TABLE - 2

Chasma Jhelum Link Canal-Sand and Aggregates Test Results

SAND

Property	ASTM specified requirement.	Actual Properties (from Total of 22 Tests)					
		Coarsest Sand		Finest Sand		Average Sand	
		Indiv	Cummul	Indiv	Cummul	Indiv	Cummul
1	2	3	4	5	6	7	8
Gradation Percent Retained on Standard Screen Number :							
4	0.5	0.37	0.37	0.23	0.23	0.16	0.16
8	6-15	16.25	16.62	6.60	6.83	10.30	10.46
16	10-25	28.25	44.87	14.90	21.73	20.65	31.11
30	10-30	18.90	63.77	21.99	43.72	21.04	52.15
50	15-35	14.25	78.02	21.69	65.41	20.92	73.07
100	12-20	16.80	94.82	26.40	91.81	21.16	94.23
Pan	3-7	5.18	100.00	8.19	100.00	5.77	100.00
Total		100.00		100.00		100.00	
Fineness Modulous	(a)	2.98		2.30		2.61	
Specific Gravity	(a)	—		—		2.68	
Absorption (Percent)	(a)	—		—		1.27	
Silt Content (percent)	3.0 max.	—		—		1.85	
Colour Test for Organic Impurities.	No. organic impurities					No organic Impurities.	

(Contd.)

COARSE AGGREGATES

Property	¾" Nominal Size (Total of 16 Tests)		½" Nominal Size Total of 15 Tests)	
	Specified	Actual	Specified	Actual
1	2	3	4	5
Undersize-Percent passing :				
No. 5 Screen	Max. 2.0	7.27		
⅜" Screen	—	—	Max. 2.0	9.68
Gradation-percent Retained on				
⅜" Screen				
1" Screen	Min. 45-80	52.5	—	—
Specific Gravity	—	—	Min. 45-80	42.45
Absorption (Percent)	Min. 2.60	2.66	Min. 2.60	1.66
Material Passing 200	(a)	1.32	(a)	0.91
Screen (Percent)	Max. 1.0	0.83	Max. 1.0	0.43

(a) Not specified.

Note : Adjustment was made in the field mixes to compensate for undersize coarse aggregate.

(Concld.)

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	Specified	Actual	Specified	Actual
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Undersize-Percent passing :				
No. 5 Screen	Max. 2.0	7.27		
⅜" Screen	—	—	Max. 2.0	9.68
Gradation-percent Retained on				
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(a) Not specified.

Note : Adjustment was made in the field mixes to compensate for undersize coarse aggregate.

(Concld.)

2.22 Site Check Guides :

On small jobs or remote locations, where execution of laboratory tests is uneconomical, the judicious application of care and common sense will help to obtain aggregate reasonably conforming to the specifications related in the preceding paragraphs. The best procedure in such cases is to use well known local aggregates that are being used satisfactorily on other jobs elsewhere.

When the aggregates are being delivered on the job and the supply has attained reasonable momentum, examine random loads as delivered. Take up handfuls of aggregate and let it drop through the hands so that it can be examined in detail. In so doing, watch out for-small balls of clay, sort spongy stones, flaky stones, pieces of brick, soft shale, crumbly bits of sand stone, that is to say, watch out for all stones which are not hard, and watch out for clay and dirt left on the hands. If the Resident Engineer finds more than one or two pieces of weak stones, or more than a single piece of clay from a few handfuls, it must be brought to the notice of the supplier. If a load contains numerous weak stones or more than a few bits of clay it should be rejected. Checks should be made of the aggregate gradings in the various stock piles to ensure that there are no great variations from those used in determining the job-mix formula. If new aggreates with different gradings are supplied, the mix proportions have to be reconsidered.

Checks on the moisture content of the fine aggregate also carry significance. The volume of a given weight of fine aggregate is a minimum when it is absolutely dry or when it is completely inundated. In these states there is little difference in volume. At intermediate moisture contents of between 3 and 10 percent, the exact values depending to a large extent on the fineness of the grading ; the finer the grading the larger is the percentage by which the material bulks. In practice, if great accuracy is not required, a fine sand may be assumed to bulk by about 30 percent and a coarse sand by about 20 percent.

2.23 Washing of Aggregates

Aggregates should be stock piled on built-up platforms having proper slopes for draining out the water used for washing the aggregate. Unwashed aggregates suitable for concreting are very rare. They are invariably dangerous to use. Sometimes a river sand is supplied unwashed with the assumption that the sand has already been washed by the river water. This should not be accepted as a fact. A river carries silt and clay, and more than likely the river sand will have its quota of those materials too. Seabed or beach sands and aggregates require washing to remove the salt from them. The chlorides in sea shore sand and shingle are liable to cause corrosion of the reinforcement. Hence, always choose washed aggregate, because good concrete cannot be made when clay, organic matter, or salt are present. If there is no economic alternative to using unwashed aggregates, then specialised technical control must be set up immediately. This is a situation to be avoided if possible.

2.3 Water

The water to be used for making concrete should be a good drinking water. It should be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities. The water to be used in the concrete must be tested by the Resident Engineer to determine compliance with these requirements.

2.4 Admixtures

Admixtures are used in the concrete in order to improve certain of its properties. They consist chiefly of those which accelerate and those which retard hydration or setting of cement, finely divided materials for improving workability, air entraining and water reducing agents, water proofers, pigments, and pozzolanas.

The most commonly used accelerator is calcium chloride. Calcium Sulphate in small amounts is commonly used retarder and yet, with increased amounts, its behaviour changes and it becomes powerful accelerator. Organic materials such as gelatin, glue, and sugar are used as retarders. The use of calcium chloride as accelerator in prestressed concrete should be avoided altogether.

The amount of air-entraining admixture used should be such as will effect the entrainment of from four to not more than six percent of air by volume of the concrete as discharged from the mixer. The admixture should be added to the batch in solution in a portion of mixing water. The solution is to be batched by means of a mechanical batcher capable of accurate measurement and in such a manner as will ensure uniform distribution of the agent throughout the concrete batch during the specified mixing period. The amount of water-reducing admixture to be used in the concrete is also added in the form of solution as a part of mixing water. The amount of water-reducing agent used and mixing thereof should conform to the requirements of A S T M Designation : C 494 and should be subject to sampling and testing by the Engineer.

3. Concrete Mixes

A comprehensive discussion about the mix design is beyond the scope of this article. However, some working information is provided covering important aspects of mix design. Various concrete mixes which were used for the construction of all the concrete structures, like control cum fall and culvert structures, all types of bridges, drainage inlets etc. on Chasma-Jhelum Link Canal, which is the biggest link canal of 21,700 causecs discharge constructed under Indus Basin Plan, are given in Table 3 for guidance. Mixes are designed by taking into account the compressive strength specifications and workability necessary for the satisfactory placing of the concrete. The method of designing a mix for a given compressive strength has a wide acceptance, as most of the desirable properties of concrete improve as its strength is increased. The primary change in the modern practice is to specify a mix by weights instead of nominal proportions, e.g.1 : 2:4 etc. The British Standard Code of practice for reinforced concrete (CP114) stipulates that also.

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TABLE - 3

CHASMA JHELUM LINK CANAL-CONCRETE MIX DESIGNS

Mix No.	Period of use on Project.		Cement Content (a) (lbs/cu. yd)	Water/ Cement Ratio	Slump (inches)	Amount of Entrained (b) percent.	Unit Weight of mix (lbs. cft)	Aggregate Proportions (Percent)		
	From	To						Sand	⅜ inch	1½ inch
1	2	3	4	5	6	7	8	9	10	11
1	Dec. 1967	Feb. 1968	500	0.56	3.0	5	143.0	38.0	24.8	37.2
1-A	Jan. 1968	Apr. 1968	480	0.56	2.0	5	143.7	36.0	25.6	38.4
2	Dec. 1967	Jul. 1968	575	0.56	3.0	6	139.4	44.0	56.0	—
3(c)	Dec. 1967	Dec. 1967	430	--	--	—	143.3	44.0	56.0	—
3A(c)	Dec. 1967	Mar. 1970	256	—	—	—	141.5	49.0	51.0	—
4	Feb. 1968	Jul. 1968	480	0.58	3.0	5	143.7	36.0	25.6	38.4
5	Jul. 1968	May 1969	540	0.59	3.0	5	142.1	45.0	55.0	—
6	Mar. 1968	Jul. 1968	600	0.52	3.0	5	142.7	45.0	55.0	—
7	Apr. 1968 Nov. 1969	Jul. 1968 Sep. 1970	460	0.58	2.0	5	146.0	36.0	25.6	38.4
8	Jul. 1968	Nov. 1969	460	0.59	3.0	5	145.7	36.0	25.6	38.4
9	Jul. 1968	Nov. 1969	440	0.59	2.0	5	146.4	36.0	25.6	38.4
10(d)	Sep. 1968	Mar. 1970	500	0.55	3.0	5	146.0	36.0	25.6	38.4
11(e)	Sep. 1968	Feb. 1969	700	0.43	6.0	4	145.3	35.0	26.0	39.0
12	Apr. 1969	May 1969	420	0.59	2.0	5	147.0	34.0	26.4	39.6
12A	May 1969	Feb. 1970	420	0.59	2.0	5	147.0	35.0	26.0	39.0
13	Nov. 1969	Feb. 1970	480	0.58	3.0	5	144.5	36.0	25.6	38.4

(a) All cement used on the project was Maple Leaf Cement manufactured in Pakistan.

(b) Water-reducing and air-entraining agents were used together at the rate of :

Febflow = 21-32 ounces per cubic yard.
Febcrete = 2.5-5.6 ounces per cubic yard.

(c) Blinding course concrete.

(d) High early strength concrete.

(e) Tremie concrete (used in the well foundations of railway Bridge).

(i) The mix should be designed to meet some particular strength requirement, or (ii) failing this, a 'standerd mix' should be used by weight rather than by volume.

British standard code of practice CP114 (CL. 208 (b) gives three well-known mixes and the amounts of fine and coarse aggregates usually required per bag (112 Ibs) of cement to make them up. The data is set out in Table 4

TABLE 4 NOMINAL MIX PROPORTIONS

Nominal Mix.	Volume of aggregate per 50 Kg (112 Ibs approx *Cement	
	Fine Aggregate (Sand)	Coarse Aggregate
1:1:2	0.035 m3 ($1\frac{1}{4}$ Cft)	0.07 m3 ($2\frac{1}{2}$ Cft)
1:$1\frac{1}{2}$:3	0.05 m3 ($1\frac{7}{8}$ Cft)	0.10 m3 ($3\frac{5}{8}$ Cft)
1:2:4	0.07 m3 ($2\frac{1}{2}$ Cft)	0.14 m3 (5 Cft)

*50 kg of cement

These are the nominal volumes specified ; the ratio of fine to coarse aggregate may need to be altered according to the actual grading of the aggregates available and the actual total grading required. This the code permits, provided the sum of volume of the aggregates used (each measured seperately) equals the sum of volumes in the above table for approximate mix.

The compressive strength of concrete may preferably be obtained from tests on 6 inch by 12 inch cylinders. Cubes are used in Europe ; these are simple to make and are useful for testing, but do not always give satisfactory results. The minimum 28 day compressive strength of 3,000 p.s.i. should be attained by all the trial mixes, for reinforced concrete ; the concrete mix for pretressed members should indicate minimum cylinder streugth of 4,500 p.s.i. at 28 days.

4. Construction Methods

Now-a-days, the batching, mixing, transportation, placing and vibration of concrete are carried out with mechanized techniques. Nevertheless, for smaller jobs the production of concrete can be done by the use of locally avaibable labour. In this case, considerable care and attention is required for obtaining requisite quality of concrete. Table 5 indicates principal concreting equipment deployed for the construction of concrete structures on Chasma-Jhelum Canal.

4.1 Form-work :

The care and time spent on the forms is of great importance, for it is the mould which gives shape, finish, and texture in the building. All kinds of forms, especially forms for beams, copings, belt courses, and other exposed concrete works should not only be straight when completed, but should also be braced in such a manner that they will remain straight and secure until the concrete has set. Accorningly, it is one of the essential duties of the Resident Engineer to examine the forms under the subsequent headings :

1. Are all the forms true to the lines, grades, and dimensions of the concrete ?

Table 5 - Chasma Jhelum Link Canal
List of Principal Concrete Equipment.

Quautity	Equipment	New or used	Manufacturer	Country of Manufacture
2.	Batching Plant TY-227, 30 Cubic Yard.	Used	Johnson	U.S.A.
4.	Concrete Mixers 10/7	New	BECO	Pakistan
6.	Concrete Buckets 1.7 m^3	Used	CIFA	Italy.
10.	Concrete Buckets 1 m^3	New	Secatol	France.
8.	Immersion Concrete Vibrators, STV Model 32 GR	New	STV	France.
10.	Immersion Concrete Vibrators, STV Medel 50 NM	New	STV	France.
26.	Immersion Concrete Vibrators, STV Model 70 NM	New	STV	France.
4.	Immersion Concrete Vibrators STV Model 104 GR	New	STV	France.
6.	External Vibrators, G 50 S	New	STV	France.
1.	Curing Compound Applicator.	New	Allman	U.K.
1.	Concrete Chipper Model B 40	New	Renault	France.
1.	Concrete Lifter	New	Hammerein	France.
2.	Mobile Conveyors.	New	Camn	France.
1.	Dragline Tower	New	Pellauto-Elha	France.

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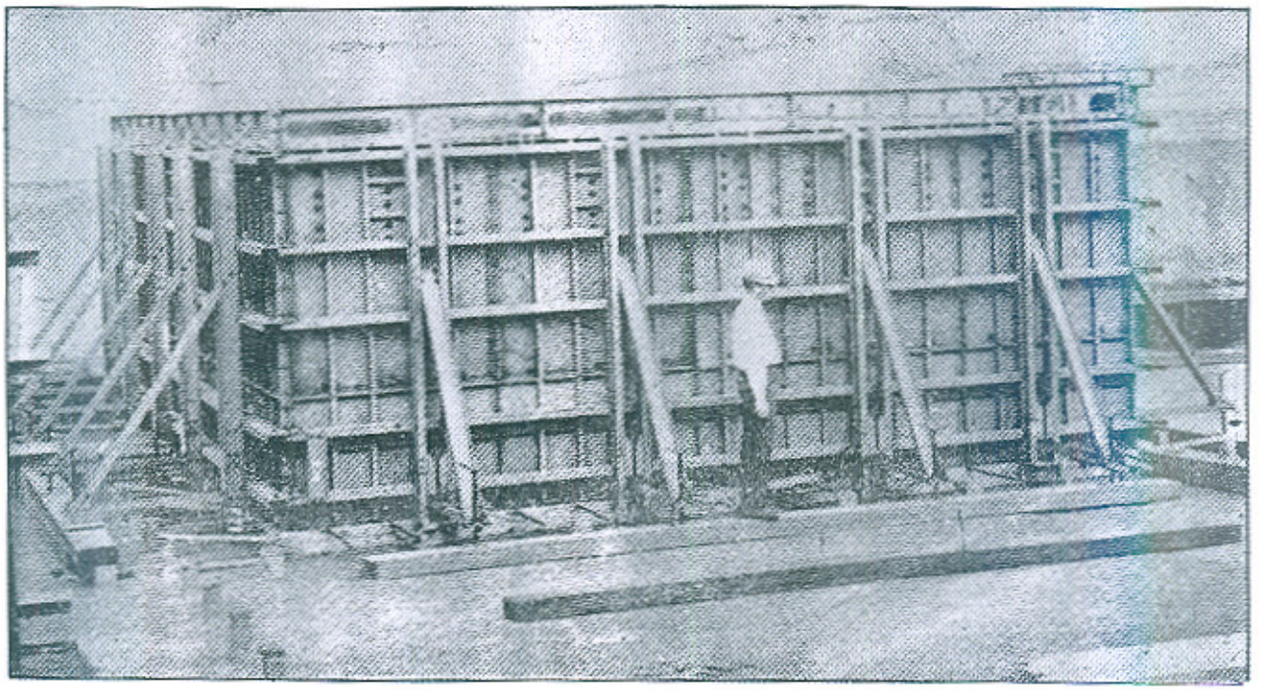

Fig. 1 Steel forms for one of the pours of down stream floor of Rasul barrage

2. Are all the forms properly secured in position and well strutted to resist all the forces to be exerted on them ?
3. Are all the form-supports carried to firm foundation to preclude any settlement of forms during construction ?
4. Are all the joints water tight and flush ?

Forms may be of metal, metal-lined timber, fir plywood lining, tempered pressed wood lining, or smoothed planned boards in good condition, so as to produce good surface finish. Suitable and effective means should be provided in the consturction of all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, offsets or similar surface defects in the finished concrete surface. Figure 1 shows steel forms for one of the pours of down stream floor of Rasul Barrage.

Before the concrete is placed, the surfaces of the forms should be oiled with a commercial form oil that will effectively obviate sticking of the concrete to the forms and will not stain the concrete. All bond breaking materials or processes should be subject to the approval of the Resident Engineer. Care should be taken in applying form oil to avoid its touching with reinforcing steel as it will cause a loss in the bonding characteristics of the steel bars.

It is invariably desirable to place chamfer strips in the corners of forms so as to produce bevelled edges onpermanently exposed concrete surfaces. Interior angles on such surfaces and edges at formed joints will not require bevelling unless requirement for bevelling is so indicated on the drawings.

4.2 **Batching :**

The amounts of cement, sand and aggregate entering each batch of concrete should be determined by weighing or by volume, if specified so in the mix design. The amount of water is determined by weighing or volumetric measurement. In the case of volume batching, allowance has to be made for the bulking of the fine aggregate caused by moisture as well as the adjustment for the actual quantity of water contained in the aggregate.

The contractors generally try to save the cement. The Resident Engineer should, therefore, make arrangements to ensure that every batch of concerete is receiving its specified amount of cement. Cement should be weighed in an individual weighing hopper. Scales for weighing cement should be equipped with an accurate recorder for registering the weight of cement used in each batch of the concrete. The recorder should be completely enclosed and capable of being locked.

The mixing time has some effect on the variation of concrete strength. The concrete ingredients should be mixed in a batch mixer for not less than 1½ minutes after all ingredients, except for the full amount of water, are in the mix. The mixing time will be increased where the batch mixer exceeds a capacity of 2 cubic

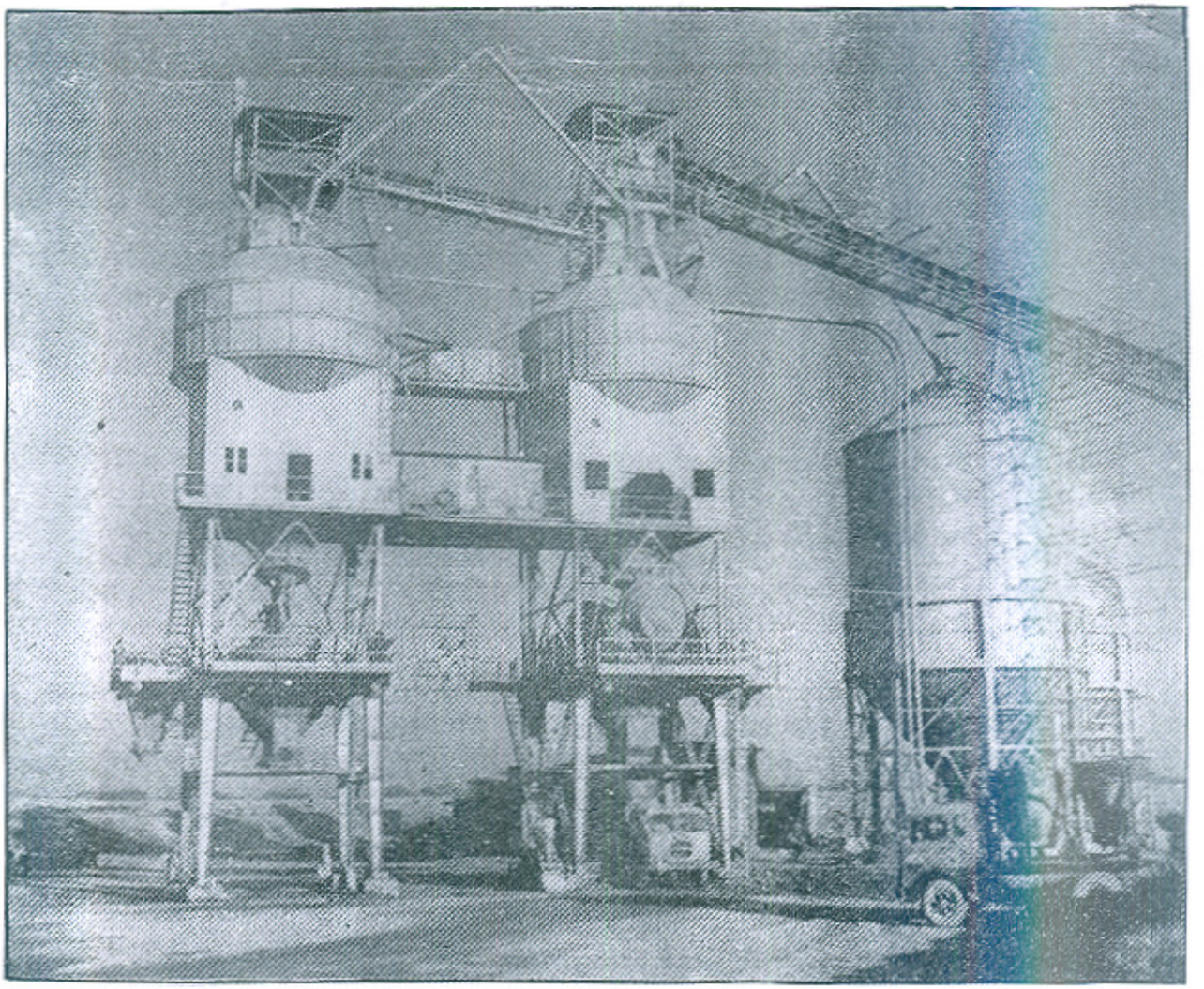

Fig. 2 Main concrete batching and mixing plant with cement sillos in the background

yards. The Resident Engineer should have sound understanding of good quality concrete mix and should increase the mixing time when the charging and mixing operations fail to produce a concrete batch in which the ingredients are thoroughly and evenly distributed and consistency is uniform. Execessive overmixing requiring the addition of water to preserve the required concrete consistency should not be allowed.

The speed of the mixer should be checked periodically as it is in fact the number of revolutions of the drum which is important rather than the actual time of mixing.

4.3 Temperature

The temperature of concrete when it is being placed should not be more than 90 degrees fahrenheit and not less than 40 degrees Fahrenheit, except that the temperature of the concrete placed in large slabs having a thickness of 5 feet or more should not exceed 80 degrees Farcheit. When the temperature of the concrete as placed is to be between 80 degrees Fahrenheit and 90 degrees Fahrenheit the concrete should be mixed at the job-site and discharged immediately into the work after mixing. If the concrete is placed when the weather is such that the temperature of concrete would exceed 90 degrees Fahrenheit, effective means, such as precooling of aggregate and mixing water, and placing at night, to maintain the temperature of the concrete below the maximum limits specified herein, should be adopted.

4.4 Preparation for Placing

Before permitting the placing of concrete, the Resident Engineer must pay special attention to the following points.

1. All formwork, reinforcement, installation of parts to be embedded, bracing of forms and preparation of surfaces involved are in accordance with requisite specifications.
2. No concrete should be placed in running water or be subject to the action of the running water until after the concrete has suffciently hardened.
3. Except for the concrete to be placed in well foundations, no concrete should be placed in water without adopting some special measures and methods of depositing the concrete.
4. All surfaces of forms and embedded materials that have become encrusted with dried mortar or grout from concrete previously placed should be cleaned of all such mortar or grout before surrounding or adjacent concrete is placed.
5. Immediately before placing the concrete, all surfaces upon or against which the concrete is to be placed should be free from standing water, mud, debris or loose material. The surfaces of absorptive materials against or upon which concrete is to be placed should be moistened thoroughly so that moisture will not be drawn from the freshly placed concrete.

6. Where surfaces to be covered by fresh concrete are absorptive, and where it is necessary to facilitate placing and vibrating concrete in paving and base slabs, a "blinding course" consisting of a 2 inch layer of concrete be placed and allowed to set for 24 hours prior to the placement of the fresh concrete.

7. Concrete surfaces upon or against which concrete is to be placed, and to which new concrete is to adhere while these surfaces have become so rigid that the new concrete cannot be incorporated integrally with them, are defined as "construction joints". The surfaces of construction joints should be clean and damp when covered with fresh concrete or mortar. Cleaning will consist of the removal of all laitance, loose or defective concrete, coatings or foreign material. The surfaces of construction joints should be cleaned by wet sandblasting or other approved methods and then washed thoroughly with high pressure air-water jets immediately prior to the placement of fresh concrete. The sandblasting and washing would be performed at the last opportunity prior to placement of concrete. All pools of water should be removed from the construction joint surfaces before the new concrete is placed.

8. The surfaces of all contraction joints or expansion joints should be thoroughly cleaned or accretions of concrete of other foreign materials by scrapping, chipping or by other means satisfying to the Resident Engineer.

4.5 Placing

1. The means and equipment used for transporting concrete should be such that concrete having the required composition and consistency will be delivered to the work without objectionable segregation or loss of slump. Many ingenious devices are used for conveyance of concrete to its place in the structure. Wheelbarrows, two wheeled buggies and head-baskets have been long used and are reliable conveyances for small projects. Cubical hinged-bottom buckets were once extensively used but these have been superseded almost completely by cylindrical buckets provided with a rolling gatelike bottom discharge. Great quantities of concrete are placed by pumping from the mixer to the forms through several hundred feet of 6 or 8 inch pipe, with verticle lifts as much as 200 ft. This is carried out with ramlike pumping machine and has trade name pump-crete. The selection of suitable means and equipment for handling and placing of concrete depend upon the type and location where the concrete is to be placed in a structure. Accordingly, now it is more often required that contractors should arrange suitable equipment for the kind of concrete desired in the structure.

2. All concrete which has become so stiff that proper placement cannot be assured should be wasted, Concrete should be deposited in all cases as nearly as possible directly in its final position and should not flow in a manner to permit or cause segregation. Excessive seperation of coarse aggregate in concrete, caused by allowing the concrete to fall freely from too great a height, or too great an angle from the verticle, or to strike the forms of reinforcing steel, should not be permitted ; and where such seperation whould otherwise occur, the contractor should be asked to provide suitable drop chutes and baffles to confine and control the falling concrete.

The deposition of concrete in deep water generally poses many a difficulty. The cement is likely to be washed away by turbulance of water through which it is to be dropped, and thus may greatly aggravate segregation and cause weak and sloping bearing planes for subsequent lifts. Placement of concrete in water is accomplished by means of vertical pipes called tremies, which must be maintained filled with concrete and must have their lower ends submerged in concrete for the duration of a pour. Flow of concrete down the tremie is assisted by increasing the hydraulics head of concrete in the tube, by pounding or vibrating the tremie, and by raising the tube in its entirety so that its lower end is nearly withdrawn from the submerged plastic mass. If the tremie is withdrawn so far as to lose its charge of concrete and become filled with water, then great difficulty is some-times experienced in re-establishing placement of concrete without harming the partially completed pour. An illustration of this method of underwater placement is shown in figure 3. Rich mixes are always necessary for underwater placement to compensate for possible losses of cement.

3. After the surfaces have been prepared satisfactorily, surfaces of construction joints upon which new concrete is to be placed, should be covered with a layer of morter approximately $\frac{1}{8}$ inch thick. The mortar should have the same proporations of cement and sand, cement ratio, as that of the regular concrete mixture. The mortar should be spread uniformly and worked thoroughly in all the irregularities of the surface. Concrete should be placed immediately upon the fresh mortar.

4. Except as intercepted by joints, all formed concrete in walls, piers and other restricted areas should be placed in horizontal layers, the depths of which generally should not exceed 20 inches. The resident engineer must reserve the right to require lesser depths of layers where concrete in 20 inch layer cannot be placed in accordance with the - stipulated requirements.

5. If concrete is placed monolithically around openings having vertical dimensions greater than 2 feet, or if concrete in decks, floor slabs, beams, girders or other similar parts of structure is placed monolithically with supporting concrete, the following instruction should be strictly observed :

a. Placing of concrete should be delayed from one to three hours at the top of openings and at the bottoms af bevels under decks, floor slabs, beams, girders or other

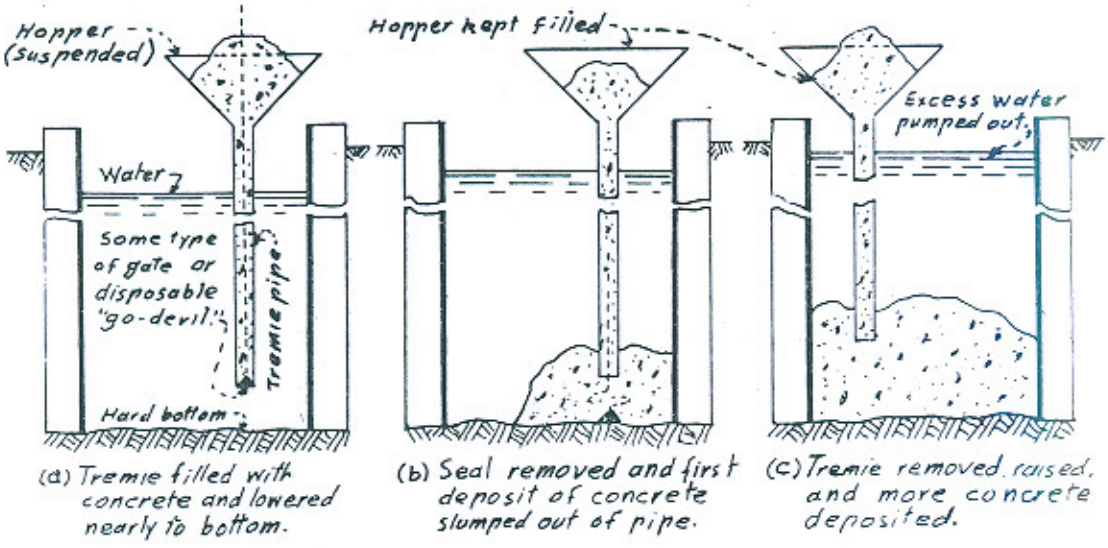

Fig. 3 PLACING OF CONCRETE BY TREMIE

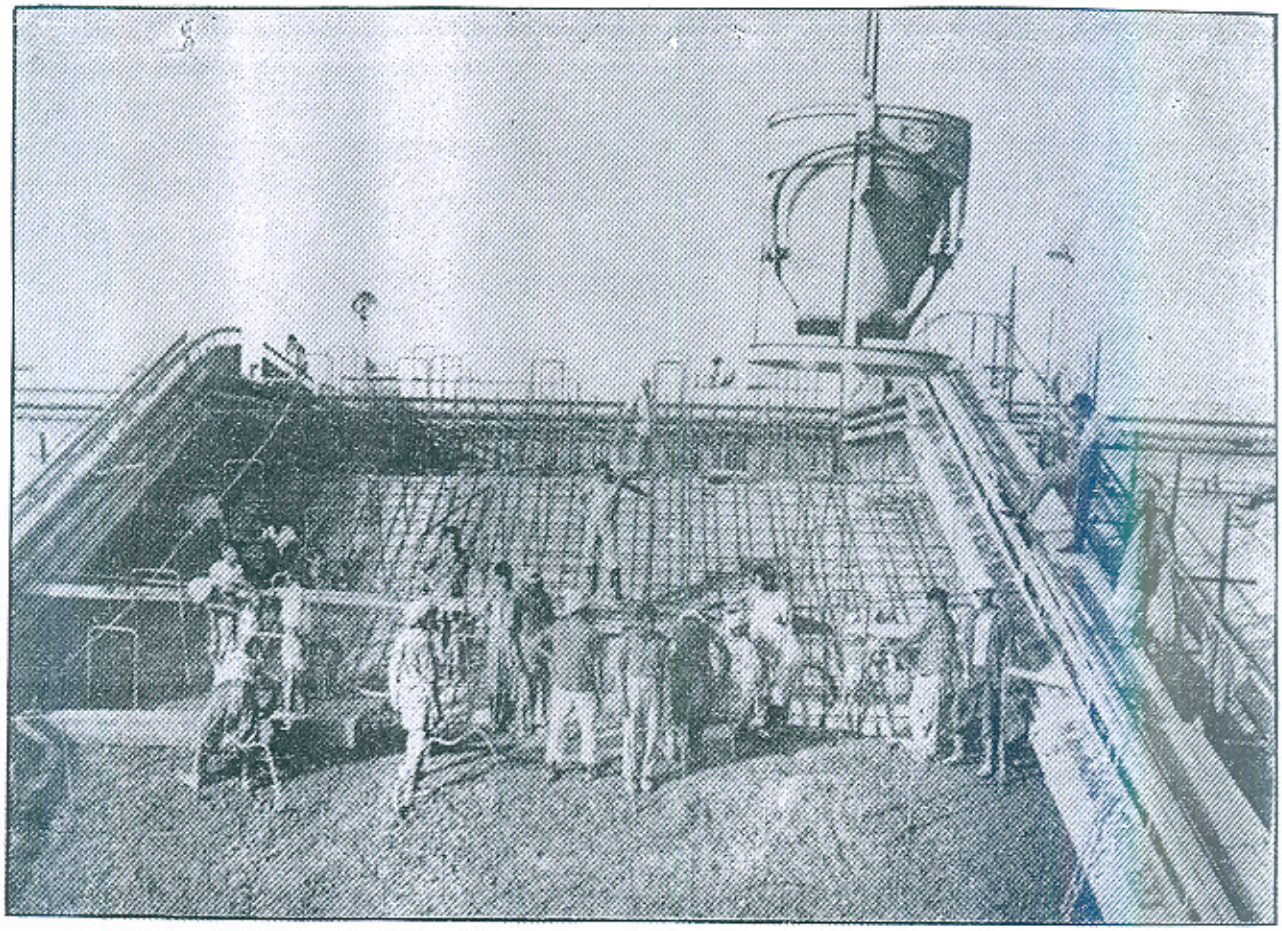

Fig. 4 Placing concrete by skip and vibrating with poker vibrators in the central floor of Rasul barrage

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similar parts of structure members when bevels are specified and at the bottom of such structure members when bevels are not specified ; but in no case should the placing, be delayed so long that the vibrating unit will not readily penetrate of its own weight the concrete placed before the delay. When consolidating the concrete placed after the delay, the vibrating unit should penetrate and revibrate the concrete placed before the delay.

b. The last 2 feet or more of concrete placed immediately before the delay should be placed with as low a slump as practicable and special care should be exercised to effect thorough consolidation of the concrete.

c. The surfaces of concrete where delays are made should be clean and free from loose and foreign material when concrete placing is started after the delay.

d. Concrete placed over openings and in decks, floors, beams, girders and other similar parts of structures should be placed with as low a slump as practicable and special care should be exercised to effect thorough consolidation of the concrete.

4.6 Vibration :

Now-a-days, nearly all reinforced concrete is placed using internal or external vibrators. Vibration should not continue at one spot longer than is necessary. As the vibrator is plunged in, freshly placed concrete will slump and spread rapidly, while bursting bubbles of air will appear at the surface. When those bubbles have diminished, and mortar appears to be rising to the surface, this is an indication that sufficient vibration has been given. Vibration should not be continued after water appears at the surface, nor, while waiting for further concrete, should the vibrator be left in motion in the previously placed batch. Care must also be taken to lift out the barrel of the vibrator slowly from from the concrete so that the hole left by its removal fills up. A point to remember when considering vibrated concrete work is that the cement content per finished cubic yard will always be higher than for hand-tamped concrete. It is usual in contracts, now-a-days, to stipulate that all main structural concrete shall be vibrated into place.

4.7 Stripping of Forms :

One of the first troubles that the Resident Engineer experiences in concreting work is that of stripping times. Nearly all specifications contain a clause on this subject. Typical instances mentioned are that wall, column, and beam sides are not to be struck untill after 2 days, beam soffits (Props left under) 7 days, removal of props to beams 14-21 days. These figures are for ordinary portland cement at normal temperatures.

The effect of applying these rules too rigidly to walls will cause trouble with the contractor. Experienced but careful

Resident Engineer will sometimes be amazed at the reactions that such applications can cause. He may well wonder, why this very definite clause was inserted in the specifications initialy.

There is a fair way out of this dilemma. The British Standard Code of Practice for Reinforced Concrete suggests that shuttering should not be struck until the concrete reaches a cube strength of at least twice the stress to which the concrete may be subjected at the time of striking. This is an elastic clause, and since the forces likely to be encountered are usually quite small, it will frequently be found possible to strip wall, column, and beam sides the day after concreting. If the Resident Engineer puts this solution up to his Engineer, and it is approved, he will usually find that the contractor is willing to agree on the matter of stripping by providing a number of test cubes or cylinders to be tested at 24 hours. If test results prove satisfactory, the Engineer can give permission for the removal to be carried out forthwith, provided the contractor takes responsibility for any damage resulting from the departure from the specification requirements. It must be ensured, however, that no undue loads come on to the concrete immediately, such as the erection of scaffolding, tying of ropes etc.

It is well to remember that the Resident Engineer not only has a duty to see that the work is properly carried out in accordance with the terms of the specification but also to see that the work is expeditiously and economically carried out. If he can satisfy himself professionally that stripping of shuttering on a 24 hour cycle is a feasible and safe proposition in certain cases, then he will undoubtedly be helping the progress of the work.

Notwithstanding the remarks above, the premature stripping of shuttering from the underside of beams and slabs is very dangerous. Several fatal accidents have been caused by this. Removal of support from these members is a very different matter from removing the cladding to walls.

4.8 Curing :

Strength is very seriously impaired by poor curing. The specifications, therefore, generally place great emphasis ensuring that concrete surfaces are kept adequately damp for a period of at least 14 consecutive days immediately following placement of the concrete. This purpose may be achieved by water-curing or with the application of curing compound, except that the construction joints should always be cured by water curing. Water curing may be effected by covering the concrete surfaces with water-saturated hessian or burlap or other suitable materials. A-system of perforated pipes, mechanical sprinklers, porous hose, or other approved method that will keep all surfaces to be cured continuously (non periodically) wet may be used for water-curing. Water used for curing should meet the requirements of the specifications for water used for mixing concrete.

Membrane curing consists of the application of a white-pigmented sealing

compound which forms a water retaining membrane on the surface of the concrete. The Resident Engineer should use his judgement to specify the type of curing to be used in the different portions of the works during different cycles of the season. It should be realized that wetting of concrete for more prolonged periods is necessary during hot summer months.

4.9 Testing :

Installation of a material testing laboratory at the site must be specified under the contracts of bigger jobs. It is required to carry out all tests on materials to be incorporated in concrete, as well as the testing of actual concrete. In order to ensure that good-quality concrete is produced the strength tests are carried out for the actual concrete produced for the construction of various works. The average compressive strengths of concrete used in the structures of Chasma-Jhelum Link Canal, as determined by cylinder tests, are listed in Table 6.

5. Repairing Concrete Surfaces.

If, after removal of forms, any concrete shows a defective surface or is out of alignment or level, it should be rectified in accordance with techniques described below.

1. Defects that require replacement or repair are those that consist of honeycomb, damage due to stripping of forms, loose pieces of concrete, bolt-holes, tie-rod holes, ridges form joints and bulges because of movement of forms. Ridges or bulges are removed by chipping or tooling followed by rubbing with a grinding stone. Honeycomb and other defective concrete is chipped out, the chipped, openings being sharp-edged and sharped so that the filling will be keyed in place. All holes are thoroughly moistened for 24 hours before the filling is placed. The surface of the filling is finished flush with surrounding surfaces and should have the same texture. All patches should be cured.

2. When, in the opinion of the Resident Engineer, the extent of the imperfections in the concrete surfaces exposed to view are such that paching alone will not produce a well satisfactory appearance, the contractor will be required to give such walls, as well as adjacent walls, a sack-rubbed mortar finish. In such cases, the mortar will be made to match the colour of the concrete by substituting white portland cement in the required amount for a portion of the regular cement.

3. Imperfections ; bolt and tie-rod holes, and the chipped out honeycomb areas to be repaired, filled with dry patching mortar composed of one part or portland cement to two parts of regular concrete sand (volume-measurement) together with a non-shrink

patching compound, like aluminum powder, in the amount specified by the manufacturer, and just enough water so that after the ingredients are thoroughly mixed, the mortar will stick together on being moulded into a ball by slight pressure of the hand and will not extrude free water. Mortar repairs should be placed in thin layers and thoroughly compacted with suitable tools. Care should be taken in filling bolt, rod and pipe holes so that entire depth of the holes is completely filled with compacted mortar.

6. Construction Joints

The location of the construction joints is specified by the Engineer, by keeping in view the concreting potentialities of the contractor. They should be located so as to cause no serious weakness in the structure. It must be tried by the Engineer to reduce the number of construction joints to a minimum. Before fixing the location of the constructian joints, the Resident Engineer must keep in view some technical and practical considerations. The concreting of beams should not be stopped off adjacent to a support where the shear is the greatest. Great care should be taken to see that wall concrete is not carried out too far so that there is too little steel projecting to give proper bond lap to the next lift of steel.

Normally, joints in floors should be located near the centres of the spans of beams, slabs, and, girders because the shear is usually small at such point. If the beam intersects at the centre of girder, it is obvious that the joint has to be offset. An offset equal to twice the width of the beam is generally sufficient. Such a joint which must resist a substantial shear might well have at least one bar or strirrup passing, through its centre at an angle of 45° to take tension when resisting the shear. These joints must be adequately keyed, in order to transfer the necessary shearing forces.

7. Contraction and Expansion Joints

Contraction and expansion joints are provided in concrete to obviate the appearance of cracks caused by shrinkage and temperature deformation. These joints are made by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of it. The surface of the concrete first placed at contraction joints is coated with curing sealing compound or some bituminous compound before the concrete on the other side of the joint is placed. Generally no filler is placed in contraction joints.

Expansion joint filler should be placed in all expansion joint of concrete structures. The expansion joint filler should be sponge rubber or self expanding cork conforming to the requirements of ASTM Designation : D 1752, Type I or III, respectively.

The expansion joint filler should be studded with copper nails and positioned against the concrete previously placed

before the additional concrete is placed. Care should be exercised in storing and handling self-expanding cork type expansion joint filler so that the wrapping may not be disturbed or broken so as to permit hydration. In no case should self-expanding cork type expansion joint filler be unwrapped and placed in the joint more than four hours before placing the final section of concrete.

After the completion of concrete placement, all exposed edges of expansion joint filler should be sealed. At the top of all horizontal expansion joints and at the surface of all vertical expansion joints that will be in contact with flowing water, the expansion joint filler should be set back one inch from the base of the chamber and the remaining one inch depth should be filled with hot-poured type elastic joint sealer conforming to the requirements of ASTM Designation : D 1190. At the option of the contractor and when approved by the Engineer, a cold-applied type joint sealer conforming to ASTM Designation : D 1850 may be used in lieu of the hot-poured type. All other exposed surfaces of expansion joint filler should be sealed with two coats of clear vinyl-resin paint conforming to the specified requirements. The completed expansion joint should be well-sealed and neat in appearance to the satisfaction of the Resident Engineer.

8. WATER STOPS

In water-retaining structures, all type of joints must be water-tight. In order to achieve this purpose, rubber or polyvinyl chloride water stops are used. Copper strip may also be used. 9-inch and 6-inch water stops are generally used. 9-inch water stop signifies three bulb natural rubber water-stop, with a minimum web thickness of $\frac{3}{8}$ inch, while 6-inch water stop will mean, two bulb natural rubber water-stop, a minimum web thickness of $\frac{5}{16}$ inch.

Suitable precautions to support and protect the water-stops during the progess of the work must be made. One half of the waterstop should be inserted in the first part of the joint and the other half projecting into the second part of the joint to be constructed latter on. The author has the experience to observe the shuttering crew nailling the water-stops directly with the wooden forms in order to fix its position for its embedment in the first part/lift of the joint. This type of action of the carpenters, if passed un-noticed, will damage the water-tightness of thejoint which may bring about dangerous effects on the life and serviceability of the structure. It is, therefore, extremely important for the Resident Engineer to ensure the position and condition of the waterstops before placing of concrete is taken in hand.

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Mian Karam Din Muhammad Ramzan

Government Contractors

Bridging the Indus at Ghazi Ghat—A Case Study

by

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1. THE PROJECT

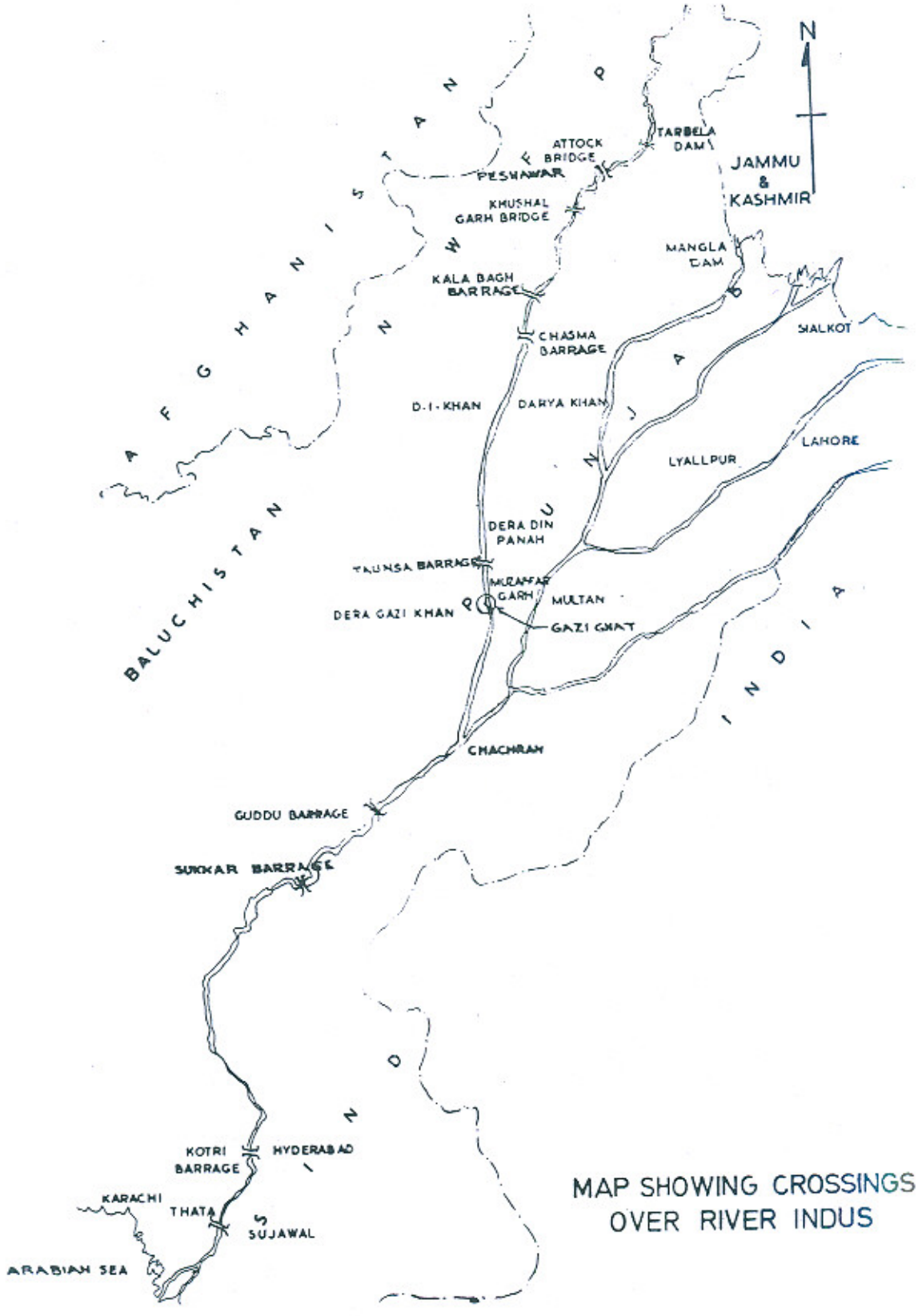
The proposal to bridge the Indus river at Ghazi Ghat had been included in the "Credit request for the rehabilitation of major roads in the province of Punjab" by the Punjab Highway Department in June, 1973, for eliciting foreign loan/aid. The estimated cost of the project at that time was Rs. 9 crore. Due to devaluation etc., costs have increased and now the revised cost has been roughly estimated at Rs. 15 to 20 crore. There is, however, need for a proper engineering and economic feasibility study of this gigantic project so that the same can be made technically sound and economical. The major cost of the scheme pertains to river training works, spread over several miles on both flanks of the proposed bridge, both upstream as well as downstream of the site.

2. EXISTING BRIDGES OVER INDUS

The Indus river devides the country into two parts. Bridging this river is, therefore, extremely important politically, administratively and, above all, for economic development. The present crossings over this river with the approximate distances from each other are as follows :—

Sr. No.	Site From	To	Miles
1.	Tarbela	Attock rail-road bridge	40
2.	Attock rail-road bridge	Khushhalgarh rail-road bridge	45
3.	Khushhalgarh rail-road bridge	Kalabagh Barrage	50
4.	Kalabagh Barrage	Chasma Barrage	40
5.	Chasma Barrage	Taunsa Barrage	80
6.	Taunsa Barrage	Guddu Barrage	150
7.	Guddu Barrage	Sukkur Barrage	95
8.	Sukkur Barrage	Kotri Barrage	282
9.	Kotri Barrage	Thatta-Sujawal bridge	60

In addition, a bridge at Darya Khan-D.I. Khan site (about 50 miles downstream from Chashma Barrage) has been sanctioned and another bridge over the Indus in the province of Sind at Morro has been planned.



MAP SHOWING CROSSINGS OVER RIVER INDUS

3. IMPORTANCE OF GHAZIGHAT SITE

To further illustrate the situation of crossings over the Indus river, the accompanying map will indicate that the longest stretch of river Indus without adequate crossing arrangements in the Punjab is between Taunsa Barrage and Guddu Barrage (150 miles). This situation becomes further aggravated when we find that one of the maximum intensities of population, agriculture and even industrial activity is concentrated in the area close to the Ghazighat site (about 40 miles-downstream from Taunsa Barrage across the the river from D.G. Khan). Furthermore, Ghazighat will connect D. G. Khan, the minerally rich district of the Punjab, with the rest of the province, besides providing an all-weather, quick means of communications, not only between the Frontier Province and the Punjab but also between the Punjab and Baluchistan Provinces.

4. SAVING IN DISTANCES WITH THE PROPOSED BRIDGE

The proposed Ghazighat bridge over the Indus river will decrease the present motorable distances between Muzaffargarh and D.G. Khan by 65 miles, which will reduce the distance by the same amount between Lahore and Quetta - two important Provincial capitals-between which there is great amount of movement of goods and passengers. While foodgrains are taken from the Punjab to Quetta, fresh and dry fruit as well as coal from Bluchistan find major market in the Punjab. This bridge will also reduce the road distance between Lahore and Iran and further to the Middle East.

5. TRAFFIC DATA

No 'origin and destination' traffic surveys have been carried out for the traffic between Lahore and Quetta which-when done-will certainly make out a still better case for the construction of the Ghazighat bridge. However, actual traffic counts have heen carried out by the Highway Department since 1967 to assess the traffic volumes and trends. The following is the data :—

Route	Traffic Station No.	Year	Cars	Buses	Trucks	Total motorised.	
1. Muzaffargarh D G Khan via (hazighat (Existing Traffic)	334-302	1972	35	71	28	143	
		1971	58	101	53	231	
		1970	38	68	43	170	
		1969	34	36	20	102	
		1968	33	37	19	98	
		1967	20	41	26	103	
2. Indus Highway (D.G. Khan to D D Pannah) (Diverted raffic)	334-401	1972	34	127	167	340	%age
		1971	39	106	205	364	increase
		1970	26	89	200	325	31%
		1969	31	84	189	311	P.A.
		1968				271	
3. D.G. Khan-Fort Munro.	334-102	1972	6	10	135	152	
		1971	11	11	149	173	
		1970	6	8	9	107	
		1969	11	20	104	137	
		1968				187	

6. BENEFITS IN TERMS OF SAVINGS

It is evident from the above data that the traffic on Routes No. 1 and 2 above will directly use the high level bridge-when built-on the Indus river at Ghazighat. Thus, even if we ignore the diverted traffic between the major parts of the Punjab and Quetta for the present, and account for the savings to the national economy on account of the savings of detouring of 65 miles involved in route No. 2 above, the annual benefits will be of the following order :—

Trucks	167x65x365x Rs. 0.54	Rs. 21,39,520
Buses	127x65x365x Rs. 0.66	Rs. 19,98,630
Cars	34x65x365x Rs. 0.16	Rs. 1,29,064
	Total per year	Rs. 42,37,214

The road traffic is increasing normally at the compound-interest rate of 8% annualy. The estimated investment on this project, therefore, will be returned to the public exchequer in 40 years at the most. The life of the bridge has to be reckoned at not less than 100 years. There is, thus, roughly a benefit cost ratio of over 2 : 1. The project can, as such, be considered economically feasible, though it is justified even purely from the point of view of administration and quick communication to Iran and beyond.

7. COMPARISON WITH DARYA KHAN - D.I. KHAN SITE

The construction of a bridge between D.I. Khan and Darya Khan is also very much desirable as, perhaps, already decided by the authorities, but the Ghazighat site also deserves priorily on the basis of economic justification.

The traffic studies carried out by the Highway Department prove that the amount of traffic originating and destined between Dera Ghazi Khan and Muzaffargarh is much more than between D.I. Khan and Darya Khan. Moreover, the hinterland, the supporting population, traffic volume, industries and agriculture around Darya Khan site are not even a fraction of the quantum supporting the hinter-lands around the Ghazighat site.

On the Punjab side of D.I.Khan - Darya Khan bridge, site there spreads the desert of Thal with scanty population, little agriculture and almost no industries. On the N.W.F.P. side of this site, again, there are the barren and bleak waste tracts of land without much population, little agriculture and no industry as compared to the areas around the Ghazighat site. While on the eastern bank of Ghazighat we have the agriculturally rich and active districts of Multan and Muzaffargarh with substantial Textile and other industries. We have, again, the agriculturally rich and active as well as populous district of D.G. Khan on the western bank, which is now reported to be rich in mineral wealth, awaiting exploration. This exploration will be possible only after good means of communications are provided.

The economic feasibility of Darya Khan site could not be established by M/S. Donovan H. Lee, Cousultants of London, in 1964-65, when the bridge was estimated to cost only Rs. four crores. The World Bank had not agreed to the loan request for this bridge project as it was a poor

economic investment and because benefit/cost ratio of the project was much lower than a figure acceptable to them. Now that the cost of the bridge between Darya Khan and D.I. Khan may be about Rs. 22 crores, the benefit/cost ratio will be still lower.

The Ghazighat site has manifold potentials. It is sure to have a benefit cost ratio of more than 2 : 1, besides linking up other provinces with the Punjab and even proving to be a popular land route between R.C.D. countries. In addition to the clear economic benefits of Ghazighat site, its engineering feasibility is also apparently much more practical. For example, the traffic volume in 1972 at Ghazighat was a total of 473 motorized vehicles over the boat bridge plus 376 motorized vehicles via Taunsa Barrage, a total of 849 vehicles per day compared to 246+143=389 motorized vehicles in total between the whole of the Mianwali District on one hand and the entire D. I. Khan Civil Division on the other. With the completion of the Indus Highway, the main traffic volume will naturally divert to the Punjab over the proposed Ghazighat Bridge, being a shorter and quicker travel route. Any proposal to build a bridge over the Indus in the Punjab cannot be considered independent of the Ghazighat site which has the best economic potentials and promise of return of public investment in the form of direct and indirect benefits both to the Government and the road users of all the four Provinces of Pakistan. The Darya Khan site does not benefit even one third of the present traffic volume at Ghazighat site besides serving a very small fraction of population of D.I. Khan and Mianwali Districts, not to speak of all the four provices served by the proposed Ghazighat site. In fact, Ghazighat site (presently falling on Primary Route No. 105) forms the biggest gap in a potential international route. A direct road between Punjab and Baluchistan is only possible by providing a bridge over the Indus river at Ghazighat site. On the Baluchistan side, the D.G Khan-Lora Lai Road is also being improved.

There is, therefore, need for according a high priority to this bridge site.

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Problems of Sanitation in Municipal Areas

by

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1. Introduction

The rapid growth of cities in our times remains one of the most striking example of present development trends in the countries of the world. With almost incredible advances in Science and Technology and their application to many a land and community, the cities of the world have been provided with facilities, unthought of a few decades ago - such as modern transportation and services, public utilities and expanding industries which made them centres of attraction for rural population. With few exceptions, the flow of people from the country to municipal areas is on the increase throughout the Afro-Asian countries. This continued expansion of municipal areas is perhaps the greatest single problem facing man in the second half of the twentieth century.

A global survey of population in municipal areas shows that in 1800, there were fewer than 50 cities of over 100,000 inhabitants, representing less than 2% of the whole population. By 1950, this planet was still only about 20% urbanized. During the previous hundred years, urban population in Europe had increased from 5 to 118 million, and here, in Asia, from 10 to 106 million. During the same period, the total population of all municipal areas with over 20,000 inhabitants jumped from 22 million to 500 million. If present rate of growth continues (but not increase), the total world population may increase from 2½ billion in 1950 to some 6 billion people by the year 2000, of which two third will be urban.

In Pakistan, too, urbanization has been very rapid. The municipal population of 6.02 million in 1951 rose to an estimated 17 million in West Pakistan in 1971. The population of Lyallpur, for example, was 70,000 in 1947. It increased to the persent 750,000 persons, in 25 years. The average increase in West Pakistan's municipal population has been estimated at 8% per annum.

2. Environmental Sanitation Problems

The most obvious and immediate result of this process of population growth and its concentration in the municipal areas is the rapid deterioration of the human environment. The enviromental problems relating to sanitation in the municipal areas resulting from this situation include :—

(i) Provision of pure and wholesome water supplies

(ii) Disposal of surface and domestic wastewaters in a sanitary manner
(iii) Disposal of industrial wastes, liquid, solid and gas.
(iv) Safe disposal of domestic refuse
(v) Control of atmospheric pollution
(iv) Control of atomic radiation
(vii) Planning of municipal areas as related to environment.

Let us now examine some of the above factors in a little detail and pinpoint the challenges which municipal authorities in Pakistan face.

(a) Water Supplies

The importance of safe water supplies from the public health standpoint can hardly be emphasized. It has now been recognized beyond any doubt that there exists a relationship between disease and lack of water supplies and that contaminated water supplies are associated with widespread epidemics. In Pakistan, 5% of the population living in municipal areas suffers from one or another water-borne disease at any one time and that one hospital bed out of every four is occupied by patients suffering from water-borne diseases. A safe piped water supply is an essential factor in the economic, social and cultural development of a community and it can greatly reduce the incidence of water-borne diseases like cholera, typhoid, paratyphoid, dysenteries etc. It has, however, been estimated that only 30% of the population living in large municipal areas of West Pakisan have a direct or indirect access to municipal water systems. None of the municipal water system in West Pakistan provides adequate service. An adequate service means continuously available deliveries of potable water at adequate pressure and in suffcient quantities to individual consumers. At least 1/3 of the population presently receiving service from municipal water systems in Pakistan obtain deliveries from public standposts.

(b) Wastes Disposal

Along with the provision of public water supplies, it is of great importance to consider the establishment of waste-water collection and disposal facilities in order to complete the water cycle.

In municipal areas of Pakistan, piped sewerage is available to 2-4% of the population only, and the substantial portion of this population does not have an access to even open drains. In West Pakistan, 15% urban population in municipal areas is served with underground sewerage and 60% of the population is served with open drains. There are almost no sewage treatment facilities for the treatment of domestic waste-water. The prevailing practice is that the sewage collected at one end of the city is either discharged directly into the nearby river or is used for irrigation purposes and for growing vegetables for daily use. This unhygienic practice of waste-water treatment has resulted in the public health hazards associated with such a practice. Majority of the city population suffers from one or another water-borne disease. The recent survey done in Lahore showed that almost 80% of the people of a locality have suffered or are suffering from dysentery and hook-worm diseases.

A street in Bilal Ganj in a dismal condition

Heaps of filth on Shahalam Market Main Road

While the improper disposal of domestic sewage must cause the pollution of rivers, streams, water-courses, beaches etc., the wastes discharged by the industries are greatly aggrevating the situation. Some of the industries discharge highly polluted toxic chemical wastes, thus affecting the quality of the receiving water.

In Karachi, 2000 industries located at SITE, Landhi and Korangi have been discharging untreated wastes into Lyari and Malir rivers with impunity and incomplete disregard for public safety and sea life consisting of prawns, shrimps and oysters which incidentally are a great potential foreign exchange earners. Unless stringent measures through introduction of law are taken, the valuable sea life will vanish for ever from this zone. The example of Lyallpur should also be cited where the underground water is in danger of complete contamination due to unmindful disposal of industrial waste-water. The pollution problems created by the wastes of Kala Shah Kaku industrial complex and tanneries are known to us all.

(c) Refuse Collection and Dsiposal

Refuse collection and disposal is as important as waste-water collection and disposal. The source of refuse is both from the private households and industries. If these solid wastes are not collected and disposed off in an approved sanitary manner, they form harbourage for rodents and breeding places for flies. These are unsightly and are a source of odour and a nuisance. The methods adopted for containing this problem in municipal areas of Pakistan, to say the least, are highly unsatisfactory. The domestic and industrial solid wastes are transported through open animal driven carts. The dumping process too is highly unscientific. Today, the developed countries of the world have adopted methods by means of which useful ingredients of the solid wastes are recovered and are made use of. Through engineering process like composing, waste can be converted into a useful fertilizer. Our municipal authorities have yet to give this matter the attention it deserves. There is a talk today, and I think there is a Government decision, to beautify our cities-particularly the city of Lahore. I believe that by merely tackling the environmental sanitation problems of this city, Lahore can be made the most beautiful city of Asia.

(d) Air Pollution

Air which we breath must be pure, fresh and free from disease causing organisms, Air becomes polluted because of emission of smoke, gases from the domestic fires andfrom industries. In Pakistan, most of the industries have not grown to the extent that the pollution caused by these can be considered hazardous. The brick kilns used by brick making industry, haphazardly located as they are in most of our municipal areas, remain the biggest offenders. There are, for example, 120 kilns scattered all over Lahore. The consumption of coal during one season, and it is of very inferior quality, (October to June) is about 600 tons per kiln. One can easily see why Lahore is becoming a dirtier city.

Smoke from diesel-run rickshaws and buses is creating truly hazardous and polluted environment for the people living in such municipal areas as Karachi, Rawalpindi and Lahore. People of these areas are, therefore, exposed to all the diseases, some of these very serious, associated with air pollution.

(e) Housing

Housing is one of the most important element of the environment that directly relates to health and urbanization. The problem of housing is not confined to developing countries alone, it is universal. As early as 1870, J.B. Russel, while studying the effects of housing on people, concluded that even though people were better rehoused, the effects of bad housing lasted for more than one generation. Bad housing can cause acute respiratory infections (colds, bronchities, grippe) related to multiple use of toilet and water facilities, minor digestive disease, skin diseases etc.

The housing situation in Pakistan has been gradually deteriorating. The housing backlog in municipal areas has increased progressively from a shortage of 600,000 dwelling units in 1960 to approximately 1½ million in 1970.

Other problems with regard to sanitation facing municipal authorities in this country include food and milk sanitation, proper maintenance of slaughter houses, animal driven transport and milk producing animals.

How Best to Tackle Environmental Sanitation Problems

In the foregoing paras, I have tried to enumerate the sanitation problems which must be tackled by the municipal authorities in this country if the objective of better health for our people and eradication of the diseases is to be achieved. It is a known fact that preventive measures, if taken in time, can result in appreciable savings in the cost of clinical facilities for the treatment of diseases relating to environment as well as in the overall cost of man-hours lost due to sickness and enforced absenteeism from work. We can save ten or twenty lives by the preventive measures for the one life that curative programme at equal or greater cost will save.

To achieve these objectives, following proposals are being suggested for consideration of the municipal authorities as indeed the Government :

(1) Separation of medical curative services from preventive health services.

(2) Shift in emphasis from the curative to precentive side, both financially and administratively.

(3) Provision of environmental health engineering wings to be staffed by qualified environmental health engineers. Many of the engineering functions now being performed by the Medical Officers in the Municipalities should be handed over to environmental engineers. These functions include the disposal of refuse, maintenance of public latrines, inspection of food and milk sanitation, construction and maintenance of slaughter houses etc.

(4) To carry out legislation for the prevention and control of evironmental pollution and to set up an organization to maintain constant vigilance and see that the measures proposed are efficiently carried out.

(5) In order to effectively carry out the measures against country-wide pollution, a Board of Environmental Health, responsible directly to the National Assembly, be set up at the National levels. It will be the duty of the Board to do overall planning and to influence Government policy relating to the total human environment. The Board should be composed of persons representing different learned professions and industry.

(6) To support the Board, prepare reports, draft legislation, supervise developments throughout the country, represent the Government and adjudicate between local authorities and industrial developers, it would be necessary to set up an Inspectorate with wide powers to direct endorcement of Government Acts and Orders. This Organization called Inspectorate General Environmental Health will be under the Central Government.

(7) Provincial Organization similar to the one proposed at the National level be set up.

(8) Environmental Health must be represented at all levels of National Planning with the realization that, in the long run, poor sanitation is just as expansive as good sanitation.

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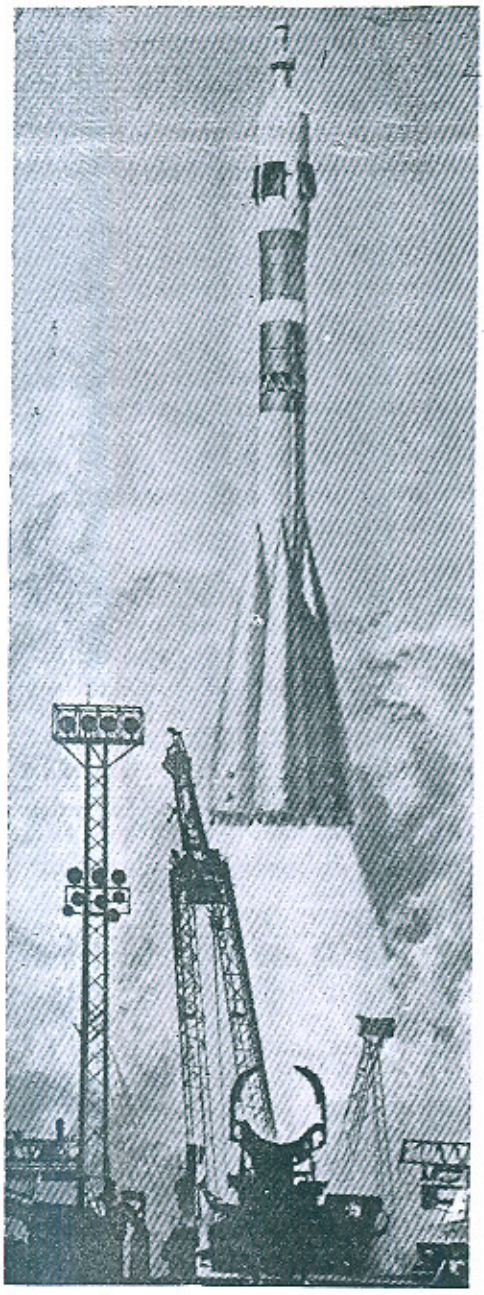
General Section

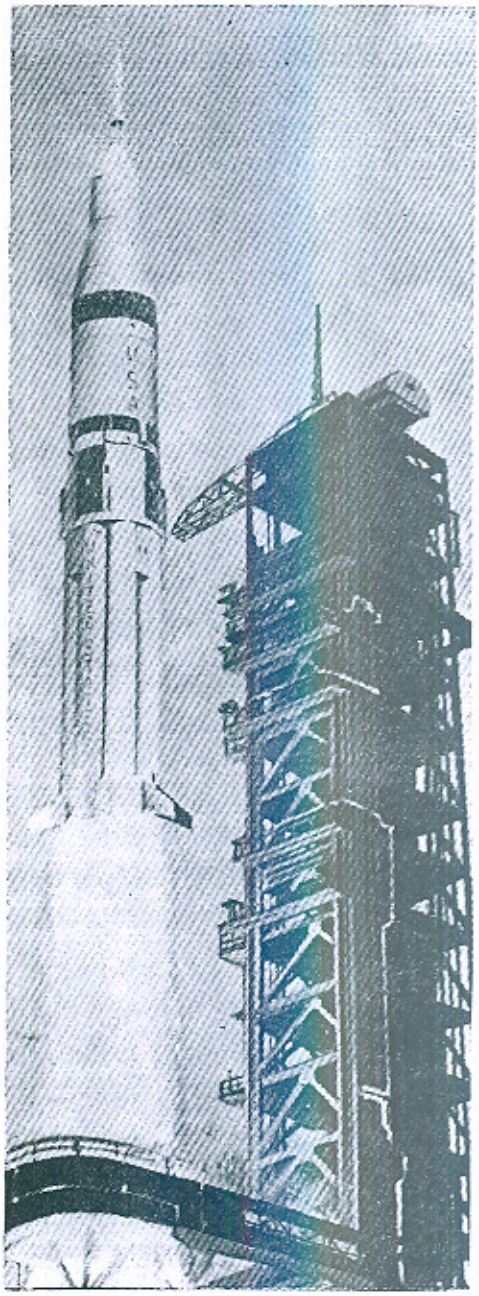
RENDEZVOUS IN SPACE

ENGINEERING NEWS REPORT



Soyuz Launch
Soyuz rockets from the Baikonur launch complex near the Aral Sea in Kazakhstan, U.S.S.R.

"It seems a long time since Yuri Gagarin of Russia brought space travel from the realm of fiction into the world of reality. Many new doors have since been opened which promise exciting adventures into the unknown. Engineers are playing the most vital role in space exploration by constantly providing practical solutions to unusual problems. The latest spectacle of a rendezvous in space between the American Apollo and the Russian Soyuz is a tribute to the thousands of engineers and technicians whose professional skill made such a feat possible.



Apollo Launch
About 7½ hours later, Apollo is launched from the John F. Kennedy Space Center on the Atlantic coast of Florida, U.S.A.

Rendezvous in Space

In mid July, 1975, three American and two Russian cosmonauts brought their space crafts Apollo and Soyuz together in Earth Orbit, exchanged visits and conducted joint technical and scientific experiments.

The Russian Soyuz was launched from the Baikonur launch complex near the Aral Sea in Kazakhstan, using a Soyuz Rocket Booster, and circularized its orbit at an altitude of 225 km (140 miles).

A few hours later, American Apollo was rocketed into Orbit from the John F. Kennedy Space Centre in Florida, using a Saturn IB Rocket, having a first stage thrust of 720,000 kg (1.6 million pounds).

About 52 hours after the Soyuz launch, docking occured, following a series of complicated manoeuvres by Apollo. The two space crafts remained docked for approximately two days as exchange of visits took place and joint experiments were conducted.

Twenty seven experiments planned for Apollo - Soyuz involved space science, space processing and manufacturing, Earth surveys and life science. To mention a few examples :

(i) The stable and relatively long mission was employed to gain more data on a comparatively low energy, X-ray background in the sky detected by sounding rocket studies. The aim was to ascertain both the source of radiation and the process by which it is generated. Just as the studies on the solar emission processes contributed to development of atomic power plants, understanding of these x-ray sources may lead to development of improved techniques for generating energy.

(ii) Mixtures of living cells were separated by electrophoresis into groups, each having a different function. (Electrophoresis is the movement of particles suspended in a fluid under the influence of an electric field). The aim was to establish whether weightlessness in space permitted better separation than that obtained on earth. If so, the process could be usefully employed for biological research on future space flights.

(iii) Observations made on earth features covered many disciplines. Among these were surveying the Himalayan snow fields and drainage patterns as an aid to irrigation and flood control on the Indo-Pak sub continent and mapping extensions of the San Andreas Fault and related fracture systems in the United States for oil and mineral exploration and earthquake studies.

(iv) Among the life sciences experiments were studies on how weightlessness may affect the body's response or resistance to infection. Studies were made of lympocyles and polymorphonuclear leukocytes in blood samples taken from the astronauts before and after the mission. Leukocytes are the white cells that attack infectious bacteria. Lymphocytes either manufacture antibodies that battle viruses and other infectious agents or transmit informations to other cells on how to repel disease. The studies will add to knowledge about the body's defence mechanisms.

Communications from the docked Apollo and Soyuz spacecraft were relayed to Earth through NASA'S Applications Technology Satellite-6, a versatile spacecraft being used for experiments on the frontiers of communications, meteorology and space science.

If the Apollo Soyuz were transmitting directly to earth stations, as was done in the previous manned space flights, its comparatively low orbit and limited number of stations would have restricted the communications between the Astronauts and Mission Controls to an average of only 15 minutes out of each approximately 90 - minute orbit.

Applications Technology Satellite - 6, however, is in a constant communications view of nearly half the globe, from its vantage point about 35,680 km (22,300 miles) above Earth, and with supporting ground stations, Apollo and the ground - based flight controllers were able to communicate for about 50 minutes out of each orbit.

Apollo and Soyuz are long tried space vehicles which were suitably modified for this joint venture. Among the major modifications of Soyuz for the joint programme were a new type of docking mechanism, additional communications equipment to accommodate the United States Ultra-high frequency of 296 MHz, a transponder (a combined receiver transmitter that becomes a signal when triggered by another radio signal) for Apollo use in ranging (distance calculation) during rendezvous, and alignment aids to help Apollo in docking.

Among the major modifications to the Command/Service Module for Apollo-Soyuz were an increased number of propellant tanks for the reaction control (orientation and stabilization) system, added equipment required to operate the new docking module and the American Russian Rendezvous and docking systems, and provision for scientific and technical experiments.

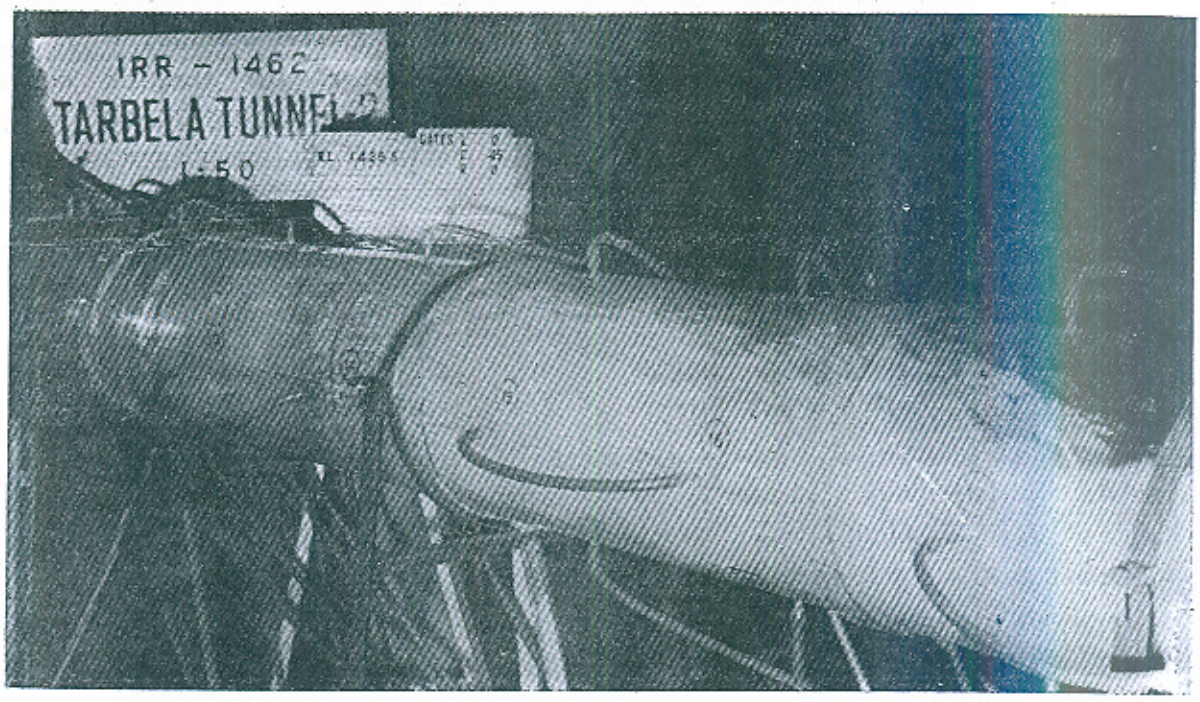
The internal atmosphore of Soyuz consisted of Nitrogen and Oxygen at an Earth sea-level pressure of 760 mHg (millimeters of mercury) or 14.7 pounds per square inch. Apollo's atmosphere was pure Oxygen at about 260 m Hg (5 pounds per square inch). To facilitate transfer of crew, Soyuz pressure was reduced to about 520 m Hg (10 pounds per square inch) during docking and re-pressurised to sea level before atmosphere entry. Equipment to reduce and increase pressure was added to Soyuz. The lowered air pressure in Soyuz enabled the men to transfer from Soyuz to Apollo without a lengthy period in the air lock to breathe pure Oxygen and wash Nitrogen from their bodies.

The docking module developed by NASA and Soyuz used a compatible docking system designed by NASA and Soviet engineers. Such a system will later be employed on the US space Shuttle, on Soviet manned space flights and, possibly, on future space craft of other nations.

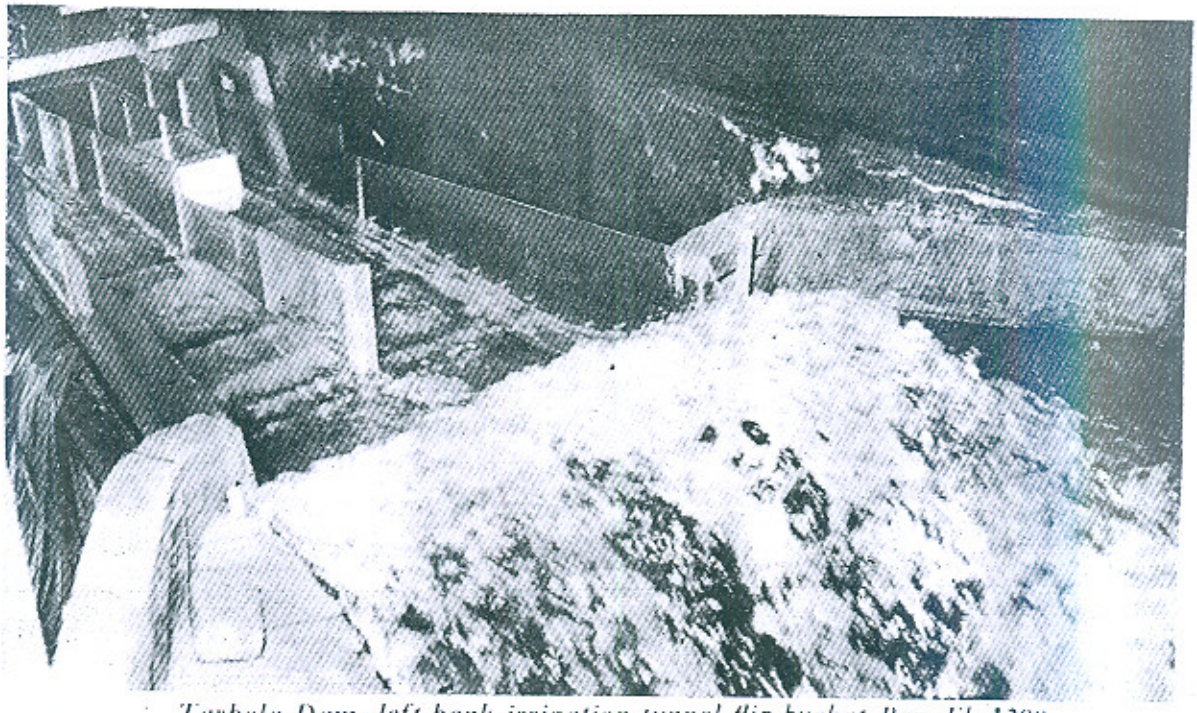
The system provides international space rescue capabilities as well as facilitating future international manned space flights requiring docking of two or more vehicles.

News in Pictures

Model Tests in Irrigation Research Institute, Lahore



Tarbela Dam, Tunnel 2 Model Original Design Flow Condition through 45' dia Tunnel - Res. El. 1426.5 - Gates : Left = O - Central = 45' - Right = O



Tarbela Dam, left bank irrigation tunnel flip bucket Res. El. 1300

News and Notes

Efforts to harness desert resourees to yield fruit.

The Sind Minister for Forests, Mr. Bashir Ahmad Shah, stated in Thatha that several countries were prospering by making their deserts bloom and we, too, must learn from countries like Australia and China to make our deserts productive. He was speaking at the inaguration Ceremony of a Windmill, installed in Gaghar.

He expressed the hope that the pioneering efforts being made to harness the potential resources of the desert would prove rewarding and fruitful.

Mr. Bashir Ahmad Shah said he was happy to note that a variety of exotic drought-resisting grass, shrubs and wild-plants had been successfully grown in an experimental nursery at Gaghar, which would now be introduced in the area commanded by the Windmill for further multiplication.

The Minister for Forests further said that these shrubs and wild-plants would henceforth be planted on a larger scale in the arid areas, for providing the needed fodder for livestock.

He hoped the Australian-built windmill will go a long way in utilising desert lands for economic benefits.

He said efforts were on to procure seasonal rain-drained water in and around the area so as to provide water for additional fodder cultivation.

The windmill, first of its kind in Pakistan, will start functioning for fodder research programme of the range-management project, aimed at irrigating an area over 20 acres.

300 Tubewells being installed.

Three hundred tubewells are to be installed on the right bank of Indus from Sukkur to Dadu at a cost of Rs. 6.50 crore during 1975-76, says an official handout.

Work on 100 tubewells has so far been let out, while the plans are underway for the remaining 200 tubewells. The project will be completed by June 1976.

Besides, the Government has decided to install 15,00 handpumps in the flood affected areas to provide drinking water to the people at a cost of Rs. 1 crore, out of the US flood aid grant.

Feasibility report on Kalabagh Dam by Pakistani firm.

Detailed discussions were held in Lahore in early July, 1975, by WAPDA and a panel of foreign experts on the technical feaslbility report on Kalabagh Dam project prepared by the Pakistani consultants, Messrs Associated Consulting Engineers (ACE).

The report was submitted to the WAPDA after three years of field and design studies comprising extensive survey and geological investigations carried out at the proposed site of Kalabagh Dam by Pakistani engineers and geologists.

Maj. Gen. Saad Tarique, Chairman WAPDA, presided over the meeting, which lasted for over two hours.

This is for the first time that a firm of Pakistani consulting engineers has prepared a technical feasibility report of a large dam of this magnitude, which can be compared with Mangla and Tarbela Dams.

Magnecite deposits found in commercial quantity.

PAKISTAN has discovered magnecite deposits in commercial quantities near Khunhar, Chitral in the Frontier province, A.P.P. says.

Proved deposits are stated to be around 1.5 million tons while the estimated deposits are 11 million tons of magnecite which is used for producing refractory bricks for steel and chemical furnaces and cement factory kilns.

At present, Pakistan is spending large sums on the import of dead burnt magnecite and magnecite bricks.

Pakistan Industrial Development Corporation, it is understood, has planned to set up a specialised refractories plant at Hattar in the Frontier province to produce dead burnt magnecite and magnecite bricks on the basis of these deposits.

Samples of deposits were sent to the people's Republic of China for experiment which has been completed,

Chinese experts are preparing a detailed project report which is expected to be received by the PIDC shortly.

At the same time Chinese experts, it is further learnt, are designing machinery and equipment for the proposed refractories plant. The machinery and equipment are being designed in such a way that natural gas could be used as a fuel.

The proposed plant will have a capacity of producing 15,000 tons of magnecite bricks and 5,000 tons of dead burnt magnecite annually.

Pakistan to Aid Algeria

NESPAK has been nominated by the Government of Pakistan to partner the Algerian Bureau of Hydraulic Studies in the formation of the joint Algero-Pakistan. Company for Hydraulic Studies (ALPHA).

The formation of this joint consulting engineering organisation is stipulated in the protocol recently signed between the Governments of Algeria and Pakistan by virtue of which Pakistan will offer all manner of assistance to Algeria in the development of her water resources.

The protocol also envisages the formation of a joint construction company to be called the Algero-Pakistan Company for the implementation of Hydraulic Works. Both these companies are expected to begin operation by early next year.

Pakistan will provide the expertise and know-how, help train Algerian engineers, provide hydraulic equipment and material for projects in Algeria, and also assist in the establishement of manufacturing units for such equipment in Algeria.

A Pakistani expert mission visited Algeria at the end of April, 1975 to work out

(*Contd. on page* 100)

Special Feature

Introducing Pakistani Consulting Engineers

3 - NOON QAYUM & COMPANY

Fascimiles of Pakistani Postage Stamps showing the Projects on which NOON QAYUM & Co. were associated.

Background

Established in August, 1959.

NOON QAYUM & CO. have been categorised as an "independent consulting firm" by the WORLD BANK (IBRD) and ASIAN DEVELOPMENT BANK.

During its working of about 16 years it has successfully completed Projects in the fields of Planning, designing and supervision.

The Firm is keeping with the age of Atomic Technology by having handled the project of Phase-II of the Pakistan Institute of Nuclear Science and Technology which involved varied services.

NOON QAYUM & CO. have the capacity to render specialized and expert consulting services extending over a wide range of disciplines including Project planning, Project appraisals, feasibility and financial studies, project design, contract administration and general engineering services and supervision.

Organizational Set-up

The Management of NOON QAYUM & COMPANY is conducted by the two

dartners - Mr. A. H. NOON and Mr. ABDUL QAYUM. Both these Principals are eminent Civil Engineers having extensive professional experience of engineering and administration.

There are following Engineering Divisions in NOON QAYUM & CO :

1. Civil Engineering Division
2. Architectural Division
3. Electrical Engineering Division
4. Mechanical Engineering Division
5. Electronic Engineering Division
6. Tele-communication Division

The engineering services rendered by NOON QAYUM & COMPANY are directed and controlled by the Associates and Principal Engineers who are highly qualified and reputed engineers having vast experience in their respective fields.

The execution of the planning, investigation, design and other engineering services are carried out by the professionally skilled and respective Associate or Principal Engineer.

Noon Qayum and Company also offers complete or top-supervision if desired by the client.

Field of Activity :

Highways :

Traffic studies ;
Geometric Design of Highways ;
Interchange Design ;
Foundation and Pavement Design ;
Design of Bridges.

Soil Mechanic and Foundation Engineering

Detailed soil studies with reference to the respective fields.

Industrial Building :

Structural, Architectural and Services Design.

Airports and Runways :

Layout and planning.

Engineering Design of flexible or rigid pavements.

Design of Hangers.

Architectural and structural design of Terminal Buildings and Workshops.

Design of Airport and Runway lightings.

Tele-communication and Remote Control systems.

Hospitals :

Architectural, structural and Hospital services design.

Railways :

Design of Railway Tracks ;
Design of Railway Bridges ;

Educational Institutions :

Master Planning, Architectural, Structural and Services Design, Laboratory layouts, Auditoriums, Students Hostels, Sport Facilities.

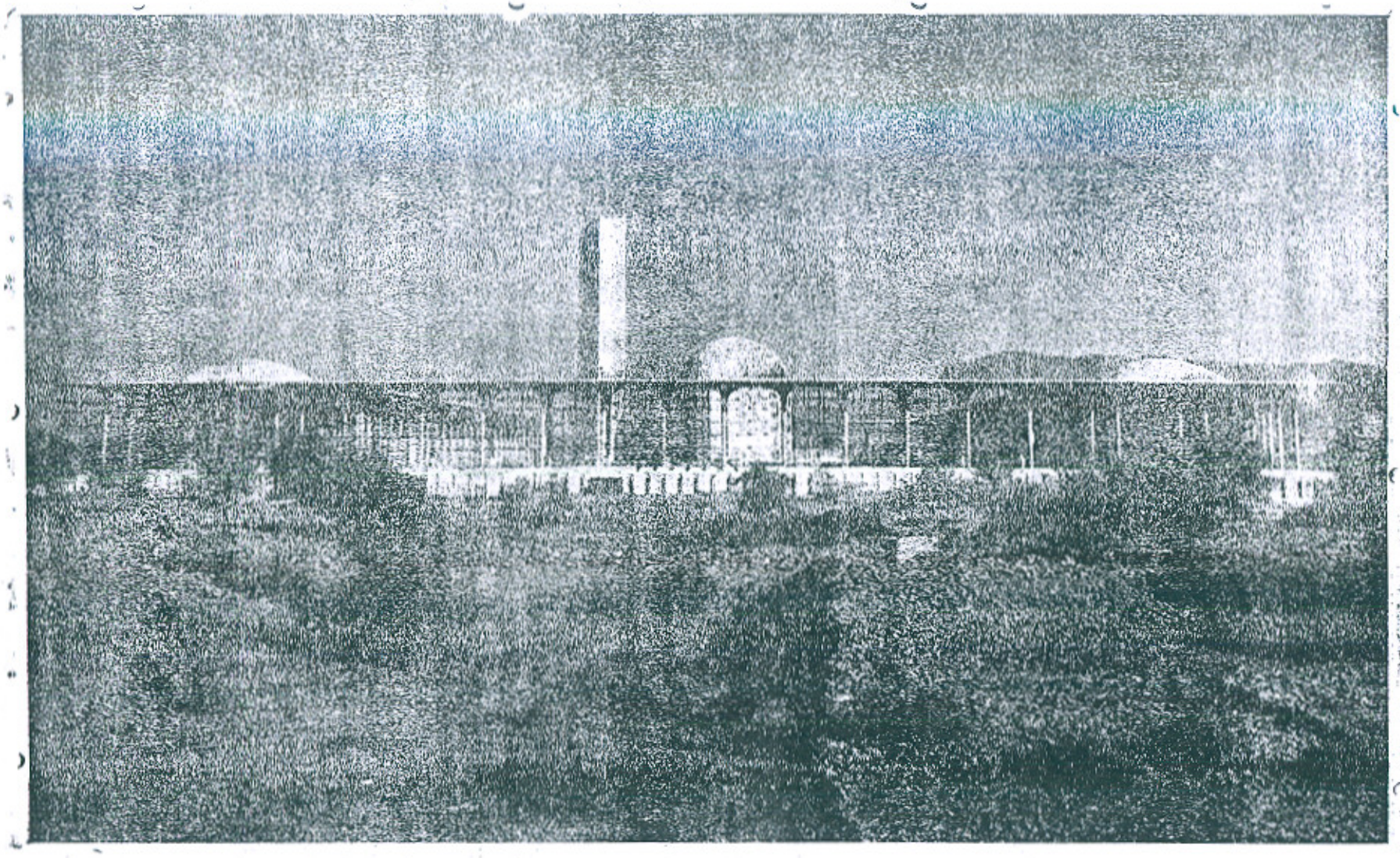
Banks and Commercial Buildings :

Architectural, Structural and Services Design.

Water Supply, Sewerage and Environmental Engineering :

Municipal, Urban and Industrial Water Supply ;

Disposal of Urban Waste water and air and water pollution studies.



General view of Pinstech (Phase-II) nearing completion

Canals and Irrigational Engineering :

Hydraulic Design of alluvial channels and their affiliated structures.

Nuclear Power Stations :

Planning and Designing.

Thermal Power Stations :

Planning, Designing and Contract Administration.

Electrical Transmission and Distribution Schemes :

Planning and Design.

Tele-Communication :

Radio and Television Stations, Telephones and Telegraph Communication. Although all such projects have not been handled, yet the firm has the manpower potentials to undertake projects of Airports and Runways, Railways, canals and Irrigation Engineering, Electrical Transmission and Distribution, and Telecommunication.

Projects Executed or in hand :

1. **Power Stations :**

Guddu Thermal Power Station Extension Unit No. 3-210 MW.

Associates :

V/O TEPLOELECTORJECT, MOSCOW.

The equipment is supplied by V/O Technopromexport and the designing is done by V/O Teploelectroproject, Moscow.

Services Rendered :

The project incorporates the construction of Civil Works and installation of machinery and equipment. The Main Building which is to house the Turbogenerator set and other allied equipment is to be constructed alongwith other auxiliary buildings for accommodating associated feasibilities. The associated services like water chemical treatment plant, hydrogenerating plant, hydrotechnical equipment for the closed cycle and open eycle, cooling water system, battery charging station, oil and fuel oil facilities, workshop facilites, are included in the project scheme.

The scope of services rendered by M/s. Noon Qayum and Company, covers the construction of Civil Works and Service, explained above, erection and commissioning of Turbogenerator set of 210 MW capacity and connected equipment and boiler drum of natural circulation type duel fixed with a single drum.

2. **Highways :**

(a) Pakistan National Highway (Lahore-Sahiwal Section).

Associates :

MESSRS. EDWARDS & KELCEY Inc.

Services Rendered

Detailed design. Work included detailed survey, selection of final alignment, longitudinal and vertical

control of highway, soil studies including field investigations and laboratory tests, pavement, design, inter sections, toll-plazas and detailed design of structures including pre-stressed concrete bridges and reinforced cement concrete box culverts. Estimates of quantities and costs, specification, contract working drawings and tender documents were prepared.

(b) Pakistan National Highways (Hyderabad - Reti Section)

Associates :

MESSRS. J.E. GREINER COMPANY.

Services Rendered :

Economic and Engineering Feasibility Report.

3. **Industrial Buildings :**

(a) Pakistan Machine Tools Factory, Karachi

Noon Qayum and Company were associated with Dip. Ing. Rolf Waldmann and Dott. Ing. Silvano, Zorni.

Services Rendered :

Central Air-conditioning, Internal External electrification, passenger lifts, plumbing, fuel gas service, Compressed Air Service, Industrial Waste Disposal, Fire Fighting system, water supply and sewerage, service roads, architectural and structural residential colony, administration building, canteen, service station, construction supervision.

(b) **Jute Mills :**

Siraj Ganj, Narsingdi, Ghorasal.

Services Rendered :

Design Co-ordination site supervision.

4. **Commercial Buildings :**

(a) Alfalah Building, Lahore

Associates :

Architect J.A. Ritchie.

Services Rendered :

Architectural and structural design and detailing, Central Air-conditioning, Internal electrification, Accoustics, Plumbing, Passenger Lifts and Top Site supervision.

(b) **W.P.I.D.C. House, Lahore**

Services Rendered :

Architectural development and detailing, structural design and detailing, central air-conditioning, passenger lifts, plumbing and water supply.

(c) **National Press Trust Building :**

Associate :

Architect J.A. Ritchie.

Services Rendered :

Architectural Development and detailing, structural design and detailing, central air-conditioning, passenger lifts, plumbing.

(d) **Regional Office Inslamabad - National Bank of Pakistan :**

Associate :

Architect, J.A. Ritchie.

Services Rendered :

Architectural Development and Detailing, Structural Design and Detailing, Central Air-conditioning electrification, passenger lifts, plumbing.

(e) **Principal Office, Lahore, National Bank of Pakistan :**

Services Rendered :

Architectural design and detailing, structural design detailing, plumbing and water supply, passenger lifts.

(f) **Television House, Lahore :**

Services Rendered :

Architectural design and detailing, structural design and detailing, central air-conditioning, plumbing, passenger lifts, electrification.

5. **Educational Institutions :**

(a) **Law College, University of Peshawar.**

Architectural design and detailing, plumbing and detailing, electrification.

(b) **Teacher students centre ; University of Peshawar**

Services Rendered :

Architectural design, structural design, plumbing, electrification.

(c) **Buildings of Dacca University :**

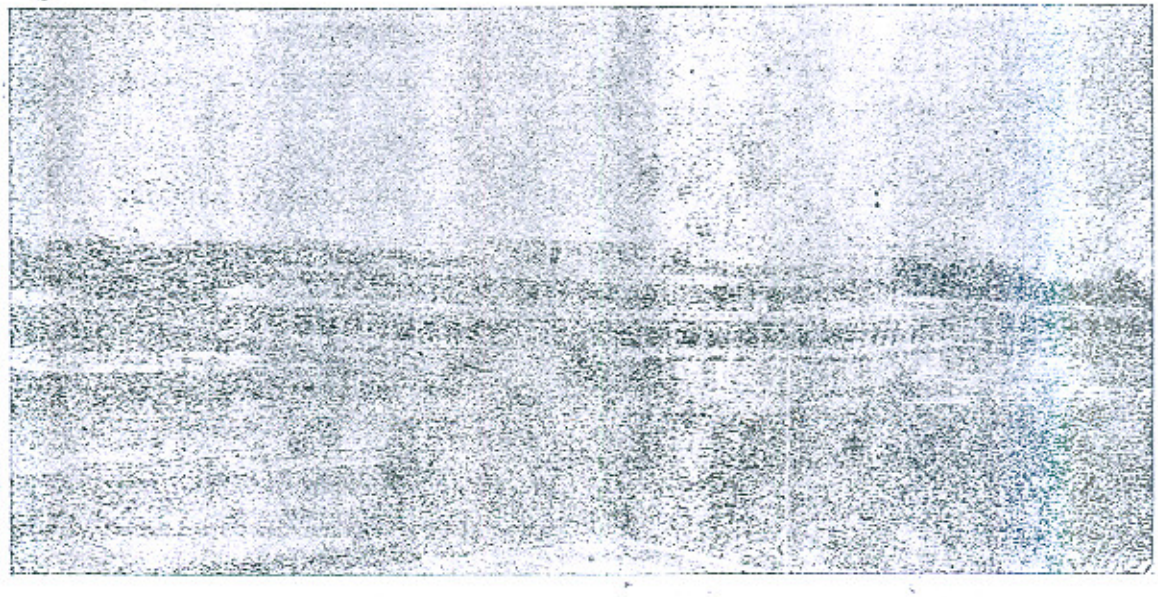
Services Rendered :

Architectural design, structural design, plumbing and water supply, electrification.

(d) **Campus of the College of Mineral Technology, Quetta :**

Associate :

Architect J.A. Ritchie.



Ayub Teaching Hospital, Peshawar

Services Rendered :

Master planning, architectural development and detailing, structural design and detailing, campus roads, central air-conditioning and heating, plumbing and water supply and sewerage.

(c) **East Pakistan Agricultural University, Mymemsingh**

Services Rendered :

Architectural development and detailing, structural design, central air-conditioning services, detailed site supervision.

6. **Hospitals :**

(a) **Ayub Teaching Hospital, Peshawar.**
Services Rendered :

Master planning, architectural development and detailing, structural design, services, bed lifts and service lifts, centralized anaesthesia gas service, radioactive waste disposal, hospital equipment layout.

(b) **Pakistan Institute of Nuclear Science and Technology, Islamabad, Phase - II.**

Associate :

Architect E.D. Stone

Services Rendered :

Architectural development and detailing, roads design and detailing, central air-conditioning and heating system, freight and passenger lifts and dumb waiters, compressed air and vacuum service, demineralized water supply system, low radio-active waste collection system.

In addition to the above mentioned projects, various other projects like Iudus Super Highway, Terminal Building of Karachi International Airport etc. are in negotiation stage.

Key Personnel of Noon Qayum & Company

Mr. A. H. NOON
B. Sc. Engineering (Bristol), F.I.E. (Pak)
Ex-Chief Engineer of the Pakistan Public Works Department,
Government of Pakistan.
42 years of professional experience.

Mr. ABDUL QAYUM
T. Pk. B.A. B. Sc. Engg. M.S. Illinois,
F. ASCE-F : I : E (Pak)
Ex-Superintending Engineer,
Pakistan Public Works Department,
Government of Pakistan
33 years of professional experience.

Mr. M. SHAFIE
S.Q.A. C.E. (Roorkee), D.C.T. (London)
Ex. Chief Engineer of the Pakistan Public Works Department, Government of Pakistan
39 years of professional experience.

Mr. ZAFAR HUSAIN
B. Sc. (Engg) D.I.C. (London) M.I.E. (Pak)
23 years of professional experience.

Mr. S.A. AZIZ
B.Sc. M.Sc. (Physics) M.S. (Electrical Engg) University of Illinois Engineers (London).
Member of the Institution of Electrical Engineers, London.
Ex-Chief Engineer and Director of Engineering, Pakistan
Broadcasting Corporation.
28 years of Professional Experience.

Mr. S.Z.H. SYED
B.E. (Civil) M.I.E., P.R.S.E. (Retd.)
Ex-Chief Engineer, P.W. Railways,
34 years of professional experience.

Mr. MAHMUD HUSAIN
B. Sc. Engg (Electrical)
Member American Institute of Electrical Engineers
Ex-Chief Engineer Multan Electric Supply Company,
39 years of professional experience.

Mr. NAZAR ALI BUTT
Fellow Institute of Electrical and Electronic Engineers (London)
Member Association of Supervision and Executive Engineers (London)
Ex-Additional Chief Engineer (Generation and Services)
Karachi Electric Supply Corporation Limited,
42 year of professional experience.

Mian NASIR ALI
B.A. B. Sc. Engineering (CIVIL)
Ex-Superintending Engineer, Irrigation Department, Government of Punjab.
33 years of professional experience.

MIAN ABDUL QAYUM
B. Sc. Engg (Electrical), F.I.E. (Pak)
Ex-Superintending Engineer, WAPDA
27 years of professional experience.

SH. GHULAM AHMED
B. Sc. Engineering (Civil)
B. Sc. Engineering (Mechanical)
23 years of professional experience.

MR. MUHAMMAD ASHRAF
B. Sc. Engg. M.I.E. (Pak)
Member Pakistan Engineering Congress
10 years of professional experience.

(*Contd. from page* 92)

the details of this co-operative enterprise. The delegation comprised Mr. Khalil-ur Rehman, Joint Secretary, Ministry of Fuel, Power & Natural Resources, Mr. Nisar Ahmad, General Manager (Water), Water & Power Development Authority.

Tarbela Power House Extension.

An agreement for rendering Engineering Services in respect of Tarbela Power House Extension Project was signed between WAPDA and Messrs ACRES International Limited of Canada, in association with NESPAK, as Civil Consultants.

Tarbela Power House Extension Project is an essential part of a programme to develop the country's hydropower resources to cope with the rapidly expanding power market in Pakistan.

The project envisages the construction of civil works to house four additional generating units (Units 5-8) and the immediate addition of two 175-MW turbine generators (Units 5&6). The total cost of the Project is estimated to be U.S. $91 million including U.S. $41 million in foreign exchange to be made available through a loan from the Asian Development Bank. Work on the Project is scheduled for completion by end of 1976.

CODE OF ETHICS

PAKISTAN ENGINEERING CONGRESS

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

In the name of God, the Beneficent, the Merciful.

WHEREAS Allah enjoineth upon his men to faithfully observe their trusts and their covenants ;

that the practice and profession of engineering is a sacred trust entrusted to those whom Nature in its magnificent bounty has endowed with this skill and knowledge ;

that every member of the profession shall appreciate and shall have knowledge as to what constitutes this trust and covenant, and

that a set of dynamic principles derived from the Holy Quran shall guide his conduct in applying his knowledge for the benefit of society.

Now, therefore, the following Code of Ethics is promulgated. It shall be incumbent upon the members of the Pakistan Engineering Congress to subscribe to it individually and collectively to uphold the honour and dignity of the engineering profession :

١- إِنَّ اللّٰهَ يَأْمُرُكُمْ أَنْ تُؤَدُّوا الْأَمٰنٰتِ إِلٰى أَهْلِهَا وَإِذَا حَكَمْتُمْ بَيْنَ النَّاسِ أَنْ تَحْكُمُوا بِالْعَدْلِ إِنَّ اللّٰهَ نِعِمَّا يَعِظُكُمْ بِهٖ

"Allah commands you to render back your trusts to those to whom they are due, and that when you judge between people, you judge with justice. Allah admonishes you with what is excellent". iv : 58

1. You shall be honest, faithful and just, and shall not act in any manner derogatory to the honour, integrity or dignity of the engineering profession.

٢- أَوْفُوا الْكَيْلَ وَالْمِيْزَانَ بِالْقِسْطِ وَلَا تَبْخَسُوا النَّاسَ أَشْيَاءَهُمْ وَلَا تَعْثَوْا فِي الْأَرْضِ مُفْسِدِيْنَ

"Give full measure and weight justly and defraud not men of their things, and act not corruptly in the land making mischief". xi : 85

2. You shall use your knowledge and skill of engineering for human welfare, and render professional service and advice which reflects your best professional judgment.

٣- وَلَا يَجْرِمَنَّكُمْ شَنَاٰنُ قَوْمٍ عَلٰى أَلَّا تَعْدِلُوْا اِعْدِلُوْا هُوَ أَقْرَبُ لِلتَّقْوٰى

"And let not hatred of a people incite you not to act equitably. Be just ; that is nearer to observance of duty". v : 8

3. You shall not injure maliciously, directly or indirectly, the reputation or employment of another Engineer, nor shall you fail to act equitably while performing professional duty.

٤- أَوْفُوْا بِالْعُقُوْدِ

"Fulfil the obligations". v : 1

4. You shall faithfully observe and fulfil all your obligations.

٥- وَلَا تَأْكُلُوْا أَمْوَالَكُمْ بَيْنَكُمْ بِالْبَاطِلِ وَتُدْلُوْا بِهَا إِلَى الْحُكَّامِ لِتَأْكُلُوْا فَرِيْقًا مِّنْ أَمْوَالِ النَّاسِ بِالْإِثْمِ وَأَنْتُمْ تَعْلَمُوْنَ

"And swallow not up your property among yourselves by false means, nor seek to gain access thereby to the judges, so that you may swallow up a part of the property of men wrongfully while you know". ii : 188

5. You shall not abuse your position or power, nor accept illegal gratification of any sort.

٦- وَقُوْلُوْا قَوْلًا سَدِيْدًا

"And speak straight words." xxxiii : 70

6. You shall express your opinion on engineering or other matters in a frank, open and straightforward manner.

٧- اِجْتَنِبُوْا كَثِيْرًا مِّنَ الظَّنِّ إِنَّ بَعْضَ الظَّنِّ إِثْمٌ وَلَا تَجَسَّسُوْا وَلَا يَغْتَبْ بَّعْضُكُمْ بَعْضًا

"Avoid most of suspicion for surely suspicion in some cases is sin; and spy not nor let some of you backbite others". xlix : 12

7. You shall not criticise another engineer's work without his knowledge, nor malign, or injure his professional reputation.

٨- وَلَا تَقْفُ مَا لَيْسَ لَكَ بِهٖ عِلْمٌ إِنَّ السَّمْعَ وَالْبَصَرَ وَالْفُؤَادَ كُلُّ أُولٰئِكَ كَانَ عَنْهُ مَسْئُوْلًا

"And follow not that of which thou hast no knowledge. Surely the hearing and the sight and the heart, of all these it will be asked." xvii : 36

8. Your professional advice shall be based on full knowledge of the facts and honest conviction, and you shall not write articles or advertise in self-laudatory language or in any manner derogatory to the dignity of the profession.

٩- وَتَعَاوَنُوْا عَلَى الْبِرِّ وَالتَّقْوٰى وَلَا تَعَاوَنُوْا عَلَى الْإِثْمِ وَالْعُدْوَانِ وَاتَّقُوا اللّٰهَ

"And help one another in righteousness and piety, and help not one another in sin and aggression and keep your duty to God." v : 2

9. You shall help one another in upholding and doing what is right, and shall not associate with those who transgress and those who indulge in unethical practices.

١٠- وَأَمْرُهُمْ شُوْرٰى بَيْنَهُمْ

"And whose affairs are decided by counsel among themselves." xlii : 38

10. You shall decide matters of common professional interest by mutual consultation.

١١- وَاعْتَصِمُوْا بِحَبْلِ اللّٰهِ جَمِيْعًا وَّلَا تَفَرَّقُوْا

"And hold fast by the covenant of God all together and be not disunited." iii : 102

11. You shall strive individually and collectively to enhance the prestige of the engineering profession by ordering your conduct in accordance with this Code of Ethics, and shall not be disunited.

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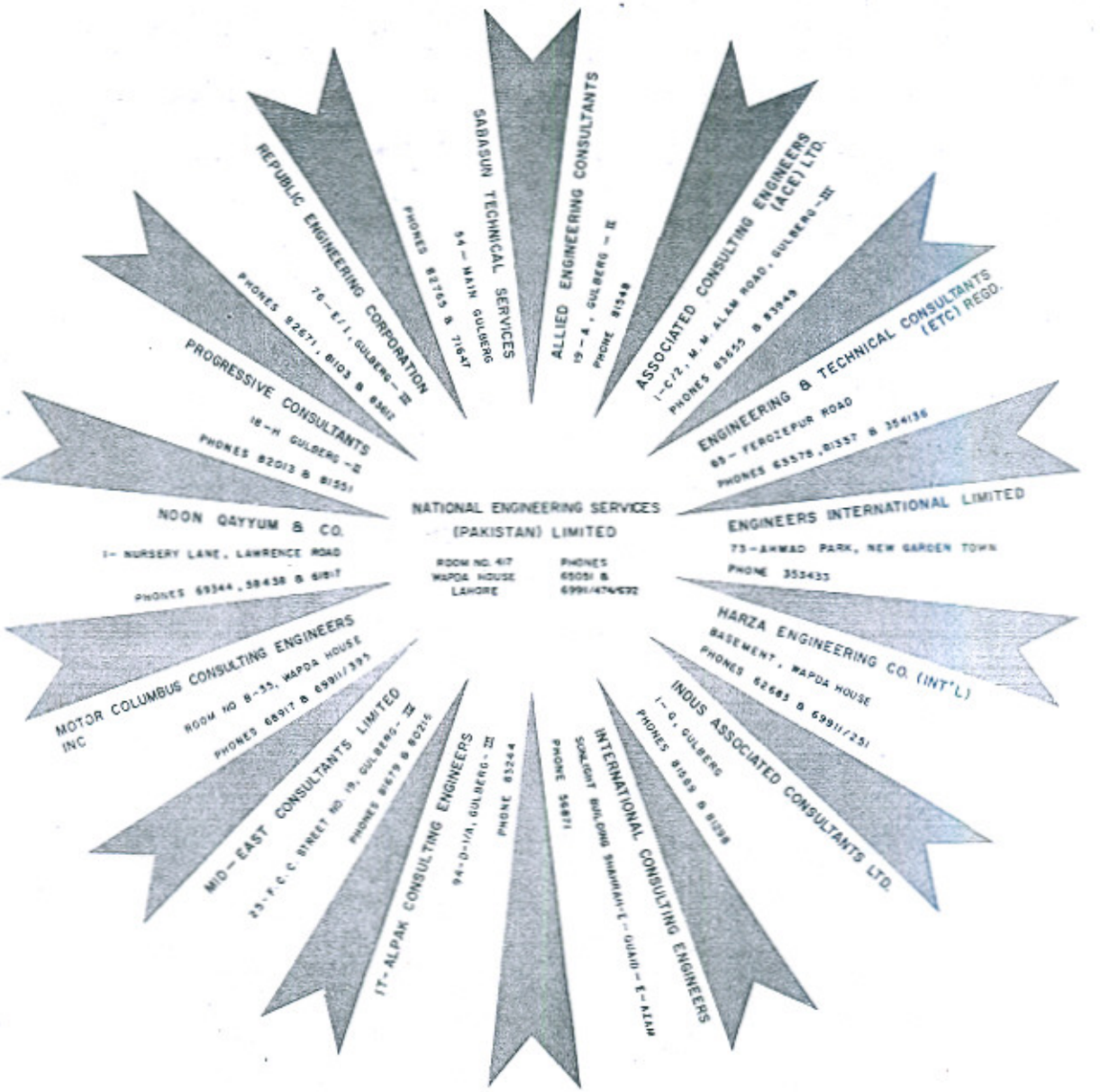

NOTES :-

1. Consulting Engineers not listed above are requested to send their particulars to the Chief Editor "Engineering News" for publication in the next issue of the Magazine.
2. Any change in the name, address or telephone number of any firm may also be promptly notified for carrying out a correction in the next issue.