LIST OF RESULTS

6-55'

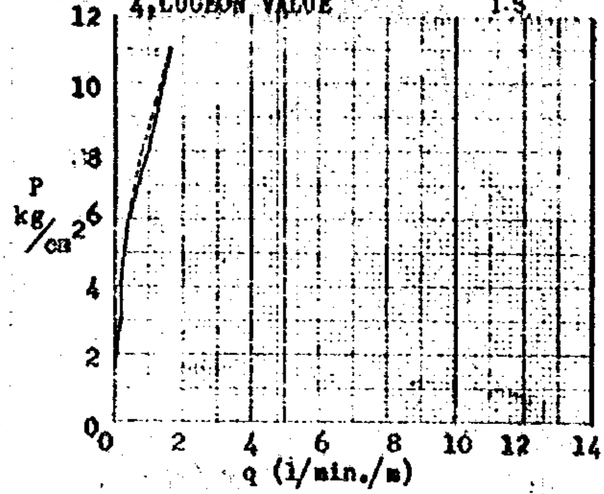
Fig. 6 - 9 (AN)

RESULT OF WATER PRESSURE TESTS

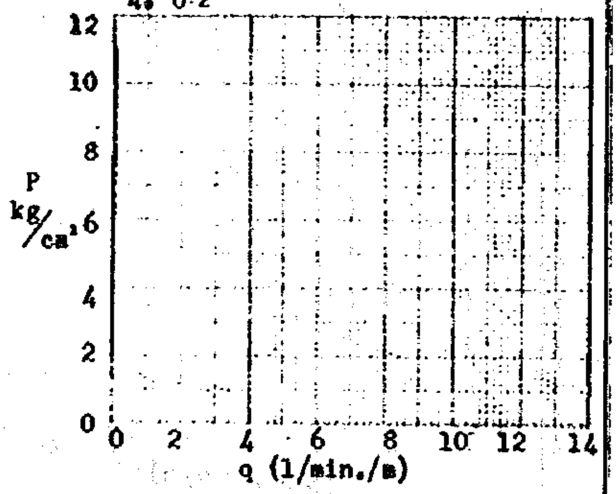
RESULT OF WATER PRESSURE TEST (1)

BOREHOLE NO. BM-1

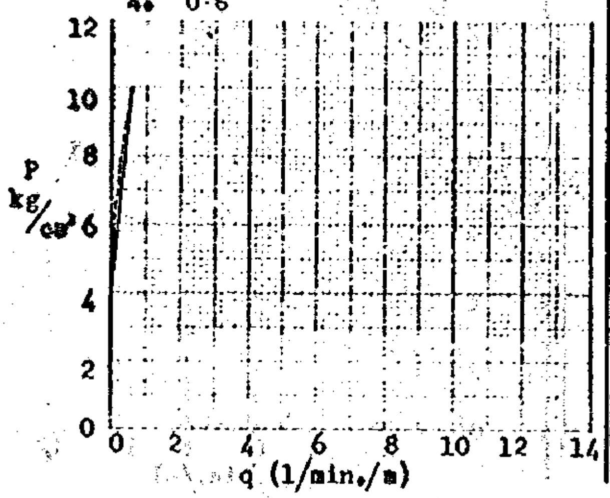
1. DEPTH OF TEST SECTION 10.00-15.00 m
2. MAXIMUM PRESSURE 11.0 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 1.5



1. 15.00-20.00 m
2. 11.0 kg/cm² 3. – kg/cm²
4. 0.2

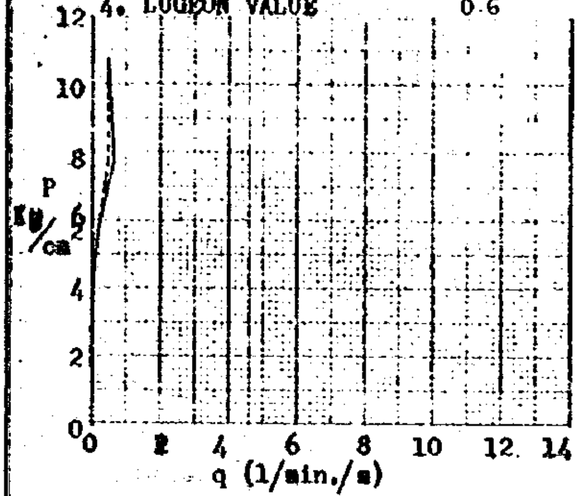


1. 20.00-25.00 m
2. 10.9 kg/cm² 3. kg/cm²
4. 0.6

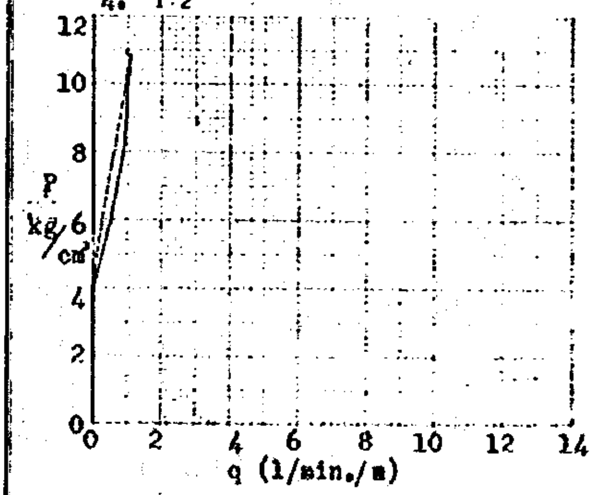


BOREHOLE NO. BM-1

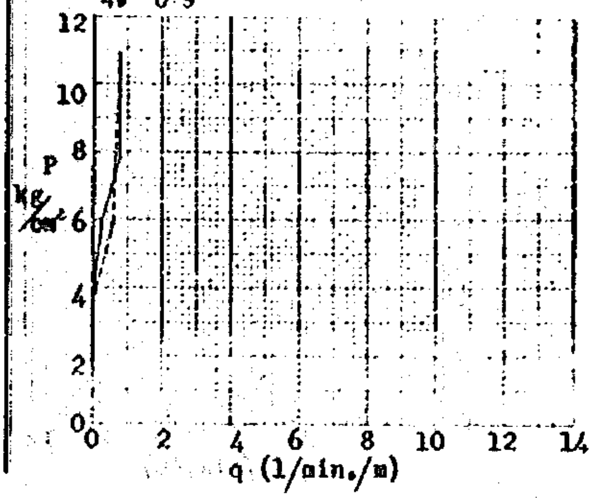
1. DEPTH OF TEST SECTION 25.00-30.00 m
2. MAXIMUM PRESSURE 10.8 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.6



1. 30.00-35.00 m
2. 10.9 kg/cm² 3. – kg/cm²
4. 1.2



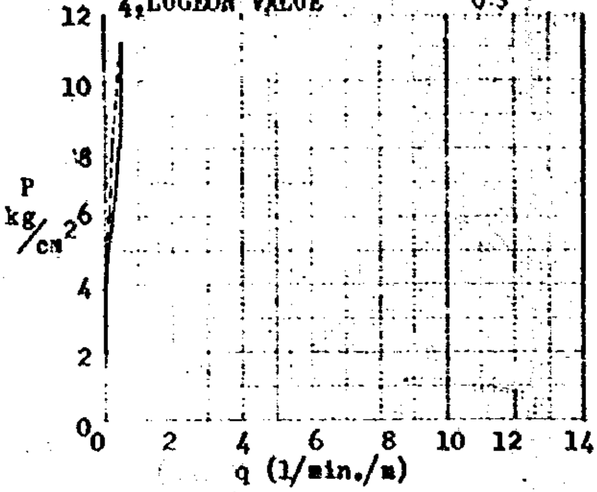
1. 35.00-40.00 m
2. 11.0 kg/cm² 3. kg/cm²
4. 0.9



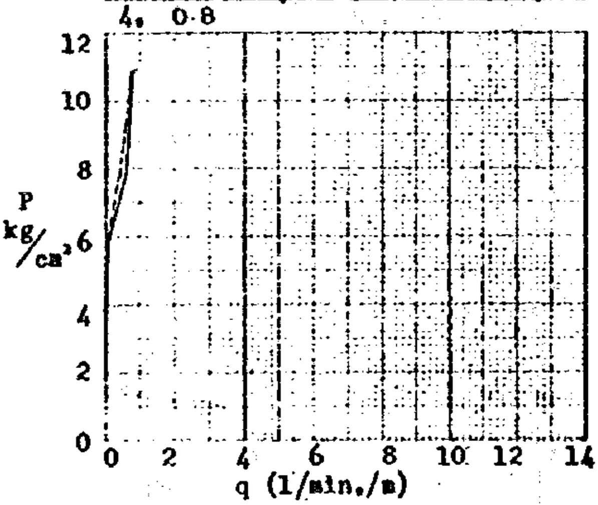
RESULT OF WATER PRESSURE TEST (2)

BOREHOLE NO. BM-1

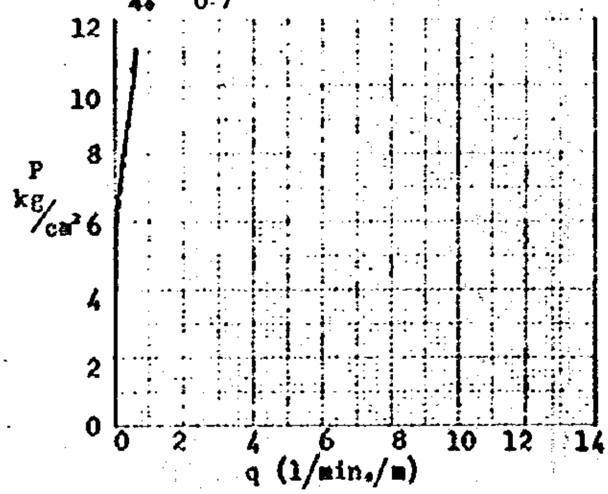
1. DEPTH OF TEST SECTION 40.00-45.00 m
2. MAXIMUM PRESSURE 11.1 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.5



1. 45.00-50.00 m
2. 11.0 kg/cm² 3. — kg/cm²
4. 0.8

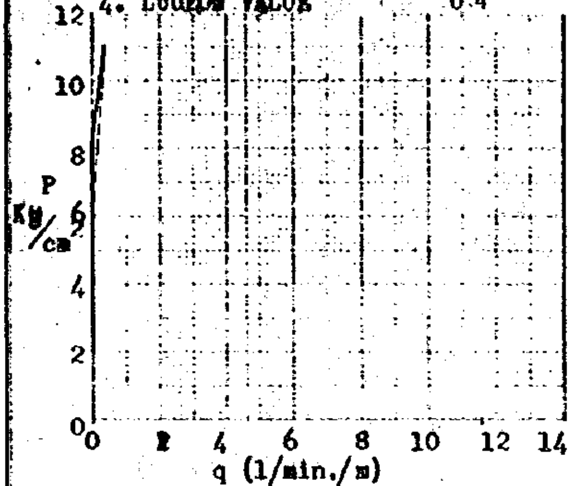


1. 50.00-55.00 m
2. 11.1 kg/cm² 3. - kg/cm²
4. 0.7

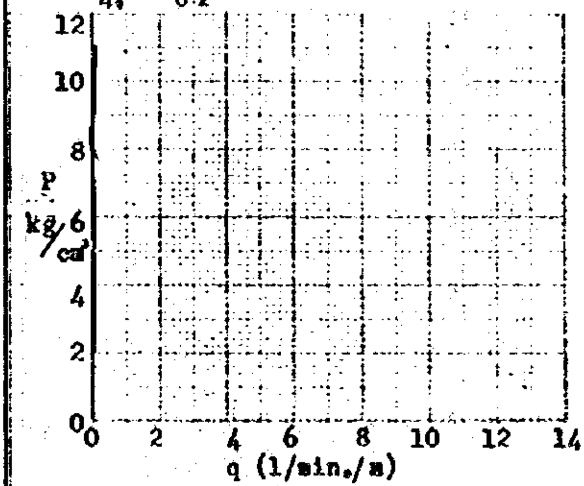


BOREHOLE NO. BM-1

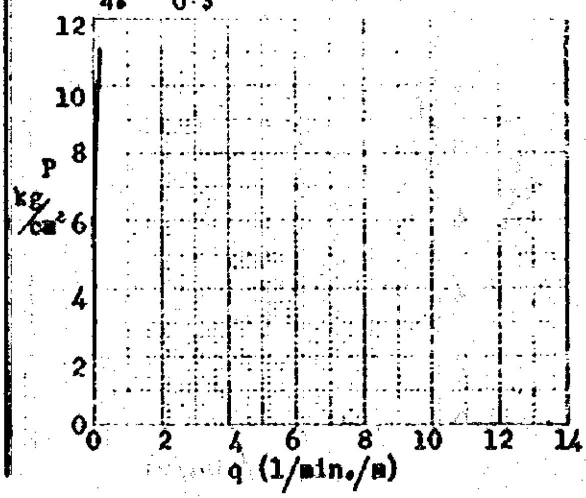
1. DEPTH OF TEST SECTION 55.00-60.00 m
2. MAXIMUM PRESSURE 11.0 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.4



1. 60.00-65.00 m
2. 11.0 kg/cm² 3. — kg/cm²
4. 0.2



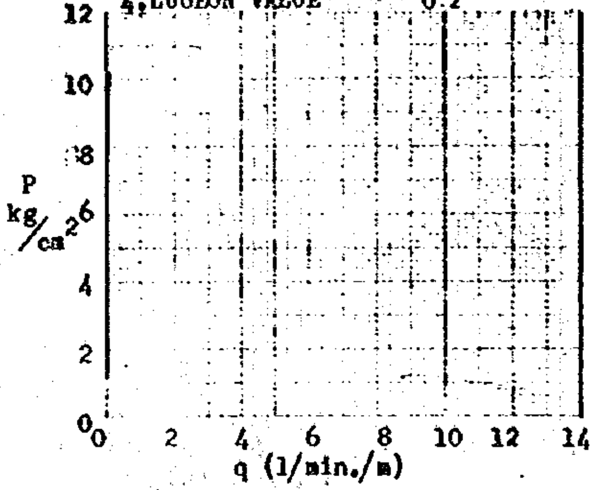
1. 65.00-70.00 m
2. 11.1 kg/cm² 3. — kg/cm²
4. 0.3



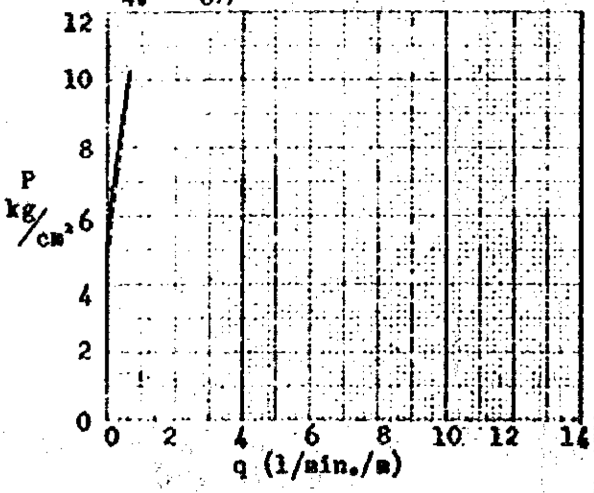
RESULT OF WATER PRESSURE TEST (3)

BOREHOLE NO. BM.2.

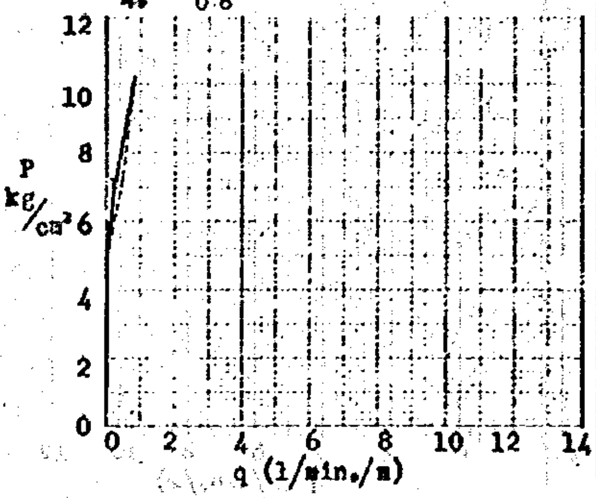
1. DEPTH OF TEST SECTION 5.00-10.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.2



1. 10.00-15.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.7

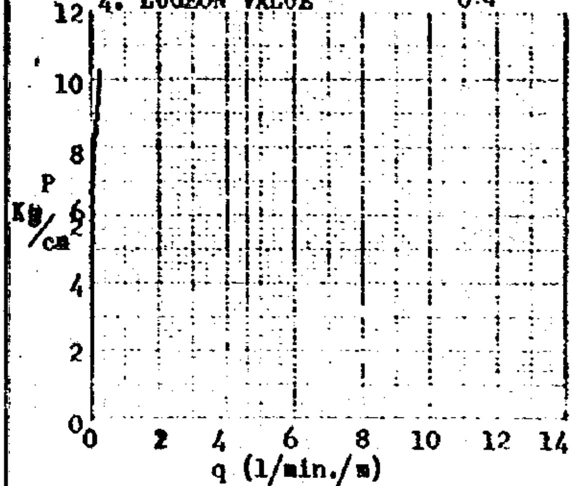


1. 15.00 - 20.00 m
2. 10.3 kg/cm² 3. – kg/cm²
4. 0.8

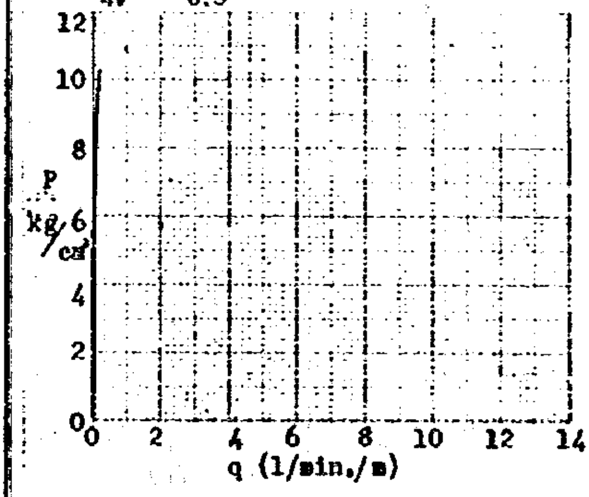


BOREHOLE NO. BM.2.

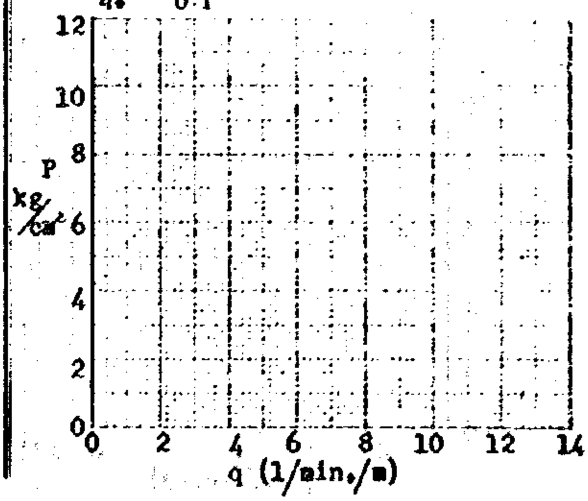
1. DEPTH OF TEST SECTION 20.00-25.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.4



1. 25.00-30.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.3



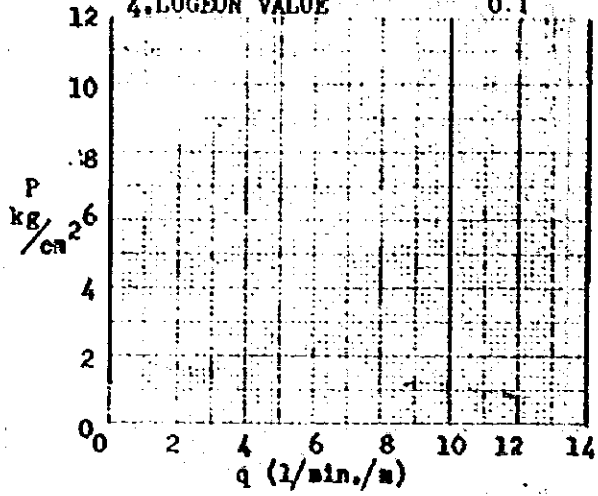
1. 30.00 - 35.00 m
2. 10.2 kg/cm² 3. kg/cm²
4. 0.1



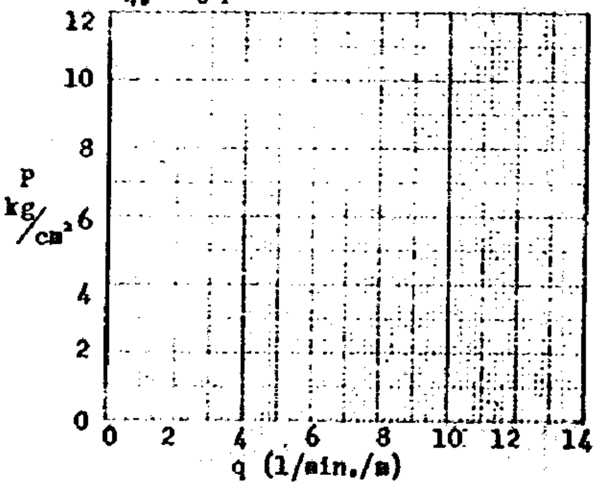
RESULT OF WATER PRESSURE TEST (4)

BOREHOLE NO. BM. 2.

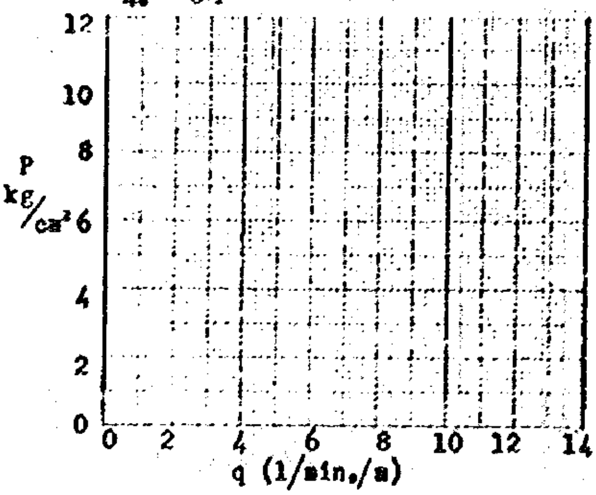
1. DEPTH OF TEST SECTION 35.00-40.00 m
2. MAXIMUM PRESSURE 10.2 Kg/cm²
3. CRITICAL PRESSURE - Kg/cm²
4. LUGEON VALUE 0.1



1. 40.00 - 45.00 m
2. 10.2 Kg/cm² 3. - Kg/cm²
4. 0.1

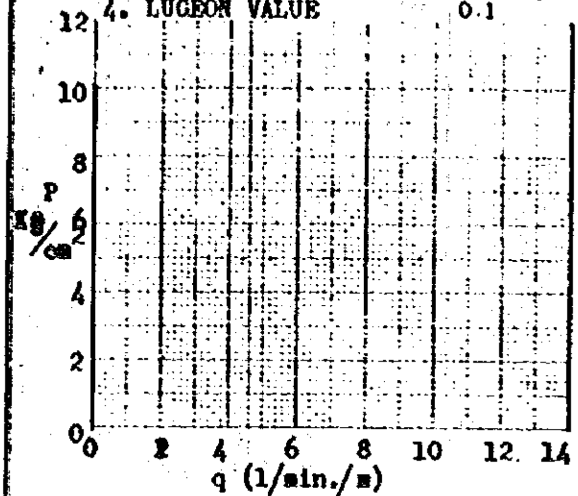


1. 45.00-50.00 m
2. 10.1 Kg/cm² 3. Kg/cm²
4. 0.1

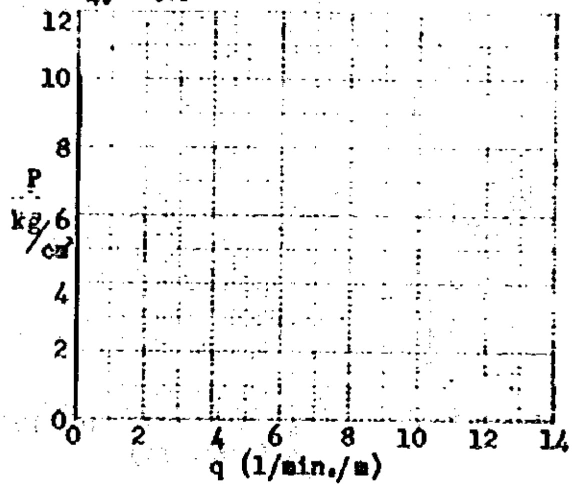


BOREHOLE NO. BM. 2.

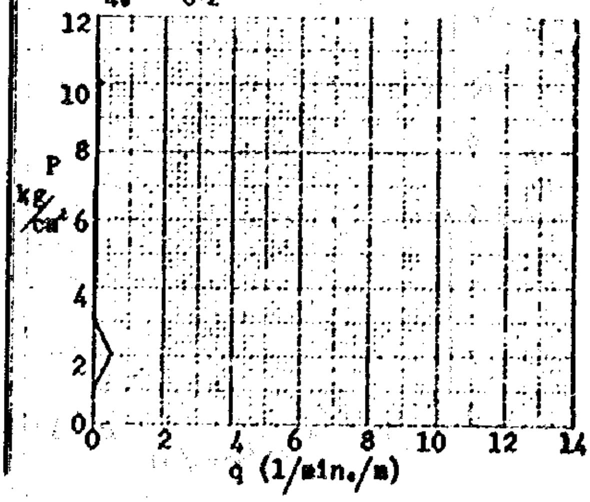
1. DEPTH OF TEST SECTION 50.00-55.00 m
2. MAXIMUM PRESSURE 10.2 Kg/cm²
3. CRITICAL PRESSURE - Kg/cm²
4. LUGEON VALUE 0.1



1. 55.00 - 60.00 m
2. 10.2 Kg/cm² 3. - Kg/cm²
4. 0.1



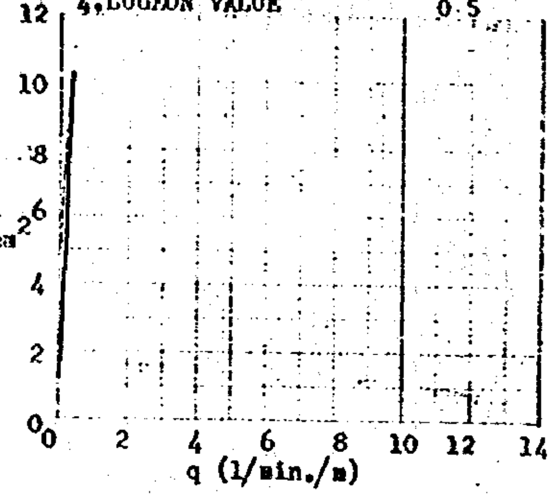
1. 60.00-65.00 m
2. 10.1 Kg/cm² 3. - Kg/cm²
4. 0.2



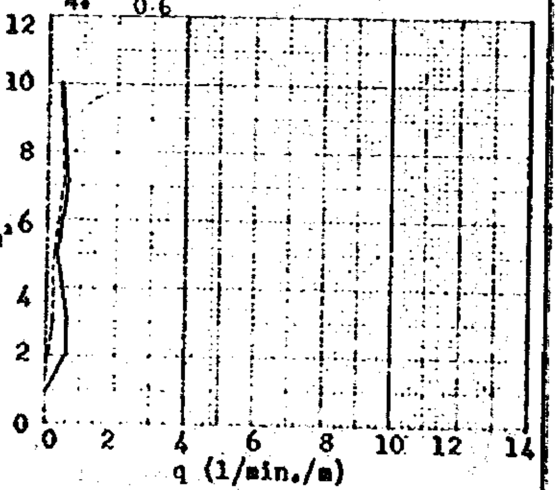
RESULT OF WATER PRESSURE TEST (5)

BOREHOLE NO. BM 3

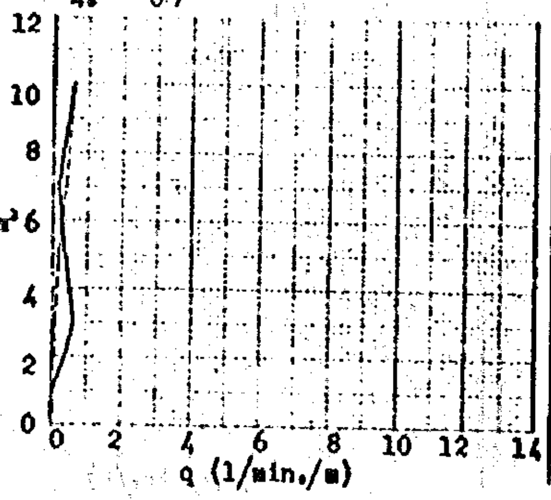
1. DEPTH OF TEST SECTION 10.00-15.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.5



1. 15.00-20.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.6

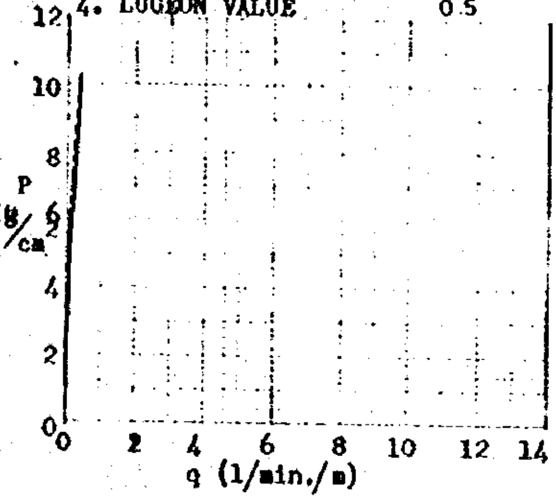


1. 20.00-25.00 m
2. 10.3 kg/cm² 3. – kg/cm²
4. 0.7

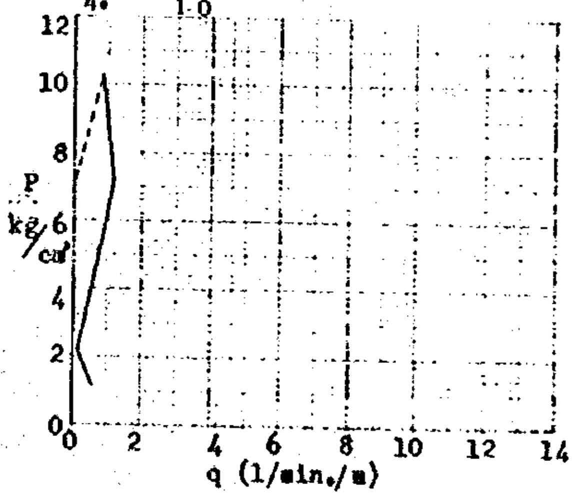


BOREHOLE NO. BM 3

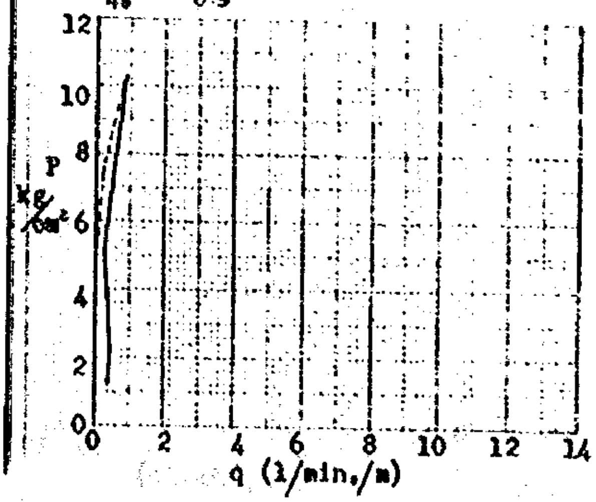
1. DEPTH OF TEST SECTION 25.00-30.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.5



1. 30.00-35.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 1.0



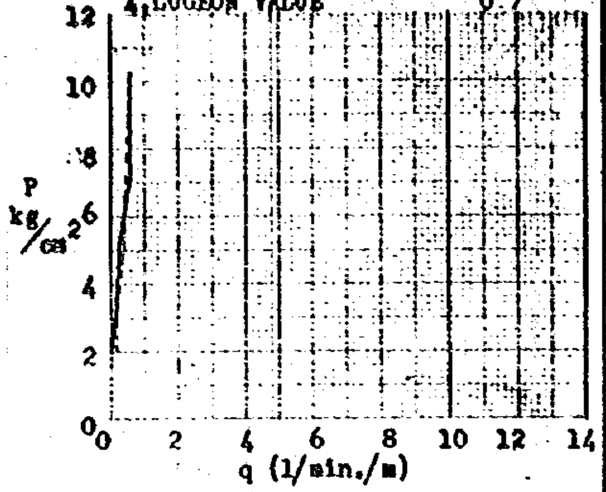
1. 35.00-40.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.9



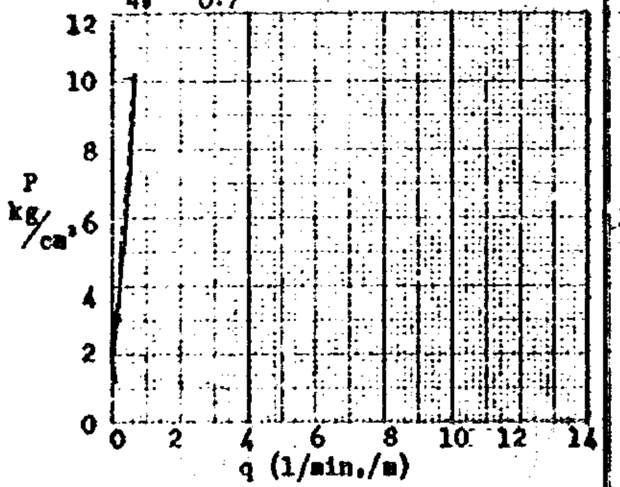
RESULT OF WATER PRESSURE TEST (6)

BOREHOLE NO. BM-3

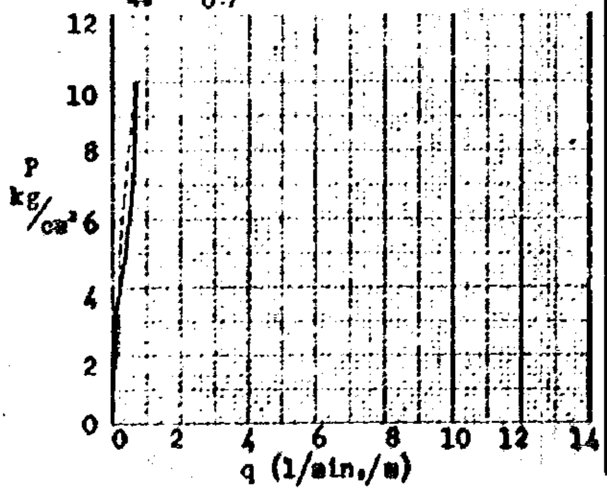
1. DEPTH OF TEST SECTION 40.00-45.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.7



1. 45.00-50.00 m
2. 10.3 kg/cm² 3. – kg/cm²
4. 0.7

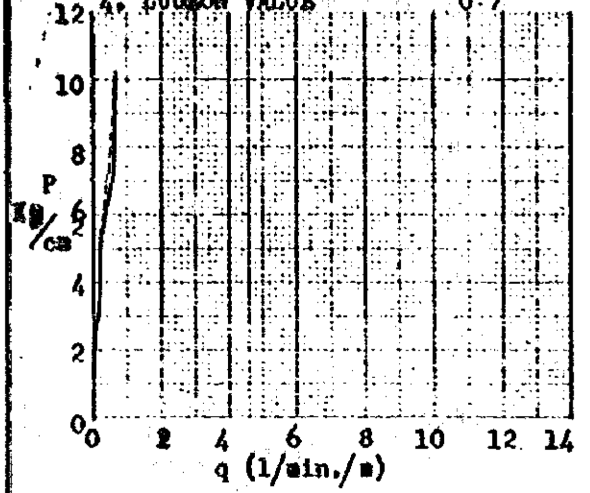


1. 50.00-55.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.7

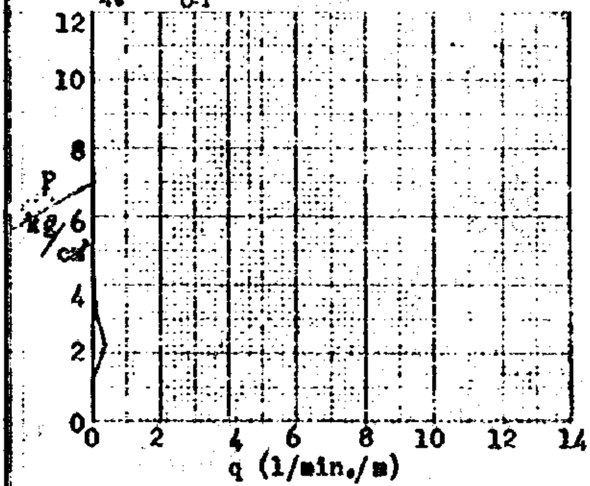


BOREHOLE NO. BM-3

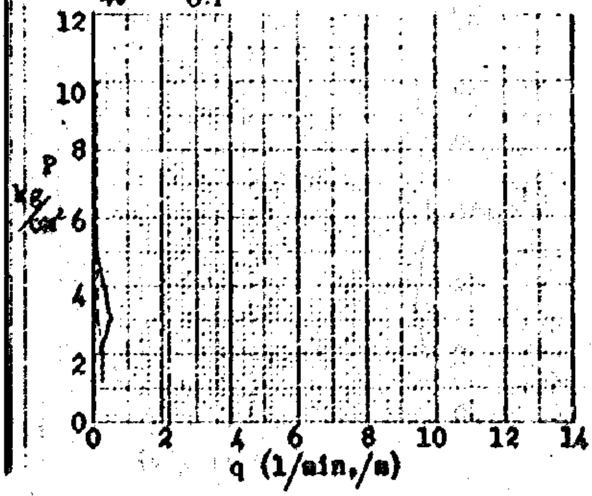
1. DEPTH OF TEST SECTION 55.00-60.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.7



1. 60.00-65.00 m
2. 10.1 kg/cm² 3. – kg/cm²
4. 0.1



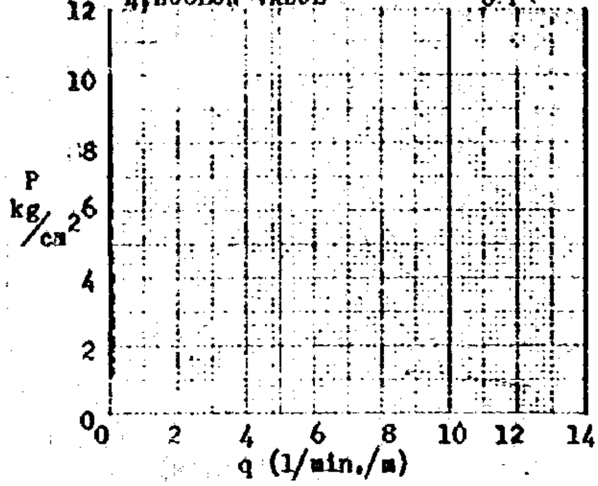
1. 65.00-70.00 m
2. 10.3 kg/cm² 3. – kg/cm²
4. 0.1



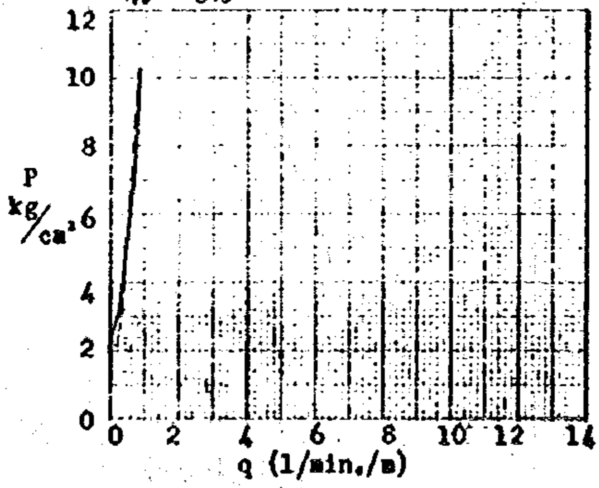
RESULT OF WATER PRESSURE TEST (7)

BOREHOLE NO. BM.3.

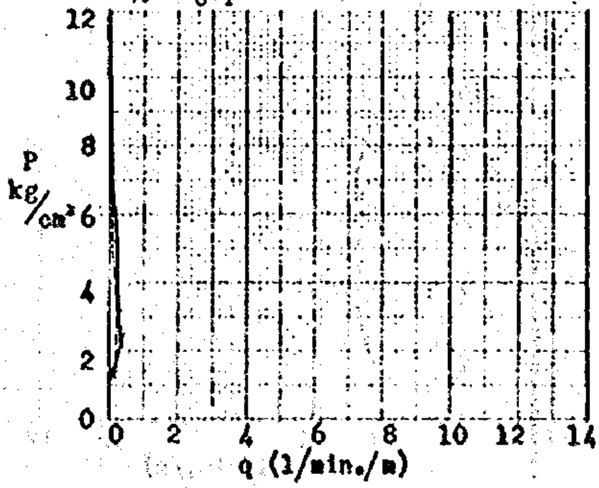
1. DEPTH OF TEST SECTION 70.00-75.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.1



1. 75.00 - 80.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.9

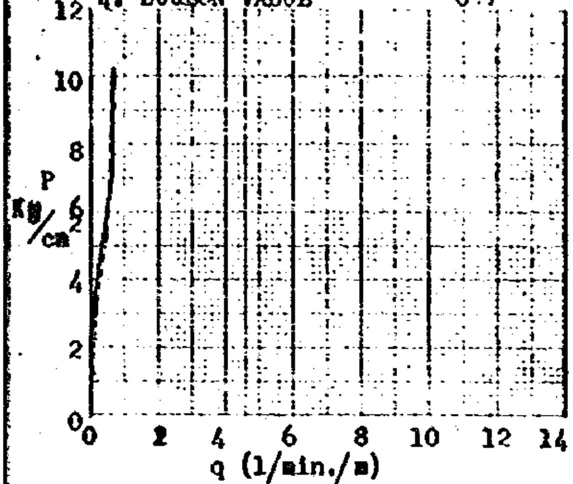


1. 80.00-85.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.1

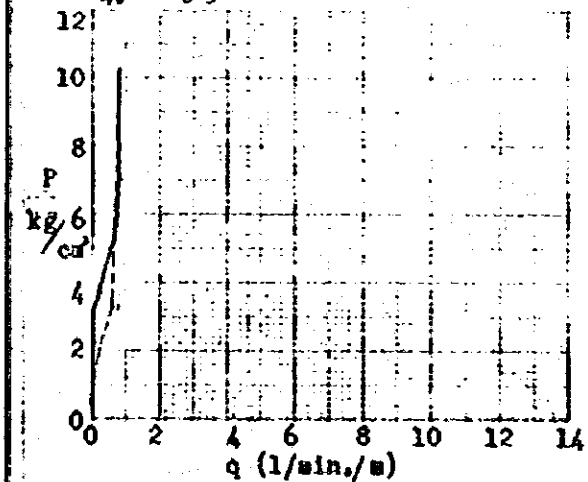


BOREHOLE NO. BM.3.

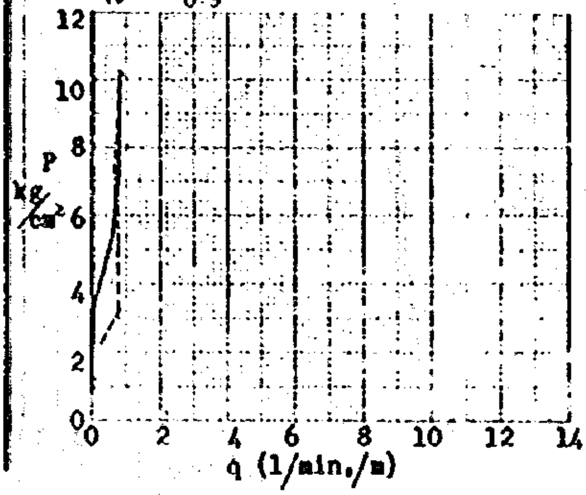
1. DEPTH OF TEST SECTION 85.00-90.00 m
2. MAXIMUM PRESSURE 10.3 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0.7



1. 90.00-95.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.9



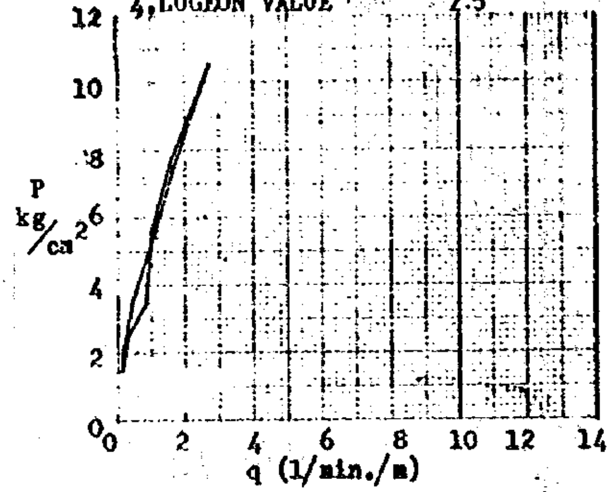
1. 95.00 - 100.00 m
2. 10.2 kg/cm² 3. – kg/cm²
4. 0.9



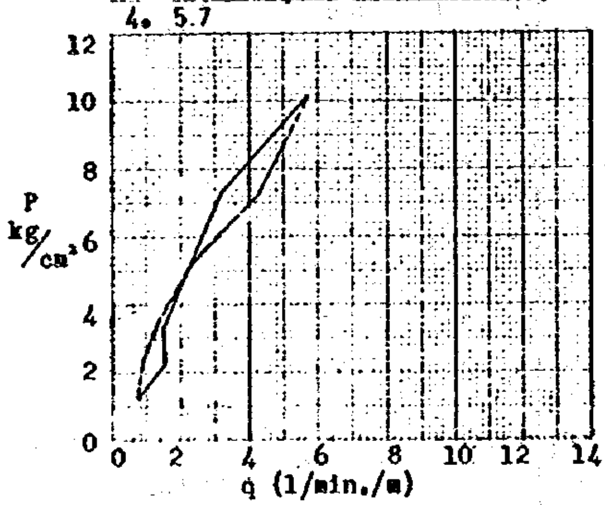
RESULT OF WATER PRESSURE TEST (8)

BOREHOLE NO. BM-4

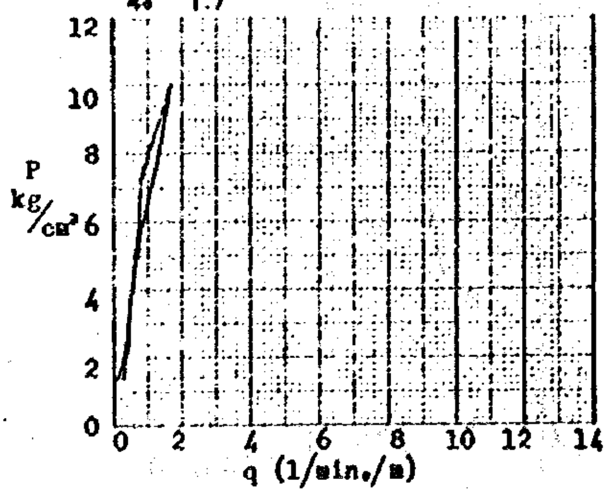
1. DEPTH OF TEST SECTION 10.00-15.00
2. MAXIMUM PRESSURE 10.47 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 2.5



1. 15.00-20.00 m
2. 10.19 kg/cm² 3. — kg/cm²
4. 5.7

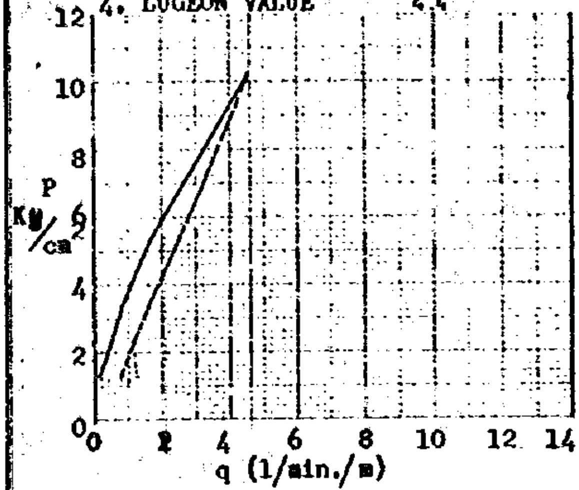


1. 20.00-25.00 m
2. 10.38 kg/cm² 3. — kg/cm²
4. 1.7

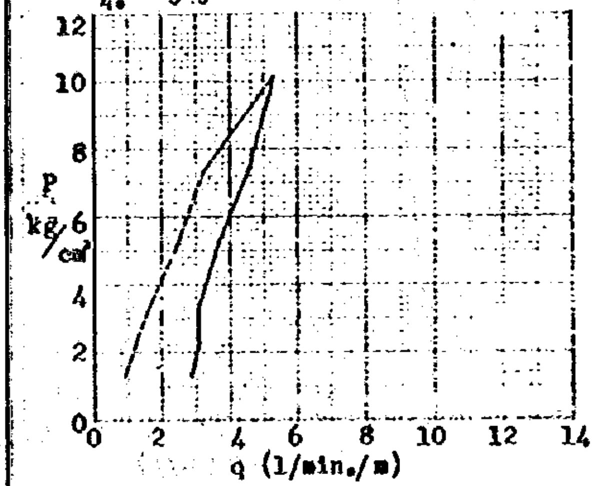


BOREHOLE NO. BM-4

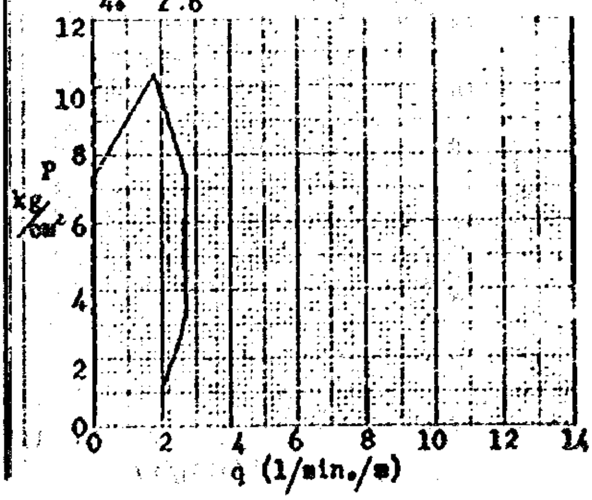
1. DEPTH OF TEST SECTION 25.00-30.00
2. MAXIMUM PRESSURE 10.20 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 4.4



1. 30.00-35.00 m
2. 10.12 kg/cm² 3. — kg/cm²
4. 5.3



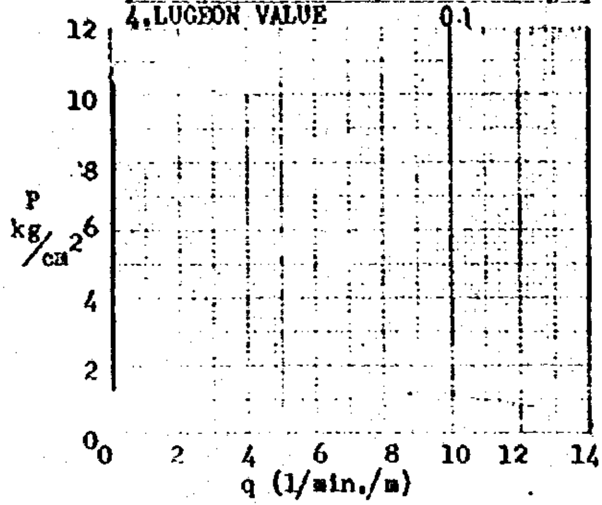
1. 35.00-40.00 m
2. 10.34 kg/cm² 3. — kg/cm²
4. 2.8



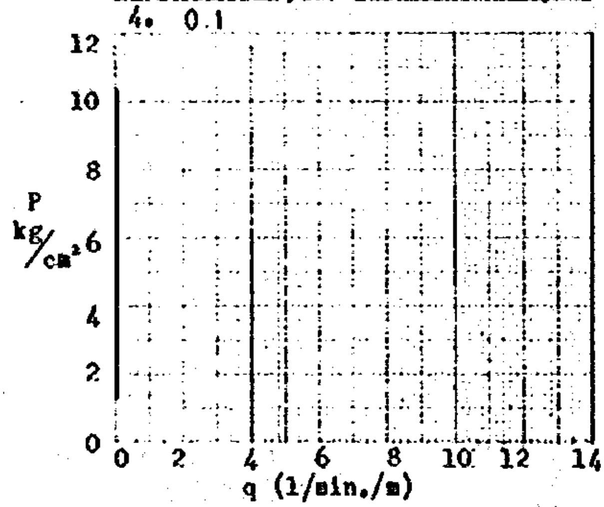
RESULT OF WATER PRESSURE TEST (9)

BOREHOLE NO. BM-4

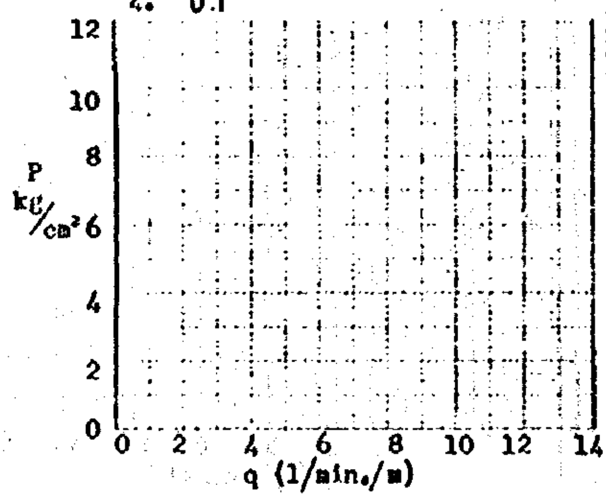
1. DEPTH OF TEST SECTION 40.00-45.00 m
2. MAXIMUM PRESSURE 10.36 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.1



1. 45.00-50.00 m
2. 10.35 kg/cm² 3. — kg/cm²
4. 0.1

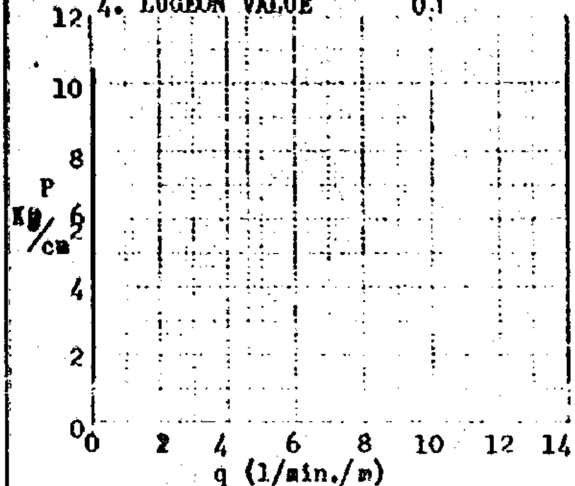


1. 50.00-55.00 m
2. 10.42 kg/cm² 3. — kg/cm²
4. 0.1

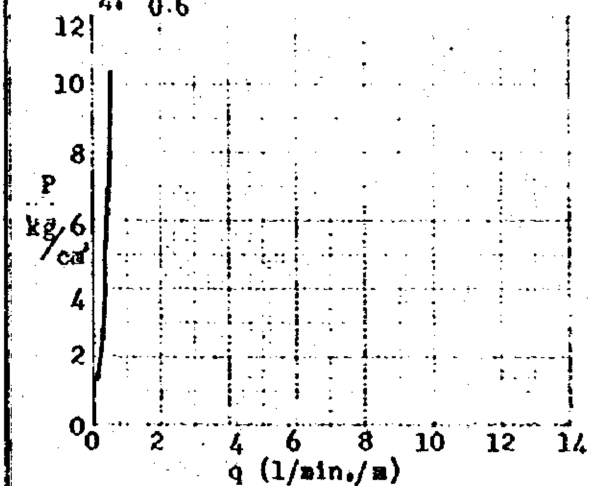


BOREHOLE NO. BM-4

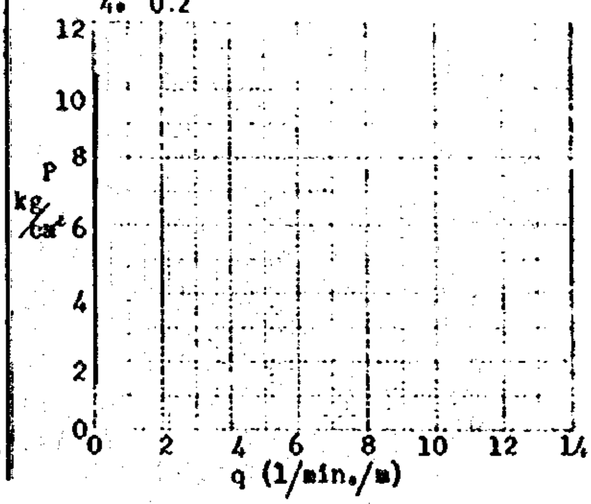
1. DEPTH OF TEST SECTION 55.00-60.00
2. MAXIMUM PRESSURE 10.35 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.1



1. 60.00-65.00 m
2. 10.34 kg/cm² 3. — kg/cm²
4. 0.6



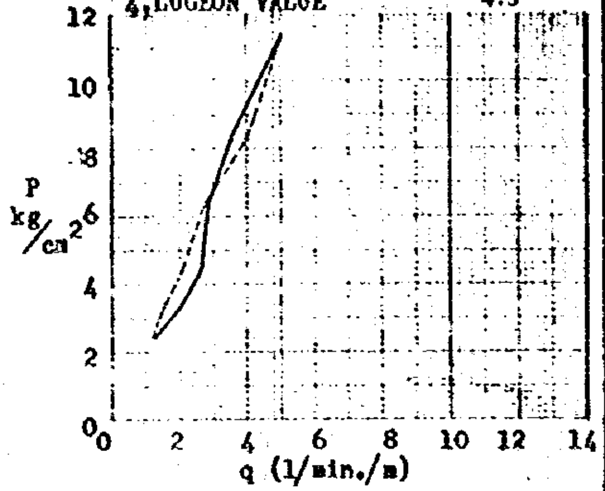
1. 65.00 - 70.00 m
2. 10.40 kg/cm² 3. — kg/cm²
4. 0.2



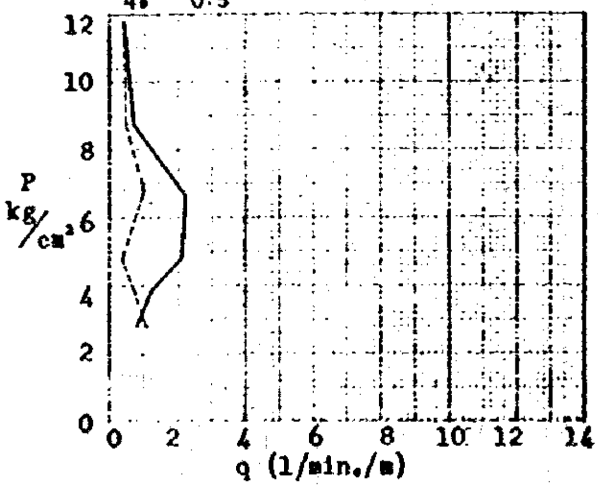
RESULT OF WATER PRESSURE TEST (10)

BOREHOLE NO. BR-1

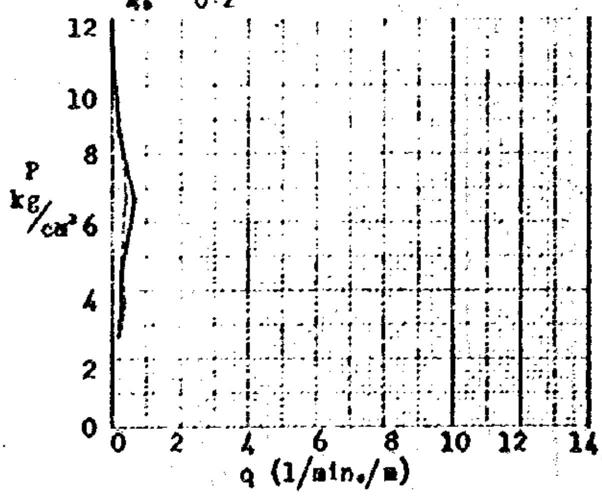
1. DEPTH OF TEST SECTION 15.00-20.00 m
2. MAXIMUM PRESSURE 11.3 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 4.5



1. 20.00-25.00 m
2. 11.8 kg/cm² 3. — kg/cm²
4. 0.5

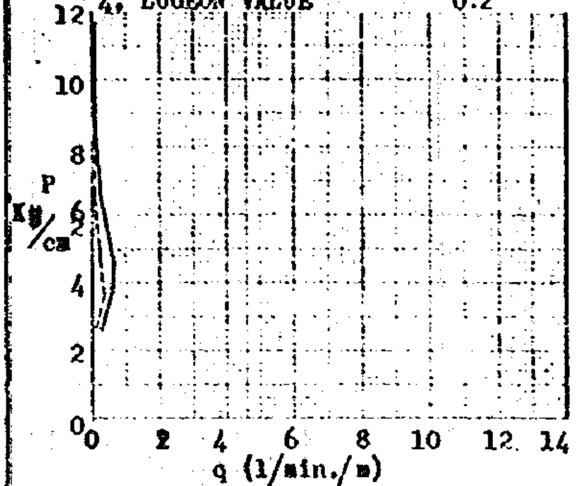


1. 25.00-30.00 m
2. 11.8 kg/cm² 3. — kg/cm²
4. 0.2

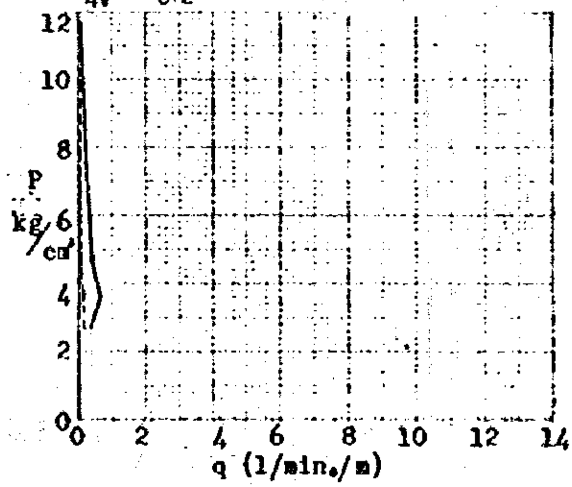


BOREHOLE NO. BR-1

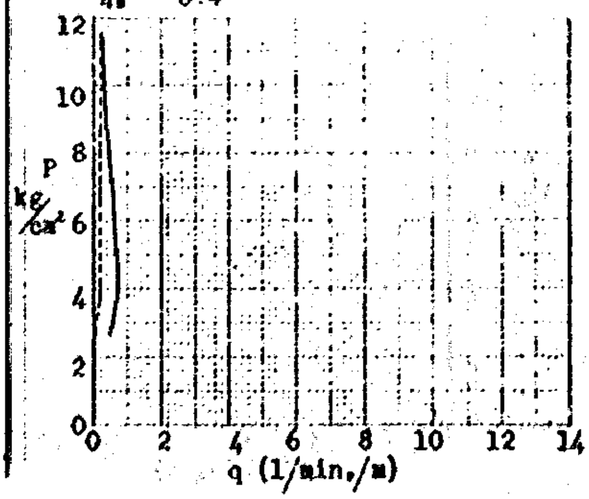
1. DEPTH OF TEST SECTION 30.00-35.00 m
2. MAXIMUM PRESSURE 11.7 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.2



1. 35.00-40.00 m
2. 11.8 kg/cm² 3. — kg/cm²
4. 0.2



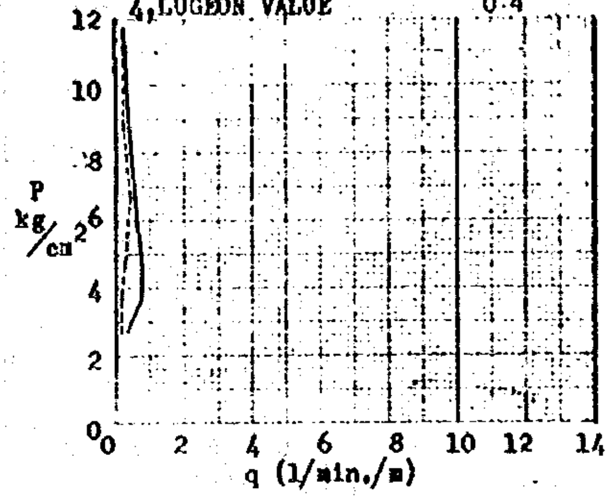
1. 40.00-45.00 m
2. 11.7 kg/cm² 3. kg/cm²
4. 0.4



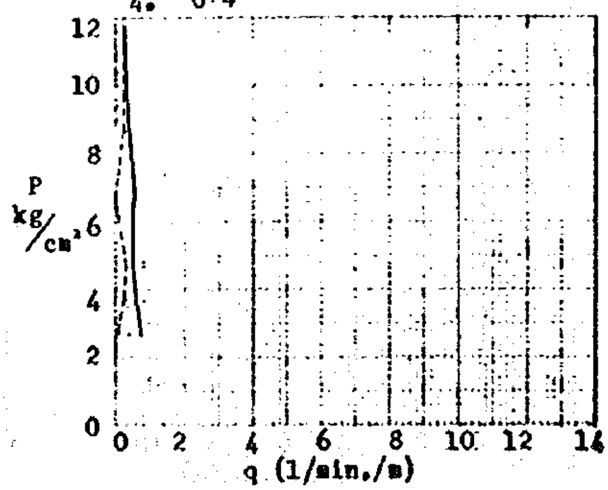
RESULT OF WATER PRESSURE TEST (11)

BOREHOLE NO. BR.1

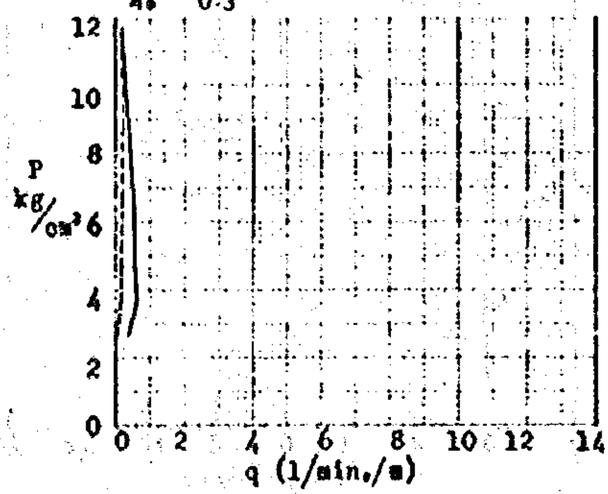
1. DEPTH OF TEST SECTION 45.00-50.00 m
2. MAXIMUM PRESSURE 11.7 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.4



1. 50.00-55.00 m
2. 11.7 kg/cm² 3. — kg/cm²
4. 0.4

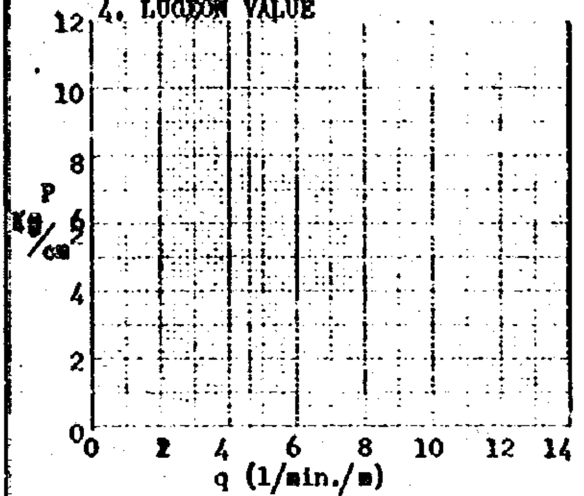


1. 55.00-60.00 m
2. 11.7 kg/cm² 3. — kg/cm²
4. 0.3

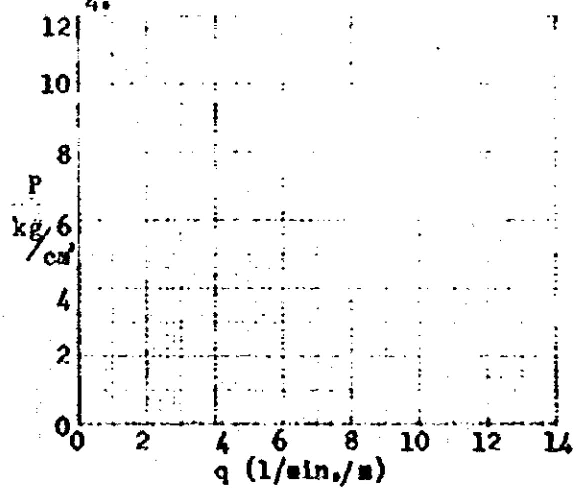


BOREHOLE NO.

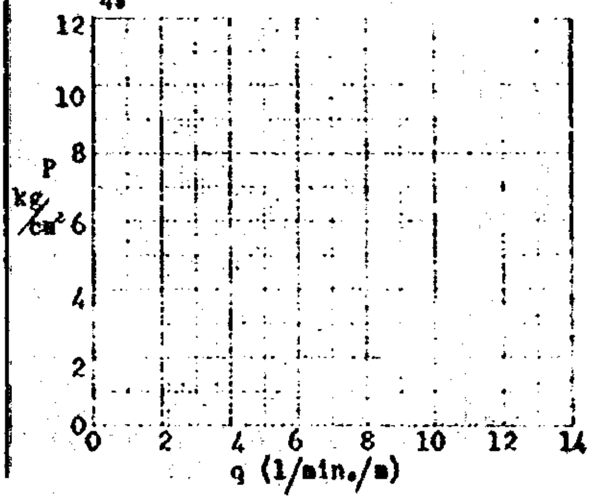
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



1. m
2. kg/cm² 3. kg/cm²
4.



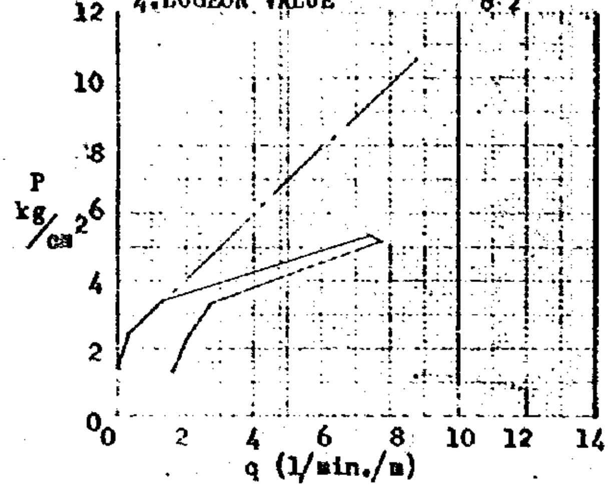
1. m
2. kg/cm² 3. kg/cm²
4.



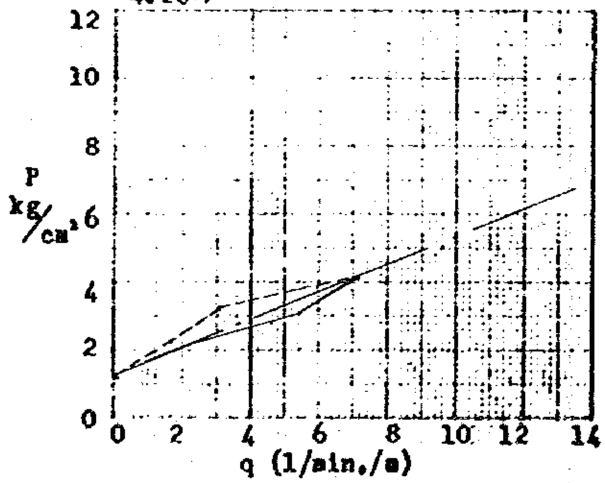
RESULT OF WATER PRESSURE TEST (12)

BOREHOLE NO. BR-2

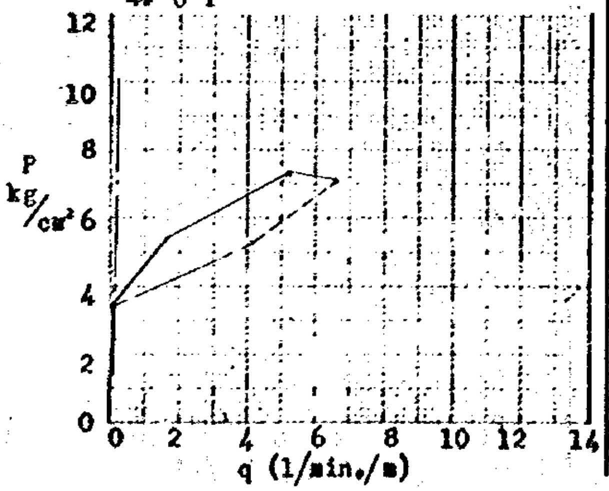
1. DEPTH OF TEST SECTION 10.25-15.00 m
2. MAXIMUM PRESSURE 5.2 kg/cm²
3. CRITICAL PRESSURE 3.4 kg/cm²
4. LUGEON VALUE 8.2



1. 15.80-20.00 m
2. 4.1 kg/cm² 3. — kg/cm²
4. 20.7

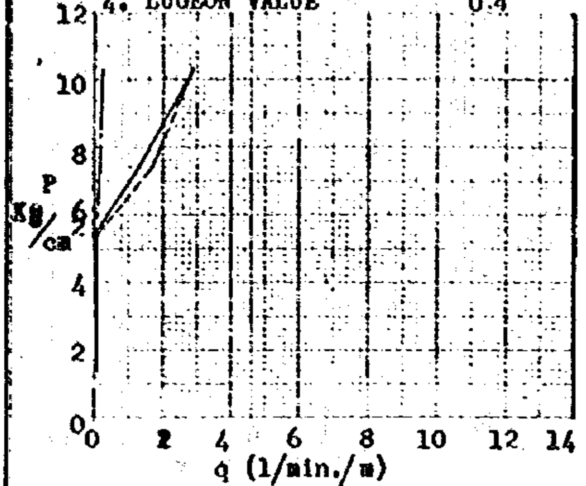


1. 20.00 - 25.00 m
2. 7.3 kg/cm² 3. 3.5 kg/cm²
4. 0.1

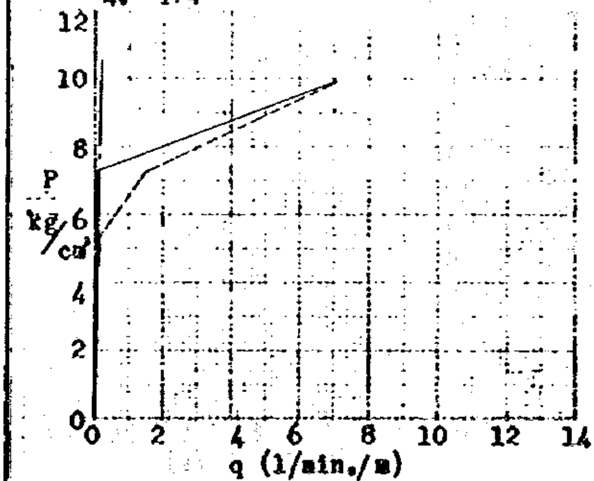


BOREHOLE NO. BR-2

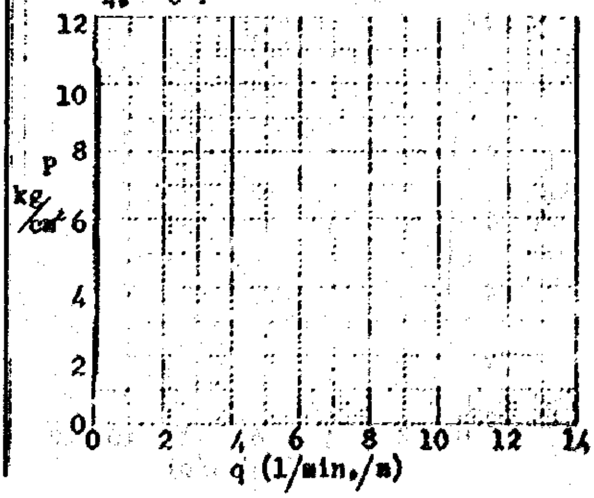
1. DEPTH OF TEST SECTION 25.00-30.00
2. MAXIMUM PRESSURE 10.4 kg/cm²
3. CRITICAL PRESSURE 5.4 kg/cm²
4. LUGEON VALUE 0.4



1. 30.00 - 35.00 m
2. 10.0 kg/cm² 3. 7.4 kg/cm²
4. 1.4



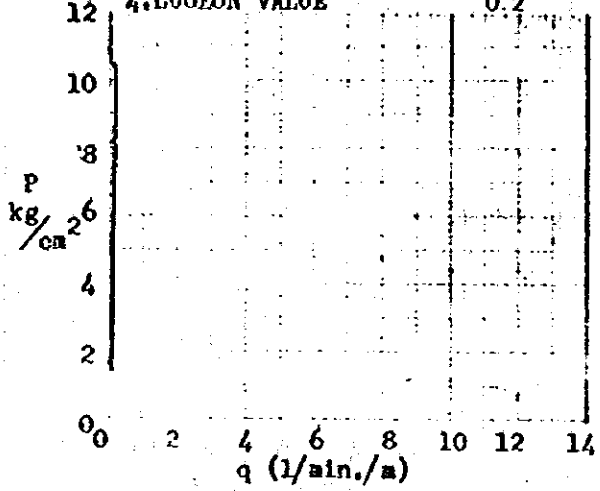
1. 35.00 - 40.00 m
2. 10.5 kg/cm² 3. — kg/cm²
4. 0.1



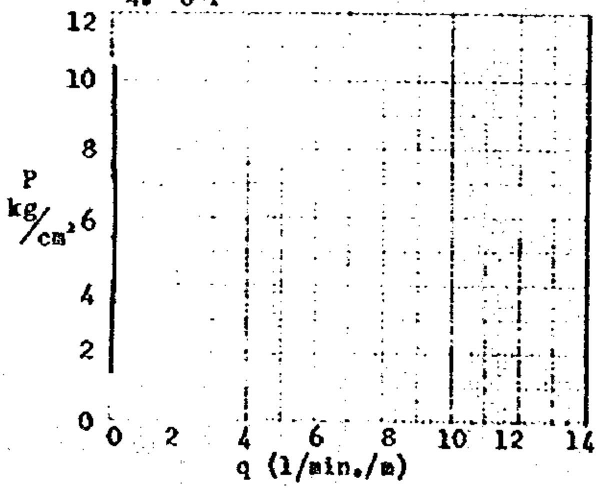
RESULT OF WATER PRESSURE TEST (13)

BOREHOLE NO. BR-2

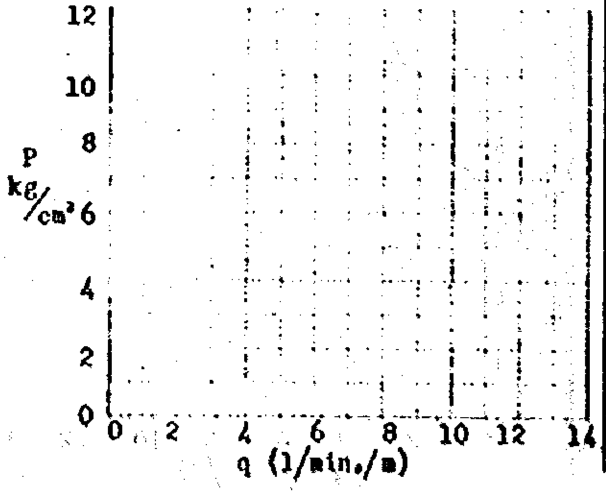
1. DEPTH OF TEST SECTION 40.00-45.00
2. MAXIMUM PRESSURE 10.4 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.2



1. 45.00 - 50.00 m
2. 10.4 kg/cm² 3. — kg/cm²
4. 0.1

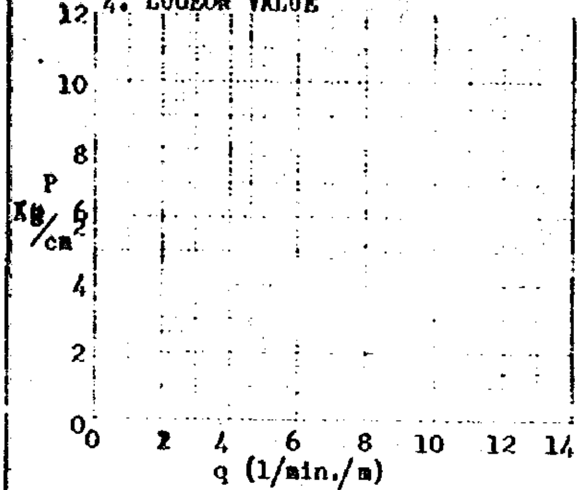


1. m
2. kg/cm² 3. kg/cm²
4.

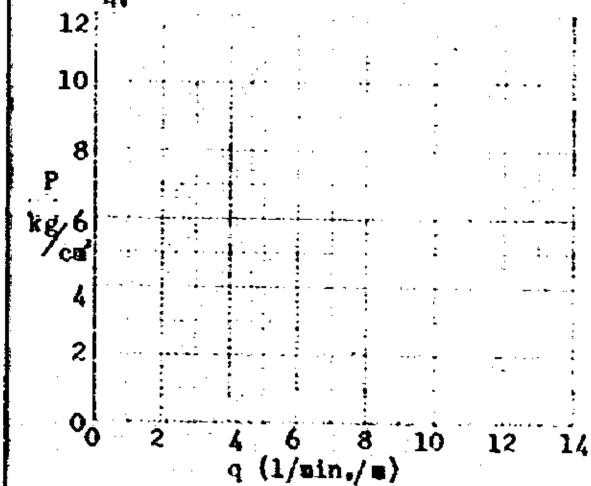


BOREHOLE NO.

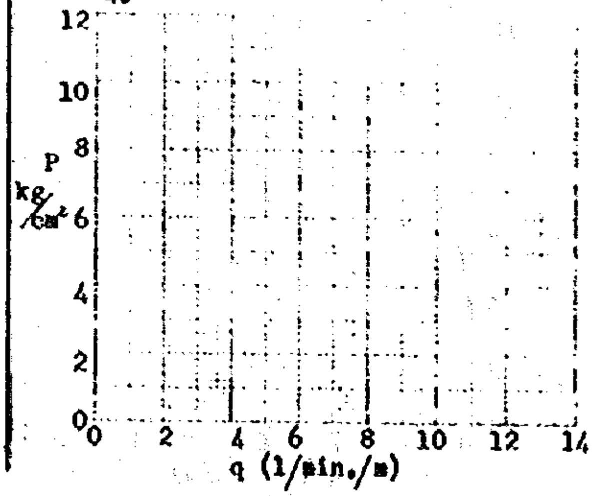
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



1. m
2. kg/cm² 3. kg/cm²
4.



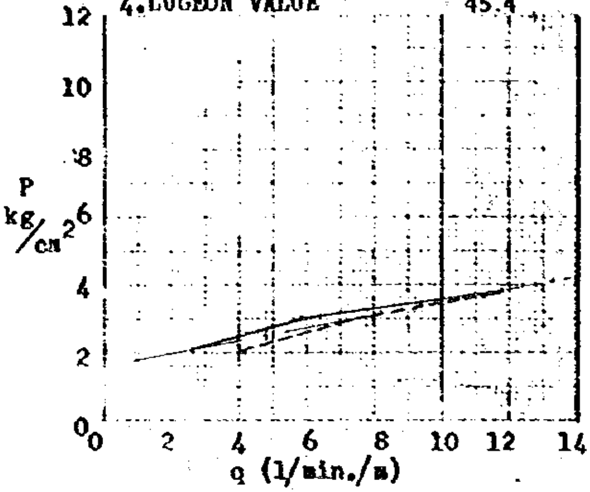
1. m
2. kg/cm² 3. kg/cm²
4.



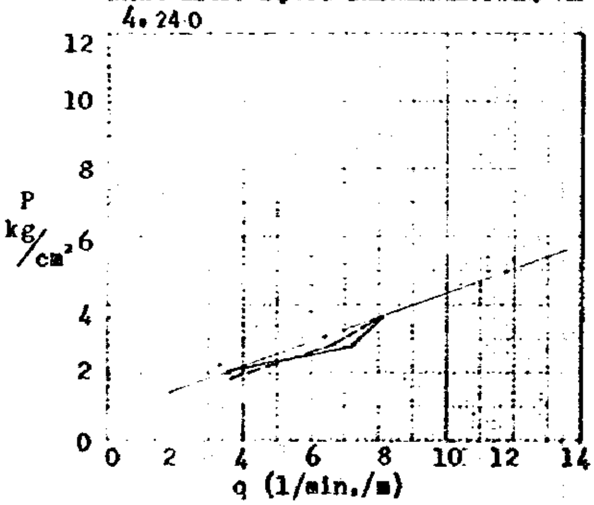
RESULT OF WATER PRESSURE TEST (14)

BOREHOLE NO. BR.3

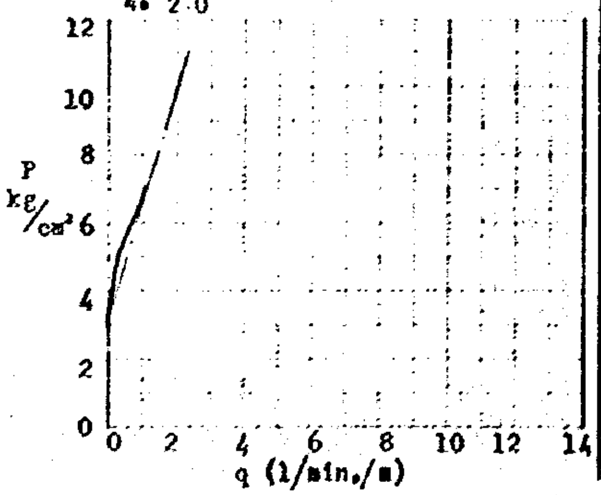
1. DEPTH OF TEST SECTION 11^{00}-15^{00} m
2. MAXIMUM PRESSURE 3.81 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 45.4



1. 15^{00}-20^{00} m
2. 3.75 kg/cm² 3. — kg/cm²
4. 24.0

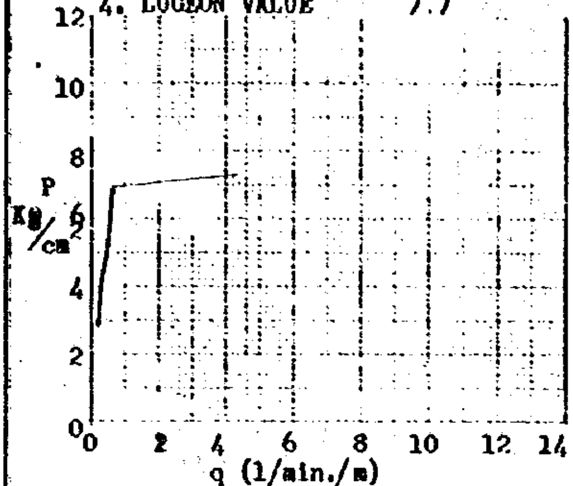


1. 25^{00}-30^{00} m
2. 5.01 kg/cm² 3. kg/cm²
4. 2.0

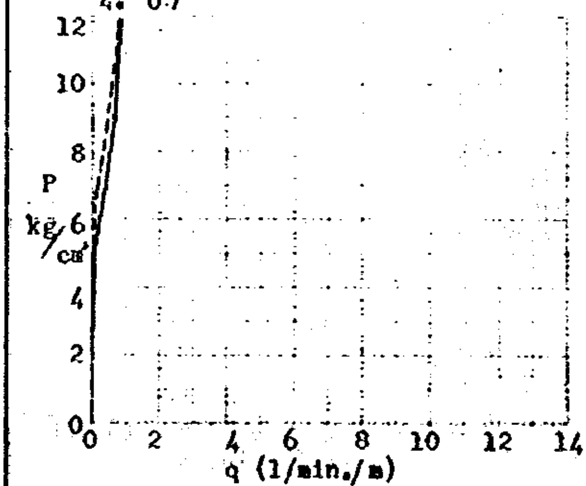


BOREHOLE NO. BR.3

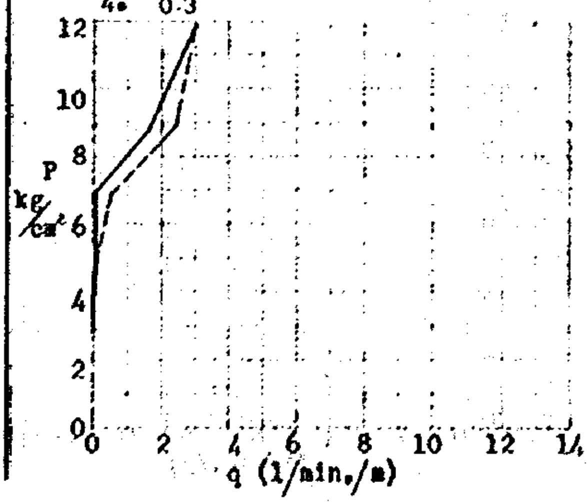
1. DEPTH OF TEST SECTION 30^{00}-35^{00} m
2. MAXIMUM PRESSURE 6.98 kg/cm²
3. CRITICAL PRESSURE 6.98 kg/cm²
4. LUGEON VALUE 1.1



1. 35^{00}-40^{00} m
2. 11.85 kg/cm² 3. — kg/cm²
4. 0.7



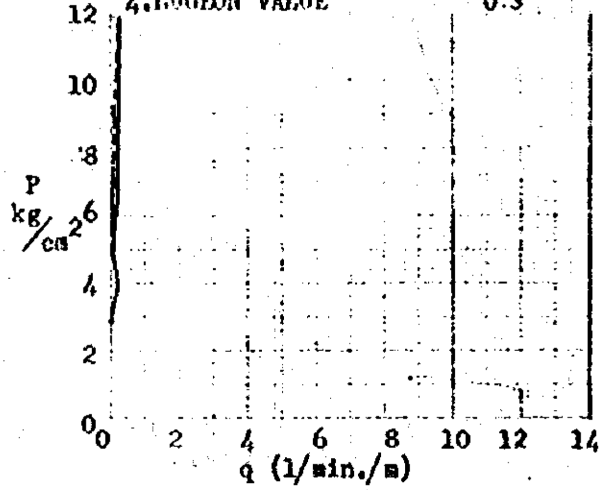
1. 40^{00}-45^{00} m
2. 11.82 kg/cm² 3. 6.92 kg/cm²
4. 0.3



RESULT OF WATER PRESSURE TEST (15)

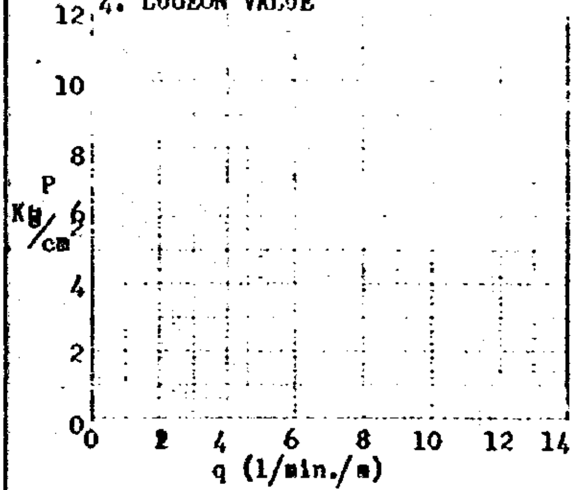
BOREHOLE NO. BR 3

1. DEPTH OF TEST SECTION 43.00-50.00
2. MAXIMUM PRESSURE 11.92 kg/cm²
3. CRITICAL PRESSURE -- kg/cm²
4. LUGEON VALUE 0.3

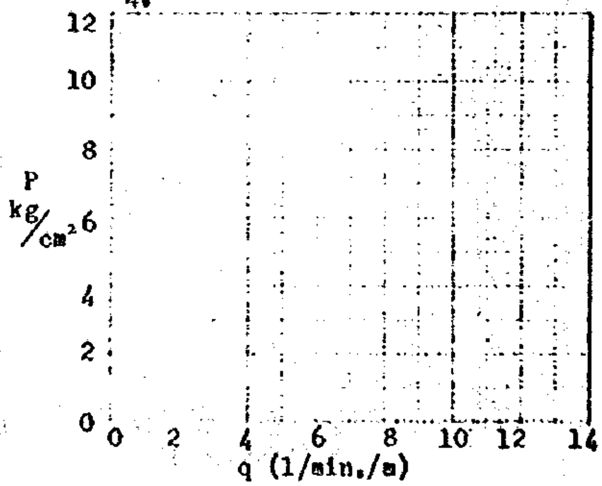


BOREHOLE NO.

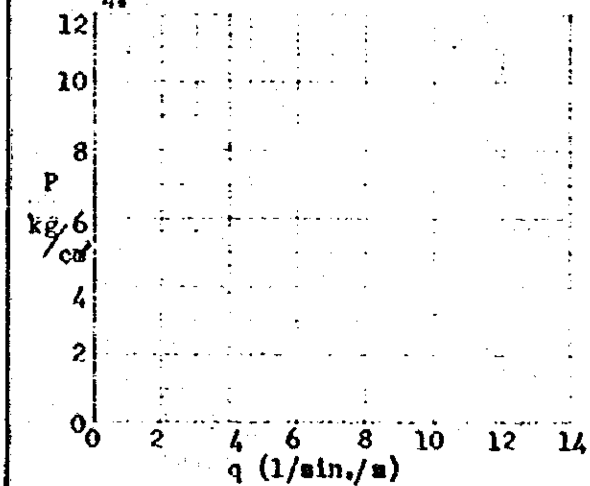
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



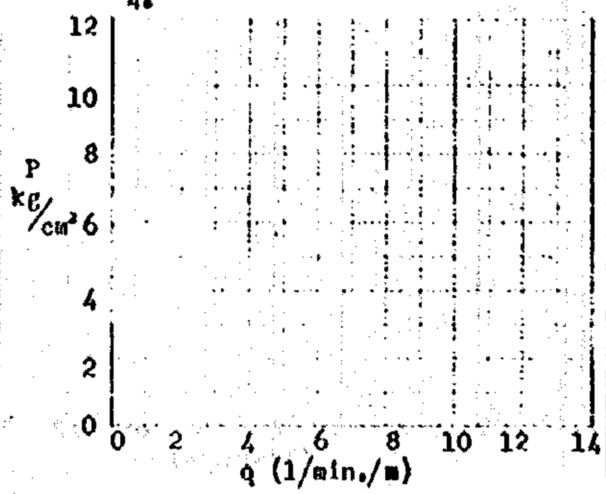
1. m
2. kg/cm² 3. kg/cm²
4.



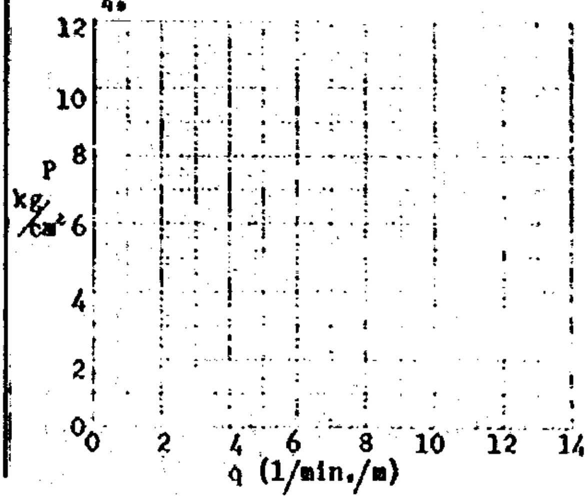
1. m
2. kg/cm² 3. kg/cm²
4.



1. m
2. kg/cm² 3. kg/cm²
4.



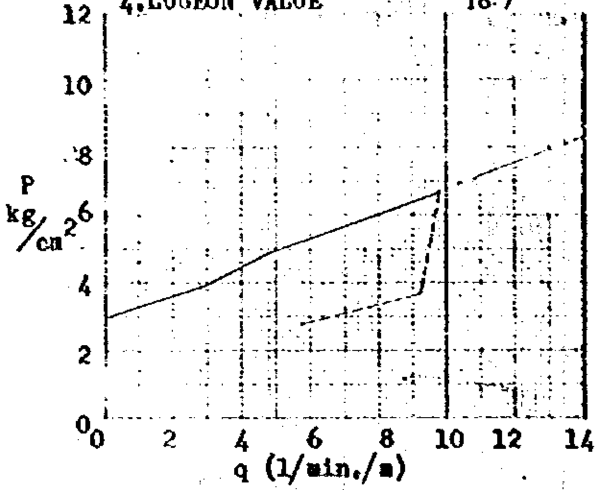
1. m
2. kg/cm² 3. kg/cm²
4.



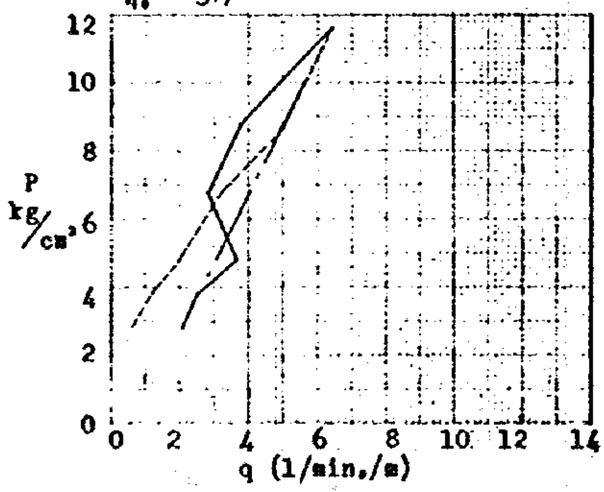
RESULT OF WATER PRESSURE TEST (16)

BOREHOLE NO. BG-1

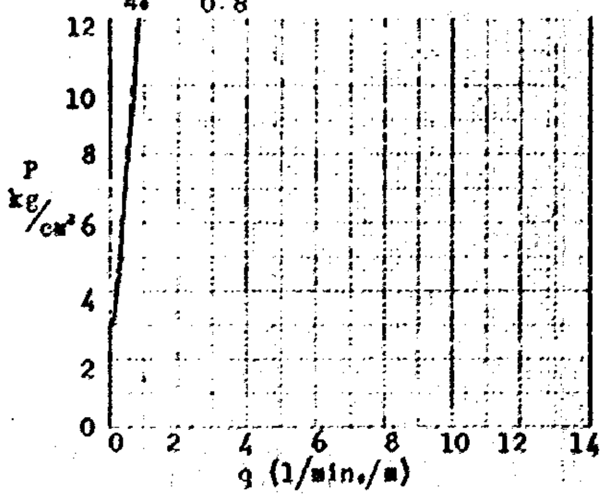
1. DEPTH OF TEST SECTION 16.00-20.00 m
2. MAXIMUM PRESSURE 6.7 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 16.7



1. 20.00-25.00 m
2. 11.7 kg/cm² 3. – kg/cm²
4. 5.7

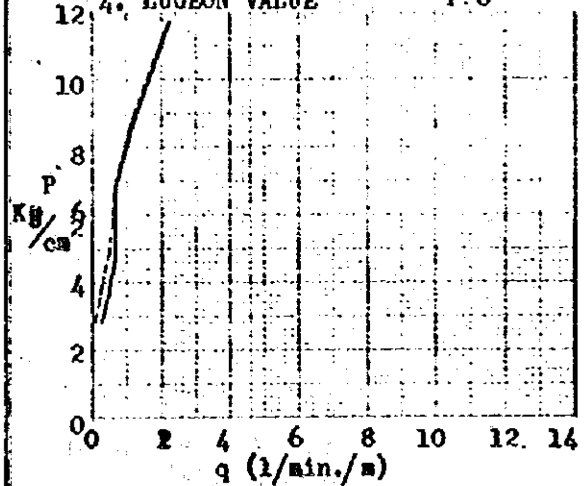


1. 25.00-30.00 m
2. 12.0 kg/cm² 3. – kg/cm²
4. 0.8

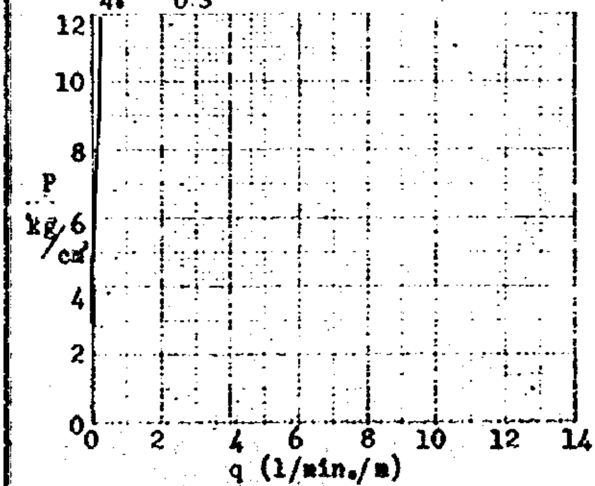


BOREHOLE NO. BG-1

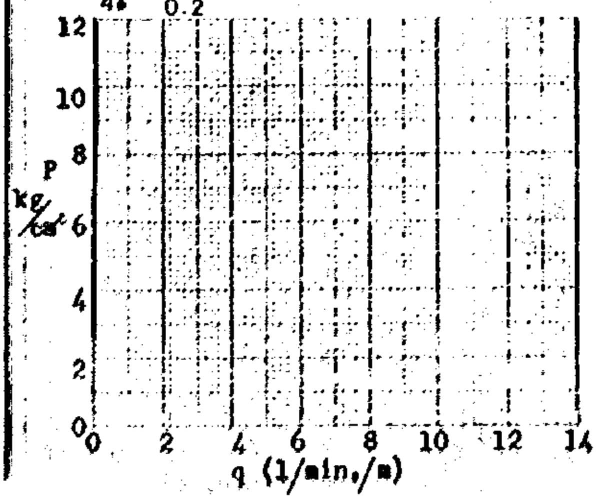
1. DEPTH OF TEST SECTION 30.00-35.00 m
2. MAXIMUM PRESSURE 11.8 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 1.8



1. 35.00-40.00 m
2. 11.9 kg/cm² 3. – kg/cm²
4. 0.3



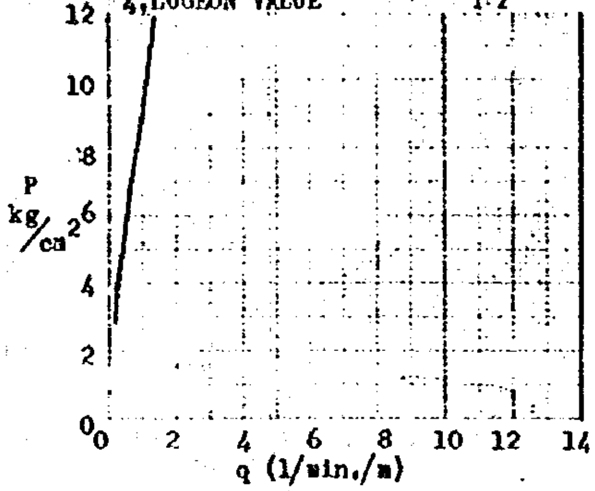
1. 40.00-45.00 m
2. 11.9 kg/cm² 3. – kg/cm²
4. 0.2



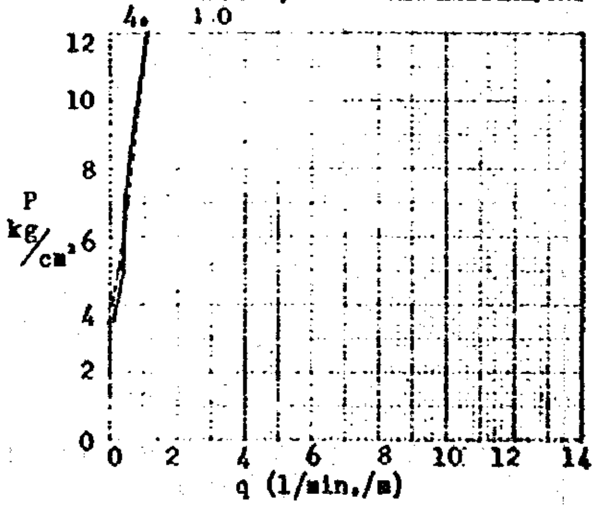
RESULT OF WATER PRESSURE TEST (17)

BOREHOLE NO.BG.1

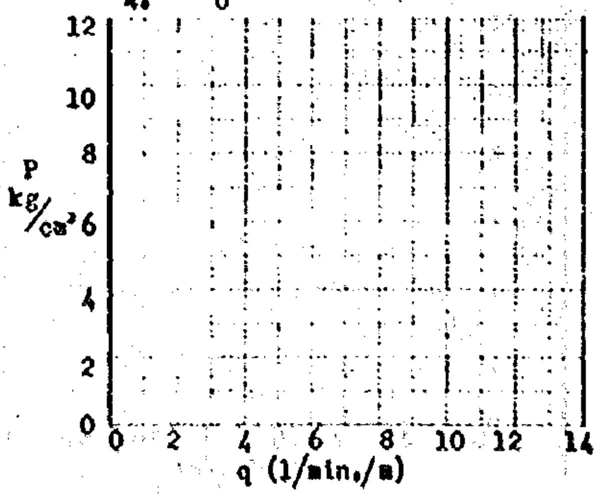
1. DEPTH OF TEST SECTION 45.00-50.00 m
2. MAXIMUM PRESSURE 12.0 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 1.2



1. 50.00-55.00 m
2. 12.0 kg/cm² 3. – kg/cm²
4. 1.0

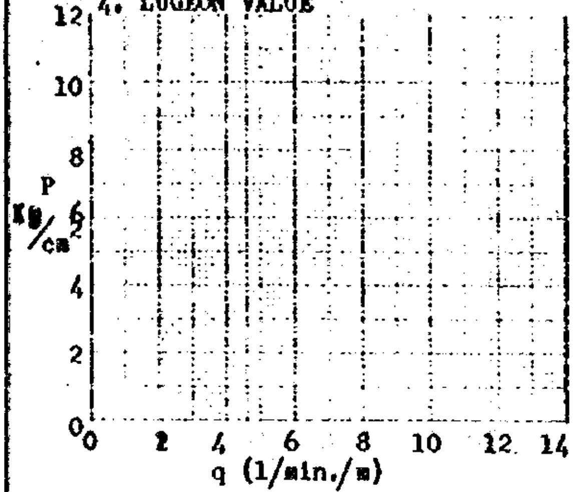


1. 55.00-60.00 m
2. 12.0 kg/cm² 3. – kg/cm²
4. 0

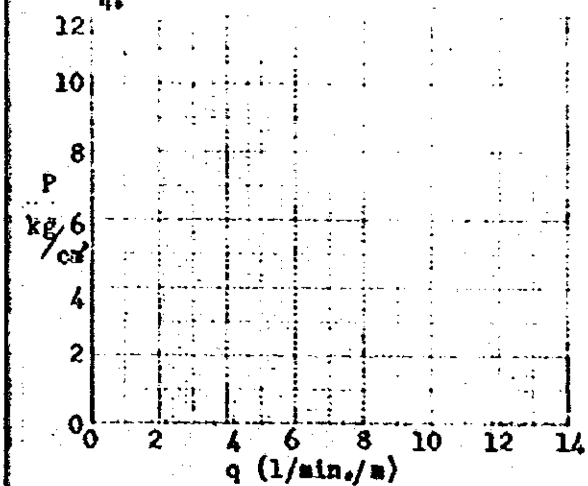


BOREHOLE NO.

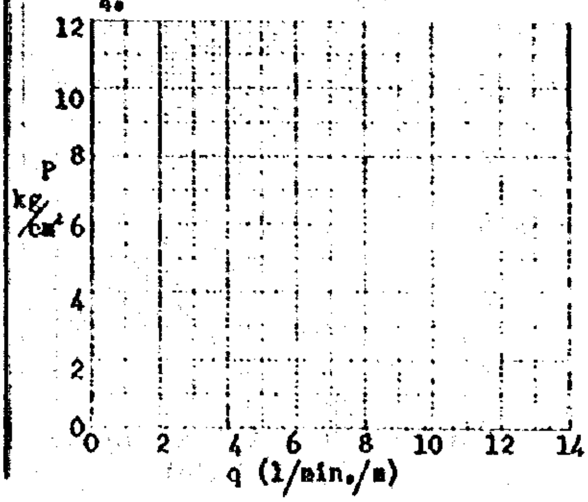
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



1. m
2. kg/cm² 3. kg/cm²
4.



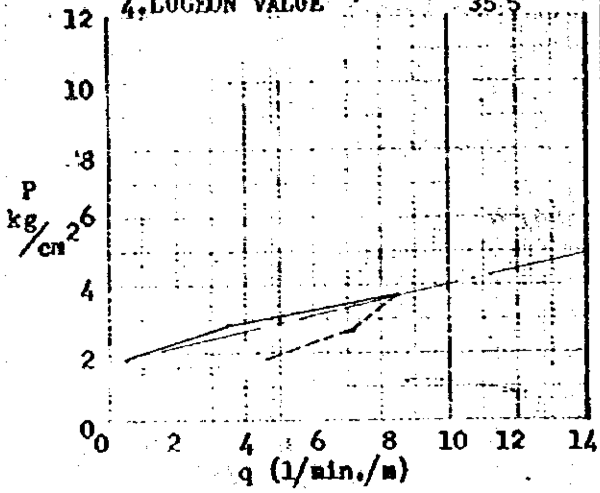
1. m
2. kg/cm² 3. kg/cm²
4.



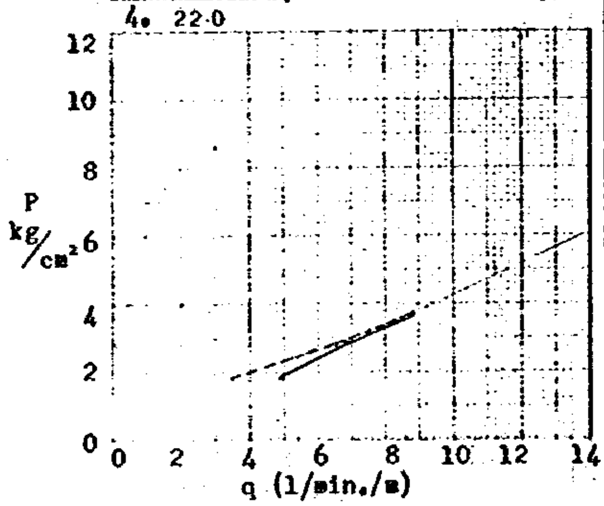
RESULT OF WATER PRESSURE TEST (18)

BOREHOLE NO. BL-1

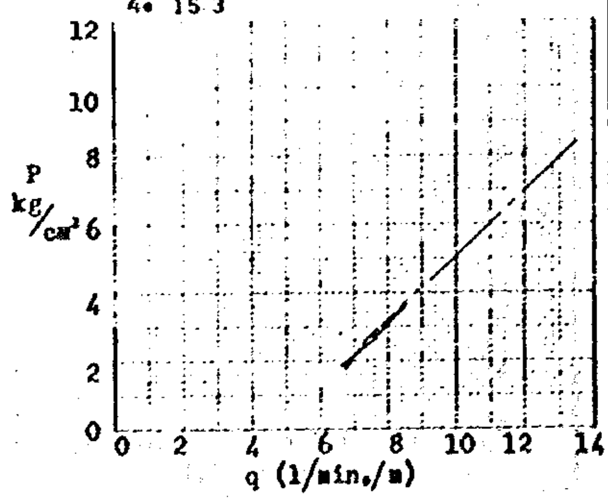
1. DEPTH OF TEST SECTION 8.00 - 10.00 m
2. MAXIMUM PRESSURE 3.8 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 35.5



1. 10.00 - 15.00 m
2. 3.8 kg/cm² 3. – kg/cm²
4. 22.0

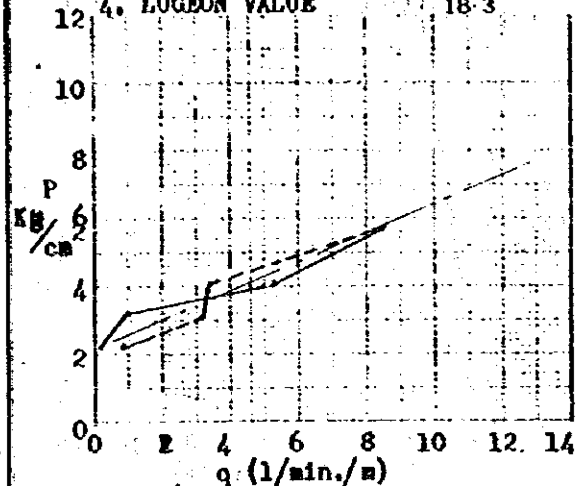


1. 15.00 - 20.00 m
2. 3.7 kg/cm² 3. – kg/cm²
4. 15.3

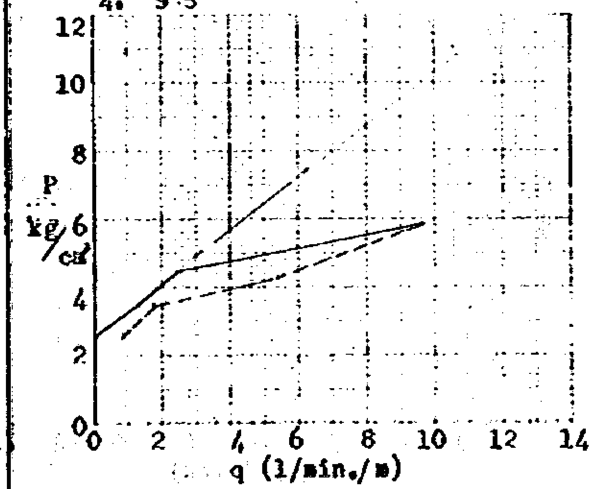


BOREHOLE NO. BL-1

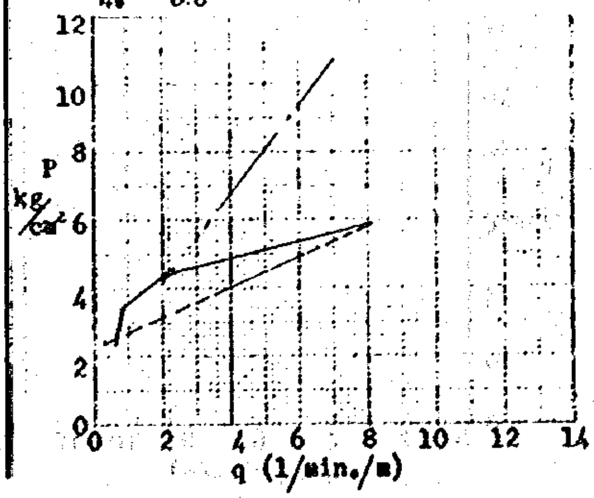
1. DEPTH OF TEST SECTION 20.00 - 25.00 m
2. MAXIMUM PRESSURE 5.8 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 18.3



1. 25.00 - 30.00 m
2. 5.9 kg/cm² 3. 4.6 kg/cm²
4. 9.5



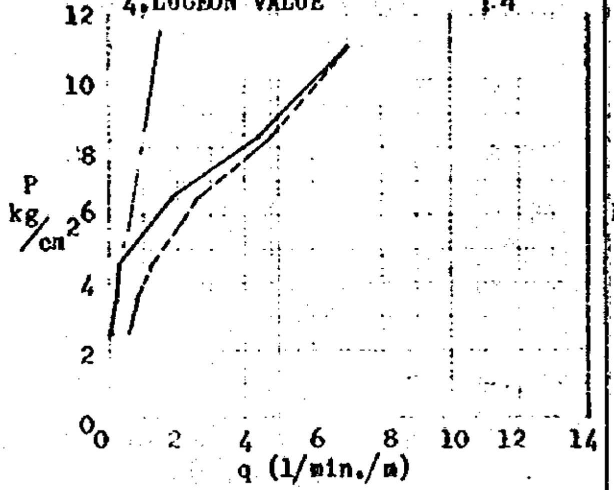
1. 30.00 - 35.00 m
2. 6.0 kg/cm² 3. 4.5 kg/cm²
4. 6.6



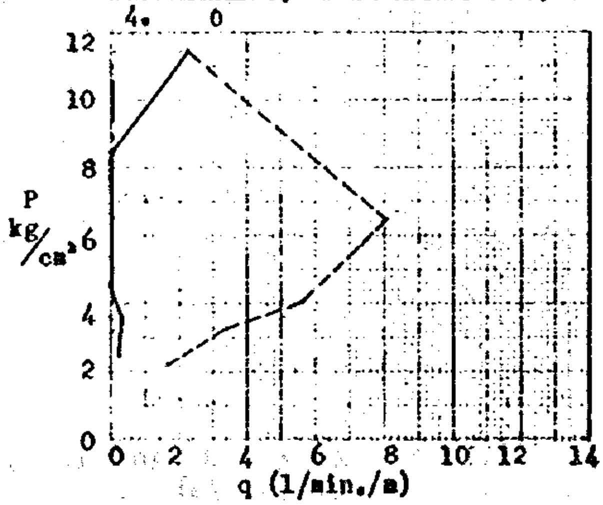
RESULT OF WATER PRESSURE TEST (19)

BOREHOLE NO. BL-1

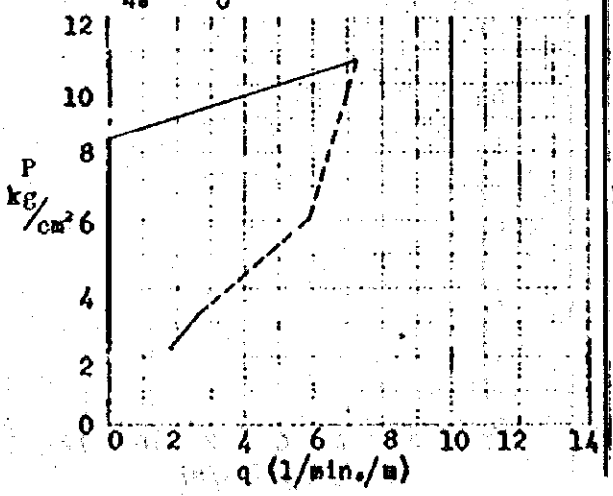
1. DEPTH OF TEST SECTION 35.00-40.00 m
2. MAXIMUM PRESSURE 11.1 kg/cm²
3. CRITICAL PRESSURE 4.6 kg/cm²
4. LUGEON VALUE 1.4



1. 40.00-45.00 m
2. 11.5 kg/cm² 3. 8.6 kg/cm²
4. 0

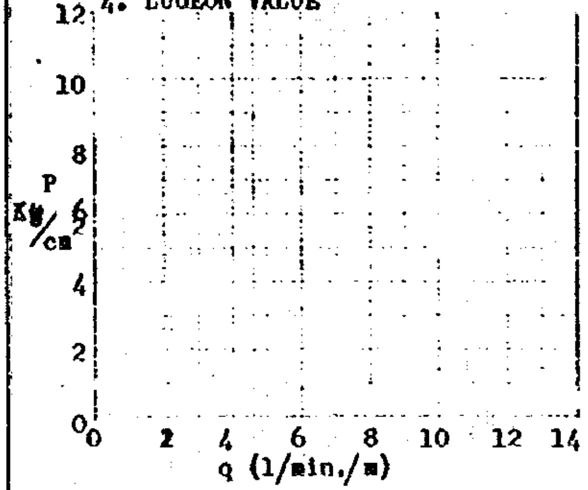


1. 45.00-50.00 m
2. 10.8 kg/cm² 3. 8.4 kg/cm²
4. 0

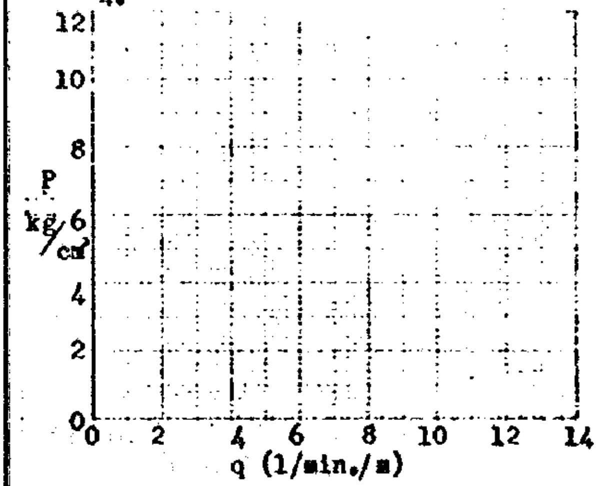


BOREHOLE NO.

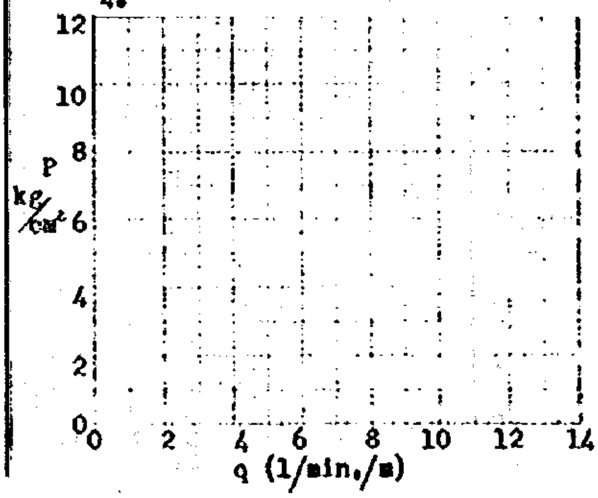
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



1. m
2. kg/cm² 3. kg/cm²
4.



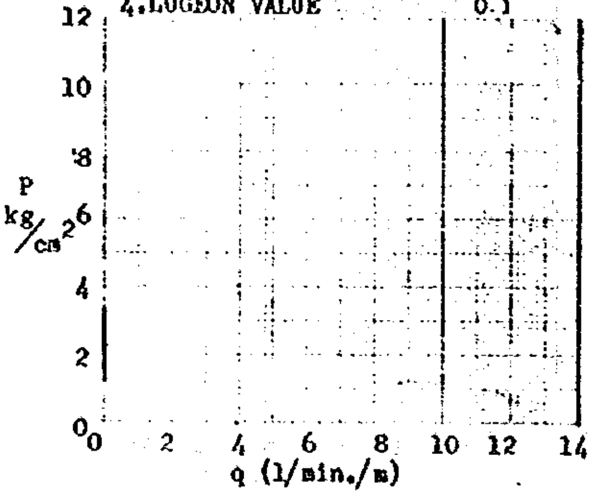
1. m
2. kg/cm² 3. kg/cm²
4.



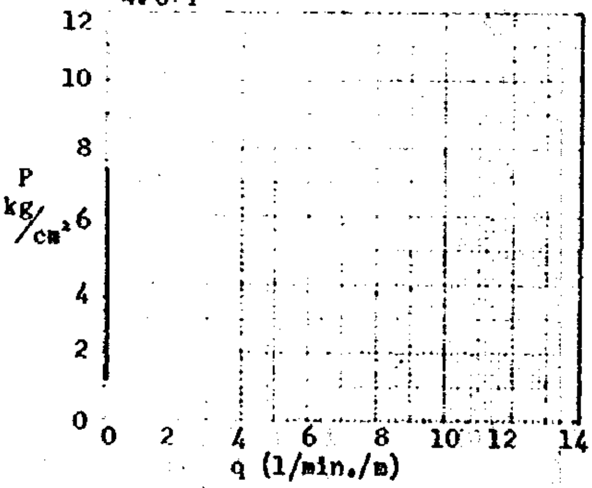
RESULT OF WATER PRESSURE TEST (20)

BOREHOLE NO. BL - 2

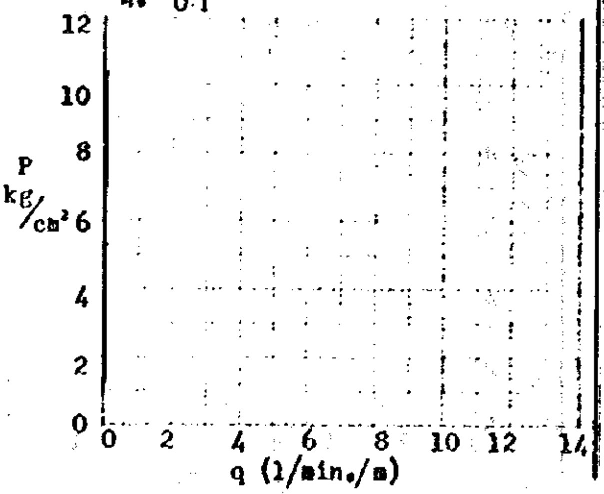
1. DEPTH OF TEST SECTION 2.00-5.00
2. MAXIMUM PRESSURE 3.4 kg/cm²
3. CRITICAL PRESSURE — kg/cm²
4. LUGEON VALUE 0.1



1. 5.00 - 10.00 m
2. 7.4 kg/cm² 3. — kg/cm²
4. 0.1

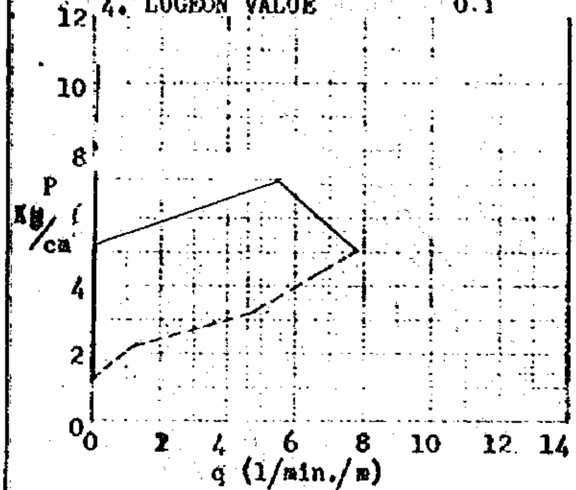


1. 10.00 - 15.00 m
2. 10.3 kg/cm² 3. — kg/cm²
4. 0.1

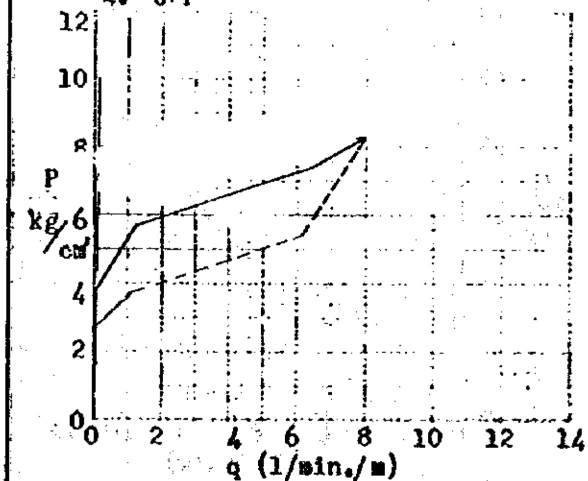


BOREHOLE NO. BL - 2

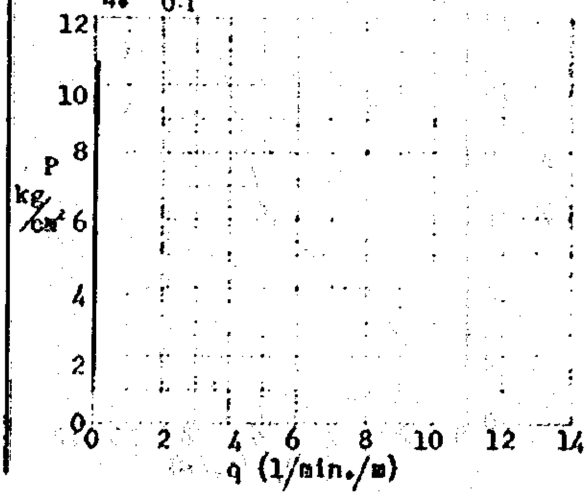
1. DEPTH OF TEST SECTION 15.00-20.00m
2. MAXIMUM PRESSURE 7.2 kg/cm²
3. CRITICAL PRESSURE 5.3 kg/cm²
4. LUGEON VALUE 0.1



1. 20.00 - 25.00 m
2. 8.3 kg/cm² 3. 3.7 kg/cm²
4. 0.1



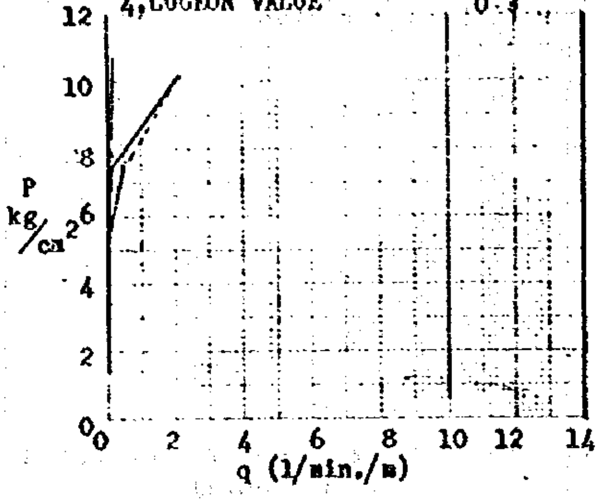
1. 25.00 - 30.00 m
2. 10.7 kg/cm² 3. — kg/cm²
4. 0.1



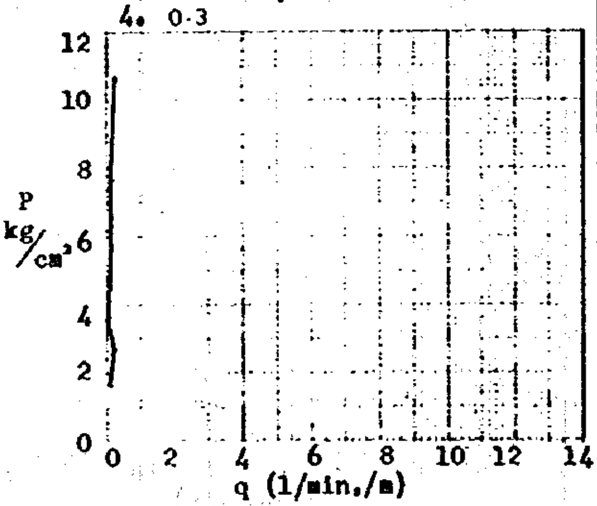
RESULT OF WATER PRESSURE TEST (21)

BOREHOLE NO. BL-2

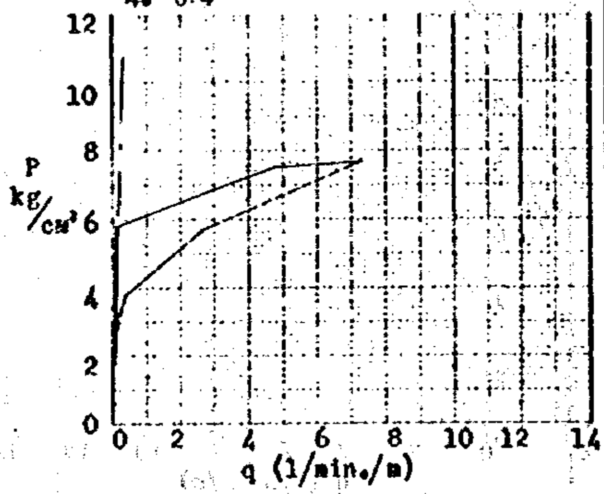
1. DEPTH OF TEST SECTION 30.00-35.00m
2. MAXIMUM PRESSURE 10.4 kg/cm²
3. CRITICAL PRESSURE 7.4 kg/cm²
4. LUGEON VALUE 0.3



1. 35.00 - 40.00 m
2. 10.8 kg/cm² 3. - kg/cm²
4. 0.3

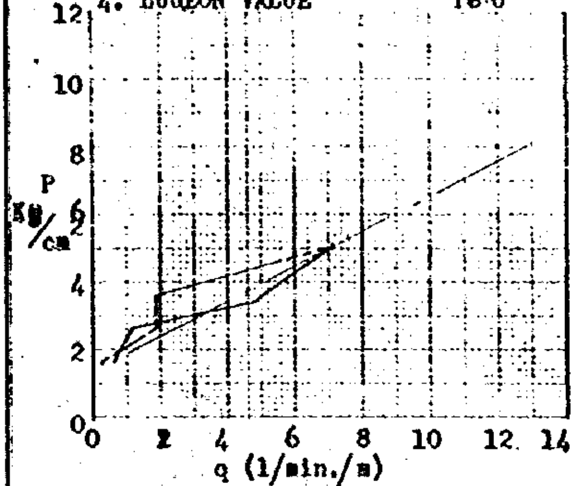


1. 40.00 - 45.00 m
2. 7.8 kg/cm² 3. 5.9 kg/cm²
4. 0.4

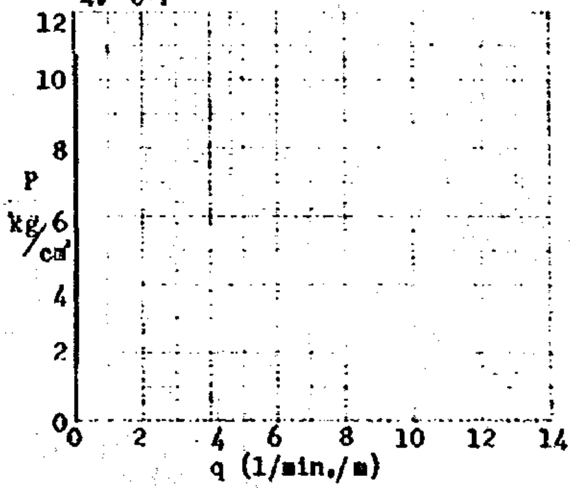


BOREHOLE NO. BL-2

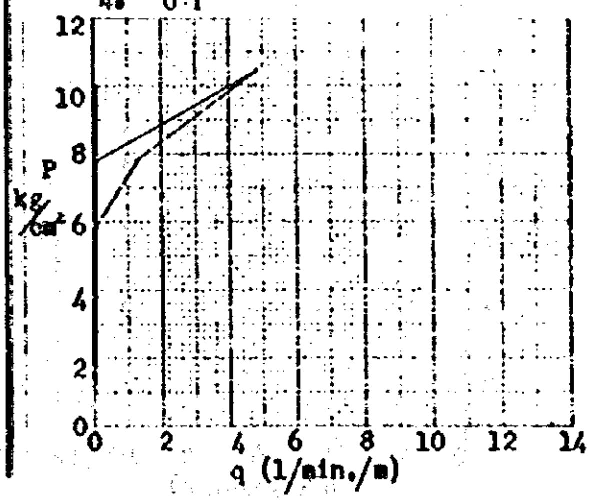
1. DEPTH OF TEST SECTION 45.00-50.00m
2. MAXIMUM PRESSURE 5.1 kg/cm²
3. CRITICAL PRESSURE - kg/cm²
4. LUGEON VALUE 16.6



1. 50.00 - 55.00 m
2. 10.7 kg/cm² 3. - kg/cm²
4. 0.1



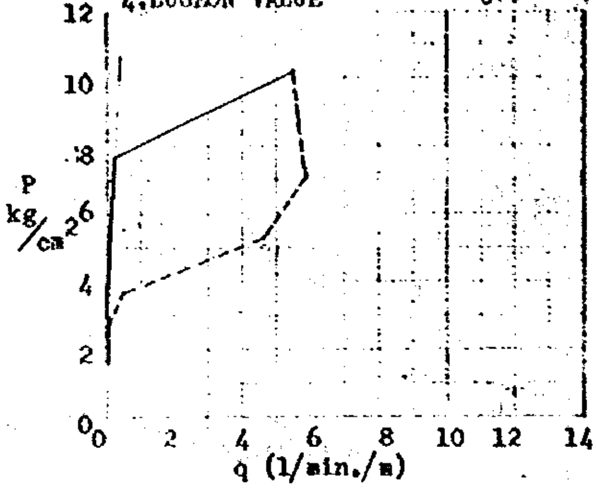
1. 55.00 - 60.00 m
2. 10.5 kg/cm² 3. 7.8 kg/cm²
4. 0.1



RESULT OF WATER PRESSURE TEST (22)

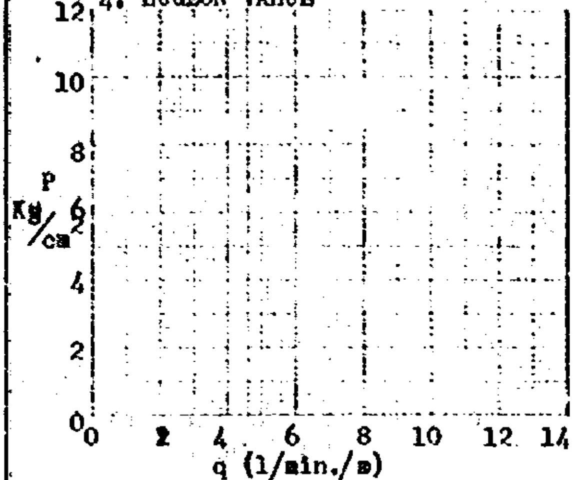
BOREHOLE NO. BL - 2

1. DEPTH OF TEST SECTION 60.00-65.00 m
2. MAXIMUM PRESSURE 10.2 kg/cm²
3. CRITICAL PRESSURE 7.7 kg/cm²
4. LUGEON VALUE 0.4

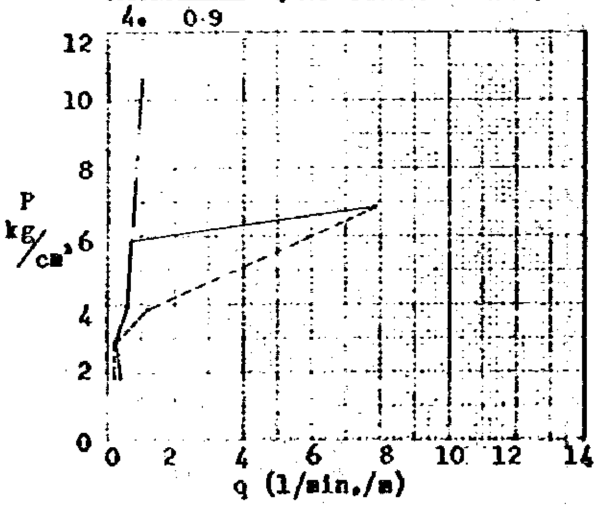


BOREHOLE NO.

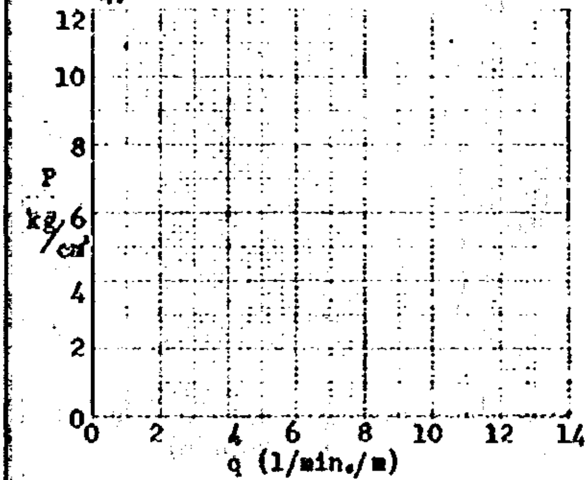
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



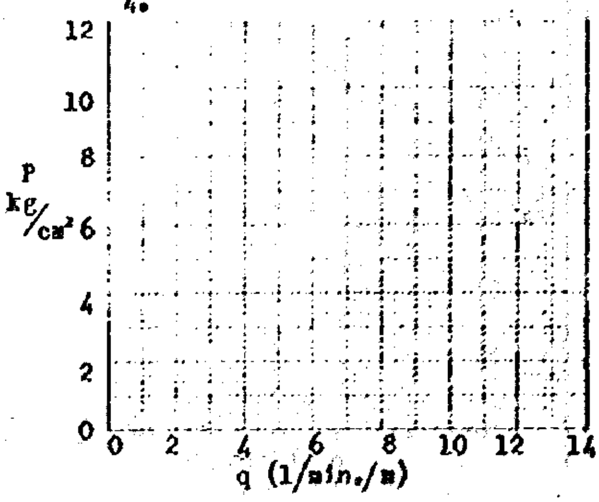
1. 65.00- 70.00 m
2. 6.8 kg/cm² 3. 5.8 kg/cm²
4. 0.9



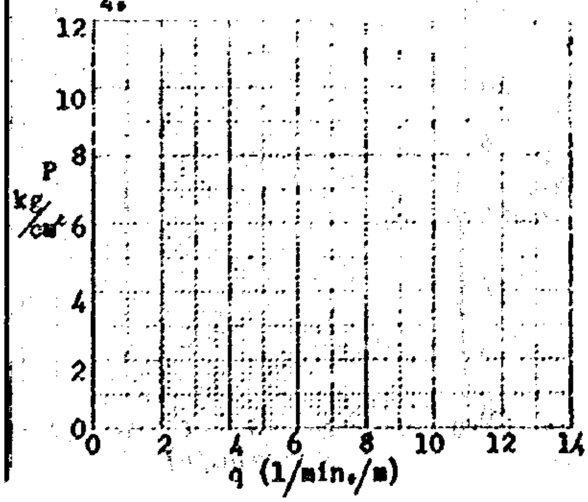
1. m
2. kg/cm² 3. kg/cm²
4.



1. m
2. kg/cm² 3. kg/cm²
4.



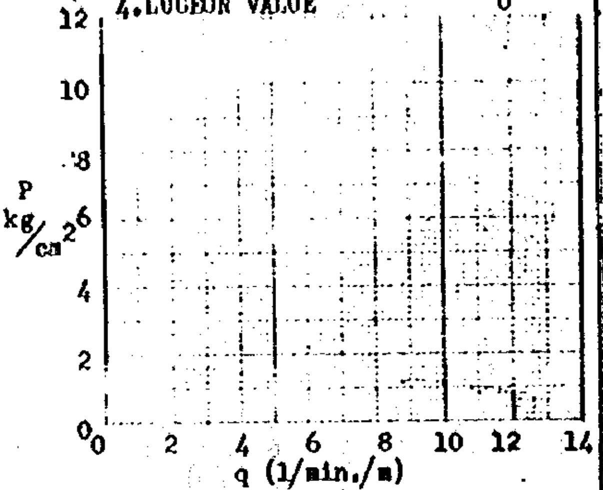
1. m
2. kg/cm² 3. kg/cm²
4.



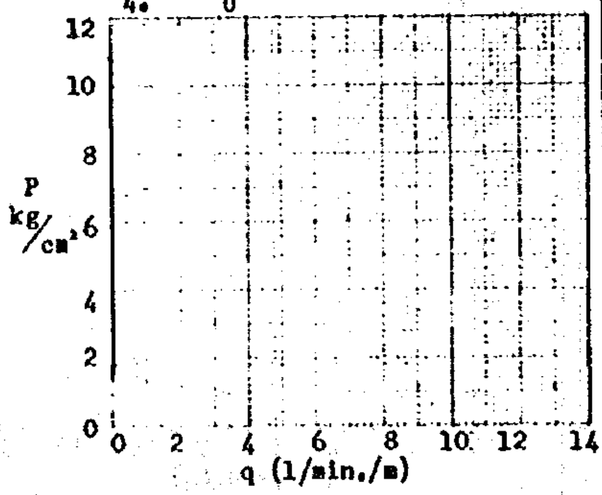
RESULT OF WATER PRESSURE TEST (23)

BOREHOLE NO. BL-3

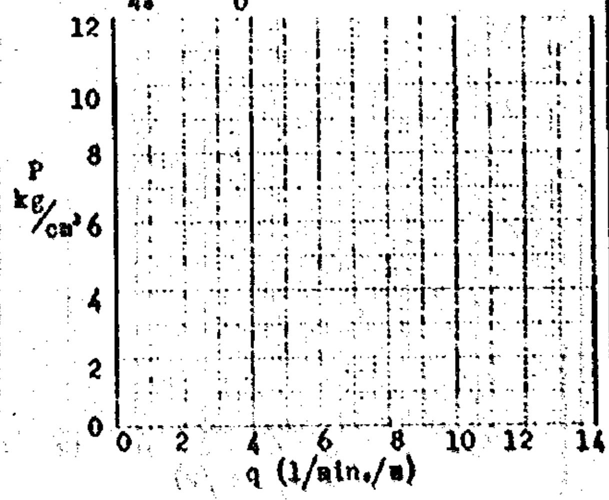
1. DEPTH OF TEST SECTION 15.00-20.00 m
2. MAXIMUM PRESSURE 10.9 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0



1. 20.00-25.00 m
2. 10.8 kg/cm² 3. – kg/cm²
4. 0

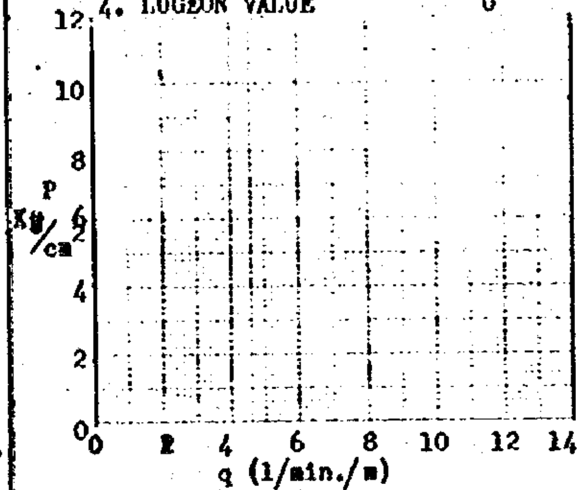


1. 25.00-30.00 m
2. 10.9 kg/cm² 3. – kg/cm²
4. 0

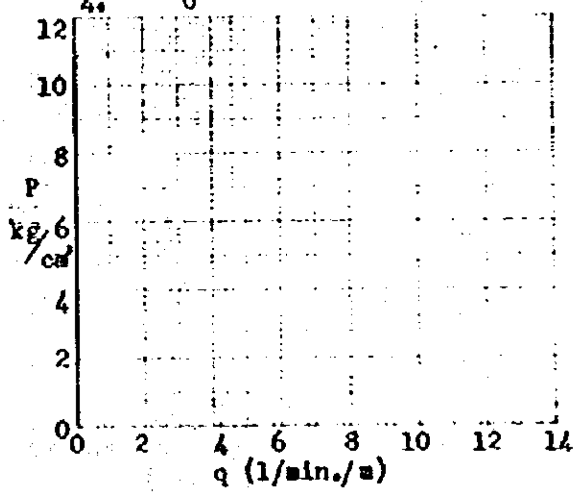


BOREHOLE NO. BL-3

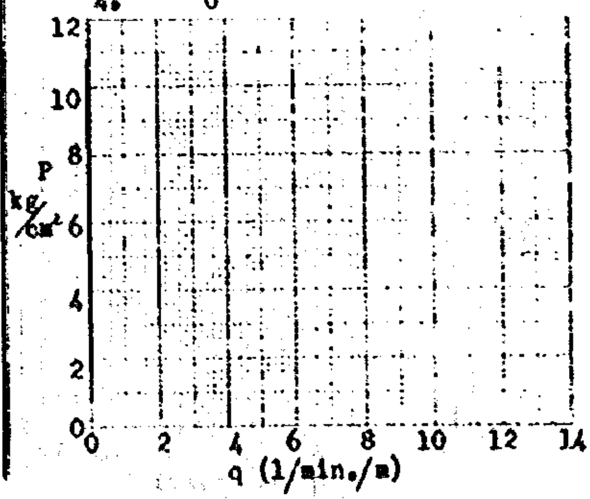
1. DEPTH OF TEST SECTION 30.00-35.00 m
2. MAXIMUM PRESSURE 10.9 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0



1. 35.00-40.00 m
2. 10.9 kg/cm² 3. – kg/cm²
4. 0



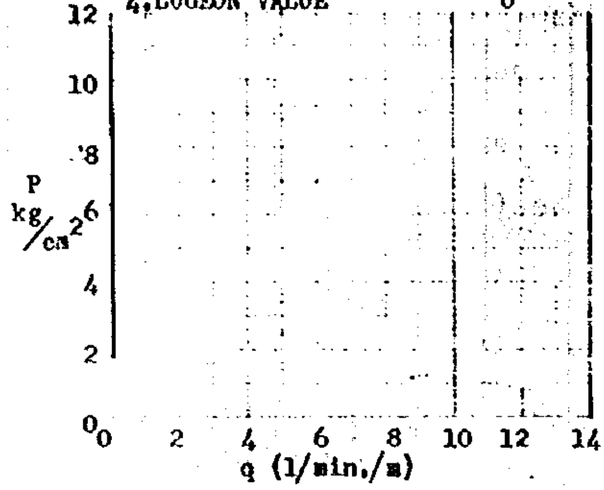
1. 40.00-45.00 m
2. 10.8 kg/cm² 3. – kg/cm²
4. 0



RESULT OF WATER PRESSURE TEST (24)

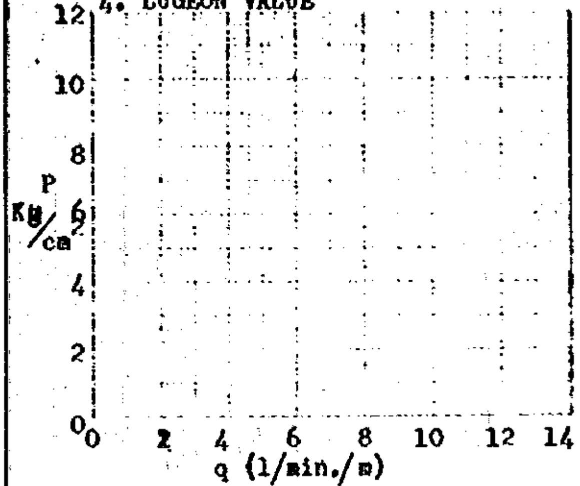
BOREHOLE NO. BL.3

1. DEPTH OF TEST SECTION 45.00-50.00 m
2. MAXIMUM PRESSURE 10.8 kg/cm²
3. CRITICAL PRESSURE – kg/cm²
4. LUGEON VALUE 0

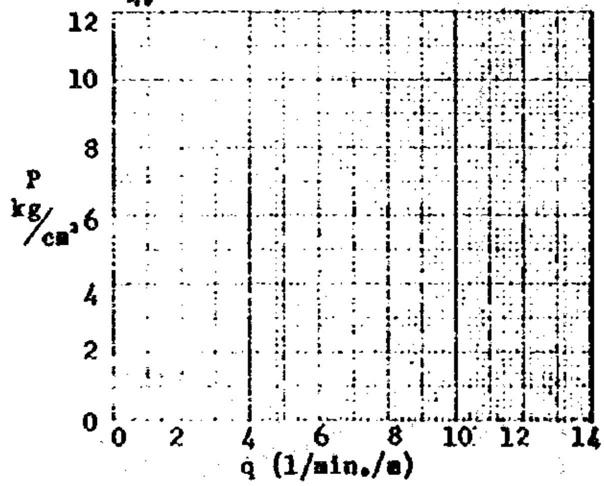


BOREHOLE NO.

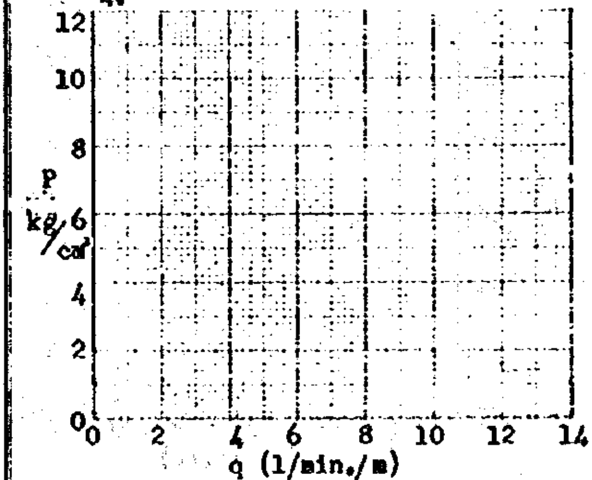
1. DEPTH OF TEST SECTION m
2. MAXIMUM PRESSURE kg/cm²
3. CRITICAL PRESSURE kg/cm²
4. LUGEON VALUE



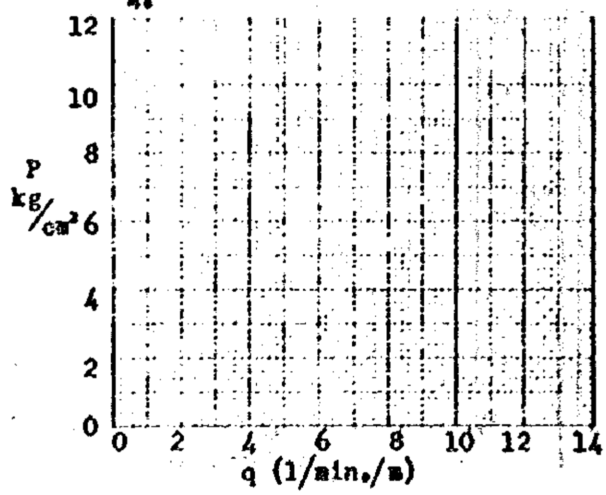
1. m
2. kg/cm² 3. kg/cm²
4.



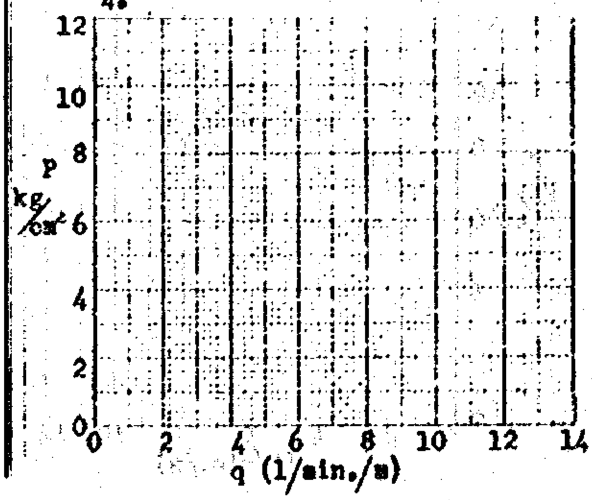
1. m
2. kg/cm² 3. kg/cm²
4.

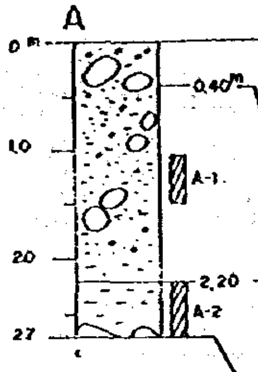


1. m
2. kg/cm² 3. kg/cm²
4.



1. m
2. kg/cm² 3. kg/cm²
4.

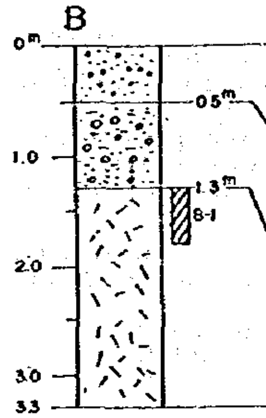




Top soil mixed with boulder gravels. Black in color. Consist of sandy clays, plant roots and hard breccia of 3-500m/m in diameter.

Tulus. Yellowish grey in color. Gravel ranged from 5 m/m to 400m/m in diameter. Smaller gravels consist of soft and hard rocks but larger boulder gravels consist of fresh hard rock of dyke. Gravel content approximetely 50 %.
Matrix consist of soft clayey soil.

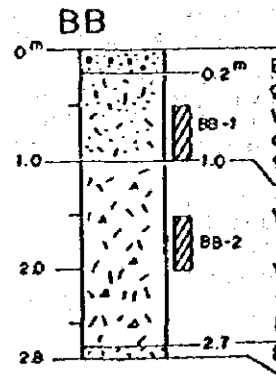
Tulus. Brown in color. Consist of sandy clays and gravels. At 2.20m in depth little water springs and dissolved iron deposits. At the bottom of 2.70m in depth, boulder gravels of 300m/m in diameter are found.



Black brown top soil of humus clays mixed with large angular gravels of hard rock less than 200m/m in diameter.

Tulus. Grey and brown in color. Angular hard gravels from ranged from 10-200m/m in diameter. Maximum gravel of 300 m/m in diamerer is found. Matrix consists of clayey soils. Gravels content is approximetely 30% to 50%.

Reddish brown silty tuff. Soft rock showing crumbs of 10 m/m to 50m/m in diameter by weathering.
Some clays of greyish white in color are found along the crack.
Around the boundary of 1.3 m in depth, weathered soils are found.



Black brown top soil of humus clays including soft and hard gravels less than 100m/m in diameter.
Weathered soil of lapilli tuff. Reddish brown in color clayey sandy soil with ferrous deposits. Include tuffous gravels less than 15m/m in diameter.

Weathered lapilli tuff. Yellowish brown and reddish brown in color. Very soft rocks easily digged by pick of hammer. Grey weathered clay and ferrous deposits are found. Include soft tuffous gravels less tham 50m/m in maximum diameter.
Little water spring around the boundary of 2.7m in depth.

Reddish brown soft tuff.

Fig.6-10(AN)

COLUMN SECTIONS OF TEST PITS(1)

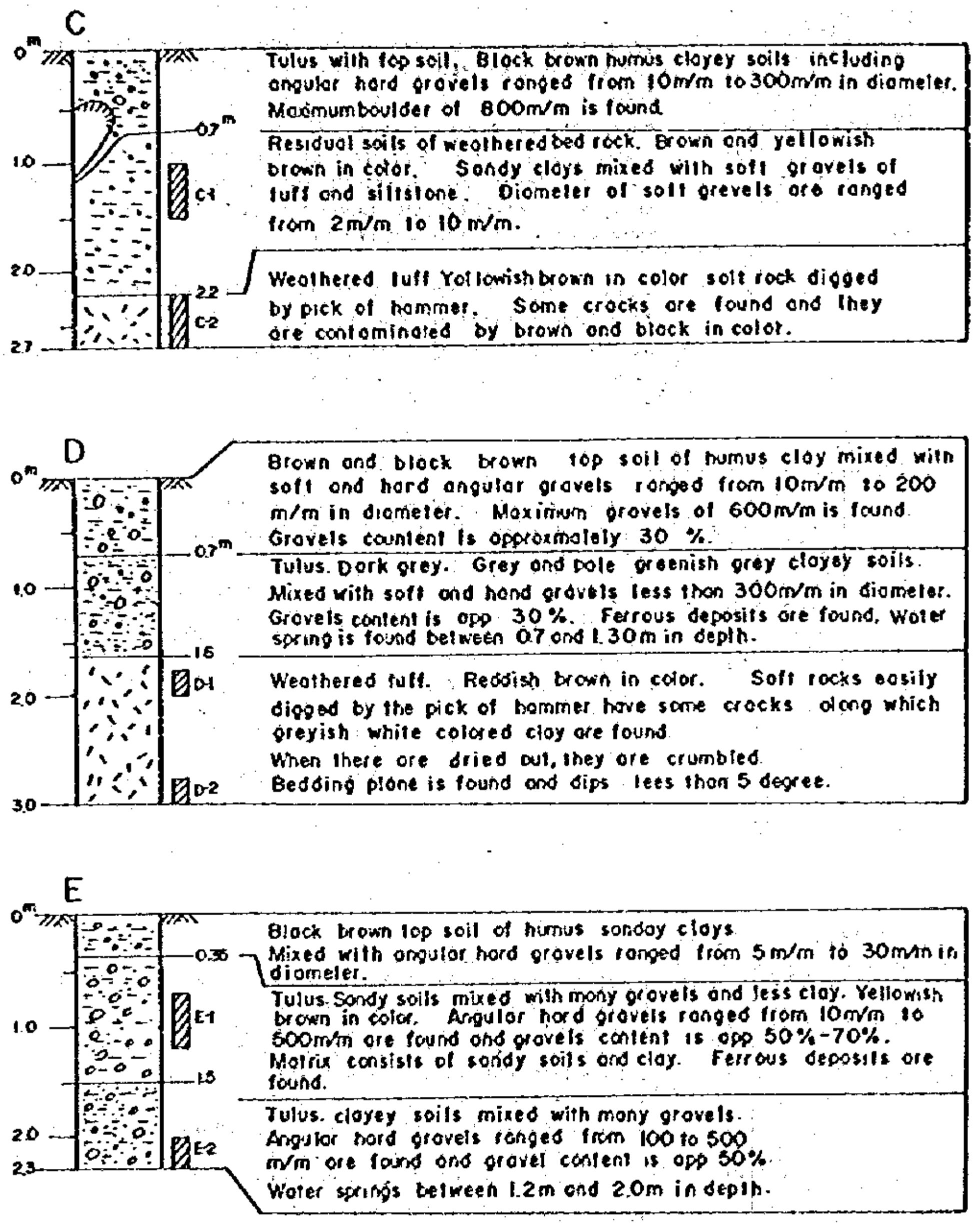


Fig.6-10(AN)

COLUMN SECTIONS OF TEST PITS(2)

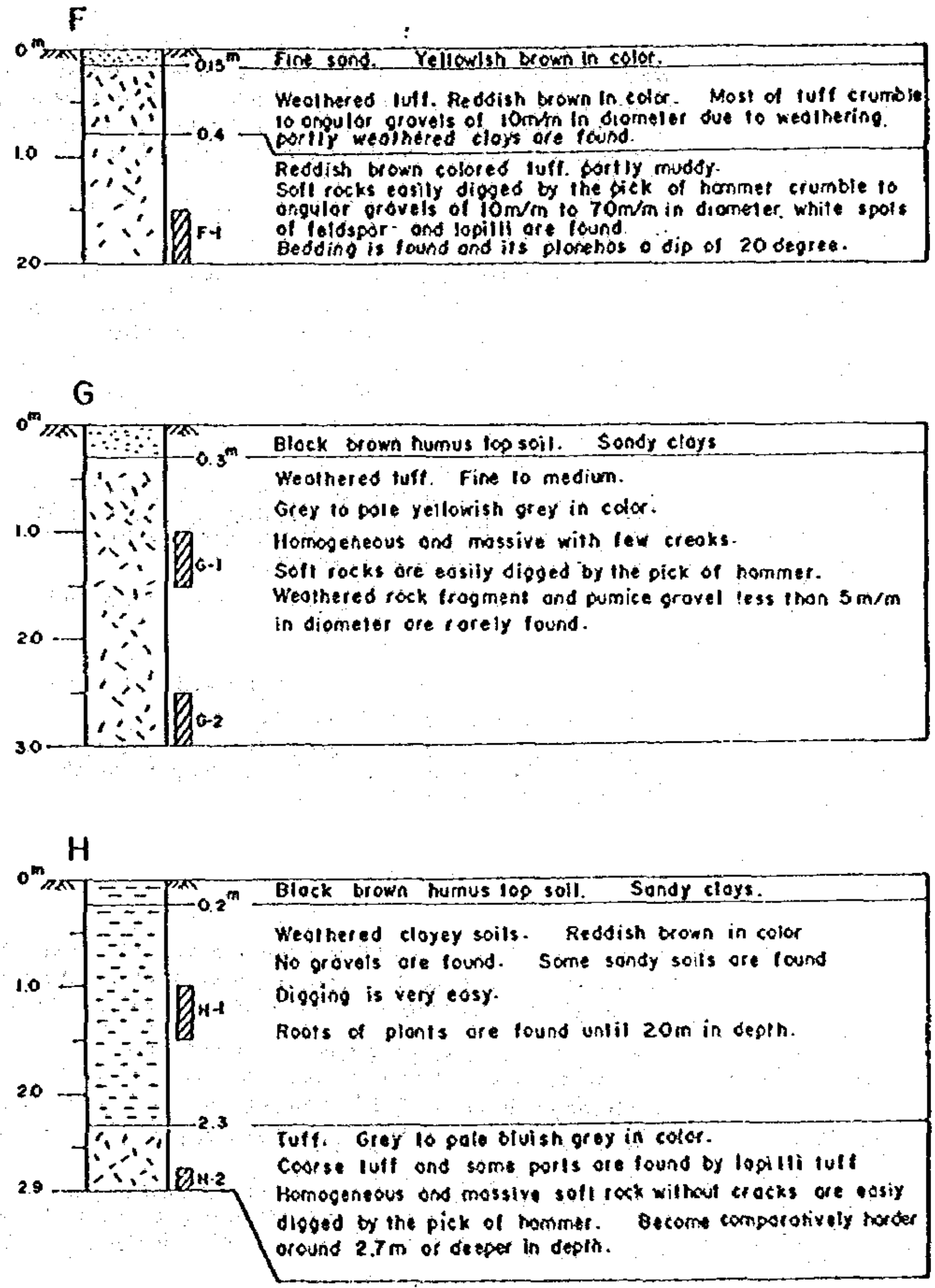


Fig.6-10(AN)

COLUMN SECTIONS OF TEST PITS(3)

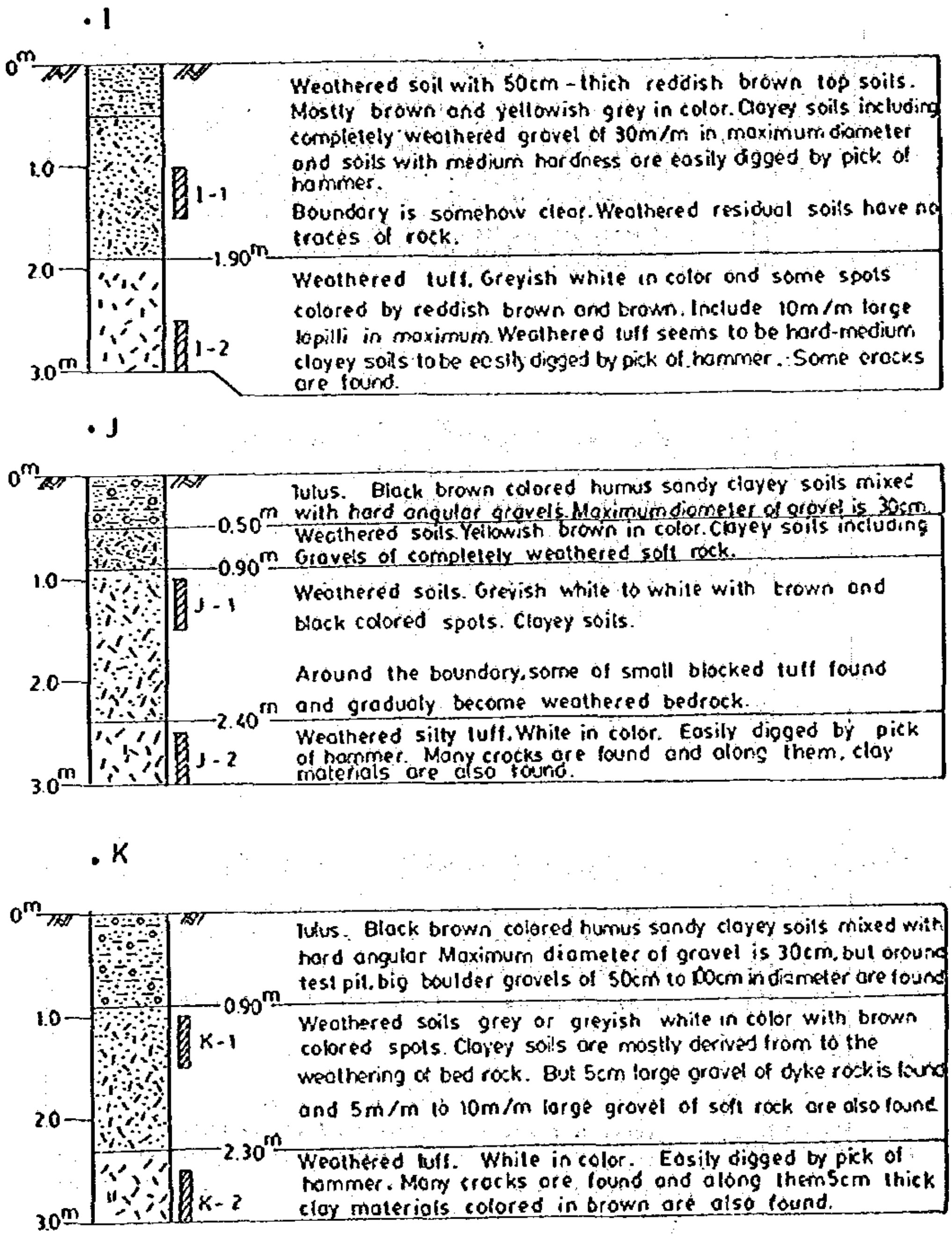


Fig.6-10(AN)

COLUMN SECTIONS OF TEST PITS(4)

7. WATER SUPPLY

CONTENTS OF WATER SUPPLY

LIST OF TABLES

LIST OF FIGURES

1. GENERAL

The waterworks for Ujung Pandang city had been administrated by the department of public works of the municipality until 1976, and transferred to PAM for management and operation.

"Pemimpin Proyek Air Bersih Sulawesi Selatan" forecasts that the population of Ujung Pandang grows to about 1,500,000 in the year 2,000, and that the scope of the municipal water supply broadens to reach nearly 70% of the population. To meet with the above mentioned circumstances, the total municipal water supply of 3,500 l/s will be required based on the estimated municipal water demand percapita at 150 l/day. The above total supply consists of 64% for domestic and 23% for industrial and commercial.

The plan specifies the Jeneberang river as a source of a daily supply of 2,300 l/s which is about 70% of the required total.

In the preliminary study of this project, the proposed Bili-Bili reservoir is specified as a source of water supply, then an available volume of dependency is established, and a water supply method is considered giving preference to a pipeline.

2. PRESENT CONDITION

2.1 Water Source and Supply

Ujung Pandang is getting the municipal and industrial water from two sources, each of different origin : the one is from the Jeneberang river through the old treatment plant and the other, from the Maros river through the new treatment plant. The former system was built in 1924 with the design treatment capacity of 50 l/s which was subsequently expanded to 100 l/s in and around 1943. Although capacity has been increased to 150 l/s through the expansion work which was undertaken from 1967 to 1969, the actual intake water volume is 100 l/s at present. This system is treating the river water taken from the Jeneberang, being pumped up at its right bank immediately below the Sungguminasa bridge. A concrete pipe with 500 mm diameter transmits the river water for a distance of some 7 km to the old treatment plant. During dry season, discharge of the Jeneberang drops to about 50 l/s, diminishing the volume available for municipal and industrial water to the bottom; consequently, the municipal and industrial water for Ujung Pandang is largely switched over to that supplied from a new water supply system.

The new water supply system was built in 1977 by assistance from France and it treats the river water taken from the Maros, which is flowing in the north of the city, at Lekopancing weir to the amount of 500 l/s which is sent over a distance of some 28 km to the new treatment plant (refer to Fig. 7-1).

2.2 Treatment Plants

The existing facilities equipped with both the old and the new treatment plants will be outlined in the below:

	Old treatment plant	New treatment plant
Capacity	100 l/s	500 l/s
Raw Water Transmission	500 mm concrete pipe x 7 km	28 km aqueduct
Treatment Method	Rapid sand filtration	Rapid sand filtration
Related Facilities	Low lift pumps Sedimentation tanks Filters Reservoir Elevated tank Chemical apparatus Distribution pumps	Sedimentation tanks Filters Reservoir Chenical apparatus Distribution pumps

2.3 Water Distribution and Demand

The water treated at the old plant needs to be pumped up to an elevated tank for distribution among the consumers. As the distribution system was equipped in the 1920's, its facilities are now causing a lot of pipe-loss to make a stabilized supply of municipal and industrial water rather difficult. The new plant sends out pumppressurized water through distribution pipes with diameter ranging from 1,000 mm to 50 mm.

The daily demand total of municipal and industrial water in 1980 was at 400 l/s approximately. Out of the total, about 25% was intended for domestic consumption (about 30% of the total population), about 60% for industrial and comercial and the balance for various public facilties, such as schools, etc.

The major water distribution network in Ujung Pandang is shown in Fig. 7-2.

3. WATER DEMAND IN THE FUTURE

3.1 Future Demand

The supply-demand master plan for the municipal and industrial water in Ujung Pandang city was prepared by Pemimpin Proyek Air Bersih Sulawesi Selatan in 1981. The transition of the future demand during 1985 - 2000 is presented in Table 7-1.

According to the above-mentioned master plan, the future demands of the municipal and industrial water are 2,000 l/s in 1990 and 3,500 l/s in 2000 respectively.

Thus, it now constitutes an important problem which needs to be solved with urgency how to secure water sources to meet with the increasing demand for drinking water and industrial water in and around Ujung Pandang city.

Considering the future program of the increasing water demand, the target year for water supply has been fixed in the year 2000. Out of 3,500 l/s of the water demand in 2000, the water supply of 2,300 l/s has been determined to be secured from the Jeneberang river (proposed Bili-Bili reservoir) in due consideration of the prospective water resources develoment in the area.

The remaining part of the future water demand will have to be supplied from the present water source, that is, the Maros river.

PAM is considering to increase the capacity of the new treatment plant which remains at 500 l/s at present, by 600 l/s in 1982 and further by 1,100 l/s in 1985.

3.2 Required Reservoir Storage Capacity

The municipal and industrial water of 2,300 l/s will be taken directly from Bili-Bili reservoir, the municipal and industrial water has been estimated on the basis of the river discharge during the last five years for which reliable data are available, as follows:

Year	Required volume ($\times 10^3 m^3$)
1976	17,000
1977	13,400
1978	3,100
1979	13,000
1980	14,000

The volume of water to be supplied to Ujung Pandang as its municipal and industrial water has thus been designed at $17,000 \times 10^3$ m^3 so that it could cover the water requirement in 1976 which is design year for municipal and industrial water supply.

4. WATER SUPPLY METHOD

4.1 Comparative Study on Water Supply Method

There are four methods to supply the raw water meant for the municipal consumption from Bili-Bili reservoir to Ujung Pandang, as follows:

Method 1.	To make use of the Jeneberang river;
Method 2.	To make use of the Bili-Bili irrigation channel;
Method 3.	To excavate a new open channel as a conveyance route, and
Method 4.	To install a new pipeline.

The conveyance routes according to these 4 methods are shown in Fig. 7-3, and their tentatively estimated construction costs and annual running costs for the water purifications are presented below:

	Open channel			Pipeline
	Method 1	Method 2	Method 3	Method 4
Construction cost ($\times 10^6$ US$)	18	17	21	39
Annual running cost ($\times 10^6$ US$/year)	14.5	14.5	10.9	3.6

Note: Table 7-2 shows the annual running costs in detail.

Judging from the study results mentioned below, pipeline is proposed for the water supply from the proposed reservoir to the consumption site.

1) Though the construction cost estimated for a new installation of a pipeline will be enormous, the purification cost of the raw water conveyed by means of the open channel is also far bigger than that of the pipeline. The total construction cost required for conveyance and purification of raw water is not deemed to have any difference between two cases; open channel and pipeline.

2) To improve the sanitary condition in the site, the raw water is preferable to be conveyed without any deterioration in quality.

3) To prevent the conveyance loss due to evaporation, seepage and so on, the conveyance facilities are preferable to be a closed type such as pipeline.

4.2 Benefit

As aforementioned, a storage capacity for the municipal and industrial water will be secured in the second priority next to flood control, because it is one of the basic human needs and Ujung Pandang city suffers from shortage of the municipal and industrial water, especially in a dry season.

The municipal and industrial water supply will surely grade up the living standard, improve the sanitary condition, decrease the frequency of desease, and moreover spur the industrial and commercial activities development. In this sense, a great deal of benefit can be expected to accrue in the future, although it is quite difficult to quantify the benefit.

5. PRELIMINARY DESIGN

5.1 Water Intake Facilities

Intake of the reservoir water can be arranged either through the intake facilities exclusively for the municipal and industrial water or through those meant for both the municipal /industrial water and the irrigation water. At the present stage, a preliminary design of the intake facilities for the municipal and industrial water will be done for common use with the irrigation water which are more economical than those for exclusive use of the municipal and industrial water.

Intake Volume

The common intake will be designed to draw the design volume of 32 m^3/s which is almost equal to the maximum demand of the municipal and industrial water, the irrigation and the vested right water.

Intake volume for the municipal and industrial water is fixed at the required municipal and industrial water of 2.3 m^3/s all through the year.

The intake water will be distributed at the regulating basin on the right bank immediately below the right wing dam.

Intake Facilities

Intake facilities of the municipal and industrial water shall satisfy the conditions as specified below.

- Regardless of a reservoir storage, an intake of a certain predetermined volume required of municipal and industrial water shall be guaranteed all through the year.
- As the water is intended for drinking, the facility must be designed to eliminate the possiblity of inclusion of suspended matters and sediment discharge into the water as much as possible.

- As the facilities are deeply connected to the daily lives of the population, measures to facilitate maintenance and administration are to be worked out.

To satisfy the conditions mentioned above, some appurtenant facilities will be required. The water from the reservoir will be sent through the hydro power facilities and, after generation, will be divided into two purpose, the one for the municipal and industrial and the other for the irrigation.

The municipal and industrial water will be supplied to the sand basin and the regulating basin on the right bank of the river through the conduit buried under the river. The principal facilities in regard to the intake are as follows:

Gate-controlled division works	:	1 L.S.
Conduit	:	200 m in length
Sand basin	:	1 place
Regulating basin	:	1 place

The outline of the water supply facilities is shown in Fig. 7-4.

5.2 Conveyance Facilities

Conveyance of the municipal and industrial water will be made through a pipeline. The water taken from the reservoir will be deposited for sometime in the regulating basin nearby the dam, then sent to the treatment plant through a pipeline extending for approximately 25 km. Ductile cast-iron pipe with 1,500 mm diameter is proposed. This pipeline will be generally buried underground alongside the road between Ujung Pandang and Malino. The sharp bending of the pipeline should be avoided, either horizontally or vertically, from hydraulic viewpoint and its structural weakpoint. Furthermore, the pipeline should be installed below the hydraulic gradient line in order to prevent intra-pipeline pressure from dropping below the atmospheric pressure.

Again, to ensure conveyance of a well-stabilized volume of water through the pipeline, it is desirable to install the junction well, regulating valve, flow-meter, air-vent, etc. with an interval of every 1 - 3 Km. The principal features of the proposed pipeline are as follows:

Design conveyance volume	:	2.3 m^3/s
Conveyance pipe	:	1,500 mm dia. Ductile cast-iron pipe
Junction well, regulating valve, flow-meter, air-vent	:	12 sites

6. CONSTRUCTION SCHEDULE AND COST ESTIMATE

6.1 Construction Schedule

The main work items involved in water supply will consist of:

1) Gate-controlled division works
2) Sand basin and regulating basin
3) Conveyance pipeline and appurtenant facilities

Construction schedule has been so arranged as to see its completion by 1990, in view of putting all the related facilities in serviceable conditions simultaneously with the completion of Bili-Bili dam.

A period of 4 years from 1984 has been assumed for feasibility study and detailed design and the construction works will be undertaken during the remaining 3 years from 1988 to 1990.

The construction schedule is shown in Fig. 7-5.

6.2 Cost Estimate

Construction Cost

The construction cost of the water supply has been estimated on the contract basis and on 1981 prices.

The cost comprises civil works, gates and equipment, land acquisition, compensation, engineering services and plus 15% contingencies. The construction cost totals to US$53.5 million which is made up of the foreign currency portion amounting to US$28.8 million and the local currency portion of US$6.7 million. The construction cost and the annual disbursement schedule are shown in Tables 7-3 and 7-4, respectively.

Operation, Maintenance and Replacement Cost

The operation and maintenance cost comprises the personnel cost, operation machinery and equipment, vehicles, administrative cost and miscellaneous. US$0.09 million will be estimated for an annual operation and maintenance cost. The replacement cost of the regulating valve and the flow meter in each 25 years is estimated at US$0.48 million.

Table 7-1 FUTURE DEMAND OF MUNICIPAL AND INDUSTRIAL WATER

(Unit: m^3/day)

Distinguish	1985	1990	1995	2000
Houses	47,180	64,812	91,555	127,911
Public Facilities	1,887	2,991	4,578	6,396
Industry	23,400	29,100	31,100	33,100
Trading	8,580	9,610	10,770	12,070
Hotels	2,003	2,244	2,515	2,817
Sea Port	328	361	394	426
Office	4,804	5,816	7,043	8,527
Hospitals	674	890	1,168	1,523
Schools	3,002	5,609	9,684	15,228
Mosques	630	780	930	1,140
Sub-Total (m^3/day)	92,488	122,213	159,737	209,138
Loss	39,638	52,377	68,459	89,631
Total (m^3/day)	139,126	174,590	228,196	298,769
(l/sec)	1,526	2,021	2,641	3,458
	[1,500]	[2,000]	[2,700]	[3,500]

Table-7-4 WATER QUALITY AND PURIFICATION COST

Class	Water Quality	Slow Sand Filter	Chlorine Disin-fection	Chemical Coagulo-Sedimentation Basin	Rapid Sand Filter	Pre-Chlori-nation	Activated Carbon Treatment	Remarks	Purification Cost approx. US$/$m^3$	Annual Running Cost x 10^6 US$
I	BOD 1.0 mg/l COD 1.0 mg/l Turbidity 2.0 mg/l NH_4zN 0.1 mg/l	Yes, as required	Yes	-	-	-	-		0.02 - 0.05	1.5 - 3.6
II	BOD 2.0 mg/l COD 2.0 mg/l Turbidity 10.0 mg/l NH_4N 0.1 mg/l	-	Yes	Yes	Yes	-	-	Require more than once daily water quality check-up, and to fix a dosage of chemicals accordingly	0.07 - 0.15	5.1 - 10.9
III	BOD 3.0 mg/l COD 3.0 mg/l Turbidity 30.0 mg/l NH_4N 0.5 mg/l	-	Yes	Yes	Yes	Yes	Yes		0.20 - 0.50	14.5 - 36.3

Note: This table shows estimated water purification costs to upgrade the quality of the conveyed municipal water (2,300 l/s) to the drinking water requirements in class I (water conveyed by pipeline), II and III (water conveyed by open channel).

Table 7-3 CONSTRUCTION COST OF WATER SUPPLY

Work Item	Total Amount ($\times 10^3$ US$)	Foreign Currency ($\times 10^3$ US$)	Local Currency ($\times 10^3$ US$)
1. Civil Works			
Gate-controlled division works	197	36	161
Sand basin & regulating basin	238	70	168
Pipeline & appurtenant structures	8,981	4,535	4,446
Preparatory works	942	464	478
Sub-total	10,358	5,105	5,253
2. Gates & Equipment			
Gates	42	-	42
Ductile cast-iron pipe	17,151	17,151	-
Valves	44	44	-
Sub-total	17,237	17,195	42
3. Land Acquisition	11	-	11
4. Compensation	80	-	80
5. Engineering Service	3,153	2,727	426
Sub-total (1 - 5)	30,839	25,027	5,812
6. Physical Contingency	4,626	3,754	872
Grand-total (1 - 6)	35,465	28,781	6,684

Table 7-4 ANNUAL DISBURSEMENT SCHEDULE FOR WATER SUPPLY

(Unit: x 10^3 US$)

Work Item	Total		1986		1987		1988		1989		1990	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Civil Works												
Gate-controlled division works	36	161	-	-	-	-	-	-	-	-	36	161
Sand basin & regulating basin	70	168	-	-	-	-	70	168	-	-	-	-
Pipeline & appurtement facilities	4,535	4,446	-	-	-	-	1,452	1,423	1,997	1,959	1,086	1,064
Preparatory works	464	478	-	-	-	-	152	159	200	196	112	123
Sub-total	5,105	5,253					1,674	1,750	2,197	2,155	1,234	1,348
2. Gats & Equipment												
Gates	-	42	-	-	-	-	-	32	-	-	-	10
Ductile cast-iron pipe	17,151	-	-	-	-	-	5,455	-	7,480	-	4,216	-
Valves	44	-	-	-	-	-	15	-	22	-	7	-
Sub-total	17,195	42					5,470	32	7,502	-	4,223	10
3. Land Acquisition	-	11	-	-	-	-	-	8	-	2	-	1
4. Compensation	-	80	-	-	-	-	-	26	-	35	-	19
5. Engineering Service	2,727	426	1,023	138	477	81	409	69	409	69	409	69
Sub-total (1-5)	25,027	5,812	1,023	128	477	81	7,553	1,885	10,108	2,261	5,866	1,447
6. Physical Contingency	3,754	872	153	21	72	12	1,133	283	1,516	339	880	217
Grand-total (1-6)	28,781	6,684	1,176	159	549	93	8,686	2,168	11,624	2,600	6,746	1,664

Fig. 7-1

HEADRACE FOR NEW TREATMENT PLANT

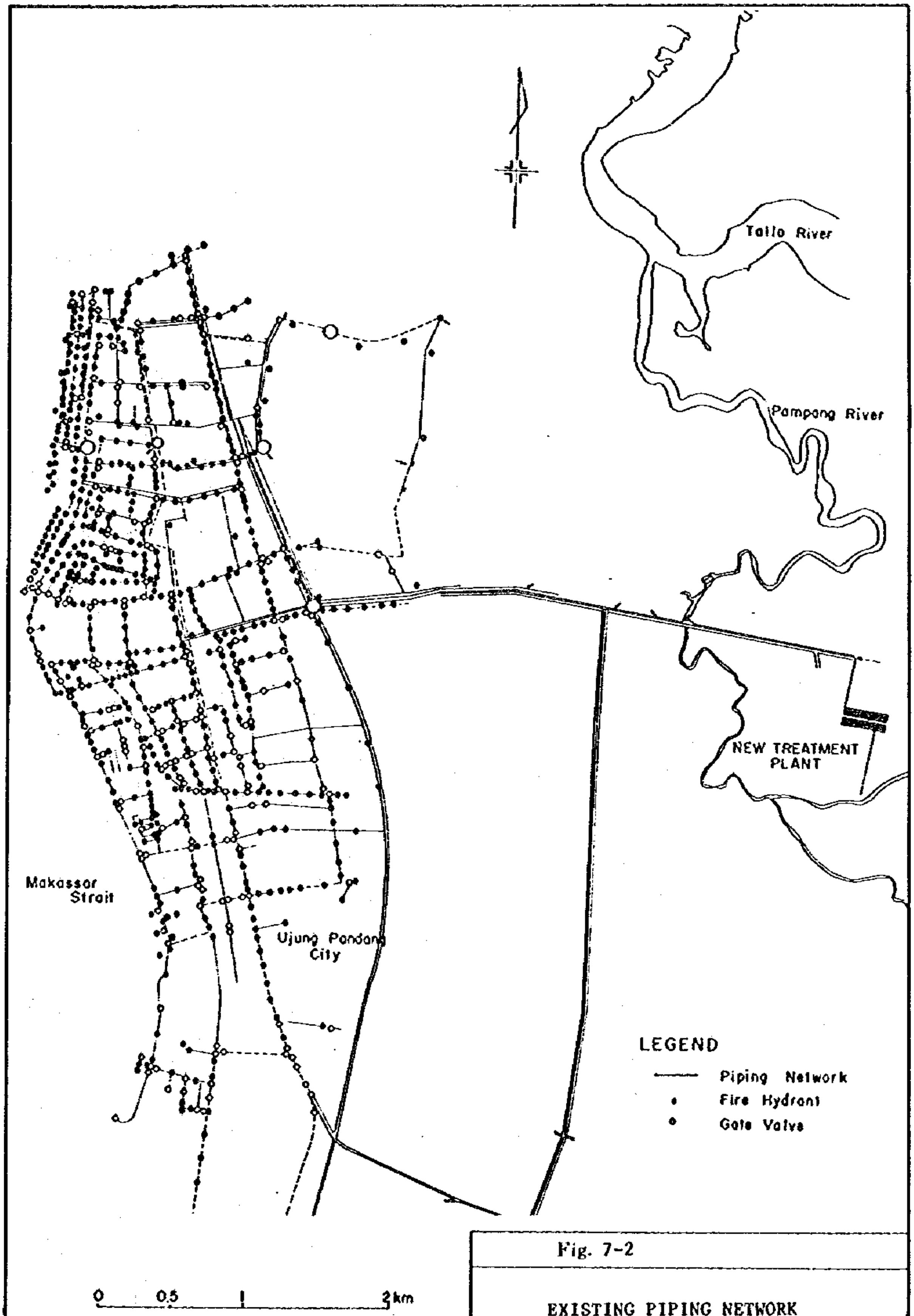


Fig. 7-2

EXISTING PIPING NETWORK
(MUNICIPAL WATER SUPPLY)

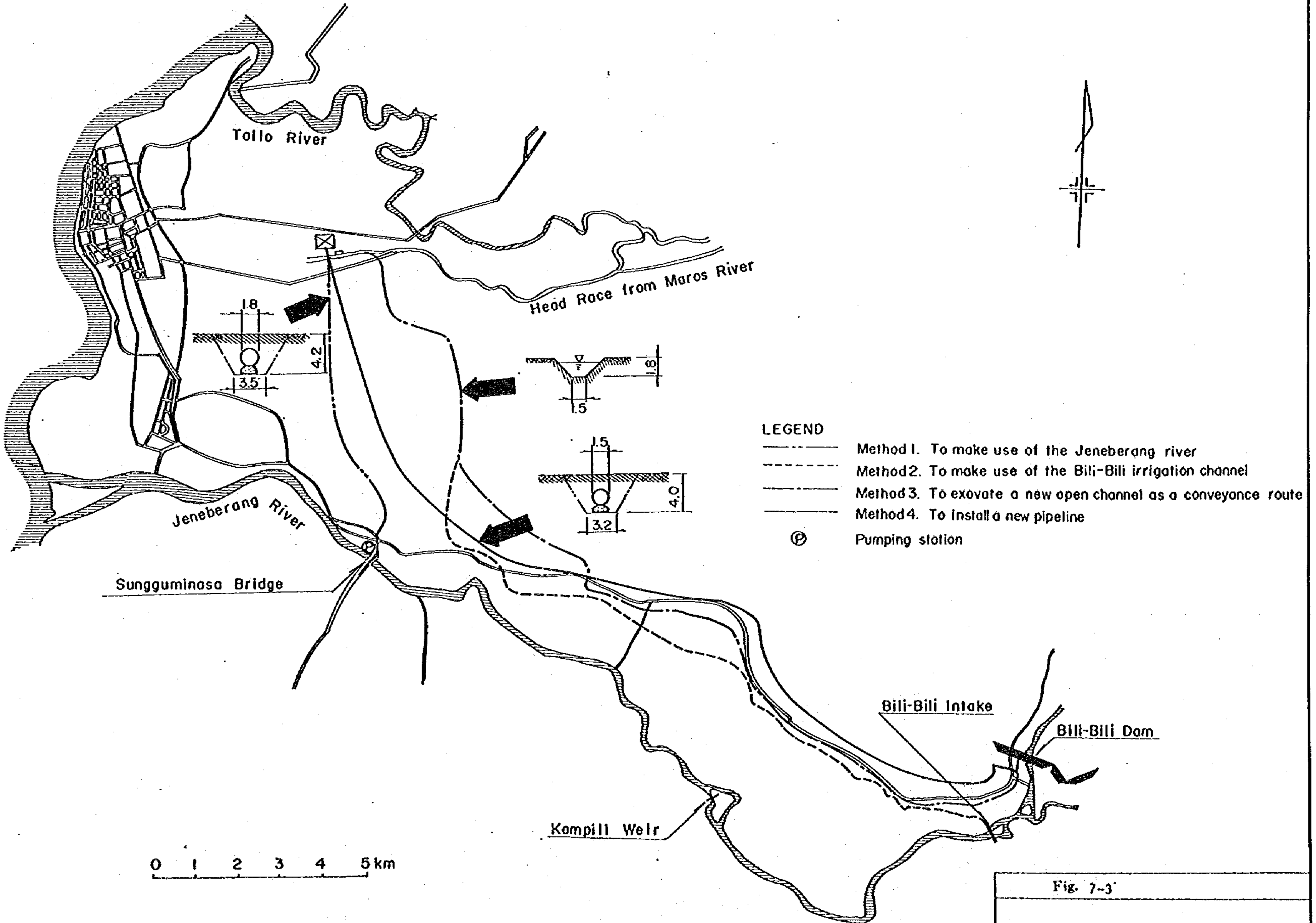


Fig. 7-3

THE MUNICIPAL AND INDUSTRIAL WATER HEADRACE ROUTE

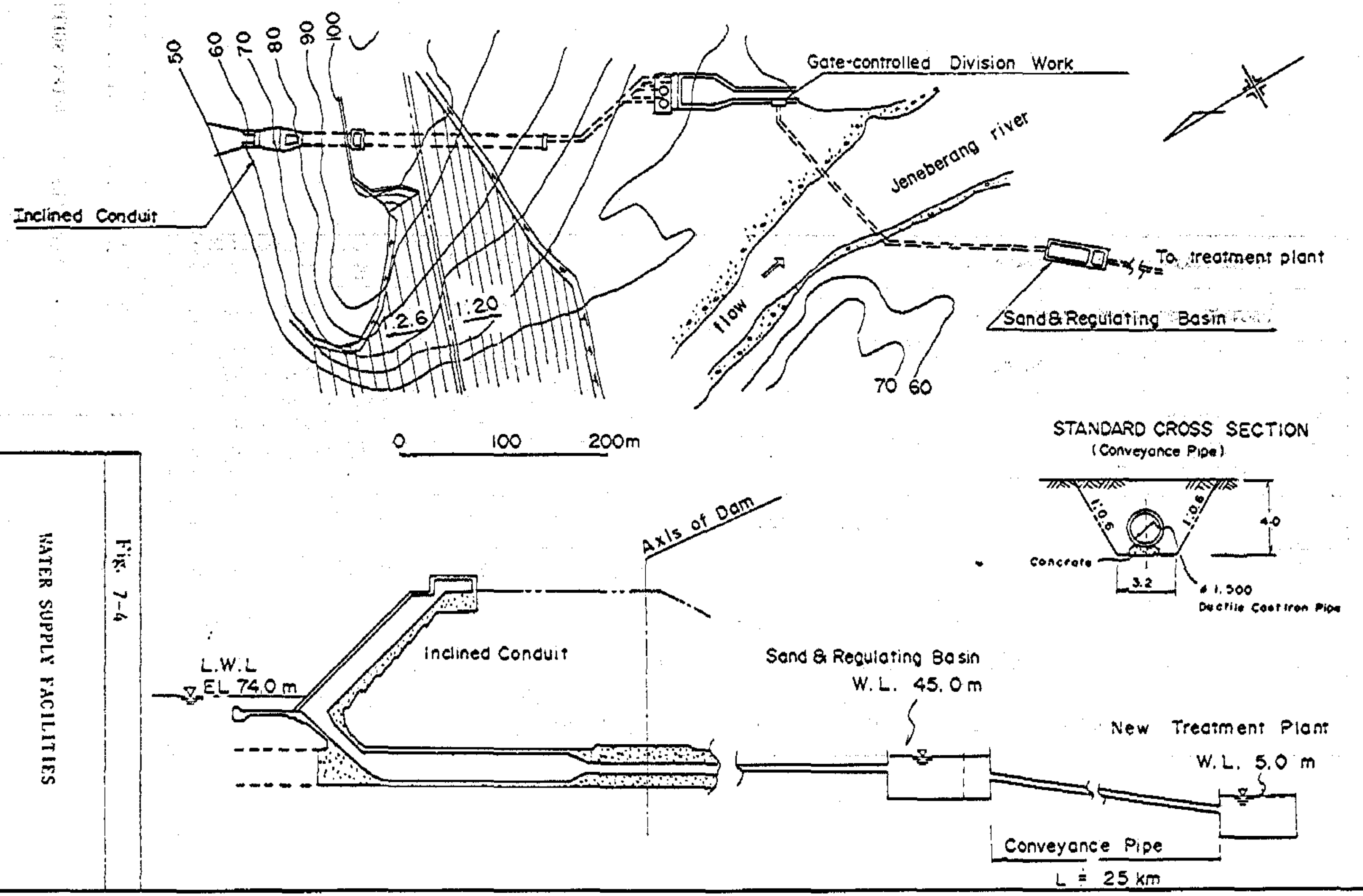


Fig. 7-4

WATER SUPPLY FACILITIES

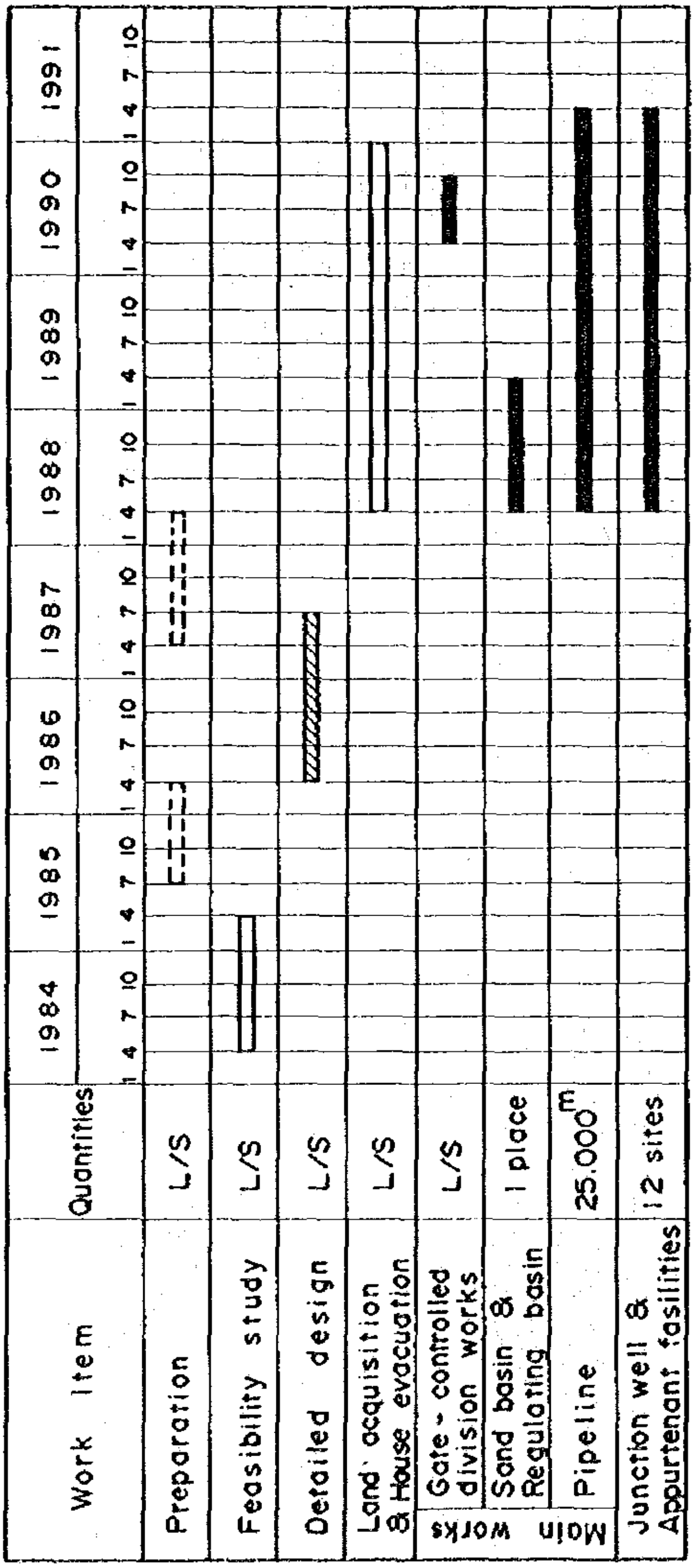


Fig. 7-5

CONSTRUCTION SCHEDULE FOR WATER SUPPLY

8. IRRIGATION

CONTENTS OF IRRIGATION

LIST OF TABLES

LIST OF FIGURES

1. GENERAL

The objective of the agricultural development is to stabilize the supply of irrigation water to existing facilities in the lower Jeneberang river. The irrigation water requirement of 241 x $10^6 m^3$ will be provided by the proposed Bili-Bili dam.

2. PRESENT CONDITION

2.1 Agricultural Development Potential

As shown in Fig. 8-1, up to 34,000 ha of land in the project area and related area is considered suitable for agricultural development.

The irrigation water to be developed by Bili-Bili dam is intended for use in Kampili and Bili-Bili irrigation system with 24,000 ha paddy field, which are relatively well maintained systems where expected benefit is large.

After the realization of the project, however, 4,800 ha of paddy will be left behind with conventional cultivation of single crop in wet season.

Other irrigable areas include 5,000 ha land to the left bank of Kampili channel and 5,000 ha in Pamukulu irrigation system of Pamukulu river basin. Combined area of irrigable area is 14,800 ha and water requirement is estimated to be 180 x 10^6 m^3.

A comprehensive feasibility study for agriculture and water resources development would be necessary in the following stage of development.

2.2 Overall Condition of the Area meant for Agricultural Development

The area which is proposed for agricultural development under the present project consists of the paddy field approximately 24,000 ha. in size which is spreading on the alluvial plain on the both banks of the Jeneberang river; this area is administratively divided into Kab. Gowa, Kab. Takalar, and the Municipality of Ujung Pandang.

Out of this 24,000 ha. paddy field, about 5,000 ha. which is spreading on the right bank and administratively divided between Kab. Gowa and the Municipality of Ujung Pandang, is being irrigated by existing Bili-Bili system, of which intake structure is located at about 5 km downstream of the proposed Bili-Bili dam, that is immediately below the confluence point of the Jeneberang and Jenelata rivers; the remaining 19,000 ha. is located in Kab. Gowa and Kab. Takalar is on the left bank of the Jeneberang river and is irrigated by Kampili intake which is situated at about 7.5 km downstream of the above mentioned Bili-Bili intake structure.

Bili-Bili intake is not provided with any weir except a makeshift barrage piling cobblestones on the river bed extending for a certain distance from the right bank; the river water is taken into the channel through two gates. Kampili intake was built in the early part of the 1920's as a fixed weir on the foundation rock which is outcropped from the riverbed. It is equipped with two intake gates which are furnished with a scouring sluice built on the left bank. Since deterioration of its irrigation channel had advanced to a considerable degree, the Public Works Sulawesi Selatan (DPUSS) has been taking up repair works along its channel and with its appurtenant structures since 1979 fiscal year.

During dry season, paddy field spreading on both the right and the left banks of the Jeneberang river is made irrigable to the extent of 10%; the water taken at Bili-Bili intake would not irrigate more than 10% of its benefitted area which is spreading on the right bank, that is about 500 ha. in the upstream part of Kab. Gowa only, leaving the remaining area, particularly the paddy field in Ujung Pandang which is situated in the downstream part, in drought condition. Similarly, the water taken from Kampili intake would enable dry season paddy cultivation in 10% of the entire paddy field on the left bank.

2.3 Available Water Resources

The existing paddy field is generally rain-fed by rainfall during wet season and by the Jeneberang river water is utilized during dry season.

The river discharge falls down to about 4.5 m^3/s on an average during the three months of August, September and October. The detailed figures of the monthly river discharge at the Bili-Bili and Kampili intakes are shown in Table 8-1.

2.4 Irrigation System

Irrigation system prevailing in the project area which is spreading in Kab. Gowa, Kab. Takalar and Ujung Pandang city will be classifiable as shown in Table 8-2.

The benefitted area (24,000 ha.) consists of the area fed by Bili-Bili and Kampili intakes and is covered by the irrigation system defined by DPUSS as either technical or semi-technical. However, the benefits are not obtained as expected due to shortage of water supply.

An accurate estimation of the flow capacity of the existing facilities needs to be based on survey results with the intake facilities as well as the irrigation channels; for Kampili irrigation system, it can be known from the data on hand that the maximum intake capacity of the weir is approx. 25 m^3/sec. and the flow capacity of its channel is about 12 m^3/sec. in the section with the lowest flow capacity because of bottlenecks along its course. As for Bili-Bili system the capcity of the intake is approximately 3.5 m^3/sec when the discharge of the Jeneberang river is 30 m^3/sec.

The flow capacity of the channel between the intake and Pakatto weir is about 3.2 m^3/sec due to the bottleneck located at the channel's crossing at Jl. Malino.

2.5 Cropping Pattern

The cropping pattern which has come to be consolidated in the project area has as its nucleus the paddy cultivation during wet season (November to April) when the entire paddy field is devoted to paddy cultivation. Other crops being raised include corn, cassava, sweet potato and green beans. Cultivation of paddy during dry season is restricted according to the availability of irrigation water.

The present cropping pattern prevailing in the related area is illustrated in Fig. 8-2.

While the improved varieties of paddy such as C_4-63, PB30, PB32, PB42, Adil, Citarum and others are mainly planted in the BIMAS/INMAS areas, the local varieties predominate in the other areas. The area planted by different varieties of paddy in Kab. Gowa and Kab. Takalar, in contrast with that in South Sulawesi, during 1980 agricultural year is shown in Table 8-3.

2.6 Farming Practices

Paddy is the most important crop in the project area. Its cultivation is undertaken, from the very stage of sowing to that of harvesting, by human labour consisting of almost all the members of the farm family with the help of two kinds of animal, viz., buffaloes and oxen which are extensively used for land preparation. In a word, the farming practices having been adhered to in the project area still remain "traditional", and only a limited kinds and number of mechanical equipment have so far been introduced therein.

The improvement program, both varietal and technical, of paddy cultivation has been positively extended in South Sulawesi. However, it now seems to be confronted with the problem of stagnation in its return, due to planting in unfavourable area and shortage of irrigation water, after experiencing successful expansion in the last several years. While the use of chemical fertilizers and agro-chemicals has been universalized by BIMAS program side by side with wider use of the improved varieties, the per-ha. yield does not rise as expected. The reasons for such a stagnancy are supposed to be two-fold: an increasing ratio of inferior land on one hand, and the the poor irrigation facilities, on the other. Provision of adequate irrigation facilities and increased supply of irrigation water would, therefore, contribute enormously for an increased production of paddy. This is evident, within the project area itself, from the higher paddy productivity in Kab. Gowa where the irrigation facilities are in better condition in comparison with those in Kab, Takalar and Ujung Pandang city where the irrigation facilities are not as well equipped as in Kab. Gowa.

Land holdings in the project area will be shown in Table 8-4, for reference.

2.7 Crop and Yield

Production of paddy and the other principal food crops per ha. of South Sulawesi province and the project area are shown in Table 8-5, 8-6 and 8-7, respectively. The annual mean yield is at level of about 3.6 t/ha. in the wet season and at about 3.0 t/ha. in the dry season. These figures are for the average of last three years in Kab. Gowa and kab Takalar.

2.8 Livestock Production

Livestock raising does not occupy an important position due to it in agricultural undertaking in the project area. The animals and birds are mostly grazed on small scale in and around paddy fields and yet they consit of the vital source of draught-power in farm operation and transportation, and of protein foods consumable by the inhabitants.

The number of the livestock and poultry in the project area and its vicinity is summarized in Table 8-8.

2.9 Propagation of BIMAS and INMAS

The increase of paddy production which is one of first priority policy in pelita I and II has gradually shown its achievements through improvement of irrigation system and introduction of BIMAS/INMAS and other high yielding varieties together with agricultural extension programs.

At Batangkaluku in Kab. Gowa of South Sulawesi province, an agricultural training center was founded in 1974 as a part of technical cooperation from Japan. Staff members for agricultural extension as well as administrative offices are trained there under the guidance of resident expert from Japan. After the training, they would go into the field propagating BIMAS/INMAS cultivation. Tables 8-9 and 8-10 show the distribution of BIMAS/INMAS in South Sulawesi province and the related area.

2.10 Processing and Marketing

The main crop for marketing is rice in the project area. Three routes are provided for rice marketing there as shown in Fig. 8-3. Most of the surplus paddy, after consumtpion of farmers, is generally sold to KUD and/or middle men through brokers. Sub-DOLOG in each Kabupaten purchases rice from KUD. The rice purchased by Sub-DOLOG is distributed for the local government use, and further transferred to the provincial DOLOG. The provincial DOLOG arranges for the provincial consumption and its movement to other provinces. The paddy collected by the middle men is usually sold at the regional market in Ujung Pandang city. Some of the surplus paddy is sold at the local markets in and around the project area directly by farmers or sometime by brokers.

The price of rice is generally controlled by the Government through DOLOG. In 1980/81, the floor price of milled rice is set at Rp. 175/kg. and the ceiling price at Rp. 190/kg. When the market price goes down below the floor price, DOLOG purchase the market rice and when the price is over the ceiling price, DOLOG sells its stock.

2.11 Farm Income

The income and production cost per ha. of the farm products in South Sulawesi province as identified and reported by the Agricultural Training Center at Batangkaluku in Kab. Gowa through its survey undertaken in 1978 are presented in Table 8-11.

3. CROP AND YIELD

3.1 Decision of the Crop

Irrigation water made available by construction of the proposed dam will primarily be used for crop cultivation during dry season. Among various kinds of crops to be planted during dry season, paddy has been selected on the ground of the following reasons:

1) The benefitted area is not going to be created anew but has already been developed as paddy field in its entirety, with its own irrigation network;

2) The benefitted area is largely made up of a flat alluvial plain and is most suitable for paddy cultivation;

3) From the economic point-of-view, paddy is the most favorable crop among those which have been cultivated during dry season such as maize, green bean, cassava, etc., as will be easily understood from the comparison given in Table 8-12; and

4) Indonesia as a whole is still in short of rice.

Movement of paddy from South Sulawesi is shown in Table 8-13.

3.2 Proposed Cropping Pattern

Through an analysis of the hydrological data, it has been found that paddy cultivation in the benefitted area can depend on the effective rainfall from November to April and on the river discharge from November to May. Puddling, a process of paddy cultivation during which irrigation water requirement comes to a peak, should preferably fall, in case of both wet season paddy as well as dry season paddy, in the above-said period of the year. As for the wet season paddy, harvesting of paddy and its drying will be performed in a wet season. This will make farmer's activities inconvenient. Therefore, to avoid the above inconvenience, the proposed cropping pattern has had to assume the shape as proposed in Fig. 8-4, though it may be somewhat less advantageous from irrigation water point-of-view.

This cropping pattern has been worked out on the assumption that the growth period of paddy would be 125 days, which is an average of the HYV's of rice that are expected to be planted in the benefitted area (refer to Table 8-14) as recommended by the Agricultural Extension Service in Ujung Pandang under BIMAS/INMAS program (up till 1983).

3.3 Estimated Crop Yield

The paddy yield expected at the full fruition stage of the project has been estimated as below, by taking into consideration 1) the past performance in South Sulawesi province and 2) improvement of appropriate cultivation techniques including proper use of fertilizers and agro-chemicals.

The paddy yield with the project is as follows.

(Unit: tons/ha)

	Paddy	Dry stalk paddy	Gaba
Wet season paddy:	4.59	6.00	3.12
Dry season paddy:	4.59	6.00	3.12

The paddy yield "without the Project" would remain as follows:

(Unit: tons/ha)

	Paddy	Dry stalk paddy	Gaba
Wet season paddy:	3.85	5.03	2.62
Dry season paddy:	3.30	4.31	2.24

4. WATER REQUIREMENTS

4.1 Basic Year for Planning

In Indonesia, it has been customary to select the second droughtiest year in the last 10 years (equivalent to a 5-year probability) as the "basic year" for its irrigation projects. It seems appropriate to adopt the second droughtiest year in the past decade for this project also.

The "drought year" in this case will be defined as such a year when the dependency on the reservoir could have become the largest due to the climatological condition, the availability of river discharge and the other reasons. Undoubtedly, the year 1972 has been the top droughtiest year during the last decade (1971-1980), as evidenced by various data on hand including the past rainfall records. Identification of the second droughtiest year during the same period cannot be made from the rainfall records alone and, therefore, a possible dependence on reservoir supply for its irrigation requirements has been computed with those years whose dry season rainfall may be put in the order starting from the second to the fifth, as folllows (refer to Table 8-18)

Consequently the year 1976 happens to be the year in which the dependency on reservoir supply could possibly be the one next to the largest. Hence this specific year has been adopted as the "basic year" for planning the present irrigation plan.

4.2 Benefitted Area

As much as 24,000 ha of paddy field in wet season (the entire project area) and 19,200 ha in dry season would benefit from the irrigation project. Allocation of water to Kampili and Bili-Bili area is summarized below:

Wet season paddy

Kampili area	19,000 ha
Bili-Bili area	5,000 ha
	24,000 ha

Dry season paddy

Kampili area	15,200 ha
Bili-Bili area	4,000 ha
	19,200 ha

The proposed distribution system for Kampili area as well as Bili-Bili area are illustrated in Figs. 8-5 and 8-6.

4.3 Irrigation Requirements

Evapotranspiration

For estimation of evapotranspiration from crops, two popular methods in Indonesia i.e., Modified Penman and Hargreaves were compared and modified Penman was adopted because it showed larger values. Table below shows monthly evapotranspiraiton.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Penman	5.7	5.0	3.1	*	4.3	4.7	6.1	6.5	4.7	*	4.7	4.7
Har-greaves	2.6	1.9	1.4	*	3.0	3.3	4.9	6.0	4.1	*	2.5	2.4

Table 8-15 shows monthly data of evapotranspiration from crops based on Modified Penman method for five year period of 1976 to 1980.

Crop factor at respective growth stage of paddy is estimated as below:

0% - 0.80	60% - 1.30
10% - 0.95	70% - 1.20
20% - 1.05	80% - 1.10
30% - 1.15	90% - 0.90
40% - 1.20	100% - 0.50
50% - 1.30	

Crop consumption factor for each month is shown in Fig. 8-7.

Unit Irrigation Requirement

Diversion requirement at both Bili-Bili and Kampili intakes have been computed on the basis of the evapotranspiration obtained in the preceding sub-section. The items necessary for computation will be as follows:

1) Water requirement in depth (percolation)

Wet season (November-April)	2.5 mm/day
Dry season (May-October)	3.0 mm/day

2) Effective rainfall

Re = 0.7 x Rm (mm/month)

Re: effective rainfall
Rm: monthly rainfall

3) Water required for preparation of paddy field and for puddling

Preparation	150 mm
Puddling	50 mm

4) Conveyance loss

Main channel, Branch channel	20%
Field internal	10%

Thus, the overall water conveyance efficiency will be 0.80 x 0.90 = 0.72

Diversion requirements during dry season in the Basic Year (1976) will be as shown in Table 8-16.

Diversion Requirement

Diversion requirement at headrace on 5-day basis would be 29.3 m^3/sec at maximum in August. The components are as below:

Kampili Intake $Q = 1.527 \times 15,200 \times \frac{1}{1,000} = 23.2\ m^3/sec$

Bili-Bili Intake $Q = 1.527 \times 4,000 \times \frac{1}{1,000} = 6.1\ m^3/sec$

Monthly diversion water requirement of 1976 which is selected as "basic dry year" is shown in Table 8-17.

5. IRRIGATION BENEFIT

Irrigation benefit is defined as an incremental net production value under the with- and without-the-project conditions. In this study, only the net incremental rice production has been calculated as the irrigation benefit derived from this project.

The allocation of water between the areas of Bili-Bili and Kampili was based on their respective area, i.e., 4,000 ha for Bili-Bili and 15,200 ha for Kampili in the dry season and 5,000 ha and 19,000 ha in the wet season, respectively.

Economic Price of Rice

Economic price of rice is assumed to be equivalent to the import substitution price, whose calculation is based upon the projected international market price (F.O.B. price at Bangkok). Projected price to 1985 in 1980 constant US dollars which was prepared by IBRD, has been employed to its calculation.

The price of rice at the full operation stage of the project has been assumed at Rp. 353,000/ton (refer to Table 8-19), in reference to the example of Langkemme Irrigation Project (which is proposed at about 130 km northwest along the provincial road away from Ujung Pandang).

Production Cost

The corresponding production cost has been estimated as below. Langkemme Irrigation Project has also been referred to for its estimation.

(Unit: RP/ha)

	Without project	With project
Wet season paddy	180,000	190,000
Dry season paddy	190,000	200,000

Net Production Value With and Without the Project

The net production value without project would remain at approximately Rp.19,319 million (US$30.91 million) or Rp.731,780 (US$1,171) per ha. in a year. On the other hand, net production value with project in a year would be Rp.38,980 million (US$62.37 million) or Rp.902,315 (SU$1,444) per ha.

Consequently, the project would bring about an increment of income amounting to Rp.19,661 million (US$31.46 million) per year, as detailed in Table 8-20.

6. PRELIMINARY DESIGN AND COST ESTIMATE

6.1 Bili-Bili Irrigation System

The maximum discharge projected for Bili-Bili system is Q = 6.1 m^3/sec. The volume tapped at Bili-Bili by natural intake is 3.5 m^3/sec when the discharge water amount of the Jeneberang is 30 m^3/sec.

The flow capacity of the channel between the intake and Pakatto weir is known to be Q = 3.2 m^3/sec where the channel meets Jl. Malino, which is subject to improvement.

The improvement scale of the Bili-Bili system would be as follows.

1) Channel construction (Bili-Bili dam to Bili-Bili irrigation system)

Conduit	200 m
Open channel	1,300 m
Total	1,500 m

The route of and the cross section of the connecting channel are shown in Fig. 8-8.

2) Improvement of existing system (Bili-Bili intake to Pakatto weir)

8,000 m in total

3) Improvement of secondary channels and other facilities

5,000 m in total

<u>Improvement of Intake Facilities</u>

Natural intake by present facility is very limited in volume. Additional volume would be diverted from discharge at power plant and conveyed to Bili-Bili irrigation system by conduit and open channel.

The alternative intake methods would be as follows.

1) *Direct tapping from stream*
2) Direct tapping from reservoir for Bili-Bili irrigation requirement
3) Direct tapping from tailrace at hydro power station

Direct tapping from Jeneberang with relatively lower intake stage would require damming of water by weirs as high as 1.2 m from riverbed (width: 150 m) for the intake water of 6.1 m^3/sec. The construction cost is estimated to be US$1.34 million.

The irrigation requirement at Bili-Bili may be tapped at intake placed at dam. The water is then conveyed to irrigation system by open channel laid out for 1,000 m. The construction cost would be US$3.85 million.

The third alternative which utilize the discharge from hydro power station require channel composed of conduit and open channel extending 1,100 m from power station. The construction cost would be US$0.91 million.

A comparative study for three alternative plans above has revealed that the third alternative would be the optimum choice for such advantages as below:

- Less construction cost

Improvement of Present Channels

The channel between Bili-Bili intake and Pakatto weir extending 8 km make use of natural river channel. Irregular sections and bottlenecks of the natural channel require improvement by adjustment of channel section.

Improvement of Secondary Channels and Relevant Facilities

The area subject to this improvement work corresponds to the benefitted area in wet season, which is 5,000 ha. As for the cost of improvement, US$900/ha. is adopted same as the cost for Bili-Bili system.

6.2 Kampili Irrigation System

The maximum projected amount for Kampili irrigatin system is disjoined at $Q = 23.2\ m^3/sec$. The present intake capacity of the Kampili intake is approximately 25 m^3/sec, making available the continued use of such facilities as intake and silting basin. Bottlenecks in some sections of main channel (flow capacity: approximately 12 m^3/sec) will be expanded. The improvement works of the system may be summarized as below:

1) Improvement of main channel (Setting basin to BL_1)	2,500 m
2) Improvement of secondary channel and relevant facilities	19,000 ha

Improvement of Main Channel

The narrow sections between silting basin to BL_1 diversion work (approximately 2,500 m) will be expanded to allow volume of $Q = 23.2\ m^3/sec$. The work volume would be 25 m^3 per meter, and the total, 62,500 m^3.

Fig. 8-9 shows the improvement section of main channel and its cross-section.

Improvement of Secondary Channels and Relevant Facilities

The area subject to this improvement work corresponds to the benefitted area in wet season, which is 19,000 ha. As for the cost of improvement, US$900/ha. is adopted same as the cost for Bili-Bili system.

6.3 Construction Schedule

The construction schedule is based on the assumption that 4 years (1983-1986) will be required for preparation works for commencing the construction works, and also that the improved irrigation facilities shall be ready for immediate use upon completion of Bili-Bili dam in 1990. Accordingly, the irrigation construction works would be started in 1987 and completed in 1990, so that the irrigation facilities could be used from 1991 onward. The construction schedule is shown in Fig. 8-10.

6.4 Cost Estimate

Construction Cost

Irrigation construction cost primarily comprises the direct construction cost, land acquisition cost, engineering cost and plus 15% physical contingencies. Construction cost would be US$29.8 million, which might be broken down into the local currency portion of US$22.7 million and the foreign currency portion of US$7.1 million, as detailed in Table 8-21 and Table 8-22 shows annual disbursement currency.

Operation, Maintenance and Replacement Cost

The operation and maintenance cost comprises the personnel cost, operational machinery and equipment, vehicles, administrative cost and miscellaneous. The annual operation and maintenace cost is estimated at US$0.50 million. Replacement cost of wooden bar, gabion and screen in every 10 years amounts to US$0.12 million.

Table 8-1 MONTHLY RIVER DISCHARGE AT THE BILI-BILI AND KAMPILI INTAKES

(Unit: m^3/sec)

	1975	1976	1977	1978	1979	1980
Jan.	54.07 87.73	94.82 153.85	112.57 182.65	67.54 109.59	98.67 160.09	85.65 138.14
Feb.	57.46 93.23	68.68 111.44	176.41 286.23	64.73 105.03	58.41 94.77	106.25 172.14
Mar.	51.20 83.07	68.79 111.61	60.02 97.38	35.34 57.34	61.18 99.27	73.56 119.95
Apr.	53.60 86.97	16.59 26.92	53.13 86.20	21.05 34.15	25.55 41.46	49.32 80.59
May	28.77 46.68	13.75 22.31	11.67 18.93	22.27 36.13	22.31 36.20	20.75 33.32
Jun.	10.76 17.46	2.89 4.69	20.33 32.99	16.09 26.11	10.72 17.39	5.33 8.18
Jul	4.66 7.56	2.75 4.46	2.72 4.41	27.54 44.68	2.67 4.33	2.57 11.60
Aug.	3.55 5.76	2.58 4.18	2.60 4.22	6.69 10.85	2.54 4.12	2.44 4.90
Sep.	2.58 4.19	2.33 3.78	2.40 3.89	4.34 7.04	2.38 3.86	2.29 3.80
Oct.	3.99 6.47	7.69 12.48	2.23 3.62	4.44 7.20	2.44 3.96	6.79 5.60
Nov.	41.77 67.77	17.48 28.36	17.05 27.66	20.57 33.38	7.07 11.47	21.53 28.10
Dec.	68.19 110.64	24.10 39.10	64.13 104.05	76.11 123.49	70.75 114.79	85.84 139.11
Dry Season Average	10.86 17.62	6.40 10.38	8.39 13.61	16.27 26.40	8.61 13.97	8.03 13.04

Note: Upper figures in the column - Bili-Bili
Lower figures in the column - Kampili

Table 8-2 IRRIGATION SYSTEM PREVAILING IN THE PROJECT AREA

(Unit: ha)

	Gowa		Takalar		Ujung Pandang	
	Area	%	Area	%	Area	%
D.P.U.P.S.S. technical	12,950	36.5	5,090	25.6	0	0.0
D.P.U.P.S.S. semi-tech.	7,450	21.0	1,920	9.6	0	0.0
Desa simple tech.	4,670	13.2	1,800	9.0	350	9.5
Desa non-tech.	10,410	29.2	11,100	55.8	3,330	90.5
Total	35,480	100.0	19,910	100.0	3,680	100.0

Table 8-3 PLANTED AREA BY DIFFERENT PADDY VARIETIES IN THE PROJECT AREA

- 1980 -

(Unit: ha)

	Gowa		Takalar		South Sulawesi	
Varieties	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season
Pl - 1	-	-	-	-	663.33	-
Pl - 2	-	-	-	-	5.00	-
PB - 5	-	4) 1,319.00	-	123.50	15,253.67	6,220.30
PB - 8	-	225.00	-	-	266.00	449.00
C4 - 63	-	559.00	3.50	4) 1,250.25	18,919.90	5) 8,760.55
Pelita	-	2,205.00	-	150.00	-	4,499.16
Adil	1) 756.95	307.00	-	-	1,296.95	1,301.52
Makmur	-	125.00	-	-	545.45	629.65
Cemar	-	21.00	-	-	-	168.00
Sub Total	756.95	4,761.00	3.50	1,532.75	36,950.30	22,078.18
PB - 20	-	98.00	-	-	2,379.34	1,340.95
PB - 26	64.69	209.00	4.00	78.50	5) 21,184.65	3,386.95
PB - 28	3.00	18.00	-	10.00	8,132.56	1,437.83
PB - 29	-	17.00	-	-	7,259.26	1,697.13
PB - 30	3) 216.13	212.00	5) 16.25	345.00	13,599.11	4,054.42
PB - 32	4) 174.00	5) 1,018.00	3) 56.65	5) 1,141.65	1) 56,998.47	3) 36,787.68
PB - 34	71.28	429.00	4) 55.65	2) 1,434.50	2,315.23	2,061.41
PB - 36	2.00	264.00	-	584.65	4) 26,330.87	4) 18,883.45
PB - 38	5) 112.83	641.00	2) 63.85	1,075.70	3,857.35	8,471.36
PB - 42	-	28.00	2.50	3) 1,373.50	2) 36,306.67	1) 57,088.63
Brantas	-	2) 1,697.00	-	423.96	2,786.81	4,384.14
Citarum	2) 301.60	1,594.00	1) 219.75	1) 1,678.30	3) 26,385.69	3) 35,337.02
Serayu	-	8.00	-	-	1,719.82	655.98
Asahan	62.38	55.00	-	5.00	2,527.44	6,903.61
Semeru	-	144.00	-	-	154.35	343.00
Cisadane	-	22.00	-	-	-	341.71
Ayung	-	-	-	-	-	118.32
Sub Total	1,007.91	6,454.00	418.50	8,150.76	211,936.86	183,296.58
U. Lama	906.18	5,198.00	26.00	151.00	18,629.27	14,223.18
Lokal	697.52	12,219.00	-	6,251.04	47,137.07	73,246.73
Galur	59.44	-	8.50	-	10,570.80	4,475.92
Total	3,428.00	28,632.00	456.50	16,085.55	325,224.20	297,320.59

Table 8-4 THE NUMBER OF FARM HOUSES IN KABUPATEN GOWA (1980)

(Unit: Nos.)

No	Name of Kecamatan	< 0.25 ha				0.25 - 0.50 ha				> 0.50 ha			
		Yeoman	Tenant	Yeoman and Tenant	Total 3+4+5	Yeoman	Tenant	Yeoman and Tenant	Total 7+8+9	Yeoman	Tenant	Yoeman and Tenant	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bontonompo	1,733	196	126	2,055	1,441	298	406	2,145	1,028	91	636	1,755
2	Bajeng	1,910	563	149	2,622	1,614	383	390	2,387	1,133	116	700	1,949
3	Tompobulu	813	70	45	928	2,123	212	521	2,861	6,749	293	2,331	9,373
4	Tinggimoncong	1,332	197	187	1,716	1,690	160	437	2,287	2,236	92	863	3,191
5	Parangloe	813	139	54	1,006	820	160	207	1,187	668	103	374	1,145
6	Bontamarunnu	306	309	51	666	825	539	340	1,704	908	392	707	2,007
7	Pallangga	2,164	219	127	2,510	1,735	229	578	2,532	810	106	1,002	1,918
8	Somba Opu	325	120	69	514	369	201	89	659	343	200	271	814
	Total	9,396	1,813	808	12,017	10,612	2,182	2,968	15,762	13,875	1,393	6,884	22,152

Source: Sensus penduduk 1980, penduduk Kabupaten Gowa 1980

Table 8-5 PRODUCTION OF PADDY AND OTHER PRINCIPAL FLOOD CROPS

South Sulawesi (ton/ha)					
	1975	1976	1977	1978	1979
Wet land paddy					
rainy season	3.267	3.519	3.656	3.748	3.944
dry season	3.567	3.814	4.583	4,239	3.656
(sub-total)	3.391	3.591	3.883	3.875	4.633
Dry land paddy	1.343	1.483	1.441	1.501	1.688
Maize (corn)	0.645	0.669	0.723	0.774	0.690
Cassava	7.260	7.100	7.044	7.173	6.961
Sweet potato	5.032	4.649	4.714	5.149	5.475
Soy bean	0.608	0.582	0.630	0.715	0.546
Green bean	0.485	0.450	0.471	0.599	0.607
Peanuts	0.586	0.587	0.625	0.626	0.607

Table 8-6 PRODUCTION OF PADDY IN THE RELATED AREA

Project Area = (Gowa + Takalar + U. Pandang)				
	1977	1978	1979	mean
Wet land paddy				
rainy season	3.263	3.446	3.797	3.50
dry season	2.400	3.624	2.986	3.00

Table 8-7 HARVESTED AREA, YIELD AND YIELD RATE OF FOOD CROPS BY KIND IN THE RELATED AREA

		HARVESTED ARES (HA)			YIELD (TON)			YIELD RATE (TON/HA)		
		1977	1978	1979	1977	1978	1979	1977	1978	1979
PADDY	WET LAND PADDY	52,255	56,544	53,429	166,453	196,240	199,410	3.185	3.467	3.732
	RAINY SEASON	47,531	48,828	49,154	155,114	168,275	186,646	3.263	3.446	3.797
	DRY SEASON	4,724	7,716	4,275	11,339	27,965	12,764	2.400	3.624	2.986
	DRY LAND PADDY	1,664	1,436	1,173	2,673	3,391	2,280	1.606	2.361	1.944
	T O T A L	53,919	57,880	54,602	169,126	199,631	201,690	3.137	3.449	3.694
M A I Z E		26,834	29,067	24,594	18,771	19,146	16,519	0.700	0.659	0.662
C A S S A V A		4,919	6,179	5,578	32,275	43,392	32,893	6.561	7.022	5.897
SWEET POTATO		851	776	627	3,212	2,969	2,813	3.774	3.826	4.486
SOY BEAN		44	19	39	21	9	24	0.477	0.474	0.615
GREEN NUTS		9,301	3,865	2,868	4,560	1,790	1,294	0.505	0.463	0.451
PEANUTS		650	531	451	380	321	275	0.585	0.605	0.610

SOURCE: AGRICULTURE SERVICE OF SOUTH SULAWESI
RELATED AREA: TAKALAR + GOWA + UJUNG PANDAND

Table 8-8 NUMBER OF THE LIVESTOCKS

	U.Pandang	Gowa	Takalar	Total
Horse	182	2,214	9,785	12,181
Cow	788	6,210	16,350	23,348
Buffalo	3,750	67	35,850	39,667
Goat	4,330	6,245	26,535	37,110
Pig	23,040	4,960	4,260	32,260
Village hen	164,820	64,575	927,675	1,157,070
Improved hen	72,560	450	470	73,480
Duck	19,290	1,830	19,510	40,630

Source: Statistical year book South Sulawesi 1979

Table 8-9 PROGRESS OF BIMAS AND INMAS OF RICE IN SOUTH SULAWESI

YEAR	BIMAS (ha)	INMAS (ha)	TOTAL(Ha)	INDEX'S
1969/1970	47,549	13,190	60,379	100
1970/1971	46,432	21,791	68,223	112.9
1971/1972	28,006	82,780	110,786	183.4
1972/1973	89,025	77,910	116,935	193.6
1973/1974	87,117	58,287	145,404	240.8
1974/1975	95,034	17,680	112,714	186.6
1975/1976	94,646	30,533	125,179	207.3
1976/1977	114,579	66,134	180,713	299.2
1977/1978	112,528	106,615	219,143	362.9
1978/1979	110,763	143,202	153,965	420.6
1979/1980	70,959	155,073	226,032	374.3

Table 8-10 PROGRESS OF BIMAS AND INMAS OF RICE IN THE RELATED AREA

(DRY + WET SEASON)

KABUPATEN/ KOTAMADYA	YEAR	BIMAS (ha)	INMAS (ha)	TOTAL (ha)	%
GOWA	1977	6,109	5,820	11,929	36.7
	1978	7,240	6,946	14,186	39.5
	1979	3,658	7,328	10,986	33.1
TAKALAR	1977	1,924	1,589	3,513	21.7
	1978	2,175	1,710	3,885	22.8
	1979	1,369	2,796	4,165	25.1
J.PANDANG	1977	205	454	659	18.6
	1978	90	196	286	8.0
	1979	25	324	349	9.6
TOTAL	1977	8,238	7,863	16,101	30.8
	1978	9,505	8,852	18,357	32.5
	1979	5,052	10,448	15,500	29.0

Source: Agriculture Service of South Sulawesi

$$\% : \frac{\text{Bimas + Inmas}}{\text{Bimas + Inmas + Non Bimas \& Inmas}} \times 100$$

Table 8-11 ECONOMIC ASPECTS OF FARM PRODUCTS

(Results of Field Survey)

Index / Commodity		Paddy Wet season	Paddy Dry season	Corn	Cassava	Green bean	Soy bean	Ground bean
Method of Cultivation (Traditional: New technic Bimas, Inmas, etc.)		traditional type	by animal	up land	up land	traditional type	traditional type	traditional
Gross Product								
Area planted	ha	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Products	ton/ha	2.500	2.000	0.670	7,000	0.290	1.410	0.800
Unit price	Rp/ton	71,500	71,500	35,000	10,000	125,000	70,000	125,000
(A) Gross products		178,750	143,000	23,450	70,000	36,500	98,700	96,000
Labor Force								
Family labors	day	10	24	30	70	20	10	95
Employed labors	day	160	33	10	-	-	30	37.5
(B) Total labors	day	170	57	40	70	20	40	132.5
Animals	day	-	10	-	-	-	-	-
Machines	day	-	-	-	-	-	-	-
Production Cost								
Cost of employed labor	Rp.	33,000	12,800	2,000	-	-	6,000	14,400
Cost of material	Rp.	30,900	29,400	2,850	10,400	3,500	9,500	7,500
Cost of depreciation	Rp.	-	-	-	-	-	-	-
Chargersand fees	Rp.	-	22,000	-	-	-	-	-
Tax	Rp.	-	-	-	-	-	-	-
(C) Production cost	Rp.	63,900	64,200	4,850	10,400	3,500	15,000	21,900
Income Profit								
(D) Family in income (A-C)	Rp.	114,850	78,800	18,600	59,600	32,750	83,200	74,100
(E) Cost of family labor	Rp.	2,000	16,000	6,000	13,000	4,000	2,000	15,000
(F) Farm profit (D-E)	Rp.	112,850	62,200	12,600	41,600	28,750	81,200	59,100
(G) Labor productivity (D:B)	Rp./day	676	1,091	465	851	1,638	2,080	559

Source : Agricultural Training Center in Cowa, 1978

Table 8-12 INCOME OF CROP

	Yield (ton/ha)	Unit Price (Rp/ton)	Gross Products (Rp/ha)	Production Cost (Rp/ha)	Income (Rp/ha)
Paddy	2.5	71,500	178,750	64,000	114,750
Maize	0.7	35,000	24,500	4,850	19,650
Green bean	0.5	125,000	62,500	3,500	59,000
Cassava	7.0	10,000	70,000	10,400	59,600

Table 8-13 MOVEMENT OF PADDY FROM SOUTH SULAWESI

(Unit: ton)

	1978 - 1979	1979 - 1980
NORTH SULAWESI	8,460	14,490
CENTRAL SULAWESI	2,000	2,995
EAST KALIMANTAN	9,976	23,930
WEST KALIMANTAN	3,000	17,400
MALUKU	10,250	15,450
SOUTH-EAST ISLANDS	2,000	--

Table 8-14 GROWTH PERIOD OF VARIETIES OF PADDY

(Unit: Number of Days)

Varieties of Paddy	Growth Period of Seedlings	After Transplanting		Total Growth Period
		Irrigation	Cultivatio	
1. C4 - 63	20 - 25	95	105	125 - 130
2. PB - 26	20 - 25	95	105	125 - 130
3. PB - 32	21 - 27	108 - 109	118 - 119	140 - 145
4. PB - 36	18 - 21	82 - 89	92 - 99	110 - 120
5. Cicarum	20 - 25	95	105	125 - 130

Note 1 : Persuasion seed sowing : 7 - 10 days
Note 2 : Puddling : 10 - 14 days

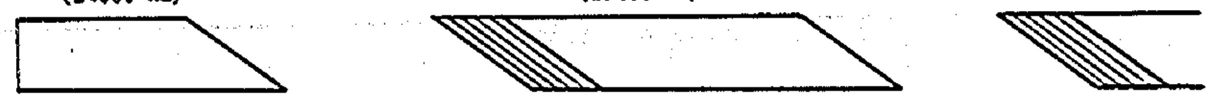
Table 8-15 CALCULATION OF EVAPOTRANSPIRATION (MODIFIED PENMAN METHOD)

(Unit: mm/day)

	Crop Consumptive use factor	1976		1977		1978		1979		1980	
		E	Er	E	Er	E	Er	E	Er	E	Er
Jan.	1.27	4.476	5.7	4.067	5.2	4.377	5.6	3.742	4.8	3.577	4.5
Feb.	1.15	4.357	5.0	4.015	4.6	4.443	5.1	3.763	4.3	3.477	4.0
Mar.	0.75	4.079	3.1	4.638	3.5	4.689	3.5	3.724	2.8	4.181	3.1
Apr.	*	5.136	*	5.000	*	5.079	*	4.312	*	4.116	*
May	0.92	4.625	4.3	4.753	4.4	4.302	4.0	3.963	3.6	4.049	3.7
Jun.	1.12	4.227	4.7	4.078	4.6	4.267	4.8	3.921	4.4	3.761	4.2
Jul.	1.27	4.792	6.1	4.929	6.3	4.134	5.3	3.851	4.9	4.179	5.3
Aug.	1.15	5.673	6.5	5.425	6.2	5.053	5.8	4.593	5.3	4.536	5.2
Sep.	0.75	6.308	4.7	6.372	4.8	5.228	3.9	4.955	3.7	5.238	3.9
Oct.	*	5.860	*	6.879	*	5.944	*	5.097	*	5.215	*
Nov.	0.92	5.084	4.7	5.918	5.4	5.181	4.8	4.986	4.6	4.925	4.5
Dec.	1.15	4.116	4.7	4.664	5.4	4.142	4.8	3.864	4.4	3.656	4.2

Table 8-16 MONTHLY CONSUMPTIVE USE BY CROP AND WATER REQUIREMENT (1976)

Item		Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1) Cropping Pattern			Wet season paddy (24000 ha)					Dry season paddy (19200 ha)						
(2) Evaporation (day)		mm	5.7	5.0	3.1	*	4.3	4.7	6.1	6.5	4.7	*	4.7	4.7
(3) Evaporation (month)		mm	176.7	140.0	96.1	*	133.3	141.0	189.1	201.5	141.0	*	141.0	145.7
(4) Percolation (day)		mm	2.5	2.5	2.5	*	3.0	3.0	3.0	3.0	3.0	*	2.5	2.5
(5) Percolation (month)		mm	77.5	70.0	77.5	*	93.0	90.0	93.0	93.0	90.0	*	75.0	77.5
(6) Water requirement (I)	(3)+(4)	mm	254.0	210.0	173.6	*	226.3	231.0	282.1	294.5	231.0	*	216.0	223.2
(7) Planted area ratio			1.0	0.9851	0.3360	*	0.0048	0.5950	1.0	1.0	0.5	*	0.0556	0.7849
(8) Water requirement (II)	(6)x(7)	mm	254.0	206.9	58.3	*	1.1	137.4	282.1	294.5	115.5	*	12.0	175.2
(9) Puddling water		mm	0.0	0.0	0.0	*	86.7	113.3	0.0	0.0	0.0	*	133.3	66.7
(10) Water requirement (III)	(8)+(9)	mm	254.0	206.9	58.3	*	87.8	250.7	282.1	294.5	115.5	*	145.3	241.9
(11) Rainfall		mm	834.0	524.0	382.0	*	46.0	45.0	0.0	0.0	0.0	*	328.0	445.0
(12) Effective rainfall	0.7x(11)	mm	583.0	366.8	267.4	*	32.2	31.5	0.0	0.0	0.0	*	229.6	311.5
(13) Area ratio			1.0	0.9851	0.3360	*	0.2844	0.9728	1.0	1.0	0.5	*	0.5	1.0
(14) Effective rainfall	(12)x(13)	mm	583.0	361.3	89.8	*	9.2	37.6	0.0	0.0	0.0	*	114.8	311.5
(15) Field delivery	(10)-(14)	mm	*	*	*	*	78.6	220.1	282.1	294.5	115.5	*	30.5	*
(16) Field requirement		l/sec/ha	*	*	*	*	1.032	0.873	1.053	1.100	0.891	*	0.235	*
(17) Diversion requirement	(16)/0.72	l/sec/ha	*	*	*	*	1.433	1.212	1.463	1.527	1.238	*	0.327	*



NOTE: (16)=(15)/[days of month x (13)] x 10,000 / 86,400

Table 8-17 DIVERSION REQUIREMENTS DURING DRY SEASON (1976)

	Unit	May	Jun.	Jul.	Aug.	Sep.
Unit Water Requirement	l sec/ha	1.433	1.212	1.463	1.527	1.238
Bili-Bili Intake (4,000 ha)	m^3/sec	0- 4.396 *1)	4.848	5.852	6.108	4.952-0 *2)
Kampili Intake (15,200 ha)	m^3/sec	0-16.706 *1)	18.422	22.238	23.210	18.818-0 *2)
Total (19,000 ha)	m^3/sec	0-21.102 *1)	23.270	28.090	29.318	23.770-0 *2)

* 1) : May 0% - 76.7% area
* 2) : Sep. 100% - 0% area

Table 8-18 IDENTIFICATION OF BASIC YEAR FOR PLANNING

Benefitted Area: 19,200 ha

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Volume dependent on reservoir supply (x $10^6 m^3$)	--	--	--	--	--	241	190	69	178	198
Order of the "drought year"	7th	1st	9th	6th	10th	2nd	5th	8th	4th	3rd

Note: The order of the "drought year" was determined based on the rainfall amount during dry season at Hasanuddin.

Table 8-19 ECONOMIC PRICE OF RICE (GABA)
- Import Substitution Price -

(Unit: Rp/ton)

1. International Market Price (F.O.B. Bangkok) /1 US$557	348,125
2. External Transportation Cost (Bangkok - Ujung Pandang)	8,125
3. Port Handling Charge and Storing Cost (including cost of sacks) /2	5,710
4. Selling Price of Rice at Ex-mill Gate	361,960
5. Milling Charge	- 6,000
6. Handling and Transportation Cost (Farm gate to mill)	- 2,700
7. Economic Farm Gate Price of Dry Stalk Paddy	353,260 [353,000]

Note: /1 : Source - Price prospects for Major Primary Commodities IBRD, 1980

Projected price to 1985 in 1980 constant US dollars.

/2 : Handling charge at harbor 30 Rp/ton
Storing chasrge 7 Rp/ton/day x 240 days
Cost of sacks 4000 Rp/ton

Table 8-20 IRRIGATION BENEFITS

Description	W/O Project	W/Project	Increment
1. Planted Area (ha)			
-wet season paddy field	24,000	24,000	0
-dry season paddy field	2,400	19,200	16,800
2. Unit Yield (ton/ha)			
-wet season rice	2.62	3.12	0.50
-dry season rice	2.24	3.12	0.88
3. Project Price of Paddy (Rp/ton)			
-rice (Gaba)	353,000	353,000	0
4. Unit Production Cost (Rp/ha)			
-wet season rice	180,000	190,000	10,000
-dry season rice	190,000	200,000	10,000
5. Gross Production Value (1x2x3) ($x10^6$ Rp)	24,095	47,579	23,484
-wet season rice	22,197	26,433	4,236
-dry season rice	1,898	21,146	19,248
6. Total Production Cost (1 x 4) ($x10^6$ Rp)	4,776	8,400	3,624
-wet season rice	4,320	4,560	240
-dry season rice	456	3,840	3,384
7. Net Production Value (5 - 6) ($x10^6$ Rp)	19,319	39,179	19,860
-wet season rice	17,877	21,873	3,996
-dry season rice	1,442	17,306	15,864
8. Crop Damage Due to Water Shortage ($x10^6$ Rp)	0.0	282	282
-wet season rice	0.0	109	109
-dry season rice	0.0	173	173
9. Adjusted Net Production Value (7 - 8) ($x10^6$ Rp)	19,319	38,897	19,578
-wet season rice	17,877	21,764	3,887
-Dry season rice	1,442	17,133	15,691

Table 8-21 CONSTRUCTION COST OF IRRIGATION

Work Item	Total Amount ($x10^3$ US$)	Foreign Currencey ($x10^3$ US$)	Local Currency ($x10^3$ US$)
1. Main Works			
Work I (S.C. & R.F.)	5,400	778	4,622
Work II (S.C. & R.F.)	5,400	778	4,622
Work III	5,833	984	4,849
S.C. & R.F.	5,400	778	4,622
Kampili main channel	433	206	227
Work IV	6,214	1,018	5,196
S.C. & R.F.	5,400	778	4,622
Bili-Bili connecting channel	648	161	487
Bili-Bili existing channel	166	79	87
Sub-total	22,847	3,558	19,289
2. Engineering Service	3,100	2,640	460
Sub-total (1-2)	25,947	6,198	19,749
3. Physical Contingency	3,892	930	2,962
Grand-total (1-3)	29,839	7,128	22,711

Note: S.C. & R.F. = Secondary Channel and Relevant Facilities

Table 8-22 ANNUAL DISBURSEMENT SCHEDULE FOR IRRIGATION

(Unit: x 10^3 US$)

Work Item	Total		1985		1986		1987		1988		1989		1990	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Main Works														
Work I	778	4,622	-	-	-	-	778	4,622	-	-	-	-	-	-
Work II	778	4,622	-	-	-	-	-	-	778	4,622	-	-	-	-
Work III	984	4,849	-	-	-	-	-	-	-	-	984	4,849	-	-
Work IV	1,018	5,196	-	-	-	-	-	-	-	-			1,018	5,196
Sub-total	3,558	19,289	-	-	-	-	778	4,622	778	4,622	984	4,849	1,018	5,196
2. Engineering Service	2,640	460	800	140	-	-	460	80	460	80	460	80	460	80
3. Physical Contingency	930	2,962	120	21	-	-	186	705	186	705	217	739	221	792
Grand-total (1-3)	7,128	22,711	920	161	-	-	1,424	5,407	1,424	5,407	1,661	5,668	1,699	6,068

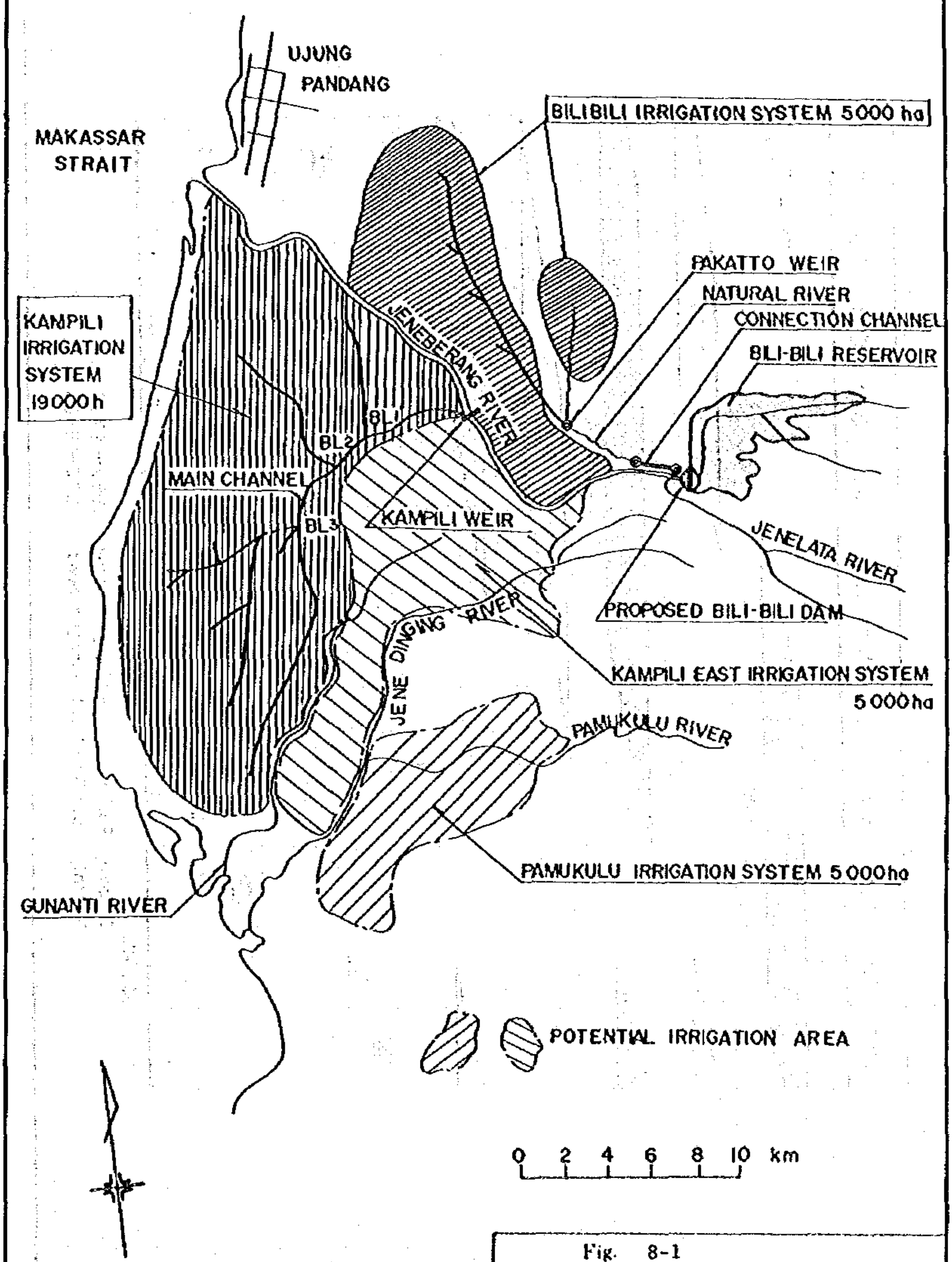


Fig. 8-1

IRRIGATION STUDY AREA

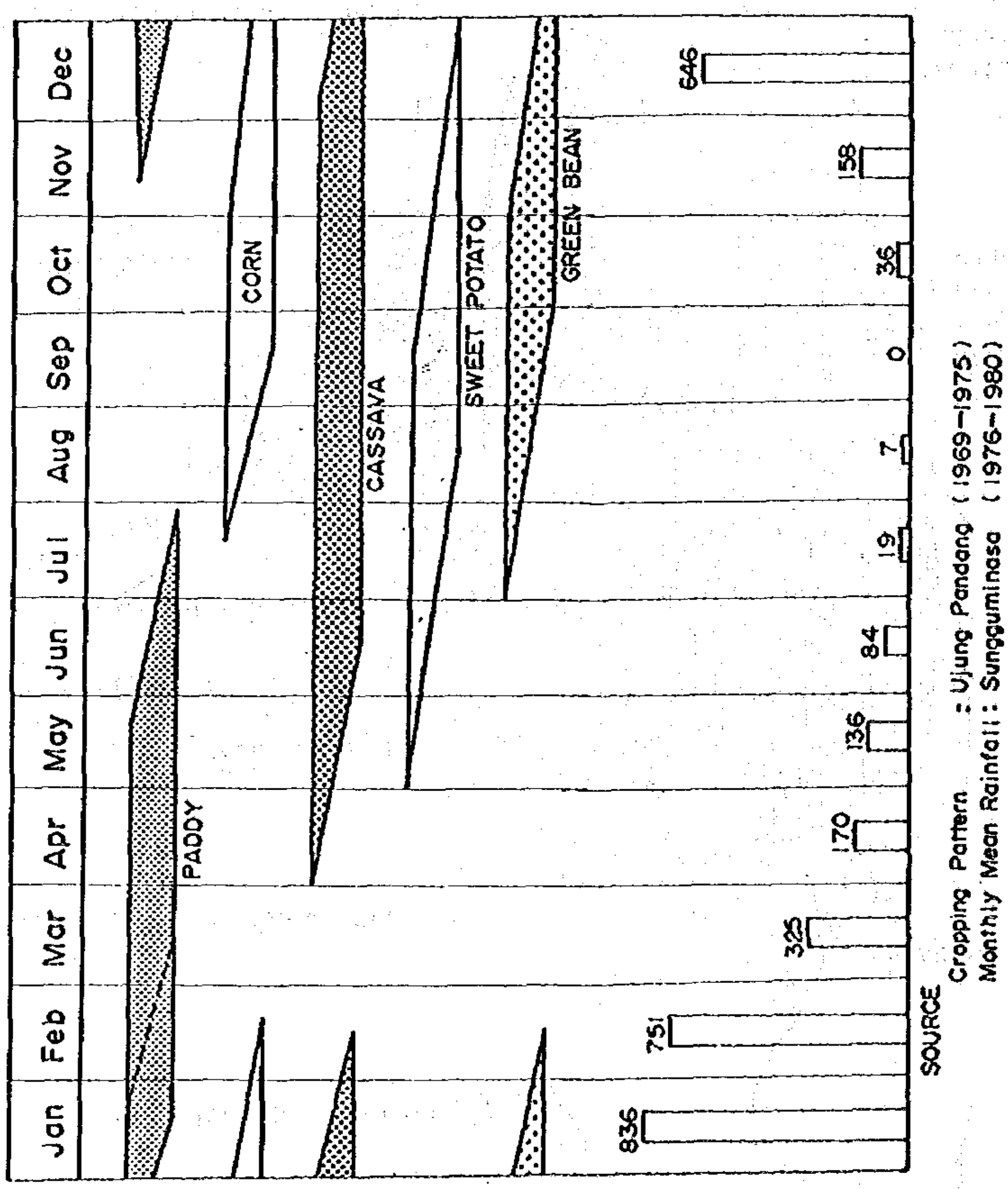


Fig. 8-2

PRESENT CROPPING & RAINFALL PATTERN IN PROJECT AREA

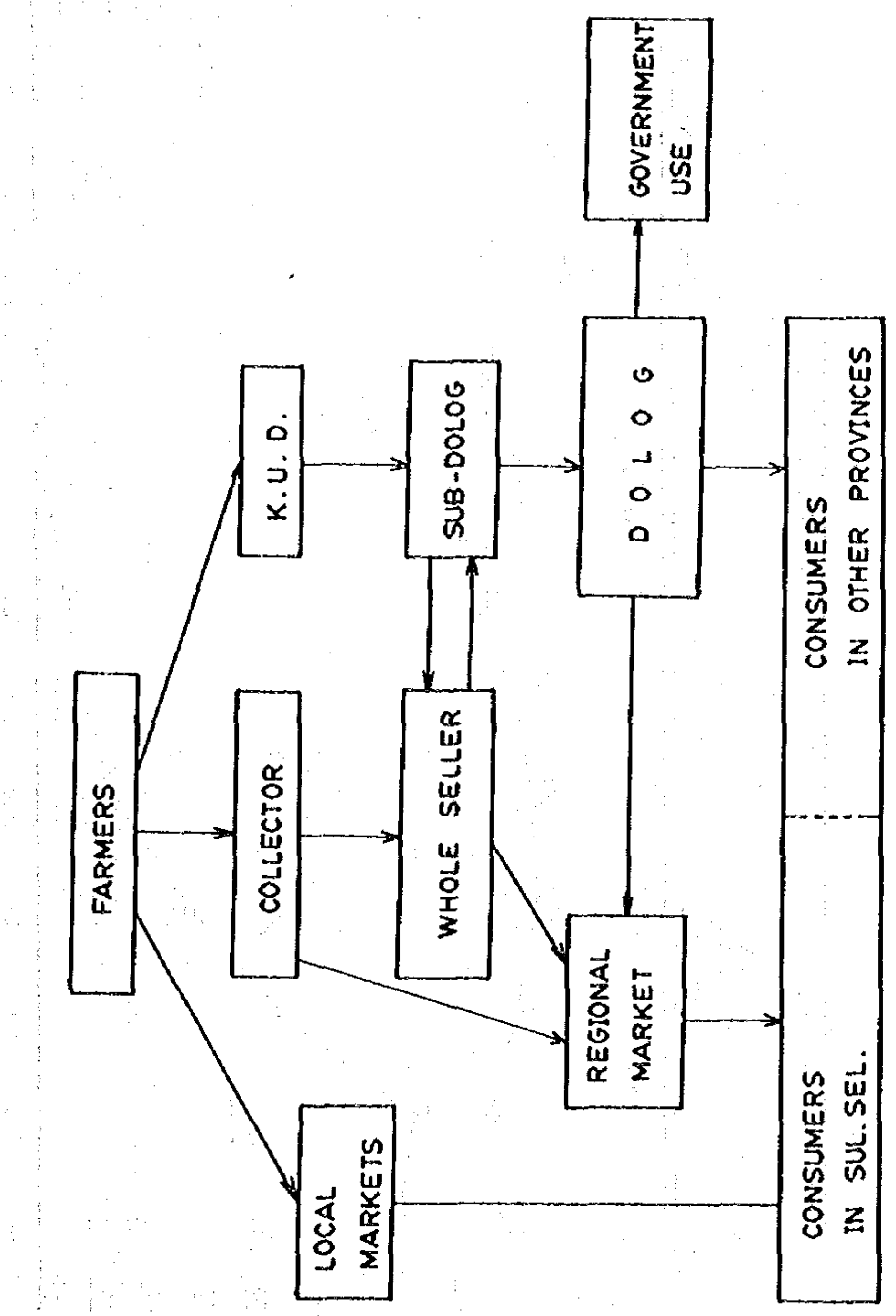


Fig. 8-3

MARKETING SYSTEM OF RICE

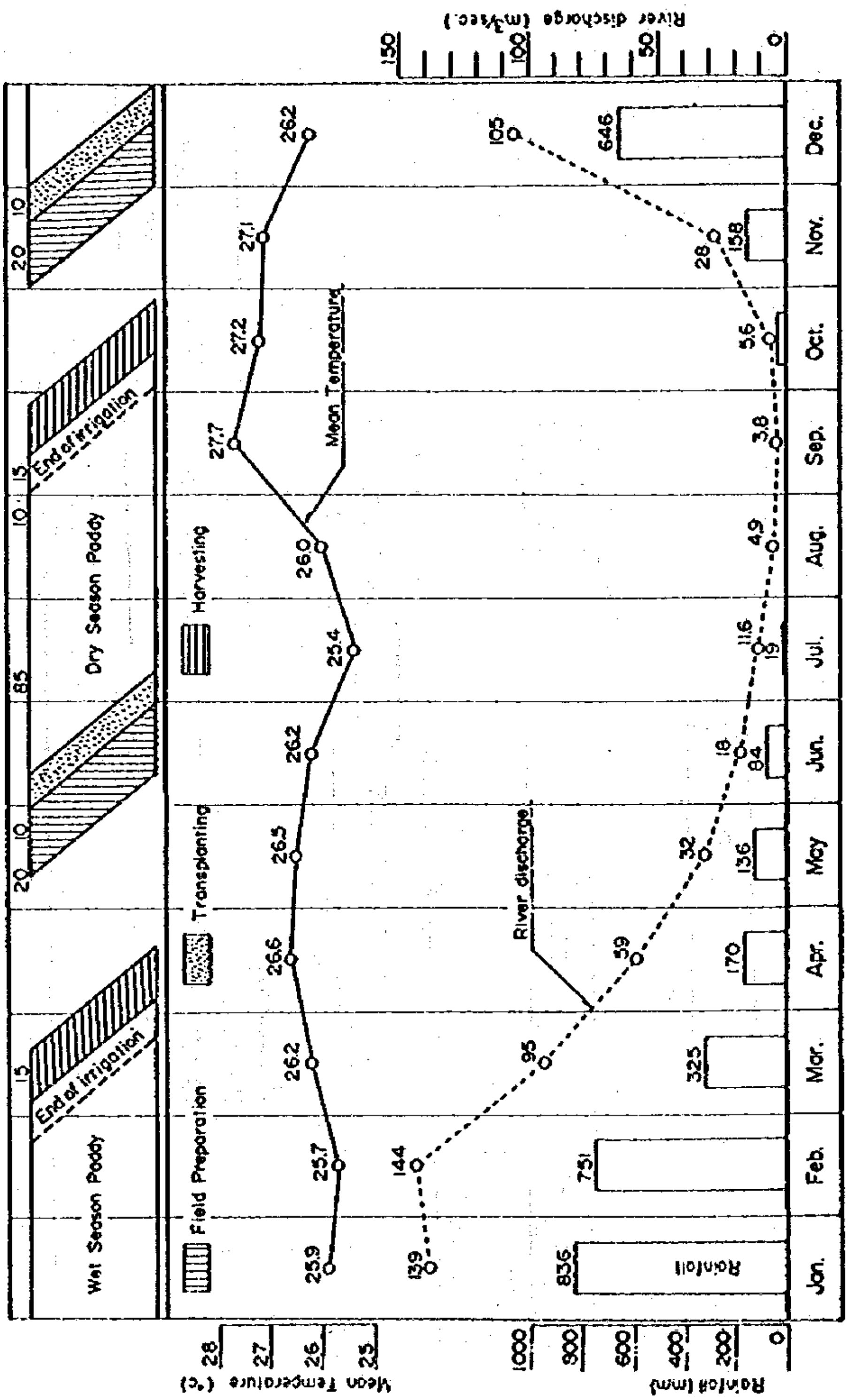


Fig. 8-4

PROPOSED CROPPING PATTERN

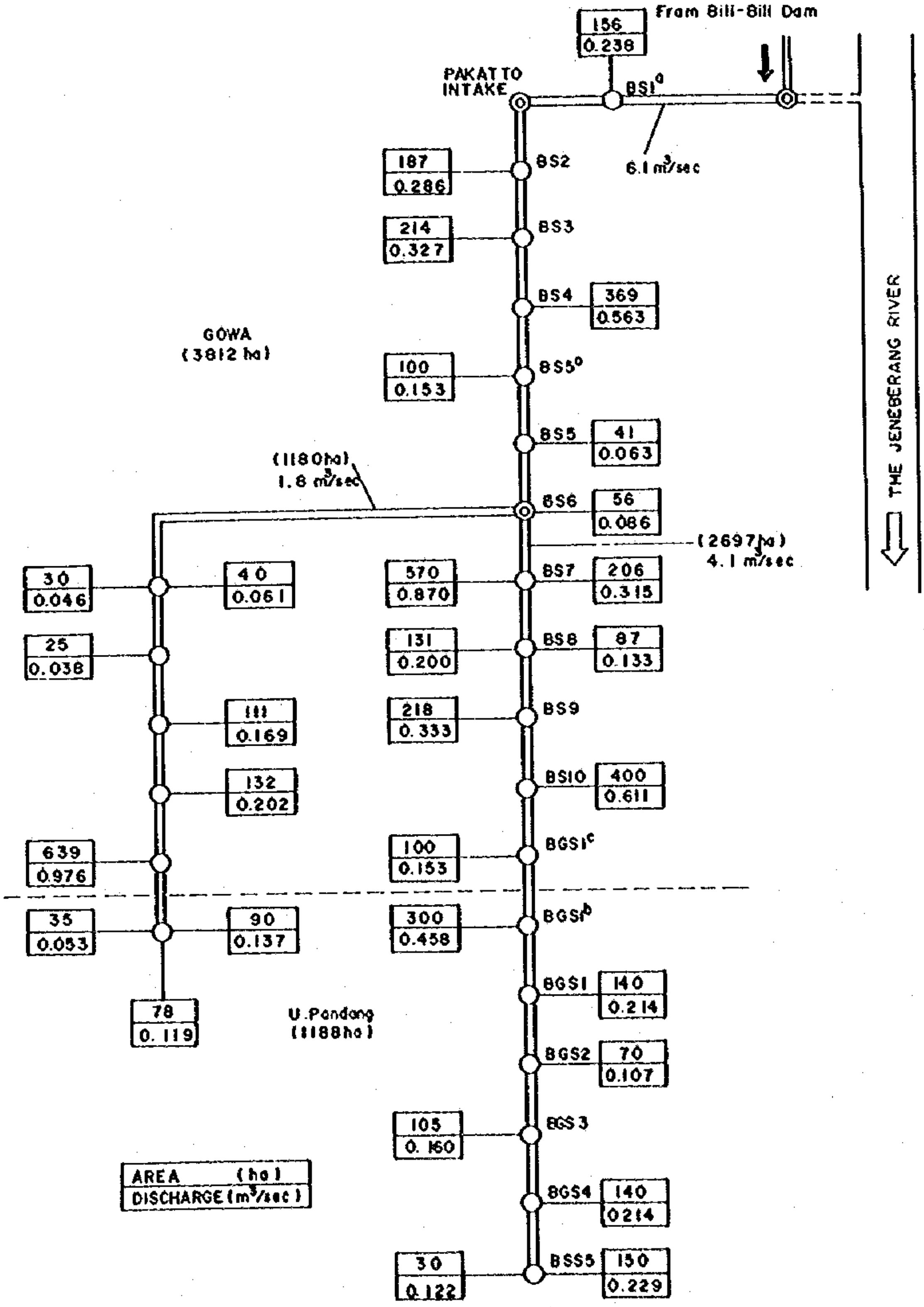


Fig. 8-5

DIAGRAM OF DISTRIBUTION SYSTEM

(BILI-BILI BENEFITTED AREA)