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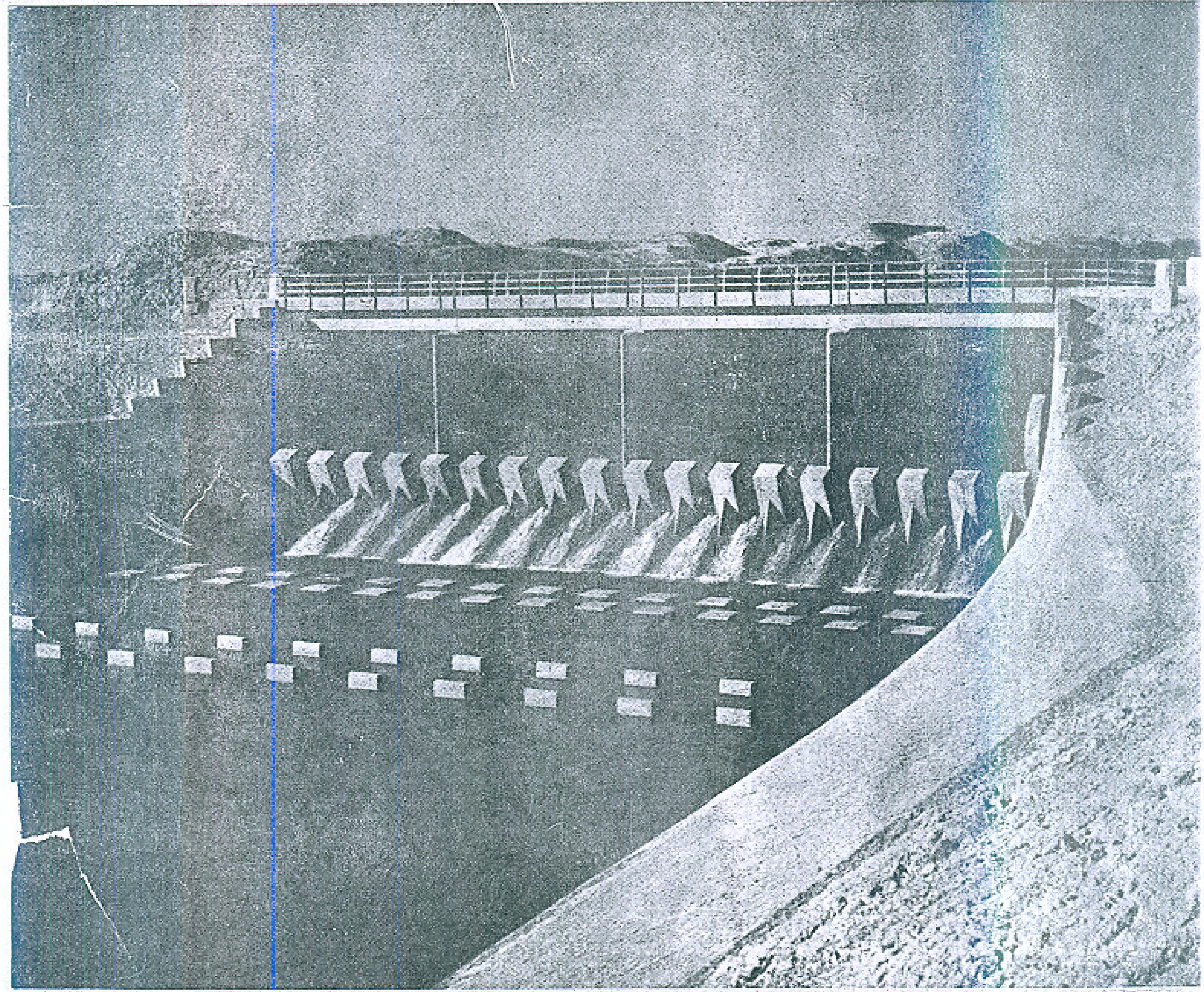

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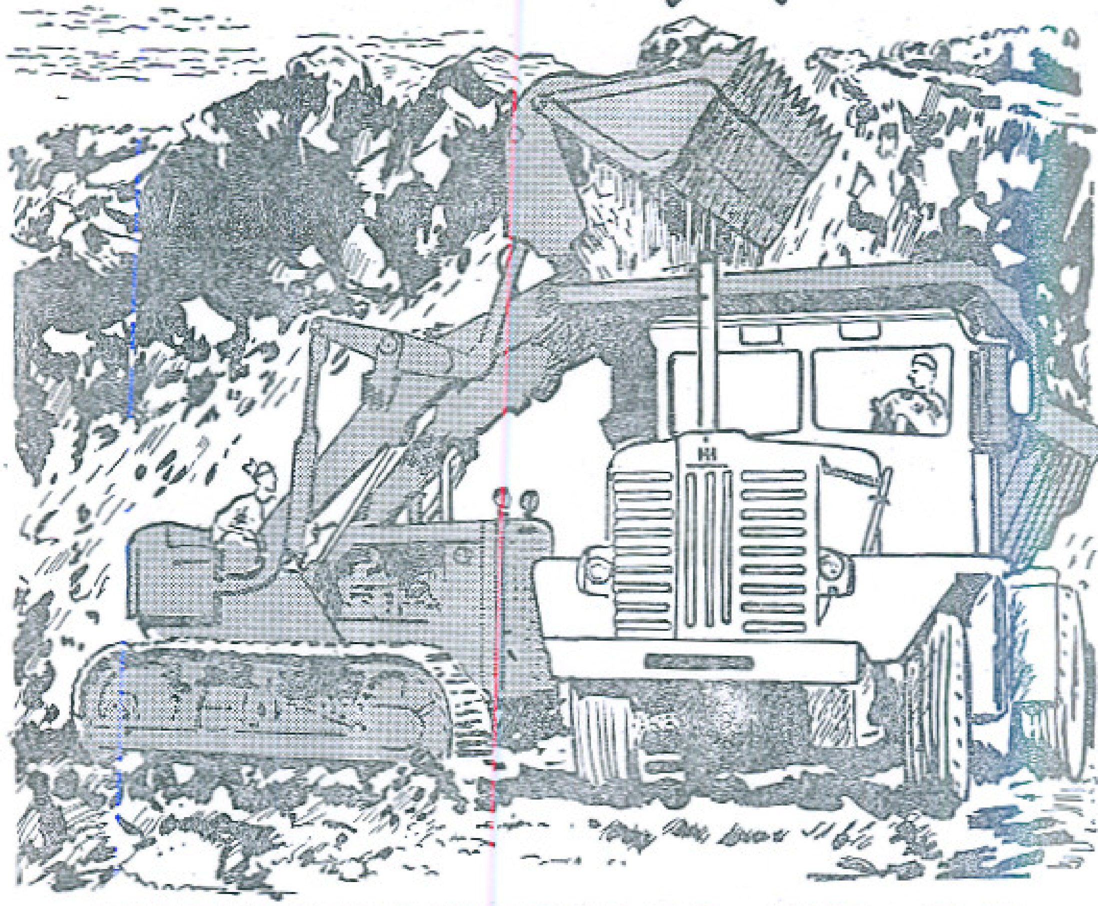

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To make the best use of it

THE next decade presents to Pakistani engineers such an opportunity of carrying out engineered construction that, perhaps, knocks at the door of a nation, like ours, once in a century. It presents to the engineering profession a challenge of tremendous magnitude.

In the final analysis, the challenge is: whether or not, during the next decade, we are capable of acquiring sufficient experience and confidence so as to make the country independent of foreign aid on the designing table, at the construction site, and in the workshop where construction machinery is looked after. In many fields, experience we already possess in a great measure, but confidence we utterly lack.

To gain the necessary experience as well as confidence, the basic pre-requisite is that Pakistani talent should have an opportunity to do the exciting jobs that await them in terms of the gigantic projects that lie ahead. Although this may seem to be the most obvious and logical thing to do, it is not a simple operation to bring the right men to the right jobs or the right jobs to the right men. For historical reasons, the talent and the jobs are not to be found in the same place. How can their meeting be brought about without resorting to costly and painful surgery? It is a vital problem, indeed.

It is suggested that a pool of Engineering Talent should be created on an All-Pakistan basis. On the lists of the pool should be engineers who have had a specified amount of experience of a certain standard of construction, or design, or research. The lists should be drawn from the PWDs and the WAPDAs. It is imperative that the pool should steer clear of those who may be termed as pure administrators, those who have no direct experience of construction, design, or research. The pool should also have lists, again on an All-Pakistan basis, of the jobs in the Nation which require special experience or knowledge in construction, design, or research. Once these lists of jobs and of men have been prepared on a purely technical, matter-of-fact criterion, allocation of right men for right jobs will become simple. Those engineers who are selected for the pool should be allowed an allowance over and above their present pay, the scales of which should preferably be made identical with those of PWDs.

The pool may be administered either by the Central Government or jointly by the organizations contributing talent to it and drawing benefits from its resources.

This seems to be a suitable way of proportionately, if not adequately, staffing the vital engineering jobs in the Nation as a whole. Its benefits will be immense and far-reaching.

Wapda And Economic Development

BY

G. Faruque, Chairman, West Pakistan Wapda

THE future development of Pakistan depends on the proper harnessing of its water and power resources. To accomplish this task the Government has set up what are popularly known by their initialised names as Wapdas. And these organisations in their turn depend on engineers.

The West Pakistan Water and Power Development Authority was the first to come into being. It started functioning towards the end of 1958 and since then its activities have been in the news quite often. But that is not enough. It is necessary that more should be known in the right circles about its responsibilities and activities. And in a journal such as this more should be known of its requirements of engineers in the coming years.

I like to think of the West Pakistan Wapda as an army at war with the relentless and destructive forces of nature and of the engineers as generals, colonels, captains and frontline soldiers in this fight which ultimately is against hunger and poverty. The role of the engineers is a vital one and there is no better way of explaining this than by outlining Wapda's responsibilities in the sphere of economic development, especially in the agricultural and industrial sectors.

First, let us consider the problem. West Pakistan's population is increasing at the rate of 1·8 per cent. The production of food is not keeping pace with population growth. To meet the food requirements in 1965 West Pakistan's production of cereals should be 6·5 million tons that year. However, the maximum that can be produced with improved farming techniques but without an increase in the present irrigation supplies will be about 1·25 million tons short of the target. To make up this deficit

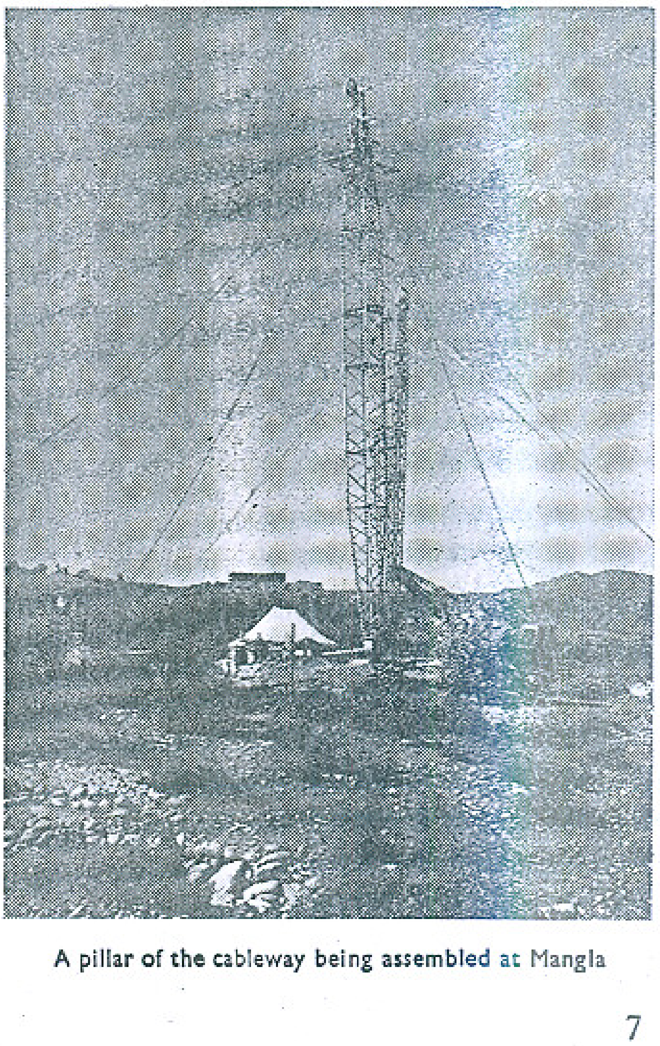
the quantity of additional water needed to bring about 6 to 8 million more acres of land under cultivation is estimated at 1·8 million acre feet.

But this is only a five-year target. Wapda has to look much further ahead and work according to a long term programme of development. Briefly, the position is that West Pakistan spreads over 198 million acres, of which 130 million acres are covered by the Indus basin and the remaining 68 million acres (mostly the Baluchistan and adjoining regions) have a different hydrological system comprising coastal tributaries and desert streams. In the Indus basin region the mean annual inflow of three western rivers, Indus, Jhelum and Chenab, is estimated at 135 million acre feet and West Pakistan can count on that supply if no further diversions are made from these rivers in the upper riparian regions not under Pakistan's control. Of the 135 million acre feet of water, West Pakistan is already using about 70 million acre feet for the irrigation of about 21·5 million acres. With the completion of the Ghulam Muhammad, Taunsa and Gudu irrigation schemes the total culturable commanded area will go up to 35 million acres. Of the gross area of 130 million acres in the Indus basin region in West Pakistan only 75 million acres are culturable. This means that with the completion of the weir controlled irrigation schemes mentioned above another 40 million acres of culturable land will remain to be developed. And with these irrigation schemes in operation 96 million acre feet of water will have been accounted for, leaving about 39 million acre feet of flow in three western rivers. Wapda's plan is to make the maximum feasible use of this flow supplemented by as much ground water as can be tapped to bring more land under cultivation, to reclaim 6 million acres of waterlogged and saline land to increase supplies, to the present sown area (90 per cent of which produces not more than one crop a year), and to replace the waters of the eastern rivers that may be diverted under the forthcoming water treaty with India.

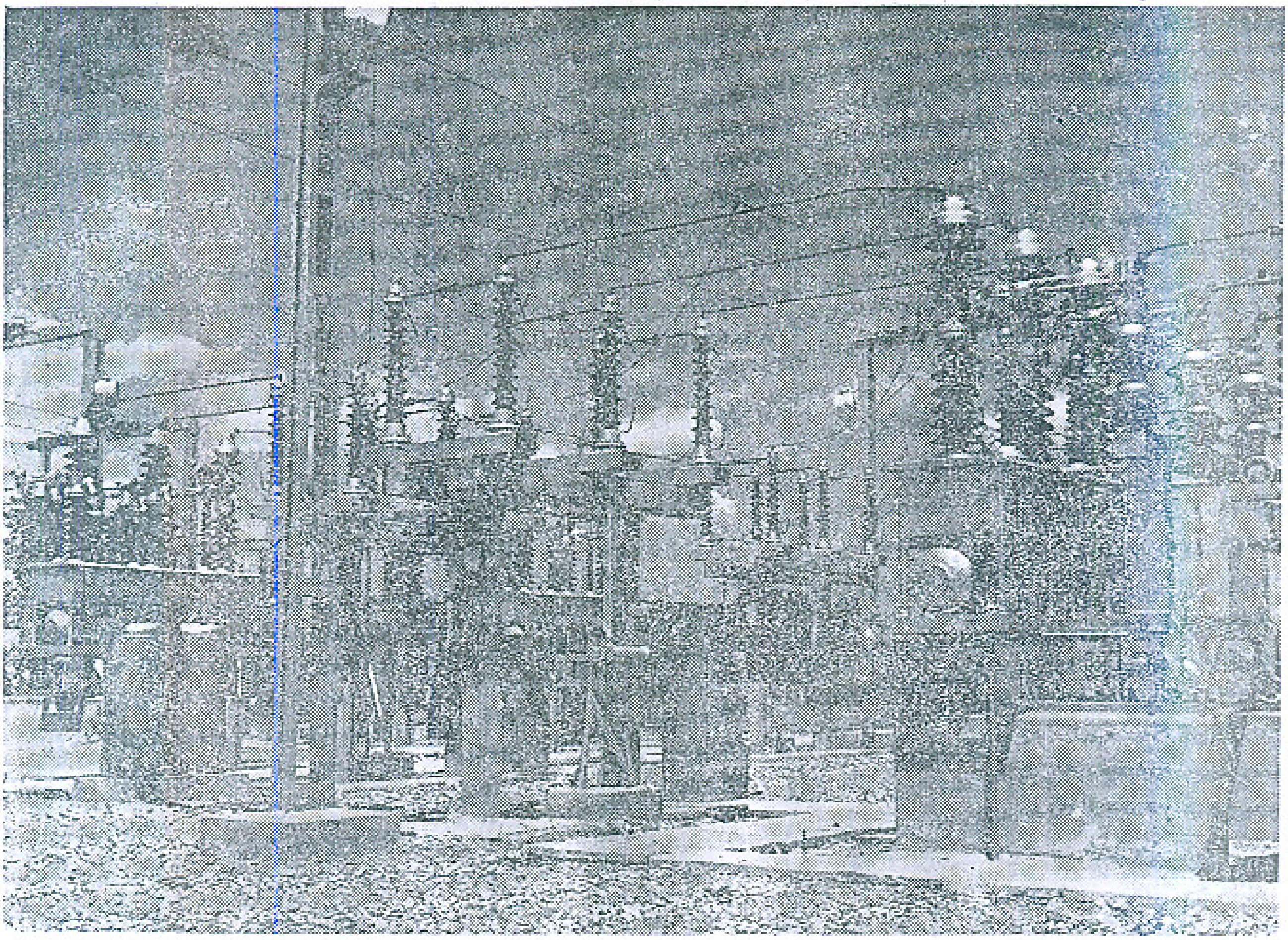
West Pakistan being mostly an arid or semi-arid region the extension of irrigation facilities is the only solution to the problem. And in the context of engineering the answer lies in the construction of storage facilities (such as the Mangla, Tarbela and smaller dams), link and other canals, tube-wells and pumps for lift irrigation schemes.

The position in the Baluchistan region which covers about one-third of the province is that cultivated land exists in patches. It is scattered all over the region and the total area does not exceed 4 million acres. But another 6 million acres of land in this region can be cultivated. And the utilisation of the 4 million acres at present cultivated can be increased from its current low average of 20 per cent. So far the development of water and related resources in this area, served by small tributaries and desert streams, has been of a local character. Data regarding rainfall, run-off and stream flow is scanty. Before any sizable projects are planned a great deal of hydrological, meteorological and geological data, much more than is required in the case of the Indus basin, will have to be collected. With this end in view Wapda is making a start with the Poralai basin in the Las Bela region. The survey area will later be extended to cover other areas of the Quetta and Kalat divisions.

Let us return to our five-year target of developing 18 million acre feet of additional water. Towards that end West Pakistan is planning to spend nearly Rs. 3,800 million on water development. Wapda's share of this is expected to be in the neighbourhood of Rs. 3,150 million. But this programme and expenditure is only till 1965. Under this programme Wapda is to construct at least



A pillar of the cableway being assembled at Mangla



The switchyard at the Chichokimalian Hydel station recently completed

two major dams, one at Mangla on the Jhelum and the other at Tarbela on the Indus.

The design of the Mangla Dam is being finalised. It is to be an embankment type of dam and probably the biggest of its kind in the world. Present estimates put the cost of the project at Rs. 1400 million, and its reservoir will cover an area of over 100 square miles. It is estimated that the water impounded in this reservoir will help to irrigate three million acres of new or reclaimed land, that is, an increase of about 10 per cent in the total productive irrigated land in West Pakistan. The project includes a hydel powerhouse with an installed capacity of 300 thousand kilowatts.

Wapda has also started preliminary work on the Tarbela Project. Under this a dam is to be built on the Indus about 30 miles upstream from Attock. Tentative estimates put the cost of this dam at about the same figure as that for the Mangla Dam. Tarbela's storage capacity will be about 4·2 million acre feet and it will increase the annual supply of irrigation water by about six million acre feet. Since it is a multipurpose project it will also be producing about 600 thousand kilowatts of electricity.

The Authority is moving into position to undertake, without loss of time, the construction of storages and the link canals that will have to be built in West Pakistan under the World Bank's plan for the settlement of the Indo-Pakistan canal water dispute. Details of this programme, which has to be carried out by Wapda and the West Pakistan Irrigation Department, will be announced after an international agreement has been finally reached.

In addition to the replacement works Wapda has a programme under way in the sphere of water development. It is building the huge Gudu Barrage on the Indus at an estimated cost of about Rs 37 crores and has undertaken or is planning the construction of several small dams on minor rivers in various parts of West Pakistan. Wapda has also started tackling on a large scale the problem of salinity and waterlogging. Its first project aims at sinking over 2000 tubewells to reclaim nearly 1·5 million acres of the affected land. These activities will be extended to other areas after investigations now under way have been completed. And special attention is being paid to the development of arid zones where schemes for lift irrigation by pumping are being implemented.

By any standards, even American, the programme for water development that I have outlined is a very formidable one. It has to be implemented mainly by engineers. At present Wapda has not more than 200 engineers working on its water development projects. Our estimate is that during the next few years we shall be needing over one thousand civil and mechanical engineers for the water programme alone. About 200 engineers will be available after the Warsak Dam Project is completed. But the remaining number will have to be recruited from the various engineering colleges.

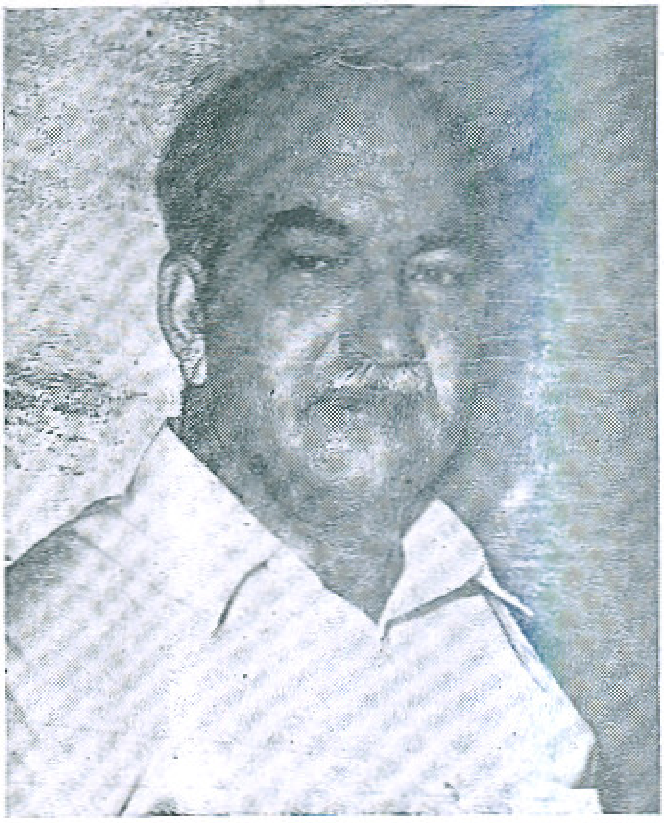
On the power side, Wapda's programme is just as stupendous and its need of electrical engineers very considerable. At present the total generation of electricity by various hydel, steam and diesel stations in West Pakistan is just over 100 thousand kilowatts. It is our estimate that the power requirements of West Pakistan in 1960 will be 285 thousand kilowatts; in 1965, 460 thousand kilowatts and in 1970, 740 thousand kilowatts. The target for 1960 will be met by the commissioning of the 140 thousand kilowatt capacity Multan Natural Gas station and the 160 thousand kilowatt capacity Warsak Hydel Project. But power requirements will continue to grow as our industrial development gathers further momentum because of Wapda's plan to carry electricity to every village in West Pakistan and because of its big programme of reclaiming saline and waterlogged land through tubewell pumping. It is estimated that in the soil reclamation programme it will be necessary to continue sinking 750 tubewells annually for several years to come. To meet the growing demand for power Wapda will be tapping more sources of power. These projects include an extension of the Multan Power Station; building of power stations at Hyderabad and Sukkur, both based on natural gas; at Quetta based on indigenous coal, and the Kunhar hydel project which can produce 180 thousand kilowatts in its first phase and 360 thousand kilowatts when it is completed. The Kunhar project has been planned to bridge the gap between supply and demand till the Mangla Hydel Station comes into operation. And all these power staions, present and future, will be connected to 750 mile long primary grid and 4,000 miles of secondary transmission and distribution lines.

Wapda's estimate is that in the next five years it will be spending about Rs. 900 million on its power schemes. It will require engineers not only for its new projects but also for the maintenance and operation of the present power stations and grids. The generation, transmission and distribution of electricity in West Pakistan became Wapda's responsibility in April this year with the transfer of the Electricity Department to the Authority by the West Pakistan Government. At present the Authority has over 300 electrical engineers on its rolls. During the next year alone, Wapda will be requiring a large number of electrical engineers to operate the Multan and Warsak power houses and the sections of the grid that will be ready. In later years the demand will grow as Wapda's power schemes are taken up for implementation or are completed and brought into commission.

Pakistani Engineer Visits China

by

Khan Muhammad Azam
Chairman, Wapda, East Pakistan.



Khan Muhammad Azam Visited China with the party of the Prime Minister of Pakistan.

Canton was the first contact with China when we arrived there on October 18, 1956. During the short drive from the aerodrome to the Rest House, it was noticed that the standard of agriculture was high and that trees about 3 years' old lined the entire road on either side. On the same day we reached Peking.

On October 19, instead of calling on Minister Futso-yo of Water Conservancy as per programme, I had to call on Madam Chian, Vice-Minister of Water Conservancy. Madam Chian is a graduate Engineer and has 15 years of experience in Water Conservancy. Our talk was a preliminary one to acquaint myself with their set-up for Water Conservancy and covered many aspects like foreign aid, education of engineers, control of labour, system of work and status of engineers. It appears that China realises that her salvation lies in controlling the rivers and making them serve people. To control the rivers they needed a large number of engineers. They appeared to have gone full out to increase facilities for engineering education. Besides the Water Conservancy there are big development schemes and for every such development scheme a large number of engineers are needed. To attract the best talent engineers get higher pay than others.

Russian specialists' services are being made use of to a great extent to help the Chinese engineers, but such help is basically of guiding the Chinese engineers, and not to undertake Water Conservancy work themselves. The result is that this gives Chinese engineers self-confidence and they are now tackling most of their works themselves even without the help of Russian experts. They only consult the Russians on matters of extreme importance where the Chinese themselves feel diffident.

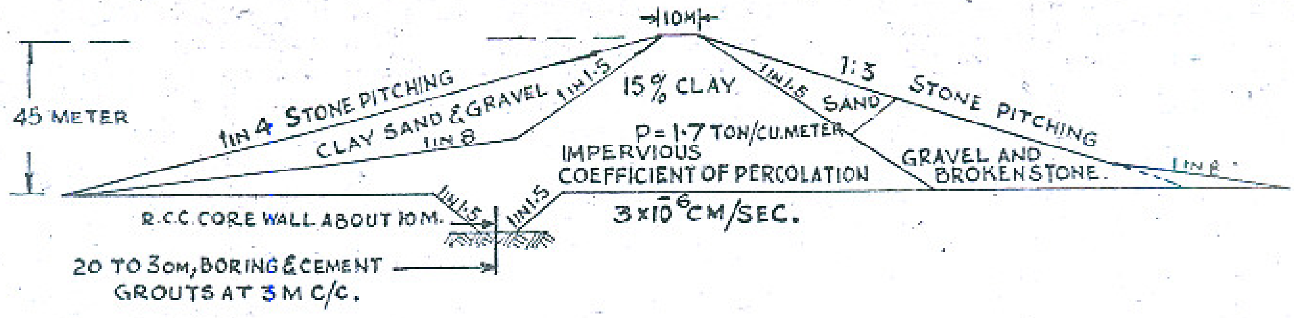


Fig 1. KUANTING DAM. Earth dam 45 meters high and 290 meters long at the top, capacity 2270 million cubic meters; Highest flood 8800 cubic meters per sec; Lowest flow 30 c.m.s. Construction started in November 1951 and the dam raised to a sufficient height by July 1953. Earthunk 2,200,000 cubic meter, Cement concrete 5,000 cubic meters, stone 350,000 cubic meters, length of boring and grouting 5800 meters.

Due to the large population, mechanisation of conservancy works has not so far been resorted to on a large scale. It is however felt that the Yellow River works will have to be mechanised to show quicker results.

I expressed a wish to Madam Chian that my visit only to Kuanting Reservoir which was completed in 1953 was not sufficient. I wanted to see actual works under construction and that I was also interested to visit engineering colleges. My programme was therefore altered slightly.

My first visit was to Kuangting reservoir, which has capacity to store 2270 million cubic meters. The details of the dam are given in Fig 1. The Russian help given is effective and aims at two things, *i.e.* (1) to make China self sufficient industrially, and (2) to create know-how in the country in every direction. There were 3 Russians who helped in this project, one for geological survey, one for design and one for construction. Actual field and office work were done by Chinese under the guidance of these Russians. The work was started in November, 1951, and they were able to hold up flood waters of July 1953. Fig 2. is a labour chart which shows that the maximum labour employed was 36,000 for the crucial period just before the floods of 1953. The quality of work was very good and the Engineer-in-Charge most competent. He was responsible for the actual construction.

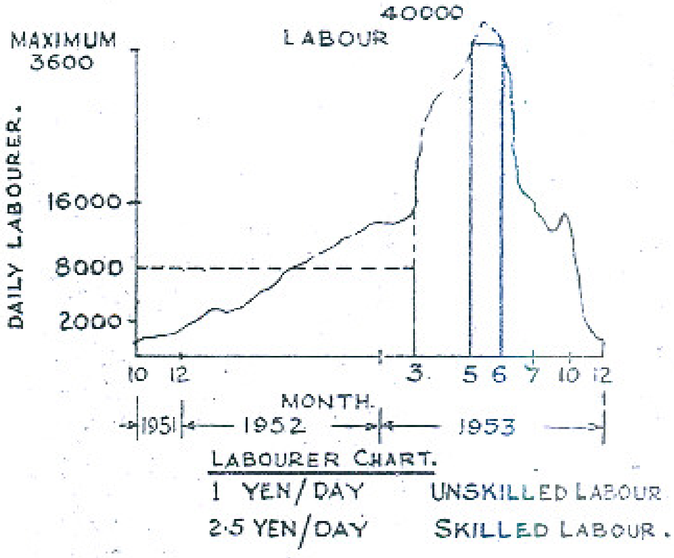


Fig 2. Labour chart for Kuanting Dam.

For my visit to the second work, I had to fly to Pumfu and from there go by train to Hufei. From Hufei I had to motor up to Maison dam. At Pumfu I was shown models of Huai river development scheme which consists of a number of delay dams, flood embankments, drainage, irrigation and hydro-electric works. The scheme is very comprehensive and on its successful completion, the Huai River will be completely under control. The model showed the various phases of scheme electrically and was most impressive. Both at Hufei and Pumfu they have built Rest Houses for foreigners which are very modern. The railway compartment was tolerably good, but very clean. Going out to Maison dam I had to motor 200 kilometers, out of which 50 kilometers were in sub-mountainous tract. The road was metalled but not bituminised due to lack of bitumen and tar. The rut formation in metalled road was being repaired in a very scientific manner. It consisted of correct precentage of sand, clay and stone chips. The ruts were wetted and the correct mixture of sand, clay and stone chips was spread to correct level. Wetness of the ruts penetrated the mixture and the motor traffic automatically did the consolidation. The freshly repaired portions were indeed very good. Along the entire length of the route on either side were trees about 3 years old and not a single tree was damaged. The method by which they looked after the trees is that the Co-operative Farms in whose area the tree lies are held responsible for its looking after (all agriculture is on co-operative basis). The result is almost unbelievable, as not a single tree was noticed to be damaged. These trees were 10 ft. high with 3" dia. stems. The tree guard of wood supports each plant to a height of 3′ to 4′ so that even the strong wind will not be able to damage it. In the last 30 miles in the sub-mountainous tract fresh forest were seen as as far one could see. The trees were coniferous and not more than 10′ high.

Maison dam had just been completed. It is a multi-purpose project costing 70 million yuane. The capacity of the reservoir is 2,275 million cubic meters. It will generate 40,000 kw. and irrigate 300,000 acres. The dam is of multiple concrete arch type. It has 16 arches of 13 meter internal diameter each. The maximum height of the dam is 88·24 meters, average being 34·4 meters. It has a spillway of 7 bays of 12 meters each with tainter gates. The downstream glacis has curved lip with friction block to throw the jet 100 meters away on to a solid rock.

From Maison dam I was taken to Shahamdi dam in the next valley. This dam is under construction and they had on that day just diverted the supply through the diversion tunnel. This dam is also multipurpose, but essentially is meant for flood control. It has a storage capacity of 2,345 million cubic meters and is capable of reducing the flood peak of a thousand years of 9,800 cubic meters per second to 1,300 cubic meters per second. It will generate a power of 40,000 kw. It will be a gravity arch concrete dam, 370 meters long with a radius of 108 meters, subtending an angle of 115° at the centre average height 80 meters. The diversion tunnel will be 8 meters in diameter after concrete lining and will be capable of taking 700 cubic meters per second. There will be, in addition, a power tunnel, 7 meters diameter and 240 meters long with 4 units of 10,000 kw. each. The discharge of the river at the time of inspection was 6 cubic meters per second and labour employed was 12,000 in three shifts, out of which 3,500 were skilled labourers.

When the Huai River Development Scheme was started considerable difficulty was felt to get skilled labour and the Government had to direct the skilled labour from far off places in Manchuria as well as Shanghai and other industrial towns. This band of 3,500 skilled labourers is being taken from one dam to another after completion. There was practically no machinery worth mentioning. The sand gravel and earth required was carried by tip wagons loaded by manual labour. To obtain the various size of gravel the material was screened by manual labour. Carriage of earthwork and other material was done in pairs, with a bamboo on their shoulders lifting baskets containing 3 cu.ft. of material. This means that each person was carrying about 150 lbs. The pile driving in the centre of the coffer dam was being done by usual pile driving equipment. In order to economise on steel sheet piles, timber piles were added to them as shown in Fig 3. There was no difficulty in obtaining unskilled labour through the Co-operative Societies which benefit from the scheme The unskilled labour was paid 1.25 yuans per day per labourer, and the skilled labourer got between 2 and 3 yuans per day. The labour working in the tunnel had helmets made out of tunnel willow branches instead of the steel helmets used in the West. A sample of this has been brought for making similar helmets for Warsak.

The entire area is fitted with loud-speakers through which labourers are cautioned to follow 3 important principles, *viz.*, safety first, quality of work second, and speed third. It appeared that on each of the above principles they were given a talk and these talks were given between periods of music. Such talks could also be political, social or merely annoucements.

At the site of work all facilities are provided, *viz.*, accommodation, food, hospitalisation, education for children, shopping centre, library, gymnasium, and lecture halls. Although the work consists of 8 hours shift, yet the remaining period is also controlled to a great extent. They have to attend various meetings, take evening classes, attend political lectures, and take part in sports. Life appears to be organised in great detail.

The accommodation consists of barracks with bamboo matting walls, bamboo matting roofs on bamboo trusses and mud floor. They are packed almost like sardines. Sanitary arrangements are communal, and only a certain category of employees is permitted to have families. Arrangements for food appeared to be good and reasonably cheap. In a stone grinding shop every labourer had a mask on to prevent stone dust being inhaled. Whatever little machinery there was was made in China. The hospital too was housed in a similar type of building. Even the operation theatre building was of the same kind except that it had a brick floor. The X-Ray plant was most up-to-date and was made in Shanghai.

The set up of the headquarter organisation is quite different for the system we are used to in our country. A study of this shows that at almost every level they have Partymen in order to control the

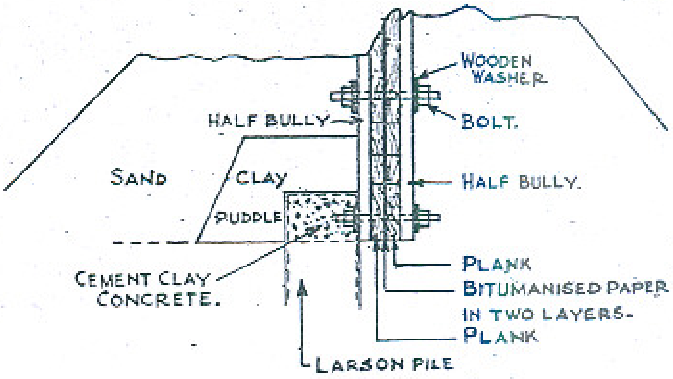


Fig 3. Sketch showing junction of Larson and Timber Piles in the concrete coffer dam used in Kuanting Dam.

work, and guard against defections and subversion. It appears that Partymen are proved communists who had to pass a theoretical examination as well as prove by action and deeds that they truly believed in Communism.

Another important engineering work visited was a combined rail-road bridge across the Youngtse River at Hangkao. This is a steel girder bridge to carry a double track of railway line with 3-lane roadway on the top. The maximum clearance of the bridge at low water is 100′ and at high level it is 50′. The central 9 bays are 300′ each. This bridge will be an important communication link between Russia and Indo-China. The project is supposed to have been completely designed by the Chinese and is being constructed by them as well. All the steel used is produced in Manchuria and they hope to finish the entire work in two years.

Besides the above engineering works a visit was paid to the traditional brick kilns as well as a modern kiln at Hufei. All the brick burning was done by the Co-operatives for Arts and Handicrafts. A lot of building construction is in progress almost in every town. The building construction is well planned and most new buildings consist of 3 to 4 storeys. Although modern in architecture, it has its own individuality as well. Many roads are widened in Hufei. New buildings were constructed before dismantling the old houses for widening and the population transferred to the new houses. There appears to be a standard rent all over China of annas -/6/- per sq. meter per month. The accommodation given per family is very small, in view of the fact that there is no purdah and all bathroom facilities are communal. The quarters are kept clean most probably due to strict supervision. Similarly pavements in front of shops are kept very clean. There appear to be individual responsibilities for keeping houses and shops frontage clean.

Visits were paid to a Textile as well as a Jute Mill. The efficiency appeared to be high, cleanliness excellent, and quality of work produced extremely good. Manchuria province has been further developed through Russian help and they have improved the heavy engineering industry to such an extent that they are now able to produce very complicated machines themselves. In most cases the machines produced are imitations with slight improvements. All the machinery required in the Textile as well as Jute Mills was Chinese imitation of well-known foreign manufacturers. They are even able to produce turbines and generators of 15,000 kw each. A large number of varieties of steel is produced to the extent of 2 million tons a year. As such they are able to produce structural as well as industrial equipment.

Flying from Shanghai to Hangchaw, the deltaic area of the Yangtse River looked very similar to East Pakistan. It appeared that every house had a navigable channel to approach it. There were neither roads nor railway lines in this area, but there was a net work of navigable channels. Furthermore, the Yangtse river had huge embankments on either side to prevent over-flow. From the above it is obvious that a lot can be learnt by us from China in coping with flood protection as well as river communication in the deltaic area.

Engineering Education:—While at Peking I visited the Chiang Wah University. This institution was an engineering college of the Peking University before the present regime. It used to take about 200 students every year. Now the admission is 2300 based on competitive examination results. Quite 30% admitted are girls. There are 7 degrees awarded by this University, viz, Civil Engineering, Hydraulic Engineering, Electrical Engineering, Radio Engineering, Mechanical Engineering, Mechanical Power Engineering and Architecture. Except Architecture, the courses are spread over 4½ years, while the architectural course is spread over 5 years. The majority of students of Architecture are girls. There are 1100 teachers, out of which 100 have experience of more than 10 years teaching, 200 have experience of about 5 years, and 200 are new graduates. The teaching staff gets higher pay than engineers in the field.

The University's Administration Office is headquartered in one of the old palaces. Majority of the buildings are new and the Laboratories are well equipped indeed. Great importance is given to hydraulic laboratory. A small actual hydro-electric station has also been constructed generating about 5 kw. Equipment in all the laboratories is new. A vast majority of apparatus is Chinese made. Yet there are many excellent machines in the workshops mostly from Communist countries. The workshop has very modern lathes which ordinarily would be used in an industrial concern rather than in a college. There appeared to be no difficulty in finding funds for laboratory and buildings.

In order to give an idea of education in colleges in China. the following figures would be found useful:

There are 225 universities and colleges. Of these, 53 are for training teachers, 48 for engineering, 37 for medicine, 26 for agriculture and 15 comprehensive.

The total enrolment of students in these colleges is 393,000 out of which 147,000 are engineering students.

In 1955-56, 61,000 graduated, out of which 21,000 were for engineering.

These figures speak for themselves to show how much importance the Chinese Government attaches to various kinds of education. It is significant to mention that out of several thousand graduating every year from Universities of Pakistan, less then 300 are engineering graduates, and unless special efforts are made to increase the number and increase the number of courses as well, Pakistan will not be able to develop. This aspect of national activities appears to be sadly neglected.

Impression :—My impression of the tour is that due to regimentation there is considerable discipline amongst the people. They work hard and they carry out policies laid down. They are fortunate in having Manchuria which was developed by Japanese as a highly industrialised country and the Chinese are reaping the benefit of it.

The Chinese like the Russians are attaching considerable importance to technical personnel and they are attracting the best brains towards technical professions. The figures quoted above indicating college education emphasize the fact very clearly, and in actual service too the best paid people are technical employees.

Recommendations :—The tour was a hurried one. None the less it is possible to recommend the following :

(1) A strong team of engineers should be sent to China to study in detail their water conservancy schemes, particularly flood protection ;

(2) The number of technical institutions in Pakistan should be increased. The teaching staff of such institutions must be paid more than technical staff in field, and as such the best brains among the technical graduates should be attracted towards the teaching profession ;

(3) If Pakistan wants to develop she must attract the best brains for technical professions. This can only be done by improving the conditions of service of technical employees. They must be paid more than others. They must be given opportunities to rise higher than others, and they must not be stifled by non-technical services. The present trend in Pakistan is very detrimental. The best brains are attracted away from technical professions, which are worse off now than before the Independence ;

(4) In order to cope with industrial development it is very necessary to lay great stress on development of heavy engineering industry, which in its turn depends upon the mining resources of the country ;

(5) On big works where there is concentration of labour greatest stress should be laid on labour welfare. It is not enough to leave the labour to its own resources when they are off duty. Great attention should be paid towards their education both with a view to increasing literacy as well as training within the trade. Lectures should be arranged for them also on social matters ;

(6) The Public Works Department's function should be split up into (*a*) engineering ; (*b*) administration ; (*c*) stores ; and (*d*) payments and accounts. A lot of office work now done by engineers can be done by non-engineers, leaving the engineers to devote more time to design work and proper execution. It is recommended that a high powered committee of P.W.D. officers may be appointed to go into this question of channelising all the work of P.W.D. so that engineers get more chance of concentrating on the engineering aspect of P.W.D.

Flood Embankments Practice in Sind

BY

DR NAZIR AHMAD

THE SIND PRACTICE

THE practice of the Sind authorities for construction of flood embankments is an art of their own developed during the last several years. Two most common type designs of the embankments are given in the Sind Bund Manual. There are three specialities of these designs :

(1) the provision of a wetting channel; (Fig. 1)

(2) imposition of a core wall; (Fig. 2.)

(3) addition of a pushta on the down-stream end of a bank. (Fig. 1)

The first two of these features have not been adopted by any other country of the world. The third feature is, however, used

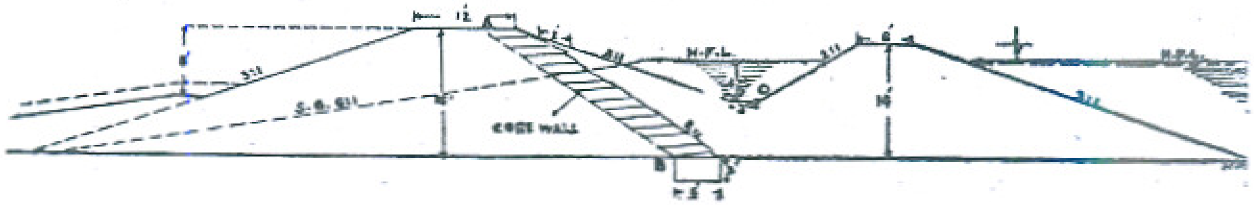


Fig. 1 Wetting channel between two embankments. A pushta is shown on extreme left.

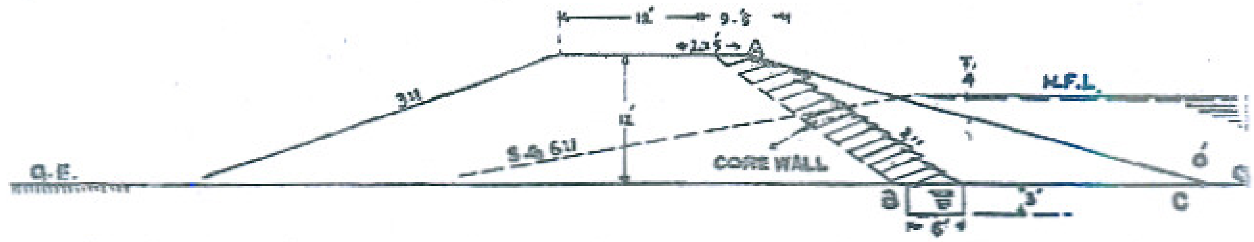


Fig. 2. A Sind type core wall which slopes towards inner toe of the embankment.

in other countries as well. Each of these devices has its own special function.

Wetting Channels :—Embankments in Sind are subjected to a long spell of dryness and become wet only for two or three months in a year. The expansion and shrinkage of soil develops cracks which form weak points and sometimes cause failure. There are two types of remedies which are generally adopted against these. The first is to have a channel in between adjacent bunds. Water is let into this channel before the start of the flood season to wet the soil which expands and thus eliminates the shrinkage cracks. Another precaution is the use of sand or sandy soil in the construction of a bank. This type of soil has a low order of shrinkage and is free from cracks.

Sand Core Wall :—In the Sind design, use is made of a sand core wall nearly equal to half the width of the bank at top and is kept sloping in the same direction as the upstream bank. This device is mainly adopted as a safeguard against rats or other burrowing animals. It has an added advantage of low shrinkage.

Pushta on the downstream end :—This is not a speciality of the Sind design alone as it is also adopted in other countries of the world. It is provided to insure that the hydraulic gradient line remains embedded at the downstream end and no erosion of the toe of the bund starts.

It is also a common practice to add materials of high permeability at the toe of the bank to attract the flow lines. Alternatively, one may instal vertical, baked clay strainers about 1½ to 6 inches in diameter, shrouded if possible, 2 to 5 feet below the downstream natural surface. The tops of these vertical strainers may be connected by a horizontal baked clay pipe so as to carry away the seepage to a depression (Fig. 3). This will permanently depress the flow lines within the soil medium and will insure safety against hydraulic forces.

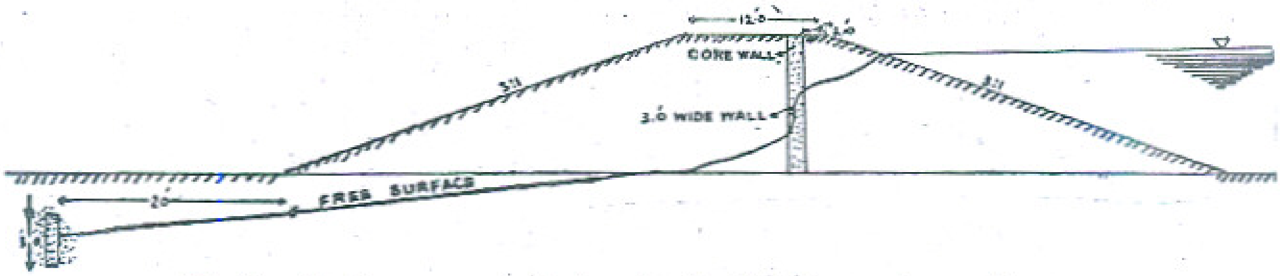


Fig. 3. Strainers are provided under the downstream toe wall.

FLOW THROUGH A HOMOGENEOUS BANK

It is well known that flow characteristics through a homogeneous bank depend upon its geometry and the water levels on the upstream and downstream ends, and are independent of the materials forming the bank. Flow net through a bank made of clay or of sand is similar under indentical geometric conditions and levels. A bank of soil of low permeability is preferable as the exit gradient at the downstream end is too small to dislodge the particles of the bank.

Another characteristic of flow through a homogeneous bank is that the free surface or the topmost flow line opens out on the downstream face at the same point in a narrow or a wide bank having the same position of water levels on the upstream and the downstream sides. The free surface readjusts itself in the body of the bank with the increase in its width. This proves that widening of a bank by provision of a pushta does not effect the point of emergence of the free surface. A longer path of flow, however, reduces the volume of seepage at the downstream end and makes the bank more stable.

If the flow takes place through stratified media or through an embankment provided with a core wall either of sand or clay, flow pattern does not remain similar to one through a homogeneous bank but it changes with the angle of incidence of the flow lines to the interface of the two media and their permeability co-efficients. If i_1 and i_2 are the angles of incidence and emergence to a normal to the interface of the two media, then $\frac{\tan i_1}{\tan i_2}$ is directly proportional to the ratio of the permeability coefficients of these media i.e. $\frac{K_1}{K_2}$ (Fig. 4.)

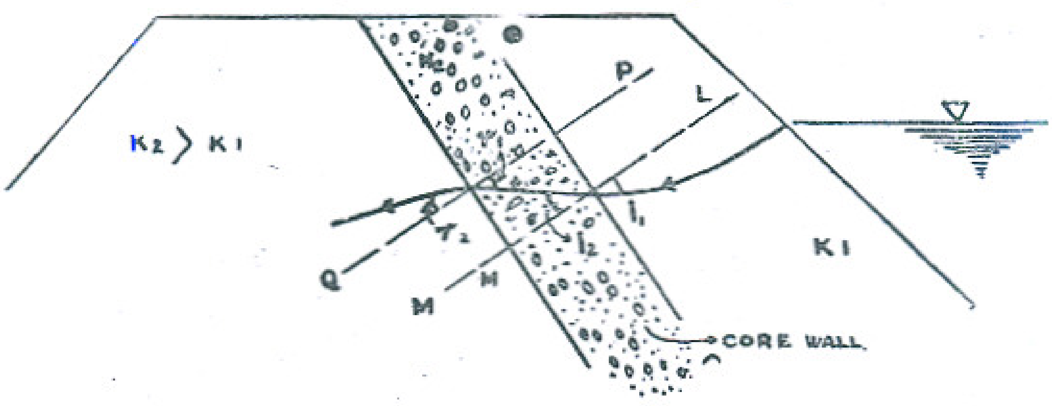


Fig. 4. Angles of incidence and emergence are i, r_1 and i_2, r_2 respectively.

EXPERIMENTS ON EMBANKMENTS WITH CORE WALLS CARRIED OUT AT THE IRRIGATION RESEARCH INSTITUTE, LAHORE

A sand core wall of a higer permeability than that of material used for the construction of the bank was placed at various angles and positions. Conclusions from these tests are shown in Figures 5 to 8. It will be seen that a core wall placed at an angle as practised in Sind (Fig. 6.) does not depress the top stream line at all. In fact had this core wall not been present (Fig. 5), the level of the top stream line would have been lower than what it is in Fig. 6 after travelling the same distance. On the other hand core wall at a suitable angle (Fig. 7) gives a much steeper downward direction to the top flow line as it passes through the core wall. On comparing Fig. 7 with Fig. 8 one may conclude that

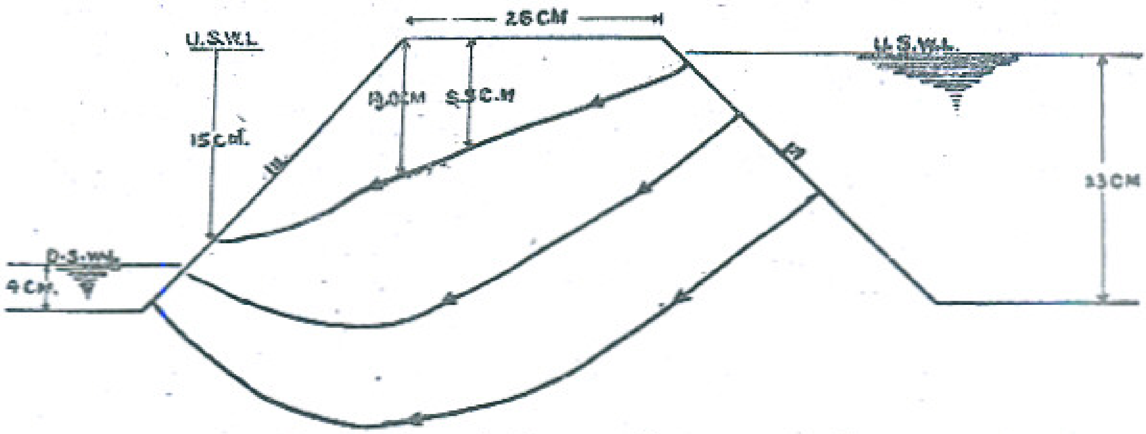


Fig. 5. An embankment without a core wall.

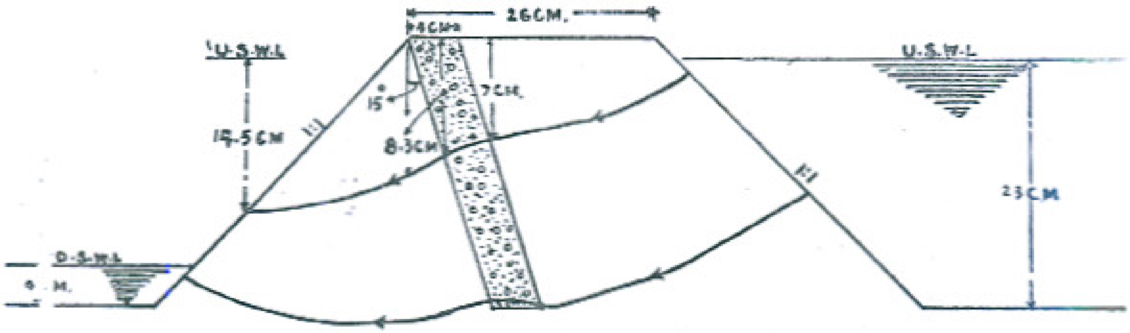


Fig. 6. An embankment with a Sind type core wall. At d/s end flow emerges higher than in Fig. 5.

too much inclination of a core wall is also of much help.

The experimental results are given in Table 1. From these the following conclusions may be drawn.

(1) $\frac{\tan i_1}{\tan i_2} = \frac{\tan r_2}{\tan r_1} = \frac{K_1}{K_2}$

(2) A thin core wall about 1/5th the width of the bank at the top and laid 2 to 3 feet from the upstream edge of the bank, sloping 15° to the vertical in the direction of downstream slopes, gives the best results. The next suitable is a vertical core wall as it is much easier to instal and also lowers the flow grandient. A core wall of Sind type, instead of helping, worsens the conditions.

Table No. 1

S. No.	Position and type of core wall	Angle from fine to coarse		Angle from coarse to fine		$\tan i_1$	$\tan i_2$	$\frac{\tan i_1}{\tan i_2}$	$\tan r_1$	$\tan r_2$	$\frac{\tan r_2}{\tan r_1}$	Remarks.
		Incidence, i_1	Deviation, i_2	Incidence, r_1	Deviation, r_2							
1.	Single central core wall ...	12	40	45	35	0.213	0.839	$\frac{1}{4}$	1.0	0.7	$\frac{1}{1.3}$	(1) Ratio or permeability co-efficient of
2.	Single core wall, 15° to vertical ...	40	60	25	20	0.84	1.7	$\frac{1}{2}$	0.47	0.36	$\frac{1}{1.3}$	core wall to bank is
3.	Single core wall 30° to vertical ...	15	45	30	13	0.28	1.0	$\frac{1}{3}$	0.6	0,23	$\frac{1}{2.6}$	equal to
4.	Core wall at middle point from beginning of bank ...	13	37	25	10	0.23	0.75	$\frac{1}{3}$	0.47	0.18	$\frac{1}{2.6}$	$\frac{0.00146 \text{ ft/sec}}{0.00051 \text{ ft/sec.}}$
5.	Core wall at $\frac{1}{3}$ from beginning of bank ...	20	42	48	20	0.36	0.9	$\frac{1}{3}$	1.11	0.36	$\frac{1}{3.1}$	$=2.9$
6.	Two core walls one close to beginning of bank and second beginning at mid-point of banks ...	15	45	40	15	0.28	1.0	$\frac{1}{4}$	0.48	0.28	$\frac{1}{0.3}$	(2) S. No. 1 & 4 were repetition.
7.	Two core walls one close to beginning of bank and second beginning at midpoint of banks ...	25	70	32	5	0.47	2,75	1/5	0.63	0.19	$\frac{1}{3}$	
8.	Single core wall towards d/s ...	10	42	44	14	0.17	0.9	1/5	0.96	0,234	$\frac{1}{4.5}$	(3) Mean ratio of
9.	Single core wall towards u/s ...	18	39	68	41	0.32	0.80	1/2.5	2.6	0.87	$\frac{1}{3.0}$	$\frac{\text{Tan } i_1}{\text{Tan } i_2}$ & $\frac{\text{Tan } r_2}{\text{Tan } r_1}$
10.	Core wall 30° to vertical at d/s end of bank ...	17	38	52	25	0.30	0.78	1/2.6	1.28	0.46	$\frac{1}{2.8}$	$=1/3.3$
11.	Core wall inclined at 45° to vertical, u/s side ...	48	81	80	42	1,11	6.31	1/5.7	5.67	0.9	$\frac{1}{6.3}$	
12.	Core wall inclined at 30° to vertical on u/s ...	52	65	70	57	1.19	2.14	1/1.8	2.75	1.55	$\frac{1}{1.83}$	
13.	Core wall inclined at 45° to the vertical on d/s ...	15	50	48	13	0.27	1.19	1/4.3	1.11	0,23	$\frac{1}{6.2}$	
14.	Core wall inclined at 15° to the vertical on u/s ...	42	79	75	31	0.90	5,14	1/5.7	3.73	0.60	$\frac{1}{6.2}$	

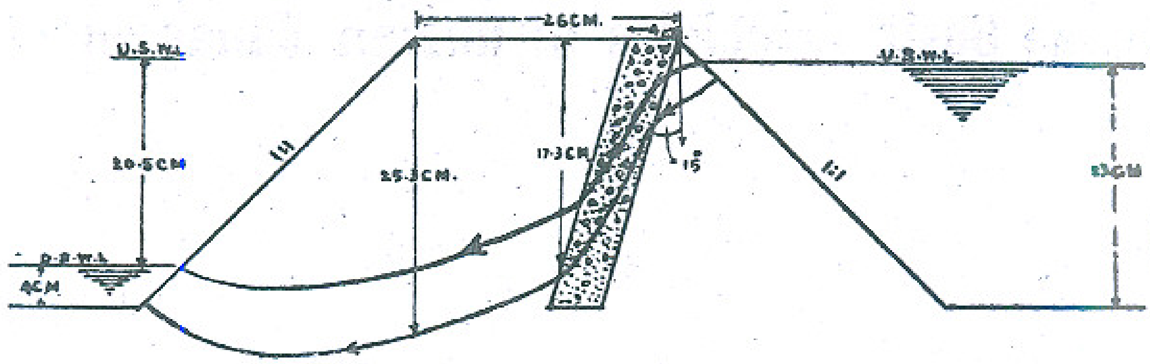


Fig. 7. A core wall at the most suitable angle

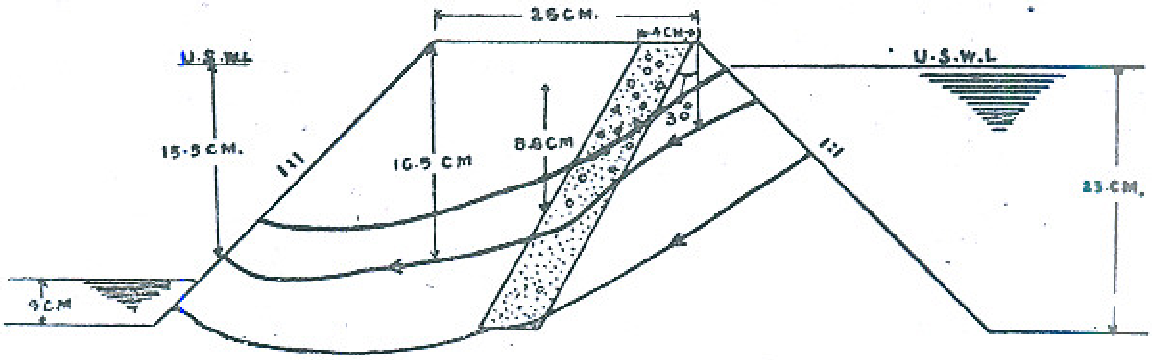


Fig. 8. A core wall with too much outward inclination

Recommendations :—In discussing the practice of the Sind authorities to design flood embankments it may be recommended that :—

(1) The use of wetting channels to eliminate shrinkage cracks is a useful device.

(2) The use of sand core wall, provided its size, position and slope of the incident flow lines is kept with scientific consideration, is also helpful.

(3) A flow line incident on a core wall of greater permeability than that of the bank deviates on emergence and a proper angle of incidence causes a considerable deviation to the emergent flow lines. A thin core wall sloping 15° to the vertical in opposite direction to the slope of the upstream bank causes the largest deviation to the flow lines. A vertical sand core wall is the next best.

(4) Deviation of the free surface downward leaves a considerable top portion of the bank either dry or moist, the weight of which is more than saturated or submerged soil and this improves the stability of the bank.

(5) Another device to increase the stability is to add 3 to 5 feet long baked clay strainers preferably shrouded, kept 2 to 5 feet below the natural surface and installed 10 to 25 feet apart having their top connected by a banked clay pipe to carry away the discharge to an outlet.

(6) Generally a bank is considered stable if constructed to a hydraulic gradient of 1 : 6 to 1 : 7.

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Some Basic Principles of Human Management

by

C. J. HARROWER

Consultant, Government of Pakistan on Training of Secretariat Staff

It has often been stated that man management revolves round human relations. Human management is an art and not a science. Our failure in the field of man management is not due to lack of knowledge but is a result of not developing the right attitude. There are some general principles which can help supervisors and officers in inculcating the correct attitudes. These can be briefly described as follows:—

(1) No one enjoys being bossed around. It is no good to throw the fact that a junior is a subordinate into his face. The residual effect of being unnecessarily commanded is the clenching of mental fists by the subordinate. The emotional back-log results in the orders not being carried out in the spirit in which they should be obeyed. An officer with self-confidence should never need to emphasise differences in status.

(2) Avoid pointing out mistakes directly. If errors are pointed out to the subordinate directly, they set up a defensive reaction in the latter's mind which stands in the way of the recognition of the mistakes and the efore stalls their correction. Nearly always the man at fault knows in his heart that h[illegible] has committed a mistake. The mistak[illegible] should not be reinforced by being pointe[illegible] out bluntly.

(3[illegible] Criticism should be abolished. Use of criti[illegible]sm as a technique for correction has been [illegible]und to be unsuccessful It only serves [illegible]o emphasise the difference between rank a[illegible] it consists in talking down to a [illegible]on. The defensive reaction created in [illegible]icised person hinders improvement [illegible]s negatives the very purpose of

too much [illegible]

[illegible] It is not so [illegible]portant how [illegible] and [illegible]ink as [illegible] they feel. Therefore, [illegible] you take action, you should always [illegible]rself how the man feels about it.

Ta[illegible] may be [illegible]

It must always be remembered (1[illegible] pect cannot be command[illegible]d or forced. [illegible]ries to catch it, it slips away. Usually (2) [illegible]n who does what we are afraid to do [illegible]r respect and herein lies the paradox [illegible]ct. In official matters, among other [illegible] respect comes through the admission [illegible]kes. Admitting ones own mistakes is something of which the subordinates are usually incapable. Hence they respect the man who admits his own mistakes.

(6) It is a strange fact that if you are looking for trouble, it usually comes to you. Similarly if you expect good things like loyalty and co-operation you get them. If any officer develops the attitude of expecting these and subtly lets it be known, people will try to live up to his expectations.

(7) Psychologically sneaking the make-up of everybody is different. Everybody, therefore, requires special treatment. Officers will be well-advised to avoid driving everybody with the same stick. Another moral that can be drawn from this principle is that snap judgements should always be avoided. Jumping to conclusions is a habit which can mar the smooth working of an organization.

(8) Head-on collision should always be avoided. If there are any conflicts in the organization, the officer should not allow himself to be committed absolutely to a position from which there is no retreat. For example, if he finds that a subordinate has not been working properly, he should not go all-out to condemn the man lest he should later on find that his opinion was based on hasty conclusions and that an immediate collision was not necessary. In cases of this sort, it will be advisable to delay decisions or actions. Better improvement can be brought about by the use of sustained pressure, given out in small instalments, rater than a full-fledged invasion of the problem.

[illegible] nise that arguments always commit people absolutely to certain stands. Also, arguments do nothing to achieve a compromise or the resolution of a conflict. The worst thing that anybody can do is to win an argument. Arguments, therefore, give rise to a chain of fears and worries and of unavoidable collisions. Discussion, on the other hand, brings people closer to each other because it does not militate against people's drive for importance. It is, therefore, advisable to discuss matters rather than argue about them.

Forum on Sanitary Engineering Problems in West Pakistan

Date :	April 28, 1959
Time :	5-30 to 7 p.m.
Place :	Nedou's Hotel, Lahore
Sponsor :	West Pakistan Engineering Congress, Lahore Centre.

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1.	Introduction	*Mr. Y. M. Liu*
2.	The Scope and Requirements of Sanitary Engineering Services	*Dr. R. G. Mirza*
3.	Problems of Sanitary Engineering in West Pakistan	*Mian Hamid-ud-din*
4.	The Role of Sanitary Engineering in Housing and Town Planning	*Mr. Mazhar Munir*
5.	The Role of Sanitary Engineering in Industry	*Mr. Irshad Hussain*
6.	The Financing of Sanitary Engineering Development	*Mr. Bashir Ahmad Khan*
7.	Discussion	*Professor B. W. Holman* *Mian Abdul Aziz* *Dr. G. R. Mirza* *Mr. Liu* *Mr. Mukhtar Ahmad*
	Conclusion	*Dr. Mubashir Hasan*

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INTRODUCTION

BY

Y. M. LIU.

I believe the gathering of us here today bears great significance. In view of the broad knowledge required by this profession, I have the pleasure to organize a group of celebrities to present to you a "Forum on the Sanitary Engineering Problems in West Pakistan." We welcome your participation in the discussion as well as comments afterwards.

Our panel consists of Dr. Ghulam Rasul Mirza, Assistant Director of Health Services, West Pakistan, one of the most experienced Public Health doctors; Mian M. Hamid-ud-Din, Chief Engineer of Lahore City Corporation, a very learned Public Works Engineer; Mr. Mazhar Munir, Provincial Town Planner, West Pakistan, a very aristocratic Planning man; Mr. Irshad Hussain, General Manager of Packages Ltd., Lahore, a very successful Sanitary Engineer-cum-industralist; and Mr. Bashir Ahmed Khan, Section Officer, Social Welfare and Local Bodies Department, a very shrewd secretariat officer. They are serving as rapporteurs. As regards myself, I am only serving as a moderator, who is nothing more than a timekeeper, a traffic controller.

SANITARY ENGINEERING SERVICE IN WEST PAKISTAN

BY

G. R. MIRZA

The need for the provision of safe drinking water supply and proper drainage system has been recognised all the world over from the past 50 years or so and since the establishment of the bacterial theory in the world. The prevention of bowel disorders, namely cholera, typhoid fever, dysentery, diarrhoea and worm diseases like hookworm can be eradicated with the provision of these two basic sanitary facilities.

To stress and to narrate history in the sub-continent of Indo-Pakistan, the Bhore Committee which comprised of [illegible] Physicians and Engineers, recommended in their report after labouring for three years that Public Health Engineering Unit should be set up in the Provincial Health Directorate to initiate and plan schemes of drinking water supplies and drainage for the Province. In India the Sanitary Engineering services have been set up and are functioning in the Centre as well as in the provinces, and a number of engineers have been trained with a public health bias and are working as members of the public health teams, to improve environmental conditions with special stress on the provision of safe potable water supply and drainage schemes.

The Central Ministry of Health procured for us the services of a senior Sanitary Engineer from the W.H.O. in the year 1957. The Provincial Government have now sanctioned the creation of a Sanitary Engineering Unit in the West Pakistan attached to the West Paki[illegible] Health Services with effect from 1[illegible] 1959. The Sanitary Engineer in [illegible] Unit will be acting as a [illegible] member [illegible] W.H.O. Sanitary [illegible] and would [illegible] in clo[illegible] with the Health Services [illegible] well as the Additional Chief Eng[illegible] In the Social Welfare Works Orga[illegible] were He will get his instructions for the [illegible] differ- tion of sanitary projects from the [illegible] bodies. Health Services, West Pakistan [illegible] wing the planning and execution of the [illegible] he would get his instructions from the Social Welfare Engineering Department. This Sanitary Engineer of the status of a Superintending Engineer would be treated on deputation to the Health Services Department with lien in his parent department and will replace the W.H.O. Sanitary Engineer after the completion of his tenure as an adviser during the next year. He will have an Assistant Sanitary Engineer to work under him and who will be of the status of Sub-Divisional Officer. Besides this he will have adequate administrative and clerical staff.

These Sanitary Engineers would afford technical advice and support to the local bodies, *i e.*, Municipal Committees, District Boards, and would assist these organisations to prepare plans and estimates for sanitary projects under their control and would supervise the execution and operation of water supply and drainage schemes. These Local Bodies will either bear the cost of expenditure on the schemes themselves or apply for grants-in-aid from the Government through the agency of District Development Committees, Divisional Development Boards and finally the West Pakistan Sanitary Board. The design and execution of such works will be done by the Social Welfare Works Organisation of the Buildings and Roads Department, which will soon build up a strong planning and design division.

In the end, I might venture to point out that so far in our country, the duties of Sanitary Engineer have been entrusted to Civil Engineers of the P.W.D., B & R, Public Health Divisions, who have not got training in Public Health and have not been orientated in its philosophy in any institution. It will, therefore, be advisable if the Engineering Department as well as the Public Health Department take cognizance of this point and take steps to arrange for training of Sanitary Engineers in the Engineering institute as well as in the Institute of Hygiene and Preventive Medicine, Lahore.

PROBLEMS OF SANITARY ENGINEERING

BY

MIAN HAMID-UD-DIN

Introduction.—Public Health and Sanitary Engineering in Public Health is directed towards the control of the environment for the protection and improvement of health and promotion of the comfort of human beings. The Sanitary Engineering is particularly directed towards the solution of problems in water supply, drainage, sewerage, waste collection and disposal and in the control of environment in the prevention of communicable diseases.

[illegible] municable diseases which may [illegible] epidemic are preventable through [illegible] tive and engineering methods [illegible] t reduction in the wate[illegible] rne [illegible] e cholera, [illegible] and typhoid [illegible] be attributed in great part to [illegible] ag advances in water treatment and [illegible] disposal. Degenerative diseases, [illegible] y resulting from improper social [illegible] ent, dietary deficiencies, and mental [illegible] sent problems requiring sociological [illegible] ical rather than an engineering approach. Procurement of water, collection of sewage and disposal of sullage water and design of structures are Civil Engineering problems whereas water purification, sewage treatment, collection and disposal of human excreta and municipal refuse, sewage and industrial waste treatment, environmental sanitation, industrial hygiene, air-conditioning, food sanitation, housing improvement, flies, mosquito and other insect control are the Sanitary Engineering problems.

The work of Sanitary Engineer involves the application [illegible] ledge in the major branches of professional engineering, such as civil, mechanical, electrical and hydraulic in addition to special knowledge of sanitary chemistry, bacteriology and biological sciences to solve the problems encountered in his practice in the control of environment in the prevention of communicable diseases; besides, he is required to have thorough knowledge of the theory and practice of water purification, waste disposal, destruction of the vectors of infection and conduct of the Health Department activities, in the field of sanitation. It is pointed out that the type of activities in the various fields include planning, designing, construction, maintenance, management, control and supervision which requires a specialised training, knowledge and experience. Unfortunately this type of sanitary engineering training is not imparted in any of our Engineering Colleges in West Pakistan. The Civil Engineers who are appointed to hold the Public Health Engineering charges in the Government Departments or the Local Bodies feel greatly handicapped due to lack of the specialised knowledge required to successfully handle the charge. This not only results in abnormal delay in the preparation and execution of Sanitary Engineering projects, the schemes produced and executed are far from being perfect. Their operation and maintenance is likely to be less efficient and less economical. The need for the services of properly qualified engineers in the field of Sanitary Engineering is keenly felt; I suggested the opening of post-graduate diploma class in Sanitary Engineering at least in one of the Engineering institutions in West Pakistan. The development of protected public water supplies, introduction of modern water-borne sanitary systems in the various towns and rapid industrial development would provide an almost inexhaustible field of activities for the engineer in public health that assure a continued demand for his services. You will be pleased to know that the Provincial Government is actively considernig the opening of one year Diploma Class in Sanitary Engineering at the Government College of Engineering and Technology, Lahore.

Effect of Sanitary Engineering on City Life.—The effect of Sanitary Engineering is greatly reflected in the reduction of death rate, improved health and increase in life span. The present national death-rate from all causes is about 12 per thousand of population and total death due to enteric diseases is 2 per thousand. The estimated annual morbidity is 20 per cent of the population. The mortality rate in West Pakistan is much higher than that of other advanced countries. This can be ascribed to the prevailing insanitary conditions, overcrowding of people in towns, rapid increase in population, lack of proper sanitary disposal of wastes and unprotected public water supplies. Water supply of good quality is a major defence in the protection of public health. The development of Water Supply and waste disposal in West Pakistan should deserve top consideration..

Development Programme.—The sanitary development has badly suffered owing partly to the large expansion in the other activities of the Local Bodies which have outrun the increase of their sources and has resulted in neglect of proper expansion of water supply and drainage systems. Only by a comprehensive plan of development of sanitary conditions the existing sad condition could be corrected, and that, to be effective, such a plan must be impartially financed from Government grants or loan funds to the extent to which the provisions for future maintenance can be relied on. The preparation of a comprehensive plan appears to be necessary. Detailed plans will take some time to work out. Rough schemes, on the basis of average rate of cost per capita and even on the basis of area, should be considered.

According to the estimation, in the year 1980, the population in the cities of over one lac population group will be 85 lacs, population of towns of 50,000 to a lac group will be 25 lacs and population with 10,000 to 50,000 groups would be 44½ lacs. Population in towns of 25000 to 10,000 group would be 12½ lacs. Altogether there will be around 400 communities with 167 lacs urban population to be supplied with water which will require about 100 crores. The improvement of water supplies in the rural villages of population below 2500 is also tr[illegible]mendous and urgently needed. At present, there is hardly few percent of population covered by adequate water supply. Therefore, th[illegible] problem of Sanitary Engineering [illegible] Pakistan is to develop municipal [illegible] water supply. The development [illegible] supply simt[illegible] raises the [illegible] proper drainage and disposal. It [illegible] a great part in the use of s[illegible] In systems with water flush toilets nece[illegible] were underground sewerage system, [illegible] differ- and disposal works. It is recog[illegible] bodies. the sanitation would be best serv[illegible] are wing use of sewers to convey human [illegible] away from the dewellings as pro[illegible] possible. Investment in sewers is usually a valuable but indirect financial return. The value of their installation lies in the service rendered, the protection of environment and the improvement of health and living standards.

For the successful implementation of the sanitary development plan besides the adequacy of finances, procurement of materials has to be properly planned. The waterworks engineers laboured under the severe handicap of having no type of locally manufactured pipes that would stand even moderate pressures The progress of any water supply project is greatly effected due to delay in the procurement of materials and pumping machinery, for reasons of restricted foreign exchange.

This suggests the creation of planning and procurement division in the Health Directorate. Besides this there should be a Survey and Project Division for the preparation of individual schemes. For municipal works a strong engineering organisation supported by financial loans would be the answer.

The drainage and water borne sewerage system would be planned only for the big cities. For towns and villages, the different kind of urban rural sanitary latrines must be developed for adoption. For the collection and disposal of municipal refuse and garbage some study and research should be carried out to improve the situation.

Environmental Sanitation.—Besides water and waste the other environmental factors of varying importance in disease transmission are food, insects, housing, air pollution and other industrial hazards. The prevention of disease through scientific control of these conditions or vehicles of infection is practice of sanitation. For these activities I do not think we can get on to them immediately. Special personnel should be trained gradually through limited staff before we can come to the development.

THE ROLE OF SANITARY ENGINEERING IN HOUSING AND TOWN PLANNING

BY

MAHZAR MUNIR

The [illegible]ubject I shall deal with in my paper is rega[illegible]ng the role of Sanitary Engineers in the [illegible]eld of housing and Town Planning.

Th[illegible] objective of both the Town Planner and the Sanitary Engineer is the same a[illegible]d that is giving the individual in partic[illegible]lar and the community in general [illegible]lt[illegible]y environment.

[illegible]ting housing conditions are, general[illegible]g, extremely unsatisfactory. There [illegible] too much [illegible]owding and sound hygien[illegible] con[illegible] [illegible] has been [illegible] A state of [illegible] in towns and the country. Ta[illegible] [illegible] like tuberculosis, dysentery, typhoid, may be [illegible]ence and spread of which are affected [illegible]ousing conditions of the community (1) [illegible] non. It is the aim of both the Town [illegible] and the Sanitary Engineer that there (2) [illegible]e decent water supply, drainage, and adequate provision for refuse collection in each house.

The importance of the close collaboration between the Sanitary Engineer and the Town Planner may be judged from the fact that if a site is to be selected for a new town or any extension of the old one, the first question that the Town Planner will ask will be: Is enough water for drinking purposes available in the area and [illegible] of good q[illegible] both the answers are in the affirmative only then will the Town Planner proceed to assess the site from the viewpoint of other requirements essential from the Town Planning point of view. The Sanitary Engineer must also be consulted regarding the depth of the sub-soil water. This is to ensure that the area is not water-logged and it is not liable to water-logging in the future. Subsoil water at a depth of 10 feet or so is likely to create unhealthy conditions.

The housing problem as well as the layout of streets, roads, etc., their slopes and levels, drainage, etc., is an essentially important matter closely related to public health engineering and unless these matters are placed on a proper footing serious mistakes will occur in the future as have occurred in the past. Some of the developments in recent times have not made adequate provision for playgrounds and open spaces. These are vital for the health of the people. Moreover the Town Planner has to keep in view reservation for the siting of water supply mains, hydrants, valves, fittings, storm water drains and gullies.

We have often heard of Ribbon Development. By Ribbon Development is meant the premature development, which takes place along the main arterial roads of an expanding town. It is a development in the shape of a ribbon with all length but practically no depth. The Town Planners take strong objection to ribbon development due to the fact that it entails wasteful expenditure on public services like water supply and drainage as very long connections have to be provided in order to serve such areas. Moreover long length of sewers means excessive depth for sewers which increases the cost tremendously. If the developments were to take place in an orderly manner, expenditure on these items can be considerably reduced.

Although the cost of providing water supply and drainage are considerable in any development scheme the appreciation in value of that area due to provision of these items is considerable. The area is in a much more sanitary condition, clean to look at, not emitting bad smell. It will also raise the value of the colony in general and the houses in particular. It has also been noticed that if a house has to be given on rent, the one which has sanitary fittings easily fetches about Rs 50/- to Rs. 100/- more than a house without sanitary fittings. Moreover such a house is a much better place to live in from the point of view of health.

THE ROLE OF SANITARY ENGINEERING IN INDUSTRY

BY

MR IRSHAD HUSSAIN

In the Western countries the industrial revolution came—the industry sprang uncontrolled by leaps and bounds and today we find that the industrial areas are the dirtiest and constitute the unhealthy slums. The modern planned industrial areas are much cleaner. In [illegible] the lessons learnt by the West are before us. We can and should do effective sanitary planning before the installation of an industry or an industrial estate.

Nuisance industries like tanneries, glue factories and bone processing plants, etc., should be installed in locations far away from the residential or business areas. Non-polluting industries can be located more close to the habitation. From a sanitary engineering view-point, the foll[illegible]ing items have to be looked into before an [illegible]ndustry is installed.

(i) *Water demand, its [illegible]ource and quality:* Most of the bigger in[illegible]dustries in the northern region of West Pakis[illegible] [illegible]nd in East Pakistan arrange their [illegible]r supplies from tube-well water or [illegible] [illegible]treating the river water. In [illegible] areas [illegible] water suppl[illegible] arranged on [illegible] basis. W[illegible] of the industries is so varia[illegible] difficult to estimate accuratel[illegible] In studying the nature of industri[illegible] were demand of textile, paper and cann[illegible] differ- will be high while printing pre[illegible] bodies. shops, cigarette and pharmaceut[illegible]re wing tries will have a low water de[illegible] design purposes the industrial demand can be placed at 40 to 50% of the total demand for towns where industry is expected to expand.

One of the first and foremost investigation to be done at the time of picking up a site for the factory is to verify the quality of the water to determine its suitability for the manufacturing processes. High iron and manganese contents will be detrimental to the manufacture process of textiles, fabrics and dyeing industries. High chlorides will give poor quality glue in the glue industry. Excessive hardness will necessitate the use of a softening plant where water is to be used for raising steam or when it is employed as a condenser water in refrigeration. Bore holes for taking water samples should be drilled on alternate industrial sites. If it is for municipal authorities to supply water then adequate provisions have to be made to ensure that the copious quantity of water will be made available to the industry.

(ii) *Disposal of Industrial Waste* : An average person or even an Engineer sometimes fails to appreciate the magnitude of the problem created by the industrial wastes. For a highly industrialized country the pollution contributed by the industry is almost equivalent to the one contributed by the population. Nature of industrial waste varies from one industry to another. Pulping mills will have a very high biochemical oxygen demand. Dairy and creamery industry will have a loading on the sewerage system. [illegible]pulation equivalent of some other typical w[illegible]tes are indicated below :

Indu[illegible]ries of aver[illegible]ge size	*Population equivalent*
Dairy and creamery	800 to 1,000
Tomato cannery	3,000 to 4,000
[illegible] cannery	6,000 to 8,000
P[illegible]	4,000 to 5,000
[illegible]ulphite	250,000 to 400,000
[illegible]getable	18,000 to 20,000
[illegible]le mill	[illegible]
[illegible]ill	[illegible]
[illegible]	[illegible] 22,000

[illegible] in [illegible]

Ta[illegible] cases where the industrial waste may be[illegible]d into the sewer, the treatment [illegible] the Sewerage Treatment Plant (1) [illegible] be decided not on the basis of [illegible]fluent, but it will depend on the (2) [illegible]he industrial waste. If a new [illegible]rings up, it might completely upset the existing treatment plant and in such cases pre-treatment at the industrial site is essential. Most of the industries in Pakistan which are discharging heavy loads of B.O.D. do not provide any pre-treatment. The wastes are discharged in rivers or in open ponds. It is a common site to see ponds and lagoons of water in the vicinity of textile mills which form mosquito breeding grounds.

Unfortunately there is not enough strength in the public opinion to force the industry into investing money on the pre-treatment process. No laws have been formulated and the enforcement of the existing laws to prevent pollution or the creation of nuisance in the vicinity of the industry is quite inadequate and lukewarm. The responsibility for a clean environment in the vicinity of the industry does not rest only on the industry, but the city authorities have also to share the responsibility. The industries in Pakistan are paying substantial taxes to the Government and the returns forthcoming to them in the form of ameneties are at the lowest. Industry is a blessing and a boon to the country. After all, why is the West more prosperous as compared to the East. The one big difference is the vast industrialisation of the West. Therefore, the corrective treatments are to be applied without interfering with the process or the turnover. By a joint effort of the Government and the Industry, pollution problem can be abated.

Air Pollution by Industries : It is only during the past couple of years that the nuisance of atmospheric pollution by the industry has been noticed in the industrial sites like Lyallpur, Karachi (Sind Industrial Trading Estate). Dense fogs have been noticed in Karachi area which used to have an unequalled visibility and one of the best airports in the world. [illegible] fogs due to the industrial smoke are becoming a significant feature and it is the right time to sound an alarm signal. The health authorities have to look into this problem and maintain statistics in order to curb the problem in its infancy.

Industrial Hygiene and Occupational Diseases : On looking through the various industries in Pakistan, there is a fantastic difference in standards of cleanliness, medical aid and sanitary engineering. As one goes from one industry to another, one finds that one industry is much more conscious of maintaining high standards of hygiene and cleanliness while the other has hopelessly unhealthy conditions of work. Both are being administered by the same law. Enforcement of the law by the Labour Department will certainly improve conditions in the badly maintained industries and bring about improvement in the health of the workers. Certain minimum standards have to be maintained. Every industry must provide facilities like full medical aid, canteen, sport recreations and flush equipped lavatories. These are absolutely essential and the industry should not economize on these items. Health and well-being of the workers cannot be jeopardized just to give extra margin of profit to the industry. The hazardous industries like handling of lead, hides and skins, etc., have to be watched jointly by the Labour Department and Health Department. A good liaison between the two will bring about results. The labour inspectors are not fully competent to appreciate the chemical hazard and a joint effort of the two departments will improve the conditions.

Lately there have been fatal accidents in the coal mines. The coal mine owners are able to get away easily by paying compensation of two to three thousand rupees per head killed. This is not enough penalty for the owners for not having adopted first class safety engineering techniques. Again proper legislation and control will improve conditions in this sphere.

THE FINANCING OF SANITARY ENGINEERING DEVELOPMENT

BY

BASHIR AHMED KHAN

THE success of sanitary schemes depends to a great extent on good financial planning. It is proposed to confine this discussion to financial problems of water supply and disposal of sewage in the rural and urban areas According to the Municipal and District Boards Works Rules all sanitary schemes of the urban and rural areas, which cost more than Rs. 50,000/- or Rs. 30,000/- respectively are to be submitted, irrespective of the fact whether grant is required or not, for the approval of the Sanitary Board. The Sanitary Board sanctions the works costing up to Rs. one lac and the schemes of over one lac are [illegible]oved by the Government. The basic principle on w[illegible] Sanitary Board functions is that the grant to a local body should not be more than Rs. 50, 000/- or 50% of the total expenditure, whichever is less and no recurring commitment is made about maintenance, etc. Government takes decision about the merits of each scheme falling in its jurisdiction and the percentage of grant to be made in each case. The provision of funds is made through the Schedule of New Expenditure when the scheme is approved by Government.

In practice the local bodies try to get cent per cent grant expendi[illegible]ure. The Sanitary Board has only Rs. 1[illegible] lacs for the whole of the Province. Ever[illegible] attempt should be made to achieve the [illegible]aximum possible results with this m[illegible]y. The following principles, which were [illegible]id down in 1925 by Mr. Beazley still [illegible]old good in this connection :—

(*a*) Can the local body not f[illegible]nance the work itself either from existing r[illegible]sources or from the proceeds of additional t[illegible]x[illegible]

(*b*) If not, can the local [illegible] finance the work within the aid [illegible] the [illegible] which existing r[illegible] sufficient [illegible] resources [illegible] obtained by additional [illegible]

(*c*) If not, is the work s[illegible] In and useful that it should not be [illegible] were and that a portion or the w[illegible] differ- expenditure should be met by [illegible] bodies. aid. [illegible]re wing

A strict application of these rules should ensure maximum benefit.

The question of financing the rural and urban water supply schemes was discussed with the representatives of the Planning Board, P.W.D. and the Central Ministry of Rehabilitation in November, 1956. It was agreed that the principle of advancing loans to the local bodies for the implementation of urban water supply schemes and sewerage was not practicable, as the finances of the local bodies needed that the schemes should be subsidized. As regards the rural area, it was felt that there was more necessity of subsidizing these schemes than in the urban areas.

Later on the question of financing the rural and urban water supply schemes was discussed in November, 1957 in connection with three year programme for rural and urban water supply. This meeting had the benefit of the views of the Secretary, Sanitary Board and a representative of the Finance Department. It was decided that as there was financial stringency, every urban local body should prepare self-liquidating water supply schemes. The local bodies should get loan for the initial expenditure and recover it in the form of water rate. As regards the rural area, it was laid down that the expenditure on the rural water supply schemes should be met in the following proportion :—

District Boards	$37\frac{1}{2}\%$
Sanitary Board	$37\frac{1}{2}\%$
Benefiting Communities	25%

It w[illegible] agreed that 25% of the expenditu[illegible] to be met by the benefiting communit[illegible]s will be mostly in the form of manual la[illegible]our to be contributed by each village. T[illegible]e villagers should provide free labour, bu[illegible]n the bricks themselves, provide wood for t[illegible]is purpose and do the maximum ar[illegible] of self-help in each case. It w[illegible]lvisable for the Board to imple-[illegible] principles in the allocation of [illegible]erence should be given to [illegible] too much ask for the [illegible] percen-[illegible] and grant-in-[illegible] These principles [illegible]racticable and consistent with [illegible]l condition. Even if any grant-[illegible] may be [illegible]be given by the Sanitary Board [illegible] local body, it should be given (1) [illegible]ose cases in which the financial (2) [illegible]f a local body justifies it, and the scheme is of great urgency. It should also be ensured that the Municipal Committee is prepared to contribute the maximum expenditure within its financial capacity.

The urban and rural water supply schemes were prepared by the West Pakistan Government, as it was given to understand that foreign aid will be made available in the form of grant. So far no foreign aid has been made available and the schemes are still pending with the Central Government. It may however be observed here that the rural and urban water supply schemes are based on the consideration that the external expenditure will be available in the form of grant and not loan.

In the satellite towns the expenditure on all types of developments including water supply and sewerage is met in the first instance by the Central and the Provincial Governments. The former contributes 50% of the total expenditure and it is utilized for subsidizing the sites meant for the displaced persons earning below Rs. 150/- per month. The investment made by the latter Government is utilized for the development of higher category of sites and the entire amount is recoverable from the allottees. The amount contributed by the Central Government comes from the Rehabilitation Tax.

The following principles are suggested regarding the financing of the sanitary schemes :—

(*i*) The urban water supply schemes should not only be self-liquidating, but should yield some profit. In the first instance, a Municipal Committee may get a loan to meet the capital expenditure, but it should be recoverable with interest with a slight margin of profit in the form of water rate.

(*ii*) The underground sewerage [illegible] partially self-sufficient by making schemes for the disposal of sullage to the neighbouring farms on payment. It is not possible to meet the entire expenditure from the revenue by the sale of sullage water. The remaining should be met by imposing house-tax as is being done by the Lahore Corporation. Some other tax can be imposed according to local conditions.

(*iii*) In the urban areas the provision of drainage and pavement of streets should be done by imposing taxes by the local bodies concerned as in the case of Lahore Corporation.

(*iv*) Almost all finances of the Sanitary Board should be diverted to rural areas in which the cost should be apportioned as proposed earlier.

(*v*) The Sanitary Board should implement these principles strictly and try to inculcate self-help by encouraging those villages, which are prepared to share the maximum burden of the schemes.

This object can be achieved by proper co-ordination between the local bodies and the Village-Aid Administration. As the later should be able to pursuade villages to implement schemes on the basis of self-help.

DISCUSSION

Professor B. W. Holman. The question of disposing of the sewerage has assumed great importance in U.K. You might be aware that cities of London, Manchester and Ipswich maintain large ships to dump the sewage in the sea. Against this practice, speakers from public came forward and objected that millions of pounds were spent on ships to barge the waste from London, Manchester and Ipswich to the North Sea. Therefore there naturally arose many arguments about using this waste as manure and fertilizer and even for processing food from it for animal consumption. Then it was said that it should be used as manure in the rural areas. The waste may be taken from urban areas and exported to rural areas and this would fetch much money. Now skilled staff have heen trained in Sanitary Engineering to handle these things and utilise the human waste for a profitable business.

Mian Abdul Aziz explained the necessity of overall planning and the preparation of master plan after carrying out comprehensive survey of the area for rural and urban water supply schemes for whole of West Pakistan. He said that we have been [illegible] the necessity of this work to the Governme[illegible] with the efforts of Secretary, Social Welfare and Local Government Department, and Mr. Liu, the Government have now agreed to the opening of a Survey and Planning Division for the preparation of schemes from 1st of July, 1959 which will work in close co-ordination with W.H.O Senior Sanitary Engineer and the Sanitary Engineer being appointed in the Health Directorate.

The opening of Division of Planning and Survey, in fact, is the first step towards the tackling of problem of water supply which is of vital importance for the province of West Pakistan. It is hoped that Government will give necessary financial assistance in carrying out these schemes.

The other very important question is that for the efficient execution of these schemes, we have not got experienced staff available with the department. Before Independence, B & R Department used to have specialised Public Health Department but in 1951 the old Punjab Public Health Department which was a specialised branch of P.W.D was amalgamated with the general B & R cadre with the result that many of the officers and staff now working in the "Public Health" Circles and Divisions are really no longer specialists. In fact, very few persons with necessary Public Health experience are now available in the B & R Department. It is, therefore, recommended that Government should make some sort of arrangement so that we must have persons with specialised knowledge in the field of w[illegible] supply and sanitary engineering t[illegible] the schemes of water supply and [illegible] properly.

At pres[illegible] bodies are respo[illegible] the construction, [illegible] and [illegible] ment of community services such [illegible] supply, drainage, sanitary works, [illegible] In the past, local bodies' work[illegible] were not being handled properly due to different staff available with the local bodies. With the creation of Social Welfare wing of B & R for development works of the local bodies, a definite improvement has been accomplished but this is only temporary and partial solution of the important problems of the local bodies' engineering works because only new original schemes of water supply, drainage, etc., are being attended to by Social Welfare wing whereas maintenance and repairs, etc., are still being handled by the engineering staff of the local bodies. The efficient and proper maintenance of the existing works is, in fact, more important than the construction of new schemes and, as such, it is necessary to have full-fledged engineering staff of the local bodies. The scheme for rationalization of engineering service of local bodies is being prepared for the whole of West Pakistan which is considered to be the only solution ...

local bodies which are spending a substantial amount on the running of the schemes and the income is very small, a fraction of their annual expenditure. Lack of planning and organization in such cases is the cause of loss instead of income.

In the case of the towns which are in the stage of establishment and development, the schemes cannot be productive and paying for a period of 4 to 5 years and the local bodies cannot meet the capital expenditure out of their revenues. It will be desirable that the Sanitary Board of the province should come forward in giving at least 50% grant-in-aid, instead of Government advancing loans. It is hoped that the local bodies can meet the running expenditure of the schemes for the first 4 to 5 years till the schemes ...

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The Editor

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MOGHALPURA.

... on the maintenance ... r supply and sewerage schemes but too much earning. The ... Committees ... and ... are earning, after ... 20 times more than what they earned ... years ago, about 25% to 30% more than what they are spending on the running of water supply and drainage schemes for the past few years. There are

... Munir, Mr Irshad Hussain, Mr Bashir Ahmed and Mr Liu. They have done a great job and the Lahore Centre of the Congress is very grateful to them. On my part I would only like to add that Sanitary Engineering problem actually arose with the advance of civilization. As the means of communications developed the communities and nations came nearer each other and so did the diseases.

Engineers were responsible for the development of communications and, therefore, it may be said that they were indirectly responsible for many of the public health problems of today. If is very heartening to see that the engineers have taken up the challenge and are coming forward in helping mankind to eradicate the diseases through public health works. It has been shown that many of the public health problems are really engineering problems and it may be hoped that the engineers will rise to the occasion in the interest of mankind. Thank you.

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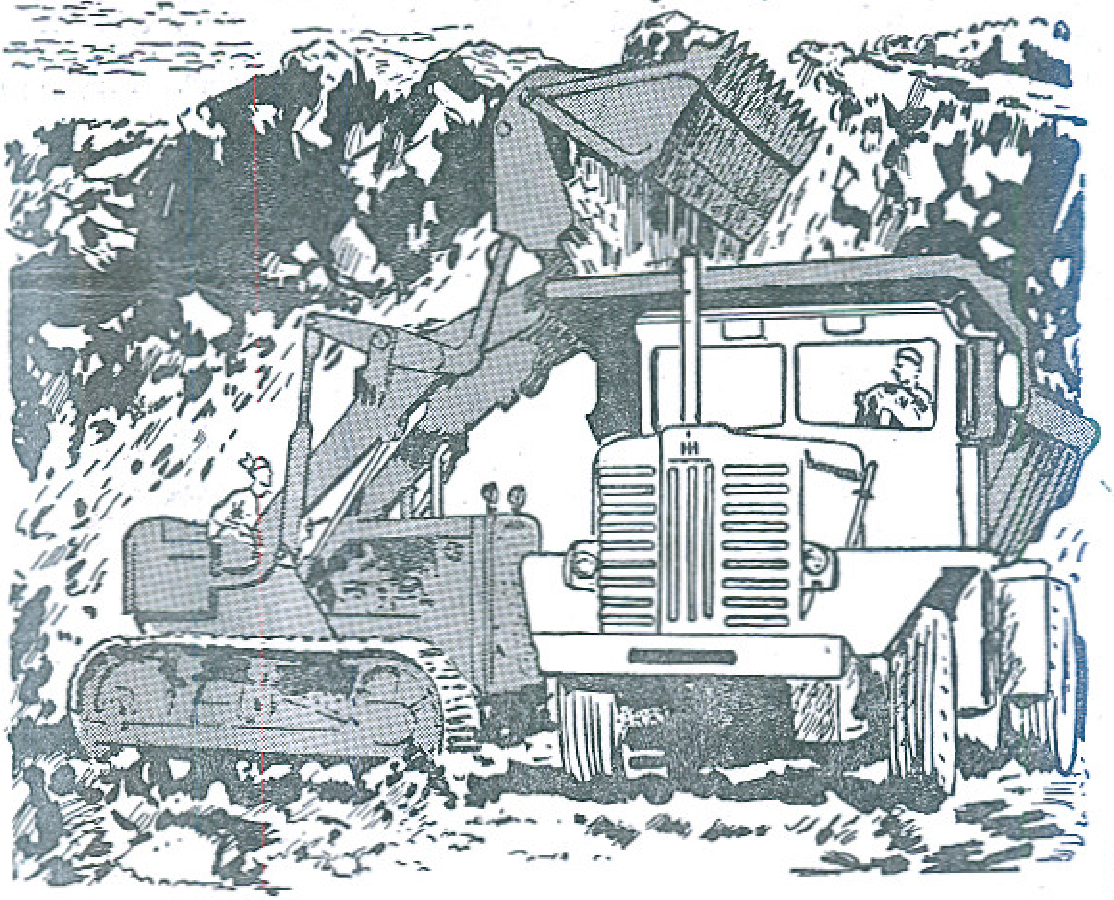

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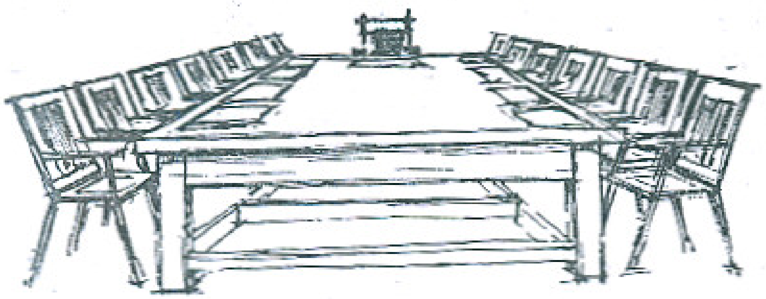

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13.	Sh: Abid Ali,	M.O. Irrigation Research Institute, Lahore.
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16.	Khan Abdur Rauf Khan,	Executive Engineer, Peshawar Canals Division, Peshawar.
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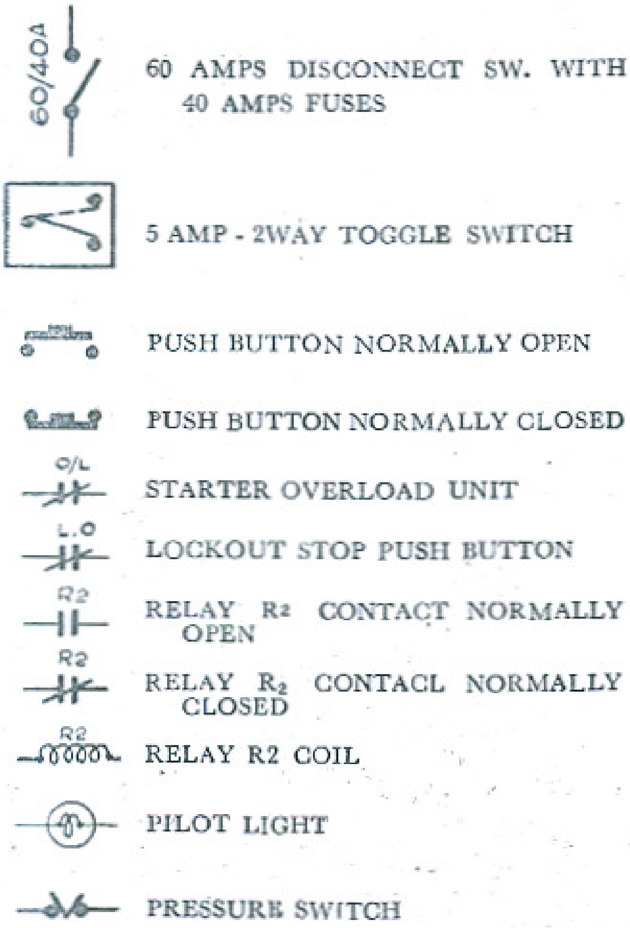
41.	Zafar Ali Shah,	Municipal Engineer, C.L.C. Lahore.

Electrical Features of the Warsak Batching and Mixing Plant

by

Tafazal Rahim Ghauri

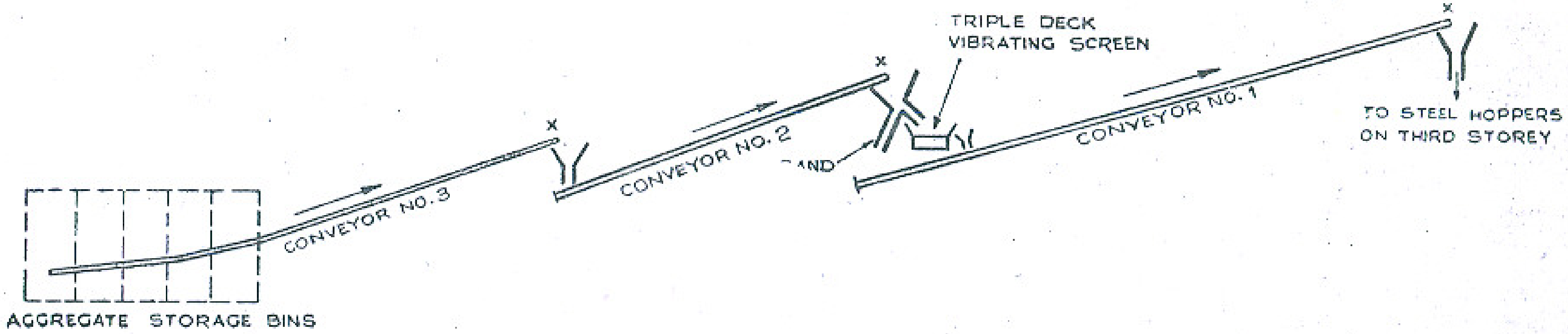
General Description.—The plant at Warsak is capable of producing 180 cu. yds of concrete per hour for a mixing time of 2 minutes per batch of 2 cu. yds. The plant is four storeyed steel structure. The uppermost storey consists of a wooden cabin in which an operator is stationed to control the supply of aggregate to the plant. The storey below this has four steel hoppers for storing various sizes of aggregate. In the middle of these hoppers is a cement silo for supplying cement direct to the plant. These hoppers and the silo project through the roof of the second storey and the bottom of each one of them is provided with an electrically operated gate (fill-gate). The second storey has weigh-batchers for all ingredients to be used in the manufacture of concrete (three sizes of gravel, sand, cement, water, water and pozzolith solution). The main control panel is also stationed on this floor, from where the operator controls the operation of the whole plant.



ELECTRICAL CONVENTIONS

On the first storey there are three 2 cu. yds. tilt-mixers. Above the mixers rotates a swivel chute attached to the bottom of a big cone which is fixed to the ceiling. At the bottom of the swivel chute is fixed an extension chute capable of sliding up and down the swivel chute. At the time of loading a particular mixer the extension chute is made to slide down so as to cover the face of the mixer. The material from all the weigh-batchers reaches the mixers after passing through the cone, swivel chute and extension chute in succession. In between the mixers there is a round opening in the floor, below which is fixed a steel hopper provided with a mechanically operated gate. Mixers pour concrete into this hopper from where it is supplied to various sites on the project.

Supply of Aggregate.—Aggregates of the various sizes required are hauled from the crushing and screening plants in auto cars. The auto-cars dump the aggregates directly into their respective storage bins, consisting of coarse gravel, medium gravel, fine gravel and sand. Below the storage bins runs a small tunnel. The discharge gates of these bins, located inside the tunnel, operate mechanically and deliver the material through chutes on to a belt conveyor, Fig. I (conveyor No. 3). This conveyor carries the aggregate out of the tunnel and passes it on to conveyor No. 2. From conveyor No. 2 the three sizes of gravel pass on to a triple-deck horizontal



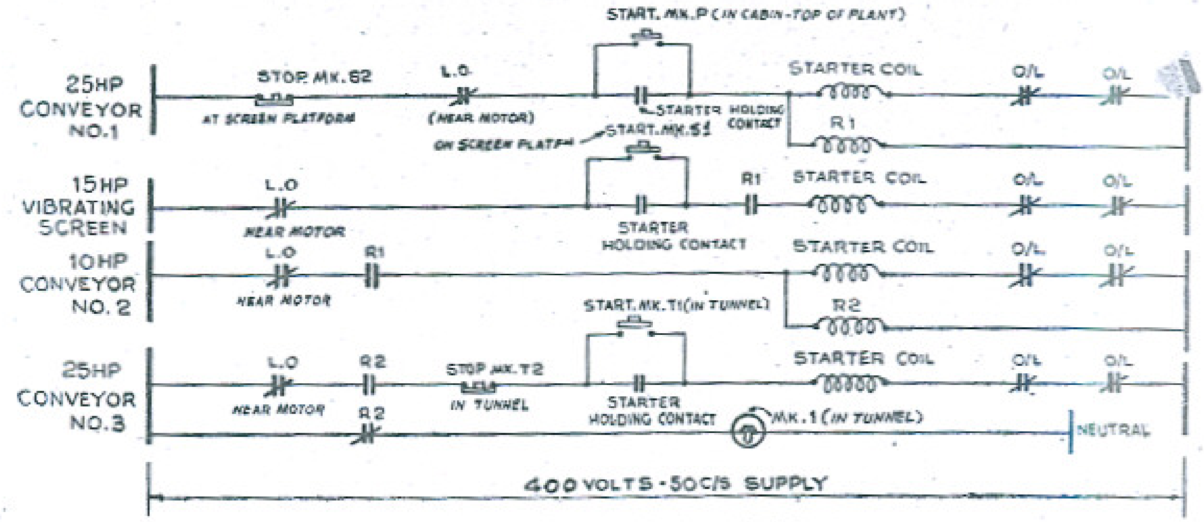
<u>*NOTES*</u>

CONVEYOR NO. 1	- *LENGTH.* 265 FEET	- *H.P.* 25
CONVEYOR NO. 2	- *LENGTH.* 61 FEET	- *H.P.* 10
CONVEYOR NO. 3	- *LENGTH.* 288 FEET	- *H.P.* 25
VIBRATING SCREEN		*H.P.* 15
DRIVING END OF CONVEYOR		*MK:* X

DIAGRAMATIC SKETCH OF CONVEYORS FOR HAULING AGGREGATE.

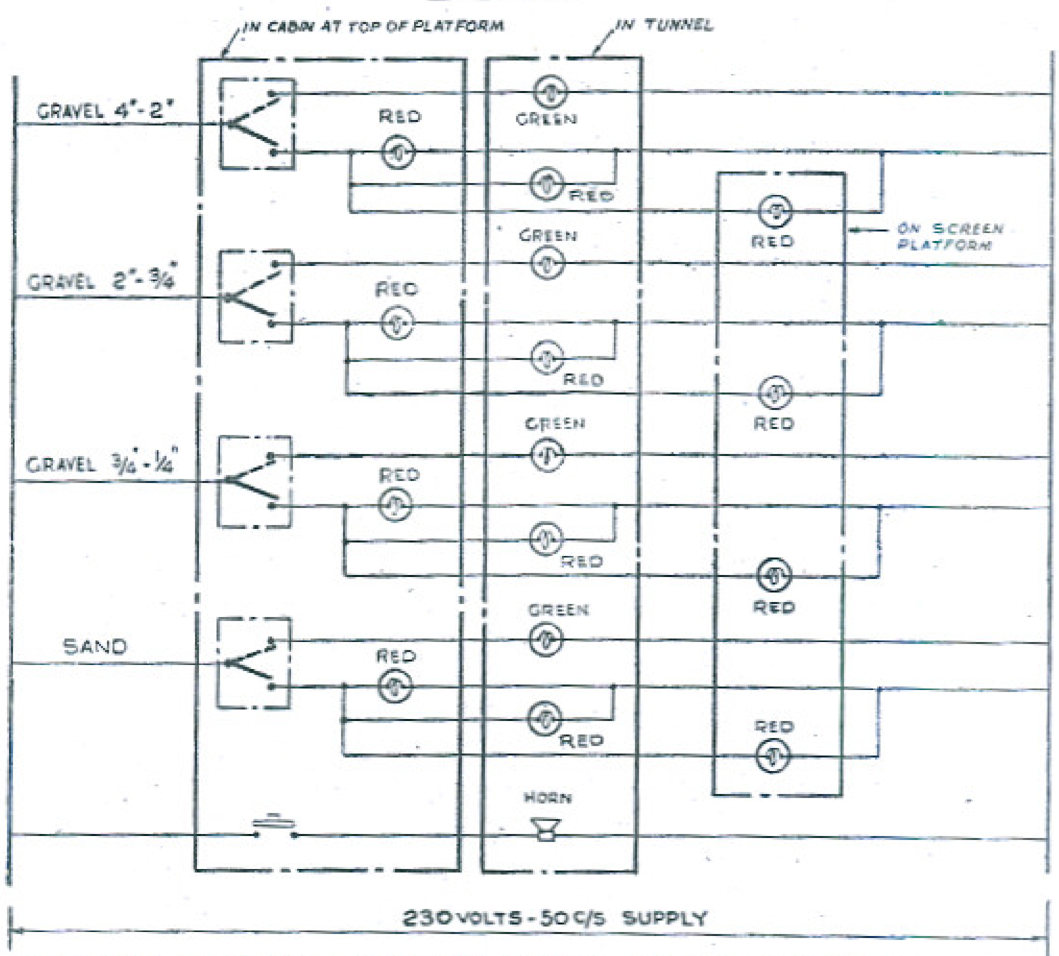
FIGURE. 1

vibrating-screen, while sand flows through a chute directly on to conveyor No. 1. The three sizes of gravel after being screened also pass through a chute and on to conveyor No. 1. This conveyor conveys the aggregates to the uppermost storey of the plant.



SCHEMATIC DIAGRAM - HAULING OF AGGREGATE

FIGURE 2(a)



SCHEMATIC DIAGRAM - SIGNALLING SYSTEM - HAULING OF AGGREGATE

FIGURE 2(b)

The three belt conveyors and the vibrating screen are electric driven. Figure 2 shows the schematic diagram and the signalling system used for the hauling of aggregate from the storage bins to the top of the plant. When no material is being conveyed, the conveyors and screen are at rest. All the green pilot lights in the tunnel are 'on.' As the operator in the wooden cabin at the top of the plant notices that the coarse gravel hopper is about to be emptied, he switches 'on' the 2-way toggle switch for coarse gravel. This puts 'on' the red pilot light for coarse gravel in the cabin and also at the screen platform so that the operator there is informed as to which material is coming. With the same operation the green pilot light beside the coarse gravel discharge gate in the tunnel goes 'off' while the red pilot comes 'on.' Thus the operator in the tunnel knows that he has to send coarse gravel.

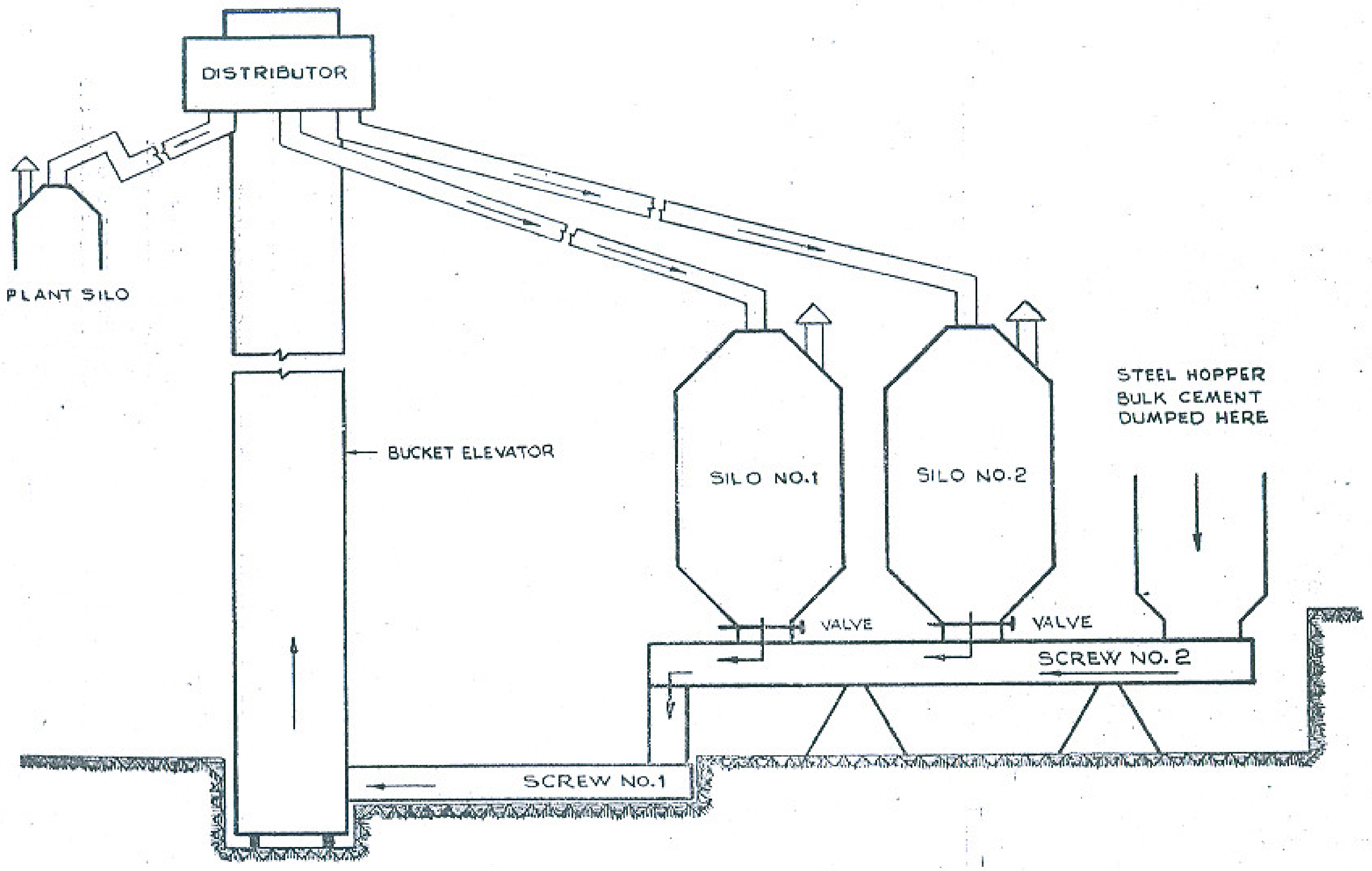
When all the signals have gone through, the operator in the cabin presses the start push button Mk. P and releases it. This starts up conveyors No. 1 and 2, also the pilot light Mk. 1 in the tunnel goes 'off.' The moment this happens the operator in the tunnel starts conveyor No. 3 by pressing the start push button Mk. TI and releasing it. When this conveyor picks up speed the operator opens the coarse gravel discharge gate allowing the material to flow on the conveyor. The operator at the screen platfrom starts the vibrating screen by using the start push button Mk. SI. The vibrating screen is run only when gravel is being conveyed. When the operator in cabin sees that he does not require any more of coarse gravel he switches "off" its 2-way toggle switch. This informs the man in the tunnel to stop the supply of coarse gravel. When all the conveyors are empty the operator in the cabin presses the stop push button Mk. S2 and releases it. This operation brings the whole set-up to rest.

Supply of Cement.—Bulk cement is hauled in special cement-cars from the storage silos at Jamrud. These cars dump the cement directly into a steel hopper from where it is conveyed to the plant silo by two screws and a bucket elevator, Figure 3. The cement screws and bucket elevator are electric powered. Figure 4 shows the schematic diagram and annunciator circuits used for conveying cement from the hopper to the silos. The moment bulk cement is dumped into the steel hopper, an operator stationed at the elevator pit presses the start push button and releases it. This starts up the cement elevator, screw No. 1 and Screw No. 2, one after the other, almost simultaneously. Thus cement is transferred from the hopper to the distributor. By means of a mechanical arrangement the same operator can convey cement from the distributor to any one of three silos at a time. In case of no external supply of cement either of the two storage silos (No. 1 and 2) can feed the plant silo. The whole set-up can be brought to a standstill by making use of the stop push button located at the elevator pit.

The position of cement in the three silos is indicated to the operator by the high and low level pilot lights mounted in small panels at the elevator pit. The condition of the plant silo is also indicated to the operator of the main control panel, located on the second storey, by a set of high and low level pilot lights mounted near the main panel. The cement weigh-batcher receives its supply of cement directly from the plant silo which must never run out. In addition to the pilot lights a horn is mounted at the elevator pit which blows when cement in the plant silo is about to reach the high or low level condition thus keeping the operator well informed of the condition of the plant silo.

Supply of Water and Pozzolith Solution.—Water for mixing is pumped form a well to a high level stoarge tank. From this tank it is fed by gravity to a stoarge tank on the second storey, thence fed to a small tank under which hangs the water weigh-batcher.

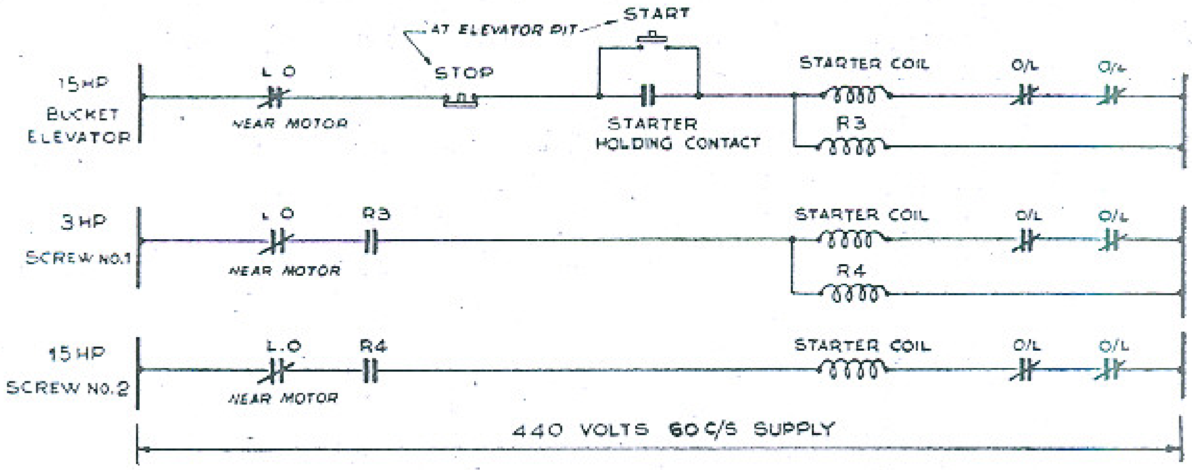
Pozzolith solution is prepared in two big tanks placed in a small room a little distance off the main plant. From this room the solution is pumped by a 1.h.p. single phase pump into a metalic container located on the second storey. Figure 5 shows the schematic diagram designed to control the flow of pozzolith solution from the tanks to the container. The discharge limit switch is closed when discharge valve is closed and vice-versa, ensuring no pumping of the solution into the container as long as the discharge valve remains open. The float switch is mechanically linked to a pointer



SCREW NO.1 LENGTH 15 FEET, HP.3
SCREW NO. 2 LENGTH 54 FEET, HP.15
BUCKET ELEVATOR HEIGHT 100 FEET, HP 15

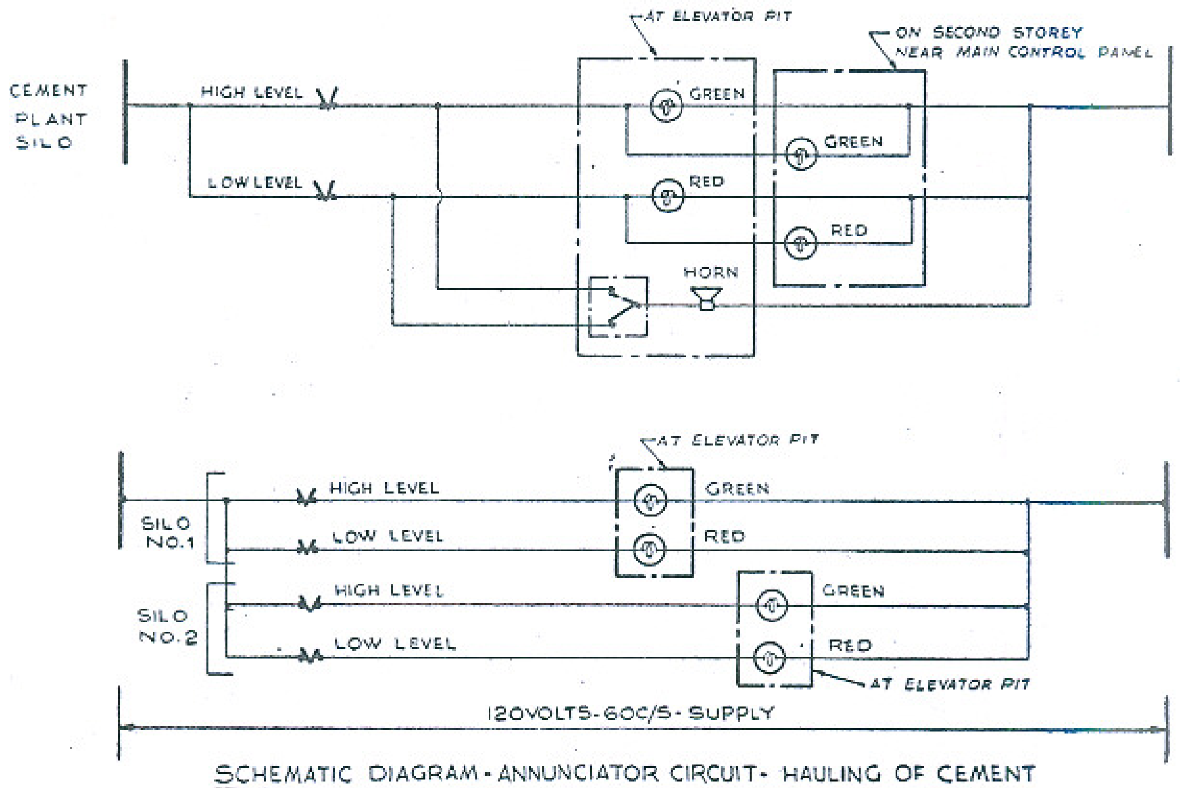
DIAGRAMATIC SKETCH OF SET UP FOR HAULING CEMENT

FIGURE 3



SCHEMATIC DIAGRAM - HAULING OF CEMENT

FIGURE 4(a)



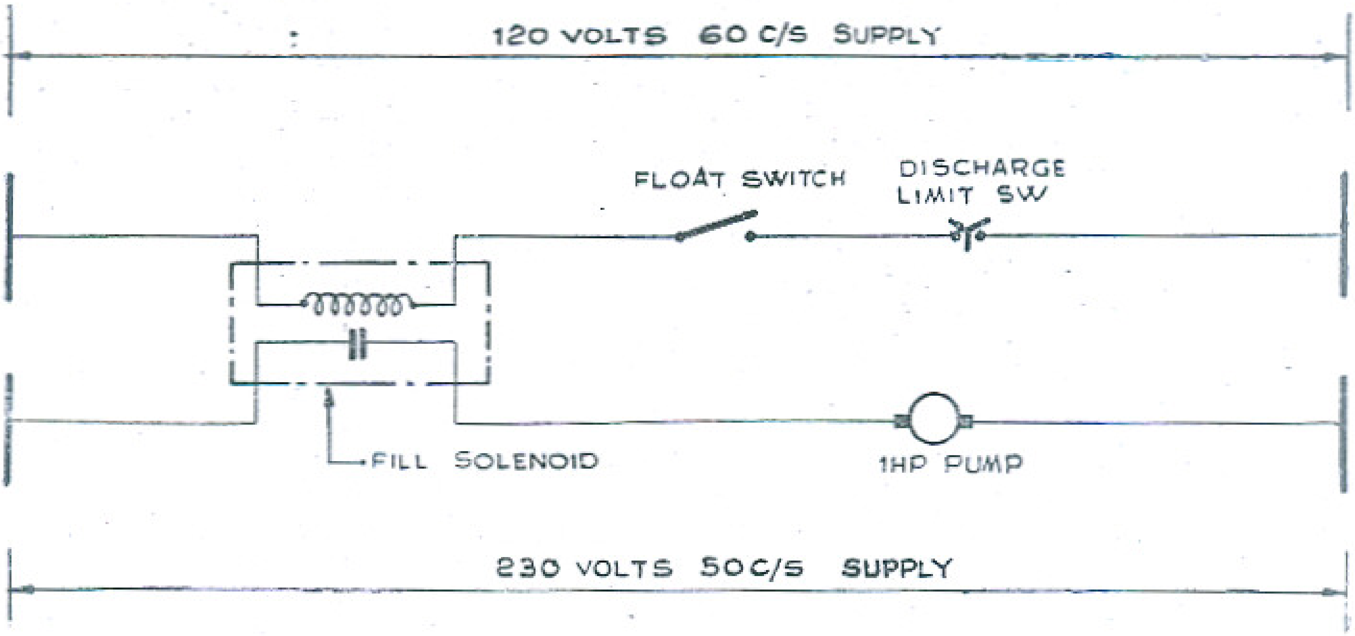
SCHEMATIC DIAGRAM - ANNUNCIATOR CIRCUIT - HAULING OF CEMENT

FIGURE 4(b)

NOTES (1) THE HIGH LEVEL PRESSURE SWITCH IS MOUNTED NEAR THE TOP OF THE SILO ITS CONTACT CLOSES WHEN THE DIAPHRAGM IS PRESSED i.e, WHEN THE SILO IS FULL

(2) THE LOW LEVEL PRESSURE SWITCH IS MOUNTED NEAR THE BOTTOM OF THE SILO ITS CONTACT CLOSES WHEN THE PRESSURE ON THE DIAPHRAGM IS RELEASED i.e WHEN THE SILO IS EMPTY.

(3) SEE LEGEND FOR ELECTRICAL CONVENTIONS



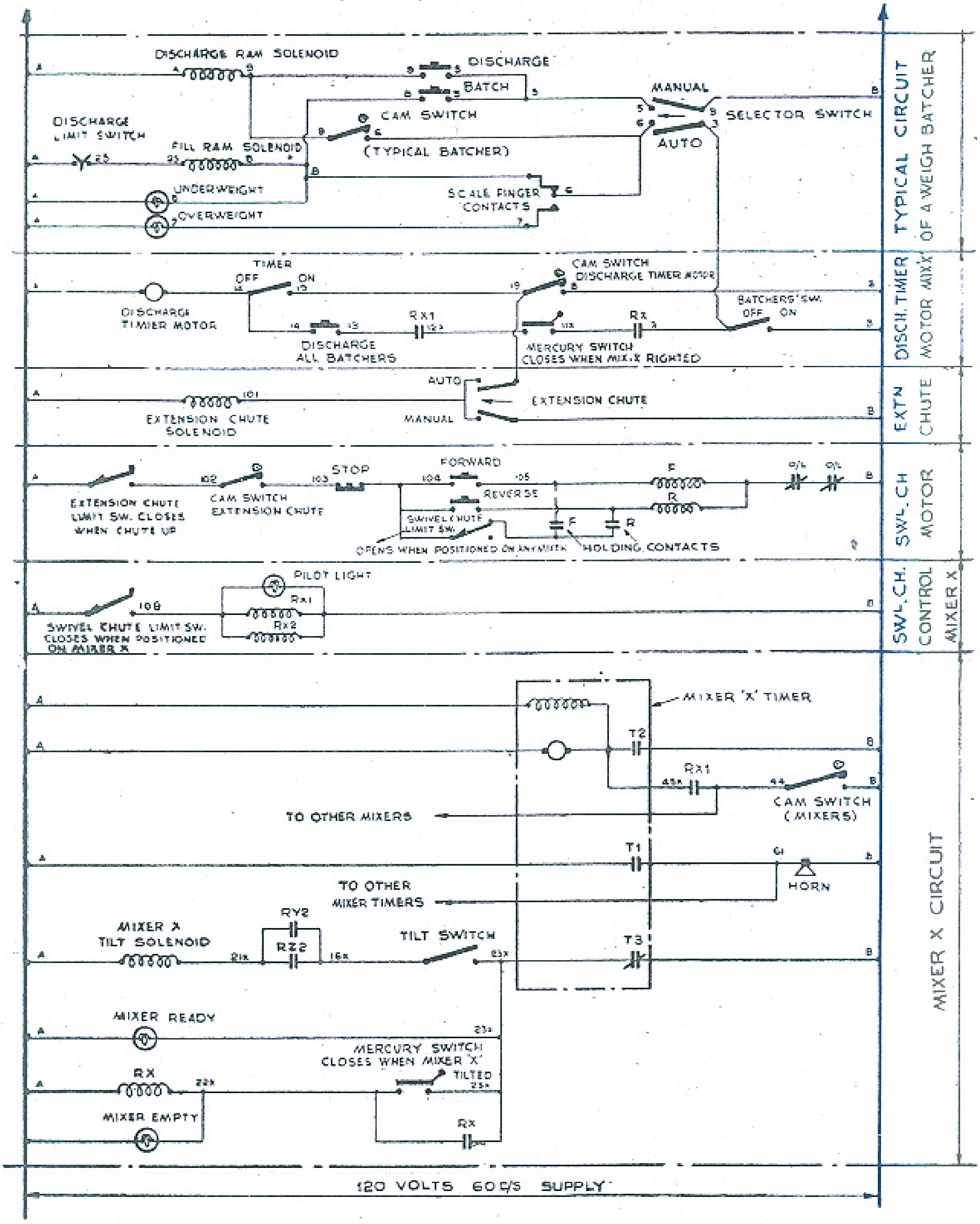
SCHEMATIC DIAGRAM - PUMPING POZZOLITH SOLUTION

FIGURE. 5

which moves on a scale fitted on the face of the container. The amount of pozzolith solution required per batch of 2 cu. yds is set on the scale manually. The moment the container gets empty, discharge limit switch and float switch close, fill solenoid energises starting up the pump motor. This pump motor is automatically stopped by the float switch when the amount of solution set on the scale has been pumped into the container.

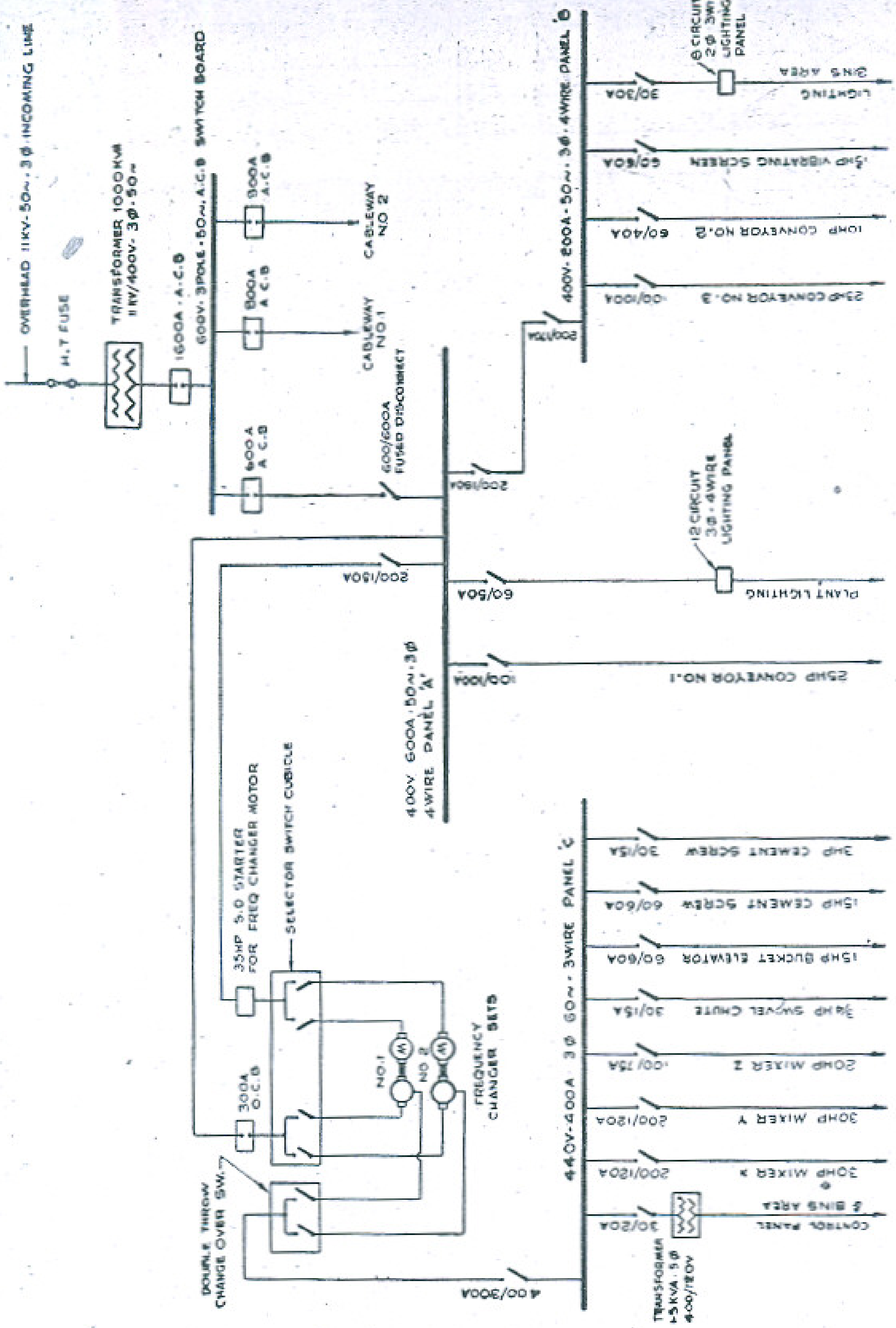
Weighing and Mixing—Weigh batchers for various materials hang below the fill-gates of their respective hoppers on the second storey. Figure 7 (*a*) gives a diagramatic sketch of a typical weigh batcher indicating the position of the two air arm-solenoids and the discharge limit switch. The limit switch is so mounted that its contact closes when the discharge gate is closed and vice-versa. This ensures that the fill-gate can open only when the discharge gate is closed. Figure 6 shows control circuits for the weighing and mixing operation.

The weighing and mixing operation is controlled by the operator stationed at the main control panel on the second storey. In order to study the weighing operation, consider any one batcher and assume it to be empty with its discharge gate closed. At this instant the stud is resting on the knob pressing it down so as to make contact between terminals 6 and 8. Figure 7 (*b*). Under this condition as soon as the operator turns the selector switch to 'auto' and the batchers switch to 'on', the under weight light comes on, fill ram-solenoid is energised, fill-gate opens allowing flow of material from the hopper to the weigh batcher, Figure 6. As the material keeps coming into the weigh-batcher the stud keeps steadily rising and a condition pre-set approaches when there is neither contact between terminals 6 and 8 nor between terminals 6 and 7. At this stage, under weight light goes off, fill ram-solenoid de-energises and fill-gate closes. If by chance the pre-set weight is slightly off, the stud is lifted to such an extent that contact is made between terminals 6 and 7, by virtue of which the over weight light comes on, indicating to the operator that the material has been over weighed. The motion of a lever (due to the weight in the batcher) fitted on the weigh batcher is communicated to the stud by a steel wire running over a number of pulleys. Every weigh-batcher has its own set of scale finger-contacts and a graduated dial to indicate the weight. These dials



SCHEMATIC DIAGRAM - WEIGHING & MIXING OPERATION

FIGURE 6



SINGLE LINE DIAGRAM
11KV & 400V CONNECTIONS
FIGURE 10

are mounted on the main control panel in front of the operator. The quantities weighed in the weigh-batchers for every batch are recorded automatically on graph paper.

When all the ingredients have been weighed and the swivel chute set opposite an empty up-righted mixer, say mixer 'X' the operator turns the timer switch to 'on', extension chute switch to 'auto', presses the discharge-all-batchers push button and releases it. This starts the discharge timer motor which closes the cam-actuated switches turn by turn depending upon the setting of the cams on the motor shaft, Fig 8. Thus the discharge ram-solenoid of every weigh-batcher is energised opening the discharge gate and allowing the material to flow into the mixer via the swivel and extension chutes. The transfer of material from weigh-batchers to mixer is completed in one revolution of the discharge timer motor, e.g., fifteen seconds. The moment the weigh-batchers get empty they are again automatically filled and thus the cycle continues on. Weighing and discharging of material from weigh batchers to mixer can also be done manually by setting the selector and extension chute switches to 'manual' and using the 'Discharge' and 'Batch' push buttons of each weigh batcher.

The moment the discharge timer motor starts up, the cam switch marked 'mixers' closes and starts the mixer 'X' timer which has been set for a mixing time of two minutes. T2 closes, T3 opens, mixer ready and mixer empty lights go off. Swivel chute is moved to the next mixer, say mixer 'Y', energising relays RY1 and RY2. About two seconds before end of mixing time, T1 closes blowing the horn, which is a signal for the operator to close the tilt switch. When the mixing time is over T2 and T1 open, T3 closes, mixer-ready light comes on, mixer 'X' is tilted and mixer-empty light comes on. Opening the tilt-switch brings mixer 'X' to the upright position which is thus ready for mixing another batch.

Sub-Station.—The outdoor transformer sub-station is situated at a point from where it can conveniently supply power to two cable-ways and the two Batching and Mixing Plants. It taps power from the 11 KV tranmission line being fed by the 4,000kw diesel power house located near the Warsak Colony. The sub-station is composed of a 1,000 KVA, 11000/400 volt, 3 phase, 50 cycle transformer and a 600 volt air-circuit breaker switchboard. This switchboard houses one 1600 Amp, two 800 Amp and one 600 Amp air circuit breakers, manually operated, fixed mounted and tropicalized. Figure 10 shows the power schematic diagram of the batching and mixing plant.

Switch-Room.—This is built on the ground floor on the Western side of the main plant. The power panels 'A' and 'C' and the two frequency changer sets along with their accessories are mounted inside this room. Power panel 'B' located near the aggregate storage bins is fed from power-panel 'A' via a short span of overhead line. Each frequency-hanger of capacity 162.5 KVA is driven by a 35 H.P. 400 volt, 3 phase induction motor at 575 R.P.M. 400 volt, 3-phase, 50 cycle input to each frequency-changer is fed from power panel 'A' while the 440 volt, 3-phase, 60 cycle output of each frequency-changer is supplied to power panel 'C'. The selector-switch-cubicle and the double throw change-over switch enables us to use one frequency-changer set at a time and keep the other as stand by.

Fused-disconnect-switches and starters for various motors on the plant are mounted on the three power panels A, B and C, Fig. 10. All the starters are magnetic, direct across-line except the one for the 35 H. P. frequency-changer motor, which is a star-delta starter and are provided with no volt and overload protection. Every motor has a remote control start stop push button station mounted at a suitable place from where the operation of the motor is to be controlled. A lockout stop push-button station located beside each motor is to be used whenever the motor is to be checked. This kills the motor leads even if the disconnect switch of the motor, mounted on a power panel, is on.