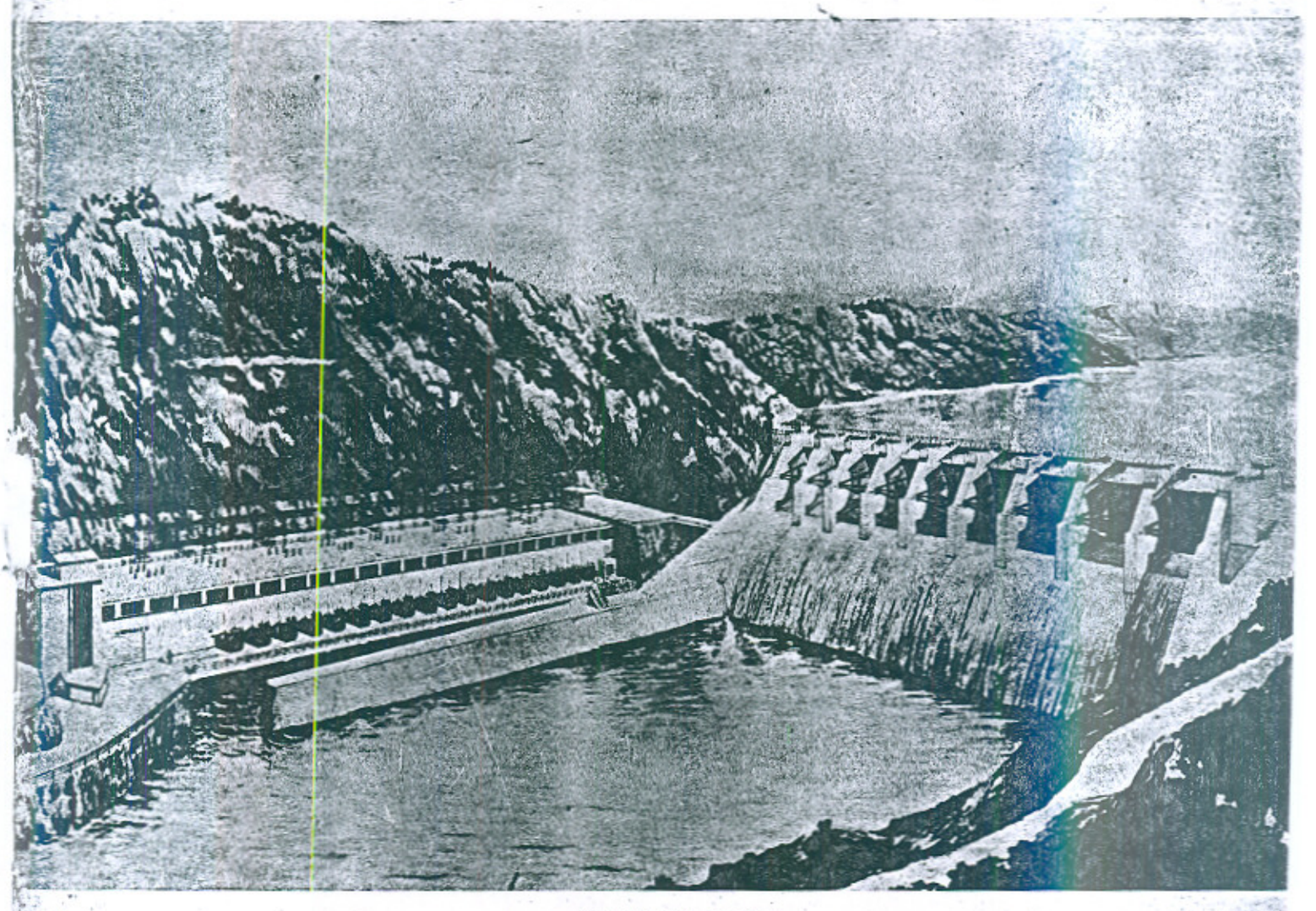
ENGINEERING NEWS

QUARTERLY JOURNAL OF THE WEST PAKISTAN ENGINEERING CONGRESS

VOLUME 3 No. 2 | LAHORE, West Pakistan | JUNE 1958



An Artists' Impression
of
WARSAK DAM AND POWER HOUSE

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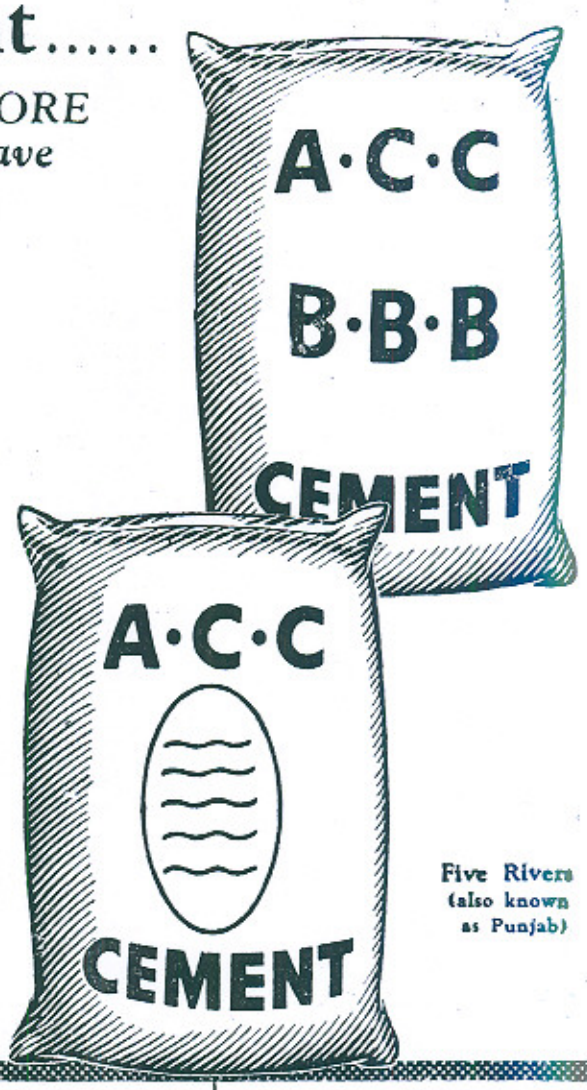
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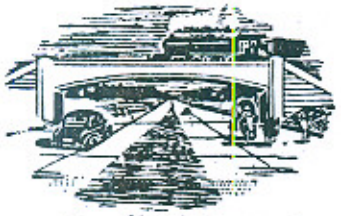
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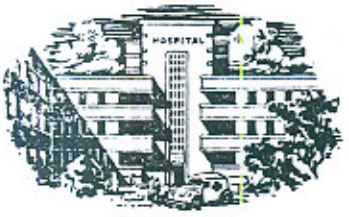
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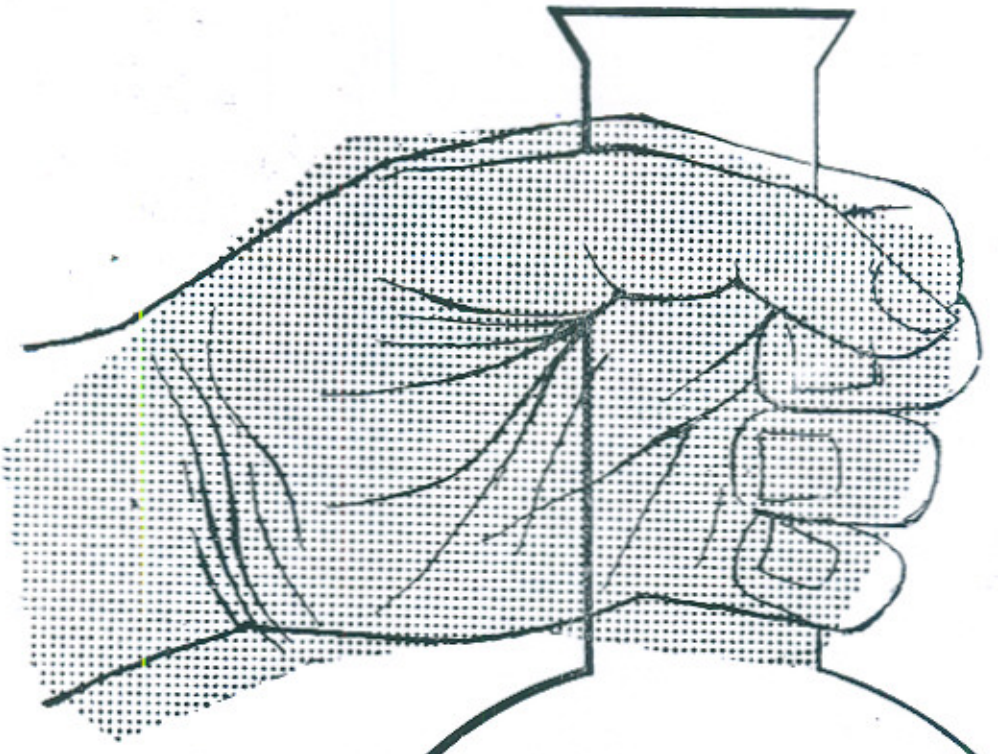
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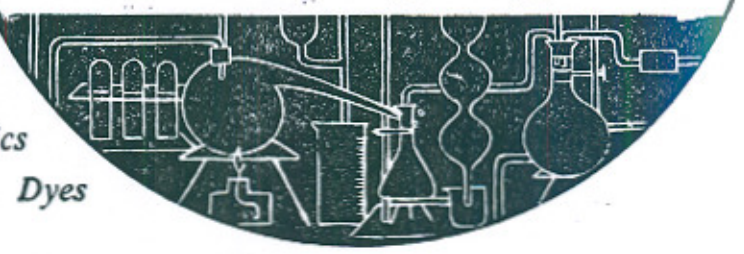
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The Moving Finger writes;
and having writ,

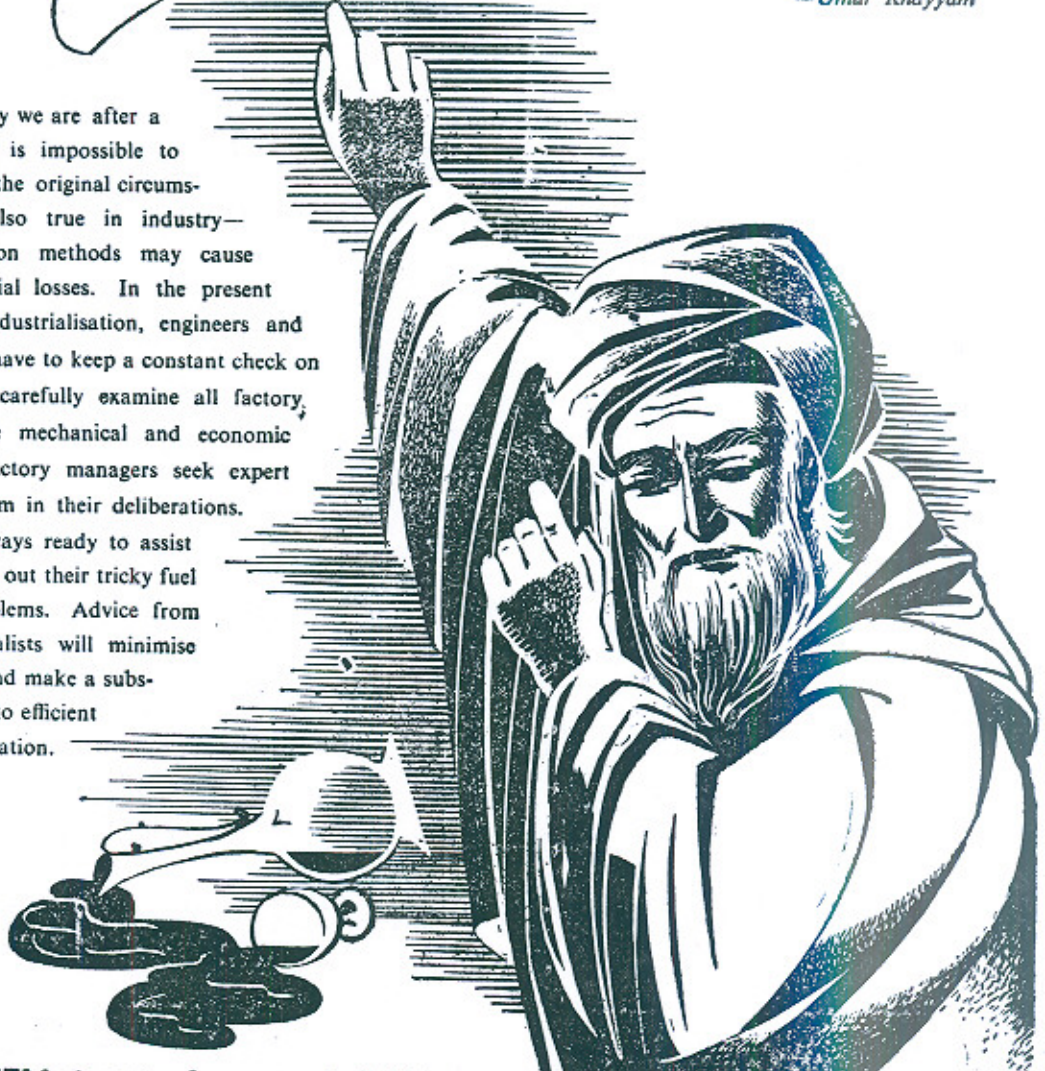
Moves on; nor all thy
Piety nor Wit

Shall lure it back to cancel
half a line

Nor all thy Tears wash out
a word of it.

—Omar Khayyam

No matter how sorry we are after a distressing event, it is impossible to completely restore the original circumstances. This is also true in industry—inefficient production methods may cause irrecoverable financial losses. In the present age of intensive industrialisation, engineers and production experts have to keep a constant check on all operations and carefully examine all factory problems to achieve mechanical and economic efficiency. Wise factory managers seek expert advice to guide them in their deliberations. Burmah-Shell is always ready to assist industries in sorting out their tricky fuel and lubrication problems. Advice from Burmah-Shell specialists will minimise maintenance costs and make a substantial contribution to efficient and economical operation.



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A FEATURE ON THE WARSAK HYDRO-ELECTRIC PROJECT

SERIES—5

CONCRETE AGGREGATES

By
Mian Irshad Nabi, P.S.E.I.*

WARSAK Hydro-Electric Project when completed would consume approximately 6,26,000 cu. yds. of cement concrete the biggest concrete Project undertaken so far in Pakistan. This amount of concrete in other words would require roughly 1,000,000 tons of both fine and coarse aggregates. The major problem, therefore, was to find out the economical sources of such aggregates, which would involve least overburden and haulage distance and would give good quality aggregate. For this purpose aggregate survey was carried out which meant field investigations for concrete materials prior to construction of the Project and was confined chiefly to prospecting of aggregates and to exploration and sampling of available deposits. For such a purpose the following information was necessary.

1. Approximate quantity of aggregate required.
2. Maximum size to be used.
3. General nature of proposed construction.

A simple way of finding out approximate quantity of aggregates required for the Project is shown in Table 1. The unit weights have been taken from Table 2, and the figures in the Proposed mix are only tentative, the final figures however, will depend upon *trial mixes* to be made in the concrete laboratory. For the purpose of rough estimation the figures are sufficiently good. In the main dam concrete, 4" maximum size aggregate has been proposed because it was found, as is apparent from the analysis of test pits in the three aggregates areas, that the size fraction over 4" is very little. It is, however, economical to use largest size aggregates compatible with job requirements.

Three areas known to have contained concrete aggregates were surveyed and field investigations were started as far back as July, 1955. These areas have been designated as Areas "A", "B" and "C" as shown on the Drawing 1.

1. Area "A"—Two dry river beds South-West of Warsak Colony and West of Jamrud Road approximately one mile from Warsak Head.
2. Area "B"—Known as Jabbar Pit, dry river bed adjacent to Malik Jabbar's village on the north side of Kabul River approximately one mile West of 2nd Michni Bridge.
3. Area "C"—A River deposit on the South bank of the Kabul River between Warsak Colony and river.

FIELD INVESTIGATIONS

Test Pits :—The first step towards these investigations was the location of test pits. 29 test pits in Area A, 35 in Area B, and 34 in Area C were spread uniformly in order to represent the deposit under investigations. On account of nearness of Areas B and C to the river, all the test pits ended at the spring level. The best method of sampling the aggregate deposit is by the steel-cased test holes ; which could not be employed here on account of large boulders in the deposits which would

* Executive Engineer, Warsak Project.

TABLE 1

Name of work	Concrete required (cu. yds.)	Max. size agg.	Proposed mix per cu yds.				Average unit wt. of conc. (lbs/cft)	Total agg. per cyds. (pounds)	Sand per cyd. (tons.)	Stone per cyd. (tons.)	Total for Work	
			Cement (lbs)	Water (lbs)	Air %	Sand %					Sand tons.	Stone tons.
Main Dam	4,66,000	4"	400	200	4	25	152	$152 \times 27 = (4104 - 200 - 400) = 3504$	$\frac{25 \times 3504}{2240} = \cdot 39$	$\frac{(3504 - 876)}{2240} = 1 \cdot 17$	$0 \cdot 39 \times 466{,}000 = 1{,}81{,}740$	$1 \cdot 17 \times 466.000$ 5,45220
Diversion Tunnel & Transition	35,000	2"	600	300	5	30	150	$150 \times 27 = (4050 - 600 - 300) = 3150$	$\frac{30 \times 3150}{2240} = \cdot 42$	$\frac{(3154 - 945)}{2240} = \cdot 98$	$\cdot 42 \times 35000$ 14700	$\cdot 98 \times 35000$ 34,300
Power House	79000	$1\frac{1}{2}$"	520	280	5	30	150	$150 \times 27 = (4050 - 520 - 280) = 3250$	$\frac{30 \times 3250}{4240} = \cdot 43$	$\frac{(3250 - 975)}{2240} = 1 \cdot 01$	$\cdot 43 \times 79000$ 33,970	$1 \cdot 01 \times 79000$ 79000
Irrigation Tunnel	46000	2"	600	300	5	30	150	3150	$\frac{3150 \times 30}{2240} = \cdot 42$	·98	$\cdot 42 \times 46000$ 19320	$\cdot 98 \times 46000$ 45080
Total	6,26,000	—	—	—	—	—	—				2,49730	7,03,600

Grand total of Aggregate = 953330 tons.

Say 953000 tons.

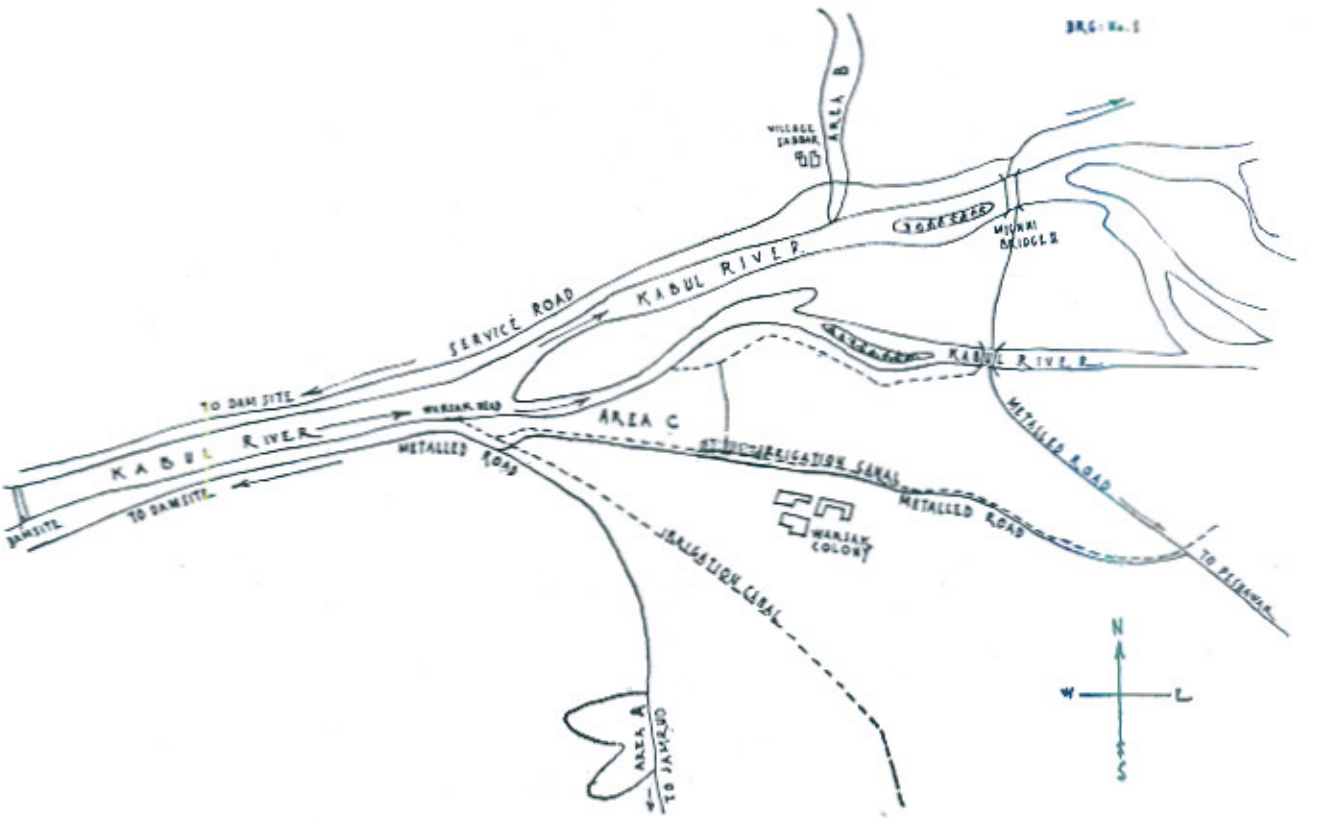


TABLE 2

Maximum size of Aggregate inches	AVERAGE VALUES			Unit Weight pounds per cu. foot				
	Air Content percent	Water Pounds cu. yd.	Cement Pounds per cu. yds.	Specific Gravity of Aggregate				
				2·55	2·60	2·65	2·70	2·75
¾	6·0	283	564	137	139	141	143	145
1½	4·5	245	490	141	143	146	148	150
3	3·5	204	408	144	147	149	152	154
6	3	164	282	147	149	152	154	157

have made the sampling difficult. Steel-cased test holes are made by driving steel casing mechanically or by other methods similar to the driving of tube-well and obtaining the sample at different depths.

The method employed in all the aggregate deposits was to put in test pits, which were dug mechanically in Area B, and manually in Area A and C. After the pits had been completed the most important point was to take representative samples from each of these test pits ; because the accuracy of these samplings was to give us the available quantities of fine and coarse aggregates in each deposit as closely as possible.

No cribbing was necessary in any of the test pits in Area A, B, or C, on account of nature of deposit ; but where the sides of the test pits do not stand but fall, cribbing or shuttering may be engaged. Representative samples were then obtained by scraping the whole face of test pits in Area B with a drag line and collecting the material from the bucket into canvas bags so as to retain all the fines ; whereas the sampling, from test pits in Area A and C, was done by manually scraping a strip of face and collecting the material in bags. These representative samples were then taken to the Concrete Control Laboratory for analysis.

Care was taken to label the samples with the test pit number, depth at which taken, location, date, and other information concerning the test pit. The samples were then tested for grading, unit weight, specific gravity, absorption, silt content, organic impurities, petrographic analysis, soundness, abrasion and other tests for which facilities were available in the laboratory.

Grading :—The samples were split up into sand and coarse aggregate, using No. 4 or $\frac{3}{16}$" screen and then sieve analysis was run on each for the grading test. The grading test gives us the percentages of each size fraction, contained in fine and coarse aggregates. Not less than 100 pounds of material should be used for $1\frac{1}{2}$" maximum size aggregate and preferably not less than 500 pounds for aggregate of larger size. Sand sample should not be less than 500 grams. The screens are to be the standard square mesh screens of 6", 3", $1\frac{1}{2}$", $\frac{3}{4}$", $\frac{3}{8}$", and No. 4 size for coarse aggregate or other sizes as may be required to test the materials in accordance with specification requirements. For sand the screens used were standard square mesh screens designated by numbers 4, 8, 16, 30, 50 and 100. In the case of coarse aggregate the screen analysis was done by hand shaking the representative samples through 18" × 18" standard square mesh screens. Sand samples from Area B were screened by mechanical shaker, where as sands from Area A were screened by hand shaking.

Seven minutes running time was given to mechanical shaker for each sample. The results of these analyses are given in Tables 3, 4, 5, 6, 7 and 8.

The fineness modulii for each sample both for coarse and fine aggregate has also been calculated. The fineness modulus of sand is computed by adding the cumulative percentages retained on the six standard screens from No. 4 to No. 100 inclusive and dividing the sum by 100 ; and the same method is used for coarse aggregate except that 500 is added for the five screens Nos. 8, 16, 30, 50 and 100 before dividing it by 100.

Now that the test pit data, screen analysis and the areas represented by the test pits having been known the quantity of suitable material in each Area A, B and C was computed.

AREA "A"

Referring to Drawing 2 of Area A, showing cross-sections through testpits, the available quantity of aggregates were computed as under :—

Cross-Sectional area of sand and stone deposit through Section AA
= 10,590 sq. ft.

Cross-Sectional area of sand and stone deposit through section BB
= 17,615 sq. ft.

Average of two AA and BB
= 14,102 sq. ft.

Volume of material between these two sections = 14102 × 400
= 56,40,800 cu. ft.

Volume of material between sections BB and CC = 11307 × 400
= 45,22,800 cu. ft.

Volume of material between sections CC and DD = 5462 × 400
= 21,84,800 cu. ft.

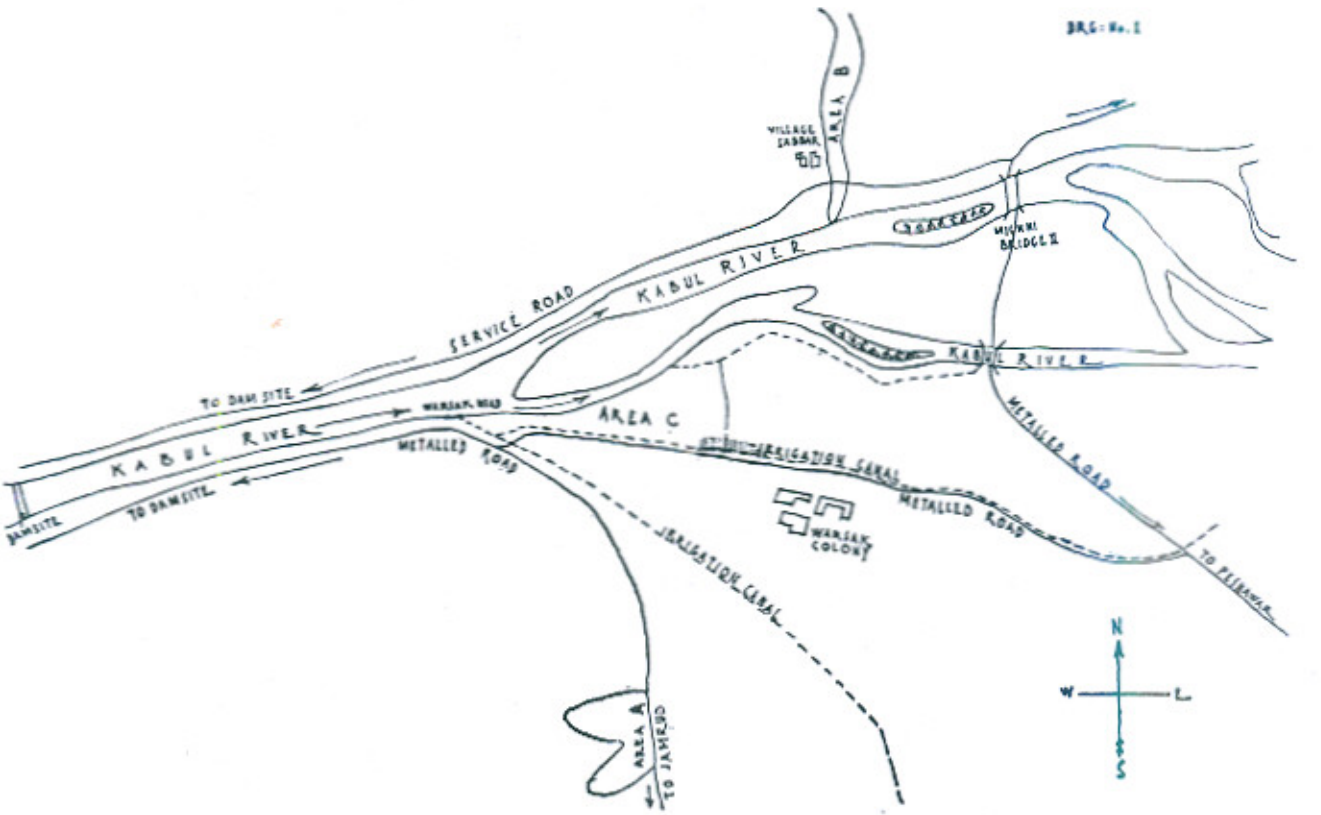
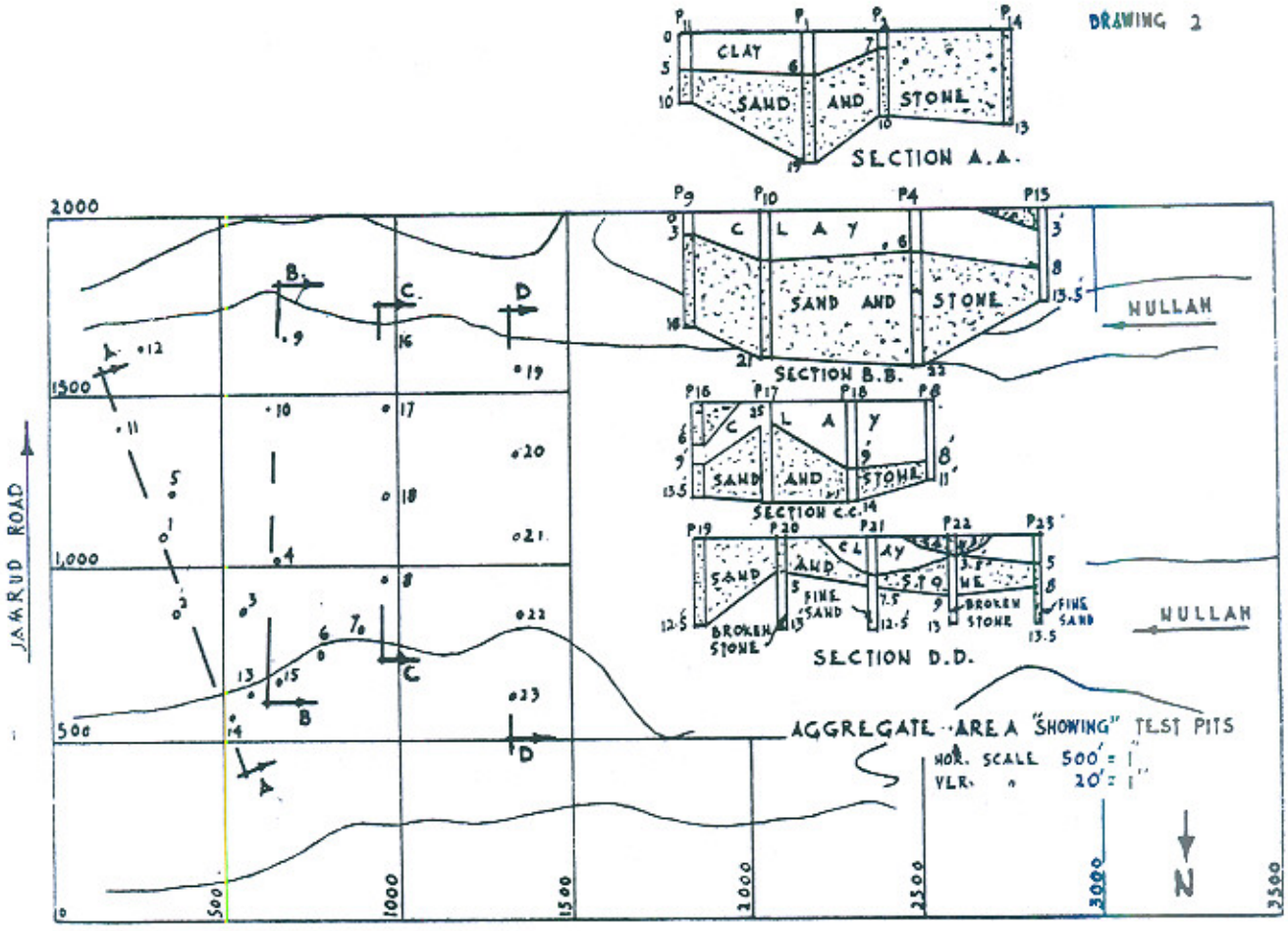


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1½	4·5	245	490	141	143	146	148	150
3	3·5	204	408	144	147	149	152	154
6	3	164	282	147	149	152	154	157



Total volume of sand and stone
= 123,48,400 cu. ft.
= 4,57,000 cu. yds.

Sand = 42% refer to Table 3

$$= \frac{42}{100} \times 457000 = 1{,}91{,}940 \text{ cu. yds.}$$

Stone = 58% refer to Table 3

$$= \frac{58}{100} \times 457000 = 2{,}65{,}060 \text{ cu. yds.}$$

Aggregate quantities are much better expressed in tons than in cubic yards. These are converted by multiplying with their respective unit weights, thus sand

$$= \frac{191940 \times 27 \times 100}{2240} = 2{,}30{,}000 \text{ tons.}$$

and stone

$$= \frac{265060 \times 27 \times 105}{2240} = 3{,}40{,}000 \text{ tons.}$$

Total = 5,70,000 tons.

Coarse aggregate can be further divided into separate size fractions in accordance with the sizes desired. Referring to Table 3.

+3" stone = 3·4% = 3·4 × 340000
= 11,560 tons.

3" – 1½" stone = 28·2% = 28·2 × 340000
= 95,880 tons.

1½" – ¾" stone = 28·5% = 28·5 × 340000
= 96,900 tons.

¾" – ⅜" stone = 23·0% = 23·0 × 340000
= 78,200 tons.

⅜" – 1/16" stone = 16·9% = 16·9 × 340000
= 57,460 tons.

Total = 3,40,000 tons.

AREA "B"

The available quantity of aggregates were computed as follows. (See Drawing 3 and Table 5).

Length of the deposit
= 3,000 feet.

Average width of deposit
= 500 feet.

Area of deposit
= 3,000 × 500 = 15,00,000 sq. ft.

Average depth of material
= 4·4 feet.

Therefore quantity of available aggregates
= 15,00,000 × 4·4 = 66,00,000 cft.
= 2,44,000 cu. yds.

TABLE 3

Coarse Aggregate Area A

Individual Percent Retained (Average of 21 Samples)

Screens	4"	3"	1½"	¾"	⅜"	$\frac{3}{16}$"	F.M.	Percent Sand	Percent Gravel
	—	3·4	28·2	28·5	23·0	16·9	7·78	42	58

TABLE 4

Fine Aggregate (Sand) Area A

Individual Percent Retained (Average of 21 Samples)

Screens	No. 4	8	16	30	50	100	Pass 100	F. M.
	—	13·0	21·0	23·0	19·8	11·5	11·7	2·69

TABLE 5

Coarse Aggregate (Stone) Area B

Individual Percent Retained (Average of 21 Samples)

Screens	2"	1½"	¾"	⅜"	No. 4	F.M.	Percent Sand	Percent Stone
	13·80	11·98	31·14	21·99	21·09	7·75	40·0	60·0

TABLE 6

Fine Aggregate (Sand) Area B

Individual Percent Retained (Average of 21 Samples)

Screens	4	8	16	30	50	100	Pass 100	F. M.
	—	17·3	23·7	22·1	16·1	10·6	9·0	2·93

TABLE 7

Coarse Aggregate (Stone) Area C

Individual Percent Retained (Average of 6 Samples)

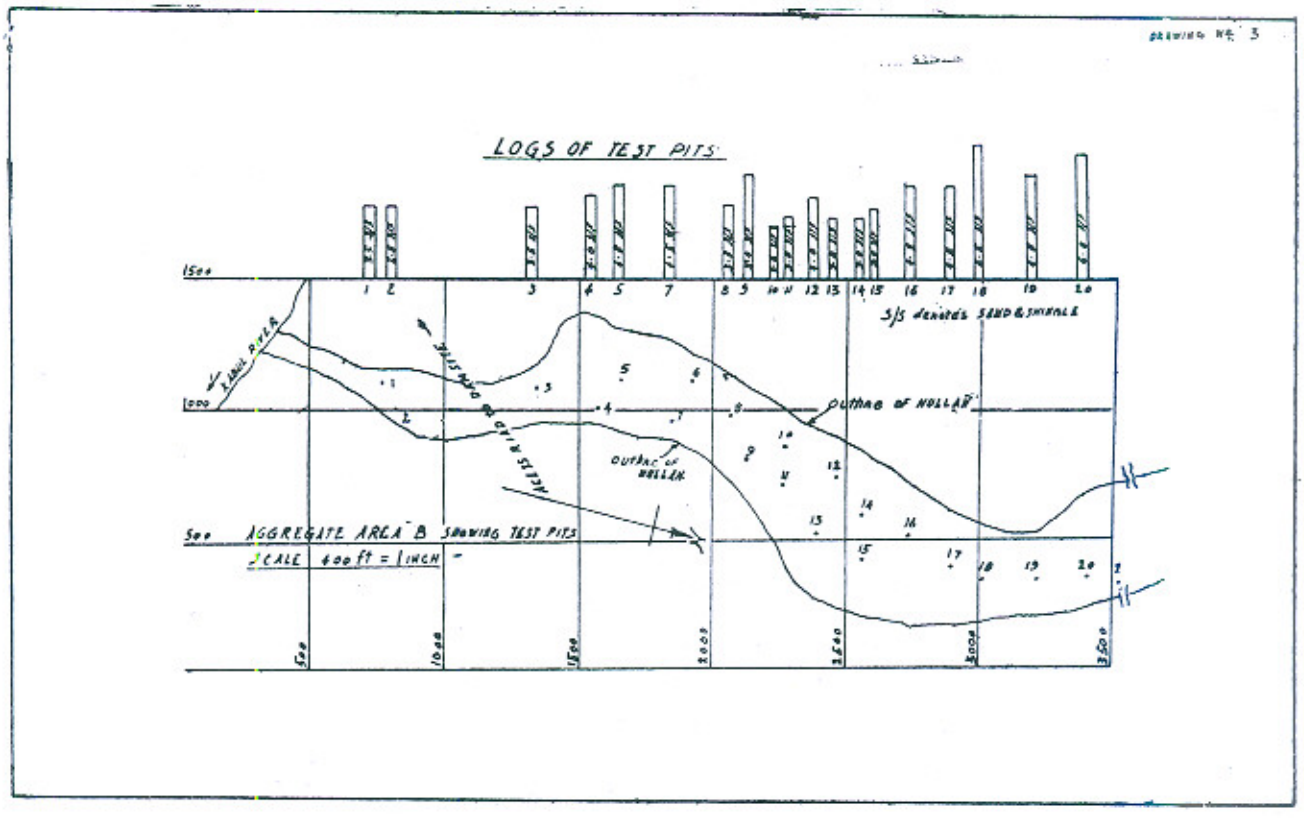
Screens	3"	1½"	¾"	⅜"	$\frac{3}{16}$"	F. M.
	6·4	40·8	42·6	9·7	0·5	7·92

TABLE 8

Fine Aggregate (Sand) Area C

Individual Percent Retained (Average of 11 Samples)

Screens	4	8	16	30	50	100	Pass 100	F.M.
	—	0·3	0·9	1·20	17·4	51·3	28·6	0·97



Another way of computing the quantity of aggregates available is to divide the deposit into small compartments so that each compartment is represented by one or more number of test pits, as closely representing the compartment as possible. Multiplying area of each compartment with the average depth of material in it, and finally combining the quantity calculated for all compartments, the total quantity of available aggregates could be determined. This method is slightly more precise than the previous one and according to this the available quantity is found to be 62,55,000 cubic feet or 2,30,000 cubic yards.

Fine aggregate (sand), refer Table 5
$= 40\% = 92{,}000$ cu. yds.

Coarse aggregate (stone), refer Table 5
$= 60\% = 1{,}38{,}000$ cu. yds.

Total $= 2{,}33{,}000$ cu. yds.

Knowing the unit weights of fine and coarse aggregate, the quantities in cubic yards can be converted to tons. The average, unit weight of fine and coarse aggregate was found to be 100 and 105 pounds per cubic foot respectively. Using these figures :

Fine aggregate (sand)

$$= \frac{2000 \times 27 \times 100}{2240} = 1{,}10{,}000 \text{ tons.}$$

Coarse aggregate (stone)

$$= \frac{13800 \times 27 \times 105}{2240} = 1{,}74{,}000 \text{ tons.}$$

$= 2{,}84{,}000$ tons.

Coarse aggregate can be further divided in accordance with size-separation, proportions selected, or those which it is expected the supply will provide. Referring to Table 5 :

$+2''$ stone $= 13{\cdot}8\% = 174000 \times 13{\cdot}8 = 24{,}200$

$2'' - 1\frac{1}{2}''$ stone $= 11{\cdot}98\% = 174000 \times 11{\cdot}98 = 20{,}800$

$1\frac{1}{2}'' - \frac{3}{4}''$ stone $= 31{\cdot}14\% = 174000 \times 31{\cdot}14 = 54{,}000$

$\frac{3}{4}'' - \frac{3}{8}''$ stone $= 21{\cdot}99\% = 174000 \times 21{\cdot}99 = 38{,}000$

$\frac{3}{8}'' - $ No. 4 $= \frac{21{\cdot}09}{100{\cdot}00} = 174000 \times 21{\cdot}09 = 37{,}000$

These quantities may be considered as conservative, because this represent materials upto water table, which was high at the time of digging test pits. The quantities can be increased by digging in low water table or dredging under water.

AREA "C"

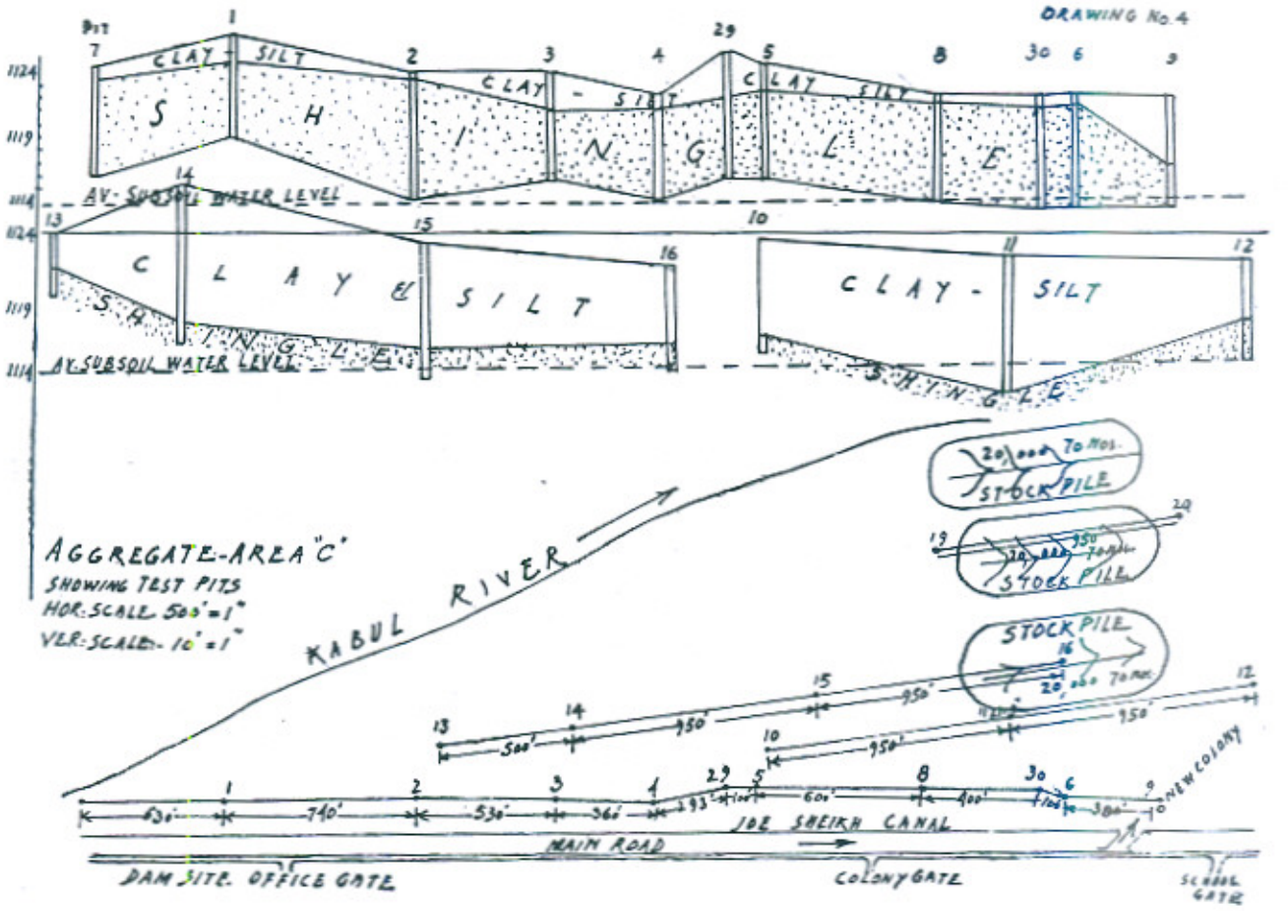
The drawing 4 shows the area "C," location of test pits, their logs and cross-sections of strata. The available quantity of coarse aggregate in the area is computed which comes to 600,000 tons. The cross-sections show that the over burden is least in the portion near to Joe Sheikh canal. In order to recover the full quantity of available coarse aggregate 5,500,000 cubic feet of overburden will have to be removed.

The sand available in this area is too fine to be of any use for concrete work. Its grading characteristics have been dealt in the coming pages.

The natural grading of fine as well as coarse aggregate from Aggregate Areas A, B and C is now compared with the Recommended Limits set down by the specifications in order to know if there is any excess or deficiency of a certain size fraction in the aggregates. There are some inferences made and conclusions arrived at, after comparing two Grading Curves. The Project is subjected to the specifications of Canadian Engineering Standards Association.

Area "A".—The natural grading of the coarse aggregate with $+1\frac{1}{2}$" material removed is graphically represented in Graph 1; it falls within the limits and has ideal grading. As compared to Area B stone, Area A stone is better graded having some improvement in $\frac{3}{4}$" – $\frac{3}{8}$" size fraction. The screen analysis in Table 3 for Area A stone shows that there is about 28% of 3" – $1\frac{1}{2}$" size stone, sufficient to produce 3" maximum size aggregate in case necessary.

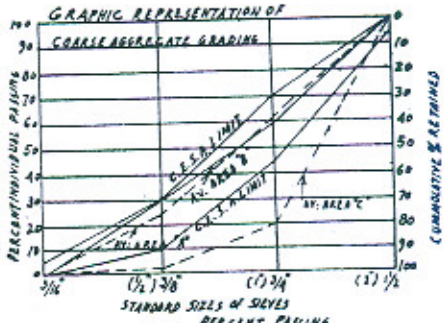
The average grading of sand in Area A also falls within the C. E. S. A. recommended limits except for pass 100 material which is much higher than the maximum prescribed, otherwise the



sand grading on average is ideal and much better graded than Area B sand. The sand will have to be processed to reduce its pass 100 material within permissible limits. Though on the elimination of surplus percentage of pass 100 material the average figure of Fineness Modulus of 2·63 will be affected but it would still remain desirable unlike Area B sand.

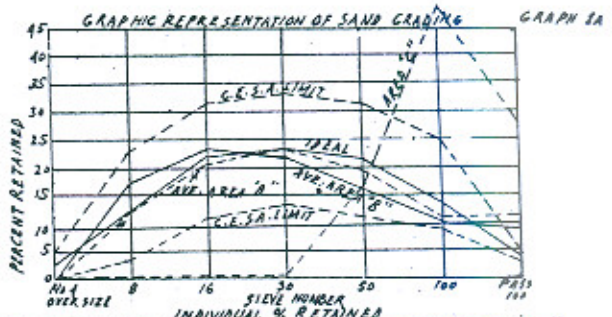
Area "B".—Graph 1 depicts the recommended limits of grading for a $1\frac{1}{2}$" and 2" maximum size aggregates as set down by Canadian Engineering Standards Association. The graph also shows the natural grading of the coarse aggregate, with $+1\frac{1}{2}$" aggregate removed. It will be seen that the natural grading falls within the limits of the specifications. However, it was not intended to use the coarse aggregate as it came out of the deposit but it was classified and separated into at least two size fractions for a $1\frac{1}{2}$" or 2" maximum size aggregate which were $1\frac{1}{2}"-\frac{3}{4}"$, $\frac{3}{4}"-\frac{3}{16}"$ and $2"-\frac{3}{4}"$, $\frac{3}{4}"-\frac{3}{16}"$ respectively. This was done to reduce segregation of aggregate during transportation, handling and stockpiling. Anyhow the natural grading has shown that there is no deficiency of any size fraction and the different size fraction can be combined in the recommended proportions, without fear of running short of any size fraction. The perusal of Table 5 shows yet another fact that an average of 25·78% (13·80 + 11·98) of the coarse aggregate was retained on $1\frac{1}{2}$" screen, thus the area has sufficient material to produce concrete with 3" maximum size stone; in case necessary.

The average grading of the sand in Area B is also represented graphically in Graph 1 A along with the recommended and ideal limits set down by the Canadian Engineering Standards Association. On comparison the average grading of the sand falls within the limits of maximum deviation except for pass 100 material which is 9·0% against the maximum of 5%. This concludes that it will be necessary to reduce pass 100 materials so as to bring it within permissable limits. By doing this the average fineness modulus which is 2·93 shall further soar to little over 3·0 which would be undesirable as



PERCENT PASSING

0½" (1")	¾" (½")	⅜" (¼")	¼"	
95-100	35-70	10-30	0-5	C.E.S.A.
100	59	29.5	0	AVE: AREA "B"
100	58	24	0	" " "A"
100	20	1.5	0	" " "C"



INDIVIDUAL % RETAINED

No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	PASS	
0-5	3-28	11·5-31·5	13·5-33	8·5-31·5	9-30	2·5-5	C.E.S.A.
0	17.3	23.7	22.1	16.1	10.6	9.0	AV. AREA B
0	13.0	21.0	23.0	19.8	11.5	11.7	B " "
0	0.8	0.9	1.2	17.4	51.3	28.6	C " "

it becomes fairly coarse sand for concrete work. It is, therefore, inferred that blending sand will have to be used consisting predominently of material retained on No. 48 and 100 screens in order to bring down its fineness modulus to 2·85% which is the desired figure.

Area "C"—Graph 1 shows the natural grading of coarse aggregate fromArea C with $+1\frac{1}{2}$" material removed. It is noticed that it falls much outside the recommended limits of C. E. S. A.; and at the same time it is poorly graded with excess of $1\frac{1}{2}"-\frac{3}{4}"$ material and deficient in the other two sizes, *viz.* $\frac{3}{4}"-\frac{3}{8}"-\frac{3}{16}"$. The perusal of Table 7 will show that material $\frac{3}{8}"-\frac{3}{16}"$ is 0.5% of the total stone which in other words is negligible. There is however, sufficient material of $3"-1\frac{1}{2}"$ size fraction to produce concrete with 3" maximum size aggregate. The grading, of the coarse aggregate will need improvement on its fine sizes before it could be used for good quality concrete.

The sand too from this area falls outside the recommended limits, and is poorly graded. The grading indicates that about 80% passes sieve No. 50, which makes it too fine a sand for use in concrete work. It may prove useful as a blending sand, to be blended with coarser sand from Area B. Its usefulness can only be established through proportioning it in different proportions with area B sand and testing it for its grading.

Organic Impurities.—The test for the presence of organic impurities is mainly carried out on fine aggregate. The presence of such matter delays the hardening of concrete and reduces the concrete strengths greatly. In order to find out the presence and amount of organic material present in the sand, calorimetric test was carried out on unwashed sands from Area A and B. If the sands do not pass the test it does not mean that these should be rejected, however it may be considered as a warning and the sands be subjected to other tests to determine its suitability for use in concrete, ***viz.***, tensile and compressive strength tests. For this purpose each sample is immersed for 24 hours in a 3 per cent solution of sodium hydroxide in a clear glassbottle. The colour of the liquid is then noted and compared with the standard colour chart which ranges in colour from light yellow to dark brown in five different colours, (light yellow), yellow, light brown, brown, dark brown). Each one of these colours represent the quality of sand to be used for works in their varying importance as tabulated below.

Light Yellow : Sand suitable for use in high grade concrete.

Yellow: Sand which may be used in unimportant concrete work.

Light Brown : Sand which should never be used in concrete.

Brown: An unusually bad sand, soil or loam.

Dark Brown :

Colours of treated sands with suggested ranges of application :

All sand samples from Area A and B, passed the calorimetric test, and indicated colour ranging between light yellow and yellow.

Sodium Sulphate Soundness test :—

The aggregates from all the three areas were subjected to sodium sulphate soundness test, the results of which indicated the ability of aggregates to resist weathering. Since the structures where these aggregates are going to be used, will be subjected to abrasion, weathering, wetting and drying it is imperative that aggregates are physically sound. This test consists in subjection of coarse or fine aggregate to five alterations of the sodium sulphate soundness test.

Fine aggregate for the test shall be passed through a $\frac{3}{8}$ inch sieve. The sample shall be of such size that it will yield not less than 100 grams of each of the following sizes :

Retained on Sieve :

No. 50 = 100 grams.
No. 30 = 100 grams.
No. 16 = 100 grams.
No. 8 = 100 grams.
No. 4 = —

Coarse aggregate for the test shall consist of material from which the size finer than No. 4 sieve have been removed. The sample shall be of the following sizes with their amounts against each.

No. 4 — $\frac{3}{8}$ inch = 300 grams.
$\frac{3}{8}$ — $\frac{3}{4}$ inch = 1000 grams.
$\frac{3}{4}$ — $1\frac{1}{2}$ inch = 1500 grams.
$1\frac{1}{2}$ — $2\frac{1}{2}$ inch = 3000 grams.

The following data was recorded while conducting the test,

(*a*) weight of each fraction before test,

(*b*) weighted average calculated from the percentage of loss for each fraction based on the grading of the material in the aggregate area, from which sample was taken.

(*c*) In the case of particles coarser than $\frac{3}{4}$ inch, before test

(*i*) the number of particles in each fraction was noted, before test

(*ii*) number of particles affected classified as regards number disintegrated, splitting, crumbling, cracking, flaking, etc.

The form used for recording the data is shown in Table 9, with an specific example.

Canadian Engineering Standard Association Specifications demand that coarse aggregate when subjected to five alterations of the sodium sulphate soundness test shall show an average weighted loss preferably not exceeding 12% and in no

TABLE 9

Sieve size	Original Grading	Weight of test fractions before test (grams)	Actual loss	Weighted average
Soundness Test of Fine Aggregate				
No. 100	—	—		
No. 50	—	—		
No. 30	30	100	6·7	2·0
No. 16	30	100	9·6	2·9
No. 8	20	100	5 6	1·1
No. 4	20	100	7·1	1·4
$\frac{3}{8}$ inch	—			
Total	100	400		7·4
Soundness Test of Coarse Aggregate				
$1\frac{1}{2}$ inch	50	1500	2·6	1·3
$\frac{3}{4}$"	30	1000	2 0	0·6
$\frac{3}{8}$"	20	300	6·8	1·4
Total	100	2800		3·3

case more than 15%, whereas for fine aggregate shall show an average weighted loss preferably not exceeding 8 per cent in no case more than 12 per cent. Table 10 shows the average weighted loss from the results of sodium sulphate soundness test, 5 cycles, carried out on aggregates from the three Areas "A", "B" and "C".

The study of Table 10 shows that coarse aggregate from Area B and C are physically much stronger than A; and that the fine aggregate in Area B is more sound than that of Area A in certain fractions, and the total weighted, average loss for fine aggregate in both the areas border the maximum allowed for, under the specifications.

Los Angeles Abrasion Test : This test is carried out on coarse aggregate, and is intended to determine the abrasive resistance of aggregate. Since the Spillway Section, Stilling basin of the Dam and Power Tunnel of Power House will be subjected to high degree of abrasive action it is necessary to conduct this test. The test sample shall consist of 5000 grams of clean, dry aggregate and shall conform to grading, representing the aggregate furnished for the work. The abrasion loss is then calculated after the test, which

TABLE 10

Sodium Sulphate Soundness Test-Coarse Aggregate

Sieve Size		Average Grading			Actual Loss Percent (Average)			Weighted average (Corrected % loss)		
Passing	Retained	A	B	C	A	B	C	A	B	C
3"	1½"	31·6	2578	47·2	24·5	0·5	·25	7·7	0·5	·117
1½"	¾"	28·5	31·14	42·6	30·5	0·5	·30	8·7	0·5	·126
¾"	⅜"	23·0	21·99	9·7	31·5	0·7	·70	7·3	0 7	·07
⅜"	3/16"	16·9	21·09	0·5	31·9	1·1	·70	5 4	1·1	·07
Total		100	100	100				29·1	2 8	·243

Fine Aggregate

No. 4	No. 8	13·0	17·3	...	26·3	15·3	...	3·40	2 65	Not tested since it was not considered suitable for use as fine aggregate.
No. 8	No. 16	21·0	23·7	...	16·1	14·8	...	3·35	3·50	
No. 16	No. 30	23·0	22·1	...	16·3	17·9	...	3·70	3·95	
No. 30	No. 50	19·8	16·1	...	19·6	20·2	...	3·70	3·20	
No. 50	No. 100	11·5	10 6	...	...	...	...			
No. 100		11·7	9·0	...	...	...	...			
Total		100	100					14·15	13·30	

is the difference between the original weight and final weight of test sample expressed as a percentage of the original weight of the test sample. The C.E.S A. specification demand a maximum loss of 20% for gravel with a recommended value of 10%. The results of Los Angles Abrasion Test carried out on aggregates from the three areas "A", "B", "C" are given in Table 11.

TABLE 11

Los Angeles Abrasion Test

Source of Aggregate	Percent loss by weight	Permissible
Area "A"	31.75	20%
" "B"	51.3	20%
" "C"	20.6	20%

The abrasion resistance of fine aggregate was also determined ; and the tests were designed to compare the performance of concrete made with coarse aggregate from Area C and fine Aggregate from Area A with the performance of good quality concrete which have already been used on other works. The resistance of the concrete from Warsak aggregates against abrasion was the primary consideration and the tests were chosen with this in mind. A secondary consideration was the resistance to wetting and drying. From the results of abrasion tests it was found that the loss in weight of the specimens was comparable in all cases.

Specific Gravity and Absorption of Aggregates

Specific Gravity of aggregates has a marked effect upon the unit weight of concerte and for that reason Specific Gravity of aggregates may be of some importance in the design of Gravity Dam. Specific Gravity of aggregates is necessary for the purposes of Mix Design. These tests were carried out on aggregates from Area A, B and C the results of which are given in Table 12.

TABLE 12

Source of Aggregate	Coarse Aggregate		Fine Aggregate	
	Specific gravity.	Absorption	Specific Gravity	Absorption
Area A	2 80	0 6%	2 80	0 9%
Area B	2·80	0·7%	2·80	1·3%
Area C	2·70	0·0%	Unsuitable for concrete	

Structural Strength of Sand: The test is intended for use in determining the "Structural Strength" of sand to be used as fine aggregate in concrete. Mortar specimens were made with the sands from different sources to be tested and compared with similar specimens made with a graded sand of known quality. The results of these tests carried out on fine aggregate from Area A & B are given in Table 13.

TABLE 13

Source of Aggregate	Compressive Strength, lbs per sq. in.				Tensile Strength lbs per sq. in.			Remarks
	Cylinder Test		Cube Test					
		7 days	3 days	7 days	1 day	3 days	7 days	
Area A	1336	2467	2400	3000	—	—	—	Unwashed
Area A	2227	3500	1600	4000	272	386	392	Washed
Area B	1336	2467	2400	3000	355	442	463	Unwashed
Area B	1750	2911	2050	3100	322	385	470	Washed
Ottawa	1655	2507	1768	2720	341	380	440	Standard

Petrographic Examination : The Petrographic examination is carried out on the aggregate to determine whether or not the aggregates are chemically reactive with alkalies of cements. Certain aggregates are attacked by high alkali-cements. The reactions lead to internal expansion, external cracking, decreased elasticity and strength. Rocks known to be susceptible to this kind of reaction are opal, many volcanic rocks, glass, Chalcedonic rocks, some phyllites and so on. In the petrographic analysis, aggregates are examined visually, and representative fractions are segregated into appropriate lithlogic groups based on three considerations, Petrographic identity, Physical quality, Chemical stability, for example particles of granite may be placed in several categories depending upon the effects of varying degrees of weathering or limestones may be classfied as chemically innocuous or deleterious. The petrographic analysis of coarse aggregate is give in Tables 14, 14A, for Area " B ".

TABLE 14

Petrographic Analysis of Coarse Aggregate Area "B"

Rock Types	Percentage by Weight	Quality	
	$3'' - 1\frac{1}{2}''$	Chemical	Physical
Sand Stone	3·6	Innocuous	Good
,, ,,	10·2	,,	Satisfactory
,, ,,	3·6	,,	Fair
Quartzites	8·4	,,	Good
,,	7·2		Satisfactory
Quartz	3·6	,	Good
Carbonate Rock	1·2	,,	Poor
Diorites	24·0	,,	Good
,,	3·6	,,	Fair
,,	2·4	,,	Poor
Mica Schist	2·0	,,	Poor
Schists	9·6	,,	Fair
Phylites	20·6	,,	Good

TABLE 14-A

Quality of Coarse Aggregate based upon Petrographic Analysis

Area B

Quality	Degree of Quality	Percentage by Weight $3'' - 1\frac{1}{2}''$
Chemical	Innocuous	100
	Deleterious	—
Physical	Good	59·6
	Satisfactory	17·4
	Fair	16·8
	Poor	6·2

Concrete making properties of Aggregates from Area A, B and C.

Coarse Aggregate : Trial concrete mixes were conducted in the Concrete Control Laboratory, using coarse aggregate from Areas B and C to find out the concrete making properties. As a result of these tests the following facts came to light.

(1) That coarse aggregate from Area C requires less water per cubic yard of concrete than Area B coarse aggregate, for the same workability ; which in other word means that a lower water cement ratio can be obtained with Area C coarse aggregate, thus giving higher strengths with the same cement content.

(2) That the concrete with Area C coarse aggregate is more workable than concrete with Area B coarse aggregate with the same consistency.

(3) The optimum and percentage for coarse aggregate from Area C is less than for Area B aggregate for the same workability, which further contributes to a reduction in unit water content.

Conclusions : Various tests on these aggregates show, that Area C coarse aggregate is the best available aggregate. It is chemically innocuous with only 0·3 to 0·6 percent of deleterious material, physically fresh, sound and hard, particle shape rounded, surface fairly smooth, with 99.7 per cent of good material. It is economical on cement ; giving greater workability when used as concrete aggregate. It has been decided, therefore, to use this aggregate in all permanent works such as Main Dam, Stilling Basin, Power House and Irrigation Tunnel There is however, a deficiency in the available quantity of $\frac{3}{4}'' - \frac{3}{16}''$ material which would be increased by crushing the $+4''$ material from that area. The sand from this area is too fine to be used as concrete aggregate. It is also unsuitable as a blending sand.

Coarse aggregate from Area B, though not so good has been used in unimportant and temporary works such as Diversion Tunnel, Cableways, Batching Plants and other miscellaneous works. Though chemically 100 per cent innocuous, physically it has 6 2 per cent of poor and 16·8 per cent of fair material ; particle shape cubicle to subrounded, surface fairly rough, high on water and sand requirements in concrete making properties, which makes it uneconomical aggregate as compared to Area C.

Sand from both Areas A and B is satisfactory as concrete aggregate. Both the sands are well graded except Pass 100 material which is more than desired. In order to improve this, sands have been processed, where Pass 100 material has been kept at minimum.

All the aggregates are available within economical distance from the Project.

THE SOIL-TEST STORY

By
Theodore W. Van Zelst, P.E.,*

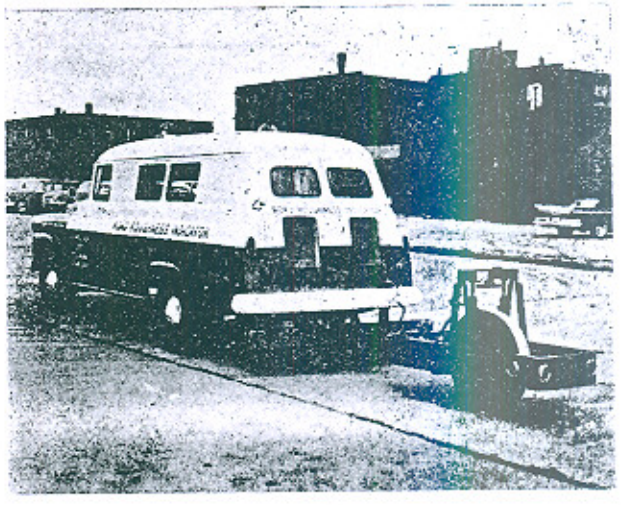
TEN years ago the science of soil mechanics and foundation engineering was relative unknown. After World War II there were only about twelve universities in the United States actively teaching the subject and offering laboratory instruction in soil mechanics. There were then only a few commercial testing laboratories or consulting engineering firms qualified to do soil testing and consulting work on soils and foundation problems.

The technological advance in the last ten years, the rapid rise of prices and the resultant high cost of construction, have all contributed to the development of a company-named SOILTEST, Inc.

Now, in 1957, there are over 200 universities and colleges in the United States teaching the subject of soil mechanics. More than 2,000 consulting engineering firms and commercial educational and governmenal laboratories do specialized work in soils and foundations.

These consulting engineers and laboratories need specialized field and laboratory apparatus to carry out their evaluation of soil properties. The original company from which SOILTEST, Inc., has developed started in 1946 as a testing laboratory specializing in soil testing, foundation borings and foundation engineering. The intention was to have a complete laboratory installation in Chicago, Illinois, to serve customers from the Midwest United States. The laboratory was to contain all of the routine testing instruments as well as specialized apparatus for special problems in research of soils.

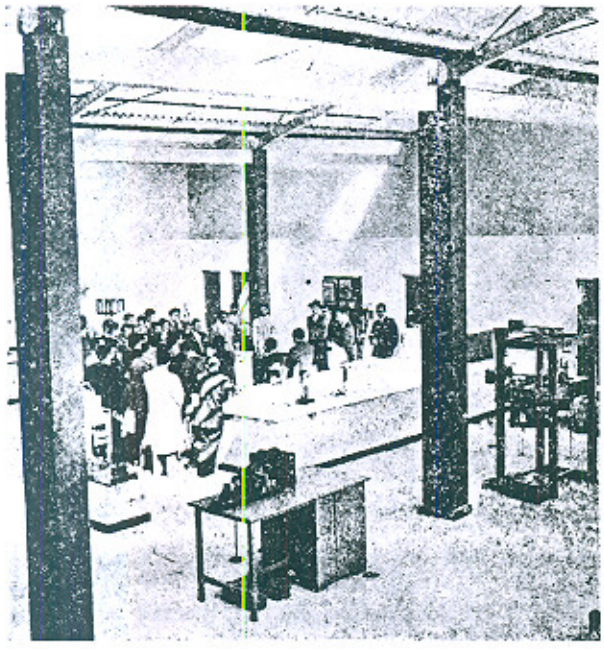
*President, Soiltest, Incorporated.



Road Roughness indicator.

After the formation of the company it became apparent that only a very few items of test equipment necessary to outfit the laboratory were available from commercial sources. The few items available were usually poorly designed and extremely costly.

We found that if we were to develop a laboratory as planned, it would be necessary to design our own testing apparatus. This was done. When we reached the point of trying to locate machine shops to make the equipment, we again found prices completely out of our range. None of the shops understood the operating function of this special test apparatus and their shop estimators added a wide margin of safety to take care of the "confusion factor." The few items that were made on a contract



Various items of soil testing equipment being demonstrated to personnel of the Department of Publ.c Works.

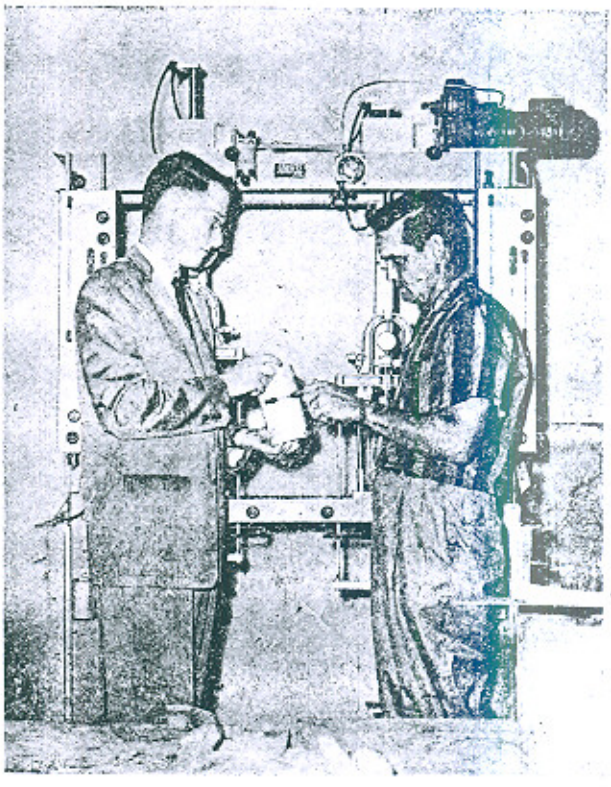
basis by local machine shops, almost drained our young company's meagre finances because of the high price and non-conformance with the drawings and specifications.

The next realism which struck us was the fact that if we were to have a laboratory at all it would be necessary for us to both design the apparatus and make it in our own shop, under our own control. We established a small machine shop in a two car garage building and set to work to equip the laboratory.

As fast as the new equipment was added to our laboratory, and visitors had a chance to see it in operation, we received requests for quotations for the same equipment to be supplied to other laboratories! Originally we had no intention of entering into the manufacturing business. However, the market appeared to exist and we started to offer quotations on the standard equipment which we had designed. Soon orders were received from all parts of the world. We then had not only a soil testing laboratory, but also a manufacturing business.

The manufacturing activity expanded rapidly. In 1951 it became apparent we were competing with our customers by both manufacturing and operating a testing laboratory. In that year the new company, SOILTEST, Inc., was founded using the trade name "SOILTEST," which has been used since the manufacture of the first piece of test apparatus. The manufacturing and laboratory companies completely separated and are now totally indepenedent and under separate ownership.

In the subsequent ten years, SOILTEST, Inc., has reached a point where its testing apparatus is used in over 2,500 laboratories in some eighty-five countries. Daily shipments are made to all parts of the world from the Chicago factory. The company has over seventy exclusive sales representatives in major countries. SOILTEST equipment has been accepted as a standard throughout the world and it is significant that a very high percentage of the company's products are sold outside of the United States. Interest in soil mechanics and foundation engineer-



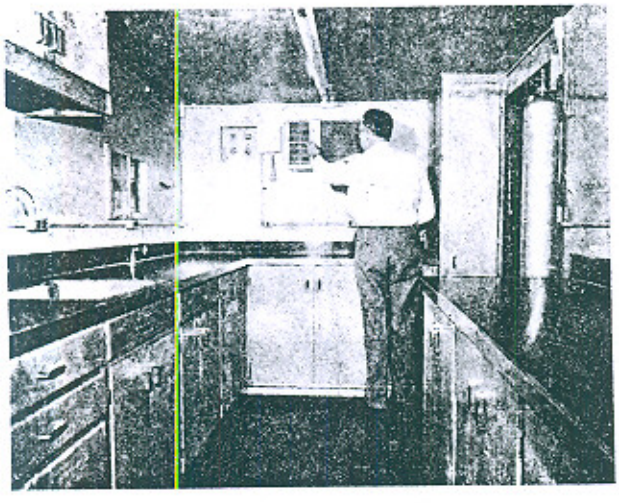
Triaxial apparatus.

ing is not centered in the United States alone; the interest is international.

The original "catalogue" published by SOILTEST consisted of a single page with photographs and simple descriptions of three items. The latest catalogue illustrates and describes over 1,350 items of soils, concrete and asphalt testing apparatus and has 128 pages.

The expansion of inteinst in soilr mechanics and related testng activitiese has initiated many changes i the design and use of test apparatus. The early designs were made on a functional basis. It was considered necessary to have the working parts and controls located in the open so that the test operator could see all of the parts while the test was being conducted and make necessary adjustments during the test.

In the early post-war days, the man running the laboratory tests was usually an experienced engineer. The trend rapidly changed as engineers became scarcer and it became necessary to have laboratory technicians and other personal perform the tests. With the changes in operating personnel came changes in the appearance of equipment. From the functional design, a streamlined design has evolved. The working parts are enclosed in modern dust-proof and pleasingly shaped and finished cabinets or housings. The modern trend calls for testing equipment to be simple to operate.



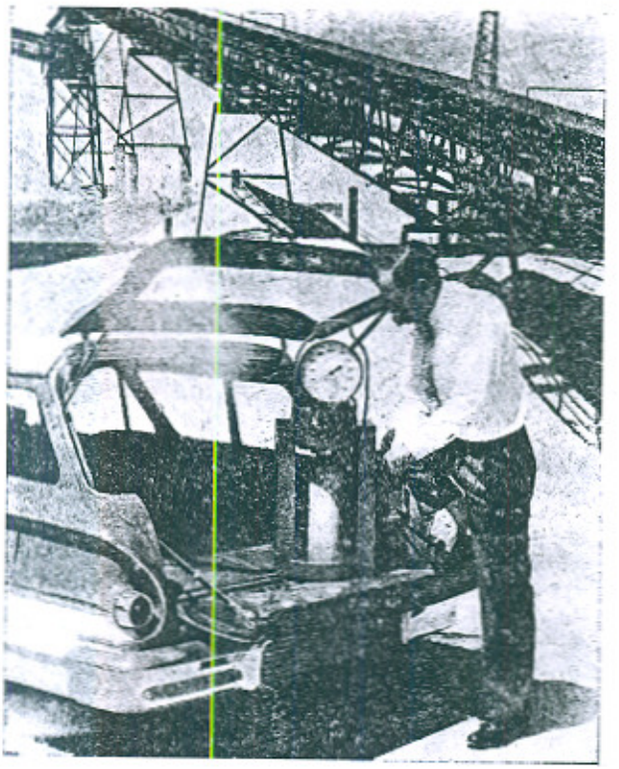
Interior of Soiltest Mobile Laboratory.

Demand has increased for automatic devices to eliminate personnel errors and to reduce manpower requirements in the laboratory. Typical examples of time-saving devices in the soil mechanics field are the mechanical soil trimming lathe used to prepare cylindrical test specimens; the automatic mechanical compactor for rapid and uniform moisture-density tests; and the Volumeasure which greatly speeds up in place field density tests of soils.

In the early years, we relied on civil engineers to do equipment designing We felt that the designer should have the experience in actually performing the tests to design a proper piece of equipment. Later, our thinking changed and mechanical engineers handled all of the equipment design with the civil engineers guiding the functional design.

Necessity for increased production and the complexity of many of the new pieces of equipment requires that a company such as SOILTEST, manufacturing specialized equipment, have available the services of mechnical, electrical, chemical and civil engineers. Their job assignments range from design and experimentation with special types of castings for use in hydraulic pressure systems; design and calibration of specially blown glass test containers; development of new hydraulic components and systems; calibration of test equipments and similar projects. Thus, a small company, starting as a testing laboratory, has grown into one of manufacturing a diverse line of standard and specialized apparatus for construction materials.

Interestingly, the advancement of the design of modern test equipment has not brought about a corresponding increase in the selling prices of this equipment. This has been accomplished by constant improvement of design of the apparatus produced in our factory. It is expensive to improve design, but with production considered, these costs are quickly paid for in savings of manufacturing time. The added savings in production costs go a long way



Portable 200,000 lbs. concrete tester being used in the field.

in absorbing increases in labour and material. The acceptance of SOILTEST products and the advancement of the testing industry have assisted in further decreasing actual manufacturing costs by enabling us to run larger production quantities. These savings are used to offset material and other economic increases.

Experience in the organization and management of SOILTEST, Inc., has confirmed opinion that engineers have a vital place in manufacturing. Modern technology has brought engineering into all consumer and industrial manufacturing. Engineers have the know-how in the use and operation of a product. There are also opportunities for engineer in the sale of a product.

The items manufactured by SOILTEST, Inc., are usually sold to engineers. The engineering background of our company and our interest in engineering activities has aided us greatly in the development of the market for our products.

Most engineers are well aware of the necessity of testing construction materials. However, their superiors in government or private industry are often non-technical people who do not share the same feeling. It is necessary to impress top management and legislative groups with the necessity for engineering evaluation of the materials used in construction.

Dramatic construction failures are one of the ways to demonstrate the necessity for proper engineering design and control. Costly failures in concrete construction in public housing in one of the Carribbean area countries forced the government to decree that all concrete producers must have their own modern testing laboratories. These laboratories are further cross-checked by newly established governmental testing laboratories.

In a South American country, failure of a large road project in less than one year after construction induced the legislature to pass laws requiring all road contractors to maintain fully equipped laboratories. This government has also established a large central laboratory.

The world-wide economic developments and the high costs of construction are convincing more and more authorities of the need for proper engineering design and construction control. With this comes need for more laboratory and field testing equipment to be used by engineers to effect this design and control. There has been a tremendous development in the field of design and manufacture of laboratory and field engineering testing equipment. There is still much to be done.

SOILTEST plans to continue to develop its products and its market through the use of engineering principles. Engineering is necessary in all aspects of manufacturing and sales of an engineered product. Thus the step from engineer to manufacturer is a logical one.

SMALL SCALE HYDEL SCHEMES IN GILGIT AGENCY

By
B.A. Malik P,S E.,*

AFTER long last Gilgit Agency - one of the most backward regions of West Pakistan - will receive a fillup in the execution of several small scale hydel schemes; three are already under Government consideration. Development of hydel power becomes essential because of complete absence of coal, extreme paucity of wood and high cost of kerosene oil (flown from Rawalpindi). Without requisite topographic details and adequate hydrologic data, projecting water resources developments here is nothing but a 'rodeo'; shying the uninitiated. Only bold initiative and unorthodox approach could bear fruit. A study of these schemes will be quite interesting. Being identical in concept and principle, a brief description of one will be fairly illustrative Baltit Hydel Scheme (Hunza State) with initial capacity of 150 K.W at a cost of Rs. 4½ lacs, with completion time one year, is proposed to be the subject of this article.

The Region:—A bird's eye view of the region as a whole and the town in particular would render the study more comprehensible.

Brushing the borders of Afghanistan and Soviet Russia, Hunnza forms the extreme northern part of Gilgit Agency. The region is mountainous, arid and mostly barren with elevation above 4,000', including some of the highest peaks as 'Rakhd-Poshi' 25500 ft. It is interspersed with numerous streams and rivers such as the Hunza, the Gilgit and the mighty Indus. Climate is extremely cold with long drawn winters. Summers though short are mild and pleasant.

Rainfall is scanty and erratic. Precipitation at higher elevations is mainly in the form of snow. Mountains remain snow covered for most part of the year; some mounts adoring eternal snow caps. Streams are generally flashy in nature; thriving in summers due to snow melt and some rain and receding or even receding in winters when the temperatures rule below zero. Only the glacier-fed are perennial character. This is quite significant as a seasonal stream cannot be a dependable source for hydel power.

Cultivation is done in the valleys of such nallas and rivers It gives the appearance of small 'oases' in the 'desert' of blank and bleak hills; devoid of any vegetal cover. Fruits such as apples, apricots and nuts etc. grow in abundance though there are little means of marketting mainly due to lack of efficient means of transport.

Communications:—Communications are extremely difficult and poor. Mule paths, linking with plains through Kashmir valley have been severed since Independence. Now Gilgit is connected by air with Rawalpindi Most of the supplies and passenger traffic is by air as the only surface link via Kaghan valley remains closed to traffic for more them 9 months in a year. Internally, important towns have been linked with Gilgit town by jeepable fair weather roads. These are mainly converted pony tracks with improvised suspension bridges across streams and rivers. It was an appalling experience to travel over these breath taking paths and structures including rope bridges.

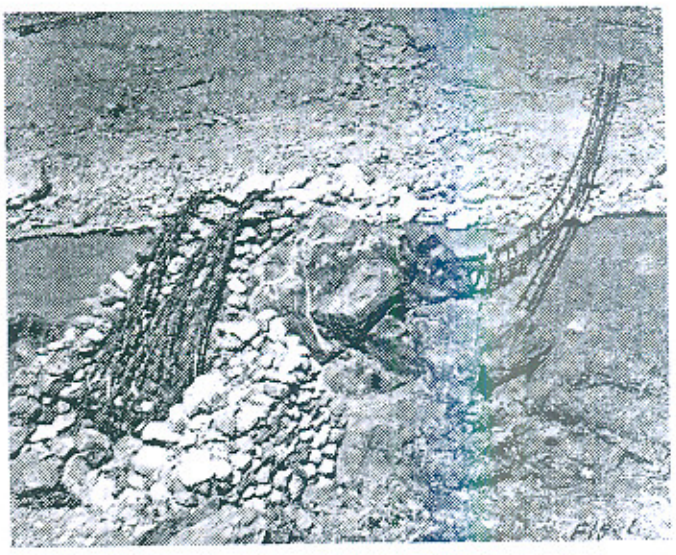
*Executive Engineer, Mangla Dam Project.

Hunza is still without jeep tracks, though one is under construction. Mules are beast of burden here. A tired traveller riding a tardy pony, entering the Hunza valley is fascinated to behold a calm but medieval spectacle; peaceful, devoid of time and speed; unfolding a rolling green vista in a deep valley with the towering snow clad mounts, scraping the skies and smiling at the whistling Hunza river; jumping down the canyons; probably the only fastest thing on surface here.

Population:—Population is very thin sprinkled over the mountain slopes in the form of hamlets here and there. Villages and towns all over the Agency are located mostly on river banks. Population of Baltit and its suburbs such as Aliabad & Hassanabad is roughly estimated to be 12000 souls.

Needs:—One of the priority needs of the region is abundant supply of cheap fuel. Due to paucity of wood and then lack of cheap transport facilities, supply to the towns is very costly. Kerosene oil flown from down country is very expensive renderning its use prohibitive to the common folks. Consequently their homes and hearths go without light. The region, therefore, stands in dire need of cheap alternative to fuel and light by means of developing hydel power from the neighbouring streams and rivulets.

The Town:—Baltit the seat of that world famous beautiful, 'tiny', cute State of Hunza, governed most democratically, by the 'Amir' about 70 miles north east of Gilgit, situated aslant the right bank of the deeply cut Hunza river, elevated above 8,000'; its buildings, in caricature like 'dolls' houses studded in emerald green, on the terraced hilly landscape, slumberous in the foster lap of the dreamy valley; under subdued glow of peripherial halo of the eternal snow line, with the uptruding giants (peaks) doning perpetual snow caps and standing grinning sentinels to the whole captivating 'vista vision' of a heavenly spectacle, in this fairly land of enchanting environs, and fascinating charm; fragrant with peace, contentment and cheer is inhabitated by over 12,000 souls of pleasant countenance, attractive border features and robust health, dwelling in about 3,000



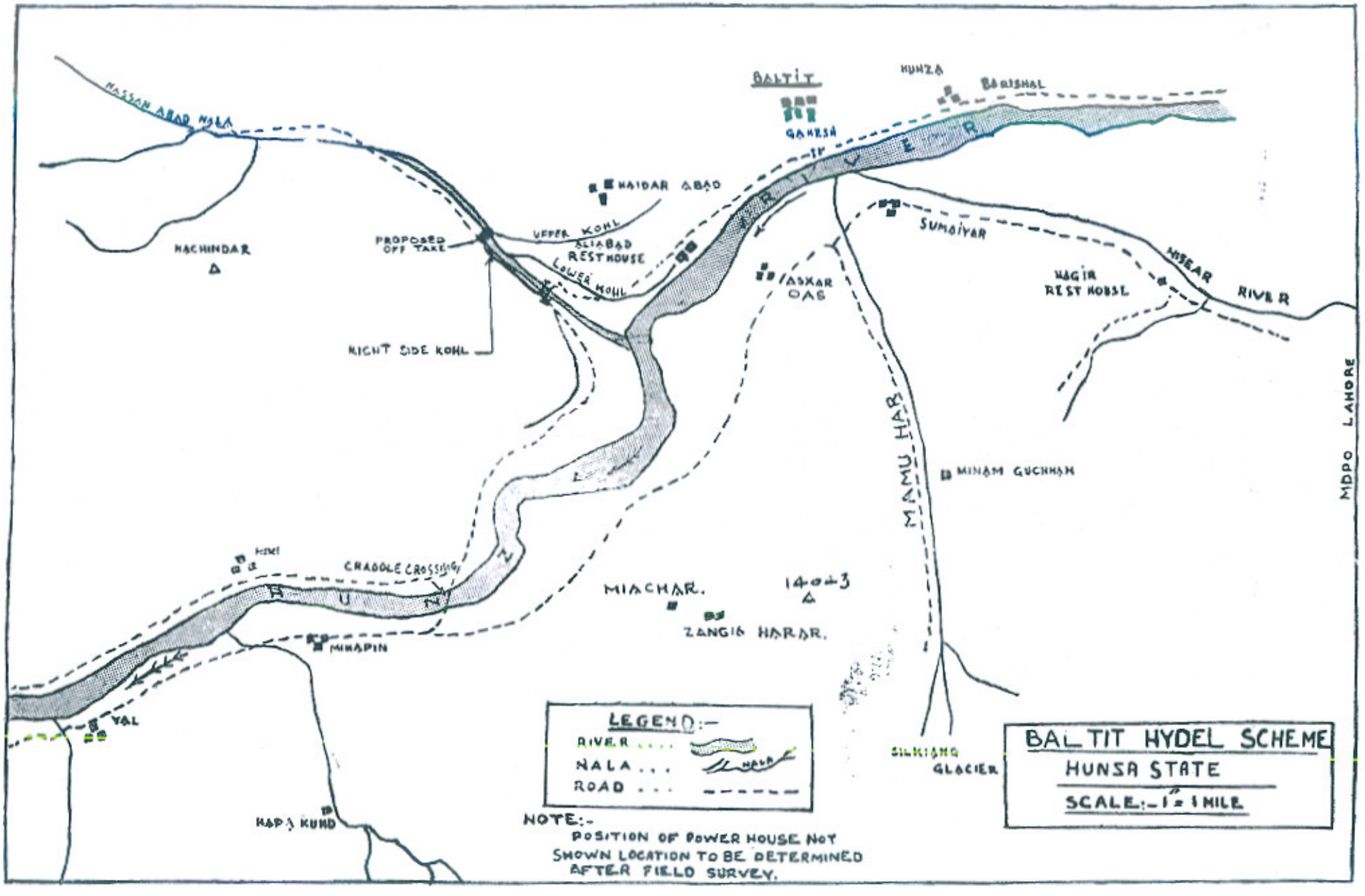
Rope bridge across Hunza River.

'hilly' houses. some well built, others modest, but all clean, tidy and homely, enjoying the luxury of 'court-yard' facility of vine-yards and fruit trees of such rare varieties as the cherry-glass, apples and apricots so untenable even for the richest in the plains.

Regarding public buildings, there are numerous schools, jamiat-khanas and mosque, besides a singular hospital unit at Aliabad, 6 'mule' miles away from Baltit. No bazars or streets of the conventional pattern are there as habitation is on terraces and hetregenous in disposition.

The Amir's palace, situated at the far end of the enclave housing the town, is a unit by itself. There is one 9 K.W. diesel set already installed for his private use. Exorbitant cost of diesel flown to Gilgit, then 'muled' to Baltit renders diesel generation prohibitive. Few hours daily running of the unit with subsidised cost of fuel is costing as much as Rs. 120/- p.m., hence quite uneconomical. It caters mainly for the household lighting load only.

The entire populace hibernates during long drawn, dreary and dull winters necessitating incessent heating and long lighting hours. The necessity for hydel power here is thus evident. This can easily be provided by tapping some neighbouring but perennial streams.


BALTIT
HUNZA
BADISHAL
GANESH
HASSAN ABAD NALA
HAIDAR ABAD
HACHINDAR
PROPOSED OFF TAKE
UPPER KOHL
SHABAD REST HOUSE
LOWER KOHL
RIGHT SIDE KOHL
HUNZA RIVER
SUMAIYAR
NAGIR REST HOUSE
NAGAR RIVER
ASKAR DAS
MAMU HAR
MINAM GUCHHAN
MDPO LAHORE
CRADDLE CROSSING
HINAPIN
MIACHAR.
14023
ZANGIA HARAR.
YAL
KAPS KUND
SILKIANG GLACIER
LEGEND:-
RIVER ....
NALA ...
ROAD ...
NOTE:-
POSITION OF POWER HOUSE NOT SHOWN LOCATION TO BE DETERMINED AFTER FIELD SURVEY.
BALTIT HYDEL SCHEME
HUNSA STATE
SCALE:- 1" = 1 MILE

Scope for Hydel Power:—Hunza river can lend a huge power potential in the State. But it may remain untapped until some discovery of mineral resources warrant its large scale exploitation. For the needs of Baltit town a much smaller source will be the answer. After having pondered over the possiblity of using minor streams nearer the town, final choice fell over the perennial Hassanabad Nalla, about 4miles south west of Baltit as the crow flies. A tributary of the Hunza river, it is quite a sizeable stream, reportedly carrying perennial flows mainly glacier and partly snow fed. By virtue of its very steep gradients it can afford a considerable drop in a much shorter length.

Discharge available:—The stream has never been gauged, hence no flow records. At the time of reconnaissance (3. 7. 57) it was visually estimated to be carrying a heavy discharge, maybe to the tune of 1000 cusecs at the road bridge after feeding three 'Kohls' (small irrigation canals) with a combind withdrawal of 20 cusecs. From local enquires it transpired that its minimum (December to February) would be about 20 Cusecs. A reference to catchment characteristics supported this assumption. Over 50% area is perpetually under glaciers while most of the remaining becomes snow bound early in winter. It can thus be imagined that thawing of snow packs particularly those facing east must be contributing considerably to the stream flows even during critical winter months.

Hussanabad Nalla, therefore, apparently has ample supplies to meet combined requirements of irrigation and power in summer while its entire winter discharge, about 20 cusecs, would be available for power; agricultural operations remaining closed in that period.

Power Potential:—It was not practicable to indicate without requisite field details precise potential available. It is however estimated to be over 400 K W. by having a power canal of 26 Cusecs capacity about 2 miles long giving nearly 300' drop. This is the minimum potential in critical months of December, January and February, while in the remaining part of the year it would be considerably higher.

Power Requirements:—With the population of mainly rural character; uninitiated even to the very idea of electricity, it was neither practicable nor necessary at this stage to attempt at any precise determination of power load. 'Ad hoc' requirements based more on guess work than any rational analysis are summed up as under:

Domestic lighting load @ 10 watts/capita	120	K. W.
Street lighting and public-buildings etc.	10	K. W.
Heating-cum-Industrial	135	K. W.
Amir's palace-including heating and lighting	25	K. W.
Unforeseen	10	K. W.
Total—	300	K. W.

Obviously available potential is much in excess of planned requirements.

Generating Equipment:—For small units to be scattered all over the Agency with extremely primitive means of transportation it will be essential to use robust and self contained units; as automatic in operation as practicable to require minimum of attention and expense over operation and maintenance. Besides these should be light in weight to be easily transportable by air and then 'muled' to site. Sets are now available which can remarkably meet such requiremeets. These are ideal for low discharge, high head small scale developments. Hence the same are proposed for Baltit Hydle Scheme.

The unit selected is G-40 Ossberger set suitable for a fall upto 300', generating nearly 152 K.W. It is capable of operation at partial water supplies, viz. 1/3rd and 2/3rd capacity and also adjustable to varying heads though in the present case there will be little or no head variation. The turbine will be coupled to one 3-phase constant voltage generator of 400/230 volts. Its weight is such that it can easily be transported by air.

Installed Capacity:—Baltit and its suburbs need 300 K.W. at 100% load factor. This is the capacity that would be required after development probably over ten years. A start can, however, be made with a less intial capacity; additional units added subsequently as and when required. To begin with, therefore

an installed capacity of 150 K.W. is proposed. One Ossberger unit capable of meeting widely varying loads with a maximum generating capacity of 150 K.W. is, therefore, proposed to be installed here. The existing 9 K.W. diesel set in Amir's palace would become a standby for him.

Works and their Layout :—The works involved are few and simple viz.,

(i) Head Race (Power Channel).
(*ii*) Tail Race (Outfall channel).
(*iii*) Power House.

Head & Tail Races :—One of the existing irrigation channels (Kohls) might be used as head race and a lower one as tail race. This could render the scheme very cheap but it may be found more convenient to have a separate channel as remodeling of the existing ones might interfere with irrigation operation. The exact type and design will be determinable only after detailed field surveys have been carried out. For the present a separate channel with a capacity of 26 cusecs and 2 miles long including tail race is proposed.

Power House :—The incidence of disproportionately high cost and difficult transmission proposition renders it imperative to fetch the power house as close to the load centre as practicable,. Its final location is dependent upon the ease and relative cost of transmission line and the head race, will, therefore, be decided subsequent to field work.

The plant is to be housed in a stone masonry structure with timber roofing supported preferably by wooden trusses. The number of the sets as planned at present is one, increasing as the load developes. Hence enough space will be left for future additions. The power house will be provided with fore-bay regulator and a penstock in the beginning. Steel being costlier, hume pipes with special re-inforcement may be used instead. Should good quality timber become available locally it would be better alternative to use wooden pipes adequaately braced and provided with well designed wire hoops.

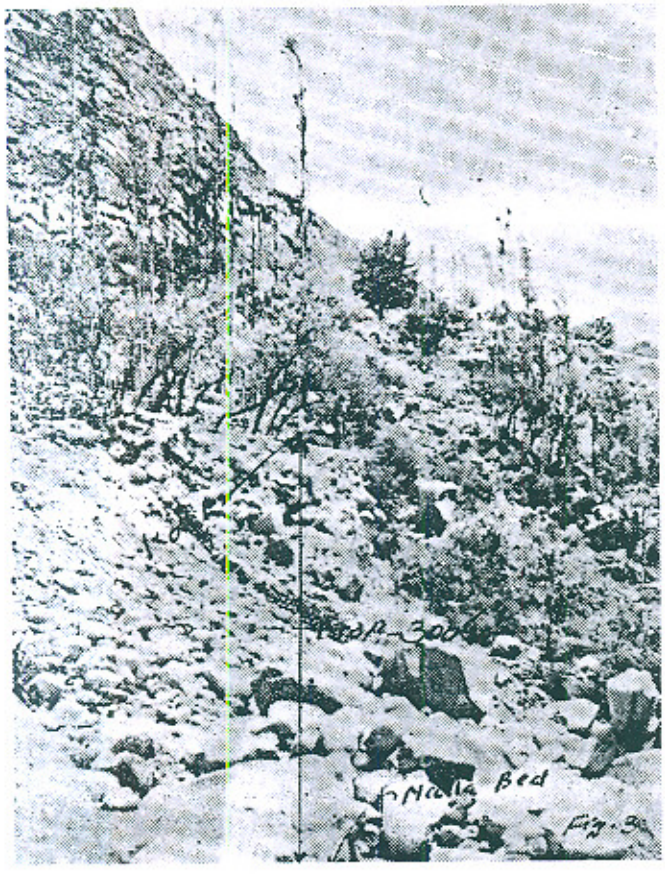
Transmission and Distribution :—Due to uncertain Kaghan road conditions, costly air lift and difficult and slow transport by mules the quantity of materials required for transmission and distribution shall have to be obviously kept the minimum. Should it be found practicable to locate the power house at or near the load centre, the necessiy of transmission may eventually be obviated, saving a considerable expense as the generation proposed at 440 230 volts can be fed directly into the distribution system dispensing with costly stepping up, transmission and stepping down arrangement.

Local chil wood or pines are to be used as poles. Only the conductors, insulators and other non-indigenous materials obtained from down country. NO metering is recommended. A flat rate depending upon the number of light points and the capacity of cooking ranges heaters and the industrial plants etc. will be a better expedient here to begin with.

Distribution (and transmission) of electric supply can thus become quite cheap involving the minimum of foreign exchange and materials obtained from the plains, in addition to being easy of operation and maintenance.

Financial Aspect :—It is not practicable to work out precise cost estimates without requisite field data. As a horse-back estimate total cost of the scheme is expected to be Rs. 4,50,000/- for the first stage with an installed capacity of 150 K.W. Cost per K.W. installed is Rs. 1,400/-. It would be interesting to know that this rate is much less than that shown by Punjab Canal Falls Projects though they lie in plains—the heart of industrially developed area in West Pakistan. Baltit and for that matter other schemes proposed in the Agency are cheaper probably because no costly civil and transmission works are involved. Besides the generating equipment would also cost less be cause of its being a high head development. The comparison may not be as real, never the less it does show that cost per K.W. installed of Baltit scheme would be quite competitive with its biggers in the plains.

With a load factor of 50%, annual generation will be 5,91,000 K. W. H. delivered at consumer end. Operation charges are Rs. 40,000/- per annum giving cost per unit @ 13 pies. This of course is without interest as the scheme is suppo-



Drop between Lower Kohl and the parent stream.

sed to be fina ced from development funds. Rate proposed to be charged from the consumers is -/2/- per unit This would bring a net revenue of Rs 34,000/- per year rendering the scheme. capable of paying itself within 14 years.

Progamme of Construction :—The scheme as proposed, invoives very simple civil works which can be completed within 4 months. The only time consuming item is import of generating equipment. This is expected to take at-least ten months after placing firm order. It is thus obvious that the whole project can be completed and commissioned within one year.

Benefits :—Immense direct and indirect benefits will accrue to Baltit, Aliabad and Hassanabad, etc. in Hunza State from the Baltit Hydel Scheme—developing 150 K.W. initially and over 400 K W. ultimately. The most direct and immediate benefit would be cheap and abundant power becoming available for lighting, cooking, heating and even for industrial purposes.

Flown from down country and then 'muled' to Baltit, a kerosene oil tin is said to cost between Rs. 40/- and 45/- here. Consumption was told to be nearly 500 tins per annum. Assuming cost @ Rs. 42/- per tin, saving in extra expense in import of oil at Rs. 36/- (Rs 42/- less Rs. 6/- cost in the plains) per tin is of the order of Rs. 18,000/-. On the other hand 5,91,000 units of electric energy delivered at consumer end cost only Rs. 40,000/-. This not only cuts the quantity and expenss of oil now used for lighting but also caters for heating, cooking and industrial load within the same cost—lighting eventually becoming a sort of by product.

Hydel power is far cheaper than the conventional means of lighting and cooking besides being easier of use. An average house bearing 4 lighting points, 30 watts each, will consume, at the rate of 4 lighting hours per night 15 Units. At the proposed rate of -/2/- per unit, the charge becomes less than Rs. 2/- per month, whereas kerosene oil for corresponding 4 lamps, assuming one bottle a night consumes 30 bottles or $1\frac{1}{4}$ tin per month, costing over Rs. 52/-. Tremendous saving in costs with the use of electric power is thus obvious especially for cooking. Assuming 1,000 watts range and 3 hours' daily cooking, total consumption per momth would be 90 units, costing Rs. 11/4/- against about 10 maunds fuel wood at Rs. 30/- per month. These comparatives are more illustrative than being exact.

Industries run by electric energy have no comparison ; there being no other source of power. Hence in this field electric energy will be a 'talisman' and may render Baltit one day, humming with small scale industries, prosperity and happiness-not in the too-distant future.

Due to extreme cold the entire valley hibernates in winter which are rather long drawn. With cheap heating facilities becoming available life, even during winter, will remain active adding to the economic and social well being of the people. Cheap power may give rise to several industries such as woollen power looms, saw mills, fruit preservation and canning, etc. This would provide wherewithal to scores of local people thereby improving their economic plight. Lucrative means of

livelihood at home will put a stop or at least mitigate the ever increasing tendency of migration of male population to down country, which if unabated is likely to have adverse repercussions on the socio-economic pattern of life here besides causing split homes.

It is therefore, evident that magic wand of electricity will galvanize the life here, rendering the people more cheerful, bright and happier, besides providing a much needed stimulus to this tribal fringe-infusing confidence and a feeling of being self-contained, free from the pangs of separation and divided homes which is inevitable at present due to considerable migration to the plains in search of 'bread and butter'.

Field reconnaissance was led by Ch. Abdul Hamid P. S. E. I., Deptuy Chief Engineer, Mangla Dam Project. The schemes were developed under his veteran guidance by the author. Actually these are the result of his keen observation, resourcefullness and exceptional command over the subject plus spurring encouragement to his lieutenants at every stage in the field and the office.

Before concluding a word is necessary to critic. Some of the assumptions and even the very approach to the problem, may seem not only unorthodox but open to question. Quite so? Nature has bestowed every facility for easy hydel power development in Gilgit Agency. But no topographic and hydrographic data are available to help plan such schemes. It was the question of doing or not doing something without anything. Instead of accepting defeat on the plea of non-availability of records and thus denying immense benefit and development potential to this needy area for their good, this challenge was accepted and the schemes were drawn and submitted to the Government based on more applied commonsense: 'real civil engineering' than anything pure theoretical. Maybe some of the assumptions and results betray expectations .It should not raise eye brows. The greatest achievement would lie in unfolding numerous development possibilities and setting the ball rolling for betterment of the area.

(*Contd. from Page 31*)

The principal problems are:

(1) *The problem of the distribution of the artesian basin.* I think that this problem may be solved by means of the geological and hydro-geological investigation with the participation of the geophysical investigation.

Now it is possible to confirm that a great system of the artesian basin extends from Africa to India. The hydro-geological conditions of these zones are very complicated. According to these condition there may be fresh or saline artesian water.

(2) *The problems of the resources of the artesian and groundwater.* This problem is very complicated too. It may be solved by means of the application of the hydro-geological and hydro-dynamical methods. The geophysical methods may be applied to obtain some information about the thickness of the deposits in the artesian basin and about porosity.

(3) *The problems of the chemical composition of the artesian water.* This problem may be solved by means of the application of geophysical method and boring some deep wells.

The problems of distribution of the groundwater are very complicated too. I think that it is possible to identify three zones of the distribution of the groundwater in the area round Quetta,

(1) *Zone of groundwater in the alluvial fans.* These are the fresh water. Karezes are good and usual form to capture this water.

(2) *Zone of the discharge of the groundwater at the periphery of the alluvial fans.* Here are some springs. The tube-well will be the best form for capture.

(3) *Zone of saline water.* In the 1st, 2nd zones it is very important to calculate the water balance and to know the maximum productivity of the karez and tube-wells. It is possible to do with the application of the hydro dynamical methods

I think that the Geophysical Institute of Pakistan will take an active part in solving these problems.

NOTES ON THE DYNAMICS OF GROUND WATER IN U.S.S.R.

By
Professor A. Siline-Bektchourine*

DYNAMICS of ground water based on the law of Darcy are developed in U.S.S.R. by a huge geological foundation, co-ordinated with the science of mathematical physics, in relation to which two lines of thought have been developed; one geological and the other hydro-dynamical.

In the first, study is based on geology, hydro-geology, general laws of movement, and the regime and balance of ground water. The second sets out to apply hydro-dynamic laws to the analysis of natural environment, concrete laws of filtration of ground water and on natural objectives in predetermined conditions.

The studies in the field dynamics of ground water in Russia commenced in the 18th Century and are associated with the names of D. Bernulli and M. Lomonoov. D. Bernulli propounded the first thesis which gave a start to the investigations on groundwater from a hydro-dynamical angle. The work "Hydro-dynamique" published at Strasbourg in 1738 was the result of his sustained work at the Academy of Sciences of Russia, and this is acknowledged on the title page. In 1750, M. Lomonosov in his classic work "On the Layers of the Earth" has established the geochemical relation between groundwater and rock in which it is circulating and is thus being contaminated with the chemicals in rock. This work was the basis of geological thought in the study of groundwater.

*Academy of Sciences, Moscow.

The co-ordinated development of the studies of movement of groundwater began in Russia after the classic work of Darcy at Dijon (France) on filtration of water through sand—

$$V = \frac{K.\partial H}{\partial X}$$

where V = speed of filtration
K = coefficient of permeability
$-\frac{\partial H}{\partial X}$ = gradient

It is very interesting to note the analogy between Darcy's law of the movement of groundwater and ohm's law of electric current

$$i = c.\frac{\partial V}{\partial X}$$

i = density of electric current
c = co-efficient of conductivity
$\frac{\partial V}{\partial X}$ = gradient

This analogy shows that it is possible to study the law of filtration of ground water by means of the law governing the flow of electric current.

The eminent scientist of the XIXC, N. Joukovsky, the founder of aviation and aerodynamics in Russia, was also working on the question of the dynamics of groundwater. In his work regarding movement of sub-soil water (1899) he deduced on the basis of the equation of d'Eyler, a differential equation of movement which is the expression of Darcy's

law in another form. Having shown that pressure of groundwater confirms to the equation of Laplace, N. Joukovsky contributed to the development of mathematical analogies between the filtration of water and electrical conductivity on the basis of which precise integration for solving many hydro-geological problems are formulated at present in the U.S.S.R.

Towards the end of the XIXC the new work of Russian Scientists of filtration of groundwater was founded on the application of the principles of geology and hydro-dynamics. At this period an enormous part of the knowledge of hydro-geological laws in Russia contributed to the doctrine of V. Bekoutchaev on the zonality of soils and the processes of their formation (1899). In his initial work on the study of the zones of nature (1899), he arrived at the following conclusions: Groundwater complies with the law of correlation with climate, vegetation, and other agencies. This correlation reflects the general zonality of nature, as a result of which is established zones of natural history, geography, geomorphology, soils, and other.

During the Soviet period, huge construction works brought up many problems such as: construction of buildings on saturated soils; maximum utilisation of liquid resources namely petroleum and water; water supplies for towns and other populated areas; irrigation of dry areas; drainge of extensive swamps; removal of water from mines etc. The solution to these problems could be found on the basis of the increased knowledge of hydrogeological laws and of a greater elaboration of the technique of hydro-geological investigation and of the theory of movement of groundwater.

With this objective institutions have been established in the U.S.S.R. which are within the system of the Academy of Sciences and various ministries. They are meant for training personnel in hydrogeological mapping of the territory of the U. S. S. R., for carrying out studies on the regime of groundwater at various hydrogeological stations. In these technical instituties, hydro-geological specialists are trained and given lectures concerning the dynamics of groundwater. During this time new theoretical principles are developed on the condition of movement of these groundwaters in the U. S. S R. Particular attention is paid to the study of deep waters of the strata, to the explaining of the role of river valleys and sea caves in relation to the discharge of groundwater by deep horizontal aquifers. Groundwaters and their levels are examined in their dynamic condition, circulation, and geochemical correlation with surrounding rocks. The theories of Bokouchaev on zonality in nature are brought into the doctorine of zonal hydrodynamics. It is possible to recognise,

(1) The hydrogeological structures not covered by a layer of complex sedimentary rocks below the level of the sea, where there is active circulation and the water is sweet.

(2) The closed hydrological structures in which the complex of the same rocks are found below the level of the sea and which are covered again by a bed of completely impermeable rocks; the criculation of waters is restricted, and the waters have a high mineral content.

In 1939-1940 the principle of the three zones of circulation of groundwater was developed: An upper zone which lies higher than the level of rivers and which ordinarily contains sweet water flowing quickly; a middle zone lying much deeper than the river levels and which contains mineralised water flowing slowly; and lastly the lowest zone lying below the level of the sea which contains brine and flows extremely slowly.

At the same time, ideas concerning the effect of geological movement on the deeper layers of rocks were introduced into the dynamics of groundwater. On the basis of hydrodynamic laws:

(*a*) one can calculate the speed of movement of waters in the geosphere and crust of earth,

(*d*) one can distinguish migration of artesian waters in the atmosphere and rocks strata, and

(*c*) the existence of a vertical movement of groundwater traversing beds of

clay hitherto believed impermeable can also be confirmed

Hydrotechnical constructions.

The fundamental problems facing us in the field of groundwater dynamics are (*i*) to estimate the loss by filtration at the base of and around a hydrotechnical construction, and

(*ii*) to determine the amount of pressure at the foot of the hydrotechnical construction in order to estimate the stability of the construction In solving these problems a big part was played by a member of the Academy, Prof. N. Povlovsky, who in 1932 further elaborated the theory of the movement of under ground-waters available just below a hydrotechnical construction. The very valuable method of electro-hydrodynamics for solving the various problems of water filtration was also developed by him.

Petrol and gas

The important work done in 1930 by L. Leibenson, member of the Academy, has a great value in understanding the theory of gas filtration and the mixing of gas and petrol.

Based on the application of Darcy's law for laminary filtration, we have elaborated the method of injecting water around the oil field in order that a complete extraction is made possible.

Domestication of Groundwater.

The main problem of the dynamics of underground water lies in calculating and preparing the maps showing the distribution of groundwater and then its rational utilizatin by using water pipes. Some very important work has, therefore, been done in preparing the hydrogeological map of the U. S. S. R. and in undertaking theoretical and experimental investigation on the filtration of underground water.

Irrigation.

In the field of irrigation, some of the very important problems are the hydrodynamical regime, the groundwater balance, and influence of water filtration on the system of canal irrigation.

For solving these problems we have studied the eastern Trans-Caucasus region which has led to the establishment of hydro-chemical zonality and we could distinguish between the types of groundwater.

This helps in the study of the various processes of water filtration in the irrigation canals and for developing methods of calculation of the water balance of the irrigated area.

Three types of groundwater regions have been established (1950)

(1) Type of infiltration evaporation for districts which are completely deprived of underground flow of water,

(2) Type of flow of water which has a predominantly horizontal circulation, and

(3) A combined type which forms under conditions of a considerable flow by the infiltration of the superficial water, the atmospheric precipitation and evaporation of the underground water.

For the present, a thorough research on the groundwater and water balance is being carried out in the irrigated regions of the Republics of Ouzbeike, Kazakie, Tadjikie and Kirghizie. It has been found that the problem of the water balance over irrigated region becomes all the more complex because of the measurements of the various components of water balance which have to be made simultaneously i.e evaporation, superficial and underground flow, returning water, etc. While studying the movements of the underground waters in the irrigated regions it has been found that the speed of the movement of the groundwater in these areas is very slow of the order of 1 to 5 metres/year.

Mining Industry

The exploitation of the useful minerals present in humid rocks has lately gained considerable importance and thus the problem of pumping out water from the mines has become all the more important; several thousand metre cubes of water is pumped in 24 hours. To solve these problems a new method of drying the area by means of special boring has to be developed. The water was pumped into specially drilled drains.

Artesian Water

The dynamics of the artesian water play an important part in the solution of many problems in the desert areas.

(*Continued on page 26*)

DRY DOCK FOR KARACHI SHIPYARD

THE Karachi shipyard and Engineering Works situated as it is on the sea route to the Persian Gulf and the Middle-East Oil area is in a commanding position and offers dry docking and repair facilities to cargo and tanker tonnage, the former upto 16-18 thousand tons dead-weight and the latter upto 22,000 tons dead-weight. Pakistan's merchant tonnage of 160,000 need no longer proceed to Calcutta, Bombay, Singapore or Hong Kong for survey and repairs and the Pakistan Navy hitherto sailing to Malta and other ports for repairs will have the facilities of this shipyard. Besides the ship repair and dry docking facilities offered by this yard, it is essentially a ship-yard for construction of new vessels. The present capacity is for building ships upto 7,000 tons dead-weight, although in its final concept the yard should deliver 10-12 thousand tons ships with a total tonnage of about 50,000 a year.

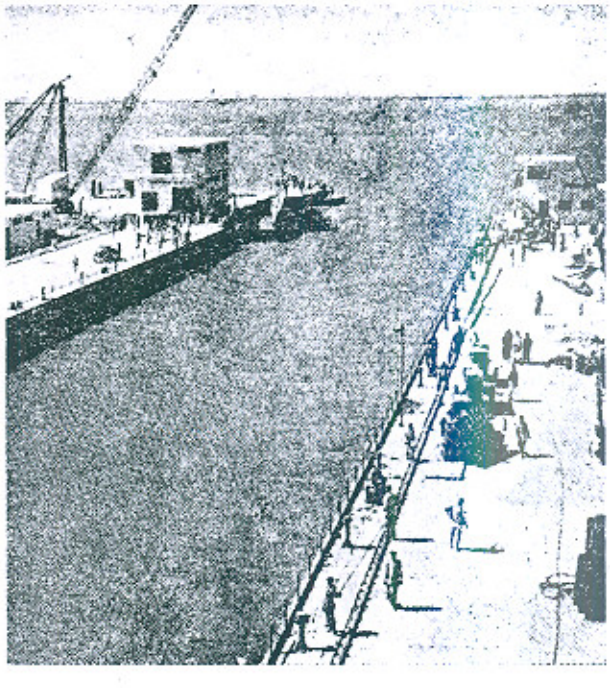
The Karachi Shipyard has, therefore, a special place in the industrial projects of the country. With the long coast line and the vast sea distance seperating the two wings of the country, Pakistan had to establish itself as a strong maritime state. Without a shipyard of our own this was not possible. A commercial dry Dock for Karachi had been sanctioned as far back as 1950, but no progress had been made. The Government subsequently transferred the project to the P.I.D.C.

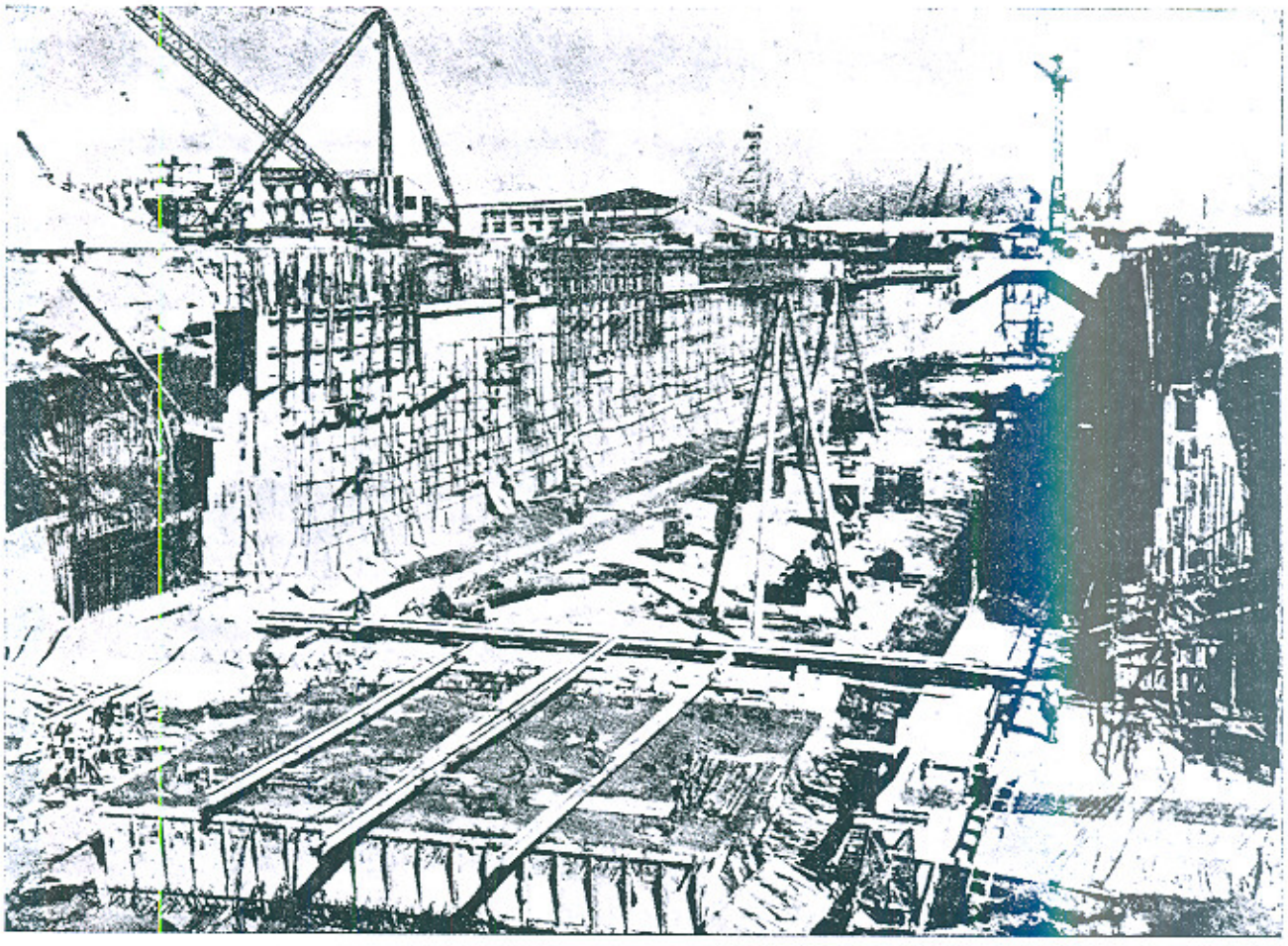
DRY DOCK AND WARPING-IN JETTY

The Dry Dock is 640 feet long, 90 feet wide and 38 feet deep with top level at R.L +16 and dock floor at R. L. — 22, and sill of the dock at R.L. — 18. Six sections with five numbers expansion joints are provided. Four sections each are 100 feet long, section near the entrance equals 137 feet and the section at the far end is trapezoidal shaped. The construction of the Dock involved huge excavation accompanied with dewatering and then concreting. Two drag lines of $1\frac{1}{2}$ cu.yd. and $\frac{3}{4}$ cu.yd. capacity respectively and 8 Nos. dumpers of 3 cu.yd. capacity for the disposal of the earth were employed. Excavation upto R.L. + 6.00 was carried in dry moist soil after which dewatering had to be done.

Well point system of dewatering was adopted for excavation below R L. + 6.00. Three stages of dewatering were necessary. 36 H.P. centrifugal vacuum pumps spaced at 300 feet pumped out sub-soil water from the well points through 8 in diameter header pipes. Well points consisting of $1\frac{1}{2}$" diameter 15 feet long pipes with 3 feet brass strainers at the lower end, were driven into the soil by jetting, and were connected to the header pipe at every 2 feet distances. At every pump station two pumps were employed. One as stand by. Water was thrown back into the sea through 8" diameter steel pipes. The three stages of dewatering mentioned above were established as follows :—

1st stage (temporay) at + 6.00 level dewatered upto 0.00 level.





2nd stage (permanent) at 0.00 level dewatered upto -18,00 level.

3rd stage (permanent) at —18.00 level dewatered upto —30.00 level.

Upto section B_2, excavation was made through the help of dewatering. But for section C_1 and C_2 most of which was under sea, a temporary single row cofferdam consisting of anchored 50 feet long fordiugham steel sheet pile was constructed about 100 feet away from the dock entrance. Its length was about 500 feet and about 23 feet width of earth filling behind the cofferdam wall was levelled off to serve as a temporary service road during the construction period. This cofferdam was removed when the dry dock and its gate was completed and warping-in jetty was completed. It took about six weeks to remove the cofferdam. The gradual withdrawal of the dewatering system and subsequent back filling was only started when the dock walls were completed upto + 16.00 level.

Warping-in jetty is 118 feet long and 24′ 4½″ wide and consists of 60 feet long anchored double row steel sheet piles spaced 23′ 7½″ apart, filled inside with loose boulder filling from —15. 00 to + 15 00 level. The floating dock gate rests in the jetty when the dock gate is opened for allowing the ships to warp-in and out of the dock.

Two concrete mixing plants were installed for the concreting of the dry dock, one each near middle of the dock on the north and south. The northern plant was an electrical batching plant consisting of two 14 S Blawknox non-tilting mixers, each of ½ cu. yd. capacity per mix. The plant on the south comprised of two 10/7 mixers, non-tilting type, erected on an elevated platform. The plants discharged the concrete into one cu.yd. concrete buckets placed on trolleys. These buckets were manually pushed on the trolly lines near the place of concrete and then lifted by a 5 ton

scotch mobile derrick crane with a 120 feet jib. Two such cranes one on either side of the dock were used. These cranes also handled steel, shuttering, etc., required during construction. While concreting the floor slab, pouring from both sides were done. The average daily concreting of walls and floors was roughly 20 0 cu.ft. with a maximum of 12,000 cu.ft.

For design and control of the concrete mixes, a well equipped loboratory was installed at site. All the mixes were designed by weight. Hub river shingle, as coarse aggregate, and Malir sand, as fine aggregate were used. Blast furnace cement conforming to B. B. S. 146/1947 was used. Keeping in view the impermeability and the strength of the concrete, the quantity of cement used was 430 lbs. per cu. yd. Concrete cubes were filled and tested after 3, 7 and 28 days. About 24 gallons of water was used per cu. yd. of concrete.

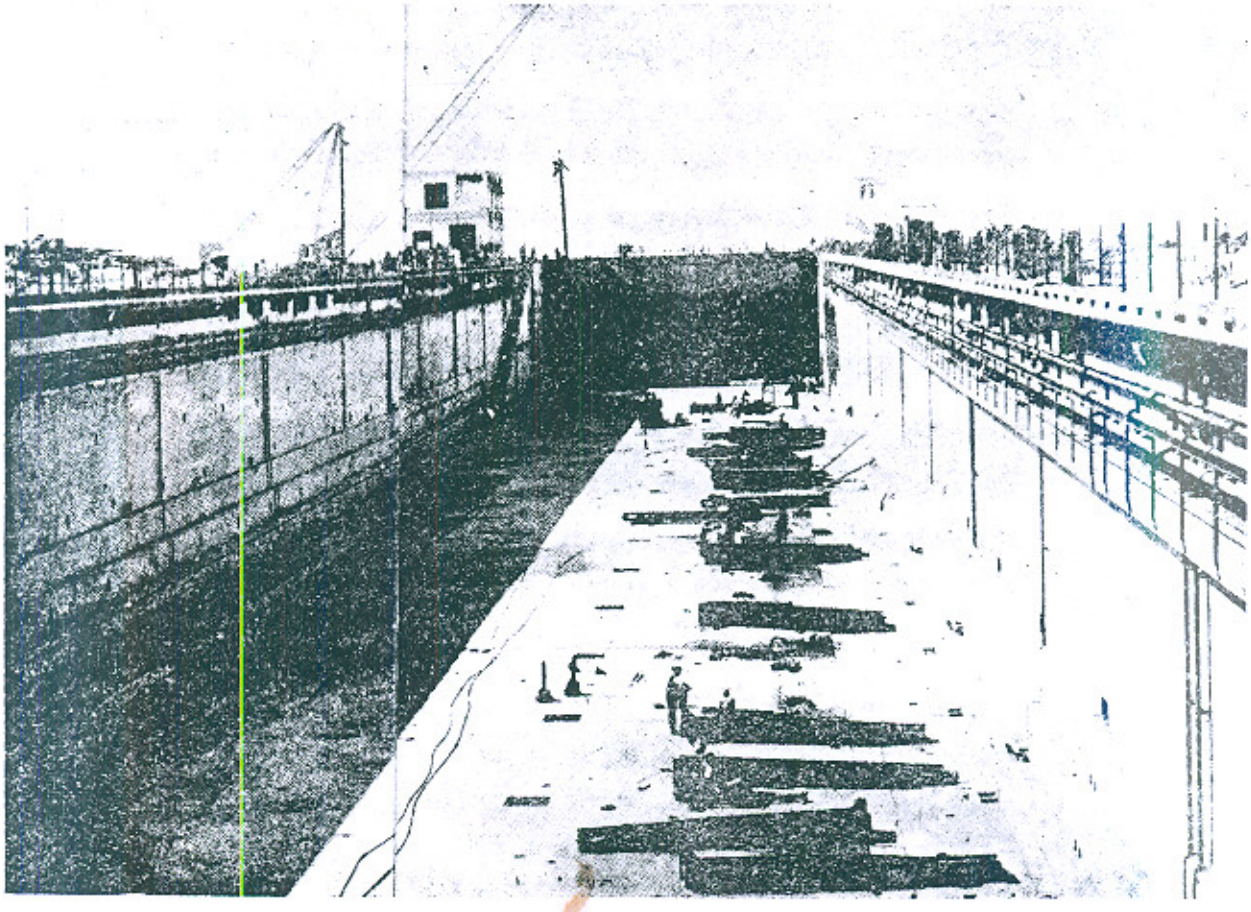
Expansion and Construction Joints

Five numbers expansion joints are provided in the dock. They are 1" thick gaps filled with an inch thick sand bitumen sheet and are provided with a double sheet of copper running from the top levels of the walls into the wall footings and the floor slab.

Full height of the dock wall was divided into 8 lifts with a construction joint between every lift. Each lift was then divided into panel lengths not exceeding 40 feet with a 3 feet construction joint gap between each panels. These gaps were filled after 14-21 days after concreting the panels on either side. The 7 feet construction joint mentioned above was cast when (*i*) the back filling behind the walls was completed upto 0.00 level, (*ii*) dewatering was withdrawn to allow the G. W. L. to rise to—10.00 level and (*iii*) floor anchorages were fully stressed.

Dock Gate

It is a floating gate with wooden facing with special rubber fillets, provided at the bottom and sides, which make the gate water tight. The dead-weight of the gate which is filled with 100 tons



of concrete, and the side thrust of sea water keep the rubber fillet tightly abutting against the sill and sides respectively. The dock gate can occupy two position Grooves have been left in the dock walls and sill which have been faced with steel plates. The gates has a gangway on the top and is symmetrical in sectiod. It has been constructed in such a way that either side can be made to abuut against the vertical support in the wall by turning the gate through 180°. This arrangement of the gate makes its painting and repair work easier.

The gate is lowered into the entrance of the dock and then filled with water. The gate begins to sink gradually and ultimately rests in its posit.on at the required level. Filling culvert, which is a channel with 7 Nos. rectangular openings 2′ 7½″ × 5′ 3″, in the sill of the dock, is connected with the inlet channel, which has its rectangular opening at—12.00 level. An electrically operated sluice valve, with provision for hand soperation in case of emergency, is fitted across the inlet channel inside a valve haft. This sluice valve controls the inlet of water through the inlet channel. When the gate is to be opened, water is flooded in the filling culvert by opening the valve. The water rises in the vertical direction through the rectangular openings in the sill of the dock. When the outside and inside level of water are the same, compressed air is filled in the gate which drives out the water filled in the gate enabling the gate to float. The gate is then hauled by means of Manilla ropes to the jetty where it rests.

PUMP HOUSE

The Pump House structre is monolithic with the northern dock wall, near the dock entrance. In this are housed (*a*) three main pumps, (*b*) two bilge pumps, (*c*) one fire extinguisher pump and (*d*) one percolating pump.

Three electrically driven main pumps with antisyphonic discharge system has been installed on the floor slab at R—L.-3. 00 in the Pump House. Each pump discharges 22,800 gallons per minute. Three circular delivery pipes 2′ 7½″ diameter diverge to 2′ 7½″ × 6′ 7½″ concrete culvert channel made in the north wall of the Pump House These three discharge channels, shaped as syphons, rise to an invert level of +12.00 and end in a main channel (with invert level at—12.50) which in turn discharge into the sea (invert level at −23.10) Automatic air relief valves have been provided on top of each syphon to stop the water syphoning back and prevent air blocking. These valves remain open when the pumps are not working. It is estimated that when two main pumps are working, the dock can be emptied in about 3 hours times or less depending on the level of water in the dock and the size of ship.

The pump cellar, slab and walls are insulated with 5 m.m steel plate for water tightening. There is a collecting basin in the dock floor (at—22.-60) near the Pump House which is connected with the main sump (at R. L. —32 00) immediately below the pump floor. This collecting basin is connected with (*i*) the longitudinal drainage channels which run on both sides in the floor of the dock and (*ii*) the filling culvert. Two Bilge pumps are meant for pumping out remaining water, rain water and waste water. The discharge from each is 1320 gallons per minute. A special fire extinguisher pump sucks water direct from the sea and serves both the sides of the dock. One percolating pump is meant to pump out small quantity of water remaining in the main pumps and the bilgep umps, after they are put off. A small sump is provided in the pump floor for collecting small quantity of water from these pumps. The roof of the Pump House has three openings for the main pumps, and two for the bilge pumps, right above the pumps for lowering or removing the pumps for repairs. The openings are closed by water tight concrete covers.

Anchorages.

Since the floor level of the dock is much below the water level, the floor has to resist tremendous amount of uplift pressure when the dock is empty. In conventional simple design the floors of docks are made so thick that the weight of

the concrete counteracts the uplift. They are called gravity docks. Such designs involve colossal amounts of excavation and concreting.

The Karachi dry dock is designed as an anchored reinforced slab and its thickness is only 6 feet. If it was designed as gravity dock, the floor thickness would be 20 feet; the design of the slab is based on "Beam on Elastic foundation" theory. 242 Nos, of anchors are anchored in clay which is of excellent cohesion. They are spaced 11'4" transversely and 10'1" longitudinally, and are designed for a working pull due to uplift of 95 tons per anchor, and actually stressed to 105 tons. Each anchor consist of 46 Nos. 0.2 " diameter high tensile prestressing wires stressed on B.B.R. system of prestressing. These wires, forming cables, are anchored through a "Concrete Bulb" to the bottom of a very stiff clay nearly 14 feet thick below R.L. —60.000 level. The clay has 2 tons per sq. ft. shear strength and is of very good bearing quality. Both the two central rows of anchors are anchored at R L. —71.00 to R.L. —73.00 level, and the end rows at R.L. —64.00 to R.L. —6.700 level.

The top end or the stressing head comprise of anchor head into which the cable wires are secured with pin headed ends. The anchor heats on a distribution plate 12" ×12" ×1" size. This plate is embedded perfectly in level with the concrete. The portion of the anchor which is on the anchor sparring, left in the 44 feet strip of floor slab at the time of concreting, is enclosed by a steel sheathing 4 inches diameter, and is packed with bituminous material. The anchor head is screwed to the stressing machine for stressing. The whole length of wires from top end to bottom upto concrete, is tightly insulated with five layers of bituminous taps to guard against corrosion. The anchor sparrings are closed with precast covers, so that subsequently it would be possible to check the stress in the cables, and restress them, if there is any loss of stress.

22 inches diameter steel casing pipes were used for boring holes for anchorages. Boring equipment consisted of a heavy cylindrical bucket with a one way opening plate, and a cutting edge at the bottom. This was operated with an electrically driven winch and a tripod frame of timber. Extension to the pipe was screwed on as the boring went deeper and deeper, until the bottom level of the concrete bulb was reached. At this stage a special arrangement was made for enlarging tube in the clay to the exact shape of the concrete cone. Sun-rays were reflected down the bore holes to check the correct cutting of the clay. After this was done, the completed anchor cable was lowered down and colgrout poured into the casing to fill the whole cavity of the bulb cut in the clay, and the bore hole up to 10 feet below the bottom of the slab. The casing tube was then pulled out, and the remaining space of the bore hole was filled with clay. The sparring to the slab was finally concreted keeping the anchor head plumb and central. The 50 per cent stressing was carried out after a minimum of 21 days and full stressing after 28 days.

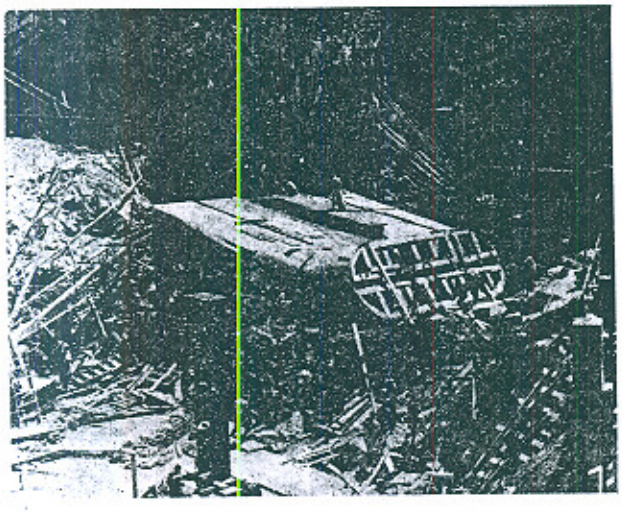
A two storey stucture rising from R.L. +16.00 with its top most roof at R.L. +39.50 and located on the north side of the dock adjacent to the pump room is being used as Switch House. In the ground floor are placed the switch panels. The top floor has a control board which operates all the electrically operated fittings such as capstans, sole light, top lights, roller gate (sluice valve) pumps. loud speaker, etc.

Another two storeyed structure rising from R.L. +16.00 to R.L. +45.50 is situated on the south side of the dock near the entrance. The is the Transformer substation to house:

(*a*) 3 Nos. main transformers 500 KVA 11000/380 V each,
(*b*) 1 No. transformer for AC supply to ships 380 KVA 380/440 220 V,
(*c*) Rectifiers 2 Nos. each for D.C. Supply for ships and tools respec tively.

There are provisions of two craneways, one on north side and the other at the south of the dock. The outer rails of both the craneways rest on beams cast on concrete piles. The crane rails are 32' 10" apart. At present a 10.00 ton Luffing crane is provided on the northern craneway.

The Power House area itself consists of the main Power House building, erection bay area and the control building. The control building shall consist of six storeys and will house the cable gallery, elevator, offices and some control equipment. The erection bay area will house the fire pumps and suction lines and strainers in the lower storeys along with the compressors, oil storage tanks, etc. In the upper storeys of the erection bay area will be building service equipment, batteries room and air-conditioning equipment. The main Power House building may be divided into two parts, substructure from R.L.+1086 to +1149 and superstructure R.L.+1149 to+1210. Above R.L +1210 will be the Switching Station.



Formwork for Draft tube unit 1 being erected in the Power House.

The superstructure houses the air-conditioning cooling units, the top of the generators, transformers, transmitters and the switching station and the 70 ton crane with hoisting machinery to place the generators, etc., as need arises. In the substructure will be located the draft tubes taking the water away from the turbines to the tail race. The water to the turbines is led by the penstocks through a spiral casing and that makes the turbines, and in turn the generators, produce electricity.



Showing Power House pit., Penstocks Tunnel and Drilling Jumbo are seen on the left. Excavation of rock is to be taken 30 ft. to 40 ft. below the level of the pit as seen here

Arrangements have been made, (*i*) to prevent the water entry in the power tunnel at the intake when necessary for dewatering by roller type head gates, (*ii*) to dewater and inspect the scroll case and turbines by, (*a*) closing butterfly valves at the downstream end of the penstocks and, (*b*) closing the draft tube outlets by sliding steel gates.

In the first phase, the power plant shall consist of four installed hydro-electric units, and the necessary auxiliary equipment. Each unit will be composed of a generator with a continuous rating of about 40,000 K.W. at 100% power factor, rated speed being 136 r.p.m. The generator will be coupled to the turbine by a vertical shaft. Provision is made for six turbines but at the present only four turbines units will be installed. The substructure of the remaining two generating units will be completed, but their installation will be deferred to a later date.

The power tunnel connecting the forebay with penstocks serves as a header and will be 650 ft. long, with a finished diameter of 39 ft, while the length of the intake of the power tunnel will be 138 ft. The penstocks are 150 ft. long with steel liners 120 ft. long, 18 ft. dia. to give as smooth a flow as possible. They are properly

WARSAK POWER HOUSE

By

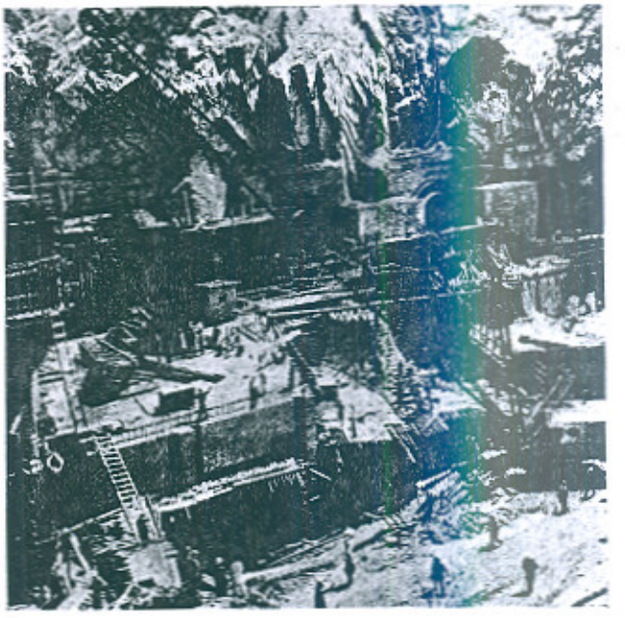
Saeed Minhas P.S.E.I.,*

LOCATED in the right bank of the Kabul River, near the toe of the main dam at Warsak, the 240,000 K.W , Power House will go a long way to meet the growing demand of industrial and domestic load in West Pakistan, besides fulfilling the needs of electrically operated tube-wells to undo the menace of salinity and water-logging.

Estimated to cost nearly 11 crores, the entire work of the Warsak Power House is expected to be ready by the Middle of the year 1960.

In the construction of this Power House is being employed the skill of Canadian management, engineers and technicians supplemented by Pakistani personnel and engineers. The entire machinery is supplied by the Government of Canada under the Colombo Plan while the local expenditure in rupees is borne by the Government of Pakistan, some of which is derived from the sale of the gift of wheat to Pakistan by Canada. The Power House is designed for a total ultimate capacity of 240,000 K.W. to be produced by 6 turbines and generators each capable of generating 40,000 K.W. at a head of 145 ft., utilizing a total discharge of 24,000 cusecs.

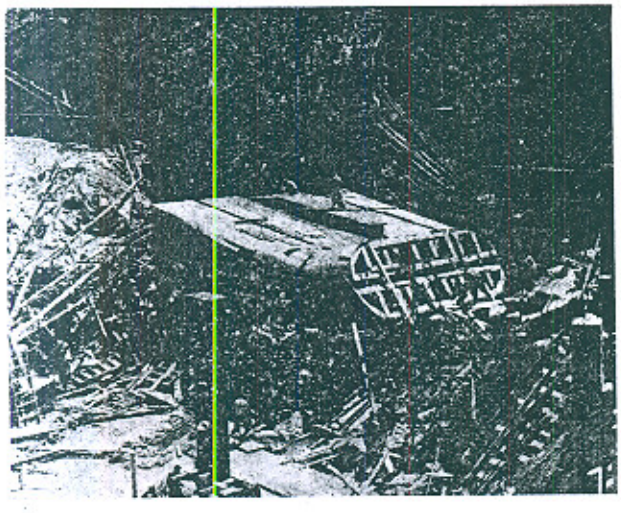
Construction of the Power House of Warsak Dam called for great ingenuity in its location. The narrow gorge of the river and the vertical mountain sides yielded no open space for the Power House. The entire dam length was only sufficient to pass the anticipated flood spill and would not admit of Power House being located at the foot of the dam. Eventually it was decided that the water from the storage reservoir should be taken through a tunnel on the south bank of the river, branching off into the penstocks, below which the turbine units would be installed. The side slope of an entire hill had to be blasted and rock removed for locating turbines units and the generators. The total area excavated on the hill side is approximately 500×100 square feet involving a total rock excavation of about 584,000 cubic yards.



Showing Power House progress. Draft tube roof slab for unit 1 has been placed. Formwork for Draft tubes for units 2 and 3 being prepared.

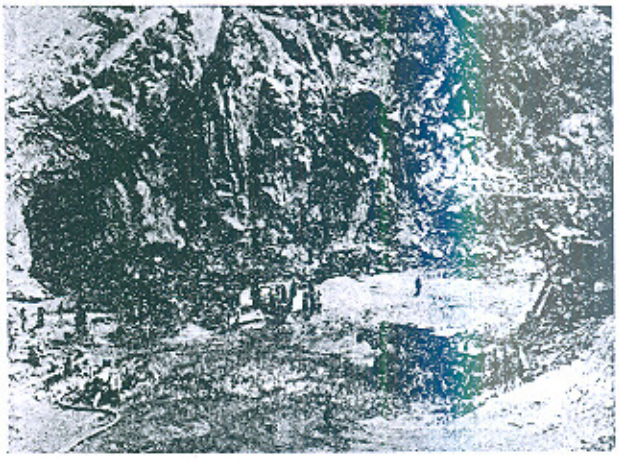
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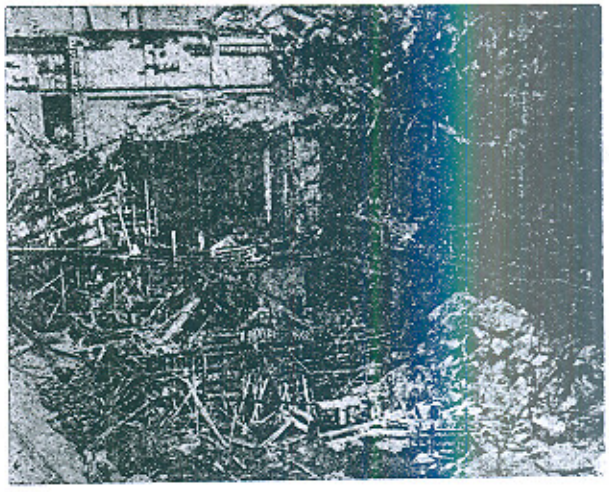
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designed to withstand the effect of water hammer and high head. The ultimate capacity of each turbines will be 55,000 H.P. at a net head of 145 ft., but in the first year of this service, the turbines will work at a net head of 135 ft. The increase in operating head is anticipated due to subsequent retrogression of river bed below the power house.

The operation of the turbines is regulated by the river flow, power demand and the storage capacity of the Warsak Dam reservoir. The permissible draw-down of the reservoir under which turbines will operate, is restricted to 10 ft., i.e., from elevation 1269 to El. 1259. The live storage for a draw-down of 10 ft., is 20,000 acres ft. which will cater satisfactorily for the daily and weekly load factors. In the minimum flow period, the Kabul River will carry 5000 cusecs which will give ample supply for the operation of one turbine for all the 24 hours and three more turbines for 4 hours during the peak demand hours. The power so generated will be gridded up with Daud Khel Power House, the Malakand Hydel Power Station and the Multan Sui gas Power House to meet demands over a large-area in West Pakistan. The final installed capacity of the Power House is 240,000 K.W. and the present installed capacity is 160,000 K.W. This may be compared with the proposed installed capacity of Sui Gas Multan Power House which is 130,000 K.W. The installed capacity of Hydel Power House at Rasul is 22,000 K.W.

The work at present is proceeding at a brisk pace on the excavation of the power tunnel and the Power House area, while the work of excavation of the 6 penstocks and their concreting is in hand. The construction of the control building is also going ahead and already three storeys of this building have been completed. The foundation work in the Erection Bay area has also started with the concreting of the main sump where the relief drains from under the draft



Penstock Steel liner for unit 1 and formwork for concreting in draft-tube in position. A portion of the control bui ding is seen on the top left.

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The welding of the penstock liners and assembly of scroll casing has been done at Warsak by the sub-contractors M/s. Herman & Mohatta of Karachi, Pakistan.

A NOTE ON THE DETERIORATION OF CEMENT CONCRETE IN CONTACT WITH SEWAGE

By Ghias-ud Din Habib*

Physical Characteristics.

Whenever concrete comes into contact with the sewage, decomposition of the former is not necessarily inevitable, because normal sewage, at ordinary temperature and in the absence of air currents does not attack cement mortar. The deterioration of concrete by sewage has nevertheless been observed in many instances where the destruction is attributed to sulphur bacteria. The concrete in such cases is reduced in thickness by intermittant crumbling, and eventually loses most of its strength.

Chemical Analysis.

The corrosion of concrete takes place in two separate stages as a result of two different bacteriological processes namely the formation of hydrogen sulphide and its oxidation to sulphuric acid.

Stage 1.—The formation of hydrogen sulphide is brought about by either :—

(*a*) The reduction of mineral sulphates by aneorobic bacterial organism,

(*b*) Splitting up of the three sulphur containing animo acids by variety of saprophytic micro-organisms.

The bacterial reduction of sulphates which is the most significant of the two actions is an oxidation of organic matter with the help of the inorganic combined sulphate oxygen. This is indicated by the following equation in which 'C' represents an organic compound and 'M' represents a metal or inorganic base.

$$2C + MSO_4 + H_2O = MCO_3 + CO_2 + H_2S$$

The bacterium in question is a non-sporing and aneorobic organism. The hydrogen sulphide under reactions (*b*) is produced by the numerous forms of bacteria commonly existant in sewage at nearly every stage of its becoming septic.

Stage 2.—In the second stage the absorption of hydrogen sulphide takes place by the true sulphur bacteria, which during their metabolism absorbs hydrogen sulphide, oxidize it to sulphur, and store sulphur within the bacterial cell in the form of granules. The sulphur is then excreted and oxidised either to sulphuric acid or to sulphates according to the following reactions.

(*i*) $2H_2S + O_2 = 2H_2O + S$.

(*ii*) $S_2 + 3O_2 + 2H_2O = 2H_2SO_4$.

It is this resulting sulphuric acid which is directly responsible for the decomposition of the concrete. But decomposition does not occur under all conditions and circumstances. For each reaction and change there are definite environments essential for optimum development of the particular form of bacteria responsible for the change. Thus if the pH-value, oxygen pressure, temperature, amount of organic material, or any other condition is not suitable to optimum development of some bacterium taking part in the formation of sulphuric acid, then the subsequent corrosion will not occur.

Prevention of Deterioration.

In view of the chemical reaction as explained above, it is desirable to avoid the formation of septic sewage with corresponding bacterial flora which produces hydrogen sulphide. In case the latter is already present the oxidation to sulphuric acid should be prevented by taking precautions to minimise the conditions favourable to the development of true sulphur bacteria. Both these bacteria are unable to exist in large concentrations of oxygen or under well oxidised conditions. The preventive measures are therefore, summarised as below :—

1. Adequate ventilation.
2. Chemical treatment.
3. The use of cast iron for mains where possible.
4. Employment of acid resisting material in plaster work.
5. Completely filled system. Those parts which are entirely submerged in sewage rarely display sign of sulphur bacteria. Also total exclusion of the air is equally as good in preventing the action as complete exposure to the air.

*Superintending Engineer.

designed to withstand the effect of water hammer and high head. The ultimate capacity of each turbines will be 55,000 H.P. at a net head of 145 ft., but in the first year of this service, the turbines will work at a net head of 135 ft. The increase in operating head is anticipated due to subsequent retrogression of river bed below the power house.

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Physical Characteristics.

Whenever concrete comes into contact with the sewage, decomposition of the former is not necessarily inevitable, because normal sewage, at ordinary temperature and in the absence of air currents does not attack cement mortar. The deterioration of concrete by sewage has nevertheless been observed in many instances where the destruction is attributed to sulphur bacteria. The concrete in such cases is reduced in thickness by intermittant crumbling, and eventually loses most of its strength.

Chemical Analysis.

The corrosion of concrete takes place in two separate stages as a result of two different bacteriological processes namely the formation of hydrogen sulphide and its oxidation to sulphuric acid.

Stage 1.—The formation of hydrogen sulphide is brought about by either :—

(*a*) The reduction of mineral sulphates by aneorobic bacterial organism,

(*b*) Splitting up of the three sulphur containing animo acids by variety of saprophytic micro-organisms.

The bacterial reduction of sulphates which is the most significant of the two actions is an oxidation of organic matter with the help of the inorganic combined sulphate oxygen. This is indicated by the following equation in which 'C' represents an organic compound and 'M' represents a metal or inorganic base.

$$2C + MSO_4 + H_2O = MCO_3 + CO_2 + H_2S$$

The bacterium in question is a non-sporing and aneorobic organism. The hydrogen sulphide under reactions (*b*) is produced by the numerous forms of bacteria commonly existant in sewage at nearly every stage of its becoming septic.

Stage 2.—In the second stage the absorption of hydrogen sulphide takes place by the true sulphur bacteria, which during their metabolism absorbs hydrogen sulphide, oxidize it to sulphur, and store sulphur within the bacterial cell in the form of granules. The sulphur is then excreted and oxidised either to sulphuric acid or to sulphates according to the following reactions.

(*i*) $2H_2S + O_2 = 2H_2O + S$.

(*ii*) $S_2 + 3O_2 + 2H_2O = 2H_2SO_4$.

It is this resulting sulphuric acid which is directly responsible for the decomposition of the concrete. But decomposition does not occur under all conditions and circumstances. For each reaction and change there are definite environments essential for optimum development of the particular form of bacteria responsible for the change. Thus if the pH-value, oxygen pressure, temperature, amount of organic material, or any other condition is not suitable to optimum development of some bacterium taking part in the formation of sulphuric acid, then the subsequent corrosion will not occur.

Prevention of Deterioration.

In view of the chemical reaction as explained above, it is desirable to avoid the formation of septic sewage with corresponding bacterial flora which produces hydrogen sulphide. In case the latter is already present the oxidation to sulphuric acid should be prevented by taking precautions to minimise the conditions favourable to the development of true sulphur bacteria. Both these bacteria are unable to exist in large concentrations of oxygen or under well oxidised conditions. The preventive measures are therefore, summarised as below :—

1. Adequate ventilation.
2. Chemical treatment.
3. The use of cast iron for mains where possible.
4. Employment of acid resisting material in plaster work.
5. Completely filled system. Those parts which are entirely submerged in sewage rarely display sign of sulphur bacteria. Also total exclusion of the air is equally as good in preventing the action as complete exposure to the air.

*Superintending Engineer.

A REVIEW OF JUTE INDUSTRY

By

J. G. Winterbottom

THE swift and considerable progress that industrialisation has made in Pakistan during the last nine years is most marked and conspicuous in the field of Jute and Cotton textiles. Most of the world's Jute is grown in the Eastern wing of Pakistan where for hundreds of years the peasants have manufactured it into binding cords and primitive clothing. Jute, therefore, constitutes a major factor in East Pakistan's economy. The present rate of cultivation is remarkably high, and within the past decade annual crops of approximately two million tons or about 70 per cent of the world's total yield have been recorded. In fact, East Pakistan has world monopoly in finer varieties of the fibre.

Prior to the Partition of the Subcontinent in 1947, India was able to provide her mills with the Jute grown in the Eastern part of the then province of Bengal. With the advent of Partition when the Eastern portion of Bengal became the territory of the new dominion of Pakistan, the Indian Jute industry was left in possession of some 90 mills, concentrated in the Calcutta area, while the principal Jute fields were located within the newly erected Pakistan borders. In brief, India possessed the Jute manufacturing facilities and Pakistan the main Jute cultivation area.

Pakistan Government soon formulated a scheme to erect new factories within this area, sufficient to absorb a portion of the Jute produced in that region. Accordingly a target was set to create a manufacturing capacity of 6000 looms by the middle of the year 1975. The Project was entrused to the care of Pakistan Industrial Development Corporation and the target of 6000 looms has been achieved by the middle of 1955, two years ahead of schedule. By the year 1957 more looms were added taking the total to 7750. Total investment on establishing this manufacturing capacity is Rs. 236.89 millions of which P.I.D.C's share is Rs. 82.75 million and private capital is Rs. 154.32 million. The total output of finished product this year is expected to be 220000 tons of the value of about Rs. 200 million. The mills will consume 1.2 million bales of raw Jute of the value of about Rs. 125 million. In the year 1957 Pakistan earned about Rs. 120 million by the export of jute goods.

Pakistan has been able to secure the most modern machinery designed to reduce labour, with improved efficiency and the outstanding feature of producing goods out of a lower grade Jute. Thus Pakistan's Jute industry with its modern machinery, ready access to all qualities of Jute and plentiful supply of labour capable of being trained to a high standard of efficiency, stands in a strong position capable of successfully competing with any country in the world. Today due to Government's foresight, East Pakistan is feeling its way through and can claim to have in its bosom some of the finest and biggest industrial units of Asia. The Jute industry is thus providing employment to large numbers of people, earning foreign exchange and has helped in stabilising local Jute market.

THE RAW MATERIAL.

Jute, with its stalks about $\frac{3}{4}$ inch thick, reaches maturity in four to five months from planting in a normal season, and its height varies from 5 feet to 15 feet. The serrated leaves are from 4 to 5 inches long and $1\frac{1}{2}$ inch broad, with pale yellow flowers at maturity, and small seeds in the fruit occurring after the plant has passed its best from the aspect of fibre production.

A cross-section of the stem of the Jute plant, reveals a centre core of pith surrounded by a ring of woody matter The 'bast layer' which contains the valuable Jute fibres embraces this

woody structure, and finally the outer skin, or cuticle of the plant, envelops the whole.

After cropping, the plant is submerged in pools of water for periods of ten to twenty days; this is the steeping process, or 'retting' as it is termed. The gummy bark, or cuticle, is softened, and the 'bast layer' of valuable fibres is then stripped away from the stem. It is then washed thoroughly and dried by hanging over poles. Bunches of these straw-like strips are known as 'stricks' and they contain masses of fibres adhering to each other. Only about 4½ per cent by weight of the original plant contains this usable fibre.

The dried stricks are finally made up into bundles and conveyed by road or country boat, from the cultivation points to the many press houses situated up-country. In these establishments they are classified for grade and quality and converted under pressure into 'Kutcha' bales weighing 300 lbs. each for the local mills, and 'Pucca' bales of 400 lbs. for export. The baling is performed by heavy hydraulic presses, powered by steam or diesel engines where electricity supplies are remote.

MANUFACTURE OF JUTE TEXTILES.

To assist in understanding the manner in which the stricks of bast fibre are treated after the arrival of the bales at the spinning and weaving mills.

The initial process after the bale has been opened is the softening of stricks for the removal of the vegetable matter holding the individual fibres together. Bales arriving at the local mills are fairly soft in character and their contents are comparatively loose. Consequently the bundles of stricks can be introduced immediately to the softening process. On the other hand, heavily pressed bales, such as the 'Pucca' bales, contain hard compressed layers of strick bundles. These must be passed through a bale opening machine in order to crush the masses into a relatively soft state suitable for presentation to the softening process.

Then comes the carding operation in which the softened stricks are subjected to a continuos combing and splitting treatment. Next is the drawing section where the fibres are drafted further, and then the spinning, winding, and the weaving and finishing processes.

Opening and Softening.

The bales of different qualities or growths are broken open and stricks are blended in varying quantities and fed into a softener where they are mechanically ossened and softened. The machine consists of some 71 pairs of heavy spiral and fluted rollers located along its whole length. These rollers bend and knead the strands of Jute strick and ultimately deliver them in a very much softer condition at the outgoing delivery sheet of the machine. During the treatment the stricks are subjected to a spray of oil and water emulsion which is necessary.

The softener is generally considered essential for low class rooty Jute and Jute cuttings. For the cleaner grades of Jute the stricks may be worked directly on a Jute spreader, thereby saving an operation. Its purpose is to comb and open the 'pieced out fibre and to convert it into an even continuous ribbon which receives a constant spray of emulsion. The machine is fed with either softened or raw Jute according to the desired yarn quality. The mcahine consists of a feed sheet on to which the stricks of jute are fed, together with back rollers that feed the fibres into a pair of endless sheets of sharp steel pinned gill bars running in sequence and at different relative speeds. Here the fibres are held, combed, drafted and bonded into a continuous sliver which is drawn off by two pairs of delivery rollers on to a 'former' where it is finally converted into a roll of material.

Teaser and Waste Breaker Card.

Short lengths of Jute recovered in a loose state in the spreading and softening processes are fed into a teaser card, whilst Jute root cuttings, and hard waste from different parts of the mill, are converted into a 'two' by passing the material through a waste breaker card. These machines card, comb and clean the material into a suitable condition for introducing into the ensuing carding process.

Carding.

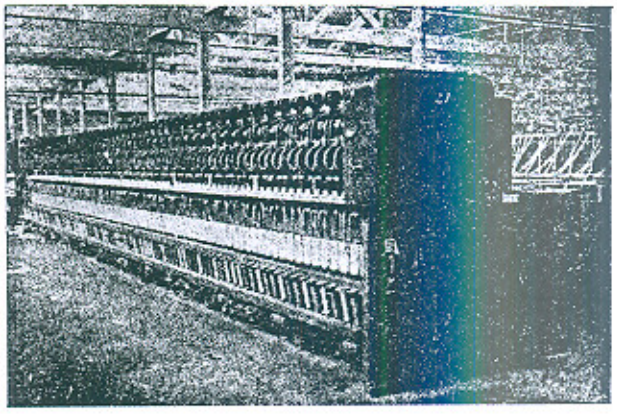
From the softener, or spreader, the stricks or rolls are fed into the breaker card where the second stage of combing and splitting of the fibre takes place. Here a cleaning and breaking action is imparted to the fibre. The breaker card comprises a main cylinder 48 inches diameter and 72 inches wide, with a 12-inch diameter feed roller. There are two pairs of stripping rollers and worker rollers. All these rollers and the cylinder are fitted with many fine pointed pins set at varying angles relative to the axis of the rollers. These rollers, set at varying distances from the main cylinder, run at different surface speed ; with the result that the stricks, or sliver as it is now known, is given considerable combing action. The sliver issuing from the breaker card is again in a flat form and wound into a roll by a device known as a roll former.

The final carding process is the finisher carding. Here the sliver from the breaker card is introduced and it is subjected to additional combing and cleaning The delivery is again in the nature of a flat sliver taken up into a roll former. A single roll may be 42 inches in diameter and have wound on about 900 yards of sliver ; it is sufficient to keep a drawing frame running for about two hours.

At this juncture it would be well to explain that Jute fabric is often produced in two main forms in a given Jute mill. One cloth is known as 'Hessian' and this is used principally for the manufacture of light sacks, linoleum and for baling material. The other type of cloth is known as 'Sacking' or 'Gunny' which, as its name implies, is devoted to the manufacture of bags and sacks to hold grain, rice and the like. Certain groups of Jute Mill machinery are constantly engaged in the production of either Hessian or Sacking material ; hence the subsequent references to these qualities in this article.

Drawing and Doubling.

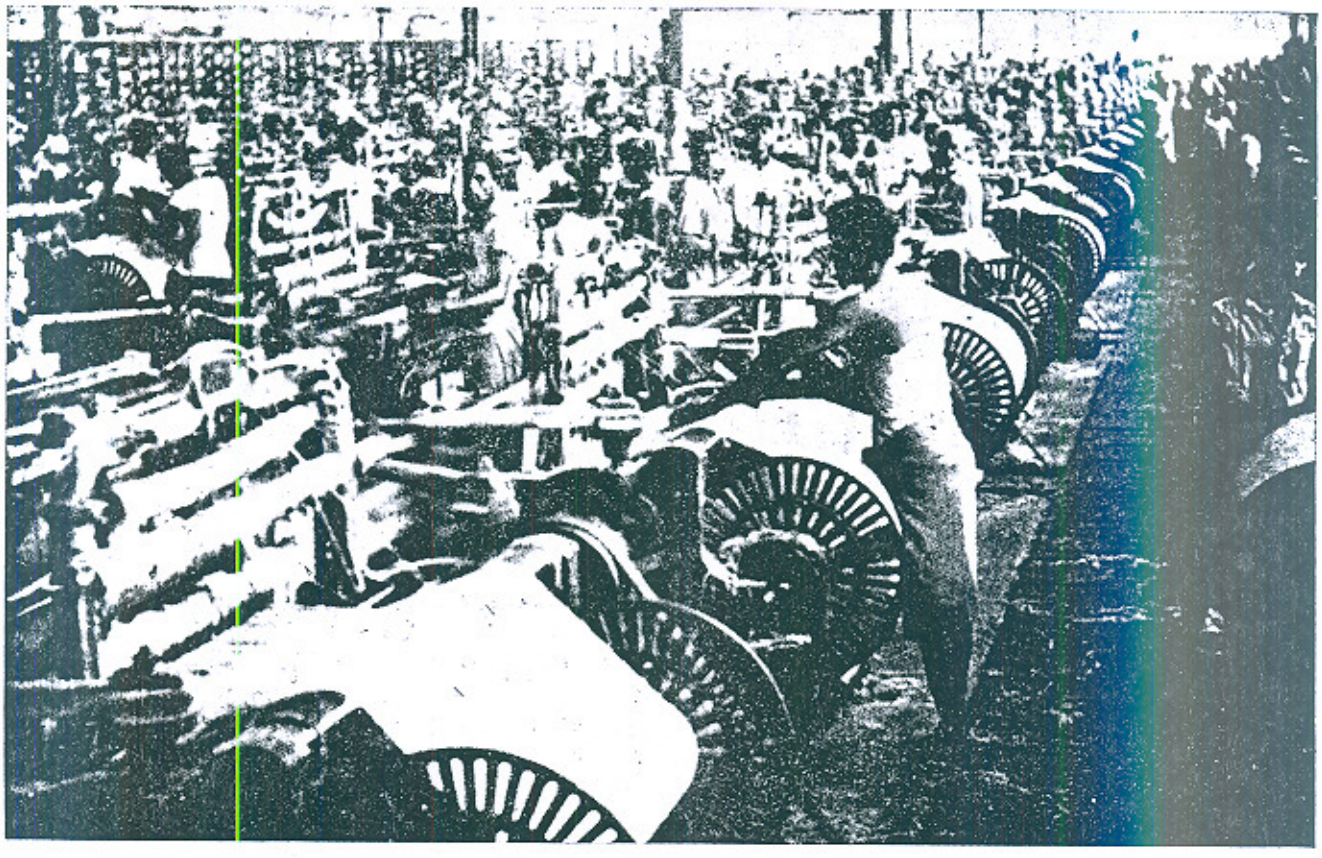
From the finisher cards the rolls of sliver are transported to the section of processing known as drawing and doubling. Here the Jute is given the first stage of parallelisation of the fibres, together with doubling and further drafting. This is usually carried out in three consecutive stages ; the first drawing, the intermediate drawing and finisher drawing. In each machine the sliver is fed into a pair of rotating nip rollers and presented to an endless horizontal movement of sharp pointed pins which effect the paralleling of the fibres, and with the delivery rollers a drafted sliver. As many as four slivers can be fed into the machine and these emerge in one single sliver possessing the total fibre content of the four slivers introduced at the feed side reduced in unit weight according to the degree of draft introduced.



The product of the finisher drawing frame takes the form of a narrow crimped tape or sliver which is delivered into tall cans for transport to the spinning section. Up to this final stage of drawing the Jute fibres have been drafted many times since leaving the spreader. In the carding there may be a draft of 10 to 1, first drawing 3 to 1, intermediate drawing 5 to 1, and finisher drawing 7 to 1. Ultimately, in the spinning the degree of draft may be 10 to 1 or more. These are merely figures taken at random in various mills to illustrate how important the draft process is, and the resulting sliver is remarkably clean and regular in colour. In one instance it was observed that up to the last stage of drawing as many as 1,750 doublings, or mixings of the rolls of Jute, had taken place in order to attain the desired degree of quality.

Spinning

Here the crimped tape of Jute sliver is fed up to the sliver spinning frames. It is led through a system of pairs of



slow and high speed rollers to impart still further an appreciable draft. From these drafting rollers the sliver proceeds to the flyer which rotates at speeds of as much as 4,000 r. p. m. Twist is imparted into the sliver after leaving the drafting rollers. The amount of twist can be varied by adjusting the ratio between the flyer speed and the delivery speed of the drafting rollers. The finished yarn is eventually spun on to a bobbin. A typical spinning frame is shown. In this illustration will be seen the crimped Jute sliver issuing upwards from the can at the back of the frame, and through the drafting rollers at the front with the yarn leading down to flyers and bobbins. A frame may have as many as 100 spindles or more, according to the particular conditions of the mill concerned. The productivity of a spinning frame is governed basically by its operational speed. This, in turn, depends upon the quality of the raw material in the yarn, the twist required for the partilular yarn size and its ultimate purpose. The average yarn output is about 900 inches delivery per minute.

Twisting.

This, as its name implies, refers to the twisting together of two or more single Jute yarns, thus creating an ultimate folded twine of considerable strength. In appearance a twister resembles as spinning frame with its row of vertical spindles. It produces twines for binding in carpets, sewing of bags, and other items of household and industrial usage. Its yarn does not normally appear in Jute cloths, and only a few of these machines are usually installed in a Jute mill for the manufacture of sewing twine for internal use.

Winding.

Much of the yarn output from the spinning section is routed to the winding machines. The cop winders prepare the yarn in packages up to 12 inches long and $1\frac{3}{4}$ inches diameter suitable for inserting into the weft shuttles of the weaving looms. These packages, or cops as they are known, are wound on vertical spindles of which there may be 120 on an average frame. The yarn speed is approximate 100 yards per minute.

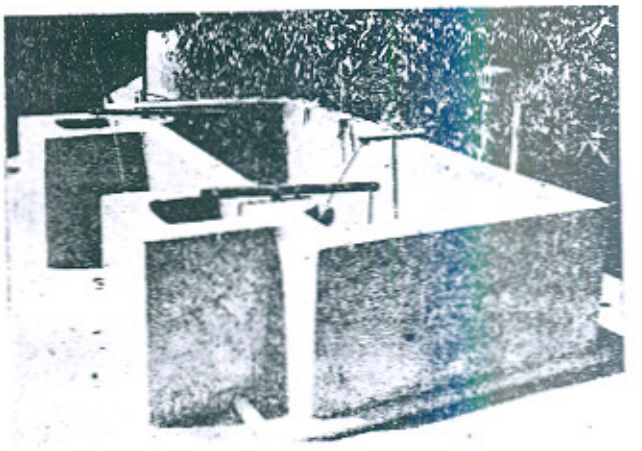
The roll winders convert the spun yarn into suitable packages, known as spools, of about 10 inches dirmeter and 10 inches

DOOR FUNCTIONING FLUSHING LATRINES AT LYALLPUR

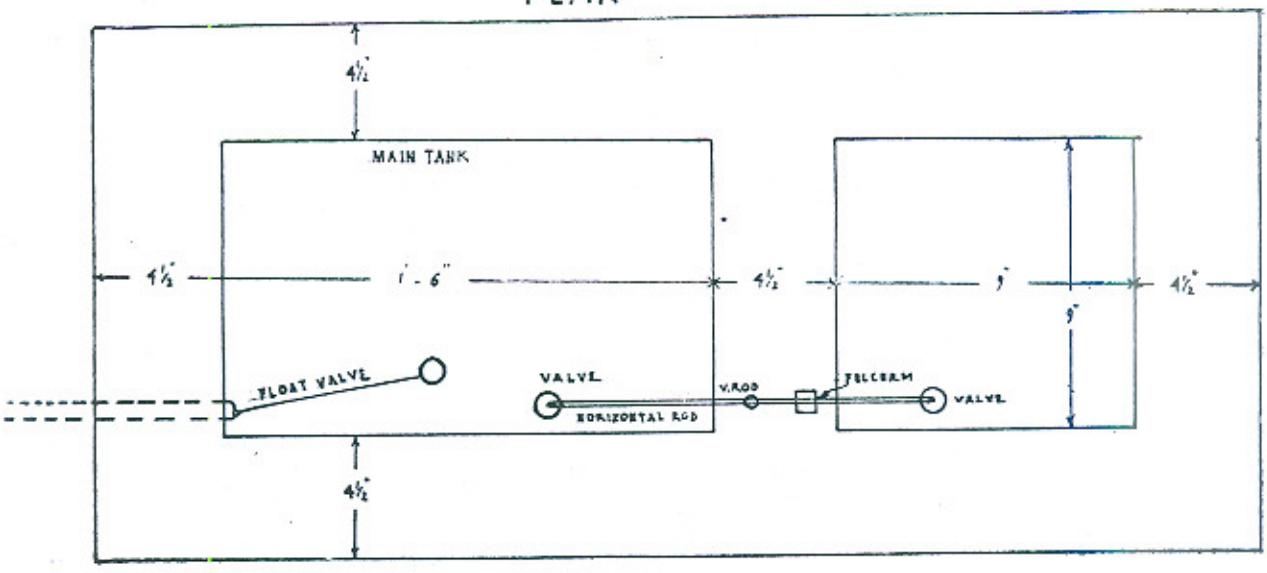
By M. Fazil Qureshi

50 Public Latrines have been constructed at Lyallpur with *Door Functioning Flushing System*. This system is quite a departure from chain pulled 3 gallons flushing C. I. Cistern which usually remains out of order in the Public Latrines as at present the general public does not know how to use. In the case of 3 gallon C. I. Cistern a slight pull of chain will make the syphone of the cistern to work and flush the water-closet but what usually happens is that a strong pull is given to the chain which lifts the cover plate on the cistern and makes the lever stick and put the cistern out of order. Sometimes when there is no water in the cistern the user goes on pulling and releasing the chain which displaces the syphone or strokes the ball valve and damages the inlet valve. The loose parts of the cistern require careful handling. It is not possible to depute a plumber on each and every cistern to keep it in working order. After good attempts to flush the water-closet the user leaves the watercloset dirty and bars others from using it. Good plumbers are not available in the country even to repair the lead connection of watercloset. All these shortcomings are over come with *Door Functioning System*. The parts are such that no special casting is required. Any blacksmith will be able to make the parts and install. No special teaching is required. This is the simplest possible arrangement and most durable and fool-proof. This system can be adopted for houses also. This can be compared to the modern car's door functioning light system Even provision of automatic flushing cistern for urinals results in waste of water. There is already shortage of water and a town like Lyallpur cannot afford it. These days the price of Pig Iron is quite high and there is also every likli-hood of theft of C. I. Cistern, which can easily be removed from public places. In order to meet the above exigencies the Door Functioning System has been evolved. This system is in experimental stage. With use further improvments will be possible. The different parts of it have been shown in the attached sketch and described below. Photographs have also been appendixed.

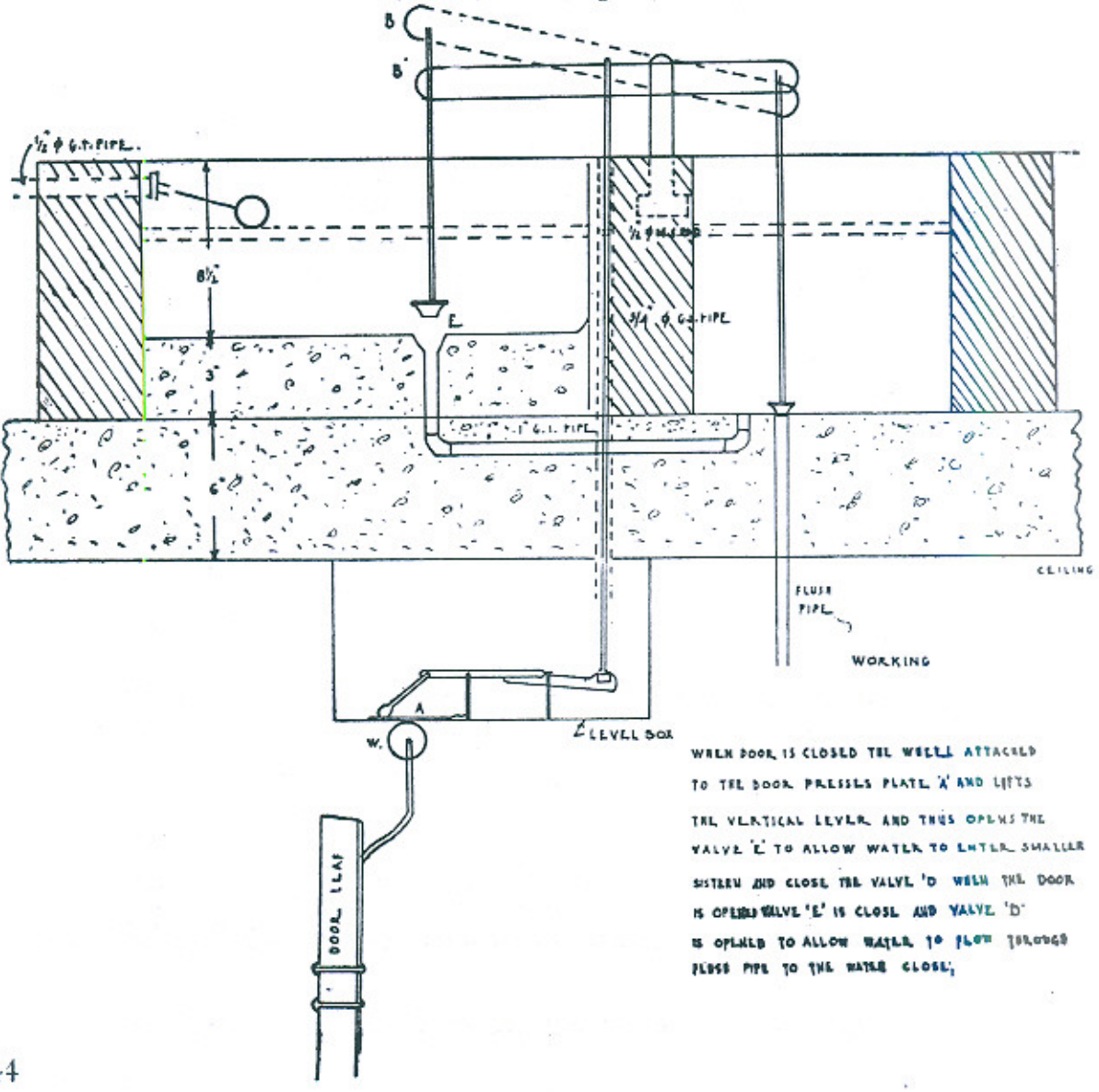
Two cement concrete tanks on roof of the latrines are to be provided as is clear from the photograph. One is to be large enough to store water for use when town water-supply is off and the smaller one with a capacity of nearly 3 gallons of water for flushing water-closet. The bottom of the bigger portion is higher than the smaller cistern so that whole of water can flow in the smaller portion for use as flushing of the water-closet. The two portions are connected through 1" i/d pipe syphone. The outlet of this syphone in the bigger storage can be opened by the lever arrangement, only when the door of the cubical is shut. This position will keep the valve "D" closed, "E" opened (sketch). The water starts entering the small cistern through the syphone to equalize the water level in the two tanks. A flushing pipe of 1" i/d is connected from the bottom of smaller cistern with the water-closet.



PLAN

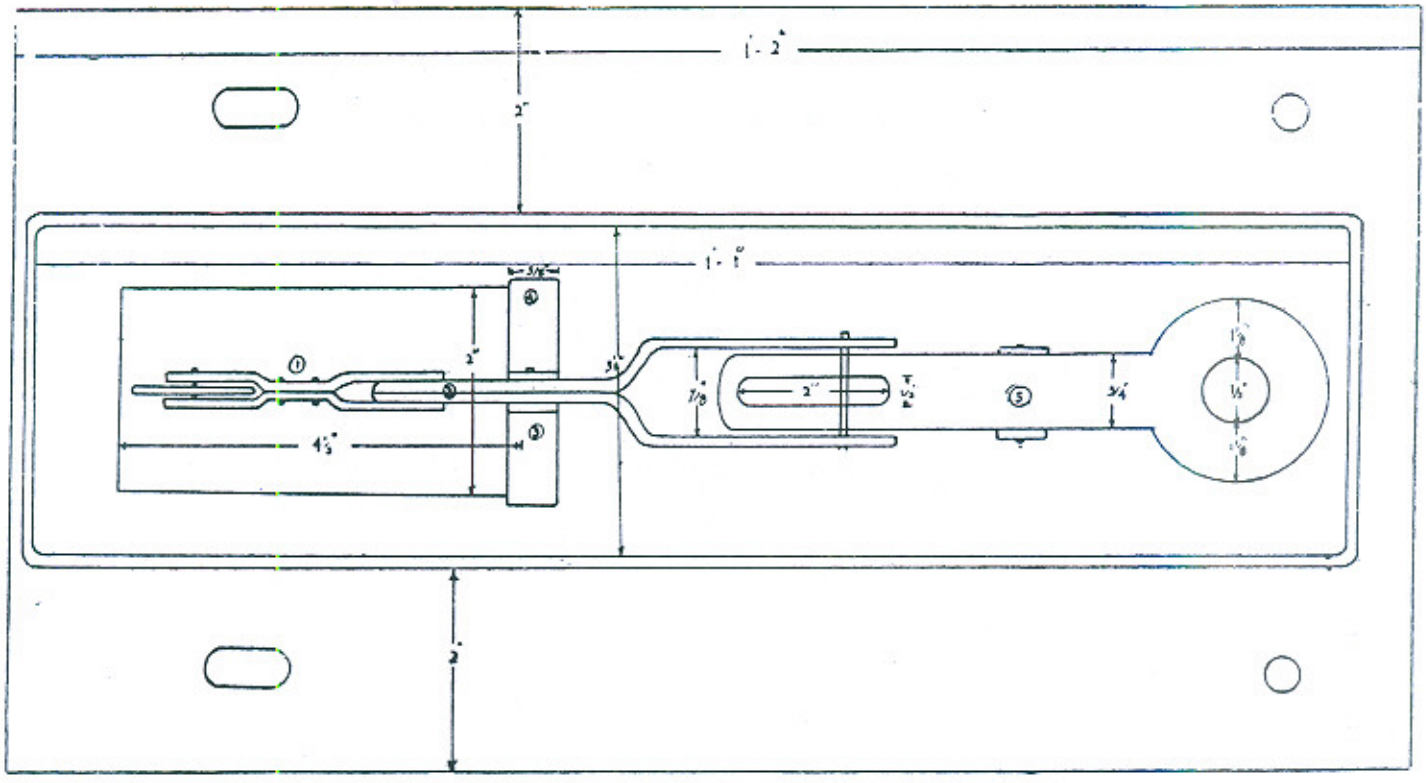


DOOR FUNCTIONING FLUSH SYSTEM

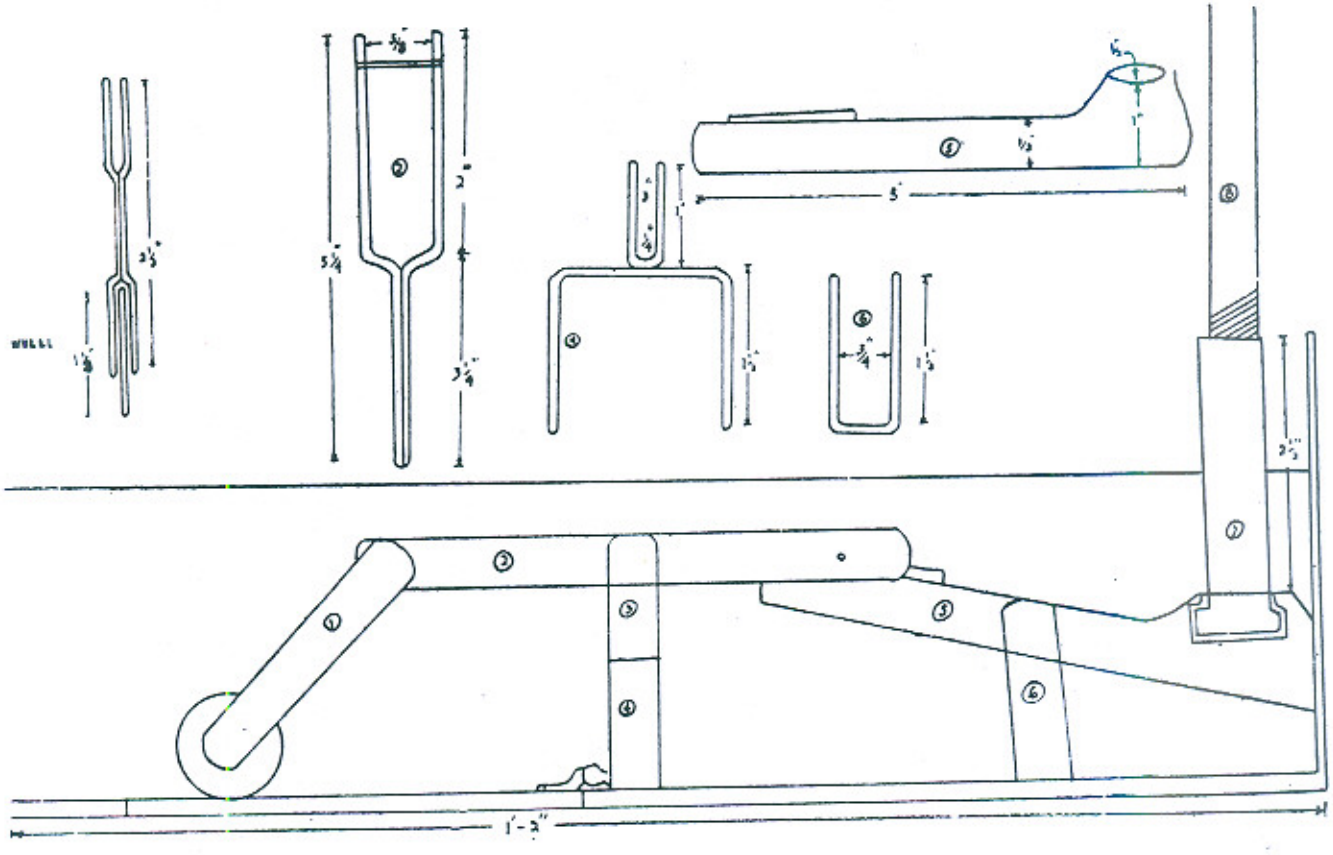


WHEN DOOR IS CLOSED THE WEIGHT ATTACHED TO THE DOOR PRESSES PLATE 'A' AND LIFTS THE VERTICAL LEVER AND THUS OPENS THE VALVE 'E' TO ALLOW WATER TO ENTER SMALLER SISTERN AND CLOSE THE VALVE 'D' WHEN THE DOOR IS OPENED VALVE 'E' IS CLOSE AND VALVE 'D' IS OPENED TO ALLOW WATER TO FLOW THROUGH FLUSH PIPE TO THE WATER CLOSET.

DETAIL IN PLAN OF LEVER IN BOX ABOVE DOOR



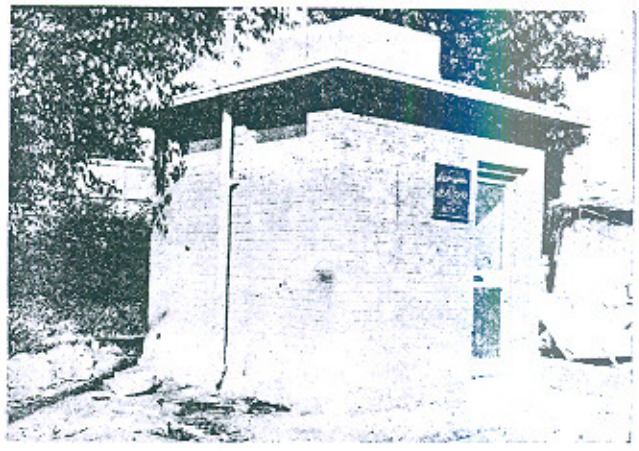
DETAIL OF LEVER IN BOX ABOVE DOOR



The outlet of the flushing pipe is closed by the lever arrangement simultaneously with the opening of syphone outlet in the bigger tank when the door of the cubical is shut. When the door is opened the outlet of the syphone is closed automatically and that of flushing pipe opens and the water collected in the smaller cistern gushes down through flushing pipe to clean the water closet. The door of the cubical is to be left open after use.

To the door is attched a flat iron arm carrying a small wheel. When the door is closed this wheel pushes the moveable iron plate upwards and thus lifts the connecting rod vertically inorder to change the angle of horizontal lever which operates the opening and closing of syphone outlet as well as flushing pipes outlet simultaneously. The details of levers which move into action the valves by closing and opening of door has been shown in the attached sketches.

To control the level of water in the bigger tank which is fed by municipal water supply, float valve is fitted at the



inlet water pipe. As soon as the water drops from a particular level more water enters through the inlet pipe. Except for lever attachments with the door and a flat iron small moveable plate and a box there is nothing visible below the ceiling. So the damage to the fittings cannot be done easily. These are functioning in Lyallpur since November 1957 satisfactorily and have proved to be very useful for the public.

(*Contd. from page 42.*)

long. These are afterwards taken to the warp beaming machines that prepare the long warps of yarn which the shuttle interlaces with its trailing weft during the ensuing weaving operation The practical winding speed varies from 400 to 600 yards per minute according to the yarn size and quality.

Dry Beaming Machines.

These machines are used in 'beaming' the sacking warp yarns They draw the individual threads at the feed end from many spools of wound yarn mounted in creels or frames alongside, converting these many ends or threads into a long roll or beam ready for placing up to the loom.

Dressing.

The dressing machine is used for treating the warp yarns, either before or after beaming, with a starch solution which, after drying, provides a stiff thread in a condition suitable for the actual weaving operations. This treatment is given particulary for Hessian yarn where dressing is most necessary.

Weaving.

The weaving of cloth in its basic simplicity can be compared with darning a hole in a fabric. The darning needle can be likened to the shuttle of the loom which trails its weft thread across and through the hundreds of transverse warp threads. In weaving, the warp threads are unrolled from the beam at the back of the loom and contrivances raise and lower them alternately to all the passage of the shuttle across the face. After the weft has made each run a comb beats it up to the rest of the finished cloth, and so the operation continues untill a completed roll of fabric is finally produced at the front of the loom. Looms of 37½ inches width are principally used for sacking and 47½ inches for Hessain. Larger looms of up to 175 inches width are also manufactured.

Finishing.

All Hessian is first passed through a damping machine, then calendered on a heavy 5-bowl chesting calender, and lapped into two-yard folds. It is then press packed ready for delivery.

Sacking is similarly damped and calendered and then cut and folded into the necessary lengths for sewing. Finally it is side sewn, mouth hemmed and press-packed as in the case of Hessian.

THE INSTITUTE OF ENGINEERS (Pakistan) Holds Fifth Annual Convention

By
Qazi Zahur Hussain

Inauguration.

The Fifth Annual Convention of the Institute of Engineers Pakistan was inaugurated by Major-General Iskander Mirza, President of Islamic Republic of Pakistan in the precincts of the Institute building at Dacca on the 27th April, 1958, in the presence of a very large and distinguished gathering including the Governor, Ministers, high officials of the Government of East Pakistan and many dignitaries of the town.

A large number of delegates not only from various centres of the Institute but also from foreign countries such as China, Yugoslavia, Britain and America were present in the spacious and most tastefully decorated Pandal. The President of the Republic who arrived according to the schedule, was received by the President of the Institute, who after presenting the Members of the Council escorted him to his seat on the dais. The proceedings started as usual by the recitation from the Holy Quran and were followed by an Address of Welcome by the Chairman Reception Committee Mr. M. A. Jabbar and by the Presidential Address delivered by Mr. S. M. Hasan. The President of the Republic then rose to address the engineers and having done so and declaring the Convention open left the Pandal to inspect the Institute building and Iskander Mirza Hall which had been founded by him two years ago. It was a pity that the building could not be completed in time for lack of availability of materials and funds, but through the good graces of East Pakistan Government both these hurdles have since been overcome, and it should now be possible to complete it in all respects in the next few months.

Reasons for the Success of this Convention.

This Convention was easily the msot successful of all the annual functions of its kind in the past for the following reasons:

(1) The arrangements made by Mr. Jabbar and his co-workers for the successful completion of the programme, which had been very carefully drawn up, were excellent and everything went off well in accordance with the plan without the slightest hitch.

(2) The personal interest taken by the Chief Minister and Minister of Communications and the hospitality shown by them to the Institute Members, and the assistance rendered by the Government in arranging transport, and in placing the Circuit House at the disposal of delegates who could not be accomodated in the luxurious Shahbagh Hotel added in no small measure to the comforts of the delegates and success of the Convention.

(3) The Government of Pakistan's decision of last July on the subject of recognition of the Institute diploma and raising it to the same status as a University degree contributed much to the importance and prestige of the Institute, and induced many to attend its Annual Convention.

(4) The interest shown by foreign engineering institutions and especially by the Conference of Engineering Institutions of British Commonwealth by inviting a representative of this Institute to the Conference held recently in Australia added much to the popularity and prestige of this Institute as it is considered to be a prelude to the recognition of this Institute not only by the Institution of Engineers, London, but also by all the Institutes in British Commonwealth. It may be pointed out in this connection, that Mr. M. A. Jabbar, Chief Engineer and Vice-President of the Institute who was sent, to represent this Institute, to Australia to attend this Conference has most favourably been impressed by its activities, and after recount-

ing some of them in a printed note has very strongly recommended the membership of the Conference.

Discussion of Papers.

Eleven Papers on various subjects such as Waterlogging and Thur problems in West Pakistan, Earthquake effects and the design of Earthquake Resistant Structures, Railways and Rivers in East Pakistan, Flood Control in East Bengal Delta, Geology and Engineering, Regirdering of Ravi Bridge on the N.W.R., Solar Radiation in Air-conditioning and Flat Plate Heat Collectors, etc. were discussed. All these Papers which contained much useful material were commented upon by various speakers, but Mr. G. Mohiyuddin's Paper on Earthquake Resistant Structures called attention to the general lack of appreciation of stresses set up by earthquake in engineering structures resulting in the total absence of any such provision in their designs. This was considered to be a serious matter and it was thought that a Committee of Engineers be set up with Mr. G. Mohiyudin as a convenor to go into the matter and prepare draft rules governing the design of Earthquake Resistant structures which on approval by the Institute Council should be forwarded to the government for incorporation in its Engineering Code.

Remarks by A Chinese Delegate.

It is not the intention to give a resume of the remarks made on various Papers, as they will form part of the Proceedings of the Convention which will be printed and distributed amongst the members in due course, but it will perhaps interest many to know what a Chinese delegate said in the course of his speech. He told his audience that as far as he could see Pakistan and China were facing similar development problems, but with this radical difference, that while these problems in Pakistan were being handled by foreign consultants and contractores, in China they were being tackled by the Chinese engineers and contractors by utilising country's resources in men and materials. He was at a loss to understand why Pakistani engineers, for whom he had a great respect, were shy in taking up the development work of their own country as the Chinese were doing, and he thought the best way to get over the shyness was for a few Pakistani engineers to go to China to study the methods of planning and executing some of the large Projects in that country, on the receipt of an invitation from Chinese Institute of Engineers which he would arrange to issue on his return to China. He was thanked for his speech and his offer of a visit to China, but he was not at all satisfied when he was told that some of the large Projects in this country were being executed under the Foreign aid programme, which stipulates amongst other things, that all these Projects are to be planned and executed by the Aid-giving Agencies.

Visits to Important Industrial and Engineering Works.

The delegates had a crowded programme of visits to works. The Siddhirgunj Power House, Adamjee Jute Mill and the Karnafuly Paper Mill were amongst the large industrial undertakings, while the extension to Chittagong Port and the construction of the multi-purpose Karnafuly dam at Kaptai were two very important engineering works visited by them.

Social Functions.

This Convention will long be remembered for a number of social functions and lavish entertainments in which the East Pakistan Government, the Institute and other Public and Private Bodies took a prominent part. A brief description of these entertainments is outside the scope of this Article, but the writer will be guilty of ingratitude to these worthy hosts if he failed to acknowledge with grateful thanks the hospitality show by the Chief Minister, Mr. Ata-ur-Rahman Khan, for the grand Garden Party he arranged at his residence to entertain the engineers, the sumptuous lunch at Shahbagh Hotel provided by the Communication Minister, Mr. Kafiluddin Ahmad Chowdry, and the Reception by Mr. Hamid Ali, Governor of East Pakistan, at the Government House. Amongst the list of other hosts the Managements of Siddirgunj Power House and Karnafuly Paper Mills, Messrs. Omarsons, Gammons, Dacca Builders Association, Chittagong Centre of the Institute and the Construction Engineers of Karnafully Dam stand out very prominently, and it is no exaggeration to say that the writer fails to find words to thank them for their

overwhelming hospitality and warmth of feelings they showed towards their guests and especially the delegates from West Pakistan.

The words "build better world" as inscribed on the insignia of the Institute is our principal aim, and with such warmth of feelings and unity of purpose as were exhibited at this and all other meetings of the Convention, there can be no doubt that we will succeed in achieving this object ?

Values of Conventions.

The social and technical values of these Conventions are too self evident to need any proofs. The engineers by virtue of their assignments are scattered all over Pakistan and are engaged on multifarious works of very diverse nature under different conditions. There are no doubt well defined rules of procedure, and set specifications and standard drawings to guide them, but in spite of this, every engineer in the course of his career is faced with problems which are neither described in the text books he has read, nor mentioned in any departmental Manuals, and he has to use his own initiative in solving them. By enrolling himself as a Member of the Institute and attending its Conventions and visiting important Engineering Works in company of some senior engineers he gains a wealth of experience which he cannot otherwise have except by trial and error method which may cost his employer much money and may cost him his job. Moreover, a visit to such a big Project as the Karnafuly dam which is sited in the midst of a dense forest full of wild animals, arouses in him the spirit of enterprise and courage which characterised the early pioneers and he is greatly benefitted by studying the special arrangements made for executing the works under different circumstances and he is tempted to emulate the examples of those engineers engaged in performing difficult tasks. Such annual gatherings of engineers and their visits to important engineering works are normal features of all Engineering Institutions in the world, but the necessity for such gatherings is greater in Pakistan than anywhere else as we have just started on the road to industrial development and have still a long way to go to bring our country in line with the industrialised countries of the world.

Address by the President of Pakistan.

The following is the full text of the speech delivered by the President, Major-General Iskander Mirza, at the opening ceremony of the Institute of Engineers headquarters building and the inauguration of the Annual Convention of Institute in Dacca.

"I have heard with great interest of the progress made by the Institute of Engineers during the last year. The fact that the membership of the Institute has increased to 1.300 and it has also been invited to become a member of the Conference of the Engineering Institute of the British Commonwealth affirms that it has succeeded in finding a stable footing in the very early stages of its young career. I congratulate you warmly on this fine achievement.

"In the fast developing technological age of today the role of technical education has assumed an unprecedented importance. It is in this field that our country needs immediate and all-round expansion. The fear that the employment of foreign experts may hinder our own engineers and technicians from attaining perfection is hardly justified. The technical know-how does not develop in isolation. On the contrary it requires constant and up-to-date touch with the advancement of science in every corner of the globe. The presence of foreign experts in Pakistan should, in fact, provide a valuable opportunity to our young men to keep pace with the theory and practice of modern technology. For this purpose, it is essential that our engineers should be actively associated with the planning and execution of all national projects entrusted to the care of foreign agencies and experts. I hope this is being done. It is both for the Governments and the executing agencies to ensure that this aspect of mutually beneficent co-operation is not ignored.

"The problems of our technical development are so wide and varied and the need for their progressive solution is so urgent that we need more and more engineers gifted with bold imagination and practical approach. Mere increase in

engineering colleges or multiplication of graduate will hardly meet the demand. What is really needed is pride in the profession and a flair for a truly national outlook. I do not think the conditions of Engineering Services in Pakistan compared unfavourably with the terms of other equivalent administrative services. All public services have their own peculiar spheres of work and responsibility and any attempt to equate them in terms of emoluments would be unrealistic and unjustified. However, if there are any genuine inequites or disparities my Government would no doubt pay careful attention to them.

"I agree with you, Mr. President, that the establishment of good and reliable firms of consulting engineers and contractors controlled and staffed by Pakistani engineers should be encouraged. I understand this question is already under the consideration of my Government who would be only too glad to receive helpful suggestions and advice from your Institute. The degree awarded by the Institute has already been recognised and I assure you that Government would give their sympathetic attention to your legitimate demands for financial aid.

"There is one important question, Mr. President, which I would like to bring to the pointed notice of this assembly of experts. As a layman I feel that the pace of our development can never reach its full stride unless we devise effective ways and means to utilise our own indigenous resources in place of imported materials. Our economy is already under a heavy strain and our foregin exchange resources are extremely limited. If we go on depending on foreign imports for implementing our engineering plans we are bound to face serious handicaps.

Nature has luckily endowed us with unlimited resources and it is for the ingenuity and imagination of our engineers to harness them to our plans of development. The ultimate key of our progress lies in a complete utilisation of our own natural resources. I hope our experts will give this matter their earnest attention.

"I have now great pleasure in declaring this Convention open. I also declare open this Hall which you have so kindly decided to name after me. I value this honour and thank you most sincerely for this generous gesture."

Presidential Address.

Mr. S. M. Hasan, President of the Institute of Engineers (Pakistan), in his presidential address appealed to the Government to encourage the profession of engineering by giving it its due status and by not making engineering services subordinate to any non-technical service. He felt that the Government policy of making the engineering services subordinate to non-technical service stifled the growth of engineering talent and was not suited to a country like Pakistan, which was to be governed by the representatives of her own people.

Mr. Hasan stressed the necessity for establishing more engineering colleges in East Pakistan as otherwise, he said, it would not be possible to meet the constitutional obligation of parity in engineering services.

He put forward three suggestions which, according to him, would make the way congenial for the development of the country in the field of engineering. These are :

(*a*) Creating conditions which would ensure that a reasonable proportion of the country's best young talent was regularly attracted towards engineering.

(*b*) Increasing the number of engineering colleges and raising the standard of the existing ones ; and

(*c*) Re-orientating the systems of utilising the services of the engineers so that sufficient scope and incentive are provided for them to work hard to increase their professional ability.

Mr. Hasan expressed the hope that the Government would come forward with help and co-operation to crown the efforts of the Pakistan engineers with success.

Consulting Engineers.

Mr. Hasan felt that the Government should encourage the establishment of firms of consulting engineers and contractors controlled and staffed by Pakistan engineers. He further pleaded for entrusting them, on a competitive basis, with the preparation, supervision and execution of all big projects in the country.

He, however warned that the policy should be so framed as not to permit the setting up of monopolies by individuals or firms.

NOTES & NEWS

Karnafuli Multipurpose Project.

Situated on the Karnafuly river about 60 miles upstream of the Chittagong port, Karnafuly Multipurpose Project will cost Rs. 320 million to complete. On completion, by the year 1961, it will be the biggest and most important Project for East Pakistan for it is intended, to produce cheap power to the extent of 160,000 K.W. and will thus provide incentive for the developement of many new industries, to control floods in the lower part of the Karnafuly Valley, to provide navigation facilities for a distance of 400 miles upstream of the proposed dam in an area which has remained practically inaccessible inspite of its being rich in forest produce and mineral resources, to form a large reservoir of 250 square miles in area at the maximum reservoir level and thus convert the existing wilderness into a health resort and recreation spot not only attracting tourist but also improving the commercial and fishing prospects, to control if not eliminate the deposit of silt at the upstream site of the reservoir and prevent its carriage to the lower reaches of the river to be deposited in the channel between Chittagong port and the sea forming silt bars and making navigation difficult.

Karnafuly dam is an earth-filled dam, 2200 feet long with a cross sectional width of 25 feet on the top and 800 feet at the base and a maximum height of 150 feet above foundation. It is being filled in with specially selected soil which is being carried to site in heavy trucks, spread evenly in layers and consolidated by sheepsfoot rollers to ensure uniform structure, well compacted and of high impermeability.

The spillway which is designed to take the maximum outflow of 520,000 cusecs is located on the left abutment of the main dam. It is to be 737 feet 6 inches long at its crest and is to have 16 large gates 40 feet by 32 feet in size capable of discharging the maximum overflow into a channel 4000 feet long with a bed width of 400 feet and bed fall of 1 in 80 and with side slopes of 1 to 1½ to 1. This work is to consume 376,000 cu.ft. of concrete.

The diversion tunnel which is to be 1270 feet long and 20 feet in diameter is designed to handle 2000 cusecs with the dual purpose of carrying the normal discharge of the river during the construction stage and of maintaining an adequate volume of water below the dam when the reservoir level drops below the base of spillway gates. It is to have a concrete lining for which 217,000 cu. ft. concrete will be consumed. The diversion channel is 3500 feet long with a base width of 150 feet and side slope of 1 to 1 on the right bank and 2 to 1 on the left. The total earthwork in excavation as per estimate is 25 million cu. ft. The diversion tunnel and diversion channel are complete and in operation.

The Power House will consist of 3 units of generating plant of 40,000 K.W. each, two of which will be installed initially. When the third unit will be installed, the increasing power requirements of Narayangunj and Dacca area will be met by inter-connecting it with Siddhirgunj Power Station. The work on the Power House foundation is nearly complete.

A navigation lock is also being provided in the main dam to allow the passage of timber, bamboo and other traffic from the upstream to the downstream side of the dam. This work is however, being put off for some time, but a contrivance called monorail cargo transfer will be installed to deal with all such traffic.

Siddhirgunj Power House.

This is the largest Power House at present in East Pakistan and is meeting the power requirements of the highly industrialised area of Narayangunj and Dacca. A 15000 K.W. diesel plant at present meets the urgent requirements of Adamjee Jute Mill and several other industrial concerns. But in view of the ever growing power demand, the installation of 3 × 10,000 K.W. steam turbo allernators is in progress, which on completion will make this area self sufficient for quite a long time when eventually it will be connected by a grid to Karnafuly Power Station.

The extent and magnitude of this Power House can be gauged from the fact that it covers an area of 82 acres, occupies a river front of 925 feet and will cost Rs. 45 4 millions. As the area on which it was built was very low and subject to inundation from Lakbya river, the entire ground had to be raised by 9 feet and all heavy building columns, heavy machinery and pump house had to be provided with raft foundation supported on 20 to 30 tons concrete piles.

Karachi Electric Supply Co.

The World Bank has announced the grant of $ 14 million loan to the Electric Supply Corporation of Karachi, a public utillity, for financing a 600,000 Kilowat steam Power Station. The World Bank had earlier also made a loan of $ 13.8 million to the K E.S.C. in June, 1935 for financing foreign exchange cost of construction of a 30,000 Kilowat steam Power plant. This brings the total of World Bank loan to Pakistan to $ 126, 450,000.

Power and Fertilizer from Sui Gas.

Prime Minister Noon laid the foundation stones of the P. I. D. C. National Gas Power Station and P.I D.C Natural Gas Fertilizer Factory at Multan on April, 24, 1958. The Power Station will have a total capacity of slightly over 140,000 K.W., comprising two large turbo-alternators of 65,000 K.W. each and two gas-turbo sets of 57,000 K.W. each. It will be the largest thermal station in Pakistan.

Nishtar Hospital at Multan.

Forming part of the main scheme of Nishtar Medical College, the Nishtar Hospital with 400 beds, main administrative wing, modern operation theatres and kitchen block is nearing completion. Two hundred beds became available in the year 1955 along with the operation theatres. The work had slowed down due to financial difficulties and the remaining work is now being completed. About Rs. 90 lakhs have been spent on the hospital works The hospital has been planned on the most modern lines with all ancilliary requirements. Four hundred more beds can be further added to the hospital in furture for Rs. 35 lakhs.

Ship Building at Competitive Rates.

The P.I.D.C. Karachi Shipyard is facing a problem. How to build ships for national companies at competitive rates without Government subsidy? The issue came to the fore-front when the Center proposed to the national shipping concerns that they place orders for the construction of new vessels with the P.I.D.C. Shipyard, and they have agreed with a reservation that the shipyard must quote competitive prices. The P.I.D C. contends that it can do so only if the Government subsidises the shipyard. It has pointed out that Bharat ship building industry is subsidised by the Government to the extent of 30 per cent in addition to the subsidised steel the shipyard gets. Moreover, the Bharati Government also finances the Bharati ship owners to the extent of 80 per cent of the cost of these ships for a period of 10 to 12 years at nominal rates of interest. Even in U.S.A., the Government provides subsidy for the country's ship building industry. The other condition imposed by the national shipping concern about payments over long period on pattern of foregin ship building concerns has been accepted by the P.I.D.C

Development Plan for Zhob.

The West Pakistan Irrigation Department have completed the blue print of scheme which on implementation would

help in bringing 1500 acres of additional cultivable land under irrigation in Zhob district, Quetta Division, at an intitial cost of Rs. 2,80,000. It will take two years to complete and will benefit the villagers to the extent of Rs. 4 lakh annually and will bring to the Government a revenue of Rs. 35,000/-.

Lead Deposit in Kalat Area.

Large deposits of superior quality lead extending over a large area have been found in the Drang Kalat area of Chagai district. Lead is used extensively in electrical, chemical and explosive industry for making electrical cables, water pipes and lead chambers in the manufacture of sulphuric acid, etc. Its export can fetch large quantities of foreign exchange.

West Wing plan for improving Water Supply.

The Provincial Government has decided to spend Rs. 10,00,000 for the improvement and extension of water supply arrangement in the rural and urban areas of the Province. The amount, it is understood has been placed at the disposal of Provincial Sanitary Board and will be disbursed as grants-in-aid among those local bodies and Government institutions which undertake to contribute half of the estimated expenditure for the implementation of such schemes in their respective areas during the current financial year.

800 Mile Embankment for East Pakistan.

About 800 mile long embankment on the coastal belt of Bakergunj, Noakhali and Chittagong districts will be constructed to safeguard a vast tract of paddy land from annual inundation by saline water from the sea. It will make cultivable about 1.3 million acres of land.

Deposits of Chromite ore Promissing.

According to the Japanese Mining Research Team leader, Mr. Mine Toshi Tohma, deposits of high grade chromite ore in Baluchistan were highly promising and if a thorough survey was conducted, additional deposits might be found.

Water Supply Plan for Karachi.

The Karachi Development Authority has allotted Rs. 55 million this year to complete the first phase of the bulk water supply scheme for Karachi. External financial requirements about Rs. 4.5 million will be contributed by the I. C. A.

Research in U.S. Industry.

According to figures collected by the Mac Graw-Hill Publishing Company, the U.S. companies will be spending 8000 million dollars on research this year. This is 14 per cent more than the last years expenditure. At the same time, outlays on plant and equipment are being reduced by 12 per cent. The amount will be 34,000 million dollars. Nine out of the 10 companies who supplied data for the survey said that they expected to receive their spending on research work within five years either through increased sales or reduced expenses.

World Industrial output at new height.

The volume of world industrial output last year set a new record. Combined exports of the industrialised countries of Western Europe, including Britain, Canada, Japan and the United States totalled £ 4000 million i.e., nine per cent above the 1956 figures.

Transport Link with Kabul.

Pakistan and the I. C. A. signed a project assistance agreement involving over seven million dollars to improve Pakistan's transport links with Afghanistan. A separate agreement on similar lines has also been signed by America and Afghanistan. This American assistance will help Pakistan and Afghanistan to implement the provisions of a transit trade agreement recently concluded between the two countries. The main feature covered by this agreement are the development of rail transport facilities in Pakistan from Karachi over the short route via Dadu and Quetta to the Afghanistan border near Chaman. The N. W. R. will purchase 11 new diesel locomotives for use on the Quetta route and approximately 500 new goods

wagons including tank cars to increase the carrying capacity. Automatic electric block signal will be installed on the main line from Karachi tc Landhi. A new goods marshalling yard will be constructed at Karachi on the railway main line and improvements in track and layout, bridges, etc., on the branch line from Kotri and the extension of N. W. R. from Chaman to a point on the Pakistan-Afghan border.

Vehicle-Speed Measuring Equipment.

The vehicle-speed measuring equipment of Venner Electronics Ltd., incorporates 54 transistors, and is receiving consideration by the Metropolitan Police, who are testing the device on outer London roads. It was primarily developed for the Road Research Laboratory of D. S. I. R., and is basically a device for measuring small intervals of time to a high degree of accuracy. Attached to the electronic elapsed-time indicator are two rubber tubes long enough to span a road, each of which is connected to a pressure switch. The two tubes are laid across the road at right angles to traffic flow, and spaced a little under 6 ft. apart. Immediately the front wheels of a vehicle cross the first tube, the pressure switch starts the timer. As soon as the wheels cross the second tube the timer stops, the elapsed time being recorded by the meters. The reading remains on the meters until the equipment is manually reset. The equipment incorporates a crystall oscillator operating at 10 Kc/s as the basic time element. The output of this unit is passed to two binary dividers to give a 2.5 Kc/s singal, which is in turn fed to a gating circuit. The gate is opened by the vehicle passing over the first strip, and closed when it reaches the second strip. The number of pulses passing through the gate whilst it is opened are counted by three decade-counting stages with digital presentation on meters calibrated from O to 9. The frequency and distance are chosen so that the resultant indication may be divided into 10,000, giving the speed of the vehicle.

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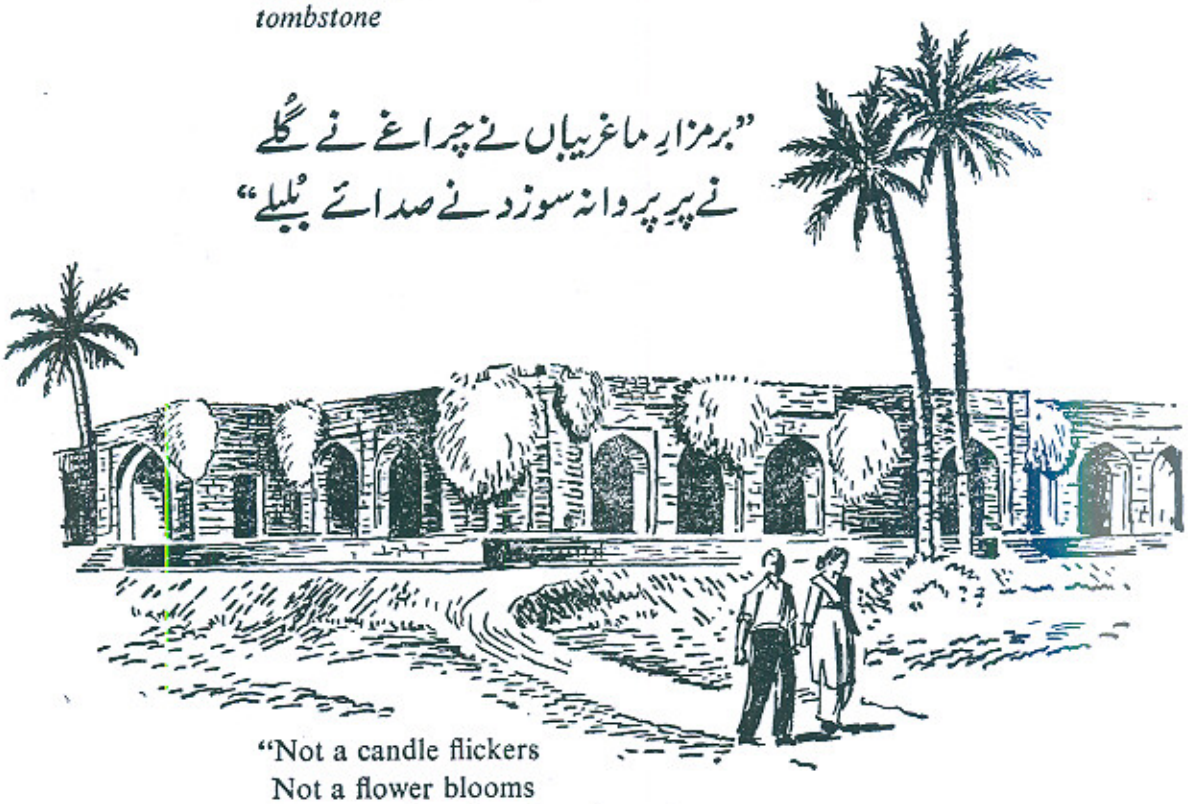
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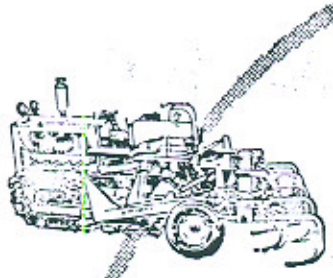
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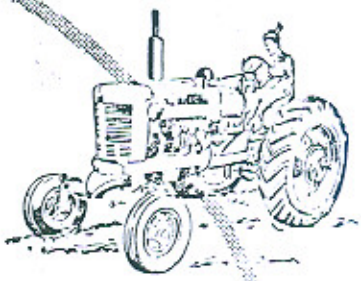
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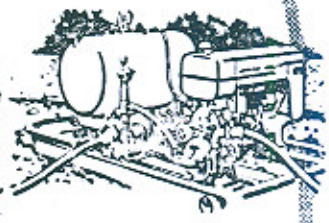




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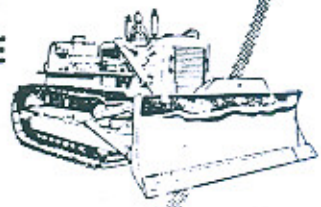


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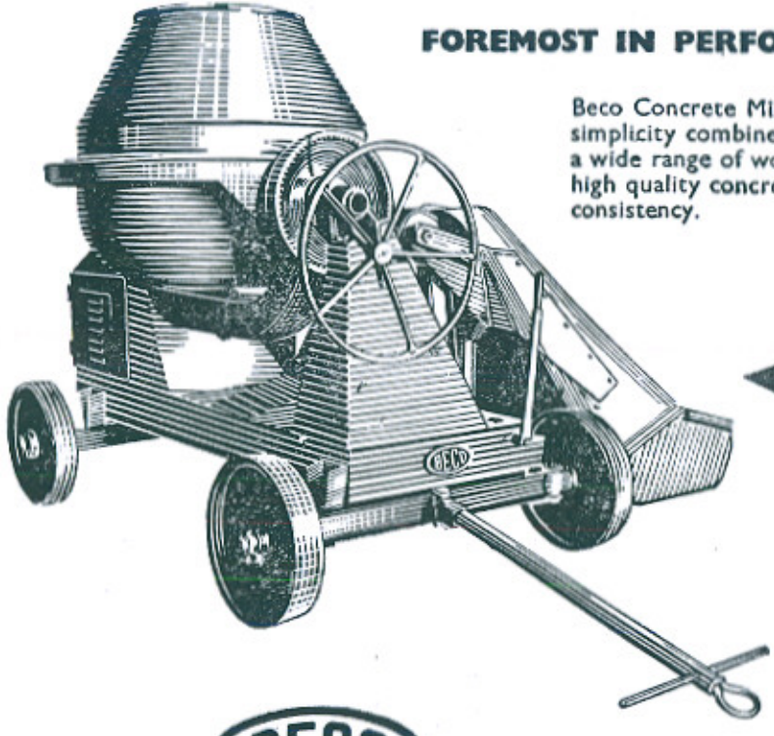
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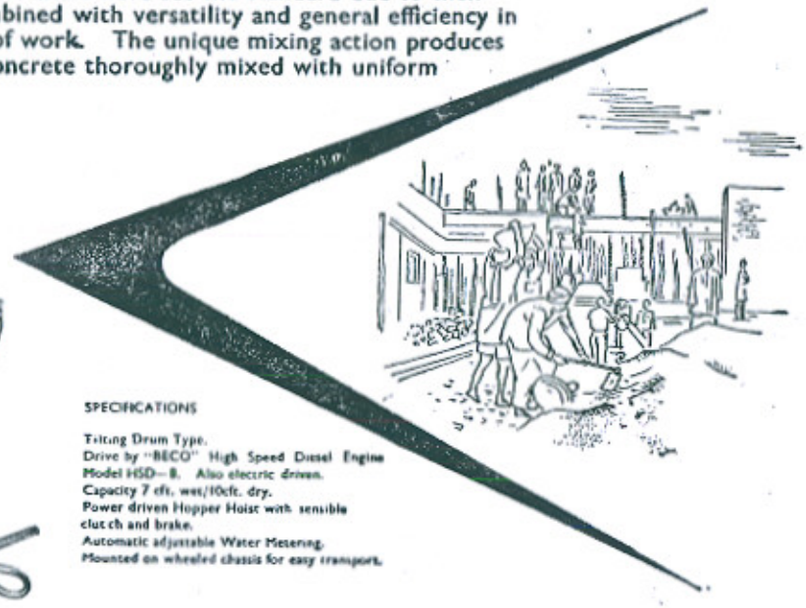
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