CONSTRUCTION OF TEXTILE FACTORY AT PUGODA

by

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Introduction

The third cotton textile mill of the National Textile Corporation was formally opened by the Hon. Prime Minister, Mrs. Sirimavo Bandaranaike on the 14th March, 1975. This Mill is an outright gift from the Peoples Republic of China. Total value of the machinery and other construction materials provided by the Chinese Government for the Mill has been assessed at approximately Rs. 42 million. The cost of all civil engineering works including the housing scheme is around Rs. 16 million. The factory consisting of a Spinning & Weaving Department has an annual production capacity of 3.12 million pounds of cotton yarn and 13.2 million yards of cloth and the total power consumption of 2.5 MW in full operation. There are 25000 spindles and 600 looms.

2. Location

This Mill is located at Pugoda in Dompe electorate, the distance to the Mill from Colombo being around 26 miles. It has been sited close to the Kelani river so that the large quantity of water required for the Mill and the housing scheme could be obtained from the river.

It could be seen that the setting up of this Mill at Pugoda has had an immediate impact on the people living in and around Pugoda which was a very industrially backward area prior to the setting up of the Mill. Transport facilities have since improved. The town is electrified off the power lines running to the Mill. Small industries such as the production of starch from manioc which is needed for sizing of cotton yarn have also been started. This in turn has given rise to the cultivation of manioc on a large scale in this area. Provision has also been made for tapping off water for the town in the supply mains to the Mill.

The main disadvantage in setting up the Mill at Pugoda is that frequently all except one access road to the Mill go under water when the Kelani river which is about one mile away from the Mill overflows its banks. Sometimes these roads remain under water for weeks. Certain roads go under water in so many places and workmen have to incur heavy expenditure on boat fare. Absenteeism which is generally high in our work places goes sky high during floods and it had its very adverse effects on the construction programme. Since the workmen who are operating the machines are not provided with living quarters the production too is seriously affected during these days. It will continue to affect the production until the access roads are improved.

Pugoda being a small village could not provide accommodation for the sudden influx of people, officers and workmen who came for construction work. The N.T.C. very wisely commenced work on the Housing Scheme first and were very generous in accommodating all officers who came for construction work in these houses.

3. Design of works

The factory building, auxiliary buildings consisting of the Bale Store, Workshop, Boiler House, Refrigeration Station, Administration Block, Welfare Building and the Water Supply and the Sewage Connections for them were designed in China. The water tower and the structures for the Water Purification Plant were designed by the State Engineering Corporation, while the supply mains, Intake Well and Sewage Disposal Schemes were designed by the Department of Water Supply and Drainage. Layout of factory is as in Fig. (1).

4. Materials

In this project the procurement of large quantities of materials was not a major problem as most of the material requirements had been gifted from China. These included all structural steel, sufficient cement to start construction work and cast iron pipes, pipe specials, valves, paints, water proofing materials etc. Asbestos sheets, reinforcement steel, timber bricks and cement were obtained locally.

Approximately 3.5 million bricks were used in this project. Bricks specified for the building by the Chinese were the highest quality wire cut bricks. Since our wire cut brick factories could not cope up with such a demand and also due to the high cost, it was decided to try common bricks in place of wire cut bricks. Crushing strength of the common bricks were found to be sufficient for the purpose, as the walls were not load bearing. When tenders were called for the supply of bricks conforming to Sri Lanka standards none of

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the samples submitted could be accepted. At this stage it was found that most bricks available in this area were very much smaller in size than the standard bricks. Although local brick manufacturers showed reluctance to supply bricks to specifications, it was possible to impress upon them the necessity to change their moulds and manufacturing processes and we were able to get bricks that were very close to the specifications from a few suppliers. This saved at least 30% of expenditure on bricks and also the cement and sand that would have been used to fill the gaps to bring the wall to the required width if smaller bricks had been used.

5. Scheme of Recruitment of labour

A master programme was drawn and equipment and labour schedules were prepared before the actual construction work on the Mill was started. A decision had been reached at a Ministry level conference on the scheme of recruitment of unskilled labour. All unskilled workmen for State Engineering Corporation were to be recruited by the National Textile Corporation and they were to have the minimum qualifications required to be absorbed to N.T.C. later on. Under this agreement workmen were recruited in stages and released to the N.T.C. on their requests and this process continued throughout the duration of the project.

All skilled labour and staff requirements for construction work were brought in from other construction sites of the SEC and were transferred out when the work was completed. Unskilled labour that were recruited by the client and were first sent to work with SEC in construction work, were absorbed into the NTC for installation and the operational work, in the order of seniority. These workmen always liked to leave the field work as quickly as possible, and tried to maintain good records of work, conduct and attendance. This way it was possible to have a good control of workmen and also avoid the unhappy situation of having to discontinue workmen when the work was over. It also avoided the usual labour problems that arose in this type of construction project towards the end. Since the workmen were assured of places in the factory, instead of trying to slow down the work they tried to complete the work early so that they could get employment in the factory.

One disadvantage in this system was that except at the beginning, the State Engineering Corporation could not retain any particular workman for more than about nine months. Almost all workmen who were recruited at the site were just out of school as the qualifying age limits were between 18 and 25. These workmen took some time in learning the excavation, mortar mixing, carpentry work etc. and as a result the construction workers were always amateurs. This however, was a gain for the client as they were always getting workmen who had some training in technical work.

The other disadvantage was that with a constraint on the total number of unskilled workmen that could be employed by the contractor depending on the ultimate requirements of the mill, sometimes the contractor could not expand the work-force even though the work demanded it. Labour position at the site is shown in Fig. (2)

6. The Chinese team

The Chinese team consisted of about 60 members at the peak construction and installation period lived at the site under very modest conditions with bare minimum facilities (by request). This is quite in contrast to Technicians who come as specialists and enjoy even DPL status in some of the projects. They were self-sufficient in every way. They had their own doctor, cook etc. It was interesting to see the doctor treating even our workmen with his acupuncture needles.

A major portion of the Chinese team were involved in the installation work which they did together with the NTC. With regard to the construction work the Chinese participation was limited, to assisting and supervising work. There were only two persons in the Chinese team who could communicate directly with us because of the language problem. Monthly progress meetings were held with all parties in attendance. The Chinese engineers who did not understand a word of English were able to follow the discussions with the help of the two interpreters who were non technical personnel.

At the early stage of the construction work it was not possible to attempt alterations to any of the designs since approval for these had to be obtained from China. This problem was overcome subsequently when a qualified and experienced civil engineer arrived at the site. Since then so many alterations were done with consultations between SEC, NTC and the Chinese personnel.

7. Construction

Very careful consideration was given in the construction of temporary buildings for the construction works. These were constructed so as not to interfere with the permanent works and also in such a way that labour control was easy.

Construction work on the Main Factory was started in November 1971. Main Factory building consisting of eleven 60 ft. span bays and two annexes running along the length of the building on the North and South ends covers an area of 375,009 sq.ft. (approximately. Main part of the structure was done in steel. Steel columns, trusses, purlins etc. which came in semi-fabricated form from China were assembled, welded and then erected at site using local labour.

The columns came fully fabricated and needed only painting before erection, except certain items which had got damaged in transit and needed straightening. The purlins too needed only straightening and painting.
However, there was a large amount of welding in the assembly of the girders and trusses. As all the steel had been transported to site it was decided to carry out all fabrication work at the site.

A welding unit was organised under an experienced welding foreman. Two bases were prepared in the open on which the trusses could be laid out. The first truss of each kind was fixed to the base and made into a jig by welding vertical pieces at critical points to serve as guides. The subsequent trusses of each type were then assembled on the jig very much faster and welded. After welding on one side was completed the truss was lifted off the jig making way for a second truss and welding completed outside the jig. Temporary protection from the sun and rain was provided with tarpaulins. The workmen were on an incentive scheme where they were to complete a norm in a given time and extra production was remunerated.

The Chinese engineers very closely supervised the work and they were full of praise for local workmen for completing the work to their entire satisfaction.

The trusses thus fabricated were transported to the point of erection on a 60 ft. trailer and erected with the help of a 10T truck mounted crane.

Norms had been worked out for completing a bay and all workers involved were financially benefited by extra work. A very high team spirit was seen among these groups of workers and once organised the work proceeded very smoothly.

A substantial amount of construction work on structures, was completed by October 1972 and the installation work of machinery was started by the client. Commissioning of machines started in July 1973, exactly 20 months after the commencement of the construction work and the factory went into commercial production in December 1973.

An unexpected delay in the arrival of the steel for the Main Factory ceiling which incorporates the air conditioning ducts and insulation medium etc. posed a problem in the early commissioning. It was thought that the fixing of the ceiling would be impossible without damaging the spinning and weaving machines which had to be installed at very close intervals. But it was decided to carry through the installation programme as otherwise the commissioning of the Mill would have got delayed by several months and the Chinese engineers insisted in keeping to their programme. When the ceiling steel finally arrived at the site about 75% of the installation work was over and the machines were being commissioned. However, due to the co-operation that existed among all parties responsible for the construction and installation, it was possible to do the construction of the ceiling while the machines were being commissioned beneath the ceiling.
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The ceiling had to be fixed at a height of 13 ft. and the height of the machines were about 7 ft. A mobile platform of 10 x 6 ft. (approx) supported on four G.J. pipes with castor wheels was used for the purpose. The length and breadth of this platform was selected so that it could be moved on the wheels in between the spinning and weaving frames by two workmen to any place in the factory. This was done without damaging any of the machinery.

A special feature of the factory building was that all the members in the Main Factory steel structure were very slender. A 60 ft. span truss which carried an asbestos roof area of 1100 sq. ft. and a ceiling which incorporated the air conditioning ducts and insulation media was less than one ton in weight.

The Chinese purlins used in all buildings was a special rolled section. (Fig. 3) The Chinese purlin spanning 5.3 M had a weight of 4.74 kg/M while the equivalent channel section using angle iron 50 x 50 x 7 mm would have a weight 10.30 kg/M. It is seen that by the use of the rolled steel purlin the saving in steel is more than 50% and being a light member it facilitates easier handling.

The two annexes each of 20' x 600' were covered with spiral slabs and were made water proof by two layers asphalt sheets and bitumen. This waterproofing which is not normally used in this country was found to be hundred per cent successful.

The 20 ft. span spiral slabs were placed on brick walls at a slope of 2%. The top surface of the slabs were then wire brushed and a 200 mm cement sand rendering was done. On this hot bitumen was applied and a layer of felt sheet was laid while the tar was still hot. Bitumen was applied again on this layer of felt sheet and a second felt sheet was pasted. These felt sheets were continued vertically up to about 18' on the exposed surface on the adjacent walls. The underside of the spiral slabs formed top of the air conditioning duct. It was necessary that the bitumen absorb as little heat from outside as possible. Therefore these water proofing arrangement had been covered with 500 x 500 x 20 mm concrete slabs placed on 100 x 100 x 100 mm concrete blocks. This arrangement is shown in (Fig. 4).

The water supply scheme of the factory which was not included in the original aid programme became the most critical service for the commissioning of the factory. From the beginning there were delays. Originally, all pipes, pumps, fitting equipment etc. were not to be supplied by China. Later China agreed to provide all pipes, a part of pipe specials etc. The rest was imported from other countries.

This water supply scheme which was designed by the Water Supplies Department consisted of an intake well at the Kelani River, 7,500 L.ft. of 8' dia. pumping main, pumping station, Iron Removal Plant and Water Tower. The Intake Well was constructed about 50 ft. away from the river. This well was sunk up to the rock and two 100 ft. laterals were driven horizontally from the bottom of the well under the river bed. The water infiltrated through the laterals contained iron bacteria, the removal of which was to be accomplished by the gravity type Iron Removal Plant situated at the factory.

One of the major problems encountered during the construction of the well was that due to insufficient data from the geological survey report the rock level had been fixed erroneously. The bottom of the well when fully sunk should have rested on the rock on its entire perimeter, but actually rested on the rock only along one edge. It was later revealed that only one bore hole had been sunk in the site of the well before deciding on the depth. It had been assumed that the rock would be at a horizontal plane at 42 ft. below
ground level, where as it was actually 42 ft. below ground level at the centre of the well and is sloping. It was not possible to empty this well even with a pump of capacity 50,000 gallons per hour, to do the base concrete of the well. When this was being attempted mud and sand started coming into the well from the gap between the ring beam of the well and the rock. It was then decided to do an underwater concreting to construct the base of the well. The concreting was done with 25 ft. of water in the well. This concrete slab had a few weak points and was sealed later by sending a water jet down to the rock level from outside the well and then pumping grout through the same pipe. After extensive grouting, it was possible to reduce the seepage of water through the weak spots. This could have been avoided if bore holes had been sunk at least at four points on perpendicular diameters and a more suitable place to sink the well had been found.

A water tower of 100,000 gallons and a head of 125 ft. was designed and constructed by the SEC for the Water Supply Scheme. (Fig. 5) Though the original design was to do the entire tower and the tank with precast sections it was later decided to do the tower in precast units and the tank insitu.

This change was done for two reasons. The tank being of the shape of a truncated cone, the formwork could not be re-used when horizontal sections are precast. Hence there was no saving in formwork.

Water-tightness at the joints between the rings if precast had to be achieved with an epoxy resin joint and this had to be done to very strict specifications. A similar tower constructed in Colombo with precast rings posed considerable difficulties.

In constructing the tank insitu, the biggest problem was propping the external shutter. The tank itself was 33 ft. in height.

This problem was overcome by constructing the inner shaft in advance and supporting the inner formwork on 6 mm dia. mild steel wire drawn radially from
the inner shaft. The reinforcement was then connected to the formwork with 6 mm wire and the outer formwork was tied on to the reinforcement.

Only a scaffolding and a deck for the workmen was necessary and this saved much time and materials. All the steel protruding from the concrete after stripping the formwork was removed by chipping around them and burning off the ends.

Domestic sewage was disposed into two tanks and the water discharged through two static trickling filters. However, the quantity of sewage to be handled from the factory being large a more sophisticated system with a rotary trickling filter designed by the DWSD was used. The entire machinery for this system including the sewage pumps were designed, manufactured and installed by SEC. This type of equipment which are normally imported to this country could very well be fabricated here except for few items like bearings. This scheme is now functioning very satisfactorily. A schematic representation of the system is as per Fig. 6.

According to the Chinese designs all roads around the factory were to be macadamised. However, after the price escalation of bitumen it was decided to do these roads with a layer of 6" thick concrete. Though the concrete roads were costing 55% more than the macadamised roads it was felt that in the long run concrete roads would be more economical as no maintenance would be required on them. Also it was possible to give a better surface which allows a smooth ride on the concrete road.

A list of plant and machinery used is given in Schedule I.
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This factory was completed and commissioned quite expeditiously compared with most work sites. The main reason for this was the excellent relationships that existed among the N.T.C. officials, Chinese team and the SEC officials. Special mention should be made of Mr. Hamim Magdon Ismail who was the pioneer officer for this project from N.T.C. for his untiring endeavour to solve as many problems at the site, without the least bitterness.

Another very important lesson we could learn from this project was the attitude of the Chinese team towards work. This was perhaps earlier demonstrated amply in the construction of BMICH, where there was a large Chinese workforce. At Pugoda the Chinese personnel were limited to a few technicians and a few engineers. Yet for all their presence, their modesty and simplicity, and what we heard from them at informal gatherings, sometimes over a cup of 'Mou-Tai' followed by green tea, was an immense source of inspiration. For them their individual needs were always subordinate to the needs of their country, and they would go wherever their country wanted them to go.

It may be impossible to create such patriotism in our set up and also it may never be possible for us to prosper unless such patriotism is built up in every one of us.

10. Acknowledgements

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SCHEDULE I
Construction Equipment

A 10 ton truck mounted crane was used for the erection of the steel trusses, columns, spiral slabs and for the construction work of the intake-well.

An excavator fitted with 1 cu.yd. bucket was used for the excavation of a 20 ft. wide and 6 ft. deep trench around the factory to lay the external service pipe lines and a trench of average depth 14 ft. to lay the sewage pipe line.

A Potain Tower crane was used for the construction work of the 133 ft. water tower.

Concrete was supplied from a Batching plant with two truck mixers for all concreting at the site.

Given below is a list of equipment used at the site.

1. 10 T P & H truck mounted crane 1
2. Nobas excavatory (1 cu. yd bucket) 1
3. Batching plant 1
4. Front end loader 1
5. Truck mixers 2
6. Tower crane 1
7. 60 ft. long Tractor trailer 1
8. Baby dumpers 2
9. Tippers 2
10. Jeeps 2
11. Tractor trailer 2
12. Welding plant 4
13. Water pump 8