415

Attn: Mr. Greg Finstad

Re: 79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

Gentlemen:

Attached is a report containing the results of the six standard penetration test borings performed on the above referenced site. This work was authorized by you on July 18, 1979.

The borings generally encountered dense to very dense granular soils to their termination depths. Bedrock was generally encountered at depths of approximately 50 feet. The report recommends that the proposed structure could, in our opinion, be supported utilizing conventional spread footings proportioned to exert maximum stresses of 4000 or 6000 psf. For the more detailed results and recommendations, your attention is directed to the body of the report.

If we may be of further assistance in evaluating the contents of this report, performing additional soil borings or in providing additional services on earthwork, concrete or bituminous testing, please contact us at your convenience.

Very truly yours,

BRAUN ENGINEERING TESTING, INC.

Wm M. Weyrauch

William M. Weyrauch
Project Engineer

C. G. Kruse

C. G. Kruse, P.E.
Vice President - Engineering

WMW/CGK:jn

August 17, 1979

79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

A. INTRODUCTION:

A.1. Purpose: The purpose of the borings was to provide subsurface soil and groundwater information for the foundation design and construction of the proposed structure.

A.2. Scope: A total of six standard penetration test borings were taken. These borings were extended to depths of 35 to 51 feet. At two of the boring locations (ST-1 and ST-6), NQ sized rock cores were taken 10 feet into bedrock. Penetration resistances were recorded in the soils. The soil samples and rock cores were returned to our laboratory for further testing and examination by a Soils Engineer. Laboratory tests were performed on a limited number of samples returned to our laboratory. These tests were performed in accordance with appropriate ASTM procedures. An engineering report presenting our opinions and recommendations regarding foundation design and construction has been prepared.

A.3. Available Information:

A.3.a. Proposed Structure: The project is located on the east end of the block bounded by University Avenue, Central Avenue, 2nd Street S.E. and 2nd Avenue. It is our understanding that a 7 to 8-story reinforced concrete parking structure is planned. We understand that the proposed structure will have overall dimensions of approximately 165 feet by 302 feet. At this time, bay sizes of 20' x 54' are planned. It has been indicated that the column loads will be a maximum of 900 kips at the interior of the structure and that a maximum of about 3 feet of fill will be placed on the site (near University Avenue). Generally the final grade is to approximate the existing site grade.

A.3.b. Previous and Existing Structures: At the present time, the structure for the Foremost Ice Cream Company exists on the site. It is our understanding that this structure will be demolished. As this site is located in an urban area, previous structures may have existed on this site. Experience on other urban projects suggests that it is possible that old foundation walls or other buried man-made materials from pre-existing structures may be encountered below grade on this site.

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A.3.c. Site Geology: As the site is situated relatively near the existing Mississippi River channel, river channel deposits (alluvium) are anticipated. Results of the borings indicate that the soils encountered are generally characteristic of alluvial type soils. It should be noted that glacial till material was also encountered. This represents deposition during glacial encroachment on or over a previously existing river channel. The bedrock encountered is typical of the Platteville Formation. The rock cores recovered show dolomitic limestone and dolomite.

A.4. Boring Locations and Elevations: The borings were taken at the approximate locations indicated on the plan provided by Carl Walker & Associates. The borings were laid out in the field by a Soils Engineer. Due to the presence of existing structures and parked cars, offsets were necessary in order to complete the borings. The final boring locations are shown on the attached sketch.

The surface elevations of borings ST-1 through ST-3 were referenced to the existing sidewalk grade at a traffic control box just north of ST-1. This elevation has been indicated to be 136.72 on the City of Minneapolis datum. The surface elevations of borings ST-4 through ST-6 were referenced to the top of the steel frame of a truck scale in the parking lot northeast of the intersection of 2nd Avenue S.E. and 2nd Street S.E. This bench mark has been indicated to have an elevation of 131.04 on the City of Minneapolis datum.

A.5. Field Testing and Sampling: The borings were completed on July 25 through 31, 1979, using a truck-mounted core and auger drill in accordance with ASTM D1586 "Penetration Test and Split Barrel Sampling of Soils". Using this method, the bore hole is advanced with the hollow-stem auger to the desired test depth. Then a 140-pound hammer falling 30 inches drives a standard 2-inch OD split barrel sampler a total penetration of 1½ feet below the tip of the hollow-stem auger. The blows for the last foot of penetration are recorded and are an index of soil strength characteristics. Soil samples were taken at 2½-foot increments to the 15-foot depth and at 5-foot increments to the termination depth in each of the borings. Use of the hollow-stem auger eliminated the driving of casing and the need for jetting water.

A.6. Classification of Soils: Mineral soils encountered in the borings were visually and manually classified in the field by the crew chief in accordance with ASTM D2487 "Unified Soils Classification System" and ASTM D2488 "Recommended Practice for Visual and Manual Description of Soils". A copy of ASTM D2487 is

attached. All samples were then returned to the laboratory for verification of the field classifications by a Soils Engineer. Representative samples will remain in this office for a period of 60 days to be available for your examination.

A.7. Groundwater Probings: Immediately after taking the final sample in the bottom of the borings, the borings were probed with the hollow-stem auger in the ground to check for groundwater. In addition, immediately after removal of the auger, the borings were probed and the depth to cave-in and the presence or absence of water was noted. The borings were then immediately back-filled.

B. RESULTS:

B.1. Logs: Log of Boring sheets indicating the depth and identification of the various soil strata, the penetration resistances, laboratory test results and water level information are attached.

B.2. Rock Coring Logs: The Log of Rock Coring sheets indicating the rock descriptions, RQD (rock quality designation) and fracture frequency are also attached.

B.3. Soils Encountered: At borings ST-1 and ST-2, approximately 1 to 2 feet of silty sand topsoil was encountered at the surface. At borings ST-3 and ST-6, approximately 6 to 7½ feet of material believed to be fill was encountered at the surface. The indicated fill material is granular and the "N" values recorded indicate very loose to medium dense conditions. At boring locations ST-3 through ST-6, as much as 8 inches of bituminous or concrete materials were noted at the surface.

Beneath the topsoil, fill and bituminous/concrete materials, the borings generally encountered dense to very dense granular alluvial deposits and granular glacial till. In borings ST-1, ST-2 and ST-4, a layer of glacial till, varying in thickness from 3 feet to 12½ feet, was encountered at depths of about 11 to 12½ feet. The "N" values recorded in the granular soils encountered in borings ST-1 through ST-4, indicate generally dense to very dense conditions.

At boring ST-5, sand (alluvium) was encountered to approximately the 11½-foot depth. The "N" values recorded in these sands indicate medium dense to very dense conditions. Below the 11½-foot depth, silty clayey sand to silty sandy clay glacial till was encountered to the termination depth of the boring. The "N"

values recorded in the granular till indicate medium dense to very dense conditions. The "N" values recorded in the cohesive till indicate very stiff to hard consistencies.

At boring ST-6, alternating layers of granular glacial till and sand alluvium were encountered to the termination depth of the boring. A glacial till layer approximately 4 feet thick was encountered at the 7½-foot depth and a till layer 5 feet thick was encountered at the 23-foot depth. The "N" values recorded in these granular soils indicate generally dense to very dense conditions.

It should be noted that boulders were encountered at all of the boring locations.

B.3. Groundwater Probing: Generally, groundwater was not encountered in the soils during the drilling operation. Based upon the results of the groundwater probes and visual examination of the samples obtained, it appears that some localized perched groundwater conditions exist on this site. Based upon the relatively dry to moist condition of the granular soils encountered, it does not appear that a stabilized groundwater level exists within 20 feet of the ground surface. It appears that the stabilized groundwater level exists in or just above the bedrock surface.

Variations in groundwater levels should be expected from place to place and should be expected to vary with normal seasonal and annual fluctuations.

C. ANALYSIS AND RECOMMENDATIONS:

C.1. Foundation Recommendations: The following recommendations are based upon the structural information provided to us and discussed in section A.3.

It is our opinion that the proposed structure can be supported on spread footings. We recommend that the spread footings be proportioned to exert maximum soil bearing pressures of 4000 psf or 6000 psf with additional excavation. The extent of earthwork and the settlements will vary depending upon which soil bearing pressure is utilized. An economic decision between earthwork and concrete costs should be made.

It is anticipated that this structure will not be heated. Spread footings for unheated structures should typically extend a minimum of 6 feet below the final ground surface.

The soils encountered on this site are not considered to be particularly frost susceptible and are generally dry to moist. It may be possible to reduce the depth of footings if surface water can be kept from below the floor slab.

If boulders are encountered at the footing elevation, these should be removed to prevent development of excessive stress concentration.

C.1.a. 4000 psf Spread Footings: Based upon the existing grades, it is our opinion that footings proportioned to exert maximum stresses of 4000 pounds per square foot (psf) could be utilized at frost depth at each of the boring locations. Using this approach, maximum settlements of about 3/4 inch and maximum differential settlements of 1/2 inch have been estimated.

C.1.b. 6000 psf Spread Footings: Alternatively, a higher soil bearing pressure may be utilized with an increased depth of footing or a limited amount of excavation and backfill below the footings. Maximum overall settlements of about 1 inch and maximum differential settlements of about 1/2 inch to 3/4 inch have been estimated. Using this approach, it is recommended that footings placed at or below the indicated elevations (see below) could be proportioned to exert maximum stresses of 6000 psf. The tabulation below indicates the maximum recommended bottom of footing elevations. If footings would normally be placed above these elevations the footings would have to be subcut to the elevations shown below.

Footing/Subcut Elevations

Boring	Existing Grade	Maximum 4000 psf Elevation *	Maximum 6000 psf Elevation *
ST-1	139.8	135.5	133.0
ST-2	137.6	136.5	132.5
ST-3	142.5	138.5	133.5
ST-4	133.6	133.0	133.0
ST-5	132.4	128.5	126.0
ST-6	129.4	122.5	120.5

* Approximate, anticipated elevations. Actual elevations should be determined by observation during excavation.

C.2. Excavation Oversizing: In the event that fill is placed below the footings, it is recommended that the excavations be

oversized a minimum of 1 foot horizontally for each 1 foot of excavation below the bottom of footing elevation.

C.3. Excavation Observations: It is recommended that the excavations be observed by a qualified Soils Engineer or his representative prior to placement of fill and/or foundation materials to check that the soils encountered by the borings are typical of the soils encountered during excavation. In addition, the bottoms of the excavations should be checked to see that they have not been unduly disturbed by the excavation process.

C.4. Fill Placement: Although any inorganic, mineral, debris-free soil may be used for fill, it is recommended that granular soils be used for ease of placement and compaction. With the exception of the topsoils encountered, it is our opinion that the granular soils encountered on the site could be reused as fill. It is recommended that any fill placed be placed in thin lifts. If fill is placed for support of footings proportioned to exert maximum stresses of 4000 psf, we recommend that the fill be compacted to a minimum of 93% and minimum average of 95% of the modified Proctor density (ASTM D1557-70). Where fill will be placed to support footings proportioned to exert maximum stresses of 6000 psf, we recommend that the fill be compacted to a minimum of 98% and a minimum average of 100% of the modified Proctor density. Compaction tests are recommended to assist in evaluating the actual densities obtained.

Based upon the groundwater probings and the moisture contents within the soils encountered, it does not appear likely that groundwater will be encountered during construction. In the event that water is encountered in the excavation, (perched conditions, run-off, etc.) we recommend that it be removed prior to fill placement in order to allow observation of the excavation bottom and to facilitate good compaction in the fill.

C.5. First Floor Slab: You have indicated that some fill may be required below the first floor slab. It is recommended that fill placed below the first floor slab be compacted to a minimum of 89% and minimum average of 90% of the modified Proctor density.

C.6. Demolition Considerations: As previously mentioned, existing structure(s) are present on the site. Previous structures may have also been situated on this site. Consequently special considerations should be made during site preparation. Experience on other projects where previous structures were located has shown that unexpected, buried, man-made structures encountered during construction may add considerable costs to

construction. We recommend that all walls, tanks, footings and floor slabs be removed prior to backfilling. In order to minimize the cost of encountering these structures during construction we recommend that the demolition of existing structures, in accordance with City codes, be observed on a full-time basis.

D. GENERAL:

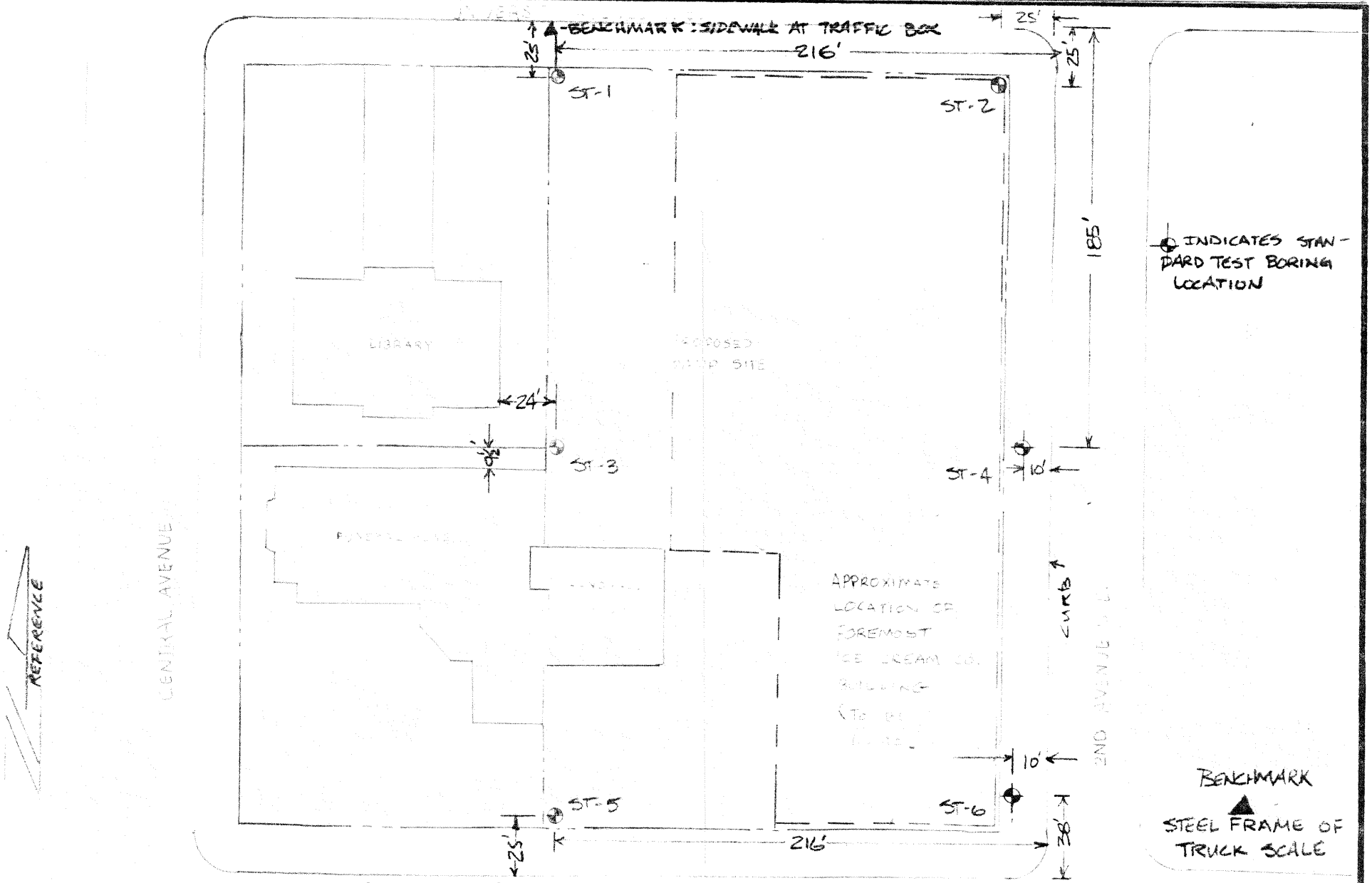
The analysis and recommendations submitted in this report are based upon the data obtained from the 6 soil borings performed at the locations indicated on the attached sketch. Variations may occur between these borings, the nature and extent of which may not become evident until construction. If variations are encountered, it will be necessary to make a re-evaluation of the recommendations of this report after performing on-site observations during the construction and noting the characteristics of any variations. Such variations may result in additional foundation costs and it is suggested that a contingency be provided for this purpose.

To permit correlation of the soil data obtained to date with the actual soil conditions encountered during construction and to provide continuing professional responsibility for the conformance of the construction to the concepts originally contemplated in this report and to the plans and specifications, it is recommended that we be retained to develop and perform the necessary observation and testing program for the excavation and foundation phases of the project.

If others perform the recommended observations and/or testing of construction, professional responsibility becomes divided since in doing so, they assume responsibility for verifying that the soil conditions throughout the construction areas are similar to those encountered in the borings or recognizing variations which would require a change in recommendations.

This report is based on the preliminary design of the proposed structure as was submitted to us for the preparation of this report. Because of the limited amount of information available, a number of assumptions were necessary to permit us to made recommendations. It is recommended that we be provided an opportunity to briefly review the final design and specifications to determine whether those assumptions were satisfactory, whether any change in concept may have had any effect on the validity of the recommendations contained herein, and whether those recommendations have been implemented in the design and specifications. If we are not permitted an opportunity to make this recommended

review, we cannot assume responsibility for the validity of the assumptions, for misinterpretation or misapplication of the recommendations, or for their validity in the event changes have been made from the preliminary design provided. Review of the final design and specifications will be noted in writing and will become an addendum to this report.



BRAUN
ENGINEERING TESTING

79-387 FOUNDATION INVESTIGATION
PROPOSED PARKING RAMP
2ND AVE & 2ND ST. S.E.
MINNEAPOLIS, MINNESOTA

Date:	
Revised:	
Drawn:	ANNIN
Scale:	1" = 40' ±

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-1

LOCATION: See Attached Sketch

DATE: 7/25/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes Sheet 1 of 2
139.8	0					
137.8	2	SM	SILTY SAND, fine-grained, with a trace of coarse Gravel, black, moist. (Topsoil)			
133.3	6.5	SM	SILTY SAND, fine-grained, with a trace of fine to medium Gravel and boulders, brown to dark brown, moist, loose to medium dense. (Coarse Alluvium)	9 19		
128.3	11.5	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace of coarse SAND and fine to medium Gravel, boulders noted, brown to reddish-brown, dry to moist, very dense. (Coarse Alluvium)	53 55		Boulders noted below the 2½' depth.
121.8	18	SM	SILTY SAND, fine to medium-grained with a trace to a little fine to coarse Gravel, boulders noted, reddish-brown, moist, dense. (Glacial Till)	43 33		Surface elevations of borings ST-1 through ST-3 referenced to sidewalk adjacent to traffic control box north west of ST-1.
110.8	29	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace to a little fine to coarse Gravel, boulders noted, brown, moist, dense. (Coarse Alluvium)	49 40		Indicated Elevation: 136.72 (City Datum)
109.8	30	SP	SAND, fine to medium-grained, *	39		*with a trace of coarse grained SAND and fine to medium Gravel, boulders noted, brown, moist, dense. (Coarse Alluvium)

(Continued on Sheet 2)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-1 (Continued)

LOCATION: See Attached Sketch

DATE: 7/25/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
109.8	30					Sheet 2 of 2
105.8	34	SP	SAND, fine to medium-grained, with a trace of coarse-grained SAND and fine to medium Gravel, boulders noted, brown, moist, dense. (Coarse Alluvium)			
96.8	43	SP	SAND, fine to coarse-grained, with a trace to a little fine to coarse Gravel, boulders noted, brown, moist, very dense. (Coarse Alluvium)	58 114		
93.8	46	SM-GM	SILTY SAND and GRAVEL, fine-grained SAND and medium to coarse Gravel, with pieces of limestone noted, brown, dry, very dense. *	100	blows per 2"	*(Weathered Limestone and Coarse Alluvium)
88.8	51		WEATHERED LIMESTONE AND SHALE, gray, dry. (Platteville Formation)	100	blows per 1"	
78.8	61		BEDROCK CORED 51' to 61', see attached log of coring sheet.			**51' of hollow-stem auger in ground. Water level not encountered with 50' of hollow-stem auger in ground. Boring immediately backfilled.
			Water level not encountered with **			

LOG OF CORING

Project: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

Coring: ST-1 Run #1 & Run #2
Location: See Attached Sketch.
Date: 7/25/79 **Scale:** 1"=2'

Elev.	Depth	Description of Core	Rate of Advance	Water Press.	Water Return	% Rec.	RQD	Fracture Freq'ncy	Strat-igraphy	Remarks
88.8	51									
87.8	52	Dolomite & Dolomitic Limestone: thin to medium bedded, dolomitic to about 52', 1/4" calcareous shale layer at 51', 3/4" calcareous shale layer at 55.5', clay particles noted at fractures, fractures are horizontal to subhorizontal, one diagonal fracture noted at 53.8', small vugs** noted to 52.8', gray to buff	5 mpf*	0-50 psi			56% Run #1	2	Shale layer at 51	
86.8	53							2		
85.8	54	Limestone between 54' and 55.5 Grades to Dolomite below 55.5'.	6 mpf					2		
84.8	55	DOLOMITE: thin to medium bedded, clay particles noted at most fractures, fractures are horizontal to subhorizontal, highly fractured zone between 57½ and 58½', gray to dark gray.			Low			1	Shale layer at 55.5	
83.8	56		5 mpf			100		3		
82.8	57							1		
81.8	58	Grades to Dolomitic Limestone below 59'.	7 mpf				70% Run #2	Highly Fractured 57½'-58½'		
80.8	59		5 mpf					1		
79.8	60	(Platteville Formation)						0		
78.8	61							0		

*mpf - minutes per foot
**vugs are caused by dissolution of fossil remnants.

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-2

LOCATION: See Attached Sketch

DATE: 7/27/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes Sheet 1 of 2
137.6	0					
136.6	1	SM	SILTY SAND, fine-grained, black,*			*moist. (Topsoil)
132.6	5	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace of coarse SAND and fine Gravel, light brown to brown, moist, medium dense. (Coarse Alluvium)	22		
126.6	11	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace to a little coarse SAND and fine to coarse Gravel, small cobbles and boulders noted, with a layer of SILTY SAND at 10', brown to grayish brown, moist, very dense. (Coarse Alluvium)	100 143 129		blows per 1" due to presence of boulder. Boulders noted below the 5' depth.
123.6	14	SM	SILTY SAND, fine-grained, with a trace of coarse Gravel, boulders noted, reddish brown, moist, very dense. (Glacial Till)	59		
113.6	24	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace to a little fine to coarse Gravel, boulders noted, with a layer of fine SILTY SAND at 20' depth, brown, moist, dense to very dense. (Coarse Alluvium)	54 47		
107.6	30	SP	SAND, fine to medium-grained, with a trace to a little coarse SAND and fine to coarse Gravel, boulders noted, brown, moist, dense to very dense. (Coarse Alluvium)	34		
			(Continued on Sheet 2)	43		

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-2 (Continued)

LOCATION: See Attached Sketch

DATE: 7/27/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
107.6	30					Sheet 2 of 2
		SP	SAND, fine to medium-grained, with a trace to a little coarse SAND and fine to coarse Gravel, boulders noted, brown, moist, dense to very dense. (Coarse Alluvium)	75		
98.6	39					
		SM-GM	SILTY SAND AND GRAVEL, fine to medium-grained SAND and fine to coarse Gravel, boulders noted, brown to gray, dry, very dense. (Coarse Alluvium)	100		blows per 6"
93.6	44					
		SM	SILTY SAND, fine to medium-grained, with a trace to a little coarse SAND and fine Gravel, yellowish *	121		*brown, moist, very dense. (Coarse Alluvium)
91.6	46					
			WEATHERED LIMESTONE AND SHALE, with layering noted at 50' depth, brown to yellowish brown and gray. (Platteville Formation)	130		
86.6	51					
			Refusal of auger in bedrock at 51' depth. Water level down 48' with 51' of hollow-stem auger in ground. Water level down 47' 3/4 hour after completion of boring. Boring immediately backfilled.			

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 FOUNDATION INVESTIGATION
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-3

LOCATION: See Attached Sketch

DATE: 7/26/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes Sheet 1 of 2
142.5	0					
		SP-SM	SAND, SLIGHTLY SILTY, fine-grained, bituminous layer at surface, brown, moist, loose to medium dense. (Possible Fill)	8		
136.5	6			18		Boulders noted below the 9' depth.
		SM	SILTY SAND, fine-grained, with a trace of fine to coarse Gravel, coloration layering, dark brown to brown, moist, medium dense. *	30		*(Coarse Alluvium)
133.5	9					
		SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, with a trace to a little coarse SAND noted at 12½', trace to a little fine to medium Gravel, boulders noted, brown, moist, dense to very dense. (Coarse Alluvium)	39		
				48		
				66		
				57		
119.5	23					
		SP	SAND, fine to coarse-grained, with a trace to a little fine to medium Gravel, boulders noted, brown, moist, dense. (Coarse Alluvium)	19/6	4*	*high blow count due to presence of boulder.
113.5	29					
112.5	30	SM	SILTY SAND, fine to medium-grained **	91		**with a trace of fine to medium Gravel, boulders noted, brownish-gray, dry, very dense. (Coarse Alluvium)
			(Continued on Sheet 2)			

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St.S.E.
Minneapolis, MN

BORING: ST-3 (continued)
LOCATION:
DATE: 7/26/79
SCALE: 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
112.5	30					Sheet 2 of 2
108.5	34	SM	SILTY SAND, fine to medium-grained trace to some fine to medium Gravel, boulders noted, brownish gray, dry, very dense. (Coarse Alluvium)			
103.5	39	SP	SAND, fine-grained, trace of fine Gravel, boulders noted, light brown to brown, moist, very dense. (Coarse Alluvium)	99		
98.5	44	SP-GP	SAND and Gravel, fine to medium-grained SAND and fine to medium Gravel, boulders noted, brown, moist, dry, very dense. (Coarse Alluvium)	100		blows per 6"
92.5	50	SM	SILTY SAND, fine to medium-grained a little to some fine to coarse Gravel, boulders noted, brownish gray, moist to dry, very dense. (Coarse Alluvium)	148		
			Refusal of Auger at 50' depth due to presence of boulders or bedrock.	100		blows per 2"
			Water level not encountered with 50' of hollow-stem auger in ground.			
			Water level not encountered 1/2 hour after completion of boring.			
			Boring immediately backfilled.			

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-4

LOCATION: See Attached Sketch.

DATE: 7/30/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
133.6	0					Sheet 1 of 2
		SP	SAND, fine to medium-grained, a little coarse SAND, trace to a little fine to coarse Gravel, layer of coarse Gravel noted at 7½', boulders noted, layer of SILTY SAND at 5', dry to moist, dense to very dense. (Coarse Alluvium)	31 21/70* 100 37		Surface elevations of borings ST-4 through ST-6 referenced to top of steel frame of truck scale in NW quad. of 2nd Ave. & 2nd St. Indicated Elev. 131.04** *High blow count due to presence of boulders. **(City datum) Boulders noted below the 5' depth. 6" of concrete noted at the surface.
121.1	12.5					
		CL/SM	SILTY SANDY CLAY - SILTY SAND, fine to medium-grained, trace of medium to coarse Gravel, boulders noted, brown to reddish brown, moist, hard to dense. (Glacial Till)	57 41 48		
110.1	23.5					
		SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, trace of fine to coarse Gravel, brown to light brown, moist, medium dense. (Coarse Alluvium)	30		
103.6	30					
				19		

(continued on Sheet 2)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-4 (continued)

LOCATION:

DATE: 7/30/79 **SCALE:** 1"=4'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
103.6	30					Sheet 2 of 2
99.6	34	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, trace of fine to coarse Gravel, brown to light brown, moist, medium dense. (Coarse Alluvium)			
		SM	SILTY SAND, fine to coarse-grained some medium to coarse Gravel, boulders noted, layers of very fine SILTY SAND at 45', color stratification noted, brown to gray, dry to moist to 45', water-bearing below 45', dense to very dense. (Coarse Alluvium)	31/74*		
				110*		*High blow counts due to boulders.
				31		
87.1	46.5					
85.6	48		WEATHERED LIMESTONE AND SHALE, gray to brown, waterbearing.	150	blows per 2"	
			Refusal of Auger in bedrock at 48' depth.			
			Water level down 48' with 48' of hollow-stem auger in ground.			
			Water level down 46' 1-3/4 hours after completion of boring.			
			Boring immediately backfilled.			

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-5

LOCATION: See Attached Sketch.

DATE: 7/30/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
132.4	0					Sheet 1 of 2
128.4	4	SP-SM	SAND, SLIGHTLY SILTY, fine to medium-grained, trace of fine to coarse Gravel, 2" of bituminous at the surface, brown, moist, medium dense. (Coarse Alluvium)	11		2" bituminous at the surface.
120.9	11.5	SP	SAND, fine to medium-grained, trace to some fine to coarse Gravel, boulders noted, grayish brown, moist to dry, medium dense to very dense. (Coarse Alluvium)	18 64 96		Boulders noted below the 7½' depth.
108.4	24	SC-SM/CL	SILTY CLAYEY SAND - SANDY CLAY, fine to coarse SAND grains, trace of fine to medium Gravel, layer of SILTY SAND at 15', numerous boulders noted, brown to reddish brown, moist to wet, medium dense to very dense. (Glacial Till)	67 20 91/32		
102.4	30	CL	SILTY SANDY CLAY, trace of fine to coarse Gravel, boulders noted, trace of shale noted at 30', gray, dry, hard. (Glacial Till)	100		
				71		L.L. = 40% P.L. = 22% P.I. = 18% M.C. = 16.8%

(continued on Sheet 2)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-5 (continued)
LOCATION:
DATE: 7/30/79
SCALE: 1"=4'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
102.4	30					Sheet 2 of 2
		CL	SILTY SANDY CLAY, trace of fine to coarse Gravel, boulders noted, trace of shale at 30', gray, dry, hard.			
97.4	35		(Glacial Till)	150		blows per 2"
			Refusal on auger at 35' possible bedrock or limestone boulder.*			*Calcareous material recovered in the sampler.
			Water level down 13' with 35' of hollow-stem auger in ground.			
			Water level not encountered to 35' depth 1 day after completion of the boring.			
			Boring immediately backfilled.			

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-6

LOCATION: See Attached Sketch.

DATE: 7/31/79 **SCALE:** 1"=4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
129.4	0					Sheet 1 of 2
		SM	SILTY SAND, fine-grained to 5½', fine to coarse-grained below 5½', trace of fine to medium Gravel, 8" of brick and concrete at the surface, dark brown to brown, moist, very loose to loose. (Possible Fill)	7 4		8" of brick and concrete at the surface. Boulders noted below 7½' depth.
121.9	7.5					
		SC-SM/ SM	SILTY CLAYEY SAND - SILTY SAND, fine-grained, trace of fine to medium Gravel, boulders noted, reddish-brown, moist, medium dense to very dense. (Glacial Till)	26 52		
117.9	11.5					
		SP	SAND, fine to medium-grained, trace of fine Gravel, boulders noted, brown to light brown, moist, dense. (Coarse Alluvium)	41 32 38		
105.9	23.5					
		SM	SILTY SAND, fine-grained, trace of fine to coarse Gravel, boulders noted, reddish brown, moist, very dense. (Glacial Till)	39/100		
100.4	29					
99.4	30	SP	SAND, fine to medium-grained, trace of fine to medium Gravel, * *boulders noted, brown, moist, very dense. (Coarse Alluvium)	64		

(Continued on Sheet 2)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

BORING: ST-6(continued)

LOCATION:

DATE: 7/31/79

SCALE: 1"=4'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM: D2488)	BPF	WL	Tests or Notes
99.4	30					Sheet 2 of 2
		SP	SAND, fine to medium-grained, trace of fine to medium Gravel, boulders noted, brown, moist, very dense. (Coarse Alluvium)	68		
89.4	40					
			Refusal on auger at 40', bedrock cored 40 to 50'. See Attached Log of Coring Sheet.	150		blows per 2"
79.4	50					
			Water level not encountered with 40' of hollow-stem auger in ground. Water level notencountered to cave-in depth of 10' immediately after withdrawal of auger. Boring immediately backfilled.			

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF CORING

Project: 79-387 Foundation Investigation
Proposed Parking Ramp
2nd Ave. & 2nd St. S.E.
Minneapolis, MN

Coring: ST-6 Run #1 and Run #2

Location: See Attached Sketch.

Date: 7/31/79 **Scale:** 1"=4'

Elev.	Depth	Description of Core	Rate of Advance	Water Press.	Water Return	% Rec.	RQD	Fracture Freq'ncy	Strat-igraphy	Remarks
89.4	40									
88.4	41	Dolomite: thin to massive bedded, highly fractured, shale layer at 43.2, weathered, iron staining noted in fractures, horizontal to subhorizontal fractures noted below 43.2, occasional vugs***noted, gray to light gray.	10 mpf*					Highly Fractured**		
87.4	42									
86.4	43		7 mpf	0-50 psi	Low	87 Run#1	35% Run #1		Shale layer at 43.2'	
85.4	44		5 mpf					1		
84.4	45	Grades to dolomitic limestone below 47'.								
83.4	46		6 mpf					0		
82.4	47	DOLOMITIC LIMESTONE, thin to massive bedded, 1" shale layers at 47', 48.7' and 49', clay particles noted at the fractures, horizontal to subhorizontal fractures noted, vugs noted to 47', gray to buff.				98% Run #2	71% Run #2	4	Shale layer at 47'.	
81.4	48		7 mpf					2		
80.4	49		5 mpf					3	Shale layer at 48.7'	
79.4	50	(Platteville Formation)						2	Shale layer at 49'	

*mpf = minutes per foot
**vertical and horizontal fractures noted.
***vugs are caused by dissoltuion of fossil remnants

DESCRIPTIVE TERMINOLOGY

PARTICLE SIZE IDENTIFICATION

Boulders	over 3"
Gravel	
Coarse	1" – 3"
Medium	1/2" – 1"
Fine	No. 4 – 1/2"
Sand	
Coarse	No. 4 – No. 10
Medium	No. 10 – No. 40
Fine	No. 40 – No. 100
Very Fine	No. 100 – No. 200
Silt	No. 200 – .005 mm
Clay	less than .005 mm

SOIL INTRUSIONS

THICKNESS

lense	0 – 1/8"
seam	1/8" – 1"
layer	1" – 12"
varved	alternating seams or lenses of clays and silts in lake deposit

RELATIVE PROPORTIONS

with a few	0 – 10%
with some	11 – 20%
with	over 20%

MOISTURE CONTENT

Dry	less than 5%
Moist	under optimum moisture
Wet	over optimum moisture
Waterbearing	saturated sand

ORGANIC CONTENT

0 – 5%	non to slightly organic
6 – 10%	slightly organic
11 – 25%	organic
26 – 65%	muck
65+	peat

RELATIVE DENSITY OF COHESIONLESS SOILS

very loose	0 – 4 BPF
loose	5 – 10 BPF
medium dense	11 – 30 BPF
dense	31 – 50 BPF
very dense	50+ BPF

CONSISTENCY OF COHESIVE SOILS

very soft	0 – 1 BPF
soft	2 – 3 BPF
rather soft	4 – 5 BPF
medium	6 – 8 BPF
rather stiff	9 – 12 BPF
stiff	13 – 16 BPF
very stiff	17 – 30 BPF
hard	30+ BPF

PLASTICITY OF SOILS WITH LESS THAN 20% CLAY

non plastic	gritty, cannot thread
slightly plastic	rough to smooth, hard to thread
plastic	smooth to waxy, easy to thread

RELATIVE PROPORTIONS OF GRAVEL

a trace	0 – 5%
a little	6 – 15%
some	16 – 30%
and	31 – 50%

LABORATORY TESTS

DD	Dry Density, pcf	OC	Organic Content, %
WD	Wet Density, pcf	S	Percent of Saturation, %
MC	Natural Moisture Content, %	SG	Specific Gravity
LL	Liquid Limit, %	C	Cohesion
PL	Plastic Limit, %	ϕ	Angle of Internal Friction
PI	Plasticity Index, %	qu	Unconfined Compressive Strength

DRILLING NOTES: Standard penetration test borings were advanced by 2¼" or 3¼" I.D. hollow-stem augers unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube).
Power auger borings were advanced by 4" or 6" diameter, continuous-flite, solid stem augers. Soil classification and strata depths are inferred from disturbed samples augered to the surface and are therefore somewhat approximate. Power auger borings are designated by the prefix "B".
Hand probings were advanced manually with a 1½" diameter probe and are limited to the depth from which the probe can be manually withdrawn. Hand probings are indicated by the prefix "H".

CLASSIFICATION: Classification on logs is made by inspection in accordance with the Unified Soils Classification System (see attached chart) using visual-manual procedures unless noted otherwise.

GROUND WATER: Observations were made at the times indicated. Porosity of soil strata, seasonal weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

SAMPLING: All samples are taken with the standard 2" O. D. split-tube sampler, except where noted. TW indicates thin-wall undisturbed sample.

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler is set 6" into undisturbed soil below the hollow-stem auger. Driving resistances are then counted for second and third 6" increments and added to get BPF. Where they differ significantly, they are reported in the following form – 2/12 for the second and third 6" increments respectively.

WH: WH indicates that sampler penetrated soil under weight of hammer and rods alone, driving not required.

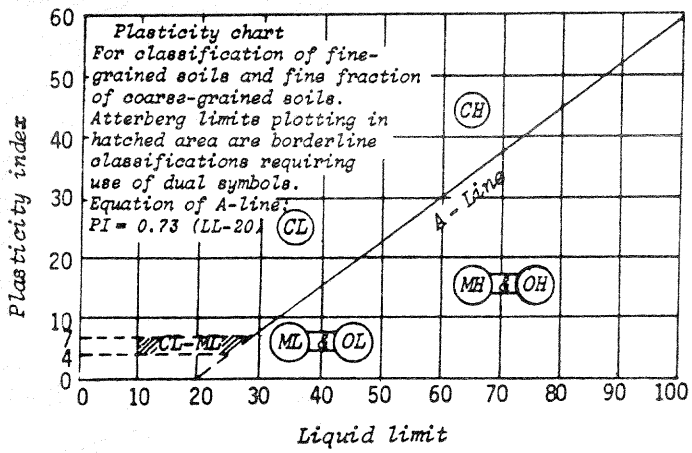
NOTE: All tests run in accordance with applicable ASTM standards.

BRAUN
ENGINEERING TESTING

Classification of Soils for Engineering Purposes
ASTM Designation D-2487

Major Divisions			Group Symbols	Typical Names	Classification Criteria	
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	*GW*	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting <u>both</u> criteria for *GW*	
		Gravels with Fines	*GM*	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean Sands	*SW*	Well-graded sands and gravelly sands, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting <u>both</u> criteria for *SW*	
		Sands with Fines	*SM*	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7	
Fine-Grained Soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		*ML*	Inorganic silts, rock flour, silty or clayey fine sand		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and Clays Liquid limit greater than 50%		*MH*	Inorganic silts, micaceous or diatomaceous silts, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity		
Highly organic soils			*Pt*	Peat, muck and other highly organic soils	Visual-manual identification	

Classification on basis of percentage of fines
Less than 5% Pass No. 200 sieve--*GW, GP, SW, SP*
More than 12% Pass No. 200 sieve-*GM, GC, SM, SC*
5% to 12% Pass No. 200 sieve-----Borderline classification requiring use of dual symbols



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