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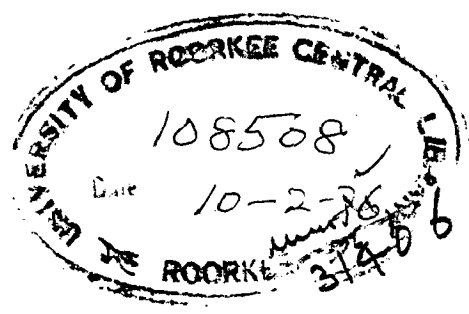
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GAR

**CRITICAL ANALYSIS OF  
TYPE DESIGN HOUSES IN PUBLIC SECTOR  
WITH SPECIAL REFERENCE TO HOUSING  
IN DELHI**

**A DISSERTATION**  
submitted in partial fulfilment  
of the requirement for the award of the degree  
of  
**MASTER OF ARCHITECTURE**

By:  
**J. S. GARG**



**DEPARTMENT OF ARCHITECTURE & PLANNING  
UNIVERSITY OF ROORKEE  
ROORKEE (INDIA)  
Oct. 1975**

**CERTIFICATE**

Certified that the dissertation entitled " CRITICAL ANALYSIS OF TYPE DESIGN HOUSES IN PUBLIC SECTOR WITH SPECIAL REFERENCE TO HOUSING IN DELHI" being submitted by Sri J.S.Garg in partial fulfilment for the award of degree of MASTER OF ARCHITECTURE, Department of Architecture and Planning, University of Roorkee, Roorkee, India, is a record of student's own work carried out by him under my supervision and guidance. The matter embodied in this dissertation has not been submitted for the award of any other degree or diploma.

This is further to certify that he has worked from January, 1975 to October, 1975 for preparing this dissertation at this University.

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J.S. GARG

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**CHAPTER-I****INTRODUCTION**

In India, the population is increasing rapidly, which demands urgent solution to the housing problems of urban cities, specially in big cities like Calcutta, Bombay, Delhi, Madras, Bangalore, Ahmedabad, Hyderabad and Kanpur etc.

Delhi had population of 2.08 lacs in 1901 and had grown to a city of 36,29,812 in 1971 according the Census of India. The population trend in Delhi from 1911 to 1971 is decade-wise indicated in the Plate and refer table in Appendix 1-A. The population projection as estimated as per work studies volume I Delhi Master Plan is as under:-

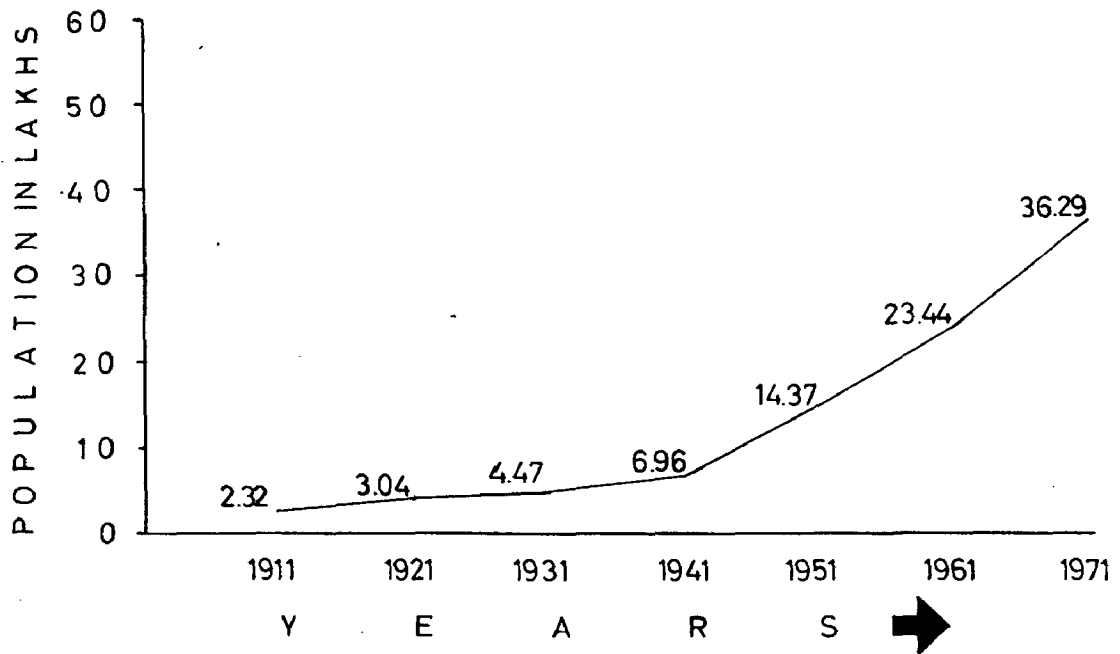
**TABLE No.1 (1)****FUTURE URBAN POPULATION OF DELHI**

<b>Year</b>	<b>Projected population in lacs</b>
<b>1961</b>	<b>23.4</b>
<b>1971</b>	<b>33.1</b>
<b>1981</b>	<b>49.8</b>

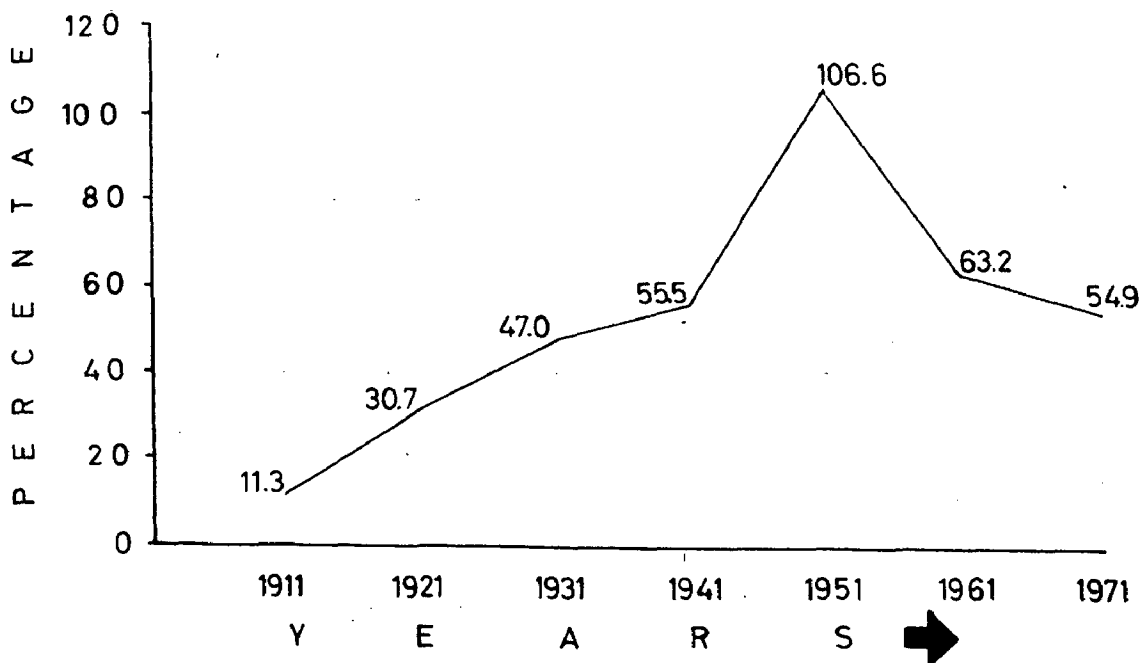
**SOURCE: Works Studies Vol. I, Delhi Master Plan.**

**Sri Shri Manohar, Architect and Planner, Town and Country Planning, New Delhi had summarised the situation in the**

# POPULATION INCREASE IN DELHI. 1911-1971



POPULATION GROWTH IN EACH DECADE.



PERCENTAGE GROWTH IN EACH DECADE.

J.S. Garg .  
M.Arch. Dissertation.

Article 'HOUSING IN METROPOLITAN URBAN CENTRE' that

In metropolitan towns of India, if the rate of growth continues to be what it is today, their sizes will swell within a decade to the extent that any solution to the housing problem will be far beyond our reach.

Similar position is existing in public sector housing.

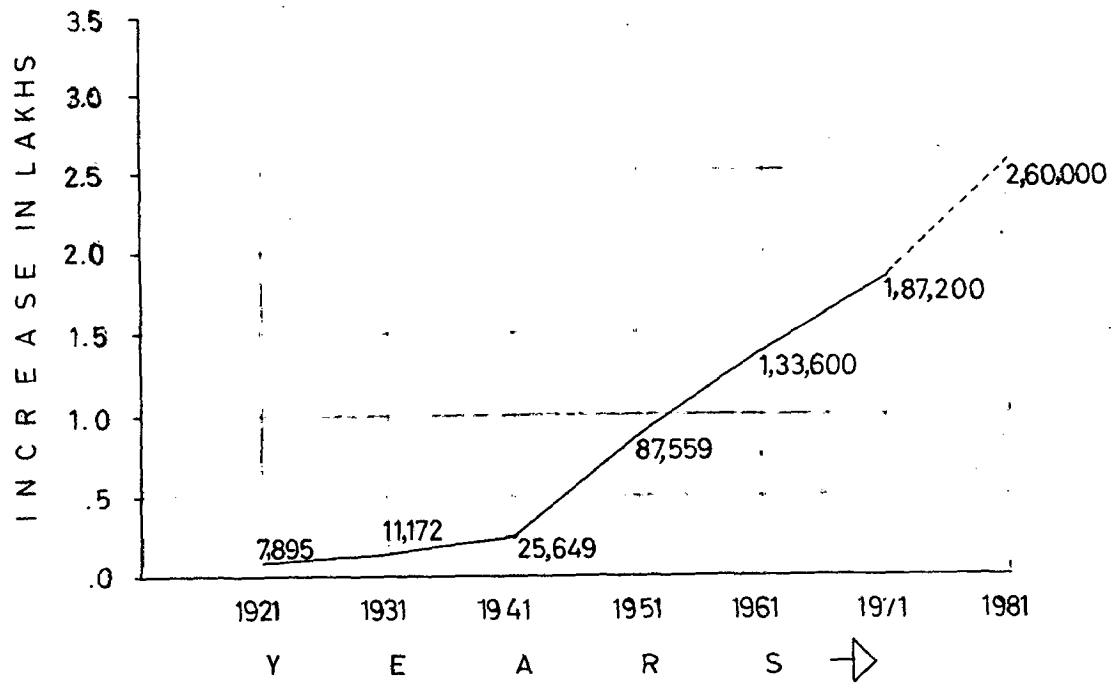
Due to the progressive urbanisation of Delhi, it has resulted into expansion of central offices and ministries. A large\* number of Govt. employees increase during past decades; in 1921 it was only 7,895 which increased upto 1,87,200 in 1971 as per census of Govt. employees, Ministry of Labour and Employment records. It is shown in Plate decade-wise increase and percentage increase in each decade. "But shortage is occurring beyond control. In Govt. housing at Centre, States and Local levels; it was proposed to build 63,000 units (Type Design Houses) by 1971, while the total units actually constructed till 1971, were estimated only 21,065. The units constructed by various public agencies are given in Table No.1(ii) and residential areas are shown in Plate.

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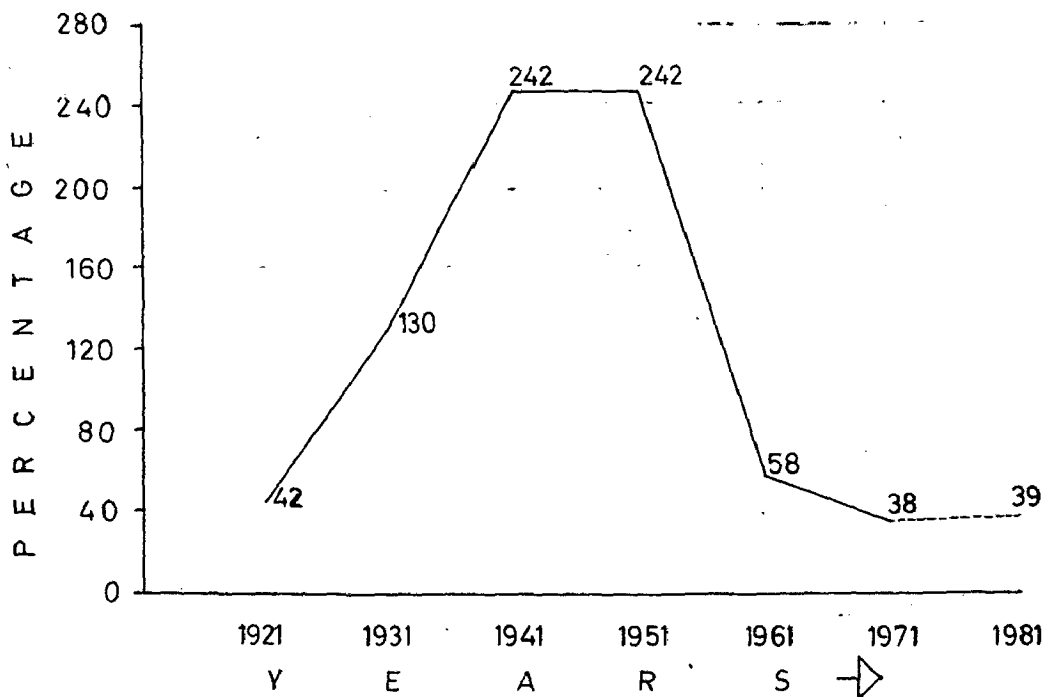
\*The present shortage is illustrated in Chapter II under the role of Public Sector, sector-wise.

# INCREASE IN CENTRAL GOVT. EMPLOYEES

1921-1981



## INCREASE IN EACH DECADE



## PERCENTAGE INCREASE IN EACH DECADE



### 1.1. Identification of the Problem

Perhaps the most formidable problem, which the Public Sector faces in India is acute shortage of housing (quantitative); the other problem is qualitative. To solve the problem of shortage is a impossible task for the Govt. with her resources in a short period. The author wishes to define only qualitative aspects of housing.

In India, Public agencies construct and maintain a large number of quarters known as Type Design Houses. There are various types of quarters from Type I to Type VI classified as per recommended plinth areas. In detail it is defined in Chapter III. Previous records of the Public Sector show that the construction of houses take much time than Private Sector housing. In Public housing whether in Central or State Govt, there are three separate operations; each house or building is designed by the Architect, the layout of the colony is prepared by the Town Planner, design of structure and execution through Engineers by contract system (procedure is defined in Chapter II). In the private sector all the work is done in coordination except the production through contractors or the individuals themselves by employing labour. The quality of the private sector housing is considered better than public housing is also a matter requiring assessment.

Apart from this, type design houses represent many physical and economic problems. The physical problems are as

functionally the house is not efficient; for example housewife has to live in house throughout the day and husband has to go for duty regularly. So house wife has to perform many activities during day time; she is engaged in some sort of house works i.e. cleaning, cooking and looking after the children. For all these activities she always prefer easy access and and easy space for movement. During holidays and night time the family come together and separates for different activities i.e. formal and informal meals and entertaining friends etc. They also want to relax and rest. All these activities have impact on the space requirements, standards etc. All these aspects are related with each other. The occupant feels that his house is not properly designed after deeply considering the functional demand. So this is a matter of study for efficient designing.

A criterion of good design house is that it must provide inhabitants a proper environment for healthy growth, both from spiritual and physical points of views.

To provide inhabitants a proper environment for healthy growth is influenced by several factors i.e. efficient design of sufficient size to meet the daily requirements of the households/families. These spaces are fixed in the public sector on the basis of their income range, perhaps without considering their social needs. Secondly, the rooms sizes are not based on the some fundamental demands. Sometime the designer provide them two rooms and sometime three rooms et.



It is fact that more rooms are good keeping privacy in view, but on the other hand it creates a problem of furniture layout and instead of providing healthy environment it becomes untidy. For healthful housing good lighting and ventilation is desired and for thermal comfort orientation of houses require proper attention. All these problems are related with physical requirements of human beings.

'Man is a social animal', he is always influenced by the external environment. Therefore, he always needs open spaces around the house for sitting and for social gathering etc. - may be parks and play grounds etc. Master Plan also made some recommendations i.e. front and rear courtyards for sitting, sleeping in summer and drying clothes etc. In the multistoroyed housing these amenities are provided in the shape of balcony, terrace etc. But still all these problems are not solved to the extent. Therefore, it is also a matter of concern. Another problem is of densities. It is said that more dense areas create problem of overcrowding. It is also believed that "high densities" are inherently evil and that of "low densities" are inherently good.

The people, who live in certain areas or colonies wanted to live safely and always prefer easy approach to the market schools and offices etc. Sometime it is felt that due to heavy vehicular traffic is linking their houses and causes accidents or these facilities are quite away from their residences. So these type of problems also exist in housing

areas, is a matter of examination for solving future problems. When various agencies construct any colony or area, it has got some impact on the urban form. Since public authorities in Delhi had also developed many areas in the form of type design, these have some impact on the city, which is a matter of analysis for the town planners to find out its visual effect on the city in the shape of urban form.

Housing cost is increasing day by day due to rise in prices of materials etc. So it has become difficult for the organisations to control the cost of the buildings. Taking cognizance of this, attempts are made to reduce the cost by using design techniques and materials which could solve the problem and bring down the cost.

Social aspirations also play a decisive part in formulation of basic requirement for a particular type design housing, but to a very large extent it is determined by the economic status of the family. To observe this socio-economic problem survey was conducted by M.B.O. and published a report. Some brief results are given at the end of this chapter.

## 1.2.

### OBJECTIVE OF THE STUDY :

Housing problems are numerous in type design housing as identified in brief, which occupy a place of importance in the present set-up of the Public organisations. Keeping this in view and to fulfil objective, the study is oriented to critically analyse the undermentioned aspects, by the author, which, if given due consideration, might be useful

for the concerned organisations:-

- to examine the shortcomings and role of the following public sectors.
  - i. Central Public Works Department, New Delhi.
  - ii. New Delhi Municipal Committee, New Delhi.
  - iii. Delhi Development Authority, Delhi

to find demand, supply and reasons of delay in implementing decisions and construction programming. Further to suggest changes and improvement in the set-up accordingly.
- to analyse type design housing of the above sectors,; to suggest suitable improvements in accommodation for healthy living.
- to compare different standards adopted by various public agencies to find its feasibility.
- to provide sufficient living space within and around the house to meet the demands of the families and to suggest adequate open spaces for private and communal enjoyment, outdoor living, recreation, etc.
- to provide adequate vehicular and pedestrian access.
- to provide visually pleasant housing with respect to open spaces and urban form to meet the physical requirements of the inhabitants for healthy environment.
- To suggest cost reduction techniques in designing and materials for economical type design.
- to provide suitable and useful data in compiled form for the use of future planning and designing.

### 1.3. Scope and Limitation of the Study

The scope of type design housing problems is too wide. There

are about seven types of houses in public sectors, i.e. type I to VII or in some cases more; each having different space accommodation and allotted on the basis of different scale of pay. But the study is limited to type II quarters of public agencies under case studies, due to similar space requirements and pay range and average household sizes etc. The criteria for selection of case studies is defined in Chapter III under the Head, Evaluation of Case Studies.

The various information have been collected personally from the departments and may vary. The anthropometric data is based on directly C.B.N.I. dimensions published in Journals of Indian Institute of Architects and Socio-economic results of N.B.O. Survey Reports.

#### 1.4. N.B.O. Socio-Economic Results:

This information based on the socio-economic survey was conducted by N.B.O. by interviewing the residents of selected type II, III and IV flats in New Delhi. Since the author is more concerned with type II quarters of Public Sectors, some more emphasis is given to II in relation to other.

##### 1.4.1. State of Origin.

The employees occupying these flats belong to different States of India. But 72% of them came from neighbouring States of U.P., Punjab, Haryana and Himachal Pradesh.

##### 1.4.2. Period of Stay

The average stay of an allottee in Delhi and in Government

quarters worked out to 199 months, 84 months and 21 months respectively (i.e. II, III and IV)

#### 1.4.3. Age composition

58% of the allottees of type II are in the age group of 36-45, but 52% of allottees of type III and nearly 77% of the allottees of type IV are worked out to the age of 46-55 years. Overall average is 43 years.

#### 1.4.4. Household Size

The average household size was worked out 5.1. The household size did not vary much from one type to other; 1/3rd of household members was below 15 years of age and 1/5th in the age of 15-24 and 43% in the age group of 25-59 years. The allottees of type II flats are younger in age in comparison to others.

#### 1.4.5. Income Patterns

A particular type of quarters is allotted to the employees on the basis of their pays. Income of 86% of occupants of type II flats was worked out Rs.500 or less and 93% of type III flats were between Rs.400-700 and nearly 4/5th of the occupants of Type IV flats had monthly income of Rs.600-1000.

#### 1.4.6. Conveyance ownership

62.1% of allottees were keeping cycles, 12.1% scooters and 25.8% were having no conveyance of their own in type II occupants.

#### 1.4.7. Cooking and Dining

It depends upon the income level and taste of the occupants to use those fuels which are non-smoking and want some energy for cooking. 37.4% use gas 31% kerosen oil, 31.6% use soft coke.

#### 1.4.8. Sleeping during Summers

Nearly 30% of allottees were sleeping inside the rooms in summer in four-storoyed flats, because the balcony is insufficient to accommodate all members of the household. In double storoyed, where the employaes have choice to sleep in lawns and terrace, 21% of allottees were estimated sleeping inside the rooms due to change of the living habits of the people.

#### 1.4.9. Occupants Demand

1. There is a demand for bigger or additional balcony from allottees irrespective of their household size.
2. Bigger kitchen even at the cost of reduction in some areas, mostly the passage space has been suggested. Allottees of Type IV multistoroyed buildings preferred bigger kitchen by reducing the dining space near the kitchen.
3. A number of allottees were prepared to pay more than Rs.20 per month if they were provided with extra space.
4. A wash basin in every type of flat appears to be a 'must'.
5. 69% of allottees were satisfied with the arrangement of

of sun light during winter and were happy with the protection provided against heat. No serious complaint was made about day light.

6. Problems of waste disposal and cleanliness of common spaces causing some concern in four storeyed buildings.

7. Some other important suggestions relate to:-

- a. Readjustment and distribution of spaces in Type II four storeyed buildings and kitchen should not open directly in living rooms.
- b. Provision of separate entrance for sweeper is desired by providing a verandah on the backside, which could help in getting sun in winter.
- c. Provision of more shelves/racks in rooms and bath rooms etc.

## CHAPTER - 2

### ROLE OF PUBLIC SECTOR

Public housing implies to the dwelling that are owned by the Central, State and local governmental agencies or a public body. In common usage, the distinction between public and private housing has been defined in terms of dwellings, whose capital cost is financed by a Government agency or by a public body. There are various agencies as defined in Chapter I, construct type design houses in Delhi. The description of few agencies under study is as follows:-

1. Central Public Works Department, New Delhi.

2. New Delhi Municipal Committee

3. Delhi Development Authority

#### 2.1 Central Public Works Department:

The Central Public Works Department is the agency of Central Government operating throughout the country for construction maintenance and repairs of all works and buildings financed from civil works budget, including renting and purchase of buildings.

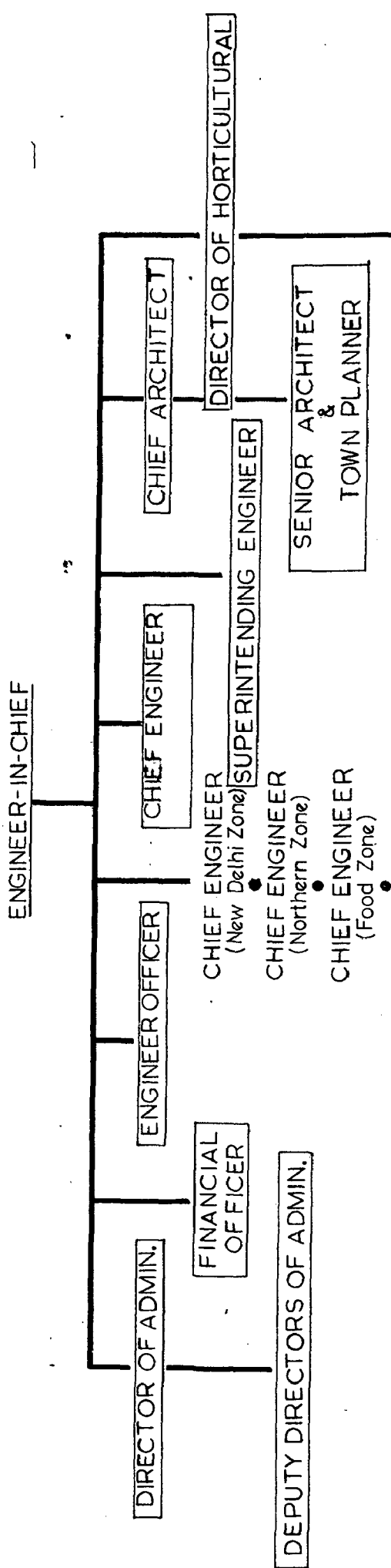
The Engineer-in-Chief, who is the head of the Department acts, also as a technical adviser to the Government of India. On the administrative side, he is assisted by the Director of Administration and Deputy Directors. Besides this, Chief Architect, Town Planner and Director of Horticulture assist

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The role of public sector has already been defined in Chapter I, i.e. Introduction Table No.1 (ii).



# ORGANISATION CHART OF CENTRAL PUBLIC WORKS DEPARTMENT,



## FUNCTIONS.

- CONSTRUCT, MAINTAIN AND REPAIR OF ALL WORKS, AND BUILDINGS FIANCED FROM CIVIL BUDGET, THROUGHOUT THE COUNTRY.
- TECHNICAL CONTROL OVER THE P.W.D. OF STATES LIKE TRIPURA MANIPUR ALL WORKS OF N.E.F.A. ETC.
- CONSTRUCTION OF RESIDENTIAL ACCOMODATION FOR CENTRAL GOVT. EMPLOYEE.

## ORGANISATION

### ENGINEER-IN-CHIEF

Head of the Department, responsible to the Govt. for efficient administration and has full technical control over Chief Engineers, Chief Architect and others working in the Department.

### CHIEF ENGINEERS.

Zone or area of the Mins./Deptts. handled by Zonal Chief Engineer.

### ARCHITECTURAL WING.

It is headed by the Chief Architect with Town Planning Unit and Senior Architects units attached to various zones.

DEPUTY DIRECTOR OF HORTICULTURAL

him and chief engineers in their respective zones by Senior Architects and their staff as defined in organisation Plate.

#### 2.1.1 Functions:

Apart from other works, this department also undertakes construction of type design houses for the employees of Central Government i.e. various Ministries and their subordinate organisations. When houses are completed in every respect, they hand it over to the Directorate of Estate, who is according to the requirements or seniority of employees in various categories, send the intimation to the Head of the Departments. Maintenance of such houses is also done by the C.P.W.D.

#### 2.1.2. Procedure:

For the selection of site, the Ministry consults the C.P.W.D. regarding the suitability of site. After selection, the Ministry intimate the requirements to the Additional Chief Engineer concerned. The Senior Architect is deputed to prepare the Architectural drawings for the work. At this stage the Architect is in close contact with the client i.e. Ministries regarding the requirements. Then preliminary estimate is prepared on preliminary drawings for administrative approval. In case of the project costing more than 10 lacs, approval of expenditure of Finance Committee presided by the Finance Minister has to be obtained. After sanction, detailed drawings and estimate are prepared.

### 2.1.3. Technical Sanctions

Technical sanction is then accorded on the basis of detailed estimate and for inviting tenders. Powers of the sanction are given below:-

Engineer-in-Chief	....	Full power
Chief Engineer	....	Full power
Superintending Engineer	....	Rs.10 lakhs
Executive Engineer	....	Rs. 1 lakh
Assistant Engineer	....	Rs.5,000

### 2.1.4. Tenders:

Tenders costing more than Rs.25,000 are advertised in the press through advertisement and visual publicity. The powers of Engineers to accept the tenders are:-

Engineer-in-Chief/Chief Engineer	Over 19 lakhs
Superintending Engineer	Rs.1-10 lakhs
Executive Engineer	Rs.1 lakh

### 2.1.5. Acceptance letters:

When the competent authority has taken the decision, the Executive Engineer issue the letter of acceptance and directing the tenderer to commence the work.

### 2.1.6. Allocation of funds:

The Ministry of Works, Housing according to the provision in various plans intimate the other Ministries. These funds are placed at the disposal of C.P.W.D. for construction,

# GENERAL POOL RESIDENTIAL ACCOMMODATION IN DELHI

TYPE OF DWELLING UNIT.



● BASED ON THE FIGURES AVAILABLE REPORT FROM THE DIRECTORATE OF ESTATE AND SATISFACTION ACHIEVED DURING IV PLAN.

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out of the General Pool Fund

The financial allocations made for housing in Plan projects for construction of residential and non-residential accommodation were:-

	<u>Allocation</u>	<u>Expenditure</u>
1st Plan	12.50 crores	11.00 Crores
2nd Plan	18.50 "	14.90 "
3rd Plan	35.00 " 15.00 "	28.50 "
4th Plan	30.83 "	24.42 "

Sources: Estimate Committee Report,  
Ministry of Works, Housing &  
Directorate Estate, New Delhi.

### 2.1.7. Target and Achievements:

Details of accommodation available in Delhi and percentage of satisfaction achieved during Ist, IInd, IIRd and IVth Plan are shown in Table No.            and plotted in Chart, Position of Type II in Plate    (Appendix 2-'A').

### 2.2. New Delhi Municipal Committee:

In 1958, all eleven local bodies were merged with Delhi Municipal Corporation except N.D.M.C. The New Delhi Municipal Committee had to be kept separate, because under its jurisdiction vested most of the central offices and M.P. Quarters and it had certain special characteristics and to keep away from the hands of elected council of the Corporation. The nominated body having a member including

including the President of Committee who is the head and full-time officer.

#### 2.2.1. Structure:

New Delhi Municipal Committee is constituted of various Departments having executives of various departments with deliberation wings. The President, who is an official member is the administrative Head. The other members of the Committee are either officials, ex-officials or nominated members. There are sub-committees such as work sub-committees.

#### 2.2.2. Functions:

- Construction of drains, drainage work, latrines, urinals and cleaning etc. which is in public use.
- Removal of objectionable projection from streets, bridges and other public places.
- the provision of housing accommodation for any class of inhabitants.
- Construction and provision of accommodation for its staff in the shape of type design.

The functions of the N.D.M.C. are similar to Municipal Corporation, but within limited area.

#### 2.2.3. Procedure

The procedure which is being followed in different departments of this organisation is particularly same except with the

difference, that in case of general wing, the estimates have to be processed through the Works Committee, whereas in case of undertakings, the estimates have to be forwarded through the respective committees.

#### 2.2.4. Funds:

The Committee has got enough funds at its disposal.

#### Targets and Achievements:

Details of accommodation available in Delhi till 1973 are tabulated in Chart and shown in Appendix 'B')

#### 2.2.5. Allotment Rules:

Allotment rules are same as being adopted by Central Govt. except on priority basis, which is done in consultation with the allotment sub-committee.

SOURCE: Land & Estate Development, N.D.M.C.

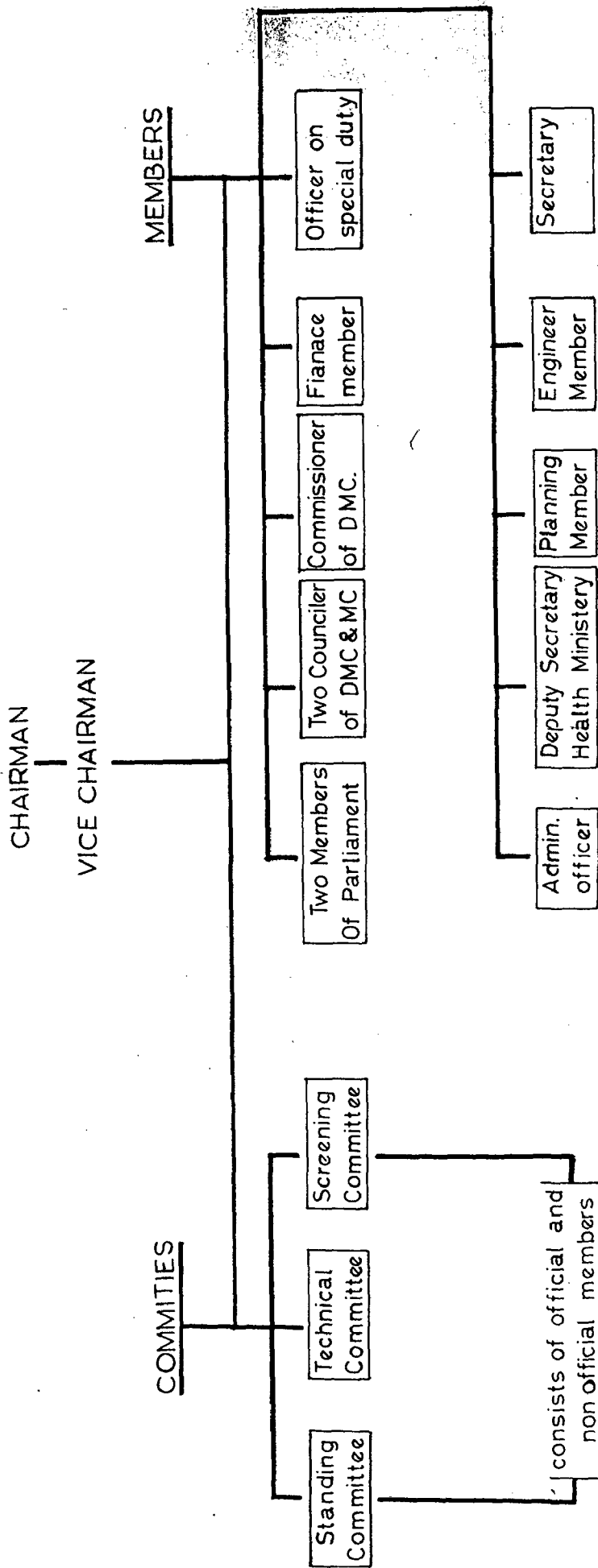
#### 2.3. Delhi Development Authority:

Delhi Development Authority is constituted of eleven members with the Lt. Governor as the Chairman and other member of D.D.A. is Vice-President, 2 members of Parliament, 4 Councillors of Municipal Corporation, of Delhi, Member of Metropolitan Council, President of N.D.M.C. and Engineer members, one finance and accounts member, an officer on Special Duty and one administrative officer.

#### 2.3.1. Committees:

Standing committees: Before the cases are referred to Delhi

# ORGANISATION CHART OF DELHI DEVELOPMENT AUTHORITY.



## FUNCTIONS

- FRAMMING POLICIES & PROGRAMME.
- DEV. OF LAND, CONST. OF MIG, LIG AND ITS DISPOSAL.
- PREPRATION OF ZONAL DEV. PLAN.

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and all development charges are recovered from D.D.A.

Then D.D.A. advertises its programme of disposal of land.

### 2.3.5. Funds:

Out of revolving funds of Rs.5 crores placed at the disposal of Lt.Governor, all transactions relating to the land development under the scheme for large scale acquisition, "Development and Disposal of land in Delhi" are operated from this funds.

### 2.3.6. Targets & achievements:

As per latest information regarding the type of houses constructed, under construction and process of construction are as given below.

#### D.D.A. HOUSING POSITION AS ON 31ST JULY 1975.

<u>Flats already constructed</u>	<u>Under Construction</u>	<u>Process of Construction</u>
Janta	6366	1789
L.I.G.	11031	4106
M.I.G.	26790	1199
		1649

Total = 8694

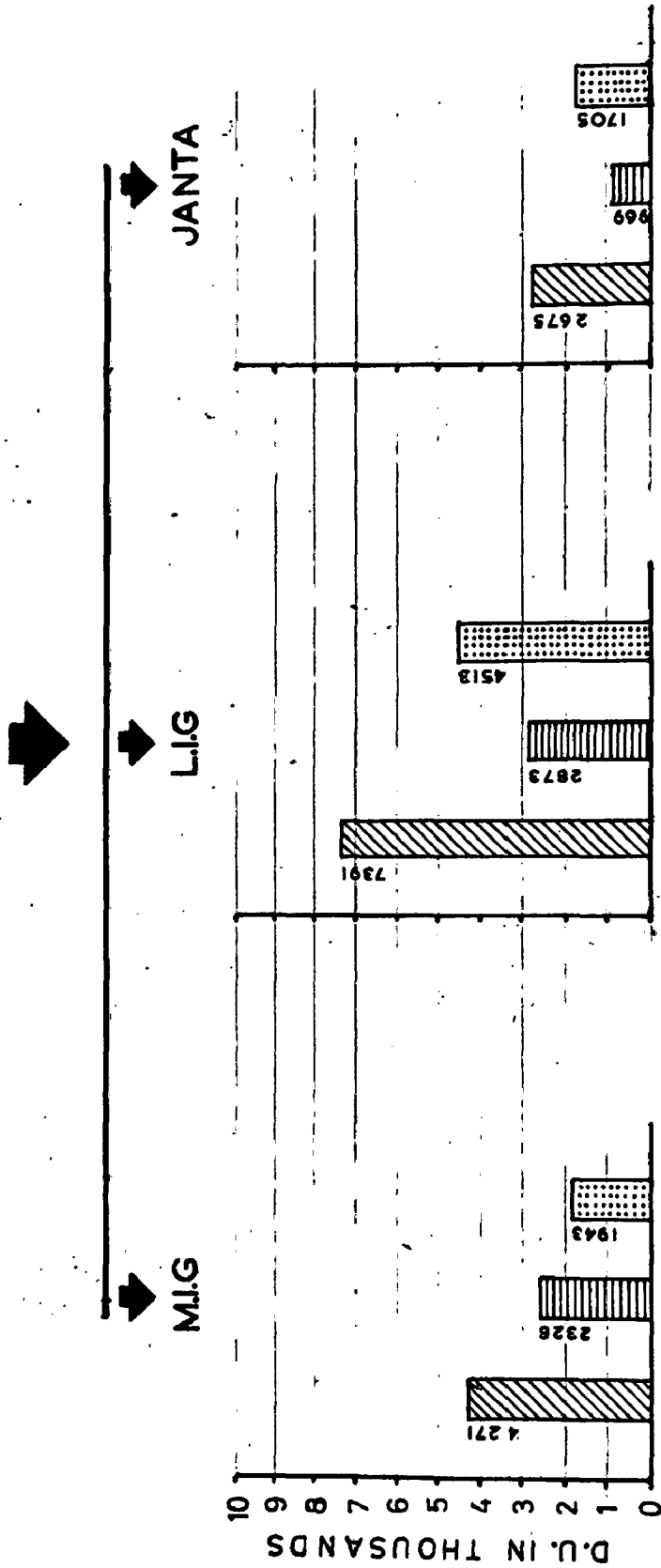
Old position of the D.D.A. type (March 1972)

Houses are tabulated in the Plate.

Sources: Planning Cell D.D.A.

# DELHI DEVELOPMENT AUTHORITY

## TYPE OF DWELLING UNIT



CONSTRUCTED

### OWNERSHIP STATUS

FIFTY PERCENT OF THE TOTAL HOUSES ARE SOLD, OWNERSHIP GRANTED ON FULL PAYMENT BEFORE TAKING POSSESSION. THE BALANCE ARE GIVEN ON HIRE PURCHASE.

● BASED ON DATA AVAILABLE HOUSING SECTION D.D.A. NEW DELHI.

DISPOSED

### COST.

COST OF DIFFERENT TYPE OF HOUSES ARE :—  
 ● M.I.G. RS. 27000 TO 42000.  
 ● L.I.C. RS. 12500 TO 22000.  
 ● JANTA RS. 8500  
 NOW COST INCREASED 50% MORE.

D.D.A. HOUSING POSITION ACHIEVED AS ON JULY, 1973.  
 FLATS CONSTRUCTED:— M.I.G. 26790 L.I.G. 11031. JANTA. 6366.

BALANCE

### HIRE PURCHASE

● ONE THIRD OF D.U. IS TO PAID BEFORE POSSESSION. BALANCE OF THE AMOUNT :—  
 ● 60 MONTHLY INSTALMENTS IN POPULAR AREA. 180 MONTHLY FOR UNPOPULAR AREA.

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CHAPTER - 3TYPE DESIGN HOUSING WITH SPECIFIC REFERENCE TO CASE STUDIES  
OF TYPE II DESIGN

The Government of India and other similar agencies provides housing accommodation to its employees in view of the scarcity in private sector of proper houses within the rent paying capacity of the employees. Considering this Government accommodation is allotted to the employees on the basis of duration of service and pay of the employees.

3.0.1 Classification of Residential Accommodation  
Type-wise

S.No.	Type	Delhi & Other Places except Bombay & Calcutta							
		Residential Unit		Staircase & common passage		Sleeping Balconies			
1.	I	34 Sq.m.	365 Sft.	5.0 Sq.m.	54.0 Sft	5.6 Sq.M.	60		
2.	II	50 "	535 "	5.0 "	54.0 "	5.6 "	60		
3.	III	66 "	710 "	5.0 "	54.0 "	6.0 "	60		
4.	IV	84 "	900 "	5.0 "	54.0 "	7.8 "	84		
5.	V	139 "	1500 "	6.0 "	64.5 "	8.9 "	96		
6.	VI	195 "	2100 "	6.0 "	64.5 "	8.9 "	96		

No plinth areas have been provided for Type VII and VIII. These are decided on the merit of each case.

Source: Ministry of Works,  
Housing, New Delhi.

3.0.2. Eligibility for Office Accommodation

Eligibility for different types of accommodation area-wise is given below:-

Type	Plinth Area	Pay Range (per month)
I	365 Sft.	Below Rs.175
II	540 "	Rs.175-349
III	710 "	Rs.350-499
IV	900 "	Rs.500-799
V	1500 "	Rs.800-1299
VI	2100 "	Rs.1300-2249

Sources: Directorate of Estate,  
New Delhi.

### 3.0.3. Revised Classification and related scales of pay.

Recently August 1975, the Government of India has revised the plinth area as per new pay scales, after Third Pay Commission Report.

The revised scale of plinth areas are given in Table No.3.03.



### 3.0.4 Space accommodation & Amenities

Broadly accommodation in every sector is normally similar. N.D.M.C. has not built any composite type construction and D.D.A. has not stipulated any demarcation for fixed plinth area. However, the accommodations provided by C.P.W.D. are laid for general information and reference. These buildings are-- Double storeyed, Four Storeyed and composite type constructed in Type II, III, IV accommodation and facilities in those flats differ according to the design and type of flat.

Irrespective of the type of flat and design of building, each flat has essential facilities like kitchen, bath, W.C. and water tap in Bath, kitchen and W.C. etc. & electric fittings in rooms, fans and electric points.

There are open lawns for occupants of ground floor and terrace on the top of buildings. Wash basin has been provided in type IV and type III.

Accommodation provided in flat is given below:-

#### Type I

- |                                  |  |
|----------------------------------|--|
| I. Single storeyed<br>(old type) | - Two rooms, a verandah and courtyard etc  |
| II. Double storeyed              | - A room, a kitchen, with separate W.C. and Bath and common bath & W.C. for two allottees. |
| III. Four storeyed               | - Two rooms, a balcony with services.  |

#### Type II

- |                    |                                     |
|--------------------|-------------------------------------|
| I. Double storeyed | - Two rooms, a verandah, a balcony. |
|--------------------|-------------------------------------|

II. Four storeyed - Two rooms (bed), a living room, a projected balcony.

III. Composite type - Two rooms, a verandah, a small terrace.

### Type III.

I. Double storeyed - Two rooms, a small store room, a verandah, a balcony.

II. Four storeyed - Two bed rooms, a living room, a lobby (Generally used as dining), a projected balcony, a small box room.

III. Composite type - Two rooms, a verandah, a big terrace.

### Type IV

I. Double storeyed - Three rooms, a store, a verandah, a balcony.

II. Four storeyed - a. Three bed rooms, a living room, a dining room, a projected balcony.  
b. Three bed rooms, a living room a store room, a lobby (generally used as dining room), a projected balcony.

III. Composite type Three rooms, two verandahs.

---

Composite types: Type IV on ground floor, type III on first floor, Type II on Second and third floor.

### 3.0.5. Household sizes

According to the N.B.O. socio-economic survey results, the average household size worked out as shown in Table No.3.05.

The percentage is higher for type I and Type II allottees and lower in Type IV allottees.

TABLE NO.3.05

PERCENTAGE DISTRIBUTION OF ALLOTTEES BY HOUSEHOLD SIZE

Household Type	Percentage of allottees			
	Type II	Type III	Type IV	All Types
Single	7.4	3.0	0.8	4.0
2-3	13.2	13.9	13.6	13.4
4-5	40.5	34.6	17.6	41.6
6 & above	38.9	48.5	38.3	40.9
Total	100.0	100.0	100.0	100.0
Average	5.0	5.2	5.1	5.1

### 3.1 Housing Standards

A house is defined as inhabited space, including all the installation necessary from technical and social point of view. As the problem of housing concerns low-income sector of population, minimum requirements in relation with local conditions should be defined in terms of economy and liability. However,



there should a balanced line below which the standards must not be allowed to lowered and should also fulfil the basic needs of the household at all levels of housing from qualitative as well as quantitative point of view.

There are various standards prevailing in Public agencies of Delhi, which is a matter of concern and for good living condition minimum standard may fulfil the housing situation, but not socially acceptable.

### 3.2.1. Recommendations of Expert Committee:

The summary of the recommendations of the Expert Committee on low-cost Housing appointed by Government of India (1958) is as follows:-

- . Two living rooms
- . Kitchen with store
- . Bath
- . W.C.
- . Verandah
- . Courtyard (single storeyed).

### 3.1.2. Minimum Standards

- I. - One room of area not less than 12 sq.m.
- II. Another room or an enclosed verandah of an area of 8 to 10 sq.m.
- III. A separate kitchen with built-in cupboard and shelves of area not less than 6 sq.m.
- IV A bath room of area not less than 2 sq.m.



Government every time after some gap reduce the area specially in lower income category type design, perhaps to maintain a balance between cost in respect to areas. As per recent instructions Government has again reduced the area of type II from 510 sqft. to 484 sqft, which is a matter of concern, keeping in view the minimum requirements of the family in relation to their belongings.

Another reason of selecting type II due to similar plinth area and pay range of the employees, a comparative study may result into gauging the feasibility of design efficiency in fixed norms. It may also highlight the deficiencies and merits of design and layout plan. Since D.D.A., at present, is not at all constructing special type design for their employees and sometime back allotted and still constructing three types of Houses, i.e. Janta, L.I.G. and M.I.G. Considering way of allotment on the basis of income pattern L.I.G. house has been taken up for study and analysis.

The selection of type II and public agencies under critical study is due to the reason that they belong to different organisations with separate Architectural and Planning Cells. So their way of solving the problem and trend may differ.

### 3.2.2. Description of Case Studies

Case Study I - Type II quarters at Masjid Moth, New Delhi  
C.P.W.D. Type Design Accommodation.

Case Study II - Type II Quarters at Reading Road, New Delhi  
N.D.M.C. Type Design Accommodation.

Case Study III : L.I.G. Type quarters at Nariana, West Delhi  
D.D.A. type accommodation.

### 3.3. Case Study I : Type II Quarters at Masjid Moth, New Delhi.

Masjid Moth Area, to the South of Andrews-gang is developed as residential colony and density of 196 persons per acre is achieved. This area is bounded by 150' wide main road and 80 ft. wide zonal road in South.

According to estimate Rs.49,00,5000 for the cost of construction of 344 type II quarters (4 storeyed strip designed)

#### 3.3.1. Area Statements

The plinth area s permissible and provided for type II as per drawings are as given under:-

#### DESCRIPTION OF AREAS

Description	Plinth Area permissible	Actual Plinth Area provided
a. Residential	50.20 Sq.m.	50.00 Sq.M.
b. Staircase	4.85 Sq.m.	5.00 Sq.m.
c. Sleeping balcony	5.75 "	5.60 "
Total	60.60	60.60

#### 3.3.2. Accommodation provided

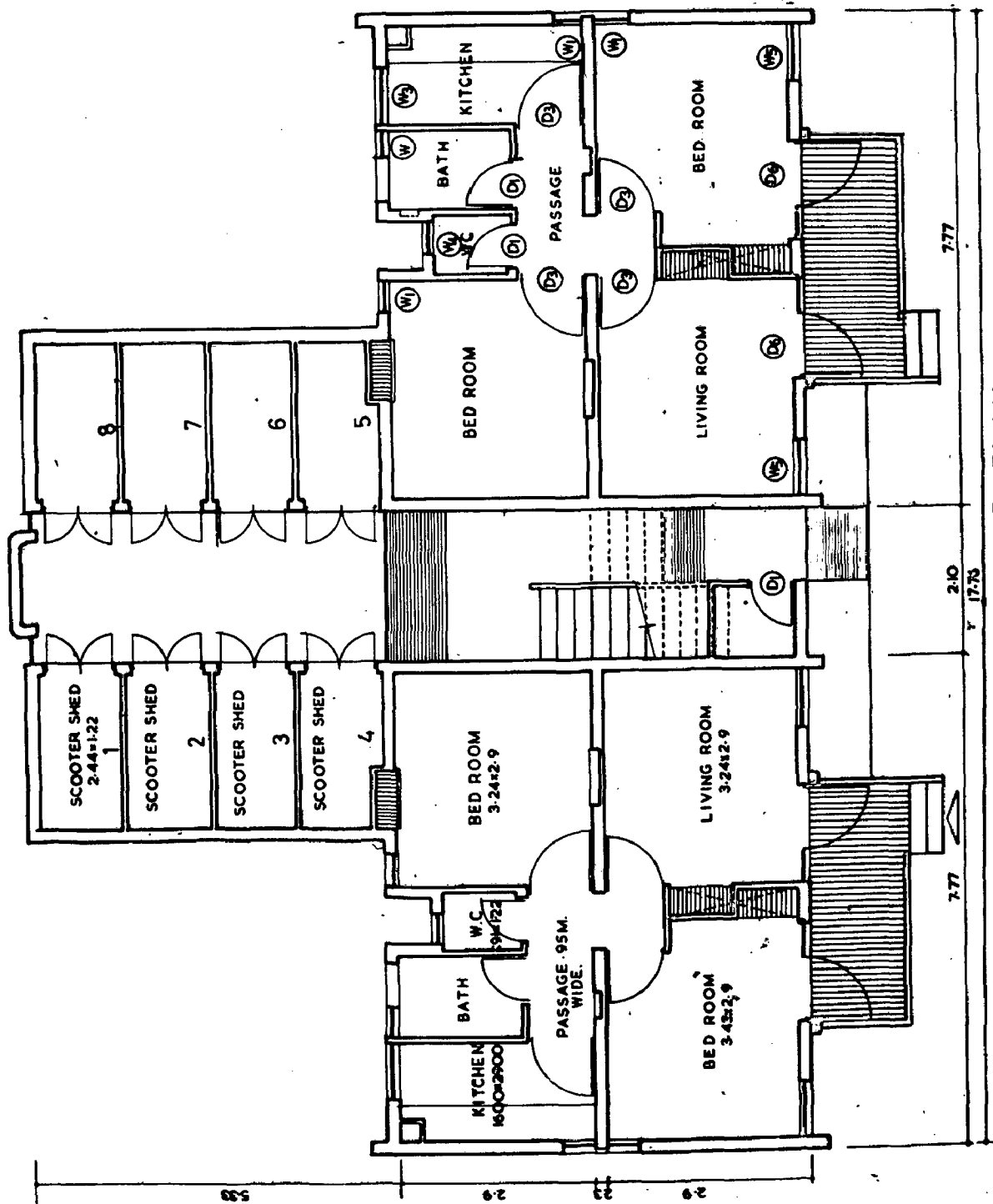
1. Four storeyed: A living room, two bed rooms, kitchen, bath and N.C. In addition to it upper floors are provided with balcony, while ground floor quarters have platform and open urinal and these are provided at the terrace.

3.3.3. Floor Area Analysis - given in plate in detail.

# C.P.W.D TYPE DESIGN RESIDENTIAL ACCOMMODATION

CASE STUDY - TYPE II QUARTERS AT MASJID MOTH AREA, NEW DELHI

DESIGN. P.K. AGGARWAL.  
SENIOR ARCHITECT.



## DETAILS OF FLOOR AREA

ROOMS	Area
LIVING ROOM	9.39 sq.m.
BED ROOM I	9.39 sq.m.
BED ROOM II	9.94 sq.m.
KITCHEN	4.64 sq.m.
BATH	2.23 sq.m.
W.C.	1.11 sq.m.
TOTAL	36.70 sq.m.
PASSAGE	
NEAR BATH & W.C.	2.45 sq.m.
VERANDAH (G.F.)	
BALCONY	5.55 sq.m.
STAIR CASE PER UNIT AREA	4.85 sq.m.
TOTAL FLOOR AREA	49.50 sq.m.

FLOOR AREA OF SCOOTER SHED IS NOT INCLUDED



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GROUND FLOOR PLAN

### 3.3.4. Analysis Type II Design Houses at Masjid Moh, New Delhi.

Plinth Area = 60.60

Scooter Shed = 27.58 (8 Nos.)

	X Floor	X L/D	X Bed Room	X Kitchen	X Bath	X W.C.	X Circulation	X Verandah X Balcony
Area	G.F.	9.39	9.39X 9.94X	4.64	2.23	1.11	8.00 ) Staircase)	5.75
	F.F.	9.39	"	4.64	2.23	1.11	4.85 )	"
	S.F.	9.39	"	4.64	2.23	1.11	"	"
	T.F.	9.39	"	4.64	2.23	1.11	"	"
Direct Access		Yes No.)	Yes	Yes	Yes	Yes	Yes	Yes
Cross Vent.		Yes)	Yes	Yes	Yes	Yes		
Adequate light		Yes	No.) Yes)	Yes	Yes	Yes		
Noise		No	No.					
Storage space		Through cupboard		Through cupboard	No	No.		
Cycle/Scooter shed	G.F. 8 Nos.							
Height		2.9	2.9	2.9	2.9			

- Direct access means from outside, for other room it means independent access.
- Cross ventilation considered when the doors are open
- The access to W.C. & Bath is not direct to sweeper.

### 3.4. Case Study II - Type II Quarters at junction of Reading Road, and Panchkula Road, New Delhi.

It is an area of 1.23 acre, towards North of D.1.2 Area, is developed

as residential staff quarters for N.D.M.C. staff. Density achieved 349 persons per acre. This small pocket is bounded by two main roads, Reading Road and Punchkuian Road.

The detailed estimate was amounting to Rs.13,60,000, the total cost for the construction of 96 quarters as per Delhi Schedule of Rates, 1967.

### 3.4.1. Area Statement:

The Plinth Area as permissible for Type IX as per Drawings is as under in sq.ft.

Description	Plinth Area Permissible	Actual Area Provided
i. Residential	535 Sft.	557 Sft.
ii. Staircase	54 Sft.	720 Sft.
iii. Sleeping Balcony	60 Sft.	460 Sft.
	649.00 Sft.	675.0 Sft.

### 3.4.2. Accommodation Provided:

1. Four storied: A living room, two bed rooms, a kitchen, a bath & N.C.

In addition to it upper floors are provided with balconies and G.P. quarters have platforms.

3.4.3. Floor Area - given in plate in detail.

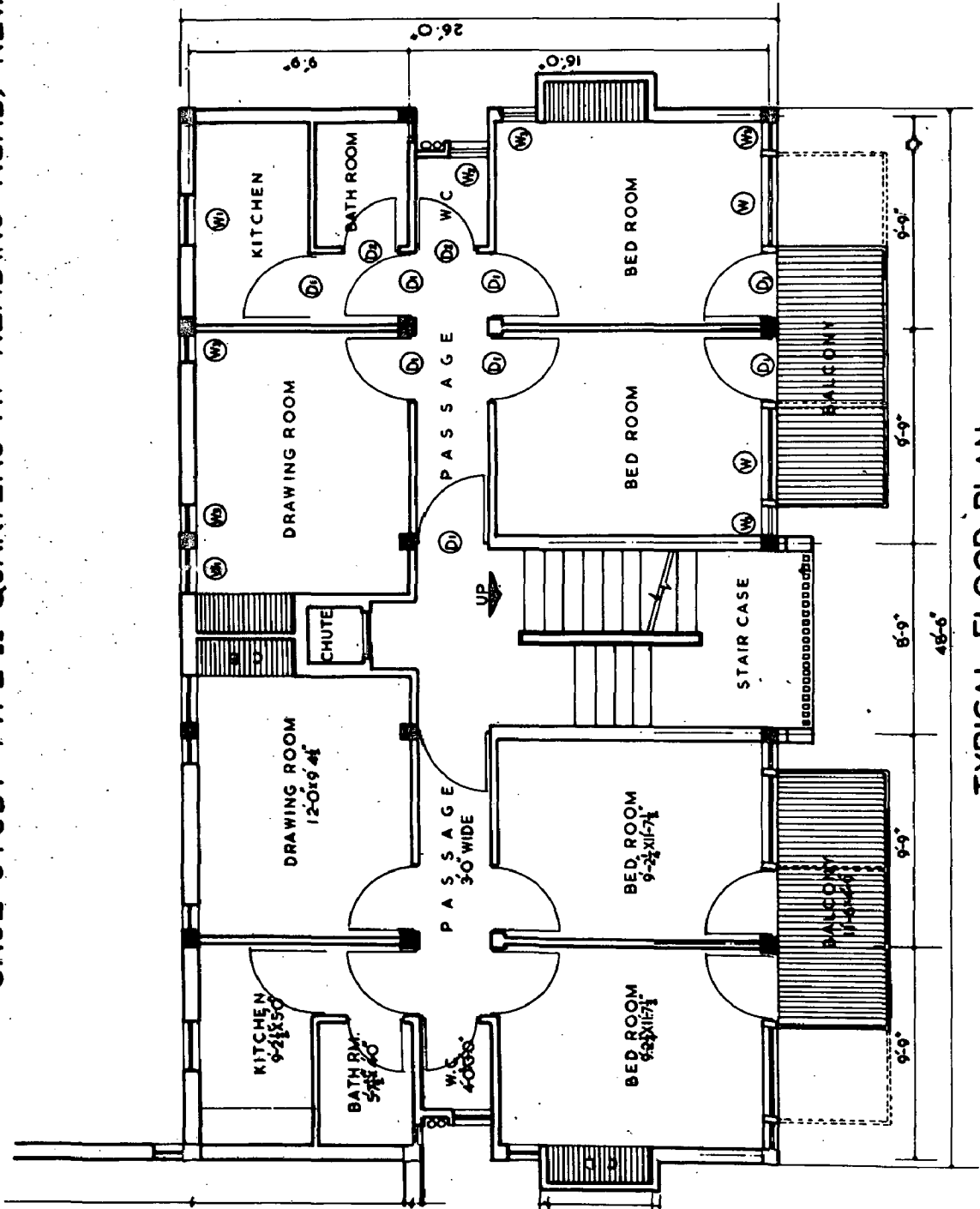
# NEW DELHI MUNICIPAL COMMITTEE RESIDENTIAL ACCOMMODATION

CASE STUDY-TYPE II QUARTERS AT READING ROAD, NEW DELHI.

DESIGN. V.P.DHAMIJA.  
CHIEF ARCHITECT.

## DETAILS OF FLOOR AREA

ROOMS	
DRAWING ROOM.	112.5
BED ROOM I	106.8
BED ROOM II	106.8
TOTAL	326.1
KITCHEN	46.0
BATH	22.5
W.C.	12.0
TOTAL	406.6
PASSAGE	
NEAR ROOMS	39.0
NEAR KITCHEN	14.2
COMMON STAIR CASE	7.2
PER UNIT AREA	72.2
TOTAL FLOOR AREA	532.0



TYPICAL FLOOR PLAN



**3.4.4. Analysis of Type II Design Houses at Reading Road, New Delhi  
(N.D.M.C. Type Design)**

**Total Plinth Area = 675 Sft. (including balcony)**

	Floor	L/D	Bed Room	Kitchen	Bath	W.C.	Circulation	Ver. balco
Area in Sft.	G.F.		106.0	46.0	22.5	12.0	53.2	46.0
	P.F.		106.0	46.0	22.5	12.0	S. Case 72.2	46.0
	S.F.	112.5	106.3	46.0	22.5	12.0		46.0
	T.F.	112.5	106.3	46.0	22.5	12.0		46.0
Direct Access		Yes	Yes	Yes	Yes	Yes		
Cross Vent.		Yes	Yes	Yes	Yes	Yes		
Adequate light		Yes	Yes	Yes	Yes	Yes		
Noise		No.	No.	No.	No.	No.		
Storage space		Throu cup board	No. & Cup board	Throu shelves	No.	No.		
Cycle shed	No.	-	-	-	-	-		
Height		10'	10'	10'	10'	8'-6"		

- Direct access means from outside or to other rooms it means independent access.
- Cross ventilation is considered only when the doors are open.
- The access to the Bath room & W.C. is not direct.

### 3.5. Case Study III (Four storeyed L.I.C. Type quarters at Naraina, West Delhi).

The area is situated in West Delhi of Naraina, residential Scheme B Block II. Total Area of the Scheme is 10.8 Acre, out of which 2.20 Acre is allotted to L.I.C. type Housing. A density of 277 persons per acre is achieved.

The dwelling units were allotted in August 1971. The period of payment of hire purchase instalments is 15 years and 30% of the cost was paid in advance for taking possession. The rental value of these flats is Rs.200/-. Each flat covers the area of 518 Sft.

#### 3.5.1. Area Statement

The plinth area provided in this type design is as under:-

<u>Description</u>	<u>Area provided</u>
1. Residential	473 Sft.
2. Sleeping Balcony	56 sft.
3. Staircase	17 Sft. per unit
Total	518 Sft.

#### 3.5.2. Accommodation Provided

1. Four storeyed: A living room, a bed room, a kitchen, a bath, W.C. & back courtyards.
- In addition to the upper floors are provided sleeping balcony and long passage.

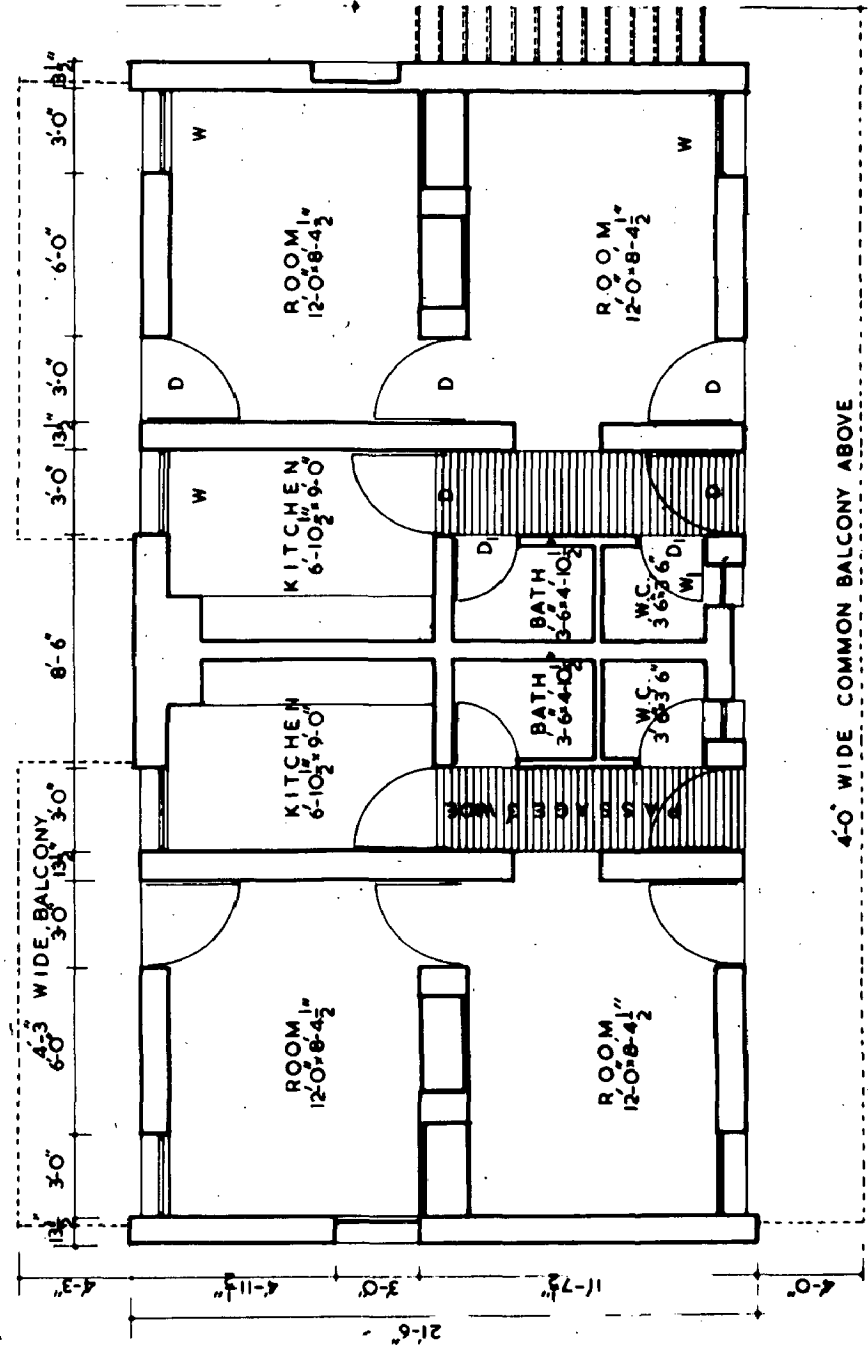
#### 3.5.3- Floor Area

Floor area is shown in plate room-wise.

# D.D.A. TYPE DESIGN RESIDENTIAL ACCOMMODATION

CASE STUDY—L.I.C. QUARTERS AT NARAINA, WEST DELHI.

## DETAILS OF FLOOR AREA



<u>ROOMS</u>	
ROOM I	98.5 sq. ft.
ROOM II	98.5 sq. ft.
KITCHEN	61.8 sq. ft.
BATH	17.0 sq. ft.
W.C.	12.2 sq. ft.
<b>TOTAL</b>	<b>288.0 sq. ft.</b>

<u>PASSAGE</u>	
NEAR BATH AND W.C.	33.0 sq. ft.
BALCONY	32.0 sq. ft.
STAIR CASE	24.0 sq. ft.
<b>TOTAL FLOOR AREA</b>	<b>377.0 sq. ft.</b>

4'-0" WIDE COMMON BALCONY ABOVE

### 3.5.3. Analysis of L.I.C. Type Houses at Naraina, W. Delhi. (D.D.A. Type)

Plinth Area = 518 Sft.

	X NFloors	X L/D	X Bed Room	X Kitchen	X Bath	X N.C.	X Cir. Space	X Ver.	X Remarks
Area	4 Storeyed	98.5	98.5	61.8	17.0	12.2	33.0 Stair- case 24 Sft.	32.0	
Direct Access		Yes	Throu. L/Room	Yes	Yes	Yes	---	---	---
Cross Vent.		Yes	Yes	Yes	Throu Par- tition wall	Yes	---	---	---
Adequate light		Yes	Yes	Yes	Yes	No.			
Noise		No	No.	No.	No.	No.			
Storage space		Throu shel- ves	Shelves or CB	Shelves	No.	No.			
Cycle/Scooter shed		No. provis- ion							
Height		9'-6"	9'-6"	9'-6"	9'-6"	8'-6"			

. Direct access means from outside, for other rooms it means independent access.

. Cross ventilation is considered only when the doors are open.

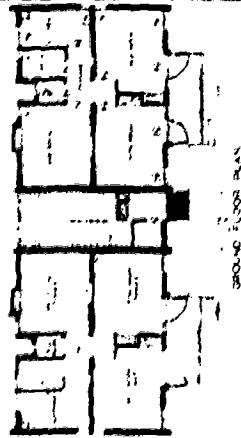
### 3.6. Comparative Analysis:

To find design efficiency in these designs, the various aspects are analysed i.e. wall area, its percentage, circulation area in percentage, design efficiency percentage wise and light and ventilation on total floor area. (Refer plate).

# COMPARATIVE ANALYSIS OF TYPE QTRS. UNDER CASE STUDIES

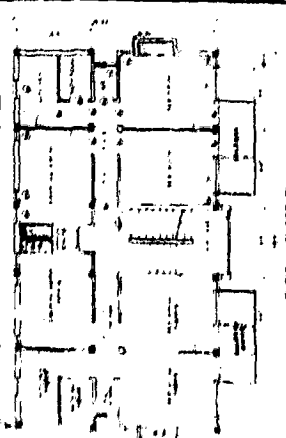
## TYPE-II QUARTERS AT MASJID MOTH, NEW DELHI.

TYPE	PLINTH AREA 2	FLOOR AREA 3	WALL AREA 4	PERCENTAGE 5	EFFICIENCY 6	LIGHT/VENT. 7	REMARKS 8
II	60.60 S.M. OR 652.2 S.FT.	LIV. AREA 287.2. SER. " 7.98, CIR. " 7.30. TOTAL " 44.00 OR 434.2 S.FT.	16.60 S.M. OR 178.1 S.FT.	27.4 %	60.5 %  CIR. 12.4 %	14.6 %	



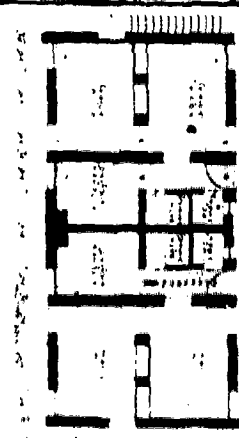
## TYPE-II QUARTERS AT READING ROAD, NEW DELHI.

I	2	3	4	5	6	7	8
II	630.5 S.FT.	LIV. AREA 326.1 SER. " 80.5 CIR. " 125.4 TOTAL " 532.0 S.FT.	985 S.FT.	15.6 %	64.5 %  CIR. 19.8 %	13.4 %	ST. COL. AND 4" USED AS PARTITION WALLS.



## L.I.C. QUARTERS AT NARAINA, WEST DELHI.

I	2	3	4	5	6	7	8
L.I.C	518.0 S.FT.	LIV. AREA 197.0 SER. " 91.0 CIR. " 57.0 TOTAL " 345.0 S.FT.	173.0 S.FT.	33.4 %	55.6 %  CIR. 11 %	14.0 %	1 1/2" TH. WALLS USED LOAD BEARING HAS WALLS HAS DECREASED efficiency.



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CHAPTER - 4PHYSICAL ANALYSIS OF TYPE DESIGN (INTERNAL)4.1. Role of Activities:

Efficient design of homes and layouts is related with analysis of activities. Activities are those generally performed in house and functional design fulfils maximum satisfaction.

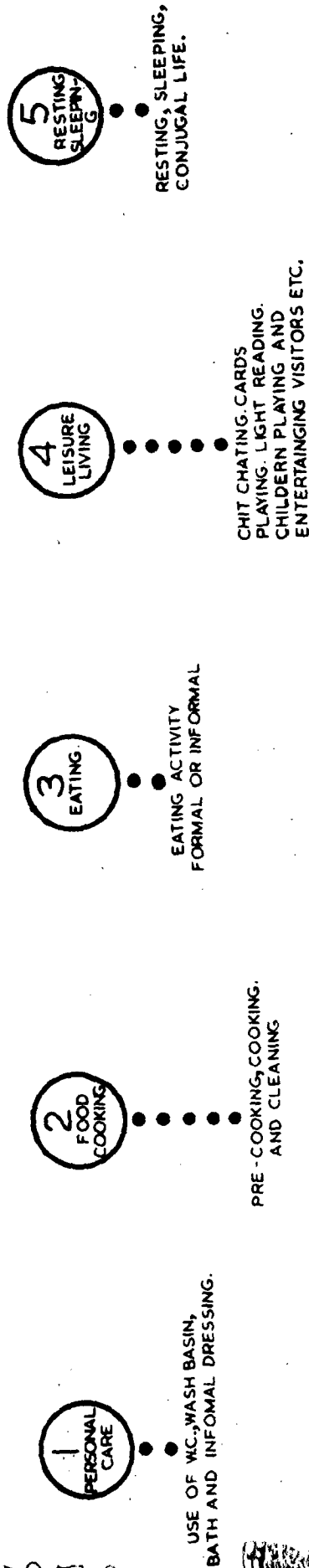
4.1.1. Living Activities:

The nature of domestic activities vary from region to region and country to country. These are guided by the living habits, social customs, cultural values and technological advancements and economic advancement of the occupants. Although a reasonable diversity is noticeable in this country too, in the patterns of these activities, a good deal of accord prevails in this basic range. Only mode of performance varies according to heritage. The low and average income group families with conservative attitude, for example cook and eat while squatting, whereas in the families of higher economic status raised platform is used for cooking and dining table for eating. In India, both the extremes coexist. Therefore, in this study, there is a wide spectrum for possible variations. Broadly, the living activities have been covered under the following groups:-

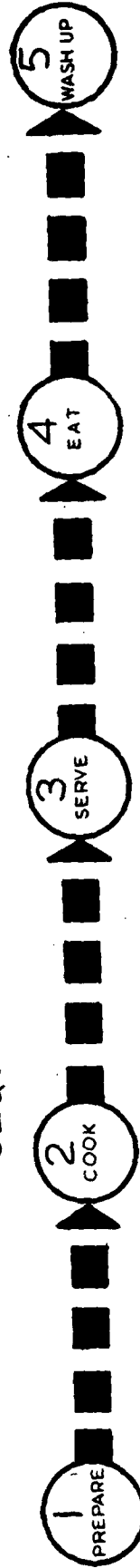
- . Personal care: Use of W.C., wash basin, bath and informal dressing.
- . Food cooking: Pre-cooking, cooking and cleaning
- . Eating: Sewing, eating activity formal and informal.

# SPACE REQUIREMENTS AND ACTIVITIES

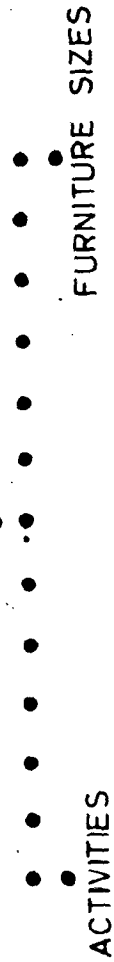
## LIVING ACTIVITIES



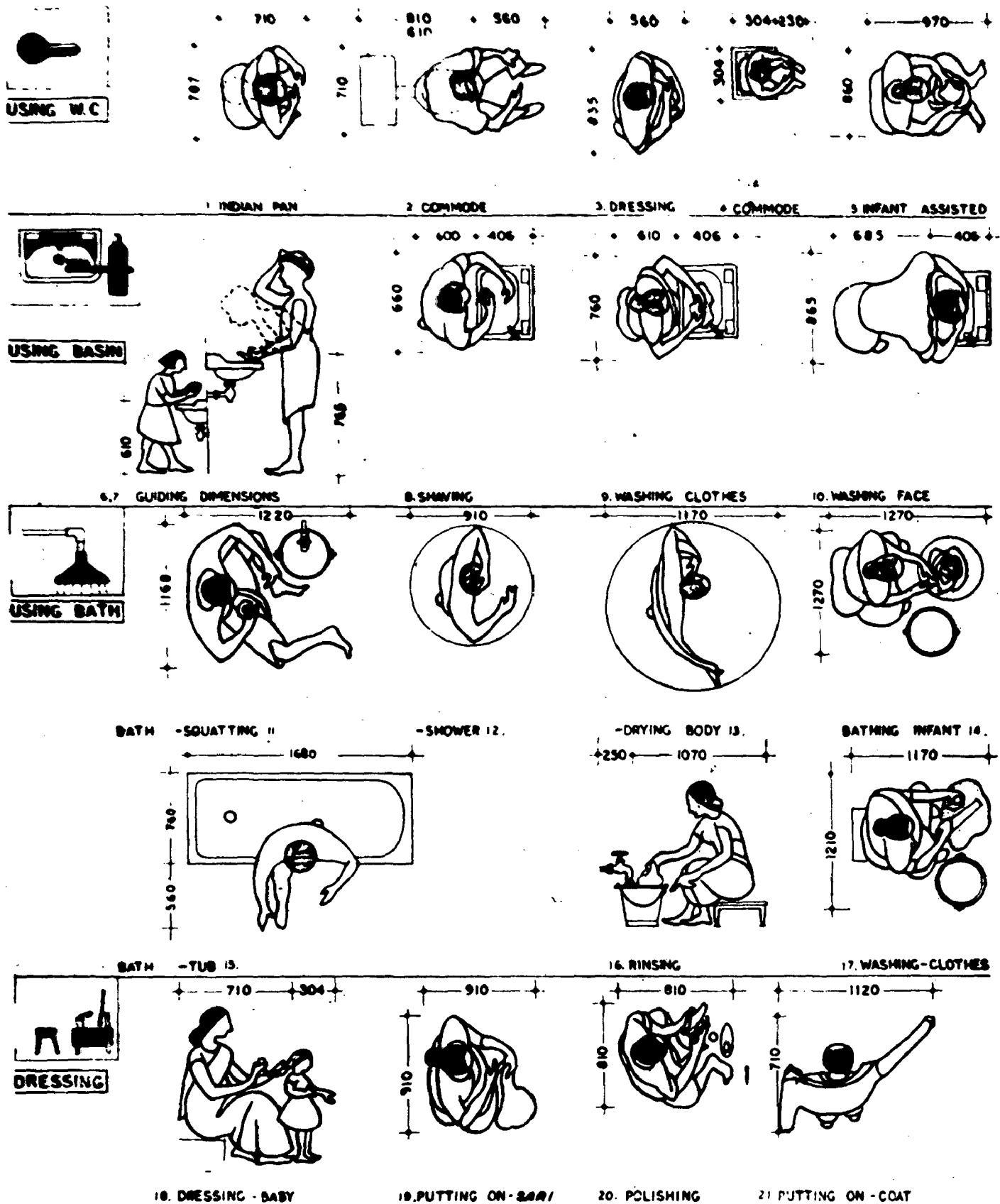
## SEQUENCE OF KITCHEN ACTIVITIES



## SPACE REQUIREMENTS RELATED TO ACTIVITIES



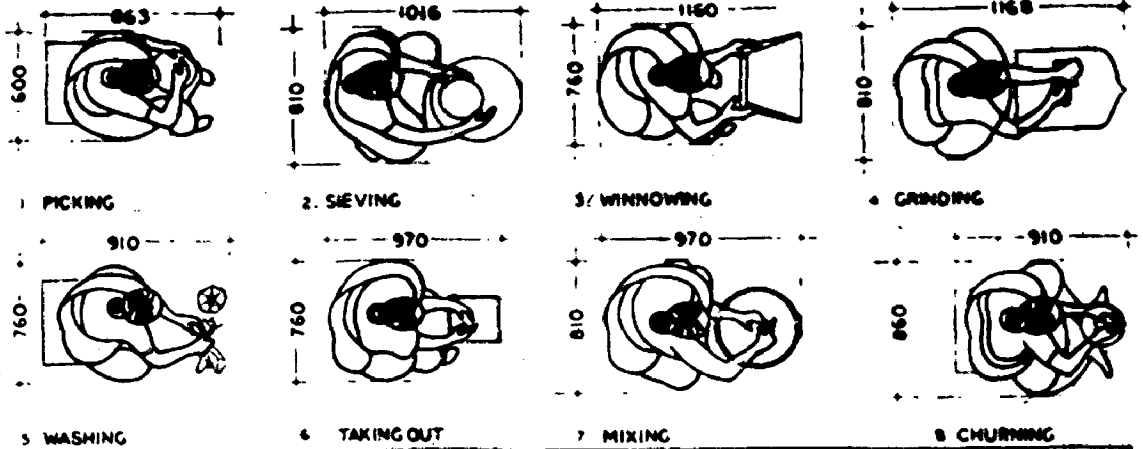
ANTHROPOMETRIC DIMENSIONS



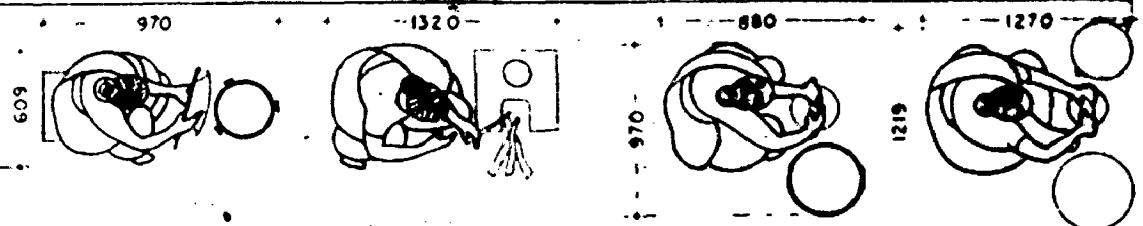




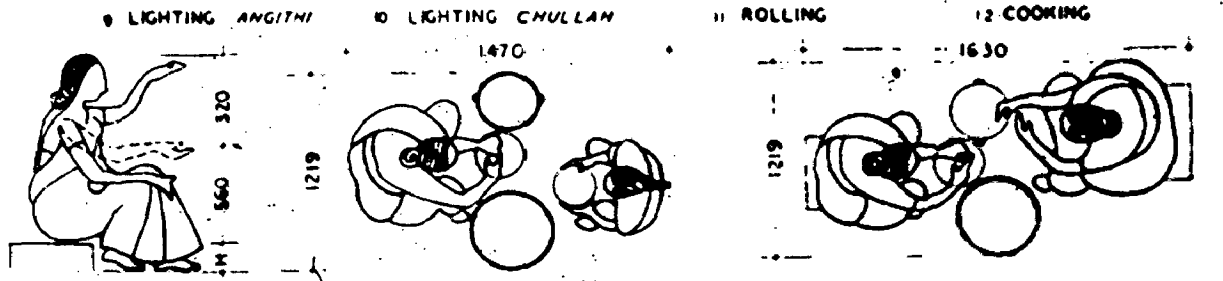
**PRE-COOKING**



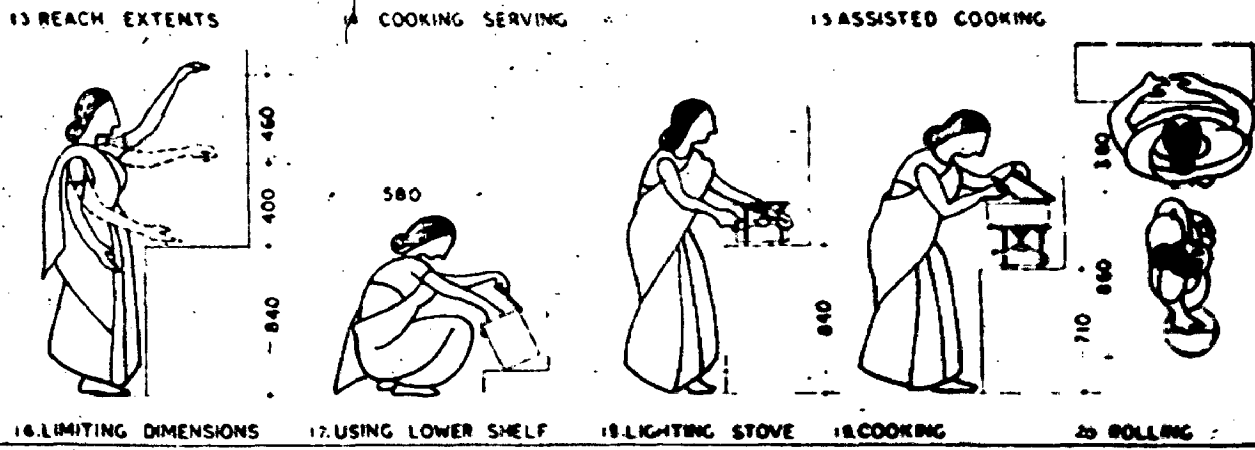
**COOKING**



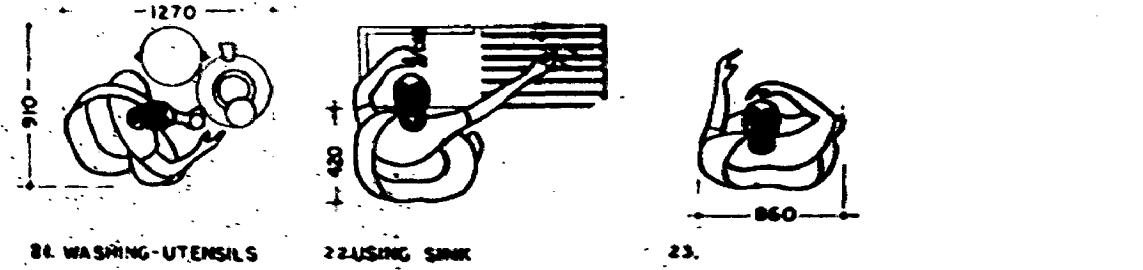
**SQUATTING**



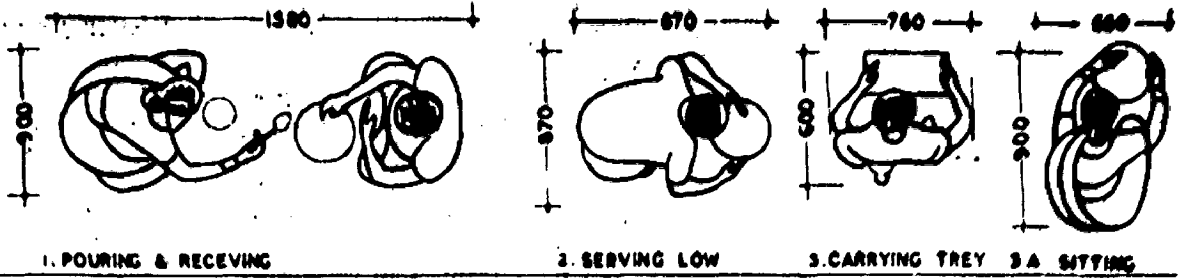
**STANDING**



**CLEANING**

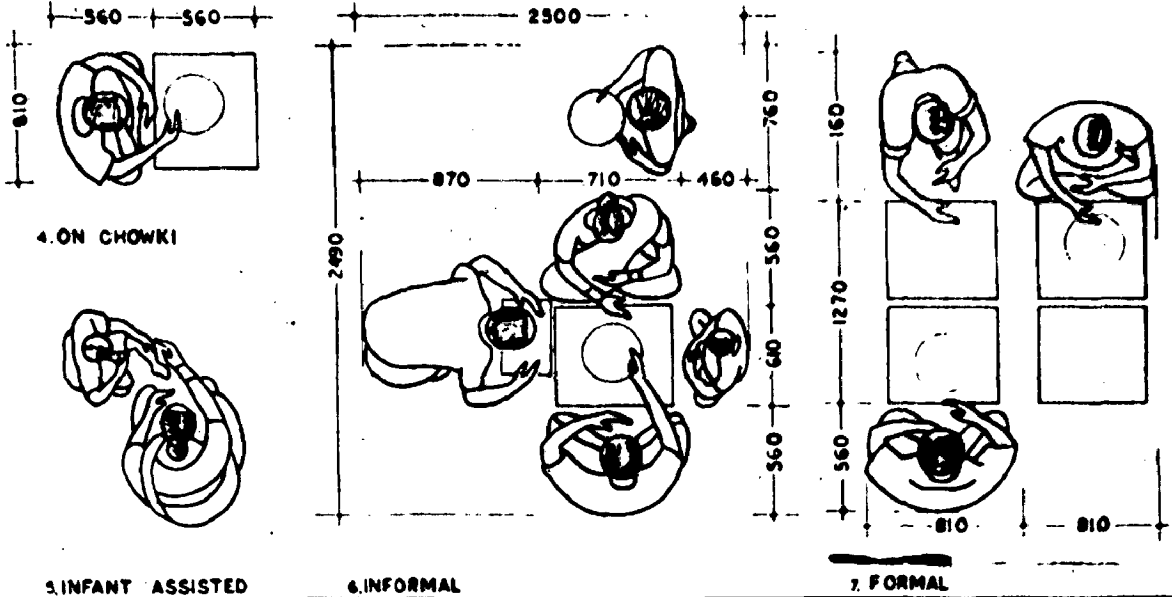


**SEWING**

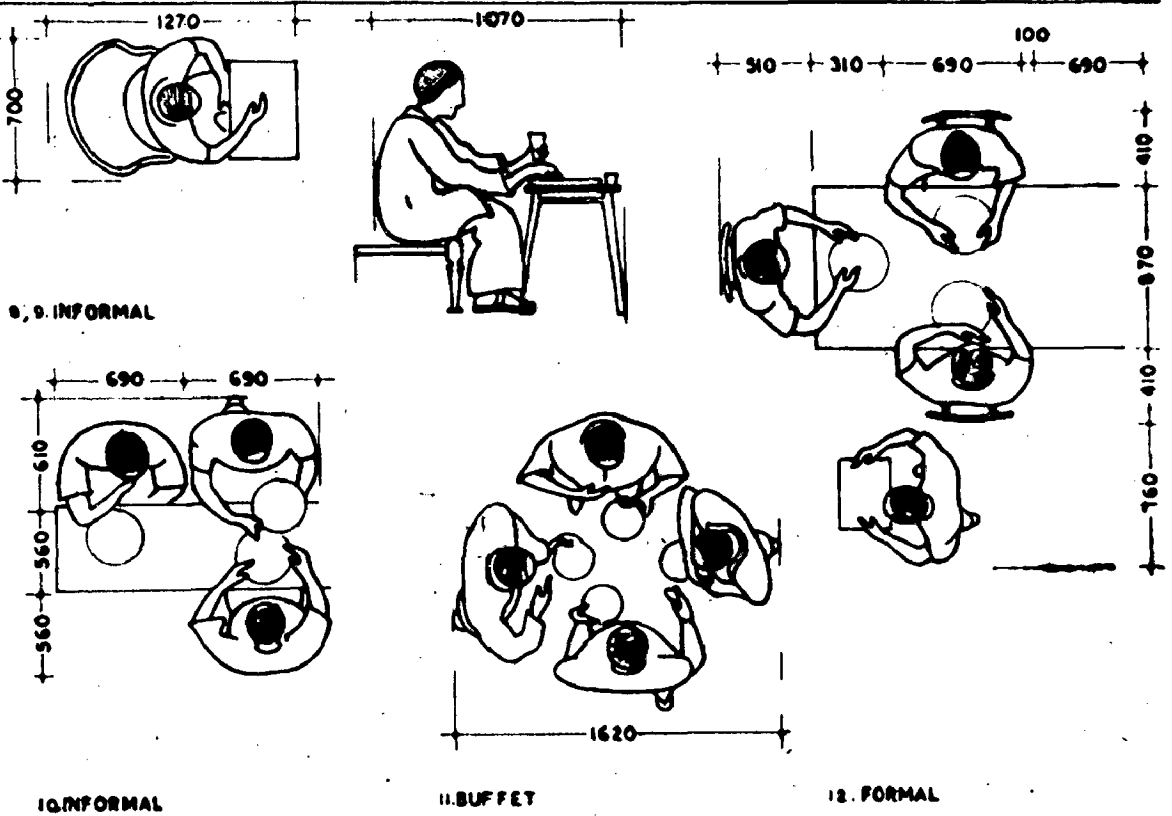


**EATING**

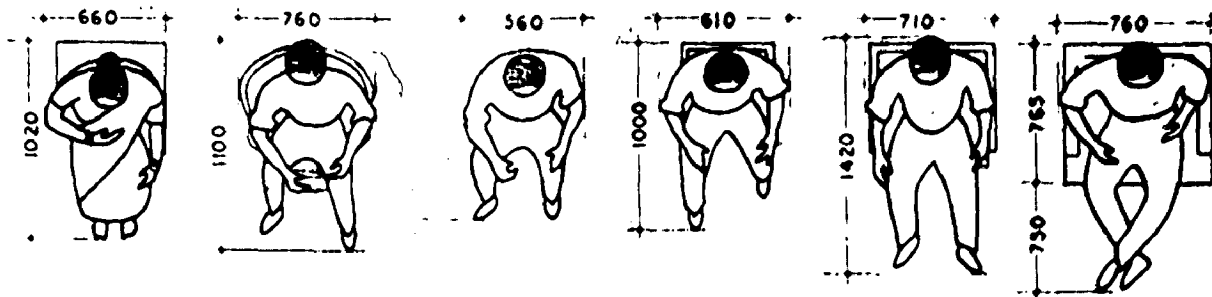
**SQUATTING**



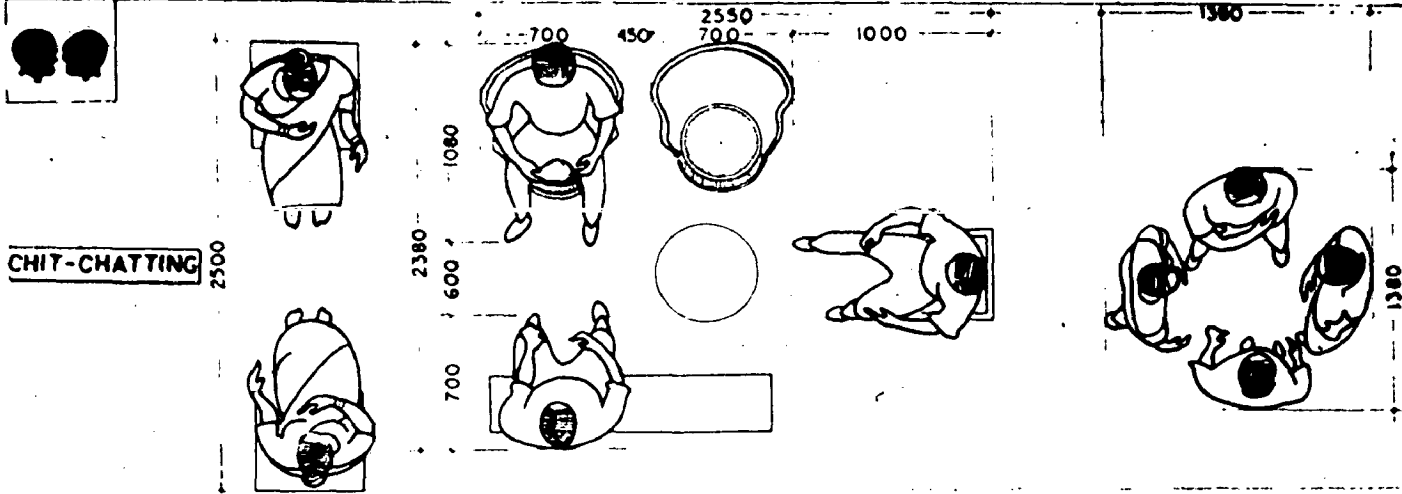
**SITTING & STANDING**



**BASIC DIMENSIONS**

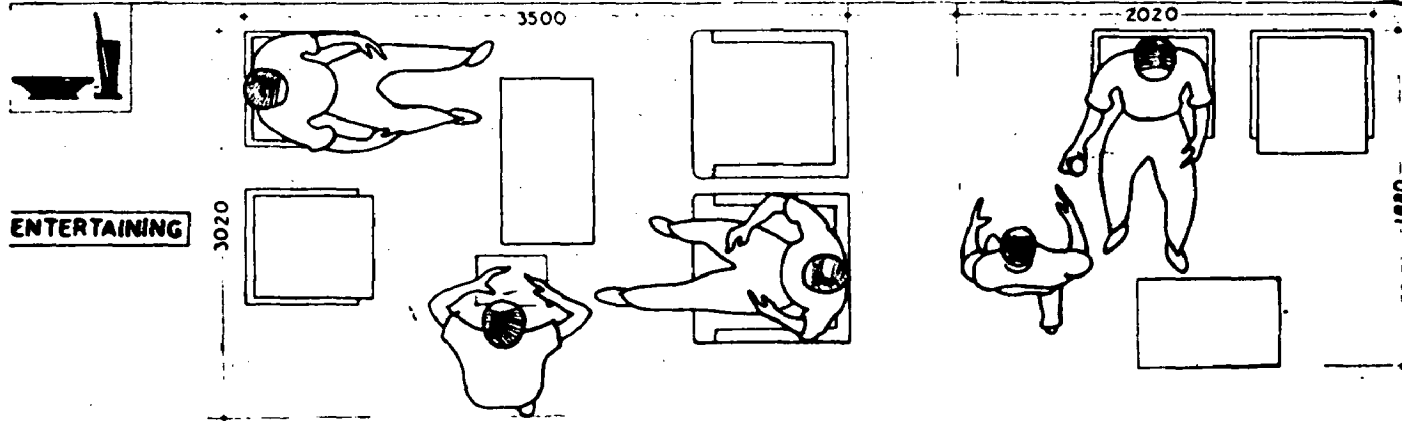


SITTING ON -PIRHI 1. -MURRAH 2. -PUFF 3. -OFFICE CHAIR 4. -EASY CHAIR 5. -SOFA-CHAIR 6.



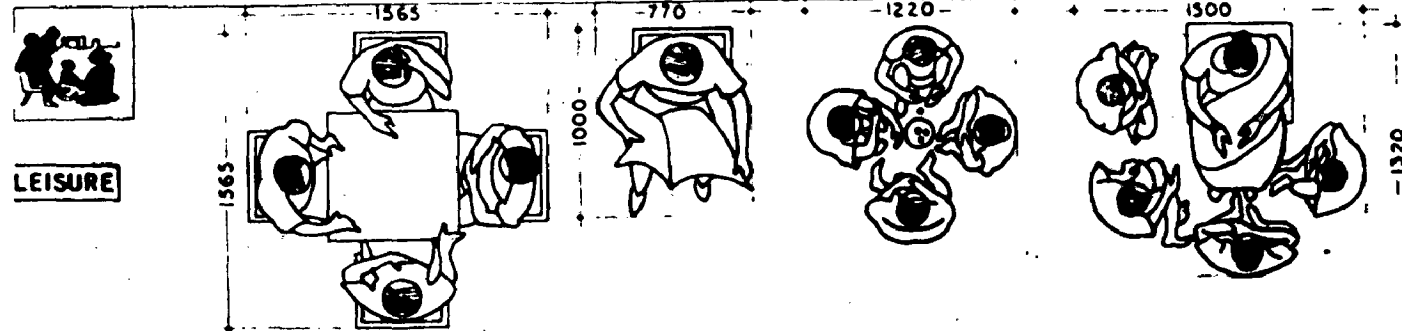
**CHIT-CHATting**

7. OPPOSITE 8. INFORMAL 9. CHIT-CHATting (SD)



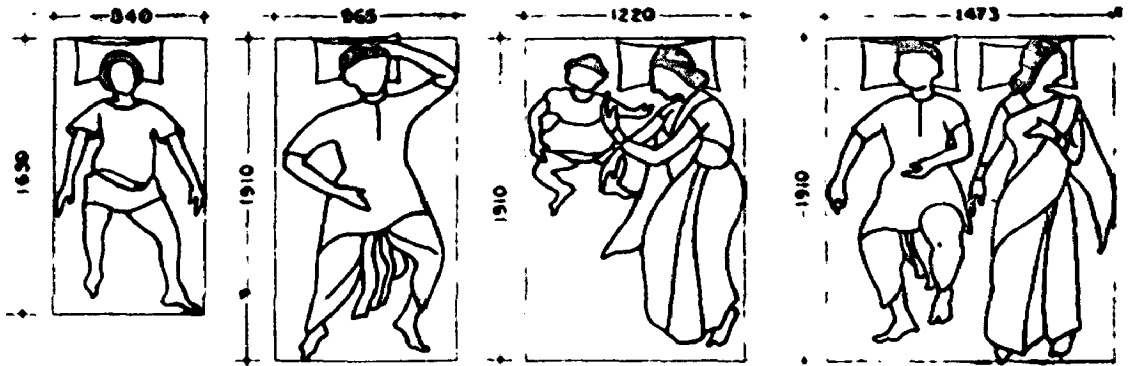
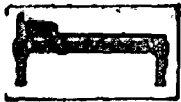
**ENTERTAINING**

10. FORMAL 11. INFORMAL



**LEISURE**

12. PLAYING CARDS 13. LIGHT READING 14. CHILDREN-PLAYING 15. STORY TELLING



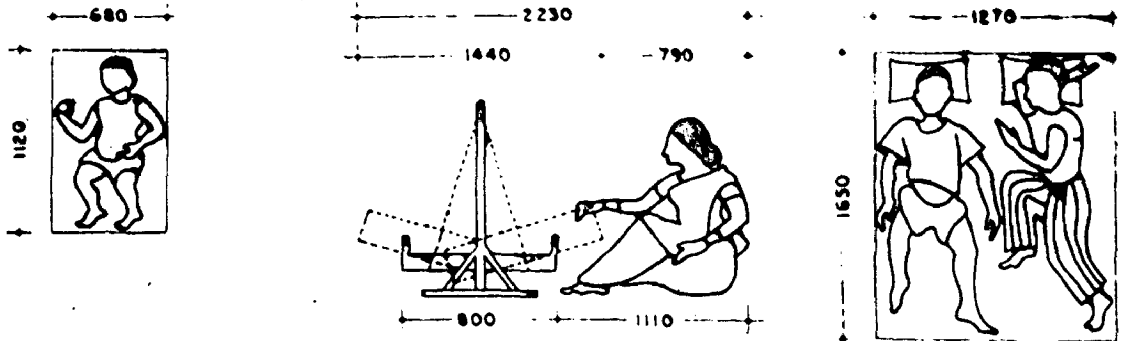
1. GROWN-UP

2. ADULT

3. CHILD & ADULT

4. TWO ADULTS

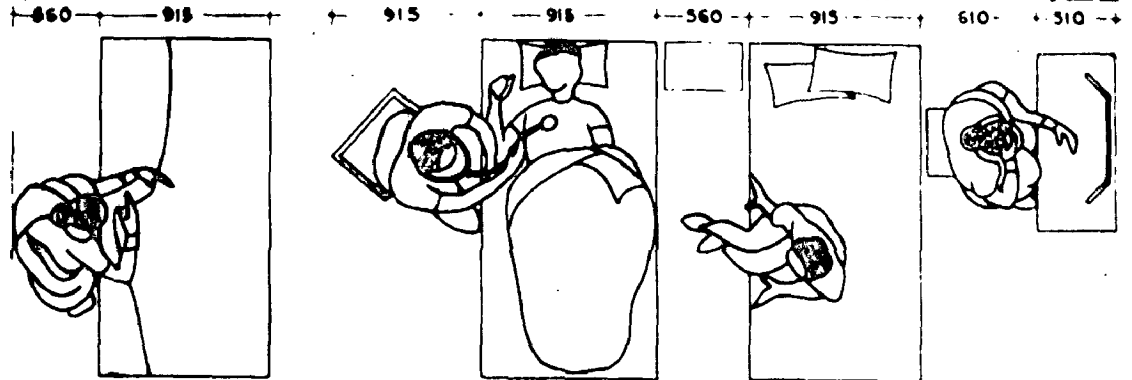
**GUIDING DIMENSIONS**



5. INFANT

6. INFANT IN CRADLE

7. GROWN-UPS



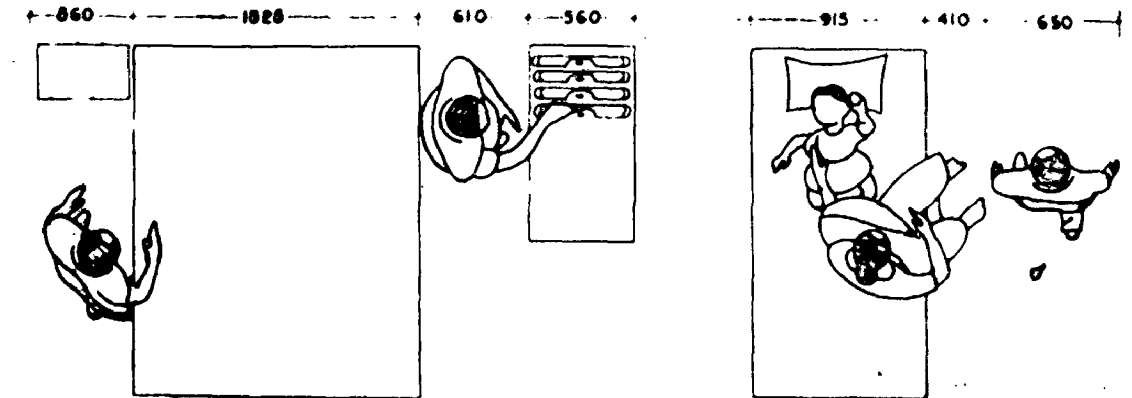
8. MAKING BED

9. DOCTOR-ATTENDING

10. LEAVING BED

11. DRESSING

**CLEARANCES AROUND BED**



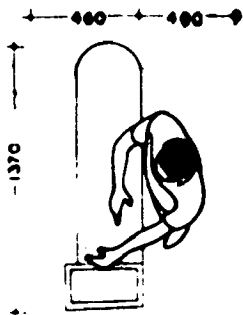
12. APPROACHING BED

13. USING-CUPBOARD

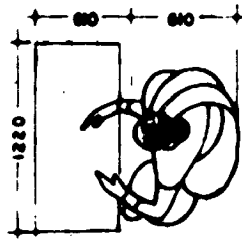
14. COMFORTING CHILD



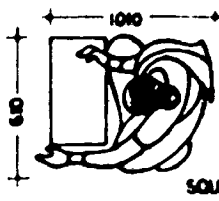
COMMON ACTIVITIES



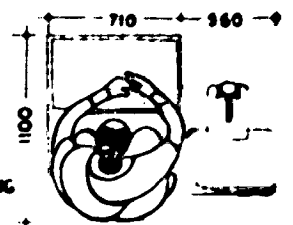
1 IRONING - ON STAND



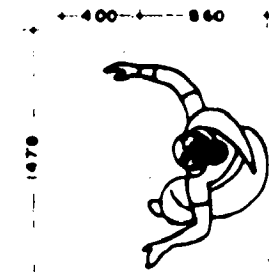
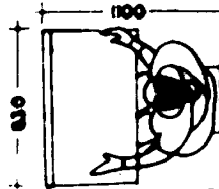
2 -SITTING ON FLOOR



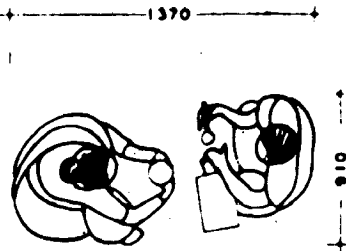
3 SEWING



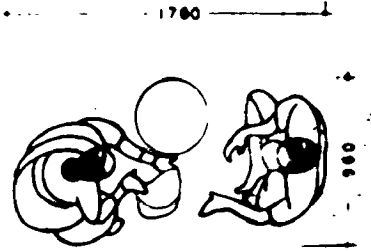
4 ARRANGING BOX



5 SPINNING



6 RECEIVING MILKMAN



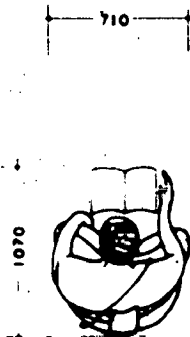
7 RECEIVING VENDOR



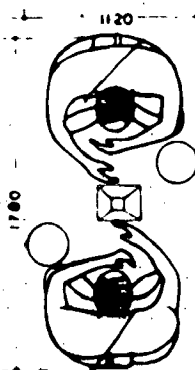
WORSHIPPING



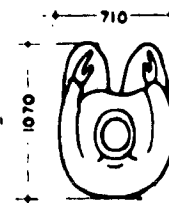
8 WORSHIPPING - INFRONT OF DIETYS



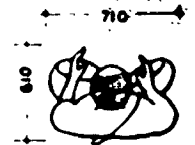
9 -READING



10 PERFORMING NAMAZ

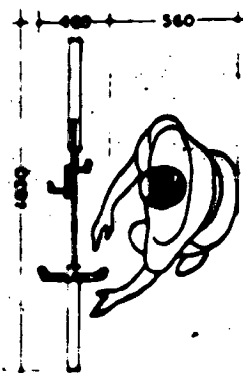


11.PERFORMING NAMAZ

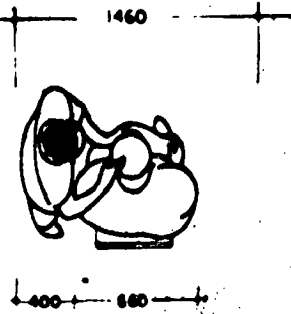


12.MEDITATION

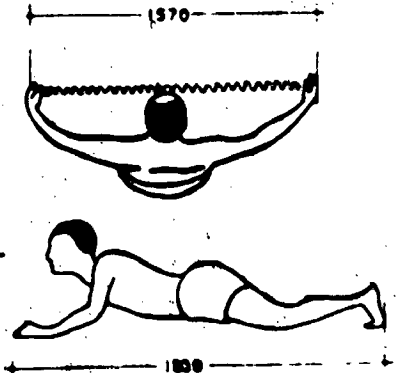
CASUAL ACTIVITIES



13 BALANCING BICYCLE



14 BARBER ATTENDING



15. EXERCISING

- . Leisure & Living: Chitchatting, playing cards, light reading, children playing and entertaining visitors etc.
- . Resting & Sleeping: Relaxing, sleeping, conjugal life.

Apart from this, various miscellaneous types of activities are sewing, ironing, exercising etc. All these activities whether in rooms or kitchen are also related with sequence of performances. Space requirements related to anthropometric dimensions for effective planning.

For this anthropometric dimensions are given as recommended by C.B.R.I. in plates for the judgement, when and where tight spots show up in the course of working up a plan.

#### 4.1.2. Space Requirements:

In order to work out the space requirements, the grouping of activities is essential. Each activity is performed by certain persons wherein some equipment and furniture is also associated. The space requirements based on the functional needs once arrived at can form basis of further studies.

Cooking and eating spaces can also be combined with alternative system of cooking and eating.

The analysis of activities is related with furniture sizes and types of dimensions.

1. Furniture

2. Dimensions between furniture layout in relation to family members.

## SCHEDULE OF FURNITURE ASSUMED FOR ASSESSING PLANS

1. KITCHEN	A SMALL COOKING TABLE UNLESS ONE IS BUILT IN. SINK OR WASHING PLACE.	5. STUDY BED ROOMS	PLUS DESK CHAIR BOOK CASE
2. DINING SPACE	DINING TABLE AND CHAIRS	6. MAIN BED ROOMS	DOUBLE OR TWO SINGLE BEDS BESIDE TABLES CHEST OF DRAWERS DOUBLE WARDROBE DRESSING TABLE.
3. LIVING SPACE	A SETTEE 2 OR 3 EASY CHAIRS SMALL TABLE A T.V. SET.  REASONABLE SPACE FOR: SEWING BOOK CASE ETC.	7. CABIN SINGLE	BED OR DIVAN CLOTHES STORAGE CHAIR SMALL WORKING SURFACE
4. BED ROOM SINGLE	BED OR DIVAN BESIDE TABLE CLOTHES STORAGE ● BUILT IN WARDROBE ● CHEST OF DRAWERS ● STORAGE FOR PERSONAL POSSESSIONS.		

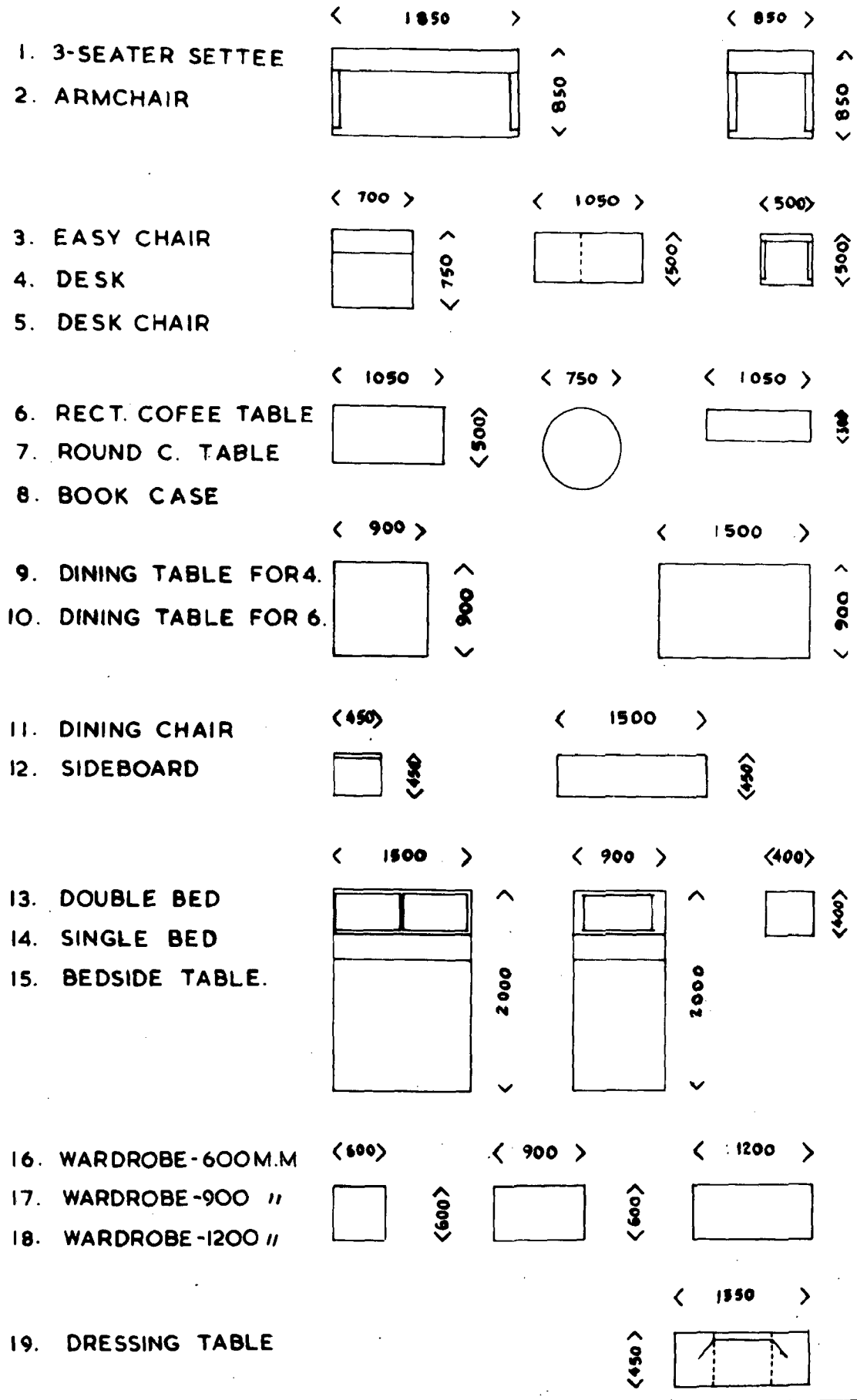
'HOMES FOR TODAY AND TOMORROW' POINTS OUT THAT IN ORDER TO ENSURE THAT A ROOM IS EFFICIENT AND ENJOYABLE TO LIVE IN, THE FURNITURE MUST NOT ONLY FIT INTO THE IN A SENSIBLE WAY, BUT MUST LEAVE SUFFICIENT SPACE TO MAKE THE CONVENIENT AND COMFORTABLE TO USE. IT IS POSSIBLE THAT LIVING SPACE MAY NEED ADDITIONAL ITEMS SUCH AS EXTRA CHAIRS, SIDE-BOARDS ETC.

SOURCE - BASED ON RECOMMENDATION MADE IN SPACES IN HOME,  
PUBLISHED BY DEPART OF THE ENVIRONMENT, LONDON.

J S GARG.  
M Arch. Dissertation.

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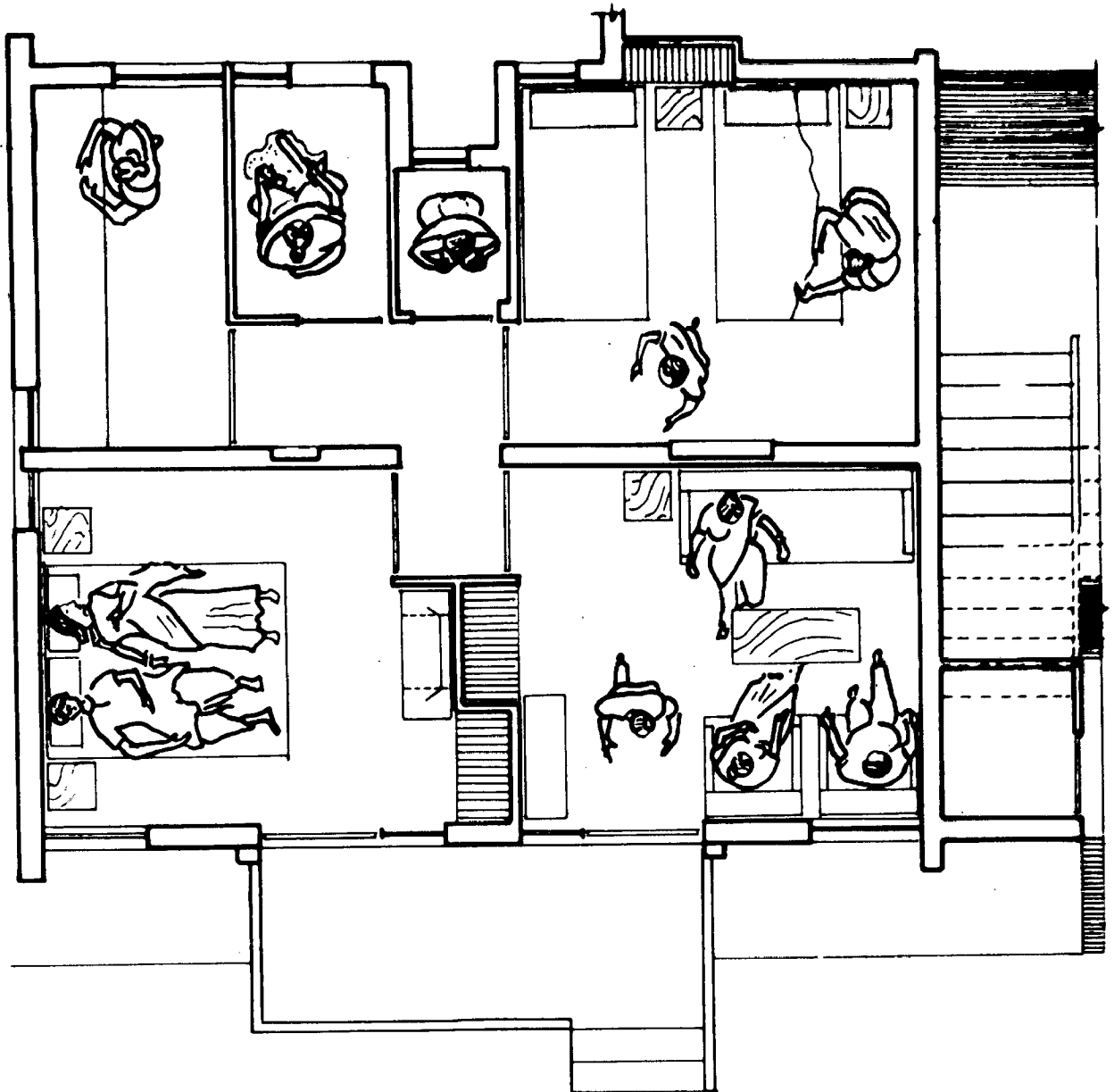
FURNITURE SIZES.



SOURCE:- SPACES IN HOME DEPARTMENT OF ENVIORNMENT LONDON.

J.S.Garg.  
M. Arch. Dissertation.





## TYPE-II QUARTERS AT MASJID MOTH NEW DELHI.

### Observations:

1. ANTHROPOMETRIC ANALYSIS OF HOUSE REVEAL THAT THE SIZES OF ROOMS ARE NOT CONSIDERED ON THE BASIS OF ANTHROPOMETRIC DIMENSIONS FOR GREATER WORKING EFFICIENCY AND COMFORT.

2. DETAILS OF THE OBSERVATIONS ARE AS GIVEN:—

- BASED ON THE DIMENSIONS WORKED OUT BY C.B.R.I. ROORKEE, AND DATA PROVIDED IN SPACES IN HOME PUBLISHED BY DEPTT. OF ENVIRONMENT, LONDON.

J.S.Garg.

M.Arch. Dissertation.

2. The efficiency of circulation space, i.e. approaching from bed rooms to bath rooms, W.C. without going through other rooms, least use of living room as passage. Relationship of house wife with living area.
3. The extent to which activities need privacy and quiet.
4. The convenience of entering and leaving in relation to callers i.e. sufficient room at the entrance to receive visitors, etc.

#### 4.2. Residential Space Analysis:

##### Case Study I - Type II Quarters at Masjid Moth, New Delhi (C.P.W.D. Type Design, Refer Plate).

Furniture normally required is laid out to analyse space relationship with activities on the basis of above stated outlines.

#### 4.2.1. Observations:

##### a. Living room

Size 3.24x2.9

Area: 9.39 Sq.M.  
101 Sft.

Considering anthropometric dimensions and furniture layout it gives a tidy impression. There is no other possibility of layout omitting. The study reveals that 3.5 M width is required minimum for this type of arrangement, whereas width comes to 2.9 m which is less.

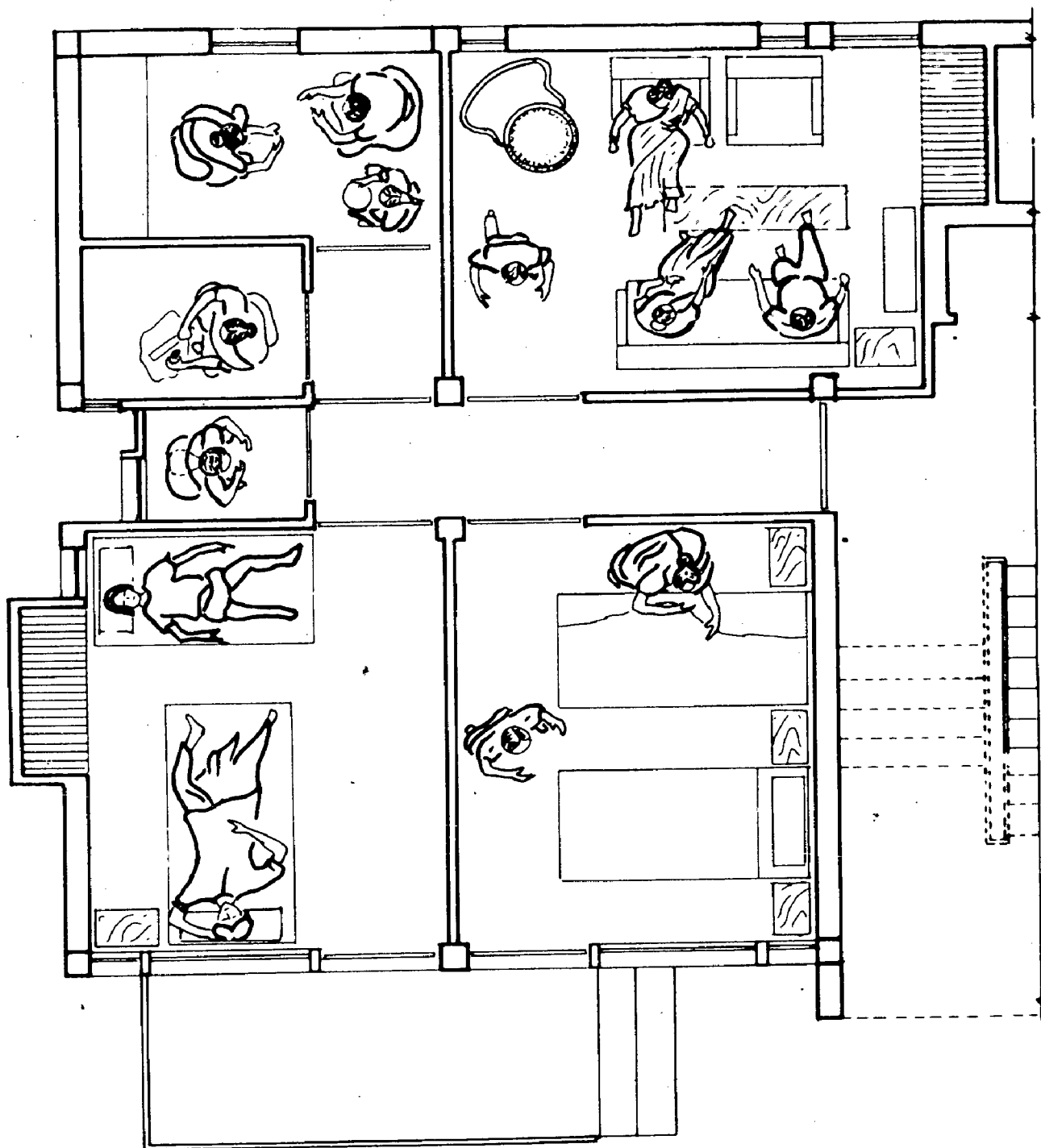
##### b. Bed Room

Size 3.24x2.9

Area 9.39 Sq.M.  
101 Sft.

The size of the Bed Room is sufficient for laying two beds. But the position of cupboards provided is not good.

## RESIDENTIAL SPACES ANALYSIS



## TYPE-II QUARTERS AT READING ROAD, N.DELHI.

## Observations:

1. THE STUDY REVEAL THAT EFFECTIVE PLANNING OF THE DESIGN, ANTHROPOMETRIC DIMENSIONS IS NOT CONSIDERED FOR GREATER WORKING EFFICIENCY AND COMFORT.
2. DETAILS OF THE OBSERVATIONS ARE GIVEN:-

- BASED ON THE DIMENSIONS PROVIDED BY C.B.R.I. ROORKEE, AND SPACES IN HOME PUBLISHED BY DEPTT. ON ENVIRONMENT, LONDON.

- c. Bed Room II  
 Size: 3.29x2.9  
 Area: 9.99 Sq. M.  
 107 Sft.
- d. Kitchen  
 Size: 1.6x2.9  
 Area: 4.64 Sq.M.  
 50 Sq.ft.
- e. Bath Room  
 & W.C.
- Sufficient in size, but wastage of space is more due to openings. Difficult to accommodate two separate beds with side table, otherwise it loses privacy. Only good for cooking etc. but there is no dining place for even informal eating. There is no other place which could be used for formal eating if required.
- Sufficient in size as per min. anthropometric dimensions.

#### 4.2.2. General Comments:

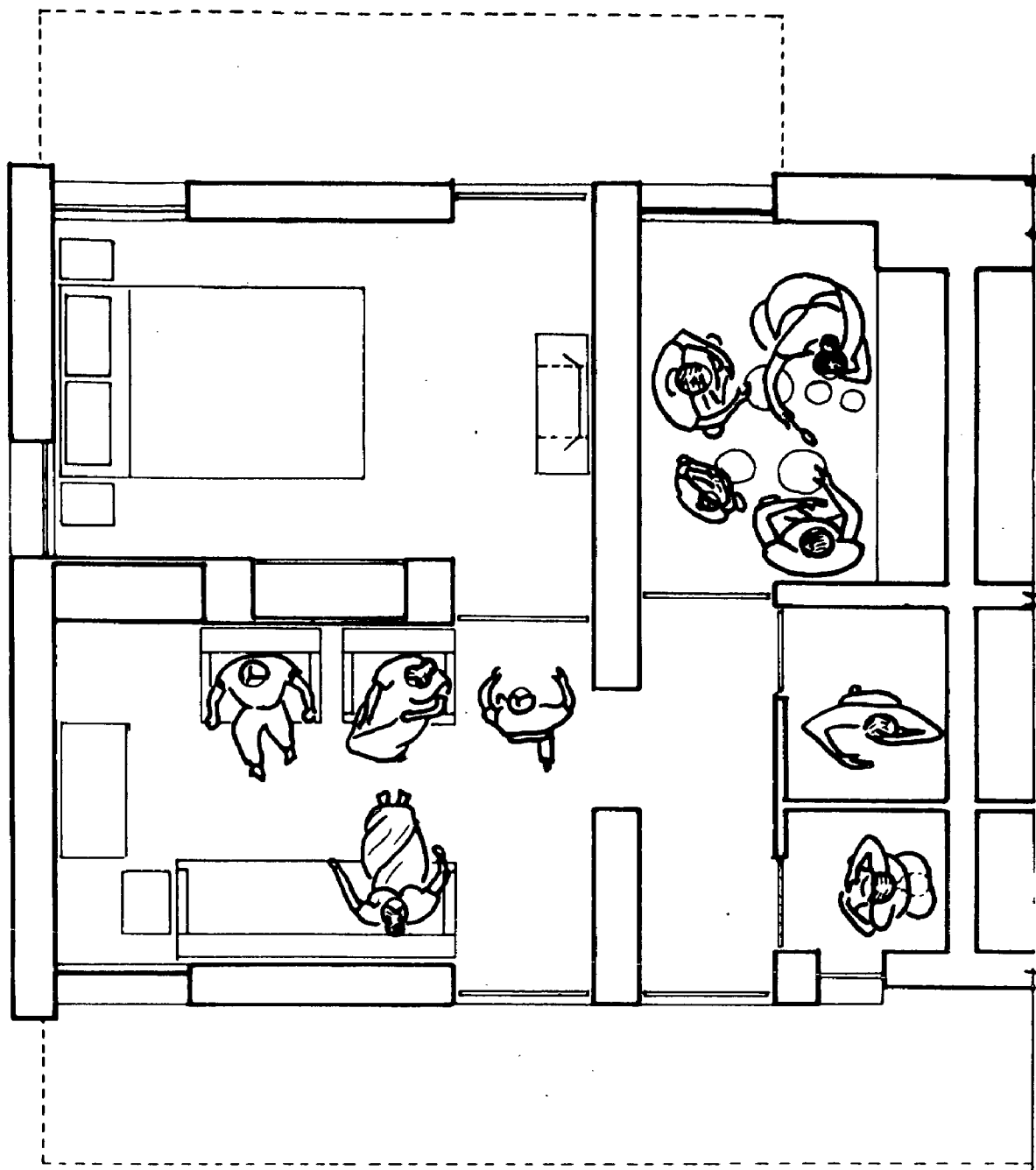
Overall the design is good. Efficiently approachable W.C. and Bath from bed rooms without passing through other rooms. With this much, sufficient space for furniture and movement but creates difficulty in opening windows efficiently. There is not much problem of receiving friends in living area without disturbing other rooms and easy to enter and leaving the dwelling. The parking scooter sheds are provided at back cause some inconvenience and in leaving room directly.

#### 4.3. Cage Study II - Type Design Quarters at Reading Road, New Delhi (N.D.M.C. Design, Refer Plate)

##### 4.3.1. Observation

- a. Living room  
 Size: 12'x9'x4½"  
 Area 112 Sft.
- Considering anthropometric dimensions and furniture layout it also provide a tidy space not in sitting but for moving. With this much, much furniture, movement to cupboard is difficult. In this case the width 9'-4½" is less

# RESIDENTIAL SPACES ANALYSIS



L.I.C. QUARTERS AT NARAINA W. DELHI.

### Observations:

1. ANTHROMETRIC SPACE ANALYSIS REVEL THAT WIDTH THE LIVING ROOM IS LESS, AND AREA IS ALSO LESS THAN 100 SQ.FT IS NOT PERMISSIBLE UNDER BUILDING BYE-LAWS DELHI.
2. DETAIL OBSERVATIONS ARE AS GIVEN:

● BASED ON THE DIMENSIONS WORKED OUT BY C.B.R.I ROORKEE, AND DETA PROVIDED IN SPACES IN HOME PUBLISHED BY DEPTT. OF ENVORNMENT, LONDON.

- with type of arrangement.
- b. Bed Room I  
 Size: 9'-2½" x  
 11'-7½"  
 Area: 106.8 Sft.
- The size of the bed room is sufficient for two beds arrangement, but no cupboard etc. provided for storage of clothing etc.
- c. Bed Room II  
 Size: 9'-2½" x  
 11'-7½"  
 Area: 106.8 Sft.
- The bed room size is good but the partition of cup board is not appropriate and creates problem of furniture layout and therefore max. space goes waste.
- d. Kitchen  
 Size: 9'-2½" x  
 5'-0"  
 Area: 46 Sft.
- Less in size for eating meals in kitchen as there is no dining space near to it due to storage etc. it becomes difficult and does not provide space for moving.

#### 4.3.2. General Comments:

Design is compact, but maximum plan goes into circulation. The approach from bed room to W.C. and Bath through the living room is not desirable. Window opening are easy to open with this much assumed furniture, the access to the living is good to receive visitors. Secondly, from privacy point of view, the position and layout of bed room is desirable, door openings are not disturbing. Sleeping balconies provided on upper floors are less in width, but quite long to accommodate two beds during summer.

#### 4.4. Case Study III L.I.C. Type Quarters at Harijans (D.D.A. Design Refer Plate)

##### 4.4.1. Observation

- a. Living room  
 Size: 12' x 8'-4½"  
 Area: 98.5 Sft.
- The anthropometric study reveals that the size of living room is small and does not provide space for coffee table at centre.

- b. Bed Room: The size of the bed room is only sufficient for double bed. Due to less width creates problem of didiness, if two separate beds are accommodated, the position of cupboards is good.
- Size: 12'-0" x 8'-4 1/2"  
Area: 98.5 Sft.
- c. Kitchen, Bath & W.C. The size of kitchen, bath & W.C. are tolerable to meet the needs of the family as per min. dimensions of anthropometric study.
- d. Bath Room & W.C. Sufficient in size as per min. requirements of anthropometric dimensions.

#### 4.4.2. General Comments:

Overall design is not based on anthropometric dimensions and furniture size to achieve greater efficiency. Bath and W.C. had direct approach from bed room, but door provided with bath will be not of any use. Most of the area goes waste and windows openings are difficul to open in relation to furniture layout. The position of drawing room is good, but door is away and creates the problem of privacy to other members of households, while entertaining friends and visitors. Most of the circulation area is wasted in passages. There is no provision of space for scooter parking etc. which cause great inconvenience to the occupants.

#### 4.5. Light and Ventilation

##### 4.5.1. Lighting:

Good light is always desired in all buildings. It is a factor which effects the comfort of eyes and the clarity

of vision, which always increase efficiency in work. The usual factors which adversely effect eye sight and insufficient intensity of light, glare and poor distribution of it. Therefore, sufficient natural light is always required for healthy living.

#### 4.5.2. Ventilation

Proper ventilation is required to supply fresh air for respiration and withdrawal of foul air, so as to maintain certain standard of purity and to promote proper circulation of air inside the rooms. Ventilation of kitchen and lavatories requires special attention, so that their smell may not enter into the living area, for that, proper outlet is required for circulation of air.

Keeping this objective in view, the case studies are done as follows:-

4.6. Case Study I Type Design by C.P.W.D. (Refer Plate)

4.8. Case Study II Type Design by N.D.M.C. (Refer Plate)

4.8. Case Study III Type L.I.C. by D.D.A. (Refer Plate)



# C.P.W.D. TYPE DESIGN ACCOMMODATION

## WINDOW AREA TO ROOMS

ROOMS	FLOOR AREA	WINDOW SYMBOL	SIZE OF OPENING	AREA	% TO FLOOR AREA	REMARKS
LIVING ROOM	9.39 SQ.M.	W-5	89x123	1.094 S.m	11.6 %	ENOUGH
BED ROOM I	9.39 SQ.M.	W-1	47x123	.578 S.m	6.1 %	LESS
BED ROOM II	9.94 SQ.M.	W-5 W-1	89x123 47x123	1.094 S.m .573 S.m	16.9 %	ENOUGH
KITCHEN	4.64 SQ.M.	W-3 W-1	89x85 47x123	.756 S.m .573 S.m	28.6 %	MUCH
BATH	2.23 SQ.M.	W-4	47x85	.399 S.m	17.3 %	ENOUGH
W.C.	1.11 SQ.M.	W-4	47x85	.399 S.m	35.9 %	MUCH

### LIGHTING AND VENTILATION.

● ROOMS SHALL HAVE, FOR THE ADMISSION OF LIGHT AND AIR, ONE OR MORE APERTURES, SUCH AS WINDOWS AND FAN LIGHTS, OPENING DIRECTLY TO THE EXTERNAL AIR OR INTO AN OPEN VERANDAH.

● THE MINIMUM AGGREGATE AREA (SEE NOTES 1 AND 2) OF SUCH OPENINGS EXCLUDING DOORS INCLUSIVE OF FRAMES SHALL BE NOT LESS THAN:

- a. ONE-TENTH OF FLOOR AREA FOR DRY HOT CLIMATE, AND
- b. ONE-SIXTH OF FLOOR AREA FOR WET CLIMATE.

NOTE 1 - IF A WINDOW IS PARTLY FIXED, THE OPENABLE AREA SHALL BE COUNTED.  
NOTE 2 - NO ROOM PORTION SHALL BE ASSUMED LIGHTED IF IT IS MORE THAN 7.5m AWAY FROM OPENING.

# N.D.M.C. TYPE DESIGN ACCOMMODATION

## WINDOW AREA IN RELATION TO ROOMS

ROOMS	FLOOR AREA	WINDOW SYMBOL	SIZE OF OPENING	AREA	% TO FLOOR AREA	REMARKS
DRAWING ROOM	112.5 SQ. FT.	W-1 W-3(2 no)	2'-3" X 4'-0" 1'-1 1/2" X 4'-0"	9.0 SQ. FT. 4.5 "	16.0 %	ENOUGH
BED ROOM I	106.8 SQ. FT.	W W-3	4'-0" X 4'-0" 1'-1 1/2" X 4'-0"	16.0 " 4.5 "	18.7 %	ENOUGH
BED ROOM II	106.8 SQ. FT.	W W-3(2 no)	4'-0" X 4'-0" 1'-1 1/2" X 4'-0"	16.0 " 4.5 "	23.4 %	MUCH
KITCHEN	46.0 SQ. FT.	W-1	2'-3" X 4'-0"	9.0 "	19.6 %	ENOUGH
BATH	22.5 SQ. FT.	W-3	1'-1 1/2" X 4'-0"	4.5 "	20.0 %	ENOUGH
W.C.	12.0 SQ. FT.	W-2	1'-9" X 4'-0"	7.0 "	58.0 %	MUCH

### LIGHTING AND VENTILATION.

- ROOMS SHALL HAVE FOR THE ADMISSION OF LIGHT AND AIR, ONE OR MORE APERTURES, SUCH AS WINDOWS AND FAN LIGHTS, OPENING DIRECTLY TO THE EXTERNAL AIR OR INTO AN OPEN VERANDAH.

- THE MINIMUM AGGREGATE AREA SEE NOTES 1 AND 2) OF SUCH OPENINGS EXCLUDING DOORS INCLUSIVE OF FRAMES SHALL BE NOT LESS THAN:

- ONE-TENTH OF FLOOR AREA FOR DRY HOT CLIMATE, AND
- ONE-SIXTH OF FLOOR AREA FOR WET CLIMATE.

NOTE 1 - IF A WINDOW IS PARTLY FIXED, THE OPENABLE AREA SHALL BE COUNTED.  
NOTE 2 - NO ROOM PORTION SHALL BE ASSUMED LIGHTED. IF IT IS MORE THAN 7.5m AWAY FROM OPENING.

SOURCE - NATIONAL BUILDING CODE OF INDIA 1970.  
PART III GENERAL BUILDING REQUIREMENTS.

J S Garg  
March Dissertation

# D.D.A. TYPE DESIGN ACCOMMODATION

## WINDOW AREA IN RELATION TO ROOMS

ROOMS	FLOOR AREA	WINDOW SYMBOL	SIZE OF OPENING	AREA	% TO FLOOR AREA	REMARKS
ROOM I	98.5 SQ. FT.	W	3-0x4-0	12.0 S.FT.	12.2 %	ENOUGH
ROOM II	93.5 SQ. FT.	W	3-0x4-0	12.0 S.FT.	12.2 %	ENOUGH
KITCHEN	61.3 SQ. FT.	W	3-0x4-0	12.0 S.FT.	19.5 %	ENOUGH
BATH	17.0 SQ. FT.	-	-	-	-	LIGHT REC. THROUGH W.C. PARTITION WALL.
W.C.	12.2 SQ. FT.	W-I	1-6x3-0	4.5 S.FT.	36.8 %	MUCH

CHAPTER - 5PHYSICAL ANALYSIS OF TYPE DESIGN (EXTERNAL)5.1. Densities in Housing:

Housing density is measure of intensity of occupation of land. It is calculated on total population with respect to total area i.e. as number of persons/acre/Hectare. It has also been defined as "the degree of closeness with which the dwellings and hence the people occupy them, are arranged in the residential areas of towns and villages". In general we believe that high densities are inherently evil in comparison to that of low densities. But, it depends on the conditions and circumstances, bad living conditions may derive from lack of light, air, sunshine and from overcrowdings in terms of closeness. On the other hand unhealthy conditions of overcrowding may exist in low densities, because of the particular nature of development, the quality bulk and ground coverage of building in the manner in which it is occupied.

Analysis of case studies are as shown in the layout plan. The factors influencing housing area density for reference in Table No.52.

5.1.1. Case study I Type II quarters at Hanjia Math, New Delhi (C.P.W.D. Type Design Layout Plan).

5.1.2. Case Study II Type II quarter at Reading Road, New Delhi (N.D.M.C. Type Design Layout Plan).

5.1.3. Case Study III E.I.C. Quarters at Naraina, N.Delhi (D.D.A. Type layout plan)

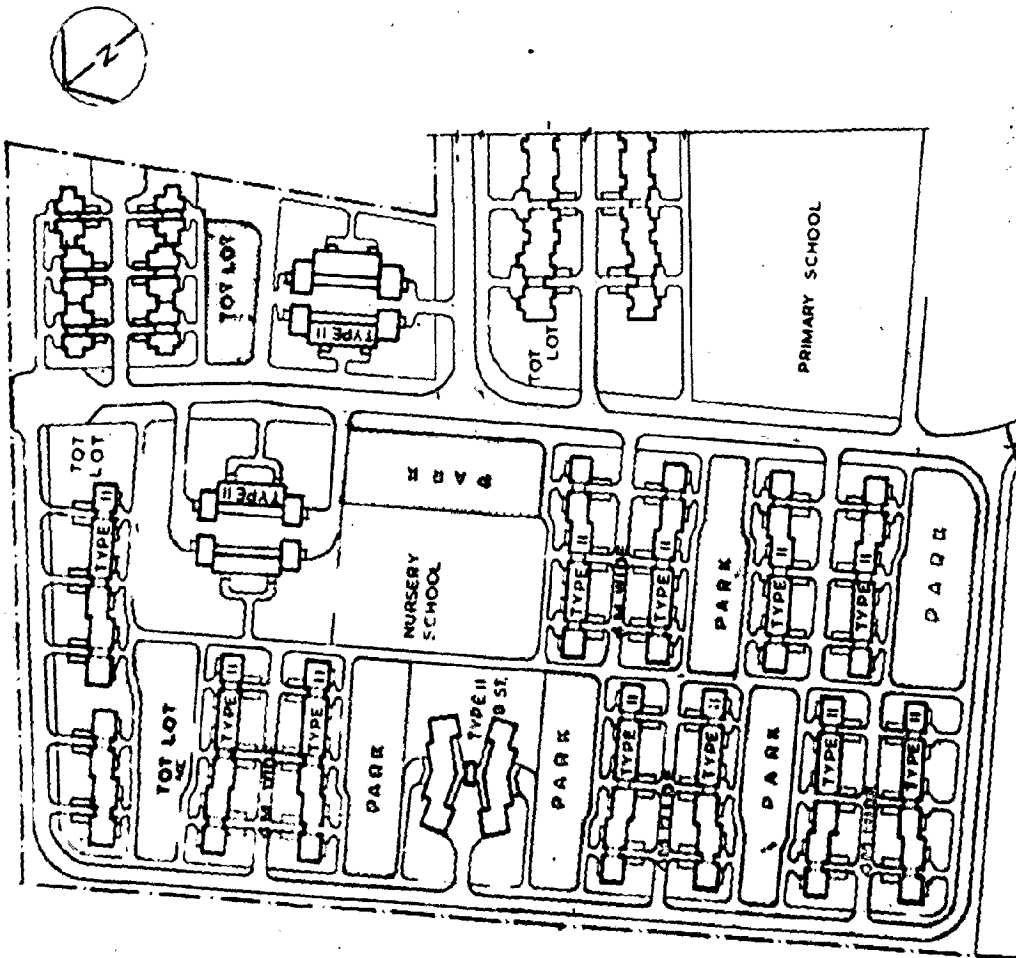
C.P.W.D. TYPE DESIGN ACCOMMODATION  
CASE STUDY TYPE-II QUARTERS AT MASJID MOTH,  
NEW DELHI.

- OWNERSHIP AREA C P W D
1. AREA UNDER TYPE II QUARTERS 7.9 ACRES
  2. NO. OF D.U. PROVIDED 344 UNITS
  3. POPULATION 4.5 X 344 1543 PERSONS
  4. DENSITY 196 P.P.A
  5. AREA UNDER ONE UNIT 60.6 SQM 50 FT
  6. AREA FOR SCOOTER SHED FOR 3 UNITS 27.6 SQM
  7. TOTAL GROUND COVERAGE OF ONE BLOCK 148.03 SQM
  8. TOTAL GROUND COVERAGE 5804.37 OR 62455.02 S.FT
  9. GROUND FLOOR PERCENTAGE 18.23

Observation.

- o BUILT UP AREA AMOUNTS TO 18.23% OF THE TOTAL AREA GIVING A DENSITY OF 430 D.U / ACRE OR 196 P.P.A. (TYPE-II 3 ST. PROPOSED IS NOT INCLUDED)
- o PERIPHERAL ROAD OF 4M. WIDE IS ONLY PROVIDED FOR LOCAL VEHICULAR, WHICH IS WELL ORGANISED AND ATTACHED TO SCOOTER SHED. FRONT ENTRY THROUGH PEDESTRIAN PATH IS GOOD.

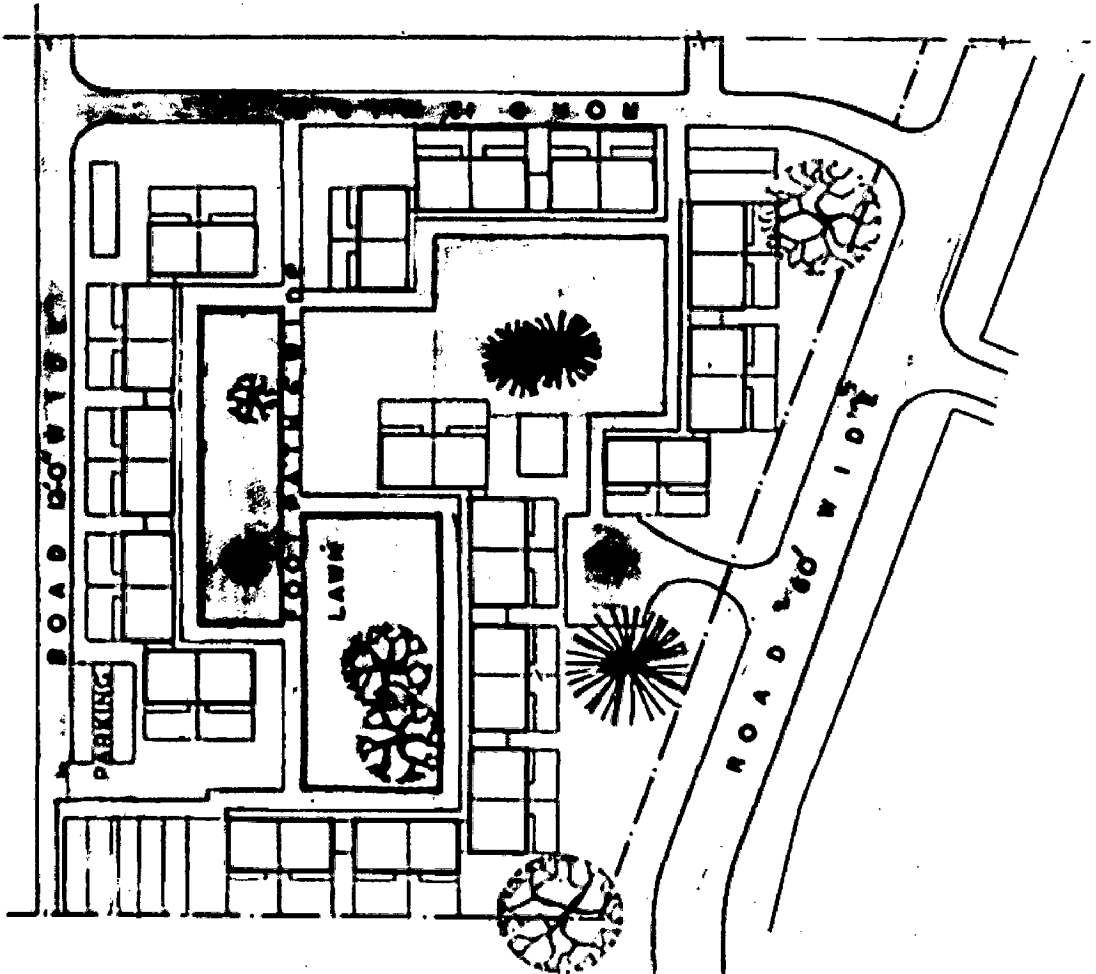
J.S Garg,  
M. Arch. Dissertation.



LAY OUT PLAN



**D.D.A. TYPE DESIGN ACCOMMODATION.**  
**CASE STUDY - L.I.C. QUARTERS AT NARAINA,**



OWNER SHIP: FOR SALE BY D.D.A.

- 1. AREA OF THE POCKET 2.20 ACRES
- 2. NO. OF D.U. PROVIDED 136 UNITS
- 3. POPULATION 451196 612 PERSONS
- 4 DENSITY 277 P.P.A.
- 5. AREA UNDER ONE UNIT. 513 SQ FT
- 6. TOTAL GROUND COVERAGE 0.40 ACRES
- 7. GROUND COVERAGE PERCENTAGE 18.41

**Observation.**

- BUILT UP AREA AMOUNTS TO 18.41% OF THE TOTAL AREA GIVING A DENSITY OF 61.67 D.WACRE OR 277 P.P.A.
- SPACES ARE WELL ARRANGED TO FACE BUILDINGS, WHICH IS USEFUL TO THE CHILDRENS FOR PLYING AND ADULTS FOR SITTING.

L A Y O U T P L A N

## 5.2. FACTORS INFLUENCING AREA DENSITY

Factors	X	Effect of reducing density	X	Effect of increasing density
---------	---	----------------------------	---	------------------------------

### LIGHT, SUNSHINE, AIR & QUIET

#### 1. Day light

Less risk of sky obstruction by near buildings; important in higher latitudes and where sky mostly over-cast.

Greater risk of sky obstruction by nearby buildings; but use of high buildings and low plot coverage, mixed development (i.e. buildings of different heights) and especially open plan arrangements, may considerably reduce this risk; less important in lower latitudes where sky are bright and protection from glare welcome.

#### 2. Sunshine

Less liability to shading by nearby buildings; important in higher latitudes where summer is short and sunshine welcome.

Increased possibility of shading by nearby buildings; important in lower latitudes where shelter from the sun is desirable.

#### 3. Air

Enables breeze to circulate more freely; beneficial in warm and particularly humid climates where the air is often still.

Neighbouring buildings may help to give protection against wind; beneficial in climates where cold or very hot winds prevail.

#### 3. Quiet

Less risk of discomfort from noise but reduction in density effected by decrease in height of building alone may have little effect on external noise levels at lower storeys.

Increased risk of discomfort from noise; particularly in warm, humid, climates where buildings usually open to catch breeze; but increase in height of buildings may give relief from external street level noises to upper storeys.

ECONOMIC LAND COST related to physical shortage of land or to special suitability for other purpose.

Increased cost tend to force housing development further out to less convenient but cheaper land

Lower costs



**DISTANCE FROM HOME TO WORK AND TRANSPORTATION COSTS**

The siting of homes conveniently in relation to work places may be a factor of great importance to the economic life of households.

Results in increased distance to work, making journeys more tiring and costly, public transport is dearer to run & service less frequent.

Results in shorter distances to work, making journeys easier and cheaper, unless development is well planned, very high densities may produce congestion and make public transport more difficult to operate efficiently and cheaply, and travel by cycle or car difficult.

**AVAILABILITY AND COST OF ESSENTIAL SERVICES**

S.g. water, sewerage drainage, lighting, power roads, and footpaths, public transport, etc. Detailed aspects are discussed separately.

As densities increase, the cost of services generally tends to rise, but at certain level and depending on local conditions, it may be possible to modify the whole or part of the system and thus effect counterbalancing economies.

As densities increase the cost of services generally tends to fall, but at certain levels, e.g. in high buildings, higher standards are needed, which may be more costly.

**AVAILABILITY AND COST OF BUILDING SKILLS, MATERIALS & EQUIPMENT.**

May permit less complicated building techniques, and, where it results from increase in space between buildings, less durable or fire-resistance materials, may reduce first cost and permit exploitation of traditional local building techniques, or use of self-help building.

As densities increase, building techniques tend to become more complicated and costly, involving more complicated and costly, involving more durable and fire-resistant materials; upto a certain level, increase in density may result in savings in first cost due to economies in land use, service, space standards, and the adoption of multiple house types. However, a point is reached when higher densities involve even more complex and specialised building skills design techniques and work organization, with consequent increase in first cost, at this level.

1.

X

2.

X

3.

greater rationalization of building processes, especially on large projects, may bring reduction in cost.

**SOCIAL**

**PRIVATE & OPEN SPACES**  
Depends on availability & cost of land, habits & preferences of the occupants; also on climate, soil, etc.

1. Space for food growing

Beneficial at lower densities where climate and soil favourable & traditional favour good food growing; may permit market-gardening as subsidiary income.

Less easy to provide, except perhaps in allotment for the less well-off, the need to buy cheap food calls for adequate neighbourhood markets as an alternative.

2. Space for recreation, garden & outdoor living.

Permits sleeping out & outdoor living generally in warm climates; & consequently lower indoor space standards; beneficial for gardening except where climate and soil conditions are difficult; limit reached when space becomes too large to be well kept, or is used for non-domestic purposes or illegal building.

Less easy to provide may be necessary to provide communal landfills, drying areas, stores for prams, cycles, etc. where families own car, there is tendency to keep them on the public ways.

3. PRIVACY

Importance largely derived from religious, social & cultural traditions. Design & construction of buildings, and the layout and planning of their surroundings may influence degree of privacy.

1. Overlooking  
 Beneficial, especially important in warm climate where curtaining intolerable at night.

2. Overhearing & unvented noise.  
 Beneficial, especially in warm humid climates & at night in hot dry climates, where openness is required.

Disadvantageous in warm climates where people live and sleep outdoors; courtyards and screened roof-tops better than high buildings with open space between them.

Disadvantageous for full privacy in warm climate, air condition may be needed at high densities.

LIVING SPACE WITHIN DWELLINGS.

Depends largely on the means of the household but also on social habits & personal preferences, & on climate & shortage of accommodation.

Tends to increase as, all other things being equal, it is cheaper to provide.

Tends to decrease as, especially in high buildings, it more costly to provide.

SOURCE: Manual Extension Service Courses in Housing in Urban Development, University College London, Development Planning Unit.

The Concept of Housing Density Abstracted from Stephen, P.M., Densities in Housing Areas H.M.S.O. London, 1960.

### **5.3. Urban Form**

In the past residences were to provide shelter during night time purposes and other activities were performed outside. The form is therefore governed by their own pattern. In the later age, the huge and big monuments were constructed on the hillocks with thick walls to have protection from enemies and floods etc., which reflected different forms. Similarly, urban form is the result of its function, which reflects its form.

With the rapid increase of population resulting into large number of dwellings and residential colonies in the type designed houses of repetitive type. These standard design of houses determines the urban form of the city, which require due consideration.

To identify the urban form the analysis part of case-studies is divided as under:-

#### **5.3.1. General Analysis**

- . Building layout
- . Back lanes and street pattern
- . Skyline relationship

(Refer Plates)

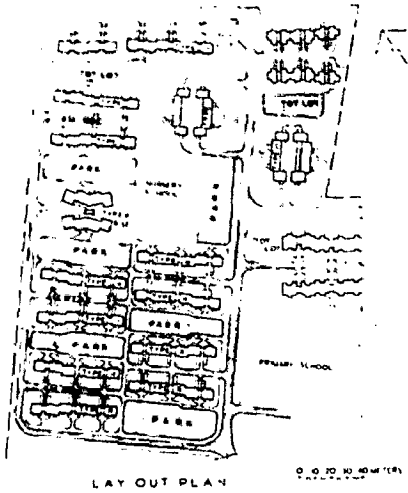
#### **5.3.2. Space Building Relationship**

- . Spaces in front of buildings
- . Function of these spaces
- . Space relationship with building

(Refer Plate)

TYPE-II DESIGN OF C.P.W.D.

## GENERAL ANALYSIS

BUILDING LAYOUT

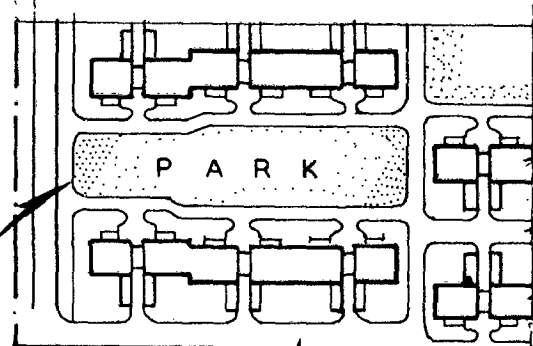
WHOLE AREA UNDER TYPE-II IS DEVIDED INTO POCKETS OF EQUAL SIZES. BUILDING BLOCKS ARE ARRANGED IN ROW HOUSES IN REPEATIVE FORM, BUT SOME UNITS PACED BACK TO REDUCE MONOTONY. A STANDARD PRINCIPLE IS REPEATED.

BACK LANES

BACK LANES ARE FORMED BY LONG WALLS OF BUILDING, BUT SET BACKS REDUCE THE EFFECT OF ROW HOUSES TO SOME EXTEND. THE BACK LANE OF 4 M. WIDE FOR VEHICLES AND TO SCOOTER SHED IS USEFUL.

SKY LINE RELATIONSHIP

BUILDING AT UNIFORM HEIGHT CREATE LACK OF INTEREST AND NOT RELATED WITH NEW URBAN FORM. DUE TO SIMILARITY IDENTIFICATION BECOMES DIFFICULT.

2. SPACE BUILDING RELATIONSHIP

SPACES PROVIDED INFRONT OF BUILDINGS USUALLY OF REPEATIVE SHAPE, USEFUL FOR PLAYING, SITTING AND PLACING BUILDINGS AT DISTANCE ALSO FEELING OF OPENESS.



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### 3. BUILDING FORM



BUILDING ARE FOUR STOREYED WITH COMMON STAIR CASE IN GIVING EFFECT OF ROWS AND BALCONIES IN REGULAR DISTANCE, ADD TO REPEATITIVENESS, ONLY SETBACKS IN THE BUILDING REDUCE IT. BUT BALCONIES GIVE FEELING OF OPENNESS.



UNIFORM COLOUR

EXPOSED BRICK AT WINDOW LEVEL

### 4. ROAD PATTERN.



#### TEXTURE AND COLOUR

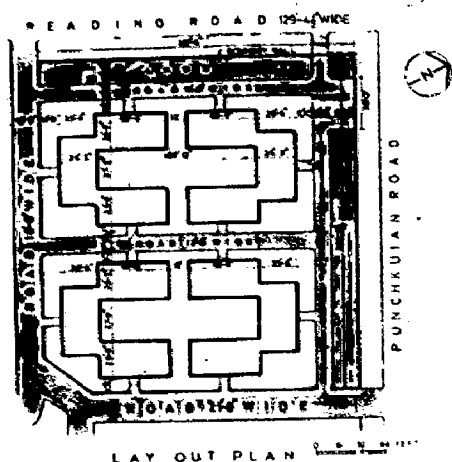
CONSTRUCTION IS IN BRICK WORK AND UNIFORM PLASTERING, UNIFORM COLOUR ADDS TO UNIFORM CHARACTER OF BUILDINGS. REGULAR WINDOWS AT BACKSIDE WITH SINGLE COLOUR ALSO GIVES THE SAME EFFECT



TWO TYPES OF ROAD PATTERN ARE ADOPTED FOR BUILDING ACCESS, ONE 4 M. WIDE PERIPHERIAL ROAD FOR VECHICULAR ACCESS AND OTHER FOR PEDESTRIAN ACCESS 2M. WIDE LINKING THEIR PARK. THE PICTURE SHOWS LOOP ROAD 3M. AWAY FROM DWELLING UNIT.

TYPE-II DESIGN OF N.D.M.C.

## GENERAL ANALYSIS

BUILDING LAYOUT

THE AREA UNDER TYPE DESIGN IS DEVIDED INTO TWO POCKETS AND THREE BLOCKS ARE ATTACHED AROUND A COURT YARD. A STANDARD PATTERN IS REPEATED, RESULT IN LACK OF INTEREST.

STREET VIEW

DISPACED BALCONIES IS INTERESTING AT LOOKING BUT SIMILAR CHARACTER REDUCE DUE ITS NEARNESS AND PARALLEL TO THE ROAD. THERE IS NO BACK LANES PROVIDED.

SKY LINE RELATIONSHIP

BUILDINGS AT SAME SHAPE AND HEIGHT RESULTS IN UNIFORM SKYLINE, WHICH IS NOT RELATED WITH NEW URBAN FORM.

## 2. SPACE BUILDING RELATIONSHIP.



SPACES PROVIDED IN FRONT OF HOUSE IS NEGLIGIBLE AND BACK COURT YARK NOT ONLY RESULTS IN LACK OF INTEREST, BUT CREATS UNHEALTHY ENVIRONMENT TO THE RESIDENTS DUE TO DIRT, GABAGE AND WATER ACCUMULATION.

J.S Garg.

M. Arch. Dissertation.

### 3. BUILDING FORM



BUILDINGS ARE FOUR STOREYED WITH COMMON STAIRCASE IN THE CENTER OF TWO UNIT. THE ROWS ARE AT CLOSING DISTANCE RESULTS IN LACK OF PRIVACY AND LIGHT AND VENTILATION OF BUILDINGS. HEIGHT LACKS RELATIONSHIP WITH ROAD WHICH GIVES CORRIDOR FORM.



#### TEXTURE AND COLOUR

CONSTRUCTION IN R.C.C. FRAMED STRUCTURE AND BRICK WALLS AND DIFFERENT COLOUR REDUCES MONOTONY.



#### ACTIVITIES

ACTIVITIES PERFORMED IN BUILDINGS GIVE LIVELY CHARACTER TO THE FORM

### 4 ROAD PATTERN.



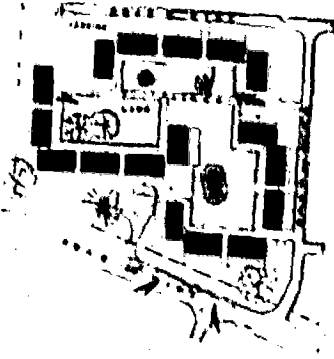
FOR BUILDING ACCESS 12 FEET WIDE ROAD ALONG THE FRONTAGE LACKS SITTING AND OPEN SPACE FOR SLEEPING. LACK OF PEDESTRIAN PATHS IS THE REASON OF UNSAFETY. THE PICTURE SHOWS ROAD PATTERN ADOPTED. GATES PROVIDED AT FOR SECURITY.

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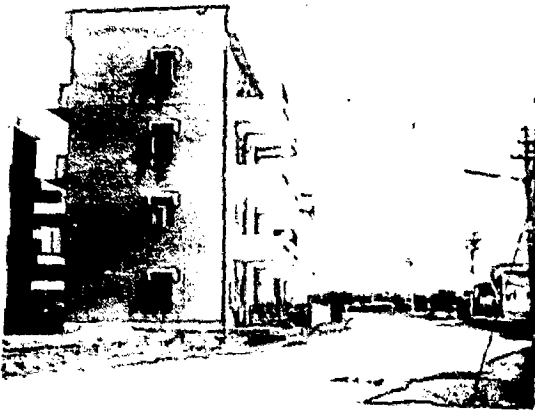
## GENERAL ANALYSIS



APRIL 1958

### BUILDING LAYOUT

BUILDING LAYOUT IS GOVERNED BY VARIOUS OPEN SPACES AND BUILDINGS ARE PLACED FACING TOWARDS THEM. A STANDARD TYPE OF PATTERN IS NOT REPEATED, BUT GIVES INTERESTING EFFECT.



### STREET VIEW

STREET VIEW IS INTERESTING DUE TO SETBACKS AND SMALLER UNITS ALONG THE ROAD, BUT SIMILAR CHARACTER RESULTS IN EXPECTANCY.

## L.I.C. TYPE DESIGN OF D.D.A



### BACK LANES

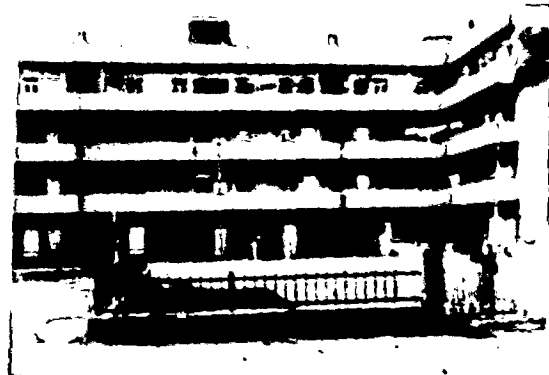
BACK LANES ARE PROVIDED GIVES CORRIDOR TYPE OF AND MONOTONY.



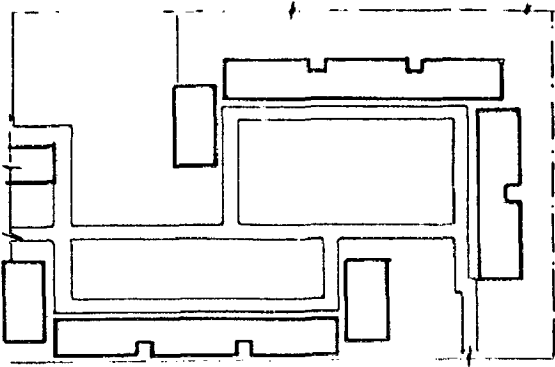
### SKYLINE RELATIONSHIP

UNIFORM HEIGHT RESULTS IN LACK OF INTEREST.

## 2. SPACE BUILDING RELATIONSHIP



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SPACE BETWEEN BUILDINGS VARY IN SCALE SHAPE REDUCE THE MONOTONY EFFECT, BUT FORM INTROVERT-SPACES DUE TO ENCLOSURE IN RELATION TO BUILDING HEIGHT.

### 3. BUILDING FORM



BUILDINGS ARE GOOD IN LOOKING AND FOUR STOREYED HIGH WITH COMPOUND WALLS AT GROUND FLOOR.

VARIOUS SETBACKS IN PLAN BREAKS THE FORM OF CONTINUITY AND REDUCE THE WALL LIKE EFFECT.

RESIDENTS ARE NOT SATISFIED WITH THE MATERIAL USED, IN CONSTRUCTION AND BALCONIES HEIGHT IS KEPT LESS RESULTS IN ACCIDENTS.

REAR FORMS OF BUILDING GIVES CORRIDOR EFFECT DUE TO UNIFORM LONG PASSAGE.



### TEXTURE AND COLOUR

THE FRONT FACADE IS OF UNIFORM TEXTURE, BUT END WALLS WITH EXPOSED BRICK IN RED COLOUR ARE PROMINENT.

### 4. ROAD PATTERN -

TWO TYPE OF ROAD PATTERN ARE ADOPTED FOR APPROACHING THE BUILDINGS, ONE 12 FEET WIDE FOR VEHICULAR AND PARKING AT END AND ANOTHER FOR PEDESTRIAN ACCESS AROUND LAWNS AND ACCESS TO QUARTERS. IT IS OBSERVED THAT THE RESIDENTS KEEP THEIR VEHICLES ALONG THE PATHS INSTEAD OF AT PARKING PLACE OR CUL-DE-SAC. DUE TO WIDER OPENINGS AND PROPER ENCLOSURE TO THE PARKS

### 5.3.3. Building form (Block pattern)

- . Type of building in relation to number of storeys.
- . Distance between the buildings
- . Texture, treatment & colour effect etc.
- . Block relationship with environment and activities

(Refer Plates)

### 5.3.4. Road Patterns

- . Type of approachable roads
- . Its relationship with environment and dwelling unit.
- . Function of Roads

(Refer Plates)

Considering this, the photographic survey analysis is done of undermentioned case studies as shown in the attached photographic plates.

- . C.P.N.D. Type II Design Housing
- . N.D.M.C. Type II Design Housing
- . D.D.A. Type (L.I.C.) Design Housing

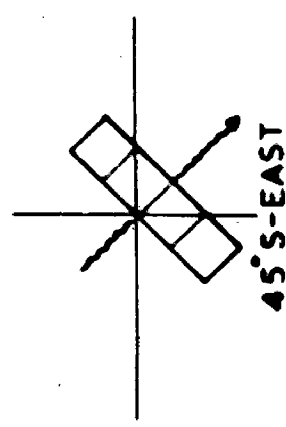
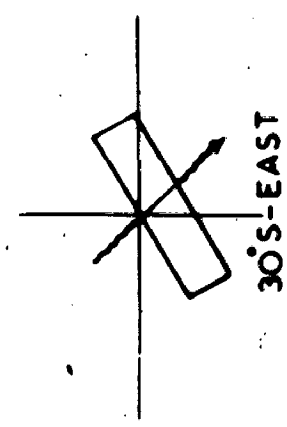
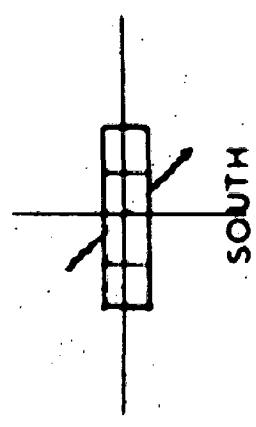
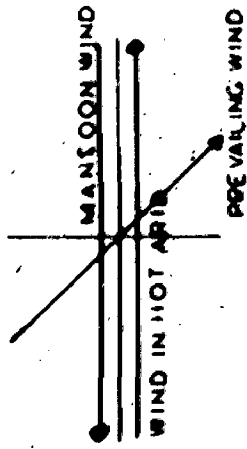
### 5.4. Orientation

Orientation of building flats influences availability of adequate sunshine, proper natural light and ventilation in the dwelling units. The difference of these factors on health and physical comfort varies considerably with differences of geographical location and climate and consequently the climatic conditions prevailing in the locality have an impact on the design and construction of residential buildings.

In tropical areas, for enjoying these free gifts of nature, sufficient open space (in proportion to the height of building) or block of buildings and position of buildings or flats in

# ORIENTATION OF BUILDINGS

FOR GOOD ORIENTATION OF BUILDING, STUDY OF WIND DIRECTION AND SUN BEATING ON VARIOUS SURFACES, THE SOUTH SIDE IS ONLY BEST, CONSIDERING SUN BEATING STUDY. CONSIDERING WIND DIRECTION, THE ORIENTATION IN SOUTH DIRECTION WILL NOT YIELD GOOD RESULT. FOR GETTING GOOD VENTILATION EAST WINDS IN SUMMER SEASON WEST WINDS IN MONSOON SEASON AND NORTH WEST PREVAILING WIND MUST ALLOW TO PENETRATE THE THE BUILDING. CONSIDERING THESE FACTOR THE RESULTANT ORIENTATION COMES OUT AS SOUTH EAST GOOD FOR SUN AND WINDS. THEREFORE RESIDENTIAL BUILDING SHOULD BE ORIENTED SOUTH EAST. OTHER BUILDINGS SCHOOLS ETC. TOWARDS NORTH TO PROTECT FROM DIRECT SUN BUT MAX. LIGHT.



RATING OF ORIENTATION FOR WIND

WIND DIRECTION	ORIENTATION		
	SOUTH	30° S-E	45° S-E
NORTH WEST PREVAILING WIND DIRECTION	FAIR	GOOD	EXCELLENT
WEST WIND HOT-ARID SEASONS	POOR	FAIR	GOOD
EAST WIND MANSOON SEASONS	POOR	FAIR	GOOD

in relation to the direction of sun and wind are very important factors.

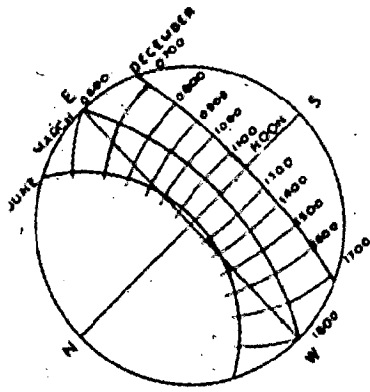
5.4.1. Orientation of Buildings (Refer Plate)

5.4.2. Case Study I

5.4.3. Case Study II

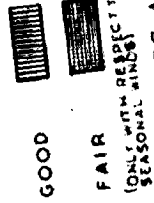
5.4.4. Case Study III

5.4.4. Building Details design construction (Refer Plates)

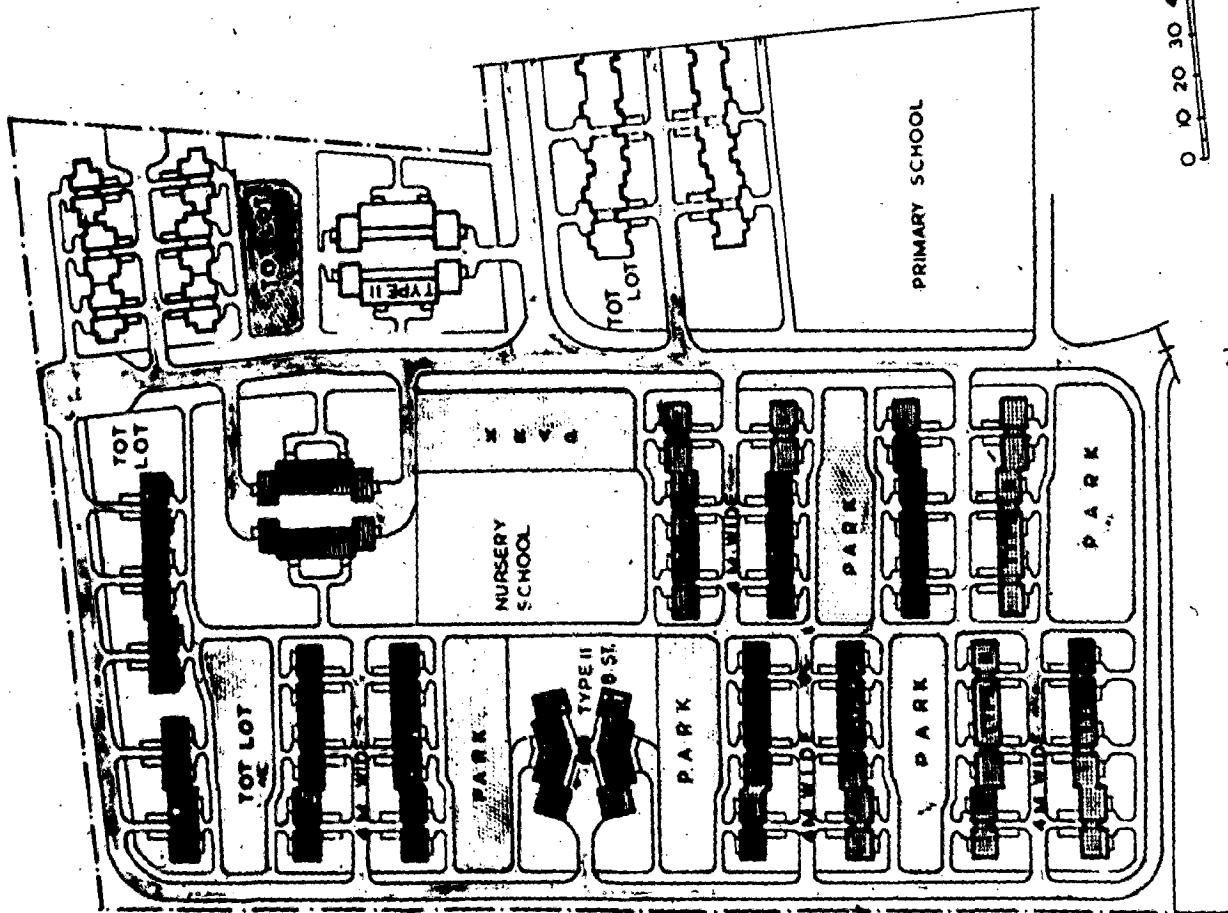


SUNPATH

BUILDING ORIENTATION ON THE BASIS OF WIND & SUN

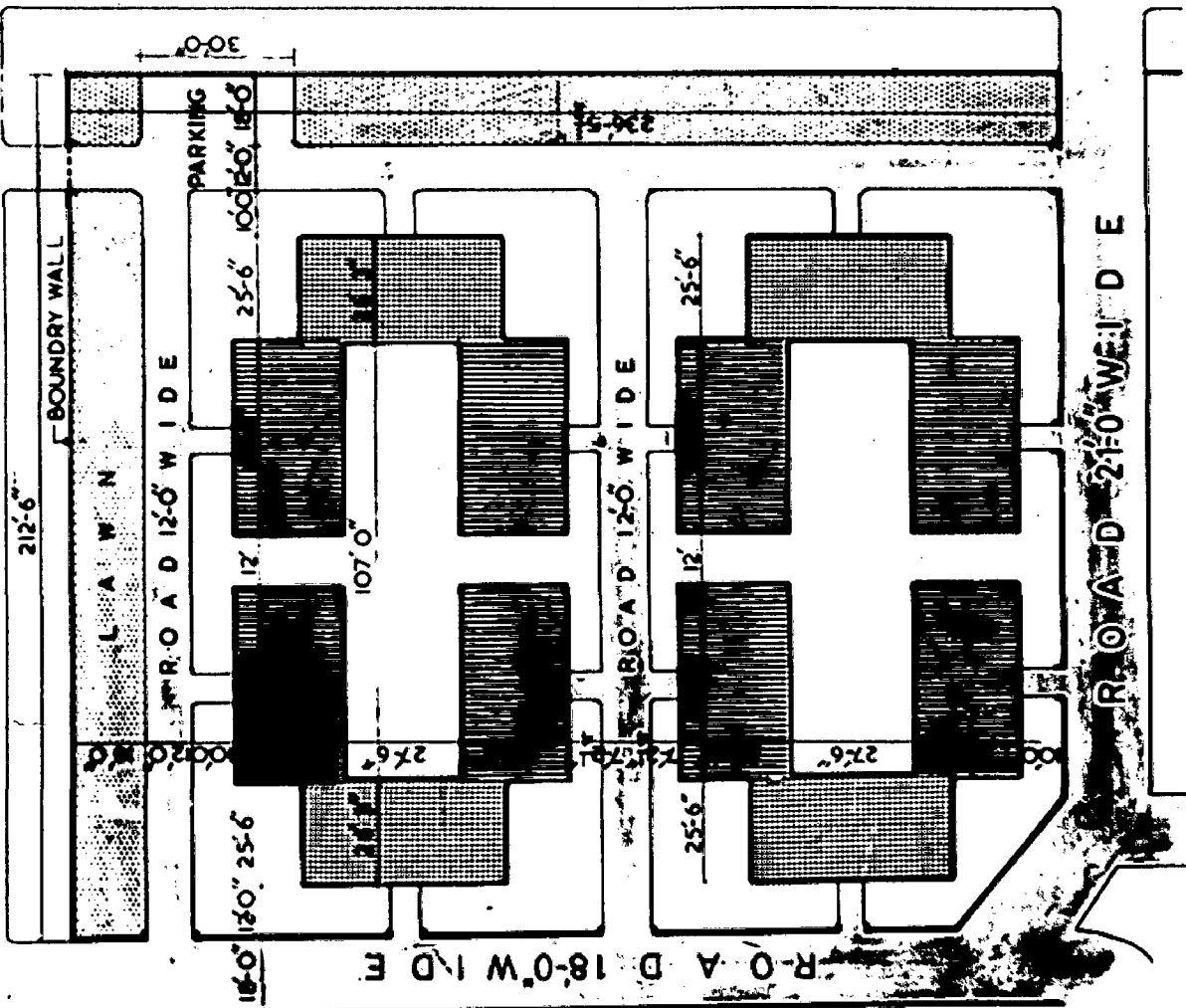


TYPE-II QUARTERS AT MASJID MOTH, N. DELHI.

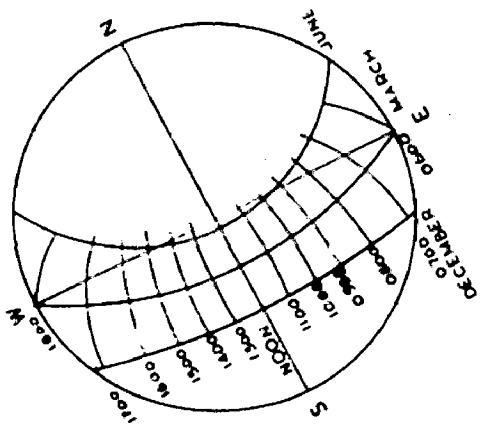


LAY OUT PLAN

READING ROAD 129'-4 1/2" WIDE.

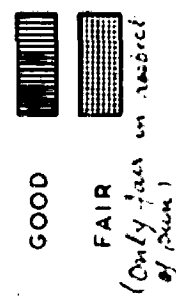


LAY OUT PLAN

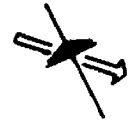


SUNPATH

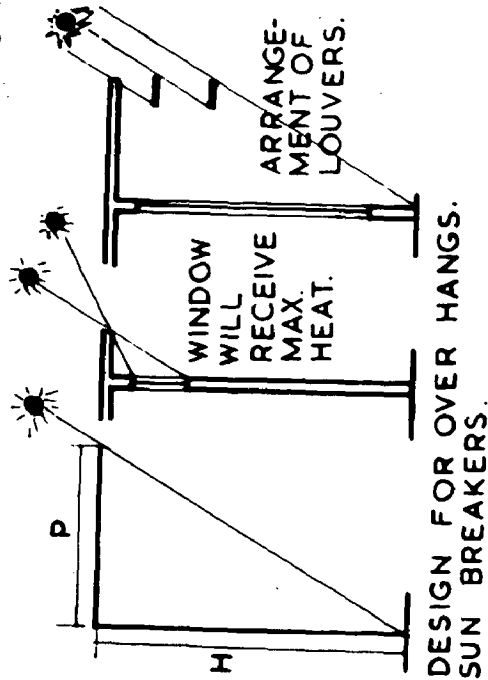
BUILDING ORIENTATION ON THE BASIS OF WIND & SUN



TYPE-II QUARTERS AT READING ROAD, N. DELHI.



# BUILDING DETAILS DESIGN CONSIDERATIONS.



## PROJECTION

- IN DELHI THE ALTITUDE OF SUN
  - JUNE SUMMER SOLSTICE 85°
  - MARCH 21 SEPT. 21 EQUINOX 61.2°
  - DECEMBER 21. 38°

THIS SEASONAL CHANGE IN ALTITUDE ENABLES UTILIZATION OF SOLAR HEATING IN COOL PERIODS.

- THE ANGLE RECOMMENDED FOR THIS ORIENTATION, DETERMINES THE RATIO OF THE DEPTH OF THE DEVICE TO THE HEIGHT.

## WINDOWS

HEAT TRANSMITTANCE OF TRANSPARENT SURFACES IS MUCH GREATER THAN THAT OF OPAQUE ONE. HENCE OPENING EFFECT COMFORT CONDITIONS.

- WINDOWS AREA SHOULD BE 1/8TH OR 1/10TH FLOOR AREA.
- EASTERLY ORIENTATION SHOULD BE AVOIDED.
- SHADING FOR GLASS SURFACES MUST BE PROVIDED.

## CEILING HEIGHTS

ROOM TEMPERATURE VARIES WITH RESPECT TO CEILING HEIGHT. HEIGHT PREFERRED 8' TO 9'.

## COLOUR

IT PLAYS IMPORTANT ROLE IN REFLECTING HEAT RAYS. THE FOLLOWING RECOMMENDATIONS ARE MADE.

- ROOF WITH LIGHT COLOUR
- WALLS WITH LIGHT COLOUR
- GROUND SHOULD BE OF DARK COLOUR
- INTERIOR OF BUILDING SHOULD OF DARK COOLING COLOUR LIKE GREEN OR BLUE TONES
- OVER HANG CEILING SURFACE SHOULD BE DARK
- LOUVERS SHOULD BE LIGHT IN COLOUR FROM OUTSIDE BUT OF DARK COLOUR FROM INSIDE.





## REFLECTION

GRASS AND PLANTATION REDUCE THE REFLECTION EFFECT. HOWEVER DARK COLOUR SHOULD BE USED FOR PAVING PATH IN SURROUNDING AREAS.

## MATERIAL

MATERIAL IN USE SHOULD HAVE MINIMUM COEFFICIENT OF THERMAL CONDUCTIVITY, SO IT MAY PROVIDE RESISTANCE TO HEAT FLOW, WALLS TO ENSURE COOLER ATMOSPHERE INSIDE, MATERIALS OF HIGH THERMAL CAPACITY MAY BE USED FOR WALLS. & LOW CAPACITY SHOULD BE USED FOR ROOFING TO ENSURE COOL SLEEPING AREAS AT NIGHT.

## ROOF SHAPE & COLOUR

WHITE WASHED FLAT ROOF IS PREFABE FROM CLIMATE POINT OF VIEW. IT REFLECT MOST OF THE INCIDENT RADIATIONS. SO FOR WINDOW FLAT WHITE WASHED IS GOOD ENOUGH TO MAINTAIN THE SAME TEMPRATURE INSIDE, IF NOT DECREASED.

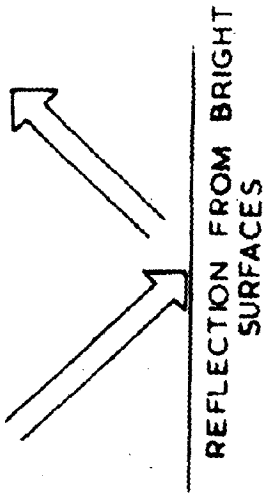
## EXPANSION JOINT

DUE TO EXPANSION HABITS OF THE MATERIALS, EXPANSION JOINTS ARE PROVIDED. IN HOT CLIMATE AREA EXPANSION JOINT HAVE TO BE PROVIDED, AFTER THE MAX. LENGTH OF 100. COURT YARD

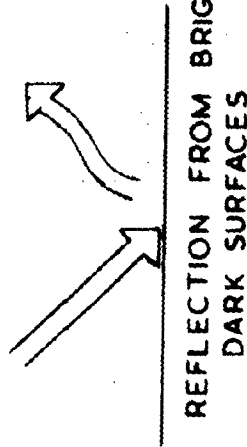
COURT YARD SURROUNDED BY WALLS OR ROOMS PRODUCE COOLING EFFECT. COURT YARD ALONG THE NORTH DIRECTION, AND COVERED BY GRASS ETC. PRODUCE A COOLING EFFECT OF 10°F THAN ORDINARY ONE. COURT YARD'S SIZE BEING IN SHADE IS GIVN BY:

$$a = 2 \cdot m \cdot \cot B.$$

WHERE  $a$  = WIDTH.  $m$  = WALL HEIGHT.  $B$  = ALTITUDE OF THE SUN PER PERTICULAR WALLS.



REFLECTION FROM BRIGHT SURFACES



REFLECTION FROM DARK SURFACES

- WHITE WASHED FLAT IS PREFRED IN HOT CLIMATE WHILE RED TILES PITCHED ROOFS IN COLD CLIMATIC ZONES.

## CHAPTER - 6

### COST ANALYSIS AND COST REDUCTION TECHNIQUES

The cost of building construction has been increasing over a period of years. Attempts are continuously made to reduce its cost. A lot of research is being done by the Research institutions in finding out new materials to replace traditional materials and to reduce cost by design techniques. It is necessary to have investigation on these issues and concerned Housing Agencies must implement them at site.

#### 6.1. Case Studies Analysis

This cover general cost analysis of two buildings under case studies. The data have been obtained from the estimates of the concerned agencies i.e. C.P.W.D. & N.D.M.C. This study covers only one aspect of building.

Cost of building portion - includes the cost of foundation walling, plaster, roofing, flooring and wood work etc. The cost of the land has not been considered.

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The undermentioned cost is not included due to the non-availability of complete data.

- Sanitary service includes cost of water supply, sanitary fixtures, electric fittings, approach roads and the cost of the establishment employed on the work.

TABLE NO.6.1.(1)

GENERAL DATA REGARDING COST CASE STUDIES

CASE STUDY-I	X	CASE STUDY-II
<u>TYPE II QUARTERS at Masila Mohd. N. Delhi</u>	X	<u>TYPE II QUARTERS at Raudling Road, N. Delhi</u>
Total Cost = Rs.49,00,500/-		Total No. of quarters = 12,60,000
No. of quarters = 244		No. of Quarters = 96
Covered Area = 60.60 or 652.2 Sqr.		Covered Area = 630.5 Sqr.
Specifications: C.P.W.D.		
Rates As per Delhi Schedule of Rates 1967. Extra 35% is also added to increased rates of building materials.		Rates Based on the rates adopted by C.P.W.D. Extra 35% is also added to increased rates of building materials.
Land: Possession of C.P.W.D.		Land: Possession of N.D.M.C.
Method: By Contract system		Method: By contract System
Time: 18 1/2 months		Time = 12 months

TABLE NO.6.1.1.

BUILDING COST & COST PERCENTAGE ANALYSIS

Case Study - Type II Quarters at Masjid Mohd X Rm, Delhi		Case Study - Type II Quarters at Reading Road, New Delhi	
S.No.X Description	Total cost X IN Rupees X	S.No.X Description	Total cost X IN Rupees X
1. Earth work	566.00	1. Earth work	753.33
2. Cement Concrete	2243.00	2. Cement Concrete	2026.83
3. R.C.C.Work	26763.00	3. R.C.C.Work	28900.75
4. Brick work	12397.00	4. Brick work	16119.00
5. Wood work	16690.00	5. Wood work	94499.08
6. Steelwork	1313.00	6. Steel work	1970.25
7. Flooring	2884.00	7. Flooring	2969.33
8. Roofing	1666.00	8. Roofing	1267.50
9. Finishing	6242.00	9. Finishing	5774.17
10. Miscellaneous	826.00	10. Miscellaneous	641.75
<b>TOTAL</b>	<b><u>71589.00</u></b>	<b>TOTAL</b>	<b><u>69922.00</u></b>
Add 35% rise in cost	<u>25056.15</u>	Add 35%, rise in cost	<u>24472.70</u>
<b>GRAND TOTAL</b>	<b>96645.15</b>	<b>GRAND TOTAL</b>	<b>94394.70</b>

TABLE NO. 6.1.2.

COMPARATIVE COST ANALYSIS

Sl. No.	Name of Project	Location	Estimate No.	Area (Acres)	Period	No. of Pines	Area (Acres)	Floor (Acres)	Total Cost	Cost per Unit	Big Cost	Cost of Sane. & Water supply
1.	1.	Type II Quarter at Masjid Rooh Area New Delhi by CPWD.	1971-72	346	4	652.2	422	49,00,500	113965	96645.15	17319.85	
2.	Type II Qtrs. at Reading Road Area, New Delhi by K.D.M.C.	1969-70	96	4	630.5	459	13,00,000	113333.	94394.70	18938.70		

**TABLE 6.1.3a**  
**COMPARATIVE MATERIAL SPECIFICATION ANALYSIS**  
**(CASE STUDIES)**

Project - Type II Quarters at Masjid Mohd New Delhi		Project: Type II Quarters at Reading Road, New Delhi	
No. Element	Specification	No. Element	Specification
1.	Foundation & a. Wall's footing on cement concrete 1:5:10 (1 cement 5 sand, 10 graded stone aggregate 40 mm nominal size.	1.	Foundation & a. Wall footing on cement concrete 1:5:10
2.	1st Floor	2.	2nd Floor
3.	2nd Floor	3.	3rd Floor
4.	Plinth	4.	Plinth
5.	Super Structure	5.	Super Structure
a.	201 Class brick work in cement mortar 1:6 (1 cement, 6 coarses sand)	a.	2nd Class Brick work in cement mortar 1:6
b.	R.C.C. Col, footing 1:2:4 (1 cement, 2 coarse sand & aggregate) 20 mm nominal size.	b.	R.C.C. col, footings 1:2:4 (1 cement, 2 coarse sand, & graded sand)
c.	Plinth ht. 50 cm. 1.6 16"	c.	Plinth height = 16" 50 cm.
d.	Floor ht. 2.90 m or 9'-6"	d.	Floor Height = 10 ft.
e.	Thickness of wall 9" on all floors	e.	Thickness of wall 13 1/2" on G.F. & 7.5" and 9" on above floors.
f.	Brick masonry in course mortar 1:2 with 2nd class brick	f.	Brick work necessary 1:6, 2nd class brick

	1	2	3	4	5	6
	X	X		X	X	X
3. Roofing			a. R.C.C. slab, over hot bitu- men asphalt 80/100 over 10 cm. mud phushkha. Brick tiles grouted in 1:3 cement mortar.	3. Roofing a. R.C.C. slab over with mud phushkha, brick tiles grouted in cement mortar.		
			b. 100 mm. (4") dia water pipe.	b. 4" dia A.C. drainage pipe @ 500 sq. roof area.		
4. Flooring			a. 40 mm. (1 1/2") cement conc. flooring 1:2:4	a. 40 mm. (1 1/2") cement conc. flooring 1:2:4.		
			b. Skirting 10 cm. (4") high 1:3 (one cement conc. 3 coarse sand)	b. Skirting 15 cm. (6") high in 1:3.		
5. R.C.C. work			R.C.C. work 1:2:4 (1 cem. 4 sand, 4 graded stone aggregate 20 mm nominal size) in slabs, beams, columns, footings, lintels & chajjas 1:3 dada in W.C., Bath etc.	5. R.C.C. work R.C.C. work 1:2:4 in column, slab beams, columns, footing, lintels & Chajjas etc. Dada 1:3 in W.C. & Bath 3" high.		
			d. R.C.C. lintels for all openings.	d. R.C.C. lintels & Chajjas over all openings.		



1.	X	2.	X	3.	X	4.	X	5.	X	6.
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5. Wood work a. Windows & shutters will be of 1st class Kail wood with oxidised iron fittings. All the doors are specified flush door shutters.

5 Wood work

1 1/2" thick flush door shutters commercial quality with M.S. sheet frame 3" x 1 1/2" and glazed steel windows provided with iron frame.

7. Finishing

a. All exposed surfaces plastered 15 mm thick on rough side of brick walls 12 mm. on the other.

6. Finishing

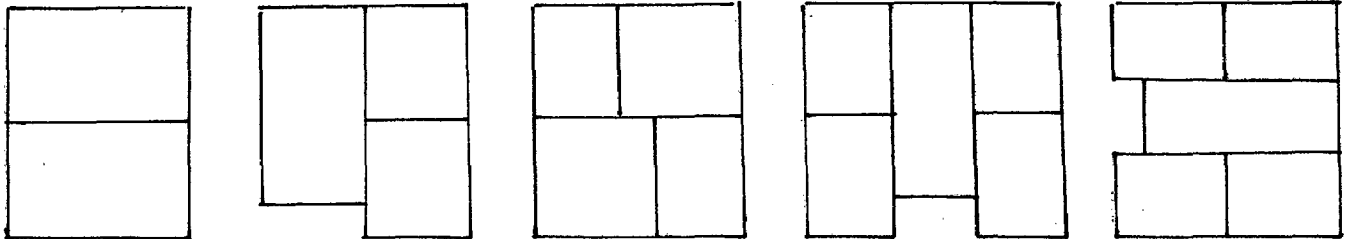
a. Wall plastered both the sides with cement mortar 1:6

b. White washing, colouring approved shade and wood work and steel painted over priming coat.

b. Colour on exposed brick wall and ordinary colour on steel.

## 6.2. Factors of Economy\*

In the present day houses can be classified into three divisions - single block system (Fig. A), Two Block System (Fig. B & C) and three block system (D & E)



A

B

C

D

E

- In single block system, there is very little possibility of introduction of economy as that itself originates from the idea of low-income standards.
- In two and three block systems, there is a possibility of introducing economic measures in building construction. The two block system is common among middle-income group and extensively used due to the reasons, that they are more in number.

Few cases were taken up and cost of estimate was critically discussed item by item by the writer and their relative costs and its concluding results are as under:-

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\* Economy in Building Construction by N.V. Arunachalam, Lecturer in Structural Engineering College, Guindy, Madras. Symposium on Construction Cost - Case Studies by N.B.O. Feb. 1970.

Foundation 19% of the total cost

Superstructure 50% of the total cost

Finish 21% of the total cost

Electrification, Water Supply & Sanitary fittings 10% of the total cost

(Refer Table No. 6'A' in Appendix)

### 6.2.1. Proposals for Savings

The writer had suggested that in the case of two block system three walls are load bearing walls. The normal dimensions of the two block system are 8' x 8', 6' x 10', 10' x 10', 10' x 12', 12' x 12' and 12' x 10'. The variation between them is less than 20% which renders the possibility of continuous span approach in design and uniform slab without any beam.

This will effect a considerable saving in the centering cost. If, in addition to this, welded mesh is used for reinforcement (standard type), a reduction can be effected in fabrication cost of grills.

He suggested to adopt different foundation width and depth for different walls - main and cross wall. This would bring saving in foundation cost approximately 40% in two block system (Refer Table 6'B in Appendix). All cross walls are to be constructed as single brick wall 4 1/2".

This will result in 50% saving in cost of superstructure masonry (Refer Table No. 6'B in Appendix).

The above means lead to an overall economy of 40% in the total cost of building. 4½" brick wall will also render surface on both the sides as against that of other solid walls, so it would be possible to plaster the surface with minimum mortar. This will add to economy.

In all it is expected that these measures would bring economy of about 70% in the present day of building construction.

### 6.3. Selection of Suitable Cost Reduction Techniques

This would include various improved construction techniques that have been recommended for adoption by various research and academic institutions and the leading pioneers in building industry which are based either on their laboratory trials or also having been subjected for field trials.

The design and structural considerations for these new ideas although shall be briefly covered, main emphasis in this chapter shall be on highlighting their relative merits and demerits particularly in terms of ECONOMY and SPEED as compared to their traditional counterparts.

#### (a) Foundations

The type of foundation primarily depends upon the type of soil below the structure. The bearing capacity of the soil at the proposed site is 1.5 T/Sq.ft. Thus for the load bearing wall structure, simple spread footings shall be suitable. They shall be designed based on the rational design approach.

For the given site condition, the economy in foundations lies in rationalised design based on exact assessment of loads and moments to be taken by the foundations, and the properties of sub-soil strata available at site. Thus for a large housing project, it will be quite rewarding to spend some money on site investigations. This will afford efficient and economic foundations, which will pay off the initial investment on such investigations. Investigations should be carried out in accordance with I.S.-1892-1962 Code of Practice.

Simple type of spread foundations shall be placed at a depth of not less than 33 inches. In single storied building, this could be further reduced. Since concrete widths are not restricted and due to their better load spreading property, the designed foundation width can be achieved in much less width. It is therefore desirable that concrete in the footings is provided in the maximum possible thickness, and if practicable, brick masonry is started only from 6" below the ground level. Reduced depth of foundation due to better load spreading properties of concrete, would also reduce the self-load of the foundation and consequently the requirement of foundation width. In the case of plain concrete footings resting on soil, the thickness normally be not less than 20 cm. and in the case of lightly loaded buildings not less than 15 cm. Relation of plinth projection would further facilitate the damp

proofing of walls and laying of floors with proper slope. This would also reduce the section of the footing and the load on the foundation.

### Savings

There is a saving of 15 to 20% in the cost of foundation or a saving of 1 to 1½% in the building cost if designed on rational basis in place of conventional design of foundation.

#### (b) Dampproof Course

The conventional practice is either with cement mortar (1:3) or cement concrete (1:2:4) with integral water-proofing bands is not suitable. The better method is providing:-

- (a) A layer of bitumen laid over 1:2:4 concrete
- (b) Use of 400 gauge alkathene sheet laid over 3/8" thick cement mortar 1:3.

The latter technique is expected to give an economy of 30% over the former (0.07% saving in building cost). However, the user trials have not been given a satisfactory report on the provision of alkathene sheet.

#### (c) Superstructure

The traditional brick wall construction with 18", 13½", 13½" and 9" for 1st, 2nd, 3rd and 4th storey respectively is replaced by 9" thick wall for the entire height of the building can be used with advantage. This technique requires high strength bricks. But since good quality bricks are being manufactured in Delhi, adoption of this

technique shall not be handicapped on this account. Besides the saving in time, this technique reduce the cost of construction.

This technique has been proposed for adoption in the 'Construction of one four storeyed Block 16 Type III Quarters at Dhaula Kuan, New Delhi'. Sponsored by the M.S.S. under Experimental Housing Scheme, this technique has resulted in a saving of 6% in the overall cost of the building.

The structural compatibility of masonry walls depends upon several factors amongst which the strength of the bricks and mortar, method of bonding, unsupported height or length of walls, eccentricity in vertical loading, location and dimension of openings, location of longitudinal and cross walls effect the soundness of the construction.

Masonry structures gain stability from support afforded by cross walls, floors, roofs and other elements. Load bearing wall offers best efficiency when the imposed load is distributed uniformly and the eccentricity of loading is distributed and kept to a minimum. The above factors should get a thoughtful consideration during the planning stages of the building.

The bricks and mortar to be used for this should be of the following strength for various floors upto four storey buildings.

(a) Walls upto First Floor Level Mechanised bricks in

**Cement Mortar 1:6 or cement lime mortar 1:2:9 having maximum strength of 105 Kg. per Sq.cm. (1500 lbs. per sq.in.**

**(b) For First Floor to Second Floor: Bricks having maximum strength of 70 kg. per sq.cm. in cement mortar 1:3 or lime cement mortar (1:1:6).**

**(c) Walls above Second Floors Bricks having a strength of 70 Kg. per sq.cm. in cement mortar 1:6 or cement lime (1:2:9).**

### **Savings**

It is very economical - the overall economy being derived from saving in materials, labour and time. The saving in the covered area due to reduction in thickness of wall from 18" to 9". The overall saving derived from this is 6% in the total cost of construction.

### **(d) Door and window frames**

The doors and windows is one of the expensive items of construction. The traditional method of providing timber frame for doors and windows is becoming expensive. The reason being non-availability of seasoned timber and very heavy demand on timber on account of huge construction activities. If an unseasoned and inferior timber is used, it will not last long thus creating a lot of maintenance problem adding additional expenditure. There are really very few manufacturers in this country. The transportation is exorbitant. It consumes time. So far low cost housing the provision of steel windows and doors can be ruled out



### Lightaway.

The best solution to solve this problem is to provide simple reinforced concrete frames, both for doors and windows. R.C.C. frames for doors and windows have been developed by various institutions - the difference being mainly in the fixing arrangements of the shutters.

### Savings:

This technique gives an economy upto 50% as compared to teak wood frames. R.C.C. and window frames with steel plate fixture can, therefore, be suitable to adopt in low-cost housing.

### (c) Lintels:

This technique developed by the C.B.R.I., Roorkee which can lead to substantial saving as compared to the usual cast-in-site thick lintels based on the triangular loading theory. The actual loads to be carried by the lintel are difficult to determine, as these greatly depend upon the extent of arching action developed within brick work on top. Test conducted in U.K., on plinth beams supported on piles have indicated that subject to certain conditions the plinth beams carrying brick walls may be designed on the basis of an equivalent bending moment. It has also been established that such beams mostly act as composite members, tension being taken by the R.C.C. beam and the compression by the brick work above. This is greatly in contrast with the conventional method of designing lintels over door or

window openings are also subjected to conditions of loading comparable to the plinth beams, the lintels could be designed on this principle.

The depth of the lintel has been fixed as 7.6 cm. to correspond to a course of brick work and to give adequate rigidity against deflection during handling and placing in position. Load tests carried out by the C.B.R.I., Roorkee on 23 cm. wide and 7.6 cm. thick lintels, reinforced with 3 bars of 10 mm. dia placed centrally and having a span of 1.83 m. with 46 cm. high brick work in cement mortar (1:6) on top, have shown that failure occurred at a load intensity of 8.33 tons per running meter. It has also been established that load carrying capacity of the lintel increases with the increase in the length of the side supporting masonry; but for normal loading conditions, a length of min. 23 cm. of side supporting brick masonry is sufficient. The bearing for lintel should be min. 11.5 cm. Hence for normal loading conditions in building single or multi-storeyed, a 7.6 cm. thick precast lintel having min. of 46 cm. brick masonry above is adequate for opening upto 1.83 m. The mortar for brick masonry shall be 1:1:6 cement, lime sand or 1:6 cement, sand, three 10 mm dia bars as main reinforcement and 6 mm. dia distribution bars @ 30 cm. wide lintel. The reinforcement shall be placed centrally in the lintel. The top surface of the precast lintel shall be finished rough to provide key with the

brick work on top. The lintel shall be temporarily supported to a length of about 30 cm. in middle till the wall above attains the necessary strength. Where required provision of R.C.C. chajjas can be readily made by projecting the steel bars during the casting of lintels and chajjas cast-insitu subsequently. Where two lintels cross each other, half related and doubled joints may be provided while precasting the lintels.

#### Savings:

These lintels are economical and save time in construction. It saves approximately 50% in materials and in overall cost as compared to lintels based on conventional design.

#### (f) Roofing:

Roof constitutes about 25% of the building costs, any saving in this item will have substantial influence on the total cost of the building. The foregoing review of the conventional types of roof automatically leads us to the validity of prefabrication and standardisation of the roofing system so as to attain speed and economy in this element of the structure. In prefabrication as the shuttering is replaced by moulds, which can be used more number of times than the shuttering, there will be saving in this item. In prefabricated construction, it is also possible to introduce cores or hollows in the precast units to reduce the materials consumption and self-weight. If the roof units are precast and kept ready, then as soon as the

walls reach the floor level, the units can be laid and the construction above can proceed without delay. However, in the present context the techniques of prefabrication and standardisation suffer from the limitations of the building industry such as lack of equipment for handling and lifting large and heavy components, skilled manpower and adequate transport facilities thus making fully industrialised techniques unsuitable for some time to come.

The C.B.R.I., Roorkee and other institutes have therefore concentrated and developed techniques more suitable for partial prefabrication. The accent has been primarily on manual handling of precast units. The following types of units for roofs have therefore been developed for adoption.

1. Precast R.C.C. Planks
2. Cellular Unit
3. Doubly curved roof
4. Hollow blocks
5. Channel unit
6. Cored Unit

Following criteria have been taken into account for the selection of suitable type of roofing system -

1. Cost economics
2. Consumption of steel and cement
3. Flush ceiling from aesthetic point of view

4. Weight or precast units to facilitate easy handling
5. Composite or fully precast construction
6. Simplicity in the method of casting.

The table below gives a comparison between various types of roofs in terms of percentage savings of steel, cement and cost over the traditional 11.25 cm. thick R.C.C. slab for a span of 3.5 meters.

**COMPARISON BETWEEN 11.25 CM. THICK R.C.C. SLAB & OTHER TYPES OF NEW ROOFS FOR A SPAN OF 3.5 M.**

S.No. X	Type of Roof	Saves saving over R.C.C. Slab		
		Cement	Steel	Cost
1.	Precast R.C.C. Planks	45%	43%	47%
2.	Cellular Unit:			
	a. with rectangular beam	37%	76%	42%
	b. with 'T' Beam	22%	54%	35%
3.	Doubly curved roof	27.55%	37.84%	36.5%
4.	Hollow Blocks	-	-	25%
5.	Channel Unit	42.5%	4.24%	18%
6.	Comb Unit	22.2%	5.8%	13.5%

SOURCE: C.B.R.I. DIGEST

It is evident from the above comparison that Precast R.C.C. plank type of roof offers the maximum comparative economy in terms of materials and unit cost.

CHAPTER - 7CONCLUSIONS & RECOMMENDATIONS7.1. CONCLUSIONS

There is no end of the problem of Housing and it is not possible to accede to all the aspects in type design housing. However, the effort has been made to analyse and conclude the observations in details in Chapters itself the conclusions of of all the studies are given below:-

Population of Delhi is increasing and various Ministeries and Central Government offices are expanding. Consequently, housing demands are also increasing. The Government had made provisions of funds under Five-Year Plans through public agencies, but it resulted into a limited role in this field, due to high rate of housing shortage. In general pool residential accommodation, the demand was estimated after IV Plan, 99,828 and supply was only 40904. In the Department of N.D.M.C., demand was 8266 and supply was 1927. Hence, the position of Housing in public sector is going out of control.

In the public sector housing, speed of construction is also observed to be very slow. The designing, planning, estimating, approval and award of contract takes unexpected long time, which results into delay and eligible Govt. servants suffer for long time for the want of official accommodation. The quality of the houses is also not found upto the standard, because of the contract system. The contractor always tries to use substandard type of material and to make least use of the weakness of

of supervisory staff. Secondly, the technical set-up is also responsible to a great extent, because of the reason that concerned technical cells are not working in close coordination among among the Architects, Planners and Structure Engineer and site engineer which also delay the construction for the want of decisions and to bring solution and implementation of the same. The study has also revealed that users reactions have not been incorporated in the designing.

The comparative analysis has revealed that the wall and circulation areas are also more. For greater efficiency in design, it could be possibly reduced. The ceiling height is more keeping in view the economy.

The space areas of the type designs are reducing, perhaps due to the reason to keep balance between the overall cost of the building and minimum space requirements which had also resulted into untidy spots and does not fulfil the socio-economic demand of the family. In Type II some designs are of 2 room set and some are 3 room set. The more number of rooms may be good for privacy, but due to their being lesser in size create the problems of furniture layout, the position of the cupboards, shelves and almirah are not properly chalked out, which creates difficulty in movement spaces, often furniture dimensions, & the anthropometric dimensions, the rooms have been found untidy as observed in residential space analysis Plates in the Chapter 4 Physical Analysis of Type Design.

Certain shortcomings are also observed in the room sizes and kitchen sizes. The spaces are not related to the size of

furniture layout and anthropometric dimensions, which resulted into inadequate space for performing household activities, in living rooms and taking meals in kitchen, as no provision of separate dining space is possible in the limited standards of Type II.

In addition to it, considering consumers demands and family space requirements the balcony provided on upper floor is quite less in width to accommodate cots etc. for sleeping during summer and further no provision of wash basin is made.

In general the houses are compact with no serious problems of light and ventilation only it is less due to some unavoidable circumstances.

The case study of type II quarters at Reading Road had revealed that more density is achieved by providing more built-up area in relation to space which resulted in overcrowding, lack of cross ventilation and lighting due to the reason of closeness of the structure as compared to open spaces. The front and rear courts around the house with much less living space for sitting, sleeping and drying clothes and privacy of dwelling units. The community spaces i.e. play ground and parks etc. are also observed much less than the recommendation of N.B.O. Code 1970 and Master Plan for Delhi.



The socio-economic study results of M.B.O. revealed that 62.1% of allottees are keeping cycles and 12.1 % scooters and only 25.8% are having no conveyance of their own in type II. No provision of cycle shed/scooter shed is made in general, as the study reveals it is an essential part of the inhabitants to park their vehicle, in urban city like Delhi.

The access of roads to the dwelling units is also observed not properly segregated and defined, which may result into accidents and unsafe for inhabitants and no space for parking etc. Relationship between building height and open spaces is also lacking.

All the type designed houses are of the same height resulting into uniform patten in relation to skyline. The repetitive type of construction, same texture and colours etc. give tiresome, monotonous impression and lacks visual interest.

Not much difference in cost is observed by traditional method of construction, only structural column, have increased the cost. It seems that public secto is not giving proper attention to reduce the cost by using techniques in design and replacing materials. The design pattern is same as adopted quite back with only certain modification. No new construction and economy in design techniques are followed to reduce overall cost by this sector.

## 7.2. Recommendations

Shortage of houses can only be avoided with long-term planning and

and mass production of houses. For improving the existing situation, maximum provision for funds allocation should be made to fill up the gap, because the Central Govt. had played a very limited role in this field.

For good and economical designing, speed in construction, decision and implementation etc. the present set up of the public organisation needs modification. The technical cells, instead of working separately should be made to work together in collaboration. There should be proper coordination among the Architects, Town Planners and Engineers and they have to accept the challenge to produce good functional and economical type design houses, users reactions about the dwelling units should be obtained for improvement and also to be incorporated in next type design of houses and planning of layouts.

The comparative study has revealed lack of design efficiency, walls and circulation areas can be possibly reduced to a greater extent by proper designing, maximum cross load bearing walls to save cost and to serve more units.

From social consideration and family sizes, three room set is desirable for the occupant of type II. The living room has been to be less than 120 sq.ft. Its length and width should be so arranged, keeping relevance with anthropometric dimensions and standard furniture sizes, which normally found in general, so that most of the space does not go waste. The bed room size of 100 Sft is sufficient, but proper attention should be given to decide the position of cup boards, shelves etc. Secondly more space

for clothing etc. and every bed room should be provided with facilities of cupboards. The kitchen should be approximately square in sizes with more area, provides good sitting space while eating. More storage space should also be provided.

The occupants of upper floors should be provided with bigger balconies for sleeping in summer, and provision of wash basin should be also provided in view of the socio-economic needs of the family. In general houses are compact with adequate light and ventilation. However, kitchen, bath, W.C. etc. should have more light. It is also recommended that it should have 4 Sq.m. opening for permanent ventilation.

The dwelling units should have living space, around the houses and community type of amenities i.e. play grounds, parks etc. for healthy environment indifferent sizes and composition. It should also fulfill the recommendation of N.B.O. code 1970 and Delhi Master Plan. All these shortcomings are observed in Type II quarters at Reading Road, New Delhi constructed by N.D.M.C.

Provision of cycle/scooter shed, with facilities of parking vehicle should also be provided, considering it the essential feature of the urban life.

Keeping in view the safety, proper segregation of vehicular and pedestrian access to the dwelling units should be provided.

The type designed houses of same height are resulting into uniform pattern in relation to skyline. To improve this different heights should be given, which will result into

APPENDIX 2-A : DEMANDS ON GENERAL 2022 RESIDENTIAL ASSOCIATION AVAILABLE IN

DEMAND/PLAN DEMAND (FROM ICE PLAN TO IV PLAN)

TYPE	First Five Year Plan	Next Five-Year Plan	Next Five Year Plan	Next Five Year Plan	Next Five Year Plan	Next Five Year Plan	
	Available Demand of electric section, 1989	Available Demand of electric section	Available Demand of electric section	Available Demand of electric section	Available Demand of electric section	Available Demand of electric section	
	Percent of electric section	Percent of electric section	Percent of electric section	Percent of electric section	Percent of electric section	Percent of electric section	
VIII (Type- 100 figures are not available)		61	115	53	21	147	14.4
VII	-0-	205	311	66	121	424	23.5
VI	-0-	643	1552	47.6	350	1495	50.3
V	-0-	2151	4450	48.3	1009	5270	34.2
IV	-0-	4530	9115	49.0	4023	10142	47.6
III	-0-	4244	15343	27.7	5063	14095	34.0
II	-0-	19001	49605	51.3	14316	39730	30.5
I	-0-	13095	25846	50.7	13205	27769	47.5
	20,024 64,596 32.2	29,001 90,730 52	38616 100000		40904	95320	

Source :- Estimate Committee report, Directorate of Electric, New Delhi.

APPENDIX 2-D : DETAIL OF INCIDENTAL ACCOMMODATION AVAILABLE IN U.D.F.C., NEW DELHI

Type	Availability	Demand	Shortage	Percent of Satisfaction
I	1513	4903	3490	27.4
II	348	2806	2458	12.4
III	216	428	212	50.5
IV	34	177	143	19.2
V	16	53	37	19.2

Position as on March 1973

Source :- Estate Branch, U.D.F.C., New Delhi.

APPENDIX 6-A : COMPARATIVE COST ANALYSIS OF THE BUILDINGS

Estimate cost (Rs)	Foundations		Superstructure		Finish		Electrification water supply and sanitary fittings	
	Cost Rs	Cost percent	Cost Rs.	Cost percent	Cost Rs	Cost percent	Cost Rs	Cost percent
15,500	2709	17.5	6301	40.7	3590	25.1	2600	16.7
18,000	3565	19.8	4822	46.9	4013	22.2	2000	11.1
22,500	4019	17.8	12036	53.6	4295	19.1	2100	9.5
25,000	5404	21.6	11975	47.9	4621	18.5	3000	12.0
25,000	4765	19.1	11392	45.5	6449	25.8	2400	9.6
28,000	6796	24.2	14586	52.0	4110	14.7	2500	9.1
30,000	5211	17.4	15599	52.0	6790	22.6	2400	8.0
35,000	6218	17.8	10255	52.1	6547	18.7	4000	11.4

Foundations 19 percent of the total cost.

Superstructure 50 percent of the total cost.

Finish 21 percent of the total cost.

Electrification water supply and sanitary fittings 10 percent of the total cost.

Source :- Economy in Building Construction, By P.V. Arumachalam, Lecturer in Structural Engg., Madras.

APPENDIX 6-B : SHARING OF COST BY DIFFERENT ELEMENTS OF THE BUILDINGS

Estimate Rs	FOUNDATIONS										SAVING			
	Total ft	Total ft	Total Rs	Main Rs	Cross Rs	Cost Saving Rs when 4 1/2" walls are used (Rs)	Depth ft	Total Cost Rs	Main Rs	Gross Rs	Suggested depth (ft)	Saving Rs	Cost Rs	percentage of total cost
15,000	99	39	2250	1615	635	318	4.5	1696	1216	480	2.0	213	531	3.46
18,000	95	47	2650	1774	876	438	4.5	2845	1903	942	2.0	418	856	4.75
22,000	124	59	3000	2030	970	435	4.5	2360	1590	770	2.0	342	777	3.46
25,000	131	69	3088	2020	1068	534	4.5	3800	2490	1310	2.0	581	1115	4.46
25,000	108	66	2580	1440	1140	570	4.5	3184	1775	1409	2.0	625	1195	4.78
28,000	167	61	3676	2692	982	492	5.00	3936	2880	1056	2.0	469	961	3.43
30,000	127	66	5550	3650	1900	950	4.5	3999	2240	1159	2.0	515	1465	4.88
35,000	198	85	7758	5440	2318	1159	4.5	4758	3340	1418	2.0	630	1789	5.11

Sources :- Economy in Building Construction by P.V. Arunachalam, Lecturer in Structural Engg., College of Engineering, Guindy, Madras.

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ERRATA

Page No.	Line No.	Description
1	1	rapidly to be read as rapidly
1	9	projction to be read as projection
7	2	quantitaive to be read as quantitative
10	22	occupay to be read as occupy
12	22	falts to be read as flats
24	3	hafe to be read as have
26	4	council to be read as council
29	2	ot-is to be read as to its
32	11	electrif citting to be read as electric fittings
32	12	lawns to be read as lawns
32	13	wash bisin to be read as wash basin
39	1	Nariana to be read as Naraina
62	13	thee to be read as the
67	3	didiness to be read as tightness
95	4	institutions to be read as institutions
104	21	tye to be read as the
110	22	cmenet to be read as cement
111	24	lollows to be read as hollows
118	7	heeds to be read as needs
118	8	spearatly to be read as separately
120	4	shoudi to be read as should
126	11	koppelman to be read as koppleman

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UNIVERSITY OF ROORKEE  
ROORKEE

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1995

REPORT OF THE EXAMINERS FOR AWARD OF M. E. DEGREE

1. Name of the Candidate J. S. GARG
2. Department ARCHITECTURE & PLANNING
3. Specialised Subject ARCHITECTUREL DESIGN
4. Title of dissertation CRITICAL ANALYSIS OF TYPE DESIGN HOUSE IN PUBLIC SECTOR WITH REFERENCE TO HOUSING IN DELHI
5. The Viva-Voce Examination was held on 15.11.1975 at Roorkee.

EXAMINER'S REPORT

Shri Garg has collected extensive data from varied sources relevant to his topic on investigation. His presentation matter through graphics, photographic plates was neat. His analysis of data was however not as exhaustive as it should have been. The conclusions and recommendations were mundane. He does not seem to have taken up the study as enthusiastically as was desired.

However, in view of his painstaking efforts and the potential usefulness of the data collected his dissertation is approved.

- (a) The dissertation is approved.
- (b) The dissertation is graded as Satisfactory.

SC/-

SC/-

SIGNATURE OF INTERNAL EXAMINER  
DATED 19.11.1975

SIGNATURE OF INTERNAL EXAMINER  
DATED 19.11.1975.

UNIVERSITY OF ROORKEE  
ROORKEE

NO. 11/ /PF/JSG

Dated December , 1975.

Copy forwarded to :-

1. Professor & Head of Architecture & Planning Department
2. Professor R. K. Jhu, Professor & Head of Arch. & Planning Department.

for clothing etc. and every bed room should be provided with facilities of cupboards. The kitchen should be approximately square in sizes with more area, provides good sitting space while eating. More storage space should also be provided.

The occupants of upper floors should be provided with bigger balconies for sleeping in summer, and provision of wash basin should be also provided in view of the socio-economic needs of the family. In general houses are compact with adequate light and ventilation. However, kitchen, bath, W.C. etc. should have more light. It is also recommended that it should have 4 Sq.m. opening for permanent ventilation.

The dwelling units should have living space, around the houses and community type of amenities i.e. play grounds, parks etc. for healthy environment indifferent sizes and composition. It should also fulfil the recommendation of N.B.O. code 1970 and Delhi Master Plan. All these shortcomings are observed in Type II quarters at Reading Road, New Delhi constructed by N.D.H.C.

Provision of cycle/scooter shed, with facilities of parking vehicle should also be provided, considering it the essential feature of the urban life.

Keeping in view the safety, proper segregation of vehicular and pedestrian access to the dwelling units should be provided.

The type designed houses of same height are resulting into uniform pattern in relation to skyline. To improve this different heights should be given, which will result into

variation and establish new urban form.

To reduce monotonous effect and to create visual interest, setbacks in buildings with varying spaces, different texture and different colours should be provided to break uniformity.

The back lanes or long passage in front are producing dull and corridor form, which should be avoided and relationship between the height and spaces should be maintained. The building plan should be so oriented that the area of sunlit walls and windows in them is kept to a minimum.

The reflective properties of light colour (white washed roof and walls) should be used for warding off solar heat.

Trees should be planted in such a manner that these should not prevent the cooling summer breeze.

For good ventilation prevailing wind should also penetrate the building.

The cost of the building could be substantially reduced by judicious planning, maximum benefit of cross walls, use of new materials and developed techniques invented by C.B.R.I. and other institutions as stated in 6th Chapter.

For economy in construction cost, the ceiling height is also one of the important factors in designing any building. Therefore, height provided 9'-6" and 10'-0" is on the upper side. After considering physical and psychological comforts C.B.R.I. has recommended ceiling height of 8'-4". Thus providing lesser height in four storey construction could heavily minimize the overall construction cost.

The cost of the doors is more than walling; therefore doors provided needs to be reduced after due consideration.

APPENDIX 1-A POPULATION INCREASE IN DELHI 1911-1971

Years	Urban Population in lacks	Percentage growth in each decade
1911	2.32	11.3
1921	3.04	30.7
1931	4.47	47.0
1941	6.96	55.5
1951	14.37	106.6
1961	23.44	63.2
1971	36.29	54.9

Source :- Works studies Volume I, Censures of India for 1971(Delhi)