



## establishment of dairy training centres

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#### **guidelines to dairy development**

**meat and milk development service  
animal production and health division**

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## **I. INTRODUCTION**

**Dairying is a complex industry and requires specialized personnel in milk production, collection, processing, maintenance and marketing. In many respects the professional qualifications of this personnel differ from those of general animal production specialists, general food technologists and engineers. Considering the perishable character of milk and milk products, even transport and marketing methods have their particular requirements, differing from those in other branches of the food industry. It is therefore essential that in countries where the dairy industry is to be developed manpower requirements are assessed at the early stages of development planning and steps taken to establish appropriate training facilities.**

**Education and training in various aspects of the dairy industry can be provided through the existing educational institutions, beginning with farmers' training centres and up to university level, depending on the type of students trained and type of skills. In some countries dairy education enjoys formal status and only persons with an appropriate educational certificate can be employed in milk plants or dairy extension services. In others no legal restrictions are put to people employed in the dairy industry, but even**

**there a successful dairy industry cannot exist without trained personnel. In many developing countries scarcity of qualified teachers makes it very difficult to include dairy training in a large number of existing educational institutions (agricultural schools, food technicians education centres, agriculture and food science faculties). Effective education requires facilities for practical training and demonstrations. Such facilities are expensive and also therefore it might be of advantage to the country concerned to establish a dairy training centre at one place, where all resources available could be concentrated and personnel trained at required levels.**

**Planning and constructing a dairy training centre with different levels of through-put require the cooperation of dairy specialists, teachers, administrators, architects and building supervisors, but guidelines for such cooperation are often not available. It is to remedy this situation that the present document has been prepared. It aims at providing a concise account of the concept of dairy training and a dairy training centre. The document could serve as a useful guide and checklist for planning expenditures required for establishing a dairy training centre which may be of particular importance in the event that financial assistance is provided from outside sources or that the centre is built on contract.**

**Two versions are given in the text. The first is intended for a first level training centre with courses lasting up to six months and the second caters for courses from six months to three years - in fact up to diploma level training. Both layouts include optional buildings to allow for training in both milk production and milk processing. Most of the buildings cater for multiples of 20 students, selected as the most economic**

**student module. For training purposes it has been assumed that time will be equally divided between practical and theoretical training.**

**The plans, layouts and specifications given in this publication are based on conditions prevailing in Africa but, subject to any changes deemed necessary after thorough review by those concerned, they could have a more universal application. The construction plans may also be used to add buildings to existing training institutions to establish facilities for dairy training.**

**The preparation of this document was initiated by Mr. A. Sørensen, the then Director of the FAO Regional Dairy Development and Training Centre for English-speaking countries in Africa, who also prepared with the assistance of a consultant architect the bulk of this publication. Some sections were prepared by the Officers of the AGA Division of FAO Rome, who also did the editorial part of the preparation of this document.**



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## **II. THE FAO DAIRY TRAINING PROGRAMME**

**Past**

Until 1960, FAO dairy training in developing countries was carried out mainly through the regular Fellowship Programme. In 1960, with support from the Danish International Development Agency (DANIDA) training was expanded.

Between 1960 and 1965 dairy training courses were held in India for participants from Asian countries. A Training Centre for the Latin America Region was established in 1963, for the Near East Region in 1965, for English-speaking Countries in Africa in 1966 and for the Asia and the Pacific Region in 1972. The Programme is biased toward practical training in dairy technology and milk production. Courses are run at the country level and at the regional level (groups of countries within a region). In addition, interregional courses have been arranged, mainly in Denmark, for participants from the four regions where Training Centres have been established. However, more recently courses for training at managerial level have been introduced at the regional and national levels. Thus, the Programme has developed a number of courses and seminars suiting the content, level of training and geographical pattern to a variety of conditions, educational background and professional experience.

Groups catered for in the training programme include:

- i. Milk producers and advisers to milk producers
- ii. Milk plant staff, advisers to milk plants and milk product distributors
- iii. Quality control and laboratory staff
- iv. Teachers in dairy husbandry and dairy technology



**v. Agricultural administrators and planners**

The main thrust of the training activities is directed at intermediate level personnel with the broad aim of assisting developing countries to:

- i. improve milk quality, and increase the efficiency of milk production, collection and the supply of locally produced milk;
- ii. improve the quality of locally manufactured milk products and increase the efficiency of milk processing and milk products distribution.

**Pattern of Dairy Training**

To advise on improving and coordinating training and education in dairy science and technology throughout the world was a principal duty of the FAO Expert Panel in Dairy Education. Between 1965 and 1970 the Panel prepared studies which set out a desirable pattern of dairy education and training at different levels in countries at different stages of development, namely:

- A. Basic studies
- B. Agricultural science, animal husbandry and milk production
- C. Milk collection and handling
- D. Milk processing and products manufacture
- E. Product development and distribution

## **Future**

**At the 3rd FAO/DANIDA ad hoc Meeting on Dairy Training held in Rome in January 1974, it was agreed that the future policy should be to secure the acceptance of the philosophy that viable training programmes at vocational, intermediate and university levels in dairy husbandry (and therefore in general animal husbandry) must be developed on a country basis. However, as an interim solution to training where national facilities do not exist or are inadequate, it was considered necessary to continue to provide regional and inter-regional training in addition to giving assistance to national courses. In principle this philosophy also applies to training in dairy technology. However, it should be noted that in many developing countries there are no facilities for lower and intermediate level education in dairy technology whereas agricultural or animal health training institutions exist in most of these countries, offering general animal husbandry training (in a number of countries including instruction in dairy husbandry) as part of an agricultural or animal health curriculum. A salient feature of modern industry however is its “internationality” and the dairy industry is no exception to this general rule and, generally speaking, dairy technology is similar all over the world which is the reason why training in dairy technology can be carried out successfully even at the interregional level.**

**The aim of training in dairy technology should be:**

- i. to meet the demand of the dairy industry for qualified staff capable of manufacturing and distributing products satisfying quality-conscious consumers; and**

- ii. to satisfy the trainees as regards the knowledge and experience gained and possibly as regards their career possibilities. Official recognition of the training would be facilitated if the training fitted into the educational system of the countries concerned.**

**The gradual integration of a variety of dairy technology courses at national and regional levels into existing or emerging national training systems is bound to be a longterm process. To build up national training systems is likely to take even longer. However, the FAO Dairy Training Courses could help to get the national training programmes started and speed up their development.**

### **Provision of Milk Plants and Dairy Farms for Training**

**It is necessary that national schools have access to a training dairy farm and/or milk plant so that practical training need not be confined to commercial farms and milk plants. Training in the latter is certainly important but in most cases allows the participation of only a small number of trainees at one time. If training farms and milk plants operate on commercial lines, care must be taken (and sufficient resources must be provided) to ensure that the training is not subordinated to commercial interests. Training in milk production/dairy husbandry may be carried out in schools of general agriculture, animal husbandry, animal health assistants or special dairy schools depending on existing facilities and the demand for dairy husbandry/milk production specialists.**

**Training in dairy technology (and milk plant maintenance) may be conducted at the**

**same schools or at food technology schools. However, for both types of training dairy husbandry/milk production and dairy technology - adequate dairy training facilities both for practical and theoretical instruction are essential.**

### **Refresher Courses, Quality Control and Industry Advisory Services**

**The proposed integration of the FAO dairy training courses into formal national dairy training systems may necessitate changes in the level and type of these courses and their duration. The integration will also require continuous adjustments determined by the demand for trained manpower which in turn depends on the stage of dairy development and the pace with which it is progressing.**

**In addition to formal training, refresher courses on special subjects and of varying duration should be arranged to maintain the standard of efficiency of staff. It is also necessary to build up a system of quality control and extension agents, such services using national institutes as a basis. The training of extension agents should be given high priority in any dairy training system as these agents - though small in number - will have a key role to play in the refresher training of milk plant staff.**

### **Organization for Dairy Development**

**Another important target group for training programme are persons responsible for the organization of dairy development since one of the most crucial constraints to development is the lack of a body to coordinate dairy development activities.**



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### III. DAIRY TRAINING IN A NATIONAL DAIRY TRAINING CENTRE

The kind of training offered in a national dairy training centre will largely depend on the manpower requirements and on other training facilities available in the country. The dairy training centre envisaged in this publication has been designed with the view to suit a variety of requirements. First of all it comprises on one site the following facilities:

- accommodation of students with all complementary facilities
- classrooms and laboratories
- milk plant for training purposes but on small commercial scale
- small scale milk production unit for training purposes

Should some of the above mentioned facilities be available in an existing training institution and should this institution be designated to undertake dairy training, the information provided in this publication could be utilized for establishing the complementary facilities required. It should be mentioned however, that the milk plant included for the centre as proposed in this publication would be sufficient to supply a town of about 25 000 inhabitants with liquid milk and milk products. The plant is of

**somewhat sophisticated design and in certain circumstances it may be considered desirable to build a simpler version.**

**The two versions of the proposed dairy training centre should be considered as two extreme examples of a vast variety of possible projects.**

**The first is an example of a centre for 40 students at any one time, with training facilities basically in milk production and collection, with emphasis on dairy hygiene. The buildings are designed and equipped to cater for courses lasting not longer than six months, but brief courses or seminars could also be given as and when required.**

**The second is an example of a centre designed for courses lasting up to three years in dairy technology (diploma level) and dairy husbandry. The buildings and equipment are designed for a maximum of 120 students at any one time, divided into six classes of 20 students each. This centre can provide almost any combination of long and short courses and seminars. Table 1 gives an indication of how facilities could be used to run a three year diploma course in dairy technology and dairy husbandry for 120 students (40 students on each academic study year).**

**The most essential component of the decision concerning the establishment of a dairy training centre is always the estimate of the number and type of trainees for whom the centre is designed. The centres are equipped to provide for training for:**

**TABLE 1 Utilization of Facilities for Three Year Diploma Courses in Dairy Technology and Dairy Husbandry**

	1st year				2nd year				3rd year			
	Technology		Husbandry		Technology		Husbandry		Technology		Husbandry	
	Class 1		2		3		4		5		6	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Classroom 1		(20) <del>XXXX</del>	(20) <del>XXXX</del>									
Classroom 2					(20) <del>XXXX</del>				(20) <del>XXXX</del>			
Classroom 3								(20) <del>XXXX</del>			(20) <del>XXXX</del>	
Classroom 4												
Micro lab 1	(10) <del>XXXX</del>			(10) <del>XXXX</del>								
Micro lab 2					(5) <del>XXXX</del>		(5) <del>XXXX</del>			(5) <del>XXXX</del>		(5) <del>XXXX</del>
Chem. lab 1	(10) <del>XXXX</del>			(10) <del>XXXX</del>								
Chem. lab 2					(5) <del>XXXX</del>		(5) <del>XXXX</del>			(5) <del>XXXX</del>		(5) <del>XXXX</del>
Milk plant					(10) <del>XXXX</del>					(5) <del>XXXX</del>		(5) <del>XXXX</del>

Stable 1						(5) XXXX	--- =		(5) XXXX			--- =
Stable 2						(5) XXXX	--- =		--- =			(5) XXXX

**Notes: Classrooms 1, 2 and 3 are in constant use throughout the course.**

**Classroom 4 is available for other purposes as required. Numbers in brackets indicate number of students**

**xxxx = utilized 100 percent**

**- - - - not fully utilized**

- i. Milk producers (farmers). The centre can also be utilized for demonstrations to neighbouring farmers.**
- ii. Animal production/dairy husbandry extension officers. The training centre could be very well utilized for basic, post scholastic, in-service or refresher training for extension officers at all levels, depending on the requirements of the country.**
- iii. Dairy farmers' associations, dairy cooperatives. Seminars and longer term courses could be offered by the centre.**
- iv. Milk collection, transport and milk hygiene. The centre (in both versions) has all facilities required to provide training in this essential part of dairy development.**



- v. **Milk processing and marketing. Vast types of courses can be offered by the centres equipped with a milk plant to all levels of employees of milk processing plants.**
- vi. **Quality control in the dairy industry. The centres are particularly well equipped to provide training in this aspect of the dairy industry.**
- vii. **Teachers in milk production and processing. This essential aspect of dairy development can also be catered for, the type and duration of courses depending on requirements.**

**The above list does not exhaust the vast possibilities of training which the centres are able to offer but gives an indication of the type of training which could be made available. In both types of centres presented in this publication the assumption was made that theoretical training will amount to 50 percent of the courses, practical training 40 percent and educational tours 10 percent.**

**The staffing pattern for the teaching staff of the centres will largely depend on the structure of courses offered and no standards can be suggested in this respect in this publication. The examples given below should be considered as a demonstration of the structure of the teaching staff of the centres for a given type of courses visualized.**

**Example 1. First level training centre - courses up to six months, 40 students at a time  
Types of courses run at the centre.**

- i. **Pre-apprenticeship courses for the milk processing sector (two to six weeks),**
- ii. **Completion of apprenticeship training in the milk processing sector (three to six months)**
- iii. **In-service courses on milk processing (two to fourteen days)**
- iv. **The management of milk collecting centres (two to four months)**
- v. **In-service courses for extension officers working on milk production with the emphasis on dairy hygiene (two to fourteen days)**
- vi. **Brief courses or seminars on dairy development.**

### **Teaching staff requirement based on a one-year training schedule**

#### Teachers

2 dairy technologists  
1 nutrition and food specialist  
1 dairy husbandry specialist

#### Demonstrators

1 for microbiology  
1 for chemistry  
1 for animal husbandry  
1 for dairy technology

**Example 2 Second level training centre - three year course at diploma level in dairy technology and/or dairy husbandry, 120 students at a time.**

### **Teaching staff requirement based on a three-year training schedule**

Teachers

- 1 dairy technologist
- 1 dairy engineer
- 1 dairy husbandry specialist
- 1 animal health specialist
- 1 dairy economist
- 1 chemist
- 1 microbiologist
- 1 nutrition and food specialist

Demonstrators

- 2 for milk plant operation
- 3 for dairy husbandry
- 2 for microbiology
- 2 for chemistry
- 1 for engineering



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## IV CONSTRUCTION AND EQUIPMENT

## **4.1 General specification**

**This section comprises a brief description of the site; general specifications for construction and for selected items of equipment; a list of the buildings; a description and drawing of each building together with cost estimates in US\$ at 1975 exchange rates <sup>1</sup> and a layout of furniture, equipment, machinery, and sketches of furniture. Lighting, piping and sewage disposal are shown only for the milk plant. The following is not included in cost estimates:**

- i. purchase and development of the site;**
- ii. connection to mains electricity and water; water storage; fire precautions; and any special needs such as air-conditioning;**
- iii. carriage insurance and freight of machinery and equipment;**
- iv. housing for staff;**
- v. an allowance for contingencies (except for 10 percent in construction costs).**

### **<sup>1</sup> 8.4 Kenya Shillings to 1 US\$**

**In drawing 01 a model site layout is shown comprising all buildings required for a full-scale dairy training centre. In the event that a simpler version is required this drawing could serve as a general guide for arranging the buildings on the site, particularly if expansion is envisaged in the future.**

**Costings have been based on the following specifications and these will have to be**

**adapted to local conditions. Only a brief description of construction requirements has been given as it is considered that Ministry of Workd specifications will generally be followed.**

### **Standard Length**

**All buildings have been designed on a standard module length of three meters.**

### **Foundations**

**Foundations are excavated to a depth of 90 cm and comprise concrete blocks layed on a concrete strip. Where required, protection against earthquakes or earth tremors should be incorporated.**

### **Walls**

These may be constructed from:

- cement blocks
- bricks
- natural stone cut to size
- prefabricated material

### **Roof construction**

**Untreated timber is used for roof construction. If local conditions necessitate the use of treated timber, the estimate will have to be increased.**

**For covering the roof corrugated asbestos sheets or best quality galvanized or painted corrugated iron is used.**

### **Ceilings**

**Ceilings are lined with cellotex boards or similar material.**

### **Floors**

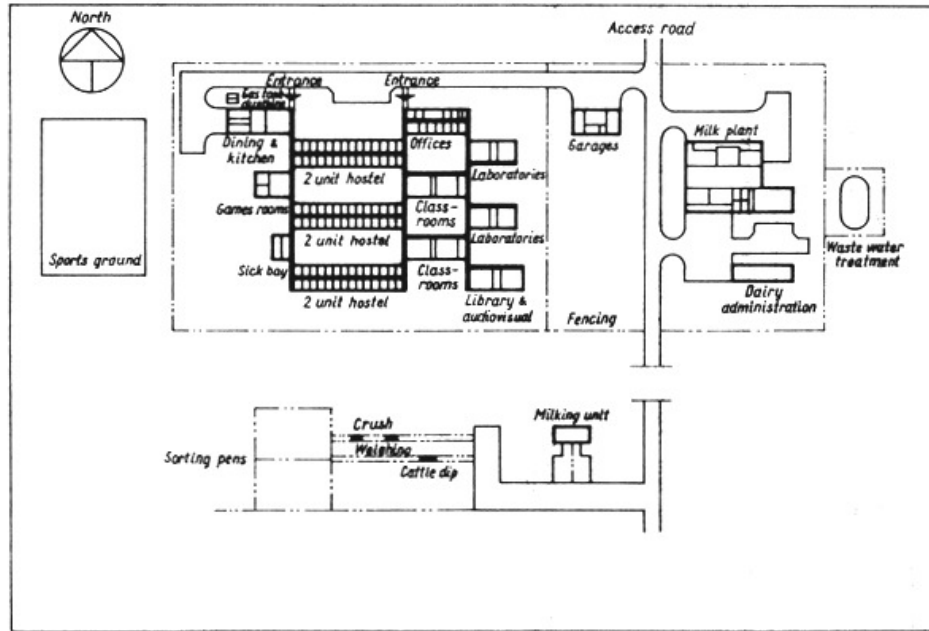
**All floors are finished with 150 mm of concrete followed by 40 mm of screed. Terrazo of grano finish is used where specified in the drawings and where floor covering is included vynil tiles are used.**

### **Windows**

**Metal windows are used throughout with panes fitted in putty.**

### **Doors**

**Flush doors are used except where otherwise specified.**



**01 Site layout 1:2000**

## Sanitation

Porcelain is used for toilets and stainless steel for kitchen units, etc. galvanized iron piping is used for the water supply. Sewage piping below ground is of cast iron and above ground either cement pipes or pitch fibre pipes.

## **Electricity**

All wires are enclosed in PVC conduits and wherever possible fluorescent lighting is used. Provision for automatic fusing has been included for all units.

## **Paint and emulsion**

Walls and ceilings should be given two coats of plastic emulsion. In areas where traffic is likely to be heavy, a further coat of oil paint should be applied to a height of 100 cm.

## **Curtains**

Curtains are hung from a standard rail system and made of cotton.

## **Equipment**

In the kitchen and laboratories stainless steel is used in preference to other materials.

## **Furniture**

Drawing and specifications are given for the construction of furniture. If preferred, this may be purchased locally.

## **4.2 Summary of Estimated Cost (May 1976) of buildings, furniture and equipment**

		Second Level Training
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Drawing No.	Essential Buildings	First Level Training Centre		Centre	
		Recommended No. of units	Estimated cost, US\$	Recommended No. of units	Estimated cost, US\$
02	Classrooms, 40 place unit	1	38,700	2	77,400
03	Laboratories, 20 place unit	1	75,300	2	150,600
04	Library & audio-visual rooms	1	39,600	1	39,600
05	Hostel, 20 place unit	2	106,600	6	319,800
06	Dining hall, 44 place unit & kitchen	1	92,400	1	92,400
07	Sick bay, 4 place unit	1	16,400	1	16,400
08	Games rooms	1	22,900	1	22,900
09	Offices	1	57,200	1	57,200
10	Garages	1	33,300	1	33,300
	Sub-total		482,400		809,600
	<u>Optional Buildings</u>				
15	Milk plant, administration building	-	-	1	28,700

16	Milk plant	-	-	1	1,100,500
24	Milk collecting Centre	1	26,700		
25	Milking unit, hand (6–10 cows)	1	2,500		
	Milking unit, mechanized (20–40 cows)			1	14,900
			511,600		1,953,700

(say US\$ 520,000)

(say US\$ 2,000,000)



## V. DESCRIPTION, COST ESTIMATES, SPECIFICATIONS AND DRAWINGS

### 5.1 Classrooms

**Description** - The classroom is designed as a unit of two classrooms each with a capacity for 20 students (drawing 02) and each has a store for educational material.

**Toilets and cleaning facilities are common to both classrooms so that when only one classroom is to be built that part of the building containing the common facilities should be selected.**

**Assuming three or four lectures a day, one held in each class, the unit of two classroom is sufficient for an intake of 60 to 80 students.**

### **Cost estimates**

	<u>US\$</u>
Construction 250 m <sup>2</sup> at US\$ 118 m <sup>2</sup>	29,500
Electricity	1,000
Plumbing	2,100
Sewage	<u>400</u>
Total building costs	33,000
Furniture	4,600
Equipment	<u>1,100</u>
Grand total	<u>38,700</u>

### **Specifications**

- a. **Electricity - installed power 3.5 Kw.  
19 mounted single tube fluorescent fittings**

**6 weatherproof tunsten fittings**  
**6 5A socket outlets**

**b. Plumbing**

**3 bowl urinals**  
**4 wash basins with cold water taps**  
**3 water closets**  
**pipng**  
**drainage**  
**1 water storage tank**

**c. Sewage**

**1 gully trap**  
**2 manholes**  
**100mm dia. cast iron piping**  
**100mm dia. pitch fibre piping**

**d. Furniture**

**40 students' desks**  
**42 school chairs**  
**2 teachers' desks**  
**4 running metres of light shelving**  
**2 blackboards 120cm × 480cm**  
**2 white screens**  
**2 notice boards 120cm × 240cm**

**30m of 120cm curtain material****e. Equipment****2 overhead projectors****5.2 Laboratories**

**Description** - The laboratory unit (drawing 03) is designed to house both a chemistry and a microbiology laboratory each with working space for ten students. Between the two laboratories common facilities for storage, media preparation and wash-up have been included.

Each work space has easy access to water, electricity, gas and washing-up facilities. Room is allowed for the students to have a personal issue of general laboratory equipment and easy access to the specialized laboratory equipment.

The equipment included for the laboratory unit is sufficient to carry out the following:

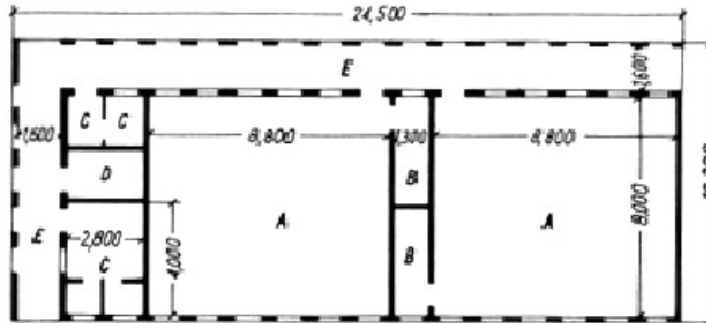
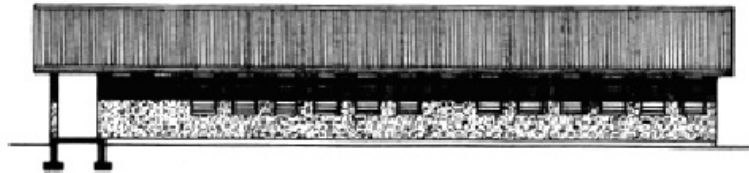
- basic physical experiments, e.g. temperature checks, volumetric measuring, determination of specific gravity and distillation;
- quantity determination and components in milk and dairy products;
- routine tests carried out on farmers' milk supplies;
- routine control of liquid milk and manufactured dairy products;
- direct methods for determination of microbes in milk and dairy products;
- bacteriological water control;

- **indirect methods for determination of microbes in milk and dairy products;**
- **bacteriological control of cleaning and sanitation procedures in the dairy.**

**The equipment will have to be supplemented to some degree if diploma level courses are to be run.**

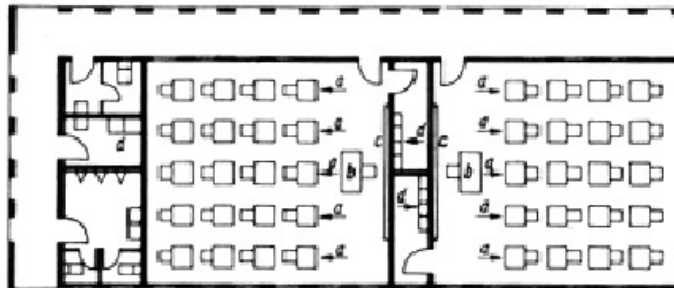
### **Cost estimate**

	<u>US\$</u>
Construction 204 m <sup>2</sup> at US\$ 130 m <sup>2</sup>	26,700
Electricity	1,900
Plumbing	4,100
Sewage	<u>700</u>
Total building costs	33,400
Furniture	6,000
Equipment	<u>36,000</u>
Grand total	75,300



### Area (m<sup>2</sup>)

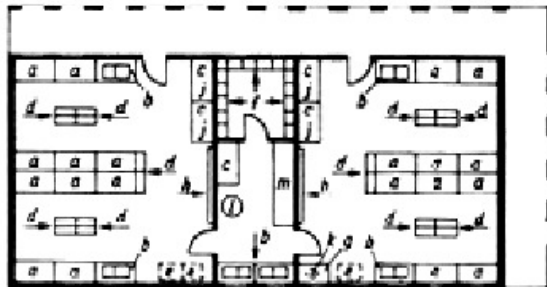
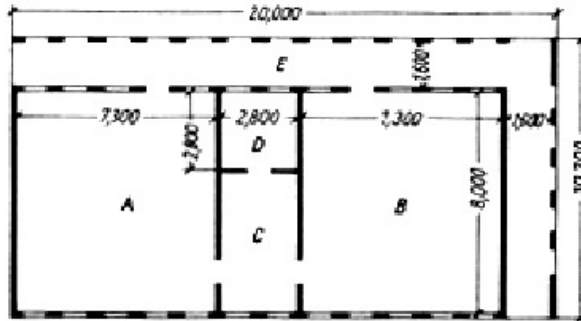
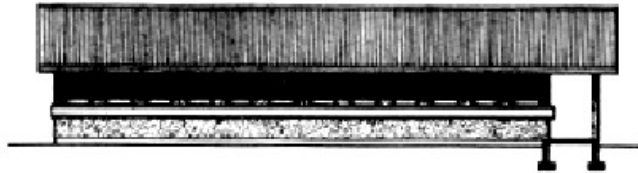
A Classrooms	149.4
B Stores	12.4
C Toilets	20.0
D Cleaner's room	5.7
E Corridors	<u>62.6</u>
Total area	250 m <sup>2</sup>



### Furniture and Equipment

- a Students' tables and chairs
- b Teachers' tables and chairs
- c Blackboard
- d Shelves

## 02. Classrooms 1:200



### Area (m<sup>2</sup>)

A Microbiology	63.0
B Chemistry	63.0
C Wash-up room	15.2
D Store	9.0
E Corridors	<u>53.8</u>
Total area	204 m <sup>2</sup>

### Furniture and Equipment

- a Laboratory table type 1
- b Laboratory table type 2
- c Laboratory table type 3
- d Laboratory table type 4
- e Trolley
- f Shelves
- g Cupboard



h Blackboard  
j Incubators  
k Water heater  
l Autoclave

m Concrete slab

### ***03. Laboratories 1:200***

#### **Laboratory specifications**

**a. Electricity - installed power 20.0 Kw.**

- 18 mounted single tube fluorescent fittings**
- 3 weatherproof tungsten fittings**
- 25 5A socket outlets**
- 5 20A cord outlets**

**b. Plumbing**

- 20 vulcathene sinks**
- 20 vulcathene cold water taps**
- 6 stainless steel sinks with draining boards**
- 6 hot and cold water mixer taps**
- acid resistant drainage with 20 gas outlets**
- 1 water storage tank**

**c. Sewage**

- 7 gully traps**
- 5 manholes**
- 100mm. dia. concrete or pitch fibre piping**

**d. Furniture**

- 20 type 1 working tables**
- 6 type 2 working tables**
- 1 type 2A working table**
- 4 type 3 working tables**
- 20 type 4 storage units**
- 3 trolleys**

- 24 high stools**
- 2 blackboards**
- 7 running metres of four-tier shelving**
- 20 m of 9cm plastic curtaining**
- 3 m concrete slab**

**e. Equipment**

- 3 incubators**
- 1 incubator/refrigerator**
- 1 autoclave**
- 1 sterilizing oven**
- 2 laboratory balances**
- 4 thermostatically controlled water baths**
- 10 microscopes**
- 2 Gerber centrifuges**
- 1 set of automated milk testing equipment recording fat, protein and total solids**
- 1 apparatus for methylene blue test**
- 1 scale to determine the moisture content of butter**
- 1 apparatus for freezing point determination**
- 1 water distiller**

**Glassware, chemicals and substitutes sufficient for one year comprising: titration sets, sediment testers, filter pads, petri dishes, test tubes, rubber mats, measuring flasks, measuring cylinders, pipettes, Erlenmeyer flasks, evaporation dishes, funnels, beakers,**

**spatulas, reagent flasks, drip bottles, mortars, stoppers, special butyrometer stands, thermometers, phosphatase test equipment, Durham tubes, slides and cover glasses, lactometers.**

**Phenolphthalein, sodium hydroxide, resazurin, methylene-blue, phosphatase reagents, alizarin, alcohol, hydrochloric acid, sulphuric acid, nitric acid, amylalcohol, paraphenyldiamin, hydrogen-peroxide, litmus, immersion oil, sodium carbonate.**

**Milk agar, plate-count agar, violet red bile agar, potato dextrose agar, trypsin digest agar, MacConkey broth.**

### **5.3 Library**

**Description - The library (drawing 04) incorporates a visual-aid room which can accomodate up to 60 students, a film operator's room and reading space for 18 students.**

**The visual aid room is sufficiently equipped for holding seminars and conferences and the library will house about 4,000 books and space is provided for newspaper and magazine stands. The complete unit is sufficient to cope with an intake of 60 to 80 students.**

### **Cost Estimate**

US\$

Construction 235 m <sup>2</sup> at US\$ 118 per m <sup>2</sup>	27,700
Electricity	1,100
Plumbing	
Sewage	
Total building costs	<u>28,800</u>
Furniture	7,900
Equipment	<u>2,900</u>
Grand total	<u>39,600</u>

### **Library and Audio-visual Room specifications**

- a. **Electricity** - installed power 5.0 Kw.
  - 12 mounted single tube fluorescent fittings
  - 5 mounted twin tube fluorescent fittings
  - 3 weatherproof tungsten fittings
  - 8 5A socket outlets
  - 1 20A double pole switch with cord outlets
  - 2 loudspeaker outlets
- b. **Plumbing** - nil
- c. **Sewage** - nil

**d. Furniture**

**18 students' desks**

**80 school chairs**

**2 conference tables**

**1 office desk**

**1 office chair**

**32 library-type bookcases**

**4 shelves for newspapers**

**3 running metres light storage shelving**

**1 blackboard 120 cm × 480 cm**

**1 notice board 120 cm × 240 cm**

**6 m of 120 cm light-proof curtain material**

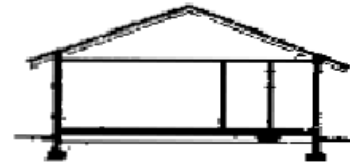
**12 m of 120 cm cotton curtain material**

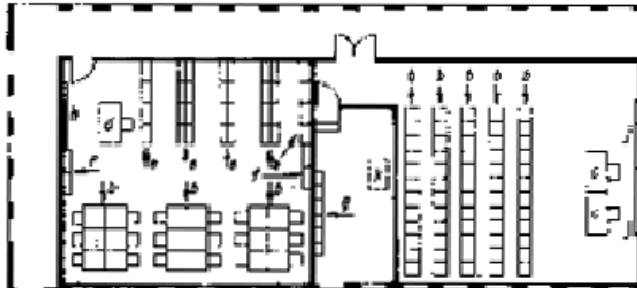
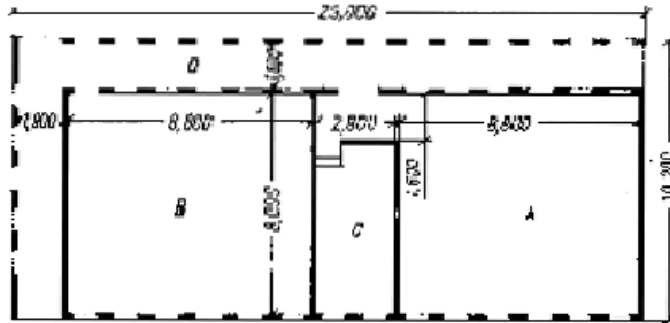
**e. Equipment**

**1 16mm film projector with two loudspeakers**

**1 screen - 1.5 m × 2 m**

**1 slide projector**





### Area (m<sup>2</sup>)

A Audio-visual room	80.9
B Library	74.7
C Operator's room	19.5
D Corridor	<u>59.5</u>
Total area	235 m <sup>2</sup>

### Furniture and Equipment

- a Student's desk
- b School chairs
- c Conference table
- d Office desk with chair
- e Library bookcase
- f Newspaper shelves
- g Light storage shelves
- h Notice board
- j Blackboard
- k Film projector

**04. Library and audio-visual room 1:200****5.4 Hostel**

**Description** - the hostel (Drawing 05) contains 10 double rooms, a store, a laundry room and two toilets. Each room is furnished with tables, chairs, beds and cupboards. The laundry room allows hostel occupants to wash their personal laundry.

**Cost estimate**

	<u>US\$</u>
Construction 235 m <sup>2</sup> at US\$ 170 m <sup>2</sup>	40,000
Electricity	2,000
Plumbing	2,400
Sewage	<u>700</u>
Total building costs	45,100
Furniture	7,700
Equipment	<u>500</u>
Grand total	<u>53,300</u>

**Hostel Specifications****a. Electricity - installed power 5.5 Kw.**



- 36 Standard light fittings**
- 6 Weatherproof tungsten fittings**
- 14 5A socket outlets**
- 1 20A cord outlet**

**b. Plumbing**

- 3 Sinks**
- 3 Water closets**
- 3 Wash basins**
- 3 Bowl urinals**
- 3 Shower fittings**
- 1 Water storage tank**
- 13 Taps, plus piping**

**c. Sewage**

- 1 Gully trap**
- 4 Manholes**
- 100 mm dia. cast iron piping**
- 100 mm dia. pitch fibre or concrete piping**

**d. Furniture**

- 20 Tables**
- 20 School chairs**
- 20 Beds**
- 20 Foam mattresses 75 cm × 200 cm**

**20 Built-in cupboards**

**7 Running metres heavy storage shelving**

**7 m of 90 cm plastic curtain material**

**90 m of 120 cm cotton curtain material**

**25 Blankets**

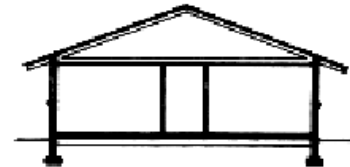
**80 Sheets**

**80 Towels**

**e. Equipment**

**1 225 l (50 gall) water heater**

**3 Irons**



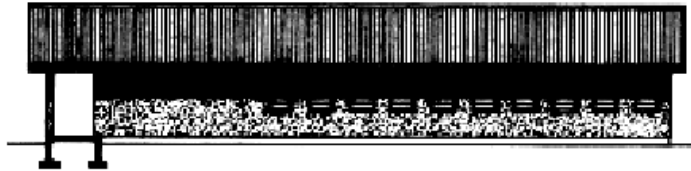
Area (m<sup>2</sup>)

A Students' rooms 128.0

B Toilets and baths 25.8

C Laundry 12.9

D Store 12.9

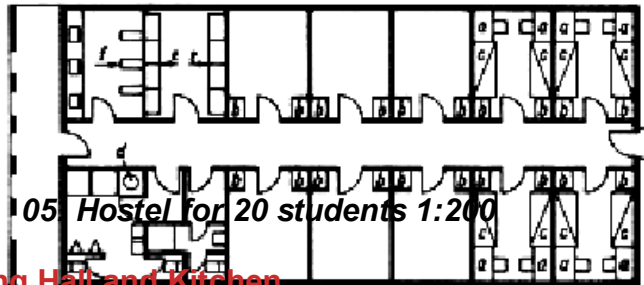
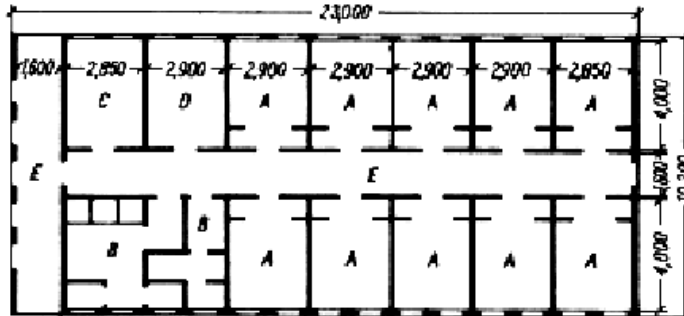


E Corridor  
Total area

55.3  
235  
m<sup>2</sup>

Furniture and Equipment

- a Tables and chairs
- b Built-in cupboards
- c Beds
- d Water heater
- e Heavy storage shelves



f Concrete slabs

**5.5 Dining Hall and Kitchen**

**Description** - The unit comprises a dining hall kitchen, office, two stores and a

**combined laundry and ironing room (Drawing 06). The dining hall can accommodate 42 students and is furnished to the same standard as the hostel and classrooms.**

**The laundry and ironing room is equipped with one heavy duty washing machine, a tumbler dryer, a spin dryer, three ironing boards and cupboard space for finished laundry. The comparatively large laundry area is designed for washing working clothes issued to students.**

**The cooking island in the kitchen is equipped with two stainless steel cooking pans, one tea and one coffee urn, a potato frier and two four-burner stoves with ovens. All cooking equipment is gas-operated. Ancillary equipment includes a potato peeler and a heated cupboard for keeping food warm, two refrigerators with a total capacity of 800 litres and a deep freeze with a capacity of 400 litres.**

**For food preparation the kitchen has two bays, one for vegetables and one for meat; a third bay is the washing-up area.**

**The kitchen and dining hall layout are designed for a cafeteria system of food service.**

**The office is placed for ease of control over catering and the reception area has facilities for the control of purchasing and a stainless steel table for sorting.**

**The storage area is divided into a vegetable store and a dry goods store. One wall of the vegetable store is fitted with two tiers of weldmesh baskets and the two longer walls are fitted with four-tier shelving.**

**Toilet facilities are solely for kitchen staff.**

**The unit is sufficient for an intake of 40 to 80 students.**

### **Cost estimate**

	<u>US\$</u>
Construction 265 m <sup>2</sup> at US\$ 157 m <sup>2</sup>	41,600
Electricity	8,100
Plumbing	2,000
Sewage	<u>1,000</u>
Total building costs	52,700
Furniture	7,900
Equipment	<u>31,800</u>
Grand Total	<u>92,400</u>

### **Dining Hall and Kitchen Specifications**

- a. **Electricity - installed power 25.0 Kw.**
  - 23 Mounted single tube fluorescent lights**
  - 18 5A socket outlets**
  - 3 Weatherproof tungsten fittings**

- 1 20A cord outlets**
- 1 Outlet for fan**
- 1 15A triple pole and neutral switch**
- 1 13A spur unit switched and fused with pilot lamp**
- 1 Mains distribution meter**

**b. Plumbing**

- 3 Wash basins**
- 1 Water closet**
- 2 Mixer taps**
- 5 Taps**
- Piping**
- 2 Water storage tanks**
- Gas installation and 1 ton capacity gas tank**

**c. Sewage**

- 3 Gully traps**
- 1 Grease trap**
- 4 Manholes**
- 100 mm dia. cast iron piping**
- 100 mm dia. pitch fibre or concrete piping**

**d. Furniture**

- 1 Office table**
- 2 School chairs**

**22 Students' desks**  
**44 School chairs**  
**1 Filing cabinet**  
**1 Library type bookcase**  
**7 Kitchen tables - type 1**  
**2 Kitchen tables - type 2**  
**2 Kitchen tables - type 3**  
**1 Kitchen table - type 4**  
**Ironing boards**  
**Linen cupboard**  
**3 Vegetable racks**  
**10 Running meters of heavy storage shelving**  
**1 Hot-food cupboard**  
**1 Rack for Kitchen utensils**  
**1 Chopping block**  
**1 Crockery cupboard**  
**30 m of 120 cm cotton curtain material**

**e. Equipment**

**1 Potato fryer**  
**2 Gas stoves**  
**2 Boiling pans**  
**2 Urns (tea and coffee)**  
**Sterilizing tank and 4 stainless steel baskets**

- 1 Electric mixer**
- 1 Extractor hood**
- 1 Potato peeler**
- 2 Refrigerators 400 l each**
- 1 Deep freeze 400 l**
- 1 Washing machine**
- 1 Spin dryer**
- 1 Tumbler dryer**
- 1 Large weighing scale**
- 1 90 l (20 gal) water heater**
- 3 Irons**
- 4 10-litre pots with lids**
- 8 5-litre pots with lids**
- 4 Pans**
- 4 Ladles**
- 8 Bowls, glass and plastic**
- 1 Potato chipper**
- 1 Chopper**
- 4 Carving knives**
- 2 Strainers**
- 100 Sets of plates**  
**(large, soup and small)**
- 100 Cups and saucers**
- 100 Sets of knives, forks, spoons and teaspoons**



**100 Glasses**  
**20 Water jugs**  
**10 Sets of dishes and bowls**  
**50 Wooden trays**  
**50 Dish towels**  
**50 Tablecloths**

### 5.6 Sick bay

**Description** - The Sick Bay (Drawing 07) can accommodate four students or, when not in use, it could be used as a guest house.

There are two double rooms, two separate toilets, a doctor's room and a waiting room.

### Cost estimate

	<u>US\$</u>
Construction 81 m <sup>2</sup> at US\$ 157 m <sup>2</sup>	12,700
Electricity	500
Plumbing	1,200
Sewage	<u>500</u>
Total building costs	14,900

Furniture	1,300
Equipment	<u>200</u>
Grand Total	<u>16,400</u>

### **Sick Bay Specifications**

- a. **Electricity** - Installed power 2.0 Kw.
  - 4 Mounted single tube fluorescent lights
  - 5 Weatherproof tungsten fittings
  - 4 5A socket outlets
  - 1 20A cord outlets
- b. **Plumbing**
  - 2 Wash basins with cold water taps
  - 2 Water closets
  - 2 Shower fittings
  - 1 Sink with hot and cold water taps
  - Piping
  - 1 Water storage tank
- c. **Sewage**
  - 2 Gully traps
  - 4 Manholes
  - 100 mm dia. cast iron piping

**100 mm dia. pitch fibre or concrete piping**

**d. Furniture**

**4 Beds**

**4 Foam mattresses 75 cm × 200 cm**

**10 School chairs**

**4 Cupboards**

**Working top**

**6 m of 90 cm plastic curtain**

**24 m of 120 cotton curtain material**

**4 Blankets**

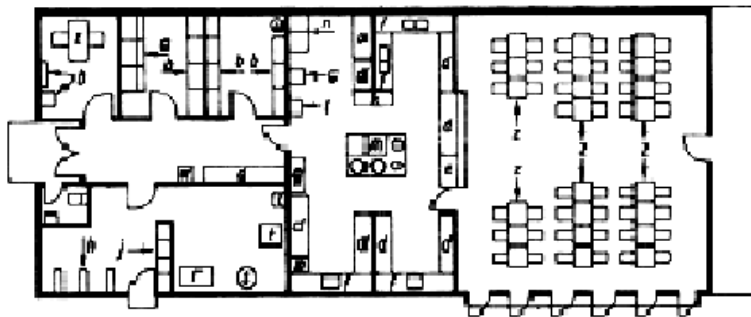
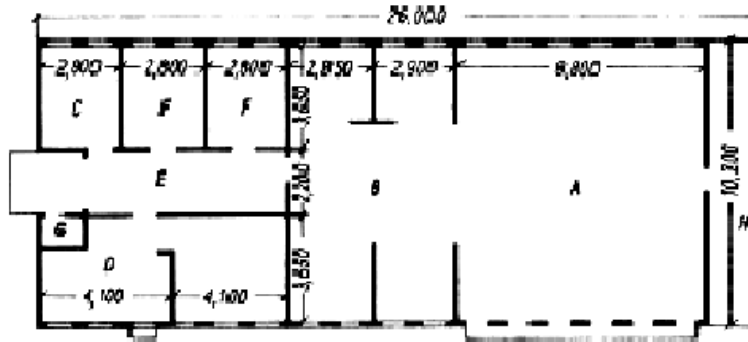
**8 Sheets**

**8 Towels**

**e. Equipment**

**1 90-litre (20 gal) water heater**





Area (m<sup>2</sup>)

A Dining hall	91.8	E Reception area	21.8
B Kitchen	61.2	F Stores	23.4
C Office	12.1	G Toilet	2.3
D Laundry	33.1	H Corridor	19.4

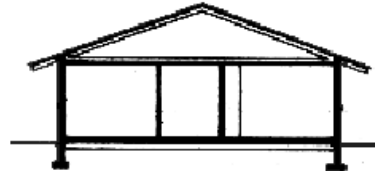
Total area 265m<sup>2</sup>

Furniture and Equipment

- a Weldmesh rack
- b Shelves
- c Chopping block
- d Kitchen table
- e Hot cupboard
- f Kitchen table and sink
- m Kitchen island
- n Refrigerator
- o Deep freeze
- p Potato peeler
- r Washing machine
- s Spin drier

g Rack for utensils	t Tumbler dryer
h Ironing boards	u Water heater
j Cupboard for linen	w Scale
k Cupboard for crocery	z Tables and chairs
l Sink	

### 06. Dining hall and kitchen 1:200



#### Area (m<sup>2</sup>)

A Bedrooms	25.4
B Waiting room	10.9
C Doctor's room	10.9
D Toilets	7.8
E Corridor	<u>25.6</u>

Total area

81 m<sup>2</sup>

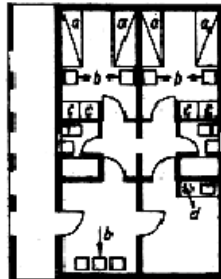
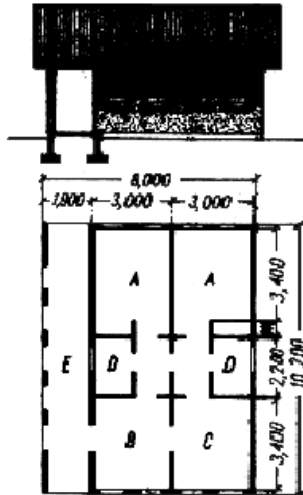
Furniture and Equipment

a Bed

b Chair

c Cupboard

d Water heater



**07 Sick bay 1:200**

## **5.7 Games Room**

**Description** - The unit (Drawing 08) comprises three rooms, one for darts, one for table tennis and one for television viewing.

The darts room is equipped with two dart boards, ten sets of darts, two scoreboards and special light fittings over the dart boards. A fixed bench is fitted along the free walls.

The table tennis room has two standard size tables, four nets, eight bats and eight dozen balls. Fixed benches are fitted along the window walls.

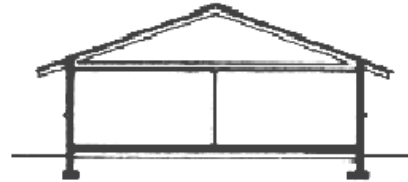
The TV room has a 26-inch black and white television set and 28 chairs.

It is considered that this unit is sufficient to cater for the needs of 60 to 80 students.

### **Cost Estimate**

	<u>US\$</u>
Construction 143 m <sup>2</sup> at US\$131 m <sup>2</sup>	18,700
Electricity	600
Plumbing	-
Sewage	-

establishment of dairy training centres  
Total building costs 19,300



Area (m<sup>2</sup>)

A Table tennis	61.2
B T.V. room	31.1
C Darts	31.1
D Corridor	<u>19.4</u>
Total area	143 m <sup>2</sup>

Furniture and Equipment

- a Chairs
- b Fixed benches
- c Table tennis table
- d Television
- e Dart board





Furniture

US\$

2,800

Equipment

800

Grand total

22,900

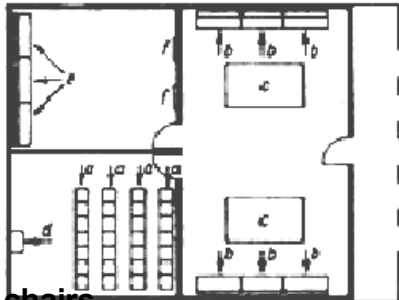
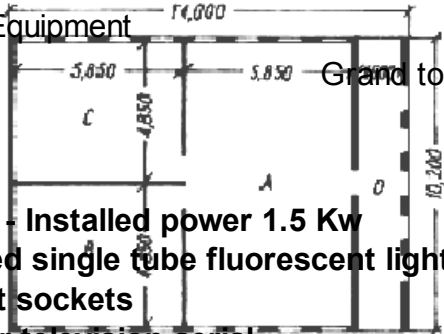
**Specifications**

- a. **Electricity** - Installed power 1.5 Kw  
 10 mounted single tube fluorescent lights  
 6 5A outlet sockets  
 1 outlet for television aerial

- b. **Plumbing**  
 nil

- c. **Sewage**  
 nil

- d. **Furniture**  
 28 School chairs  
 9 Fixed benches



**2 Table tennis tables**  
**32 m of 120 cotton curtain material**

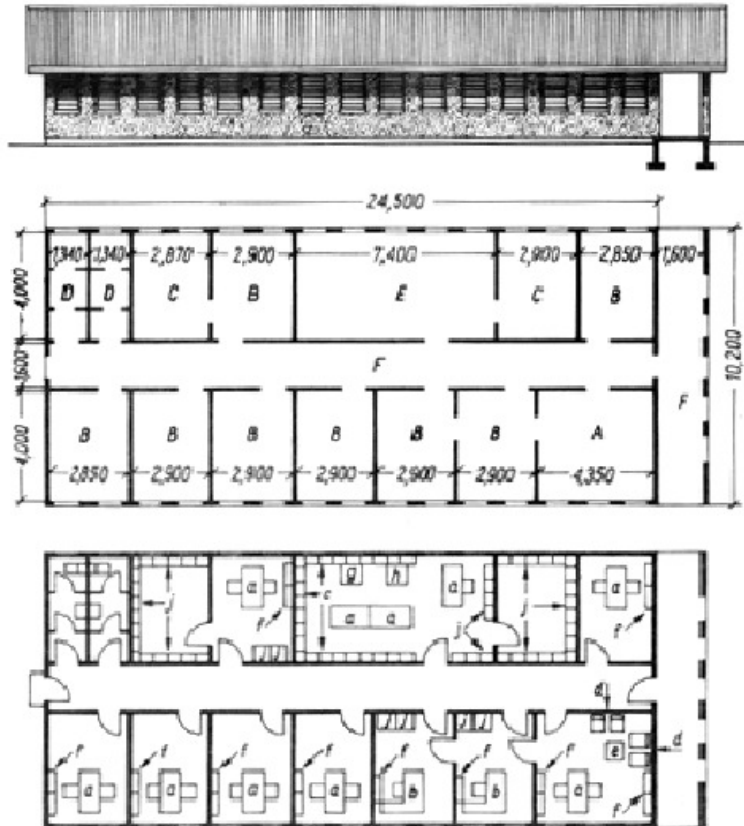
e. **Equipment**

**1 Television**  
**2 Dart boards**  
**10 Sets of darts**  
**2 Score-boards**  
**4 Table tennis nets**  
**8 Table tennis bats**  
**8 dozen table tennis balls**

**5.8 Offices**

**Description** - The Office block comprises the following rooms (Drawing 09):

- **one large office for principal**
- **seven standard size offices**
- **two stores**
- **one printing room**
- **one registry**
- **two toilets**



Area (m<sup>2</sup>)

A Principal's office	19.0
B Offices	101.4
C Stores	25.4
D Toilet	12.8
E Printing room	31.5
F Corridor	60.0
Total area	250 m <sup>2</sup>

### Furniture and Equipment

- a Desks and chairs
- b Typists' desks and chairs
- c Library bookcases
- d Easy chairs
- e Small table

f Filing cabinets  
g Duplicator

h Photocopy machine

j Shelves

### ***09. Office building 1:200***

**The offices are equipped with furniture as outlined in the specifications.**

**A switchboard with 10 extensions is installed in one of the typists' offices. The extensions are distributed as follows:**

Principal's office	- one extension
Teachers' offices	- four extensions
Administrative office	- one extensions
Office in boarding unit	- one extension
Office in model milk plant	- one extension
Available as required	- two extensions

**The stores are equipped with four-tier shelving all around the walls giving approximately 30 m of shelving space in each store.**

**The printing room installation consists of a duplicating machine and a photocopying machine. A large table in the middle of the room and a two-tier shelving unit on the wall**

**between the corridor and the printing room will facilitate the assembly of reports, lecture notes, etc.**

**The end wall between the administration office and the printing room has a fivetier shelving unit for storage of paper, stencils, etc. Shelves are also shown for other available wall space and may be incorporated if desired.**

**Office accommodation as described is considered sufficient for an intake of 60 to 80 students. By doubling up the offices accommodation would be sufficient for an intake of 120–140 students.**

**Junior personnel should be accommodated within their respective disciplines, e.g. the demonstrator in laboratory techniques should be accommodated in the laboratory.**

### **Cost Estimate**

	<u>US\$</u>
Construction	
250 m <sup>2</sup> at	36,000
US\$144 m <sup>2</sup>	
Electricity	1,200
Plumbing	900
Sewage	<u>500</u>

	Total building costs	38,600
Furniture		9,000
Equipment		<u>9,600</u>
	Grand total	<u>57,200</u>

### **Specifications**

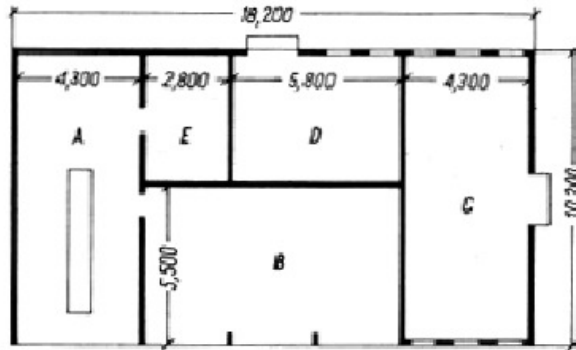
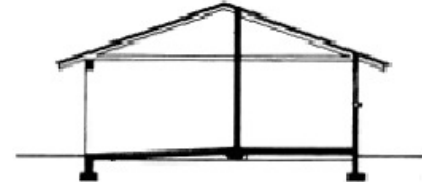
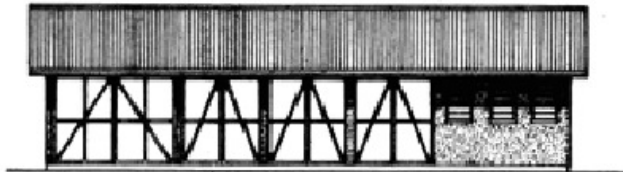
- a. **Electricity** - Installed power 4.0 Kw
  - 20 mounted single tube fluorescent lights
  - 1 Weatherproof tungsten fitting
  - 1 Electric clock
  - 15 5A socket outlets
  
- b. **Plumbing**
  - 2 Wash basins with cold water taps
  - 2 Water closets
  - 1 Water storage tank
  - Piping
  
- c. **Sewage**
  - 2 Manholes
  - 100 mm dia. cast iron piping
  - 100 mm dia. pitch fibre or concrete piping

**d. Furniture****7 Office desks****5 Office chairs****2 Typists' desks****2 Students' desks****2 Teachers' desks****18 Library bookcases****4 Easy chairs****1 Small table****5 Steel filing cabinets****1 Safe****31 Running metres of four-tier light storage shelving****42 m of 120 cm cotton curtain material****e. Equipment****2 Electric typewriters****1 Duplicator****1 Photocopy machine****1 Switchboard with 10 extensions****Office supplies****5.9 Garages**

**Description - The unit (Drawing 10) comprises a garage for a 30-seater bus, space to garage a 1-½ ton pickup, a covered VW type pickup for transport of dairy products and**

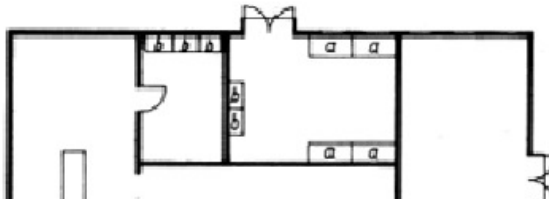
a saloon car. A repair pit is built into the bus garage.

A demonstration hall with a floor space of 50 m<sup>2</sup> is also included in the unit, as a workshop and a store.



### Area (m<sup>2</sup>)

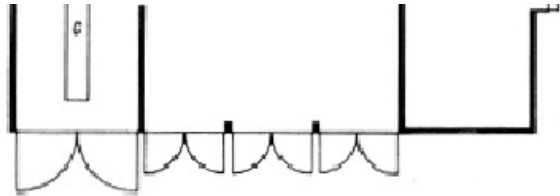
A Bus garage	46.9
B Car garage	50.4
C Demonstration room	46.9
D Workshop	27.6
E Store	<u>13.8</u>
Total area	186 m <sup>2</sup>



### Furniture and Equipment

- a Work benches
- b Four-tier shelves
- c Pit





### **10. Garage 1:200**

The workshop supplements the workshop in the dairy and can be used both as a repair unit and a teaching unit. It is equipped with work benches, tools and one universal power tool.

The demonstration hall is intended to test new machinery and equipment and to house demonstration equipment not covered by other teaching facilities.

### **Cost Estimate**

	<u>US\$</u>
Construction	
186 m <sup>2</sup> at	23,100
US\$124 m <sup>2</sup>	
Electricity	1,500
Plumbing	100

Sewage	<u>200</u>
Total building costs	24,900
Furniture	600
Equipment	<u>7,800</u>
Grand total	<u>33,300</u>

### **Garage Specifications**

- a. **Electricity** - Installed power 15.0 Kw  
12 mounted single tube fluorescent lights  
1 Weatherproof tungsten fitting  
13 5A socket outlets  
4 15A triple pole and neutral isolator distribution board
- b. **Plumbing**  
2 Taps and piping
- c. **Sewage**  
1 Oil trap  
100 mm dia. cast iron piping  
100 mm dia. pitch fibre or concrete piping
- d. **Furniture**  
4 Work benches

## **4–5 Running metres of four-tier shelving**

### **e. Equipment**

#### **Tools**

### **5.10 Sketches of furniture**

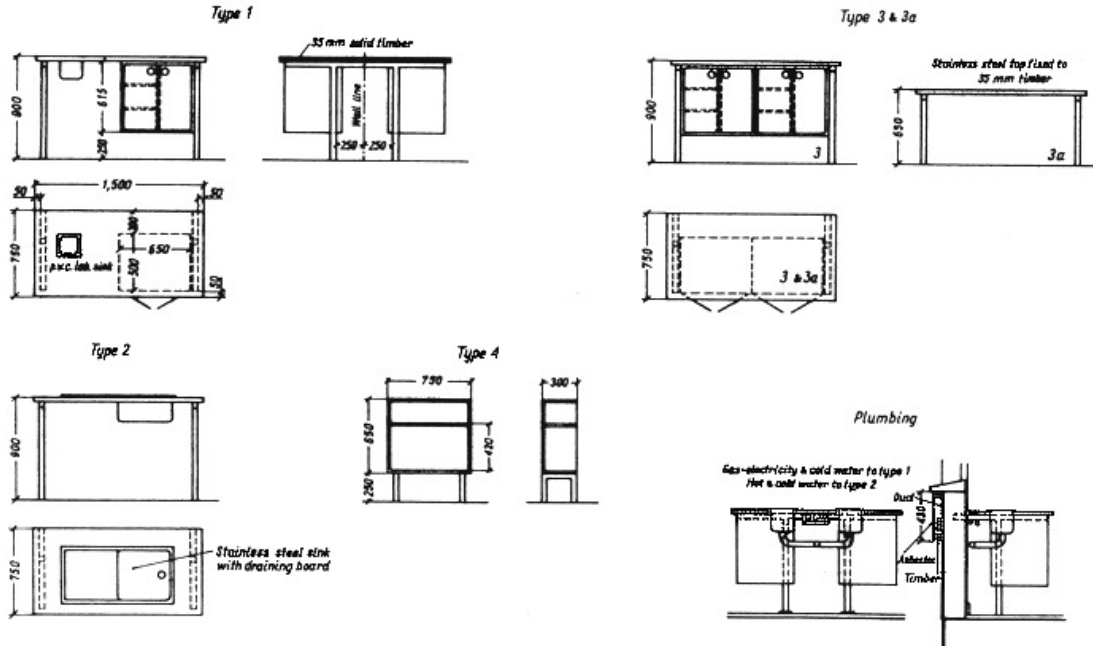
#### **5.10.1 Laboratory**

#### **5.10.2 Kitchen**

#### **5.10.3 Office, classroom and hostel**

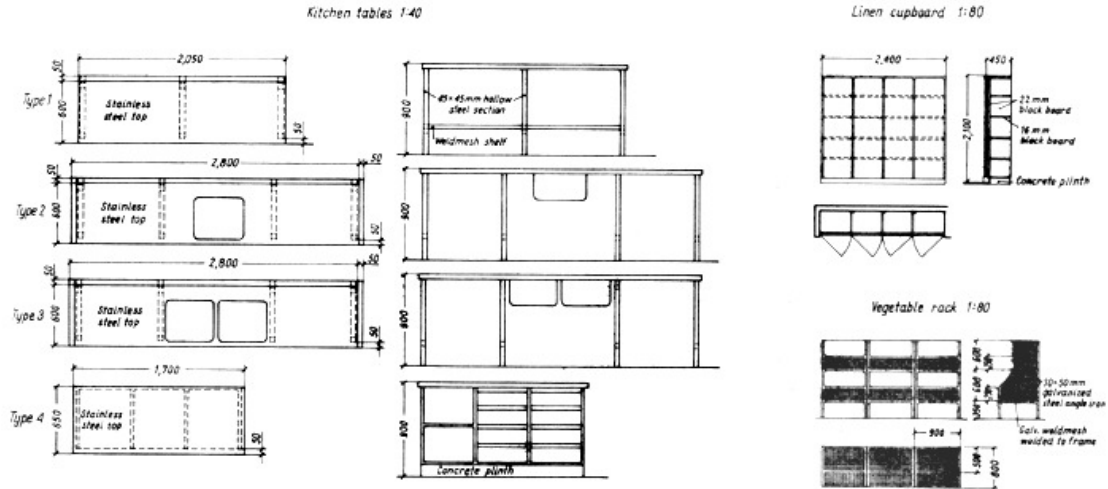
#### **5.10.4 Miscellaneous**

#### **5.10.1**



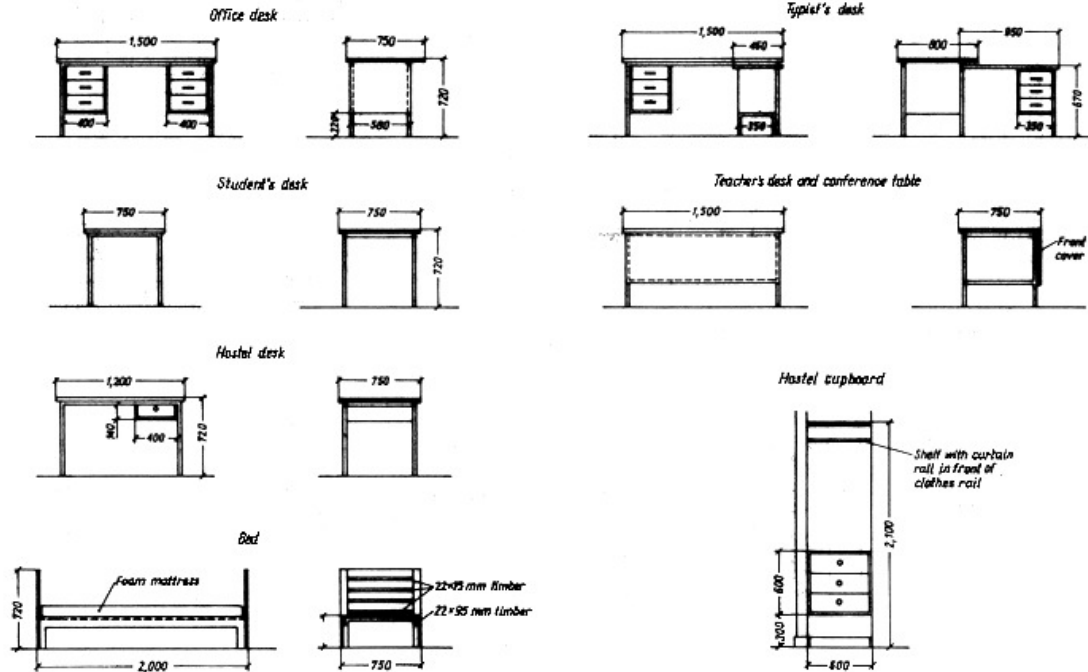
**11. Sketches of laboratory furniture 1:40**

**5.10.2**



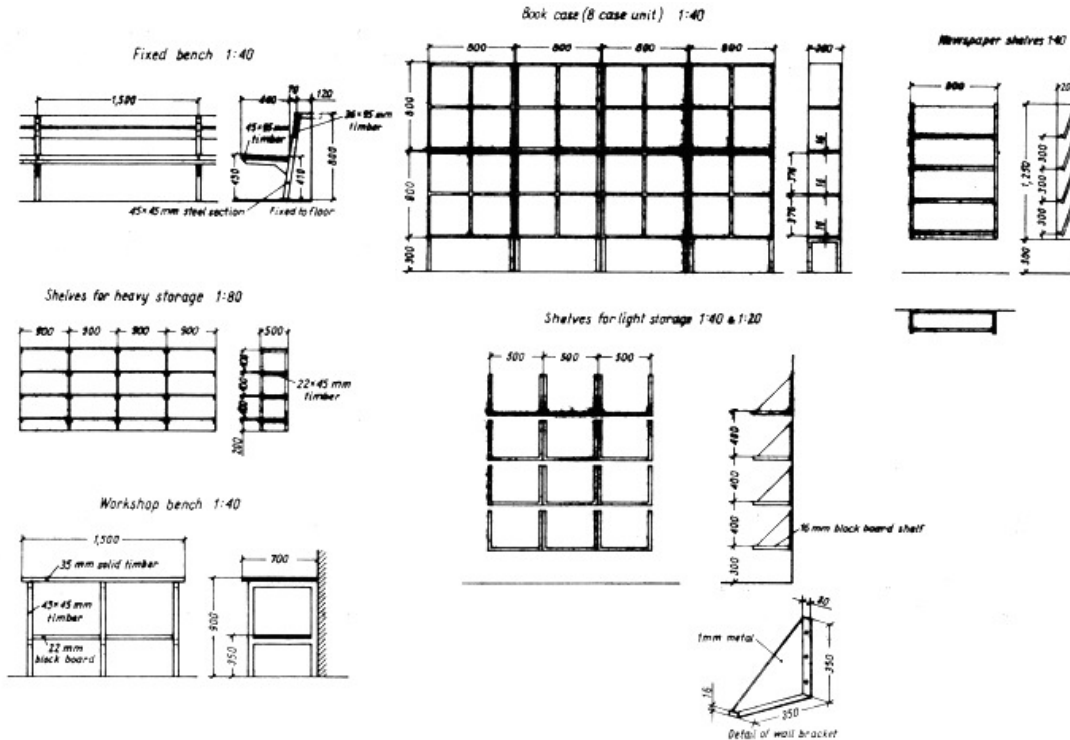
## 12. Sketches of kitchen furniture

### 5.10.3



### 13. Sketches of office, classroom and hostel furniture 1:40

5.10.4



## 14. Sketches of miscellaneous furniture

### 5.11 Milk Plant - Administration Building

**Description** - The administration building (Drawing 15) comprises:

- **one classroom**
- **four offices**
- **one store**
- **two toilets**

**The offices are equipped as outlined in the specifications.**

**The above is equipped with four-tier shelving around the walls.**

**The classroom can accommodate 12 students and is meant for use before and after practical training.**

### **Cost Estimate**

	<u>US\$</u>
Construction 150 m <sup>2</sup> at US\$144 m <sup>2</sup>	21,600
Electricity	700
Plumbing	700
Sewage	<u>200</u>
Total building costs	23,200
Furniture	4,400
Equipment	<u>1,100</u>



Grand total

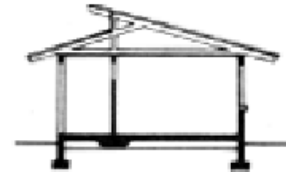
28,700**Milk Plant Administration Building - Specifications**

- a. **Electricity - Installed power 2.5 Kw**
  - 12 Mounted single tube fluorescent lights**
  - 2 Weatherproof tungsten fittings**
  - 6 5A socket outlets**
  
- b. **Plumbing**
  - 2 Wash basins with cold water taps**
  - 2 Water closets**
  - 1 Water storage tank**
  
- c. **Sewage**
  - 1 Manhole**
  - 100 mm dia. cast iron piping**
  - 100 mm dia. pitch fibre or concrete piping**
  
- d. **Furniture**
  - 3 Office desks**
  - 6 Office chairs**
  - 1 Typist desk**
  - 1 Typist chair**
  - 12 Students' desks**

- 12 School chairs**
- 2 Steel filing cabinets**
- 4 Easy chairs**
- 1 Small table**
- 7 Library bookcases**
- 7 Running metres of four-tier light storage shelving**
- 1 Blackboard 120 cm × 240 cm**
- 36 m of 120 cm cotton curtain material**

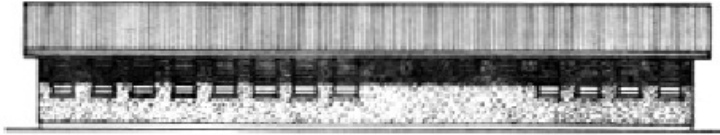
e. **Equipment**

- 1 Typewriter**
- Office supplies**

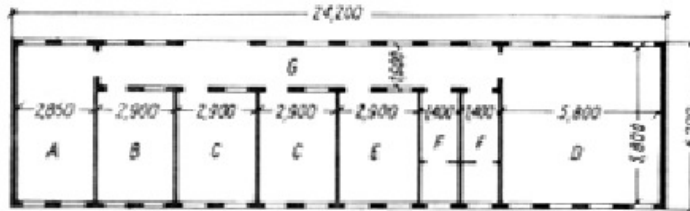


Area (m<sup>2</sup>)

A Manager's office	19.2
B Typist's office	12.9
C Offices	25.8



D Classroom	37.8
E Store	12.9
F Toilets	12.9
G Corridor	28.5



Total area 150 m<sup>2</sup>

### 15. Milk plant - administration building 1:200

#### 5.12 Milk Plant

**Description-** The milk plant (Drawings 16 to 23) is designed to serve the double purpose of giving practical training space for up to 20 students attending diploma courses, and of providing facilities for manufacturing conventional dairy products.

The flow line has a capacity of 1,000 litres/h. The capacity of the reception and storage facilities is based on approximately 6,000 litres/day liquid milk, or corresponding to an

**eight-hour working day (one shift).**

**The production line incorporates the following units:**

- **milk packaging**
- **cheese (2 types)**
- **fermented milk**
- **butter**
- **ghee**
- **ice-cream**
- **evaporated milk**
- **spray-dried milk**

**The equipment is itemized in the lists of equipment.**

**The storage capacity is based on peak production of the whole production line.**

**All service units have standby units to ensure a continuous operation in case of breakdown and to facilitate training in the operation and maintenance of equipment.**

**An emergency generator takes care of power cuts.**

**A waste water treatment plant is included to comply with the strict environmental legislation in many countries.**

**An emergency reservoir with a capacity of 60,000 litres water corresponding to 2 to 3**

**days' consumption will offset any breakdown of the water supply.**

**An independent water supply must be considered as a separate item.**

### **Cost Estimate**

	<u>US\$</u>
Construction 943 m <sup>2</sup> at US\$261 m <sup>2</sup>	247,000
Special floor	33,500
Electricity and power	96,000
Plumbing	50,000
Sewage	<u>60,000</u>
Total building costs	486,500
Furniture	7,500
Equipment, fittings, erection and running in	<u>606,500</u>
Grand total	<u>1,100,500</u>

### **Milk Plant - Specifications**

- a. Electricity - Installed power 180 Kw  
Power load 170 kVA**

**Light load 10 kVA**

**70 Power points**

**1 125 kVA emergency generator**

**1 Main switchboard**

**b. Plumbing**

**2 Wash basins**

**2 Water closets**

**6 Showers**

**1 Set of stainless steel pipes and fittings for internal connection of dairy machinery**

**1 Set of steel pipes and fittings consisting of:**

**steam pipes**

**water pipes**

**chilled water pipes**

**condensed water pipes**

**air pipes inclusive of bends, valves, breakers, etc.**

**1 Set of pipe insulation material consisting of:**

**insulation material for steam pipes**

**insulation material for chilled water pipes**

**insulation material for ammonia pipes**

**insulation material to be completed with vapour seal, asphalt, nails, wire, glue, tape, etc. The pipes to be covered with polystyrene tapes steam pipes with aluminium plates.**

**c. Sewage**

**10 Manholes**

**15 Floor gullies**

**100 to 150 mm dia. pitch fibre piping**

**Vent pipes**

**1 Waste water treatment plant**

**- 30,000 1 a day complete with all accessories**

**d. Special floor**

**400 m<sup>2</sup> acid-proof tiles**

**e. Furniture**

**1 Laboratory table type 2**

**2 Laboratory tables type 3**

**46 Cupboards 30 cm × 50 cm × 150 cm counter and shelving for shop**

**7 Running metres of heavy storage shelving**

**12 m of 90 cm plastic curtain**

**f. Equipment**

**Milk/Reception (\*Numbers refer to Figures 19 & 20)**

\* **No.**

**101 2 4-metre Roller Conveyors for transportation of milk cane**

**102 1 Milk Reception Scale with manually operated valve including weight tank**

**Maximum weighing: 250 kgs.**

**Graduated: kg and litres**

**103 1 Rectangular Milk Reception Vat in stainless steel**

**Capacity: 500 litres**

**104 1 Drip Saver**

**Length: 2 metres**

**105 Double Milk Filter**

**Capacity of each filter: 2,000 litres/hour**

**106 1 Rotary Type hand-operated Can Washing Machine with 3 compartments**

**Capacity: approximately 180 cans/hour of 50 litres or smaller scale**

**107 1 Boiling Vessel in stainless steel**

**Capacity: 150 litres**

**Cooling and storage of Raw Milk**



**201 1 Centrifugal Pump in stainless steel****Capacity: 2,000 litres/hour milk****202 1 Plate Cooler in stainless steel****Capacity: 2,000 litres/hour milk, cooled from 35°C to 4°C with chilled water****203 1 Chilled Water Centrifugal Vertical Multistage Pump with direct coupled motor****Capacity: 3,000 litres/hour****204 1 2,000 litre Vertical, Enclosed Milk Storage Tank inclusive of agitator and all necessary accessories****205 1 Two-speed Centrifugal Pump in stainless steel Capacity: 1,000/3,000 litres/hour****Processing****301 1 Float Controlled Balance Tank - Capacity: 100 litres****302 1 Centrifugal Pump in stainless steel - Capacity: 1,000 litres/hour****303 1 Plate Heat Exchanger in stainless steel - Capacity: 1,000 litres/hour****304 1 Centrifugal Pump in cast iron housing for hot water****Capacity: approximately 5,000 litres/hour****1 Set of hot water pipes for connecting the pump to the plate heat exchanger**

**305 1 Control Panel inclusive of thermograph, thermometer and flow diversion valve, etc.**

**306 1 Chilled Water Centrifugal, Vertical, Multistage Pump with direct coupled motor - Capacity: approximately 5,000 litres/hour**

**307 1 Separator complete with all necessary accessories - Capacity: 1,000/2,000 litres/hour**

**308 1 Homogenizer complete with all necessary accessories  
Capacity: 1,000 litres/hour at 210 kg/cm<sup>2</sup>**

**1 Boiling Vessel in stainless steel - Capacity: 150 litres**

### **Milk Storage and Filling**

**401 1 2,000 litre Vertical, Enclosed Milk Storage Tank, inclusive of agitator and all necessary accessories**

**402 1 2,000 litre Vertical, Enclosed Milk Storage Tank, inclusive of agitator and all necessary accessories**

**403 1 Centrifugal Pump in stainless steel - Capacity: 1,000 litres/hour**

**404 1 Automatic Filling Machine for filling of milk into plastic bags**

**405 1 Manual Filling Machine for filling of milk into plastic bags**

**406 2 Plastic Vats for manual cleaning of plastic crates**

**Yoghurt Manufacture**

**501 1 Batch Pasteurizer in stainless steel - Capacity: 300 litres**

**1 Set of accessories for the batch pasteurizer**

**502 1 Centrifugal Pump in stainless steel - Capacity: 1,000 litres/hour**

**503 1 Semi-automatic Yoghurt Filling and Closing Machine**

**Capacity: approximately 200 litres/hour**

**504 1 Stainless Steel Table**

**505 2 Starter Heaters for mother culture**

**Butter and Ghee Manufacture**

**601 1 Batch Pasteurizer in stainless steel**

**Capacity: 300 litres**

**1 Set of Accessories for the batch pasteurizer**

**602 1 Centrifugal Pump in stainless steel**

**Capacity: 2,000 litres/hour**

**603 1 Butter Churn in stainless steel**

**Capacity of bowl: 600 litres**

**604 1 Butter Milk Trolley**

**605 1 Butter Milk Pump in stainless steel**

**Capacity: 2,000 litres/hour**

**606 1 Butter Moulding Machine in stainless steel**

**Capacity: 1,000 packs/hour**

**607 1 Ghee Boiler in stainless steel**

**Capacity: 180 litres**

**608 1 Stainless Steel Table inclusive of control weighing scale**

**609 1 Boiling Vessel in stainless steel**

**Capacity: 150 litres**

### **Cheese Manufacture**

**701 and 702 2 Cheese Vats in stainless steel - Capacity: 500 litres each**

**703 1 Cheese Press, complete with all necessary accessories**

**1 Set of Cheese Equipment consisting of cheese knives, moulds for various types of cheese**

**704 and 705 2 Stainless Steel Tables**

**706 1 Cheese Coating Machine, complete with all necessary accessories**

**707-709 3 Cheese Salting Vats made of reinforced glass fibre  
Capacity: 500 litres each**

**710 1 Cheese Packing Table in stainless steel**

**Ice Cream Plant**

**801 1 Batch Pasteurizer in stainless steel - Capacity: 300 litres  
1 Set of accessories for the batch pasteurizer**

**802 1 Ice-cream Pump in stainless steel - Capacity: approximately 1,000 litres/ hour**

**803 1 Batch Pasteurizer in stainless steel - Capacity: 300 litres**

**804 1 Continuous Ice-Cream Freezer, complete with all necessary accessories**

**805 and 806 2 Deep-Freeze, complete- Capacity: 400 litres each**

**Evaporation**

**901–908 1 Complete Evaporating Plant for re-circulating 100 litres milk/hour**

**evaporation 73 kgs/hour water  
consumption 27 kgs/hour  
44% dry solids**

**909 1 Stainless steel tank for evaporated milk The tank to be complete with agitator and all necessary accessories Capacity: 200 litres**

### **Spray Drying**

**1001 – 1003 1 Spray Drying Plant, type Production Minor, complete with all necessary accessories Capacity: 10–25 kgs/hour**

### **Cleaning in Place**

**1101 1 500-litre Cylindrical, Vertical, Uninsulated, Stainless Steel Tank**

**1102 1 Centrifugal Pump in stainless steel Capacity: 10,000 litres/hour**

**1103 1 500-litre Cylindrical, Vertical, Uninsulated, Stainless Steel Tank**

### **Refrigeration Plant**

**1201 2 Centrifugal Pumps, each with a capacity of 4,200 litres/hour**

**1202 1 Water Pressure Tank - Capacity: 500 litres**

**1203 1 Air Compressor for the above water pressure tank Capacity: approximately 150 litres/hour**

**1204 1 Air Compressor, complete with all necessary accessories and air dryer Capacity: 1,060 litres/hour**

**1205 1 60 m<sup>3</sup> Water Storage Tank**

**1301 – 1302 2 Compressors for ammonia, complete with all necessary accessories**

**1303 1 Ice Water Tank, complete with coils and all necessary accessories**

**1304 1 Condenser, complete with all necessary accessories**

**1305 1 Receiver, complete with all necessary accessories**

**1306 1 Flow Control Valve**

**1307 - 1310 4 Evaporators, complete with all necessary accessories**

**1311 First filling with ammonia and oil**

### **Boiler Plant**

**1401 1 Boiler Plant complete with oil burner, feed water pump, control panel and all necessary accessories**

**Capacity: 500 kgs/hour**

**1402 1 Boiler Plant complete with oil burner, feed water pump, control panel and all necessary accessories**

**1403 1 10-metre uninsulated Chimney inclusive of smoke funnel**

**1404 1 Water Softening Unit**

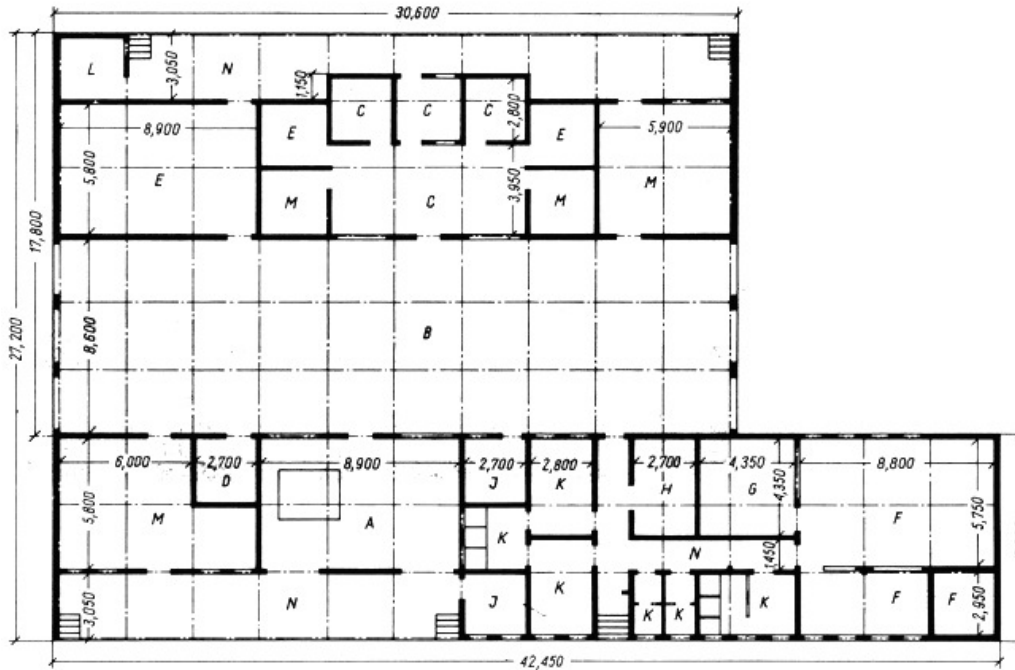
**4 Trolleys for transportation of various items**

**2 Trolleys for transportation of plastic crates from the packing machine**

**9 Doors, especially made for cold stores**

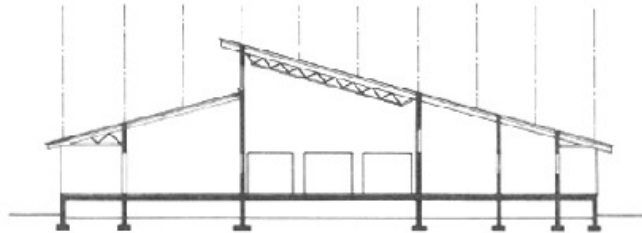
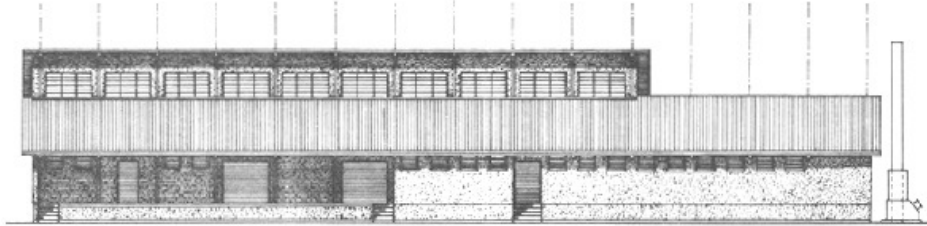
	<u>Area (m<sup>2</sup>)</u>
A Reception	53.0
B Processing	269.0
C Cheese manufacture	97.0
D In-place cleaning	8.5
E Cold stores	53.5
F Steam &	83.0





refrigeration parts	18.0
G Spare parts	
H Main switch	15.0
J Laboratories	18.0
K Changing rooms & toilets	56.5
L Shop	10.0
M Other stores	80.0
N Platforms and corridors	<u>183.0</u>
Total area	947.0 m <sup>2</sup>

**16. Milk plant - plan 1:200**



**17. Milk plant - elevation and section 1:200**

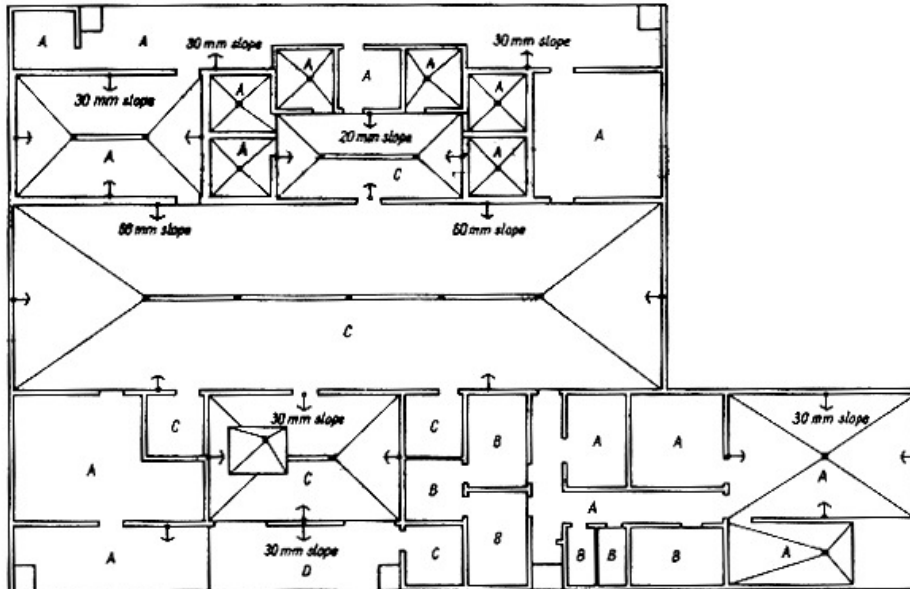
**LEGEND**

*A. Grano*

*B. Terazzo*

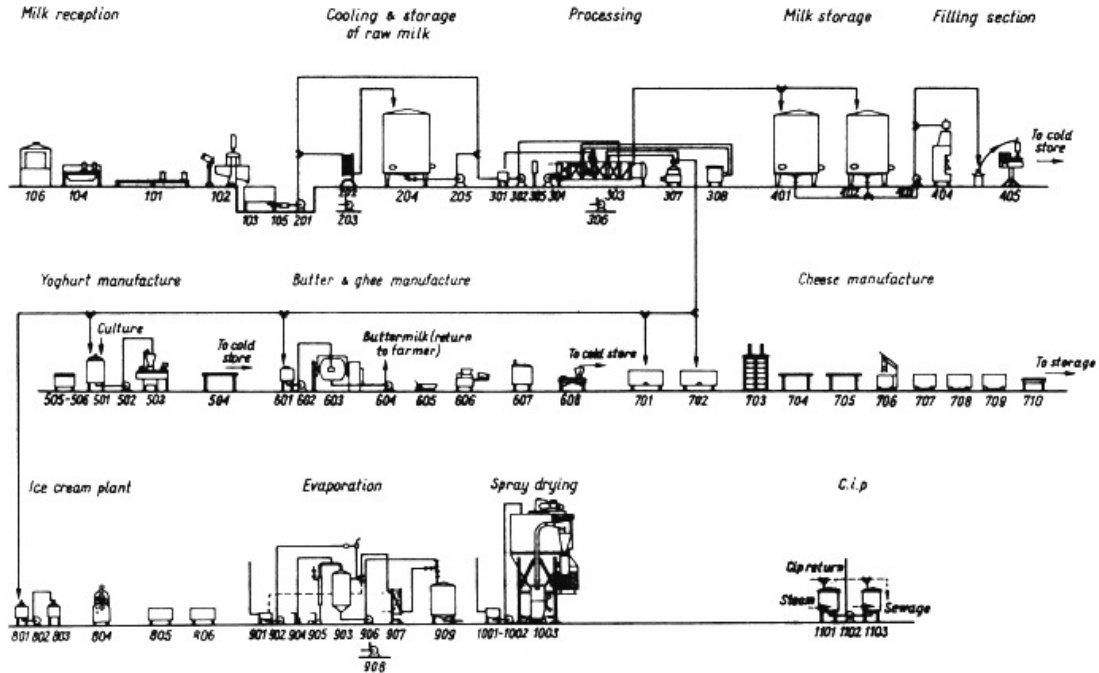
*C. Acid proof  
tiles*

*D. Cast iron tiles*

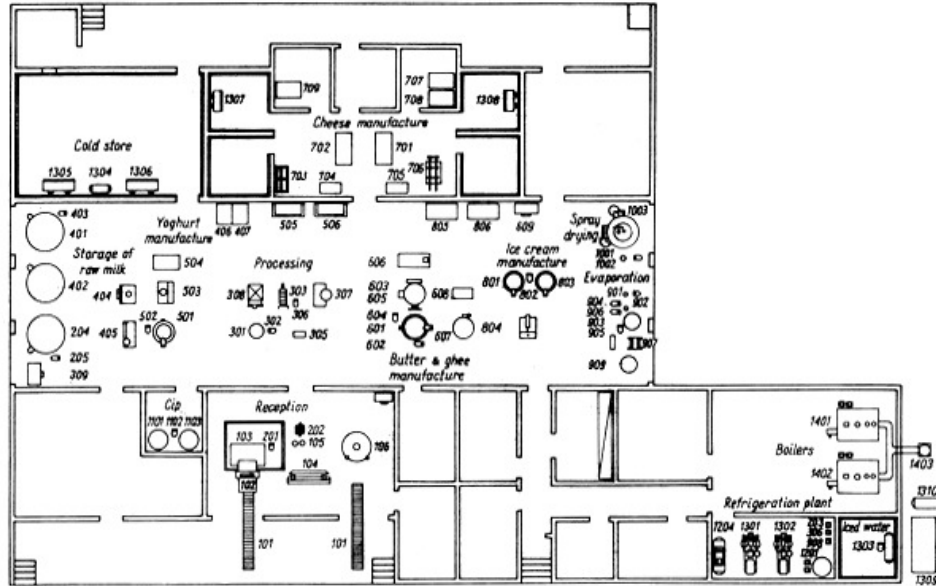


**18. Milk plant - floor finishing 1:200**

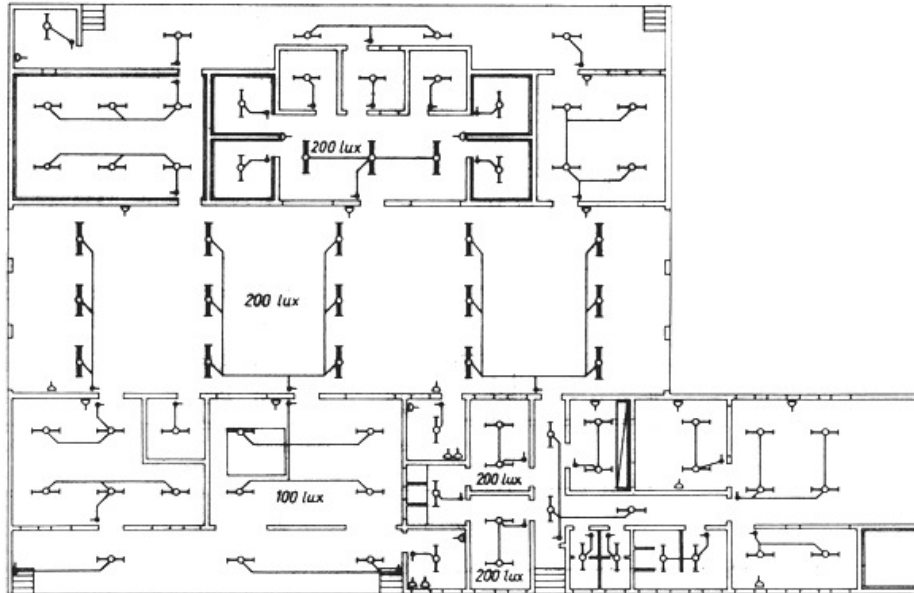
establishment of dairy training centres



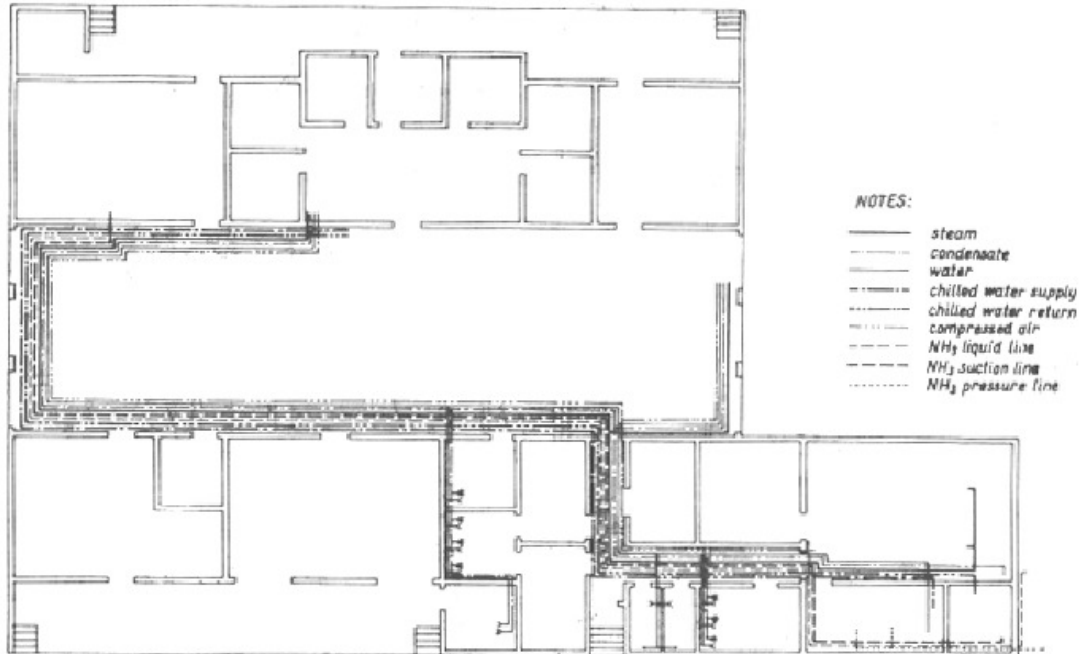
**19. Milk plant - flow diagram**



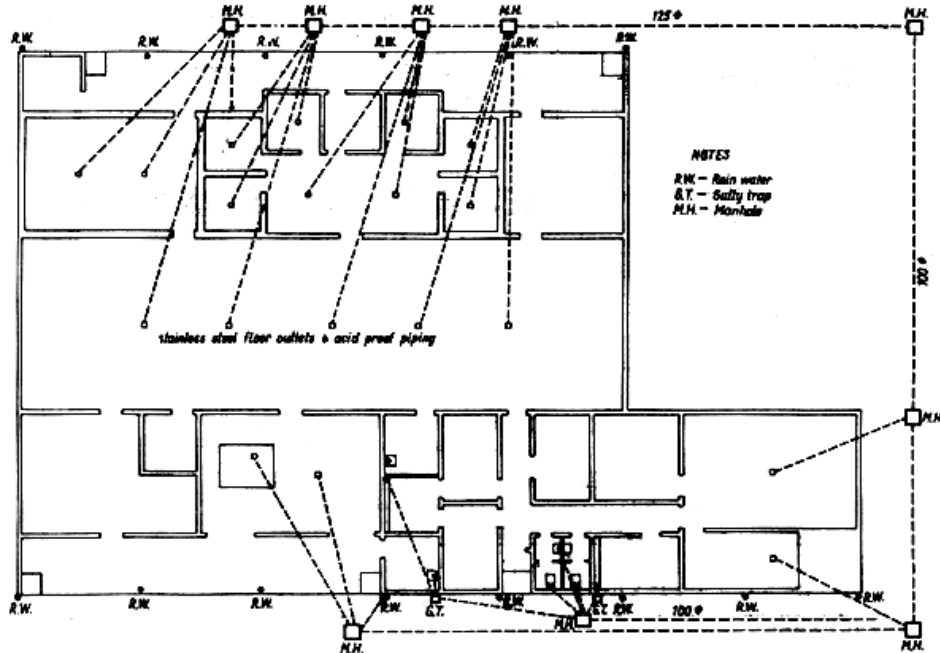
**20. Milk plant - machinery layout 1:200**



**21. Milk plant - lighting 1:200**



**22. Milk plant - piping layout 1:200**



23. Milk plant - sewage layout 1:200

1 Set of various dairy equipment, consisting of:

- pails
- brushes
- detergents



- **incinerator**

**about 4–6 months' consumption**

**1 Set of laboratory equipment, complete for the following tests:**

**Butter fat test**

**Acidity test**

**Density test**

**Reduction test**

**Plate count/coli test**

**Total solids test**

**Butter moisture test**

**Freezing point test**

**The workshop consists of tools and equipment necessary for the maintenance of the plant.**

**1 Set of spare parts for the Dairy Machinery, Boiler Plant, Refrigeration Plant, Water and Air Supply Plant, and Electrical Installation**

**Erection and running - in include:**

**Erection of the Dairy Machinery**

**Erection of the Refrigeration Plant, Boiler Plant, Water and Air - Supply Plant**

**Air - conditioning for the dairy plant includes extension of the ice water tank****5.13 Milk Collecting Centre****Description**

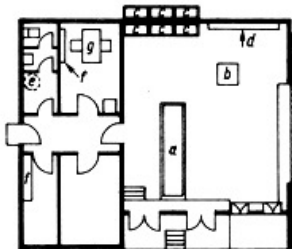
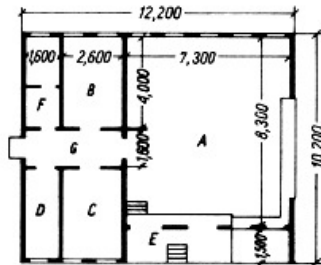
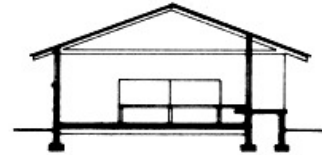
The milk collecting centre (Drawing 24) is designed to handle 1,000 litres of milk a day.

The reception area has two sections, one counter to receive milk from small holders and a ramp where large quantities of milk can be received.

There is easy access from both reception areas to the collecting equipment. In the layout a Basin cooler with space for 25 40-litre milk cans has been shown. It is possible, if the collection system justifies it, to install a cooling tank.

A compressor room has been allowed for, to cater for individual choice regarding the cooling systems. The compressor room should also serve as a workshop and spare parts store.

Washing facilities are available inside for equipment used in the milk collecting centre and outside for farmers to wash their milk containers after milk delivery.



### Area (m<sup>2</sup>)

A Milk handling	67.7
B Office	11.6
C Compressor room	11.6
D Store	7.5
E Ramp	7.0
F Toilet	7.5
G Corridor	<u>7.8</u>

Total area

121 m<sup>2</sup>

### Furniture and Equipment

- a In-can milk cooler
- b Milk separator
- c Wash basins
- d Two-tier can rack
- e Water heater
- f Shelves

### ***24, Milk Collecting centre 1:200***

**It is assumed that hot water will be supplied from an electric water heater. Where no electricity is available a 44–gallon drum can be built into a chimney arrangement and provide sufficient hot water for both washing operations mentioned above.**

**A hand-operated cream separator with a capacity of approximately 500 litres an hour is included to facilitate separation of low grade milk.**

**The centre is large enough to give practical training to six students at a time.**

#### **Cost Estimate**

	<u>US\$</u>
Construction	
121 m <sup>2</sup> at US\$	15,800
130 m <sup>2</sup>	
Electricity	1,400
Plumbing	800
Sewage	<u>300</u>
Total building costs	18,300

Furniture	600
Equipment	<u>7,800</u>
Grand total	26,700

## **24. Milk Collecting Centre - Specifications**

- a. Electricity - Installed power 5.0 Kw**
  - 12 Mounted single tube fluorescent fittings**
  - 1 Weatherproof tungsten fitting**
  - 2 5A socket outlets**
  - 2.20A cord outlet boxes**
  - 1 13A spur unit switched and fused with pilot lamp**
  
- b. Plumbing**
  - 2 Water storage tanks**
  - 1 Water closet**
  - 1 Wash basin**
  - 13 Water taps and piping**
  
- c. Sewage**
  - 1 Manhole and piping**
  
- d. Furniture**
  - 1 Set four-tier shelves**
  - 1 Writing desk**

**2 Chairs**

**1 Metal filing cabinet**

**3.5 metres cotton curtain material**

**e. Equipment**

**1 Cooling unit**

**1000 litres milk an hour from 35°C to 8°C**

**1 Hand-operated separator**

**400 litres/hour**

**6 Galvanized wash basins**

**1 Platform weighing scale 250 kg**

**4 Spring balances 30 kg**

**1 Water heater - Electric**

**150/200**

**1 Two-tier can rack**

**30 Milk cans, each 40 litres**

**4 Strainers**

**6 Stainless steel buckets**

**Brushes**

**Brooms**

**12 Lactometers**

**12 Thermometers**

**1 Water bath and other resazurin equipment**

**Detergents (Washing soda and soap)**

**Sterilizers (Chloride of lime)**

**Whitewash**

**2 Litre measures**

**6 Dippers for sampling**

**Set of tools**

### **5.14 Hand Milking Unit 6 to 10 cows**

#### **Description**

The hand milking unit (Drawing 25) is designed to cater for small scale dairy farmers with handmilked herds of six to ten mature cows.

The unit contains two milking places, two calf pens, a fodder store and a milk room equipped with the essentials for carrying out a technically correct milking procedure.

It is assumed that no electricity or cooling equipment is available. Needs for light must be covered with kerosene or gas-fuelled lamps. Delivery of milk have to take place immediately after each milking.

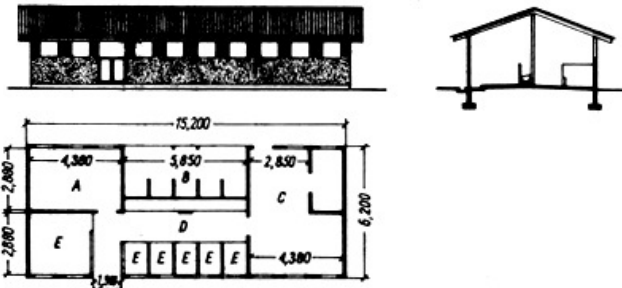
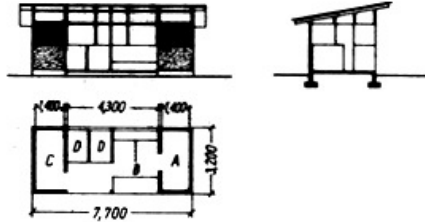
#### **Milking unit for 6–10 cows**

A Feed store

B Milking room

C Milk store

D Calf pens

Milking unit for 20–40 cows

- A Feed store
- B Milking room
- C Milk store
- D Feeding area
- E Calf pens

**25. Milking units 1:200**

The milking places have mangers for concentrate feeding and a simple fastening system ensures that the cows are kept quiet during milking. It is estimated that milking of ten cows can be completed within one hour.

The calf pens have half doors opening in the total width of the individual pen for easy cleaning.



**The milk room is equipped with a cement basin divided into two for washing equipment and has shelves along the wall.**

**Hot water will have to be supplied from a charcoal or wood-fire outside the building.**

**The unit will provide practical training for four to six students.**

### **Cost Estimate**

	<u>US\$</u>	<u>US\$</u>
Construction 25 m <sup>2</sup> at US\$ 70/m <sup>2</sup>	1,750	
Contingencies	<u>180</u>	1,930
Electricity		Nil
Plumbing		270
Sewage		<u>100</u>
	Total building cost	2,300
Brushes, brooms, clothes, baskets, etc.	<u>200</u>	
	Grand total	<u>2,500</u>

### **5.15 Mechanical Milking Unit 20 to 40 cows**

**Description**

**The mechanical milking unit is designed to cater for medium to large scale dairy farmers utilizing machine milking on herds of 20 to 40 mature cows.**

**The unit contains a milking area with space for five cows, five calf pens for young calves, a calf pen for calves more than six weeks old, a fodder store, a milk room and a compressor room.**

**A pipe machine milking unit with two teat cup clusters and milk delivery directly to the milk room facilitate an up-to-date milking system. It is estimated that milking of 20 cows can be completed within 60 to 90 minutes.**

**The calf pens for young calves have half doors in the whole width of each individual pen for easy cleaning.**

**The pen for six weeks' calves provides a free moving area.**

**The fodder store contains no special equipment except for a weighing scale and a trolley for fodder transport.**

**The milk room is provided with washing facilities, can rack and a recording desk. Hot water is supplied from an electrical water heater placed in the compressor room, where the vacuum pump for the milking machine is also placed. There is also space in this room to install a compressor for cooling the milk.**

**The unit is large enough for six to eight student at a time to be given practical training.**

### **Cost Estimate**

	<u>US\$</u>	<u>US\$</u>
Construction 94		
m <sup>2</sup> at US\$ 66	5,595	
m <sup>2</sup>		
Contingencies	<u>560</u>	6,200
Electricity		800
Plumbing		400
Sewage		<u>100</u>
Total building cost		7,500
Furniture		300
Equipment		<u>7,100</u>
Grand total		<u>14,900</u>

### **Mechanical Milking Unit - Specifications**

- a. **Electricity** – Installed power 1.5 Kw
  - 9 Mounted single tube fluorescent lights**
  - 2 20A cord outlets**

**b. Plumbing****7 Water taps and pipework****c. Sewage****1 Soak pit****d. Furniture****Managers and fastening devices for cows and calves****1 Board for pregnancy control****1 Waiting desk****1 Chair****e. Equipment****1 Pipe machine milking unit with two teat-cup clusters and five vacuum outlets****1 Vacuum pump for milking machine****1 Electric water heater 100/150 l.****3 Galvanized wash basins****20 Milk cans - 40 litres each****4 Strip cups****2 Spring balances, 30 kg****1 Platform scale, 250 kg****1 Two-tier can rack****1 Cooling unit. Capacity 1,000 l, 35°C to 8°C in one hour****1 Hand-operated separator, 400 l/hour****4 Stainless steel buckets**

**6 Galvanized iron buckets****1 Trolley with galvanized iron receptacle for fodder distribution****2 Lactometers****2 Thermometers****40 Cloths for washing udders****Brushes****Brooms****Detergents, soap and soda****Sterilizers, chloride of lime****Whitewash****Milking jelly****2 Shovels****Set of tools****THE FAO TECHNICAL PAPERS****FAO PLANT PRODUCTION AND PROTECTION PAPERS:**

- 1. Horticulture: a select bibliography, 1976 (E\*)**
- 2. Cotton specialists and research institutions in selected countries, 1976 (E\*)**
- 3. Food legumes: distribution, adaptability and biology of yield, 1977 (E\* F\*\*\* S\*)**
- 4. Soybean production in the tropics, 1977 (E\* F\* S\*)**
- 5. Les systèmes pastoraux sahéliens, 1977 (F\*)**
- 6. Pest resistance to pesticides and crop loss assesement - 1, 1977 (E\* F\* S\*)**
- 7. Rodent pest biology and control. Bibliography 1970–74, 1977 (E\*)**

8. Tropical pasture seed production of food legume crops, 1978 (E\* F\* S\*)
9. Improvement and production of food legume crops, 1977, (E\*)
10. Rev. Pesticide residues in food 1977 – Report, 1978 (E\* F\*\*\* S\*)
11. Sup. Pesticide residues in food 1977 – Evaluations, 1978 (E\*)
12. Pesticide residues in food 1965–77 –Index and summary, 1978 (E\*F\*\*\* S\*\*\*)
13. Crop calendars, 1978 (E/F/S\*)
14. Manual on the use of FAO specifications for plant production products, 1979 (E\*)
15. Integrated control of rice insect pests, 1979 (E\*)

#### FAO ANIMAL PRODUCTION AND HEALTH PAPERS:

1. Animal breeding: selected articles from World Animal Review, 1977 (C\* E\* F\* S\*)
2. Eradication of hog cholera and African swine fever, 1976 (E\* F\* S\*)
3. Insecticides and application equipment for tsetse control, 1977 (E\* F\*)
4. New feed resources, 1977 (E/F/S\*)
5. Bibliography of the criollo cattle of the Americas, 1977 (Bi. E/S\*)
6. Mediterranean cattle and sheep in cross breeding, 1977 (E\* F\*)
7. Environmental impact of tsetse chemical control, 1977 (E\* F\*)
8. Declining breeds of Mediterranean sheep, 1978 (E\* F\*)
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