

**PRE-INVESTMENT SURVEY
OF FISHING HARBOURS**

INDIA

**HONAVAR
ENGINEERING
SURVEY
SOIL INVESTIGATIONS
DESIGN**

REPORT PREPARED FOR
THE FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ACTING AS EXECUTING AGENCY FOR THE UNITED NATIONS DEVELOPMENT PROGRAMME
BY
SCANDIACONSULT

**SCANDIACONSULT INTERNATIONAL AB
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PREFACE

The Pre-Investment Survey of Fishing Harbours is being conducted by the Food and Agriculture Organization of the United Nations in cooperation with the Government of India. The Food and Agriculture Organization of the United Nations, on this Project, is acting as the Executing and Participating Agency for the United Nations Development Programme. The Agency has sub-contracted certain professional and other services to Scandiaconsult International AB, Sweden.

The Project has its Headquarters at Bangalore, India. This Technical Report constitutes one of a number of reports which will be issued during the life of the Project. The contents of this Report are based on the work of Scandiaconsult personnel and of other professional and technical staff provided by the Government of India and the Food and Agriculture Organization of the United Nations.

The conclusions and recommendations given in the Report are those considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages of the Project.

The designations employed and the presentation of the material in this document (and maps) do not imply the expression of any opinion whatsoever on the part of the United Nations or the Food and Agriculture Organization of the United Nations concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

This report is in two volumes. The first volume contains the text and the second volume the relevant drawings.

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1. SURVEY REPORT

1.1 SURVEY PERIOD

The survey was carried out during the period 14 October to 11 December 1969.

1.2 TRIANGULATION

A grid was established with 7 stations one of which (H) was used during the survey of 1959 on which Hydrographic Chart No. 2009 was based. All new stations were marked by steel-pipes cast in concrete pillars set in the ground.

The distance between station H and station 1 was measured as a baseline, triangulation measurement was carried out and a local coordinate system was established. The azimuth of the base was measured using a prismatic compass.

1.3 DATUM

All levels have been referred to Chart Datum, which according to Hydrographic Chart no. 2009 is given as being 2.848 metres (9.343 ft.) below the level of station H.

1.4 TOPOGRAPHIC SURVEY

The land area adjoining the river mouth and southeast thereof to the existing iron-ore jetties was surveyed using plane-table with tacheometric slide. Besides the grid stations an additional 20 stations were marked and used for this purpose. The positions of these stations were determined by traverses to the triangulation stations.

1.5 HYDROGRAPHIC SURVEY

Echo-soundings were carried out in the river mouth and in the area off-shore including the bar, using Kelvin Hughes Echo Sounder NS 36 MB Nk. 1 with outboard rig mounted on local fishing boat. Position fixing was done mainly by sextant readings to shore stations established in the coordinate grid.

The Echo-soundings in the entrance gorge were made in sections at intervals of about 50 m while the intervals between the sections in the sea were about 200 m.

1.6 MAPS

The data received from the echo-soundings of the sea outside the river mouth has been plotted on a map at a scale 1:5000. The results from the topographic survey and the echo-soundings in the river were plotted on maps at a scale of 1:1000. The sheets in 1:1000 were photographically reduced to scale 1:5000 and a combined map (Drawing No.07-110) was prepared. The extent of the mapped areas is shown on Survey Index Map (Drawing No.07-100).

1.7 LIST OF CO-ORDINATES

Geographical

Station H (Jetty) (Ref. I.N.S. Sheet D 26 of 1960)	Lat.	14° 16'	29.39"
	Long.	74° 26'	27.79"

Rectangular

<u>Station</u>	<u>North (m)</u>	<u>East (m)</u>	<u>Level (m)</u>
H	2740.00	5000.00	+ 2.848
1	3177.42	4848.67	+ 2.516
2	3281.31	3731.77	+ 3.980
3	2634.76	3989.67	+ 3.514
4	2204.49	4423.77	+ 2.637
5	2018.26	4037.79	+ 2.969
6	2497.97	4220.13	+ 3.254

1.8 RECORD OF ENTRANCE MOVEMENT

Surveys of the entrance and adjoining areas were carried out by the Mysore State Public Works Department in the years 1963 to 1967. The records from these surveys and the recent project survey show that considerable changes of the location and configuration of the entrance have taken place during those years resulting in a northerly migration of the entrance. Especially the changes during the monsoon periods have been remarkable.

The extent of the recent changes can be seen by comparing the map from the survey carried out by P.W.D. in May 1967 (Drawing No.07-901) with the map based on the project's survey in November 1969 (Drawing No.07-110).

To provide up to date information for calculation of quantities some further survey work will be required before a final report would be completed.

1.9 TIDE

A water level recorder was installed near the river-mouth and records were taken during the period from 17 November to 9 December 1969, except for four days from after-noon 21 November to noon 25 November during which the recorder was not functioning properly. The records are presented in Drawing No.07-301.

The lowest low water observed during the survey period was ± 0.00 m on 28 October and the highest high water was +2.00 m on 9 December.

The Hydrographic Chart No. 2009 gives the following information:

MHHW	+1.58 m (+5.2 ft.)
MLHW	+1.55 m (+5.1 ft.)
MLLW	+0.49 m (+1.6 ft.)
MHLW	+0.91 m (+3.0 ft.)

1.10 WINDS

The velocity and duration of winds have been observed in Mangalore over a long period. The results of those observations for the period 1956-62 are represented on Drawing No.07-900. Honavar is situated quite near to Mangalore and it can be assumed that the above wind records can be regarded as applicable to Honavar also.

1.11 WAVES

An instrument for continuous recording of deep water wave heights has been in operation for a few years in the sea outside the new harbour site near Mangalore. The variations of the water surface levels are measured by a pressure-cell connected by cables to the recording instrument in land.

The highest wave registered by the instrument so far was a 4.8 m high wave recorded in June 1968. The period of that wave was 9 seconds.

In the absence of long term wave measurements at Honavar the maximum wave observed in Mangalore can be taken as valid for Honavar and used for preliminary design. Reference is made to the analysis: "Monthly Wave Characteristics of the Arabian Sea" by P.S. Srivastava, D.K. Nair and K.R. Raman Kastha, November 1967. Detailed analysis of wave recordings from Mangalore may be used for final design.

1.12 TIDAL FLOW STUDIES

Observations were made to determine such tidal characteristics as tidal prism, water discharge and current velocities required for evaluation of "inlet stability".

Two methods, current measurement by float tracking and tide gauge recordings have been used simultaneously to obtain a maximum amount of data and to allow an estimate of the accuracy of the calculations.

The first method was to measure the current through the gorge section of the river-mouth by float tracking. Continuous level readings were made on a tide gauge near the actual section. The section had been determined beforehand by means of echosounding and levelling. A graph giving the cross section area at various levels was prepared. This area multiplied by the mean current velocity gave the flow in m^3/s . Integration over a time period gave the total flow during the period.

The second method involved the reading of staff gauges in the river at points indicated on the enclosed sketch, Drawing No.07-300. Each series of observations was reduced to an arbitrarily chosen datum, giving the level changes over the reading period. The surface area between two gauges multiplied by the mean level change represents the water volume change for that area. Assuming the freshwater flow being constant, the method gives the change in tidal volume over a period. After adding up the volumes at all the areas for each period and dividing the sum by the time, the various mean flows in and out of the estuary for the actual period are obtained. This method gives no information about the freshwater flow, but the tidal prism appears immediately as the difference between maximum and minimum volume.

If the two methods are combined, the amount of freshwater flow can be estimated.

The following symbols are used in the calculations:-

Q_G^F and Q_G^E - Total Change in water volume (m^3) over a period of flood and ebb. Gauge method.

Q_C^F and Q_C^E - Total change in water volume (m^3) over a period of flood and ebb. Current method.

f = Freshwater flow (m^3/s)

t^F and t^E = Periods (s)

k = Coefficient representing the systematic error involved when assuming constant velocity over the section area and/or scale error in area determination. The same coefficient is assumed for tide and ebb.

$$Q_C^F \times k + f \times t^F = Q_G^F$$

$$Q_C^E \times k - f \times t^E = Q_G^E$$

Note that during flood tide (inflow) the freshwater is added to measured inflow to obtain the change in water volume in the estuary and vice versa for ebb (outflow). For the determination of k and f the full period of tide or ebb is not necessary, but if the tidal prism is wanted a full or next to full period is essential.

Operations were carried out in the Sharavati River (Honavar) on 28/10 (Full moon spring tide) and 10/11 (New moon spring tide). Observations started at about 0700 and ended at 1815 when the light got too poor. The weather was fair and had been so for several weeks before.

The Sharavati River has one wide main branch (see Drg. No.07-193). Near the outlet is a fairly large tidal backwater, to a large extent dry at low tide, and some 6 kms. upstream a relatively wide tributary joins the river. Gauges were set up in the main river only, because of

its relatively greater importance and also because of difficulties of transportation to the other places at low water. The planned gauge No.1 outside the gorge had to be cancelled due to heavy wave action. Gauge No.2 was just inside the mouth in the large basin and the remaining five were fairly evenly distributed up to Gersoppa 29 kms. upstream from Honavar, near the end of the tidal reach. Gauge No.2 only was levelled to chart datum. The gauges were read 4 times per hours.

Current observations were made in the gorge section of the river-mouth between 2 sections 50 m apart, using floats with drogues at depths of 0.9 m and 7.8 m to 8.3 m (depending on tide level).

Summary of results obtained

(Current observations at Gorge section)	Date 28/10	Date 10/11
1. Tidal prism "Gauge Method" Flood (10^6 m^3)	10.0	10.6 xx/
2. " " " " Ebb "	17.5 xx/	20.5
3. " " "Current Method" Flood "	9.6	-
4. " " " " Ebb "	17.9 xx/	21.8
5. Computed Freshwater flow (f) m^3/s	52.5	28.3
6. " Coefficient k	1.04	0.905
7. Reported ^{x/} Freshwater flow m^3/s	59.5	59.5
8. Adjusted Coeff. Flood/Ebb	1.03/1.05	0.86/0.94
9. Mean ^{xxx/} Max. Velocities Flood m/s	0.95	0.98
10. " " " Ebb m/s	1.29	1.58
11. Max. discharge Total (10) x Section area m^3/s	1280	1640
12. " " " Adjusted (11 x 8) m^3/s	1330	1540
13. " " Tidal (12-7) m^3/s	1270	1480
14. Section area at gorge (water level +0.55m) (m^2)	1000	1000
15. Mean water velocity over gorge section at mid-water and max. discharge (13) : (14) (m/s)	1.27	1.48

x/ Sharavati hydro-electric plant reports a minimum discharge of 2100 cusecs = $59.5 \text{ m}^3/\text{s}$.

xx/ These are estimates as readings had to be interrupted before the current reversed.

xxx/ Mean over the depth in one point only.

The tidal prism at spring tide appears to be of the order of 19.10^6 m^3 . Currents are quite strong with a max. mean velocity (over the depth in one point) of 1.3 - 1.6 m/s for the ebb current. Max. tidal discharge (Q_m) appears to be about 1300 - 1500 m^3/s .

1.13 SURVEY REPORT DRAWINGS

<u>Drawing No</u>	<u>Title</u>
07 - 40	Coastline of India with location of proposed Harbour 1:10.000.000
07 - 41	Map showing Honavar and District 1:63.000
07 - 100	Survey Index Map. 1:25000
07 - 110	Topographic and Hydrographic Survey 1969 1:5000
07 - 901	Extract from survey of Public Works Department, 1967
07 - 300	Map showing the positions of Gauge Stations 1:63000
07 - 301	Tide Recordings
07 - 900	Wind Observations at Mangalore 1956-62

SOIL INVESTIGATIONS

2. SOIL INVESTIGATIONS REPORT

2.1 ASSIGNMENT

The purpose of this investigation was to obtain information for the general planning and design of a fishing harbour.

2.2 METHODS OF WORK

The methods used for carrying out the work were as follows:-

A - Penetration Test Borings

Swedish Motorsounding
Swedish Weightsounding
Hammersounding

B - Sampling

Post Hole Auger
Side Intake Sampler
Swedish Piston Sampler

A - Penetration Test Borings

Motorsounding

This drilling method is classed as one of the penetration tests similar to the Standard Penetration Test and Dutch Cone Sounding. The method has been developed in Scandinavia and provides information as to the relative compactness of the various soil layers, and gives a good idea of the granular size of the soil.

The equipment consists of a portable motor unit with a fixture for 22 mm diameter flush jointed steel rods. The rods are in pieces of 1 metre length and at the end there is fitted a 32 mm diam. screwbit 200 mm long.

During the borings the motor is used for rotating the rods, and is held in place by two operators. Special handles are used for holding the motor unit and those handles are connected to a pressure gauge instrument, which indicates the pressure load exercised by the operators on the boring rod.

When starting a boring, the rod with the bit is put into the ground and the distance the rod sinks without any extra load on the handles is measured and recorded. The operators then press the motor unit down using the handles and the load is increased in steps to 10 kg., 25 kg., 50 kg., 75 kg., and 100 kg., measurements of the penetration under each individual load being noted. When the screw bit does not sink further under a load of 100 kg., the motor is used to rotate the rods and the number of half revolutions for which the bit penetrates a depth of 20 cm is noted. This is repeated until the required depth is reached. Extra 1 m long rods are added as needed. The number of half revolutions per 20 cm penetrated are recorded and drawn up in the form of a diagram of resistance to penetration at each depth.

Weightsounding

This method of sounding is similar to Motorsounding except that the load is provided by weights and the turning of the bit is carried out manually.

Hammersounding

This method of drilling is also classed as one of the penetration tests. The equipment consists of 3 m long 32 mm dia. flush-jointed steel rods, with a square drill bit 40 x 40 mm the tip of which is turned to a conical point. The rod and bit is put into the ground, cylindrical wedges are locked on to the rod about 1.50 m above the ground. A 65 kg weight is lifted 60 cm above the locked wedges and allowed to fall freely onto them, driving the bit and rods into the ground. The number of blows required to drive the bit each stop of 20 cm is noted. The locked wedges are released and lifted up along the rods and re-locked for further driving, additional 1 m or 3 m long rods being added as required.

General

The above methods of sounding are carried out without casing. No allowance is made for the increased weight of drilling rods or the increased friction on the surface of the rods at increasing depths. These methods of sounding provide information for drawing resistance-to-penetration diagrams and indicate the general nature of the soil penetrated.

Samples are taken at points determined from the results of the soundings. The samples are examined and tested to establish the characteristics of the soil, which information is read in conjunction with the sounding diagrams.

B - Sampling

Post-Hole Auger

This is used above the water table in cohesionless soils and in all but the hardest cohesive soils, to obtain disturbed samples.

Side Intake Sampler

Where small disturbed samples are required solely for identification purposes, this sampler can be used in soft deposits of cohesive and cohesionless soils with particle sizes not exceeding approximately 2 mm.

Swedish Standard Piston Sampler (designation St II)

This sampler is used for taking 50 mm diam. undisturbed samples. The sampler containing 3 Nos. 170 mm long and 50 mm diam. reinforced plastic sample tubes is forced into the ground without the use of casing. A conical ended piston pushes the soil to the side so that it does not enter the sampler. When the desired depth is reached the rods are rotated in an anticlockwise direction thereby forcing out past the piston a thinwalled metal tube with a hard metal cutting shoe containing the sample tubes. The sampler is withdrawn and after removal of the cutting shoe, a clockwise rotation of the sampling rods extrudes the samples in the tubes, each end of which is then covered with a plastic disc and an air tight rubber cap. The numbers permanently marked on the sides of the tubes are recorded together with the depth from which the sample was taken.

Recording of Borings and Test Results

The symbols indicated on the enclosed pages: Soil Mechanics Symbols Sheet Nos. 1 and 2 are used on all plans, sections and diagrams describing the borings.

2.3 BORINGS EXECUTED

The soil investigation was carried out during the period 1 November to 11 December 1969.

The total number of borings was

21 Motor and Weightsoundings

22 Hammersoundings

Samples were taken at 5 points

Six samples were taken from the river bottom at points A - F. Water samples were taken at point A at high low water on 9.12.1969.

The locations of the borings are shown on the plan, Drawing No. 07-200. The results of the soundings are drawn in diagram form on Drawing Nos. 07-210 to 219.

2.4 POSITIONING AND LEVELLING

The positions and levels of boreholes were obtained by measurement from survey stations.

2.5 LABORATORY TESTS

Preliminary laboratory tests were carried out on some samples as shown in the Sample Schedule and Laboratory Results Diagram by the Geotechnical Laboratory of ScandiaConsult International AB, Sweden. Testing of further samples is at present in progress.

2.6 DESCRIPTION OF SOIL LAYERS

The site is largely covered with medium SAND with a $\phi = 30-33^{\circ}$, m/c 19%, Bulk den. 1.82 gm/cm^3 , underlain at part of the proposed quay site by gravelly sandy CLAY from about -11.6 m.

The locations of the various layers are shown on the sections Drawings Nos. 07-210 to 219.

2.7 CONCLUSIONS

The site is suitable for the use of piled constructions. At the proposed quay site the buried length of the piles is estimated to be up to 10 metres to carry the required load.

The results from the investigations are recorded on the following documents annexed hereto:-

Borehole Schedules	2 Pages
Soil Sample Schedule	1 Page
Laboratory Result Diagrams: Sieve Analysis	4 Pages
Shear Tests	5 Pages

2.8 BOREHOLE SCHEDULE

Site Description	Borehole Number	Easting	Northing	Level	Depth	Remarks
150/0	1	4129	1390	+ 5.02	14.45	H/S
350/0	2	4066	1580	+ 4.87	10.65	H/S
350/0	3	4002	1769	+ 5.41	14.65	H/S
750/+2	4	3941	1961	+ 4.76	18.21	M/S
750/+101	5	4036	1992	+ 3.36	12.59	M/S-W/s S
750/+188	6	4122	2020	+ 1.41	13.63	W/S
750/300	7	4226	2054	+ 2.74	11.43	W/S
850/0	8	3912	2056	+ 4.62	12.13	M/S
850/+100	9	4009	2079	+ 1.36	13.50	M/S
850/+150	10	4059	2093	+ 2.70	14.55	M/S
850/+199	11	4105	2104	+ 1.49	12.77	M/S
846/+389	12	4292	2144	+ 1.55	23.00	H/S
950/+208	13	4091	2203	+ 3.13	20.60	H/S
948/+260	14	4141	2214	+ 2.04	12.20	H/S
960/+385	15	4259	2253	+ 1.68	10.75	H/S
1050/+0	16	3864	2251	+ 4.68	15.65	H/S
1048/+299	17	4154	2321	+ 2.89	12.85	H/S
1060/+400	18	4249	2355	+ 2.35	19.82	H/S
1180/+332	20	4137	2492	+ 2.69	12.53	M/S S
1203/+388	21	4182	2537	- 0.10	10.88	M/S
1250/+2	19	3801	2439	+ 3.10	14.85	H/S
1280/+357	23	4127	2594	+ 2.12	15.51	M/S
1330/+160	22	3922	2574	+ 2.54	5.80	M/S S
1369/+333	26	4070	2668	+ 2.23	15.35	M/S
1387/+262	25	3997	2661	+ 1.71	12.55	M/S
1444/+310	27	4022	2729	+ 2.36	13.97	M/S S
1450/+0	24	3728	2626	+ 3.75	15.70	H/S
1528/+280	28	3963	2799	+ 2.11	19.80	M/S
1612/+283	30	3938	2878	+ 1.93	17.61	M/S
1651/-16	29	3643	2809	+ 2.52	12.65	H/S
1740/+270	33	3878	2995	+ 3.45	11.78	H/S
1754/+208	39	4749	3341	+ 1.98	7.29	M/S
1762/+152	32	3758	2972	+ 2.66	22.00	H/S
1785/+2	31	3611	2938	+ 3.14	11.54	H/S
1841/+873	38	4404	3304	+ 1.59	7.53	M/S S

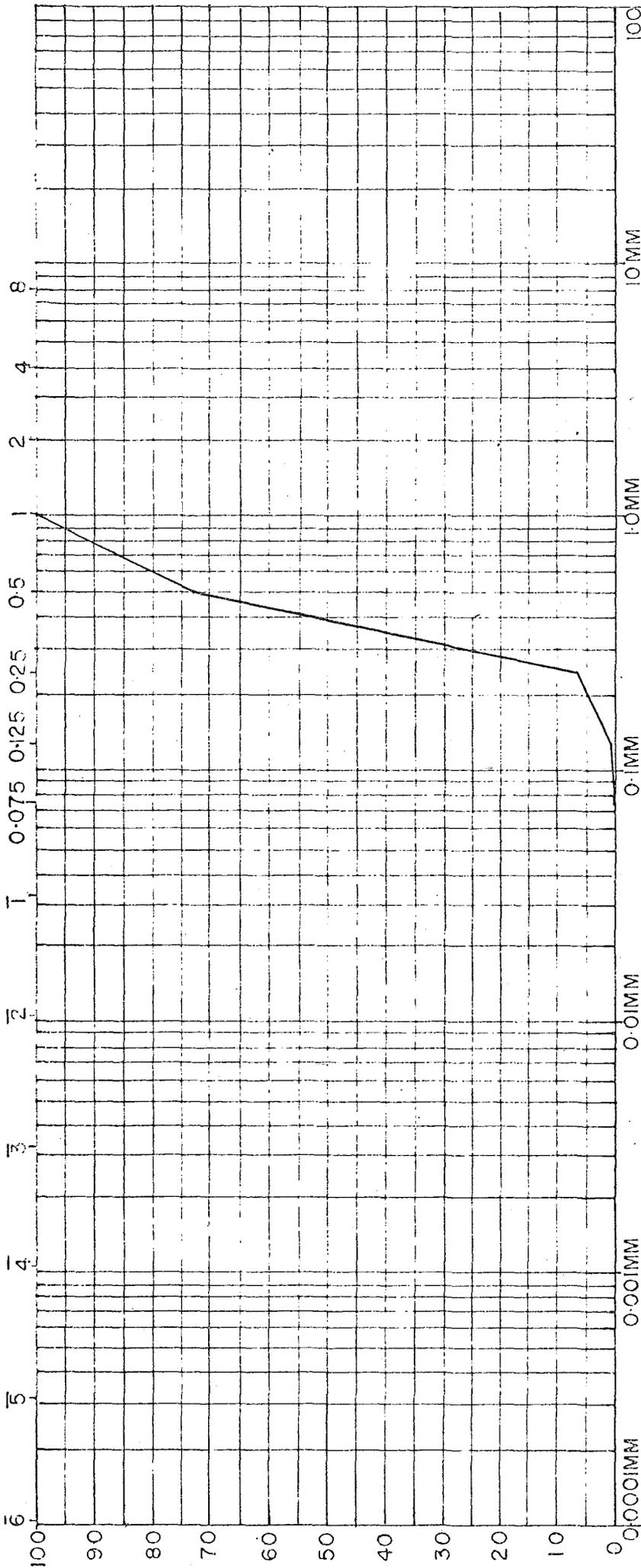
Site Description	Borehole Number	Easting	Northing	Level	Depth	R e m a r k s
1906/+608	37	4138	3270	+ 0.30	12.33	M/S
1967/+392	36	3912	3249	+ 2.69	20.00	H/S M/S S
2060/+249	35	3746	3284	+ 3.66	13.94	H/S
2103/+153	34	3640	3289	+ 2.50	21.80	H/S
2450/+0	40	3875	3556	+ 3.38	20.65	H/S
2650/+0	41	3797	3752	+ 3.55	21.60	H/S
2850/-3	42	3728	3930	+ 4.22	22.60	H/S
A	A	4152	2639	-	-	Sea Bottom Sample
B	B	4072	2639	-	-	"
C	C	3990	3159	-	-	"
D	D	3693	3167	-	-	"
E	E	3538	3268	-	-	"
F	F	3197	3407	-	-	"
L.W.	A	4152	2639	-	-	Low Water Sample
H.W.	A	4152	2639	-	-	High Water Sample

Depth below GL (M)	Sample Description	M/o %	gm/cm ³ Density D = Dry B = Bulk	Specific Gravity	LL %	PL %	PI %	C Kg/cm ²	ϕ°	Remarks, Tested by
BOREHOLE 5 2.92-3.34	Grey-brown medium SAND	14-18	B 1.81					0	32	Particle size distribution test Drained Shear Box SCANDIACONSULT
BOREHOLE 20 2.95-3.34	Grey-brown medium- coarse SAND	19	B 1.78 to 1.82					0 (0.08)	30.5 26.5)	P.S.D. test Drained Shear Box SCANDIACONSULT
BOREHOLE 27 2.83-3.34	Grey-brown fine- medium SAND	21-22	B 1.84 to 1.94					0	32-35	P.S.D. test Drained Shear Box Test SCANDIACONSULT
BOREHOLE 27 13.55-14.14	Grey-brown CLAY with gravel and sand (slightly disturbed)	28-30	B 2.10 to 2.14		50	26	24	0.03	17	P.S.D. test Quick Undrained Shear Box Test SCANDIACONSULT
BOREHOLE 36 3.6 3.35-3.94	Grey CLAY, some organic content, highly plastic, soft	62 71	B 1.75 B 1.54					0.15 0.25	0	Shear Box Quick undrained Fall-Cone Test SCANDIACONSULT

2-10 PARTICLE SIZE DISTRIBUTION ANALYSIS

SIEVE HOLE DIAMETER MM

LOG SETTLING VELOCITY IN CM PER. SEC.



0.0001MM	0.001MM	0.01MM	0.1MM	1.0MM	10MM	100
CLAY		SILT		SAND		GRAVEL
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

SIEVE SIZE M.M	16	11.3	8	4	2	1	0.5	0.25	0.125	0.075	<0.075
GRAMS RETAINED							33	81	7	1	122
% RETAINED							27.1	66.4	5.7	0.8	100
% PASSING						100	72.9	6.5	0.8		

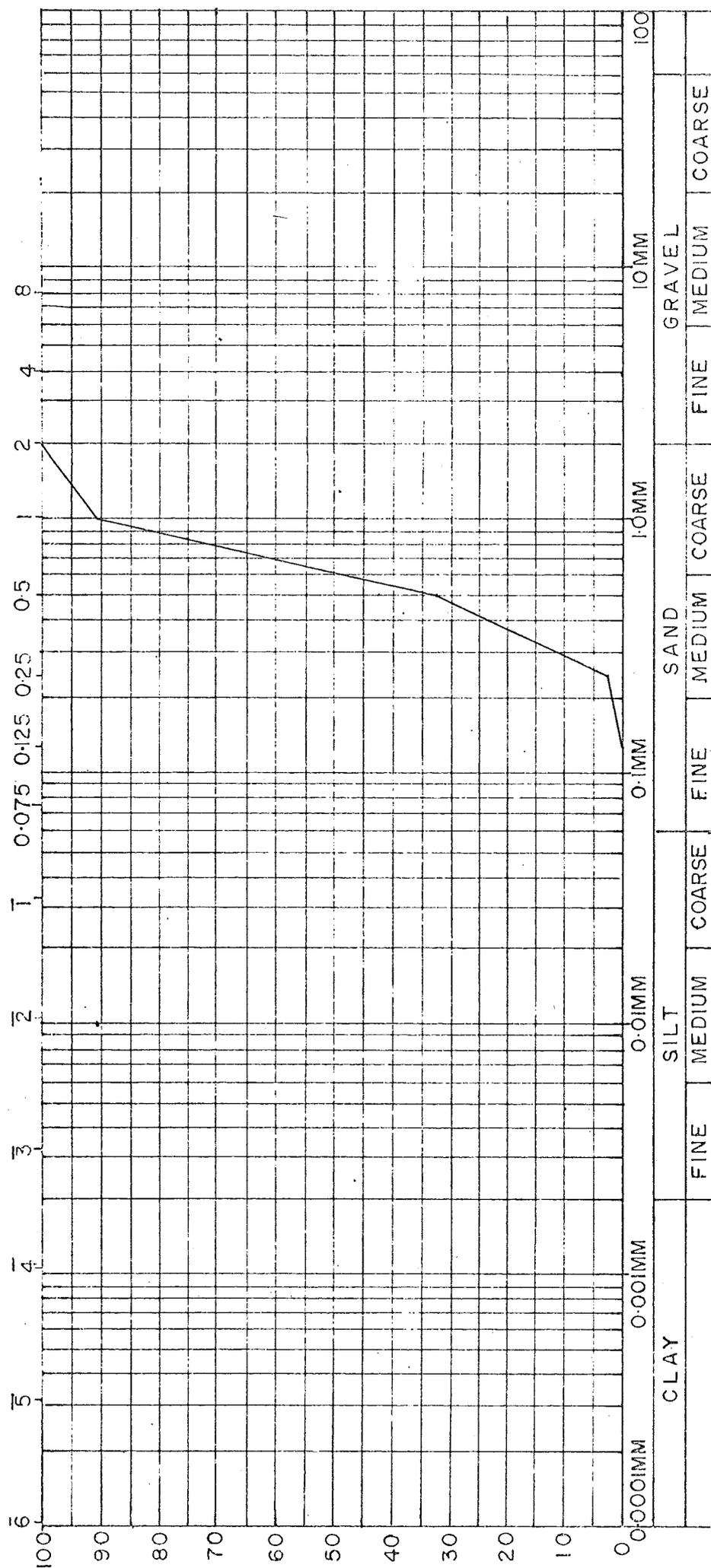
SAMPLE DESCRIPTION medium SAND
 SITE HONAVAR (CYL 5826)
 BORE HOLE 5 DEPTH UNDER G.L. 3:17.M.

WASHING:
 WEIGHT BEFORE 9
 WEIGHT AFTER 9
 WASHED AWAY 9

PARTICLE SIZE DISTRIBUTION ANALYSIS

LOG SETTLING VELOCITY IN CM. PER. SEC.

SIEVE HOLE DIAMETER MM.



SIEVE SIZE M.M.	16	11.3	8	4	2	1	0.5	0.25	0.125	0.075	<0.075
GRAMS RETAINED						10	64	33	3		110
% RETAINED						9.1	58.2	30.0	2.7		100
% PASSING					100	90.9	32.7	2.7			

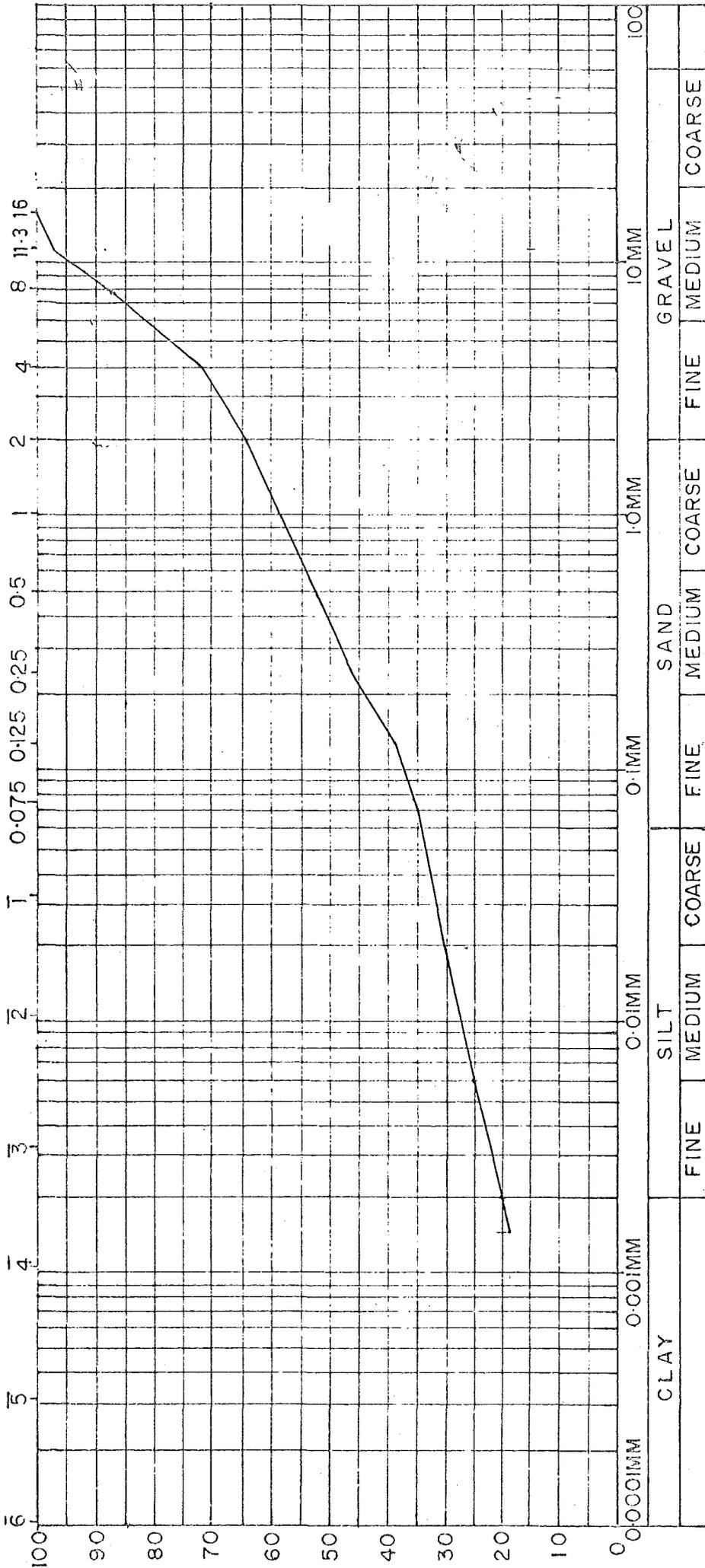
WASHING:
 WEIGHT BEFORE 9
 WEIGHT AFTER 9
 WASHED AWAY 9

SAMPLE DESCRIPTION...medium...coarse...SAND...
 SITE...HONAVAR.(CYL. 5726)...
 BORE HOLE .20.....DEPTH UNDER G.L. 3:17..M.

PARTICLE SIZE DISTRIBUTION ANALYSIS

LOG SETTLING VELOCITY IN CM. PER. SEC.

SIEVE HOLE DIAMETER MM



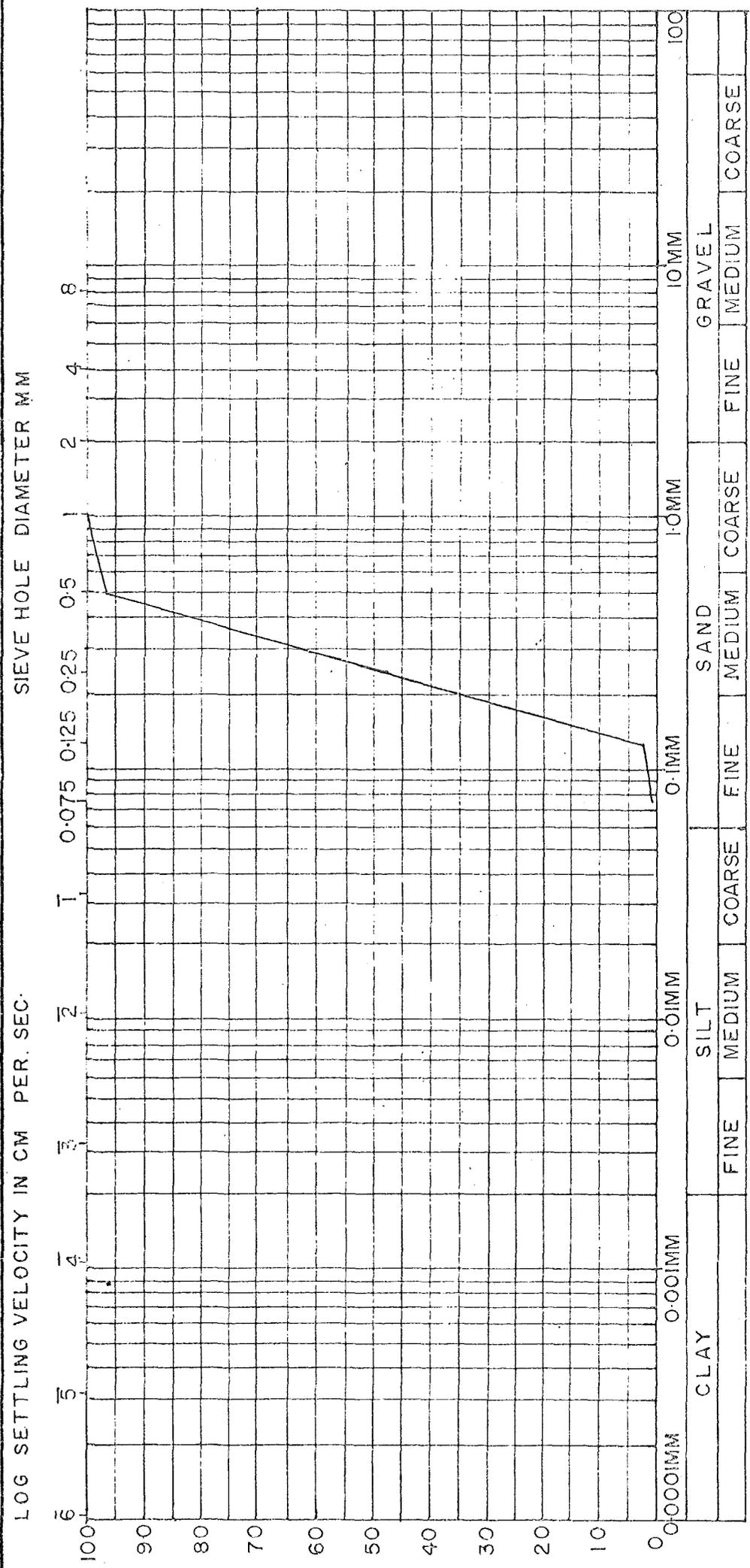
SIEVE SIZE M.M	CLAY			SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE
16	11.3	8	4	2	1	0.5	0.25	0.125	0.075	<0.075		
GRAMS RETAINED		2	6	11	5	4	4	4	5	2	24	67
% RETAINED		3.0	9.0	16.4	7.4	6.0	6.0	6.0	7.4	3.0	35.8	100
% PASSING	100	97.0	88.0	71.6	64.2	58.2	52.2	46.2	38.8	35.8		

WASHING:

WEIGHT BEFORE 6.7 9
 WEIGHT AFTER 4.4 9
 WASHED AWAY 2.3 9

SAMPLE DESCRIPTION... gravelly... sandy... silty... CLAY
 SITE... HONAVAR. (CYL-5640)
 BORE HOLE ... 27... DEPTH UNDER G.L. 13.63.M.

PARTICLE SIZE DISTRIBUTION ANALYSIS



SIEVE SIZE M.M	16	11.3	8	4	2	1	0.5	0.25	0.125	0.075	<0.075
GRAMS RETAINED							5	80	73	3	1
% RETAINED							3.1	49.3	45.1	1.9	0.6
% PASSING						100	96.9	47.6	2.5	0.6	

SAMPLE DESCRIPTION fine..... medium... SAND...
 SITE ..HONAVAR (CYL:5724).....
 BORE HOLE ..27..... DEPTH UNDER G.L. 3:17. M.

WASHING:
 WEIGHT BEFORE 9
 WEIGHT AFTER 9
 WASHED AWAY 9
 PARTICLE SIZE DISTRIBUTION ANALYSIS CARRIED OUT BY Scandia Consult International AB Sweden



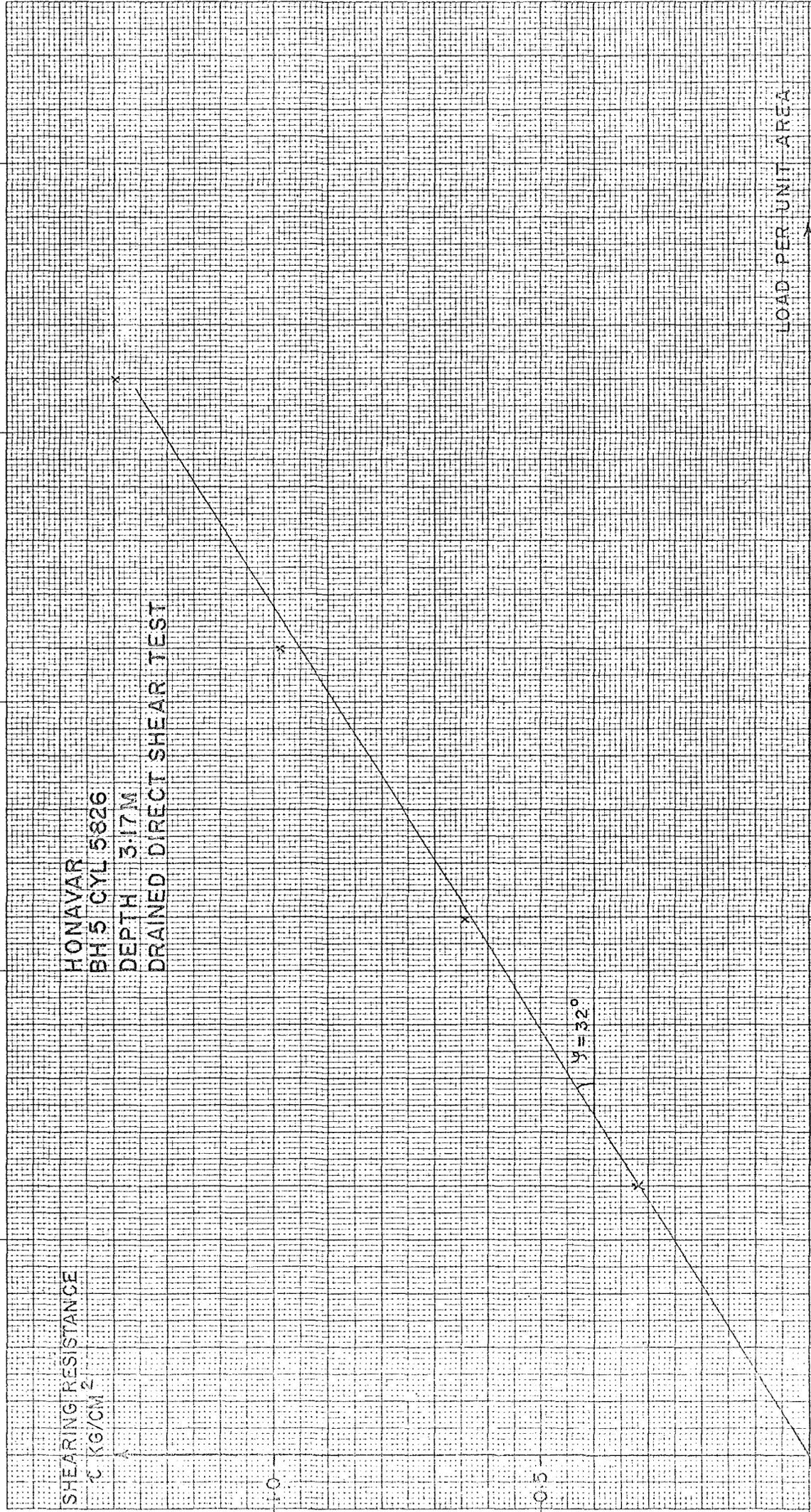
A 4 210 x 297 mm



2-11 SHEAR TEST DIAGRAM

SHEARING RESISTANCE
 τ KG/CM²

HONAVAR
BH 5 CYL 5826
DEPTH 317M
DRAINED DIRECT SHEAR TEST



LOAD PER UNIT AREA
 σ KG/CM²

Tested by ScandiaConsult International AB Sweden

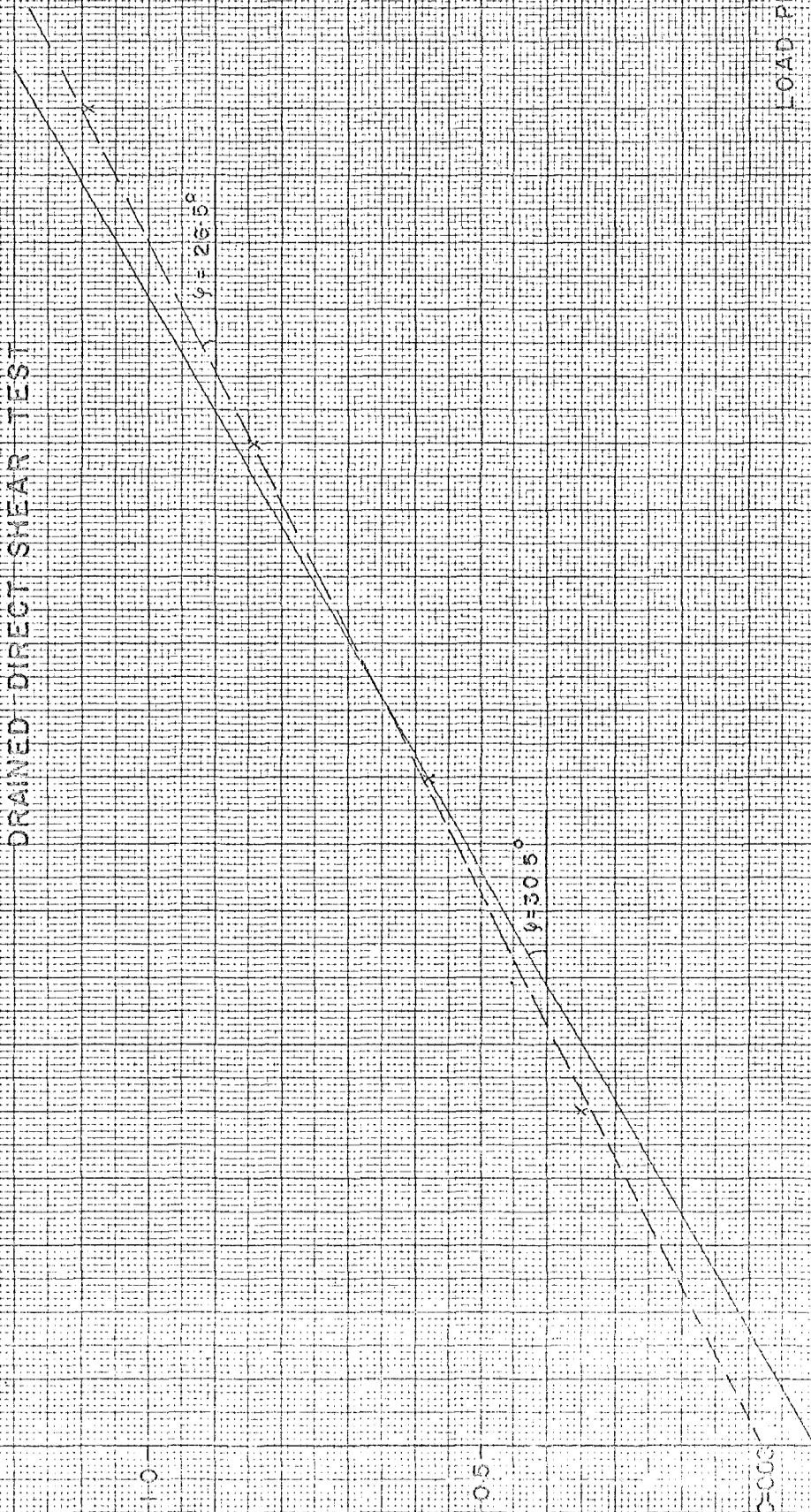
MADE IN GERMANY



SHEAR TEST DIAGRAM

SHEARING RESISTANCE
c KG/CM²

HONAVAR
BH 20 CYL 5726
DEPTH 3.17 M
DRAINED DIRECT SHEAR TEST



Tested by ScandiaConsult International AB Sweden



A 4 210 x 297 mm



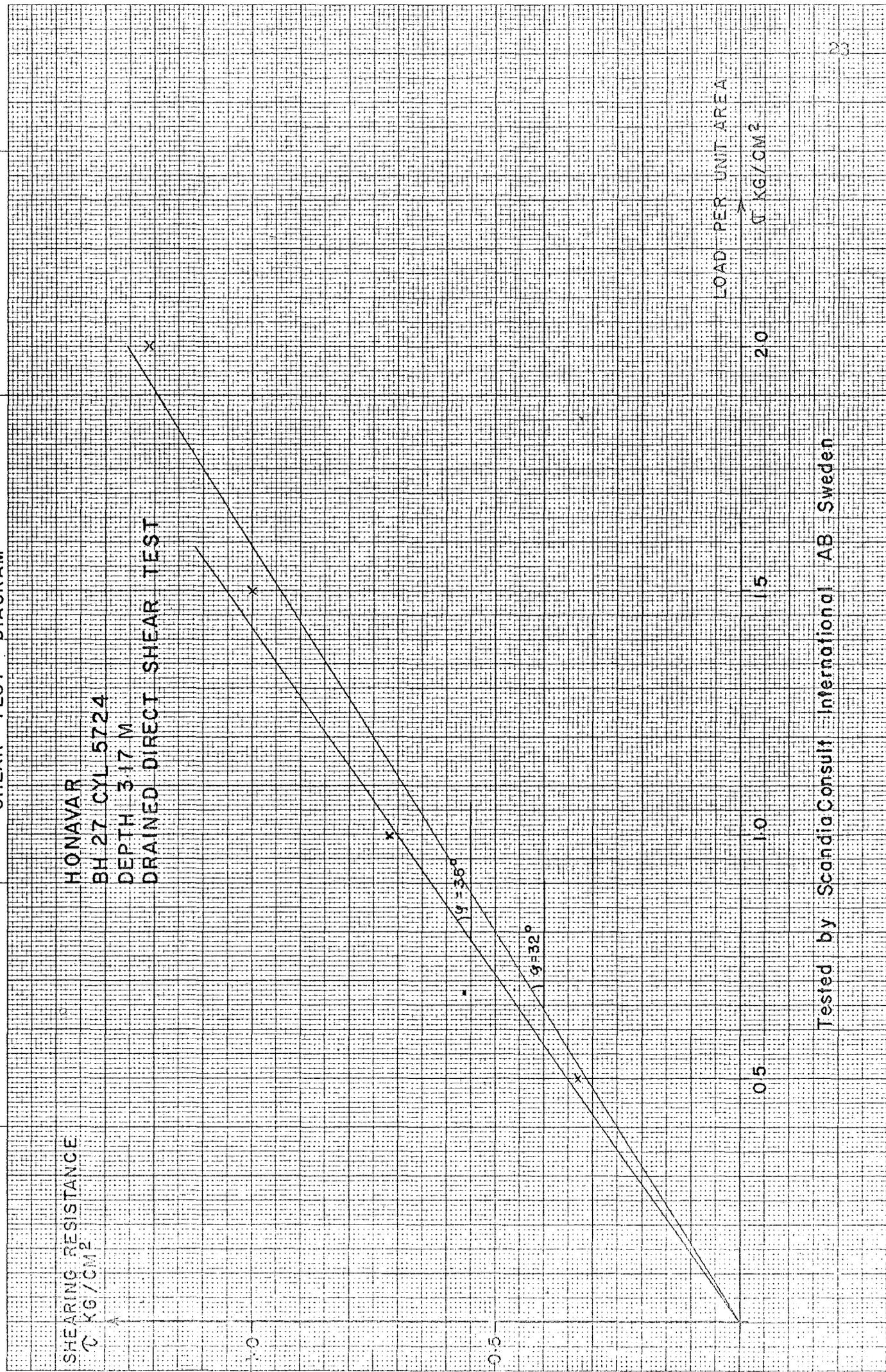
MADE IN GERMANY

SHEAR TEST DIAGRAM

SHEARING RESISTANCE
τ KG/CM²

HONAVAR
BH 27 CYL 5724
DEPTH 3.17 M
DRAINED DIRECT SHEAR TEST

LOAD PER UNIT AREA
σ KG/CM²



Tested by ScandiaConsult International AB Sweden

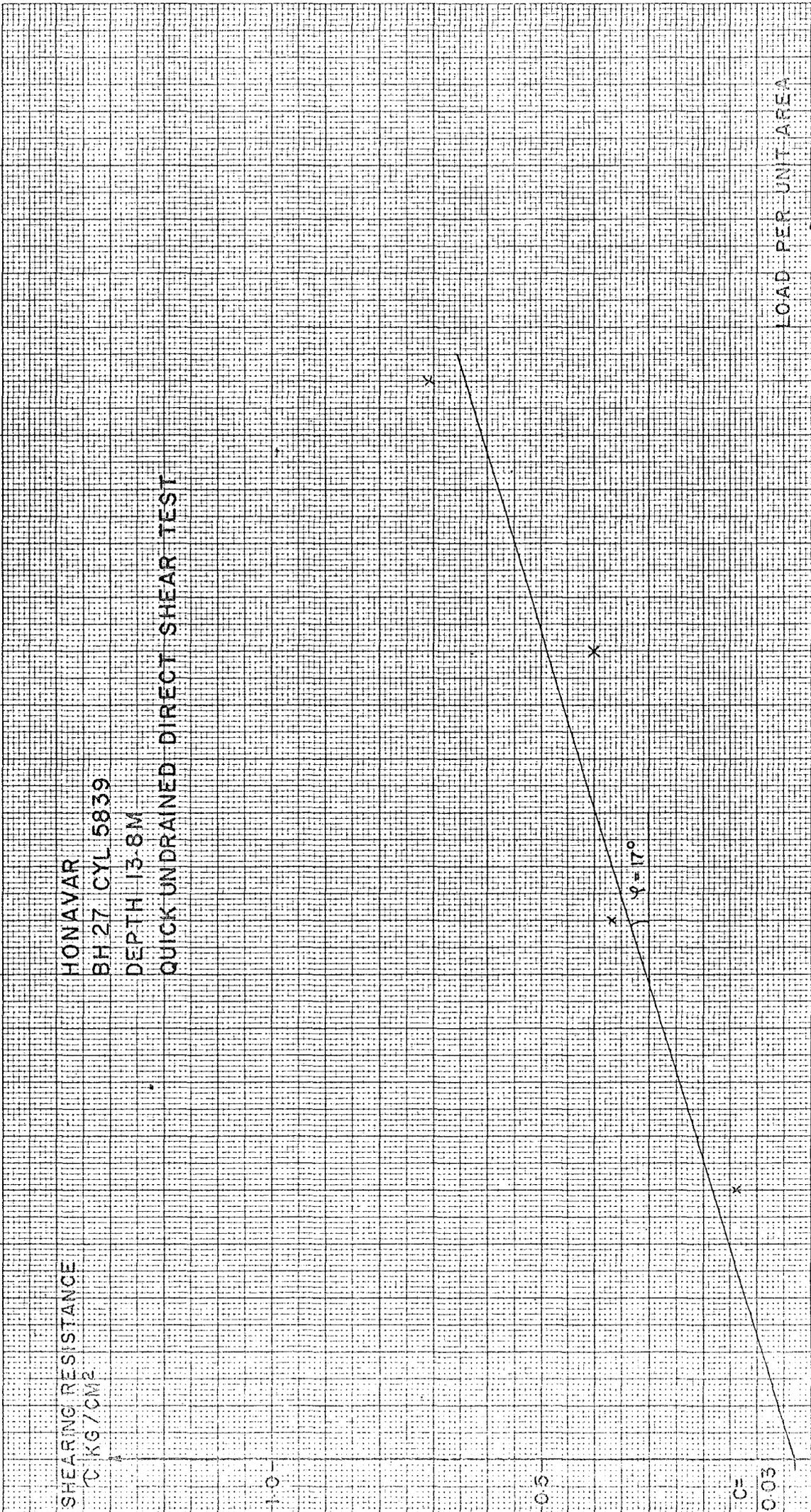
SHEAR TEST DIAGRAM

SHEARING RESISTANCE
 τ KG/CM²

HONAVAR
 BH 27 CYL 5839
 DEPTH 13.8M
 QUICK UNDRAINED DIRECT SHEAR TEST

LOAD PER UNIT AREA

σ KG/CM²



Tested by ScandiaConsult International AB Sweden

SHEAR TEST DIAGRAM

SHEARING RESISTANCE

↑ KG/CM²

HONAVAR

BH 36 CYL 5725

DEPTH 3.43 M

QUICK UNDRAINED DIRECT SHEAR TEST

$c = 0.15$ $\phi = 0$

x

x

x

x

0.5

1.0

1.5

2.0

LOAD PER UNIT AREA

↑ KG/CM²

Tested by ScandiaConsult International AB Sweden



A 4 210 x 297 mm



MADE IN GERMANY

- SOUNDING
- Sticksounding
 - ⊙ Weightsounding, Press-sounding
Motorsounding
 - ⊖ Hammersounding

- SAMPLING
- ⊙ Disturbed Sample
 - ⊖ Undisturbed Sample

- IN-SITU TESTS
- ⊗ Vane Test

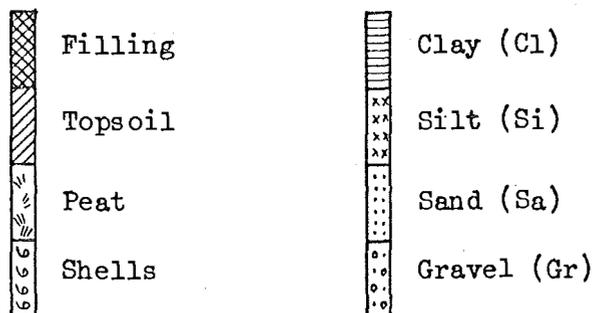
- Sounding to hard stop
- Sounding to presumed Rock
- Rock boring at least 3 m.
under presumed Rock surface
- - Ditto - with examination
of the dust
- Rock coring at least 3 m.

- HYDROLOGICAL MEASUREMENTS
- Ground Water Level measured
 - Ground Water Level recorded
over long period
 - - Ditto - short period
 - ⊖ Pump or Infiltration Test
 - ⊕ Pore Pressure Measurement
 - ⊖ Deformation Measurement
 - Trial Pit or other test point
e.g. Test Loading

	Detailed Plan		Simple Plan
	Symbol		Symbol
	81		81
	+4.10 20.09.69		
	+3.15 22.09.69		
	A		
	+6.86	⊙	⊙
		Cl +5.20	
		Sa +3.60	
		Si +3.10	
		Sa +1.60	
		Cl -2.10	
		Gr -4.45	

A Indicates Chemical or Special analysis carried out

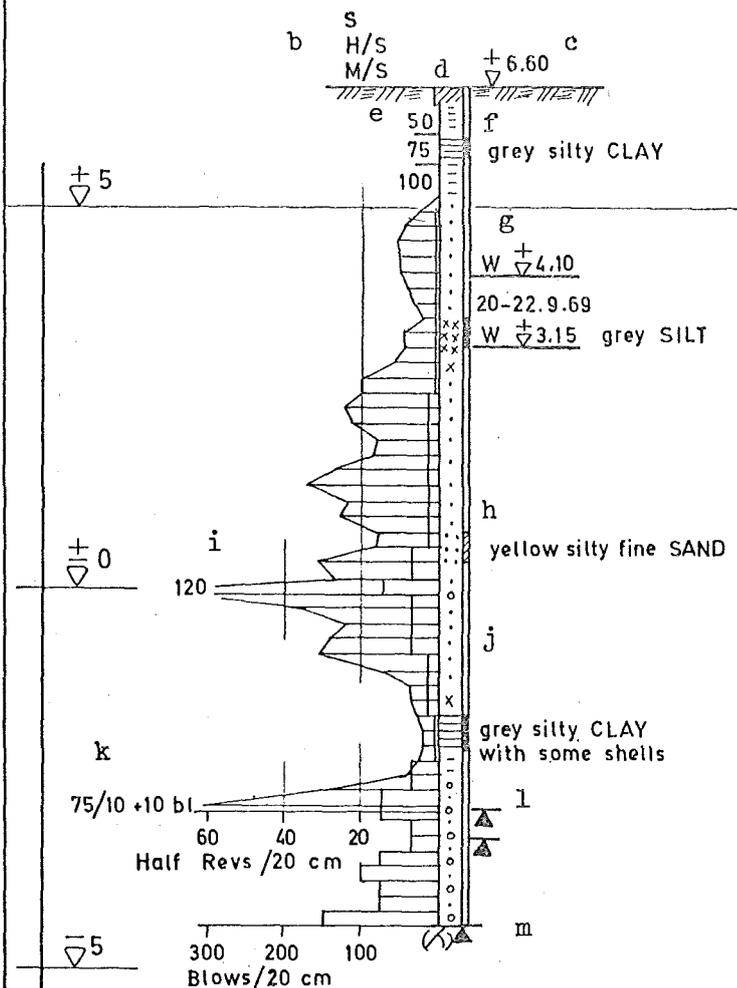
SECTIONS



BOREHOLE STOPS

Section	Plan	
	○	Probably Rock
	○ ○	Probably Stone or Rock
	○	Stone, Block or Rock
	○	Non-Rock, Stone or Block stop
	○	Boring discontinued, can be driven deeper without hammering
	○ ○	- Ditto - but only with hammering
	○ ○ ○	Rock Drilling

81 a



- a Borehole number 81
- b S Sampling carried out
H/S Hammersounding carried out
M/S Motorsounding carried out
- c Ground level in metres above or below Datum
- d Hole made in ground with auger or crow-bar. 20 cm deep
- e 50, 75, 100, pressures in Kg. applied for Motorsounding. The rods were not turned.
- f Fully shaded area indicates undisturbed sampling. The adjectives describing the sample are in small letters. Nouns are in capital letters. Borehole legend across the whole section indicates that the material has been sampled and seen. Legend in the centre of the section only indicates the material present, in the opinion of the engineer.
- g $\frac{W + 4.10}{20-22.9.69}$ Highest water level measured over the period shown.
 $\frac{W + 3.15}{}$ Lowest water level measured over same period.

h Position of disturbed sample shown cross-hatched.

i Motorsounding, half revs./20 cm., redorded in numbers when the figure is very high.

j Hammersounding, number of hammer-blows/20 cm.

k 75/10+10 bl 75 half turns. Motorsounding penetrated only 10 cm. 10 blows of a sledge hammer were applied.

l Previous boring attempt discontinued at a hard stop.

m Boring stopped on Stone, Block or Rock.

Hammersounding results are represented as follows:

- Free sinking is drawn as 0 blows/20 cm.
- 1 - 10 blows as 5 blows/20 cm.
- 11- 20 blows as 15 blows/20 cm.
- 21- 50 blows as 35 blows/20 cm.
- 51-100 blows as 75 blows/20 cm.

2.13 SOIL INVESTIGATIONS DRAWINGS

<u>Drawing No</u>	<u>Title</u>
07 - 200	Borehole Plan
07 - 210	Section of Boreholes Nos. 8, 4, 3, 2, 1
07 - 211	Section of Boreholes Nos. 31, 29, 24, 19, 16
07 - 212	Section of Boreholes Nos. 42, 41, 40
07 - 213	Section of Boreholes Nos. 4, 5, 6, 7
07 - 214	Section of Boreholes Nos. 8, 9, 10, 11, 12
07 - 215	Section of Boreholes Nos. 13, 14, 15, 17, 18
07 - 216	Section of Boreholes Nos. 25, 22, 20
07 - 217	Section of Boreholes Nos. 33, 30, 28, 27, 26, 23, 21
07 - 218	Section of Boreholes Nos. 31, 32, 33, 34, 35, 36
07 - 219	Section of Boreholes Nos. 37, 38, 39

DESIGN

3. DESIGN OF THE HARBOUR

3.1 INTRODUCTION

The town of Honnavar is situated on the north river bank of Sharavati river about one kilometre from the rivermouth which is on the North Kanara coast in Mysore State and about 175 kilometres north of Mangalore.

Honnavar town has a population of about 20,000 inhabitants including Kasarkod village on the south side of the river and has some small industries such as sawmills and tile factories. A new bridge under construction for the West Coast Highway is now nearing completion. The area inside the river entrance and the existing harbour arrangements are at present to some extent used for sailingships with limited draft carrying mainly timber and tiles. There is also river traffic carrying passengers and agricultural products. Four RCC-jetties in good condition on the south river bank were built for shipping of iron ore but due to diversion this trade has now ceased and the jetties are at present available for fisheries use.

The fishing boats operating from Honnavar have no permanent berthing facilities and the fishermen anchor their boats in the Tidal Basin as close as possible to the place where they are living. It is deemed not to be necessary to provide berthing places for all the boats in the proposed harbour. The ore jetties are at present used by the fisheries as well as by the commercial trade. The fact that the fisheries due to the commercial trade cannot make full use of the jetties at all times and that more space for landing fish will be required for the increasing number of boats, makes it necessary to construct a landing quay for fishing boats only.

3.2 LOCATION OF THE PROPOSED LANDING QUAY AND PORT FACILITIES

Due to the littoral drift and heavy waves a location of the harbour outside the rivermouth is not advisable.

The location of the landing quays has therefore been chosen in the Tidal Basin downstream of the existing RCC-jetties on the south river bank about 400 metres from the rivermouth. The advantages of

this location are:-

- A. The wharf is close to the -3.0 m bottom contour and only limited dredging is therefore required.
- B. Foundations for the structures will be quite simple and the construction thereof is deemed to be easy.
- C. The existing four RCC-jetties can be used for berthing.
- D. A good road which has been used for transport of iron ore joins the site to the West Coast Highway.
- E. There are no permanent buildings to be removed.
- F. Only limited quantities of material are required for filling up the land area of the harbour to +3.0 m.
- G. A forest provides quite good protection against winds from the sea.

3.3 ENTRANCE CHANNEL

The entrance channel to the Tidal Basin at Honnavar consists of a gorge with maximum depth of about 7 metres with a bar on the seaward side. The bar is half-moon-shaped, but stunted, giving a steep slope on the ocean side down to -5.0 m. The minimum depth over the bar is about 2.5 m at M.L.L.W.

The tidal prism at two consecutive spring tides (28/10 and 11/11) was found to be about $20 \times 10^6 \text{ m}^3$ with maximum ebb currents in the gorge of 1.3 - 1.5 m/s.

Using the cross sectional area at the entrance gorge as the determining factor and assuming that it stays rather close to approx. $1,000 \text{ m}^2$ at M.S.L. during most of the monsoon period and classifying the situation at the entrance as "poor" on the "fair" side because the gorge is deep and the bar still keeps about 2.5 metres depth, the drift by comparison with other similar inlets (Ref. Tidal Inlets and Littoral Drift by Prof. P Bruun, 1966) would be of the order of

magnitude 250,000 to 300,000 m³ per year. The situation with heavy drift does however only last for 1/3 to 1/2 year and may therefore account for only approximately 125,000 m³. For the main part of the year the drift will be less. Comparing this situation to similar cases on the lower Florida Gulf Coast, where wave action most of the year does not exceed 1.5 metres in height, it is believed that the non-monsoon period at Honnavar may account for another 50,000 to 75,000 m³ or a total quantity of the order of magnitude 200,000 m³ per year affecting the inlet entrance.

The position could be improved by utilising natural self-flushing together with mechanical bypassing. The flushing could be made effective by training walls which at the same time protect the entrance from sand drifting to the entrance from either side. Notwithstanding the provision for such training walls mechanical bypassing of order of 100,000 to 150,000 m³ per year would still be required.

Capital costs of training works would be of order of Rs. 25 x 10⁶ with maintenance costs of Rs. 1 x 10 per annum. Such costs could not be justified purely for the provision of a fishing harbour at Honavar. Hence no improvement of the river entrance is anticipated and the present depth over the bar will therefore limit the permissible draft of the boats using the harbour. It should also be noted that the channel has a northerly migration which will require regular moving of channel markers.

3.4 LAND AREA OF THE HARBOUR

The land area proposed for development of fishing facilities covers about 53,000 M². The area behind the existing RCC-jetties which is about 10,000 M² is not required now, but can be used for fish industries or fish drying for which more space may be needed later on. A large area is also available north of the proposed harbour for future extension.

The area for auction and packing hall, indicated on Drawing No. F-07-43 is about 3000 M².

The entire harbour site should be fenced in.

3.5 LANDING AREA

In the first stage the harbour will be constructed for 80 boats 10 m in length and 40 boats 14 m in length using the harbour.

It has been assumed that at any one time 10% of the total number of boats are not fishing due to maintenance or other reasons.

The number of boats to be considered for design of landing area are thus:-

72 boats 10 m length and
36 boats 14 m length, in total 108 boats

Average length of each landing place assuming 0.5 m space between the boats is thus:-

$$\frac{72 \times 10 + 36 \times 14}{108} + 0.5 = 11.3 \text{ m}$$

All boats are assumed to be engaged on one day's fishing trips.

Average catch per boat during peak month has been estimated to be

400 kg/day for 10 m boats
1,400 kg/day for 14 m boats

The unloading capacity is assumed to be 4000 kg per hour.

Total time when the vessel uses the landing quay before and after unloading is here assumed to be 5 minutes.

Hence time required for one unloading operation will be

10 m boats:-

$$\frac{400}{4000} \times 60 + 5 = 11 \text{ minutes}$$

14 m boats:-

$$\frac{1400}{4000} \times 60 + 5 = 26 \text{ minutes}$$

Average time required:-

$$\frac{72 \times 11 + 36 \times 26}{108} = 16 \text{ min./boat}$$

Studies of the length of landing quay required based on an analysis of the arrival pattern of boats at Malpe, Honnavar and Ratnagiri were carried out. Using the average time required for unloading the catch it has been estimated that with a quay of 10 landing spaces the maximum waiting time would be 29 minutes while for a quay with 12 landing spaces the maximum waiting time would be 12 minutes.

A waiting time of 29 minutes is unacceptable. Hence a quay with 12 landing spaces is being provided. The length of the quay required will be $12 \times 11.3 = 135.6$ m. Say 136 m.

3.6 BERTHING AREA

As mentioned in the introduction there is no necessity to provide permanent berthing for the boats although it will be necessary to provide a number of temporary berthing places. The proposal provides temporary berthing space for a number of 6 boats 3 abreast at the downstream end of the landing quay. During periods when fishing activities are suspended the entire length of the landing quay can be used for berthing. The existing RCC-jetties provide berthing for another 12 boats.

3.7 SUPPLYING AREA

A length of 40 m of quay has been set aside for the supply area. Provision has been made to allow boats to take on water fuel and ice at one berth. The supplying quay will also be fitted with a 5 tonne crane and the end of the quay will serve as a landing quay for a proposed slipway.

Area for Fishermen's Sheds	3000 M ²
Area for Fish Industries	16000 M ²
Area for Restaurant, Shops, Car-parking, etc.	11500 M ²

These areas will be covered with a 150 mm thick rolled layer of well graded crushed aggregate.

3.8 BOAT YARD

The boatyard covers an area of about 6000 M² surfaced with a 150 mm thick rolled layer of well graded crushed aggregate. A slipway for boats maximum 60 tonnes and with a transverse system that gives space for fifteen 15 metre long fishing boats and a separate track for boat-building is proposed. The boatyard will be separated from the other activities with a fence on both sides perpendicular to the roads.

3.9 BUILDINGS

Suitable locations for the various buildings have been indicated on Drg. No. P-07-43.

3.10 ROADS

The roads and the area near the landing quay will be surfaced with bitumen macadam.

3.11 QUAY

The proposed type of landing quay is shown on Drg. No. P-07-44. It consists of a reinforced concrete deck on a foundation of RCC piles. The deck of the quay will be brought to the level +3.0 m. The quay has been designed for a vertical live load of 1 tonne/sq. metre on the quay surface and a horizontal live load from berthing boats of 1 tonne per metre length of quay. These horizontal loads are considered to act outward perpendicular to the quay line and will in this case be taken up by anchor-plates at 8.0 metres c/c. Loads acting inwards towards the quay will be taken up by passive earth pressure on the back of the quay structure.

3.12 WATER SUPPLY

A well will be drilled to obtain fresh water, and a water tower constructed as indicated "W" on Drg. No. P-07-43.

3.13 SEWAGE AND DRAINAGE

It is proposed that the surface water drainage of the site be discharged out into the river.

The sewage will be conducted to a settling tank from which the effluent will be pumped out into the river.

3.14 FUTURE EXTENSION

The quay can be extended downstream about 100 m and the area behind can be filled out. The area behind the existing RCC-jetties (about 10,000 M²) can be used for fishing industries.

3.15 MAINTENANCE

It has been considered that the works could be completed by 1974. Maintenance costs on civil works would not be incurred until 1975. It has been estimated that maintenance costs in 1975 would amount to Rs. 10,000 rising gradually to a figure of Rs. 60,000 for 1978 and the following years.

Dredging maintenance costs are expected to be low. Following capital dredging it has been assumed that no expenditure on maintenance dredging would be incurred until 1978 from which year a nominal sum of Rs. 20,000 per annum has been allowed.

3.16 DESIGN DRAWINGS

<u>Drawing No</u>	<u>Title</u>
P - 07 - 400	Proposed Fishing Harbours Perspective
P - 07 - 42	Harbour site 1:5,000
P - 07 - 43	General Lay-out 1:1,000
P - 07 - 44	Landing Quay, Cross Section 1:50

3.17 COST ESTIMATE

Description	Unit	Quantity	Cost per Unit Rs.	Estimated Cost Rs.
1. Dredging	m ³	20000	10	200,000
2. Earth work	L.S.			61,000
3. Quay	m	215	4,000	860,000
4. Slipway and cradles, machinery and crane 5T	L.S.			592,000
5. Roads and Hard Surfaces				
Asphalt surfaced area	m ²	15500	12	186,000
Macadam covered area	m ²	10000	30	<u>300,000</u>
				486,000
6. Improvement of connection road to the West Coast Highway	m	1100	150	165,000
7. Water Supply	L.S.			300,000
8. Drainage and sewage	L.S.			150,000
9. Electricity Sub-station	L.S.			200,000
10. Port Office	L.S.			100,000
11. Fuel Station	L.S.			50,000
12. Toilets	L.S.			60,000
13. Lighting	L.S.			60,000
14. Fence	L.S.			16,000
15. Navigation Lights and Marks	L.S.			50,000
				<u>3,350,000</u>
Contingencies about 10%				335,000
				<u>3,685,000</u>
Supervision charges about 12.5%				460,000
GRAND TOTAL				<u><u>4,145,000</u></u>

