

detail, local RMG factories, therefore, must propose materials and produce paper patterns for themselves at the stage of sample making. As they cannot start mass production until their samples are approved by foreign buyers, they have a strong demand for engineers with experience in this technology. Because of shortage of such engineers in the country, many factories employ foreign engineers. It is therefore appropriate for NITTRAD's Design Department to include fashion design training in material science and pattern making, which are necessary for sample making.

3-2-5 Examination of the Details of the Requested Facilities and Equipment

(1) Examination of the requested facilities

TIDC was founded in 1979 with financial assistance of the United Nations Development Program (UNDP). However, at present its facilities cannot meet its operational needs. For example, rooms which were initially planned as classrooms are now used as teachers' rooms. It is necessary, therefore, to examine the appropriateness of each of the requested facilities after working out a plan for the utilization of the existing facilities in relation to the proposed operations of NITTRAD and identifying necessary additional facilities.

The result of the examination of the initial facility plan of TIDC and the scale of operations planned to be conducted at NITTRAD, is that it will be appropriate to change the use of the existing facilities as in Table 3-2 to utilize them most effectively.

Table 3-2 Alteration Plan for Use of Existing Facilities

Existing facility	Present use	Change of use under this project
Administration building	Director's room, administration office, accounting office, officers' office, library, conference room	All the rooms except for the conference room to be changed into teachers' rooms
Classroom building	3 classrooms, store, 4 teachers rooms	Since there is a shortage of classrooms and some lectures are given at workshops, all the rooms to be changed to classrooms in order to concentrate lectures in one building.
Testing/workshop building	Machine shop, textile testing lab, dyeing printing and finishing workshop, textile chemistry lab, boiler room	The textile testing lab to be changed into a RMG workshop. The machine shop will remain unchanged. The dying, printing and finishing workshop to be expanded to cope with the expansion of operations. The boiler room, which is necessary for the operation of machines for use in dyeing practice, will remain unchanged. Part of the textile testing lab to be changed into a store.
Spinning/weaving workshop building	Spinning workshop, 2 weaving workshops	A weaving workshop to be changed into the knitting workshop which is planned for NITTRAD.
Dining hall building	Kitchen, dining hall, common room	In accordance with the increase of trainees, the common room to be changed to a dining hall.

As a result of the examination of the operations of NITTRAD on the basis of the alteration plan, it is concluded that the following facilities should be added to the existing facilities:

Administration building:

A new administration building shall be planned to comprise all the rooms except for the conference room of the existing administration building.

Laboratory building:

A new laboratory building shall be planned to comprise testing rooms and screen-making workshop of the Design Department which will be newly established in NITTRAD.

Hostel building:

A hostel building shall be added to cope with an increase in the number of trainees.

Canteen building:

A new canteen building shall be planned in place of the existing common room which has been changed into a dining hall.

Connecting corridor:

A new connecting corridor shall be planned to connect the hostel building to the training facilities.

Other facilities:

Pump house etc.

Besides the facilities listed above, officer's quarters were included in the request of the Bangladesh side. However, the Bangladesh side commented that staff quarters with a floor area of 930m² will be constructed at the cost of the government of Bangladesh. Therefore, it was concluded that this project should not include staff quarters.

(2) Examination of the details of the requested equipment

Necessary items of equipment should be selected based on the details of the government of Bangladesh's written request. It is necessary, however, to systematically review the existing old and new types of equipment owned by TIDC for making up the equipment plan. For this reason, the following criteria are set up for examination of the request:

1. To select items of equipment which best suit, in terms of system and size, the present technological condition as well as the future trends of the Bangladesh textile industry.
2. To save existing items of usable equipment as much as possible.

Items of equipment were examined as follows:

1) Spinning equipment

In Bangladesh it is essential issue to improve the quality of domestically made yarn in order to increase the rate of its use in the manufacture of ready made garments (RMG) for export. Eight types of spinning machines, including a card, a lap former, a simplex, a ring frame and an open-end spinning were included in the request prepared by the Bangladesh side. In consideration of minimizing equipment used in spinning process training, the requested items were reduced so that TIDC's existing equipment will also be utilized. The revised list is as follows (it should be noted that the draw frame now in use at TIDC will be used after the completion of this project):

- Card
- Simplex (approx. 40 spindles)
- Ring frame (approx. 96 spindles)
- Cone winder with an auto splicer

The card and the simplex are both high-quality, high-productivity machines which have recently been used widely in the country's spinning mills, and are therefore indispensable in conducting training in spinning that can meet the actual situation of the spinning sub-sector of the country. The ring frame is used to produce yarn as the final product of the spinning process. The ring frame selected in this project is one which has been widely used in the country's spinning mills with the following features:

- The draft system which excels in extending roving for making yarn of even specified thickness.

- The driving system which can increase productivity by increasing the speed of twisting to give specified force to yarn.
- A function of winding yarn to cops of specified size.

As for the cone winder, one with an auto splicer was selected, as this is more common in recent years. This type of cone winder is a high-speed winding machine and can detect and remove all defective portions of yarn. Having done this, splices that do not adversely affect processes that follow can be produced. It is expected that this type of cone winder will come into widespread use in the future for securing yarn quality. Therefore, training for this equipment is deemed necessary. The following items of equipment were not selected due to the reasons as given below the headings:

- Lap former, comber

Both machines are used to manufacture high-grade cotton yarn, and therefore are not considered urgently necessary for training under this project.

- Open-end spinning, air jet spinning

Both machines are used to manufacture special types of spinning yarn. In light of the situation of the country's textile mills, they are not considered urgently necessary for training under this project.

2) Weaving equipment

Purpose of the request is to introduce advanced weaving equipment. Besides rapier loom which is popular equipment, an air jet loom, a water jet loom and a gripper shuttle loom are included in the request. Since increasing the added value of export oriented RMG products

through the use of domestically made materials as well as enhancing competitiveness of locally made products vis-a-vis imported one are important for the sub-sector, equipment is selected in consideration of those issues.

- Automatic shuttle weaving machine (cop change type)

At present, six cop change type automatic shuttle weaving machines are installed at TIDC, of which two units that are still usable will be used under this project.

- Rapier loom

This is one of the shuttle-less looms in accordance with a principle different from conventional shuttle looms. It is therefore suited for manufacturing textile fabrics of multicolor pattern, and is used all over the world. It is likely that this type of weaving machine will come into widespread use in the future because of minimum abrasion of parts and economical power consumption. In addition, it has various other uses and is therefore suited for use in training. For these reasons, it was decided to procure one unit of this type of weaving machine.

- Gripper shuttle loom and air jet loom

The gripper shuttle loom is suited for manufacturing thick twilled fabric using thick yarn, but it is not suited for manufacturing thin plain fabric whose warp is subjected to great tensile force. Since its width ranges from 100 to 153 inches, it is suited for double-width weaving. But its maximum speed of revolution is about 300 rpm. This type of weaving machine is not suited for manufacturing thin cloth such as sari, which is in high demand in Bangladesh and neighboring countries. Moreover, it is less

productive than air jet loom and water jet loom. For these reasons, it is expected that this type of loom will go out of use in the country's textile industry.

While the water jet loom is used to manufacture continuous filament (synthetic fibre) fabrics, the air jet loom is used to manufacture staple fiber (cotton or blended-spun) fabrics and is rapidly coming into wide use. It is very productive (600-800 rpm), and its prices are almost the same as those of the gripper shuttle loom. It is therefore expected that this type of loom will be used more widely. It is suited for manufacturing thin plain fabric (lawn, shirking, gray sheeting, sleek, etc.) using thin or medium thick yarn. And it is best suited for manufacturing materials of sari. At the time of the basic design study, it was confirmed that about 130 air jet looms made in Czechoslovakia were installed in a local private weaving mill and that additional 230 units were planned to be installed.

For these various reasons, it is expected that the air jet loom, rather than the gripper shuttle loom, will come into widespread use in the future. Therefore, one unit of the air jet loom was selected.

As for the towel loom, a terry shuttle loom was requested by the Bangladesh side. But it was agreed by the Bangladesh side not to include this type of equipment since it is not in line with the objective of the training to be held at NITTRAD. And the water jet loom is not included either because it is normally used to manufacture synthetic-fibre fabrics and is not urgently needed by the country's textile industry.

3) Dyeing/finishing equipment

The Bangladesh side requested small model types of dyeing/ finishing equipment for use in training. It is questionable, however, to obtain the same results as with actual equipment in case of singeing machine, pressurized scouring machine and cloth mercerizing machine. On the other hand, it will be very difficult to procure such machines as yarn mercerizing machine, sanforizing machine, felt calender machine and raising machine. Therefore, instead of including the above machines it was decided to procure the following items of equipment (all of which are for business use) in this project to achieve the initial objective of the equipment plan:

- Padding mangle, stenter machine and steamer

It will be possible to conduct training in dyeing and finishing of cotton and blended-spun (cotton and synthetic fibres) fabrics on the same technical level as actual works by the use of these items of equipment.

- Sample jet dyeing machine

It is possible to conduct training in the process of designing, scouring, bleaching and dyeing at the same technical level as factory works with this equipment.

- Padding mangle, stenter machine and calender

It will be possible to conduct training in regular finishing and lustre finishing by the use of these items of equipment.

It will become possible to conduct training in a series of dyeing/ finishing processes, systematically and efficiently, by the combined use of the above-mentioned items of equipment. Since only a small

quantity (about 2 to 3 meters of 250mm wide) of cloth is necessary in each process, material costs can be minimized. It was also decided to include balances in the equipment plan.

4) Knitting equipment

Since knitting division will be newly established in NITTRAD the Bangladesh side requested a variety of knitting equipment, such as a warp knitting machine, circular knitting machines and flat knitting machines. However, it was decided to include only those which are urgently needed with the consideration that circular knitting machines are most often used in Bangladesh.

It was decided not to include the requested warp knitting machine, narrow trimmings & elastics machines, designing of fancy edgings machine, hosiery double cylinder machine, trials plain socks knitting machine, rachel sampler, tricot sampler and elementary knitting machine. Instead of including this equipment, a single plain jersey knitting machine, a single knit double fleece knitting machine, a double knit a double lain jersey knitting machine, a double knit rib machine, a flat knitting machine (rib), a flat knitting machine (jacquard) and a link grinding machine are included in the project. The introduction of these machines will make it possible to conduct effective training in production of knit underwear, undershirts and T-shirts (collars, cuffs) which is in high demand in Bangladesh.

5) Sewing machines

The production system of the country's RMG industry is commonly based on production apparel orders of foreign buyers. In other words, factory production systems are most likely not based on well-defined

marketing strategies for specific products. Therefore, manufacturers are required to be flexible in order to meet buyers' varied production requirements. For this reason, a typical apparel manufacturing factory is equipped with many different types of sewing machines, where necessary types of sewing machines suited for production of products are selected, and then a proper production line is set up. Since the use of each sewing machine varies with the type of apparel product, it is essential to work out a production plan to make effective use of sewing machines to increase productivity. When all the sewing machines owned by a factory are used effectively and the number of sewing machines which are out of operation is minimal, the factory is carrying out efficient production control. When the same sewing machine is used for the production of different products and many other sewing machines are not running, however, production control is inefficient and productivity is low. In order to increase productivity, therefore, it is essential that the managerial and supervisory technical personnel of RMG factories work out an efficient production plan based on their thorough knowledge of different functions of different sewing machines.

The objective of sewing training at NITTRAD will be to train in basic as well as applied uses of a wide variety of sewing machines. For this reason, it is important for NITTRAD to be able to offer training in many possible uses of sewing machines which are practically used at the existing RMG factories.

There are about 3,000 different types of sewing machines available in the market, each of which is suited for a different portion or different finish of an apparel product. In the basic design study, those sewing machines which are owned by RMG factories in Bangladesh

for the production of basic items were surveyed. The survey result shows that basic items produced in Bangladesh include briefs, underwear, polo shirts, T-shirts, dress shirts and trousers, and that as many as 25 types of sewing machines (as shown in Table 3-3) are used to manufacture these basic items. Since the lockstitch pocket welting machine can be substituted with the lockstitch single needle machine by using an adapter, it was decided to select the 24 types of sewing machines for this project.

Table 3-3 Relations Between Sewing Machines and RMGs

No.	Sawing Machinery	1	2	3	4	5	6
1	Lockstitch, Single Needle		○			○	
2	Overlock, Twin Needle 4 Thread		○	○			
3	Interlock, Twin Needle 5 Thread					○	
4	Lockstitch, Single Needle with Automatic Thread Trimmer Reverse and Back-track	○	○	○		○	
5	Lockstitch, Single Needle Needle Feed					○	
6	Lockstitch, Single Needle with Vertical Trimmer					○	
7	Lockstitch Bar Tacking (High Speed Cylinder Bed)						○
8	Buttonholing Machine for Woven Fabric					○	
9	Buttonholing Machine for Knitted Fabric			○			
10	Button Sewing Machine			○		○	
11	Double Chain Stitch Machine, 3-Needle					○	
12	Lockstitch, 2-Needle w/org. Split Needle-bar			○	○		
13	Double Chainstitch, Single Needle						○
14	Double Chainstitch, 4-Needle Elastic Attacher	○					
15	Double Chainstitch, 4-Needle Shirt Fronting m/c					○	
16	Lockstitch Pocket Welting Machine						○
17	Lockstitch, Twin Needle Needle Feed						○
18	Button Covering Stitch Belt-loop Making Machine						○
19	Overlock Machine, Single Needle 3-Thread						○
20	Overlock Machine with Back Tacking		○		○		○
21	Top & Bottom Cover Stitch Flat Bed Machine			○	○		
22	Lapseaming Machine (Back Top attaching)	○	○				
23	Elastic Seam Facing Machine, 8-Thread				○		
24	3-Needle Covering Machine	○					
25	Pocket Seam Facing Machine, 2-Needle	○					○

1 : brief
4 : T-shirt

2 : underwear
5 : dress shirt

3 : polo shirt
6 : trousers

In addition to the above sewing machinery, an embroidery sewing machine with which it is possible to do both zigzag sewing and embroidery sewing is also selected. As for pressing/finishing equipment, only those which are necessary for sample making such as cloth laying tables and steam irons are included. Items of equipment such as automatic fusing press, shirt folder, thread cleaner, pocket creaser, collar turner, leg press, top press, body press, metal button chalker, shape fastener and steam generator are not included in this equipment procurement plan.

Though the Bangladesh side requested computerized pattern making equipment, it was decided not to include it in this project because it is highly-automated and maintenance for such equipment would be difficult in Bangladesh.

6) Testing equipment

The Bangladesh side requested a total of 67 items of testing equipment. These items of equipment can be classified as follows according to the types of materials to be tested with them:

○ Material testing equipment (11 types)

- Double sorter
- Cotton grade box
- Testing device for honey dew content in cotton
- Trash analyzer for raw cotton
- Educational testing kit for fibre identification
- Fineness meter
- Stelometer with torsion balance, etc.

- Yarn testing equipment (14 types)
 - Twist tester
 - Yarn crimp tester
 - Yarn tension meter
 - Portable yarn counting balance
 - Electronic coarse counter
 - Uster classimat
 - Uster tester etc.

- Woven/knit testing equipment (25 types)
 - Pilling tester
 - Fabric thickness tester
 - Fabric abrasion tester
 - Fabric drapemeter
 - Elemendorf's tearing tester
 - Fabric bursting strength tester
 - Lounder meter
 - Spray rating tester
 - Hydrostatic head tester
 - Perspirometer
 - Air permeability tester
 - Fabric crease recovery tester etc.

- Common equipment (17 types)
 - Microscope
 - Precision polarising microscope
 - Electronic balance
 - Digital tachometer
 - Digital pH meter
 - Personal computer

- Overhead projector
- Combined lab. oven
- Gray scale
- Thermograph
- Micrometer etc.

These requested items of equipment include those which are of the same type as those in use at TIDC. For this reason, due consideration was given to those existing items of equipment which are used infrequently, as well as those which are used frequently (according to Table 2-7, TIDC's recent data on testing achievements), and those which will be in demand in the future. Special emphasis was placed on the procurement of knit testing equipment for which demand is likely to increase in the future. Therefore, a knit shrinkage tester and a set of glassware are selected though they are not included in the request. Since a number of RMG importing companies in EC countries and the US require formaldehyde content test and the flammability test, it is concluded that testing equipment for those tests are important and are also selected in addition to the contents of the request.

It was decided not to include certain requested items which are of the same type as existing items of equipment. As much as possible, existing equipment should be used, the exception being those which are outdated or superannuated.

As a result of the examination conducted in light of the above-mentioned criteria, the conclusion reached was that it is appropriate to include the following 52 items of equipment in this project:

- Material testing equipment (7 types)
 - Double sorter
 - Testing device for honey dew content in cotton
 - Trash analyzer for raw cotton
 - Precision polarising microscope w/ photo device
 - Stelometer with torsion balance
 - Fineness meter for wool
 - Microscope (×300)

- Yarn testing equipment (5 types)
 - Yarn tension meter
 - Uster tester
 - Yarn package hardness tester
 - Uster classimat
 - Yarn hairiness tester

- Woven/knit testing equipment (31 types)

<ul style="list-style-type: none"> ● Digital pH metre ● Pilling tester ● Fabric abrasion tester ● Fabric stiffness tester ● Fabric drapmeter ● Coarse length tester ● Elemendorf's tearing tester ● Fabric bursting strength tester ● Fabric washing machine ● Launder meter ● Water repellency tester ● Spray rating tester 	<ul style="list-style-type: none"> ● Snag tester ● Flammability tester ● Knit shrinkage tester ● AATCC durable press replica ● AATCC apparatus for tested sample evaluation ● Tumble dryer(wascator type) ● UV spectrophotometer ● Water bath ● Glassware for formaldehyde analysis ● Shaker ● Aspirator ● AATCC puckering replica
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- Perspirometer
 - Glassware
 - Air permeability tester
 - Fabric crease recovery tester
 - AATCC wrinkle tester
 - Rubbing tester (crock meter)
 - Gray scale for colour change & staining
- Common equipment (9 items)
- Electronic balance
 - Digital tachometer
 - Overhead projector w/ screen
 - Slide projector w/ screen
 - A/V equipment (Video camera, VCR, monitor)
 - Combined lab. oven
 - Thermograph
 - Electronic tensile tester
 - Chemicals and regents

Introducing above equipment will reduce testing time through the combined use with the existing items of equipment, and it will become possible to conduct tests which are now being refused because of a lack of relevant testing equipment. Some of the testing will require constant temperature and constant humidity, and therefore items of equipment used for such testing will be installed in the physical evaluation lab so that highly reliable data may be obtained.

In Bangladesh, the Bangladesh Standards Testing Institution (BSTI) has established more than 1,300 standards (BDS) which joined ISO in 1974. Out of those standards about 250 are fiber standards of raw cotton, jute, synthetic fibres, yarn, cloth and apparel products. BSTI's

textile department is conducting about 20 sample tests a month, mainly testing of physical properties, for customs houses and some private businesses. In selection of testing equipment for NITTRAD, consideration was given not only to BDS but also other standards which will be necessary for testing of export products.

7) Design equipment

The Bangladesh side requested design equipment classified as: creative design equipment, studio design equipment, fashion design equipment, sewing equipment, weaving/knitting design equipment, embroidery design equipment and print design equipment. In this project, creative design equipment, studio design equipment and print design equipment, are integrated into the print design equipment. Sewing equipment, weaving/knitting design equipment and embroidery equipment are included as training equipment. As a result of readjustment, the following category of equipment are introduced in this project:

○ Print design equipment

The Bangladesh side requested print design equipment necessary for flat screen printing and rotary screen printing. However, in Bangladesh, only a small number of factories employ rotary screen printing, it was decided to introduce flat-screen-making equipment.

As illustrated below in Fig. 3-1, the process of flat-screen-making is divided into three stages.

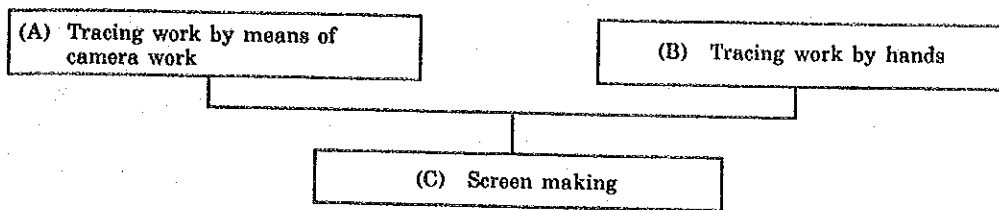


Fig. 3-1 Flat Screen Making Process

It was decided to procure a minimum number of items of equipment for each stage. Items of equipment necessary for each of the three stages are as follows:

(A) Tracing work by means of camera work

- Day light film developing machine
- Negative positive copying machine/Vacuum contact printer for camera work
- Auto developer and dryer
- Contact camera set
- Tracing & masking table
- Step and repeat machine
- Camera with zoom lens
- Tools & materials for tracing film making
- Accessories & materials for dark room works

(B) Tracing work by hands

- Set square (small, medium, large)
- T scale board
- Rotor pen set
- Tracing table

(C) Screen making

- stretching machine w/ adhesive chemicals
- Screen drying chamber

- Suction machine
- Metal frame
- Printing table
- Vacuum contact exposing machine for flat screen
- Coating bucket for photo emulsion

8) Workshop equipment

Since these items of equipment are necessary for training in repairs and maintenance of equipment, almost all the requested items of equipment are deemed necessary and are to be included in the project. TIDC has basic tools and machine tools, therefore only requested equipment found to be in short supply were selected based on the basic design study. Since existing lathes, millers and drill presses are still usable, only tool bit sets for them are included in this plan. The workshop equipment can be divided broadly into: machine tools for use in repairs and maintenance, and electrical equipment. These are listed below.

○ Machine tools

- Gas welding machine
- Tool bit sets
- Compressor
- Metal hardness measuring instrument
- Dial indicator for measuring eccentricity
- Regulator transformer
- Bearing puller set
- Power hand grinder

○ Electrical equipment

- Clip-on-meter

- Induction current testing set
- Phase sequence indicator
- AVO meters
- Tool sets for electric works
- Static voltmeter
- Oscilloscope

9) Supporting equipment

Desks, chairs, bookshelves, laboratory tables, file cabinets and other necessary fixtures will be procured for the classroom, the library, the testing room, the canteen, the dining hall and the conference room, all of which are directly related to training activities at NITTRAD. The quantity of each item was calculated on the basis of the scale of training activities at the institution.

10) Others

The following items of equipment are to be procured in this project:

- Personal computers (including printers).

The request of a personal computer for use in the analysis and accumulation of testing data, a personal computer for use in accounting, and a personal computer for use in training management is considered reasonable. In view of the power supply situation in and around the project site, each personal computer will be provided with an uninterrupted power supply (UPS) with a backup feature that works for about 10 minutes.

- Photocopy machine, duplicating machine and stencil cutting machine.
- In the production of teaching materials one set of each item will be necessary.

- Microbus

A 26-passenger microbus for transporting trainees, instructors, and staff members shall be included in the plan. As trainees will stay at the hostel in principle, it will be necessary to transport them between their places of employment and NITTRAD, or between the factories where they receive training and NITTRAD.

- Station wagon

A multipurpose station wagon for use in the transportation of training materials such as yarn and fabrics, and also for public relations activities use will be procured.

3-2-6 Examination of the Necessity of Technical Cooperation

After TIDC was established with financial assistance of the United Nations Development Programme (UNDP) in 1979, technical cooperation for the operation of facilities and equipment was offered to TIDC for several years.

In transforming TIDC into NITTRAD, the scope of its services will be expanded and its existing operations will be strengthened. In this connection, some aspects of its operations will require technical cooperation.

The testing/research department of TIDC has achieved no significant results in the field of materials testing of RMG products for export, although the department has so far been conducting more than 5,000 contract tests per year. Since the results of materials testing for export RMG product serve as criteria for buyers' selection of materials, it is planned to procure necessary equipment for obtaining testing results which meet international standards under this project. And it is also

planned to procure training equipment such as production machinery of spinning, weaving, etc. which are actually used at factories. Therefore, it is effective for NITTRAD to have technical cooperation, such as the dispatch of NITTRAD's staff members in foreign countries for training, and receiving short term experts from international donor organizations, for the purpose of effective use of the equipment.

Since the establishment of the Design Department will entail recruitment of additional staff members, there will be a need for technical cooperation. In the field of print design, there will be no problem with staffing since it has been decided to recruit an expert of BTMC in this field. In the field of fashion design, technical cooperation will be indispensable due to difficulty in recruiting personnel.

As discussed in "Recommendation" of Chapter 5, it is deemed necessary to establish an Operation Management Department for overall operation management within NITTRAD. However, presently, TIDC does not have experience in this system, and therefore NITTRAD will need technical cooperation.

As stated above, it is concluded that technical cooperation is necessary and useful for NITTRAD in terms of effective use of equipment as well as overall operation management. Therefore, the Bangladesh side should make continuous effort for seeking technical cooperation from the international donor organizations.

At present, the United Nations Industrial Development Organization (UNIDO) is showing interest in extending technical cooperation to NITTRAD and therefore it is considered important for the parties concerned to coordinate its realization.

3-2-7 Basic Policy on the Implementation of This Project

As the result of the examinations mentioned above, it is judged to be appropriate to implement this project under Japanese grant aid cooperation. The expected effects as well as feasibility of this project, and the implementing capability of the Bangladesh side have been confirmed. Therefore, the outline of this project will be examined and its basic design will be developed on the assumption that it will be implemented under Japanese grant aid cooperation. As stated earlier, it is appropriate to change, in part, details of the Bangladesh request.

3-3 Outline of the Project

3-3-1 Implementing Organization and Project Management System

(1) Implementing organization

The Ministry of Textiles of Bangladesh is the implementing organization of this project. NITTRAD's positioning in the organization of the ministry is as shown in Fig. 3-2.

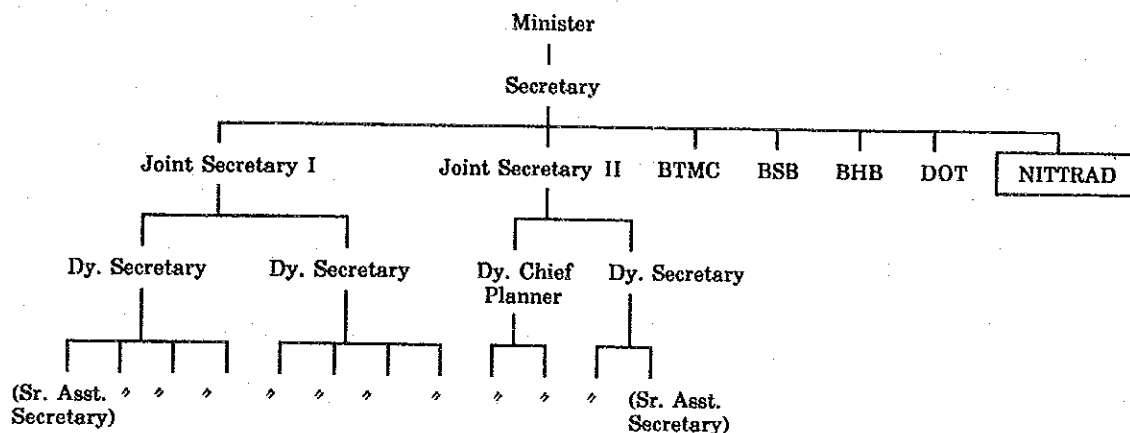


Fig. 3-2 Organization of the Ministry of Textiles

While TIDC is operating with a staff number of 95, NITTRAD is planned to operate with a staff number of 150. In the organization of the Ministry of Textiles, the director of NITTRAD is of the same rank and status as a joint secretary. A governing council (G.C.) will be formed for policy making, implementation, and overall supervision of NITTRAD. The Secretary of the Ministry of Textiles will be chairman of the council, and the director of NITTRAD will act as member secretary of the council. The other members of the council will be drawn from the concerned ministries, divisions, agencies and associations.

(2) Project management system

TIDC's existing training and operation departments are planned to be integrated into the Training/Operation Department at NITTRAD. And a

Design Department which will comprise print design and fashion design divisions is planned to be newly established. As the result of the integration, NITTRAD is planned to operate with four departments. In order to cope with the expansion of the operations, the staff number of NITTRAD is planned to be increased from 95 existing TIDC members to 150.

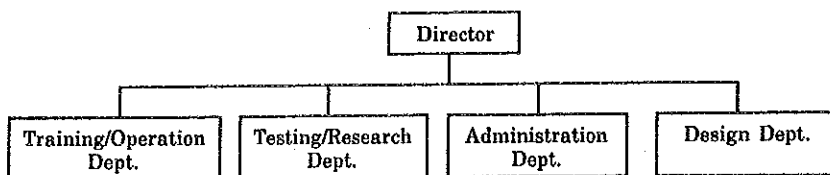


Fig. 3-3 Organization of NITTRAD

The staffing plan for each department of NITTRAD is described as follows.

Training/Operation Dept.
(35 (49))

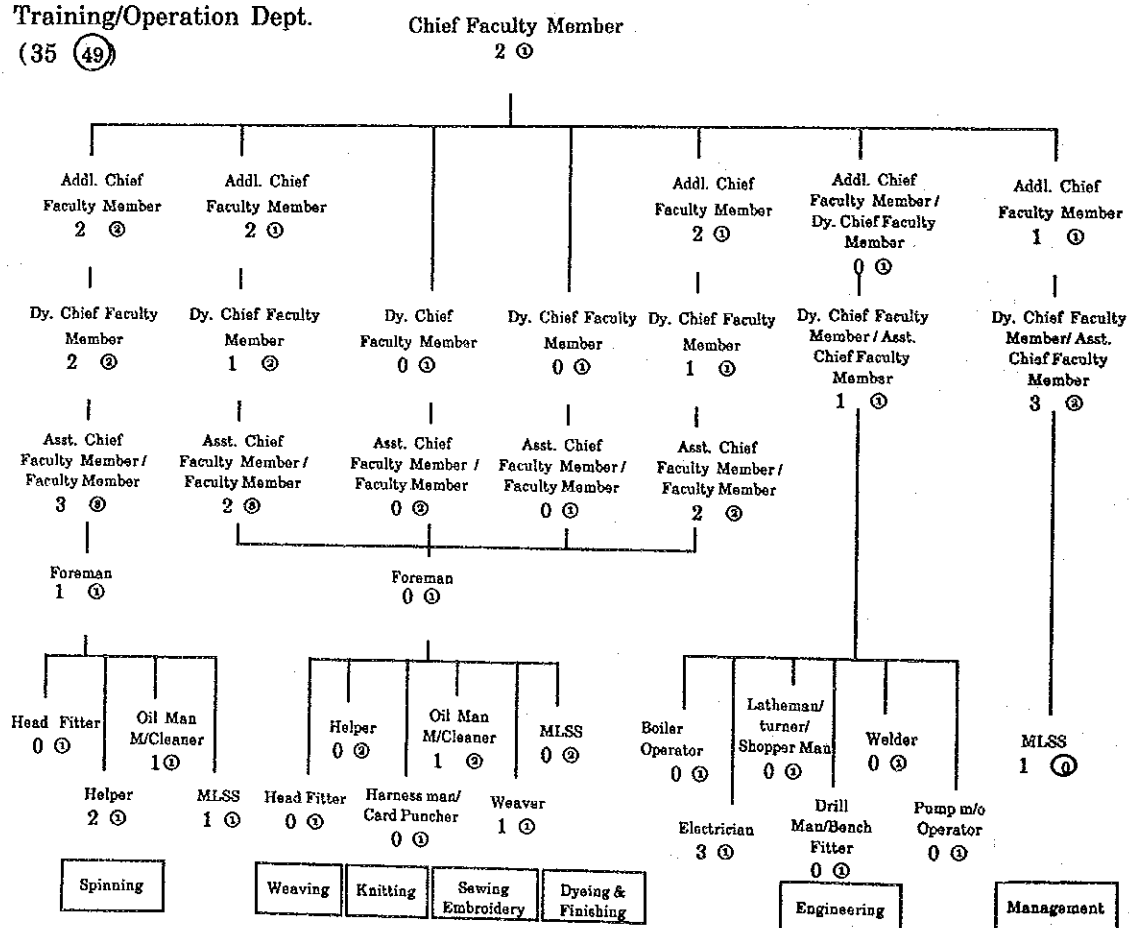


Fig 3-4 Staffing Plan of the Training/Operation Dept.

There will be no problem with the staffing plan since it is based on TIDC's past achievements. The faculty staff members of the sewing division will also serve in the workshop of the fashion design division when necessary. The boiler operator, the electrician and the pump m/o operator will be transferred to the engineering division from the Administration Department of TIDC.

Testing/Research Dept.

(14) (15)

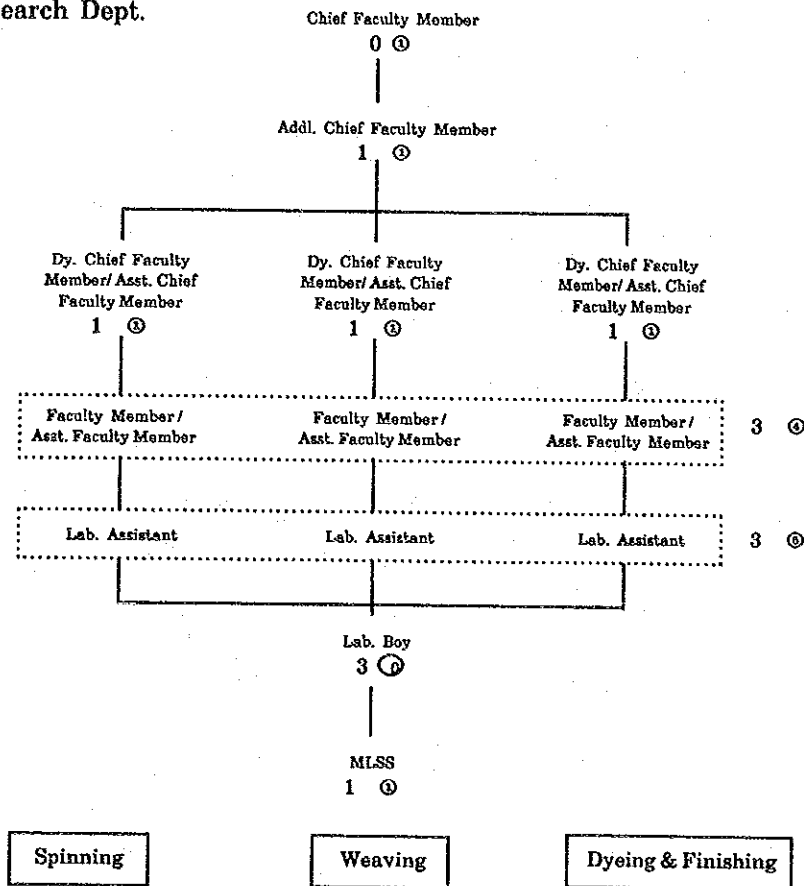


Fig. 3-5 Staffing Plan of the Testing/Research Dept.

The staffing plan in Fig. 3-5 is considered appropriate since it is based on TIDC's past achievements. Facilities of NITTRAD will be planned according to this integrated staffing plan.

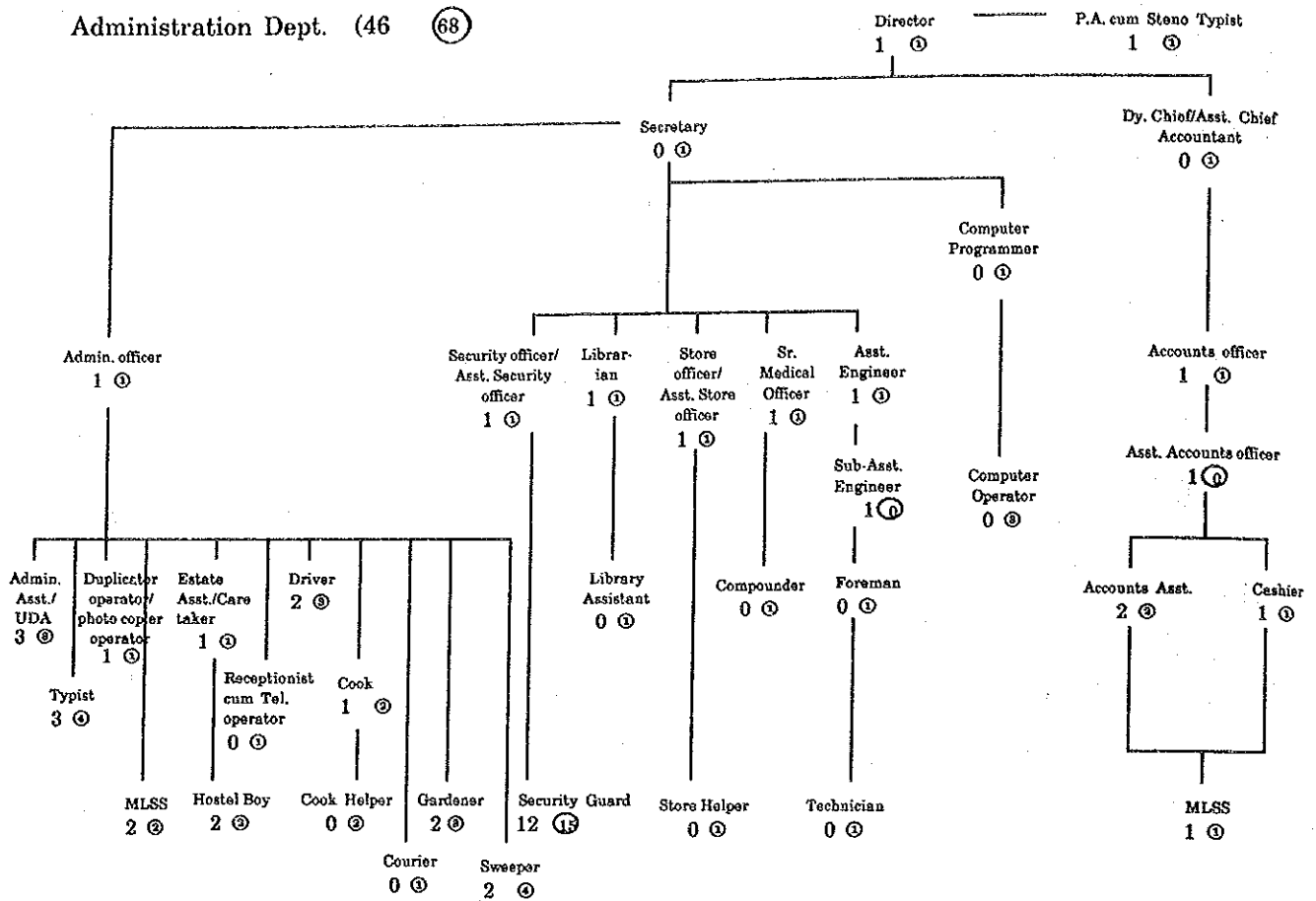


Fig. 3-6 Staffing Plan of the Administration Dept.

TIDC's present administration department will be readjusted to consist of an administration system and an accounting system, both of which are to operate under the supervision of the director. The expansion plan is aimed at reinforcing the present organization so that it will be able to cope with the proposed expansion of operations, and therefore is deemed reasonable. The electrician, the boiler operator and the pump m/o operator shall be transferred to the engineering division from the administration department of TIDC.

Design Dept. (18)

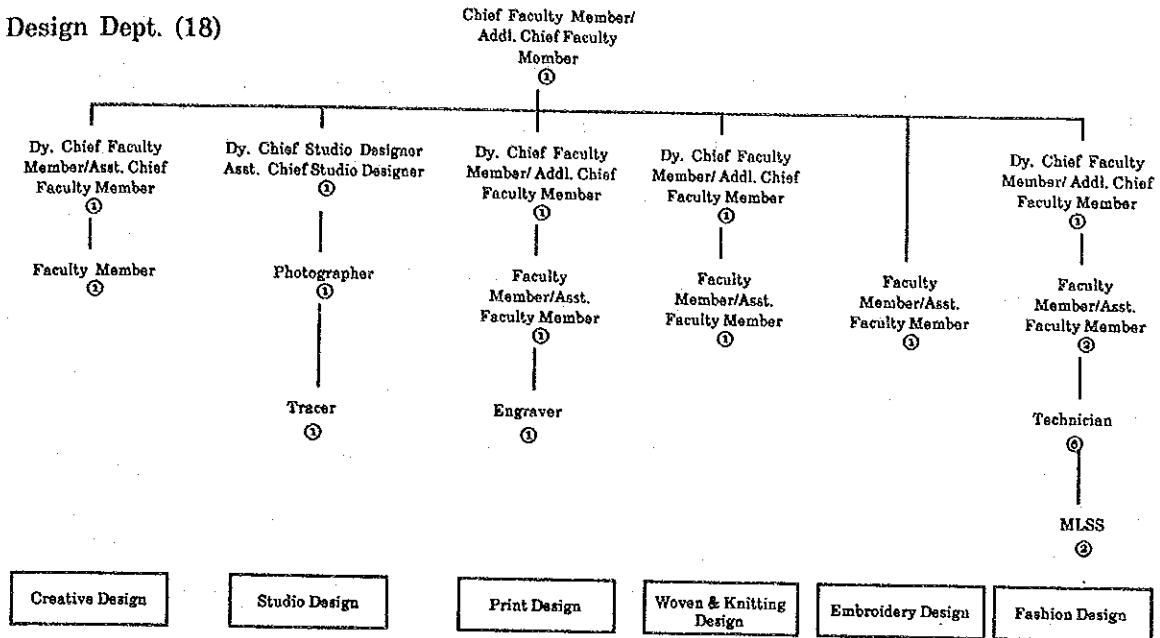


Fig. 3-7 Staffing Plan of the Design Dept. Envisaged in the Request

The organization of the Design Department shown in Fig. 3-7 is envisaged in the request of the Bangladesh side. Out of the six divisions in this organization, creative design, studio design and print design are print-screen-making process. Therefore, it is reasonable to integrate three of those divisions into a print design division. And the woven & knitting design and the embroidery design should be transferred to the Training/Operation Department because they are related to the activities of the department. Therefore, the Design Department shall be reorganized to consist of the print design division and the fashion design division. This is illustrated in Fig. 3-8.

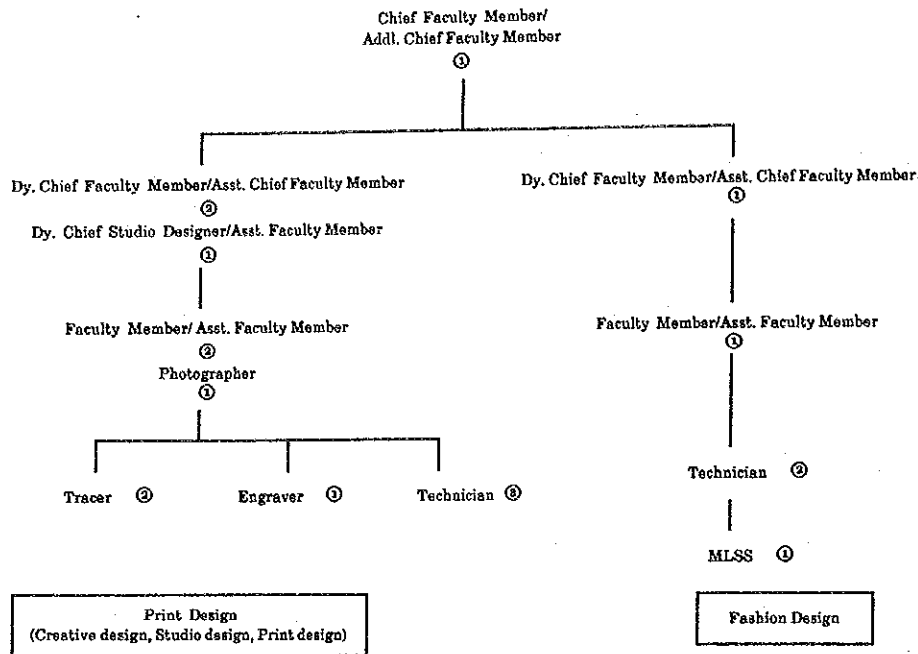


Fig. 3-8 Staffing Plan of the Design Dept.

As a result of this modification, it is considered appropriate to post three technicians in the printing division, and two in the fashion design division. Since tracers play an important role in the process of print-screen-making, the number of tracers is increased from one to two. Thus the Design Department shall operate with a staff of 18.

(In Fig. 3-4~8 above, circled numbers indicate the number of NITTRAD's staff members, and those not circled, the number of TIDC's staff members.)

3-3-2 Activity Plan

NITTRAD is planned to offer technical services to the textile industry in the fields of training/operation, testing/research and design. The outline of operations conducted in each department is as follows:

(1) Training/Operation Department

At TIDC, the operation department is an independent department which is responsible for giving technical guidance to the textile mills. This is because TIDC is an organization operating under the control of BTMC and therefore technical guidance to the BTMC mills is one of its major responsibilities. At NITTRAD the operation department will be integrated with the training department, and become the Training/Operation Department on the assumption that demand for technical guidance will decrease proportionally as privatized BTMC mills increase and whose staff members in charge of training can serve concurrently.

It is planned to add two new divisions, knitting and sewing, to the six existing training divisions of spinning, weaving, dyeing, quality control, engineering and management. The contents of the training courses in each of these fields is outlined in Table 3-4. In the division of sewing, training includes operation of various types of sewing machines which are practically utilized at local RMG factories. Faculty staff members in charge of these sewing machines will also serve the fashion design division of the Design Department when sewing machines are needed for sample making training. TIDC has accepted about 1,300 factory workers and managers as trainees per year, mainly from BTMC mills with about 60 from private mills. At NITTRAD, training is focused on bringing up managerial and supervisory technical personnel of textile mills from the standpoint of making contributions to the growth of the country's industry. Private textile mills usually bring up their staff through on-the-job training by means of inviting foreign consultants, and therefore rarely utilize domestic training institutions. This is the case with RMG factories as well, and they invite foreign instructors for on-the-job training. However, there is a limit to these on-the-job training

programmes. Demand is growing for a training institution which offers training courses for managerial and supervisory technical personnel of textile mills. According to 1989 statistics, it is estimated that about 20,000 managerial and supervisory technical personnel from 10,153 mills can be included in the target groups for the training in NITTRAD's 8 divisions. This means that NITTRAD will accept about 3,000 trainees per year. Since it is likely that the workforce will continue to grow with the increase in the number of mills, it is expected that demand for trained manpower will grow in the industry.

Table 3-4 Outline of the Training Courses (1)

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
Spinning	<ol style="list-style-type: none"> 1. Spinning <ul style="list-style-type: none"> Classification and grades of cotton Description and functions of spinning machines Practice and training 2. Standardization (practical) <ul style="list-style-type: none"> Preparation of operation standards Preparation of work standards Preparation of technical standards 3. Production control <ul style="list-style-type: none"> Production planning Process control planning Planning for higher productivity 4. Maintenance management <ul style="list-style-type: none"> Failure frequency and analysis of causes Minor maintenance plan (daily) Medium maintenance plan (monthly) Major maintenance plan (yearly) 5. Cost control <ul style="list-style-type: none"> Improvement of product unit Planning for cost reduction 6. Stock management <ul style="list-style-type: none"> Material procurement planning Stock management in process Stock management of products 7. Motivation <ul style="list-style-type: none"> Training of employees 	<ol style="list-style-type: none"> 1. Production control <ul style="list-style-type: none"> Check on production planning Check on process control Action plans of production control 2. Maintenance management <ul style="list-style-type: none"> Understanding the operating condition of facilities Investment in equipment Information of modern facilities 3. Cost control <ul style="list-style-type: none"> Direct cost Planning for cost reduction 4. Target control <ul style="list-style-type: none"> Enforcement of factory policy Improvement of factory profit Improvement of productivity 	<ol style="list-style-type: none"> 1. Spinning <ul style="list-style-type: none"> Classification and grades of cotton Description and functions of spinning machines Practice and training 2. Maintenance of spinning machine <ul style="list-style-type: none"> Method of periodic maintenance Minor overhaul (practical) Major overhaul (practical) Repairs Preventive maintenance 3. Maintenance of electric devices <ul style="list-style-type: none"> Sequence circuit Repair

Table 3-4 Outline of the Training Courses (2)

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
Weaving	<ol style="list-style-type: none"> 1. Weaving <ul style="list-style-type: none"> Faults in winding and their remedies Production calculation in winding Fabric structures Practice and training 2. Standardization (practical) <ul style="list-style-type: none"> Preparation of operation standards Preparation of work standards Preparation of technical standards 3. Production control <ul style="list-style-type: none"> Production planning Process control planning Planning for higher productivity 4. Maintenance management <ul style="list-style-type: none"> Failure frequency and analysis of causes Minor maintenance plan (daily) Medium maintenance plan (monthly) Major maintenance plan (yearly) 5. Cost control <ul style="list-style-type: none"> Improvement of product unit Planning for cost reduction 6. Stock management <ul style="list-style-type: none"> Material procurement planning Stock management in process Stock management of products 	<ol style="list-style-type: none"> 1. Production control <ul style="list-style-type: none"> Check on production planning Check on process control Action plans of production control 2. Maintenance management <ul style="list-style-type: none"> Understanding the operating condition of facilities Investment in equipment Information of modern facilities 3. Cost control <ul style="list-style-type: none"> Direct cost Planning for cost reduction 4. Target control <ul style="list-style-type: none"> Enforcement of factory policy Improvement of factory profit Improvement of productivity 	<ol style="list-style-type: none"> 1. Weaving <ul style="list-style-type: none"> Faults in winding and their remedies Production calculation in winding Fabric structures Practice and training 2. Maintenance of spinning machines <ul style="list-style-type: none"> Method of periodic maintenance Minor overhaul (practical) Major overhaul (practical) Repairs Preventive maintenance 3. Maintenance of electric devices <ul style="list-style-type: none"> Sequence circuit Repairs
Dyeing and finishing	<ol style="list-style-type: none"> 1. Basic dyeing and finishing <ul style="list-style-type: none"> Types of fibres Types and structure of fabrics Types and features of dyestuffs Types of auxiliaries (scouring, dyeing, finishing) 2. Dyeing and finishing process and machines <ul style="list-style-type: none"> Singeing Scouring Bleaching Mercerizing Dyeing Printing Finishing 3. Quality control <ul style="list-style-type: none"> Preparation of working standards Preparation of technical standards Preparation of quality standards 	<ol style="list-style-type: none"> 1. Dyeing and finishing process and machines <ul style="list-style-type: none"> Modern machines 2. Production control <ul style="list-style-type: none"> Check on production planning Check on process control Action plans of production control 3. Quality control <ul style="list-style-type: none"> Check on technical standards Check on quality standards 4. Safety control <ul style="list-style-type: none"> Check on unsafe operation Check on preserve operation 5. Cost control <ul style="list-style-type: none"> Planning for cost reduction 6. Target control <ul style="list-style-type: none"> Enforcement of factory policy Improvement of factory profit Improvement of productivity 	<ol style="list-style-type: none"> 1. Basic dyeing and finishing <ul style="list-style-type: none"> Types of fibres Types and structures of fabrics Types and features of dyestuffs Types of auxiliaries (scouring, dyeing, finishing) 2. Dyeing and finishing machines <ul style="list-style-type: none"> Structures and features of machines

Table 3-4 Outline of the Training Courses (3)

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
	<p>4. Production control Production planning Process control planning Planning for higher productivity</p> <p>5. Safety control Preparation of unsafe operation tables Handling of dangerous objects Integrity operations</p> <p>6. Cost control Cost accounting</p> <p>7. Stock management Material procurement planning Stock management of products</p>		
Knitting	<p>1. Fundamentals of knitting Types of knitting Structure of warp knit Structure of weft knit Types of yarn Types of fabric</p> <p>2. Features of knitting machines Outline and structure of knitting machines Warp knitting machine Weft knitting machine - Flat knitting machine - Circular knitting machine</p> <p>3. Operation of knitting machines Features of knitting machines Elements of knitting machines Change of needle jack Fabric setting Yarn typing Tension adjustment Knitting design (practical)</p> <p>4. Quality control Preparation of working standards Preparation of technical standards Preparation of quality standards</p> <p>5. Production control Production planning Process control planning Planning for higher productivity</p> <p>6. Cost control Cost accounting</p> <p>7. Stock management Management of consumables</p>	<p>1. Production control Check on production planning Check on process control Action plans of production control</p> <p>2. Quality control Check on technical standards Check on quality standards</p> <p>3. Cost control Planning for cost reduction</p> <p>4. Maintenance management Understanding the operating condition of facilities Investment in equipment Information of modern facilities</p> <p>5. Target control Enforcement of factory policy Improvement of factory profit Improvement of productivity</p>	<p>1. Fundamentals of knitting types of knitting Structural of warp knit Structure of weft knit types of yarn Types of fabric</p> <p>2. Maintenance of knitting machines Outline and structure of knitting machines Overhaul Adjustment Repairs Preventive maintenance Periodic maintenance cylinder change conversion Inverter</p>

Table 3-4 Outline of the Training Courses (4)

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
Sewing	<ol style="list-style-type: none"> 1. Fundamentals of sewing Fundamentals of fabrics Classification of fibres Structure of fabrics 2. Sewing Cutting Banding Sewing Finishing Inspection of garments 3. Operation of sewing machines (practical) Outline and structures of sewing machines Trends for sewing machines Operation - Preparation before operation - Operation and adjustment 4. Quality control Preparation of working standards Preparation of technical standards Preparation of quality standards 5. Production control Production planning Process control planning Planning for higher productivity 6. Cost control Cost accounting 7. Stock management Stock management of consumables Stock management of products 	<ol style="list-style-type: none"> 1. Production control Check on production planning Check on process control Action plans of production control 2. Quality control Check on technical standards Check on quality standards 3. Cost control Planning for cost reduction 4. Maintenance management Understanding the operating condition of facilities Investment in equipment Information of modern facilities 5. Target control Enforcement of factory policy Improvement of factory profit Improvement of productivity 	<ol style="list-style-type: none"> 1. Fundamentals of sewing Fundamentals of fabrics Classification of fibres Structure of fabrics 2. Maintenance of sewing machines Outline and structure of sewing machines Overhaul Adjustment Repairs Preventive maintenance Periodic maintenance
Quality control	<ol style="list-style-type: none"> 1. Testing methods Test of materials Test of yarns Test of fabrics Test of products (garments) 2. Features of testing equipment Testing equipment for materials Testing equipment for yarn Testing equipment for fabrics Testing equipment for products (garments) 3. Operation of testing equipment (practical) 4. Evaluation of test results - Physical properties (standard data, specification, replicas, etc.) - Fastness (gray scale, blue scale) 	<ol style="list-style-type: none"> 1. Testing methods Outline of testing methods 2. Evaluation of test results Confirmation and feedback 3. Standards of fibre and yarn testing Related standards in the world Relation with exportation Specification 4. Application of quality control cycle <div style="text-align: center;"> <pre> graph TD P --> D D --> C C --> A A --> P </pre> </div> <p> P: Plan D: Do C: Check A: Action </p>	<ol style="list-style-type: none"> 1. Features of testing equipment 2. Maintenance of testing equipment Outline and structures of testing equipment Adjustment Repairs Periodic maintenance

Table 3-4 Outline of the Training Courses (5)

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
	<p>5. Data arrangement Use of a personal computer (preparation of data bank)</p> <p>6. Standards of fibre and yarn testing Bangladesh Standards (BFS) International Organization for Standardization (ISO) British Standards (BS) American Society for Testing Materials (ASTM) Japan Industrial Standards (JIS)</p> <p>7. Quality control Preparation of working standards Preparation of technical Standards Preparation of quality standards</p>		
Engineering	<p>Electrical engineering</p> <p>1. Fundamentals of electrical engineering Conductor, semiconductor and insulator Resistance and resistor Capacitor and capacitance Inductor and inductance Transformer Semiconductor device Semi conductor triodes and transistor Field effect transistor Silicon controlled rectifier Silicon controlled rectifier Silicon controlled switch DIAC and TRIAC Special types of diode and transistors</p> <p>Mechanical engineering</p> <p>1. Casting and heat treatment Casting process and heat treatment Metal melting and furnace Types and process of metal casting Faulty casting and test</p> <p>2. Bearing fitting technology Metals and alloys Bearing materials Function, classification and selection of bearing Hydro dynamic lubrication and lubricants Fitting technique</p>	<p>1. Energy conservation Efficient utilization of steam How to obtain dry steam Heat transfer Steam traps Feed water treatment</p> <p>2. Humidification and air conditioning technology Air conditioning related to textile industry Humidity measurement and psychometric chart Air condition process Refrigeration cycle Psychometric chart and parameters</p> <p>3. Trouble shooting and maintenance of electrical machine Circuit breaker Starters time-current characteristic curve Maintenance of substation equipment Selection of cables and fuses Control circuit drawing</p> <p>4. Production cost analysis in workshop management Principle of costing Material costing Wages plan and incentives Motion and time study Labour costing Overhead cost Principle of estimation Maintenance cost Profit and loss Project plan</p>	

Table 3-4 Outline of the Training Courses (6)

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
	<p>3. Machine tools operation, production and maintenance Grinding Lapping and honing Drilling and boring Machine tools Other tools Maintenance Safety</p> <p>4. Hydraulic, pneumatic control system Hydraulic and pneumatic system Fluid machines Reciprocating machines Rotary machines Actuator Compressor Hydraulic pump and filters Piping system Types of valves Hydraulic and pneumatic transmission Systems used in textile machines Overhaul, maintenance procedure</p>		
Management control	<p>1. Personnel management Introduction to personnel management Employee relations Principle of organization Record management</p> <p>2. Accounting management Introduction to accounting management Double entry system Profit and loss accounts Balance sheet Budget management</p> <p>3. Marketing management Introduction to marketing management Sales promotion Distribution and market</p> <p>4. Stocking management Introduction to stock management</p> <p>5. Job order and training of employees Job order and employment Training of new employees</p>	<p>1. Labour laws, Employee discipline and accounting management Personnel management Labour laws Employee discipline Accounting management</p> <p>2. Absenteeism and labour turn-over Concept of absenteeism Concept of labour turn-over Effects on productivity</p>	

(2) Testing/Research Department

The scope of services conducted at TIDC's testing/research department is planned to be expanded in NITTRAD. TIDC's testing/research department conducts about 5,000 contract tests per year, of which about 2,000 are for private mills. Because of a shortage of testing equipment, TIDC sometimes has to refuse testing and research requests. Since most of the materials of RMG products for export are imported, most of the material tests are conducted at foreign testing institutions. Under this project, the expansion of testing/research services is planned with due consideration to the importance of testing of locally made materials for export RMG products.

Table 3-5 Testing Items

	Test items conducted at TIDC	Planned test items
Tests for materials	Trash selection Fibre length Lap quality Maturity Lap block for roving and sliver Trash analysis Fibre fineness	Fibre tensile strength test Honeydew test
Tests for yarn	Yarn evenness Yarn number Yarn tensile strength test Yarn twist test Warp reel test Lea strength test	Pilling test Yarn quality Tensile strength test
Tests for fabrics	Abrasion test Crimp test Density Reflection Crease resistance test Light fastness test Rubbing test Water resistance test Flammability test Tensile strength test Washing fastness test Washing shrinkage test	Tearing strength test Bursting strength test Pilling test Abrasion test Stiffness test Drape test Knit coarse length test Crease resistance test Perspiration test Rubbing test Crease resistance test (AATCC) Water repellency test Water proofing test Air permeability test Formaldehyde content test Flammability test

(3) Design Department

The Design Department is planned to consist of two divisions, namely a print design division, and a fashion design division.

- Print design

Domestically made textile products are not competitive with imported ones even in the domestic market. The main reason is said to be their poor quality in terms of print design. The print-screen-making technology, with which original designs are incorporated into production of textile products, is indispensable in improving the quality of print design. There are two basic printing methods: flat screen printing and rotary screen printing. In Bangladesh, only a small number of factories use the rotary screen method. Therefore, under this project, only flat screen printing will be employed.

- Fashion design

In Bangladesh, RMG factories commonly make samples based on fashion idea sketches which are provided by foreign buyers for approval before starting mass production. Therefore, there is a strong demand for engineers with wide knowledge and experience of sample making. Because of a shortage of such engineers domestically, many private factories employ foreign engineers. It is urgently necessary to develop domestic manpower in this field. For this reason, the fashion design division's training courses shall be aimed mainly at training local engineers in materials science, and paper pattern making, both of which are necessary for sample making.

Table 3-6 Outline of Training Courses of the Design Dept.

Division	Supervisory technical personnel	Managerial technical personnel	Maintenance engineer
Print design (flat screen)	<ol style="list-style-type: none"> 1. Basic print design Fundamentals of printing Types and structures of fabrics Dyestuffs and pigments 2. Basic tracing technique Design making - Bright room work - Darkroom work 3. Process of screen making Stretching process Coating and drying Exposing Washing and drying Mending Lacquer coating Test printing Inspection 4. Quality control Preparation of working standards Preparation of technical standards Preparation of quality standards 5. Production control Production planning Process control planning 6. Cost control Cost accounting 7. Stock management Stock management of consumables Stock management of products 	<ol style="list-style-type: none"> 1. Production control Check on production planning Check on process control 2. Quality control Check on technical standards Check on quality standards 3. Cost control Planning for cost reduction 4. Maintenance management Understanding the operating condition of facilities 5. Target control Enforcement of factory policy Improvement of factory profit Improvement of productivity understanding of tendency by market research 	<ol style="list-style-type: none"> 1. Print design Fundamentals of printing Types of structures of fabrics dyestuffs and pigments 2. Maintenance of printing machines Outline of structure of machines Adjustment Repairs Preventive maintenance Periodic maintenance
Fashion design	<ol style="list-style-type: none"> 1. Garment materials Types and features of fabrics Fundamentals of fabrics Structure of fabrics Characteristics of garment materials 2. Function of garments Protection of human body Social and psychological characteristics Support for social activities 3. Classification of garments User Parts of garment Layer of wears Climate Combinations Purpose Form of garment Production method 4. Pattern making process Planning/design and material Measurement/drawing Pattern making Marking 5. Quality control Preparation of working standards Preparation of technical standards Preparation of quality standards 	<ol style="list-style-type: none"> 1. Production control of garments Check on plans and design Sample checking 2. Quality control Check on material selection Check on technical standards Check on quality standards 3. Production control Production process Use of modern facilities Improvement of productivity 4. Cost control Planning for cost reduction 	

3-3-3 Location and General Condition of the Project Site

The project site is located in Nayarhat, Savar, Dhaka, about 37km northwest of Dhaka City, on the premises of TIDC. It has an area of about 51,680m².

(1) Access road

The project site is connected to the Dhaka-Aricha Highway with a 200m long, 6m wide private access road. This access road was used for the construction of TIDC's existing facilities and therefore there will be no problem with its use for this project.

(2) Ground condition

The foundation plan shall be based on the soil investigation report which was prepared at the time of the basic design study survey. According to the report, the ground condition of the site is constant, consisting of soft clayey layer with N-value of 2, 3.0-3.5m from the ground level. Further down to 10m from the ground level is sand mixed clayey layer with N-value of 8-15, and from 10m to 15m is a medium density sandy layer with N-value of 15-30. The groundwater level is as low as 1.0 to 1.3m from the ground level.

(3) Electricity

Low-tension electricity (400V/230V) is supplied to TIDC's existing facilities from the adjacent former BTMC textile mill which is now on sale for privatization purposes. Since electricity is no longer supplied from the mill due to its privatization, an application has been filed for an 11kV electricity supply. The service line will be extended to the fence

on the eastern side of TIDC's premise, and therefore it will be possible to get the supply of electricity from this to NITTRAD facilities.

(4) Telephone

Two telephone exchange lines are already installed on TIDC premises. There will be no problem with future increases in the number of telephone exchange lines since a project to digitize the telephone exchange's switchboard is under way in the Nayarhat region.

(5) Water supply

TIDC's existing facilities have no water source of their own, and are supplied with water from the adjacent BTMC textile mill. There is a plan to dig a tube well within the premises. It will be possible to supply water to NITTRAD facilities from this tube well.

(6) Sewerage

There will be no project to construct a sewage system in and around the project site. At present, waste water from TIDC's existing facilities is treated in a septic tank and discharged into the ground. For this reason, it is considered appropriate to employ a similar waste water treatment/discharge system in this project from the standpoint of the cost of maintenance and management.

(7) City gas

City gas pipes have already been installed on the premises of TIDC for the supply of gas to the kitchen and the boiler. It will be possible, therefore, to supply city gas to the proposed facilities by connecting additional gas pipes to these existing gas pipes.

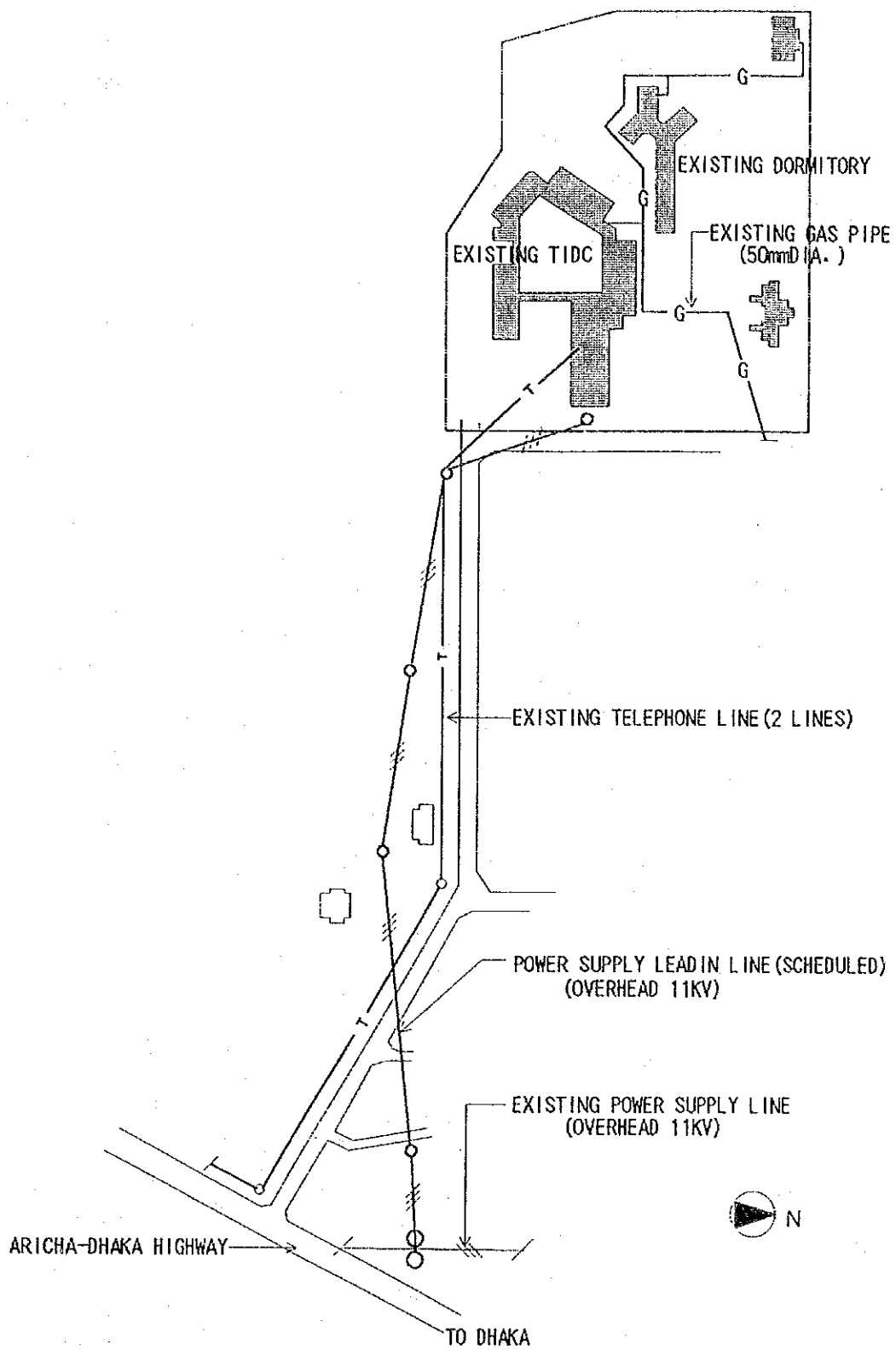


Fig. 3-9 Infrastructure of the Project Site

3-3-4 Outline of the Facilities and Equipment to be Procured under This Project

It is considered appropriate to include the following facilities and equipment in this project in order to fully carry out the operations of NITTRAD :

(1) Outline of the facilities (Approx. 3420 m²)

- Administration building (Approx. 840 m²)

Director's office, accounting office, officer's room, engineer's office, library, toilet

- Laboratory building (Approx. 1450 m²)

Print-screen-making workshop, tracing workshop, teachers' rooms, darkroom, photo-processing lab, testing labs

- Hostel building (Approx. 820m²)

12 units

- Canteen building (Approx. 140m²)

- Connecting corridor, others (Approx. 170m²)

(2) Outline of equipment

- Spinning equipment

Card, simplex, ring frame, cone winder with auto splicer etc.

- Weaving equipment

Rapier loom, air jet loom, mechanical bobby etc.

- Dyeing & finishing equipment

Sample jet dyeing machine, stinter machine, steamer etc.

- Knitting equipment

Single plain jersey knitting machine, single knit double fleece knitting machine, double knit double plain jersey knitting machine, double knit rib machine, flat knitting machine etc.
- Sewing machine

Various types of sewing machine, cloth laying table, steam iron, circular knife etc.
- Testing equipment

Double sorter, stelometer with torsion balance, testing device for honey dew content in cotton, pilling tester, yarn tension meter, fabric abrasion tester, fabric stiffness tester, fabric drapemeter, coarse length tester, fabric bursting strength tester, launder meter, water repellency tester, spray rating tester, fabric crease recovery tester, etc.
- Design equipment

Day light film developing machine, negative positive copying machine, step and repeat machine, stretching machine with adhesive chemicals, tracing & masking table etc.
- Workshop equipment

Gas welding machine, tool bit sets for lathe machine, tool bit sets for drilling machine, shaper machine, power hand grinder with spare blade, induction current testing set, wheatstone bridge, oscilloscope etc.
- Others

Tables and chairs, white board, photocopy machine, duplicating machine, typewriter, personal computer

3-3-5 Maintenance and Management Plan

(1) Maintenance and management of facilities

When this project is completed, NITTRAD's facilities will have a total floor area of about 8,700m². This is totaling the approx. 5,300m² existing facilities and the planned 3,400m² new facilities. The existing facilities are faced with some problems, such as subsidence of floors. But they are well maintained even 20 years after their completion. In working out the architectural plan under this project, therefore, every effort will be made to meet the specifications for the existing facilities so that the facility maintenance and management know-how accumulated may be effectively used. A constant-temperature and constant-humidity testing room is planned for NITTRAD so that reliable data may be obtained, and therefore the personnel engaged in maintenance must acquire sufficient technical know-how and pay special attention to avoid problems that may hamper testing activities at NITTRAD.

(2) Maintenance and management of equipment

The supporting staff under foremen will be in charge of the maintenance and operation of the equipment. Since a variety of machine tools are installed in the engineering workshop and technical staff members in charge of this equipment are stationed in the workshop, the staff members of this workshop will cooperate in the maintenance and operation of the equipment installed in NITTRAD. At the time of the installation of the equipment, operation/maintenance manuals will be provided to NITTRAD for the effective and efficient maintenance of the equipment.

Many items of equipment now in use at TIDC were manufactured in the 1950s or the 1960s and therefore are outdated. Many items of equipment to be

procured under this project will include those in which new technologies are incorporated, and therefore Japanese engineers who will be engaged in installing the equipment need to fully train the staff members in charge of maintenance of equipment after the installation.

As for the personal computers and copiers, periodical maintenance is necessary. The local distributors of these items of equipment have a maintenance system supported by a fully-trained technical staff and their technical know-how. It will therefore be necessary for NITTRAD to conclude a periodical maintenance contract with each of them so that the installed equipment may be utilized over a long period of time.

To this end, it is essential to operate each of the installed items of equipment every day even for a short time. Therefore, it will be necessary for the Bangladesh side to secure a budget for the procurement of raw materials, expendable supplies and spare parts necessary for the operation of the installed equipment as well as periodical maintenance contracts with the local distributors.

(3) Estimation of the operational costs

NITTRAD's annual operating cost is estimated, in Table 3-7, on the assumption that NITTRAD will operate with a staff of 150 after the completion of this project.

Table 3-7 Estimated Annual Operational Costs of NITTRAD

Item	Estimated costs when the project is completed (TK/year)
Personnel expenses Salary, allowance etc.	11,538,400 (11,538,400)
Utility and telephone charges Electricity Telephone Water Gas	730,300 (516,000) (150,000) - (64,300)
Consumables Materials, reagents Stationaries, teaching materials	869,000 (440,000) (429,000)
Others Facility maintenance Equipment maintenance Miscellaneous	2,711,900 (344,000) (560,000) (1,807,900)
Total	15,849,600

1) Personnel expenses

① Salary, allowance etc.

Table 3-8 Estimation of the Personnel Expenses

Rank	Basic salary (TK)	Annual salary TK/person (incl. allowance)	Nos. of personnel	Total (TK)
1	8600 - 9500	210,000	1	210,000
2	7800 - 9000	200,000	3	600,000
3	7100 - 8700	188,000	7	1,316,000
4	6300 - 8050	164,000	11	1,804,000
5	4800 - 7250	132,000	18	2,376,000
6	2850 - 5155	99,000	17	1,683,000
7	1725 - 3725	77,000	6	462,000
8	1550 - 3450	44,000	13	572,000
9	1475 - 3150	44,000	12	528,000
10	1375 - 2870	44,000	2	88,000
11	1200 - 2335	41,600	9	374,400
12	1050 - 1915	33,000	8	264,000
13	975 - 1750	31,000	7	217,000
14	900 - 1530	29,000	36	1,044,000
Grand Total				11,538,400

2) Utility and telephone charge

① Estimation of electricity charges

- Net operational days of the facility:
25 days/months (30 days/month for hostels)
- Net operational hours a day:
8 hours/day (6 hours/day)
- Daily demand ratio (simultaneous use of lightings, receptacles, equipment etc.):
Nonresidential: 0.15 Residential: 0.8
- Electricity charges (Regulation of REB)
 - Demand charge : 40TK/contracted electricity/month
 - Service charge : 60TK/month
 - Unit power cost : 2.7TK/KWh
 - Tax : 0.15TK/KWh/month
 - Contract service charge : 570TK/KW

● Annual electricity charges

Basic charge: Based on 80kW contract

$$(40\text{TK} \times 80\text{KW} + 60\text{TK}) \times 12\text{months} = 39,120\text{TK/year}$$

Power charge: Based on total capacity of 407 kW for lightings, Receptacles, equipment, etc.

$$\begin{aligned} & [407\text{KW} \times 8\text{hour} \times 25\text{day} \times 0.15 \times (2.7\text{TK} + 0.15\text{TK}) \times 12\text{months}] \\ & + [20\text{KW} \times 6\text{hour} \times 30\text{day} \times 0.8 \times (2.7\text{TK} + 0.15\text{TK}) \times 12\text{months}] \\ & = 417,582\text{TK/year} + 98,496\text{TK/year (hostel)} \\ & = 555,198\text{TK/year} \\ & \approx 555,200\text{TK/year} \end{aligned}$$

② Telephone charge 150,000TK/year

- Based on the expansion plan of number of staff members as well as telephone sets, telephone charge is estimated as follows;

$$6,250\text{TK/month} \times 2\text{times} \times 12\text{months} = 150,000\text{TK/year} \text{ (6,250TK is present average of monthly telephone charges)}$$

③ Water supply and sewerage

Since well water will be used and waste water will be treated within the facility, no cost will be needed.

④ Gas charges 64,310TK/year

a. For kitchen

- Staff 150person × 1 meal/day=150 meals/day
- Trainees 144person × 3 meals/day =432 meals/day

582 meals/day

- Assuming 1,000 kcal/meal, daily consumption is;

$$582 \text{ meals/day} \times 1,000 \text{ kcal/meal} = 582,000 \text{ kcal/day}$$

b. For the boiler

- Capacity of the existing boiler is 70kg/h. Assuming it will be run 4hours/day, daily consumption is;

$$[70 \text{ kg/h} \cdot \text{day} \times 540 \text{ kcal/kg} \times 4 \text{ h/day}] \div 0.6 (\text{boiler efficiency}) = 252,000 \text{ kcal/day}$$

c. Estimation of the gas charges

- Net operational days of the facilities: 25 day/month
- Monthly use ratio : Kitchen 0.9, Boiler 0.3
- Generated calories of gas : 9,255kcal/m³ (TITAS GAS)
- Unit gas cost : 3.31TK/m³(TITAS GAS)

- Annual gas charges

$$[582,000 \text{ kcal/day} \times 0.9 \times 25 \text{ day/month} \times 12 \text{ months/year}] + [252,000 \text{ kcal/day} \times 0.3 \times 25 \text{ day/month} \times 12 \text{ months/year}]$$

$$= 179,820,000 \text{ kcal/year}$$

$$179,820,000 \text{ kcal/year} \div 9,255 \text{ kcal/m}^3 \div 19,430 \text{ m}^3/\text{year}$$

$$19,430 \text{ m}^3/\text{year} \times 3.31 \text{ TK/m}^3 \div 64,310 \text{ TK/year}$$

3) Consumables

① Materials, reagents

- Materials and reagents cost of TIDC: 100,000TK/year
(TIDC's past budget)

Assuming that increases in proportion to the number of testings.

$$100,000\text{TK/year} \times 4 \times 1.1 = 440,000\text{TK/year}$$

(Including 10% of custom duty or value added tax.)

② Stationaries, teaching materials

- Stationaries, teaching materials cost of TIDC: 130,000TK/year
(TIDC's past budget)

Assuming that increases in proportion to the number of trainees.

$$130,000\text{TK/year} \times 3 \times 1.1 = 429,000\text{TK/year}$$

(Including 10% of value added tax.)

4) Others

① Building maintenance

Assuming 40TK/m²·year for building maintenance such as painting, waterproofing, electrical, water supply, air conditioning etc.

$$8,600\text{m}^2 \times 40\text{TK/m}^2 \cdot \text{year} = 344,000\text{TK/year}$$

② Equipment maintenance

- Equipment maintenance costs of TIDC: 140,000TK/year
(TIDC's past budget)

Assuming that increases in the same proportion as consumables.

$$140,000\text{TK/year} \times 4 = 560,000\text{TK/year}$$

(Including 135,000TK/year of maintenance contract costs for personal computer etc.)

③ Miscellaneous expenses (tax, uniform & liveries, postage & tele-gram expenses, advertisement, newspaper, insurance, entertainment, bus fare etc.)

● Miscellaneous expenses of TIDC: 1,145,000TK/year
(TIDC's past budget)

Assuming that increases in proportion to the number of staff members.

$1,145,000\text{TK/year} \times 150/95 \doteq 1,807,900\text{TK/year}$

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 Design Policies

In working out the facility and equipment plans, the basic design will be developed by giving due consideration to their functionality, economy and safety as well as to the following design policy:

(1) Design policy relating to natural conditions

Bangladesh is situated on the Indian Subcontinent, at 20°34' to 26° 38' north latitudes and 88° 1' to 92° 41' east longitudes. The mountainous region in the southeastern part of the country borders on Myanmar, and all other regions border on India. Eighty-five percent of the country's land area is a plain of alluvia soil, where the country's seven large rivers Padma, Meghna, Jamuna, Brahmaputra, Teesta, Surma, Karnaphuli and their 230 tributaries flow. The country has a tropical rain forest climate which is affected by the monsoons from the Indian Ocean. It has three seasons - winter (November to December), summer (March to May) and the rainy season (June to October). Its annual average temperature is 10°C to 34°C and its annual rainfall ranges between 1,194mm and 3,454mm. During the rainy season, there are many heavy rainfalls accompanied by tropical gales.

Table 4-1 Weather of Dhaka City

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Minimum	12.5	13.2	18.0	23.0	25.1	25.5	25.5	25.3	25.1	23.5	17.5	13.5
Maximum	25.1	27.5	30.2	35.1	33.5	32.0	30.5	31.5	31.3	31.0	28.5	26.5
Average	18.6	20.7	25.7	29.3	29.6	28.8	28.4	28.6	28.5	27.3	23.1	19.5
Sunshine Hour	272.8	254.8	275.9	264.0	257.3	147.0	161.2	179.8	183.0	232.5	258.0	279.0
Humidity (%)	75.3	71.0	66.3	73.3	79.7	84.3	85.0	84.0	83.3	81.0	77.7	77.7
Rainfall (mm/mm)	14.2	28.5	46.0	164.1	240.5	348.2	347.0	364.7	243.1	147.0	30.7	2.0
Wind velocity (m/sec)	14.2	13.6	12.7	10.8	7.7	5.4	4.4	4.5	5.0	6.7	10.3	12.6
Wind Direction	N/NW	N/NW	SW	S	S	S	SE	SE	SE	N/NE	N	N

The design policy relative to the country's natural conditions include the following:

- Since the major wind directions are from the south or the southeast during a rainy season characterized by high temperature and high humidity, the facilities of this project shall be laid out to face south or southeast in the same manner as the existing ones. The rooms which will not be equipped with air conditioners shall have windows in the exterior wall, and be provided with transom windows in the corridor side walls, to ensure sufficient natural ventilation.
- In Bangladesh, floods during rainy seasons are a serious problem. For this reason, the first floor level of the buildings shall not be lower than those of the existing buildings.
- Since the summer sunshine is strong, rooves shall be sufficiently insulated, and windows shall be recessed into the buildings to block direct sunlight as much as possible.

(2) Design policy relative to social conditions

TIDC does not have hostels or toilets for female trainees since, until recently, the institution has accepted male trainees only. With the recommendation of UNIDO, NITTRAD plans to accept female trainees as well. For this reason, the project includes toilets and facilities for the exclusive use of women.

(3) Design policy relating to the situation of the local construction industry

The government of Bangladesh is taking care that construction costs under grant aid from foreign countries will not rise. Therefore, locally

made building materials should be used as much as possible except when they pose problems in terms of usage or safety.

- (4) Design policy relating to the project implementing organization's maintenance and management capabilities

Although TIDC's existing facilities are well maintained and managed, the institution is faced with problems such as the subsidence of floors which cannot be remedied through ordinary maintenance and management efforts. Therefore, due consideration should be given to those problems which have already surfaced.

- (5) Design policy relating to the utilization of local contractors

In Bangladesh, there are many contractors and several of them have experience constructing high-rise buildings. However, the typical construction work period generally lasts longer than that of Japan, and it seems difficult for local contractors to work out a construction schedule according to a single fiscal year. Since a number of local contractors have achieved satisfactory results as subcontractors under the Japanese contractors, however, it will be possible to utilize the services of such local contractors in implementing this project.

4-2 Examination of the Design Conditions

4-2-1 Facility Composition

This project is aimed at setting up adequate facilities for NITTRAD by changing uses of the existing TIDC's facilities and constructing necessary new facilities. This project is composed of the following functions:

• Administration Department

Director's office, A new administration building
administrative office, will be constructed.
accounting office, library,
engineer's office,
officer's offices, toilets

Store Existing textile chemistry
lab. shall be changed

• Training/Operation Department

Classrooms The existing teachers' rooms
and the store shall be
changed to make a total of 6
classrooms including the 3
existing classrooms.

Dyeing printing workshop The existing workshop shall
be expanded by changing part
of the existing textile
chemistry lab.

Machine shop, spinning These workshops shall
workshops, weaving workshop basically remain unchanged
except that one of the
existing spinning rooms will
be changed into a knitting
workshop.

Knitting workshop One of the existing spinning
workshops shall be changed.

• Testing/Research Department

Physical evaluation lab., A new laboratory building
testing laboratories, will be constructed.
balance room

• Design Department

Darkroom, photo-processing A new laboratory building
lab., tracing workshop, will be constructed.
teachers room, print screen
making room

Sewing workshop The existing testing and
fabric analysis lab shall be
changed.

• Hostel and others

Hostel building 12 units shall be added to
the existing 24 units.

Dining hall The existing common room
shall be changed to expand
the existing dining hall.

Canteen A new canteen shall be
constructed to substitute the
changed common room

• Other facilities

Connecting corridor A new connecting corridor
shall be constructed to
connect the hostel building
to the training buildings.

Pump room, septic tank To be newly constructed.

4-2-2 Determination of the Size of Facility

The size of the facilities for this project shall be determined on the basis of the project implementing plan, the staffing plan, and the facility plan of TIDC's existing facilities with reference to the Japanese standard and the Bangladesh standard for required floor area.

1) Administration building

The required unit floor area are set up as follows in reference to the present use of the rooms:

Private office (Chief faculty member, secretary etc.): 12m²/person

Teachers rooms : 8m²/person

Office rooms : 6m²/person

2) Physical evaluation lab, testing lab 1, testing lab 2

The Testing/Research Department will have three testing laboratories, namely the physical evaluation lab having constant temperature and constant humidity condition, the testing lab 1 equipped with air conditioning, and the testing lab 2 with no air conditioning. The environmental conditions of the physical evaluation lab shall be a dry-bulb temperature of 20±2°C and a relative humidity of 65±5%. In the physical evaluation lab, tensile strength tests and bursting strength tests will be conducted. In testing lab 1, fibre length measurements, pilling tests, abrasion tests and stiffness tests will be conducted. This testing lab will serve as a teachers room as well. In testing lab 2, washing fastness tests, waterproofing tests, water repellency tests will be conducted. Floor area of each room shall be determined on the basis of the number of items of equipment and the size of each item of equipment. Since training in quality control

will also be conducted in these laboratories, it is necessary to take into consideration the required space for the trainees.

3) Darkroom, photo processing lab

The tracing-film-making process by means of camera work, which is prior to print-screen-making, will be conducted in these rooms. A darkroom shall be planned for the work of the negative positive copying machine, the auto developer, the step and repeat machine and the contact camera which will be procured under this project for tracing-film-making. Although it is common to provide a darkroom for each item of equipment at actual factories, a large darkroom for use of some equipment is planned under this project in consideration of convenient training. The photo processing lab will be equipped with the vacuum exposing M/C with processor, the tracing & masking tables etc. Retouching work of films will be conducted in day light. The size of each room is determined on the basis of the number of items of equipment and the size of each item of equipment.

4) Print-screen-making workshop

In this room, training in the flat-screen-making process will be conducted. The process of flat-screen-making is illustrated in Fig. 4-1 on the following page.

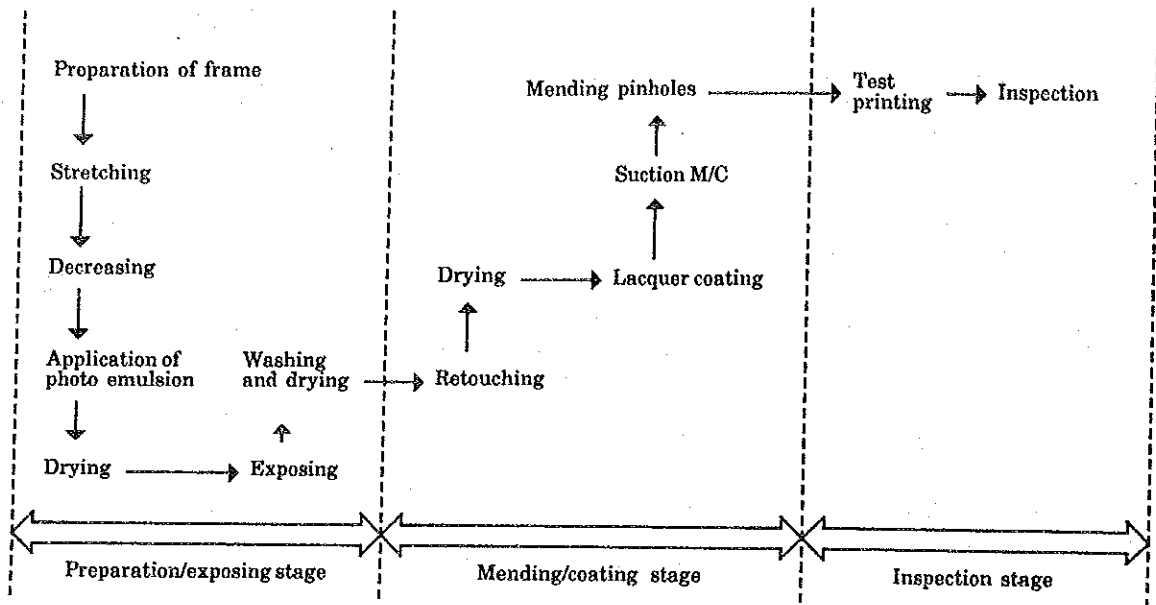


Fig. 4-1 Flat-screen-making Process

The facility composition shall be arranged to correspond to the above-mentioned production process, and the size of the rooms shall be determined on the basis of the number of the equipment as well as the size of each item.

5) Planned area of the facilities

Table 4-2 Planned area of the facilities

Name of rooms	Planned area (m ²)	Remarks
Administration building		
Director's office	38.8	To follow the size of present office (37.2m ²)
P.A. room	12.0	Waiting room for visitors
Reproduction room	19.4	Workshop for copy and personal computer Photo copier operator: 1, Computer operator: 2, Computer programmer: 1
Accounting office	41.0	Accounts officer: 1, Accounts asst.: 2, MLSS: 1
Cashier	6.5	Cashier: 1
Chief accountant office	12.0	An office for the dy. chief/asst. chief accountant
Engineer's office	22.7	Sub-asst. engineer: 1, foreman: 1, technician: 1
Administrative office	51.8	Admin asst./UDA: 3, typist: 4, receptionist: 1, MLSS: 2
Secretary's office	22.7	A office for the secretary
Admin. officer/security officer's office	25.9	Admin. officer: 1, security officer: 1
Library	97.2	Librarian: 1, library asst.: 1
Men's toilet	17.6	WC: 2, urinal bowl: 2, washing basin: 2
Women's toilet	15.1	WC: 2, washing basin: 2
Laboratory building		
Tracing workshop	58.5	A workshop for tracing work
Teachers' room	61.2	Teachers' room for the design department
Chief faculty member's office	12.8	
Print-screen-making workshop	263.4	Floor area to accommodate equipment layout
Store	16.5	For consumables and spare parts etc.
Physical evaluation lab.	38.2	w/constant temp. and constant humidity. Floor area to accommodate equipment layout.
Balance room	10.8	Exclusively for electronic balance
Testing lab 1	204.8	w/air-conditioning. Floor area to accord with equipment layout.
Testing lab 2	76.8	w/o air-conditioning. Floor area to accord with equipment layout.
Darkroom	43.9	According to the equipment layout
Photo processing lab	71.3	According to the equipment layout
Mechanical room	14.4	According to the equipment layout
Compressor room 1	7.5	According to the equipment layout
Compressor room 2	30.5	2 compressors to be installed
Electrical room	15.9	According to the equipment layout
Men's toilet	19.5	WC: 2, urinal bowls: 2, washing basin: 2
Women's toilet	18.3	WC: 2, washing basin: 2
Hostel building		
Bed room	501.6	12 units of 4 person room including bathroom
Canteen	144.0	Substituting the existing common room

4-2-3 Applicable Laws, Regulations and Standards

Since it is necessary to obtain a building permit for this project, the architectural plans shall be worked out in accordance with the Building Standard of Bangladesh. And from the standpoint of safety, due consideration should be given to the structural design standards of Japan as well.

Details of the basic design should be in compliance with the following laws, regulations and standards:

(1) Architectural plan:

Building Standard of Bangladesh

(2) Structural plan:

"Regulation to Enforce the Building Standard" (Japan), "Standard of Calculation for the Design of Reinforced Concrete Structures" (Japan)

(3) Electrical facilities plan:

International Electrotechnical Commission (IEC) standards,
British Standard (BS)

4-3 Basic Plan

4-3-1 Layout Plan

(1) Main approach

The premises of TIDC, which is the site for this project, is connected to Dhaka-Aricha highway by a 200m private road. TIDC used to share the use of the private road with the adjacent former BTMC mill. However, former BTMC mill is no longer under the control of BTMC, and ownership of the private road belongs to BTMC alone at present. Therefore, the main approach to the project is through the entrance of the private road facing Dhaka-Aricha highway.

(2) Facility function layout plan

The facility function layout plan in Fig. 4-2 on this page was worked out to ensure the integration of the functions of the existing and proposed facilities.

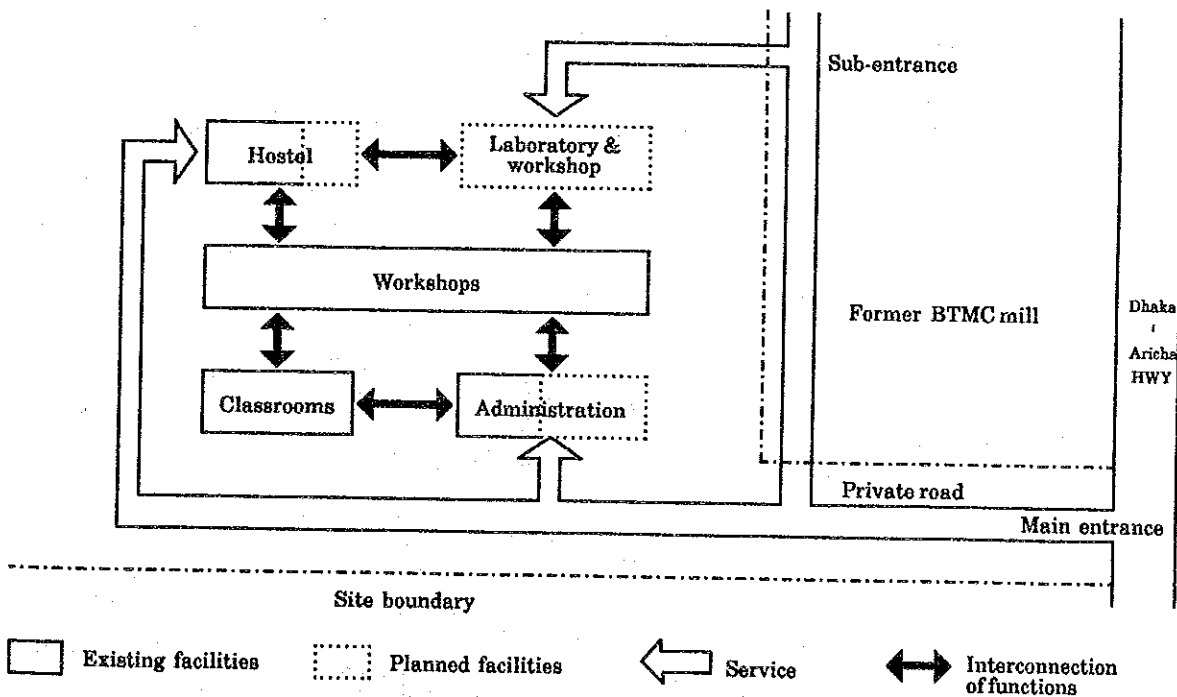


Fig. 4-2 Functional Layout Plan

4-3-2 Architectural Plan

(1) Floor plan

The floor plan, which includes the change of uses in the existing facilities, should be drawn up in accordance with the following:

- Clear zoning shall be set up in order to avoid confusion in the activities held at the lecture, training, testing, administration and hostel facilities.
- These facilities should be linked by connecting corridors for smooth interconnection of different functions.
- The Administration Department shall be located at the entrance to the site with easy access to other facilities.
- TIDC's existing facilities were planned as part of the BTMC compound. However, the adjacent BTMC mill is planned to be privatized, and in addition, NITTRAD is to operate as an autonomous institution. Therefore, independence of NITTRAD's premises shall be ensured.
- A service route for the transportation of materials, print screens and so on shall be secured.

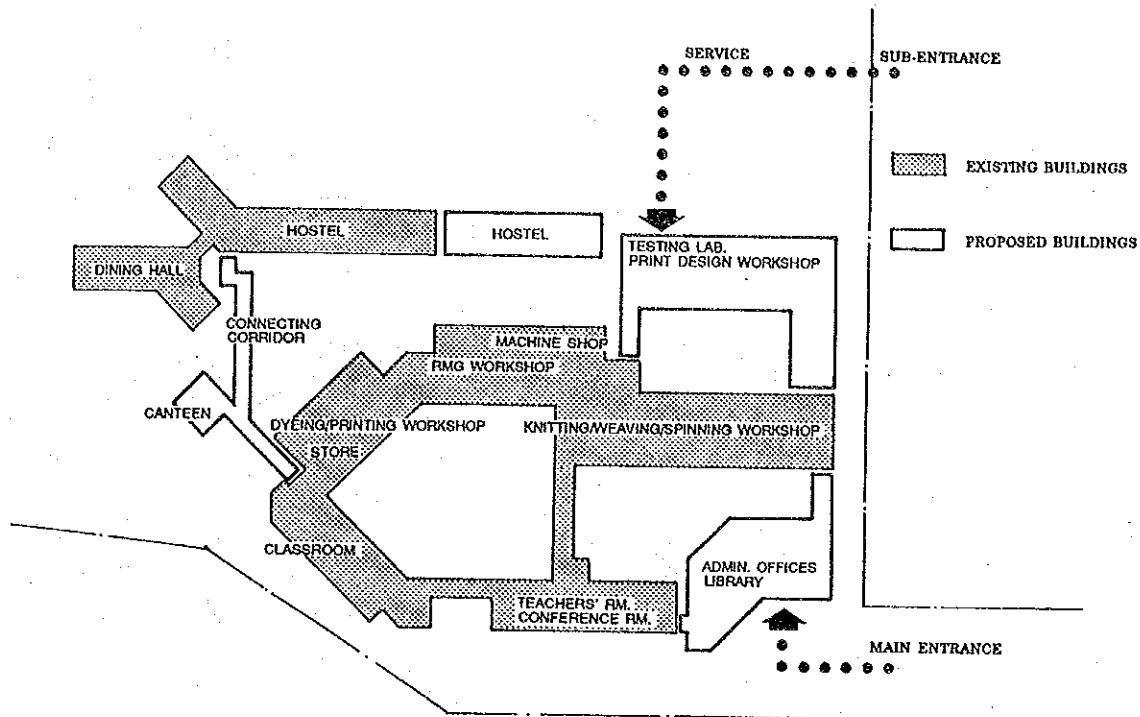


Fig. 4-3 Existing Facilities Utilization Plan/Building Layout Plan

(2) Section

A building section shall be worked out in accordance with the following criteria:

- The story heights of the proposed facilities shall be the same as those of the existing facilities so that there may be no unnecessary difference in floor levels.
- The ground floor level of the proposed facilities shall be the same as those of the existing facilities since the existing ground floor has been safe against floods.

- The window and parapet wall heights of the proposed facilities shall be the same as those of the existing facilities so that the exterior appearance of the entire facilities may harmonize.
- In consideration of the high temperature and high humidity in summer, rooms without air conditioning shall not be provided with hanging ceilings so that the air volume in each of them may be maximized. Rooms equipped with air conditioning, on the other hand, shall be provided with hanging ceilings to increase the air conditioning efficiency.
- The finishing specifications of the existing facilities shall be adopted to facilitate the existing maintenance and management techniques.

(3) Structural plan

1) Outline of the structure

The proposed facilities are an addition to the existing facilities, and therefore, in principle, the story heights, basic span and structure shall be the same as those of the existing buildings. An outline of the proposed buildings is given below:

Building uses: office, laboratory, workshop, hostel

Structure: reinforced concrete rigid frame structure

Stories/story heights:

Administration building: 2 storeys above ground with
11 feet (3.353m) for both storeys

Laboratory building: 2 storeys above ground with
12 feet and 6 inches (3.81m) for both
storeys

Hostel building: 3 stories above ground with
10 feet (3,048m) for all storeys

2) Foundation

A foundation system shall be determined according to the soil investigation which was conducted at the time of basic design study survey. According to the soil investigation report, the subsoil formation of the project site is regular throughout the site. A filling soil layer of very soft clay (N value under 2) exists down to roughly 3.0 to 3.5 meters from the existing ground level. Further below, an original layer of medium stiff clay with trace of fine sand (N value 8 to 15) exists down to 10.0 meters from the existing ground level.

Subsequent layers down to an investigation depth of 15.0 meters, a layer of medium dense fine sand (N value 15 to 30) exists.

Underground water level is roughly 1.0 to 1.3 meters below the existing ground level.

Considering these soil conditions and the size of the planned buildings, it is appropriate to adopt an isolated spread foundation system, using the second layer of medium stiff clay which exists 3.0 to 3.5 meters below the surface as the supporting layer. From the standpoint of economy and ease of construction work, the foundation base may be provided at a higher elevation by replacing the existing sub soil with compact coarse sand with a thickness of 1.5 to 2.0 meters.

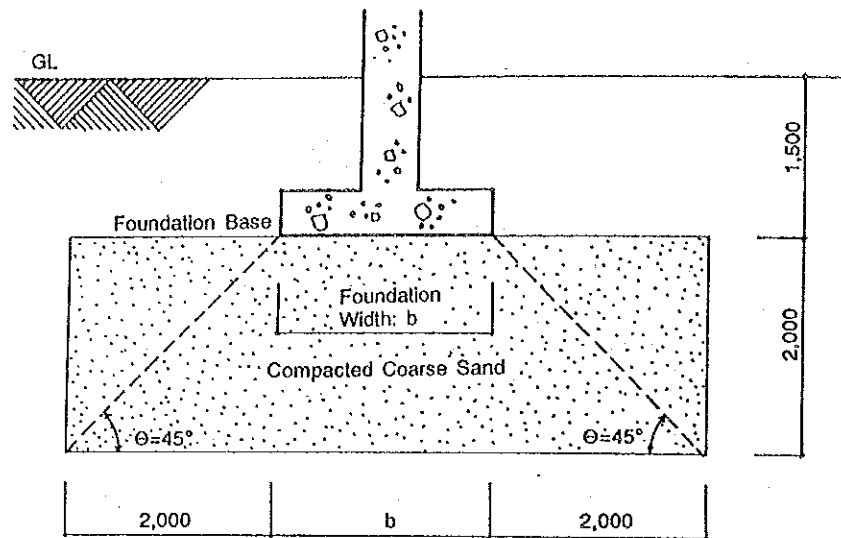


Fig. 4-4 Soil Improvement

3) Superstructure

The superstructure of the building should be a reinforced concrete rigid frame structure. This considers ease of execution, the actual situation of the local construction industry, the local natural features, and the economy. In principle, the walls should be made from bricks except for special construction in such areas as staircases. The ground floor slabs should be designed as a suspended slab and should avoid slab-on-grade systems from the stand point of moisture and crack prevention.

4) Load and external force

- Live load

Live load values should be determined with reference to the Building Standards Law Enforcement Ordinance of Japan. The live load values for the main rooms are shown in Table 4-3.

Table 4-3 Live Load for Major Rooms

(Unit: kg/cm²)

Rooms	Slab · Beam	Frame
Office	300	180
Laboratory	230	210
Testing lab.	400	300
Hostel	180	130
Machine room	500	300

• Seismic force

The Dhaka district, where the project site is located, is situated outside of the main earthquake zones, and there are no records of earthquakes that have adversely affected buildings in the past. Therefore, no seismic force shall be considered in structural planning.

5) Applicable standards

The building Standards Law of Japan, the Building Standards Enforcement Ordinance of Japan, and the Commentary on the Reinforced Concrete Structural Calculation Standards of the Architectural Institute of Japan shall be applied.

6) Main materials

Concrete : $F_c=180\text{kg/cm}^2$ (4-week compressive strength)

Reinforcing bars : less than 16mm-SD295, $F_t=3,000\text{kg/cm}^2$

less than 19mm-SD345, $F_t=3,500\text{kg/cm}^2$

(4) Electrical facilities plan

1) Substation

A service line can be received from REB's overhead 11kV power line installed along the road running in front of the project site.

A transformer will be installed on a utility pole near the border line of the project site to step down to low-tension power. The low-tension power will be led to the electric room. Source power of 11kV supplied by the REB fluctuates widely, an induction type voltage regulator (IVR) will be installed in the electric room to ensure stabilized voltage. After stabilization, electric power will be supplied to each facility through a distribution board.

- Voltage and class of power received:

3-phase, 4-wire 400/230V 50Hz

- Voltage and class of power distributed:

3-phase, 4-wire 400/230V 50Hz

- Transformer capacity:

150kVA (supplied by REB)

The government of Bangladesh is responsible for the installation of the overhead 11kV power cable (including the transformer) and the wattmeter (including installation). Shown in Fig. 4-5 is the conceptual schema of classification of responsibilities regarding the electric work.

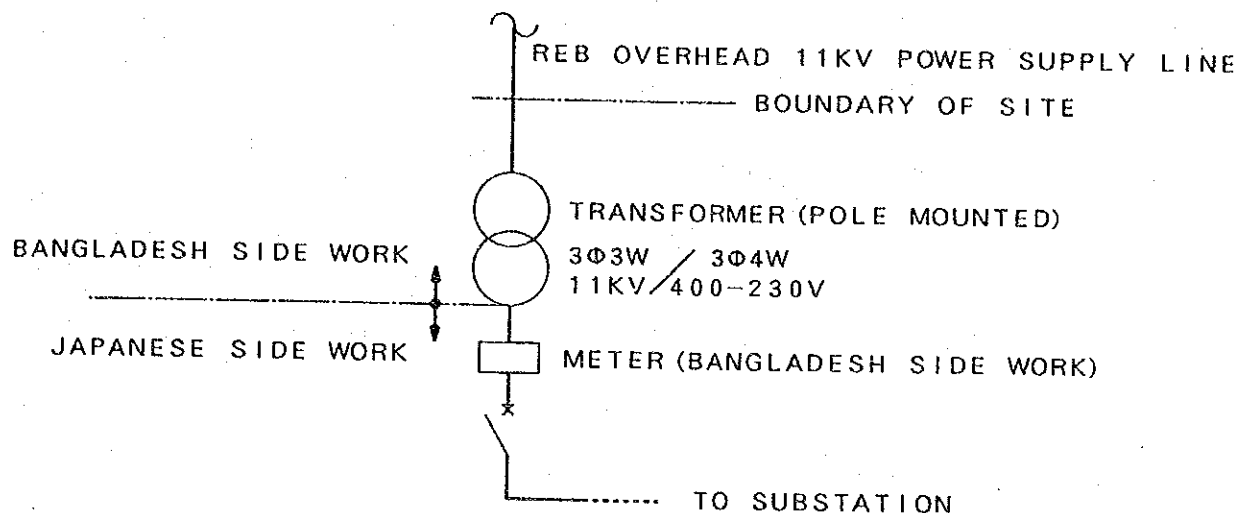


Fig. 4-5 Conceptual Schema of Classification of Responsibilities Regarding the Electric Work

2) Power distribution system

Electric power will be supplied to the distribution board and the power control board, installed in each facility from the low-tension switchboard installed in the electric room. A distribution board will be newly installed in existing buildings where an additional power supply is required. No existing distribution board should be used in such a place.

3) Power system

Supply and control of electric power to devices such as air conditioners, water supply and sanitary equipment and the like.

4) Lighting system

a. Lighting fixture

Fluorescent lamps will be the main light sources. Surface mounted lamps, hanging lamps or built-in lamps will be installed according to the room's lighting requirements. The target illumination level will be about 200lux for the print screen production room and 200 to 250lux for the other rooms so that there may be no wide difference in illumination level between rooms within the existing building.

b. Socket outlets

The required number of socket outlets for supplying electric power to small electric appliance will be installed in each location.

5) Telephone system

The two-circuit telephone trunk lines (central office line) are led-in to the project site from the road running in front of the site, and are connected to each telephone. Under this project, an MDF and a switchboard (10 circuits for the trunk line and about 50 circuits for the extension) will be installed at the reception counter on the ground floor of the administration building. A telephone will be installed in the administration office room, the director's room, the accounting room, the instructor's rooms and the testing rooms. The work to install the trunk line up to the MDF (including the supply and installation of materials) is included in the scope of Bangladesh side.

(5) Air-conditioning/ventilation Plan

A separate system of air cooled type air conditioners will be adopted considering easy operation and maintenance. An air conditioner will be installed in places as shown in Table 4-4 on the following page.

1) Design temperature/humidity

a. Design outside air temperature and humidity

Dry bulb temperature 35.1°CDB

Relative humidity RH70%

(Source: Bangladesh Meteorological Dept.)

b. Design indoor temperature and humidity

- Precision testing room

Dry bulb temperature 20±2°CDB

Relative humidity RH65±5%

- Other rooms to be equipped with air conditioner

Dry bulb temperature 26°CDB

Relative humidity Not specified

2) Air conditioning system

As the above design temperature and humidity conditions show, the precision testing room requires special temperature and humidity conditions. For this reason, an air cooled package type air conditioner (single duct system) will be installed in this room together with an electric heater and a humidifier. An air cooled separate type air conditioner will be installed in the other rooms.

Table 4-4 Air-conditioning Plan

Air conditioner	Rooms to be equipped with air conditioner
Air cooled package type air conditioner (single duct system)	<ul style="list-style-type: none"> ● Precision testing room
Air cooled separate type air conditioner	<ul style="list-style-type: none"> ● Director's room ● Printing room ● Library ● Testing room No.1 ● Balance room ● Darkroom ● Photo processing lab

3) Ventilating system

In principle, a natural ventilation system will be adopted. A mechanical ventilation system will be installed in rooms and toilets where unfavorable odors and heat are generated. A ceiling fan will be installed in each room.

(6) Water supply and sanitary plan

1) Water supply system

An underwater pump will be installed in the deep tube well (depth: about 40 meters) constructed on the western end of the project site by the government of Bangladesh, to pump up water from the well and store it in a water tank. The water stored in the tank will be pumped up and stored in an elevated water tank, and then will be supplied to each facility from the elevated water tank through the existing main water supply pipes.

2) Drainage system

A waste water treatment facility to treat waste water from the new buildings will be installed within the project site. As there is no public sewer pipe laid around the project site, part of the waste

water (mainly sewage), will be treated in septic tanks and then will be discharged into the ground. Other waste water will be discharged directly into the surrounding channel. Waste water from the laboratories, potentially a cause of pollution, will be stored in tanks and later treated at outside waste water treatment facilities. Waste unlikely to cause pollution, will be discharged directly to the surrounding channel like other waste water.

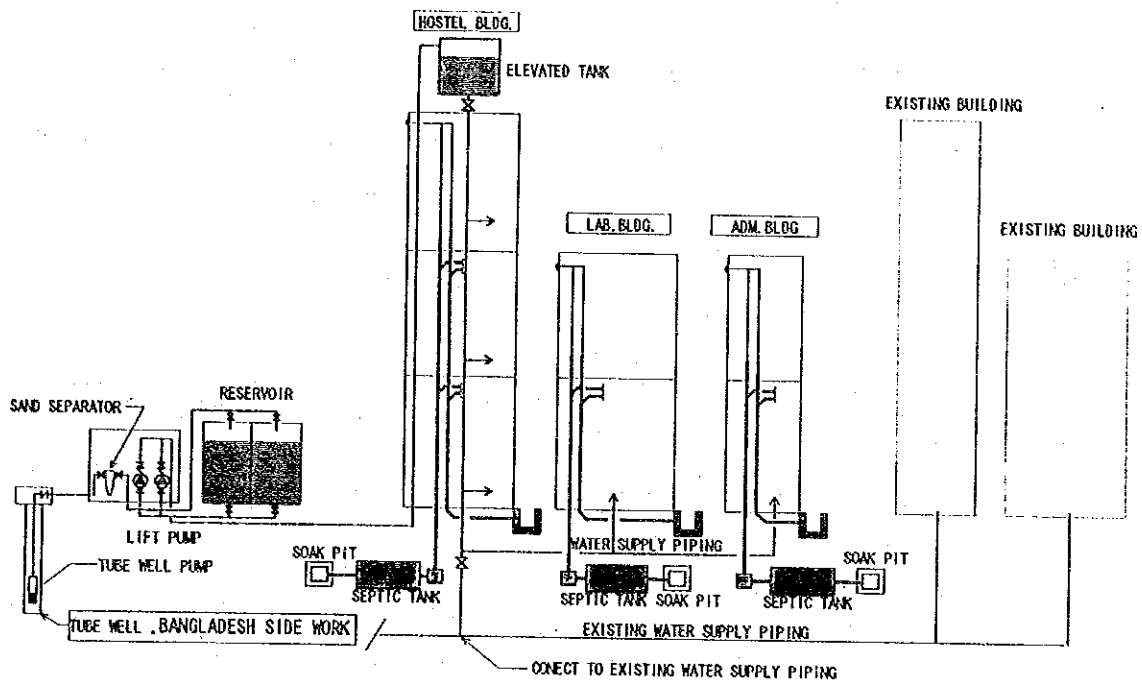


Fig. 4-6 Schematic Piping Diagram

3) Sanitary system

Sanitary equipment suited for the local customs will be installed.

4) City gas system

City gas will be supplied through pipes diverging from the existing city gas pipe.

(7) Construction material plan

Construction materials selected for the project shall have the necessary properties for required functions and match the local climate and construction practices. Thus, enhanced durability, easy maintenance and economic aspects of the facilities will be assured.

• Major structural materials

Table 4-5 Building Materials (1)

Portion	Materials	Remarks
Column, girder, floor, foundation	Reinforced concrete	Commonly used local material with satisfactory results. In-site mixing requires careful supervision.
Wall	Brick	Commonly used locally.

• Exterior finishing materials

Table 4-6 Building Materials (2)

Portion	Materials	Remarks
Roof	Limeterrasing	Commonly used locally.
Wall	Fair face brick	Ditto
Windows	Aluminium window frame	Since steel window frames rust, aluminium frames will be employed.

• Interior finishing materials

Table 4-7 Building Materials (3)

Rooms	Floor	Wall	Ceiling	Remarks
Office, canteen, hostel, workshop etc.	Terrazzo tile	Paint on cement mortar	Paint on cement mortar	Finishing matches existing buildings
Physical evaluation lab.	Terrazzo tile	Paint on calcium silicate board with insulation	Paint on calcium silicate board with insulation	For lower running cost, insulation property shall be enhanced.
Elec. room, mech. room	Cement mortar	Glasswool	Glasswool	Sound proof property shall be ensured.

4-3-3 Equipment Plan

Planned items of equipment are listed in Table 4-8 and can be classified into the following categories :

1. Spinning equipment
2. Weaving equipment
3. Dyeing & finishing equipment
4. Knitting equipment
5. Sewing equipment
6. Testing equipment
7. Design equipment
8. Workshop tools & equipment
9. Supporting equipment
10. Others

Due consideration was given to the following points in selecting equipment and examining the quantity of each item:

- ① To select items of equipment which are conducive to the smooth implementation of operations at NITTRAD on the basis of the details of training and other operations carried out.
- ② To make the most of the existing items of equipment so that they will be efficiently utilized together with those procured under this project.
- ③ To place special emphasis on the selection of those items of equipment which are easy to operate and maintain, in order to reduce the maintenance and management costs.
- ④ To give due consideration to the availability of maintenance parts and expendable supplies.

In light of the results of the investigation of similar facilities, it was concluded that the operation level of the equipment should not be overly sophisticated, yet sufficiently advanced so that it can be used over a long period of time, and in a manner that contributes to the attainment of the objective of the project.

Table 4-8 gives an outline of the main uses of the major items of equipment to be procured under this project and the purposes of these items of equipment:

Table 4-8 Main Uses of Main Items of Equipment

Item of equipment	Main use	Details of training and other operations related to its use
1. Spinning equipment		
Card	Used to remove many fibre tangles, impurities unripe fibres, short fibres, lumps of fibres to make slivers of even thickness.	Theory of card and simplex machines
Simplex	Used to make slivers thinner, to make fibres more parallel to each other, to give fibres a twist to facilitate the spinning machine's yarn making, and to have yarn wound on the bobbin.	Training in production process Standardization Maintenance
Ring frame	Used to extend coarse yarn to make it thinner, to make single yarn and to have yarn wound on the bobbin.	Theory of spinning machines Training in production process Standardization Maintenance
Cone winder with auto splicer	Used to detect defective yarn in the spinning process, to remove such yarn, to automatically connect pieces of yarn and to have yarn wound on the cone.	
2. Weaving equipment		
Rapier loom	Shuttle-less weaving machine with rapier of based or bar shaped for picking.	Weaving, standardization, maintenance, trouble shooting
Air jet loom	This is one of shuttle-less looms to make the picking movement by means of spouting of air, and is used to make cloth with rather small patterns.	
3. Dyeing/finishing equipment		
Sample jet dyeing machine	Used for dye testing of blended-spun cloth (mainly polyester fibres and raw cotton) under a tensionless condition.	Dyeing and finishing Kinds of dyestuff Processing and processing machine
Stenter machine	Used to dry and heat-treat fabric products after they are dyed and a finishing agent is applied to them.	
Steamer	Used to conduct the fixed dye testing of dyed products.	
4. Knitting equipment		
Single plain jersey knitting machine	This is a basic circular knitting machine provided with a pair of needles. It has many uses.	General knitting Characteristics of knitting machines Operation of knitting machines Maintenance
Double knit double plain jersey knitting machine	This is a basic double-surface circular knitting machine provided with two pairs of needles.	
Flat knitting machine (rib)	This is a horizontal knitting machine used to make rib stitch cloth as material of lapels and cuffs. It is commonly used.	

Item of equipment	Main use	Details of training and other operations related to its use
5. Sewing machines equipment		
Various types of sewing machine	Used in training to make shirts, polo shirts and T-shirts.	Necessary types of sewing machines for different RMG products. Practical use of sewing machines Maintenance
Circular knife	Used to cut cloth along the marking after laying cloth.	
Steam iron	Used for press finishing of apparel products.	
6. Testing equipment		
Double sorter	used to measure the length of single fibres such as raw cotton.	Testing of fibre, yarn and fabric/garments. Training in testing and quality control Maintenance of testing equipment
Stelometer w/torsion balance, electronic tensile tester	Used to measure the tensile strength of fibre, yarn and fabrics.	
Testing device for honey dew content in cotton	Used to measure the quantity of honey dew contained in raw cotton	
Precision polarizing microscope w/photo device	Used to identify fibres and observe weaving conditions.	
Trash analyzer for raw cotton	Used to analyze impurities contained in raw cotton.	
Electronic balance	Used to measure the fineness (fibre thickness) of single fibres and for precision weighing. It is capable of micro weighing with a reading limit of 0.001mg.	
Fineness meter for wool	Used to measure the fineness (fibre thickness) of single fibres.	
Pilling tester	Used to measure the degree of pilling of fabrics and knit products which is caused by friction or external force.	
Fabric abrasion tester	Used to measure the frictional resistance (the degree of surface abrasion, refraction abrasion and crease abrasion) of fabrics.	
Fabric stiffness tester	Used to measure the stiffness vis-a-vis bending of fabrics with band-shaped test specimens.	
Fabric drapometer	Used to measure the three-dimensional stiffness of fabrics by hanging circular test specimens vertically.	
Elomendorf's tearing tester	Used to measure the tearing strength of fabrics.	
Fabric bursting strength tester	Used to measure the bursting strength of fabrics.	
Yarn hairiness tester	Used to measure the degree of nep (fibres sticking out of yarn).	
Launder meter	Used to measure dyed fabrics' resistance to washing and organic solvents.	
Spray rating tester	Used to test repellency of fabrics.	
Perspirometer	Used to measure dyed textile products' resistance to sweat.	
Air permeability tester	Used to measure air permeability of fabrics	
Uster tester	Used to automatically classify and record yarn's defects (uneven thickness, knots and so on). Used also to evaluate the quality of yarn.	
Yarn package hardness tester	Used to measure the hardness of yarn in the form of a cheese or a cone.	
Fabric crease recovery tester	Used to evaluate fabric's creaseproofness.	
AATCC wrinkle tester	Used to evaluate the situation where wrinkles develop in various directions on in fabrics.	
Rubbing tester	Used to measure dyed fabric's resistance to friction.	
Gray scale for colour change & table etc.	Used as a criterion of comparison of the degree of dyed products fading and white cloth's standing.	

Items of equipment	Main use	Details of training and other operation related to its use	
Snag tester	Used for testing of knitted articles' surface change in relation to knitting condition and surface treatment conditions.		
Flammability tester	Used for testing of textile flammability in relation to surface treatment and flaming condition.		
Knit shrinkage tester	Used for testing of textile shrinkage in relation to washing.		
AATCC durable press replica	Used for evaluation of textile wrinkle in relation to surface treatment.		
AATCC apparatus for tested sample evaluation	Used for evaluation of textile articles in comparison with replicas.		
Tumble dryer (wascator type)	Used for drying cloth after washing and wringing.		
UV spectrophotometer Water bath Glassware for formaldehyde analysis	Used for testing of formaldehyde content of textile product.		
AATCC packing replica	Used for evaluation of sewn condition of textile product after washing.		
Microscopes	Used in training of discriminating fibres.		
Shaker	Used for testing of blending ratio as well as formaldehyde content.		
Aspirator	Used in separation of solid and liquid by means of vacuum filter.		
Overhead projector, slide projector	Used as supporting teaching materials.		General training
Audio-visual equipment (video camera, VTR monitor)	Used to develop audio-visual teaching materials in the course of training in operation and maintenance of equipment. Used also with video software.		
7. Design equipment			
Set square, rotor pen set, tracing table etc.	Used in manual tracing in the process of flat screen production.	Training in basic print design and print screen making. Maintenance training	
Day light film developing machine, negative positive copying machine, contact camera set, step and repeat machine etc.	Used in camera work tracing in the process of flat screen production.		
Screen drying chamber, vacuum contact exposing machine for flat screen etc.	Used in flat screen making.		
8. Workshop tools & equipment			
Gas welding machine, metal hardness measuring instrument, leveling plate, flow meters etc.	Used to repair and maintain equipment. Used also in training.	Maintenance and repair of equipment Training in maintenance	
Clip-on-meter, phase sequence indicator, oscilloscope etc.	Used to repair and maintain electric circuits and power supply parts of equipment. Used also in training.		
9. Supporting equipment			
chairs, table, white board, laboratory table, file cabinet etc.	Used as fixtures for training rooms, library, conference room, multipurpose room		
10. Others			
Photocopy machine, stencil cutting machine, electric typewriter etc.	Used to produce teaching materials and other printed matter.		
Personal computer	Used to analyze the accounting and administration department's operations and test data processing		

Table 4-9 lists the main equipment for the project.

Table 4-9 List of equipment

No.	Name of Equipment	Q'ty	Unit
	1. Spinning equipment		
SP-1	Card (semi high speed)	1	unit
SP-2	Simplex (approx. 40 spindles)	1	unit
SP-3	Ring frame (approx. 96 spindles)	1	unit
SP-4	Cone winder with auto splicer	1	unit
SP-5	Auxiliary equipment (with air compressor)	1	set
	1) Rubber roller grinding machine	1	unit
	2) Roller deflection tester	1	unit
	3) Rubber roller chemical treatment machine	1	unit
	4) Air compressor	1	unit
SP-6	Spare parts for the existing draw frame	1	lot
	2. Weaving equipment		
WV-1	Rapier loom	1	unit
WV-2	Air jet loom (with air compressor)	1	unit
WV-3	Mechanical dobby (16 shafts) for rapier loom	1	unit
	3. Dyeing & finishing equipment (lab. model)		
DF-1	Sample jet dyeing machine	1	unit
DF-2	Stenter machine	1	unit
DF-3	Padding mangle	1	unit
DF-4	Steamer	1	unit
DF-5	Calender	1	unit
DF-6	Electronic balance (0-200g×1, 0-2,000g×1)	1	set
DF-7	Air compressor	1	set
	4. Knitting equipment		
KT-1	Single plain jersey knitting machine	1	unit
KT-2	Single knit double fleece knitting machine	1	unit
KT-3	Double knit double plain jersey knitting machine	1	unit
KT-4	Double knit rib machine	1	unit
KT-5	Flat knitting machine (rib)	1	unit

No.	Name of Equipment	Qty	Unit
KT-6	Flat knitting machine (jacquard)	1	unit
KT-7	Linking machine	1	unit
KT-8	Air compressor	1	unit
	5. Sewing equipment		
SD-1	Lock stitch, single needle	5	unit
SD-2	Overlock, twin needle 4 thread	1	unit
SD-3	Interlock, twin needle 5 thread	1	unit
SD-4	Lock stitch, single needle with automatic thread trimmer, wiper & reverse feed	1	unit
SD-5	Lock stitch, single needle with variable top feed, with automatic thread trimmer, wiper & reverse feed	1	unit
SD-6	Lock stitch, single needle with vertical trimmer wiper & reverse feed	1	unit
SD-7	Bar-tacking machine	1	unit
SD-8	Button hole machine for woven fabric	1	unit
SD-9	Button hole machine for knitted fabric	1	unit
SD-10	Button sewing machine	1	unit
SD-11	Feed-off-the-arm, double chain stitch machine, 3-needle	1	unit
SD-12	Lock stitch, 2-needle w/org. split needle-bar	1	unit
SD-13	Double chain stitch, single needle	1	unit
SD-14	Double chain stitch, 4-needle elastic attacher	1	unit
SD-15	Double chain stitch, 4-needle shirt fronting m/c	1	unit
SD-16	Pocket welting plate	1	unit
SD-17	Lock stitch, twin needle feed	1	unit
SD-18	Bottom covering stitch belt loop making machine	1	unit
SD-19	Over lock machine, single needle 3 thread	1	unit
SD-20	Over lock machine with back-tacking	1	unit
SD-21	Top & bottom cover stitch flat bed machine	1	unit
SD-22	Lapseaming machine (back tap attaching)	1	unit
SD-23	Elastic seams machine, 6 thread	1	unit
SD-24	3-Needle covering machine	1	unit
SD-25	Pocket seam facing machine, 2-needle	1	unit
SD-26	Bias tape cutting machine	1	unit
SD-27	Tables (cloth laying)	1	unit

No.	Name of Equipment	Q'ty	Unit
SD-28	Circular knife (4' & 6" circular blade/set)	1	set
SD-29	Scissors (various types)	1	set
SD-30	General purpose finishing board (2 types/set)	1	set
SD-31	Steam iron	2	unit
SD-32	Vacuum cleaner	1	unit
SD-33	Zigzag sewing machine, 1-needle	1	unit
SD-34	Steel cabinet for materials	2	unit
SD-35	Pattern making equipment	1	set
	6. Testing equipment		
TS-1	Double sorter	1	unit
TS-2	Stelometer with torsion balance	1	unit
TS-3	Testing device for honey dew content in cotton	1	unit
TS-4	Precision polarising microscope w/photo device	1	unit
TS-5	Microscope (×300)	5	unit
TS-6	Trash analyzer for raw cotton	1	unit
TS-7	Fineness meter for wool	1	unit
TS-8	Yarn tension meter	1	unit
TS-9	Uster tester	1	unit
TS-10	Yarn package hardness tester	1	unit
TS-11	Uster classimat (with air compressor)	1	unit
TS-12	Electronic tensile tester	1	unit
TS-13	Pilling tester	1	unit
TS-14	Fabric abrasion tester	1	unit
TS-15	Fabric stiffness tester	1	unit
TS-16	Digital pH meter	1	unit
TS-17	Fabric drapemeter	1	unit
TS-18	Coarse length tester	1	unit
TS-19	Elemendorf's tearing tester	1	unit
TS-20	Fabric bursting strength tester	1	unit
TS-21	Yarn hairiness tester	1	unit
TS-22	Fabric washing machine	1	unit
TS-23	Launder meter	1	unit
TS-24	Gray scale for colour change & staining	1	unit

No.	Name of Equipment	Q'ty	Unit
TS-25	Water repellency tester	1	unit
TS-26	Spray rating tester	1	unit
TS-27	Perspirometer	1	unit
TS-28	Air permeability tester	1	unit
TS-29	Fabric crease recovery tester	1	unit
TS-30	AATCC wrinkle tester	1	unit
TS-31	Rubbing tester (crock meter)	1	unit
TS-32	Snag tester	1	unit
TS-33	Flammability tester	1	set
TS-34	Knit shrinkage tester	1	unit
TS-35	AATCC durable press replica	1	unit
TS-36	AATCC apparatus for tested sample evaluation	1	unit
TS-37	Tumble dryer (wascator type)	1	unit
TS-38	UV spectrophotometer	1	unit
TS-39	Water bath	1	unit
TS-40	Glassware for formaldehyde analysis	1	set
TS-41	Shaker	1	unit
TS-42	Aspirator	1	unit
TS-43	AATCC puckering replica	1	unit
TS-44	Glassware	1	set
TS-45	Electronic balance (0.001mg)	1	unit
TS-46	Digital tachometer	1	unit
TS-47	Overhead projector with screen	2	unit
TS-48	Slide projector with screen	1	unit
TS-49	Audio-visual equipment (video camera, VTR, monitor)	1	set
TS-50	Combined lab oven	1	unit
TS-51	Thermograph	2	unit
TS-52	Chemicals and regents	1	set
	7. Design equipment		
PD-1	Set square (small, medium, large/set)	6	set
PD-2	T scale board (adjustable)	4	pc
PD-3	Rotor pen set (0.1-0.8mm)	6	set
PD-4	Tracing table (with light box)	2	set

No.	Name of Equipment	Q'ty	Unit
PD-5	Drawing paper cabinet	1	unit
PD-6	Day light film development machine	1	unit
PD-7	Vacuum exposing m/c with processor	1	unit
PD-8	Negative positive copying machine (vacuum contact printer for camera work copying film)	1	unit
PD-9	Auto developer and dryer	1	set
PD-10	Compact camera set	1	unit
PD-11	Tracing & masking table	1	unit
PD-12	Graphic design table and chair	1	set
PD-13	Step and repeat machine (horizontal type)	1	unit
PD-14	Film cutting (trimmer)	1	pc
PD-15	Camera (35mm) with zoom lens	1	unit
PD-16	Developing and fixing chemicals	1	set
PD-17	Tools & materials for tracing film making	1	set
PD-18	Accessories & materials for darkroom works	1	set
PD-19	Drawing set	2	set
PD-20	Weighing scale (0-1.0 kg, by 5g graduation)	1	unit
PD-21	Colour mixing stirrer	1	unit
PD-22	Stretching machine with adhesive chemicals	1	unit
PD-23	Screen drying chamber	1	unit
PD-24	Suction machine	1	unit
PD-25	Metal frame	50	pcs
PD-26	Printing table	1	unit
PD-27	Vacuum contact exposing machine for flat screen stencil	1	unit
PD-28	Tension meter for checking the tension of cloth	1	unit
PD-29	Polyester screen cloth (fine, medium, coarse-3 types)	4	roll
PD-30	Photo emulsion for flat screen (in small can/kg)	50	kg
PD-31	Coating bucket for photo emulsion	5	pc
PD-32	Rubber squeegee for test printing	5	pc
PD-33	Test printing paper with testing colour paste	1	set
PD-34	Polyurethane black lacquer (type A & B)	5	pc
PD-35	Spray gun (retouching gun) with compressor	2	unit
PD-36	Refrigerator for chemicals (300ℓ)	1	unit
PD-37	Digital balance (0.1-200g)	1	unit

No.	Name of Equipment	Q'ty	Unit
	8. Workshop tools & equipment		
	(I) Mechanical workshop		
WS-1	Gas welding machine (excl. gas cylinder)	1	unit
WS-2	Tool bit sets for lathe machine	1	set
WS-3	Tool bit sets for drilling machine	1	set
WS-4	Milling cutter sets	1	set
WS-5	Compressor (0.3-0.4 m ³ , 2 H.P., 2,900r.p.m)	1	unit
WS-6	Shaper machine (smaller size, working L. 1/3m)	1	unit
WS-7	Metal hardness measuring instrument	1	unit
WS-8	Leveling plate	4	pc
WS-9	Dial indicator for measuring eccentricity	1	unit
WS-10	Flow meters (liquid & steam)	1	set
WS-11	Hygrometer for measuring density of fluid	1	unit
WS-12	Regulator transformer (variable)	1	unit
WS-13	Rheostat (variable resistor)	1	unit
WS-14	Paint spray gun set	1	unit
WS-15	Bearing puller set	1	set
WS-16	Vacuum Cleaner (0.5 H.P.)	1	unit
WS-17	Power hand blower (3,000 r.p.m.)	1	unit
WS-18	Diamond pointed glass cutter (pen type)	4	pc
WS-19	Pipe bender set (for steel pipe, max. 50mm)	1	unit
WS-20	Power hand grinder with spare blade	1	unit
WS-21	Power circular table saw for wood cutting	1	unit
WS-22	Electric hand drilling machine	1	unit
WS-23	Power handy saw for wood cutting (small)	1	unit
	(II) Electrical & electronic workshop		
WS-24	Clip-on-meter (for amperage)	1	unit
WS-25	Induction current testing set	1	unit
WS-26	Phase sequence indicator (for demonstration)	1	unit
WS-27	Meters (kW, KWH, kVA, kVAR, volt, Amp., etc.)	1	set
WS-28	Potential transformer (2 kVA)	1	unit
WS-29	Current transformer (variable)	1	unit

No.	Name of Equipment	Q'ty	Unit
WS-30	Multimeter (digital)	2	unit
WS-31	Wheatstone bridge	1	unit
WS-32	Capacitor tester	1	unit
WS-33	Tool sets for electronic works	1	set
WS-34	Static voltmeter (0-28 kV)	1	unit
WS-35	Oscilloscope	1	unit
WS-36	Drawing table with accessories	1	unit
WS-37	Drawing sets (for tracing paper)	1	set
	9. Supporting equipment		
	(Classroom)		
FO-1	Chair for trainees	100	pc
FO-2	Table & chair for trainer	6	set
FO-3	White board with marker & eraser	6	unit
	(Library)		
FO-4	Table	2	unit
FO-5	Chair	12	pc
FO-6	Open shelf	6	unit
	(Testing Laboratory)		
FO-7	Steel cabinet for storing spares	4	unit
FO-8	Wooden cabinet (glass sliding door) for chemicals	6	unit
FO-9	Steel file cabinet	4	unit
FO-10	Wooden round stool	36	pc
FO-11	Laboratory table with basin & gas outlet	1	unit
FO-12	Refrigerator for chemicals (300ℓ)	1	unit
	(Administration)		
FO-13	File cabinet	12	unit
FO-14	Bookshelf	2	unit
FO-15	Steel cabinet	4	unit
	(Canteen)		
FO-16	Chair	30	pc
FO-17	Table	5	unit

No.	Name of Equipment	Q'ty	Unit
	(Dining Hall)		
FO-18	Chair	40	pc
FO-19	Table	4	unit
	(Conference Room)		
FO-20	Chair	70	pc
	10. Others		
OT-1	Photocopy machine	1	unit
OT-2	Duplicating machine	1	unit
OT-3	Stencil cutting machine	1	unit
OT-4	Typewriter (electric)	1	unit
OT-5	Typewriter (manual)	3	unit
OT-6	Personal computer	3	unit
OT-7	Uninterrupt power supply	3	set
OT-8	White board with casters	2	unit
OT-9	Vehicle (station wagon type)	1	unit
OT-10	Microbus	1	unit