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ROAD RESOURCES MANAGEMENT PROJECT

PAKISTAN

EXPERIMENTAL ROADS

STATUS, DECEMBER 1990

CONSTRUCTION CONTROL SERVICES CORPORATION

USAID CONSULTANTS FOR ROAD RESOURCES MANAGEMENT PROJECT

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&

ASSOCIATED CONSULTING ENGINEERS
KARACHI-8. PAKISTAN

EXPERIMENTAL ROADS

STATUS, DECEMBER 1990

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EXPERIMENTAL ROADS

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Introduction

The Road Resources Management Project is an integrated approach to solving the problems of a deteriorating transportation infrastructure in rural Sindh. The primary overall project objectives are to:

- Rehabilitate non-maintainable paved roads to establish a fully maintainable road system;
- Define the policy, management and financial reforms needed to achieve a sustainable road system nationwide; and
- Implement such policies and administrative reforms in the Sindh.

The project is composed of five components, which, operating together will address the above-stated objectives. These components are:

1. Road Maintenance Program (RoMP)
2. Road Maintenance Management System (RoMMS)
3. Road System Improvements (RoSI)
4. Financial Management Program (FMP)
5. Training

Within the "Road System Improvements" component, there are three goals:

1. The rehabilitation of existing paved roads which have

deteriorated to the point where they can no longer be economically maintained;

2. The upgrading of katcha roads to paved surface; and
3. Construction of minimal access, low maintenance katcha roads in areas not served by the present network.

The Experimental Roads Program is a sub-component of the Road Systems Improvements which in itself will provide only a small degree of improvement in the network, but which, it is hoped, will provide useful information leading to greater efficiency in the maintenance, rehabilitation and construction of rural roads in the future, nationwide.

Purpose

The purpose of the Experimental Roads Program is to:

1. Address technical difficulties of road design in the Sindh caused by
   - difficult soil and water conditions
   - a history of accelerated pavement deterioration caused partially by inadequate design and construction standards; and
   - limited materials availability
2. Experiment with alternative road surface designs and materials.
3. Provide sufficient follow-up and statistical data base to determine the most economical pavement designs using materials and procedures which will minimize the life-cycle cost of future road projects.

It is hoped that the long-term follow-up which this program envisions, in conjunction with open information sharing with the National Transport Research Centre Demonstration Roads Program, being monitored in Islamabad, will permit the evaluation of a broad spectrum of road construction and rehabilitation alternatives and the development and implementation of an institutionalized methodology for fomenting and monitoring the efficacy of alternative construction, rehabilitation and maintenance practices.

Background

The Road Resources Management Project was originally conceived of as a National Program. Although RRMP designs will be constructed only in Sindh Province, it is important to recognize that the infrastructure maintenance and expansion problem is nation-wide in scope and, as such, it is treated in this broader context.

Statistics of the National Transport Research Centre indicate that, at the national level only 125,000 Kms of roads are available as against a requirement of 500,000 Kms, which the Planning Commission considers appropriate for adequate national, economic and social development and communications. Of the construction shortage of 375,000 Kms, the vast bulk of new infrastructure requirements is in the expansion of the rural road network. An integrated network of roads, including the basic farm to market roads, is essential for an agricultural country like Pakistan. This integration does not yet exist.

The current shortfall in development of the transportation system and the rapid deterioration of the existing rural infrastructure are partly due to severe resource constraints.

The average construction cost, nation-wide, for a new, paved, single-lane agricultural road is Rs.700,000 per Km. Rehabilitation costs under the RRMP, using traditional design and construction practices, but enforcing the highest standards of supervision and quality control, are averaging between Rs.400,000 and Rs. 600,000 per Km, including extensive shoulder widening to improve lateral support to the pavement. No solution is readily apparent using traditional approaches to construction and financing of the agricultural roads system. World-wide experience has shown beyond a doubt that better planning and more efficient utilization of limited financial resources is necessary to adequately expand and maintain a transportation infrastructure. The magnitude of the transportation demand in Pakistan, vis-a-vis the paucity of resources to meet that demand, suggests that revenue enhancement, improved planning and implementation of more effective and efficient maintenance management systems will not, in themselves, provide the optimum solution to the infrastructure dilemma. Improved construction practices and application of more appropriate pavement designs incorporating alternative construction materials may provide an additional means to accelerate national development. Minimization of life-cycle cost is a key element of any integrated approach to maximizing the utility and efficiency of the transport system.

The Road Resources Management Project attempts to improve system efficiency in general. The Experimental Roads component attempts to contribute to the solution of the life-cycle cost problem in particular, by finding appropriate low-cost construction alternatives and encouraging implementation of the concept of stage-construction at the earliest point of road network expansion.

Project Evolution

The project paper states the following:

"Experiments with low-cost and/or low-maintenance requirement construction methods and designs will be made to identify technologies suited to the special conditions of the Sindh... To the extent possible, these experimental designs will be used on katcha roads constructed in the first year of Phase II, to allow the maximum period of observation. Consideration will also be given to constructing short experimental roads in the second year of Phase I, to improve cost estimates for alternative designs....

The soil and water conditions in the Sindh create a technical environment that tends to make road construction more costly... (Waterlogging and salinity) make it necessary to increase the height as well as... drainage ... The failure to make these investments has led to rapid deterioration of the roads ....

The program design incorporates plans for the technical services team to work with local officials to design and test several alternative construction methods on short stretches of district road. These test sites would be completed in the third year of the project ... in order to provide the maximum period for observation of their performance. The selection of specific designs and techniques for testing will be made by the technical services team, in consultation with local engineers".

It was recognized that the experimental road construction effort had to be multi-faceted, taking into consideration past experience in the districts, the C&W, the National Highway Board and the National Transport Research Centre, but implementation of the program had to take place through the district councils in order to provide feedback on the types of problems that these bodies face in administering construction projects and to provide hands-on experience in the alternative construction practices that would be attempted.

At the initial phases of the RRMP, it was thought that the experimental roads would be limited to higher standard katcha or gravel roads. However, by early 1989 it was recognized that this component should address problems of rehabilitation of existing paved roads, the upgrading of katcha to paved roads and the construction of new paved roads. The desire to emphasize roads with heavier traffic volumes and a consensus of opinion at district level has, over time, shifted the emphasis of the experimental roads project more and more toward pavement design and rehabilitation alternatives. The existance of long stretches of paved roadway needing rehabilitation makes it possible to try as many as four experiments on one road, making it possible to evaluate behavior of each design and construction technique over an extended period of time under identical traffic/loading conditions.

Research

Prior to establishing any new design parameters, the Consultant

undertook a review of previous experimental work performed by C&W, The National Highway Board and The National Transport Research Centre. Experimental projects of C&W and The National Highway Board suffered from inadequate documentation. Basic cost data, long-term maintenance statistics and evaluation of structural integrity and functional servicibily were totally lacking. The experimental aspects of initial design and construction procedures, or even dates of construction were undefined. There was a general lack of documentary evidence to permit determination of the value or validity of the experiments.

The National Transport Research Centre, however, appears to be taking a more effective approach to alternative design and construction practices in its Demonstration Roads Program. Because this is a relatively new ongoing program, the results will not be known for some time. However, RRMP personnel have reviewed the demonstration designs and inspected some of the roads to evaluate their condition one year after construction. It is hoped that by working together and sharing information, the RRMP effort can be integrated into the NTRC database to widen the scope of construction alternatives available to district councils in the expansion and rehabilitation of their rural road network.

In addition to the above, CCSC reviewed numerous reports provided by various officials at the different levels of government that are cooperating with this project including reports on chemical soil stabilization, provided by C&W, and technical support and supplementary information provided by Associated Consulting

Engineers and Geotech Consultants. Site inspection of cement treated base work, now being supervised by Bechtel at the Karachi Airport, was also conducted as part of the search for the most promising technical alternatives.

EVALUATION OF PROPOSED PROJECTS

During 1989 and 1990 a number of katcha roads submitted by the Districts for experimental upgrading were investigated.

After inspecting each road and reviewing preliminary requirements, prior to undertaking actual design, many of these projects had to be eliminated from consideration for various reasons. Some would have required excessive costs for embankment and/or culverts, which would leave little or no money available for the actual construction of the experimental pavements. Some of the proposed projects were located on the berms of canals belonging to other authorities, making it impossible to upgrade the right-of-way. In other cases canals ran down the shoulder of the road, which would have required complete relocation. Projects of such a magnitude fell outside the scope of the experimental pavements program. A number of roads initially submitted for experimentation and evaluated by CCSC were subsequently turned over to the Provincial Communications and Works department and were no longer under the jurisdiction of the Districts.

Material sources for possible use in experimental roads were located after extensive field investigation by the CCSC Materials Engineer. Local materials which were considered included bricks, brick dust, broken bricks, murram, gravel, sand and low quality stone. Embankment material and borrow for potential experimental roads and district roads throughout Sindh in general were tested and the classification determined as a guide for potential treatment.

A comprehensive testing program was carried out to identify the properties of the sub-grade of each of the projects considered. Materials from the most promising potential borrow sites for the experimental roads were also carefully analyzed. This permitted a site by site review of the alternative treatments most appropriate for the range of properties of District roads and available materials through-out Sindh.

Based on this preliminary review of alternative treatments, the most suitable types of stabilization were selected and tested for the specific soils types detected.

I. Lime Stabilization

In general lime is best suited for stabilizing soils with a high active clay content since it reacts with the clay to form a cementing agent. For such soils types, this material is superior to bitumen or cement, which must neutralize existing clay before it can effectively provide cementing action. Consequently, bitumen or cement would have to applied more generously to these types of soils at prohibitive expense.

Lime may also be effective with some silts that contain material which provide pozzolanic action and appears to be a promising means of stabilizing many of the roads investigated. For those primarily silty soils, which exhibit insufficient pozzolanic qualities, brick dust may be combined with lime to produce the required pozzolanic

reaction. Small amounts of lime in combination with cement may also be practical. This alternative is being investigated in greater detail now that the design phase of the experimental road component is underway.

Most soils identified for the experimental roads were found to be very fine grained, near the border line between clay and silt.

II. Bitumen Stabilization

Tests with bituminous stabilization indicated it would be uneconomical, since only small strength gains were developed for reasonable amounts of asphalt.

III. Cement Stabilization

Cement stabilization has the disadvantage of developing severe shrinkage cracks for the high cement content (as previously mentioned) that would be required for these fine-grained soils. The District Engineers have also expressed concern that cement cannot be stored on site because of threat of robbery. Given the prevalent characteristics of the soils on the qualified projects, cement stabilization would be economical only in cases where the haul from the nearest approved stone quarry exceeds 80 miles, given the current carriage costs. Once new carriage costs are determined as a result of the fuel price increase, this material will be economical for shorter distances. The consultant with continue to monitor the costs and effectiveness of such alternatives throughout

the project.

IV. Salt Stabilization

Salt stabilization is a possibility for low traffic volumes in arid climates. The salt attracts moisture which keeps the material at a sufficient moisture content such that loss of dust is greatly reduced. Rain leaches the salt out, however. Although salt appears to be a very visible natural component of the soil in some areas, it has not been found in sufficient naturally occuring concentration to make salt stabilization economically practical in the Sindh. Further exploration is underway to determine the possibility of locating satisfactory material where it has been bladed into windrows by the irrigation authorities.

V. Other Types of Soil Stabilization

Blending of materials (such as murram, gravel, broken brick, brick dust, etc.) with the embankment material can be used to improve the properties. The practicality of blending depends on the economic availability of these materials at the experimental site and the quantities which would be required to respond to the specific requirements of the given soils types and expected traffic loads.

Slag may be practical as an aggregate provided it can be obtained at a cost competitive with stone, taking carriage charges into account. Although this material has proven economical in some experiments of the National Transport Research Center in other provinces, to date, no local

sources of slag have been suggested in the areas of the road projects of the Sindh.

Experimental projects involving blending or use of other local materials may be located in areas where the price is advantageous. Chemical stabilizers such as SA-1 may be practical in some areas where stone haul is excessive. CCSC is studying the possibility of selecting additional roads located in areas where materials are available, economics are advantageous and traffic is suitable for comprehensive evaluation of performance.

REHABILITATION

Causes of Distress

1. Distortion

Distortion occurs from excessive deflection of material in the embankment or pavement structure after construction, resulting from stresses above the design capacity of pavement, or from lateral displacement of the pavement structure under load.

1(a) Consolidation

Additional consolidation occurs in all roads under traffic and results in a strengthening of the pavement although causing undesirable distortion. Additional consolidation of embankment materials is to be expected especially when the pavement is placed immediately after embankment construction. Excessive additional consolidation resulting

in severe levels of distortion will occur when compaction of embankment and pavement material is not adequate. For that reason, compaction of 95% AASHTO specification will be required in all experimental road construction, just as it is the required minimum in all RRMP rehabilitation projects.

1(b) <u>Displacement</u>

Lateral displacement occurs when the pavement structure is inadequate for the imposed vertical as well as horizontal loads and results in a loss of structural integrity of the pavement, thereby diminishing its strength. This can be the result of pavement structure that does not comply with design specification or which deteriorates due to excessive moisture or inadequate drainage conditions as a result of under design or poor maintenance of drainage structures. The net result is a generalized weakening of the sub-grade and pavement structure. Intrusion of sub-grade material into the pavement structure will probably occur due to pumping action aggravated by traffic, further weakening the pavement. This problem is compounded by a reduced thickness under the wheel tracks because of the migration of material in response to the uneven distribution of repetitive loading over the transverse section of the pavement.

2. Cracking

2(a) Causes of Cracking

Cracks occur when an asphalt pavement is strained beyond its ability to tolerate the normal temporary deflections which occur under design loading. They may result from a large number of small strain repetitions (deflections or shrinkage) or a smaller number of larger strain repetitions.

These cracks allow the entrance of water, weakening the pavement. They may propagate to the point that they intersect. This results in further loss of the impermeability of the wearing surface, disintegration of the wearing course itself, and concomitant exposure of the base to severe damage. An asphalt-rich flexible pavement can tolerate more strain without cracking than can a stiff pavement. On the other hand, a stiff pavement adds more strength to the pavement, thereby reducing the strain.

2(b) Pavement Stiffness

In general, a thick pavement is stiffer (less flexible) than a thinner pavement of the same material. Higher asphalt contents result in more flexible pavements. A pavement with high voids in the mineral aggregates filled with asphalt is more flexible than a dense graded pavement with less aggregate voids and less asphalt. Fines mixed with the asphalt cause it to be harder and result in a stronger, but less flexible, pavement.

Methods of Rehabilitation

1. Present Practice

The standard method of rehabilitation used by the districts has been overlay with a stone layer of base material surfaced with one inch of premix, without improving the shoulders.

Experimental sections are being designed to explore other possibilities in an effort to determine whether satisfactory performance can be obtained at lower cost or if small additional cost can be justified by significantly improved performance.

In the method presently used the stone layer is used to re-establish the proper pavement cross-section and grade while reinforcing the structural capacity of the carriageway. If the existing pavement is intact, some of the potential strength of the pavement is not realized, because a weaker material (unbound stone) separates two stronger materials (premix).

The stone layer does, however, reduce the likelihood that cracks in the underlying pavement will reflect through to the new surface.

2. Alternative Methods for Experimentation

Possible rehabilitation alternative designs which may be tried on experimental sections are as follows:

2(a) Asphalt Aggregate Mix

An asphalt aggregate mix may be placed directly on the existing pavement. This would more effectively utilize the strength of the existing pavement by eliminating the weaker stone layer and reducing the cost of the new pavement structure. An initial leveling course would have to be placed on the existing pavement, composed of small sized angular aggregate so that evening out of distortions can be done without producing weak spots. A number of different mix types which have been used by Pakistan road authorities could be tried. Some of these mixes are:

Surface Dressing, Premix Macadam, Premix with Bajri, Sheet Asphalt, Grouted Macadam, and Asphalt Concrete.

These mixes differ in stiffness. Surface Dressing and 1" Pre-Mix Macadam are the most flexible, while asphalt concrete is the stiffest.

2(b) Scarification and Re-surface

The existing pavement could be scarified to partial depth, the surfacing broken up to under 2 inch size, some lime added to react with any intruded material and the material re-shaped and compacted at optimum moisture content. An additional layer of stone may be placed if needed to compensate for excessive deformation at the base and subgrade levels. Surfacing would then be placed.

Different surface types previously mentioned could be applied utilizing this approach.

3) Factors Influencing Rehabilitation Choices

The type of section to be tried would depend on the traffic conditions, pavement condition, and the economics of the particular area.

Traffic

Traffic loading on district roads is in general very light, with a few notable exceptions. On those roads with light traffic a minimum pavement section of 10 inches as called for by the Indian Road Congress is provided with a minimum embankment of 1 meter above high water where feasible.

The few roads with heavy loading are checked using the criteria set forth in British Road Note 29 and AASHTO. While heavily loaded roads offer the opportunity to evaluate roads under these conditions, the great majority of district roads have light loading. It is, therefore, also desirable to determine the best approach for reconstruction and design of low volume roads.

Pavement Condition

Where the pavement is essentially intact with moderate distortion, an asphalt pavement overlay or scarification and re-compaction is appropriate.

Pavements with heavy distortion, or those with considerable pavement deterioration, are appropriate for scarification and re-compaction. Where heavy distortion is apparently caused by moisture in the sub-grade, or inadequate

structural capacity, additional structural reinforcement of the pavement or elevation of the embankment may be required.

Economics

In locations where there is a long haul for aggregate, scarification and a relatively thick asphalt aggregate surface can be placed economically.

ROAD RESOURCES MANAGEMENT (RRM) PROJECT, 391 - 0480
EXPERIMENTAL ROAD / CONSTRUCTION PROGRAM
SCHEDULE FOR EXPERIMENTAL ROADS IMPLEMENTATION

24th, Dec. 1990

NAME OF DISRICT AND ALLOCATION	ROAD NUMBER	CCSC DESIGN ESTIMATES SPECIFICATION STATUS	CCSC - USAID AGREE ESTIMATES	SEND ESTIMATES TO DIST. ENGINEER	PRE-BID CONFERENCE	ADVERTISE TENDER	BID OPENING	USAID APPROVAL	DISTRICT COUNCIL AWARDS CONTRACT
BADIN (Rs. 2,200,000)	BA-M5 4-Experiments	Dec 20	Jan 16	Jan 24	Jan 30	Feb 8	Feb 19	Feb 24	Feb 28
LARKANA (Rs. 2,000,000)	LA-2 4-Experiments	Jan 10	Jan 24	Feb 3	Feb 9	Feb 15	Feb 24	Feb 28	Mar 6
JACOBABAD (Rs. 1,650,000)	JA-E-01 1-Experiment	Dec 31	Jan 16	Jan 24	Jan 31	Feb 8	Feb 18	Feb 24	Mar 3
KHAIRPUR (Rs. 1,650,000)	KH-E-01 1-Experiment	Dec 31	Jan 16	Jan 24	Jan 29	Feb 7	Feb 16	Feb 21	Feb 27
DADU (Rs. 1,650,000)	DA-D3 1-Experiment	Jan 5	Jan 31	Feb 7	Feb 13	Feb 20	Feb 28	Mar 6	Mar 11
	SH-69 4-Experiments	Dec 20	Jan 31	Feb 7	Feb 14	Feb 22	Mar 3	Mar 10	Mar 14
SHIKARPUR (Rs. 1,650,000)	SH-E-01 1-Experiment	Jan 15	Jan 31	Feb 7	Feb 14	Feb 22	Mar 3	Mar 10	Mar 14

ANNEX I

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ANNEX II

CONSTRUCTION OF ROAD ON EXPERIMENTAL BASIS

TENTATIVE PROPOSED DESIGNS

SH-69 Shikarpur to Buja Napar Rehabilitation

Section - I (Length = 0.80 Km)

Chainage: Km 00 + 000 to Km 00 + 080

Proposed Design: $1-^{1}/_{2}$ inch thick premic (Carpet)

1 inch thick premix carpet

Section - II (Length = 0.95 Km)

Chainage: Km 00 + 080 to Km 01 + 750

Proposed Design: 1 inch thick premix carpet

Section - III (Length = 0.40 Km)

Chainage: Km 01 + 750 to Km 02 + 015

Proposed Design:

- Scarifying existing surface and adding 2% of lime.
- 1 inch thick premix Asphalt Macadam

Section -IV (Length = 2.35 Km)

Chainage: Km 02 + 015 + Km 04 + 050

Proposed Design:

- Scarifying existing surface and adding 2% of Lime
- 1 inch premix Carpet including Seal Coat

Shikarpur District

Mirzapur to Daro - 1.2 Km - Kacha Road Upgrade

Proposed:

Salt Stabilized:

LA-1 **750 M Rehabilitation**

$1^1/_2$ inch Premix Overlay

LA-2 **3.9 Km - 1.2 Km under Maintenance, 2.7 to Rehabilitate**

Proposed Design: Scarify and various surfacing.

BA-M5 **HAJI SAWAN BUS STAND TO SAMI JI KABAR REHABILITATION**

Section - I **(Length = 400 Meter)**

Chainage: Km 01 + 050 to 01 + 448

Proposed Design:
- $1^1/_2$ inch thick premix
- 2 inch thick premix macadam

Section II **(Length = 400 Meters)**

Chainage: Km 01 + 448 to 01 + 850

Proposed Design:
- $1^1/_2$ inch thick premix
- 2 inch thick grouted macadam including Seal Coat

Section III **(Length = 750 Meters)**

Chainage: Km 01 + 850 to Km 02 + 060

Proposed Design:
- Scarifying existing surface
- 3 inch stone metal overlay
- D.B.S.T.

Section IV (Length = 750 Meter)

Chainage: Km 02 + 060 to Km 03 + 350

Proposed Design:
- Scarifying existing surface
- 3 inch stone metal overlay
- 1 inch premix carpet

KHAIRPUR KACHA ROAD UPGRADE

KH-E-1 Proposed Design Brick Paved over Lime Treated Base. Embankment must be raised.

Experimental Feature - Lime will be used to provide sub-base rather than sand layer.

JACOBABAD KACHA UPGRADE

JA-E-1 Proposed Design - "Premix Macadam or fully Grouted Macadam over lime Treated & broken bricks and murram stone blend.

DADU

New Roads must be located and evaluated.

MEMORANDUM

C.C.S.C.

ANNEX III

SAMPLE EXPERIMENTAL DESIGN

To: Chief of Party

Date: December 24, 1990

From: Design Staff

Sub: Experimental Roads (Upto date position review status)

Ref: As desired by you

Dear Sir,

1. All the designs except the one of Shikarpur District (Mirzapur to Daro SH-E-1) are complete.

2. The soil samples of the above road have been dispatched today in 2 packets. Salts (chloride) contents in lbs per cft as well as % by weight should be got known by chemical analysis and liquid limit and plastic limits are also needed.

3. The Typical X-Sections of the exp. roads of Khairpur (KH-E-1) and Jacobabad JA-E-2 are attached.

4. The Typ. X. Section of LA-2 (Larkana District) shall be started by the D/Man in this week on Sunday, expected to be ready by 2nd of Jan. 91. I am sending the estimated quantities of LA-2 for Mr. Aslam to make estimate ready.

5. As for other road of Shikarpur District (SH-69) is ready but there will be some adjustment of amount for the other Kacha road, therefore we may finalize it by 10th, depending upon test results as read at sl. 2 above.

LA-2

	Quantities	Exp. Basis
1.	Excavate trench for widening of road (6" - 11" deep).	7,880 Sft
	Embankment of Earth	1,54,050 Cft
2.	Scarifying the existing road metal and relaying with soil and 8 % lime.	1,07,740 Sft
3.	Laying base course stone metal	66,785 Cft

4.	DBST 2 Coats		31,650 Sft
5.	1" thick Premix Carpet		87,950 Sft
6.	2" thick asphalt macadam (i/c making prep surface)		34,425 Sft
7.	Repair of culverts a. Cleaning of culverts b. Repair parapet walls	 5 Nos. 3 Nos.	 (Rs. 6,000/-) (Rs. 45,000/-)
8.	Testing		Rs. 10,000/-
9.	Road Signs		
10.	Diversion		

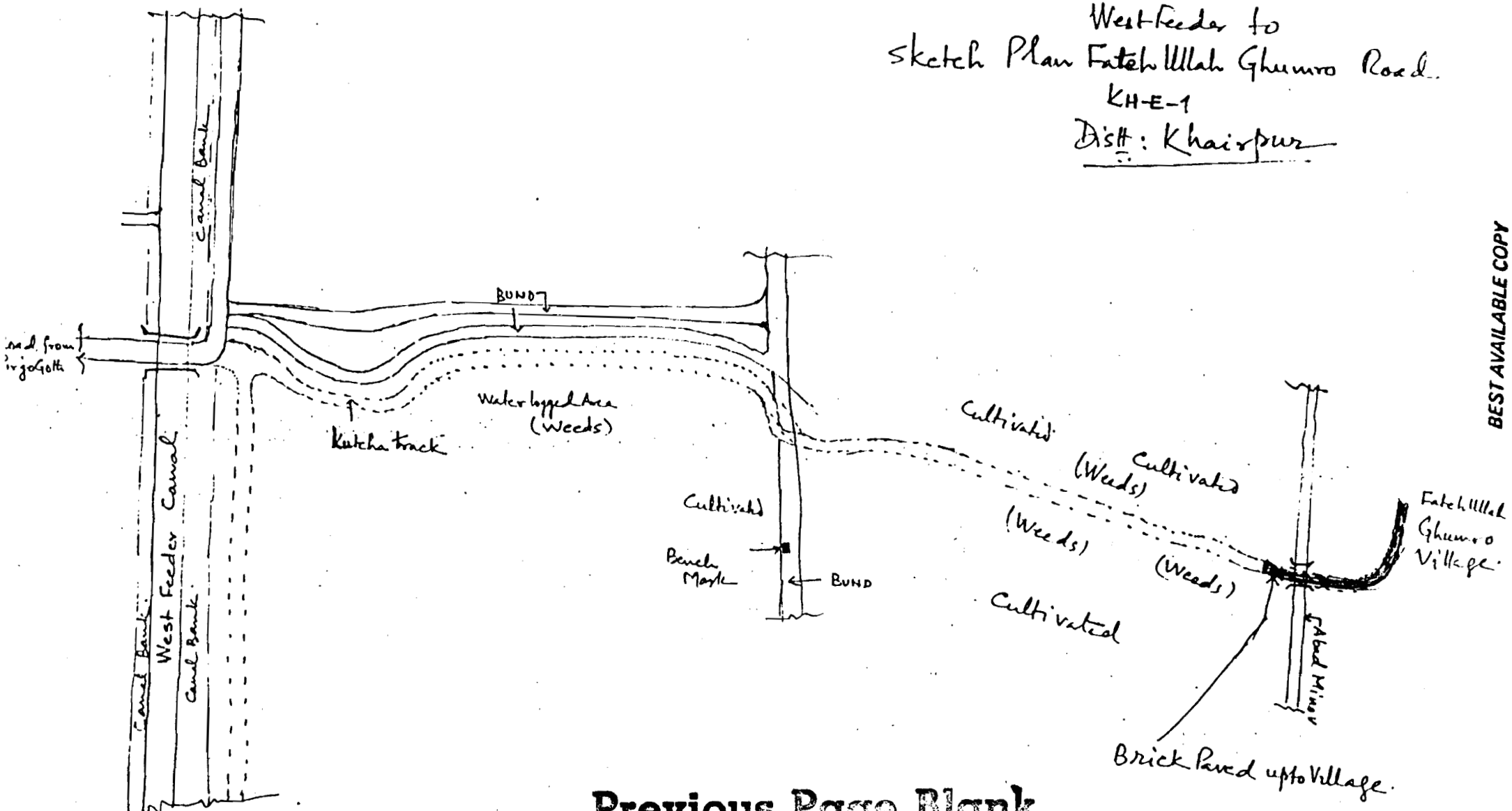
Experimental Roads

LA -2 Larkana District

Leads

1.	Earth Borrow :	Approx.	5 miles
2.	Stone Metal (From Arore Quary)	130	Km
3.	Lime	165	Km
4.	Bitumen (Take same as LA-1) in Rehabilitation 89-90)		

West Feeder to
Sketch Plan Fateh Illah Ghumro Road.
KH-E-1
Distt: Khairpur



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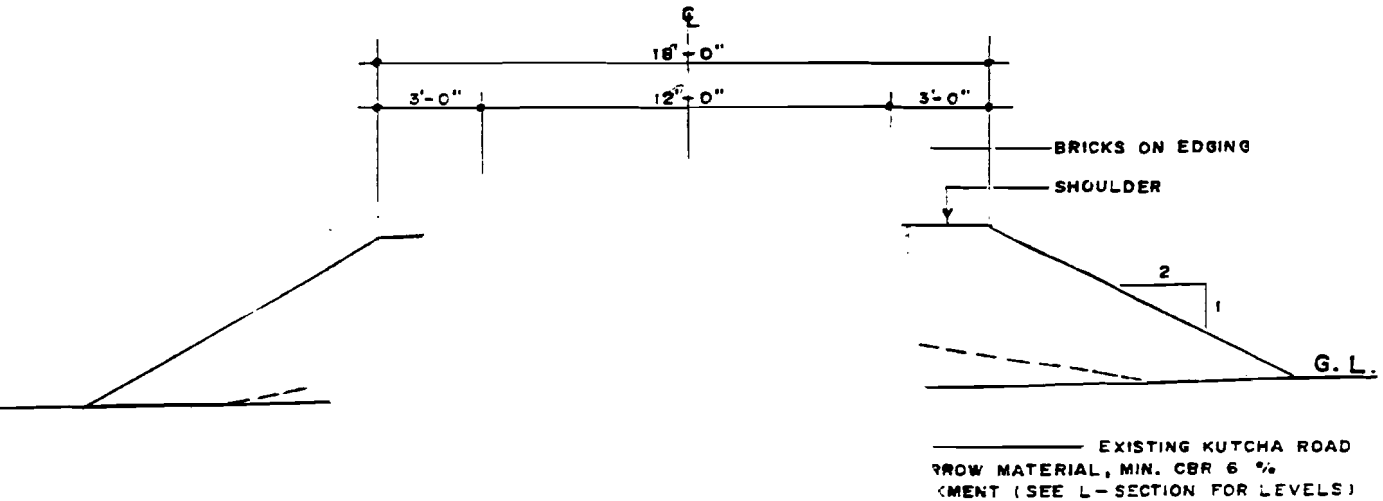
TYPICAL CROSS SECTION

(EXPERIMENTAL ROAD)



SHEET No.	:- 1 OF 1
DISTRICT	:- JACOBABAD
ROAD NAME	:- SIKANDRABAD TO FAKHARUDDIN, KHOSO VILLAGE.
ROAD No.	:- JA-E-2
LENGTH OF ROAD	:- 1·461 miles (2·35 km)
LEGTH OF EXPERIMENTAL ROAD	:- 1·461 miles (2·35 km)

SHOULDER AND EMBANKMENT

APPROVED SELECTED MATERIAL IN LA (6") THICK
SHOULD BE COMPACTED AT OPITIMUM M ENT (O.M.C.)
TO MINIMUM 95 % MODIFIED AASHTO C(EXCEPT AREA
WHERE ROLLER CAN NOT OPERATE :

PAVEMENT

SUB. BASE: WILL CONSIST OF 8 % LIME, 20 % BROKEN BRICKS AND 72 % SOIL ALL MIXED, SPREAD AND COMPACTED TO 6" THICKNESS.

SURFACE PAVING : 2 nd CLASS BRICKS 9"x 4½"x 3" LAID ON EDGE OVER THE SUB BASE, JOINTS IN BETWEEN FILLED WITH SAND.

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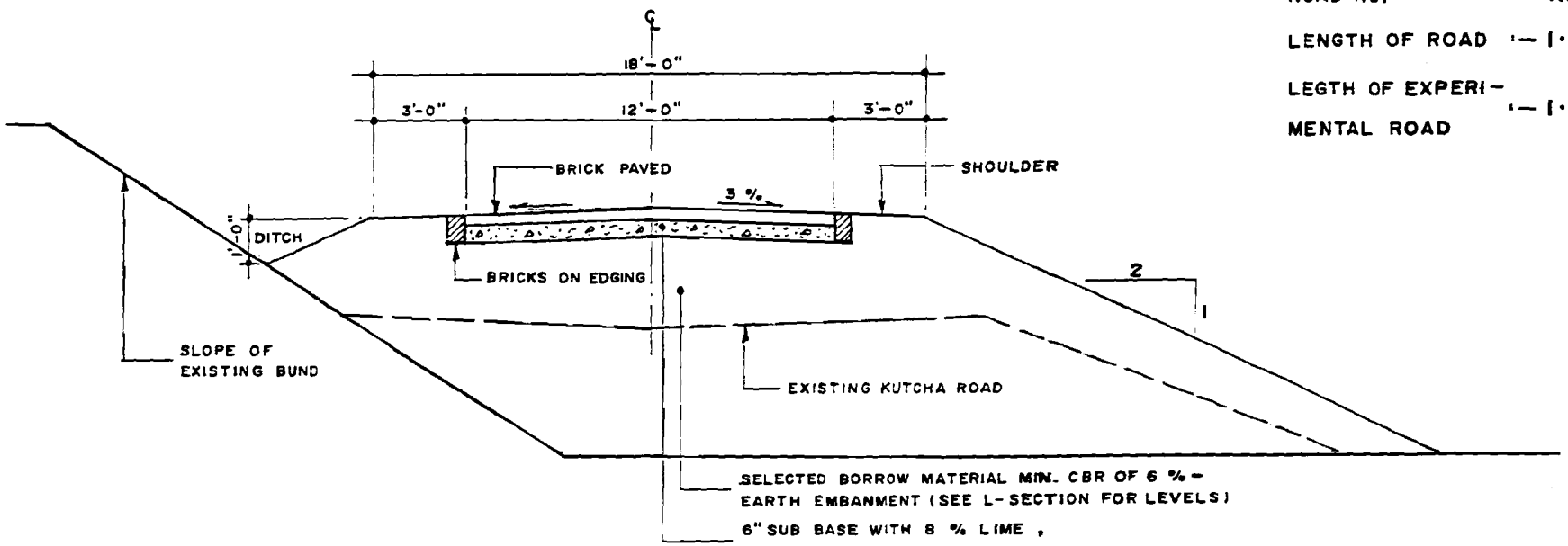
TYPICAL CROSS SECTION
(EXPERIMENTAL ROAD)

SHEET No.	:— 1 OF 2
DISTRICT	:— KHAIRPUR
ROAD NAME	:— WEST FEEDER TO FATEH ULLAH, GHUMRO VILLAGE
ROAD No.	:— KH-E-1
LENGTH OF ROAD	:— 1·119 miles (1·800 km)
LEGTH OF EXPERIMENTAL ROAD	:— 1·119 miles (1·800 km)



SHOULDER AND EMBANKMENT

APPROVED SELECTED MATERIAL IN LAYER OF 150 mm (6") THICK SHOULD BE COMPACTED AT OPITIMUM MOISTURE CONTENT (O.M.C.) TO MINIMUM 95 % MODIFIED AASHTO COMPACTION EXCEPT AREA WHERE ROLLER CAN NOT OPERATE.

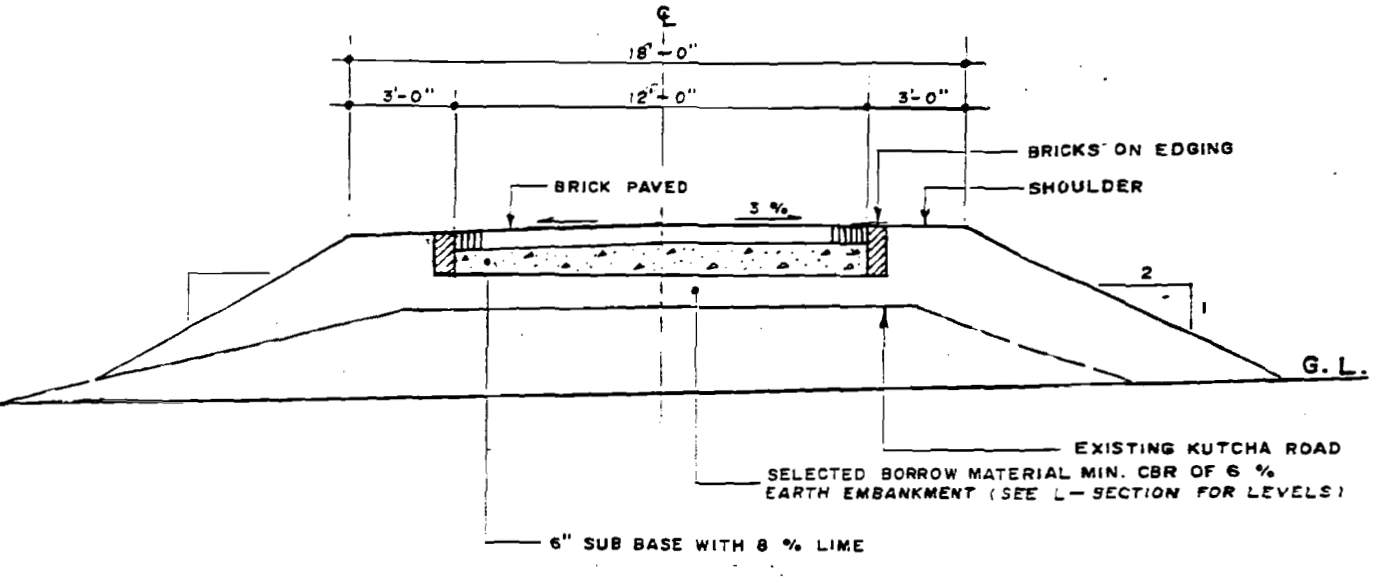
PAVEMENT

SUB. BASE: WILL CONSIST OF 8 % LIME, 20 % BROKEN BRICKS AND 72 % SOIL ALL MIXED, SPREAD AND COMPACTED TO 6" THICKNESS.

SURFACE PAVING : 2nd CLASS BRICKS 9"x 4½"x 3" LAID ON EDGE OVER THE SUB BASE, JOINTS IN BETWEEN FILLED WITH SAND.

YPICAL CROSS SECTION
(EXPERIMENTAL ROAD)

SHEET No. :— 2 OF 2
DISTRICT :— KHAIRPUR
ROAD NAME :— WEST FEEDER TO FATEH ULLAH, GHUMRO VILLAGE
ROAD No. :— KH — E — 1
LENGTH OF ROAD :— 1·119 miles (1·800 km)
LEGTH OF EXPERIMENTAL ROAD :— 1·119 miles (1·800 km)



SHOULDER AND EMBANKMENT

APPROVED SELECTED MATERIAL IN LAYER OF 150 mm (6") THICK SHOULD BE COMPACTED AT OPITIMUM MOISTURE CONTENT (O.M.C.) TO MINIMUM 95 % MODIFIED AASHTO COMPACTION EXCEPT AREA WHERE ROLLER CAN NOT OPERATE.

PAVEMENT

SUB. BASE: WILL CONSIST OF 8 % LIME, 20 % BROKEN BRICKS AND 72 % SOIL ALL MIXED, SPREAD AND COMPACTED TO 6" THICKNESS.

SURFACE PAVING: 2nd CLASS BRICKS 9"x 4½"x 3" LAID ON EDGE OVER THE SUB BASE, JOINTS IN BETWEEN FILLED WITH SAND.

BEST AVAILABLE

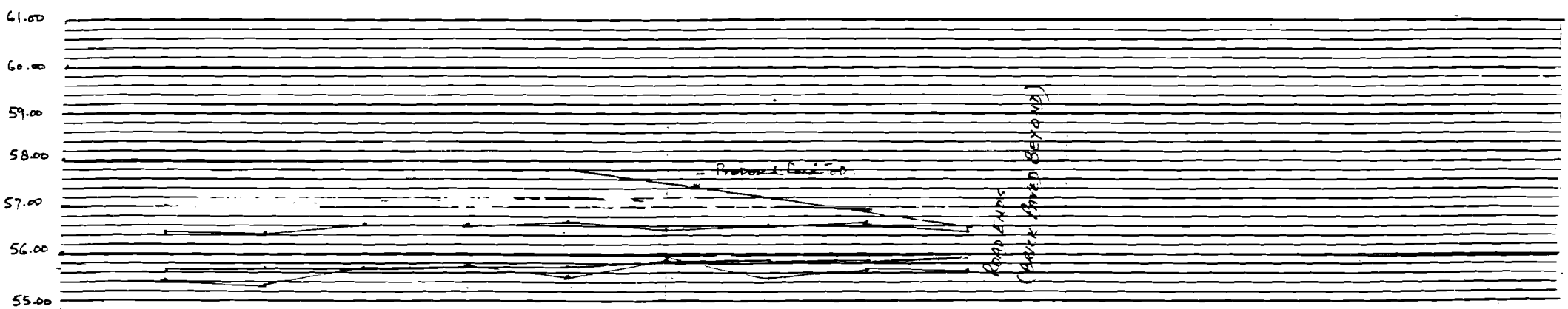
L-SECTION OF ROAD

WEST FEEDER TO FATEH ULLAH GHUMRO

KH-E-1

DISH. KHAIRPUR

Sheet 3



OPOSED FINISHED LEVEL		57.80	57.80	57.80	57.80	57.80	57.563	57.375	57.088	56.5
XISTING ROAD LEVEL T CENTER LINE	—	56.472	56.427	56.457	56.445	56.772	56.500	56.613	56.738	56.408
ROUND LEVEL (LEFT)	—	55.694	55.730	55.667	55.678	55.685	55.872	55.848	55.878	55.878
ROUND LEVEL (RIGHT)	—	55.447	55.357	55.767	55.793	55.552	55.[illegible]	55.438	55.663	55.68
HAINAGE (km.)		1+400	1+450	1+500	1+550	1+600	1+650	1+700	1+750	1+800

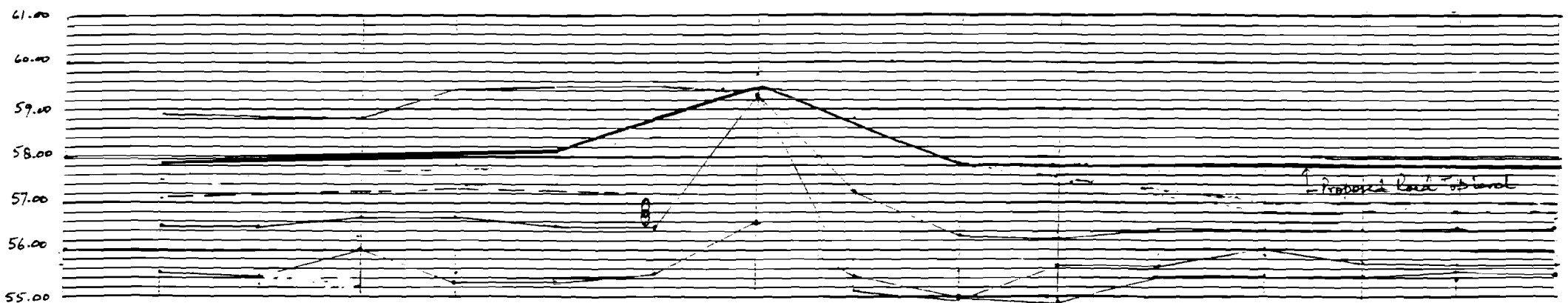
BEST AVAILABLE

L- SECTION OF ROAD

WEST FEEDER (CANAL) TO FATEH ULLAH GHUMRO (KH-E-1)

Dist: KHAIRPUR

Sheet 2



POSED FINISHED LEVEL	57.900	57.950	58.00	58.050	58.10	58.800	59.30	59.00	57.80	57.80	57.80	57.80	57.80	57.80	57.80
STING ROAD LEVEL CENTER LINE	56.527	56.537	56.727	56.677	56.597	56.543	59.297	57.238	56.795	56.217	56.437	56.497	56.447	56.472	56.476
OUND LEVEL (LEFT)	58.927	58.887	58.817	57.445	57.436	57.477	57.869	55.115	54.538	55.622	55.677	55.872	55.782	55.738	55.676
OUND LEVEL (RIGHT)	55.501	55.427	56.027	55.327	55.354	55.494	56.634	55.460	54.744	54.676	55.416	55.477	55.402	55.384	55.477
AINAGE (km.)	0+700	0+750	0+800	0+850	0+900	0+950	1+000	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400
						2 Pipe 72" Dia.									

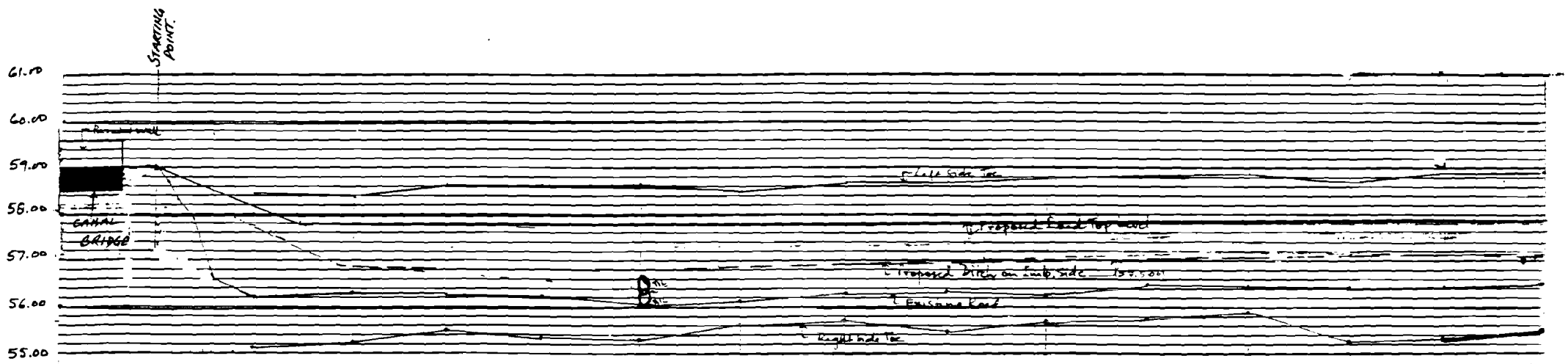
BEST AVAILABLE

L - SECTION OF ROAD

WEST FEEDER TO FATEH ULLAH GHUMRO (KH-E-1)

Distt: KHAIRPUR

Sheet 1



POSED FINISHED LEVEL	59.000	59.00	58.00	57.800	57.80	57.80	57.800	57.80	57.800	57.83	57.87	57.900	57.90	57.90	57.900
ISTING ROAD LEVEL CENTER LINE	—		56.218	56.340	56.248	56.220	56.083	56.868	56.356	56.372	56.463	56.529	56.446	56.417	56.529
OUND LEVEL (LEFT)	—		58.477	58.396	58.618	58.611	58.623	58.488	58.735	58.674	58.783	58.863	58.878	58.762	58.710	58.927
OUND LEVEL (RIGHT)	—		55.126	55.248	55.504	55.509	55.326	55.618	55.748	55.472	55.718	55.798	55.938	55.262	55.512	55.501
AINAGE (km.)		0+00	0+50	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700

2 Pipes 12" Dia.

Flood level: 57.500

BEST AVAILABLE

OFFICE OF THE CHAIRMAN, DISTRICT COUNCIL, KHAIRPUR.

No: Eng/ 841 /1990 dated:- 20-12-90.

To,

Mr: Robert .E. Katz,
Chief of Party COSC
USAID, Consultants for Road Resources
Management Project 43/10/F P.E.C.H. Society
Block No: 6 Karachi-29.

Subject:- EXPENDITURE INCURRED FOR THE 10% MAINTANANCE FOR THE YEAR 1989-90.

For the maintainance of Roads for the years 1989-90, this District Council has incurred expenditure of an amount of Rs: 97,947/- (Rupees Ninty Seven Thousand Nine Hundred forty Seven only) work is done Departmentally.

Sd/-
DISTRICT ENGINEER.
DISTRICT COUNCIL, KHAIRPUR.

Copy forwarded with Compliments to
Mr: Nishmat Rai Oad maintanance Engineer C.C.S.O Sukkur
for information. further detail follows.

DISTRICT ENGINEER,
DISTRICT COUNCIL, KHAIRPUR.

BEST AVAILABLE COPY

CCSR SUKKUR

FROM 16.12.1990 TO 20.12.1990

SR. NO.	NAME AND DESIGNATION	SUNDAY	MONDAY	TUESDAY	WEDNSDAY	THURSDAY	REMARKS
	HASHMAT ULLAH MAINTENANCE ENGINEER CCSR SUKKUR	Met DE DADU. He told me that they have done about 4km patch repair and resurfacing on DA-D1 No intimation is given to COP CCSC. I have advised him to inform COP and get the proper 35% maintenance program charted out. Dadu's co-ordinator I am told shall be Mr. Ali Gohar Sahto. Met DE N'Feroze. He is giving NA-17 and NA-13 for 35% maintenance along with NA-11 and NA-18 coordinator of the D.C N'Feroze shall be Mr. Abdul Karim Karim.	Office work	Office work	Office work	Met DE KHP and recieved the expenditure figure incurred in 1989-90 on maintenance 10%	G.S of Khairpur district Council has been patch worked and resurfaced. Such intimation has not been given to COP though DE KHP had told me verbally on 11/12

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MEMORANDUM

C.C.S.C.

ANNEX III

SAMPLE EXPERIMENTAL DESIGN

To: Chief of Party

Date: December 24, 1990

From: Design Staff

Sub: Experimental Roads (Upto date position review status)

Ref: As desired by you

Dear Sir,

1. All the designs except the one of Shikarpur District (Mirzapur to Daro SH-E-1) are complete.

2. The soil samples of the above road have been dispatched today in 2 packets. Salts (chloride) contents in lbs per cft as well as % by weight should be got known by chemical analysis and liquid limit and plastic limits are also needed.

3. The Typical X-Sections of the exp. roads of Khairpur (KH-E-1) and Jacobabad JA-E-2 are attached.

4. The Typ. X. Section of LA-2 (Larkana District) shall be started by the D/Man in this week on Sunday, expected to be ready by 2nd of Jan. 91. I am sending the estimated quantities of LA-2 for Mr. Aslam to make estimate ready.

5. As for other road of Shikarpur District (SH-69) is ready but there will be some adjustment of amount for the other Kacha road, therefore we may finalize it by 10th, depending upon test results as read at sl. 2 above.

LA-2

	Quantities	Exp. Basis
1.	Excavate trench for widening of road (6" - 11" deep).	7,880 Sft
	Embankment of Earth	1,54,050 Cft
2.	Scarifying the existing road metal and relaying with soil and 8 % lime.	1,07,740 Sft
3.	Laying base course stone metal	66,785 Cft

31

4.	DBST 2 Coats		31,650 Sft
5.	1" thick Premix Carpet		87,950 Sft
6.	2" thick asphalt macadam (i/c making prep surface)		34,425 Sft
7.	Repair of culverts		
	a. Cleaning of culverts	5 Nos.	(Rs. 6,000/-)
	b. Repair parapet walls	3 Nos.	(Rs. 45,000/-)
8.	Testing		Rs. 10,000/-
9.	Road Signs		
10.	Diversion		

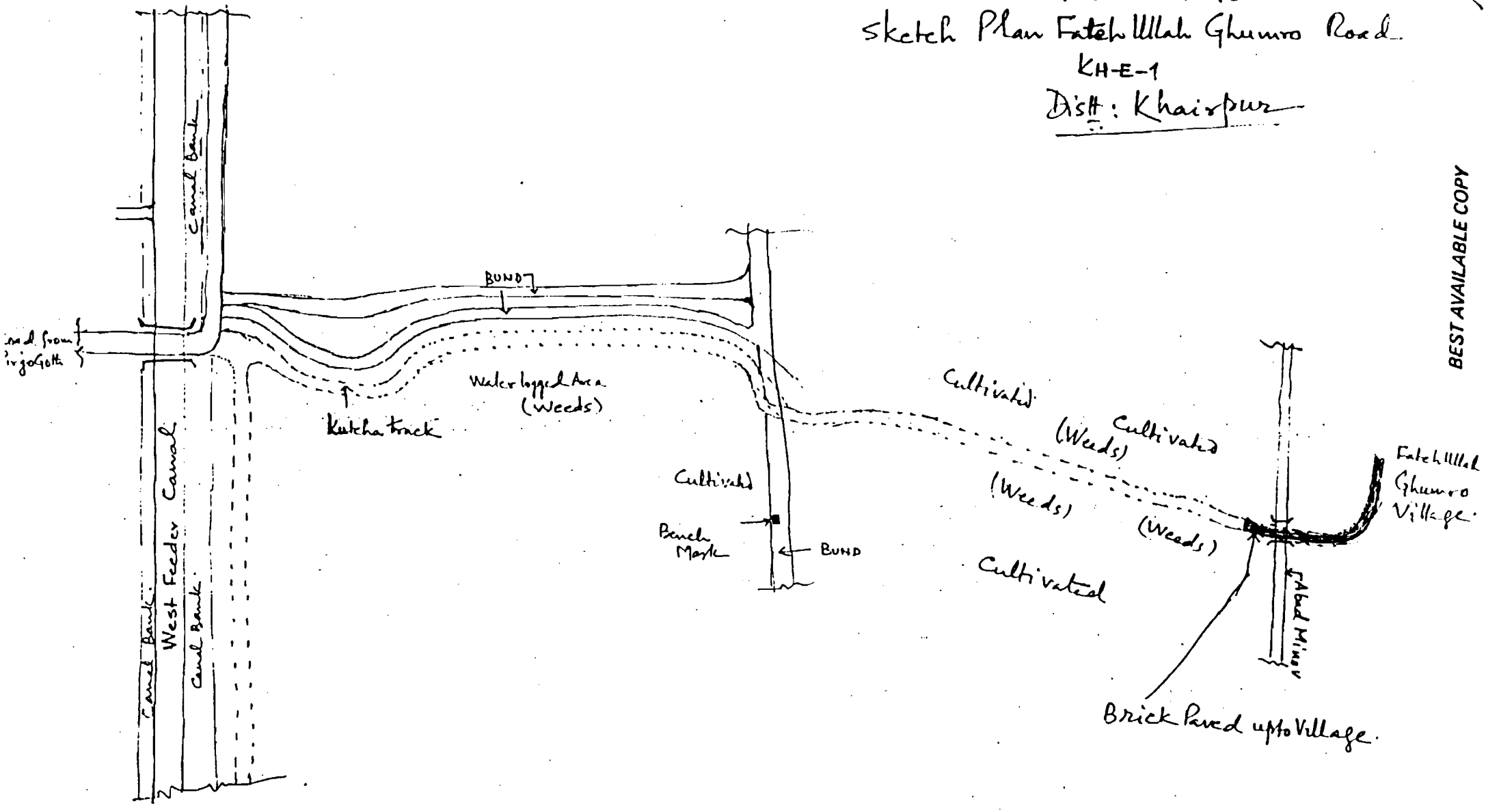
Experimental Roads

LA -2 Larkana District

Leads

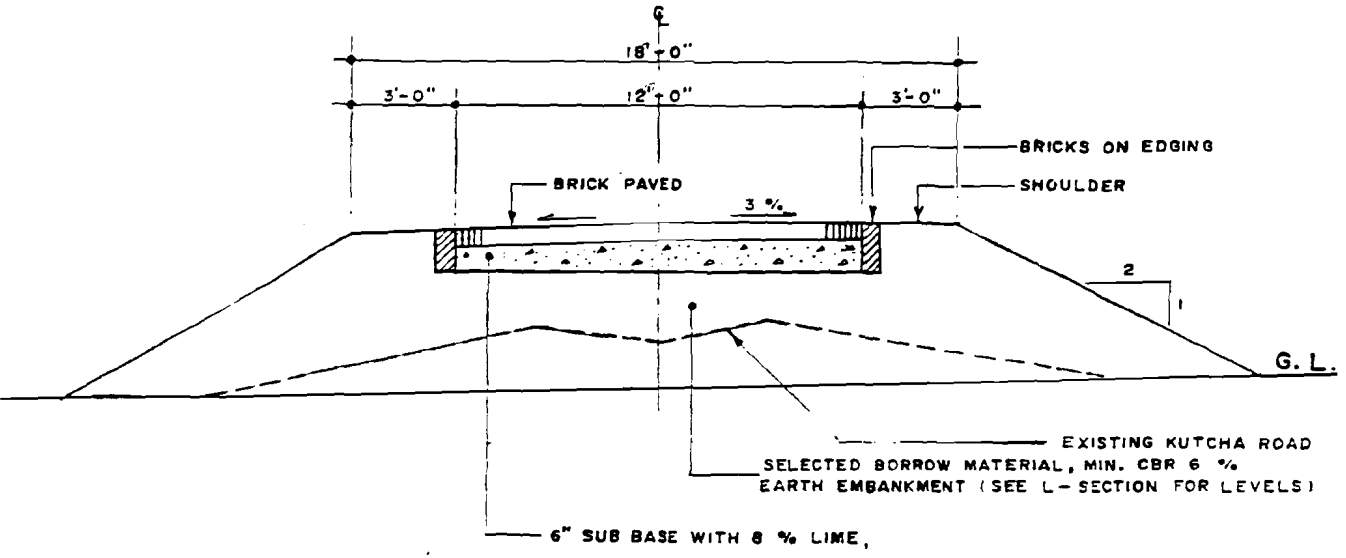
1.	Earth Borrow :	Approx.	5 miles
2.	Stone Metal (From Arore Quary)	130	Km
3.	Lime	165	Km
4.	Bitumen (Take same as LA-1) in Rehabilitation 89-90)		

West Feeder to
Sketch Plan Fateh Ullah Ghumro Road
KH-E-1
Distt: Khairpur



BEST AVAILABLE COPY

TYPICAL CROSS SECTION
(EXPERIMENTAL ROAD)



SHEET No.	:- 1 OF 1
DISTRICT	:- JACOBABAD
ROAD NAME	:- SIKANDRABAD TO FAKHARUDDIN, KHOSO VILLAGE.
ROAD No.	:- JA-E-2
LENGTH OF ROAD	:- 1·461 miles (2·35 km)
LEGTH OF EXPERIMENTAL ROAD	:- 1·461 miles (2·35 km)

SHOULDER AND EMBANKMENT

APPROVED SELECTED MATERIAL IN LAYER OF 150 mm (6") THICK SHOULD BE COMPACTED AT OPITIMUM MOISTURE CONTENT (O.M.C.) TO MINIMUM 95 % MODIFIED AASHTO COMPACTION EXCEPT AREA WHERE ROLLER CAN NOT OPERATE.

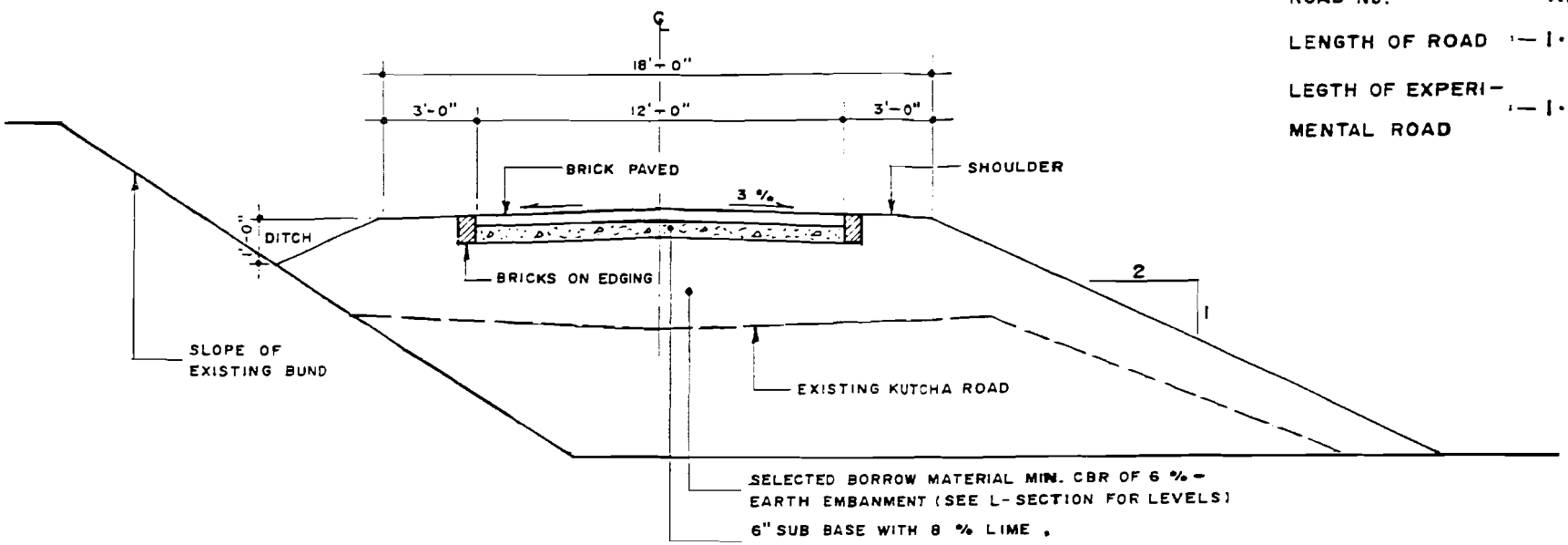
PAVEMENT

SUB. BASE: WILL CONSIST OF 8 % LIME, 20 % BROKEN BRICKS AND 72 % SOIL ALL MIXED, SPREAD AND COMPACTED TO 6" THICKNESS.

SURFACE PAVING: 2nd CLASS BRICKS 9"x 4½"x 3" LAID ON EDGE OVER THE SUB BASE, JOINTS IN BETWEEN FILLED WITH SAND.

TYPICAL CROSS SECTION
(EXPERIMENTAL ROAD)

SHEET No. :— 1 OF 2
DISTRICT :— KHAIRPUR
ROAD NAME :— WEST FEEDER TO FATEH ULLAH, GHUMRO VILLAGE
ROAD No. :— KH-E-1
LENGTH OF ROAD :— 1·119 miles (1·800 km)
LEGTH OF EXPERIMENTAL ROAD :— 1·119 miles (1·800 km)



SHOULDER AND EMBANKMENT

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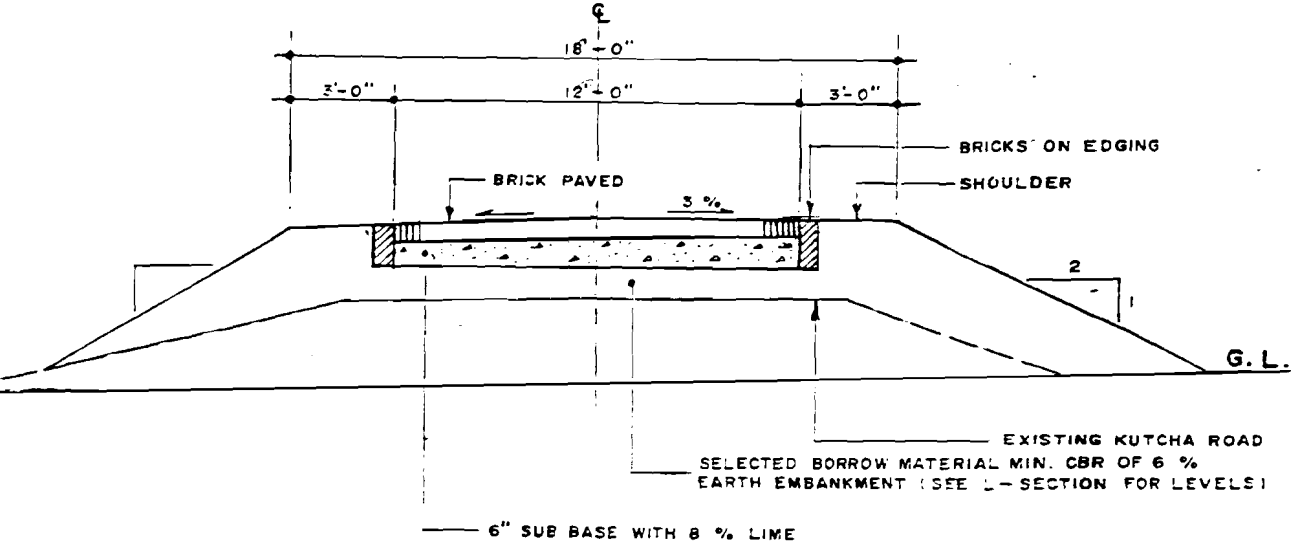
PAVEMENT

SUB. BASE: WILL CONSIST OF 8 % LIME, 20 % BROKEN BRICKS AND 72 % SOIL ALL MIXED, SPREAD AND COMPACTED TO 6" THICKNESS.

SURFACE PAVING: 2nd CLASS BRICKS 9"x 4½"x 3" LAID ON EDGE OVER THE SUB BASE, JOINTS IN BETWEEN FILLED WITH SAND.

YPICAL CROSS SECTION
(EXPERIMENTAL ROAD)



SHEET No.	:- 2 OF 2
DISTRICT	:- KHAIRPUR
ROAD NAME	:- WEST FEEDER TO FATEH ULLAH, GHUMRO VILLAGE
ROAD No.	:- KH-E-1
LENGTH OF ROAD	:- 1·119 miles (1·800 km)
LEGTH OF EXPERIMENTAL ROAD	:- 1·119 miles (1·800 km)

OULDER AND EMBANKMENT

APPROVED SELECTED MATERIAL IN LAYER OF 150 mm (6") THICK SHOULD BE COMPACTED AT OPITIMUM MOISTURE CONTENT (O.M.C.) TO MINIMUM 95 % MODIFIED AASHTO COMPACTION EXCEPT AREA WHERE ROLLER CAN NOT OPERATE.

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SURFACE PAVING: 2nd CLASS BRICKS 9"x 4½"x 3" LAID ON EDGE OVER THE SUB BASE, JOINTS IN BETWEEN FILLED WITH SAND.

BEST AVAILABLE

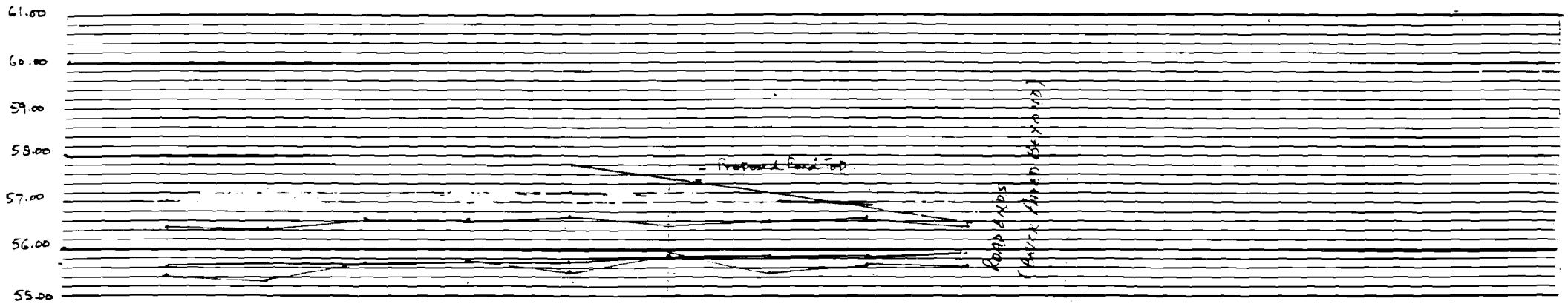
L-SECTION OF ROAD

WEST FEEDER TO FATEH ULLAH GHUMRO

KH-E-1

DISH. KHAIRPUR

Sheet 3



SED FINISHED LEVEL		57.80	57.80	57.80	57.80	57.80	57.563	57.375	57.088	56.5							
TING ROAD LEVEL ENTER LINE	—	56.472	56.427	56.452	56.449	56.772	56.540	56.418	56.728	56.408							
ND LEVEL (LEFT)	—	55.690	55.730	55.667	55.678	55.685	55.872	55.868	55.878	55.878							
ND LEVEL (RIGHT)	—	55.447	55.357	55.747	55.798	55.552	55.840	55.458	55.663	55.619							
AGE (km.)		1+400	1+450	1+500	1+550	1+600	1+650	1+700	1+750	1+800							

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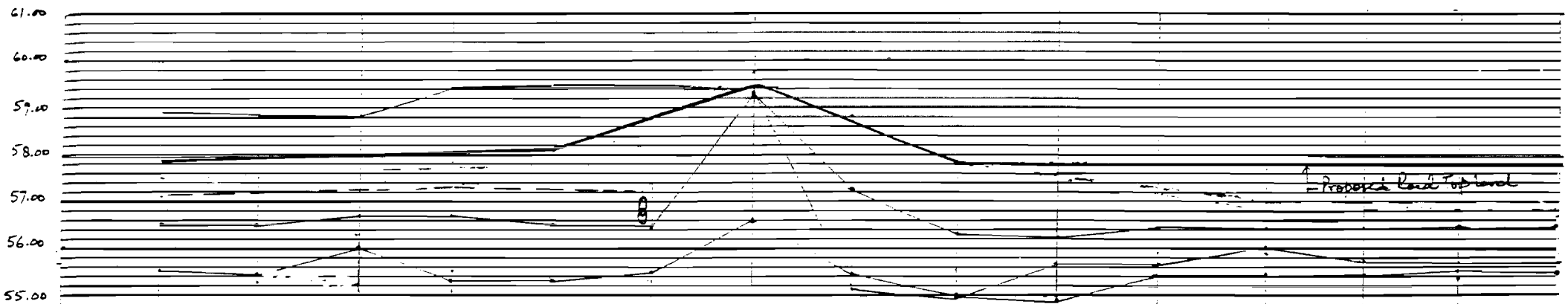
L- SECTION OF ROAD

WEST FEEDER (CANAL) TO FATEH ULLAH GHUMRO (KH-E-1)

Dist : KHAIRPUR

Sheet 2



PROPOSED FINISHED LEVEL		57.900	57.950	58.00	58.050	58.10	58.800	58.80	58.80	57.26	57.8	57.80	57.80	57.80	57.80
EXISTING ROAD LEVEL AT CENTER LINE	—	56.537	56.537	56.727	56.97	56.597	56.598	57.297	57.28	56.295	56.277	56.427	56.457	56.447	56.474
GROUND LEVEL (LEFT)	—	58.927	58.887	58.817	59.445	59.496	59.477	59.314	55.115	54.538	55.622	55.677	55.872	55.782	55.738	55.670
GROUND LEVEL (RIGHT)	—	55.501	55.427	56.027	55.329	55.354	55.494	56.154	55.460	54.744	54.576	55.416	55.477	55.402	55.384	55.447
CHAINAGE (km.)		0+700	0+750	0+800	0+850	0+900	0+950	1+000	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400
							2 Pipe 12" Dia.								

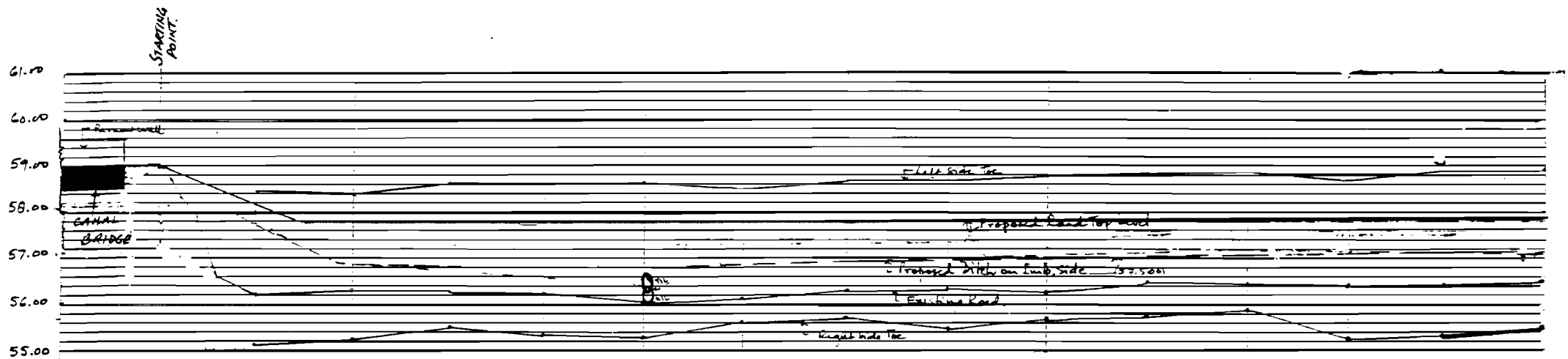
BEST AVAILABLE COPY

L - SECTION OF ROAD

WEST FEEDER TO FATEH ULLAH GHUMRO (KH-E-1)

Distt: KHAIRPUR

Sheet 1



OPOSED FINISHED LEVEL	59.000	59.00	58.00	57.800	57.50	57.50	57.800	57.50	57.800	57.83	57.87	57.900	57.90	57.90	57.90	57.900
ISTING ROAD LEVEL CENTER LINE	—	59.000	56.218	56.399	56.218	56.224	56.083	56.189	56.30	56.372	56.463	56.524	56.444	56.417	56.44	56.524
OUND LEVEL (LEFT)	—		58.477	58.386	58.618	58.511	58.623	58.483	58.735	58.674	58.783	58.813	58.878	58.762	58.910	58.927
OUND LEVEL (RIGHT)	—		55.126	55.248	55.501	55.389	55.326	55.618	55.748	55.472	55.718	55.770	55.939	55.262	55.511	55.501
AINAGE (km.)		0+00	0+50	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700

2 Pipes 92" Dia.

0 0

Flood Level = 57.500

BEST AVAILABLE COPY

OFFICE OF THE CHAIRMAN, DISTRICT COUNCIL, KHAIRPUR.

No:Eng/ 841 /1990 dated:- 2-10-1990

To,

Mr:Robert .E.Katz,
Chief of Party CCSC
USAID, Consultants for Road Resources
Management Project 43/10/F P.E.C.H.Society
Block No:6 Karachi-29.

Subject:- EXPENDITURE INCURRED FOR THE 10% MAINTANANCE FOR THE YEAR 1989-90.

For the maintainance of Roads for the years 1989-90, this District Council has incurred expenditure of an amount of Rs:97,947/-(Rupees Ninty Seven Thousand Nine Hundred forty Seven only) work is done Departmentally.

Sd/-
DISTRICT ENGINEER,
DISTRICT COUNCIL, KHAIRPUR.

Copy forwarded with Compliments to
Mr:Hishmat Rai Oad maintanance Engineer C.C.S.C Sukkur
for information. further detail follows.

DISTRICT ENGINEER,
DISTRICT COUNCIL, KHAIRPUR.

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CCSR SUKKUR

FROM 16.12.1990 TO 20.12.1990

SR. NO.	NAME AND DESIGNATION	SUNDAY	MONDAY	TUESDAY	WEDNSDAY	THURSDAY	REMARKS
	HASHMAT ULLAH MAINTENANCE ENGINEER CCSR SUKKUR	Met DE DADU. He told me that they have done about 4km patch repair and resurfacing on DA-D1 No intimation is given to COP CCSC. I have advised him to inform COP and get the proper 35% maintenance program charted out. Dadu's co-ordinator I am told shall be Mr. Ali Gohar Sahb. Met DE N'Feroze. He is giving NA-17 and NA-13 for 35% maintenance along with NA-11 and NA-18 Coordinator of the D.C N'Feroze shall be Mr. Abdul Karim.	Office work	Office work	Office work	Met DE KHP and recieved the expenditure figure incurred in 1989-90 on maintenance 10%	G.S of Khairpur district Council has been patch work and resurfaced. Such COP has not been given intimation

ANNEX IV

SOIL TESTING PROCEDURES AND SAMPLE RESULTS

It is proposed that the program shall start as a pilot project and 8 roads were selected for this purpose. These roads are located in the districts of Badin, Larkana, Sangher, Nawab Shah, Jacobabad and Khairpur.

METHODOLOGY

1. The improvement in obtaining better load carrying capacity is aimed at by standardization for road construction materials or stabilizing road bed soils, sub base or base courses by the addition of admixtures of lime or asphalt.
2. The physical properties of soils in the province of Sindh varies from place to place. The use of admixtures and its proportions is specific to the soil properties.
3. Soil testing were performed to determine the basic soil properties such as Classification and Compacting Characteristics.
4. In order to determine which agent is best for a particular soil certain proportion of the soil were examined. The parameters chosen for most applications were the percentage of the material passing the mesh 200 sieve and the plasticity index, The strength parameters were CBR, Unconfined Compression Strength and the Compaction effects relative to Moisture Content for Proctor.

for GEOTECH CONSULTANTS
Office : 45 3. C.P. & BERAR SOCIETY, OFF SHAHEED-E-MILLAT ROAD KARACHI. • Phone : 413980
B.E. Civil(Mich)M.S.C. Land
PROFESSION
MIE (PAK) MEMBER (F.C.)
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GEOTECH
CONSULTANTS

5. The admixtures of lime and asphalt were used.

(A) Lime Admixture.

Hydrated lime was used as a stabilization agent lime is abundantly produced in kilns throughout Sindh,It works well with medium, modertely fine and fine grained soils.

It was proposed that trial mixes with 4,6,and 8 percent respectively of lime by dry weight of soil be made and tested in as Unconfined Compression Test, CBR Test and Optimum Moisture Density Relationship.

(B) Asphalt Stabilization.

Bitumenous Stabilization agents are usualy available in the form of Asphalt Cement or Asphalt Emulsions. The near plastic soils with less than 20 percent of the material passing the number 200 sieve and Plasticity Index of less than 6 are good materials for Asphalt Stabilization. It was decided to use 3,4,5, and 6 percents respectively of asphalt by dry weight of soil. CBR Tests were performed on trial mixes. The appropriate technology relevant to the soil stabilization were developed.

for GEOTECH CONSULTANTS

Office : 45/3, C.P. & BERAR SOCIETY. OFF SHAHEED-E-MILLAT ROAD KARACHI. Phone : 413980
B.E. Civil (Mich) ... PROFESSIONAL ENGINEER MIE (PAK) MEMBER (P.E.C.)

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GEOTECH
CONSULTANTS

Laboratory work was comprised of the following stages of testing activities.

FIRST STAGE

At the initial stage of work the following tests were carried out on supplied samples to determine the engineering characteristics and behaviour of soil of the eight experimental roads- JA-E-1, JA-E-2, KH-E-1,KH-E-3, LA-E-1, SA-E-1, NA-E-1, and BA-E-1). All these tests were planned to establish the basic parameters for the soil to be used in the later stages of testing work for stabilization and blending of soils.

Details of the tests performed at this stage is given below :

1.	Sieve Analysis	:	51 Nos.
2.	Atterberg Limits.	:	51 Nos.
3.	Modified AASHTO Compaction	:	51 Nos.
4.	Moisture Content.	:	21 Nos.
5.	Soaked CBR (3 Points)	:	25 Nos.
6.	Unsoaked CBR (3 Points)	:	25 Nos.
7.	Chemical Tests.	:	30 Nos.

for GEOTECH CONSULTANTS

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GEOTECH CONSULTANTS

SECOND STAGE

At the second stage of work,stabilization of soil was completed according to the following program.
The stabilization method was based on the parameters of soil obtained at the initial stage of testing work. Following stabilized samples were tested at this stage of work.

1. 4% Lime + 20% Brick bats + 76% Soil.	4 Nos.
2. 6% Lime + 94% Soil.	6 Nos.
3. 8% Lime + 92% Soil.	1 No.
4. 4% Lime + 96% Soil.	5 Nos.
5. 5% Lime + 95% Soil.	1 No.
6. 6% Lime + 20% Brick bats + 74% Soil.	1 No.
7. 20% Lime stone fragement + 80% Soil	2 Nos.
8. 25% Lime stone fragement + 75% Soil	2 Nos.
9. 30% Lime stone fragement + 70% Soil	1 No.
10.20% Brick bats + 80% Soil.	1 No.
11. 3% Bitumen + 97% Dune sand	1 No.
12. 4% Bitumen + 96% Dune sand	1 No.
13. 5% Bitumen + 95% Dune sand	1 No.
14. 6% Bitumen + 94% Dune sand	1 No.
15.50% Brick Powder + 50% Soil.	1 No.

Modified AASHTO Compaction, 3 point Soaked CBR,Unconfined Compression Tests were performed for the above stabilized samples at the second stage of work.

for GEOTECH CONSULTANTS

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The detail of tests performed is as follows.

Modified AASHTO Compaction Test.	32 Nos.
3 Point Soaked CBR Test.	65 Nos.
Unconfined Compression Test.	75 Nos.
Grain Size Analysis.	03 Nos.
Atterberg Limit.	03 Nos.

Grain Size Analysis and Atterberg Limit Tests were performed on 3 samples at this stage for Shadi Shaheed Morum,Uban Shah and Arore Quarries.

THIRD STAGE

At the third stage of work, the soil blending work was completed according to the following program.
The blending was based on the parameters of soil obtained at the initial stage of testing work.
Following blended samples were tested at this stage of work.

1. 25% Morum + 75% Soil - 2 Nos.
2. 30% Morum + 70% Soil - 2 Nos.
3. 20% Dune Sand + 80% Soil - 1 No.
4. 30% Dune Sand + 70% Soil - 1 No.
5. 30% Lime stone fragement + 70% Soil. - 1 No.

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6. 30% Lime stone Powder + 70% Soil. - 1 No.
7. 50% Brick Powder + 50% Soil. - 3 Nos.

The detail of tests performed is as follows.

1. 3 Point Soaked CBR Tests - 11 Nos.
2. Modified AASHTO Compaction Tests. - 11 Nos.
3. Grain Size Analysis. - 11 Nos.
4. Atterberg Limit Tests. - 11 Nos.

CONCLUSION

Our comments on the tests carried out on Untreated soil samples, Stabilized soil samples, Blended soil samples and Blended & Stabilization soil samples are as follows.

A. UNTREATED AND UNBLENDED SOIL SAMPLES

1. 96 hours soaked CBR test results show the CBR values according to the compactive efforts between 6 to 8.
2. The CBR values are lower for silt and higher for soil with good percentage of sand or silty clay soil.
3. CBR values on silty clay soil are better with molded moisture content at +2% optimum moisture content.

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4. Generally swelling percentage is higher for lesser compactive efforts and the CBR values are lower for higher swelling percentage.

B. STABILIZED SOIL SAMPLES

1. Soaked CBR test on 4% lime stabilized soil shows higher values for 7 days than 14 days and vice versa with 6% lime stabilized soil means higher value for 14 days than 7 days.
2. The CBR value is increased considerably upto 28 for 6% lime stabilized soil.
3. 7 days soaked CBR value is higher than 96 hours soaked CBR values for 4 or 6% lime stabilized soil.
4. The CBR results are not fairly improved for 3 to 6% bitumen stabilized soil.
5. 4 to 6% lime stabilized soil shows the unconfined compressive strength of 3 to 8 kg/cm^2 with strain 2 to 4%.
6. Swelling percentage shows increament with curing time, Highest swelling recorded for 14 days curing in moist condition.

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C. BLENDED SOIL SAMPLES

1. Soil blended with 20 to 30% morum yielded good CBR values.
2. CBR value improves with increasing percentage of brick powder blended with soil.
3. CBR value did not improve at all for soil blended with lime stone fragements.
4. CBR value has been improved for soil blended with Dune sand.
5. Soil blended with lime stone fragements yielded discouraging results for CBR values.
6. Soil blended with lime stone fragements shows the Unconfined Compressive Strength upto 19 kg/cm^2.
7. Blended soil either with lime stone fragements or brick bats shows swelling increament with curing time in moist condition.

D. BLENDED AND STABILIZED SOIL SAMPLES

1. Soil with brick bats and 4 to 6% lime shows better results for 14 days than 7 days, CBR values.
2. Blended soil with 20% brick bats and 4 to 6% lime treatment shows much improved values of soaked CBR for 14 days than 7 days or 96 hours.

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3. Unconfined Compressive Strength are higher by blending of 20% brick bats and 4 to 6% lime with soil.
4. Blending of soil with stone fragements and 4 to 6% lime shows fairly higher values of unconfined compressive strength.
5. Blending of soil with brick bats or stone fragements and treatment with 4 to 6% lime shows the value of unconfined compressive strength upto 19 kg/cm^2 and strain of 3 to 4%.
6. Swelling percentage increases with curing period and maximum swelling obtained at 14 days curing.

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TESTING AT STAGE - 1

*	Sieve Analysis.	51 Nos.
*	Modified AASTHO Compaction Test	51 Nos.
*	Atterberg Limit.	51 Nos.
*	Moisture Content.	21 Nos.
*	3 Point CBR (Soaked)	25 Nos.
*	3 Point CBR (Unsoaked)	25 Nos.
*	Chemical Test.	30 Nos.

****

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Reporting Date: 20th,May,1990

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SOILS AND MATERIALS TESTING LABORATORIES

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HOUSING SOCIETY
KARACHI.
Phone : 413980

CLIENT : M/S, USAID.
PROJECT : R.R.M.P.Sindh.
DISTRICT: JACOBABAD.
ROAD NO: JA - E-1
Consultants : M/S, C.C.S.C.

TEST RESULTS OF SOIL SAMPLES TAKEN FROM TEST PITS.

TABLE NO: 01

LAB No.	TEST PIT No.	LOCATION (Km)	GRAIN SIZE ANALYSIS (% PASSING BY WT)			ATTERBERG LIMITS		AASHTO SOIL CLASSIFICATION.	UNIFIED SOIL CLASSIFICATION.	MODIFIED AASHTO COMPACTION		SOAKED CBR AT 95% M.D.D.
			# 10	# 40	# 200	LL %	PI %			M. D. D. g/cc	O.M.C %	
02	1	0 + 000	100.0	99.4	47.7	29	13	A - 6	CL	1.96	10.2	-
03	3	0 + 800	100.0	99.9	26.6	NP	NP	A - 4	ML	1.77	8.2	7.6
01	1*	0 + 800	100.0	100.0	51.3	NP	NP	A - 4	ML	1.77	10.2	7.6

Note : * = Borrow Pits.

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Report No: GEO/USA/CCSC/FDT.90025.I
Reporting Date: 20th, May, 1990

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K A R A C H I .
Phone : 413980

CLIENT : M/S, USAID
PROJECT : R.R.M.P.SINDH.
DISTRICT: ---
ROAD NO: -----

TEST RESULTS OF SOIL SAMPLES

(BLENDED FOR EXPERIMENTAL ROADS)

TABLE NO: 09

LAB No.	TEST PIT No.	ROAD No.	GRAIN SIZE ANALYSIS (% PASSING BY WT)			ATTERBERG LIMITS		AASHTO SOIL CLASSIFICATION.	UNIFIED SOIL CLASSIFICATION.	MODIFIED AASHTO COMPACTION		SOAKED CBR AT 95% M.D.D.
			# 10	# 40	# 200	LL %	PI %			M. D. D. g/cc	O.M.C %	
ST-1		JA - E-1	100.0	98.7	64.6	27.0	6.0	A - 4	CL	1.95	10.0	
ST-2		JA - E-2	100.0	98.7	84.1	28.0	13.0	A - 6	ML	1.97	12.5	
ST-3		KH - E-3	100.0	98.9	78.9	33.0	13.0	A - 6	ML	1.97	10.5	
ST-4		NA - E-1	100.0	98.7	95.7	28.0	11.0	A - 6	CL	1.96	11.0	
ST-5		BA - E-1	100.0	99.6	96.6	29.0	10.0	A - 4	CL	1.96	11.0	
ST-6		SA - E-1	100.0	99.6	70.7	28.0	5.0	A - 4	CL	1.98	11.5	
ST-7		KH - E-1	100.0	99.6	98.7	30.0	6.0	A - 4	CL	1.95	11.0	

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Report No.: GEO/USA/CCSC/CBR.90025.I

Table No.: 10

Date: 20th,May,1990

PROJECT: ROAD RESOURCES MANAGEMENT PROJECT SINDH.

CLIENT: M/S, USAID.

CONSULTANTS: M/S,CONSTRUCTION CONTROL SERVICES CORPORATION.

SUBJECT: 3 POINT CBR TEST. (SOAKED & UNSOAKED)

S. No.	IDENTIFICATION No.		COMPACTION: MODIFIED AASHTO T180		CBR T193-72 AT OPT MOISTURE CONTENT AND MAXIMUM DRY DENSITY				SWELLING %	VISUAL DESCRIPTION
			DRY DENSITY g/cc	MOISTURE CONTENT %	UNSOAKED .1"	UNSOAKED .2"	SOAKED 96 HRS .1"	SOAKED 96 HRS .2"		
	ROAD NO.	LAB No	MOLDING							
1.	JA-E-1	03	1.85	8.2	13.3	17.4	5.3	7.8	1.48	56 Blows.
			1.75	8.2	12.0	15.5	5.0	7.7	1.65	30 "
			1.61	8.2	10.6	11.1	4.8	7.3	1.69	15 "
2-	JA-E-1	01	1.90	10.2	15.8	19.1	9.5	14.2	1.33	56 "
			1.71	10.2	10.6	12.4	6.6	8.0	1.67	30 "
			1.60	10.2	9.3	12.2	5.0	6.8	1.76	15 "
3-	KH-E-3	07	2.00	12.5	11.3	14.9	8.6	12.2	1.95	56 "
			1.87	12.5	8.5	12.6	3.3	7.5	2.22	30 "
			1.71	12.5	9.3	11.0	3.1	5.1	2.52	15 "

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REGD. PROFESSIONAL ENGINEER (MICH)
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Report No.: GEO/USA/CCSC/CBR.90025.I

Table No.: 11

Date: 20th, May,1990

PROJECT: ROAD RESOURCES MANAGEMENT PROJECT SINDH.

CLIENT: M/S, USAID.

CONSULTANTS: M/S, CONSTRUCTION CONTROL SERVICES CORPORATION.

SUBJECT: 3 POINT CBR TEST. (SOAKED & UNSOAKED)

S. No.	IDENTIFICATION No.		COMPACTION: MODIFIED AASHTO T180		CBR T193-72 AT OPT MOISTURE CONTENT AND MAXIMUM DRY DENSITY				SWELLING %	VISUAL DESCRIPTION
			DRY DENSITY g/cc	MOISTURE CONTENT %	UNSOAKED .1"	UNSOAKED .2"	SOAKED 96 HRS .1"	SOAKED 96 HRS .2"		
	ROAD NO.	LAB No	MOLDING							
4-	KH - E-3	05	1.70	8.7	11.0	16.9	8.3	9.7	1.92	56 Blows.
			1.60	8.7	8.1	13.1	7.5	8.8	1.83	30 "
			1.45	8.7	7.3	12.3	6.5	8.2	2.32	15 "
5-	KH-E- 3	09	1.95	11.2	11.3	17.3	5.0	7.3	3.35	56 "
			1.76	11.2	10.0	15.3	4.3	6.4	3.61	30 "
			1.67	11.2	9.0	14.4	3.3	4.2	3.25	15 "
6-	KH-E -3	08	1.98	12.5	21.3	18.0	8.7	12.8	3.08	56 "
			1.93	12.5	13.1	16.0	7.0	11.1	2.07	30 "
			1.72	12.5	8.3	13.1	2.6	4.8	3.14	15 "

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Table No. : 20

Date : 20th,May,1990

PROJECT : R.R.M.P.SINDH.

CLIENT : M/S, USAID.

CONSULTANTS : M/S, C.C.S.C.

ROAD NO : JA-E-1.

(Field density and Laboratory Compaction)

S.No.	LAB.No.	PIT.No.	LOCATION (Km)	LAB DENSITY		FIELD DENSITY		FIELD COMPACTION %	REMARKS
				OMC %	g/cc	M.C %	g/cc.		
1.	02	1	0 + 000	10.2	1.96	11.0	1.72	89.0	
2.	03	2	0 + 500	8.2	1.77	9.7	1.60	90.0	
3.	03	3	0 + 800	8.2	1.77	12.2	1.72	97.0	

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Report No. : GEO/USA/CCSC/FDT.90025.I

Table No. : 21

Date : 20,May,1990

PROJECT : R.R.M.P.SINDH.

CLIENT : M/S, USAID.

CONSULTANTS : M/S, C.C.S.C.

ROAD NO : KH- E-3

(Field density and Laboratory Compaction)

S.No.	LAB.No.	PIT.No.	LOCATION (Km)	LAB DENSITY OMC %	LAB DENSITY g/cc	FIELD DENSITY M.C %	FIELD DENSITY g/cc.	FIELD COMPACTION %	REMARKS
4.	07	1	0 + 000	12.5	1.94	3.2	1.76	91.0	
5.	05	2	0 + 500	8.7	1.65	6.9	1.66	100.0	
6.	04	3	1 + 000	11.0	1.69	5.6	1.64	97.0	
7.	06	4	1 + 500	11.5	1.94	8.0	1.70	88.0	

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Table No. : 27

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh (RRMP)

CLIENT : M/S, US'AID.

CONSULTANTS : M/S, C.C.S.C

SUBJECT : Chemical Analysis on Soil Samples.

S.No.	Road No.	Rd No.	Description	Chloride (Cl) %	Sulphate (SO_4) %	pH Value %	REMARK
1.	JA-E-1	0 + 000	From Road Alignment.	0.092	0.120	7.1	
2.	JA-E-1	0 + 500	From Road Alignment.	0.089	0.105	7.0	
3.	JA-E-1	0 + 800	From Road Alignment.	0.094	0.125	7.2	
4.	JA-E-1	0 + 800	Borrow Source.	0.088	0.100	7.1	
5.	JA-E-2	0 + 000	From Road Alignment.	0.078	0.092	7.0	
6.	JA-E-2	1 + 000	From Road Alignment.	0.069	0.086	7.0	
7.	JA-E-2	0 + 500	Borrow Source.	0.086	0.110	7.1	
8.	JA-E-2	0 + 500	Borrow Source.	0.082	0.108	7.1	

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Report No. : GEO/USA/CCSC/CT.90025.I

Table No. : 28

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh (RRMP)

CLIENT : M/S,US'AID.

CONSULTANTS : M/S, C.C.S.C.

SUBJECT : Chemical Analysis.

S.No.	Road No.	Rd No.	Description	Chloride (Cl) %	Sulphate (SO_4) %	pH Value %	REMARKS
9.	KH-E-3	0 + 000	From Road Alignment.	0.096	0.130	7.2	
10.	KH-E-3	1 + 500	From Road Alignment.	0.094	0.126	7.2	
11.	KH-E-3	0 + 300	Borrow Source.	0.097	0.122	7.1	
12	KH-E-3	1 + 500	Borrow Source.	0.090	0.120	7.1	
13.	NA-E-1	0 + 000	From Road Alignment.	0.078	0.094	7.0	
14.	NA-E-1	1 + 000	From Road Alignment.	0.080	0.090	7.0	
15.	NA-E-1	2 + 000	From Road Alignment.	0.082	0.091	7.1	
16.	NA-E-1	1 + 200	Borrow Source.	0.084	0.096	7.1	
17.	BA-E-1	0 + 000	From Road Alignment.	0.105	0.135	7.2	
18.	BA-E-1	1 + 500	From Road Alignment.	0.110	0.140	7.2	
19.	BA-E-1	2 + 000	From Road Alignment.	0.100	0.124	7.1	

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GRAIN SIZE DISTRIBUTION

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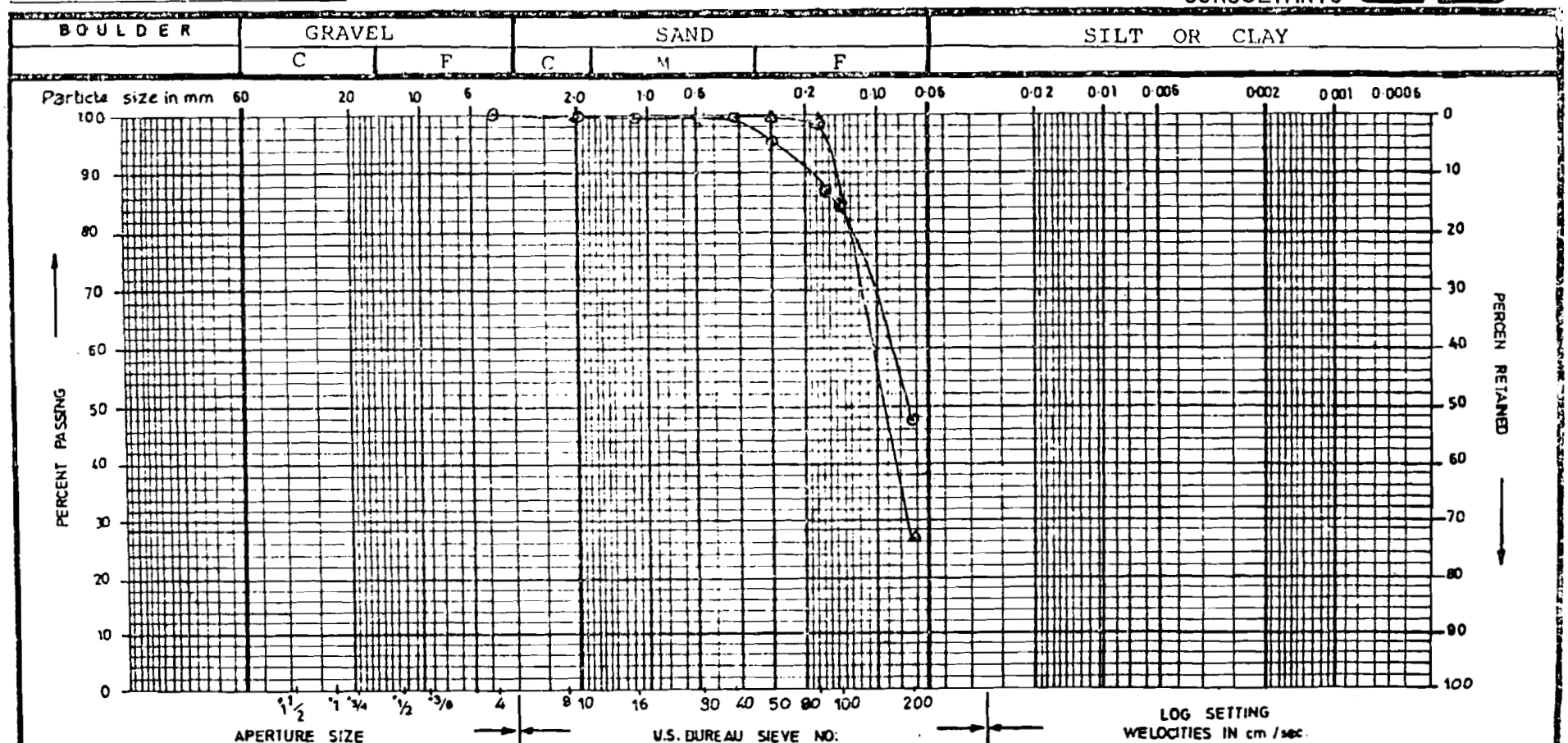
PROJECT : R.R.M.P.SINDH



SYMB.	LAB.No	PIT No	ROAD NO	LOCATION (Km)	BOULD. %	GRAV %	SAND %	SILT %	CLAY %		L_L	P_L	P_X	REMARKS
⊙	2	1	JA-E-1	0 + 000										
△	3	3	JA-E-1	0 + 800										
				for GEOTECH CONSULTANTS										

CLIENT : M/S, USAID.

CONSULTANTS : M/S, CCSC .

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MIE (PAK) MEMBER(PEC.)

PROJECT : R.R.M.P.SINDH

GRAIN SIZE DISTRIBUTION

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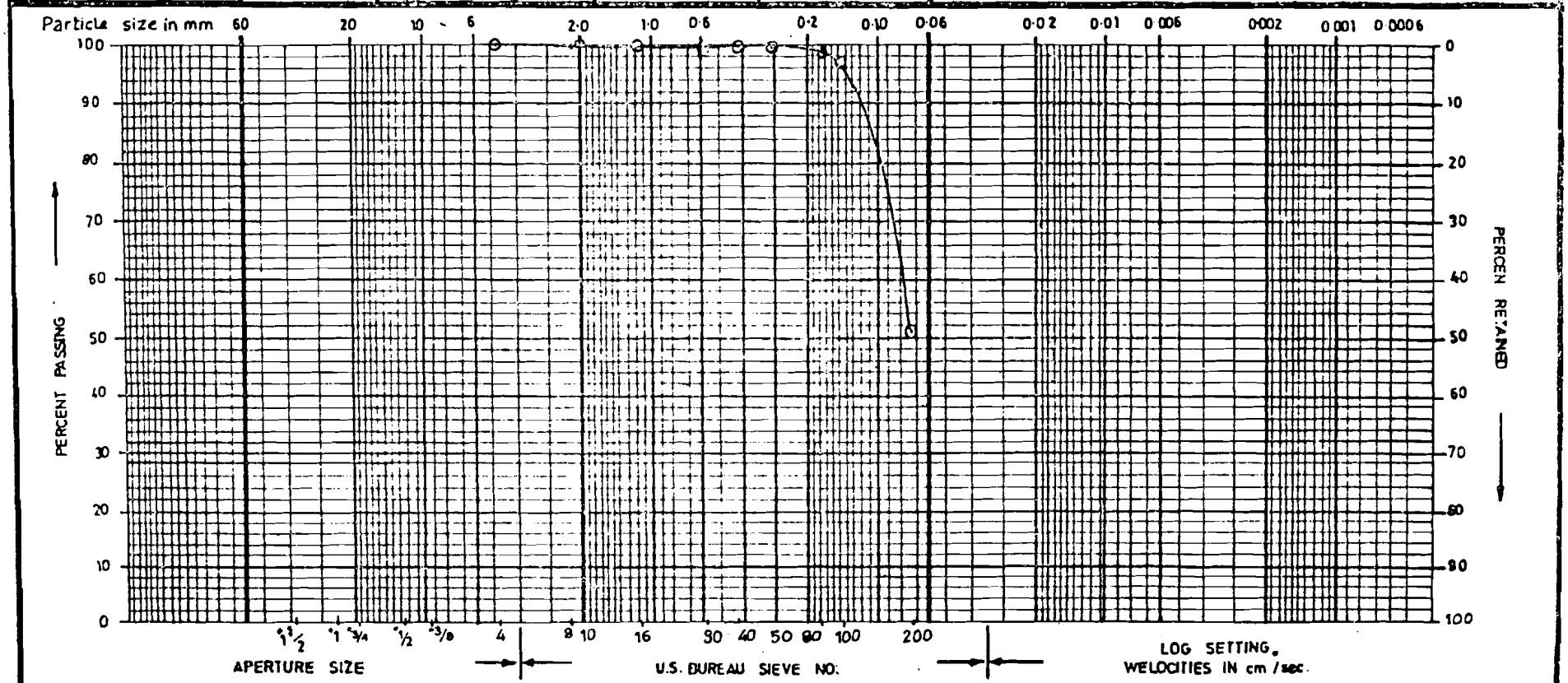

SYMB	LAB.No	PIT No	ROAD NO	LOCATION (Km)	BOULD. %	GRAV %	SAND %	SILT %	CLAY %		L_L	P_L	P_X	REMARKS
	1	1*	JA-E-2	0 + 000 [Borrow]										

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CONSULTANTS : M/S, CCSC .

PROJECT : R.R.M.P.SINDH

GRAIN SIZE DISTRIBUTION

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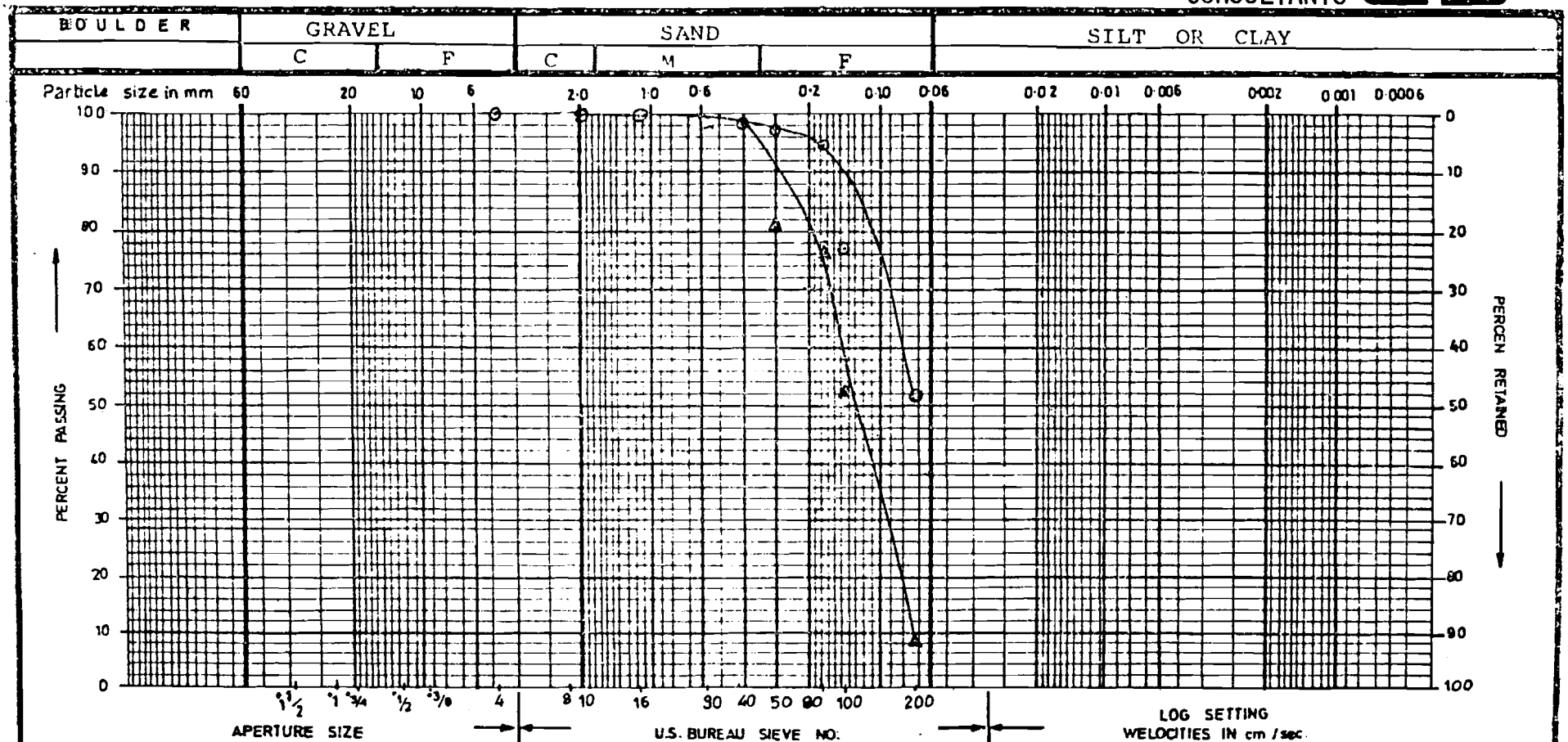

SYMB.	LAB.No	PIT No	ROAD NO	LOCATION (Km)	BOULD. %	GRAV %	SAND %	SILT %	CLAY %		L_L	P_L	P_X	REMARKS
	7	1	KH-E-3	0 + 000										
	5	2	KH-E-3	0 + 500										

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MIE (PAK) MEMBER (PEC.)

CLIENT : M/S, USAID.

CONSULTANTS : M/S, CCSC .

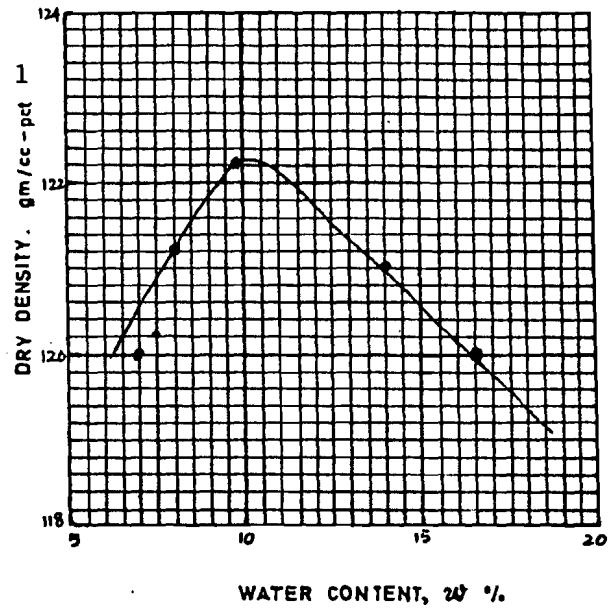
MOISTURE DENSITY RELATION PER MODIFIED ASSHO COMPACTION

PIT NO. 1

JA-E-1

0 + 000

Lab No.2



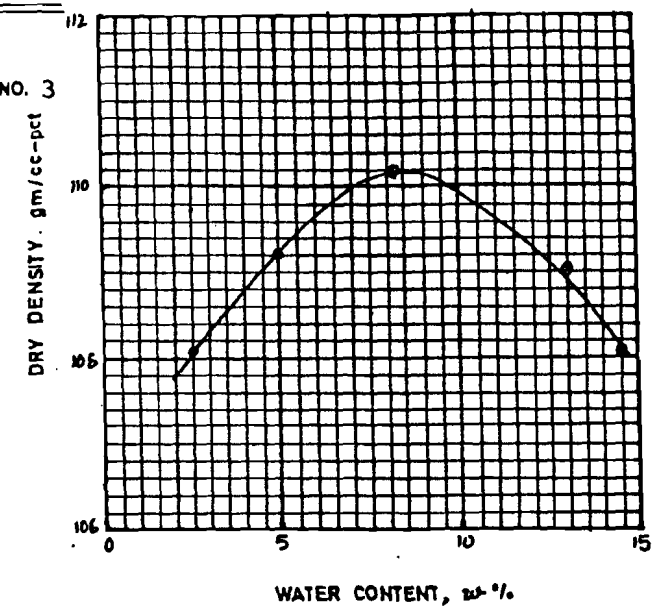
OPTIMUM MOISTURE = 10.2 %. MAX. DRY DENSITY = 122.2 pct

PIT NO. 3

JA-E-1

0+800

Lab No.3



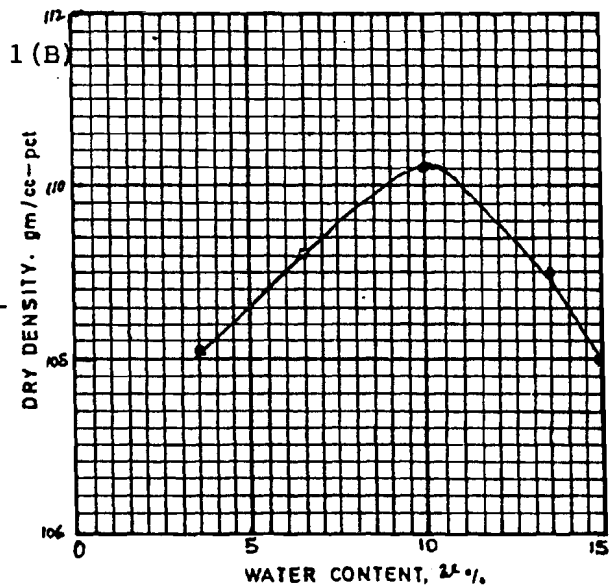
OPTIMUM MOISTURE = 8.2 %. MAX. DRY DENSITY = 110.2 pct

PIT NO. 1 (B)

JA-E-1

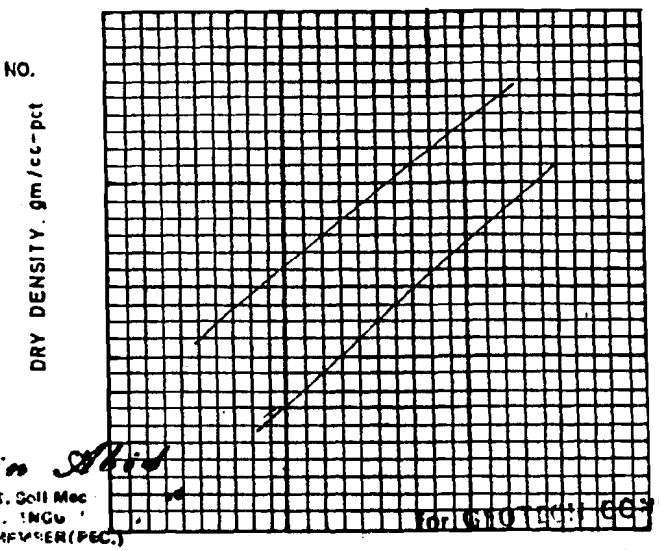
0 + 800

Lab No.1



OPTIMUM MOISTURE = 10.2 %. MAX. DRY DENSITY = 110.2 pct

PIT NO.



Husain Shah
B.S. Civil (Mich) M.S. Soil Mec
PROFESSIONAL ENGG
MIE (PAK) REVISER (PEC)

for GHOTKI CONSULTANTS

OPTIMUM MOISTURE = ____ %. MAX. DRY DENSITY = ____ pct

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69

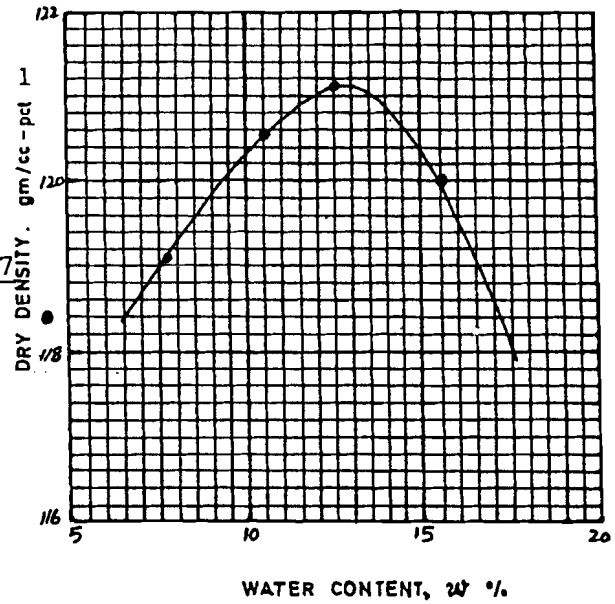
MOISTURE DENSITY RELATION PER MODIFIED ASSHO COMPACTION

PIT NO. 1

KH-E-3

0+000

Lab No.7



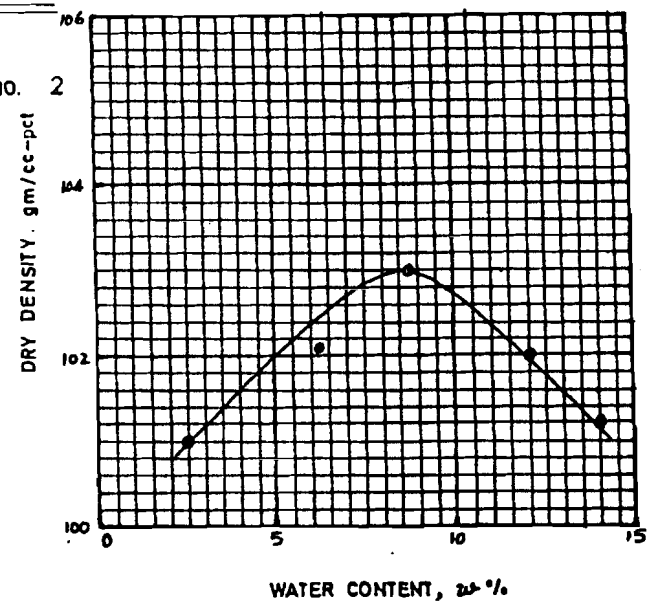
OPTIMUM MOISTURE = 12.5 % MAX.DRY DENSITY = 121.1 pct

PIT NO. 2

KH-E-3

0+500

Lab No.5



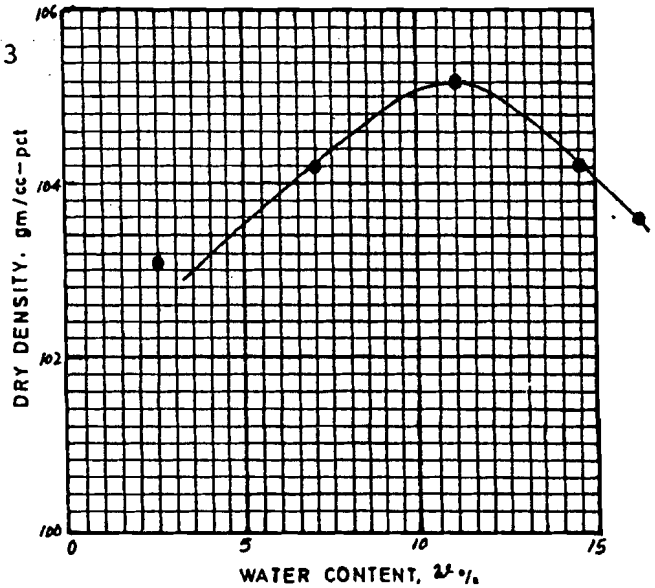
OPTIMUM MOISTURE = 8.7 % MAX.DRY DENSITY = 103.0 pct

PIT NO. 3

KH-E-3

1+000

Lab No.4



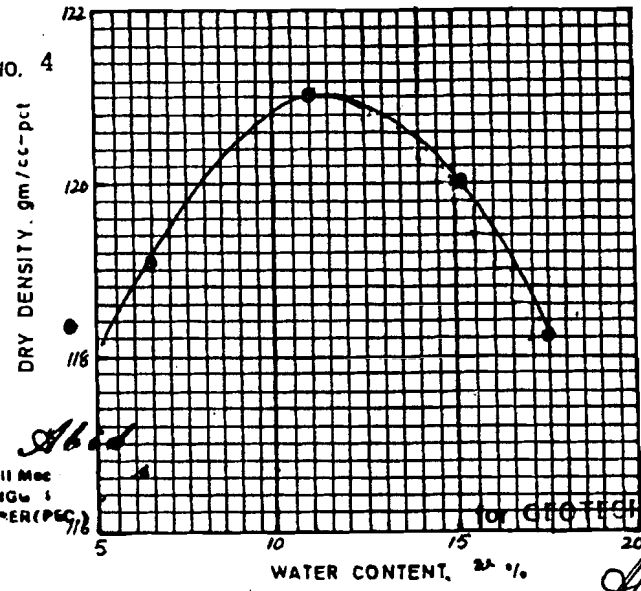
OPTIMUM MOISTURE = 11.0 % MAX.DRY DENSITY = 105.2 pct

PIT NO. 4

KH-E-3

1+500

Lab No.6



OPTIMUM MOISTURE = 11.5 % MAX. DRY DENSITY = 121.0 pct

Husain Abed
B.S. Civil (Mich) M.S. Soil Mec
PROFESSIONAL ENGG
MIE (PAK) CHARTERED (PEC)
for GEOTECH CONSULTANTS

Abd Hussain

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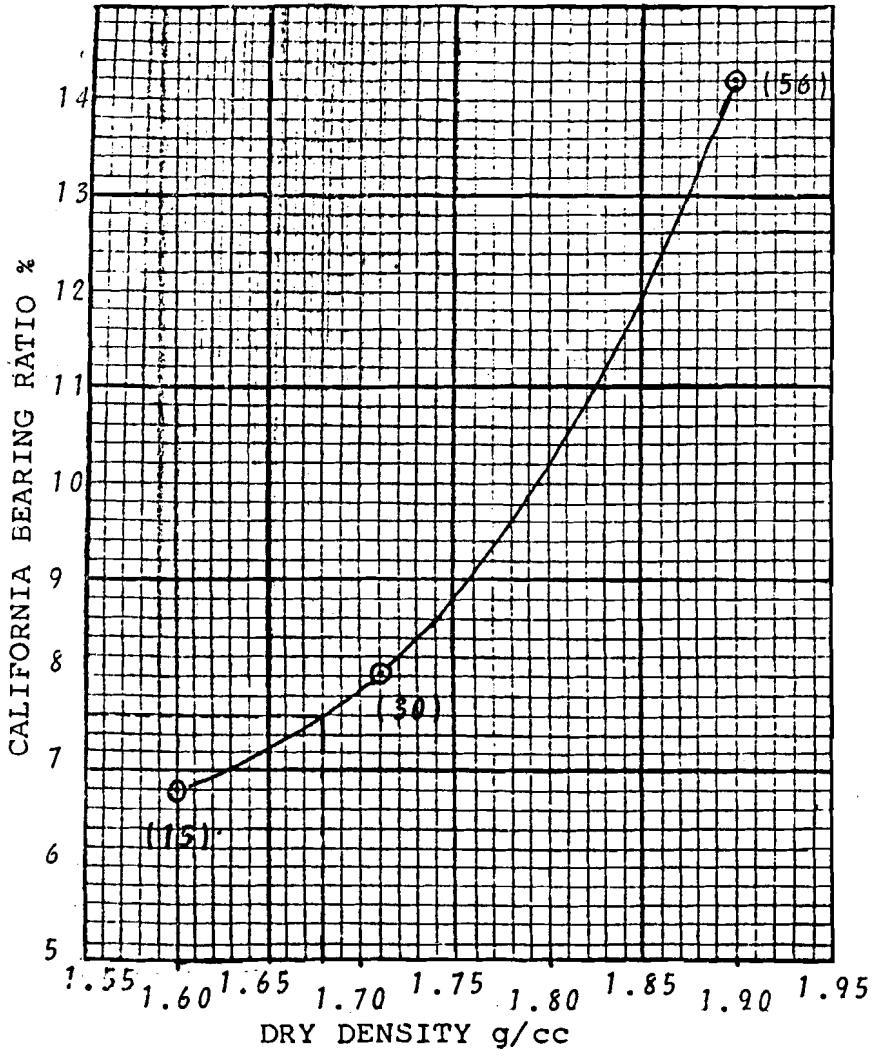
10

Road No: JA-E-1 Lab No: 01

Project: R.R.M.P Client: USAID

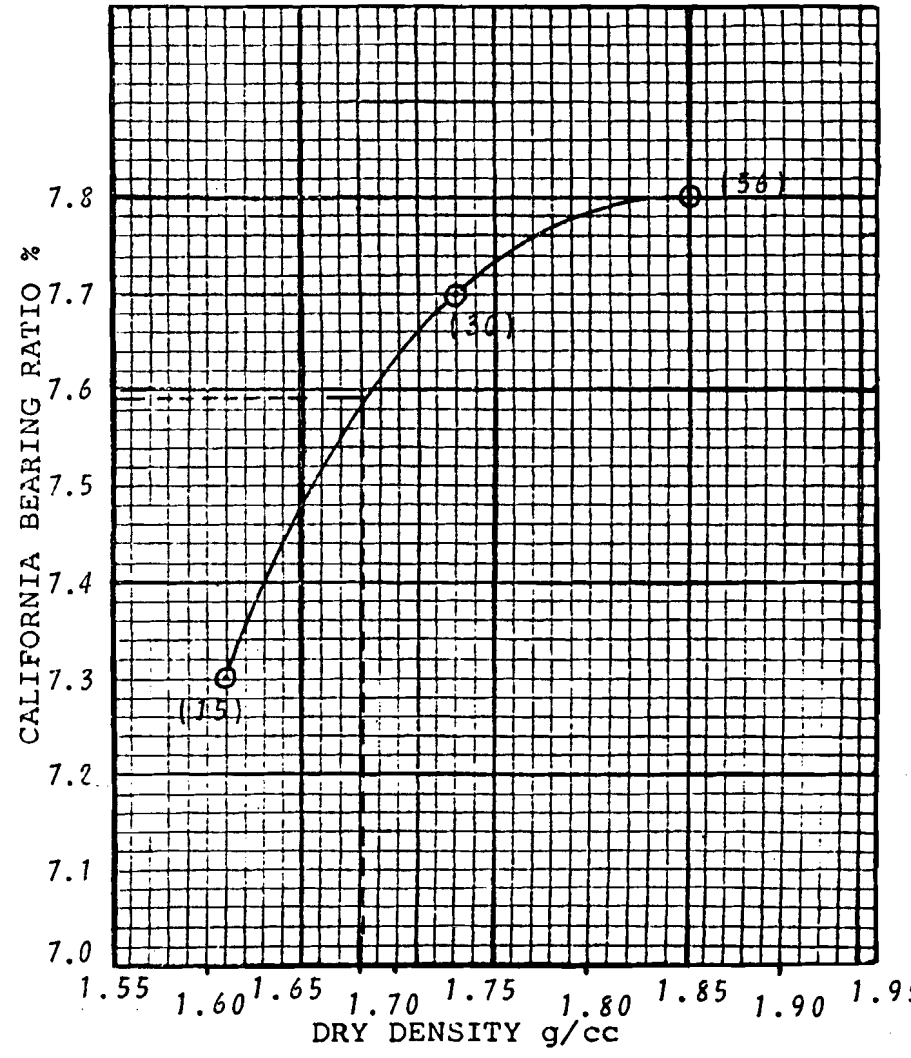
Max Dry Density (MDD). 1.77 g/cc.
CBR at 95% (MDD). 7.6 %



Road No: JA-E-1 Lab No: 03

Projent: R.R.M.P Client: USAID

Max Dry Density (MDD). 1.77 g/cc.
CBR at 95% (MDD). 7.6 %



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PROFESSIONAL ENGINEER (P.C.)

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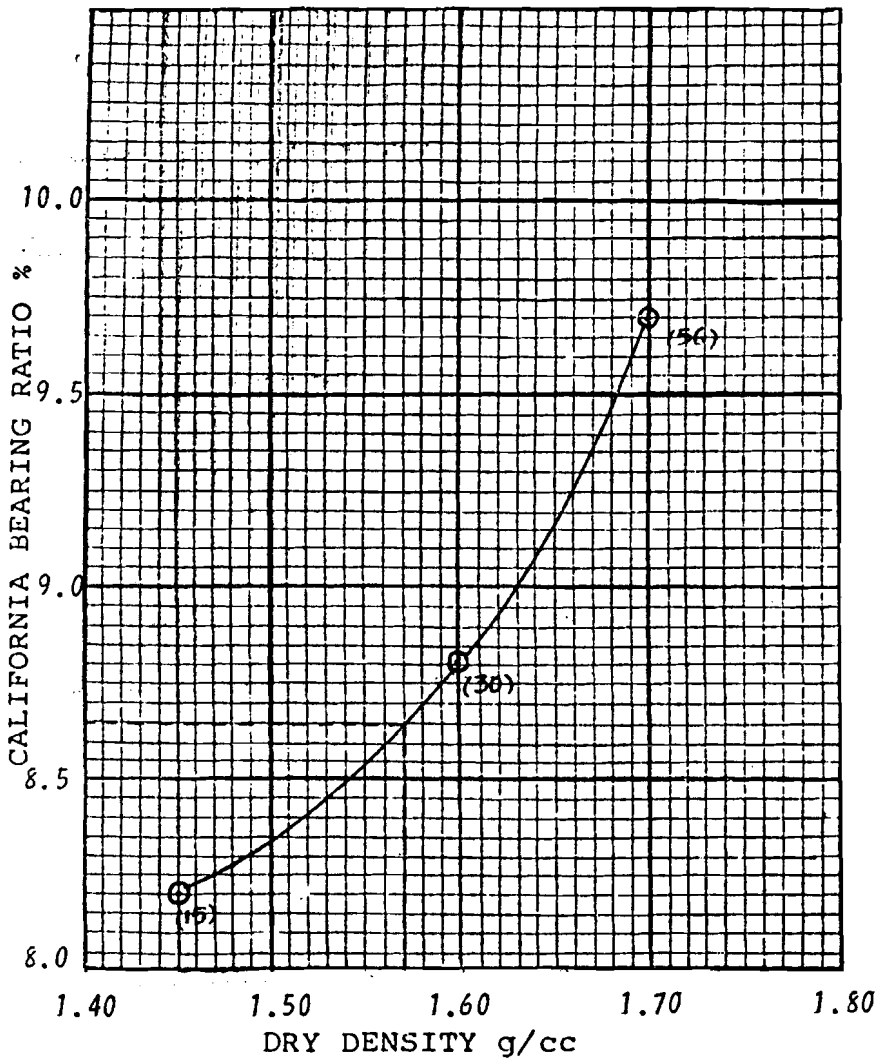
Road No: KH-E-3 Lab No: 05

Project: R.R.M.P Client: USAID

Max Dry Density (MDD). 1.65 g/cc

CBR at 95% (MDD). 8.6 %

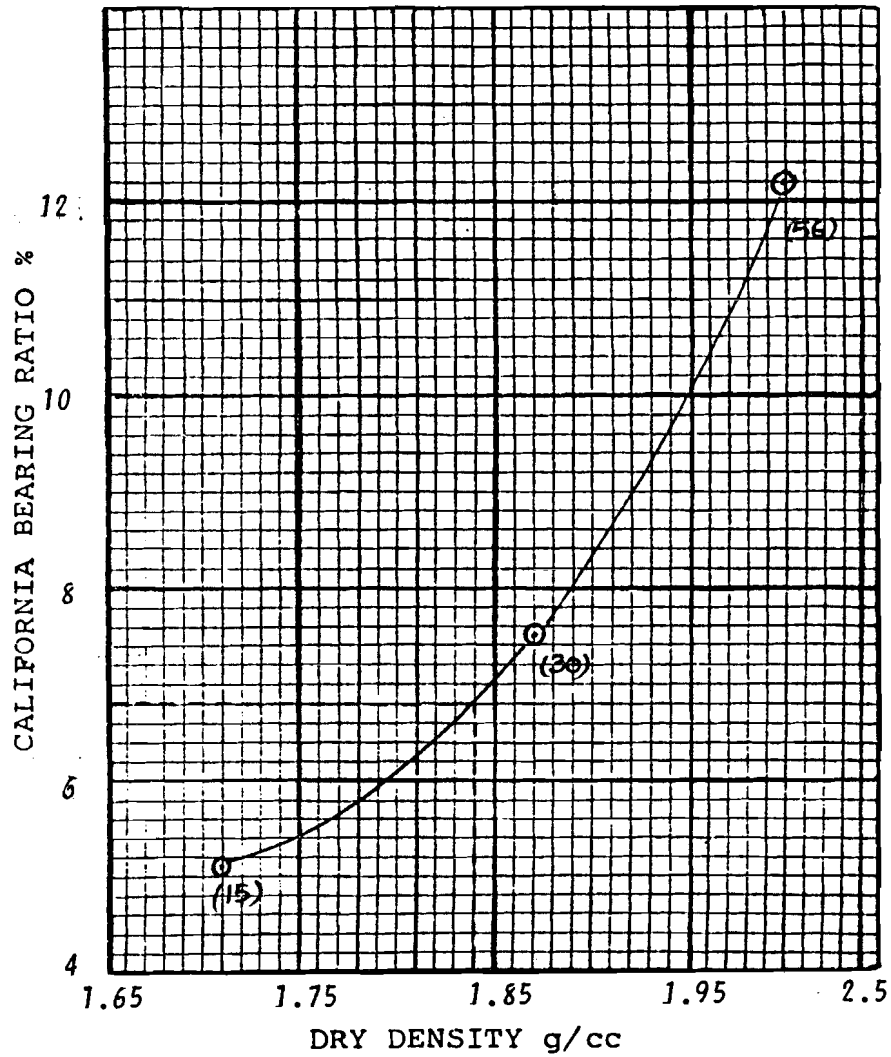


Road No: KH-E- 3 Lab No: 07

Projent: R.R.M.P Client: USAID

Max Dry Density (MDD). 1.94 g/cc.

CBR at 95% (MDD). 6.8 %



for GEOTECH CONSULTANTS

Hussain Abid
B.S. Civil(Mich)M.S. Soil Mech
PROFESSIONAL ENGG
MIE(PAK) MEMBER(PEC.)

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GEOTECH
CONSULTANTS

TESTING AT STAGE - 2

* Modified AASHTO Compaction.	-	32 Nos.
* 3 Point CBR (Soaked)	-	65 Nos.
* Unconfined Compression	-	75 Nos.
* Sieve Analysis.	-	03 Nos.
* Atterberg Limits.	-	03 Nos.

for GEOTECH CONSULTANTS

Husain Abid
B.S. Civil(Mech)M.S. Soil Mech. F[illegible]
PROFESSIONAL ENGG ([illegible])
MIE(PAK) MEMBER(PEC.)

GEOTECH CONSULTANTS

SOILS AND MATERIALS TESTING LABORATORIES

45/3 CP & BERAR
HOUSING SOCIETY
OFF SHAHEED-E-
MILLAT ROAD
KARACHI.
Phone : 413980

Report No. : GEO/USA/CCSC/90025.I

Table No. : 01

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh.

CLIENT : M/S, US'AID.

CONSULTANTS : M/S, C.C.S.C.

TEST RESULTS OF SOIL STABILIZATION SAMPLES

S.No.	STABILIZATION. No.	Road No.	DESCRIPTION	Modified AASHTO Compacti		3 Point Soaked CBR						SWELLING %		
				O,M.C %	M.D.D g/cc	96 hours		7 days		14 days		96 hours	7 days	14 days
						95%	98%	95%	98%	95%	98%			
	ST-1.	JA-E-1	4% lime + 96% Soil	11.3	1.99	12.5	13.9	-	-	16.4	21.5	0.77	-	3.34
	ST-1.	JA-E-1	6% lime + 94% Soil.	11.0	2.00	13.9	15.9	-	-	20.0	25.0	0.90	-	3.54
	ST-1.	JA-E-1	6% lime + 94% Soil (-2% M.C)	11.0	2.00	17.2	19.0	-	-	18.0	20.7	1.40	-	2.16
	ST-1.	JA-E-1	6% lime + 94% Soil (+2% M.C)	11.0	2.00	20.8	23.5	-	-	27.7	30.3	1.85	-	2.56
	ST-2.	JA-E-2	4% lime + 96% Soil	11.2	1.99	12.3	13.8	-	-	21.6	26.0	0.86	-	3.68
	ST-2.	JA-E-2	4% lime + 96% Soil (-2% M.C)	11.2	1.99	17.2	18.8	-	-	20.0	23.0	1.74	-	3.38
	ST-2.	JA-E-2	4% lime + 96% Soil (+2% M.C)	11.2	1.99	12.7	13.5	-	-	20.0	25.0	0.92	-	2.43
	ST-2.	JA-E-2	6% lime + 94% Soil.	13.2	1.99	13.8	15.8	-	-	22.1	26.0	1.03	-	2.97
	ST-3.	KH-E-3	4% lime + 96% Soil.	12.8	1.99	-	-	17.0	18.6	7.2	7.7	-	0.85	2.63
	ST-3.	KH-E-3	6% lime + 94% Soil	11.0	2.00	-	-	13.5	14.4	4.6	5.0	-	0.24	0.69
	ST-3.	KH-E-3	8% lime + 92% Soil.	13.0	1.99	-	-	18.3	19.7	10.8	11.8	-	0.83	5.07

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S.No 1 to 7 - Specimen Covered by Damp Cloth

B.E. Civil (Hons) M.E. ... PROFESSIONAL ENGINEER (P.E.C.)

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SOILS AND MATERIALS TESTING LABORATORIES

45/3 CP & BERAR HOUSING SOCIETY
OFF SHAHEED-E-MILLAT ROAD
KARACHI.
Phone : 413980

Report No. : GEO/USA/CCSC/ 90025.I

Table No. : 02

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh.
CLIENT : M/S, US'AID.
CONSULTANTS : M/S, C.C.S.C.

TEST RESULTS OF SOIL STABILIZATION SAMPLES

No.	STABILIZATION. No.	Road No.	DESCRIPTION	Modified AASHTO Compacti		3 Point Soaked CBR						SWELLING %		
				O,M.C %	M.D.D g/cc	96 hours		7 days		14 days		96 hours	7 days	14 days
						95%	98%	95%	98%	95%	98%			
.	ST-4	NA-E-1	4% lime + 96% soil.	11.3	2.00	-	-	6.9	7.7	8.2	8.7	-	4.46	5.88
.	ST-4	NA-E-1	6% lime + 94% soil.	12.3	2.01	-	-	8.2	8.7	4.6	4.9	-	3.81	5.76
.	ST-4	NA-E-1	6% lime + 94% soil.(-2%M.C	12.3	2.01	13.9	16.2	-	-	10.5	11.9	2.87	-	4.67
.	ST-4	NA-E-1	6% lime + 94% soil.(+2%M.C	12.3	2.01	12.9	15.0	-	-	12.3	13.0	3.19	-	4.89
.	ST-5	BA-E-1	4% lime + 96% soil.	12.3	1.99	-	-	11.2	12.3	9.2	9.9	-	2.20	3.81
.	ST-5	BA-E-1	6% lime + 94% soil.	13.2	1.99	-	-	10.2	11.5	12.8	13.2	-	1.95	2.68
.	ST-6	SA-E-1	5% lime + 95% soil.	11.5	1.99	-	-	12.0	12.6	13.0	17.6	-	2.00	3.11
.	ST-6	SA-E-1	6% lime + 94% soil.	12.3	2.03	13.4	13.8	15.0	15.7	-	-	1.65	3.20	-
.	ST-1	JA-E-1	4% lime + 20% Brick bats + 76% soil.	12.3	2.08	-	-	20.3	22.2	24.8	27.0	-	0.95	1.82
.	ST-2	JA-E-2	4% lime + 20% Brick bats + 76% soil.	13.2	2.05	-	-	17.9	18.9	19.5	22.6	-	1.10	2.00
.	ST-4	NA-E-1	4% lime + 20% Brick bats + 76% soil.	11.0	2.05	19.0	21.4	-	-	22.4	25.0	2.10	-	4.11

S. No. 20, 21, 22 Specimen Covered by Damp Cloth

B.S. Civil (Mich) M.E. ... PROFESSION... MIE (PAKISTAN) ENGINEER (P.E.C.)

For GEOTECH CONSULTANTS

GEOTECH CONSULTANTS

SOILS AND MATERIALS TESTING LABORATORIES

45/3 CP & BERAR
HOUSING SOCIETY
OFF SHAHEED-E-
MILLAT ROAD
KARACHI.
Phone : 413980

Report No. : GEO/USA/CCSC/90025.I

Table No. : 03

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh.

CLIENT : M/S, US'AID.

CONSULTANTS : M/S, C.C.S.C.

TEST RESULTS OF SOIL STABILIZATION SAMPLES

No	STABILIZATION. No.	Road No.	DESCRIPTION	Modified AASHTO Compacti		3 Point Soaked CBR						SWELLING %		
				O,M.C %	M.D.D g/cc	96 hours		7 days		14 days		96 hours	7 days	14 days
						95%	98%	95%	98%	95%	98%			
.	ST-6	SA-E-1	4% lime + 20% Brick bats + 76% soil.	12.1	2.04	-	-	16.5	17.3	19.5	21.3	-	0.90	2.85
.	ST-6	SA-E-1	6% lime + 20% Brick bats + 74% soil.	11.8	2.07	-	-	16.6	19.2	23.8	25.3	-	1.12	3.11
.	ST-1	JA-E-1	20% Brick bats + 80% soil.	13.2	2.09	21.3	21.9	-	-	-	-	2.40	-	-
.	ST-2	JA-E-2	50% Brick Powder + 50% soil	12.3	2.14	16.2	17.5	-	-	-	-	3.98	-	-
	ST-3	KH-E-3	20% lime stone fragement + 80% soil.	13.2	2.05	3.0	4.0	4.8	5.2	-	-	4.03	4.89	-
	ST-3	KH-E-3	25% lime stone fragement + 75% soil.	12.0	2.08	5.5	6.6	5.9	6.5	-	-	3.88	4.25	-
	ST-3	KH-E-3	30% lime stone fragement + 70% soil.	10.5	2.13	7.9	8.7	9.6	10.3	-	-	3.16	3.92	-
	ST-7	KH-E-1	20% lime stone fragement + 80% soil.	12.0	1.80	1.8	2.3	-	-	-	-	5.03	-	-
	ST-7	KH-E-1	25% lime stone fragement + 75% soil.	11.2	1.91	3.4	3.9	-	-	-	-	4.36	-	-

B.S. Civil(Mich)M.E. ... PROFESSION... MIE (PAK) ... ER(P.E.)

for GEOTECH CONSULTANTS

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SOILS AND MATERIALS TESTING LABORATORIES

45/3 CP & BERAR HOUSING SOCIETY OFF SHAHEED-E-MILLAT ROAD KARACHI.
Phone : 413980

Report No. : GEO/USA/CCSC/90025.I

Table No. : 04

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh.
CLIENT : M/S, US'AID.
CONSULTANTS : M/S, C.C.S.C.

TEST RESULTS OF SOIL STABILIZATION SAMPLES

No.	STABILIZATION. No.	Road No.	DESCRIPTION	Modified AASHTO Compacti		3 Point Soaked CBR						SWELLING %		
				O,M.C %	M.D.D g/cc	96 hours		7 days		14 days		96 hours	7 days	14 days
						95%	98%	95%	98%	95%	98%			
2.	ST-1	JA-E-1	3% Bitumen + 97% Dune sand	9.0	1.65	5.3	5.9	-	-	-	-	0.88	-	-
3.	ST-1	JA-E-1	4% Bitumen + 96% Dune sand	12.3	1.77	8.9	9.2	-	-	-	-	0.82	-	-
4.	ST-1	JA-E-1	5% Bitumen + 95% Dune sand	10.9	1.79	9.7	10.3	-	-	-	-	0.71	-	-
5.	ST-1	JA-E-1	6% Bitumen + 94% Dune sand	12.3	1.82	9.7	10.3	-	-	-	-	0.74	-	-

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SOILS AND MATERIALS TESTING LABORATORIES

45/3 CP & BERAR
HOUSING SOCIETY
OFF SHAHEED-E-
MILLAT ROAD
KARACHI.
Phone : 413980

CLIENT : M/S, US'AID.

PROJECT : Road Resources Management Project Sindh.

CONSULTANTS : M/S, C.C.S.C.

SUBJECT : TEST RESULTS OF SUB BASE MATERIAL .....

Table No. : 08

S.	Road No.	Lab No.	DESCRIPTION	Grain Size Analysis (% Passing by Weight)			Atterberg Limit		3 Point Soaked CBR		Modified AASHTO Compaction	
				# 10	# 40	# 200	LL %	PI %	95%	98%	O.M.C %	M.D.D g/cc
	-	48	Uban Shah Quarry.	39.6	29.7	18.0	36	13	9.0	10.5	5.8	2.04
	-	49	Shadi Shaeed Quarry.	61.2	31.1	19.3	NP	NP	34.0	41.5	8.0	2.13
	-	50	Arore Quarry.	36.8	31.5	18.3	NP	NP	32.0	37.2	10.0	2.10

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Hussain
B.S. Civil(Mech)M.E. ...
PROFESSION...
MIE (PAKISTAN)ENGINEER(F.C.)

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SOILS AND MATERIALS TESTING LABORATORIES

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MILLAT ROAD
K A R A C H I .
Phone : 413980

Report No. : GEO/USA/CCSC/90025.I

Table No. : 09

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh (RRMP)

CLIENT : M/S, US'AID.

CONSULTANTS : M/S,C.C.S.C.

SUBJECT : Swelling % of Sub base Material

S.No	Lab No.	ROAD No.	DESCRIPTION	SWELLING %		
				96 hours	7 days	14 days
1.	48.	-	Uban Shah Quarry.	2.90	-	-
2.	49.	-	Shadi Shaheed Quarry.	0.93	-	-
3.	50.	-	Arore Quarry.	0.98	-	-

for GEOTECH CONSULTANTS

Hussain

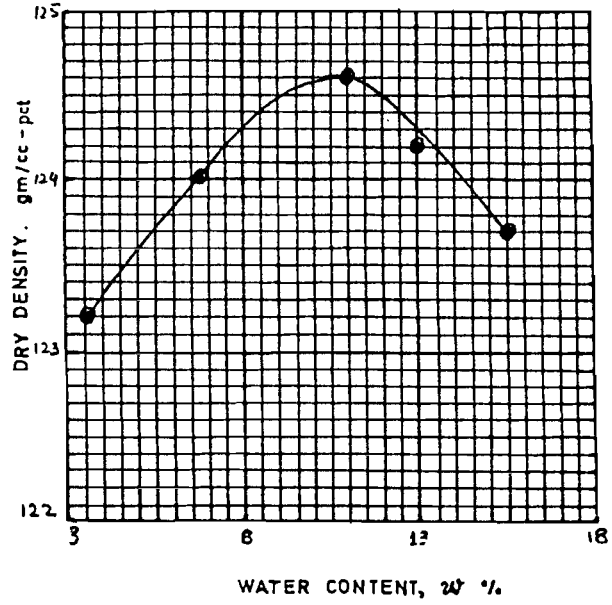
B.S. Civil(Mich)M.E. [illegible]
PROFESSION[illegible]
MIE (PAK) [illegible]

MOISTURE DENSITY RELATION PER MODIFIED ASSHO COMPACTION

ST-1

4% Lime + 96% Soil.

(1)

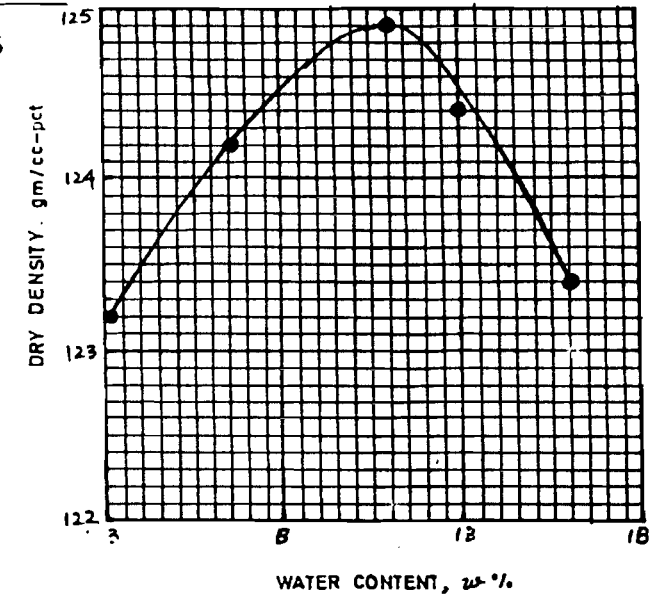


OPTIMUM MOISTURE = 11.3 % MAX. DRY DENSITY = 124.6 pct

ST-1

6% Lime + 94% Soil.

(2)

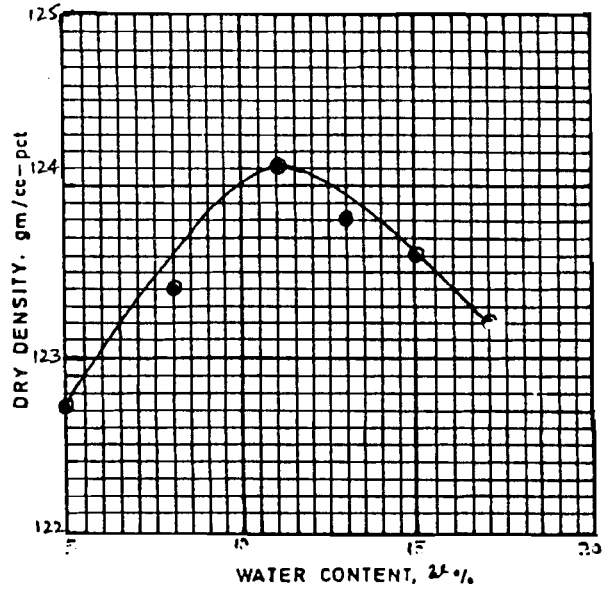


OPTIMUM MOISTURE = 11.0 % MAX. DRY DENSITY = 124.9 pct

ST-2

4% Lime + 96% Soil.

(3)

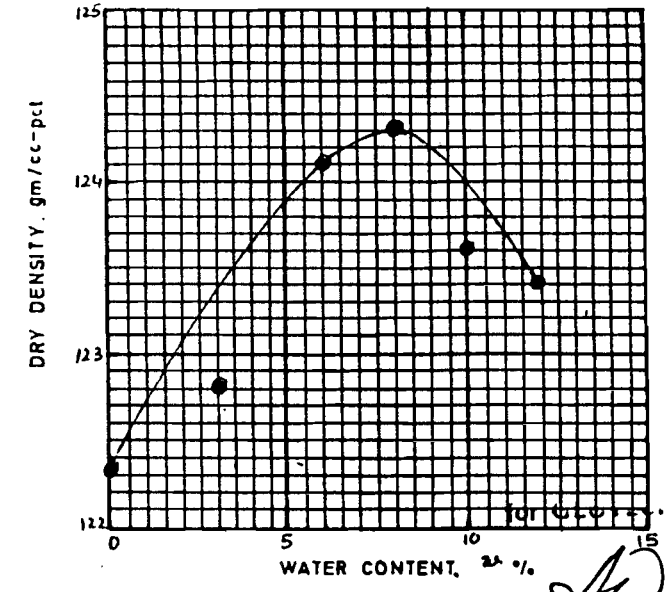


OPTIMUM MOISTURE = 11.2 % MAX. DRY DENSITY = 124.1 pct

ST-2.

6% Lime + 94% Soil.

(4)



OPTIMUM MOISTURE = 13.2 % MAX. DRY DENSITY = 124.3 pct

Hussain Abid
B.S. Civil(Mich) M.S. Soil Mech
PROFESSIONAL ENGG
MIE (PAK) MEMBER (PEC.)

CONSULTANTS

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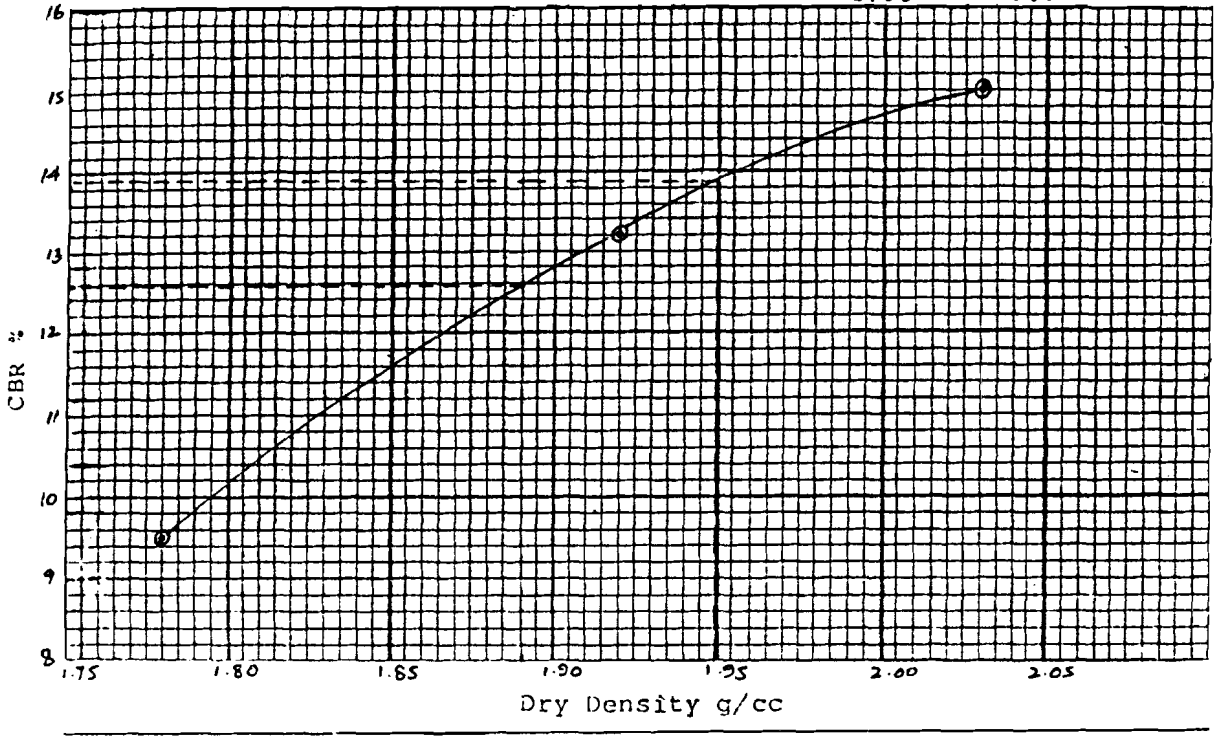
ST-1. 4% Lime + 96% Soil.

(96 hours)

Max Dry Density = 1.99 g/cc
CBR at 95% (MDD) = 12.5
CBR at 98% (MDD) = 13.9

15 Blows = 1.78 - 9.5
30 Blows = 1.92 - 13.2 (1)
56 Blows = 2.03 - 15.0



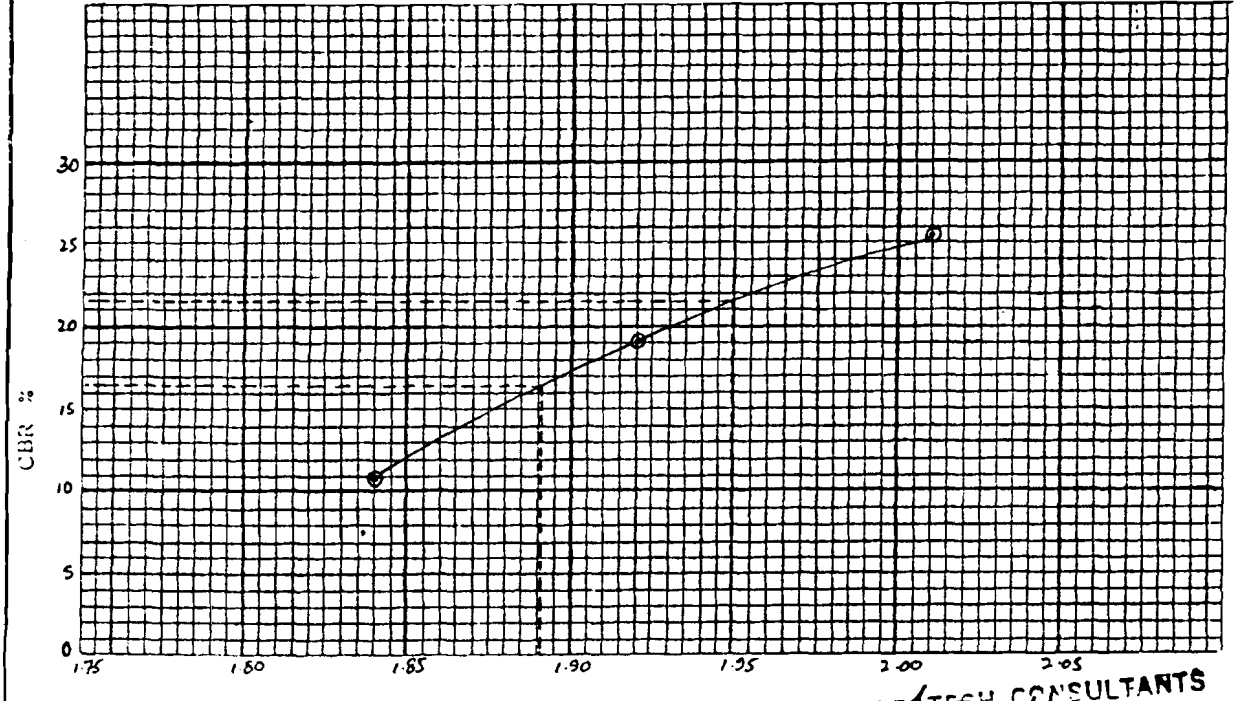
ST-1

4% Lime + 96% Soil.

(14 days)

Max Dry Density. = 1.99 g/cc.
CBR at 95% (MDD) = 16.4
CBR at 98% (MDD) = 21.5

15 Blows = 1.84 - 11.0
30 Blows = 1.92 - 19.0 (2)
56 Blows = 2.01 - 25.6



for GEOTECH CONSULTANTS

Husain Abid
B.S. Civil(Mich) M.S. Soil Mech P. ...
PROFESSIONAL ENGG ( )
MIE/PAK MEMBER/PEC

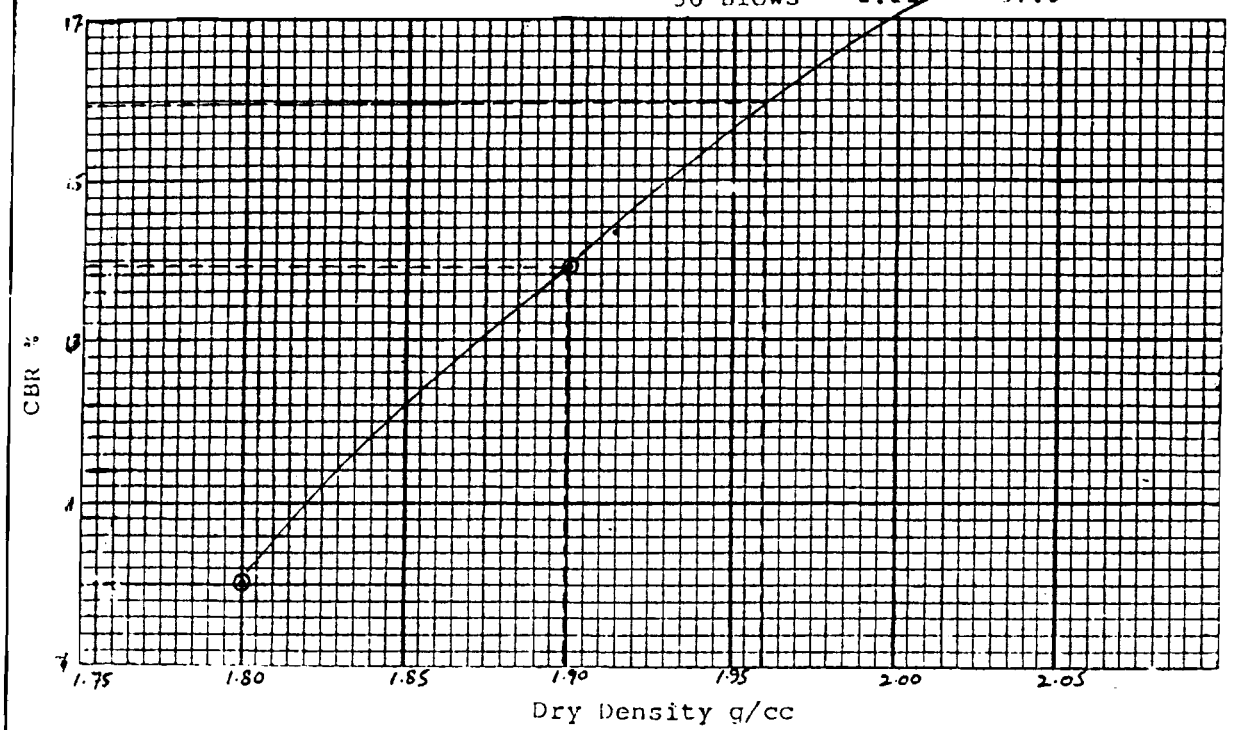
GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

ST-1. (96 Hours)

6% Lime + 94% Soil.

Max Dry Density = 2.00 g/cc
CBR at 95% (MDD) = 13.9
CBR at 98% (MDD) = 15.9

15 Blows = 1.80 - 10.0
30 Blows = 1.90 - 13.9 (3)
56 Blows = 2.02 - 17.5

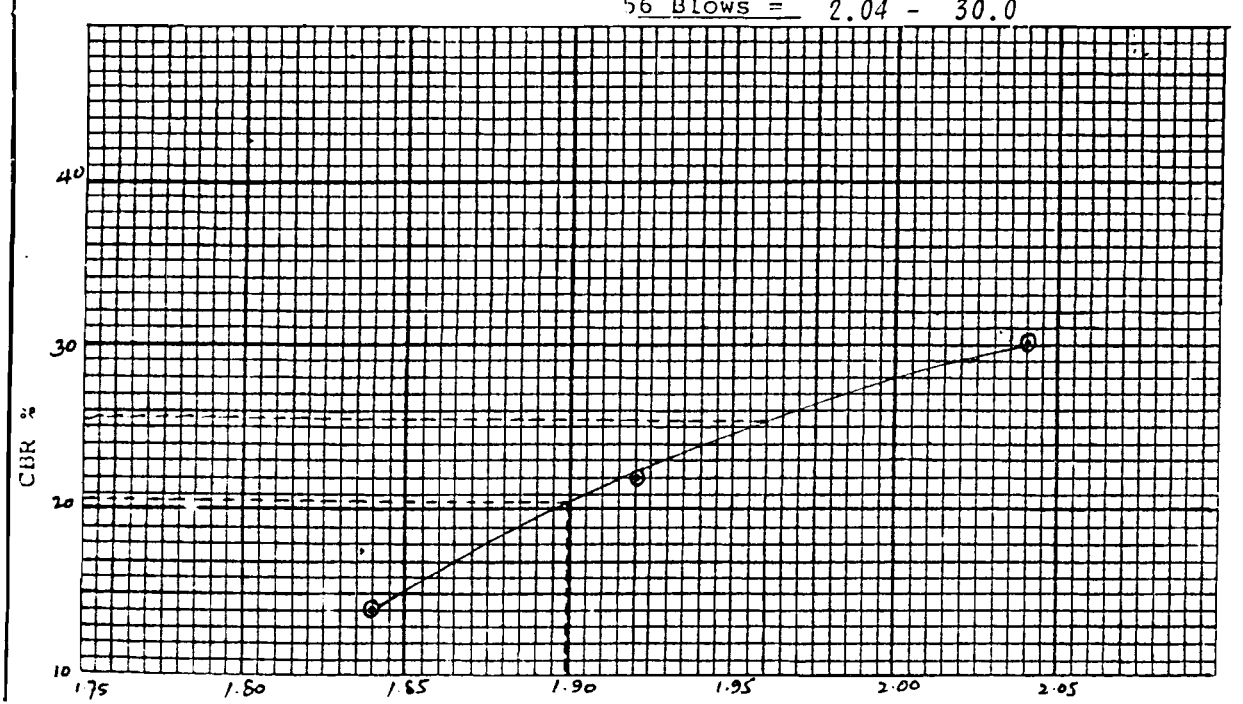


ST- 1 (14 days)

6% lime + 94% soil.

Max Dry Density. = 2.00 g/cc
CBR at 95% (MDD) = 20.0
CBR at 98% (MDD) = 25.0

15 Blows = 1.84 - 14.0
30 Blows = 1.92 - 22.1 (4)
56 Blows = 2.04 - 30.0



For GEOTECH CONSULTANTS

Abid Hasan

Hasan Abid
M.Sc. Soil Mech. P. Engg
PROFESSIONAL ENGG

97

GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

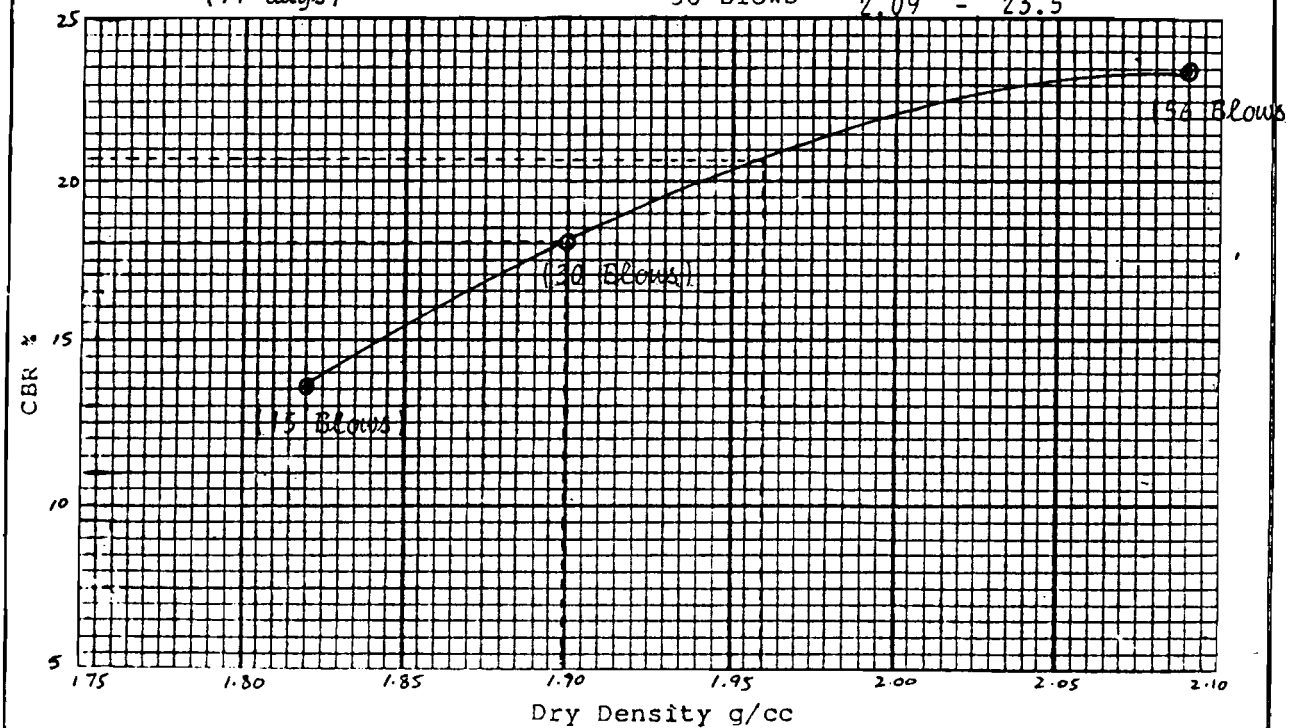
Max Dry Density - 2.00 g/cc
CBR at 95% (MDD) - 18.0
CBR at 98% (MDD) = 20.7

ST- 1 (- 2% Moisture)

6% lime + 94% soil.

(14 days)

15 Blows = 1.82 - 13.5
30 Blows = 1.90 - 18.0 (7)
56 Blows = 2.09 - 23.5



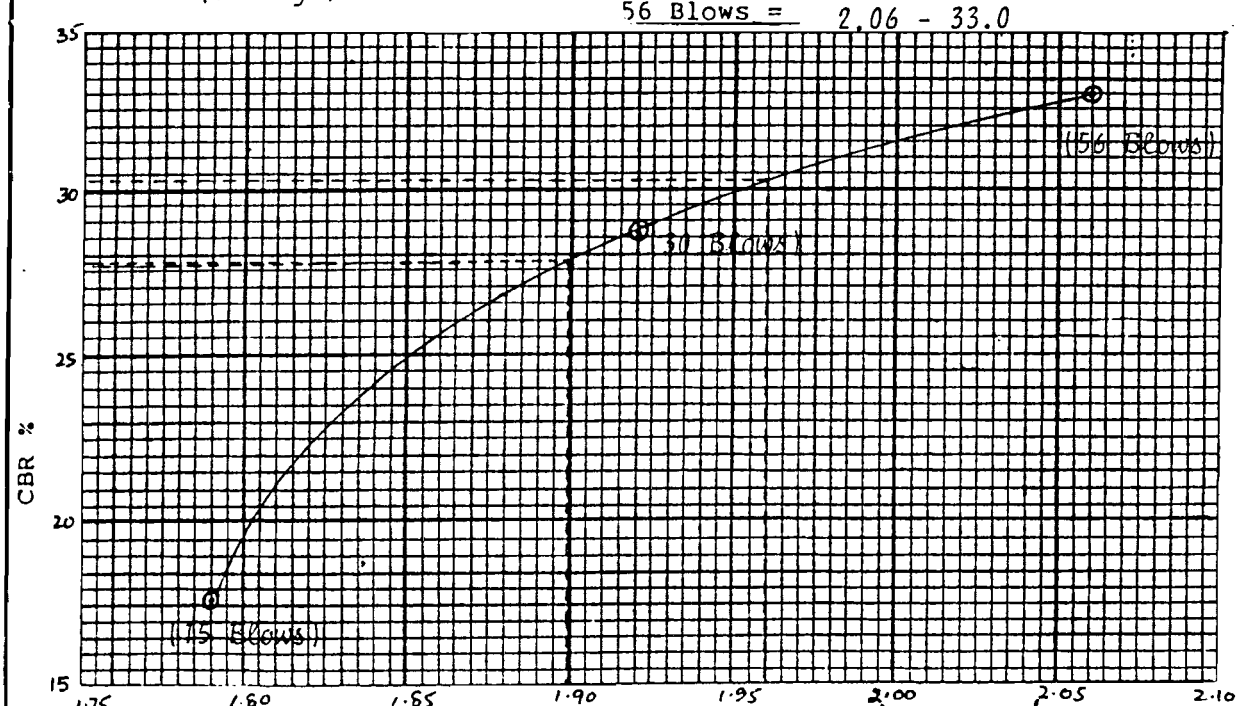
Max Dry Density. = 2.00 g/cc
CBR at 95% (MDD) = 27.7
CBR at 98% (MDD) = 30.3

ST- 1 (+ 2% Moisture)

6% lime + 94% soil

(14 days)

15 Blows = 1.79 - 17.6
30 Blows = 1.92 - 28.6 (8)
56 Blows = 2.06 - 33.0



Abid Hussain

Abid
Michigan S. Soil Mech. F. Engd

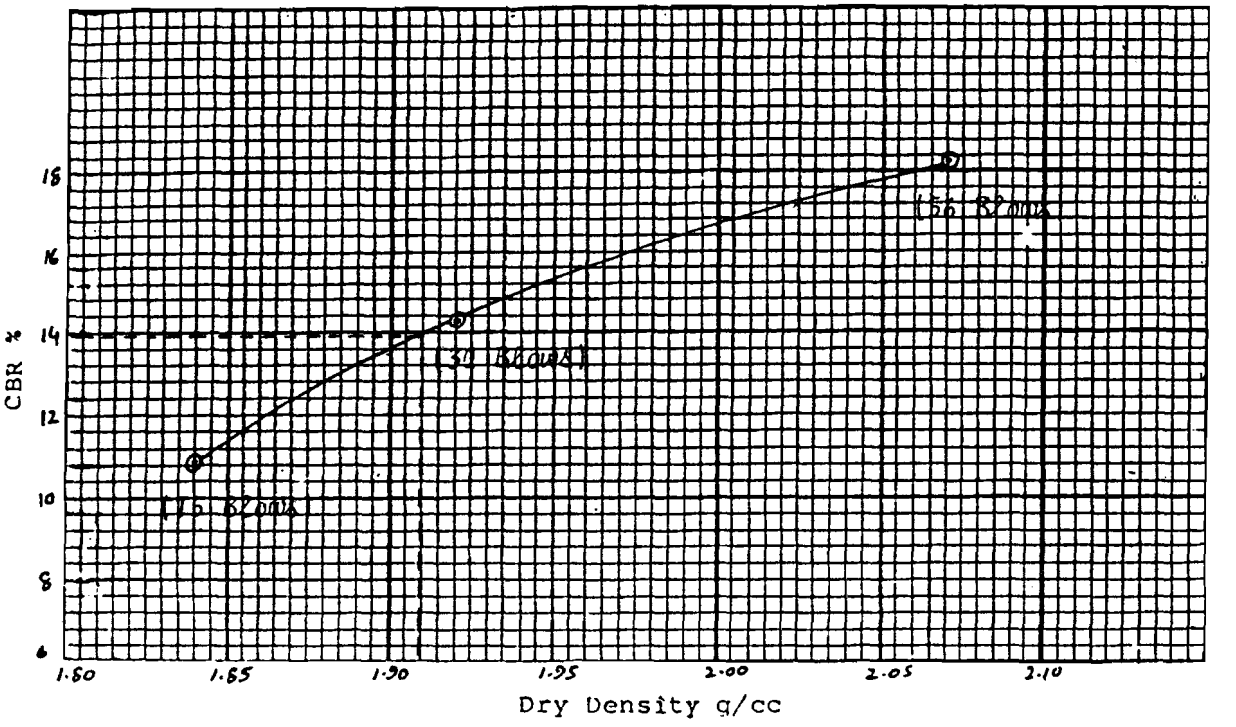
GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

ST - 4 [96 hours]

6% lime + 94 % soil. (-2% moisture)

Max Dry Density = 2.01 g/cc
CBR at 95% (MDD) = 13.9
CBR at 98% (MDD) = 16.2

15 Blows =	1.84	- 10.9	
30 Blows =	1.92	- 14.3	(27)
56 Blows =	2.07	- 18.3	

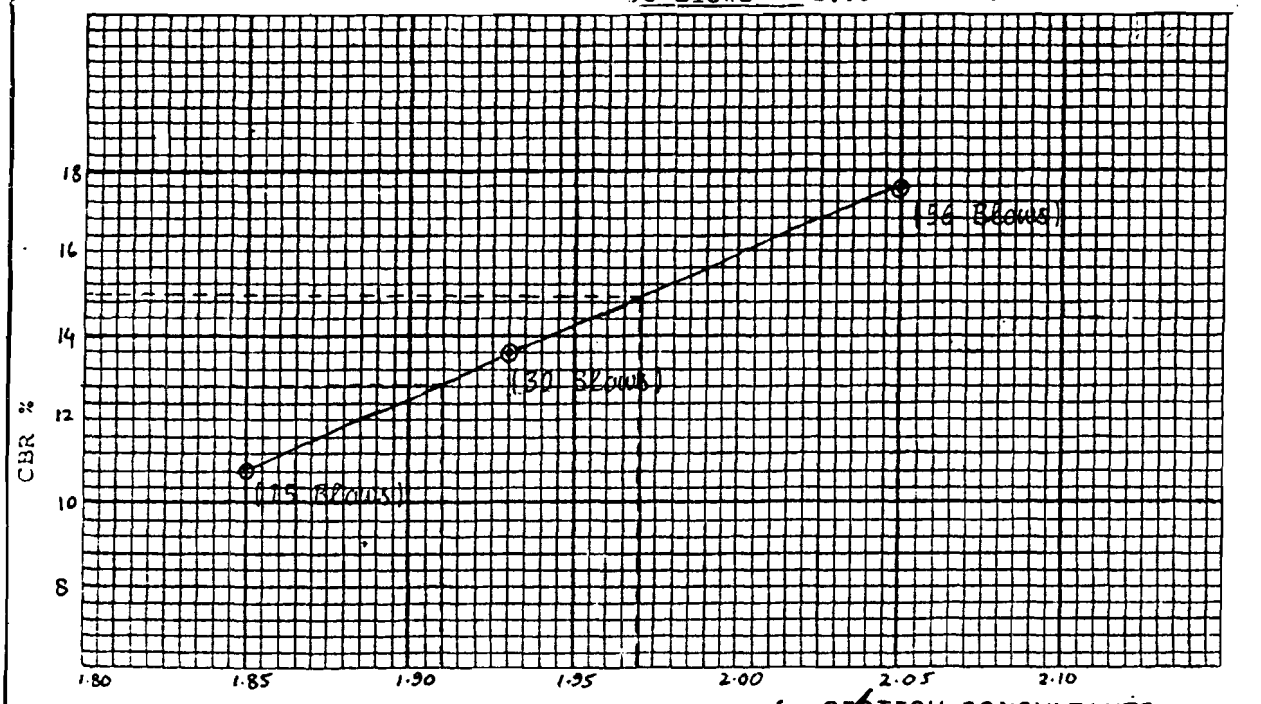


ST - 4 (96 hours)

6% lime + 94% soil. (+2% moisture)

Max Dry Density. = 2.01 g/cc
CBR at 95% (MDD) = 12.9
CBR at 98% (MDD) = 15.0

15 Blows =	1.85	- 10.9	
30 Blows =	1.93	- 13.6	(28)
56 Blows =	2.05	- 17.6	



for GEOTECH CONSULTANTS

Hussain Abid

B.S. Civil(Mich)M.S. Soil Mec... PROFESSIONAL ENGG

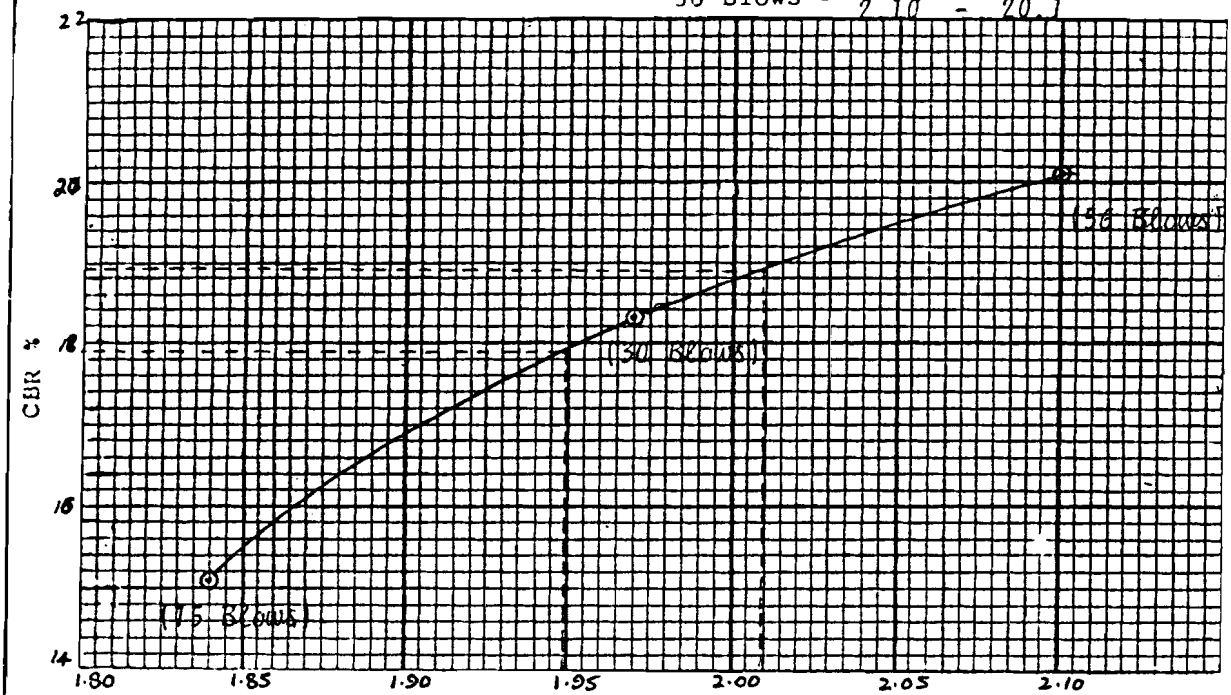
ST - 2 [7 days]

4%lime + 20%Brick bats + 76% soil.

Max Dry Density = 2.05 g/cc
CBR at 95% (MDD) = 17.9
CBR at 98% (MDD) = 18.9

15 Blows = 1.84 - 15.1
30 Blows = 1.97 - 18.3
56 Blows = 2.10 - 20.1

(41)



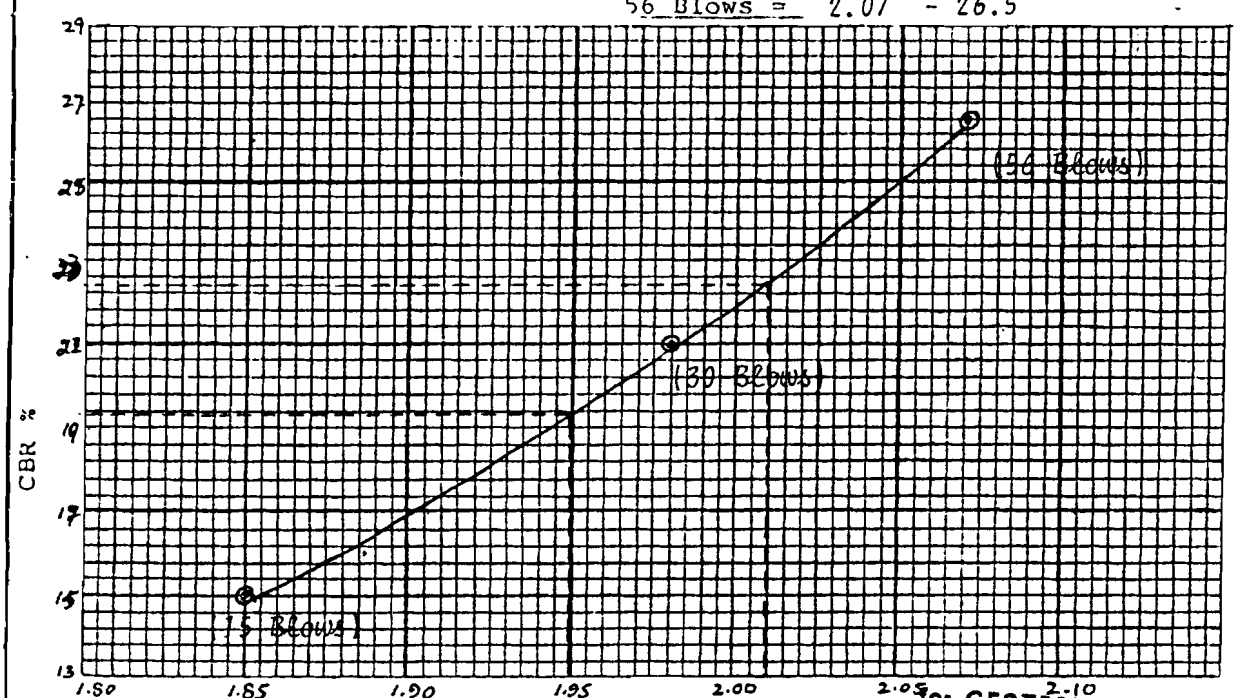
ST - 2 [14 days]

4%lime + 20% Brick bats + 76%soil.

Max Dry Density. = 2.05 g/cc
CBR at 95% (MDD) = 19.5
CBR at 98% (MDD) = 22.6

15 Blows = 1.85 - 15.0
30 Blows = 1.98 - 21.0
56 Blows = 2.07 - 26.5

(42)



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MIE (PAK) MEMBER (PEC.)

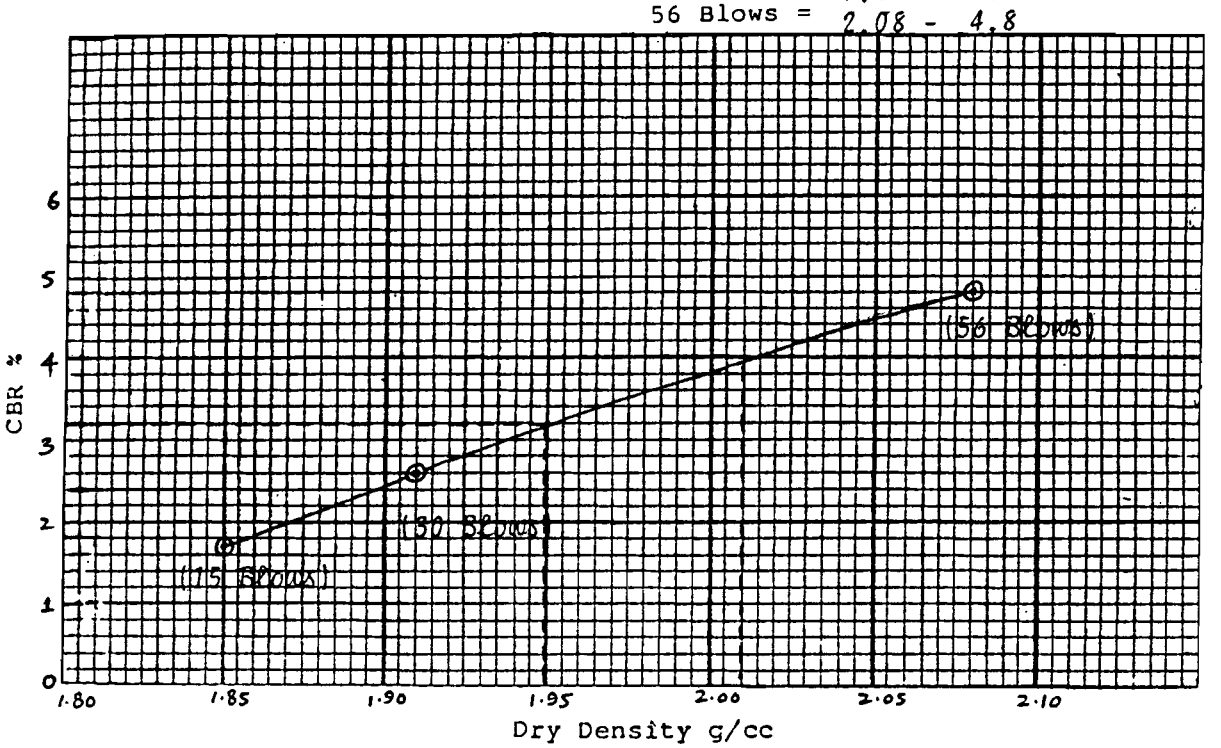
ST-3 (96 hours)

Max Dry Density = 2.05 g/cc
CBR at 95% (MDD) = 3.2
CBR at 98% (MDD) = 4.0

20% lime stone fragements + 80% soil.

15 Blows = 1.85 - 1.7
30 Blows = 1.91 - 2.6
56 Blows = 2.08 - 4.8

(51)



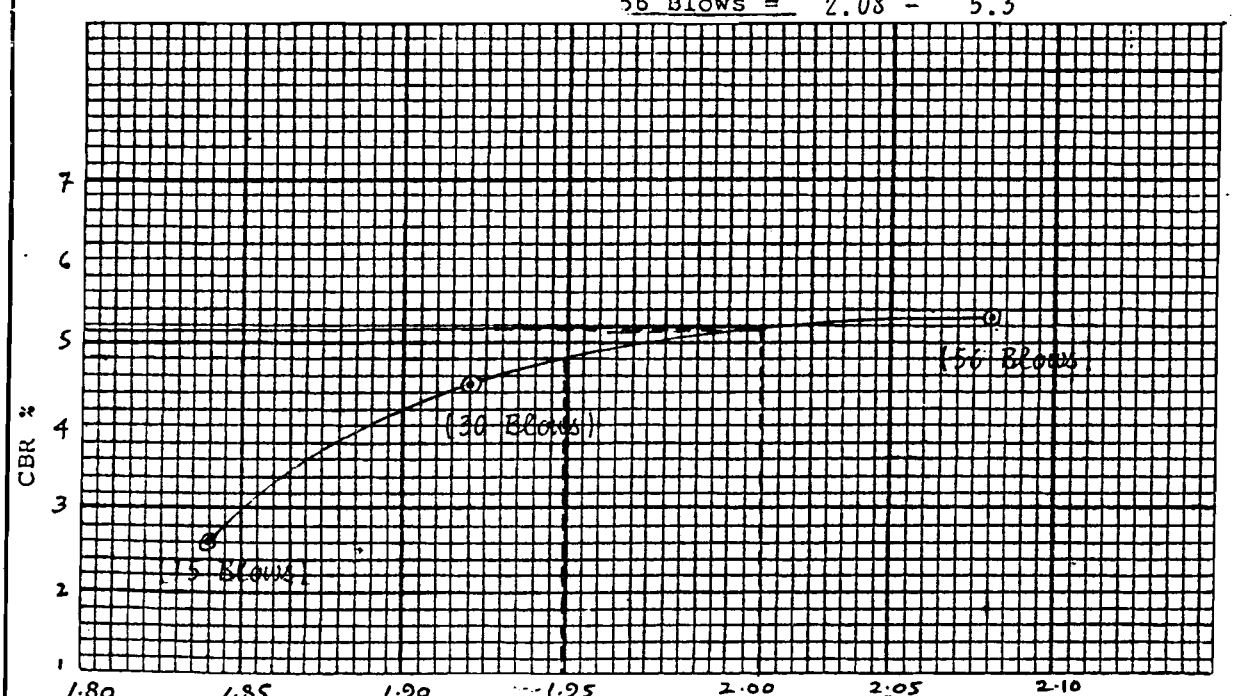
ST-3 (7 days)

Max Dry Density. = 2.05 g/cc
CBR at 95% (MDD) = 4.8
CBR at 98% (MDD) = 5.2

20% lime stone fragement + 80% soil.

15 Blows = 1.84 - 2.6
30 Blows = 1.92 - 4.5
56 Blows = 2.08 - 5.3

(52)



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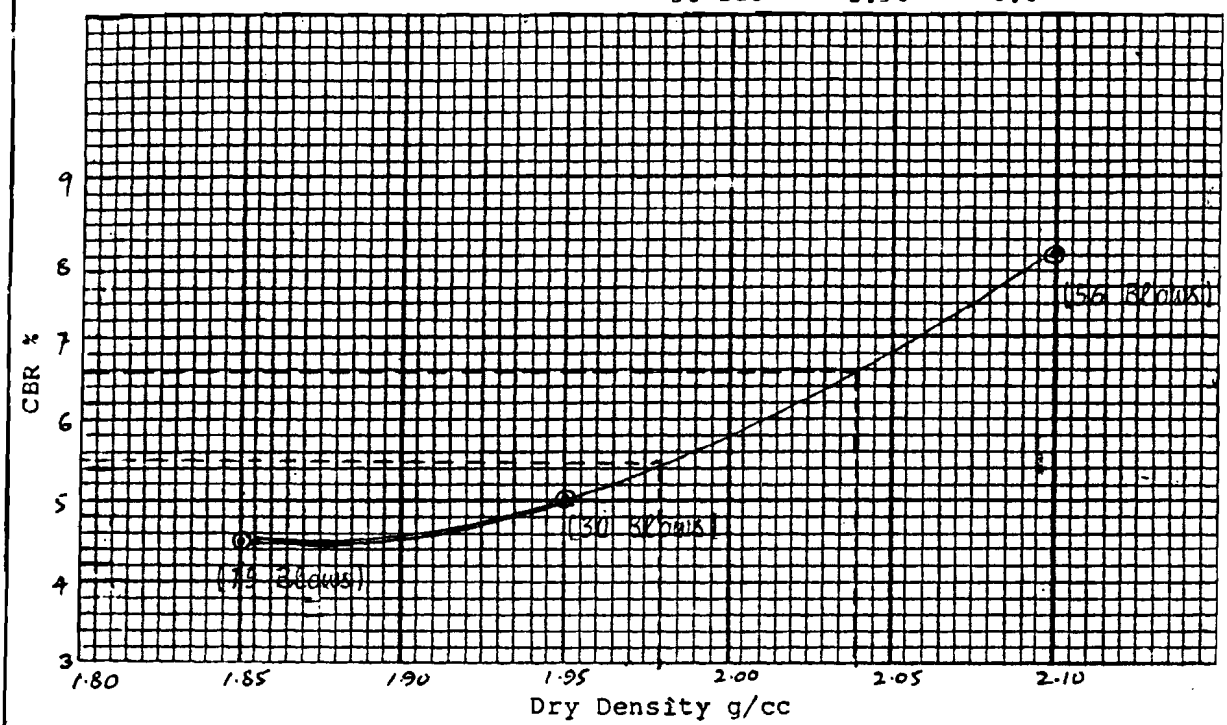
Max Dry Density = 2.08 g/cc
CBR at 95% (MDD) = 5.5
CBR at 98% (MDD) = 6.6

ST-3 [96 hours]

25% lime stone fragments + 75% soil.

15 Blows = 1.85 - 4.5
30 Blows = 1.95 - 5.0 (53)
56 Blows = 2.10 - 8.0

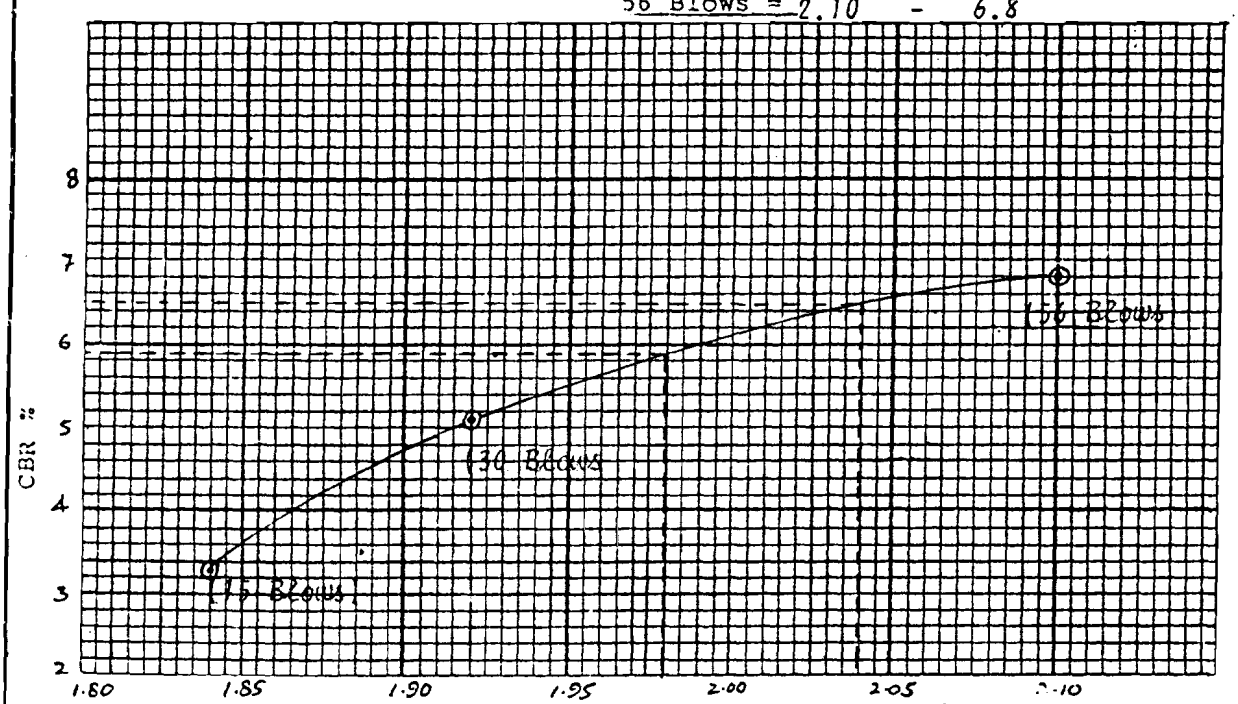


ST -3 [7 days]

25% lime stone fragments + 75% soil.

Max Dry Density. = 2.08 g/cc
CBR at 95% (MDD) = 5.9
CBR at 98% (MDD) = 6.5

15 Blows = 1.84 - 3.0
30 Blows = 1.92 - 5.1 (54)
56 Blows = 2.10 - 6.8



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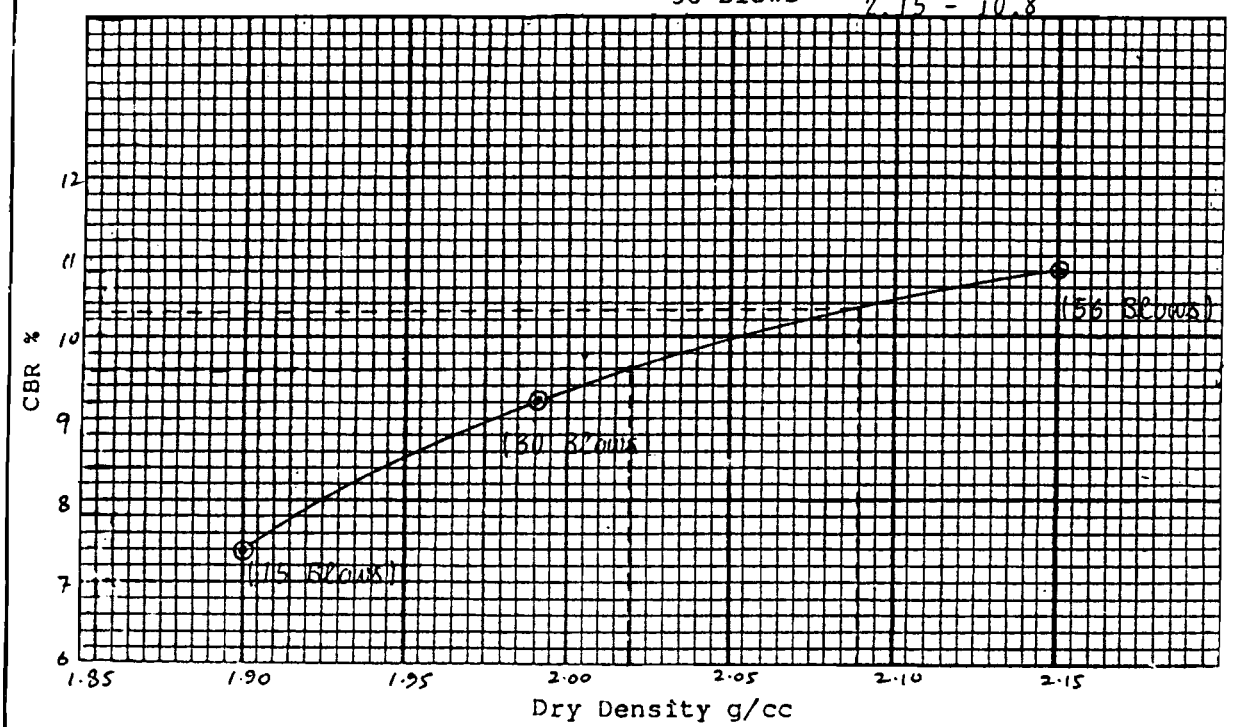
MIE (PAK) MEMBER (PEC.)

ST - 3 [7 days]

30% lime stone fragments + 70% soil.

Max Dry Density = 2.13 g/cc
CBR at 95% (MDD) = 9.6
CBR at 98% (MDD) = 10.3

15 Blows = 1.90 - 7.4
30 Blows = 1.99 - 9.2 (56)
56 Blows = 2.15 - 10.8

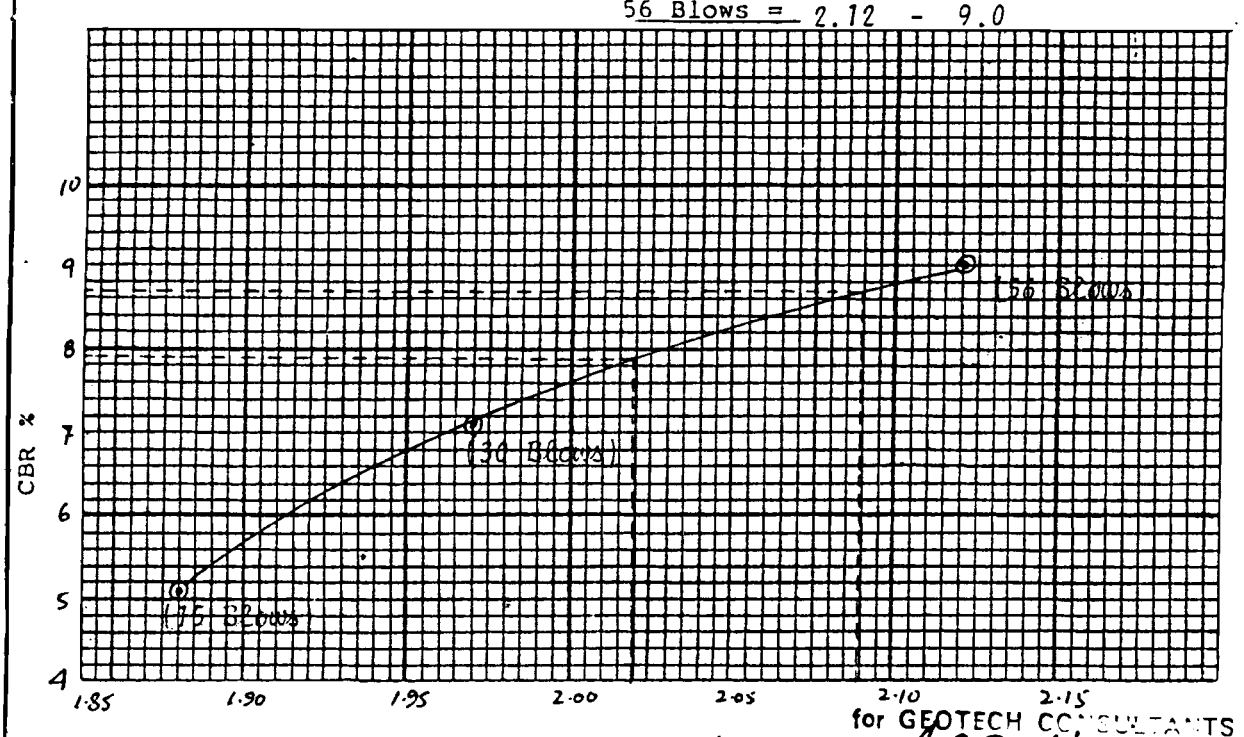


ST - 3 [96 hours]

30% lime stone fragments + 70% soil.

Max Dry Density. = 2.13
CBR at 95% (MDD) = 7.9
CBR at 98% (MDD) = 8.7

15 Blows = 1.88 - 5.1
30 Blows = 1.97 - 7.1 (55)
56 Blows = 2.12 - 9.0



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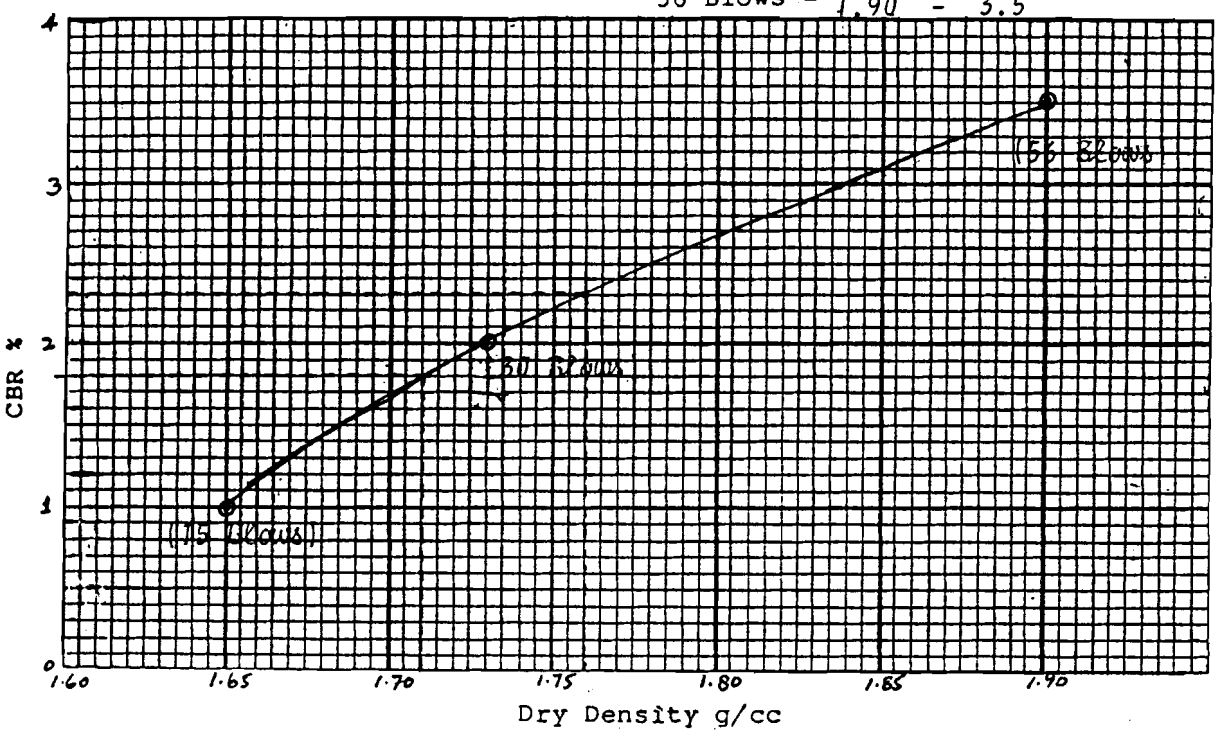
ST-7 [96 hours]

20% lime stone fragments + 80% soil

Max Dry Density = 1.80 g/cc
CBR at 95% (MDD) = 1.8
CBR at 98% (MDD) = 2.3

15 Blows = 1.65 - 1.0
30 Blows = 1.73 - 2.0
56 Blows = 1.90 - 3.5

(57)



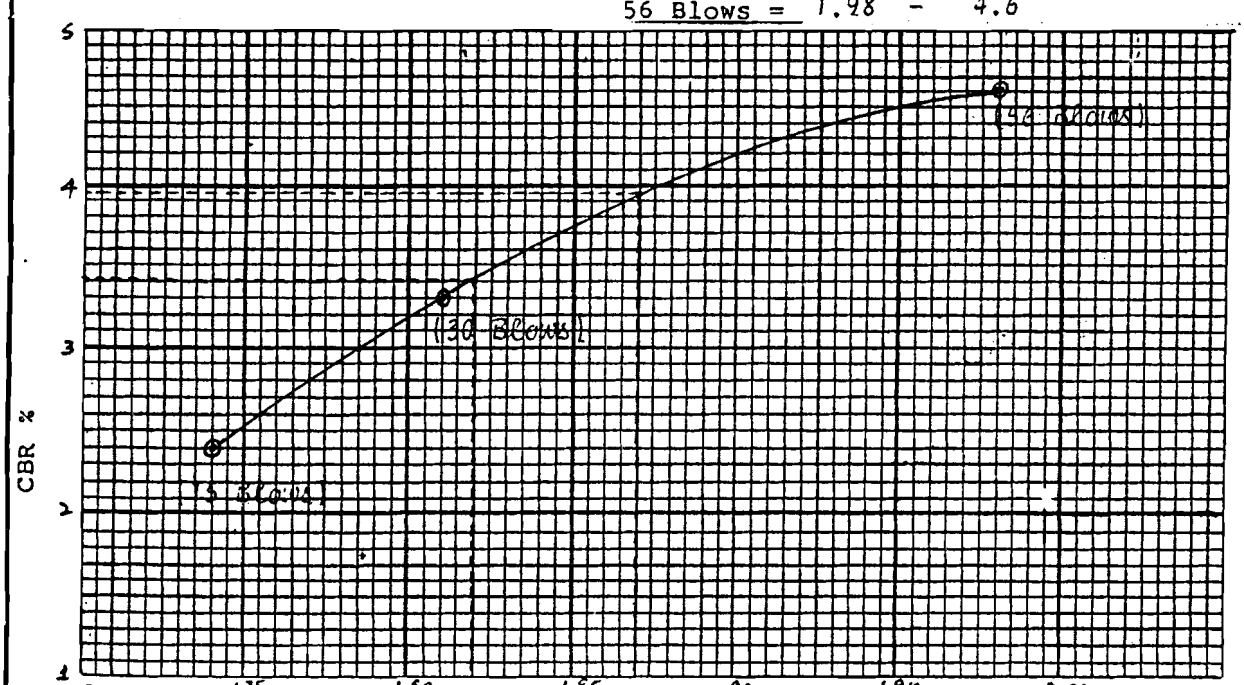
ST-7 [96 hours]

25% lime stone fragements + 75% soil.

Max Dry Density. = 1.91 g/cc
CBR at 95% (MDD) = 3.4
CBR at 98% (MDD) = 3.9

15 Blows = 1.74 - 2.4
30 Blows = 1.81 - 3.3
56 Blows = 1.98 - 4.6

(58)



Husain Abid

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PROFESSIONAL ENGG
MEMBER (PEC)

for GEOTECH CONSULTANTS

GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

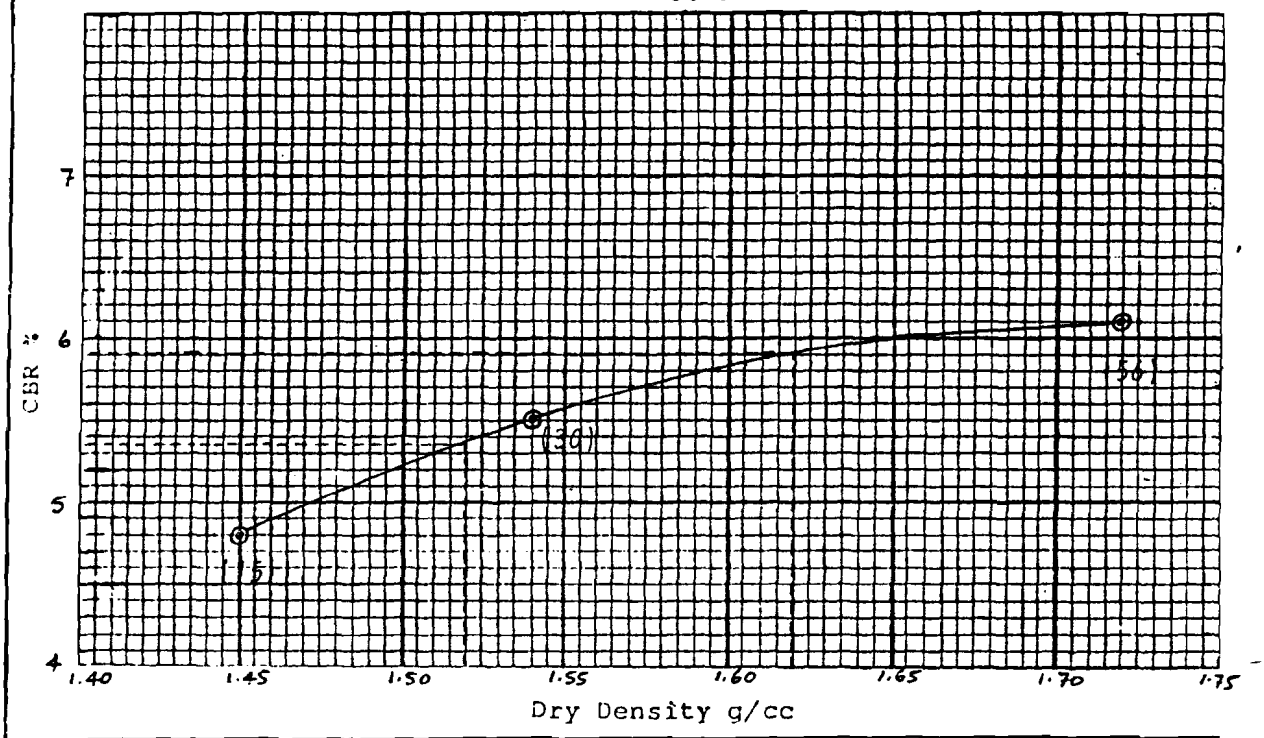
Max Dry Density = 1.65 g/cc
CBR at 95% (MDD) = 5.3
CBR at 98% (MDD) = 5.9

ST- 1 (96 hours)

3% Bitumen + 97% Dune sand.

15 Blows = 1.45 - 4.8
30 Blows = 1.54 - 5.5
56 Blows = 1.72 - 6.1

(59)



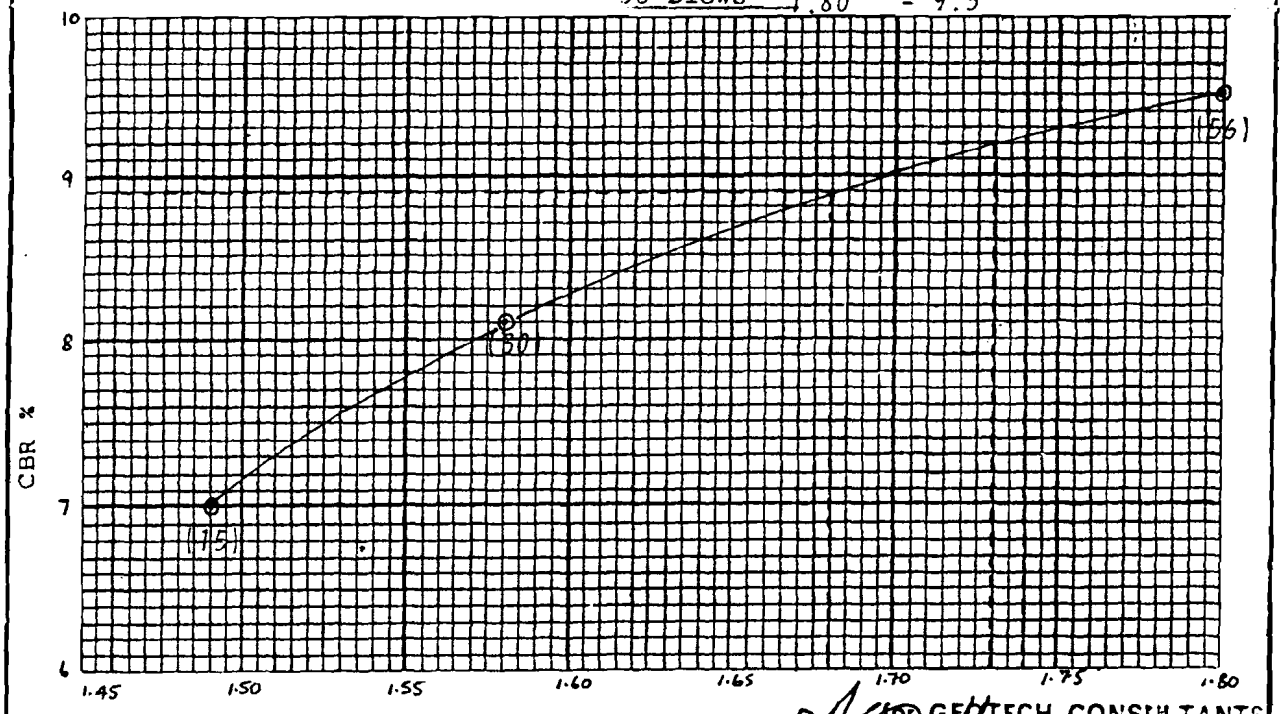
Max Dry Density. = 1.77 g/cc
CBR at 95% (MDD) = 8.9
CBR at 98% (MDD) = 9.2

ST - 1 (96 hours)

4% Bitumen + 96% Dune sand.

15 Blows = 1.49 - 7.0
30 Blows = 1.58 - 8.1
56 Blows = 1.80 - 9.5

(60)



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B.E. Civil(Mich) M.E. Soil Mec... Found
PROFESSIONAL ENGG (...)

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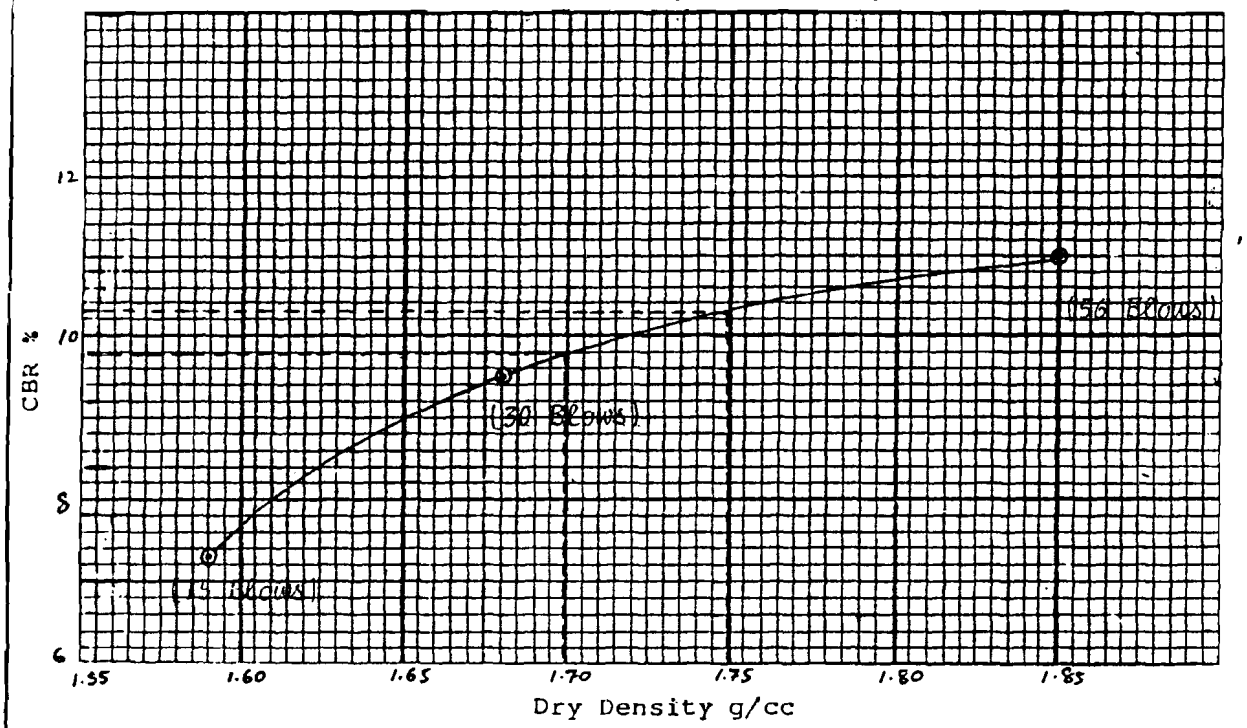
ST - 1 (96 hours)

5% Bitumen + 95% Dune sand.

Max Dry Density = 1.79 g/cc
CBR at 95% (MDD) = 9.7
CBR at 98% (MDD) = ~~10.3~~

15 Blows = 1.59 - 7.3
30 Blows = 1.68 - 9.5 (61)
56 Blows = 1.85 - 11.0

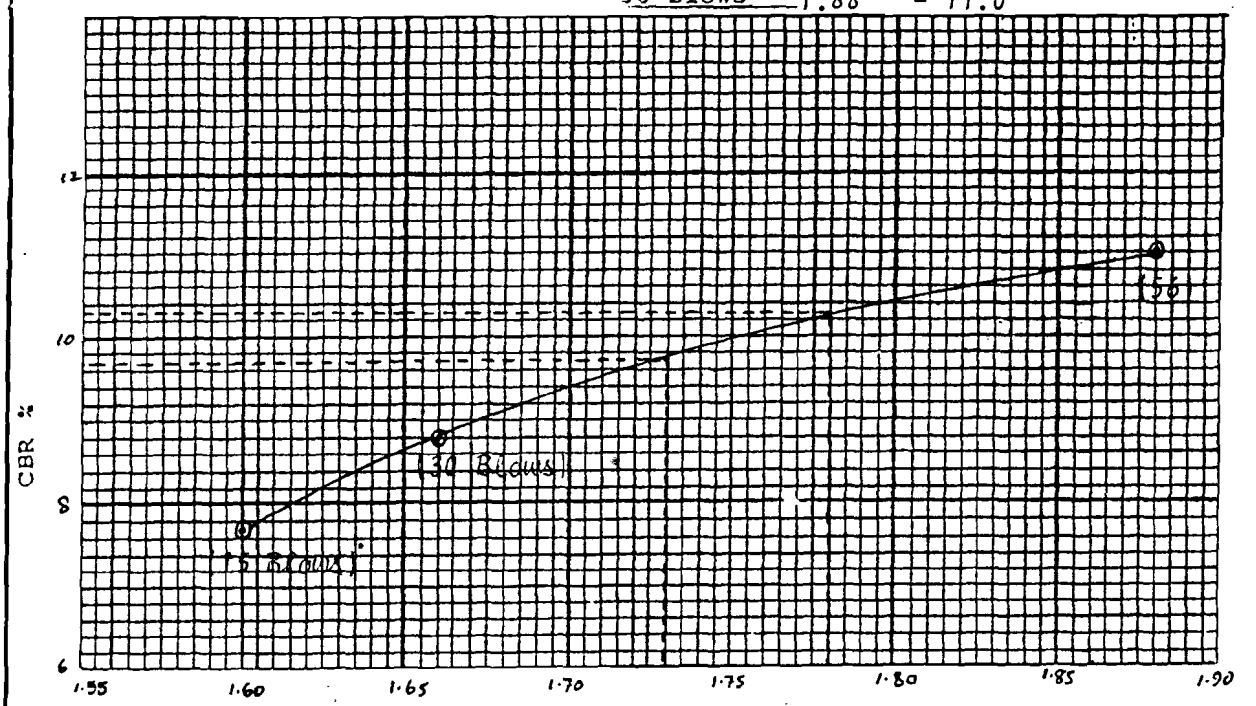


ST - 1 (96 hours)

6% Bitumen + 94% Dune Sand.

Max Dry Density. = 1.82 g/cc
CBR at 95% (MDD) = 9.7
CBR at 98% (MDD) = ~~10.3~~

15 Blows = 1.60 - 7.7
30 Blows = 1.66 - 8.8 (62)
56 Blows = 1.88 - 11.0



for GEOTECH CONSULTANTS

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B.S. Civil(Mich)M.S. Soil Mec... P... ...ed
PROFESSIONAL ENGG (...)

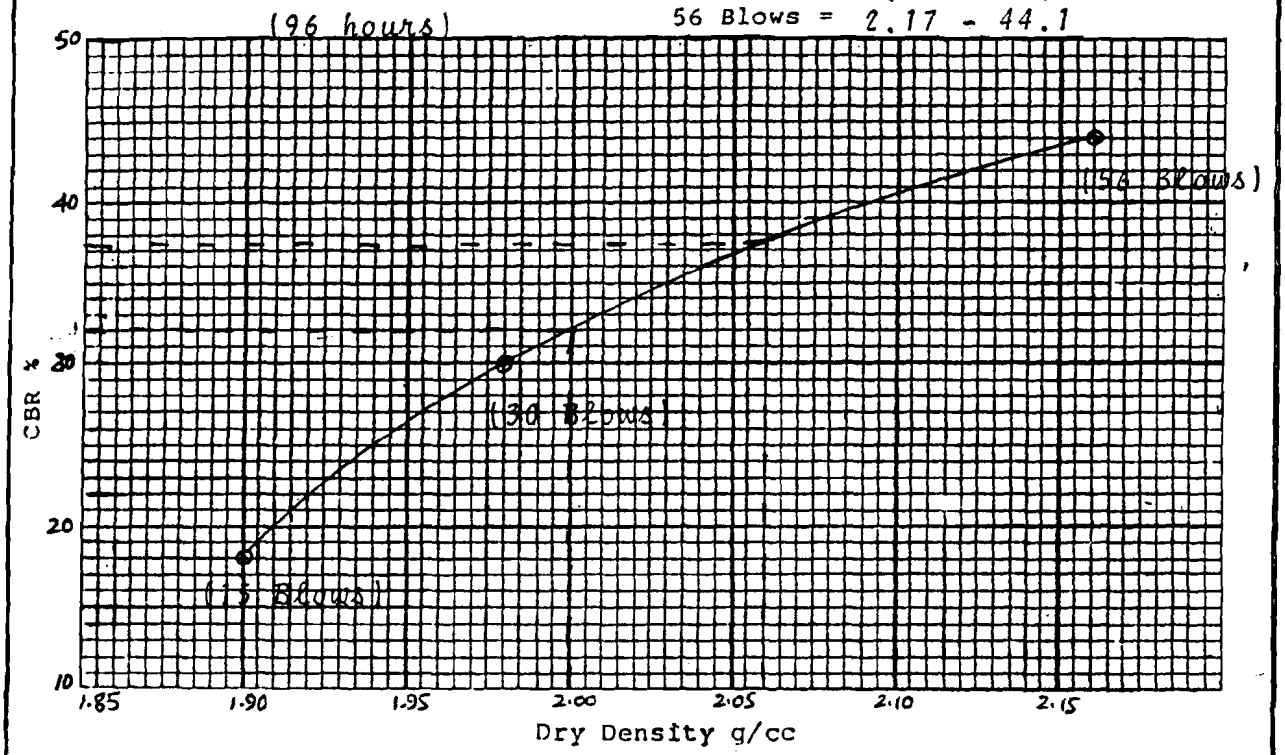
GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

Max Dry Density = 2.10 g/cc
CBR at 95% (MDD) = 32.0
CBR at 98% (MDD) = 37.2

Lab No.50

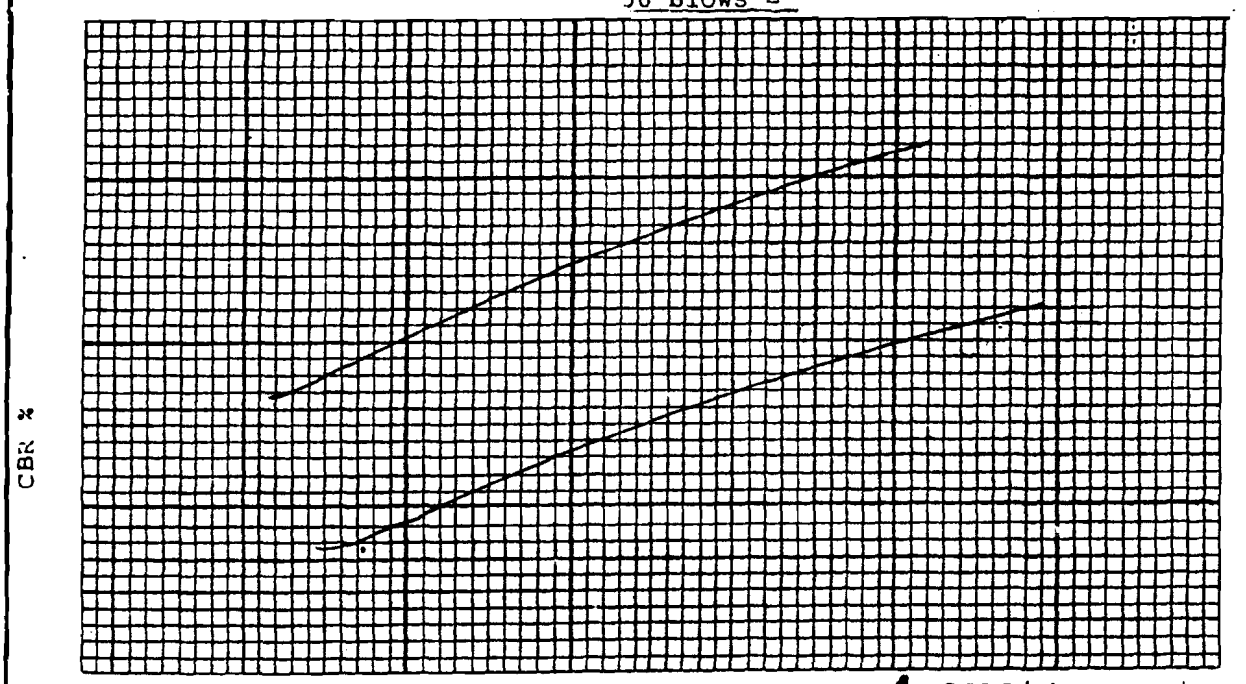
Arore Quarry.

15 Blows = 1.90 - 18.0
30 Blows = 1.98 - 30.0 (65)
56 Blows = 2.17 - 44.1



Max Dry Density. =
CBR at 95% (MDD) =
CBR at 98% (MDD) =

15 Blows =
30 Blows =
56 Blows =



Husain Abid

For GEOTECH CONSULTANTS

B.S. Civil (Mech.) M.S. Soil Mech. (...)
PROFESSIONAL ENGG (...)
MIE (PAK) MEMBER (PEC.)

UNCONFINED COMPRESSION STRENGTH

PROJECT : R.R.M.P.SINDH.
CLIENT : M/s,US'AID.
CONSULTANTS : M/s,C.C.S.C
ROAD NAME : Jacobabad - 1
ROAD NO : JA-E-1
LAB REF : ST-1 DATE : 20-05-90
4% Lime + 96% Soil.

SAMPLE NO. 1.2.3 NO OF LAYERS. 08
COMPACTION ENERGY HAMMER. 10 lbs
OMC AT COMPACTION. 11.3 SAMPLE DIA. 15.2 cm
VOLUME OF SAMPLE. 3720.3 cc
HEIGHT OF SAMPLE. 20.5 cm

TESTED AT : Molding Moisture Content.

Percentage Strain = $\frac{\Delta l}{Lo}$ (Δl is change in length of Specimen)

Average cross section area 'A' = $\frac{Ao}{1-E}$ (Ao initial cross sectional area = 182.3 Sqcm

CALCULATIONS		56 Blows	30 Blows	15 Blows
Load reading at failure/20% axial Strain kgs.	a	907.9	694.3	537.5
Average load area in Sq cm 'A'	b	186.9	186.0	186.0
Unconfined Compression Strength Kg/cm^2	a/b	4.8	3.7	3.1
Total axial strain in cm.		0.6	0.4	0.4
Percentage axial E.		3.0	2.0	2.0

REMARKS :

for GEOTECH CONSULTANTS

GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

Hussain Shah
B.E. Civil(Mich)M.E. Civil
PROFESSION-
MIE (PAK) MEMBER(P.C.)

UNCONFINED COMPRESSION STRENGTH

PROJECT : R.R.M.P. SINDH.
CLIENT : M/s, US'AID
CONSULTANTS : M/S. C.C.S.C.
ROAD NAME : Jacobabad-I
ROAD NO : JA-E-1
LAB REF : ST-1 DATE : 20-05-90

6% Lime + 94% Soil.

SAMPLE NO. 4, 5, 6 NO OF LAYERS. 8
COMPACTION ENERGY HAMMER. 10 lbs.
OMC AT COMPACTION. 11.0 SAMPLE DIA. 15.2 cm
VOLUME OF SAMPLE. 3720.3 cc
HEIGHT OF SAMPLE. 20.5 cm

TESTED AT : Molding Moisture Content.

Percentage Strain = $\frac{\Delta l}{Lo}$ (Δl is change in length of Specimen)

Average cross section area 'A' = $\frac{Ao}{1-E}$ (Ao initial cross sectional area = 182.3 Sqcm

CALCULATIONS		56 Blows	30 Blows	15 Blows
Load reading at failure/20% axial Strain kgs.	a	1575.5	1062.8	721.0
Average load area in Sq cm 'A'	b	189.9	186.8	186.0
Unconfined Compression Strength Kg/cm^2	a/b	8.3	5.7	3.8
Total axial strain in cm.		0.8	0.5	0.4
Percentage axial E.		4.0	2.4	2.0

REMARKS :

for GEOTECH CONSULTANTS

Abd Hussain

GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

Hussain Syed
B.S. Civil(Mich)M.E. [illegible]
PROFESSION[illegible]
MIE(PAK) [illegible]ER(P.E.C.)

94

UNCONFINED COMPRESSION STRENGTH

PROJECT : R.R.M.P.SINDH.
CLIENT : M/s.USAID.
CONSULTANTS : M/s,C.C.S.C.
ROAD NAME : KHAIRPUR.
ROAD NO : KH-E-1
LAB REF : ST-7 DATE : 20-05-90

25% lime stone fragement + 75% soil.

SAMPLE NO 73.4.5 NO OF LAYERS. 8
COMPACTION ENERGY HAMMER. 10 lbs
OMC AT COMPACTION. 11.2 SAMPLE DIA. 15.2 cm
VOLUME OF SAMPLE. 3720.3 cc
HEIGHT OF SAMPLE. 20.5 cm

TESTED AT : Molding Moisture Content.

Percentage Strain = $\frac{\Delta l}{Lo}$ (Δl is change in length of Specimen)

Average cross section area 'A' = $\frac{Ao}{1-E}$ (Ao initial cross sectional area = 182.3 Sq cm

CALCULATIONS		56 Blows	30 Blows	15 Blows
Load reading at failure/20% axial Strain kgs.	a	1602.2	1068.1	640.3
Average load area in Sq cm 'A'	b	190.7	188.7	186.8
Unconfined Compression Strength Kg/cm^2	a/b	8.4	5.6	3.4
Total axial strain in cm.		0.9	0.7	0.5
Percentage axial E.		4.3	3.4	2.4

REMARKS :

For GEOTECH CONSULTANTS

Abd Husain

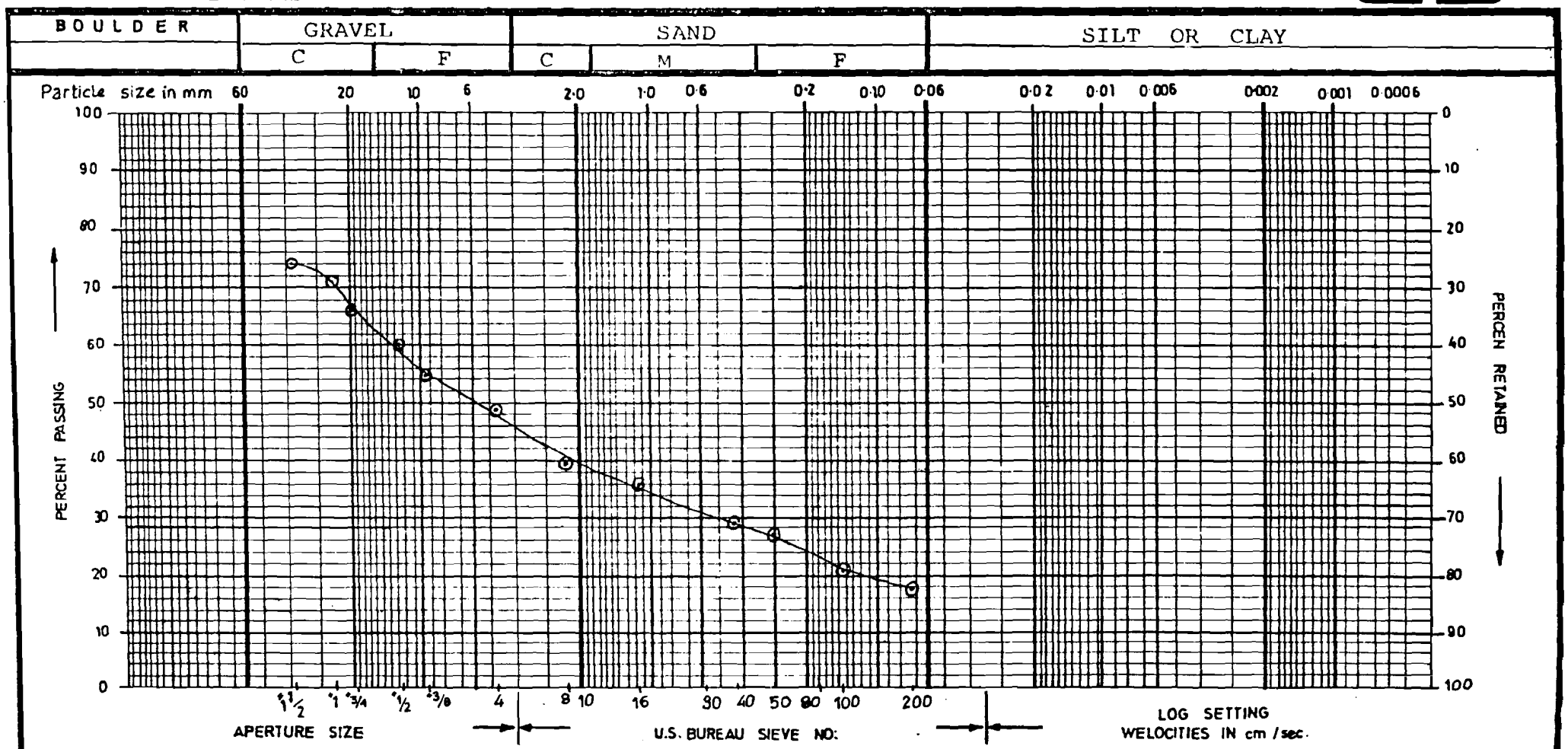
Husain Ahmed
B.S. Civil(Mich)
PROFESSIONAL
MIE(PAK)

GEOTECH CONSULTANTS FOUNDATION & STRUCTURAL ENGINEERS

97

Sub base Material .

GRAIN SIZE DISTRIBUTION



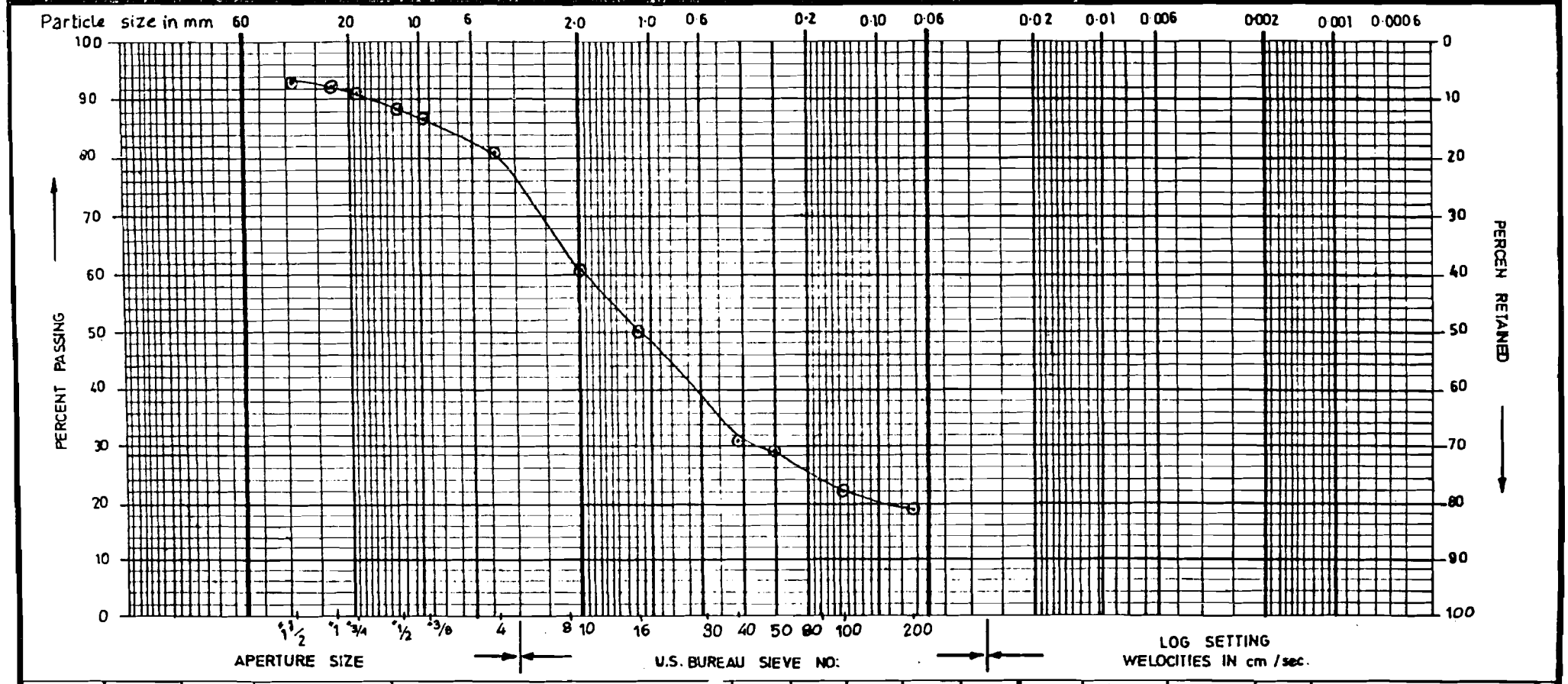
SYMB.	BORE NO.	SAMPLE	Lab No.	Location.	BOULD. %	GRAV %	SAND %	SILT %	CLAY %		L_L	P_L	P_X	REMARKS
	-	1	48	Uban Shah Quary.							36	23	13	
				for GEOTECH CONSULTANTS										

Hussain Abid
B.E. Civil(Mech)M.E. Soil Mec
PROFESSIONAL ENGINEER
MIE (PAK) PRESIDENT (PEC.)

M/s, US'AID.

Sub base Material

GRAIN SIZE DISTRIBUTION



SYMB.	BORE NO.	SAMPLE	Lab No.	Location.	BOULD. %	GRAV %	SAND %	SILT %	CLAY %		L_L	P_L	P_X	REMARKS
	-	2	49	Shadi Shaheed quary.							NP	NP	NP	
				for GEOTECH CONSULTANTS										
				Abid Hussain		Hussain Abid B.E. Civil(Mich) M.S. Geot Mec. PROFESSIONAL ENGG MIE (PAKISTAN) ENGINEER (PEC.)								

M/s, US'AID.

GEOTECH
CONSULTANTS

TESTING AT STAGE - 3

*	Modified AASHTO Compaction	-	11 Nos.
*	3 Point CBR (Soaked)	-	11 Nos.
*	Sieve Analysis.	-	11 Nos.
*	Atterberg Limit.	-	11 Nos.

for GEOTECH CONSULTANTS

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B.S. Civil(Mich)M.S. Soil Mech
PROFESSIONAL ENGG
MIE (PAK) MEMBER (PEC.)

Office : 45/3, C.P. & BERAR SOCIETY, OFF SHAHEED-E-MILLAT ROAD, KARACHI. Phone : 413980

SOILS AND MATERIALS TESTING LABORATORIES

45/3 CP & BERAR HOUSING SOCIETY OFF SHAHEED-E-MILLAT ROAD KARACHI.
Phone : 413980

CLIENT : M/S, US'AID.

PROJECT : Road Resources Management Project Sindh.

CONSULTANTS : M/S, C.C.S.C.

SUBJECT : TEST RESULTS OF SOIL BLENDING SAMPLES

Table No. : 01

No.	Road No.	Blending No.	DESCRIPTION	Grain Size Analysis (% Passing by Weight)			Atterberg Limit		3 Point Soaked CBR		Modified AASHTO Compaction	
				# 10	# 40	# 200	LL %	PI %	95%	98%	O.M.C %	M.D.D g/cc
1.	KH-E-1	BT-1	25% Morum + 75% Soil	80.0	46.2	32.4	28	04	10.5	11.6	13.2	2.04
2.	KH-E-3	BT-2	30% Morum + 70% Soil	80.2	44.1	31.0	30	09	12.5	13.1	10.8	2.13
3.	JA-E-1	BT-4	25% Morum + 75% Soil	80.5	64.3	34.3	28	04	13.3	14.8	10.9	2.16
4.	JA-E-2	BT-5	30% Morum + 70% Soil	82.2	51.5	37.0	28	08	14.7	16.1	12.3	2.18
5.	SA-E-1	BT-7	20% Dune sand + 80% Soil.	84.4	59.9	37.2	NP	NP	8.7	9.5	13.2	1.99
6.	NA-E-1	BT-3	30% Dune sand + 70% Soil	100.0	98.8	49.1	NP	NP	7.8	11.3	11.5	2.04
7.	KH-E-3	BT-2	30% Lime Stone fragement + 70% Soil.	76.4	63.2	44.2	39	17	8.2	8.6	15.1	2.17
8.	KH-E-3	BT-2	30% Lime Stone Powder + 70% Soil.	89.7	78.9	64.7	28	3.2	11.5	12.7	12.4	2.15
9.	JA-E-1	BT-4	50% Brick Powder + 50% Soil	98.4	74.5	63.2	NP	NP	9.9	12.1	12.4	2.15
10.	NA-E-1	BT-3	50% Brick Powder + 50% Soil	94.9	73.8	61.0	NP	NP	14.4	16.2	13.0	2.05
11.	SA-E-1	BT-7	50% Brick Powder + 50% Soil	93.8	74.0	69.1	NP	NP	10.1	11.3	10.9	2.16

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SOILS AND MATERIALS TESTING LABORATORIES

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HOUSING SOCIETY
OFF SHAHEED-E-
MILLAT ROAD
KARACHI.
Phone : 413980

Report No. : GEO/USA/CCSC/90025.I

Table No. : 02

Date : 20th,May,1990

PROJECT : Road Resources Management Project Sindh (RRMP)

CLIENT : M/S,US'AID.

CONSULTANTS : M/S,C.C.S.C.

SUBJECT : Swelling % of Blending Samples.

S.No	Blending No.	ROAD No.	DESCRIPTION	SWELLING %		
				96 hours	7 days	14 days
1.	BT- 1	KH-E-1	25% Morum + 75% Soil	0.94	—	—
2.	BT- 2	KH-E-3	30% Morum + 70% Soil	1.13	—	—
3.	BT- 4	JA-E-1	25% Morum + 75% Soil	1.02	—	—
4.	BT- 5	JA-E-2	30% Morum + 70% Soil	0.92	—	—
5.	BT- 7	SA-E-1	20% Dune sand + 80% soil	1.28	—	—
6.	BT- 3	NA-E-1	30% Dune sand + 70% soil	1.73	—	—
7.	BT- 2	KH-E-3	30% lime stone fragement + 70% soil.	1.41	—	—
8.	BT- 2	KH-E-3	30% lime stone Powder + 70% soil.	1.35	—	—
9.	BT- 4	JA-E-1	50% Brick Powder + 50% soil	1.97	—	—
10.	BT- 3	NA-E-1	50% Brick Powder + 50% soil	1.69	—	—
11.	BT- 7	SA-E-1	50% Brick Powder + 50% soil	1.19	—	—

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MIE (PAKISTAN)MEMBER(PEC.)

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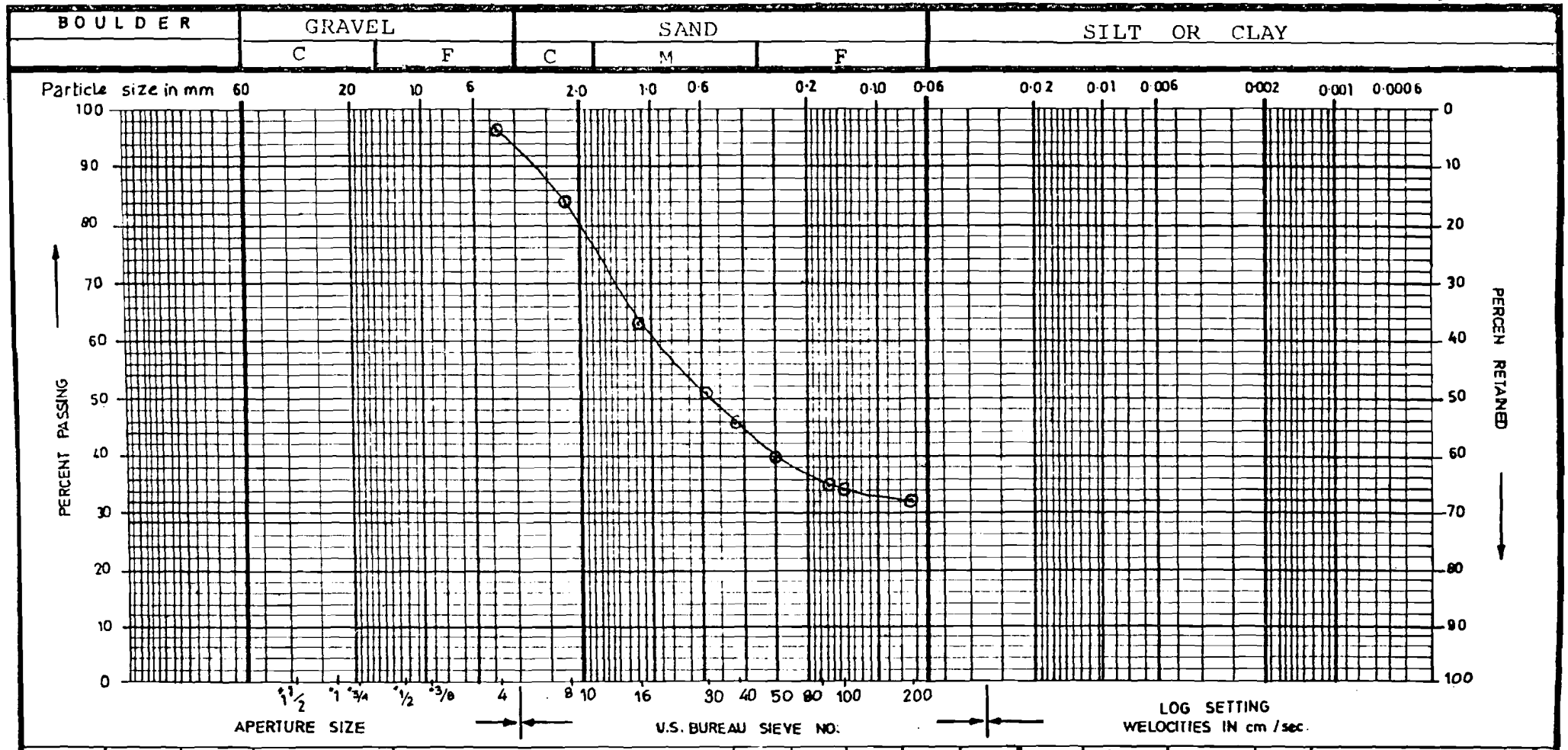
R.R.M.P.SINDH.

GRAIN SIZE DISTRIBUTION



SYMB.	BORE NO.	SAMPLE	~~DEPTH~~	CLASSIFICATION	BOULD. %	GRAV %	SAND %	SILT %	CLAY %		L_L	P_L	P_X	REMARKS
	-	1	BT-1	25% Morum + 75% Soil.							28	24	04	

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Hasan Abid

B.E. Civil(Mech)M.E. Soil Mec[illegible]
PROFESSIONAL ENGG [illegible]

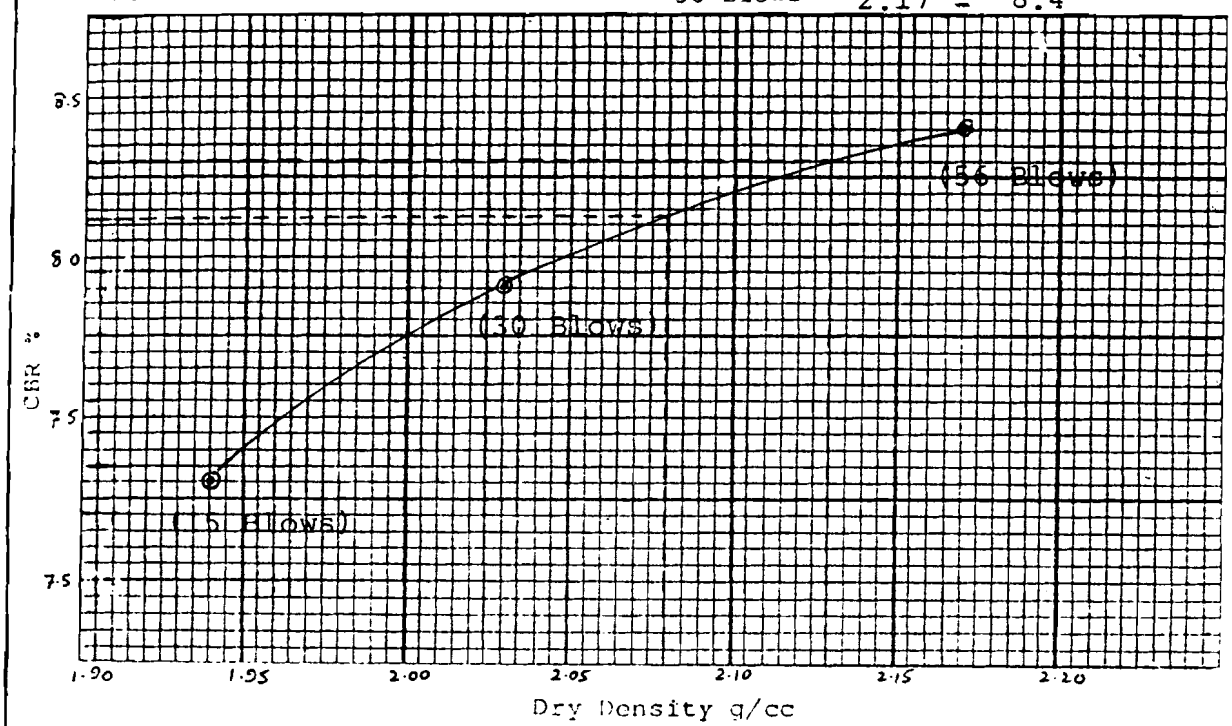
M/s, US'AID.

Max Dry Density = 2.17 g/cc
CBR at 95% (MDD) = 8.2
CBR at 98% (MDD) = 8.6

BT -2 (96 hours)

30% Lime stone fragements + 70% Soil.

15 Blows = 1.94 - 7.3
30 Blows = 2.03 - 7.9
56 Blows = 2.17 - 8.4



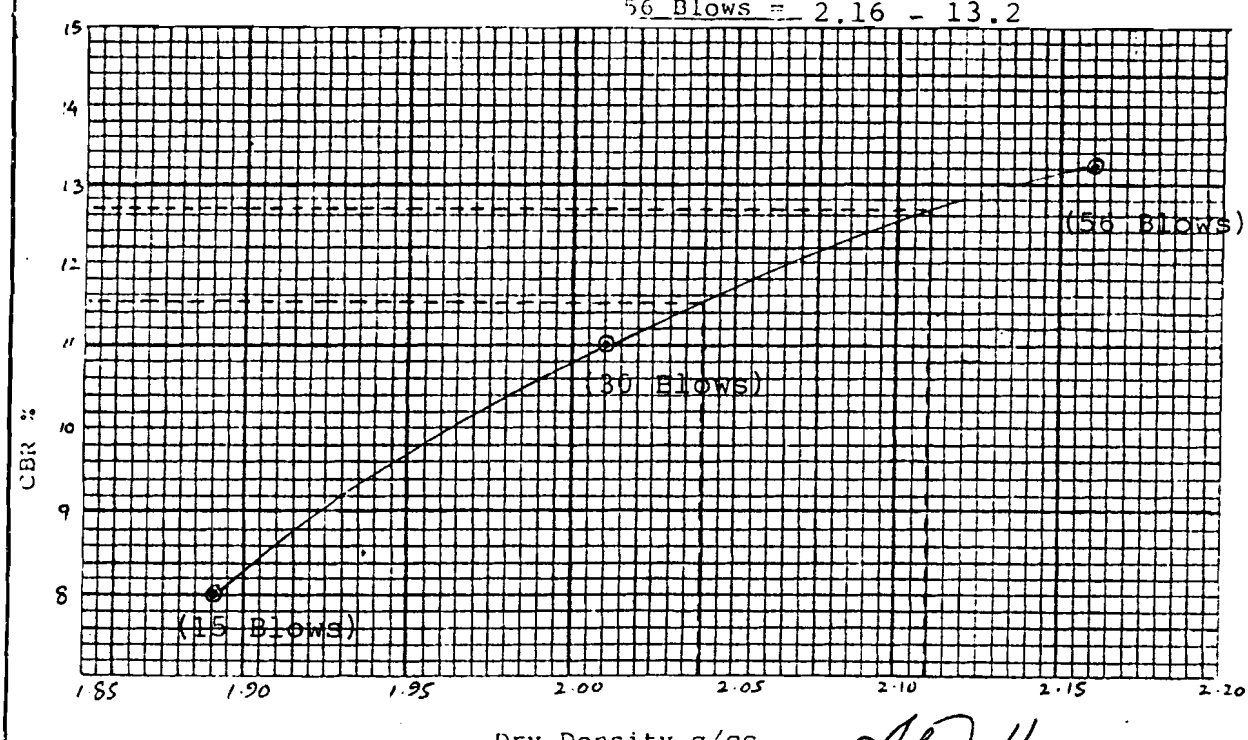
(7)

Max Dry Density. = 2.15 g/cc
CBR at 95% (MDD) = 11.5
CBR at 98% (MDD) = 12.7

BT-2 (96 hours)

30% Lime stone powder + 70% Soil.

15 Blows = 1.89 - 8.0
30 Blows = 2.01 - 11.0
56 Blows = 2.16 - 13.2



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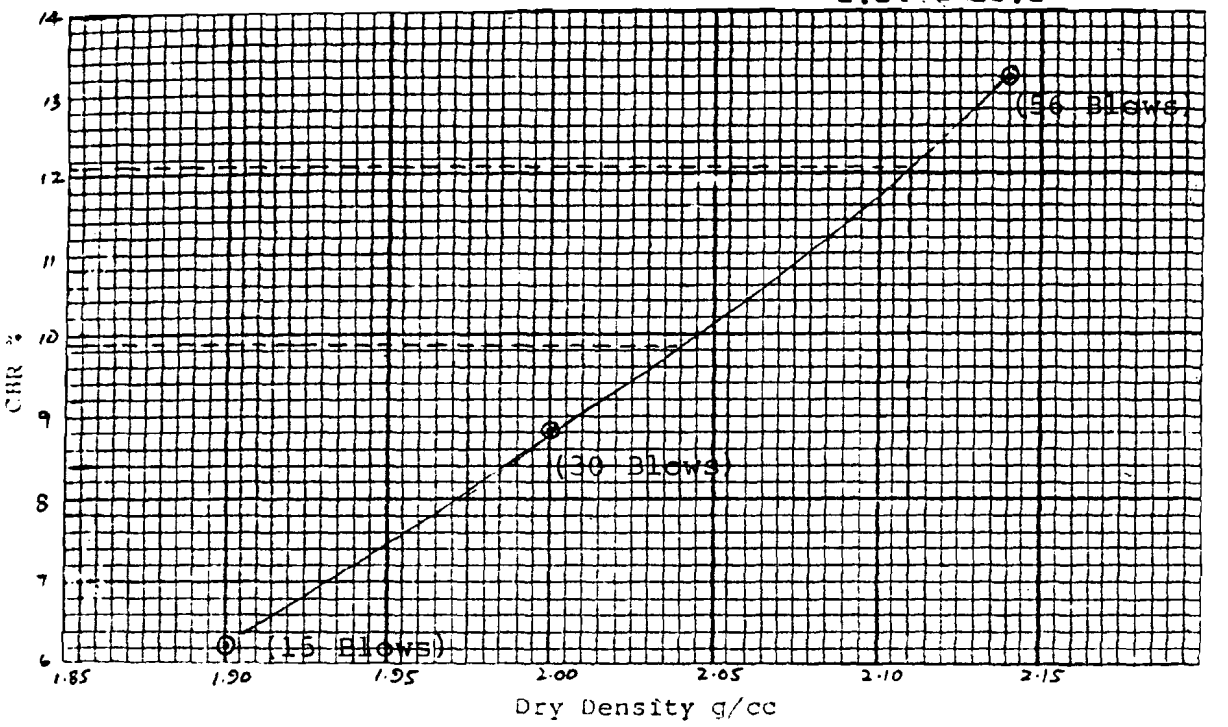
Max Dry Density = 2.15 g/cc
CBR at 95% (MDD) = 9.9
CBR at 98% (MDD) = 12.1

BT-4 (96 hours)

50% Brick Powder + 50 % Soil.

15 Blows = 1.90 - 6.2
30 Blows = 2.00 - 8.8
56 Blows = 2.14 - 13.2



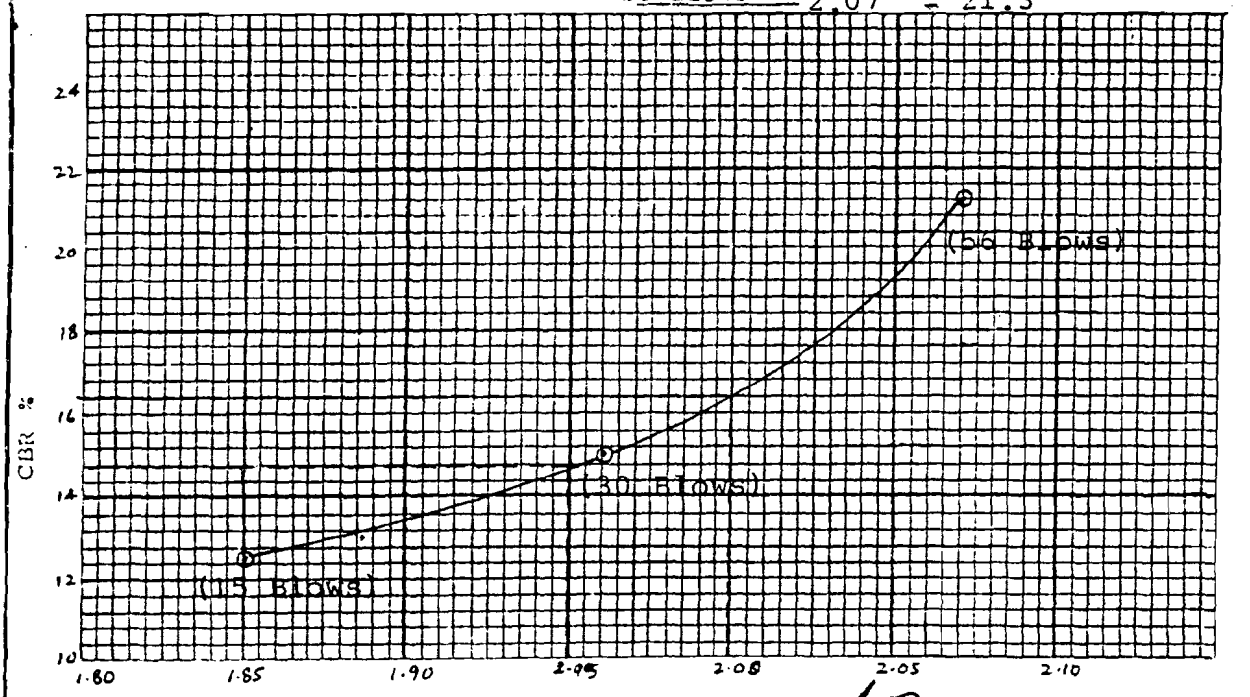
(9)

Max Dry Density. = 2.05 g/cc
CBR at 95% (MDD) = 14.4
CBR at 98% (MDD) = 16.2

BT-3 (96 hours)

50% Brick Powder + 50% Soil

15 Blows = 1.85 - 12.5
30 Blows = 1.96 - 15.0
56 Blows = 2.07 - 21.3



(10)

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