



**REPORT ON  
INDUSTRIAL TRAINING INSTITUTES  
AND  
CENTRAL TRAINING INSTITUTES**

**COMMITTEE ON PLAN PROJECTS**

**(Buildings Projects Team)**

**NEW DELHI**

*October, 1960*



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## **Composition of the Team for Selected Buildings Projects.**

### *Leader*

Shri S. K. Patil, Minister for Food and Agriculture.

### *Members*

Shri Sarup Singh, ISE (Retd.), formerly Director, National Buildings Organisation.

Shri N. G. Dewan, ISE, Chief Engineer, Central Public Works Department.

Dr. Eng. A. Carbone, Consulting Engineer, Calcutta.

Shri C. P. Malik, Director, National Buildings Organisation (*ex-officio*).

### *Secretary*

Shri T. S. Vedagiri, Superintending Engineer.



MINISTER FOR  
FOOD AND AGRICULTURE,  
GOVERNMENT OF INDIA  
*New Delhi, October 10, 1960.*

My dear Pantji,

I have great pleasure in forwarding herewith the report of the Buildings Projects Team on Industrial Training Institutes and Central Training Institutes. As a number of Industrial Training Institutes and a few Central Training Institutes are to be constructed in the Third Plan, the Team considered it worthwhile to study the space requirements, space planning and design aspects of these structures. A Panel was therefore set up under the Chairmanship of Shri M. L. Nanda, Additional Chief Engineer, CPWD in consultation with the Director General of Resettlement and Employment, two of whose Officers are also on the Panel. The Members of the Team were also closely associated with the work of the Panel.

The Panel examined in detail the lay out of workshops and other buildings and has prescribed the requirements of space for various trades and other facilities. It has also laid down recommendations for efficient space planning and structural designing.

You will be glad to know that the recommendations regarding space requirements laid down now by the Panel will lead to a saving in area of about 10% in the workshops and 17% in the main building. The report has been accepted by the Director General, Resettlement and Employment.

To facilitate implementation of the report, the Panel has prepared a proforma which when filled up by the authorities incharge of planning the Institutes would give at a glance the norms recommended by the Panel for various facilities and those achieved in actual planning. A copy of the proforma is appended to the report.

I take the opportunity of thanking the Chairman and Members of the Panel for the trouble they have taken in preparing the report.

Yours sincerely,

S. K. PATIL

Shri Govind Ballabh Pant,  
Minister for Home Affairs,  
Government of India,  
New Delhi.

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**AND**  
**CENTRAL TRAINING INSTITUTES**

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## INTRODUCTION

0-1. The necessity for increasing the number of trained craftsmen in various trades to meet the growing needs of industries in the country needs no special mention. Recognising its importance, the Planning Commission allotted Rs. 16.7 crores in the Second Five Year Plan for the development of craftsmen training facilities. Out of this, Rs. 14.72 crores are earmarked for the development of training facilities at training institutes while the remaining amount will be utilised for apprenticeship training and other schemes. This amount has been apportioned among the various States depending upon their needs.

0-2. In view of the large number of institutes to be set up all over the country, the Committee on Plan Projects in consultation with the Director General of Resettlement and Employment decided to set up a Panel to determine rational space requirement of the institutes and suitable specifications to be adopted for the buildings etc. The composition of the Panel is given below :—

Shri M. L. Nanda,  
Additional Chief Engineer,  
C. P. W. D.

*Chairman*

Shri P. Raj Nath,  
Director of Training,  
D. G. R. & E.

*Member*

Shri S. Sundaresan,  
Deputy Director,  
D. G. R. & E.

*Member*

Shri T. R. Mahendru,  
Architect.

*Member*

Shri T. S. Vedagiri,  
Superintending Engineer and  
Secretary, B. P. Team.

*Member-Secretary.*

0-3. The Industrial Training Institutes are intended to cater to the growing need for trained and skilled manpower. It is proposed to expand the training facilities from the existing 10,500 seats to about 31,400 seats; thus about 20,900 additional seats have to be provided during the Plan period. This will be achieved by expansion of the training facilities at existing Training Institutes and by opening new Institutes.

0-4. The pre-requisite for efficient training of craftsmen is the improvement of the quality of the instructors. The Central Training Institutes are intended for the purpose of training instructors. Six such institutes are contemplated to be established, one each at Bombay, Calcutta, Kanpur, Ludhiana, Madras and Hyderabad. Construction of the institutes at Bombay and Calcutta has been taken up and the work is in progress. The capacity of

the institute at Calcutta will be 400 while that of the other five institutes will be 250 each. An Industrial Training Institute of the same capacity for craftsmen trainees will be attached to each Central Training Institute.

0.5. The details of accommodation for Industrial Training Institutes were first worked out by an *ad-hoc* committee appointed by the Ministry of Labour in 1957. These requirements were however reviewed by the D.G.R. & E., on the basis of detailed layout worked out for each and every trade. The Panel wishes to place on record its appreciation of the work done in this direction by the D.G.R. & E. which has incidentally simplified its work. The layout diagrams have been examined in great detail by the Panel and certain reductions in areas have been effected by cutting out unnecessary circulation space and by rearranging the equipment wherever possible.

0.6. The revised requirements of administrative building, workshop, hostel building, staff quarters etc. for Industrial Training Institutes are set out in Section 1 of the report. Regarding Central Training Institutes, the Panel has taken into account the extra requirements for the proper functioning of the Institutes and laid down the standards for administrative building, workshop, hostel building, etc. These are given in Section 2. In Sections 3 & 4 the Panel has dealt with the factors that should be taken into account in the planning and designing of these buildings. Specifications to be followed for the different items of work in order to ensure uniformity in the pattern of buildings and for effecting economy consistent with functional requirements are outlined in Section 5. Proforma for implementing the recommendations is dealt with in Section 6.

## I. INDUSTRIAL TRAINING INSTITUTES

1.1. Under the Craftsmen Training Scheme of the D.G.R. & E., training is being imparted in engineering and non-engineering trades. The period of training for engineering trades is two years of which 18 months are to be spent in the Institute and 6 months in an industrial establishment for practical training. In the case of non-engineering trades the period of training is only 12 months and there is no provision for practical training. Admissions are made after 9 months intervals for engineering trades and 12 months for non-engineering trades.

1.2. Accommodation to house an Industrial Training Institute will consist of a main building, workshop, hostel building, staff quarters and ancillary buildings. The size of each is to be determined on the basis of the number of persons to be trained. Depending on the demands of each locality, the institutes may have seating capacities of 250, 500, 750 or 1000. There may be a few with a strength of about 160 also. A model institute with a capacity of 368 seats according to break up given in Appendix I was taken up for study. The space requirements of all the buildings mentioned above agreed upon after detailed examination and discussions are given in the succeeding paragraphs.

### 1.3. Main Building

The main building will accommodate the administrative wing classrooms, library, assembly hall, drawing section etc. The break up of area for different strengths are given in Table I below :—

TABLE I—MAIN BUILDING OF AN I. T. I.

| Sl. No. | Sub Head                                | Carpet area in sft for a strength of |                  |        |         |         |         |
|---------|---|--------------------------------------|------------------|--------|---------|---------|---------|
|         |   | 368                                  | 160              | 250    | 500     | 750     | 1000    |
| 1.      | Principal's Room . . . . .              | 300                                  | 200              | 200    | 300     | 300     | 300     |
| 2.      | Vice Principals Room . . . . .          | ..                                   | ..               | ..     | 200     | 200     | 200     |
| 3.      | Secretary/Steno/ Waiting Room . . . . . | 200                                  | ..               | ..     | 200     | 200     | 200     |
| 4.      | Staff Room . . . . .                    | 600                                  | 150              | 250    | 600     | 800     | 1000    |
| 5.      | Clerks Room* . . . . .                  | 360                                  | —See note below— |        |         |         |         |
| 6.      | Records Room . . . . .                  | 200                                  | 80               | 100    | 200     | 200     | 200     |
| 7.      | Library & Reading Room . . . . .        | 1000                                 | 300              | 500    | 1000    | 1000    | 1000    |
| 8.      | Class Room† . . . . .                   | 2700                                 | 900              | 1200   | 3600    | 4500    | 5400    |
|         |   | (9nos)                               | (3nos)           | (4nos) | (12nos) | (15nos) | (18nos) |
| 9.      | Demonstration Hall . . . . .            | 600                                  | 500              | 500    | 800     | 800     | 800     |
| 10.     | Drawing Hall . . . . .                  | 600                                  | 300              | 400    | 600     | 1200    | 1800    |
| 11.     | Canteen . . . . .                       | 1013                                 | 400              | 600    | 1100    | 1150    | 1200    |
| 12.     | Lockers . . . . .                       | 100                                  | 40               | 60     | 120     | 240     | 300     |

NOTE :—An Assembly Hall may be provided at a future date when funds permit. The floor area may be determined at the rate of 6 sft. per head for the total strength of the Institute (including craftsmen trainees and staff). An additional area of 600 sft. may be adequate for dais.



The area for clerks room should be calculated at the rate of 40 sq. ft./clerk + 10% for storage of records.

The institute works in two shifts from 7 A. M. to 2.30 P. M. & 12.30 P. M. to 8 P. M. The time table is so arranged that the theory classes are held from 7 A.M. to 9 A.M. for the first shift and 12.30 P. M. to 2.30 P.M. for the second shift. The overlapping period of two hours from 12.30 P.M. to 2.30 P.M., is utilised for theory classes in the second shift. Thus the workshop is utilised fully from 9 A.M. to 8 P.M. The utilisation of class rooms for a period of four hours only in a day may appear to be on the low side but this is the only possible arrangement if the workshops are to be put to continuous use. However, in arriving at the number of class rooms required for the various strengths, the dispersion effect of certain sections using the drawing hall and the demonstration hall has been taken into account.

#### 1.4. Workshop Building

The trades which will be accommodated and the space requirements are given in Table II below :—

TABLE II—WORKSHOP BUILDING OF AN I.T.I.

| Sl. No. | Trade                                    | Carpet area per seat in sq. ft. |
|---------|--|---------------------------------|
| 1.      | Blacksmith                               | 132                             |
| 2.      | Carpenter                                | 210                             |
| 3.      | Fitter                                   | 64                              |
| 4.      | Moulder                                  | 127                             |
| 5.      | Machinist                                | 166                             |
| 6.      | Turner                                   | 125                             |
| 7.      | Mechanic (Inst.)                         | 47                              |
| 8.      | Mechanic (Motor)                         | 175                             |
| 9.      | Sheet Metal Worker                       | 65                              |
| 10.     | Electrician                              | 122                             |
| 11.     | Mechanic (Radio)                         | 60 (In Main Building)           |
| 12.     | Draughtsman                              | 66 Do.                          |
| 13.     | Welding Shop                             | 98                              |
| 14.     | Tailoring Section                        | 62                              |
| 15.     | Weaving Section                          | 158                             |
| 16.     | Leather Section                          | 63                              |
| 17.     | Grinder Section                          | 125                             |
| 18.     | Mechanic (I.C. Engine/Dom. Refrigerator) | 94                              |
| 19.     | Surveyor Section                         | 66                              |
| 20.     | Tool Maker/ Die Fitter.                  | 75                              |
| 21.     | Wireless Operator                        | 50                              |
| 22.     | Electroplator                            | 100                             |
| 23.     | Wireman                                  | 64                              |
| 24.     | Painter & Decorator.                     | 65                              |
| 25.     | Pattern Maker                            | 120                             |
| 26.     | Plumber                                  | 66                              |
| 27.     | Upholstery                               | 62                              |
| 28.     | Watch & Clock repair                     | 47                              |
| 29.     | Mechanic (Tractor)                       | 175*                            |

|   | Carpet area in sq. ft. for a strength of   |      |      |      |      |      |
|---|--|------|------|------|------|------|
|   | 368  | 160  | 250  | 500  | 750  | 1000 |
| 30. Allied Trades . . . . .   | 3200   | 1500 | 2000 | 3200 | 5000 | 6000 |
| 31. Foreman . . . . .   | 200  | 100  | 200  | 200  | 300  | 300  |
| 32. Supervisors . . . . .   | 400  | 250  | 300  | 400  | 800  | 800  |
| 33. Demonstration Room . . . . .  | 400  | 250  | 300  | 400  | 400  | 400  |
| 34. Lockers . . . . .   | 640  | 200  | 450  | 800  | 1000 | 1200 |
| 35. Stores (Exhibition, Model Room Inflammable Stores Finished goods inspection etc.) | 15% of the total workshop area.<br>(NOTE: The area under items 11 & 12 above may also be included for working out the total workshop area for this purpose.) |      |      |      |      |      |

\*The Mechanic (tractor) section needs more parking space as compared to Mechanic (Motor) section. Where possible half an acre of land may be set apart for testing purposes.

1.5. While arriving at the total area of workshop the following points may also be kept in view—

- (1) The area per trainee given in Table-II has been worked out on the basis of a group strength of 16. Where two or more groups of same trade work in the same shift, some of the equipment can be shared. The area per student should be accordingly reduced. It is not possible to prescribe to what extent these reductions should be made as it will differ from trade to trade. The Panel would only emphasise that this should be kept in view while determining the total area requirements.
- (2) Wherever there is carpentry as well as pattern making the two can be so laid out in order to make more effective use of common equipments and thus reduce the space.
- (3) Along with the workshop, a first aid room and a time keepers office each of size 120 sq. ft., should also be provided in a convenient location.

### 1.6. Hostel Building

The Industrial Training Institutes are normally located at regional centres. Number of students, therefore, who may require hostel accommodation are not likely to be more than 50 to 60% of the total strength. In the first instance dormitory type accommodation may be provided for 50% of the strength. In the lay out, space should be reserved for extension at a later date as necessity arises and funds permit.

### 1.7. Staff Quarters

It is recommended that quarters must be provided for the "essential staff". For the rest of the staff a coverage of 30% appears to be reasonable. The provision must be limited to 50% of the total strength of staff. In the layout,

however, space must be reserved for expansion. The scales of accommodation should be in accordance with those recommended for industrial housing in public sector as per details below :—

| Type          | Salary P.M.      | Plinth area.                                    |
|---------------|------------------|---|
| I . . . . .   | Below Rs. 60/-   | 365 sft.  |
| II . . . . .  | Upto Rs. 150/-   | 400 sft.  |
| III . . . . . | Rs. 151—300/-    | 600 sft.  |
| IV . . . . .  | Rs. 301—750/-    | 900 sft.  |
| V . . . . .   | Rs. 751—1500/-   | 1500 sft.                                       |
| VI . . . . .  | Above Rs. 1500/- | 2100 sft.<br>240 sft. (Ser.)<br>225 sft. (Gar.) |

NOTE —The pay scales mentioned above are the existing ones. They do not take into account the new scales introduced on the recommendations of the Pay Commission.

### 1-8. Ancillary Buildings

The provision of ancillaries may be regulated in accordance with the needs of situation in each institute. The Panel would define ancillaries as those facilities which are essential to the working of an institute. It is difficult to define these with exactitude in each case as much will depend upon the facilities available in the neighbourhood. However, facilities such as the provision of a cycle-stand, reasonable number of garages for motor vehicles utilised in the institute, a dispensary and utility shops where the shopping neighbourhood is at a distance, would be acceptable items. The provision of a post office or a bank should be ruled out in almost all the cases except in very special circumstances.

## 2. CENTRAL TRAINING INSTITUTES

2.1. Planning of a Central Training Institute with 250 seats was studied in detail and the space requirements decided upon are given in Table III below :—

TABLE III—MAIN BUILDING OF A C.T.I.

| Sl. No.      | Sub Head                                | No. of rooms | Total, carpet area in sq. ft. |
|--------------|---|--------------|-------------------------------|
| 1            | Principal's room and P.A.'s Room        | 1            | 300                           |
| 2            | Vice Principal's Room                   | 2            | 320                           |
| 3            | Registrar's Room                        | 1            | 160                           |
| 4            | Visitors Room                           | 1            | 300                           |
| 5            | Chief Expert                            | 1            | 300                           |
| 6            | Room for Office Clerks*                 | 1            | 400                           |
| 7            | Committee Room                          | 1            | 500                           |
| 8            | Record Room                             | 1            | 200                           |
| 9            | Staff Room                              | 1            | 400                           |
| 10           | Drawing Hall                            | 1            | 600                           |
| 11           | Class Rooms (all of demonstration type) | 11           | 3,300                         |
| 12           | Lecture Hall                            | 1            | 800                           |
| 13           | Library & Reading Room                  | 1            | 1,500                         |
| 14           | Dark Room                               | 1            | 160                           |
| 15           | Canteen Kitchen & Tiffin Room           | 1            | 1,000                         |
| 16           | Lecture Room                            | 2            | 800                           |
| 17           | Store & Stationery Room                 | 1            | 300                           |
| 18           | Show Room (Model Room)                  | 1            | 600                           |
| <b>TOTAL</b> |   |              | <b>12,040</b><br>sft.         |

\*The area for clerk's room should be calculated at the rate of 40 sq. ft./ clerk + 10% for storage of records.

NOTE:—An Assembly Hall may be provided at a future date when funds permit. The floor area may be determined at the rate of 6 sq. ft. per head for the total strength of the institute (including instructor trainees and staff). An additional area of 600 sq. ft. may be adequate for dais.

## 2.2. Workshop Building

The workshop building of Central Training Institutes is to accommodate additional equipment as compared to Industrial Training Institute. The space requirements of the workshop for C.T.I. are given in Table IV below:—

TABLE IV—WORKSHOP BUILDING OF C.T.I.

| Sl. No. | Trade                                    | Carpet area per seat in sq. ft. |
|---------|--|---------------------------------|
| 1       | Black Smith                              | 140                             |
| 2       | Carpenter                                | 210                             |
| 3       | Fitter                                   | 70                              |
| 4       | Moulder                                  | 140                             |
| 5       | Machinist                                | 180                             |
| 6       | Turner                                   | 140                             |
| 7       | Mechanic (Instrument)                    | 50                              |
| 8       | Mechanic (Motor)                         | 190                             |
| 9       | Sheet Metal Worker                       | 70                              |
| 10      | Electrician                              | 135                             |
| 11      | Mechanic (Radio)                         | 60                              |
|         |  | (In main Building)              |
| 12      | Draughtsman                              | 66                              |
|         |  | Do.                             |
| 13      | Welding Shop                             | 110                             |
| 14      | Tailoring Section                        | 62                              |
| 15      | Weaving Section                          | 170                             |
| 16      | Leather Section                          | 70                              |
| 17      | Grinder Section                          | 140                             |
| 18      | Mechanic (I.C. Engine/Dom. Refrigerator) | 105                             |
| 19      | Surveyor Section                         | 66                              |
| 20      | Tool Maker/Die fitter                    | 85                              |
| 21      | Wireless Operator                        | 50                              |
| 22      | Electroplator                            | 100                             |
| 23      | Lineman & Wireman                        | 64                              |
| 24      | Painter & Decorator                      | 65                              |
| 25      | Pattern Maker                            | 135                             |
| 26      | Plumber                                  | 66                              |
| 27      | Upholstery                               | 62                              |
| 28      | Watch & Clock Repair                     | 47                              |
| 29      | Mechanic (Tractor)                       | 190                             |

| Sl. No. | Trade   | Total carpet area in sft for 250 seats.   |
|---------|---|---|
| 30      | Allied Trades . . . . .   | 4000  |
| 31      | Mill Wright Section . . . . .   | 1000  |
| 32      | Foreman . . . . .   | 200   |
| 33      | Supervisors . . . . .   | 400   |
| 34      | Demonstration Room . . . . .  | 400   |
| 35      | Lockers . . . . .   | 800   |
| 36      | Stores<br>(Exhibition, Model Room, Inflammable Stores,<br>Finished goods inspection etc.) | 15% of total work-<br>shop area. (Items<br>11 & 12 may be in-<br>cluded for working<br>out the total work-<br>shop area for this<br>purpose). |

NOTE :—(1) The points referred to in working out total workshop area in para 1.5 should be kept in view with regard to the Workshops of Central Training Institutes also.

(2) As an I.T.I. will be invariably attached to the C.T.I. the facilities should be proportioned to suit the working of both in two separate shifts. This has already been taken into account in the requirements of items 30 to 36 above.

### 2.3. Hostel Building

The Central Training Institutes are located at a few selected places and the persons to be trained come from all parts of the country. The number of trainees who do not need hostel accommodation is negligible. Hostel accommodation may, therefore, be provided for the whole of the sanctioned strength. Also because of the disparity in age and status amongst the instructor trainees the hostel accommodation should consist of single seater type.

### 2.4. Staff Quarters

Staff quarters may be provided for 50% of the total strength. Space should however, be left in the layout for future expansion to cover 80% of staff. As regards the scales of accommodation, the recommendations for industrial housing in the public sector as detailed in para 1.7 should apply.

### 2.5. Ancillary Buildings

The principles enumerated for ancillary buildings in para 1.8 would apply.

### 3. PLANNING OF SPACE

In the foregoing sections of the Report, the requirements of space and of her facilities for I.T.I. s and C.T.I. s have been discussed. The Planning of space within the buildings is a matter of detail. Broad guiding principles for securing maximum efficiency in planning are outlined in this section.

#### 3.1 Main Building

For the purpose in view it would not be convenient to have the main building consisting of more than two or three storeys. Preferably it should be of the central corridor pattern, the corridor having a clear width of 8 ft. The grid should give economical size of rooms consistent with requirements. It may be necessary from the point of view of economy to adopt different grid pattern in the different sections of the building. The Library should in all cases be in the ground floor. The Assembly Hall may be an integral part of the main structure but should be capable of being constructed at a later date.

The design efficiency\* for a building of this type should be of the order of 65 to 70 %.

#### 3.2 Workshop Building

The area per trainee in the workshop for different trades has already, been specified. This is based on the assumption that for each trade a separate building will be required. But in practice it is rarely the case. Several trades will be accommodated and rightly so in the same building. This arrangement leads to better utilisation of common facilities, such as, canteen, WCs, etc. This also affords a certain degree of flexibility in the planning of space for the different trades in the building. To the workshop area determined by the norms for various trades to be accommodated, addition of 15 to 20% may be made for passage, corridor, entrance hall, lavatories, walls, partitions and columns. In other words, the design efficiency in this case should be of the order of 80 to 85%.

In the proposed plans for the workshops there does not seem to be any uniformity in the sizes of workshops or the spans of structural members. Some of the sizes adopted are 23' x 45', 30' x 55' and 38' x 64'.

Standardisation of span would lead to economy. In the opinion of the Panel adoption of a standard span of 40 ft. would prove suitable' around. The spacing between the trusses may be kept from 12½ ft. to 15 ft. Two-bay or three-bay shed of this type with lengths in multiples of 12½ ft. to 15 ft. suited to meet particular requirements would be a satisfactory solution.

#### 3.3 Sanitary Accommodation

The scales of sanitary accommodation both for Central Training Institutes and Industrial Training Institutes may be as follows:

- (i) 3 WCs per 100 persons.

---

\*The ratio of usable area to plinth area.

- (ii) 4 Urinals per 100 persons.
- (iii) 4 Wash hand basins per 100 persons for the Main Building and 15 taps per 100 persons arranged in a longitudinal mosaic trough for the Workshop.

The above norms should be applied to the expected peak figure of attendance at a time and not to the total strength. Separate provision of sanitary facilities may be made for the staff members.

Sanitary accommodation should be so placed as to avoid long leads. There should be adequate day light and ventilation in the lavatories and W.C.s. Area for ventilation must be 15% of floor area and half of this should be such as to serve as permanent ventilation.

### 3·4 Hostel Buildings

For Industrial Training Institutes the accommodation may consist of dormitories. One dormitory should serve 8-10 persons at the rate of 55—60 sq. ft. per trainee. In the Central Training Institutes, single seater rooms of size 85-90 sq. ft. may be provided. This is considered adequate to meet all normal requirements of living and study.

The Planning and Design of University Hostel Buildings has been examined by a Panel set up by the Chairman of the University Grants Commission and their recommendations would soon be out. These should be kept in view in the planning of hostel buildings. Broad principles are, however, outlined below.

The service area of a hostel normally includes the dining hall, kitchen and toilets. The dining space may be provided for 2/3rds of the total strength of the hostel at the rate of 10-12 sq. ft. per trainee. The kitchen, pantry and store area can similarly be worked out on the basis of 5-7 sq. ft. per trainee. These norms are for a strength of 100 trainees and can be reduced say by 10% for bigger hostels.

Apart from living rooms and service space, a common room of 500-650 sq. ft. for lounge and recreation may be provided for a hostel of 100 trainees.

Toilet blocks should be suitably located in the hostel and the provision may be at the rate of one urinal, one wash basin and one bath room with shower for every eight persons while W.Cs may be one for ten persons.

The circulation space which consists of corridors, stair cases, lobbies etc., should not exceed 1/3rd of the total of living, service and common room space. To the total floor area so obtained the thickness of walls and columns should be added to obtain the total built up area. The aim of planning must be to arrive at a total built-up area that does not exceed 140—145 sq. ft. per trainee in the case of Industrial Training Institutes. For Central Training Institutes the built-up area per trainee should not be more than 2·30 to 2·50 times the floor area per trainee.

If the hostel is far away from the town, shopping facilities must be provided within the campus. It is advisable to have a warden attached to each hostel block. One warden can conveniently look after 100 persons. In cases where block of 200-300 persons are proposed, two or three wardens may have to be commissioned.



It is not possible to lay down the extent of accommodation required for hostel staff. Circumstances vary but it is recognised that in the case of hostels of Technical Institutions the staff has to start work fairly early in the morning and need accommodation in the campus.

### 3.5. Staff Quarters

As mentioned earlier the scale of accommodation to be adopted for the various categories of staff will be in accordance with standards laid down by the Government. The utility of the accommodation depends not only on what is given but also on how it is given. The subject of Residential Buildings has been studied in detail by the Buildings Projects Team and their report will be published shortly. The recommendations made therein may be referred to for the planning of staff quarters.

In general the design of the building should be such that for a given plinth area the degree of livability is a maximum. Sufficient care should be taken with regard to positioning of doors and windows and in fixing the size and shape of the room in a manner that their utility is not impaired.

As regards space utilisation the break up of figures as recommended in the report on Residential Buildings for load bearing construction are given below :—

|  |        |
|--|--------|
| (a) Living space<br>(living, dining & bed rooms)           | 47—50% |
| (b) Service Space<br>(Kitchen, Bath & W.C.)                | 15—20% |
| (c) Horizontal circulation Space<br>(passages & verandahs) | 10—12% |
| (d) Vertical circulation Space<br>(Staircases)             | 4—7%   |
| (e) Walls and Columns                                      | 15—17% |

Efforts should be made to adhere to these in preparing the plans for staff quarters.

## 4. DESIGN FEATURES

### 4.1 Main Building

Normally the main building will be two or three storeyed high and load bearing structure will be adopted. For four or more storeys, RCC framed construction would be the solution.

The plinth height may be kept 1'-6" above the crown of approach road. A floor to floor height of 11 ft. is considered adequate. The design features of multi-storied construction have already been discussed in the report of the Buildings Projects Team on multi-storeyed buildings which can be referred to but for facility of reference a few salient points are given below:

- (i) At present a working stress of 16,000 lbs. per sq. inch is assumed for mild steel reinforcement as an appreciable part of the steel supply is of untested quality. It will be better if tested and untested varieties of steel are stored separately and used according to the design provision. It may be possible to reserve tested steel for important projects like multi-storeyed buildings. If this is assured, there will be no difficulty in assuming higher stresses in steel and thereby achieving economy.
- (ii) Some have adopted a higher working stress for concrete. It may be pointed out that increase in the working stress of concrete alone cannot lead to economy unless the working stress in steel is also correspondingly increased.
- (iii) Economy in RCC frame-work also depends to some extent on the judicious choice of the concrete mix for the various components. The omnibus adoption of 1:2:4 mix for all components as has been done in most buildings observed by the Panel, is not conducive to economy. It is advantageous to use a mix of 1:1½:2 or even 1:1:2 for members which are predominantly in compression. The normal 1:2:4 mix can be adopted for members subject to flexural stresses. It is, however, better to design the mix and use quality controlled concrete.
- (iv) Frame analysis is normally done according to the well known method of moment distribution. Several variants of this are in use, but the basic principle is the same. As against this laborious method, the procedure sometimes adopted is to ignore the continuity of the structure and to design the beams as simply-supported and the columns for direct load only. This saves time in calculations but the procedure is technically not correct. Ignoring the rigidity of the junctions of beam and columns will not induce them to work as free members.
- (v) The ultimate load design is getting increasingly popular in some other countries. This method can be adopted for proportioning the members of a framed structure and is particularly advantageous in the case of compression members and doubly reinforced beam. It, however, requires expert handling.

- (vi) A high and consistent quality of concrete is necessary for work designed on the basis of the ultimate load theory. This should only be adopted, if, at the design stage, it is decided to entrust the work to builders who can be depended upon to produce quality work. It will necessitate selective tendering.
- (vii) The live load for the rooms in the main building may be taken as 60 lbs. per sq. ft. and for the corridors 80 lbs. per sq. ft.
- (viii) Expansion joints in R.C.C. frames are normally necessary at intervals of 60 to 100 feet. The exact location of these requires careful consideration. A joint provided on the straight face of the building may be difficult to treat architecturally. It is essential that it should be so located that it is not conspicuous. Recesses and turns in buildings are the best places. Joints can also be concealed behind some projections.
- (ix) In some cases the cost of foundations compared to the overall cost of the buildings was found to be too high. There was no evidence of experts knowledge having been employed in determining the bearing capacity of the soil and the type of foundations to be adopted. Foundation engineering has now become a special subject. It is our opinion that, where foundation exploration shows special features and where the structure is heavy, qualified foundation experts should be consulted. The data should be properly analysed and alternative foundation designs prepared in order to arrive at the most economical solution.

#### 4.2 Workshop Building

*Plinth height:* A Plinth height of 1 ft. above the crown of approach road is sufficient if adequate arrangements are made for surface drainage.

*Height upto tie level of roof from plinth:* As there will not be any necessity for installing over-head cranes in most of the workshops, the height of workshop may be 14' to 16' upto tie level of the truss. A height of 14' should be acceptable in humid areas if provision is made for sufficient cross ventilation. In arid regions, a height of 16' may be provided.

*Roofing:* For worksheds of this type, North light roofing is not necessary. Adequate lighting within the workshop can be obtained by arranging the sheds in East-West direction, and by providing adequate number of glazed windows in the North and South walls. This permits the use of ordinary-gable roofs which is cheaper than the North Light roofs. Where two or more bays are to be put side by side and the area exceeds 12,000 sq.ft. (i.e.  $2 \times 40' \times 150'$ ) North Light roof may be provided.

As mentioned earlier, a span of 40' would be economical and satisfactory for worksheds of this nature. Roofing may be of light structural steel work, RCC trusses and purlins, tubular trusses. Nailed timber trusses can be tried for such shops where there is no fire hazard. The economics of these alternatives have got to be worked out in each case before a final selection is made. The economy calculations should invariably take into account not only the initial cost of construction but also the cost of maintenance. The columns need not be in RCC everywhere. Stone or brick can be employed if satisfactory quality is available.

### 4.3 Staff Quarters

As mentioned earlier, the Report of the Buildings Projects Team on Residential Buildings may be referred to for the designing of staff quarters. Some of the important points are given below:—

- (1) Plinth height may be 1'-0" to 1'-6" above the crest of the approach road.
- (2) Ceiling height (*i.e.* height from top of floor to bottom of ceiling) of 9' to 11' may be adopted.
- (3) Load bearing construction with brick walls can be adopted for 3 or 4 storeyed buildings also. Incidentally this will result in saving in steel.
- (4) Regarding sizes of doors in residential buildings a reference may be made to the N. B. O. publication on standardised doors and windows.
- (5) In regions of heavy rainfall pitched roof is preferable. In areas of moderate rainfall R.C.C. flat roofs or Madras terrace may be adopted. Where construction work is taken on a larger scale, doubly curved shell units could be tried.

## 5. SPECIFICATIONS

One of the pre-requisites for economical and efficient planning is the standardisation of specifications of various items of work. Suggestions of the Panel with regard to some of the important items are given in the following paragraphs.

### 5.1 Flooring

Flooring in work sheds should have a reasonable degree of resistance to impact and abrasion. Where flooring has to come into contact with mineral oil and petrol as in garages or motor mechanic shops, monolithic flooring would be satisfactory. In general, flooring may consist of 6" rubble or sand, 4" course or lean concrete 1:5:10 and 2" wearing surface of 1:2:4 laid monolithically with the base course. Flooring in workshops should not be taken up as far as possible before the items of machinery are fixed in position. For foundries no flooring is required.

In the case of the main building, however, superior flooring with mosaic tiles may be adopted for entrance halls and corridors and ordinary cement concrete flooring for class rooms etc. For W.C. blocks also terrazzo flooring with a 3ft high dado may be adopted as it will be easy to maintain it in a sanitary condition.

For Hostel buildings cement concrete or other locally available materials can be adopted for major portion excepting toilet blocks, dining and common rooms where mosaic tile flooring or terrazzo can be adopted.

For residential buildings, in places where stone is available in plenty, stone set flooring can be adopted. Stone slabs should be laid in cement mortar over a bed of lime concrete or lean cement concrete. Generally the flooring in ground floor may consist of 6" sand filling, then a layer of 3" or 4" lime concrete and a topping course. For baths and WCs of all types of residences excepting the lowest, terrazzo flooring may be adopted.

### 5.2 Joinery

The doors and windows should be of timber available in the locality. For the main building, however, the adoption of steel windows may be considered. In the smithy & foundry portions of the workshop it is advisable to have steel windows. With seasoned timber, the thickness of door & window shutters need not be more than an inch and a quarter.

The number of entrance and exit doors for a workshop depends upon the requirements of each workshop. The size of door must be such as to facilitate the bringing in or removal of machinery. Excepting in motor mechanic shop where the door size may be 9' x 11', doors elsewhere in the workshop need not exceed 6' x 8'. The shutters may be of the sliding or rolling pattern.

### 5.3 Lighting & Ventilation

For residential buildings we recommend a window area of 12-15% for hot and dry climate and 15-20% for hot and humid climate. In sheds with gabled roof which have their longitudinal axis along East West direction, the window area should be at least 20% of the floor area, arranged in the North & South walls. For arid regions the figure can be reduced to 12-15 per cent

For adequate ventilation in a building, it is necessary to provide sufficient open space both in front and the rear and if possible, on one of the sides as well. The provision of simple opening on top of doors cannot produce the necessary ventilation as it cannot result in air circulation without an opening on the leeward side. The revolving type of the ventilator induces natural air circulation.

For workshops where gable roofs are used, windows shall be provided in the North & South walls and ventilators in the East & West walls. Slots of 9 inch width shall be provided between the wall and the roof along the eaves of the building. Where monitors are provided, the slots can be fitted in it.

#### **5.4 Water proofing terraces of main building**

Some kind of water proofing has to be provided for flat roofs. Where bitumen is used for this purpose, it is the practice to cover it with stone, chips, china mosaic or aluminium foil in order to prevent its deterioration due to exposure to sun. As light coloured chips have higher co-efficient of reflection, these should be used, when available, in preference to darker coloured chips.

## 6. IMPLEMENTATION OF RECOMMENDATIONS.

6.1 A comparative statement of areas for an Industrial Training Institute with 368 seats is given in Appendix II. It will be observed that the recommendations of the Panel envisage a saving in area of about 17% in the Main Building and 10% in the Workshop Buildings.

6.2 It is hoped that the norms, design details and specifications suggested would be of help in achieving uniformity and greater design efficiency. To ensure that the norms and standards recommended in this report are translated into practice, it is suggested that any estimate for an Industrial Training Institute should be accompanied by a proforma setting forth the norms laid down in this report and the extent to which these are realised in the particular case. The Panel has drawn a proforma of this character which is given in Appendix III.

## APPENDIX—Y

### Shift Arrangement for an L.T.L.

| Trade                   | First Shift | Second Shift |
|-------------------------|-------------|--------------|
| 1. Blacksmith           | 16          | 16           |
| 2. Carpenter            | 16          | 16           |
| 3. Fitter               | 16          | 16           |
| 4. Moulder              | 16          | 16           |
| 5. Mechanist            | 12          | 12           |
| 6. Turner               | 12          | 12           |
| 7. Mechanic Instrument  | 16          | 16           |
| 8. Mechanic Motor       | 16          | 16           |
| 9. Sheet Metal Worker   | 16          | 16           |
| 10. Draughtsman (Mech.) | 32          | —            |
| 11. Electrician         | 16          | 16           |
| 12. Mechanic Radio      | 16          | 16           |
| <b>TOTAL</b>            | <b>200</b>  | <b>168</b>   |



## APPENDIX—II

### Comparative Statement of Areas for an I.T.I. of 368 seats

| Sl. No.                           | Item                  | Areas in sft. as recommended by |                |               |
|-----------------------------------|-----------------------|---------------------------------|----------------|---------------|
|                                   |                       | <i>Ad hoc</i><br>Committee      | D.G.R.<br>& E. | B.P.Team      |
| <b>I. Administrative Building</b> |                       |                                 |                |               |
| 1.                                | Principal             | 400                             | 300            | 300           |
| 2.                                | Steno                 | ..                              | 200            | 200           |
| 3.                                | Waiting Room          | 400                             | 300            | ..            |
| 4.                                | Staff Room            | 800                             | 600            | 600           |
| 5.                                | Clerk's Room (Office) | 800                             | 320            | 360           |
| 6.                                | Record Room           | 400                             | 200            | 200           |
| 7.                                | Library Room          | 1000                            | 1000           | } 1000        |
| 8.                                | Reading Room          | ..                              | 500            |               |
| 9.                                | Class Rooms           | 3000                            | 3600           | 2700          |
| 10.                               | Demonstration Hall    | 800                             | 800            | 800           |
| 11.                               | Drawing Halls         | 1000                            | 600            | 600           |
| 12.                               | Canteen               | 480                             | 1013           | 1013          |
| 13.                               | Lockers               | ..                              | 100            | 100           |
| <b>TOTAL</b>                      |                       | 9080<br>sft.                    | 9533<br>sft.   | 7873<br>sft.  |
| <b>II. Workshop Building</b>      |                       |                                 |                |               |
| 1.                                | Black Smith           | 4800                            | 2496           | 2112          |
| 2.                                | Carpenter             | 2400                            | 4275           | 3360          |
| 3.                                | Fitter                | 4800                            | 1025           | 1024          |
| 4.                                | Moulder               | 2400                            | 2025           | 2032          |
| 5.                                | Machinist             | 4000                            | 1995           | 1992          |
| 6.                                | Turner                | 4000                            | 1500           | 1500          |
| 7.                                | Mechanic (Inst.)      | 3200                            | 750            | 752           |
| 8.                                | Mechanic (Motor)      | 6000                            | 2800           | 2800          |
| 9.                                | Sheet Metal Worker    | 2400                            | 1035           | 1040          |
| 10.                               | Electrician           | 3200                            | 1950           | 1952          |
| 11.                               | Draughtsman           | 2400                            | 2960           | 2112          |
| 12.                               | Mechanic (Radio)      | 2400                            | 1120           | 960           |
| 13.                               | Allied Trades         | 6400                            | 3200           | 3200          |
| 14.                               | Foreman               | 500                             | 300            | 200           |
| 15.                               | Supervisors           | ..                              | 600            | 400           |
| 16.                               | Demonstration Room    | ..                              | 400            | 400           |
| 17.                               | Lockers               | ..                              | 300            | 640           |
| 18.                               | Stores                | 5250                            | 4600           | 3242          |
| <b>TOTAL</b>                      |                       | 54150<br>sft.                   | 33331<br>sft.  | 29718<br>sft. |

## APPENDIX—III

### Proforma regarding Industrial Training Institutes

#### PART I—General.

1. Name of Institute

2. Location

3. Total Strength

4. Break up

| <i>Trades</i>            | <i>Seats</i> | <i>Ist<br/>Shift</i> | <i>2nd<br/>Shift</i> |
|--------------------------|--------------|----------------------|----------------------|
| (i) Blacksmith . . . . . | ..           | ..                   | ..                   |
| (ii) Carpenter . . . . . | ..           | ..                   | ..                   |
| (iii) .. . . .           | ..           | ..                   | ..                   |
| <b>Total .</b>           | ..           | ..                   | ..                   |

5. Estimated cost of

- (a) (i) Main Building
- (ii) Workshop
- (iii) Hostel
- (iv) Staff quarters
- (v) Ancillary Buildings

- (b) (i) Land
- (ii) Development

6. Cost per sft. of built-up area of

|                               | <i>(a)</i> | <i>(b)</i> |
|-------------------------------|------------|------------|
| (i) Main Building . . . . .   | ..         | ..         |
| (ii) Workshop . . . . .       | ..         | ..         |
| (iii) Hostel . . . . .        | ..         | ..         |
| (iv) Staff Quarters . . . . . | ..         | ..         |

(a) excluding cost of internal services

(b) including cost of internal services such as water-supply and electrical installations.

7. Cost index of the place.

## PART II—Design Details

| Sl. No.                  | Particulars   | Norms laid down by B.P. Team                                    | Figures realised with reasons for deviations if any |
|--------------------------|---|---|---|
| (1)                      | (2)   | (3)   | (4)   |
| <b>A. Main Building</b>  |   |   |   |
| 1                        | Carpet area   | ..  | ..  |
| 2                        | Total built-up area   | ..  | ..  |
| 3                        | Design efficiency   | 65 to 70%   | ..  |
| 4                        | Plinth height   | 1'-6" above crown of approach road.                             | ..  |
| 5                        | Floor to floor height   | 11ft.   | ..  |
| 6                        | Live load assumed in design                                     | Rooms—60 lbs/sft.<br>Corridor—80 lbs/sft.                       | ..  |
| <b>B. Work shop</b>      |   |   |   |
| 1                        | Carpet area   | ..  | ..  |
| 2                        | Total built-up area   | ..  | ..  |
| 3                        | Design efficiency   | 80 to 85%   | ..  |
| 4                        | Sizes of work sheds   | Span 40 ft.<br>Length in multiples of 12½ to 15ft. as required. | ..  |
| 5                        | Plinth height   | 1'-5" above crown of approach road                              | ..  |
| 6                        | Height from plinth to tie level of roof.                        | 14 to 16 ft.  | ..  |
| <b>C. Hostel</b>         |   |   |   |
| 1                        | Number of trainees to be accommodated in the hostel             | 50% of the total strength.                                      | ..  |
| 2                        | Floor area per trainee in the dormitory.                        | 55 to 60 sft.   | ..  |
| 3                        | Built-up area per trainee.                                      | 140 to 145 sft.   | ..  |
| <b>D. Staff Quarters</b> |   |   |   |
| 1                        | Total number of staff.  | ..  | ..  |
| 2                        | Percentage of staff for whom staff quarters have been provided. | 50 % of total staff strength.                                   | ..  |